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CIR 1302

UF/IFAS Nutrient Management Series: Computational Tools for Field Implementation of the Florida Phosphorus Index - Sumter County Florida [1]

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PURPOSE

This Circular contains tables with numerical values for each of the various factors listed in the Florida P Index to be used for computation, with examples, during field implementation.

NOTE: This Circular was developed as a source of information and guidance for preparing nutrient management plans for agricultural farms in Florida, specifically to address Phosphorus management through manure/organic by-product applications. This material is therefore intended for any and all agricultural professionals with sufficient training and background in nutrient management to be certified as a Nutrient Management Specialist. This publication is NOT intended for those individuals seeking basic information regarding agricultural nutrients and their environmental impact.

Detailed information about the Florida Phosphorus Index (P-Index) including background, developmental process and considerations can be obtained from the NRCS Field Office Technical Guide (Florida Phosphorus Index Work Group. 2000) or by contacting any of the work group member listed below. The electronic Field Office Technical Guide (eFOTG) can be found at http://efotg.nrcs.usda.gov/treemenuFS.aspx?Fips=12001&MenuName=menuFL.zip (The Florida Phosphorus Index sheets are located in Section IV of the Table of Contents under C.Tools.) It is important that the reader has understood the concept and scope of the P index as described on the website before actual field evaluation and implementation. These fact sheets are available for each of the 67 counties in Florida as part of the Nutrient Management series, Circular 1263 and Circular 1273 through 1338, on the internet at: http://edis.ifas.ufl.edu/TOPIC_SERIES_Florida_Phosphorous_Index .

SCIENTIFIC SUPPORT

The following individuals are members of the Florida Phosphorus Index Work Group and were instrumental in the development of the P Index:

University of Florida, Institute of Food and Agricultural Science (UF/IFAS): D.A. Graetz, V.N. Nair, W.G. Harris, G. Kidder, K.L. Campbell, R.S. Mylavarapu, and R.D. Rhue.

Natural Resources Conservation Service (NRCS): S.P. Boetger, G.W. Hurt, W.G. Henderson, W.R. Reck, N. Watts, P.B. Deal and W.D. Tooke.

Florida Department of Agriculture and Consumer Service (FDACS): J.C. Love and D. Smith.

INTRODUCTION

The Phosphorus Index (P Index) is a site-specific, qualitative vulnerability assessment tool. This tool allows a conservation planner to determine the sites that are potentially most vulnerable to off-site movement of phosphorus. The P Index is used to determine whether application of manure/organic by-products should be based on either a nitrogen-based budget or a phosphorus-based budget. The P Index is NOT to be used in any area designated as phosphorus-limited by legislation (e.g. Everglades, Green Swamp, and Okeechobee Basin) to determine if a nitrogen-based nutrient budget can be used. These areas are to have phosphorus-based nutrient budgets regardless of the nutrient source or soil type. The P Index should, however, be used to implement conservation practices to reduce phosphorus movement in these areas.

The purpose of the P Index is to aid planners and others in the decision-making process involved in designing conservation plans related to land application of animal wastes. The P Index is not intended to be an evaluation tool to determine compliance of water quality standards by any regulatory agency. Any attempt to use the P Index as a regulatory tool would be grossly beyond the intent of the concept and philosophy of the P Index developers.

The P Index is a science-based decision-making tool that will support conservation planning and component planning of nutrient management. Concerns regarding P management of manure/organic by-product recycling can be effectively communicated to landowners if the P Index is consistently applied.

COMPONENTS OF THE P INDEX

The P Index assesses two major categories of characteristics: (1) those related to site and transport – Part A (Table 1); and (2) those related to phosphorus sources – Part B (Table 2). The P Index results are then obtained by multiplying the total for Part A by the total for Part B.

P Index = Total for Part A (Site and Transport) X Total for Part B (Source Management)

Table 1. Phosphorus Index Worksheet – Part A

Part A: Transport Potential Due to Site and Transport Characteristics						
Site and Transport Characteristics	**Phosphorus Transport Rating**					**Value**
Soil Erosion	No Surface Outlet **0**	<5T/A[a] **1**	5-10 T/A **2**	10-15 T/A **4**	>15 T/A **8**	
Runoff Potential	Very Low **0**	Low **1**	Medium **2**	High **4**	Very High **8**	
Leaching Potential	Very Low **0**	Low **1**	Medium **2**	High **4**	Very High **8**	
Potential To Reach Water Body	Very Low **0**	Low **1**	Medium **2**	High **4**		
					Total for Part A: Site and Transport[b]	

[a] T/A = tons per acre.
[b] If the sum for Part A is 0 (zero), then change the sum to 1 (one).

Table 2. Phosphorus Index Worksheet – Part B

Part B: Transport Potential Due to Phosphorus Source Management					
Phosphorus Source Management	**Phosphorus Loss Rating**				**Value**
Fertility Index Value	Soil Fertility Index x 0.025 (_____ ppm P x 2 x 0.025)[c]				
P Application Source and Rate [d]	0.05 x (_____ lbs P_2O_5) for fertilizer, manure or compost 0.015 x (_____ lbs P_2O_5) for biosolids 0.10 x (_____ lbs P_2O_5) for waste water				
Application Method	No Surface Outlet Or Solids incorporated immediately or injected **0**	Applied via irrigation Or Solids incorporated within 1 day of application **2**	Solids incorporated within 5 days of application [e] **4**	Solids not incorporated within 5 days of application **6**	
Waste Water Application	0.20 x _____ acre inches/year				
				Total for Part B: Phosphorus Source	

[c]From soil test (Mehlich-3) results.
[d]Initial evaluation should be N-based rates.
[e]Solids include fertilizers, composts, biosolids, and manure and other animal wastes.

The result of an analysis using the P Index gives the producer a vulnerability rating for each field or portion of a field analyzed (Table 3). This rating may be LOW, MEDIUM, HIGH, or VERY HIGH. As the vulnerability rating increases, so does the potential for phosphorus transport off-site, and for phosphorus to become associated with water quality impairment.

