Protect Our Water Conference 2019

How to Put The BEST Into Your BMPs

Keynote By

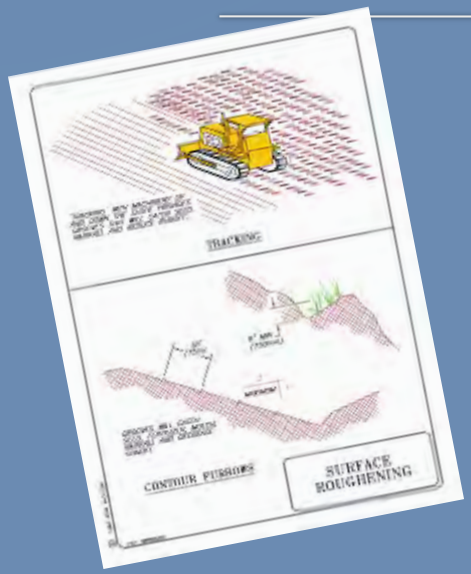
John McCullah, Geomorphologist, CPESC

Sponsored

State of Hawaii DOT – Highways, Harbors, and Airports

How to Put the BEST into Your BMPs

EFFECTIVE and Sustainable BMPs



Presented by

John McCullah CPESC #311
Salix Applied Earthcare
Redding CA

Contact John at:

www.dirttime.tv

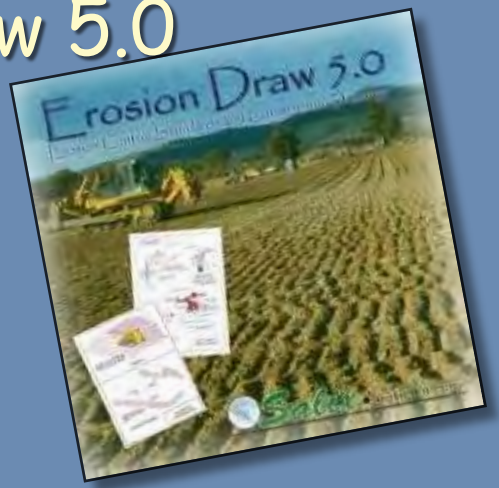
John McCullah, Host, Dirt Time

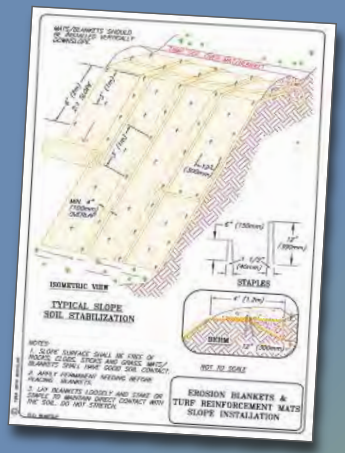
President, Salix Applied Earthcare

- **CPESC** #311 (since 1986 (27 yrs))
- **BS Watershed Geology**, Humboldt State University
- **Landscape Contractor** (1984-present
- **Fluvio-Geomorphologist / Restorationist** (since 1989)
- **Bioengineering Practitioner** (20yr)
- **Instructor** – Wtrshd Restoration/Erosion Control, Shasta College
- **Exec. Director** - Sacramento Watersheds Action Group (SWAG)
- **IECA & Caltrans Trainer** – 1998 to present

Course Intent

- I'd like this presentation to be "like a day in the field", on an actual construction site," learning by experiencing and doing".
- We will use case studies, lots of pictures and "Dirt Time Clips*
- Typical drawings are from Erosion Draw 5.0





* Dirt Time Clips" are available from IECA or www.dirttime.tv

Dirt Time Trailer

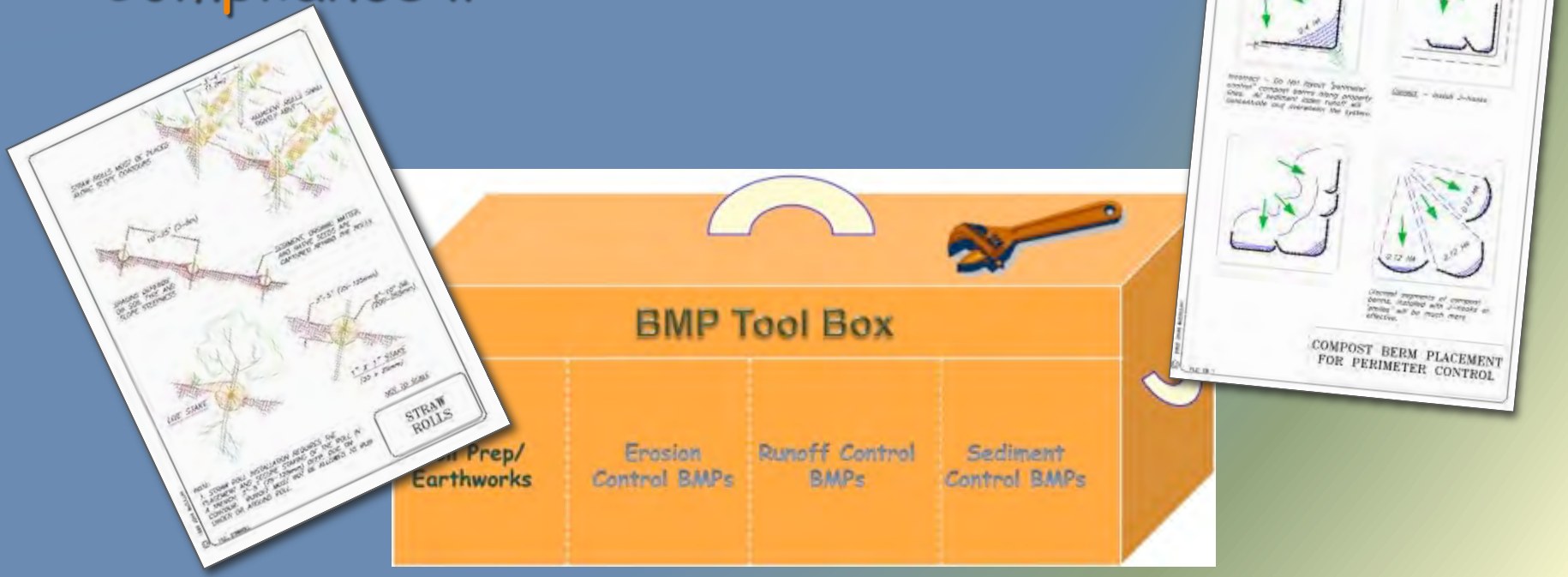
We will discuss:

By focusing on the BMP ;

1. The types and causes of erosion.
2. The physical processes which influence erosion
3. How to select BMPs based on process
4. Erosion and sediment control planning strategies
5. About BMP implementation
6. How to "confidently" review plans and inspect, monitor and report on EC and SC BMPs in the field

Course Intent

- This BMP course is NOT about the regulations
- The Construction General Permits will be discussed generally
- However, BMPs are the TOOLs of Compliance !!



Other Courses: Knowledge of the Regulations and CGP

- How to obtain permit coverage (NOI)
- Who is Legally Responsible Party
- Elements of the SWPPP
- How to use RUSLE or calculate runoff

(2 day)

- When and how to monitor and sample (1 day)
- How to report

This Course: Knowledge of the BMPs

- How and where are they meant to be applied
- How are they installed to maximize effectiveness
- These are the elements of compliance

Construction General Permit

Qualified SWPPP Developer Training (QSD)

22-Hour Course !!

Presented by: The URS Team

- URS Corporation
- AEI-CASC
- Salix
- Vali Cooper

January 2012

Special Topics In Erosion

Today we will also cover

- Jr. Raindrop
- The Caltrans Experience
- Continuity Equation and Check dams
- Myth Busting
- Filter Fabrics - Do they "filter"?
- Perimeter Controls

Understanding Erosion and Run Off Control

- It is often informative to check in with **Jr. Raindrop**, Papa Cloud, and **Mother Earth** to get their perspective.
- "The Adventures of Junior Raindrop"?

