



Source Water Protection Practices Bulletin

Managing Livestock, Poultry, and Horse Waste to Prevent Contamination of Drinking Water

Animal waste or feces have long been isolated from people for public health reasons. Yet, animal waste is deposited daily into rivers, streams, and other water bodies. This waste poses a continuous threat to human health. Appropriate steps must be taken to lower this risk and prevent contamination of drinking water sources. This fact sheet addresses some source water contamination prevention measures related to livestock, poultry, and horses that can improve water quality and reduce the burden on drinking water treatment facilities. (Refer to the fact sheet on pet and wildlife waste for information on management measures related to these animals.)

SOURCES OF ANIMAL WASTE

Livestock and poultry are major sources of waste. Estimates indicate that the amount of livestock waste is 13 times greater than the amount of human sanitary waste generated in the United States. Livestock and poultry waste can be introduced to the environment through direct discharges, through land application of manure, and from open feedlots, barns and housing, and pastures.



Cattle feedlot

Companion animals, such as horses used for showing and recreation, also produce waste that should be accounted for in pollution prevention. Horses raised on hobby farms, while similar to livestock, are managed differently, allowing for alternative prevention measures. The average horse produces about 45 pounds of waste each day, an amount that can be overwhelming to those operating small, suburban horse farms. Horses are rarely kept in a single facility of more than 50 animals. Although this lower density eliminates some of the concerns that pertain to livestock, horse waste can be managed using many of the same prevention measures used for livestock.

WHY IS IT IMPORTANT TO MANAGE ANIMAL WASTE NEAR THE SOURCES OF YOUR DRINKING WATER?

Animal waste contains many pollutants that can contaminate surface and ground waters used as drinking water sources. Probably the greatest health concern associated with livestock, poultry, and horse wastes is pathogens. Many pathogens found in animal waste can infect humans if ingested. Organisms like *Cryptosporidium*, *Giardia lamblia*, and *Salmonella* can induce symptoms ranging from skin sores to chest pain. *E. coli*, which causes diarrhea and

abdominal gas, has been the source of disease outbreaks in several States. Particularly virulent strains of *E. coli* can cause serious illness and even death. *Cryptosporidium* is of particular concern because it is highly resistant to disinfection with chlorine. This protozoan causes gastrointestinal illness that lasts 2 to 10 days in healthy individuals but can be fatal in people with weakened immune systems. *Cryptosporidium* was responsible for more than 50 deaths and an estimated 403,000 illnesses after contaminating a Milwaukee drinking water supply. Runoff from cow manure application sites was a suspected source of the *Cryptosporidium*.

Animal wastes can contribute to nitrates in drinking water. Consumption of nitrates can cause methemoglobinemia (blue baby syndrome) in infants, which reduces the ability of the blood to carry oxygen. If left untreated, methemoglobinemia can be fatal. Because of this health risk, EPA set a drinking water maximum contaminant level (MCL) of 10 milligrams per liter or parts per million for nitrate measured as nitrogen.

Animal waste contains many other pollutants of concern that affect humans and water quality. Such pollutants include oxygen-demanding substances that can lead to fish kills and degraded water quality. Solids from animal waste can increase turbidity and adversely affect the taste and odor of waters. In addition, metals such as arsenic, copper, selenium, and zinc, which are often added to animal feed, can be toxic to humans. Antibiotics, pesticides, and hormones, also used in animal feeding operations, can become harmful pollutants as well.

AVAILABLE PREVENTION MEASURES TO ADDRESS ANIMAL WASTE

Many prevention measures can significantly reduce the impact of waste from livestock, poultry, and horses on water supplies. These measures vary greatly in complexity and cost. It should be noted that individual prevention measures might not be adequate to prevent contamination of source waters. Measures should be combined in an overall pollution prevention approach that considers the nature of the animal waste, the vulnerability of the drinking water sources, and the cost and operation and maintenance requirements of the measures.

Proper management of livestock waste includes preventing animals and their waste from coming into contact with runoff and water sources, properly applying waste as fertilizer on crop or pastures, and appropriately managing pastures.

