

West Virginia and Kentucky HGM Stream Assessment : Development, Validation, and Outcomes

Status Report

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ERDC Environmental Laboratory
Appalachian Stream Mitigation Workshop
April 11-15, 2011
Lexington, KY

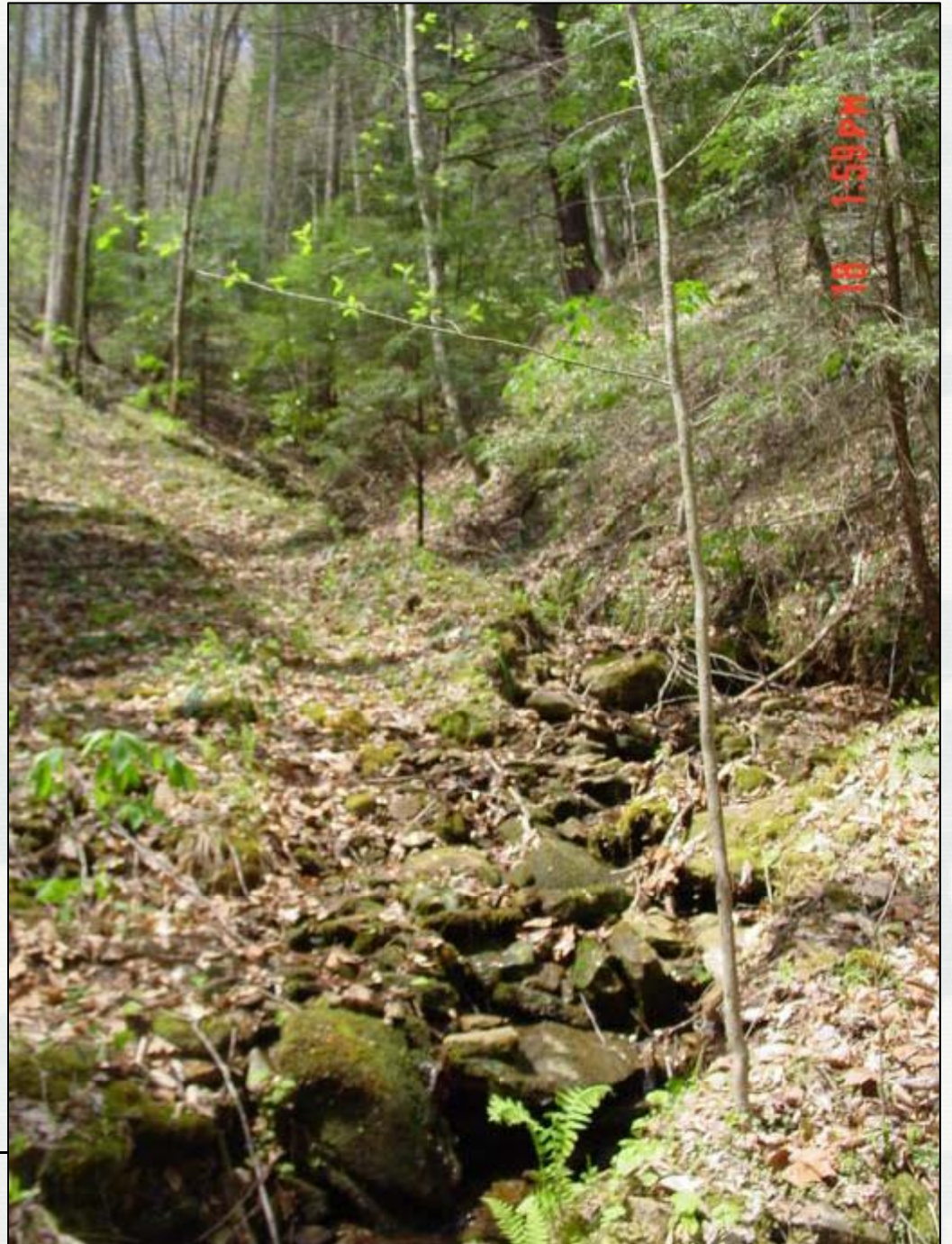


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Outline

- Background
- Model development
- Current work
- Validation
- Anticipated outcomes



Hydrogeomorphic (HGM) Approach

- Based on geomorphic setting, water source, and hydrodynamics
- Developed to assess:
 - ▶ Ecosystem functions
 - ▶ Baseline conditions
 - ▶ Environmental impacts
 - ▶ Mitigation



HGM Background

- Developed for CWA 404
- Interagency
 - ▶ (EPA, FWS, COE, FHWA, NRCS)
- Literature supports structure inferring function
- Identifies specific functions
- Reference data based
- Peer reviewed & tested
- >20 HGM guidebooks

Stream Protocol Requirements

Corps stream assessment protocol requirements:

- ▶ Science-based
- ▶ Repeatable results
- ▶ Applied any time of the year
- ▶ Useful for impact assessment /mitigation
- ▶ Rapid
- ▶ Account for impacts to stream function



Functions - the physical, chemical, and biological processes that occur in ecosystems [33 CFR 332.2]

