

APPENDIX H
SOIL LOSS CALCULATIONS

UNIVERSAL SOIL LOSS EQUATION CALCULATION SONOMA COUNTY CENTRAL DISPOSAL SITE

The Universal Soil Loss Equation (USLE) is an empirical equation developed by the National Resources Conservation Service for calculating average soil loss due to rainfall runoff. The equation only applies to sheet and rill erosion and does not account for soil losses due to gully erosion. Average erosion from initial mobilization in a watershed is computed. The USLE does not include the effects of soil redeposition.

Soil Loss Equation: $A = R * K * LS * C * P$

A = the computed soil loss per unit area. In practice, these are usually selected so that they are computed in tons per acre per year, but other units can be selected.

R = the rainfall erosion index – the measure of the erosive force and intensity of rain in a normal year.

K = the soil erosion factor – the measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff.

LS = the slope length gradient factor – the combined effect of soil erodibility due to slope length and slope gradient per unit area.

C = the cover and management factor – the ratio of soil-loss from an area with specified cover and management practices.

P = the support practice factor – the ratio of soil loss due to practices that may reduce the velocity of runoff by plowing, tilling, or other factors.

DATA SOURCES

A = In order to minimize the future maintenance and potential for gully development, the maximum recommended annual rate of erosion is 2 tons/acre/year (U.S. EPA, July 1982).

R = The Sonoma County Central Disposal Site, located within Sonoma County, is within Storm Type 1A region (Figure 1). The R factor of 28 is based on the Storm Type 1A equation, $R = 10.2 * P^{2.2}$ (Figure 1). P represents the total rainfall experienced during the 2-year return frequency storm, 6-hour intensity duration rainfall, as determined from the National Oceanic and Atmospheric Association (NOAA) Atlas 2 website. P equals 1.57 inches based on the location of the site at latitude 38.30° N and longitude 122.75° W.

K = The unadjusted soil erosion factor, K, of 0.18 was determined from plotting the cover soil properties on Figure 2. The cover soil properties were determined by laboratory testing of soil samples collected at the Sonoma County Central Disposal Site. The USLE considers higher percentages of gravel present in the soil to lower the soil erosion factor K. For soil with an unadjusted K value of 0.18, consisting of 35-60% gravel, the corrected value of K = 0.13.

C = The “C” factor of 0.013 was obtained from *Guides for Erosion and Sediment Control in California*, USA SCS, 1985 (Figure 3). This factor assumes no appreciable canopy and 80 percent grass-covered surface. In this analysis, the landfill cover was assumed to be vegetated ground.

LS = The LS factor is defined as the slope length gradient factor. The LS factor was calculated as follows:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10,000} + \frac{4.56 \times s}{\sqrt{s^2 + 10,000}} \div 0.065 \right) \left(\frac{l}{72.5} \right)^m$$

Where:

- l = length in feet along slope
- s = slope in %
- $m = 0.5$ when the slope is greater than 5%

Rather than calculating the LS value for each area of the Sonoma County Central Disposal Site, LS was calculated for the worst case scenario at the site. The greatest slope at the site is 33.3% (3:1 slope) with the maximum slope length between bench roads or drainage ditches being approximately 240 feet. However, SCS used a slope length of 1,300 feet representing the longest distance of the final cover system as measured from the crest to the toe of the slope. Use of this conservative value for slope length ignores the effect of sediment removed in ditches on the slope face. The computed maximum LS factor, using 1,300 feet as the slope length for the site is 34.02. Please note that although longer slope lengths may occur at the site, these areas are not as steep and produce a lower LS factor.

P = The P Factor is also known as a conservation factor. The P factor was determined to be 0.9. This assumes that the slopes at the site will be track walked vertically by a bulldozer or similar piece of equipment prior to application of hydroseeding materials.

