Maine Farm-A-Syst

Farmstead Assessment System Fact Sheet 7

Reducing the Risk of Groundwater Contamination by Improving Livestock Waste Storage

Storage of livestock wastes involves simply accumulating wastes until they can be land applied. From an environmental standpoint, this waste storage can be either positive or negative.

Manure storage can provide environmental benefits by allowing wastes to be stored until they can be safely spread, incorporated in the soil and used by a growing crop. The environmental safety of collecting large amounts of manure in one place for an extended period depends on three things:

1) The design and construction of the storage facility.

2) Proper land application of the manure once it leaves the storage facility.

3) The physical and chemical characteristics of the soil and subsurface geologic materials within the storage area and the soil and subsurface geologic materials of the area to which any runoff might flow.

Topics Covered:

Waste storage is an important management option available to livestock producers. Stored manure can be applied to the soil when crops are not actively growing and the soils are open. This allows manure to be injected or incorporated by tillage immediately following application. Handling manure in this way ensures maximum fertilizer value from the waste materials while reducing risks of groundwater and surface water contamination from the over-application of nutrients.

Stored manure can be sampled and tested to determine how much nitrogen, phosphorus and potassium it contains. When sampling manure, be sure to obtain as representative a sample as possible. To do this consult with Cooperative Extension guidelines for appropriate sampling techniques at http://www.umext.maine.edu/onlinepubs/PDFpubs/2286.pdf . This information, combined with knowing the amount of manure applied per acre, enables a farmer to determine whether additional commercial fertilizer is needed to meet realistic crop production goals.

It is illegal in Maine to spread manure on agricultural fields December 1st through March 15th. It is also illegal to spread manure on frozen ground within a great pond watershed unless this activity is in accordance with a conservation plan on with a state soil and water conservation district. Additionally restrictions may apply if the farm is involved with certain USDA contracts. In any emergency situation, the Commissioner of Agriculture may grant a variance for spreading manure during the restricted period.

Waste storage reduces the need for land application during winter months when soil is frozen. Not applying manure in the winter also saves wear and tear on farm equipment, conserves nutrients contained in the manure and minimizes manure nutrient leaching and runoff. Storage is also valuable during extended periods of bad weather and when crops are actively growing, making application impractical.

Long-Term Storage

Livestock wastes can be stored either in solid, semi-solid or liquid states.

- Solid facilities use walls and slabs for stacking of heavily bedded manure.
- Semi-solid facilities use pumps to move manure into containment areas and may separate solids from liquids.
- Liquid facilities hold manure in tanks, pits or bermed areas.

Liquid and semi-solid storage systems are self-contained. A threat to surface water exists if pits are not emptied frequently enough, allowing wastes to flow over the top of the structure. Liquid storage systems require the use of pumps and pipes for moving wastes from the barn to the storage structure. These must be carefully installed and maintained to ensure that they do not leak.

Groundwater contamination can occur if the facility is not structurally sound, allowing waste materials to seep into the soil.

Each time they are emptied, carefully check steel and concrete structures for cracks or the loss of watertight seals. If any breaks are apparent, repair them immediately. Likewise, check the walls of earthen waste storage pits to be certain that liner materials have not been eroded away by pit agitation.

Groundwater contamination will result if the subsurface materials do not have sufficient ability to break down contaminants contained in the leachate.

After a period of years, freezing and thawing, as well as wetting and drying, may cause the sidewalls of earthen pits to crack and erode, allowing wastes to seep into the underlying soil or subsurface geologic material. Earthworm channels can also allow wastewater to move through the liner. Evidence suggests that the design life for earthen pits is probably 10 years.

While seepage from in-ground waste storage facilities is not always easy to recognize, there are some telltale signs:

- A properly designed structure has the capacity to handle wastes from a specific number of animals for a known number of days. If a pit designed for 180 days of storage and receiving designated waste amounts has not needed pumping for a year, the pit is almost certainly leaking.
- Evaporation from liquid storage pits is minimal, particularly with manure from dairy cattle, which forms a crust when it is stored. If additional liquids have to be added before the pits can be agitated and pumped, they may be leaking. (Monitoring wells installed around the pit upslope and downslope would be required to confirm the seepage.)