Junior Raindrop

3:25

6:36

Jr. will hurt his butt and then get a bad attitude.
He needs "Cush for his Tush"

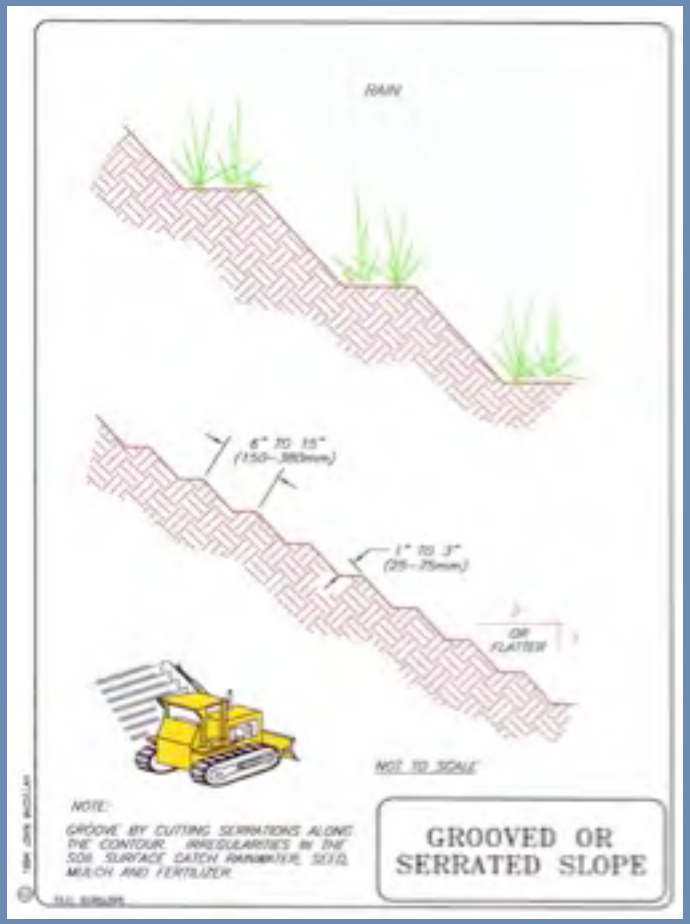
Raindrop energy is the predominate physical cause of soil detachment / erosion – 90%

What did we learn from video?

- Key remedies:
  - ✓ Mulch or Cover for raindrop impact, "Cush for his Tush"
  - ✓ ROUGHEN the SOIL SURFACE!!
  - ✓ Slope breaks, surface roughness, fiber rolls etc. to slow Jr. down
  - ✓ INCREASE INFILTRATION

Slope Interrupters

- Break up slope length



Slow Junior Down

Fiber Rolls – New Technology?

Caltrans LS specified coir rolls $$ for this Orange County Hwy

CA State Parks Recreation Vehicles Area

- Carnegie SVRA, Tracy CA

State CA OHV Parks – Carnegie 1920s

Slope approx. 1.5:1

1. Slopes were "scaled"
2. Trackwalked - 52% effective
3. Straw Wattles installed in 3" trench.
4. Mychorrizae fungus added
5. Biosol organic fertilizer
6. CA Native grasses

Car
Rec

The Caltrans Experience

California Department of Transportation has been a major developer of BMPs, Stormwater protocols, and training programs

- In 1996 received violation for non-compliance$300 million !!!
- BMP Research and Training in lieu of monetary fine

Soil Erosion Research – San Diego State U

- This tilting test bed was constructed at SDSU to conduct rainfall simulation testing for Caltrans.

For example

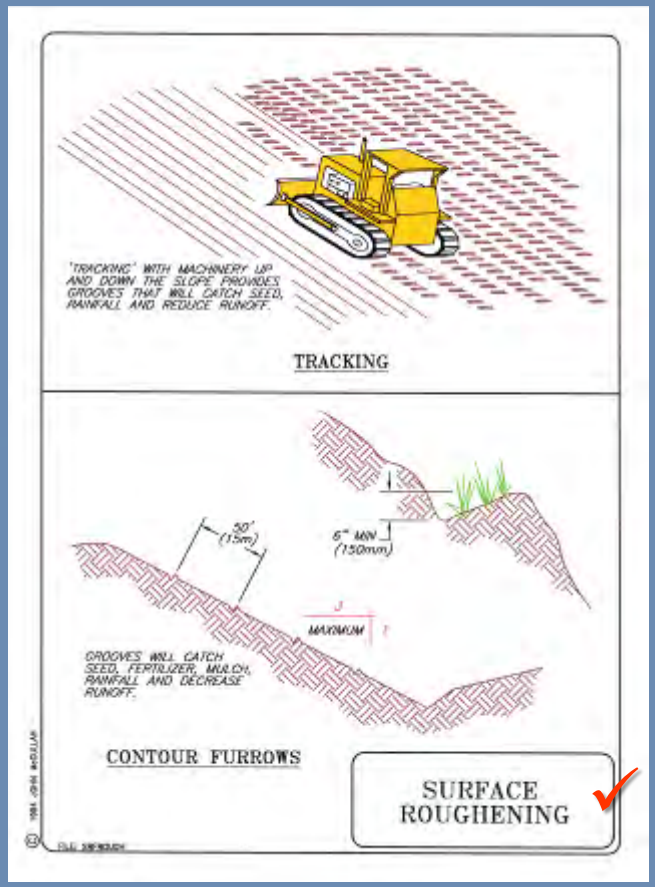
Imprinting

This laboratory close-up shows the test bed prepared to evaluate imprinting.

BTW - Imprinting

- Imprinting was occasionally specified for gentle slopes, sandy soils and arid regions, So. Cal, Arizona etc.

Surface Roughening



Track Walking reduces erosion by 52%-
Caltrans/SDSU Erosion Study

Surface Roughening – Track Walking

Surface Roughening – Track Walking

Slope is 1.5:1

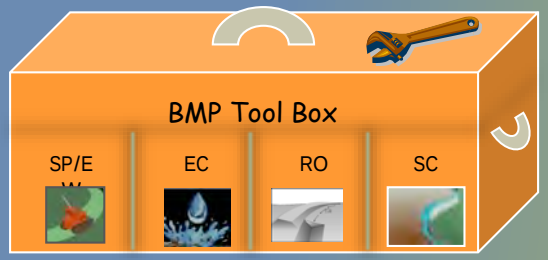
Soil Roughening - Trackwalking

- Trackwalking results in "hydraulic roughness"
- Reduced runoff results in less runoff erosion (less 'Gangster' action)

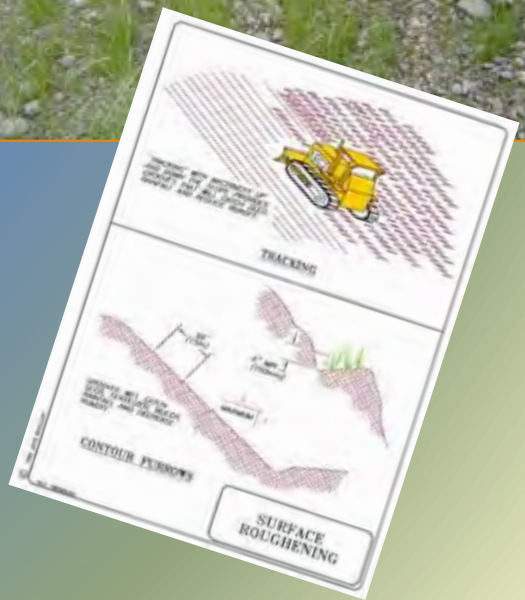
- Reduced runoff equals less pollutant delivery
- Reduced runoff means more water in the soil (infiltration and less hydromodification)

Earthwork and Soil Preparation BMPs

Soil Prep / Earthworks



- This category of practices:
  - Roughens the soil to slow 'Junior' down
  - Reduces erosion *
  - Increases infiltration ✓
  - Prepares soil for plant establishment
  - Stable platforms for planting



Soil Preparation BMPs

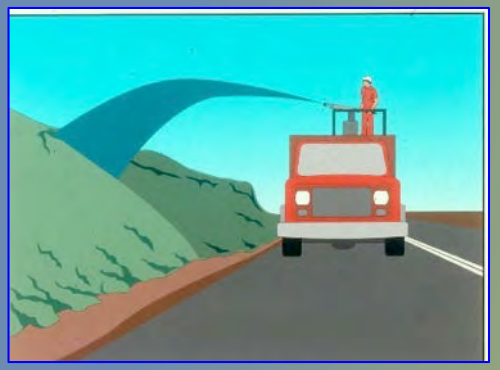
- Surface Roughening
- Grooved or Serrated slopes
- De-compaction soil surface

Earthworks BMPs

- Stepped Slopes
- Contour Grading and Slope Rounding
- Topsoil / Duff
- Compost Incorporate

Soil Preparation

- Proper preparation of the soil is essential - prior to the application of soil stabilization materials.

