PENNSYLVANIA PHOSPHORUS INDEX UPDATE

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This afternoon....

• Brief overview of the P Index revision process
• Revisions: Potential changes to the P Index
  – P Index structure
  – Soil loss
• Implications: of proposed revisions
  – Information required for the revised P Index
  – Training requirements
• Timeline for future activities
Phosphorus Loss and the P Index

>> Estimating the risk of P loss <<

Sources

- N P K
- Leaching
- Tile flow
- Subsurface flow
- Hydrology
- Erosion

Transport

- Volatilization
- Runoff
- Critical Source Area

Phosphorus Index
Identify and manage critical source areas for environmental protection from P losses

Penn State Extension
Critical source area concept – P-Index

~90% of P comes from ~10% of Watershed
**PA Phosphorus Index Version 2**

### PART A: SCREENING TOOL

<table>
<thead>
<tr>
<th>Is the CMU in a Special Protection Watershed?</th>
<th>Field ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a significant farm management change as defined by Act 38?</td>
<td>If the answer is yes to any of these questions Part B must be used.</td>
</tr>
<tr>
<td>Is the Soil Test Mehlich-3 P greater than 200 ppm P?</td>
<td></td>
</tr>
<tr>
<td>Is the contributing distance from this CMU to water less than 150 ft?</td>
<td></td>
</tr>
</tbody>
</table>

### PART B: SOURCE FACTORS

#### SOIL TEST

<table>
<thead>
<tr>
<th>Soil Test Rating</th>
<th>Mehlich-3 Soil Test P (ppm P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2 * Mehlich-3 Soil Test P (ppm P)</td>
<td></td>
</tr>
</tbody>
</table>

#### FERTILIZER P RATE

<table>
<thead>
<tr>
<th>Fertilizer Rate</th>
<th>Fertilizer Application Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>Placed or injected 2&quot; or more deep</td>
</tr>
<tr>
<td>0.4</td>
<td>Incorporated &lt;1 week following application</td>
</tr>
<tr>
<td>0.6</td>
<td>Incorporated &gt;1 week or not incorporated following application in April - October</td>
</tr>
<tr>
<td>0.8</td>
<td>Incorporated &gt;1 week or not incorporated following application in Nov. - March</td>
</tr>
<tr>
<td>1.0</td>
<td>Surface applied to frozen or snow covered soil</td>
</tr>
</tbody>
</table>

Fertilizer Rating = Fertilizer Rate x Fertilizer Application Method

#### MANURE P RATE

<table>
<thead>
<tr>
<th>Manure Rate</th>
<th>Manure Application Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>Placed or injected 2&quot; or more deep</td>
</tr>
<tr>
<td>0.4</td>
<td>Incorporated &lt;1 week following application</td>
</tr>
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<td>1.0</td>
<td>Surface applied to frozen or snow covered soil</td>
</tr>
</tbody>
</table>

Manure Rating = Manure Rate x Manure Application Method x Manure P Availability

### PART B: TRANSPORT FACTORS

#### EROSION

<table>
<thead>
<tr>
<th>Soil Loss (ton/A/yr)</th>
<th>Field ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Excessively</td>
</tr>
<tr>
<td>2</td>
<td>Somewhat Excessively</td>
</tr>
<tr>
<td>4</td>
<td>Well/Moderately Well</td>
</tr>
<tr>
<td>6</td>
<td>Somewhat Poorly</td>
</tr>
<tr>
<td>8</td>
<td>Poorly/Very Poorly</td>
</tr>
</tbody>
</table>

#### RUNOFF POTENTIAL

| 0 | None |
| 2* | Random |

#### SUBSURFACE DRAINAGE

| 0 | > 500 ft. |
| 2 | 350 to 500 ft. |
| 4 | 200 to 349 ft. |
| 6 | 100 to 199 ft. OR <100 ft. with 35 ft. buffer |
| 8 | < 100 ft. |

#### CONTRIBUTING DISTANCE

| 0.85 | 50 ft. Riparian Buffer APPLIES TO DIST < 100 FT |
| 1.0 | Grassed Waterway or None |

Transport Sum = Erosion + Runoff Potential + Subsurface Drainage + Contributing Distance

Transport Sum x Modified Connectivity/24

P Index Value = 2 x Source x Transport

* OR rapid permeability soil near a stream
‡ "9" factor does not apply to fields with a 35 ft. buffer receiving manure.
Challenges to the P Index

- P Index allows excess P to be applied
  - Environmental concerns
  - Sustainability of a finite P resource

- P Index not consistent across the country
  - Especially interpretation
  - Science + Value Judgement

- Limited direct calibration of the P Index

- If we are going to continue to use the P Index these concerns must be addressed
  - EPA & NRCS
National effort to improve the P Index and P Management

Chesapeake Bay Watershed: “Refining and Harmonizing Phosphorus Indices in the Chesapeake Bay Region”

