Quantity and Quality of Seepage from Two Earthen Basins Used to Store Livestock Waste in Southern Minnesota, 1997-98--Preliminary Results of Long-Term Study

James F. Ruhl[1]

Numerous earthen basins have been constructed in Minnesota for storage of livestock waste. Typically, these basins are excavated pits with above-grade, earth-walled embankments and compacted clay liners. Some have drain tile installed around them to prevent shallow ground and soil water to discharge into the basins. Environmental concerns associated with the waste include contamination of ground water by nitrogen compounds and pathogens.

The U.S. Geological Survey, in cooperation with the Minnesota Pollution Control Agency (MPCA), studied the quantity and quality of seepage from two earthen basins used to store livestock waste in southern Minnesota during their first year of operation. One basin (site A), located at a small dairy farm, holds a manure-silage mixture, milkhouse wastewater, and local runoff; the other basin (site B), located at a large hog farm, holds a manure-water mixture from a nearby gestation barn. Monitoring systems were installed below compacted clay liners in portions of the sidewalls and bottoms of the basins to determine the quantity and quality of the seepage.

Total seepage flow from the site A basin ranged from about 900 to 2,400 gallons per day (gal/d) except during April 1998 when the flow increased to about 4,200 gal/d. Seepage flow in areal units, which closely correlated with flow in gallons per day, ranged from about 0.07 to 0.28 inches per day (in/d), which exceeded the recommended maximum design rate of 0.018 in./d established by the MPCA. Seepage flow commonly was greater through the sidewalls than through the bottom.

Seepage from the site A basin (based on 11 samples each from the bottom and sidewall) had chloride concentrations of 220-350 milligrams per liter (mg/L); ammonium-N (nitrogen) concentrations of 2.40 mg/L or less (except for one concentration of 18.4 mg/L); nitrate-N concentrations of 5.24 mg/L or less; and organic-N concentrations of 6.97 mg/L or less. Ground water would be enriched in chloride and diluted in nitrogen compounds from mixing with basin seepage. Fecal coliform bacteria, although abundant in the basin wastewater, were present in very small amounts in the seepage.

Total seepage flow from the site B basin generally ranged from 400 to 2,200 gal/d except during 1-month and 3-month periods when the flow ranged from about 3,800 to 6,200 gal/d. Seepage flow in areal units ranged from about 0.025 to 0.43 in/d, and, as at the site A basin, exceeded the MPCA recommended maximum design rate of 0.018 in/d. Seepage flow in areal units generally correlated with the flow in gallons per day except through the sidewalls when the basin was unfilled. Except during the first three months of the study, seepage flow was greater through the sidewalls than through the bottom.

Seepage from the site B basin (based on 11 samples each from the bottom and sidewall) had chloride concentrations of 11 to 100 mg/L; ammonium-N concentrations of 2.58 mg/L or less; nitrate-N concentrations of 25.7 mg/L or less (except for one concentration of 146 mg/L); and organic-N concentrations of 0.920 mg/L or less. Although background ground-water quality indicated nitrate contamination, seepage from the basin was potentially an additional source of nitrate contamination of the ground water. Nitrate-N concentrations in the seepage exceeded the U.S. Environmental Protection Agency drinking water standard of 10 mg/L in 17 of 22 samples. Fecal coliform bacteria, as at the site A basin, were abundant in the basin wastewater but not in the seepage.

---

[1]U.S. Geological Survey, 2280 Woodale Drive, Mounds View, MN 55112 (ruhl@usgs.gov)