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Determination of erosion factors by the nomograph method and their use in soil-loss prediction on some Tennessee soils

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To the Graduate Council:

I am submitting herewith a thesis written by Fred E. Rhoton entitled "Determination of erosion factors by the nomograph method and their use in soil-loss prediction on some Tennessee soils." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Plant, Soil and Environmental Sciences.

Maxwell E. Springer, Major Professor

We have read this thesis and recommend its acceptance:

R. J. Lewis, W. L. Parker

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

To the Graduate Council:

I am submitting herewith a thesis written by Fred E. Rhoton entitled "Determination of Erosion Factors by the Nomograph Method and Their Use in Soil-Loss Prediction on Some Tennessee Soils." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Plant and Soil Science.

M. E. Springer
Maxwell E. Springer, Major Professor

We have read this thesis
and recommend its acceptance:

Russell J. Lewis

W L Parks

Accepted for the Council:

Hilton A. Smith
Vice Chancellor
Graduate Studies and Research

DETERMINATION OF EROSION FACTORS BY THE NOMOGRAPH METHOD AND THEIR USE IN SOIL-LOSS PREDICTION ON SOME TENNESSEE SOILS

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee

Fred E. Rhoton
August 1974

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ABSTRACT

The universal soil-loss prediction equation has served for several years as the guide to sound conservation planning on cropland. Up until now, its use for nonagricultural land has been limited. These limitations were due primarily to the lack of information on the soil erodibility factor values. In the past, these values were obtained through actual soil-loss measurements on only a few representative soils, to which other soils were compared. Undoubtedly, the method had quite a margin of error.

Now, the development of the nomograph method has enabled the land user to obtain fast solutions to erodibility equations through computation of the erodibility factor at any given depth on any soil. In order to use the nomograph, one only needs to know five soil parameter values which can be obtained from routine laboratory determinations and standard soil profile descriptions. These five soil parameters are: percent silt plus very fine sand; percent sand greater than 0.10 millimeters; organic matter content; structure; and permeability.

Once the erodibility factor is determined, it may be combined with five other major factors in the soil-loss prediction equation to predict annual soil loss on any given site. The other factors in the equation evaluate effects of rainfall pattern, slope length, slope steepness and shape, cover and management, and conservation practices on erosion.

Forty-four soil series were selected on the basis of their representative physical characteristics, geographical location, and available laboratory data. The K-values calculated for these soils ranged from a low of 0.11 to a high of 0.69. As was anticipated, the soils in West Tennessee, containing more silt and less sand, exhibited the higher erodibility factor values. Also, large amounts of soil organic matter greatly decreased the erodibility factor values. The effects of soil structure and permeability were found to be significant enough to change individual erodibility predictions.

After sediment yields were calculated on a portion of these representative soils, recommendations were given which if adopted would greatly reduce the volume of soil being lost by runoff.

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CHAPTER I

INTRODUCTION

In the past several years, the face of this country has been reformed, through excavation work, at a rate unequaled anywhere else in the world. Through this alteration of the landscape, extensive and complex problems have been created in the areas of land use, erosion, and siltation.

The demands of a steadily increasing population, along with economic prosperity, are bringing about, in many portions of the country and Tennessee in particular, a rapid conversion of farms and woodlands to highways, industrial and shopping centers, subdivisions and other urban uses. Not only are these areas stripped of all cover, occasionally for excessive periods of time, but paved lots and rooftops are added. These will increase tremendously the amount of storm runoff, thus adding to the erosion potential of the surroundings. Very often, such construction operations are carried out without any regard for the effects of soil erosion on an area.

Therefore, the main objective of this study is to provide the land user with information on the soil erosion process. This information will include determination of the K (soil erodibility) factors by use of a simple nomograph, and its relationship with the other factors in the soil-loss equation. The use of this equation, and how it may be be used to possibly alleviate some of the problems will be explained.

CHAPTER II

REVIEW OF SELECTED LITERATURE

I. THE UNIVERSAL SOIL-LOSS EQUATION, DEVELOPMENT AND USE

Development

The development of an equation for calculating and predicting soil losses under field conditions began in the midwest, about 1940. The procedure for predicting soil-losses which were formulated in that region between the years of 1940 and 1956 has been referred to as the slope practice method. An equation was published in 1940 by Zingg (17) which related soil-loss rate to the length and percentage of slope. In 1941, Smith (5) introduced the concept of conservation practice factors along with a specified soil-loss limit. From these, he developed a graphical method for determining conservation practices needed on soils in the midwest. Later, Browning and coworkers (1) added soil erodibility and management factors and a set of tables to simplify field use of the equation.

In 1946, a nationwide committee on soil-loss prediction met in Ohio for the purpose of adapting the Corn Belt equation to other cropland areas with erosion problems. The result of this committee meeting was the addition of a rainfall factor (4), along with a reappraisal of the factor values assigned to the Corn Belt region.

An improved soil-loss equation which was developed in the latter 1950's (8,14) overcame most of the limitations of the earlier equations.

The improved equation was developed at the Runoff and Soil Loss Data Center of the Agricultural Research Service, which was established at Purdue University in 1954. Most of the basic runoff and soil-loss data obtained in studies in the United States since 1930 were assembled at this location for summarization and further analysis (9). Several major improvements which resulted from these analyses were used in the new soil=loss equation. These included; 1. an improved rainfall-erosion index (10); 2. a system of evaluation cropping management effects on the basis of local climatic conditions (11); 3. a method of accounting for effects of interrelation of such variables as productivity level, crop sequence, and residue management.

Due to these developments, it was possible to remove the geographical and climatic restrictions placed on earlier equations. Since it could be applied anywhere, the new equation was referred to as a "universal" soil-loss equation.

The new soil-loss equation thus developed, Wischmeier (10), is $A = RKLSCP$, which considers all of the major factors known to influence rainfall erosion. The predicted average annual soil loss in tons per acre, "A," is the product of:

R, the rainfall factor, which is the erosion potential of rainfall in a particular locality, or the ability of rain to erode soil from farm fields and construction sites. Soil-loss measurements have shown that the erosion potential is not necessarily determined by the total amount of rainfall or any specific intensity-frequency. The best indication of rainfall erosion potential now known is the rainfall erosion index (2).

> The rainfall erosion index is a function of the characteristics of each individual rainstorm. Analysis of extensive soil-loss data and associated rainfall records revealed that when factors other than rainfall are held constant, storm soil losses from cultivated fallow fields are directly proportional to the product value of two rainstorm characteristics total kinetic energy of the storm times its maximum 30 minute intensity (2).
>
> The rainfall erosion index for a given time period is the sum of the EI values computed for the individual storm occurring during the period. The average annual value of the erosion index in any specific locality is the rainfall factor (R) for the soil-loss predicting equation in that locality (10).

K, the soil erodibility factor,the meaning of which is distinctly different from that of the term "soil erosion." As used in the soil-loss equation, it is a quantitative value, experimentally determined, until recently. For a particular soil, it is the rate of erosion per unit of erosion index from unit plots on that soil (9).

A unit plot is 72.6 feet long, with a uniform lengthwise slope of 9 percent, in continuous fallow, tilled up and down the slope.

Some of the important soil physical properties that influence erodibility are size and stability of structure, soil texture, percentage of coarse fragments, especially on the soil surface, organic matter, infiltration, permeability, type of clay mineral, and depth of soil material (2).

L, the slope length, is defined as the distance from the point of origin of overland flow to either of the following, whichever, is limiting for the major part of the area under consideration: 1. the point to where the slope decreases to the extent that deposition begins; or 2. the point where runoff enters a well defined channel that may be part of a drainage network or a constructed channel such as a terrace or diversion (6).

S, the slope gradient factor, or the steepness of the slope expressed in percent. In 1940, A. W. Zingg (17) concluded that soil loss varies as the 1.4 power of percent slope. Based on the analysis of the data assembled at the Runoff and Soil Loss Data Center, Smith and Wischmeier (6) in 1957 proposed the relation:

$$S = \frac{0.43 + 0.30s + 0.043s^2}{6.613}$$

where s is the gradient expressed as percent slope and S is the slope factor in the erosion equation. The relation of soil loss to gradient is influenced by the density of vegetative cover and soil particle size. The rate of soil erosion by water is greatly affected by both slope length and gradient. The two effects have been evaluated separately in research and are represented in the erosion equation by L and S, respectively. In field application of the equation, however, it is convenient to consider the two as a single topographic factor LS as seen in a later table.

The factor LS is the expected ratio of soil loss per unit area on a field slope to corresponding loss from the basic 9 percent slope, 72.6 feet long. This ratio, for specific combinations of slope length and gradient, may be taken directly from the table. For example, a 10 percent slope, 360 feet long would have an LS ratio of 2.6.

C, the cropping management factor, on farmland, is the ratio of soil loss from land cropped under specified conditions to the corresponding loss from tilled, continuous fallow (which is the basic condition on which the soil factor K is evaluated). C ranges in value from near zero for excellent sod to 1.0 for continuous fallow. On construction sites, C reflects the influences of various types and rates of mulch, methods of revegetation, chemical soil stabilizers, and loose and compacted fills.

P, the erosion practice factor, on farmland, reflects the runoff control and erosion reducing effects of superimposed practices such as contour farming, terracing, or contour stripcropping. The effectiveness of terraces or diversions, which reduce effective slope length and runoff concentration, would be similar on construction sites.

Before the equation can be used to select practices on farmland, soil loss tolerance (T) values must be established for areas under study. These values are the average annual soil losses that land users of these areas can tolerate and still achieve the degree of conservation needed.

At present time, T values are estimates. They may vary between one ton and five tons per acre per year depending on the type, depth, and quality of the soil. T values may not be applicable on construction sites, so some attempt should be made to establish reasonable T values.

Use

The use of the soil-loss predicting equation on farmland can best be explained by considering the example from Jent (2), but using new K values.

Assume a field in Maury County, Tennessee which consists of a Maury silty clay loam, moderately eroded on an 8 percent slope that is 300 feet long. To develop information on soil losses, first write down the equation A = RKLSCP and assign values to the factors RKLS from Tables 1 and 2, and a later table showing prediction of K values:

R = 240
K = .38 at a depth of 11 inches
LS = 1.7

Multiplying these factors tegother gives 155 tons of soil which would erode from this field if it were tilled continuous fallow up and down the slope. But when the C and P factors are changed, the amount of soil lost is greatly reduced. For example, a C factor of 0.079 is assigned for a cropping management system of a three-year cycle of corn-wheat-meadow. Since the cultivation has been up and down the slope, the practice factor (P) has a value of 1, and does not change the calculated soil loss.

