

Do Agricultural Best Management Practices Really Work?

by John J. LaGorga and John G. Ferrante

Introduction

New York State and Onondaga County have developed a total maximum daily load (TMDL) for phosphorus entering Onondaga Lake that requires a 37 percent reduction in nonpoint sources of phosphorus. Agricultural runoff has been identified as a main source of phosphorus within the watershed. The State and County are currently implementing a multiphase (Phase I and Phase II) project to quantify and reduce nutrient runoff from agricultural practices.

During the Phase I study, multiple best management practices (BMPs) were implemented on each of three farms within the Onondaga Lake watershed. The purpose of implementing multiple BMPs was to measure their collective effectiveness at preventing nutrients from reaching the tributaries of Onondaga Lake. The agricultural BMPs implemented in Phase I proved very successful. However, there was consensus among the stakeholders, including the County and the State, that additional monitoring data for select BMPs were needed. Therefore a second phase of agricultural BMPs was implemented. During the Phase II study, individual BMPs were implemented and evaluated on two farms within the Onondaga Lake

watershed. Two types of BMPs were implemented during Phase II, namely a bark filter system for milkhouse wastewater treatment and a nutrient management plan for a cornfield. Figure 1 shows the locations of the study farms within the Onondaga Lake watershed. These farms are referred to as Farm A, Farm B, Farm C, and Farm D. Farm A participated in both phases of this project.

This article summarizes findings from Phase I and describes in more detail preliminary findings from Phase II.

Phase I Summary

During the Phase I study, multiple BMPs were implemented on the three farms in areas around the barnyards and milkhouses. The Phase I BMPs were mainly implemented to improve manure management and to control manure-laden runoff from reaching the receiving waters. The percent removals presented in table 1 reflect the performance of multiple BMPs and not individual BMPs.

During Phase I, water quality samples were collected in receiving waters adjacent to the farmsteads approximately once per month both before (pre-BMP) and after (post-BMP) BMP implementation. Pollutant concentrations significantly decreased between the pre-BMP sampling period and the post-BMP sampling period at all three farms. Discussions with the farm owners indicated that the only changes on the farms was the implementation of the BMPs, which suggests the BMPs successfully reduced the load of pollutants released from the farms.

Table 1 presents the mass-load of total phosphorus (TP) and total Kjeldahl nitrogen (TKN) released during the pre- and post-BMP periods. Percent removals during Phase I are also provided.

Table 1. Pre-BMP versus Post-BMP Results for Phase I

Farm/ Parameter	Pre-BMP (lbs)	Post-BMP (lbs)	Percent Removal
Farm A			
TP	865	265	70%
TKN	2,830	900	68%
Farm B			
TP	1,700	684	61%
TKN	10,400	2,174	79%
Farm C			
TP	799	359	55%
TKN	5,837	2,922	50%

