Taking Green Building to the Construction Phase

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Water Quality Impacts

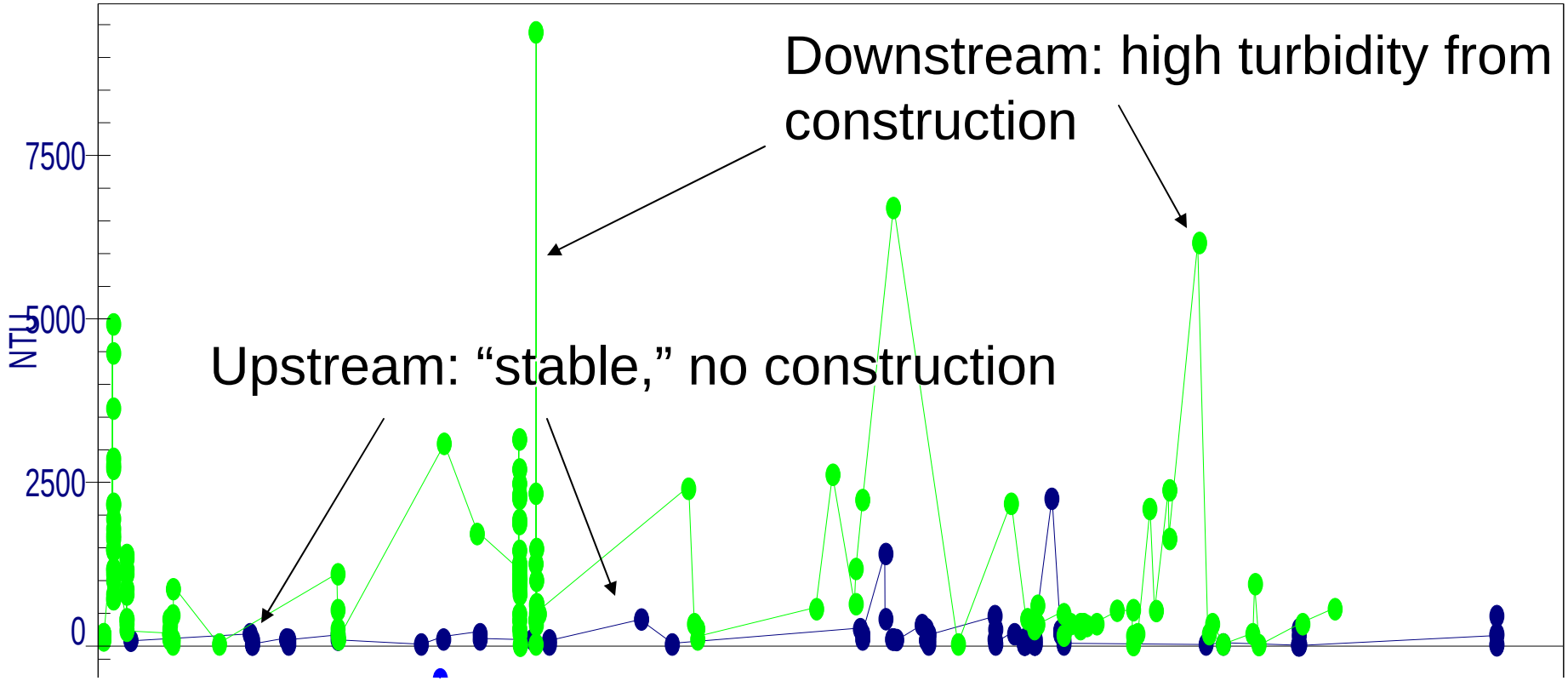
Sediment Export?

NC STATE UNIVERSITY
DEPARTMENT of **SOIL SCIENCE**

COLLEGE OF
AGRICULTURE & LIFE SCIENCES
ACADEMICS ▲ RESEARCH ▲ EXTENSION

Example of Construction Impacts on Streams

- Construction site greatly increases in-stream turbidity during storm events



150
Scout

WOC.COM
864

Suspended Sediment Effects

Newcombe & McDonald, 1991

- Review of 120 Studies

Rank	Description of effect
14	>80 to 100% mortality
13	>60 to 80% mortality
12	>40 to 60% mortality, severe habitat degradation
11	>20 to 40% mortality
10	0 to 20% mortality
9	Reduction in growth rates
8	Physiological stress and histological changes
7	Moderate habitat degradation
6	Poor condition of organism
5	Impaired homing
4	Reduction in feeding rates
3	Avoidance response, abandonment of cover
2	Alarm reaction, avoidance reaction
1	Increased coughing rate

