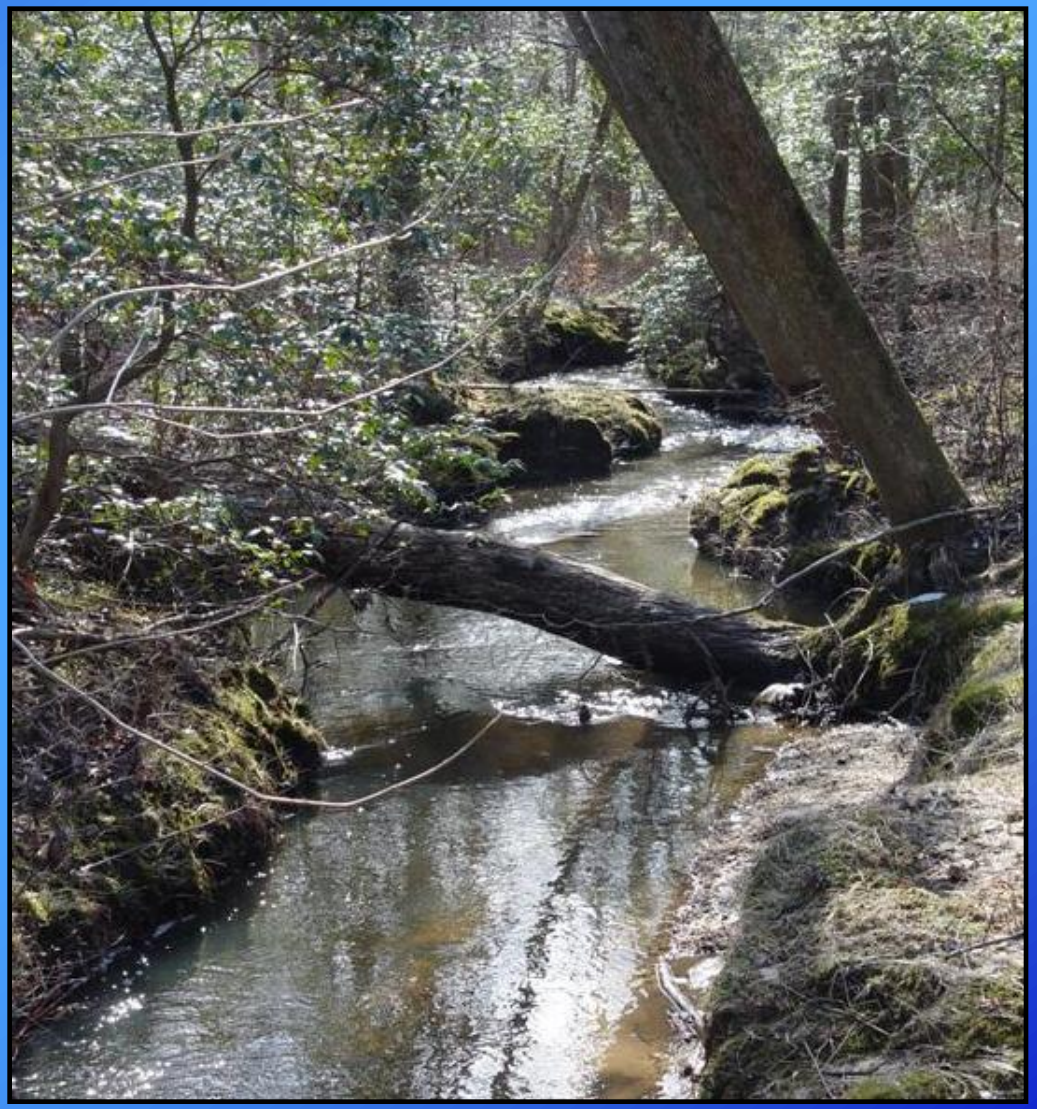
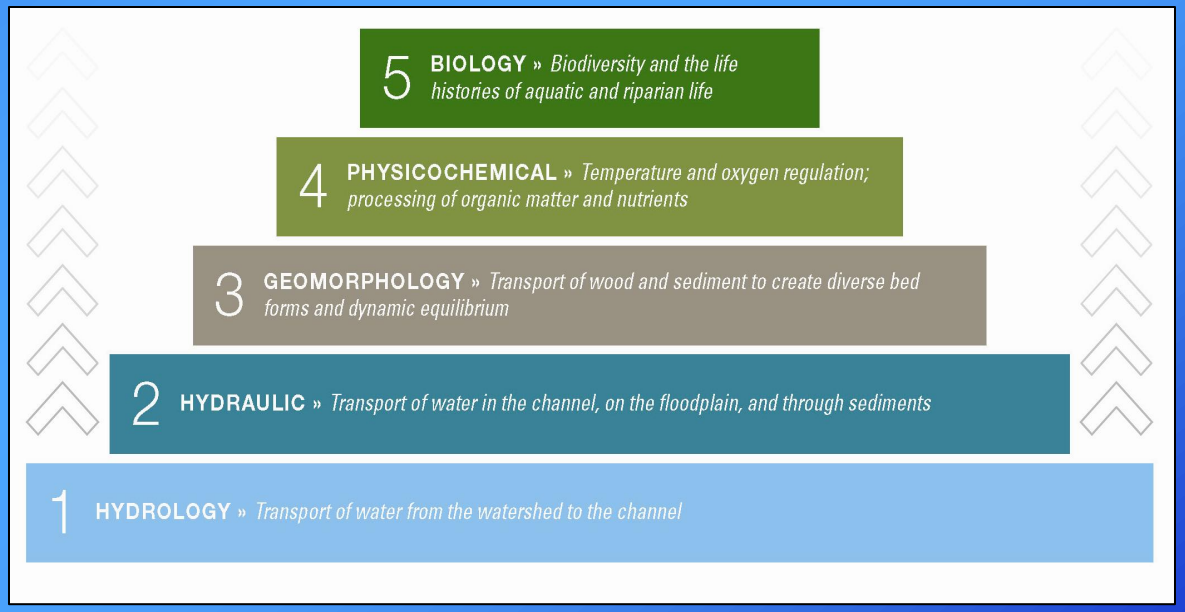
Stream Health Workgroup

