THE DEVELOPMENT OF AN EVALUATION METHOD FOR BEST MANAGEMENT PRACTICES ON AGRICULTURAL LANDS

by

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Abstract

The Development of Evaluation Methods for Best Management Practices on Agricultural Lands

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(ABSTRACT)

To help local, rural planners make decisions on which Best Management Practices (BMPs) are most appropriate for the control of Non-Point Sources of Pollution (NPSP) within their jurisdiction, a method is developed for unbiased site-specific evaluation of BMPs appropriateness. An appropriate BMP is functional, practical, and cost effective.

The method developed is a rational method suitable for the general evaluation of agricultural BMPs to control NPSP in rural watersheds. The method is functional, practical, and cost effective because it uses existing data and personnel wherever and whenever possible.

Unlike other NPSP modeling methods, this method lends itself to the selective application of BMPs throughout the watershed based on its actual landuse and physical composition. This means, BMP's can be applied to the entire watershed uniformly or applied to a subset of the watershed based on selection criteria such as a field slope, soil type, or existing cover crop. In addition, a combination of selection criteria can be used, and a combination of BMPs. This flexibility in selecting various BMPs and BMP combinations, allows planners to pose many different schemes for controlling NPSP within the watershed. The results of the schemes can be compared to determine which scheme is the most *appropriate* for use within the specific watershed.

The method developed relies heavily on the United States Department of Agriculture's Soil Conservation Service's (SCS) Universal Soil Loss Equation (USLE) and uses data already being collected by the SCS and the Agricultural Stabilization and Conservation Service (ASCS). The method does require the creation of Hydrologic Response Units (HRUs) comprised of unique combinations of soil type and landuse areas.

To demonstrate the method's ability to select an effective BMPs for a watershed, a series of BMP scenarios were evaluated. The BMP scenarios were divided into three categories: a uniform application of a BMP throughout the watershed; a selective application of a BMP throughout the watershed and; the selective application of a set of BMP's throughout the watershed. Using a series of trial runs, the benefits of using the method were demonstrated. For example, similar results were obtained using a cropping BMP of "Corn, grain, soybean and cover" throughout the sample, and a "no-till" BMP on 3 percent of the sample. This type of information was used by economic modelers to help target precious BMP implementation dollars.

As an indirect result of the method's HRU development, it was possible to test the independence of each of the USLE factors within the Nansemond/Chuckatuck watershed. The results of the Duncan's Multiple Range Test shows an interdependence between the "soil type and the cover", "overland flow versus cover", and "overland flow versus soil type".

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The author expresses a special gratitude to his wife and daughter who have had to sacrifice the most precious of commodities in order that this work could be completed, their life as a family.

Last but not least, the author is at a loss of words in describing the gratitude he has for his parents continuous support in the many endeavors he has undertaken in his life.

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Symbol **Definition**

N1 = the original form of nitrogen. (Defined on page 23).

N2 = the form of nitrogen N1 is transformed into. (Defined on page 23).

$K_{N1,N2}$ = the reaction rate of the transformation from N1 to N2. (Defined on page 23).

SEDN = the Kg/ha of the nitrogen transported by the sediment. (Defined on page 25).

SOILN = the content of nitrogen in the field (Kg N/Kg soil). (Defined on page 25).

SED = the Kg/ha of the sediment transported. (Defined on page 25).

ERN = the soil nitrogen enrichment ratio (see below). (Defined on page 25).

AN = coefficient for nitrogen. (Defined on page 25).

BN = exponent for nitrogen. (Defined on page 25).

C = mass pollutant washing off the watershed. Any mass units. (Defined on page 27).

P = potency factor converting sediment, S, to pollutant, C. (Defined on page 27).

S = mass sediment washing off watershed. Any mass units. (Defined on page 27).

pA = negative log of concentration of A. (Defined on page 31).

[A] = the concentration of A in mg/l (Defined on page 31).

LIST OF SYMBOLS (Continued)

Symbol **Definition**

K_a = the solubility product of the compound A. This is the product of the concentration of the products of the reaction (Defined on page 31).

X = total soil loss from land (Defined on page 38).

C = constant of variation, (Defined on page 38).

S = degree of land slope, and (Defined on page 38).

L = horizontal length of the land. (Defined on page 38).

E = probable soil loss, (Defined on page 39).

P = a soil factor (based primarily upon the erodibility (Defined on page 39).

R = cover factor, (Defined on page 39).

S = slope (expressed as a percentage), (Defined on page 39).

L = slope length (feet), (Defined on page 39).

P_{30} = rainfall based upon the maximum 30-minute rainfall using a two year frequency (inches). (Defined on page 39).

A = annual estimates of soil loss in tons/acre, (Defined on page 39).

T = tons/acre of measured soil loss from soil type of given slope, with known slope, with known conservation practices and cropping pattern, (Defined on page 39).

S = steepness of slope, (Defined on page 39).

L = length of slope, (Defined on page 39).

P = practice effectiveness, (Defined on page 39).

K = soil erodibility, (Defined on page 39).

I = intensity of 30 minute rainfall, (Defined on page 39).

LIST OF SYMBOLS (Continued)

Symbol **Definition**

E = previous rainfall, (Defined on page 39).

R = rotation effectiveness, and (Defined on page 40).

M = management. (Defined on page 40).

A = the computed soil loss per unit area, expressed in the units selected for K and for the period selected for R. In practice, these are usually so selected that they compute A in tons per acre per year, but other units can be selected. (Defined on page 41).

R = the rainfall and runoff value, is the number of rainfall erosion index units, plus a value for runoff from snowmelt or applied water where such runoff is significant. (Defined on page 42).

K = the soil erodibility value, is the soil loss rate per erosion index unit for a specified soil as measured on a unit plot, which is defined as a 72.6 ft. length of uniform 9 percent slope continuously in clean-tilled fallow. (Defined on page 42).

L = the slope-length value, is the ratio of soil loss from the field slope length to that from a 72.6-ft. length under identical conditions. (Defined on page 42).

S = the slope-steepness value, is the ratio of soil loss from the field slope gradient to that from a 9-percent slope under otherwise identical conditions. (Defined on page 42).

C = the cover and management value, is the ratio of soil loss from an area with specified cover and management to that from an identical area in tilled continuous fallow. (Defined on page 42).

LIST OF SYMBOLS (Continued)

Symbol **Definition**

P = the support practice value, is the ratio of soil loss with a support practice like contouring and stripcropping, to that with straight-row farming up and down the slope. (Defined on page 42).

R = storm erosivity, EI units, For convenience, Wischmeir (1959) scaled the values of R by 0.01 because the values had a natural range from 100 to 10,000. (Defined on page 43).

I = average storm intensity, in/hr, and (Defined on page 43).

I_{30} = maximum 30 minute intensity, in/hr. (Defined on page 43).

P = 2 year, 6 hour rainfall amount. (Defined on page 44).

X_1 = %percent silt * (1 / % organic matter), (Defined on page 46).

X_2 = % silt * reaction, (Defined on page 46).

X_3 = % silt * structure length, (Defined on page 46).

X_4 = % silt * % sand, (Defined on page 46).

X_5 = % sand * % organic matter, (Defined on page 46).

X_6 = % sand * % aggregate index, (Defined on page 46).

X_7 = soil's clay proportion (clay ratio), (Defined on page 46).

X_8 = clay ratio * % silt, (Defined on page 46).

X_9 = clay ratio * %organic matter, (Defined on page 46).

X_{10} = clay ratio * 1 / %organic matter, (Defined on page 46).

X_{11} = clay ratio * aggregation index, (Defined on page 46).

X_{12} = clay ratio * 1 / aggregation index (Defined on page 46).

X_{13} = aggregation index, (Defined on page 46).

X_{14} = antecedent soil moisture, (Defined on page 46).

X_{15} = increase in acidity below plow zone, (Defined on page 46).

LIST OF SYMBOLS (Continued)

Symbol	Definition
X_{16}	= structure, (Defined on page 46).
X_{17}	= structure strength, (Defined on page 46).
X_{18}	= structure change below plow layer, (Defined on page 46).
X_{19}	= Thickness of "granular" material, (Defined on page 46).
X_{20}	= depth from "friable" to "firm", (Defined on page 46).
X_{21}	= loess = 1, other = 0, (Defined on page 46).
X_{22}	= over calcareous base = 1, other = 0, (Defined on page 47).
X_{23}	= % organic matter * aggregation index, and (Defined on page 47).
X_{24}	= reaction * structure. (Defined on page 47).
M	= the percent silt minus (one hundred minus percent clay) (Defined on page 47).
a	= the percent organic matter. (Defined on page 47).
b	= the soil structure code used in soil classification. (Defined on page 47).
c	= the profile-permeability class. (Defined on page 47).
y	= slope length, in feet. (Defined on page 48).
x	= angle of slope, in feet. Foster (Defined on page 48).
m	= slope length exponent: (Defined on page 48).
SLTW	= soil Loss Total Weighted Average for the entire watershed. (Defined on page 59).
wt(i)	= area of the watershed with a unique soil type / landuse combination divided by the total watershed area. (Defined on page 59).
sl(i)	= the soil loss for the unique soil type / landuse combination calculated using the full USLE. (Defined on page 59).

LIST OF SYMBOLS (Continued)

Symbol **Definition**

i = a counter for N (see next variable). (Defined on page 59).

N = the number of unique soil type / landuse combinations (Defined on page 59).

sl = the slope length in feet. (Defined on page 68).

t = the angle of the HRU's slope. (Defined on page 68).

$[c]$ = concentration of a pollutant within a soil. (Defined on page 73).

S = the adsorbed portion of the pollutant within the soil. (Defined on page 73).

p = the specific density of the dry soil. (Defined on page 73).

C = the soluble portion of the pollutant within the soil. (Defined on page 73).

p = moisture content (assume that p = porosity). (Defined on page 73).

Y_i = the loading concentration of the pollutant (Defined on page 74).

p_i = the (Defined on page 74).

Y_s = the loading concentration of the sediment. (Defined on page 74).

S_{is} = the concentration of the pollutant in the soil. (Defined on page 74).

ER_i = the (Defined on page 74).

Q^o = the adsorption at the fixed temperature. (Defined on page 75).

b = a constant related to the energy of the net enthalpy of adsorption. (Defined on page 75).

C_e = equilibrium Concentration. (Defined on page 75).

K = pollutant dependent constant. (Defined on page 75).

LIST OF SYMBOLS (Continued)

Symbol **Definition**

n = pollutant dependent constant. (Defined on page 75).

$\%$ OM = the soil's Organic Matter (Defined on page 76).

Y_p = the loading concentration of Phosphate (Defined on page 78).

ER_p = enrichment ratio of phospahte (Defined on page 78).

S = solid phase (Defined on page 79).

C = solution concentration (Defined on page 79).

TKN = the HRU's soil calculated Total Kjeldahl Nitrogen assumed to be 4 times the ammonium ion applied to the field based on discussions with Jim Wright of the SCS. (Defined on page 80).

S = the HRU's soil calculated solid phase of the ammonium (Defined on page 80).

A = the HRU's soil loss for the individual storm event. (Defined on page 80).

ER_{or} = the enrichment ratio of organic matter. (Defined on page 80).

θ_{eff} = effective soil moisture of the HRU's soil (Defined on page 81).

θ = actual soil water content. (Defined on page 81).

θ_{15bar} = the HRU's soil wilting point. (Defined on page 81).

θ = soil moisture (Defined on page 81).

DPM = depth of runoff penetration and mixing (Defined on page 81).

C = total concentration in soil. (Defined on page 81).

DS = depression Storage (Defined on page 81).

C^1 = concentration in surface runoff. (Defined on page 81).

Re_t = reynolds number (Defined on page 83).

v_s = flow velocity through the grass media (Defined on page 83).

LIST OF SYMBOLS (Continued)

Symbol **Definition**

v = kinematic viscosity (Defined on page 83).

R_s = spacing parameter defined by the following equation: (Defined on page 83).

D_f = depth of flow (Defined on page 83).

s = spacing of grass blades (Defined on page 83).

N_f = particle fall number (Defined on page 84).

L_T = overland Flow length (Defined on page 84).

w = settling velocity (Defined on page 84).

X = removal efficiency estimator (Defined on page 84).

n = mannings roughness factor. (Defined on page 85).

A = cross sectional area of flow. (Defined on page 85).

R_H = hydraulic radius defined by A/P, where P is the wetted perimeter (Defined on page 86).

S = slope (Defined on page 86).

S = slope as determined by the SCS and reported in the (Defined on page 86).

q = surface runoff rate per unit width determined from the amount of runoff times the HRU area divided by the storms duration. (Defined on page 86).

S = slope of the filter strip (Defined on page 87).

1. INTRODUCTION

The United States government through legislative history has made the prevention and control of water pollution a national goal (PL-92-500, 1972). After years of attempting to keep water clean through the control of pollution discharges into navigable waters, it was realized that pollution abatement required the control of the pollutants from non-discrete or non-point sources as well. In 1972 and 1978, the Federal Water Pollution Control Amendments (FWPCA) were approved. This legislation divided pollution in two main categories:

- Point Sources of Pollution (PSP), and
- Nonpoint Sources of Pollution (NPSP).

A national goal was set to eliminate pollution discharges into navigable waters by 1985. In addition to recognizing NPSP as a problem, the FWPCA also defined a method of controlling it called Best Management Practices (BMPs). A major problem in reducing NPSP is with selecting *appropriate* BMPs for a given area.

This problem is solved by the development of a generalized evaluation method for the determination of *appropriateness* for a local, rural watershed. The method is a rational method suitable for the general evaluation of Agricultural BMPs to control NPSP in rural watersheds. The method is functional, practical, and cost effective because it uses existing data and personnel wherever and whenever possible.

1.1 THE USE OF APPROPRIATE BEST MANAGEMENT PRACTICES

Selecting an *appropriate* BMP for a given locality is dependent upon the definition of *appropriate*. For this study, an *Appropriate* BMP is defined as a BMP which is functional, practical, and cost effective. These terms are defined as:

Functional A BMP which will measurably reduce NPSP during testing.

Practical A BMP which will functionally reduce NPSP and can be put into practice on actual NPSP sources.

Cost Effective A BMP which will sufficiently reduce NPSP to warrant the cost of implementation and maintenance. The cost need not be completely defrayed by the farmers and may not be justified on an increase in crop productivity basis.

At the same time, the term *appropriate* BMP, signifies that the main purpose of implementation is for the reduction of NPSP and not a misnomer for another economic subsidy program. There are several methods of encouraging the adoption of BMPs by the NPSP originators. It is possible to subsidize the installation and maintenance of BMPs directly or indirectly or to use a permit or certification process. Because of the disperse nature of NPSP, the process of using permits or certifications is generally not practical. Before continuing the discussion on *appropriate* BMPs, it is important to further refine the definition NPSP and BMP.

1.1.1 THE DEFINITION OF NON-POINT SOURCE POLLUTION

The definition for NPSP criteria postulated by J. R. Churchill (1975) is used as the definition of a nonpoint source. These criteria are:

1. Nonpoint source pollutants enter the receiving water in a diffuse manner.
2. They are intermittent.
3. The pollutants arise over an extensive area of land and are transient over land before they enter navigable waters.
4. Nonpoint source pollutants generally can not be monitored readily at their point of origin and are not always traceable to their exact source.
5. Their prevention or control must be directed by a site-specific management or conservation practice.
6. Compliance monitoring for nonpoint sources is conducted on land rather than on water.
7. Nonpoint sources can not be measured in terms of effluent limitations.
8. The extent of nonpoint sources pollution relates, at least in part, to certain uncontrollable climatic events.

9. From an institutional management point of view, man's activities which cause nonpoint pollution are typically non-repetitive processes on extensive land areas, as contrasted with repetitive operations on smaller but intensively used areas.

1.1.2 THE DEFINITION OF BEST MANAGEMENT PRACTICES

In conjunction with part 7 of Churchill's criteria and by the authorization granted within the FWPCA (208.b.2.f-k), the control of NPSP can not be regulated by permits. However, a set of procedures and methods (including land requirements) are acceptable for the control of NPSP. These procedures and methods are referred to as BMPs. BMPs have been further defined by the Environmental Protection Agency's (EPA) regulations as follows:

> BMPs are those methods, measures, or practices to prevent or reduce water pollution and include but are not limited to structural and non-structural controls and operation and maintenance procedures. BMPs can be applied before, during, and after pollution producing activities to reduce or eliminate the introduction of pollutants into receiving waters (EPA, 1977).

The responsibility for the adoption of BMPs is not easily assigned and presents itself as a dilemma. The resulting reduction of NPSP is the stated goal of the United States government and benefits a wide range of downstream "use" classes from utilitarian to aesthetic, but the financial burden rests primarily with the originators of NPSP. As a consequence, the voluntary adoption of BMPs without some form of incentive is unlikely.

1.1.3 THE DEVELOPMENT OF AN APPROPRIATE BMP SELECTION METHOD

This dissertation is concerned with agricultural NPSP and how to control it through the use of *appropriate* BMPs. As mentioned earlier, *appropriate* signifies three main components. The first two components (*i.e.* functional and practical), are the principal concern here. While the last two components (*i.e.* practical and cost effective) are covered by McSweeny (1984).

1.1.3.1 THE CRITERIA AND ASSUMPTIONS - In order to determine if a BMP is *appropriate*, a method must be developed for the evaluation process. The method developed should meet the following criteria if it is to be successful.

1. Use existing data wherever and whenever possible.

2. Use existing personnel wherever and whenever possible.

3. Be generalized for use in most areas in the country.

4. Use simple simulation equation (models) or rational methods to predict soil loss and pollutant loading (yield).

The method developed can not be generalized to handle all types of NPSP in this study. It will be limited in scope to those sources of NPSP which are directly related to cropping practices and can be strongly correlated to soil loss.

1.1.3.2 THE UNIVERSAL SOIL LOSS EQUATION - The United States Department of Agriculture (USDA) has invested considerable amounts of time and money in developing a method to predict soil loss and collecting supporting data for the purpose of conserving soil. Their efforts have culminated in the development of an equation which predicts the annual soil loss from any given agricultural site. The equation is referred to as the Universal Soil Loss Equation (USLE), and is dependent upon the following criteria for predicting soil loss (Wischmeir and Smith, 1978):

1. The rainfall in the area,
2. The soil's erodibility,
3. The length of the areas slope,
4. The steepness of the slope,
5. The vegetative cover, and
6. The management practices.

It is possible to classify criteria 1 through 4 are geomorphic in nature, and are not subject to short term human modification, while criteria 5 and 6 are landuse in nature and are ephemeral at best. This separation of the criteria is useful for the development of a BMP evaluation method and will be referred to again later.

1.1.3.3 HYDROLOGIC RESPONSE UNITS - This taxonomy of the soil loss prediction criteria into two main groups is also used for the definition of Hydrologic Response Units (HRUs) as defined by Li in 1975. In Li's original proposal, HRUs were used for event simulation rather than annual simulations. However, the concept can be easily adapted. The original definition is an area which responds homogenously when subjected to similar rainfall events. The HRUs are identified by creating two maps, one with soil mapping units delineated and the other with land use. When the maps are overlaid, the junction of the soil mapping units and landuse areas defines HRUs.

1.1.3.4 THE EXISTING DATA - The two main agencies within the USDA charged with soil conservation can also be classified using the same categories used with the USLE criteria, namely geomorphic and landuse. The Soil Conservation Service (SCS) is primarily concerned with the geomorphic topics of soil conservation while the Agricultural Stabilization and Conservation Service (ASCS) is primarily concerned with landuse.

1.1.3.5 SUMMARY - The method developed for the evaluation of BMPs relies heavily upon the classification of soil loss parameters into the geomorphic and landuse categories. Since the USLE parameters and the USDA's SCS and ASCS can also be classified into the same categories, it is possible to use existing data and personnel to develop an *appropriate* BMP evaluation method which avoids redundancy.

1.1.4 THE STUDY AREA

The area selected for the development, testing and use of the agricultural cropping BMP evaluation method is the Nansemond River and Chuckatuck Creek watersheds which lie within the the City of Suffolk (see Figure 1 and 2). These watersheds were selected for use in this study because they were the location of a Federal Rural Clean Water Program (RCWP) beginning in 1980. The RCWP is the result of PL-83-217 enacted by congress in 1979. It is a voluntary program which . . .

> . . . provides long-term financial and technical assistance to owners an operators of privately held agricultural land in selected project areas who install and maintain Best Management Practices (BMPs) to control water pollution (PL-83-217).

These watersheds are used extensively as water supplies for the cities of Norfolk and Portsmouth, Virginia with a combined service of 800,000 people. In addition, current and past water quality studies indicate excessive levels of nutrients, fecal coliform bacteria, pesticides, and aquatic vegetation (RCWP Local Coordinating Committee).

1.1.5 THE AGRICULTURAL CROPPING BMP SELECTION METHOD

Ideally, it should be possible to create two different maps of geomorphic characteristics and landuse and at any moment in time create HRUs for an estimate of soil loss. Unfortunately, the time required to gather the data, establish the maps and delineate the HRUs is too great. By the time the data is ready for analysis, the land uses have changed, rendering the effort useless. In this research, the time constraint is overcome by selecting a random sample of farms within the watershed for use in developing HRUs. From this random sample, a mean soil load is calculated as a representative of the entire watershed.

Once this baseline of soil load is established, it is possible to select various types of cropping BMPs for theoretical implementation on the watershed. The USLE allows for the use of different management practice constants. Therefore, it is possible to estimate the effects of using BMPs on the watershed by changing the constants. The new constants can be obtained from the SCS, the literature, preliminary calculations based upon a generalized farm, or from field studies, if resources permit.

In the theoretical implementation of BMPs, the method should allow for selected implementation based upon criteria such as soil type, slope and distance from waterways. This selection criteria can then be set by the economic modelers as well as BMP designers. The use of selection criteria helps evaluate whether an *appropriate* BMP implementation should be uniformly or selectively applied to a watershed.

Once the new soil loss loading factors are calculated, the economic modelers can use the results to predict how to induce farmers to adopt BMPs without adversely effecting their income.

In summary, through the use of existing agencies, personnel and data and with the joint efforts of cropping BMP designers and economic modelers, it is possible to determine if the proposed agricultural cropping BMPs are *appropriate* for a given area by using the evaluation method.

2. LITERATURE REVIEW

In order to properly review the literature concerned with this treatise, the literature will be subdivided into several different sections. The first section covers the definition of terms that will be used throughout the rest of the document and is primarily interested in defining pollution from both the scientific and legal perspective. In the discussion of legal history, the definition of pollution in the United States is traced. This history is important in demonstrating how the definition has evolved because of changing public attitudes and increased technical aptitude in determining contamination. In this section, definitions are also developed for NPSP, BMPs, modeling, and contamination estimators (*i.e.* nutrients, bacteria, etc.).

The last section reviews hydrologic and pollution models currently in use for evaluating pollution and summarizes their use in evaluating BMPs for agricultural NPSP.

2.1 HISTORY AND DEFINITION OF POLLUTION

Webster's New College Dictionary defines pollution as deriving from the verb, pollute, and defines pollute as "to make unclean, impure, or corrupt; desecrate; defile; contaminate; dirty" The English word pollute finds its origins from the Latin word *polluere* which is literally translated as "to soil". The definition, though grammatically correct is not concise enough for use in this study. These definitions are too general for an application use and need to be refined both scientifically and legally.

2.1.1 A SCIENTIFIC DEFINITION

Alexander in 1977 defined pollution as:

> . . . an undesirable change in the physical, chemical, or biological characteristics of our air, land, and water, that may or will hostilely affect human life or that of other desirable species, or industrial process, living conditions, and cultural assets, or that may or will deteriorate our natural resources.

This definition, though more specific in some ways is more vague in others. It specifies precisely what needs to be "defiled" and what it must affect, but still uses such non-specific terms as "hostilely affect" and "cultural assets".

In this discussion, the primary interest is in water pollution. Krenkel and Novotny (1980) have defined pollution as it relates to water as "the addition of something to water which changes its natural quality so that downstream riparian owners do not obtain the natural water of the stream transported to them". This definition uses water quality as part of the definition of water pollution. Unfortunately, at this point "water quality" is as nebulous of a term as "cultural assets". Also, as the analytical methods improve, the definition of "natural water" will evolve and have to be redefined. As can be seen in the above definitions, scientific definitions are vague because each scientist and scientific discipline will have its own definition partially determined by the technology available when the definition is formulated.

2.1.2 A LEGAL DEFINITION

The following discussion will try to define pollution by using a legal history. The legal definition of pollution has changed over time reflecting the change in the attitudes of the legal systems and the technical aptitude in determining contamination.

2.1.2.1 PUBLIC HEALTH SERVICES ACT OF 1912 - The original United States legal definition was put forth in the **Public Health Services Act of 1912.** This federal government act created the Public Health Service (PHS) which was classified as part of the Department of Treasury. Its charter was "to investigate pollution in navigable waters for the prevention of waterborn diseases". Noticing the placement of the PHS within the federal government and its original charter, it is obvious that the earliest legal definitions were primarily concerned in human public health because of the cost.

2.1.2.2 SOIL CONSERVATION AND DOMESTIC ALLOTMENT ACT OF 1936 - The **Soil Conservation and Domestic Allotment Act of 1936** was passed to address some of the problems that became prevalent during the 1930's dust bowl and depression. The original act was more than just conservation. The major points of this legislation are:

- Preservation and improvement of the soil fertility.

- Promotion of the economic use and conservation of the land.

- Dimunition of exploitation and wasteful and unscientific use of national soil resources.

- The protection of rivers and harbors against the result of soil erosion in aid of maintaining the navigability of water and water courses and aid flood control.

- The re-establishment, at as rapid a rate as the Secretary of Agriculture determines to be practicable, and in general public interest, of the ratio between purchasing power of the net income per person on farms and of persons not on farms . . .

In this act lies the origin of the USDA, the SCS, and the ASCS. The responsibilities divided so that the SCS is primarily responsible for the first four points of the legislation and the ASCS primarily responsible for the last.

2.1.2.3 THE WATER POLLUTION CONTROL ACT OF 1948 - In 1948, the **The Water Pollution Control Act** was passed but unfortunately was never funded. Provisions were for the education, treatment, and research of water pollution. This act was primarily for the establishment of publicly owned waste treatment works.

2.1.2.4 THE WATER POLLUTION CONTROL ACT OF 1956 - The Water Pollution Control Act of 1956 (PL-84-660) was important because it had the following provisions.

- It was the first permanent legislation passed by congress.

- It still promoted the jurisdiction of states for pollution control except in interstate waters.

- It required the consent of the governor in the state of the infraction before enforcement actions could be taken.

The second point has become the corner stone of later legislation, and national environmental protection enforcement. However, this act's positive force was negated by the the last point because a governor could eventually block any enforcement schemes without fear of federal retribution or intervention.

2.1.2.5 THE WATER POLLUTION CONTROL ACT OF 1961 - In 1961, the earlier legislative short comings were overcome with the **The Water Pollution Control Act (PL-87-88)** which attempted to re-structure the administration of pollution control legislation. It extended the coverage to all navigable waters and provided the United States Attorney General some enforcement powers over the governors.

2.1.2.6 WATER QUALITY ACT OF 1965 - During the Johnson administration, the federal water pollution regulations were reorganized by the Water Quality Act of 1965. At first, the pollution control responsibilities were moved from the Public Health Service and placed in its own part of Health Education and Welfare and within eight months, the legislation was changed to place it in the the Department of Interior. These re-organization efforts indicated the importance that pollution control was beginning to take within the federal government.

In addition to its re-organizational impact, the Water Quality Act of 1965 included storm water as a pollution source and made provisions for more federal control; mandatory minimum water quality standards to be adopted by the individual states; and provided for federal intervention if the states failed to comply. This system of federal standards with individual state compliance has become the major enforcement tool of the federal government. It has provided for each state to execute legislation tailored to its individual needs and still meet Federal quality standards.

Later during the Johnson administration, a further consolidation of water pollution control took place with the removal of oil pollution from the Army Corps of Engineers and the Department of the Army to the Secretary of the Interior.

2.1.2.7 THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) OF 1969 - Probably one of the most important pieces of environmental legislation that has been enacted is the National Environmental Policy Act (NEPA) of 1969. Trelease interprets the legislation not as placing environmental protection as the goal of the federal government, but as a "reordering of priorities, so that environmental costs and benefits will assume their proper place along with other considerations". This legislation is the justification of the now ubiquitous Environmental Impact statements. In response to these considerations, President Richard Nixon presented to Congress, **Reorganization Plan Number 3 of 1970.** This plan transferred all federal environmental activities into the newly created Environmental Protection Agency (EPA).

2.1.2.8 FEDERAL WATER POLLUTION CONTROL AMENDMENTS OF 1972 AND 1977 - The water pollution legislation was reorganized again under the **Federal Water Pollution Control Amendments (FWPCA) of 1972 and 1977 (PL-92-500 and PL-95-217).** The overall goals of the acts are:

- Eliminate discharges of pollution in navigable waters by 1985.

- Make the nations waters suitable for recreation and fish and wildlife propagation.

- Eliminate discharges of toxic pollutants in toxic amounts.

- Provide financial assistance to construct publicly owned treatment works.

- Develop an area-wide waste treatment management planning process to assure adequate control of sources of pollutants in each state (*i.e.* Section 208).

- Provide incentives to major research and demonstration efforts to develop the technology necessary for eliminating discharge of pollutants into navigable waters, the contiguous zone, and oceans.

The definition of water quality is specifically dependent upon its use. The federal **Water Pollution Control Act** (Pl 92-500) outlines specific water beneficial use categories to be used in establishing the water quality standards. Some of these beneficial uses are:

- Municipal, industrial, and domestic water supply.

- Water contact recreation, i.e., swimming and water skiing.

- Noncontact recreation including boating, fishing, aesthetic.

- Fish and wildlife propagation and protection.

- Agricultural irrigation.

2.1.3 THE DEFINITION OF A MODEL

In an attempt to hold the cost down during the screening process of BMPs, models of the NPSP and BMPs will be used. As has been done with pollution, NPSP and BMP's, it is necessary to define a model. Walkers (1975) has defined models in the following manner:

> Mathematical symbols provide a useful shorthand for describing complex ecological systems, and equations permit formal statements of how the ecosystems are likely to interact. The process of translating physical or biological concepts about any system into a set of mathematical relationships, and the manipulation of the mathematical systems thus derived, is called systems analysis. The mathematical system is called a model and is an imperfect abstract representation of the real world.

2.1.4 SELECTING EVALUATION PARAMETERS

One of the most important steps after the decision to use modelling techniques to solve a problem is to select which model to use. Beasley, *et al.* (1977) have summarized the selection process as follows:

> The selection of a specific model for use as a planning tool is a difficult process complicated by the large number of different models developed in recent years. The most appropriate model to use will depend upon the intended application, the type of input data available and the suitability of the output information generated. The accuracy of the model's simulation should also be an important consideration, but unfortunately, this is very difficult to judge. Primarily, this must be done intuitively by a thorough study of the relationships incorporated into a model.

Using these considerations and the criteria postulated by Churchill, the selection of an appropriate NPSP/BMP model can be undertaken.

The first step in the selection of the model must be the delineation of the specific parameters of the environment to be modeled. This selection must not lose sight of the original intent of the FWPCA which was to "maintain the chemical, physical, and biological integrity of the Nation's waters". However, the selection of mathematical relationships must be limited in scope to a reasonable number of parameters. These limitations are based upon the data availability and those parameters which are known to be common contributors to eutrophication. Wetzel (1975) has defined eutrophication as the "effect of human impact upon aquatic ecosystems". And that it is a . . .

> . . . multifaceted term generally associated with the increased productivity, structured simplification of biotic components, and a reduction in the ability of the metabolism of organisms to adapt to growth responses to imposed changes.

2.1.4.1 MACRO NUTRIENTS - The manifestation of a biotic impact is often associated with algal blooms and fecal contamination. Algal blooms are the result of an increase in essential nutrients required for plant growth. It has been documented (Wetzel, 1975) that the macro-nutrients nitrogen and phosphorus are most often limiting factors in water quality and must be monitored as pollutants.

2.1.4.2 FECAL COLIFORMS - Fecal coliforms are used as an indicator species for the contamination of water by fecal material. Fecal material will contain large numbers of bacteria and virus which cause intestinal infections and the consequent need for "elimination". "Experience has established the significance of the coliform group densities as a criteria of the degree of pollution and thus the sanitary quality of the water" (APHA, 1976).

In addition to bacteria as a result of animal contamination, bacteria may also result from an increase in the supply of energy rich organic compounds. The degradation of these compounds may result in the consumption of most of the free oxygen in the water, and the consequent death of oxygen dependent fauna. The decrease in oxygen may also cause the production of taste and odor problems, which can reduce the aesthetic value of the water for both potable and non-potable uses.

2.1.4.3 SOLIDS - Suspended and settable solids are important for several reasons:

1. They are in themselves deleterious to the aesthetics of water;
2. They cause untold damage to the benthic fauna and flora;
3. They cause physical changes to the water courses which may accentuate high and low flow conditions; and
4. They have been associated with certain pollutants which are known to adsorb to the solids.

2.1.5 SUMMARY

It is not only necessary to model these water quality parameters in the environment as they currently exist, but it is also necessary to model their change after the implementation of any BMPs. The model must be able to reflect the partial or selected implementation of BMPs over an entire watershed. This is a spatial or geographic enigma that is irrevocably bound to the solution and must be considered.

Water quality parameters are usually determined as a concentration. A concentration is "the total mass of the suspended or dissolved particles contained in a unit volume . . ."(Liptak ed., 1974). Therefore, it is not only paramount that these water quality parameters be estimated, but it is necessary to determine the volume of water produced in the watershed. Conservation practices such as contour farming, conservation tillage, terracing, and grassed waterways can reduce the amount of runoff as well as erosion or leaching. As a consequence, a BMP to reduce pollution may also reduce runoff.

2.2 BACKGROUND AND MODELING OF NPSP AND BMP MONITORING PARAMETERS

2.2.1 MACRO NUTRIENTS

2.2.1.1 NITROGEN -

> Soil nitrogen is prominent among the many nutrients essential for crop growth and has probably received more study and attention than any other. Nitrogen occupies an unique position among the major nutrients because it only occurs in trace amounts in the soil parent materials but is required by plants in relatively large quantities. (Richards, 1965).

"Although men and other land animals live in an ocean that is 79 percent nitrogen, their supply of food is limited more by the availability of fixed nitrogen than by any other plant nutrient" (Delwiche, 1970). This abundance of nitrogen in the atmosphere is not readily available to plants. This indicates that not only is the quantity of nitrogen important, but also its valance state. The state may range from a plus 5 in the nitrate ion to a minus 3 in the ammonium ion. The changes in state from one form to another is usually vectored by organisms and are known as transformations. These transformations from one state to another are the driving force of the nitrogen cycle. The nitrogen cycle may best be described as the flow of nitrogen from one sphere to the next (i.e. atmosphere, geosphere, hydrosphere, biosphere, etc). The nitrogen cycle is summarized in Figure 3.

As a matter of convenience, certain transformations or series of transformations have been given names. This nomenclature will be discussed to avoid future misunderstandings.

Denitrification is the process of going from an oxidized state to a more reduced state. In other words, it is the process of reducing nitrogen. However, the definition of denitrification will be restricted to only those transformations from a plus 5 state to the ground state of 0. The reductions from the ground state to a minus 3 are given the special title of nitrogen fixation.

Nitrification is the process of going from a reduced state to a more oxidized state. In other words, it is the process of oxidation of nitrogen. In the most extreme case, it is the transformation from a minus 3 in ammonia to a plus 5 in nitrate.

As mentioned earlier, nitrogen fixation is the process of going from extremely stable, divalent nitrogen gas to the minus 3 ammonia. It deserves special note in that it is the only transformation that is endothermic.

Mineralization, unlike the other transformations discussed so far, does not involve a state change. It is the conversion of nitrogen from a combined or organic form to an inorganic form. The antithesis process is generally referred to as immobilization.

2.2.1.1.1 **Nitrogen Models** - The estimation of nitrogen as a water quality parameter by mathematical models can be categorized into two different types: I) those which are based upon physical and chemical relationships of the soil and water, and; II) those which are based upon the assumption that "the mass emission rate of each pollutant to be a simple function of sediment mass emission rate in runoff from the watershed" (Zison, 1980).

2.2.1.1.1.1 Type I Nitrogen Models - The first type of model attempts to simulate the nitrogen cycle as a detailed in Figure 3, and discussed in the preceding sections. Three computerized mathematical models are in use at the present: the EPA's Agricultural Runoff Management (ARM) Model; the USDA's Chemicals, Runoff, and Erosion from Agricultural Management Systems (CREAMS) Model and; the EPA's Hydrocomp Simulation Program in FORTRAN (HSPF). The ARM Model (Donigian, 1976) is based on the Stanford Watershed Model and divides the soil into four zones: the surface zone; the upper zone; the lower zone, and; the groundwater zone. The depth of the surface zone is important because it is used in the calculation of washoff and degradation of nitrogen. This zone is used regardless of whether nitrogen is incorporated into the soil or applied to the surface. The lower zone depth is critical in the determination of ground water contamination.

In this model the nitrogen transformations are considered a set of first order reactions and can be expressed in the generalized equation as:

$$\frac{dN2}{dt} = K_{N1,N2}N1 \qquad (1)$$

where:

$N1$ = the original form of nitrogen.

$N2$ = the form of nitrogen N1 is transformed into.

$K_{N1,N2}$ = the reaction rate of the transformation from N1 to N2.

The transformations are utilized in each zone to simulate the nitrogen cycle and determine the various nitrogen forms concentration within each zone. All zones are allowed to contribute to the stream. The surface zone may contribute sediment borne nitrogen and solute nitrogen in the overland flow. The upper zone only through interflow. The lower zone through the groundwater.

In summary, the ARM Model simulates nitrogen as a "book-keeping" process with the transformation of nitrogen from one form to another being conducted through first order reactions. Only ammonia in solution, nitrate, and nitrite are allowed to contribute to the stream in the surface, upper, and lower zones and is calculated as a function of nitrogen in storage. Davis *et al.* (1979) simulated nutrient movement and transformation with the ARM model. Their results were mixed using two different locations. They concluded that:

> The results from the initial testing of the nutrient section of the ARM model have been satisfactory. The use of the first order reaction rates in simulating both soil nitrogen and phosphorus is a usable approach when comparing soil storage values. Additional testing of the ARM Model is needed to further substantiate this conclusion. Monthly runoff results also appear adequate. However, results from the simulation of nutrients for individual events are mixed. They showed that a better understanding of the pathway of soluble nutrient flow through and over soils in relation to the surface and interflow runoff is needed. Further testing of models and field studies should help to clarify this problem. Development and testing of the ARM Model has revealed that more quantitative knowledge about soil transport, soil temperature, plant uptake, and soil environmental processes is needed.

The CREAMS Model derives an unique equation for plant uptake, immobilization, denitrification, and mineralization (Frere *et al.*, 1980). In addition to the elucidation of the nitrogen cycle through mathematical expressions, the CREAMS model divides sources of nitrogen in runoff into two main categories: 1) sediment transport of nitrogen, and; 2) soluble nitrogen in runoff waters. Unlike the ARM Model, CREAMS does not use the nitrogen cycle to calculate nitrogen in the runoff. The cycling portion of the model is used to determine leachate quality.

The nitrogen transported by sediment in this model is again assumed to be proportional to the total amount of sediment transported. However, it is not assumed to be a linear relationship as assumed in the type II models to be discussed later. The relationship is given by the following equation:

$$\mathrm{SEDN} = \mathrm{SOILN} * \mathrm{SED} * \mathrm{ERN} \tag{2}$$

where:

SEDN = the Kg/ha of the nitrogen transported by the sediment.
SOILN = the content of nitrogen in the field (Kg N/Kg soil).
SED = the Kg/ha of the sediment transported.
ERN = the soil nitrogen enrichment ratio (see below).

$$\mathrm{ERN} = \mathrm{AN} * \mathrm{SED} ** \mathrm{BN} \tag{3}$$

where:

AN = coefficient for nitrogen.
BN = exponent for nitrogen.

Unfortunately, little is known about the coefficient or exponent in terms of physical parameters.

> It is suspected that changing soils, crops, or management practices should result in different coefficients and exponents in the equation. However, the amount of data available at the present time does not permit a statistically significant distinction in these parameters (Frere *et al.*, 1980).

The soluble nitrogen in runoff waters is considered to be comprised of two parts: that portion contributed by rainfall, and; that portion that has been artificially applied to the soil. The portion attributed by rainfall is considered to be a constant portion of the rainfall and usually about 1 ppm (Frere *et al.*, 1980).

The applied nitrogen in the form of fertilizers (with the exception of slow release fertilizers) are highly soluble. Because most additions to the soil are mixed into the soil, only a small portion of the additive is exposed to runoff water. In the CREAMS Model, it is assumed that the top 1 cm of soil is capable of contributing to nitrogen in runoff. As a consequence, an elaborate set of equations attempts to relate the concentration at the soil surface to the concentration in the runoff. Frere *et al.*, (1980) admits that, "while considerable data have been reported on the integrated or gross effects, very little research has been reported on the individual processes"

The EPA's HSPF Model is a combination of the ARM model already discussed, and the EPA's Nonpoint Source Pollution Model (NPS) discussed as a Type II model below. HSPF allows the user to specify the type (I or II) of simulation to be used for each nutrient.

2.2.1.1.1.2 Type II Models - The second type of model attempts to simulate the nitrogen cycle as if it were a "black box". The details of the cycle are lost, and nitrogen in runoff is considered to be a function of the sediment detached. There are a host of these models including: the Army Corps of Engineers Hydrologic Engineering Center's (HEC) Storage, Treatment, Overflow, Runoff Model (STORM), (HEC, 1977); The EPA's Stormwater Management Model (SWMM) (Metcalf *et al.*, 1971), and; the EPA's Non-point Source Pollutant Loading Model (NPS) (Donigian *et al.*, 1976). These models attempt to simulate runoff water quality and a simple linear function of the total sediment transported. The appropriate multipliers (potency factors) must be provided as input. This linear relationship may be represented by the generalized equation:

$$C = P * S \tag{4}$$

where:

C = mass pollutant washing off the watershed. Any mass units.
P = potency factor converting sediment, S, to pollutant, C. Units depending upon units of S and C.
S = mass sediment washing off watershed. Any mass units.

Zison (1980) undertook a statistical correlation study in an effort to expedite the determination of these potency factors for agricultural, suburban and urban watersheds. He studied nine different locations and made the following conclusions as to the models adequacy:

1. The temporal variance of the suspended sediment concentration in storm runoff can account for a relatively small proportion of the temporal variance of nearly all other water quality constituents considered.

2. Watershed type appears to be very important in determining the reliability of the potency factors. Based upon the results of this study, potency factors computed for urban runoff are more reliable than those developed for suburban, rural, and agricultural areas.

3. There is a very substantial variability of potency factors among agricultural watersheds representing diverse geographical and climitological regions.

4. Within the single urban area the potency factors are quite similar from sampling station to sampling station for a number of pollutant sources, and deposition and transport phenomena as well.

5. When factors in addition to suspended sediment load are taken into consideration, explication of runoff water quality improves significantly. Factors which proved important include number of dry days preceding storms, time elapsed since the beginning of the storms cumulative rainfall (the later two sometimes simultaneously important), time since application of chemical (agricultural watersheds) and elapsed time since some reference date (suggesting long-term trends).

6. The fact that time since the beginning of the storm is sometimes significant even after cumulative storm rainfall is accounted for suggests that wetting rates may be important in temporal profile of runoff water quality from a watershed. Additionally, it may be that some pollutants are exposed to the

dislodging and transporting action of raindrop impingement and overland flow.

7. In some cases, the correlation between suspended solids and dry days preceding storms is relatively weak. In many of these same cases, the correlation between suspended solids and certain water quality constituents is also weak, while the direct correlation between dry days preceding storms and runoff water quality concentrations is substantially stronger. Both SWMM and NPS model simulate dust and dirt accumulation as a function of dry days preceding storms and compute water quality as a function of sediment transported.

2.2.1.2 PHOSPHORUS - In addition to nitrogen as an essential plant nutrient, phosphorus is a required essential macro-nutrient.

> The turn over of soil phosphorus is traditionally represented as a cycle (Figure 4). One major feature of this cycle is that the bulk of the phosphorus in soil is 'hors de combat' and only about 1% of it or less is incorporated into the above ground vegetation. With agricultural crops the phosphorus cycle is an open one because of the input of fertilizer phosphate to replace that permanently removed in the harvest. With natural vegetation the cycle is virtually closed, except for very small amounts that enter in rainfall and from deeper soils or are lost by leaching, and most plant phosphate is recycled by microbial breakdown of litter and organic debris (Hayman, 1975).

It is the "open-cycle" created by agricultural practices which are important in the evaluation of phosphorus as a pollutant. Unlike nitrogen, phosphorus normally has only a single valence state of +5. Its transformation from one combined form (*i.e.* clay minerals) to another available form (*i.e.* H_3PO_4.) is not generally vectored by organisms, but is the results of chemical equilibrium governed by thermodynamics. This prompted Lindsay and Moreno (1960) to present a detailed synopsis of the use of thermodynamics to predict phosphate availability in soils. Utilizing their foundations, it can be demonstrated that the normal amount of phosphate in soil solution would be around 1 ppb. These soil chemistry calculations would hardly suggest phosphorus to be a major pollution problem. This exemplifies the need to categorize phosphate pollution into two groups based upon its mode of entry into the hydrosphere: 1) as a solute, and; 2) as a portion of the sediment.

2.2.1.2.1 Phosphate as Related to Solutions - The following section discusses the results obtained by Lindsay and Moreno (1960). It has been included to aid in the understanding of solution chemistry and that portion of phosphate contamination added as solution. As of yet, no model incorporates these principles.

> The formation of secondary minerals in soils generally results from the combination and additions of ions and molecules from soil solution to the solid phase. This mechanism was originally given little consideration, because aluminum and silicon in solution did not appear to combine during laboratory experiments. Only relatively recently have the slow kinetics of such reactions been appreciated. Experiments that take slow reactivity into account and that provide nucleation centers for crystal formation have shown that secondary minerals can precipitate from solutions containing the proper constituent ions and $SI(OH)_4$ (Bohn *et al.*, 1979).

A list (Lindsay *et al.*, 1960) has been included in Table 2 of some of the compounds that are known to be part of the phosphate reactions in soil. Also, the chemical formulations, solubility expressions and dissociation constants have been included. In acidic soils the aluminum/iron compounds will predominate, and in alkaline soils the calcerious compounds will predominate (*i.e.* equations 1 through 5 and 6 through 12 respectively). As the discussion progresses, equations 13 through 16 will be used for calculations.

The following discussion of soil chemistry will require the use of several symbols. These symbols will not be discussed in detail. A brief explanation will be given, for more information see Buttler (1964):

pA = negative log of concentration of A. (\hp1.e.g.\ehp1. pH is the negative log of the hydrogen ion concentration).

[A] = the concentration of A in mg/l (\hp1.e.g.\ehp1. [H] is the concentration of the hydrogen ion).

K_a = the solubility product of the compound A. This is the product of the concentration of the products of the reaction (*e.g.* $NaC1 = NA^+ + CL^-$, $KNaC1 = [NA^+][CL^-]$

Note: The solubility product is the product of the equilibrium constant and the concentration of NaCL(s).

For example, if the secondary clay mineral, Variscite, is added to water the following reaction is expected:

$$AL(0H)2(H_2PO_4^-) \rightarrow AL^{+++} + 2OH^- + H_2PO_4^- \qquad (5)$$

This reaction has a solubility product, pK_v, of 30.5 (see Table 2). Keeping in mind the above definition of Ka AND pA, this creates the following equation:

$$K_v = [AL^{+++}][OH^-]^2[H_2PO_4^-] \qquad (6)$$

If we assume that the activity coefficients of all the compounds is equal to 1.0 and, if the negative log is taken of the equation, the following form is derived:

$$pK_V = pAL^{+++} + 2pOH^- + pH_2PO_4^- \tag{7}$$

Recall that pK_V is equal to 30.5. Therefore, the sum of the negative logs of the aluminum, hydroxide, and phosphate ion concentrations must be equal to 30.5 if equilibrium is to be obtained. If the sum is less than 30.5, more Variscite will be dissolved. If the sum is greater than 30.5, more Variscite will be precipitated.

Using only the ions already in the system one other reaction is possible. Gibsite is the combination of the aluminum and hydroxide ions in the following manner:

$$pK_G = pAL^{+++} + 3pOH^- \tag{8}$$

From Table 2 the dissociation product of this reaction is 33.8. By inspection, this reaction is controlled by the dissociation of water, which is represented by the following equation:

$$pK_W = pH^+ + pOH^- \tag{9}$$

Again from Table 2, the dissociation constant is found to be 14. If the above equations are combined into one system of equations referred to as the Variscite/Gibsite system, the concentrations of all the component ions can be determined given the pH and temperature of the system. Solving the system of equations at 25% C and using Table 2 the following relationship may be derived for the determination of the concentration of H_2PO_4:

$$pH_2PO_4^- = 10.7 - pH^+ \tag{10}$$

Using this equation and solving the equation at pH of 5.7 and 2.7 the concentration would be 5.0 units and 8.0 respectively. (NOTE: Because the pH_2PO_4 is a negative log, the concentration of H_2PO_4 is greater at pH of 5.7 than at 2.71)

In nature, there are more reactions than just these in the Variscite/Gibsite system. For example, the Strengite system and the buffering phosphoric acid system listed in Table 2.

2.2.1.2.2 **Phosphate/Sediment Models** - Phosphate compounds in soils may be generally classified as being in heterogeneous equilibrium. This is the equilibrium which, "exists between a substrate in two or more physical states" (Sawyer and McCarty, 1967). In the previous section, the principle concern is the solute portion of the equilibrium. In the present section, the principal concern will be the solid phase of the phosphate compounds. As mentioned above, the contribution of the solute portion is probably not critical to the pollution problem. Therefore, some of the existing models assume that phosphate contamination of water is related to the total sediment transported is reasonable.