Some facilities for storage of solid or semi-solid manure are designed to allow seepage from the waste stack. In these instances, structure design must include treatment for the wastes that seep out. If conditions allow, structures such as picket dams can be used to hold back solids and grass wastewater treatment strips help remove remaining pollutants in runoff water so that nutrients or other contaminants will not enter surface water bodies. These systems should not be considered on sites with coarse-textured soils, fractured bedrock or shallow water tables. Care must be taken to ensure that the system is not overloaded.

Both systems require maintenance. With grass wastewater treatment strips, it is important to ensure that the highly concentrated wastes do not "burn" vegetation in the wastewater treatment strip. (A thick, healthy stand of vegetation allows runoff to seep into the soil and uses the nutrients in the water.)

The best way to handle seepage is to channel it into a watertight holding pond or storage tank. In those areas where sufficient soil is unavailable for the construction of wastewater treatment strips, or where the construction of a holding pond is not feasible, another option is to build a roof over the structure to eliminate additional water being added to the manure stack.

Short-Term Storage

Short-term storage (usually 30-90 days) is an important option available to farmers. It allows livestock wastes to be held during periods of bad weather when daily spreading may not be feasible, when crops are growing and land is not available for applying manure, or when there is a shortage of crop acres to handle daily hauling and spreading of manure without the threat of runoff. Short-term storage, which is restricted primarily to solid manure, has the disadvantage of requiring that the manure be handled twice. Designs are available, though, for structures for short-term storage that facilitate handling and provide effective protection for surface water and groundwater.

If field stacking is unavoidable, a site-specific evaluation should be conducted by a qualified professional. Soils that are best suited for field stacking have slow permeability, slopes that are less than or equal to 5 percent, greater than 2 feet to seasonal high water table, and greater than or equal to 40 inches to bedrock.

Short-term storage systems may be applicable for those who often find themselves having to stack manure in fields, particularly during periods of bad weather. If manure is frequently stacked in fields, it might be appropriate to consider constructing a short-term storage facility.

Likewise, many farmers will scrape manure into piles in the livestock yard rather than haul it during bad weather or busy work periods. This practice is not recommended either, because of possible herd health problems and water problems. The severity of those problems depends on characteristics of the livestock yard area where the manure is piled and the area to which runoff flows.

Many farmers have open housing for young stock, such as pole sheds, where wastes are allowed to accumulate for extended periods of time. Roofs on these structures keep rain and snow off the manure. These structures are relatively safe for water quality if they are protected from surface water runoff, and if adequate bedding is provided to absorb liquids in

the wastes. To minimize water quality impacts, provide adequate bedding to reduce seepage and clean these sheds as frequently as possible.

Waste Storage Location

The location of livestock waste storage in relation to any well is an important factor in protecting the water supply. Stacking facilities should be located a minimum of 300 feet upslope or 100 feet down slope from a well. Set backs from other properties need to be considered as well. State and local regulations may also dictate separation distances.

Observing separation distances when sighting a new facility is a good way to help protect drinking water. Locating manure storage facilities downslope of the well is also important for protection of the water supply. (For more information about separation distances, and how the condition of your well might affect the potential for contamination, see Worksheet and Fact Sheet #1, Groundwater Aquifers, Watersheds, and Wells.)

Depth to seasonal high water table or bedrock, along with soil type at the waste storage location, is another important factor when siting a waste storage structure. These are among the site vulnerability characteristics in Worksheet #11, Site Evaluation. Ranges in depth to seasonal high water table are available in the USDA-NRCS, County Soil Survey. A site-specific soil evaluation needs to be conducted by a qualified professional when locating a suitable site for a waste storage facility. Your county Extension Educator, Natural Resources Conservation Service or Soil and Water Conservation District specialist may also be able to help you gather this information.

