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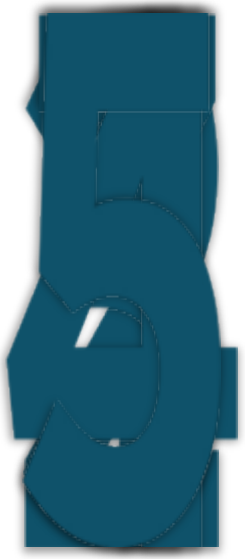
Tennessee Water Resources Research Center

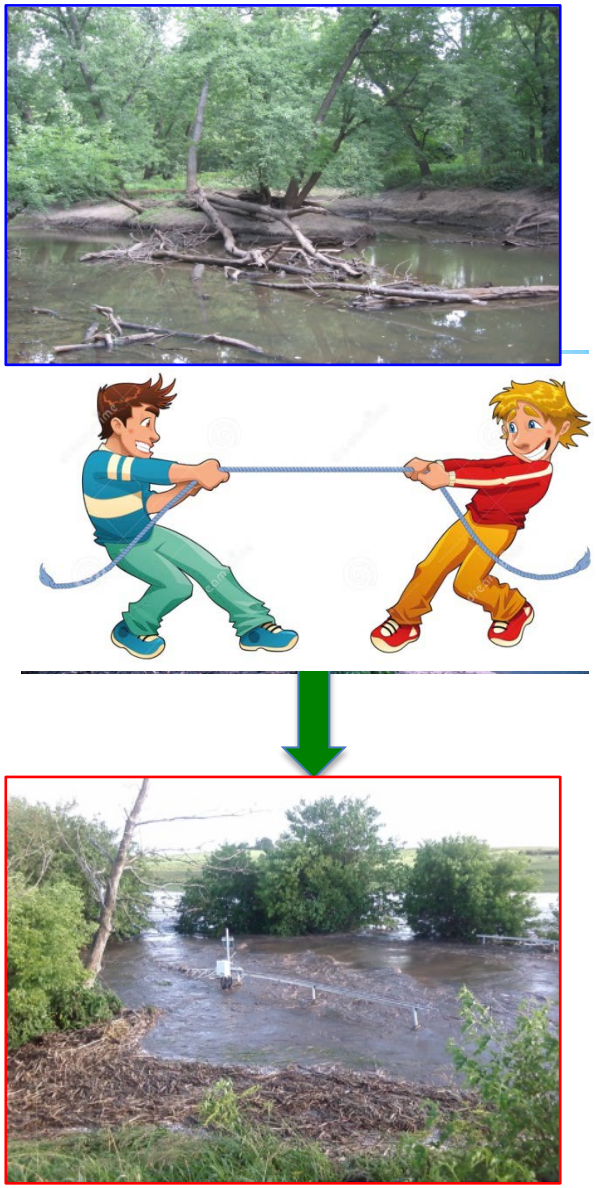
Connecting Landscapes with Rivers:

Challenges and Future Directions



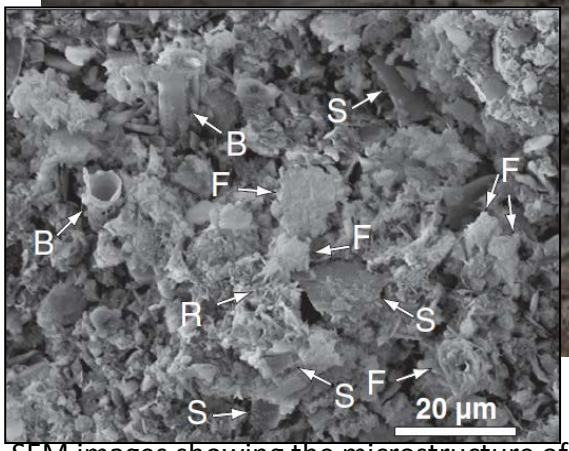
Hypothesis

- Landscapes have passed a tipping point resulting from human modification, and have gradually shifted from being a *transformer* with high nutrient, water, and sediment storage to being a *transporter* with low nutrient, water and sediment storage.
  - System is in dis-equilibrium and maintained so due to anthropogenic activities
  - Driven by event dynamics rather than seasonal/annual averages



