The Impact of Phosphorus Limiting Regulations on Land Application

A Contractor’s Perspective
Regulations

• Ohio Administrative Code, Section 3745-40 ‘Sewage Sludge Regulations’

• New rules governing agronomic rate determination effective July 2013
Objective of Regulations

• Prevent or limit the movement of phosphorus to waters of the State

• Improve water quality
Significance of Understanding Impacts

Understanding the effects of these new regulations can help ensure that land application of biosolids remains a viable avenue.
Phosphorus

- Nutrient vital to plant growth
- Typically applied annually
  - Commercial Fertilizer
  - Manure
  - Biosolids
- Plants only take up what they require
Phosphorus Depletion

- Phosphorus leaves an area in one of three ways:
  - Erosion (water or wind)
  - Surface water runoff
  - Crop Uptake
- Up to 90% of Phosphorus transported from farmed ground is attached to the soil particles
Factors Hindering the Natural Balance

• Large metropolitan areas & confined feed operations
  – Both lead to phosphorus being moved into concentrated areas
  – Leads to higher potential for water contamination in those areas

• Mining of phosphate rock for commercial fertilizer
  – Introduces phosphorus into the natural cycle that wasn’t originally there
Organic vs. Inorganic

• Organic phosphorus are phosphorus compounds containing carbon-based molecules
  – Biosolids and manure are sources
  – Organic phosphorus is changed to inorganic phosphorus through mineralization

• Inorganic phosphorus are phosphorus compounds where phosphorus is bound to other non-carbon based molecules
  – Commercial fertilizers
Water Soluble vs. Water Insoluble

- Water soluble phosphorus - phosphorus in solution
- Water insoluble phosphorus
  - Labile phosphorus – becomes available to plants
  - Unavailable phosphorus - fixed
Soil Testing

• Total P
  – A measure of the total phosphorus in a material

• Available P
  – An indication of the amount of phosphorus available to plants
    • Water Soluble
    • Labile
  – Reported as Phosphate (a compound)
  – Not a good indicator of potential for movement
Phosphorus Indexing

Measures the likelihood of phosphorus to escape a particular area

- Soil tests
- Method of fertilizer application
- Application rates
- Subsurface drainage
- Distance to surface water
- Surface water runoff class
- Buffer zones
Phosphorus Indexing Con’t

• Ohio NRCS Phosphorus Index – Ohio Department of Agriculture website
  http://www.agri.ohio.gov/divs/DLEP/Regs/Appx/Appendix%20E%20Table%201%20901-10-2-14.pdf

• P Source Coefficients are used for particular P sources that have less probability of impacting water quality (less environmentally relevant)
  – In some States, Biosolids are assigned a lower coefficient than commercial fertilizer
Phosphorus Sources are Not Equal

- Up to 90% of inorganic P applied to farm ground can become unavailable to plants within 2-4 weeks of application.
- Commercial fertilizer requires mining phosphate rock:
  - A limited resource
  - Mining process is environmentally damaging
  - Adds more phosphorus into the environment with the potential to contaminate water
Biosolids as a Phosphorus Source

• Biosolids naturally contain phosphorus
  – Part of a natural phosphorus cycle
  – Phosphorus removal processes in wastewater treatment can increase the concentration of P in bioslids

• Biosolids contain less mobile P than other fertilizers (24% vs 60%)

• P in biosolids can become plant available over time due to microbial activity.
Best Management Practices for Biosolids

- Nutrient Management Plans - farmer
- Minimize erosion – farmer
- Application rates – contractor
- Vegetative buffers – contractor
- Proper storage – contractor
- Timing of application - contractor
- Applying amendments to reduce P solubility – farmer or contractor
Buffer Zones

• Biosolids cannot be applied (by any method) within 33 feet of surface waters of the State
• Isolation distances are specified from bedrock and sinkholes as well to protect groundwater
• Buffers are more effective if they contain vegetation
• The specified zones are minimums
Proper Storage

• At least 100 feet from surface waters
• Away from low lying or frequently flooded areas
• Slope less than 15%
• Ensure proper drainage, shape stockpiles to shed water
• Surface water diversion
• Cover stockpiles
Timing of Application

• Biosolids are not land applied during a rain event
• Biosolids are not land applied when there a probable chance of significant precipitation in the 24 hours following application
• Biosolids are rarely applied to frozen ground and only under stringent circumstances
Application Rates

• Phosphorus based agronomic rate rules effective July 2013
• Prior rates were based upon nitrogen needs
  – N has the most potential for negative impact on surface water
  – N based applications provide enough N for the next crop
    • Leads to over-application of P and under-application of K
Phosphorus Based Application

- Uses soil test results to determine how rates are calculated
- Single year application
- Multi-year application
## Rules Comparison

<table>
<thead>
<tr>
<th>Soil Phosphorus Level (Bray Kurtz)</th>
<th>Old Rules</th>
<th>New Rules</th>
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</thead>
<tbody>
<tr>
<td>&lt;40 ppm</td>
<td>N rate</td>
<td>A. N rate</td>
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<td>B. P rate of 250 lb/A</td>
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<td>C. P rate 251 – 500 lb/A if certain criteria met</td>
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### Biosolids Agronomic Rate Calculation Worksheet

