Soil Loss Prediction Techniques:

Past, Current, and Future

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Overview of Erosion

- Definition of erosion
- Erosion processes
- Types of erosion
- Why erosion is a concern
- Uses of erosion prediction tools

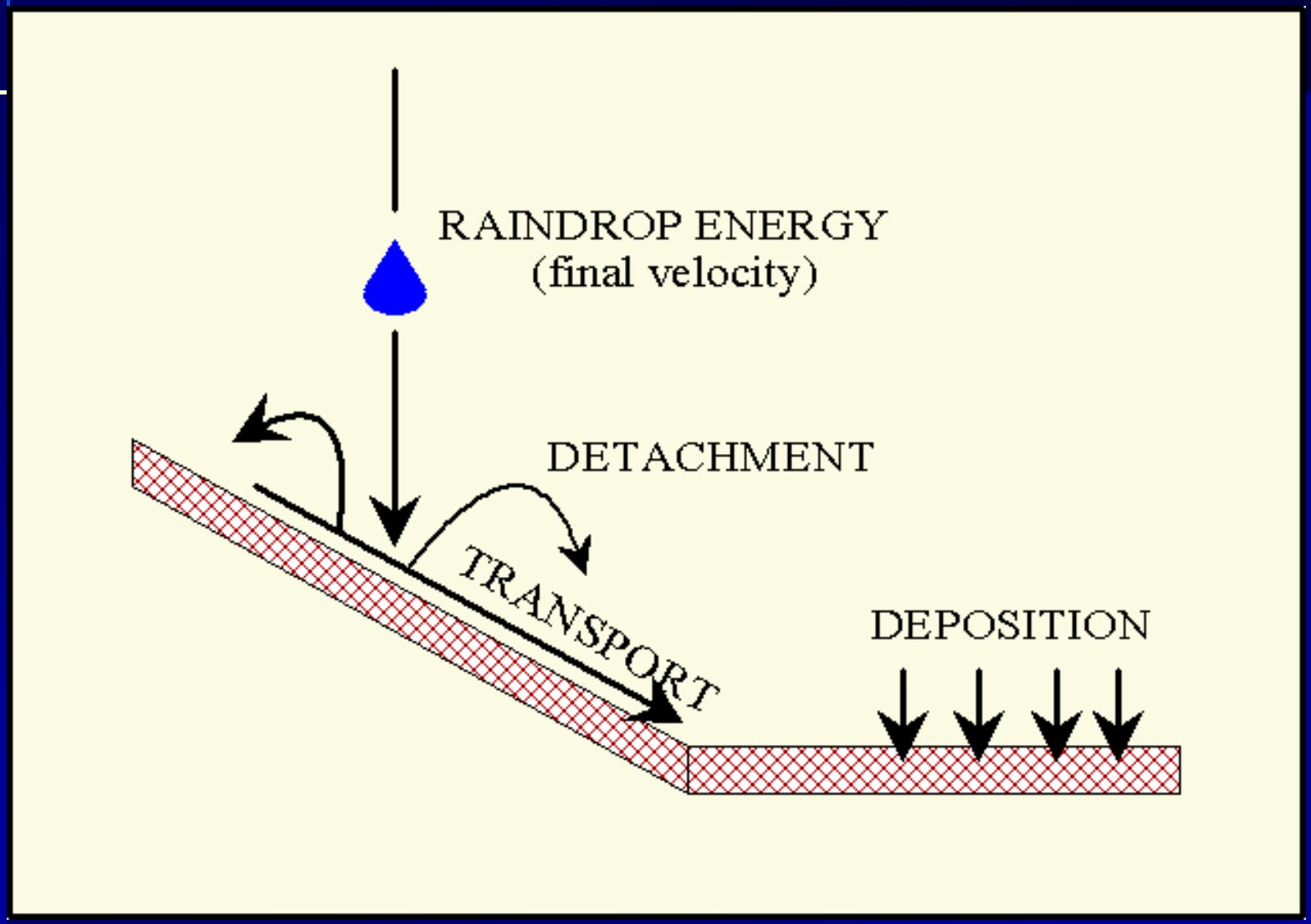
Definition of Erosion

"Erosion is a process of detachment and transport of soil particles by erosive agents."

