AEN-103

Cooperative Extension Service

Stormwater BMPs for Confined Livestock Facilities

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Introduction

The U.S. Environmental Protection Agency (EPA) states that agricultural sediment, pathogens, and nutrients account for more than 50 percent of water pollution in the United States. Animal confinement facilities, widely used for holding, feeding, and handling animals, are potential sources of that pollution. The pollution load of these facilities can be reduced by installing and maintaining best management practices (BMPs). The BMPs may be implemented as part of permit compliance or may be used to ensure that a permit is not needed.

Types of Animal Feeding Operations

An animal feeding operation (AFO) is defined as a lot or facility where (a) animals have been, are, or will be stabled/confined and fed/maintained for a total of 45 days or more in any 12-month period and (b) crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season. AFOs are classified by size as large, medium, or small (Table 1). Some AFOs may also be classified as Concentrated Animal Feeding Operations (CAFOs).

A CAFO must meet the definition of a medium or large AFO and either (a) discharge pollutants into waters of the United States through a man-made ditch, flushing system, or other similar man-made device or (b) discharge pollutants directly into waters of the United States.

Water that does not infiltrate into the ground will run off, and on animal feeding operations, this runoff can become contaminated with manure, sediment, pathogens, and nutrients. This polluted runoff then has the potential to move off-site and enter surface and groundwater resources.

Because of stormwater runoff and other pollution potential, the Kentucky Division of Water (KDOW) considers confinement operations to be potential sources of pollutants, and therefore requires water quality permits for AFOs and CAFOs. A Kentucky No Discharge Operational Permit (KNDOP) or a Kentucky Pollution Discharge Elimination system (KPDES) permit may apply to animal feeding operations. AFOs are not allowed to discharge to the waters of the United States, and either the KNDOP or KPDES permit can be used to ensure compliance. CAFOs are required to obtain a KPDES permit.

Types of Confinement Facilities

There are three general types of confinement facilities: totally enclosed, partially enclosed, and open. Each is predisposed to a different kind of runoff pollution and requires different management strategies.

In totally enclosed facilities, the animals are managed completely under a roof. Totally enclosed facilities generally do not produce runoff if designed correctly, although pollution can still originate from these facilities if stormwater is allowed to drain through the facility or if generated manure is not collected and managed properly and stormwater comes in contact with the manure or other waste. In contrast, partially enclosed facilities may contain a roofed building that covers a portion of the holding area, with the animals also having access to uncovered areas that may be paved or unpaved. Open confinement facilities are unroofed corrals or holding areas where the animals are held, fed, and handled. Partially enclosed and open facilities may be a significant source of pollution if stormwater runoff is not properly managed.

The surface used for partially open and totally open facilities affects runoff quantity and quality. Generally, confinement facility surfaces are either paved

Table 1. Animal feeding operation (AFO) classification by animal type and number.

Animal Type	AFO Size Small	Medium	Large
Mature dairy cows	<199	200 - 699	>700
Veal calves	<299	300 - 999	>1,000
Cattle (including heifers, steers, bulls, cows, or calf pairs)	<299	300 - 999	>1,000
Swine (weighing >55 pounds)	<749	750 - 2,499	>2,500
Swine (weighing <55 pounds)	<2,999	3,000 - 9,999	>10,000
Horses	<149	150 - 499	>500
Sheep or lambs	<2,999	3,000 - 9,999	>10,000
Turkeys	<16,499	16,500 - 54,999	>55,000
Laying hens or broilers[1]	<8,999	9,000 - 29,999	>30,000
Chickens[2]	<37,499	37,500 - 124,999	>125,000
Laying hens[2]	<24,999	25,000 - 81,999	>82,000
Ducks[2]	<9,999	10,000 - 29,999	>30,000
Ducks[1]	<1,499	1,500 - 4,999	>5,000

[1] If the AFO uses a liquid manure handling system.
[2] If the AFO uses other than a liquid manure handling system.

Figure 1. Over the years, gravel has been added to this driveway, increasing its height so it now drains into the production area.

