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Nonpoint Source Pollution Loading Factors and Related Parameters from the Literature

Chesapeake Bay Program

NONPOINT SOURCE POLLUTION LOADING FACTORS AND RELATED PARAMETERS FROM THE LITERATURE

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Using a modified version of TR-20 (SCS computer program), McTernan et al. (1987) conducted a study to evaluate the effectiveness of various BMPs upon the production of nonpoint source pollutants from small agricultural watersheds in northern Virginia. The SCS CN equation and the USLE are incorporated in TR-20. Observed data collected from five basins are compared to data simulated by the model.

TABLE 3. Calculated Algebraic Yield Comparisons Between Simulations and Observed Data Base for Delivered Sediment.

Storms Evaluated**	Mean Yield (pounds)	Calculated Error* (pounds)	Percent of Mean
All	558	15.9	2.85
Small Events	1.39	0.84	61
Large Events	1115	32.7	2.9

$$\text{*Error} = 1/N \sum_{i=1}^{N} (M-S)$$

N = Number of Samples.
M = Measured Sediment Yield.
S = Simulated Sediment Yield.

**Six Total Storms
3 small events ($x \leq 0.5$ inch)
3 large events ($x \geq 2.5$ inches)

TABLE 4. Model Parameters Used to Simulate Discharge and Delivered Sediment for Select Management Practices.

Practice	Name of Parameter: CN	C	LS	P	K
No-Till	81	0.003	1.3	1.0	0.43
Minimum-Till	83	0.024	1.3	1.0	0.43
Conventional Till	85	0.338	1.3	1.0	0.43
Well-Managed Pasture	74	0.004	1.3	1.0	0.43
Overgrazed Pasture	88	0.01	1.3	1.0	0.43
Forest	73	0.0001	1.3	1.0	0.43
No-Till Contour	75	0.003	1.3	0.50	0.43
Min.-Till Contour	78	0.024	1.3	0.50	0.43
Conv.-Till Contour	82	0.338	1.3	0.50	0.43
No-Till Terrace	73	0.003	1.8	0.50	0.43
	73	0.003	0.35	0.50	0.43
Min.-Till Terrace	76	0.024	1.8	0.50	0.43
	76	0.024	0.35	0.50	0.43
Conv.-Till Terrace	78	0.338	1.8	0.50	0.43
	78	0.338	0.35	0.50	0.43

CN = SCS Curve Number.
C = USLE Cover Factor.
LS = USLE Length-Slope Factor.
P = USLE Practice Factor.
K = Soil Erosion Factor.

Source: McTernan, W.F., B.L. Weand, and T.J. Grizzard. 1987. Evaluation of management practices to control agricultural pollutants. Water Res. Bull. 23(4):691-700.

TABLE 5. Simulation Results for Three Tillage Alternatives Without Additional Practices.

Practice	Rain Depth (inches)	Time to Peak (hours)	Time to Base (hours)	Peak Flow (cfs)	Runoff Volume (acre feet)	Total Sediment Load (lbs)	Peak Sediment Discharge (lbs/hr)
No Till	0.50	2.0	2.2	0.03	0.0005	0.023	0.11
	3.25	8.9	13.6	5.6	2.00	1,318	384
	5.50	2.4	6.2	69	7.30	15,385	19,525
	7.50	9.9	24.2	70	11.2	16,660	19,580
Minimum Till	0.50	2.0	2.2	0.58	0.008	15.2	90
	3.25	8.9	13.2	10.5	3.55	23,960	8,170
	5.50	2.4	6.2	73	7.7	134,380	171,050
	7.50	9.9	24.2	73	11.7	142,084	166,655
Conventional Till	0.50	2.0	2.2	1.5	0.02	913	5,375
	3.25	8.9	13.2	11.1	3.9	381,085	126,550
	5.50	2.4	6.2	77	8.2	2,058,210	2,622,800
	7.50	9.9	24.2	76	12.2	2,125,620	2,484,300

TABLE 6. Simulation Results for Three Alternative Tillage Methods, Practice = Contour Plowing.

Practice	Rain Depth (inches)	Time to Peak (hours)	Time to Base (hours)	Peak Flow (cfs)	Runoff Volume (acre feet)	Total Sediment Load (lbs)	Peak Sediment Discharge (lbs/hr)
No Till	0.50	N/A	N/A	0	0	0	0
	3.25	8.9	13.2	7.8	2.4	878	324
	5.50	2.4	6.2	57	6.1	5,762	7,170
	7.50	9.9	24.2	61	9.8	6,713	7,889
Minimum Till	0.50	N/A	N/A	0	0	0	0
	3.25	8.9	13.2	8.8	2.8	8,664	3,122
	5.50	2.4	6.2	63	6.7	53,520	67,404
	7.50	9.9	24.2	66	10.5	60,082	70,716
Conventional Till	0.50	2.0	2.2	0.24	0.003	26	155
	3.25	8.9	13.2	10.2	3.4	158,489	54,730
	5.50	2.4	6.2	71.3	7.5	905,974	1,151,855
	7.50	9.9	24.2	71.7	11.4	969,383	1,138,515

Source: McTernan, W.F. et al. 1987. Evaluation of management practices to control agricultural pollutants. Water Res. Bull. 23(4):691-700.

TABLE 7. Simulation Results for Three Alternative Tillage Methods, Practice = Terracing.

Practice	Rain Depth (inches)	Time to Peak (hours)	Time to Base (hours)	Peak Flow (cfs)	Runoff Volume (acre feet)	Total Sediment Load (lbs)	Peak Sediment Discharge (lbs/hr)
No Till	0.50	N/A	N/A	0	0	0	0
	3.25	9.0	17.4	5.5	2.2	850	213
	5.50	2.5	8.8	36	5.7	5,824	3,155
	7.50	10.0	26.4	43	9.4	7,230	3,880
Minimum Till	0.50	N/A	N/A	0	0	0	0
	0.25	9.0	17.2	6.3	2.5	8,577	2,115
	5.50	2.5	8.6	41	6.2	54,185	30,480
	7.50	10.0	26.2	48	10.1	65,150	35,875
Conventional Till	0.5	N/A	N/A	0	0	0	0
	3.25	9.0	17.2	6.9	2.8	135,415	34,040
	5.50	2.5	8.6	45	6.6	821,816	482,595
	7.50	10.0	26.2	51	10.6	971,420	551,820

TABLE 8. Sediment Yield Comparisons for Simulated and Collected Data Bases.

Practice/Cover	Sediment Yield		
	Simulated Data (lb/ac/yr)	Collected Data (lb/ac/yr)	Percent Change
Overgrazed Pasture	330	106	211
Well Managed Pasture	0	5	—
No-Till Corn	0.06	15	−99.6
Minimum-Till Corn	39	19	105
Forest	0	119	—

Source: McTernan, W.F. et al. 1987. Evaluation of management practices to control agricultural pollutants. Water Res. Bull. 23(4):691-700.

Two watersheds in Ohio - Treynor and Coshocton - were selected to model sediment yield for a single-storm event. Both watersheds were planted in corn on the contour. Sediment yield or deposition was calculated by comparing total soil detachment and the transport capacity (basic equation was USLE). Runoff volumes and peak rates were predicted using USDAHL-73 (Holton & Lopez, 1973). C factors of 0.50 for Treynor and 0.29 for Coshocton were held constant through the run.

TABLE 1. EROSION-DEPOSITION CHARACTERISTICS FOR STORMS SIMULATED ON TREYNOR W2 AND COSHOCTON W113.

Date	Rainfall amount, in.	R_{st}	Sediment yield		Predicted erosion		Predicted deposition
			Meas.	Pred.	Interrill	Rill	
					tons per acre		
Treynor							
6-25-65	0.53	8.8	0.51	0.98	0.47	0.60	0.09
6-28-65	0.62	8.5	1.84	1.49	0.37	1.26	0.14
6-28-65	1.20	31.8	5.36	5.74	1.36	4.90	0.53
6-29-65	2.42	26.4	3.65	8.21	1.01	7.95	0.76
7-1-65	0.68	1.6	0.58	0.33	0.07	0.30	0.03
7-1-65	0.25	0.5	0.15	0.05	0.03	0.02	0.004
Coshocton							
8-6-71	1.71	10.4	1.73	4.31	0.25	4.06	0
6-13-72	1.60	17.9	2.12	9.45	0.35	9.10	0
6-15-72	0.70	8.7	4.49	4.81	0.17	4.64	0
7-10-72	0.60	2.8	0.69	0.73	0.64	0.09	0
11-7-72	1.35	5.9	0.38	3.68	0.21	3.47	0

Source: Onstad, C.A. and G.R. Foster. 1975. Erosion modeling on a watershed. Trans. ASAE. 288-292.

During 1985-86, a rainfall simulator was used to evaluate the effectiveness of BMPs on water quality on eight (8) demonstration plots in Virginia. Seven of the eight sites were located in the Chowan River Basin. Plot descriptions and results are tabulated below.

Table 1. Plot Characteristics and Operating Conditions

PLOT	TILLAGE SYSTEM	AREA (m^2)	SLOPE (%)	SOIL TYPE
	SOUTHAMPTON COUNTY, VIRGINIA - CORN - MAY 15 & 16, 1985			
RS01	No-till	2320	2	Goldsboro fine sandy loam
RS02	Conventional	2320	2	Goldsboro fine sandy loam
	ESSEX COUNTY, VIRGINIA - SOYBEANS - JUNE 19 & 20, 1985			
RS07	Conventional	1390	5	Slagle fine sandy loam
RS08	No-till	1390	5	Slagle fine sandy loam
	CITY OF SUFFOLK, VIRGINIA - SOYBEANS - JULY 26 & 27, 1985			
RS09	Conventional	270	2	Suffolk loamy sand
RS10	Chisel plow	270	2	Suffolk loamy sand
RS11	No-till	270	2	Suffolk loamy sand
	RICHMOND COUNTY, VIRGINIA - CORN - AUGUST 6 & 7, 1986			
RS12	Conventional	690	7	Tetotum fine sandy loam
RS13	No-till	690	7	Tetotum fine sandy loam
	SURRY COUNTY, VIRGINIA - SOYBEANS - AUGUST 11 & 12, 1986			
RS14	No-till	1210	6	Caroline fine sandy loam
RS15	Conventional	1210	6	Caroline fine sandy loam

Table 5. Sediment and Nutrient Yield (areal basis)

	PLOT	TSS kg/ha	NH_4 kg/ha	NO_3 kg/ha	TKN kg/ha	T-N kg/ha	T-P kg/ha	O-P kg/ha	TKN-P kg/ha	TP-P kg/ha
				SOUTHAMPTON - CORN						
NO-TILL	RS01	9.82	0.11	0.15	0.40	0.55	0.16	.	0.30	0.03
CONV.	RS02	558.53	0.30	0.51	2.65	3.17	1.25	.	0.71	0.10
				ESSEX - SOYBEANS						
CONV.	RS07	914.38	0.32	0.08	2.93	3.00	0.61	.	1.07	0.02
NO-TILL	RS08	10.26	0.04	0.03	0.58	0.61	0.05	.	0.36	0.01
				SUFFOLK - SOYBEANS						
CONV.	RS09	1225.44	0.08	0.05	2.36	2.42	1.29	.	0.44	0.06
CHISEL	RS10	880.74	0.05	0.03	1.51	1.54	0.79	.	0.45	0.06
NO-TILL	RS11	101.38	0.13	0.03	1.45	1.48	0.28	.	0.53	0.09
				RICHMOND - CORN						
CONV.	RS12	236.95	0.32	0.03	1.42	1.65	0.43	0.01	0.33	0.22
NO-TILL	RS13	41.98	0.06	0.22	0.48	0.70	0.08	0.02	0.15	0.02
				SURRY - SOYBEANS						
NO-TILL	RS14	4.64	0.17	0.14	0.31	0.45	0.08	0.07	0.25	0.05
CONV.	RS15	1397.58	0.49	0.20	3.65	3.84	2.46	0.03	0.99	0.12

Source: Ross, B.B., M.L. Wolfe, V.O. Shanholtz, M.D. Smolen, and D.N. Contractor. 1982. Model for simulating runoff and erosion in ungaged watersheds. Virginia Water Resources Research Center Bulletin, VPI, Blacksburg, VA. 130:72 p.