Their Results…

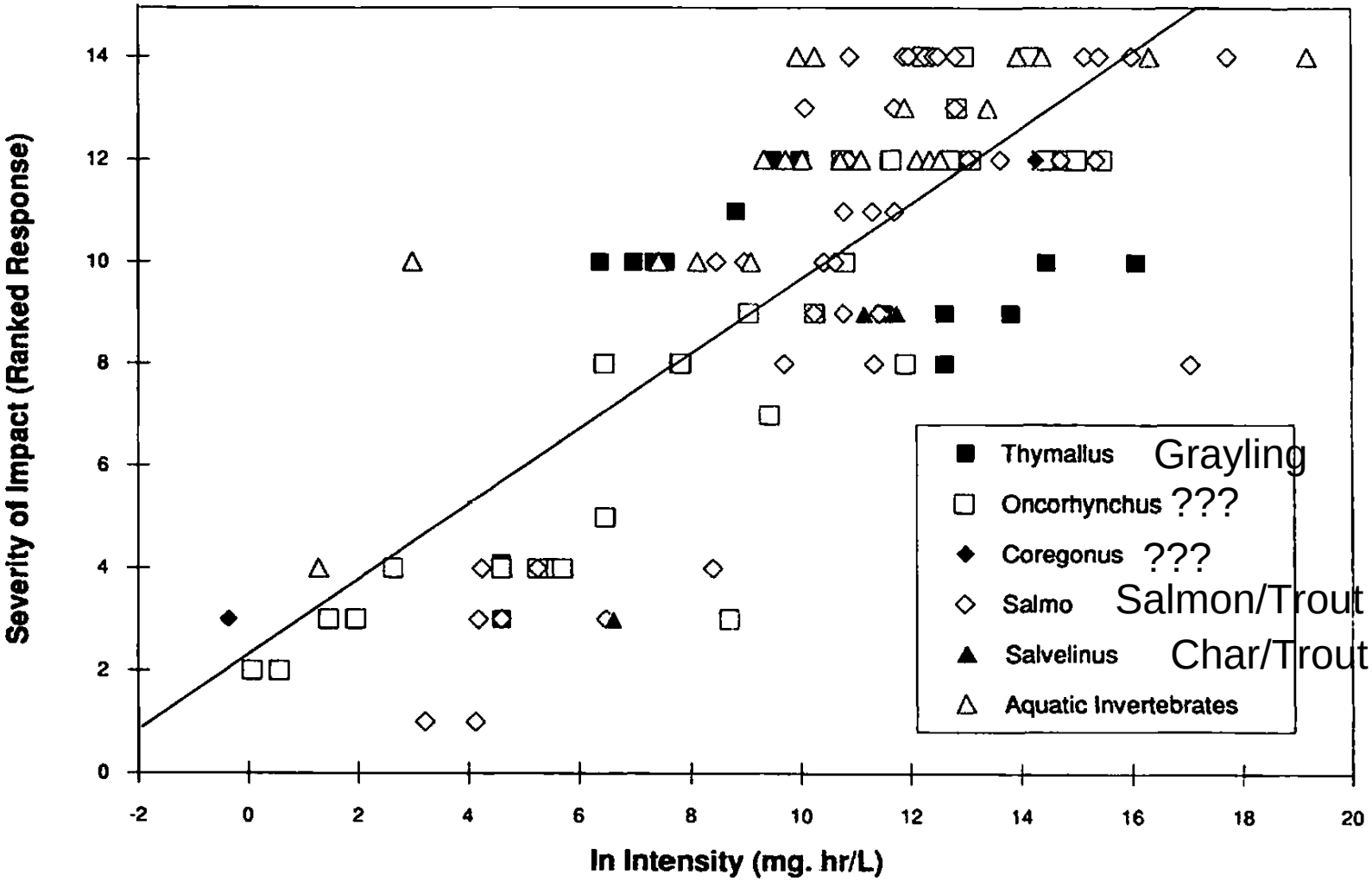
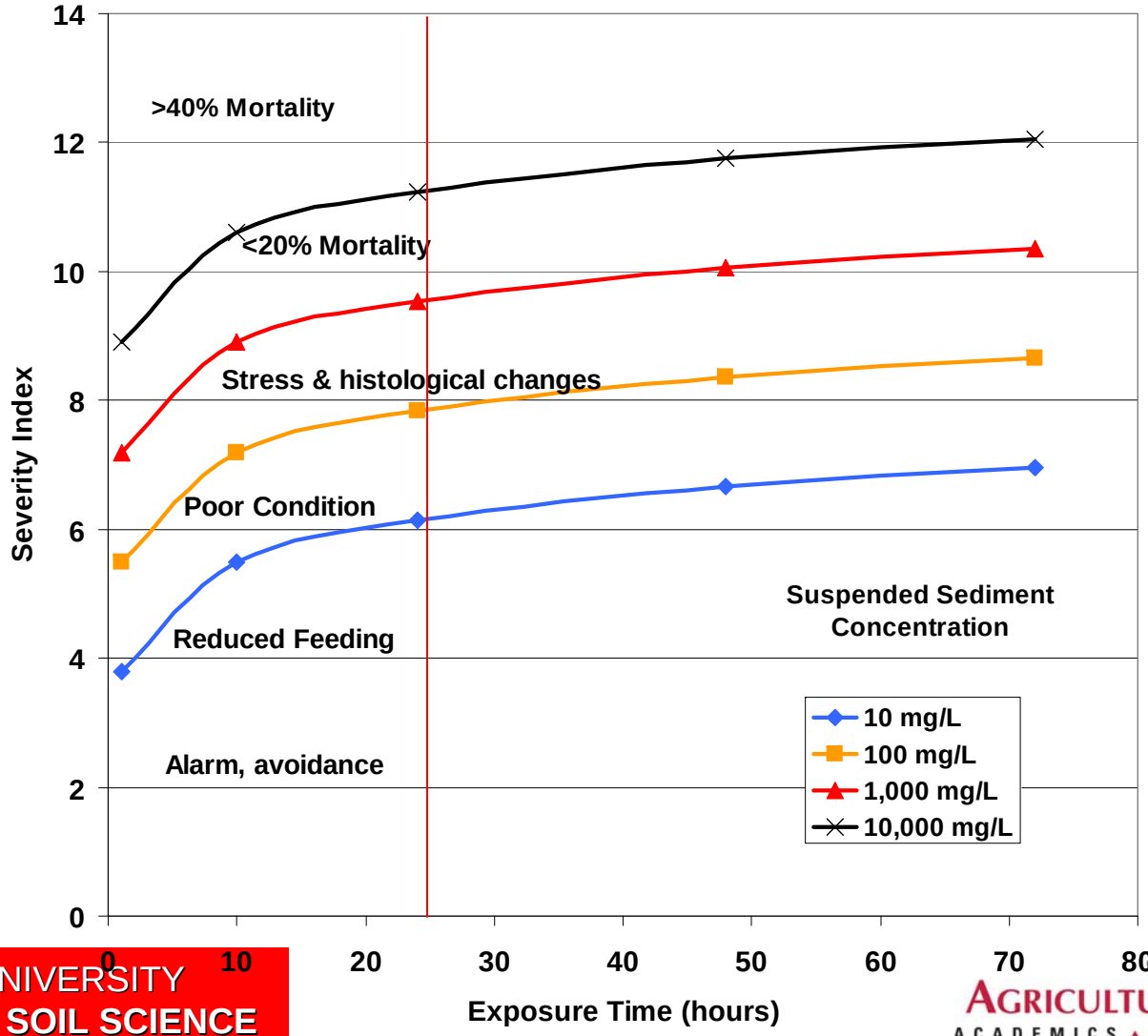


FIGURE 2.—Relationship between $\log_e$ (ln) of suspended sediment intensity and severity of effects on salmonid fishes and aquatic invertebrates. Severity of effect = 0.738 $\log_e$ intensity + 2.179; $r^2 = 0.638$, $N = 120$. Intensity is concentration (mg/L) times duration of exposure (h).

Suspended Sediment Effects on Aquatic Organisms

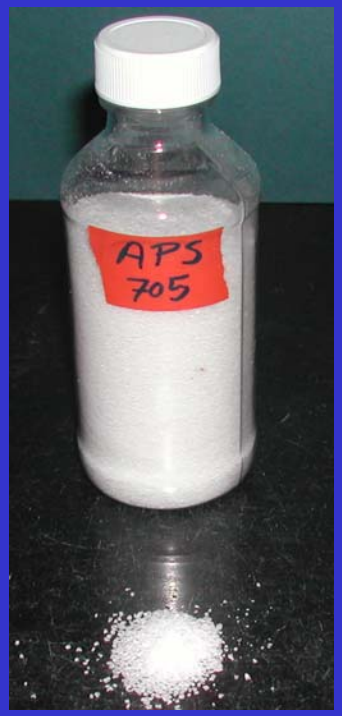
(from Newcombe & McDonald, 1991)



Erosion Prevention: First Line of Defense

Research to the Rescue?

PAM



Erosion Studies Conclusions

- Any ground cover is better than none (90% rule).
- Hydromulches and blankets may be more effective than straw.