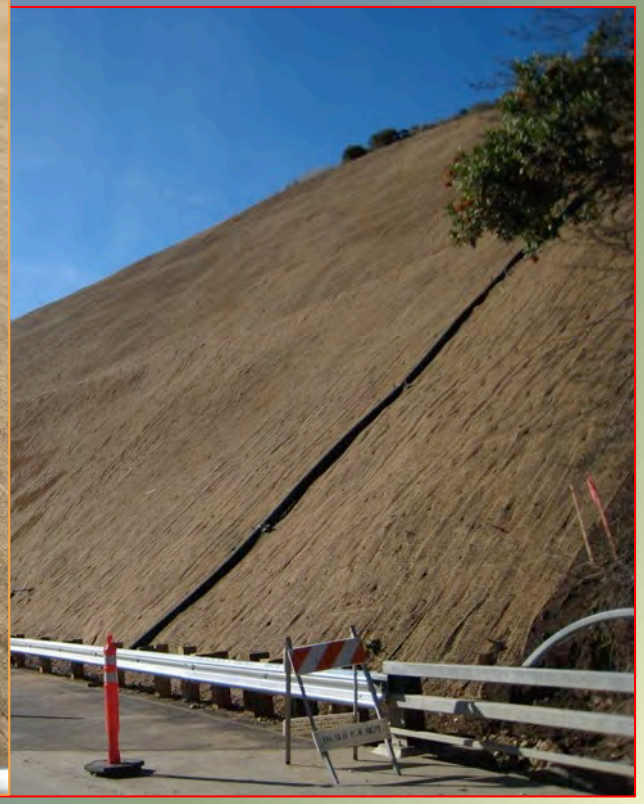


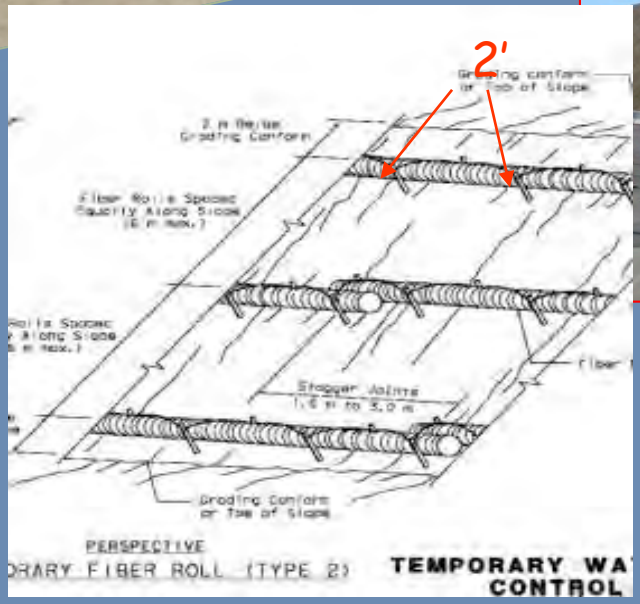
Soil Preparation

- In my opinion, one of the primary reason soil stabilization practices (hydromulch, ECBs, BFMs, seeding) fail or are ineffective is due to inadequate soil preparation

Soil Preparation

- Rills can form UNDER ECBs, even the most costly, if the soil is not prepared !!



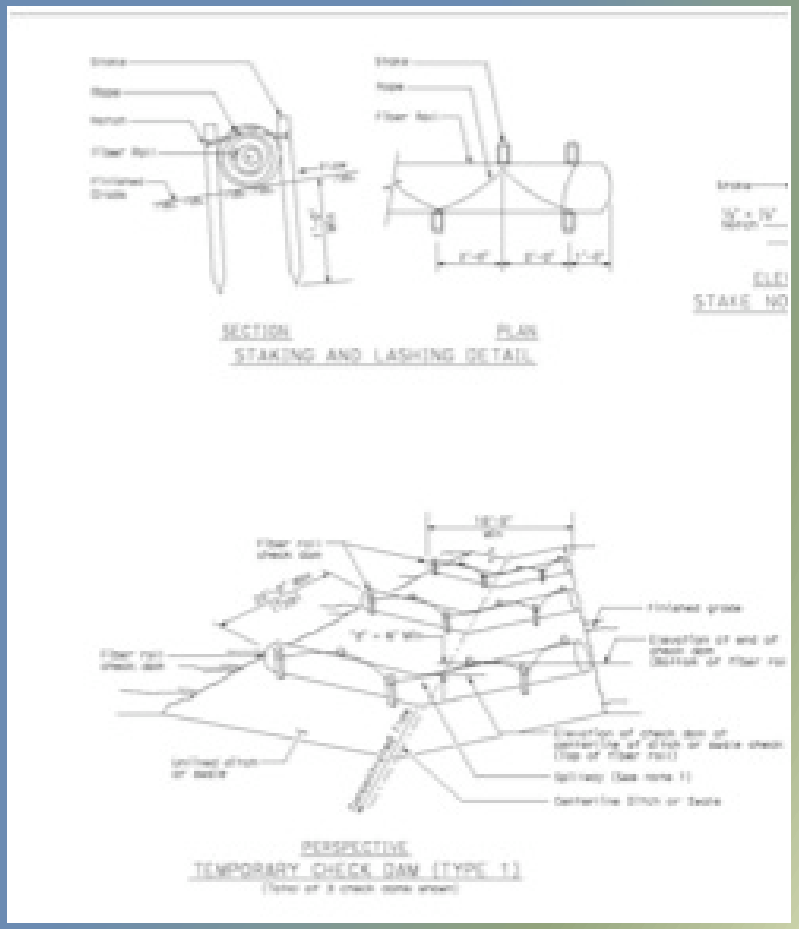

2'
Grading conform
or top of slope
2 m Maximum
Grading Conform
Fiber Rolls Spaced
Equally Along Slope
(6 m max.)
Stagger Joints
1.5 m to 5.0 m
Grading Conform
or Toe of Slope
PERSPECTIVE
ORARY FIBER ROLL (TYPE 2)
TEMPORARY WA
CONTROL