Table 3: Assessing the P Index Results

P Index for Site	Generalized Interpretation of P Index for Site
<75	**LOW** potential for P movement from the site. If current practices are maintained there is a low probability of an adverse impact to surface waters from P losses at this site. N-based nutrient management planning is satisfactory for this site. Soil P levels and P loss potential may increase in the future due to N-based nutrient management.
75-150	**MEDIUM** potential for P movement from this site. The chance for an adverse impact to surface waters exists. *Nitrogen-based nutrient management planning is satisfactory for this site when conservation measures are taken to lessen the probability of P loss*. Soil P levels and P loss potential may increase in the future due to N-based nutrient management.
151-225	**HIGH** potential for P movement from the site and for an adverse impact on surface waters to occur unless remedial action is taken. Soil and water conservation and P management practices are necessary (if practical) to reduce the risk of P movement and water quality degradation. If risk cannot be reduced then a P-based management budget based on soil test crop P requirements will be utilized.
>225	**VERY HIGH** potential for P movement from the site and for an adverse impact on surface waters. Remedial action is required to reduce the risk of P movement. All necessary soil and water conservation practices, plus a P-based management plan must be put in place to avoid the potential for water quality degradation. The P-based management plan will be based on soil test crop requirement to reduce P over a defined period (not to exceed 20 years).

FIELD EVALUATION AND IMPLEMENTATION FOR SUMTER COUNTY

Phosphorus Transport Potential Due to Site & Transport Characteristics – Part A (Table 1)

Phosphorus transport potential due to site and transport characteristics is as follows:

- Soil Erosion
- Runoff Potential
- Leaching Potential
- Potential to Reach Water Body

Soil Erosion

Soil erosion by water is defined as the loss of soil along a slope or unsheltered distance and is estimated from erosion prediction models. Soil erosion is not calculated for sites that have No Surface Outlet. For all other sites soil erosion by water is predicted using the Revised Universal Soil Loss Equation (RUSLE). RUSLE is used in this index to indicate an average annual long-term movement of soil, thus potential for sediment and attached P movement toward a water body. The RUSLE methodology presented here is a simplified version of that presented in Chapter 6, Florida Agronomy Field Handbook (Florida Ecological Sciences Staff. 1999, as revised) which is available from any NRCS office. Version 2 of the Revised Universal Soil Loss Equation (RUSLE 2) uses factors that represent the effects of climatic erosivity, soil erodibility, topography, cover-management and support practices to compute erosion. This Circular provides values for calculating only RUSLE. However, those users that choose to use RUSLE2 may download the details from the following website: http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm.

The average annual erosion expected on fields is computed by:

$$A = R * K * LS * C * P$$

Where:
A is the average soil loss. A is a computed value expressed in tons/acre/year.

R is the rainfall factor. For Sumter County the R-factor is 450.

K is the soil erodibility factor. K-factor values are soil specific (see Table 13 for these values).

K-factors presented in Table 13 are values to be used in conjunction with the soil survey of Sumter County (Yamataki, et al.1988) if the surface texture of a field is the same as reported in the soil survey. The soil survey is available at the local NRCS field office (352-742-7005). Since K-factors presented in the soil survey are only interpretations, they **should be confirmed by on-site investigations.** Where surface textures differ from those in the soil survey, the following K-factors should be used: muck = 0.2, mucky sand = 0.05, sand = 0.10, loamy sand = 0.15, sandy loam = 0.20, sandy clay loam = 0.24, and clay = 0.37.

LS is the topographic factor. Slope length (L) begins where runoff starts and ends where slope decreases and deposition begins, or it is the horizontal distance between terraces, or it includes the entire width of contoured or contour strip-cropped fields without terraces. L is expressed in feet and must be determined on-site. Average slope lengths in Sumter County range from 40 to 120 feet. Slope (S) is the ratio of horizontal distance to vertical distance. S is expressed in percent and must be determined on-site.

Table 4, Table 5, and Table 6 contain common LS-factors for Sumter County. Additional LS-factors are available in Chapter 6, Florida Agronomy Field Handbook (Florida Ecological Sciences Staff. 1999).

Table 4. Values for topographic factor (LS) for rangeland and other land uses with cover.

Slope	Horizontal slope length (ft.)						
(%)	9	25	50	75	100	150	200
0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.5	0.08	0.08	0.08	0.08	0.09	0.09	0.09
1.0	0.12	0.13	0.13	0.14	0.14	0.15	0.15
2.0	0.20	0.21	0.23	0.25	0.26	0.27	0.28
3.0	0.26	0.29	0.33	0.36	0.38	0.40	0.43
4.0	0.33	0.36	0.43	0.46	0.50	0.54	0.58
5.0	0.38	0.44	0.52	0.57	0.62	0.68	0.73
6.0	0.44	0.50	0.61	0.68	0.74	0.83	0.90
8.0	0.54	0.64	0.79	0.90	0.99	1.12	1.23
10.0	0.65	0.81	1.03	1.19	1.31	1.51	1.67
12.0	0.75	1.01	1.31	1.52	1.69	1.97	2.20
14.0	0.85	1.20	1.58	1.85	2.08	2.44	2.74
16.0	0.95	1.38	1.85	2.18	2.46	2.91	3.28
20.0	1.11	1.74	2.37	2.84	3.22	3.85	4.38

Table 5. Values for topographic factor (LS) for row-cropped agricultural and other land uses with little-to-moderate cover.

