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An Economic Analysis of Erosion and Sedimentation Damage in the Duck Creek Watershed, Dickens County, Texas

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CONTENTS

INTRODUCTION

The Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500, established a national goal of eliminating the discharge of pollutants into the nation's waterways by 1985. As a step toward that goal an interim water quality standard of "fishable, swimmable waters nationwide" by July 1, 1983 was determined. Under section 208 of this law, each state was required to establish a "continuing planning process" to define controls for agricultural non-point sources of water pollution.

Section 208 calls for the development of state and area-wide water quality management plans. The plans are to include "a process to (i) identify if appropriate, agriculturally and silviculturally related non-point sources of pollution, including runoff from manure disposal areas, and from land used for livestock and crop production, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources."

The water quality issue of concern in this study is fertilizer and pesticide residuals carried into waterways by sediment.

Since sediment is a potential transporter of pollutants, practices to control agricultural non-point source pollution would probably be aimed at reducing soil loss. Conservation and conservation related practices are, at present, considered the best technical practices to abate agricultural non-point source pollution.

This study examines the economic impact of various policies that could be used to reduce soil loss. Both regulatory and voluntary policies are considered. Economic impacts examined include: (a) impacts of the policies on farm income; (b) government costs associated with the policies, including administration costs; (c) off-site sediment damages that would be abated; and (d) social desirability of the policies.

The first section of the report describes the selected "Best Management Practices" and examines the on-farm economics of soil conservation. Then, the second section postulates various sediment damage control options and models the economic consequences, both to agricultural producers as a group, and to society of implementing them.

DESCRIPTION OF THE WATERSHED

The Duckcreek watershed encompasses an area of 208 square miles almost entirely in Dickens county, Texas. It consists of the main streams of Duck Creek from its origin, approximately four miles east of McAdoo, to the Dickens-Kent county line and its major tributaries: Cottonwood Creek, Dockum Creek, Spade Draw, and Wilson Draw. A map of the watershed is given in Figure 1.

The topography of the watershed is quite varied and can be separated into three distinct areas: the Rolling Plains Land Resource Area; the High Plains Resource Area; and the Cap Rock Escarpment which separates the two.

The High Plains Land Resource Area, which amounts to about eight percent of the watershed, is characterized by a flat surface with a general southeastward slope. The surface contains many shallow depressions or sinks called playas, which are occasionally filled to overflow by heavy rains. This causes a small portion of the High Plains to contribute water to Duck Creek as runoff spills over the Cap Rock Escarpment.

The Rolling Plains Land Resource Area has a surface that is gently sloping to rolling in the uplands with many nearly level areas in the broad alluvial valleys. It encompasses approximately eighty percent of the watershed.

The remaining twelve percent of the watershed is formed by the Cap Rock Escarpment which delineates the eastern edge of the High Plains. The slopes along the escarpment range up to twenty to fifty percent. The buttes, canyons, large gullies, and "arroyo

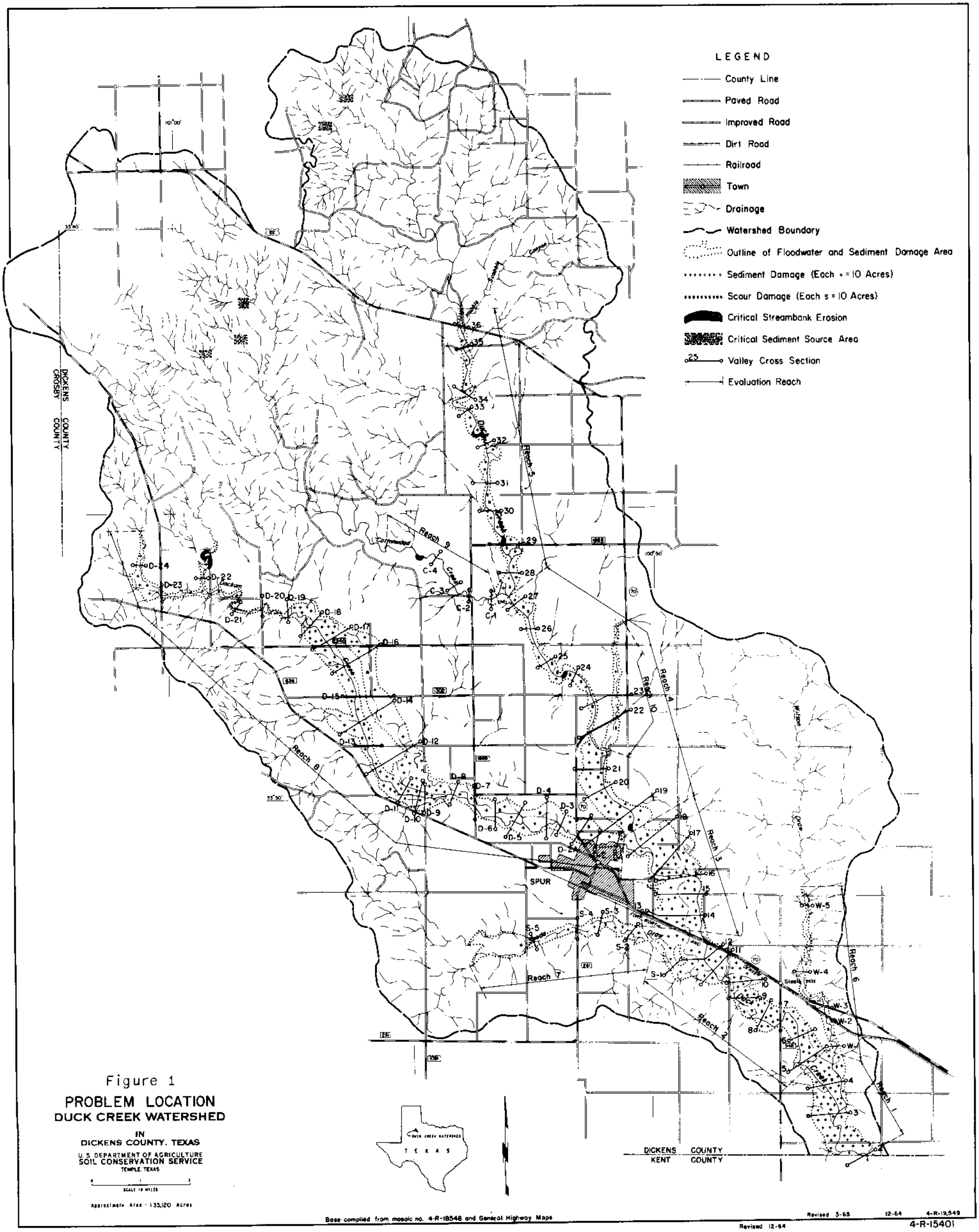

Figure 1
PROBLEM LOCATION
DUCK CREEK WATERSHED
IN
DICKENS COUNTY, TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

Revised 12-64
4-R-15401

USDA-SCS-FORT WORTH, TEX. 1965

like" channels, characteristic of the escarpment, illuminate the geologic instability of the area and the rapid rate of erosion.

Elevations in the watershed range from greater than 2,900 feet on the High Plains to about 2,140 feet on the flood plain at the Dickens-Kent county line.

The climate is warm and semi-arid. Mean monthly temperatures range from 42 degrees Fahrenheit in January to 82 degrees in July. The normal growing season in 242 days, extending from March 19 to November 16. The average annual rainfall is 21.36 inches with the heaviest rainfall period extending from April through October. The monthly average ranges from 2.96 inches in September to 0.55 inches in January. Much of the rain falls as intense local showers which result in rapid runoff and an increased potential for severe soil erosion.

The watershed soils are in general deep, fertile, moderately permeable fine sandy loams and clay loams in the valleys; very shallow to deep, moderately to very slowly permeable clay loams in the rolling uplands; very shallow to deep, moderately to somewhat rapidly permeable fine sandy loams and clay loams in the Cap Rock Escarpment; and shallow to deep, slowly to very slowly permeable clay loams on the High Plains. The dominant soil series are Spur, Miles, Abilene, Wichita, Weymouth, Vernon, Bippus, Mansker, Potter, and Pullman. The individual soils and extent of each are listed in Table 1.

Over the last five years approximately 20 percent of the watershed has been planted to cotton, 14 percent to sorghum, and 11

Table 1. Acreages of cropland and rangeland in the Duck Creek watershed by soil mapping unit.[a]

Soil	Table Abbrev.	Acreage
Abilene clay loam, 0-1% slopes	AU01	2,960
Berda-Mansker complex, 3-8% slopes	BMCO	4,678
Berda-Potter association, 3-30% slopes	BPAS	4,061
Bippus clay loam, 1-3% slopes	BC13	548
Brownfield-Nobscot association	BNAU	5,623
Latom gravelly soils, 3-8% slopes	LG38	462
Lofton clay loam	LTCL	738
Mansker loam, 1-3% slopes	MK13	2,957
Mansker loam, 3-5% slopes	MK35	1,183
Meno fine sandy loam	MFSL	1,874
Meno loamy fine sand	MLFS	3,749
Miles fine sandy loam, 0-1% slopes	ML01	4,003
Miles fine sandy loam, 1-3% slopes	ML13	19,721
Miles fine sandy loam, 3-5% slopes	ML35	15,874
Miles fine sandy loam, 5-8% slopes	ML58	704
Miles loamy fine sand, 0-3% slopes	MS03	7,477
Miles loamy fine sand, 3-5% slopes	MS35	5,689
Miles soils, 2-6% slopes	MI26	704
Mobeetie fine sandy loam, 1-3% slopes	MB13	164
Mobeetie fine sandy loam, 3-5% slopes	MB35	384
Olton clay loam, 0-1% slopes	OC01	4,986
Olton clay loam, 1-3% slopes	OC13	10,969
Pullman clay loam, 0-1% slopes	PC01	7,793
Pullman clay loam, 1-3% slopes	PC13	1,063
Randall clay	RANC	689
Randall fine sandy loam	RANL	49
Rough broken land	RBLD	4,521
Spur clay loam	SPCL	899
Spur fine sandy loam	SPSL	1,499
Stanford clay 1-3% slopes	SC13	462
Tillman clay loam, 0-1% slopes	TC01	154
Tillman clay loam, 1-3% slopes	TC13	308
Vernon soils, 3-8% slopes	VN38	3,811
Vernon-Badland complex	VBCO	2,128
Weymouth clay loam, 1-3% slopes	WC13	3,511
Weymouth clay loam, 3-5% slopes	WC35	1,351
Woodward loam, 1-3% slopes	WL13	152
Woodward loam, 3-5% slopes	WL35	278
Woodward-Quinlan loam, 3-15% slopes	WQLM	1,414
Total Acreage		129,590

[a]Source: Soil and Water Conservation Service.

percent to wheat and other small grains. Only about 1200 acres are irrigated in the watershed. Table 2 lists the average land use pattern in the watershed for the 1970-1975 period.

The Duckcreek watershed is a Public Law 566 watershed protection project area. A system of 12 floodwater retarding structures, 5 grade stabilization structures and 7 structures for streambank protection have been erected. The floodwater retarding structures have a combined design storage capacity of 29,089 acre-feet of which 10,281 acre-feet is designated for sediment accumulation.

In a 1976 survey of conservation problems in Texas as viewed by the Soil and Water Conservation District Directors, agricultural non-point source pollutants in the Rolling Plains Land Resource Area were rated as a problem of slight to moderate severity, as were floods. They were ranked fourteenth and tenth, respectably, among the area's problems. However, water erosion, as an on-farm soil management problem, and the economics of conservation were ranked second and third, being considered problems of moderate to severe proportions. Thus, the on-farm erosion problem is viewed as more critical than the off-farm down stream flooding and pollution problem. The complete survey results for the Rollings Plains Resource Area are given in Table 3.

Table 2. Approximate land use in the Duck Creek watershed for the period of 1970-1975.[a]

Land Use	Acreage	Percent
Cropland		
Cotton	27,000	20.3
Grain Sorghum	19,000	14.3
Wheat, Small grains	15,000	11.3
Pasture and Minor Crops	3,500	2.6
	64,500	48.5
Rangeland	65,000	48.8
Miscellaneous[b]	3,600	2.7
Total	133,100	100.0

[a]Source: Soil and Water Conservation Service

[b]Includes roads, railroads, towns, stream channels, etc.

Table 3. Soil and water conservation district directors' rating of conservation problems in the Rolling Plains Land Resource Area.[a]

Problems	Rank	Present Severity[1/]	Change in Condition in Past 10 Years[2/]
Water-Related Problems			
1 Non-Point Source Pollution			
i Agricultural Non-Point Source Pollutants	14	1.36	+.41
ii Silvicultural Non-Point Source Pollutants	23	.73	0
iii Mining Operations Non-Point Source Pollutants	19	1.05	-.02
iv Construction Site Non-Point Source Pollutants	17	1.20	-.14
v Waste Disposal Non-Point Source Pollutants	12	1.45	-.05
vi Salt Water Intrusion	12	1.45	-.16
vii Hydrologic Modifications	21	.91	+.05
2 Floods	10	1.66	+.36
3 Inadequate Drainage	20	1.00	-.02
4 Inefficient Irrigation Systems	16	1.27	+.07
5 Improper Use of Ground Water	18	1.18	+.05
Soil Management Problems			
6 Water Erosion	2	2.27	+.59
7 Wind Erosion	8	1.80	+.54
8 Soil Compaction	13	1.41	+.50
9 Inefficient Tillage Systems	8	1.80	+.43
10 Salinity	15	1.32	-.07
11 Loss of Soil Moisture	6	1.89	+.36
Plant Management Problems			
12 Undesirable Brush & Weeds	1	2.66	-.09
13 Weeds on Cropland	5	1.95	+.02
14 Difficulty of Grass Establishment	4	2.06	+.57
15 Overgrazing	3	2.11	+.50
Other Problems, Issues, and Policies			
16 Economics of Conservation	3	2.11	-.75

Scale of Present Severity[1/]	Scale of Change in Condition[2/] in Past 10 Years
0 - 1.5 Slight to None	-1.5 to -2.5 Much Worse
1.5 - 2.5 Moderate	-0.5 to -1.5 Worse
2.5 - 3.5 Severe	-0.5 to 0 Slight decline
3.5 - 4.5 Very Severe	0 to 0.5 Slight improvement
	0.5 to 1.5 Better
	1.5 to 2.5 Much Better

[a]Source: Association of Texas Soil and Water Conservation Districts.

THE APPROPRIATE PLANNING HORIZON AND DISCOUNTING FUTURE BENEFITS AND COSTS

The effect of soil conservation and erosion control on the agricultural economy is only felt over a period of years as the mix of inputs change for a given output. Erosion carries away the topsoil reducing soil fertility and thus reducing crop yields. If erosion is slowed, future crop yields will be higher than they would otherwise have been given the same level of management.

Farmers make many short-run decisions because they are concerned with next year's income. On the surface this suggests that farmers would use a short time horizon for planning conservation practices. However, most farmers are concerned about the future value of their land in addition to income flow. Inasmuch as the the agricultural component of land values is the capitalized value (present value) of a highest and best use profit stream into perpetuity, and given the limited alternate uses for agricultural land in this part of Texas, the value of the land is tied closely to its future agricultural productivity. Thus, it was important that this study consider not only present productivity but also the effect on future productivity, and hence land values, of cropping and conservation practices. Therefore, a long planning horizon is the only appropriate time period for determining what is the appropriate combination of crop rotations--conservation practices a landowner should employ. In order to emphasis this point and to demonstrate the importance of the length of the planning horizon, calculations were made for time horizons of 10, 100 and 200 years.

Discounting Future Benefits and Costs

As a point of reference from which to calculate the present value of future benefits and costs, 1977 was designated the base year.

All future benefits and costs were discounted to 1977 dollars using standard discounting techniques and a real interest rate of 1.5 percent. The 1.5 percent rate was arrived at by subtracting the average inflation rate of the last ten years, which is 5.8 percent, from the 7.3 percent average private interest rate charged by banks over the same 10 year period.

The present values of net returns associated with particular crop production activities are given in this study. Present value of net returns was computed as:

$$PV = \sum_{t=1}^{T} [B_t (\frac{1}{1+i})^t - C_t(\frac{1}{1+i})^t]$$

where

Σ = summation of discounted benefits and costs over time

t = time, in years

B_t = gross benefits in year t

C_t = gross costs in year t

i = interest rate minus inflation rate

$(\frac{1}{1+i})$ = discount rate

T = length of planning horizon

ON-FARM ECONOMICS OF SOIL CONSERVATION

In order to study the farm income consequences of soil conservation, a great deal of data both technical and economic is necessary. The data required for this type of analysis includes: (a) expected yields of all relevant crops for each soil in the watershed; (b) expected prices for each crop and its associated production costs; (c) additional costs for the applicable conservation practices; (d) expected soil loss associated with each cropping practice-soil type combination; and (e) the effects of crop rotations on the yield of individual crops. These sets of data were combined to estimate the net present value return for each crop rotation-conservation practice-soil mapping unit combination over time periods of 10, 100 and 200 years.

Crop Yields

Table 4 gives the expected yield of the three major crops in the Duckcreek watershed for each soil series plus the yield of range grasses that could be expected if the land is not cropped.

Yields for irrigated crops are given for those few soils that are presently irrigated. Though irrigation would increase yields on several of the soils, the amount of irrigated land is not increasing nor is it expected to in the foreseeable future due to the lack of additional water for irrigation. All yields are for a typical level of management and input quality. The yield data were furnished by U.S.D.A. Soil Conservation Service and Texas Agricultural Extension Service personnel familiar with the area.

Table 4. Crop Yields for each soil mapping unit in Duckcreek watershed.[a]

Soil	Dryland			
	Cotton Lint (lbs)	Grain Sorghum (bu)	Wheat (bu)	Range (AUM)
AU01	275.0	35.0	25.0	2.2
Irr. (Max 200 ac.)	550.0	69.6	50.0	
BMCO	90.0	15.0	9.0	1.6
BPAS	102.0	17.0	10.2	1.7
BC13	200.0	20.0	16.0	2.7
BNAU	105.0	10.6	8.8	2.5
LG38	0	0	0	0.8
LTCL	190.0	20.0	15.0	2.0
MK13	150.0	17.9	12.0	2.0
MK35	125.0	14.3	10.0	1.9
MFSL	300.0	30.0	20.0	2.6
MLFS	250.0	25.0	15.0	2.4
ML01	300.0	30.0	20.0	2.6
ML13	250.0	25.0	20.0	2.4
Irr. (Max 500 ac.)	600.0	60.0	40.0	
ML35	200.0	20.0	15.0	2.3
ML58	0	0	0	2.2
MS03	250.0	25.0	15.0	2.4
MS35	0	0	0	2.3
MI26	0	0	0	2.2
MB13	200.0	22.3	15.0	2.1
MB35	0	17.9	10.0	1.9
OC01	200.0	20.0	16.0	1.9
OC13	175.0	15.0	14.0	1.7
PC01	200.0	20.0	15.0	1.8
PC13	150.0	15.0	12.0	1.6
RANC	0	0	0	1.3
RANL	0	0	0	1.6
RBLD	0	0	0	0.8
SPCL	225.0	25.0	20.0	2.9
Irr. (Max 50 ac.)	450.0	50.0	40.0	
SPSL	250.0	25.0	18.0	2.9
Irr. (Max 450 ac.)	500.0	50.0	36.0	
SC13	150.0	20.0	15.0	1.4
TC01	250.0	30.0	25.0	1.9
TC13	225.0	25.0	20.0	1.7
VN38	0	0	0	1.6
VBCO	0	0	0	0.8
WC13	200.0	20.0	15.0	1.6
WC35	150.0	15.0	10.0	1.6
WL13	300.0	30.0	20.0	3.1
WL35	200.0	25.0	15.0	2.9
WQLM	0	0	0	2.3

[a]Source: Soil Conservation Service and Texas Agricultural Extension Service.

Crop Prices and Production Costs

Expected prices were defined as the average price received by Texas farmers for the specified crop between 1958-1976 adjusted to 1977 dollars by the index of prices paid for production items. This was done in order to arrive at as stable a set of long run price relationships as possible while at the same time tying prices to production costs.

Table 5 lists the production cost data. This production cost information was developed from a set of 1977 crop budgets for the Rolling Plains Land Resource Area prepared by the Texas Agricultural Extension Service. The basic cost data was modified to fit each soil mapping unit. The modification consisted of: (a) changing the harvest costs proportional to the yield for that crop for each rotation; and (b) adding the appropriate costs of the specified conservation practice. As the yield is reduced due to the effect of soil erosion the harvest cost per acre is proportionally reduced but the preharvest costs and equipment costs remain constant. For contouring preharvest machinery and labor costs were increased by 10 percent. The added cost attributable to terracing was assumed to be the discounted sum of: (a) initial construction cost (Table 6); (b) an annual maintenance cost equal to five percent of the constuction cost; (c) the cost of rebuilding terraces every 10 years, assumed to be one-third of the construction cost; and (d) an increase in preharvest machinery and labor costs of five percent. Terracing construction cost are listed by soil in Table 6.