When this C factor of 0.079 is used in the equation the A value drops to 12 tons per acre per year. Since T (tolerance) is four tons

TABLE 1

RAINFALL-EROSION INDEX FACTOR "R" VALUES BY COUNTIES--TENNESSEE

County	R-Factor Values	County	R-Factor Values
Anderson	190	Houston	220
Bedford	230	Humphreys	230
Benton	230	Jackson	210
Bledsoe	230	Jefferson	180
Blount	200	Johnson	150
Bradley	260	Knox	190
Campbell	180	Lake	260
Cannon	230	Lauderdale	280
Carroll	210	Lawrence	270
Carter	150	Lewis	250
Cheatham	210	Lincoln	250
Chester	300	Loudon	210
Claiborne	150	McMinn	230
Clay	200	McNairy	310
Cocke	170	Macon	200
Coffee	230	Madison	260
Crockett	270	Marion	250
Cumberland	220	Marshall	240
Davidson	210	Maury	240
Decatur	250	Meigs	230
DeKalb	220	Monroe	220
Dickson	220	Montgomery	200
Dyer	260	Moore	240
Fayette	320	Morgan	200
Fentress	200	Obion	260
Franklin	250	Overton	210
Gibson	250	Perry	250
Giles	260	Pickett	200
Grainger	170	Polk	250
Greene	150	Putnam	220
Grundy	240	Rhea	230
Hamblen	170	Roane	210
Hamilton	260	Robertson	200
Hancock	150	Rutherford	230
Hardeman	320	Scott	180
Hardin	300	Sequatchie	250
Hawkins	150	Sevier	180
Haywood	300	Shelby	300
Henderson	250	Smith	210
Henry	230	Stewart	210
Hickman	230	Sullivan	140

TABLE 1 (continued)

County	R-Factor Values	County	R-Factor Values
Sumner	200	Warren	230
Tipton	300	Washington	150
Trousdale	210	Wayne	280
Unicoi	150	Weakley	250
Union	170	White	220
Van Buren	230	Williamson	230
		Wilson	210

Source: USDA, Soil Conservation Service. Predicting Soil Losses for Urbanizing Areas in Tennessee. Chapter 5, 1972.

TABLE 2

ADJUSTMENT FACTORS (LS)* FOR SLOPE PERCENT AND SLOPE LENGTH

Percent	Slope Length (Feet)																													
Slope	10	15	20	25	30	35	40	50	60	72.6	80	90	100	120	140	160	180	200	220	240	260	280	300	350	400	500	600	700	800	900	1000
0.5	0.03	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.09	0.09	0.10	0.11	0.12	0.12	0.13	0.14	0.15	0.16	0.16	0.17	0.18	0.18	0.20	0.21	0.24	0.26	0.28	0.30	0.32	0.33
1.0	0.04	0.05	0.06	0.07	0.08	0.08	0.09	0.10	0.11	0.12	0.12	0.13	0.14	0.15	0.16	0.17	0.19	0.20	0.21	0.21	0.22	0.23	0.24	0.26	0.28	0.31	0.34	0.36	0.39	0.41	0.44
2.0	0.07	0.08	0.10	0.11	0.12	0.13	0.14	0.15	0.17	0.18	0.19	0.20	0.21	0.24	0.25	0.27	0.29	0.30	0.32	0.33	0.35	0.36	0.37	0.40	0.43	0.48	0.53	0.57	0.61	0.64	0.68
3.0	0.10	0.12	0.14	0.15	0.17	0.18	0.19	0.22	0.24	0.26	0.27	0.21	0.31	0.34	0.36	0.39	0.41	0.43	0.45	0.48	0.49	0.51	0.53	0.57	0.61	0.69	0.75	0.81	0.87	0.92	0.97
4.0	0.13	0.16	0.19	0.21	0.23	0.25	0.26	0.29	0.32	0.35	0.37	0.39	0.41	0.45	0.49	0.52	0.56	0.59	0.61	0.64	0.67	0.69	0.72	0.77	0.83	0.93	1.01	1.09	1.17	1.24	0.31
5.0	0.17	0.21	0.24	0.27	0.29	0.37	0.34	0.39	0.42	0.46	0.48	0.51	0.54	0.59	0.63	0.68	0.72	0.76	0.80	0.83	0.86	0.90	0.93	1.00	1.07	1.20	1.31	1.42	1.52	1.61	1.70
6.0	0.21	0.26	0.30	0.34	0.37	0.40	0.43	0.48	0.52	0.57	0.60	0.64	0.67	0.74	0.80	0.85	0.90	0.95	1.00	1.04	1.09	1.13	1.17	1.26	1.35	1.51	1.65	1.78	1.91	2.02	2.13
7.0	0.26	0.32	0.37	0.41	0.45	0.49	0.52	0.58	0.64	0.70	0.74	0.79	0.83	0.91	0.98	1.05	1.11	1.17	1.23	1.28	1.33	1.38	1.43	1.55	1.65	1.85	2.02	2.19	2.34	2.48	2.61
8.0	0.31	0.39	0.44	0.50	0.55	0.59	0.63	0.70	0.77	0.85	0.89	0.95	0.99	1.09	1.18	1.26	1.33	1.41	1.48	1.54	1.60	1.66	1.72	1.86	1.99	2.22	2.44	2.63	2.81	2.98	3.14
9.0	0.37	0.46	0.53	0.59	0.65	0.70	0.74	0.83	0.91	1.00	1.05	1.12	1.18	1.29	1.39	1.49	1.58	1.67	1.75	1.82	1.90	1.97	2.04	2.20	2.36	2.63	2.84	3.12	3.33	3.53	3.72
10.0	0.44	0.53	0.62	0.69	0.75	0.82	0.87	0.97	1.07	1.17	1.23	1.31	1.38	1.51	1.63	1.74	1.85	1.95	2.04	2.13	2.22	2.30	2.38	2.57	2.75	3.08	3.37	3.64	3.89	4.13	4.35
11.0	0.50	0.62	0.71	0.80	0.87	0.94	1.00	1.12	1.23	1.35	1.42	1.51	1.59	1.74	1.88	2.01	2.13	2.25	2.36	2.46	2.56	2.66	2.75	2.97	3.18	3.55	3.89	4.21	4.50	4.77	5.03
12.0	0.58	0.70	0.81	0.91	1.00	1.08	1.15	1.29	1.41	1.55	1.63	1.73	1.82	1.99	2.15	2.30	2.44	2.57	2.70	2.82	2.93	3.04	3.15	3.40	3.64	4.07	4.45	4.81	5.14	5.45	5.75
13.0	0.65	0.80	0.92	1.03	1.13	1.22	1.30	1.46	1.60	1.76	1.84	1.96	2.06	2.26	2.44	2.61	2.77	2.92													
14.0	0.74	0.90	1.04	1.17	1.28	1.38	1.47	1.65	1.81	1.99	2.08	2.21	2.33	2.55	2.76	2.95	3.13	3.30													
15.0	0.82	1.01	1.16	1.30	1.42	1.54	1.64	1.84	2.01	2.21	2.32	2.46	2.60	2.84	3.07	3.28	3.48	3.67													
20.0	1.33	1.62	1.88	2.10	2.30	2.48	2.65	2.97	3.25	3.58	3.75	3.98																			
25.0	1.95	2.39	2.76	3.09	3.38	3.66	3.90	4.37	4.79	5.26	5.52	5.86																			
30.0	2.70	3.30	3.82	4.27	4.68	5.05	5.40	6.04	6.62	7.27	7.63	8.10																			
35.0	3.56	4.36	5.04	5.64	6.18	6.68	7.13	7.97	8.74	9.61	10.08	10.70																			
40.0	4.55	5.57	6.44	7.20	7.89	8.52	9.10	10.18	11.56	12.27	12.87	13.66																			
50.0	6.88	8.43	9.73	10.89	11.93	12.89	13.76	15.40	16.88	18.55	19.47	20.67																			

*(LS) = $\frac{\sqrt{L}}{100}(0.76 + 0.545 + 0.076S^2)$

Source: USDA, Soil Conservation Service. Predicting Soil Losses for Urbanizing Areas in Tennessee. Chapter 5, 1972.

it will be necessary to use other management systems or slope practices to reduce the A value to that level. This could be accomplished by selecting another cropping management system which gives a C value of 0.026, or stripcropping could be used with the C factor of 0.079 to reduce the soil loss to 3.3 tons per acre.

II. THE NOMOGRAPH METHOD

Development

Soil erosion by water is a complex process that involves the interrelations of many factors. Some of these influence the capability of the erosive agents, rainfall and runoff, to detach and transport soil material. Others influence the ability of the soil to resist the forces of the erosive agents. Extensive research has identified the major factors that influence soil erosion and has established functional relationships of soil, rainfall, topography, cover, and management to soil loss.

The term soil erodibility has several possible meanings. At the Agricultural Research Service, it has been used to denote the relative susceptibility of different soils to erosion when other factors are essentially equal. By this interpretation, erodibility is a function of soil properties only and, therefore, a soil parameter. On the other hand, expressions of soil erodibility on a construction area are more likely to mean the expected soil loss rate or sediment yield from a particular site. The prediction of erodibility in this sense will require that the effects of local rainfall pattern, slope length, slope steepness, land cover and management practices be evaluated along with the soil factor (16).

The factor relationships were derived from statistical analysis of soil loss and associated data obtained in 40 years of research by the Agricultural Research Service and assembled by the ARS Runoff and Soil Loss Data Center at Purdue University (12). Several developments at the ARS data center have provided convenient working tools for farmland erosion control planning that can also be adapted to conditions at construction sites as well. The developments include: 1. a new rainfall erosivity index, EI; 2. a more informative parameter to describe soil particle size distribution; 3. a soil-erodibility nomograph; 4. a slope effect chart; 5. a technique for evaluating cover and management effects in relation to specific rainfall patterns; and 6. the universal soil-loss equation. The first five developments were incorporated in the sixth.

The dimensional soil factor K, derived for the universal soil-loss equation (15), is usually expressed in tons per acre per unit of rainfall EI, under conditions of 9 percent slope 72.6 feet long, continuously fallowed. Previously, the K value had to be obtained from actual soil-loss data. For the major soils on which the erosion plot studies were located, K ranged from 0.30 to 0.69. This range in magnitude emphasizes the importance of the soil factor in gross sediment prediction.

The susceptibility of a soil to particle detachment and transport by rainfall and runoff is a major factor in the universal erosion equation. This equation, now widely used as a guide to sound conservation planning, has, with appropriate evaluation of its basic parameters, become equally useful in sediment control planning on urban and suburban construction sites. This evaluation now permits the determination of the erodibility of any given soil without actual soil-loss measurements.

A new statistical parameter, which describes the influence of particle size interrelations, makes it possible to determine erodibility factors through use of a simple nomograph (Figure 1). The five parameters needed to read numerical soil erodibility values directly from the nomograph can be obtained from routine laboratory determinations and standard soil profile descriptions. The five soil parameters that are necessary to predict erodibility accurately are: percent silt plus very fine sand; percent sand greater than 0.10 millimeters; organic matter content; structure; and permeability (13).