Slope	Horizontal slope length (ft.)						
(%)	9	25	50	75	100	150	200
0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.5	0.07	0.08	0.08	0.08	0.09	0.09	0.09
1.0	0.11	0.12	0.13	0.14	0.14	0.15	0.16
2.0	0.17	0.19	0.22	0.25	0.27	0.29	0.31
3.0	0.22	0.25	0.32	0.36	0.39	0.44	0.48
4.0	0.26	0.31	0.40	0.47	0.52	0.60	0.67
5.0	0.30	0.37	0.49	0.58	0.65	0.76	0.85
6.0	0.34	0.43	0.58	0.69	0.78	0.93	1.05
8.0	0.42	0.53	0.74	0.91	1.04	1.26	1.45
10.0	0.50	0.67	0.97	1.19	1.38	1.71	1.98
12.0	0.58	0.84	1.23	1.53	1.79	2.23	2.61
14.0	0.65	1.00	1.48	1.86	2.19	2.76	3.25
16.0	0.72	1.15	1.73	2.20	2.60	3.30	3.90
20.0	0.85	1.45	2.22	2.85	3.40	4.36	5.21

Table 6. Values for topographic factor (LS) for freshly prepared construction and other highly disturbed soil conditions with little or no cover.

Slope	Horizontal slope length (ft.)						
(%)	9	25	50	75	100	150	200
0. 2	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.5	0.07	0.07	0.08	0.08	0.09	0.09	0.10
1.0	0.09	0.10	0.13	0.14	0.15	0.17	0.18
2.0	0.13	0.16	0.21	0.25	0.28	0.33	0.37
3.0	0.17	0.21	0.30	0.36	0.41	0.50	0.57
4.0	0.20	0.26	0.38	0.47	0.55	0.68	0.79
5.0	0.23	0.31	0.46	0.58	0.68	0.86	1.02
6.0	0.26	0.36	0.54	0.69	0.82	1.05	1.25
8.0	0.32	0.45	0.70	0.91	1.10	1.43	1.72
10.0	0.37	0.57	0.91	1.20	1.46	1.92	2.34
12.0	0.45	0.71	1.15	1.54	1.88	2.51	3.07
14.0	0.45	0.85	1.40	1.87	2.31	3.09	3.81
16.0	0.56	0.98	1.64	2.21	2.73	3.68	4.56
20.0	0.67	1.24	2.10	2.86	3.57	4.85	6.04

C is the cover management factor. C is defined as the ratio of soil loss from an area with specified cover and management to soil loss from an identical area in tilled continuous fallow. C-factors for most crop-management systems have been computed and are listed in two tables. Table 7 contains C-factors for cultivated fields and pasture land and Table 8 contains C-factors for other agronomic land uses. The higher the number the higher the potential soil loss.

Table 7. C-Factor - Cover Management Factor (Cultivated Fields and Pasture Land).

Cover/Management	Remarks	C-Factor
Bahiagrass/Bermuda grass	Established with no grazing and no haying	0.006
Bahiagrass/Bermuda grass	From planting to 4 years, grazed	0.067
Bahiagrass/Bermuda grass	From planting to 4 years, hayed	0.057
Bahiagrass/Bermuda grass	From planting to 5 years, grazed	0.055
Bahiagrass/Bermuda grass	From planting to 6 years, grazed	0.047
Corn Conventional Tilled	Average yield 80 bushels/acre/year - 30 inch rows	0.348
Corn Conventional Tilled	Average yield 112 bushels/acre/year - 30 inch rows	0.253
Corn Conventional Tilled	Average yield 125 bushels/acre/year - 30 inch rows	0.229
Corn Conventional Tilled	Average yield 150 bushels/acre/year - 30 inch rows	0.198
Corn Conservation Tillage	Average yield 80 bushels/acre/year - 30 inch rows	0.282
Corn Conservation Tillage	Average yield 112 bushels/acre/year - 30 inch rows	0.187
Corn Conservation Tillage	Average yield 125 bushels/acre/year - 30 inch rows	0.180
Corn Conservation Tillage	Average yield 150 bushels/acre/year - 30 inch rows	0.136
Corn No Till	Average yield 80 bushels/acre/year - 30 inch rows	0.140
Corn No Till	Average yield 112 bushels/acre/year - 30 inch rows	0.082
Corn No Till	Average yield 125 bushels/acre/year - 30 inch rows	0.068
Corn No Till	Average yield 150 bushels/acre/year - 30 inch rows	0.051
Cotton Conventional Tilled	Average yield 500lbs/acre/year - 30 inch rows	0.375
Cotton Conventional Tilled	Average yield 500lbs/acre/year - 38 inch rows	0.436
Cotton Conventional Tilled	Average yield 750lbs/acre/year - 30 inch rows	0.310
Cotton Conventional Tilled	Average yield 750lbs/acre/year - 38 inch rows	0.381
Cotton Conventional Tilled	Average yield 1000lbs/acre/year - 30 inch rows	0.271
Cotton Conventional Tilled	Average yield 1000lbs/acre/year - 38 inch rows	0.298
Cotton Conservation Tillage Residue Not Removed	Planted in Rye Average yield 500lbs/acre/year - 30 inch rows	0.079
Cotton Conservation Tillage Residue Not Removed	Planted in Rye Average yield 500lbs/acre/year - 38 inch rows	0.094
Cotton Conservation Tillage Residue Not Removed	Planted in Rye Average yield 750lbs/acre/year - 30 inch rows	0.062
Cotton Conservation Tillage Residue Not Removed	Planted in Rye Average yield 750lbs/acre/year - 38 inch rows	0.081

Table 7. C-Factor - Cover Management Factor (Cultivated Fields and Pasture Land).

