Index - Nitrogen and Phosphorous Transport - Risk Assessment Procedures

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Introduction - Nitrogen and Phosphorous Transport - Risk Assessment Procedures

Nitrogen and Phosphorous are the two nutrients most often associated with the impairment of the quality of our groundwater and surface water. Nitrogen leaching out the root zone may enter a tile and be transported to surface water or it may leach to the groundwater. The EPA Drinking Water Maximum Contaminant Level (MCL) for Nitrates is 10 mg/L. Phosphorous leachate, or runoff entering the surface water may contribute to excessive algae growth which may cause low oxygen levels in surface water. This in turn may impair aquatic live and adversely effect the taste of the water.

To supply the needed nutrients to achieve realistic yield goals and minimize the transport of nitrogen and phosphorous to ground and surface water the Nitrogen and Phosphorous Risk Assessment Procedures have been developed.

The Nitrogen and Phosphorous Risk Assessment Procedures are designed to assist the planner and the producer to identify fields or areas of a field that have varying risks of nutrient transport and assist in the planning the land treatment and management to minimize nutrient transport and achieve production goals.

Nitrogen Leaching Risk Assessment

The Nitrogen Leaching Index evaluates a site's risk of nitrogen leaching out of the plant root zone into tile flow or to groundwater.

The Nitrogen Leaching Index classifies soils as having a high, medium, or low nitrogen leaching potential with relative index ratings from 0-10+ for their potential to leach nitrates below the root zone. The leaching potential is rated as high, medium, or low by combining the soil’s hydrologic soil grouping (A, B, C, or D), the local county's annual rainfall, and the local county's season rainfall (Oct. 1 to March 1).

Phosphorous Transport Risk Assessments

Two phosphorous risk assessment options are available in Ohio for planners and producers to use to plan land treatment and management to minimize phosphorous transport and achieve production goals. The two options are (1) The Phosphorous Index and (2) the Soil Test Risk Assessment Procedure. It is the decision of the planner and the producer as to which method is most appropriate to meet the resource concerns and producer objectives.

(1) Phosphorous Index (P Index) Risk Assessment Procedure

The P Index is a procedure that combines well established factors that influence the transport of phosphorous to surface waters. Each of the factors is evaluated based on site specific data and weighted according to its overall effect on phosphorous transport. Each of the site subvalues are added together to establish an overall site rating of Low, Moderate, High, or Very High risk.

In most cases the use of the P Index will allow higher rates of phosphorous application than the Soil Test Risk Assessment Procedure. The use of the P Index should be viewed as a

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temporary measure until other alternatives can be developed to utilize excess phosphorous produced on the farm.

(2) Soil Test Risk Assessment Procedure

The Soil Test Risk Assessment Procedure establishes risk based on the soil test phosphorous level of the soil. As soil test phosphorous levels increase, water passing over the surface more easily absorbs phosphorous and transports it in the runoff. The Soil Test Risk Assessment Procedure establishes increasing levels of phosphorous application management as the soil test phosphorous levels increase. When soil test values for phosphorous reach Bray P1 of 150 ppm or more no additional phosphorous application is recommended.

The Soil Test Risk Assessment Procedure allows a more sustainable soil and water resource system because it establishes a maximum of 150 ppm Bray P1. By keeping soil test levels below 150 ppm Bray P1 the producer keeps more options open for future land use and treatment options. The use of the P Index, although it may allow additional phosphorous application in the short term, will require more restrictive land treatment and management in the future to minimize the risk of phosphorous transport.

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Ohio - Nitrogen Leaching Assessment Procedure

Soils are classified as having a high, medium, or low nitrogen leaching potential with relative index ratings from 0-10+ for their potential to leach nitrates below the root zone. The leaching potential is rated as high, medium, or low by combining the soil's hydrologic soil grouping (A, B, C, or D), the local county's annual rainfall, and the local county's season rainfall (Oct. 1 to March 1).

To determine the soil's nitrogen leaching potential use the following procedure.

1st , determine the soils hydrological soil grouping (Found in Section II of the FOTG) - A, B, C, or D.

2nd , Refer to the Table (next page) - **Ohio (By County) Leaching Index Ratings for Soils by Hydrologic Groups (A, B, C, D)** for the respective county to determine the soils relative leaching index rating.

