RUSLE2 Advanced Topics

August 18, 2011

Agenda

- Introductions
- Webinar logistics:
  phones, how to submit questions, how Q&A will run, etc
- RUSLE2 Advanced Topics
- Q&A with Caltrans Panel

Introductions

Presenter: Jeff Bold

Q&A: Robert Schott

Lisa Worthington

Agenda

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- RUSLE2 Advanced Topics
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Communication during webinar

- Your phone is automatically muted.
- Please submit your questions electronically in the Q&A window on your screen.
- Questions will be addressed at the end of the presentation.

Agenda

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Where to go for more information?

http://www.dot.ca.gov/hq/oppd/stormwtr/index.htm

This site contains:

- Updated Caltrans RUSLE2 program (2011 version)
- A recording of this presentation
- A copy of the Q&A Session

Additional information is available
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Course objectives

- Today's presentation has 4 parts:

1) Why learn and use RUSLE2?
2) A quick review of RUSLE2
3) Using RUSLE2 to evaluate landform grading options
4) Using RUSLE2 to compare erosion control options

Part 1) Why learn and use RUSLE2?

1) RUSLE2 is a predictive tool that quantitatively ***estimates*** soil erosion and sediment transport

2) The value of RUSLE2 to designers is the insight gained through comparing variable soil erosion factors

3) Designers can compare alternative slope designs with realistic soil types, climate, and slope geometry

4) Landscape Architects can ***compare the relative performance*** of BMPs under site-specific conditions

Cause of soil erosion

	Property	Soil Erosion Rate	USLE Factor
↑	• Soil Organic Matter (OM)	↓	K
↑	• Silt Content	↑	K
↑	• Infiltration Rate	↓	K
↑	• Slope Length <u>or</u> Slope %	↑	LS
↑	• Surface Roughness	↓	P
↑	• Vegetative Cover	↓	C
↑	• Rainfall Intensity	↑	R
↑	• Rock, Concrete or Gravel	↓	C
↑	• Control of Surface Water Drainage	↓	-

Part 2) A quick review of RUSLE2

- Today's presentation will cover:

1) Why use RUSLE2?
2) A quick review of the USLE and RUSLE2
3) Using RUSLE2 to evaluate landform grading options
4) Using RUSLE2 to compare erosion control options

2) . . . a quick review of RUSLE2

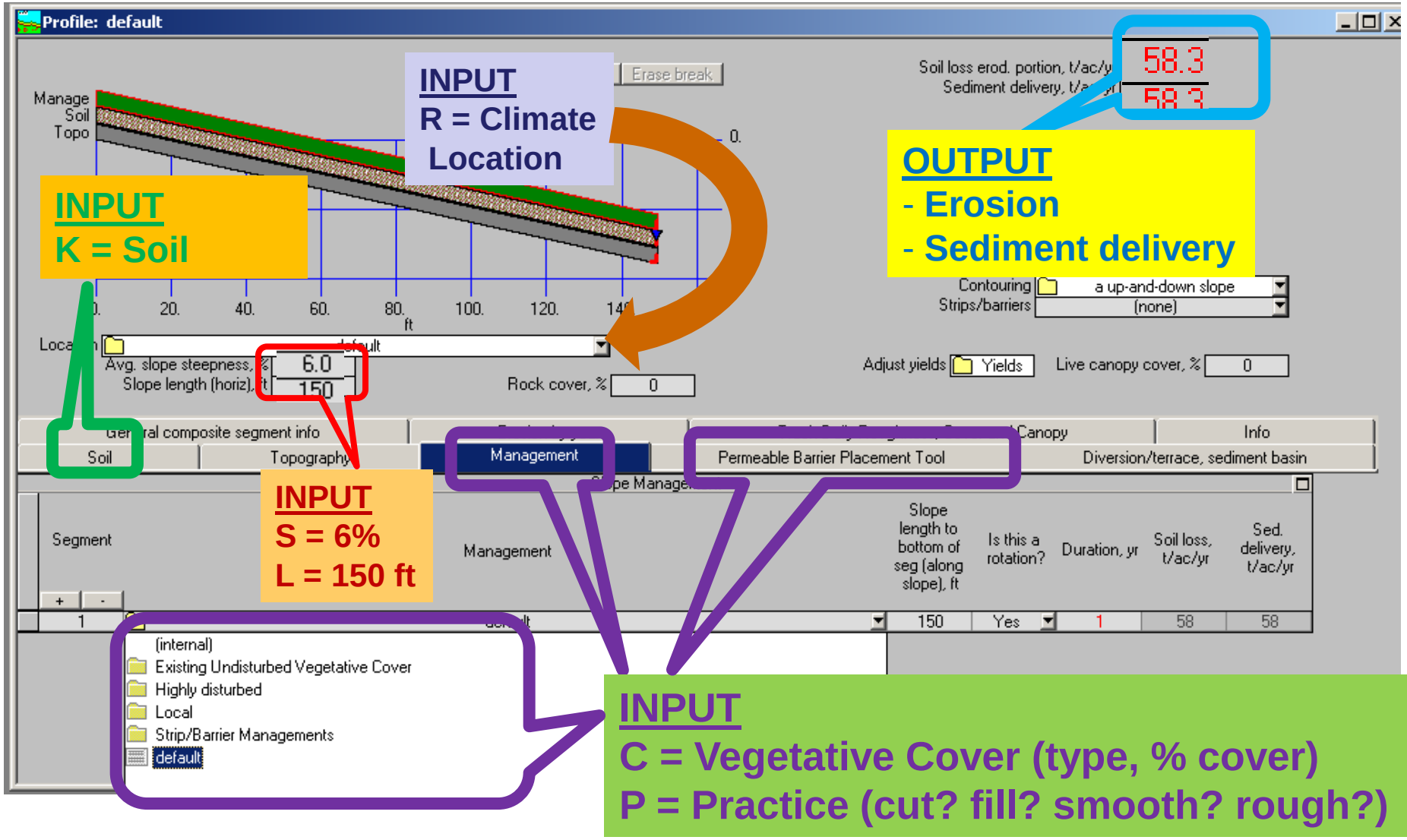
RUSLE2 is based on

Universal Soil Loss Equation (USLE)

$$A = R \bullet K \bullet L \bullet S \bullet C \bullet P$$

A = average soil loss [ton/ac/yr]	
R = rainfall-runoff erosivity	**S** = slope steepness
K = soil erodibility	**C** = cover management
L = slope length	**P** = practice or surface

2) . . . and RUSLE2 basics



Part 3) Landform grading

1) Why use RUSLE2?
2) A quick review of how to operate RUSLE2
3) Using RUSLE2 to evaluate landform grading options
4) Using RUSLE2 to compare erosion control options

3) Enter project specific inputs

Truckee Bypass - construction phase cut slope:

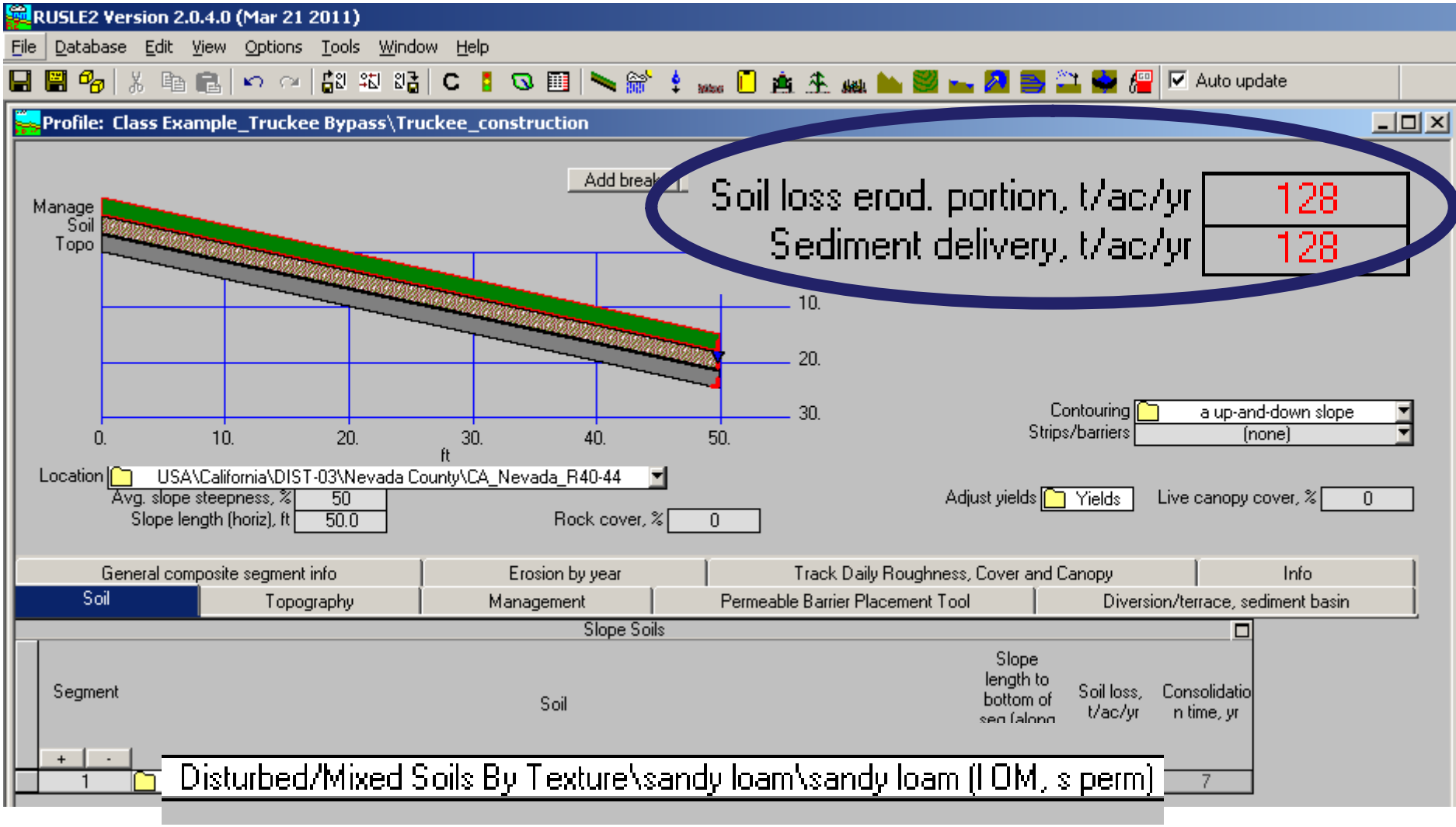
Inputs

- **Climate (R)** – District 3, Nevada County, R_40-44
- **Soil (K)** – Disturbed/Mixed Soils By Texture\sandy loam (Low OM%, slow permeability)
- **Slope Steepness % (S)** – 50%
- **Slope Length (L)** – 50 feet
- **Cover (C), Practices (P)** [combined in the Management tab] – Cut slope (bare soil, no cover), track walked

Output – Soil loss erod. portion, t/ac/yr **128**

Sediment delivery, t/ac/yr **128**

3) Truckee Bypass – construction phase



3) Exercise 1 – construct a natural slope

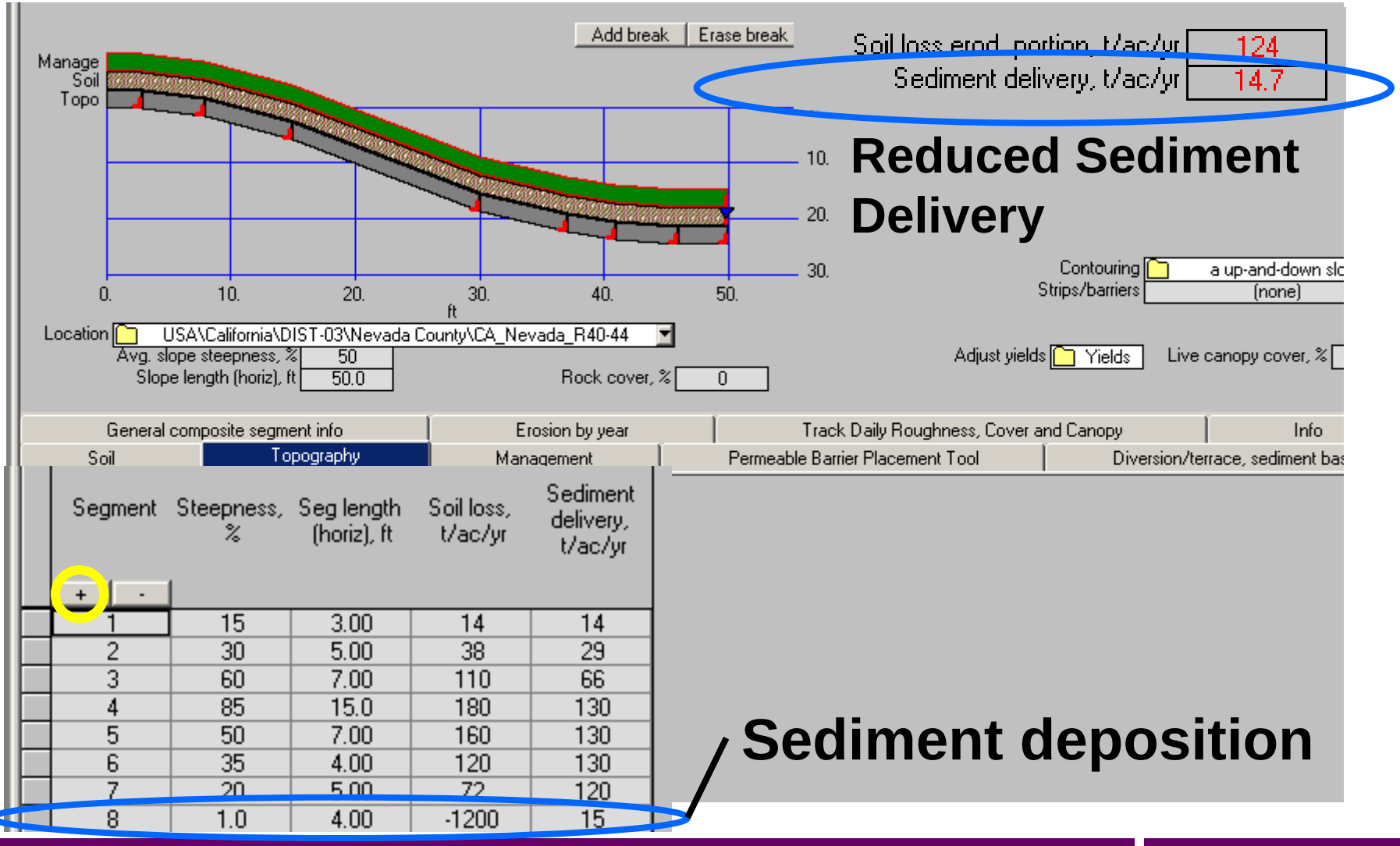
Start by selecting the “Topography” tab

Steps:

1) Add breaks in the Topo layer to subdivide the slope into sections

2) Change slope % in each section for rounding

3) Exercise 1 – construct a natural slope

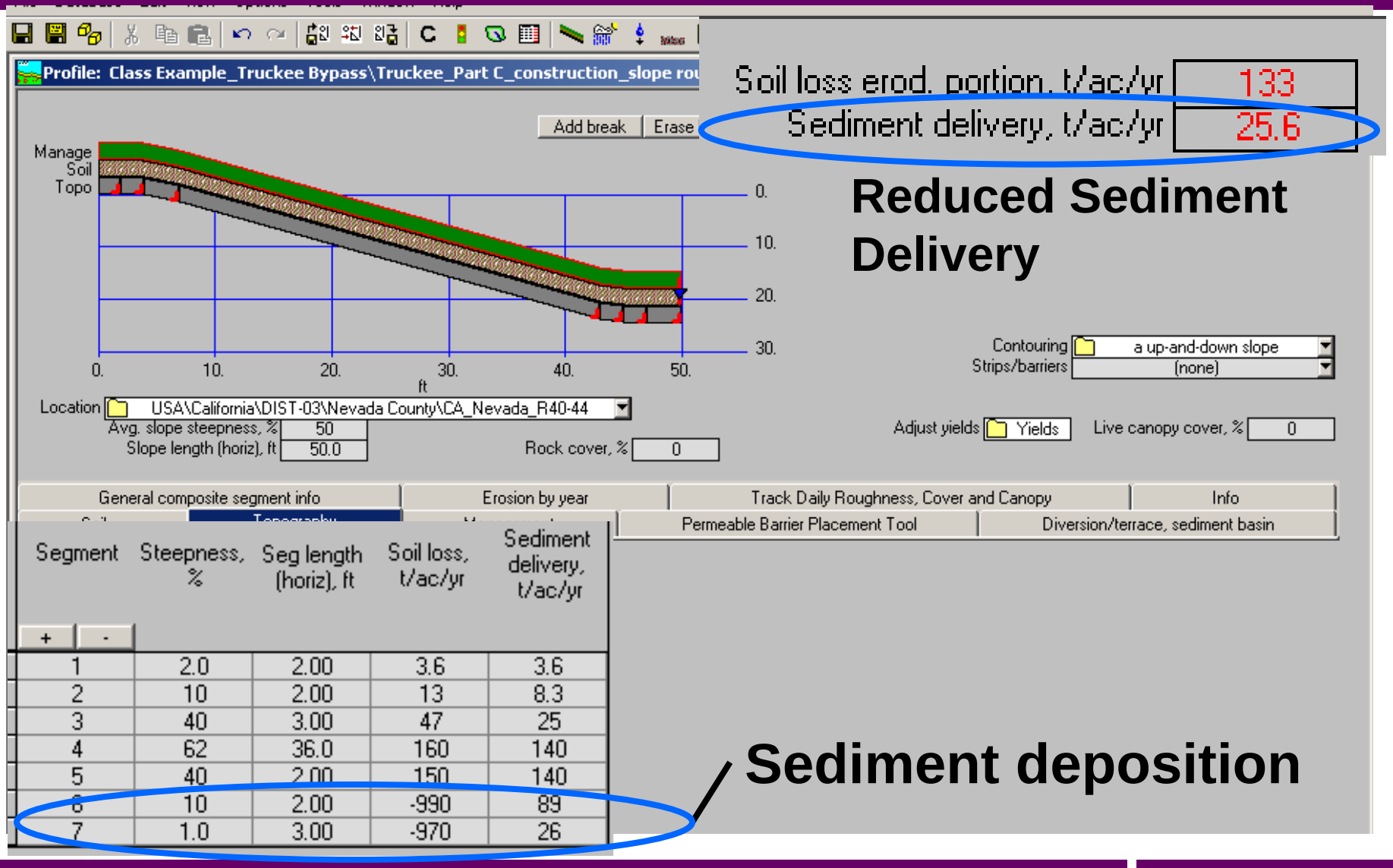


3) Exercise 2 – slope rounding

Objective of slope rounding:

Reduce sediment transport from constructed slopes

3) Exercise 2 – slope rounding



Reduced Sediment Delivery

Segment	Steepness, %	Seg length (horiz), ft	Soil loss, t/ac/yr	Sediment delivery, t/ac/yr
1	2.0	2.00	3.6	3.6
2	10	2.00	13	8.3
3	40	3.00	47	25
4	62	36.0	160	140
5	40	2.00	150	140
6	10	2.00	-990	89
7	1.0	3.00	-970	26

Sediment deposition

3) Exercise 3 – benches

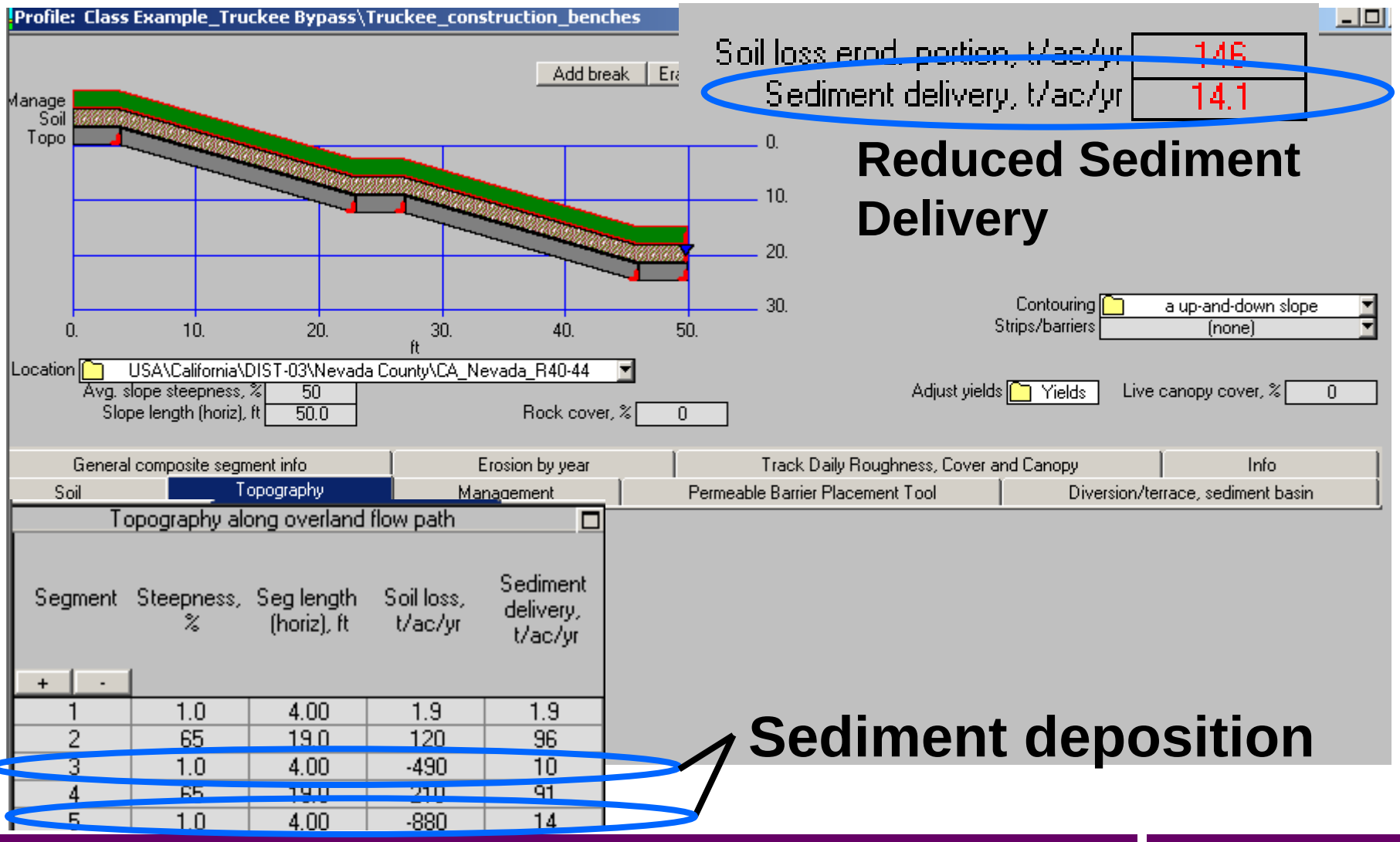
Horizontal benches every 10 meters (vertical) on a slope:

1) Required under the Unified Building Code Grading Provisions. CA Building Code, Appendix J, 2007
2) Reduces sediment transport from constructed slopes
3) Reduces risk of a landslide or slope failure
4) Is easily modeled with RUSLE2