Fiber Rolls

- Stake and twine method for anchoring

FIBER ROLLS for Ditch Checks

- Fiber rolls may be used for inlet protection if properly anchored



Fiber Rolls

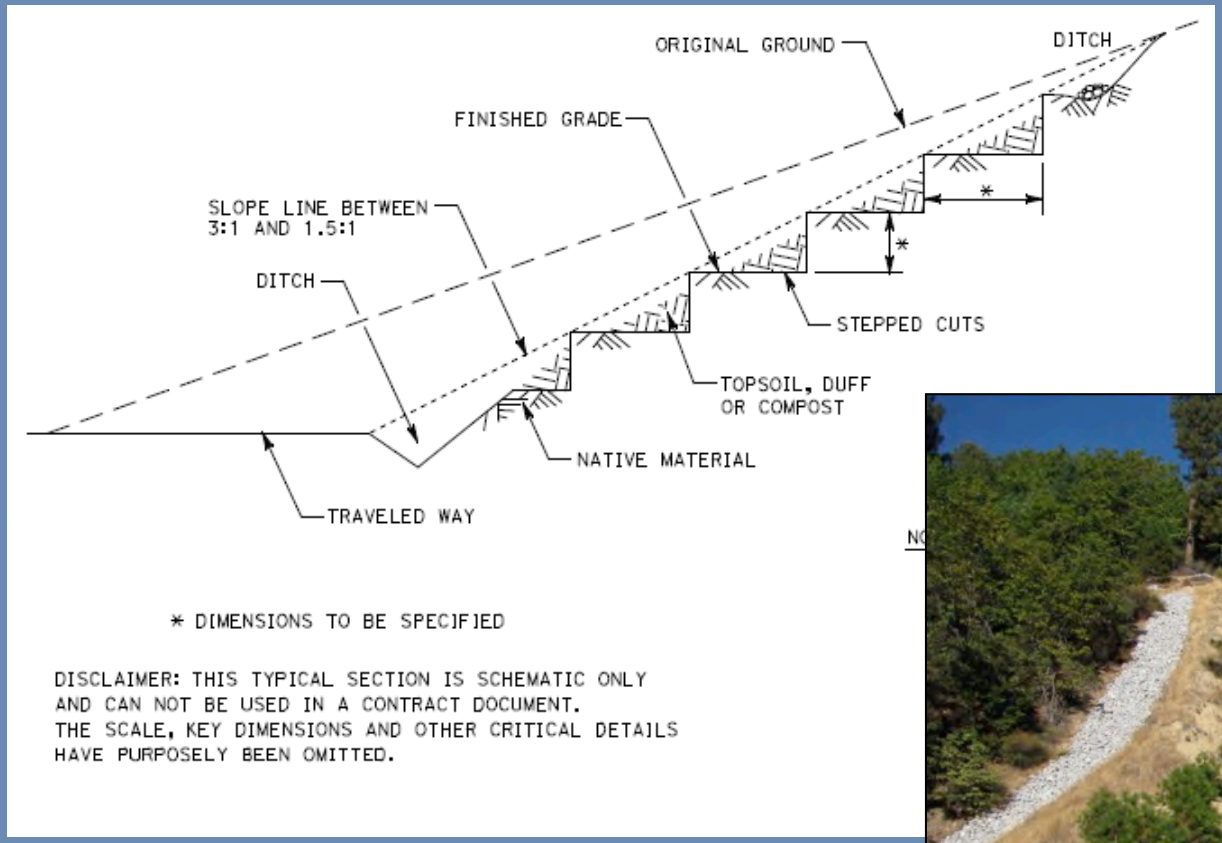
TIP

- J-Hook up on compound slopes

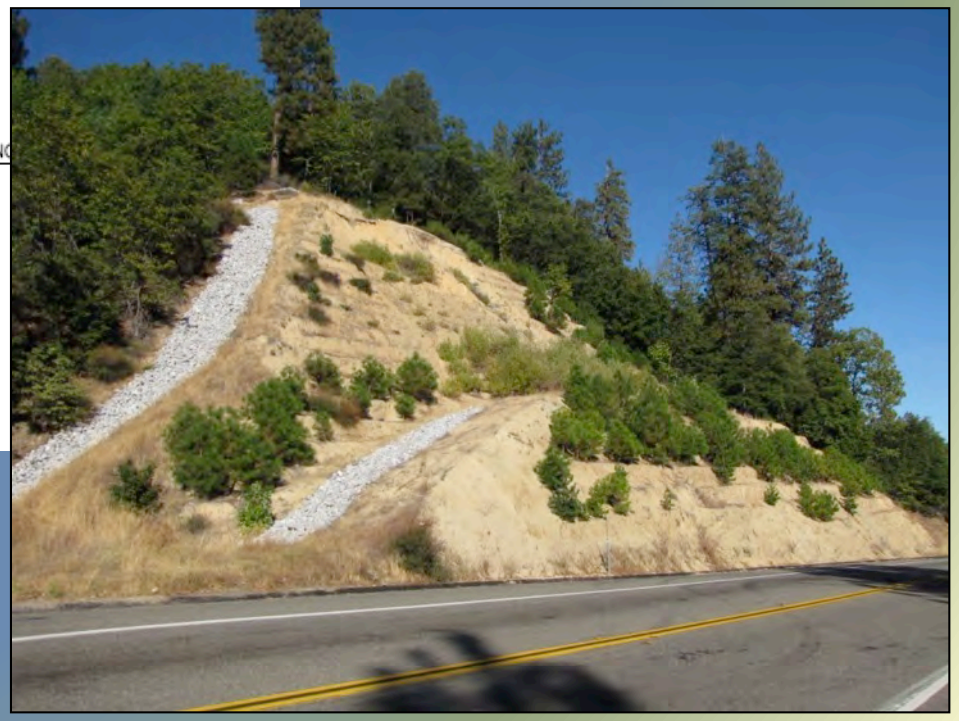
Earthwork BMPs

- Contour Grading for Erosion Control, Planting and Maintenance of Planting
- Stepped Slopes
- Topsoil
- Duff
- Compost Incorporate
- Grooved or Serrated Slopes

Steep Slope Solutions

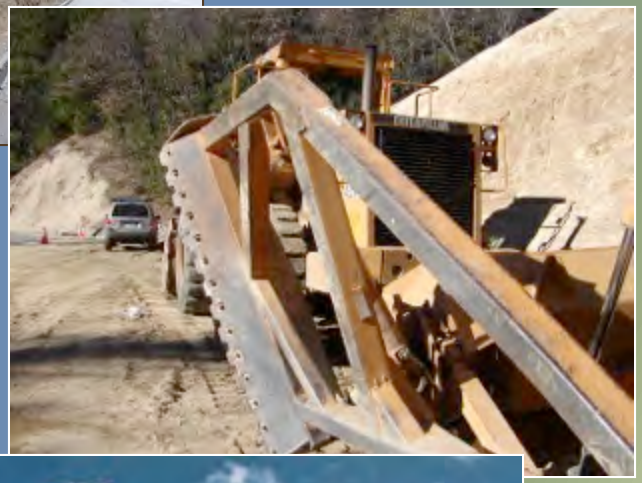


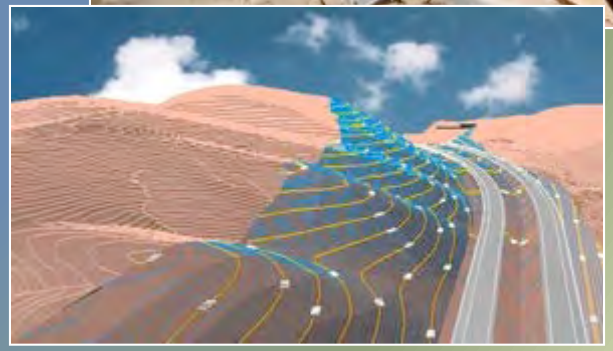
Stepped Slopes



Soil Prep / Earthworks

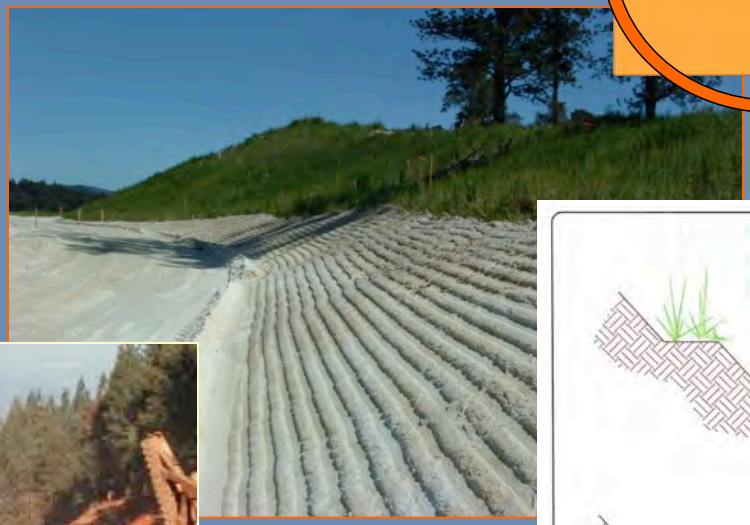
- Stepped Slopes *HDM 304.5
- Topsoil **SSP 20-170
- Duff ** SSP 20-005
- Compost Incorporate **SSP 20-056
- Surface Roughening
- Grooved or Serrated Slopes
- Contour grading and slope rounding, *HDM 303.4)
- See Caltrans Landscape Architecture Erosion Control Tool Box

