Maine Farm-A-Syst

Farmstead Assessment System Fact Sheet 6

Reducing the Risk of Groundwater Contamination by Improving Household Wastewater Treatment

A properly installed and maintained system for treating and disposing of household wastewater will minimize the impact of that system on groundwater and surface water. State and local codes specify how wastewater systems must be designed, installed and maintained. For example, the State of Maine Subsurface Wastewater Disposal Rules regulates private sewage systems and local Plumbing Inspectors approve their installation. The best way to evaluate your septic system is to hire a licensed site evaluator or certified septic system inspector. However, you can get a general idea of risks by reading this fact sheet and by completing Worksheet #6.

Topics Covered:

Septic tank/soil absorption system: The most common system

In this system:

- Wastewater flows from the household sewer into an underground septic tank.
- In the tank waste components separate–the heavier solids (sludge) settling to the bottom and the grease and fatty solids (scum) floating to the top.
- Bacteria partially decompose and liquefy the solids.
- Baffles are placed in the tank to provide maximum retention of solids, prevent inlet and outlet plugging and prevent rapid flow of wastewater through the tank.
- The more liquid portion (effluent) flows through an outlet to the soil absorption field.
- The absorption field is usually a rectangular bed containing distribution pipes embedded in drain field stone or manufactured leaching devices which usually do not need stone or gravel.
- The effluent leaks out through holes in the pipe or beneath leaching devices, then down through the drain field gravel or rock (if used) and into the soil.

- The soil filters out remaining minute solids and pathogens (disease-producing microorganisms). Dissolved substances slowly percolate down to groundwater.

Note: Outhouses are an approved part of a septic system, provided that graywater also goes into a treatment system.

Figure 1 shows a typical household system for wastewater generation, collection, treatment and disposal. Systems for many farmsteads may be very similar (groundwater supply, septic tank, subsurface treatment and disposal). The "leakage," "overflow," "infiltration" and "clearwater" components represent possible problems with the system. Unfortunately, these problems are often difficult to recognize. Overflow from systems may be noticed as wet spots, odors and some changes in vegetation cover. Water entry (infiltration and clear water) will be more difficult to detect, and involves tracing where floor drains, roof drains, foundation drains and sumps are directing waters that do not need treatment into the treatment system. Leakage from the collection and treatment system and infiltration of water into the system through unsealed joints, access ports and cracks can be very difficult to assess. The flow chart at the bottom of the box follows the flow of waste waters and sludge through the treatment system.