Field Scale

Co-evolution of non-linear processes for biota, soil, and water



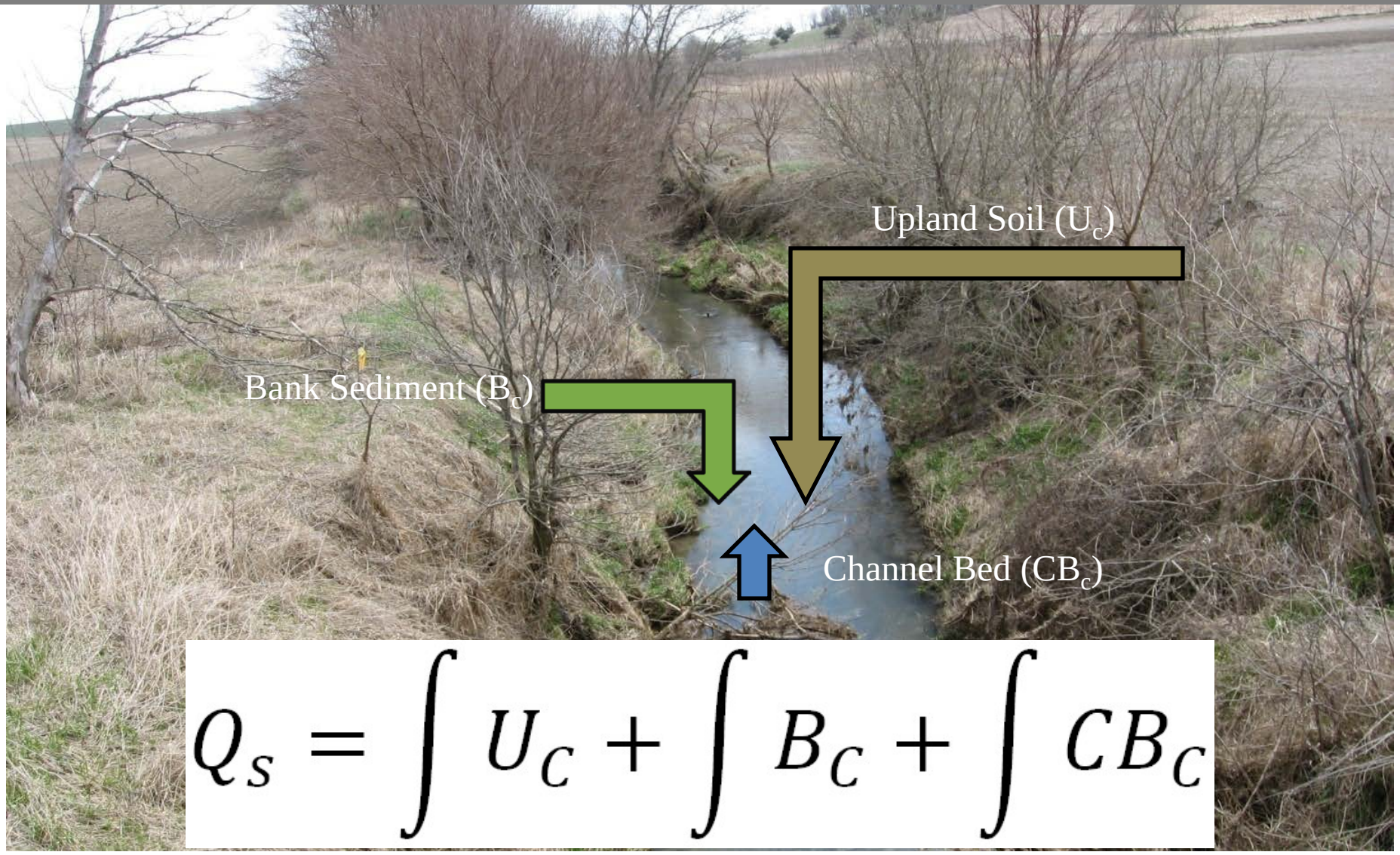
SEM images showing the microstructure of fluid-mud deposits fron
the Rokkaku River estuary, which contains bioclasts (B), a silt fractic
(S), FF-aggregates (F), and randomly oriented clay particles (R).
Papanicolaou , Wacha et al. 2014 Global Biogeochemical Cycles