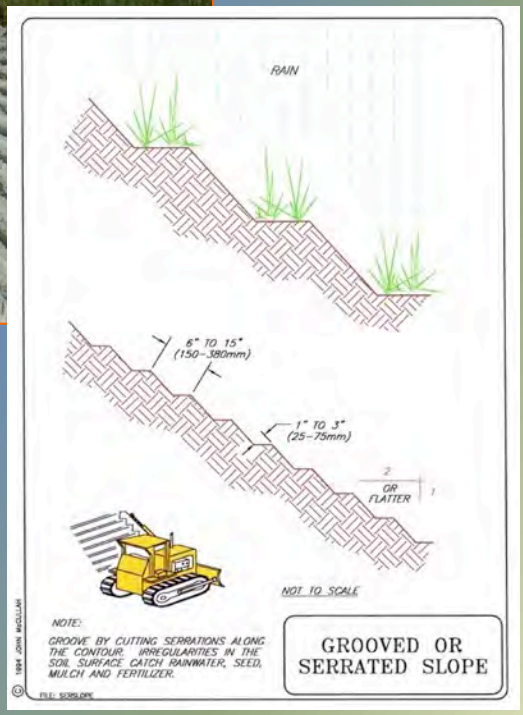




* Highway Design Manual, ** Caltrans Standard Special Provisions,

Grooved or Serrated Slopes

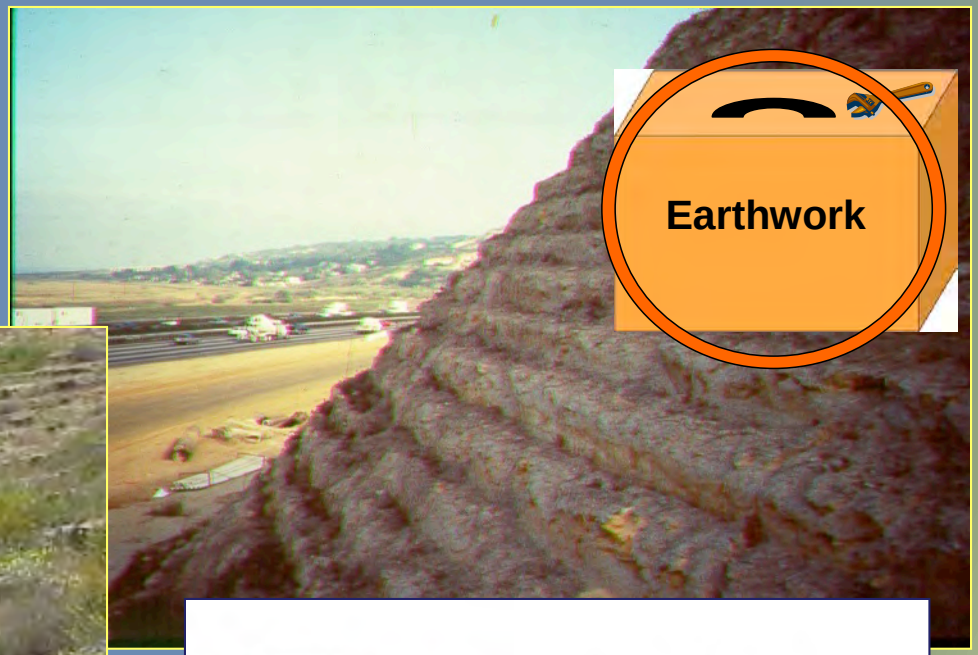


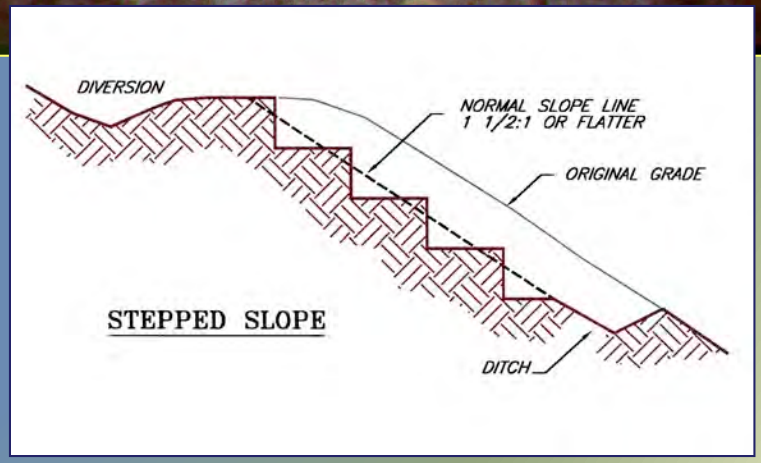


Stepped or Terraced Slopes HDM 304.5

Adding steps to a slope can reduce erosion while providing a stable substrate for vegetation establishment

Stepped or Terraced Slopes HDM 304.5





Field Trials

- CT conducted many onsite trials

Temporary Soil Stabilization Criteria Matrix

CLASS	TYPE	Antecedent Moisture	Availability	Ease of Clean-Up	EC Effectiveness (%)	Degradability	Length of Drying Time (hrs)	Time to Effectiveness	Longevity	Mode of Application	Residual Impact	Native	Runoff Effect
Straw Mulch	Wheat Straw	D	S	H	90-95	B	0	1	M	L/M	M		+
	Rice Straw	D	S	H	90-95	B	0	1	M	L/M	M		+
Wood Fiber Mulch	Wood Fiber	D	S	H	50-60	B	0-4	1	M	H	L		+
Recycled Paper Mulch	Cellulose Fiber	D	S	H	50-60	B	0-4	1	S	H	L		+
Bonded Fiber Matrix	Biodegradable	D	S	H	90-95	B	12-18	1	M	H	M		+
Biodegradable	Jute Mesh	D	S	H	65-70	B		1	M	L	M		+
	Curled Wood Fiber	D	S	H	85-90	P/B		1	M	L	M		+
	Straw	D	S	H	85-90	P/B		1	M	L	M		+
	Wood Fiber	D	S	H	85-90	P/B		1	M	L	M		+
	Coconut Fiber	D	S	H	90-95	P/B		1	L	L	M		+
	Coconut Fiber Mesh	D	S	H	85-90	B		1	L	L	M		+
	Straw Coconut Fiber	D	S	H	90-95	P/B		1	L	L	M		+
Non-Biodegradable	Plastic Netting	D	M	H	<50	P		1	L	L	H		+
	Plastic Mesh	D	M	H	75-80	P		1	L	L	H		+
	Synthetic Fiber with Netting	D	M	H	90-95	P		1	L	L	H		+
	Bonded Synthetic Fibers	D	M	H	90-95	P		1	L	L	H		+
	Combination with Biodegradable	D	M	H	85-90	P		1	L	L	H		+
High-Density	Ornamentals		S-M	H	50-60			28	M-L	H	L-M	N/E	+
	Turf species		S	H	50-60			28	L	H	M-H	N/E	+
	Bunch grasses		S-M	H	50-60			28	L	H	L-M	N	+

Based Binders

= not applicable for category, class or type

UNK = unknown

M Moderate potential to impact water quality

H Higher potential to impact water quality

Source: *Guidance Document – Soil Stabilization for Temporary Slopes*, URS Greiner Woodward Clyde, November 1999.

See handout

- Installed cost (refer to updated cost at end of training material)
- Erosion control effectiveness - level of control (%) over bare soil
- BEEs, Caltrans Best Engineers Est.

EROSION AND SEDIMENT CONTROL BMPs
INSTALLED COSTS AND EFFECTIVENESS

BMP	Unit Cost Installed	Estimated Relative Erosion/ Sediment Control Effectiveness
Sediment Control		
Silt Fence	$1.50 – 2.00 per lineal foot	UNK
Fiber Rolls	$1.50 – 2.00 per lineal foot	58%
Erosion Control		
Fertilizer	$450 – 550 per acre	N/A
Seeding	$870 – 2,170 per acre	50%
Stolonizing	$2,200 per acre + cost of stolons	90%
Hydraulic Mulching	$900 – 1,200 per acre	50 – 60%
Compost Application	$900 – 1,200 per acre	40 – 50%
Straw Mulching	$1,800 – 2,100 per acre	90 – 95%
Soil Binders		
Plant Material-Based (Short-Term)	$700 – 900 per acre	80 – 85%
Plant Material-Based (Long-Term)	$1,200 – 1,500 per acre	60 – 65%
Polymeric Emulsion Blends	$700 – 1,500 per acre	30 – 70%
Petroleum Resin-Based	$1,200 – 1,500 per acre	25 – 20%
Cementitious Binder-Based	$800 – 1,200 per acre	80 – 85%
Bonded Fiber Matrices	$5,000 – 6,500 per acre	90 – 95%
Rolled Erosion Control Products		
Biodegradable		
Jute	$6,000 – 7,000 per acre	65 – 70%
Curled Wood Fiber	$8,000 – 10,500 per acre	85 – 90%
Straw	$8,000 – 10,500 per acre	85 – 90%
Wood Fiber	$8,000 – 10,500 per acre	85 – 90%
Coconut Fiber	$13,000 – 14,000 per acre	90 – 95%
Coconut Fiber Net	$30,000 – 33,000 per acre	85 – 90%
Straw Coconut	$10,000 – 12,000 per acre	90 – 95%
Non-Biodegradable		
Plastic Netting	$2,000 – 2,200 per acre	< 50%
Plastic Mesh	$3,000 – 3,500 per acre	75 – 80%
Synthetic Fiber w/Netting	$34,000 – 40,000 per acre	90 – 95%
Bonded Synthetic Fibers	$45,000 – 55,000 per acre	90 – 95%
Combination Synthetic and Biodegradable Fibers	$30,000 – 36,000 per acre	85 – 90%

Source: Erosion Control Pilot Study Report, URS Greiner Woodward Clyde, June 2000, Table 4-1

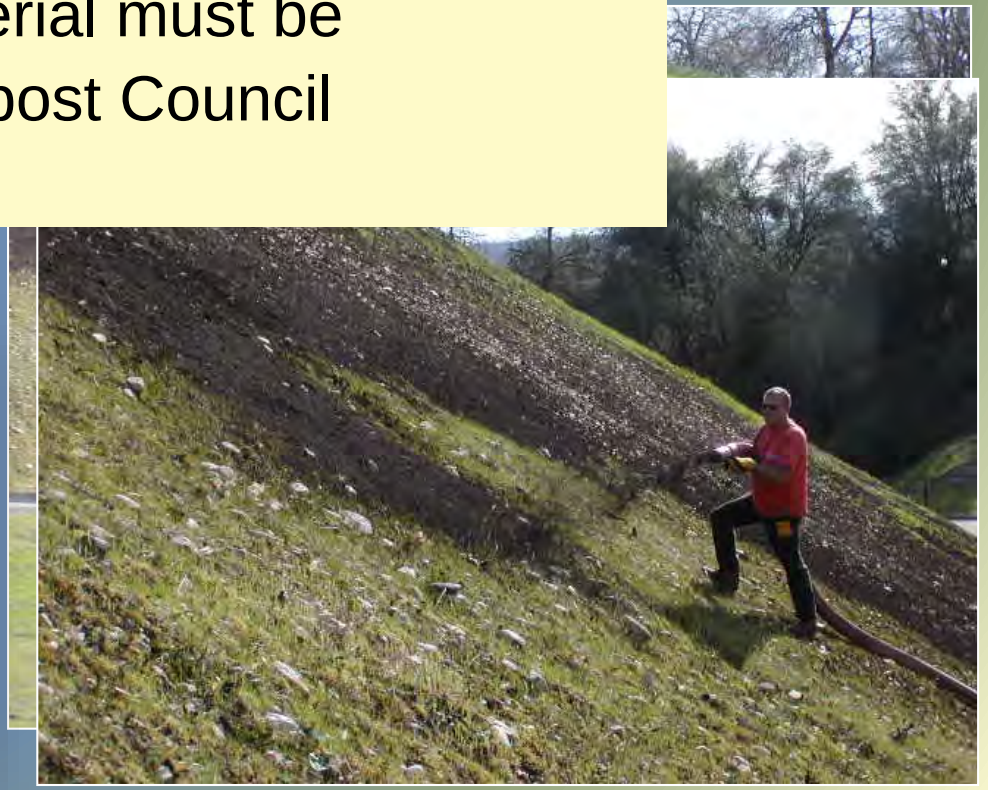
Developed SSPs (standard special provisions)

