

Nitrogen and Phosphorus Risk Assessment Tools

Nitrogen Leaching Index
Phosphorus Soil Test Method
Phosphorus Index



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Nitrogen Leaching Assessment Procedure



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N Risk Assessment - Objective

- To minimize agricultural non-point source pollution in surface & ground water.
 - N has potential to leach out the root zone, may enter tile and be transported to surface water or it may leach to the groundwater.
 - EPA Drinking Water Maximum Contaminant Level is 10 mg/L



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Nitrogen Leaching Risk Assessment

- Used to assess each field's potential for nitrates to leach out of the plant root zone and into tile flow or to groundwater.
- Nitrogen Leaching Risk Assessment Procedure found in Section 1, FOTG.
- Nitrogen leaching potential is determined by combining the soil's hydrologic soil grouping, the local county's annual rainfall, and the local county's seasonal rainfall.
- Tile Drainage.



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Step 1. Are Significant Areas of the Field Tiled or Systematically Tiled.

- All soils with systematic subsurface drains are rated as having a “high risk potential” to leach nitrates to tile flow.
- Fields with random tile lines present the potential to carry nitrates and may be considered as “high risk”. Is significant if $\geq 1/3$ is tile drained.



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Step 2. If not Tile Drained. What is the Predominant Soil Type for Each Field?

- The soil type mapped over the majority of the field.
- Consider the most limiting soil type (based on its hydrological soil grouping) as mapped in the field.
- May subdivide the field if significant areas are rated high or low in the same field.



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Step 3. If Field Not Tiled. What is the Soils' Hydrologic Group

- Found in Section II, FOTG by soil types. (Should be included in the "Conservation Plan")
- Soils are labeled by their Hydrologic Soil Group (A, B, C, D)
(Used with Runoff Computations)



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Step 4. Determine the Leaching Index by Hydrologic Soil Group


- Refer to "Ohio (By County) Leaching Index Ratings for Soils by Hydrologic Groups" found in Section I, FOTG.
- The Leaching Index factors include:
 - Soil Hydrologic Group
 - County's annual rainfall
 - County's rainfall amount from Oct. 1- March 1



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N - Leaching Index Ratings

- Fields with:
 - 0-2 rated low potential to leach nitrates
 - 3-10 medium potential
 - > 10 high potential




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Example of County Leaching Index Ratings

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




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Comparing Ohio's Leaching Index with Soil Hydrologic Group

<p>Soil Hydrologic Group:</p>	<p>Leaching Index:</p>																
<div style="border: 1px solid black; background-color: #FFD700; padding: 2px; display: inline-block; margin-bottom: 5px;">Depends On County / Climate</div>	<table border="0" style="width: 100%;"> <tr><td style="width: 10%;">A</td><td style="width: 10%;">15</td><td style="width: 80%;">High</td></tr> <tr><td>A</td><td>10</td><td>Medium</td></tr> <tr><td>B</td><td>6-10</td><td>Medium</td></tr> <tr><td>C</td><td>4-6</td><td>Medium</td></tr> <tr><td>D</td><td>2-4</td><td>Low to medium</td></tr> </table>	A	15	High	A	10	Medium	B	6-10	Medium	C	4-6	Medium	D	2-4	Low to medium	
A	15	High															
A	10	Medium															
B	6-10	Medium															
C	4-6	Medium															
D	2-4	Low to medium															


Generally Sandy & Gravelly Soils With High Permeability are Rated "High" (> 10)



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Criteria: "High Risk Potential" Fields with Manure as Source of Nitrogen


- Applicable when making manure applications in the summer and/or fall periods.
- After October 1, or when soil temperature is averaging below 50-degree F.
- Severe limitations on fall applied commercial nitrogen.



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**Nitrogen Criteria – High Leaching Fields
Summer Applied
Max N Application If Applied Before Oct. 1st:**

Next Crop ↓	Max. N Applic. No Growing Crop	Max. N Applic. Growing Cover Crop
Non Legume Crop	50 #/Ac Calculated at Application Time	Recommended N Rate For Next Crop Calculated at Application Time
Legume Crop	50 #/Ac Calculated at Application Time	N Crop Removal For Next Crop Calculated at Application Time


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**Criteria: “High “N” Risk Potential” Fields
with Commercial “N” Fertilizer**

Spring Planted Crops

Apply the recommended nitrogen for spring planted crops either ...

- prior to planting spring crops
- or, split applications between pre-plant and a sidedress application

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Criteria: "High Risk Potential" Fields with Commercial Fert. As Source of N

Fall Planted Crops

20 to 30 Lb/Ac of N at planting with remaining "N" applied in early spring.