Table 5. Crop Production Cost and input data.[a]

Crop	Pre-harvest Costs ($/acre)	Harvest Costs ($/acre)	Equipment Depreciation Costs ($/acre)	Price Per Unit ($)	Pre-harvest Machinery and labor costs[b]	Insecticide Costs[b] ($/acre)	Herbicide Costs[b] ($/acre)	Fertilization Rates (lbs./acre) N	Fertilization Rates (lbs./acre) P
Dryland									
Cotton	53.64	19.46	14.14	0.52/lb lint 0.05/lb seed	28.99	4.50	5.06	33.0	0
Grain Sorghum	15.86	7.41	8.10	3.65/cwt.	13.15	0	0	0	0
Wheat, Small Grains	33.99	9.70	6.70	3.36/bu 14.73/AUM	14.89	3.00	0	16.0	20.0
Range	5.73	0	2.36	14.73/AUM	1.68	0	0	0	0
Irrigated									
Cotton	98.50	42.19	43.95	0.52/lb lint 0.05/lb seed	53.36	9.00	6.72	20.0	20.0
Grain Sorghum	54.49	13.02	16.68	3.65/cwt.	35.30	3.00	0	40.0	20.0
Wheat, Small Grains	90.55	13.75	15.75	3.36/bu 14.73/AUM	39.27	3.00	0	100.0	40.0

[a]Source: Texas Agricultural Extension Service Crop Budgets for the Texas Rolling Plains Region.

[b]These costs are included in the pre-harvest variable costs given in column 1.

Table 6. Terrace construction costs, average thickness of topsoil and yield loss equation by soil mapping unit.[a]

Soil	Terrace Construction Costs for:		Average Topsoil Thickness (inches)	Yield Loss Equation (See Fig. 2)
	Close Grown Crops ($/acre)	Row Crops ($/acre)		
AU01	27.57	33.10	8.	B
BMCO	82.76	91.96	8.	B
BPAS	89.97	99.71	6.	A
BC13	47.29	55.18	8.	C
BNAU	27.59	33.10	26.	B
LG38	82.76	91.96	6.	A
LTCL	27.59	33.10	9.	B
MK13	47.29	55.18	6.	B
MK35	73.25	82.76	5.	B
MFSL	27.59	33.10	12.	B
MLFS	47.29	55.18	10.	B
ML01	27.59	33.10	10.	B
ML13	47.29	55.18	9.	B
ML35	73.25	82.76	6.	B
ML58	89.97	99.71	5.	B
MS03	47.29	55.18	16.	B
MS35	73.25	82.76	12.	B
MI26	62.23	70.74	8.	B
MB13	27.59	33.10	10.	C
MB35	62.23	70.74	8.	C
OC01	27.59	33.10	8.	B
OC13	47.29	55.18	7.	B
PC01	27.59	33.10	9.	B
PC13	47.29	55.18	7.	B
RANC	27.59	33.10	24.	C
RANL	27.59	33.10	15.	A
RBLD	89.97	99.71	2.	A
SPCL	27.59	33.10	15.	C
SPSL	27.59	33.10	16.	C
SC13	47.29	55.18	7.	C
TC01	27.59	33.10	6.	B
TC13	47.29	55.18	5.	B
VN38	73.25	82.76	6.	A
VBCO	82.76	91.96	6.	A
WC13	47.29	55.18	6.	C
WC35	73.25	82.76	6.	C
WL13	47.29	55.18	6.	C
WL35	73.25	82.76	6.	C
WQLM	89.97	99.71	6.	C

[a]Source: Texas Soil and Water Conservation Board and Texas Agricultural Extension Service.

Crop Rotations

Crop rotations rather than just single crops were considered in this study for two reasons. One reason is that the previous crop influences the amount of erosion from the current crop, and the average erosion rate for a rotation is not a simple average of the erosion rates of the same crops grown continuously. The second reason that rotations were considered is that the yield of some crops will be higher (or lower) when grown in rotation with another crop, or crops.

Table 7 lists the crop rotations that were considered and the yield changes assumed for the cropping combinations. The yield of cotton grown continuously was reduced seventeen percent as the crop budget and yield information on cotton was given for cotton in rotation with small grains. Continuous cotton would not benefit from the plant nutrient carryover or organic residue left by the small grain crop in a rotation and thus over time the expected cotton yield would be less. Cotton grown in roation with sorghum was penalized five percent due to the fact that while sorghum would provide some fertility carryover, it would not be as great as the carryover from small grains. The yield of cotton with small grains or cotton in a three year rotation was not decreased. Sorghum yields were increased seven percent in two year rotations and fourteen percent in three year rotations. This yield increase is attributable to Johnson grass control and fertility carryover in the various rotations. Small grains in rotation with either cotton or sorghum were reduced ten percent as the small grains would have to be planted late

Table 7. Crop rotations considered in the analysis, associated USLE "C" factors and the additional yield resulting from growing a crop in rotation with another crop.[a]

Rotation and Added Yield (in percent)	Table Abbrev.	"C" Factor
<u>Dryland</u>		
Cotton (-17)	C	.65
Grain Sorghum	S	.50
Wheat, Small Grains	W	.15
Range	R	.04
Cotton (-5)/Sorghum(7)	C/S	.45
Cotton/Wheat(-10)	C/W	.35
Sorghum(7)/Wheat(-10)	S/W	.30
Cotton/Sorghum(14)/Wheat(-10)	C/S/W	.35
<u>Irrigated</u>		
Cotton(-17)	C-I	.65
Grain Sorghum	S-I	.50
Wheat, Small Grains	W-I	.15
Cotton(-5)/Sorghum(7)	C/S-I	.45
Cotton/Wheat(-10)	C/W-I	.35
Sorghum(7)/Wheat(-10)	S/W-I	.30
Cotton/Sorghum(14)/Wheat(-10)	C/S/W-I	.35

[a]Source: Soil Conservation Service and Texas Agricultural Extension Service.

and on stalk ground. The late planting would decrease the moisture available for plant growth and the stalks would interfere with field preparation and even seed placement.

Soil Loss Factors

The universal soil loss equation was used to calculate average soil loss per acre for each soil series-crop rotation-conservation practice combination in the watershed. This equation is:

$$A = RK(LS)CP$$

where A is gross erosion in tons per acre, R is a rainfall erosivity index, K is a soil-erodibility factor, LS is a topographic factor that represents the combined effects of slope length and steepness, C is a cover and management factor, and P is a conservation practice factor. Values for all of these factors were furnished by the Soil Conservation Service and are reported in Tables 7 and 8. Also shown in Table 8 are the erosion tolerance limits, or "T" values, that have been established for each soil. Theoretically, if erosion is less than this T value, little or no yield reduction results from the soil loss. These T values are treated as potential constraints on erosion in the part of the economic analysis that is presented in the second section of this report.

Table 9 shows estimated per acre erosion rates for each soil series-conservation practice-crop rotation combination considered in the study.

Table 8. USLE factors by Soil mapping unit for Duck Creek watershed.[a]

Soil	USLE Factors					
	K	LS Without Terraces	LS With Terraces	P Contouring	P Terracing	T Ton/Acre/Year
AU01	0.32	0.16	0.16	1.00	1.00	5.0
BMCO	0.28	0.72	0.50	0.50	0.50	4.3
BPAS	0.28	1.30	0.70	0.60	0.50	3.0
BC13	0.28	0.38	0.30	0.60	0.60	5.0
BNAU	0.16	0.13	0.13	1.00	1.00	5.0
LG38	0.24	0.76	0.76	1.00	1.00	1.0
LTCL	0.32	0.12	0.12	1.00	1.00	5.0
MK13	0.28	0.50	0.25	0.50	0.60	3.0
MK35	0.28	0.95	0.42	0.50	0.50	3.0
MFSL	0.24	0.17	0.17	1.00	1.00	5.0
MLFS	0.20	0.31	0.23	0.60	0.60	5.0
ML01	0.24	0.17	0.17	1.00	1.00	5.0
ML13	0.24	0.31	0.23	0.60	0.60	5.0
ML35	0.24	0.53	0.42	0.50	0.50	5.0
ML58	0.24	0.95	0.95	1.00	1.00	5.0
MS03	0.20	0.38	0.30	0.60	0.60	5.0
MS35	0.20	0.53	0.53	1.00	1.00	5.0
MI26	0.20	0.40	0.40	1.00	1.00	5.0
MB13	0.24	0.18	0.18	1.00	1.00	3.0
MB35	0.24	0.35	0.35	1.00	1.00	3.0
OC01	0.32	0.16	0.16	1.00	1.00	5.0
OC13	0.32	0.22	0.19	0.60	0.60	5.0
PC01	0.32	0.18	0.18	1.00	1.00	5.0
PC13	0.32	0.24	0.19	0.60	0.60	5.0
RANC	0.32	0.16	0.16	1.00	1.00	5.0
RANL	0.24	0.14	0.14	1.00	1.00	5.0
RBLD	0.37	2.74	2.74	1.00	1.00	1.0
SPCL	0.28	0.15	0.14	1.00	0.60	5.0
SPSL	0.24	0.15	0.14	1.00	0.60	5.0
SC13	0.32	0.15	0.15	0.60	1.00	4.0
TC01	0.32	0.17	0.17	1.00	1.00	5.0
TC13	0.37	0.20	0.20	0.60	0.60	5.0
VN38	0.37	0.53	0.53	1.00	1.00	2.0
VBCO	0.37	0.80	0.80	1.00	1.00	0.6
WC13	0.32	0.32	0.30	0.60	0.60	3.0
WC35	0.32	0.48	0.42	0.50	0.50	3.0
WL13	0.28	0.32	0.30	0.60	0.60	3.0
WL35	0.28	0.40	0.40	0.50	1.00	3.0
WQLM	0.28	1.20	1.20	1.00	1.00	3.0

[a]Source: Soil Conservation Service and Texas Agricultural Extension Service.

Table 9. Expected soil loss (tons/acre/year) for each crop rotation, soil type, and conservation practice.

Soil	CP	Crop Rotation							
		C	S	W	R	C/S	C/W	S/W	C/S/W
AU01	SR	5.59	4.30	1.29	0.34	3.87	3.01	2.58	3.01
BMCO	SR	22.01	16.93	5.08	1.35	15.24	11.85	10.16	11.85
	C	11.01	8.47	2.54	0.68	7.62	5.93	5.08	5.93
	T	7.64	5.88	1.76	0.47	5.29	4.12	3.53	4.12
BPAS	SR	39.75	30.58	9.17	2.45	27.52	21.40	18.35	21.40
	C	23.85	18.35	5.50	1.47	16.51	12.84	11.01	12.84
	T	10.70	8.23	2.47	0.66	7.41	5.76	4.94	5.76
BC13	SR	11.62	8.94	2.68	0.72	8.04	6.26	5.36	6.26
	C	6.97	5.36	1.61	0.43	4.83	3.75	3.22	3.75
	T	5.50	4.23	1.27	0.34	3.81	2.96	2.54	2.96
BNAU	SR	2.27	1.75	0.52	0.14	1.57	1.22	1.05	1.22
LG38	SR	19.92	15.32	4.60	1.23	13.79	10.73	9.19	10.73
LTCL	SR	4.19	3.23	0.97	0.26	2.90	2.26	1.94	2.26
MK13	SR	15.29	11.76	3.53	0.94	10.58	8.23	7.06	8.23
	C	7.64	5.88	1.76	0.47	5.29	4.12	3.53	4.12
	T	4.59	3.53	1.06	0.28	3.18	2.47	2.12	2.47
MK35	SR	29.05	22.34	6.70	1.79	20.11	15.64	13.41	15.64
	C	14.52	11.17	3.35	0.89	10.05	7.82	6.70	7.82
	T	6.42	4.94	1.48	0.40	4.45	3.46	2.96	3.46
MFSL	SR	4.46	3.43	1.03	0.27	3.08	2.40	2.06	2.40
MLFS	SR	6.77	5.21	1.56	0.42	4.69	3.65	3.12	3.65
	C	4.06	3.12	0.94	0.25	2.81	2.19	1.87	2.19
	T	3.01	2.32	0.70	0.19	2.09	1.62	1.39	1.62
ML01	SR	4.46	3.43	1.03	0.27	3.08	2.40	2.06	2.40
ML13	SR	8.12	6.25	1.87	0.50	5.62	4.37	3.75	4.37
	C	4.87	3.75	1.12	0.30	3.37	2.62	2.25	2.62
	T	3.62	2.78	0.83	0.22	2.50	1.95	1.67	1.95
ML35	SR	13.89	10.68	3.21	0.85	9.62	7.48	6.41	7.48
	C	6.95	5.34	1.60	0.43	4.81	3.74	3.21	3.74
	T	5.50	4.23	1.27	0.34	3.81	2.96	2.54	2.96
ML58	SR	24.90	19.15	5.75	1.53	17.24	13.41	11.49	13.41
MS03	SR	8.30	6.38	1.92	0.51	5.75	4.47	3.83	4.47
	C	4.98	3.83	1.15	0.31	3.45	2.68	2.30	2.68
	T	3.93	3.02	0.91	0.24	2.72	2.12	1.81	2.12
MS35	SR	11.58	8.90	2.67	0.71	8.01	6.23	5.34	6.23
MI26	SR	8.74	6.72	2.02	0.54	6.05	4.70	4.03	4.70
MB13	SR	4.72	3.63	1.09	0.29	3.27	2.54	2.18	2.54

Table 9 (continued).

Soil	CP	Crop Rotation							
		C	S	W	R	C/S	C/W	S/W	C/S/W
MB35	SR	9.17	7.06	2.12	0.56	6.35	4.94	4.23	4.94
OC01	SR	5.59	4.30	1.29	0.34	3.87	3.01	2.58	3.01
OC13	SR	7.69	5.91	1.77	0.47	5.32	4.14	3.55	4.14
	C	4.61	3.55	1.06	0.28	3.19	2.48	2.13	2.48
	T	3.98	3.06	0.92	0.25	2.76	2.15	1.84	2.15
PC01	SR	6.29	4.84	1.45	0.39	4.35	3.39	2.90	3.39
PC13	SR	8.39	6.45	1.94	0.52	5.81	4.52	3.87	4.52
	C	5.03	3.87	1.16	0.31	3.48	2.71	2.32	2.71
	T	3.98	3.06	0.92	0.25	2.76	2.15	1.84	2.15
RANC	SR	5.59	4.30	1.29	0.34	3.87	3.01	2.58	3.01
RANL	SR	3.67	2.82	0.85	0.23	2.54	1.98	1.69	1.98
RBLD	SR	110.71	85.16	25.55	6.81	76.64	59.61	51.10	59.611
SPCL	SR	4.59	3.53	1.06	0.28	3.18	2.47	2.12	2.47
	C	2.75	2.12	0.64	0.17	1.91	1.48	1.27	1.48
	T	2.57	1.98	0.59	0.16	1.78	1.38	1.19	1.38
SPSL	SR	3.93	3.02	0.91	0.24	2.72	2.12	1.81	2.12
	C	2.36	1.81	0.54	0.15	1.63	1.27	1.09	1.27
	T	2.20	1.69	0.51	0.14	1.52	1.19	1.02	1.19
SC13	SR	5.24	4.03	1.21	0.32	3.63	2.82	2.42	2.82
	C	3.14	2.42	0.73	0.19	2.18	1.69	1.45	1.69
TC01	SR	5.94	4.57	1.37	0.37	4.11	3.20	2.74	3.20
TC13	SR	8.08	6.22	1.86	0.50	5.59	4.35	3.73	4.35
	C	4.85	3.73	1.12	0.30	3.36	2.61	2.24	2.61
VN38	SR	21.41	16.47	4.94	1.32	14.83	11.53	9.88	11.53
VBCO	SR	32.32	24.86	7.46	1.99	22.38	17.40	14.92	17.40
WC13	SR	11.18	8.60	2.58	0.69	7.74	6.02	5.16	6.02
	C	6.71	5.16	1.55	0.41	4.64	3.61	3.10	3.61
	T	6.29	4.84	1.45	0.39	4.35	3.39	2.90	3.39
WC35	SR	16.77	12.90	3.87	1.03	11.61	9.03	7.74	9.03
	C	8.39	6.45	1.94	0.52	5.81	4.52	3.87	4.52
	T	7.34	5.64	1.69	0.45	5.08	3.95	3.39	3.95
WL13	SR	9.78	7.53	2.26	0.60	6.77	5.27	4.52	5.27
	C	5.87	4.52	1.35	0.36	4.06	3.16	2.71	3.16
	T	5.50	4.23	1.27	0.34	3.81	2.96	2.54	2.96
WL35	SR	12.23	9.41	2.82	0.75	8.47	6.59	5.64	6.59
	C	6.12	4.70	1.41	0.38	4.23	3.29	2.82	3.29
WQLM	SR	36.69	28.22	8.47	2.26	25.40	19.76	16.93	19.76

Yield Loss Attributal to Erosion

In a long-run analysis of soil conservation the relationship between erosion and future crop yield is critical. This is because the on-farm benefits from conservation practices arise mainly from the relatively higher future crop yield resulting from that conservation practice. Unfortunately, very little experimental or field data on this important relationship are available. Consequently, for purposes of this study it was necessary to develop estimates of this relationship for each soil mapping unit.

Yield loss attributal to topsoil loss depends to a certain extent on the suitability of the subsoil for crop production. Soils in the watershed were classified into one of three groups. Group A consists of soil series that have subsoil that is unsuitable for field crop production. For this group, crop yield was assumed to be zero after all topsoil was eroded. Group B consists of soil series with subsoils that are slightly suitable for field crop production. It was assumed that crop yield on Group B soils would be 25 percent of the currently attainable yield after all the topsoil was eroded away. Group C consists of those soil series with subsoils that are somewhat more suitable for crop production. After the loss of all topsoil, yield in this group was assumed to be 50 percent of present yield. The group to which each soil belongs and initial average topsoil depth for each soil is shown in Table 6.

Due to paucity of experimental or field data on the relationship between topsoil thickness and yield, it was necessary to subjectively specify this relationship for each soil group. After considerable discussion with Soil Conservation Service and Texas A&M University scientists, the three relationships shown in Figure 2 were specified. The functions in Figure 2 have two important characteristics. One is that each function is expressed in terms of percent of topsoil lost and percent of initial yield attainable after erosion. This reflects the fact that the loss of one inch on an initially shallow soil will decrease yield more than the loss of one inch of an initially deep soil. For example, the loss of one inch of a soil in Group A with an initial depth of 20 inches will reduce yield by about 2 percent, while the loss of one inch on a soil with an initial depth of 5 inches will decrease yield by about 8 percent.

The second important characteristic of the functions in Figure 2 is that the loss of the last remaining topsoil will reduce yield by more than the loss of the upper portions of initial topsoil. For instance, the loss of the first 20 percent of topsoil in Group A will reduce yield by about 8 percent, while the loss of the last 20 percent of topsoil will reduce yield by about 46 percent. Because of the critical nature of the relationships shown in Figure 2, additional experimental and field research appears warranted.

In determining the effects of erosion on yield, the bulk density of soil is important. Since erosion typically occurs when the soil is saturated with water, the bulk density of saturated soil was used. Based on unpublished field data, a bulk density of 140 tons per acre inch was used for all soils in the Duckcreek watershed.