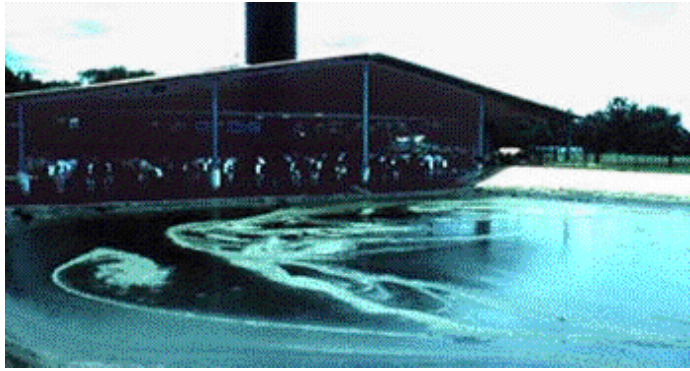
Feedlot Management Measures

Several options are available to reduce contact between manure and precipitation or runoff through proper storage and treatment of the manure from animal operations. Among them are waste storage lagoons, litter storage structures, clean water diversions, composting, and runoff treatment.

CAFO Permits

Under the National Pollutant Discharge Elimination System (NPDES) regulations, concentrated animal feeding operations (CAFOs) are defined as point sources and are subject to permitting where they discharge or have the potential to discharge pollutants (40 CFR 122.23). EPA regulations define a CAFO based on the size of the animal feeding operation or its size in combination with the manner of discharge. An animal feeding operation can also be designated a CAFO when the permit authority determines it is a significant source of pollution. A NPDES permit authorizes, and imposes conditions on, the discharge of pollutants. The permit must include technology-based limitations and, if necessary, more stringent water quality-based limitations. EPA has published technology-based limitations (e.g., effluent guidelines) for feedlots at 40 CFR Part 412. The guidelines include numeric limits, non-numeric effluent limitations, and requirements for facilities to use specific BMPs. EPA published a proposed rule in the *Federal Register* on January 12, 2001 (66 FR 2960), that would revise and update both the definition of a CAFO and the effluent guidelines for feedlots. These revisions seek to address water quality issues posed by changes in the animal production industry as well as to more effectively address the land application of CAFO-generated manure and process wastewater. Additional information on this proposed rule can be obtained at <http://www.epa.gov/npdes/afo>.

A **lagoon**, or waste storage pond, is made by excavating earth fill to provide temporary storage of animal waste. This practice can reduce the amount of organics, pathogens, and nutrients entering surface waters; however, lagoons can contaminate ground water if they are not



Lagoon

constructed and maintained properly. Lagoons have three distinct zones containing liquids, sludge, and solids. These wastes can later be pumped out and applied to cropland as fertilizer.

Because of the risk to ground water, good planning, design, and maintenance are critical when using a lagoon for animal waste storage. Two important components are the location and

the liner of the lagoon. A lagoon should be placed in accordance with State and local requirements for separation distances from nearby drinking water wells. Lagoons should be located downslope from wells and never sited on floodplains. Lagoons should be designed to contain at least a 25-year, 24-hour storm plus process wastewater. (A 25-year storm is one that has a one-in-25 chance of occurrence in a given year).

A lagoon should be constructed with a **low-permeability liner** made of synthetic material or geotextiles or formed by compacted clay or other soil material. Once the liner is established, it is imperative to maintain its integrity during the waste removal process. Any erosion can lead to seepage and subsequent contamination of ground water. Two practices to protect the liner are building a concrete access ramp for waste removal equipment, and operating equipment under dry conditions by first removing all the liquids and letting the solids dry.



Hog parlor with lagoon

Poultry litter storage facilities are designed to keep rainwater and runoff away from poultry house waste being stored for later application to crops. Litter storage can ensure that poultry waste is applied under the proper conditions to protect the environment and to coincide with soil and crop needs. Types of litter storage buildings (ranging from the least to the most protective of water sources) include open stockpiles, covered stockpiles, bunker-type storage, and roofed storage structures. The appropriate size of the storage structure depends on the amount of litter removed and how often the poultry houses are cleaned out.

Clean water diversion is an effective measure that prevents contamination of precipitation or surface flow as it makes its way to drinking water sources. Proper storm water management in and around feedlots and livestock yards, including proper protection (or isolation) of agricultural drainage well inlets, is essential to guarding against ground water contamination. Rain gutters and downspouts on animal shelter roofs keep runoff clean by directing precipitation away from manure. Another tactic to prevent runoff contamination is to construct superficial diversions, such as earthen ridges or diversion terraces built above the feedlot or barnyard, to direct surface flow away from waste.