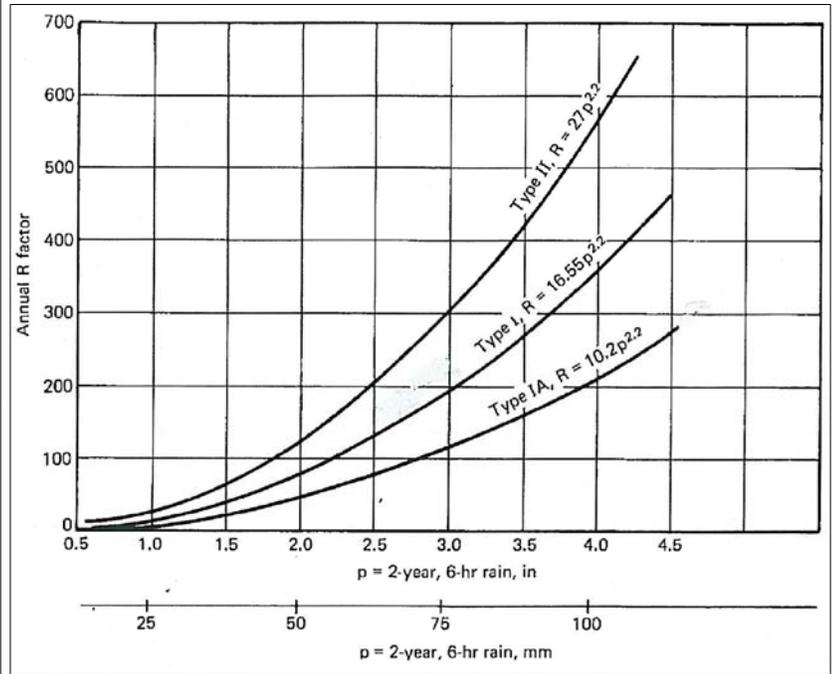
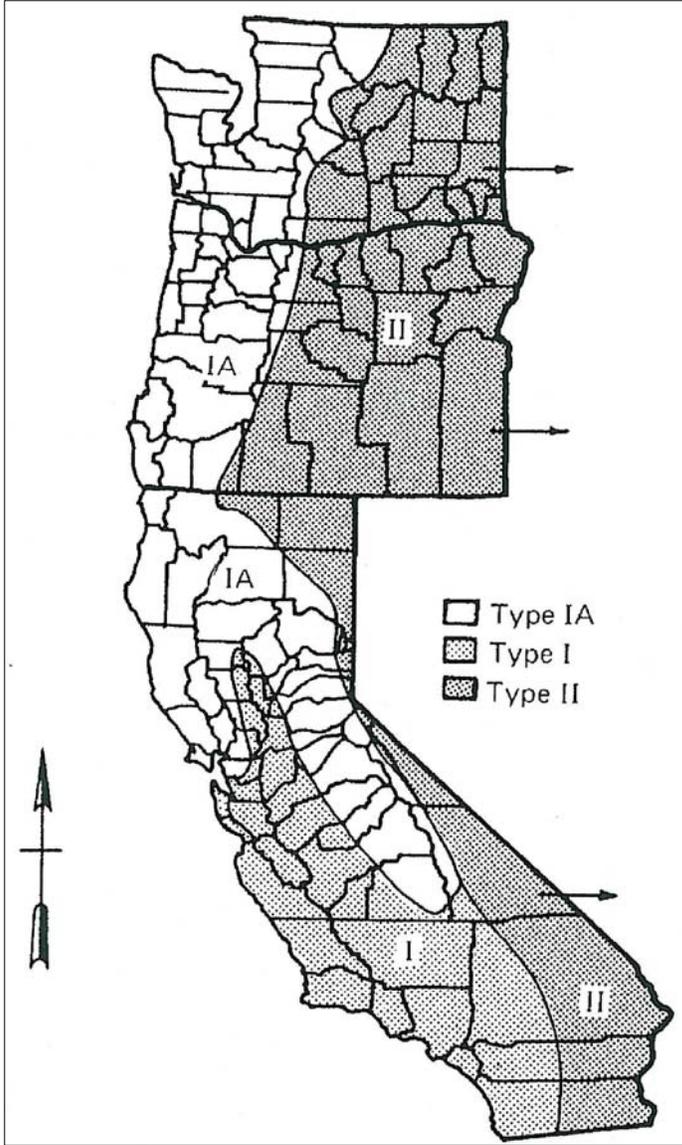
RESULTS

