

53:171 Water Resources Engineering
Lesson 29: Erosion Processes

Rainfall Erodibility Factor R

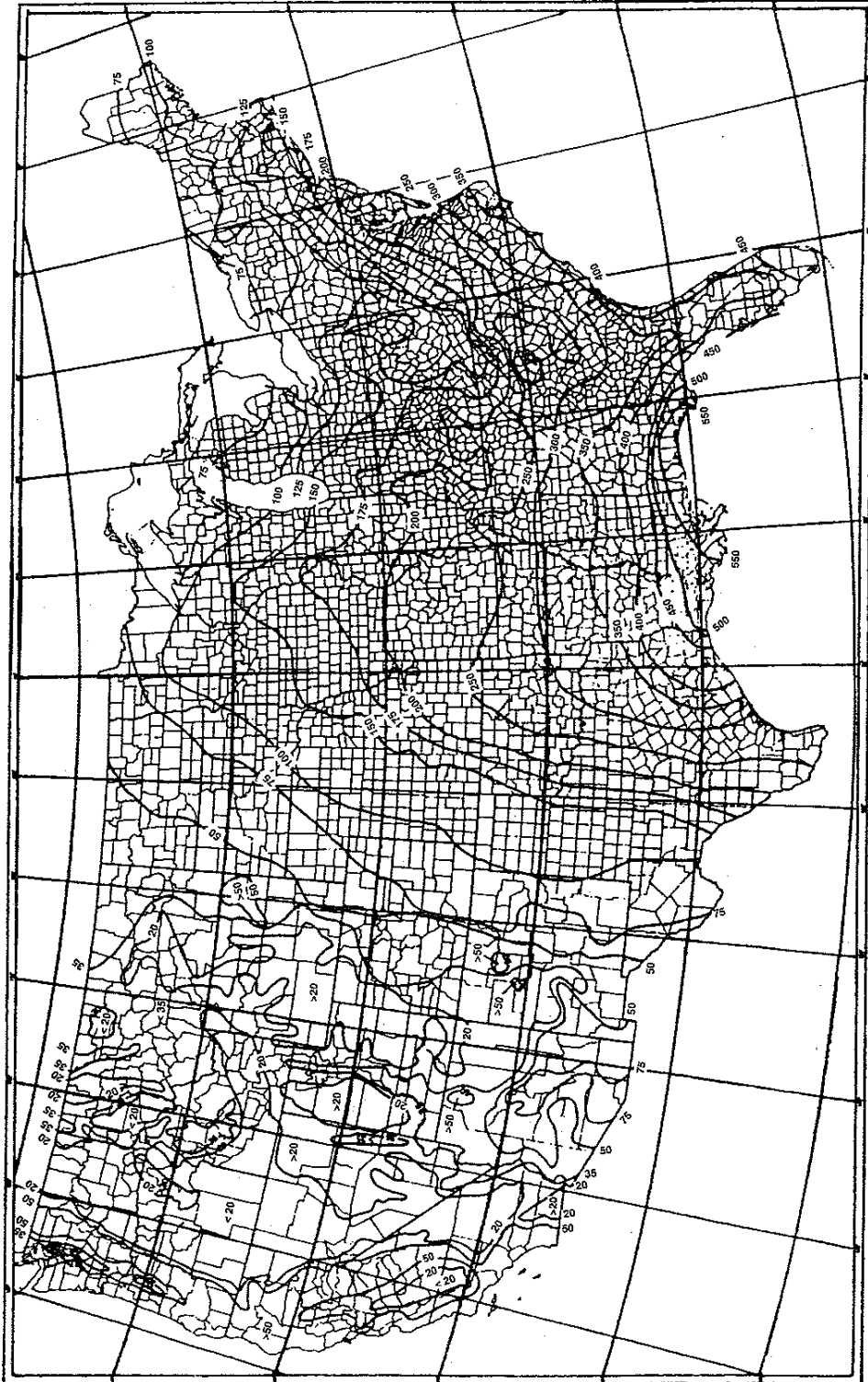


Figure 18.7.1 Average annual values of the rainfall erosion index R (Wischmeier and Smith, 1978).