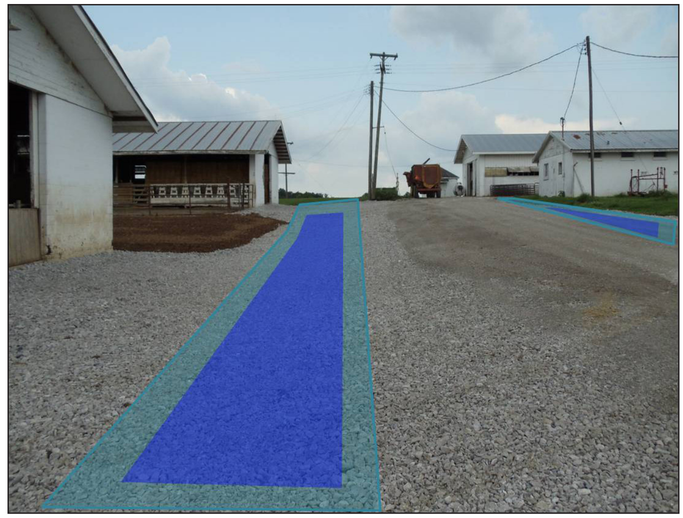

Figure 2. This rock-lined channel diverts clean water away from the production area (left) and prevents erosion near the buildings.

with concrete or asphalt or left unpaved and lined with soil or heavy-use pads made of rock and geotextile fabric. Paved surfaces usually generate more runoff than unpaved surfaces because they do not allow water to infiltrate the soil. Unpaved surfaces allow water to infiltrate, but they also tend to become compacted, which can increase runoff.

Best Management Practices

By far, the best method for reducing the pollution potential of a confinement facility is stormwater BMPs. Urban areas use these BMPs to reduce the "first flush," a high concentration of pollutants that is washed into streams, ponds, and lakes once a rainfall event begins. Agricultural producers can use stormwater BMPs with the same concept in mind. This document describes stormwater best management practices (BMPs) that producers with confined livestock facilities should consider implementing to prevent pollution from discharging off-site. Producers should carefully select appropriate practices to create a sustainable livestock operation. The right BMPs depend on several factors, many of which are site specific. No single BMP will prevent all types of pollution, and in many cases, multiple BMPs are needed to prevent a discharge of pollutants into the waters of the Commonwealth.

There are several BMPs that a livestock producer can implement to control stormwater pollution. These BMPs fall into three main categories: structures, vegetation, and facilities management.

Structures

Headwater Diversion

An ideal building site is one in which drainage is diverted away from the production area, but over time, topography can be altered with road creation, structure remodeling, and facilities additions, which can cause runoff to flow through the production area (Figure 1). To keep clean runoff clean, diversion practices should be implemented if water enters the production facility from upland sources, such as streams or overland flow. Headwater diversion entails installation of structures such as levees, dikes, drainage swales, and diversion ditches that carry the water away from the production area and to a natural drainageway (Figure 2). Figures 3 and 4 show a before-and-after aerial photo of a production area in which headwater diversion techniques have been incorporated.

Gutters

If a confinement facility has a roof that drains onto the production area, consider installing gutters with downspouts. Placing gutters on the sides of buildings diverts clean rain water away from animal handling and holding areas and prevents the pollution of this otherwise clean and usable water. Downspouts should be directed into diversion ditches, and guttered water should be carried away from animal containment areas.

Hardened Structures

Confinement areas have impervious surfaces that cause large volumes of water to flow quickly from the area. The force created by the flow of this water can cause erosion, and although some erosion is natural, a lack of soil management accelerates the process and can become a significant problem. To prevent severe erosion, hardened (or armored) structures should be installed. To construct a hardened structure, simply line diversion ditches or swales with geotextile fabric and large rock (riprap). It may be possible

Diverting Clean Stormwater

Diverting clean stormwater from the production area can reduce the water volume that must be managed and can increase storage capacity of holding ponds and lagoons, which is a management philosophy called "keeping clean water clean." In many cases, diverting clean runoff not only reduces the amount of water that needs to contained and managed, but it also creates a drier environment for the animals and reduces odors.

Figure 3. Before clean water diversion methods were implemented, the production area drained into the liquid storage ponds.

