

Michigan Dairy Review

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Comprehensive Manure & Milking Parlor Wastewater Management

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Two significant problems facing dairy farmers with herds of less than 200 cows are managing impacted storm water runoff and milking center wastewater. Often the use of large storage lagoons and manure storage structures are not available to serve as collection sites for impacted water and expensive engineered treatment systems are not economically feasible. Yet improper discharge of impacted water to surface and ground water may result in health risks and environmental harm. Effective, economical technologies need to be researched and developed.

The need to identify water treatment solutions is equally applicable to larger farms as impacted storm water runoff must be properly managed to prevent discharges. The other common practice of storing milking parlor wastewater in manure storage lagoon results in the need to increase its size by 20 to 50% (Livestock Wastes Subcommittee, 1985), increases hauling costs, dilutes manure nutritional value, and negatively impacts nutrient balancing (Safferman, 2008).

Project in the Making

An ongoing demonstration project by MSU researchers is examining a novel small farm storm water runoff filter strip and milking parlor wastewater treatment system. The research is sponsored by the Michigan Milk Producers Association and Aqua Technologies, Ontario, Canada. Specifically, the runoff technology is based on the USDA Michigan Natural Resources Conservation Service (NRCS) Wastewater Treatment Strip Practice Standard 635 with some modifications that may enhance treatment.

This technology collects impacted runoff in a small sedimentation basin where more dense materials settle by gravity. The collected water then travels through a bioretention basin, one of the modifications to the original standard that provides some treatment and storage when needed so that the filter strip is not overloaded. Water exits the basin through a flow controlling hydraulic structure into vegetated filter strips. As water flows through the slightly sloped filter strip, the vegetation and soil remove pollutants.

Treatment of the milking parlor wastewater in a vertically constructed wetland, designed by Aqua Technologies, is also being researched. The water first enters a septic tank where larger

materials settle and fats, oils, and grease float. From the tank, clarified water is dosed into the wetland which contains three equally sized cells. The first cell aerobically removes the bulk of soluble pollutants and includes a recirculation loop. Next, the water enters the second cell, which is anaerobic so that nitrate is converted to nitrogen gas. The third cell is aerobic and removes most of the remaining organic, soluble pollutants from the water. All cells are filled with pea gravel to a depth of approximately 4 ft and planted with pollutant-tolerant vegetation. The design is unique because in the summer water is distributed above the surface directly into the vegetation. To prevent freezing in winter, water enters approximately 2 ft below the surface. Upon exiting the wetland, water is subsurface discharged through a drain field.

Demo Site with a Purpose

The objective of this project is to document all aspects of designing, constructing, and operating both technologies and determine the life-cycle costs and performance with the goal of providing technology transfer materials. A small farm in mid-Michigan was selected for the demonstration site. The filtration strip generally only treats water that has the potential to be impacted from feed and manure during storm events and therefore, is designed specifically to the farm's layout. For the demonstration farm, this resulted in a collection area of approximately 0.15 acres. Designing the wetland depends on the number of cows and the number of times they are milked each day. For this farm, 50 cows are milked up to 3 times a day.

Installation of both systems at the demonstration farm is nearly complete. Monitoring is scheduled to begin as soon as plants are established and is to continue through 2010. Figure 1 shows the bioretention channel under construction. The geotextile running down the middle covers a gravel filled trench with a tile that drains the basin between storm events. Figure 2 shows the constructed wetland nearing completion. The PVC pipes distribute wastewater onto the surface during the summer. Pollutant-tolerant plants will be grown in the wetland.

Critical Design Decisions

Important design considerations documented during the planning and construction of the system included the following:

1. Technologies require a minimum depth between the water discharge level and ground water table elevation. Consequently, the seasonal high ground water elevations must be accurately determined.
2. Coordination with NRCS technical service providers is crucial as other conservation practices planned for a farm, such as barn guttering, milking facility wastewater storage, and manure stacking, greatly impact the design and layout of the settling basin, wastewater treatment, strip and the constructed wetland.
3. Designs must account for farm operational and management changes. Examples include, increasing milkings from 2 to 3 times a day, increasing the herd size, and relocating feeding operation and silo storage.
4. Layout of treatment technologies should maximize gravity fluid flow and minimize disruption of day-to-day farm activities. However, set back distances are required from protected features, such as creeks, regulated natural wetlands, and water supply wells.
5. Clean water should be kept clean by keeping it away from manure and feed impacted surfaces so that the filter strip size can be minimized. This often requires the installation of diversion structures such as barn gutters and physical curbs and barriers around manure storage locations.
6. Financial planning, including grant opportunities, needs to be fully explored in advance of design.



Figure 1: Filter strip lined bioretention channel under construction.



Figure 2: Constructed wetland nearing completion of installation.

This project is part of a research theme relating to milking facility wastewater treatment systems for small to medium sized farms. Progress has been documented in the Michigan Dairy Review. The first article discussed characteristics of milking facility wastewater (Safferman, 2008). Another article examined the utility of aerobic units to treat milking facility wastewater (Larson and Safferman, 2008). A technical article titled “Aerobic Treatment Unit Performance on Milking Parlor Wash Water” by Larson and Safferman was published in Transactions of the ASABE, Volume 53, Number 3, in June 2009. The bark filter mound was the subject of another article (Davis et al., 2009). An additional demonstration project on this technology started during the summer of 2009. Updates on research concerning all of these technologies will continue to be included in the Michigan Dairy Review.

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