Comm. N Applic. Spring Seeded Crops

Table 1

Nitrogen Form	Applied in Fall Soil <50° F	Applied in Spring Soil <50° F	Applied Spring Soil >50° F	Early Summer Sidedress or Split
Urea – Broadcast		X ³⁾		
Urea – Incorporate ²⁾	X ¹⁾	X ⁴⁾	X ⁴⁾	X ⁵⁾
Urea with Urease (Inhibitor)			X ⁴⁾	X
UAN – Broadcast		X ³⁾		
UAN – Incorporate		X ⁴⁾	X ⁴⁾	X ⁵⁾
Ammonium Based	X ¹⁾	X ^{3) 4)}	X ⁴⁾	X ⁵⁾
NH ₃ Inject Only	X ¹⁾	X	X	X ⁵⁾
NH ₃ Inject Only with Inhibitor	X ^{1) 7)}	X ⁴⁾	X ⁶⁾	

Footnotes:

1. Only recommended on well drained silt loam and loam soils with low to medium leaching potential.
2. Incorporation includes the use of standard primary and secondary tillage tools, knife, and injectors.
3. Preferred timing for wheat production.
4. Preferred timing for corn production on FINE OR MEDIUM textured soils that are tile drained to minimize nitrate leaching losses in tile flow.
5. Recommended for untilled poorly and somewhat poorly drained MEDIUM and FINE soils; and for COARSE TEXTURE soils.
6. On poorly and somewhat poorly drained soils.
7. Option for Fall application for spring planted crops on soils with a high leaching potential (due to being tile drained).

Criteria: "High Risk Potential" Fields with Commercial Fert. As Source of N

Perennial Crop

2 to 3 split applications early spring,
early and/or late summer



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Nitrogen Management Summary

- Tiled fields are high risk
 - short distance to interception and transport to surface water
- Apply N as close as possible to crop use
- Fall Application Not Recommended
- Special Summer Manure Application
 - Max. 50 Lbs/Ac of N based on manure as applied.
- Fall Applications after October-November to limit N mineralization (Soils at or below 50 degrees).



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Purpose of “P” Risk Assessment

To Assess the Risk of Phosphorus Movement from Field(s)

Two Assessment Methods:

1. Phosphorus Soil Test Risk Assessment
2. Phosphorus Index Risk Assessment



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Phosphorus Soil Test Risk Assessment

- Based on Soil Test Result for Each Field
- Current, 3 to 5 years
- Bray-Kurtz P1 or adjusted Mehlich 3



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Soil Test Assessment Method P Transport Risk for Manure Application

- Low Risk Potential < 40 ppm Bray P1
- Mod. Risk Potential 40 - 100 ppm Bray P1
- High Risk Potential 100-150 ppm Bray P1
- Very High Risk Potential >150 ppm Bray P1



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Low Risk Potential

< 40 ppm or 80 Lbs/ac

- Recommended N for succeeding crop
- OR P205 recommended/removal for annual or multiple year manure (P205) applications.

Example:

5 tons/ac for P205 needs

15 tons/ac for N needs

- Apply 15 tons to meet N need and 3 years of P205 needs

Note: May need to calculate Bray P1 Soil Buildup



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Moderate Risk Potential

40-100 ppm or 80 to 200 lb/ac

- Recommended N for succeeding crop or P205 removal whichever is less
- > 30% ground cover or manure incorporated within one week
- No commercial P205 recommended



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High Risk Potential

100-150 ppm or 200-300 lb/a

- Recommended N for succeeding crop or P205 removal whichever is less.
- Plus distance criteria:
 - 100 Ft. from drainageways, water sources, or other sensitive areas if NOT Incorporated and NO Filter Strip.
 - 33 Ft. Filter Strip
 - "0" setback if manure is incorporated within 24 hours
- > 50% ground cover, or manure incorporated within 7 days



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Very High Risk Potential

> 150 ppm or > 300 lb/a

- No manure or organic by-products
- No additional P205
- Use P205 draw-down strategies
 - change rotation
 - cover crops
 - double crop
 - removal of crop residue
 - change feed ration



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Other Criteria for Summer, Fall, and Winter Application

Nitrogen application from manure for spring planted crops is to be based on:

Total Ammonium N + 1/3 of Organic N
Calculated @ time of application



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"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 1. 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



Other Criteria - Spring Manure Application

Nitrogen application from manure for spring planted crops:

May be adjusted to apply the recommended N

(Increase manure application rate to offset N losses)

Within the P205 and K20 limitations



Other Manure Application Criteria

Do not exceed in one year's application:

- 250 lb/ac of P2O5
or
- 500 lb/ac of P2O5 for High Nutrient Concentrated Manure (Fields < 100 ppm Bray P1)
 - 60 Lbs of P2O5 per 1000 gallons, or
 - 80 Lbs of P2O5 per ton
- 500 lb/ac of K2O



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Commercial P2O5


- Phosphorus is not to be applied above the amount recommended per the Tri-State Fertility Guide or by OSU guidance
- Erosion rate managed to "T" or less



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Phosphorous Index Assessment Method


Purpose
Factors
How to Use



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Purpose of P - Index

- Tool for field personnel to identify fields, areas, and practices that have the greatest risk of “P” transport.
- The tool is based on “widely accepted” factors (not just one factor) contributing to “P” transport.
- It is not an absolute measure - it is planning tool.