Composting can help eliminate pathogens and reduce the volume of manure. Composting is the controlled biological decomposition of organic materials; it can be aerobic (occurring with oxygen) or anaerobic (occurring with little or no oxygen). It is perhaps the most common and least costly method of handling livestock waste. Compost sites should be located away from drinking water wells and water sources to avoid leaching during heavy rain. Also, piles should be situated on fairly flat sites where water does not collect or run off. Once manure has fully broken down into usable compost, it can be spread as fertilizer, using proper application methods. Composting should take place at the correct temperature and for an appropriate length of time to kill the pathogens in the manure.

Once runoff becomes contaminated, **vegetative filter strips** and other means can be used to control overland flow. Such measures treat the runoff from feedlots or grazing areas by absorbing nutrients, bacteria, and chemicals. More detailed descriptions of these types of prevention measures can be found in the fact sheet on managing storm water runoff.

Proper Land Application of Manure

Effective nutrient management minimizes the quantity of nutrients available for loss. This is achieved by developing a comprehensive **nutrient management plan** and using only the types and amounts of nutrients necessary to produce the crop, applying nutrients at the proper times and with appropriate methods, implementing additional farming practices to reduce nutrient losses, and following proper procedures for fertilizer storage and handling.



Animal waste used as fertilizer

Correct placement of manure in the root zone can greatly enhance plant nutrient uptake and minimize losses. Manure should be incorporated into the subsurface,

rather than simply applied to the surface to reduce runoff and production of vapors. Waste should never be applied to frozen, snow-covered, or saturated ground. Good management of irrigation water can help maximize efficiency and minimize runoff or leaching.

Proper manure application rates are also important. Applying waste at the time of maximum crop uptake can minimize loss to surface runoff and decrease the amount of manure needed to fertilize crops. Calculating the optimal rate of application also includes **crediting other sources** that contribute nitrogen and phosphorus to the soil. Furthermore, appropriate manure application is based on **yield goals** established by the crop producers. Yield expectations are established for each crop and field based on soil properties, available moisture, yield history, and management level. **Soil sampling** is necessary to determine plant nutrient needs and to make accurate fertilizer recommendations.

Conservation tillage and buffers can reduce runoff over feeding and grazing lands and transport of livestock wastes to water sources. In **conservation tillage**, crops are grown with minimal cultivation of the soil. Plant residues are not completely incorporated into the soil; instead they remain to provide cover and reduce runoff. **Buffer strips** and **filter strips** are created by planting dense vegetation near surface water bodies. The vegetation reduces runoff and filters sediments and chemicals. For more information on buffer strips and filter strips, see the fact sheet on storm water runoff.

In some areas of the country, the amount of animal waste produced is more than can be used by all the crops in the area. In these cases, programs to move the excess manure out of the

watershed or source water protection area or to develop an alternative use for the manure (other than land application) might be necessary.

Crop rotation can often yield crop improvement and economic benefits by minimizing fertilizer and pesticide needs. Planting legumes as part of a crop rotation plan provides nitrogen for subsequent crops. Deep-rooted crops can be used to scavenge nitrogen left in the soil by shallow-rooted crops. See the fact sheet on agricultural application of fertilizer for additional information on measures such as laser-controlled land leveling, conservation tillage, and buffer strips.

Pasture Management

Several methods are available to keep livestock away from water bodies. In addition to preventing damage to stream banks, **fencing** can be used to keep livestock from defecating in or near streams or wells. Fencing designs include



standard or conventional (barbed or smooth wire), suspension, woven wire, and electric fences. The height, size, spacing, and number of wires and posts are a function of the landscape topography as well as the animals of concern. Optimum design criteria depend on the specific situation and should be developed through consultation with biologists. Providing **alternative water sources** and **hardened stream crossings** for use by livestock lessens their impact on water quality.



FOR ADDITIONAL INFORMATION

These sources contain information on animal waste pollution prevention measures. All of the documents listed are available free of charge on the Internet.

Contact the Natural Resources Conservation Service (NRCS), Conservation District, and Agricultural Extension Service representatives in your area. They can provide more information on nutrient management and cost-share programs, such as the Environmental Quality Incentives Program (EQIP), the Conservation Reserve Program (CRP), and the Conservation Reserve Enhancement Program (CREP), to assist in financing source water protection measures.