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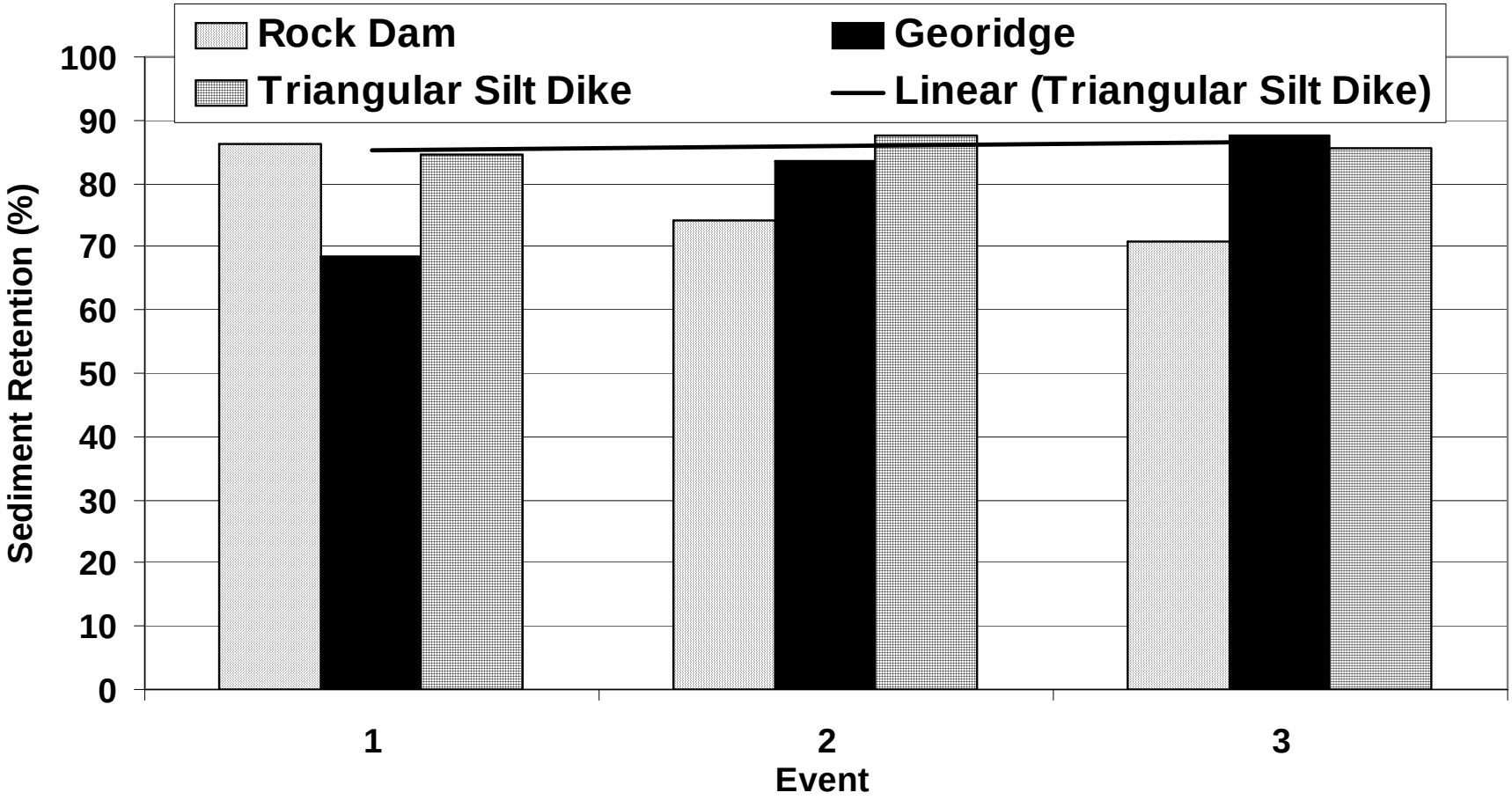
Does PAM Reduce Erosion?

- PAM usually reduced erosion rates by 50% or more for typical ground covers.
- Straw + PAM (20 lb/ac or more) can outperform blankets and hydromulch.