Standard textural classes as defined in the USDA Soil Survey Manual (7) were found to be poorly correlated with soil erodibility. Soils classified as silt loams, for example, ranged all the way from moderately to very highly erodible. Mechanical analysis data, based on the USDA classification system, accounted for less than 25 percent of the soil loss variance for the fallowed plots (16). This system classifies particles smaller than 0.002 mm diameter as clay, those from 0.002 mm to 0.05 mm as silt, and those from 0.05 to 2.0 mm as sand. Generally speaking, the silt size particles erode most easily,

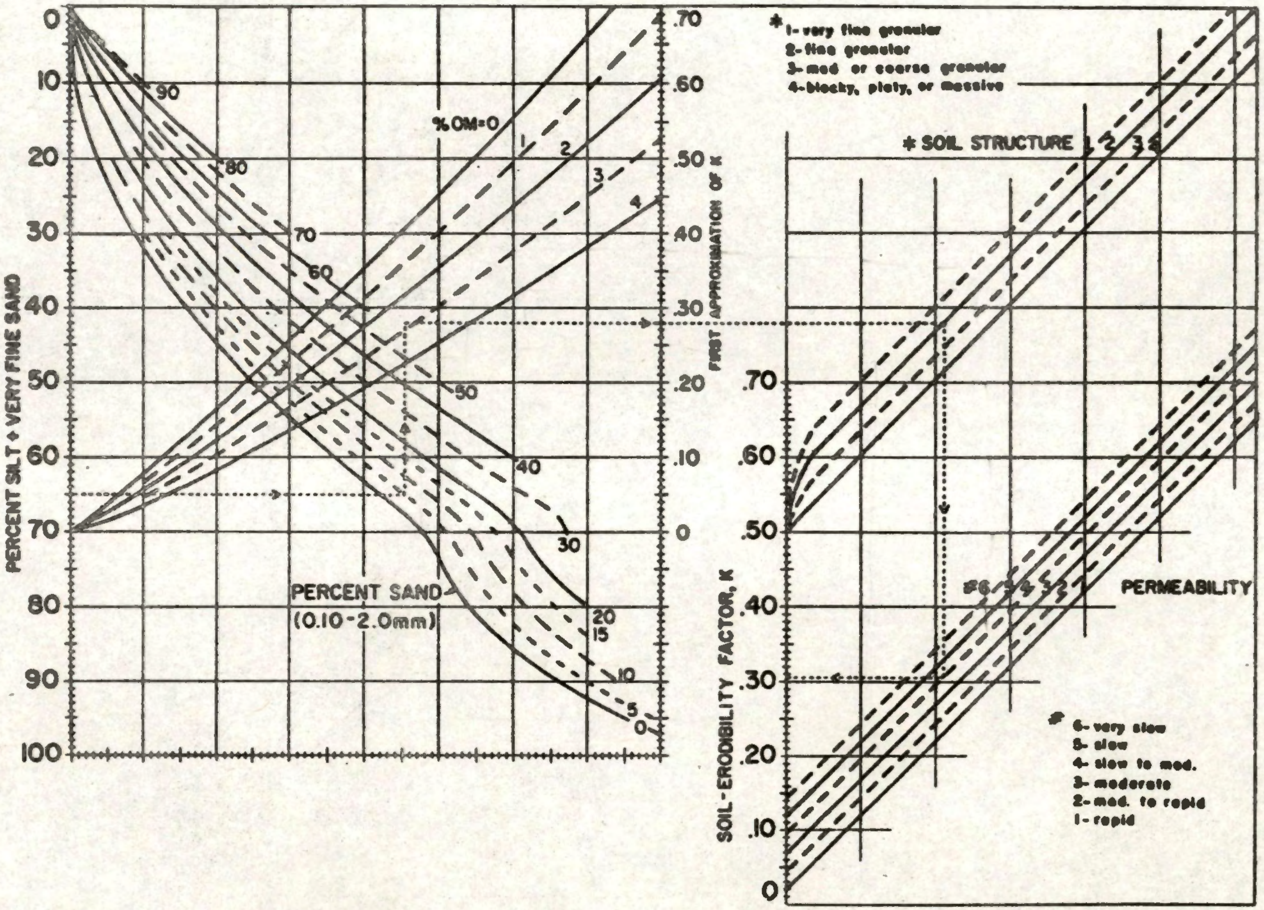

Figure 1. Soil-erodibility nomograph.

Procedure: With appropriate data, enter scale at left and proceed to points representing the soil's percent sand (0.10-2.0 mm), percent organic matter, structure, and permeability, in that sequence. Interpolate between plotted curves. The dotted line illustrates procedure for a soil having: si+vfs 65 percent, sand 5 percent, OM 2.8 percent, structure 2, permeability 4. Solution: K = 0.31.

Source: W. H. Wischmeier, ARS-SWC, Purdue Univ. 2/1/71.

and soils become less erodible as either the sand or the clay fraction increases. The rate of increase in erodibility with additional increments of silt-size material becomes less as either organic matter or the clay to sand ratio increased. Wischmeier and Meyer (16) found that the rate of decrease in erodibility with increased clay content declined with higher organic matter content or higher aggregation index.

Analysis of the rainulator and natural rain soil erodibility data showed conclusively that particles classified by the USDA system as very fine sand (0.05 to 0.10 mm) behave more like silt than like larger sand. When silt was redefined to include particles from 0.002 to 0.10 mm and sand was redefined as 0.10 to 2.0 mm, the prediction values of the two parameters were substantially improved (16).

Even with the improved particle size classification, the relation of erodibility to percentage of silt depended very much on the clay to sand ratio and associated levels of other properties of the particular soil. Development of a statistical parameter that adequately described the whole particle-size distribution for a given soil greatly enhanced the predictive capability of mechanical analysis data. The new particle size parameter (13), which was designated as M, is:

$$M = (\text{percentage of } 0.002 \text{ to } 0.10 \text{ mm}) \times (\text{percentage of } 0.002 \text{ to } 2.0 \text{ mm})$$

where the first group is percentage of silt and very fine sand and second is percentage of silt plus sand (or 100 minus percentage of clay).

The soil-erodibility nomograph shown in Figure 1, page 14, graphically solves an abridged equation that incorporates the new particle size distribution parameter M and the revised definitions of silt and sand. The parameter M appears in the nomograph as the unidentified horizontal scale in the left section. The scale does not need identification because M is computed in the first step of the nomograph solution.

> The soil parameter M accounted for 85 percent of the variances in observed K-values on rain plot tested soils. Some of the individual soil predictions, however, still deviated rather widely from the observed values. Three more parameters were required to account for these deviations; soil organic matter content, structure, and permeability (16).
>
> Organic matter was inversely related to sediment content of the runoff and was directly related to the amount of rain needed to initiate and to the final infiltration rate. The inverse relationships of erodibility to organic matter level and water-stable aggregation were strongest for silts, silt loam, loams, and sandy loams and declined significantly as clay content increased (12).

The percentage of organic matter was obtained by multiplying the percent organic carbon times the factor of 1.7.

> Soil structure apparently bears a close relation to several soil properties that influence erodibility. When a soil structure index was included with the particle size parameter M and organic matter content, it significantly improved the accuracy of individual erodibility predictions (16).

Structure codes as shown in Figure 1 are as indicated in Table 3. The only additional parameter needed to obtain prediction accuracy within the range of practical needs was the standard permeability classification (7). The six permeability classes are as shown in Table 4.

TABLE 3

LIST OF STRUCTURE INDEXES FOR NOMOGRAPH METHOD

Structure Index	Definition
1	Very fine granular
2	Fine granular
3	Medium to coarse granular
4	Blocky, platy, or massive

TABLE 4

LIST OF PERMEABILITY CLASSES FOR NOMOGRAPH METHOD

Permeability Class	Definition	Possible Rates in Inches Per Hour
1	Rapid	5.00-10.00
2	Moderate to rapid	2.50-5.00
3	Moderate	0.80-2.50
4	Slow to moderate	0.20-0.80
5	Slow	0.05-0.20
6	Very slow	<0.05

For soils with silt (0.002 to 0.10 mm) fractions less than 70 percent, the nomograph solves the equation:

$$[2.1\ (10^{-4})\ (12-0\ M^{1.14} + 3.25\ (S-2) + 2.5\ (P-3)]^{10^{-2}}$$

where 0 is percentage of organic matter, M is the particle size parameter, S is the structure index and P is the permeability class. Changes in the relationships of the equation when the silt fraction exceeds 70 percent are introduced by the inflections in the curves of percentage of sand (16).

According to Wischmeier and coworkers (13), the error of estimate based on the data used derivation of the nomograph indicates that, of 100 K values obtained by its solution, 68 would be within 6.4 percent of the true values, 90 within 11 percent, and 99 within 17 percent. When the nomograph was applied to descriptive data for bench-mark soils on erosion research stations, all the solutions were well within accuracy requirements for practical use.

Soil erodibility factor values obtained from rainulator tests on two construction sites with exposed subsoil horizons, were compared with the values predicted by the nomograph method. In each case, the measured K-values were within 0.02 of the value predicted by the nomograph (16).

CHAPTER III

METHODS AND PROCEDURE

I. SOIL SELECTION

Forty-four soils, on which laboratory data were available, were selected to represent ones that had contrasting profile characteristics and particle size distribution from different physiographic regions across the state. The particle size distribution included percent silt, sand, clay, and coarse fragments. The information for each soil was obtained from data sheets published by the Soil Survey Laboratory, Soil Conservation Service. Organic matter, structure, and permeability were not used as criteria in the selection.

After selection, information was obtained for each sample depth within the various soils. The percent silt was added to the percent very fine sand to obtain the initial entry value for the nomograph. The percent sand (0.10-2.0 mm) was totaled next, then percent organic matter was calculated by multiplying the percent organic carbon times the factor of 1.7. Structure and permeability information was taken from the profile descriptions and assigned to classes as given in Tables 3 and 4 respectively, page 17.

II. USE OF THE NOMOGRAPH METHOD

When the five necessary values were obtained for a given layer, they were entered in the nomograph to give a predicted K-value. The same procedure was repeated on the other layers to give K-values for the remainder of the soil profiles.

The procedure for K-value prediction is explained by the following example:

Assume that a residential development is being planned on Arrington silt loam in Coffee County, Tennessee. To determine K for a particular layer, begin by referring to a detailed description and laboratory data sheet of Arrington (except for the K-values) as given in the table for prediction of K values. Using first, the information for the Ap horizon, enter the left scale of Figure 1, page 14, with the 77.4 percent silt plus very fine sand (0.002-0.10 mm), move horizontally to the curve for 2.3 percent sand (0.10-2.0 mm), vertically to the organic matter = 2.2 percent curve, horizontally to structure = 2, and vertically to permeability = 3. On the scale to the left of this point, a K-value of 0.36 is obtained.

CHAPTER IV

RESULTS AND DISCUSSION

I. PREDICTION OF K-VALUES

Erodibility factors calculated on 44 soils by the nomograph method gave values ranging from 0.11 to 0.69. These soils with their calculated values are listed in alphabetical order (Tables 5-26). The higher values were associated with the high silt content soils which generally predominate in West Tennessee. Such soils were Bosket, Calloway, Collins, Falaya, Grenada, Henry, Loring, Paden, Silerton, and the lower horizons of Tunica.

