LID at the Construction Phase

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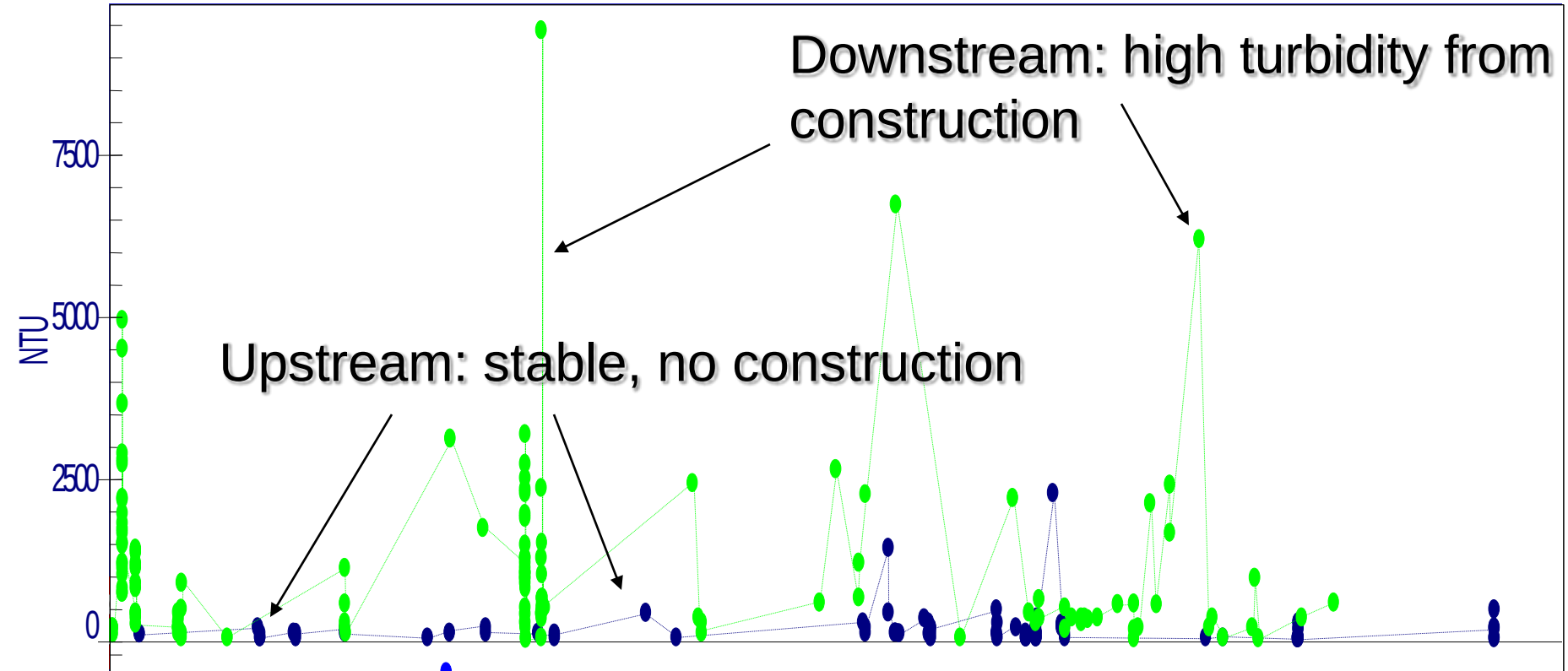
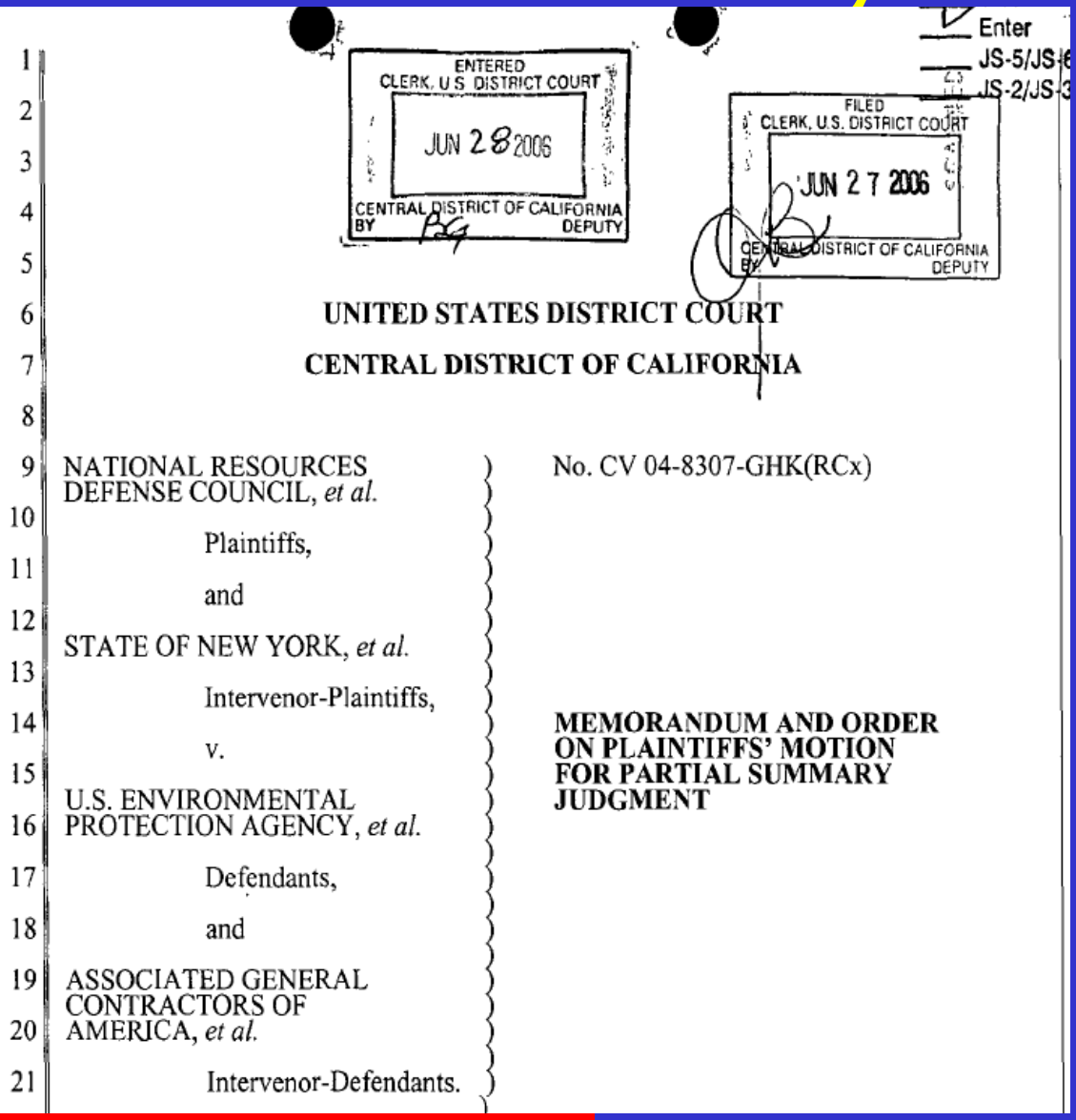
Example of Construction Impacts on Streams

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



New Policy from EPA



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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

- Need to set Effluent Limit Guidelines (ELGs) and New Source Performance Standards (NSPS)

EPA Web Site

- **Four of the Nation's Largest Home Builders Settle Storm Water Violations**
-

  Centex: $1,485,000
  KB Home: $1,185,000
  Pulte: $877,000
  Richmond: $795,000

  Pulte Homes has also agreed to complete a supplemental environment project at a minimum cost of $608,000. The project will reduce the amount of sediment going into a northern California watershed and improve the habitat for aquatic life.

