PHOSPHOROUS SITE INDEX FOR MARYLAND

Source: University of Maryland Cooperative Extension, September, 2000
Regulatory Citation: COMAR 15.20.08.05E

The nutrient management regulations identify the Phosphorus Site Index (P-index) as the primary tool to be used for evaluating the potential risk for phosphorus movement from agricultural land to state waters. It is used when soil fertility index values are greater than 150 to determine the limiting nutrient and identify required management as delineated by COMAR 15.20.08.04E(3).

Definition

The Phosphorus Site Index is a tool that can be used to evaluate the potential P soil losses as they relate to certain site characteristics and management practices. This tool provides nutrient management planners and farmers with a method to evaluate their fields and to make management decisions based on the values obtained from the P-index.

How to Use the P-Index

The P-index evaluates potential P losses in two steps. Part A evaluates potential phosphorus loss due to site and transport characteristics, and Part B evaluates potential phosphorus loss due to management practices.

Part A: Phosphorus loss potential due to site and transport characteristics

–**Soil Erosion** (estimate tons soil loss /acre/year, using the NRCS Field Office Technical Guide)
–**Soil test P Fertility Index Value** or **FIV** (using the soil test results)
–**Soil Runoff Class**
–**Subsurface Drainage**
–**Leaching Potential** (using the NRCS Field Office Technical Guide)
–**Distance from Edge of Field to Surface water or Drainage** (using the map or site measurement in feet)
–**Priority of Receiving Water**

Part B: Phosphorus Loss Potential Due to Management Practices

–S**oil Test P**- fertility index value conversion (see "Converting among Soil Test Analyses Frequently Used in Maryland")
–**P Fertilizer Application Rate** (lbs P_2O_5/ acre)
–**P Fertilizer Application Method**
–**Organic P Application Rate** (lbs P_2O_5/ acre)
–**Organic P Source Application Method**

Part A: Phosphorus loss potential due to site and transport characteristics

Characteristics	Phosphorus Loss Rating					Value
Soil Erosion (tons/acre)	**2** X tons soil loss/acre/year					
Soil Runoff Class	Negligible or Very Low **0**	Low **2**	Medium **4**	High **6**	Very High **8**	
Subsurface Drainage	Very Low **0**	Low **2**	Medium **4**	High **6**	Very High **8**	
Leaching Potential	Low **0**		Medium **2**	High **4**		
Distance From Edge of Field to Surface Water (feet)	> 100 feet **0**	< 100 feet AND >50 feet vegetated buffer OR <100 feet AND > 25 feet vegetated buffer AND > 25 feet additional no P application zone **2**	< 100 feet AND > 25 feet vegetated buffer AND < 25 ft additional no P application zone **4**	< 100 feet AND < 25 feet vegetative buffer AND > 25 feet additional no P application zone **6**	< 100 feet AND < 25 feet vegetative buffer AND < 25 ft additional no P application zone **8**	
Priority of Receiving Water	Category 2 **0**	Category 3 **1**	Category 3, Selected **2**	Category 1 **3**	Category 1, Priority **4**	

Sum of Site and Transport Characteristics:_____

Scaling Factor: *x* 0.02

Total Site and Transport Value: _____

Part B: Phosphorus loss potential due to management practice and source characteristics

Characteristics	Phosphorus Loss Rating					Value
Soil Test P Fertility Index Value	**0.2** X FIV					
P Fertilizer Application Rate (lbs P_2O_5)	**0.6** X (lbs P_2O_5 / acre)					
P Fertilizer Application Method	None applied **0**	Injected/ Banded below surface at least 2" **15**	Incorporated within 5 days of application **30**	Surface applied March through November OR Incorporated more than 5 days after application **45**	Surface applied December through February **60**	
Organic P Application Rate (lbs P_2O_5)	**PAC** X (lbs P_2O_5 / acre)					
Organic P Application Method	None applied **0**	Injected/banded below surface at least 2" **15**	Incorporated within 5 days of application **30**	Surface applied March through November OR Incorporated more than 5 days after application **45**	Surface applied December through February **60**	

Total Management and Source Value:_____

PHOSPHORUS INDEX WORKSHEET

To solve for P loss rating - add all numbers on Part A and all numbers on Part B. Write these numbers on the worksheet. Multiply Part A x Part B. This is your final P loss rating.