Of these soils, highest values were in Tunica (Table 25): 0.69 at a depth of 25 to 32 inches and 0.68 at 32 to 44 inches. These high values are due to a large amount of silt plus very fine sand, and a small amount of clay. This effect can be seen by contrasting with the values at the 0 to 5-inch depth where the K-value is less than 0.13. At that depth the percent silt plus very fine sand is 40.1, sand 0.3 percent, and organic matter 4.37 percent. As the depth increases, the percent silt increases and organic matter decreases, leading to an increase in the K-value. Below the 44-inch depth, the decrease in silt values and increase in percent organic matter lead to a reduction in K-values. The soils that are high in silt and low in clay and organic matter content are the most erodible since particles of silt and very fine sand are most easily detached when content of clay and organic matter is low. Due to the aggregation effect of organic matter, the

TABLE 5

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR ALCOA S53TENN-5-16 AND ARMOUR S55TENN-16-29

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc- ture	Perme- ability	K
			inches	---------------percent-------------					
Alcoa	A2	sil	0-13	40.2	33.1	1.20	2	3	.21
S53TENN-5-16	B21	cl	13-44	29.8	27.9	0.20	4	3	.19
	B22	cl	44-60	23.9	30.2	0.10	4	3	.16
Armour	Ap	sil	0-7	73.8	7.7	2.60	2	3	.35
S55TENN-16-29	B1	sicl	7-17	60.8	2.2	0.94	4	3	.38
	B21	sicl	17-24	60.4	1.4	0.61	4	4	.40
	B22	sil	24-34	63.2	1.9	0.51	4	4	.43
	B23	sicl	34-44	60.8	4.6	0.51	4	4	.41
	C	sicl	44-50	58.2	6.6	0.48	4	4	.40

TABLE 6

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR ARRINGTON S54TENN-16-17 AND ASHWOOD S65TENN-75-3

Series	Horizon	Texture	Depth	Silt + vfs	Sand	Organic	Struc-	Perme-	K
				0.002-0.10 mm	0.10-2.0 mm	Matter	ture	ability	
			inches	---------------percent---------------					
Arrington	Ap	sil	0-12	77.4	2.3	2.20	2	3	.36
S54TENN-16-17	C11	sil	12-30	71.4	4.1	1.60	3	3	.43
	C12	sicl	30-36+	58.3	6.0	1.60	4	3	.33
Ashwood	Ap	sicl	0-4	61.7	6.1	8.80	3	4	<.28*
S65TENN-75-3	A12	sicl	4-9	50.7	6.5	7.40	3	4	<.19*
	B1t	sic	9-13	31.8	5.6	4.80	4	4	<.14*
	B21t	c	13-19	43.4	6.3	1.20	4	4	.24
	B22t	c	19-25	37.1	7.3	0.78	4	4	.21
	B23t	c	25-36	28.2	5.1	0.56	4	4	.16

*The influence of organic matter in decreasing K values has not been determined beyond 4 percent.

TABLE 7

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR BODINE S54TENN-16-7 AND BOSKET S61TENN-23-12

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc- ture	Perme- ability	K
			inches	---------------	percent	-------------			
Bodine	A2	sil	1-9	73.5	13.1	2.33	3	1	.39
S54TENN-16-7	C1	sicl	9-20	67.1	21.7	0.53	4	1	.52
	C2	sicl	20-60+	55.6	15.1	0.48	4	1	.35
Bosket	Ap	sil	0-6	82.7	3.6	0.87	2	3	.50
S61TENN-23-12	B21	sicl	6-14	74.5	1.5	0.54	4	3	.49
	B22	sil	14-24	76.2	0.9	0.32	4	3	.52
	B3	sil	24-34	80.8	0.4	0.27	4	3	.55
	C1	sil	34-40	79.1	1.2	0.17	4	3	.55
	C2	sil	40-50	79.8	6.4	0.17	4	3	.58

TABLE 8

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR BRAXTON S65TENN-94-1 AND CALLOWAY S59TENN-24-2

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc-ture	Perme-ability	K
			inches	---------------percent	-------------				
Braxton S65TENN-65-1	Ap	sil	0-5	61.7	13.8	3.00	3	5	.36
	B21t	c	5-14	26.7	8.3	1.00	4	5	.13
	B22t	c	14-25	26.4	7.3	0.41	4	5	.18
	B23t	c	25-36	23.2	8.8	0.29	4	5	.17
	B24t	c	36-50	26.5	9.1	0.17	4	5	.20
	B31	c	50-65	27.6	9.1	0.03	4	5	.18
	B32	c	65.80	30.8	7.5	0.20	4	5	.18
Calloway S59TENN-24-2	Ap	sil	0-6	74.5	6.1	1.00	2	4	.47
	B2	sil	6-11	72.6	3.2	0.53	4	4	.52
	B3mg1	sil	11-15	78.6	4.7	0.25	4	4	.58
	B3mg2	sil	15-29	74.5	2.9	0.17	4	4	.53
	B3mg3	sil	29-39	77.6	1.9	0.17	4	4	.56
	B3mg4	sil	39-50	75.8	6.2	0.12	4	4	.58
	B3m5	1	50-74	42.9	44.1	0.12	4	4	.41

TABLE 9

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR COLLINS S59TENN-24-3 AND CUMBERLAND S53TENN-5-13

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Structure	Permeability	K
			inches	percent					
Collins S59TENN-24-3	Ap	si	0-6	84.5	4.1	1.17	2	2	.48
	C11	sil	6-11	85.9	1.0	0.80	4	2	.56
	C12g	sil	11-21	86.9	1.6	0.54	4	2	.60
	C13g	sil	21-33	81.0	7.3	0.32	4	2	.57
			33-35			not sampled			
	C14g	sil	35-51	87.4	0.8	0.54	2	2	.52
	A1b	sil	51-58	81.7	2.8	1.24	2	2	.42
	B2b	sil	58-68	77.0	3.9	0.48	2	2	.44
Cumberland S53TENN-5-13	Ap	sil	0-5	54.3	24.7	4.00	3	3	.25
	B1	sicl	5-14	45.0	16.6	0.75	4	3	.31
	B2	sic	14-56	29.8	12.0	0.36	4	3	.16

TABLE 10

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR DICKSON S54TENN-16-4 AND DELLROSE S65TENN-21-1

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Structure	Permeability	K
			inches	percent					
Dickson S54TENN-16-4	A1	sil	0-1	78.0	11.1	8.50	2	3	<.31*
	A2	sil	1-6	79.8	7.3	1.75	2	3	.36
	B1	sil	6-11			not sampled			
	B2	sil	11-23	74.0	5.6	0.27	4	3	.53
	B3	sil	23-27			not sampled			
	Bm	sil	27-48	73.0	5.2	0.14	4	4	.55
	D	sicl	48+	59.8	7.3	0.09	4	4	.43
Dellrose S65TENN-21-1	Ap	sil	0-8	65.1	9.2	3.00	3	3	.31
	A1	sil	8-12	65.6	8.2	0.78	4	3	.47
	A3	sil	22-28	60.9	17.0	0.26	4	3	.47
	B1t	sicl	28-34	58.5	12.9	0.19	4	4	.45
	B21t	sicl	34-45	51.4	9.6	0.20	4	4	.35
	B22t	sicl	45-54	48.1	12.0	0.22	4	4	.32
	B23t	sicl	54-62	49.1	17.2	0.17	4	4	.36
	B3t	sicl	62-80	53.4	17.3	0.12	4	4	.41
	C	sicl	80-90	56.0	11.6	0.03	4	4	.41

*The influence of organic matter in decreasing K values has not been determined beyond 4 percent.

TABLE 11

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR EGAM S59TENN-36-4 AND FALAYA S57TENN-39-11

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc- ture	Perme- ability	K
			inches	----------------	percent	----------------			
Egam	Ap1	sicl	0-5	59.7	1.5	2.31	3	5	.32
S59TENN-36-4	Ap2	sic	5-8	54.7	1.5	1.75	4	5	.32
	A1b	sic	8-13	53.1	3.6	1.97	4	5	.32
	C1	sic	13-22	51.9	1.6	1.67	4	5	.31
	C2	sic	22-33	49.7	7.0	1.75	4	5	.31
	C3	sil	33-49	57.4	1.4	1.02	4	5	.31
	Du1	cl	49-58	63.3	6.0	0.65	4	5	.47
	Du2	l	58-75	60.3	13.9	0.51	4	5	.49
	Du3	scl	75-91	46.1	32.3	0.34	4	5	.42
Falaya	Ap	sil	0-9	77.0	9.6	1.68	2	3	.42
S57TENN-39-11	C1	sil	9-20	71.4	10.6	0.53	3	3	.50
	C2	sil	20-30	69.0	8.8	0.29	4	3	.51
	C3	sil	30-42	70.8	10.4	0.29	4	3	.54
	C4	sil	42+	71.6	9.3	0.19	4	3	.55

TABLE 12

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR FORESTDALE S61TENN-23-14 AND FULLERTON S53TENN-5-12

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Structure	Permeability	K
			inches	--------------percent-------------					
Forestdale S61TENN-23-14	Ap	sil	0-8	52.3	16.4	1.20	3	5	.32
	Blg	sicl	8-16	49.3	16.0	0.39	4	5	.37
	B2g	sil	16-27	53.2	14.1	0.24	4	5	.42
	B3g	cl	27-35	58.1	41.9	0.24	4	5	.47
	Cg	cl	35-45	51.5	26.8	0.10	4	5	.47
	Du1	ls	45-51	18.8	74.4	0.03	4	5	.27
	Du2	s	51-69	16.9	76.7	0.03	4	5	.23
Fullerton S53TENN-5-12	Ap	sil	0-7	64.8	19.4	2.60	3	4	.42
	A3	sil	7-13	b1.3	17.1	0.73	4	4	.48
	B1	sicl	13-19	58.2	15.1	0.51	4	4	.47
	B2	sicl	19-41	50.7	13.3	0.19	4	4	.36
	C	sicl	41-55	41.8	13.3	0.14	4	4	.37

TABLE 13

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR GRENADA S59TENN-24-1 AND HAMPSHIRE S65TENN-21-2

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc- ture	Perme- ability	K
			inches	---------------	percent	-------------			
Grenada	Ap	sil	0-7	82.1	5.6	1.00	2	3	.50
S59TENN-24-1	B21	sil	7-16	70.6	3.2	0.48	4	3	.48
	B22	sil	16-21	69.4	3.7	0.32	4	3	.47
	B3mg1	sil	21-31	73.0	12.5	0.15	4	3	.56
	B3mg2	sil	31-43	60.7	20.9	0.17	4	3	.50
	B3mg3	l	43-55	42.9	42.1	0.10	4	4	.41
	B3mg4	sl	55-65	31.2	54.0	0.12	4	4	.32
	D1u	sl	65-74	22.6	66.7	0.10	4	4	.25
	D2u	s	74-90+	6.5	92.0	0.03	4	4	.15
Hampshire	Ap	sil	0-7	68.7	8.3	2.10	3	3	.39
S65TENN-21-2	B1	sicl	7-12	59.1	8.1	0.49	4	3	.39
	B21t	c	12-24	49.1	9.2	0.34	4	3	.30
	B22t	c	24-30	49.1	11.9	0.27	4	3	.30
	B3t	cl	30-39	50.1	22.1	0.26	4	3	.37
	C1	c	39-50	52.5	30.4	0.20	4	3	.43
	C2	c	50-60	63.4	22.8	0.10	4	3	.53

TABLE 14

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR HARTSELLS AND HENRY S59TENN-24-7

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Structure	Permeability	K
			inches	percent					
Hartsells	A1	l	0-2	64.0	26.5	6.30	2	1	<.24*
	A2	l	2-9	67.4	22.6	1.20	2	2	.46
	B1	l	9-15	60.1	21.9	0.83	4	3	.50
	B21t	scl	15-22	49.2	28.2	0.24	4	3	.40
	B22t	cl	22-29	42.7	20.8	0.32	4	3	.30
	B23t	cl	29-31	40.9	24.2	0.27	4	3	.31
Henry S59TENN-24-7	Ap	si	0-8	86.1	4.7	1.12	2	5	.52
	A2g1	sil	8-18	80.4	6.7	0.29	4	5	.62
	B2g1	sil	18-32	74.0	3.2	0.24	4	5	.57
	B2g2	sil	32-40	73.4	2.9	0.17	4	5	.57
	B3g1	sil	40-57d	81.2	0.9	0.12	4	5	.62
	B3g1	sil	40-57e	76.8	3.6	0.19	4	5	.59
	B3g2	sil	57-84d	81.1	2.3	0.20	4	5	.62
	B3g2	sil	57-84e	79.1	2.8	0.20	4	5	.60
	C1	sil	84-121	70.1	12.3	0.17	4	5	.60

*The influence of organic matter in decreasing K values has not been determined beyond 4 percent.

d = brown material.

e = gray material.