Mark A. Secrist
U.S. Fish and Wildlife Service



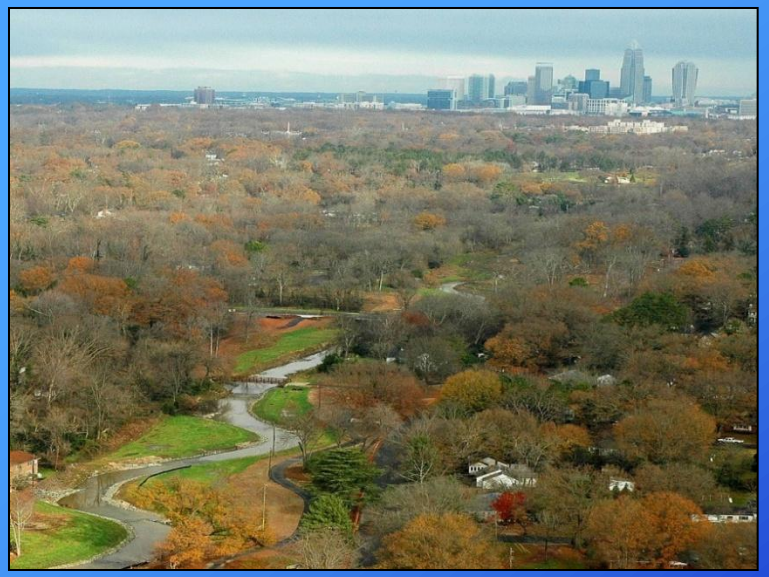
Functional Lift Framework: A Guide for Restoring Stream Functions



20th Century Shift

Traditional Channel Design

Transport water quickly; Bed and banks don't move



Natural Channel Design

Create a dimension, pattern, and profile that transports water and sediment.

