Assessment Variables in Appalachian Headwater and Perennial Streams

United States Army Corps of Engineers, ERDC
Assessment Variables – Headwater Streams

- Channel Canopy Cover
- Channel Substrate Embeddedness
- Channel Substrate Size
- Channel Bank Erosion
- Large Woody Debris
- Riparian/Buffer Zone Tree Diameter
- Riparian/Buffer Zone Snag Density
- Riparian/Buffer Zone Sapling/Shrub Density
- Riparian/Buffer Zone Vegetation Species Richness
- Riparian/Buffer Zone Soil Detritus
- Riparian/Buffer Zone Herbaceous Cover
- Watershed Land-use
### Assessment Variables – Headwater Sampling Locations

#### Watershed Variables
- Watershed Land-use

#### Channel Variables
- Canopy Cover
- Substrate Embeddedness
- Substrate
- Bank Erosion

#### Riparian/Buffer Zone Variables
- Large Woody Debris
- Riparian Tree DBH
- Riparian Snag Density
- Riparian Sapling/Shrub Density
- Riparian Species Richness
- Riparian Herbaceous Vegetation
- Riparian Soil Detritus
Watershed Variables
- Watershed Land Use

Water Flow Direction
Left and Right sides of the channel are determined as one looks downstream.

Channel Variables
Sampled at equidistant points along the channel
- Canopy Cover
- Substrate Embeddedness
- Substrate Size
- Bank Erosion

Riparian/Buffer Zone Variables
Sampled throughout the 50'-wide buffer
- Large Woody Debris
- Riparian Tree DBH
- Riparian Snag Density
- Riparian Sapling/Shrub Density
- Riparian Species Richness

Sampled in 8 1x10 m plots within buffer
- Riparian Herbaceous Vegetation
- Riparian Soil Detritus
Channel Canopy Cover – Headwater Streams

\((V_{CANOPY})\)

- Average percent cover of vegetation over the stream channel
- Only used for stream reaches with >20% canopy cover
- Canopy cover \(\geq 88\%\) receives score 1.0
- Only used in the wildlife habitat function
How to Measure Channel Canopy Cover

- Measure using a densiometer while standing in the stream
- Measure at 10 points along stream reach
Channel Canopy Cover Variable Scaling – Headwater Streams

- Subindex is never 0
Channel Substrate Embeddedness – Headwater Streams

\( V_{\text{EMBED}} \)

- Average embeddedness index of stream substrate
- Embeddedness ratings between 3.5 and 4 receive a score of 1.0

<table>
<thead>
<tr>
<th>Rating</th>
<th>Rating Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>&lt;5 percent of surface covered, surrounded, or buried by fine sediment (or bedrock)</td>
</tr>
<tr>
<td>4</td>
<td>5 to 25 percent of surface covered, surrounded, or buried by fine sediment</td>
</tr>
<tr>
<td>3</td>
<td>26 to 50 percent of surface covered, surrounded, or buried by fine sediment</td>
</tr>
<tr>
<td>2</td>
<td>51 to 75 percent of surface covered, surrounded, or buried by fine sediment</td>
</tr>
<tr>
<td>1</td>
<td>&gt;75 percent of surface covered, surrounded, or buried by fine sediment (or artificial substrate)</td>
</tr>
</tbody>
</table>

- Used in hydrology, biogeochemistry and habitat functions
How to Measure Embeddedness

- Measure at least 30 points along stream reach
- Randomly select a particle from the stream bed
- Visually estimate percentage of the particle that is covered, surrounded or buried with fine materials
Embeddedness Examples

Category 5: Bedrock

Category 1: >75% covered

Category 4: 5-25% covered

Category 3: 26-50% covered
Embeddedness Variable Scaling – Headwater Streams

- Subindex is never 0
Channel Substrate Size – Headwater Streams

\( V_{\text{SUBSTRATE}} \)

- Median substrate size of bed material in the stream channel
- Median substrate size between 2 and 6 in. receives a score of 1.0
- Used in hydrology and habitat functions for headwater streams
How to Measure Substrate Size

- Measure at the same time as embeddedness
- Randomly select a particle from the stream bed
- Measure the median (b) axis to the nearest 0.1 in
- Bedrock = 99 in
- Concrete or asphalt = 0 in
- Sand or finer = 0.08 in
Channel Substrate Size Variable Scaling – Headwater Streams
Channel Bank Erosion