TABLE 15

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR IBERIA S65TENN-75-5 AND INMAN S65TENN-21-3

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc- ture	Perme- ability	K
			inches	---------------percent-------------					
Iberia	Ap	sil	0-11	44.8	5.9	2.90	3	5	.20
S65TENN-75-5	A12	c	11-19	38.2	7.8	2.40	4	5	.20
	A13	c	19-28	40.0	7.2	1.60	4	5	.23
	B21g	c	28-36	38.2	12.5	1.00	4	5	.24
	B22g	c	36-46	44.5	7.3	0.65	4	5	.28
	B3g	c	46-60	---------------not sampled---------------					
Inman	Ap	sicl	0-6	54.0	11.8	1.12	3	4	.32
S65TENN-21-3	B21t	c	6-10	45.1	13.1	0.36	4	4	.30
	B22t	c	10-18	59.1	4.4	0.34	4	4	.40
	B23tg	c	18-24	59.0	13.6	0.34	4	4	.46
	B3g	c	24-30	45.6	12.2	0.37	4	4	.30
	C	cl	30-34	52.1	19.3	0.37	4	4	.41

TABLE 16

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR LANDISBURG S58TENN-53-10 AND LAWRENCE S55TENN-16-31

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc-ture	Perme-ability	K
			inches	---------------percent-------------					
Landisburg S58TENN-53-10	Ap	sil	0-9	63.2	24.5	1.90	2	3	.41
	B1	l	9-17	55.8	27.9	0.20	4	3	.45
	B21	l	17-26	42.7	39.8	0.10	4	3	.36
	B22	scl	26-33	29.2	49.6	0.17	4	5	.29
	B22m	scl	33-41	26.0	40.5	0.12	4	5	.25
	B3	scl	41-47	31.5	39.5	0.03	4	5	.29
	C	cl	47-60	36.5	32.1	0.05	4	5	.32
Lawrence S55TENN-16-31	A1	sil	0-1	81.7	8.3	3.54	2	4	.38
	A2	sil	1-7	78.0	6.0	0.85	2	4	.51
	B1	sil	7-15	72.4	5.4	0.39	4	4	.55
	B2	sil	15-24	75.7	5.7	0.24	4	4	.59
	B3m1	sicl	24-35	75.6	6.5	0.17	4	4	.60
	B3m2	sicl	35-47	69.7	5.3	0.10	4	4	.51
	Cm1	sicl	47-59	65.0	7.1	0.10	4	4	.47
	Cm2	sicl	59-71	53.9	19.0	0.03	4	4	.40

TABLE 17

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR LEXINGTON S55TENN-39-3 AND LINKER S59TENN-71-25

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Structure	Permeability	K
			inches	---------------	percent	-------------			
Lexington	Ap	sil	0-5	71.6	9.8	1.00	3	3	.48
S55TENN-39-3	B21	sicl	5-9	67.3	4.1	0.43	4	3	.49
	B22	sicl	9-13	66.3	5.7	0.34	4	3	.47
	B23	sil	13-20	64.6	8.6	0.27	4	3	.47
	C1	sil	20-30	60.8	15.6	0.15	4	3	.47
	C2	sil	30-42	58.7	21.4	0.15	4	3	.48
	D1	l	42+	35.3	42.3	0.15	4	3	.28
Linker	A2	l	0-5	35.1	40.4	1.95	2	3	.24
S59TENN-71-25	B1	l	5-10	31.9	38.0	1.34	4	3	.21
	B21	cl	10-15	28.7	37.9	1.00	4	3	.20
	B22	cl	15-25	22.9	38.5	0.68	4	3	.12
	B23	scl	25-43	17.7	52.4	0.15	4	3	.15
	B31	sl	43-58	14.5	66.3	0.12	4	3	.16
	B32	sl	58-69	10.7	66.3	0.10	4	3	.13

TABLE 18

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR LORING AND MAURY S60TENN-94-24

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc- ture	Perme- ability	K
			inches	percent					
Loring	Ap	sil	0-6	82.5	1.4	1.20	2	3	.45
	B21	sicl	6-13	70.7	0.9	0.60	4	3	.42
	B22	sil	13-20	74.0	0.9	0.30	4	3	.51
	B3	sil	20-28	76.8	1.7	0.20	4	3	.54
	B3m1	sil	28-36	80.7	1.5	0.20	4	3	.56
	B3m2	sil	36-48	81.3	1.1	0.20	4	3	.57
Maury S60TENN-94-24	Ap	sil	0-7	66.2	16.9	1.90	2	2	.38
	A3	sil	7-11	64.0	14.7	0.80	2	2	.38
	B1	sicl	11-16	51.2	17.5	0.60	4	2	.32
	B21	sil	16-25	49.8	15.3	0.43	4	2	.30
	B22	sil	25-40	40.6	18.0	0.26	4	2	.23
	B23	c	40-56	33.8	22.9	0.15	4	2	.19
	B31	sil	56-69	26.6	26.9	0.22	4	2	.15
	B32	cl	69-85	30.6	27.6	0.15	4	2	.17
	C1	cl	85-112	22.4	35.2	0.10	4	2	.15
	C2	c	112-114	not sampled					
	C3	c	114-129	30.1	21.0	0.12	4	2	.16
	C4	c	129-139+	32.4	5.0	0.09	4	2	.13

TABLE 19

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR MIMOSA S60TENN-71-34 AND MONONGAHELA S59TENN-71-27

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc- ture	Perme- ability	K
			inches	-----------------	percent	-----------------			
Mimosa	Ap	sil	0-9	63.9	8.6	2.36	2	5	.36
S60TENN-71-34	B21	sicl	9-18	35.2	4.0	0.56	4	6	.24
	B22	c	18-24	35.5	3.1	0.37	4	6	.24
	B3	c	24-27	37.4	4.3	0.34	4	6	.27
	C	c	27-41	37.3	3.5	0.29	4	6	.27
Monongahela	Ap	sil	0-7	65.9	21.8	1.00	2	5	.51
S59TENN-71-27	A2	sil	7-12	69.3	14.3	0.49	3	5	.56
	B21	sil	12-17	65.1	17.0	0.31	4	5	.54
	B22	1	17-26	61.9	19.0	0.22	4	5	.54
	B3m1	1	26-30	60.7	21.2	0.12	4	5	.54
	B3m2	1	30-42	60.8	21.8	0.10	4	5	.55
	B3m3	1	42-53	59.6	22.7	0.10	4	5	.53
	B3m4	1	53-68	51.2	27.0	0.14	4	5	.45
	Cg	fsl	68-95	46.6	41.6	0.07	4	5	.48

TABLE 20

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR MOUNTVIEW S54TENN-16-1 AND MUSKINGUM S59TENN-71-29

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc-ture	Perme-ability	K
			inches	----------------	percent	----------------			
Mountview	A1	sil	0-1	79.1	6.6	6.70	2	3	<.30*
S54TENN-16-1	A2	sil	1-8	80.6	5.4	2.20	2	3	.41
	A3	sil	8-10	74.7	4.1	0.73	2	3	.47
	B21	sicl	10-29	68.8	4.4	0.17	4	3	.49
	IIB22	sicl	29-34	63.7	3.2	0.14	4	3	.43
	IIB23	sic	34+	49.5	2.9	--	4	3	.27
Muskingum	A1	sil	0-2	71.2	13.5	6.70	2	3	<.30*
	A2	1	2-9	69.2	13.8	0.95	3	3	.48
	BC	1	9-19	62.6	14.1	0.37	4	3	.47
	C1	cl	19-30	51.8	10.6	0.29	4	3	.34

*The influence of organic matter in decreasing K values has not been determined beyond 4 percent.

TABLE 21

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR PADEN S59TENN-36-2
AND PEMBROKE S65TENN-75-2

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Structure	Permeability	K
			inches	---------------	percent	-------------			
Paden S59TENN-36-2	A1	si	0-2	86.1	5.7	5.70	2	4	<.37*
	A2	si	2-9	85.7	4.7	1.53	2	4	.51
	B21	sil	9-18	77.8	3.5	0.47	4	4	.55
	B22	sil	18-23	72.0	4.9	0.27	4	4	.54
	B23	sil	23-26	74.1	5.7	0.15	4	4	.56
	B3m	sil	26-42	70.4	4.9	0.10	4	4	.54
	IIB21b	sil	42-52	52.2	5.6	0.12	4	4	.34
	B22b	c	52-71	43.5	6.5	0.15	4	4	.37
	B3b	sic	71-87	48.0	7.3	0.14	4	4	.32
	Cb	sicl	87-111	52.4	10.3	0.15	4	4	.37
Pembroke S65TENN-75-2	Ap	sicl	0-6	58.8	8.6	1.50	2	3	.28
	B1t	sicl	6-14	63.3	4.8	0.36	4	3	.43
	B21t	sicl	14-25	55.1	7.6	0.20	4	3	.35
	B22t	sic	25-37	48.1	8.9	0.22	4	3	.28
	B23t	c	37-49	39.4	7.2	0.22	4	3	.21
	IIB24tb	c	49-57	22.8	5.3	0.17	4	3	.11
	IIB25tb	c	57-65	20.6	7.3	0.17	4	3	.11

*The influence of organic matter in decreasing K values has not been determined beyond 4 percent.