Few ecological assessment methods directly measure functions

Rapid assessment methods infer functions from structure

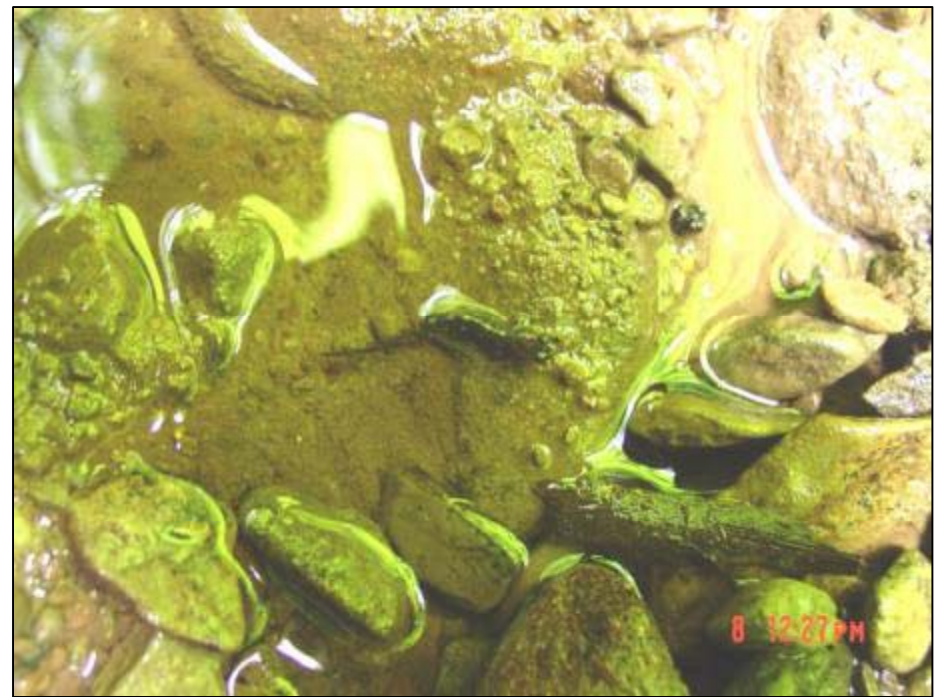
HGM tied to reference standards (semi-quantitative)

Other methods use best professional judgment, checklists



Why the Corps Uses HGM

- The best rapid functional assessment tool available
- Developed for 404 CWA
- Uses standard HGM protocol
- Calibrated in Appalachia
- Used for projects other than surface mining



Development Sequence

Task	Description	Start	Complete
1	Organize Regional Assessment Team (A-Team)	12/07	01/08
2	Identify and Prioritize Regional Subclasses	12/07	01/08
3	Construct the Conceptual Assessment Models	05/07	12/07
4	Peer Review Precalibrated Draft of the Regional Guidebook	05/07	06/07
5	Calibrate and Field Test Assessment Models	12/07	11/09
6	Peer Review Calibrated Draft of the Regional Guidebook	12/09	02/10
7	Field Test Operational Draft of the Regional Guidebook	10/09	10/09
8	Transfer Technology in Operational Draft Regional Guidebook to End Users	06/10	06/10
9	Revise Operational Draft of the Regional Guidebook and Publish (<i>Anticipated</i>)	10/12	12/12



What is an A-Team?

Assessment Team – Interagency working group of regional experts

- ▶ EPA Region 3 & 4, WVDNR, USACE, WVDEP, USFWS

A-Team goals:

- ▶ Selection of variables and functional models
- ▶ Assist with site location and data collection
- ▶ Review field protocol
- ▶ Comment and review draft documents