\( V_{BERO} \)

- Proportion of stream channel with eroded bank
- Ranges from 0 to 200 percent
- Less than 14% eroded bank receives a score of 1.0
- Used in hydrology, biogeochemistry and habitat functions for headwater streams
How to Measure Channel Bank Erosion

- While standing in the channel, measure erosion length on both the left and right streambanks.
Channel Bank Erosion Variable Scaling

![Diagram showing the relationship between channel bank erosion and variable subindex (V_{BERO})](image-url)
Large Woody Debris – Headwater Streams

\( V_{LWD} \)

- Number of down woody stems in the riparian/buffer zone per 100 ft of stream reach
- At least 4 in. diameter and 36 in. long
- Streams with 8-20 pieces of LWD receive a score of 1.0
- Used in the hydrology, biogeochemistry and habitat functions for headwater streams
How to Measure Large Woody Debris

- Measure within the riparian/buffer zone, extending 25 ft on either side of the channel
- Count each piece of LWD along the entire stream assessment reach
- Count broken logs as one piece
Large Woody Debris Variable Scaling – Headwater Streams
Riparian/Buffer Zone Tree Diameter – Headwater Streams

\( V_{TDBH} \)

- Average diameter at breast height (DBH) of trees within the riparian/buffer zone
- Stream reaches with average DBH of \( \geq 8.7 \text{ in.} \) receive a score of 1.0
- Used in the biogeochemistry and habitat functions for headwater streams
How to Measure Tree Diameter – Headwater Streams

- Use a calipers or DBH tape to measure diameter of all trees at least 4 in. DBH
- Measure all trees within the riparian/buffer zone, extending 25 ft on either side of the channel
Riparian/Buffer Zone Tree Diameter Variable Scaling
Riparian/Buffer Zone Snag Density

\((V_{SNAG})\)

- Number of snags per 100 ft of stream assessment reach
- Stream reaches with 0.6-3 snags per 100 ft receive a score of 1.0
- Used only in the habitat function for headwater streams
How to Measure Snag Density

- Count all snags at least 4 in. diameter and 36 in. high
- Measure snags within the riparian/buffer zone, extending 25 ft on either side of the channel
Riparian/Buffer Zone Snag Density Variable Scaling

![Graph showing variable scaling of snag density with respect to snags per 100 ft of SAR (count).]
Riparian/Buffer Zone Sapling/Shrub Density ($V_{SSD}$)

- Density of woody stems at least 36 in. high and less than 4 inches DBH
- Used only for stream reaches with <20% canopy cover
- Stream reaches with $\geq 65$ stems per 100 ft of stream reach receive a score of 1.0
- Used in the biogeochemistry and habitat functions for headwater streams
How to Measure Sapling/Shrub Density

- Measure only at stream reaches where canopy cover is <20%
- Count all sapling and shrub stems within the riparian/buffer zone, extending 25 ft on either side of the channel
- Does not include herbaceous plants or woody vines
Riparian/Buffer Zone Sapling/Shrub Density Variable Scaling
Riparian/Buffer Zone Vegetation Species Richness

\( V_{SRICH} \)

- Index reflecting richness of native tree species (group 1)
- Downgrades stream reaches for each exotic plant species in any stratum (group 2)
- Stream reaches with species richness of at least 2.1 receive a score of 1.0
- Used only in the habitat function for headwater streams