(a) Soils with a rating of 0-2 have a low potential to leach nitrates below the root zone.
(b) Soils with a rating of 3-10 have a medium potential to leach nitrates below the root zone.
(c) Soils with a rating of 10+ have a high potential to leach nitrates below the root zone.
(d) All soils with systematic subsurface drains (tile) are rated high potential.

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Ohio (By County) Leaching Index Ratings for Soils by Hydrologic Groups (A, B, C, D)

County	A	B	C	D	County	A	B	C	D
1. Adams	15	10	6	4	45. Licking	15	8	6	4
2. Allen	10	6	4	2	46. Logan	15	8	4	4
3. Ashland	15	8	4	4	47. Lorain	15	8	4	2
4. Ashtabula	15	10	4	4	48. Lucas	10	6	4	2
5. Athens	15	10	6	4	49. Madison	15	8	6	4
6. Auglaize	10	8	4	2	50. Mahoning	15	8	4	4
7. Belmont	15	10	6	4	51. Marion	15	8	4	4
8. Brown	15	10	6	4	52. Medina	15	8	4	4
9. Butler	15	10	6	4	53. Meigs	15	10	6	4
10. Carroll	15	8	4	4	54. Mercer	10	8	4	2
11. Champaign	15	8	4	4	55. Miami	15	8	4	4
12. Clark	15	8	6	4	56. Monroe	15	10	6	4
13. Clermont	15	10	6	4	57. Montgomery	15	10	6	4
14. Clinton	15	10	6	4	58. Morgan	15	8	6	4
15. Columbiana	15	8	4	4	59. Morrow	15	8	4	4
16. Coshocton	15	8	4	4	60. Muskingum	15	8	6	4
17. Crawford	15	8	4	2	61. Noble	15	8	6	4
18. Cuyahoga	15	8	4	4	62. Ottawa	10	6	4	2
19. Darke	15	8	4	4	63. Paulding	10	6	4	2
20. Defiance	10	6	4	2	64. Perry	15	8	6	4
21. Delaware	15	8	4	4	65. Pickaway	15	8	6	4
22. Erie	10	8	4	2	66. Pike	15	10	6	4
23. Fairfield	15	8	6	4	67. Portage	15	8	4	4
24. Fayette	15	10	6	4	68. Preble	15	10	6	4
25. Franklin	15	8	6	4	69. Putnam	10	6	4	2
26. Fulton	10	6	4	2	70. Richland	15	8	4	4
27. Gallia	15	10	6	4	71. Ross	15	10	6	4
28. Geauga	15	10	4	4	72. Sandusky	10	6	4	2
29. Greene	15	10	6	4	73. Scioto	15	10	6	4
30. Guernsey	15	8	6	4	74. Seneca	10	6	4	2
31. Hamilton	15	10	6	4	75. Shelby	15	8	4	4
32. Hancock	10	6	4	2	76. Stark	15	8	4	4
33. Hardin	10	8	4	2	77. Summit	15	8	4	4
34. Harrison	15	8	6	4	78. Trumbull	15	8	4	4
35. Henry	10	6	4	2	79. Tuscarawas	15	8	4	4
36. Highland	15	10	6	4	80. Union	15	8	4	4
37. Hocking	15	10	6	4	81. Van Wert	10	6	4	2
38. Holmes	15	8	4	4	82. Vinton	15	10	6	4
39. Huron	10	8	4	2	83. Warren	15	10	6	4
40. Jackson	15	10	6	4	84. Washington	15	10	6	4
41. Jefferson	15	8	6	4	85. Wayne	15	8	4	4
42. Knox	15	8	4	4	86. Williams	10	6	4	2
43. Lake	15	10	4	4	87. Wood	10	6	4	2
44. Lawrence	15	10	6	4	88. Wyandot	10	8	4	2

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Phosphorous Index (P Index) Assessment Procedure

Purpose:
The P Index is a planning tool designed to help identify fields or areas of fields on a farm that have a higher or lower risk of phosphorous runoff from the application of commercial P fertilizers or from manure or other organic materials. Based on the risk assessment the appropriate land treatment and nutrient application treatments can be planned to minimize phosphorous transport from the site.