2.2.1.2.2.1 **Type I Models** - In the EPA's Hydrocomp Simulation Program FORTRAN (HSPF), phosphate is simulated in much the same method as nitrogen. HSPF is a combination of the NPS Model already discussed, and the ARM Model. The user has the capability to choose between the simulation methods. If the ARM Model is selected, the soil profile is divided into four zones: The surface zone; the upper one, the lower zone, and; the groundwater zone. Each zone is divided into a storage "bin" or "storage". For phosphate four "storages" have been defined:

1. The plant phosphorus;

2. The organic phosphorus;

3. The solution phosphorus, and;

4. The adsorbed phosphorus.

2.2.1.2.2.2 Type II Models - In the EPA's Nonpoint Source Pollution Loading (NPS) Model, the EPA's Stormwater Management Model (SWMM) and the U.S. Army Corps of Engineers Storage, Treatment, and Overflow Runoff Model (STORM) the common assumption of a simple linear relationship between sediment transported and pollutant loading is made. In the STORM and SWMM models the sediment load is multiplied by a single potency factor for phosphate. In the NPS Model, the accumulation is to be a function of the sediment transported multiplied by the potency factor for any particular month.

2.2.2 COLIFORMS

Unlike phosphorus and nitrogen, a high coliform count is not necessarily deleterious. Coliforms are bacteria which reside in the colons of warm blooded animals and may be typified by *Esherichia coli* and Fecal steptococci. These are organisms which occur in large numbers in untreated domestic wastes and are useful as indicators of fecal contamination. Untreated domestic wastes characteristically may contain more than 3 million coliforms per 100 ml of water (Hammer, 1975).

2.2.2.1 COLIFORMS AS AN INDICATOR SPECIES: - The use of an indicator species as implicative of the presence of pathogens offers a substantial reduction in the number of tests required to assure safe water. For example, if a bacterial determination is made for *Shigella*, it is first necessary to be confident that a large enough sample has been taken to isolate *Shigella*. Second, it is necessary to assume that other bacterial pathogens are not present (*i.e.* *Salmonella*, *Vibro*, etc.). And third, it is necessary to continue the screening for viruses and other pathogens (Hammer, 1975).

Standard Methods for the Examination of Water and Wastewater (American Public Health Association, 1976) defines the coliform group (*i.e.* total coliforms) as comprised of ″all of the aerobic and facultative anerobic, gram negative, nonspore forming, rod shaped bacteria that ferment lactose with gas formation within 48 hours at 35° C″. Therefore, it would be impossible to establish the degree of contamination, because the original inoculum of the sample water theoretically needed only one coliform cell to establish a positive test. As a consequence, the coliform population of a water sample is enumerated using a statistical method known as the Most Probable Number (MPN) Method. The method is based on the dilution of the original sample and a series of replications. The population density is used as part of the classification of water into categories of acceptability. The acceptability of the water is also a function of the intended usage. For example, the acceptable limit for drinking water is more stringent than the acceptable limit for body contact.

In addition to the total coliforms, the APHA refines the coliform group into those of fecal origins and those non-fecal origins. Fecal coliforms are defined as those already isolated coliforms which will produce gas in brilliant green lactose broth at the elevated temperature of $44.5 + .02^{\circ}$ C for 24 ± hours. The enumeration of the fecal coliforms is accomplished using the MPN method described for the total coliforms.

In recent years, mounting evidence indicates that it may not only be possible to segregate fecal contamination into total and fecal coliforms, but also into categories dependent upon the animal origin. This further refinement is attributable to:

> . . . development of improved methodology, microbiologists observed that the streptococcus densities in polluted water were frequently of the same or greater magnitude than that known for coliform bacteria. This phenomenon was related most directly to the improved recovery of *Streptococcus bovis* and S. equinus, *two members of the streptococcus* group that frequently predominate in the waste discharges from animals (Geldreich et. al, 1969).

However, this refinement of the contamination indicator classification is still not officially accepted by the APHA.

2.2.2.2 COLIFORM MODELS: - Unlike the nitrogen and phosphorus models discussed previously, the coliform models can not be classified into two different types. All the hydrologic models discussed in the review that consider coliforms use the Type II model discussed previously (Recall the generalized discussion of the Type II models in the Nitrogen section).

The USDA's CREAMS Model does not have any capacity for the simulation of coliforms. The EPA's models (SWMM, STORM and HSPF) all utilize the dust and dirt (D&D) accumulation between storm events as the basis for coliform simulation. In the SWMM and STORM Models coliforms are associated with a single D&D value used for all pollutants. In the HSPF Model coliforms are assigned a unique accumulation and removal rate.

The NPS Model segregates the watershed into pervious and impervious areas. The impervious areas are simulated in a similar manner as SWMM and STORM Models. The pervious area considers D&D accumulation in addition to sediment transport.

In summary, none of these models specifically considers coliforms. They all consider coliforms to be a general pollutant related to D&D through a potency factor.

2.2.3 EROSION

> Soil is continually being removed from the land surfaces of the earth and transported downstream in rivers until it is deposited in lakes, estuaries, and the oceans. Since water is the primary agent of erosion and the principal vehicle for transport of the eroded material, the process is of interest to hydrologists. Of concern to the hydrologist are the rates of deposition of the sediment in reservoirs, harbors, and estuaries and the methods of controlling erosion at its source, both to conserve the soil in place and to minimize the accumulation in reservoirs and harbors (Linsley *et al.*, 1958).

The control of erosion at its source has been the stated function of the USDA's ASCS and SCS offices from their inception. Part of the problem of controlling erosion at its source has been the need to predict the soil loss without having to expend tremendous resources in monitoring and collecting field data for each individual site. The need to predict soil loss prompted the development of soil loss estimation equations as early as 1940 by Znigg. Znigg's original work was performed in the corn belt of the United States and has been generally referred to as the slope-practice method. As a result of Znigg's early work, he published the following equation which related the length of overland flow across a site and the steepness of the slope.

$$X = C * S^{1.49} * L^{1.53} \tag{11}$$

where:

X = total soil loss from land

C = constant of variation,

S = degree of land slope, and

L = horizontal length of the land.

This equation was based upon the statistical relationships found between the slope of the land, the length of the slope, and the soil loss determined from field studies.

In the subsequent years Smith expanded upon the original Znigg equation by considering such factors as the type of crop grown and the conservation practices used on the site. In 1947 Smith and Whitt published tables for the use in Missouri which accounted for Znigg equation, crop, and conservation practices.

Browning *et al.* (1949) used the work of Znigg, Smith and Whitt as a foundation and added the effects of soil management factors to the equation. He presented his work similarly to Smith and Whitt in table format for Iowa.

Other researchers were also developing equations to predict erosion besides Znigg. In 1947, Musgrave developed an equation to predict sheet erosion using statistical relationships found in field data between slope, slope length, cover, the maximum 30 minute rainfall using a two year frequency, and a soil dependent erodibility factor.

$$E = P * (R / 100) * (S / 10)^{1.39} * (l / 72.6)^{0.35} * (P_{30} / 1.25)^{1.75} \qquad (12)$$

where:

E = probable soil loss,

P = a soil factor (based primarily upon the erodibility of the soil).

R = cover factor,

S = slope (expressed as a percentage),

L = slope length (feet),

P_{30} = rainfall based upon the maximum 30-minute rainfall using a two year frequency (inches).

Van Doren and Bartelle in 1956 used field data to develop tables for the prediction of soil loss based on information required by the Znigg and Musgrave equations but included additional items such as crop rotations, soil type, and previous rainfall. Their table can be summarized as follows:

$$A = f(\ T, S, L, P, K, I, E, R, M\ ) \qquad (13)$$

where:

A = annual estimates of soil loss in tons/acre,

T = tons/acre of measured soil loss from soil type of given slope, with known slope, with known conservation practices and cropping pattern,

S = steepness of slope,

L = length of slope,

P = practice effectiveness,

K = soil erodibility,

I = intensity of 30 minute rainfall,

E = previous rainfall,

R = rotation effectiveness, and

M = management.

In 1954, a unified effort for developing soil loss prediction data was started at Purdue University know as the National Runoff and Soil-loss facility. Runoff data equivalent to 8,000 plot years from 37 sites were collected from 21 states. This effort led to the search for a universally applicable erosion equation around 1956 and culminated in 1960 with the development of the USLE by Wischmeir and Smith.

The USLE was developed similarly to the original Znigg equation using statistical relationships between the rainfall and runoff, the soil's inherent erodibility, the length of the slope, the slope, the cover and management, and the support factor. The development utilized the data collected at the National Runoff and Soil-loss Data facility and predicted the "gross annual rill and inter-rill erosion loss from agricultural lands" (Wischmeir and Smith, 1960).

The erosion capacity of water is directly related to its energy. The water derives its energy from the energy of the rain drops hitting the surface of the soil, or from the force of gravity pulling the rainfall excess off the soil. Once the water starts to flow over the surface of the soil, erosion is classified into two different categories (Meyer *et al.*, 1975 and Hutchenson, 1976):

Rill Erosion	A small intermittent channel a few inches deep with steep sides. Rills rarely affect normal tillage practices.
Gully Erosion	A larger intermittent channel approximately ranging in depth from 1 to 10 feet. Gullies often interfere with normal tillage practices.

The USLE was only intended for rill and inter-rill prediction of soil loss. Gully and stream channel erosion must be treated as a separate entity. The USLE predicts the total soil detached from the site, while the sediment yield is the total amount removed from the site. In other words, the sediment yield is the total amount of soil detached predicted by the USLE minus the amount deposited during transport to the stream.

2.2.3.1 THE UNIVERSAL SOIL LOSS EQUATION - Any equation which is to accurately predict soil loss must consider the following criteria:

1. The capacity of the expected rainfall to detach and transport soil.

2. The natural susceptibility of the soil to erosion.

3. The effectiveness of the cover and management variables in reducing the erosive forces of flow, or the protection afforded from these forces.

These factors were used by Wischmeir and Smith (1978) in formulating the USLE. The first criterion expresses the energy available to erode the soil. The second criterion expresses the inherent ability of the soil to resist erosion, and the final criterion expresses a sites non-soil ability to resist erosion. In order to adequately represent these criteria (Wischmeir, 1976) used six different factors. The following is the USLE as proposed by Wischmeir and Smith (1978):

$$A = R * K * L * S * C * P \qquad (14)$$

where:

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

R = the rainfall and runoff value, is the number of rainfall erosion index units, plus a value for runoff from snowmelt or applied water where such runoff is significant.

K = the soil erodibility value, is the soil loss rate per erosion index unit for a specified soil as measured on a unit plot, which is defined as a 72.6 ft. length of uniform 9 percent slope continuously in clean-tilled fallow.

L = the slope-length value, is the ratio of soil loss from the field slope length to that from a 72.6-ft. length under identical conditions.

S = the slope-steepness value, is the ratio of soil loss from the field slope gradient to that from a 9-percent slope under otherwise identical conditions.

C = the cover and management value, is the ratio of soil loss from an area with specified cover and management to that from an identical area in tilled continuous fallow.

P = the support practice value, is the ratio of soil loss with a support practice like contouring and stripcropping, to that with straight-row farming up and down the slope.

2.2.3.1.1 Rainfall Erosion Index - The Rainfall Erosion Index (R), is used as an indicator of the erosive potential of rainfall in a given area on an annual basis. The erosion potential of the rainfall can best be represented by the Rainfall Erosion Index (EI_{30}) as defined by Wischmeir in 1959 (Free, 1960; Dragoun, 1962; and McGuinness *et al.*, 1971). The EI_{30} was defined as:

> The best predictor of storm erosive capacity was found to be the product of the total storm energy and the maximum 30-minute intensity (Wischmeir and Smith, 1978).

Wischmeir and Smith (1958) used field data and statistics to establish a relationship between the average storm intensity (I) and the maximum 30 minute intensity (I_{30}). The units of I and I_{30} are inches per hour and the units of R are known as EI_{30} units. In equation form:

$$R = (916 + 331 * \log_{10} I) * I_{30} \tag{15}$$

where:

R = storm erosivity, EI units, For convenience, Wischmeir (1959) scaled the values of R by 0.01 because the values had a natural range from 100 to 10,000.

I = average storm intensity, in/hr, and

I_{30} = maximum 30 minute intensity, in/hr.

While studying the relationship between the soil loss and EI_{30} units in a storm, Wischmeir (1958) found linear relationship existed. If the EI_{30} were totaled over an entire year, a annual rainfall and runoff erosion index could be calculated for the locality. When the index was calculated for different geographic regions in the country it was found that it was also related to the average annual rainfall (Wischmeir, 1962). He used this relationship to build isoerodent maps from which values of R could be obtained. Unfortunately, the relationships and equations did not work west of the Rockies. This shortcoming was later corrected by National Runoff and Soil-Loss Center at Purdue in 1976. Two new equations could then be used for land west of the Mississippi and east of the Sierra Nevada Range and west of the Sierra Nevada Range. For land Between the Rockies and the Sierra Nevada Range, the following equation was developed.

$$EI = 2.38 * P^{2.17} \tag{16}$$

And for land west of the Sierra Nevada Mountains the equation:

$$EI = 16.55 * P^{2.2} \tag{17}$$

where:

P = 2 year, 6 hour rainfall amount.

2.2.3.1.2 **The Erodibility Factor** -

> The meaning of the term "soil eodibility" is distinctly different from that of the term "soil erosion". The rate of soil erosion, A, in the Universal Soil Loss Equation, may be influenced more by land slope, rainstorm characteristics, cover, and management than by inherent properties of the soil. However, some soils erode more readily than others even when all other factors are the same. This difference, caused by properties of the soil itself, is referred to as the soil erodibility (Wischmeir and Smith, 1978).

The soil erodibility factor, K, is a quantitative measure of the soil loss from "unit" plot as defined by Wischmeir in 1978.

> A unit plot is 72.6 ft long, with a uniform lengthwise slope of 9 percent, in a continuous fallow, tilled up and down the slope. Continuous fallow, for this purpose, is land that has been tilled and kept free of vegetation for 2 years. During the period of soil loss measurements, the plot is plowed and placed in conventional corn seedbed condition each spring and is tilled as needed to prevent vegetative growth and severe surface crusting. When all these conditions are met, L, S, C, and P each equal 1.0, and K equals A/EI (Wischmeir and Smith, 1978).

Soil erodibility is therefore linked to actual field data collected on sample "unit" plots for each soil type. Unfortunately, the task of obtaining a K value for many soil types is economically prohibitive. As a consequence, Wischmeir and Mannering in 1969 proposed a 24 term regression equation to predict K. The equation contained such soil properties as the percent sand, clay, and organic matter, as well as antecedent soil moisture, and other soil properties. Their efforts revolved around the use of the following equation:

$$K = 0.013 * (18.82 + 0.62X_1 + 0.043X_2 + 0.07X_3 + 0.0082X_4 - 0.10X_5 - 0.214X_6 + 1.73X_7 - 0.0062X_8 - 0.26X_9 - 20.42X_{10} + 0.30X_{11} - 21.5X_{13} - 0.18X_{14} - 1.0X_{15} + 5.4X_{16} + 4.4X_{17} + 0.65X_{18} - 0.39X_{19} - 0.43X_{20} - 2.82X_{21} + 3.3X_{22} + 3.29_{23} - 1.38_{24}) - .024X_{12}$$

where:

X_1 = %percent silt * (1 / % organic matter),
X_2 = % silt * reaction,
X_3 = % silt * structure length,
X_4 = % silt * % sand,
X_5 = % sand * % organic matter,
X_6 = % sand * % aggregate index,
X_7 = soil's clay proportion (clay ratio),
X_8 = clay ratio * % silt,
X_9 = clay ratio * %organic matter,
X_{10} = clay ratio * 1 / %organic matter,
X_{11} = clay ratio * aggregation index,
X_{12} = clay ratio * 1 / aggregation index
X_{13} = aggregation index,
X_{14} = antecedent soil moisture,
X_{15} = increase in acidity below plow zone,
X_{16} = structure,
X_{17} = structure strength,
X_{18} = structure change below plow layer,
X_{19} = Thickness of "granular" material,
X_{20} = depth from "friable" to "firm",

X_{21} = loess = 1, other = 0,

X_{22} = over calcareous base = 1, other = 0,

X_{23} = % organic matter * aggregation index, and

X_{24} = reaction * structure.

Unfortunately, this did not yield an adequate generalized model of soil erodibility. The only validity the model had was "medium textured soils containing less than 65% sand and 35% clay". In addition, the number of parameters made its use as inexpensive as the original field plot method.

Wischmeir, Johnson and Cross (1971) later reworked the regression analysis to include only the percent silt, clay, and organic matter as well as the soil structure code and the profile-permeability class. Their new rendition of the equation was:

$$100K = 2.1M^{1.14} * 10^{-4} * (12 - a) + 3.25 * (b - 2) + 2.5 * (c - 3) \qquad (18)$$

where:

M = the percent silt minus (one hundred minus percent clay)

a = the percent organic matter.

b = the soil structure code used in soil classification.

c = the profile-permeability class.

This equation was then used to create a nomograph from which K could be obtained graphically rather than empirically. This method is currently used by the SCS in determining K for soils classified in new soil surveys (Soil Survey for the City of Suffolk, 1981).

2.2.3.1.3 The Length Slope Factor - The length slope factor of the USLE is used to relate the length of overland flow and the slope of the overland flow to soil loss. Wischmeir and Smith (1978) define LS as the expected ratio of soil loss per unit area from a fields actual slope to that from the "unit" area defined for soil erodibility, K.

Several attempts were made to relate the length and slope factors to soil loss (Znigg, 1940; Musgrave, 1947; and Van Doren and Bartelli, 1956). When the results were compared to one another there was a wide range of variation in the L and S values. Wischmeir (1976) later combined the effects of L and S together into a factor he referred to as the length-slope factor, LS. Using actual field data on slopes from 3 to 18%, his work resulted in the following equation:

$$LS = (y / 72.6)^{m} * (65.41 * \sin^{2} x + 4.56 * \sin x + 0.065) \qquad (19)$$

where:

y = slope length, in feet.

x = angle of slope, in feet. Foster *et al.* (1977) cautions against using this equation for slopes outside the range of field data used by Wischmeir.

m = slope length exponent:

0.5 if x > = 5,
0.4 if x = 3.5 and x < 5,
0.3 if x = 1 and x < 3.5, and
0.2 if x < 1.

The values for LS can also be determined using tables (Clyde, *et al.*, 1978; Haan and Barfield, 1978; and Wischmeir and Smith, 1978).

2.2.3.1.4 Cover - As with the LS factor, earlier permutations of soil loss prediction equations have tried to use cover as a factor. Musgrave (1947) had a specific factor for cover, while Van Doren and Bartelle (1956) used inferences to it by having factors for "rotation effectiveness and management". Wischmeir and Smith (1978) feel that the effects of cover and management can not be adequately separated and combine them into a single value called cover as can be ascertained from the following quote:

> Cover and management effects cannot be independently evaluated because their combined effect is influenced by many significant interrelations. Almost any crop can be grown continuously, or it can be grown in rotations. Crop sequence influences the length of time between successive crop canopies, and it also influences the benefits obtained from residual effects of crops and management (Wischmere and Smith, 1978).

Being consistent with the definition of LS, Wischmeir and Smith (1978) go on to define the cover factor, C, as the ratio of soil loss from land cropped under specific conditions to the corresponding loss from a "unit" plot.

Estimates of the C-factors for various crops have been summarized in charts and tables (Wischmeir, 1960; Clyde *et al.*, 1978; McGregor, 1978; and Wischmeir and Smith, 1978) and updating, upgrading and maintenance is a constant task at the SCS.

2.2.3.1.5 The Support Practice - The support practice was considered by Van Doren and Bartelle (1956) in their early soil loss prediction equation as well as in the USLE. Wischmeir and Smith (1978) summarized their consideration of the support factor as:

> In general, whenever slopping soil is to be cultivated and exposed to erosive rains, the protection offered by sod or close growing crops in the system needs to be supported by practices that will slow the runoff water and thus

> reduce the amount of soil it can carry. The most important of these supporting cropland practices are contour tillage, stripcropping on the contour, and terrace systems (Wischmeir and Smith, 1978).

Being consistent with the definition of LS, Wischmeir and Smith (1978) go on to define the Support factor, P, as the ratio of soil loss from land cropped under specific support practice to the corresponding loss from a "unit" plot.

3. THE DEVELOPMENT OF A BMP EVALUATION METHOD

The development of a BMP evaluation method is presented in a chronological and pedagogical manner. The earliest attempt is presented *in toto* with subsequent developments having only refinements presented. The final method is presented as the last section in the chapter.

In developing a BMP evaluation method for *appropriate* BMPs, a set of restrictive criteria have been used in order to minimize the cost of the evaluation process. These criteria are:

1. Use existing data wherever and whenever possible.
2. Use existing personnel wherever and whenever possible.
3. Be generalized for use in most areas of the country.
4. Use simple simulation equation (models) or rational methods to predict soil loss and pollutant loading (yield).

Unfortunately in this study, the evaluation method developed can not be generalized to handle all types of NPSP. As a consequence, the evaluation method will concentrate on those sources of NPSP which are directly related to cropping practices and can be strongly correlated to soil loss. Because of this emphasis, the USLE can be used to estimate relative effectiveness of BMPs by estimating soil loss. It is important to note the use of the word relative.

The initial evaluation method developed requires less data and time than the final method, but is also less accurate. All the methods assume that the USLE can estimate the relative difference in soil loss between different cropping BMPs and rely on it heavily for soil loss estimations. The later incantations of the method, reduce the number of assumptions and limitations placed on the results, but require more data collection, with a finer resolution of NPSP response areas, and more data manipulation.

3.1 THE FIRST METHOD

The initial method estimates relative soil loss using a minimum amount of data. This can be done by reducing the dependence upon a fine geographic resolution of NPSP response areas, and assuming some of the USLE parameters can be set to unity because they are mere multipliers ubiquitously applied to all response areas regardless of BMP implementation. Consequently, the results are proportionate and will yield the same relative values useful in determining BMP effectiveness.

For this study, the following cropping BMPs were selected through discussions with the City of Suffolk ASCS and SCS offices and through discussions with McSweeny (1984).

- Corn
- Corn (No-Till)
- Soybeans
- Peanuts
- Grain/Soybean

- Peanuts Cover/Corn
- Peanuts Cover/Corn/Small-grain
- Peanuts Small-grain Corn
- Peanuts Cover Soybeans Corn
- Peanuts Cover Soybeans Corn/Cover
- Corn/Small-grain Soybeans (2 yr.)
- Corn/Small-grain Soybeans (2 yr.)
- Corn/Small-grain Soybeans (3 yr.)
- Corn/Small-grain Soybeans/Cover (3 yr.)
- Corn Small-grain Soybeans (3 yr.)

In the initial method, in addition to assuming the above BMPs were to be considered, the following assumptions are made:

- All the fields are identical in size.
- The USLE support factor, P, has no effect on relative soil loss and is set to unity, in other words, the same support factor is used for all the cropping BMPs.

In this initial method the individual factors of the USLE are identified and values are assigned for each. However, the assignment of values for the individual factors requires some geographic/hydrologic resolution based upon the soil type and land use. The land use can be assumed to be one of the previously selected BMPs. The soil type can be determined from a SCS survey. At the time of this study, the Isle of Wight did not have a current soil survey. Therefore, only the portion of the Nansemond/Chuckatuck watershed within the City of Suffolk was used.

In summary, this method amounts to identifying the factors of the USLE and determining appropriate values for each of the cropping BMPs on each soil type for the entire watershed.

The following discussion is arranged into subsections, each subsection corresponding to one of the factors of the USLE. The individual subsections covers the assumptions and the values assigned to each factor for watershed under study. The next to last subsection presents the results of this method, and the last subsection presents a discussion of what improvements could be made. This discussion will then introduce the next section and iteration of an evaluation method.

3.1.1 THE RAINFALL AND RUNOFF FACTOR

The Rainfall Erosion Index, R, is representative of the total erosive potential of rainfall in a given locality for a given year and it is representative of moderate and severe storms. The Rainfall Erosion Index can be determined from the isoerodent map presented by Wischmeier and Smith in 1978. The value represents the cumulative effects of moderate and severe storms and is indicative of the erosive capacity of rainfall and runoff combined. The value of R assumed in these calculations is based upon the map in Figure 5.

The City of Suffolk is half way between the 250 and 300 isoerodent lines, therefore by linear interpolation, the value of R is set to 275.

3.1.2 THE SOIL ERODIBILITY FACTOR

The erodibility value, K, is representative of a soils inherent potential for erosion and is influenced by a soil's ability to resist detachment and transport. The erodibility value is determined from the *Soil Survey of the City of Suffolk Virginia* (1981). The survey reports an erodibility value for each of the soil types in the study area. These values have been summarized in Table 3

3.1.3 THE LENGTH SLOPE FACTOR

The Length-slope value, LS, is representative of the distance from the point of origin of flow to either the point of discharge into an established channel or to the point of deposition. The Length-slope value is determined from a table provided by Wischmeir and Smith (1978) and for the average slopes for each soil type provided in the *Soil Survey of the City of Suffolk Virginia.* The LS table is shown in Table 4. For this method, the same size field is assume for all the soils with a length value of 200. The average slope for each soil as reported in the soil survey is shown in Table 5.

3.1.4 THE COVER FACTOR

The cover-management value, C, is representative of the ratio of soil loss under specific vegetative conditions to the continuously fallow condition. The cover-management value for each cropping BMP was obtained from the USDA's City of Suffolk SCS office and is reported in Table 6.

3.1.5 THE SUPPORT FACTOR

The support factor value, P, is representative of the ratio of soil loss from a given area with erosion control practices to the same area with up and down slope cultivation. The support factor value for all cropping BMPs is assumed to be equal to unity. This is done because no attempt will be made to demonstrate different conservation practices, but to compare different BMPs for the region. Since the support factor is a multiplier, and since its value does not change for any of the cropping BMPs, the relative amount of soil loss is unaffected by changing this value.

3.1.6 THE CALCULATIONS

Table 7 is a summary of the calculation of the soil loss using the USLE with the values discussed above. The table lists the soil loss by BMP method within each of the soil types reported for the City of Suffolk. Because the rainfall and runoff (R), the length (L), the slope (S) , and the support (P) factors were all held constant in this initial method, the only variation in the results were due to the erodibility (K) and cover (C) factors.

The mean soil loss for the watershed is reported in Table 8. This same summary could have been produced by determining the average erodibility (K) value for the watershed and then using the USLE with the only one variable, the cover factor (C). However, Table 7 is important because it can be used to calculate different soil losses if other factors in the USLE were changed. For example in these calculations, the support factor

(P) is set to unity. As a consequence, the calculations could be corrected for different P-values by multiplying all the values in Table 7 by a new support factor.

Another example, is to change the size, shape or slope of the field used and calculate a new soil loss. The following steps describe how this can be done.

1. Determine the slope used for the soil type from Table 5.
2. Using this slope and the assumed 200 foot slope length, look up the LS value from Table 4.
3. Create an adjusted LS value by dividing the soil loss reported in Table 7 by the LS value obtained in step 2.
4. Determine a new LS value from Table 4 using the desired length and slope.
5. Multiply this value and the adjusted value from step 3 together.

3.1.7 SUMMARY

As has been stated, these calculations are primarily for comparisons between the different soil types and cropping sequences. Extrapolations beyond this comparative approach with these soil loss values is subject to question, and should be avoided. Any calculated decrease in soil loss from a field by the implementation of a BMP does not necessarily imply a reduction in downstream impact. Reduction in downstream impact can be assessed by using these results in other models such as HSPF.

This method was rejected as adequate because an assumption was made that all the agricultural BMPs will be practiced on all the soils in the survey area. In other words, all of the watershed's soils are actively used for agricultural purposes. To overcome this problem, only those soils classified by the SCS as agricultural in the *Soil Survey of the City of Suffolk* were used. The method did meet the original selection criteria for the evaluation as previously defined.

3.2 THE SECOND METHOD

In the second method, the problems of assuming that all the land in the City of Suffolk is useable as agricultural is addressed. Any soil type which is not deemed as agricultural in the *Soil Survey of the City of Suffolk* is eliminated from the calculation of the summary table.

3.2.1 THE CALCULATIONS

The difference between this method and the previous method is only reflected in the summary presented in Table 9.

3.2.2 SUMMARY

As has been stated, these calculations are primarily for comparisons between the different soil types and cropping sequences. Extrapolations beyond this comparative approach with these soil loss values is subject to question, and should be avoided. Any calculated decrease in soil loss from a field by the implementation of a BMP does not necessarily imply a reduction in downstream impact. Reduction in downstream impact can be assessed by using these results in other models such as HSPF.

This method was rejected as adequate because an assumption was made that all of the soils within the watershed which were classified as agricultural are uniformly distributed within the watershed. To overcome this problem, a weighted method of calculating the mean soil loss can be used rather than an equal apportionment method. The method did meet the original selection criteria for the evaluation as previously defined.

3.3 THE THIRD METHOD

In the third method, the problems of assuming that the watershed's soil types are all of equal importance is addressed. This is done by using a weighted average, where the weighting is determined from the area with a unique soil type divided by the area of the entire watershed. The equation used for calculating the weighted average is:

$$SLTW = \sum_{i=1}^{N} (wt(i) * sl(i))/N \qquad (20)$$

where:

SLTW = soil Loss Total Weighted Average for the entire watershed.
wt(i) = area of the watershed with a unique soil type / landuse combination divided by the total watershed area.
sl(i) = the soil loss for the unique soil type / landuse combination calculated using the full USLE.
i = a counter for N (see next variable).
N = the number of unique soil type / landuse combinations

This equation can be applied to the results of the first method presented in Table 7. As a consequence, no new data needs to be collected other than the soil types proportion of the entire watershed. These values have been reported in the *Soil Survey of the City of Suffolk* and are summarized in Table 10.

3.3.1 THE CALCULATIONS

This method like the previous method, uses the initial calculations as a starting point. This method was done twice. The first time starting just from the initial calculations, and the second time eliminating non-agricultural soils from the calculations. The results of the calculations are presented in Tables 11 and 12 respectively.

3.3.2 SUMMARY

As has been stated, these calculations are primarily for comparisons between the different soil types and cropping sequences. Extrapolations beyond this comparative approach with these soil loss values is subject to question, and should be avoided. Any calculated decrease in soil loss from a field by the implementation of a BMP does not necessarily imply a reduction in downstream impact. Reduction in downstream impact can be assessed by using these results in other models such as HSPF.

This method is an improvement over the earlier methods. However, it still has limitations which derive from one of the original assumptions used in the initial method. The assumption that "All fields are the same size". One possible method around this problem would be to collect statistics about the average size and shape of a field in the watershed.

The calculated average size could then be used in the procedure outlined at the end of the initial method. This would then be used to adjust all the values in Table 7.

This proposal though possible, still does not effectively overcome the original assumption that "all fields are the same size". It does not adequately reflect the diversity in a field shape and more importantly, possible correlations between a soil type and field shape.

The speculation of a possible correlation between field shape and soil type is based upon the following. Soil taxonomy is dependent upon the physical characteristics of the soil (i.e. the proportions of sand, silt, clay and organic matter). These physical characteristics are reflective of a soils parent material such as granite, silt, or sediment. The relative erodibility of the parent material, helps determine the present topography. And finally, the topography can play an important role in determining field shape.

Therefore, the extension of this method into a new method to help gain accuracy is flawed because the original method is flawed. This does not mean that this method is not to be used, but that extensions to it belie its true accuracy and should be avoided.

This method was rejected because the assumptions made limit the number of truely variable factors within the USLE to the soil erodibility, R, and the cover, C, factors. and the indirect assumption that the size, shape, slope, cover, and soil types are all independent. To overcome these problems, refinements need to be made in the soil data and land use data. The method did meet the original selection criteria for the evaluation as previously defined.

3.4 THE FOURTH METHOD

In the fourth method, the problem of assuming "All the fields are the same size" is addressed. In the initial method, the USLE was used to calculate the soil loss for the watershed using readily available data from the City of Suffolk's SCS office. In the next two methods, refinements were made in the soil data based upon the SCS's *Soil Survey of the City of Suffolk* soil data. However, these methods did not refine the landuse data. In this method, the landuse data is refined using data available in the ASCS office and the soil data is refined using the SCS data.

The method used to refine both the soil data and landuse data at the same time is to define Hydrologic Response Units (HRUs). An HRU is a unit of land that responds uniformly to a hydrologic event. The procedure for defining HRUs was initially established by Li in 1975. In summary:

1. Develop a soils map.
2. Develop a landuse map.
3. Overlay the two.
4. Identify HRUs as areas with unique combinations of soil and landuse.

Graphically this procedure is presented in Figure 6. The first two steps can be accomplished by using the SCS's *Soil Survey of the City of Suffolk* maps and the ASCS's farm maps, photographs, and crop data. The last two steps require considerable amounts of time and effort. Because these steps require additional personnel to generate more data, the first two criteria for the "Development of a BMP Evaluation Method" are compromised. As a consequence, in order to reduce the impact of developing HRUs for the entire watershed, only a sample of all the farms in the watershed need to done.

There are several ways in which a sample set can be taken. One method would be to select a geographic subset of the watershed for HRU development. This method has its merits but it is subject to bias. One bias which needs to be overcome is to find a subset which is physiographically representative of the entire watershed. Another bias is to find a geographic subset which is also a socio-economic subset of the watershed because socio-economic units may have different landuse practices.

For example, certain socio-economic units of the population may have a predilection for raising tobacco or peanuts while another does not. If these units are not homogenously distributed throughout the watershed, then a geographic subset is impossible. Therefore, the only way to determine if a geographic subset is representative is to collect and analyze more data. This Collection and analysis is even a further infringement on the original criteria for the "Development of a BMP Evaluation Method" by only using existing personnel and data wherever possible.

Another way of selecting a subset of the watershed is to not use geographic subsets, but to use a random subset of all the farms within the watershed. In this method a list of all the farms within the watershed is made and a random sample drawn. For each of the members of the random sample, HRUs are developed according to method given by Li. For each HRU created, a soil type and land use is known. The soil type for any specific HRU is then used to determine a USLE K and LS factor for the HRU from the SCS soil survey. The landuse is then used to determine the USLE C factor from the ASCS records.

Using the ASCS list of farms within the watershed, it is possible to select the subset targeted for HRU development without additional personnel or data are requirements.

3.4.1 CREATING A WATERSHED SUBSET FOR HRU DEVELOPMENT

A list of the farms in the City of Suffolk was obtained from the city's ASCS office and is presented in Appendix A and Appendix B. In summary, the list is comprised of the following data:

Name This data were not collected or reported as a courtesy to the people of the City of Suffolk in order to preserve privacy.

Address This data were not collected or reported as a courtesy to the people of the City of Suffolk in order to preserve privacy.

Farm Number Every unique farm within the City of Suffolk is given a unique number by the ASCS.

Tract Number A farm may be comprised of several tracts of land, each unique tract of land is given a unique number by the ASCS.

Total Acres For each unique farm number and tract, the total acres within the tract are recorded.

Tilled Acres For each unique farm number and tract, the number of tilled acres within the tract is recorded.

Watershed Number For each unique farm number and tract, a watershed number or numbers are assigned. This is not necessarily an exclusive number because a tract may reside in more than one watershed.

Status For each unique farm number and tract, the Rural Clean Water Program for the Nansemond and Chuckatuck Watersheds selected those which they felt to be critical and non-critical for participation.

Select For each unique farm number and tract, an indicator of whether the farm was selected for HRU development in this study.

Owner/Operator For each unique farm number and tract, an indicator as to whether it is run by an operator or an owner.

Once the list of farmers in the City of Suffolk had been compiled, a sample size of 10 percent was selected for HRU development. In Appendix B a column labeled "Select" has an asterisk in it if the farm was chosen as a member of the watershed subset.

Once these farms had been selected, the development of the HRU's could begin. The ASCS not only divides the watershed into farms and tracts, it also divides the tracts into fields. For each field the farmers report what crops they are growing (i.e. landuse). These fields are identified on photographs by the farmers and the ASCS staff with the crop being grown recorded in ASCS records. A select number of fields then have size and current crop confirmations made via site inspection by the SCS. Using these records and by using the SCS's *Soil Survey of the City of Suffolk* maps the individual HRUs could be identified. To avoid ambiguity when dealing with the ASCS and the SCS, the HRUs were referred to as "plots".

The results of the HRU development are presented in Appendix C In summary the table contains the following data.

Record Type Is a descriptor which tells the type of information that the record contains.

T The record represents a total for the entire field. These records do not have a soil number associated with them because there is more than one soil type for the field. Every "T" record is comprised of several partial records (See "P" below).

P The record represents a partial area of a field which is consistent in both land-use and soil type. One to several of these records will comprise a total record (See "T" above).

C The record represents a complete area of a field which is consistent in both land-use and soil type. It differs from the partial records because the ASCS already treats it as a unique entity.

Farm Number Every unique farm within the City of Suffolk is given a unique number by the ASCS.

Tract Number A farm may be comprised of several tracts of land, each unique tract of land is given a unique number by the ASCS.

Field Number The field number is a number that is assigned by the ASCS. Unfortunately, the designation of a parcel of land as a field by the ASCS, does not indicate that it is used for a single crop. An ASCS field may be further segmented into HRU plots. All HRU plots will have the same crop.

Field Acre The number of acres in the field as determined by the ASCS and the SCS.

Crop The crop presently being grown in the field. In Appendix D is a list of abbreviations used by ASCS for different land uses.

Overland Flow The longest distance that water would have to flow across the field times 2/3. The reason the longest distance was multiplied by 2/3 is because in the development of the LS equation, the plot is rectangular with the point of discharge neatly aligned on an edge of the plot. In the field, the longest distance was often at an angle to the field, and the field was rarely rectangular. After several field measurements, a correcting multiplier of 2/3 was obtained for this effect.

Soil Map Number The soil map number where the field can be found. This is used as a method of quickly re-checking soil information.

Soil Number Is the SCS soil number as described in the *Soil Survey of the City of Suffolk*.

3.4.2 THE RAINFALL AND RUNOFF FACTOR

The Rainfall and Runoff Factor, R, was determined as in the initial method. The value was determined from the Isoerodent map provided by Wischmeir and Smith in 1978 (See Figure 5). As in the first method, this value was set at 275.

3.4.3 THE SOIL ERODIBILITY FACTOR

The Soil Erodibility Factor, K, was determined as in the initial method. The value was determined from the *Soil Survey of the City of Suffolk*. The difference is that the K value for each soil is used for each HRU rather than for the entire watershed. These values are presented in Table 3.

3.4.4 THE LENGTH SLOPE FACTOR

The Length Slope Factor, LS, was determined from the original equation described be Wischmeir and Smith in 1978. In the initial method, this value was determined from a table derived from the equation. This "Table lookup" could not be employed successfully in this method without compromising the quality of the data collected. Because the overland flow was calculated for each HRU, the only method of obtaining a value from the table would have been to estimate it by either linear interpolation or by lumping the overland flow lengths into values provided for in Table 4.

The LS equation presented by Wischmeir and Smith is:

$$LS = (sl / 72.6)^{m} * (65.41 * \sin^{2} t + 4.56 * \sin t + 0.065) \qquad (21)$$

Where:

where:

sl = the slope length in feet.

t = the angle of the HRU's slope.

3.4.5 THE COVER FACTOR

The Cover Factor, C, was determined from the list of possible cropping schemes presented in the Table 6 and from the crops actually being raised on the HRUs that were developed. All HRUs that did not have an existing crop of:

- Corn
- Peanuts
- Soybeans
- Grain/Soybeans

were eliminated from the study. If the HRU had one of the chosen crops on it, then the soil loss was determined for the HRU. The soil loss was not only calculated once, but was calculated once for each of the "Cropping and Rotation" entries given in Table 6. For example, if a particular HRU had an existing crop of corn, then the following "Cropping and Rotation" entries were used from Table 6.

- Corn - 0.260
- Corn (No-Till) - 0.033
- CG SB (2 yr.) - 0.246

- CG SBc (2 yr.) - 0.236
- CG SB (3 yr.) - 0.267
- CG SBc (3 yr.) - 0.258
- C G SB (3 yr.) - 0.320

In this way, seven new soil loss predictions were made, one for each different "Cropping and Rotation" entry. This "Cropping and Rotation" entry information is maintained as part of the soil loss record, so that when summary reports are compiled, questions can be asked such as, "What if all the farmers in the watershed who now grow corn using conventional practices switched to no-till"?

In this study any HRUs that presently have corn on them, would now have all of the "Cropping and Rotation" practices applied to them. It would also be possible to subset the applications practices to certain HRUs with certain soil types, slopes, sizes, or farm numbers.

In a similar fashion, the HRUs with peanuts, soybeans, or grain/soybeans were selected and expanded to use all their respective "Cropping and Rotation" entries from Table 6.

3.4.6 THE SUPPORT FACTOR

The Support Factor, P, is set to unity as in the first method. This value could be set for each HRU depending upon any special support practices applied to the HRU using selection criteria such as size of field, overland flow length, soil type, or "Cropping and Rotation" practices.

3.4.7 THE CALCULATIONS

The results of this method are presented in in Table 13. In the table, each unique combination of watershed and cropping BMP is reported. For each of these combinations, the number of HRUs developed, the mean field size (in acres), mean overland flow length (in feet), mean soil loss (in feet), and total number of acres is given.

In addition to Table 13, the results are summarized in Table 14. In this table, the same data is presented as in Table 13, but is reported as a mean for the entire Nansemond/Chuckatuck watershed.

3.4.8 SUMMARY

As has been stated, these calculations are primarily for comparisons between the different soil types and cropping sequences. Extrapolations beyond this comparative approach with these soil loss values is subject to question, and should be avoided. Any calculated decrease in soil loss from a field by the implementation of a BMP does not necessarily imply a reduction in downstream impact. Reduction in downstream impact can be assessed by using these results in other models such as HSPF.

This method is an improvement over the earlier methods because it is less prone to bias introduced by the assumptions made when the method was formulated.

In addition to overcoming these problems, this method is well suited for calculating nonpoint pollutants other than soil loss. If the soil's physical parameters reported in the

Soil Survey of the City of Suffolk are used for each of the HRU's, then it is possible to estimate other pollutants such as Phosphorus, and Organic Matter.

3.5 NONPOINT POLLUTANTS OTHER THAN SOIL LOSS

3.5.1 INTRODUCTION

In addition to soil loss, it is important to consider other types of pollutants than sediment. Two pollutants often associated with eutrophication are phosphorus and nitrogen. In the following discussions an indicator will be developed to help assess the relative loading of phosphorus and nitrogen in the watershed. In the evaluation of these indicators it is important to stress their relative nature. The methods used to obtain these values can ostensibly be quantitative, however the values used for the calculations are estimates.

Most waterborne pollutants are comprised of two fractions:

- The adsorbed portion which is carried on the surface of the sediment, and
- The dissolved portion which is actually dissolved in the water.

The ability of a soil to adsorb pollutants is directly related to its surface area, which is directly related to the soils specific density. For example, the lower the specific density of soil, the more airspace within the soil. The more air space, the more surface area.

The ability of a soil to have dissolved pollutants within it is directly related to a soils porosity. For example, the more space available within a soil, the more water the soil can contain.

These relationships can be quantified using the following equation (Novotny and Chesters, 1981).

$$[c] = S * \rho + C_e * p \tag{22}$$

where:

$[c]$ = concentration of a pollutant within a soil.

S = the adsorbed portion of the pollutant within the soil.

ρ = the specific density of the dry soil.

C = the soluble portion of the pollutant within the soil.

p = moisture content (assume that p = porosity).

3.5.1.1 POLLUTANT TRANSPORT - In many cases, pollutant transport is closely related to sediment transport. As a consequence, many studies will equate the concentration of a pollutant with the concentration of sediment. Since the pollutant is dependent on the sediment for transport, the concentration of the pollutant is considered a proportion of the sediment. Therefore the sediment concentration is multiplied by a proportionality constant or potency factor to determine the concentration of the pollutant. In equation form, this can be expressed as:

$$Y_i = p_i * Y_s \tag{23}$$

where:

Y_i = the loading concentration of the pollutant "i".

p_i = the "potency" factor of the pollutant.

Y_s = the loading concentration of the sediment.

The potency factor is considered dependent upon two other factors:

- The concentration of the pollutant in the parent soil, and
- A constant which reflects the difference between the parent material concentration and the observed concentration.

These factors are related as shown in the following equation:

$$p_i = S_{is} * ER_i \tag{24}$$

where:

S_{is} = the concentration of the pollutant in the soil.

ER_i = the "enrichment ratio" between the source and sample point.

3.5.1.2 ADSORPTION OF POLLUTANTS - The adsorption of pollutants in soil can be explained as an equilibrium reaction between the pollutants concentration in the soluble part of the soil, and the concentration of the pollutant adsorbed onto the solid portion of the soil. There are two main mathematical models for predicting the adsorption equilibria, the Langmuir and Freundlich isotherms. The Langmuir isotherm model has the following form:

$$S_e = (Q^o * b * C_e) / (1 + b * C_e) \qquad (25)$$

where:

Q^o = the adsorption at the fixed temperature.

b = a constant related to the energy of the net enthalpy of adsorption.

C_e = equilibrium Concentration.

The other isotherm is the Freundlich isotherm model. This model is useful when the energy term in the Langmuir model changes with the adsorption component of the equilibria. The Freundlich model can be expressed in the following equation.

$$S_e = K * (C_e)^{1/n} \qquad (26)$$

where:

K = pollutant dependent constant.

n = pollutant dependent constant.

3.5.2 ORGANIC MATTER

The prediction of organic matter pollutants was done using the enrichment ratio (ER) method. Because no information was available for the determining an ER value for the soils in the watershed, the following equation was used based on information published by Young and Onstad (1976) for Midwestern soils.

$$ER_{or} = (0.30 / (\%\ OM)) + 1.08 \qquad (27)$$

where:

% OM = the soil's Organic Matter

For every HRU developed, the percent organic matter is known (See Table 15). Therefore, an ER value was calculated for each soil and was multiplied by the amount of organic matter for that soil. This value was then multiplied by the soil loss predicted for the HRU using the USLE in method 4.

3.5.3 PHOSPHORUS

The prediction of phosphorus pollutants was done primarily using the Langmuir equilibria isotherm model. In order to use the model it was necessary to estimate the values of adsorption maxima, Q^{o}, and energy coefficient, b. These values were calculated using the following equations published by Ryden *et al.* (1972).

$$Q^{o} = -3.5 + 10.7 * (\%\text{clay}) + 49.5 * (\%\ \text{OM}) \tag{28}$$

$$b = 0.061 + 169.832 * 10^{-pH} + 0.027 * (\%\ \text{clay}) + 0.76 * (\%\ \text{OM}) \tag{29}$$

For every HRU developed, the percent clay, percent organic matter, and the pH are known (See Table 15). Therefore, a concentration of phosphorus adsorbed by the solid phase, S_e, was calculated for every HRU.

The total phosphorus, TP, for every HRU was determined by multiplying the phosphorus fertilizer applied for every crop by the recommended till depth for the watershed. The SCSs recommended till depth is 30 cm.

These values were then used to calculate the equilibrium solution concentration, C_e. The calculations using the following equation:

$$TP = S * p + C_e * p \tag{30}$$

Making the substitutions and re-arranging the equation yields:

$$P = (Q^{o} * b * C_e) / (1 + b * C_e) * p + C_e * p \tag{31}$$

$$P * (1 + b * C_e) = (Q^{o} * b * C_e) * p + C_e * p * (1 + b * C_e) \tag{32}$$

$$C_e^2 * (p * b) = C_e * (Q^{o} * b * p + p - P*b) - P = 0 \tag{33}$$

This form of the equation can be solved using the quadratic formula as shown in the following set of equations.

$$a_q * x^2 + b * x + c = 0 \tag{34}$$

where:

$$x = C_e \tag{35}$$

$$a_q = p * b \tag{36}$$

$$b_q = Q^o * b * p + p - P * b \tag{37}$$

$$c_q = (- P) \tag{38}$$

Once a value for C_e was obtained for each HRU developed, then the Langmuir isotherm model was solved to obtain a value for S_e. Finally this value could be used to determine the phosphate loading. An ER_P of 2.0 was used based on values reported in the literature by Massey *et al.* (1952, 1953) and Stoltenberg and White (1953).

$$Y_P = S_{is} * ER_P * Y_s \tag{39}$$

where:

Y_P = the loading concentration of Phosphate

ER_P = enrichment ratio of phospahte

3.5.4 NITROGEN

As could be seen from the literature review, the determination of nitrogen in the soil lost by erosion is far more complicated than the calculation of phosphate because the nitrogen cycle is not driven by physical chemistry but by biologic processes. As a consequence, the prediction of nitrogen loadings for this study were restricted to the ammonium ion using the Freundlich adsorption isotherm model. This restriction required that the ammonium loadings be calculated for a single theoretical storm event with a magnitude of 3 cm, a surface runoff from the event of 0.5 cm., and the HRU depression storage was 3 cm.

Preul and Schroepfer (1968) produced Freundlich isotherms for predicting the relationship of adsorbed ammonium to the ammonium in solution for various soils. They summarized their work using the following isotherm equation:

$$S = 7.0 * C^{0.8} \tag{40}$$

where:

S = solid phase
C = solution concentration

Keeping this equation in mind, and using the mass balance equation to determine the total ammonium nitrogen available at any time.

$$TN = S * p + C_e * p \tag{41}$$

The solution phase, C, of ammonium can be determined by substituting the Freundlich isotherm expression into the mass balance equation as demonstrated below:

$$TN = p * (7.0 * C^{0.8}) + p * C \tag{42}$$

Unfortunately, there is only one equation and two unknowns. The method chosen to overcome this problem is to assume that the total ammonium ion available within the soil is the ammonium ion applied as fertilizer to the field. This assumption is not a poor one in light of the reports made by Novotny and Chesters (1981) that "greater than 90 percent soil nitrogen is contained in organic matter" and is not readily available. In addition to making the total nitrogen assumption to solve the equation, it is necessary to solve the equation for C. This was done by an iterative trial-and-error method for each HRU individually, to an accuracy of 0.1.