Cover/Management	Remarks	C-Factor
Cotton Conservation Tillage Residue Not Removed	Planted in Rye Average yield 1000lbs/acre/year - 30 inch rows	0.050
Cotton No Till, Planted in last years cotton residue	Average yield 500lbs/acre/year - 30 inch rows	0.143
Cotton No Till, Planted in last years cotton residue	Average yield 500lbs/acre/year - 38 inch rows	0.177
Cotton No Till, Planted in last years cotton residue	Average yield 750lbs/acre/year - 30 inch rows	0.100
Cotton No Till, Planted in last years cotton residue	Average yield 750lbs/acre/year - 38 inch rows	0.137
Peanut Conventional Till Residue Not Removed	Average yield 2000lbs/acre/year - 36 inch rows	0.371
Peanut Conventional Till Residue Not Removed	Average yield 3000lbs/acre/year - 36 inch rows	0.281
Peanut Conventional Till Residue Not Removed	Average yield 4000lbs/acre/year - 36 inch rows	0.230
Peanut Conventional Till Residue Removed	Average yield 2000lbs/acre/year	0.534
Peanut Conventional Till Residue Removed	Average yield 3000lbs/acre/year	0.449
Peanut Conventional Till Residue Removed	Average yield 4000lbs/acre/year	0.436
Peanut Conservation Tillage Planted in Rye	Average yield 2000lbs/acre/year - Residue Removed	0.479
Peanut Conservation Tillage Planted in Rye	Average yield 3000lbs/acre/year - Residue Removed	0.362
Peanut Conservation Tillage Planted in Rye	Average yield 4000lbs/acre/year - Residue Removed	0.269
Peanut No Till, Residue Not Removed	Average yield 3000lbs/acre/year	0.084
Peanut No Till	Average yield 3000lbs/acre/year - Residue Removed	0.154
Peanut No Till Planted in Rye	Average yield 3000lbs/acre/year - Residue Removed	0.089
Ryegrass, grazed		0.273
Rye, grazed	2800lbs/acre Residue Remaining	0.113
Rye, not grazed	4200lbs/acre Residue Remaining	0.080
Soybeans	Average yield 35 bushels/acre/year	0.355
Watermelon		0.320
Watermelon	With good summer weed or grass cover	0.173
Watermelon	Followed by rye, not grazed	0.269
Weed/Grass, idle	With good summer weed/grass cover	0.079
Weed/Grass, idle	With good summer and winter weed/grass cover	0.035
Weed/Grass, idle	With good winter weed/grass cover	0.245

Table 8. C-Factor - Cover Management Factor for Groves/Orchards (citrus, blueberries, etc.) Rangeland, Disturbed Forest Land , and Long-Term Hay Land, and Idle Land.

Vegetation Canopy Type			Percentage Surface Contact of Ground Cover					
Type and Height of Canopy	Canopy Cover [a]	Type [b]	0	20	40	60	80	>95
No appreciable canopy		G	.450	.200	.100	.013	.013	.003
		W	.450	.240	.150	.090	.043	.011
Tall weeds/short brush [c]	25	G	.360	.170	.090	.038	.012	.003
		W	.360	.200	.130	.082	.041	.011
	50	G	.260	.130	.070	.035	.012	.003
		W	.260	.160	.110	.075	.039	.011
	75	G	.170	.100	.060	.031	.011	.003
		W	.170	.120	.090	.067	.038	.011
Brush or bushes [d]	25	G	.400	.180	.090	.040	.013	.003
		W	.400	.220	.140	.085	.042	.011
	50	G	.340	.160	.085	.038	.012	.003
		W	.340	.190	.130	.081	.041	.011
	75	G	.280	.140	.080	.036	.012	.003
		W	.280	.170	.120	.077	.040	.011
Trees [e]	25	G	.420	.190	.100	.041	.013	.003
		W	.420	.230	.140	.087	.042	.011
	50	G	.390	.180	.090	.040	.013	.003
		W	.390	.210	.140	.085	.042	.011
	75	G	.360	.170	.090	.039	.012	.003
		W	.360	.200	.130	.083	.041	.011

[a] Percent of total surface area hidden from view by canopy.
[b] G = Surface cover is grass, grasslike plants, and/or decaying litter at least 2 inches thick.
W = Surface cover is broadleaf herbaceous plants and/or decaying litter less than 2 inches thick.
[c] Average height that water drops from canopy in autumn is less than 3 feet.
[d] Average height that water drops from canopy in autumn is 3 to 12 feet.
[e] Average height that water drops from canopy in autumn is more than 12 feet.

C-Factors for Dual Cropping Systems

The C-factor for dual cropping systems is determined by averaging the individual C-Factors. For example, bahiagrass (6 years, grazed) followed by ryegrass, grazed would have a C-Factor calculated as follows:

C-Factor for bahiagrass, 6 years grazed 0.047 (from Table 7) plus C-Factor for ryegrass, grazed 0.273 (from Table 7) divided by 2 equals a C-Factor of 0.016 .

P is the support practice factor. P is the ratio of soil loss with a conservation support practice (contour cropping, contour strip cropping, or terracing) to soil loss with straight-row farming up and down the slope. P-factors for these conservation support practices have been computed and are listed in Tables 9, Table 10, and Table 11).

The methodology provided herein to calculate P-Factor is a simplified version. A more thorough methodology is explained in Chapter 6, Florida Agronomy Field Handbook, NRCS.

Table 9. P-Factors for Up and Down Hill Cropping and Contour Cropping.

Land Slope Percent	Up and Down Hill Farming P-Factor	Contour Farming P-Factor
1.1 to 2	1.0	0.60
2.1 to 7	1.0	0.50
7.1 to 12	1.0	0.60
12.1 to 18	1.0	0.80
18.1 to 24	1.0	0.90

Table 10. P-Factors for Contour Strip Cropping.

Land Slope Percent	P-Factor [a]	P-Factor [b]	P-Factor [c]	Contour Strip Width (feet) [d]	Maximum Slope Length (feet) [e]
1.0 to 2.5	0.30	0.45	0.60	130	800
2.6 to 5.5	0.25	0.38	0.50	100	600
5.6 to 8.5	0.25	0.38	0.50	100	400
8.6 to 12.5	0.30	0.45	0.60	80	240
12.6 to 16.5	0.35	0.52	0.70	80	160
16.5 to 20.5	0.40	0.60	0.80	60	120
21.5 to 25	0.45	0.68	0.90	50	100

[a] For 4-year rotation of row crop, small grain with grass seeding, and 2 years of grass. A second row crop can replace the small grain if grass is established following harvest.
[b] For 4-year rotation of 2 years of row crops, 1 year of winter grain with grass seeding, and 1 year of grass.
[c] For alternative strips of row crop and small grain.
[d] Adjust strip width limits, generally downward, to accommodate widths of equipment.
[e] Length limits may be increased by 10 percent if residue cover after crop planting will regularly exceed 50 percent.