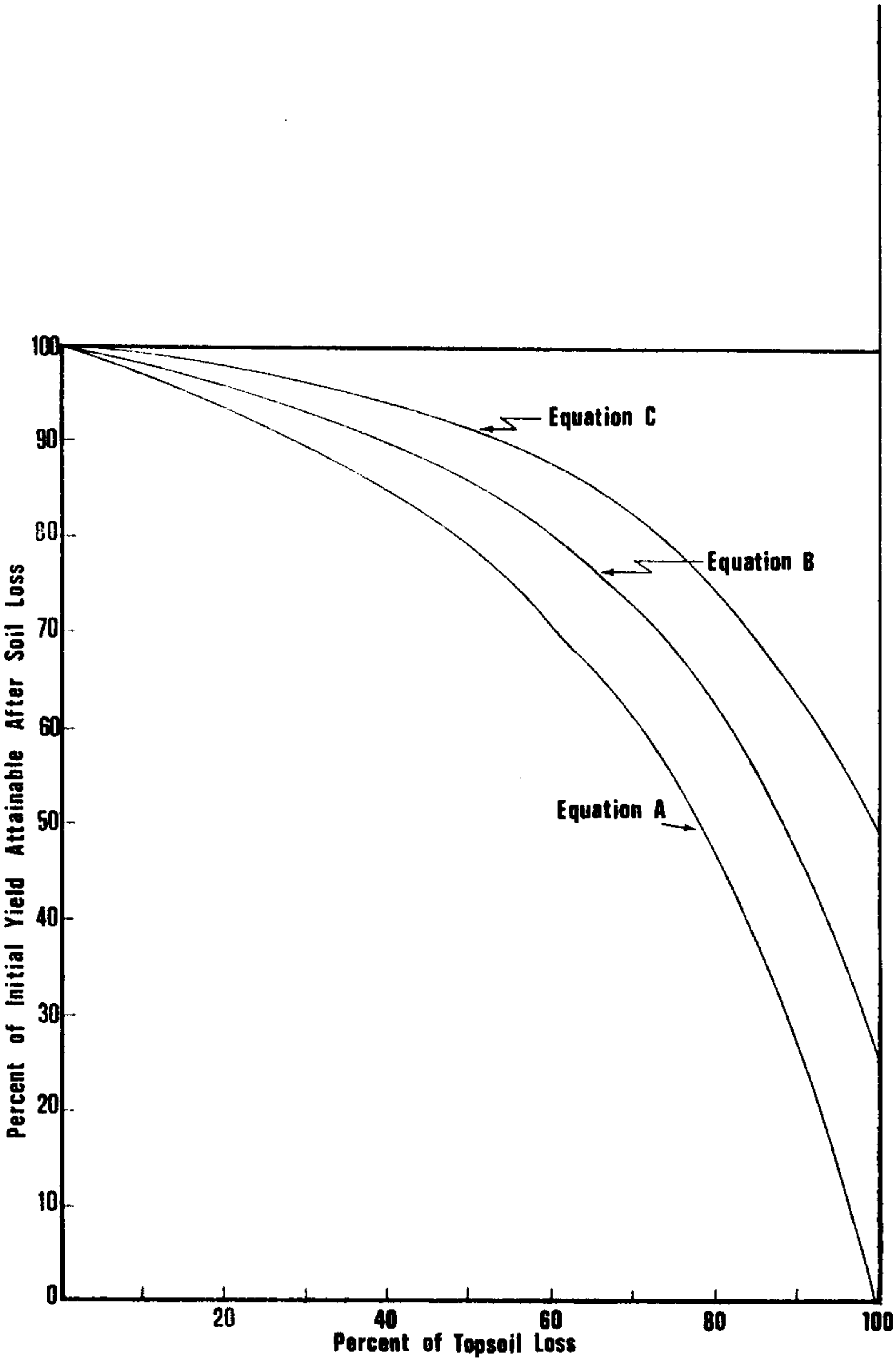

Figure 2. Relationships between yield and topsoil eroded.

Profitability of Conservation Practices

Profitability information for the various crop rotation-conservation practice combinations for each soil in the Duckcreek watershed is given in Appendix A, Tables 14 through 52. All figures are based on the assumptions previously stated. All on-farm costs associated with the conservation practices of contouring and terracing are included when their profitability is calculated, but there is no Federal cost sharing of terrace construction added in nor is there any cost charged for the sediment leaving the fields.

As an illustration of the information given in these Tables, consider Table 27 which gives the data for Miles fine sandy loam with 3-5% slopes.

The first column of this Table gives the crop rotations considered for this soil, while the second column gives the conservation practice considered. Column 3 gives the estimated percent of topsoil lost annually for each respective crop rotation-conservation practice combination. Column 4 given the per acre profit in year 1. The next block of columns gives annual yield as a percent of initial yield, and expected profit for years 10, 100, and 200. The final block of columns gives the present value of a profit stream to year 10, 100, and 200.

As a specific example consider continuous cotton on Miles fine sandy loam with 3-5% slope (Table 27). Given the assumed topsoil thickness with straight row cultivation, 1.654 percent of the six inches of topsoil (Table 6) would be lost annually. In year 1 net profit from cotton production on this soil would be 15.67. The expected profit declines year by year as the topsoil is eroded away until by the 200th year profit has dropped to a negative $46.92. In physical terms the yield has declined to 96.0 percent of the initial yield in year 10, to 25 percent in years 100 and 200. The present value of profit for a 10 year period is $130. The present value of profit over 100 years is negative $547 and negative $1093 for 200 years. Negative present value of profit results from the negative returns in the later years of the time horizon. Table 27 shows the most profitable alternate over a 200 year period to be range.

Many of the soils in the Duckcreek watershed are too flat for contouring and terracing to have any effect on the rate of soil loss. For these soils only the straight row cultivation practice is listed. Also, only the crops that the soil can realistically be expected to grow are listed. Thus, a few soil series such as Randall fine sandy loam have no field crop options and are only listed for completeness.

Four soil mapping units have the potential for irrigation on a restricted number of acres. The expected yields for crops under irrigation and the acres available are listed as part of Table 4. On these soils profit and yield information is also given for the irrigated rotations as it is for example in Table 14.

The information in Tables 14 through 52 can also be used to compare the profitability of the three cultural practices for a particular crop as the time horizon is varied. For example, the present value of profit from continuous cotton production on Bippus clay loam with 1-3% slope, (Table 17), and a ten year time horizon is $140 under straight row cultivation versus $116 for contouring and only $34 for terracing. However, as the time horizon is stretched to 200 years straight row cotton cultivation is the least profitable option at $81 bettered both by terracing at $273 and contouring at $352.

Not only can the profitability of the conservation practices for each crop rotation be compared but the profitability of all the rotations can be compared to each other at the same time. The best crop rotation-conservation practice for each soil series and time horizon can then be located. To illustrate, given a 10 year time horizon the most profitable crop rotation-conservation practice combination on Tillman clay with 1-3% slopes, (Table 45), is a cotton-small grain rotation using straight row cultivation. When the time horizon is shifted to 100 years, however, it is found to be more profitable to contour with the cotton-small grain rotation, but it is the most profitable to shift to a continuous small grain cropping pattern.

Table 10 lists the most profitable (or least costly) conservation practice for each crop rotation and soil series, given a 100 year planning horizon. For most soils with slopes greater than one percent, contouring or terracing was more profitable than straight row cultivation for row crops. Table 11 shows the effects of increasing the planning horizon to 200 years, which results in a further shift out of straight row cultivation into contouring or terracing.

Table 10. Most profitable conservation practice[a] by soil mapping unit and crop rotation with 100 year planning horizon.[a]

Soil	Crop Rotation							
	C	S	W	R	C/S	C/W	S/W	C/S/W
AU01[b]	SR	SR	SR	SR	SR	SR	SR	SR
BMCO	C	C	SR	SR	C	C	C	C
BPAS	Z	TZ	CZ	SR	TZ	TZ	TZ	TZ
BC13	C	SR	SR	SR	SR	SR	SR	SR
BNAU[b]	SR	SR	SR	SR	SR	SR	SR	SR
LG38	--	--	--	SR	--	--	--	--
LTCL[b]	SR	SR	SR	SR	SR	SR	SR	SR
MK13	T	C	SR	SR	C	C	C	C
MK35	T	C	C	SR	T	C	C	C
MFSL[b]	SR	SR	SR	SR	SR	SR	SR	SR
MLFS	SR	SR	SR	SR	SR	SR	SR	SR
ML01[b]		SR	SR	SR	SR	SR	SR	SR
ML13	C	SR	SR	SR	SR	SR	SR	SR
ML35	C	C	SR	SR	C	C	C	C
ML58	--	--	--	SR	--	--	--	--
MS03	SR	SR	SR	SR	SR	SR	SR	SR
MS35	--	--	--	SR	--	--	--	--
MI26	--	--	--	SR	--	--	--	--
MB13[b]	SR	SR	SR	SR	SR	SR	SR	SR
MB35[b]	--	SR	SR	SR	--	--	SR	--
OC01[b]	SR	SR	SR	SR	SR	SR	SR	SR
OC13	C	SR	SR	SR	SR	SR	SR	SR
PC01[b]	SR	SR	SR	SR	SR	SR	SR	SR
PC13	C	SR	SR	SR	SR	SR	SR	SR
RANC	--	--	--	SR	--	--	--	--
RANL	--	--	--	SR	--	--	--	--
RBLD	--	--	--	Z	--	--	--	--
SPCL	SR	SR	SR	SR	SR	SR	SR	SR
SPSL	SR	SR	SR	SR	SR	SR	SR	SR
SC13	SR	SR	SR	SR	SR	SR	SR	SR
TC01[b]	SR	SR	SR	SR	SR	SR	SR	SR
TC13	C	C	SR	SR	C	C	C	C
VN38	--	--	--	SR	--	--	--	--
VBCO	--	--	--	SR	--	--	--	--
WC13	C	C	SR	SR	C	SR	SR	SR
WC35	C	C	SR	SR	C	C	C	C
WL13	C	C	SR	SR	C	SR	SR	SR
WL35	C	C	SR	SR	C	C	SR	C
WQLM	--	--	--	SR	--	--	--	--

[a]T denotes terracing, C contouring, SR straight row, Z means yield in year 100 is zero for all systems, TZ means yield is zero in year 100 for all practices except terracing, and CZ means yield is zero in year 100 for straight row cultivation.

[b]Contouring and terracing infeasible due to flatness of land or shortness of average slope length.

Table 11. Most profitable conservation practice by soil mapping unit and crop rotation with 200 year planning horizon.[a]

Soil	Crop Rotation							
	C	S	W	R	C/S	C/W	S/W	C/S/W
AU01[b]	SR	SR	SR	SR	SR	SR	SR	SR
BMCO	C	C	C	SR	C	C	C	C
BPAS	Z	Z	TZ	SR	Z	Z	Z	Z
BC13	C	C	SR	SR	C	C	SR	C
BNAU[b]	SR	SR	SR	SR	SR	SR	SR	SR
LG38	--	--	--	SR	--	--	--	--
LTCL[b]	SR	SR	SR	SR	SR	SR	SR	SR
MK13	T	C	C	SR	T	C	C	C
MK35	T	C	C	SR	T	T	C	T
MFSL[b]	SR	SR	SR	SR	SR	SR	SR	SR
MLFS	C	C	SR	SR	SR	SR	SR	SR
ML01[b]	SR	SR	SR	SR	SR	SR	SR	SR
ML13	C	C	SR	SR	C	C	SR	C
ML35	C	C	C	SR	C	C	C	C
ML58	--	--	--	SR	--	--	--	--
MS03	C	SR	SR	SR	SR	SR	SR	SR
MS35	--	--	--	SR	--	--	--	--
MI26	--	--	--	SR	--	--	--	--
MB13[b]	SR	SR	SR	SR	SR	SR	SR	SR
MB35[b]	--	SR	SR	SR	--	--	SR	--
OC01[b]	SR	SR	SR	SR	SR	SR	SR	SR
OC13	C	C	SR	SR	C	C	SR	C
PC01[b]	SR	SR	SR	SR	SR	SR	SR	SR
PC13	C	C	SR	SR	C	C	SR	C
RANC	--	--	--	SR	--	--	--	--
RANL	--	--	--	SR	--	--	--	--
RBLD	--	--	--	Z	--	--	--	--
SPCL	SR	SR	SR	SR	SR	SR	SR	SR
SPSL	SR	SR	SR	SR	SR	SR	SR	SR
SC13	SR	SR	SR	SR	SR	SR	SR	SR
TC01[b]	SR	SR	SR	SR	SR	SR	SR	SR
TC13	C	C	SR	SR	C	C	C	C
VN38	--	--	--	SR	--	--	--	--
VBCO	--	--	--	SR	--	--	--	--
WC13	C	C	SR	SR	C	C	C	C
WC35	C	C	SR	SR	C	C	C	C
WL13	C	C	SR	SR	C	C	C	C
WL35	C	C	SR	SR	C	C	C	C
WQLM	--	--	--	SR	--	--	--	--

[a]T denotes terracing, C contouring, SR straight row, Z means yield in year 200 is zero for all systems, TZ means yield is zero in year 200 for all practices except terracing, and CZ means yield is zero in year 200 for straight row cultivation.

[b]Contouring and terracing infeasible due to flatness of land or shortness of average slope length.

Once again it can be seen that the need for conservation practices becomes greater as the planning horizon is increased.

Cost-Sharing for Terrace Construction Cost

Profitability estimates for conservation practices shown in Appendix A, Tables 14 through 52, were based on the assumption that farmers would pay the full cost of adopting a conservation practice. The Agricultural Stabilization and Conservation Service presently makes a limted number of payments to farmers for 50 percent of the initial cost of constructing terraces. This type of payments would obviously make terracing a more attractive alternative. To determine if this would make terracing more profitable than contouring or straight row farming, one can determine the amount of such a payment by taking 50 percent of the appropriate terrace cost figure in Table 1 and add it to the present value figures (Tables 14 through 52).

There are only a few instances where 50 percent cost-sharing payments would make terracing profitable where it would not otherwise be profitable. However, the payments may induce farmers to terrace where it is already profitable because such payments greatly ease the initial financial burden associated with constructing terraces. Also since this model must of necessity deal in average conditions, it may be that certain fields could be profitably terraced with the construction assistance even though the average soil mapping unit could not. Therefore, cost sharing for conservation practices may have a greater impact than would be indicated by the profitability calculations shown in Tables 14 through 52.

PUBLIC POLICY OPTIONS FOR NPS CONTROL

The previous section of this report focused on the on-farm economics of conservation aside from the NPS pollution issue. Let us now turn to the pollution question and consider whether controls are justified on economic grounds, on which control is economically the most efficient, and on implementing a control if a problem does indeed exist.

In designing a NPS control plan, it is necessary to define the feasible control methods from a technical perspective. For control of sheet and rill erosion and sediment resulting therefrom, the control methods considered here are the conservation practices of contouring and terracing, and changes in land use such as shifting to a crop which causes less erosion.

Once these technical alternatives are specified it is necessary to determine a way of implementing a pollution control method. The standard policy options for implementing a control include regulation, provision of economic incentives, education, and public investment. For point sources of pollutants, regulations are typically directed toward the pollutant at the point of emission into waterways. However, this is not possible with NPS pollutants because they enter waterways at an infinite number of points. Hence, regulations must be directed toward the agricultural practices that cause or influence the NPS pollutants.

The economic incentive option includes alternatives such as Federal or State cost-sharing arrangements for conservation practices, and excise taxes on inputs such as fertilizers and pesticides or even on soil loss. Education is a viable policy option in situations where producers or others are misusing inputs that cause pollution, or are not adopting conservation practices that would be profitable. In these situations a successful education program would increase producer's income as well as reducing the environmental damage caused by misuse of agricultural chemicals and production practices. Public investment is appropriate for controls that are not appropriate for individuals, but that can be justified by governmental units. An example would be the construction of municipal waste water treatment plants. In any particular NPS situation, a combination of the above policy options may provide the best solution to the problem.

The specific erosion-sedimentation control options considered for Duckcreek watershed are:

1. Restricting soil loss to be no greater than the SCS tolerance or "T" limits.
2. Restricting soil loss to be no greater than 2, 5, or 10 tons per acre.
3. Terracing subsidies or cost sharing arrangements for 50 and 100 percent of the annual costs.
4. Contouring subsidies or cost sharing arrangements for 50 and 100 percent of the additional cost for contouring.
5. Subsidies of 50 and 100 percent on the initial cost of constructing terraces.
6. Restricting soil loss to be no greater than the SCS limit

or a specific limit of 5 tons per acre combined with contouring or terracing subsidies.

7. Restricting soil loss to less than the SCS limit or a specific limit of 5 tons per acre combined with a 50 percent subsidy toward initial construction costs of terraces.
8. Taxes on soil loss of 4, 6, 8, 10, 12, 16 and 20 cents per ton.
9. Taxes on soil loss of 4, 6, 8, 10, 12, 16 and 20 cents per ton combined with a subsidy of 50 percent of the cost of terracing or contouring.

Table 12 lists the control options with the abbreviation for each used in the tables in Appendix B.

These policy options were chosen to cover a wide range of available alternatives. Section 208 of the 1972 Federal Pollution Control Act Amendments does not specify the type of regulation or incentive that must be used so decision makers may choose from the above set of options or use the model to test others which experience or experiment may suggest.

The soil loss tax policy, while not practical, was considered because it is an economic efficiency norm for reducing off-site sediment damages. Economic theory says that in a frictionless economy where all producers maximize profit, the "optimal" way to correct for off-site damages is to impose a tax on erosion exactly equal to marginal off-site damages at the socially optimal level of erosion. No other policy option will give a socially more

Table 12. Alternate control options modeled.

Control Option	Table Abbrev.
Annual soil loss less than SCS Tolerance limit (T)	SL < T
Annual soil loss less than 2 tons per acre	SL < 2
Annual soil loss less than 5 tons per acre	SL < 5
Annual soil loss less than 10 tons per acre	SL < 10
Subsidy equal to 50 percent of annual terracing costs	TR 50
Subsidy equal to 100 percent of annual terracing costs	TR 100
Subsidy equal to 50 percent of annual contouring costs	C 50
Subsidy equal to 100 percent of annual contouring costs	C 100
Subsidy equal to 50 percent of the initial cost of constructing terraces	IT 50
Subsidy equal to 100 percent of the initial cost of constructing terraces	IT 100
Soil loss < T, 50% terracing costs subsidy	SL < T, TR 50
Soil loss < T, 50% contouring costs subsidy	SL < T, C 50
Soil loss < T, 50% initial terrace construction cost subsidy	SL < T, IT 50
Soil loss < 5, 50% terracing costs subsidy	SL < 5, TR 50
Soil loss < 5, 50% contouring costs subsidy	SL < 5, C 50
Soil loss < 5, 50% initial terrace construction costs subsidy	SL < 5, IT 50
A tax on annual soil loss of 4 cents per ton	TX 4
A tax on annual soil loss of 6 cents per ton	TX 6
A tax on annual soil loss of 8 cents per ton	TX 8
A tax on annual soil loss of 10 cents per ton	TX 10
A tax on annual soil loss of 12 cents per ton	TX 12
A tax on annual soil loss of 16 cents per ton	TX 16
A tax on annual soil loss of 20 cents per ton	TX 20
A 4 cent tax on soil loss with a 50% subsidy on terracing or contouring costs	TX 4 50 T&C
A 6 cent tax on soil loss with a 50% subsidy on terracing or contouring costs	TX 6 50 T&C
A 8 cent tax on soil loss with a 50% subsidy on terracing or contouring costs	TX 8 50 T&C
A 10 cent tax on soil loss with a 50% subsidy on terracing or contouring costs	TX 10 50 T&C
A 12 cent tax on soil loss with a 50% subsidy on terracing or contouring costs	TX 12 50 T&C
A 16 cent tax on soil loss with a 50% subsidy on terracing or contouring costs	TX 16 50 T&C
A 20 cent tax on soil loss with a 50% subsidy on terracing or contouring costs	TX 20, 50 T&C

efficient (i.e. less costly from society's viewpoint) allocation of resources to crop production. Other requirements for this to be the most efficient policy for pollution abatement are that: (a) the administrative and enforcement costs be equal for all policies; and (b) the administrative and enforcement costs be less than the gains associated with a tax policy. Under these conditions, the tax policy can be used as a norm against which the other policies (which may be more practical and politically viable) can be evaluated.

To decide whether erosion-sedimentation control is justified on economic grounds and to identify the economically most efficient policy option, the following types of information are needed:

A. The off-site environmental damages that would be abated by the policy;

B. The private and social costs incurred by farmers and society when alternative policy options are implemented at various levels of control; and

C. The implementation, administrative, and enforcement costs associated with each policy.

These benefits and cost components, once combined, indicate whether a particular policy at a specific level of control is justified on economic efficiency grounds. Of course, in deciding between policies, the distributional or equity aspects and political acceptability must also be considered.

Estimates of the above economic impacts for the policy options listed previously are presented in the sections which follow.

OFF-SITE DAMAGES

A procedure for estimating off-site damages resulting from sediment in a watershed was developed by Lee and Guntermann. This procedure attributes damages to the following factors: (1) an increase in annual cost for a reservoir resulting from a shortened economic life; (2) an increase in the annual cost for flood control structures caused by sediment reducing their economic life; (3) the sediment component of flood damages and damages associated with sediment that remains in the watershed; (4) the increase in sediment damage that occurs after the end of a reservoir's economic life or after the end of a flood control structure's economic life; (5) the loss of recreational benefits resulting from the siltation of a reservoir; and (6) the loss of water supply benefits resulting from sediment displacing the water supply pool in a reservoir.