CREAMS was applied on a typical field in the Southern Coastal Plain land resource area of Georgia. The model was run for seven management systems for a 20-year period. Major crops grown on the Tifton loamy sand are corn, soybeans, and peanuts; but cotton, tobacco, small grain, and horticultural crops are also grown. A three-year rotation of corn-soybeans-peanuts is a common cropping system.

TABLE 1.--Management Systems on Tifton Loamy Sand for CREAMS Application

Management System	Description
1	Conventional tillage: fall moldboard 130 mm deep; spring disk 100 mm deep; two sweep cultivations 50 mm deep; tillage across concentrated-flow area; straight rows.
2	Conventional tillage: same as system 1 except a grass waterway is maintained in the concentrated-flow area.
3	Contour tillage: tillage is the same as in system 1 except on approximate contour; grass waterway is maintained in concentrated-flow area.
4	Contour terraces: tillage is the same as system 1 except on contour; grass waterway in concentrated-flow area as a terrace outlet channel.
5	Contour tillage, residue management: shred crop residue; chisel on contour 315 mm deep; maintain grass waterway in concentrated-flow area. (Spring moldboard prior to peanuts).
6	Contour terraces; contour tillage, residue management; same as system 5 except field is terraced.
7	Conventional tillage, winter cover: tillage and waterway same as in system 2.

TABLE 3.--Summary of CREAMS Erosion Simulation, Average Annual Values, 1955-74, Southern Coastal Plain Field in Georgia

Management System	Runoff (mm)	Sediment Yield (t/ha)	Enrichment Ratio[a]	Product (SY·ER)[b] (t/ha)	Rank[c]
1	70.4	6.94	2.08	14.44	1
2	70.4	0.92	6.88	6.33	2
3	55.4	0.40	8.65	3.46	3
4	29.7	0.09	13.79	1.24	6
5	30.0	0.20	9.13	1.83	5
6	17.5	0.04	14.45	0.58	7
7	33.5	0.25	7.90	1.97	4

[a]Enrichment ratio is ratio of sediment particle surface area to original soil particle surface area.

[b]Product of sediment yield (SY) and enrichment ratio (ER).

[c]Ranking SY·ER, highest to lowest values.

Source: DelVecchio, J.R. and W.G. Knisel. 1982. Application of a field-scale nonpoint pollution model. Water and Soil Management 11:227-236.

TABLE 4.--CREAMS Erosion Simulation By Element For Single Storm of March 6, 1959

Management System	Runoff	Sediment Yield: Overland	Overland-Channel[a]	Overland-Channel-Channel[b]	Field	Enrichment Ratio Field[c]
	(mm)	(t/ha)				
1	37.6	1.14	7.46	-	7.46	2.26
2	37.6	1.14	1.14	-	1.14	5.75
3	33.5	0.54	0.54	-	0.54	6.00
4	24.9	1.12	0.09	0.09	0.09	9.72
5	25.4	0.34	0.34	-	0.34	5.65
6	19.3	0.40	0.02	0.02	0.02	10.12
7	21.3	0.13	0.13	-	0.13	5.44

[a]Overland-channel represents the overland flow and waterway flow sequence (systems 1, 2, 3, 5, and 7).

[b]Overland-channel-channel represents interterrace overland flow, terrace channel flow, and grassed waterway flow sequence (systems 4 and 6).

[c]Enrichment ratio is ratio of sediment particle surface area to original soil particle surface area.

TABLE 5.--Summary of CREAMS Plant Nutrient Simulation, Average Annual Losses, 1955-74, Southern Coastal Plain in Georgia

Management System	Runoff: Nitrogen	Runoff: Phosphorus	Sediment: Nitrogen	Sediment: Phosphorus	Nitrate-N leached
	(kg/ha)				
1	1.15	0.17	34.67	12.83	33.72
2	1.15	0.17	6.26	2.25	33.72
3	0.84	0.13	3.02	1.07	34.82
4	0.40	0.07	0.72	0.25	36.46
5	0.39	0.07	1.51	0.53	37.16
6	0.21	0.04	0.32	0.11	37.69
7	0.49	0.08	1.75	0.62	20.18

Source: DelVecchio, J.R. and W.G. Knisel. 1982. Application of a field-scale nonpoint pollution model. Water and Soil Management 11:227-236.

The table below compares loadings from urban and rural Wisconsin watersheds. The values represent 2- to 4-year averages determined by monitoring.

Table 2. Comparison of water and pollution yields from Wisconsin experimental watersheds - 1980-81 (Source - Wisconsin Department of Natural Resources)

Watershed type	Watershed area (ha)	Imperviousness (%)	Runoff coefficient*	Pollution yield** (kg/ha-yr) Suspended solids	Total P	Total lead
Urban						
Storm sewers						
Commercial I	11.7	77	0.58	718	1.48	1.33
Commercial II	18.2	81	0.69	1197	1.50	3.90
Residential I	14.6	57	0.40	487	1.12	0.90
Residential II	25.3	51	0.33	272	0.62	0.28
Residential III	13.3	50	0.33	161	0.54	0.21
Residential - 10% under construction	522	47	0.31	767	0.75	0.21
Suburban						
Low density residential, partly sewered	4974	7	0.10	217	0.30	0.12
Agricultural I	3900	<5	0.06	752	1.11	-
II	1528	<5	0.14	743	0.74	-
III	2615	<5	0.09	470	-	-
IV	2144	<5	0.06	386	0.63	-

*Annual runoff volume:rainfall volume.
**Excluding winter.

Source: Novotny, V. and G. Chesters. 1986. Delivery of sediments and pollutants from nonpoint sources - a water quality perspective. Milwaukee River Nonpoint Source Abatement Research Project. Water Resources Center, University of Wisconsin-Madison. 34 p.

A site in the lakebed region of northern Ohio was selected to study the sediment and chemical content of agricultural drainage water. The soil is poorly drained, fine-textured, and classified as Toledo silty clay; a Mollie Haplaquept, fine, illitic, nonacid, mesic. Clay content ranges 47-59% in the upper 150 cm. Crops by years starting in 1969, in order, were: three years of corn,oats (with tallage in July), bare soil, two years of alfalfa-timothy sod, and three years of corn-oats-soybeans combination in each plot. Fertility levels were as recommended by soil test for typical farm usage. Tillage practice was conventional with fall moldboard plowing and spring seedbed preparation, except during 1969-71 when two of the four replications were managed with no-tillage cultural practices. Annual surface runoff losses averaged:

2548 kg/ha for sediment
12.1 kg/ha for NO3-N
2.2 kg/ha for P

TABLE 1. ANNUAL RAINFALL, DRAINAGE FLOW, AND SEDIMENT LOSS BY DRAINAGE TREATMENT.

Year	Crop	Precip. mm	Shallow Pipe Drains Flow mm	Shallow Pipe Drains Sediment kg/ha	Deep Pipe Drains Flow mm	Deep Pipe Drains Sediment kg/ha	Surface Drains Flow mm	Surface Drains Sediment kg/ha
1969	Corn*	1061			206	2776	157	2098
1970	Corn*	818			160	419	154	1751
1971	Corn*	689			51	236	88	773
	Average	856			139	1144	131	1541
1972	Oats-bare	1152			341	5405	331	9054
1973	Bare soil	967			298	4484	301	7365
	Average	1060			320	4945	316	8210
1974	Alf-grass	799	166	423	251	837	147	1085
1975	Alf-grass	842	189	165	108	163	196	828
	Average	820	178	294	180	500	172	957
1976	C-S-O*	827	76	141	29	82	46	221
1977	C-S-O*	1022	161	205	354	543	261	910
1978	C-S-O*	845	175	157	169	348	149	1391
	Average	898	137	168	184	324	152	841
Average (all years)		902	153	218	197	1529	183	2548

* Conventional tillage for corn and soybeans.

Source: Schwab, G.O., N.R. Fausey, and D.E. Kopcak. 1980. Sediment and chemical content of agricultural drainage water. ASAE Paper No. 79-2024. Ohio Agricultural Research and Development Center, Wooster, OH. 16 p.

TABLE 3. CHEMICAL LOSSES BY DRAINAGE SYSTEM AND YEARS.

Chemical (analysis of)	Year	Losses in kg/ha: Shallow pipe drains	Deep pipe drains	Surface drains
NO_3-N (water)	1969		20.9	19.3
	70		25.4	35.3
	71		17.5	10.6
	72		26.8	18.6
	73		22.0	9.5
	74	9.4	14.1	9.0
	75	4.4	5.3	0.8
	76	10.4	6.6	5.1
	77	25.4	38.3	8.7
	78	6.3	10.4	3.6
Average Annual		11.2	18.7	12.1
Avg. Percentage for Dormant Season		40%	43%	29%
Phosphorus (water and sediment)	1969		0.9	1.2
	70		0.8	8.3
	71		0.3	1.3
	72		2.4	2.5
	73		2.0	2.6
	74	0.8	1.2	1.2
	75	1.3	1.5	3.6
	76	0.4	0.4	0.2
	77	1.0	2.1	1.2
	78	0.3	0.6	0.3
Average Annual		0.8	1.2	2.2
Avg. Percentage for Dormant Season		57%	50%	35%
Potassium (water and sediment)	1969		12.5	2.9
	70		7.9	17.6
	71		2.2	7.6
	72		87.2	113.7
	73		57.4	92.2
	74	9.7	16.6	23.0
	75	9.7	19.4	34.4
	76	5.8	1.0	3.9
	77	13.3	14.8	15.0
	78	5.4	6.0	5.4
Average Annual		8.7	22.5	31.6
Avg. Percentage for Dormant Season		42%	38%	39%

Source: Schwab, G.O. et al. 1980. Sediment and chemical content of agricultural drainage water. ASAE Paper No. 79-2024. Ohio Agricultural Research and Development Center, Wooster, OH. 16 p.

Using simulated rainfall, Sharpley (1980) evaluated the effects of varying soil physical and chemical properties, soil slope, rainfall intensity, and source on the enrichment of soil P in runoff. ER values for total P have ranged from 1.3 (Rogers, 1941) to 1.5-3.1 (Knoblauch et al.,1942; Neal, 1944; Stoltenberg and White, 1953). Soils used were Bernow (fine-loamy, siliceous, thermic Glossic Paleudalfs), Kirkland (fine, mixed, thermic Udertic Paleustolls), and Pullman (fine, mixed thermic Typic Ustochrepts) which represent major soil types in Oklahoma and Texas.

Table 3—Enrichment ratios for P in rainfall runoff from several soils, with 0, 25, 50, and 100 kg/ha P amendments.

Soil	Enrichment ratios at P addition (kg/ha)†			
	0	25	50	100
Bernow	2.43	4.15	5.87	6.29
Houston	1.42	2.23	2.54	2.77
Kirkland	1.26	2.05	2.40	2.66
Pullman	1.23	–‡	2.56	–
Woodward	1.19	–	2.36	–

† All treatments, 4% slope and 6 cm/hour rainfall intensity.
‡ Not determined.