Procedure:
Use the P Index Assessment Procedure Worksheet to determine the site's overall P Index. Use the following guidance to determine each of the site's subvalues. The subvalues are added together to determine the overall site P Index. The worksheet can be photocopied as needed. A "Field Summary Worksheet" is also available with this procedure to record a series of site/field values for a given farm. It can be photocopied as needed.

1. **SOIL EROSION** – Sheet and rill erosion as measured by the most current version of the Revised Universal Soil Loss Equation (RUSLE) or Wind Erosion Prediction Procedure (where wind erosion is the primary concern) in Section I of the NRCS FOTG. Determine the predicted soil loss and multiply by (1) to determine the "soil loss" site subvalue.

2. **RUNOFF CLASS** – This represents the effect of the Hydrologic Soil Group (A, B, C, D) combined with the effect of slope. This factor represents the site's runoff vulnerability. Use the table below to determine the runoff class. The runoff class is the site's subvalue.

Runoff Class Matrix - Phosphorous Index Values

	Hydrologic Soil Group			
Slope Range	**A**	**B**	**C**	**D**
<1 %	0	1	3	6
1-3%	1	2	4	7
4-6%	2	3	5	8
7-10%	3	5	7	10
11-15%	4	6	9	12
>15%	6	8	11	15

3. **CONNECTIVITY TO WATER** – Defines the vulnerability of P to be transferred from the site to a perennial stream or water body. The more closely connected the runoff is from the field via concentrated flow (from a defined grassed waterway or surface drain) to a perennial stream or water body the higher the vulnerability of P transport. To determine the "connectivity to water" site subfactor ask the question: Does concentrated flow (via a defined waterway, tile inlet, or surface drain) leave the site? Read the value definitions to determine the site's "connectivity to water" subvalue.

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4. **SOIL "P" TEST (BRAY-KURTZ P1)** – The soil test procedure using the Bray P1 extraction, or other extraction test calibrated to Bray P1, that provides an index of plant available P expressed in either ppm or lbs/ac (ppm X 2 = lbs/ac). Determine the Bray P1 value in PPM and multiply the PPM by (0.07) to determine the "soil P test site subvalue.

5. **FERTILIZER P2O5 APPLICATION RATE** - The amount of manufactured (commercial) phosphate fertilizer applied expressed in lbs/ac of P2O5. To determine the site's subvalue multiply the year's P fertilizer application rate by (0.05).

6. **FERTILIZER P2O5 APPLICATION METHOD** – Defines if the phosphate (P2O5) fertilizer is actually incorporated into the soil and the time interval between application and incorporation or if the fertilizer is applied over a given amount of crop residue. Incorporation is either through direct injection with the fertilizer application equipment or using a tillage tool operated a minimum of 3-4 inches deep to incorporate the P2O5 fertilizer. To determine the site's subvalue select the description that most closely describes the method of application. The value with that description is the site's subvalue.

7. **ORGANIC P2O5 APPLICATION RATE** - The amount of phosphate applied (expressed in lbs/ac of P2O5) from manure, sludge, or other bio-solids. To determine the site's subvalue multiply the year's P fertilizer application rate by (0.06).

8. **ORGANIC P2O5 APPLICATION METHOD** - Defines if the phosphate (P2O5) from the manure, sludge, or other bio-solids is actually incorporated into the soil, the time interval between application and incorporation, or if the manure/bio-solids are applied over a given amount of crop residue. Incorporation is either through direct injection with the application equipment or by using a tillage tool operated a minimum of 3-4 inches deep to incorporate the manure, sludge, or other bio-solids. To determine the site's subvalue select the description that most closely describes the method of application. The value with that description is the site's subvalue.

9. **FILTER STRIP** - Deduct 2 points if field runoff flows via sheet flow through a designed filter strip - minimum 33 feet wide. The filter strip must meet the NRCS FOTG Filter Strip (393) Standard criteria. It is critical that sheet flow crosses the filter strip, not concentrated flow, to credit a 2 point deduction.