Current Geographic Extent of WV/KY HGM Guidebook

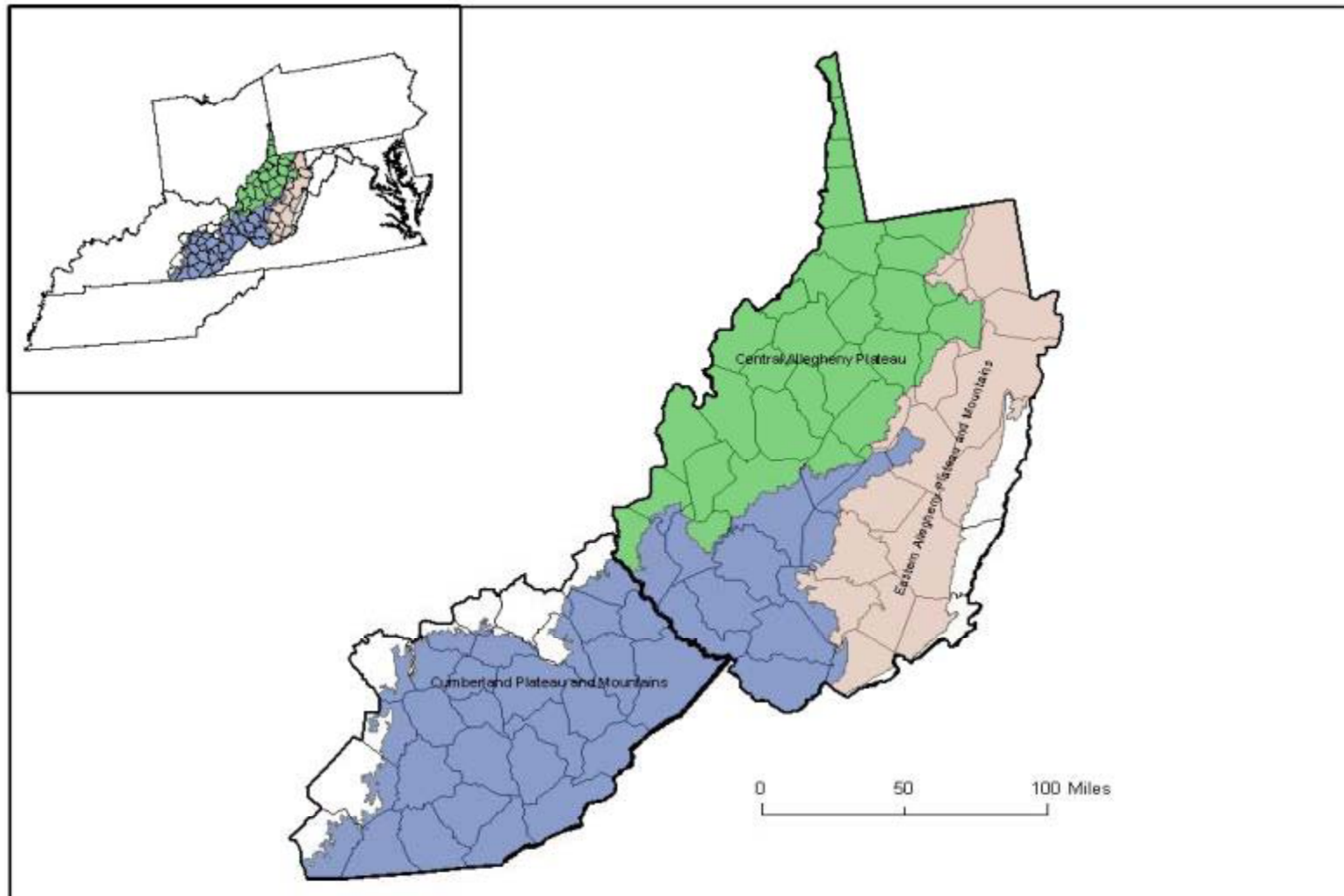


Figure 3. Map of the Reference Domain for High-gradient Headwater Streams in Western West Virginia and Eastern Kentucky

Application of HGM to WV/KY

- Classification - High-gradient, headwater streams, not perennial streams
- Data collected from >90 sites in WV & KY
- Functional models
 - ▶ 12 variables combined for assessment of 3 functions



Variables Collected for the High-Gradient Ephemeral and Intermittent Headwater Streams in Western West Virginia and Eastern Kentucky HGM Assessment Models

Functions:

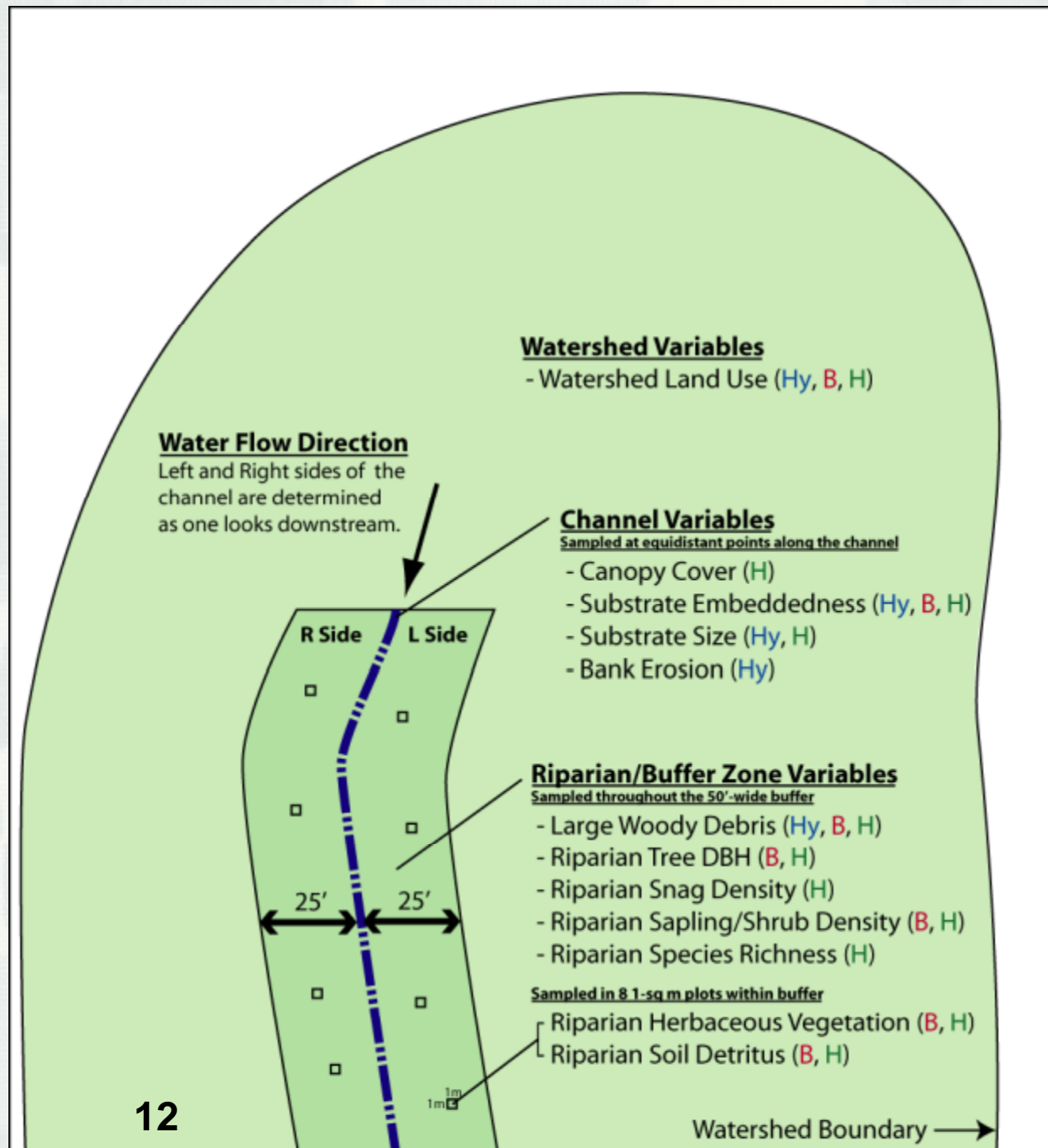
Hy = Hydrology

B = Biogeochemical Processing

H = Habitat



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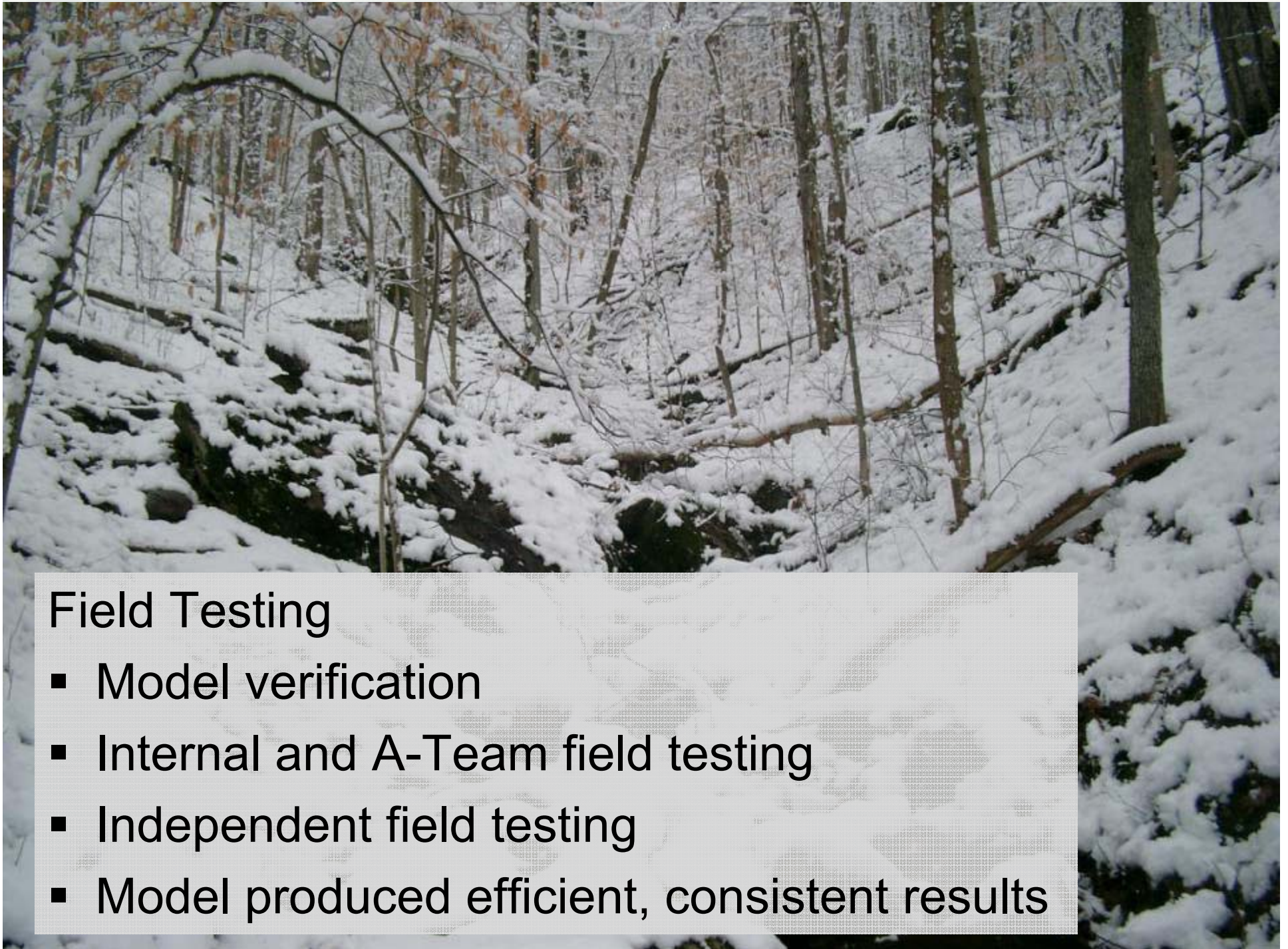


Functions

- Three functions incorporated in the assessment:
 - ▶ Habitat
 - ▶ Biogeochemical cycling
 - ▶ Hydrology

Peer Review conducted by:

- A-Team
- ERDC Technical Review
- External peer review - East Carolina University, University of North Carolina, Marshall University, IWR
- Grammatical and format edit
- ERDC Environmental Laboratory



Field Testing

- Model verification
- Internal and A-Team field testing
- Independent field testing
- Model produced efficient, consistent results

ERDC/EL TR-10-X

Environmental Laboratory



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Wetlands Regulatory Assistance Program

**Operational Draft Regional Guidebook for the
Functional Assessment of High-gradient
Ephemeral and Intermittent Headwater
Streams in Western West Virginia and Eastern
Kentucky**

U.S. Army Corps of Engineers

June 2010



Approved for public release; distribution is unlimited.