Home Depot Settlement
$1.3 million fine

Inspections in 2002-2003 turned up violations:

- discharge of polluted storm water runoff
- failure to develop an adequate Storm Water Pollution Prevention Plan (SWPPP) for minimizing the amount of sediment and other pollutants in storm water runoff from the site;
- failure to install or implement storm water controls
- incorrect installation of BMPs (for example, silt fences were not properly trenched into the ground, sediment basins were not completed prior to commencing construction);
- failure to keep BMPs in effective operating condition
- failure to adequately or routinely inspect BMPs to ensure proper maintenance.

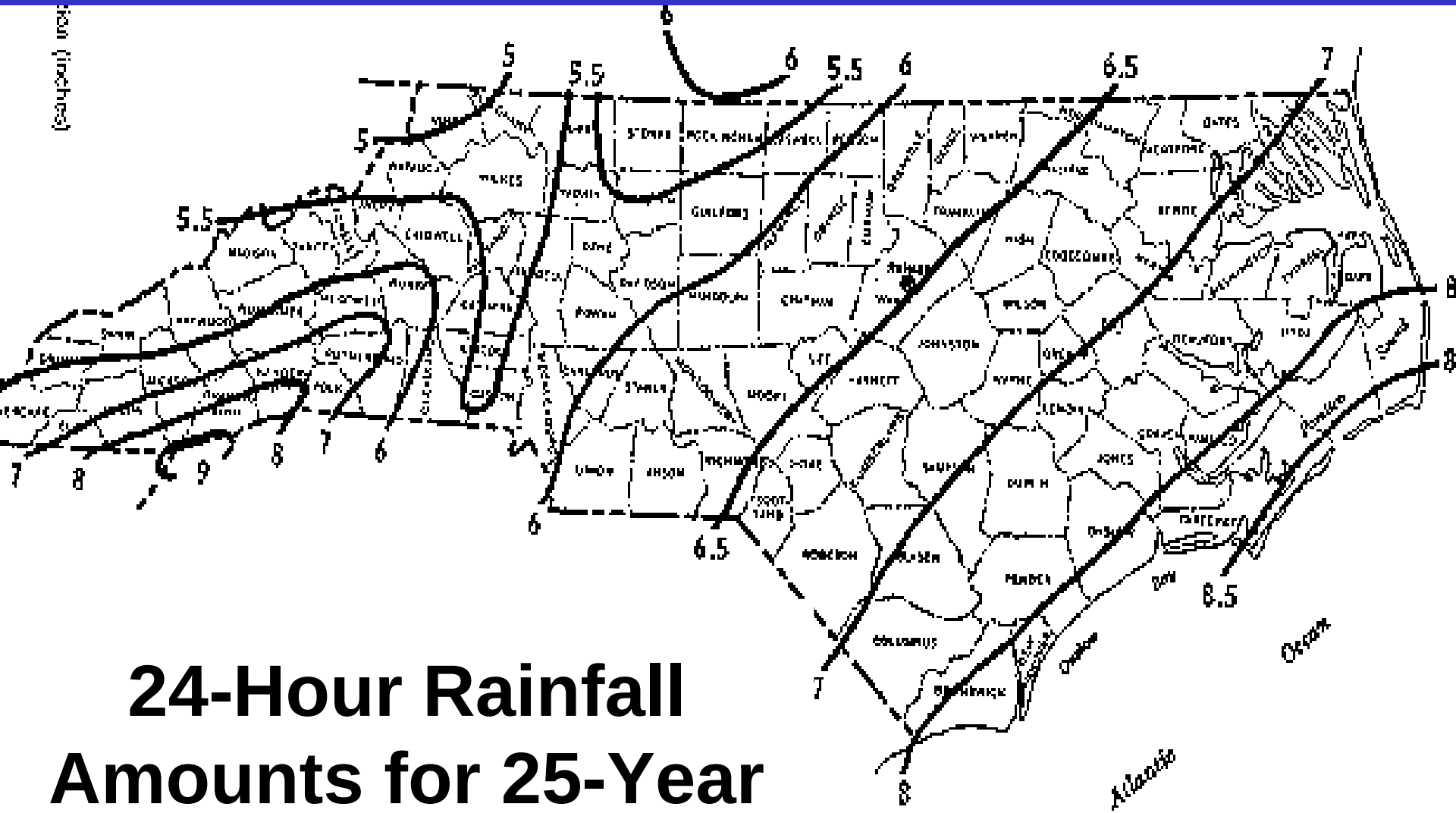
Change Coming

Soil Erosion: Two Phases

- Detachment: individual particles are loosened from the soil mass.
  - Rainsplash > running water > wind
- Transport: water or wind carries the detached particles downslope or downwind.
  - Flow in rills is the most important.

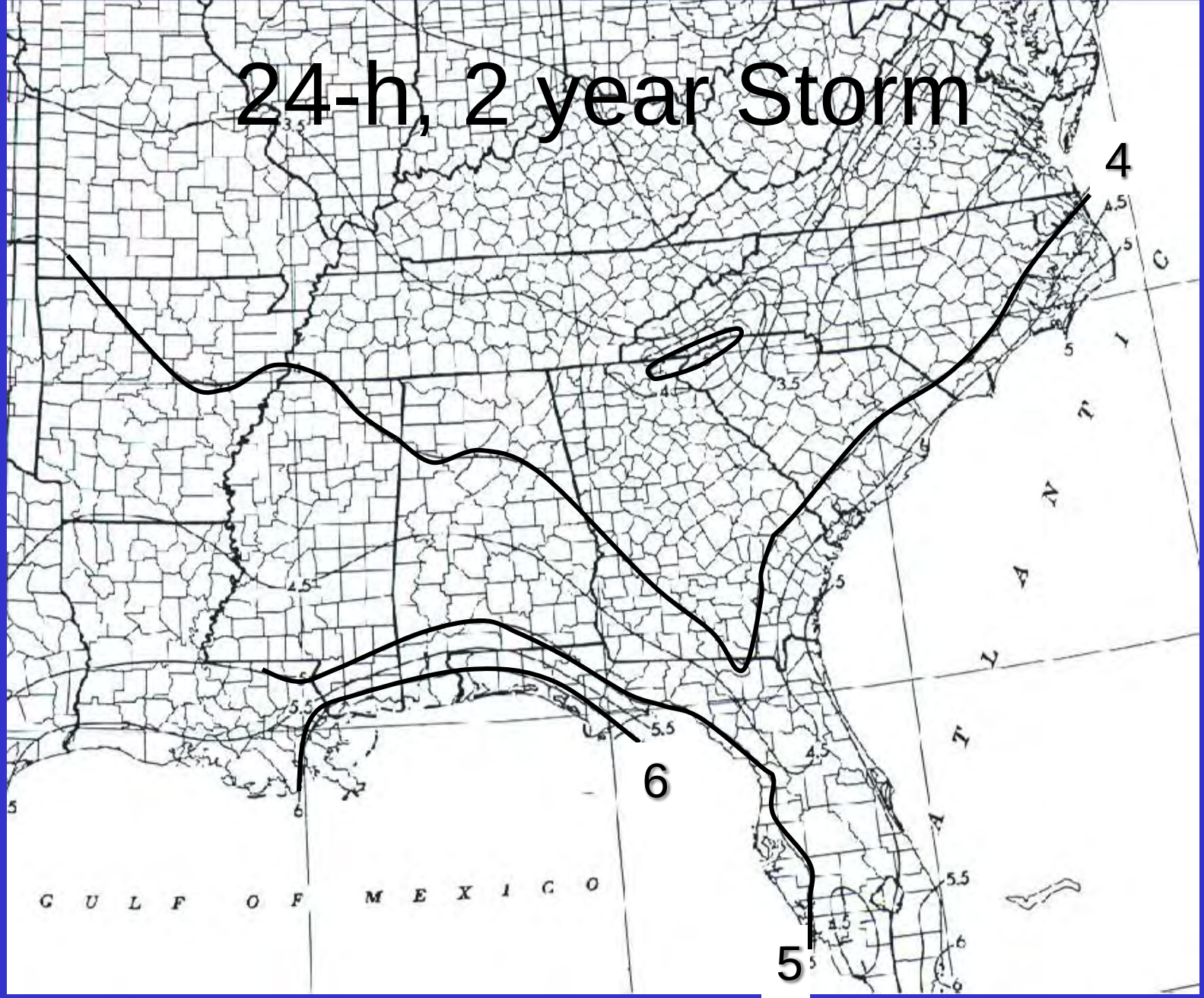
Factors in Soil Losses

- *Rainfall*: intensity, duration, and energy.
- *Soil Erodibility*: texture, structure, organic matter content.
- *Topography*: slope length, steepness.
- *Surface Condition*: vegetation, mulch, bare, etc.
- *Erosion Control Practices*: contours, terraces, silt fences, basins, etc.



