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A STUDY OF AGRICULTURAL NONPOINT POLLUTION AND AVAILABLE BEST MANAGEMENT PRACTICES FOR CONTROL IN OKLAHOMA.

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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

A STUDY OF AGRICULTURAL NONPOINT POLLUTION AND AVAILABLE BEST MANAGEMENT PRACTICES FOR CONTROL IN OKLAHOMA

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

MARK RANDOLPH COX

Norman, Oklahoma

1978

A STUDY OF AGRICULTURAL NONPOINT POLLUTION AND AVAILABLE

BEST MANAGEMENT PRACTICES FOR CONTROL

IN OKLAHOMA

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ABSTRACT

This study utilizes the highly proven research model developed by the Soil Conservation Service known as the Universal Soil Loss Equation with pollution loading equation developed by the Midwest Research Institute, Kansas City, Kansas to predict areas of the state which have the greatest potential for nonpoint pollution from agricultural sources. Sediment loss from agricultural landuses serves as the indicator of other nonpoint pollutants such as nutrients and organic matter which are transported adsorbed to the sediment particles.

Data generated from this study originates from the use of the Universal Soil Loss Equation for representative landuse-soil type acreages across the state. This information is compiled in the form of landuse-land capability matrices. Data from the matrices provides the following information:

1) Incompatible landuse-soil capability class combinations which are resulting in large quantities of nonpoint pollution.

2) Sources of the nonpoint pollution, e.g. what portion of the nonpoint pollution originates from cropland, pasture, range or forest. From this information decisions as to the amount, type and cost of nonpoint pollution control

measures (Best Management Practices) can be made.

3) A priority listing for counties is developed to determine which counties will require greater allocations of federal monies for nonpoint pollution control.

The nonpoint pollution predictions are compared to completed nonpoint pollution studies and surveys for the purpose of determining whether the predictions are supportive of these studies. The results of this research are in general agreement with other nonpoint pollution studies in Oklahoma.

Best Management Practices are identified which are applicable to nonpoint pollution control in Oklahoma. A general guide is developed for selection of Best Management Practices and a simplified cost-effectiveness evaluation is carried out on the more common Best Management Practices used on cropland. The data generated and conclusions derived from this study encourage and justify the implementation of Best Management Practices for the control of nonpoint pollution from agricultural sources.

A STUDY OF AGRICULTURAL NONPOINT POLLUTION AND AVAILABLE BEST MANAGEMENT PRACTICES FOR CONTROL IN OKLAHOMA

CHAPTER I

INTRODUCTION

Background of Study

The 1972 Amendments to the Federal Water Pollution Control Act (PL 92-500) specifically require that nonpoint sources of water pollution be considered in the development of statewide water quality management plans. Nonpoint sources of water pollution (NPSP) differ from point sources of pollution primarily by the mechanism by which the pollutants reach a given body of water. Nonpoint pollution is diffuse in its spacial dimensions and quite variable in its temporal movement whereas point sources of pollution are more exact in both spacial and temporal characteristics. Examples of nonpoint pollution in which this study is primarily concerned with are sediment, organic matter and nutrients entering a waterway from agricultural surface runoff. An example of point pollution is a site where municipal wastes enter a body of water. From the above examples of the two different types of water pollution one can readily envision that the techniques used to assess the two types of pollution will differ. The following statement conveys the importance of nonpoint source pollution:

> If an average American were asked to describe the sources of pollution that degrade the nation's waters, he would most likely point to industrial wastes dumped into our rivers by manufacturing plants or untreated municipal sewage poured into our lakes and streams. In reality, these 'point sources of pollution' by no means account for all our water quality problems. We are becoming increasingly aware of the significant deleterious impact that 'nonpoint sources of pollution'--agricultural and silvicultural runoff, acid mine drainage, urban runoff, and sediment from construction sites--have on the quality of our national water resources. (Pisano, 1976)

Generally, the concern with nonpoint sources of pollution is focused on the pollution carried by storm water runoff. Urban nonpoint sources have received considerable attention in the past few years and several acceptable models have been developed to assess nonpoint pollution from urban areas. In contrast, information on nonpoint pollution from rural areas has been developed more recently and will be discussed later in Chapter II.

Three general approaches are available for estimating the quantity and quality of surface runoff from agricultural sources; each have certain limitations. The most suitable approach for assessment of the nonpoint source problem depends on a number of factors including:

1) size of the study area,
2) availability of landuse, soils, water quality, and other pertinent data, and
3) time available to gather base line data if not currently available.

The approach selected should be able to respond to future changes in landuse and agricultural practices if it is to be an effective tool for proper land management. The first approach is to gauge and sample runoff from a land area. The sampling approach has advantages in being based on data obtained directly from local conditions such as landuse, rainfall, topography, soils and other watershed characteristics. These advantages are outweighed, however, by its being time-consuming, expensive and static. For example, it would be difficult as well as expensive to set up sampling stations in each of the fifty-nine river segments draining the waters of Oklahoma. (The state has been divided into fifty-nine river segments by the Water Resources Board for water quality management, see figure 1.) Even with the economics of selective sampling, a longer time period for sampling would be both expensive and beyond the scope of this research study. In addition, a short term sampling program might not turn up a precipitation event which will have a significant load impact on stream quality. This was a problem encountered by the Oklahoma Conservation Commission in their short term nonpoint pollution sampling program. (Roach, 1978)

The second approach utilizes a "black-box" predictor to multiply acreage values for various landuses by previously established unit runoff values in order to obtain total loads. However, this approach excludes considerations which may differ widely from one geographic area to another. Such considerations include watershed characteristics, such as vegetative cover, conservation practices, soil types, topographic features as well as climatological factors that affect rainfall and its transport properties. The third approach, as described herein, to a large extent overcomes the problems and limitations of the first two approaches.

FIGURE 1 WATER QUALITY PLANNING BASINS AND SEGMENTS

OKLAHOMA

Source: Oklahoma Water Resources Board

Purpose of the Study

The approach utilized in this study combines the use of a highly proven research model developed by the Soil Conservation Service termed the Universal Soil Loss Equation (Wischmeier, 1965) with pollution loading equations developed by the Midwest Research Institute (McElroy, 1976) to predict areas of the state which have the greatest potential for nonpoint source pollution from agricultural runoff. The mathematical equations are used to compute nonpoint pollution such as sediment, organic matter and nutrients from agricultural landuses which reach the stream or are "loaded" into the stream, hence the name pollution loading equations. Furthermore, the Universal Soil Loss Equation provides the opportunity to select alternative cropping and management combinations (Best Management Practices) that limit nonpoint source pollution, specifically erosion rate, organic matter and nutrient loadings, to acceptable limits. The output of the prediction equations will aid water quality planners to better understand the nonpoint pollution contributed from agricultural sources over all areas of Oklahoma. Some of the applications of this study follow.

Application of Information Developed from This Study

Data generated from this study basically originates from the use of the Universal Soil Loss Equation (USLE) on different landuse-soil type acreages across the state. This information is compiled in the form of landuse - land capability matrices attached in appendix A. Calculations of soil loss from the matrices enables the user to assess the following:

1) Identify incompatible landuse - soil capability class combinations.

2) Identify current landuse patterns which are resulting in large quantities of nonpoint pollution (soil loss and other soil-borne pollutants such as organic material and nutrients).

3) Identify counties and conservation districts which will require greater allocations of federal monies for conservation treatment.

4) Identify the source of the nonpoint pollution, e.g. cropland, range, pasture or forest, such that the amount, type and cost of conservation treatment needed to reduce nonpoint pollution can be estimated.

5) Through the use of the Universal Soil Loss Equation, the effectiveness of nonpoint pollution control practices (Best Management Practices) can be estimated.

6) Actual mapping of land capability classes within a county which are generating large quantities of nonpoint pollution would be possible through the use of landuse - land capability matrices and county soil maps.

Scope and Limitations of the Study

The study area includes all seventy-seven counties in the state of Oklahoma. Due to the large size of the study area, estimates must be made concerning area characteristics which are used in the prediction equations. The predictions are long term average yields of nonpoint pollution and an accuracy estimate is given in Chapter III. Specific limitations which occur when developing factors to estimate nonpoint pollution will be discussed at appropriate points throughout the study. Verification of the results of this study will be discussed in Chapter IV.

CHAPTER II

LITERATURE SURVEY

Nonpoint Pollution Assessment Considerations

One of the problems one encounters in planning for water quality management for large areas is the diverse nature of the area of study. Oklahoma, due to its physiographic location in the North American continent, displays an extreme diversity in land form, vegetation, hydrology, soils and other pertinent features which must be evaluated when assessing nonpoint pollution. For example, rainfall which is the major determinant of surface runoff varies from sixteen inches per year in the western panhandle to as much as fifty-six inches per year in the southeastern part of the state. (Cox, 1977) Elevation ranges from almost 5000 feet above sea level in the Oklahoma panhandle to approximately 287 feet in the southeastern part of the state. (Johnson, 1972) For a general review of general environmental characteristics of the state refer to the Oklahoma Comprehensive Water Plan as referenced.

Quantitative evaluation of the magnitude and impact of nonpoint pollution from agricultural sources is currently more of an art than science. Application of any assessment methodology should be carried out only with the proper understanding of factors involved with nonpoint pollution such as hydrology, soils, cropping practices, and sediment transport. Equally important is determining what level of resolution you are seeking and recognizing the limitations associated with assessment of different size land areas. The following is a discussion concerning the general characteristics of nonpoint source loads to serve as a primer before the consideration of the different assessment methodologies available.

General Characteristics of Nonpoint Source Pollution

Landuse and the associated environmental conditions, e.g. watershed characteristics, determine the type, form, concentration, location, quantity, and time distribution of pollutants which are generated from a given area. Table 1 (Mulkey, 1977) gives a summary of the nonpoint pollutants which are generated from various agricultural activities. Although sediment, organic matter and nutrients are the only nonpoint pollutants predicted in this study, other resulting pollutants, such as pesticides, microorganisms and salts, are transported at least partially by sediment and therefore are commonly loaded into streams in direct proportion to sediment.

The hydrologic cycle is the primary determinant of the timing, volume, frequency and quality of nonpoint pollution loadings. Figure 2 (Chow, 1964) is an interpretation of the components of the hydrologic cycle. The watershed responds to this cycle as a system which yields outputs (including nonpoint source pollutants) in response to a series of inputs. Yevjevich described this concept in this way:

Continental surfaces, underground acquifers, inland bodies of water,

TABLE 1

SUMMARY OF AGRICULTURAL ACTIVITIES AND ASSOCIATED POLLUTANTS

Activity	Pollutant: Sediment	Nutrients	Pesticides	Organic material	Micro-organisms	Salts
Crop Production						
Seed bed preparation	X					
Chemical application	X	X	X			
Cultivation	X					
Harvesting	X			X		
Animal Production						
Concentrated feeding	X	X		X	X	X
Grazing - normal	X		X			
- overgrazing	X		X			
- along streams		X		X	X	

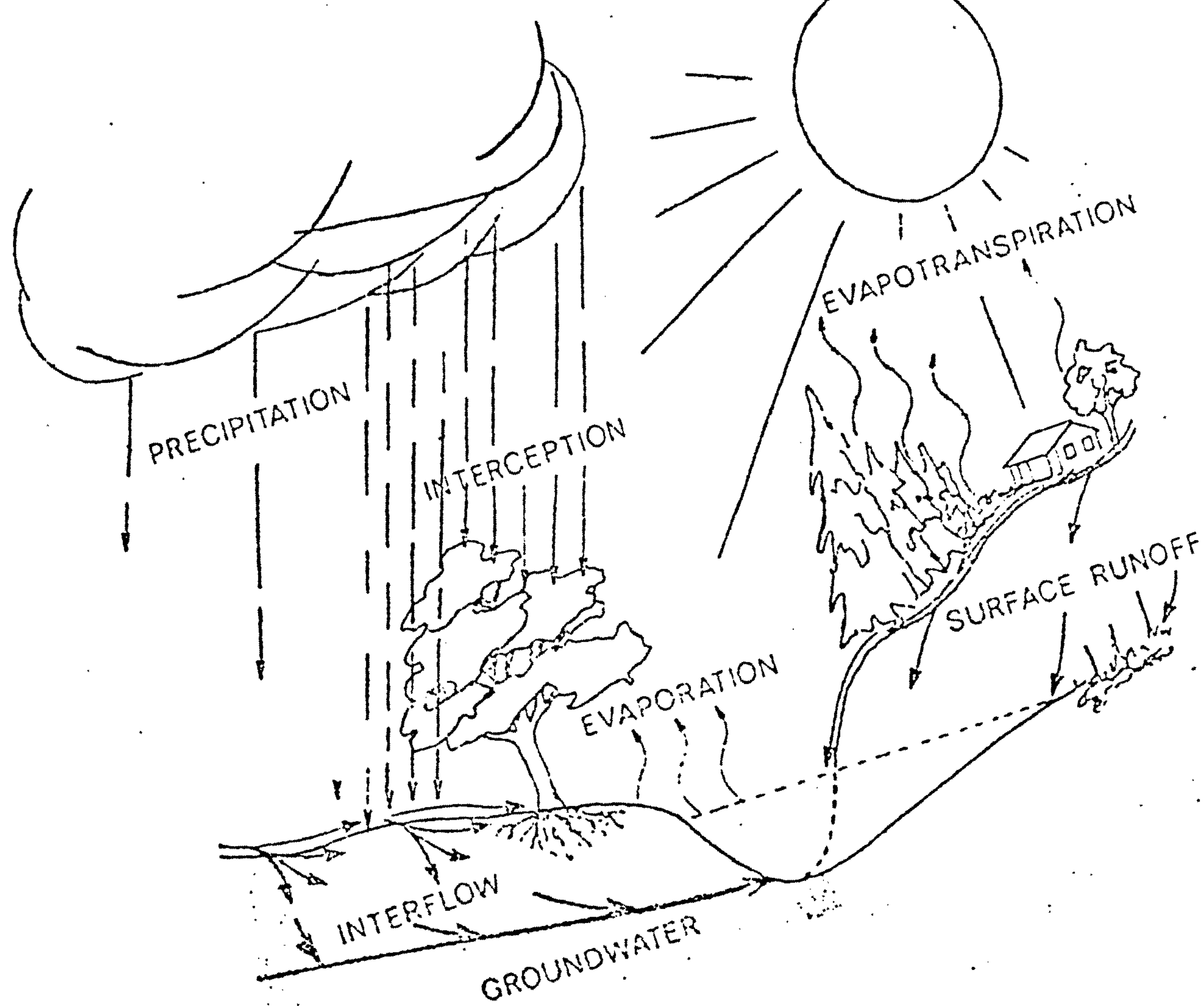


FIGURE 2

THE HYDROLOGIC CYCLE

> plants, and soil are environments with complex water inputs, environmental trinity, input-response-output, in combinations, mutual dependences, and feedbacks is defined as the hydrologic system. (Yevjevich, 1971)

A systems description of agricultural watersheds is given by Stewart, et. al. which can be generalized to describe any nonurban system. Figure 3 demonstrates this idea (Mulkey, 1977). From this pictorial representation of the watershed and its loading response one should immediately recognize the importance of a clear understanding of the components in order to properly assess the potential nonpoint pollution problems.

The noncontrollable or partially controllable inputs indicated in Figure 3 are precipitation, solar radiation and pollutant rainout. Precipitation, which is in part influenced by solar radiation, is the driving force for pollutant transport. Surface runoff and subsurface flow (interflow and ground water movement) act as the transport vehicle by which the nonpoint pollutants reach a body of water. The majority of the pollutants travel adsorbed to the sediment which is transported by surface runoff. The adsorbed pollutants include the following: organic matter, nutrients such as organic nitrogen, some ammonia and basically all forms of phosphorus, pesticides which are nonsoluble in water and microorganisms. The pollutants which are leached into subsurface water or travel via surface runoff per se without attachment to sediment are the following: soluble forms of nitrogen such as NO_2, NO_3, soluble forms of pesticides, microorganisms washed off in suspension, organic matter in suspension. The prediction equations and runoff models which have been developed to this point in time have not been

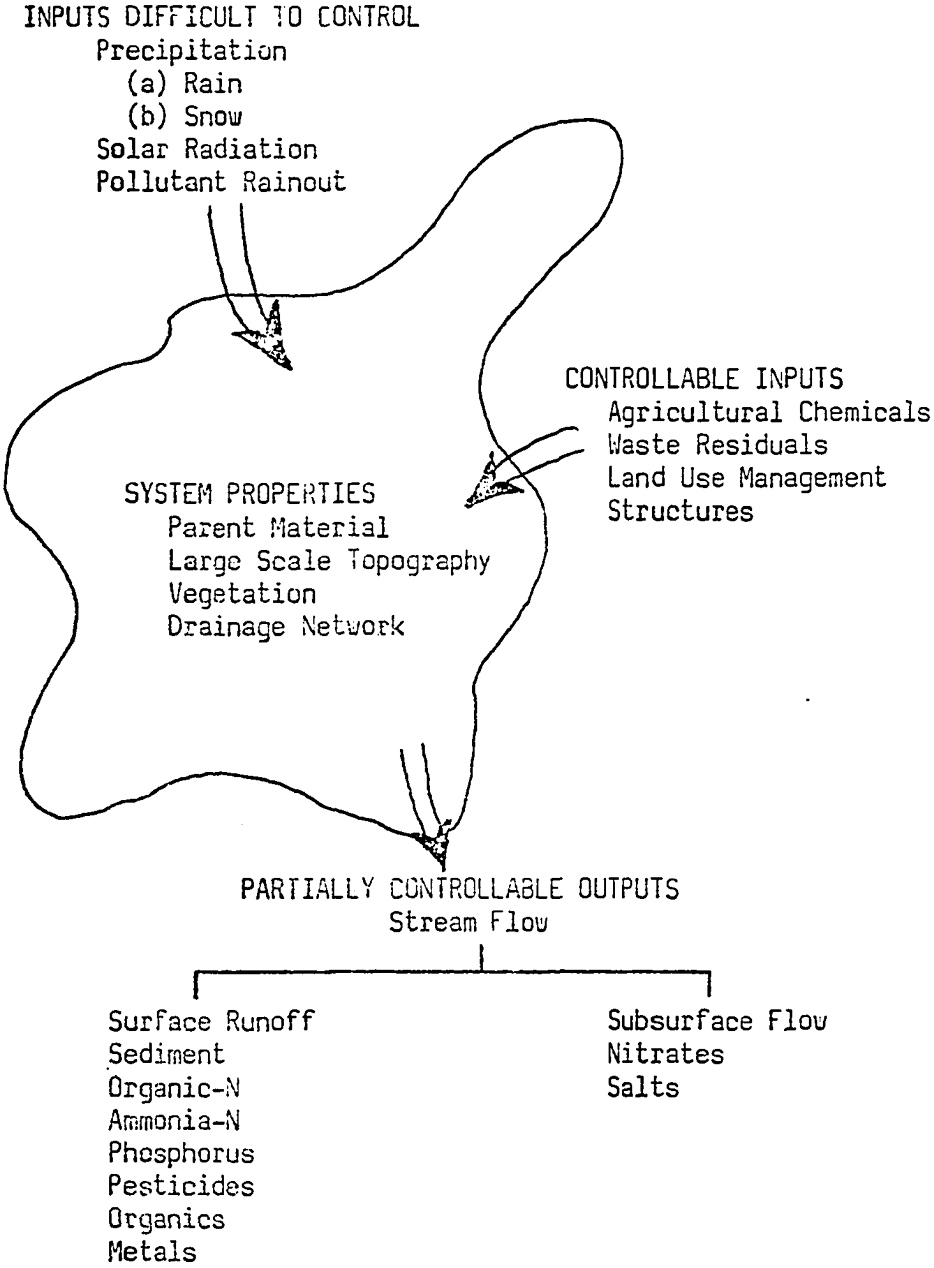


FIGURE 3

WATERSHED NPSP LOADING RESPONSE TO HYDROLOGY AND LAND USE able to address adequately this "partitioning" of pollutants into the two modes of transport. Some attempts have been made to develop techniques which will adequately describe or predict the transport of pollutants by both modes of transport (soluble transport verses sediment adsorbed transport), namely the Agricultural Chemical and Transport Model (ACTMO) developed by the Agricultural Research Service, U.S. Department of Agriculture (Frere et. al., 1975) and the Agricultural Runoff Management Model (ARM) developed for the Environmental Protection Agency by Hydrocomp Inc. of California (Donigan, 1976). Unfortunately, these two prediction models are applicable only to small land areas which make them unsuitable for large area studies.

Significance of Selected Nonpoint Pollutants on Water Quality

Before a review of the various nonpoint pollution prediction models applicable to agriculture, a brief discussion of the significance of the pollutants should be presented. The nonpoint pollutants discussed will be the ones predicted by the USLE-MRI prediction equations used in this study.

Sediment

Sediment is composed of detached soil particles transported by surface runoff to bodies of water. The sediment produced by erosion of sloping lands, gullies, and streambanks and deposited in surface water is generally recognized as the greatest single pollutant from nonpoint sources (McElroy et. al. 1976). Sediment affects water quality and resources in the following ways:

1) Decreases light transmission which not only affects aquatic life, e.g. photosynthesis and the basic food chain processes, but is esthetically undesirable.

2) Sediment occupies space needed for water storage and therefore decreases the functional capacity of water reservoirs.

3) Decreases fish reproduction due to deleterious effect on egg hatching, feeding, breeding, etc.

4) Harbors other pollutants such as nitrogen, phosphorus, organic matter, pesticides and pathogens.

5) Increases water treatment cost for public usage.

6) Decreases the capacity of streams to assimilate oxygen demanding wastes. It is estimated that each year farming operations pollute the water with approximately two billion tons of sediment. (Klutz, 1978) In addition to the effect of sediment on water resources, the loss of top soil from agricultural lands represents a significant drain on our natural resources.

Nitrogen

Nitrogen occurs in the following interconvertible forms: organic nitrogen, such as simple amino acids and amines, ammonia or ammonium ions, nitrite, nitrate, nitrogen gas. The following is a simplified illustration of the nitrogen cycle. (modified from Robertson, 1973)

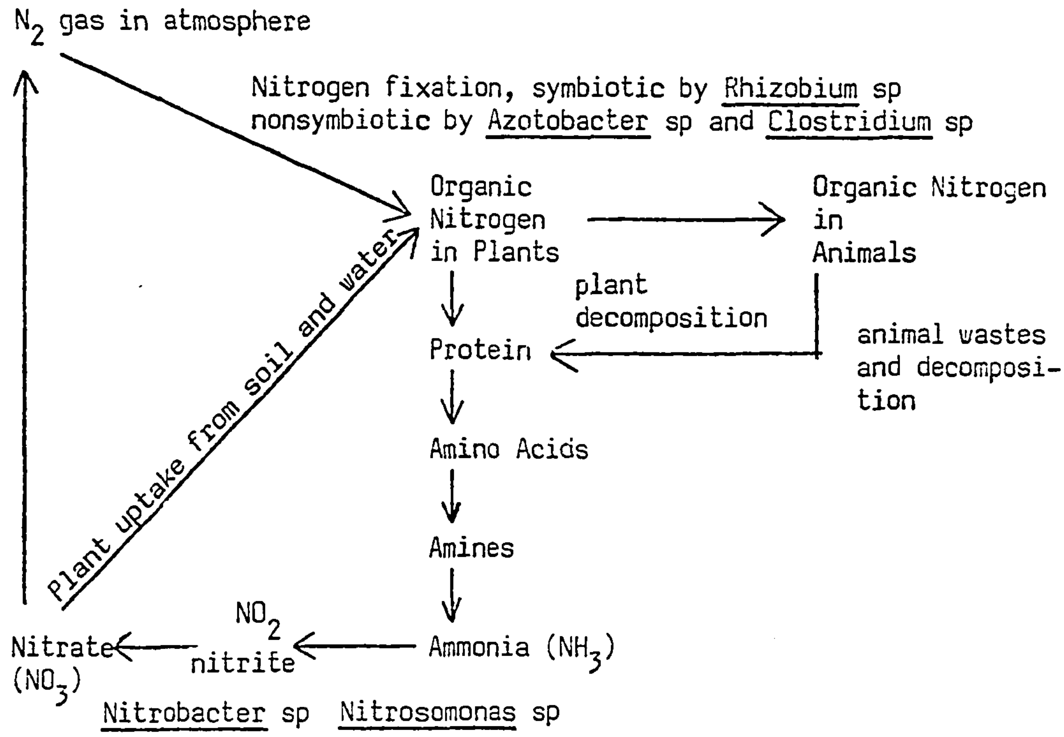


Figure 4

Nitrogen is an important rate-limiting nutrient for algal growth in some surface waters. If algal growth proceeds unchecked at a rapid rate, depletion of dissolved oxygen, offensive odors, elimination of desired aquatic species and premature aging of a reservoir can occur. This process is termed eutrophication. See Table 2 Eutrophication Potential as a Function of Nutrient Concentration (Zison et. al., 1976). Cultivated soils contain two to four tons of total nitrogen per acre in the plowed layer. As much as 95% of the total nitrogen in the soil is organically bound and not readily released in the form of plant growth (Kansas Conservation Commission, 1978). However, since the nitrogen forms are interconvertible, the unavailable nitrogen reaching the water from the soil erosion process acts as a nutrient sink which will

TABLE 2

EUTROPHICATION POTENTIAL AS A FUNCTION OF NUTRIENT CONCENTRATIONS

P (mg-P/l)	N (mg-N/l)	Dry Algal Cells (mg/l)	Significance
0.013	0.092	1.45	Problem threshold
0.13	0.92	14.5	Problem likely to exist
1.3	9.2	145.0	Severe problems possible

later be available for plant utilization. Rainfall is also a significant source of nitrogen loading to surface water and will be discussed later in conjunction with the prediction equations for nonpoint pollutants. The increasing use of synthetic fertilizers is another source of nitrogen available for transport to surface waters and in many cases probably has been responsible for the increased awareness of nutrient damage to waters.

Phosphorus

Phosphorus is also considered a rate-limiting nutrient for algal growth in surface waters. Phosphorus in water encourages the growth of aquatic plants and therefore leads to similar problems mentioned in the nitrogen discussion. See Table 2 Eutrophication Potential as a Function of Nutrient Concentrations. Phosphorus occurs naturally in soil from weathering of primary phosphorus bearing minerals in the parent material. Addition of plant residues and fertilizers by man enhances the phosphorus content of the surface soil layer. Soil erosion is the predominant mode of phosphorus transport to surface waters (McElroy et. al., 1976) and therefore high phosphorus concentration in water may be an indicator of a high rate of sediment loading. The following is a simplified version of the phosphorus cycle (modified from Robertson, 1978).

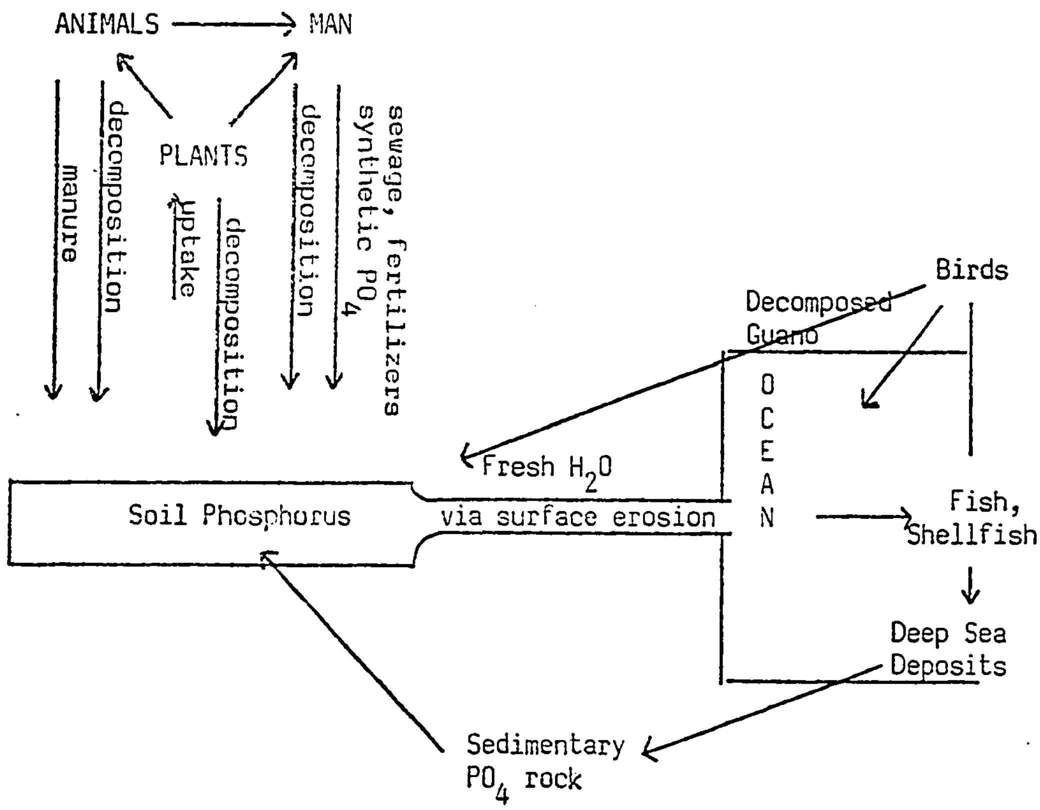


Figure 5

Organic Matter

Organic matter content of soils is derived from the decomposition of living organisms. It includes plant, animal and microbial residues of various stages of breakdown. There is a constant cycling of organic remains to inorganic minerals and then back to organic matter. This occurs on both land and in water. The organic-inorganic conversion requires the presence of oxygen to oxidize the organic molecules and therefore can deplete the oxygen reserve of a body of water. If dissolved oxygen levels fall below a critical level, desirable fish species begin to decline and in severe conditions the water may become septic and devoid of all desirable life forms. A simplified organic-inorganic cycling is given below.

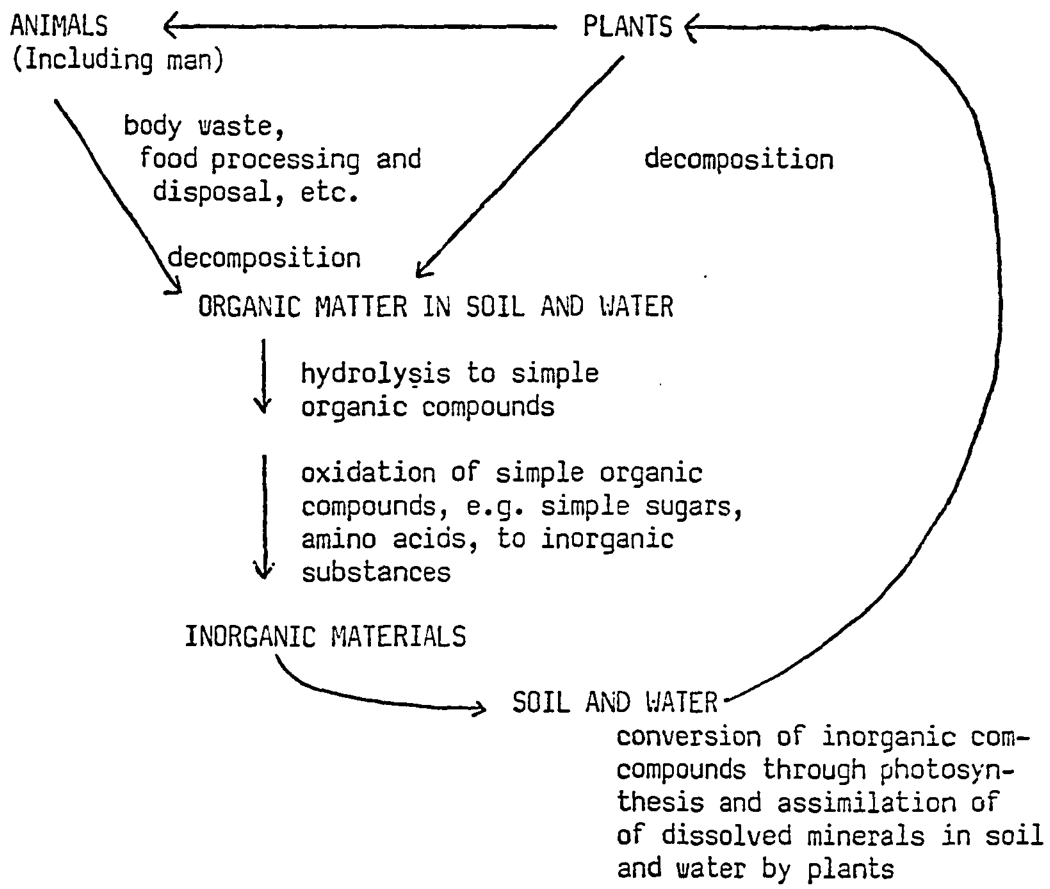


Figure 6

Models Available for Assessment of Nonpoint Pollution from Agricultural Sources

An excellent review of the mathematical models available for predicting nonpoint pollution is given in the EPA publication 600/

9-76-014 "Areawide Assessment Procedures Manual Volume I." Basically mathematical models are of one of the four types:

1) Empirical methods - calculation procedures based on analysis of data or certain known relationships among variables.
2) Deterministic methods - models based on a rigorous representation of known relationships (physical or mathematical).
3) Stochastic methods - models based on the concepts of probability theory and the idea that future events are determined by random processes.
4) Simulation methods - models containing components of each of the above methods which attempt to simulate the behavior of the processes known to influence the variable of interest.