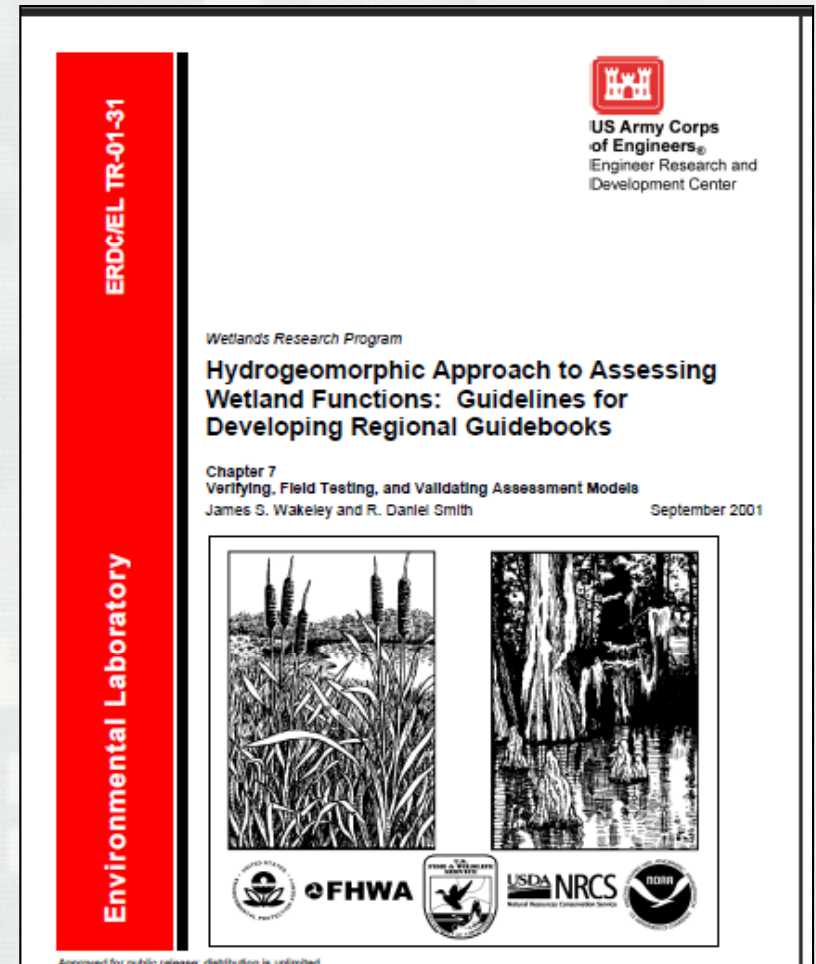
Current work

- **Implement**
 - Districts develop implementation plan
 - Training – Agency, consultants, applicants, academia
 - Communication/Outreach
- **Assess**
 - ▶ Use method and gather additional information (2-year process)
- **Refine based on feedback/additional data**
- **Validate - Testing the models' accuracy and reliability by comparing model results against independent measures of function**



Model Validation:

- Conducted by comparing model outputs to independent, quantitative measures of function
- Determines and improves accuracy of FCI values derived from an assessment model



- For the purposes of validation, the independent, quantitative measure of function serves as the de facto standard of comparison for functional capacity.