Soil Erodibility Factor *K*

Table 18.7.1 Soil Erodibility Factor *K* in tons/acre

Textural class	Organic matter content, %	
	0.5	2
Fine sand	0.16	0.14
Very fine sand	0.42	0.36
Loamy sand	0.12	0.10
Loamy very fine sand	0.44	0.38
Sandy loam	0.27	0.24
Very fine sandy loam	0.47	0.41
Silt loam	0.48	0.42
Clay loam	0.28	0.25
Silty clay loam	0.37	0.32
Silty clay	0.25	0.23

Source: From Schwab et al. (1981).

Length-Steepness Factor *LS*

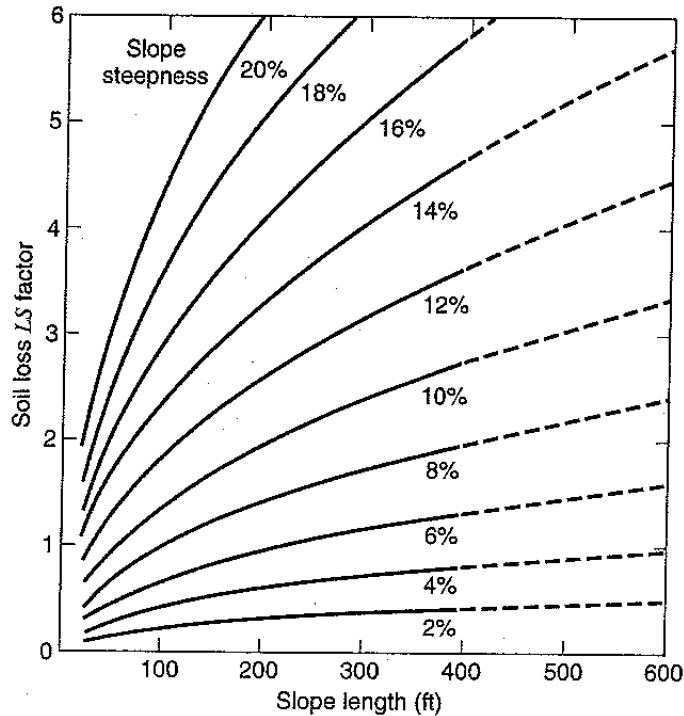


Figure 18.7.2 Topographic-effect graph used to determine *LS*-factor values for different slope-steepness-slope-length combinations (Wischmeier and Smith, 1965).

Cropping Management Factor C

Table 18.7.2 Cropping Management Factor C

Undisturbed forest land							
Percent of area covered by canopy of trees and undergrowth		Percent of area covered by duff at least 2 in deep			Factor C		
100-75		100-90			0.0001-0.001		
70-45		85-75			0.002-0.004		
40-20		70-40			0.003-0.009		
Permanent pasture, range, and idle land*							
Cover that contacts the soil surface							
Vegetative canopy		Percent ground cover					
Type and height†	Type‡	0	20	40	60	80	95+
No appreciable canopy	G	0.45	0.20	0.10	0.042	0.013	0.003
	W	0.45	0.24	0.15	0.091	0.043	0.011
Tall weeds or short brush with average drop fall height of 20 in.	G	0.17-0.36	0.10-0.17	0.06-0.09	0.032-0.038	0.011-0.013	0.003
	W	0.17-0.36	0.12-0.20	0.09-0.13	0.068-0.083	0.038-0.041	0.011
Appreciable brush or bushes, with average drop fall height of 6 1/2 ft	G	0.28-0.40	0.14-0.18	0.08-0.09	0.036-0.040	0.012-0.013	0.003
	W	0.28-0.40	0.17-0.22	0.12-0.14	0.078-0.087	0.040-0.042	0.011
Trees, but no appreciable low brush. Average drop fall height of 13 ft	G	0.36-0.42	0.17-0.19	0.09-0.10	0.039-0.041	0.012-0.013	0.003
	W	0.36-0.42	0.20-0.23	0.13-0.14	0.084-0.089	0.041-0.042	0.011

Table 18.7.2 Cropping Management Factor C (continued)

Construction slopes		
Type of mulch	Mulch rate (tons/acre)	Factor C
Straw	1.0-2.0	0.06-0.20
Crushed stone, 1/4-1.5 in	135	0.05
	240	0.02
Wood chips	7	0.08
	12	0.05
	25	0.02

*The listed C values assume that the vegetation and mulch are randomly distributed over the entire area.

†Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33 ft.

‡G: cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 in deep. W: cover at surface is mostly broadleaf herbaceous plants (as weeds with little lateral-root network near the surface) or undecayed residues or both.

Source: Shen and Julien (1993).

Length-Steepness Factor *LS*

TABLE 3.—Values of the topographic factor, *LS*, for specific combinations of slope length and steepness¹

Percent slope	Slope length (feet)											
	25	50	75	100	150	200	300	400	500	600	800	1,000
0.2	0.060	0.069	0.075	0.080	0.086	0.092	0.099	0.105	0.110	0.114	0.121	0.126
0.5	.073	.083	.090	.096	.104	.110	.119	.126	.132	.137	.145	.152
0.8	.086	.098	.107	.113	.123	.130	.141	.149	.156	.162	.171	.179
2	.133	.163	.185	.201	.227	.248	.280	.305	.326	.344	.376	.402
3	.190	.233	.264	.287	.325	.354	.400	.437	.466	.492	.536	.573
4	.230	.303	.357	.400	.471	.528	.621	.697	.762	.820	.920	1.01
5	.268	.379	.464	.536	.656	.758	.928	1.07	1.20	1.31	1.52	1.69
6	.336	.476	.583	.673	.824	.952	1.17	1.35	1.50	1.65	1.90	2.13
8	.496	.701	.859	.992	1.21	1.41	1.72	1.98	2.22	2.43	2.81	3.14
10	.685	.968	1.19	1.37	1.68	1.94	2.37	2.74	3.06	3.36	3.87	4.33
12	.903	1.28	1.56	1.80	2.21	2.55	3.13	3.61	4.04	4.42	5.11	5.71
14	1.15	1.62	1.99	2.30	2.81	3.25	3.98	4.59	5.13	5.62	6.49	7.26
16	1.42	2.01	2.46	2.84	3.48	4.01	4.92	5.68	6.35	6.95	8.03	8.98
18	1.72	2.43	2.97	3.43	4.21	4.86	5.95	6.87	7.68	8.41	9.71	10.9
20	2.04	2.88	3.53	4.08	5.00	5.77	7.07	8.16	9.12	10.0	11.5	12.9

¹ $LS = (\lambda/72.6)^m (65.41 \sin^2 \theta + 4.56 \sin \theta + 0.065)$ where λ = slope length in feet; $m = 0.2$ for gradients < 1 percent, 0.3 for 1 to 3 percent slopes, 0.4 for 3.5 to 4.5 percent slopes, 0.5 for 5 percent slopes and steeper; and θ = angle of slope. (For other combinations of length and gradient, interpolate between adjacent values or see fig. 4.)

Settling Velocities

Table 1: Typical soil particle settling velocities

Particle	Diameter (ft)	Settling Velocity @ 60° F (ft/sec)
Fine Silt	3.3×10^{-5}	2.62×10^{-4}
Medium Silt	6.6×10^{-5}	1.02×10^{-3}
	9.8×10^{-5}	2.26×10^{-3}
Coarse Silt	1.3×10^{-4}	4.00×10^{-3}
	1.6×10^{-4}	6.27×10^{-3}
	2.0×10^{-4}	9.02×10^{-3}
Very Fine Sand	2.3×10^{-4}	0.012
	2.6×10^{-4}	0.016
	3.0×10^{-4}	0.020
	3.3×10^{-4}	0.025
	3.6×10^{-4}	0.030
	3.9×10^{-4}	0.036
Fine Sand	4.3×10^{-4}	0.042
	4.6×10^{-4}	0.049
	4.9×10^{-4}	0.056
	5.2×10^{-4}	0.064
	5.6×10^{-4}	0.073
	5.9×10^{-4}	0.081
	6.2×10^{-4}	0.091
	6.6×10^{-4}	0.100

Source: Adapted from Fifield, 2001.