Table 11. P-Factors for Terraces.

Horizontal Interval (feet)	Closed Outlet [a]	Open Outlets with Percent Channel Grade Indicated [b]		
	P-Factor	P-Factor for 0.1-0.3	P-Factor for 0.4-0.7	P-Factor for >0.7
<110	0.50	0.60	0.70	1.0
111-140	0.60	0.70	0.80	1.0
141-180	0.70	0.80	0.90	1.0
181-225	0.80	0.80	0.90	1.0
226-300	0.90	0.90	1.0	1.0
>300	1.0	1.0	1.0	1.0

[a] P-Factors for closed outlet terraces also apply to terraces with underground outlets and to level terraces with open outlets.
[b] The channel grade is measured on the 300 feet of terrace or the 1/3 of total terrace length closest to the outlet, whichever is less.

Possible phosphorus transport rating values for soil erosion are (Part A - Table 1):

0 for fields with no surface outlet (such as for karst areas in the Suwannee River watershed).

1 for fields with a calculated soil loss (A) of less than 5 tons/acre/year.

2 for fields with a calculated soil loss (A) of between 5 and 10 tons/acre/year.

4 for fields with a calculated soil loss (A) of between 10 and 15 tons/acre/year.

8 for fields with a calculated soil loss (A) of more than 15 tons/acre/year.

Soil Erosion Calculation Example

Situation: An area in the central portion of the county has the following conditions:

Soil: From soil survey the soil is map unit 33 (Sparr). The soil was verified on-site as being Sparr, on a 1 percent slope with a slope length of 100 feet.

Crop: The field is a bahiagrass planted every 4 years and grazed.

$$A = R * K * LS * C * P$$

R = 450 (for all of Sumter County)

K = 0.10 (from Table 13)

L S= 0.14 (from Table 4)

C = 0.067 (from Table 7)

P = 1.0 (from Table 9; field is not contour cropped, contour strip cropped, or terraced)

A = 450 * 0.10 * 0.14 * 0.067 * 1.0

A = 0.4 tons/acre/year

The resulting Soil Erosion value assigned to the Phosphorus Transport Rating - Part A (Table 1) would be 1 (<5 T/A), the most common result obtained in Sumter County.

Runoff Potential

Usage of the following runoff potential criteria is based on a minimum of 10 observations (soil borings) per spray field/application area unless the number of borings identify the site as a problem area or a uniform area. At least one observation is to be made in each of the landforms present. Examples of landforms are flats, flatwoods, depressions, terraces, rises, knolls, hills, hillsides, sideslopes, toeslopes, footslopes, etc. If there is no surface outlet for the field in consideration, the rating is Very Low **(0)** for Runoff Potential.

The NRCS Hydrologic Soil Groups, slope, and the presence or absence of artificial drainage are used to evaluate runoff potentials.

Runoff Potential Rating Criteria - Part A (see Table 1)

Very Low (0):

Soils in Hydrologic Soil Group A with ≥75% ground cover **and slopes of 8% or less.**

or:

any Hydrologic Soil Group with no surface outlet.

Low (1):

Soils in Hydrologic Soil Groups A with < 75% ground cover with surface outlet and A/D **(**with effective drainage depth of greater than 48”**) and slopes of 8% or less** (Effective drainage is water control that is designed and maintained according to NRCS standards that will perform the desired water control.)

Medium (2):

Soils in Hydrologic Group A and A/D (with effective drainage depth of 37” to 48”) **and slopes of more than 8%**.

or:

Soils in Hydrologic Groups B and A/D or B/D **(**with effective drainage depth of 37” to 48”**) and slopes of 5% or less**.

High (4):

Soils in Hydrologic Group B and B/D (with effective drainage depth of 20” to 36”) **and slopes of more than 5% up to and including 8%.**

or:

Soils in Hydrologic Groups C and A/D, B/D or C/D (with effective drainage depth of 20” to 36”) **and slopes of 5% or less.**

Very High (8):

Soils in Hydrologic Group B and B/D (with effective drainage depth of 37” to 48”) **and slopes of more than 8%.**

or:

Soils in Hydrologic Groups C and C/D (with effective drainage depth of 20” to 36”) **and slopes of more than 5%.**

or:

Soils in Hydrologic Groups D and A/D, B/D, and C/D in undrained condition.

Runoff Potentials are presented in Table 13 based on the above criteria and the definitions of the four hydrologic soil groups below. These are potentials to be used in conjunction with the soil survey of Sumter County (Yamataki, et al. 1988). Potentials presented are interpretations and are not factual data. As with all interpretations, **runoff potentials should be confirmed by on-site investigations. Slope and hydrologic group should be determined on-site.**

Group A: Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well-drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B: Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well-drained or well-drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C: Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D: Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink/swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Artificial Drainage

Presence of artificial drainage can change the runoff potential of a soil. Drained Runoff Potentials in Table 13 have been assigned to those soils deemed drainable by NRCS. Drained Runoff Potentials presented are based on NRCS "Technical Release No. 55-Urban Hydrology for Small Watersheds, Amendment FL3" (Table 12).

Table 12. Reclassification of Runoff Potential and Hydrologic Group Based on Drainage.

Effective Drainage Depth (Inches) [a]	Drained Runoff Potential	Drained Hydrologic Group
Less than 20	Very High	D
20-36	High	C
37-48	Medium	B
Greater than 48	Low	A

[a] Effective drainage is defined as having good surface drainage with a designed subsurface drainage system properly installed and maintained with a water removal rate of at least 0.5 inches/day. **Rarely have agricultural fields in Sumter County been effectively drained to a depth of more than 24 inches.**

Drained Runoff Potentials in Table 13 are based on the maximum effective drainage depth expected for each soil. Actual effective drainage may be less than the maximum. For example, Immokalee (Table 13--map unit 50) has a drained runoff potential of Medium. This rating is based on a maximum effective drainage depth of 37 to 48 inches. If field conditions indicate a site had been effectively drained to a depth of only 24 inches, then the on-site runoff potential would be High (Table 12) and the resulting Phosphorus Transport Rating – Part A value for runoff would be 4 (Table 1).