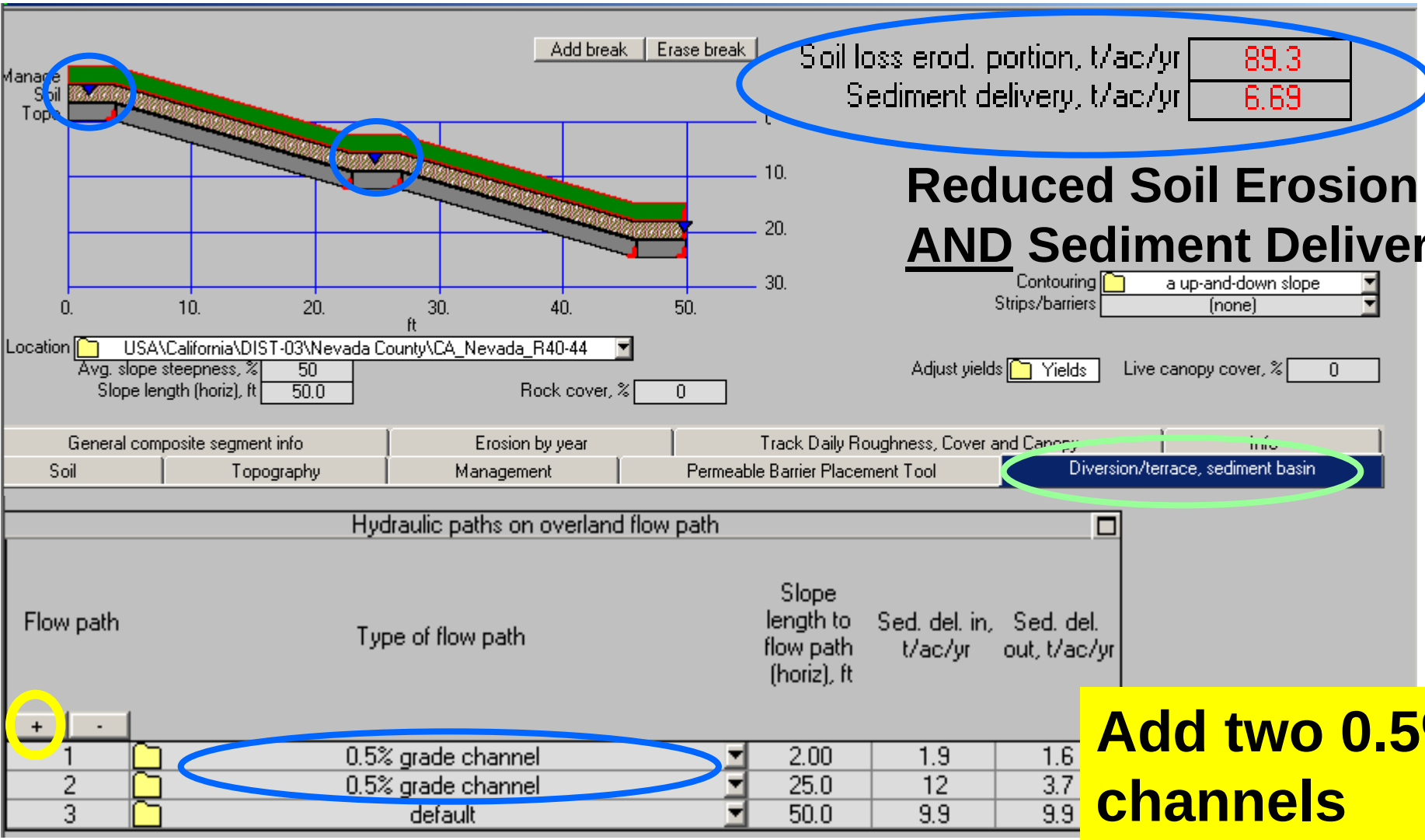
3) Exercise 3 - benches

- Note benched slope with surface drainage

3) Exercise 3 – benches



3) Exercise 3 – benches with drainage



Reduced Soil Erosion AND Sediment Delivery

Add two 0.5% channels

3) Compare erosion/sediment transport

Slope Design	Soil Erosion Rate (T/ac/yr)	Sediment Delivery (T/ac/yr)
Simple flat slope	128	128
Natural slope	124	15
Slope rounding	133	26
Benching	146	14
Benching with drainage	89	7

3) RUSLE2 as a slope design tool for landform grading

1. **The Topography tool is simple intuitive and flexible**
2. **Natural slopes have less predicted sediment delivery than simple flat constructed slopes**
3. **Slope rounding and terracing reduces sediment delivery at the toe of the slope**
4. **Managing surface water drainage also significantly reduces soil and sediment loss**

Part 4) Comparing EC options

- Today's presentation will cover:

1) Why use RUSLE2?
2) A quick review of how to operate RUSLE2
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4) Comparing EC options

- Most students have comments similar to this one:

RUSLE2 will not allow us to select multiple EC treatments . . . . for example, I want to combine:

Treatment A - hydroseeding

Treatment B - compost blanket

Treatment C - coir netting

Treatment D - incorporating compost

4) Comparing EC options

The 2011 RUSLE2 **does** allow the designer to compare individual EC options **if**:

1. **The user is familiar with RUSLE2 program options**
2. **User understands R, K, L, S, C, P factors**
3. **A systematic approach is used to compare BMPs**
4. **Creativity is used**

Treatment A - Hydroseed

Treatment A - hydroseeding;

Treatment B - compost blanket

Treatment C - coir netting

Treatment D - incorporating compost

Lets start by using our bare slope and apply Hydroseeding from the **Management** tab

Truckee Bypass – construction, bare slope

RUSLE2 Version 2.0.4.0 (Mar 21 2011)

File Database Edit View Options Tools Window Help

Auto update

Profile: Class Example_Truckee Bypass\Truckee_construction

Add break

Soil loss erod. portion, t/ac/yr 128

Sediment delivery, t/ac/yr 128

Manage
Soil
Topo

0. 10. 20. 30. 40. 50. ft

10. 20. 30.

Contouring a up-and-down slope

Strips/barriers (none)