Regression equations like the Universal Soil Loss Equation and the urban runoff equations are examples of empirical approaches. Deterministic models have been developed for estimating pipe and rigid-boundary, open channel flow but as to date no deterministic nonpoint source models are available due to the complexity of quantifying watershed parameters. Stochastic models are becoming popular tools in water resource problem solving (Shen, 1976). These methods require large amounts of data generally not available for water quality studies. Stochastic models have been used by the National Oceanic and Atmospheric Administration (NOAA) e.g. Sacramento model (Burnash, 1973) to predict streamflow and potential flooding conditions. The Sacramento model is currently being used at the

National Weather Service River Forecast Center located in Tulsa (Yates, 1976). Simulation models are currently employed at the Agricultural Research Center located at Chickasha (Nicks, 1978). Application of any of the above models to estimate nonpoint pollution requires calibration and verification. For some empirical models, like regression equations, e.g. U.S.L.E., both are trivial tasks because the exact form of the model is determined by the available data. The test of "accuracy" is inherent and reflected in the statistical measures of correlation (Mulkey, 1976).

Nonpoint pollution models can also be evaluated by their properties, e.g. prediction capabilities to the watershed-hydrologic system. Three fundamental properties can be listed: spacial resolution, temporal resolution, and transport assumptions.

Spacial resolution of the models varies from field scale predictions to very large aeral, e.g. river basin predictions. Temporal resolution ranges from models which predict individual runoff events or annual average pollutant loadings to models which continuously simulate the water quality. Transport assumptions deal with the mode and route of travel of nonpoint pollutants from the land area to the stream or body of water. Pollutants will be transported as mentioned earlier either adsorbed to the sediment and move with the surface runoff or will travel in dissolved form in the surface runoff or subsurface flow. Table 3 (Mulkey, 1976) illustrates the above properties of nonpoint pollution prediction models.

Table 4, Input Data Features Concerned in Models, was compiled by the Oklahoma Conservation Commission (Chin, 1978) to compare the data

TABLE 3

SELECTED CHARACTERISTICS OF NONURBAN NONPOINT SOURCE MODELS

Characteristic	Model				
	NPS	AGRUN	ACTMO	ARM	MRI
<u>Spatial Resolution</u>					
Field scale	X		X	X	X
First-order watershed	X	X	X	X	X
Basin		X			X
<u>Temporal Resolution</u>					
Runoff event	X	X	X	X	
Annual average	X		X	X	X
Continuous	X		X	X	
<u>Transport Assumption</u>					
Sediment	X	X			X
Partitioned			X	X	

TABLE 4

INPUT DATA FEATURES CONCERNED IN NONPOINT SOURCE MODELS
(Chin, 1978)

Concerned Input Data Features	NPS Model	ARM Model	MRI Model
Geographical Factors of Watershed	X	X	X
Soil Classification	X	X	X
Precipitation	X	X	X
Sediment from Universal Soil Loss Equation	X	X	X
Enrichment Ratio*	X		X
Air Temperature	X	X	X
Wind Effect	X	X	
Solar Radiation	X	X	
Evapotranspiration	X	X	
Interception	X	X	
Upper and Lower Zone Storage	X	X	
Initial Moisture Condition	X	X	
Infiltration or Seepage	X	X	X
Groundwater Recharge and Discharge	X	X	
Snowmelt Simulation	X	X	
Nutrient Inter-transformation		X	
Pesticide Degradation		X	

* Nutrient in sediment/nutrients in soil

requirements of three selected models. It might be mentioned that the input requirement and the complexity of the computer runs for the NPS and ARM model make these models cost prohibitive in evaluating large areas.

The following gives a brief description of these nonpoint pollution models and is taken from Mulkey's work:

NPS: The Nonpoint Source Pollutant Loading Model (NPS) was developed by Hydrocomp, Inc., for the EPA. The model was specifically designed for use in planning studies and is compatible with existing water quality impact models. The model is comprised of sub-programs to represent the hydrologic processes in a watershed, including snow accumulation and melt, and the processes of pollutant accumulation, generation, and washoff from the land surface. The hydrologic components, derived from the Stanford Watershed Model, have been previously tested and verified on a number of watersheds across the country. The sediment and pollutant transport components have been tested on several urban and rural watersheds for selected pollutants and are currently undergoing additional testing. The simulation of pollutants is based on sediment as an indicator. Erosion processes are simulated and the resulting loads are converted to pollutant loads by user-specified "potency factors" that indicate the pollutant strength of the sediment for each pollutant simulated.

The NPS model can simulate loads from a maximum of five different landuses in a single production run. In addition to runoff, water temperature, dissolved oxygen, and sediment, the NPS model can simulate up to five user-specified pollutants from each landuse category. The Oklahoma Conservation Commission is currently experimenting with the NPS model on small land areas (Chin, 1978).

Documentation of the model, complete with a user manual and program listing, is available from the EPA in a report entitled "Modeling Nonpoint Pollution from Land Surfaces," EPA 600/3-76-083 (July, 1976).

ACTMO: The Agricultural Chemical and Transport Model (ACTMO) was developed by the Agricultural Research Service, U.S. Department of Agriculture. The model consists of three components simulating hydrology, erosion and sedimentation, and interactions of agricultural chemicals with soil-water-plant systems. The USDA HL-74 Model (Holtan, 1975) was used for the hydrologic component and the Universal Soil Loss Equation was modified to generate erosion/sedimentation. ACTMO is one of two models (ARM is the other) that simulate the partitioning of pollutants between water and sediment. The hydrologic model has been tested on several watersheds, the sediment model has been tested in two locations and the chemical transport model is essentially untested. Portions of this model were developed by personnel at the Agricultural Research Center in Chickasha, Oklahoma (Frere, 1976).

Documentation of the model is available from the ARS-USDA in a report entitled, "ACTMO - An Agricultural Chemical Transport Model," ARS-H-3 (June, 1975).

ARM: Agricultural Runoff Management Model (ARM) simulates runoff, sediment, pesticides, and nutrient contributions to stream channels from both surface and subsurface sources. No channel routing procedures are included. Thus, the model is applicable to watersheds that are small enough for channel processes and transformations to be negligible. Although the limiting area will vary with climate and topographic characteristics, watersheds greater than one to two square miles are approaching the upper limit of applicability. Channel processes will significantly affect the water quality in larger areas (Roach, 1978).

The major components of the model individually simulate the hydrologic response of the watershed, sediment production, pesticide adsorption/desorption, pesticide degradation, and nutrient transformations. Attempts to utilize this model on small areas in Oklahoma have resulted in less than acceptable results (Nicks, 1978).

Documentation of this model may be obtained from "Modeling Pesticides and Nutrients on Agricultural Lands," (Donigan, 1976) and from "Agricultural Runoff Management Model (ARM) - Version II - Refinement and Testing" (Donigan, 1976).

AGRUN: (Water Resources Engineers). AGRUN is a revised version of the runoff block of the Stormwater Management Model (SWMM) which can be used to estimate runoff quantity and quality from agricultural lands. AGRUN has not been extensively tested and therefore needs further analysis before it becomes a usable tool for nonpoint pollution assessment. Documentation of this model is available from an EPA report (Roesner et. al., 1975).

The discussion of Best Management Practices (BMPs) will include the following:

1) Definition of BMPs and a review of applicable BMPs in Oklahoma.
2) Determination of the BMPs needed to control nonpoint pollution in Oklahoma.

Definition and Examples of Best Management Practices

Best Management Practices (BMPs) refer to a conservation practice, or combination of practices, that is determined by a state (or designated areawide planning agency) after problem assessment, examination of alternative practices, and with appropriate public participation to be the most effective, practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals (Davey, 1977). Best Management Practices have been used for almost forty years by the Soil Conservation Service to control soil erosion and protect our national resources and were previously just referred to as conservation practices. As with most government programs, new programs call for new terminology; hence with the advent of PL 92-500 and Section 208, the term Best Management Practices arose.

Best Management Practices may consist of agronomic practices or structural measures and more frequently, a combination of each. Agronomic practices are conservation measures which improve crop residue management, cropping sequences, seeding methods, soil treatments, tillage methods, and timing of field operations. Structural practices include contour farming, terraces, diversions, waterways and other control structures. When the land properties such as excessive slope length or slope gradient, very erodible soil, poor drainage, etc. are present, agronomic practices alone are not adequate in controlling nonpoint pollution and other supportive practices such as the structural practices mentioned may be required (Stewart et. al., 1975). In November 1975 a joint publication from the USDA Agricultural Research Service and EPA Office of Research and Development was made available to the states to serve as a guideline for the development of land management strategies which would control pollution resulting from agricultural activities. Section four of this manual deals specifically with pollution control practices and their applicability to the different types of nonpoint pollution resulting from agricultural landuse.

The following is a listing of the various pollution control practices (Best Management Practices) applicable in Oklahoma as presented in the USDA-EPA publication. Tables 5, 6, 7 and 8 give a brief description of each of the conservation practices. The practices are divided into four groups:

1. Erosion Control Practices — Table 5
2. Runoff Control Practices — Table 6
3. Nutrient Management Practices — Table 7
4. Pesticide Management Practices — Table 8

It should be recognized that an important interrelationship exists between many of the four groups of practices. For example, the introduc-

TABLE 5
PRINCIPAL TYPES OF CROPLAND EROSION CONTROL PRACTICES AND THEIR HIGHLIGHTS

No.	Erosion Control Practice	Practice Highlights
E1	No-till plant in prior-crop residues	Most effective in dormant grass or small grain; highly effective in crop residues; minimizes spring sediment surges and provides year-round control; reduces man, machine and fuel requirements; delays soil warming and drying; requires more pesticides and nitrogen; limits fertilizer and pesticide placement options; some climate and soil restrictions.
E2	Conservation tillage	Includes a variety of no-plow systems that retain some of the residues on the surface; more widely adaptable but somewhat less effective than E1; advantages and disadvantages generally same as E1 but lesser degree.
E3	Sod-based rotations	Good meadows lose virtually no soil and reduce erosion from succeeding crops; total soil loss greatly reduced but losses unequally distributed over rotation cycle; aid in control of some diseases and pests; more fertilizer-placement options; less realized income from hay years; greater potential transport of water soluble P; some climatic restrictions.
E4	Meadowless rotations	Aid in disease and pest control; may provide more continuous soil protection than one-crop systems; much less effective than E3.
E5	Winter cover crops	Reduce winter erosion where corn stover has been removed and after low-residue crops; provide good base for slot-planting next crop; usually no advantage over heavy cover of chopped stalks or straw; may reduce yield of cash crop.

TABLE 5
continued

No.	Erosion Control Practice	Practice Highlights
E6	Improved soil fertility	Can substantially reduce erosion hazards as well as increase crop yields.
E7	Timing of field operations	Fall plowing facilities more timely planting in wet springs, but it greatly increases winter and early spring erosion hazards; optimum timing of spring operations can reduce erosion and increase yields.
E8	Contouring	Can reduce average soil loss by 50% on moderate slopes, but less on steep slopes; loses effectiveness if rows break over; must be supported by terraces on long slopes; soil, climatic, and topographic limitations; not compatible with use of large farming equipment on many topographies. Does not affect fertilizer and pesticide rates.
E9	Contour strip cropping	Rowcrop and hay in alternate 50- to 100-foot strips reduce soil loss to about 50% of that with the same rotation contoured only; fall seeded grain in lieu of meadow about half as effective; area must be suitable for across-slope farming and establishment of rotation meadows; favorable features similar to E3 and E9.
E10	Terraces	Support contouring and agronomic practices by reducing effective slope length and runoff concentration; reduce erosion and conserve soil moisture; facilitate more intensive cropping; conventional gradient terraces often incompatible with use of large equipment, but new designs have alleviated this problem; substantial initial cost and some maintenance costs.

TABLE 5
continued

No.	Erosion Control Practice	Practice Highlights
E11	Grassed outlets	Facilitate drainage of graded rows and terrace channels with minimal erosion; involve establishment and maintenance costs and may interfere with use of large implements.
E12	Change in land use	Sometimes the only solution. Well managed permanent grass or woodland effective where other control practices are inadequate; lost acreage can be compensated for by more intensive use of less erodible land.
E13	Other practices	Contour furrows, diversions, subsurface drainage, land forming, closer row spacing, etc.

TABLE 6

PRACTICE FOR CONTROLLING DIRECT RUNOFF AND THEIR HIGHLIGHTS[1]

No.	Runoff Control Practicing	Practice Highlights
R1	No-till plant in prior crop residues	Variable effect on direct runoff from substantial reductions to increases on soils subject to compaction.
R2	Conservation tillage	Slight to substantial runoff reduction.
R3	Sod-based rotations	Substantial runoff reduction in sod year; slight to moderate reduction in rowcrop year.
R4	Meadowless rotations	None to slight runoff reduction.
R5	Winter cover crop	Slight runoff increase to moderate reduction.
R6	Improved soil fertility	Slight to substantial runoff reduction depending on existing fertility level.
R7	Timing of field operations	Slight runoff reduction.
R8	Contouring	Slight to moderate runoff reduction.
R9	Contour strip cropping	Moderate to substantial runoff reduction.
R10	Terraces	Slight increse to substantial runoff reduction.
R11	Grassed outlets	Slight runoff reduction.
R12	Change in land use	Moderate to substantial runoff reduction.
R13	Other practices Contour Furrows Diversions Drainage Landforming	Moderate to substantial reduction. No runoff reduction. Increase to substantial decrease in surface runoff. Increase to slight runoff reduction.

TABLE 6
continued

No.	Runoff Control Practicing	Practice Highlights
R14	Construction of ponds	None to substantial runoff reduction. Relatively expensive. Good pond sites must be available. May be considered as a treatment device.

[1] Erosion control practices with same number are identical. Limitations and interactions shown in Table 1, Principal Types of Cropland Erosion Control Practices and Their Highlights, also apply to runoff control practices.

TABLE 7
PRACTICES FOR THE CONTROL OF NUTRIENT LOSS FROM AGRICULTURAL APPLICATIONS AND THEIR HIGHLIGHTS

No.	Nutrient Control Practice	Practice Highlights
N1	Eliminating excessive fertilization	May cut nitrate leaching appreciably, reduces fertilizer costs; has no effect on yield.
	Leaching Control	
N2	Timing nitrogen application	Reduces nitrate leaching; increases nitrogen use efficiency; ideal timing may be less convenient.
N3	Using crop rotations	Substantially reduces nutrient inputs; not compatible with many farm enterprises; reduces erosion and pesticide use.
N4	Using animal wastes for fertilizer	Economic gain for some farm enterprises; slow release of nutrients; spreading problems.
N5	Plowing-under green legume crops	Reduces use of nitrogen fertilizer; not always feasible.
N6	Using winter cover crops	Uses nitrate and reduces percolation; not applicable in some regions; reduces winter erosion.
N7	Controlling fertilizer release or transformation	May decrease nitrate leaching; usually not economically feasible; needs additional research and development.
	Control of Nutrients in Runoff	
N8	Incorporating surface applications	Decreases nutrients in runoff; no yield effects; not always possible; adds costs in some cases.
N9	Controlling surface applications	Useful when incorporation is not feasible.
N10	Using legumes in haylands and pastures	Replaces nitrogen fertilizer; limited applicability; difficult to manage.

TABLE 7
continued

No.	Nutrient Control Practice	Practice Highlights
	Control of Nutrient Loss by Erosion	
N11	Timing fertilizer plow-down	Reduces erosion and nutrient loss; may be less convenient.

TABLE 8
PRACTICES FOR THE CONTROL OF PESTICIDE LOSS FROM AGRICULTURAL APPLICATIONS AND THEIR HIGHLIGHTS

No.	Pesticide Control Practice	Practice Highlights
	Broadly Applicable Practices	
P1	Using alternative pesticides	Applicable to all field crops; can lower aquatic residue levels; can hinder development of target species resistance.
P2	Optimizing pesticide placement with respect to loss	Applicable where effectiveness is maintained; may involve moderate cost.
P3	Using crop rotation	Universally applicable; can reduce pesticide loss significantly; some indirect cost if less profitable crop is planted.
P4	Using resistant crop varieties	Applicable to a number of crops; can sometimes eliminate need for insecticide and fungicide use; only slight usefulness for weed control.
P5	Optimizing crop planting time	Applicable to many crops; can reduce need for pesticides; moderate cost possibly involved.
P6	Optimizing pesticide formulation	Some commercially available alternatives; can reduce necessary rates of pesticide application.
P7	Using mechanical control methods	Applicable to weed control, will reduce need for chemicals substantially; not economically favorable.
P8	Reducing excessive treatment	Applicable to insect control; refined predictive techniques required.
P9	Optimizing time of day for pesticide application	Universally applicable; can reduce necessary rates of pesticide application.

TABLE 8
continued

No.	Pesticide Control Practice	Practice Highlights
	Practices Having Limited Applicability	
P10	Optimizing date of pesticide application	Applicable only when pest control is not adversely affected; little or no cost involved.
P11	Using integrated control programs	Effective pest control with reduction in amount of pesticide used; program development difficult.
P12	Using biological control methods	Very successful in a few cases; can reduce insecticide and herbicide use appreciably.
P13	Using lower pesticide application rates	Can be used only where authorized; some monetary savings.
P14	Managing aerial applications	Can reduce contamination of non-target areas.
P15	Planting between rows in minimum tillage	Applicable only to row crops in non-plow based tillage; may reduce amounts of pesticides necessary.

tion of an erosion control practice, such as minimal tillage to control sediment loss, may also reduce the amount of runoff as a result of the increase in ground cover and greater absorption capacity of the soil. Nutrient and pesticide loss may be reduced due to the fact that most nutrient forms and many pesticides adhere to the sediment. The loss of soluble forms of nutrients and pesticides may also be reduced as a result of the decreased amount of surface runoff. These might represent some of the positive aspects of the application of a pollution control measure directed toward the control of sediment. Some of the negative aspects which may result from the above sediment control practice might be the increased need for more nutrients (due to leaching) or the application of larger amounts of pesticides to control weeds which may occur with minimal tillage. Also, reduced amounts of surface runoff may result in the leaching of soluble nutrients and pesticides resulting in ground water pollution. Other important factors should be considered. For example, will the pollution control practice affect the farmer's crop yield? Does the farmer have the appropriate farm machinery to accommodate the changes resulting from implementation of the control practices? (Cox, 1978) For a more complete discussion of individual best management practices consult the USDA-EPA publication "Control of Water Pollution from Cropland" Volume I, A Manual for Guideline Development.

Determination of the Best Management Practices Needed to Control Nonpoint Pollution in Oklahoma

Method utilized to identify Areas of the State where BMPs are needed to control Nonpoint Pollution. The Universal Soil Loss Equation is the tool of choice when the Soil Conservation Service personnel construct a conservation plan for the control of soil erosion and the protection of natural resources from field size areas. The conservation plan is a recommended cropping-management system which includes the BMPs necessary to control nonpoint pollution. The procedure follows the general outline given below:

1. Determine area characteristics
    a. rainfall - runoff
    b. soil erodibility and tolerance limits
    c. topographic features such as slope gradient and length

These factors determine the area's erosion potential (indicator of nonpoint pollution potential).

2. Determine what Best Management Practices (when considering the area's erosion potential and the desired landuse) will keep soil loss compatible with soil tolerance limits.

Soil tolerance limits are defined as the maximum amount of soil loss which can be lost per given unit of time without causing excessive damage to the soil profile. Soil losses greater than five tons per acre per year is generally considered excessive for most landuses.

Fortunately this same method is possible on large scale study if the limitations of the methodology are recognized (Wischmeier, 1976). A more general approach for identifying Best Management Practices is necessary when planning on a statewide basis. The USLE still serves as the tool for identifying erosion potential and consequent nonpoint pollution. The methodology for determining the BMPs needed will be outlined in Chapter III.

Nonpoint Pollution Studies Completed or Ongoing in Oklahoma

The following agencies and the work which they have completed concerning nonpoint pollution from agricultural sources are listed and then will be briefly discussed.

1) Oklahoma Conservation Commission - Evaluation of Nonpoint Pollution Loading from Watersheds in Oklahoma, completed.
2) Agricultural Research Service - Several nonpoint pollution study projects completed and ongoing.
3) Oklahoma State University - Study of Nonpoint Pollution from a Rangeland Watershed Grazed by Beef Cattle, ongoing.
4) Oklahoma Foundation for Research Development and Utilization - Various nonpoint pollution assessment projects detailing problem areas of the state, completed and ongoing.

Oklahoma Conservation Commission's Work

The Oklahoma Conservation Commission (OCC) under the direction of Dr. William Roach established a network of nonpoint pollution monitoring stations across the state. The purpose of the monitoring station network was to provide a method to locate, evaluate and rank nonpoint pollution problems across the state. The sampling sites were established for different landuses (sources of nonpoint pollution) over representative areas of the state, e.g. stations were set up in all four corners of the state. The nonpoint pollution ranking model which was developed was based on the assumption that specific landuses have definable pollutants and that these pollutants generated from specific landuses could be used to predict nonpoint pollutants from similar landuses in other parts of the state. The monitoring program lasted approximately eighteen months and one of the major problems was the lack of significant rainstorms and runoff events in order to evaluate the "typical" pollutants from the sampled landuses. However, a ranking of the state's seven river basins was developed (see figure 21) which is discussed later in this study. The ranking gives the basin with the most serious nonpoint pollution problems a numerical value of one and the others are ranked similarly.

Agricultural Research Service (name recently changed to the Science and Education Administration - Federal Research)

The Agricultural Research Service located in Chickasha each year completes basic and applied research pertaining to land and water management. The most current and related nonpoint pollution studies include: 1) Eight 4 acre watersheds have been instrumented with water quality monitoring equipment to evaluate the effect of different landuse and management practices on nonpoint pollutants loadings. These small watersheds are located near El Reno; and 2) Little Washita River Watershed Model Implementation Project. This project began as of June 1978 and is designed to study the effects of the implementation of Best Management Practices on water quality. Some of the specific objectives are given below:

a) Demonstrate the effectiveness of the existing conservation districts and county ASC committees as functioning local bodies of government to implement nonpoint pollution control.

b) Demonstrate the ability of the local government to determine best management practices needed, develop best management practices and implement installation.

c) Demonstrate the cost effectiveness of selected best management practices for the control of nonpoint pollution.

d) Demonstrate effectiveness of best management practices to achieve water quality standards through voluntary installation.

e) Demonstrate that adequate federal cost-sharing will accelerate application of best management practices.

These objectives are listed in the "Implementation Plan - Little Washita River Watershed Nonpoint Sources of Pollution." The Model Implementation Project (MIP) as it is referred to is a joint effort of many agencies including the Soil Conservation Service, Oklahoma Conservation Commission, OSU Extension Service, Agricultural Stabilization and Conservation Service, Farmers Home Administration, Environmental Protection Agency, Oklahoma Department of Pollution Control, local conservation districts, county commissioners and a few other agencies or people. The Little Washita River Watershed was selected as the site of the MIP project for various reasons, some of which are listed below:

1) Severity of nonpoint pollution problems.

2) Large amount of existing data concerning water quality, hydrology, landuse, etc. was already available.

3) Cooperativeness of the farmers in this area of the state.

4) Access of the project area to responsible agencies.

The MIP project should provide vital information concerning the effectiveness of best management practices to control nonpoint pollution within the next three years.

Oklahoma State University - Department of Agronomy

The OSU study is being sponsored by an EPA grant to study the nonpoint pollutants associated with rangeland activities. The objectives of this study are stated by the project director (Powell, J. 1975):

1) To determine the source, transfer and transformation of potential pollutants on a rangeland watershed grazed by beef cows.

2) To determine and monitor the hydrologic and meteorologic parameters necessary to establish the water budget and movement of potential pollutants from a rangeland watershed in central Oklahoma.

3) To determine effects of environmental conditions on the rate of degradation of grazing cattle feces on rangeland.

4) To determine the effects of cattle waste concentration, chemical composition and distribution on levels of potential pollutants in rangeland soils.

This project commenced September 1976 and is still in operation at the present time.

Oklahoma Foundation for Research, Development and Utilization

The Oklahoma Conservation Commission has contracted with the Oklahoma Foundation for Research, Development and Utilization (OKF) to provide information concerning land and water use and management. OKF has placed in its computer Soil Conservation Service information concerning landuse, soils, topographic features, rainfall-runoff and other factors pertinent to assess nonpoint pollution problems across the state. OKF has used this information in conjunction with NASA's land satellite photographic information to develop a list of the counties which are the most serious sources of sediment. Table 19, discussed later in this study, gives a listing of these counties relative to their contribution to sediment loss.

CHAPTER III

METHODOLOGY AND RESULTS

This chapter will describe in detail the methods by which nonpoint pollution from agricultural sources is estimated and how Best Management Practices to control nonpoint pollution are determined.

Estimation of Nonpoint Pollution from Agricultural Sources

Nonpoint pollution from agricultural sources will be estimated based on the amount of annual sediment yield of various landuses. The major nonpoint pollutants identified are sediment, nutrients and organic matter transported adsorbed to the sediment. Nutrients and organic matter have been found to be directly related to erosion and sedimentation (McElroy et. al., 1976). This fact has resulted in the development of numerous nonpoint pollution models using soil loss as an indicator of other nonpoint pollutants, e.g. ACTMO, NPS, AGRUN, and MRI. The Midwest Research Institute loading equations were utilized for the following reasons:

1) data base availability,
2) simplicity of equations,
3) utility of equations, and
4) documentation and accuracy of equations.

The following is an explanation of the Midwest Research Institute equations used in this study to identify nonpoint pollution:

1. Estimation of Sediment Loading

   a. Sediment loading from surface erosion

      The Universal Soil Loss Equation (USLE) is used to predict the quantity of sediment loss from sheet and rill erosion (surface erosion). The loading function based on the USLE is

$$Y(S)_E = A(RKLSCPS_d)$$

Where: $Y(S)_E$ = Sediment loading from surface erosion, tons per acre per year.

A = Source area.

R = The rainfall factor which is the number of erosion index units in a normal year's rain.

K = The soil erodibility factor.

L = The slope length factor.

S = The slope-gradient factor.

C = The cropping-management or plant cover factor which is the ratio of soil loss from a field with a specified cropping and management or plant cover to that of a fallow condition. This factor measures the combined effect of all the interrelated cover, management variables plus the growth stage and vegetal cover at the time of the rain.

P = The erosion control practice factor. It is the ratio of soil loss with contour, stripcropping, or cross slope farming to that of straight row farming, up and down the slope.

Sd = Sediment delivery ratio which is the ratio of sediment delivered at a location in the stream system to the gross erosion from the drainage area above that point.

Comment: The factors of the USLE will represent an average of the given conditions for each county. Soil loss and loading from other sources of erosion such as gully, streambank, and roadside erosion are not estimated by this equation. Sediment from the sources other than surface erosion will not be estimated by this study.

Data Base for the USLE

Measurements of runoff and soil loss from field plots in the United States began about 1917, in Missouri (Smith, 1962). Between 1929 and 1933 the U.S. Department of Agriculture established ten Federal-State erosion research stations, in regions where the problem had become most critical. In the next 25 years, erosion plot studies were established at 32 more locations. Precise measurement of precipitation, runoff, soil loss and related field conditions at the 42 stations in 23 states were continuous for periods of five to thirty years (Wischmeier, 1972). From the experimental data collected from these erosion research stations the various factors influencing soil loss were quantified.

Factors Used in the USLE

The following is an explanation of the factors contained in the USLE.

A - Source Area

Landuse information in the form of cropping patterns on various land capability class - subclass combinations were obtained from the "Oklahoma Conservation Needs Inventory", March 1970, and the "Oklahoma Land Inventory, January 1978", both Soil Conservation Service publications. Land capability classification is an interpretive grouping of soil survey maps which group arable soils according to their potentialities and limitations for sustained production of common cultivated crops that do not require specialized site conditioning or site treatment. Non-arable soils were grouped according to their potentialities and limitations for the production and permanent vegetation and according to their risk of soil damage if mismanaged.

The capability classification provides three major categories: a) capability unit, b) capability subclass, and c) capability class. These categories are defined as such: Capability unit - grouping of soils that have about the same influence on production and responses to systems of management of common cultivated crops and pasture plants and require similar alternative systems of management for these crops. Longtime estimated yields of adapted crops for individual soils within the unit under comparable management do not vary more than twenty-five percent. Capability subclass - grouping of capability units having similar kinds of limitations and hazards. Four types of limitations or hazards are reccgnized: (1) erosion hazard - e; (2) wetness - w; (3) root zone limitations - s; and (4) climate - c. Capability class - this grouping is the broadest category in the capability classification system. The state soils are grouped into eight classes with the risks of soil damage or limitations becoming progressively greater from class I to class VII. Soils in class I through IV are capable under proper management of producing adapted plants, such as forest trees or range plants, and the common cultivated field crops and pasture plants. Soils in classes V, VI and VII are suited to the use of adapted native plants. Some soils in classes V and VI are also capable of producing specialized crops such as certain fruits and ornamentals, and even field and vegetable crops under highly intensive management involving elaborate practices for soil and water conservation. Soils in class VIII do not return onsite benefits for inputs of management for crops, grasses or trees.

R - Rainfall and Runoff Erosivity Index

R is numerically defined as the number of El units (erosivity index) for the specified time period. El is calculated as the product of two rainstorm parameters: kinetic energy of the storm in hundreds of foot-tons per acre times the maximum 30-minute intensity in inches per hour. Data from weather stations having 22 years or longer of recording-rainage records were analyzed to determine the long term, annual average R values for various locations (Wischmeier, 1958). The R values in El units range from 100 in Cimarron County in the far northwestern part of the state to 340 in McCurtain County in the far southeastern part of Oklahoma (see figure 7, Rainfall Erosion Index Map). As a result of the wide range of R factors for the different areas of the state (greater than 3 fold difference from NW to SE), the R factor is one of the major determinants of soil loss variations across the state.

K - Soil Erodibility Factor

This variable considers properties of given soil types which affect erodibility such as texture, structure, organic content and permeability. Also factors such as resistance to dispersion, splashing, abrasion and resistance to the transporting energy of the rainfall and runoff are considered in assigning the erodibility factor to a given soil type. Numerical estimates for certain soils were determined by measurements of soil loss per unit of R for a standard set of conditions established on small plots. A procedure for determining K values for soils is possible by using the soils textural class and percent organic matter. See table 9, Indications of the General Magnitude of the Soil-Erodibility Factor, K (Stewart et. al., 1975). A nomograph has also been developed to aid in determining K factors, see figure 8 (Wischmeier, 1965). The Soil Conservation Service has developed a state erodibility table for the various soils found in Oklahoma. The K factor ranges from 0.17 to 0.49 with most of the values in the 0.28 to 0.37 range and, therefore, is not a significant source of error when using the USLE for large areas in Oklahoma.