Grade Control System Comparisons



Triangular Silt Dike

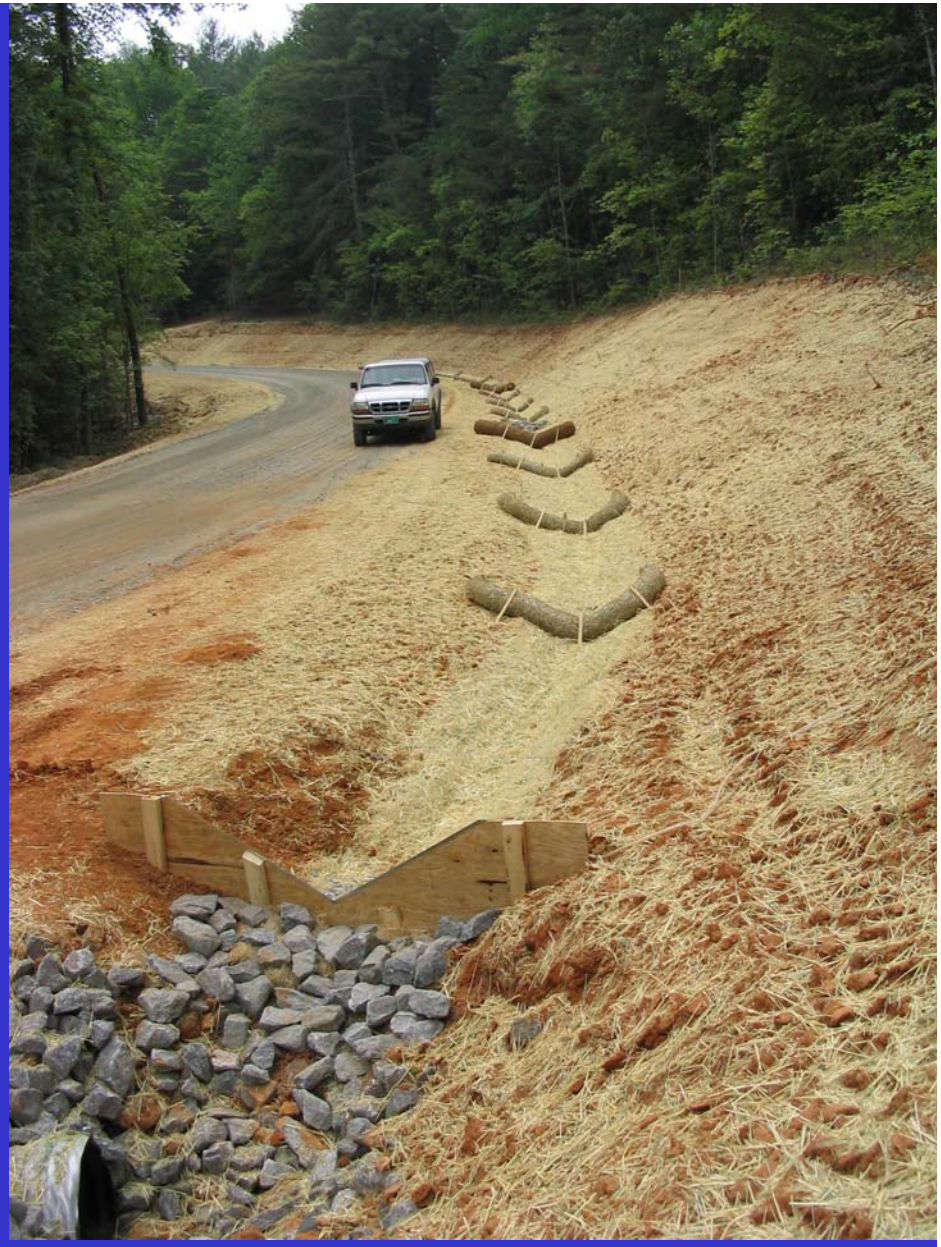
Check Dam Placement/Installation…

Alternative Check Dam System

Standard Checks/Traps

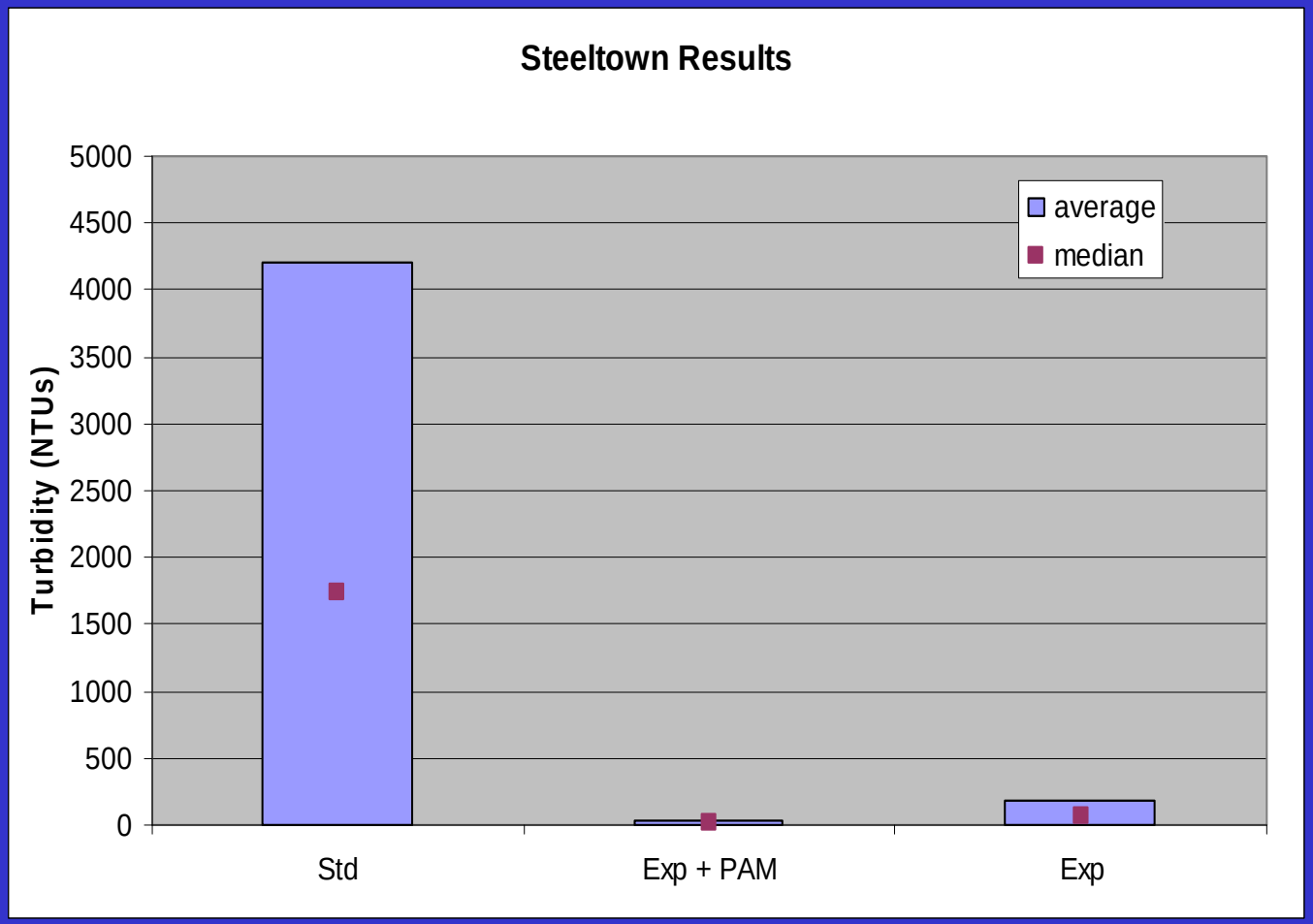
Coir/Straw Checks, PAM

4,000 NTU



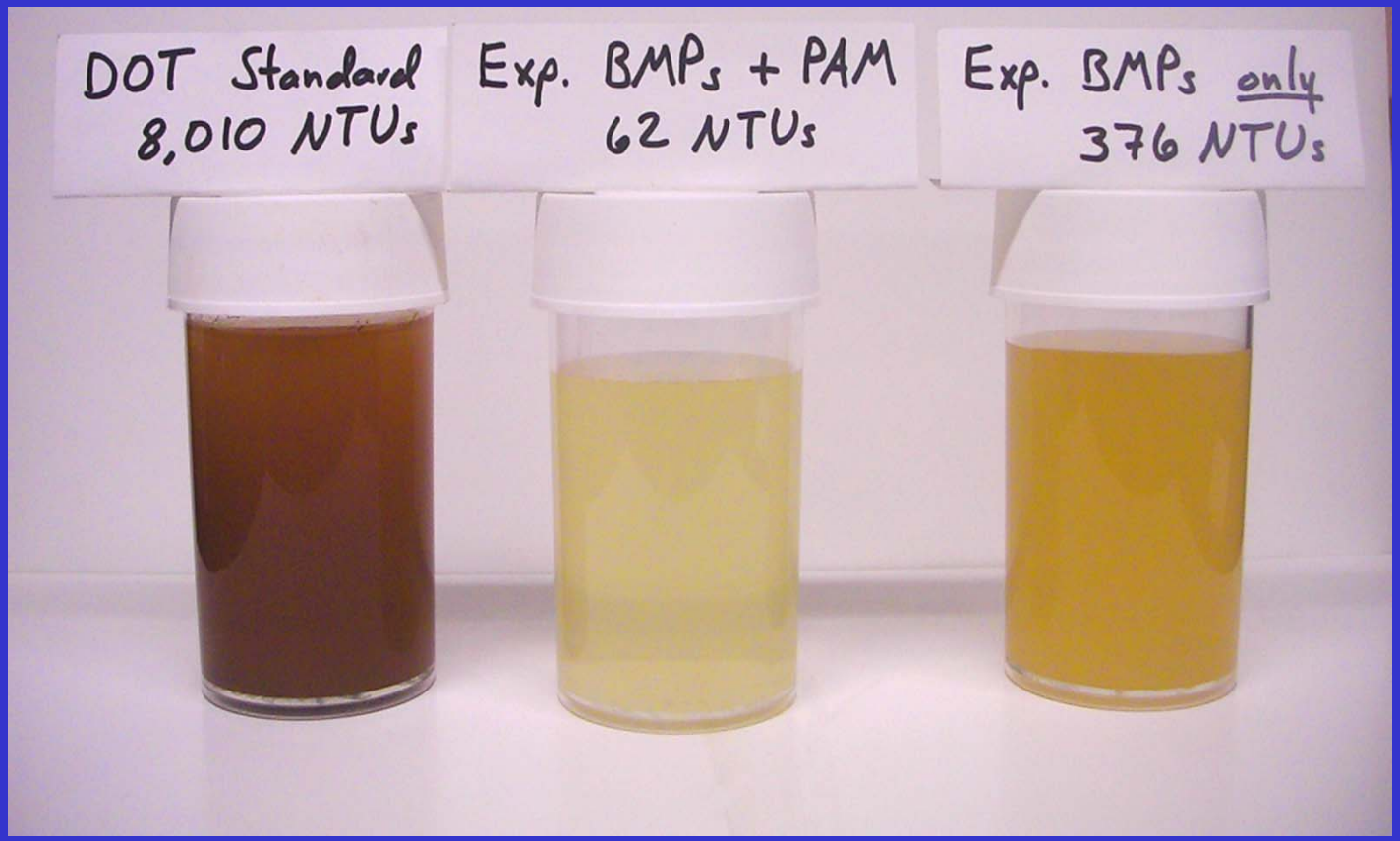
19 NTU!

Results: Steeltown Rd



Results: Steeltown Rd Averages
(Through Dec 06)

Some initial storms had 14,000+ NTU for Standard BMPs but just 190 and 250 NTU for Exp BMPs!