Location USA\California\DIST-03\Nevada County\CA_Nevada_R40-44

Avg. slope steepness, % 50

Slope length (horiz), ft 50.0

Rock cover, % 0

Adjust yields Yields

Live canopy cover, % 0

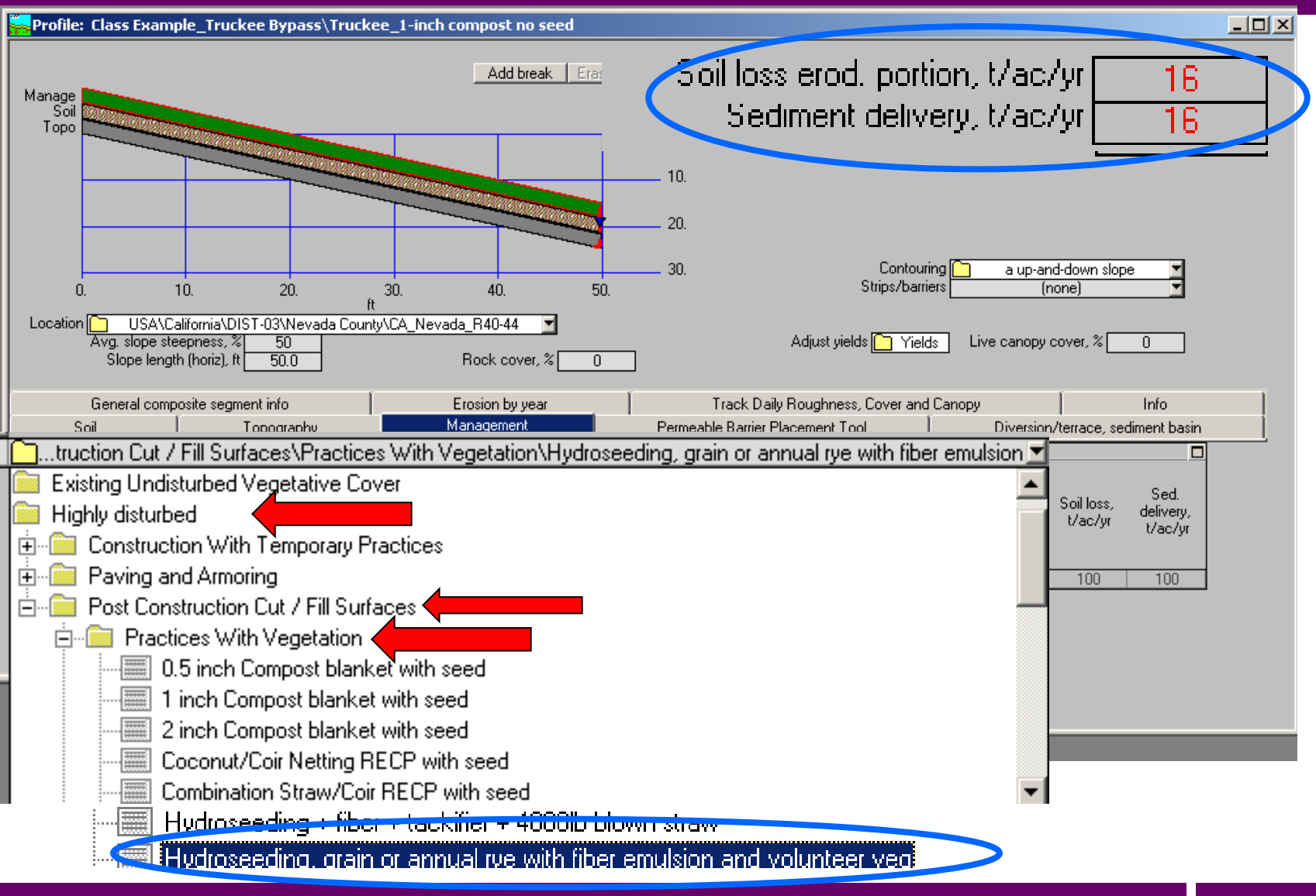
General composite segment info | Erosion by year | Track Daily Roughness, Cover and Canopy | Info

Soil | Topography | Management | Permeable Barrier Placement Tool | Diversion/terrace, sediment basin

Slope Soils

Segment	Soil	Slope length to bottom of seg (along slope), ft	Soil loss, t/ac/yr	Consolidation time, yr
1	Disturbed/Mixed Soils By Texture\sandy loam\sandy loam (l OM, s perm)	56	130	7

