Long term impacts of effluent from vegetative filter systems used to treat runoff and milking facility wastewater discharge from dairy farms on water quality

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Abstract

In light of the current concerns over contamination of water supplies by wastewater from AFOs, it would be prudent to revisit some of the existing technologies to determine their effectiveness in protecting the waters of Illinois. Vegetative filter systems have been utilized for many years as a solution to the problem of treating runoff and milking facility wastewater in small AFO, even those bordering environmentally sensitive wetland areas. However, acceptance by the industry has been limited due to lack of definitive long-term results dealing with their effectiveness in controlling environmental pollutants. The opportunity exists to study the long-term effects of a vegetative filter system that has been in continuous use for the last 25 years. The information generated from this research could have direct impacts on regulation of animal waste in Illinois, and on the sustainability of the dairy industry in Illinois.

Objectives:

1. Determine if the long-term application of effluent from a vegetative filter system used to treat wastewater from a dairy farm leads to the accumulation of nitrogen and phosphorus and proliferation of microbial pathogens in soil and groundwater.
   - Subobjectives: a.) Determine and compare the current and original levels of nitrogen, phosphorus and microbial pathogens in soil and groundwater from a vegetative filter system that has been continuously utilized for 25 years to treat feedlot runoff and milking facility wastewater from a dairy farm that houses 40-60 lactating cows. This will include evaluating current nutrient and pathogen loading over a one-year period.
     b.) Compare the current levels of nitrogen, phosphorus and microbial pathogens in soil and groundwater from the ground utilized for the vegetative filter system to those from comparable adjacent ground that has received regular annual applications of dairy manure for the past 25 years.

2. Determine the best management practices (BMP) for improving the performance of an established vegetative filter system used to treat wastewater from a dairy farm.
   - Subobjectives: a.) Using baseline data on nitrogen, phosphorus and pathogen levels, management practices will be developed to reduce the nutrient and pathogen levels in the raw wastewater being generated from the feedlot and milking facility of the dairy.
     b.) Using baseline data on nitrogen, phosphorus and pathogen levels, management practices will be developed to remove or reduce nutrient or pathogen accumulation in the soil and groundwater of the vegetative filter system.

The initiation of the project did not commence until the end of August 2000 due to the delay in funding.

Changes and Progress on Objective 1.

Subobjective A. Soil samples collected in October 2000 have been dried and ground. These samples are now being analyzed for N and P fractions as originally described in the grant proposal. The next scheduled soil core collection will be in October 2001. Forage samples from

last fall have been analyzed for total N and fiber content, and are being prepped for P analysis. Forage collection for 2001 started on 5/10/01, and forage collection will occur when grass is just beginning to head out, which should be on a monthly basis. Water sampling sites have and are being prepared (See Figure 1). Dustpan surface water collectors and lysimeters have been installed, and samples are being collected. Groundwater wells are being constructed, and will be installed in June 2001. Initial analysis of surface water samples for total P is shown in Table 1. *The investigators would like to indicate that these are initial data, and no averaging or statistical analyses have been performed on the data. Therefore, no data interpretation can be provided.*

Water samples for pathogenic bacteria determination have been collected from cows, the effluent collection cistern, and six surface water collection sites (See Figure 1). The data from these analyses is presented in Tables 2 & 3. *Again, the investigators would like to indicate that these are initial data, and no averaging or statistical analyses have been performed on the data. Therefore, no data interpretation can be provided.*