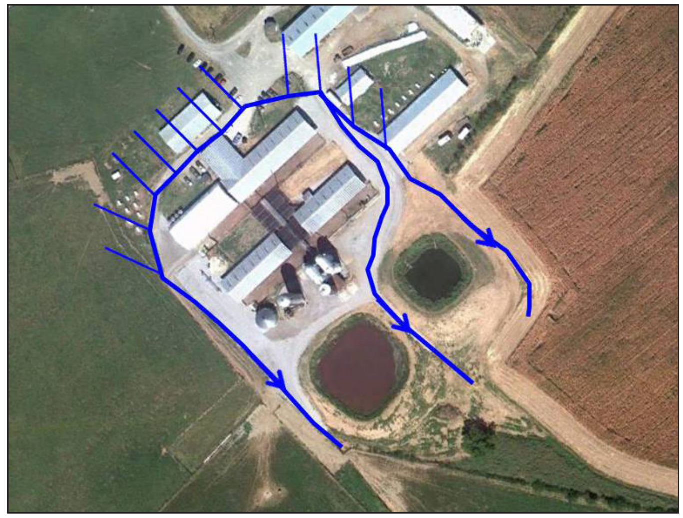

Figure 4. Installing clean water diversions increased capacity in the liquid storage ponds.

to line ditches that have a slope of 3% to 6% with vegetation, depending on the soil type. Silty soils will erode more easily than clayey soils, so in these instances, rock may be required to stabilize the soil.

To manage suspended sediments in runoff, small center-overflow dams made of stone, known as check dams, could be used. Check dams reduce the velocity of runoff, allowing the sediment to settle out of suspension, thus serving as a sediment trap. Multiple check dams located along the same channel should be spaced so that the toe of the upper structure is at the same elevation as the top of the downstream dam. Check dams should be installed to form a notch (6 inches lower than the outer edge) to allow water to flow in the center of the channel—notches located on the side of the check dam contribute to erosion. Slopes greater than 10% require heavy armoring and possibly grade stabilization structures.

Grade Stabilization Structures

A grade stabilization structure allows water to move to a lower elevation while reducing its energy and velocity so that erosion can be controlled. Unlike a weir or a dam, it is usually not meant for water impoundment, diversion, or raising the water level. These structures typically consist of a series of closely placed posts and cattle panels that hold large rocks in place. They are built on small or minor waterways that have steep channel gradients. See University of Kentucky Cooperative Extension publication *Building a Grade Stabilization Structure* (AEN-100) for more information.

Runoff Collection, Treatment, and Application

Water contaminated by manure and other wastes at the production facility must be appropriately managed. The extent of collection and treatment will depend on the facility's size. In a small-scale operation, settling channels or basins may be enough. For larger operations, it may be necessary to install and manage holding ponds and/or lagoons, which should be managed based on Natural Resources Conservation Service (NRCS) Standard Practice Code 590 Standard.

Wastewater should be tested for nutrient concentrations and land-applied as irrigation water to crops or forages based on soil test results, crop or forage nutrient requirements, and a realistic yield goal. The producer will need to develop and implement a Nutrient Management Plan (NMP) or a Comprehensive Nutrient Management Plan (CNMP). The application of these wastes should be accomplished without edge-of-field losses. The best way to prevent these losses is to adhere to manure setback criteria and install Riparian buffer size should be based on the distance between the water body and the next adjacent land use. The more area available for a forested riparian buffer, the better, but even a buffer of 20 feet can provide some streambank protection. Forvegetative buffers between fields and sensitive areas like streams, sinkholes, and wetlands.

Vegetation

Bioengineering solutions use vegetation to prevent water pollution. Vegetation used typically consists of native grasses, shrubs, and trees. The combination of different root sizes and depths holds soil in place and slows water flows, while also using and treating water.

Vegetative buffers can provide numerous benefits, including contaminant filtration, field separation, and soil stabilization. Though the ecological goal of vegetative buffers is usually the same, their name and site-specific purpose may change according to their position on the landscape. The three main types of conservation buffers used in livestock operations are filter strips, grassed waterways, and riparian buffers. Filter strips are designed for sheet flow, grassed waterways for intermittent flow, and riparian buffers for ephemeral and perennial flow.

Figure 5. Clogged driveway grate that allows a discharge from the production area.

Figure 6. Functioning grate that forces polluted water to the proper waste storage facility.

Filter Strips

Filter strips are areas of grass or other permanent vegetation that are maintained to reduce sediment, organic material, nutrients, pesticides, and other runoff contaminants in order to enhance water quality. Filter strips slow the velocity of water, allowing the settling out of suspended soil particles and increased infiltration. In most cases, filter strip efficiency is reliant upon flow length or filter width. For more information about filter strips, see University of Kentucky Cooperative Extension Publication *Vegetative Filter Strips for Livestock Facilities* (ID-189).