Treatment A - Hydroseed



Treatment B – Compost blanket

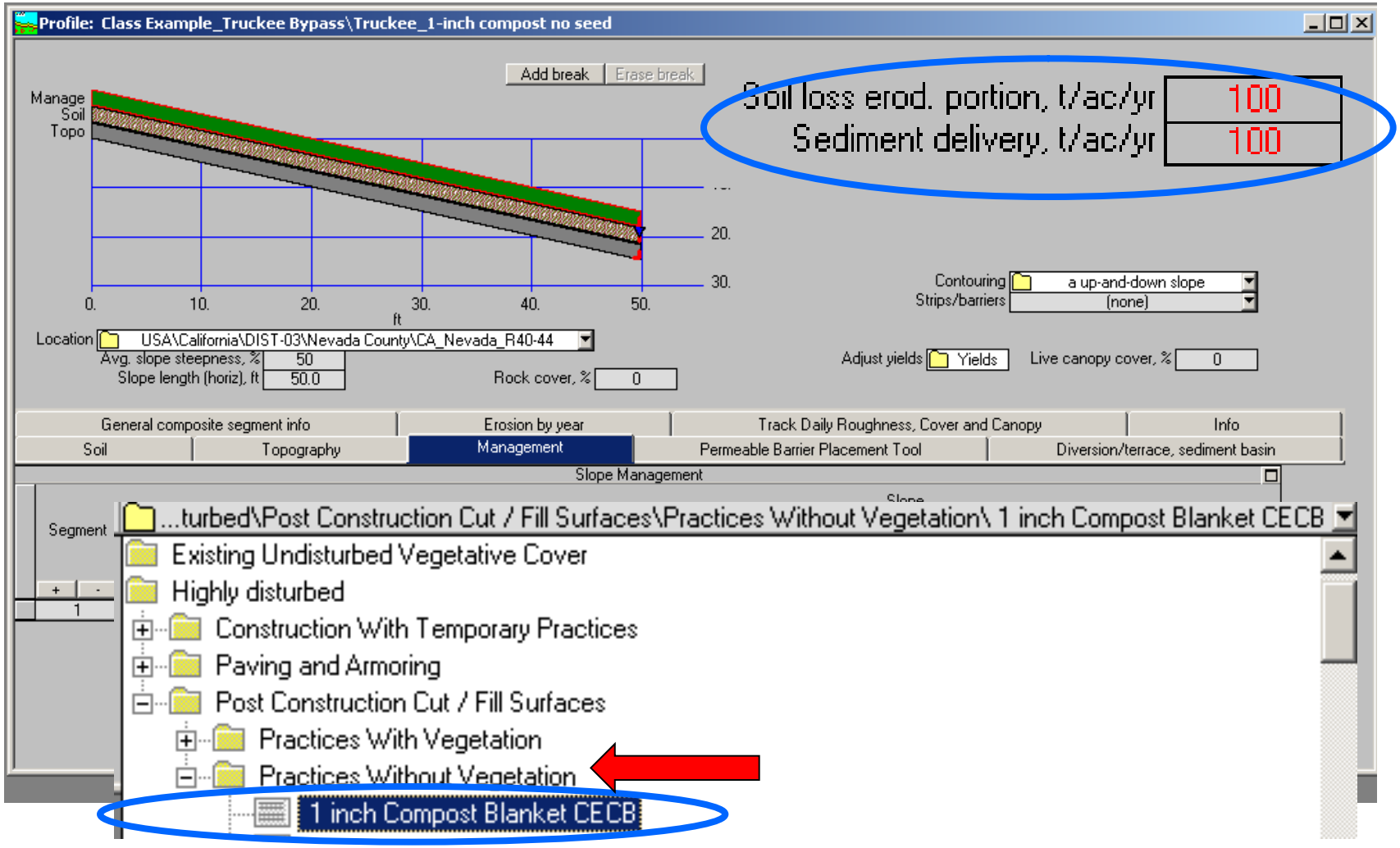
Treatment A - hydroseeding

Treatment B - compost blanket

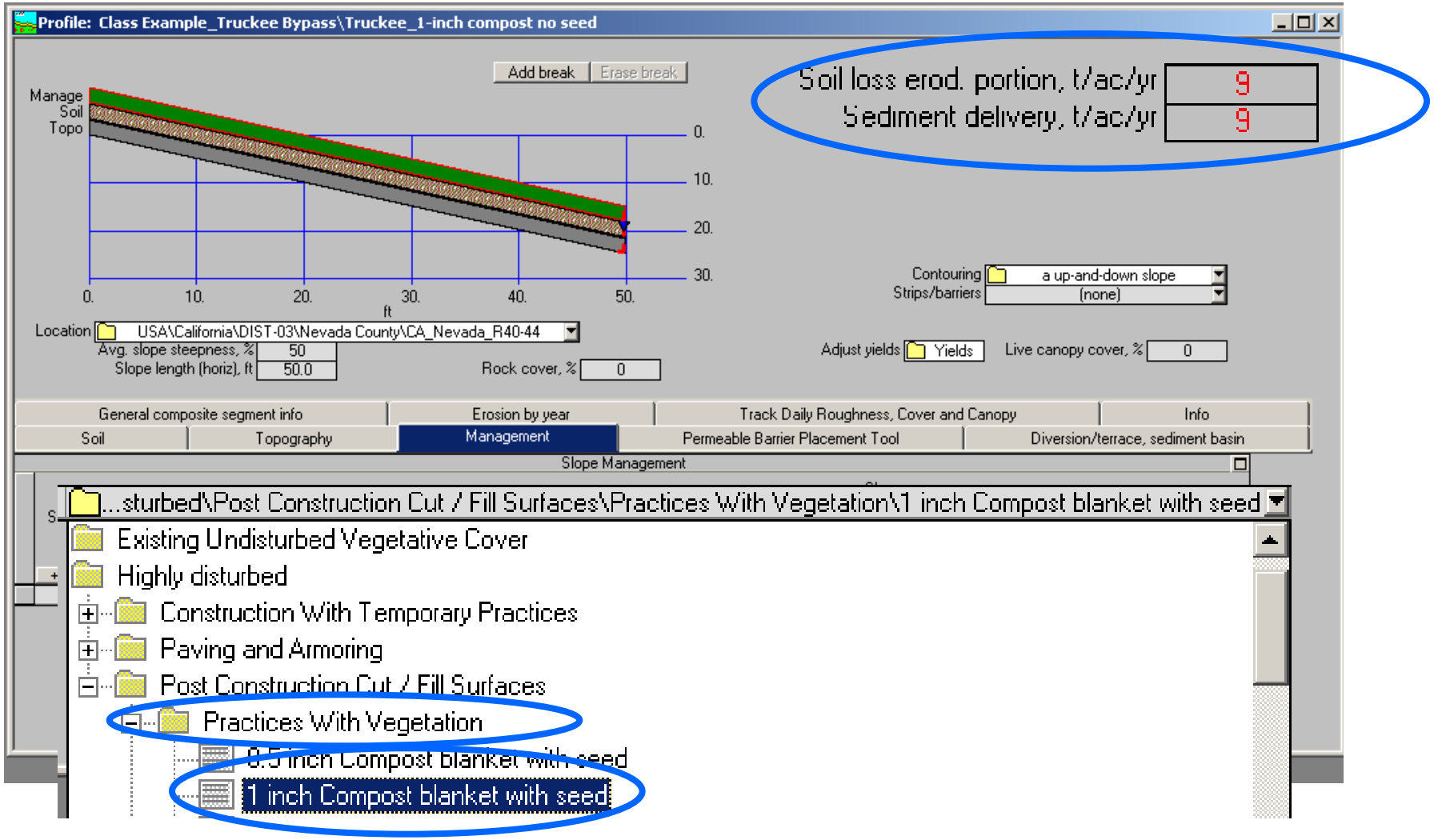
Treatment C - coir netting

Treatment D - incorporating compost

B. Compost blanket



A+B - Compost blanket + seed



Treatment C – Coir netting

- Now let's compare netting under the same conditions:

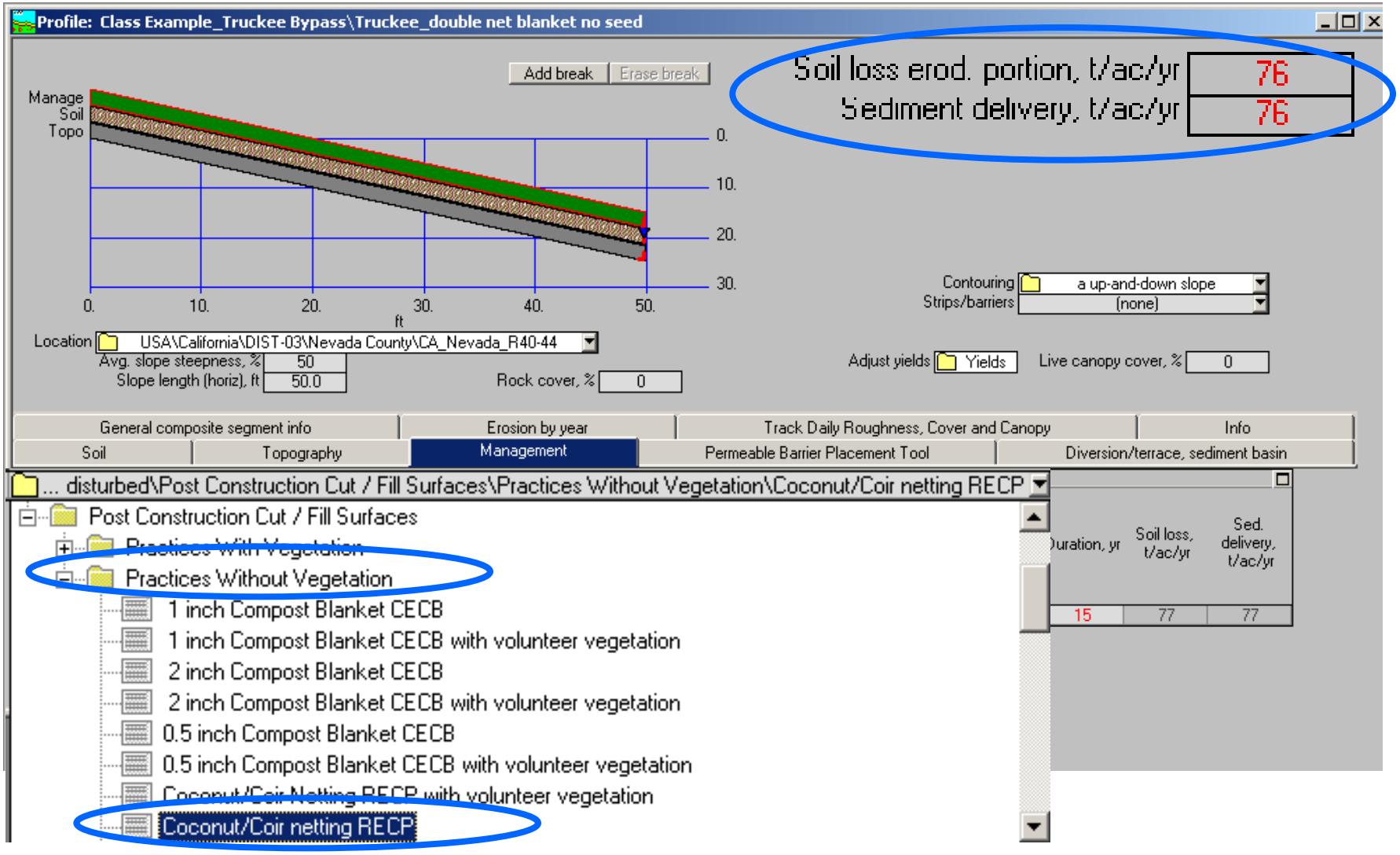
Treatment A - hydroseeding

Treatment B - compost blanket

Treatment C - coir netting

Treatment D - incorporating compost

C. Coir netting



A+C – Coir netting + seed

Profile: Class Example_Truckee Bypass\Truckee_double net blanket with seed

Add break | Erase break

Soil loss erod. portion, t/ac/yr 14
Sediment delivery, t/ac/yr 14

Manage
Soil
Topo

0. 10. 20. 30. 40. 50. ft

30.