TABLE 22

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR SEQUATCHIE S59TENN-71-30 AND SEQUOIA S53TENN-5-10

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc-ture	Perme-ability	K
			inches	---------------percent------------					
Sequatchie S59TENN-71-30	A11p	fsl	0-4	46.0	40.4	1.22	3	3	.34
	A12p	l	4-12	45.1	34.4	0.90	3	3	.31
	B2	sl	12-26	48.6	27.6	0.56	4	3	.35
	B3	sl	26-35	27.7	55.6	0.36	4	3	.25
	Du1	s	35-43	5.9	87.1	0.15	4	3	.11
	Du2	s	43-55	8.8	83.9	0.15	4	3	.12
Sequoia S53TENN-5-10	Ap	sil	0-7	62.0	12.6	1.90	3	3	.35
	B2	sic	7-29	45.2	3.9	0.41	4	4	.26
	C	sic	29-45	51.5	4.3	0.20	4	4	.33

TABLE 23

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR SILERTON S55TENN-39-5 AND STIVERSVILLE S60TENN-94-27

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc- ture	Perme- ability	K
			inches	----------------	percent	----------------			
Silerton S55TENN-39-5	Ap	sil	0-4	83.1	9.5	1.70	2	2	.46
	A3	sil	4-7	81.2	5.8	1.00	4	3	.57
	B21	sil	7-10	72.8	4.2	0.83	4	3	.49
	B22	sicl	10-16	66.4	4.1	0.68	4	3	.45
	C1	sil	16-22	67.1	6.4	0.36	4	3	.48
	D1m	sil	22-27	69.7	8.6	0.19	4	3	.52
	D2m	sil	27-32	75.2	10.2	0.12	4	3	.57
	D3m	l	32-38	65.8	11.3	0.10	4	3	.51
	D3m2	scl	38-45	58.8	9.8	0.08	4	3	.42
	D4m	scl	45-52	57.7	11.9	0.12	4	3	.42
	D5m	cl	52+	66.6	6.2	0.10	4	3	.49
Stiversville S60TENN-94-27	Ap	sil	0-9	69.2	14.9	2.00	2	3	.41
	A3	sil	9-13	65.9	13.9	1.60	2	3	.39
	B1	sil	13-19	63.9	13.5	0.60	4	3	.47
	B21	sicl	19-27	62.2	14.2	0.37	4	3	.47
	B22	sicl	27-34	57.9	17.2	0.22	4	3	.44
	B23	sic	34-40	49.8	21.8	0.22	4	3	.37
	B3	sic	40-45	45.2	25.5	0.26	4	3	.33
	CD	c	45-52+	32.9	37.2	0.27	4	3	.25

TABLE 24

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR TALBOTT S58TENN-53-2 AND TELLICO S58TENN-53-3

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc- ture	Perme- ability	K
			inches	----------------	percent-	------------			
Talbott	Ap	sil	0-6	66.4	12.1	3.00	1	3	.29
S58TENN-53-2	A3	sic	6-10	50.7	5.1	0.46	4	3	.29
	B1	c	10-15	29.1	1.9	0.29	4	4	.15
	B21	c	15-24	26.3	1.1	0.22	4	4	.14
	B22	c	24-37	27.8	1.2	0.22	4	4	.15
	B3	c	37-48	36.5	1.6	0.22	4	4	.15
	C1	sic	48-56	43.0	4.3	0.20	4	4	.24
	C2	sic	56-66	48.0	3.5	-.05	4	4	.30
Tellico	A1	l	0-7	40.6	36.4	2.70	2	3	.18
	AB	cl	7-12	32.6	29.3	1.00	4	3	.20
	B21	c	12-22	31.2	24.0	0.56	4	3	.19
	B22	cl	22-37	39.5	22.0	0.84	4	3	.25
	B3	cl	37-54	42.8	21.9	0.09	4	3	.30
	C	c	54-74	32.9	20.7	0.09	4	3	.20

TABLE 25

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR TUNICA S61TENN-23-10 AND WAYNESBORO S58TENN-53-9

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc- ture	Perme- ability	K
			inches	----------------	percent----------	----------			
Tunica S61TENN-23-10	Ap	sic	0-5	40.1	0.3	4.37	3	5	<.13*
	B21-C1	sic	5-19	57.8	0.2	1.80	4	5	.34
	B22-C2	sil	19-25	75.0	0.3	1.34	4	5	.50
	Du1	fsl	25-32	84.5	7.8	0.37	4	5	.69
	Du2	fsl	32-44	86.1	5.8	0.41	4	5	.68
	Du3	c	44-46	67.9	0.9	0.92	4	5	.50
	Du4	sil	46-52	80.7	1.3	0.85	4	5	.59
	Du5	c	52-55	59.7	0.8	0.79	4	5	.41
	Du6	sic	55-65	75.4	0.8	0.92	4	5	.53
Waynesboro S58TENN-53-9	A1	l	0-2	45.9	42.3	4.60	2	3	<.19*
	A2	l	2-7	48.8	35.8	1.80	2	3	.28
	A3	l	7-15	47.3	26.5	0.56	4	3	.34
	B1	cl	15-21	37.8	30.8	0.47	4	3	.37
	B21	c	21-31	31.2	28.7	0.22	4	3	.20
	B22	c	31-42	23.5	24.6	0.07	4	3	.18
	B3	c	42-53	14.3	29.2	0.15	4	3	.11
	C1	c	53-60	11.5	32.3	0.07	4	3	.13

*The influence of organic matter in decreasing K values has not been determined beyond 4 percent.

TABLE 26

PREDICTION OF K VALUES BY THE NOMOGRAPH METHOD FOR WELLSTON S59TENN-71-23 AND WOLFTEVER S59TENN-36-5

Series	Horizon	Texture	Depth	Silt + vfs 0.002-0.10 mm	Sand 0.10-2.0 mm	Organic Matter	Struc- ture	Perme- ability	K
			inches	-----------	-percent-	------------			
Wellston	A1	sil	0-2	72.8	12.7	6.60	2	3	<.31*
S59TENN-71-23	A2	sil	2-7	67.9	9.4	1.50	3	3	.42
	B1	sicl	7-12	59.2	6.8	0.90	4	3	.47
	B21	sic	12-18	48.7	4.6	0.51	4	3	.26
	B22	sic	18-25	42.7	2.8	0.39	4	3	.21
	B3	sic	25-29	43.1	2.7	0.31	4	3	.20
	C1	sic	29-39	47.3	2.7	0.29	4	3	.35
	C2	sic	39-45	47.6	5.7	0.36	4	3	.26
Wolftever	Ap	sicl	0-7	65.1	1.7	2.48	3	3	.31
S59TENN-36-5	B1	sic	7-15	54.7	4.0	0.42	4	3	.32
	B21	sic	15-22	50.8	2.8	0.29	4	4	.32
	B22	sic	22-31	55.5	2.6	0.20	4	4	.35
	B23	sicl	31-42	58.7	3.3	0.20	4	4	.40
	B24	sicl	42-53	59.0	9.5	0.19	4	4	.45
	C1	sicl	53-65	60.7	9.6	0.15	4	4	.46
	C2	cl	65-89	------------------	---------not	sampled-------	------	------	----

*The influence of organic matter in decreasing K values has not been determined beyond 4 percent.

rainfall energy needed to start runoff is increased. Infiltration rates also increase when the organic matter content increases. The effects of sand and clay will be discussed later.

The lower K-values were obtained from the soils which were low in silt and high in sand, clay, or organic matter. These soils are primarily in the eastern part of the state. Some of these soils are Alcoa, Ashwood, Cumberland, Linker, Talbott, Tellico, Waynesboro, and Sequatchie.

The effects of a reduction in the content of silt plus very fine sand and an increase in either sand or clay can be seen in the Cumberland soil (Table 9). Where there is a decrease in percent silt and very fine sand, and an increase in either sand or clay, the soil becomes less erodible regardless of whether the corresponding increase is in the sand fraction or clay fraction. At the 0 to 5-inch depth in the Cumberland, size distribution is silt plus very fine sand 54.3 percent, sand 24.7 percent, clay 21 percent (100 percent of 0.002 to 2.0 mm). Organic matter content is 4 percent, and K-value is 0.25. At 14 inches, the silt plus very fine sand decreases to 45 percent, sand to 16.6 percent, and organic matter to 0.75 percent. Clay increases to 38.4 percent, but the K-value also increases to 0.31. This is due primarily to a decrease in the organic matter content, and only partly to less sand. But, at the 56-inch depth, content of organic matter is 0.36 percent, the silt plus very fine sand is 29.8 percent, sand is 12.0 percent, and the clay content is 58.2 percent, which leads to a decrease in the K-value to 0.16.

Erodibility decreases as the clay fraction becomes larger. Most of this effect is attributable to the increased cohesiveness. The effect of the clay ratio declines, however, as organic matter content or sand/silt ratio increases. According to Wischmeier and Meyer (16), the influence of clay is related to sand and organic matter. For a soil high in clay and 4 percent organic matter, erodibility decreases in relation to aggregation index, so long as the sand content is greater than 35 percent. At 2 percent organic matter, the critical sand level drops to about 10 percent. With clay content high and sand percentages considerably less, erodibility increases since aggregates composed largely of clay particles are more susceptible to erosion. There is some uncertainty about the accuracy of the nomograph extrapolations (13) on soils that are very high in clay which are virtually devoid of organic matter.

No provisions are included in the K-value prediction method for the effects of different types of clay on erodibility. However, since 2:1 expanding lattice type clays exhibit more cohesiveness, it follows that these type clays should be less erosive. Contrarily, the hydrous oxides and 1:1 clays are more stable and less affected by wetting and drying, have a lower Coefficient of Linear Extensibility, and a higher bearing capacity. Needless to say, further work is needed in this area to determine the relative effects of each type. At present time, research is being conducted to explain this through a parameter based on the sum of free iron and aluminum oxides.

With the Sequatchie soil (Table 22, page 39), the influence of an increasing sand content on predicted K-values can be seen. At a depth of four inches, there was 40.4 percent sand, 46 percent silt plus very fine sand, 1.2 percent organic matter, 13.6 percent clay, and a K-value of 0.34. At 35 inches, the sand increased to 55.6 percent, silt decreased to 27.7 percent, organic matter to 0.36 percent, clay decreased to 16.7 percent, and the K-value decreased to 0.25. Then, at 43 inches, the percent silt plus very fine sand decreased to 5.9 percent and sand increased to 87.1 percent, organic matter decreased to 0.15 percent, and clay decreased to 7.0 percent. These values give a substantial decrease to 0.11, in the K-value, illustrating the effect of sand on K-value predictions.

In this group of soils, some contain considerable amounts of coarse fragments (2.0-76 mm). The soils with the higher percentages include Dellrose with an average of 31 percent, Fullerton 11 percent, Stiversville 17 percent, Bodine 46 percent, Muskingum 16 percent, and Braxton 20 percent. These coarse fragments will decrease erodibility values by reducing the detachment effects of raindrops and reducing the velocity of runoff. The amount of reduction of the K-values will depend upon the content of coarse fragments. According to Meyer (3), when 16 percent of the surface is covered by coarse fragments there is little reduction in soil loss, but a 60 percent coverage (Figure 2) effected a 75 percent reduction. Based on this information, the actual K-values will be lower than those predicted for the fine fraction alone, but between these two rates of coverage exact values would be difficult to predict.