Typical tools and products needed for installation

Metal sod staples and mallet

24” long wooden stakes

Erosion control blanket

straw wattle

Close up of the mesh

Wattle Theft!

Cost Estimate Comparison

Steeltown:

450’ Standard section	$570 / $90 to maintain $1.26 / foot
668’ Fiber Checks + PAM	$734 / $41 to maintain $1.10 / foot
461’ Fiber Checks only	$652 / no maintenance $1.41 / foot (spacing closer)

Curley Maple:

450’ Standard section	$570 / $90 to maintain $1.26 / foot
668’ Fiber Checks + PAM	$734 / $41 to maintain $1.10 / foot

The logs and wattles do not have to be removed either, they can decompose in place.

Other Approaches to Improvements

- Surface Outlets
- Baffles
- Infiltration
- Turbidity Reduction: Chemical Treatment (Polyacrylamide – PAM)
  - Passive: solid, liquid
  - Active: solid, liquid

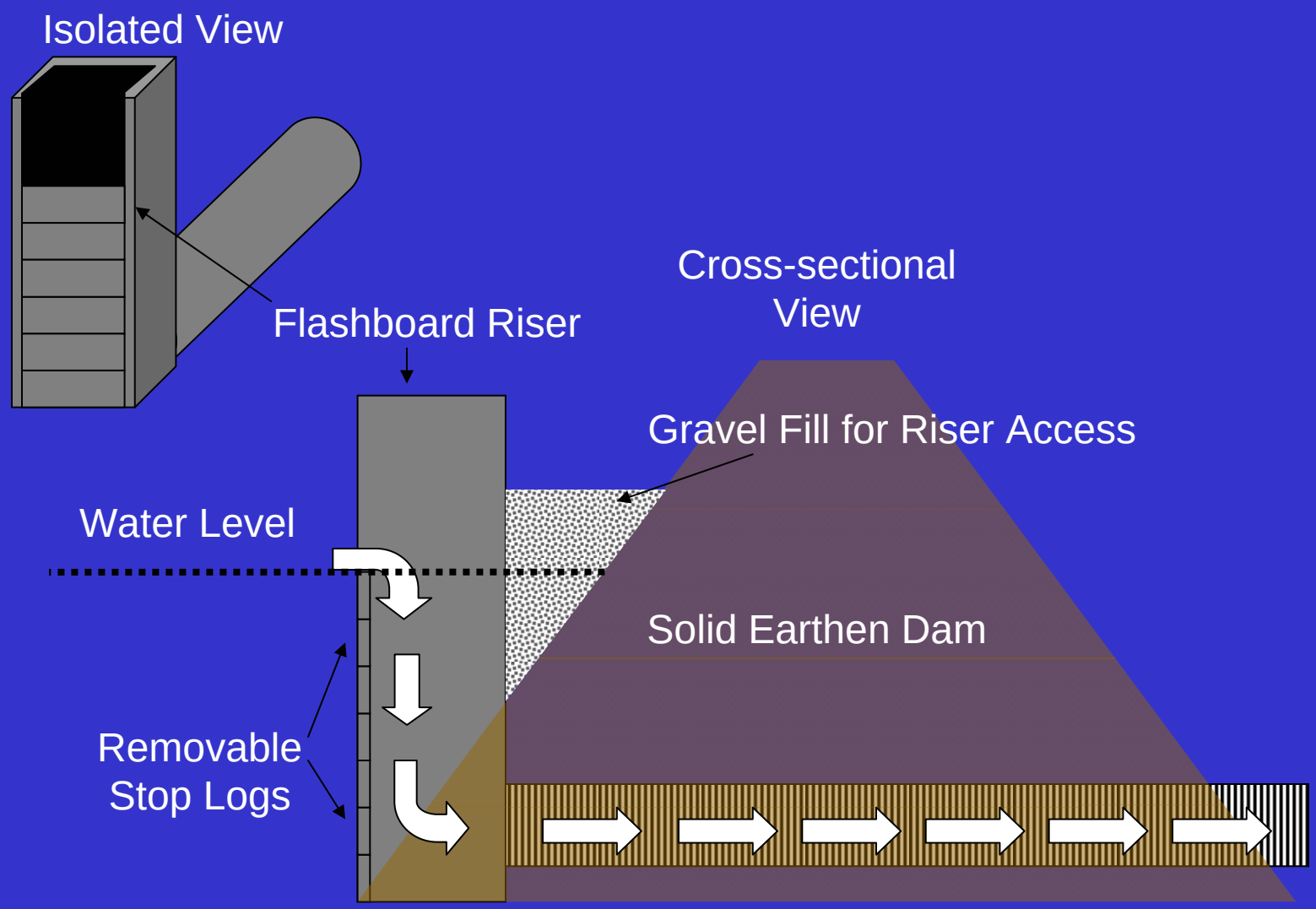
Surface Outlet (Faircloth Skimmer)

Skimmer Basin Functions

- Skimmer backs up inflow to create pool
- Pool acts to slow flow and drop sediment
- Basin dewater primarily over emergency spillway!
- Skimmer dewaters basin once inflow ceases.
  - Allows sediment to dry between storms
  - Reduces standing water (liability, mosquitoes)

Skimmer Basin Example

Flashboard Riser Outlet



Flashboard Riser Outlet

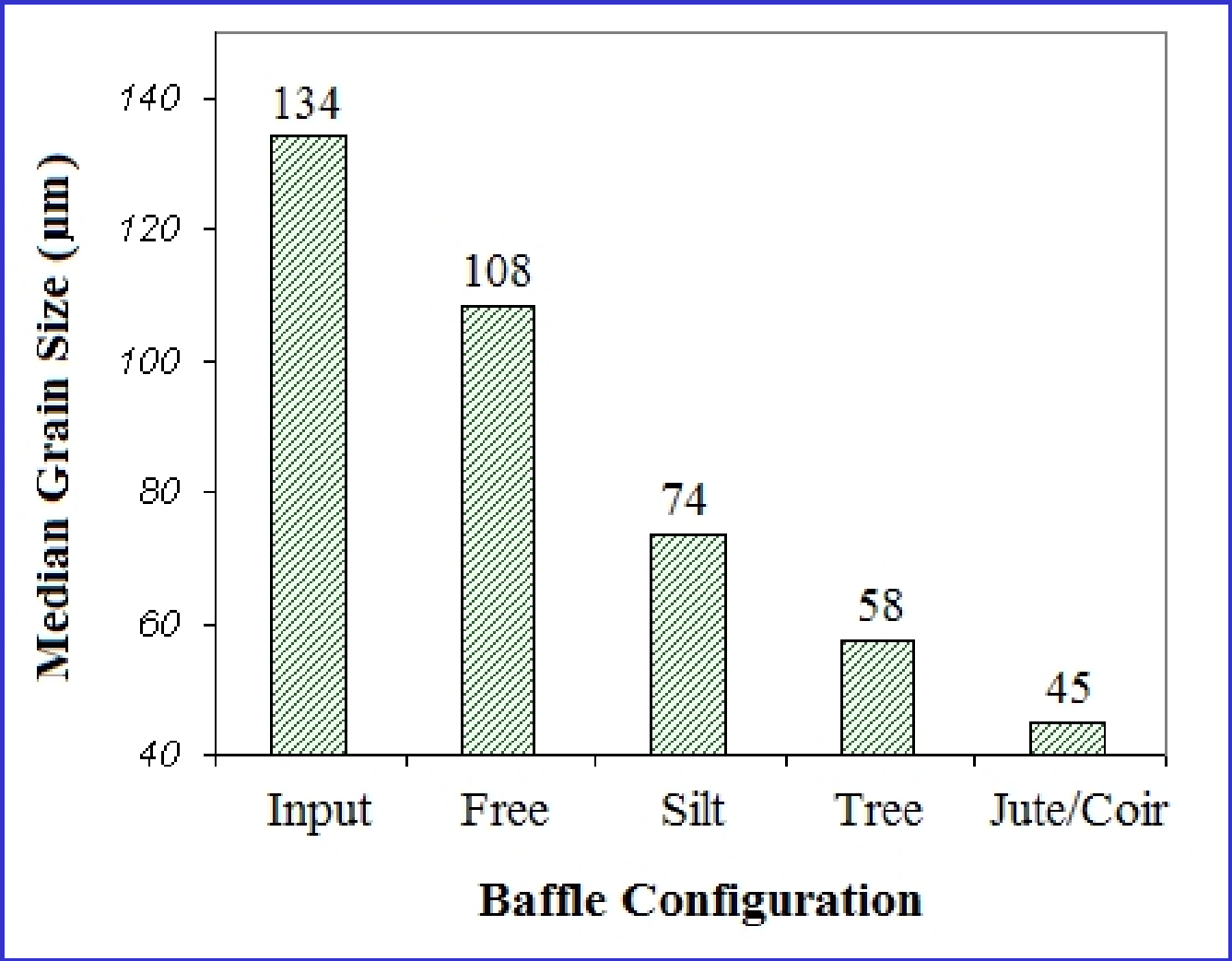
- Adjustable standing pool
- Can empty for sediment removal
- Could be used for stormwater wetlands etc.
- Doesn't automatically dewater
- Could be left open…