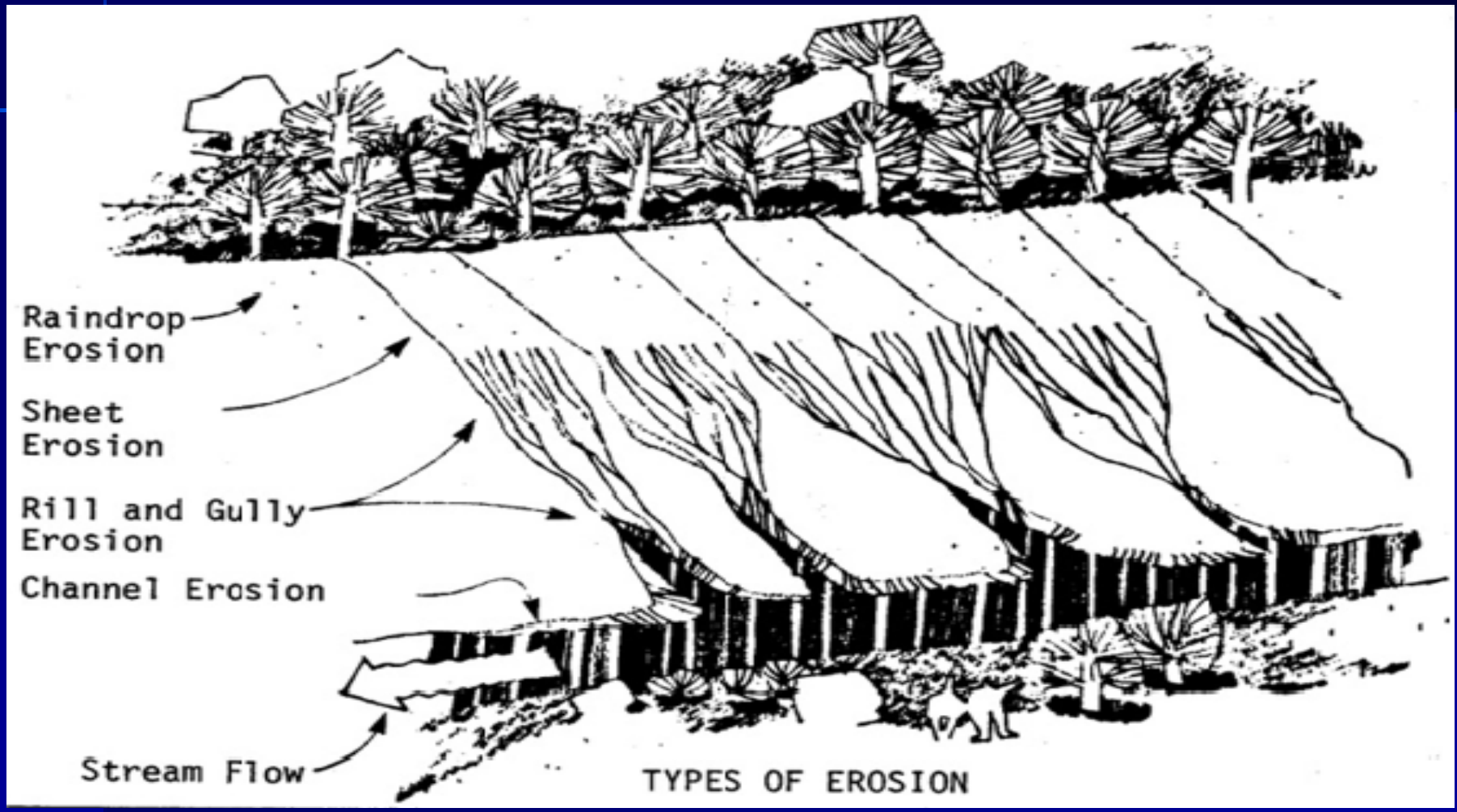
Ellison, 1944

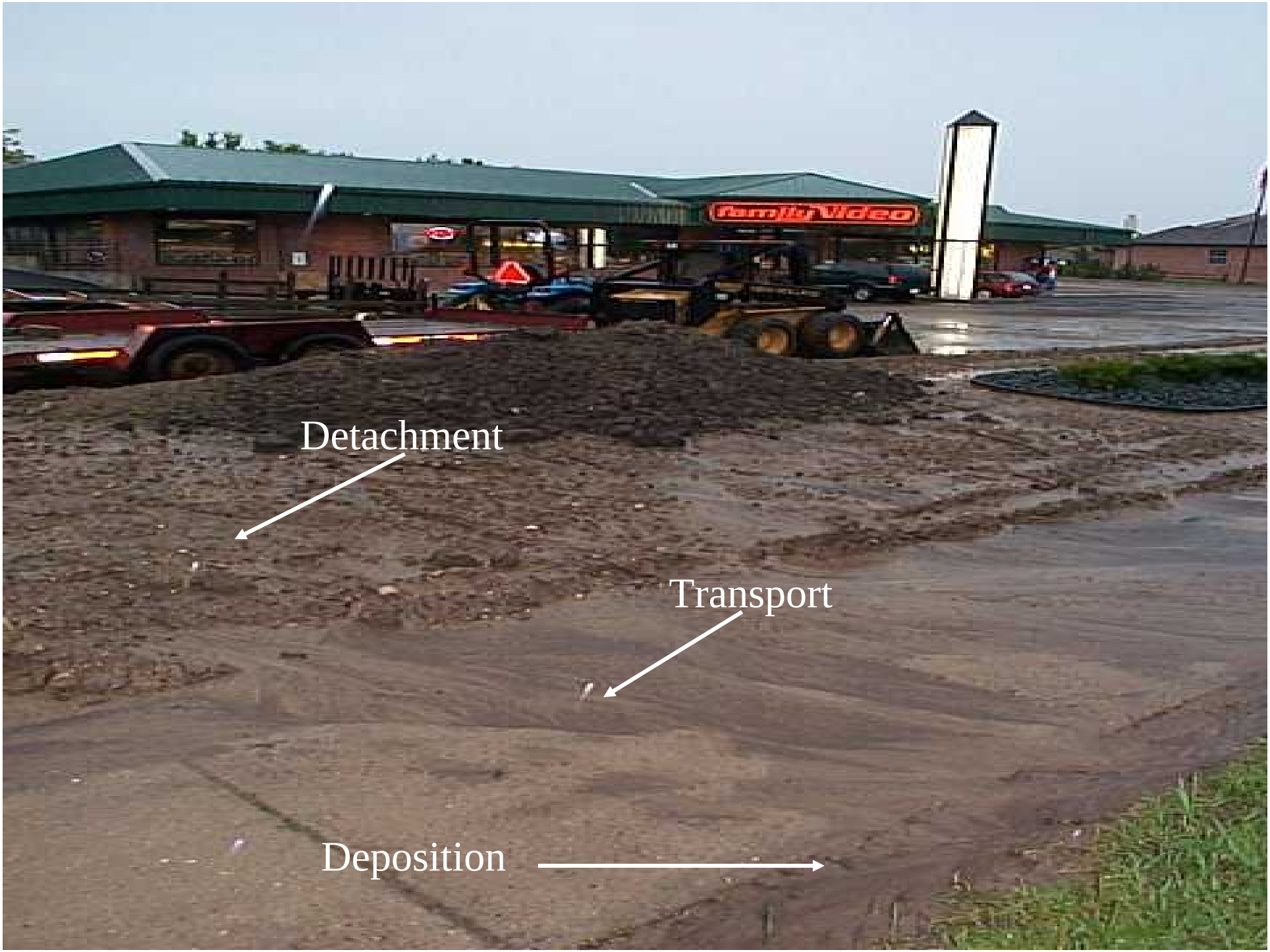
- Erosive Agents
  - Raindrop impact
  - Overland flow surface runoff from rainfall

Conceptual Model of Erosion



Conceptual Model of Erosion




Detachment
Transport
Deposition

Sediment Delivery

1 acre construction

=

75 acres cropland

A=(%R)(R)(K)(LS)(C)