Table 4—Enrichment ratios for P in runoff from the 50 kg P/ha amendment to Bernow and Houston soils subjected to several treatments.

Runoff source	Soil slope, %	Rain intensity, cm/hour	Enrichment ratio	
			Bernow	Houston
Rain	4	6	5.87	2.64
Rain	4	12	5.59	2.59
Rain	8	6	4.23	2.30
Rain	4	6 Large screen	6.33	3.02
Rain	4	6 Medium screen	6.42	4.16
Rain	4	6 Fine screen	6.63	5.93
Overland flow	4	6	6.81	5.39

Source: Sharpley, A.N. 1980. The enrichment of soil phosphorus in runoff sediments. J. Environ. Qual. 9(3):521-526.

The New York State Department of Agricultural Engineering published a bulletin " Determining Sediment Yield from Agricultural Land". The bulletin provides a simple procedure for evaluating the effects of field location upon the amount of sediment delivered to a stream. A small farm with six fields located southeast of Skaneateles, NY was used as the example site. The USLE was Used.

Table 2. Factors Used in Determining Soil Erosion on Example Farm, Skaneateles, N.Y.

Field Identification	Soil Type	Cropping History	Slope Gradient	Slope Length	Conservation Practices	R	K	C	LS	P	Soil Erosion T/ac
115	Honeoye	Corn/Corn/Oats	3%	600 ft	None	100	.32	.43	.49	1.0	6.7
116	Honeoye	Corn/Corn/Oats	5%	300 ft	Contoured	100	.32	.43	.93	0.5	6.4
117	Lima	Hay/Hay/Oats	3%	200 ft	Contoured	100	.32	.17	.35	0.5	1.0
118	Angola	Wheat/Corn/Corn	3%	325 ft	Contoured	100	.37	.41	.41	0.5	3.1
119	Angola	Wheat/Hay/Hay	5%	360 ft	None	100	.37	.14	1.01	1.0	5.2
120	Honeoye	Hay/Hay/Corn	11%	195 ft	Contoured	100	.32	.23	2.20	0.6	9.7

Table 3. Estimated Sediment Delivered to a Stream from Example Farm

Field Identification	Distance to Stream ft	SDR	x	Soil Erosion* T/ac	=	Sediment Yield T/ac	x	Area ac	=	Total Sediment Yield T
115	200	.31		6.7		2.1		8.0		16.8
116	0	1.0		6.4		6.4		2.8		17.9
117	840	.23		1.0		0.2		8.0		1.6
118	540	.25		3.1		0.8		8.2		6.6
119	180	.32		5.2		1.7		10.0		17.0
120	0	1.0		9.7		9.4		3.4		33.0
								40.4		92.9

*See Table 2

Source: Walter, M.F. and R.D. Black. 1982. Determining sediment yield from agricultural land. 11 p.

Smith et al. measured amounts of nitrogen, phosphorus, and sediment in runoff from grassland watersheds in the Blackland Prairies (BP), High Plains (HP), Reddish Prairies (RP), and Rolling Red Plains (RRP), Texas. Three- to five-year study periods included treatments involving fertilization, cultivation, and burning. Overall nutrient concentrations ranged from 2-10 mg/L for N and 0.3-2 mg/L for P.

Table 1. Characteristics of the grassland watersheds for various years 1976 through 1980.

Resource area	Water-shed	Size (ha)	Approx slope (%)	Total events	Major soils	Major grasses	Land use
BP (Riesel, Tex.)	Y-14	2.2	2	29	Houston Black clay (Udic Pellusterts)	Klein (*Panicum coloratum*)	Moderate graze
	W-10	7.9	2	19		Coastal bermuda) (*Cynodon dactylon*)	Moderate graze[1]
	SW-11	1.1	1	20		Harding wintergreen (*Phalaris acquatica*)	Moderate graze
HP (Bushland, Tex.)	N.G.	0.04	1	4	Pullman clay loam (Torrertic Paleustolls)	Blue grama (*Bouteloua gracilis* and	Idle
	S.G.	0.04	1	4		Buffalo (*Buchloe dactyloides*)	Idle
RP (El Reno, Okla.)	FR-1	1.6	3	12	Bethany silt loam (Pachic Paleustolls)	Little bluestem (*Andropogon scoparius*)	Heavy graze (double stocking)
	FR-2	1.6	3	14			Moderate graze/fertilizer[2]
	FR-3	1.6	3	13	and	and	Moderate graze
	FR-4	1.6	4	13	Kirkland silt loam (Udertic Paleustolls)	Big bluestem (*Andropogon gerardii*) and Sideoats grama (*Bouteloua curtipendula*)	Moderate graze/fertilizer/ Spring burn[3]
	FR-5	1.6	4	15			Moderate graze to wheat[4]
	FR-6	1.6	3	15			Moderate graze to wheat[4]
	FR-7	1.6	3	18			Moderate graze to wheat[4]
	FR-8	1.6	3	17			Moderate graze to wheat[4]
RRP (Wood-ward, Okla.)	WW-1	4.7	7	21	Woodward loam (Typic Ustochrepts)	Sideoats grama (*Bouteloua curtipendula*)	Moderate graze
	WW-2	5.5	8	35	and	and	Moderate graze[5]
	WW-3	2.7	8	22	Quinlan loam (Typic Ustochrepts)	Hairy grama (*Bouteloua hirsuta*)	Moderate graze to wheat[6]
	WW-4	2.9	8	27			Moderate graze to wheat[6]

[1]160 kg N·ha surface broadcast in 1978.
[2]56 kg N.ha surface broadcast in 1979, 80; 22 kg P_2O_5/ha in 1980.
[2]56 kg N.ha surface broadcast in 1979, 80; 22 kg P_2O_5/ha in 1980.
[3]April burn in 1979 prior to fertilizing. 0.6 Kg/ha 2-4D applied in May, 1980, but not runoff events occurred til following year.
[4]Planted to wheat since fall 1978, fertilized according to soil test for 40 quintals/ha yield goal.
[5]38 kg N ha, 22 kg P_2O_5/ha in 1980; May and Sept. defer grazing.
[6]Planted to whet since fall 1979, fertilized according to soil test for 40 quintals/ha yield goal.

Source: Smith, S.J., R.G. Menzel, E.D. Rhoades, J.R. Williams, and H.V. Eck. 1983. Nutrient and sediment discharge from southern plains grasslands. J. Range Mgmt. 36(4):435-439.

Table 2. Flow-weighted mean nutrient concentrations (mg/liter) in runoff from representative watersheds.

Resource area	No. watersheds	Period	NO_2^--N	NO_3^--N	NH_4^+-N	TKN	TP	Sol. P	React. P
					Unfertilized Grasslands				
NP	2	1978-80	0.036 (0.063)[b]	0.500 (0.810)	1.230 (2.90)	4.39 (8.74)	0.780 (0.850)	0.670 (1.830)	0.626 (0.850)
RP	2	1977-80	0.023 (0.130)	0.220 (0.380)	0.208 (0.670)	1.66 (2.84)	0.204 (0.450)	0.109 (0.230)	0.067 (0.210)
RRP	1	1977-80	0.015 (0.200)	0.213 (0.370)	0.210 (0.530)	2.80 (15.28)	0.764 (9.940)	0.174 (0.340)	0.158 (0.330)
					Fertilized Grasslands				
BP	3	1976-80	0.214 (5.80)	1.474 (13.0)	0.647 (14.28)	2.67 (24.5)	0.413 (1.711)	0.082 (0.273)	0.073 (0.212)
RP	2	1979-80	0.028 (0.190)	3.18 (11.2)	2.59 (11.5)	4.00 (8.9)	0.448 (2.667)	0.339 (1.258)	0.301 (1.247)
RRP	1	1979-80	0.009 (0.032)	0.249 (1.08)	0.147 (1.55)	3.70 (7.47)	1.700 (4.416)	0.128 (0.439)	0.105 (0.452)
					Croplands				
BP[a]	3	1976-80	0.082 (1.48)	2.67 (28.4)	0.081 (0.590)	4.73 (20.6)	1.385 (5.514)	0.052 (0.109)	0.050 (0.110)
NP[a]	3	1978-80	0.042 (0.103)	0.353 (3.05)	0.108 (0.540)	6.38 (17.6)	2.085 (6.640)	0.138 (0.454)	0.123 (0.436)
RP	4	1979-80	0.099 (0.610)	1.84 (9.23)	0.549 (14.2)	7.83 (22.1)	1.648 (9.200)	0.309 (7.760)	0.291 (2.590)
RRP	2	1977-80	0.014 (0.095)	0.264 (9.20)	0.335 (5.32)	8.83 (21.6)	1.553 (4.097)	0.120 (1.724)	0.104 (1.399)

[a]BP cropland watersheds are in a cotton-oats-sorghum rotation. NP cropland watersheds are in a wheat-sorghum-fallow rotation. Additional details about the cropland watersheds are given in Sharpley et al. 1982.
[b]Values in parenthesis are the highest concentrations observed.

Table 3. Mean annual amounts (kg/ha) of nutrient discharge from watersheds.

Resource area	No. watersheds	Period	NO_2^--N	NO_3^--N	NH_4^+-N	TKN	TP	Sol. P	Reactive P
					Grasslands				
BP	3	1976-80	0.3	2.3	1.1	4.3	0.6	0.12	0.10
NP idle	2	1978-80	0.0	0.1	0.1	0.5	0.1	0.08	0.07
RP	4	1977-80	0.0	0.3	0.3	0.8	0.1	0.04	0.04
RRP	2	1977-80	0.0	0.0	0.0	0.8	0.2	0.06	0.06
					Croplands				
BP	3	1976-80	0.1	3.5	0.1	4.2	1.7	0.06	0.06
NP idle	3	1978-80	0.0	0.3	0.1	3.3	1.2	0.08	0.07
RP	4	1979-80	0.0	0.5	0.1	1.8	0.5	0.06	0.06
RRP	2	1979-80	0.0	0.1	0.1	1.8	0.02	0.01	0.01

Table 4. Mean annual amounts of rainfall, runoff and sediment discharge for watersheds.

Resource area	No. watersheds	Period	Rainfall: Long-term	Rainfall: Study period	Runoff	Sediment
			cm	cm	cm	kg/ha
				Grasslands		
BP	3	1976-80	86	95	14 ±3[1]	686±539[1]
NP	2	1978-80	46	43	1.2±0.2	56± 63
RP	4	1977-80	75	74	3.6±0.4	46± 22
RRP	2	1977-80	61	65	1.6±1.3	787±990
				Croplands		
BP	3	1976-80	86	95	12 ±4	3004±1765
NP	3	1978-80	46	43	6.8±0.5	2285± 120
RP	4	1979-80	75	74	2.4±0.6	410± 132
RRP	2	1979-80	61	65	2.5±0.4	517± 199

[1]The ± values represent single standard deviations of the means.

Source: Smith,S.J. et al. 1983. Nutrient and sediment discharge from southern plains grasslands. J. Range Mgmt. 36(4):435-439.

Total P efflux from the Sandusky River into Lake Erie has been measured since 1969. In 1976, a P removal plant was installed upstream from the measurement point. The following table shows no such decrease in P loads. Conclusion was that longer records are necessary to determine reductions.