The Lee and Guntermann procedure implicitly assumes that sediment will not be dredged from a reservoir or removed from a flood control structure. Also implicitly assumed was that a new reservoir or a new flood control structure would not be built to replace an existing one once it is completely filled with silt. These do not appear to be realistic assumptions for the Duckcreek watershed because the watershed does not contain a reservoir with a permanent pool and because the flood control structures were not built with large sediment storage capacity. Consequently, the Lee and Guntermann procedure was not used. Rather, sediment damages were attributed to: (a) the cost of removing the sediment build-up in the

12 flood control structures by draining and then cleaning out the accumulated sediment; and (b) the sediment component of flood damages and damages associated with sediment that remains in the watershed. Computational formula and damage estimates for each of these components follow.

Cost of Removing Sediment from Flood Control Structures

For this component of damages, it was assumed that the sediment pool in a flood control structure would be allowed to completely fill. Then, before sediment reduced the flood control capacity of the structure, the structure would be drained in a dry period and the sediment removed by bulldozing or a similar operation. SCS engineers estimate that this type of operation would cost about $1.01 per ton of sediment removed. With N as the life of the sediment pool it was assumed that a structure would be cleaned every N years. N was computed by the following formula:

$$N = \frac{K\ C_{RS}}{G_e A_N D_R T_E}$$

where

N is the life of the sediment pool in years;

C_{RS} is the capacity of the sediment pool in acre-feet;

G_e is the gross erosion based on a particular crop rotation, tillage system, conservation practice, and management level for the watershed in tons/acre/year.

A_N is the net drainage area in acres;

D_R is the delivery ratio used to convert gross erosion to sediment delivered.

T_E is trap efficiency of the reservoir; and

K is the conversion constant from acre-feet to tons.

Values for C_{RS}, A_N, and D_R were obtained from the PL-566 watershed work plans for the Duckcreek watershed. K was assumed to equal 1680 tons per acre-foot, and T_E to equal .95.

The present value cost of removing sediment from flood control structures in the watershed into perpetuity is given by the formula:

$$PV = \sum_{S=1}^{12} \sum_{t=1}^{\infty} \left(\frac{1}{1+i}\right)^{N_s t} C_r C_{RS,S} K$$

$$= \sum_{S=1}^{12} \frac{\left(\frac{1}{1+i}\right)^{N_s}}{1 - \left(\frac{1}{1+i}\right)^{N_s}} C_r C_{RS,S} K$$

where

PV = present value cost

C_r = per ton cost of removing sediment from a flood control structure (= $1.01)

N_s = life of the sediment pool of the S^{th} structure

i = interest rate

$C_{RS,S}$ = capacity of the sediment pool in the S^{th} structure in acre-feet.

The annualized cost of removing sediment from flood control structures is:

$$D_{FS} = i \cdot PV = i \sum_{S=1}^{12} \frac{(\frac{1}{1+i})^{N_s}}{1 - (\frac{1}{1+i})^{N_s}} C_r C_{RS,S} K$$

where

D_{FS} = annualized cost of removing sediment from all flood control structures in Duckcreek watershed

Estimates of D_{FS} for various levels of erosion are given in Table 13.

Sediment Component of Flood Damages and Damages Associated with Sediment that Remains in the Watershed

Estimates of this component of damages (D_S) were obtained directly from the PL-566 watershed work plan. In 1977 dollars the damages totalled $24,156 for a gross erosion rate of 10.26 tons per acre. For other erosion rates these damages were assumed proportional to total erosion.

Total Damages

The total off-site damages in Duckcreek watershed with the average gross erosion rate at 10.26 tons per acre per year are $184,492 annually. Total damages for other erosion rates are given in Table 50 and the total damage function is shown in Figure 3. In evaluating the off-site damages that would be abated by controls on sheet and rill erosion, it was assumed that erosion due to gullies and streambanks would be about 423 thousand tons per year. Thus, referring to Figure 3 it can be seen that off-site damages would be approximately $10,000 in the absence of sheet

Table 13. Annualized off-site sediment damages in Duck Creek watershed for various gross erosion levels.

Damage Component	Damages (Dollars) Associated with Gross Erosion (1000 Tons) of:						
	333	666	998	1,333	1,666	1,988	2,330
Flood Control Structures (D_{FS})	4,406	41,208	97,357	160,336	226,846	294,826	363,948
Other (D_S)	6,039	12,078	18,117	24,156	30,195	36,234	42,273
Total Damages	10,445	53,286	115,474	184,492	257,041	331,060	406,221

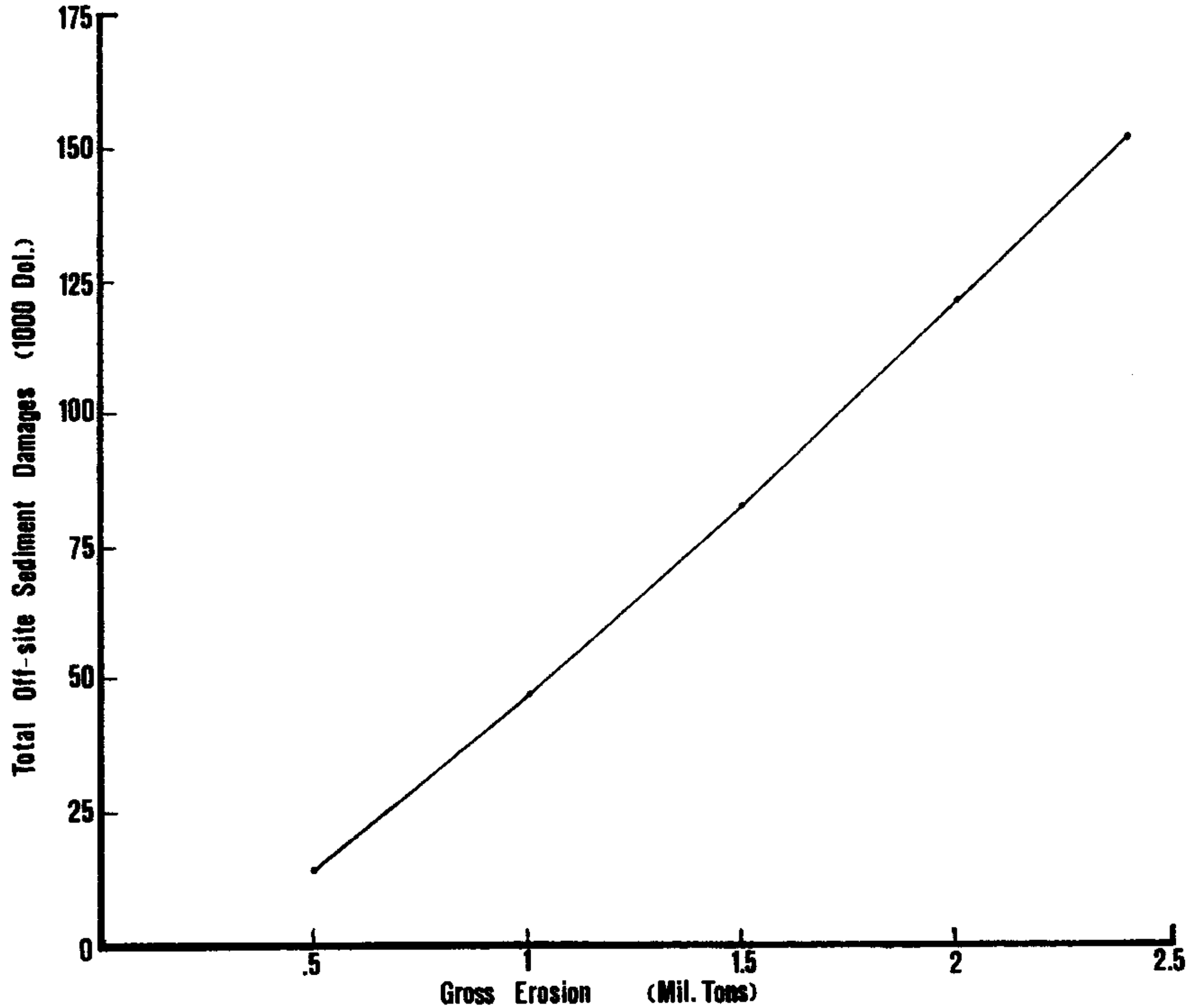

Figure 3. Total off-site sediment damages in Duck Creek watershed.

and rill erosion. Damages attributed to sheet and rill erosion would be in addition to this base level of damages.

ECONOMIC CONSEQUENCES OF NPS POLLUTION CONTROL POLICIES

To calculate the economic consequences of various control options it was necessary to make certain basic assumptions. These assumptions can be critical to the results of the study and must be kept in mind if the report is to be correctly interpreted. These assumptions include: (a) relative expected prices will remain constant; (b) expected present value of profit is a good indicator of farmers' decision criteria; (c) farm profits, government cost or revenue and sediment damage abatement have the same social value weights; and (d) farmers will act rationally and in their own self interest.

Assumption one rules out any large technological breakthroughs that would drastically change production costs or yield of one crop in relation to the others. It also rules out the discovery of presently unknown ways to cheaply restore the soil fertility of eroded soils or to remove sediment from waterways at little or no cost. Furthermore, major changes in crop prices relative to the general price structure would invalidate the conclusions of this study. If crop prices fell relative to other prices, off-site damages would carry significantly more weight and greater erosion control would be socially beneficial. On the other hand, if relative crop prices rose, off-site damages would become less important and the optimal erosion control would depend on the on-farm trade-offs between present production and future production.

The second assumption asserts that the shifts in cropping patterns will take place, as this is the decision criteria built into the model. Farmers have other criteria besides profit that they base their decisions on. These other criteria might include; personal preference for one crop over another, preference for leisure rather than more profit, varying estimates of risk and uncertainty, and others. While these other criteria play a part in farmers decisions it is a general assumption of economics that expected profit is the most important consideration and focusing on it alone will yield generally accurate results.

The third assumption is the rationale behind the net social benefit calculation. It indicates that for the purposes of this study "government" is considered only as a point of accounting, i.e. a frictionless point of transfer for part of the jointly held social wealth. Net social benefit does not change if money transfers from farm income to government or vice versa. Also, it implies that farm income is equal in social desirability to a similar dollar amount of off-site sediment damage abatement. This can be defended by noting that if the dollar value of the off-site damages have been correctly estimated then it would be better for farmers as a group to pay for the damages directly rather than lose a greater amount of profits than the value of the damages abated.

The last assumption rules out ignorance of, or uncertainty about the most profitable cropping system--conservation practice. It also implies the assumption that financing will be available for any necessary equipment shifts or terrace construction. Neither of these conditions will always be met and that failure will reduce the actual change caused by implementation of any of the control options specified.

Because the benefits of soil conservation accrue over time, rather than immediately, the length of a farmer's planning horizon also influences the crops that will be grown and the conservation practices employed. This, in turn, influences the estimated economic impact of NPS control options. Due to uncertainty about the length of farmers' planning horizon, estimated effects are shown for three horizons. These are 10 years, 100 years, and 200 years. Results based on these planning horizons will likely bracket the actual economic impact of the erosion controls considered.

Administrative and Enforcement Costs

The cost of administering and enforcing any of the NPS controls considered here has been estimated to be 21 cents per acre of land in Duckcreek watershed.* For the watershed as a whole, these costs will thus be $27,214 annually for the agricultural land in the watershed. The largest component of this cost estimate is based on the amount of technical assistance that would be required to implement the policies. While there will be slight cost differences between policies, this figure gives a rough floor to the administration and enforcement costs. This cost figure should be kept in mind when considering the benefit and cost figures given in Appendix B; Tables 53 through 61.

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*G.E. Kretzschmar, Jr. Texas Soil and Water Conservation Board, personal communication.

Estimated effects of various erosion-sedimentation control policies on farm income, government cost or revenue, soil loss, off-site sediment damages abated, and net social benefits are shown in Table 53 for a planning horizon of 10 years. Table 54 gives the associated acreage distribution, while Table 55 shows the extent and cost of terracing and contouring by control option. With only a ten year planning horizon, terracing and contouring were found to be unprofitable in the benchmark model solution (Table 55). The distribution of crop acreage in the benchmark solution (Table 54) was reasonably close to actual crop acreages in recent years (Table 2).

The first column of Table 53 gives the estimated farm income effect of the policies. For example, a restriction that per acre soil loss not exceed the SCS tolerance (T) limits, would decrease annualized farm income in the watershed by $60,090. Since this policy does not involve a tax or subsidy, the government cost is zero (column 2). The limit to T values would reduce soil loss in the watershed by 73.54 thousand tons, which decreases off-site sediment damages by $4,630 annually. The final column gives net social benefits excluding any administrative or enforcement costs. This column is calculated by adding off-site damages abated plus government revenue, minus government subsidies, to the change in farm income. For the soil loss less than "T" option, net social benefits, excluding administrative costs, declined by $47,270. If administrative costs for this policy are added, the net social benefits would decline even further. The negative net social welfare is the result of a larger loss in annual farm income than gain in off-site damages abated.

From Table 53 it can be seen that none of the policy options chosen show a positive net social benefit. Thus, we must conclude that with a 10 year planning horizon and the previously stated assumptions none of the options considered would be an economically advantageous policy.

Model results for a 100 year planning horizon are given in Tables 56 through 58 and results for the 200 year planning horizon in Tables 59 through 61. Comparison of these results with the 10 year planning horizon results demonstrates the importance of the length of the planning period.

When comparing the benchmark or base run of the three time periods it is notable that as the time horizon lengthens the trend is for the optimum crop distribution to shift away from cotton to more sorghum and small grains. Also, the distribution shifts out of field crops back to pasture and range. With a ten year planning horizon (Table 54) the base run calls for 53.9 percent of the land to be left as range. The 200 year planning horizon benchmark run (Table 60) directs 60.6 percent of the land to range. These shifts are directly due to the reduced present value of profits expected over the longer periods of soil erosion. These shifts would be even more pronounced if contouring was not introduced on 3,663 acres for the 100 year time horizon (Table 58) and 19,873 acres over the 200 year planning period, (Table 61).

There is a noticable trend in the way the various options effect the change in farm income, net social benefit, crop distribution, and amount of contouring and terracing as the planning period lengthens. Given a short 10 year planning horizon regulation of soil loss causes large losses in annualized farm income and net social benefits without causing much change in cropping patterns or large increases in conservation practices. That is with the exception of the extreme regulation forcing soil loss to be kept below 2 tons per acre. This limitation does force large changes in the cropping pattern but significantly it does not make conservation practices profitable except on 152 acres which are terraced.

Taxes on soil loss have no effect on cropping patterns, soil loss, or terraced and contoured acreage with the 10 year planning horizon. This is true even when a 50 percent terracing subsidy is added. Terracing and contouring subsidies do not effect the cropping pattern though a contouring subsidy of 100 percent does direct 34,918 acres into contouring causing an annual reduction in gross soil loss of 70,730. But even that has a net social cost of $60,990.

In short, given a ten year planning horizon the control options chosen either fail to reduce gross soil loss or are exceedingly expensive.

As the planning period is lengthened the control options tend to have more effect on cropping patterns, conservation practices and gross soil loss. This influence is greatest with the 200 year planning horizon, (Table 59, 60, 61).

The change in annualized farm income is not as drastic nor is the change in net social benefit. This is because the long time period allows the requirements or advantages of the various controls to work in adjusted crop patterns and applied conservation practices. Over the long time period the future yield effects of reduced soil erosion work in conjunction with the sediment abatement action of the control options to demonstrate the actual long term effects of the various controls. As would be expected from economic theory the soil loss tax options had the highest net social benefit of the options tested. Nonetheless, even they were not large enough to defray the expected administrative costs of even the simplest tax scheme.

SUMMARY AND CONCLUSION

This report looks at both the on-farm economics of soil conservation and the economic consequences of various non-point source pollution control options. These topics are joined in this study because they deal with different facets of the same problem. Unlike some pollutants, the sediment that washes off farmers' fields to become a problem downstream is a valuable resource, not a waste product. Because the soil is valuable in itself, some level of soil conservaton practice is going to be economically desirable even if the downstream pollution damages are not considered by the farmer. The results presented in the first section show that soil conservation does indeed pay and that its value is greater, the longer the planning horizon of the decision maker. To the extent that farmers do not employ the most profitable conservation practice, an educational program in this area may reduce sediment damage while increasing farm income at the same time.

The second section of this report deals with the total economic impact of various soil loss control options. Options based on regulation, taxation, economic incentive and combinations thereof were modeled. Given the estimate of off-site sediment damages and the assumptions of the model, <u>the analysis suggests that regulatory erosion-sedimentation controls or subsidies are not presently warranted from a social welfare viewpoint in the Duckcreek watershed.</u> However, it should be noted that the estimate of off-site damages is imprecise at best. Many types of environmental damage are intangible and others are caused indirectly. Future research should be directed toward calculating more precise and complete estimates of environmental damage.

The estimated farm income consequences of NPS controls options that are presented in this report were based on the assumption that crop prices would not change in response to the implementation of a particular policy. This is a reasonable assumption as long as the policy is imposed only in a small area with no changes in outside areas. However, if a pollution control policy is imposed in a large area or for the whole nation, it is expected that crop prices will change in response to implementing a policy that significantly effects cropping patterns, yield or production costs. Thus, the results presented in this study apply only if NPS controls are imposed in small areas or in ways that do not effect comparative crop prices.

APPENDIX A

Profit and yield information by soil series for 10, 100 and 200 year planning horizons.

TABLE 14. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES AU01.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.499	46.96	99.2	46.04	84.8	29.47	26.5	-37.33	431.	2135.	2260.
S	SR	0.384	41.41	99.6	41.13	89.7	34.69	63.0	17.25	381.	2018.	2363.
W	SR	0.115	50.30	100.0	50.30	97.3	47.83	94.3	45.09	464.	2562.	3106.
R	SR	0.031	24.61	100.0	24.61	99.8	24.55	98.8	24.23	227.	1270.	1555.
C/S	SR	0.346	54.77	99.7	54.46	91.0	45.72	71.1	25.70	505.	2665.	3127.
C/W	SR	0.269	55.83	99.9	55.77	93.3	48.41	82.7	36.74	515.	2749.	3269.
S/W	SR	0.230	43.59	100.0	43.59	94.3	39.25	86.6	33.43	402.	2174.	2609.
C/S/W	SR	0.269	53.53	99.9	53.48	93.3	46.98	82.7	36.67	494.	2646.	3155.
IRRIGATED CROPS												
C-I	SR	0.499	89.94	99.2	88.08	84.8	54.53	26.5	-80.78	825.	4058.	4250.
S-I	SR	0.384	66.15	99.6	65.56	89.7	52.02	63.0	15.38	609.	3164.	3645.
W-I	SR	0.115	75.88	100.0	75.88	97.3	70.95	94.3	65.47	700.	3848.	4649.
C/S-I	SR	0.346	99.65	99.7	99.02	91.0	81.08	71.1	40.01	918.	4811.	5612.
C/W-I	SR	0.269	97.60	99.9	97.48	93.3	82.65	82.7	59.10	900.	4771.	5645.
S/W-I	SR	0.230	66.71	100.0	66.71	94.3	57.83	86.6	45.91	615.	3288.	3915.
C/S/W-I	SR	0.269	92.59	99.9	92.49	93.3	79.24	82.7	58.22	854.	4541.	5385.