Soil loss erod. portion, t/ac/yr 14
Sediment delivery, t/ac/yr 14

Contouring: a up-and-down slope
Strips/barriers: (none)

Location: USA\California\DIST-03\Nevada County\CA_Nevada_R40-44
Avg. slope steepness, % 50
Slope length (horiz), ft 50.0
Rock cover, % 0

Adjust yields: Yields
Live canopy cover, % 0

General composite segment info | Erosion by year | Track Daily Roughness, Cover and Canopy | Info
Soil | Topography | Management | Permeable Barrier Placement Tool | Diversion/terrace, sediment basin

- Existing Undisturbed Vegetative Cover
- Highly disturbed
  - Construction With Temporary Practices
  - Paving and Armoring
  - Post Construction Cut / Fill Surfaces
    - Practices With Vegetation
      - 0.5 inch Compost blanket with seed
      - 1 inch Compost blanket with seed
      - 2 inch Compost blanket with seed
      - Coconut/Coir Netting RECP with seed
      - Combination Straw/Coir RECP with seed

	Slope length to bottom of seg (along slope), ft	Is this a rotation?	Duration, yr	Soil loss, t/ac/yr	Sed. delivery, t/ac/yr
ith seed	56	No	15	14	14

Treatment D – Incorporate compost

- Now let's compare compost incorporation under the same conditions:

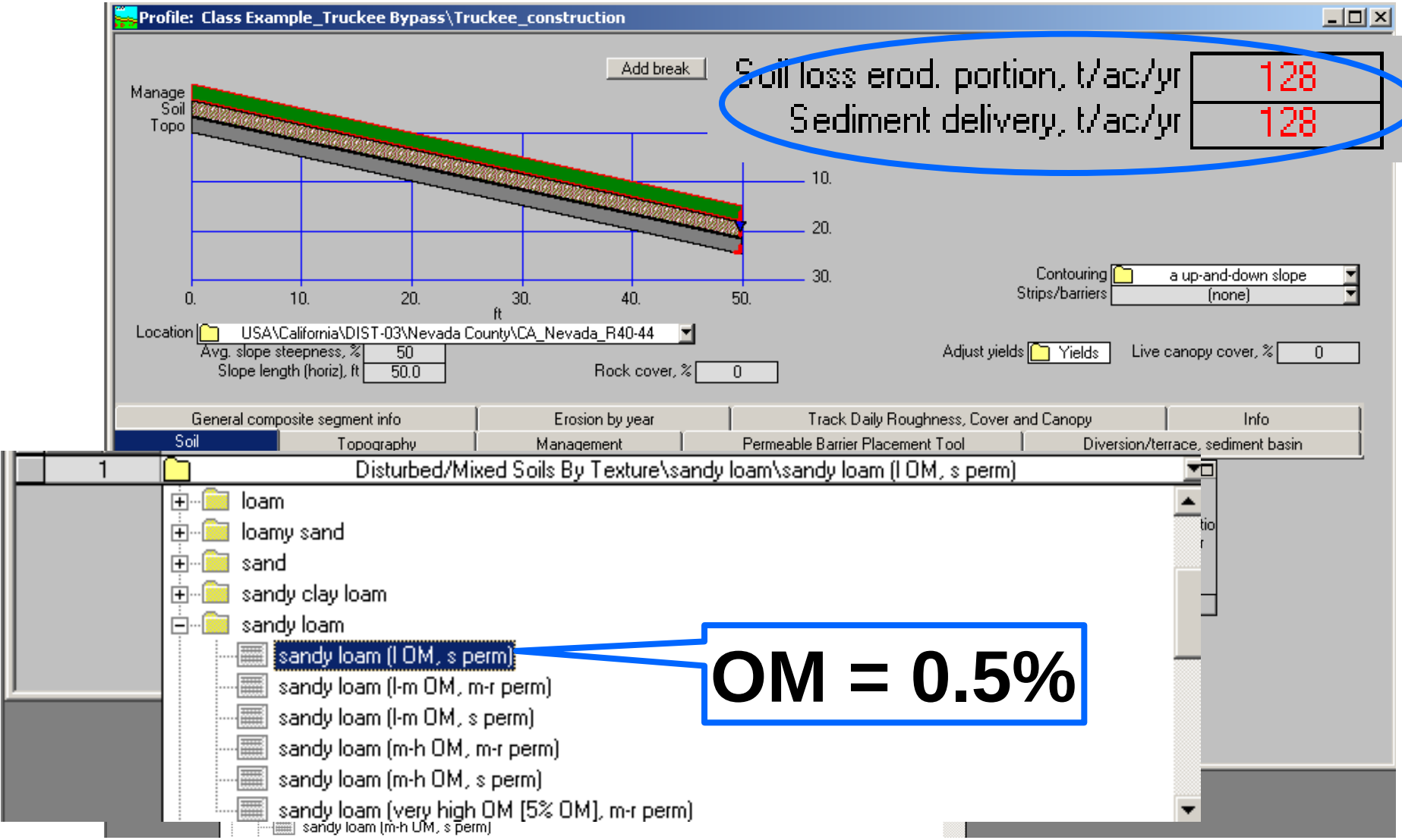
Treatment A - hydroseeding

Treatment B - compost blanket

Treatment C - coir netting

Treatment D - incorporating compost

D. Incorporate compost – Get creative!



How to find soil properties

Profile: Class Example_Truckee Bypass\Truckee_construction

Add break | Erase break

Soil loss erod. portion, t/ac/yr 128
Sediment delivery, t/ac/yr 128

Soil: from mod. RUSLE2 nomograph (How get soil erodibility?[1]) of Disturbed/Mixed Soils By Texture\sand...

Very fine sand (0.05-0.1 mm), % 22
Silt+very fine sand (0.002-0.1 mm), % 47
Sand - v. fine sand (0.1-2 mm), % 42

How get very fine sand? calc from sand amount

Inherent organic matter, % 0.50

Structure Med. or coarse granu

Permeability Slow
Is perm. with coarse fragments present? Yes
Coarse fragment, % 0

Slope length (horiz), ft 50.0

General composite segment info | Erosion h
Soil | Topography | Managemen

Segment

Soil

1 Disturbed/Mixed Soils By Texture\sandy

Soil: Disturbed/Mixed Soils By Texture\sandy loam\sandy loam (l OM, s perm)

Graphic

Rock cover, % 0

How get soil erodibility? from mod. RUSLE2 nomograph
Erodibility, US 0.35

Calc. consolidation from precip? Yes
Nominal consolidation time, yr

Texture Sandy loam
Clay (<0.002 mm), % 10
Silt (0.002-0.05 mm), % 25
Sand (0.05-2 mm), % 65