The process of applying

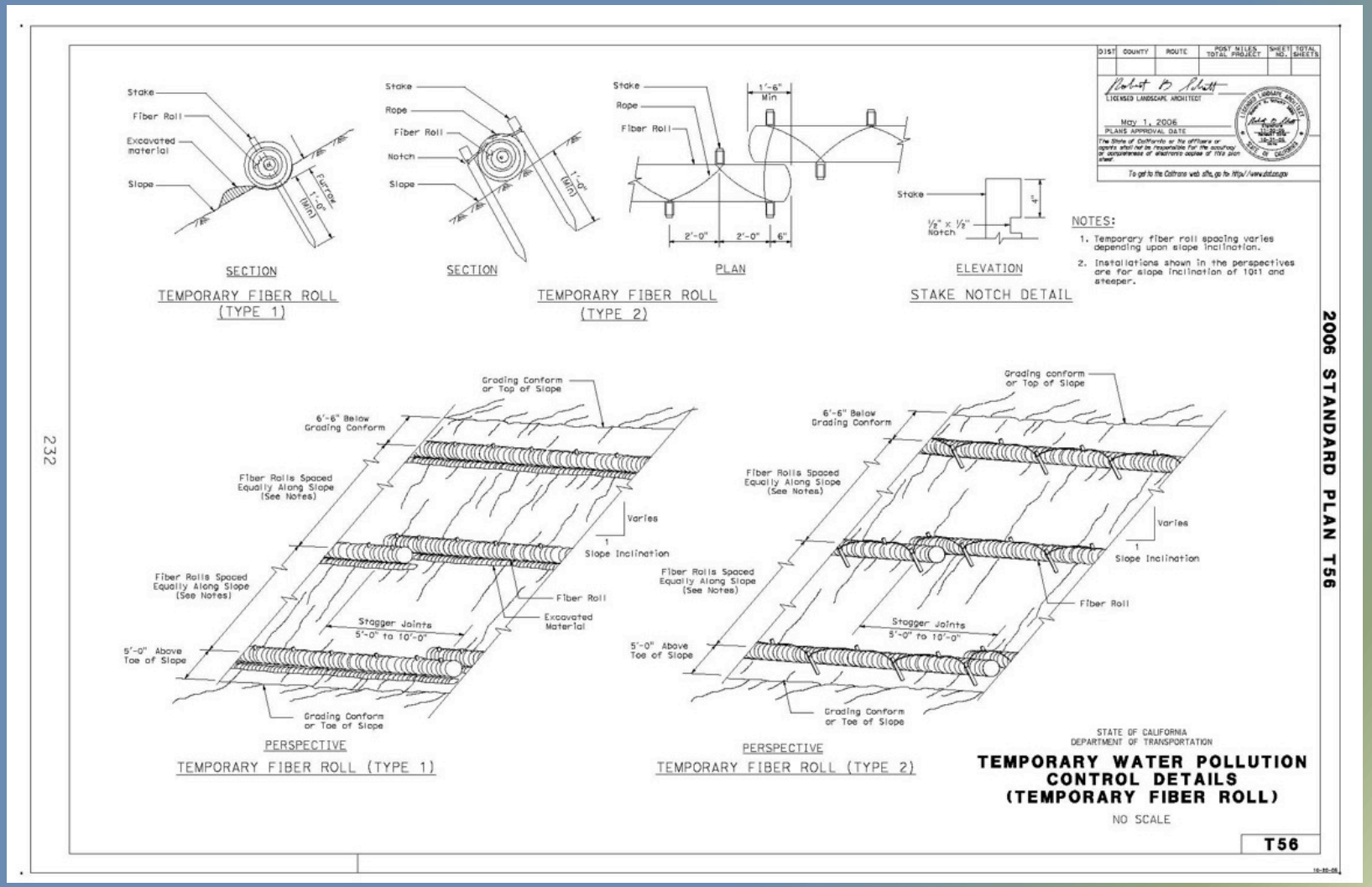
Note : Wood mulch, composted sewage is not actually Compost. To be called compost, a special OM-state that does all the things outlined during

the rest of the day, the material must be "composted". See US Compost Council specifications.

water

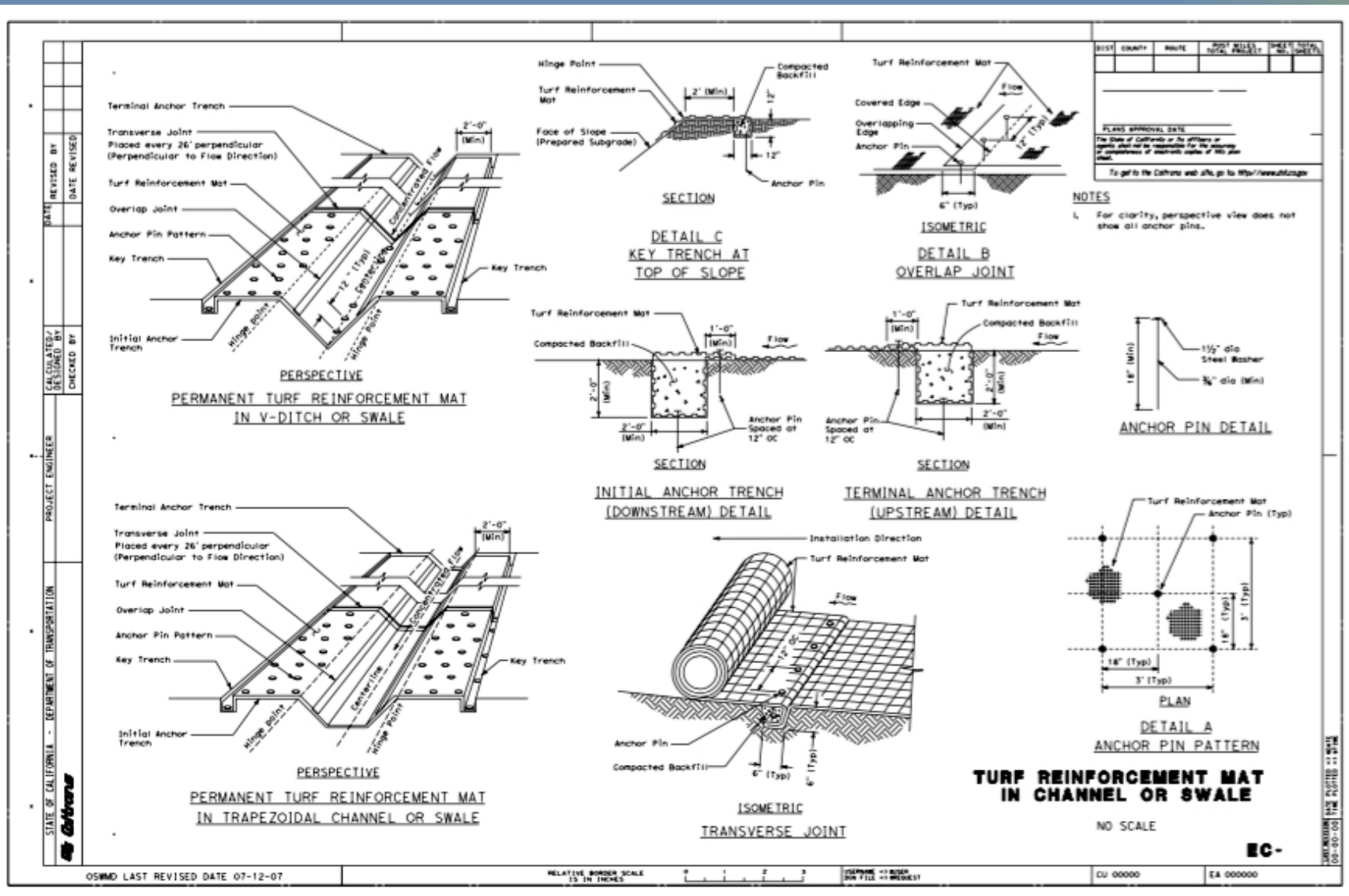


CalTrans - Standard Plan sheets



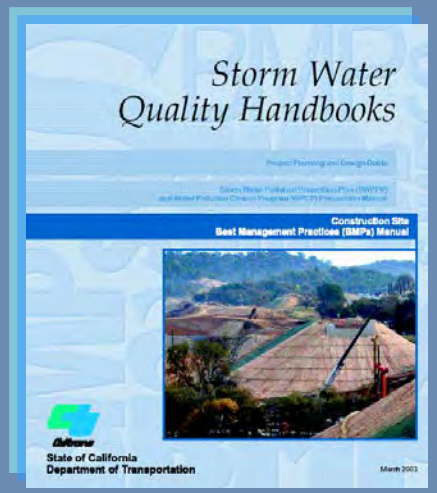
http://www.dot.ca.gov/hq/construc/stormwater/details.htm