Source: Michael Baker Corporation

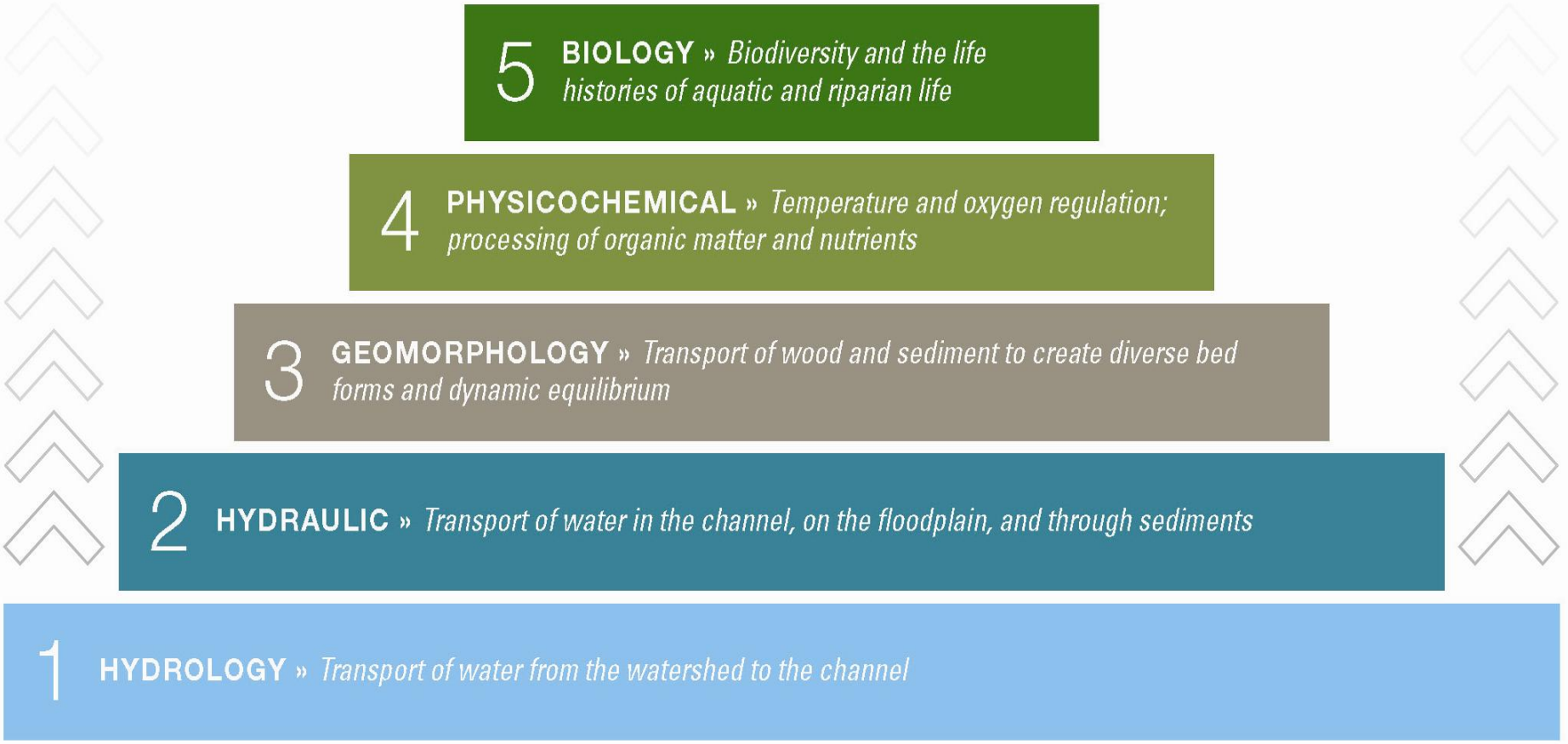
21st Century Goal

Restoration of Dimension, Pattern, and Profile