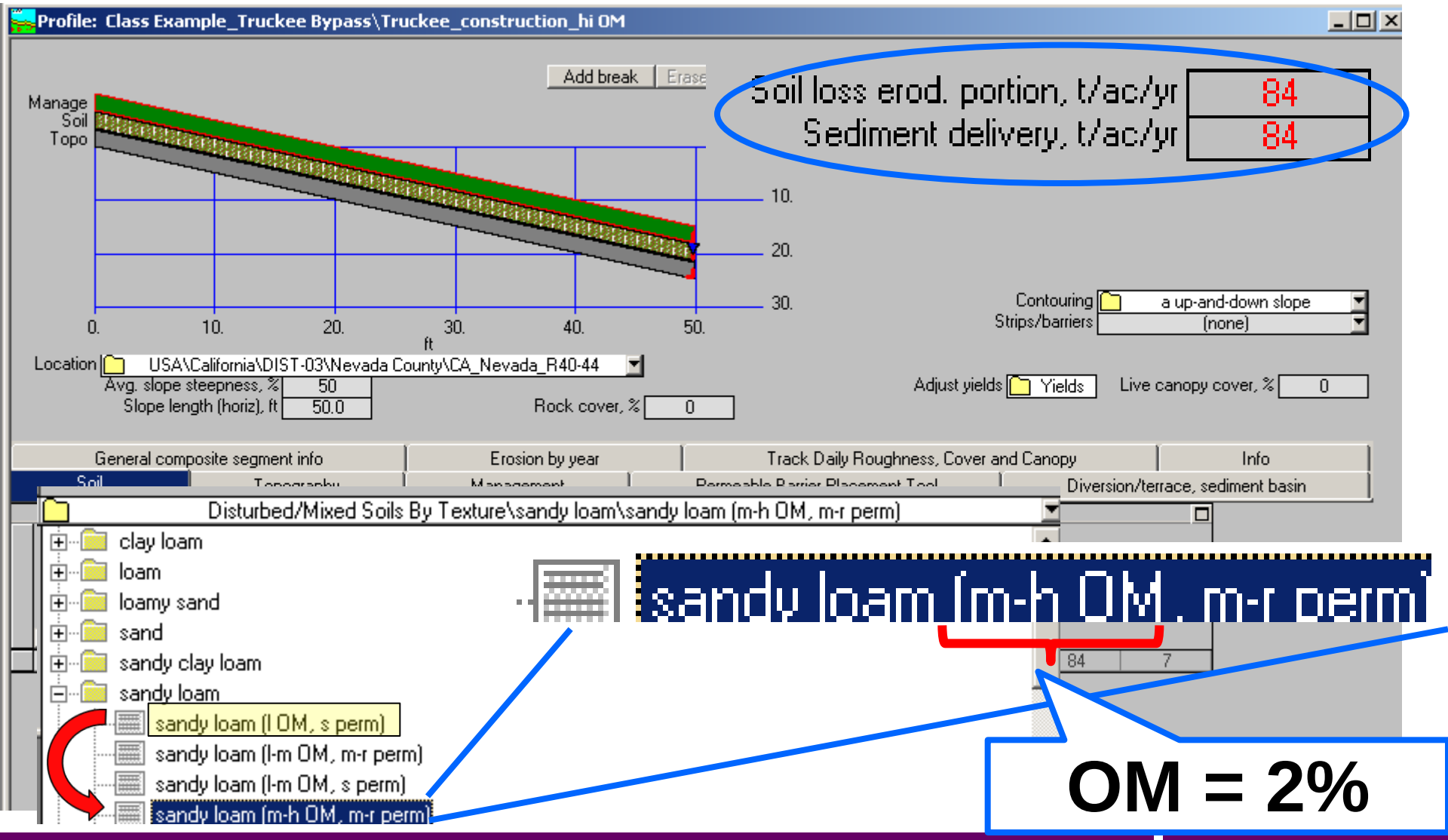
T value, t/ac/yr 3.0

Hydrologic class C - mod. high runoff
Hydrologic class with subsurface drainage C - mod. high runoff

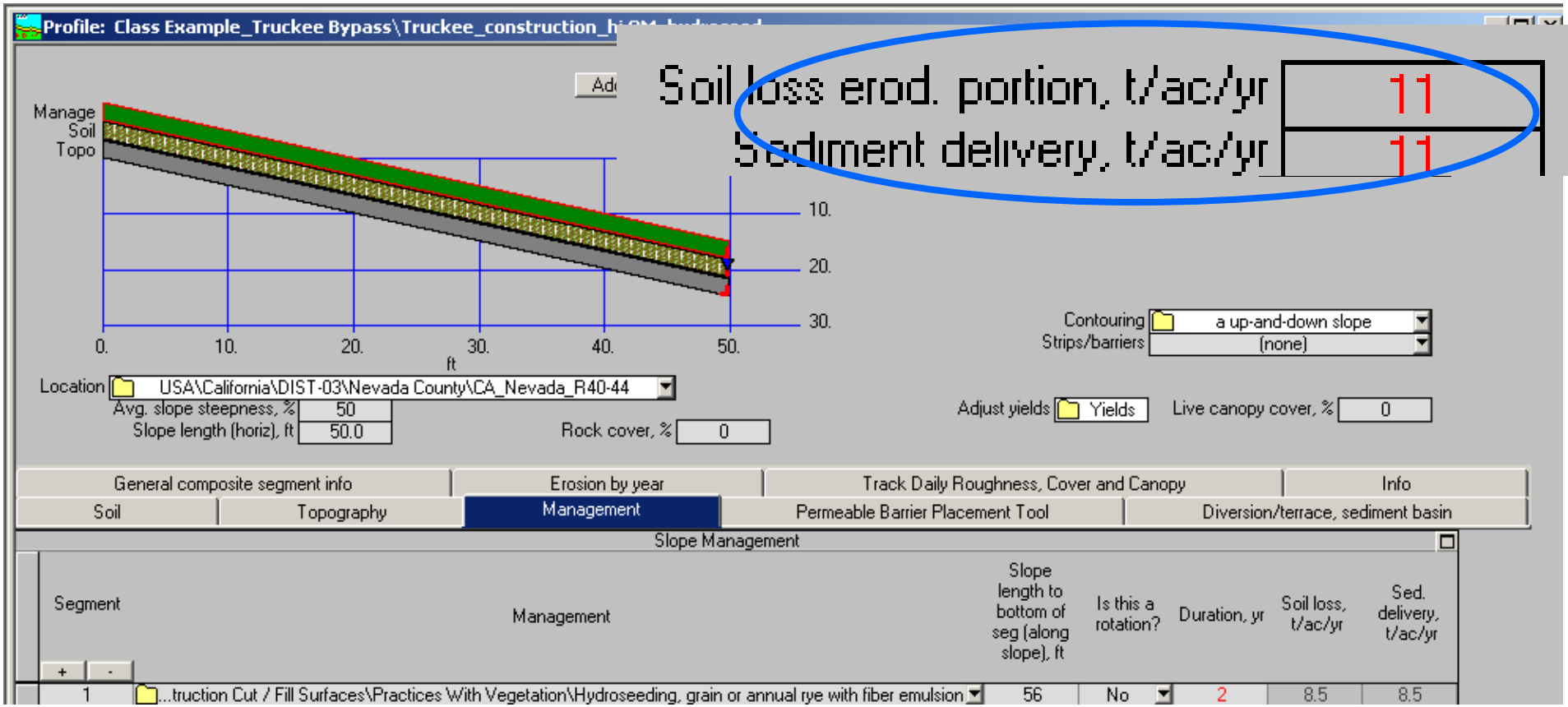
Info | Detached particles

Info
OM-organic matter content in unit plot condition
Structure typical for particular texture
Perm-SOIL PROFILE permeability rating in unit plot condition
MUST ASSIGN HYDROLOGIC SOIL GROUP to soil in site-specific situation to compute effect of subsurface drainage
Soil erodibility factor value computed with RUSLE2 modified soil erodibility nomograph
Use for mixed soils and soils at construction sites, surface mine, landfills, and other similar highly disturbed areas

D. Select similar soil with higher OM%



A+D Increase OM% with hydroseed



Compare EC options

Slope Design	Soil Erosion Rate (t/ac/yr)	Sediment Delivery (t/ac/yr)
Control – bare cut track walked	128	128
A - hydroseeding	16	16
B – 1” compost blanket	100	100
C – coir netting	76	76
D – increased soil OM%	84	84
A+B	9	9
A+C	14	14
A+D	11	11

Summary of EC options

1) Establishing plant cover is the most effective way to reduce erosion
2) Establishing sustainable, adapted or native vegetation takes one or more years
3) Transitional BMPs such as compost blankets, netting, or mulch are recommended until plants become established
4) Mulches and organic materials vary in their decomposition rates in soil
5) Decomposition rates, soil properties, climate characteristics are incorporated in RUSLE2 simulations

Summary

RUSLE2 as a landform grading tool

A flexible, quantitative tool

RUSLE2 to compare, customize EC options

We can use RUSLE2 to simulate many EC options

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Q&A Session

Please submit your questions.

Type in questions using the Q&A box.

Q&A Session

Do you know of a database that you can query for the R factor (10 year, 24 hour rain intensity) using Lat/Long?

Q&A Session

Please explain the relationship, if any, between the RUSLE2 R-value and the erosivity waiver R-factor.

Q&A Session

In future trainings it would be nice to go into greater detail of how to determine the R factor.

If a first time user gets as far as the State, County they well be faced with various R factors. It would be nice if you address how to determine a sites R.

Q&A Session

I had a CD with RUSLE2 software but was unable to download it. Can we download the program from the website?

Q&A Session

What documentation would be appropriate to justify a change in K value?

Are there any theoretical ways to predict the final % of OM?

Q&A Session

Regarding Compost Incorporate. How does the OM at 2% reflect what your actually incorporating?

Not sure the measurements are equivalent. Incorporate 2 inch of compost and OM 2%. The units are not equal (inches and %).

Q&A Session

On a five mile project, how many sections would a designer look at?

How many would you run the RUSLE2 program on?

Q&A Session

So correct me if I am wrong, but it seems to me that vegetation/planting seems to be the best alternative?

Q&A Session

If slope rounding changes parts of the slope to be steeper than 2:1, will this require District Maintenance approval and Geotech involvement and review?