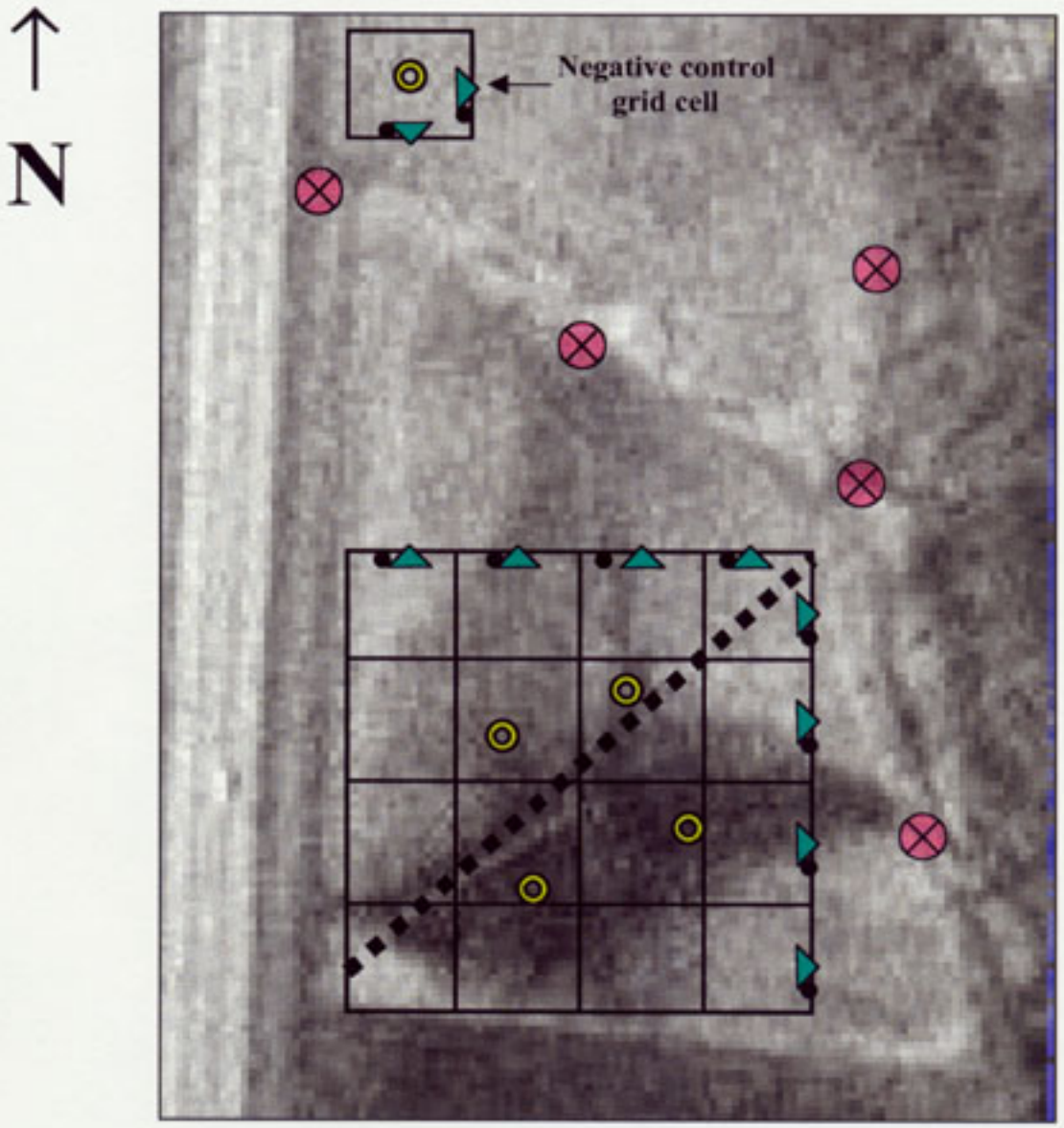
Subobjective B. Water and soil samples have been collected from the negative control grid cell, and are being analyzed along with the samples from the field application area.

Progress on Objective 2.

The field application has been split into two sections along the natural ridgeline that runs diagonally through the gridcells (See Figure 1). Effluent is only being applied to the southeastern section with the distribution manifold being rotated to different location every two weeks in a random manner. Comparison of water and soil sample levels of N, P and pathogenic bacteria from each side of the ridgeline should allow the investigators to determine potential nutrient and pathogenic loading problems with the system, and then, determine proper procedures for correcting potential problems.

Any questions about the project should be directed to Dr. Ken Griswold by phone at (618) 453-1766 or by email at drgriz@siu.edu.

Figure 1. Overhead view of VFS field application area with positioning of sample sites



Legend:

- Grid boundary
- Dustpan Surface Water Collector
- Lysimeter
- Groundwater well
- Surface water collection site
- Natural Ridgline

Table 1. Total phosphorus levels in surface water samples from VFS system.

Sample site	Total P, mg/mL
1	**5.07**
2	**0.82**
3	**2.66**
4	**23.71**
5	**84.47**

Table 2. Levels of fecal coliforms and fecal streptococci in samples from VFS system.

Sample site	Fecal coliforms	Fecal streptococci
	CFU per mL	
Cows	2.5×10^4	5.3×10^5
Collection cistern	6.5×10^4	7.3×10^3
Surface water sites		
1	[a]NS	NS
2	NS	NS
3	<1	<5
4	<1	<2
5	NS	NS
Negative control	<1	<1

[a]NS = no sample due to insufficient water flow.

Table 3. Antibiotic resistance patterns for fecal streptococci from VFS system.

Sample Site	Vancomycin	Oxytetracycline	Ciproflaxin	Streptomycin	Erythromycin	Tetracycline	Neomycin
Cows	S	R	S	R	S	R	I
Collection cistern	S	NA	S	I	NA	NA	
Surface water sites							
1	NA	NA	NA	NA	NA	NA	NA
2	NA	NA	NA	NA	NA	NA	NA
3	S	R	S	R	S	S	S
4	S	S	I	R	S	S	R
5	S	R	S	I	S	S	I
Negative control	S	S	S	R	S	S	I

S = susceptible
R = resistant
I = intermediate
NA = not available