Riparian/Buffer Zone Species Richness

\[
\text{Species Richness} = \left( \frac{\text{Group 1 species} - \text{Group 2 species}}{\text{Total length of SAR (ft)}} \times 100 \right) \times \left[ 1 - \left( \frac{10 \times \text{Group 2 species}}{\text{Total length of SAR (ft)}} \right) \right]
\]
<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer pensylvanicum</td>
<td>striped maple</td>
<td>Ailanthus altissima</td>
<td>tree of heaven</td>
</tr>
<tr>
<td>Acer rubrum</td>
<td>red maple</td>
<td>Alliaria petiolata</td>
<td>garlic mustard</td>
</tr>
<tr>
<td>Acer saccharum</td>
<td>sugar maple</td>
<td>Alternanthera philoxeroides</td>
<td>alligator weed</td>
</tr>
<tr>
<td>Aesculus flava</td>
<td>yellow buckeye</td>
<td>Asimina triloba</td>
<td>pawpaw</td>
</tr>
<tr>
<td>Betula alleghaniensis</td>
<td>yellow birch</td>
<td>Aster tataricus</td>
<td>tatarian aster</td>
</tr>
<tr>
<td>Betula lenta</td>
<td>black birch</td>
<td>Coronilla varia</td>
<td>crown vetch</td>
</tr>
<tr>
<td>Carya cordiformis</td>
<td>bitternut hickory</td>
<td>Elaeagnus umbellata</td>
<td>autumn olive</td>
</tr>
<tr>
<td>Carya glabra</td>
<td>pignut hickory</td>
<td>Lespedeza bicolor</td>
<td>shrub lespedeza</td>
</tr>
<tr>
<td>Carya ovata</td>
<td>shagbark hickory</td>
<td>Lespedeza cuneata</td>
<td>sericea lespedeza</td>
</tr>
<tr>
<td>Carya tomentosa</td>
<td>mockernut hickory</td>
<td>Ligustrum obtusifolium</td>
<td>border privet</td>
</tr>
<tr>
<td>Cornus</td>
<td>flowering dogwood</td>
<td>Ligustrum sinense</td>
<td>Chinese privet</td>
</tr>
<tr>
<td>Fagus grandifolia</td>
<td>American beech</td>
<td>Lonicera japonica</td>
<td>Japanese honeysuckle</td>
</tr>
<tr>
<td>Fraxinus</td>
<td>white ash</td>
<td>Lonicera tatarica</td>
<td>Tatarian honeysuckle</td>
</tr>
<tr>
<td>Liriodendron tulipifera</td>
<td>tuliptree</td>
<td>Lotus corniculatus</td>
<td>bird’s-foot trefoil</td>
</tr>
<tr>
<td>Magnolia acuminata</td>
<td>cucumber-tree</td>
<td>Lythrum salicaria</td>
<td>purple loosestrife</td>
</tr>
<tr>
<td>Magnolia tripetala</td>
<td>umbrella-tree</td>
<td>Microstegium vimineum</td>
<td>Nepalese browntop</td>
</tr>
<tr>
<td>Nyssa sylvatica</td>
<td>blackgum</td>
<td>Paulownia tomentosa</td>
<td>princess tree</td>
</tr>
<tr>
<td>Oxydendrum arboreum</td>
<td>sourwood</td>
<td>Fallopia japonica</td>
<td>Japanese knotweed</td>
</tr>
<tr>
<td>Pinus strobus</td>
<td>eastern white pine</td>
<td>Pueraria montana</td>
<td>kudzu</td>
</tr>
<tr>
<td>Prunus serotina</td>
<td>black cherry</td>
<td>Rosa multiflora</td>
<td>multiflora rose</td>
</tr>
<tr>
<td>Quercus alba</td>
<td>white oak</td>
<td>Sorghum halepense</td>
<td>Johnsongrass</td>
</tr>
<tr>
<td>Quercus cocinea</td>
<td>scarlet oak</td>
<td>Verbenia brasiliensis</td>
<td>Brazilian vervain</td>
</tr>
<tr>
<td>Quercus imbricaria</td>
<td>shingle oak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quercus montana</td>
<td>chestnut oak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quercus rubra</td>
<td>northern red oak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quercus velutina</td>
<td>black oak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sassafras albidum</td>
<td>sassafras</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tilia</td>
<td>American basswood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tsuga canadensis</td>
<td>eastern hemlock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ulmus</td>
<td>American elm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How to Measure Species Richness

- Check off each tree species present in Group 1 within the riparian/buffer zone, extending 25 ft on either side of the channel.
- If canopy cover $\leq 20\%$, use the sapling/shrub stratum.
- Check off all exotic species from any strata.
Riparian/Buffer Zone Vegetation Species Richness Variable Scaling

![Graph showing the relationship between Riparian/Buffer Zone Vegetation Species Richness (V_{rich}) and Species richness index (unitless).]
Riparian/Buffer Zone
Soil Detritus

\( V_{DETRITUS} \)

- Average percent cover of detrital material on the soil surface within the riparian/buffer zone
- Organic material (e.g., leaf litter, sticks, needles, flowers, fruits)
- Stream reaches with at least 82% detritus cover receive a score of 1.0
- Used in the biogeochemistry and habitat functions for headwater streams
How to Measure Soil Detritus