24-Hour Rainfall Amounts for 25-Year Recurrence

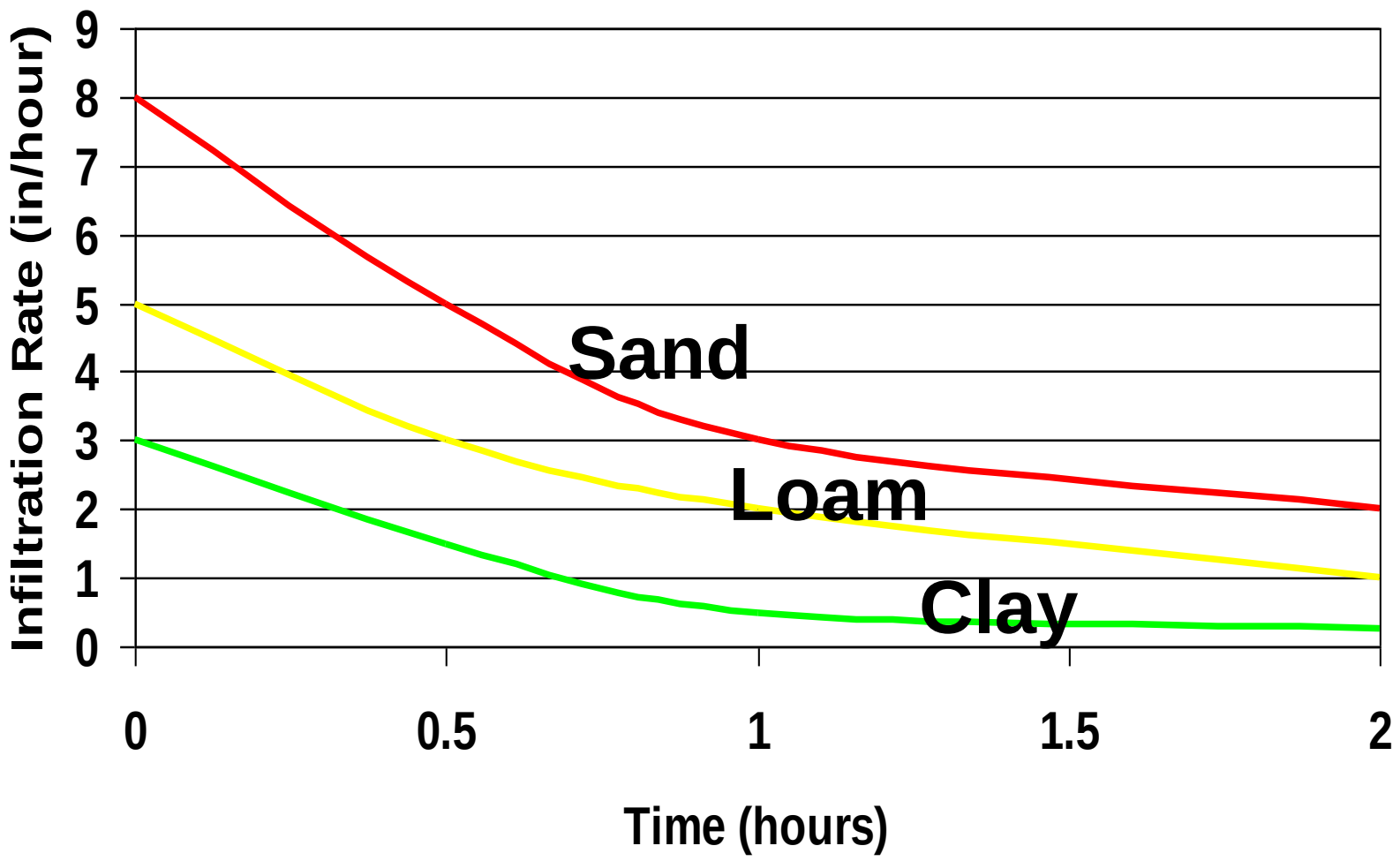
24-h, 2 year Storm



Saturated Soils Needed

- Water is initially drawn into soil by gravity and capillary forces.
- Runoff occurs once the soil is saturated and rainfall exceeds infiltration rates.
- How quickly this occurs depends on the soil…

Soil Infiltration Rates Decline Over Time



After Soil is Saturated …

Requirements First

- Contractor has received approval for all E&SC plans from either State or local agencies.

- All necessary permits have been obtained from various regulatory agencies.
  - Wetland impacts
  - Stream buffer limitations
  - Threatened & Endangered species requirements
  - Historic property issues

Erosion Control vs. Sediment Control

Erosion Control

- Main objective
- Primary defense
- Goal: to hold soil in place
- High effectiveness

Erosion Control vs. Sediment Control

Sediment Control

– Secondary defense

– Goal: to settle out sediment after it's been suspended into runoff water

– Medium to low effectiveness, very difficult

– Much more expensive than erosion control

Erosion Prevention: First Line of Defense

Don’t Forget the Soil!

- Most construction site soil is a subsoil w/ very little nutrient content
- pH is usually low for optimal plant growth
- So…a soil test would be the best plan
- Otherwise, 2 tons lime + 500 lb NPK (10:20:20)

Straw Mulch Problems

- Not enough straw applied
- Insufficient tack on mulch
- Too steep or long of slope for straw mulch


BFI

Rills Start At Top…

Erosion Control Blankets

- Temporary Products- used on 2:1 slopes and steeper where grass establishment is poor
- Permanent products- used when vegetation alone will not prevent erosion
- Main types:
  - Excelsior
  - Coir (Coconut)
  - Permanent Soil (Turf) Reinforcement (TRM)

Hydraulically Applied Mulch

Examples:

- wood fiber
  - 1500-2500 lbs/ac
  - Slope: 4:1 to 2:1
- bonded fiber matrix
  - 3000-4000 lbs/ac
  - Slope: 3:1 and steeper