#### General Information
- **Ohio EPA #:**
- **Field ID #:**
- **Generator Name:**

#### Biosolids Data and Beneficial Use Methods
- **Ammonia Nitrogen:**
- **Total Kjeldahl Nitrogen:**
- **Total Phosphorus:**
- **Organic Nitrogen:** 0.00 lbs/ton
- **Available Nitrogen:** 0.00 lbs/ton
- **Phosphate (P₂O₅):** #N/A lbs/ton
- **Will Immediate Incorporation / Injection be performed?**

#### Beneficial Use Site Information
- **Soil Phosphorus:** #N/A ppm

Please note that the agronomic rates and phosphorus index have been calculated within the Calculated Agronomic Rates section; however, based upon the above provided Soil Phosphorus result, you must utilize the most limiting factor (Phosphorus Index):

**County**

**Soil Type**

**Hydrologic Soil Group**

#### Crop Type(s)
- **Expected Crop Yield(s):** bu/acre or tons/acre

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#### Calculated Agronomic Rates

**Nitrogen Agronomic Rate**
- i. Calculated Agronomic Rate
- #DIV/0! dry tons/acre

**Single Year Phosphate Agronomic Rate**
- #N/A dry tons/acre

**Multi-Year Phosphate Agronomic Rate**
- #N/A dry tons/acre

**Phosphorus Index**
#N/A

#### Beneficial Use Site Records
- **Quantity of Biosolids Beneficially Used:** dry tons
- **Phosphate (P₂O₅) Beneficially Used Per Acre:** #DIV/0! lbs/acre
- **Acreage:**
- **Date Biosolids Delivered to Beneficial Use Site:**
- **Dates of Beneficial Use:** to
- **Total Days Biosolids Stored at Beneficial Use Site:** 0.00 Days
- **Is a permanent sign posted at the beneficial use site?**
- **Date Signage Removed from Beneficial Use Site:**

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Soil Amendments

The application of certain material to farm ground can reduce the solubility of P:
  – Water Treatment Residuals
  – Gypsum

P binds to these materials forming compounds that are less prone to movement
How does this change land application of biosolids?
THE GOOD
Multi-year application can be a benefit to farmers:

- One application will meet phosphorus needs for up to 5 years – phosphorus in biosolids will continue to be available
- Reduces truck traffic in the area
- Reduces field compaction
THE BAD
• Overcome mindset that phosphorus should be applied annually
• If multi-year application is not possible, nitrogen supplementation necessary
• Incorporation/Injection is often necessary, but conflicts with no-till operations
• Unless farmers adhere to similar restrictions in application of commercial fertilizer/manure, benefits of biosolids regulations are null.
THE UGLY
Local Sites Off-Limits

Many land application sites within close proximity to plants are phosphorus-limited

Longer haul distances are costly!
Example of Haul Distance Increase
Since 2012......

- Haul distances have more than doubled from around 12 miles round trip to over 28 miles round trip.
- Daily haul volumes have decreased by about 40%
- Cost to do the job has increased 38%
Another Example
Acreage Requirements

Finding adequate acreage is challenging

- No till ground is often out
- Some farmers want nitrogen needs met
- Certain areas have a large amount of phosphorus-limited ground or less than ideal soil types
- Sites that are useable are exhausted rapidly
Consequences

- **Significantly more time and effort required to find homes for biosolids**
- Additional cost to contractors and municipalities due to longer haul distances
- More storage necessary at wastewater plants to store biosolids
- Larger volumes of valuable biosolids are being landfilled
What Can Be Done?
Contractors

• Educate farmers regarding the biosolids being applied
• Work with farmers adhering to NMPs and erosion control measures
• Ensure adequate training of land application personnel
• Employ proper equipment for land application
• Use incorporation/injection whenever possible
• Work with farmers to allow tillage of spreading boundaries
Municipalities

• Cake biosolids advantageous
• Increase plant storage
• Be prepared for increased cost of land application programs
• Consider implementing technologies to harvest a portion of the excess nutrients
Farmers

• Implement and adhere to well constructed Nutrient Management Plans
• Engage in erosion control measures, specifically utilizing cover crops and vegetative buffer areas
• Know the potential for phosphorus loss at any given site
• Become familiar with the different phosphorus sources and their advantages and disadvantages
Regulatory

• Work together to ensure success in water improvement by implementing similar restrictions for all types of fertilizer applications

• Ensure adequate personnel are available to quickly and efficiently analyze and turn around new site permit applications.
Why Do We Care?
Why Land Application?

• Still the most cost effective means of managing biosolids
• Landfilling & Incineration also have a major environmental impact
• Continues to be a beneficial resource for farmers
• Biosolids are less likely to produce P in runoff or leachate than commercial fertilizers or manure
Land Application is Sustainable!

Land application maintains the natural nutrient cycle

Land application decreases the need to add additional nutrients to the environment by depleting limited resources.
Thank You!