• P Index Evaluation and Improvement: Monitoring & Modeling
  – Not feasible to have enough experimental sites to completely calibrate a P Index with monitored data
  – Process based models can be used to simulate fate and transport of P over a much wider range of conditions
    • SWAT, APEX, DRAINMOD
  – Monitoring network will be used to validate the models
  – Models will be used to develop calibrations, suggest improvements to the P Index, and evaluate revised P Indices

NRCS Conservation Innovation Grants
Revision would consider dissolved P and particulate P
Restructuring the P Index

Current

SOURCE Factor
- Soil Test
- Fertilizer Rate
- Method
- Manure Rate
- Method
- PSC

Transport Factor
- Erosion
- Runoff
- Leaching Distance
- Modified Connectivity

= P Index

Modeled P Loss (kg/ha)

\[ r^2 = 0.52 \]

Revised “Component” PI

Sediment P SOURCE
- Soil Test

Sediment Transport
- Erosion

= Sediment P Factor

Soluble P SOURCE
- Manure P
- Fertilizer P
- Soil P_{sat}

Runoff Transport
- Runoff

= Runoff Soluble P Factor

Soluble P SOURCE
- Manure P
- Fertilizer P
- Soil P_{sat}

Leaching Transport
- Leaching

= Leaching Soluble P Factor

Each Source Factor weighted

Each Transport Factor weighted

Distance Connectivity

= P Index

Modeled P Loss (kg/ha)

\[ r^2 = 0.65 \]

(Bolster et al. 2012)
P Index Restructuring: Management Recommendations

**Soluble P Factor – 4 R Practices**
- Right place
- Right time
- Right source
- Right rate

**Sediment P Factor – Soil Conservation Practices**
- Erosion
- Landscape factors contributing to erosion
  - Soil type
  - Slope
Potential Revisions: Soil loss

Currently, the P Index uses soil loss calculated across the crop rotation

- Results indicate annual soil loss may be a more appropriate indicator of P loss potential
## Rotation vs Annual Soil Loss

<table>
<thead>
<tr>
<th>Rotation 4 t/A*</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Corn</td>
<td>7 t/A</td>
</tr>
<tr>
<td>2. Corn</td>
<td>7 t/A</td>
</tr>
<tr>
<td>3. Corn</td>
<td>7 t/A</td>
</tr>
<tr>
<td>4. Corn</td>
<td>7 t/A</td>
</tr>
<tr>
<td>5. Hay</td>
<td>1 t/A</td>
</tr>
<tr>
<td>6. Hay</td>
<td>1 t/A</td>
</tr>
<tr>
<td>7. Hay</td>
<td>1 t/A</td>
</tr>
<tr>
<td>8. Hay</td>
<td>1 t/A</td>
</tr>
</tbody>
</table>

- This is not a specific requirement of 590, but could come into play with the revised P Index
- Annual soil loss makes sense
- RUSLE2 calculates annual soil loss
  - Not typically reported
- How are we going to get this done on all fields that need the PI?
  - PAOneStop

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*Currently used in P Index and for conservation planning to meet “T” soil loss
Watershed in Northumberland County

<table>
<thead>
<tr>
<th>Year</th>
<th>Sediment P Loss (kg/ha)</th>
<th>P Index Value</th>
<th>P Index Erosion (T/A)</th>
<th>Sediment Yield (T/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>0.31</td>
<td>40</td>
<td>2</td>
<td>0.15</td>
</tr>
<tr>
<td>2007</td>
<td>6.50</td>
<td>83</td>
<td>2</td>
<td>1.15</td>
</tr>
<tr>
<td>2008</td>
<td>15.64</td>
<td>39</td>
<td>2</td>
<td>7.27</td>
</tr>
<tr>
<td>2009</td>
<td>1.13</td>
<td>33</td>
<td>2</td>
<td>1.13</td>
</tr>
<tr>
<td>2010</td>
<td>0.56</td>
<td>33</td>
<td>2</td>
<td>0.44</td>
</tr>
</tbody>
</table>
PAOneStop.org

- Currently used to develop maps for NMPs
  - Fields
  - Soils
  - Topography
  - Setbacks

- Tools for E & S planning are under development within PAOneStop
Implications...

• Most information required for the revised P Index will be similar to the current P Index
  – The exception, annual soil loss
  – Tools needed will be RUSLE 2 and PA OneStop

• Training updates will be needed
  – Nutrient management specialists
  – Manure brokers

• Update to nutrient management planning tools
  – Standard format for Nutrient Management Plan and Nutrient Balance Sheet
  – PAOneStop
Future Activities...

• **Proposed revised P Index**
  – Review with stakeholder groups
  – Field evaluation to assess implementation
  – Tools needed will be RUSLE 2 and PA OneStop

• **Maintenance and update of supporting tools**
  – **PAOneStop**
  – Nutrient Management Standard Format spreadsheets