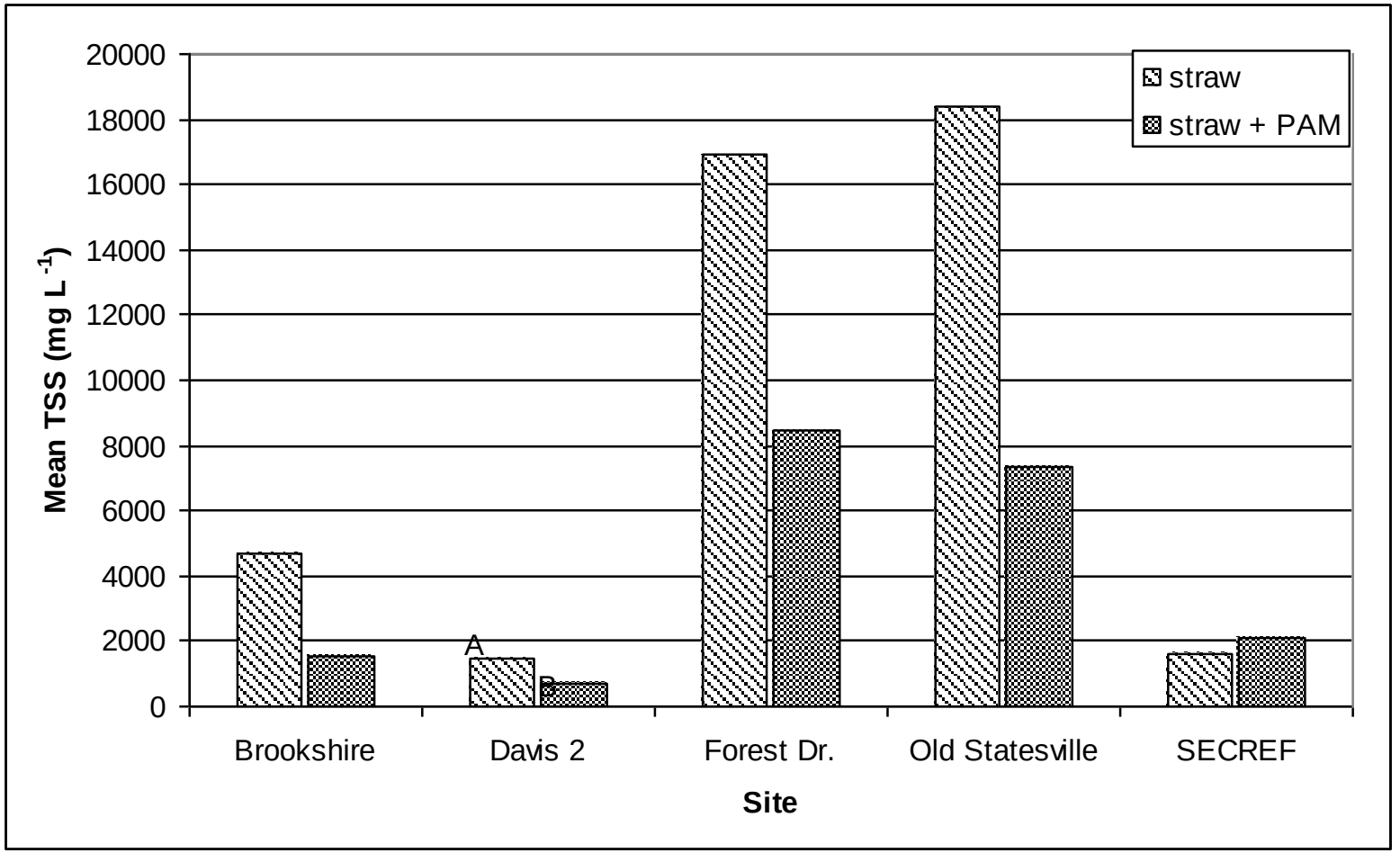
Application technique is critical

Compost – blown in seed and mulch

Erosion Control: Can Polyacrylamide Help?

PAM

Straw Enhanced by PAM



Erosion Studies Conclusions

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

.

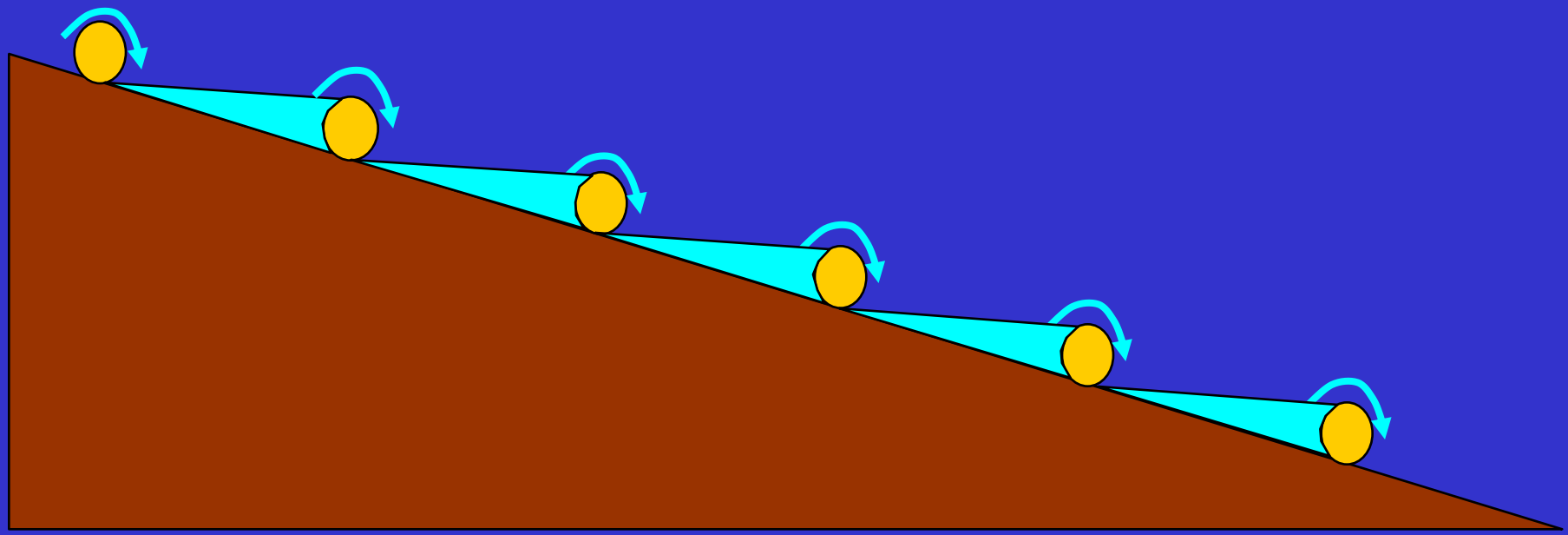
Does PAM Reduce Erosion?

- 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.

Options for Check Dams

Check Dams: Function

- BMPs theoretically spaced such that flow goes from pool to pool… reducing the erosive velocity of the water