convex
concave
lateral contributions
M1
channel pathway
concentrated flow
erosive
oriented
roughness
aggregates
M2
residue
depositional area
M3

$$\frac{\Delta SCSP}{\Delta t} = \left\{\begin{matrix} replacement\ of \\ soil\ OC\ at \\ erosion\ site \end{matrix}\right\} + \left\{\begin{matrix} burial\ of \\ non- \\ complexed\ OC \end{matrix}\right\} + \left\{\begin{matrix} respiration\ of \\ non- \\ complexed\ OC \end{matrix}\right\} + \left\{\begin{matrix} formation\ of \\ OC-mineral \\ complex \end{matrix}\right\}$$

Mechanism: **M1** **M2** **M3** **M4**

Sediment Budgets and Sediment Source partitioning



$$Q_s = \int U_C + \int B_C + \int CB_C$$

Scaling Up Issues

- Scale dependent thresholds – emergent patterns/properties
- Rates and threshold dynamics change under human impacts

Large Basin

Sum of small h
Storage an
net

Small Basin

Sum of hillslope
Slope/channel
channel
ba

Hillslope

Sum of plots +
Hydraulics of
flow, gr
hydrau
re

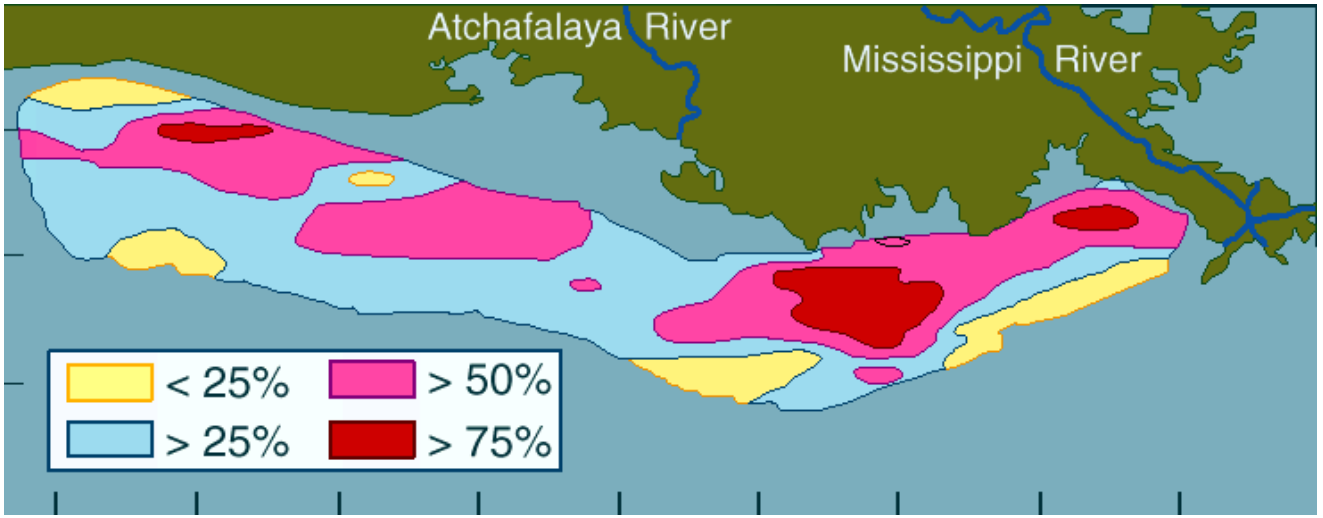
precip tensity,
in ability,
soil physics, soil moisture dynamics