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Phosphorous Index Risk Assessment Procedure Worksheet

Site Characteristic	Phosphorous Vulnerability Values					Site Sub - Value
1. Soil Erosion	**Soil Loss (Tons/Acre/Year) X 1.0**					
2. Connectivity to Water. Does concentrated flow (via a defined waterway, tile inlet, or surface drain) leave the site?	NO, and the site is not adjacent to an intermittent or perennial stream. **Value = 0**	NO, but the site is adjacent to an intermittent or perennial stream. **Value = 4.0**	Yes, but the site is not adjacent to an intermittent or perennial stream. **Value = 8.0**	Yes, and the site is adjacent to and/or the concentrated flow outlets into an intermittent stream or through a tile inlet. **Value = 12.0**	Yes, and the site is adjacent to and/or the concentrated flow outlets into a perennial stream or through a tile inlet; OR Outlets to a pond or lake within 1 mile. **Value = 16.0**	
3. Runoff Class	**See Runoff Class Matrix**					
4. Soil Test Bray-Kurtz P1 PPM	**Bray – Kurtz P1 (PPM) X (0.07)**					
5. Fertilizer P2O5 Application Rate	**Fertilizer P2O5 Applied (Lbs/Acre) X (0.05)**					
6. Fertilizer P2O5 Application Method	0 Applied **Value = 0**	Immediate Incorporation Or Applied on 80% Cover **Value = 0.75**	Incorporation < 1 Week Or Applied on 50-80% Cover **Value = 1.5**	Incorporation > 1 Week & < 3 Months Or Applied on 30-49% Cover **Value = 3.0**	No Incorporation Or Incorporation > 3 Months Or Applied on < 30% Cover **Value = 6.0**	
7. Organic P2O5 Application Rate	**Available - Manure / Biosolids P2O5 Applied (Lbs/Ac) X (0.06)**					
8. Organic P2O5 Application Method	0 Applied **Value = 0**	Immediate Incorporation Or Applied on 80% Cover **Value = 0.5**	Incorporation < 1 Week Or Applied on 50-80% Cover **Value = 1.0**	Incorporation > 1 Week & < 3 Months Or Applied on 30-49% Cover **Value = 2.0**	No Incorporation Or Incorporation > 3 Months Or Applied on < 30% Cover **Value = 4.0**	
Filter Strip Factor (Deduct 2 points if field runoff flows through a designed filter strip - minimum 33 feet wide)						
Total Site Index Value						

Field Vulnerability for Phosphorous Loss to Surface Water

Phosphorous Index for Field	Generalized Interpretation of Phosphorous Index & Management
LOW < 15	LOW potential for P movement from the field. If farming practices are maintained at the current level there is a low probability of an adverse impact to surface waters from P loss. Manure or other bio-solids can be applied to meet the recommended nitrogen for the next grass crop or nitrogen removal of the next legume crop.
MEDIUM 15-30	MEDIUM potential for P movement from the field. The chance of organic material and nutrients getting into surface water exists. Runoff reduction practices such as buffers, setbacks, lower manure/bio-solid rates, cover crops, and crop residue practices alone or in combination should be considered to reduce P loss impacts. Manure or other bio-solids can be applied to meet the recommended nitrogen for the next grass crop or nitrogen removal of the next legume crop. Applications of P at the crop removal rate should be considered.
HIGH 31-45	HIGH potential for P movement from the field and for an adverse impact on surface waters unless remedial action is taken. Runoff reduction practices such as buffers, setbacks, lower manure/bio-solid rates, cover crops, and crop residue practices alone or in combination should be considered to reduce P loss impacts. Limit application of P to crop removal rates.
VERY HIGH > 45	VERY HIGH potential for P movement from the field and an adverse impact on surface water. Remedial action is required to reduce the risk of P loss. A complete soil and water conservation system is needed. Apply no additional P.

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P Index Field Summary

Name: **Farm:**

	Fields										
Site Characteristic											
1. Erosion (Value)											
2. Connectivity to Water (Value)											
3. Runoff Class (Value)											
4. STP (Value)											
5. P2O5 Fertilizer Rate (Value)											
6. P2O5 Fertilizer Method (Value)											
7. Manure Rate (Value)											
8. Manure Application Method (Value)											
9. Filter Strip (-2)											
Total Field Score											
Field Rating											