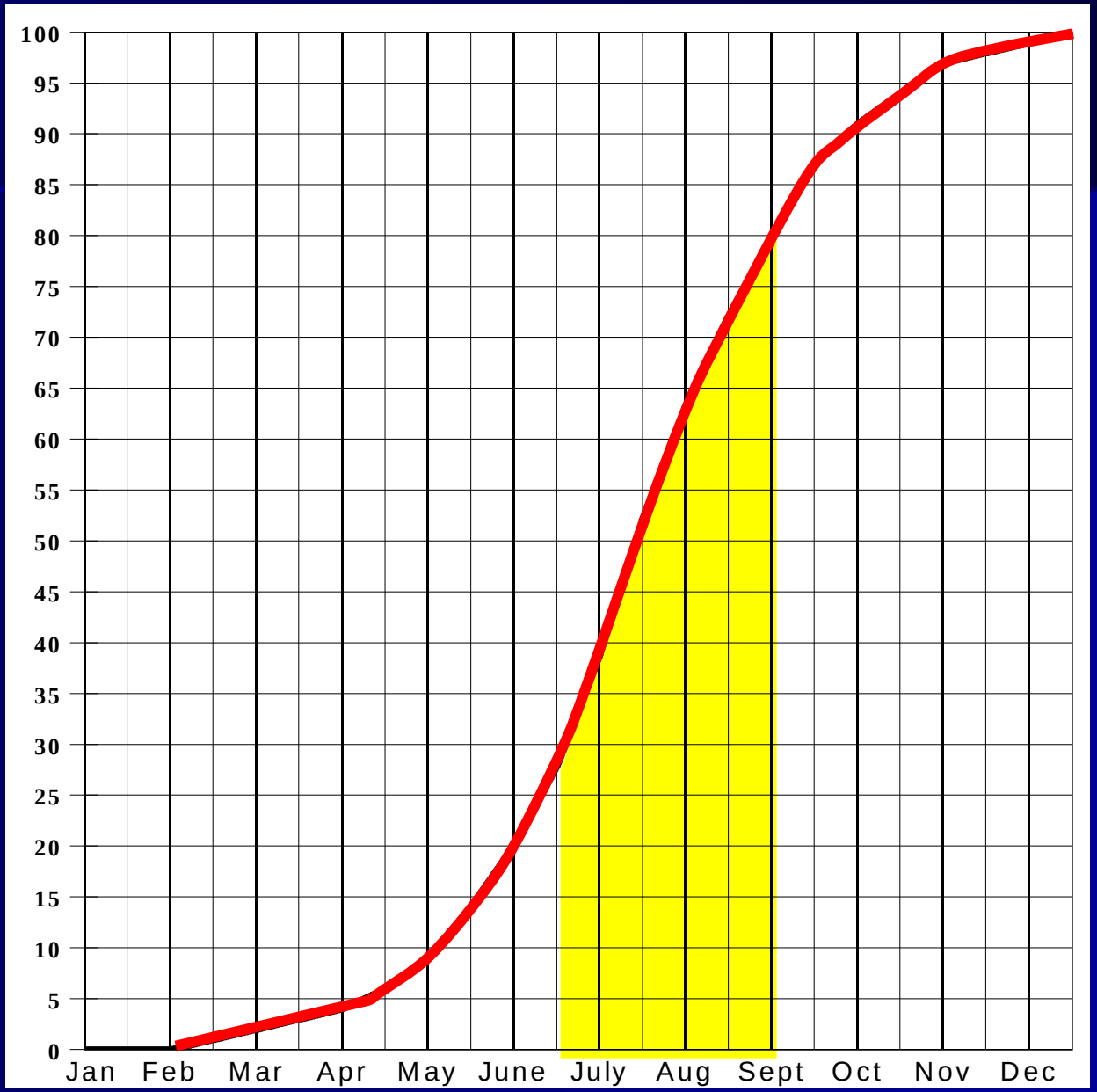
- A Computed Soil Loss Rate (ton/acre)
- %R Percent of annual R factor to date.
- R Annual Rainfall and Runoff Factor
- K Soil Erodibility Factor type
- LS Slope length/Steepness Factor
- C Cover and Management Factor

Rainfall and Runoff Factor (R)

- Amount of energy in a location's annual rainfall.
- For example, the R factor for Dane County is 150.

Monthly Distribution of R

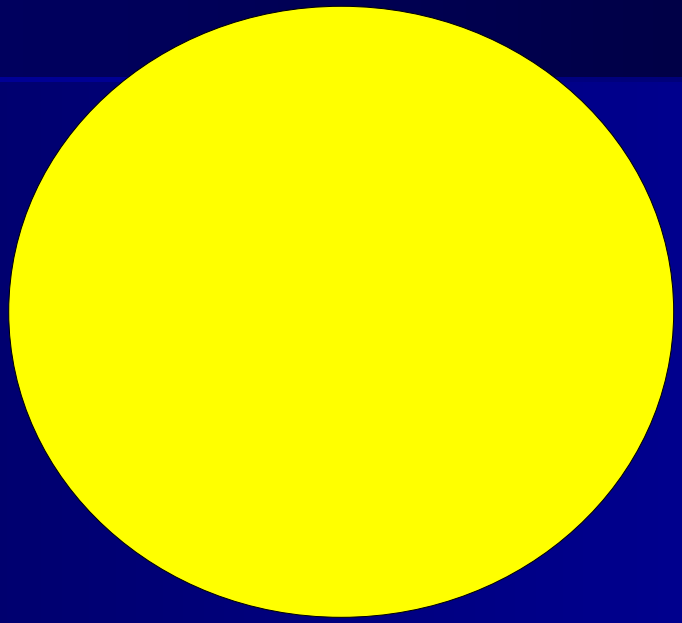
Percent of Annual R



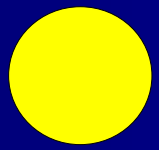
Soil Erodibility Factor (K)