Cascade of small scale processes and practices to large scale impacts

Adopted from Kumar & Papanicolaou, Arlington , Oct. 2014

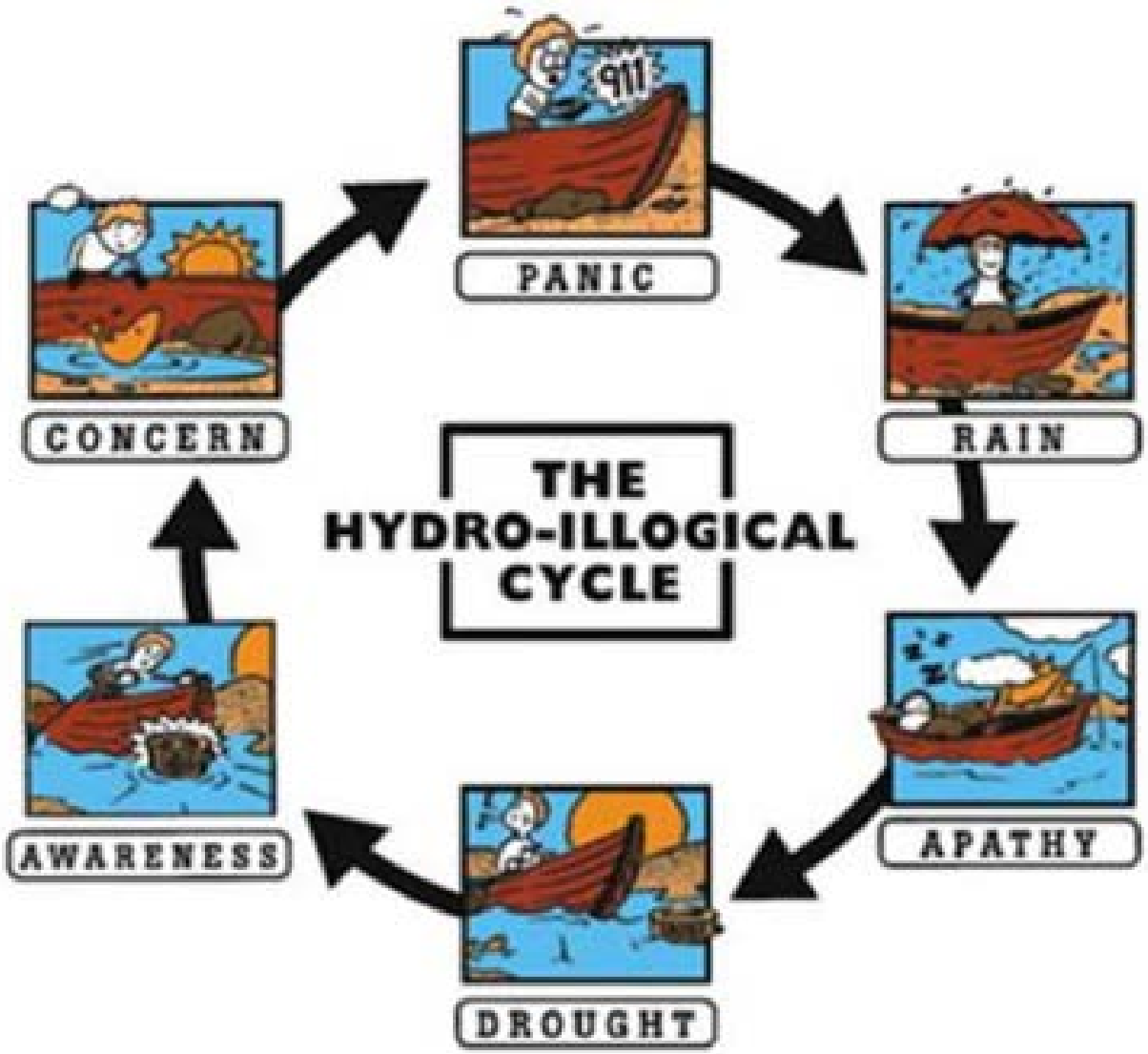
4. National Needs: Reducing Gulf Hypoxia- we can do them here in TN!