Baffles

Porous

Silt Fence/Weir

Effects of Baffles: Grain Capture



Installation Important…

Do Not Use Jute Alone!

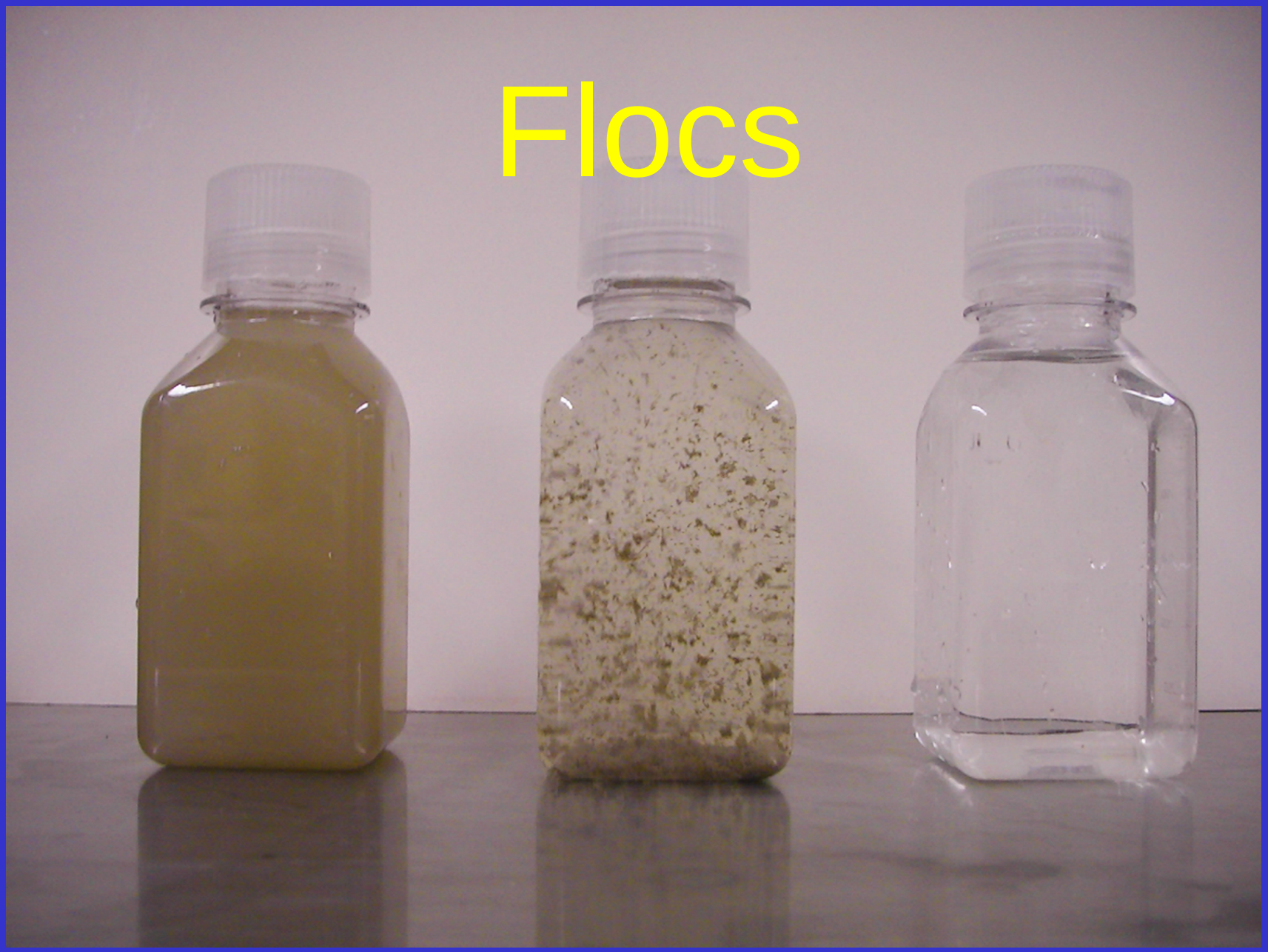
Baffles Should Not Be Overtopped!

Protect Inlet!

Chemical Treatment for Turbidity

- Polyacrylamide (PAM) is very common in water treatment, industrial processes.
- 1-2 mg/L will usually be the maximum required.
- Other chemicals: gypsum/alum (need high doses), chitosan (very expensive), inorganics (higher doses).