→

Restoration of **Functions**

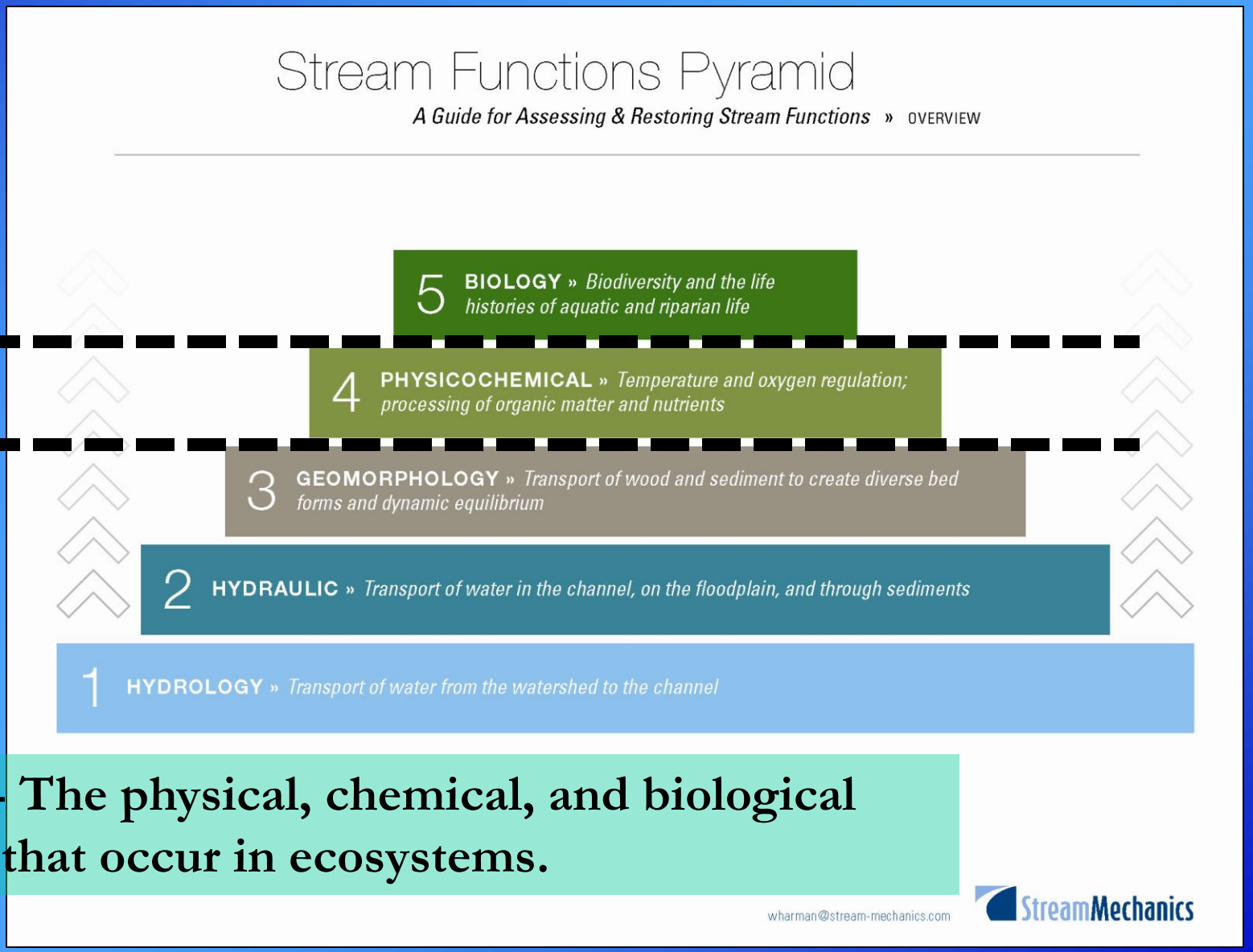
Stream Functions Pyramid



Biological

Chemical

