



TECHNICAL HIGHLIGHTS
Ground Water Impacts
by
Land Application Practices at AFOs
Region 6 “Lessons Learned”

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Contamination of ground water by nitrate (greater than 10 mg/L as nitrate-nitrogen) has been documented at a number of animal feeding operations (AFOs) in Region 6 and across the United States. Investigation of ground water quality at AFOs has primarily focused on leakage from waste holding lagoons, but a review of available data shows that many land application areas are also contaminated. Ground water samples at New Mexico dairies and several swine operations in Oklahoma commonly have elevated levels of nitrate in land application areas.

The principle governing land application of organic wastes is that the wastewater will be taken up by the roots of growing plants and incorporated into plant tissues. The amount of nutrients which are applied is calculated based on growth rates of the specific crop planted and typically is reported as an application rate in pounds per year (the agronomic rate). In practice, specific application procedures and schedules may have to be followed in order to achieve full utilization of the nutrients applied and to prevent the movement of the applied fluids into ground water. **In light of the evidence of nutrient contamination at some land application sites, staff of the Ground Water Center reviewed common land application practices at AFOs and identified several that may result in contamination of ground water as discussed below.**

The Use of Flood Irrigation

Land application of fluids at most sites is accomplished by use of spray irrigation. However, at some dairy operations wastewater from lagoons is commonly applied to the land by flood irrigation. On highly permeable soils wastewater applied in this manner infiltrates rapidly with the consequence that there is a high potential for movement of fluids below the root zone and into the underlying aquifer. Information on ground water quality and land application practices at a number of dairies in New Mexico shows that there is a strong correlation between flood irrigation and high nitrate levels in ground water. The EPA health-based standard for nitrate-N in drinking water is 10 mg/L. Of 30 dairies where flood irrigation was practiced, 45% (fourteen dairies) reported nitrate-N concentrations exceeding 10 mg/L, while none of the 8 dairies using spray or center pivot irrigation reported nitrate-N levels this high. **As indicated by the data, flood irrigation should not be considered an acceptable practice for land application of liquid wastes.**

Considering Grazing as Crop Removal

As noted above, the amount of nutrients which can be land applied depends on the amount of nutrients which are utilized by plant growth. In order for this method to work continuously the plant crop must be removed as it reaches maturity and growth rates decline. Some AFO operators consider grazing by cattle to constitute removal of the crop and therefore removal of nitrate. However, a bulletin issued by the Oklahoma State Extension asserts that, "Nutrients are not effectively removed from the forage system by grazing livestock . . . nutrient removal is accomplished only by removing forage as a hay crop and transporting the nutrients away from the application site. Grazing, for the most part, recycles most of the nutrients back into the forage system." Agricultural specialists who were contacted by Region 6 staff generally agreed that grazing would recycle part of the nutrients. **The use of grazing, instead of crop removal, can lead to over-application of nutrients and the potential for contamination of ground water.**

Failure to Consider Soil Characteristics

A number of Natural Resource Conservation Service (NRCS) guidance documents include consideration of soil characteristics among the factors which determine land application practices. These considerations include the ability of the soil to hold the applied nitrogen long enough to be taken up by the plants before it can percolate below the root zone. The NRCS recommends "severe" limitation on land application where soils do not hold applied liquids for a sufficient length of time.

Agricultural specialists contacted by the Region indicated that best management practices developed by the states and widely used in the field, commonly do not consider all of the detail contained in the NRCS guidance. The worksheets used in calculation of nutrient application volumes cover available soil nutrients, crop needs and effluent content, and for nutrient limited watersheds land slope, soil depth and phosphorus content are also considered. However, certain factors such as intake rate, cation-exchange-capacity ratio, and permeability are seldom explicitly addressed. There was no general agreement among the specialists as to how the NRCS category of "severe" limitation on land application should be interpreted, presumably reflecting confusion about how land application should be modified for soils which may be highly permeable. **The vulnerability of soils to rapid infiltration should be an important consideration in the design of any land application program.**