Part A: Value:_____

Part B: Value:_____

Multiply A x B = _____= _____P Loss Rating

P Loss Rating	Generalized Interpretation of P Loss Rating
0-50	**LOW** potential for P movement from this site given current management practices and site characteristics. There is a low probability of an adverse impact to surface waters from P losses from this site. Nitrogen-based nutrient management recommendations are approved for this site. Soil P levels and P loss potential may increase in the future due to N-based nutrient management.
51-75	**MEDIUM** potential for P movement from this site given current management practices and site characteristics. A nitrogen-based plan may be implemented no more than one year out of three. Phosphorus rates during the other two years shall be limited to the expected amount removed from the field by the crop or plant harvest, or the amount indicated by soil testing in accordance with recommendations described in the Maryland Nutrient Management Manual, whichever is greater.
76-100	**HIGH** potential for P movement from this site given current management practices and site characteristics. Phosphorus rates shall be limited to *the expected amount removed from the field by the crop or plant harvest*, or the amount indicated by soil testing in accordance with recommendations described in the Maryland Nutrient Management Manual**,** *whichever is greater***.** All practical management practices for reducing P losses by surface runoff, subsurface flow, or erosion shall be implemented.
>100	**VERY HIGH** potential for P movement from this site given current management practices and site characteristics. No phosphorus should be applied to this site. All practical management practices for reducing P losses by surface runoff, subsurface flow, or erosion shall be implemented.

TABLE 1: THE SURFACE RUNOFF CLASS

Table 1–The Surface Runoff Class site characteristic determined from the relationship of the soil permeability class and field slope. Adapted from the soil survey manual (1993) Table 3-10.

Soil Permeability Class*					
Slope (%)	**Very Rapid**	**Moderately Rapid and Rapid**	**Moderately Slow and Moderate**	**Slow**	**Very Slow**
Concave**	N	N	N	N	N
<1	N	N	N	L	M
1-5	N	VL	L	M	H
5-10	VL	L	M	H	VH
10-20	VL	L	M	H	VH
>20	L	M	H	VH	VH

N = Negligible
M = Medium
VL = Very low
L = Low
H = High
VH = Very high

* Permeability class of the least permeable layer within the upper 39 inches (one meter) of the soil profile. Permeability classes for specific soils can be obtained from a published soil survey or from local USDA-NRCS field offices.

Soil permeability Classes in inches per hour (in/hr):
very slow (<0.06 in/hr) slow (0.06 - 0.20 in/hr)
moderately slow (0.20 - 0.60 in/hr) moderate (0.60 - 2.00 in/hr)
moderately rapid (2.00 - 6.00 in/hr)

** Area from which no or very little water escapes by overland flow.

TABLE 2: SUBSURFACE DRAINAGE POTENTIAL

Depth to Seasonal High Water Table (feet)	Soil Drainage Class						
	very poorly drained	poorly drained	somewhat poorly drained	moderately well drained	well-drained soils	somewhat excessively drained	excessively drained
0 - 1	H	VH	VH	VH	VH	VH	
1 - 3	M	M	M	M	H	H	H
3 - 6	L	L	L	L	M	M	M
> 6		VL	VL	L	L	L	L
Artificial Subsurface Drainage (any depth)	H	H	H	H	H	H	H

VL = Very low
L = Low
M = Medium
H = High
VH = Very high

TABLE 3: PRIORITY OF RECEIVING WATERS– MARYLAND STATE WATERSHEDS

Very Low (0)

02130101	Atlantic Ocean
02130607	Christina River

Low (1)

02050301	Conewago Creek
02130402	Little Choptank
02130501	Eastern Bay
02130504	Kent Narrows
02130605	Little Elk Creek
02131106	Middle Patuxent River
02130104	Sinepuxent Bay
02130403	Lower Choptank
02130502	Miles River
02130505	Lower Chester River
02130705	Aberdeen Proving Ground
02140301	Potomac River FR County

Medium (2)

02120203	Octoraro Creek
02130106	Chincoteague Bay
02130204	Diving Creek
02130206	Tangier Sound
02130302	Monie Bay
02130306	Marshyhope Creek
02130401	Honga River
02130508	Southeast Creek
02130601	Lower Elk River
02130606	Big Elk Creek
02130702	Lower Winters Run
02130801	Gunpowder River
02130804	Little Gunpowder Falls
02130906	Patapsco River LN
02131001	Magothy River
02131005	West Chesapeake Bay
02131108	Brighton Dam
02140105	St.Clements Bay
02140108	Zekiah Swamp
02140202	Potomac River MO County
02140501	Potomac River WA County
02140505	Little Conococheague
02140508	Potomac River AL County
02141003	Wills Creek
02120205	Broad Creek
02130201	Pocomoke Sound
02130205	Nassawango Creek
02130207	Big Annemessex River
02130303	Wicomico Creek
02130307	Fishing Bay
02130404	Upper Choptank

TABLE 3: PRIORITY OF RECEIVING WATERS– MARYLAND STATE WATERSHEDS

Medium (2) ...continued

02130510	Upper Chester River
02130602	Bohemia River
02130609	Furnace Bay
02130703	Atkisson Reservoir
02130802	Lower Gunpowder Falls
02130805	Loch Raven Reservoir
02130908	S. Branch Patapsco
02131004	West River
02131107	Rocky Gorge Dam
02140101	Potomac River Lower Tidal
02140106	Wicomico River
02140201	Potomac River Upper Tidal
02140304	Double Pipe Creek
02140503	Marsh Run
02140506	Licking Creek
02140509	Little Tonoloway Creek
05020202	Little Youghiogheny River