To determine the actual soil loss at the Sonoma County Central Disposal Site, all of these variables were plugged into the universal soil loss equation. The estimated soil loss was calculated as follows:

$$\begin{aligned} A &= R * K * LS * C * P \\ A &= (28) * (0.13) * (34.02) * (0.013) * (0.9) \\ A &= 1.45 \text{ tons/acre-year} \end{aligned}$$

CONCLUSIONS

According to the universal soil loss calculations, sheet and rill erosion should not be a significant problem at the Sonoma County Central Disposal Site. The anticipated soil loss of 1.45 tons per acre per year, as a worst case scenario, is much lower than the EPA design recommendations of 2 tons per acre per year.



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PROJ. NO.	DWN. BY:	ACAD FILE:
	ALT	
DSN. BY:	CHK. BY:	APP. BY:
ALT	JJM	JJM

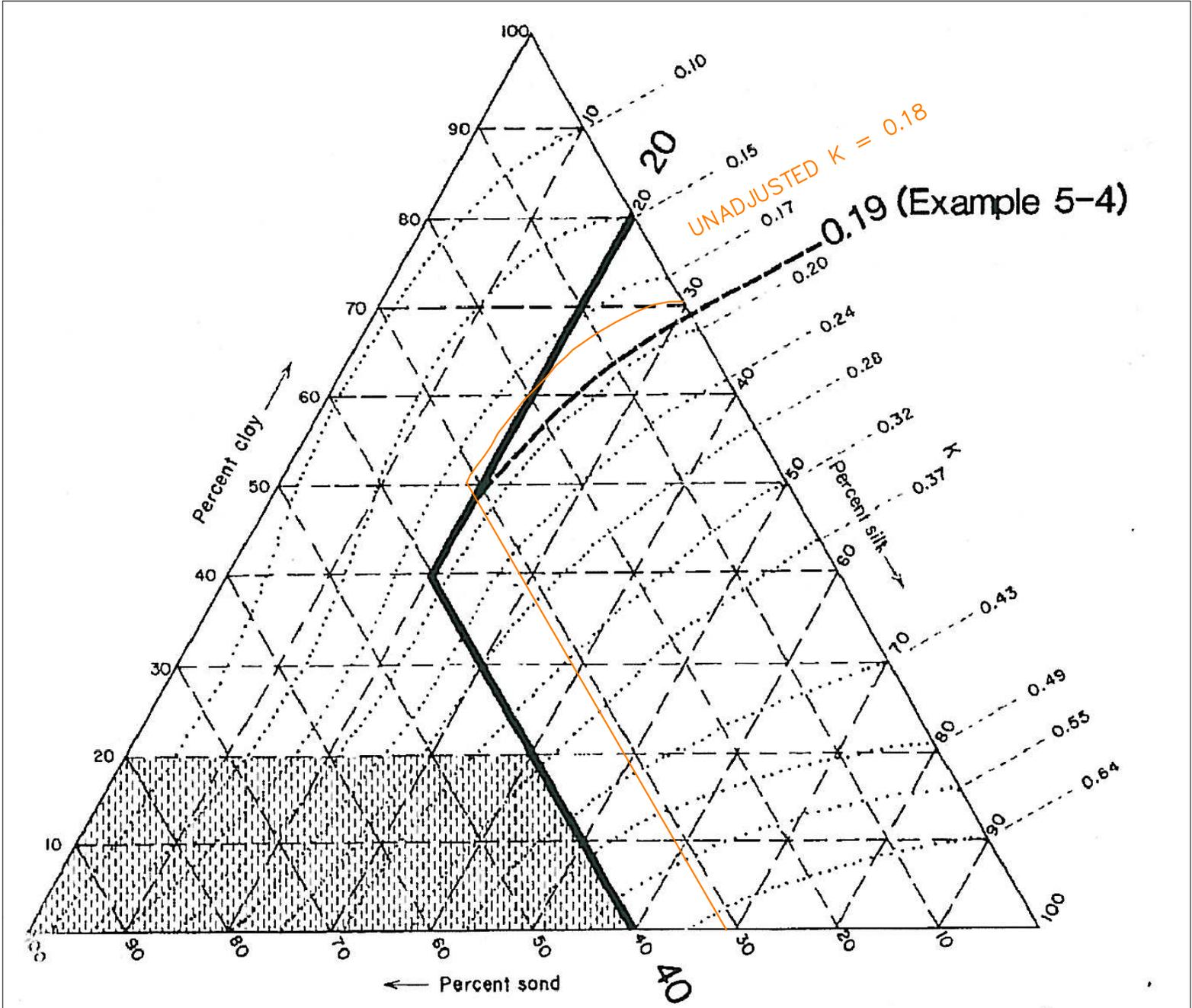
SHEET TITLE:
R FACTOR ZONES AND APPLICABLE CURVES

PROJECT TITLE:
 SONOMA COUNTY CENTRAL DISPOSAL SITE
 500 MEACHAM ROAD
 PETALUMA, CALIFORNIA

DATE:
 1/24/11

SCALE:
 N/A

FIGURE NO. **1**



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PROJ. NO.	DWN. BY: ALT	ACAD FILE:
DSN. BY: ALT	CHK. BY: JJM	APP. BY: JJM

SHEET TITLE: NOMOGRAPH TO DETERMINE K FACTOR
PROJECT TITLE: SONOMA COUNTY CENTRAL DISPOSAL SITE 500 MEACHAM ROAD PETALUMA, CALIFORNIA

DATE: 1/24/11
SCALE: N/A
FIGURE NO. 2

"C" Values for Permanent Pasture, Rangeland, Idle Land or Grazed Woodland¹

Vegetal Canopy			Cover that Contacts the Surface					
Type and Height of Raised Canopy ²	Canopy Cover ³ %	Type ⁴	Percent Ground Cover					
			.00	20	40	60	80	95-100
Column No.:	2	3	4.00	5	6	7	8	9