NPS and Hypoxia



Distribution of frequency of occurrence of midsummer hypoxia — based on data from Rabalais, Turner and Wiseman

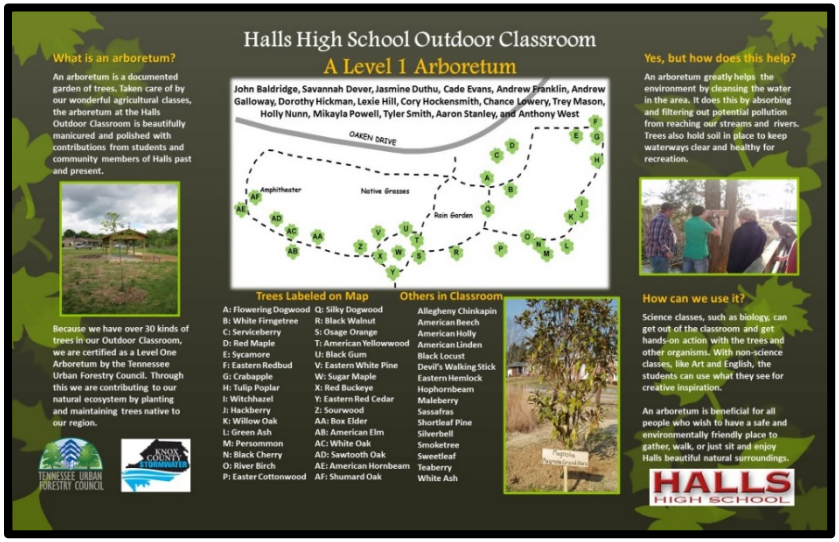
Challenge 5: short memory effects!



- 1. Use of sensor technology to develop national infrastructure and databases critical to agricultural and urban communities & support/enhance the work of mission agencies

Knox County Adopt-A-Watershed Crosses Disciplines

Construction Trades installs a green roof

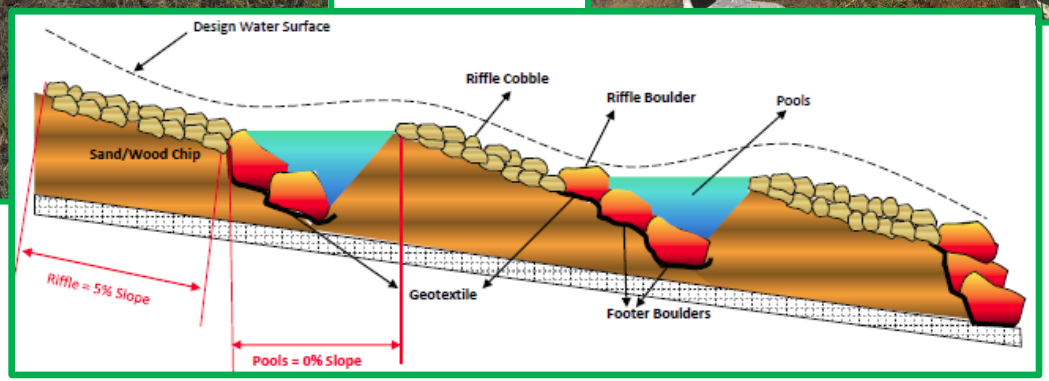


Agriculture class creates arboretum guide for outdoor classroom using GPS

Knox County Adopt-A-Watershed

West High students working with UT Engineering Program to set up bioretention mescosm study units on campus