While observing well separation minimum distances may help protect your own well, poorly designed or poorly maintained livestock waste storage facilities could still contaminate the groundwater that supplies other local drinking water wells. Protecting the groundwater resource as a whole can help protect your neighbors' wells, public drinking water wells, as well as possible drinking water supplies for future generations.

Other Management Factors

Many Maine towns and cities have waste storage ordinances that regulate manure storage facilities. Contact your town or city for more information. If animal waste storage causes any significant water contamination, the Department of Environmental Protection may issue a violation, which may require corrective measures. Contact the Department of Agriculture, Food, and Rural Resources for information about state regulations.

Abandoned Pits

Abandoned waste storage pits, especially earthen ones, can pose significant water quality problems. Any abandoned structure should be completely emptied. In the case of earthen waste storage facilities, liner materials (to a depth of about two feet) should be removed and spread over croplands. The remaining hole should be filled and leveled. Manure packs from pole sheds no longer in use should also be removed and the wastes land applied. If manure is stacked in fields, it should be removed as soon as conditions permit.

Source Water Protection/Wellhead Protection Area

Almost half of Maine's population depends on groundwater for its drinking water supply from either private or public wells. We are lucky to have some of the best water supplies in the world, and it is our job to keep them safe. Being aware of potential problems on your property that might pollute drinking water sources is important. You may not even know that there is a potential threat. Taking the time to read and fill out the applicable Farm-A-Syst sections is a great first step. From there you will sit down with a district employee or someone trained in Farm-A-Syst to discuss some possible solutions such as best management practices (BMP) that can be applied. BMPs are a method, measure, or practice that, when correctly installed or performed, will prevent, reduce, or minimize water pollution. In this case, the focus is on drinking water supplies and the areas that provide them with water.

There are some laws that pertain to areas within a source water protection zone that don't apply to other landowners. Be sure to check with your local water district and municipality for local ordinances or if you are unsure if you live in a source water protection area.

It is the landowner's responsibility to know local and state laws pertaining to their land, although it is hard to navigate sites and wade through the legal jargon of written laws.

If you are living or operating in a source water protection area (the surface and subsurface areas surrounding a drinking water supply for a public water system where activities can contaminate the supply) or wellhead protection area (an area used to protect groundwater, a form of source water) you should pay extra special attention. We have tried to find pertinent information pertaining to this section. You can find links to these laws along with helpful information in the following Contact & Reference section as well as in appendices A: Law and Regulations & B: Resources.

The following ,authored by Maine Drinking water program, is excerpted from the document "Best Management practices for Groundwater Protection". This manual is intended for the use of local officials, public water suppliers and landowners in Maine. It is intended to encourage educated decisions, informed practice, and directed planning in regard to groundwater protection, particularly in the vicinity of public drinking water supply wells. http://www.maine.gov/dhhs/eng/water/forms/Sections/BMPv2%200A.htm

Chemical Storage

BMPs for chemical storage

1. Manure, ash, and liming agents used for agricultural purposes must also be stored under cover.

CONTACTS AND REFERENCES

Who to call about...

Animal waste management

Your county Extension office, the Natural Resources Conservation Service, or your local Soil and Water Conservation District office.

Cost-sharing funds

Financial assistance for animal waste management practices, including waste storage, may be available through the Environmental Quality Incentive Program (EQIP) administered by the NRCS. Contact your local NRCS office for more information.

What to read about...

Publications are available from sources listed at the end of the reference section. (Refer to number in parentheses after each publication.)