Flocs



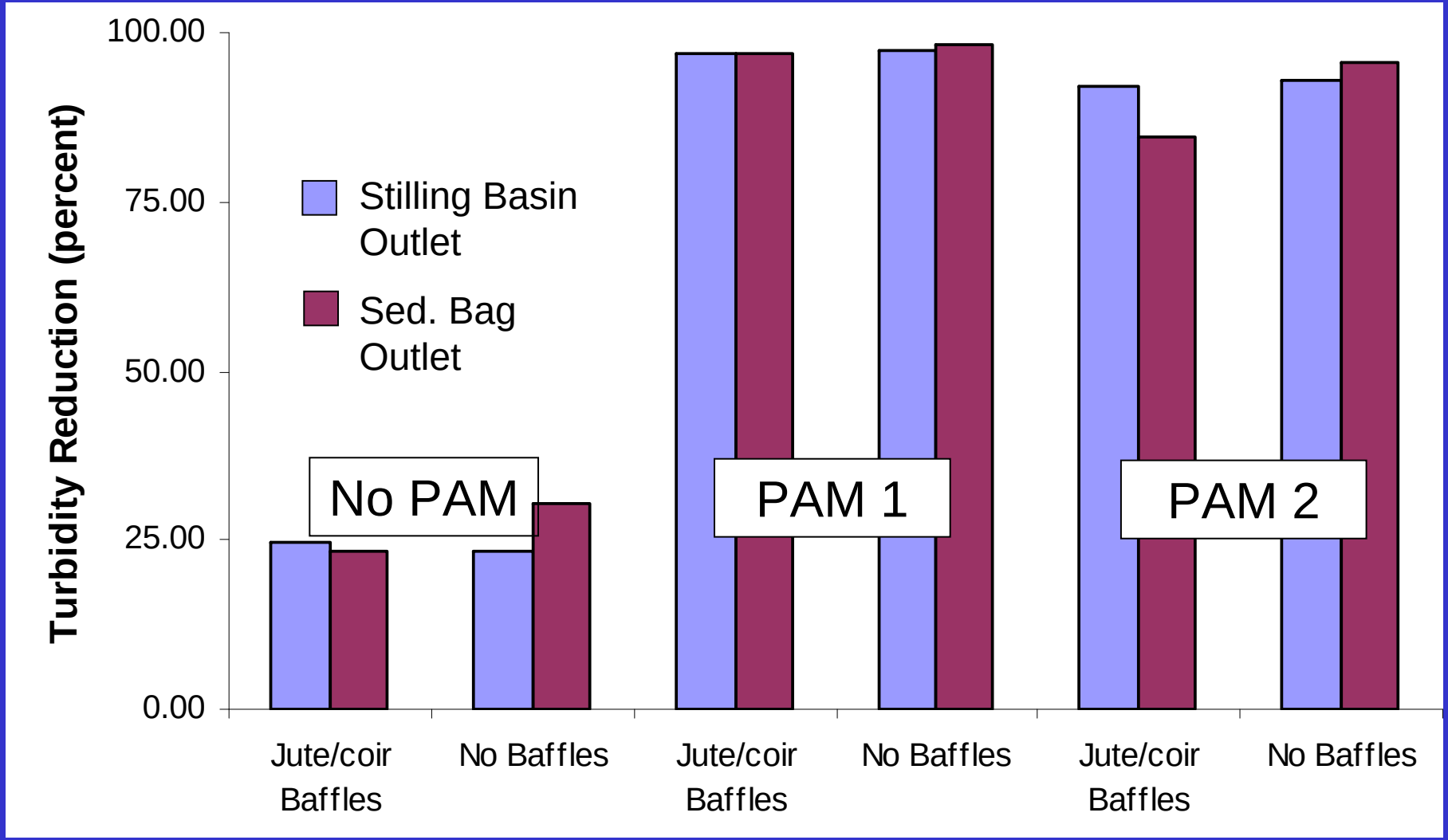
Field Testing PAM Logs: Passive Treatment

Riser Barrel – Great Log Location…

Two Chamber Basin Design

Active PAM Dosing

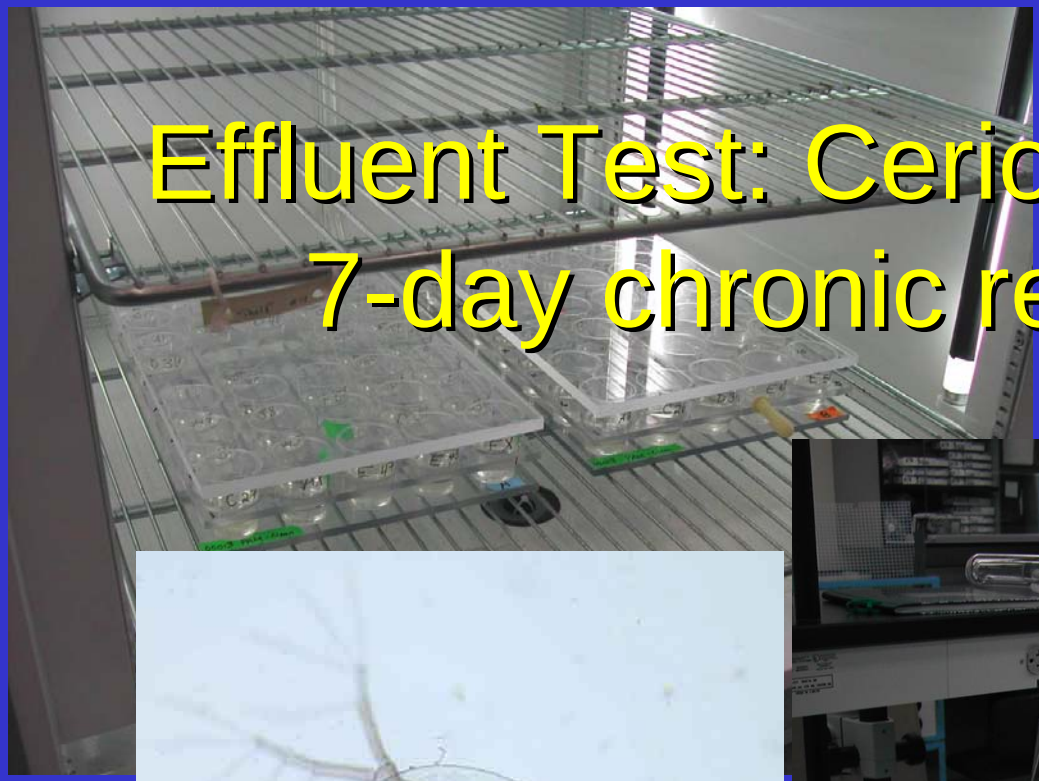
Turbidity Reductions in Liquid Dosing Tests

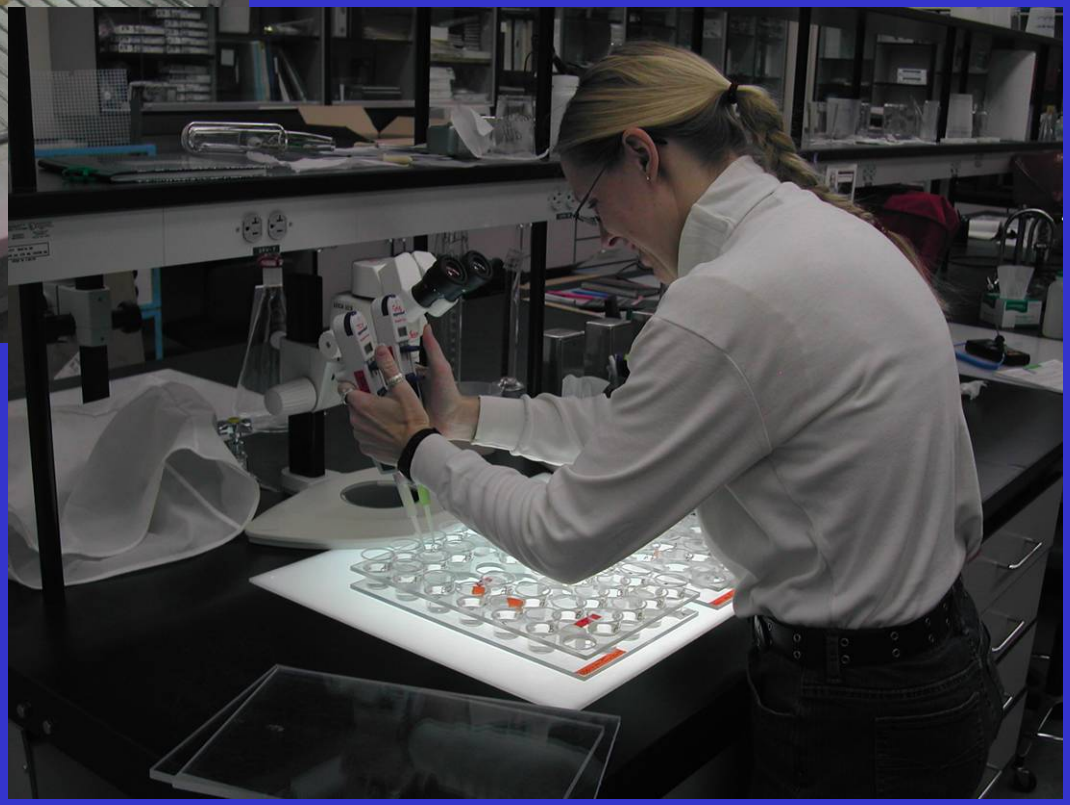


PAM Toxicity?