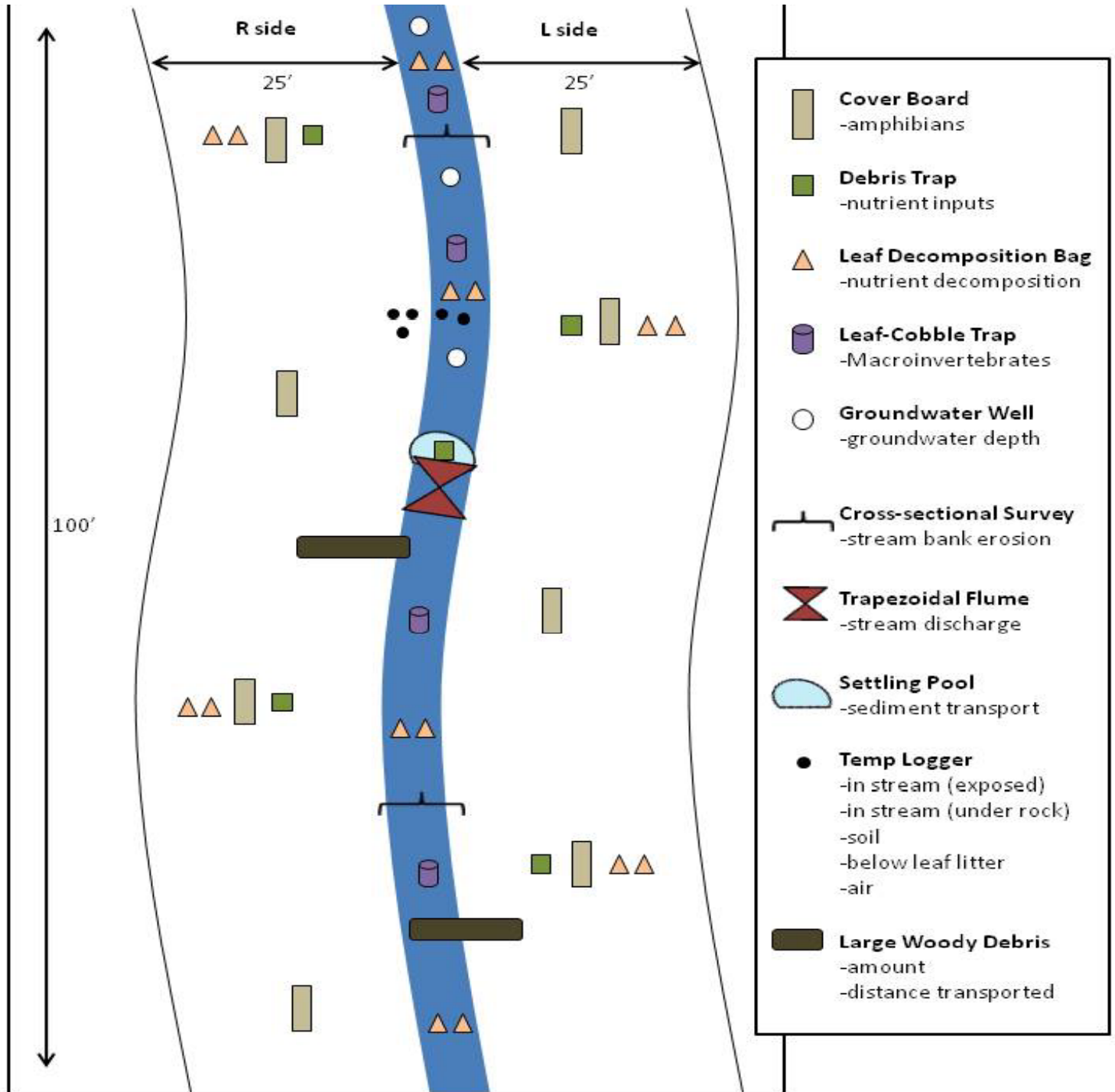
Project Development Team

- Interagency group (>30)
 - ▶ Academia, EPA, USACE, USGS, WVDNR, USDA, OSM, FWS, DOT, and others
- Provided input, guidance, and review of validation study plan
- Will review draft documents and provide comments