Table 1—Annual phosphorus loads from the Sandusky River to Lake Erie.†

Parameter	Calendar year				
	1969	1974	1975	1976	1977
Annual loads of:					
Total P	407	606	446	333	684
Metric tons/year as P	±161	±128	± 24	± 16	±153
Annual flow, $m^3 sec^{-1}$	34.6	35.3	29.0	21.8	37.6
Mean annual loads of:					
Total P	329	279	317	296	312
Metric tons/year as P	±110	± 31	± 16	± 33	± 13

† Data provided by the River Studies Laboratory, Heidelberg College, Tiffin, Ohio.

‡ Calculated using the flow-concentration relationship for that year and flow probabilities from the 50-year record.

Source: Verhoff, F.H. and S.M. Yaksich. 1982. Storm sediment concentrations as affected by land use, hydrology, and weather. J. Environ. Qual. 11(1):72-78.

Three research watersheds located at the Southern Piedmont Consevation Research Center near Wakinnsville, GA were used to evaluate cropping-tillage effects on erosion probabilities in Southern Piedmont. Soils were predominately Cecil sandy loam (Typic Haplupults). The four tillage systems and results are described below:

TABLE 1. CROPPING-TILLAGE SYSTEMS ON THREE RESEARCH WATERSHEDS IN THE SOUTHERN PIEDMONT

Watershed	System Number	Period in Effect	Summer Crop	Winter Crop	Tillage	Implement
P1	1	10-1-72 to 10-21-74	Soybeans	None	Conventional	Disk Harrow
	2	10-22-74 to 10-1-76	Grain Sorghum	Barley	Conservation	Fluted Coulter
	3	11-5-76 to 11-7-80	Soybeans	Wheat	Conservation	Coulter Inrow Chisel
	4	11-8-80 to 10-13-82	Grain Sorghum	Clover	Conservation	Coulter Inrow Chisel
P3	5	12-4-72 to 11-5-75	Soybeans	Rye, Barley	Conventional	Disk Harrow
	6	11-6-75 to 11-5-78	Grain Sorghum	Barley, Wheat	Conservation	Fluted Coulter
	7	11-6-78 to 11-7-79	None	Wheat, Rye Grass	None	None
	8	11-8-79 to 11-9-82	Soybeans	Wheat	Conservation	Coulter Inrow Chisel
P4	9	11-2-73 to 11-5-75	Corn	Rye	Conventional	Disk Harrow
	10	11-6-75 to 11-5-78	Soybeans	Barley, Wheat	Conservation	Fluted Coulter
	11	11-6-78 to 11-7-79	None*	Wheat, Rye Grass	None	None
	12	11-8-79 to 11-10-82	Soybeans	Wheat	Conventional	Disk Harrow

* Terraces reconstructed during summer.

Source: Mills, W.C., A.W. Thomas, and G.W. Langdale. 1985. Erosion probabilities in Southern Piedmont: cropping-tillage effects. ASAE Paper No. 842546. 24 p.

TABLE 3. MAXIMUM, MINIMUM, AVERAGE, AND NUMBER OF SCS CURVE NUMBERS OBTAINED FOR THREE RESEARCH WATERSHEDS UNDER DIFFERENT CROPPING-TILLAGE SYSTEMS IN THE SOUTHERN PIEDMONT

	Watershed											
	P1				P3				P4			
	Cropping-Tillage System				Cropping-Tillage System				Cropping-Tillage System			
	1	2	3	4	5	6	7	8	9	10	11	12
Max.	98.03	90.26	86.71	54.43	94.95	87.32	88.08	86.01	91.91	85.78	86.46	89.44
Min.	55.96	55.25	51.39	40.92	63.41	46.63	67.59	44.03	52.25	45.32	64.03	44.03
Avg.	85.57	76.11	68.69	47.68	80.93	69.07	80.19	63.05	80.80	66.93	80.03	72.75
No.	36	19	10	2	38	12	7	10	23	12	5	14

TABLE 5. MAXIMUM, MINIMUM, AVERAGE, AND NUMBER OF USLE C - P FACTORS OBTAINED FROM THREE RESEARCH WATERSHEDS UNDER DIFFERENT CROPPING-TILLAGE SYSTEMS IN THE SOUTHERN PIEDMONT

	Watershed											
	P1				P3				P4			
	Cropping-Tillage System				Cropping-Tillage System				Cropping-Tillage System			
	1	2	3	4	5	6	7	8	9	10	11	12
Max.	1.5888	0.0195	0.0090	0.0021	0.8312	0.0398	0.0113	0.0722	0.2401	0.0567	0.0115	0.1159
Min.	0.0162	0.0003	0.0001	0.0015	0.0109	0.0036	0.0000	0.0000	0.0000	0.0049	0.0041	0.0000
Avg.	0.2555	0.0048	0.0030	0.0018	0.1498	0.0129	0.0050	0.0316	0.0659	0.0270	0.0081	0.0497
No.	36	19	10	2	38	12	7	10	23	12	5	14

Source: Mills, W.C. et al. 1985. Erosion probabilities in Southern Piedmont: cropping-tillage effects. ASAE Paper No. 842546. 24 p.

Rudra et al. applied CREAMS to a loam soil research plot in southern Ontario.

TABLE 10. BEST-FIT PHOSPHORUS PARAMETERS FOR EACH PLOT

Plot	Plot management	Soluble-P parameters		Particulate-P parameters	
		SOLP kg/ha	EXKP	A	B
1	NS, NM, NP	1.5	0.015	1.1	-0.003
2	NS, M, NP	8.0	0.008	1.0	-0.002
3	S, M, NP	0.6	0.080	30.0	-0.5
4	NS, M, P	1.5	0.008	2.9	-0.20
5	S, M, P	0.5	0.030	0.7	0.0

NS — No Stover (Stover removed)
S — Stover (Stover left)
NM — No Manure applied
M — Manure applied
NP — No fall ploughing
P — Ploughed in fall

TABLE 12. COMPARISON OF OBSERVED AND COMPUTED SOLUBLE PHOSPHORUS IN RUNOFF FOR MAJOR EVENTS FOR THE CALIBRATION AND VERIFICATION PHASES

Event date	Soluble phosphorus, kg/ha							
	Plot 3		Plot 5		Plot 6		Plot 7	
	Computed	Observed	Computed	Observed	Computed	Observed	Computed	Observed
June 13 1971	0.125	0.164	0.057	0.019	0.076	0.003	0.153	0.003
July 26 1971	0.086	0.038	0.037	0.006	0.073	0.012	0.066	0.022
Aug 26 1971	0.071	0.022	0.030	0.030	0.015	0.015	0.070	0.022
May 16 1974	0.162	0.175	0.213	0.258	0.062	0.106	0.189	0.185
June 19 1975	0.033	0.064	0.060	0.016	0.086	0.036	0.021	0.023
Aug 23 1975	0.112	0.142	0.081	0.053	0.072	0.049	0.063	0.086

*The best fit SOLP and EXKP are given in Table 10.

Source: Rudra, R.P., W.T. Dickinson, and G.J. Wall. 1985. Application of the CREAMS model in southern Ontario conditions. Trans. ASAE 28(4):1233-1240.

In 1980, Beasley et al. reported using ANSWERS to simulate several management alternatives for a primarily agricultural watershed in northeastern Indiana under several different precipitation events. A summary of two Black Creek watersheds is below:

TABLE 3. SUMMARY OF OBSERVED AND PREDICTED WATERSHED RESPONSES FOR SEVERAL STORMS IN 1975

Watershed name	Manage-ment practice	Date	Rainfall, mm	Runoff		Sediment yield	
				Observed, mm	Predicted mm	Observed, kg	Predicted, kg
Smith-Fry (942 ha)	2	4/21/75	31.5	3.5	1.4	20000	39100
	2	6/3/75	22.5	9.5	6.5	75000	96600
	3	6/3/75	22.5	—	6.5	—	53100
Upper Black Creek (714 ha)	2	4/21/75	33.8	4.0	3.2	30000	36300
	2	6/3/75	25.1	8.2	7.2	55000	73200
	2	6/23/75	64.0	16.5	17.4	325000	282300
	3	6/3/75	25.1	—	7.2	—	46900
	3	6/23/75	64.0	—	7.6	—	102000

Source: Beasley, D.B., L.F. Huggins, and E.J. Monke. 1980. ANSWERS: A model for watershed planning. Trans. ASAE 23(4):938-944.

ANSWERS was tested by Park et al. with data from two small agricultural watersheds (5.6 and 7.5 ha) in the Four Mile Creek watershed in Iowa. Soils were Tama silt loam and Colo-Judson silt loam. Eleven storms from 1977-78 were used in the simulation. Watersheds were planted with soybeans and corn in rotation. They were tilled in the spring and one of the watersheds was covered with cornstalk residue.

TABLE 2. SUMMARY OF EROSION MODEL PARAMETERS AND SIMULATED MAXIMUM SEDIMENT CONCENTRATION

Watershed	Storm event	Soil parameters*				Crop parameters*			Max. concentration, ppm		Predicted sediment yield, kg
		e1	K_r	e2	K_f	C_p	C_m	C_f	observed	simulated	
ISU1	77/4/19	2.0	0.33	1.0	0.25	1.00	0.40	0.40	97440	84547	36924
	77/8/15	2.0	0.33	1.0	0.25	0.60	0.25	0.15	36070	54945	10719
	77/8/28	2.0	0.30	1.0	0.13	0.45	0.25	0.15	2647	8355	47
	78/4/17	2.0	0.23	1.2	0.25	0.80	0.45	0.30	14500	23767	1065
	78/5/27	1.8	0.13	1.0	0.08	0.60	0.32	0.25	45540	43521	2125
	mean	2.0	0.28	1.0	0.20	0.68	0.33	0.25	37938	42550	8596
ISU2	77/8/15	2.0	0.33	1.5	0.25	0.14	0.17	0.03	44590	43011	2592
	78/4/17	2.0	0.25	1.0	0.03	1.00	0.25	0.10	3190	11550	1446
	78/4/18	1.5	0.12	1.0	0.03	0.66	0.25	0.04	4560	14853	287
	78/5/27	1.5	0.12	1.2	0.11	0.65	0.25	0.10	26020	20033	12934
	mean	1.8	0.21	1.2	0.11	0.61	0.26	0.08	19590	22362	4315

*Soil and crop parameters defined in equations [6] and [11].

Source: Park, S.W., J.K. Mitchell, and J.N. Scarborough. 1982. Soil erosion on small watersheds: a modified ANSWERS model. Trans. ASAE 25(4):1581-1588.

Total N and P Loading Rates

Land Use	Total N Load (lb/ac/yr)	Total P Load (lb/ac/yr)	Reference
Lo Till	5.0	0.42	Chesapeake Bay Basin Model-A Final Report (Jan. 1983)
Hi Till	12.0	2.05	
Lo Till	10.6	0.87	Hartigan et al. 1983. Calibration of NPS model loading factors. J. Environ. Eng. 109(6):1259-1272.
Hi TIll	17.9	5.64	
Lo Till	9.64	1.50	Southerland, E. 1981. A continuous simulation modeling approach to nonpoint pollution management. (Dissertation).
Hi Till	18.56	4.20	

Table 1. Suspended Solids and Total Phosphorous Loadings to Surface Waters From Different Land Uses

Land Use	Suspended Solids (tons/ac/yr)	Total Phosphorus (lbs/ac/yr)	References
Undisturbed Forest	.001	.07	Nicolson*
Native Prairie	...	.11	Timmons and Holt**
Agriculture			
Tilled Land	.03 - .8	.14 - 1.87	Kewaskum Watershed, Washington County +
Barnyard	.11 - 3.13	1.14 - 22.0	
Urban			
Developing Subdivision Site	1.5 - 20.	2.6 - 32.	Germantown Watersheds, Washington County +
Low Density Urban Residential Area	.002	.05	Menomonee Watershed, near Elm Grove, Wis. ++
Medium Density Urban Residential Area	.01	.06	Menomonee Watershed near New Berlin, Wis. ++
Medium Density Urban Residential Area	.25	.69	Menomonee Watershed near Wauwatosa, Wis. ++

* Nicolson, J.A. 1977. *Summary Technical Report PLUARG Task C Activity, 2 Forested Watershed Studies.* Environment Canada, Great Lakes Research Centre, Sault Ste. Marie, Ontario, p. 16.