Caltrans TRM Detail Sheet



CalTrans – Course Handbooks

- Caltrans Storm Water Quality Handbooks and Manuals
  - Construction Site BMPs Manual (Reference Only)
  - Guidance for Temporary Soil Stabilization
    - Get Manuals online at http://www.dot.ca.gov/hq/construc/stormwater/manuals.htm or hard copies are available from Caltrans Publications



Caltrans Construction Stormwater Pollution Prevention Training

Construction Site BMPs and Field Applications

Module 2

As of 2010 in CA the BMPs have to be effective, why?

- Education required
- Responsibility is designated
- Inspections are required …so
- Fines go to Landowner or DOT
- DOT more likely to make things like Trackwalking a "pay item"
- Annual reports
- NO notice of Termination until site shows 70%....

Over 400 FEC trainings held in 8 years !

Highway RE and Inspectors MUST know everything about BMPs before approving payment

Laguna Highway, SoCal

Los Angeles

San Bernadino

- Inspectors MUST approve installations, i.e, intimate soil contact ?

New Technology – "Skimmer Outlet"

Redding

- Calibration for Inspectors
  what does 2000#/ac look like? 3500#/ac ?

Inspired development of Shasta College Erosion Control Training Facility

- Erosion Control Class
- Watershed Restoration
- Heavy Equipment Operations

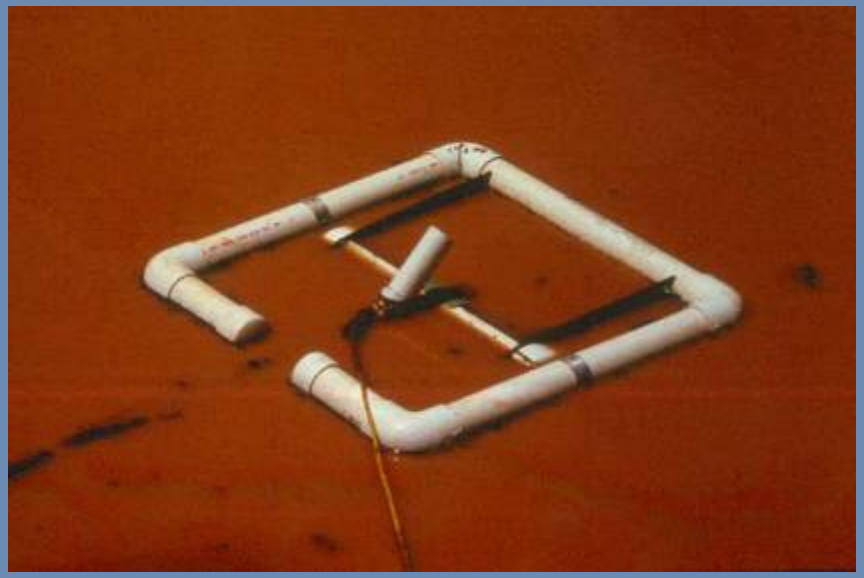
Mt. McCullah

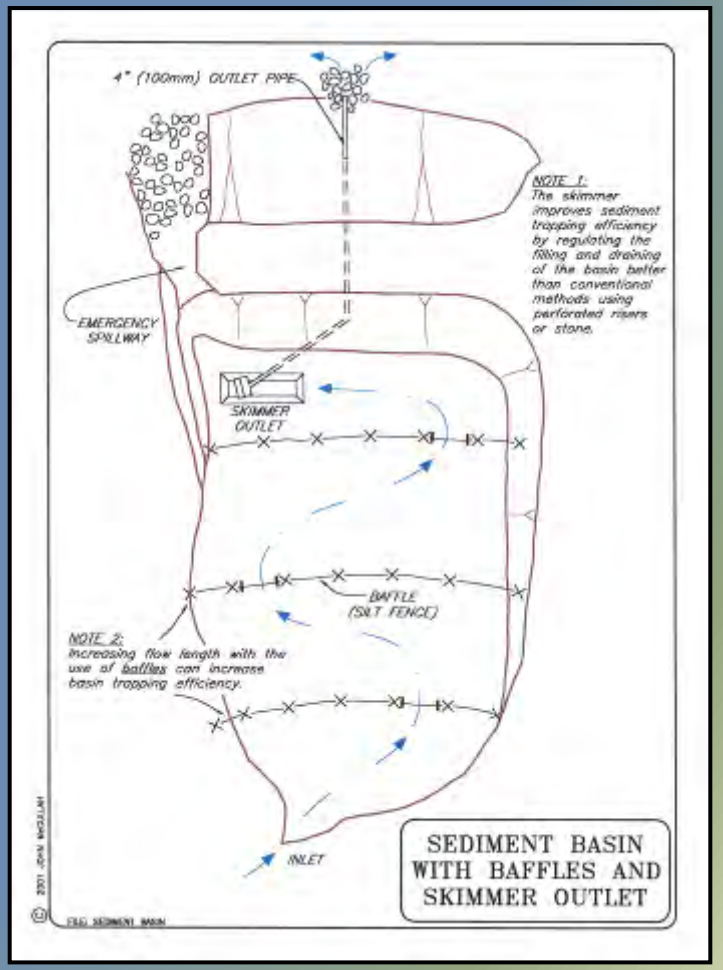
The SC Hydromulch Study is available on WYD file downloads


Shasta College
Erosion Control Training Facility

- The Worlds Longest Fiber Roll
- 176' long

Trying out newest technology Baffles and Skimmer Outlet






NOV 11 2005

Compost Trials

Field Study – Will 2" compost "stifle" grass establishment? NO

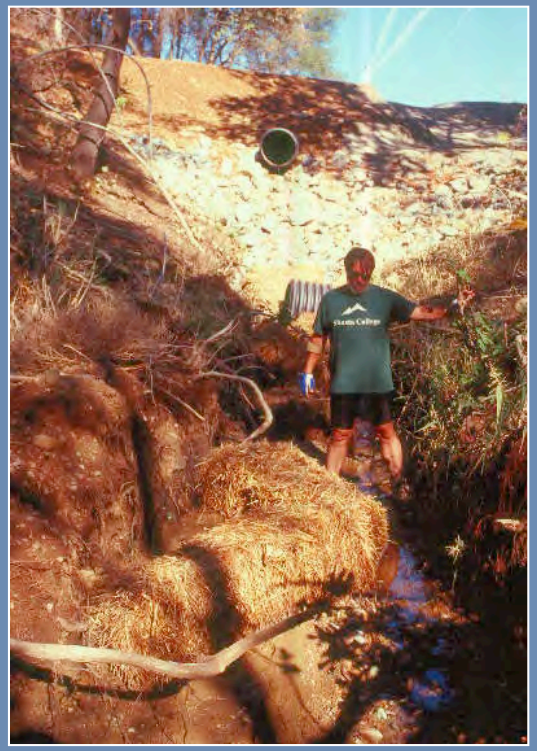
Italian Rye

Ca Native grass (on top and under)