Health effects of livestock waste in groundwater

Nitrates: Groundwater and livestock Health. University of Maine Cooperative Extension Water Quality. Bulletin #7086. (1)

Nitrate: Health Effects in Drinking Water. University of Maine Cooperative Extension Water Quality Fact Sheet #22, Publication # 7107. (1)

Handling, management and storage of livestock waste

Outside Liquid Manure Storages. 1979. 8 pages. Midwest Plan Service. AED-23. Discusses earth storage basins and non-earth above-ground storages. (2)

Best Management Practices for Maine Agricultural Producers. 1989. 43 pages. University of Maine Cooperative Extension. Discusses manure best management practices. Bulletin #20 14. (1)

Planning and design of livestock waste storage facilities

Livestock Waste Facilities Handbook 1985. 112 pages. Midwest Plan Service. Focuses on planning and design of livestock waste facilities and equipment, and information about land application techniques and animal waste utilization. Includes worksheet to help determine manure application rates. (2)

USDA-Natural Resources Conservation Service Field Office Technical Guide codes 312, 313, 425, and 633. These are the standards and specifications used by the USDA-NRC S in planning and designing agricultural waste management facilities. (3)

Agricultural Waste Management Field Handbook. 1992. USDA-Natural Resources Conservation Service. Provides specific guidance for planning, designing, and managing systems where agricultural wastes are involved. (3)

Land application of livestock waste

Livestock Waste Facilities Handbook. 1985. 112 pages. Midwest Plan Service. Includes information about land application techniques and animal waste utilization, as well as a worksheet to help determine manure application rates. (2)

University of Maine Cooperative Extension - Manure Management Computer Program. 1)

Publications available from...

1. Your county Extension office. There may be charges for publications, postage and sales tax.
2. Your county Natural Resource Conservation Service office.
3. The Midwest Plan Service Secretary, Agricultural Engineering Department, 460 Henry Mall, University of Wisconsin, Madison, ‘Wisconsin 53706, (608) 262-3310.

Websites:

This link will take you to the Natural Resources Conservation Service (NRCS) Conservation Practice Standards. Here you can find technical guides that are the primary scientific references for NRCS. They contain technical information about the conservation of soil, water, air, and related plant and animal resources.
http://efotg.nrcs.usda.gov/treemenuFS.aspx

Below is a link to "Manual of Best Management Practices for Maine Agriculture" put out by the Maine Department of Agriculture, Food & Rural Resources Division of Animal Health & Industry. January 2007. This resource has links to many different BMPs that apply to a farm.
http://mainegov-images.informe.org/agriculture/narr/documents/BMPManual2007.pdf
This manual doesn't have any of the actual BMPs written out. It is literally a guide that will lead you to other links. To make things a little easier you will find direct links to BMPs suggested by the manual that pertain to this specific section.

- **Barn and Manure Storage Safety**. University of Maine Cooperative Extension Bulletin 2304. http://www.cdc.gov/nasd/docs/d000901-d001000/d000905/d000905.pdf

- **Manure Utilization Guidelines, February 1, 2001**. Maine Dept. of Agriculture, Food & Rural Resources, (Craig Leonard's BMP Manual). http://maine.gov/agriculture/narr/nutrientmanagement.html

- **Guidelines for Horsekeeping in Maine.** University of Maine Cooperative Extension, Bulletin 1011. http://www.umext.maine.edu/onlinepubs/htmpubs/1011.htm

- **Horse Stable Manure Management.** College of Agricultural Sciences, Agricultural Research and Cooperative Extension, Penn State University. http://pubs.cas.psu.edu/freepubs/pdfs/ub035.pdf

- **Broiler Litter Storage.** Alabama Cooperative Extension System, Publication ANR-0839. www.aces.edu/pubs/docs/A/ANR-0839/

- **Earthen Manure Storage Design Considerations.** NRAES – 109. www.NRAES.ORG/PUBLICATIONS/NRAES109.HTML

- **Manure Management for Small Scale Livestock Operations,** Pennsylvania Small-Scale Livestock Committee. http://www.agriculture.state.pa.us/agriculture/lib/agriculture/pasccfiles/nutrientmanagement/Small_Scale Livestock_Farm Manure.pdf

- **Dairy Manure Systems: Equipment and Technology.** NRAES – 143. http://www.mwps.org/index.cfm?fuseaction=c_Products.viewProduct&catID=719&productID=6350&skunumber=NRAES-143&crow=13

- **Livestock Waste Facilities Handbook.** USDA, Midwest Plan Service, MWPS – 18. http://extension.oregonstate.edu/catalog/html/em/em8597/