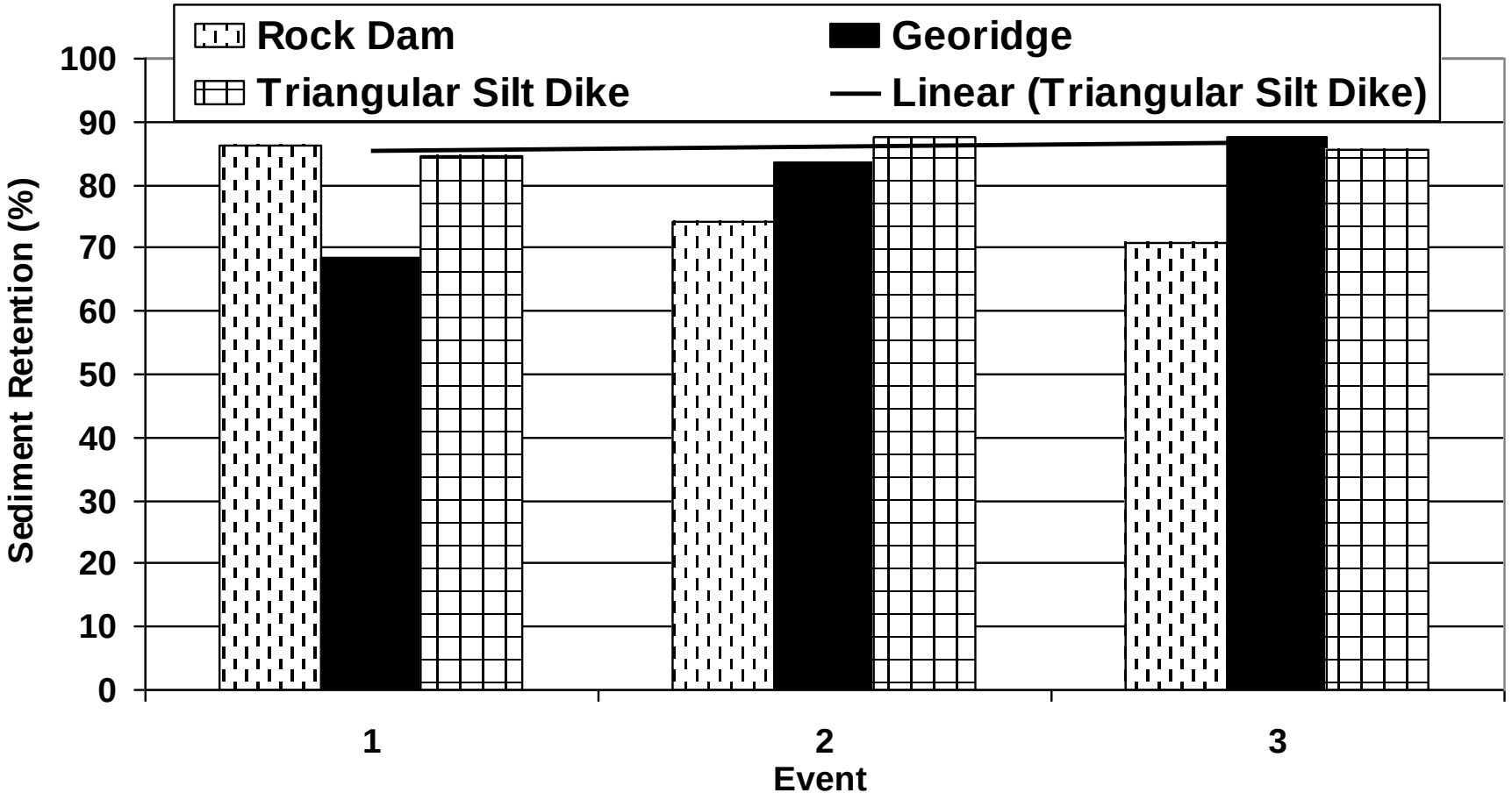


Other Options for Check Dams

Other Options for Check Dams

Triangular Silt Dike™

Grade Control System Comparisons



Check Dam Placement/Installation…

Alternative Check Dam System

Standard Checks/Traps

Coir/Straw Checks, PAM

4,000 NTU

19 NTU!

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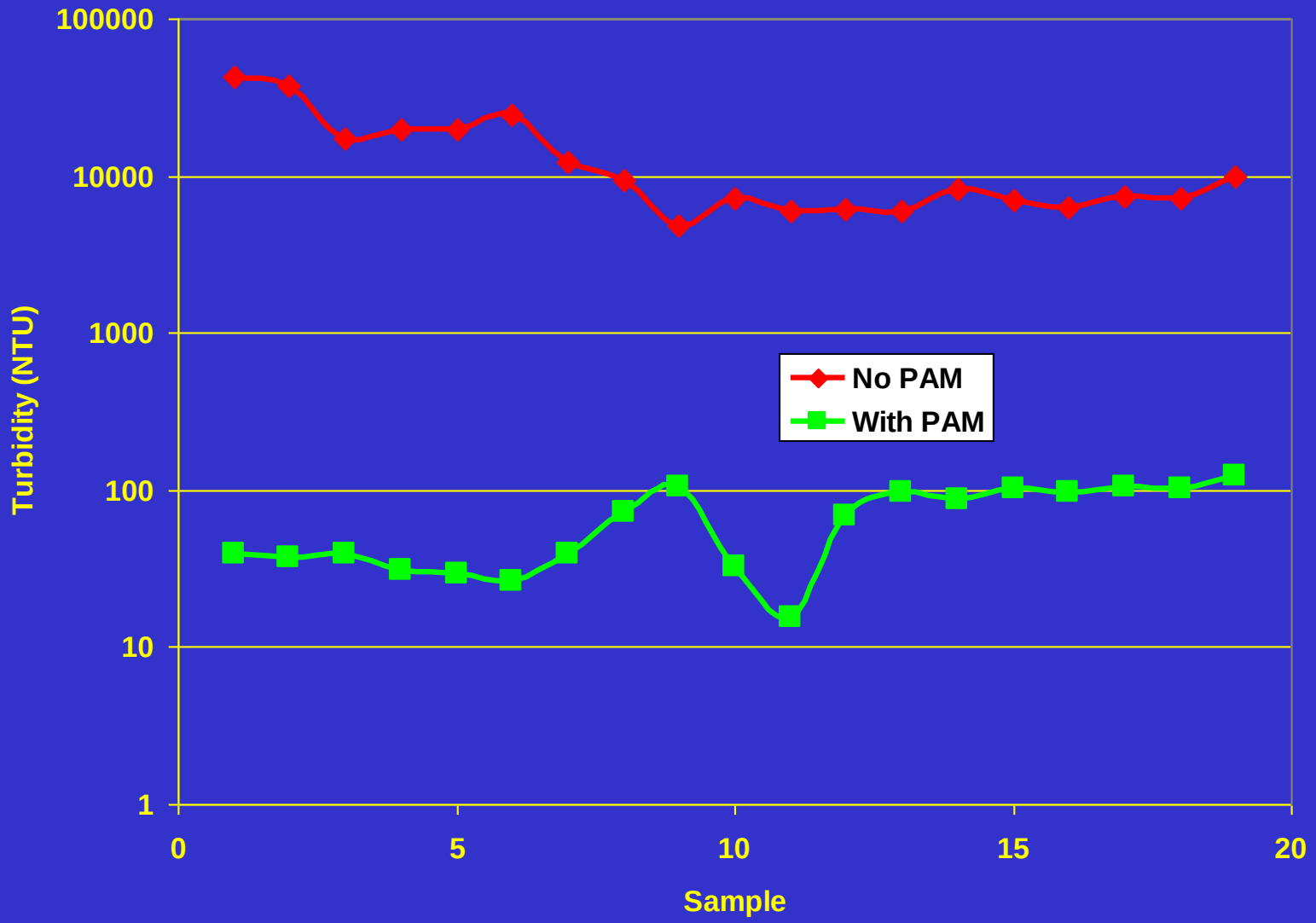
Skimmer Basin: With and Without PAM in ditches



Cost Estimate Comparison

Steeltown:

450’ Standard section	**$1726/$90 to maintain**
668’ Experimental BMPs + PAM	**$1340/$61 to maintain**
461’ Experimental BMPs only	**$1541/ no maintenance (spacing closer)**

Curley Maple:

450’ Standard section	**$1726/$90 to maintain**
668’ Experimental BMPs + PAM	**$1340/$61 to maintain**