- Based on the soil type of the site.
- Corresponds to the erosivity of the soil in a bare condition.
- Major factors: texture, organic matter, structure, permeability

Relative Sizes of Soil Particles



Sand, 50 microns



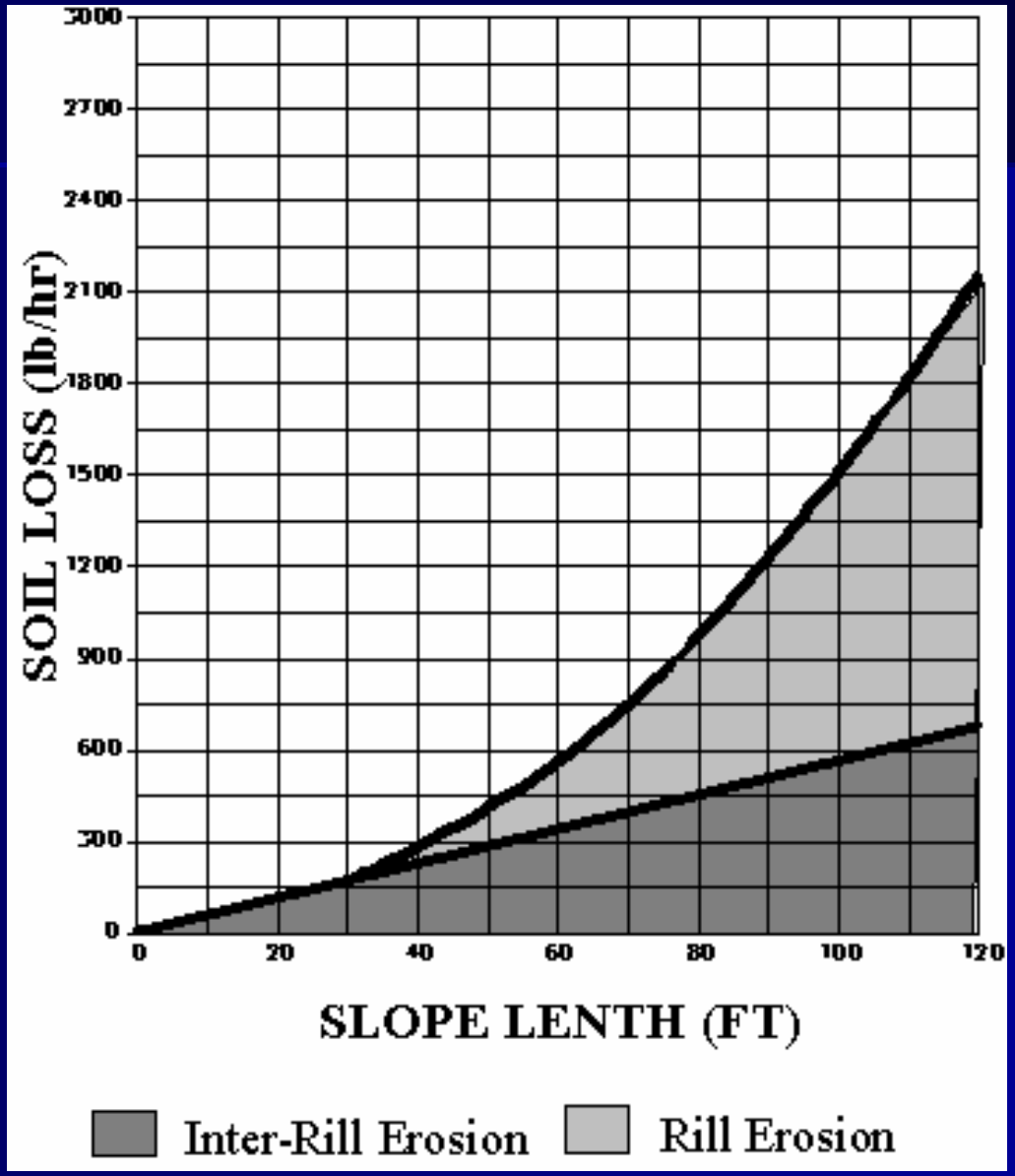
Silt, 10 microns

Clay, 2 microns

Slope Length/Steepness Factor (LS)

- Ratio based on the relationship between the percent slope and slope length of the disturbed area.

Soil Erosion vs. Slope Length



Cover and Management Factor (C)

- The factor representing the site's cover protection from rainfall impact.
- The ratio of erosion between a specific ground cover and bare ground.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Tyvek
SKY TRAK
6036


Tyvek
Tyvek
Tyvek


Pellitteri

Universal Soil Loss Equation for Construction Sites

for use in the State of Wisconsin

commerce.wi.gov Wisconsin Department of Commerce

Developer: _____

Project: _____

Date: 03/01/2006

County: Bayfield

PRINT SHEET | HELP PAGE

Version 3.0

Land Disturbing Activity	Begin Date	End Date	Period % R	Annual R Factor	Sub Soil Texture	Soil Erodibility K Factor	Slope (%)	Slope Length (feet)	LS Factor	Land Cover C Factor	Soil loss A=%RxRxKxLSxC (tons/acre)	Percent Reduction Required
												(5.0 tons/acre)
		-----	-----	-----		-----			-----	-----	-----	
		-----	-----	-----	-------	-----			-----	-----	-----	
		-----	-----	-----	-------	-----			-----	-----	-----	
		-----	-----	-----	-------	-----			-----	-----	-----	
		-----	-----	-----	-------	-----			-----	-----	-----	
		-----	-----	-----	-------	-----			-----	-----	-----	
										TOTAL	-----	NONE

Land Disturbing Activities:

input	definition
Bare Ground	activity which leaves the ground devoid of vegetation
Seed and Mulch	application of straw at 1.5 tons/acre with or without seeding
Seeding	temporary or permanent seeding without the use of mulching materials
Sod	installation of sod
End	end of 60 day cover establishment or permanent stabilization (required input)

Notes:

Designed By:	
Date	
Checked By:	
Date	

Practice Efficiencies

- Straight forward reduction
- Simple calculation
- Calculated efficiency using an approved model

Silt Fence Efficiency

A silt fence prevents soil loss by reducing the flow velocity of runoff by forcing it through filter fabric. When properly installed and maintained, a silt fence with a 20-micron pore size yields an efficiency of 42%.

