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Soil Fertility Management

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THE MARYLAND PHOSPHORUS SITE INDEX: AN OVERVIEW

The Phosphorus Index Concept

In 1990, a national cooperative workgroup of scientists from numerous Universities and the USDA was organized to develop a procedure that could identify soils, farm management practices, and specific locations within a farm where phosphorus (P) losses in field drainage water may pose the potential for negative environmental impacts on nearby surface waters. The goals of this national workgroup were:

- To develop an easily used field rating system that rates farm fields according to the potential for P loss to surface water (the Phosphorus Index).
- To relate the P Index to the sensitivity of receiving surface waters to eutrophication and degradation resulting from nonpoint source P enrichment.
- To facilitate adaptation and modification of the P Index to regional and site-specific conditions.
- To develop agricultural management practices that will minimize the buildup of soil P to excessive levels and the transport of P from soils to sensitive water bodies.

The Objective of the Phosphorus Index

The P Index uses readily available information to evaluate two broad categories of factors that contribute to the potential for P loss from agricultural land: 1) P loss potential due to site and transport characteristics; 2) P loss potential due to management and source characteristics. The first group of factors assesses the potential for P to be transported off of the field with runoff, leaching, and drainage water. The second group of factors assesses the quantity, availability, and forms of P present at the site and the likelihood that the P present in the soil is a source of potential environmental concern. The aim of the P Index is to identify critical areas where there is a high P loss potential from the site because there is both a large potential for transport of P off of the field and a large source of P present in the soil that may potentially pose a significant environmental impact if it reaches nearby surface waters.

Development of a Modified Phosphorus Index Specifically for Maryland Conditions

In 1994, we began the development of a P Index specifically tailored to Maryland's soils, agricultural management practices, climate, topography, hydrology and surface water characteristics. The Maryland Phosphorus Site Index (PSI) was originally based on the generic national model published in 1993 by the USDA's Natural Resources Conservation

Service, but has undergone many substantive changes and modifications during its development so that it more accurately reflects Maryland conditions.

The Maryland PSI has been evaluated on nearly eight hundred farm fields across the state. The information generated from those on-farm evaluations has been used to develop this initial version of the PSI. As more farm fields are evaluated and we gain more information on the strengths and weaknesses of this nutrient management planning tool, revised and improved versions of the PSI will likely be developed.

How the Maryland Phosphorus Site Index Works

The Maryland PSI is structured into two distinct portions: Part A and Part B (Table 1). Part A evaluates the P loss potential due to physical site characteristics and P transport potential. This assessment is made by evaluation of six site-specific characteristics: soil erosion, surface runoff, subsurface drainage, leaching potential, distance to surface water, and watershed priority ranking. Part B evaluates the P loss potential due to farm management practices and P source characteristics by assessing six additional factors: conventional soil-test P level, P fertilizer application rate, P fertilizer application method, organic-source P (manures, biosolids, composts, etc.) application rate, organic-source P availability or solubility, and organic-source P application method.

Each of the twelve site characteristics or management factors is evaluated for a specific location and assigned a numeric value. The sum of the site characteristics determined for Part A is multiplied by a scaling factor (0.02) so that P transport potential is expressed on a relative scale with a range of 0 to 1, for most situations. Thus, the total site and transport value determined for Part A can be interpreted as the proportion of the P source present at the site that is susceptible to being transported off of the field by drainage water and impacting adjacent surface waters.

The sum of the management practice and source characteristic values determined for Part B is multiplied by the total site and transport value determined for Part A and the product is the final "P Loss Rating" for the site. This multiplicative operation assures that the fields that have the highest P Loss Rating have both a high P transport potential (large Part A value) and large source of potentially damaging P (large Part B value). If either the P transport potential (Part A) or the P source characteristics (Part B) are low, then the final P Loss Rating will be relatively low.

Interpreting the P Loss Rating

The final P Loss Rating is subdivided into four interpretive categories: Low, Medium, High, and Very High. Table 2 can be used to interpret the management implications of the P Loss Rating determined for a specific site. It is important to understand that the P Loss Rating is only a relative value and is not a numeric or quantitative prediction of P loss from the field. Sites with a P Loss Rating in the "Low" category are predicted to have a relatively lower potential for P losses than sites in the "Medium" category. Sites with a P Loss Rating in the "Medium" category are predicted to have a relatively lower potential for P losses than those locations with a "High" P Loss Rating, and so on.

Using the Maryland Phosphorus Site Index

The purpose of this publication was to present a brief overview of the Maryland Phosphorus Site Index. For specific detailed information on how to use the Maryland PSI in developing an agricultural nutrient management plan, please see *The Maryland Phosphorus Site Index Technical Users Guide*, Soil Fertility Management Information Series, SFM-7, which is available from the Maryland Cooperative Extension.

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Table 1. The Maryland Phosphorus Site Index, April 2005.

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)	**PSC** 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: _____

Table 2. Interpretation of the Maryland Phosphorus Site Index P Loss Ratings.

P Loss Rating	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 planning is satisfactory for this site. • Soil P levels and P loss potential may increase in the future due to continued nitrogen-based nutrient management.
51-75	• **MEDIUM** potential for P movement from this site given current management practices and site characteristics. Practices should be implemented to reduce P losses by surface runoff, subsurface flow, and erosion. • Nitrogen-based nutrient management planning should be implemented no more than one year out of three. • Phosphorus-based nutrient management planning should be implemented two years out of three during which time P applications should be limited to the amount expected to be removed from the field by crop harvest or soil-test based P application recommendations, whichever is greater.
76-100	• **HIGH** potential for P movement from this site given current management practices and site characteristics. • Phosphorus-based nutrient management planning should be used for this site. Phosphorus applications should be limited to the amount expected to be removed from the field by crop harvest or soil-test based P application recommendations. • All practical management practices for reducing P losses by surface runoff, subsurface flow, or erosion should 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. • Active remediation techniques should be implemented in an effort to reduce the P loss potential from this site.