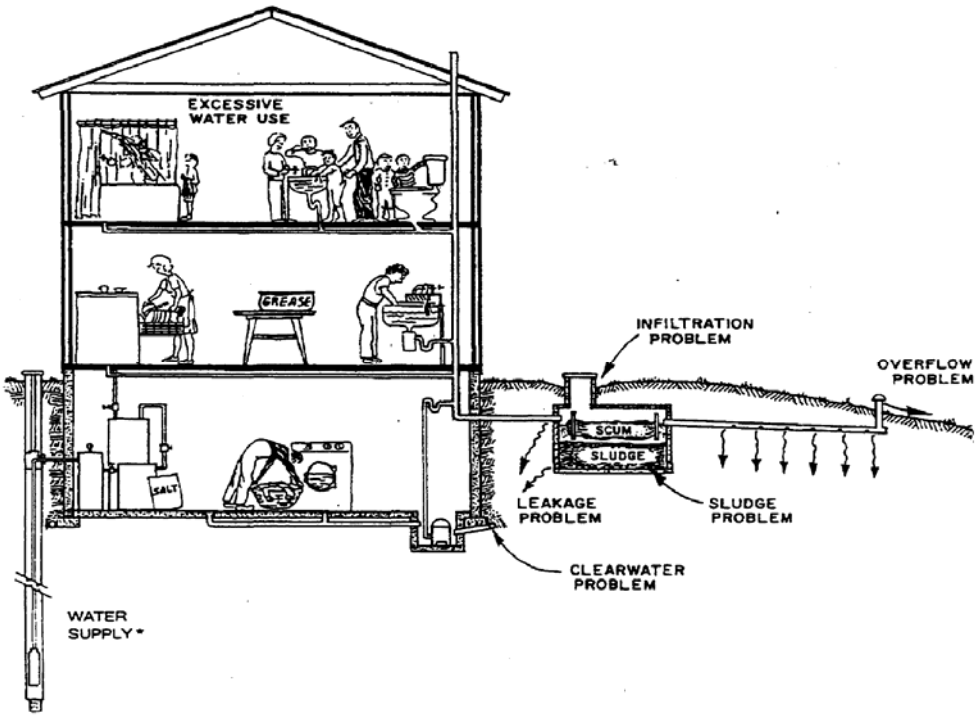

Figure 1: Typical household wastewater treatment system with problems. *Illustration by Andy Hopfensperger, University of Wisconsin-Madison, Department of Agricultural Engendering.*

Quantity of wastewater

Strategy: Minimize the volume of household wastewater.

Average water use in rural households is 40-50 gallons per person per day.

Reducing the volume of wastewater entering the treatment system is important because less flow (volume) means better treatment, longer system life and less chance of overflow. The quantity of water used depends upon the number of people using the dwelling, how water is used and maintenance of the water supply system. With low-flow

fixtures and individual awareness and concern, a reduction to fewer than 25 gallons per person per day is possible. However, even conservative use by several people may exceed the capacity of the wastewater treatment system. Reducing the volume of water entering the system will improve treatment by increasing the time waste spends in the system, thus providing more time for settling in the septic tank and allowing the disposal field to become more aerobic.

Consider the following ways to minimize water use:

- **Eliminate non-functional uses**, such as flushing toilets to dispose of tissues or other wastes that should be handled as solid waste. Turn off water between uses, fix plumbing fixture leaks and try to eliminate sources of clear water and infiltration into the system. For example, divert roof drains away from the soil absorption field. You might consider investing in a rain barrel that can be purchased on-line or from your local conservation district.

- **Consider which actions use the most water**. Toilet flushing usually ranks highest. Low-flow models could decrease water use by more than half. In Maine, low flow models are required in all new construction and replacements. If you still have an older model, consider replacing it with a low-flow. If that isn't possible consider putting a brick in your tank to save water. Composting toilets allow even greater reductions but they can present other waste disposal challenges.

- **Bathing and clothes washing are next in order of water use.**
  - For bathing, consider such reduction options as installing low-flow or controlled-flow showerheads, which give good cleansing with less water; taking shorter showers; and taking "wet down-soap-up-without water-then-rinse" showers.

  - For clothes washing, use a suds saver and run full loads. Front-loading washers use much less water. When running small loads, be sure to use the reduced water level setting.

- **Modern efficient plumbing fixtures**, including 0.5 to 1.5-gallon toilets, 0.5 to 2.0 gallons per minute (gpm) showerheads, faucets of 1.5 gpm or less, and front-loading washing machines of 2O to 27 gallons per 10-to-12 pound dry load, offer the potential of substantial reduction in residential water use and wastewater generation. These reductions have commonly amounted to between 30 and 70 percent of total in-house water use. (See Figure 2.)

- **In hard water areas**, the water softener may be a significant user of water as well as cause failure of the disposal field due to chemical alteration of the soil. Proper adjustment and timing of the softener's regeneration mechanism can reduce excessive water use. It is recommended that clean water not be directed to septic tank disposal fields.

Keep in mind that your awareness of your family's water use and how each of you can reduce it is as important as the use of water conservation devices.

Figure 2: Water Use by Conventional Fixtures and Water-Saving Fixtures and Devices

Conventional fixture	Gal. used	Water-saving fixture/device* used	Gal.
Toilet	4-6/flush	Air-assisted toilet	0.5/flush
Shower head	4-6/min.	Low-flow shower head	2.0/min.
Faucets: Bathroom and kitchen	4-6/min.	Faucet-flow-control aerators: Bathroom Kitchen	0.5/min. 1.5/min.
Top-loading clothes washer	40-55/load	Front-loading clothes washer	22-33/load

* Installation of all these water-saving devices could reduce water use by about 35%.

Source: Penn State Cooperative Extension Circular 302

Quality of wastewater

Strategy: Minimize the amount and complexity of contaminants in the wastewater.

The quality of water refers to what is in the water, not to the water itself. Even wastewater is more than "99.44% pure" water. Wastewater usually contains relatively small amounts of contaminants but they make a big difference in the usefulness of the water.