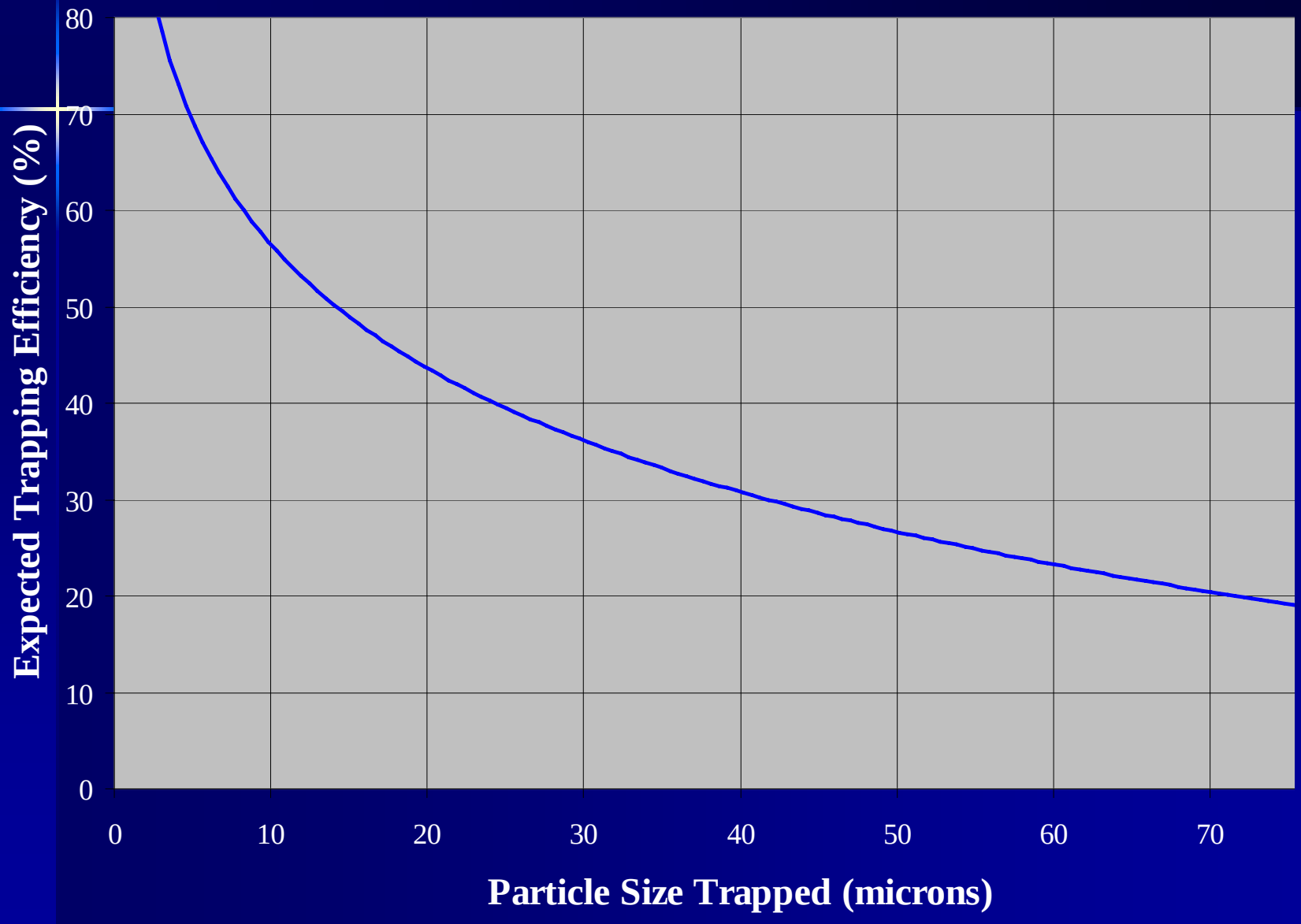
Diversion Efficiency

Diversions effectively reduce the slope length by diverting runoff away from slopes and other areas that are prone to erosion. The efficiency for this practice is thus derived from the reduction in slope length that it provides. To calculate the efficiency, simply use the new, reduced slope length in place of the pre-existing one in the USLE and recalculate. The difference is the efficiency for the practice.

Sedimentation Basin

Sedimentation basins reduce peak flows and act as a sediment trapping device during construction. An approved sedimentation model must be run to determine the practice's efficiency.

Soil Particle Size Distribution



RUSLE 2 WI Construction Erosion Interface

DNR received EPA grant in 2003 to create a construction erosion interface for RUSLE2.

Team:

Dr. Daniel Yoder, U-Tennessee

Dr. John Tyner, U-Tennessee

Jim Lyon, U-Tennessee

Jeremy Balousek, Dane Co. LCD

Kevin Kirsch, WDNR

John Panuska, UW-Madison

NRCS and WisDOT Support

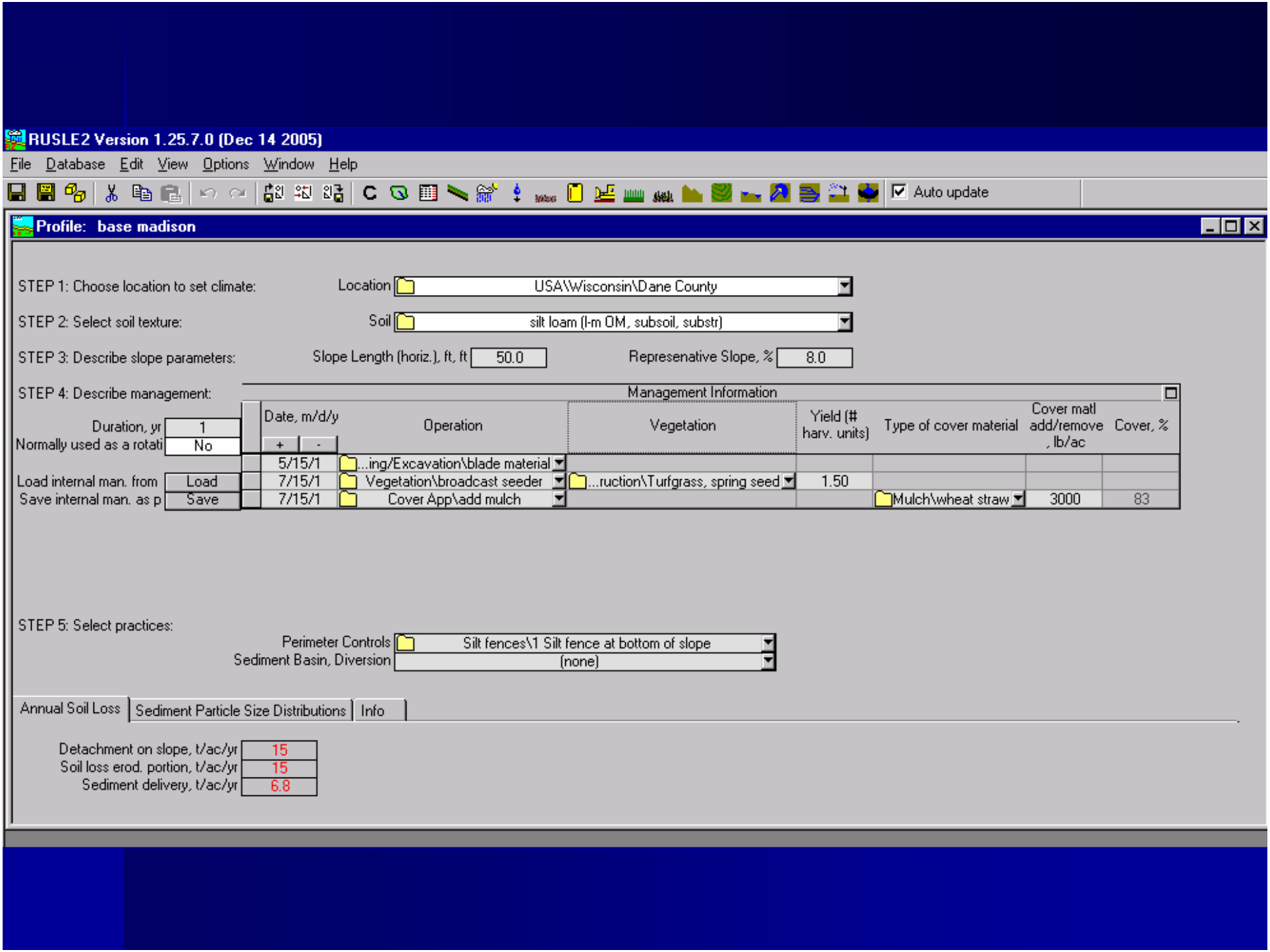
RUSLE 2 WI Construction Erosion Interface

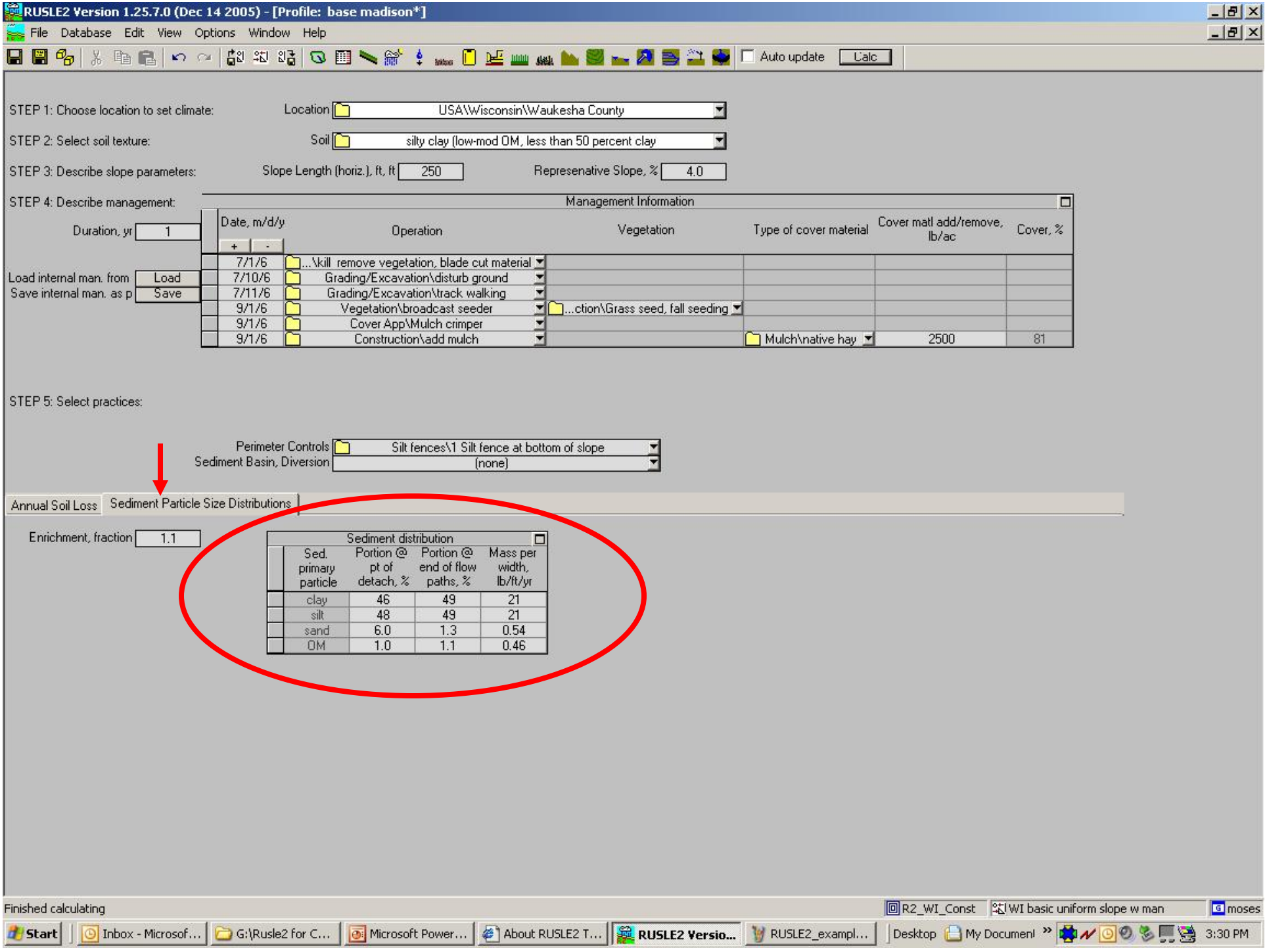
Beta version being delivered April 24, 2006

Beta Testing proceeding through summer

User's manual under development – expected fall of 2006.