Leaching Potential

Usage of the following leaching potential criteria is based on a minimum of 5 observations (e.g. soil borings) per 40 acres of application area unless the number of borings identify the site as a problem area or a uniform area. Ground penetrating radar (GPR) should be used for the assessment of all Karst areas. At least one observation is to be made in each landform present.

Presence or absence of a loamy/clayey layer and thicknesses of sandy layers, and presence or absence of coated sand are used to evaluate leaching potentials.

Leaching Potential Rating Criteria – Part A (see Table 1)

Very Low (0):

At least 80 percent of observations have a loamy or clayey layer at least 25 cm (10 inches) thick starting within 50 cm (20 inches). Typically, these soils are Typic Paleudults.

Low (1):

At least 80 percent of observations have a loamy or clayey layer at least 25 cm (10 inches) thick starting within 200 cm (80 inches). Typically, these soils are Arenic and Grossarenic Paleudults.

Medium (2):

At least 80 percent of observations have a loamy or clayey layer at least 25 cm (10 inches) thick starting at a depth below 200 cm (80 inches) but above seasonal high saturation **and** sand grains in the E and Bw horizons have coatings (chroma $\geq$ 3) to a depth of at least 100 cm (40 inches); or at least 80 percent of observations have no loamy or clayey layer at least 25 cm (10”) thick, but have a layer at least 200 cm (80”) thick with coated sand grains (chroma equal to or greater than 3). The entire 200 cm (80”) layer must be above seasonal high saturation.

High (4):

At least 20 percent of observations have no loamy or clayey layer,(or the loamy or clayey layer is less than 25 cm (10 inches) thick) **and** the combined thickness of layers with coated sand grains (chroma $\geq$ 3 in the E, Bw, and C horizons and any chroma in the Bh horizons) is more than 50 cm (20 inches) and less than 200 cm (80 inches).

Very High (8):

At least 20 percent of observations have no loamy or clayey layer (or the layer is less than 25 cm (10 inches) thick **and** the combined thickness of layers with coated sand grains (chroma $\geq$ 3 in the E, Bw, and C horizons and any chroma in the Bh horizons) is equal to or less than 50 cm (20 inches).

Leaching Potentials are presented in Table 13 based on the above criteria. These are potentials to be used in conjunction with the soil survey of Sumter County (Yamataki, et al. 1988). Potentials presented are interpretations, and are not factual data. As with all interpretations, **leaching potentials should be confirmed by on-site investigations.**

The rating of Medium Leaching Potential may be unique to Florida. This rating is based on deeper observation of soils that would normally be rated as having a High or Very High Leaching Potential. The rating of Medium Leaching Potential is given to soils with a significant loamy/clayey layer below the normal (2m or 80 inches) soil classification depth. Use of Ground Penetrating Radar (GPR) and/or geological investigations is needed to rate a site as having a Medium Leaching Potential and the depth to the loamy/clayey layer must be **above** the seasonal high saturation (water table).

Sinkholes occur where calcareous limestone below the land surface has been naturally dissolved by circulating ground water. A sinkhole forms when soil or weakened rock falls into underlying cavernous limestone. The sinkhole depth to width ratio tends to relate to soil slope stability-- typically the width is 5 times the depth. Sumter County has areas considered to be high risk for sinkhole development. In these areas the GPR will be used to determine the leaching potential.

Phosphorus Runoff and Leaching Potentials Ratings for Florida Soil Survey Map Units

The runoff and leaching potentials (Table 13) were created by comparing estimated soil properties found in the soil survey of Sumter County (Yamataki, et al. 1988) with the above criteria. The potentials presented herein are interpretations, and not factual data. As with all interpretations based on information in a published soil survey or other sources of estimated soil properties, **phosphorus runoff and leaching potentials should be confirmed by on-site investigations.** However, a soil survey is an excellent place to initiate off-site investigation before making on-site determinations. For information on how to use a soil survey, see Circular 959 Soil Ratings for Crop Production and Water Quality Protection (Brown, et. al. 1991). However, note that phosphorus runoff and leaching potentials were derived from criteria that are different from the criteria used to derive the pesticide runoff and leaching potentials.

Table 13. Runoff, Leaching Potentials and K-Factors for Sumter County Soils.

Map Unit	Seq. No.[a]	Soil Name	Undrained Runoff Potential	Undrained and Drained Leaching Potential	Drained Runoff Potential	K-Factor
001	1	Arrendondo	Low[b]	Low		0.10
003	1	Astatula	Low[b]	High		0.10
004	1	Candler	Low[b]	High		0.10
005	1	Candler	Low[b]	High		0.10
006	1	Kendrick	Low[b]	Low		0.15
008	1	Lake	Low[b]	Low		0.10
009	1	Paisley	Very High	Very Low	Very High	0.15
010	1	Sparr	High	Low		0.10
011	1	Millhopper	Low[b]	Low		0.10
013	1	Tavares	Low[b]	High		0.10
014	1	Lake	Low[b]	High		0.10
015	1	Adamsville	Low[b]	High[c]		0.10
016	1	Apopka	Low[b]	Low		0.10
017	1	Sumterville	High	Low		0.10
017	2	Mabel	High	Very Low		0.10
017	3	Tavares	Low[b]	High		0.10
018	1	Okeelanta	Very High	Very High	Medium	0.02
019	1	Apopka	Low[b]	Low		0.10

Table 13. Runoff, Leaching Potentials and K-Factors for Sumter County Soils.