High (4)

02130102	Assawoman Bay
02130105	Newport Bay
02130208	Manokin River
02130304	Wicomico River Headwaters
02130405	Tuckahoe River
02130507	Corsica River
02130511	Kent Island Bay
02130610	Sassafras River
02130701	Bush River
02130706	Swan Creek
02130807	Middle River-Browns Creek
02130902	Bodkin Creek
02130904	Jones Falls
02131003	South River
02131103	Western Branch
02131105	Little Patuxent River
02140203	Piscataway Creek
02140205	Anacostia River
02140207	Cabin John Creek
02140305	Catoctin Creek
05020203	Deep Creek Lake
02130103	Isle of Wight Bay
02130203	Upper Pocomoke River
02130301	Lower Wicomico River
02130308	Transquaking River
02130506	Langford Creek
02130509	Middle Chester River
02130604	Back Creek
02130611	Stillpond-Fairlee

TABLE 3: PRIORITY OF RECEIVING WATERS– MARYLAND STATE WATERSHEDS

High (4) ...continued

02130704	Bynum Run
02130803	Bird River
02130901	Back River
02130903	Baltimore Harbor
02131002	Severn River
02131102	Patuxent River Middle tidal
02131104	Patuxent River upper
02140104	Breton Bay
02140204	Oxon Creek
02140206	Rock Creek
02140208	Seneca Creek
02140504	Conococheague Creek

Very High (8)

02120201	Lower Susquehana River
02120204	Conowingo Dam Susq.Run
02130305	Nanticoke River
02130603	Upper Elk River
02130806	Prettyboy Reservoir
02130907	Liberty Reservoir
02140102	Potomac River Middle tidal
02140107	Gilbert Swamp
02140110	Nanjemoy Creek
02140302	Lower Monocacy River
02140502	Antietam Creek
02140510	Sideling Hill Creek
02140512	Town Creek
02141002	Evitts Creek
02141005	Potomac River Upper N.Br.
05020201	Youghiogheny River
02120202	Deer Creek
02130202	Lower Pocomoke River
02130503	Wye River
02130608	Northeast River
02130905	Gwynns Falls
02131101	Patuxent River Lower tidal
02140103	St.Mary's River
02140109	Port Tobacco River
02140111	Mattawoman Creek
02140303	Upper Monocacy River
02140507	Tonoloway Creek
02140511	Fifteen Mile Creek
02141001	Potomac River Lower N.Br.
02141004	Georges Creek
02141006	Savage River
05020204	Casselman River

ATTACHEMENT 1: REVISED UNISERVAL SOIL LOSS EQATION (RUSLE)

Source: USDA Natural Resources Conservation Service, 1995

The Revised Universal Soil Loss Equation (RUSLE) is a soil erosion prediction tool that identifies the factors that are a part of the interaction of rain and soil. While similar to the Universal Soil Loss Equation (USLE), RUSLE adds more specifics to the factors of the equation. These factors are quantified as the equation:

$$\mathbf{A = R \times K \times LS \times C \times P}$$

A, the predicted soil loss, is a product of:

R	=	Rainfall erosivity	Rain-related factor
K	=	Soil erodibility	
L	=	Slope length	} Soil-related factors
S	=	Slope gradient or steepness	
C	=	Cover and management	} Land management factors
P	=	Erosion control practices	

Rainfall erosivity factor R represents the driving force for sheet or rill erosion. It takes into consideration total rainfall, intensity and seasonal distribution of the rain. R is generally he same in the two equations; however, RUSLE computes a correction to R to reflect, for flat land, he effect of raindrop impact on water ponded on the surface.

Soil erodibility factor K indicates a soil's inherent susceptibility to erosion. Two important soil characteristics influencing erodibility are the infiltration capacity of the soil and the soil's structural stability. RUSLE accounts for season change in the soil such as freezing, thawing, soil moisture, and soil consolidation.

Topographic factors LS reflect the influence of length and steepness of slope on soil erosion. RUSLE refines USLE by assigning new equations based on the ration of rill to interrill erosion and accommodates complex slopes.

Cover and management factor C is the ratio of soil loss under the conditions in question to that which would occur under continuously bare soil. C uses subfactors: prior land use, canopy cover, surface cover and roughness, and soil moisture. RUSLE divides each year in the rotation into 15-day intervals, calculating the soil loss ratio for each time period. It also recalculates a new soil loss ration every time a tillage operation changes one of the subfactors.

Support practice factor P is the ration of soil loss with a given support practice (generally, a best management practice) to the corresponding loss if there were no support practices. P factor values are based on hydrologic soil groups, slope row grade, ridge height, and the 10-year single storm erosion index value. RUSLE computes the effect of strip cropping based on the transport capacity of flow in dense strips relative to the amount of sediment reaching the strip. The P factor for conservation planning considers the amount and locations of deposition.