

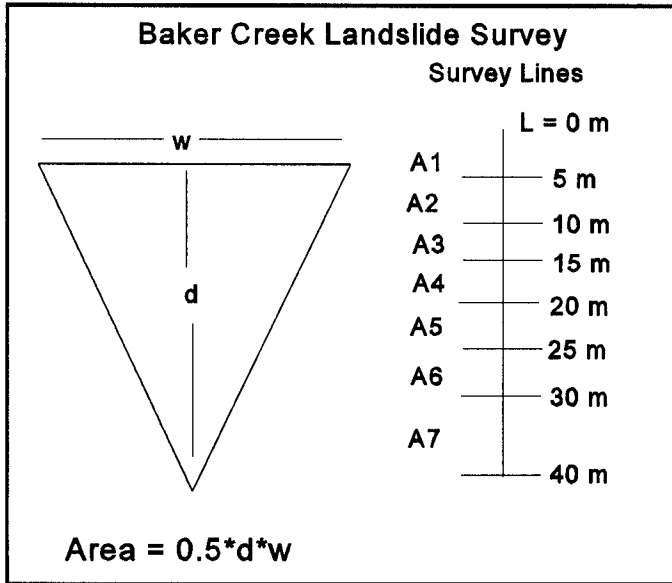
Key

Geomorphology G322

Class Exercise on Landscape Erosion Rates Using the Baker Creek Landslide Geometry Data

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The class measured the geometry of a landslide scar at Baker Creek, near Sulpher Springs. The scar shape is approximated by that of an upside down equilateral triangle. The geometric relations and a sketch map of the field measurements is shown below.



w = scar width (m), d = scar depth (m),  
L = slope length (m)

Baker Creek Landslide Data

Survey Line No.	Scar Width (m)	Scar Depth (m)	Slope Distance (m)	Unit Slope Length (m)	Unit Scar Area (m <sup>2</sup> )	Unit Scar Volume (m <sup>3</sup> )
0	N/D	N/D	0			
1	6.25	2.5	5	L1 = 5	A1 = 7.8	V1 = 39
2	11.5	3.2	10	L2 = 5	A2 = 18.4	V2 = 92
3	15	5.0	15	L3 = 5	A3 = 37.5	V3 = 187.5
4	14	5.3	20	L4 = 5	A4 = 37.1	V4 = 185.5
5	13	3.0	25	L5 = 5	A5 = 19.5	V5 = 97.5
6	13	1.8	30	L6 = 5	A6 = 11.7	V6 = 58.5
7	13	1.8	40	L7 = 10	A7 = 11.7	V7 = 117

Total Scar Volume (m<sup>3</sup>) = 777.0

Fill in the Table; follow the procedures below.

- Step 1. Calculate the unit length for each survey line (e.g. L1 = slope distance1 - slope distance0).
- Step 2. Calculate the unit scar area for each survey line (area of triangle = 0.5\*d\*w)
- Step 3. Calculate the unit scar volume for each survey line (unit L \* unit Area)
- Step 4. Sum the unit area volumes to determine the total landslide volume.

Work through the following problems:

1. Assume that a small Coast Range watershed has a drainage area of  $10.2 \text{ km}^2$ , and a small-scale landslide density of  $50 / \text{km}^2$  (Assume that all landslides are of a scale exactly like the Baker Creek example above). Considering a recurrence interval of 2000 years for each landslide, calculate the following parameters:

A. The total number of landslides that will occur in the watershed in 2000 years.

$$(10.2 \text{ km}^2) (50 / \text{km}^2) = 510 \text{ SLIDES}$$

B. The total volume of landslide transport over a period of 2000 years.

$$(510 \text{ SLIDES}) (777 \text{ m}^3 / \text{SLIDE}) = 396,270 \text{ m}^3 / 2000 \text{ yrs}$$

C. The total volume of landslide transport over a period of 100,000 years.

$$\left( \frac{396,270 \text{ m}^3}{2000 \text{ yrs}} \right) (100,000 \text{ yrs}) = 19,813,500 \text{ m}^3$$

2. Given the basin area ( $\text{km}^2$ ) and total volume transported over 100,000 years ( $\text{m}^3$ , from 1C above), calculate the average vertical thickness of regolith that is denuded by landslide processes during that period of time.

Answer in meters.

$$\text{Area} = 10.2 \text{ km}^2 \left( \frac{1000 \text{ m}}{\text{km}} \right) \left( \frac{1000 \text{ m}}{\text{km}} \right) = 1.02 \times 10^7 \text{ m}^2$$

$$\text{THICKNESS} = \frac{\text{VOL}}{\text{A}} = (19,813,500 \text{ m}^3) / 1.02 \times 10^7 \text{ m}^2 = 1.94 \text{ m} / 100,000 \text{ yrs}$$

3. Calculate the rate of vertical regolith denudation in  $\text{mm}/1000 \text{ yrs}$ .

$$1.94 \text{ m} \left( \frac{1000 \text{ mm}}{\text{m}} \right) = \frac{1940 \text{ mm}}{100,000 \text{ yrs}} \frac{100,000 \text{ yrs}}{100 \text{ t.y.}} = 19.4 \text{ mm} / \text{t.y.}$$

4. Given that the ratio of bulk density of bedrock:regolith is 0.6, calculate the average rate of vertical bedrock denudation from answer 3 above, in  $\text{mm}/1000 \text{ yrs}$ , Answer in  $\text{m}/\text{m.y.}$

$$(0.6) \left( \frac{19.4 \text{ mm}}{\text{t.y.}} \right) = 11.6 \text{ mm} / \text{t.y.}$$

$$\left( \frac{1 \text{ m}}{1000 \text{ mm}} \right) \left( \frac{11.6 \text{ mm}}{\text{t.y.}} \right) \left( \frac{1000 \text{ t.y.}}{1 \text{ m.y.}} \right) = 11.6 \frac{\text{m}}{\text{m.y.}}$$