Through use of this nomograph method, it is now possible to determine the differences in K-values for different horizons and layers within

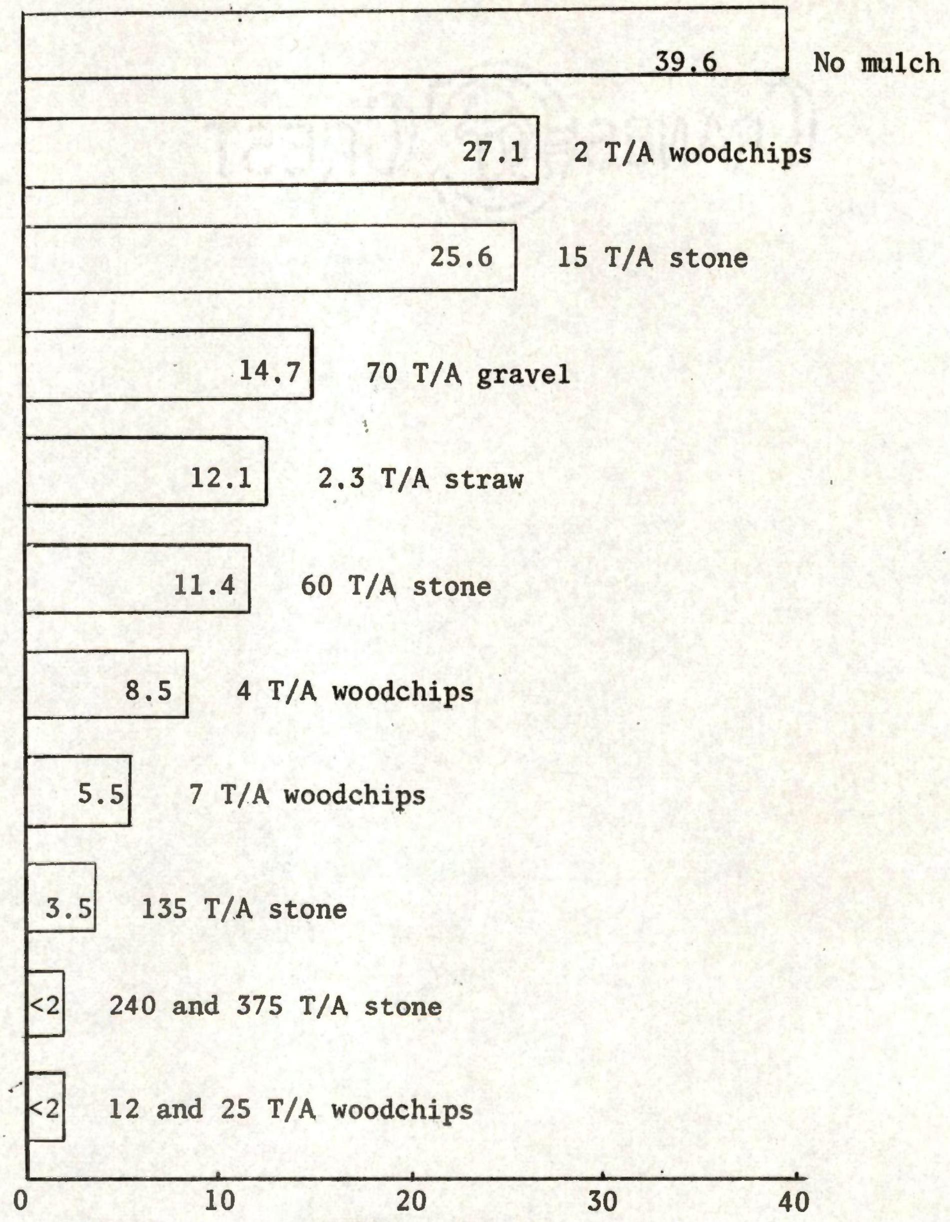

Figure 2. Influence of several mulch types and rates on soil loss from 5:1 construction side slopes (rain intensity = 2.5 in./hr.; total applied = 5 in.; slope length = 35 ft.).

Source: Reference 3.

horizons. This method can also be very helpful in updating published K-values which are now in use.

Comparison of these values predicted by the nomograph with the published values now in use, shows some differences. For soils high in coarse fragments, the nomograph values were higher than the published values which probably had taken the coarse fragments into consideration. They are not accounted for in the nomograph. For soils high in clay, the nomograph predicted lower values. The nomograph predicted higher values for silty soils, and much lower values for soils high in organic matter. This is because of the new knowledge which has been obtained on the effects of particle size distribution and organic matter on erodibility.

II. APPLICATION OF SOIL-LOSS INFORMATION ON CONSTRUCTION SITES

Once the K-values have been determined for various excavation depths on the soil series with which the contractor is working, it will be possible to predict the amount of soil loss expected from the site. It will also be possible to select alternative methods which will reduce soil loss substantially, as seen in Table 27, and the section entitled recommendations.

III. RECOMMENDATIONS FOR REDUCING SOIL LOSS

There are basically four methods which, if used correctly, will effect a large reduction in soil loss from any given soil. They are as follows:

TABLE 27

EXAMPLES OF APPLICATION OF SOIL-LOSS INFORMATION WITH ALTERNATIVES*

												Soil Loss Per Year		
Series	County	Site Size	Excavation Depth	Texture	Slope	Slope Length	R	K	LS	C	P	Tons Per Site	X Factor	Cubic Yards Per Site
		acres	inches		percent	feet								
Dellrose*	Dekalb	8	34	sicl	12	300	220	.45	3.15	1	1	2,495	0.92	2,295
		8	45	sicl	12	300	220	.35	3.15	1	1	1,940	0.92	1,785
Dickson	Coffee	10	6	sil	8	260	230	.36	1.60	1	1	1,320	0.87	1,148
		10	23	sil	8	260	230	.53	1.60	1	1	1,950	0.87	1,697
Fullerton	Knox	5	13	sil	15	200	190	.48	3.67	1	1	1,674	0.87	1,456
		5	41	sicl	15	200	190	.36	3.67	1	1	1,255	0.92	1,155
Henry	Fayette	25	18	sil	5	400	320	.62	1.07	1	1	5,307	0.87	4,617
		25	40	sil	5	400	320	.57	1.07	1	1	4,879	0.87	4,245
Loring	Fayette	30	13	sicl	10	500	320	.42	3.08	1	1	12,418	0.92	11,425
		30	28	sil	10	500	320	.54	3.08	1	1	15,966	0.87	13,891
Maury	Rutherford	20	16	sicl	12	350	230	.32	3.40	1	1	5,004	0.92	4,604
		20	40	sicl	12	350	230	.23	3.40	1	1	3,597	0.92	3,309
Sequatchie	Putnam	15	26	sl	14	200	220	.35	3.30	1	1	3,811	0.87	3,316
		15	26	sl	14	200	220	.35	3.30	0.10	1	381	0.87	332
		15	43	s	14	200	220	.11	3.30	1	1	1,198	0.67	803
		15	43	s	14	100	220	.11	3.30	1	0.70	839	0.67	562

*Based on the soil-loss equation: A = RKLSCP

R values from Table 1, page 8.
K values from Tables 5-26, pages 22-43, respectively.
LS values from Table 2, page 10.
C value of 0.10 from table on effectiveness of ground cover on erosion and sediment control on construction sites.
P value of 0.70 calculated from Table 2, LS factor 2.3 for 100 feet divided by factor for 200-foot slope, 3.3, equals 70 percent reduction in soil loss.
C and P are assumed to have a value of 1.0 for prediction on construction sites, unless otherwise stated.
Conversion factors from table for converting soil losses from tons per acre to cubic yards per acre.

**This Dellrose sample contains an average of 31 percent coarse fragments, or those ranging in size from 2-76 mm. Of the arbitrary depths selected, 28 percent by weight was attributed to coarse fragments at a depth of 34 inches and 36 percent by weight at 45 inches.

Coarse fragments reduce soil losses, the reduction depending on the amount present. Meyer (3) found that coarse fragments covering 16 percent of the soil surface had little effect on soil loss from an unvegetated 20 percent slope, but a 60 percent stone mulch cover (Figure 2, page 47) effected a 75 percent reduction in soil loss. Therefore, the actual soil loss is expected to be somewhat less than that predicted by the K-values at the depths calculated for the fine fraction.

1. Depth of cut adjustment - Adjust the designed depth of cut so it will end either above or below a highly erodible soil layer. In other words, select the layer with the lowest K-value, when possible.

For example, if the planned excavation depth for the Dickson series is 23 inches, its K-value would be 0.53.

Solving the equation A = RKLSCP for a 10-acre site in Coffee County, with an 8 percent slope 260 feet long, an R-value of 230 is obtained from Table 1, page 8, and an LS-value of 1.6 from Table 2, page 10. The C and P factors are assigned a value of 1.0.

Therefore:

A = 230 x 0.53 x 1.6 x 1.0 = 195 tons per acre per year.

195 x 10 = 1950 tons per year for the site.

Converting to cubic yards, 1950 tons x 0.87 (conversion factor for silt loam from Table 28) = 1697 cubic yards.

When the excavation depth is reduced to six inches, the K-value decreases to 0.36, giving:

A = 230 x 0.36 x 1.6 x 1.0 = 132 tons per acre per year.

132 x 10 = 1320 tons per year for the site.

Converting to cubic yards, 1320 tons x 0.87 (conversion factor) = 1148 cubic yards.

2. Use a mulch - Four different economical sources of mulching materials have been tested and found to be very satisfactory in reducing

TABLE 28

FACTORS FOR CONVERTING SOIL LOSSES (AIR-DRY) FROM TONS PER ACRE (T/A) TO CUBIC YARDS PER ACRE (CU. YDS./A)

Soil	Factor
Sands	Multiply soil losses in T/A by .67 (110)*
Sandy loam	Multiply soil losses in T/A by .70 (105)
Fine sandy loam	Multiply soil losses in T/A by .74 (100)
Sandy silt loam	Multiply soil losses in T/A by .82 (90)
Silt loam	Multiply soil losses in T/A by .87 (85)
Silty clay loam	Multiply soil losses in T/A by .92 (80)
Clay loam	Multiply soil losses in T/A by .98 (75)
Clay	Multiply soil losses in T/A by 1.06 (70)

*The number in parentheses is the air-dry weight of the soil per cubic foot and from which the conversion factors were calculated.

Source: USDA, Soil Conservation Service. Predicting soil losses for urbanizing areas in Tennessee. Chapter 5, 1972.

erosion (3). The amount of reduction (Figure 2, page 47) will depend on the amount of surface covered by the mulch (Table 29) and the length of slope (Figure 3).

The four recommended sources of mulches are as follows:

a. Woodchips can be used at a rate of seven tons per acre and effect an 86 percent reduction in erosion (Figure 2). This should be considered a minimum rate.

b. Crushed stone, when used at a rate of 135 tons per acre, can reduce the rate of soil loss by 91 percent (Figure 2).

c. Gravel, at the rate of 70 tons per acre in Figure 2, reduced the amount of soil loss by approximately 37 percent.

d. Straw, when applied at a rate of 2.3 tons per acre reduced erosion loss by 70 percent on slopes up to 20 percent.