No appreciable canopy		G	.45	.20	.10	.042	.013	.003
		W	.45	.24	0.15	.090	.043	.011
Tall grass, weeds, or bushes with average drop fall height of less than 3 ft.	25	G	.36	.17	.09	.038	.012	.003
		W	.36	.20	.13	.082	.041	.011
	50	G	.26	.13	.07	.035	.012	.003
		W	.26	.16	.11	.075	.039	.011
	75	G	.17	.10	.06	.031	.011	.003
		W	.17	.12	.09	.067	.038	.011
Appreciable brush or bushes (2 m fall ht.)	25	G	.40	.18	.09	.040	.013	.003
		W	.40	.22	.14	.085	.042	.011
	50	G	.34	.16	.085	.038	.012	.003
		W	.34	.19	.13	.081	.041	.011
	75	G	.28	.14	0.08	.036	.012	.003
		W	.28	.17	.12	.077	.040	.011
Trees but no appreciable low brush (4 m fall ht.)	25	G	.42	.19	.10	.041	.013	.003
		W	.42	.23	.14	.087	.042	.011
	50	G	.39	.18	.09	.040	.013	.003
		W	.39	.21	.14	.085	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.083	.041	.011

¹ All values shown assume: (1) random distribution of mulch or vegetation, and (2) mulch of appreciable depth where it exists

² Average fall height of waterdrops from canopy to soil surface: m=meters

³ Portion of total area surface that would be hidden from view by canopy in a vertical projection, (a bird's eye view)

⁴ G: Cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 inches deep
 W: Cover at surface is mostly broadleaf herbaceous plants (as weeds) with little lateral-root network near the surface, and/or undecayed residue

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PROJ. NO.	DWN. BY: ALT	ACAD FILE:	SHEET TITLE: C VALUES FOR USLE	DATE: 1/24/11
DSN. BY: ALT	CHK. BY: JJM	APP. BY: JJM	PROJECT TITLE: SONOMA COUNTY CENTRAL DISPOSAL SITE 500 MEACHAM ROAD PETALUMA, CALIFORNIA	SCALE: N/A
				FIGURE NO. 3