Map Unit	Seq. No.[a]	Soil Name	Undrained Runoff Potential	Undrained and Drained Leaching Potential	Drained Runoff Potential	K-Factor
020	1	Florahome	Low[b]	High		0.10
021	1	EauGallie	Very High	Low	Medium	0.10
022	1	Smyrna	Very High	High	Medium	0.10
023	1	Ona	Very High	High	Medium	0.10
024	1	Basinger	Very High	Very High	Low[b]	0.10
025	1	Kanapaha	Very High	Low	Medium	0.10
026	1	Vero	Very High	Low	High	0.10
027	1	Sumterville	High	Low		0.10
028	1	Seffner	High	High[c]		0.10
029	1	Nittaw	Very High	Very Low		0.02
030	1	Placid	Very High	Very High	Low[b]	0.10
031	1	Myakka	Very High	High	Medium	0.10
032	1	Pompano	Very High	Very High	Low[b]	0.10
033	1	Sparr	High	Low		0.10
034	1	Tarrytown	High	Very Low		0.10
035	1	Pompano	Very High	Very High	Low[b]	0.10
036	1	Floridana	Very High	Low	High	0.10
037	1	Astatula	Low[b]	High		0.10
039	1	Mabel	High	Very Low		0.10
040	1	Millhopper	Low[b]	Low		0.10
041	1	Everglades	Very High	Very High		0.02
042	1	Adamsville	High	High[c]		0.10
043	1	Basinger	Very High	Very High	Low[b]	0.10
044	1	Oldsmar	Very High	Low	Medium	0.10
045	1	Electra	High	Low		0.10
046	1	Ft. Green	Very High	Low	High	0.10
047	1	Okeelanta	Very High	Very High		0.02
048	1	Malabar	Very High	Low		0.10
049	1	Terra Ceia	Very High	Very High	Medium	0.02
050	1	Immokalee	Very High	High	Medium	0.10
051	1	Pits	Variable	Variable		0.10
052	2	Dumps	Variable	Variable		0.10
053	1	Tavares	Low[b]	High		0.10
054	1	Monteocha	Very High	Low	Medium	0.15
055	1	Pomello	High	High[c]		0.10
056	1	Vero	Very High	Low	High	0.10

Table 13. Runoff, Leaching Potentials and K-Factors for Sumter County Soils.

Map Unit	Seq. No.[a]	Soil Name	Undrained Runoff Potential	Undrained and Drained Leaching Potential	Drained Runoff Potential	K-Factor
057	1	Gator	Very High	Low		0.02
058	1	Paisley	Very High	Very Low	Very High	0.15
059	1	Arents	Variable	Variable		0.10
060	1	Delray	Very High	Low	Medium	0.10
061	1	EauGallie	Very High	Low	Medium	0.10
062	1	Urban Land	Very High	Variable		No Value
063	1	Floridana	Very High	Low		0.10
063	2	Basinger	Very High	Very High		0.10
064	1	Gator	Very High	Low		0.02
065	1	Candler	Low[b]	High		0.10
066	1	Arrendondo	Low[b]	Low		0.10
067	1	Vero	Very High	Low	High	0.10
068	1	Chobee	Very High	Very Low		0.15

[a] Seq. No. indicates a particular soil series name among one or more names constituting a map unit name.

[b] Rate Very Low where percent ground cover is greater than 75%.

[c] Rate Very High if combined thickness of layers with chroma 3 or more and Bh horizons is less than 20 inches.

Potential to Reach Water Body

This parameter is used to address the potential for runoff to reach a water body. If there is no direct discharge from the edge of a field, the potential to affect a water body is considered to be "very low." If the P concentration of the runoff can be attenuated by flow through a wetland, buffer strip or overland treatment area, the potential is considered "low." If there is ditch drainage or direct discharge to a water body, the index value is increased to "medium." When there is potential for direct discharge to a lake, sinkhole, or natural stream the potential for water quality degradation by P is enhanced and the index rating is increased to "high."

Potential to Reach Water Body Rating Criteria (see Table 1)

Very Low (0):
No direct discharge from the edge of the field.

Low (1):
Discharge through wetlands, buffer area (refer to table below for buffer width), storm water detention, or overland treatment.

Medium (2):
No buffer, ditch drainage to or direct discharge to a water body.

High (4):
Direct discharges to a lake, sinkhole, or natural stream.

Non-Application Buffer Widths [1]

Object, Site	Situation	Base Buffer Width from Object, Site (ft.)
Well, potable	Located up-slope of application site	150
Well, potable	Located down-slope of application site provided conditions warrant application	300
Waterbody, Stream2/, sinkhole or wetland	Good vegetation 3/. Add 2 feet for each 1% slope for slopes up to 8%.	50 (+)
Waterbody, Stream2/, sinkhole or wetland	Poor vegetative cover or Predominant slope > 8%3/	100
Public Road – roadside ditch	Irrigated wastewater or solids applied with spreader	30

1/ Research has shown that forested or forest/grass buffers are more effective at removing phosphorus. Grass buffers are more effective at removing nitrogen. Every effort should be made to reduce phosphorus inputs at their sources. If phosphorus is managed responsibly on-site, buffers can store significant amounts of the excess; but if phosphorus is uncontrolled buffers can quickly become saturated and over whelmed. Even with their limits, buffers still perform a valuable service by displacing phosphorus-producing activities away from streams and regulating the flow of phosphorus. Taken in part from "A Review Of The Scientific Literature On Riparian Buffer Width, Extent And Vegetation", Institute of Ecology, University of Georgia.

2/ Waterbody includes pond, lake, or open sinkhole. Open sinks include paleo sinks without a confining layer within 80 inches of the surface. Stream includes both perennial and intermittent streams and canals.

3/ Good vegetation refers to a well-managed, dense stand that is not overgrazed.

Phosphorus Transport Potential Due to Phosphorus Source Management - Part B (Table 2)

Phosphorus transport potential due to phosphorus source management is as follows:
- Fertility Index Value
- P Application Source and Rate
- Application Method
- Waste Water Application

Criteria

Fertility Index Value:

Existing soil P levels are included in the P Index and identified as the "fertility index". The "fertility index" is defined as Mehlich-3 extractable P, of a 0-15 cm (0-6 inches) depth soil sample, in ppm (parts per million) multiplied by 2 to convert to pounds per acre. The 0.025 multiplication factor was selected to provide a value range similar to those used for other parameters in the P Index.

