Key

Geomorphology G322

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

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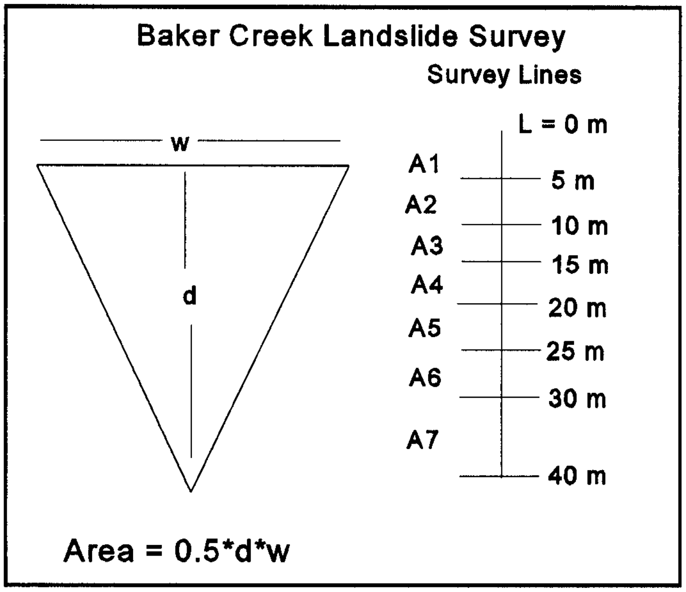
The class measured the geometry of a landslide scar at Baker Creek, near Sulpher Springs. The scar shape is approximated by that of an upside down equilateral triangle. The geometric relations and a sketch map of the field measurements is shown below.



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^2)	Unit Scar Volume (m^3)
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^3)= 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 km^2, and a small-scale landslide density of 50 / 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.

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

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

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

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

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

2. Given the basin area (km^2) and total volume transported over ~~100,000 years (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.

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

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

3. Calculate the rate of vertical regolith denudation in mm/1000 yrs.

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

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~~ Answer in mm/1000 yrs. , Answer in m/m.y.

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

$\left(\frac{1\ m}{1000\ mm}\right)\left(\frac{11.60\ mm}{t.y.}\right)\left(\frac{1000\ t.y.}{1\ m.y.}\right) = 11.6\ \frac{m}{m.y.}$