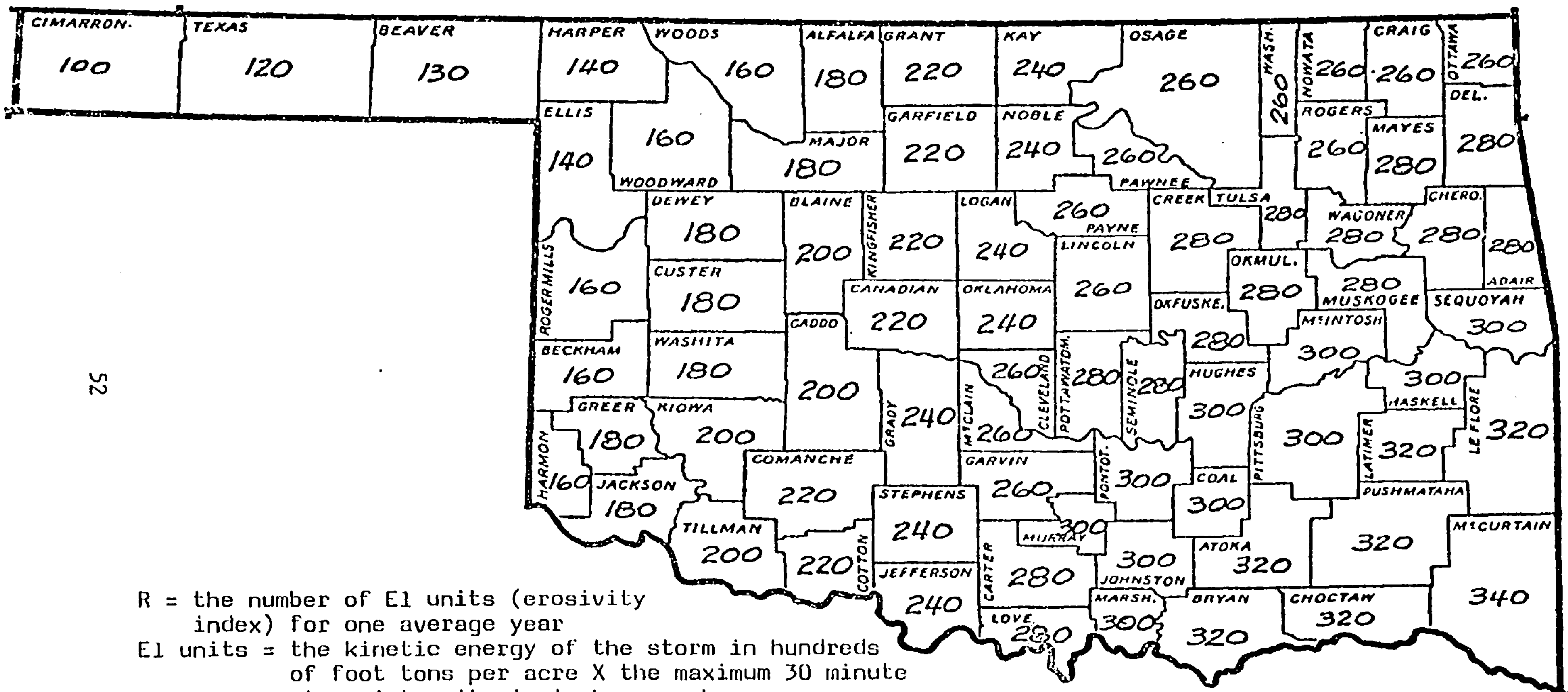
L - Slope Length Factor

This is the ratio of soil loss from the field slope length

OKLAHOMA

FIGURE 7

ANNUAL RAINFALL EROSION INDEX MAP "R"



R = the number of El units (erosivity index) for one average year

El units = the kinetic energy of the storm in hundreds of foot tons per acre X the maximum 30 minute storm intensity in inches per hour

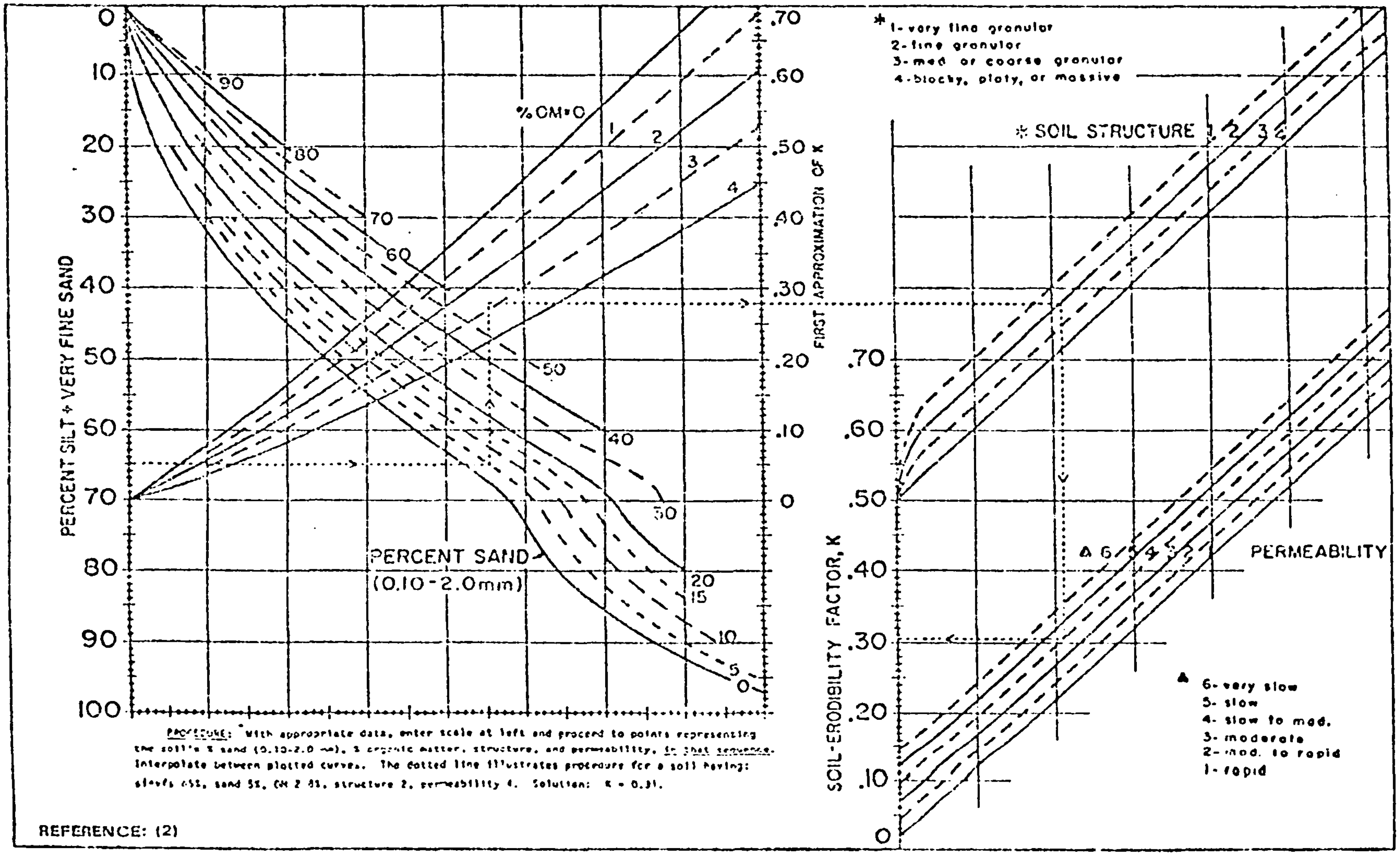


FIGURE 8 - Nomograph for determining soil-erodibility factor, K, for U.S. Mainland soils.

TABLE 9

INDICATIONS OF THE GENERAL MAGNITUDE OF THE SOIL-ERODIBILITY FACTOR, K

	Soil Erodibility Factor, K Organic Matter Content		
Texture Class	0.05%	2%	4%
Sand	0.05	0.03	0.02
Fine Sand	0.16	0.14	0.10
Very fine sand	0.42	0.36	0.28
Loamy sand	0.12	0.10	0.08
Loamy fine sand	0.24	0.20	0.16
Loamy very fine sand	0.44	0.38	0.30
Sandy loam	0.27	0.24	0.19
Fine sandy loam	0.35	0.30	0.24
Very fine sandy loam	0.47	0.41	0.33
Loam	0.38	0.34	0.29
Silt loam	0.48	0.42	0.33
Silt	0.60	0.52	0.42
Sandy clay loam	0.27	0.25	0.21
Clay loam	0.28	0.25	0.21
Silty clay loam	0.37	0.32	0.26
Sandy clay	0.14	0.13	0.12
Silty clay	0.25	0.23	0.19
Clay	0.13-0.29		

The values shown are estimated averages of broad ranges of specific-soil values. When a texture is near the borderline of two texture classes, the average of the two K values is used. For specific soils, Soil Conservation Service K-value tables will provide much greater accuracy.

to that from a 72.6 foot length on the same soil type and gradient. Slope length is defined as the distance from the point of origin of overland flow to 1) the point where the slope decreases to the extent that deposition begins or 2) the point where runoff enters a defined channel. See figure 9, Slope-Effect Chart and table 10, Slope-Effect Table (SCS publication, Estimating Soil Loss from Water and Wind Erosion).

S - Slope Gradient Factor

It is the ratio of soil loss from the field gradient to that from a 9 percent slope. The relation of soil loss to gradient is influenced by density of vegetative cover and by soil particle size. (Figure 9 and table 10, Slope-Effect Chart)

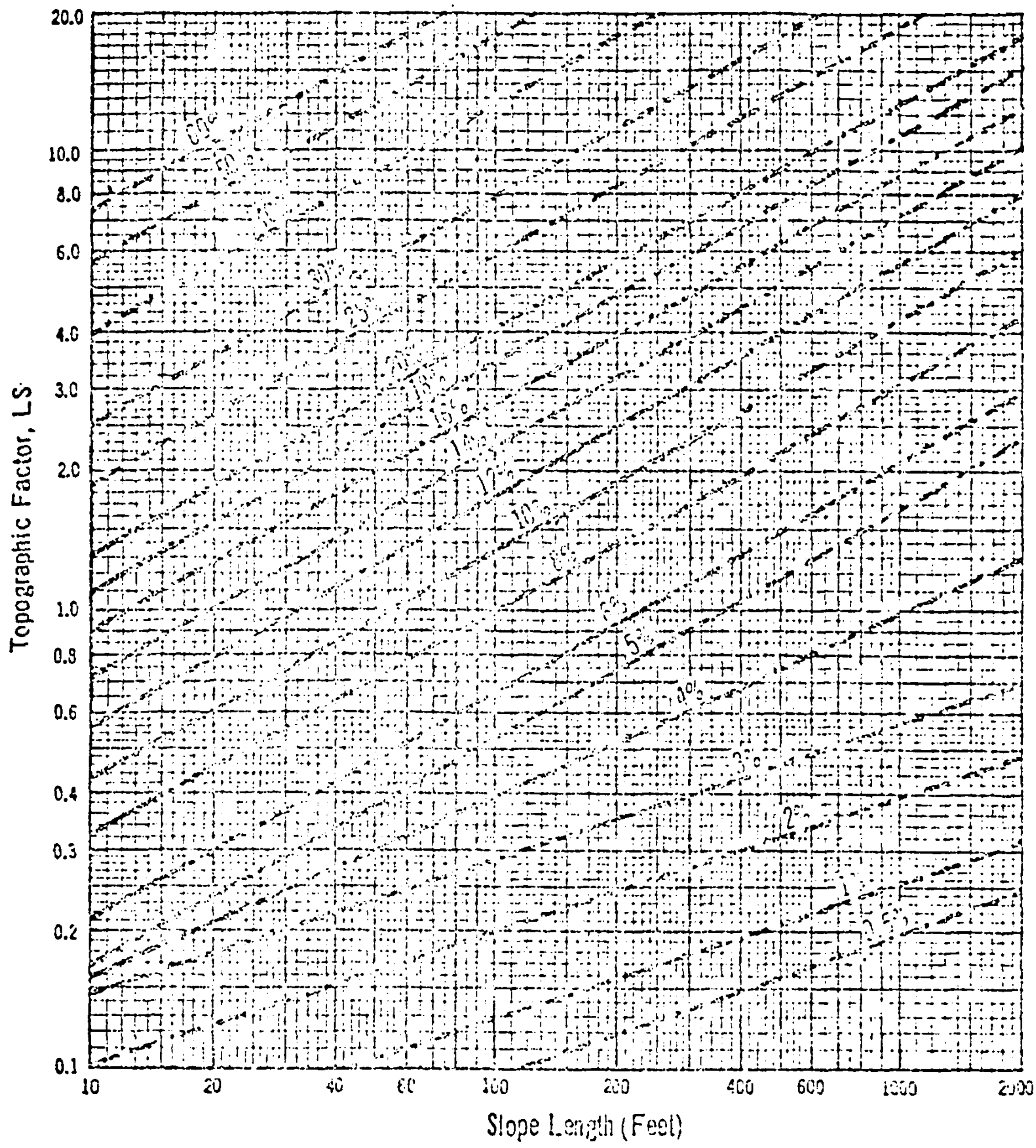
LS - Topographic Factor

The topographic factor ranges from 0.21 to 0.97 (over a four fold variation) and therefore is a major factor in determining soil loss accurately. When calculating soil loss over large areas, the topographic factor is probably the greatest source of error. In this study, the topographic factor was developed in the following manner:

1) Average slope gradient was obtained for specific soil types from the county soil survey.
2) Average slope length was obtained from a correlation of average slope percent, to slope length (feet). This relationship is shown below and was obtained from Don Bartolina of the Soil Conservation Area Office in Oklahoma City.

FIGURE 9

SLOPE-EFFECT CHART (Topographic Factor, LS)*



*The dashed lines represent estimates for slope dimensions beyond the range of lengths and steepnesses for which data are available. The curves were derived by the formula:

$$LS = \left(\frac{\lambda}{72.6}\right)^m \left(\frac{430x^2 + 30x + 0.43}{6.57415}\right)$$

where λ = field slope length in feet and m = 0.5 if s = 5% or greater, 0.4 if s = 4%, and 0.3 if s = 3% or less; and x = sin θ. θ is the angle of slope in degrees.

SLOPE-EFFECT TABLE 10 (Topographic Factor, LS)

Percent Slope	Slope Length in Feet																					
	40	60	80	100	120	140	160	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1500	1700	2000
0.2	0.06	0.07	0.08	0.08	0.09	0.09	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.15	0.16	0.16	0.17	0.17	0.18	0.19	0.19	0.20
0.3	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.16	0.17	0.18	0.18	0.18	0.19	0.20	0.21	0.22
0.4	0.07	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.13	0.14	0.15	0.16	0.17	0.17	0.18	0.19	0.19	0.20	0.20	0.21	0.22	0.23
0.5	0.08	0.08	0.09	0.10	0.10	0.11	0.11	0.12	0.14	0.15	0.16	0.17	0.18	0.18	0.19	0.20	0.20	0.21	0.21	0.22	0.23	0.24
1.0	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.18	0.20	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.27	0.28	0.29	0.30	0.32
2.0	0.15	0.17	0.19	0.20	0.21	0.22	0.23	0.25	0.28	0.31	0.33	0.34	0.36	0.38	0.39	0.40	0.41	0.42	0.43	0.45	0.47	0.49
3.0	0.22	0.25	0.27	0.29	0.30	0.32	0.33	0.35	0.40	0.44	0.47	0.49	0.52	0.54	0.55	0.57	0.59	0.61	0.62	0.65	0.67	0.71
4.0	0.28	0.33	0.37	0.40	0.43	0.46	0.48	0.53	0.62	0.70	0.76	0.82	0.87	0.92	0.96	1.01	1.04	1.08	1.12	1.18	1.24	1.33
5.0	0.34	0.41	0.48	0.54	0.59	0.63	0.68	0.76	0.93	1.07	1.20	1.31	1.42	1.52	1.61	1.69	1.78	1.86	1.93	2.07	2.21	2.40
6.0	0.43	0.52	0.60	0.67	0.74	0.80	0.85	0.95	1.17	1.35	1.50	1.65	1.73	1.90	2.02	2.13	2.23	2.33	2.43	2.61	2.77	3.31
8.0	0.63	0.77	0.89	0.99	1.09	1.17	1.25	1.40	1.72	1.98	2.22	2.43	2.62	2.81	2.98	3.14	3.29	3.44	3.58	3.84	4.09	4.44
10.0	0.87	1.06	1.23	1.37	1.50	1.62	1.73	1.94	2.37	2.74	3.06	3.36	3.62	3.87	4.11	4.33	4.54	4.74	4.94	5.30	5.65	6.13
12.0	1.14	1.40	1.61	1.80	1.98	2.14	2.28	2.55	3.13	3.61	4.04	4.42	4.77	5.10	5.41	5.71	5.99	6.25	6.51	6.99	7.44	8.07
14.0	1.45	1.78	2.05	2.29	2.51	2.72	2.90	3.25	3.98	4.59	5.13	5.62	6.07	6.49	6.88	7.26	7.61	7.95	8.27	8.89	9.46	10.26
16.0	1.80	2.20	2.54	2.84	3.11	3.36	3.59	4.01	4.92	5.68	6.35	6.95	7.51	8.03	8.52	8.98	9.42	9.83	10.24	11.00	11.71	12.70
18.0	2.17	2.66	3.07	3.43	3.76	4.06	4.34	4.86	5.95	6.87	7.68	8.41	9.09	9.71	10.30	10.86	11.39	11.90	12.38	13.30	14.16	15.36
20.0	2.58	3.16	3.65	4.08	4.47	4.83	5.16	5.77	7.07	8.16	9.12	9.99	10.79	11.54	12.24	12.90	13.53	14.13	14.71	15.80	16.82	18.24
25.0	3.73	4.56	5.27	5.89	6.45	6.97	7.45	8.33	10.20	11.78	13.17	14.43	15.59	16.66	17.67	18.63	19.54	20.41	21.24	22.82	24.29	26.35
30.0	5.03	6.16	7.11	7.95	8.71	9.41	10.06	11.25	13.78	15.91	17.79	19.48	21.04	22.50	23.86	25.15	26.39	27.55	28.68	30.81	32.80	35.57
40.0	8.00	9.20	11.32	12.65	13.86	14.97	16.01	17.90														
50.0	11.27	13.81	15.94	17.82	19.53	21.09	22.55	25.21														
60.0	[illegible]	17.93	20.71	23.15	25.36	27.39	29.29	32.74														

AVERAGE SLOPE %	SLOPE LENGTH (FEET)
0-1	500
2	350
3	250
4	200
5	150
6	100
7	80
8	70
9	60
10	50

C - Cropping-Management Factor

The cropping-management or plant cover factor is the ratio of soil loss from a field with a specified cropping and management or plant cover to that from the fallow condition on which the K factor is evaluated. This factor measures the combined effect of all the interrelated cover, management variables plus the growth stage and vegetative cover at the time of the rain. See Table 11, Typical Cropping-Management Factor for Oklahoma.

P - Erosion Control Practice Factor

It is the ratio of soil loss with contour, stripcropping, or crop slope farming to that with row farming up and down the slope (Table 11 - Typical Cropping Management Factor). For the landuse-land capability matrix, crops were divided into continuous small grain and row crops and CP values were assigned for farming with and without con-

TABLE 11

TYPICAL CROPPING - MANAGEMENT FACTOR

	CP Factor		
	Up & Down Slope Farming	W/Terr. & Field Boundary Farming	W/Contour Farming
Continuous Small Grain M.R.U. 6/20	.29	.21	.15
Continuous Small Grain H.R.U. 6/20	.22	.16	.11
Continuous Small Grain M.R.U. 8/1	.22	.16	.11
Continuous Small Grain H.R.U. 8/1	.18	.13	.09
Continuous Small Grain, 500-1000 R.O.S.	.12	.09	.06
Continuous Cotton, Mod. Fert. no W/C	.59	.42	.30
Continuous Cotton, Mod. Fert. with W/C	.50	.35	.25
R.C., Continuous Grain Sorghum, 25-30 bu.	.48	.34	.24
R.C., Continuous Grain Sorghum, 35-45 bu.	.42	.30	.21
Continuous Peanuts with W/C	.43	.30	.22
Continuous Peanuts no W/C	.54	.38	.27
Alfalfa 5-yr., Small Grain 2-yr. (Av./yr.)	.05	.05	.05

M.R.U. = Moderate Residue Under

H.R.U. = Heavy Residue Under

R.C. = Row Crop

R.O.S. = Residue on Surface at Seeding Time

W/C = Winter Cover

servation treatment (0.21 for row crop, 0.11 for small grain with conservation treatment, and 0.42 for row crop, 0.22 for small grain without conservation treatment). Pasture and rangeland were assigned CP values based on the presence of poor cover (0.06) versus the presence of good cover (0.035). Forest lands were given CP values for poorly stocked (0.04) versus well stocked conditions (0.004). These values represent state averages and were obtained through consultation with personnel in the Soil Conservation profession. The CP values mentioned above were kept constant for all areas to provide a comparison of the erosion potential index (RKLS) of various areas across the state with the exception of CP values for range, pasture and forest for land east of the 97^{o} meridian (eastern 1/3 of Oklahoma). These values were adjusted as follows: range and pasture, 0.03 without conservation treatment and 0.013 with conservation treatment; forest, 0.02 without conservation treatment and 0.002 with conservation treatment. The rationale for this adjustment of CP factors is due to the increase in ground cover which occurs in the eastern portion of the state as a result of a greater annual rainfall. The 97^{o} meridian was chosen as a demarkation point separating the area of the state which receives generally less than 34" of annual rainfall from the eastern portion in which the annual rainfall will range from 34 to 56 inches a year increasing as you progress in the southeast direction. The native vegetation changes with the increase in precipitation eastward and the following changes are readily apparent:

1) Short grass and mixed grass eroded plains type gradually

changes to the tall grass prairie type.

2) The density of Postoak-Blackjack forest type increases dramatically when you move eastward and rainfall increased above 32 inches per year.

3) Appearance of the Oak-Hickory forest type (especially northeastern portion of Oklahoma) and Oak-Pine forest type (predominately in the southeastern portion of Oklahoma).

The vegetation changes are documented by "A Game Type Map of Oklahoma" produced by the Game and Fish Division of the Oklahoma State Wildlife Department.

Sd - Sediment Delivery Ratio

This factor adjusts the gross sediment estimate to compensate for deposition along the path traveled by the runoff as it moves from a field slope to a continuous stream system. The sediment delivery ratio-Sd, is defined as the ratio of sediment delivered at a location in the stream system to the gross erosion from the drainage area above this point. The sediment reaching the stream can be estimated by multiplying the sediment loss calculated by the USLE times the sediment delivery ratio. By this procedure, one accounts for the sediment which settles out or is trapped before it reaches the stream system. Some of the factors which affect the sediment delivery ratio are listed by the Midwest Research Institute's report, "Loading Functions for Assessment of WATER POLLUTION from NONPOINT Sources," and are as follows:

1) Proximity of sediment sources to the receptor water - chan-

nel - type erosion produces sediment that is immediately available for transport, and therefore has a high delivery ratio. Materials derived from surface erosion often move short distances and settle out before reaching the stream, therefore having a low delivery ratio.

2) Size and density of sediment sources - when the amount of sediment available for transport exceeds the capability of the runoff transport system, deposition occurs and the sediment delivery ratio is decreased.

3) Characteristics of the transport system - runoff resulting from rainfall and snow melt is the chief agent for transporting eroded material. The ability to transport sediment is dependent on the velocity and volume of water discharge.

4) Texture of eroded material - in general, delivery ratio is higher for silt or clay soils than for course texture soils. This fact is significant since the finer particles such as clay and silt have a greater surface area for pollutant adsorption.

5) Availability of deposition areas - deposition of eroded materials mostly occurs at the foot of upland slopes, along the edges of valleys and in valley flats.

6) Relief and length of watershed slopes - the relief ratio of a watershed has been found to be a significant factor influencing the sediment delivery ratio. The relief ratio is defined as the ratio between the relief of watershed between the minimum and maximum elevation, and the maximum length of watershed.

Table 12, Typical Values of Drainage Density and figure 10, Sediment Delivery Ratio for Relatively Homogeneous Basins provide a method of determining a sediment delivery ratio. This information came from the Midwest Research Institute's report mentioned earlier. A 0.25 sediment delivery ratio was selected to provide an estimate of the sediment reaching the stream in this study. It is recognized that the delivery ratio probably will range from 0.10 to 0.85 with the most typical state values falling somewhere between 0.15 and 0.30.

2. Estimation of Nutrient Loadings

a) Nitrogen

Yields of total nitrogen (NT, all forms of nitrogen) are estimated by multiplying sediment yields by concentrations of total nitrogen in soil and by an enrichment factor. In addition to sediment-carried nitrogen, nitrogen carried in rainfall can be included in the loading function.

$$Y(NT)_E = a \cdot Y(S)_E \cdot C_S(NT) \cdot r_N$$

$$Y(N)_{Pr} = A \cdot \frac{Q(OR)}{Q(P)} \cdot N_{Pr} \cdot b$$

$$Y(NT) = Y(NT)_E + Y(N)_{Pr}$$

Where:
$Y(S)_E$ = sediment load
$Y(NT)_E$ = total nitrogen from erosion (lb/ac/yr)
$Y(N)_{Pr}$ = nitrogen from rainfall, discharged to streams
NT = sum of nitrogen of all chemicals
A = area of source
rN = enrichment factor

TABLE 12

TYPICAL VALUES OF DRAINAGE DENSITY

Location	Drainage density	
	km/km^2	mile/mile^2
Appalachian Plateau Province	1.9-2.5	3.0-4.0
Central and eastern United States	5-10	8.0-16.0
Dry Areas of the Rocky Mountain Region	31-62	50-100
The Rocky Mountain Region (except the above)	5-10	8.0-16
Coastal ranges of southern California	12-25	20-40
Badlands in South Dakota	125-250	200-400
Badlands in New Jersey	183-510	310-820

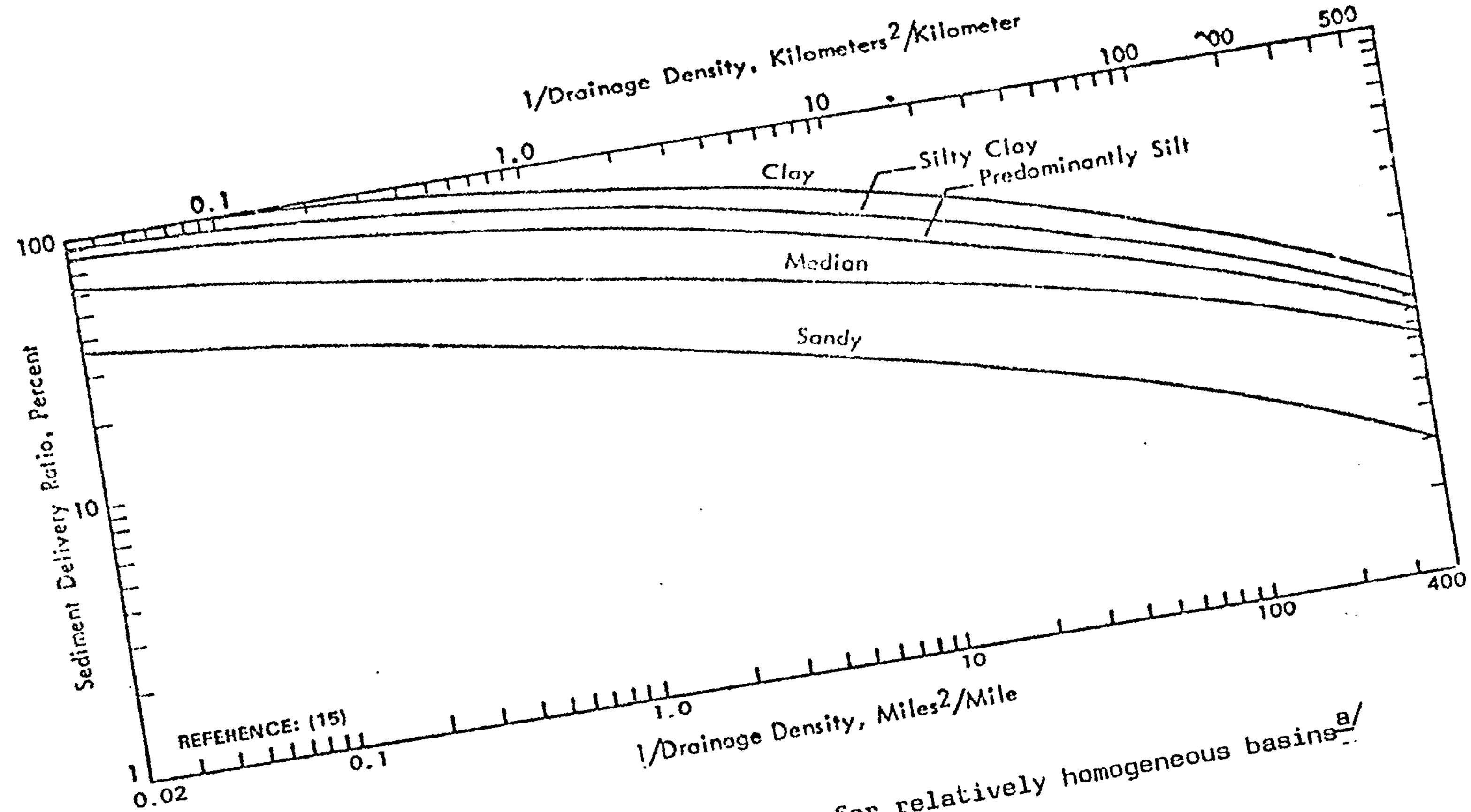


FIGURE 10 - Sediment delivery ratio for relatively homogeneous basins[a/]

a/ Source: Midwest Research Institute

a = dimensional constant (10 metric, 20 English)

b = attenuation factor

N_{Pr} = rate of deposition of nitrogen from the atmosphere in precipitation

$C_S(NT)$ = concentration of nitrogen in soil

$Q(OR)$ = overland runoff

$Q(P)$ = total precipitation

The loading functions for nitrogen do not encompass soluble nitrogen forms, principally nitrate, which are leached into subsurface waters and eventually reach surface waters in groundwater or drainage flows. Methods for treating such situations via a generalized function are not available, and local experience, data, and expertise must be relied upon.

The loading functions for nitrogen based on sediment as a carrier become increasingly inadequate as sediment yields diminish. This inadequacy will be most evident in situations where erosion is minimal and mineralized nitrogen is abundant. A newly harvested forest temporarily devoid of growing timber may have a temporary excess of mineralized nitrogen which is susceptible to both leaching and transport overland in sediment and in solution. Nitrogen emissions from terraced fields will be proportionately lower in mineralized nitrogen than will emissions from fields with less control of runoff and erosion (McElroy et. al., 1976).

Data for Nitrogen Loading Equation

The value of $Y(S)_E$ can be evaluated from the sediment loading function presented earlier. The enrichment ratio, r_N, corrects for the selectiveness by which the soil fines are eroded. Soil particles transported by water tend to be much smaller on the average than the general texture of the inplace soil. Adsorption of nutrients is a function of available surface area which is determined by the size of the particles. The fact that the smaller particles are eroded more freely results in a higher concentration of nutrients adsorbed to the eroded soil than in the inplace soil. Therefore, the enrichment ratio is utilized to adjust for this difference in nutrient concentration. The relationship of surface area to textural classes has been determined by researches (Frere et. al., 1975) as follows:

$$SS = 200(\%\ Cl) + 40(\%\ Si) + 0.5(\%\ Sa)$$

Where: SS = Specific Surface area m^2/g

%Cl = Clay content of the soil, fraction of total

%Si = Silt content of the soil, fraction of total

%Sa = Sand content of the soil, fraction of total

From this equation one can readily visualize the importance of the clay content in determining the available surface area for pollutant interaction.