After the solid phase of the ammonium ion is calculated, it is possible to calculate the total amount of ammonium ion. It is comprised of two components. The amount held in organic matter and held as free. In equation form:

$$Y_{SN} = ((\%\ OM) * TKN + S) * A * ER_{or} \tag{43}$$

where:

TKN = the HRU's soil calculated Total Kjeldahl Nitrogen assumed to be 4 times the ammonium ion applied to the field based on discussions with Jim Wright of the SCS.

S = the HRU's soil calculated solid phase of the ammonium ion.

A = the HRU's soil loss for the individual storm event.

ER_{or} = the enrichment ratio of organic matter.

As in the solid phase, the dissolved phase can be summarized as a mass balance equation where the total dissolved ammonium ion is comprised of two parts. The soil moisture containing dissolved ammonium and the surface runoff containing dissolved ammonium. The soil moisture has been defined as the sum of the "effective water content" and the water content at the wilting point. In equation form the soil moisture is:

$$\theta = \theta_{eff} + \theta_{15bar} \tag{44}$$

where:

θ_{eff} = effective soil moisture of the HRU's soil

θ = actual soil water content.

θ_{15bar} = the HRU's soil wilting point.

With the total dissolved ammonium ion can be expressed as:

$$\theta * DPM * C = \theta * DPM + DS) * C^1 \tag{45}$$

where:

θ = soil moisture

DPM = depth of runoff penetration and mixing

C = total concentration in soil.

DS = depression Storage

C^1 = concentration in surface runoff.

Since all the variables in the equation are know, the concentration of ammonium ion in the surface runoff can be calculated. Consequently, the load can be derived from the concentration. Once this has been done, the total ammonium ion in the runoff can be calculated by summing the solid and dissolved loads for the storm.

The calculation of the ammonia pollutant concentration can be used if a strong caveat regarding the poor quantitative nature of the results is made and that the results are merely for comparative purposes on a single HRU with different BMPs. The only way to improve the quantitative nature of the results is to invest more resources into the effort of being more site specific.

3.6 INCLUDING BMPS OTHER THAN CROPPING

In addition to soil loss and nutrient loadings, it is possible to use the fourth method to develop other BMPs evaluation data than just cropping BMPs. As an example, the development of a grass filter strip will be described.

3.6.1 INTRODUCTION

Barfield *et al.* (1975) and Toller *et al.* (1977) demonstrated an empirical relationship for predicting the trapping efficiency of grass filter strips. They reported that the efficiency of removal is a function of two dimensionless numbers:

- The Reynolds number, Re_t, the relationship of the velocity, density, and viscosity of a fluid flowing through a specified diameter pipe. And,

- The particle fall number, N_f, the probability of how many times a particle reaches the bottom during a flow period.

The Reynolds number is given by the following equation:

$$Re_t = (v_s * R_s) / (v) \tag{46}$$

where:

Re_t = reynolds number
v_s = flow velocity through the grass media
v = kinematic viscosity
R_s = spacing parameter defined by the following equation:

$$R_s = (s * D_f) / (2 * D_f + s) \tag{47}$$

where:

D_f = depth of flow
s = spacing of grass blades

The "particle fall" number can be determined by the following expression.

$$N_f = (L_T * w) / (v_s * D_f) \tag{48}$$

where:

N_f = particle fall number

L_T = overland Flow length

w = settling velocity

The particle removal efficiency relationship of the Reynolds number and the "particle fall number" is given by the following expression and is depicted graphically in Figure 7.

$$X = (Re_t)^{0.82} * (N_f)^{-0.91} \tag{49}$$

where:

X = removal efficiency estimator

3.6.2 GRASS FILTER STRIP CALCULATIONS

The calculations of the effectiveness of a grass filter strip BMP were done for the HRUs developed from the watershed. However, unlike the calculations used for the other BMPs which only require annual data to predict annual soil loss, these calculations require individual storm data. This is not a major point of concern as long as the data is used for comparative purposes only.

The following assumptions were made for the grass filter strip calculations:

- Grass blade spacing, $s = 3\ mm$

- Clay Particle size, $d = 0.002\ mm$

- Clay settling velocity from the literature, $w = 0.001\ cm/sec$

- Manning's roughness factor for grass worst case scenario, $n = 0.035$

- Rainfall for storm, *3.0 cm*

- Runoff for storm, *0.5 cm*

- Duration of storm, $t = 3.0\ hrs$

- Kinematic viscosity $v = 1.0\ mm^2/sec$

Using the equation for *X* and these assumptions, there remain only two parameters which need to be determined for each HRU.

- The flow velocity through the grass media, v_s , and

- The depth of flow, D_f

These two values can be determined using variations of the Manning equation. Starting with the Manning equation as given below:

$$Q = (1/n) * A * R_H{}^{2/3} * S^{1/2} \tag{50}$$

where:

n = mannings roughness factor.

A = cross sectional area of flow.

R_H = hydraulic radius defined by A/P, where P is the wetted perimeter of the cross section.

S = slope

If the flow is assumed to be shallow flow over a wide channel, then the Manning equation can be rewritten as:

$$v_s = (1/n) * D_f^{2/3} * S^{1/2} \tag{51}$$

where:

S = slope as determined by the SCS and reported in the *Soil Survey of the City of Suffolk*.

And by using a variation to the definition of water flow given here:

$$v_s = q / D_f \tag{52}$$

where:

q = surface runoff rate per unit width determined from the amount of runoff times the HRU area divided by the storms duration.

The following equation can be developed for determining the depth of flow over each HRU.

$$D_f = (q * n)^{0.6} / S^{0.3} \tag{53}$$

where:

S = slope of the filter strip

Once the depth of flow has been determined for each HRU, then this value can be used in the "shallow flow in a wide channel" version of the Manning equation. This will yield a value for the flow velocity through the grass media for each HRU.

Since the required values for determining ***X*** have been determined for each HRU, then a value for ***X*** can be determined for each HRU. These ***X*** values can then be used to determine the efficiency of a grass filter for each HRU using the relationship established by Barfield *et al.* in 1975. Instead of using the continuous relationship defined in Figure 7, the values were lumped into the ranges defined in Table 17. In this way, an HRU may have a theoretical grass filter strip applied to it by multiplying the soil loss for the HRU times the HRU's grass filter strip efficiency.

In the results reported in Tables 18, 19, and 20 only the HRUs with an overland flow greater than or equal to 300 feet and a slope of 2 percent or more were chosen for grass filter installation. These selection criteria could just as easily been set for a HRU's soil type, crops, field size, or even a farms total acreage.

4. DISCUSSION

Four methods were developed to evaluate BMPs to control NPSP in Agricultural Watersheds. The merit of each of the methods was judged according to the following criteria:

1. Use existing data wherever and whenever possible.

2. Use existing personnel wherever and whenever possible.

3. Be generalized for most acres of the country.

4. Use simple simulation equation (models) or rational methods to predict soil loss an pollutant loading (yield).

All of the methods developed use the USLE as their foundation. In general, the first three methods assumed that all the fields within a watershed are of equal size with the two successive method a refinement of the previous method. The fourth method overcomes the limits of this assumption, but partially compromises the first two criteria of the evaluation scheme.

4.1 THE FIRST METHOD

In the first method, the parameters of the USLE were assigned values specific for the Nansemond/Chuckatuk watershed. The Rainfall and Runoff factor (R), the Length-Slope factor (LS), and the Support factor (P) were all considered as singular values applicable to the entire watershed. The Soil Erodibility factor (K) and the Cover factor (C) were both considered as more complex with a spectrum of values being assigned, each value assigned being dependent upon the soil type or cover crop, respectively.

The soil Erodibility Factor (K) was assigned a value for each of the 37 soil types within the watershed and the Cover factor was assigned a value for each of the cropping sequences. The cropping sequences were selected by the City of Suffolk SCS office and by McSweeny (1984) as representative and plausible for the watershed. As a result of using the spectrum of values for these USLE factors, 555 different soil loss values were generated as representative of the soil loss for the watershed instead of a single value. This refinement in the resolution of the calculated soil loss, though more representative than a single value, greatly increases the complexity of the linear model calculations required by the economic forecasters. As a consequence, a summary of the calculations was produced based on the mean soil loss in the watershed for each cropping sequence. One of the major shortcomings of this method is that all the soils within the watershed were used, regardless of the extent of its use for agricultural purposes by the farmers within the watershed.

4.2 THE SECOND METHOD

The second method, like the first, used singular values for the R, LS, and P factors, and a spectrum of values for the K and C factors. However, this method attempted to overcome the previous assumption of using all the soils within the watershed for agricultural production. This refinement was made by using the Soil Survey for the City of Suffolk prepared by the SCS. In the survey, the soils are classified into general landuse categories such as agricultural, woodland, and urban. These classifications were then used to eliminate all non-agricultural soils from the calculations. Reducing the number of soils from 37, as used in the first method, to 25 soils. This resulted in the total number of soil loss values calculated being reduced from 555 to 375. This reduction was still to complex for use in the economic models, so the mean soil loss values were again used.

As expected, the mean soil losses for truly agricultural land with each of the cropping sequences in this method were less than those calculated in the first method. The second method's mean soil loss values were about 80 percent of the first method's calculations with the standard deviations only a third of the standard deviations for the first method. Unfortunately, this method like its predecessor had its shortcomings. In this method, all the agricultural soils within the watershed were assumed to be uniformly distributed throughout the watershed. As a consequence, each soil type contributed equally to the mean soil loss, regardless of its areal proportion of the watershed.

4.3 THE THIRD METHOD

The third method, like the first and second methods, used singular values for the R, LS, and P USLE factors, and a spectrum of values for the K and C factors. However, this method attempted to overcome the problem of using all the soils within the watershed as agricultural and treating the soils as uniformly distributed throughout the watershed. This refinement was made by again using the Soil Survey for the City of Suffolk prepared by the SCS. In the survey, the number of acres of each soil type within the city is reported as well as its percentage of the entire city. The assumption is made that the distribution of soil types within the city is representative of the distribution of soil types within the watershed. Therefore, these percentages are used to weight each soil types calculated soil loss before the mean soil loss for each cropping sequence is calculated. The mean soil loss was calculated twice, once with the non-agricultural land included, and once without it.

The results of this method need to be discussed considering the inclusion and exclusion of agricultural soil types separately. The results of this method with the non-agricultural soil types included, produced results that were lower than the first method and not much different from the second method.

The results with non-agricultural soil types excluded, produced soil loss values less than those in the first method. In fact, these results do not indicate that soil loss is a significant problem for the watershed (Wischmeir and Smith, 1978). However, this is in direct conflict with the RCWP findings. This indicates that the most refined of the three methods presented, produces results which are questionable, and casts serious doubts upon the usefulness of these methods for evaluating the *appropriateness* of BMPs.

A major problem with the first three methods is the assumption that all fields have the same size, the same slope, and the same overland flow. As a consequence, the only factor in the USLE allowed to vary for each cover crop is the soil type. This implies that the only variation in USLE soil factors is the Soil Erodibility factor (K).

Another fault with these methods is the indirect assumption that there is little interdependence between the soil type and the topography of the field. Since a major facet in the determination of a soil type is its parent material. And since the parent materials characteristics can affect the current topography of the area. The size, shape and slope of a field may not be independent of the soil type. These concerns are justified in a later discussion of the fourth method (See paragraph 4.4.1).

In addition, these methods assume that the cropping sequences are also independent of the soil types. In other words, all the cropping sequences are used uniformly on all the soil types. This may not be the case. Some crops within a rotation sequence are expensive to raise, and will not be raised on soils that have a marginal production capability.

This is especially true of crops which are expensive to raise and the number of acres in production is controlled by the ASCS crop support programs (*i.e.* peanuts).

In summary, these methods are dependent upon assumptions which limit the number of truly variable factors within the USLE to K and C. In addition, these methods also indirectly assume that the size, shape, slope, cropping sequence and soil type are independent of each other. The questioning of these assumptions is confirmed in the discussion of the next method in paragraph number (4.4.1).

4.4 THE FOURTH METHOD

The fourth method attempts to overcome the problems of allowing only K and C to vary, and to overcome the assumptions of interdependency of size, slope, cropping sequence and soil type. However, in addressing these problems, it is necessary to collect additional data, which consequently requires additional labor. These additional required resources compromise the first two criteria for an evaluation method as stated in the overall goals. Therefore, the BMP evaluation method developed needs to minimize these compromises.

Two possibilities for a new method were considered. Both of the methods attempted to reduce the impact made by the assumption that "all the fields are the same size". Both the methods considered use the the concept of Hydrologic Response Units (HRUs) proposed originally by Li in 1975. In summary, an HRU is a unit of land that responds uniformly to a hydrologic event. In general, HRUs are delineated by overlaying soil maps and landuse maps. The intersection of the different areas create a series of polygons with the same soil type and land use. Each of these polygons is considered an unique HRU. Because the task of developing HRUs is tedious and in order to reduce the impact caused by compromising the first two evaluation criteria, only a subset of the watershed had HRUs developed.

The two methods of selecting a subset were considered:

1. A geographic subset of the watershed, and

2. A sample subset of the watershed.

The first possibility was rejected because of the the difficulty in determining which geographic subsection of the watershed would be "representative". The determination of "representative" would require a preliminary survey and consequently, preliminary data collection. This preliminary work results in a requirement for more personnel time and a further compromise of the the first two criteria for the development of an evaluation method.

The second possibility uses a random sample drawn from the total number of farms within the watershed. The total number of farms can be determined from existing ASCS farm data and a random subset made using the Statistical Analysis System (SAS) to select 10 percent of the farms within the Nansemond/Chuckatuck watershed. Once these farms were identified, HRUs were developed for each one using only SCS Soil Survey data and ASCS Crop data.

The ASCS not only divides the city into farms but it divides the farms into tracks and the tracks into fields. The farmers report the crops produced on each of the fields to the ASCS. The fields can then be located on the Soil Survey maps and the the soil type identified. Unfortunately, each field is not homogenously comprised of one soil type.

Therefore, each field was further divided into HRUs. For each of the HRUs the overland flow length was recorded, as well as the crop being grown and the soil type.

In summary, this meant that all the USLE factors for a single HRU were now singular values simplifying calculations. It also meant that any interdependences of soil type, landuse, and physiography were no longer of concern because the values for landuse and physiography were no longer assumed but determined by observation for each HRU. As a result of the HRU development, it is also possible to do more than merely conjecture about the interdependences of soil type, landuse and physiography but to demonstrate them through statistical analysis of the HRU data.

4.4.1 INTERRELATIONSHIPS OF USLE FACTORS

The assumption used for the earlier evaluation methods that "the parameters of the USLE are independent" can be evaluated using data collected for the fourth method. The evaluation tests used were the Duncan's Multiple Range Test and Frequency Distribution Analysis. The results of the tests are offered only as a further justifcation for the abandonment of the earlier methods. Any other use of the results would be invalid.

Using the Duncan's Multiple Range test (Walpole and Meyers, 1978) to determine if the mean value for the field acreages of each cover crop were significantly different at 90 percent level, two groups were determined (See Table 21). The first group included the cover crops of peanuts, small grain/soybeans, and corn. The second group contained just soybeans. When the significance level was dropped to 80 percent, three groupings were possible. These results justify the concerns raised about cover crop and soil type independence.

As with soil type and cover, the interdependency of overland flow length and cover were tested using the Duncan's test (See Table 22). The test indicate three groups are discernible. The first is comprised of just peanuts. The second is comprised of small grain/soybeans and corn, and the third of corn and soybeans. These results justify the concerns about cover crop and overland flow length independence.

The interdependency of the field acreage and the cover crop did not appear to be significant when the Duncan's test was used (See Table 23). This does not indicate that there is not an interdependency between field acreage and cover crop. The results indicate a lack of interdependency in this watershed.

A final Duncan's test was used to determine if there was any interdependences between the overland flow and the soil type (See Table 24). The results indicate there are three overland flow and soil type groups. This would indicate that the concerns about the interdependency of overland flow and soil type are justifiable.

The final analysis of the raw HRU data were done to determine any relationships between soil type and cover. This was done by using a frequency analysis (See Table 25). Because the data was not collected for this type of analysis, the results should be used only as a justification for concerns of interdependency and not as definitive answers. Some important observations about the data are:

- Over 45 percent of the peanuts fields are one of 4 soil types (33 total soil types in the watershed).
    - 13.79 percent on soil number 8A, Eunola.
    - 13.10 percent on soil number 16A, Nansemond.

    - 11.03 percent on soil number 11, Kenansville.
    - 7.59 percent on soil number 22A, Suffolk.

- Over 45 percent of the corn fields are one of 4 soil types (33 total soil types in the watershed).
    - 12.66 percent on soil number 8A, Eunola.
    - 14.44 percent on soil number 16A, Nansemond.
    - 11.39 percent on soil number 14, Lynchburg.
    - 9.70 percent on soil number 29, Weston.

- Over 60 percent of the soybean fields are one of 4 soil types (33 total soil types in the watershed).
    - 9.92 percent on soil number 8A, Eunola.
    - 13.22 percent on soil number 16A, Nansemond.
    - 23.97 percent on soil number 29, Weston.
    - 13.22 percent on soil number 6, Dragston.

This indicates that the Eunola and the Nansemond are generally preferred for the production of most crops. In addition, the Kenansville and Suffolk are preferred for peanuts, the Lynchburg and Weston for corn and the Weston and Dragston for soybeans.

These preferences may explain the other interdependences of field size, overland flow, and cover as already discussed but further discussion is beyond the scope of this study.

The purpose of the BMP evaluation method is to help planners target precious BMP resources to the trouble spots and to evaluate a given BMP as *appropriate* for the region. Simply finding a BMP which reduces the mean soil loss for the watershed is not adequate. For example, by changing the cropping rotation from a 2 year "Corn, small-grain, and Soybean" sequence to a 2 year "Corn, small-grain, Soybean and cover" sequence for all fields were corn is grown, the mean soil loss for the watershed would be lowered. However, if economic incentives were provided to accomplish this cropping rotation change, money may be spent for inducing farmers to change their behavior on fields where the return is minimal. This misguided incentive program could consequently detract from other BMP plans that are more effective at attacking more significant problems on individual fields.

4.4.2 THE RESULTS

The cropping BMP results shown in Tables 13, 14, and 16 indicate that cropping BMPs most successful at reducing soil loss for HRUs currently growing corn is "no-till" production with a mean annual soil loss of 1.20 tons/acre/year which is about 12 percent of the soil loss loads produced on traditional corn fields.

The cropping BMP most successful at reducing soil loss for HRUs currently growing peanuts is a "Peanuts, small grain, and cover two year rotation" with a mean annual soil loss of 8.57 tons/acre/year which is about 78 percent of the soil loss loads produced on traditional peanut fields.

These results though informative express little more than each cropping BMPs USLE cover factor, C, relative to the other cropping BMPs C value. For example, the C value for "no-till" corn is 12 percent of the C value for traditional corn. And, the ratio of a peanut 2 year rotation C value is is 83 percent.

Fortunately, the BMP/HRU method can be used more creatively than used in original demonstration. Because of the method's design, it is possible to propose complicated BMP scenarios using such HRU features as:

1. Overland flow length.
2. Overland flow slope.
3. The HRU soil type.
4. The current HRU crop.
5. The size of the HRU.
6. The watershed the HRU is located within.

4.4.3 TEST TRIALS

In order to adequately test the BMP evaluation method, a series of test trials were developed. The results of the trials were grouped into three main categories. The first category (trials 1 and 2) demonstrates the method's ability to uniformly apply a BMP throughout the sample. The second category (trials 3 through 7) demonstrates the method's ability to selectively apply a BMP or a group of BMPs on individual HRUs.

The third category (trials 3, 7, and 8 through 10) demonstrates the method's ability to selectively and simultaneously apply a BMP. (*i.e.* soil loss, phosphorous, and nitrogen).

The scenarios of each of the trials is described below:

Trial 1. Running the BMP evaluation method without applying any BMPs to the sample (See Table 26 for the results).

Trial 2. Running the BMP evaluation method using a two year cropping rotation of "Corn, grain, soybean, and cover" on all corn producing fields, and using "no-till" practices on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. (See Table 27 for the results).

Trial 3. Running the BMP evaluation method using a two year cropping rotation of "Corn, grain, soybeans" on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet (See Table 28 for the results).

Trial 4. Running the BMP evaluation method using a two year cropping rotation of "Corn, grain, soybeans, and cover" on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. On all other fields, a two year cropping rotation of "Corn, grain, and soybeans" is used (See Table 29 for the results).

Trail 5. Running the BMP evaluation method using "No-till" on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. On all other fields, a two year cropping rotation of "Corn, grain, and soybeans" is used (See Table 30 for the results).

Trial 6. Running the BMP evaluation method using "Corn, grain, and soybeans" on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. On all other fields, a two year cropping rotation of "Corn, grain, soybeans" is used. In addition, a "liming" BMP is used on all fields to raise the pH to 5.0 (See Table 31 for the results).

Trial 7. Running the BMP evaluation method using "No-till" on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. On all other fields, a two year cropping rotation of "Corn, grain, soybeans" is used. In addition, a "liming" BMP is used on all fields to raise the pH to 5.0 (See Table 32 for the results).

Trial 8. Running the BMP evaluation method using "No-till" on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. On all other fields, a two year cropping rotation of "Corn, grain, soybeans" is used. In addition, a "liming" BMP is used on all fields to raise the pH to 5.0 and an adjustment made to the organic matter of the soil from BMP implementation. (See Table 33 for the results).

Trial 9. Running the BMP evaluation method using two BMPs applied to corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. The first BMP is a two year cropping rotation of "Corn, grain, and soybeans" and the second is a grass filter strip. The filter strip parameters are the same as defined for the modified fourth method described on page 84. (See Table 34 for the results).

Trial 10. Running the BMP evaluation method using two BMPs applied to corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. The first BMP is a two year cropping rotation of "Corn, grain, and soybeans" and the second is a grass filter strip. The filter strip parameters are the same as defined for the modified fourth method described on page 84 except for the Manning's number of 0.25 rather than 0.35. (See Table 35 for the results).

In the first category, a single cropping BMP is applied to all the fields throughout the sample that have characteristics which match a prescribed set of selection criteria. In trial 2 this is done by assuming that all the fields which grew corn in the sample set used a "Corn, grain, soybean, and cover" rotation and that the BMP was a "no-till" corn on fields with an overland flow greater than or equal to 300 feet and a slope greater or equal to 3 percent. As expected, the BMP reduces the soil loss by over 30 percent. In addition, the phosphate load is reduced by over 30 percent. This "parallel" reduction is not surprising because the phosphate predictive equations used are heavily dependent upon the soil loss estimate.

This approach to solving the problem gives promising results if the purpose of the BMP is to reduce soil loss and phosphate throughout the watershed. However, the category gives little relief to the planners trying to "target" their BMP resources to specific "problem" areas within the watershed.

In the second category, a series of trials are used to selectively apply BMPs to the sample set. In this series, trial 5 achieves a similar reduction in phosphate and soil loss NPSP as did trial 2 in the first category. However, this method separates the HRUs that had BMPs applied to them from the HRUs that did not. Using this separation mechanism, an indication is given that the "no-till" BMP acreage was only targeted at 177 acres or about 3 percent of the total sample to obtain approximately a 40 percent reduction in soil loss and phosphate loading.

In the third category, a series of trials are used to selectively apply multiple BMPs to the sample set simultaneously. As can be seen from the results in Table 36, trial 7 is not only successful in reducing soil loss and phosphate loadings, but also in reducing the nitrogen loadings. However, in trial 8 an adjustment is made to the organic matter content of the soils in HRUs which have had BMPs applied to them. The magnitude of the adjustments are based strictly on conjecture, but are designed to demonstrate the impact that increased soil organic matter due to BMP activity might have on the NPSP loadings. In this trial, the adjustment only increased the nitrogen loadings in the fields with BMP activity. The results of this type of testing are not meant to be definitive, but to be representative of the types of questions planners might need to ask about the impact of BMP activities and the actual organic matter adjustments would have to more thoroughly investigated.

Which method should be used can not be adequately determined just by reviewing these BMP scenarios, but must be analyzed in more detail by economic modelers such as McSweeny (1984) and Faulkner (1983).

These results indicate that given any BMP scenario, questions need to be formulated and answered before any recommendations can be made. Some of the questions might be:

1. Which BMP will be more productive in cutting extreme soil loss values within the watershed?

2. Which BMP will be more productive in cutting the mean soil loss for the entire watershed?

3. Which BMP will be more productive in cutting the soil loss at the least cost?

4. Which BMP will be more productive in cutting the nutrient NPSP at the least cost?

4.4.4 NON-CROPPING SEQUENCE BMPS

In addition to developing BMPs using different cropping sequences, it was also necessary to develop some non-cropping BMPs. The main non-cropping BMP chosen by both McSweeny (1984) and Faulkner (1983) was the use of "Grass filter strips" on selected fields. This was done by defining a BMP similar to the following:

> A financial incentive to farmers who have fields with an overland flow greater than or equal to 300 ft. and a slope greater than or equal to 2 percent to install a grass filter strip which is two thirds the overland flow length.

The grass filter strip BMP results shown in Tables 18, 19, and 20 indicate that their overall efficiency as described in the definition is about 20 to 25 percent in reducing soil loss and phosphate loadings. The results also indicate that the filter strips were only about 10 to 15 percent successful in reducing the nitrogen loadings.

4.4.5 TEST TRIALS

Two test trials (9 and 10) were developed using grass filter strips. The trials were applied to corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. Trial 9 used the grass filter strip parameters defined on page 84 as a worst case scenario and reduced the soil loading by around 33 percent from control. Trial 10 was identical to Trial 9 except that the Mannings number was reduced to 0.25. This reduction in the Manning's number produced a soil loss of around 37 percent.

Trial 10 and Trial 2 achieved about the same reduction in soil loss except that trial 2 had a cropping sequence BMP applied uniformly to all corn producing fields and to have "No-till" practices applied to corn fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

A method was developed for the evaluation of Agricultural BMPs to control NPSP in agricultural watersheds. The method was functional, practical, and cost effective because it:

1. Used existing data wherever and whenever possible;
2. Used existing personnel wherever and whenever possible;
3. Was generalized for use in most areas of the country;
4. Used simple simulation equation (models) or rational methods to predict soil loss and pollutant loading (yield).

Unlike other NPSP modeling methods, this method lends itself to the selective application of BMPs throughout the watershed based on its actual landuse and physical composition. This means, BMP's could be applied to the entire watershed uniformly or applied to a subset of the watershed based on selection criteria such as a fields slope, soil type, or existing cover crop. In addition, a combination of selection criteria could be used, and a combination of BMPs. This flexibility in selecting various BMPs and BMP combinations allow planners to pose many different schemes for controlling NPSP within the watershed. The schemes can then be compared to determine which scheme is the most *appropriate* for use with in the specific watershed.

The method developed relies heavily on the USLE used by the USDA's SCS and on data collected by the SCS and the ASCS, but it does require special compilation of the data for the creation of HRUs. The impact of this compilation was minimized by using a random sample of the active farms for the creation of HRUs rather than all the farms within the watershed. The HRUs are the result of overlaying the SCSs Soil Survey Maps and the ASCSs Cropping maps. The soil type and current crop were then recorded for each of the HRUs.

Different types of BMPs were evaluated for various types of NPSPs responses. The BMPs considered were cropping and rotation BMPs, and grass filter strips. The NPSPs considered were soil loss, phosphate, and nitrogen.

To demonstrate the methods ability to select a BMP's effectiveness within the watershed, a set of BMP scenarios were evaluated. The BMP scenarios were divided into three categories: a uniform application of a BMP throughout the watershed; a selective application of a BMP throughout the watershed and; the selective application of a set of BMP's throughout the watershed. Using a series of trial runs, the benefits of using the the method were demonstrated. For example, similar results were obtained using a cropping BMP of "Corn, grain, soybean and cover" throughout the sample, and "no-till" BMP on 3 percent of the sample. This type of information can be used in economic modelers to help target precious BMP implementation dollars.

As an indirect result of the method's HRU development, it was possible to test the independence of each of the USLE factors within the Nansemond/Chuckatuck watershed. The results of the Duncan's Multiple Range Test shows an interdependence between the "soil type and the cover", "overland flow versus cover", and "overland flow versus soil type".

5.2 RECOMMENDATIONS

The most important recommendation to be made is for the individual agencies helping the farmers within the area to adopt a single identification scheme for units of land and to share the information which is already available. The HRU/BMP method does not require a massive data collection effort but a dedicated effort to have data in a form which is useful to all. For example:

- The ASCS and SCS adopt the use of HRU plot numbers as the smallest level of refinement rather than field numbers for maintaining internal records.
- The Virginia Cooperative Extension Service adopt HRU plot numbers for processing soil analysis data and fertilizer recommendations.
- The Virginia Geographic Information System (GIS) adopt HRUs as the smallest level of refinement rather than cell data.

This unified system is not without its faults because the communication and sharing of data on individuals or an individuals activities by divergent groups with different charters is not to be treated lightly. If the HRU/BMP method were to be re-written using a database manager which could control access and granularity of the information distributed, the problem could be overcome. Obviously, the information must be indexed by HRU plot number to integrate the data. For example, and ASCS officer might report the current cover crop for a single field, the database manager would then resolve the field into its component HRUs, and assign a the cover for each one. A Virginia Cooperative extension agent collecting soils samples for the field, might be expected to submit one sample for each HRU rather than for one for the entire field. The GIS might randomly select HRUs to validate cover, by using remote sensing.

In addition to sharing and communicating data, site specific "tuning" of specific model parameters needs to be seriously undertaken if the HRU/BMP evaluation method is to produce definitive rather than comparative results. For example, the erodibility factors produced by the SCS have not been verified by data collection and analysis within the study area. Since approximately 25 percent of the crops grown within the sample area are grown on 2 soil types and almost 50 percent of the crops are grown on 7 soil types, USLE trial plots might prove to be advantageous and cost effective.

Another problem aside from the collection of better estimates of the model parameters, is the cost of collecting land use or cropping activity data. This has been overcome by the concept of "Cross Compliance" adopted in 1985 by the federal government. Usually, "Cross Compliance" is the concept of requiring farmers who participate in price support programs to also participate in conservation programs. As a consequence, the additional cropping activity data collection costs could be minimized to data entry by the ASCS and random spot checks for validity by SCS.

Finally, if the determination of the definitive results becomes crucial, hydrologic models can be used to estimate the actual amount of sediment transported and delivered by the waterways for single events. Models like the Finite Element Storm Hyrdrograph Model (FESHM) developed originally by B. Ross in 1978 are logical extensions of this method.

In summary, the method developed can not be considered to be the final answer for questions about which BMPs are the most *appropriate* for a specific watershed. However, it does an adequate job using data and personnel already available and does provide a foundation on which to build more complex solutions should they be necessary.

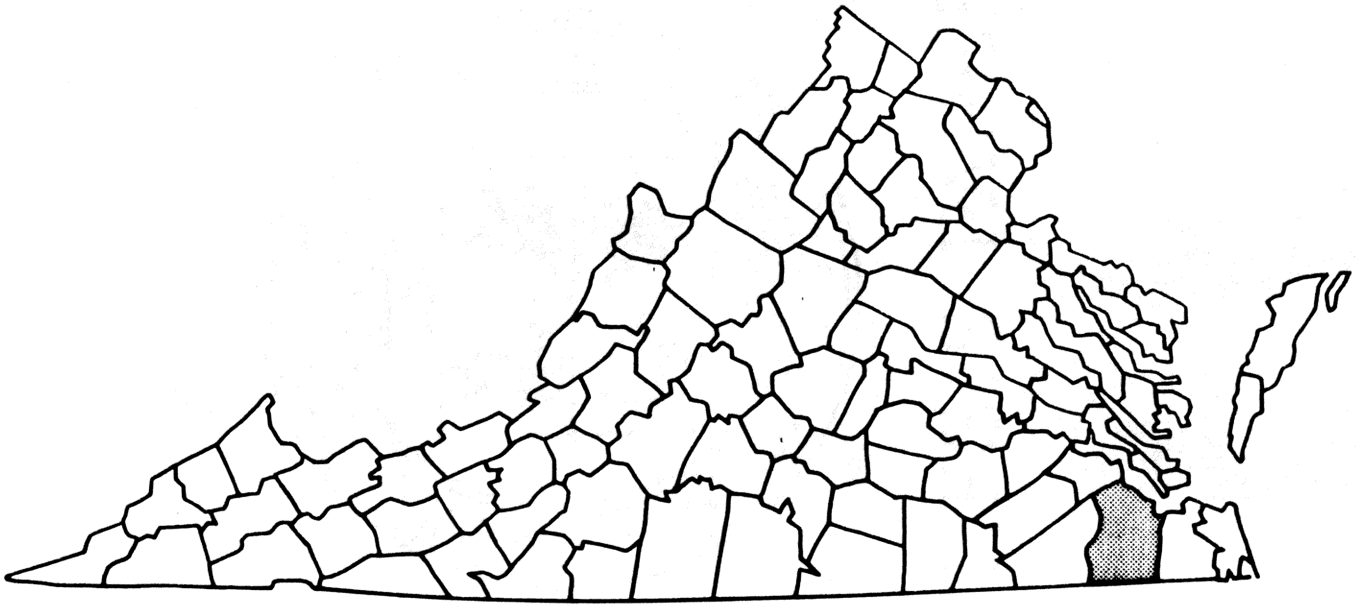


Figure 1. Location of the City of Suffolk and Isle of Wight County, Virginia.

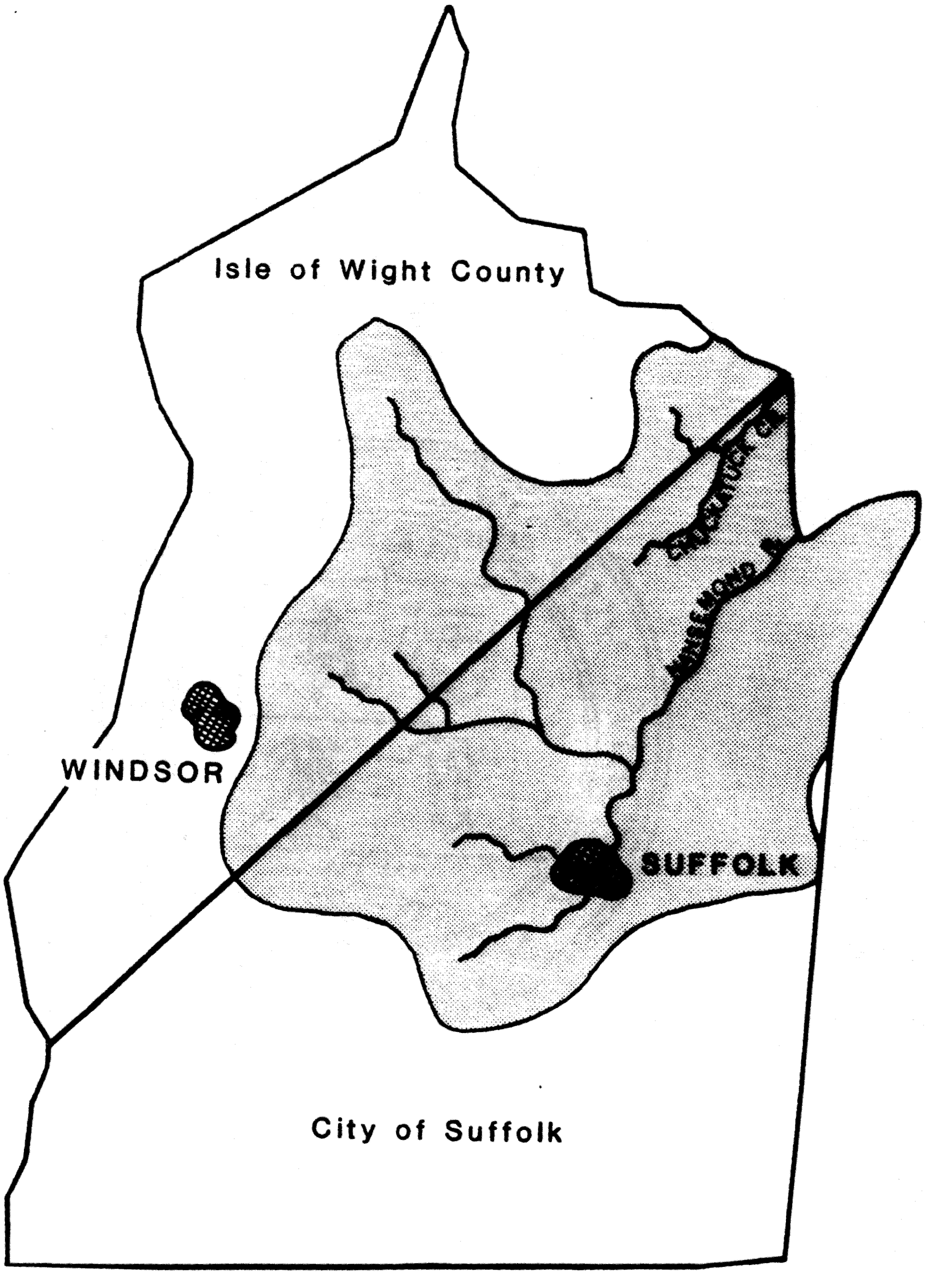


Figure 2. The Nansemond/Chuckatuck Watershed.

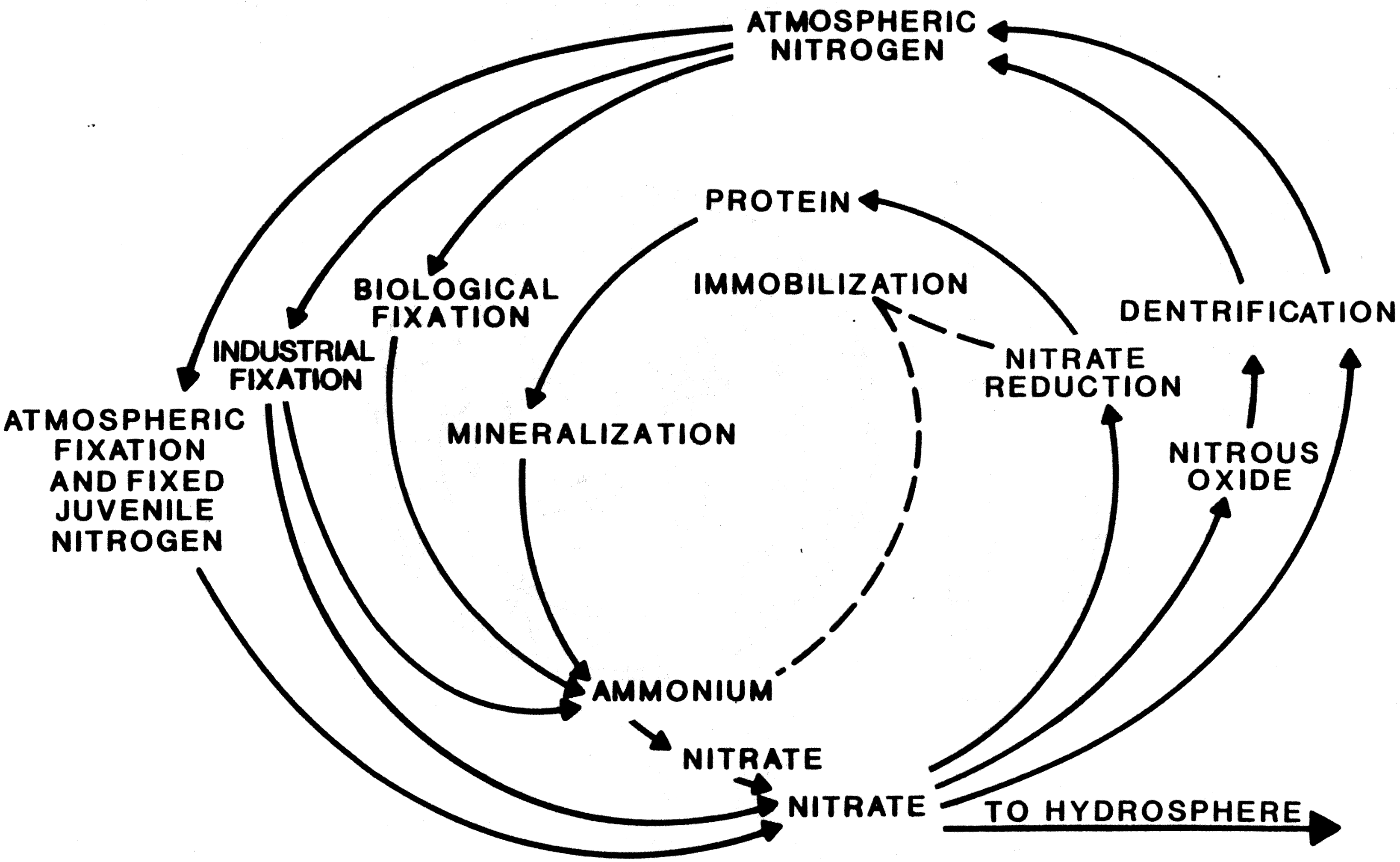


Figure 3. The Nitrogen Cycle.

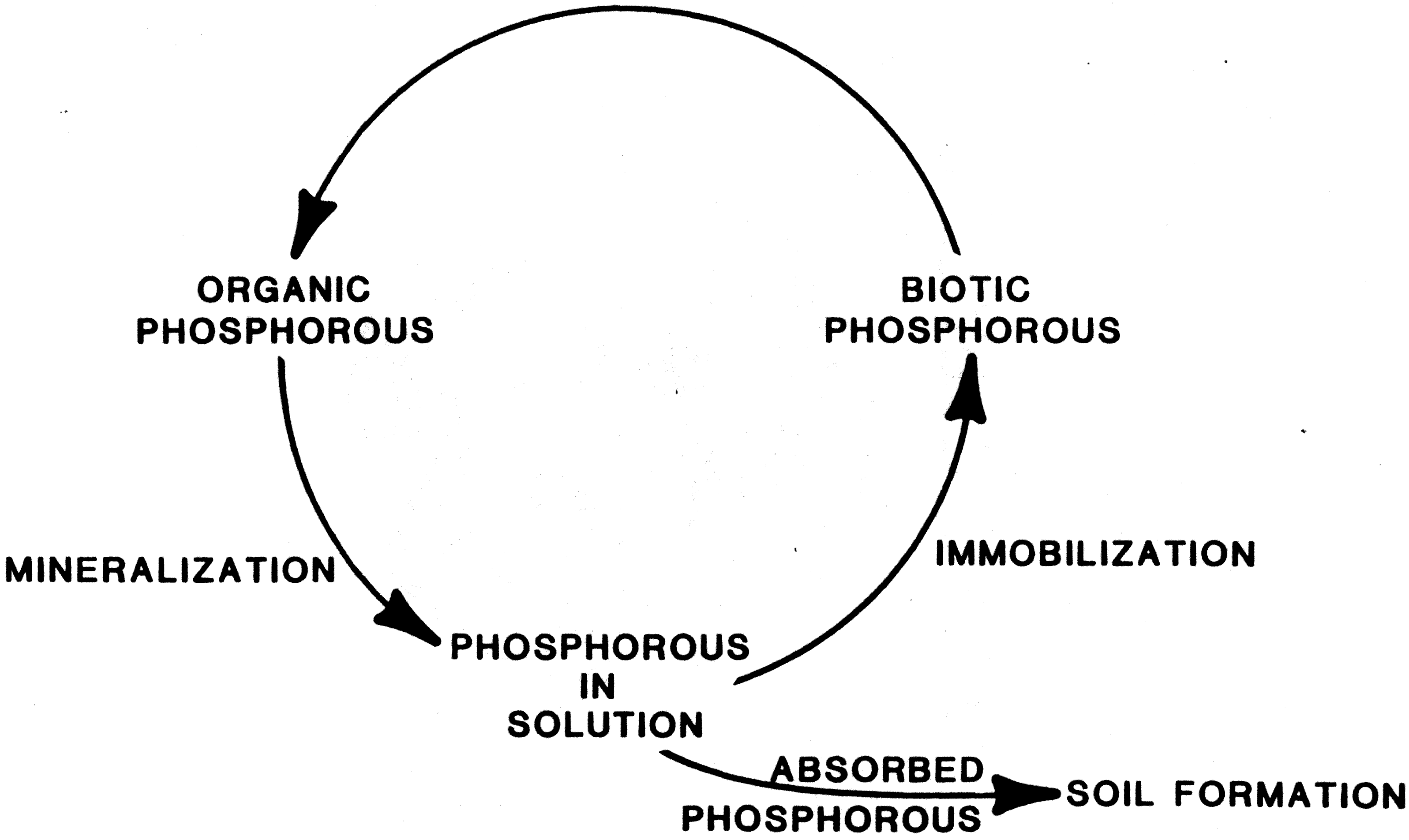
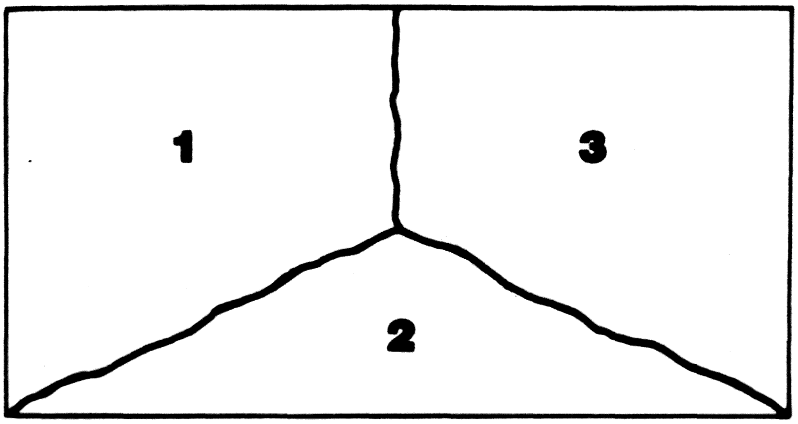


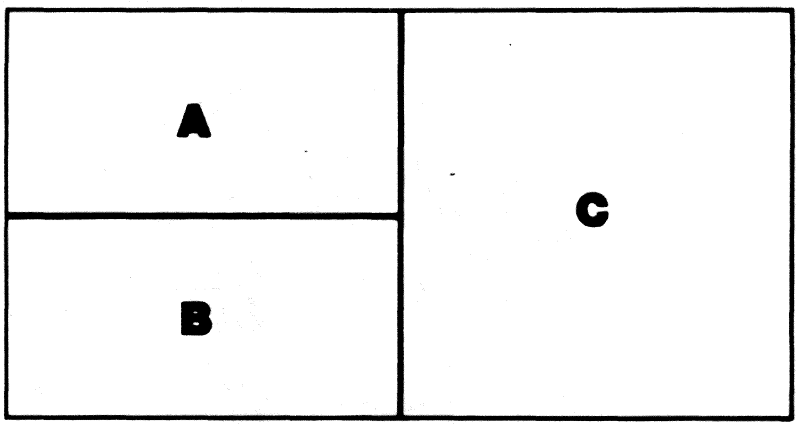
Figure 4. The Phosphorous Cycle.

Figure 5. The Isoerodent Map.

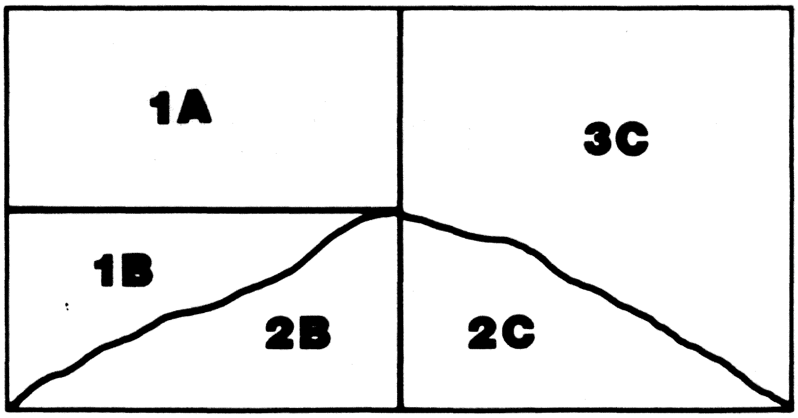
Isoreodent contours of eastern Uniter States as presented by Wischmeir and Smith, 1978).



SOIL MAP



LANDUSE MAP



HRU MAP

Figure 6. The Graphical Representation of Developing Hydrologic Response Units.