- Visually estimate percent cover of organic material within at least 8 representative $1m^2$ plots in the riparian/buffer zone.
Riparian/Buffer Zone Soil Detritus Variable Scaling
Riparian/Buffer Zone Herbaceous Cover

\( V_{HERB} \)

- Average percent cover of herbaceous vegetation in the riparian/buffer zone
- Used only for stream reaches with <20% canopy cover
- Stream reaches with \( \geq 75\% \) receive a score of 1.0
- Used in the biogeochemistry and habitat functions for headwater streams
How to Measure Herbaceous Cover

- Measure only at stream reaches where canopy cover is <20%
- Visually estimate percent cover of organic material within the same 1m² plots used for Soil Detritus
Riparian/Buffer Zone Herbaceous Cover Variable Scaling
Watershed Land-use

($V_{WLUSE}$)

- Weighted average of land-use indices in watershed
- Reflects surface runoff potential
- Land-use type is multiplied by a land-use index
- Stream reaches with a land-use $\geq 75$ receive a score of 1.0
- Used in the hydrology, biogeochemistry and habitat functions for headwater streams
How to Measure Watershed Land-use

- Delineate watershed using topographic maps, aerial photos, or other methods
- Estimate percent cover of land-use types using remote techniques, verify in the field

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Watershed Land-use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land-use type</td>
<td>Land-use index</td>
</tr>
<tr>
<td>Forest and native range</td>
<td>1.0</td>
</tr>
<tr>
<td>Low density residential (≥1 acre lots)</td>
<td>0.3</td>
</tr>
<tr>
<td>Open space (pasture, lawns, parks, golf courses, cemeteries):</td>
<td>0.2</td>
</tr>
<tr>
<td>High density residential (&lt;1 acre lots)</td>
<td>0.1</td>
</tr>
<tr>
<td>Impervious areas (parking lots, roofs, driveways, etc)</td>
<td>0</td>
</tr>
<tr>
<td>Gravel</td>
<td>0</td>
</tr>
<tr>
<td>Industrial, commercial and business</td>
<td>0</td>
</tr>
<tr>
<td>Newly graded areas (bare soil, no vegetation or pavement)</td>
<td>0</td>
</tr>
</tbody>
</table>
Watershed Land-use Variable Scaling

![Graph showing Watershed Land-use variable scaling](image)
Assessment Variables – Perennial Streams

- Channel Canopy Cover
- Channel Substrate Embeddedness
- Channel Substrate Size
- Streambank Stability
- Large Woody Debris
- Riparian/Buffer Zone Tree Diameter
- Riparian/Buffer Zone Tree Density
- Coefficient of Conservatism
- Watershed Forest Cover
Assessment Variables – Perennial Sampling Locations

Watershed Variables
- Watershed Forested Area

Channel Variables
- Canopy Cover
- Substrate Embeddedness
- Substrate Size
- Streambank Stability

Riparian/Buffer Zone Variables
- Large Woody Debris
- Tree Diameter
- Tree Density
- Coefficient of Conservatism
**Watershed Variables**
- Watershed Forested Area

**Channel Variables**
- Sampled at equidistant points along the channel
  - Channel Canopy Cover
  - Substrate Embeddedness
  - Substrate
  - Streambank Stability

**Riparian/Buffer Zone Variables**
- Sampled throughout the 100'-wide buffer and channel
  - Large Woody Debris
  - Sampled in 4 0.032-acre subplots
    - Riparian/Buffer Zone Tree Diameter
    - Riparian/Buffer Zone Tree Density
    - Riparian/Buffer Zone Coefficient of Conservatism

300 ft: suggested minimum thalweg length
Channel Canopy Cover – Perennial Streams

($V_{CCANOPY}$)

- Average percent cover of vegetation over the stream channel
- Used for all perennial stream reaches, even those with <20% canopy
- Canopy cover $\geq 87\%$ receives score 1.0
- Only used in the wildlife habitat function
How to Measure Channel Canopy Cover

- Measurement is the same as for headwater streams
- Measure using a densiometer while standing in the stream
- Measure at 10 points along stream reach
Channel Canopy Cover Variable Scaling – Perennial Streams
Channel Substrate Embeddedness – Perennial Streams

$(V_{EMBED})$

- Average embeddedness index of stream substrate
- Average embeddedness ratings $>4.15$ receive a score of $1.0$