TABLE 15. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES BMCO.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	1.966	-30.23	95.2	-32.05	25.0	-58.39	25.0	-58.39	-287.	-2270.	-2950.
	C	0.983	-33.13	97.8	-33.97	29.7	-59.53	25.0	-61.29	-309.	-1996.	-2709.
	T	0.682	-40.59	98.6	-49.62	71.9	-51.47	25.0	-68.76	-455.	-2259.	-2961.
S	SR	1.512	4.06	96.3	3.03	25.0	-16.96	25.0	-16.96	33.	-205.	-403.
	C	0.756	2.74	98.4	2.30	64.4	-7.23	25.0	-18.27	24.	12.	-164.
	T	0.525	-5.52	99.1	-14.28	83.4	-10.50	25.0	-26.53	-130.	-377.	-540.
W	SR	0.454	-7.94	99.3	-8.15	86.9	-12.21	43.4	-26.46	-74.	-483.	-672.
	C	0.227	-9.42	100.0	-9.42	94.4	-11.27	86.9	-13.70	-87.	-519.	-660.
	T	0.157	-16.70	100.0	-24.37	96.2	-18.25	92.0	-19.34	-225.	-898.	-1098.
R	SR	0.121	15.48	100.0	15.48	97.1	14.80	94.0	14.06	143.	789.	958.
C/S	SR	1.361	-9.39	96.7	-10.58	25.0	-36.75	25.0	-36.75	-92.	-962.	-1390.
	C	0.680	-11.50	98.6	-11.99	72.1	-21.67	25.0	-38.86	-108.	-736.	-1107.
	T	0.472	-19.36	99.3	-28.14	86.1	-24.77	36.9	-42.39	-258.	-1102.	-1429.
C/W	SR	1.058	-16.87	97.6	-17.79	25.0	-44.89	25.0	-44.89	-159.	-1202.	-1725.
	C	0.529	-19.07	99.1	-19.40	83.1	-25.37	25.0	-47.09	-177.	-1086.	-1465.
	T	0.367	-26.89	99.6	-35.55	90.3	-30.84	66.7	-39.32	-327.	-1470.	-1839.
S/W	SR	0.907	-2.60	98.0	-3.20	43.4	-19.41	25.0	-24.89	-26.	-326.	-610.
	C	0.454	-4.00	99.3	-4.19	86.9	-7.88	43.4	-20.81	-37.	-273.	-408.
	T	0.315	-12.21	99.8	-20.79	92.0	-14.93	76.4	-19.24	-191.	-691.	-860.
C/S/W	SR	1.058	-8.50	97.6	-9.37	25.0	-34.90	25.0	-34.90	-82.	-750.	-1157.
	C	0.529	-10.39	99.1	-10.70	83.1	-16.32	25.0	-36.78	-97.	-632.	-901.
	T	0.367	-18.36	99.6	-27.01	90.3	-22.11	66.7	-30.07	-248.	-1026.	-1291.

TABLE 16. YIELD LOSS AND PER ACRE RETURN TO LANC AND MANAGEMENT FOR SOIL SERIES BPAS.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	4.732	-26.03	80.4	-33.56	0.0	0.0	0.0	0.0	-273.		
	C	2.839	-28.48	88.6	-32.96	0.0	0.0	0.0	0.0	-284.		
	T	1.274	-36.40	94.4	-47.98	0.0	0.0	0.0	0.0	-432.		
S	SR	3.640	7.38	85.6	3.23	0.0	0.0	0.0	0.0	48.		
	C	2.184	6.33	90.9	3.60	0.0	0.0	0.0	0.0	45.		
	T	0.980	-2.60	95.6	-13.16	6.9	-32.45	0.0	0.0	-115.	-484.	
W	SR	1.092	-3.57	95.1	-5.38	0.0	0.0	0.0	0.0	-41.		
	C	0.655	-5.06	97.2	-6.11	65.9	-17.72	0.0	0.0	-51.	-467.	
	T	0.294	-13.09	99.1	-21.71	88.3	-17.71	72.4	-23.36	-198.	-780.	-955.
R	SR	0.291	16.46	99.1	16.24	88.4	13.61	72.8	9.79	151.	790.	935.
C/S	SR	3.276	-4.98	87.0	-9.88	0.0	0.0	0.0	0.0	-69.		
	C	1.966	-6.78	91.7	-10.07	0.0	0.0	0.0	0.0	-78.		
	T	0.882	-15.31	96.1	-26.11	30.5	-44.34	0.0	0.0	-233.	-1164.	
C/W	SR	2.548	-12.18	89.6	-16.28	0.0	0.0	0.0	0.0	-132.		
	C	1.529	-14.13	93.3	-16.91	0.0	0.0	0.0	0.0	-144.		
	T	0.686	-22.72	97.0	-33.16	62.4	-38.93	0.0	0.0	-299.	-1437.	
S/W	SR	2.184	1.21	90.9	-1.69	0.0	0.0	0.0	0.0	-3.		
	C	1.310	-0.03	94.2	-1.99	0.0	0.0	0.0	0.0	-10.		
	T	0.588	-9.07	97.5	-19.08	72.4	-18.67	0.0	0.0	-172.	-647.	
C/S/W	SR	2.548	-4.09	89.6	-7.94	0.0	0.0	0.0	0.0	-56.		
	C	1.529	-5.73	93.3	-8.35	0.0	0.0	0.0	0.0	-65.		
	T	0.686	-14.48	97.0	-24.85	62.4	-29.77	0.0	0.0	-223.	-998.	

TABLE 17. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES BC13.

		% SOIL	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT							P.V. OF PRT STREAM TO YR		
ROT	CP	LOST/YR	YR 1	YEAR 10		YEAR 100		YEAR 200		10	100	200
C	SR	1.037	15.67	98.7	14.56	50.0	-26.06	50.0	-26.06	140.	385.	81.
	C	0.622	12.77	99.4	12.25	86.9	1.85	50.0	-28.95	116.	506.	352.
	T	0.491	8.87	99.6	3.44	92.0	2.02	53.7	-29.75	34.	338.	273.
S	SR	0.798	13.40	99.1	13.05	75.0	4.06	50.0	-5.28	122.	586.	549.
	C	0.479	12.08	99.6	11.95	92.4	9.24	57.2	-3.89	111.	576.	643.
	T	0.378	7.39	99.9	2.22	94.7	5.22	78.5	-0.65	21.	335.	389.
W	SR	0.239	17.54	100.0	17.54	96.8	15.68	92.4	13.11	162.	872.	1045.
	C	0.144	16.05	100.0	16.05	98.1	14.93	96.2	13.82	148.	812.	981.
	T	0.113	12.21	100.0	7.83	98.5	11.18	97.0	10.44	72.	610.	747.
R	SR	0.064	31.19	100.0	31.19	99.3	30.93	98.3	30.52	288.	1608.	1967.
C/S	SR	0.718	21.87	99.2	21.33	81.3	9.18	50.0	-12.00	200.	971.	918.
	C	0.431	19.77	99.7	19.59	93.6	15.44	68.8	-1.37	182.	944.	1071.
	T	0.340	15.47	99.9	10.31	95.4	12.13	83.7	4.44	95.	731.	858.
C/W	SR	0.559	22.24	99.5	21.85	89.7	14.39	50.0	-16.00	204.	1028.	1064.
	C	0.335	20.05	99.9	20.00	95.4	16.56	84.3	8.06	185.	970.	1135.
	T	0.265	15.79	100.0	10.68	96.5	12.90	90.8	8.77	99.	756.	903.
S/W	SR	0.479	13.86	99.6	13.70	92.4	10.35	57.2	-5.88	128.	657.	726.
	C	0.287	12.46	100.0	12.46	96.2	10.69	89.1	7.42	115.	611.	724.
	T	0.227	7.81	100.0	2.70	97.0	6.22	93.1	4.61	25.	369.	447.
C/S/W	SR	0.559	20.82	99.5	20.50	89.7	14.20	50.0	-11.44	191.	974.	1028.
	C	0.335	18.94	99.9	18.90	95.4	16.00	84.3	8.83	175.	924.	1086.
	T	0.265	14.53	100.0	9.42	96.5	12.06	90.8	8.61	87.	699.	838.

TABLE 18. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES BNAU.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.062	-23.97	100.0	-23.97	98.8	-24.49	97.0	-25.27	-221.	-1242.	-1531.
S	SR	0.048	-4.16	100.0	-4.16	99.3	-4.31	97.8	-4.59	-38.	-216.	-267.
W	SR	0.014	-8.66	100.0	-8.66	100.0	-8.66	99.9	-8.70	-80.	-447.	-548.
R	SR	0.004	29.03	100.0	29.03	100.0	29.03	100.0	29.03	268.	1499.	1837.
C/S	SR	0.043	-10.21	100.0	-10.21	99.4	-10.41	98.1	-10.88	-94.	-528.	-652.
C/W	SR	0.034	-13.43	100.0	-13.43	99.7	-13.54	98.7	-13.97	-124.	-694.	-854.
S/W	SR	0.029	-7.32	100.0	-7.32	99.9	-7.35	99.0	-7.58	-68.	-378.	-465.
C/S/W	SR	0.034	-9.32	100.0	-9.32	99.7	-9.42	98.7	-9.78	-86.	-482.	-593.

TABLE 19. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES LG38.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
R	SR	0.146	4.18	99.9	4.18	93.6	3.40	88.3	2.75	39.	202.	238.

TABLE 20. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES LTCL.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.333	11.50	99.7	11.29	91.4	4.69	73.4	-9.57	106.	471.	475.
S	SR	0.256	13.40	100.0	13.39	93.6	11.01	84.1	7.45	124.	649.	764.
W	SR	0.077	13.90	100.0	13.90	98.4	13.02	96.3	11.86	128.	708.	854.
R	SR	0.020	21.37	100.0	21.37	100.0	21.37	99.5	21.22	197.	1103.	1352.
C/S	SR	0.230	19.48	100.0	19.48	94.3	15.75	86.6	10.74	180.	940.	1104.
C/W	SR	0.179	18.09	100.0	18.09	95.6	14.91	90.6	11.28	167.	881.	1039.
S/W	SR	0.154	12.23	100.0	12.23	96.3	10.56	92.2	8.74	113.	605.	720.
C/S/W	SR	0.179	18.08	100.0	18.08	95.6	15.37	90.6	12.27	167.	889.	1054.

TABLE 21. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES MK13.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	1.820	-5.19	95.5	-7.99	25.0	-52.13	25.0	-52.13	-60.	-1378.	-1986.
	C	0.910	-8.09	98.0	-9.36	43.0	-43.79	25.0	-55.03	-79.	-824.	-1453.
	T	0.546	-11.99	99.1	-17.70	82.2	-23.36	25.0	-58.93	-159.	-807.	-1217.
S	SR	1.400	9.47	96.6	8.35	25.0	-15.60	25.0	-15.60	83.	36.	-146.
	C	0.700	8.16	98.6	7.69	70.3	-1.78	25.0	-16.92	74.	285.	154.
	T	0.420	3.47	99.5	-1.83	88.4	-0.62	53.8	-11.99	-16.	101.	67.
W	SR	0.420	2.98	99.5	2.74	88.4	-2.10	53.8	-17.21	27.	65.	-10.
	C	0.210	1.49	100.0	1.49	94.8	-0.77	88.4	-3.59	14.	38.	18.
	T	0.126	-2.35	100.0	-6.73	97.0	-3.83	93.7	-5.09	-62.	-149.	-189.
R	SR	0.112	20.98	100.0	20.98	97.4	20.22	94.4	19.36	193.	1072.	1304.
C/S	SR	1.260	7.83	97.0	6.22	25.0	-32.44	25.0	-32.44	66.	-229.	-607.
	C	0.630	5.73	98.8	5.08	76.4	-6.96	25.0	-34.55	51.	110.	-136.
	T	0.378	1.43	99.6	-3.90	89.9	-4.18	64.4	-17.68	-34.	-33.	-116.
C/W	SR	0.980	3.12	97.8	1.84	30.2	-36.90	25.0	-39.90	24.	-272.	-737.
	C	0.490	0.93	99.2	0.48	85.2	-7.55	30.2	-39.09	7.	-93.	-285.
	T	0.294	-3.33	99.9	-8.52	92.6	-7.79	79.5	-15.11	-78.	-259.	-365.
S/W	SR	0.840	5.22	98.2	4.53	53.8	-12.14	25.0	-22.94	46.	60.	-185.
	C	0.420	3.81	99.5	3.61	88.4	-0.56	53.8	-13.55	35.	120.	70.
	T	0.252	-0.84	100.0	-5.95	93.7	-3.39	84.5	-6.65	-55.	-95.	-136.
C/S/W	SR	0.980	6.73	97.8	5.61	30.2	-28.46	25.0	-31.09	58.	-34.	-395.
	C	0.490	4.85	99.2	4.46	85.2	-2.60	30.2	-30.34	44.	126.	5.
	T	0.294	0.44	99.9	-4.74	92.6	-3.51	79.5	-9.92	-43.	-55.	-108.

TABLE 22. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES MK35.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	4.150	-15.90	88.6	-21.60	25.0	-54.74	25.0	-54.74	-171.	-2269.	-2907.
	C	2.075	-18.52	94.9	-21.20	25.0	-57.64	25.0	-57.64	-183.	-1983.	-2655.
	T	0.917	-25.10	97.9	-33.83	41.7	-55.78	25.0	-64.21	-306.	-1655.	-2379.
S	SR	3.192	2.69	91.8	0.57	25.0	-17.28	25.0	-17.28	15.	-533.	-735.
	C	1.596	1.43	96.1	0.40	25.0	-18.60	25.0	-18.60	9.	-345.	-561.
	T	0.706	-5.93	98.6	-13.98	69.7	-14.31	25.0	-25.96	-127.	-432.	-668.
W	SR	0.958	-4.30	97.8	-5.08	34.5	-28.12	25.0	-31.59	-43.	-484.	-850.
	C	0.479	-5.78	99.3	-6.05	85.8	-10.96	34.5	-29.61	-54.	-386.	-575.
	T	0.212	-12.14	100.0	-18.93	94.8	-14.31	88.2	-16.43	-175.	-673.	-833.
R	SR	0.255	20.00	100.0	19.99	93.6	18.20	84.2	15.55	184.	1000.	1202.
C/S	SR	2.873	-1.78	92.8	-4.93	25.0	-34.84	25.0	-34.84	-31.	-1151.	-1557.
	C	1.436	-3.84	96.5	-5.37	25.0	-36.94	25.0	-36.94	-42.	-815.	-1245.
	T	0.635	-10.81	98.8	-19.01	76.0	-21.71	25.0	-43.91	-172.	-728.	-1098.
C/W	SR	2.234	-6.44	94.5	-9.08	25.0	-42.29	25.0	-42.29	-72.	-1324.	-1817.
	C	1.117	-8.63	97.4	-9.88	25.0	-44.48	25.0	-44.48	-85.	-912.	-1431.
	T	0.494	-15.56	99.2	-23.60	85.0	-23.01	28.7	-49.65	-215.	-937.	-1275.
S/W	SR	1.915	-1.66	95.3	-3.10	25.0	-24.66	25.0	-24.66	-22.	-653.	-941.
	C	0.958	-3.06	97.8	-3.72	34.5	-23.14	25.0	-26.06	-31.	-379.	-681.
	T	0.423	-10.38	99.4	-18.22	88.2	-14.29	52.8	-24.86	-167.	-614.	-798.
C/S/W	SR	2.234	-2.11	94.5	-4.41	25.0	-33.30	25.0	-33.30	-30.	-972.	-1360.
	C	1.117	-3.99	97.4	-5.08	25.0	-35.19	25.0	-35.19	-41.	-612.	-1022.
	T	0.494	-11.07	99.2	-19.07	85.0	-17.59	28.7	-40.74	-174.	-690.	-953.

TABLE 23. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES MFSL.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.265	57.39	100.0	57.34	93.4	49.08	83.1	36.20	529.	2814.	3337.
S	SR	0.204	32.07	100.0	32.07	95.0	29.25	88.8	25.81	296.	1608.	1934.
W	SR	0.061	32.10	100.0	32.10	98.9	31.26	97.1	29.98	296.	1649.	2007.
R	SR	0.016	29.52	100.0	29.52	100.0	29.52	99.8	29.43	272.	1524.	1868.
C/S	SR	0.184	55.74	100.0	55.74	95.5	51.16	90.3	45.88	514.	2801.	3375.
C/W	SR	0.143	53.92	100.0	53.92	96.6	50.19	92.8	46.14	497.	2726.	3293.
S/W	SR	0.122	30.41	100.0	30.41	97.1	28.59	93.9	26.59	280.	1543.	1867.
C/S/W	SR	0.143	48.76	100.0	48.76	96.6	45.57	92.8	42.10	450.	2468.	2984.

TABLE 24. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES MLFS.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.484	36.53	99.2	35.75	85.5	21.45	32.7	-33.66	335.	1633.	1702.
	C	0.290	33.63	99.9	33.50	92.7	25.99	80.0	12.75	310.	1599.	1853.
	T	0.215	29.73	100.0	24.62	94.7	23.98	87.9	17.14	227.	1429.	1692.
S	SR	0.372	22.74	99.6	22.55	90.1	18.13	65.7	6.74	209.	1091.	1263.
	C	0.223	21.42	100.0	21.42	94.5	18.84	87.3	15.47	198.	1061.	1267.
	T	0.166	16.73	100.0	11.62	96.0	14.64	91.5	12.74	107.	823.	997.
W	SR	0.112	13.90	100.0	13.90	97.4	12.48	94.5	10.88	128.	698.	836.
	C	0.067	12.41	100.0	12.41	98.7	11.69	96.8	10.66	114.	634.	765.
	T	0.050	8.57	100.0	4.19	99.2	7.97	97.7	7.33	39.	431.	531.
R	SR	0.030	27.95	100.0	27.95	99.9	27.90	98.9	27.55	258.	1443.	1766.
C/S	SR	0.335	38.81	99.7	38.58	91.3	31.48	73.1	16.01	358.	1871.	2183.
	C	0.201	36.70	100.0	36.70	95.0	32.51	89.1	27.44	338.	1823.	2181.
	T	0.149	32.40	100.0	27.29	96.4	29.15	92.4	26.01	252.	1615.	1952.
C/W	SR	0.260	33.17	100.0	33.15	93.5	27.48	83.6	18.84	306.	1611.	1898.
	C	0.156	30.97	100.0	30.97	96.2	27.65	92.0	24.00	286.	1546.	1852.
	T	0.116	26.72	100.0	21.61	97.3	24.14	94.2	21.69	199.	1336.	1617.
S/W	SR	0.223	17.22	100.0	17.22	94.5	14.48	87.3	10.91	159.	841.	996.
	C	0.134	15.82	100.0	15.82	96.8	14.23	93.3	12.50	146.	793.	951.
	T	0.099	11.17	100.0	6.06	97.7	9.85	95.1	8.75	56.	552.	673.
C/S/W	SR	0.260	31.55	100.0	31.53	93.5	26.65	83.6	19.22	291.	1541.	1823.
	C	0.156	29.67	100.0	29.67	96.2	26.81	92.0	23.67	274.	1486.	1785.
	T	0.116	25.26	100.0	20.15	97.3	23.01	94.2	20.93	186.	1265.	1535.

TABLE 25. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES ML01.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.318	57.39	99.8	57.12	91.9	47.20	75.9	27.18	529.	2779.	3257.
S	SR	0.245	32.07	100.0	32.07	93.9	28.66	85.2	23.81	296.	1595.	1911.
W	SR	0.073	32.10	100.0	32.10	98.5	30.99	96.4	29.51	296.	1645.	1999.
R	SR	0.020	29.52	100.0	29.52	100.0	29.52	99.5	29.35	272.	1524.	1868.
C/S	SR	0.220	55.74	100.0	55.74	94.5	50.20	87.5	43.04	514.	2781.	3337.
C/W	SR	0.171	53.92	100.0	53.92	95.8	49.39	91.1	44.30	497.	2710.	3263.
S/W	SR	0.147	30.41	100.0	30.41	96.4	28.18	92.6	25.75	280.	1535.	1852.
C/S/W	SR	0.171	48.76	100.0	48.76	95.8	44.89	91.1	40.53	450.	2454.	2958.
IRRIGATED CROPS												
C-I	SR	0.318	111.07	99.8	110.52	91.9	90.42	75.9	49.88	1024.	5361.	6270.
S-I	SR	0.245	47.21	100.0	47.21	93.9	40.00	85.2	29.74	435.	2309.	2736.
W-I	SR	0.073	39.45	100.0	39.45	98.5	37.23	96.4	34.26	364.	2012.	2432.
C/S-I	SR	0.220	101.61	100.0	101.61	94.5	90.24	87.5	75.56	937.	5048.	6040.
C/W-I	SR	0.171	93.93	100.0	93.93	95.8	84.77	91.1	74.50	866.	4699.	5643.
S/W-I	SR	0.147	40.18	100.0	40.18	96.4	35.60	92.6	30.60	371.	2003.	2396.
C/S/W-I	SR	0.171	83.04	100.0	83.04	95.8	75.13	91.1	66.25	766.	4158.	4995.