Numerical estimates of the enrichment ratio therefore vary with the soil texture and cultural treatment. Because of the wide variations in the properties of erodible soil, a single value of r_N is not probable. Values generally range from less than 2.0 to greater than 4.0 (McElroy, 1976). For a first approximation in this study, the enrichment ratio for nitrogen will be held constant at 3.0 recognizing the variation which exists from field to field. Table 13 (McElroy, et. al., 1976) is a summary of experimentally determined enrichment ratios. The value of nitrogen in the topsoil, $C_S(NT)$ is also highly variable from field to field and also varies from season to season. Estimates of native soil nitrogen in the U.S. range from 0.02 to 0.4% (Jenny, 1930). A map indicating the percent nitrogen in the surface foot of soil was published in 1946 and will be used to approximate the nitrogen content of Oklahoma soils, see Figure 11 (Parker, 1946). A value of 0.15% nitrogen was selected. It should be recognized that this is a very crude approximation and that the addition of fertilizers is unaccounted for.

The rate of deposition of nitrogen from the atmosphere in precipitation, N_{Pr}, can be estimated from a map developed by the U.S. Department of Agriculture (McElroy et. al., 1976) and is presented in Figure 12. Values of overland flow from precipitation, Q(OR) and total annual precipitation amounts are found in the "Oklahoma Comprehensive Water Plan" published by the Oklahoma Water Resources Board, September 1975.

b) Phosphorus

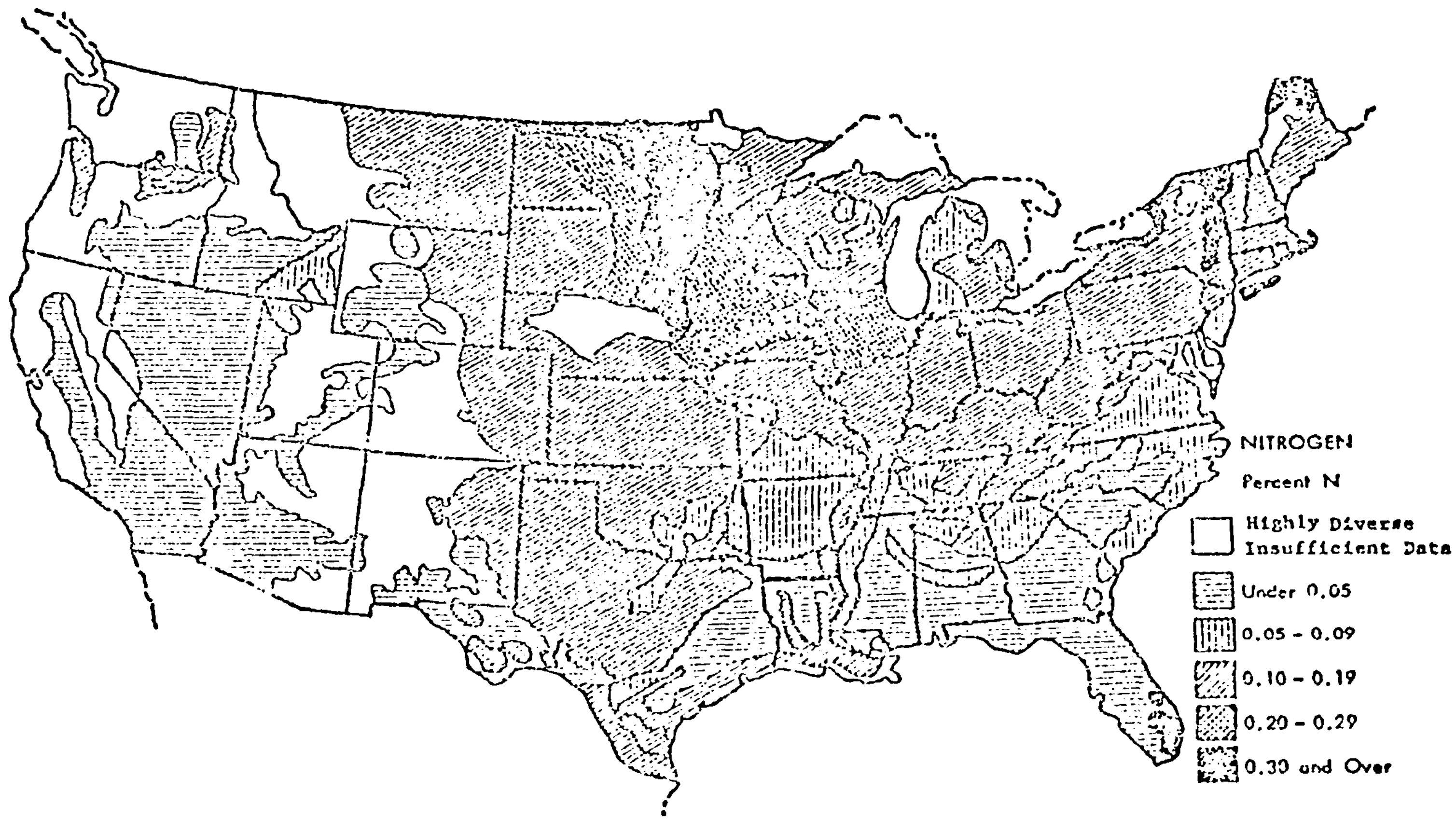
Phosphorus is carried almost entirely on sediment. In situations where erosion can be predicted, the loading function for phosphorus can be expressed as the product of sediment yield times the phosphorus concentration in the sediment. As was the case for nitrogen loading, phosphorus loading must be multiplied by an enrichment ratio to account for the higher concentration in the sediment than in the noneroded topsoil.

TABLE 13

EXPERIMENTALLY DETERMINED NITROGEN ENRICHMENT RATIOS

(modified from McElroy et. al., 1976)

Source	N Enrichment ratio, r
Check	3.88
Rye winter cover crop	4.08
Manure (45 MT/ha)	4.28
Rye and Manure (45 MT/ha)	3.35



REFERENCE: (15)

FIGURE 11 - PERCENT NITROGEN (N) IN SURFACE FOOT OF SOIL[a/]

a/ Source: Midwest Research Institute

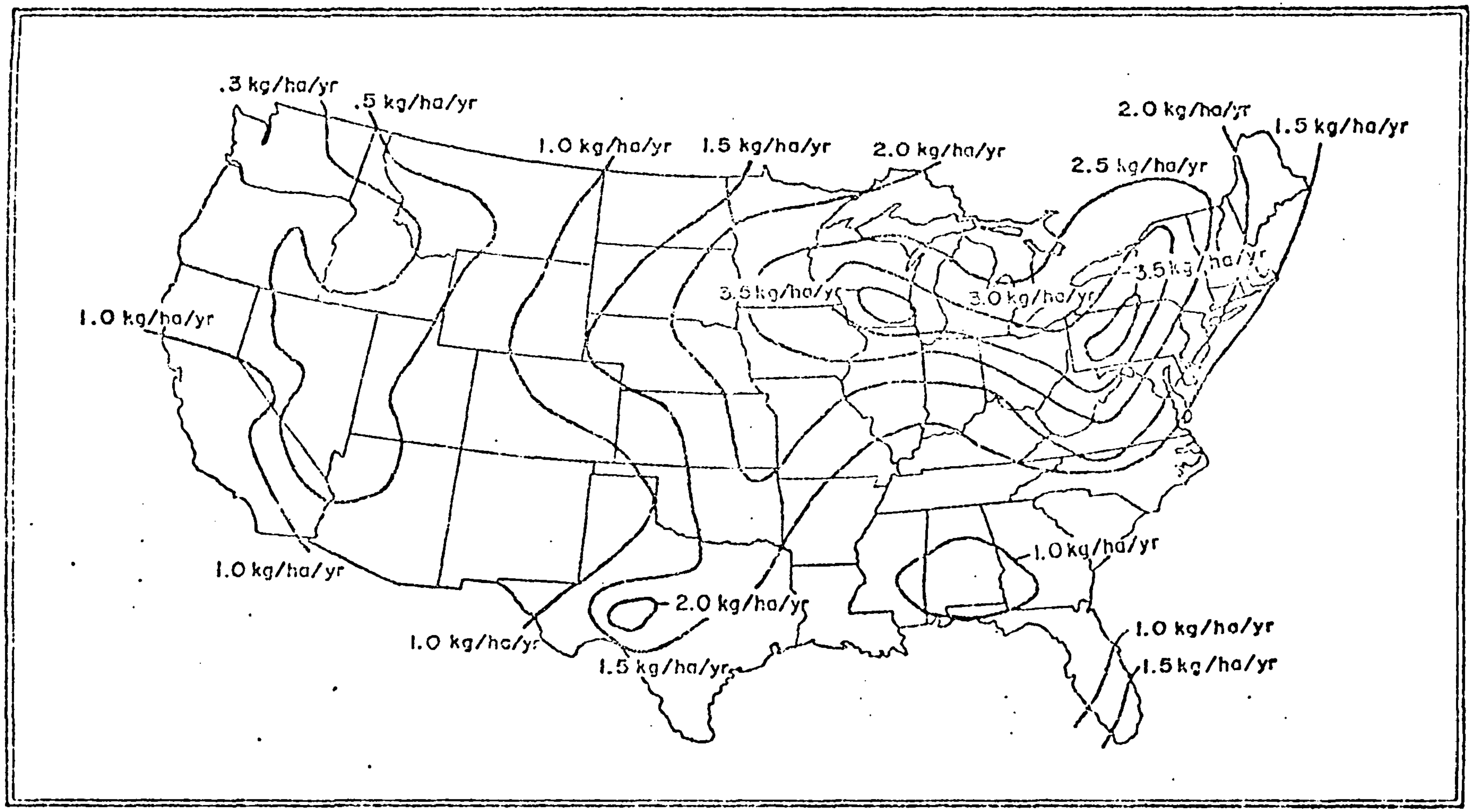


FIGURE 12 - NITROGEN (NH_4-N and NO_3-N) IN PRECIPITATION

The equation has the following form:

$$Y(PT) = a \cdot Y(S)_E \cdot C_S(PT) \cdot r_P$$

$Y(PT)$ = yield of total phosphorus (lb/ac/yr)

a = dimensional constant (10 metric, 20 English)

r_P = enrichment ratio. The enrichment ratio values found in the literature average around 1.2 so this figure was chosen as a representative value recognizing its limitations.

$C_S(PT)$ = total phosphorus in the soil ranges from 0.01 to 0.09 (Parker et. al., 1946) and is indicated in Figure 13. A value of 0.05 was used to estimate the phosphorus content of the soil. This estimation does not account for phosphorus resulting from fertilization and is meant to serve as a very crude approximation of phosphorus concentration in the soil.

3. Organic Matter

The equation for estimation of organic loading into water has the form:

$$Y(OM)_E = a \cdot C_S(OM) \cdot Y(S)_E \cdot r_{OM}$$

$Y(OM)_E$ = organic matter loading function (lb/ac/yr)

a = dimensional constant

$Y(S)_E$ = total sediment loading from surface erosion

$C_S(OM)$ = concentration of organic matter in the soil and is estimated as being equal to 20 times the con-

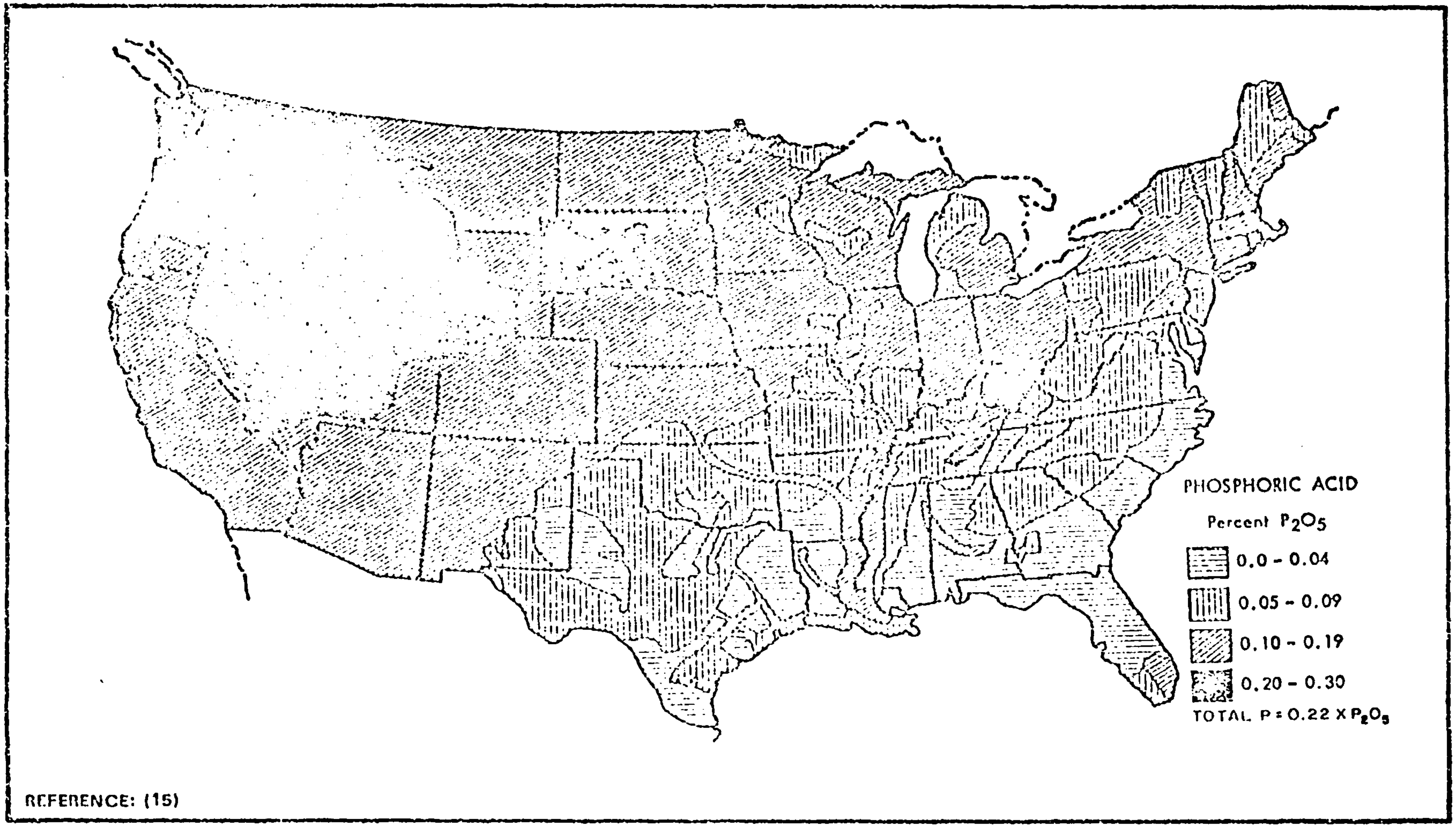


FIGURE 13 - PHOSPHORUS CONTENT IN THE TOP 1 FT OF SOIL[a/]

a/ Source: Midwest Research Institute

centration of nitrogen in the soil (Buckman, 1969).

Accuracy of the Loading Functions

The accuracy of the predicted nonpoint pollution loading is a direct reflection of the availability of reasonably accurate data for the various parameters in the equations. The values reflect long term average rather than a specific year, and if reasonably large areas are used, such as large watersheds (greater than 100 square miles) rather than individual plots or small watersheds, the expected accuracy can be reasonably estimated. Using the reasoning that the error in individual parameters will tend to culminate to a larger error, the expected ranges of predicted values for a given "true" or estimated values of load are given in Table 14 (McElroy et. al., 1976).

Determination of Best Management Practices to Control Nonpoint Pollution from Agricultural Sources

The nonpoint pollution loadings determined through the use of the Midwest Research loading equation were conducted in part under the assumption that no conservation practices (Best Management Practices) were in place. A general comparison of the severity and extent of soil loss by county must be accompanied by an acknowledgement of the area which has already been treated by BMPs. The best source of conservation treatment information is the "Conservation Needs Inventory, March 1970," a Soil Conservation Service publication. Soil loss from sheet and rill erosion has been calculated for land capability class, sub-

TABLE 14

PROBABLE RANGE OF LOADING VALUES FOR

NUTRIENTS AND ORGANIC MATTER

Loading Function	Estimated value lb/ac/yr	Probable range lb/ac/yr
Total N sediment[a]	0.89	0.09 - 8.90
Total N sediment	8.90	4.45 - 17.8
Total N sediment	44.50	26.7 - 66.75
Total N precipitation[b]	0.27	0.09 - 0.53
Total P[c]	0.89	0.45 - 2.70
Total P	4.45	1.78 - 8.90
Total P	8.9	4.45 - 17.8
Organic matter	8.9	4.45 - 17.8
Organic matter	89	44.50 - 178.0

[a]Available N in sediment will range from 3 - 8% of total N

[b]Available N is equal to total N in precipitation

[c]Available P in sediment will range from 5 - 10% of total P

class-landuse combinations in all 77 counties of the state. This information is in the form of landuse-land capability matrices. These soil losses and associated nonpoint pollutants are based on no conservation treatment and with conservation treatment. Each county has been placed in one of the following classifications:

Class I   Low nonpoint pollution potential
          0-5 tons/ac/yr of soil loss

Class II Moderate nonpoint pollution potential
          5-10 tons/ac/yr of soil loss

Class III High nonpoint pollution potential
          10-20 tons/ac/yr of soil loss

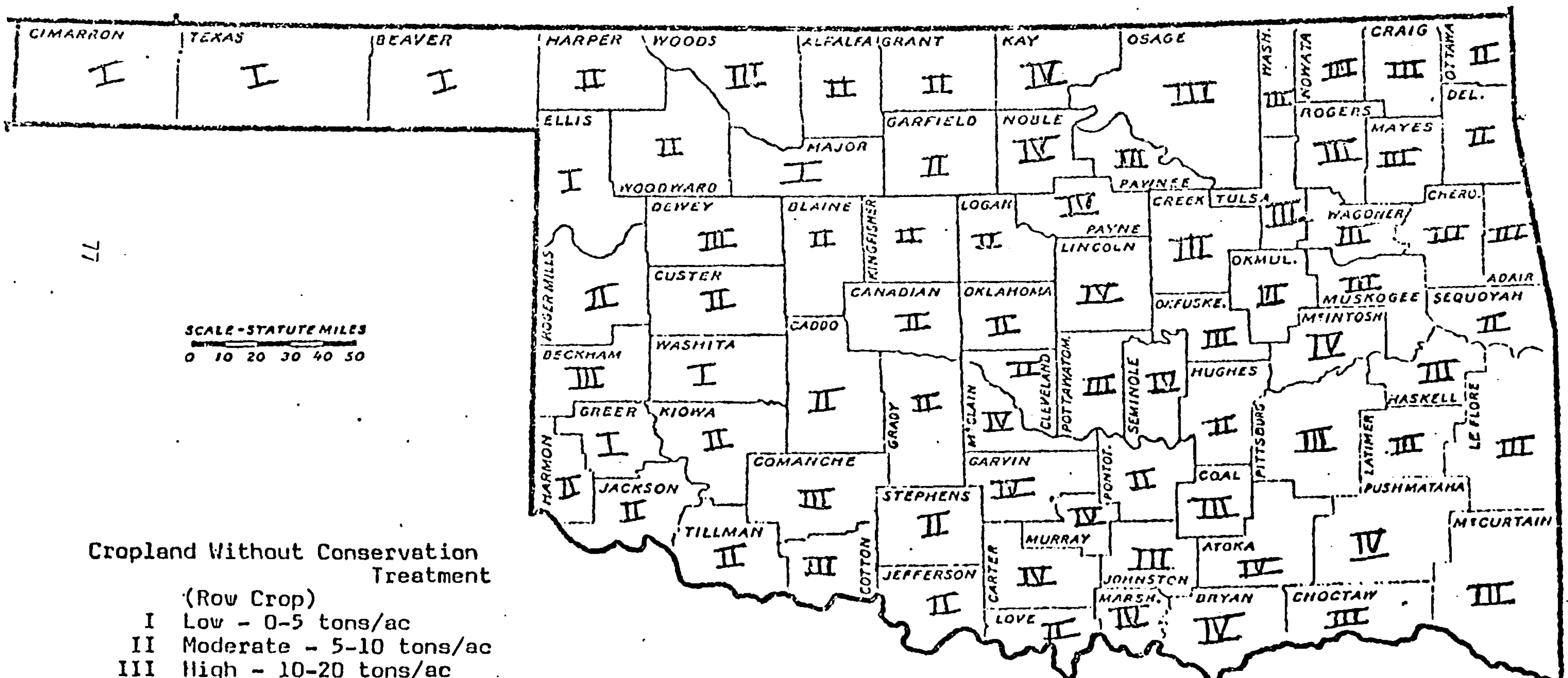
Class IV Very high nonpoint pollution potential
          20+ tons/ac/yr of soil loss (See Figures 14-23)

Each county has been analyzed to identify the sources of nonpoint pollution so that Best Management Practices needed for nonpoint pollution abatement can be outlined. This information is expressed as a percentage of the total sediment loss from each county from each of the following sources: cropland, range, pasture and forest. Calculations of soil loss are based on no conservation treatment, and thus represent the nonpoint pollution potential for a given county (see Table 15). The relationship of nutrients and organic matter loading to sediment loss has been illustrated through the Midwest Research Institute equations. Table 16 has been developed to relate sediment loss in various areas of the state to nutrient and organic matter loading.

OKLAHOMA

FIGURE 14

NONPOINT POLLUTION POTENTIAL



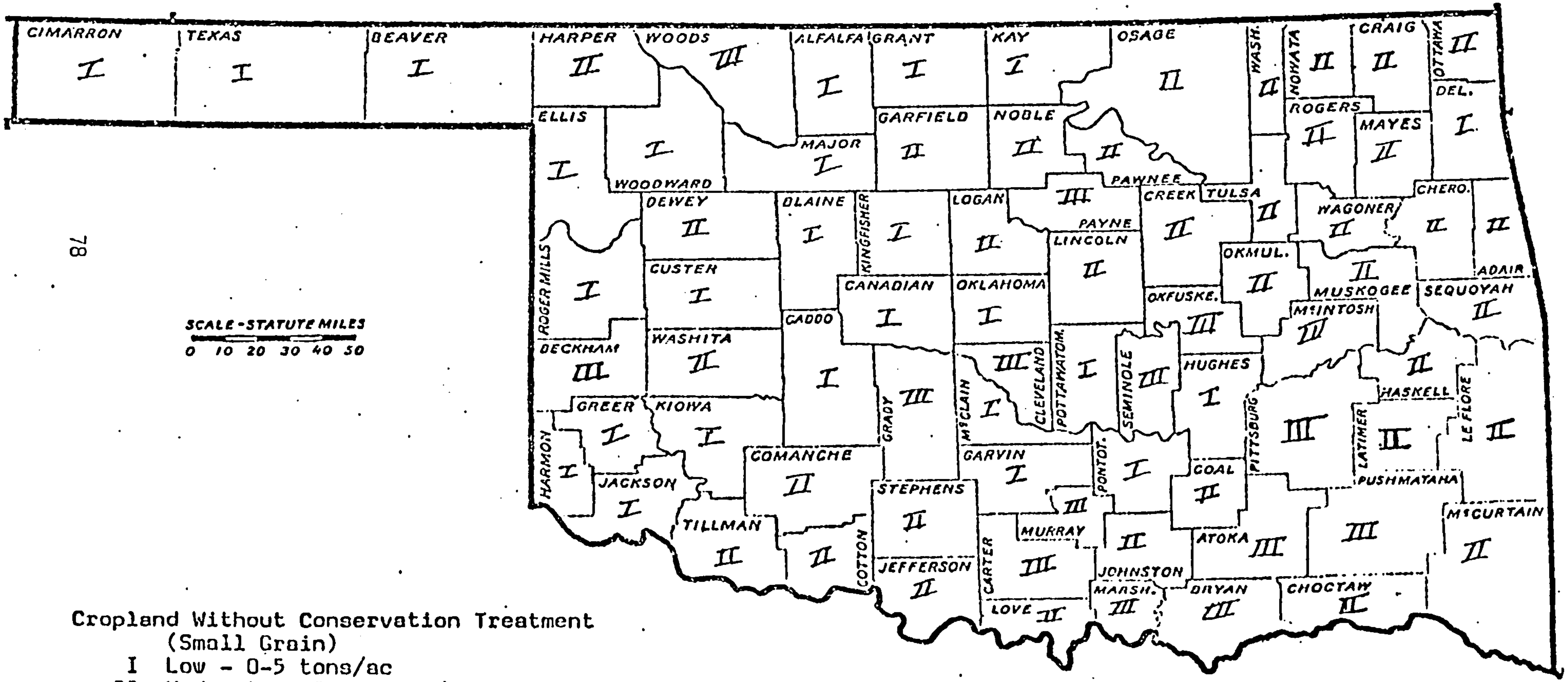
Cropland Without Conservation Treatment (Row Crop)

I Low - 0-5 tons/ac
II Moderate - 5-10 tons/ac
III High - 10-20 tons/ac
IV Very High - 20+ tons/ac

OKLAHOMA

FIGURE 15

NONPOINT POLLUTION POTENTIAL



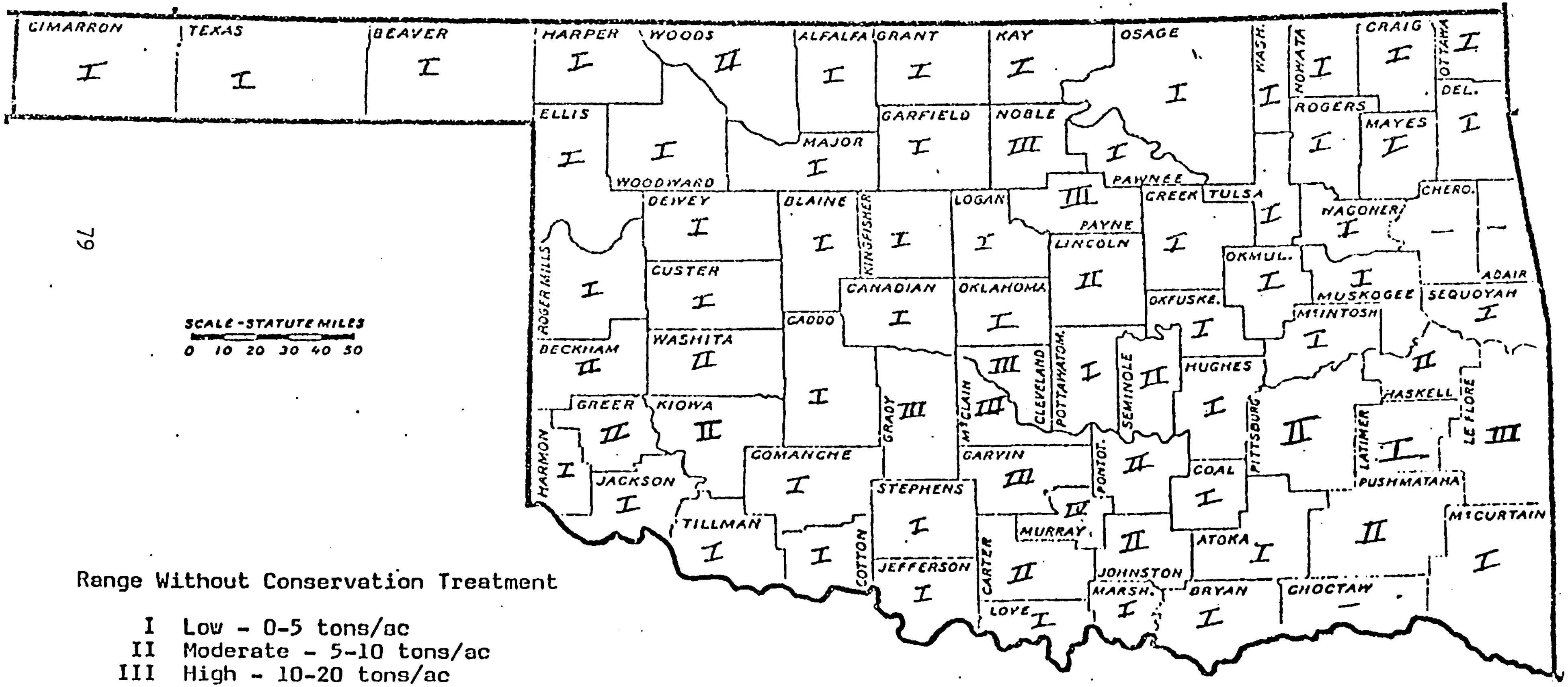
Cropland Without Conservation Treatment
(Small Grain)

I	Low - 0-5 tons/ac
II	Moderate - 5-10 tons/ac
III	High - 10-20 tons/ac
IV	Very High - 20+ tons/ac

OKLAHOMA

FIGURE 16

NONPOINT POLLUTION POTENTIAL



Range Without Conservation Treatment

- I Low - 0-5 tons/ac
- II Moderate - 5-10 tons/ac
- III High - 10-20 tons/ac
- IV Very High - 20+ tons/ac

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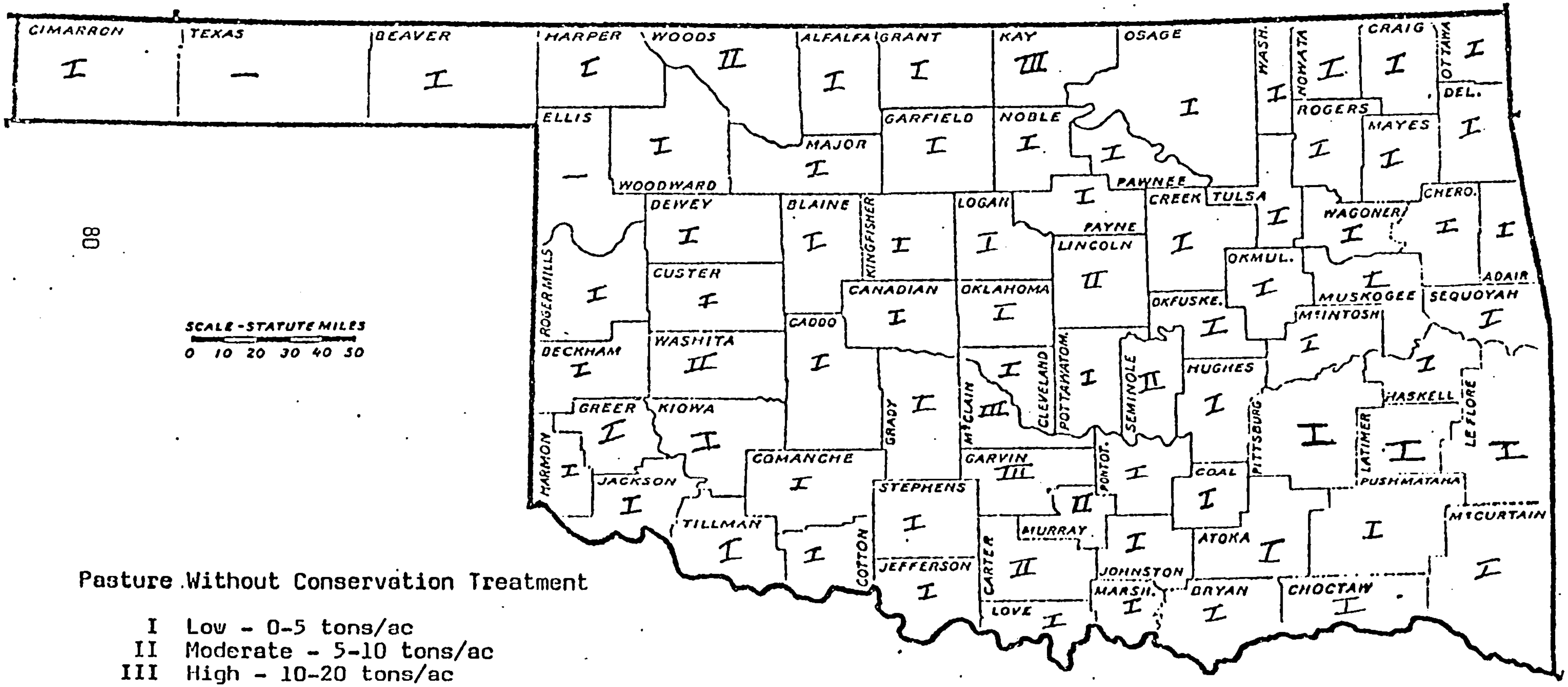
FIGURE 17

NONPOINT POLLUTION POTENTIAL



Pasture Without Conservation Treatment

- I Low - 0-5 tons/ac
- II Moderate - 5-10 tons/ac
- III High - 10-20 tons/ac
- IV Very High - 20+ tons/ac

