

# Decreasing the Phosphorous Index Using Mine Drainage Residuals

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## BACKGROUND

The Pennsylvania Phosphorous Index is used to identify situations that have a high risk for the transport of phosphorous (P) from land applied manure to surface waters (PA State Conservation Commission 2009). The P index considers P sources (soil, fertilizer, manure) and transport factors (erosion, runoff, subsurface drainage, distance and connectivity to receiving body). The result is a numerical value that estimates the risk of P loss.

Our project involves the use of mine drainage residuals (MDR) to modify the chemistry of dairy manure and thus effect the P Index result. Our results could be the basis for a new BMP for farmers whose manure management is limited by P.

## P INDEX CALCULATIONS

Table 1 shows key aspects of the P Index spreadsheet. A handout is available that shows the complete P index spreadsheet for Table I scenarios. The baseline condition is a field with elevated soil P that receives year-round dairy manure applications totaling 90 lb P<sub>2</sub>O<sub>5</sub> per acre per year. The calculated P Index for the baseline condition is 100. This is a high value and requires BMP implementation (Table 2).

## P INDEX MODIFICATION

The P Index can be modified by several BMPs shown in Table 1. The setback from the stream could be increased from 150 ft to 250 ft, which lessens the P Index to 86. Manure applications could be decreased by 50%, which lessens the P Index to 75. Application of manure could be restricted to April through October, which lessens the P Index to 87.

Table 1. P Index inputs and results with various BMPs.

|                    | Units or source                      | Base-line  | Increase buffer | Decrease manure | Modify spread | MDR addition |
|--------------------|--------------------------------------|------------|-----------------|-----------------|---------------|--------------|
| Soil P             | ppm P                                | 210        | 210             | 210             | 210           | 210          |
| <b>Fertilizer</b>  |                                      |            |                 |                 |               |              |
| Rate               | lb P <sub>2</sub> O <sub>5</sub> /ac | 20         | 20              | 20              | 20            | 20           |
| Method             | Injected                             | 0.2        | 0.2             | 0.2             | 0.2           | 0.2          |
| <b>Manure</b>      |                                      |            |                 |                 |               |              |
| Rate               | lb/acre                              | 90         | 90              | 45              | 90            | 90           |
| Application method | Surface                              | Surface    | Surface         | Surface         | Surface       | Surface      |
| Application time   | anytime                              | anytime    | anytime         | anytime         | Apr-Oct       | anytime      |
| PSC                | From lab                             | 0.65       | 0.65            | 0.65            | 0.65          | 0.30         |
| <b>Transport</b>   |                                      |            |                 |                 |               |              |
| Erosion            | ton/acre/yr                          | 3          | 3               | 3               | 3             | 3            |
| Sub-drains         |                                      | none       | none            | none            | none          | none         |
| Distance to Stream | feet                                 | 150        | 250             | 150             | 150           | 150          |
| <b>P Index</b>     |                                      | <b>100</b> | <b>86</b>       | <b>75</b>       | <b>87</b>     | <b>73</b>    |

Table 2. P Index Management Guidance (PA State Conservation Commission 2009)

| P-Index Value | Rating    | Management Guidance   |
|---------------|-----------|---|
| 0 to 59       | Low       | Nutrients can be applied to meet the N crop requirement.                  |
| 60 to 79      | Medium    | Nutrients can be applied to meet the N crop requirement. BMPs considered. |
| 80 to 99      | High      | Nutrients can be applied to meet the P crop removal. BMPs recommended.    |
| > 100         | Very High | No P can be applied.  |

## PSC MODIFICATION WITH MDR

The P Source Coefficient (PSC) is a measure of the solubility of manure P and estimates its vulnerability for transport off-site. Currently the PSC is considered fixed. Our project has demonstrated that a dairy manure's PSC can be decreased by the addition of mine drainage residuals (MDR) prior to field application. Figure 1 shows the effect of two MDRs on PSC. A 10 g/L dosing resulted in 70% decrease in PSC and lessened the P Index to 73 (Table 1).

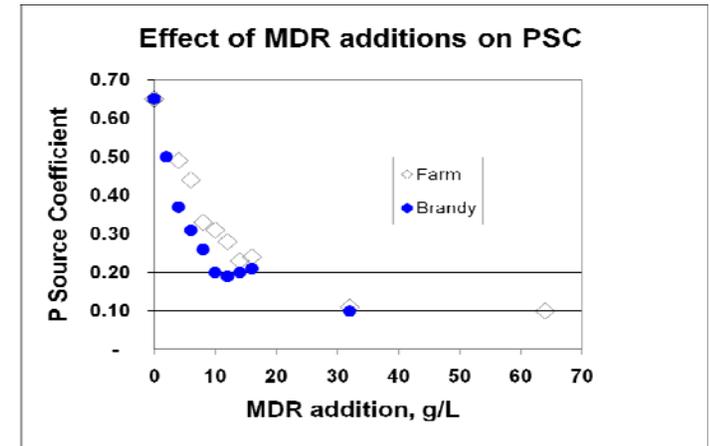


Figure 1. Effect of MDR additions on the PSC of dairy manure.

## MDR FEASIBILITY

A 10 g/L MDR dose is equivalent to 83 lb/1000 gallons and has an applied cost of ~\$10/1000 gallons. This is less than the cost to truck manure to another location. We do not know how it compares to productivity costs associated with removing land from production or modifying manure spreading practices. The effect of MDR on crop productivity is currently being assessed in a Penn State University greenhouse study. Concerns about hazardous metals have been investigated and both MDRs are well below the Section 503 concentration limits established by EPA (see handout).

## REFERENCES

Pennsylvania State Conservation Commission. 2009. Pennsylvania's Nutrient Management Act Program, Technical Manual, v 4.0. Harrisburg, PA. 373 p.

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