Contaminants found in wastewater include:

- Bacteria and viruses, some of which can cause disease in humans. Bacteria are large enough to be removed by settling or through filtration in biologic mats or soil. Many will die from the adverse conditions or aging in the system. Viruses are typically adsorbed by fine soil particles or organic soil particles.

- Suspended solids, particles which are more dense (sludge) or less dense (scum) than water. Most can be separated from liquid waste by allowing enough time in a relatively calm tank. Grease and fats are a part of the suspended solids. Filtration beds and absorption systems can be clogged by wastewater high in suspended solids.

- Oxygen demand. The microorganisms that decompose organic wastes use oxygen. The amount of oxygen required to "stabilize" wastewater is typically measured as biochemical and chemical "oxygen demand." Wastes such as blood, milk residues and garbage grindings adds to the oxygen demand. These types of

additions will overload the tank or the tank will have to be pumped out much more frequently. If the tank becomes overwhelmed then it can't remove solids from the waste stream causing them to flow into the drainage field and plug up the soil pores, the results will be a toilet that won't flush. This one of the most common problems of failed septic systems. In a properly functioning septic system, aeration and digestion processes, in the presence of oxygen and organisms, produce stable, low-odor wastewater when given enough time.

- Organic solvents from cleaning agents and fuels will not be degraded or removed through treatment and can pass along with the wastewater back into the water supply.

- Nutrients. Nitrogen from human wastes and phosphorus from machine dishwashing detergents and some chemical water conditioners are the most notable. Nitrate-nitrogen is a common groundwater contaminant and phosphorus is a common surface water contaminant.

Consider the following ways to improve wastewater quality:

- Avoid use of the garbage disposal unit. Garbage disposal use contributes a large load of suspended solids and organic matter to wastewater as well as using additional water.

- Do not put items down drains that may overload septic tanks or don't break down such as fats, grease, coffee grounds, paper towels, sanitary napkins, tampons, disposable diapers.

- Do not put toxic substances in drains that might end up in the groundwater, such as solvents, degreasers, acids, oils, paints, disinfectants and pesticides. Limit the use of antibacterial soaps as they may kill the beneficial organisms in the septic system. Do not flush left over medication, they may create super pathogens that may effect us in the future and may also kill the beneficial organisms in the systems. This does not include using bleach to disinfect laundry or to wash clothing worn for pesticide applications.

- Do not use additives to clean or "sweeten" your system. They may interfere with the biological action in the tank, clog the drain field by flushing sludge and scum into the field or add toxic chemicals to groundwater.

Collection of wastewater

Strategy: Collect all wastes that need treatment. Minimize loss of untreated waste. Exclude water that doesn't need treatment or disposal from the treatment system.

- Leaking piping or treatment tanks ("leakage losses") can allow wastewater to return to the local water supply without adequate treatment. This is especially true if you are on highly permeable or shallow to bedrock soils. In you are on soil with a high water table you can get infiltration of groundwater into the tank that can overwhelm the system.

- Infiltration of clear water overloads the system.
- Don't allow water that doesn't need treatment (basement floor drain sumps, foundation drains, infiltration of rain water, roof drainage) to add to your waste volume.
- Divert clear water, which doesn't require treatment, away from the wastewater treatment system.

Pretreatment system

Strategy: Make wastewater more suitable for further treatment or disposal.

Septic tanks retain most of the suspended solids (sludge and scum) from wastewater. In the tank, bacteria digest solids to create sludge. The partially treated water moves on for additional treatment or disposal in a soil absorption field.

Design and construction of septic tanks influence their water tightness and effectiveness of retaining sludge and scum. Multiple tanks or chambers in series can improve sludge and scum removal. Gas deflectors, filter screens, multiple septic tanks or multiple compartment septic tanks help to minimize solids carryover. Tanks should be sized to accommodate at least 24 hours of wastewater flow while still allowing for sludge and scum retention. Pumping the tank before it is more than one-third filled with scum and sludge improves functioning of the system. As a rule of thumb, tanks should be pumped every 2 to 5 years. When the tank is pumped, you should also have the baffles checked and check for tank leaks.