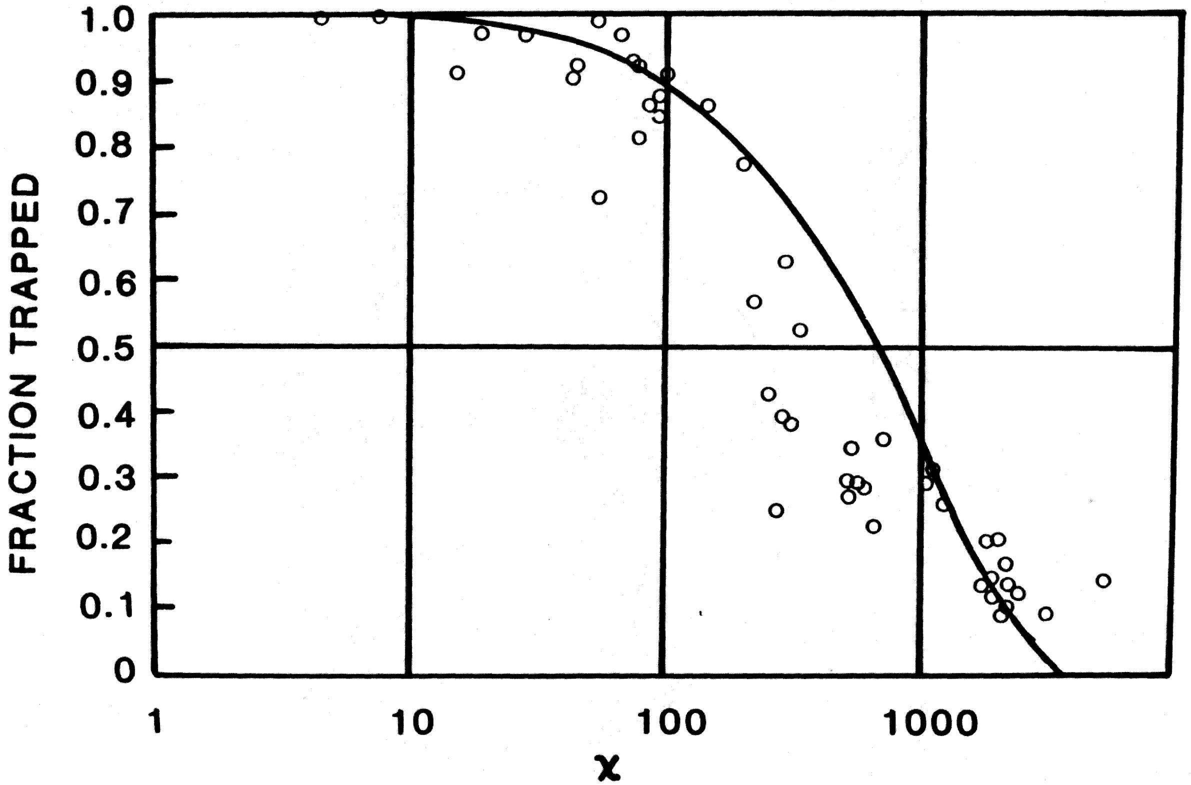


Figure 7. The Particle Removal Efficiency

The relationship of particle removal efficiency of grass filter to the Reynolds number, Re_t, and the particle fall number, N_f. Note: o - signifies observed values, curve predicted by regression analysis, R = 0.87 (From Barfield *et al.*, 1975).

Table 1. The Valance States of Nitrogen.

Valence	Compound	Formula
+5	Nitrate	NO_3
+3	Nitrite	NO_2
+2	Nitric Oxide	NO
+1	Nitrous Oxide	N_2O_2

Table 2. Selected Phosphorous Solubility Products and Dissociation Constants at 25 Degrees C.

Number	Compound or Species	Chemical Formula	Value pK
1	Gibbsite	$Al(OH)_3$ $pK_g = pAl + 3pOH$	33.8
2	Variscite	$Al(OH)_2PO_4$ $pK_v = pAl + 2pOH + H_2PO_4$	30.5
3	Goethite	$FeOOH$ $pK_{gt} = pFe + 3pOH$	Unknown
4	Ferric Hydroxide	$FeOOH$ $pK_{fh} = pFe + 3pOH$	38.1
5	Strengite	$Fe(OH)2H_2PO_4$ $pk_{st} = pFe + 2pOH + pHPO_4$	33.6-35.0
6	Dicalcium phosphate dihydrate	$CaHPO_4 2H_2O$ $pK_{dcpd} = pCa + pHPO_4$	6.56
7	Dicalcium phosphate anhydrous	$CaHPO_4$ $pK_{dcpa} = pCa + pHPO_4$	6.66
8	Octocalcium Phosphate	$Ca_4H(PO_4) \cdot 3H_2O$ $pK_{ocp} = 4PCa + pH + 3pPO_4$	46.91
9	Hydroxypatite	$Ca_{10}(PO_4)_6(OH)_2$ $pK_{ha} = 10pCa + 6pPO_4 + 2pOH$	113.7
10	Fluorapatite	$Ca_{10}(PO_4)_6F_2$ $pK_{fa} = 10pCa + 6pPO_4 + 2pF$	118.4

Table 2. Selected Phosphorous Solubility Products and Dissociation Constants (Continued).

Number	Compound or Species	Chemical Formula	Value pK
11	Fluorite	CaF_2 $pK_{ft} = pCa + 2pF$	9.84
12	Calcite	$CaCO_2$ $pK_{cc} = pH - \frac{1}{2}pCa + \frac{1}{2}\log pCO_2$	4.93
13	Phosphoric Acid	H_3PO_4 $pK_1 = pH + pH_2PO_4 - pH_3PO_4$	2.12
14	Dihydrogen Phosphate	H_2PO_4 $pK_2 = pH + pHPO_4 - pH_2PO_4$	7.20
15	MonoHydrogen Phosphate ion	HPO_4 $pK_3 = pH + pPO_4 - pHPO_4$	12.32
16	Water	H_2O $pK_w = pH + pOH$	14.0

Table 3. The Erodibility Factor, K, for the City of Suffolk, VA, Soils.

Soil Type	Erodibility Factor (K)
Alaga	0.17
Belhaven	0.24
Bohicket	0.32
Deloss	0.28
Doque	0.28
Doque	0.28
Dragston	0.17
Emporia	0.28
Emporia	0.28
Eunola	0.28
Goldsboro	0.20
Goldsboro	0.20
Kalmia	0.20
Kenansville	0.15
Kenansville	0.15
Levy	0.32
Lynchburg	0.20
Nansemond	0.15
Nansemond	0.15
Nansemond	0.15
Nansemond	0.20
Nansemond	0.20
Pactolus	0.10
Pungo	?
Rains	0.17
Rumford	0.24
Rumford	0.24
State	0.28
State	0.28
Suffolk	0.24
Suffolk	0.24
Tetotum	0.32
Tetotum	0.32
Tomotley	0.20
Torhunta	0.15
Wahee	0.28
Weston	0.24

Table 4. Values of Topographic Factor, LS.

The Length-Slope values for for specific combinations of slope, length and steepness.

	Slope Length (feet)											
Percent Slope	25	50	75	100	150	200	300	400	500	600	800	1000
0.2	.060	.069	.075	.080	.086	.092	.099	.105	.110	.114	.121	.126
0.5	.073	.083	.090	.096	.104	.110	.119	.126	.132	.137	.145	.152
0.8	.086	.098	.107	.113	.123	.130	.141	.149	.156	.162	.171	.179
2	.133	.163	.185	.201	.227	.248	.280	.305	.326	.344	.376	.402
3	.190	.233	.264	.287	.325	.354	.400	.437	.466	.492	.536	.573
4	.230	.303	.357	.400	.471	.528	.621	.697	.762	.820	.920	1.01
5	.268	.379	.464	.536	.656	.758	.928	1.07	1.20	1.31	1.52	1.69
6	.336	.476	.583	.673	.824	.952	1.17	1.35	1.50	1.65	1.90	2.13
8	.496	.701	.859	.992	1.21	1.41	1.72	1.98	2.22	2.43	2.81	3.14
10	.685	.968	1.19	1.37	1.68	1.94	2.37	2.74	3.06	3.36	3.87	4.33
12	.903	1.28	1.56	1.80	2.21	2.55	3.13	3.61	4.04	4.42	5.11	5.71
14	1.15	1.62	1.99	2.30	2.81	3.25	3.98	4.59	5.13	5.62	6.49	7.26
16	1.42	2.01	2.46	2.84	3.48	4.01	4.92	5.68	6.35	6.95	8.03	8.98
18	1.72	2.43	2.97	3.43	4.21	4.86	5.95	6.87	7.68	8.41	9.71	10.9
20	2.04	2.88	3.53	4.08	5.00	5.77	7.07	8.16	9.12	10.0	11.5	12.9

Table 5. The Primary Use Classes for the Nansemond and Chuckatuck Creek Soils.

Soil Type	Primary Use	Average % Slope
Alaga	Woodland	*
Belhaven	Woodland	*
Bohicket	Woodland	*
Deloss	Woodland	*
Doque/A	Agricultural	0.54
Doque/B	Agricultural	0.54
Dragston	Agricultural	1.89
Emporia/A/B	Agricultural	0.60
Eunola/A/B	Agricultural	13.94
Goldsboro/A	Agricultural	0.78
Goldsboro/B	Agricultural	0.78
Kalmia/A	Agricultural	0.54
Kalmia/B	Agricultural	0.54
Kenansville	Agricultural	6.15
Kenansville	Agricultural	*
Levy	Woodland	*
Lynchburg	Woodland	*
Nansemond/A	Agricultural	0.15
Nansemond/B	Agricultural	1.80
Nansemond/C	Agricultural	1.80
Nansemond/D	Woodland	*
Nansemond/E	Woodland	*
Pactolus	Woodland	*
Pungo	Woodland	*
Rains	Woodland	*
Rumford/A	Agricultural	*
Rumford/B	Agricultural	*
State/A	Agricultural	0.25
State/B	Agricultural	0.25
Suffolk/A	Agricultural	2.05
Suffolk/B	Agricultural	2.05
Tetotum/A	Agricultural	0.87
Tetotum/B	Agricultural	0.87
Tomotley	Woodland	3.06
Torhunta	Woodland	*
Wahee	Agricultural	*
Weston	Woodland	*

* - Signifies non-farmed soil types.

Table 6. The C-Values for Differrent Cropping Schemes.

Crop and/or Rotation	C-value
Corn	0.260
Corn (No-Till)	0.033
SoyBeans	0.344
Peanuts	0.355
Grain/SoyBean	0.026
Peanuts cC	0.316
Peanuts cCG	0.333
Peanuts GC	0.279
Peanuts c SB C	0.355
Peanuts c SBc Cc	0.333
CG SB (2 yr.)	0.246
CG SBc (2 yr.)	0.236
CG SB (3 yr.)	0.267
CG SBc (3 yr.)	0.258
C G SB (3 yr.)	0.320

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Table 7. The Soils with Different Cropping Rotations

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Alaga	Corn	9.213
	Corn (No-Till)	1.169
	SoyBeans	12.190
	Peanuts	11.871
	Grain/SoyBean	0.921
	Peanuts cC	11.198
	Peanuts cCG	11.800
	Peanuts GC	9.887
	Peanuts c SB C	12.580
	Peanuts c SBc Cc	11.800
	CG SB (2 yr.)	8.717
	CG SBc (2 yr.)	8.363
	CG SB (3 yr.)	9.462
	CG SBc (3 yr.)	9.143
	C G SB (3 yr.)	11.340
Belhaven	Corn	1.888
	Corn (No-Till)	0.240
	SoyBeans	2.497
	Peanuts	2.432
	Grain/SoyBean	0.189
	Peanuts cC	2.294
	Peanuts cCG	2.418
	Peanuts GC	2.026
	Peanuts c SB C	2.577
	Peanuts c SBc Cc	2.418
	CG SB (2 yr.)	1.786
	CG SBc (2 yr.)	1.713
	CG SB (3 yr.)	1.938
	CG SBc (3 yr.)	1.873
	C G SB (3 yr.)	2.323
Bohicket	Corn	2.517
	Corn (No-Till)	0.319
	SoyBeans	3.330
	Peanuts	3.243
	Grain/SoyBean	0.252
	Peanuts cC	3.059
	Peanuts cCG	3.223
	Peanuts GC	2.651
	Peanuts c SB C	3.436
	Peanuts c SBc Cc	3.223
	CG SB (2 yr.)	2.381
	CG SBc (2 yr.)	2.284
	CG SB (3 yr.)	2.585
	CG SBc (3 yr.)	2.497
	C G SB (3 yr.)	3.098

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Deloss	Corn	3.003
	Corn (No-Till)	0.381
	SoyBeans	3.973
	Peanuts	3.869
	Grain/SoyBean	0.300
	Peanuts cC	3.650
	Peanuts cCG	3.846
	Peanuts GC	3.222
	Peanuts c SB C	4.100
	Peanuts c SBc Cc	3.846
	CG SB (2 yr.)	2.841
	CG SBc (2 yr.)	2.726
	CG SB (3 yr.)	3.084
	CG SBc (3 yr.)	2.980
	C G SB (3 yr.)	3.696
Dogue/a	Corn	3.003
	Corn (No-Till)	0.381
	SoyBeans	3.973
	Peanuts	3.869
	Grain/SoyBean	0.300
	Peanuts cC	3.650
	Peanuts cCG	3.846
	Peanuts GC	3.222
	Peanuts c SB C	4.100
	Peanuts c SBc Cc	3.846
	CG SB (2 yr.)	2.841
	CG SBc (2 yr.)	2.726
	CG SB (3 yr.)	3.084
	CG SBc (3 yr.)	2.980
	C G SB (3 yr.)	3.696
Dogue/b	Corn	10.571
	Corn (No-Till)	1.342
	SoyBeans	13.986
	Peanuts	13.620
	Grain/SoyBean	1.057
	Peanuts cC	12.847
	Peanuts cCG	13.538
	Peanuts GC	11.343
	Peanuts c SB C	14.433
	Peanuts c SBc Cc	13.538
	CG SB (2 yr.)	10.001
	CG SBc (2 yr.)	9.595
	CG SB (3 yr.)	10.855
	CG SBc (3 yr.)	10.489
	C G SB (3 yr.)	13.010

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Dragston	Corn	1.823
	Corn (No-Till)	0.231
	SoyBeans	2.412
	Peanuts	2.349
	Grain/SoyBean	0.182
	Peanuts cC	2.216
	Peanuts cCG	2.335
	Peanuts GC	1.956
	Peanuts c SB C	2.489
	Peanuts c SBc Cc	2.335
	CG SB (2 yr.)	1.725
	CG SBc (2 yr.)	1.655
	CG SB (3 yr.)	1.872
	CG SBc (3 yr.)	1.809
	C G SB (3 yr.)	2.244
Emporia/a	Corn	3.003
	Corn (No-Till)	0.381
	SoyBeans	3.973
	Peanuts	3.869
	Grain/SoyBean	0.300
	Peanuts cC	3.650
	Peanuts cCG	3.846
	Peanuts GC	3.222
	Peanuts c SB C	4.100
	Peanuts c SBc Cc	3.846
	CG SB (2 yr.)	2.841
	CG SBc (2 yr.)	2.726
	CG SB (3 yr.)	3.084
	CG SBc (3 yr.)	2.980
	C G SB (3 yr.)	3.696
Emporia/b	Corn	10.571
	Corn (No-Till)	1.342
	SoyBeans	13.986
	Peanuts	13.620
	Grain/SoyBean	1.057
	Peanuts cC	12.847
	Peanuts cCG	13.538
	Peanuts GC	11.343
	Peanuts c SB C	14.433
	Peanuts c SBc Cc	13.538
	CG SB (2 yr.)	10.001
	CG SBc (2 yr.)	9.595
	CG SB (3 yr.)	10.855
	CG SBc (3 yr.)	10.489
	C G SB (3 yr.)	13.010

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Eunola/a	Corn	7.087
	Corn (No-Till)	0.900
	SoyBeans	9.377
	Peanuts	9.131
	Grain/SoyBean	0.659
	Peanuts cC	8.614
	Peanuts cCG	9.077
	Peanuts GC	7.605
	Peanuts c SB C	9.677
	Peanuts c SBc Cc	9.077
	CG SB (2 yr.)	6.655
	CG SBc (2 yr.)	6.433
	CG SB (3 yr.)	7.278
	CG SBc (3 yr.)	7.033
	C G SB (3 yr.)	8.723
Eunola/b	Corn	7.087
	Corn (No-Till)	0.900
	SoyBeans	9.377
	Peanuts	9.131
	Grain/SoyBean	0.659
	Peanuts cC	8.614
	Peanuts cCG	9.077
	Peanuts GC	7.605
	Peanuts c SB C	9.677
	Peanuts c SBc Cc	9.077
	CG SB (2 yr.)	6.655
	CG SBc (2 yr.)	6.433
	CG SB (3 yr.)	7.278
	CG SBc (3 yr.)	7.033
	C G SB (3 yr.)	8.723
Goldsboro/a	Corn	2.145
	Corn (No-Till)	0.272
	SoyBeans	2.838
	Peanuts	2.764
	Grain/SoyBean	0.214
	Peanuts cC	2.607
	Peanuts cCG	2.747
	Peanuts GC	2.302
	Peanuts c SB C	2.929
	Peanuts c SBc Cc	2.747
	CG SB (2 yr.)	2.029
	CG SBc (2 yr.)	1.947
	CG SB (3 yr.)	2.203
	CG SBc (3 yr.)	2.128
	C G SB (3 yr.)	2.640

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Goldsboro/b	Corn	6.306
	Corn (No-Till)	0.800
	SoyBeans	8.344
	Peanuts	8.125
	Grain/SoyBean	0.631
	Peanuts cC	7.665
	Peanuts cCG	8.077
	Peanuts GC	6.767
	Peanuts c SB C	8.611
	Peanuts c SBc Cc	8.077
	CG SB (2 yr.)	5.967
	CG SBc (2 yr.)	5.724
	CG SB (3 yr.)	6.476
	CG SBc (3 yr.)	6.258
	C G SB (3 yr.)	7.762
Kalmia	Corn	5.062
	Corn (No-Till)	0.643
	SoyBeans	6.698
	Peanuts	6.522
	Grain/SoyBean	0.506
	Peanuts cC	6.153
	Peanuts cCG	6.484
	Peanuts GC	5.432
	Peanuts c SB C	6.912
	Peanuts c SBc Cc	6.484
	CG SB (2 yr.)	4.790
	CG SBc (2 yr.)	4.595
	CG SB (3 yr.)	5.198
	CG SBc (3 yr.)	5.023
	C G SB (3 yr.)	6.230
Kenansville.1	Corn	2.660
	Corn (No-Till)	0.338
	SoyBeans	3.519
	Peanuts	3.427
	Grain/SoyBean	0.266
	Peanuts cC	3.233
	Peanuts cCG	3.407
	Peanuts GC	2.854
	Peanuts c SB C	3.632
	Peanuts c SBc Cc	3.407
	CG SB (2 yr.)	2.517
	CG SBc (2 yr.)	2.414
	CG SB (3 yr.)	2.731
	CG SBc (3 yr.)	2.639
	C G SB (3 yr.)	3.274

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Kenansville.2	Corn	2.660
	Corn (No-Till)	0.338
	SoyBeans	3.519
	Peanuts	3.427
	Grain/SoyBean	0.266
	Peanuts cC	3.233
	Peanuts cCG	3.407
	Peanuts GC	2.854
	Peanuts c SB C	3.632
	Peanuts c SBc Cc	3.407
	CG SB (2 yr.)	2.517
	CG SBc (2 yr.)	2.414
	CG SB (3 yr.)	2.731
	CG SBc (3 yr.)	2.639
	C G SB (3 yr.)	3.274
Levy	Corn	2.517
	Corn (No-Till)	0.319
	SoyBeans	3.330
	Peanuts	3.243
	Grain/SoyBean	0.252
	Peanuts cC	3.059
	Peanuts cCG	3.223
	Peanuts GC	2.651
	Peanuts c SB C	3.436
	Peanuts c SBc Cc	3.223
	CG SB (2 yr.)	2.381
	CG SBc (2 yr.)	2.284
	CG SB (3 yr.)	2.585
	CG SBc (3 yr.)	2.497
	C G SB (3 yr.)	3.098
Lynchburg	Corn	2.145
	Corn (No-Till)	0.272
	SoyBeans	2.838
	Peanuts	2.764
	Grain/SoyBean	0.214
	Peanuts cC	2.607
	Peanuts cCG	2.747
	Peanuts GC	2.302
	Peanuts c SB C	2.929
	Peanuts c SBc Cc	2.747
	CG SB (2 yr.)	2.029
	CG SBc (2 yr.)	1.947
	CG SB (3 yr.)	2.203
	CG SBc (3 yr.)	2.128
	C G SB (3 yr.)	2.640

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Nansemond/b.15	Corn	3.486
	Corn (No-Till)	0.442
	SoyBeans	4.612
	Peanuts	4.491
	Grain/SoyBean	0.349
	Peanuts cC	4.236
	Peanuts cCG	4.464
	Peanuts GC	3.740
	Peanuts c SB C	4.759
	Peanuts c SBc Cc	4.464
	CG SB (2 yr.)	3.298
	CG SBc (2 yr.)	3.164
	CG SB (3 yr.)	3.579
	CG SBc (3 yr.)	3.459
	C G SB (3 yr.)	4.290
Nansemond/d.15	Corn	20.914
	Corn (No-Till)	2.654
	SoyBeans	27.665
	Peanuts	26.947
	Grain/SoyBean	2.091
	Peanuts cC	25.418
	Peanuts cCG	26.786
	Peanuts GC	22.442
	Peanuts c SB C	28.555
	Peanuts c SBc Cc	26.786
	CG SB (2 yr.)	19.788
	CG SBc (2 yr.)	18.983
	CG SB (3 yr.)	21.477
	CG SBc (3 yr.)	20.753
	C G SB (3 yr.)	25.740
Nansemond/e.15	Corn	61.883
	Corn (No-Till)	7.854
	SoyBeans	81.876
	Peanuts	79.734
	Grain/SoyBean	6.188
	Peanuts cC	75.212
	Peanuts cCG	79.258
	Peanuts GC	66.405
	Peanuts c SB C	84.494
	Peanuts c SBc Cc	79.258
	CG SB (2 yr.)	58.551
	CG SBc (2 yr.)	56.171
	CG SB (3 yr.)	63.549
	CG SBc (3 yr.)	61.407
	C G SB (3 yr.)	76.164

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Nansemond/a.16	Corn	2.145
	Corn (No-Till)	0.272
	SoyBeans	2.838
	Peanuts	2.764
	Grain/SoyBean	0.214
	Peanuts cC	2.607
	Peanuts cCG	2.747
	Peanuts GC	2.302
	Peanuts c SB C	2.929
	Peanuts c SBc Cc	2.747
	CG SB (2 yr.)	2.029
	CG SBc (2 yr.)	1.947
	CG SB (3 yr.)	2.203
	CG SBc (3 yr.)	2.128
	C G SB (3 yr.)	2.640
Nansemond/B.16	Corn	7.550
	Corn (No-Till)	0.958
	SoyBeans	9.990
	Peanuts	9.728
	Grain/SoyBean	0.755
	Peanuts cC	9.177
	Peanuts cCG	9.665
	Peanuts GC	8.102
	Peanuts c SB C	10.309
	Peanuts c SBc Cc	9.665
	CG SB (2 yr.)	7.144
	CG SBc (2 yr.)	6.853
	CG SB (3 yr.)	7.754
	CG SBc (3 yr.)	7.492
	C G SB (3 yr.)	9.293
Pactolus	Corn	1.072
	Corn (No-Till)	0.136
	SoyBeans	1.419
	Peanuts	1.382
	Grain/SoyBean	0.107
	Peanuts cC	1.303
	Peanuts cCG	1.374
	Peanuts GC	1.151
	Peanuts c SB C	1.464
	Peanuts c SBc Cc	1.374
	CG SB (2 yr.)	1.015
	CG SBc (2 yr.)	0.973
	CG SB (3 yr.)	1.101
	CG SBc (3 yr.)	1.064
	C G SB (3 yr.)	1.320

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Rains	Corn	1.823
	Corn (No-Till)	0.231
	SoyBeans	2.412
	Peanuts	2.349
	Grain/SoyBean	0.182
	Peanuts cC	2.216
	Peanuts cCG	2.335
	Peanuts GC	1.956
	Peanuts c SB C	2.489
	Peanuts c SBc Cc	2.335
	CG SB (2 yr.)	1.725
	CG SBc (2 yr.)	1.655
	CG SB (3 yr.)	1.872
	CG SBc (3 yr.)	1.809
	C G SB (3 yr.)	2.244
Rumford/a	Corn	2.574
	Corn (No-Till)	0.327
	SoyBeans	3.406
	Peanuts	3.316
	Grain/SoyBean	0.257
	Peanuts cC	3.128
	Peanuts cCG	3.297
	Peanuts GC	2.762
	Peanuts c SB C	3.514
	Peanuts c SBc Cc	3.297
	CG SB (2 yr.)	2.435
	CG SBc (2 yr.)	2.336
	CG SB (3 yr.)	2.643
	CG SBc (3 yr.)	2.554
	C G SB (3 yr.)	3.168
Rumford/b	Corn	9.060
	Corn (No-Till)	1.150
	SoyBeans	11.988
	Peanuts	11.674
	Grain/SoyBean	0.906
	Peanuts cC	11.012
	Peanuts cCG	11.604
	Peanuts GC	9.723
	Peanuts c SB C	12.371
	Peanuts c SBc Cc	11.604
	CG SB (2 yr.)	8.573
	CG SBc (2 yr.)	8.224
	CG SB (3 yr.)	9.304
	CG SBc (3 yr.)	8.991
	C G SB (3 yr.)	11.151

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
State/a	Corn	3.003
	Corn (No-Till)	0.381
	SoyBeans	3.973
	Peanuts	3.869
	Grain/SoyBean	0.300
	Peanuts cC	3.650
	Peanuts cCG	3.846
	Peanuts GC	3.222
	Peanuts c SB C	4.100
	Peanuts c SBc Cc	3.846
	CG SB (2 yr.)	2.841
	CG SBc (2 yr.)	2.726
	CG SB (3 yr.)	3.084
	CG SBc (3 yr.)	2.980
	C G SB (3 yr.)	3.696
State/b	Corn	10.571
	Corn (No-Till)	1.342
	SoyBeans	13.986
	Peanuts	13.620
	Grain/SoyBean	1.057
	Peanuts cC	12.847
	Peanuts cCG	13.538
	Peanuts GC	11.343
	Peanuts c SB C	14.433
	Peanuts c SBc Cc	13.538
	CG SB (2 yr.)	10.001
	CG SBc (2 yr.)	9.595
	CG SB (3 yr.)	10.855
	CG SBc (3 yr.)	10.489
	C G SB (3 yr.)	13.010
Suffolk/a	Corn	2.574
	Corn (No-Till)	0.327
	SoyBeans	3.406
	Peanuts	3.316
	Grain/SoyBean	0.257
	Peanuts cC	3.128
	Peanuts cCG	3.297
	Peanuts GC	2.762
	Peanuts c SB C	3.514
	Peanuts c SBc Cc	3.297
	CG SB (2 yr.)	2.435
	CG SBc (2 yr.)	2.336
	CG SB (3 yr.)	2.643
	CG SBc (3 yr.)	2.554
	C G SB (3 yr.)	3.168

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Suffolk/b	Corn	9.060
	Corn (No-Till)	1.150
	SoyBeans	11.988
	Peanuts	11.674
	Grain/SoyBean	0.906
	Peanuts cC	11.012
	Peanuts cCG	11.604
	Peanuts GC	9.723
	Peanuts c SB C	12.371
	Peanuts c SBc Cc	11.604
	CG SB (2 yr.)	8.573
	CG SBc (2 yr.)	8.224
	CG SB (3 yr.)	9.304
	CG SBc (3 yr.)	8.991
	C G SB (3 yr.)	11.151
Tetotum/a	Corn	3.432
	Corn (No-Till)	0.436
	SoyBeans	4.541
	Peanuts	4.422
	Grain/SoyBean	0.343
	Peanuts cC	4.171
	Peanuts cCG	4.396
	Peanuts GC	3.683
	Peanuts c SB C	4.686
	Peanuts c SBc Cc	4.396
	CG SB (2 yr.)	3.247
	CG SBc (2 yr.)	3.115
	CG SB (3 yr.)	3.524
	CG SBc (3 yr.)	3.406
	C G SB (3 yr.)	4.224
Tetotum/b	Corn	12.081
	Corn (No-Till)	1.533
	SoyBeans	15.984
	Peanuts	15.565
	Grain/SoyBean	1.208
	Peanuts cC	14.683
	Peanuts cCG	15.473
	Peanuts GC	12.963
	Peanuts c SB C	16.495
	Peanuts c SBc Cc	15.473
	CG SB (2 yr.)	11.430
	CG SBc (2 yr.)	10.966
	CG SB (3 yr.)	12.406
	CG SBc (3 yr.)	11.988
	C G SB (3 yr.)	14.868

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Tomotley	Corn	2.145
	Corn (No-Till)	0.272
	SoyBeans	2.838
	Peanuts	2.764
	Grain/SoyBean	0.214
	Peanuts cC	2.607
	Peanuts cCG	2.747
	Peanuts GC	2.302
	Peanuts c SB C	2.929
	Peanuts c SBc Cc	2.747
	CG SB (2 yr.)	2.029
	CG SBc (2 yr.)	1.947
	CG SB (3 yr.)	2.203
	CG SBc (3 yr.)	2.128
	C G SB (3 yr.)	2.640
Torhunta	Corn	1.609
	Corn (No-Till)	0.204
	SoyBeans	2.128
	Peanuts	2.073
	Grain/SoyBean	0.161
	Peanuts cC	1.955
	Peanuts cCG	2.060
	Peanuts GC	1.726
	Peanuts c SB C	2.197
	Peanuts c SBc Cc	2.060
	CG SB (2 yr.)	1.522
	CG SBc (2 yr.)	1.460
	CG SB (3 yr.)	1.652
	CG SBc (3 yr.)	1.596
	C G SB (3 yr.)	1.980
Wahee	Corn	3.003
	Corn (No-Till)	0.381
	SoyBeans	3.973
	Peanuts	3.869
	Grain/SoyBean	0.300
	Peanuts cC	3.650
	Peanuts cCG	3.846
	Peanuts GC	3.222
	Peanuts c SB C	4.100
	Peanuts c SBc Cc	3.846
	CG SB (2 yr.)	2.841
	CG SBc (2 yr.)	2.726
	CG SB (3 yr.)	3.084
	CG SBc (3 yr.)	2.980
	C G SB (3 yr.)	3.696

Table 7. The Soils with Different Cropping Rotations (Continued)

Soil Type	Crop and/or Rotation	Soil Loss (Tons/Acre/Yr)
Weston	Corn	2.574
	Corn (No-Till)	0.327
	SoyBeans	3.406
	Peanuts	3.316
	Grain/SoyBean	0.257
	Peanuts cC	3.128
	Peanuts cCG	3.297
	Peanuts GC	2.762
	Peanuts c SB C	3.514
	Peanuts c SBc Cc	3.297
	CG SB (2 yr.)	2.435
	CG SBc (2 yr.)	2.336
	CG SB (3 yr.)	2.643
	CG SBc (3 yr.)	2.554
	C G SB (3 yr.)	3.168

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Table 8. A Summary of the Soil Loss Estimates for All Soils within the Nansemond/Chuckatuck Basin.

Variable	N	Mean	Standard Deviation	Minimum Value	Maximum Value
C G SB (3 yr.)	37	8.110	12.580	1.320	76.164
Corn	37	6.590	10.222	1.072	61.883
Corn (Notill)	37	0.836	1.2973	0.136	7.8540
CG SB (2 yr.)	37	6.235	9.6713	1.015	58.551
CG SB (3 yr.)	37	6.767	10.497	1.101	63.549
CG SBc (2 yr.)	37	5.981	9.2782	0.973	56.171
CG SBc (3 yr.)	37	6.539	10.143	1.064	61.407
Grain/Soybean	37	0.659	1.0221	0.107	6.1880
Peanuts	37	8.491	13.170	1.382	79.734
Peanuts c SB C	37	8.997	13.956	1.464	84.494
Peanuts c SBc Cc	37	8.440	13.092	1.374	79.258
Peanuts cC	37	8.009	12.423	1.303	75.212
Peanuts cCG	37	8.440	13.092	1.374	79.258
Peanuts GC	37	7.071	10.969	1.151	66.405
Soybeans	37	8.719	13.524	1.419	81.876

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Note: All soil loss estimates are given as Tons/Acre/Year.

Table 9. A Summary of the Soil Loss Estimates for All Agricultural Soils within the Nansemond/Chuckatuck Basin.

Variable	N	Mean	Standard Deviation	Minimum Value	Maximum Value
C G SB (3 yr.)	25	6.552	4.099	2.244	14.868
Corn	25	5.327	3.331	1.823	12.081
Corn (Notill)	25	0.676	0.423	0.231	1.5330
CG SB (2 yr.)	25	5.037	3.151	1.725	11.430
CG SB (3 yr.)	25	5.467	3.420	1.872	12.406
CG SBc (2 yr.)	25	4.832	3.023	1.655	10.966
CG SBc (3 yr.)	25	5.283	3.305	1.809	11.988
Grain/Soybean	25	0.532	0.333	0.182	1.2080
Peanuts	25	6.859	4.291	2.349	15.565
Peanuts c SB C	25	7.269	4.547	2.489	16.495
Peanuts c SBc Cc	25	6.818	4.265	2.335	15.473
Peanuts cC	25	6.470	4.047	2.216	14.683
Peanuts cCG	25	6.818	4.265	2.335	15.473
Peanuts GC	25	5.713	3.574	1.956	12.963
Soybeans	25	7.044	4.407	2.412	15.984

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Note: All Soil loss estimates are given as Tons/Acre/Year.

Table 10. The Soils Acreage of the Nansemond and Chuckatuck Creek Soils.

Soil Type	Acreage (acres)	Percent of Total
Alaga	1,200	0.4
Belhaven	13,400	4.9
Bohicket	5,100	1.9
Deloss	4,260	1.5
Dogue/A	1,700	0.6
Dogue/B	2,300	0.8
Dragston	5,800	2.1
Emporia/A	760	0.3
Emporia/B	1,200	0.4
Eunola/A	34,800	12.6
Eunola/B	3,500	1.3
Goldsboro/A	5,700	2.1
Goldsboro/B	2,800	1.0
Kalmia/A	1,700	0.6
Kalmia/B	1,400	0.5
Kenansville	15,100	5.5
Kenansville	2,100	0.8
Levy	13,400	4.9
Lynchburg	18,300	6.6
Nansemond/B	4,100	1.5
Nansemond/D	4,600	1.7
Nansemond/E	8,700	3.2
Nansemond/A	7,000	2.5
Nansemond/B	1,300	0.5
Pactolus	2,500	0.9
Pungo	13,700	5.0
Rains	36,600	13.3
Rumford/A	340	0.1
Rumford/B	190	0.1
State/A	830	0.3
State/B	670	0.2

Table 10. The Soils Acreages of the Nansemond and Chuckatuck (Continued).

Soil Type	Acreage (acres)	Percent of Total
Suffolk/A	5,300	1.9
Suffolk/B	6,200	2.3
Tetotum/A	3,800	1.4
Tetotum/B	1,100	0.4
Tomotley	9,100	3.3
Torhunta	6,750	2.5
Udorthents	1,500	0.5
Urban	300	0.1
Wahee	1,800	0.7
Weston	6,400	2.3
Water	17,900	6.5
Total	275,200	100.0

Table 11. A Summary of the Soil Loss Estimates for Farm Soils within the Nansemond/Chuckatuck Basin Using a Weighted Method.

Variable	N	Mean
C G SB (3 yr.)	37	6.540
Corn	37	5.314
Corn (Notill)	37	0.674
CG SB (2 yr.)	37	5.021
CG SB (3 yr.)	37	5.457
CG SBc (2 yr.)	37	4.823
CG SBc (3 yr.)	37	5.273
Grain/Soybean	37	0.524
Peanuts	37	6.847
Peanuts c SB C	37	7.256
Peanuts c SBc Cc	37	6.806
Peanuts cC	37	6.458
Peanuts cCG	37	6.806
Peanuts GC	25	5.700
Soybeans	25	7.030

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Note: All Soil loss estimates are given as Tons/Acre/Year.

Table 12. A Summary of the Soil Loss Estimates for All Farm Soils within the Nansemond/Chuckatuck Basin Using a Weighted Method.

Variable	N	Mean
C G SB (3 yr.)	22	2.134
Corn	22	1.978
Corn (Notill)	22	0.251
CG SB (2 yr.)	22	1.864
CG SB (3 yr.)	22	2.031
CG SBc (2 yr.)	22	1.795
CG SBc (3 yr.)	22	1.962
Grain/Soybean	22	0.191
Peanuts	22	2.548
Peanuts c SB C	22	2.700
Peanuts c SBc Cc	22	2.533
Peanuts cC	22	2.403
Peanuts cCG	22	2.533
Peanuts GC	25	2.122
Soybeans	25	2.617

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Note: All Soil loss estimates are given as Tons/Acre/Year.

Table 13. The Results of Using the Fourth Method.
Using the fourth method to evaluate cropping BMPs for the Nansemond/Chuckatuck watershed.

Shed No.	Cover Crop	N	Field area	Over-land flow length	Soil loss	Phos-phate	Nitro-gen	Total area
46	Corn	57	7.50	269.82	7.34	0.06	0.97	427.60
46	Corn (No-till)	57	7.50	269.82	0.93	0.01	0.30	427.60
46	CG SB (3 yr.)	57	7.50	269.82	7.54	0.06	0.99	427.60
46	CG SBc (2 yr.)	57	7.50	269.82	6.66	0.05	0.90	427.60
46	CG SBc (3 yr.)	57	7.50	269.82	7.28	0.06	0.97	427.60
46	Grain/Soybeans	23	9.31	282.39	0.90	0.00	0.14	214.20
46	Peanuts	15	4.79	209.00	7.01	0.01	0.35	71.89
46	Peanuts c SB C	15	4.79	209.00	7.01	0.01	0.35	71.89
46	Peanuts c SBc Cc	15	4.79	209.00	6.57	0.01	0.33	71.89
46	Peanuts cC	15	4.79	209.00	6.24	0.01	0.32	71.89
46	Peanuts cCG	15	4.79	209.00	6.57	0.01	0.33	71.89
46	Peanuts GC	15	4.79	209.00	5.50	0.01	0.29	71.89
46	Soybeans	56	6.21	257.50	9.67	0.03	0.53	347.71
47	Grain/Soybeans	38	6.40	388.55	0.76	0.01	0.16	243.30
47	Soybeans	50	3.92	210.50	7.77	0.03	0.45	196.10
48	Corn	8	7.04	435.00	9.90	0.08	1.14	56.30
48	Corn (No-till)	8	7.04	435.00	1.25	0.01	0.30	56.30
48	CG SB (2 yr.)	8	7.04	435.00	9.37	0.08	1.09	56.30
48	CG SB (3 yr.)	8	7.04	435.00	10.17	0.09	1.16	56.30
48	CG SBc (2 yr.)	8	7.04	435.00	8.99	0.08	1.05	56.30
48	CG SBc (3 yr.)	8	7.04	435.00	9.83	0.08	1.13	56.30
48	Grain/Soybeans	20	6.65	205.00	0.56	0.00	0.14	132.90
48	Peanuts	13	9.74	483.46	12.76	0.01	0.47	126.60
48	Peanuts c SB C	13	9.74	483.46	12.76	0.01	0.47	126.60
48	Peanuts c SBc Cc	13	9.74	483.46	11.97	0.01	0.45	126.60
48	Peanuts cC	13	9.74	483.46	11.35	0.01	0.43	126.60
48	Peanuts cCG	13	9.74	483.46	11.97	0.01	0.45	126.60
48	Peanuts GC	13	9.74	483.46	10.02	0.01	0.38	126.60
48	Soybeans	21	6.96	243.81	7.70	0.02	0.38	146.20
49	Corn	26	7.81	246.73	15.32	0.10	1.50	202.97
49	Corn (No-till)	26	7.81	246.73	1.94	0.01	0.37	202.97
49	CG SB (2 yr.)	26	7.81	246.73	14.49	0.09	1.43	202.97
49	CG SB (3 yr.)	26	7.81	246.73	15.73	0.10	1.53	202.97
49	CG SBc (2 yr.)	26	7.81	246.73	13.90	0.09	1.38	202.97
49	CG SBc (3 yr.)	26	7.81	246.73	15.20	0.10	1.49	202.97
49	Peanuts	23	6.43	294.13	8.30	0.02	0.37	147.80
49	Peanuts c SB C	23	6.43	294.13	8.30	0.02	0.37	147.80
49	Peanuts c SBc Cc	23	6.43	294.13	7.78	0.02	0.35	147.80

Note: Area is in Acres. Overland flow length is in feet. Soil loss is in Tons/Acre/Year. Phosphate is in Pounds/Acre/Year. Nitrogen is in Pounds/Acre/Event.

Table 13. The Results of Using the Fourth Method (Continued).

Shed No.	Cover Crop	N	Field area	Overland flow length	Soil loss	Phosphate	Nitrogen	Total area
49	Peanuts cC	23	6.43	294.13	7.39	0.02	0.34	147.80
49	Peanuts cCG	23	6.43	294.13	7.78	0.02	0.35	147.80
49	Peanuts GC	23	6.42	294.13	6.52	0.02	0.31	147.8
49	Soybeans	9	2.73	98.33	5.15	0.23	0.58	24.6
50	Corn	25	8.92	341.60	10.96	0.08	0.00	223.2
50	Corn (No-till)	25	8.92	341.60	1.39	0.01	0.25	223.2
50	CG SB (2 yr.)	25	8.92	341.60	10.37	0.08	0.95	223.2
50	CG SB (3 yr.)	25	8.92	341.60	11.26	0.09	1.02	223.2
50	CG SBc (2 yr.)	25	8.92	341.60	9.95	0.08	0.92	223.2
50	CG SBc (3 yr.)	25	8.92	341.60	10.88	0.08	0.99	223.2
50	Grain/Soybeans	4	9.60	310.00	0.66	0.00	0.10	38.4
50	Peanuts	19	14.97	573.68	15.79	0.03	0.73	284.5
50	Peanuts c SB C	19	14.97	573.68	15.79	0.03	0.73	284.5
50	Peanuts c SBc Cc	19	14.97	573.68	14.81	0.03	0.69	284.5
50	Peanuts cC	19	14.97	573.68	14.06	0.03	0.66	284.5
50	Peanuts cCG	19	14.97	573.68	14.81	0.03	0.69	284.5
50	Peanuts GC	19	14.97	573.68	12.41	0.03	0.59	284.5
50	Soybeans	3	2.46	165.00	16.87	0.13	0.64	7.4
50	Peanuts	1	17.50	500.00	10.96	0.02	0.30	17.5
50	Peanuts c SB C	1	17.50	500.00	10.96	0.02	0.30	17.5
50	Peanuts c SBc Cc	1	17.50	500.00	10.28	0.02	0.29	17.5
50	Peanuts cC	1	17.50	500.00	9.76	0.02	0.28	17.5
50	Peanuts cCG	1	17.50	500.00	10.28	0.02	0.29	17.5
50	Peanuts GC	1	17.50	500.00	8.61	0.02	0.25	17.5
50	Soybeans	1	0.40	50.00	17.97	0.23	0.59	0.4
51	Corn	5	4.42	365.00	17.88	0.71	2.19	22.1
51	Corn (No-till)	5	4.42	365.00	2.27	0.09	0.49	22.1
51	CG SB (2 yr.)	5	4.42	365.00	16.92	0.67	2.09	22.1
51	CG SB (3 yr.)	5	4.42	365.00	18.37	0.73	2.24	22.1
51	CG SBc (2 yr.)	5	4.42	365.00	16.23	0.64	2.01	22.1
51	CG SBc (3 yr.)	5	4.42	365.00	17.75	0.70	2.18	22.1
51	Grain/Soybeans	7	4.60	355.00	2.19	0.03	0.24	32.2
51	Soybeans	12	3.23	261.25	7.11	0.17	0.63	38.8
52	Corn	6	13.95	333.33	7.13	0.04	0.74	83.7
52	Corn (No-till)	6	13.95	333.33	0.90	0.01	0.23	83.7
52	CG SB (2 yr.)	6	13.95	333.33	6.75	0.04	0.71	83.7
52	CG SB (3 yr.)	6	13.95	333.33	7.32	0.05	0.76	83.7
52	CG SBc (2 yr.)	6	13.95	333.33	6.47	0.04	0.69	83.7
52	CG SBc (3 yr.)	6	13.95	333.33	7.07	0.04	0.74	83.7
52	Grain/Soybeans	9	13.23	88.88	0.67	0.01	0.15	119.1

Note: Area is in Acres. Overland flow length is in feet. Soil loss is in Tons/Acre/Year. Phosphate is in Pounds/Acre/Year. Nitrogen is in Pounds/Acre/Event.

Table 13. The Results of Using the Fourth Method (Continued).

Shed No.	Cover Crop	N	Field area	Over-land flow length	Soil loss	Phos-phate	Nitro-gen	Total area
52	Peanuts	4	9.12	202.50	7.95	0.01	0.29	36.5
52	Peanuts c SB C	4	9.12	202.50	7.95	0.01	0.29	36.5
52	Peanuts c SBc Cc	4	9.12	202.50	7.46	0.00	0.27	36.5
52	Peanuts cC	4	9.12	202.50	7.08	0.00	0.26	36.5
52	Peanuts cCG	4	9.12	202.50	7.46	0.00	0.27	36.5
52	Peanuts GC	4	9.12	202.50	6.25	0.00	0.24	36.5
52	Soybeans	2	17.20	275.00	7.76	0.00	0.34	34.4
52	Corn	10	5.67	77.50	3.90	0.13	0.75	56.7
52	Corn (No-till)	10	5.67	77.50	0.49	0.02	0.26	56.7
52	CG SB (2 yr.)	10	5.67	77.50	3.69	0.12	0.72	56.7
52	CG SB (3 yr.)	10	5.67	77.50	4.00	0.13	0.77	56.70
52	CG SBc (2 yr.)	10	5.67	77.50	3.54	0.11	0.70	56.70
52	CG SBc (3 yr.)	10	5.67	77.50	3.87	0.13	0.75	56.70
52	Grain/Soybeans	5	8.36	110.00	0.54	0.01	0.14	41.80
52	Peanuts	5	9.94	185.00	8.25	0.03	0.39	49.70
52	Peanuts c SB C	5	9.94	185.00	8.25	0.03	0.39	49.70
52	Peanuts c SBc Cc	5	9.94	185.00	7.73	0.02	0.37	49.70
52	Peanuts cC	5	9.94	185.00	7.34	0.02	0.35	49.70
52	Peanuts cCG	5	9.94	185.00	7.73	0.02	0.37	49.70
52	Peanuts GC	5	9.94	185.00	6.48	0.02	0.32	49.70
52	Soybeans	2	11.20	200.00	7.56	0.08	0.46	22.40
53	Corn	14	2.75	158.92	8.80	0.09	0.93	38.50
53	Corn (No-till)	14	2.75	158.92	1.11	0.01	0.27	38.50
53	CG SB (2 yr.)	14	2.75	158.92	8.33	0.09	0.89	38.50
53	CG SB (3 yr.)	14	2.75	158.92	9.04	0.09	0.96	38.50
53	CG SBc (2 yr.)	14	2.75	158.92	7.99	0.08	0.86	38.50
53	CG SBc (3 yr.)	14	2.75	158.92	8.73	0.09	0.93	38.50
53	Grain/Soybeans	4	12.22	228.75	0.55	0.01	0.14	48.90
53	Peanuts	9	8.62	257.22	8.51	0.01	0.33	77.60
53	Peanuts c SB C	9	8.62	257.22	8.51	0.01	0.33	77.60
53	Peanuts c SBc Cc	9	8.62	257.22	7.98	0.01	0.31	77.60
53	Peanuts cC	9	8.62	257.22	7.57	0.01	0.30	77.60
53	Peanuts cCG	9	8.62	257.22	7.98	0.01	0.31	77.60
53	Peanuts GC	9	8.62	257.22	6.68	0.01	0.27	77.60
53	Soybeans	30	5.25	243.16	11.04	0.07	0.52	157.68
54	Corn	61	6.88	290.73	8.02	0.11	0.95	420.09
54	Corn (No-till)	61	6.88	290.73	1.01	0.01	0.27	420.09
54	CG SB (2 yr.)	61	6.88	290.73	7.58	0.10	0.90	420.09
54	CG SB (3 yr.)	61	6.88	290.73	8.23	0.11	0.97	420.09
54	CG SBc (2 yr.)	61	6.88	290.73	7.28	0.10	0.87	420.09

Note: Area is in Acres. Overland flow length is in feet. Soil loss is in Tons/Acre/Year. Phosphate is in Pounds/Acre/Year. Nitrogen is in Pounds/Acre/Event.

Table 13. The Results of Using the Fourth Method (Continued).

Shed No.	Cover Crop	N	Field area	Over-land flow length	Soil loss	Phos-phate	Nitro-gen	Total area
54	CG SBc (3 yr.)	61	6.88	290.73	7.95	0.11	0.94	420.09
54	Grain/Soybeans	5	5.34	330.00	0.73	0.00	0.13	26.73
54	Peanuts	43	6.11	301.74	11.47	0.27	0.61	263.12
54	Peanuts c SB C	43	6.11	301.74	11.47	0.27	0.61	263.12
54	Peanuts c SBc Cc	43	6.11	301.74	10.76	0.25	0.57	263.12
54	Peanuts cC	43	6.11	301.74	10.21	0.24	0.55	263.12
54	Peanuts cCG	43	6.11	301.74	10.76	0.25	0.57	263.12
54	Peanuts GC	43	6.11	301.74	9.02	0.21	0.49	263.12
54	Soybeans	54	4.81	267.03	11.36	0.06	0.51	259.79
58	Corn	22	8.36	225.22	12.53	0.30	1.36	184.00
58	Corn (No-till)	22	8.36	225.22	1.59	0.04	0.33	184.00
58	CG SB (2 yr.)	22	8.36	225.22	11.86	0.28	1.29	184.00
58	CG SB (3 yr.)	22	8.36	225.22	12.87	0.30	1.39	184.00
58	CG SBc (2 yr.)	22	8.36	225.22	11.38	0.27	1.25	184.00
58	CG SBc (3 yr.)	22	8.36	225.22	12.44	0.29	1.35	184.00
58	Grain/Soybeans	4	13.90	660.00	1.50	0.01	0.15	55.60
58	Peanuts	13	13.03	394.23	12.65	0.03	0.41	169.50
58	Peanuts c SB C	13	13.03	394.23	12.65	0.03	0.41	169.50
58	Peanuts c SBc Cc	13	13.03	394.23	11.87	0.03	0.39	169.5
58	Peanuts cC	13	13.03	394.23	11.26	0.02	0.37	169.5
58	Peanuts cCG	13	13.03	394.23	11.87	0.03	0.39	169.5
58	Peanuts GC	13	13.03	394.23	9.94	0.02	0.33	169.5
58	Soybeans	1	8.70	330.00	9.12	0.01	0.40	8.7

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Note: Area is in Acres. Overland flow length is in feet. Soil loss is in Tons/Acre/Year. Phosphate is in Pounds/Acre/Year. Nitrogen is in Pounds/Acre/Event.