Here is a sneak peak….


RUSLE2 Version 1.25.7.0 (Dec 14 2005)
File Database Edit View Options Window Help
Auto update
Profile: base madison
STEP 1: Choose location to set climate:
Location
USA\Wisconsin\Dane County
STEP 2: Select soil texture:
Soil
silt loam (l-m OM, subsoil, substr)
STEP 3: Describe slope parameters:
Slope Length (horiz.), ft, ft
50.0
Represenative Slope, %
8.0
STEP 4: Describe management:
Management Information
Duration, yr
1
Normally used as a rotati
No
Load internal man. from
Load
Save internal man. as p
Save
Date, m/d/y
Operation
Vegetation
Yield (# harv. units)
Type of cover material
Cover matl add/remove, lb/ac
Cover, %
5/15/1
...ing/Excavation\blade material
7/15/1
Vegetation\broadcast seeder
...ruction\Turfgrass, spring seed
1.50
7/15/1
Cover App\add mulch
Mulch\wheat straw
3000
83
STEP 5: Select practices:
Perimeter Controls
Silt fences\1 Silt fence at bottom of slope
Sediment Basin, Diversion
(none)
Annual Soil Loss
Sediment Particle Size Distributions
Info
Detachment on slope, t/ac/yr
15
Soil loss erod. portion, t/ac/yr
15
Sediment delivery, t/ac/yr
6.8


RUSLE2 Version 1.25.7.0 (Dec 14 2005) - [Profile: base madison*]
File Database Edit View Options Window Help
Auto update
Calc
STEP 1: Choose location to set climate:
Location
USA\Wisconsin\Waukesha County
STEP 2: Select soil texture:
Soil
silty clay (low-mod OM, less than 50 percent clay
STEP 3: Describe slope parameters:
Slope Length (horiz.), ft, ft
250
Represenative Slope, %
4.0
STEP 4: Describe management:
Management Information
Duration, yr
1
Load internal man. from
Load
Save internal man. as p
Save
Date, m/d/y
Operation
Vegetation
Type of cover material
Cover matl add/remove, lb/ac
Cover, %
7/1/6 ...\kill remove vegetation, blade cut material
7/10/6 Grading/Excavation\disturb ground
7/11/6 Grading/Excavation\track walking
9/1/6 Vegetation\broadcast seeder ...ction\Grass seed, fall seeding
9/1/6 Cover App\Mulch crimper
9/1/6 Construction\add mulch Mulch\native hay 2500 81
STEP 5: Select practices:
Perimeter Controls
Silt fences\1 Silt fence at bottom of slope
Sediment Basin, Diversion
(none)
Annual Soil Loss
Sediment Particle Size Distributions
Enrichment, fraction
1.1
Sediment distribution
Sed. primary particle
Portion @ pt of detach, %
Portion @ end of flow paths, %
Mass per width, lb/ft/yr
clay 46 49 21
silt 48 49 21
sand 6.0 1.3 0.54
OM 1.0 1.1 0.46
Finished calculating
R2_WI_Const
WI basic uniform slope w man
moses
Start
Inbox - Microsof...
G:\Rusle2 for C...
Microsoft Power...
About RUSLE2 T...
RUSLE2 Versio...
RUSLE2_exampl...
Desktop
My Document
3:30 PM

RUSLE2 Modeling Guidelines

- Assumes BMPs have been maintained and installed correctly.
- Modeling code has been written for BMPs following DNR/SOC standards.