Knox County Adopt-A-Watershed



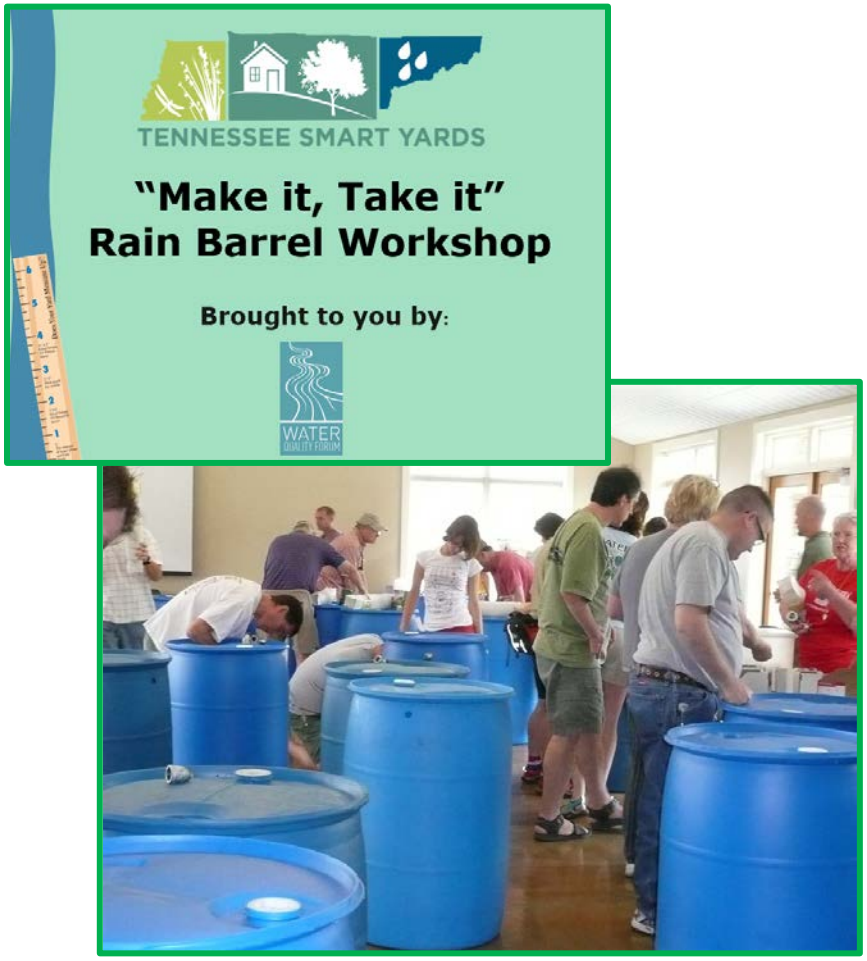
South Doyle Middle students install plants at an onsite UT Engineering Dept. research project demonstrating a regenerative stormwater conveyance system