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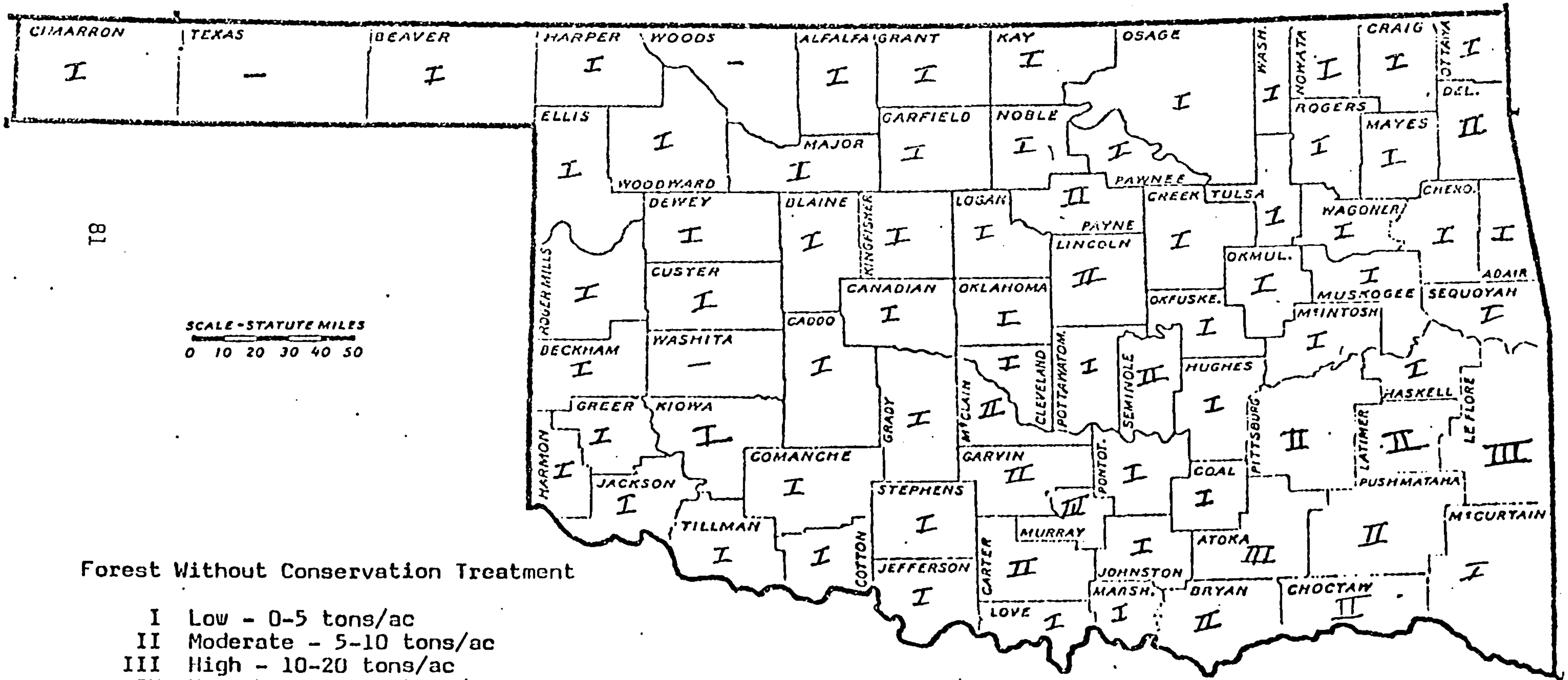
FIGURE 18

NONPOINT POLLUTION POTENTIAL



Forest Without Conservation Treatment

I Low - 0-5 tons/ac
II Moderate - 5-10 tons/ac
III High - 10-20 tons/ac
IV Very High - 20+ tons/ac

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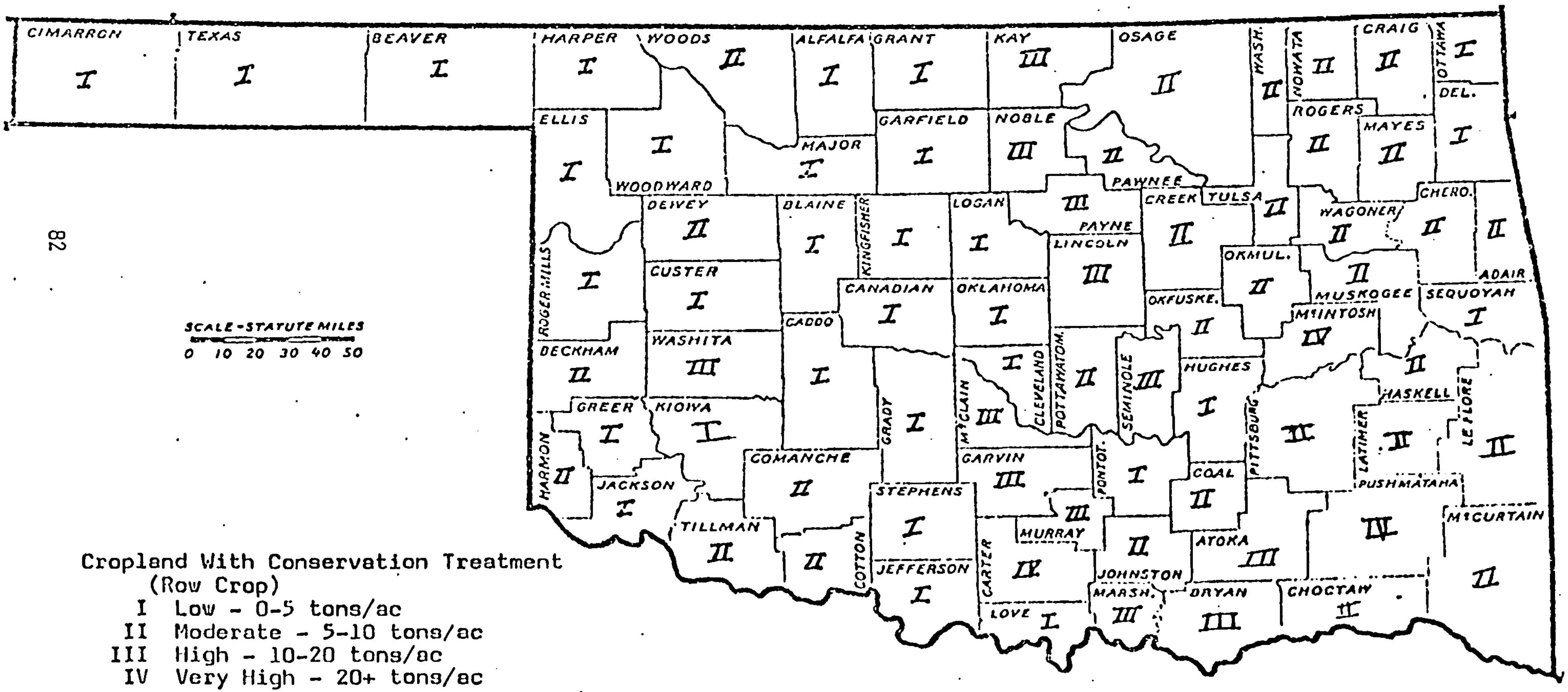
FIGURE 19

NONPOINT POLLUTION POTENTIAL



Cropland With Conservation Treatment
(Row Crop)
- I Low - 0-5 tons/ac
- II Moderate - 5-10 tons/ac
- III High - 10-20 tons/ac
- IV Very High - 20+ tons/ac

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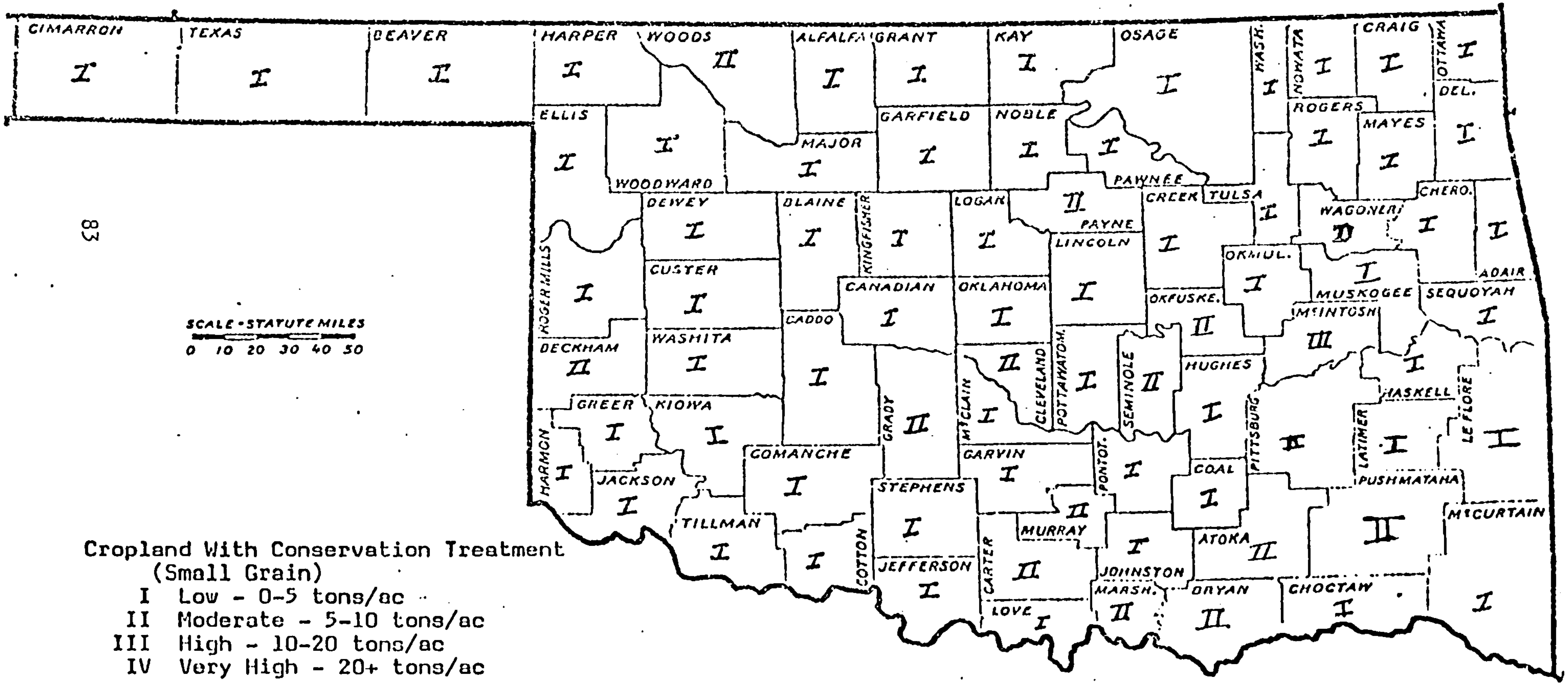
FIGURE 20

NONPOINT POLLUTION POTENTIAL



Cropland With Conservation Treatment
(Small Grain)

I Low - 0-5 tons/ac
II Moderate - 5-10 tons/ac
III High - 10-20 tons/ac
IV Very High - 20+ tons/ac

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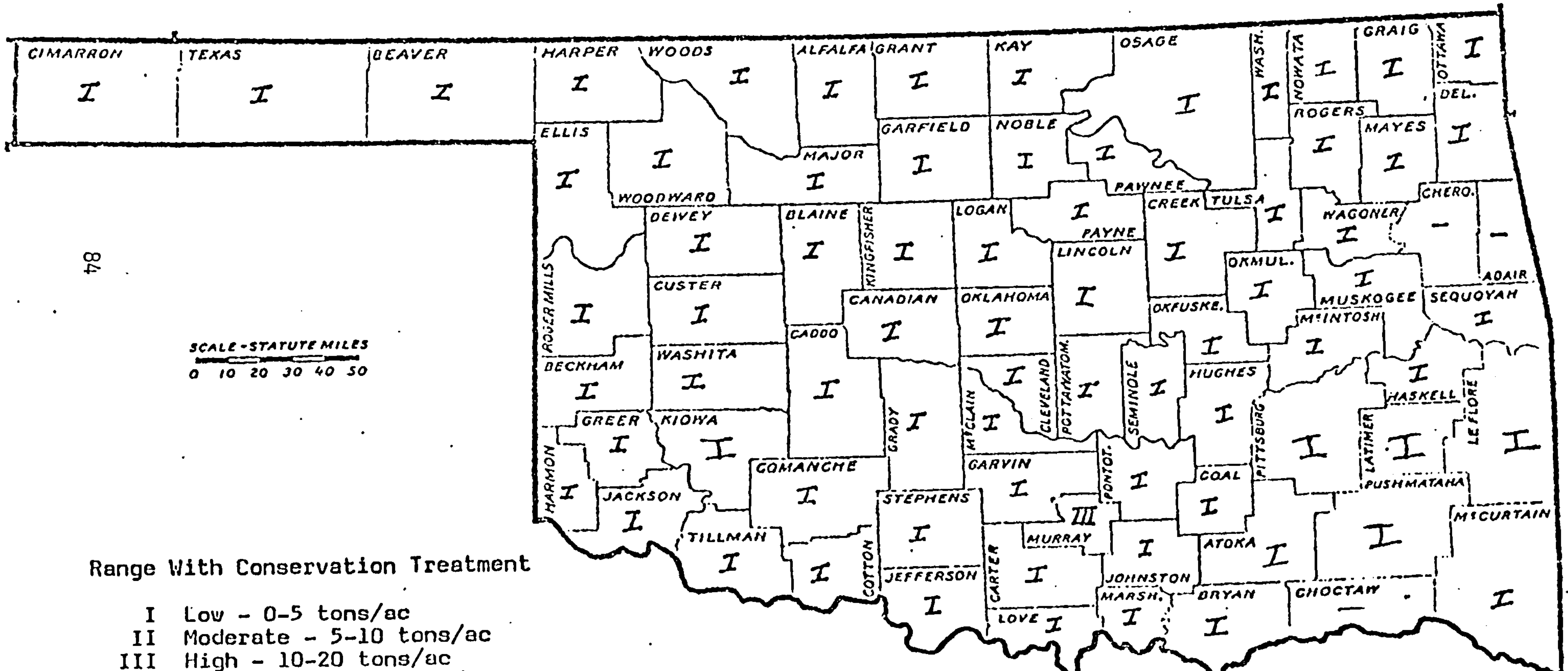
FIGURE 21

NONPOINT POLLUTION POTENTIAL



Range With Conservation Treatment

I Low - 0-5 tons/ac
II Moderate - 5-10 tons/ac
III High - 10-20 tons/ac
IV Very High - 20+ tons/ac

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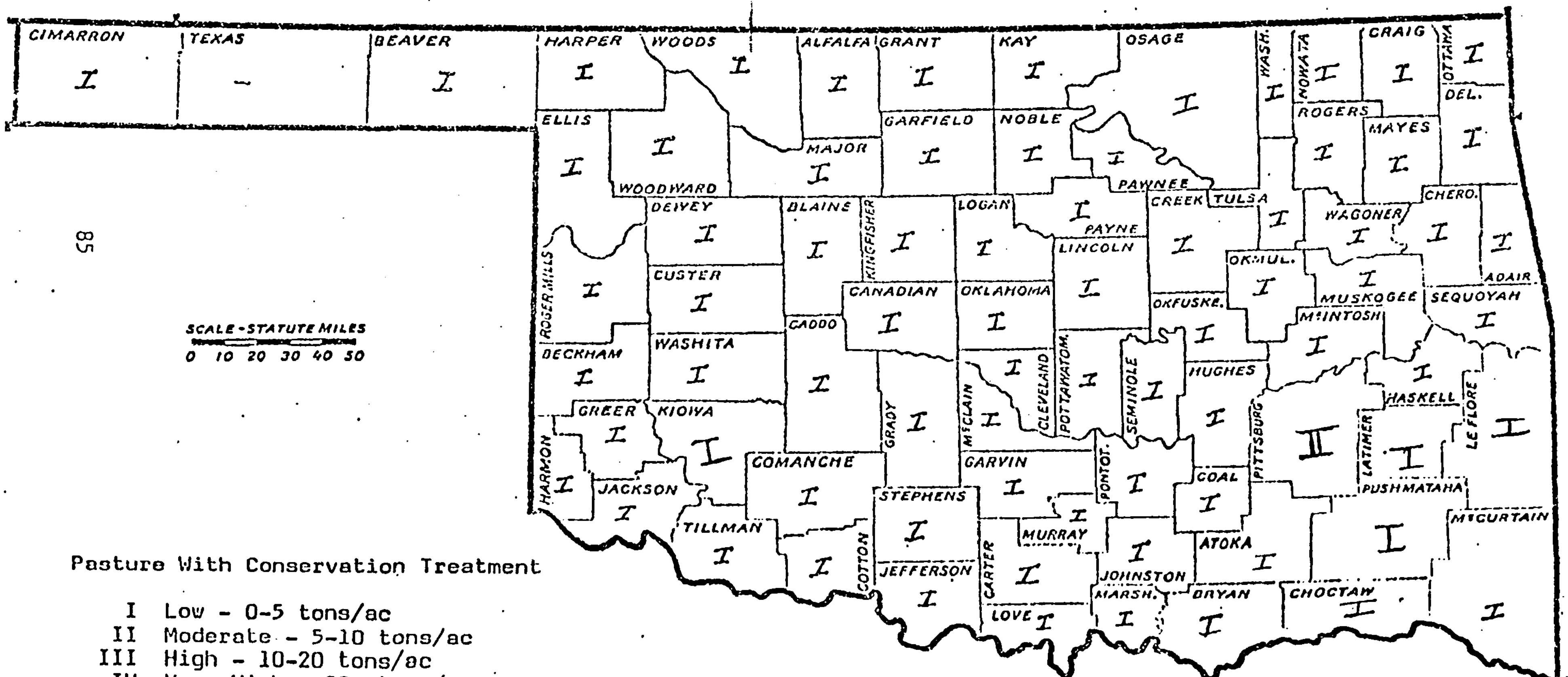
FIGURE 22

NONPOINT POLLUTION POTENTIAL



Pasture With Conservation Treatment

I Low - 0-5 tons/ac
II Moderate - 5-10 tons/ac
III High - 10-20 tons/ac
IV Very High - 20+ tons/ac

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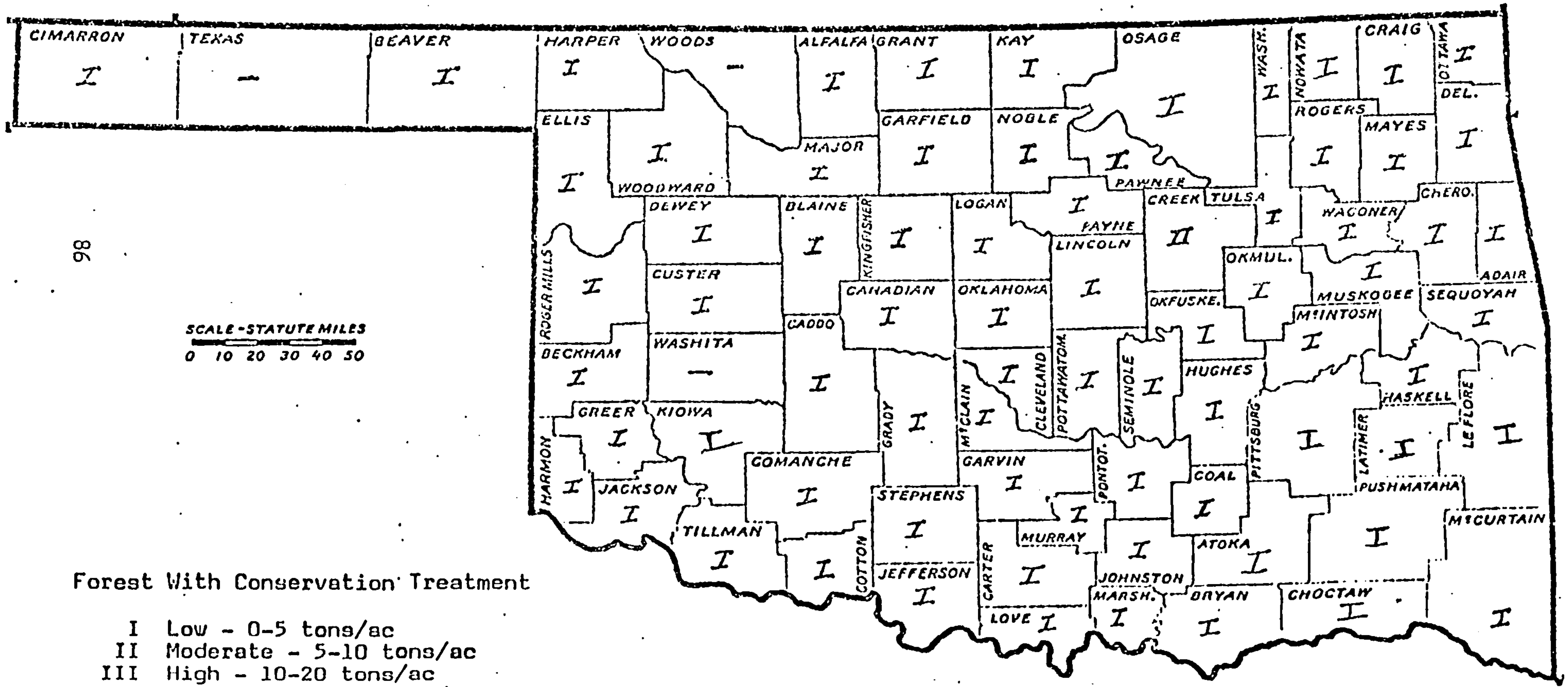
FIGURE 23

NONPOINT POLLUTION POTENTIAL



Forest With Conservation Treatment

I Low - 0-5 tons/ac
II Moderate - 5-10 tons/ac
III High - 10-20 tons/ac
IV Very High - 20+ tons/ac

TABLE 15

PERCENTAGE OF POTENTIAL SOIL LOSS BY SOURCE

WITHOUT CONSERVATION TREATMENT

County	Cropland	Range	Pasture	Forest
1. Adair	1	0	30	69
2. Alfalfa	81	19	1	1
3. Atoka	7	4	10	79
4. Beaver	49	50	.5	.5
5. Beckham	59	40	1	1
6. Blaine	69	26	3	2
7. Bryan	47	2	39	12
8. Caddo	62	22	9	7
9. Canadian	71	23	3	3
10. Carter	15	54	17	15
11. Cherokee	2	0	18	80
12. Choctaw	3	0	11	86
13. Cimarron	63	37	0	1
14. Cleveland	19	52	18	11
15. Coal	16	35	24	25
16. Comanche	54	35	6	5
17. Cotton	77	20	2	1
18. Craig	66	12	20	1
19. Creek	32	17	19	32
20. Custer	70	28	1	1
21. Delaware	5	1	9	86
22. Dewey	59	38	1	3
23. Ellis	41	59	0	1
24. Garfield	81	19	1	1
25. Garvin	20	60	15	5
26. Grady	41	49	7	2
27. Grant	92	8	1	1
28. Greer	42	55	3	0

	County	Cropland	Range	Pasture	Forest
29.	Harmon	77	21	1	1
30.	Harper	59	41	0	0
31.	Haskell	12	13	50	25
32.	Hughes	30	33	10	26
33.	Jackson	81	18	1	1
34.	Jefferson	28	60	9	3
35.	Johnston	14	51	12	23
36.	Kay	63	15	22	1
37.	Kingfisher	87	11	1	1
38.	Kiowa	60	37	1	2
39.	Latimer	.5	.5	3	96
40.	Leflore	4	14	0	82
41.	Lincoln	17	54	18	11
42.	Logan	64	24	12	0
43.	Love	31	40	15	14
44.	McClain	29	62	6	4
45.	McCurtain	15	4	10	71
46.	McIntosh	51	7	33	9
47.	Major	39	55	3	3
48.	Marshall	29	24	8	39
49.	Mayes	42	5	26	27
50.	Murray	6	74	7	13
51.	Muskogee	54	22	17	6
52.	Noble	40	58	2	1
53.	Nowata	40	51	9	1
54.	Okfuskee	30	19	19	33
55.	Oklahoma	21	36	36	7
56.	Okmulgee	43	32	9	16
57.	Osage	20	41	7	32
58.	Ottawa	73	6	17	3
59.	Pawnee	66	29	3	2

County	Cropland	Range	Pasture	Forest
60. Payne	39	52	7	2
61. Pittsburg	4	39	7	50
62. Pontotoc	2	81	14	3
63. Pottawatomie	25	46	19	10
64. Pushmataha	1	8	6	85
65. Roger Mills	32	65	1	2
66. Rogers	46	24	21	9
67. Seminole	9	31	35	25
68. Sequoyah	16	1	16	68
69. Stephens	44	33	14	9
70. Texas	67	33	0	0
71. Tillman	83	15	2	1
72. Tulsa	55	8	17	21
73. Wagoner	78	6	12	5
74. Washington	39	48	7	6
75. Washita	74	23	3	0
76. Woods	50	49	1	0
77. Woodward	48	51	1	1

TABLE 16

NUTRIENT AND ORGANIC MATTER LOADING

Soil Loss tons/ac/yr	Tons of soil delivered to waterway[1]	Nitrogen[2] lb/ac/yr	Phosphorus lb/ac/yr	Organic Matter lb/ac/yr
0.25	0.06	0.54	0.07	9
0.5	0.13	1.2	0.16	19.5
1	0.25	2.3	0.30	37.5
2	0.5	4.5	0.6	75
4	1.0	9	1.2	150
6	1.5	13.5	1.8	225
8	2.0	18	2.4	300
10	2.5	22.5	3.0	375
12	3.0	27	3.6	450
14	3.5	31.5	4.2	525
16	4.0	36	4.8	600
18	4.5	40.5	5.4	675
20	5.0	45	6.0	750

[1] Assume 25% of the estimated soil loss reaches the waterway

[2] This table does not account for nitrogen loading resulting from precipitation.

Methodology to Determine Best Management Practices Needed to Control Nonpoint Pollution

From the nonpoint pollution prediction equations discussed above, areas of the state which represent the greatest contributors to non-point pollution are identified. From the knowledge of the areas already adequately treated, the areas high in nonpoint pollution will be analyzed to determine the following:

1) areas needing treatment (percent of the total cropland, rangeland, pastureland and forestland needing treatment according to information from the "Oklahoma Conservation Needs Inventory", see Table 17).

2) Type of Best Management Practices needed. This is possible by looking at the areal characteristics such as rainfall, soils, topography and landuse to determine existing soil loss (and other nonpoint pollution). The soil loss predicted will dictate the severity of the management practices needed. For example, if soil loss is just slightly above the allowable limits, then possible agronomic practices will control the problem. If excessive slope and landuse combinations are resulting in a high soil loss, structural measures such as terraces may be required or a change of landuse indicated. Each matrix (Appendix A) gives a value for the symbol λ, Lambda. Lambda represents the maximum CP value (cover management value) which will adequately contain soil losses to ac-

TABLE 17

CONSERVATION TREATMENT NEEDS BY LANDUSE
(Percent of the Land Needing Treatment)

	County	Cropland	Range	Pasture	Forest
1.	Adair	56	100	87	50
2.	Alfalfa	36	78	38	--
3.	Atoka	50	72	78	87
4.	Beaver	63	52	--	--
5.	Beckham	52	71	50	100
6.	Blaine	45	88	61	0
7.	Bryan	56	64	69	58
8.	Caddo	25	86	66	9
9.	Canadian	31	80	57	18
10.	Carter	39	77	75	10
11.	Cherokee	76	96	82	82
12.	Choctaw	25	--	81	93
13.	Cimarron	48	30	--	--
14.	Cleveland	37	85	89	--
15.	Coal	44	78	83	55
16.	Comanche	54	88	59	19
17.	Cotton	46	71	21	--
18.	Craig	45	92	54	7
19.	Creek	32	77	61	9
20.	Custer	32	46	90	36
21.	Delaware	56	89	69	100
22.	Dewey	38	51	22	--
23.	Ellis	47	72	--	100
24.	Garfield	34	66	--	--
25.	Garvin	14	78	67	4
26.	Grady	24	69	40	15
27.	Grant	32	78	--	--
28.	Greer	55	91	66	100

County	Cropland	Range	Pasture	Range
29. Harmon	53	90	52	100
30. Harper	44	45	--	--
31. Haskell	19	--	88	76
32. Hughes	46	83	71	7
33. Jackson	51	84	34	100
34. Jefferson	28	80	68	--
35. Johnston	46	80	93	12
36. Kay	46	55	7	--
37. Kingfisher	40	88	43	--
38. Kiowa	28	98	28	--
39. Latimer	92	--	43	86
40. Leflore	59	--	59	85
41. Lincoln	40	71	85	0
42. Logan	28	58	78	--
43. Love	74	70	83	--
44. McClain	28	90	58	36
45. McCurtain	44	--	78	84
46. McIntosh	49	80	55	68
47. Major	28	54	36	--
48. Marshall	39	97	85	39
49. Mayes	38	60	70	100
50. Murray	43	56	56	21
51. Muskogee	45	60	69	13
52. Noble	29	57	53	28
53. Nowata	27	34	38	45
54. Okfuskee	32	72	79	14
55. Oklahoma	39	90	66	9
56. Okmulgee	29	60	74	19
57. Osage	30	69	88	4
58. Ottawa	29	19	70	90
59. Pawnee	41	81	66	13
60. Payne	37	47	59	18

County	Cropland	Range	Pasture	Forest
61. Pittsburg	60	--	71	55
62. Pontotoc	22	83	77	18
63. Pottawatomie	42	83	75	--
64. Pushmataha	78	80	74	74
65. Roger Mills	32	46	79	100
66. Rogers	42	59	67	25
67. Seminole	51	88	81	--
68. Sequoyah	22	94	74	52
69. Stephens	26	84	46	7
70. Texas	59	35	--	--
71. Tillman	48	74	21	100
72. Tulsa	21	58	79	2
73. Wagoner	26	70	44	32
74. Washington	68	54	65	25
75. Washita	42	79	66	100
76. Woods	49	46	--	--
77. Woodward	58	49	--	7

ceptable levels. The maximum acceptable level of soil loss, T, is set at 5 tons/ac/yr. The formula used to obtain Lambda is given below:

$$\lambda = \frac{T}{RKLS} \quad \text{(Stewart et.al., 1975)}$$

RKLS is fixed for a given area under consideration and represents the erosion potential index for that area. The lower the allowable CP factor (the value which will maintain an acceptable soil loss level), generally the more elaborate and expensive the land treatment or Best Management Practices will be. In some instances, Best Management Practices may not be sufficient to contain soil loss to acceptable levels and a change of landuse is indicated, e.g. change from cropland to pasture. Tables 5-8 represent a list of alternative Best Management Practices which could be implemented to control nonpoint pollution and Table 17a gives a selection guide to the appropriate Best Management Practice alternatives.

3) Cost-effectiveness of Best Management Practices. Once the alternative treatment measures have been selected, a cost-effective evaluation can be carried out on the alternatives. The cost-effectiveness evaluation will be based on the following:

   a) annualized cost of the Best Management Practices

   b) effectiveness of the Best Management Practices in controlling nonpoint pollution.