NICK STAY AWAY

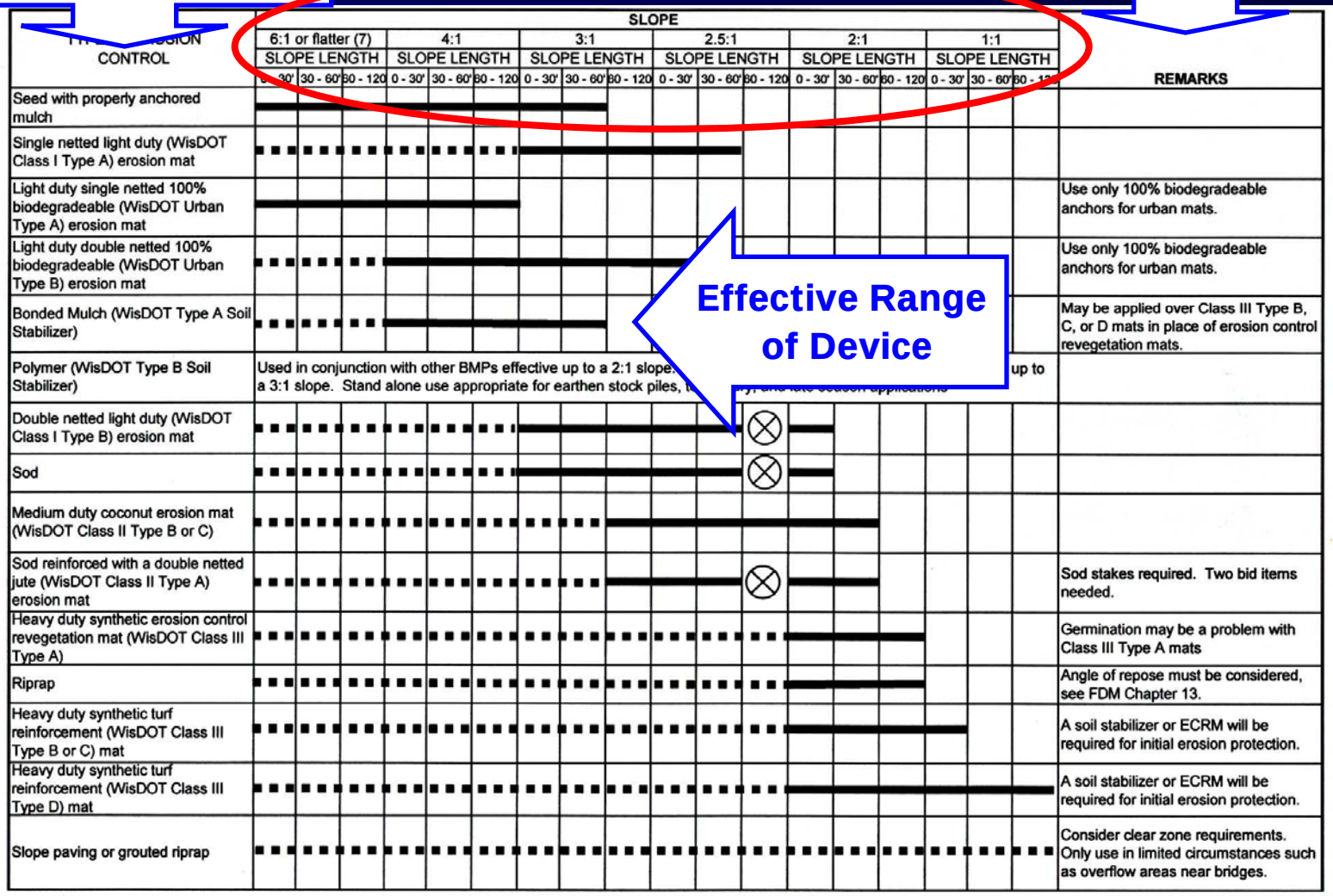
Erosion Estimation vs. Stormwater Models

- SLAMM / P-8 and other storm water pollutant models should not be used to simulate erosion processes.
  - Models rely on build/up wash-off routines
  - Models use particle size distributions for urban storm water runoff

WisDOT Matrix Does Not Predict Sediment Loss

Available Devices

Remarks



Effective Range of Device

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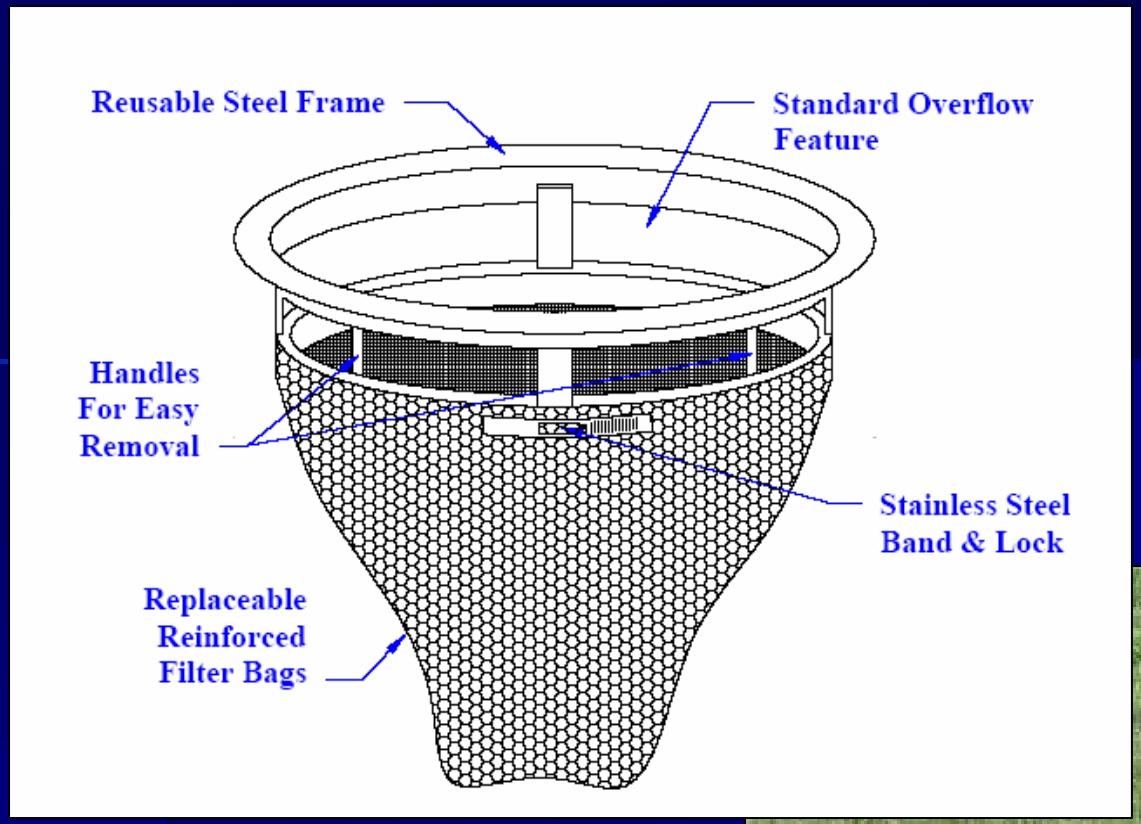
Advantages of Soil Loss Standard

- Able to target areas for more effective control.
- Gives credit for exposure time and phasing.
- USLE Aids in the design of practices.
- Spreadsheet increases efficiency.

Principles of Erosion Control Addressed with Soil Loss Prediction

- Fit development to the site.
- Timing of grading and construction.
- Retain existing vegetation.
- Minimize the length and steepness of slopes.


Buffer
Seed/Mulch/Polymer
Silt fence/reinforced w/straw bales


Reusable Steel Frame
Standard Overflow Feature
Handles For Easy Removal
Stainless Steel Band & Lock
Replaceable Reinforced Filter Bags