Grassed Waterways

Grassed waterways are natural or constructed channels shaped to required dimensions and established in suitable vegetation. While their main purpose is to transport runoff so that erosion and flooding don't occur, proper planning and careful design can enhance these buffers so that they also filter and divert runoff. Grassed waterways must be constructed properly in order to decrease the runoff's velocity. In order to maximize the benefit of these waterways, a more hands-off approach than farm crews typically use is required. No-mow zones should be established, and their width should be based on the amount and the speed of the runoff received by the grassed waterway. Encouraging vegetation growth will prevent rutting of channels and encourage filtration of sediments and plant uptake of nutrients.

Riparian Forest Buffers

Riparian forest buffers consist of trees, shrubs, and grasses next to streams, lakes, ponds, and wetlands. Riparian forest buffers perform many functions, including stream bank stabilization, shade, temperature moderation, and pollution filtration. Riparian buffer size should be based on the distance between the water body and the next adjacent land use. The more area available for a forested riparian buffer, the better, but even a buffer of 20 feet can provide some streambank protection. For more information see the University of Kentucky Cooperative Extension publications *Riparian Buffers: A Livestock Best Management Practice for Protecting Water Quality* (ID-175) and *Planting a Riparian Buffer* (ID-185).

Facilities Management

Several facilities management practices can reduce the potential for off-site movement of pollutants from a livestock production area. The appropriate practice(s) depends on the type of operation, equipment available, management skills, and amount of labor and capital available.

Management practices that control water pollution include:

- Installing a curb to contain liquid effluent
- Installing grates with large openings in driveways (Figures 5 and 6)
- Cleaning the manure from exposed surfaces at regular intervals appropriate to the amount of accumulation of manure
- Locating storage (silage) and feeding areas away from environmentally sensitive areas such as streams, sinkholes, and depression basins
- Installing heavy-use pads around feeding areas to reduce soil erosion

- Reducing the stocking rate to decrease the amount of manure produced
- Relocating the facility if natural drainage flows through the production area
- Converting open or partially open confinement facilities to closed facilities
- Cleaning manured or otherwise contaminated areas before rainfall events to reduce pollution of stormwater runoff
- Storing scraped manure in a covered stack pad area

For more information on some of these practices, see the following University of Kentucky Cooperative Extension publications:

- *Using Dry Lots to Conserve Pastures and Reduce Pollution Potential* (ID-171),
- *Using Soil-Cement on Horse and Livestock Farms* (ID-176),
- *High Traffic Area Pads for Horses* (ID-164), and
- *Using Geotextiles for Feeding and Traffic Surfaces* (AEN-79).

When it comes to the environment, producers need to consider not only whether the facilities can handle an operation of a certain size, but also whether the land can handle the pressures inherent in that operation's size. For example, a producer should not only use the capacity of a barn to determine the size of an operation, but should also determine if their land area can support land applications of manure from the animals contained in that barn. A producers considering building a new facility should also consider if the site's available drainage and soils can support a commercial building.

Summary

As a livestock producer, compliance with water quality regulations is not only encouraged, it is required by law. Select BMPs carefully, because most of them are site specific. In most cases, multiple BMPs will be needed to achieve regulatory compliance.

In some cases, there could be cost-share assistance available to implement BMPs. Check with your local conservation district about design criteria and cost-share availability.

The following Natural Resources and Conservation Service (NRCS) practice codes are examples of practices that might be appropriate and eligible for funding under state or Environmental Quality Incentives Program (EQIP) cost share:

- Comprehensive Nutrient Management Plan (Code 102)
- Constructed Wetland (Code 656)
- Dike (Code 356)
- Diversion (Code 362)
- Filter Strip (Code 393)
- Grade Stabilization Structure (Code 410)
- Grassed Waterway (Code 412)
- Heavy Use Area Protection (Code 561)
- Lined Waterway or Outlet (Code 468)
- Nutrient Management (Code 590)
- Roof Runoff Structure (Code 558)
- Sediment Basin (Code 350)
- Structure for Water Control (Code 587)
- Waste Storage Facility (Code 313)
- Water and Sediment Control Basin (Code 638)

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