TABLE 17a

BEST MANAGEMENT PRACTICE SELECTION GUIDE

Landuse	Practices to Control Erosion (see table 5 for description of practices)	Practices to Control Runoff (see table 6 for description of practices)	Practices to Control Nutrient Loss (see table 7 for description of practices)	Practices to Control Pesticide Loss (see table 8 for description of practices)
Cropland	$E_1 - E_{13}$	$R_1 - R_{14}$	$N_1 - N_{11}$	$P_1 - P_{15}$
Pasture	Reestablishment, Protection and Improvement of cover E_6, E_{11}	Same as practices to to control erosion plus R_{14}	$N_1, N_2, N_4, N_7, N_8, N_9, N_{10}$	$P_1, P_2, P_6, P_7, P_8, P_9, P_{10}, P_{11}, P_{12}, P_{13}, P_{14}$
Range	Reestablishment, Protection and Improvement of cover E_6, E_{11}	Same as practices to control erosion plus R_{14}	$N_1, N_2, N_4, N_7, N_8, N_9, N_{10}$	$P_1, P_2, P_6, P_7, P_8, P_9, P_{10}, P_{11}, P_{12}, P_{13}, P_{14}$
Forest	Reestablishment and Improvement of cover E_6, E_{11}	Same as practices to control erosion plus R_{14}	$N_1, N_2, N_4, N_7, N_8, N_9, N_{10}$	$P_1, P_2, P_6, P_7, P_8, P_9, P_{10}, P_{11}, P_{12}, P_{13}, P_{14}$

The two items of the cost effectiveness evaluation have been provided through consultation with Soil Conservation Service personnel (Henson, 1978). The cost-effective analysis has been carried out only for the Best Management Practice alternatives utilized to control non-point pollution from cropland since the Best Management Practices used to protect range, pasture and forest are limited to those practices exclusively aimed at increasing the amount of cover and therefore there is less of a selection problem. Table 18, Comparison of the Cost-Effectiveness of Best Management Practices, provides this highly simplified cost-effectiveness analysis.

TABLE 18

A COMPARISON OF THE COST EFFECTIVENESS OF BEST MANAGEMENT PRACTICES FOR THE ABATEMENT OF NONPOINT POLLUTION FROM AGRICULTURAL SOURCES

Best Management Practice	Cost/Ac/Yr[1]	Effectiveness	Rank
Alternatives			
No till plant			
Sown crops	$18.00/ac/yr less than conventional farming	94%	1
Row crops	$18.00/ac/yr less than conventional farming	60%	2
Conservation tillage			
Sown crops	$12.00/ac/yr less than conventional farming	88%	3
Row crops	$12.00/ac/yr less than conventional farming	50%	4
Contour strip cropping	$2.00/ac/yr more than conventional farming	75%	5
Contouring	$2.00/ac/yr more than conventional farming	50%	6
Contour listing	$3.25/ac/yr more than conventional farming	50%	7
Terracing	$2.00/ac/yr more than conventional farming	30%	8
Winter cover crop	$12.50/ac/yr more than conventional farming	30%	9
Improved soil fertility	$5.65/ac/yr more than conventional farming	7%	10

TABLE 18
continued

[1]Cost/ac/yr estimates were obtained from Soil Conservation Service Agronomist, Odos Henson, Conservation Agronomist, State Office, Stillwater, Oklahoma.

[2]Effectiveness estimates represent an average on site soil loss reduction precentage resulting from implementation of the Best Management Practices compared to soil loss without proper management practices. The effectiveness will vary with site specific conditions. The estimates of effectiveness were obtained from Control of Water Pollution from Cropland, Volume I.

Comments:

1. The above list of the Best Management Practices is not a complete list of potential management practices but rather just a few of the more important practices.

2. The cost effective ranking of the above practices was made by the following formula:

Rank = cost per acre/effectiveness

The smaller the number the more cost effective the practice.

3. The ranking of the management practices does not infer that because the cost effectiveness rank is high the practice should not be used. For example, although the cost effectiveness of terracing ranks near the bottom of the list, terracing is and will continue to be one of the most important and effective management practices we have.

TABLE 18
continued

4. The cost of these management practices do not include secondary cost which may be realized by the farmer, i.e., less yield per acre, more pesticide usage, etc.

5. This is a very crude approximation of the cost effectiveness of management practices which through the criticism of personnel in the field of Soil Conservation could be refined to represent site specific conditions of the farmer and the land farmed.

CHAPTER IV

SUMMARY AND CONCLUSION

Verification of the Nonpoint Pollution Rankings

As mentioned earlier in this study, verification of soil loss and associated nonpoint pollutants as predicted by the Universal Soil Loss Equation is virtually a trivial task since with regression equations the exact form of the model is determined by the available data. The test for "accuracy" is inherent and is reflected in the statistical measures of correlation (Mulkey, 1976). One of the most significant questions one should consider is whether or not the Universal Soil Loss Equation (USLE) has been used properly in evaluating soil loss from such a large land area. The developer of the USLE cautions users that application of the equation to very large land areas where the factors of the equations cannot be realistically estimated constitutes a misuse of the equation (Wischmeier, 1976). Although very large land areas (counties) are evaluated for nonpoint pollution potential in this study, misuse of the USLE is avoided by selectively sampling small areas of the counties thought to be representative of the county. This procedure was carried out with the development of the "Landuse-Land Capability Matrices" (see appendix A). These are used to develop the nonpoint pollution priority rankings. The factors of the equation will be briefly reviewed again for the specific purpose of evaluating possible misuse of the equation.

A - Area

The area of specific landuses was obtained from the Soil Conservation Service's latest landuse publication "Oklahoma Land Inventory, January 1978" and is felt to be the most accurate estimate of landuse available. The type of soil the specific landuses occur on was determined from the "Oklahoma Conservation Needs Inventory" in conjunction with the appropriate county soil survey for further verification.

R - Rainfall Erodibility Factor

This factor is a single numerical value given for each county; hence, a reasonable estimate is given for each county and no possible misrepresentation of the R value occurs. See figure 4.

K - Erodibility Factor

This value was chosen from a table developed by the Soil Conservation Service which gives the numerical value of the K factor for the different soil types found in the state. The values range from 0.17 to 0.49 with most of the values ranging between 0.28 and 0.37 and therefore is not a significant source of error. The information sources used to determine the predominant soil types for specific landuses were the county soil surveys in conjunction with the "Oklahoma Conservation Needs Inventory."

LS - Topographic Factor

This value was also determined by using the county soil surveys along with information concerning landuse-land capability classes found in the "Oklahoma Conservation Needs Inventory." It is recognized that a typical slope for a given landuse is a large assumption but a necessary one when evaluating the entire state of Oklahoma. See Chapter III for more details concerning the topographic factor.

CP - Cropping Management Factors

These values were selected after consultation with Soil Conservation Service personnel. Table 11 gives CP values which were used for cropland. A more indepth discussion of the CP factor is given in Chapter III. Since the erosion potential index, RKLS, is fixed for a given land area, by holding the CP factors at a constant value for specific landuses, one can successfully identify areas which have a high "nonpoint pollution potential."

Sediment Delivery Ratios, Nutrient Concentrations, Enrichment Ratios

Although these are not part of the Universal Soil Loss Equation, a justification of the selection of one value for these factors to represent the entire state is appropriate. The purpose of using the Midwest Research Institute's loading equations is not to determine an actual loading value for the associated pollutants, but rather to relate the major nonpoint pollutant (sediment) to the other frequently associated pollutants (nutrients and organic matter) and thereby determine the general magnitude of nonpoint pollution loading over different parts of the state. No precise estimation of nutrient or organic loads can be made from such a large scale study, but the relationship of sediment to these other nonpoint pollutants is illustrated by the use of the Midwest Research Institute's loading equations (see table 16 mentioned earlier).

Comparison of Nonpoint Pollution Predicted by This Study With Other Nonpoint Pollution Studies in Oklahoma

1. Oklahoma Foundation for Research, Development and Utilization's (OKF) Study - Of the top sixteen counties rated highest in sediment yield in OKF's study, all of these counties have been selected as top priority counties for receiving funds to correct the nonpoint pollution problem by this study. (comparison of tables 19 and 20)

2. Oklahoma Conservation Commission's Study - The nonpoint pollution monitoring program operated by the OCC had reportings from five water quality monitoring stations (three located in eastern Oklahoma, two located in western Oklahoma). The data from these stations indicate the following:

   a) Pollutant concentrations and loading rate are significantly higher in the west than in the east, with the exception of nonpoint pollution loadings from cropland.

   b) Pollution concentrations and loading rates from cropland were higher for nutrients in areas in the eastern part of the state. (see tables 21, 22, and 23)

   c) The short term sampling program produced a wide range in nutrient values. These values are even more variable than

TABLE 19

COUNTIES SEVERELY ERODED

According to the Oklahoma Foundation for Research, Development and Utilization's Land Satellite - Soil Survey Information

County	% of the land eroded or severely eroded
McClain	27.0
Grady	14.0
Lincoln	13.9
Garvin	12.0
Seminole	9.6
Pottawatomie	8.9
Stephens	8.0
Cleveland	7.4
Carter	7.0
Pittsburg	6.3
Bryan	5.0
Washita	5.0
Oklahoma	4.7
Johnston	4.6
Pontotoc	4.2
Beckham	4.0

TABLE 20

PRIORITY LISTING OF COUNTIES RANKING HIGH IN NONPOINT POLLUTION POTENTIAL AND REQUIRING CONSERVATION TREATMENT BY LANDUSE

(Counties are ranked by landuse from highest nonpoint pollution potential to lowest nonpoint pollution potential)

CROPLAND	RANGE	PASTURE	FOREST
Beckham	Cleveland	Seminole	Atoka
McIntosh	Garvin	Adair	Leflore
Bryan	McClain	Garvin	Choctaw
Comanche	Murray	Haskell	Delaware
Cotton	Pontotoc	Lincoln	Latimer
Harmon	Carter	McClain	Cherokee
Jackson	Greer	Atoka	Pushmataha
Grady	Johnston	Bryan	McCurtain
Wagoner	Noble	Carter	Mayes
Garfield	Grady	Cherokee	Pittsburg
Tillman	Jefferson	Choctaw	Sequoyah
Alfalfa	Kiowa	Cleveland	Adair
Cherokee	Lincoln	Coal	Beckham
Craig	Major	Custer	Bryan
Dewey	Payne	Johnston	Ellis
Grant	Seminole	Logan	Greer
Kay	Beckham	Love	Harmon
Kingfisher	Blaine	McCurtain	Haskell
Latimer	Coal	McIntosh	Jackson
Marshall	Comanche	Marshall	Murray
Muskogee	Ellis	Mayes	Ottawa
Pawnee	Hughes	Murray	Roger Mills
Payne	Oklahoma	Okfuskee	Tillman
Seminole	Pawnee	Oklahoma	Coal

CROPLAND	RANGE	PASTURE	FOREST
Washington	Pottawatomie	Osage	McClain
Harper	Pushmataha	Pontotoc	McIntosh
Logan	Stephens	Roger Mills	Marshall
Love	Washita	Tulsa	Carter
Noble	Alfalfa	Washita	Creek
Okfuskee	Beaver	Blaine	Custer
Ottawa	Caddo	Caddo	Garvin
Pittsburg	Canadian	Canadian	Hughes
Texas	Craig	Comanche	Noble
Washita	Creek	Craig	Nowata
Woods	Delaware	Creek	Okfuskee
Adair	Dewey	Delaware	Osage
Atoka	Grant	Greer	Wagoner
Blaine	Harmon	Harmon	Washita
Canadian	Jackson	Hughes	Caddo
Carter	Kingfisher	Jefferson	Canadian
Creek	Love	Kay	Comanche
Custer	McIntosh	Leflore	Craig
Kiowa	Marshall	Muskogee	Grady
Leflore	Nowata	Noble	Johnston
McClain	Okmulgee	Okmulgee	Lincoln
Mayes	Osage	Ottawa	Muskogee
Murray	Roger Mills	Pawnee	Oklahoma
Nowata	Sequoyah	Payne	Okmulgee
Okmulgee	Washington	Pittsburg	Pawnee
Rogers	Woods	Pottawatomie	Pontotoc
Tulsa	Woodward	Pushmataha	Rogers
Woodward	Atoka	Rogers	Seminole
Beaver	Bryan	Sequoyah	Stephens
Cimarron	Cimarron	Washington	Tulsa
Greer	Cotton	Alfalfa	Washington
Jefferson	Custer	Beckham	Woodward
Lincoln	Garfield	Grady	Alfalfa
Stephens	Harper	Jackson	Beaver

CROPLAND	RANGE	PASTURE	FOREST
Caddo	Kay	Kingfisher	Blaine
Cleveland	Logan	Kiowa	Cimarron
Coal	Mayes	Latimer	Cleveland
Delaware	Muskogee	Major	Cotton
Pushmataha	Okfuskee	Nowata	Dewey
Hughes	Rogers	Stephens	Garfield
Johnston	Texas	Wagoner	Grant
McCurtain	Tillman	Cotton	Harper
Osage	Tulsa	Dewey	Jefferson
Roger Mills	Wagoner	Woods	Kay
Ellis	Leflore	Beaver	Kingfisher
Major	Pittsburg	Garfield	Kingfisher
Pottawatomie	Haskell	Grant	Logan
Choctaw	Ottawa	Harper	Love
Garvin	Latimer	Woodward	Major
Haskell	McCurtain	Cimarron	Pottawatomie
Oklahoma			
Sequoyah			
Pontotoc			

TABLE 21

LOADING RATES OF POLLUTANTS BY LAND USE

LOCATION	LAND USE	LOADING RATES OF VARIOUS POLLUTANTS BY LAND USE (lb/ac/yr)[1]		
		TOT-N	TOT-P	EST SOIL LOSS
Idabel	Rangeland	2.23	0.22	500
	Pasture	2.5	0.63	300
	Cropland	110.3	8.7	6200
	Woodland (cc)	1.95	0.13	360
Mangum	Cropland	1.25	0.72	520
	Rangeland	0.91	0.21	156
	Pasture	0.08	0.09	60
	Heavy Agri.	0.3	0.18	400
Freedom	Cropland	1.08	0.2	6800
	Rangeland	13.1	2.6	3200
	Ungrazed Range	2.0	0.52	140
	Pasture	24.3	11.6	18400
Tahlequah	Cropland	25.5	6.1	440
	Pasture	0.24	0.01	10
	Rangeland	0.14	0.02	60
Muskogee	Active Mine	40.7	0.29	3000
	Inactive Mine	2.0	1.61	1320
	Reclaimed Mine	69.8	0.14	2800

[1]Average Values

Source: Roach, 1978, note values have been updated with current sampling data.

TABLE 22

A COMPARISON OF THE RANGE OF CONCENTRATIONS (MG/L) OF FIVE POLLUTANTS BETWEEN THREE DIFFERENT LAND USES IN THE EASTERN HALF OF OKLAHOMA TO THE SAME LAND USES AND POLLUTANTS IN THE WESTERN HALF OF THE STATE

PARAMETER	RANGE		CROP		PASTURE	
	EAST	WEST	EAST	WEST	EAST	WEST
TOT P	.07 - .33	.14 - 1.3	.16 - 2.1	.12 - 1.8	.02 - 1.4	.34 - 4.
TOT N	.90 - 2.1	1.3 - 4.4	1.3 - 15.0	.32 - 4.6	1.1 - 3.5	.75 - 9.
$NO_2 + NO_3$	.10 - .70	.20 - 1.3	.20 - 12.1	.10 - 1.9	.10 - 2.2	.10 - 2.
COD	14.0 - 68.0	4.0 - 88.0	21.0 - 171.0	1.6 - 340.0	14.0 - 71.0	35.0 - 402.
SS	.30 - 455.0	1.0 - 1942.0	17.0 - 958.0	1.0 - 10000.0	.10 - 695.0	1.0 - 2197.

Source: Roach, 1978.

TABLE 23

A COMPARISON OF THE RANGE OF LOADING RATES (LB/AC/YR) OF FIVE POLLUTANTS BETWEEN THREE DIFFERENT LAND USES IN THE EASTERN HALF OF OKLAHOMA TO THE SAME LAND USES AND POLLUTANTS IN THE WESTERN HALF OF THE STATE

PARAMETER	RANGE		CROP		PASTURE	
	EAST	WEST	EAST	WEST	EAST	WEST
TOT P	.0016 - 8	.080- 38	.00019 - 120	.0021 - 150	.0048 - 27	.044 - 440
TOT N	.018 - 56	.22 - 180	.00062 - 2200	.017 - 300	.10 - 81	.40 - 720
$NO_2 + NO_3$	.0022 - 16	.024- 56	.00026 - 1900	.0028 - 14	.0087 - 42	.030 - 320
COD	.58 - 1192	3.0 - 3200	.014 - 5700	.18 - 15000	1.3 -1800	8.1 - 15000
SS	.54 - 3551	29.0 -15000	.17 -77000	2.4 -110000	.30 -1500	4.9 - 620000

Source: Roach, 1978.

the range of nutrient values reported in Mulkey's study (Mulkey, 1976). Table 24, Nutrient Loading from Agricultural Sources, was taken from Mulkey's study and provides an overview of the nutrient values found in 25 previous nutrient studies. The nutrient values predicted by the Midwest Research Institute's loading equations for the various soil loss levels in Table 16 of this study are in general agreement with the range of nutrient values in Table 24.

The first two general trends indicated by the Oklahoma Conservation Commission's study (a and b) are apparent from studying the nonpoint pollution potential classification of the counties developed by this study (Figures 14-23), the exception being the counties in the far northwestern portion of the state, especially the panhandle. These counties are generally rated low in nonpoint pollution potential as a result of the very low annual rainfall and runoff which occurs on relatively level or slightly sloping farm land. Furthermore, the counties indicating the highest nonpoint pollution potential in Figures 14-23 are the ones in the south-central portions of the state. This area was identified by the Oklahoma Conservation Commission's (Figure 24) study as the most severe nonpoint pollution area of the state and is in general agreement with a consensus reached in a conference with a conservation specialist at the State Soil Conservation Service office at Stillwater (Fortney et. al.). From this meeting, the Oklahoma Conservation Commission and the Soil Conservation Service developed a ranking

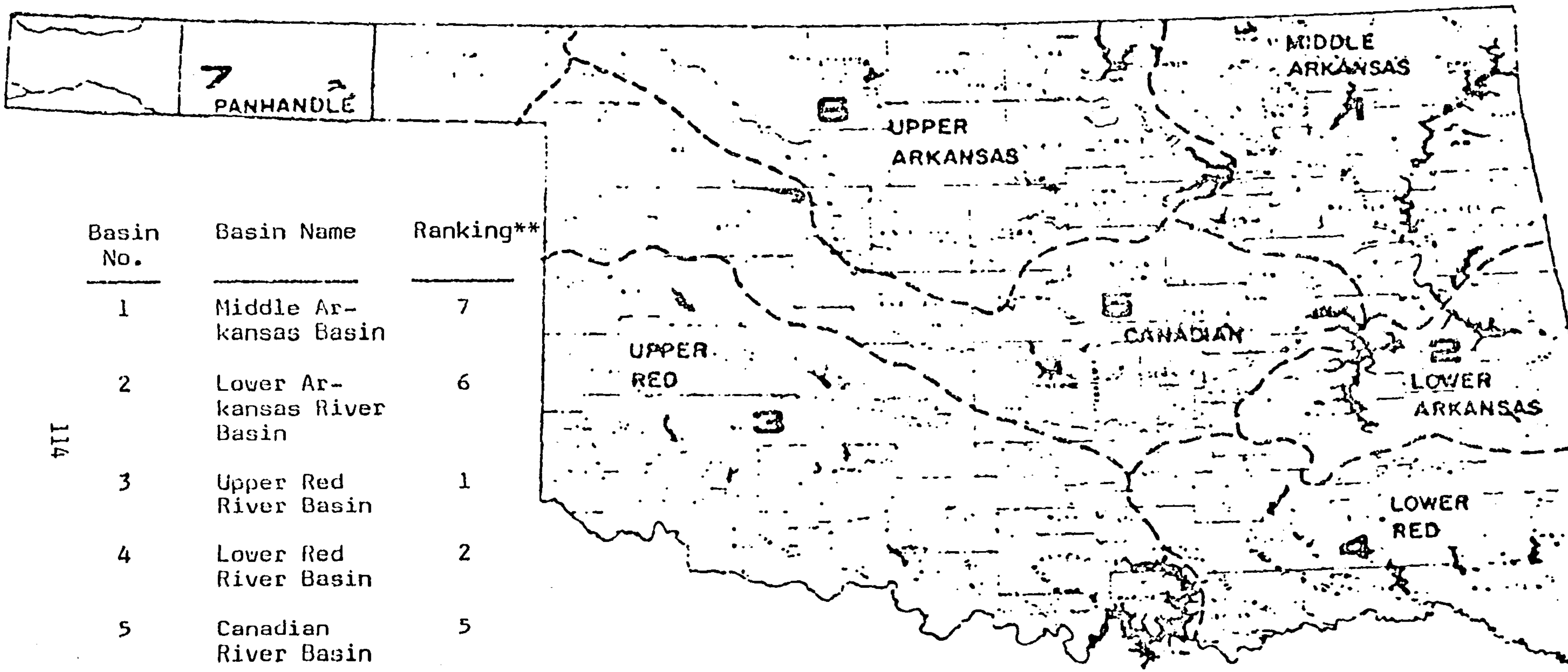
TABLE 24

NUTRIENT LOADING FROM AGRICULTURAL SOURCES -

A Summary of Reported Nutrient Values[1] (lb/ac/yr)

	Total Nitrogen Average (Range)	Total Phosphorus Average (Range)
Agriculture	8.55 (1.08 - 33.1)	0.57 (0.029 - 2.22)
Forest	2.28 (0.74 - 9.13)	0.14 (0.006 - 0.80)
Pasture	4.60 (2.22 - 7.59)	0.29 (0.23 - 0.57)

[1]These are averages and the range of values which have appeared in 25 different research articles (Mulkey, 1976).



Basin No.	Basin Name	Ranking**
1	Middle Arkansas Basin	7
2	Lower Arkansas River Basin	6
3	Upper Red River Basin	1
4	Lower Red River Basin	2
5	Canadian River Basin	5
6	Upper Arkansas River Basin	4
7	Panhandle Basin	3

** A ranking of 1 is highest in nonpoint pollution; a ranking of 7 is lowest in nonpoint pollution.

FIGURE 24

RANKING OF WATER QUALITY MANAGEMENT PLANNING BASINS BY THE OKLAHOMA CONSERVATION COMMISSION'S "NONPOINT POLLUTION STUDY" of the state's 59 river segments as to their nonpoint pollution problems (see Figure 25). This ranking generally supports the conclusions of this study.

3. Sedimentation surveys conducted on reservoirs throughout the state by the Soil Conservation Service and the U.S. Corp of Engineers - A comprehensive search was conducted during the course of this study for sedimentation data which would support the findings of this research. The following is a partial list of the information sources:

a) Jack Clayton, Soil Conservation Service Geologist
b) Carroll Scoggins, U.S. Corp of Engineers Hydrologist
c) Agricultural Research Service's report on sediment surveys
d) Water Resources Council, Sedimentation Committee's report on Sedimentation Activities.

From the sedimentation information gathered, the following are some general trends:

1) Sedimentation rates are highest in the west-central, south-central and north mid-central parts of the state.
2) Sedimentation rates are lowest in the eastern one-fourth of the state and in the northwest.
3) The following factors are significant in addition to the physiographic location of the reservoirs:
    a) drainage area of the reservoir - the smaller the drainage area the greater the sediment delivery ratio.
    b) landuse in the immediate area of the reservoir - the greater the amount of cultivation or reduction of

OKLAHOMA

FIGURE 25 RANKING OF RIVER SEGMENTS BY THE SOIL CONSERVATION SERVICE AND THE OKLAHOMA CONSERVATION COMMISSION**

1. 310820
2. 311100
3. 310830
4. 520700
5. 310810
6. 520500
7. 311510
8. 311600
9. 520800
10. 620910
11. 621000
12. 720500
13. 311500
14. 311800
15. 310840
16. 520620
17. 311310
18. 311300
19. 311210
20. 311200
21. 620920
22. 621010
23. 520530
24. 520610
25. 310800
26. 520600
27. 621100
28. 621210
29. 621200
30. 620900
31. 620930
32. 720510
33. 720900
34. 520810
35. 520520
36. 520710
37. 520510
38. 410210
39. 410200
40. 410310
41. 410300
42. 410400
43. 410600
44. 410700
45. 220600
46. 220100
47. 220200
48. 220300
49. 410100
50. ~~121600~~
51. 121400
52. 121300
53. 120420
54. 120410
55. 120400
56. 121700
57. 121500
58. 121510
59. 121610

**Ranked in decreasing order of severity.

ground cover, the greater the sedimentation rate.

c) the presence of conservation measures (especially small ponds) above the drainage area - conservation measures greatly reduce the sedimentation rate.

Figure 26 is an illustration of the sedimentation rates of reservoirs over the state. This figure was constructed from an analysis by the Soil Conservation Service and the Corp of Engineers. The shaded area on the map indicates areas which are experiencing a high rate of sediment deposition. This area roughly corresponds to the west-central, south-central and north mid-central parts of the state.

4. A comparison of soil loss values estimated by a Soil Conservation Service Survey of the Upper Red River Basin with soil losses predicted by landuse-land capability class matrices - A recent completed survey of soil loss from watersheds in the Red River Basin (Clayton, 1977) was obtained for the purpose of comparing soil loss estimated on a watershed basis with soil loss predicted on a county level in this study. Several watersheds in each of the counties listed in Table 25 were sampled by the Soil Conservation Service and the range of watershed soil loss is given for each county. The range of soil loss as predicted by the land capability class matrices gives soil loss for that county without and with conservation treatment and is found to the right of the Soil Conservation Service soil loss values. For cropland the small grain crops are the most dominant acreages so this value is taken from the land capability matrix for comparison with the Soil Conservation Service's soil loss estimates. Soil loss estimates from small

OKLAHOMA

FIGURE 26

SEDIMENTATION SURVEY OF RESERVOIRS ACROSS THE STATE

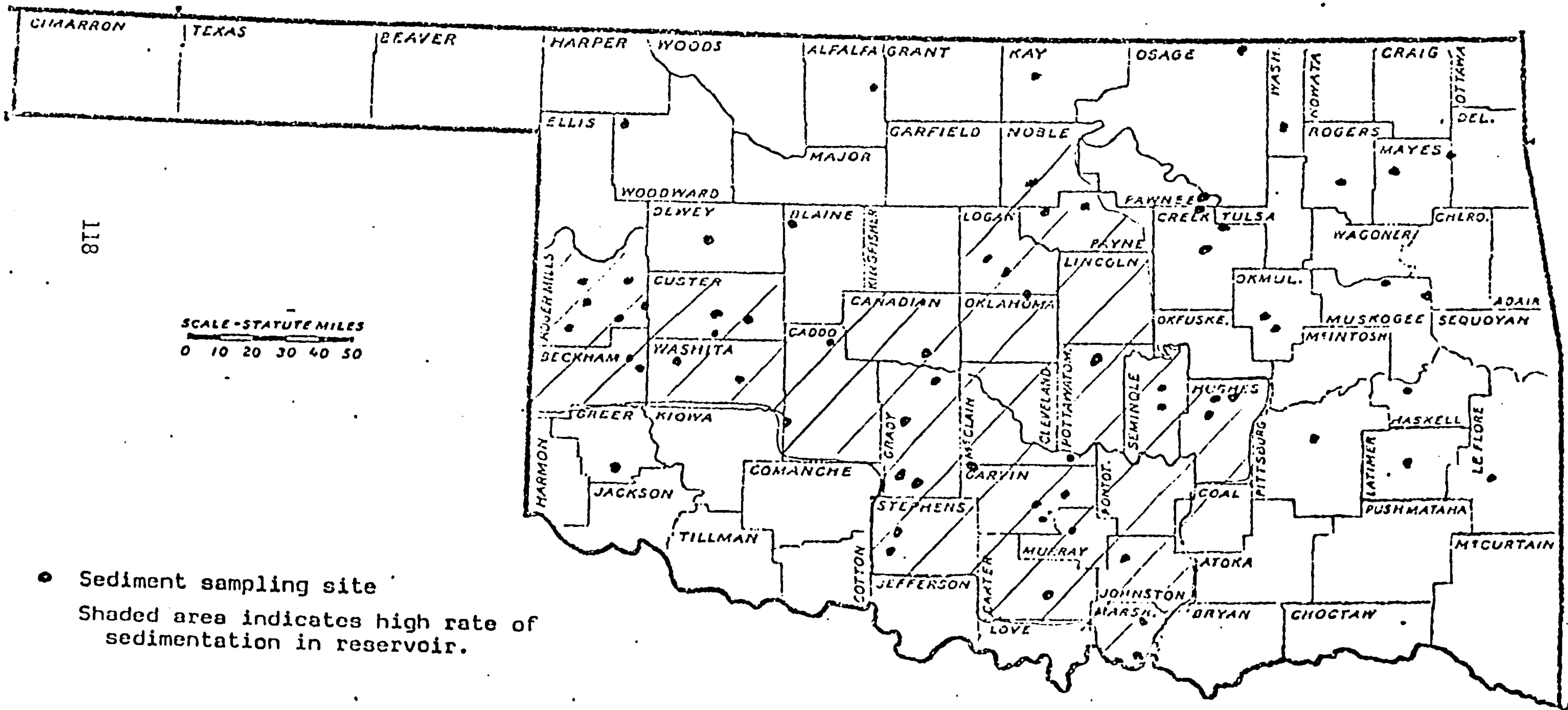


TABLE 25
A COMPARISON OF SOIL LOSS ESTIMATED BY A SOIL CONSERVATION SERVICE SURVEY OF THE UPPER RED RIVER BASIN WITH SOIL LOSSES PREDICTED BY LANDUSE - LAND CAPABILITY CLASS MATRICES (LCC)**

COUNTY	CROPLAND		RANGE		PASTURE		FOREST	
	SCS	LCC	SCS	LCC	SCS	LCC	SCS	LCC
Beckham	4.2-6.8	5.1-10.2	1.6-3.2	2.9-7.1	1.5-1.8	0.8-1.8	0.6-1.5	0.2-1.9
Caddo	6.5*	1.9-3.8	2.2	1.1-2.6	1.3	0.7-1.6	1.5	0.2-1.7
Carter	8.7-12.0	5.2-10.5	1.9-5.4	4.1-9.7	1.4-2.4	4.1-9.7	1.4-3.0	0.7-6.5
Comanche	5.9-6.7	3.3-6.6	1.8-3.0	0.8-1.8	1.2-1.5	1.4-3.3	1.0-1.5	0.2-1.9
Cotton	5.3-7.1	3.7-7.4	1.7-3.5	1.4-3.3	1.0-1.5	0.8-2.0	1.0-1.5	0.1-0.8
Grady	6.2*	5.8-11.6	1.8	4.4-10.6	1.4	1.3-3.2	1.3	0.2-2.1
Greer	5.9-6.5	2.2-4.3	2.2-2.6	2.5-5.9	1.5-1.52	1.3-3.2	1.4-1.5	0.2-2.1
Harmon	5.8-6.5	1.8-3.5	2.4-3.0	1.8-4.3	1.5-1.6	1.2-2.8	1.3-1.4	0.3-2.9
Jackson	5.6-6.3	1.5-3.1	2.2-3.0	1.1-2.7	1.3-1.5	0.4-0.8	1.2-1.4	0.1-1.0
Jefferson	4.6-7.6	2.9-5.8	1.6-3.9	1.4-3.4	1.0-2.6	1.4-3.4	1.0-1.9	0.2-2.2
Kiowa	6.2-6.7	2.2-4.4	2.8-3.2	2.3-5.4	1.6-2.0	1.5-3.5	1.5-2.0	0.4-3.6
Love	7.0-8.7	2.7-5.4	1.9-2.7	1.8-4.3	1.4-1.7	1.0-2.5	1.4-1.5	0.2-1.7
Marshall	7.4*	6.3-12.5	1.9	1.4-3.4	1.2	1.4-3.4	1.2	2.2-21.6
Stephens	4.6-7.6	3.4-6.7	1.6-3.9	1.8-4.3	1.0-2.6	1.8-4.3	1.0-1.9	0.1-1.2
Tillman	4.6-7.7	2.7-5.5	2.1-3.5	1.5-3.7	1.1-1.8	0.6-1.5	1.4-1.5	0.07-0.7
Washita	5.9*	3.8-7.5	3.1	3.3-8.0	1.7	3.3-8.0	1.6	--------

*Only one watershed was surveyed in this county.
Source: Jack Clayton, Soil Conservation Service Geologist, Chickasha, Oklahoma

**Refer to Appendix B for a statistical evaluation of the average soil loss values predicted by these two studies.

grain crops tend to be somewhat lower than soil loss from row crops due to the extra plant cover available to retard soil loss. The Soil Conservation Service survey did not differentiate between small grain and row crops and therefore their estimates probably reflect an average of both crop types. As a result, the estimates taken from the matrices for cropland tend to underestimate the soil loss when comparing these values with the Soil Conservation Service values for cropland. Even so, the cropland estimates are relatively close and the other soil loss values are in good agreement.