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P - Index vs. Soil Test Method

- Soil Test Method is the most “sustainable”.
- P - Index generally permits higher “P” application rates - could be short-term.
- P - Index buys time until new technology comes along.



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P - Index Factors




1. Erosion
2. Connectivity to Water
3. Runoff Potential
4. Bray P1 Soil Tests
5. Amt. Fert. Applied
6. Method of Fert. Appl.
7. Amt. Manure Applied
8. Method of Manure Appl.
9. Filter Strip Management




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P Index - Erosion

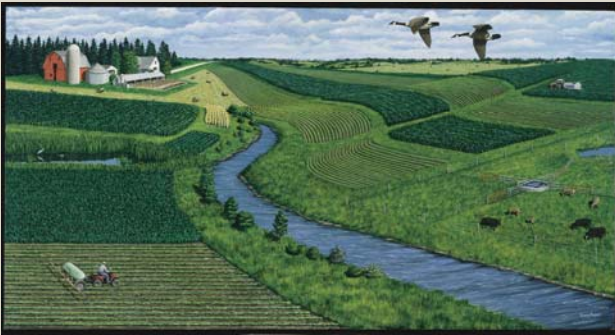


- Addresses P attached to soil
- Indirectly dissolved P in runoff
- Measure using RUSLE and WEQ/WEPS


The lower the erosion rate the lower the risk of “P” runoff.


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P Index - Connectivity to Water



- Measure of the risk of P transported in water runoff to a perennial stream or water body.
- The closer the connection the higher the risk.


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Connectivity to Water



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Runoff Class

- Looks at the sites potential to produce runoff.
- Combines Soil Hydrologic Group with Slope
- Use Soil Survey and Measured Field Slope
(Generally the same slope used for RUSLE)

Runoff Class Matrix - Phosphorous Index Values


Slope Range	Hydrologic Soil Groups			
	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




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P Index - Bray P1 STP



- The higher the P level in the soil the more P subject to transport via soil and water.
- Measured as Bray P1 in PPM






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P Index Amount Fertilizer & Manure Applied




- The more P added at any one time the higher the risk of P transport.
- Fertilizer weighted more than Manure.
(fertilizer is more soluble)
- Measure lbs/ac P2O5




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P Index Method of Fertilizer & Manure Application

- Incorporated & High Residue Reduces Risk.
- Quicker Incorporation Reduces Risk
- Fertilizer Weighted Higher than Manure



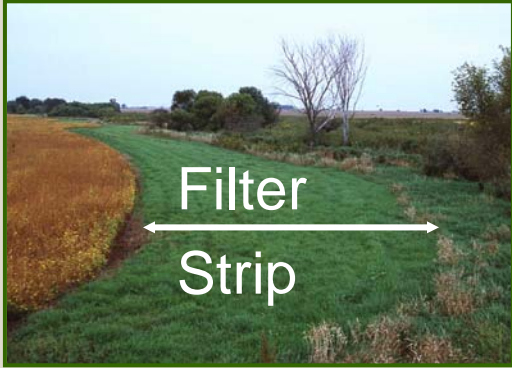
The top photograph shows a combine harvester operating in a green field, kicking up a cloud of dust. The bottom photograph shows a white manure spreader truck driving through a field of harvested corn stalks, spreading material.




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P Index - Filter Strips

- Well managed filter strips reduce sediment and P transport to water.
- Reduce risk by 2 points for a well managed filter strip (minimum 33 feet wide)



The photograph shows a lush green grassy area (the filter strip) situated between a field of golden-brown crops and a body of water. A white double-headed arrow points across the grassy area, with the words 'Filter Strip' written in white text above and below the arrow.



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P Index - How to Use

- Field by Field or Cons. Treatment Unit.
- Subfields (High risk vs. Lower Risk Areas)
- Management Based on Risk
 - Low (<15) N based
 - Medium (15-30) N based - However, P removal rate is recommended.
 - High (31-45) P based (removal rate)
 - Very High (>45) - No additional P
- [..\\..\\excel\\Ohio P Index\\Ohio P Index May 2002.xls](#)



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P Index Summary

- Planning Tool
- P Risk Assessment Tool
 - (combines effects of multiple factors)
- Best if used when soil test method is at limit.
- Not a long term solution - need to get to a P balance.
- Seek Alternative Utilization Options



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N & P Risk Summary

- Nitrogen Leaching Index
 - Tiled Fields and Sandy Soils
- P Soil Test Assessment Method
 - Sustainable
- P Index
 - Multiple Factors Considered
 - Allows Additional Time to Seek Alternatives