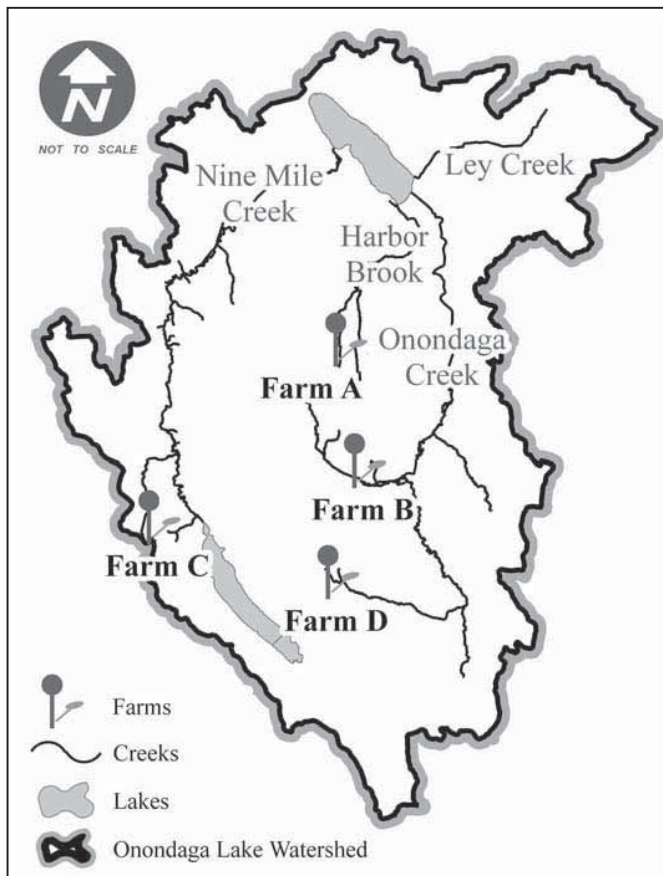


Figure 1. Farm Locations in Onondaga County

Phase II Agricultural BMP Implementation

Farm A

A nutrient management plan was implemented at Farm A where a 20-acre cornfield was divided into two equal 10-acre plots. These were designated as the control plot and the test plot. The control plot was managed as it was before this project, which included an excessive application of manure and fertilizer. The test plot was managed as recommended by the Onondaga County Soil and Water Conservation District. This included the application of specific amounts of manure and fertilizer with the intent of maximizing yields but minimizing nutrient-laden runoff. Prior to sampling, tile drains were installed underneath both plots for the purpose of monitoring and sampling water quality.

Farm D

A bark filter system was designed and constructed at Farm D for treating milkhouse wastewater in accordance with the New York State Natural Resources Conservation Service (NRCS) Conservation Practice Standard: Milkhouse Wastewater Infiltration Area (NY719).

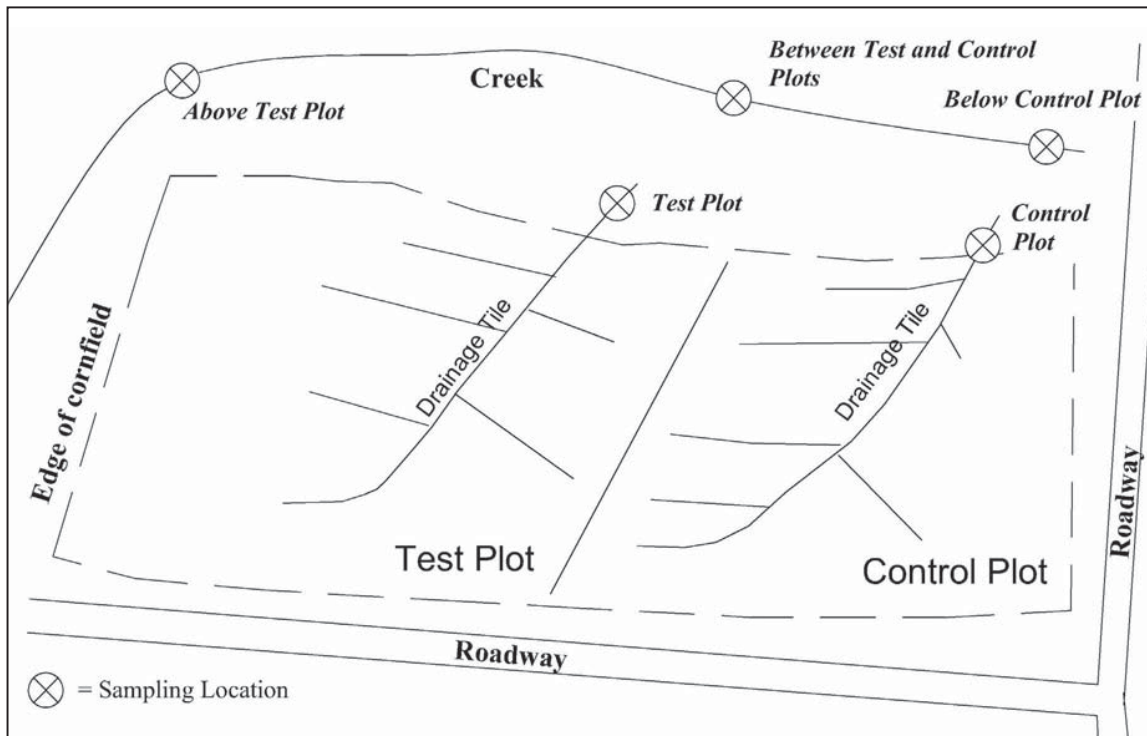


Figure 2. Nutrient Management Plan – Farm A

Wastewater from the milking process, which contains high concentrations of solids, nutrients, and biochemical oxygen demand (BOD), is conveyed to a settling tank where milk solids are removed and the effluent is conveyed to a subsurface, woodchip disposal bed. The bark filter is approximately four feet deep and acts as a bioreactor and absorption field. Prior to the implementation of this BMP, the milkhouse wastewater was discharged directly into a nearby receiving water tributary to Onondaga Lake.

Phase II Monitoring Program Approach

Farm A

The objectives of monitoring and sampling the nutrient management plan at Farm A were to

- document nutrient concentrations in cornfield runoff,
- assess the impact of a nutrient management plan on cornfield runoff, and
- document the impact of cornfield runoff on receiving water quality. Water quality characterizations included BOD, TP, TKN, and total suspended solids (TSS). Flow measurements and water quality samples were collected during 21 storm events and spring runoff conditions. The cornfield layout and sampling locations are illustrated in figure 2.

