



## Sizing Dairy Soil/Plant Filters with Conservative Management

Charles Fulhage and Donald Pfost, Department of Agricultural Engineering

### Approval permits

The Missouri Department of Natural Resources (DNR) requires a permit or letter of approval for constructing and/or operating dairy enterprises above a certain size, see Table 1.

| Type of animal              | Construction/operation permit or letter of approval |
|-----------------------------|---|
| Mature lactating dairy cows | 150 or more   |
| Dry cows and heifers        | 500 or more   |

Table 1. Size of dairy operation requiring a letter of approval.

Present regulations are primarily concerned with concentrated animal feeding operations. A concentrated animal feeding operation is defined as an operating location where animals have been, are or will be stabled or confined and fed or maintained for 45 days or more in any 12 month period; and a ground cover of vegetation is not sustained on at least 50 percent of the animal confinement area.

If dry cows and heifers are kept in a concentrated location with the milking cows, the total concentrated animal units will determine the requirements for a letter of approval or permit. For more information on regulations, see MU Publication WQ 200, *Animal Waste Regulations for Livestock Producers in Missouri*.

Operations smaller than listed in Table 1 may not be required to obtain a letter of approval, but are required to operate in a no-discharge manner in compliance with the Missouri Clean Water Law.

Approval of an animal waste management system by DNR requires that sufficient land be available to receive the generated waste. If you do not own suitable land, a legally binding agreement must be

reached with neighboring landowners to allow spreading the waste on their land. A specific form (M121-F, *Spreading Agreement*) is available from DNR outlining the necessary requirements.

DNR currently accepts three approaches for estimating land-area requirements for the soil/plant filter receiving the spread wastes. They are conservative management, intensive management and plant-available nitrogen approaches.

These approaches differ in the degree of detail required for estimating land-area requirements. In general, the conservative management approach results in the greatest land-area requirement and the plant-available nitrogen approach requires the least land area.

### The conservative management approach

This publication deals only with the conservative waste management approach to estimating land-area requirements for dairy waste.

The conservative approach to sizing the soil/plant filter for animal waste disposal is based on the annual application of 100 pounds of nitrogen per acre with no allowance for application loss. This approach is intended as a conservative application rate that is suitable for all soils and crops.

This method is used in Missouri when land area available for waste disposal is not limited. By contrast, the intensive approach is used when the land area available for waste disposal is limited. The intensive (nutrient removal) approach to sizing the soil/plant filter more closely matches manure nutrient application to crop nutrient needs. In some situations, the operator may choose to base waste application limits on phosphorous or potassium, because of

excessive amounts of phosphorus or potassium in the soil, rather than on nitrogen removal. However, the Missouri DNR currently uses nitrogen rather than phosphorous and potassium to size the minimum soil/plant filter area.

In estimating the land-area requirements under the conservative management approach, the adjusted thousand-weights of animals is multiplied by an index figure for the type of operation. The result is the acres of soil/plant filter area required for a permit under this approach. Table 2 gives the index figures for dairy cattle.

| Animal type | Index figure per 1,000 of animal live weight* |                         |
|-------------|---|-------------------------|
|             | For lagoon effluent                           | For liquid/solid manure |
| Dairy       | 0.143**                                       | 0.833***                |

\*Index figures based on applying 100 pounds nitrogen per acre per year. Does not include losses during land application, see Manual 121, Table 7. The thousand-pound units should be adjusted downward for percent of time animals are on pasture, etc., since their manure will not be directed to the concentrated feeding facility.  
 \*\*Assumes 100 percent of annual manure production to soil/plant filter via a lagoon.  
 \*\*\*Assumes 100 percent of annual manure production to soil/plant filter as liquid or solid.

**Table 2. Index figures for estimating the land area needed under the conservative management approach.**

## How to determine land-area requirements

The following example is used, along with Worksheets 1 and 2, see page 3, to illustrate how to determine land-area requirements using the conservative management approach.

Estimate the land-area requirement using the conservative management approach for a dairy with 150 cows averaging 1,400 pounds per cow in a combination confined feeding/pasture situation, such that 80 percent of the total manure production will occur in confinement and 20 percent will be dropped on pasture. Compare the land-area requirement for the manure from the confinement facilities if handled as a liquid with the land-area required if the manure is treated in a lagoon.

For the example under the conservative management approach using liquid manure, 140 acres of soil/plant filter must be available for land application vs. only 24 acres required if manure is treated in a lagoon. This procedure is primarily intended to ensure that sufficient land is available to receive waste from a given size dairy operation. Spreading the manure on the noted acreage for the given size operation will not necessarily meet the nutrient needs of the crop. For example, nitrogen losses fol-

lowing land application and before incorporation may be substantial. In some cases, the phosphorus and potassium applied using this approach may exceed the requirements of the crop.

Table 3 gives land-area requirements for different size dairy operations, assuming the cows average 1,400 pounds each and 100 percent of the manure is removed from a concentrated or confined dairy.

| Number of cows | Acres required      |                         |
|----------------|---------------------|-------------------------|
|                | For lagoon effluent | For liquid/solid manure |
| 100            | 20                  | 117                     |
| 200            | 40                  | 234                     |
| 300            | 60                  | 350                     |

**Table 3. Soil/plant filter land-area required by DNR for approval of operations under conservative management. Numbers are rounded up to the next whole number.**

## Nutrient utilization and management

To have value, wastes must be utilized in a manner that results in a saleable product. To keep the addition of nutrients from waste and fertilizer in balance with the nutrient removal by crops requires a recordkeeping system. Use laboratory tests showing the nutrient content of the wastes that were applied. The quantities of waste added and crops removed should be measured or estimated as accurately as possible. Reliable nutrient data requires that the waste be kept well mixed during the loading, sampling, transport and land application process.

## Percent loading worksheet

Form M121-G in Manual 121 contains a procedure for determining the percent loading to a lagoon or basin, to pasture or hauled for various manure handling scenarios. University of Missouri Extension Agricultural Engineering specialists and Soil Conservation Service engineers have a computer program that performs the calculations for this table.

## REFERENCES

1. MU Publication WQ 200, *Animal Waste Regulations for Livestock Producers in Missouri*, University of Missouri Agricultural Engineering.
2. Manual 121, *Design Guidelines for Animal Waste Management for Concentrated Animal Feeding Operations*. Second edition, July 1989. Missouri DNR Resources, Water Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102.

## Worksheet 1.

### Estimating land-area requirements for liquid manure:

|   | Example   | Your farm |
|---|-----------|-----------|
| 1. Calculate thousand-weights of animals:<br>150 cows x 1,400 pounds per cow ÷ 1,000 pounds =                 | 210       | _____     |
| 2. Adjust the thousand-pound units for time on pasture:<br>Adjustment factor = 1.0 - 0.2 = 0.8<br>210 x 0.8 = | 168       | _____     |
| 3. Multiply the adjusted animal weight from (2) by the index number from Table 2.<br>168 x 0.833 =            | 140 acres | _____     |

## Worksheet 2.

### Estimating the land-area for lagoon effluent:

|   | Example  | Your farm |
|---|----------|-----------|
| 1. Calculate thousand-weights of animals:<br>150 cows x 1,400 pounds per cow ÷ 1,000 pounds =                 | 210      | _____     |
| 2. Adjust the thousand-pound units for time on pasture:<br>Adjustment factor = 1.0 - 0.2 = 0.8<br>210 x 0.8 = | 168      | _____     |
| 3. Multiply the adjusted animal weight from (2) by the index number from Table 2.<br>168 x 0.143 =            | 24 acres | _____     |



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