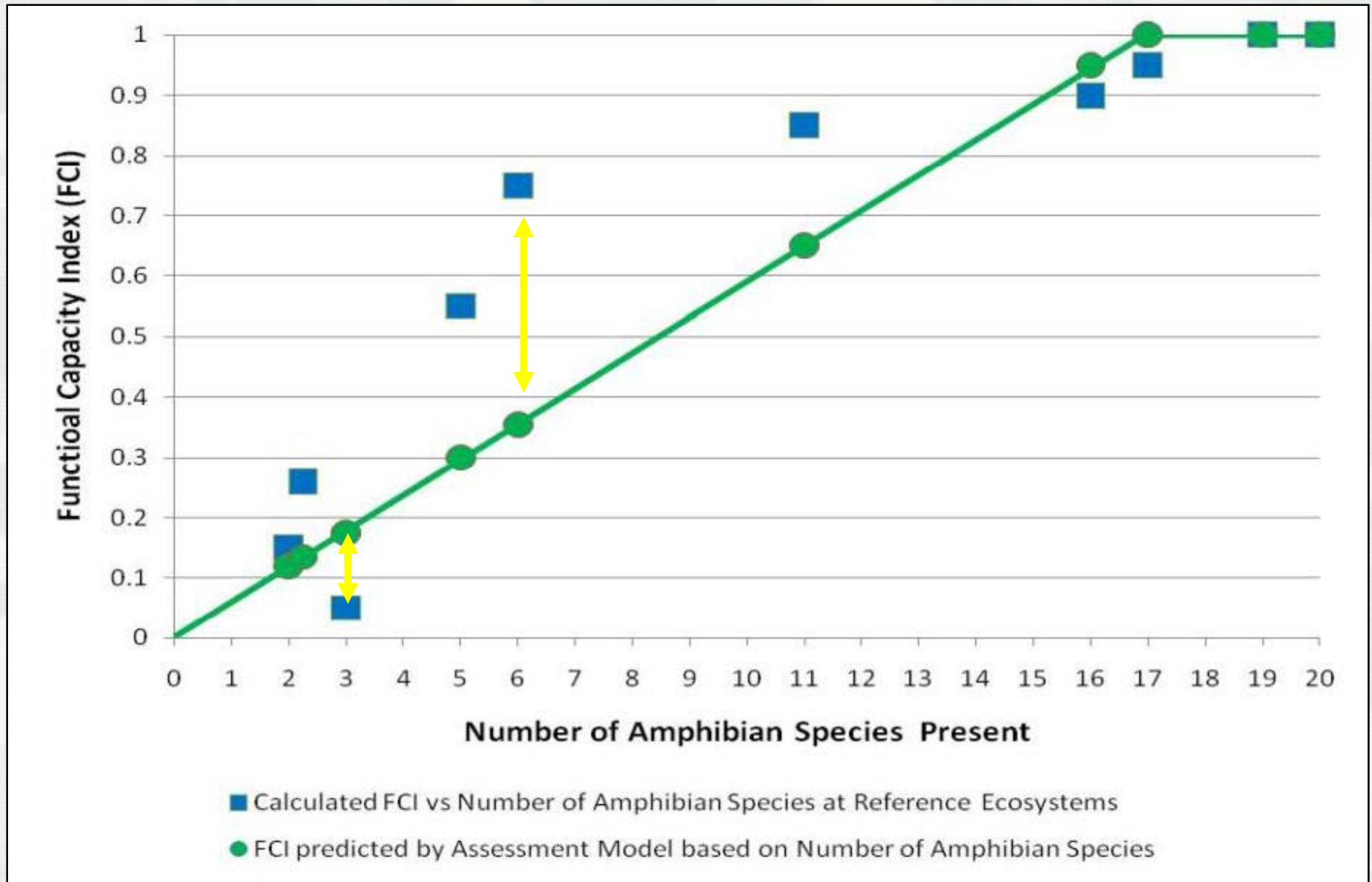


Assessment Model(s)	Function/ Variable	Independent quantitative measure	Data collection method
Hydrology	Function: Maintain Natural Hydrologic Regime	Stream Discharge	Flume installed within the study area and outfitted with automated data logger recording stream level at 15 minute intervals.
Biogeo-chemical cycling	Function: Maintain Biogeochemical Cycling	Dissolved Nutrient Flux	Water samples collected and analyzed for pH, EC, and nutrients. The export of nutrients will be evaluated based on stream discharge (nutrient flux).
Habitat	Function: Maintain Characteristic Amphibian Habitat	Amphibian population	Cover boards (will be checked once per month for the presence of amphibians. Amphibian species present in the channel will be evaluated using the leaf-cobble traps described above. Species richness, abundance, and health (based on biomass) will be evaluated on a seasonal basis.
Independent measures of function			