Obtain soil samples by taking 15 to 20 small cores (for areas up to 40 acres) at random over the entire area to a depth of about 6 inches. Place the 15 to 20 plugs in a container, mix them thoroughly, and send approximately one pint of the mixed sample to the UF/IFAS Extension Soil Testing Laboratory (ESTL) or other qualified laboratory for analysis.

P Application Source and Rate:

The multiplication factors for the application of P vary based on the source (fertilizer, manure, compost, biosolids, or waste water). Fertilizer, manure, and compost have the multiplier 0.05. For biosolids the multiplier is lower (0.015) because of evidence that the Fe and Al content of biosolids will decrease the P availability in biosolids-amended soils. In contrast, P in water from municipal and lagoon effluents is mostly in a soluble form and therefore the multiplier is higher (0.10).

Application Method:

The application method is not a consideration for sites that have No Surface Outlet or where solids are incorporated immediately after application or injected (value 0). For all other sites, effluent applied via irrigation are typically applied frequently (weekly, bi-weekly) and in small amounts or where solids are incorporated within one day of application; therefore, the potential for P loss is low (value 2). In contrast, solids (fertilizers, compost, biosolids, manures) surface-applied and not incorporated would have a higher potential for loss, particularly through surface runoff (value 6). Incorporated solids within 5 days of application have a medium potential for loss (value 4).

Waste Water Application Volume:

Excessive volumes of water may exacerbate movement of P via downward or lateral leaching, depending on the landscape. The 0.20 multiplication factor was selected to provide a value range similar to those used for other parameters in the P Index.

RESULTING P INDEX

The P Index is obtained by multiplying the site and transport characteristics totals – Part A (Table 1) by the phosphorus source totals – Part B (Table 2). The results are interpreted according to guidelines in Table 3.

On sites with a LOW or MEDIUM vulnerability rating, it is possible to use a nitrogen-based budget to determine application rates. On sites with a HIGH or VERY HIGH vulnerability rating, it is necessary to use a phosphorus-based budget to determine application rates.

Assessing the P Index Results

The numerical result of the P Index has no absolute value, but is immediately translated into a qualitative rating (LOW, MEDIUM, HIGH, or VERY HIGH). For each qualitative rating a description is given for the level of concern that each specifically assessed field has for P loss potential (Table 3). Some general guidance is given for each qualitative level as to the intensity and type of remedial action or mitigation that would be necessary to reduce P loss risk.

Conservation Planning Notes

Since output from the P Index includes information that is specific to each of the site and transport characteristics – Part A (Table 1) and phosphorus source management – Part B (Table 2), the conservation planner can identify which characteristics/management have the greatest influence in determining the final vulnerability rating and may be targeted for remedial action. Table 14 may be used to record notes to explain, clarify, and/or define site characteristics and source management used to evaluate a site. Each factor can be revisited and planning changes made, thereby changing the resulting P Index. For example, terraces can be installed, thereby lowering soil erosion and the final P Index. Similarly, the P Index can be lowered by reducing the planned P application rate.

Table 14. Conservation Planning Notes.

Client Name:	County:	Date:
Planner:	Field(s):	Crop:
Site and Transport Characteristics	**Remarks**	
Soil Erosion		
Runoff Potential		
Leaching Potential		
Potential to Reach Water Body		
Phosphorus Source Management		
Fertility Index Value		
P Application Source and Rate		
P Application Method		
Waste Water Application		

GLOSSARY (as used in the P Index the following definitions apply)

No Surface Outlet – The combination of slope and permeability of the application site that will not discharge surface flow from that site in a 2 year – 24 hour rainfall event.

(This level of evaluating runoff is not intended to require calculation for the rainfall events but is intended to evaluate those sites that do not have external surface flows during most years. Where these sites occur, additional comments may need to be recorded on the back of form FL-CPA-41)

Compost – animal wastes and plant debris that has gone through the composting process.

Biosolids – Residuals, domestic wastewater residuals and/or septage as defined in Chapter 62-640 Florida Administrative Code. Biosolids include co-compost with a minimum of 50% biosolids.

Landform - Any physical, recognizable form or feature of the earth's surface, having a characteristic shape and produced by natural causes.

Examples of individual landforms and their definitions are:

> **Karst** - Topography with sinkholes, caves, and underground drainage that is formed in limestone, gypsum, or other rocks by dissolution, and that is characterized by sinkholes, caves, and underground drainage.
> **Knoll** - A small, low, rounded hill rising above adjacent landforms.

Subsurface Drainage – Lowering of the water table in order to improve vegetative growth, remove surface runoff from wet areas, or relieve artesian pressure. Subsurface drainage can be achieved by either using drainage tile or drainage ditches, typically spaced at regular intervals.

REFERENCES

Brown, R.B., A.G. Hornsby, and G.W. Hurt. 1991. Soil ratings for crop production and water quality protection. Circular 959. Florida Cooperative Extension Service, University of Florida, Gainesville, FL.

Florida Ecological Sciences Staff. 1999. Florida Agronomy Field Handbook, Chapter 6. USDA, NRCS, Gainesville, FL.

Florida Phosphorus Index Work Group. 2000. The Florida phosphorus index. http://efotg.nrcs.usda.gov/treemenuFS.aspx?Fips=12001&MenuName=menuFL.zip (The Florida Phosphorus Index sheets are located in Section IV of the Table of Contents under C.Tools.)

Yamataki, H., A.O. Jones, D.E. Leach, W.E. Pucket, and K.J. Sullivan. 1988. Soil Survey of Sumter County, Florida. USDA/SCS in cooperation with the University of Florida, Institute of Food and Agricultural Sciences, Agricultural Experimental Stations and Soil Science Department; Florida Department of Transportation; and Florida Department of Agriculture and Consumer Services.