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

Typical tools and products needed for installation

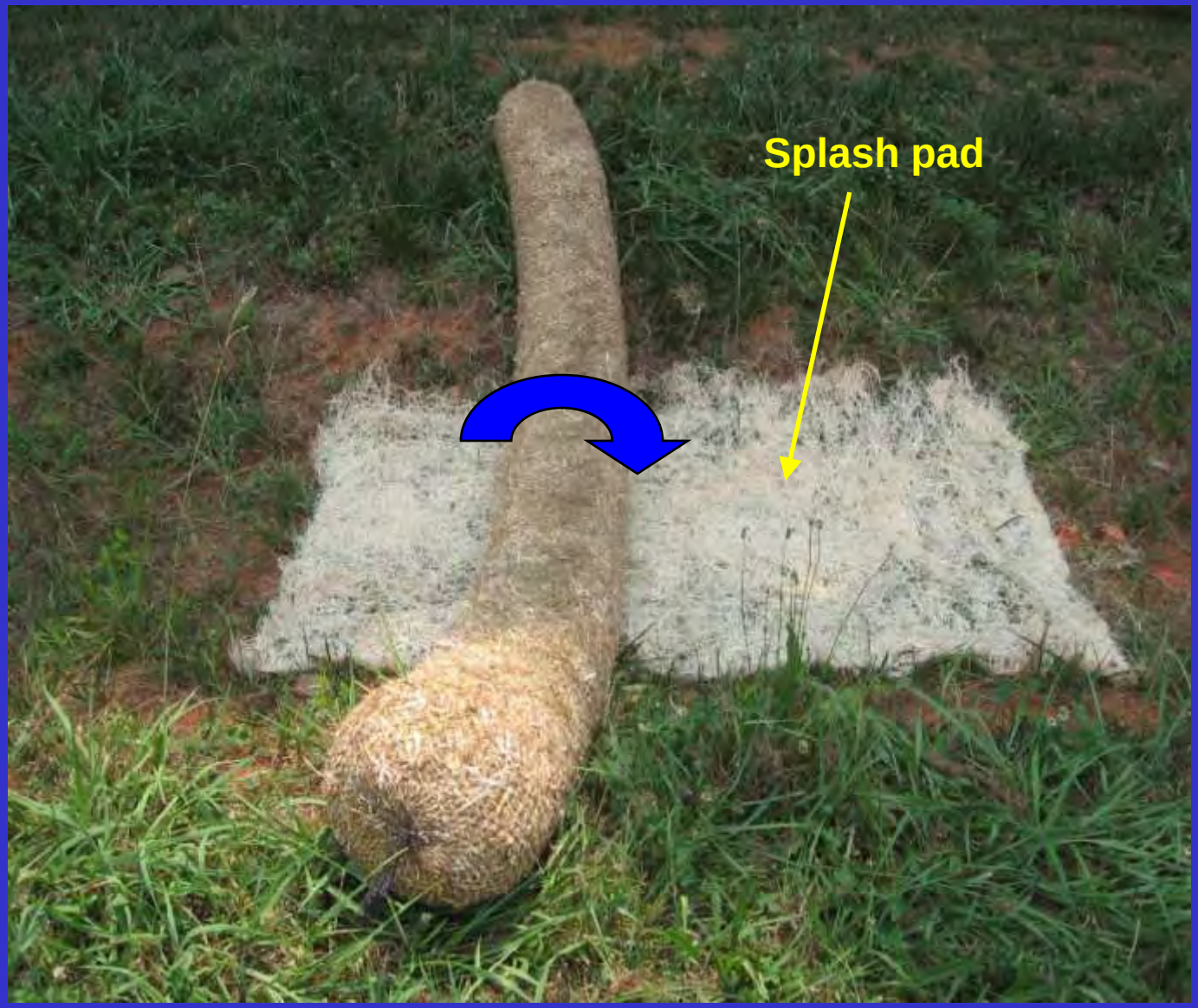
Metal sod staples and mallet

24” long wooden stakes

Erosion control blanket

straw wattle

Close up of the mesh


Splash pad

Must replace with new PAM every so often as the weather dictates – Maintenance is always important!

Check Dams as Lawn Art

Wattle Theft!

Proper installation required…

Stokes' Law

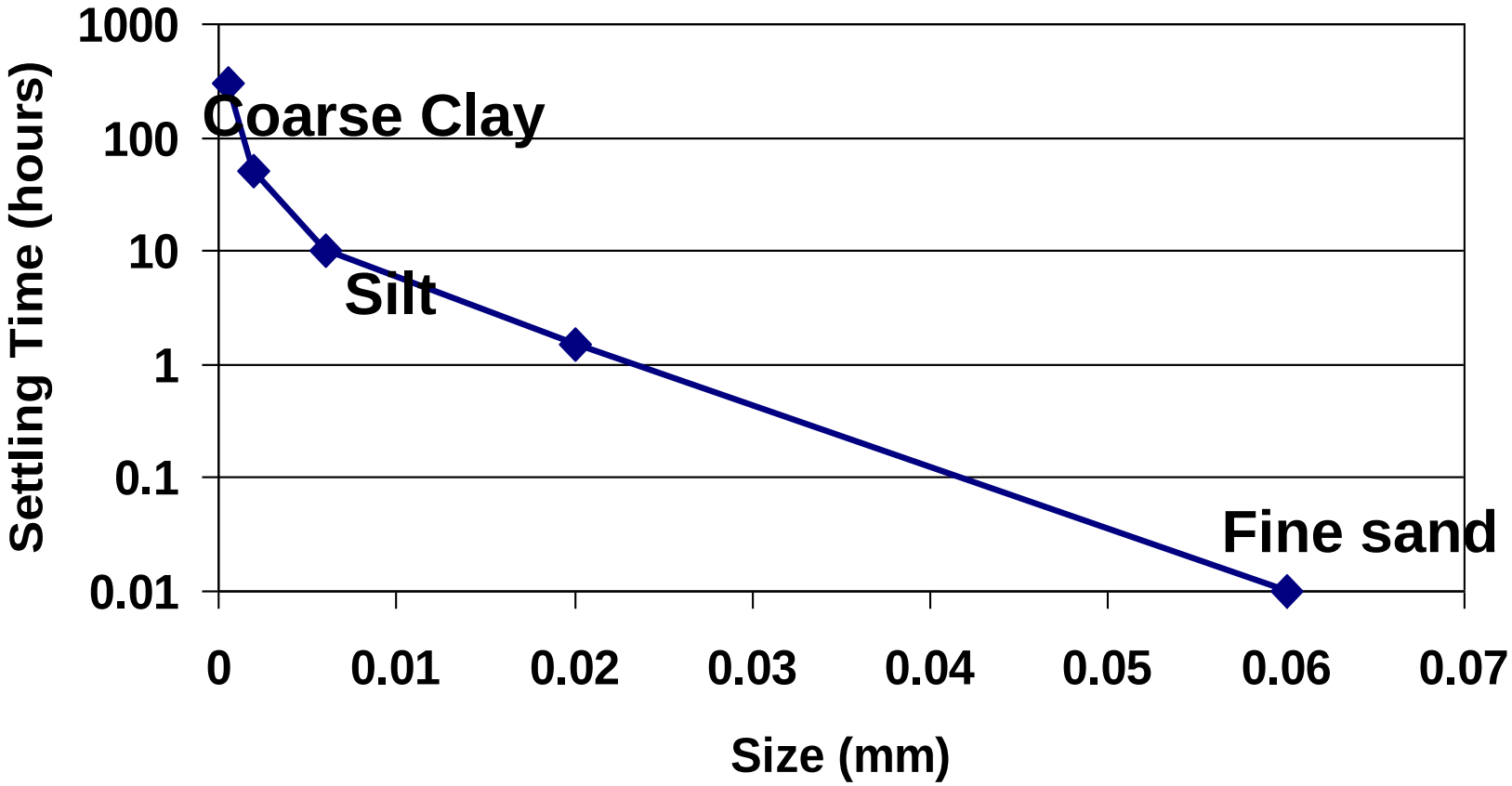
$$V_s = \frac{2}{9}\frac{(\rho_p - \rho_f)}{\mu} g R^2$$

