NSSH 618.55 Soil Erodibility Factors, USLE, RUSLE.

(a) Definition. Soil erodibility factors (Kw) and (Kf) are erodibility factors which quantify the susceptibility of soil detachment by water. These erodibility factors predict the long-term average soil loss, which results from sheet and rill erosion under various alternative combinations of crop systems and conservation techniques. Factor Kw considers the whole soil, and factor Kf considers only the fine-earth fraction, which is the material <2.0 mm in diameter. The procedure for determining the Kf factor is outlined in Agriculture Handbook No. 703, Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE), USDA, ARS, 1997. The K factors in Hawaii and the Pacific Basin were extrapolated from local research. The nomograph was not used.

(b) Classes. Kw factors obtained experimentally vary from 0.02 to 0.69. For the purpose of soil interpretations, the factors have been grouped into 14 classes. The classes are identified by a representative class value as follows: .02, .05, .10, .15, .17, .20, .24, .28, .32, .37, .43, .49., .55, and .64.

(c) Significance. Soil erodibility factors Kw or Kf are used in erosion prediction equations USLE and RUSLE. Soil properties that influence rainfall erosion are (1) those that affect infiltration rate, movement of water through the soil, and water storage capacity and (2) those that affect dispersion, detachability, abrasion, and mobility of soil particles by rainfall and runoff. Some of the most important properties are texture, organic matter content, size and stability of structural aggregates in the exposed layer, permeability of the subsoil, and depth to a slowly permeable layer.

(d) Estimates. Kw factors are measured by applying a series of simulated rainstorms on freshly tilled plots. Direct measurement of the erodibility factor is both costly and time consuming and has been conducted only for a few major soils.

Reliable estimates of Kf can be made using the soil erodibility nomograph on page 11 of Agricultural Handbook 537, which is reproduced in Exhibit 618-12, or by using the soil erodibility equation. The nomograph integrates the relationship between the Kf factor and five soil properties: (1) percent silt plus very fine sand, (2) percent sand greater than 0.10 mm, (3) organic matter content, (4) structure, and (5) permeability. The soil erodibility equation also provides an estimate of Kf, which can be calculated using the following equation:

$$100 \text{ X (K factor)} = 2.1 \text{ X } M^{1.14} \text{ X } 10^{-4} \text{ X } (12\text{-a}) + 3.25(\text{b}-2)+2.5 \text{ X } (\text{c}-3)$$

or

$$\text{K factor} = \{2.1 \text{ X } M^{1.14} \text{ X } 10^{-4} \text{ X } (12\text{-a})+3.25 \text{ X } (\text{b}-2)+2.5 \text{ X } (\text{c}-3)\}/100$$

where:

M = (percent si + percent vfs) X (100 - percent clay)

For this equation, si = silt and vfs = very fine sand;

thus for the given data:
M = (29.0+12.3) X (100-36)
or M = 2,643.20.

a = percent organic matter
b = structure code
c = profile permeability class

Rock or pararock fragments are not taken into account in the nomograph or the equation. If fragments are substantial, they have an armoring effect, and the Kf factor should be adjusted downward. Pararock fragments are assumed to break down with cultivation.

The accuracy of the nomograph and the equation has been demonstrated for a large number of soils in the United States. However, the nomograph and the equation may not be applicable to some soils having properties that are uniquely different from those used in developing the nomograph. For example, they do not accurately predict Kf factors for certain Oxisols in Puerto Rico or in the Hawaiian Islands. In these cases, Kf factors are estimated from the best information at hand and knowledge of the potential for rainfall erosion.

When using the nomograph and the equation, care should be taken to select the organic matter level that is most representative of the horizon being considered. For horizons that have organic matter in excess of 4 percent, one should not extrapolate, but should use the 4 percent curve.

If a soil has fragments, the Kw factor should reflect the degree of protection afforded by those fragments. Guidelines for determining Kw factors are as follows:

(1) Use the nomograph in Exhibit 618-12 or the equation to determine the Kf factor for material less than 2 mm in diameter.

(2) Use Exhibit 618-11 to convert the weight percentage of the material greater than 3 inches and of the material less than 3 inches, which is retained on the #10 sieve, to a volume percent of the whole soil that is rock fragments, specifically rock fragments >2 mm in diameter. First, find the volume percentage greater than 3 inches on the whole soil basis by taking the midpoint of the weight percentage of material greater than 3 inches and comparing the weight percentage in column 2 to the volume percentage in column 1. On that same line, move to the right to the weight percent passing #10 sieve column to find the volume percent gravel, specifically rock fragments that are 2 to 75 mm in size, on a whole soil basis. Then add the volume greater than 3 inches from column 1 and the volume gravel to find the volume percent of the whole soil that is rock fragments. Add in the percent pararock fragments on noncultivated areas.

(3) Use Exhibit 618-13 to convert the Kf value of the fraction less than 2 mm derived from the nomograph in Exhibit 618-12 or from the equation, to a Kw factor adjusted for volume of rock fragments.

If the soil on site contains more or less rock fragments than the mean of the range reported, adjustments can be made in Kf by using Exhibit 618-13. Convert the estimates of rock fragments from weight percentages to volume percentages using Exhibit 618-11, then enter Exhibit 618-13 in line with this volume percentage and find in that line the nearest value to the Kf factor. Within that column, read the Kw factor on the line with the percentage of rock fragments of the soil for which you are making the estimate. <u>Round the factor to the closest factor class.</u> This is the new Kw factor adjusted for rock fragments on site.

(e) Entries. Enter the coordinated Kw and Kf classes for each horizon posted, except organic horizons.

Acceptable entries for Kw and Kf are .02,. 05, .10, .15, .17, .20, .24, .28, .32, .37, .43, .49, .55, and .64. Soil textures that do not have rock fragments have equal Kw and Kf factors. Where rock fragments exist, Kw is always less than Kf. For example:

Depth (in)	USDA Texture	Kw	Kf
0-5	GR-L	.20	.32
0-5	L	.32	.32
0-5	GRV-L	.10	.32
5-46	CL	.28	.28
46-60	SL	.20	.20

Soils that have similar properties and erosivity should group in similar K classes.