3. Use a vegetation ground cover - Ground covers have reduced soil losses by 90-98 percent (Table 30). Using the Sequatchie series at a depth of 26 inches in Table 27, page 49, a C factor value of 0.10 was obtained when annual ryegrass was established since it reduced the rate by 90 percent.

Ground covers may be used separately when soil conditions will permit their establishment at the various excavation depths. Also, they may be used in conjunction with the crushed stone, woodchips or straw mulch to give excellent stands and erosion control.

4. Slope modification -

a. Shape - Concave slopes will erode less than convex slopes, as seen in Figure 4. The amount of deviation will depend upon the the degree of curvature.

TABLE 29

PORTION OF SOIL SURFACE COVERED BY MULCH

Mulch Type	Mulch Rate tons/acre	Average Cover percent
No mulch	---	---
Straw	2.3	95
Stone	15	16
	60	62
	135	90
	240	100
	375	100
Gravel	70	62
Woodchips	2	32
	4	68
	7	88
	12	99
	25	100

Source: Reference 3.

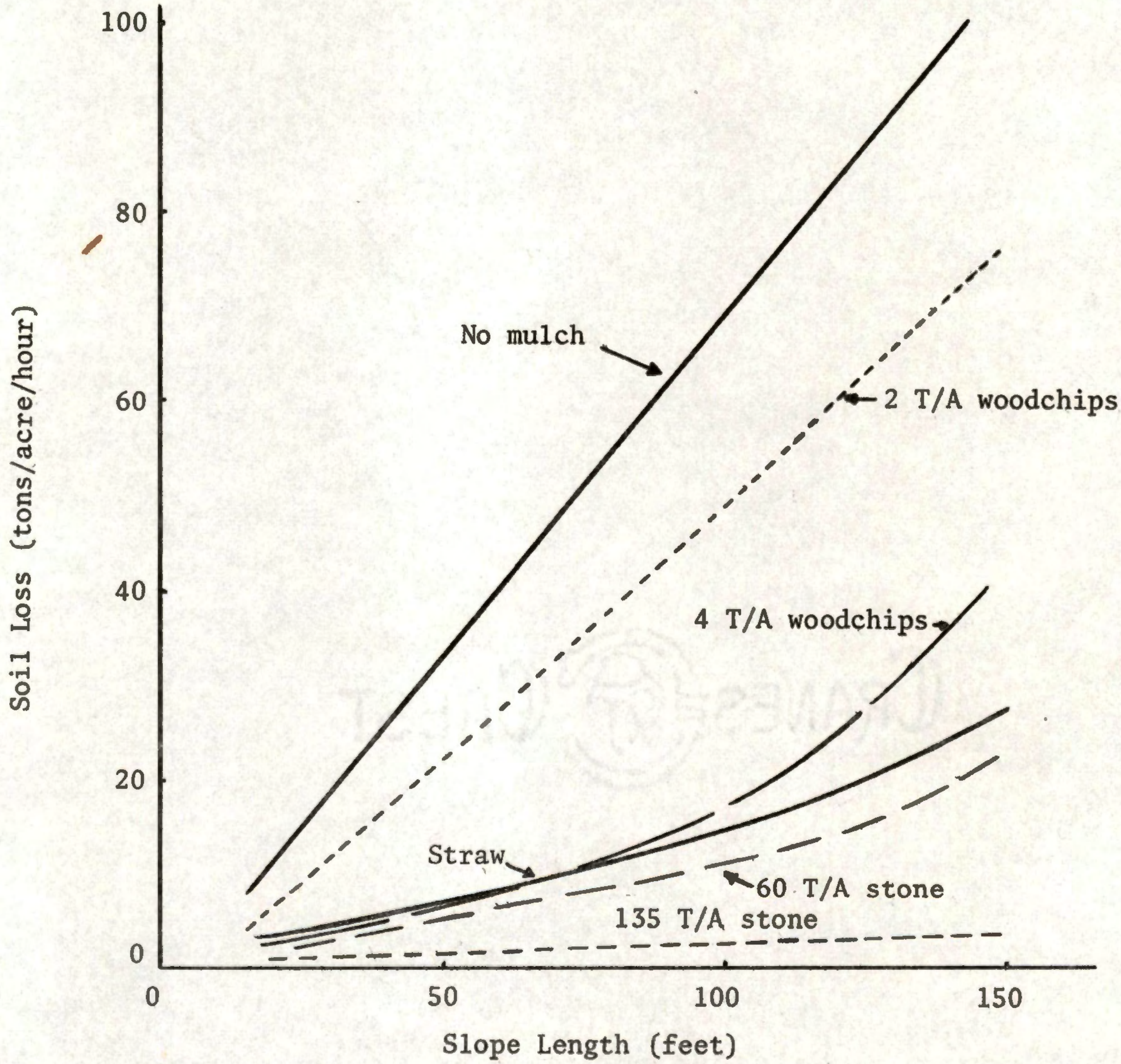

Figure 3. Influence of slope length on erosion rate for several mulch types and rates (5:1 slope).

Source: W. H. Wischmeier, "Soil erodibility on construction areas." Highway Research Board - Special Report 135, Washington, D. C., 1973.

TABLE 30

EFFECTIVENESS OF GROUND COVER ON EROSION AND SEDIMENT CONTROL ON CONSTRUCTION SITES

Kinds of Ground Cover*	Soil Loss Reductions Related to Bare Surfaces
	percent
Permanent grasses	99
Ryegrass (perennial)	95
Ryegrass (annual)	90
Small grain	95
Millet or sudangrass	95
Field bromegrass	97
Grass sod	99

*Values based upon full, established stand.

Source: USDA, Soil Conservation Service, Technical Guide. Estimating Rainfall-Erosion Soil Losses on Construction Sites and Similarly Disturbed and Unvegetated Areas in West Virginia. Section II-A - III-B. 1970.

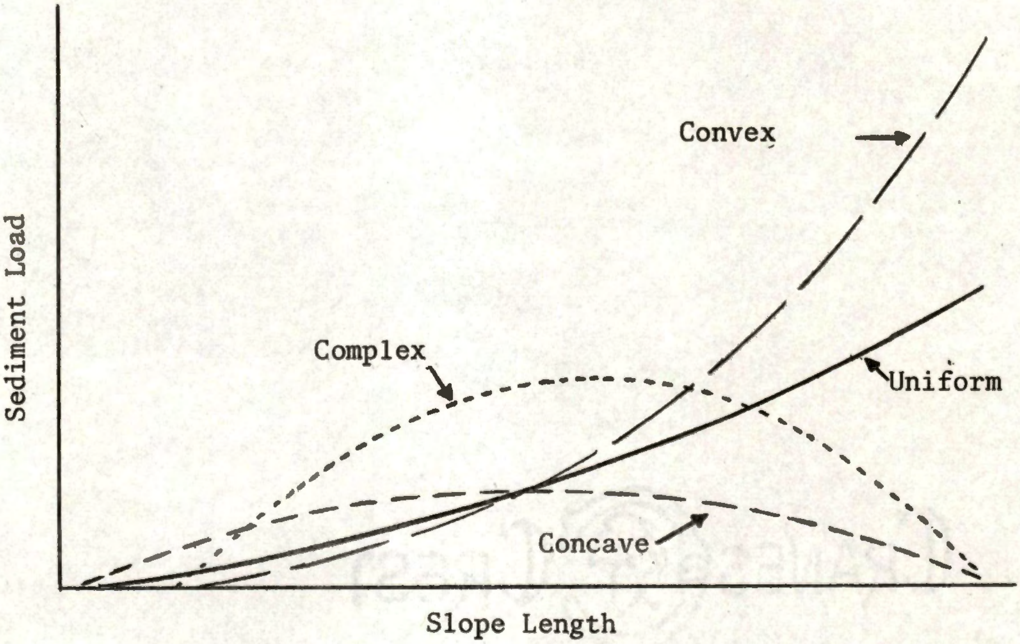

Figure 4. Influence of land slope shape on sediment load.

Source: W. H. Wischmeier, "Soil erodibility on construction areas." Highway Research Board - Special Report 135, Washington, D. C., 1973.

b. Length - Soil loss can be reduced by decreasing the length of slope. Using Sequatchie, at a depth of 43 inches in Table 27, page 49, as an example, in which the length of slope is cut from 200 feet to 100 feet by benching or terracing. By reducing slope length, the LS factor is reduced from 3.3 to 2.3, thus decreasing soil loss 359 tons per year for the site. Also, as seen in Figure 4, the effectiveness of mulches is greatly influenced by the length of slope.

The largest reductions were observed in the use of vegetative covers. The change in loss is relatively small in most instances for depth adjustment, unless the lower portions of the profile contain a considerable amount of sand and/or clay, with a relatively small amount of silt and very fine clay. Changing the length of slope leads to a small reduction, while mulches effected a relatively small to moderate reduction. Although some of these recommendations effect a larger reduction than others, none should be overlooked when attempting to reduce soil loss.

CHAPTER V

SUMMARY AND CONCLUSIONS

The soil-loss prediction equation was described from its early development through its present form. This description also included an example of how the equation may be used to predict soil losses from farmland, along with conservation measures which might be adopted to reduce the losses to acceptable levels.

The nomograph method, as developed by W. H. Wischmeier and coworkers, was also discussed. Included within the discussion was its development through the statistical analysis of the five parameters needed for its solution. Also included were the results of a statistical analysis of the accuracy when compared with actual erosion from plot tests. This analysis proved the nomograph to be very favorable for K-value prediction purposes. An example of the procedure in the use of the nomograph was included. A land owner could use this procedure to determine K-values for his particular soil.

Soil erodibility values were then determined, through use of the nomograph, on 44 representative soils from across the state. These soils were selected from different geographical locations to give a range in physical properties, for comparison purposes.

The K-values obtained from these soils varied considerably, as was expected.

The soils of West Tennessee exhibited the higher K-values. The values from these soils were in the 0.50 to 0.60 range, with the highest value being 0.69. These high values were attributed to the high amounts of silt and very fine sand. The lower K-values were calculated for the soils of the middle and eastern portions of the state which contained higher amounts of sand and clay, along with sufficient amounts of organic matter to reduce the predicted values. Some of these predicted values were as low as 0.11. For the soils high in coarse fragments, the nomograph values were higher than those published in previous literature, probably because the published values had taken the coarse fragments into consideration, whereas they are not accounted for in the nomograph.

Using the K-values predicted for some of these soils, examples were set up to demonstrate the importance of K-values in the erosion prediction equation. In these examples, soil loss prediction was indicated under one set of conditions on construction areas, with recommendations for reducing soil loss. These recommendations included depth of cut adjustment, mulching, slope modifications, and the use of vegetative cover. From these recommendations, the largest reductions were observed in the use of vegetative covers.

Information on the subsoil K-values not only show the depths of cut that would result in the most or the least sediment yield potential but also show whether return of stockpiled topsoil on the exposed subsoil would be beneficial or detrimental.

The nomograph solution, although quantitative, reflects only the effect of the soil on gross erosion. The universal soil-loss equation combines this soil parameter with effects of five other factors to predict gross sediment from specific farm or construction site areas.

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