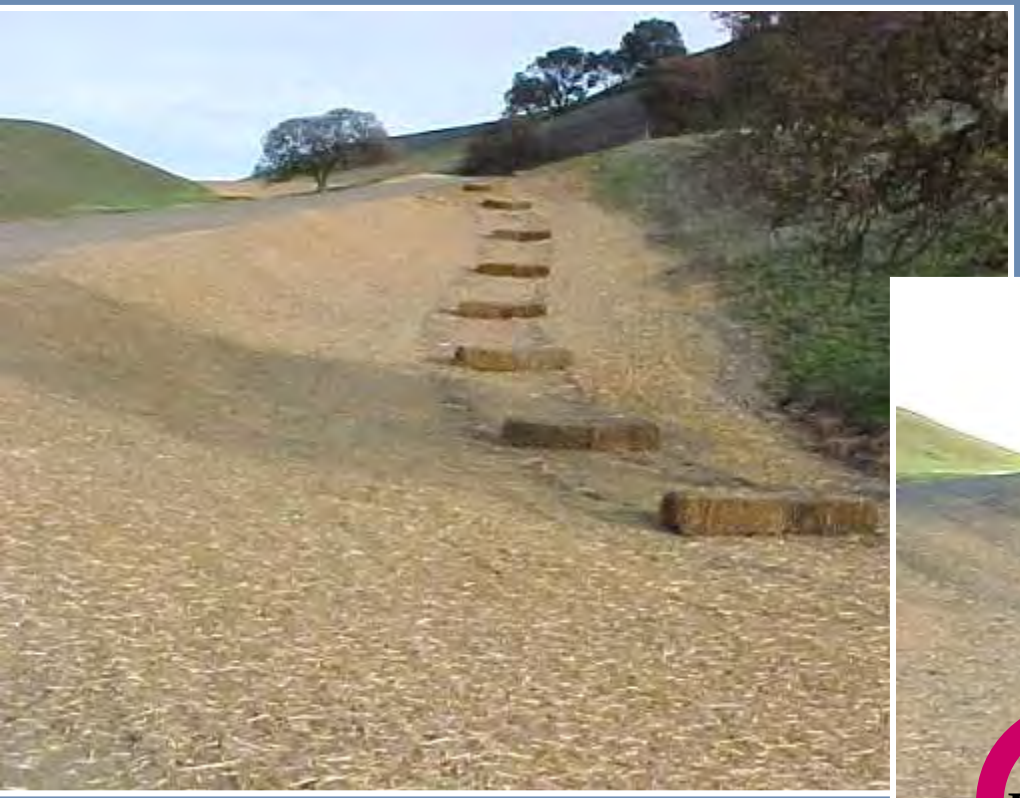
Test shows that 2" thick compost WILL allow grasses to grow

Special Topics In Erosion

- ~~Jr. Raindrop~~
- ~~The Caltrans Experience~~
- Continuity Equation and Check dams
- Myth Busting
- Filter Fabrics - Do they "filter"
- Perimeter Controls



Straw Bale Check Dam ?



Is this a good BMP as bales will slow and filter runoff, eh?

- ✓ Velocity reducer?
- ✓ Straw Bale "erosion increaser"

Straw Bale Ditch Check ?

- Is this a good BMP?
- Continuity Equation predicts what will happen

Continuity Equation (Q =A x V)

Flow Quantity = Area x Velocity

Area = depth x width

The continuity equation, Q=A x V, predicts that if, for example, straw bales were placed in a drainage way, the velocity would likely increase. This increase in erosive energy will result in accelerated channel erosion.

Question A Check dam in a drainageway is an effective sediment control BMP …

- Answer
  - NO
  - It is very ineffective to try and trap sediment in a concentrated flow channel.
  - However, a low-profile ditch check, made from permeable materials (rock, gravel bags, enviroberm, etc) or a "roughened channel" can reduce velocity and local scour.
  - Ditch Checks will be covered later in Runoff BMPs

Q: What is the estimated erosion rate and sediment production for two acres of DSA? High erosion soil, rills visible

A: Probably 50T /ac = 100T

Q: How many T got caught by these ditch checks?

A: 4-6T = 5% effective as Sediment Control

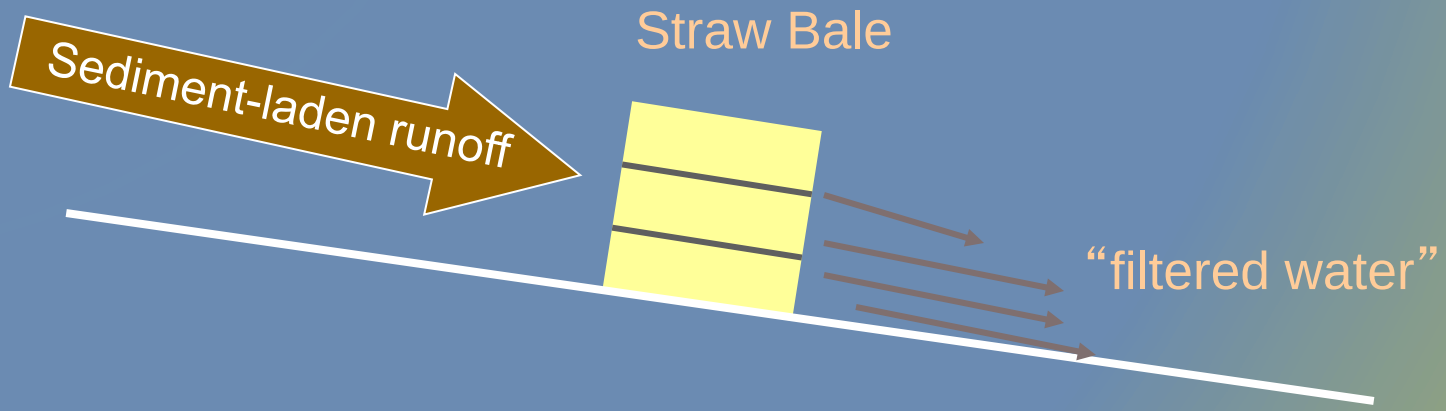
Don't let the Solution become the Pollution

Special Topics In Erosion

- ~~Jr. Raindrop~~
- ~~The Caltrans Experience~~
- ~~Continuity Equation and Check dams~~
- Myth Busting
- Filter Fabrics - Do they "filter"
- Perimeter Controls

Myth 2 – BMPs can filter sediment

- This "filtering" concept has caused more difficulty than anything else



This kind of drawing was prevalent in early Erosion and Sediment Control Manuals

Filtering Concept Myth

- Magical Thinking – "Straw will absorb sediment, suck it up like absorbent pads"!

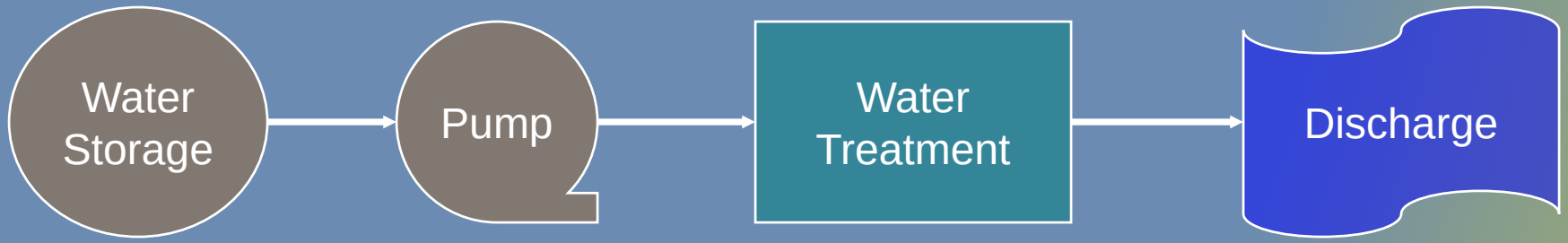
Filtering Concept Myth

- Another example of the "Straw Bale Sediment SUCTION" principle
- And the "Its better than nothing" paradigm

KEY POINT – Nothing Filters but Filters

- Filter Fabric doesnt "filter"
- Geotextiles and Silt Fence are not immune to the misconception and subsequent problems resulting from this myth.
- In fact, most of the problems associated with silt fences can be attributed to this idea that they filter sediment.
- "If water flows right through, why do we need to fuss with all the anchors and trenches?"

Dewatering or Filtering



Most common BMPs do not filter

Dewatering and Filtering

- Can require combinations of
  - Settling
  - Media filters
  - Cartridge filters
  - Chemicals, flocculants
  - testing

Active Treatment Systems

ATS won't work at > 600 NTU

- Can produce flow-thru filtration if designed properly AND turbidity not too high

Filtering Concept Myth.

Material Requirements

- Silt fence shall be woven

Flow rates through the fences under field conditions were two orders of magnitude less than would be calculated using standard ASTM index characteristics of the fabrics. This discrepancy resulted from clogging of the fabric with sediment and from the turbulent flow through the fabric openings at the hydraulic heads on the fabrics when used as silt fences. .

For a geotextile, the volumetric flow rate of water per unit cross-section area, per unit head, under laminar flow conditions, in the normal direction through a material (ASTM D-4491).CalTrans Specs

- Runoff will not flow through the geotextile

- ✓ SO …The silt fence must be designed for runoff to flow over when full


✓Where is the 20-100 ga/min/ft2 ?

..”the problems associated with silt fences can be attributed to this idea that they filter sediment.”

Curb Inlet Barriers

Silt Fence CAN be effective

Size the pond allow drainage from 1/3 ac only
Design the Pond embankment as a Catenary curve (smile)

Cover material stockpiles daily

Comments or Questions?