5. Measured sediment losses from small plots monitored by the Agricultural Research Service - The Agricultural Research Service (ARS) located in Chickasha, Oklahoma has conducted runoff and sediment yield monitoring for both cropland and rangeland plots located near Chickasha and El Reno. The El Reno research plots have been monitored for just over a year and data is not readily available at this time for comparison purposes. The Chickasha plots, however, provide measurements for almost a ten-year period. Table 26, Measured Sediment Losses from Small Plots Monitored by the Agricultural Research Service, gives sediment losses from both cropland and rangeland. The cropland plots are located at the Cotton Research Station approximately one mile east of Chickasha. Slope on the cropland is estimated at one-half of one percent and therefore is one major reason the soil losses were so small. The slope on the rangeland is estimated at three percent (Welch, 1978). The rangeland is located approximately fifteen miles northeast of Chickasha.

TABLE 26

MEASURED SEDIMENT LOSSES FROM SMALL PLOTS MONITORED BY THE AGRICULTURAL RESEARCH SERVICE

LANDUSE	AREA (AC)	SEDIMENT YIELD tons/ac/yr	
		1968-1975	1975
Mixed	26.5	0.85	0.58
Row crop, Dryland	17.8	0.66	1.18
Row crop, Irrigated	44.3	1.83	2.13
Small grain, Dryland	13.0	0.73	1.76
Range, Properly Grazed	23.7	0.04	0.054
Range, Properly Grazed	27.2	0.19	0.30
Range, Overgrazed		4.76	4.85
Range, Overgrazed		6.61	8.71

Comments: The cropland slope is approximately one-half of one percent. The rangeland slope is approximately three percent. This research was conducted by Norman H. Welch and Donnie J. Galindo of the Agricultural Research Service and was published in the <u>1975 Annual Research Report Southern Great Plains Research Watershed</u>, U.S. Department of Agriculture, Agricultural Research Service, Chickasha, Oklahoma.

Summary

Nonpoint pollution potential is illustrated in Figures 14-23. For each county the four major landuses are placed in one of the four following classes for both with and without conservation treatment:

I Low nonpoint pollution potential

II Moderate nonpoint pollution potential

III High nonpoint pollution potential

IV Very high nonpoint pollution potential

For example, Cleveland county cropland without conservation treatment rates II for row crops and III for small grain crops. Range rates a III, pasture rates a I as does forest. Table 15 gives the contribution of the four major landuses to the nonpoint pollution problem. For example, in Cleveland county 19% of the total nonpoint pollution is from cropland, 52% is from rangeland, 18% from pastureland and the remaining 11% is from forestland. By combining this information, the nonpoint pollution potential and the source of the pollution with the known conservation treatment needs (Table 17) one can obtain a priority rating for counties and landuses within the counties which will enable a logical approach to correcting the nonpoint pollution problem across the state. (See Table 20) Counties rating high in the priority ratings as well as specific landuses within each county should be given the first opportunity for federal and state money to correct the problems. The correction of the nonpoint pollution problems will come through the application of Best Management Practices to the various agricultural sources of pollution.

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APPENDICES

APPENDIX A

LAND USE - LAND CAPABILITY MATRIX, TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY ADAIR

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	342											
Row crop 2e	168	280	0.35	0.30	29.4	0.17	0.42	0.21	12.3	6.2	2066	
Small grain 2e	174	280	0.35	0.30	29.4	0.17	0.22	0.11	6.5	3.2	1131 2197 cropland	1
RANGELAND	**	280	--	--	--	--	--	--	--	--	--	0
PASTURE 2e	134,069	280	0.35	0.30	29.4	0.17	0.03	0.013	0.9	0.4	120,662	30
FOREST 7s	183,377	280	0.28	0.97	76.0	0.07	0.02	0.002	1.5	0.2	275,066 397,925 total	69

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY ALFALFA

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	333,615											
Row crop 1-	30,025	180	0.33	0.21	12.5	0.40	0.42	0.21	5.2	2.6	156,130	
Small grain 1-	303,590	180	0.33	0.21	12.5	0.40	0.22	0.11	2.7	1.4	819,693 975,823 cropland	81
RANGELAND 7e	124,554	180	0.17	0.97	29.7	0.17	0.06	0.025	1.8	0.7	224,197	19
PASTURE 5s	4,971	180	0.37	0.30	20.0	0.25	0.06	0.025	1.2	0.5	5,965	< 1
FOREST 4s	926	180	0.19	0.30	10.3	0.49	0.04	0.004	0.4	0.04	380 1,206,365 total	< 1

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

OUNTY ATOKA

AND USE AND LAND APABILITY CLASS	ACRES	R	(K	X LS)	EROSION POTENTIAL INDEX	λ^5	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a W/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
[illegible] total	10,168											
Row crop 3e	6,906	320		0.26	83.2	0.06	0.42	0.21	34.9	17.5	241,019	
Small grain 3e	3,262	320		0.26	83.2	0.06	0.22	0.11	18.3	9.2	59,695 300,714 cropland	7
ANGELAND 4e	43,624	320		0.45	144.0	0.03	0.03	0.013	4.3	1.9	187,583	4
ASTURE 2e	236,436	320		0.19	60.8	0.08	0.03	0.013	1.8	0.8	425,585	10
ORE ST 7s	297,778	320		1.8	576.0	0.01	0.02	0.002	11.5	1.2	3,424,447 4,338,329 total	79

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

OUNTY BEAVER

AND USE AND LAND APABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
ROPLAND total	453,556											
Row crop 3e	88,549	130	0.27	0.30	10.5	0.48	0.42	0.21	4.4	2.2	389,616	
Small grain 3e	365,007	130	0.27	0.30	10.5	0.48	0.22	0.11	2.3	1.2	438,008 827,624 cropland	49
ANGELAND 6e	600,723	130	0.21	0.83	22.7	0.22	0.06	0.025	1.4	0.57	841,012	50
ASTURE 6e	771	130	0.21	0.83	22.7	0.22	0.06	0.025	1.4	0.57	1,079	.5
OREST 6e	1,466	130	0.21	0.83	22.7	0.22	0.04	0.004	0.9	0.09	1,329 1,671,044 total	.5

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

OUNTY BECKHAM

AND USE AND LAND APABILITY CLASS	ACRES	R	(K	x LS)	EROSION POTENTIAL INDEX	λ^5	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
ROPLAND total	211,963											
Row crop 3e	95,383	160		0.29	46.4	0.11	0.42	0.21	19.49	9.74	1,859,015	
Small grain 3e	116,580	160		0.29	46.4	0.11	0.22	0.11	10.21	5.1	1,190,282 3,049,297 crop	59
ANGELAND 4e	293,151	160		0.74	118.4	0.04	0.06	0.025	7.1	2.96	2,081,372	40
ASTURE 2e	6,860	160		0.19	30.4	0.16	0.06	0.025	1.82	0.76	12,485	<1
OREST 3e	11,902	160		0.29	46.4	0.11	0.04	0.004	1.86	0.19	22,138 5,165,292 total	1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

OUNTY BLAINE

AND USE AND LAND APABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ5	CP1	CP2	t/a w/o C.T. 3	t/a w/ C.T. 4	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
ROPLAND total	300,914											
Row crop 2e	30,091	200	0.29	0.30	17.4	0.29	0.42	0.21	7.3	3.7	219,664	
Small grain 2e	270,823	200	0.29	0.30	17.4	0.29	0.22	0.11	3.8	1.9	1,029,127 1,248,791 cropland	69
ANGELAND 7s	177,600	200	0.31	1.1	68.2	0.07	0.06	0.025	4.1	1.7	482,160	26
ASTURE 3e	25,299	200	0.28	0.53	29.7	0.17	0.06	0.025	1.8	0.7	45,538	3
OREST 4e	27,788	200	0.29	0.67	38.9	0.13	0.04	0.004	1.6	0.16	44,461 1,820,950 total	2

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY BRYAN

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	X LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	70,915											
Row crop 2e	53,186	320		0.19	60.8	0.08	0.42	0.21	25.54	12.77	1,356,243	
Small grain 2e	17,729	320		0.19	60.8	0.08	0.22	0.11	13.38	6.69	237,569 1,593,812 crop	47
RANGELAND 2e	22,889	320		0.19	60.8	0.08	0.06	0.025	3.65	1.52	84,689	2
PASTURE 2e	357,609	320		0.19	60.8	0.08	0.06	0.025	3.65	1.52	1,323,153	39
FOREST 6e	68,379	320		0.45	144.0	0.03	0.04	0.004	5.76	0.58	396,598 3,398,252 total	12

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

OUNTY CADDO

AND USE AND LAND APABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
ROPLAND total	291,692											
Row crop 2e	110,843	200	0.29	0.30	17.4	0.29	0.42	0.21	7.3	3.7	809,154	
Small grain 2e	181,604	200	0.29	0.30	17.4	0.29	0.22	0.11	3.8	1.9	690,095 1,499,249 croplan	62
ANGELAND 6e	207,648	200	0.26	0.83	43.16	0.12	0.06	0.025	2.59	1.08	537,808	22
ASTURE 3e	138,185	200	0.35	0.38	26.6	0.19	0.06	0.025	1.6	0.67	221,096	9
OREST 6e	100,995	200	0.26	0.83	43.16	0.12	0.04	0.004	1.73	0.17	174,721 2,432,874 total	7

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY CANADIAN

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ [5]	CP [1]	CP [2]	t/a w/o C.T. [3]	t/a w/ C.T. [4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	306,449											
Row crop 1-	39,838	220	0.37	0.21	17.09	0.29	0.42	0.21	7.18	3.59	286,037	
Small grain 1-	266,378	220	0.37	0.21	17.09	0.29	0.22	0.11	3.76	1.88	1,001,581 1,287,618 cropland	71
RANGELAND 4e	128,021	220	0.37	0.66	53.72	0.09	0.06	0.025	3.22	1.34	412,228	23
PASTURE 2e	42,580	220	0.29	0.38	24.24	0.21	0.06	0.025	1.45	0.61	61,741	3
FOREST 7s	17,216	220	0.33	1.1	79.86	0.06	0.04	0.004	3.19	0.32	54,919 1,816,506 total	3

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

:OUNTY CARTER

.AND USE AND LAND :APABILITY CLASS	ACRES	R	(K	X LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T. [3]	t/a w/ C.T. [4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
:ROPLAND total	31,582											
Row crop 3w	6,948	280		0.53	148.4	0.03	0.42	0.21	62.33	31.16	433,069	
Small grain 3e	24,634	280		0.17	47.6	0.11	0.22	0.11	10.47	5.24	257,918 690,987 cropland	15
:ANGELAND 6e	255,283	280		0.58	162.4	0.03	0.06	0.025	9.74	4.06	2,486,456	54
'ASTURE 6e	81,234	280		0.58	162.4	0.03	0.06	0.025	9.74	4.06	791,219	17
'OREST 6e	104,255	280		0.58	162.4	0.03	0.04	0.004	6.50	0.65	677,658 4,646,320 total	15

l - Cover management factor without conservation treatment
? - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
| - tons/ac soil loss with conservation treatment
; - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY CHEROKEE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	1,775											
Row crop 2e	675	280	0.33	0.31	28.6	0.17	0.42	0.21	12.0	6.0	8,100	
Small grain 4e	1,100	280		0.10	28.0	0.18	0.22	0.11	6.2	3.1	6,820 14,920 cropland	2
RANGELAND 4e	**	280	--	--	--	--	--	--	--	--	--	0
PASTURE 2e	152,696	280	0.33	0.31	28.6	0.17	0.03	0.013	0.9	0.4	137,426	18
FOREST 7s	268,941	280	0.28	1.4	109.8	0.05	0.02	0.002	2.2	0.2	591,670 744,016 total	80

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY CHOCTAW

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	X LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	6,194											
Row crop 2e	3,496	320		0.10	32.0	0.16	0.42	0.21	13.4	6.7	46,846	
Small grain 2e	2,698	320		0.10	32.0	0.16	0.22	0.11	7.0	3.5	18,886 65,732 cropland	3
RANGELAND 2e	**	320	--	--	--	--	--	--	--	--	--	0
PASTURE 2e	240,579	320		0.10	32.0	0.16	0.03	0.013	0.96	0.41	230,956	11
FOREST 6e	208,230	320		1.4	448.0	0.01	0.02	0.002	9.0	0.9	1,874,070 2,170,758 total	86

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY CIMARRON

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	476,811											
Row crop 3e	200,261	100	0.24	0.31	7.44	0.67	0.42	0.21	3.12	1.56	624,814	
Small grain 3e	276,550	100	0.24	0.31	7.44	0.67	0.22	0.11	1.64	0.82	453,542 1,078,356 cropland	63
RANGELAND 6e	614,293	100	0.32	0.53	16.96	0.29	0.06	0.025	1.02	0.42	626,579	37
PASTURE --	**	100	--	--	--	--	--	--	--	--	--	0
FOREST 3e	75	100	0.24	0.31	7.44	0.67	0.04	0.004	0.30	0.03	23 1,704,958 total	<1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

OUNTY CLEVELAND

AND USE AND LAND APABILITY CLASS	ACRES	R	(K	x LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T. [3]	t/a w/ C.T. [4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
ROPLAND total	34,294											
Row crop 1-	5,487	260		0.08	20.8	0.24	0.42	0.21	8.74	4.37	47,956	
Small grain 2e	28,807	260		0.22	57.2	0.09	0.22	0.11	12.58	6.29	362,392 410,348 cropland	19
ANGELAND 6e	96,216	260		0.74	192.4	0.03	0.06	0.025	11.54	4.81	1,110,333	52
ASTURE 4e	82,940	260		0.30	78.0	0.06	0.06	0.025	4.68	1.95	388,159	18
OREST 4e	75,275	260		0.30	78.0	0.06	0.04	0.004	3.12	0.31	234,858 2,143,698 total	11

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

OUNTY COAL

AND USE AND LAND APABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
ROPLAND total	10,024											
Row crop 2e	6,616	300	0.37	0.31	34.4	0.15	0.42	0.21	14.4	7.2	95,270	
Small grain 2e	3,408	300	0.37	0.31	34.4	0.15	0.22	0.11	7.6	3.8	25,901 121,171 cropland	16
ANGELAND 7s	74,533	300	0.28	1.4	117.6	0.04	0.03	0.013	3.5	1.5	260,866	35
ASTURE 3e	150,101	300	0.36	0.38	41.0	0.12	0.03	0.013	1.2	0.5	180,121	24
OREST 7s	75,116	300	0.28	1.4	117.6	0.04	0.02	0.002	2.4	0.2	180,278 742,436 total	25

142

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY COMANCHE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	106,378											
Row crop 3e	19,148	220	0.36	0.38	30.1	0.17	0.42	0.21	12.64	6.32	242,031	
Small grain 3e	87,230	220	0.36	0.38	30.1	0.17	0.22	0.11	6.62	3.31	577,463 819,494 cropland	54
RANGELAND 3e	289,414	220	0.36	0.38	30.1	0.17	0.06	0.025	1.81	0.75	523,839	35
PASTURE 6e	29,864	220	0.30	0.83	54.78	0.09	0.06	0.025	3.29	1.37	98,253	6
FOREST 4e	39,839	220	0.40	0.53	46.64	0.11	0.04	0.004	1.87	0.19	74,499 1,516,085 total	5

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY COTTON

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	196,603											
Row crop 4e	27,524	220	0.4	0.53	46.64	0.11	0.42	0.21	19.59	9.79	539,195	
Small grain 3e	169,079	220	0.4	0.38	33.44	0.15	0.22	0.11	7.36	3.68	1,244,421 1,783,616 cropland	77
RANGELAND 6e	137,229	220	0.305	0.83	55.69	0.09	0.06	0.025	3.34	1.39	458,345	20
PASTURE 3e	28,356	220	0.4	0.38	33.44	0.15	0.06	0.025	2.01	0.84	56,996	2
FOREST 3s	11,094	220	0.43	0.21	19.87	0.25	0.04	0.004	0.79	0.08	8,764 2,307,721 total	<1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

OUNTY CRAIG

AND USE AND LAND APABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T. 3	t/a w/ C.T. 4	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
ROPLAND total	61,425											
Row crop 2e	31,327	260	0.37	0.31	29.8	0.17	0.42	0.21	12.5	6.3	391,588	
Small grain 2e	30,098	260	0.37	0.31	29.8	0.17	0.22	0.11	6.6	3.3	198,647 590,235 cropland	66
ANGELAND 2s	153,141	260	0.43	0.21	23.5	0.21	0.03	0.013	0.7	0.3	107,199	12
ASTURE 2e	200,208	260	0.37	0.31	29.8	0.17	0.03	0.013	0.9	0.4	180,187	20
OREST 1-	27,690	260	0.37	0.21	20.2	0.25	0.02	0.002	0.4	0.04	11,076 888,697 total	1

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY CREEK

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ 5	CP 1	CP 2	t/a w/o C.T. 3	t/a w/ C.T. 4	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	30,236											
Row crop 1-	9,373	280	0.32	0.31	27.8	0.18	0.42	0.21	11.7	5.8	109,664	
Small grain 1-	20,863	280	0.32	0.31	27.8	0.18	0.22	0.11	6.1	3.1	127,264 236,928 cropland	32
RANGELAND 7s	103,758	280	0.17	0.83	39.5	0.13	0.03	0.013	1.2	0.5	124,510	17
PASTURE 7s	119,897	280	0.17	0.83	39.5	0.13	0.03	0.013	1.2	0.5	143,876	19
FOREST 7s	292,582	280	0.17	0.83	39.5	0.13	0.02	0.002	0.8	0.1	234,066 739,380 total	32

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY CUSTER

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	296,911											
Row crop 2e	53,444	180	0.375	0.31	20.93	0.24	0.42	0.21	8.79	4.4	469,773	
Small grain 2e	243,467	180	0.375	0.31	20.93	0.24	0.22	0.11	4.60	2.3	1,119,948 1,589,721 cropland	70
RANGELAND 6e	255,233	180	0.28	0.83	41.83	0.12	0.06	0.025	2.51	1.05	640,635	28
PASTURE 6e	6,297	180	0.28	0.83	41.83	0.12	0.06	0.025	2.51	1.05	15,805	1
FOREST 6e	8,625	180	0.28	0.83	41.83	0.12	0.04	0.004	1.67	0.17	14,404 2,260,565 total	1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY DELAWARE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	12,696											
Row crop 2e	4,317	280	0.26	0.31	22.6	0.22	0.42	0.21	9.5	4.7	41,012	
Small grain 2e	8,381	280	0.26	0.31	22.6	0.22	0.22	0.11	5.0	2.5	41,905 82,917 cropland	5
RANGELAND 2e	7,473	280	0.26	0.31	22.6	0.22	0.03	0.013	0.7	0.3	5,231	<1
PASTURE 2e	220,824	280	0.26	0.31	22.6	0.22	0.03	0.013	0.7	0.3	154,577	9
FOREST 7s	182,732	280	0.24	6.0	403.2	0.01	0.02	0.002	8.1	0.8	1,480,129 1,722,854 total	86

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY DEWEY

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	206,250											
Row crop 3e	28,875	180	0.31	0.53	29.57	0.17	0.42	0.21	12.42	6.21	358,628	
Small grain 3e	177,375	180	0.31	0.53	29.57	0.17	0.22	0.11	6.51	3.25	1,154,711 1,513,339 cropland	59
RANGELAND 6e	333,300	180	0.28	0.97	48.89	0.10	0.06	0.025	2.93	1.22	976,569	38
PASTURE 3e	185	180	0.31	0.53	29.57	0.17	0.06	0.025	1.77	0.74	327	<1
FOREST 6e	34,158	180	0.28	0.97	48.89	0.10	0.04	0.004	1.96	0.20	66,950 2,557,185 total	3

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY ELLIS

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	187,411											
Row crop 3e	26,542	140	0.22	0.38	11.7	0.43	0.42	0.21	4.91	2.46	130,321	
Small grain 3e	161,173	140	0.22	0.38	11.7	0.43	0.22	0.11	2.57	1.29	414,215 544,536 cropland	41
RANGELAND 6e	533,732	140	0.21	0.83	24.4	0.20	0.06	0.025	1.46	0.61	779,249	59
PASTURE --	**	--	--	--	--	--	--	--	--	--	--	0
FOREST 5w	12,991	140	0.30	0.21	8.82	0.57	0.04	0.004	0.35	0.04	4,547 1,328,332 total	1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY GARFIELD

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	425,365											
Row crop 2e	4,254	220	0.31	0.31	21.14	0.24	0.42	0.21	8.88	4.44	37,776	
Small grain 3e	421,111	220	0.40	0.38	33.44	0.15	0.22	0.11	7.36	3.68	3,099,377 3,137,153 cropland	81
RANGELAND 6e	170,277	220	0.33	0.97	70.42	0.07	0.06	0.025	4.23	1.76	720,272	19
PASTURE 4e	613	220	0.37	0.53	43.14	0.12	0.06	0.025	2.59	1.08	1,588	<1
FOREST 5w	2,459	220	0.30	0.83	54.78	0.09	0.04	0.004	2.19	0.22	5,385 3,864,398 total	<1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY GARVIN

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K X LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	75,841										
Row crop 2e	36,404	260	0.22	57.2	0.09	0.42	0.21	24.0	12.0	873,696	
Small grain 1-	39,437	260	0.08	20.8	0.24	0.22	0.11	4.6	2.3	181,410 1,055,106 cropland	20
RANGELAND 6e	281,093	260	0.74	192.4	0.03	0.06	0.025	11.5	4.8	3,232,570	60
PASTURE 6e	70,300	260	0.74	192.4	0.03	0.06	0.025	11.5	4.8	808,450	15
FOREST 6e	40,528	260	0.74	192.4	0.03	0.04	0.004	7.7	0.8	312,066 5,408,192 total	5

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

OUNTY GRADY

AND USE AND LAND APABILITY CLASS	ACRES	R	(K	X LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T. ^{3}	t/a w/ C.T. ^{4}	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
ROPLAND total	207,315											
Row crop 1-	45,609	240		0.08	19.2	0.26	0.42	0.21	8.06	4.03	367,609	
Small grain 3e	161,706	240		0.22	52.8	0.09	0.22	0.11	11.6	5.8	1,875,790 2,243,399 cropland	41
ANGELAND 6e	251,572	240		0.74	177.6	0.03	0.06	0.025	10.66	4.44	2,681,758	49
ASTURE 3e	124,053	240		0.22	52.8	0.09	0.06	0.025	3.17	1.32	393,248	7
OREST 3e	53,223	240		0.22	52.8	0.09	0.04	0.004	2.11	0.21	112,301 5,430,706 total	2

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY GRANT

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	X LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	445,479											
Row crop 3e	17,819	220		0.09	19.8	0.25	0.42	0.21	8.32	4.16	148,254	
Small grain	427,660	220		0.09	19.8	0.25	0.22	0.11	4.36	2.18	1,864,598 2,012,852 cropland	92
RANGELAND 3e	137,874	220		0.09	19.8	0.25	0.06	0.025	1.19	0.50	164,070	8
PASTURE 1-	4,456	220		0.08	17.6	0.28	0.06	0.025	1.06	0.44	4,723	< 1
FOREST 5w	73	220		0.10	22.0	0.23	0.04	0.004	0.88	0.09	64 2,181,709 total	<1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

:OUNTY GREER

.AND USE AND LAND :APABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
:ROPLAND total	174,971											
Row crop 2w	48,992	180	0.30	0.21	11.34	0.44	0.42	0.21	4.76	2.38	233,202	
Small grain 2e	125,979	180	0.35	0.31	19.53	0.26	0.22	0.11	4.30	2.15	541,710 774,912 cropland	42
ANGELAND 7s	170,124	180	0.39	1.4	98.28	0.05	0.06	0.025	5.90	2.46	1,003,732	55
ASTURE 5w	16,450	180	0.30	0.97	52.38	0.10	0.06	0.025	3.14	1.31	51,653	3
OREST 5w	3,422	180	0.30	0.97	52.38	0.10	0.04	0.004	2.10	0.21	7,186 1,837,483 total	0

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY HARMON

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	x LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	178,969											
Row crop 3e	78,746	160		0.29	46.4	0.11	0.42	0.21	19.49	9.74	1,534,760	
Small grain 2e	100,223	160		0.10	16.0	0.31	0.22	0.11	3.52	1.76	352,785 1,887,545 crop	77
RANGELAND 7s	120,231	160		0.45	72.0	0.07	0.06	0.025	4.32	1.8	519,398	21
PASTURE 3e	9,912	160		0.29	46.4	0.11	0.06	0.025	2.78	1.16	27,555	1
FOREST 7s	2,093	160		0.45	72.0	0.07	0.04	0.004	2.9	0.3	6,070 2,440,568 total	<1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY HARPER

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	199,310											
Row crop 2e	31,890	160	0.32	0.31	15.87	0.32	0.42	0.21	6.67	3.33	213,663	
Small grain 3e	167,420	160	0.28	0.66	29.57	0.17	0.22	0.11	6.51	3.25	1,088,230 1,301,893 cropland	59
RANGELAND 6e	409,120	160	0.28	0.83	37.18	0.13	0.06	0.025	2.23	0.93	900,064	41
PASTURE 6e	**	--	--	--	--	--	--	--	--	--	--	0
FOREST 3e	4,388	160	0.28	0.66	29.57	0.17	0.04	0.004	1.18	0.12	5,178 2,207,135 total	0

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

OUNTY HACKELL

AND USE AND LAND APABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
ROPLAND total	5,228											
Row crop 2w	2,154	300	0.43	0.21	27.1	0.18	0.42	0.21	11.4	5.7	24,556	
Small grain 2e	3,074	300	0.43	0.31	40.0	0.13	0.22	0.11	8.8	4.4	27,051 51,607 cropland	12
ANGELAND 7s	5,693	300	0.33	3.2	316.8	0.02	0.03	0.013	9.5	4.1	54,084	13
ASTURE 3e	177,332	300	0.26	0.53	41.3	0.12	0.03	0.013	1.2	0.5	212,798	50
OREST 7s	133,764	300	0.43	0.31	40.0	0.13	0.02	0.002	0.8	0.08	107,011 425,500 total	25

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.
* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY HUGHES

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	49,038											
Row crop 2w	37,759	300	0.37	0.21	23.3	0.21	0.42	0.21	9.8	4.9	370,038	
Small grain 1-	11,279	300	0.30	0.21	18.9	0.26	0.22	0.11	4.2	2.1	47,372 417,410 cropland	30
RANGELAND 7s	131,565	300	0.28	1.4	117.6	0.04	0.03	0.013	3.5	1.5	460,478	33
PASTURE 2e	141,609	300	0.35	0.31	32.6	0.15	0.03	0.013	1.0	0.4	141,609	10
FOREST 7s	150,132	300	0.28	1.4	117.6	0.04	0.02	0.002	2.4	0.2	360,317 1,379,814 total	26

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY JACKSON

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	312,051											
Row crop 2c	102,977	180	0.37	0.21	13.99	0.36	0.42	0.21	5.88	2.94	605,505	
Small grain 2c	209,074	180	0.37	0.21	13.99	0.36	0.22	0.11	3.08	1.54	643,948 1,249,453 cropland	81
RANGELAND 7s	106,924	180	0.30	0.83	44.82	0.11	0.06	0.025	2.67	1.12	285,487	18
PASTURE 2c	7,797	180	0.37	0.21	13.99	0.36	0.06	0.025	0.84	0.35	6,549	<1
FOREST 6e	5,636	180	0.17	0.83	25.40	0.20	0.04	0.004	1.02	0.10	5,749 1,547,238 total	<1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY JEFFERSON

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ [5]	CP [1]	CP [2]	t/a w/o C.T. [3]	t/a w/ C.T. [4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	83,000											
Row crop 1-	30,710	240	0.28	0.21	14.11	0.35	0.42	0.21	5.93	2.96	182,110	
Small grain 3e	52,290	240	0.29	0.38	26.45	0.19	0.22	0.11	5.82	2.91	304,328 486,438 cropland	28
RANGELAND 6e	306,383	240	0.28	0.83	55.78	0.09	0.06	0.025	3.35	1.39	1,026,383	60
PASTURE 6e	43,872	240	0.28	0.83	55.78	0.09	0.06	0.025	3.35	1.39	146,971	9
FOREST 6e	26,228	240	0.28	0.83	55.78	0.09	0.04	0.004	2.23	0.22	58,488 1,718,280 total	3

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

:OUNTY JOHNSTON

.AND USE AND LAND :APABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
:ROPLAND total	21,031											
Row crop 2e	11,988	300	0.34	0.31	31.62	0.16	0.42	0.21	13.28	6.64	159,200	
Small grain 2e	9,043	300	0.34	0.31	31.62	0.16	0.22	0.11	6.96	3.48	62,939 222,139 cropland	14
:ANGELAND 7s	150,825	300	0.28	1.1	92.4	0.05	0.06	0.025	5.54	2.31	835,571	51
'ASTURE 2e	105,576	300	0.34	0.31	31.62	0.16	0.06	0.025	1.90	0.79	200,594	12
'OREST 7s	99,306	300	0.28	1.1	92.4	0.05	0.04	0.004	3.70	0.37	367,432 1,625,736 total	23

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY KAY

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	326,160											
Row crop 3e	26,093	240	0.38	0.53	48.34	0.10	0.42	0.21	20.30	10.15	529,688	
Small grain 1-	300,067	240	0.34	0.21	17.14	0.29	0.22	0.11	3.77	1.88	1,131,253 1,660,941 cropland	63
RANGELAND 3e	138,390	240	0.38	0.53	48.34	0.10	0.06	0.025	2.9	1.21	401,331	15
PASTURE 6e	54,832	240		0.74	177.6	0.03	0.06	0.025	10.66	4.44	584,509	22
FOREST 5w	2,246	240	0.32	0.83	63.74	0.08	0.04	0.004	2.55	0.26	5,727 2,652,508 total	1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY KINGFISHER

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	340,334											
Row crop 1-	10,210	220	0.33	0.21	15.25	0.33	0.42	0.21	6.41	3.20	65,446	
Small grain 3e	330,124	220	0.27	0.38	22.57	0.22	0.22	0.11	4.97	2.48	1,640,716 1,706,162 cropland	87
RANGELAND	156,813	220	0.27	0.38	22.57	0.22	0.06	0.025	1.35	0.56	211,698	11
PASTURE 3e	21,738	220	0.27	0.38	22.57	0.22	0.06	0.025	1.35	0.56	29,346	1
FOREST 4e	7,922	220	0.25	0.53	29.15	0.17	0.04	0.004	1.17	0.12	9,269 1,956,475 total	<1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY KIOWA

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	X LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	360,749											
Row crop 2c	46,897	200		0.10	20.0	0.25	0.42	0.21	8.4	4.2	393,935	
Small grain 2c	313,852	200		0.10	20.0	0.25	0.22	0.11	4.4	2.2	1,380,949 1,774,884 cropland	60
RANGELAND 7s	203,087	200		0.45	90.0	0.06	0.06	0.025	5.4	2.3	1,096,670	37
PASTURE 3e	12,535	200		0.29	58.0	0.09	0.06	0.025	3.5	1.5	43,873	1
FOREST 5w	14,853	200		0.45	90.0	0.06	0.04	0.004	3.6	0.4	53,471 2,968,898 total	2

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY LATIMER

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K X LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	75										
Row crop 2e	46	320	0.12	38.4	0.13	0.42	0.21	16.1	8.1	741	
Small grain 3w	29	320	0.09	28.8	0.17	0.22	0.11	6.3	3.2	183 924 cropland	< 1
RANGELAND 2e	21,891	320	0.12	38.4	0.13	0.03	0.013	1.2	0.5	26,269	< 1
PASTURE 3w	107,920	320	0.09	28.8	0.17	0.03	0.013	0.9	0.4	97,128	3
FOREST 7s	307,894	320	1.6	512.0	0.004	0.02	0.002	10.0	0.1	3,078,940 3,203,261 total	96