Table 14. A Summary of the Results of Using the Fourth Method. Using the fourth method to evaluate cropping BMPs for the Nansemond/Chuckatuck watershed.

Cover Crop	N	Field area	Overland flow length	Soil loss
Corn	237	7.32	268.59	9.46
Corn (No-till)	237	7.32	268.59	1.20
CG SB (2 yr.)	237	7.32	268.59	8.95
CG SB (3 yr.)	237	7.32	268.59	9.76
CG SBc (2 yr.)	237	7.32	268.59	8.59
CG SBc (3 yr.)	237	7.32	268.59	9.39
Grain/Soybeans	119	8.01	299.50	0.84
Peanuts	145	8.58	343.00	10.90
Peanuts c SB C	145	8.58	343.00	10.90
Peanuts c SBc Cc	145	8.58	343.00	10.23
Peanuts cC	145	8.58	343.00	9.70
Peanuts cCG	145	8.58	343.00	10.23
Peanuts GC	145	8.58	343.00	8.57
Soybeans	242	5.17	238.23	9.47

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Note: All Soil loss estimates are given as Tons/Acre/Year. Overland flow length is in feet. Soil loss is in Tons/Acre/Year.

Table 15. Table of the Soil Physical Properties of the City of Suffolk Soils

Soil Name	Clay Content	Density	Permeability	Pore Space	PH	Erodibility	Organic Matter
Alaga	0.070	1.40	6.00	0.07	5.25	0.17	0.0075
Belhaven	0.225	0.72	3.10	0.24	4.50	0.50	0.5000
Bohicket	0.450	1.50	0.13	0.16	7.25	0.32	0.0100
Deloss	0.125	1.35	4.00	0.11	4.25	0.28	0.0075
Doque/A	0.075	1.42	4.00	0.11	4.25	0.28	0.0075
Doque/B	0.075	1.42	4.00	0.11	4.55	0.28	0.0075
Dragston	0.080	1.35	4.00	0.06	5.00	0.17	0.0075
Emporia/A	0.125	1.35	4.00	0.13	5.00	0.28	0.0150
Emporia/B	0.125	1.35	4.00	0.13	5.00	0.28	0.0150
Eunola/A	0.070	1.32	4.00	0.85	5.00	0.28	0.0125
Eunola/B	0.070	1.32	4.00	0.85	5.00	0.28	0.0125
Goldsboro/A	0.100	1.50	4.00	0.10	5.25	0.20	0.0225
Goldsboro/B	0.100	1.50	4.00	0.10	5.25	0.20	0.0225
Kalmia/A	0.080	1.67	4.00	0.08	5.25	0.20	0.0125
Kalmia/B	0.080	1.67	4.00	0.08	5.25	0.20	0.0125
Kenansville	0.065	1.60	13.00	0.07	5.25	0.15	0.0125
Kenansville	0.065	1.60	13.00	0.07	5.25	0.15	0.0125
Levy	0.435	1.30	0.13	0.14	4.55	0.32	?
Lynchburg	0.125	1.45	4.00	0.11	4.55	0.20	0.0225
Nansemond/A	0.105	1.35	4.00	0.10	5.00	0.20	0.0150
Nansemond/B	0.105	1.35	4.00	0.10	5.00	0.20	0.0150
Nansemond/C	0.080	1.32	11.0	0.07	5.00	0.15	0.0075
Nansemond/D	0.080	1.32	11.0	0.07	5.00	0.15	0.0075
Nansemond/E	0.080	1.32	11.0	0.07	5.00	0.15	0.0075
Pactolus	0.060	?	13.00	0.07	5.25	0.10	?
Pungo	0.375	0.475	3.10	0.23	4.50	?	0.6500
Rains	0.125	1.45	4.00	0.10	5.50	0.17	0.0350
Rumford/A	0.070	1.35	6.00	0.08	4.55	0.24	0.0075
Rumford/B	0.070	1.35	6.00	0.08	4.55	0.24	0.0075
State/A	0.100	1.32	3.30	0.15	5.00	0.28	0.0200
State/B	0.100	1.32	3.30	0.15	5.00	0.28	0.0200
Suffolk/A	0.070	1.45	11.00	0.08	4.55	0.24	0.0075
Suffolk/B	0.070	1.45	11.00	0.08	4.55	0.24	0.0075
Tetotum/A	0.100	1.30	4.00	0.11	4.55	0.32	0.0125
Tetotum/B	0.100	1.30	4.00	0.11	4.55	0.32	0.0125
Tomotley	0.160	1.30	4.00	0.16	4.55	0.20	0.0350
Torhunta	0.100	1.40	4.00	0.12	4.55	0.15	?
Wahee	0.135	1.35	1.10	0.17	5.00	0.28	0.0275
Weston	0.100	1.40	1.30	0.12	5.25	0.24	0.0200

Table 16. A Summary of the Macro-Nutrient Results. Using the fourth method to evaluate cropping BMPs for the Nansemond/Chuckatuck watershed.

Cover Crop	Phosphate	Nitrogen	Total acres
Corn	0.12	1.07	1735.26
Corn (No-till)	0.01	0.30	1735.26
CG SB (2 yr.)	0.11	1.03	1735.26
CG SB (3 yr.)	0.12	1.10	1735.26
CG SBc (2 yr.)	0.11	0.99	1735.26
CG SBc (3 yr.)	0.12	1.07	1735.26
Grain/Soybeans	0.01	0.15	953.13
Peanuts	0.09	0.50	1244.71
Peanuts c SB C	0.09	0.50	1244.71
Peanuts c SBc Cc	0.09	0.47	1244.71
Peanuts cC	0.08	0.45	1244.71
Peanuts cCG	0.09	0.47	1244.71
Peanuts GC	0.07	0.40	1244.71
Soybeans	0.06	0.50	1251.48

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Note: Overland flow is in feet. Soil loss is in Tons/Acre/Year. Phosphate is in Pounds/Acre/Year. Nitrogen is in Pounds/Acre/Event.

Table 17. X Values for Grass Filter Strips

X Range	Percent Reduction
0 to 5	0.01
5+ to 100	0.10
100+ to 200	0.20
200+ to 300	0.30
300+ to 500	0.40
500+ to 800	0.50
800+ to 1000	0.60
1000+ to 2000	0.80
2000+ to 3000	0.90
3000+ to 4000	0.95
4000+	0.99

Table 18. The Results of Using the Fourth Method with Grass Filter Strips. Evaluation of cropping BMPs for the Nansemond/Chuckatuck watershed and using grass filter strips on fields with an overland flow greater than or equal to 300 feet and a slope greater than or equal to 2 percent.

Shed No.	Cover Crop	N	Field area	Overland flow length	Soil loss	Phosphate	Nitrogen	Total area
46	Corn	57	7.50	269.82	6.49	0.05	0.88	427.60
46	Corn (No-till)	57	7.50	269.82	0.82	0.01	0.29	427.60
46	CG SB (2 yr.)	57	7.50	269.82	6.14	0.05	0.84	427.60
46	CG SB (3 yr.)	57	7.50	269.82	6.67	0.05	0.90	427.60
46	CG SBc (2 yr.)	57	7.50	269.82	5.89	0.04	0.82	427.60
46	CG SBc (3 yr.)	57	7.50	269.82	6.44	0.05	0.88	427.60
46	Grain/Soybeans	23	9.31	282.39	0.69	0.00	0.13	214.20
46	Peanuts	15	4.79	209.00	7.01	0.01	0.35	71.89
46	Peanuts c SB C	15	4.79	209.00	7.01	0.01	0.35	71.89
46	Peanuts c SBc Cc	15	4.79	209.00	6.58	0.01	0.33	71.89
46	Peanuts cC	15	4.79	209.00	6.24	0.01	0.32	71.89
46	Peanuts cCG	15	4.79	209.00	6.58	0.01	0.33	71.89
46	Peanuts GC	15	4.79	209.00	5.51	0.01	0.29	71.89
46	Soybeans	56	6.21	257.50	8.12	0.03	0.46	347.71
47	Grain/Soybeans	38	6.40	388.55	0.65	0.00	0.15	243.30
47	Soybeans	50	3.92	210.50	7.66	0.03	0.44	196.10
48	Corn	8	7.04	435.00	6.87	0.08	0.88	56.30
48	Corn (No-till)	8	7.04	435.00	0.87	0.01	0.27	56.30
48	CG SB (2 yr.)	8	7.04	435.00	6.50	0.07	0.84	56.30
48	CG SB (3 yr.)	8	7.04	435.00	7.05	0.08	0.90	56.30
48	CG SBc (2 yr.)	8	7.04	435.00	6.23	0.07	0.81	56.30
48	CG SBc (3 yr.)	8	7.04	435.00	6.81	0.08	0.87	56.30
48	Grain/Soybeans	20	6.65	205.00	0.56	0.00	0.14	132.90
48	Peanuts	13	9.74	483.46	7.29	0.01	0.29	126.60
48	Peanuts c SB C	13	9.74	483.46	7.29	0.01	0.29	126.60
48	Peanuts c SBc Cc	13	9.74	483.46	6.84	0.01	0.28	126.60
48	Peanuts cC	13	9.74	483.46	6.49	0.01	0.27	126.60
48	Peanuts cCG	13	9.74	483.46	6.84	0.01	0.28	126.60
48	Peanuts GC	13	9.74	483.46	5.73	0.00	0.24	126.60
48	Soybeans	21	6.96	243.81	7.60	0.02	0.38	146.20
49	Corn	26	7.81	246.73	9.51	0.08	1.13	202.97
49	Corn (No-till)	26	7.81	246.73	1.21	0.01	0.32	202.97
49	CG SB (2 yr.)	26	7.81	246.73	9.00	0.08	1.08	202.97
49	CG SB (3 yr.)	26	7.81	246.73	9.77	0.08	1.15	202.97
49	CG SBc (2 yr.)	26	7.81	246.73	8.64	0.07	1.04	202.97
49	CG SBc (3 yr.)	26	7.81	246.73	9.44	0.08	1.12	202.97
49	Peanuts	23	6.43	294.13	7.61	0.02	0.35	147.80

Note: All areas are in acres. Overland flow length is in feet. Soil loss is in Tons/Acre/Year. Phosphate is in Pounds/Acre/Year. Nitrogen is in Pounds/Acre/Event. An event is a 3 inch, 3 hour storm.

Table 18. The Results of Using the Fourth Method (Continued).

Shed No.	Cover Crop	N	Field area	Over-land flow length	Soil loss	Phos-phate	Nitro-gen	Total area
49	Peanuts c SB C	23	6.43	294.13	7.61	0.02	0.35	147.80
49	Peanuts c SBc Cc	23	6.43	294.13	7.13	0.02	0.33	147.80
49	Peanuts cC	23	6.43	294.13	6.77	0.02	0.32	147.80
49	Peanuts cCG	23	6.43	294.13	7.13	0.02	0.33	147.80
49	Peanuts GC	23	6.42	294.13	5.97	0.02	0.29	147.80
49	Soybeans	9	2.73	98.33	5.15	0.23	0.58	24.60
50	Corn	25	8.92	341.60	7.54	0.06	0.75	223.20
50	Corn (No-till)	25	8.92	341.60	0.95	0.01	0.22	223.20
50	CG SB (2 yr.)	25	8.92	341.60	7.13	0.06	0.71	223.20
50	CG SB (3 yr.)	25	8.92	341.60	7.74	0.06	0.76	223.20
50	CG SBc (2 yr.)	25	8.92	341.60	6.84	0.05	0.69	223.20
50	CG SBc (3 yr.)	25	8.92	341.60	7.48	0.06	0.74	223.20
50	Grain/Soybeans	4	9.60	310.00	0.42	0.00	0.09	38.40
50	Peanuts	19	14.97	573.68	10.91	0.02	0.50	284.50
50	Peanuts c SB C	19	14.97	573.68	10.91	0.02	0.50	284.50
50	Peanuts c SBc Cc	19	14.97	573.68	10.23	0.02	0.47	284.50
50	Peanuts cC	19	14.97	573.68	9.71	0.02	0.45	284.50
50	Peanuts cCG	19	14.97	573.68	10.23	0.02	0.47	284.50
50	Peanuts GC	19	14.97	573.68	8.57	0.02	0.40	284.50
50	Soybeans	3	2.46	165.00	16.87	0.13	0.64	7.40
50	Peanuts	1	17.50	500.00	10.96	0.02	0.30	17.50
50	Peanuts c SB C	1	17.50	500.00	10.96	0.02	0.30	17.50
50	Peanuts c SBc Cc	1	17.50	500.00	10.28	0.02	0.29	17.50
50	Peanuts cC	1	17.50	500.00	9.76	0.02	0.28	17.50
50	Peanuts cCG	1	17.50	500.00	10.28	0.02	0.29	17.50
50	Peanuts GC	1	17.50	500.00	8.61	0.02	0.25	17.50
50	Soybeans	1	0.40	50.00	17.97	0.23	0.59	0.40
51	Corn	5	4.42	365.00	4.92	0.31	1.06	22.10
51	Corn (No-till)	5	4.42	365.00	0.62	0.04	0.35	22.10
51	CG SB (2 yr.)	5	4.42	365.00	4.65	0.30	1.02	22.10
51	CG SB (3 yr.)	5	4.42	365.00	5.05	0.32	1.08	22.10
51	CG SBc (2 yr.)	5	4.42	365.00	4.46	0.28	0.98	22.10
51	CG SBc (3 yr.)	5	4.42	365.00	4.88	0.31	1.05	22.10
51	Grain/Soybeans	7	4.60	355.	0.78	0.02	0.17	32.20
51	Soybeans	12	3.23	261.25	7.11	0.17	0.63	38.80
52	Corn	6	13.95	333.33	6.28	0.04	0.67	83.70
52	Corn (No-till)	6	13.95	333.33	0.79	0.01	0.22	83.70

Note: All areas are in acres. Overland flow length is in feet. Soil loss is in Tons/Acre/Year. Phosphate is in Pounds/Acre/Year. Nitrogen is in Pounds/Acre/Event. An event is a 3 inch, 3 hour storm.

Table 18. The Results of Using the Fourth Method (Continued).

Shed No.	Cover Crop	N	Field area	Over-land flow length	Soil loss	Phos-phate	Nitro-gen	Total area
52	CG SB (2 yr.)	6	13.95	333.33	5.94	0.04	0.64	83.70
52	CG SB (3 yr.)	6	13.95	333.33	6.45	0.04	0.68	83.70
52	CG SBc (2 yr.)	6	13.95	333.33	5.70	0.04	0.62	83.70
52	CG SBc (3 yr.)	6	13.95	333.33	6.23	0.04	0.66	83.70
52	Grain/Soybeans	9	13.23	88.88	0.67	0.01	0.15	119.10
52	Peanuts	4	9.12	202.50	6.35	0.00	0.24	36.50
52	Peanuts c SB C	4	9.12	202.50	6.35	0.00	0.24	36.50
52	Peanuts c SBc Cc	4	9.12	202.50	5.96	0.00	0.22	36.50
52	Peanuts cC	4	9.12	202.50	5.65	0.00	0.21	36.50
52	Peanuts cCG	4	9.12	202.50	5.96	0.00	0.22	36.50
52	Peanuts GC	4	9.12	202.50	4.99	0.00	0.19	36.50
52	Soybeans	2	17.20	275.00	6.72	0.00	0.30	34.40
52	Corn	10	5.67	77.50	3.90	0.13	0.75	56.70
52	Corn (No-till)	10	5.67	77.50	0.49	0.02	0.26	56.70
52	CG SB (2 yr.)	10	5.67	77.50	3.69	0.12	0.72	56.70
52	CG SB (3 yr.)	10	5.67	77.50	4.00	0.13	0.77	56.70
52	CG SBc (2 yr.)	10	5.67	77.50	3.54	0.11	0.70	56.70
52	CG SBc (3 yr.)	10	5.67	77.50	3.87	0.13	0.75	56.70
52	Grain/Soybeans	5	8.36	110.00	0.54	0.01	0.14	41.80
52	Peanuts	5	9.94	185.00	8.25	0.03	0.39	49.70
52	Peanuts c SB C	5	9.94	185.00	8.25	0.03	0.39	49.70
52	Peanuts c SBc Cc	5	9.94	185.00	7.73	0.02	0.37	49.70
52	Peanuts cC	5	9.94	185.00	7.34	0.02	0.35	49.70
52	Peanuts cCG	5	9.94	185.00	7.73	0.02	0.37	49.70
52	Peanuts GC	5	9.94	185.00	6.48	0.02	0.32	49.70
52	Soybeans	2	11.20	200.00	7.56	0.08	0.46	22.40
53	Corn	14	2.75	158.92	8.80	0.09	0.93	38.50
53	Corn (No-till)	14	2.75	158.92	1.11	0.01	0.27	38.50
53	CG SB (2 yr.)	14	2.75	158.92	8.33	0.09	0.89	38.50
53	CG SB (3 yr.)	14	2.75	158.92	9.04	0.09	0.96	38.50
53	CG SBc (2 yr.)	14	2.75	158.92	7.99	0.08	0.86	38.50
53	CG SBc (3 yr.)	14	2.75	158.92	8.73	0.09	0.93	38.50
53	Grain/Soybeans	4	12.22	228.75	0.55	0.01	0.14	48.90
53	Peanuts	9	8.62	257.22	8.51	0.01	0.33	77.60
53	Peanuts c SB C	9	8.62	257.22	8.51	0.01	0.33	77.60
53	Peanuts c SBc Cc	9	8.62	257.22	7.98	0.01	0.31	77.60
53	Peanuts cC	9	8.62	257.22	7.57	0.01	0.30	77.60
53	Peanuts cCG	9	8.62	257.22	7.98	0.01	0.31	77.60
53	Peanuts GC	9	8.62	257.22	6.68	0.01	0.27	77.60
53	Soybeans	30	5.25	243.16	11.04	0.07	0.52	157.68

Note: All areas are in acres. Overland flow length is in feet. Soil loss is in Tons/Acre/Year. Phosphate is in Pounds/Acre/Year. Nitrogen is in Pounds/Acre/Event. An event is a 3 inch, 3 hour storm.

Table 18. The Results of Using the Fourth Method (Continued).

Shed No.	Cover Crop	N	Field area	Over-land flow length	Soil loss	Phos-phate	Nitro-gen	Total area
54	Corn	61	6.88	290.73	6.88	0.09	0.87	420.09
54	Corn (No-till)	61	6.88	290.73	0.87	0.01	0.26	420.09
54	CG SB (2 yr.)	61	6.88	290.73	6.51	0.09	0.83	420.09
54	CG SB (3 yr.)	61	6.88	290.73	7.07	0.09	0.89	420.09
54	CG SBc (2 yr.)	61	6.88	290.73	6.25	0.08	0.81	420.09
54	CG SBc (3 yr.)	61	6.88	290.73	6.83	0.09	0.87	420.09
54	Grain/Soybeans	5	5.34	330.00	0.73	0.00	0.13	26.73
54	Peanuts	43	6.11	301.74	10.32	0.27	0.57	263.12
54	Peanuts c SB C	43	6.11	301.74	10.32	0.27	0.57	263.12
54	Peanuts c SBc Cc	43	6.11	301.74	9.68	0.25	0.54	263.12
54	Peanuts cC	43	6.11	301.74	9.19	0.24	0.51	263.12
54	Peanuts cCG	43	6.11	301.74	9.68	0.25	0.54	263.12
54	Peanuts GC	43	6.11	301.74	8.11	0.21	0.46	263.12
54	Soybeans	54	4.81	267.03	10.20	0.05	0.48	259.79
58	Corn	22	8.36	225.22	9.50	0.20	1.09	184.00
58	Corn (No-till)	22	8.36	225.22	1.20	0.03	0.30	184.00
58	CG SB (2 yr.)	22	8.36	225.22	8.99	0.19	1.04	184.00
58	CG SB (3 yr.)	22	8.36	225.22	9.76	0.21	1.12	184.00
58	CG SBc (2 yr.)	22	8.36	225.22	8.63	0.18	1.01	184.00
58	CG SBc (3 yr.)	22	8.36	225.22	9.43	0.20	1.09	184.00
58	Grain/Soybeans	4	13.90	660.00	1.01	0.01	0.13	55.60
58	Peanuts	13	13.03	394.23	8.36	0.02	0.29	169.50
58	Peanuts c SB C	13	13.03	394.23	8.36	0.02	0.29	169.50
58	Peanuts c SBc Cc	13	13.03	394.23	7.85	0.02	0.28	169.5
58	Peanuts cC	13	13.03	394.23	7.45	0.02	0.27	169.5
58	Peanuts cCG	13	13.03	394.23	7.85	0.02	0.28	169.5
58	Peanuts GC	13	13.03	394.23	6.58	0.02	0.24	169.5
58	Soybeans	1	8.70	330.00	3.65	0.00	0.18	8.70

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Note: All areas are in acres. Overland flow length is in feet. Soil loss is in Tons/Acre/Year. Phosphate is in Pounds/Acre/Year. Nitrogen is in Pounds/Acre/Event. An event is a 3 inch, 3 hour storm.

Table 19. A Summary of the Results of Using the Fourth Method with Grass Filter Strips.

Using the fourth method to evaluate cropping BMPs for the Nansemond/Chuckatuck watershed and using grass filter strips on fields with an overland flow greater than or equal to 300 feet and a slope greater than or equal to 2 percent.

Cover Crop	N	Field acre	Overland flow	Soil loss
Corn	237	7.32	268.59	7.29
Corn (No-till)	237	7.32	268.59	0.92
CG SB (2 yr.)	237	7.32	268.59	6.89
CG SB (3 yr.)	237	7.32	268.59	7.48
CG SBc (2 yr.)	237	7.32	268.59	6.61
CG SBc (3 yr.)	237	7.32	268.59	7.23
Grain/Soybeans	119	8.01	299.50	0.65
Peanuts	145	8.58	343.00	8.89
Peanuts c SB C	145	8.58	343.00	8.89
Peanuts c SBc Cc	145	8.58	343.00	8.34
Peanuts cC	145	8.58	343.00	7.91
Peanuts cCG	145	8.58	343.00	8.34
Peanuts GC	145	8.58	343.00	6.99
Soybeans	242	5.17	238.22	8.75

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Note: Overland flow is in feet. Soil loss is in Tons/Acre/Year.

Table 20. A Summary of the Macro Nutrient Results Using Fourth Method with Grass Filter Strips.

Using the fourth method to evaluate cropping BMPs for the Nansemond/Chuckatuck watershed and using grass filter strips on fields with an overland flow greater than or equal to 300 feet and a slope greater than or equal to 2 percent.

Cover Crop	Phosphate	Nitrogen	Total acres
Corn	0.09	0.91	1735.26
Corn (No-till)	0.01	0.27	1735.26
CG SB (2 yr.)	0.09	0.87	1735.26
CG SB (3 yr.)	0.09	0.93	1735.26
CG SBc (2 yr.)	0.09	0.84	1735.26
CG SBc (3 yr.)	0.09	0.90	1735.26
Grain/Soybeans	0.00	0.14	953.13
Peanuts	0.09	0.42	1244.71
Peanuts c SB C	0.09	0.42	1244.71
Peanuts c SBc Cc	0.09	0.40	1244.71
Peanuts cC	0.08	0.38	1244.71
Peanuts cCG	0.07	0.40	1244.71
Peanuts GC	0.07	0.34	1244.71
Soybeans	0.05	0.47	1251.48

Abbreviation	Crop
C	Corn
c	Cover crop
G	Small grain
SB	Soybean

Note: Overland flow is in feet. Soil loss is in Tons/Acre/Year. Phosphate is in Pounds/Acre/Year. Nitrogen is in Pounds/Acre/Event. An event is a 3 inch, 3 hour storm.

Table 21. The Results of Duncan's Multiple Range Test.
The mean field acerage for each cover crop ($\alpha = 0.05$, *d.f.* = 739, MSE = 59.9924).

Note: Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Cover
A	8.5842	145	Peanuts
A			
A	8.0095	119	Grain/Soybeans
A			
A	7.3218	237	Corn
B	5.1714	242	Soybeans

Table 22. The Results of Duncan's Multiple Range Test for Overland Flow. The mean overland flow for each cover crop ($\alpha = 0.05$, *d.f.* = 739, MSE = 33448.4).

Note: Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Cover
A	343.00	145	Peanuts
B	299.50	119	Grain/Soybeans
B			
C B	268.59	237	Corn
C			
C	238.22	242	Soybeans

Table 23. The Results of Duncan's Multiple Range Test for Field Acreage by Soil Type.

The mean field acreage for each soil type($\alpha = 0.05$, *d.f.* = 710, MSE = 58.6927). Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Cover
A	13.900	1	15E
A			
A	13.611	21	23A
A			
A	11.096	36	11
A			
A	10.672	10	5A
A			
A	10.290	3	28
A			
A	9.353	9	21A
A			
A	8.435	120	16A
A			
A	8.250	2	20A
A			
A	7.902	79	8A
A			
A	7.900	1	2
A			
A	7.613	23	19
A			
A	7.212	39	22A
A			
A	7.083	69	6
A			
A	7.041	19	10B
A			
A	6.731	4	21B

Table 23. The Results of Duncan's Multiple Range Test (Continued).

Duncan Grouping	Mean	N	Cover
A			
A	6.707	22	12
A			
A	6.571	14	9A
A			
A	6.231	19	10A
A			
A	6.049	12	16B
A			
A	5.830	27	22B
A			
A	5.527	52	14
A			
A	5.492	10	23B
A			
A	4.800	1	15D
A			
A	4.565	10	15B
A			
A	4.189	25	24
A			
A	3.888	94	29
A			
A	3.400	3	8B
A			
A	3.210	3	7B2
A			
A	2.700	1	13
A			
A	1.770	5	1B
A			
A	1.682	4	5B2
A			
A	1.682	4	25
A			
A	1.200	1	7A

Table 24. The Results of Duncan's Multiple Range Test for Overland Flow by Soil Type.

The mean overland flow for each soil type ($\alpha = 0.05$, *d.f.* = 710, MSE = 32654.8).

Note: Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Cover
A	660.0	1	15E
A			
B A	495.0	2	20A
B			
B C	375.6	36	11
B C			
B C	367.5	14	9A
B C			
B C	366.7	9	21A
B C			
B C	358.3	3	7B2
B C			
B C	356.7	3	28
B C			
B C	344.2	12	16B
B C			
B C	342.4	21	23A
B C			
B C	336.7	39	22A
B C			
B C	333.3	3	8B
B C			
B C	319.0	10	23B
B C			
B C	312.0	79	8A
B C			
B C	305.1	69	6
B C			
B C	293.0	22	12
B C			
B C	290.0	4	21B
B C			

Table 24. The Results of Duncan's Multiple Range Test (Continued).

Duncan Grouping	Mean	N	Cover
B C	289.5	19	10B
B C			
B C	286.1	120	16A
B C			
B C	255.9	23	19
B C			
B C	250.0	1	2
B C			
B C	237.0	10	5A
B C			
B C	231.5	27	22B
B C			
B C	230.8	19	10A
B C			
B C	229.4	25	24
B C			
B C	208.8	52	14
B C			
B C	205.3	94	29
B C			
B C	194.5	10	15B
C			
C	165.0	4	25
C			
C	153.0	5	1B
C			
C	120.0	4	5B2
C			
C	100.0	1	15D
C			
C	80.0	1	13
C			
C	80.0	1	7A

Table 25. Frequency Distribution of Crops Within Soil Types.

FREQUENCY PERCENT ROW PCT COL PCT	Corn	Peanuts	Soybeans	Grain/ Soybeans	TOTAL
Alaga	1 0.13 20.00 0.42	3 0.13 20.00 0.69	0 0.40 60.00 1.24	5 0.00 0.00 0.00	9 0.67
Kalmia/A	1 0.94 36.84 2.95	3 0.13 5.26 0.69	8 0.40 15.79 1.24	19 1.08 42.11 6.72	31 2.56
Kalmia/B	8 1.08 42.11 3.38	1 0.13 5.26 0.69	3 0.40 15.79 1.24	7 0.94 36.84 5.88	19 2.56
Kenansville.11	12 1.62 33.33 5.06	16 2.15 44.44 11.03	4 0.54 11.11 1.65	4 0.54 11.11 3.36	36 4.85
Kenansville.12	7 0.94 31.82 2.95	9 1.21 40.91 6.21	4 0.54 18.18 1.65	2 0.27 9.09 1.68	22 2.96
Levy	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.13 100.00 0.84	1 0.13
Lynchburg	27 3.63 51.92 11.39	9 1.21 17.31 6.21	11 1.48 21.15 4.55	5 0.67 9.62 4.20	52 7.00
TOTAL	237 31.90	145 19.52	242 32.57	119 16.02	743 100.00

Table 25. Frequency distribution of crops within soil types (Continued).

FREQUENCY PERCENT ROW PCT COL PCT	Corn	Peanuts	Soybeans	Grain/ Soybeans	TOTAL
Nansemond.15/B	3 0.40 30.00 1.27	4 0.54 40.00 2.76	3 0.40 30.00 1.24	0 0.00 0.00 0.00	10 1.35
Nansemond.15/D	1 0.13 100.00 0.42	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.13
Nansemond.15/E	1 0.13 100.00 0.42	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.13
Nansemond.16/A	35 4.71 29.17 14.77	19 2.56 15.83 13.10	32 4.31 26.67 13.22	34 4.58 28.33 28.57	120 16.15
Nansemond.16/B	0 0.00 0.00 0.00	1 0.13 8.33 0.69	7 0.94 58.33 2.89	4 0.54 33.33 3.36	12 1.62
Rains	12 1.62 52.17 5.06	6 0.81 26.09 4.14	5 0.67 21.74 2.07	0 0.00 0.00 0.00	23 3.10
Rumford/A	0 0.00 0.00 0.00	1 0.13 50.00 0.69	0 0.00 0.00 0.00	1 0.13 50.00 0.84	2 0.27
TOTAL	237 31.90	145 19.52	242 32.57	119 16.02	743 100.00

Table 25. Frequency distribution of crops within soil types (Continued).

FREQUENCY PERCENT ROW PCT COL PCT	Corn	Peanuts	Soybeans	Grain/ Soybeans	TOTAL
Rumford/B	0 0.00 0.00 0.00	1 0.13 100.00 0.69	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.13
State/A	4 0.54 44.44 1.69	0 0.00 0.00 0.00	1 0.13 11.11 0.41	4 0.54 44.44 3.36	9 1.21
State/B	4 0.54 100.00 1.69	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	4 0.54
Suffolk/A	12 1.62 30.77 5.06	11 1.48 28.21 7.59	12 1.62 30.77 4.96	4 0.54 10.26 3.36	39 5.25
Suffolk/B	10 1.35 37.04 4.22	4 0.54 14.81 2.76	10 1.35 37.04 4.13	3 0.40 11.11 2.52	27 3.63
Tetotum/A	4 0.54 19.05 1.69	5 0.67 23.81 3.45	1 0.13 4.76 0.41	11 1.48 52.38 9.24	21 2.83
Tetotum/B	7 0.94 70.00 2.95	0 0.00 0.00 0.00	0 0.00 0.00 0.00	3 0.40 30.00 2.52	10 1.35
TOTAL	237 31.90	145 19.52	242 32.57	119 16.02	743 100.00

Table 25. Frequency distribution of crops within soil types (Continued).

FREQUENCY PERCENT ROW PCT COL PCT	Corn	Peanuts	Soybeans	Grain/ Soybeans	TOTAL
Tomotley	7 0.94 28.00 2.95	3 0.40 12.00 2.07	13 1.75 52.00 5.37	2 0.27 8.00 1.68	25 3.36
Torhunta	0 0.00 0.00 0.00	1 0.13 25.00 0.69	3 0.40 75.00 1.24	0 0.00 0.00 0.00	4 0.54
Wahee	2 0.27 66.67 0.84	0 0.00 0.00 0.00	1 0.13 33.33 0.41	0 0.00 0.00 0.00	3 0.40
Weston	23 3.10 24.47 9.70	9 1.21 9.57 6.21	58 7.81 61.70 23.97	4 0.54 4.26 3.36	94 12.65
Dogue/A	1 0.13 10.00 0.42	4 0.54 40.00 2.76	1 0.13 10.00 0.41	4 0.54 40.00 3.36	10 1.35
Dogue/B	1 0.13 25.00 0.42	0 0.00 0.00 0.00	3 0.40 75.00 1.24	0 0.00 0.00 0.00	4 0.54
Dragston	15 2.02 21.74 6.33	9 1.21 13.04 6.21	32 4.31 46.38 13.22	13 1.75 18.84 10.92	69 9.29
TOTAL	237 31.90	145 19.52	242 32.57	119 16.02	743 100.00

Table 25. Frequency distribution of crops within soil types (Continued).

FREQUENCY PERCENT ROW PCT COL PCT	Corn	Peanuts	Soybeans	Grain/Soybeans	TOTAL
Emporia/A	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.13 100.00 0.41	0 0.00 0.00 0.00	1 0.13
Emporia/B	0 0.00 0.00 0.00	2 0.27 66.67 1.38	1 0.13 33.33 0.41	0 0.00 0.00 0.00	3 0.40
Eunola/A	30 4.04 37.97 12.66	20 2.69 25.32 13.79	24 3.23 30.38 9.92	5 0.67 6.33 4.20	79 10.63
Eunola/B	0 0.00 0.00 0.00	2 0.27 66.67 1.38	1 0.13 33.33 0.41	0 0.00 0.00 0.00	3 0.40
Goldsboro	3 0.40 21.43 1.27	6 0.81 42.86 4.14	5 0.67 35.71 2.07	0 0.00 0.00 0.00	14 1.88
TOTAL	237 31.90	145 19.52	242 32.57	119 16.02	743 100.00

Table 26. Trial 1

Running the BMP evaluation method without applying any BMPs to the sample.

Cover Crop	N	Field area	Overland flow length	Soil loss	Total area	Soil loss loading	Mean phosphate	Phosphate loading	Mean nirogen	Nitrogen loading
Corn	237	7.32	268.59	9.46	1,735.26	16,415.56	0.12	208.23	1.07	1,856.73
Grain/Soybeans	119	8.01	299.50	0.84	953.13	800.62	0.01	9.53	0.15	142.97
Peanuts	145	8.58	343.00	10.90	1,244.71	13,567.33	0.09	112.02	0.49	60.99
Soybeans	242	5.17	238.22	9.43	1,251.48	11,801.46	0.06	75.09	0.50	625.74

Note: All areas are in acres. Overland flow is in feet. Soil loss is in Tons/Acre/Year. Soil loss loading is in Tons/sample area/Year. Mean phosphate is in Pounds/Acre/Year. Phosphate loading is in Pounds/sample area/Year. Mean nitrogen is in Pounds/Acre/Event. Nitrogen loading is in Pounds/sample area/Event. An event is a 3 inch, 3 hour storm.

Table 27. Trial 2

Running the BMP evaluation method using a two year cropping rotation of "Corn, grain, soybean, and cover" on all corn producing fields, and using "no-till" practices on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet.

Cover Crop	N	Field area	Overland flow length	Soil loss	Total area	Soil loss loading
Corn	237	7.32	268.58	6.25	1,735.26	10,845.37
Grain/Soybeans	119	8.01	299.50	0.84	953.13	800.62
Peanuts	145	8.58	343.00	10.90	1,244.71	13,567.33
Soybeans	242	5.17	238.22	9.43	1,251.48	11,801.46

Cover Crop	Mean phosphate	Phosphate loading	Mean nirogen	Nitrogen loading
Corn	0.08	138.82	0.82	1,422.91
Grain/Soybeans	0.01	9.53	0.15	142.97
Peanuts	0.09	112.02	0.49	60.99
Soybeans	0.06	75.09	0.50	625.74

Note: All areas are in acres. Overland flow is in feet. Soil loss is in Tons/Acre/Year. Soil loss loading is in Tons/sample area/Year. Mean phosphate is in Pounds/Acre/Year. Phosphate loading is in Pounds/sample area/Year. Mean nitrogen is in Pounds/Acre/Event. Nitrogen loading is in Pounds/sample area/Event. An event is a 3 inch, 3 hour storm.

Table 28. Trial 3

Running the BMP evaluation method using a two yesr cropping rotation of "Corn, grain, soybeans" on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet.

Cover Crop	N	Field area	Overland flow length	Soil loss	Total area	Soil loss loading
Corn not for BMP	220	7.08	255.89	6.97	1,557.73	10,857.38
Corn for BMP use	17	10.44	432.94	39.46	177.52	7,004.94
Grain/Soybeans	119	8.01	299.50	0.84	953.13	800.62
Peanuts	145	8.58	343.00	10.90	1,244.71	13,567.33
Soybeans	242	5.17	238.22	9.43	1,251.48	11,801.46

Cover Crop	Mean phosphate	Phosphate loading	Mean nirogen	Nitrogen loading
Corn not for BMP	0.09	140.20	0.90	1,401.96
Corn for BMP use	0.52	92.14	3.12	552.09
Grain/Soybeans	0.01	9.53	0.15	142.97
Peanuts	0.09	112.02	0.49	60.99
Soybeans	0.06	75.09	0.50	625.74

Note: All areas are in acres. Overland flow is in feet. Soil loss is in Tons/Acre/Year. Soil loss loading is in Tons/sample area/Year. Mean phosphate is in Pounds/Acre/Year. Phosphate loading is in Pounds/sample area/Year. Mean nitrogen is in Pounds/Acre/Event. Nitrogen loading is in Pounds/sample area/Event. An event is a 3 inch, 3 hour storm.

Table 29. Trial 4

Running the BMP evaluation method using a two yesr cropping rotation of ″Corn, grain, soybeans, cover″ on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. On all other fields, a two year cropping rotation of ″Corn, grain, and soybeans″ is used.

Cover Crop	N	Field area	Overland flow length	Soil loss	Total area	Soil loss loading
Corn not for BMP	220	7.08	255.89	6.59	1,557.73	10,265.44
Corn for BMP use	17	10.44	432.94	37.85	177.52	6,719.13
Grain/Soybeans	119	8.01	299.50	0.84	953.13	800.62
Peanuts	145	8.58	343.00	10.90	1,244.71	13,567.33
Soybeans	242	5.17	238.22	9.43	1,251.48	11,801.46

Cover Crop	Mean phosphate	Phosphate loading	Mean nirogen	Nitrogen loading
Corn not for BMP	0.08	124.62	0.86	1,339.65
Corn for BMP use	0.50	88.76	3.00	532.56
Grain/Soybeans	0.01	9.53	0.15	142.97
Peanuts	0.09	112.02	0.49	60.99
Soybeans	0.06	75.09	0.50	625.74

Note: All areas are in acres. Overland flow is in feet. Soil loss is in Tons/Acre/Year. Soil loss loading is in Tons/sample area/Year. Mean phosphate is in Pounds/Acre/Year. Phosphate loading is in Pounds/sample area/Year. Mean nitrogen is in Pounds/Acre/Event. Nitrogen loading is in Pounds/sample area/Event. An event is a 3 inch, 3 hour storm.

Table 30. Trial 5

Running the BMP evaluation method using "No-till" on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. On all other fields, a two year cropping rotation of "Corn, grain, soybeans" is used.

Cover Crop	N	Field area	Overland flow length	Soil loss	Total area	Soil loss loading
Corn not for BMP	220	7.08	255.89	6.59	1,557.73	10,265.44
Corn for BMP	17	10.44	432.94	5.29	177.52	939.08
Grain/Soybeans	119	8.01	299.50	0.84	953.13	800.62
Peanuts	145	8.58	343.00	10.90	1,244.71	13,567.33
Soybeans	242	5.17	238.22	9.43	1,251.48	11,801.46

Cover Crop	Mean phosphate	Phosphate loading	Mean nirogen	Nitrogen loading
Corn not for BMP	0.08	124.62	0.86	1,339.65
Corn for BMP use	0.07	12.43	0.57	101.19
Grain/Soybeans	0.01	9.53	0.15	142.97
Peanuts	0.09	112.02	0.49	60.99
Soybeans	0.06	75.09	0.50	625.74

Note: All areas are in acres. Overland flow is in feet. Soil loss is in Tons/Acre/Year. Soil loss loading is in Tons/sample area/Year. Mean phosphate is in Pounds/Acre/Year. Phosphate loading is in Pounds/sample area/Year. Mean nitrogen is in Pounds/Acre/Event. Nitrogen loading is in Pounds/sample area/Event. An event is a 3 inch, 3 hour storm.

Table 31. Trial 6

Running the BMP evaluation method using "Corn, grain, and soybeans" on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. On all other fields, a two year cropping rotation of "Corn, grain, soybeans" is used. In addition, a "liming" BMP is used on all fields to raise the pH to 5.0.

Cover Crop	N	Field area	Overland flow length	Soil loss	Total area	Soil loss loading
Corn not for BMP	220	7.08	255.89	6.97	1,557.73	10,857.38
Corn for BMP	17	10.44	432.94	39.46	177.52	7,004.94
Grain/Soybeans	119	8.01	299.50	0.84	953.13	800.62
Peanuts	145	8.58	343.00	10.90	1,244.71	13,567.33
Soybeans	242	5.17	238.22	9.43	1,251.48	11,801.46

Cover Crop	Mean phosphate	Phosphate loading	Mean nirogen	Nitrogen loading
Corn not for BMP	0.05	77.89	0.90	1,401.96
Corn for BMP use	0.19	33.72	3.11	552.09
Grain/Soybeans	0.00	2.38	0.15	142.97
Peanuts	0.08	99.58	0.49	60.99
Soybeans	0.03	37.54	0.50	625.74

Note: All areas are in acres. Overland flow is in feet. Soil loss is in Tons/Acre/Year. Soil loss loading is in Tons/sample area/Year. Mean phosphate is in Pounds/Acre/Year. Phosphate loading is in Pounds/sample area/Year. Mean nitrogen is in Pounds/Acre/Event. Nitrogen loading is in Pounds/sample area/Event. An event is a 3 inch, 3 hour storm.

Table 32. Trial 7

Running the BMP evaluation method using "No-till" on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. On all other fields, a two year cropping rotation of "Corn, grain, soybeans" is used. In addition, a "liming" BMP is used on all fields to raise the pH to 5.0.

Cover Crop	N	Field area	Overland flow length	Soil loss	Total area	Soil loss loading
Corn not for BMP	220	7.08	255.89	6.59	1,557.73	10,265.44
Corn for BMP	17	10.44	432.94	5.29	177.52	939.08
Grain/Soybeans	119	8.01	299.50	0.84	953.13	800.62
Peanuts	145	8.58	343.00	10.90	1,244.71	13,567.33
Soybeans	242	5.17	238.22	9.43	1,251.48	11,801.46

Cover Crop	Mean phosphate	Phosphate loading	Mean nirogen	Nitrogen loading
Corn not for BMP	0.05	77.89	0.86	1,339.65
Corn for BMP use	0.03	5.32	0.57	101.19
Grain/Soybeans	0.00	2.38	0.15	142.97
Peanuts	0.08	99.58	0.49	60.99
Soybeans	0.03	37.54	0.50	625.74

Note: All areas are in acres. Overland flow is in feet. Soil loss is in Tons/Acre/Year. Soil loss loading is in Tons/sample area/Year. Mean phosphate is in Pounds/Acre/Year. Phosphate loading is in Pounds/sample area/Year. Mean nitrogen is in Pounds/Acre/Event. Nitrogen loading is in Pounds/sample area/Event. An event is a 3 inch, 3 hour storm.

Table 33. Trial 8

Running the BMP evaluation method using "No-till" on all corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. On all other fields, a two year cropping rotation of "Corn, grain, soybeans" is used. In addition, a "liming" BMP is used on all fields to raise the pH to 5.0 and an adjustment made to the organic matter of the soil from BMP implementation.

Cover Crop	N	Field area	Overland flow length	Soil loss	Total area	Soil loss loading
Corn not for BMP	220	7.08	255.89	6.59	1,557.73	10,265.44
Corn for BMP	17	10.44	432.94	5.29	177.52	939.08
Grain/Soybeans	119	8.01	299.50	0.84	953.13	800.62
Peanuts	145	8.58	343.00	10.90	1,244.71	13,567.33
Soybeans	242	5.17	238.22	9.43	1,251.48	11,801.46

Cover Crop	Mean phosphate	Phosphate loading	Mean nirogen	Nitrogen loading
Corn not for BMP	0.05	77.89	0.92	1,433.11
Corn for BMP use	0.03	5.32	0.63	111.84
Grain/Soybeans	0.00	2.38	0.15	142.97
Peanuts	0.08	99.58	0.49	60.99
Soybeans	0.03	37.54	0.50	625.74

Note: All areas are in acres. Overland flow is in feet. Soil loss is in Tons/Acre/Year. Soil loss loading is in Tons/sample area/Year. Mean phosphate is in Pounds/Acre/Year. Phosphate loading is in Pounds/sample area/Year. Mean nitrogen is in Pounds/Acre/Event. Nitrogen loading is in Pounds/sample area/Event. An event is a 3 inch, 3 hour storm.

Table 34. Trial 9

Running the BMP evaluation method using two BMPs applied to corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. The first BMP is a two year cropping rotation of "Corn, grain, and soybeans" and the second is a grass filter strip. The filter strip parameters are the same as defined for the modified fourth method described on page 84.

Cover Crop	N	Field area	Overland flow length	Soil loss	Total area	Soil loss loading
Corn not for BMP	220	7.08	255.89	6.97	1,557.73	10,857.38
Corn for BMP use	17	10.44	432.94	26.26	177.52	4,661.68
Grain/Soybeans	119	8.01	299.50	0.84	953.13	800.62
Peanuts	145	8.58	343.00	10.90	1,244.71	13,567.33
Soybeans	242	5.17	238.22	9.43	1,251.48	11,801.46

Cover Crop	Mean phosphate	Phosphate loading	Mean nirogen	Nitrogen loading
Corn not for BMP	0.09	140.20	0.90	1,401.96
Corn for BMP use	0.28	49.70	2.06	365.69
Grain/Soybeans	0.01	9.53	0.15	142.97
Peanuts	0.09	112.02	0.49	60.99
Soybeans	0.06	75.09	0.50	625.74

Note: All areas are in acres. Overland flow is in feet. Soil loss is in Tons/Acre/Year. Soil loss loading is in Tons/sample area/Year. Mean phosphate is in Pounds/Acre/Year. Phosphate loading is in Pounds/sample area/Year. Mean nitrogen is in Pounds/Acre/Event. Nitrogen loading is in Pounds/sample area/Event. An event is a 3 inch, 3 hour storm.

Table 35. Trial 10

Running the BMP evaluation method using two BMPs applied to corn producing fields with a slope greater than or equal to 3 percent and an overland flow greater than or equal to 300 feet. The first BMP is a two year cropping rotation of "Corn, grain, and soybeans" and the second is a grass filter strip. The filter strip parameters are the same as defined for the modified fourth method described on page 84 except for the Manning's number of 0.25 rather than 0.35.

Cover Crop	N	Field area	Overland flow length	Soil loss	Total area	Soil loss loading
Corn not for BMP	220	7.08	255.89	6.97	1,557.73	10,857.38
Corn for BMP use	17	10.44	432.94	24.82	177.52	4,406.05
Grain/Soybeans	119	8.01	299.50	0.84	953.13	800.62
Peanuts	145	8.58	343.00	10.90	1,244.71	13,567.33
Soybeans	242	5.17	238.22	9.43	1,251.48	11,801.46

Cover Crop	Mean phosphate	Phosphate loading	Mean nirogen	Nitrogen loading
Corn not for BMP	0.09	140.20	0.90	1,401.96
Corn for BMP use	0.25	44.38	1.95	346.16
Grain/Soybeans	0.01	9.53	0.15	142.97
Peanuts	0.09	112.02	0.49	60.99
Soybeans	0.06	75.09	0.50	625.74

Note: All areas are in acres. Overland flow is in feet. Soil loss is in Tons/Acre/Year. Soil loss loading is in Tons/sample area/Year. Mean phosphate is in Pounds/Acre/Year. Phosphate loading is in Pounds/sample area/Year. Mean nitrogen is in Pounds/Acre/Event. Nitrogen loading is in Pounds/sample area/Event. An event is a 3 inch, 3 hour storm.

Table 36. Summary of the Trials.

Trial	Phosphate loading	Percent of control loading	Percent change from control	Soil loss	Percent of control loading	Percent Change from control
1	208.23	control	control	16,415.56	control	control
2	138.82	66.67	33.33	10,845.37	66.07	33.93
3a	140.20	control	control	10,857.38	control	control
b	92.14	control	control	7,004.94	control	control
t	232.34	control	control	17,862.32	control	control
4a	124.62	88.89	11.11	10,265.44	94.55	5.45
b	88.76	96.33	3.67	6,719.13	95.92	4.08
t	213.38	91.83	8.17	16,984.57	95.09	4.91
5a	124.62	88.89	11.11	10,265.44	94.55	5.45
b	12.43	13.49	86.51	939.08	13.41	86.59
t	137.05	58.99	41.01	11,204.52	62.73	37.27
6a	77.89	55.56	44.44	10,857.38	0.00	100.00
b	33.72	36.60	63.40	7,004.94	0.00	100.00
t	111.61	48.04	51.96	17,862.32	0.00	100.00
7a	77.89	55.56	44.44	10,265.44	94.55	5.45
b	5.32	5.78	94.22	939.08	13.41	86.59
t	83.21	35.81	64.19	11,204.52	62.73	37.27
9a	140.20	100.00	0.00	10,857.38	100.00	0.00
b	49.70	53.95	46.06	4,661.68	66.55	33.45
t	189.90	81.73	18.27	15,519.06	86.55	13.45
10a	140.20	100.00	0.00	10,857.38	100.00	0.00
b	44.38	48.16	51.84	4,406.05	62.29	37.71
t	184.58	79.44	20.56	15,263.43	85.45	14.55

Trial	Nitrogen loading	Percent of control loading	Percent change from control
3a	1,401.65	control	control
b	552.09	control	control
t	1,953.74	control	control
7a	1,339.65	95.58	4.42
b	101.19	18.32	81.68
t	1,440.84	73.74	26.26
8a	1,433.11	102.24	-2.24
b	111.84	20.26	79.74
t	1,544.95	79.08	20.92

Note: Soil loss loading is in Tons/sample area/Year. Phosphate loading is in Pounds/sample area/Year. Nitorgen loading is in Pounds/sample area/Year.

