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Abstract

As the demand grows for cleaner water, feedlots will need to reduce and control the nutrient and sediment loading of runoff. Existing confined feedlots will need to evaluate their runoff potential. Costs of controlling the runoff must be weighed against new lot construction on an alternate location. New feedlot facilities will need to address current regulations and be designed for compliance with future regulations.

Keywords

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RUNOFF COMPLIANCE FOR KANSAS CATTLE FEEDLOTS

J. P. Murphy [1] and J. P. Harner [1]

Summary

As the demand grows for cleaner water, feedlots will need to reduce and control the nutrient and sediment loading of runoff. Existing confined feedlots will need to evaluate their runoff potential. Costs of controlling the runoff must be weighed against new lot construction on an alternate location. New feedlot facilities will need to address current regulations and be designed for compliance with future regulations.

(Key Words: Feedlot, Runoff Control, Pollution.)

Introduction

The environmental issues concerning beef cattle production continue to evolve because of increased public interest in all environmental matters. Cattle productivity, quality control, marketing, and profitable operations have resulted in cattle feedlots being accepted in the United States. However, cattle producers have the responsibility to maintain the quality of surface or groundwater near their production units. Outdoor dirt lots for confinement of cattle or calves often are overlooked as areas that need water pollution control facilities. Potential pollution problems can be minimized when operators design, construct, and manage rainfall runoff systems.

Present Kansas Laws

The Kansas beef industry has adapted to increased environmental concerns over the last 30 yrs. Current regulations start at 300 animal units. Beef cattle less than 700 lbs each are .5 animal unit; beef cattle greater than 700 lbs each are 1.0 animal unit. Operations from 300 to 999 animal units are subject to Kansas Department of Health and Environment (KDHE). Operations greater than 1,000 animal units must obtain an Environmental Protection Agency (federal) permit, which also is administered by KDHE. Separation distance from habitable structures on new feedlots with a maximum design capacity of 300-999 animal units is 1,320 ft. On feedlots with greater than 1,000 animal units, the separation distance is increased to 4,000 ft.

Runoff Management Systems

The regulations for operations between 300 and 999 animal units allow for either discharging or nondischarging systems, depending on the size of operation and location of lots in relationship to waterways and potential pollution problems. A discharging system separates the solids from the liquids by using settling basins, terraces, grass filter strips, or sedimentation structures. After separation, the water is discharged into a grassed waterway, pasture, or cropped field. A nondischarging system may include a method for separating liquids and solids but the liquid portion of the runoff or all runoff is contained in a holding pond. Little or no breakdown of solids occurs before dispersal. The pond liquid is later pumped onto cropland or pasture.

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Operations that have more than 5 acres of confinement lots or 500 cattle probably will be required in the future to have a nondischarging type of waste control facility, particularly if the pens are within 2,000 ft of surface water. A discharging system could be utilized for those with less than 5 acres of drainage area or under 500 head. The use of a discharging system for operations with 500 to 999 head will depend on the available filter area, number of days on feed; uniformity of drainage area; and proximity of creeks, roads, and neighbors. Production units with a capacity of 1,000 head or more are required to contain all runoff from lots in a holding pond.

Figure 1 shows some of the options that are available for controlling runoff from dirt lots. In each case, certain restrictions will apply and certain design specifications will have to be met. Some of the criteria are:

1. Feedlots and runoff control facilities cannot be within 100 ft of the property line.
2. Water-pollution control facilities must be able to handle the runoff generated by a 10 yr- or 25 yr- 24 hr, storm which is equal to about 5 inches in western Kansas, 6 inches in central Kansas, and 7 inches in eastern Kansas.
3. The lowest elevation of the feeding area or waste control facilities must be a minimum of 10 ft above groundwater aquifers or seasonal perched tables.
4. The lots must be located a minimum of 100 ft from wells or reservoirs (preferably downslope of water sources) and 50 ft from rural water district lines.
5. Sedimentation structures are needed, with the type depending on the drainage area.
6. If a holding pond or lagoon is used, then provisions for pumping the water must be available, including land requirements and pumping equipment.