Physical

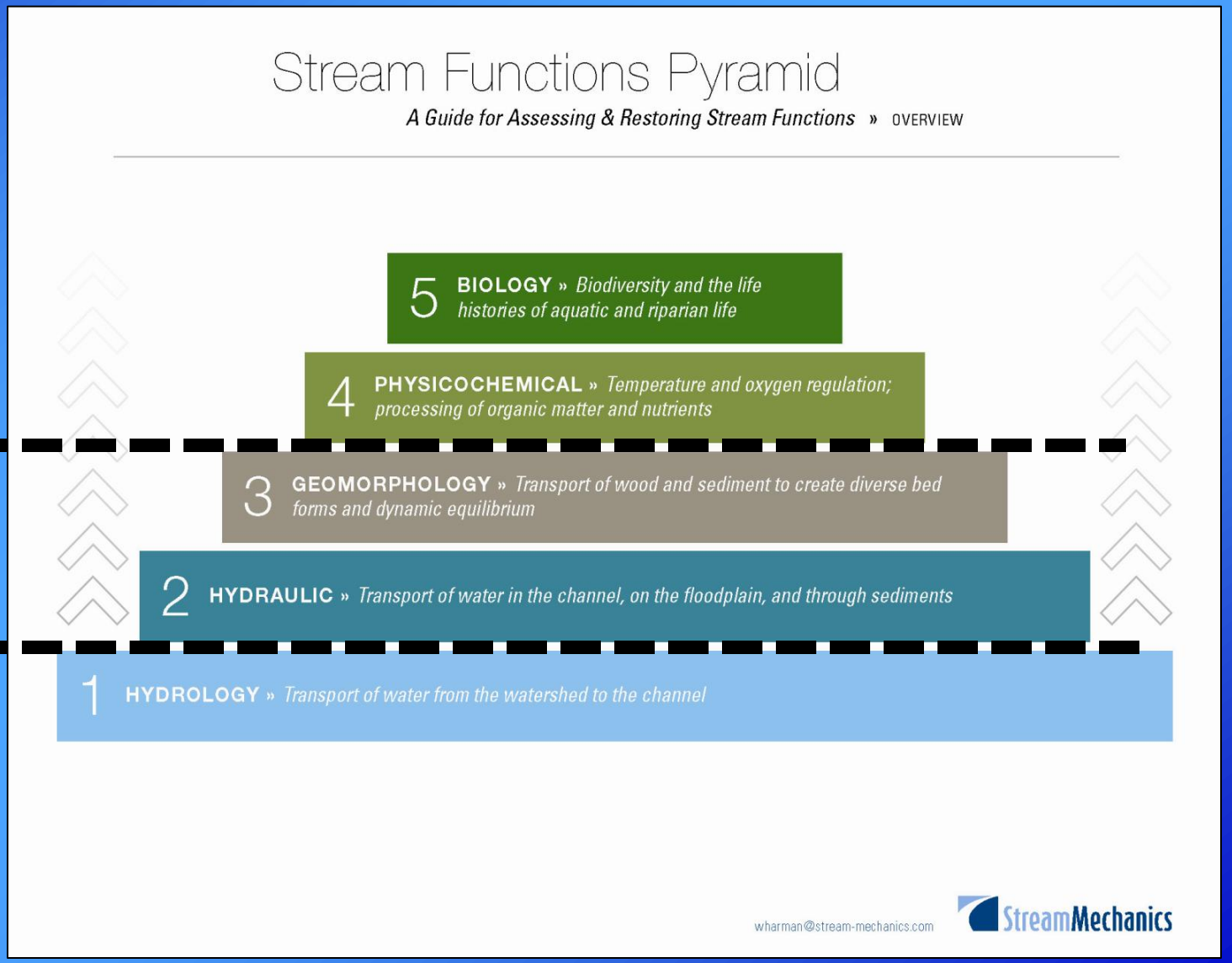


Function - The physical, chemical, and biological processes that occur in ecosystems.