Farm D

The objective of monitoring and sampling the bark filter system at Farm D was to characterize milkhouse wastewater, both before and

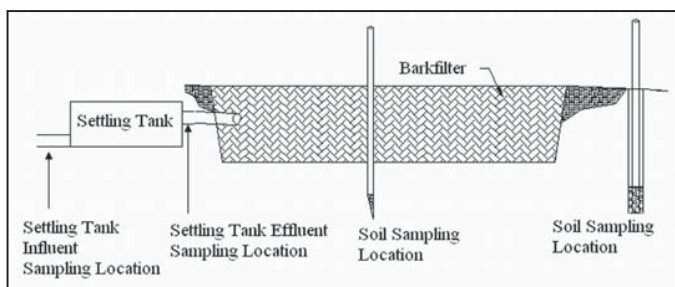


Figure 3. Barkfilter System – Farm D

after treatment. A series of grab samples were collected from settling tank influent. Corresponding grab samples were collected from the settling tank effluent and the soils below and down gradient of the woodchip disposal bed. This BMP was sampled approximately once per month for a total of 12 events. Water quality characterizations included BOD, TP, TKN, and TSS. The settling tank, bark filter, and sampling locations are illustrated in figure 3.

Phase II Results and Discussion

Farm A

The Farm A data, which is currently preliminary, indicate that during the late winter/early spring runoff period, concentrations of pollutants in the control plot runoff were significantly higher than the concentrations in the test plot runoff (greater than 75 percent). These results are presented in table 2.

Table 2. Nutrient Management Plan Results*

Parameter	Control Plot (mg/L)	Test Plot (mg/L)
BOD	46	12
TP	3	< 0.5
TKN	10	4
TSS	19	8

*Late Winter/Early Spring Data Only

Concentrations of pollutants in the control plot runoff were high in the early spring because of the heavy manure loads received throughout the winter months. A surplus of manure and associated pollutants builds on the control plot during the winter until early spring when the pollutants are flushed from the field during snow melt and/or rain events. The test plot received some manure during the winter, but it was a light application as compared to the control plot.

During the remainder of the year, concentrations in the control plot runoff were only slightly higher than in the test plot runoff, but in general the concentrations from both plots were very low. The con-

rol plot did receive higher fertilizer application rates than the test plot, but no significant difference in pollutant concentrations were observed throughout the summer and autumn. Lower concentrations of pollutants during the summer and autumn are the result of the crops utilizing the nutrients for growth. The crops also intercept and transpire rain, resulting in little or no runoff. These results are presented in table 3.

Table 3. Nutrient Management Plan Results*

Parameter	Control Plot (mg/L)	Test Plot (mg/L)
BOD	11	5
TP	0.60	< 0.25
TKN	3	1.3
TSS	38	34

*Late Spring, Summer, and Autumn Data Only

Using less manure and fertilizer on the test plot had only a slight impact on corn yield. During the duration of the study, the control plot produced approximately six percent more corn (by weight) than the test plot.

Water quality in the receiving water was only slightly improved by the test plot versus the control plot. In general, the water quality in the receiving water at both locations was very good. Receiving water concentrations are presented in table 4.

Table 4. Receiving Water Results

	Above Test Plot (mg/L)	Between Test and Control Plot (mg/L)	Below Control Plot (mg/L)
BOD	8	9	6.6
TP	0.065	0.077	0.10
TKN	0.64	0.82	1.0
TSS	11	23	35

Farm D

The Farm D data, which is currently preliminary, indicate that the settling tank removed a considerable quantity of BOD, TP, TKN, and TSS (greater than 60 percent). This suggests that a significant amount of the BOD, TP, and TKN was associated with the milk solids, which are readily settleable. However, there is a soluble component of these constituents that is not removed through sedimentation. Additionally, there was a significant decrease in BOD, TP, and TKN concentrations in the soils below and down gradient of the bark filter. This reduction in BOD, TP, and TKN concentrations was likely the result of physical removal of pollutants as the wastewater passes through the bark filter as well as dilution with groundwater. Table 5 presents the results for BOD, TP, TKN, and TSS.

Table 5. Bark Filter System Results

Parameter	Tank Influent (mg/L)	Tank Effluent (mg/L)	Soil (mg/L)
BOD	6,104	1,916	25
TP	167	62	2
TKN	318	97	8
TSS	2,625	460	NR*

*NR = No Result

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