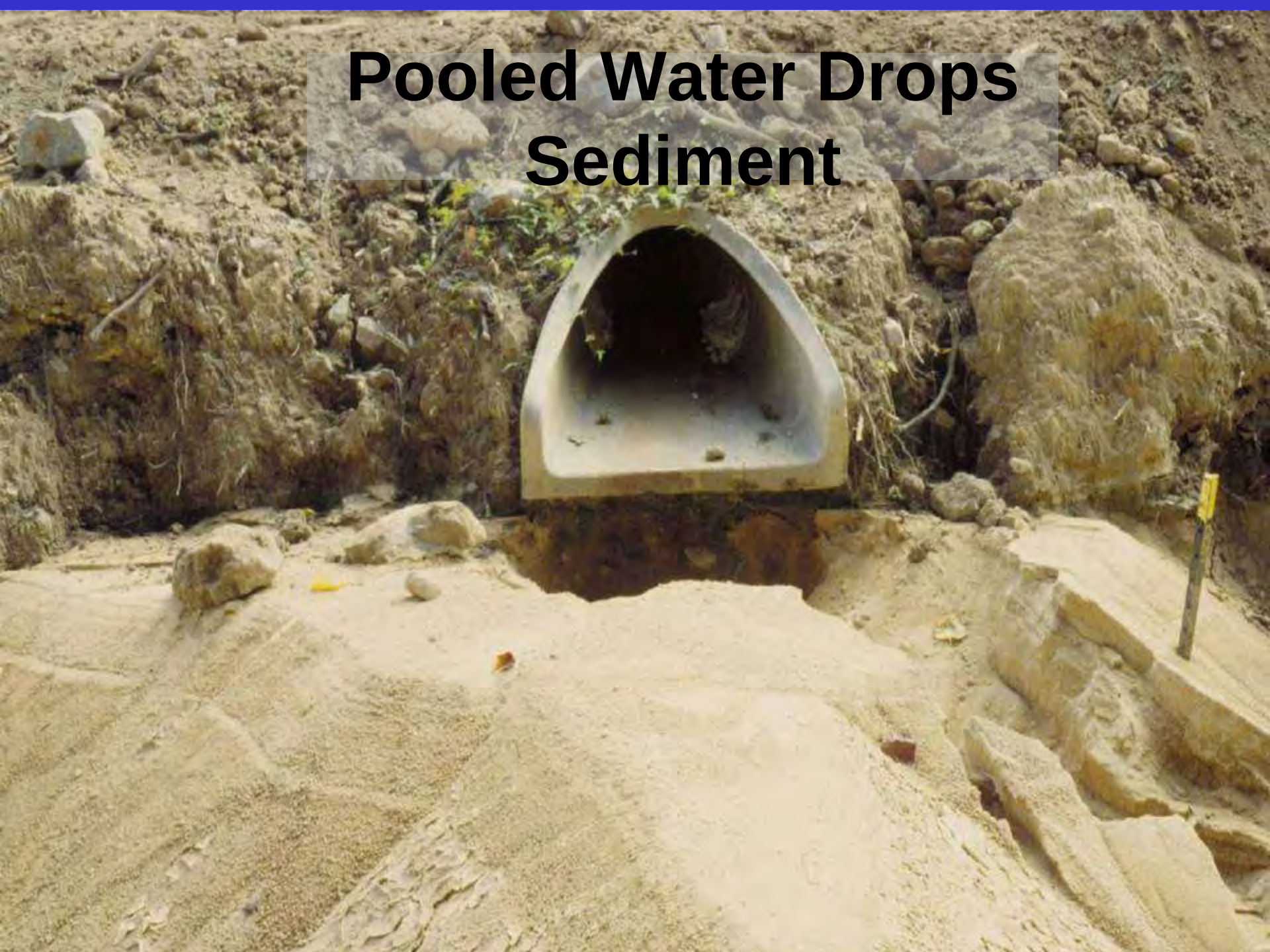
Settling Velocity = (particle density – liquid density)
divided by liquid viscosity
times gravitation force
times particle radius squared

Problems

- As particle size is reduced, settling rate declines exponentially
- Most particles are flat and settle slower than spheres
- As water gets colder, viscosity goes up

Sedimentation: Size Matters




Pooled Water Drops Sediment

Sediment Trapping, Old Style

Other Approaches to Improvements

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

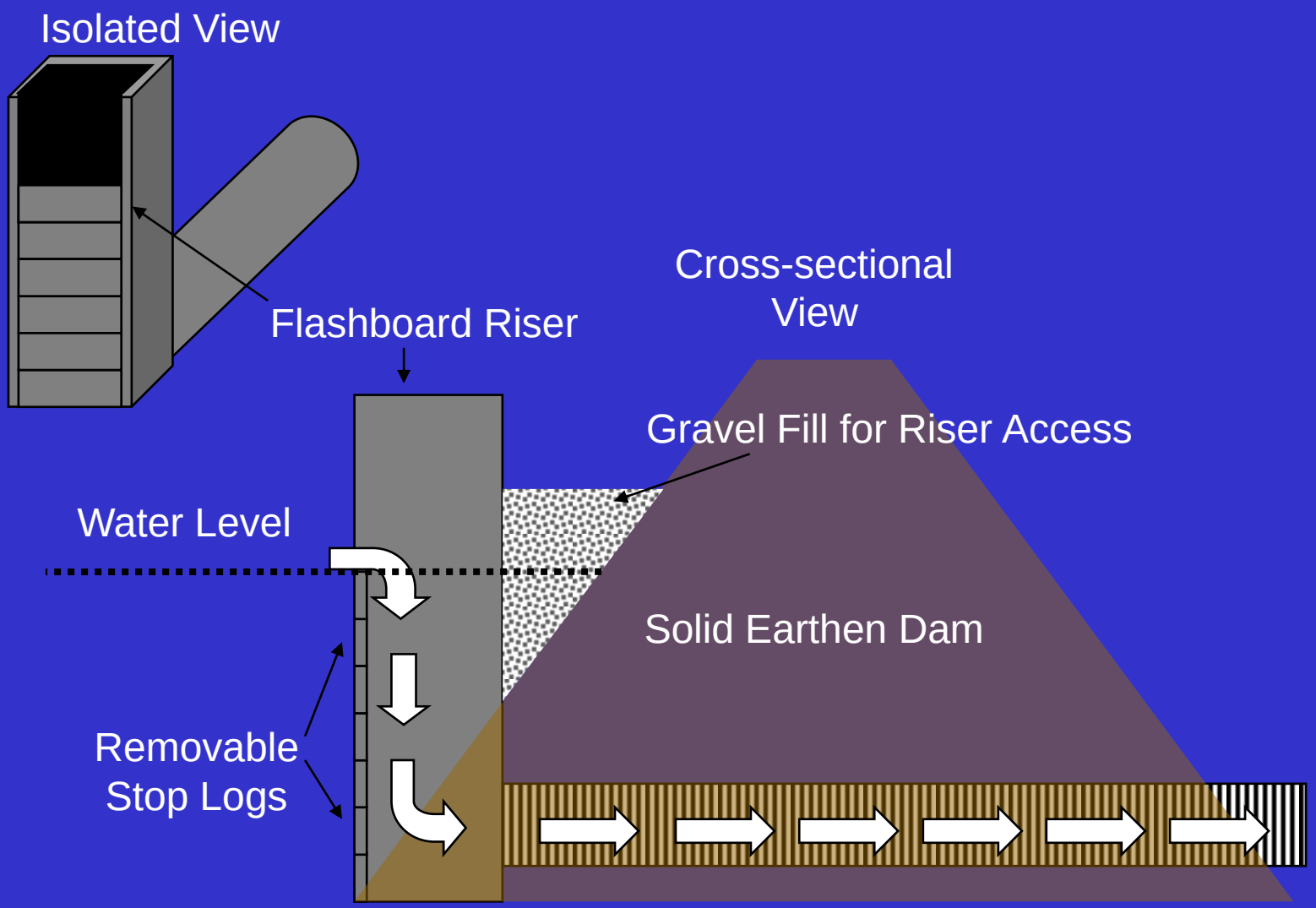
Surface Outlet (Faircloth Skimmer)