Site Selection

Reach Scale Improvements

Independent Variables



Parameters and Measurement Methods

APPENDIX A.c. Parameters and Measurement Methods

HYDROLOGY	
Parameter	**Measurement Method**
Channel-Forming Discharge	1. Regional Curves
Precipitation/Runoff Relationship	1. Rational Method 2. HEC-HMS 3. USGS Regional Regression Equations
Flood Frequency	1. Bulletin 17b
Flow Duration	1. Flow Duration Curve 2. Crest Gage 3. Monitoring Devices 4. Rapid Indicators
HYDRAULICS	
Parameter	**Measurement Method**
Floodplain Connectivity	1. Bank Height Ratio 2. Entrenchment Ratio 3. Stage Versus Discharge
Flow Dynamics	1. Stream Velocity 2. Shear Stress 3. Stream Power
Groundwater/Surface Water Exchange	1. Piezometers 2. Tracers 3. Seepage Meters

BIOLOGY	
Parameter	**Measurement Method**
Microbial Communities	1. Taxonomic Methods 2. Non-Taxonomic Methods 3. Biological Indices
Macrophyte Communities	1. Taxonomic Methods 2. Non-Taxonomic Methods 3. Biological Indices
Benthic Macroinvertebrate Communities	1. Taxonomic Methods 2. Non-Taxonomic Methods 3. Biological Indices
Fish Communities	1. Taxonomic Methods 2. Non-Taxonomic Methods 3. Biological Indices
Landscape Connectivity	1. Spatial Analysis 2. Species Tracking 3. Habitat Models

GEOMORPHOLOGY	
Parameter	**Measurement Method**
Sediment Transport Competency	1. Shear Stress Curve 2. Required Depth and Slope 3. Spreadsheets and Computer Models
Sediment Transport Capacity	1. Computer Models 2. FLOWSED and POWERSED 3. BAGS
Large Woody Debris Transport and Storage	1. Wohl, et al. (2009) 2. Large Woody Debris Index
Channel Evolution	1. Simon Channel Evolution Model 2. Rosgen Stream Type Succession Scenarios
Bank Migration/Lateral Stability	1. Aerial Photography 2. BEHI/NBS 3. Bank Pins 4. Bank Profiles 5. Cross-Sectional Surveys 6. Bank Stability and Toe Erosion Model
Riparian Vegetation	1. Buffer Width 2. Buffer Density 3. Buffer Composition 4. Buffer Growth 5. Canopy Density 6. Proper Functioning Condition (PFC)
Bed Form Diversity	1. Percent Riffle and Pool 2. Facet Slope 3. Pool-to-Pool Spacing 4. Depth Variability
Bed Material Characterization	1. Bevenger and King (1995) 2. Riffle Stability Index (RSI)
PHYSIOCHEMICAL	
Parameter	**Measurement Method**
Basic Water Chemistry	1. Temperature 2. Dissolved Oxygen 3. Conductivity 4. pH 5. Turbidity
Nutrients	1. Field test kits using reagents reactions 2. Laboratory analysis
Organic Carbon	1. Laboratory analysis

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GEOMORPHOLOGY	
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Sediment Transport Competency	1. Shear Stress Curve
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Performance Standards
Floodplain Connectivity Example

Measurement Method	Functioning	Functioning-At-Risk	Not Functioning
Bank Height Ratio (BHR)	1.0 to 1.2	1.3 to 1.5	> 1.5
Entrenchment Ratio (ER) for C and E Stream Types	> 2.2	2.0 to 2.2	< 2.0
Entrenchment Ratio (ER) for B and Bc Stream Types	> 1.4	1.2 to 1.4	< 1.2
Dimensionless rating curve	Project site Q/Q_{bkf} plots on the curve	Project site Q/Q_{bkf} plots above the curve	Project site Q/Q_{bkf} of 2.0 plots above 1.6 for $d/_{dbkf}$

How can we use the pyramid?
-Application-

Function-Based Assessments

Goals and Objectives

Debit and Credit Determination

Function-Based Assessments

Why do we need them?