The system shown in Figure 1a is normally used with operations of less than 300 head or 1 acre in size. As the capacity increases, then the options shown in Figures 1b and 1c can be used. In both of these designs, the sedimentation channel may be a terrace or channel and sized to hold the runoff for a minimum of 30 min prior to discharging onto the land. The 30-min retention time results in large sedimentation structures as the acreage of the lots increase. Figures 1d and 1e are examples of nondischarging systems. A nondischarging, serpentine, terrace system is shown in Figure 1d. The total capacity of the terrace channels has to be able to contain the 10 yr-24 hr storm runoff from the dirt lots and any additional drainage area. Figure 1e shows a sedimentation channel with the runoff draining into a lagoon or holding pond. The sedimentation structure is optional for small lots but required if the drainage area is more than 5 acres. If wastewater from a building also is draining into the pond, then a sedimentation structure should be considered.

Grassed Filter Strips

Grassed waterways are similar to infiltration ponds, except that the water can be discharged and need not be contained totally. A grassed waterway typically is limited to 400 ft in length and requires a grade less than 4.0 percent. Grassed waterways are sized based on nutrient loading and crop nutrient utilization. Therefore, if pens are used year round for finishing cattle (800 to 1,200 lbs), 1 acre of grass filter is required per 80 head in confinement. In a feeder operation where the calves (400 to 600 lbs) are in confinement only 150 days, 1 acre of filter area is required per 400 head. The filter has to be sized for a minimum of 30 min of retention time prior to water discharging from the waterway. A sedimentation pond is required ahead of the grass waterway to remove some of the nutrients.

KDHE guidelines require that the grass waterway below the pens have a uniform slope between 1 and 4 %. The minimum length of the filtering area is 200 ft per 1 % slope. Therefore, if the grass filter area has a 2 % slope, then 400 ft is required from the back fence line to the nearest waterway. With this type of system, it is important to recognize that runoff from the pens must be dispersed uniformly across the filtering area, which often requires laser-guided earth-moving equipment. The guidelines for size include meeting the nitrogen limitations for the acres of grass filter and then the minimum filter length based on the slope of the terrain. Based on the requirements for filtering area, year-round feeding or finishing feedlot operations generally opt to use one of the other alternatives.

Holding Ponds

Holding ponds are used commonly for larger operations or where space is limited. For feedlots greater than 10 acres, the sedimentation channel is required prior to the holding pond. The pond is required to have a capacity to store the runoff created by a 10 yr-24 hr storm, storage capacity for a 25 yr-24 hr storm onto the pond surface, and an allowance for sediment. In some cases, additional storage may be needed to handle runoff from normal rains, if the evaporation will not offset the collected liquid. After the pond size is determined, an additional 2 ft of free board is added to the top of the pond. This allows the runoff from two consecutive storms to be retained, if the pond cannot be pumped before the second storm occurs. The minimum allowed storage period is 120 days.

A holding pond or lagoon should be constructed with side slopes of 3 to 1 and minimum berm width of 10 ft and have a minimum of 12 in. of clay around the sides and in the bottom. The earthen structures cannot have a seepage rate greater than 1/4 in. per 24 hr. KDHE guidelines for separation distance, flooding frequency, distance to water, and other factors should be utilized during the planning stages.

Sediment Channels

Sediment channels are used to separate the nutrients from the liquid prior to discharging the runoff into an infiltration pond, holding pond, lagoon, or grassy filter strip. Normally, a sediment channel will remove about 50 % of the nitrogen leaving the pens. Sediment channels can be trapezoidal or V-shaped terraces or ponds. Sediment channels are sized based on a 10 yr-1 hr storm, which is equal to approximately 2.6 in. in Kansas. As a minimum, a sediment channel should able to contain 2 in. of runoff per acre of feedlot (includes all area draining into the pond plus the pond). The discharge from the sediment channel is sized based on a minimum retention time of 30 min. The discharge rate will be approximately 1.3 cubic ft per second (cfs) per acre of feedlot. This results in large-diameter pipes or channels between ponds. For some feedlots, sizing the sediment channel to contain 3 in. of runoff per acre of feedlot may be more economical. The discharge rate then can be sized based on a 10 yr-2 hr storm and will be approximately 0.5 cfs per acre of feedlot. The actual discharge rate may have to be increased depending on the surface area of the sediment pond.