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…

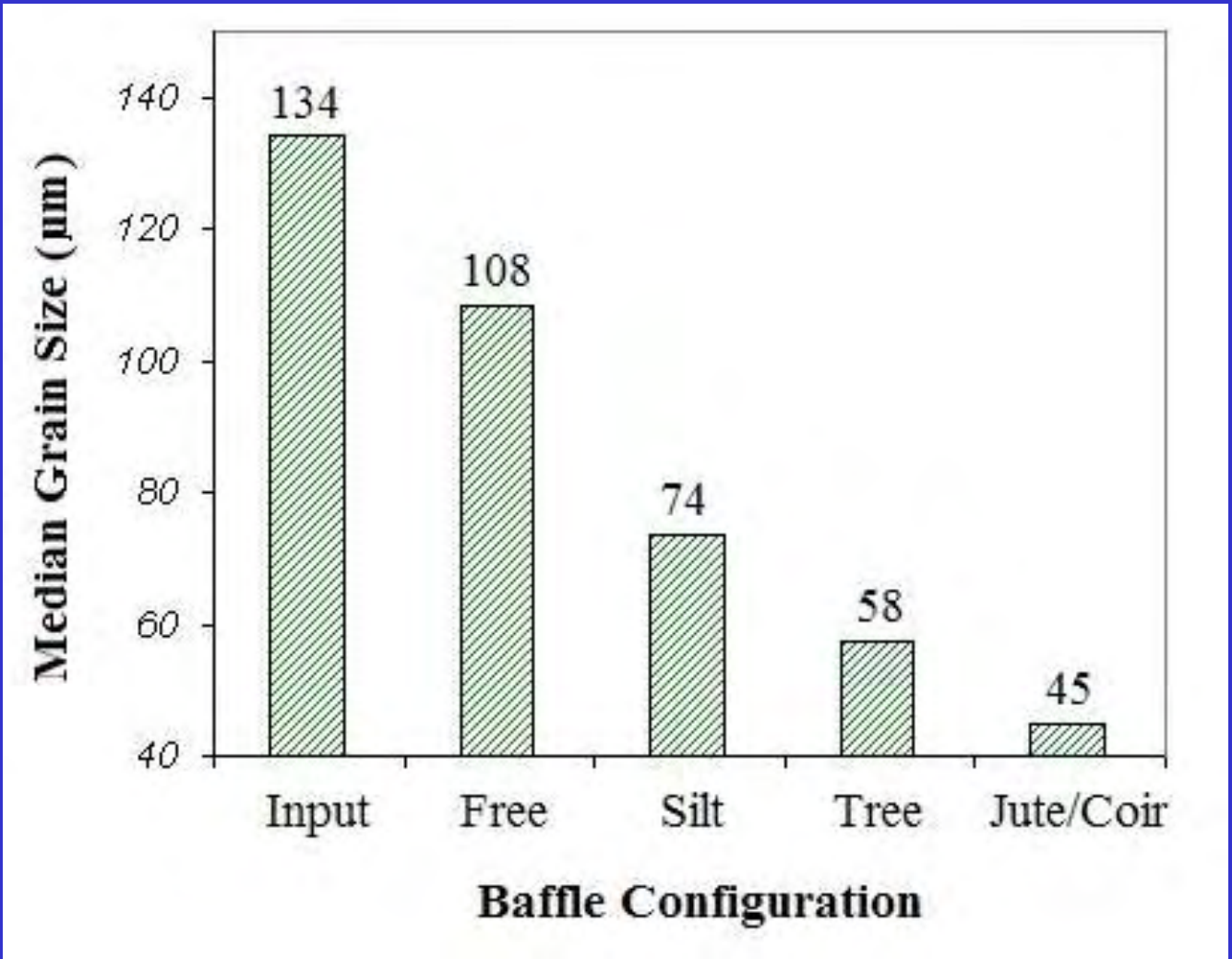
Baffles

Porous

Silt Fence/Weir

Measuring Baffle Effects

Effects of Baffles: Grain Capture



Installation Important…

Do Not Use Jute Alone!

Baffles Should Not Be Overtopped!

Protect Inlet!

Simple Inlet Protection

Basin Design for 99% Capture

- Surface Outlet
- Porous Baffles - Coir.
- Stable Slopes & Inlet
- 25 year sizing

Update: New Ruling!

- Appeals Court ruled in September that EPA has to set ELGs and New Source Performance Standards.
- Some interpret this to mean a set turbidity standard and the presumption of active chemical treatment systems


West Coast System!

Example Control Trailer

Example CTS Controller System

Influent & Effluent Monitoring

Automatic Recirculation
Of Noncompliant Discharge

Recommendations: Construction Site Stormwater Management

- Consider risks when evaluating costs.
- Costs of repeated failures can be high.
- Costs of more effective BMPs are only marginally higher, if at all.
- Work with contractors who keep up with the latest products/systems.


Any Questions?
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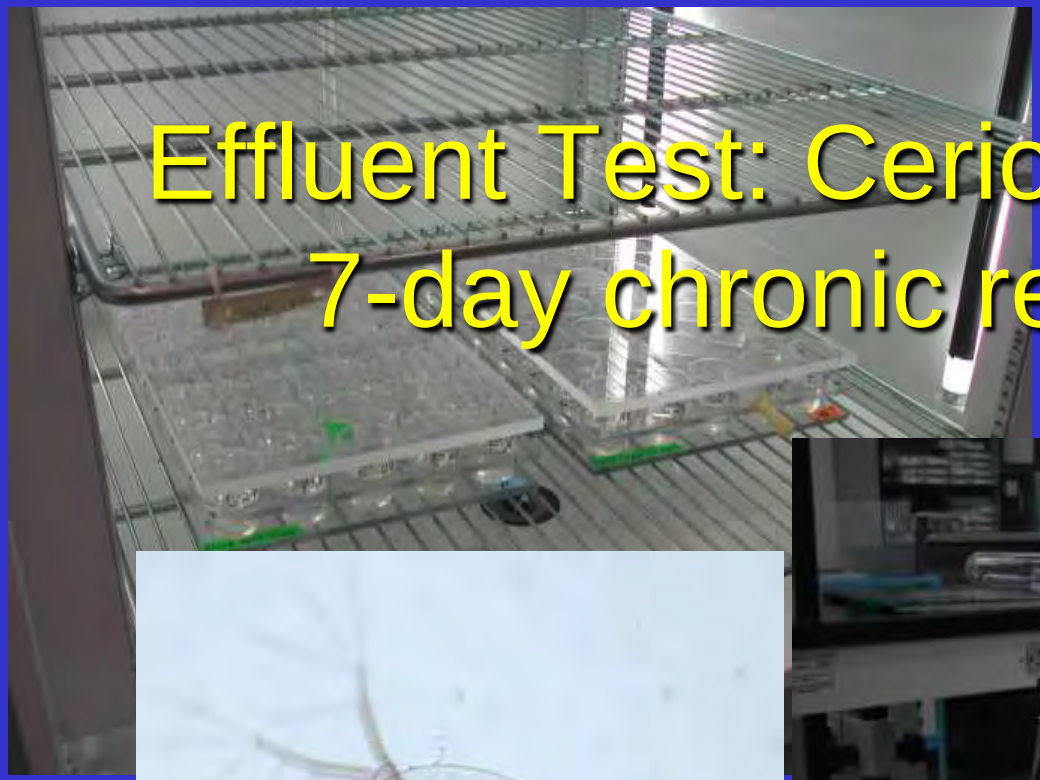
PAM Toxicity?

- PAM is known to be relatively non-toxic as measured by acute (LD_{50}) tests.
- Chronic tests on fish also show low toxicity.
- Chronic effects on smaller species less well known, but toxicity appears to be very low for these as well.

Effluent Test: Ceriodaphnia dubia 7-day chronic reproduction



Ceriodaphnia dubia Tests

- Conducted by DENR-DWQ-Aquatic Toxicology Unit or approved lab.
- Used PAM solutions replaced daily.
- Measured mortality and reproduction rates after 7 days.
- No acute toxicity apparent
- Chronic toxicity (7 day reproduction) effects >3-5 mg/L, the maximum expected dose for turbidity.

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