** Timmons, D.R. and R.F. Holt. 1977. *Nutrient losses in surface runoff from a native prairie,* Journal of Environmental Quality, Volume 6, Number 4, pp. 369-373.

\+ Washington County Project. 1979. Final Report, Technical Study Unit. Water Resources Center, University of Wisconsin-Madison.

++ International Joint Commission. 1978. Menomonee River Pilot Watershed Study. Summary Report.

Table 6-1. Urban Flow-weighted mean concentration (mg/l)

POLLUTANT	NEW SUBURBAN NURP SITES (Wash.,DC)	OLDER URBAN AREAS (Baltimore)	CENTRAL BUSINESS DISTRICT (Wash.,DC)	NATIONAL NURP STUDY AVERAGE	HARDWOOD FOREST (Northern Virginia)	NATIONAL URBAN HIGHWAY RUNOFF
PHOSPHORUS						
Total	0.26	1.08	-	0.46	0.15	-
Ortho	0.12	0.26	1.01	-	0.02	-
Soluble	0.16	-	-	0.16	0.04	0.59
Organic	0.10	0.82	-	0.13	0.11	-
NITROGEN						
Total	2.00	13.6	2.17	3.31	0.78	-
Nitrate	0.48	8.9	0.84	0.96	0.17	-
Ammonia	0.26	1.1	-	-	0.07	-
Organic	1.25	-	-	-	0.54	-
TKN	1.51	7.2	1.49	2.35	0.61	2.72
COD	35.6	163.0	-	90.8	>40.0	124.0
BOD (5-day)	5.1	-	36.0	11.9	-	-
METALS						
Zinc	0.037	0.397	0.250	0.176	-	0.380
Lead	0.018	0.389	0.370	0.180	-	0.550
Copper	-	0.105	-	0.047	-	-

Source: Schueler, T. 1987. Controlling urban runoff: a practical manual for planning and designing urban BMPs. Department of Environmental Programs.

TABLE 3. MEAN ANNUAL FLOW AND NUTRIENT LEVELS IN THE CHOWAN RIVER AND MAJOR TRIBUTARIES

Year	River System	Annual Flow m^3/sec	Annual Flow (cfs)	Total Nitrogen Average Conc. (mg/l)	Total Nitrogen Annual Load kgx10^5	Total Nitrogen Annual Load (lbx10^5)	Total Phosphorus Average Conc. (mg/l)	Total Phosphorus Annual Load kgx10^5	Total Phosphorus Annual Load (lbx10^5)
1977	Blackwater @ Mouth	19.6	(690)	0.67	13.10	(28.88)	0.14	2.65	(5.85)
	Nottoway @ Mouth	42.5	(1500)						
	Meherrin @ Parker's Ferry	30.6	(1080)	0.58	5.56	(12.25)	0.08	0.78	(1.73)
	Chowan @ Colerain	108	(3816)	0.81	27.59	(60.82)	0.11	3.64	(8.02)
1978	Blackwater @ Mouth	28.9	(1021)	0.74	24.49	(53.98)	0.14	4.50	(9.93)
	Nottoway @ Mouth	76.5	(2700)						
	Meherrin @ Parker's Ferry	59.0	(2082)	0.64	11.83	(26.09)	0.08	1.48	(3.26)
	Chowan @ Colerain	183	(6475)	0.98	56.97	(125.59)	0.11	6.16	(13.58)
1979	Blackwater @ Mouth	46.2	(1629)	1.37	19.99	(44.06)	0.12	1.81	(4.00)
	Nottoway @ Mouth	96.9	(3420)	0.83	25.44	(56.08)	0.09	2.86	(6.30)
	Meherrin @ Parker's Ferry	68.0	(2399)	0.85	18.23	(40.19)	0.08	1.64	(3.62)
	Chowan @ Colerain	242	(8534)	0.99	75.12	(165.62)	0.10	7.51	(16.55)
1980	Blackwater @ Mouth	14.6	(516)	1.61	7.44	(16.40)	0.18	0.84	(1.86)
	Nottoway @ Mouth	42.7	(1506)	0.96	12.90	(28.45)	0.09	1.24	(2.73)
	Meherrin @ Parker's Ferry	34.0	(1199)	0.90	9.68	(21.34)	0.08	0.87	(1.91)
	Chowan @ Colerain	102	(3590)	1.10	35.29	(77.80)	0.11	3.41	(7.52)
1981	Blackwater @ Mouth	5.9	(208)	1.19	2.19	(4.82)	0.23	0.43	(0.95)
	Nottoway @ Mouth	12.0	(425)	0.59	2.21	(4.87)	0.11	0.41	(0.90)
	Meherrin @ Parker's Ferry	11.5	(407)	0.52	1.88	(4.14)	0.08	0.29	(0.65)
	Chowan @ Colerain	33.5	(1181)	0.65	6.78	(14.94)	0.08	0.79	(1.73)

Note: Annual loads were calculated using monthly mean flows and concentrations.

Source: Chowan River Water Quality Management Plan. North Carolina Department of Natural Resources and Community Development, Division of Environmental Management. December 1982.

Table 2. Comparison of selected constituents for stations in the Natural-Quality Network with stations in the Primary Network, October 1974—Semptember 1975

Constituent	Mountain province		Piedmont—Coastal Plain province	
	Cataloochee Creek at Cataloochee, N.C. (natural-quality)	French Broad River at Marshall, N.C. (primary)	Turner Swamp near Eureka, N.C. (natural-quality)	Neuse River near Clayton, N.C. (primary)
Total nitrogen (mg/L).	0.18−1.7	0.66−4.8	0.58−1.7	0.33−3.1
Dissolved phosphorous (mg/L).	.01−.02	.02−.09	.02−.05	.04−.90
Total phytoplankton (cells/mL).	[1]260−320	1700−1900	64−490	1700−28,000
Fecal coliform (col./100 mL).	[1]<10−2,000	20−10,000	[1]10−3700	40−3000
Biochemical oxygen demand (mg/L).	<1−2.0	.9−3.9	.3−3.1	1.6−6.1
Periphyton—biomass ash wt. (g/m²).	1.5−3.9	3.1−18	4.6−18	4.6−5.4
Periphyton—biomass dry wt. (g/m²).	2.3−6.2	4.6−21	6.2−18	6.9−8.5
Dissolved organic carbon (mg/L).	3.6−4.9	3.6−15	6.0−	7.4−12
Chromium (μg/L)				
Total	1−<10	<10−90	<10−10	0−10
Suspended	1−<10	<10−90	<10−10	0−10
Dissolved	0−1	0	0	0
Bottom	<10	<10	<10	10−20
Lead (μg/L)				
Total	0−58	4−250	4−21	2−130
Suspended	0−58	2−250	1−21	2−130
Dissolved	0−2	0−20	1−3	0−8
Bottom	<10−10	<10	<10−10	[2]<10−250
Zinc (μg/L)				
Total	5−40	30−440	4−10	7−40
Suspended	5−40	30−430	0−7	0−40
Dissolved	0	0−50	0−10	0−20
Bottom	20	40−60	10−60	40

[1]Single nontypical value not included.
[2]One value in this concentration range.

Source: Water Quality of North Carolina Streams. Geological Survey Water-Supply Paper 2185 A-D. 1982.

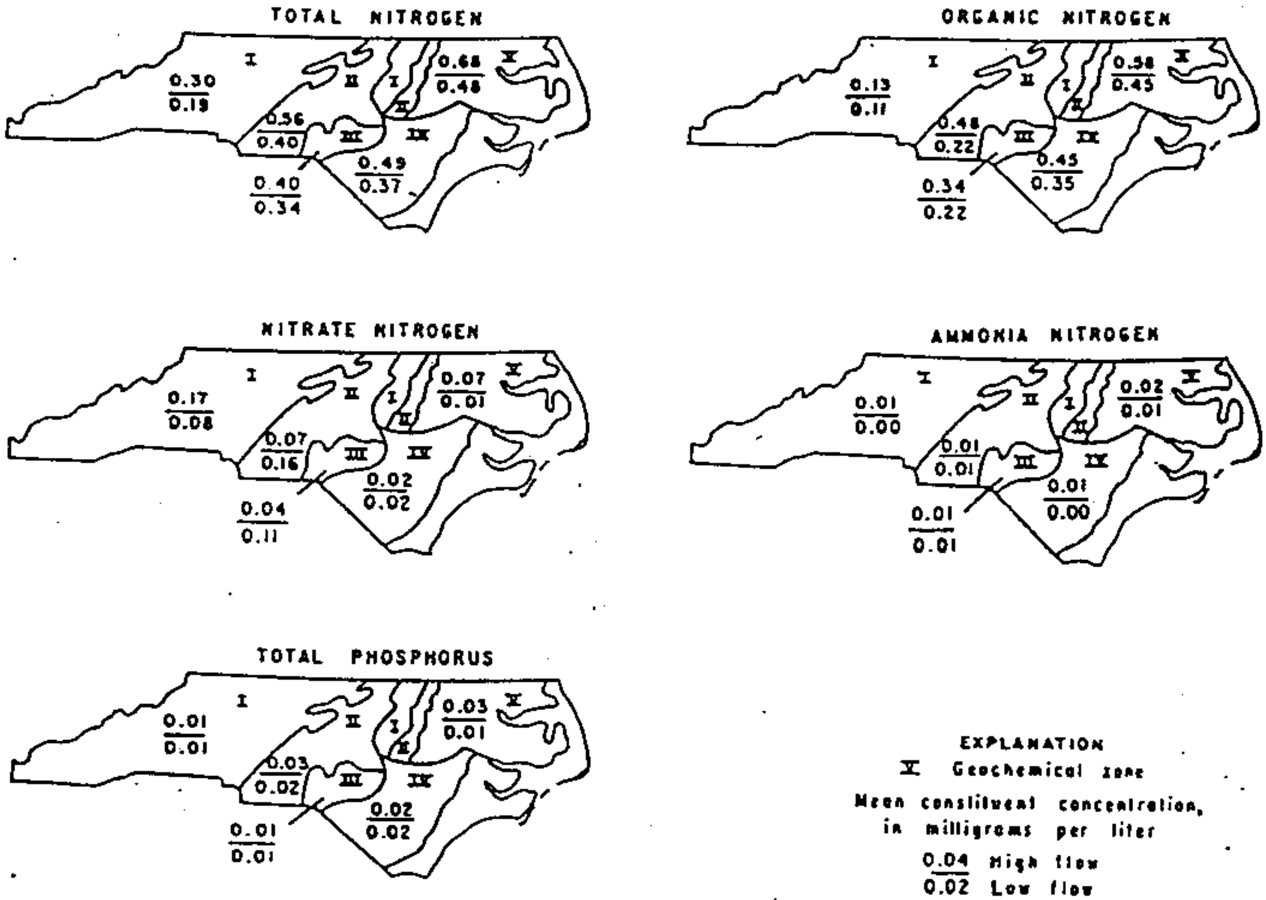

Figure 8. Mean concentrations of nutrients in unpolluted streams of North Carolina.