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APPENDIX A. ASCS ADRESS-O-GRAPH DATA.

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
100	100	2	2	50	Western Branch
101	101	20	5	58	Chuckatuck Creek
80	80	625	330	58	Chuckatuck Creek
1087	2547	12	4	54	Kilby Drainage
11	11	15	11	58	Chuckatuck Creek
112	112	15	10	50	Western Branch
113	113	223	99	50	Western Branch
114	114	75	30	50	Western Branch
12	12	228	101	50	Western Branch
12	171	28	26	50	Western Branch
12	2493	.	.	50	Western Branch
120	120	5	3	50	Western Branch
122	122	5	5	58	Chuckatuck Creek
123	123	5	5	58	Chuckatuck Creek
131	131	56	28	50	Western Branch
14	14	150	62	58	Chuckatuck Creek
141	141	85	27	50	Western Branch
143	143	100	24	58	Chuckatuck Creek
144	144	90	26	58	Chuckatuck Creek
150	150	3	3	58	Chuckatuck Creek
153	153	25	17	50	Western Branch
16	16	260	111	50	Western Branch
163	163	18	17	50	Western Branch
166	166	.	.	58	Chuckatuck Creek
17	17	.	.	50	Western Branch
1704	53	415	111	50	Western Branch
1704	59	545	112	58	Chuckatuck Creek
1709	1859	73	20	52	Cahoon Creek
1797	1797	.	.	54	Kilby Drainage
1799	1799	34	27	54	Kilby Drainage

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
1804	1804			54	Kilby Drainage
1811	1811	65	38	52	Cahoon Creek
1814	1814	54	30	54	Kilby Drainage
1817	1817	60	8	52	Cahoon Creek
1819	1819	.	.	52	Cahoon Creek
1819	1819	.	.	54	Kilby Drainage
1820	1820	230	112	54	Kilby Drainage
1820	417	.	.	52	Cahoon Creek
1824	1824	133	73	54	Kilby Drainage
1825	1825	32	14	54	Kilby Drainage
1826	1826	60	18	54	Kilby Drainage
1828	1828	65	26	54	Kilby Drainage
1830	1830	246	116	54	Kilby Drainage
1830	1879	2	2	54	Kilby Drainage
1831	1831	135	86	54	Kilby Drainage
2013	1833	120	30	54	Kilby Drainage
1835	1835	16	14	52	Cahoon Creek
1838	1838	.	.	54	Kilby Drainage
1840	1840	416	254	54	Kilby Drainage
1840	1923	123	98	54	Kilby Drainage
1840	2635	123	59	54	Kilby Drainage
1841	1841	94	33	54	Kilby Drainage
1844	1844	134	72	54	Kilby Drainage
1846	1846	11	10	54	Kilby Drainage
1847	1847	315	37	54	Kilby Drainage
1848	1848	16	14	54	Kilby Drainage
1853	1816	.	.	54	Kilby Drainage
1853	1920	.	.	54	Kilby Drainage
1854	1854	187	46	54	Kilby Drainage
1855	1855	.	.	54	Kilby Drainage
1856	1856	47	36	52	Cahoon Creek

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
186	186	3	3	50	Western Branch
1861	1861	190	96	54	Kilby Drainage
1861	1949	42	37	52	Cahoon Creek
1863	1863	37	18	52	Cahoon Creek
1866	1809	.	.	52	Cahoon Creek
1866	1866	865	382	52	Cahoon Creek
1866	2203	242	79	50	Western Branch
1866	68	119	48	50	Western Branch
1868	1868	231	125	52	Cahoon Creek
187	187	.	.	52	Cahoon Creek
1870	1870	.	.	54	Kilby Drainage
1874	1874	19	6	52	Cahoon Creek
1876	1876	34	17	54	Kilby Drainage
1881	1881	97	70	54	Kilby Drainage
1889	1889	81	22	54	Kilby Drainage
1891	1891	97	40	54	Kilby Drainage
1892	1892	.	.	54	Kilby Drainage
19	19	501	107	50	Western Branch
1902	1902	75	36	54	Kilby Drainage
1904	1904	22	6	52	Cahoon Creek
1907	1907	71	37	54	Kilby Drainage
1910	1910	42	31	54	Kilby Drainage
1913	1913	167	99	52	Cahoon Creek
1913	1916	60	32	52	Cahoon Creek
1914	1914	.	.	54	Kilby Drainage
1926	1926	50	15	52	Cahoon Creek
1927	1927	116	68	54	Kilby Drainage
1930	1930	24	9	54	Kilby Drainage
1942	1942	.	.	52	Cahoon Creek
1945	1945	24	9	52	Cahoon Creek
1947	1947	158	78	54	Kilby Drainage

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
1953	1953	24	16	54	Kilby Drainage
1956	1956	134	51	54	Kilby Drainage
1962	1962	4	3	54	Kilby Drainage
1965	2578	.	.	54	Kilby Drainage
1966	1966	100	58	54	Kilby Drainage
1975	1975	.	.	54	Kilby Drainage
1977	1977	8	5	52	Cahoon Creek
2	2	86	33	50	Western Branch
2001	174	.	.	52	Cahoon Creek
2001	2001	446	162	52	Cahoon Creek
2002	2002	323	171	52	Cahoon Creek
2003	2003	160	111	52	Cahoon Creek
2004	2004	371	165	52	Cahoon Creek
2006	2006	50	22	52	Cahoon Creek
2008	2008	51	35	52	Cahoon Creek
2010	2010	111	45	52	Cahoon Creek
2011	2011	25	8	52	Cahoon Creek
2013	1813	.	.	54	Kilby Drainage
2013	1822	253	101	54	Kilby Drainage
2013	2013	211	910	52	Cahoon Creek
2013	2020	116	46	52	Cahoon Creek
2013	2049	32	32	54	Kilby Drainage
2013	2119	52	52	54	Kilby Drainage
2013	2245	54	23	53	Shingle Creek
2013	2274	.	.	52	Cahoon Creek
2014	2014	147	54	52	Cahoon Creek
2016	2016	250	46	52	Cahoon Creek
2017	2017	556	157	52	Cahoon Creek
2019	2019	80	40	52	Cahoon Creek
2021	2021	170	72	52	Cahoon Creek
2023	2023	50	32	52	Cahoon Creek

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
2024	2024	325	200	52	Cahoon Creek
2024	2233	133	102	50	Western Branch
2026	2026	733	411	52	Cahoon Creek
2026	2032	.	.	52	Cahoon Creek
2030	2030	56	20	52	Cahoon Creek
2031	2031	84	34	52	Cahoon Creek
2033	2028	.	.	52	Cahoon Creek
2033	2029	.	.	52	Cahoon Creek
2033	2033	773	351	52	Cahoon Creek
2033	2101	38	22	52	Cahoon Creek
2033	2209	.	.	50	Western Branch
2034	2034	301	83	52	Cahoon Creek
2036	2036	261	67	52	Cahoon Creek
2037	2037	261	172	54	Kilby Drainage
2040	2040	354	135	54	Kilby Drainage
2048	2052	15	1	52	Cahoon Creek
205	204	364	85	47	Bennett Creek
205	205	572	378	47	Bennett Creek
205	217	1018	76	49	Wilroy
205	221	85	53	48	Sleepy Hole
205	2414	251	183	50	Western Branch
205	2554	80	49	49	Wilroy
205	2650	185	38	53	Shingle Creek
205	309	34	19	52	Cahoon Creek
205	342	2	2	47	Bennett Creek
205	407	14	7	51	Burnetts Mill
205	421	100	23	51	Burnetts Mill
2051	2051	350	329	54	Kilby Drainage
206	206	21	17	48	Sleepy Hole
2066	2066	200	55	52	Cahoon Creek
2067	2067	176	69	52	Cahoon Creek

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
2068	2068	119	32	52	Cahoon Creek
2070	1829	120	48	52	Cahoon Creek
2070	1834	293	62	54	Kilby Drainage
2070	1934	19	19	52	Cahoon Creek
2070	2038	43	16	54	Kilby Drainage
2070	2070	1081	307	52	Cahoon Creek
2070	2087	155	39	52	Cahoon Creek
2020	2190	87	39	52	Cahoon Creek
2070	442	65	22	51	Burnetts Mill
2072	2072	109	33	52	Cahoon Creek
2073	2073	53	29	52	Cahoon Creek
2081	2081	184	41	52	Cahoon Creek
2082	2082	31	16	52	Cahoon Creek
2083	2083	105	40	52	Cahoon Creek
2084	2084	173	52	52	Cahoon Creek
2086	2086	19	53	52	Cahoon Creek
2088	2088	371	144	52	Cahoon Creek
209	209	1541	537	46	North Branch
2091	2091	230	33	52	Cahoon Creek
2093	2093	20	9	52	Cahoon Creek
21	21	50	23	50	Western Branch
210	210	35	19	53	Shingle Creek
2112	2112	50	21	52	Cahoon Creek
2124	2124	70	26	52	Cahoon Creek
2138	2138	50	6	54	Kilby Drainage
2140	2140	.	.	52	Cahoon Creek
2141	2141	35	10	52	Cahoon Creek
2142	2142	45	19	52	Cahoon Creek
215	215	463	164	47	Bennett Creek
2152	2152	40	24	52	Cahoon Creek
216	216	613	119	46	North Branch

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
217	366	372	165	52	Cahoon Creek
217	399	9	7	51	Burnetts Mill
738	738	217	140	48	Sleepy Hole
2179	2179	.	.	52	Cahoon Creek
218	218	104	40	48	Sleepy Hole
218	2406	.	.	47	Bennett Creek
22	22	212	66	50	Western Branch
220	220	18	16	46	North Branch
2205	2205	20	9	52	Cahoon Creek
2206	2206	190	60	52	Cahoon Creek
2208	2208	40	21	52	Cahoon Creek
2210	2210	57	37	50	Western Branch
2210	2291	22	10	52	Cahoon Creek
2211	2211	298	95	52	Cahoon Creek
2212	2212	83	70	50	Western Branch
2213	2213	135	82	50	Western Branch
2215	2215	62	46	50	Western Branch
2216	2216	236	185	50	Western Branch
2217	2217	356	155	50	Western Branch
2219	2219	100	72	50	Western Branch
2223	2223	245	142	52	Cahoon Creek
2224	2202	.	.	52	Cahoon Creek
2224	2224	520	211	52	Cahoon Creek
2224	2490	.	.	52	Cahoon Creek
2224	2663	.	.	52	Cahoon Creek
2225	2225	62	38	52	Cahoon Creek
223	223	428	133	46	North Branch
2231	2198	9	8	50	Western Branch
2231	2214	136	45	50	Western Branch
2231	2231	1298	342	50	Western Branch
2231	2232	200	97	50	Western Branch

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
2231	2235			50	Western Branch
2234	2234	.	.	50	Western Branch
2237	2237	251	83	50	Western Branch
2238	1801	68	21	52	Cahoon Creek
2238	2238	110	48	52	Cahoon Creek
2239	2239	.	.	52	Cahoon Creek
2240	2240	143	34	52	Cahoon Creek
2241	2241	202	85	50	Western Branch
2242	2242	300	62	52	Cahoon Creek
2243	2243	86	37	50	Western Branch
2244	2244	215	155	52	Cahoon Creek
2247	2247	66	31	52	Cahoon Creek
2248	2248	305	116	53	Shingle Creek
2250	2250	100	39	52	Cahoon Creek
2251	2251	220	107	50	Western Branch
2255	2201	.	.	52	Cahoon Creek
2255	2218	156	70	50	Western Branch
2755	2254	.	.	52	Cahoon Creek
2255	2255	789	367	52	Cahoon Creek
2255	2280	138	51	50	Western Branch
2256	2256	806	346	53	Shingle Creek
2258	2258	.	.	50	Western Branch
226	226	106	58	46	North Branch
2260	2260	146	59	52	Cahoon Creek
2261	1890	81	51	54	Kilby Drainage
2261	2177	42	33	52	Cahoon Creek
2261	2178	191	172	52	Cahoon Creek
2261	2189	.	.	52	Cahoon Creek
2261	2261	2381	1153	50	Western Branch
2266	2266	476	184	52	Cahoon Creek
2261	2347	131	68	52	Cahoon Creek

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
2261	2349			52	Cahoon Creek
2261	2353	.	.	52	Cahoon Creek
2262	2262	165	59	50	Western Branch
2266	2204	52	27	52	Cahoon Creek
2266	2252	45	8	53	Shingle Creek
2266	2257	163	33	53	Shingle Creek
2266	2346	121	41	52	Cahoon Creek
2271	2271	48	10	52	Cahoon Creek
2272	2272	378	136	50	Western Branch
2273	2273	275	114	50	Western Branch
2279	2279	77	51	52	Cahoon Creek
2281	2281	55	41	50	Western Branch
2282	2282	65	39	52	Cahoon Creek
2287	2287	115	44	50	Western Branch
2289	2289	90	41	50	Western Branch
2290	2290	172	88	52	Cahoon Creek
2294	2294	101	24	50	Western Branch
2295	2295	111	79	50	Western Branch
2297	2230	.	.	52	Cahoon Creek
2297	2292	83	53	50	Western Branch
2297	2293	96	35	52	Cahoon Creek
2297	2297	1174	444	50	Western Branch
2298	2298	77	20	52	Cahoon Creek
2299	2299	66	29	52	Cahoon Creek
23	23	201	61	58	Chuckatuck Creek
2306	2306	283	153	50	Western Branch
2307	2307	50	17	52	Cahoon Creek
2311	2311	6	6	50	Western Branch
2313	2313	251	151	52	Cahoon Creek
2316	2316	19	11	50	Western Branch
2317	2317	219	117	50	Western Branch

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
2318	2318	50	21	50	Western Branch
2325	2325	.	.	50	Western Branch
2330	2188	.	.	50	Western Branch
2330	2220	162	62	50	Western Branch
2330	2269	283	150	50	Western Branch
2330	2310	.	.	50	Western Branch
2330	2321	.	.	50	Western Branch
2330	2330	1905	1033	50	Western Branch
2330	2404	.	.	52	Cahoon Creek
2330	2548	16	15	50	Western Branch
2332	2332	115	21	52	Cahoon Creek
2335	2335	64	46	50	Western Branch
2345	2345	.	.	50	Western Branch
2361	2361	.	.	52	Cahoon Creek
2368	2368	.	.	52	Cahoon Creek
2370	2370	30	16	52	Cahoon Creek
2398	2398	.	.	58	Chuckatuck Creek
24	102	.	.	58	Chuckatuck Creek
24	132	36	12	58	Chuckatuck Creek
24	145	.	.	50	Western Branch
24	24	292	81	58	Chuckatuck Creek
2400	2400	30	30	52	Cahoon Creek
2403	2403	.	.	52	Cahoon Creek
2406	2406	147	64	48	Sleepy Hole
2428	2428	.	.	58	Chuckatuck Creek
2462	2462	.	.	52	Cahoon Creek
2467	2467	.	.	54	Kilby Drainage
2468	2468	.	.	54	Kilby Drainage
2492	2492	.	.	52	Cahoon Creek
25	25	500	301	58	Chuckatuck Creek
2515	2515	18	18	54	Kilby Drainage

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
252	249	123	20	48	Sleepy Hole
252	252	831	347	49	Wilroy
2530	2530	72	35	52	Cahoon Creek
2537	2537	20	13	52	Cahoon Creek
2539	2539	.	.	52	Cahoon Creek
254	254	430	202	46	North Branch
2553	2553	135	45	52	Cahoon Creek
2556	2556	50	23	50	Western Branch
2557	2557	22	16	50	Western Branch
2558	2558	3	3	52	Cahoon Creek
256	256	400	192	46	North Branch
258	225	400	96	47	Bennett Creek
258	230	64	48	47	Bennett Creek
258	233	.	.	46	North Branch
258	244	67	42	49	Wilroy
258	245	60	20	49	Wilroy
258	246	20	19	48	Sleepy Hole
258	257	59	38	47	Bennett Creek
258	258	2089	1004	48	Sleepy Hole
258	262	87	64	48	Sleepy Hole
258	2669	76	27	49	Wilroy
258	301	268	113	49	Wilroy
258	405	53	13	53	Shingle Creek
258	409	59	58	53	Shingle Creek
258	410	205	23	53	Shingle Creek
258	411	.	.	53	Shingle Creek
259	2503	.	.	46	North Branch
259	259	3136	1435	46	North Branch
26	26	60	21	50	Western Branch
260	260	200	89	46	North Branch
2615	2615	16	15	54	Kilby Drainage

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
2648	2648			58	Chuckatuck Creek
265	265	179	53	47	Bennett Creek
2655	2655	81	42	52	Cahoon Creek
2670	2670	60	57	53	Shingle Creek
2685	2685	11	7	50	Western Branch
2694	2694	176	114	46	North Branch
2699	2699	.	.	58	Chuckatuck Creek
272	272	4	4	49	Wilroy
275	275	23	20	46	North Branch
296	296	456	100	50	Western Branch
30	30	20	14	58	Chuckatuck Creek
303	303	10	6	47	Bennett Creek
305	305	23	16	48	Sleepy Hole
307	307	23	20	48	Sleepy Hole
312	312	15	9	48	Sleepy Hole
32	32	110	42	58	Chuckatuck Creek
33	33	105	44	50	Western Branch
339	339	200	73	46	North Branch
340	340	435	292	58	Chuckatuck Creek
35	35	10	5	50	Western Branch
356	356	15	13	47	Bennett Creek
36	36	280	148	58	Chuckatuck Creek
363	363	250	172	47	Bennett Creek
369	369	425	218	46	North Branch
38	38	222	94	58	Chuckatuck Creek
39	39	95	27	58	Chuckatuck Creek
4	4	238	133	50	Western Branch
41	41	13	6	58	Chuckatuck Creek
42	42	.	.	58	Chuckatuck Creek
441	441	4	4	53	Shingle Creek
446	446	141	51	53	Shingle Creek

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
45	45			50	Western Branch
453	453	100	39	54	Kilby Drainage
479	479	.	.	54	Kilby Drainage
480	480	.	.	52	Cahoon Creek
5	5	259	102	50	Western Branch
505	505	94	38	53	Shingle Creek
51	51	80	23	50	Western Branch
514	514	1	1	53	Shingle Creek
54	54	314	77	50	Western Branch
55	55	289	120	50	Western Branch
56	56	60	20	50	Western Branch
57	57	14	9	58	Chuckatuck Creek
58	58	55	6	50	Western Branch
6	6	795	210	50	Western Branch
602	637	.	.	53	Shingle Creek
602	602	.	.	54	Kilby Drainage
608	700	.	.	53	Shingle Creek
620	602	.	.	53	Shingle Creek
639	639	65	36	53	Shingle Creek
64	64	44	26	50	Western Branch
66	66	61	33	58	Chuckatuck Creek
660	660	1059	347	53	Shingle Creek
711	711	.	.	53	Shingle Creek
663	663	56	34	54	Kilby Drainage
67	67	45	36	50	Western Branch
677	677	98	51	53	Shingle Creek
683	1903	.	.	54	Kilby Drainage
683	683	1007	376	54	Kilby Drainage
683	689	.	.	53	Shingle Creek
7	7	158	49	58	Chuckatuck Creek
709	709	20	15	53	Shingle Creek

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
714	714	9	9	53	Shingle Creek
715	715	.	.	53	Shingle Creek
719	719	195	62	53	Shingle Creek
12	72	259	100	58	Chuckatuck Creek
73	73	8	8	50	Western Branch
733	733	21	21	51	Burnetts Mill
74	74	157	82	50	Western Branch
757	757	.	.	53	Shingle Creek
77	77	339	68	50	Western Branch
78	78	5	5	58	Chuckatuck Creek
789	789	.	.	53	Shingle Creek
8	8	13	13	58	Chuckatuck Creek
83	83	150	33	58	Chuckatuck Creek
831	2688	70	39	50	Western Branch
85	85	9	7	58	Chuckatuck Creek
89	89	45	9	58	Chuckatuck Creek
9	9	76	26	58	Chuckatuck Creek
92	92	100	63	50	Western Branch
93	93	110	91	50	Western Branch
95	1	161	16	58	Chuckatuck Creek
95	142	100	37	58	Chuckatuck Creek
95	15	100	66	58	Chuckatuck Creek
95	20	120	33	50	Western Branch
95	27	54	23	50	Western Branch
95	37	127	43	58	Chuckatuck Creek
95	46	175	61	58	Chuckatuck Creek
95	49	225	82	58	Chuckatuck Creek
95	95	929	363	58	Chuckatuck Creek
96	96	15	8	50	Western Branch
1004	1004	1834	898	50	Western Branch
1004	814	198	83	50	Western Branch

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
1007	1007	175	41	50	Western Branch
1008	1008	508	153	50	Western Branch
1009	1009	134	35	50	Western Branch
1020	1020	505	185	50	Western Branch
1028	1053	74	47	50	Western Branch
1040	1040	100	31	50	Western Branch
1041	1041	75	46	50	Western Branch
1051	1069	75	24	50	Western Branch
1064	1064	223	50	50	Western Branch
1067	1067	150	72	50	Western Branch
1078	1078	220	53	50	Western Branch
1435	403	110	97	58	Chuckatuck Creek
540	1714	12	6	52	Cahoon Creek
1779	1779	25	5	52	Cahoon Creek
1790	1790	115	57	52	Cahoon Creek
202	282	173 1	73	57	Brewers Creek
204	204	2947	1084	57	Brewers Creek
204	222	8	4	57	Brewers Creek
204	226	279	105	57	Brewers Creek
204	233	90	35	57	Brewers Creek
204	243	150	50	57	Brewers Creek
204	249	15	7	57	Brewers Creek
204	260	134	66	57	Brewers Creek
204	272	111	64	57	Brewers Creek
206	201	92	49	57	Brewers Creek
206	2013	178	78	57	Brewers Creek
206	206	5036	1563	57	Brewers Creek
206	2069	338	81	55	Winall Creek
206	213	158	58	57	Brewers Creek
206	234	585	256	57	Brewers Creek
206	246	40	8	55	Winall Creek

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
206	261	50	13	56	Smith and Muddy Co
206	269	159	60	57	Brewers Creek
206	274	98	34	57	Brewers Creek
206	275	84	28	55	Winall Creek
206	283	30	13	56	Smith and Muddy Co
206	284	9	5	55	Winall Creek
206	308	35	10	56	Smith and Muddy Co
206	313	110	13	57	Brewers Creek
206	318	16	10	55	Winall Creek
206	352	16	3	55	Winall Creek
206	590	70	31	57	Brewers Creek
2067	2067	5	4	57	Brewers Creek
208	333	13	9	57	Brewers Creek
2080	2080	137	39	50	Western Branch
209	209	366	104	55	Winall Creek
212	212	912	402	57	Brewers Creek
216	216	1147	276	56	Smith and Muddy Cov
219	219	19	1	57	Brewers Creek
216	334	85	6	57	Brewers Creek
223	223	30	3	57	Brewers Creek
225	225	12	4	57	Brewers Creek
226	226	8	4	57	Brewers Creek
227	227	13	5	57	Brewers Creek
228	228	26	6	57	Brewers Creek
240	240	124 2	7	55	Winall Creek
241	241	34	20	57	Brewers Creek
244	244	123	66	58	Chuckatuck Creek
247	247	7	4	57	Brewers Creek
253	253	494	241	57	Brewers Creek
259	259	961	463	58	Chuckatuck Creek
262	262	211	57	56	Smith and Muddy Cov

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
265	265	32	20	58	Chuckatuck Creek
266	266	180	35	57	Brewers Creek
270	270	326	99	57	Brewers Creek
295	295	89	28	55	Winall Creek
299	299	108	43	57	Brewers Creek
300	300	75	41	57	Brewers Creek
311	311	480	128	50	Western Branch
311	873	35	7	58	Chuckatuck Creek
312	503	2	2	58	Chuckatuck Creek
320	320	59	37	57	Brewers Creek
322	322	15	11	55	Winall Creek
326	326	20	13	57	Brewers Creek
348	348	58	30	55	Winall Creek
357	357	56	38	56	Smith and Muddy Cov
349	350	12	6	57	Brewers Creek
206	356	19	8	57	Brewers Creek
361	361	35	5	56	Smith and Muddy Cov
365	365	5	3	57	Brewers Creek
371	371	4	4	57	Brewers Creek
377	377	6	2	55	Winall Creek
378	378	16	10	57	Brewers Creek
379	379	114	40	57	Brewers Creek
380	380	21	12	56	Smith and Muddy Cov
383	383	8	5	57	Brewers Creek
404	404	1351	486	50	Western Branch
404	898	.	122	50	Western Branch
406	406	110	17	50	Western Branch
407	407	157	61	50	Western Branch
405	405	25	21	50	Western Branch
410	415	100	26	50	Western Branch
410	440	97	66	50	Western Branch

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
412	412	60	53	50	Western Branch
413	413	40	13	50	Western Branch
416	416	249	82	50	Western Branch
416	417	.	43	58	Chuckatuck Creek
418	1012	241	78	50	Western Branch
418	418	1067	424	50	Western Branch
419	419	149	46	50	Western Branch
420	420	549	315	50	Western Branch
420	439	135	95	58	Chuckatuck Creek
475	539	16	9	50	Western Branch
422	422	106	48	50	Western Branch
423	423	35	33	50	Western Branch
424	424	136	42	50	Western Branch
425	425	590	208	50	Western Branch
425	426	215	65	50	Western Branch
428	428	251	100	58	Chuckatuck Creek
429	2026	37	28	58	Chuckatuck Creek
429	429	161	100	58	Chuckatuck Creek
429	542	70	40	50	Western Branch
432	401	473	104	50	Western Branch
432	432	819	328	58	Chuckatuck Creek
433	433	81	51	50	Western Branch
434	434	198	66	50	Western Branch
436	436	150	83	50	Western Branch
437	437	23	23	52	Cahoon Creek
438	438	60	31	50	Western Branch
442	442	80	42	50	Western Branch
443	443	6	6	52	Cahoon Creek
444	444	10	7	52	Cahoon Creek
445	445	150	53	52	Cahoon Creek
446	446	48	8	50	Western Branch

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
447	447	134	55	58	Chuckatuck Creek
450	450	296	139	50	Western Branch
452	421	219	93	58	Chuckatuck Creek
452	452	394	248	58	Chuckatuck Creek
452	505	25	13	58	Chuckatuck Creek
452	509	67	31	58	Chuckatuck Creek
454	454	76	29	52	Cahoon Creek
456	456	108	62	50	Western Branch
498	458	150	80	50	Western Branch
459	459	435	72	50	Western Branch
460	460	85	28	50	Western Branch
461	461	12	12	50	Western Branch
462	462	159	104	58	Chuckatuck Creek
463	457	60	5	50	Western Branch
463	463	359	99	58	Chuckatuck Creek
464	464	77	28	50	Western Branch
465	465	75	17	52	Cahoon Creek
466	466	30	24	58	Chuckatuck Creek
467	467	50	15	50	Western Branch
469	469	75	39	58	Chuckatuck Creek
470	470	100	41	50	Western Branch
471	471	192	69	50	Western Branch
473	473	67	45	52	Cahoon Creek
475	475	315	221	58	Chuckatuck Creek
476	476	51	17	52	Cahoon Creek
477	477	80	51	52	Cahoon Creek
479	479	.	.	50	Western Branch
479	544	.	.	50	Western Branch
480	480	.	.	50	Western Branch
482	482	.	.	50	Western Branch
483	483	.	.	53	Shingle Creek

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
484	484	45	21	58	Chuckatuck Creek
485	485	253	91	52	Cahoon Creek
487	487	.	.	50	Western Branch
488	488	75	44	58	Chuckatuck Creek
490	490	178	56	58	Chuckatuck Creek
494	411	.	.	58	Chuckatuck Creek
494	494	.	.	58	Chuckatuck Creek
497	497	7	5	50	Western Branch
498	498	966	322	50	Western Branch
499	2050	.	.	50	Western Branch
499	499	256	91	50	Western Branch
500	500	.	.	58	Chuckatuck Creek
500	536	.	.	50	Western Branch
502	502	.	.	50	Western Branch
504	504	89	39	50	Western Branch
507	507	.	.	50	Western Branch
508	508	123	54	58	Chuckatuck Creek
508	545	.	.	50	Western Branch
512	512	65	28	58	Chuckatuck Creek
518	518	125	56	52	Cahoon Creek
519	519	70	35	50	Western Branch
520	431	.	.	52	Cahoon Creek
521	521	376	108	52	Cahoon Creek
522	522	70	36	52	Cahoon Creek
525	525	.	.	52	Cahoon Creek
527	527	.	.	50	Western Branch
528	528	.	.	50	Western Branch
529	529	14	5	50	Western Branch
530	530	.	.	50	Western Branch
531	531	.	.	52	Cahoon Creek
534	534	210	98	50	Western Branch

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
535	535	40	22	50	Western Branch
537	537	92	25	58	Chuckatuck Creek
540	540	.	.	52	Cahoon Creek
541	541	75	25	50	Western Branch
543	543	.	.	58	Chuckatuck Creek
546	546	.	.	50	Western Branch
547	547	.	.	50	Western Branch
554	1776	.	.	50	Western Branch
554	554	.	.	52	Cahoon Creek
555	555	100	30	50	Western Branch
556	556	.	.	50	Western Branch
557	557	15	14	50	Western Branch
565	565	.	.	50	Western Branch
570	570	7	6	57	Brewers Creek
583	583	38	7	50	Western Branch
589	589	261	147	57	Brewers Creek
594	594	116	49	57	Brewers Creek
612	612	.	.	50	Western Branch
614	614	.	.	52	Cahoon Creek
708	708	.	.	57	Brewers Creek
761	1665	.	.	52	Cahoon Creek
761	761	1157	901	52	Cahoon Creek
800	800	56	25	58	Chuckatuck Creek
805	805	.	.	50	Western Branch
806	806	.	.	50	Western Branch
807	807	433	164	50	Western Branch
807	813	.	.	50	Western Branch
817	817	10	7	58	Chuckatuck Creek
819	819	55	29	58	Chuckatuck Creek
820	820	873	262	50	Western Branch
820	912	.	.	58	Chuckatuck Creek

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
827	827			50	Western Branch
830	2001	.	.	50	Western Branch
830	862	.	.	50	Western Branch
832	832	33	14	58	Chuckatuck Creek
835	835	332	99	50	Western Branch
836	2006	.	.	58	Chuckatuck Creek
836	2010	.	.	58	Chuckatuck Creek
836	836	.	.	58	Chuckatuck Creek
836	874	.	.	50	Western Branch
836	919	.	.	58	Chuckatuck Creek
842	538	.	.	58	Chuckatuck Creek
842	929	.	.	58	Chuckatuck Creek
843	910	.	.	58	Chuckatuck Creek
843	972	.	.	58	Chuckatuck Creek
847	1510	.	.	57	Brewers Creek
849	849	.	.	50	Western Branch
851	851	187	246	58	Chuckatuck Creek
857	857	295	128	58	Chuckatuck Creek
858	2030	.	.	58	Chuckatuck Creek
858	858	165	89	58	Chuckatuck Creek
861	861	18	7	58	Chuckatuck Creek
865	865	196	87	58	Chuckatuck Creek
865	866	.	.	58	Chuckatuck Creek
865	879	.	.	58	Chuckatuck Creek
867	867	50	25	58	Chuckatuck Creek
871	871	167	100	58	Chuckatuck Creek
878	1028	80	63	50	Western Branch
878	913	.	.	50	Western Branch
884	884	530	155	50	Western Branch
884	935	.	.	58	Chuckatuck Creek
884	945	.	.	50	Western Branch

Appendix A. ASCS ADDRESS-O-GRAPH Data (Continued).

Farm Number	Tract Number	Total Acres	Tilled Acres	Shed Number	Water Shed Name
887	887			50	Western Branch
894	894	.	.	50	Western Branch
895	895	.	.	50	Western Branch
902	902	.	.	50	Western Branch
903	903	225	84	50	Western Branch
904	904	.	.	50	Western Branch
907	907	.	.	50	Western Branch
920	920	19	13	50	Western Branch
923	923	100	33	50	Western Branch
927	1094	.	.	50	Western Branch
927	976	.	.	50	Western Branch
930	930	.	.	58	Chuckatuck Creek
931	931	.	.	58	Chuckatuck Creek
947	947	36	3	58	Chuckatuck Creek
953	953	10	5	58	Chuckatuck Creek
959	926	.	.	58	Chuckatuck Creek
966	966	150	63	50	Western Branch
969	969	.	.	58	Chuckatuck Creek
984	984	.	.	50	Western Branch
990	990	3	3	57	Brewers Creek
993	993	.	.	55	Winall Creek
993	993	.	.	55	Winall Creek
996	996	2	1	57	Brewers Creek
408	408	22	8	51	Burnetts Mill
419	419	388	97	51	Burnetts Mill
420	420	11	11	51	Burnetts Mill
219	219	19 7	.	56	Smith and Muddy Cov
321	321	21	5	56	Smith and Muddy Cov
357	357	56	38	56	Smith and Muddy Cov

APPENDIX B. ASCS DATA OBTAINED FROM THE OFFICE RECORDS.

Farm Number	Tract Number	status	select	survey	Owner Operator	county
10	10	NC	*		OO	COS
100	100	NC		OW	OP	COS
101	101	NC		OW		COS
80	80	C			OO	COS
1087	2547	NC		OW		COS
11	11	NC		OW	OP	COS
112	112	NC		OW		COS
113	113	NC	*		OO	COS
114	114	NC		OW		COS
12	12	NC		OW	OP	COS
12	171	C		OW		COS
12	2493	C				COS
120	120	NC			OO	COS
122	122	NC			OP	COS
123	123	NC		OW	OP	COS
131	131	NC	*	OW	OP	COS
14	14	NC	*	OW	OP	COS
141	141	NC			OP	COS
143	143	NC	*	OW	OP	COS
144	144	NC	*	OW	OP	COS
150	150	NC			OO	COS
153	153	NC		OW	OP	COS
16	16	NC	*	OW	OP	COS
163	163	NC			OO	COS
166	166	NC				COS
17	17	C	*	OW	OO	COS
1704	53	NC		OW		COS
1704	59	NC		OW		COS
1709	1859	NC		OW		COS
1797	1797	C				COS
1799	1799	C		OW	OP	COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
1804	1804	C				COS
1811	1811	NC		OW	OP	COS
1814	1814	C	*	OW	OP	COS
1817	1817	NC	*	OW	OP	COS
1819	1819	C	*	OW	OP	COS
1819	1819	C				COS
1820	1820	C	*		OP	COS
1820	417	C				COS
1824	1824	C	*	OW	OP	COS
1825	1825	NC		OW		COS
1826	1826	NC	*	OW	OP	COS
1828	1828	NC		OW	OP	COS
1830	1830	C			OP	COS
1830	1879	NC		OW		COS
1831	1831	C		OW	OP	COS
2013	1833	C		OW		COS
1835	1835	NC		OW	OP	COS
1838	1838	C		OW	OP	COS
1840	1840	C			OP	COS
1840	1923	NC		OW		COS
1840	2635	NC		OW		COS
1841	1841	C	*		OO	COS
1844	1844	NC	*		OP	COS
1846	1846	NC			OO	COS
1847	1847	C		OW		COS
1848	1848	NC		OW	OP	COS
1853	1816	C				COS
1853	1920	C				COS
1854	1854	NC			OP	COS
1855	1855	C				COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
1856	1856	NC		OW		COS
186	186	NC		OW	OP	COS
1861	1861	NC	*		OP	COS
1861	1949	NC		OW	OP	COS
1863	1863	C		OW	OP	COS
1866	1809	C				COS
1866	1866	NC	*	OW	OP	COS
1866	2203	C		OW		COS
1866	68	C		OW		COS
1868	1868	C	*	OW	OP	COS
187	187	C				COS
1870	1870	C				COS
1874	1874	NC		OW		COS
1876	1876	NC			OP	COS
1881	1881	NC			OP	COS
1889	1889	NC	*	OW		COS
1891	1891	NC	*			COS
1892	1892	C				COS
19	19	NC			OO	COS
1902	1902	C	*	OW	OO	COS
1904	1904	NC			OO	COS
1907	1907	NC		OW	OP	COS
1910	1910	C		OW	OP	COS
1913	1913	NC	*	OW	OP	COS
1913	1916	NC		OW		COS
1914	1914	C				COS
1926	1926	C		OW	OP	COS
1927	1927	C	*		OO	COS
1930	1930	C		OW	OP	COS
1942	1942	C				COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
1945	1945	NC		OW	OP	COS
1947	1947	NC			OP	COS
1953	1953	NC			OO	COS
1956	1956	C	*	OW	OP	COS
1962	1962	NC		OW		COS
1965	2578	C				COS
1966	1966	C	*	OW	OP	COS
1975	1975	C				COS
1977	1977	NC		OW		COS
2	2	NC	*		OO	COS
2001	174	C		OW		COS
2001	2001	C		OW	OP	COS
2002	2002	C			OO	COS
2003	2003	C	*	OW	OP	COS
2004	2004	NC	*		OO	COS
2006	2006	C	*		OO	COS
2008	2008	C		OW		COS
2010	2010	NC	*	OW	OP	COS
2011	2011	NC		OW	OP	COS
2013	1813	C		OW		COS
2013	1822	NC		OW	OP	COS
2013	2013	NC			OP	COS
2013	2020	NC		OW		COS
2013	2049	NC		OW		COS
2013	2119	NC		OW		COS
2013	2245	NC		OW		COS
2013	2274	C				COS
2014	2014	NC		OW	OP	COS
2016	2016	NC		OW	OP	COS
2017	2017	C	*		OP	COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
2019	2019	C	*	OW	OP	COS
2021	2021	NC	*		OO	COS
2023	2023	C		OW	OP	COS
2024	2024	C	+		OO	COS
2024	2233	C		OW		COS
2026	2026	NC	*		OO	COS
2026	2032	C				COS
2030	2030	NC	*	OW	OP	COS
2031	2031	C		OW	OP	COS
2033	2028	C		OW		COS
2033	2029	C		OW		COS
2033	2033	C	*		OP	COS
2033	2101	NC		OW		COS
2033	2209	C		OW		COS
2034	2034	C	*	OW		COS
2036	2036	C	*		OP	COS
2037	2037	NC	*		OO	COS
2040	2040	NC		OW	OP	COS
2048	2052	NC		OW		COS
205	204	NC		OW		COS
205	205	NC	*		OP	COS
205	217	NC		OW	OP	COS
205	221	NC		OW		COS
205	2414	NC		OW		COS
205	2554	NC		OW		COS
205	2650	NC		OW		COS
205	309	NC		OW		COS
205	342	NC		OW		COS
205	407	NC		OW		COS
205	421	NC		OW		COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
2051	2051	NC	*	OW	OP	COS
206	206	NC		OW	OP	COS
2066	2066	NC	*		OO	COS
2067	2067	C	*	OW	OP	COS
2068	2068	NC	*		OO	COS
2070	1829	NC		OW		COS
2070	1834	C		OW		COS
2070	1934	NC		OW		COS
2070	2038	NC		OW		COS
2070	2070	NC	*		OP	COS
2070	2087	NC		OW		COS
2020	2190	NC		OW		COS
2070	442	NC		OW		COS
2072	2072	C	*	OW	OO	COS
2073	2073	NC		OW	OP	COS
2081	2081	NC			OP	COS
2082	2082	NC		OW	OP	COS
2083	2083	C	*		OO	COS
2084	2084	C		OW	OP	COS
2086	2086	C	*		OO	COS
2088	2088	NC		OW	OP	COS
209	209	NC	*		OO	COS
2091	2091	NC		OW	OP	COS
2093	2093	NC		OW		COS
21	21	C		OW	OP	COS
210	210	NC			OO	COS
2112	2112	NC		OW	OP	COS
2124	2124	NC	*	OW	OP	COS
2138	2138	NC		OW	OP	COS
2140	2140	NC		OW		COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
2141	2141	NC			OO	COS
2142	2142	NC		OW	OP	COS
215	215	NC	*		OO	COS
2152	2152	NC			OO	COS
216	216	NC	*	OW	OO	COS
217	366	NC		OW		COS
217	399	NC		OW		COS
738	738	NC	*	OW	OP	COS
2179	2179	C				COS
218	218	NC		OW	OP	COS
218	2406	NC				COS
22	22	C	*	OW	OP	COS
220	220	NC		OW		COS
2205	2205	C	*		OP	COS
2206	2206	C	*	OW	OO	COS
2208	2208	C			OO	COS
2210	2210	C	*	OW	OP	COS
2210	2291	NC		OW		COS
2211	2211	NC		OW	OP	COS
2212	2212	NC		OW		COS
2213	2213	C		OW	OP	COS
2215	2215	NC		OW	OP	COS
2216	2216	C	+	OW	OP	COS
2217	2217	NC	+	OW	OP	COS
2219	2219	C	*	OW	OP	COS
2223	2223	C		OW	OP	COS
2224	2202	C				COS
2224	2224	C	*		OO	COS
2224	2490	C				COS
2224	2663	C				COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
2225	2225	C			OP	COS
223	223	NC	*		OO	COS
2231	2198	NC		OW		COS
2231	2214	C		OW		COS
2231	2231	C	*		OO	COS
2231	2232	C		OW		COS
2231	2235	C				COS
2234	2234	C				COS
2237	2237	C	*		OP	COS
2238	1801	NC		OW		COS
2238	2238	C		OW	OP	COS
2239	2239	C				COS
2240	2240	C	*	OW	OP	COS
2241	2241	NC		OW	OP	COS
2242	2242	NC	*		OO	COS
2243	2243	NC	*	OW	OP	COS
2244	2244	C	*		OO	COS
2247	2247	C	*		OO	COS
2248	2248	NC	+	OW	OP	COS
2250	2250	C		OW	OP	COS
2251	2251	C	*	OW	OP	COS
2255	2201	C				COS
2255	2218	NC		OW		COS
2755	2254	C				COS
2255	2255	C	*	OW	OP	COS
2255	2280	NC		OW		COS
2256	2256	NC	*		OO	COS
2258	2258	C				COS
226	226	NC		OW	OP	COS
2260	2260	C	*		OO	COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
2261	1890	NC		OW		COS
2261	2177	NC		OW		COS
2261	2178	C		OW		COS
2261	2189	C				COS
2261	2261	C	*		OP	COS
2266	2266	C	+		OP	COS
2261	2347	C		OW		COS
2261	2349	C		OW		COS
2261	2353	C		OW		COS
2262	2262	C	*		OP	COS
2266	2204	C		OW		COS
2266	2252	NC		OW		COS
2266	2257	NC		OW		COS
2266	2346	C		OW		COS
2271	2271	C		OW		COS
2272	2272	C			OP	COS
2273	2273	NC	*		OP	COS
2279	2279	NC			OO	COS
2281	2281	C	*		OP	COS
2282	2282	C			OP	COS
2287	2287	C			OP	COS
2289	2289	C			OP	COS
2290	2290	C			OP	COS
2294	2294	C	+		OP	COS
2295	2295	C	*		OP	COS
2297	2230	C		OW		COS
2297	2292	NC		OW		COS
2297	2293	C		OW		COS
2297	2297	C	*	OW	OP	COS
2298	2298	C			OP	COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
2299	2299	C	*		OP	COS
23	23	NC		OW	OP	COS
2306	2306	C	*		OO	COS
2307	2307	C			OP	COS
2311	2311	NC			OO	COS
2313	2313	C			OP	COS
2316	2316	C			OO	COS
2317	2317	C	*		OO	COS
2318	2318	NC			OP	COS
2325	2325	C				COS
2330	2188	C				COS
2330	2220	C		OW	OP	COS
2330	2269	C		OW		COS
2330	2310	C				COS
2330	2321	C				COS
2330	2330	C	+		OP	COS
2330	2404	C				COS
2330	2548	NC		OW		COS
2332	2332	NC	*	OW		COS
2335	2335	C	+		OP	COS
2345	2345	C				COS
2361	2361	C				COS
2368	2368	C				COS
2370	2370	C			OP	COS
2398	2398	NC				COS
24	102	NC		OW		COS
24	132	NC		OW		COS
24	145	NC		OW		COS
24	24	NC	*		OO	COS
2400	2400	NC			OO	COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
2403	2403	C				COS
2406	2406	NC		OW		COS
2428	2428	NC				COS
2462	2462	C				COS
2467	2467	C				COS
2468	2468	C				COS
2492	2492	C				COS
25	25	NC	*		OO	COS
2515	2515	NC			OO	COS
252	249	NC			OO	COS
252	252	NC	*		OO	COS
2530	2530	C			OP	COS
2537	2537	NC			OO	COS
2539	2539	NC	*		OO	COS
254	254	NC		OW	OP	COS
2553	2553	NC	*		OP	COS
2556	2556	NC		OW		COS
2557	2557	NC		OW		COS
2558	2558	NC			OO	COS
256	256	NC	*		OO	COS
258	225	NC		OW		COS
258	230	NC		OW		COS
258	233	NC		OW		COS
258	244	NC		OW		COS
258	245	NC		OW		COS
258	246	NC		OW		COS
258	257	NC		OW		COS
258	258	NC	*	OW	OP	COS
258	262	NC		OW		COS
258	2669	NC		OW		COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
258	301	NC		OW		COS
258	405	NC		OW		COS
258	409	NC		OW		COS
258	410	NC		OW		COS
258	411	NC		OW		COS
259	2503	NC		OW		COS
259	259	NC	*		OO	COS
26	26	NC		OW	OP	COS
260	260	NC			OP	COS
2615	2615	NC			OO	COS
2648	2648	NC				COS
265	265	NC	*	OW	OP	COS
2655	2655	C	*		OO	COS
2670	2670	NC	*		OP	COS
2685	2685	NC			OP	COS
2694	2694	NC	*		OO	COS
2699	2699	C	*			COS
272	272	NC		OW	OP	COS
275	275	NC		OW		COS
296	296	NC		OW	OP	COS
30	30	NC		OW	OP	COS
303	303	NC		OW	OP	COS
305	305	NC		OW	OP	COS
307	307	NC			OO	COS
312	312	NC		OW	OP	COS
32	32	NC	*		OO	COS
33	33	C	+	OW	OP	COS
339	339	NC	*		OO	COS
340	340	NC	*	OW	OO	COS
35	35	NC		OW	OP	COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
356	356	NC			OO	COS
36	36	NC	*		OO	COS
363	363	NC		OW	OP	COS
369	369	NC			OP	COS
38	38	NC	*	OW	OP	COS
39	39	NC	*	OW	OP	COS
4	4	C		OW	OP	COS
41	41	NC		OW		COS
42	42	NC				COS
441	441	NC		OW	OP	COS
446	446	NC	*		OP	COS
45	45	C		OW		COS
453	453	NC		OW	OP	COS
479	479	C				COS
480	480	C				COS
5	5	NC		OW	OP	COS
505	505	NC	*	OW	OP	COS
51	51	NC	*		OO	COS
514	514	NC			OO	COS
54	54	NC	*		OO	COS
55	55	NC	*	OW	OO	COS
56	56	NC	*	OW	OP	COS
57	57	NC		OW	OP	COS
58	58	NC	*		OO	COS
6	6	C	*	OW	OP	COS
602	637	NC				COS
602	602	NC				COS
608	700	NC				COS
620	602	NC				COS
639	639	NC		OW	OP	COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
64	64	NC		OW	OP	COS
66	66	NC	*	OW	OP	COS
660	660	NC	+	OW	OP	COS
711	711	NC				COS
663	663	NC	*		OP	COS
67	67	C	+	OW	OP	COS
677	677	NC		OW	OP	COS
683	1903	C				COS
683	683	NC	*		OP	COS
683	689	NC				COS
7	7	NC	*	OW	OP	COS
709	709	NC			OO	COS
714	714	NC		OW	OP	COS
715	715	NC				COS
719	719	NC			OP	COS
12	72	NC	+	OW		COS
73	73	NC			OP	COS
733	733	NC		OW		COS
74	74	NC		OW	OP	COS
757	757	NC				COS
77	77	NC		OW	OP	COS
78	78	NC			OP	COS
789	789	NC				COS
8	8	NC			OO	COS
83	83	NC		OW	OP	COS
831	2688	NC	+	OW		COS
85	85	NC		OW	OP	COS
89	89	NC		OW	OP	COS
9	9	NC	*		OO	COS
92	92	NC		OW	OP	COS

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
93	93	NC		OW		COS
95	1	NC		OW		COS
95	142	NC		OW		COS
95	15	NC		OW		COS
95	20	NC		OW		COS
95	27	NC		OW		COS
95	37	NC		OW		COS
95	46	NC		OW		COS
95	49	NC		OW		COS
95	95	NC		OW	OP	COS
96	96	NC		OW	OP	COS
1004	1004	NC	+		OP	IOW
10048	14 c.NC				IOW	
1007	1007	NC	*	OW	OP	IOW
1008	1008	NC	*	OW	OP	IOW
1009	1009	NC		OW		IOW
1020	1020	NC		OW		IOW
1028	1053	NC				IOW
1040	1040	NC	*		OO	IOW
1041	1041	NC	*		OO	IOW
1051	1069	NC				IOW
1064	1064	NC		OW		IOW
1067	1067	NC	*	OW	OP	IOW
1078	1078	NC	+	OW	OP	IOW
1435	403	NC				IOW
540	1714	NC				IOW
1779	1779	NC			OO	IOW
1790	1790	NC		OW		IOW
202	282	NC		OW		IOW