The Center for Watershed Protection, Storm Water Manager's Resource Center. *Pollution Prevention Fact Sheet: Animal Waste Collection*. Retrieved February 19, 2001, from the World Wide Web: <http://www.stormwatercenter.net>

Fulhage, Charles D. (1993, October). *Storing Poultry Litter*. University of Missouri-Columbia, Department of Agricultural Engineering. Water Quality Initiative Publication WQ212. Retrieved May 21, 2001, from the World Wide Web: <http://muextension.missouri.edu/xplor/envqual/wq0212.htm>

Hammond, C. *Animal Waste and the Environment*. The University of Georgia College of Agricultural & Environmental Sciences Cooperative Extension Service. Retrieved January 19, 2001 from the World Wide Web: <http://www/ces.uga.edu/pubcd/c827-w.html>

Kellogg, R. L., C.H. Lander, D. C. Moffitt, and N. Gollehon. (2000, December). *Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assimilate Nutrients: Spatial and Temporal Trends for the United States*. U. S. Department of Agriculture, Natural Resources Conservation Service Economic Research Service. Retrieved May 21, 2001, from the World Wide Web: <http://www.nhq.nrcs.usda.gov/land/pubs/mannttr.html>

Koelsch, R. (1999, January) *Sludge Management for Anaerobic Lagoons and Runoff Holding Ponds*. Nebraska Cooperative Extension. G98-1371-A. Retrieved February 27, 2001, from the World Wide Web: <http://www.ianr.unl.edu/pubs/wastemgt/g1371.htm>

Natural Resource Conservation Service, Water Science Institute. (2000, June). *Waterborne Pathogens in Agricultural Watersheds*. Retrieved May 1, 2001, from the World Wide Web: <http://www.wcc.nrcs.usda.gov/watershed/products.html>

North Carolina State University Water Quality Group. (2000, August). *National Management Measures to Control Nonpoint Source Pollution from Agriculture [Draft]*. U.S. EPA, Office of Water, Nonpoint Source Control Branch. Retrieved May 1, 2001, from the World Wide Web: <http://www.epa.gov/owow/nps/agmm/index.html>

U.S. Department of Agriculture, Natural Resources Conservation Service. (1999, August). *Conservation Practices Training Guide*. Retrieved April 30, 2001, from the World Wide Web: http://www.ftw.nrcs.usda.gov/tech_ref.html

U.S. Department of Agriculture, Natural Resources Conservation Service. (2000, December). *Comprehensive Nutrient Management Planning – Technical Guidance*. Retrieved April 30, 2001 from, the World Wide Web: <http://www.nhq.nrcs.usda.gov/PROGRAMS/ahcwpd/ahCNMP.html>

U.S. EPA, Office of Ground Water and Drinking Water. (1999, April). *Uncovered Finished Water Reservoirs Guidance Manual*. EPA-815-R-99-011. Retrieved February 19, 2001, from the World Wide Web: <http://www.epa.gov/safewater/mdbp/pdf/uncover/ufw8p.pdf>

U.S. EPA, Office of Science and Technology. (1999, January). *Preliminary Data Summary: Feedlots Point Source Category Study*. EPA-821-R-99-002. Retrieved February 19, 2001, from the World Wide Web: <http://www.epa.gov/ostwater>

The following sites provide publications and information on livestock management and related prevention measures:

Idaho One Plan (<http://www.oneplan.org>) provides a catalog of best management practices.

Iowa State University Extension. <http://www.exnet.iastate.edu/Pages/pubs/fm1.htm>

Michigan Department of Agriculture. Right to Farm Program. <http://www.mda.state.mi.us/right2farm/farm.htm>

Texas Agricultural Extension Service. <http://agextension.tamu.edu>
U.S. Department of Agriculture, Natural Resources Conservation Service's Conservation Practice Standards site provides links to State Conservation Practice Standards and other documents. http://www.ftw.nrcs.usda.gov/practice_stds.html

U.S. EPA, Office of Wastewater Management, has a site dedicated to animal feeding operations. <http://www.epa.gov/owmitnet/afo.htm>

U.S. EPA, Office of Wetlands, Oceans, and Watersheds. <http://www.epa.gov/owow/nps/agriculture.html>