TABLE 26. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES ML13.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.645	36.53	98.8	35.23	75.2	10.65	25.0	-41.70	333.	1512.	1309.
	C	0.387	33.63	99.6	33.17	89.6	22.79	62.4	-5.64	309.	1544.	1712.
	T	0.287	29.73	99.9	24.50	92.8	21.98	80.4	9.28	227.	1389.	1610.
S	SR	0.496	22.74	99.2	22.37	84.9	15.70	27.8	-10.96	209.	1057.	1153.
	C	0.298	21.42	99.9	21.35	92.5	17.90	79.0	11.60	197.	1042.	1228.
	T	0.221	16.73	100.0	11.62	94.5	13.98	87.5	10.87	107.	809.	971.
W	SR	0.149	32.10	100.0	32.10	96.4	29.47	92.5	26.61	296.	1616.	1947.
	C	0.089	30.61	100.0	30.61	98.0	29.17	95.6	27.42	282.	1562.	1894.
	T	0.066	26.77	100.0	22.39	98.7	25.65	96.8	24.46	206.	1364.	1667.
R	SR	0.040	27.95	100.0	27.95	99.5	27.78	98.3	27.34	258.	1442.	1764.
C/S	SR	0.446	38.81	99.4	38.27	87.3	28.02	45.8	-7.10	357.	1818.	2027.
	C	0.268	36.70	99.9	36.66	93.3	31.02	82.8	22.11	338.	1793.	2121.
	T	0.199	32.40	100.0	27.29	95.1	28.06	89.2	23.28	252.	1592.	1911.
C/W	SR	0.347	41.36	99.7	41.06	91.0	32.71	70.8	13.45	381.	1980.	2293.
	C	0.208	39.16	100.0	39.16	94.9	34.24	88.5	28.16	361.	1937.	2311.
	T	0.155	34.91	100.0	29.80	96.2	31.12	92.1	27.38	275.	1735.	2093.
S/W	SR	0.298	25.41	99.9	25.33	92.5	21.06	79.0	13.26	234.	1233.	1450.
	C	0.179	24.01	100.0	24.01	95.6	21.48	90.6	18.60	221.	1198.	1436.
	T	0.132	19.36	100.0	14.25	96.8	17.33	93.4	15.53	131.	962.	1167.
C/S/W	SR	0.347	36.96	99.7	36.70	91.0	29.66	70.8	13.41	340.	1777.	2065.
	C	0.208	35.07	100.0	35.07	94.9	30.92	88.5	25.79	323.	1739.	2078.
	T	0.155	30.67	100.0	25.55	96.2	27.44	92.1	24.31	236.	1525.	1842.

TABLE 27. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES ML35.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	1.654	15.67	96.0	12.30	25.0	-46.92	25.0	-46.92	130.	-547.	-1093.
	C	0.827	12.77	98.2	11.28	55.6	-24.29	25.0	-49.82	112.	208.	-316.
	T	0.655	6.20	98.7	-2.54	74.3	-15.53	25.0	-56.39	-17.	-2.	-430.
S	SR	1.272	13.40	97.0	12.26	25.0	-14.62	25.0	-14.62	119.	245.	75.
	C	0.636	12.08	98.8	11.62	75.9	3.08	25.0	-15.94	110.	493.	413.
	T	0.504	4.72	99.2	-3.26	84.5	-1.37	25.0	-23.30	-28.	133.	62.
W	SR	0.382	13.90	99.6	13.67	89.8	8.33	63.6	-5.98	128.	619.	667.
	C	0.191	12.41	100.0	12.41	95.3	9.85	89.8	6.84	114.	598.	700.
	T	0.151	6.06	100.0	-0.73	96.3	3.79	92.3	1.86	-7.	268.	319.
R	SR	0.102	26.28	100.0	26.28	97.7	25.48	95.0	24.55	242.	1346.	1639.
C/S	SR	1.145	21.87	97.3	20.05	25.0	-28.93	25.0	-28.93	194.	440.	103.
	C	0.572	19.77	99.0	19.07	80.5	6.56	25.0	-31.04	180.	816.	713.
	T	0.454	12.80	99.3	4.68	86.9	3.65	43.4	-25.52	46.	494.	457.
C/W	SR	0.890	20.60	98.0	19.12	46.2	-19.68	25.0	-35.53	184.	598.	205.
	C	0.445	18.41	99.4	17.94	87.3	8.91	46.2	-21.87	169.	787.	788.
	T	0.353	11.48	99.7	3.57	90.8	4.28	69.7	-11.17	35.	453.	467.
S/W	SR	0.763	12.23	98.4	11.51	63.6	-4.00	25.0	-21.19	110.	422.	231.
	C	0.382	10.82	99.6	10.64	89.8	6.28	63.6	-5.40	99.	478.	511.
	T	0.302	3.50	99.8	-4.24	92.3	-0.21	78.3	-6.18	-38.	104.	97.
C/S/W	SR	0.890	19.74	98.0	18.49	46.2	-14.41	25.0	-27.84	177.	624.	318.
	C	0.445	17.86	99.4	17.46	87.3	9.81	46.2	-16.29	164.	784.	811.
	T	0.353	10.78	99.7	2.90	90.8	4.63	69.7	-8.43	28.	436.	462.

TABLE 28. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES ML58.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
R	SR	0.219	24.61	100.0	24.61	94.6	22.84	87.6	20.56	227.	1240.	1497.

TABLE 29. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES MS03.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.370	36.53	99.6	36.12	90.2	26.29	66.1	1.14	336.	1703.	1923.
	C	0.222	33.63	100.0	33.63	94.5	27.89	87.3	20.42	310.	1636.	1931.
	T	0.175	29.73	100.0	24.62	95.7	25.05	90.8	20.17	227.	1451.	1733.
S	SR	0.285	22.74	99.9	22.69	92.8	19.38	80.7	13.70	210.	1113.	1318.
	C	0.171	21.42	100.0	21.42	95.8	19.47	91.1	17.27	198.	1074.	1291.
	T	0.135	16.73	100.0	11.62	96.8	15.02	93.2	13.57	107.	831.	1011.
W	SR	0.085	13.90	100.0	13.90	98.1	12.88	95.8	11.62	128.	705.	850.
	C	0.051	12.41	100.0	12.41	99.2	11.95	97.6	11.12	114.	637.	773.
	T	0.040	8.57	100.0	4.19	99.5	8.13	98.3	7.62	39.	432.	535.
R	SR	0.023	27.95	100.0	27.95	100.0	27.95	99.3	27.71	258.	1443.	1768.
C/S	SR	0.256	38.81	100.0	38.80	93.6	33.38	84.0	25.29	358.	1907.	2265.
	C	0.154	36.70	100.0	36.70	96.3	33.53	92.2	30.06	338.	1844.	2220.
	T	0.121	32.40	100.0	27.29	97.1	29.77	94.0	27.28	252.	1627.	1974.
C/W	SR	0.199	33.17	100.0	33.17	95.1	28.87	89.2	23.70	306.	1639.	1954.
	C	0.120	30.97	100.0	30.97	97.2	28.50	94.0	25.77	286.	1563.	1883.
	T	0.094	26.72	100.0	21.61	97.9	24.66	95.4	22.66	199.	1345.	1635.
S/W	SR	0.171	17.22	100.0	17.22	95.8	15.15	91.1	12.82	159.	855.	1022.
	C	0.103	15.82	100.0	15.82	97.6	14.65	94.9	13.31	146.	801.	966.
	T	0.081	11.17	100.0	6.06	98.3	10.11	96.0	9.21	56.	557.	682.
C/S/W	SR	0.199	31.55	100.0	31.55	95.1	27.85	89.2	23.40	291.	1566.	1872.
	C	0.120	29.67	100.0	29.67	97.2	27.54	94.0	25.19	274.	1501.	1811.
	T	0.094	25.26	100.0	20.15	97.9	23.46	95.4	21.76	186.	1273.	1550.

TABLE 30. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES MS35.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
R	SR	0.042	26.28	100.0	26.28	99.4	26.09	98.1	25.64	242.	1356.	1658.

TABLE 31. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES MI26.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
R	SR	0.048	24.61	100.0	24.61	99.3	24.37	97.8	23.90	227.	1269.	1551.

TABLE 32. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES MB13.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.337	15.67	99.9	15.61	95.4	11.84	84.1	2.41	144.	738.	845.
S	SR	0.259	17.69	100.0	17.69	96.5	16.25	91.2	14.02	163.	887.	1069.
W	SR	0.078	13.90	100.0	13.90	99.1	13.41	97.9	12.76	128.	713.	866.
R	SR	0.021	23.04	100.0	23.04	100.0	23.04	99.8	22.97	212.	1189.	1458.
C/S	SR	0.233	24.17	100.0	24.17	96.9	21.99	92.7	19.08	223.	1209.	1454.
C/W	SR	0.181	20.60	100.0	20.60	97.6	18.77	95.0	16.85	190.	1034.	1244.
S/W	SR	0.156	14.53	100.0	14.53	97.9	13.54	95.8	12.57	134.	735.	888.
C/S/W	SR	0.181	21.36	100.0	21.36	97.6	19.77	95.0	18.10	197.	1077.	1300.

TABLE 33. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES MB35.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
S	SR	0.630	9.47	99.4	9.26	86.5	4.97	50.0	-7.24	87.	427.	413.
W	SR	0.189	-4.30	100.0	-4.30	97.5	-5.22	94.7	-6.22	-40.	-237.	-302.
R	SR	0.050	19.70	100.0	19.70	99.6	19.59	98.7	19.34	182.	1016.	1244.
S/W	SR	0.378	1.94	99.9	1.89	94.7	0.13	78.5	-5.43	18.	67.	51.

TABLE 34. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES OC01.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.499	15.67	99.2	15.00	84.8	2.95	26.5	-45.63	143.	599.	474.
S	SR	0.384	13.40	99.6	13.23	89.7	9.55	63.0	-0.41	123.	623.	701.
W	SR	0.115	17.54	100.0	17.54	97.3	15.96	94.3	14.21	162.	883.	1061.
R	SR	0.031	19.70	100.0	19.70	99.8	19.65	98.8	19.38	182.	1017.	1245.
C/S	SR	0.346	21.87	99.7	21.66	91.0	15.78	71.1	2.30	201.	1020.	1156.
C/W	SR	0.269	22.24	99.9	22.20	93.3	17.09	82.7	8.97	205.	1056.	1224.
S/W	SR	0.230	13.86	100.0	13.86	94.3	11.22	86.6	7.68	128.	669.	786.
C/S/W	SR	0.269	20.82	99.9	20.79	93.3	16.48	82.7	9.63	192.	997.	1163.

TABLE 35. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES OC13.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.784	5.24	98.3	4.02	61.1	-23.19	25.0	-49.53	44.	-89.	-590.
	C	0.471	2.34	99.3	1.82	86.2	-7.77	37.5	-43.29	20.	-50.	-258.
	T	0.406	-1.56	99.5	-7.04	88.9	-9.88	57.4	-32.64	-62.	-234.	-414.
S	SR	0.603	4.06	98.9	3.74	78.4	-2.00	25.0	-16.96	36.	118.	14.
	C	0.362	2.74	99.6	2.64	90.5	0.07	67.9	-6.26	25.	94.	73.
	T	0.313	-1.95	99.8	-7.12	92.0	-4.38	76.7	-8.47	-65.	-151.	-205.
W	SR	0.181	10.26	100.0	10.26	95.6	8.00	90.5	5.41	95.	492.	574.
	C	0.109	8.77	100.0	8.77	97.5	7.49	94.6	6.03	81.	435.	516.
	T	0.094	4.93	100.0	0.55	97.9	3.69	95.4	2.58	5.	232.	280.
R	SR	0.048	16.46	100.0	16.46	99.3	16.28	97.8	15.92	152.	848.	1036.
C/S	SR	0.543	10.91	99.1	10.37	82.3	0.87	25.0	-31.68	99.	403.	279.
	C	0.326	8.80	99.8	8.66	91.6	4.04	74.6	-5.61	81.	368.	381.
	T	0.281	4.50	99.9	-0.66	92.9	0.28	81.1	-6.22	-6.	150.	141.
C/W	SR	0.422	12.68	99.4	12.31	88.3	4.82	53.1	-18.72	116.	517.	495.
	C	0.253	10.49	100.0	10.48	93.7	6.25	84.4	0.02	97.	466.	515.
	T	0.219	6.23	100.0	1.12	94.6	2.41	87.6	-2.05	10.	249.	270.
S/W	SR	0.362	5.59	99.6	5.46	90.5	1.98	67.9	-6.59	51.	224.	217.
	C	0.217	4.19	100.0	4.19	94.6	2.15	87.8	-0.45	39.	181.	196.
	T	0.188	-0.46	100.0	-5.57	95.4	-2.40	90.0	-4.24	-51.	-63.	-87.
C/S/W	SR	0.422	11.00	99.4	10.70	88.3	4.58	53.1	-14.67	101.	456.	445.
	C	0.253	9.12	100.0	9.12	93.7	5.66	84.4	0.56	84.	409.	456.
	T	0.219	4.71	100.0	-0.40	94.6	1.55	87.6	-2.06	-4.	182.	197.

TABLE 36. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES PC01.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.499	15.67	99.2	15.00	84.8	2.95	26.5	-45.63	143.	599.	474.
S	SR	0.384	13.40	99.6	13.23	89.7	9.55	63.0	-0.41	123.	623.	701.
W	SR	0.115	13.90	100.0	13.90	97.3	12.42	94.3	10.78	128.	697.	834.
R	SR	0.031	18.13	100.0	18.13	99.8	18.08	98.8	17.83	167.	936.	1145.
C/S	SR	0.346	21.87	99.7	21.66	91.0	15.78	71.1	2.30	201.	1020.	1156.
C/W	SR	0.269	20.60	99.9	20.56	93.3	15.56	82.7	7.62	190.	973.	1125.
S/W	SR	0.230	12.23	100.0	12.23	94.3	9.68	86.6	6.26	113.	587.	686.
C/S/W	SR	0.269	19.74	99.9	19.71	93.3	15.47	82.7	8.74	182.	943.	1097.

TABLE 37. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES PC13.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.856	-5.19	98.1	-6.37	51.5	-35.56	25.0	-52.13	-52.	-629.	-1206.
	C	0.513	-8.09	99.2	-8.62	84.0	-18.10	25.0	-55.03	-76.	-581.	-921.
	T	0.406	-11.99	99.5	-17.42	88.9	-19.15	57.4	-38.63	-158.	-752.	-1029.
S	SR	0.658	4.06	98.7	3.70	74.1	-3.21	25.0	-16.96	36.	106.	-21.
	C	0.395	2.74	99.5	2.61	89.3	-0.25	60.4	-8.36	25.	89.	58.
	T	0.313	-1.95	99.8	-7.12	92.0	-4.38	76.7	-8.47	-65.	-151.	-205.
W	SR	0.197	2.98	100.0	2.98	95.1	0.86	89.3	-1.68	28.	118.	117.
	C	0.118	1.49	100.0	1.49	97.2	0.27	94.1	-1.08	14.	60.	57.
	T	0.094	-2.35	100.0	-6.73	97.9	-3.44	95.4	-4.36	-62.	-142.	-176.
R	SR	0.053	14.79	100.0	14.79	99.1	14.59	97.6	14.23	136.	762.	930.
C/S	SR	0.592	4.94	98.9	4.38	79.2	-5.66	25.0	-33.17	44.	94.	-115.
	C	0.355	2.83	99.7	2.66	90.7	-1.90	69.2	-12.82	26.	61.	1.
	T	0.281	-1.47	99.9	-6.63	92.9	-5.26	81.1	-11.06	-61.	-151.	-222.
C/W	SR	0.461	3.12	99.3	2.73	86.6	-4.56	41.0	-30.72	28.	30.	-109.
	C	0.276	0.93	99.9	0.88	93.1	-3.06	81.7	-9.55	9.	-24.	-84.
	T	0.219	-3.33	100.0	-8.44	94.6	-6.63	87.6	-10.42	-78.	-236.	-317.
S/W	SR	0.395	2.32	99.5	2.16	89.3	-1.39	60.4	-11.41	21.	54.	4.
	C	0.237	0.92	100.0	0.92	94.1	-1.12	86.0	-3.93	8.	11.	-13.
	T	0.188	-3.73	100.0	-8.85	95.4	-5.53	90.0	-7.19	-82.	-230.	-289.
C/S/W	SR	0.461	4.69	99.3	4.36	86.6	-1.78	41.0	-23.86	42.	132.	38.
	C	0.276	2.81	99.9	2.77	93.1	-0.55	81.7	-6.03	26.	85.	58.
	T	0.219	-1.60	100.0	-6.71	94.6	-4.42	87.6	-7.59	-62.	-138.	-191.

TABLE 38. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES RANC.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
R	SR	0.010	11.55	100.0	11.55	100.0	11.55	100.0	11.55	107.	596.	731.

TABLE 39. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES RANL.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
R	SR	0.011	14.79	100.0	14.79	100.0	14.79	99.5	14.69	136.	764.	936.

TABLE 40. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES RBLD.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
R	SR	2.433	3.33	90.0	2.26	0.0	0.0	0.0	0.0	25.		

TABLE 41. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES SPCL.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.218	26.10	100.0	26.10	97.1	23.35	93.5	19.97	241.	1300.	1558.
	C	0.131	23.20	100.0	23.20	98.3	21.56	96.5	19.92	214.	1174.	1418.
	T	0.122	21.44	100.0	18.37	98.4	19.80	96.7	18.37	169.	1080.	1311.
S	SR	0.168	22.74	100.0	22.74	97.7	21.68	95.4	20.60	210.	1157.	1405.
	C	0.101	21.42	100.0	21.42	98.7	20.82	97.3	20.16	198.	1099.	1338.
	T	0.094	18.87	100.0	15.80	98.8	18.20	97.5	17.69	146.	962.	1178.
W	SR	0.050	32.10	100.0	32.10	99.6	31.81	98.7	31.16	296.	1656.	2023.
	C	0.030	30.61	100.0	30.61	100.0	30.61	99.4	30.18	282.	1580.	1935.
	T	0.028	28.68	100.0	26.12	100.0	28.58	99.5	28.31	241.	1476.	1813.
R	SR	0.013	34.14	100.0	34.14	100.0	34.14	100.0	34.14	315.	1762.	2160.
C/S	SR	0.151	32.84	100.0	32.84	98.0	31.24	95.9	29.65	303.	1671.	2027.
	C	0.091	30.73	100.0	30.73	98.9	29.85	97.6	28.81	283.	1577.	1919.
	T	0.085	28.58	100.0	25.51	99.0	27.66	97.7	26.78	235.	1461.	1785.
C/W	SR	0.118	35.07	100.0	35.07	98.5	33.69	96.9	32.27	323.	1792.	2178.
	C	0.071	32.88	100.0	32.88	99.2	32.19	98.1	31.19	303.	1691.	2061.
	T	0.066	30.77	100.0	27.70	99.3	30.03	98.2	29.20	255.	1577.	1930.
S/W	SR	0.101	25.41	100.0	25.41	98.7	24.67	97.3	23.85	234.	1303.	1586.
	C	0.060	24.01	100.0	24.01	99.4	23.67	98.4	23.09	221.	1237.	1510.
	T	0.056	21.50	100.0	18.44	99.5	21.09	98.5	20.65	170.	1102.	1352.
C/S/W	SR	0.118	32.81	100.0	32.81	98.5	31.62	96.9	30.40	303.	1678.	2040.
	C	0.071	30.93	100.0	30.93	99.2	30.34	98.1	29.48	285.	1591.	1940.
	T	0.066	28.66	100.0	25.59	99.3	28.01	98.2	27.31	236.	1469.	1799.

IRRIGATED CROPS

TABLE 41. CCNTINUED.

ROT	CP	% SOIL LCST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C-I	SR	0.218	47.69	100.0	47.69	97.1	42.12	93.5	35.28	440.	2365.	2829.
	C	0.131	42.35	100.0	42.35	98.3	39.03	96.5	35.70	391.	2139.	2579.
	T	0.122	41.81	100.0	38.75	98.4	38.62	96.7	35.60	357.	2110.	2553.
S-I	SR	0.168	27.48	100.0	27.48	97.7	25.24	95.4	22.98	253.	1383.	1667.
	C	0.101	23.95	100.0	23.95	98.7	22.68	97.3	21.28	221.	1221.	1479.
	T	0.094	22.51	100.0	19.44	98.8	21.23	97.5	20.01	179.	1142.	1391.
W-I	SR	0.050	39.45	100.0	39.45	99.6	38.86	98.7	37.57	364.	2033.	2480.
	C	0.030	35.52	100.0	35.52	100.0	35.52	99.4	34.66	328.	1834.	2244.
	T	0.028	34.81	100.0	32.25	100.0	34.71	99.5	34.06	297.	1792.	2199.
C/S-I	SR	0.151	54.78	100.0	54.78	98.0	51.49	95.9	48.23	505.	2778.	3363.
	C	0.091	50.35	100.0	50.35	98.9	48.54	97.6	46.40	464.	2579.	3134.
	T	0.085	49.36	100.0	46.29	99.0	47.59	97.7	45.67	427.	2524.	3077.
C/W-I	SR	0.118	55.75	100.0	55.75	98.5	52.96	96.9	50.09	514.	2841.	3445.
	C	0.071	51.12	100.0	51.12	99.2	49.73	98.1	47.71	471.	2627.	3196.
	T	0.066	50.23	100.0	47.16	99.3	48.87	98.2	47.06	435.	2577.	3144.
S/W-I	SR	0.101	29.63	10C.0	29.63	98.7	28.11	97.3	26.42	273.	1511.	1831.
	C	0.060	25.90	100.0	25.90	99.4	25.20	98.4	24.01	239.	1332.	1620.
	T	0.056	24.55	100.0	21.49	99.5	23.83	98.5	22.81	198.	1257.	1537.
C/S/W-I	SR	0.118	50.42	100.0	50.42	98.5	48.01	96.9	45.52	465.	2571.	3119.
	C	0.071	46.20	100.0	46.20	99.2	44.99	98.1	43.25	426.	2374.	2890.
	T	0.066	45.10	100.0	42.04	99.3	43.91	98.2	42.36	388.	2313.	2825.