Source: Water Quality of North Carolina Streams. Geological Survey Water-Supply Paper 2185 A-D. 1982.

Table 6. Mean values and ranges in concentrations of various forms of nitrogen and phosphorus in the French Broad River at Marshall, N.C., 1974–77 water years. (All values in milligrams per liter, except as noted.)

Constituent	Number of samples	Mean	Range	
			Minimum	Maximum
Total Nitrite plus nitrate (N)	32	0.60	0.28	2.4
Dissolved nitrite plus nitrate (N)	32	.46	.30	.84
Total ammonia nitrogen (N)	29	.12	.00	.42
Dissolved ammonia nitrogen (NH_4 as N)	29	.08	.00	.29
Dissolved ammonia (NH_4)	29	.10	.00	.37
Total organic nitrogen (N)	29	.71	.00	4.0
Dissolved organic nitrogen (N)	29	.26	.00	1.2
Total Kjeldahl nitrogen (N)	32	.83	.00	4.2
Suspended Kjeldahl nitrogen (N)	30	.54	.00	3.8
Dissolved Kjeldahl nitrogen (N)	32	.34	.10	1.2
Total nitrogen (N)	32	1.4	.66	4.8
Total nitrogen (NO_3)	32	6.3	2.9	21
Total nitrite plus nitrate in bottom deposits (mg/kg)	5	2.9	1.3	6.0
Total Kjeldahl nitrogen in bottom deposits (mg/kg)	5	200	8.0	560
Total phosphorus (P)	32	.22	.03	1.2
Dissolved phosphorus (P)	32	.07	.01	.48
Total orthophosphorus (P)	31	.10	.01	.48
Dissolved orthophosphorus (P)	31	.05	.00	.26
Dissolved orthophosphate (PO_4)	31	.15	.00	.80
Total phosphorus in bottom material (mg/kg)	4	142	100	240

Source: Water Quality of North Carolina Streams. Geological Survey Water-Supply Paper 2185 A-D. 1982.

Table 10. Comparison of water quality of samples from the French Broad River at Marshall, N.C., with samples from baseline-quality sites in the same area

	French Broad River at Marshall			Baseline quality sites			Range in percent attributable to pollution based on mean values[1]
	Mean value			Mean value			
	Low flow (<1800 ft³/s)	High flow (>1800 ft³/s)	Range of all samples	Low flow	High flow	Range of all samples	
Major dissolved constituents (milligrams per liter)							
Calcium	7.0	4.6	3.2–10.0	1.3	1.3	0.5–3.0	72–[2]81
Magnesium	1.2	1.1	.2–2.0	.6	.4	.3–0.9	[2]50–64
Sodium	14.0	5.8	2.4–22.0	1.5	.8	.4–2.2	86–[2]89
Potassium	1.7	1.6	1.0–2.9	1.0	.6	.3–1.9	[2]41–62
Bicarbonate	26.0	15.0	9.0–35.0	7.4	5.1	2.0–9.5	66–[2]72
Sulfate	24.0	11.0	5.1–42.0	2.2	2.2	.8–5.7	80–[2]91
Chloride	4.3	3.0	.9–5.8	0.9	.7	.0–2.0	77–[2]79
Fluoride	.1	.2	.0–1.2	0.1	0.1	.0–0.5	[2]0–50
Silica	10.0	8.2	3.7–11.0	8.1	6.6	3.5–9.4	[2]19–20
Dissolved solids	76.0	44.0	30.0–112.0	19.0	15.0	12.0–22.0	66–[2]75
Nutrients (milligrams per liter)							
Total nitrogen	1.2	1.5	0.66–4.8	0.19	0.30	0.0–0.92	80–[2]84
Organic nitrogen	.50	.79	.0–4.0	.11	.13	.0–0.29	[2]78–84
Nitrate nitrogen	5.2	6.8	2.9–21.0	.08	.17	.0–4.0	98–98
Ammonia nitrogen	.13	.11	.0–0.42	.0	.01	.0–0.01	91–[2]100
Total phosphorus	.16	.24	.03–1.2	.01	.01	.0–0.02	[2]94–96
Trace Metals (micrograms per liter)							
Total arsenic	0.33	5.2	0.0–10.0	0.1	0.0	0.0–1.0	[2]70–100
Total chromium	12.0	24.0	.0–90.0	10.0	10.0	1.0–[3,4]20.0	[2]17–58
Total copper	11.0	32.0	.0–230.0	4.0	4.0	.0–13.0	[2]64–88
Total iron	958.0	20,602	410–70,000	460.0	1800.0	20–[4]8600	[2]52–91
Total lead	41.0	58.0	.0–250.0	5.0	9.0	.0–[3,4]25	84–[2]88
Total mercury	.17	.12	.0–0.5	.10	.10	.0–0.50	17–[2]41
Total selenium	5.0	17.0	.0–29.0	.0	.0	.0–[3,4]10.0	100–100
Total zinc	58.0	424.0	10.0–6900.0	10.0	10.0	.0–[4]40.0	[2]83–98

[1] Some constituents have a higher percent attributable to pollution at high flow whereas others have a higher percent attributable to pollution at low flow.
[2] Low flow.
[3] Exceeded limits recommended in *Safe Drinking Water Act*, Federal Register, Dec. 24, 1975, in some samples.
[4] Exceeded limits recommended in *Quality Criteria for Water*, U.S. Environmental Protection Agency, 1976 in some samples.
[5] No recommended limits.

Source: Water Quality of North Carolina Streams. Geological Survey Water-Supply Paper 2185 A-D. 1982.

Table 8. Comparison of water quality of samples from the Neuse River near Clayton with samples from baseline water-quality sites in the basin upstream from Clayton

	Neuse River near Clayton			Baseline-quality sites			Percent attributable to pollution	
	Mean Value			Mean Value				
	Base flow (<370 ft³/s)	High flow (>370 ft³/s)	Range of all samples	Base flow	High flow	Range of all samples	Base flow	High flow
Major dissolved constituents (mg/L)								
Calcium	9.6	5.3	3.3–12	4.4	2.2	0.5–10	54	58
Magnesium	2.7	1.7	.9–3.3	1.9	.8	.3–4.1	30	53
Sodium	25	8.4	2.6–37	4.6	1.5	.4–7.3	82	82
Potassium	4.3	2.4	1.5–6.4	1	1	.3–1.9	77	58
Bicarbonate	42	22	8.3–70	4.6	5	2–44	89	77
Sulfate	13	9.1	6.3–24	2.5	5.5	.8–8.2	81	40
Chloride	26	8.3	2.7–41	4.1	1.5	0–10	84	82
Fluoride	.5	.2	.1–.8	.1	.1	0–.5	80	50
Silica	16	11	4.9–19	17	6	3.1–29	-	45
Dissolved solids	120	58	34–170	49	21	12–78	60	63
Nutrients (mg/L)								
Total nitrogen	3.7	1.9	.3–6.1	.34	.14	0–1.5	91	93
Organic nitrogen	.87	.83	0–.34	.19	.38	0–.69	86	54
Nitrate nitrogen	2.5	.62	.3–4.4	.14	.1	0–1	94	84
Ammonia nitrogen	.6	.37	0–1.8	.01	.01	0–.07	98	97
Total phosphorus	1.4	.51	.07–2.7	.02	.02	0–.05	99	96
Trace elements (µg/L)								
Total arsenic	9.3	4.2	0–30	3.6	.71	0–.3	96	83
Total chromium	8.3	9.5	0–20	10	10	10–20	50	-
Total copper	16	17	2–70	4	4	0–12	76	76
Total iron	750	4800	520–20,000	570	4100	20–13,000	24	14
Total lead	82	29	2–500	6.4	7.6	0–25	92	74
Total mercury	.25	.25	0–.5	.15	.5	0–.5	40	-
Total selenium	2	6.1	0–12	0	0	0–0	100	100
Total zinc	210	40	0–1400	10	10	0–20	95	75

Source: Water Quality of North Carolina Streams. Geological Survey Water-Supply Paper 2185 A-D. 1982.

Table 9. Comparison of water quality of samples from the Neuse River at Kinston with samples from baseline water-quality sites in the basin upstream from Kinston

	Neuse River at Kinston			Baseline-quality sites			Percent attributable to pollution	
	Mean Value			Mean Value				
	Base flow (<370 ft³/s)	High flow (>370 ft³/s)	Range of all samples	Base flow	High flow	Range of all samples	Base flow	High flow
Major dissolved constituents (mg/L)								
Calcium	6.9	4.8	3.2–8.8	2.9	1.9	0.2–4.0	58	60
Magnesium	2	1.5	1.1–2.5	1.3	.6	.1–4.1	35	60
Sodium	12	6.3	3.5–17	3.8	1.8	.4–7.3	67	71
Potassium	3.1	2.3	1.7–4	.8	.8	.1–1.9	70	65
Bicarbonate	29	15	7–40	3.4	3.3	0–44	88	78
Sulfate	11	9.5	7.2–15	4.3	6.3	.6–13	61	34
Chloride	11	7.2	3.6–17	3.9	2.3	0–10	66	68
Fluoride	.2	.2	0–.5	.1	.1	0–.5	50	50
Silica	9.4	9.2	3.1–14	13	5.4	1.4–29	-	41
Dissolved solids	70	49	34–91	39	22	11–78	44	55
Nutrients (mg/L)								
Total nitrogen	1.4	1.2	.6–2.1	.4	.5	0–1.5	71	58
Organic nitrogen	.7	.7	.06–1.1	.3	.4	0–.99	57	43
Nitrate nitrogen	-	-	-	.09	.08	0–1	-	-
Ammonia nitrogen	.03	.09	.02–.27	.01	.01	0–.07	67	89
Total phosphorus	.3	.2	.07–.38	.02	.02	0–.05	93	90

Source: Water Quality of North Carolina Streams. Geological Survey Water-Supply Paper 2185 A-D. 1982.

Table 5. A summary of nutrient statistics for samples of the Neuse River near Clayton and at Kinston, 1974–77 water years. All values are in milligrams per liter

	CLAYTON			KINSTON		
	Mean / 95 percent confidence limits	Range	Number of samples	Mean / 95 percent confidence limits	Range	Number of samples
Total organic carbon	14 / 10.2–18	5–58	34	12 / 9.1–15	4.1–27	20
Dissolved organic carbon	9.2 / 8–10.4	2.8–20	39	12 / 8.8–15.2	1–19	12
Total ammonia nitrogen (as N)	.51 / .3–.7	0–1.9	43	.07 / .03–.11	.02–.27	13
Dissolved ammonia nitrogen (as N)	.4 / .3–.5	0–1.7	39	.05 / .04–.06	0–.16	11
Dissolved ammonia nitrogen (as NH_4)	.52 / .3–.7	0.–2.2	39	.06 / .01–.11	0–.21	11
Total organic nitrogen (as N)	.84 / .7–1	0–3.4	43	.66 / .50–.82	.06–1.1	13
Dissolved organic nitrogen (as N)	.52 / .4–.6	.16–1.3	39	.52 / .61–.43	.35–.76	11
Total nitrite + nitrate (as N)	.92 / 1.2–.7	.08–4.5	44	.48 / .56–.40	0–1.1	47
Total Kjeldahl nitrogen (as N)	1.4 / 1.1–1.7	.06–4.9	44	.79 / .70–.88	.1–1.4	47
Total nitrogen (as N)	2.4 / 2.–2.8	.33–6.1	44	1.3 / 1.2–1.4	64–2.1	47
Dissolved ortho-phosphate (as PO_4)	1.4 / .8–2	0–8	42	.28 / .17–.39	.06–.55	12
Total phosphorus (as P)	.71 / .5–.9	.07–2.7	43	.23 / .21–.25	.07–.38	47

Source: Water Quality of North Carolina Streams. Geological Survey Water-Supply Paper 2185 A-D. 1982.