- PAM is known to be relatively non-toxic as measured by acute (LD_{50}) tests.
- Chronic tests on fish also show low toxicity.
- Chronic tests on smaller species (invertebrates) less well studied.

Effluent Test: Ceriodaphnia dubia 7-day chronic reproduction





North Carolina PAM List

- Approved for use in dosing turbid water.
- Requires a settling basin or sediment bag after dosing.

- **Company/Product/Maximum Application Concentration (ppm)**
  - Applied Polymer Systems APS 705 27.7
  - Applied Polymer Systems APS 712 59.3
  - Applied Polymer Systems APS 730 5.6
  - Applied Polymer Systems APS 740 5.2

  - Also 3 solid blocks are approved

- http://h2o.enr.state.nc.us/ws/documents/pams_list.pdf

Development Pressure (1997-02)

	Total Developed (Ac x 1000)	Farmland Converted (Ac x 1000)	%	Conversion Rate (1000 Ac/yr)
U.S	11217	3225	29	645
TX	894	333	37	67
OH	365	212	58	42
GA	852	184	22	37
NC	507	168	33	34
IL	247	161	65	32
% U.S.	26	33		33

Construction Site Discharges: EPA Will Promulgate Rule!

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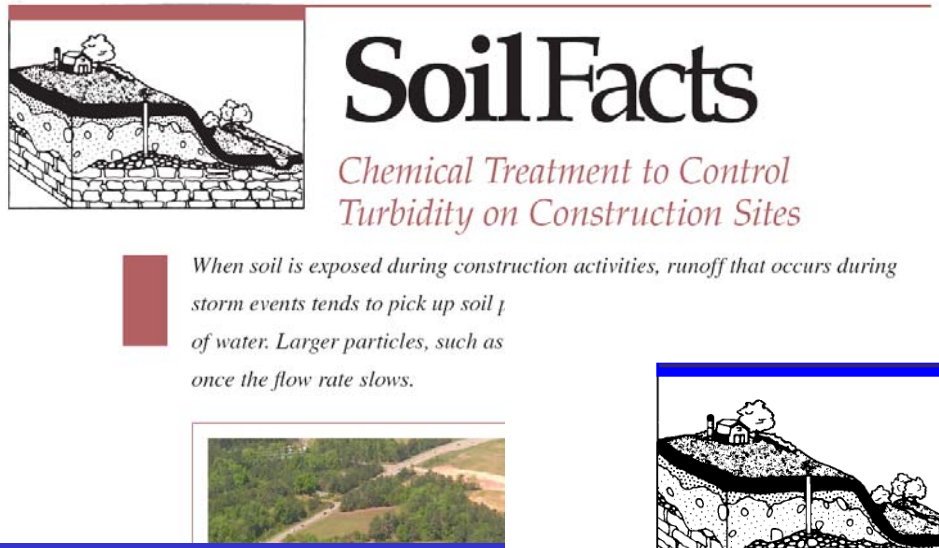
UNITED STATES DISTRICT COURT

CENTRAL DISTRICT OF CALIFORNIA

NATIONAL RESOURCES DEFENSE COUNCIL, *et al.* Plaintiffs, and STATE OF NEW YORK, *et al.* Intervenor-Plaintiffs, v. U.S. ENVIRONMENTAL PROTECTION AGENCY, *et al.* Defendants, and ASSOCIATED GENERAL CONTRACTORS OF AMERICA, *et al.* Intervenor-Defendants.	No. CV 04-8307-GHK(RCx) **MEMORANDUM AND ORDER ON PLAINTIFFS' MOTION FOR PARTIAL SUMMARY JUDGMENT**

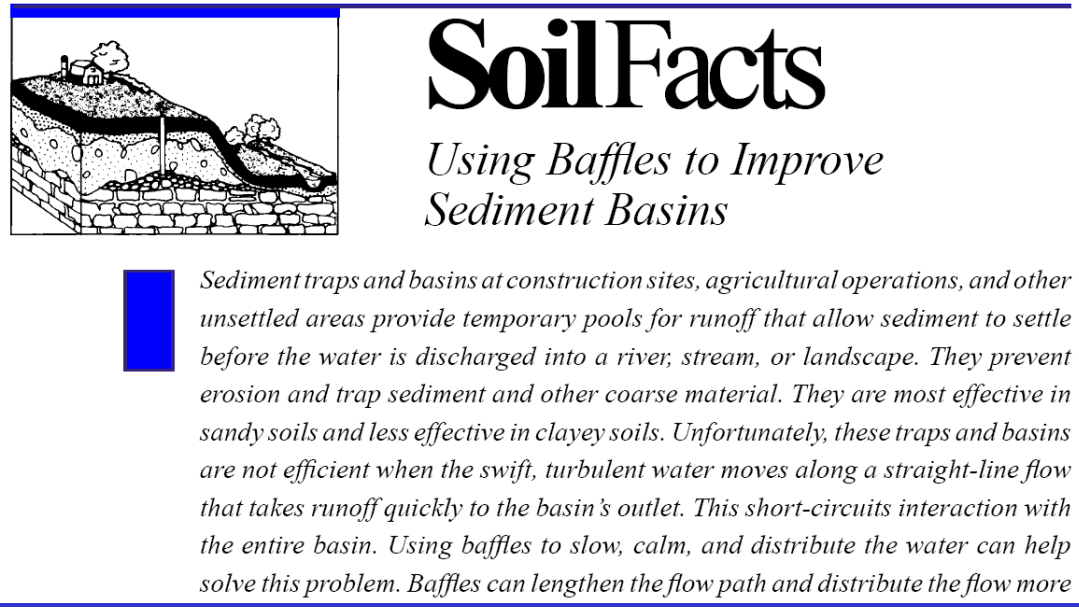
Fact Sheets Available



SoilFacts

Chemical Treatment to Control Turbidity on Construction Sites

When soil is exposed during construction activities, runoff that occurs during storm events tends to pick up soil p
of water. Larger particles, such as
once the flow rate slows.



SoilFacts

Using Baffles to Improve Sediment Basins

Sediment traps and basins at construction sites, agricultural operations, and other unsettled areas provide temporary pools for runoff that allow sediment to settle before the water is discharged into a river, stream, or landscape. They prevent erosion and trap sediment and other coarse material. They are most effective in sandy soils and less effective in clayey soils. Unfortunately, these traps and basins are not efficient when the swift, turbulent water moves along a straight-line flow that takes runoff quickly to the basin's outlet. This short-circuits interaction with the entire basin. Using baffles to slow, calm, and distribute the water can help solve this problem. Baffles can lengthen the flow path and distribute the flow more

WWW.SOIL.NCSU.EDU

Questions?

www.soil.ncsu.edu and go to faculty - McLaughlin