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY LEFLORE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K X LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	22,234										
Row crop 2w	16,763	320	0.09	28.8	0.17	0.42	0.21	12.1	6.0	202,832	
Small grain 2w	5,471	320	0.09	28.8	0.17	0.22	0.11	6.3	3.2	34,467 237,299 cropland	4
RANGELAND 6e	83,943	320	1.1	352.0	0.01	0.03	0.013	10.6	4.4	889,796	14
PASTURE 3e	96,553	320	0.41	131.2	0.04	0.03	0.013	3.9	1.7	2,897	0
FOREST 7s	507,398	320	1.6	512.0	0.01	0.02	0.002	10.2	1.0	5,175,460 6,305,452 total	82

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY LINCOLN

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K X LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	61,353										
Row crop 2w	11,657	260	0.29	75.4	0.07	0.42	0.21	31.67	15.83	369,177	
Small grain 3e	49,696	260	0.17	44.2	0.11	0.22	0.11	9.72	4.86	483,045 852,222 cropland	17
RANGELAND 6e	297,401	260	0.58	150.8	0.03	0.06	0.025	9.05	3.8	2,691,479	54
PASTURE 6e	100,373	260	0.58	150.8	0.03	0.06	0.025	9.05	3.8	908,376	18
FOREST 6e	95,501	260	0.58	150.8	0.03	0.04	0.004	6.03	0.60	575,871 5,027,948 total	11

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY LOGAN

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	140,020											
Row crop 2e	15,402	240	0.28	0.31	20.83	0.24	0.42	0.21	8.75	4.38	134,768	
Small grain 3e	124,618	240	0.28	0.66	44.35	0.11	0.22	0.11	9.76	4.88	1,216,272 1,351,040 cropland	64
RANGELAND 3e	190,710	240	0.28	0.66	44.35	0.11	0.06	0.025	2.66	1.12	507,289	24
PASTURE 3e	98,730	240	0.28	0.66	44.35	0.11	0.06	0.025	2.66	1.12	262,622	12
FOREST	**	--	--	--	--	--	--	--	--	--	--	0
											2,120,951 total	

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY LOVE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	39,353											
Row crop 3e	24,399	280	0.20	0.38	21.28	0.23	0.42	0.21	8.94	4.47	218,127	
Small grain 2e	14,954	280	0.28	0.31	24.30	0.21	0.22	0.11	5.35	2.67	80,004 298,131 cropland	31
RANGELAND 6e	90,517	280	0.31	0.83	72.04	0.10	0.06	0.025	4.32	1.80	391,033	40
PASTURE 4e	56,906	280	0.22	0.67	41.27	0.12	0.06	0.025	2.48	1.04	141,127	15
FOREST 4e	85,152	280	0.22	0.67	41.27	0.12	0.04	0.004	1.65	0.17	140,501 970,792 total	14

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY MAJOR

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	220,987											
Row crop 2w	11,049	180	0.25	0.21	9.45	0.53	0.42	0.21	3.97	1.99	43,865	
Small grain 3e	209,938	180	0.17	0.31	9.49	0.53	0.22	0.11	2.09	1.04	440,870 484,735 cropland	39
RANGELAND 6e	253,689	180	0.30	0.83	44.82	0.11	0.06	0.025	2.69	1.12	684,960	55
PASTURE 5w	71,380	180	0.24	0.21	9.07	0.55	0.06	0.025	0.54	0.23	38,545	3
FOREST 6e	17,862	180	0.30	0.83	44.82	0.11	0.04	0.004	1.79	0.18	32,152 1,240,392 total	3

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY MARSHALL

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K x LS)		EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	22,124											
Row crop 2e	11,726	300		0.19	57.0	0.09	0.42	0.21	23.9	12.0	280,251	
Small grain 2e	10,398	300		0.19	57.0	0.09	0.22	0.11	12.5	6.3	129,975 410,226 cropland	29
RANGELAND 2e	98,227	300		0.19	57.0	0.09	0.06	0.025	3.42	1.4	333,972	24
PASTURE 2e	34,419	300		0.19	57.0	0.09	0.06	0.025	3.42	1.4	117,713	8
FOREST 7s	25,528	300		1.8	540.0	0.009	0.04	0.004	21.6	2.2	551,405 1,413,316 total	39

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY MAYES

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	41,573											
Row crop 2s	17,461	280	0.43	0.21	25.3	0.20	0.42	0.21	10.6	5.3	185,087	
Small grain 2s	24,112	280	0.43	0.21	25.3	0.20	0.22	0.11	5.6	2.8	135,027 320,114 cropland	42
RANGELAND 2e	34,644	280	0.37	0.31	32.1	0.16	0.03	0.013	1.0	0.4	34,644	5
PASTURE 2e	199,840	280	0.37	0.31	32.1	0.16	0.03	0.013	1.0	0.4	199,840	26
FOREST 7s	87,412	280	0.30	1.4	117.6	0.04	0.02	0.002	2.4	0.2	209,789 764,387 total	27

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY McCLAIN

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K x LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	69,022										
Row crop 3e	31,750	260	0.22	57.2	0.09	0.42	0.21	24.0	12.0	762,000	
Small grain 1-	37,272	260	0.08	20.8	0.24	0.22	0.11	4.6	2.3	171,451 933,451 cropland	29
RANGELAND 6e	175,994	260	0.74	192.4	0.03	0.06	0.025	11.5	4.8	2,023,931	62
PASTURE 3e	55,115	260	0.22	57.2	0.09	0.06	0.025	3.4	1.4	187,391	6
FOREST 6e	16,658	260	0.74	192.4	0.03	0.04	0.004	7.7	0.8	128,267 3,273,040 total	4

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY McCURTAIN

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	34,109											
Row crop 2e	21,830	340	0.28	0.31	29.5	0.17	0.42	0.21	12.4	6.2	270,692	
Small grain 3w	12,279	340	0.28	0.31	29.5	0.17	0.22	0.11	6.5	3.2	79,814 350,506 cropland	15
RANGELAND 7s	28,024	340	0.35	0.97	115.4	0.04	0.03	0.013	3.5	1.5	98,084	4
PASTURE 2e	249,825	340	0.28	0.31	29.5	0.17	0.03	0.013	0.9	0.4	224,843	10
FOREST 6e	718,319	340	0.35	0.97	115.4	0.04	0.02	0.002	2.3	0.2	1,652,134 2,325,567 total	71

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY McINTOSH

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	x LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	25,309											
Row crop 3e	17,969	300		0.41	123.0	0.04	0.42	0.21	51.7	25.8	928,997	
Small grain 3e	7,340	300		0.41	123.0	0.04	0.22	0.11	27.1	13.5	198,914	
											1,127,911 cropland	51
RANGELAND 3e	44,359	300		0.41	123.0	0.04	0.03	0.013	3.7	1.6	164,128	7
PASTURE 3e	195,785	300		0.41	123.0	0.04	0.03	0.013	3.7	1.6	724,405	33
FOREST 3e	80,177	300		0.41	123.0	0.04	0.02	0.002	2.5	0.3	200,443	9
											2,216,887 total	

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY MURRAY

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K x LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T. [3]	t/a w/ C.T. [4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	18,143										
Row crop 2e	9,072	300	0.19	57.0	0.09	0.42	0.21	23.9	12.0	216,821	
Small grain 2e	9,071	300	0.19	57.0	0.09	0.22	0.11	12.5	6.3	113,388	
										330,209 cropland	6
RANGELAND 7s	135,826	300	1.8	540.0	0.009	0.06	0.025	32.4	13.6	4,400,762	74
PASTURE 6e	54,796	300	0.45	135.0	0.04	0.06	0.025	8.1	3.4	443,848	7
FOREST 7s	34,575	300	1.8	540.0	0.009	0.04	0.004	21.6	2.2	746,820	13
										5,921,639 total	

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY MUSKOGEE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K X LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	53,729										
Row crop 2e	31,700	280	0.16	44.8	0.11	0.42	0.21	18.8	9.4	595,960	
Small grain 2e	22,029	280	0.16	44.8	0.11	0.22	0.11	9.9	4.9	218,087 814,047 cropland	54
RANGELAND 3e	98,296	280	0.41	114.8	0.04	0.03	0.013	3.4	1.5	334,206	22
PASTURE 2e	194,258	280	0.16	44.8	0.11	0.03	0.013	1.3	0.6	252,535	17
FOREST 7s	47,640	280	0.35	98.0	0.05	0.02	0.002	2.0	0.2	95,280 1,496,068 total	6

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY NOBLE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K x LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	197,536										
Row crop 3e	5,926	240	0.22	52.8	0.09	0.42	0.21	22.2	11.1	131,557	
Small grain 2s	191,610	240	0.13	31.2	0.16	0.22	0.11	6.9	3.4	1,322,109 1,453,666 cropland	40
RANGELAND 6e	199,684	240	0.74	177.6	0.03	0.06	0.025	10.7	4.5	2,136,619	58
PASTURE 3e	23,435	240	0.22	52.8	0.09	0.06	0.025	3.2	1.3	74,992	2
FOREST 2w	13,868	240	0.10	24.0	0.21	0.04	0.004	1.0	0.1	13,868 3,679,145 total	<1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY NOWATA

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	X LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	33,650											
Row crop 1-	17,498	260		0.16	41.6	0.12	0.42	0.21	17.5	8.7	306,215	
Small grain 1-	16,152	260		0.16	41.6	0.12	0.22	0.11	9.2	4.6	148,598 454,813 cropland	40
RANGELAND 3e	182,363	260		0.41	106.6	0.05	0.03	0.013	3.2	1.4	583,562	51
PASTURE 2e	83,583	260		0.16	41.6	0.12	0.03	0.013	1.2	0.5	100,300	9
FOREST 5w	19,539	260		0.10	26.0	0.19	0.02	0.002	0.5	0.05	9,770 1,148,445 total	1

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY OKFUSKEE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	x LS)	EROSION POTENTIAL INDEX	λ5	CP1	CP2	t/a w/o C.T. 3	t/a w/ C.T. 4	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	18,726											
Row crop 3e	11,797	280		0.17	47.6	0.11	0.42	0.21	20.0	10.0	235,940	
Small grain 3e	9,929	280		0.17	47.6	0.11	0.22	0.11	10.5	5.2	72,755 308,695 cropland	30
RANGELAND	138,267	280		0.17	47.6	0.11	0.03	0.013	1.4	0.6	193,574	19
PASTURE 3e	136,356	280		0.17	47.6	0.11	0.03	0.013	1.4	0.6	190,898	19
FOREST 7s	67,728	280		0.89	249.2	0.02	0.02	0.002	5.0	0.5	338,640 1,031,807 total	33

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY OKLAHOMA

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	58,884											
Row crop 1-	4,122	240	0.24	0.21	12.1	0.41	0.42	0.21	5.1	2.5	21,022	
Small grain 1-	54,762	240	0.24	0.21	12.1	0.41	0.22	0.11	2.7	1.3	147,857 168,879 cropland	21
RANGELAND 6e	107,972	240	0.24	0.75	43.2	0.12	0.06	0.025	2.6	1.1	280,727	36
PASTURE 6e	109,033	240	0.24	0.75	43.2	0.12	0.06	0.025	2.6	1.1	283,486	36
FOREST 6e	32,311	240	0.24	0.75	43.2	0.12	0.04	0.004	1.7	0.2	54,929 788,021 total	7

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY OKMULGEE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	45,978											
Row crop 2s	31,725	280	0.43	0.21	25.3	0.20	0.42	0.21	10.6	5.3	336,285	
Small grain 2e	14,253	280	0.37	0.31	32.1	0.16	0.22	0.11	7.1	3.5	101,196 437,481 cropland	43
RANGELAND 7s	144,741	280	0.28	0.97	76.0	0.07	0.03	0.013	2.3	1.0	332,904	32
PASTURE 4e	100,243	280	0.28	0.38	29.8	0.17	0.03	0.013	0.9	0.4	90,219	9
FOREST 7s	109,564	280	0.28	0.97	76.0	0.07	0.02	0.002	1.5	0.2	164,346 1,024,950 total	16

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY OSAGE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	x LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	76,711											
Row crop 1-	14,575	260		0.10	26.0	0.19	0.42	0.21	10.9	5.5	158,868	
Small grain 1-	62,136	260		0.10	26.0	0.19	0.22	0.11	5.7	2.9	354,175 513,043 cropland	20
RANGELAND 4s	848,347	260		0.15	39.0	0.13	0.03	0.013	1.2	0.5	1,018,016	41
PASTURE 2w	170,813	260		0.13	33.8	0.15	0.03	0.013	1.01	0.4	170,813	7
FOREST 6e	201,101	260		0.77	200.2	0.02	0.02	0.002	4.0	0.4	804,404 2,506,276 total	32

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY OTTAWA

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	66,942											
Row crop 2s	28,785	260	0.43	0.21	23.5	0.21	0.42	0.21	9.9	4.9	284,972	
Small grain 2s	38,157	260	0.43	0.21	23.5	0.21	0.22	0.11	5.2	2.6	198,416 483,388 cropland	73
RANGELAND 2s	58,159	260	0.43	0.21	23.5	0.21	0.03	0.013	0.7	0.3	40,711	6
PASTURE 2e	128,497	260	0.37	0.31	29.8	0.17	0.03	0.013	0.9	0.4	115,647	17
FOREST 7s	13,211	260	0.24	1.4	87.4	0.06	0.02	0.002	1.7	0.2	22,459 662,205 total	3

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY PAYNE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	x LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T. 3	t/a w/ C.T. 4	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	95,209											
Row crop 4e	14,243	260		0.30	78.0	0.06	0.42	0.21	32.8	16.4	467,170	
Small grain 4e	80,966	260		0.30	78.0	0.06	0.22	0.11	17.2	8.6	1,409,815 1,876,985 cropland	39
RANGELAND 6e	215,446	260		0.74	192.4	0.03	0.06	0.025	11.5	4.8	2,477,629	52
PASTURE 4e	68,305	260		0.30	78.0	0.06	0.06	0.025	4.7	2.0	321,034	7
FOREST 6e	14,859	260		0.74	192.4	0.03	0.04	0.004	7.7	0.8	114,414 4,790,062 total	2

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY PAWNEE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T. [3]	t/a w/ C.T. [4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	59,672											
Row crop 2w	7,161	260	0.37	0.38	36.6	0.14	0.42	0.21	15.4	7.7	110,279	
Small grain 3e	52,511	260	0.32	0.38	31.6	0.16	0.22	0.11	7.0	3.5	367,577 477,856 cropland	66
RANGELAND 3e	236,124	260	0.32	0.38	31.6	0.16	0.03	0.013	0.9	0.4	212,512	29
PASTURE 3e	20,483	260	0.32	0.38	31.6	0.16	0.03	0.013	0.9	0.4	18,435	3
FOREST 7s	5,974	260	0.30	1.4	109.2	0.05	0.02	0.002	2.2	0.2	13,143 721,946 total	2

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY PITTSBURG

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	X LS)	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T. [3]	t/a w/ C.T. [4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	9,833											
Row crop 2e	6,588	300		0.12	36.0	0.14	0.42	0.21	15.1	7.6	99,479	
Small grain 3e	3,245	300		0.17	51.0	0.10	0.22	0.11	11.2	5.6	36,344 135,823 cropland	4
RANGELAND 7s	176,193	300		0.89	267.0	0.02	0.03	0.013	8.01	3.5	1,409,544	39
PASTURE 3e	163,127	300		0.17	51.0	0.10	0.03	0.013	1.5	0.7	244,691	7
FOREST 7s	342,278	300		0.89	267.0	0.02	0.02	0.002	5.3	0.5	1,814,073 3,604,131 total	50

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY PONTOTOC

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	8,677											
Row crop 1-	2,516	300	0.28	0.21	17.6	0.28	0.42	0.21	7.4	3.7	18,618	
Small grain 1-	6,161	300	0.28	0.21	17.6	0.28	0.22	0.11	3.9	1.9	24,028 42,646 cropland	2
RANGELAND 7s	266,621	300	0.26	1.25	97.5	0.05	0.06	0.025	5.9	2.4	1,573,064	81
PASTURE 3e	128,187	300	0.31	0.38	35.3	0.14	0.06	0.025	2.1	0.9	269,193	14
FOREST 7s	12,902	300	0.26	1.25	97.5	0.05	0.04	0.004	3.9	0.4	50,318 1,935,221 total	3

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY POTTAWATOMIE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	56,740											
Row crop 2e	15,887	280	0.28	0.31	24.3	0.21	0.42	0.21	10.2	5.1	162,047	
Small grain 1-	40,853	280	0.32	0.21	18.8	0.27	0.22	0.11	4.1	2.1	167,497 329,544 cropland	25
RANGELAND 6e	144,672	280	0.28	0.67	52.5	0.10	0.06	0.025	3.2	1.3	597,443	46
PASTURE 3e	144,672	280	0.26	0.38	27.7	0.18	0.06	0.025	1.7	0.7	245,942	19
FOREST 6e	66,495	280	0.28	0.67	52.5	0.10	0.04	0.004	2.1	0.2	139,640 1,312,569 total	10

- Cover management factor without conservation treatment
- Cover management factor with conservation treatment
- tons/ac soil loss without conservation treatment
- tons/ac soil loss with conservation treatment
- maximum allowable C.P.

* - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY PUSHMATAHA

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	X LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	2,245											
Row crop 2e	920	320		0.15	48.0	0.10	0.42	0.21	20.2	10.1	18,584	
Small grain 3e	1,325	320		0.17	51.0	0.10	0.22	0.11	11.2	5.6	14,840 33,424 cropland	1
RANGELAND 7s	40,139	320		0.89	267.0	0.02	0.03	0.013	8.0	3.5	321,112	8
PASTURE 3e	168,203	320		0.17	51.0	0.10	0.03	0.013	1.5	0.7	252,305	6
FOREST 7s	652,649	320		0.89	267.0	0.02	0.02	0.002	5.3	0.5	3,459,040 4,065,881 total	85

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

OUNTY ROGER MILLS

AND USE AND LAND APABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
ROPLAND total	172,008											
Row crop 3e	61,923	160	0.23	0.53	19.5	0.26	0.42	0.21	8.2	4.1	507,769	
Small grain 4e	110,085	160	0.20	0.38	12.2	0.41	0.22	0.11	2.7	1.3	297,230 804,999 cropland	32
ANGELAND 6e	431,909	160	0.28	1.4	62.7	0.08	0.06	0.025	3.8	1.6	1,641,254	65
ASTURE 6e	5,303	160	0.28	1.4	62.7	0.08	0.06	0.025	3.8	1.6	20,151	<1
OREST 6e	23,720	160	0.28	1.4	62.7	0.08	0.04	0.004	2.5	0.3	59,300 2,525,704 total	2

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY ROGERS

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T. 3	t/a w/ C.T. 4	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	32,817											
Row crop 2e	11,486	260	0.33	0.31	26.6	0.19	0.42	0.21	11.2	5.6	128,643	
Small grain 2e	21,331	260	0.33	0.31	26.6	0.19	0.22	0.11	5.9	2.9	125,853 254,496 cropland	46
RANGELAND 2e	166,980	260	0.33	0.31	26.6	0.19	0.03	0.013	0.8	0.3	133,584	24
PASTURE 3e	117,330	260	0.33	0.38	32.6	0.15	0.03	0.013	1.0	0.4	117,330	21
FOREST 7s	32,041	260	0.32	0.97	80.7	0.06	0.02	0.002	1.6	0.2	51,266 556,676	9

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY SEMINOLE

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K X LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	20,652										
Row crop 3e	8,674	280	0.17	47.6	0.11	0.42	0.21	20.0	10.0	173,480	
Small grain 3e	11,978	280	0.17	47.6	0.11	0.22	0.11	10.5	5.2	125,769 299,249 cropland	9
RANGELAND 6e	102,219	280	0.58	162.4	0.03	0.06	0.025	9.7	4.1	991,524	31
PASTURE 6e	115,005	280	0.58	162.4	0.03	0.06	0.025	9.7	4.1	1,115,549	35
FOREST 6e	122,081	280	0.58	162.4	0.03	0.04	0.004	6.5	0.7	793,527 3,199,849 total	25

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY SEQUOYAH

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	24,255											
Row crop 1-	15,523	300	0.37	0.21	23.3	0.21	0.42	0.21	9.8	4.9	152,125	
Small grain 1-	8,732	300	0.37	0.21	23.3	0.21	0.22	0.11	5.1	2.6	44,533	
											196,658 cropland	16
RANGELAND 2e	3,701	300	0.43	0.31	40.0	0.13	0.03	0.013	1.2	0.5	4,441	<1
PASTURE 2e	165,646	300	0.43	0.31	40.0	0.13	0.03	0.013	1.2	0.5	198,775	16
FOREST 7s	190,523	300	0.28	2.6	218.4	0.02	0.02	0.002	4.4	0.4	838,301	68
											1,238,175 total	

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY STEPHENS

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	79,505											
Row crop 2e	14,311	240	0.26	0.31	19.3	0.26	0.42	0.21	8.1	4.1	115,919	
Small grain 3e	65,194	240	0.24	0.53	30.5	0.16	0.22	0.11	6.7	3.4	436,800 552,719 cropland	44
RANGELAND 6e	235,443	240	0.31	0.97	72.2	0.07	0.06	0.025	4.3	1.8	423,797	33
PASTURE 6e	95,658	240	0.31	0.97	72.2	0.07	0.06	0.025	4.3	1.8	172,184	14
FOREST 3e	98,513	240	0.24	0.53	30.5	0.16	0.04	0.004	1.2	0.1	118,216 1,266,916 total	9

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY TEXAS

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T. [3]	t/a w/ C.T. [4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	734,069											
Row crop 3e	228,154	120	0.32	0.21	8.1	0.62	0.42	0.21	3.4	1.7	775,734	
Small grain 3e	505,915	120	0.32	0.21	8.1	0.62	0.22	0.11	1.8	0.9	910,647	
											1,686,381 cropland	67
RANGELAND 6e	489,861	120	0.28	0.83	27.9	0.18	0.06	0.025	1.7	0.7	832,764	33
PASTURE	**	--	--	--	--	--	--	--	--	--	--	0
FOREST	**	--	--	--	--	--	--	--	--	--	--	0
											2,519,145 total	

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY TILLMAN

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	358,656											
Row crop 3e	100,424	200	0.40	0.31	24.8	0.20	0.42	0.21	10.4	5.2	1,044,410	
Small grain 3e	258,232	200	0.40	0.31	24.8	0.20	0.22	0.11	5.5	2.7	1,420,276	
											2,464,686 cropland	83
RANGELAND 6e	119,201	200	0.37	0.83	61.4	0.08	0.06	0.025	3.7	1.5	441,044	15
PASTURE 3e	29,533	200	0.40	0.31	24.8	0.20	0.06	0.025	1.5	0.6	44,300	2
FOREST 5w	8,183	200	0.30	0.31	18.6	0.27	0.04	0.004	0.7	0.007	5,728	<1
											2,955,758 total	

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY TULSA

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	40,810											
Row crop 2e	17,140	280	0.37	0.31	32.1	0.16	0.42	0.21	13.5	6.7	231,390	
Small grain 2e	23,670	280	0.37	0.31	32.1	0.16	0.22	0.11	7.1	3.5	168,057 399,447 cropland	55
RANGELAND 2e	56,048	280	0.37	0.31	32.1	0.16	0.03	0.013	1.0	0.4	56,048	8
PASTURE 2e	122,149	280	0.37	0.31	32.1	0.16	0.03	0.013	1.0	0.4	122,149	17
FOREST 7s	43,580	280	0.24	2.6	174.7	0.03	0.02	0.002	3.5	0.3	152,530 730,174	21

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY WAGONER

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ^5	CP^1	CP^2	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	85,574											
Row crop 2e	45,354	280	0.40	0.31	34.7	0.14	0.42	0.21	14.6	7.3	662,168	
Small grain 2e	40,220	280	0.40	0.31	34.7	0.14	0.22	0.11	7.6	3.8	305,672 967,840 cropland	78
RANGELAND 6e	26,923	280	0.37	0.83	86.0	0.06	0.03	0.013	2.6	1.1	70,000	6
PASTURE 2e	148,763	280	0.40	0.31	34.7	0.14	0.03	0.013	1.0	0.5	148,763	12
FOREST 6e	35,122	280	0.37	0.83	86.0	0.06	0.02	0.002	1.7	0.2	59,707 1,246,310	5

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY WASHINGTON

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	29,575											
Row crop 2e	11,830	260	0.37	0.31	29.8	0.17	0.42	0.21	12.5	6.3	147,875	
Small grain 2e	17,745	260	0.37	0.31	29.8	0.17	0.22	0.11	6.6	3.3	117,117 264,992 cropland	39
RANGELAND 7s	134,850	260	0.32	0.97	80.7	0.06	0.03	0.013	2.4	1.0	323,640	48
PASTURE 2e	51,298	260	0.37	0.31	29.8	0.17	0.03	0.013	0.9	0.4	46,168	7
FOREST 7s	23,337	260	0.32	0.97	80.7	0.06	0.02	0.002	1.6	0.2	37,339 672,139 total	6

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY WASHITA

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	X LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	386,171											
Row crop 3e	100,404	180		0.29	52.2	0.10	0.42	0.21	21.9	11.0	2,198,848	
Small grain 2e	285,767	180		0.19	34.2	0.15	0.22	0.11	7.5	3.8	2,143,253 4,342,101 cropland	74
RANGELAND 6e	169,766	180		0.74	133.2	0.04	0.06	0.025	7.99	3.3	1,356,430	23
PASTURE 6e	19,131	180		0.74	133.2	0.04	0.06	0.025	7.99	3.3	152,857	3
FOREST	**	--	--	--	--	--	--	--	--	--	-- 5,851,388 total	0

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY ____WOODS____________

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	(K	x LS)	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	279,506											
Row crop 3e	72,672	160		0.29	46.4	0.11	0.42	0.21	19.5	9.7	1,417,104	
Small grain 3e	206,834	160		0.29	46.4	0.11	0.22	0.11	10.2	5.1	2,109,707 3,526,811 cropland	50
RANGELAND 6e	485,938	160		0.74	118.4	0.04	0.06	0.025	7.1	2.96	3,450,160	49
PASTURE 6e	6,288	160		0.74	118.4	0.04	0.06	0.025	7.1	2.96	44,645	1
FOREST	**	--	--	--	--	--	--	--	--	--	-- 7,021,616 total	0

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

LAND USE - LAND CAPABILITY MATRIX

TYPICAL SOIL LOSS BY COUNTY FOR SPECIFIC LAND USES

COUNTY WOODWARD

LAND USE AND LAND CAPABILITY CLASS	ACRES	R	K	LS	EROSION POTENTIAL INDEX	λ[5]	CP[1]	CP[2]	t/a w/o C.T.[3]	t/a w/ C.T.[4]	TOTAL TONS FROM SPECIFIC LAND USE WITHOUT CONSERVATION TREATMENT	% OF TOTAL
CROPLAND total	185,825											
Row crop 3e	31,590	160	0.17	0.53	14.4	0.35	0.42	0.21	6.0	3.0	189,540	
Small grain 3e	154,235	160	0.17	0.53	14.4	0.35	0.22	0.11	3.2	1.6	493,552 683,092 cropland	48
RANGELAND 6e	519,392	160	0.17	0.83	22.6	0.22	0.06	0.025	1.4	0.6	727,149	51
PASTURE 4e	6,354	160	0.17	0.66	18.0	0.28	0.06	0.025	1.1	0.5	6,989	< 1
FOREST 6e	1,767	160	0.17	0.83	22.6	0.22	0.04	0.004	0.9	0.09	1,590 1,418,820	< 1

1 - Cover management factor without conservation treatment
2 - Cover management factor with conservation treatment
3 - tons/ac soil loss without conservation treatment
4 - tons/ac soil loss with conservation treatment
5 - maximum allowable C.P.
** - total acreage too small to be significant

APPENDIX B

A STATISTICAL COMPARISON OF THE PREDICTED VALUES IN TABLE 25

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A STATISTICAL COMPARISON OF THE PREDICTED VALUES IN TABLE 25

Ideal statistical evaluation of the accuracy of this study's nonpoint pollution predictions would be possible if long term field measurements of nonpoint pollution, e.g. soil loss, were available over the state's seventy-seven counties. Unfortunately, the measured soil loss data gathered by the Agricultural Research Service (ARS) and the Oklahoma Conservation Commission (OCC) is over too short of a time frame to test the predictions made by the Universal Soil Loss Equation (USLE) in this study. The USLE predicts long term average soil loss based on a twenty-two year rainfall cycle. Also, the spatial distribution of the sites where soil loss measurements were made are limited to five different areas of the state (four different areas for the year and eight month study conducted by the OCC and one area for the ten year study conducted by the ARS). Therefore, the only meaningful statistical evaluation possible in this study is based on the predicted values in Table 25. The significance of a statistical appraisal of these predicted values is based on the following:

1) If the USLE equation is used properly, and assuming the Soil Conservation Service used the equation properly, it

has a known accuracy which is considered acceptable by today's standards (it currently is the best prediction technique for predicting soil loss). For an evaluation of the confidence limits of predictions made by the USLE consult Wischmeier's article "Use and Misuse of the Universal Soil Loss Equation" referenced in this study.

2) If no statistical difference exists at the 0.05 level for the soil loss values predicted by this study and the values predicted by the Soil Conservation Service survey, then it is assumed that the soil loss values predicted by this study are reasonably accurate.

The Statistical Evaluation Method

The statistical test used to evaluate the predicted soil loss values is termed a "two sample independent t test." The test is designed to determine whether there exists any statistical difference between the population means of two independent samples. The test statistic has the form of

$$t_{(n_1 + n_2 - 2)} = \frac{\bar{y}_1 - \bar{y}_2}{\sqrt{s_p(\frac{1}{n_1} + \frac{1}{n_2})}}$$

where n_1 = sample site of first sample

n_2 = sample site of second sample

$\bar{y}_1$ = sample mean of first sample

$\bar{y}_2$ = sample mean of second sample

s_p = the pooled variance of both samples and is equal to

$$\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

where n_1 and n_2 are the sample sizes of sample one and two respectively,

s_1^2 is the sample variance of the first sample, and

s_2^2 is the sample variance of the second sample.

The assumptions necessary to use this test statistic are as follows:

1) The populations from which samples are obtained follow the normal distribution.
2) The population variances for the two samples tested are equal, e.g. $\sigma_1^2 = \sigma_2^2$.
3) The samples were drawn at random.

For more information concerning the use of this statistical test, consult an appropriate statistical text. The text used as a reference in this study is "Statistical Inference I" by Jerome C. R. Li.

Results of the Statistical Evaluation

The hypothesis tested was that the two population means are equal (the two population means are the average soil loss predicted by the Soil Conservation Service and the average soil loss predicted by this study for each of the four different landuses). The alternative hypothesis was that the two population means are not equal. The assumptions as stated previously are that the samples are drawn at random from normal populations with the same variance. The 5% significance level was chosen to test the hypothesis. The critical regions for t with $(n_1 + n_2 - 2)$ or 30 degrees of freedom are where $t < -2.042$ and $t > 2.042$. The results of the statistical computations are given below for each of the four landuses.

	Cropland		Range		Pasture		Forest	
	SCS[1]	LCC[2]	SCS	LCC	SCS	LCC	SCS	LCC
mean soil loss (tons/ac/yr)	6.4	5.1	2.7	3.6	1.6	2.4	1.4	1.3
variance	1.9	4.6	0.3	3.5	0.05	2.7	0.07	0.48
standard deviation	1.4	2.1	0.5	1.9	0.22	1.6	0.26	0.69
sample size	16	16	16	16	16	16	16	16
t value with 30 degrees of freedom	2.00 for cropland		1.88 for range		1.90 for pasture		0.59 for forest	

[1]Soil Conservation Service's prediction

[2]Soil loss predicted in this study by the landuse - land capability class matrices

Conclusion

Since the t value for each of the four landuses falls outside the critical regions, the conclusion is that the hypothesis tested is true.

The conclusion supports the contention that the soil loss predictions made by Soil Conservation Service's survey of the Upper Red River Basin and the soil loss predicted by the landuse - land capability class matrices utilized in this study provide a reasonably accurate assessment of soil loss on a county by county basis.