TABLE III-4

GENERALIZED VALUES OF THE COVER AND MANAGEMENT FACTOR, C, IN THE 37 STATES EAST OF THE ROCKY MOUNTAINS (Stewart et al, 1975)

Line no.	Crop, rotation, and management[3]	Productivity level[2] High	Mod.
		C value	
	Base value: continuous fallow, tilled up and down slope	1.00	1.00
CORN			
1	C, RdR, fall TP, conv (1)	0.54	0.62
2	C, RdR, spring TP, conv (1)	.50	.59
3	C, RdL, fall TP, conv (1)	.42	.52
4	C, RdR, wc seeding, spring TP, conv (1)	.40	.49
5	C, RdL, standing, spring TP, conv (1)	.38	.48
6	C, fall shred stalks, spring TP, conv (1)	.35	.44
7	C(silage)-W(RdL, fall TP) (2)	.31	.35
8	C, RdL, fall chisel, spring disk, 40-30% rc (1)	.24	.30
9	C(silage), W wc seeding, no-till pl in c-k W (1)	.20	.24
10	C(RdL)-W(RdL, spring TP) (2)	.20	.28
11	C, fall shred stalks, chisel pl, 40-30% rc (1)	.19	.26
12	C-C-C-W-M, RdL, TP for C, disk for W (5)	.17	.23
13	C, RdL, strip till row zones, 55-40% rc (1)	.16	.24
14	C-C-C-W-M-M, RdL, TP for C, disk for W (6)	.14	.20
15	C-C-W-M, RdL, TP for C, disk for W (4)	.12	.17
16	C, fall shred, no-till pl, 70-50% rc (1)	.11	.18
17	C-C-W-M-M, RdL, TP for C, disk for W (5)	.087	.14
18	C-C-C-W-M, RdL, no-till pl 2d & 3rd C (5)	.076	.13
19	C-C-W-M, RdL, no-till pl 2d C (4)	.068	.11
20	C, no-till pl in c-k wheat, 90-70% rc (1)	.062	.14
21	C-C-C-W-M-M, no-till pl 2d & 3rd C (6)	.061	.11
22	C-W-M, RdL, TP for C, disk for W (3)	.055	.095
23	C-C-W-M-M, RdL, no-till pl 2d C (5)	.051	.094
24	C-W-M-M, RdL, TP for C, disk for W (4)	.039	.074
25	C-W-M-M-M, RdL, TP for C, disk for W (5)	.032	.061
26	C, no-till pl in c-k sod, 95-80% rc (1)	.017	.053
COTTON[4]			
27	Cot, conv (Western Plains) (1)	0.42	0.49
28	Cot, conv (South) (1)	.34	.40
MEADOW			
29	Grass & Legume mix	0.004	0.01
30	Alfalfa, lespedeza or Sericea	.020	
31	Sweet clover	.025	
SORGHUM, GRAIN (Western Plains)[4]			
32	RdL, spring TP, conv (1)	0.43	0.53
33	No-till pl in shredded 70-50% rc	.11	.18

Source: Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water--Part 1 (Revised-1985). US EPA. EPA/600/6-85/002a. September 1985

TABLE III-4 (Continued)

Line no.	Crop, rotation, and management[3]	Productivity level[2] High	Mod.
		C value	
SOYBEANS[4]			
34	B, RdL, spring TP, conv (1)	0.48	0.54
35	C-B, TP annually, conv (2)	.43	.51
36	B, no-till pl	.22	.28
37	C-B, no-till pl, fall shred C stalks (2)	.18	.22
WHEAT			
38	W-F, fall TP after W (2)	0.38	
39	W-F, stubble mulch, 500 lbs rc (2)	.32	
40	W-F, stubble mulch, 1000 lbs rc (2)	.21	
41	Spring W, RdL, Sept TP, conv (N & S Dak) (1)	.23	
42	Winter W, RdL, Aug TP, conv (Kans) (1)	.19	
43	Spring W, stubble mulch, 750 lbs rc (1)	.15	
44	Spring W, stubble mulch, 1250 lbs rc (1)	.12	
45	Winter W, stubble mulch, 750 lbs rc (1)	.11	
46	Winter W, stubble mulch, 1250 lbs rc (1)	.10	
47	W-M, conv (2)	.054	
48	W-M-M, conv (3)	.026	
49	W-M-M-M, conv (4)	.021	

[1] This table is for illustrative purposes only and is not a complete list of cropping systems or potential practices. Values of C differ with rainfall pattern and planting dates. These generalized values show approximately the relative erosion-reducing effectiveness of various crop systems, but locationally derived C values should be used for conservation planning at the field level. Tables of local values are available from the Soil Conservation Service.

[2] High level is exemplified by long-term yield averages greater than 75 bu. corn or 3 tons grass-and-legume hay; or cotton management that regularly provides good stands and growth.

[3] Numbers in parentheses indicate number of years in the rotation cycle. No. (1) designates a continuous one-crop system.

[4] Grain sorghum, soybeans, or cotton may be substituted for corn in lines 12, 14, 15, 17-19, 21-25 to estimate C values for sod-based rotations.

Abbreviations defined:

B - soybeans
C - corn
c-k - chemically killed
conv - conventional
cot - cotton
F - fallow
M - grass & legume hay
pl - plant
W - wheat
wc - winter cover
lbs rc - pounds of crop residue per acre remaining on surface after new crop seeding
% rc - percentage of soil surface covered by residue mulch after new crop seeding
70-50% rc - 70% cover for C values in first column; 50% for second column
RdR - residues (corn stover, straw, etc.) removed or burned
RdL - all residues left on field (on surface or incorporated)
TP - turn plowed (upper 5 or more inches of soil inverted, covering residues)

Source: Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water--Part 1 (Revised-1985). US EPA. EPA/600/6-85/002a. September 1985

TABLE III-6

C FACTOR VALUES FOR PERMANENT PASTURE, RANGE AND IDLE LAND

(Wischmeier and Smith, 1978)[1]

Vegetative canopy		Cover that contacts the soil surface						
Type and height[2]	Percent cover[3]	Type[4]	Percent ground cover 0	20	40	60	80	95+
No appreciable canopy		G	0.45	0.20	0.10	0.042	0.013	0.003
		W	.45	.24	.15	.091	.043	.011
Tall weeds or short brush with average drop fall height of 20 in	25	G	.36	.17	.09	.038	.013	.003
		W	.36	.20	.13	.083	.041	.011
	50	G	.26	.13	.07	.035	.012	.003
		W	.26	.16	.11	.076	.039	.011
	75	G	.17	.10	.06	.032	.011	.003
		W	.17	.12	.09	.068	.038	.011
Appreciable brush or bushes, with average drop fall height of 6½ ft	25	G	.40	.18	.09	.040	.013	.003
		W	.40	.22	.14	.087	.042	.011
	50	G	.34	.16	.08	.038	.012	.003
		W	.34	.19	.13	.082	.041	.011
	75	G	.28	.14	.08	.036	.012	.003
		W	.28	.17	.12	.078	.040	.011
Trees, but no appreciable low brush. Average drop fall height of 13 ft	25	G	.42	.19	.10	.041	.013	.003
		W	.42	.23	.14	.089	.042	.011
	50	G	.39	.18	.09	.040	.013	.003
		W	.39	.21	.14	.087	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.084	.041	.011

[1] The listed C values assume that the vegetation and mulch are randomly distributed over the entire area.

[2] Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33 ft.

[3] Portion of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).

[4] G: cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 in deep.

W: cover at surface is mostly broadleaf herbaceous plants (as weeds with little lateral-root network near the surface) or undecayed residues or both.

Source: Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water--Part 1 (Revised-1985). US EPA. EPA/600/6-85/002a. September 1985

TABLE III-7

C FACTOR VALUES FOR UNDISTURBED FOREST LAND

(Wischmeier and Smith, 1978)

Percent of Area Covered by Canopy of Trees and Undergrowth	Percent of Area Covered by Duff (litter) at least 5 cm deep	Factor C
100-75	100-90	0.0001-0.001
70-45	85-75	0.002-0.004
40-20	70-40	0.003-0.009

Source: Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water--Part 1 (Revised-1985). US EPA. EPA/600/6-85/002a. September 1985

TABLE III-8

C FACTOR VALUES FOR MECHANICALLY PREPARED WOODLAND SITES

(Wischmeier and Smith, 1978)

Site preparation	Mulch cover[1]	Soil condition[2] and weed cover[3]							
		Excellent		Good		Fair		Poor	
		NC	WC	NC	WC	NC	WC	NC	WC
	Percent								
Disked, raked, or bedded[4]	None	0.52	0.20	0.72	0.27	0.85	0.32	0.94	0.36
	10	.33	.15	.46	.20	.54	.24	.60	.26
	20	.24	.12	.34	.17	.40	.20	.44	.22
	40	.17	.11	.23	.14	.27	.17	.30	.19
	60	.11	.08	.15	.11	.18	.14	.20	.15
	80	.05	.04	.07	.06	.09	.08	.10	.09
Burned[5]	None	.25	.10	.26	.10	.31	.12	.45	.17
	10	.23	.10	.24	.10	.26	.11	.36	.16
	20	.19	.10	.19	.10	.21	.11	.27	.14
	40	.14	.09	.14	.09	.15	.09	.17	.11
	60	.08	.06	.09	.07	.10	.08	.11	.08
	80	.04	.04	.05	.04	.05	.04	.06	.05
Drum chopped[5]	None	.16	.07	.17	.07	.20	.08	.29	.11
	10	.15	.07	.16	.07	.17	.08	.23	.10
	20	.12	.06	.12	.06	.14	.07	.18	.09
	40	.09	.06	.09	.06	.10	.06	.11	.07
	60	.06	.05	.06	.05	.07	.05	.07	.05
	80	.03	.03	.03	.03	.03	.03	.04	.04

[1] Percentage of surface covered by residue in contact with the soil.

[2] *Excellent* soil condition—Highly stable soil aggregates in topsoil with fine tree roots and litter mixed in.

Good—Moderately stable soil aggregates in topsoil or highly stable aggregates in subsoil (topsoil removed during raking), only traces of litter mixed in.

Fair—Highly unstable soil aggregates in topsoil or moderately stable aggregates in subsoil, no litter mixed in.

Poor—No topsoil, highly erodible soil aggregates in subsoil, no litter mixed in.

[3] NC—No live vegetation.

WC—75 percent cover of grass and weeds having an average drop fall height of 20 in. For intermediate percentages of cover, interpolate between columns.

[4] Modify the listed C values as follows to account for effects of surface roughness and aging:

First year after treatment: multiply listed C values by 0.40 for rough surface (depressions >6 in); by 0.65 for moderately rough; and by 0.90 for smooth (depressions <2 in).

For 1 to 4 years after treatment: multiply listed factors by 0.7.

For 4+ to 8 years: use table 6.

More than 8 years: use table 7.

[5] For first 3 years: use C values as listed.

For 3+ to 8 years after treatment: use table 6.

More than 8 years after treatment: use table 7.