- Is this stream sick?
- Is the stream moving towards stability or instability?
- Was there functional lift?
- Was this project successful?
- What reaches in the watershed need restoration?

Function Drivers

- **Floodplain Connectivity**
- **Bedform Diversity**
- **Streambank Erosion (Lateral Stability)**
- **Riparian Buffer**
- **Site Selection**

Requires

Appropriate Watershed Condition.
Adequate hydrology functions.
Reach scale versus watershed scale understanding.

Caveats

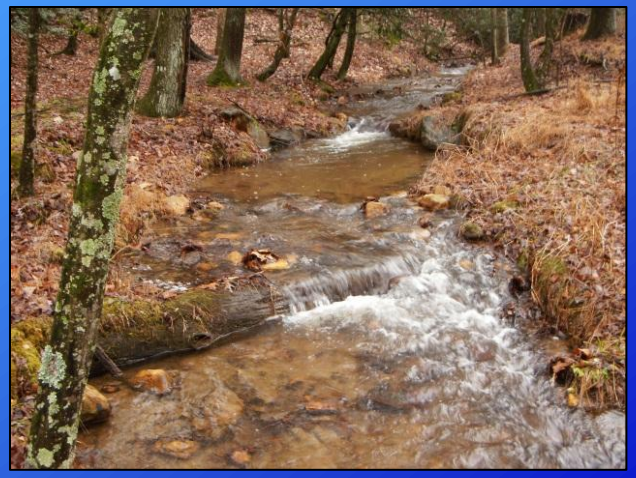
For perennial single thread, meandering, alluvial, riffle-pool dominated stream types.

Bad Goal

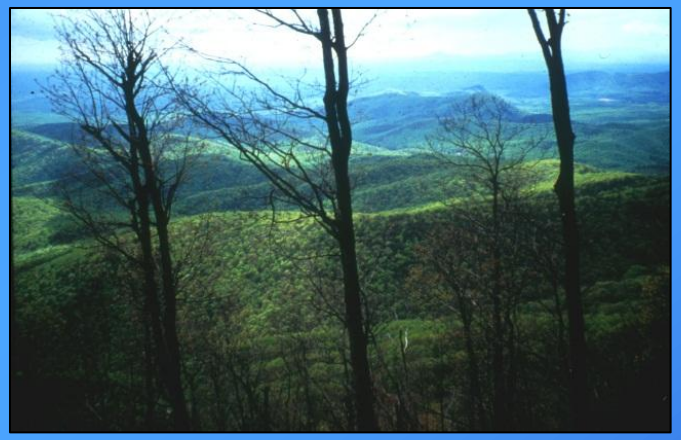
Better Habitat Goals

The goal of this project is to improve native brook trout habitat (Levels 1-3).

Even better – The goal of this project is to increase the biomass of native brook trout populations (Levels 1-5).



Quantitative Brook Trout Objectives



- Create pH of 6.5 to 8.0 (Level 4)
- Create water temperature of 11 to 16º C (Level 4)
- Create pool habitat of 40 to 60 percent (Level 3)
- Create 3 to 80 mm diameter substrate for spawning (Level 3)
- Create velocities of 2.8 to 4.3 ft/sec (Level 2)

Key Points

- The Stream Functions Pyramid can be as a tool that managers and practitioners can you to guide their restoration activities
- Restoration activities directly affect Level 2 and 3 Parameters.
  - May occasionally directly affect Level 1.
- Restoration activities along with proper site selection *may* affect Level 4 and 5 Parameters.
- This is a guide to help people think about how functions support each other and how to link restoration approaches with functional lift.
  - It is not a cookbook approach
- Successful watershed restoration results from a variety of restoration activities being implemented within a watershed and at a large enough scale to influence beneficial change.

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