<table>
<thead>
<tr>
<th>Rating</th>
<th>Rating Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>$&lt;5$ percent of surface covered, surrounded, or buried by fine sediment (or bedrock)</td>
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<tr>
<td>4</td>
<td>5 to 25 percent of surface covered, surrounded, or buried by fine sediment</td>
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<td>3</td>
<td>26 to 50 percent of surface covered, surrounded, or buried by fine sediment</td>
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<td>2</td>
<td>51 to 75 percent of surface covered, surrounded, or buried by fine sediment</td>
</tr>
<tr>
<td>1</td>
<td>$&gt;75$ percent of surface covered, surrounded, or buried by fine sediment (or artificial substrate)</td>
</tr>
</tbody>
</table>

- Used in hydrology, biogeochemistry and habitat functions
How to Measure Embeddedness

- Measure at least 60 points along stream reach
- Measurement same as in headwater streams
- Randomly select a particle from the stream bed
- Visually estimate percentage of the particle that is covered, surrounded or buried with fine materials
Embeddedness Variable Scaling – Perennial Streams

Channel Substrate Embeddedness ($V_{EMBED}$)

![Graph showing the relationship between Channel Substrate Embeddedness and Average embeddedness rating (unitless).]
Channel Substrate Size – Perennial Streams

\( V_{\text{SUBSTRATE}} \)

- Median substrate size of bed material in the stream channel
- Median substrate size >3.9 in receives a score of 1.0
- Used in hydrology, biogeochemistry and habitat functions for perennial streams
How to Measure Substrate Size

- Measure at the same time as embeddedness
- Randomly select a particle from the stream bed
- Measure the median \((b)\) axis to the nearest 0.1 in
- Bedrock = 99 in
- Concrete or asphalt = 0 in
- Sand or finer = 0.08 in
Channel Substrate Size Variable Scaling – Perennial Streams

![Channel Substrate Size Graph]

- Median channel substrate size (inches)
- Channel Substrate Size ($V_{SUBSTRATE}$)
- Variable Subindex

BUILDING STRONG®
Streambank Stability

\( V_{\text{BANKSTAB}} \)

- Index reflecting streambank integrity
  - Percentage of eroded streambank length
  - Height category of eroded bank
  - Amount of artificially stabilized bank

\[
\text{Streambank Stability} = 100 \sum_{i=1}^{n} \left( \frac{\text{bank length}_i \times \text{erosion multiplier}_i}{\text{SAR length}} \right)
\]

- Values range from 0 to 200
- Less than 15 receives a score of 1.0
- Used in the hydrology function for perennial streams
How to Measure Streambank Stability

- While standing in the channel, measure length of each section of erosion above bankfull level
- Assign height category to each eroded area
- Erosion length is multiplied by height category multiplier

Table 2. Erosion height rating for calculating Streambank Stability in perennial streams

<table>
<thead>
<tr>
<th>Height of erosion above bankfull stage (ft)</th>
<th>Height category</th>
<th>Erosion multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1–2</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>2.1–4</td>
<td>2</td>
<td>0.7</td>
</tr>
<tr>
<td>&gt;4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Artificial Bank Stabilization</td>
<td>4</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Erosion 1-2 ft above bankfull

Erosion >4 ft above bankfull

Erosion 2.1-4 ft above bankfull

Artificial stabilization
Streambank Stability
Variable Scaling

Streambank Stability ($V_{BANKSTAB}$)

Variable Subindex

Streambank stability index (unitless)

0 20 40 60 80 100 120 140 160 180 200

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Large Woody Debris – Perennial Streams

\( V_{LWD} \)

- Number of down woody stems in the riparian/buffer zone per 100 ft of stream reach
- At least 4 in. diameter and 36 in. long
- Streams with 14-22 pieces of LWD receive a score of 1.0
- Used only in the habitat function for perennial streams
How to Measure Large Woody Debris

- Measure within the riparian/buffer zone, extending 50 ft on either side of the channel
- Count each piece of LWD along the entire stream assessment reach and channel
- Count broken logs as one piece
Large Woody Debris
Variable Scaling – Perennial Streams
Riparian/Buffer Zone Tree Diameter – Perennial Streams

\( V_{TDBH} \)

- Average diameter at breast height of trees within the riparian/buffer zone
- Stream reaches with average DBH of \( \geq 9.3 \) in. receive a score of 1.0
- Used in the habitat function for perennial streams
How to Measure Tree Diameter – Perennial Streams