Operations that are less than 5 acres are not required to have a sediment structure. However, the pond capacity needs to be increased by 1.5 acre-in. per acre of feedlot to provide some storage for sediment. If the drainage area is between 5 and 10 acres, then a channel, terrace, or diversion can be used as a sedimentation structure. Above 10 acres, a sediment pond is required. If a sediment structure is used, then the capacity of the structure containing the runoff has to have an allowance of only 0.5 acre-in./acre of feedlot for sediment.

Conclusions

The actual type of system that may receive approval by KDHE depends on the site, drainage area, proximity of streams or ground water, number of cattle being fed, and other factors. Because of the variability between farms, stating exactly what will work in all situations is difficult. However, cattle operators should not locate feeding pens near streams or running water or in areas such as a ravine where cropland or pasture may drain through the pens. Any water draining from adjacent fields through a lot must be controlled using either a discharging or nondischarging pollution-control system. Therefore, it is important to divert runoff from cropland or pasture around the pens using terraces or channels. In some

some cases, relocating the pens may be easier than controlling the excess runoff. For new operations, lots should be located on upland. rather than bottomland to minimize the drainage and potential pollution problems.

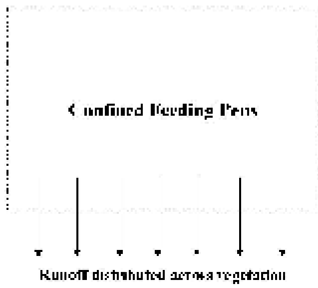

Figure 1. Controlling runoff from small confined animal feeding operations using pastures or grass land and existing land terrain.

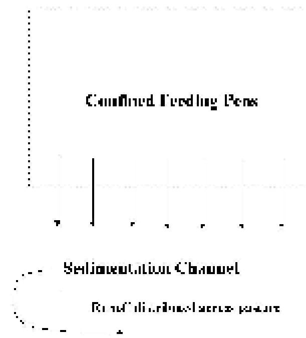

Figure 2. Controlling runoff from small confined animal feeding operations using a sediment basin and grass filters.

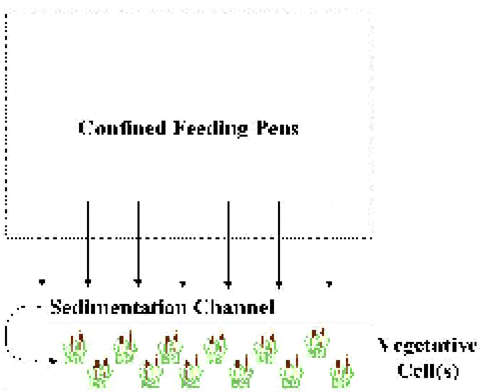

Figure 3. Controlling runoff from small confined animal feeding operations using a sediment basin discharging into vegetative system using filter strips or wetland cells.

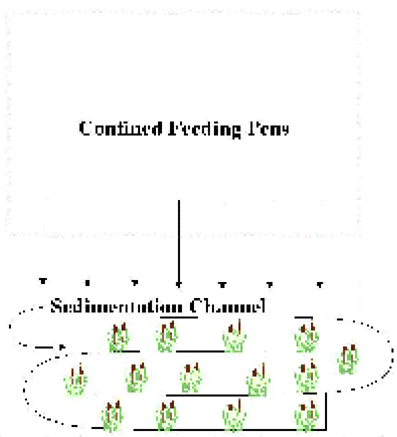

Figure 4. Serpentine terraces as a total containment system for controlling runoff from small confined animals feeding operations.

Figures 1-5 Examples of Discharging and Nondischarging Systems for Runoff Management.

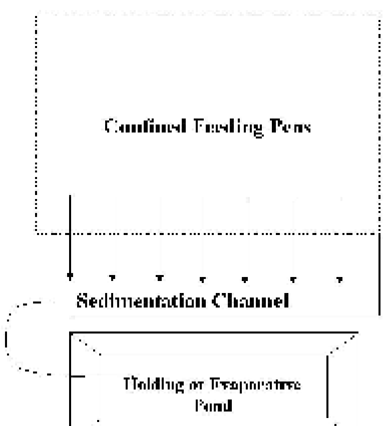

Figure 5. Controlling runoff from small confined animal feeding operations using conventional total containment structures such as holding pond, lagoons or evaporative pond.