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
204	204	NC	*	OW		IOW
204	222	C		OW	OP	IOW
204	226	C		OP		IOW
204	233	C		OP		IOW
204	243	C		OP		IOW
204	249	C		OP		IOW
204	260	C		OP		IOW
204	272	C		OW		IOW
206	201	NC		OP		IOW
206	2013	NC		OP		IOW
206	206	C	+	OW	OP	IOW
206	2069	NC		OP		IOW
206	213	NC		OP		IOW
206	234	NC		OP		IOW
206	246	NC		OP		IOW
206	261	NC		OP		IOW
206	269	NC		OP		IOW
206	274	C		OP		IOW
206	275	NC		OP		IOW
206	283	NC		OP		IOW
206	284	NC		OP		IOW
206	308	NC		OP		IOW
206	313	NC		OP		IOW
206	318	NC		OP		IOW
206	352	NC		OP		IOW
206	590	NC		OP		IOW
2067	2067	NC			OO	IOW
208	333	NC		OW	OP	IOW
2080	2080	NC				IOW
209	209	NC	*	OW	OP	IOW

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
212	212	NC	*	OW	OP	IOW
216	216	NC	*	OW	OP	IOW
219	219	NC			OO	IOW
216	334	NC		OW	OP	IOW
223	223	NC			OO	IOW
225	225	NC		OW	OP	IOW
226	226	NC				IOW
227	227	NC			OO	IOW
228	228	NC		OW	OP	IOW
240	240	NC		OW	OP	IOW
241	241	NC		OW	OP	IOW
244	244	NC		OW	OP	IOW
247	247	NC		OW	OP	IOW
253	253	C	*	OW	OP	IOW
259	259	NC	*	OW	OP	IOW
262	262	NC		OW	OP	IOW
265	265	NC			OO	IOW
266	266	NC	*		OP	IOW
270	270	NC	*		OP	IOW
295	295	NC	*		OO	IOW
299	299	NC				IOW
300	300	NC		OW	OP	IOW
311	311	NC				IOW
311	873	NC				IOW
312	503	NC				IOW
320	320	NC	*		OO	IOW
322	322	NC		OW	OP	IOW
326	326	NC			OO	IOW
348	348	NC	*		OO	IOW
357	357	NC	*	OW	OP	IOW

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
349	350	NC				IOW
206	356	NC				IOW
361	361	NC		OW		IOW
365	365	NC				IOW
371	371	NC		OW	OP	IOW
377	377	NC		OW		IOW
378	378	NC				IOW
379	379	NC		OW		IOW
380	380	NC	*	OW		IOW
383	383	NC		OW		IOW
404	404	C	*		OO	IOW
404	898	NC				IOW
406	406	C	*		OO	IOW
407	407	NC	+	OW	OP	IOW
405	405	C		OW		IOW
410	415	C				IOW
410	440	NC				IOW
412	412	NC	*	OW	OP	IOW
413	413	C			OO	IOW
416	416	NC	+	OW		IOW
416	417	C				IOW
418	1012	NC				IOW
418	418	C				IOW
419	419	C	+		OO	IOW
420	420	NC	*	OW	OP	IOW
420	439	C				IOW
475	539	NC				IOW
422	422	C	*	OW	OP	IOW
423	423	NC	+		OO	IOW
424	424	C				IOW

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
425	425	NC		OW		IOW
425	426	NC				IOW
428	428	NC		OW		IOW
429	2026	NC				IOW
429	429	C	*	OW	OP	IOW
429	542	NC				IOW
432	401	NC				IOW
432	432	NC	*	OW	OP	IOW
433	433	NC	*	OW	OP	IOW
434	434	NC		OW		IOW
436	436	NC	*	OW		IOW
437	437	C				IOW
438	438	NC		OW		IOW
442	442	NC		OW		IOW
443	443	NC		OW	OP	IOW
444	444	NC			OO	IOW
445	445	NC	*	OW	OP	IOW
446	446	NC			OO	IOW
447	447	C	*		OO	IOW
450	450	NC	*		OP	IOW
452	421	NC				IOW
452	452	C	*		OO	IOW
452	505	NC				IOW
452	509	NC				IOW
454	454	NC		OW		IOW
456	456	NC	*	OW	OP	IOW
498	458	NC				IOW
459	459	NC	*	OW	OP	IOW
460	460	NC		OW		IOW
461	461	NC				IOW

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
462	462	C	*		OO	IOW
463	457	NC				IOW
463	463	NC		OW		IOW
464	464	NC		OW		IOW
465	465	NC	+	OW	OP	IOW
466	466	C	+		OO	IOW
467	467	NC		OW		IOW
469	469	NC		OW		IOW
470	470	NC	*	OW	OP	IOW
471	471	NC	+		OO	IOW
473	473	NC		OW		IOW
475	475	NC	*			IOW
476	476	NC	*	OW	OP	IOW
477	477	NC	*	OW	OP	IOW
479	479	NC		OW		IOW
479	544	NC		OW		IOW
480	480	NC	+	OW		IOW
482	482	NC		OW		IOW
483	483	C				IOW
484	484	NC			OP	IOW
485	485	NC	*	OW	OP	IOW
487	487	NC	*	OW	OP	IOW
488	488	NC	*	OW	OP	IOW
490	490	NC	*	OW	OP	IOW
494	411	NC				IOW
494	494	NC		OW		IOW
497	497	NC			OO	IOW
498	498	NC	+	OW	OP	IOW
499	2050	C				IOW
499	499	C	*	OW	OP	IOW

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
500	500	NC				IOW
500	536	NC				IOW
502	502	NC		OW		IOW
504	504	NC	*	OW	OP	IOW
507	507	NC		OW		IOW
508	508	C	*		OO	IOW
508	545	NC				IOW
512	512	NC	*		OP	IOW
518	518	NC	*	OW	OP	IOW
519	519	NC			OO	IOW
520	431	NC				IOW
521	521	NC	*	OW	OP	IOW
522	522	NC	*		OO	IOW
525	525	NC		OW		IOW
527	527	NC				IOW
528	528	NC				IOW
529	529	NC			OO	IOW
530	530	NC				IOW
531	531	NC		OW		IOW
534	534	NC	*		OO	IOW
535	535	NC		OW	OP	IOW
537	537	NC	*		OO	IOW
540	540	NC		OW		IOW
541	541	NC	*		OO	IOW
543	543	NC				IOW
546	546	NC		OW		IOW
547	547	NC		OW		IOW
554	1776	NC				IOW
554	554	NC				IOW
555	555	NC	*	OW	OP	IOW

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
556	556	NC		OW		IOW
557	557	NC			OO	IOW
565	565	NC				IOW
570	570	NC			OO	IOW
583	583	NC			OO	IOW
589	589	NC			OO	IOW
594	594	C	*	OW	OP	IOW
612	612	NC				IOW
614	614	NC				IOW
708	708	NC				IOW
761	1665	NC				IOW
761	761	NC	*	OW	OP	IOW
800	800	NC	*	OW	OP	IOW
805	805	C	*	OW		IOW
806	806	C		OW		IOW
807	807	NC	*	OW	OP	IOW
807	813	NC				IOW
817	817	NC			OO	IOW
819	819	NC	*		OO	IOW
820	820	C	*	OW	OP	IOW
820	912	NC				IOW
827	827	NC	*	OW	OP	IOW
830	2001	NC				IOW
830	862	NC				IOW
832	832	NC			OP	IOW
835	835	C	+		OO	IOW
836	2006	NC				IOW
836	2010	NC				IOW
836	836	NC		OW		IOW
836	874	NC				IOW

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
836	919	NC				IOW
842	538	NC				IOW
842	929	NC				IOW
843	910	NC				IOW
843	972	NC				IOW
847	1510	NC				IOW
849	849	C				IOW
851	851	NC	*		OO	IOW
857	857	NC			OP	IOW
858	2030	NC				IOW
858	858	NC	*	OW	OP	IOW
861	861	NC			OO	IOW
865	865	NC	*	OW	OP	IOW
865	866	NC				IOW
865	879	NC				IOW
867	867	NC	*	OW	OP	IOW
871	871	NC	*	OW	OP	IOW
878	1028	NC	*	OW	OP	IOW
878	913	NC				IOW
884	884	NC	+	OW	OP	IOW
884	935	NC				IOW
884	945	NC				IOW
887	887	C		OW		IOW
894	894	NC				IOW
895	895	NC		OW		IOW
902	902	NC				IOW
903	903	C	*	OW	OP	IOW
904	904	NC				IOW
907	907	NC				IOW
920	920	NC		OW	OP	IOW

Appendix B. ASCS Data Obtained from Office Records (Continued).

Farm Number	Tract Number	status	select	survey	Owner Operator	county
923	923	C	*	OW	OP	IOW
927	1094	NC				IOW
927	976	NC				IOW
930	930	NC				IOW
931	931	NC				IOW
947	947	NC		OW	OP	IOW
953	953	NC			OO	IOW
959	926	NC				IOW
966	966	C	*	OW	OP	IOW
969	969	NC		OW		IOW
984	984	NC				IOW
990	990	NC			OO	IOW
993	993	NC				IOW
993	993	NC				IOW
996	996	NC				IOW
408	408	NC			OO	COS
419	419	NC	*	OW	OP	COS
420	420	NC		OW	OP	COS
219	219	NC			OO	IOW
321	321	NC			OO	IOW
357	357	NC	*	OW	OP	IOW

APPENDIX C. THE HRU DATA COLLECTED FROM ASCS AND SCS.

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	258	230	4	35.6	BS	660	8 & 16A
C	258	230	4	1.8	B	80	8 & 16B
C	258	230	4	7.6	BS	330	8 & 16B
C	258	230	4	2.9	BS	250	8 & 6
C	303	303	1	5.9	WB	250	8 & 16A
T	363	363	15	24.2	WB	660	8 & .
P	363	363	15	12.1	WB	660	8 & 21A
P	363	363	15	12.1	WB	660	8 & 23A
T	363	363	15	19.0	WB	660	8 & .
P	363	363	15	9.5	WB	660	8 & 21A
P	363	363	15	9.5	WB	660	8 & 23A
T	363	363	15	12.2	WB	330	8 & .
P	363	363	15	6.1	WB	330	8 & 21A
P	363	363	15	6.1	WB	330	8 & 23A
T	363	363	15	23.1	WB	500	8 & .
P	363	363	15	5.775	WB	500	8 & 6
P	363	363	15	17.325	WB	500	8 & 23A
C	363	363	15	2.9	WB	165	8 & 10A
T	363	363	15	18.0	WB	500	8 & .
P	363	363	15	9.0	WB	500	8 & 21A
P	363	363	15	9.0	WB	500	8 & 23A
C	363	363	15	21.9	SB	740	8 & 16A
C	363	363	15	16.6	WB	500	8 & 16A
T	363	363	15	9.2	WB	500	8 & .
P	363	363	15	4.6	WB	500	8 & 16A
P	363	363	15	4.6	WB	500	8 & 16B
T	363	363	15	7.2	WB	660	8 & .
P	363	363	15	2.4	WB	660	8 & 16A
P	363	363	15	4.8	WB	660	8 & 16B
C	363	363	15	2.7	WB	250	8 & 16A
C	363	363	15	1.9	WB	165	8 & 16A
C	363	363	15	1.3	SB	80	8 & 16B
C	363	363	15	3.1	SB	165	8 & 16B
C	363	363	15	3.1	SB	165	8 & 16B
C	258	225	28	2.9	SB	165	8 & 29
C	258	225	28	1.7	SB	80	8 & 29
C	258	225	28	3.0	SB	165	8 & 29
C	258	225	28	2.3	SB	165	8 & 29
C	258	225	28	2.1	SB	80	8 & 29
C	258	225	28	3.8	SB	410	8 & 29
C	258	225	28	2.7	SB	330	8 & 29

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	258	225	28	2.3	SB	250	8 & 29
C	258	225	28	2.3	SB	250	8 & 29
C	258	225	28	2.2	SB	250	8 & 29
C	258	225	28	2.9	SB	165	8 & 29
T	258	225	28	2.4	SB	165	8 & .
P	258	225	28	1.2	SB	165	8 & 16A
P	258	225	28	1.2	SB	165	8 & 29
T	258	225	28	3.2	SB	80	8 & .
P	258	225	28	1.6	SB	80	8 & 16A
P	258	225	28	1.6	SB	80	8 & 29
C	258	225	28	1.8	SB	165	8 & 29
C	258	225	28	8.4	SB	330	8 & 16A
C	258	225	28	5.9	SB	250	8 & 6
C	258	225	28	3.2	SB	165	8 & 6
C	258	225	28	1.8	SB	80	8 & 16A
C	258	225	28	6.5	SB	165	8 & 16A
T	258	225	28	4.1	SB	165	8 & .
P	258	225	28	2.05	SB	165	8 & 6
P	258	225	28	2.05	SB	165	8 & 16A
C	258	225	28	3.3	SB	165	8 & 29
C	258	225	28	2.4	SB	165	8 & 29
T	258	225	28	3.1	SB	410	8 & .
P	258	225	28	1.03	SB	410	8 & 6
P	258	225	28	1.03	SB	410	8 & 16A
P	258	225	28	1.04	SB	410	8 & 29
C	258	225	28	1.4	SB	80	8 & 16A
T	258	225	28	4.6	SB	250	8 & .
P	258	225	28	2.3	SB	250	8 & 6
P	258	225	28	2.3	SB	250	8 & 16A
C	258	225	28	3.3	SB	165	8 & 29
C	258	225	28	0.9	SB	80	8 & 29
C	258	225	28	0.5	SB	50	8 & 29
C	258	257	9	4.9	SB	165	12 & 16A
C	258	257	9	3.7	SB	330	12 & 16A
C	258	257	9	3.3	SB	330	12 & 6
C	258	257	9	0.5	SB	50	12 & 16A
T	258	257	9	7.8	SB	330	12 & .
P	258	257	9	2.6	SB	330	12 & 6
P	258	257	9	5.2	SB	330	12 & 16A
C	258	257	9	16.0	SB	165	12 & 29
C	258	257	9	13.1	SB	165	12 & 16A

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	258	257	9	1.2	SB	80	12 & 16A
C	258	257	9	0.9	SB	50	12 & 16A
C	218	218	15	7.9	WB	330	12 & 16A
C	218	218	15	4.7	WB	165	12 & 16A
C	218	218	15	1.9	WB	80	12 & 22B
C	218	218	15	0.4	WB	50	12 & 16A
C	218	218	15	0.8	WB	80	12 & 16A
C	218	218	15	1.7	WB	80	12 & 16A
C	218	218	15	5.4	WB	250	12 & 16A
C	218	218	15	2.8	WB	165	12 & 29
T	218	218	15	3.3	WB	250	12 & .
P	218	218	15	1.65	WB	250	12 & 16A
P	218	218	15	1.65	WB	250	12 & 29
C	218	218	15	2.7	WB	80	12 & 13
C	218	218	15	4.6	WB	250	12 & 16A
C	218	218	15	17.9	WB	330	12 & 16A
C	218	218	15	16.7	WB	250	12 & 10A
T	218	218	15	22.7	WB	330	12 & .
P	218	218	15	11.35	WB	330	12 & 10A
P	218	218	15	11.35	WB	330	12 & 16A
C	218	218	15	0.9	I	80	12 & 6
C	265	265	4	12.2	SB	330	8 & 12
C	265	265	4	18.1	SB	330	8 & 16A
C	265	265	4	10.9	WB	165	8 & 16A
C	265	265	4	9.2	WB	330	8 & 16A
T	205	205	3	7.3	WB	500	8 & .
P	205	205	3	3.65	WB	500	8 & 6
P	205	205	3	3.65	WB	500	8 & 16A
T	205	205	3	3.8	WB	330	8 & .
P	205	205	3	1.9	WB	330	8 & 6
P	205	205	3	1.9	WB	330	8 & 16A
T	205	205	3	32.2	WB	1000	8 & .
P	205	205	3	10.74	WB	1000	8 & 6
P	205	205	3	21.46	WB	1000	8 & 23A
T	594	594	7	10.6	C	990	. & .
T	594	594	7	11.1	P	165	. & .
T	594	594	7	18.5	WB	150	. & .
T	594	594	7	2.1	WB	165	. & .
T	594	594	7	10.3	WB	495	. & .
T	594	594	7	2.6	WB	120	. & .
T	222	222	1	1	.	165	. & .

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
T	272	204	5	21.5	P	825	. & .
T	272	204	5	26.8	C	700	. & .
T	272	204	5	7.7	C	330	. & .
T	272	204	5	0.7	.	80	. & .
T	272	204	5	4.5	.	80	. & .
T	274	206	3	14.2	C	660	. & .
T	274	206	3	18.1	C	500	. & .
T	274	206	3	2.1	.	50	. & .
T	260	204	13	5.3	C	500	. & .
T	260	204	13	12.4	C	500	. & .
T	260	204	13	8.9	C	600	. & .
T	260	204	13	4.2	WB	500	. & .
T	260	204	13	1.1	WB	80	. & .
T	260	204	13	1.5	.	80	. & .
T	260	204	13	4.5	WB	500	. & .
T	260	204	13	1.0	WB	80	. & .
T	260	204	13	17.0	P	500	. & .
T	260	204	13	11.8	WB	500	. & .
T	260	204	13	1.5	C	50	. & .
T	260	204	13	1.4	C	150	. & .
T	260	204	13	1.4	C	150	. & .
T	586	204	1	21.4	C	500	. & .
T	206	206	12	61.8	C	1200	. & .
T	206	206	12	51.4	C	660	. & .
T	206	206	12	10.0	P	500	. & .
T	206	206	12	4.2	PA	80	. & .
T	206	206	12	29.0	P	500	. & .
T	206	206	12	5.0	PA	50	. & .
T	206	206	12	1.8	PA	50	. & .
T	206	206	12	5.7	P	225	. & .
T	206	206	12	10.0	P	225	. & .
T	206	206	12	7.1	PA	150	. & .
T	206	206	12	16.3	P	125	. & .
T	206	206	12	6.7	P	150	. & .
T	253	253	13	7.1	WB	330	. & .
T	253	253	13	22.9	P	900	. & .
T	253	253	13	6.0	WB	600	. & .
T	253	253	13	4.6	WB	500	. & .
T	253	253	13	4.5	BE	50	. & .
T	253	253	13	9.8	C	165	. & .
T	253	253	13	20.0	WB	165.	. & .

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
T	253	253	13	9.6	WB	825.	. & .
T	253	253	13	45.9	C	1200.	
T	253	253	13	29.2	P	900	. & .
T	253	253	13	13.8	C	660	. & .
T	253	253	13	50.4	C	330	. & .
T	253	253	13	3.8	WC	495	. & .
T	243	204	5	9.0	P	165	. & .
T	243	204	5	5.0	C	165	. & .
T	243	204	5	14.6	C	165	. & .
T	243	204	5	14.6	P	600	. & .
T	243	204	5	1.5	C	25	. & .
T	249	204	2	1.1	C	50	. & .
T	249	204	2	5.5	P	400	. & .
T	201	206	3	24.6	C	500	. & .
T	201	206	3	7.0	C	80	. & .
T	201	206	3	15.0	C	80	. & .
C	408	408	4	0.5	SB	80	20 & 19
C	408	408	4	0.8	SB	80	20 & 19
C	408	408	4	4.0	SB	330	20 & 19
T	408	408	4	3.0	SB	330	20 & .
P	408	408	4	2.0	SB	330	20 & 19
P	408	408	4	1.0	SB	330	20 & 29
C	419	419	12	4.4	SB	330	15&20 24
C	419	419	12	4.9	SB	330	15&20 24
C	419	419	12	6.7	SB	250	15&20 24
T	419	419	12	6.2	C	330	15&20 .
P	419	419	12	2.07	C	330	15&20 23B
P	419	419	12	4.13	C	330	15&20 24
T	419	419	12	11.9	WB	500	15&20 .
P	419	419	12	5.95	WB	500	15&20 10B
P	419	419	12	5.95	WB	500	15&20 23B
C	419	419	12	9.0	WB	330	15&20 24
C	419	419	12	3.2	WB	165	15&20 23B
C	419	419	12	6.0	C	165	15&20 24
T	419	419	12	8.1	WB	330	15&20 .
P	419	419	12	2.7	WB	330	15&20 10B
P	419	419	12	2.7	WB	330	15&20 23B
P	419	419	12	2.7	WB	330	15&20 24
T	419	419	12	9.9	C	500	15&20 .
P	419	419	12	3.3	C	500	15&20 23B
P	419	419	12	6.6	C	500	15&20 24

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
T	419	419	12	19.5	SB	500	15&20 .
P	419	419	12	9.75	SB	500	15&20 24
P	419	419	12	9.75	SB	500	15&20 26
T	419	419	12	6.7	SB	330	15&20 .
P	419	419	12	3.35	SB	330	15&20 24
P	419	419	12	3.35	SB	330	15&20 26
C	420	420	6	0.7	SB	80	20 & 23A
C	420	420	6	0.7	SB	165	20 & 16A
C	420	420	6	1.6	NC	250	20 & 16A
C	420	420	6	1.8	.	250	20 & 24
C	420	420	6	3.0	B	500	20 & 16A
C	420	420	6	4.8	.	740	20 & 16A
T	2033	2033	8	8.9	P	80	13 & .
P	2033	2033	8	4.45	P	80	13 & 8A
P	2033	2033	8	4.45	P	80	13 & 22A
C	2033	2033	8	5.2	C	80	13 & 19B2
C	2033	2033	8	25.5	C	500	13 & 8A
C	2033	2033	8	8.7	C	400	13 & 11
T	2033	2033	8	28.0	B	500	13 & .
P	2033	2033	8	16.8	B	500	13 & 6
P	2033	2033	8	11.2	B	500	13 & 11
C	2033	2033	8	1.5	C	50	13 & 8A
C	2033	2033	8	3.4	R	50	13 & 8A
C	2033	2033	8	8.0	R	100	13 & 8A
C	2260	2260	5	2.4	SB	50	14 & 11
C	2260	2260	5	17.1	P	500	14 & 11
C	2260	2260	5	32.0	SB	500	14 & 11
C	2260	2260	5	7.6	.	.	14 & 11
C	2260	2260	5	3.3	.	.	14 & 11
C	2247	2247	4	3.3	BE	80	14 & 11
C	2247	2247	4	13.9	BE	150	14 & 11
C	2247	2247	4	10.5	P	150	14 & 11
C	2247	2247	4	1.3	BE	50	14 & 11
C	1926	1926	2	15.2	WB	100	19 & 22B
C	2266	2266	5	16.4	WB	80	19 & 23A
C	2266	2266	5	24.0	WB	80	19 & 23A
C	2266	2266	5	3.9	WB	80	19 & 23A
C	2266	2266	5	21.1	WB	80	19 & 23A
C	2266	2266	5	10.8	WB	80	19 & 23A
C	2033	2028	12	3.0	BE	50	18 & 8A
C	2033	2028	12	1.5	WB	50	18 & 8A

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	2033	2028	12	1.5	WB	50	18 & 8A
C	2033	2028	12	24.7	WB	200	18 & 14
C	2297	2230	12	3.7	WGS	150	19 & 12
C	2297	2230	12	4.3	WGS	150	20 & 23
C	2297	2230	12	4.5	WGS	150	20 & 23
C	2297	2230	12	15.4	WGS	150	20 & 23
C	2297	2230	12	7.7	WGS	150	20 & 23
C	2297	2230	12	1.0	WGS	150	20 & 23
C	2297	2230	12	6.6	GS	150	20 & 23
C	2297	2230	12	6.0	GS	150	20 & 23
C	2001	174	3	7.6	PA	200	18 & 11
C	2001	174	3	11.2	PA	200	18 & 8
C	2001	174	3	1.8	PA	200	18 & 11
C	2033	2008	4	1.0	B	50	18 & 8
C	2033	2008	4	13.5	BE	150	18 & 8
C	2033	2008	4	7.1	BE	80	18 & 22
C	2033	2008	4	7.5	BE	500	18 & 8
C	2755	2254	3	24.2	C	500	13 & 22A
C	2755	2254	3	21.3	C	500	13 & 8A
C	2755	2254	3	2.5	C	50	13 & 22A
C	2014	2014	7	7.3	C	150	13 & 14
C	2014	2014	7	5.6	P	150	13 & 14
C	2014	2014	7	3.5	C	50	13 & 14
C	2014	2014	7	7.4	P	200	13 & 14
C	2014	2014	7	8.0	WB	100	13 & 14
C	2014	2014	7	12.0	SB	200	13 & 19
C	2014	2014	7	3.5	C	50	13 & 14
C	2004	2004	4	17.2	C	400	17 & 22
C	2004	2004	4	5.6	C	400	17 & 22
C	2004	2004	4	5.8	P	300	17 & 22
C	2004	2004	4	20.4	P	300	17 & 8A
C	2279	2279	7	3.3	BE	50	17 & 14
C	2279	2279	7	8.4	P	75	17 & 8A
C	2279	2279	7	15.3	C	200	17 & 22
C	2279	2279	7	5.3	C	100	17 & 14
C	2279	2279	7	0.4	BE	50	17 & 8A
C	2020	2190	3	7.9	P	200	19 & 5A
C	2020	2190	3	10.4	SB	200	19 & 5A
C	2020	2190	3	14.0	WB	200	19 & 5A
C	1913	1916	4	10.2	WB	120	19 & 5A
C	1913	1916	4	1.6	WB	50	19 & 5A

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	1913	1916	4	11.0	C	120	19 & 5A
C	1913	1916	4	8.0	WB	80	19 & 5A
C	2124	2124	5	7.7	C	80	13 & 14
C	2124	2124	5	11.9	C	100	13 & 14
C	2124	2124	5	0.9	C	50	13 & 14
C	2124	2124	5	2.3	C	50	13 & 14
C	2124	2124	5	3.3	C	25	13 & 14
C	2068	2068	4	5.4	C	75	. & 19
C	2068	2068	4	7.3	SB	25	. & 14
C	2068	2068	4	3.3	C	100	. & 14
C	2068	2068	4	11.4	C	150	. & 14
T	554	554	6	6.8	WB	330	. & .
T	554	554	6	2.1	WB	80	. & .
T	554	554	6	24.3	C	165	. & .
T	554	554	6	9.4	P	165	. & .
T	554	554	6	1.6	WB	80	. & .
T	554	554	6	1.3	WB	50	. & .
T	1790	1790	3	7.2	SB	165	. & .
T	1790	1790	3	15.0	P	250	. & .
T	1790	1790	3	33.3	C	330	. & .
T	522	522	11	0.6	NC	50	. & .
T	522	522	11	1.3	SB	50	. & .
T	522	522	11	4.7	SB	165	. & .
T	522	522	11	1.0	SB	80	. & .
T	522	522	11	8.5	P	165	. & .
T	522	522	11	1.7	P	80	. & .
T	522	522	11	3.8	C	165	. & .
T	522	522	11	5.7	C	250	. & .
T	522	522	11	1.1	C	250	. & .
T	522	522	11	5.7	C	165	. & .
T	522	522	11	2.8	C	165	. & .
C	80	80	13	65.0	C	580	3 & 23A
C	80	80	13	25.3	C	660	3 & 28
C	80	80	13	21.3	PA	330	3 & 19
T	80	80	13	9.5	PA	330	3 & .
P	80	80	13	4.25	PA	330	3 & 23A
P	80	80	13	4.25	PA	330	3 & 28
C	80	80	13	26.5	P	660	3 & 23A
C	80	80	13	9.7	P	500	3 & 23A
C	80	80	13	3.1	PA	250	3 & 23A
C	80	80	13	6.1	PA	165	3 & 23A

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	80	80	13	13.0	P	330	3 & 23A
C	80	80	13	3.7	PA	165	3 & 23A
T	80	80	13	19.2	PA	250	3 & .
P	80	80	13	2.4	PA	250	3 & 23A
P	80	80	13	16.8	PA	250	3 & 23B
C	80	80	13	46.6	PA	500	3 & 24
C	80	80	13	11.0	PA	165	3 & 21B
C	508	508	7	4.0	C	80	. & .
C	508	508	7	2.7	C	165	. & .
C	508	508	7	1.0	SB	80	. & .
C	508	508	7	5.8	P	165	. & .
C	508	508	7	1.0	C	80	. & .
C	508	508	7	1.8	PA	80	. & .
C	508	508	7	2.0	C	165	. & .
C	452	452	7	20.0	C	330	. & .
C	452	452	7	12.6	PA	165	. & .
C	452	452	7	9.9	PA	165	. & .
C	452	452	7	13.1	WB	250	. & .
C	452	452	7	5.9	SU	165	. & .
C	452	452	7	22.1	PA	330	. & .
C	452	452	7	26.0	PA	660	. & .
C	462	462	7	12.0	SB	330	. & .
C	462	462	7	10.6	C	580	. & .
C	462	462	7	23.6	C	330	. & .
C	462	462	7	22.3	P	330	. & .
C	462	462	7	8.3	C	250	. & .
C	462	462	7	4.1	C	50	. & .
C	462	462	7	9.0	SB	165	. & .
C	447	447	5	33.6	C	250	. & .
C	447	447	5	15.1	P	330	. & .
C	447	447	5	0.5	C	50	. & .
C	447	447	5	0.9	C	80	. & .
C	447	447	5	5.1	C	165	. & .
C	429	429	12	3.1	C	165	. & .
C	429	429	12	4.0	WB	250	. & .
C	429	429	12	2.9	C	165	. & .
C	429	429	12	6.8	P	165	. & .
C	429	429	12	10.8	P	165	. & .
C	429	429	12	5.7	P	250	. & .
C	429	429	12	1.2	WB	80	. & .
C	429	429	12	2.5	WB	50	. & .

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	429	429	12	13.0	C	250	. & .
C	429	429	12	1.0	WB	50	. & .
C	429	429	12	1.6	WB	165	. & .
C	429	429	12	7.8	CH	165	. & .
C	466	466	4	8.9	P	330	. & .
C	466	466	4	3.0	SB	165	. & .
C	466	466	4	5.1	SB	165	. & .
C	466	466	4	3.0	SB	80	. & .
C	12	72	6	10.1	P	330	6 & 11
C	12	72	6	7.2	P	165	6 & 11
C	12	72	6	1.9	PA	165	6 & 11
T	12	72	6	26.9	P	580	6 & .
P	12	72	6	20.175	P	580	6 & 11
P	12	72	6	6.725	P	580	6 & 22A
T	12	72	6	10.4	P	330	6 & 11
P	12	72	6	5.2	P	330	6 & 11
P	12	72	6	2.6	P	330	6 & 20A
P	12	72	6	2.6	P	330	6 & 22B
C	12	72	6	43.3	P	330	6 & 11
C	39	39	5	4.5	C	165	3 & 10B
T	39	39	5	4.5	C	165	3 & .
P	39	39	5	3.375	C	165	3 & 10B
P	39	39	5	1.125	C	165	3 & 12
C	39	39	5	4.5	C	80	3 & 12
T	39	39	5	8.5	WA	330	3 & .
P	39	39	5	5.67	WA	330	3 & 16A
P	39	39	5	2.83	WA	330	3 & 23A
C	39	39	5	3.2	WA	80	3 & 23A
T	95	46	3	55.6	WB	660	4 & .
P	95	46	3	13.9	WB	660	4 & 8A
P	95	46	3	13.9	WB	660	4 & 20A
P	95	46	3	13.9	WB	660	4 & 22A
P	95	46	3	13.9	WB	660	4 & 22B
C	95	46	3	12.0	P	330	4 & 22A
C	95	46	3	3.6	NC	80	4 & 19
C	57	57	1	8.7	SB	330	6 & 11
C	95	15	8	10.9	C	165	3 & 23B
C	95	15	8	9.3	C	410	3 & 23B
C	95	15	8	8.8	C	410	3 & 23B
C	95	15	8	0.5	C	50	3 & 24
C	95	15	8	0.9	C	50	3 & 23B

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
T	95	15	8	5.7	C	165	3 & .
P	95	15	8	1.9	C	165	3 & 10A
P	95	15	8	3.8	C	165	3 & 24
T	95	15	8	7.2	C	80	3 & .
P	95	15	8	3.6	C	80	3 & 10A
P	95	15	8	3.6	C	80	3 & 24
T	95	15	8	23.4	C	330	3 & .
P	95	15	8	7.8	C	330	3 & 10A
P	95	15	8	7.8	C	330	3 & 23A
P	95	15	8	7.8	C	330	3 & 23B
C	851	851	9	1.7	WB	80	. & .
C	851	851	9	27.3	P	330	. & .
C	851	851	9	7.1	WB	165	. & .
C	851	851	9	2.0	WB	50	. & .
C	851	851	9	8.3	R	50	. & .
C	851	851	9	2.0	R	50	. & .
C	851	851	9	25.1	WB	330	. & .
C	851	851	9	8.1	WB	250	. & .
C	851	851	9	9.4	WB	165	. & .
C	452	505	1	13.3	PA	330	. & .
C	817	817	1	5.0	SB	165	. & .
C	871	871	5	18.2	P	330	. & .
C	871	871	5	18.3	WB	330	. & .
C	871	871	5	18.9	C	410	. & .
C	871	871	5	16.2	WB	330	. & .
C	871	871	5	5.5	C	165	. & .
C	871	871	5	1.8	WB	80	. & .
C	871	871	5	12.0	WB	660	. & .
C	930	930	5	9.0	SB	165	. & .
C	930	930	5	36.6	SB	410	. & .
C	930	930	5	19.6	C	250	. & .
C	930	930	5	2.8	C	80	. & .
C	930	930	5	3.0	C	80	. & .
T	1831	1831	10	19.4	C	580	. & .
P	1831	1831	10	6.46	C	580	25 & 8A
P	1831	1831	10	12.94	C	580	25 & 22A
T	1831	1831	10	8.0	C	330	25 & .
P	1831	1831	10	2.66	C	330	25 & 8A
P	1831	1831	10	2.66	C	330	25 & 14
P	1831	1831	10	2.67	C	330	25 & 22A
C	1831	1831	10	2.2	C	465	25 & 14

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	1831	1831	10	9.0	C	410	25 & 14
C	1831	1831	10	7.7	P	330	25 & 8A
T	1831	1831	10	5.4	P	165	25 & .
P	1831	1831	10	2.7	P	165	25 & 8A
P	1831	1831	10	2.7	P	165	25 & 14
C	1831	1831	10	1.5	SB	165	25 & 14
T	1831	1831	10	3.0	SB	165	25 & .
P	1831	1831	10	1.0	SB	165	25 & 8A
P	1831	1831	10	1.0	SB	165	25 & 14
P	1831	1831	10	1.0	SB	165	25 & 22A
T	1831	1831	10	4.0	SB	80	25 & .
P	1831	1831	10	1.33	SB	80	25 & 8A
P	1831	1831	10	2.67	SB	80	25 & 14
C	1831	1831	10	9.0	SB	410	25 & 14
T	1819	1819	12	21.8	SB	410	25 & .
P	1819	1819	12	10.9	SB	410	25 & 9A
P	1819	1819	12	10.9	SB	410	25 & 22A
T	1819	1819	12	11.5	SB	250	25 & .
P	1819	1819	12	5.75	SB	250	25 & 9A
P	1819	1819	12	5.75	SB	250	25 & 22A
C	1819	1819	12	9.6	SB	500	25 & 22A
T	1819	1819	12	8.6	C	250	25 & .
P	1819	1819	12	2.87	C	250	25 & 14
P	1819	1819	12	7.73	C	250	25 & 19
T	1819	1819	12	1.4	C	50	25 & .
P	1819	1819	12	0.7	C	50	25 & 14
P	1819	1819	12	0.7	C	50	25 & 16A
C	1819	1819	12	1.9	C	165	25 & 14
C	1819	1819	12	2.0	C	165	25 & 14
C	1819	1819	12	15.6	C	500	25 & 14
C	1819	1819	12	6.6	P	250	25 & 11
C	1819	1819	12	15.5	P	330	25 & 11
C	1819	1819	12	3.0	P	165	25 & 14
C	1819	1819	12	1.7	P	50	25 & 15B
T	1824	1824	8	19.7	P	500	25 & .
P	1824	1824	8	9.85	P	500	25 & 11
P	1824	1824	8	9.85	P	500	25 & 22A
T	1824	1824	8	6.1	P	165	25 & .
P	1824	1824	8	2.03	P	165	25 & 11
P	1824	1824	8	4.07	P	165	25 & 22B
C	1824	1824	8	6.0	P	165	25 & 8A

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
T	1824	1824	8	9.0	P	165	25 & .
P	1824	1824	8	4.5	P	165	25 & 8A
P	1824	1824	8	4.5	P	165	25 & 9B3
C	1824	1824	8	4.0	P	330	25 & 9A
T	1824	1824	8	10.8	C	330	25 & .
P	1824	1824	8	5.4	C	330	25 & 11
P	1824	1824	8	5.4	C	330	25 & 22B
C	1824	1824	8	11.5	C	500	25 & 8A
C	1824	1824	8	6.3	C	330	25 & 14
C	683	1903	5	15.7	C	660	25 & 8A
T	683	1903	5	13.5	C	410	25 & .
P	683	1903	5	9.0	C	410	25 & 8A
P	683	1903	5	4.5	C	410	25 & 22A
T	683	1903	5	5.5	P	330	25 & .
P	683	1903	5	2.75	P	330	25 & 8A
P	683	1903	5	2.75	P	330	25 & 22A
C	683	1903	5	5.0	P	330	25 & 8A
C	683	1903	5	20.3	P	410	25 & 8A
T	2013	1833	2	22.4	SB	330	25 & .
P	2013	1833	2	7.46	SB	330	25 & 11
P	2013	1833	2	14.93	SB	330	25 & 22A
T	2013	1833	2	6.1	SB	250	25 & .
P	2013	1833	2	2.03	SB	250	25 & 22A
P	2013	1833	2	4.07	SB	250	25 & 22B
C	1799	1799	5	7.8	SB	330	25 & 22A
C	1799	1799	5	9.3	SB	250	25 & 9A
C	1799	1799	5	1.6	C	165	25 & 9A
C	1799	1799	5	3.1	C	250	25 & 9A
T	1799	1799	5	6.0	C	250	. & .
P	1799	1799	5	4.0	C	250	25 & 9A
P	1799	1799	5	2.0	C	250	25 & 22A
C	1841	1841	6	2.4	P	165	25 & 14
C	1841	1841	6	3.1	P	250	25 & 9A
C	1841	1841	6	5.1	P	500	25 & 9A
T	1841	1841	6	14.1	SB	410	25 & .
P	1841	1841	6	4.7	SB	410	25 & 14
P	1841	1841	6	9.4	SB	410	25 & 22B
C	1841	1841	6	4.6	SB	500	25 & 9A
T	1841	1841	6	1.0	SB	50	25 & .
P	1841	1841	6	0.5	SB	50	25 & 16A
P	1841	1841	6	0.5	SB	50	25 & 22B

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
T	2070	1834	4	33.2	.	660	24 & .
P	2070	1834	4	11.06	.	660	24 & 8A
P	2070	1834	4	22.14	.	660	24 & 22B
T	2070	1834	4	10.1	.	330	24 & .
P	2070	1834	4	3.37	.	330	24 & 8A
P	2070	1834	4	6.73	.	330	24 & 14
C	2070	1834	4	2.7	.	165	24 & 8A
C	2070	1834	4	2.9	.	165	24 & 19
C	1966	1966	.	13.2	SB	330	19&25 8A
C	1966	1966	4	6.1	SB	165	19&25 8A
T	1966	1966	4	17.4	SB	500	19&25 .
P	1966	1966	4	4.35	SB	500	19&25 8A
P	1966	1966	4	13.05	SB	500	19&25 11
C	1966	1966	4	2.4	P	165	19&25 8A
T	1966	1966	4	16.1	P	410	19&25 .
P	1966	1966	4	8.05	P	410	19&25 8A
P	1966	1966	4	8.05	P	410	19&25 11
C	1910	1910	6	1.2	SB	50	25 & 8A
C	1910	1910	6	1.0	SB	50	25 & 8A
T	1910	1910	6	2.5	SB	250	25 & .
P	1910	1910	6	1.25	SB	250	25 & 8A
P	1910	1910	6	1.25	SB	250	25 & 22A
T	1910	1910	6	2.5	SB	500	25 & .
P	1910	1910	6	1.25	SB	500	25 & 8A
P	1910	1910	6	1.25	SB	500	25 & 22A
C	1910	1910	6	4.1	C	330	25 & 22A
C	1910	1910	6	13.1	C	500	25 & 22A
C	1840	1923	14	9.8	.	250	24&30 8A
T	1840	1923	14	9.0	.	330	24&30 .
P	1840	1923	14	6.0	.	330	24&30 8A
P	1840	1923	14	3.0	.	330	24&30 22B
C	1840	1923	14	21.2	SB	1160	24&30 8A
C	1840	1923	14	3.5	.	250	24&30 8A
C	1840	1923	14	4.0	.	165	24&30 14
C	1840	1923	14	0.6	.	80	24&30 14
C	1840	1923	14	2.6	.	80	24&30 8A
C	1840	1923	14	37.6	SB	660	24&30 8A
C	1840	1923	14	9.9	C	580	24&30 .
C	1840	1923	14	4.95	C	580	24&30 14
C	1840	1923	14	4.95	C	580	24&30 16A
T	1840	1923	14	14.0	C	330	24&30 .

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
P	1840	1923	14	4.67	C	330	24&30 8A
P	1840	1923	14	9.33	C	330	24&30 22B
T	1840	1923	14	26.1	C	250	24&30 .
P	1840	1923	14	3.2625	C	250	24&30 14
P	1840	1923	14	22.837	C	250	24&30 16
T	1840	1923	14	8.5	C	250	24&30 .
P	1840	1923	14	4.25	C	250	24&30 8A
P	1840	1923	14	4.25	C	250	24&30 16A
C	1840	1923	14	1.8	C	50	24&30 16A
C	1840	1923	14	3.1	C	165	24&30 8A
T	683	683	6	41.2	PA	1000	26 & .
P	683	683	6	13.73	PA	1000	26 & 14
P	683	683	6	27.47	PA	1000	26 & 19
T	683	683	6	11.5	P	250	26 & .
P	683	683	6	3.83	P	250	26 & 14
P	683	683	6	7.67	P	250	26 & 19
C	683	683	6	4.8	PA	80	26 & 19
C	683	683	6	8.8	PA	330	26 & 19
C	683	683	6	17.8	C	250	26 & 19
T	683	683	6	18.7	P	330	26 & 19
P	683	683	6	4.675	P	330	26 & 8A
P	683	683	6	4.675	P	330	26 & 14
P	683	683	6	4.675	P	330	26 & 16A
T	2040	2040	11	19.3	C	330	24 & .
P	2040	2040	11	9.65	C	330	24 & 8A
P	2040	2040	11	9.65	C	330	24 & 22A
T	2040	2040	11	12.1	C	250	24 & .
P	2040	2040	11	4.03	C	250	24 & 8A
P	2040	2040	11	8.07	C	250	24 & 14
T	2040	2040	11	12.4	WB	330	24 & .
P	2040	2040	11	8.27	WB	330	24 & 8
P	2040	2040	11	4.13	WB	330	24 & 14
C	2040	2040	11	8.2	P	330	24 & 8A
T	2040	2040	11	13.4	WB	330	24 & .
P	2040	2040	11	8.93	WB	330	24 & 8A
P	2040	2040	11	4.47	WB	330	24 & 22A
T	2040	2040	11	9.2	WB	330	24 & .
P	2040	2040	11	4.6	WB	330	24 & 8A
P	2040	2040	11	4.6	WB	330	24 & 22A
C	2040	2040	11	11.4	C	330	24 & 22A
T	2040	2040	11	13.3	C	165	24 & .