Teaching with the lab

THE UNIVERSITY OF TENNESSEE KNOXVILLE

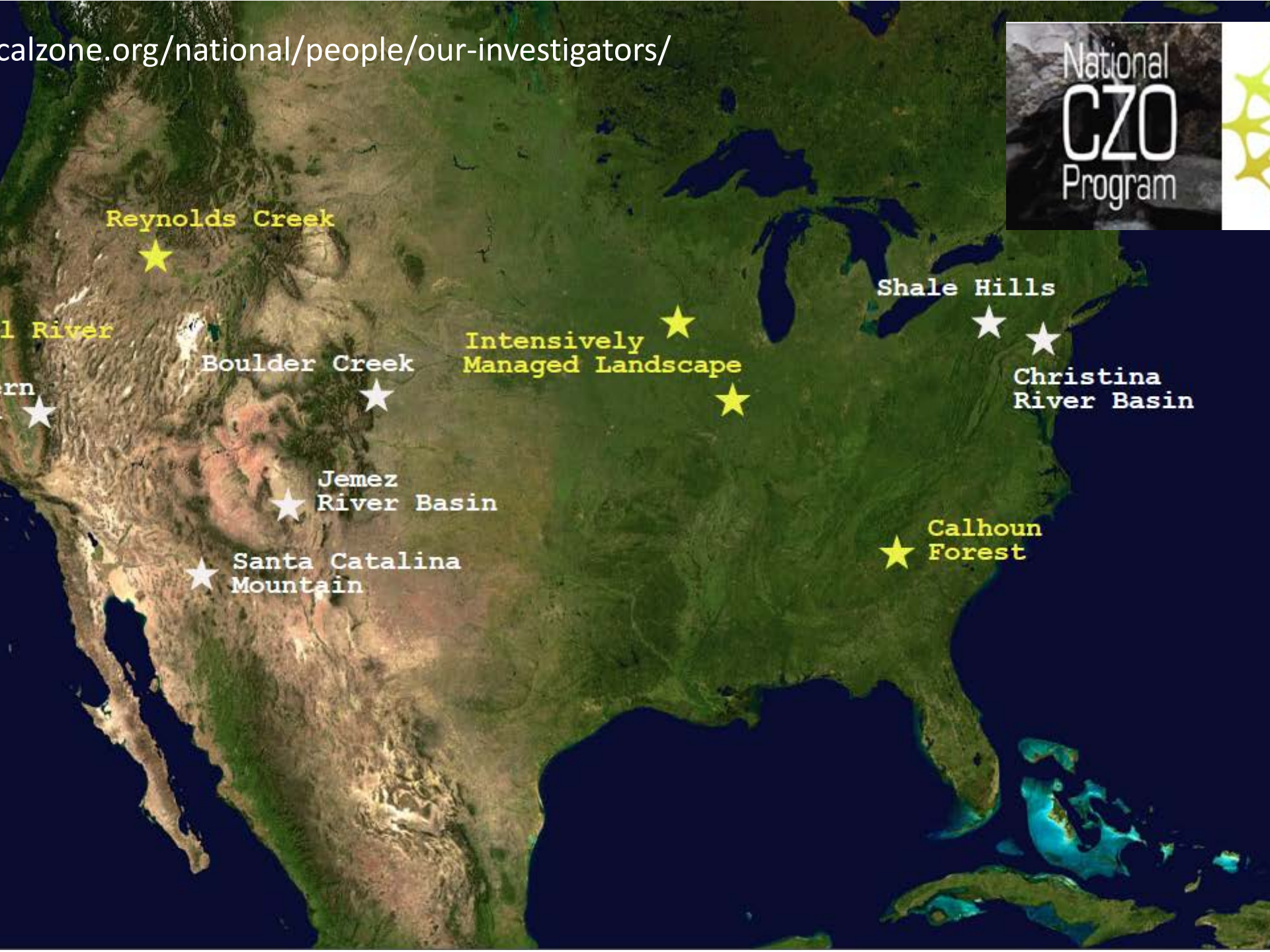
HYDRAULICS & SEDIMENTATION LAB

TENNESSEE SMART YARDS



Hands-on Workshops and Training Materials

- **Statewide partnership between TN Water Resources Research Center and & UT Extension**
- **Local level implemented by stormwater (MS4s) and County Extension programs**
- **Educates homeowners on sustainable landscaping based on nine principles**
  - Right Plant, Right Place
  - Water Efficiently
  - Fertilize Appropriately
  - Mulch
  - Attract Wildlife
  - Manage Yard Pests Responsibly
  - Reduce, Reuse and Recycle


calzone.org/national/people/our-investigators/
National
CZO
Program
Reynolds Creek
l River
rn
Boulder Creek
Intensively
Managed Landscape
Shale Hills
Christina
River Basin
Jemez
River Basin
Santa Catalina
Mountain
Calhoun
Forest