Source: Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water--Part 1 (Revised-1985). US EPA. EPA/600/6-85/002a. September 1985

TABLE III-12

REPRESENTATIVE DISSOLVED NUTRIENT CONCENTRATIONS IN RURAL RUNOFF

Soil Cover	Nitrogen (mg/l)	Phosphorus (mg/l)
Fallow[a]	2.6	0.10
Corn[a]	2.9	0.26
Small Grains[a]	1.8	0.30
Hay[a]	2.8	0.15
Pasture[a]	3.0	0.27
Inactive Agriculture[b]		
Eastern U.S.	1.6	0.14
Midwest	1.5	0.14
West	1.5	0.14
Forest[c]		
Eastern U.S.	0.19	0.006
Midwest	0.06	0.009
West	0.07	0.012
Snowmelt Runoff from Manured Fields[d]		
Fallow	12.2	1.9
Corn	12.2	1.9
Small Grains	25.0	5.0
Hay	36.0	8.7

[a]Dornbush et al (1974)

[b]Average of pasture and forest

[c]Omernik (1977). See Figures III-4,5

[d]Gilbertson et al (1979). These concentrations are associated with winter manure spreading.

Source: Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water--Part 1 (Revised-1985). US EPA. EPA/600/6-85/002a. September 1985

Table 1. Major Soils of the 3058 ha Mill Creek Watershed

Soil	Area (ha)	Percent of Total
Loam	2,242	73.3
Loamy Sand	489	16.0
Muck	153	5.0
Sandy Loam	99	3.2
Alluvial Land	30	1.0
Fine Sandy Loam	6	0.2
Fine Sand	4	0.1
(Lakes)	35	1.1

Source: Seminar on Water Quality Management Trade-Offs: Point Source vs. Diffuse Source Pollution (Conference) September 16-17, 1980, Chicago, Illinois. US EPA. EPA-905/9-80-009. September 1980.

Table 1.—Phosphorus loadings to Chesapeake Bay by major basin (March–October)

Basin	Phosphorus (kg)			% Point source contribution			% Cropland load contribution			% Other source load source contrib.			† Total nonpoint contribution		
	Dry	Avg.	Wet	Dry	Avg.	Wet	Dry	Avg.	Wet	Dry	Avg.	Wet	Dry	Avg.	Wet
Part A: at the fall line															
Susquehanna	941,000	1,318,000	2,864,000	24	23	12	–	60	77	–	16	11	76	76	[illegible]
Patuxent	156,000	149,000	174,000	92	90	76	–	7	19	–	3	5	8	10	[illegible]
Potomac	326,000	388,000	1,077,000	27	15	7	–	52	72		33	21	73	85	[illegible]
Rappahannock	48,000	47,000	130,000	1	1	1	–	58	75	–	41	24	99	99	[illegible]
York	30,000	35,000	151,000	7	7	2	–	74	86	–	19	12	93	93	[illegible]
James	299,000	349,000	890,000	45	36	21	–	46	63	–	18	16	55	64	[illegible]
TOTAL	1,801,000	2,286,000	6,086,000	33	28	14		53	72		19	14	67	72	[illegible]
Part B: to tidal waters (below the fall line)															
W. Chesapeake	988,000	1,087,000	1,384,000	93	85	67	–	8	25	–	7	8	7	15	[illegible]
Patuxent	59,000	88,000	130,000	79	69	36	–	19	61	–	12	13	21	31	[illegible]
Potomac	882,000	915,000	1,263,000	82	79	57	–	10	31	–	11	12	18	21	[illegible]
Rappahannock	54,000	79,000	221,000	89	61	22	–	27	69	–	12	9	11	39	[illegible]
York	39,000	85,000	208,000	84	50	16	–	27	68	–	10	8	16	50	[illegible]
James	1,325,000	1,374,000	1,570,000	96	93	81	–	3	14	–	4	5	4	7	[illegible]
Eastern Shore	345,000	379,000	962,000	44	40	18	–	50	79	–	10	5	56	60	[illegible]
TOTAL	3,692,000	3,967,000	5,738,000	87	81	56		12	36		7	6	13	19	[illegible]
Part C: Part A + Part B															
Susquehanna	941,000	1,318,000	2,864,000	24	23	12	–	60	77	–	17	11	76	77	[illegible]
Patuxent	215,000	217,000	304,000	88	83	58	–	10	33	–	7	8	12	17	[illegible]
Potomac	1,208,000	1,303,000	2,304,000	67	59	34	–	23	50	–	18	16	33	41	[illegible]
Rappahannock	103,000	126,000	350,000	47	39	14	–	39	71	–	22	15	53	61	[illegible]
York	69,000	100,000	359,000	50	35	10	–	44	76	–	6	14	50	65	[illegible]
James	1,624,000	1,723,000	2,259,000	86	81	63	–	12	29	–	7	8	14	18	[illegible]
W. Chesapeake	988,000	1,087,000	1,384,000	93	85	67	–	8	25	–	7	8	7	15	[illegible]
Eastern Shore	345,000	379,000	962,000	44	40	18	–	50	79	–	10	5	56	60	[illegible]
TOTAL	5,493,000	6,253,000	10,786,000	69	61	36		27	53		12	11	31	39	[illegible]

Table 2.—Nitrogen loadings to Chesapeake Bay by major basin (March–October)

Basin	Nitrogen (kg)			% Point source contribution			% Cropland load contribution			% Other source load source contrib.			† Total nonpoint contribution		
	Dry	Avg.	Wet	Dry	Avg.	Wet	Dry	Avg.	Wet	Dry	Avg.	Wet	Dry	Avg.	Wet
Part A: at the fall line															
Susquehanna	21,500,000	26,500,000	48,000,000	10	10	5	–	85	91	–	5	4	90	90	95
Patuxent	580,000	536,000	809,000	71	65	41	–	29	53	–	6	6	29	35	59
Potomac	6,270,000	7,500,000	17,800,000	10	10	10	–	83	84	–	7	6	90	90	90
Rappahannock	695,000	727,000	1,680,000	10	10	10	–	72	78	–	18	12	90	90	90
York	380,000	370,000	1,264,000	10	10	10	–	78	82	–	12	8	90	90	90
James	1,780,000	2,300,000	5,030,000	10	9	8	–	73	78	–	18	14	90	91	92
TOTAL	31,185,000	37,933,000	74,559,000	11	11	7		83	88		6	5	89	89	93
Part B: to tidal waters (below the fall line)															
W. Chesapeake	6,179,000	7,265,000	10,038,000	85	72	52	–	20	40	–	8	8	15	28	48
Patuxent	439,000	596,000	1,278,000	48	35	16	–	55	75	–	10	9	52	65	84
Potomac	8,094,000	8,399,000	11,394,000	77	74	55	–	17	37	–	9	8	23	26	45
Rappahannock	279,000	611,000	2,047,000	37	17	5	–	73	89	–	10	6	63	83	95
York	315,000	688,000	2,255,000	34	15	5	–	76	90	–	9	5	66	85	95
James	6,272,000	7,013,000	8,913,000	88	79	62	–	15	32	–	8	6	12	21	3
Eastern Shore	3,269,000	3,973,000	9,500,000	13	10	4	–	83	92	–	7	4	87	90	96
TOTAL	24,847,000	28,565,000	45,425,000	72	62	39		30	64		8	7	28	38	61
Part C: Part A + Part B															
Susquehanna	21,500,000	26,455,000	47,727,000	10	10	5	–	85	91	–	5	4	90	90	95
Patuxent	1,015,000	1,133,000	2,088,000	61	49	26	–	43	66	–	8	8	39	51	74
Potomac	14,367,000	15,944,000	29,167,000	48	44	28	–	48	66	–	8	6	52	55	72
Rappahannock	975,000	1,339,000	3,734,000	17	13	7	–	72	84	–	15	9	83	87	93
York	830,000	1,058,000	3,492,000	22	13	7	–	77	87	–	10	6	78	87	93
James	8,032,000	9,320,000	13,945,000	71	62	43	–	29	49	–	9	8	29	38	57
W. Chesapeake	6,179,000	7,265,000	10,038,000	85	72	52	–	20	40	–	8	8	15	28	48
Eastern Shore	3,269,000	3,973,000	9,500,000	13	10	4	–	83	92	–	7	4	87	90	96
TOTAL	55,967,000	66,487,000	119,891,000	38	33	19		60	75		7	6	62	67	81

Source: Macknis, Joseph. "Chesapeake Bay Nonpoint Source Pollution." Perspectives on Nonpoint Source Pollution: Estuarine Quality pp165-171

TABLE 8

NONPOINT POLLUTION LOADING FACTORS APPLIED TO CHESAPEAKE BAY DRAINAGE AREA

LAND USE/PARAMETER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
HIGH TILLAGE CROPLAND												
1. GROUND COVER (%)	0	0	0	0	20	50	85	90	95	30	0	0
2. SEDIMENT POTENCY: TOTAL-N (%)	1.76	1.76	2.32	2.32	2.32	2.32	3.34	3.34	3.34	1.76	1.76	1.76
3. SEDIMENT POTENCY: ORGANIC-N (%)	1.52	1.52	2.02	2.02	2.02	2.02	2.89	2.89	2.89	1.52	1.52	1.52
4. SEDIMENT POTENCY: AMMONIA-N (%)	0.03	0.03	0.04	0.04	0.04	0.04	0.06	0.06	0.06	0.03	0.03	0.03
5. SEDIMENT POTENCY: NITRATE-N (%)	0.21	0.21	0.26	0.26	0.26	0.26	0.39	0.39	0.39	0.21	0.21	0.21
6. SEDIMENT POTENCY: TOTAL-P (%)	0.30	0.30	0.40	0.40	0.40	0.40	0.57	0.57	0.57	0.30	0.30	0.30
7. SEDIMENT POTENCY: ORGANIC-P (%)	0.21	0.21	0.28	0.28	0.28	0.28	0.40	0.40	0.40	0.21	0.21	0.21
8. SEDIMENT POTENCY: ORTHO-P (%)	0.09	0.09	0.12	0.12	0.12	0.12	0.17	0.17	0.17	0.09	0.09	0.09
LOW TILLAGE CROPLAND												
1. GROUND COVER (%)	40	60	75	85	92	99	99	99	99	97	97	94
2. SEDIMENT POTENCY: TOTAL-N (%)	2.06	2.06	2.06	2.52	3.21	3.21	3.44	3.44	3.44	2.06	2.06	2.06
3. SEDIMENT POTENCY: ORGANIC-N (%)	0.99	0.99	0.99	1.21	1.54	1.54	1.65	1.65	1.65	0.99	0.99	0.99
4. SEDIMENT POTENCY: AMMONIA-N (%)	0.08	0.08	0.08	0.10	0.13	0.13	0.14	0.14	0.14	0.08	0.08	0.08
5. SEDIMENT POTENCY: NITRATE-N (%)	0.99	0.99	0.99	1.21	1.54	1.54	1.65	1.65	1.65	0.99	0.99	0.99
6. SEDIMENT POTENCY: TOTAL-P (%)	0.17	0.17	0.17	0.21	0.26	0.26	0.29	0.29	0.29	0.17	0.17	0.17
7. SEDIMENT POTENCY: ORGANIC-P (%)	0.14	0.14	0.14	0.17	0.21	0.21	0.23	0.23	0.23	0.14	0.14	0.14
8. SEDIMENT POTENCY: ORTHO-P (%)	0.03	0.03	0.03	0.04	0.05	0.05	0.06	0.06	0.06	0.03	0.03	0.03

Source: Chesapeake Bay Basin Model--A Final Report. January 1983.