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
P	2040	2040	11	6.65	C	165	24 & 14
P	2040	2040	11	6.65	C	165	24 & 19
T	2040	2040	11	7.9	P	250	24 & 2
P	2040	2040	11	3.95	P	250	24 & 8B
P	2040	2040	11	3.95	P	250	24 & 22A
T	2040	2040	11	18.0	P	500	24 & .
P	2040	2040	11	4.5	P	500	24 & 8A
P	2040	2040	11	4.5	P	500	24 & 8B
P	2040	2040	11	4.5	P	500	24 & 9A
P	2040	2040	11	4.5	P	500	24 & 22A
T	2040	2040	11	7.0	SB	250	24 & .
P	2040	2040	11	1.75	SB	250	24 & 8A
P	2040	2040	11	1.75	SB	250	24 & 8B
P	2040	2040	11	1.75	SB	250	24 & 9A
P	2040	2040	11	1.75	SB	250	24 & 22A
C	1854	1854	7	4.1	C	80	25 & 22B
C	1854	1854	7	4.7	C	80	25 & 8A
T	1854	1854	7	9.5	SB	250	25 & .
P	1854	1854	7	4.75	SB	250	25 & 8A
P	1854	1854	7	4.75	SB	250	25 & 14
C	1854	1854	7	18.8	SB	500	25 & 8A
T	1854	1854	7	4.5	C	165	25 & .
P	1854	1854	7	1.5	C	165	25 & 8A
P	1854	1854	7	3.0	C	165	25 & 22B
C	1854	1854	7	0.5	L	50	25 & 9A
C	1854	1854	7	1.8	C	80	25 & 22B
C	2013	2119	7	4.0	I	80	24 & 19
T	2013	2119	7	6.0	I	165	24 & .
P	2013	2119	7	3.0	I	165	24 & 8A
P	2013	2119	7	3.0	I	165	24 & 14
C	2013	2119	7	1.1	I	80	24 & 8A
C	2013	2119	7	2.6	I	165	24 & 8A
C	2013	2119	7	5.4	C	165	24 & 8A
C	2013	2119	7	6.4	C	165	24 & 8A
C	2013	2119	7	25.0	C	330	24 & 8A
C	1826	1826	6	1.8	SB	80	24 & 8A
C	1826	1826	6	1.2	SB	50	24 & 8A
C	1826	1826	6	0.7	SB	80	24 & 8A
T	1826	1826	6	3.2	SB	80	24 & .
P	1826	1826	6	2.13	SB	80	24 & 8A
P	1826	1826	6	1.07	SB	80	24 & 22B

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	1826	1826	6	5.2	C	250	24 & 8A
C	1826	1826	6	6.1	P	165	24 & 22A
C	1907	1907	4	33.7	C	330	24 & 8A
C	1907	1907	4	10.7	P	330	24 & 8A
C	1907	1907	4	2.4	P	250	24 & 8A
C	1907	1907	4	1.0	.	80	24 & 7B2
C	1953	1953	2	3.0	SB	80	31 & 28
T	1953	1953	2	7.7	C	330	31 & .
P	1953	1953	2	5.13	C	330	31 & 5B2
P	1953	1953	2	2.57	C	330	31 & 28
C	1828	1828	4	1.2	SB	80	30 & 7A
C	1828	1828	4	5.3	SB	250	30 & 8A
C	1828	1828	4	3.9	C	80	30 & 15B
C	1828	1828	4	7.1	C	330	30 & 8A
C	2013	2049	2	9.5	SB	500	24 & .
C	2013	2049	2	4.75	SB	500	24 & 8A
C	2013	2049	2	2.375	SB	500	24 & 14
C	2013	2049	2	2.375	SB	500	24 & 22B
C	2013	2049	2	21.1	P	410	24 & .
C	2013	2049	2	15.825	P	410	24 & 8A
C	2013	2049	2	5.275	P	410	24 & 22A
T	226	226	4	34.5	WB	330	5 & .
P	226	226	4	4.3125	WB	330	5 & 10B
P	226	226	4	4.3125	WB	330	5 & 16A
P	226	226	4	25.875	WB	330	5 & 29
C	226	226	4	0.3	P	80	5 & 16A
T	226	226	4	16.1	C	500	5 & .
P	226	226	4	8.05	C	500	5 & 6
P	226	226	4	8.05	C	500	5 & 29
C	226	226	4	6.2	C	250	5 & 29
C	254	254	8	18.5	WB	330	4&5 & 10B
C	254	254	8	1.2	WB	50	4&5 & 10B
C	254	254	8	3.5	WB	250	4&5 & 10A
C	254	254	8	3.5	WB	80	4&5 & 10B
C	254	254	8	14.9	SB	165	4&5 & 10A
T	254	254	8	4.9	SB	250	4&5 & .
P	254	254	8	1.225	SB	250	4&5 & 10A
P	254	254	8	3.675	SB	250	4&5 & 15B
T	254	254	8	5.2	WB	250	4&5 & .
P	254	254	8	2.6	WB	250	4&5 & 10A
P	254	254	8	2.6	WB	250	4&5 & 12

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	254	254	8	5.0	WB	165	4&5 & 10A
C	259	259	67	2.1	SB	165	12 & 29
C	259	259	67	1.7	SB	80	12 & 29
C	259	259	67	1.9	SB	80	12 & 29
C	259	259	67	1.1	SB	250	12 & 29
C	259	259	67	2.1	SB	80	12 & 29
C	259	259	67	1.0	SB	80	12 & 29
C	259	259	67	2.1	SB	80	12 & 29
C	259	259	67	1.2	SB	165	12 & 29
C	259	259	67	8.2	SB	330	12 & 29
C	259	259	67	8.2	SB	330	12 & 29
C	259	259	67	7.2	SB	330	12 & 29
C	259	259	67	2.7	SB	165	12 & 29
C	259	259	67	1.7	SB	80	12 & 29
C	259	259	67	1.8	SB	80	12 & 29
C	259	259	67	1.5	SB	165	12 & 29
C	259	259	67	0.8	SB	165	12 & 29
T	259	259	67	12.3	SB	250	12 & .
P	259	259	67	6.15	SB	250	12 & 6
P	259	259	67	6.15	SB	250	12 & 16A
T	259	259	67	10.8	SB	330	12 & .
P	259	259	67	5.4	SB	330	12 & 6
P	259	259	67	5.4	SB	330	12 & 16A
C	259	259	67	2.9	PA	165	12 & 29
C	259	259	67	2.9	PA	165	12 & 29
C	259	259	67	3.8	PA	80	12 & 29
C	259	259	67	2.9	PA	80	12 & 29
C	259	259	67	2.7	PA	80	12 & 29
C	259	259	67	3.8	PA	165	12 & 29
C	259	259	67	3.4	PA	165	12 & 29
T	259	259	67	5.4	PA	165	12 & .
P	259	259	67	2.7	PA	165	12 & 25
P	259	259	67	2.7	PA	165	12 & 29
T	259	259	67	2.0	PA	165	12 & .
P	259	259	67	.6	PA	165	12 & 25
P	259	259	67	1.4	PA	165	12 & 29
T	259	259	67	3.0	PA	250	. & .
P	259	259	67	1.0	PA	250	12 & 25
P	259	259	67	2.0	PA	250	12 & 29
T	259	259	67	6.7	PA	330	12 & .
P	259	259	67	3.35	PA	330	12 & 25

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
P	259	259	67	3.35	PA	330	12 & 29
C	259	259	67	11.9	PA	410	12 & 25
C	259	259	67	3.7	P	80	12 & 29
C	259	259	67	2.5	P	80	12 & 29
C	259	259	67	1.7	P	80	12 & 29
C	259	259	67	10.9	P	500	12 & 29
C	259	259	67	4.6	P	165	12 & 29
C	259	259	67	3.0	P	80	12 & 29
T	259	259	67	4.3	P	165	12 & .
P	259	259	67	1.43	P	165	12 & 25
P	259	259	67	2.86	P	165	12 & 29
C	259	259	67	1.4	C	165	12 & 29
C	259	259	67	4.2	C	410	12 & 29
C	259	259	67	4.1	C	250	12 & 29
C	259	259	67	7.2	SB	330	12 & 29
C	259	259	67	0.6	SB	50	12 & 29
C	259	259	67	1.7	SB	250	12 & 29
C	259	259	67	2.8	SB	250	12 & 29
T	259	259	67	2.7	SB	165	12 & .
P	259	259	67	1.35	SB	165	12 & 25
P	259	259	67	1.35	SB	165	12 & 29
C	259	259	67	0.8	SB	80	12 & 29
T	259	259	67	7.0	SB	250	12 & .
P	259	259	67	1.75	SB	250	12 & 25
P	259	259	67	5.25	SB	250	12 & 29
C	259	259	67	5.2	SB	165	12 & 29
C	259	259	67	20.7	C	410	12 & 16A
C	259	259	67	5.8	C	250	12 & 29
T	259	259	67	34.1	C	580	12 & .
P	259	259	67	25.575	C	580	12 & 16A
P	259	259	67	8.525	C	580	12 & 21B
C	259	259	67	4.8	C	165	12 & 29
C	259	259	67	3.9	C	330	12 & 29
C	259	259	67	3.5	C	165	12 & 29
T	259	259	67	6.6	C	165	12 & .
P	259	259	67	3.3	C	165	12 & 16A
P	259	259	67	3.3	C	165	12 & 29
C	259	259	67	1.7	C	250	12 & 29
C	259	259	67	3.8	C	165	12 & 29
C	259	259	67	2.5	C	250	12 & 29
C	259	259	67	2.9	C	165	12 & 29

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	259	259	67	2.8	C	330	12 & 29
C	259	259	67	0.8	C	50	12 & 29
C	259	259	67	8.0	C	165	12 & 29
C	259	259	67	1.2	C	80	12 & 29
C	259	259	67	4.2	C	165	12 & 29
C	259	259	67	6.8	C	330	12 & 29
C	259	259	67	2.4	C	165	12 & 29
C	259	259	67	6.3	C	165	12 & 29
T	259	259	67	7.8	C	165	12 & .
P	259	259	67	3.9	C	165	12 & 6
P	259	259	67	3.9	C	165	12 & 29
C	2694	2694	7	4.7	.	165	. & 16A
T	2694	2694	7	16.4	.	250	. & .
P	2694	2694	7	8.2	.	250	. & 6
P	2694	2694	7	8.2	.	250	. & 16A
C	2694	2694	7	6.1	.	330	. & 6
C	2694	2694	7	5.1	.	80	. & 6
C	2694	2694	7	23.1	.	250	. & 6
C	2694	2694	7	23.5	.	500	. & 6
T	2694	2694	7	34.3	.	410	. & .
P	2694	2694	7	11.4	.	410	. & 6
P	2694	2694	7	22.86	.	410	. & 29
T	259	2503	19	18.6	C	330	8&12 .
P	259	2503	19	6.2	C	330	8&12 16A
P	259	2503	19	12.4	C	330	8&12 21A
C	259	2503	19	30.4	C	330	8&12 16A
C	259	2503	19	7.5	C	250	8&12 16A
T	259	2503	19	24.1	C	410	8&12 .
P	259	2503	19	12.05	C	410	8&12 6
P	259	2503	19	12.05	C	410	8&12 16A
C	259	2503	19	9.4	C	165	8&12 6
T	259	2503	19	25.0	P	500	8&12 .
P	259	2503	19	6.25	P	500	8&12 6
P	259	2503	19	18.75	P	500	8&12 16A
T	259	2503	19	4.2	C	165	8&12 .
P	259	2503	19	2.1	C	165	8&12 16A
P	259	2503	19	2.1	C	165	8&12 21B
C	259	2503	19	5.5	C	165	8&12 10A
T	259	2503	19	2.4	P	80	8&12 .
P	259	2503	19	.8	P	80	8&12 10A
P	259	2503	19	1.6	P	80	8&12 16A

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	259	2503	19	8.5	P	250	8&12 16A
C	259	2503	19	5.0	P	330	8&12 16A
C	259	2503	19	3.9	C	80	8&12 16A
T	259	2503	19	7.0	C	500	8&12 .
P	259	2503	19	3.5	C	500	8&12 6
P	259	2503	19	3.5	C	500	8&12 16A
C	259	2503	19	1.5	C	50	8&12 6
C	259	2503	19	1.8	C	50	8&12 16A
T	259	2503	19	25.5	C	330	8&12 .
P	259	2503	19	8.5	C	330	8&12 6
P	259	2503	19	8.5	C	330	8&12 10A
P	259	2503	19	8.5	C	330	8&12 16A
C	259	2503	19	3.1	C	165	8&12 16A
C	259	2503	19	0.9	C	50	8&12 6
C	259	2503	19	0.6	C	50	8&12 6
T	258	233	4	7.2	WB	250	8 & .
P	258	233	4	4.8	WB	250	8 & 12
P	258	233	4	2.4	WB	250	8 & 16A
C	258	233	4	60.3	WB	660	8 & 16A
C	258	233	4	1.6	WB	250	8 & 16A
T	258	233	4	41.9	WB	660	8 & .
P	258	233	4	36.662	WB	660	8 & 16A
P	258	233	4	5.2375	WB	660	8 & 16B
C	209	209	20	28.1	SB	330	8 & 6
T	209	209	20	6.5	WB	330	8 & .
P	209	209	20	3.25	WB	330	8 & 6
P	209	209	20	3.25	WB	330	8 & 16A
C	209	209	20	40.0	SB	330	8 & 6
T	209	209	20	5.5	WB	165	8 & .
P	209	209	20	1.83	WB	165	8 & 6
P	209	209	20	3.67	WB	165	8 & 29
T	209	209	20	21.8	.	660	8 & .
P	209	209	20	7.27	.	660	8 & 6
P	209	209	20	14.54	.	660	8 & 29
C	209	209	20	1.7	.	80	8 & 6
C	209	209	20	8.3	.	330	8 & 29
C	209	209	20	12.0	SB	250	8 & 29
C	209	209	20	4.2	SB	80	8 & 16A
T	209	209	20	9.8	SB	165	8 & .
P	209	209	20	3.27	SB	165	8 & 6
P	209	209	20	6.54	SB	165	8 & 16A

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	209	209	20	9.0	SB	330	8 & 16A
C	209	209	20	6.7	SB	165	8 & 6
C	209	209	20	8.0	SB	250	8 & 16B
T	209	209	20	8.3	SB	410	8 & .
P	209	209	20	4.15	SB	410	8 & 6
P	209	209	20	4.15	SB	410	8 & 29
T	209	209	20	19.0	SB	330	8 & .
P	209	209	20	6.33	SB	330	8 & 6
P	209	209	20	12.67	SB	330	8 & 29
T	209	209	20	12.6	WB	165	8 & .
P	209	209	20	8.4	WB	165	8 & 6
P	209	209	20	4.2	WB	165	8 & 16B
C	209	209	20	10.1	SB	165	8 & 16B
C	209	209	20	9.6	SB	165	8 & 12
C	209	209	20	7.2	WB	80	8 & 10B
C	209	209	20	5.5	SB	330	8 & 10B
T	369	369	4	6.8	C	250	4&5 & .
P	369	369	4	5.54	C	250	4&5 & 10A
P	369	369	4	2.26	C	250	4&5 & 16A
T	369	369	4	19.1	C	330	4&5 & .
P	369	369	4	9.55	C	330	4&5 & 10B
P	369	369	4	9.55	C	330	4&5 & 16A
C	369	369	4	6.9	C	250	4&5 & 10B
T	369	369	4	87.2	C	660	4&5 & .
P	369	369	4	29.07	C	660	4&5 & 10B
P	369	369	4	58.13	C	660	4&5 & 16A
T	339	339	3	21.2	SB	580	8&4 & .
P	339	339	3	10.6	SB	580	8&4 & 10A
P	339	339	3	10.6	SB	580	8&4 & 10B
T	339	339	3	25.7	SB	580	8&4 & .
P	339	339	3	6.425	SB	580	8&4 & 6
P	339	339	3	6.425	SB	580	8&4 & 16A
P	339	339	3	6.425	SB	580	8&4 & 16B
P	339	339	3	6.425	SB	580	8&4 & 29
C	339	339	3	14.3	SB	330	8&4 & 16B
C	220	220	1	16.2	V	165	4 & 16B
T	446	446	3	6.1	P	80	26 & .
P	446	446	3	2.03	P	80	26 & 14
P	446	446	3	2.03	P	80	26 & 22A
P	446	446	3	2.04	P	80	26 & 22B
T	446	446	3	4.4	SB	80	26 & .

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
P	446	446	3	1.46	SB	80	26 & 14
P	446	446	3	1.46	SB	80	26 & 22A
P	446	446	3	1.46	SB	80	26 & 22B
C	446	446	3	1.6	SB	165	26 & 8A
C	602	602	8	8.1	C	330	32 & 15B
C	602	602	8	0.7	SB	50	32 & 1B
C	602	602	8	0.6	SB	50	32 & 1B
T	602	602	8	4.6	SB	165	32 & .
P	602	602	8	3.45	SB	165	32 & 1B
P	602	602	8	1.15	SB	165	32 & 8A
T	602	602	8	3.1	P	250	32 & .
P	602	602	8	1.55	P	250	32 & 1B
P	602	602	8	1.55	P	250	32 & 15B
C	602	602	8	1.0	SB	80	32 & 15B
C	602	602	8	9.4	C	250	32 & 19
C	602	602	8	11.9	P	250	32 & 14
C	258	409	15	7.8	SB	410	11&12 6
C	258	409	15	7.1	SB	410	11&12 6
C	258	409	15	7.8	SB	330	11&12 6
T	258	409	15	9.2	SB	330	11&12 .
P	258	409	15	3.07	SB	330	11&12 6
P	258	409	15	6.13	SB	330	11&12 16A
C	258	409	15	2.9	SB	165	11&12 29
C	258	409	15	4.5	SB	250	11&12 29
C	258	409	15	5.0	SB	250	11&12 6
C	258	409	15	10.4	P	250	11&12 16A
T	258	409	15	4.6	SB	250	11&12 .
P	258	409	15	1.53	SB	250	11&12 6
P	258	409	15	3.07	SB	250	11&12 16A
T	258	409	15	3.5	SB	165	11&12 .
P	258	409	15	1.75	SB	165	11&12 6
P	258	409	15	1.75	SB	165	11&12 29
C	258	409	15	9.0	SB	250	11&12 29
T	258	409	15	36.9	P	500	11&12 .
P	258	409	15	9.225	P	500	11&12 6
P	258	409	15	27.675	P	500	11&12 16A
C	258	409	15	6.1	P	165	11&12 16A
T	258	409	15	18.1	P	330	11&12 .
P	258	409	15	12.07	P	330	11&12 6
P	258	409	15	6.03	P	330	11&12 16A
C	258	409	15	35.3	SB	330	11&12 6

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	711	711	7	0.7	SB	50	31 & 5B2
C	711	711	7	0.5	SB	50	31 & 5B2
C	711	711	7	6.2	SB	330	31 & 14
T	711	711	7	6.4	SB	250	31 & .
P	711	711	7	3.2	SB	250	31 & 7B2
P	711	711	7	3.2	SB	250	31 & 8A
C	711	711	7	1.2	SB	80	31 & 8A
C	711	711	7	3.5	C	165	31 & 8A
C	711	711	7	3.1	C	165	31 & 14
C	2670	2670	3	16.1	WB	250	14&15 14
T	2670	2670	3	26.0	WB	250	14&15 .
P	2670	2670	3	13.0	WB	250	14&15 14
P	2670	2670	3	13.0	WB	250	14&15 16A
T	2670	2670	3	17.2	.	165	14&15 .
P	2670	2670	3	11.47	.	165	14&15 16A
P	2670	2670	3	7.73	.	165	14&15 19
T	210	210	1	3.9	C	165	15 & .
P	210	210	1	1.95	C	165	15 & 10A
P	210	210	1	1.95	C	165	15 & 15B
C	714	714	2	6.0	WB	250	26 & 26
C	714	714	2	6.8	WB	165	26 & 22A
C	258	410	5	3.8	C	165	15 & 6
C	258	410	5	2.8	C	165	15 & 16A
C	258	410	5	2.2	C	80	15 & 12
T	258	410	5	5.1	C	250	15 & .
P	258	410	5	2.55	C	250	15 & 1B
P	258	410	5	2.55	C	250	15 & 23A
C	258	410	5	7.7	C	165	15 & 21B
C	709	709	5	1.4	SB	165	26 & 22B
T	709	709	5	3.4	SB	250	26 & .
P	709	709	5	1.7	SB	250	26 & 8A
P	709	709	5	1.7	SB	250	26 & 22B
C	709	709	5	3.5	SB	330	26 & 8A
T	709	709	5	2.3	C	80	26 & .
P	709	709	5	1.55	C	80	26 & 8A
P	709	709	5	0.75	C	80	26 & 22B
T	709	709	5	4.1	C	165	26 & .
P	709	709	5	1.37	C	165	26 & 8A
P	709	709	5	2.73	C	165	26 & 22A
T	2266	2257	1	31.7	SB	500	15 & .
P	2266	2257	1	10.57	SB	500	15 & 8A

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
P	2266	2257	1	21.13	SB	500	15 & 22A
C	738	738	6	2.9	SB	165	11 & 12
C	738	738	6	4.9	P	250	11 & 12
C	738	738	6	31.1	SB	500	11 & 12
T	738	738	6	23.6	C	825	11 & .
P	738	738	6	11.8	C	825	11 & 12
P	738	738	6	11.8	C	825	11 & 16A
T	738	738	6	29.7	P	410	11 & .
P	738	738	6	7.425	P	410	11 & 10B
P	738	738	6	7.425	P	410	11 & 12
P	738	738	6	7.425	P	410	11 & 15B
P	738	738	6	7.425	P	410	11 & 16B
T	738	738	6	17.0	C	500	11 & .
P	738	738	6	8.50	C	500	11 & 10B
P	738	738	6	8.50	C	500	11 & 16A
T	258	262	6	1.7	.	165	11 & .
P	258	262	6	.85	.	165	11 & 6
P	258	262	6	.85	.	165	11 & 16A
C	258	262	6	1.9	BS	80	11 & 24
C	258	262	6	3.2	BS	250	11 & 24
C	258	262	6	5.8	C	250	11 & 24
T	258	262	6	20.5	P	1160	11 & .
P	258	262	6	10.25	P	1160	11 & 12
P	258	262	6	10.25	P	1160	11 & 16A
C	258	262	6	32.4	BS	1000	11 & 12
C	258	258	15	7.8	SB	410	11&12 6
C	258	258	15	7.1	SB	410	11&12 6
C	258	258	15	7.8	SB	330	11&12 6
T	258	258	15	9.2	SB	330	11&12 .
P	258	258	15	3.07	SB	330	11&12 6
P	258	258	15	6.13	SB	330	11&12 16A
C	258	258	15	2.9	SB	165	11&12 29
C	258	258	15	4.5	SB	250	11&12 29
C	258	258	15	5.0	SB	250	11&12 6
C	258	258	15	10.4	P	250	11&12 16A
T	258	258	15	4.6	SB	250	11&12 .
P	258	258	15	1.53	SB	250	11&12 6
P	258	258	15	3.07	SB	250	11&12 16A
T	258	258	15	3.5	SB	165	11&12 .
P	258	258	15	1.75	SB	165	11&12 6
P	258	258	15	1.75	SB	165	11&12 29

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	258	258	15	9.0	SB	250	11&12 29
T	258	258	15	36.9	P	500	11&12 .
P	258	258	15	9.225	P	500	11&12 6
P	258	258	15	27.675	P	500	11&12 16A
C	258	258	15	6.1	P	165	11&12 16A
T	258	258	15	18.1	P	330	11&12 .
P	258	258	15	6.03	P	330	11&12 6
P	258	258	15	12.07	P	330	11&12 16A
C	258	258	15	35.3	SB	330	11&12 6
T	305	305	3	5.4	C	165	11 & .
P	305	305	3	2.7	C	165	11 & 10B
P	305	305	3	2.7	C	165	11 & 16A
C	305	305	3	7.6	PA	410	11 & 16A
C	305	305	3	1.8	PA	165	11 & 6
C	218	2406	11	7.7	WB	165	11&12 26
C	218	2406	11	4.7	WB	250	11&12 26
C	218	2406	11	1.9	WB	165	11&12 6
C	218	2406	11	0.5	WB	50	11&12 16A
C	218	2406	11	0.8	WB	80	11&12 6
C	218	2406	11	5.4	WB	250	11&12 16A
C	218	2406	11	1.7	WB	80	11&12 6
T	218	2406	11	3.3	WB	80	11&12 .
P	218	2406	11	1.65	WB	80	11&12 6
P	218	2406	11	1.65	WB	80	11&12 16A
C	218	2406	11	2.8	WB	165	11&12 16A
C	218	2406	11	2.7	WB	50	11&12 16A
T	218	2406	11	17.9	WB	330	11&12 .
P	218	2406	11	8.95	WB	330	11&12 6
P	218	2406	11	8.95	WB	330	11&12 16A
T	258	246	1	12.3	SB	165	11 & .
P	258	246	1	8.2	SB	165	11 & 15B
P	258	246	1	4.1	SB	165	11 & 16A
T	218	218	3	16.7	WB	165	8&12 .
P	218	218	3	8.35	WB	165	8&12 10A
P	218	218	3	8.35	WB	165	8&12 16A
T	218	218	3	22.7	WB	250	8&12 .
P	218	218	3	5.675	WB	250	8&12 10A
P	218	218	3	17.025	WB	250	8&12 16A
C	218	218	3	0.9	I	80	8&12 6
T	307	307	3	3.2	SB	80	11 & .
P	307	307	3	.80	SB	80	11 & 10B

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
P	307	307	3	1.6	SB	80	11 & 16A
P	307	307	3	.80	SB	80	11 & 21A
C	307	307	3	0.6	G	50	11 & 16A
T	307	307	3	9.0	C	250	11 & .
P	307	307	3	4.5	C	250	11 & 15A
P	307	307	3	4.5	C	250	11 & 16A
C	312	312	3	2.8	.	165	11 & 6
T	312	312	3	2.5	.	250	11 & .
P	312	312	3	1.66	.	250	11 & 6
P	312	312	3	.834	.	250	11 & 29
T	312	312	3	3.5	.	250	11 & .
P	312	312	3	1.75	.	250	11 & 6
P	312	312	3	.875	.	250	11 & 29
C	216	216	4	3.0	C	250	. & .
C	216	216	4	9.4	C	250	. & .
C	216	216	4	2.0	C	80	. & .
C	216	216	4	3.6	C	165	. & .
C	380	380	7	3.0	C	410	. & .
C	380	380	7	3.3	.	330	. & .
C	380	380	7	0.9	.	80	. & .
C	380	380	7	3.0	.	250	. & .
C	380	380	7	1.6	.	50	. & .
C	380	380	7	1.4	.	80	. & .
C	380	380	7	1.1	.	165	. & .
C	361	361	3	0.7	SB	80	. & .
C	361	361	3	0.6	G	50	. & .
C	361	361	3	3.5	SB	80	. & .
C	321	321	2	2.8	C	165	. & .
C	321	321	2	1.7	C	80	. & .
C	262	262	6	3.0	C	165	. & .
C	262	262	6	11.2	C	250	. & .
C	262	262	6	26.0	WB	250	. & .
C	262	262	6	5.5	WB	165	. & .
C	262	262	6	3.7	I	80	. & .
C	262	262	6	6.6	C	250	. & .
T	2213	2213	5	20.3	P	825	9 & .
P	2213	2213	5	5.075	P	825	9 & 8A
P	2213	2213	5	15.225	P	825	9 & 11
C	2213	2213	5	10.4	WB	330	9 & 11
C	2213	2213	5	3.0	WB	160	9 & 11
C	2213	2213	5	9.9	WB	500	9 & 11

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	2213	2213	5	15.1	WB	250	9 & 11
C	2231	2235	5	15.5	P	740	14 & 9A
T	2231	2235	5	28.2	P	500	14 & .
P	2231	2235	5	18.8	P	500	14 & 9A
P	2231	2235	5	9.4	P	500	14 & 11
C	2231	2235	5	0.7	SB	80	14 & 22B
C	2231	2235	5	2.4	SB	165	14 & 22B
C	2231	2235	5	1.2	GS	80	14 & 11
C	2295	2295	6	12.0	C	580	10&14 22B
C	2295	2295	6	6.8	C	80	10&14 22B
C	2295	2295	6	12.7	P	330	10&14 22B
C	2295	2295	6	18.7	P	500	10&14 11
C	2295	2295	6	6.1	P	330	10&14 11
C	2295	2295	6	16.1	PA	500	10&14 22B
T	2330	2269	3	101.7	P	1070	14 & .
P	2330	2269	3	25.425	P	1070	14 & 5A
P	2330	2269	3	25.425	P	1070	14 & 8A
P	2330	2269	3	50.85	P	1070	14 & 19
C	2330	2269	3	14.1	P	165	14 & 5A
C	2330	2269	3	4.1	P	165	14 & 5A
C	2330	2321	6	7.1	C	165	10 & 11
C	2330	2321	6	12.1	C	500	10 & 11
C	2330	2321	6	6.2	C	660	10 & 11
T	2330	2321	6	11.6	C	330	10 & .
P	2330	2321	6	3.87	C	330	10 & 11
P	2330	2321	6	7.73	C	330	10 & 22A
C	2330	2321	6	1.3	C	80	10 & 11
C	2330	2321	6	4.8	C	100	10 & 15D
T	2335	2335	8	17.4	C	500	14 & .
P	2335	2335	8	4.35	C	500	14 & 11
P	2335	2335	8	13.05	C	500	14 & 22B
T	2335	2335	8	9.1	P	660	14 & .
P	2335	2335	8	3.03	P	660	14 & 7B2
P	2335	2335	8	6.07	P	660	14 & 8A
C	2335	2335	8	2.1	C	80	14 & 14
T	2335	2335	8	6.4	C	330	14 & .
P	2335	2335	8	2.13	C	330	14 & 8A
P	2335	2335	8	4.27	C	330	14 & 14
T	2335	2335	8	2.0	P	250	14 & .
P	2335	2335	8	.66	P	250	14 & 8A
P	2335	2335	8	1.34	P	250	14 & 14

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	2335	2335	8	4.3	SB	250	14 & 14
C	2335	2335	8	3.4	P	165	14 & 7B2
C	2335	2335	8	2.1	PA	250	14 & 8B
C	1866	68	4	13.0	C	500	10 & 11
C	1866	68	4	17.1	C	580	10 & 11
C	1866	68	4	12.0	C	330	10 & 11
T	1866	68	4	6.0	H	250	10 & .
P	1866	68	4	2.0	H	250	10 & 5B2
P	1866	68	4	2.0	H	250	10 & 19
P	1866	68	4	2.0	H	250	10 & 22B
C	2231	2214	4	11.5	HP	330	10 & 11
C	2231	2214	4	5.0	HP	250	10 & 11
C	2231	2214	4	12.8	HP	330	10 & 11
C	2231	2214	4	14.5	HP	500	10 & 11
C	2231	2231	12	20.2	C	410	14 & 16A
T	2231	2231	12	27.3	C	500	14 & .
P	2231	2231	12	9.1	C	500	14 & 8A
P	2231	2231	12	18.2	C	500	14 & 22B
C	2231	2231	12	4.3	C	165	14 & 8A
T	2231	2231	12	35.1	C	330	14 & .
P	2231	2231	12	17.5	C	330	14 & 8A
P	2231	2231	12	17.5	C	330	14 & 22B
C	2231	2231	12	4.0	C	165	14 & 8A
C	2231	2231	12	2.5	C	165	14 & 8A
C	2231	2231	12	48.6	P	825	14 & 8A
T	2231	2231	12	8.1	WM	330	14 & .
P	2231	2231	12	5.4	WM	330	14 & 8A
P	2231	2231	12	2.7	WM	330	14 & 22B
T	2231	2231	12	12.5	WM	250	14 & .
P	2231	2231	12	4.17	WM	250	14 & 14
P	2231	2231	12	8.33	WM	250	14 & 22B
T	2231	2231	12	25.6	WM	250	14 & .
P	2231	2231	12	8.53	WM	250	14 & 8A
P	2231	2231	12	17.07	WM	250	14 & 22B
C	2231	2231	12	7.5	WM	330	14 & 8A
C	2231	2231	12	1.6	I	50	14 & 7B2
T	966	966	9	14.5	SB	250	. & .
T	966	966	9	2.3	SB	80	. & .
T	966	966	9	7.6	SB	80	. & .
T	966	966	9	16.0	C	165	. & .
T	966	966	9	3.8	P	250	. & .

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
T	966	966	9	6.7	P	165	. & .
T	966	966	9	5.0	SB	250	. & .
T	966	966	9	3.8	P	80	. & .
T	966	966	9	1.4	SB	50	. & .
T	39	39	5	4.5	C	165	3 & .
P	39	39	5	1.5	C	165	3 & 10B
P	39	39	5	3.0	C	165	3 & 12
C	39	39	5	4.5	C	165	3 & 12
C	39	39	5	4.5	C	80	3 & 12
T	39	39	5	8.5	WA	330	3 & .
P	39	39	5	5.67	WA	330	3 & 16A
P	39	39	5	2.83	WA	330	3 & 23A
C	39	39	5	3.2	WA	165	3 & 23A
T	2231	2198	4	18.0	M	410	14 & .
P	2231	2198	4	9.0	M	410	14 & 11
P	2231	2198	4	9.0	M	410	14 & 22A
C	2231	2198	4	3.2	M	115	14 & 16A
C	2231	2198	4	0.4	SB	50	14 & 5B2
C	2231	2198	4	17.5	P	500	14 & 22A
T	1009	1009	3	9.8	P	250	. & .
T	1009	1009	3	9.2	C	250	. & .
T	1009	1009	3	11.2	SB	250	. & .
T	471	471	9	2.1	P	80	. & .
T	471	471	9	7.5	P	165	. & .
T	471	471	9	10.8	P	330	. & .
T	471	471	9	1.1	P	80	. & .
T	471	471	9	1.5	C	80	. & .
T	471	471	9	2.0	C	165	. & .
T	471	471	9	8.3	C	165	. & .
T	471	471	9	4.7	C	250	. & .
T	471	471	9	24.3	C	410	. & .
T	583	583	1	6.0	C	580	. & .
T	1004	1004	1	68.0	C	660	. & .
T	530	530	6	32.6	C	165	. & .
T	530	530	6	18.9	C	330	. & .
T	530	530	6	38.5	P	330	. & .
T	530	530	6	27.2	C	500	. & .
T	530	530	6	10.1	WB	500	. & .
T	530	530	6	13.9	WB	165	. & .
T	412	412	8	9.6	WB	250	. & .
T	412	412	8	0.5	WB	165	. & .

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
T	412	412	8	6.7	WB	330	. & .
T	412	412	8	2.4	WB	165	. & .
T	412	412	8	1.4	.	80	. & .
T	412	412	8	4.5	R	580	. & .
T	412	412	8	14.9	C	500	. & .
T	412	412	8	5.8	PA	250	. & .
T	1064	1064	4	4.4	WB	165	. & .
T	1064	1064	4	17.0	P	580	. & .
T	1064	1064	4	10.1	C	165	. & .
T	1064	1064	4	16.5	C	580	. & .
T	407	407	9	20.5	C	410	. & .
T	407	407	9	3.2	R	165	. & .
T	407	407	9	7.5	C	165	. & .
T	407	407	9	8.4	P	165	. & .
T	407	407	9	8.7	P	330	. & .
T	407	407	9	1.5	C	80	. & .
T	407	407	9	1.1	SB	50	. & .
T	407	407	9	3.0	SB	165	. & .
T	407	407	9	7.1	PA	165	. & .
C	258	244	5	10.6	P	165	11 & 12
T	258	244	5	5.2	P	250	11 & .
P	258	244	5	1.73	P	250	11 & 12
P	258	244	5	3.47	P	250	11 & 16A
T	258	244	5	7.1	P	330	11 & .
P	258	244	5	3.55	P	330	11 & 6
P	258	244	5	3.55	P	330	11 & 24
T	258	244	5	11.2	P	250	11 & .
P	258	244	5	3.73	P	250	11 & 6
P	258	244	5	3.73	P	250	11 & 16A
P	258	244	5	3.74	P	250	11 & 24
T	258	244	5	7.6	P	410	11 & .
P	258	244	5	3.8	P	410	11 & 6
P	258	244	5	3.8	P	410	11 & 24
T	258	301	13	41.7	C	660	15 & .
P	258	301	13	13.9	C	660	15 & 15E
P	258	301	13	27.8	C	660	15 & 16A
C	258	301	13	1.3	C	80	15 & 16A
C	258	301	13	2.3	C	80	15 & 16A
C	258	301	13	2.2	C	165	15 & 19
C	258	301	13	2.0	C	165	15 & 19
C	258	301	13	2.9	C	165	15 & 19

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
C	258	301	13	2.9	C	165	15 & 19
C	258	301	13	2.9	C	165	15 & 19
C	258	301	13	1.8	C	80	15 & 19
T	258	301	13	8.6	C	330	15 & .
P	258	301	13	5.73	C	330	15 & 6A
P	258	301	13	2.87	C	330	15 & 19
C	258	301	13	9.7	C	165	15 & 16A
T	258	301	13	2.2	C	80	15 & .
P	258	301	13	1.1	C	80	15 & 6
P	258	301	13	1.1	C	80	15 & 16A
C	258	301	13	0.2	I	50	15 & 16A
C	272	272	2	1.7	C	165	15 & 21A
C	272	272	2	1.9	C	165	15 & 21A
C	258	2669	3	8.6	C	250	15 & 21B
T	258	2669	3	11.0	C	165	15 & .
P	258	2669	3	5.5	C	165	15 & 6
P	258	2669	3	5.5	C	165	15 & 23A
C	258	2669	3	2.1	P	80	15 & 23A
T	258	245	2	16.3	P	165	15 & .
P	258	245	2	8.15	P	165	15 & 12
P	258	245	2	8.15	P	165	15 & 15B
C	258	245	2	1.3	P	165	15 & 23A
C	252	252	20	1.7	SB	50	15 & 24
C	252	252	20	1.9	SB	80	15 & 24
C	252	252	20	5.0	SB	165	15 & 24
C	252	252	20	5.0	SB	165	15 & 24
C	252	252	20	2.1	SB	80	15 & 24
C	252	252	20	4.4	SB	165	15 & 24
C	252	252	20	2.2	SB	80	15 & 25
C	252	252	20	2.6	C	80	15 & 6
T	252	252	20	9.2	B	165	15 & .
P	252	252	20	6.9	B	165	15 & 6
P	252	252	20	2.3	B	165	15 & 16A
C	252	252	20	3.3	C	80	15 & 6
C	252	252	20	1.2	SB	50	15 & 24
C	252	252	20	1.1	SB	50	15 & 24
T	252	252	20	62.0	P	740	15 & .
P	252	252	20	20.7	P	740	15 & 6
P	252	252	20	41.3	P	740	15 & 16A
T	252	252	20	54.8	C	660	15 & .
P	252	252	20	27.4	C	660	15 & 6

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
P	252	252	20	27.4	C	660	15 & 16A
T	252	252	20	5.8	P	165	15 & .
P	252	252	20	1.93	P	165	15 & 12
P	252	252	20	3.87	P	165	15 & 16A
T	252	252	20	8.4	P	330	15 & .
P	252	252	20	4.2	P	330	15 & 12
P	252	252	20	4.2	P	330	15 & 16A
C	252	252	20	3.1	P	165	15 & 29
T	252	252	20	7.1	P	330	15 & .
P	252	252	20	3.55	P	330	15 & 12
P	252	252	20	3.55	P	330	15 & 29
C	252	252	20	3.4	C	165	15 & 16A
T	252	252	20	40.9	C	410	15 & .
P	252	252	20	10.225	C	410	15 & 16A
P	252	252	20	30.675	C	410	15 & 21A
T	206	2069	5	6.4	WB	250	. & .
T	206	2069	5	7.8	WB	165	. & .
T	206	2069	5	17.2	WB	250	. & .
T	206	2069	5	40.0	SB	660	. & .
T	206	2069	5	8.1	WB	165	. & .
T	209	209	12	9.5	P	165	. & .
T	209	209	12	9.0	C	330	. & .
T	209	209	12	12.4	P	330	. & .
T	209	209	12	26.6	P	660	. & .
T	209	209	12	7.6	C	165	. & .
T	209	209	12	7.7	P	165	. & .
T	209	209	12	1.7	P	50	. & .
T	209	209	12	26.4	C	330	. & .
T	209	209	12	2.7	C	165	. & .
T	209	209	12	17.2	NC	250	. & .
T	209	209	12	30.6	NC	410	. & .
T	209	209	12	28.5	NC	330	. & .
T	206	318	1	10.7	SB	250	. & .
T	206	246	2	3.4	WB	80	. & .
T	206	246	2	4.5	NC	165	. & .
T	206	510	2	2.7	SB	165	. & .
T	206	510	2	6.6	SB	165	. & .
T	206	284	5	1.4	SB	80	. & .
T	206	284	5	0.3	SB	50	. & .
T	206	284	5	1.2	SB	80	. & .
T	206	284	5	2.3	SB	50	. & .

Appendix C. The HRU Data Collected from ASCS and SCS (Continued).

Record Type	Farm Number	Tract Number	Field Number	Field Acres	Present Crop	Flow Length	Map & Soil Number
T	206	284	5	4.9	SB	80	. & .
T	348	348	4	11.6	CH	165	. & .
T	348	348	4	6.6	WB	250	. & .
T	348	348	4	11.2	WB	250	. & .
T	348	348	4	1.9	WB	165	. & .
T	206	275	3	7.8	C	165	. & .
T	206	275	3	19.0	C	500	. & .
T	206	275	3	9.8	NC	165	. & .
T	322	322	2	10.9	PT	330	. & .
T	322	322	2	0.3	PT	50	. & .

APPENDIX D. THE LIST OF ASCS ABBREVIATIONS FOR VARIOUS LANDUSES.

Abbreviation	Landuse
B	Barley
BE	Beans
C	Corn
CG	Camp Grounds
CH	Chicken House
G	Garden
GS	Grain Sorghum
H	House
HL	Hog Lot
HP	Housing Project
I	Idle
L	Lot
M	Milo
P	Peanuts
PA	Pasture
PT	Peach Trees
R	Rye
S	Soybeans
SF	Sunflowers
SU	Sudex
V	Vegetables
W	Wheat
WA	Watermelons
ANC	Not Cultivated
.	Information Not Avaivbale.

APPENDIX E. SOURCE LISTING OF SAS PROGRAM USED FOR METHOD 4

```
DATA RCWP;
INPUT   FARM_NO  $ 1-4   TRACT_NO $ 6-9
        TOT_ACRE  11-14  TIL_ACRE  16-19
        SHED_NO  $ 22-23  H2OSHED  $ 25-47
        STATUS   $ 49-50  SELECTED $ 53
        SURVEY  $ 54    OWNER   $ 55-56
        OPERATOR $ 58-59  COUNTY   $ 65-67;
IF SHED_NO NE 50 AND SHED_NO NE 52 THEN STATUS = 'C';
CARDS;
10  10  261  40    58 CHUCKATUCK CREEK        NC  *   OO     COS
100  100  2   2    50 WESTERN BRANCH        NC    OW OP     COS
101  101  20  5    58 CHUCKATUCK CREEK        NC    OW        COS
                          •
                          •
                          •
219  219  19  7    56 SMITH AND MUDDY COVES  NC      OO     IOW
321  321  21  5    56 SMITH AND MUDDY COVES  NC      OO     IOW
357  357  56  38   56 SMITH AND MUDDY COVES  NC  * OW OP    IOW
* ABBREVIATIONS:;
*    B   =  BARLEY;
*    BE  =  BEANS;
*    C   =  CORN;
*    CG  =  CAMP GROUNDS;
*    CH  =  CHICKEN HOUSE;
*    G   =  GARDEN;
*    GS  =  GRAIN SORGHUM;
*    H   =  HOUSE;
*    HL  =  HOG LOTS;
*    HP  =  HOUSING PROJECT;
*    I   =  IDLE;
*    L   =  LOT;
*    M   =  MILO;
*    P   =  PEANUTS;
*    PA  =  PASTURE;
*    PT  =  PEACH TREES;
*    R   =  RYE;
*    S   =  SOYBEANS;
*    SF  =  SUNFLOWERS;
*    SU  =  SUDEX;
*    V   =  VEGETABLES;
*    W   =  WHEAT;
*    WA  =  WATERMELONS;
*    ANC =  NOT CULTIVATED;
*    .   =  NOT AVAILABLE;
*;
```

Appendix E. Source listing

```
*;
*;
DATA USLE_RA;
  LENGTH SOIL_NO $ 5 MAP_NO $ 10 CROP $ 10;
  RETAIN FIELD_NO;
  INPUT REC_TYPE $
      SELECT $
      FARM_NO $
      TRACT_NO $
      NO_FIELD
      FIELD_AC
      CROP $
      LENGTH
      MAP_NO $
      SOIL_NO $;
  COUNTY= 'COS';
  IF MAP_NO   EQ ''  THEN COUNTY= 'IOW';
  IF _N_      EQ 1   THEN FIELD_NO=0;
  IF REC_TYPE EQ 'T' THEN FIELD_NO=0;
  IF REC_TYPE EQ 'C' THEN FIELD_NO=1;
  R = 275;
  P = 1.0;
CARDS;
C  A 258 230 4 35.6 BS 660 8 16A              . .
C  A 258 230 4 1.8 B 80 8 16B                . .
C  A 258 230 4 7.6 BS 330 8 16B               . .
                 •
                 •
                 •
T  A 206 275 3 9.8 NC 165        .          . .
T  A 322 322 2 10.9 PT 330       .          . .
T  A 322 322 2 0.3 PT 50        .          . .
PROC SORT DATA=USLE_RA;
       BY COUNTY FARM_NO TRACT_NO;
PROC SORT DATA=RCWP;
       BY COUNTY FARM_NO TRACT_NO;
DATA USLE_RAW;
       MERGE USLE_RA RCWP; BY COUNTY FARM_NO TRACT_NO;
DATA NAN_SOIL;
  LENGTH SOIL_NO $ 5 SOIL_TYP $ 30;
  INPUT SOIL_NO $
      SLOPE
      K
      SOIL_TYP $
      CLAY_PER
      DENSITY
      PERM
      PORE
      PH
      ORG_PER;
   CLAY_PER  = CLAY_PER * 100;
```

```
   ORG_PER   = ORG_PER  * 100;
CARDS;
1B 5 .17 ALAGA           .050  1.4   6,0   .07  5.25 .0075
2 .5 .24 BELHAVEN         .225   .52  3.1   .24  4.50 .5000
3 .5 .32 BOHICKET         .450  1.3    .13  .165 7.25 .0100
                    •
                    •
                    •
25 1.0 .15 TORHUNTA        .100  1.40  4.0   .125 4.55 .
28 1.0 .28 WAHEE         .185  1.30   .11  .183 5.00 .0275
29 1.0 .24 WESTON         .100  1.40   .11  .125 5.25 .0200
* TO MAKE CHANGES BETWEEN WATERWAYS AND FILTER STRIPS LOCATE *@@;
*;
PROC SORT DATA=USLE_RAW; BY SOIL_NO;
PROC SORT DATA=NAN_SOIL; BY SOIL_NO;
DATA USLE_PRE;
  MERGE NAN_SOIL USLE_RAW; BY SOIL_NO;
  LENGTH COVER $ 20;
  IF      CROP NE 'C'
      AND CROP NE 'P'
      AND CROP NE 'SB'
      AND CROP NE 'WB'  THEN DELETE;
  IF      SLOPE EQ .    THEN DELETE;
   P    =  1.0;
   M    =   .3;
  IF      SLOPE LT 1    THEN M  = .2;
  IF      SLOPE GE 3.5
      AND SLOPE LT 4.5  THEN M  = .4;
  IF      SLOPE GE 4.5  THEN M  = .5;
  THETA  = ATAN(SLOPE/100);
   LS    = (LENGTH / 72.6)**M * (65.41 * SIN(THETA)**2+
        4.56 * SIN(THETA) + 0.065);
  IF      CROP EQ 'C'   THEN DO;
   COVER = 'Corn';
    C = 0.260;
    OUTPUT;
    COVER = 'Corn (No-till)';
    C = 0.033;
    OUTPUT;
    COVER = 'CG SB (2 yr.)';
    C = 0.246;
    OUTPUT;
    COVER = 'CG SBc (2 yr.)';
    C = 0.236;
    OUTPUT;
    COVER = 'CG SB (3 yr.)';
    C = 0.267;
    OUTPUT;
    COVER = 'CG SBc (3 yr.)';
    C = 0.258;
    OUTPUT;
    COVER = 'C G SB (3 yr.)';
```

```
    C = 0.320;
  END;
  IF     CROP EQ 'SB' THEN DO;
    COVER = 'Soybeans';
    C     = 0.344;
    OUTPUT;
  END;
  IF     CROP EQ 'WB' THEN DO;
    COVER ='Grain/Soybeans';
    C     = 0.026;
    OUTPUT;
  END;
  IF     CROP EQ 'P' THEN DO;
    COVER = 'Peanuts';
    C     = 0.355;
    OUTPUT;
    COVER = 'Peanuts cC';
    C     = 0.316;
    OUTPUT;
    COVER = 'Peanuts cCG';
    C     = 0.333;
    OUTPUT;
    COVER = 'Peanuts GC';
    C     = 0.279;
    OUTPUT;
    COVER = 'Peanuts c SB C';
    C     = 0.355;
    OUTPUT;
    COVER = 'Peanuts c SBc Cc';
    C     = 0.333;
    OUTPUT;
  END;
DATA PROD;
   LENGTH CROP $ 10 SOIL_NO $ 5;
   KEEP SOIL_NO CROP PRODUCE;
   INPUT SOIL_NO $
       D1
       D2
       D3
       D4;
    CROP    = 'C';
    PRODUCE = D1;
    OUTPUT;
    CROP    = 'SB';
    PRODUCE = D2;
    OUTPUT;
    CROP    = 'WB';
    PRODUCE = D3;
    OUTPUT;
    CROP    = 'P';
    PRODUCE = D4;
```

```
   OUTPUT;
CARDS;
1B              65   20   25   2700
5A              125  45   50    3700
5B2             115  40   45    3500
                 •
                 •
                 •
28              90  40   40       .
29              100  40   45      .
PROC SORT;
      BY SOIL_NO CROP;
PROC SORT DATA=USLE_PRE;
      BY SOIL_NO CROP;
DATA USLE_PR;
MERGE PROD USLE_PRE;
      BY SOIL_NO CROP;
  PRODUC = PRODUCE * FIELD_AC;
DATA USLE_PRO;
  SET USLE_PR;
*;
*      1 TON/ACRE * 2240 = 1 KG/HECTAR;
*;
*      1 KG/HECTARE * 1TONNE/1000 KG = TONNES/HECTARE;
*;
*      OR 2240/1000 = 2.240;
*;
   A=R*K*LS*C*P*2.240;
   IF A = . THEN DELETE;
*;
*  3.0 CM OF RAINFALL;
*  .5CM RUNOFF = .005 METERS;
*  ACRE * 4090 = METERS SQUARE;
*  3 HOUR DURATION = 10800 SECONDS;
*  CHANNEL WIDTH = 3 METERS;
*  MANNINGS N (FOR GRASS) = 0.035;
*  SPACING OF GRASS BLADES = .003 METERS;
*  KINEMATIC VISCOSITY = 1 * 10**-6 = .000001;
*  SETTLING VELOCITY = .00001;
*  LENGTH = YD * 2.7432 = METER;
*  3M/(.9144 M/YD) * 3FT/YD / (52540 FT**2/ACRE)=.00018;
*  NOTE: THE GRASS WATERWAY IS ASSUMED TO 25% OF OVERLAND LENGTH.;
*      THE OVERLAND LENGTH IS THE DISTANCE WATER MUST TRAVEL;
*      OVER LAND TO REACH A WATERCOURSE.;
*;
   TILDEPTH=30;
   IF CROP EQ 'C'  THEN P_FERT=110*1.12;
   IF CROP EQ 'WB' THEN P_FERT=60*1.12;
   IF CROP EQ 'SB' THEN P_FERT=60*1.12;
   IF CROP EQ 'P'  THEN P_FERT=20*1.12;
   IF CROP EQ 'C'  THEN N_FERT=265*1.12;
   IF CROP EQ 'WB' THEN N_FERT=165*1.12;
```

```
   IF CROP EQ 'SB' THEN N_FERT=120*1.12;
   IF CROP EQ 'P'  THEN N_FERT=100*1.12;
*;
* TOT_P AND TOT_N ARE IN UGMS/GM.;
*;
   TOT_P=(P_FERT*10**9)/(TILDEPTH*10**8);
   TOT_N=(N_FERT*10**9)/(TILDEPTH*10**8);
   Q_ZERO=-3.5+10.7*CLAY_PER+49.5*ORG_PER;
   BETA=0.061+169832*10**(-1*PH)+0.027*CLAY_PER+0.76*ORG_PER;
   QUAD_A=PORE*BETA;
   QUAD_B=PORE+Q_ZERO*BETA*DENSITY-TOT_P*BETA;
   QUAD_C=TOT_P*(-1);
   CEE_P=(((-1)*QUAD_B)+SQRT(QUAD_B**2-4*QUAD_A*QUAD_C))/2*QUAD_A;
   SIS_P=(Q_ZERO*BETA*CEE_P)/(1+BETA*CEE_P);
*;
*          1 GM/HECTARE * 1 KG/1000 GM / 2240 = TONS/ACRE
*;
*          1 TON/ACRE * 2000 LBS/TON = LBS/ACRE;
*;
*     OR, 1/1000 * 1/2240 * 2000 = 1/1120;
*;
   Y_PO4=SIS_P*2.0*A/1120;
   ER_OR=0.30/ORG_PER+1.08;
   A_STORM=0.13*A;
   CEE_N=-10.;
   AGAIN:
     CEE_N=CEE_N+10;
     IF CEE_N EQ 0 THEN CEE_N = 1;
     TEST=DENSITY*7.0*(CEE_N**.8)+PORE*CEE_N-TOT_N;
     IF TEST LT 0.0 THEN GO TO AGAIN;
   IF CEE_N GT 10 THEN CEE_N=CEE_N-10;
  AGAIN1:
    CEE_N=CEE_N+1.;
    TEST=DENSITY*7.0*CEE_N**.8+PORE*CEE_N-TOT_N;
    IF TEST LT 0.0 THEN GO TO AGAIN1;
  IF CEE_N GT 1 THEN CEE_N=CEE_N-1;
   AGAIN2:
     CEE_N=CEE_N+.1;
     TEST=DENSITY*7.0*CEE_N**.8+PORE*CEE_N-TOT_N;
     IF TEST LT 0.0 THEN GO TO AGAIN2;
   SIS_N=7.0*CEE_N**.8;
   TKN=TOT_N*4;
*;
*          1 GM/HECTARE * 1 KG/1000 GM / 2240 = TONS/ACRE
*;
*          1 TON/ACRE * 2000 LBS/TON = LBS/ACRE;
*;
*     OR, 1/1000 * 1/2240 * 2000 = 1/1120;
*;
   YSN=((ORG_PER*TKN+SIS_N)*A_STORM*ER_OR)/1120;
   C_C=1+3/(1.5*PORE*3*2);
   C_PRIME=CEE_N/C_C;
```

```
    YDN=(C_PRIME*10**-6*.5*10**8)/1120;
    Y_N=YDN+YSN;
 PROC SORT; BY SHED_NO STATUS COVER;
 OPTIONS LINESIZE=80;
 OPTIONS NODATE
       NOCENTER;
 PROC MEANS NOPRINT MAXDEC=2; BY SHED_NO STATUS COVER;
    VAR  FIELD_AC LENGTH A Y_PO4 Y_N;
    OUTPUT OUT=USLE_TOT
    MEAN=FIELD_AC LENGTH A Y_PO4 Y_N
    SUM  =  TOT_AC
    N    =  N;
 PROC SORT DATA=USLE_TOT; BY SHED_NO STATUS;
 TITLE SUMMARY OF SOIL LOSS INDICATORS - NANSEMOND WATERSHED;
 PROC PRINT;
 PROC SORT DATA=USLE_PRO; BY COVER;
 PROC MEANS NOPRINT MAXDEC=2; BY COVER;
    VAR  FIELD_AC LENGTH A Y_PO4 Y_N;
    OUTPUT OUT=USLE_TOT
    MEAN=FIELD_AC LENGTH A Y_PO4 Y_N
    SUM  =  TOT_AC
    N    =  N;
 PROC SORT DATA=USLE_TOT; BY COVER;
 TITLE SUMMARY OF SOIL LOSS INDICATORS - NANSEMOND WATERSHED;
 PROC PRINT;
```

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