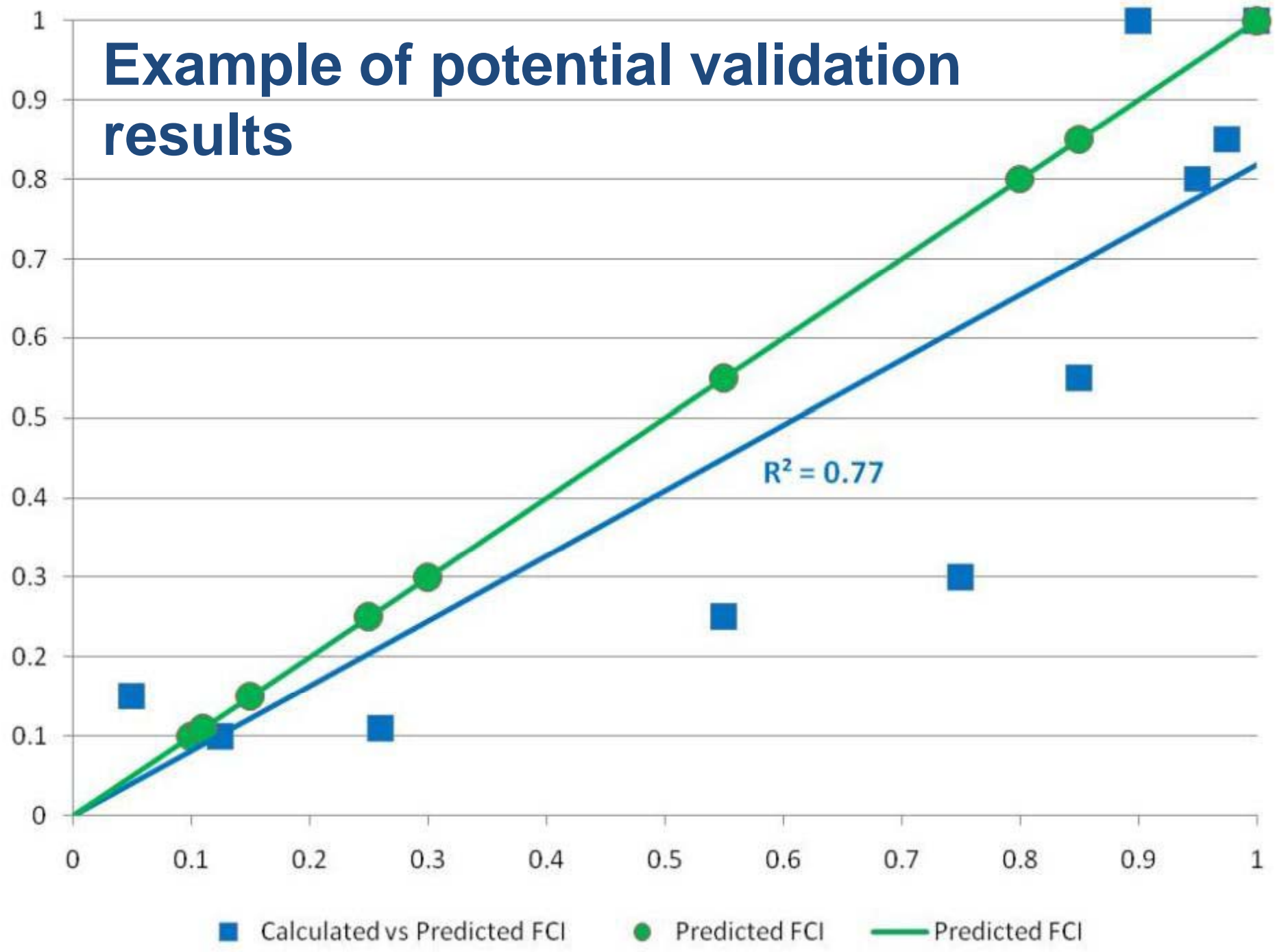
Validation Site Layout



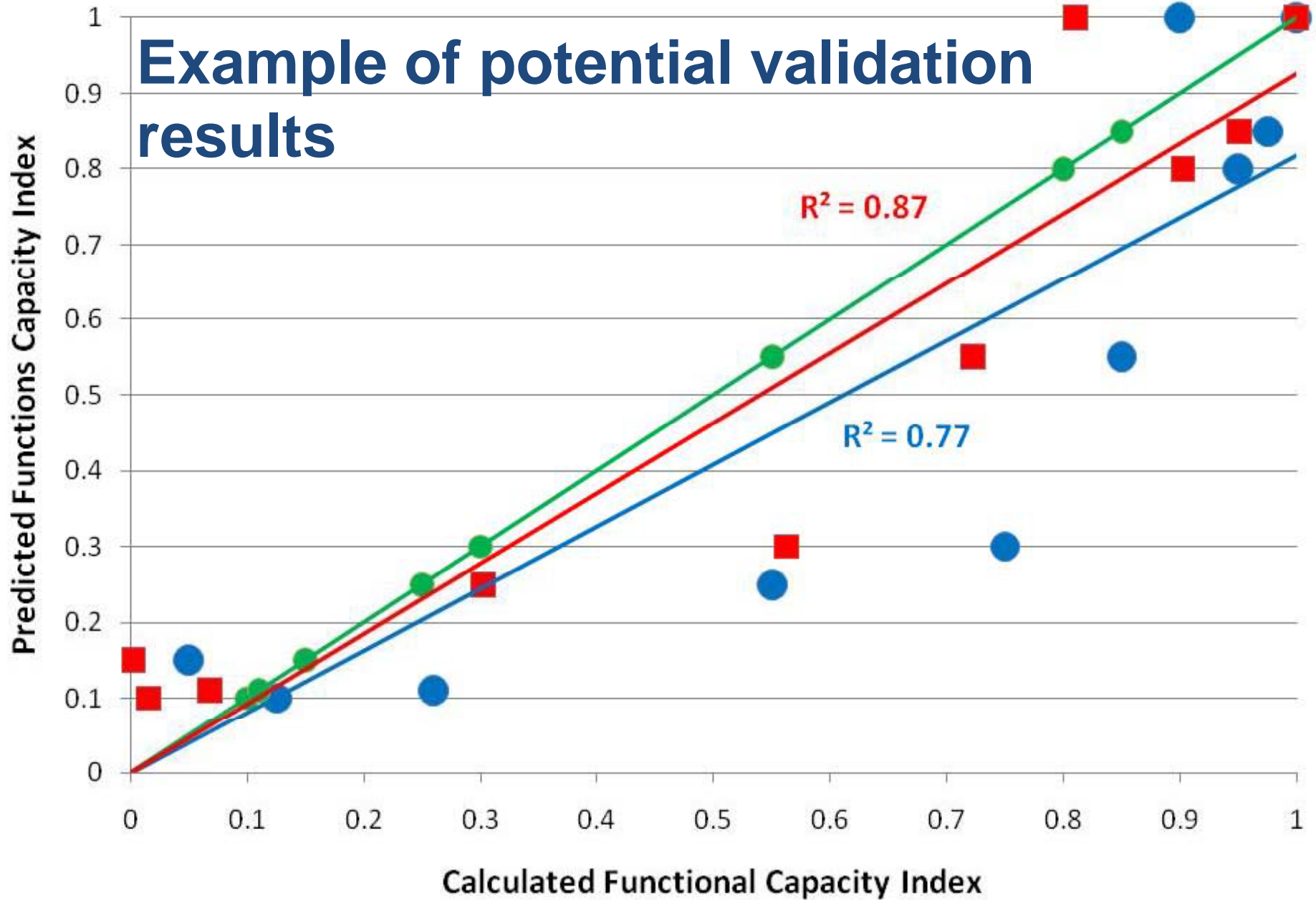
Example of potential validation results



Example of potential validation results



Example of potential validation results



● Original vs Predicted

● Predicted vs Predicted

■ Revised vs Predicted



Outcomes

Draft guidebook updated based on:

- ▶ Collection of additional data
- ▶ Input from users
- ▶ Validation results

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Questions and Acknowledgements

- Over 70 professionals participated in model development, data collection, review, and validation...THANK YOU!
- Questions?



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Appendix 1

- Responses to water chemistry and macroinvertebrate sampling
 - ▶ Available upon request



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Comments - Conductivity

- Conductivity – Reviewers commented that we should incorporate conductivity as one of the variables in the WV/KY HGM Guidebook
 - Existing procedures available to measure conductivity
 - Conductivity is a water quality parameter
 - Measuring water quality parameters is not consistent with the HGM methodology
 - Additionally, water quality parameters vary over time (yearly, seasonal, and daily)
 - Reduces repeatability
 - Can only be done when flowing water is present; values vary with stream flow
 - When appropriate and available, water chemistry data will be requested and evaluated



Comments - Macroinvertebrates and Amphibians

- Macroinvertebrates and amphibians – Reviewers commented that we should incorporate aquatic macroinvertebrate and amphibians as one of the variables in the WV/KY HGM Guidebook
 - Captured by surrogates of habitat
 - HGM assessment specifically excludes direct measures of animal populations because of:
 - Temporal (yearly, seasonal, and time of day) variability and other sources of population variation
 - Reduces repeatability
 - Requires specialized training and sampling beyond the scope of rapid assessment
 - Comparison data is difficult to interpret
 - States have protocols to measure macroinvertebrates