TABLE 42. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES SPSL.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.175	36.53	100.0	36.53	97.6	34.06	95.2	31.51	337.	1846.	2232.
	C	0.105	33.63	100.0	33.63	98.6	32.22	97.2	30.68	310.	1718.	2087.
	T	0.098	31.87	100.0	28.81	98.8	30.46	97.4	29.11	266.	1624.	1979.
S	SR	0.135	22.74	100.0	22.74	98.2	21.89	96.4	21.05	210.	1162.	1413.
	C	0.081	21.42	100.0	21.42	99.0	20.97	97.8	20.40	198.	1101.	1343.
	T	0.076	18.87	100.0	15.80	99.1	18.35	98.0	17.92	146.	964.	1183.
W	SR	0.040	24.82	100.0	24.82	99.8	24.69	99.0	24.19	229.	1281.	1566.
	C	0.024	23.33	100.0	23.33	100.0	23.33	99.6	23.09	215.	1205.	1476.
	T	0.023	21.40	100.0	18.84	100.0	21.30	99.7	21.20	174.	1100.	1354.
R	SR	0.011	34.43	100.0	34.43	100.0	34.43	100.0	34.43	318.	1778.	2179.
C/S	SR	0.121	38.81	100.0	38.81	98.4	37.45	96.8	36.06	358.	1985.	2415.
	C	0.073	36.70	100.0	36.70	99.2	36.01	98.0	35.04	338.	1888.	2303.
	T	0.068	34.55	100.0	31.48	99.3	33.81	98.2	33.00	290.	1772.	2169.
C/W	SR	0.094	38.08	100.0	38.08	98.8	36.99	97.5	35.73	351.	1953.	2378.
	C	0.057	35.89	100.0	35.89	99.5	35.41	98.5	34.52	331.	1849.	2258.
	T	0.053	33.78	100.0	30.71	99.6	33.24	98.6	32.52	283.	1735.	2126.
S/W	SR	0.081	22.14	100.0	22.14	99.0	21.62	97.8	20.95	204.	1137.	1386.
	C	0.049	20.73	100.0	20.73	99.6	20.54	98.8	20.07	191.	1069.	1306.
	T	0.045	18.23	100.0	15.16	99.7	17.94	98.9	17.62	140.	934.	1149.
C/S/W	SR	0.094	34.79	100.0	34.79	98.8	33.87	97.5	32.80	321.	1785.	2175.
	C	0.057	32.91	100.0	32.91	99.5	32.50	98.5	31.75	304.	1696.	2071.
	T	0.053	30.64	100.0	27.58	99.6	30.18	98.6	29.57	254.	1574.	1929.

IRRIGATED CROPS

TABLE 42. CONTINUED.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C-I	SR	0.175	68.82	100.0	68.82	97.6	63.82	95.2	58.65	635.	3472.	4193.
	C	0.105	63.48	100.0	63.48	98.6	60.61	97.2	57.51	585.	3241.	3933.
	T	0.098	62.94	100.0	59.87	98.8	60.19	97.4	57.35	552.	3212.	3907.
S-I	SR	0.135	27.48	100.0	27.48	98.2	25.70	96.4	23.93	253.	1393.	1684.
	C	0.081	23.95	100.0	23.95	99.0	23.01	97.8	21.79	221.	1227.	1489.
	T	0.076	22.51	100.0	19.44	99.1	21.54	98.0	20.50	179.	1148.	1400.
W-I	SR	0.040	24.87	100.0	24.87	99.8	24.60	99.0	23.62	229.	1283.	1565.
	C	0.024	20.94	100.0	20.94	100.0	20.94	99.6	20.47	193.	1081.	1324.
	T	0.023	20.23	100.0	17.68	100.0	20.13	99.7	19.84	163.	1039.	1279.
C/S-I	SR	0.121	66.87	100.0	66.87	98.4	64.08	96.8	61.24	617.	3414.	4148.
	C	0.073	62.44	100.0	62.44	99.2	61.02	98.0	59.04	576.	3210.	3912.
	T	0.068	61.45	100.0	58.38	99.3	60.06	98.2	58.28	538.	3155.	3854.
C/W-I	SR	0.094	61.92	100.0	61.92	98.8	59.72	97.5	57.18	571.	3171.	3855.
	C	0.057	57.29	100.0	57.29	99.5	56.32	98.5	54.53	528.	2951.	3599.
	T	0.053	56.40	100.0	53.33	99.6	55.44	98.6	53.85	492.	2900.	3546.
S/W-I	SR	0.081	23.07	100.0	23.07	99.0	22.00	97.8	20.63	213.	1180.	1430.
	C	0.049	19.34	100.0	19.34	99.6	18.93	98.8	17.97	178.	996.	1212.
	T	0.045	18.00	100.0	14.93	99.7	17.54	98.9	16.74	138.	921.	1129.
C/S/W-I	SR	0.094	54.49	100.0	54.49	98.8	52.60	97.5	50.42	503.	2791.	3394.
	C	0.057	50.27	100.0	50.27	99.5	49.44	98.5	47.90	464.	2590.	3158.
	T	0.053	49.17	100.0	46.11	99.6	48.34	98.6	46.99	425.	2528.	3092.

TABLE 43. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES SC13.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.535	-5.19	99.5	-5.48	90.6	-11.07	50.0	-36.49	-49.	-360.	-587.
	C	0.321	-8.09	100.0	-8.11	95.7	-10.80	85.9	-16.90	-75.	-468.	-614.
S	SR	0.411	13.40	99.8	13.32	94.0	11.17	72.7	3.20	123.	652.	757.
	C	0.247	12.08	100.0	12.08	96.7	10.85	92.0	9.08	111.	602.	721.
W	SR	0.123	13.90	100.0	13.90	98.4	13.01	96.7	12.10	128.	705.	853.
	C	0.074	12.41	100.0	12.41	99.2	11.96	98.0	11.32	114.	637.	773.
R	SR	0.033	13.22	100.0	13.22	100.0	13.21	99.3	13.07	122.	682.	836.
C/S	SR	0.370	9.93	99.9	9.86	94.9	7.06	79.7	-1.42	92.	460.	515.
	C	0.222	7.83	100.0	7.83	97.0	6.17	93.3	4.08	72.	375.	439.
C/W	SR	0.288	8.03	100.0	8.03	96.1	5.64	89.0	1.21	74.	371.	421.
	C	0.173	5.84	100.0	5.84	97.7	4.39	95.3	2.90	54.	278.	323.
S/W	SR	0.247	12.23	100.0	12.23	96.7	10.76	92.0	8.64	113.	605.	722.
	C	0.148	10.82	100.0	10.82	98.0	9.94	96.0	9.06	100.	545.	657.
C/S/W	SR	0.288	11.45	100.0	11.45	96.1	9.33	89.0	5.40	106.	552.	647.
	C	0.173	9.57	100.0	9.57	97.7	8.28	95.3	6.96	88.	473.	564.

TABLE 44. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES TC01.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	0.707	36.53	98.6	35.03	69.6	4.79	25.0	-41.70	332.	1454.	1165.
S	SR	0.544	32.07	99.1	31.55	82.3	22.14	25.0	-9.95	294.	1498.	1622.
W	SR	0.163	50.30	100.0	50.30	96.0	46.67	91.6	42.66	464.	2538.	3064.
R	SP	0.044	19.70	100.0	19.70	99.4	19.53	98.1	19.17	182.	1016.	1242.
C/S	SR	0.490	43.80	99.2	43.11	85.2	30.57	30.4	-18.62	402.	2041.	2236.
C/W	SR	0.381	49.55	99.6	49.11	89.8	38.98	63.8	11.95	456.	2370.	2731.
S/W	SR	0.326	38.60	99.8	38.42	91.6	32.64	74.5	20.53	356.	1885.	2222.
C/S/W	SR	0.381	45.87	99.6	45.50	89.8	36.76	63.8	13.42	422.	2206.	2554.

TABLE 45. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES TC13.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	1.154	26.10	97.3	23.55	25.0	-44.31	25.0	-44.31	230.	379.	-137.
	C	0.693	23.20	98.6	21.89	71.0	-4.05	25.0	-47.21	210.	822.	466.
S	SR	0.888	22.74	98.0	21.82	46.6	-2.22	25.0	-12.29	206.	885.	755.
	C	0.533	21.42	99.1	21.00	82.9	13.45	25.0	-13.60	196.	978.	1028.
W	SR	0.266	32.10	100.0	32.07	93.3	27.24	82.9	19.68	296.	1570.	1859.
	C	0.160	30.61	100.0	30.61	96.1	27.77	91.8	24.65	282.	1535.	1845.
R	SR	0.071	16.46	100.0	16.46	98.6	16.10	96.6	15.62	152.	846.	1031.
C/S	SR	0.799	32.84	98.3	31.49	59.2	0.75	25.0	-26.19	298.	1295.	1061.
	C	0.480	30.73	99.3	30.15	85.7	19.51	34.3	-21.01	282.	1398.	1492.
C/W	SR	0.622	35.07	98.8	34.02	77.0	14.56	25.0	-31.91	320.	1507.	1408.
	C	0.373	32.88	99.6	32.53	90.1	24.04	65.5	2.10	303.	1539.	1744.
S/W	SR	0.533	25.41	99.1	24.89	82.9	15.56	25.0	-17.89	233.	1154.	1204.
	C	0.320	24.01	99.8	23.88	91.8	19.28	75.6	9.94	221.	1154.	1346.
C/S/W	SR	0.622	32.81	98.8	31.91	77.0	15.23	25.0	-24.57	300.	1434.	1381.
	C	0.373	30.93	99.6	30.62	90.1	23.35	65.5	4.56	285.	1461.	1669.

TABLE 46. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES VN38.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
R	SR	0.157	14.79	99.9	14.76	93.2	13.23	87.6	11.94	136.	734.	883.

TABLE 47. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES VBCO.

ROT	CP	% SOIL LOST/YR	REMAINING YR 1	YIELD (AS A % OF YEAR 1) AND PROFITS AT YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
R	SR	0.237	4.09	99.4	4.02	90.3	2.90	80.4	1.70	38.	187.	216.

TABLE 48. YIELD LOSS AND PER ACRE RETURN TO LANC AND MANAGEMENT FOR SOIL SERIES WC13.

ROT	CP	% SOIL LOST/YR	REMAINING YR 1	YIELD (AS A % OF YEAR 1) AND PRCFITS AT YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	1.331	15.67	98.2	14.18	50.0	-26.06	50.0	-26.06	138.	147.	-156.
	C	0.799	12.77	99.1	11.99	74.9	-8.15	50.0	-28.95	115.	422.	141.
	T	0.749	8.87	99.2	3.05	79.0	-8.81	50.0	-32.85	32.	238.	-49.
S	SR	1.024	13.40	98.7	12.91	50.0	-5.28	50.0	-5.28	122.	507.	446.
	C	0.614	12.08	99.4	11.85	87.3	7.34	50.0	-6.60	111.	557.	565.
	T	0.576	7.39	99.5	2.08	89.0	3.10	50.0	-11.29	21.	310.	290.
W	SR	0.307	13.90	100.0	13.90	95.9	11.65	87.3	6.97	128.	676.	796.
	C	0.184	12.41	100.0	12.41	97.5	11.06	94.9	9.62	114.	618.	741.
	T	0.173	8.57	100.0	4.19	97.7	7.13	95.3	5.99	39.	413.	502.
R	SR	0.082	16.17	100.0	16.17	99.0	15.93	97.8	15.63	149.	832.	1016.
C/S	SR	0.922	21.87	98.9	21.10	61.9	-3.92	50.0	-12.00	199.	868.	736.
	C	0.553	19.77	99.5	19.43	90.0	12.96	50.0	-14.11	181.	916.	952.
	T	0.518	15.47	99.6	10.07	91.2	9.30	50.0	-18.40	95.	693.	717.
C/W	SR	0.717	20.60	99.2	20.01	81.4	6.65	50.0	-16.82	188.	890.	790.
	C	0.430	18.41	99.7	18.22	93.6	13.64	69.0	-4.81	169.	866.	967.
	T	0.403	14.15	99.8	8.89	94.2	9.63	74.2	-5.12	83.	643.	720.
S/W	SR	0.614	12.23	99.4	11.96	87.3	6.57	50.0	-10.05	112.	551.	536.
	C	0.369	10.82	99.9	10.77	94.9	8.54	79.9	1.87	100.	517.	595.
	T	0.346	6.18	99.9	1.03	95.3	3.88	83.1	-1.37	10.	270.	310.
C/S/W	SR	0.717	19.74	99.2	19.24	81.4	7.92	50.0	-11.98	181.	872.	814.
	C	0.430	17.86	99.7	17.70	93.6	13.82	69.0	-1.82	164.	851.	962.
	T	0.403	13.45	99.8	8.21	94.2	9.59	74.2	-2.89	77.	619.	702.

TABLE 49. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES WC35.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	1.997	-5.19	97.3	-6.87	50.0	-36.49	50.0	-36.49	-56.	-1038.	-1463.
	C	0.998	-8.09	98.7	-8.89	51.4	-38.50	50.0	-39.39	-78.	-709.	-1167.
	T	0.874	-14.67	98.9	-23.00	67.5	-35.28	50.0	-45.96	-208.	-987.	-1489.
S	SR	1.536	4.06	97.9	3.48	50.0	-9.95	50.0	-9.95	35.	-58.	-173.
	C	0.768	2.74	99.1	2.49	77.5	-3.55	50.0	-11.27	25.	68.	-39.
	T	0.672	-4.62	99.3	-12.49	84.2	-9.34	50.0	-18.63	-114.	-312.	-466.
W	SR	0.461	-4.30	99.7	-4.41	92.9	-6.89	61.9	-18.15	-40.	-266.	-382.
	C	0.230	-5.78	100.0	-5.78	96.9	-6.91	92.9	-8.38	-53.	-318.	-405.
	T	0.202	-12.14	100.0	-18.93	97.3	-13.39	94.2	-14.25	-175.	-657.	-801.
R	SR	0.123	14.79	100.0	14.79	98.4	14.42	96.7	14.04	136.	758.	925.
C/S	SR	1.382	4.94	98.1	4.00	50.0	-20.47	50.0	-20.47	42.	-170.	-408.
	C	0.691	2.83	99.3	2.45	83.1	-5.78	50.0	-22.57	25.	35.	-150.
	T	0.605	-4.14	99.4	-12.11	87.8	-10.65	50.0	-29.54	-110.	-318.	-526.
C/W	SR	1.075	-0.15	98.6	-0.91	50.0	-27.20	50.0	-27.20	-4.	-305.	-622.
	C	0.538	-2.35	99.5	-2.60	90.5	-7.48	50.0	-29.39	-22.	-202.	-374.
	T	0.470	-9.28	99.7	-17.12	92.6	-13.56	59.5	-31.19	-157.	-562.	-757.
S/W	SR	0.922	-0.96	98.9	-1.32	61.9	-12.90	50.0	-16.64	-10.	-170.	-361.
	C	0.461	-2.36	99.7	-2.46	92.9	-4.59	61.9	-14.30	-22.	-160.	-244.
	T	0.403	-9.68	99.8	-17.41	94.2	-11.79	74.2	-17.76	-160.	-548.	-686.
C/S/W	SR	1.075	2.53	98.6	1.89	50.0	-20.59	50.0	-20.59	21.	-123.	-363.
	C	0.538	0.65	99.5	0.43	90.5	-3.73	50.0	-22.47	5.	-35.	-151.
	T	0.470	-6.43	99.7	-14.25	92.6	-10.14	59.5	-25.17	-130.	-405.	-553.

TABLE 50. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES WL13.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	1.165	57.39	98.5	55.48	50.0	-5.19	50.0	-5.19	522.	2161.	2100.
	C	0.699	54.49	99.2	53.54	82.6	32.66	50.0	-8.09	500.	2535.	2622.
	T	0.655	50.59	99.3	44.63	85.2	31.86	50.0	-11.99	417.	2353.	2456.
S	SR	0.896	32.07	98.9	31.46	65.0	12.46	50.0	4.06	294.	1453.	1511.
	C	0.538	30.76	99.5	30.50	90.5	25.45	50.0	2.74	283.	1505.	1713.
	T	0.504	26.07	99.6	20.73	91.6	21.19	50.0	-1.95	193.	1259.	1446.
W	SR	0.269	32.10	100.0	32.10	96.4	29.49	90.5	25.20	296.	1610.	1938.
	C	0.161	30.61	100.0	30.61	97.8	29.03	95.6	27.44	282.	1555.	1887.
	T	0.151	26.77	100.0	22.39	98.0	25.12	95.9	23.82	206.	1351.	1647.
R	SR	0.072	37.77	100.0	37.77	99.2	37.41	98.1	36.89	348.	1947.	2380.
C/S	SR	0.806	55.74	99.1	54.78	74.2	29.57	50.0	4.94	511.	2583.	2704.
	C	0.484	53.64	99.6	53.27	92.2	45.76	55.9	8.78	494.	2638.	3055.
	T	0.454	49.34	99.7	43.92	93.1	42.10	63.7	12.44	407.	2416.	2824.
C/W	SR	0.627	53.92	99.4	53.24	86.7	39.52	50.0	-0.15	495.	2583.	2813.
	C	0.376	51.73	99.9	51.57	94.7	46.04	78.8	28.75	477.	2567.	3047.
	T	0.353	47.48	99.9	42.26	95.2	42.04	82.1	28.14	391.	2344.	2801.
S/W	SR	0.538	30.41	99.5	30.12	90.5	24.46	50.0	-0.96	280.	1477.	1663.
	C	0.323	29.01	100.0	28.98	95.6	26.27	85.7	20.06	267.	1447.	1732.
	T	0.302	24.36	100.0	19.25	95.9	21.62	87.8	16.68	178.	1200.	1447.
C/S/W	SR	0.627	48.76	99.4	48.18	86.7	36.45	50.0	2.53	448.	2346.	2573.
	C	0.376	46.88	99.9	46.75	94.7	42.02	78.8	27.23	432.	2332.	2773.
	T	0.353	42.47	99.9	37.27	95.2	37.80	82.1	25.94	344.	2100.	2513.

TABLE 51. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES WL35.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
C	SR	1.456	15.67	98.0	14.03	50.0	-26.06	50.0	-26.06	138.	63.	-241.
	C	0.728	12.77	99.2	12.09	80.6	-3.44	50.0	-28.95	116.	460.	223.
S	SR	1.120	22.74	98.5	22.05	50.0	-0.61	50.0	-0.61	207.	896.	888.
	C	0.560	21.42	99.5	21.18	89.7	16.60	50.0	-1.93	197.	1033.	1145.
W	SR	0.336	13.90	99.9	13.87	95.4	11.41	84.2	5.29	128.	672.	784.
	C	0.168	12.41	100.0	12.41	97.7	11.18	95.4	9.92	114.	621.	746.
R	SR	0.090	34.43	100.0	34.43	98.9	33.96	97.6	33.40	318.	1772.	2165.
C/S	SR	1.008	26.87	98.7	25.93	50.0	-9.50	50.0	-9.50	244.	1041.	930.
	C	0.504	24.76	99.6	24.47	91.6	18.68	50.0	-11.61	228.	1179.	1302.
C/W	SR	0.784	20.60	99.1	19.92	76.2	2.80	50.0	-16.82	188.	858.	720.
	C	0.392	18.41	99.8	18.27	94.4	14.25	76.2	0.61	170.	875.	997.
S/W	SR	0.672	17.22	99.3	16.87	84.2	9.41	50.0	-7.55	158.	786.	782.
	C	0.336	15.82	99.9	15.79	95.4	13.56	84.2	8.01	146.	775.	915.
C/S/W	SR	0.784	23.26	99.1	22.65	76.2	7.33	50.0	-10.22	213.	1017.	950.
	C	0.392	21.37	99.8	21.26	94.4	17.65	76.2	5.45	197.	1036.	1203.