- **Nutrient Management in Kentucky.** University of Kentucky College of

Agriculture, Cooperative Extension Service, Pub. IP-71.
http://www.ca.uky.edu/agc/pubs/ip/ip71/ip71.pdf

- **Agricultural Waste Management Field Handbook,** Part 651. NRCS.
http://tammi.tamu.edu/pdf%20pubs/contents.pdf

- **Poultry Waste Management Handbook.** NRAES – 132.
http://www.nraes.org/nra_order.taf?_function=detail&pr_booknum=nraes-132

- **On Farm Composting Handbook.** NRAES 54, Cornell University.
http://www.nraes.org/nra_order.taf?_function=detail&pr_booknum=nraes-54

- **Manure Management and Composting.** McGill University, Ecological Agriculture Projects.
www.eap.mcgill.ca/MagRack/COG/COGHandbook/COGHandbook_1_4.htm

- **Dairy Manure Systems: Equipment and Technology.** NRAES – 143.
http://www.mwps.org/index.cfm?fuseaction=c_Products.viewProduct&catID=719&productID=6350&skunumber=NRAES-143&crow=13

- **Manure Management Practices to Reduce Water Pollution.** Oregon State University Extension Service, Pub. FS 281. http://eesc.orst.edu

- **Manure Storage, Handling and Transportation.** Environmental Manual for Feedlot Producers in Alberta. http://www.agric.gov.ab.ca/app21/rtw/index.jsp

- **Science and Engineering of Composting: Design, Environmental, Microbiological and Utilization Aspects**. Hoitink & Keener, Editors, Ohio State University, ISBN 0-936645-15-6.

- **Site Selection for Animal Housing and Waste Storage Facilities.** AEU 6, University of Minnesota. www.bae.umn.edu/extens/aeu/aeu6.html

- **Odor Control on Livestock and Poultry Farms.** Ontario Ministry of Agriculture and Food, Fact sheet # 03-111.
www.gov.on.ca/OMAFRA/english/engineer/facts/03-111.htm

- **Site Selection for Animal Housing and Waste Storage Facilities.** University of Minnesota Extension Program, Pub. AEU-6.
http://www.bbe.umn.edu/extens/aeu/aeu6.html

- **Managing Livestock Manure to Protect Environmental Quality.** University of Nebraska Cooperative Extension, Pub. JEC 02-179.
http://ianrpubs.unl.edu/wastemgt/ec179.pdf

University of Maine Cooperative Extension: “Nitrate, Groundwater and Livestock Health”
http://www.umext.maine.edu/waterquality/Publications/7086.htm

University of Maine Cooperative Extension: “Nitrate: Health effects in drinking water”.
http://extensionpubs.umext.maine.edu/ePOS/form=robots/item.html&item_number=7107&store=413&design=413

Natural Resources Conservation Service: Animal Manure management
http://www.nrcs.usda.gov/technical/ECS/nutrient/animalmanure.html

New England Regional Water Program: Agricultural Nutrient and Pest Management
http://www.usawaterquality.org/newengland/Focus_Areas/ne_npm/research/tools.html

Chapter 317: Nutrient Management Loan Program
This rule establishes the procedures, standards and fees applicable to Borrowers applying for loans from the Authority's program of direct loans for the finance of construction of livestock manure and milk room waste containment and handling facilities as set forth in the Nutrient Management Act 7 MRSA §4201 et seq., and Chapter 565 of the Rules of the Department of Agriculture, Food and Rural Resources, from a portion of the Clean Water Revolving Loan Fund, provided by the United States Environmental Protection Agency through the Maine Municipal Bond Bank and the Maine Department of Environmental Protection.
http://www.maine.gov/sos/cec/rules/90/94/457/457c317.doc

Best management Practices for Groundwater Protection
http://www.maine.gov/dhhs/eng/water/forms/Sections/BMPv2%200A.htm

See "Appendix A: Laws and Regulations" and "Appendix B: Resources" for additional links.

Acknowledgments

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