- Select 4, 21-ft radius plots within 50 ft of the channel edge
- Use a calipers or DBH tape to measure diameter of all trees within subplots at least 4 in. DBH
Riparian/Buffer Zone Tree Diameter Variable Scaling – Perennial Streams
Riparian/Buffer Zone Tree Density

\( V_{TDEN} \)

- Average number of trees \( \geq 4 \) in. diameter per acre
- Measured in at least 4, 0.032-acre subplots within the riparian/buffer zone
- Stream reaches with 135-262 trees/acre receive a score of 1.0
- Used in the biogeochemistry function for perennial streams
How to Measure Tree Density

- Measured along with tree diameter
- When measuring diameter, total the number of trees within the 4, 21-ft radius subplots
Riparian/Buffer Zone Tree Density Variable Scaling
Coefficient of Conservatism

\( V_{C\text{VALUE}} \)

- Average of published C-values for trees and all non-native vegetation
- Ranking of 0-10 published by the WV Natural Heritage Program
- Reflects tolerance to disturbance
- Exotic species receive C-values of 0
- Measured within 0.032-acre subplots
- Average C-values >5.5 receive a score of 1.0
How to Measure Coefficient of Conservatism

- In the 4, 21-ft radius subplots, list each tree species found
- List any non-native species in any strata (herbaceous, shrub, sapling, trees)
- Assign provided C-values in (Table B1)
## Example C-values

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>C-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>boxelder maple</td>
<td><em>Acer negundo</em></td>
<td>2</td>
</tr>
<tr>
<td>black maple</td>
<td><em>Acer nigrum</em></td>
<td>7</td>
</tr>
<tr>
<td>red maple</td>
<td><em>Acer rubrum</em></td>
<td>3</td>
</tr>
<tr>
<td>sugar maple</td>
<td><em>Acer saccharum</em></td>
<td>6</td>
</tr>
<tr>
<td>yellow buckeye</td>
<td><em>Aesculus flava</em></td>
<td>7</td>
</tr>
<tr>
<td>common serviceberry</td>
<td><em>Amelanchier arborea</em></td>
<td>6</td>
</tr>
<tr>
<td>pawpaw</td>
<td><em>Asimina triloba</em></td>
<td>5</td>
</tr>
<tr>
<td>yellow birch</td>
<td><em>Betula alleghaniensis</em></td>
<td>7</td>
</tr>
<tr>
<td>sweet birch</td>
<td><em>Betula lenta</em></td>
<td>5</td>
</tr>
<tr>
<td>river birch</td>
<td><em>Betula nigra</em></td>
<td>5</td>
</tr>
<tr>
<td>American hornbeam</td>
<td><em>Carpinus caroliniana</em></td>
<td>5</td>
</tr>
<tr>
<td>mockernut hickory</td>
<td><em>Carya alba</em></td>
<td>6</td>
</tr>
<tr>
<td>bitternut hickory</td>
<td><em>Carya cordiformis</em></td>
<td>5</td>
</tr>
<tr>
<td>pignut hickory</td>
<td><em>Carya glabra</em></td>
<td>6</td>
</tr>
<tr>
<td>shagbark hickory</td>
<td><em>Carya ovata</em></td>
<td>6</td>
</tr>
<tr>
<td>Japanese barberry</td>
<td><em>Berberis thunbergii</em></td>
<td>0</td>
</tr>
</tbody>
</table>
Coefficient of Conservatism
Variable Scaling

Coeficient of Conservatism ($V_{VALUE}$)

Average coefficient of conservatism (C-value)

Variable Scaling
Watershed Forest Cover

\( V_{\text{FOREST}} \)

- Percent forested land cover in the watershed of the stream assessment area
- Stream reaches with \( \geq 93\% \) forest receive a score of 1.0
- Used in the hydrology, biogeochemistry and habitat functions for perennial streams
How to Measure Percent Forest

- Delineate watershed up-slope of the stream assessment reach using topographic maps, aerial photos, or other methods
- Estimate percent forest cover using remote techniques, verify in the field
Percent Forest Variable Scaling

![Graph showing the relationship between Watershed forest cover and Watershed Forest Cover (V_{FOREST}). The graph has a linear scale from 0 to 100 on the x-axis for Watershed forest cover (percent) and a linear scale from 0 to 1 on the y-axis for Watershed Forest Cover (V_{FOREST}). The line on the graph indicates an increasing trend as the forest cover increases.]
Questions?