TABLE 52. YIELD LOSS AND PER ACRE RETURN TO LAND AND MANAGEMENT FOR SOIL SERIES WQLM.

ROT	CP	% SOIL LOST/YR	REMAINING YIELD (AS A % OF YEAR 1) AND PROFITS AT YR 1	YEAR 10		YEAR 100		YEAR 200		P.V. OF PRT STREAM TO YR 10	100	200
R	SR	0.269	26.28	100.0	26.28	96.4	25.05	90.5	23.02	242.	1334.	1619.

APPENDIX B

Major effects of given NPS control options for 10, 100 and 200 year planning horizons.

Table 53. Major economic consequences of NPS control options in Duck Creek watershed assuming farmers have a 10 year planning horizon.

Control Option	Change in Annualized Farm Income ($1000)	Gov't Cost (-) or Revenue (+) ($1000)	Change in Gross Soil Loss (1000 T)	Offsite Sediment Damages Abated ($1000)	Net Social Benefits Excluding Administrative Costs ($1000)
SL < T	-60.09	0.0	73.54	12.82	-47.27
SL < 2	-680.85	0.0	242.86	39.20	-641.65
SL < 5	-35.37	0.0	59.71	10.47	-24.90
SL < 10	0.0	0.0	0.0	0.0	0.0
TR 50	0.0	0.0	0.0	0.0	0.0
TR 100	0.0	0.0	0.0	0.0	0.0
C 50	0.0	0.0	0.0	0.0	0.0
C 100	2.10	-75.43	70.73	12.34	-60.99
IT 50	0.0	0.0	0.0	0.0	0.0
IT 100	0.0	0.0	0.0	0.0	0.0
SL < T, TR 50	-59.23	-0.91	73.54	12.82	-47.31
SL < T, C 50	-52.21	-7.88	73.54	12.82	-47.27
SL < T, IT 50	-59.65	-4.19	73.54	12.82	-51.03
SL < 5, TR 50	-35.37	0.0	59.71	10.47	-24.90
SL < 5, C 50	-23.63	-11.74	59.71	10.47	-24.90
SL < 5, IT 50	-35.37	0.0	59.71	10.47	-24.90
TX 4	-14.50	14.50	0.0	0.0	0.00
TX 6	-21.74	21.74	0.0	0.0	0.00
TX 8	-28.99	28.99	0.0	0.0	0.00
TX 10	-36.24	36.24	0.0	0.0	0.00
TX 12	-43.49	43.49	0.0	0.0	0.00
TX 16	-57.99	57.99	0.0	0.0	0.00
TX 20	-72.48	72.48	0.0	0.0	0.00
TX 4, 50 T&C	-14.50	14.50	0.0	0.0	0.00
TX 6, 50 T&C	-21.74	21.74	0.0	0.0	0.00
TX 8, 50 T&C	-28.99	28.99	0.0	0.0	0.00
TX 10, 50 T&C	-36.24	36.24	0.0	0.0	0.00
TX 12, 50 T&C	-43.49	43.49	0.0	0.0	0.00
TX 16, 50 T&C	-57.99	57.99	0.0	0.0	0.00
TX 20, 50 T&C	-72.48	72.48	0.0	0.0	0.00

Table 54. Percent of acreage in each crop by control option for Duck Creek watershed assuming farmers have a 10 year planning horizon.

Control Option	Cotton	Grain Sorghum	Wheat	Range
Benchmark	24.47	9.16	11.52	53.92
SL < T	23.05	7.74	11.52	56.76
SL < 2	0.52	0.40	22.21	75.94
SL < 5	24.41	9.22	11.52	53.92
SL < 10	24.47	9.16	11.52	53.92
TR 50	24.47	9.16	11.52	53.92
TR 100	24.47	9.16	11.52	53.92
C 50	24.47	9.16	11.52	53.92
C 100	24.47	9.16	11.52	53.92
IT 50	24.47	9.16	11.52	53.92
IT 100	24.47	9.16	11.52	53.92
SL < T, TR 50	23.05	7.74	11.52	56.76
SL < T, C 50	23.05	7.74	11.52	56.76
SL < T, IT 50	23.05	7.74	11.52	56.76
SL < 5, TR 50	24.41	9.22	11.52	53.92
SL < 5, C 50	24.41	9.22	11.52	53.92
SL < 5, IT 50	24.41	9.22	11.52	53.92
TX 4	24.47	9.16	11.52	53.92
TX 6	24.47	9.16	11.52	53.92
TX 8	24.47	9.16	11.52	53.92
TX 10	24.47	9.16	11.52	53.92
TX 12	24.47	9.16	11.52	53.92
TX 16	24.47	9.16	11.52	53.92
TX 20	24.47	9.16	11.52	53.92
TX 4, 50 T&C	24.47	9.16	11.52	53.92
TX 6, 50 T&C	24.47	9.16	11.52	53.92
TX 8, 50 T&C	24.47	9.16	11.52	53.92
TX 10, 50 T&C	24.47	9.16	11.52	53.92
TX 12, 50 T&C	24.47	9.16	11.52	53.92
TX 16, 50 T&C	24.47	9.16	11.52	53.92
TX 20, 50 T&C	24.47	9.16	11.52	53.92

Table 55. Extent and cost of terracing and contouring by control option for Duck Creek watershed assuming farmers have a 10 year planning horizon.

Control Option	Terracing		Contouring	
	Acres (1000)	Cost ($1000)	Acres (1000)	Cost ($1000)
Benchmark	0.0	0.0	0.0	0.0
SL < T	0.15	1.81	7.48	15.75
SL < 2	0.15	1.81	1.55	4.44
SL < 5	0.0	0.0	11.14	23.47
SL < 10	0.0	0.0	0.0	0.0
TR 50	0.0	0.0	0.0	0.0
TR 100	0.0	0.0	0.0	0.0
C 50	0.0	0.0	0.0	0.0
C 100	0.0	0.0	34.92	75.43
IT 50	0.0	0.0	0.0	0.0
IT 100	0.0	0.0	0.0	0.0
SL < T, TR 50	0.15	1.81	7.48	15.75
SL < T, C 50	0.15	1.81	7.48	15.75
SL < T, IT 50	0.15	1.81	7.48	15.75
SL < 5, TR 50	0.0	0.0	11.14	23.47
SL < 5, C 50	0.0	0.0	11.14	23.47
SL < 5, IT 50	0.0	0.0	11.14	23.47
TX 4	0.0	0.0	0.0	0.0
TX 6	0.0	0.0	0.0	0.0
TX 8	0.0	0.0	0.0	0.0
TX 10	0.0	0.0	0.0	0.0
TX 12	0.0	0.0	0.0	0.0
TX 16	0.0	0.0	0.0	0.0
TX 20	0.0	0.0	0.0	0.0
TX 4, 50 T&C	0.0	0.0	0.0	0.0
TX 6, 50 T&C	0.0	0.0	0.0	0.0
TX 8, 50 T&C	0.0	0.0	0.0	0.0
TX 10, 50 T&C	0.0	0.0	0.0	0.0
TX 12, 50 T&C	0.0	0.0	0.0	0.0
TX 16, 50 T&C	0.0	0.0	0.0	0.0
TX 20, 50 T&C	0.0	0.0	0.0	0.0

Table 56. Major economic consequences of NPS control options in Duck Creek watershed assuming farmers have a 100 year planning horizon.

Control Option	Change in Annualized Farm Income ($1000)	Gov't Cost (-) or Revenue (+) ($1000)	Change in Gross Soil Loss (1000 T)	Offsite Sediment Damages Abated ($1000)	Net Social Benefits Excluding Administrative Costs ($1000)
SL < T	-26.52	0.0	61.85	10.69	-15.83
SL < 2	-496.95	0.0	254.64	40.13	-456.82
SL < 5	-10.24	0.0	47.97	8.34	-1.91
SL < 10	0.0	0.0	0.0	0.0	0.0
TR 50	0.0	0.0	0.0	0.0	0.0
TR 100	4.48	-23.17	13.25	2.33	-16.36
C 50	9.90	-29.78	41.31	7.20	-12.68
C 100	47.35	-82.71	61.45	10.62	-24.74
IT 50	0.0	0.0	0.0	0.0	0.0
IT 100	0.0	0.0	0.0	0.0	0.0
SL < T, TR 50	-26.04	-0.50	61.85	10.69	-15.86
SL < T, C 50	-12.60	-33.80	103.15	17.52	-28.87
SL < T, IT 50	-26.44	-4.19	61.85	10.69	-19.95
SL < 5, TR 50	-10.24	0.0	47.97	8.34	-1.91
SL < 5, C 50	7.54	-37.66	89.28	15.25	-14.86
SL < 5, IT 50	-10.24	0.0	47.97	8.34	-1.91
TX 4	-13.79	12.57	30.79	5.39	4.17
TX 6	-20.07	18.86	30.79	5.39	4.17
TX 8	-26.36	25.14	30.79	5.39	4.17
TX 10	-32.64	31.43	30.79	5.39	4.17
TX 12	-38.93	37.72	30.79	5.39	4.17
TX 16	-51.49	50.21	31.28	5.47	4.19
TX 20	-64.00	62.25	33.85	5.91	4.17
TX 4, 50 T&C	-2.23	-18.86	72.10	12.41	-8.68
TX 6, 50 T&C	-7.69	-13.40	72.10	12.41	-8.68
TX 8, 50 T&C	-12.93	-17.19	89.28	15.25	-14.87
TX 10, 50 T&C	-18.04	-12.08	89.28	15.25	-14.87
TX 12, 50 T&C	-23.16	-6.96	89.28	15.25	-14.87
TX 16, 50 T&C	-33.38	3.19	89.77	15.33	-14.85
TX 20, 50 T&C	-43.55	12.89	92.34	15.76	-14.90

Table 57. Percent of acreage in each crop by control option for Duck Creek watershed assuming farmers have a 100 year planning horizon.

Control Option	Cotton	Grain Sorghum	Wheat	Range
Benchmark	22.94	10.57	11.64	53.92
SL < T	21.52	9.15	11.64	56.76
SL < 2	12.40	4.79	14.60	67.27
SL < 5	22.94	10.57	11.64	53.92
SL < 10	22.94	10.57	11.64	53.92
TR 50	22.94	10.57	11.64	53.92
TR 100	22.94	10.57	11.64	53.92
C 50	23.06	10.57	11.52	53.92
C 100	23.06	10.57	11.52	53.92
IT 50	22.94	10.57	11.64	53.92
IT 100	22.94	10.57	11.64	53.92
SL < T, TR 50	21.52	9.15	11.64	56.76
SL < T, C 50	21.64	9.15	11.52	56.76
SL < T, IT 50	21.52	9.15	11.64	56.76
SL < 5, TR 50	22.94	10.57	11.64	53.92
SL < 5, C 50	23.06	10.57	11.52	53.92
SL < 5, IT 50	22.94	10.57	11.64	53.92
TX 4	22.94	10.57	11.64	53.92
TX 6	22.94	10.57	11.64	53.92
TX 8	22.94	10.57	11.64	53.92
TX 10	22.94	10.57	11.64	53.92
TX 12	22.94	10.57	11.64	53.92
TX 16	22.88	10.51	11.64	54.05
TX 20	22.16	11.23	11.64	54.05
TX 4, 50 T&C	23.06	10.57	11.52	53.92
TX 6, 50 T&C	23.06	10.57	11.52	53.92
TX 8, 50 T&C	23.06	10.57	11.52	53.92
TX 10, 50 T&C	23.06	10.57	11.52	53.92
TX 12, 50 T&C	23.06	10.57	11.52	53.92
TX 16, 50 T&C	23.00	10.51	11.52	54.05
TX 20, 50 T&C	22.27	11.23	11.52	54.05

Table 58. Extent and cost of terracing and contouring by control option for Duck Creek watershed assuming farmers have a 100 year planning horizon.

Control Option	Terracing		Contouring	
	Acres (1000)	Cost ($1000)	Acres (1000)	Cost ($1000)
Benchmark	0.0	0.0	3.66	7.72
SL < T	0.15	1.00	7.48	15.75
SL < 2	31.10	206.11	1.55	4.44
SL < 5	0.0	0.0	11.14	23.47
SL < 10	0.0	0.0	3.66	7.72
TR 50	0.0	0.0	3.66	7.72
TR 100	3.51	23.17	0.15	0.32
C 50	0.0	0.0	27.44	59.56
C 100	0.0	0.0	37.78	82.71
IT 50	0.0	0.0	3.66	7.72
IT 100	0.0	0.0	3.66	7.72
SL < T, TR 50	0.15	1.00	7.48	15.75
SL < T, C 50	0.15	1.00	31.25	67.60
SL < T, IT 50	0.15	1.00	7.48	15.75
SL < 5, TR 50	0.0	0.0	11.14	23.47
SL < 5, C 50	0.0	0.0	34.92	75.31
SL < 5, IT 50	0.0	0.0	11.14	23.47
TX 4	0.0	0.0	3.66	7.72
TX 6	0.0	0.0	3.66	7.72
TX 8	0.0	0.0	3.66	7.72
TX 10	0.0	0.0	3.66	7.72
TX 12	0.0	0.0	3.66	7.72
TX 16	0.0	0.0	3.66	7.72
TX 20	0.0	0.0	3.66	7.72
TX 4, 50 T&C	0.0	0.0	27.44	59.56
TX 6, 50 T&C	0.0	0.0	27.44	59.56
TX 8, 50 T&C	0.0	0.0	34.92	75.31
TX 10, 50 T&C	0.0	0.0	34.92	75.31
TX 12, 50 T&C	0.0	0.0	34.92	75.31
TX 16, 50 T&C	0.0	0.0	34.92	75.31
TX 20, 50 T&C	0.0	0.0	34.92	75.31

Table 59. Major economic consequences of NPS control options in Duck Creek watershed assuming farmers have a 200 year planning horizon.

Control Option	Change in Annualized Farm Income ($1000)	Gov't Cost (-) or Revenue (+) ($1000)	Change in Gross Soil Loss (1000 T)	Offsite Sediment Damages Abated ($1000)	Net Social Benefits Excluding Administrative Costs ($1000)
SL < T	-16.40	0.0	47.47	7.81	-8.60
SL < 2	-425.25	0.0	189.72	28.93	-396.33
SL < 5	-6.51	0.0	47.97	7.89	1.38
SL < 10	0.0	0.0	0.0	0.0	0.0
TR 50	0.0	0.0	0.0	0.0	0.0
TR 100	26.48	-174.75	60.63	9.91	-138.36
C 50	29.43	-37.70	14.17	2.37	-5.90
C 100	68.49	-82.80	17.14	2.86	-11.45
IT 50	0.0	0.0	0.0	0.0	0.0
IT 100	0.0	0.0	0.0	0.0	0.0
SL < T, TR 50	-15.94	-0.49	47.47	7.81	-8.62
SL < T, C 50	17.05	-33.69	54.72	8.97	-7.67
SL < T, IT 50	-16.34	-4.19	47.47	7.81	-12.73
SL < 5, TR 50	-6.51	0.0	47.97	7.89	1.38
SL < 5, C 50	28.22	-37.70	44.96	7.41	-2.07
SL < 5, IT 50	-6.51	0.0	47.97	7.89	1.38
TX 4	-11.07	9.69	37.82	6.25	4.87
TX 6	-15.40	12.69	68.74	11.19	8.47
TX 8	-19.63	16.91	68.74	11.19	8.47
TX 10	-23.86	21.14	68.74	11.19	8.47
TX 12	-28.09	25.37	68.74	11.19	8.47
TX 16	-36.49	33.51	70.73	11.51	8.53
TX 20	-44.86	41.89	70.73	11.51	8.53
TX 4, 50 T&C	18.82	-28.29	44.96	7.41	-2.07
TX 6, 50 T&C	14.62	-25.44	75.88	12.31	1.49
TX 8, 50 T&C	10.53	-21.38	76.02	12.33	1.49
TX 10, 50 T&C	6.45	-17.29	76.02	12.33	1.49
TX 12, 50 T&C	2.48	-10.59	86.29	13.93	5.82
TX 16, 50 T&C	-5.22	-3.13	88.15	14.22	5.87
TX 20, 50 T&C	-12.90	4.55	88.15	14.22	5.87

Table 60. Percent of acreage in each crop by control option for Duck Creek watershed assuming farmers have a 200 year planning horizon.

Control Option	Cotton	Grain Sorghum	Wheat	Range
Benchmark	18.88	9.88	9.71	60.61
SL < T	18.88	9.88	9.71	60.61
SL < 2	12.40	4.79	14.60	67.27
SL < 5	18.88	9.88	9.71	60.61
SL < 10	18.88	9.88	9.71	60.61
TR 50	18.88	9.88	9.71	60.61
TR 100	20.23	9.88	11.07	57.90
C 50	20.23	9.88	11.07	57.90
C 100	20.23	9.88	11.07	57.90
IT 50	18.88	9.88	9.71	60.61
IT 100	18.88	9.88	9.71	60.61
SL < T, TR 50	18.88	9.88	9.71	60.61
SL < T, C 50	18.88	9.88	9.71	60.61
SL < T, IT 50	18.88	9.88	9.71	60.61
SL < 5, TR 50	18.88	9.88	9.71	60.61
SL < 5, C 50	20.23	9.88	11.07	57.90
SL < 5, IT 50	18.88	9.88	9.71	60.61
TX 4	18.88	9.88	9.71	60.61
TX 6	15.87	6.87	9.71	66.62
TX 8	15.87	6.87	9.71	66.62
TX 10	15.87	6.87	9.71	66.62
TX 12	15.87	6.87	9.71	66.62
TX 16	15.54	6.81	9.45	67.27
TX 20	15.54	6.81	9.45	67.27
TX 4, 50 T&C	20.23	9.88	11.07	57.90
TX 6, 50 T&C	17.23	6.87	11.07	63.91
TX 8, 50 T&C	17.23	6.81	11.13	63.91
TX 10, 50 T&C	17.23	6.81	11.13	63.91
TX 12, 50 T&C	15.87	6.81	9.77	66.62
TX 16, 50 T&C	15.54	6.81	9.45	67.27
TX 20, 50 T&C	15.54	6.81	9.45	67.27

Table 61. Extent and cost of terracing and contouring by control option for Duck Creek watershed assuming farmers have a 200 year planning horizon.

Control Option	Terracing		Contouring	
	Acres (1000)	Cost ($1000)	Acres (1000)	Cost ($1000)
Benchmark	0.0	0.0	19.87	43.59
SL < T	0.15	0.97	27.20	59.02
SL < 2	31.10	199.99	1.55	4.44
SL < 5	0.0	0.0	27.35	59.34
SL < 10	0.0	0.0	19.87	43.59
TR 50	0.0	0.0	19.87	43.59
TR 100	27.13	174.75	0.0	0.0
C 50	0.0	0.0	34.92	75.40
C 100	0.0	0.0	37.78	82.80
IT 50	0.0	0.0	19.87	43.59
IT 100	0.0	0.0	19.87	43.59
SL < T, TR 50	0.15	0.97	27.20	59.02
SL < T, C 50	0.15	0.97	31.25	67.38
SL < T, IT 50	0.15	0.97	27.20	59.02
SL < 5, TR 50	0.0	0.0	27.35	59.34
SL < 5, C 50	0.0	0.0	34.92	75.40
SL < 5, IT 50	0.0	0.0	27.35	59.34
TX 4	0.0	0.0	23.62	51.49
TX 6	0.0	0.0	23.62	51.49
TX 8	0.0	0.0	23.62	51.49
TX 10	0.0	0.0	23.62	51.49
TX 12	0.0	0.0	23.62	51.49
TX 16	0.0	0.0	23.62	51.50
TX 20	0.0	0.0	23.62	51.50
TX 4, 50 T&C	0.0	0.0	34.92	75.40
TX 6, 50 T&C	0.0	0.0	34.92	75.40
TX 8, 50 T&C	0.0	0.0	34.92	75.42
TX 10, 50 T&C	0.0	0.0	34.92	75.42
TX 12, 50 T&C	0.0	0.0	31.41	67.71
TX 16, 50 T&C	0.0	0.0	31.41	67.71
TX 20, 50 T&C	0.0	0.0	31.41	67.71

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