Field Vulnerability for Phosphorous Loss to Surface Water

Phosphorous Index for Field	**Generalized Interpretation of Phosphorous Index & Management**
LOW < 15	LOW potential for P movement from the field. If farming practices are maintained at the current level there is a low probability of an adverse impact to surface waters from P loss. Manure or other bio-solids can be applied to meet the recommended nitrogen for the next grass crop or nitrogen removal of the next legume crop.
MEDIUM 15-30	MEDIUM potential for P movement from the field. The chance of organic material and nutrients getting into surface water exists. Runoff reduction practices such as buffers, setbacks, lower manure/bio-solid rates, cover crops, and crop residue practices alone or in combination should be considered to reduce P loss impacts. Manure or other bio-solids can be applied to meet the recommended nitrogen for the next grass crop or nitrogen removal of the next legume crop. Applications of P at the crop removal rate should be considered.
HIGH 31-45	HIGH potential for P movement from the field and for an adverse impact on surface waters unless remedial action is taken. Runoff reduction practices such as buffers, setbacks, lower manure/bio-solid rates, cover crops, and crop residue practices alone or in combination should be considered to reduce P loss impacts. Limit application of P to crop removal rates.
VERY HIGH > 45	VERY HIGH potential for P movement from the field and an adverse impact on surface water. Remedial action is required to reduce the risk of P loss. A complete soil and water conservation system is needed. Apply no additional P.

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Phosphorous Soil Test Risk Assessment Procedure

Nitrogen and Phosphorous Application Criteria For Manure, Organic By-Products, and Biosolids

Criteria Applicable to All Soil Test Levels:

1. Nitrogen application rates from manure, other organic by-products, or biosolids shall be based on Total Ammonium Nitrogen Content plus 1/3 of the Organic Nitrogen calculated at time of application when applied during the summer, fall, or winter for spring planted crops. When applied in the spring for spring planted crops the nitrogen application rate can be adjusted to apply the recommended nitrogen within the P2O5, K2O, and other limitations.
2. Nitrogen rates are not to exceed the succeeding crop's recommended Nitrogen for non-legume crops or the Nitrogen removal in the crop's biomass for legume crops.
3. All applications are based on current soil test results (not more than 3-5 years old).
4. No manufactured P2O5 applied above 40 ppm Bray P1 or equivalent test, unless recommended by appropriate industry standards or the land grant universities for specialty crops, vegetable crops, etc.

"P" Soil Test Level	Application Criteria
Bray P1 < 40 ppm (< 80 Lbs/Ac) OR Other Equivalents (e.g. Mehlich 3) **LOW POTENTIAL**	**Recommended N or P2O5.** Manure or other Organic By-Products can be applied to meet the succeeding crop's recommended NITROGEN requirements for non-legume crops or the NITROGEN removal for legume crops; OR the recommended P2O5 but not to exceed the NITROGEN needs of the succeeding crop.
Bray P1 40-100 ppm (80 – 200 Lbs/Ac) OR Other Equivalents (e.g. Mehlich 3) **MODERATE POTENTIAL**	**Recommended N or P2O5 Removal whichever is less.** The field shall have > 30% ground cover at the time of application or the manure or other organic by-products shall be incorporated within one week. The manure or other organic by-products can be applied to meet the succeeding crop's recommended NITROGEN requirements for non-legume crops or the NITROGEN removal for legume crops; OR P2O5 removal (annual or multiple year applications) whichever is less.
Bray P1 100-150 ppm (200-300 Lbs/Ac) OR Other Equivalents (e.g. Mehlich 3) **HIGH POTENTIAL**	**Recommended N or P2O5 Removal whichever is less PLUS additional distance criteria from drainageway/water source or other sensitive area, OR Filter Strips.** Manure or other organic by-products can be applied to meet the succeeding crop's recommended NITROGEN requirements for non-legume crops or the NITROGEN removal for legume crops; OR P2O5 removal (annual or multiple year applications) whichever is less **IF:** 1. The field has > 50% ground cover at the time of application or the material is incorporated within 7 days on areas with < 50% cover. AND 2. Unless the manure or other organic by-products are incorporated within 24 hours, no manure or other organic by-products are to be applied within 100 feet of a drainageway, water source or other sensitive area; OR, the width of a vegetative filter strip (minimum width 33 feet) maintained adjacent to the drainageway, water source, or sensitive area.
Bray P1 > 150 ppm (> 300 Lbs/Ac) OR Other Equivalents (e.g. Mehlich 3) **VERY HIGH POTENTIAL**	No additional P2O5 – Use P2O5 Draw-down Strategies

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