Aerobic (oxygen-using) biological systems (packaged systems) provide more extensive treatment of wastewater than the typical anaerobic (no oxygen) septic units reducing sludge volume and producing a better quality effluent. These systems are more expensive to install, operate and maintain and may be more subject to problems caused by changes in wastewater quality or environmental conditions.

- In Maine, holding tanks are a last choice, used only if there is no other option for disposal.
- Metal holding tanks are no longer allowed.
- Tanks should be made of concrete or plastic and must be approved by the State.

Holding tanks collect and hold the entire wastewater flow. Disposal is generally done by a licensed contractor who spreads the waste on the land at an approved site or hauls it to a municipal waste treatment facility. Tank size should allow for ample capacity to accommodate pumpage and disposal at convenient and appropriate times especially for land spreading. When pumped, the tank should be checked for leaks. A high level alarm must be installed in the tank to give notice that the tank is nearing capacity.

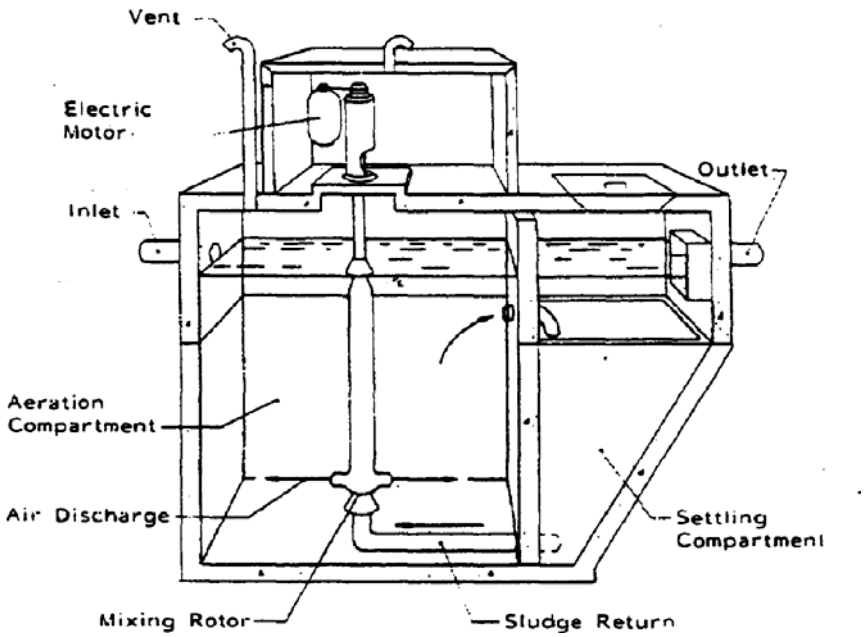

Figure 3: Aeration tank of a household aerobic treatment sytem. *Source: onsite Domestic Sewage Disposal Handbook, MWP-24, Midwest Plan Service, 1982.*

Additional treatment

Strategy: Reduce concentration and amount of contaminants in the wastewater.

Aerobic systems, described in the previous section, may be used for additional treatment of septic tank effluent. They yield a better quality effluent which requires a smaller disposal field for final treatment.

Nitrogen removal can be achieved through denitrification (conversion of nitrate to nitrogen gas) or ion exchange. Denitrification requires anaerobic conditions in the presence of more decomposable organic matter for bacteria to reduce nitrate to nitrogen gas for removal from wastewater. One such denitrification system is the “Ruck System”. These systems are more expensive to install, operate and maintain than conventional systems. They can be very useful in sites with severe limitations, such as one close to a well or water body.

Disinfection systems kill disease-causing microorganisms in wastewater. Chlorine, iodine, ozone and ultraviolet light systems are available for treatment of good quality effluents, such as those from properly functioning aerobic units and sand filters. These systems may be important if you are very close to a water body.

Sand filters improve the quality of wastewater after septic tank pretreatment. Effective treatment involves aerobic biochemical activity as well as physical filtration. Filters consist of 2 to 5 feet of sand (or other media) in a bed equipped with a distribution and collection system. Wastewater is applied by dosing and it may be re-circulated to improve treatment. Wastewater treated in such systems is generally lower in bacteria, nitrogen, phosphorus, oxygen demand, suspended solids and organic matter. The amount of reduction depends on design of the system.

Maintenance includes resting, occasional raking, removal of clogged and crusted surface media, filter media replacement and attention to dosing equipment.

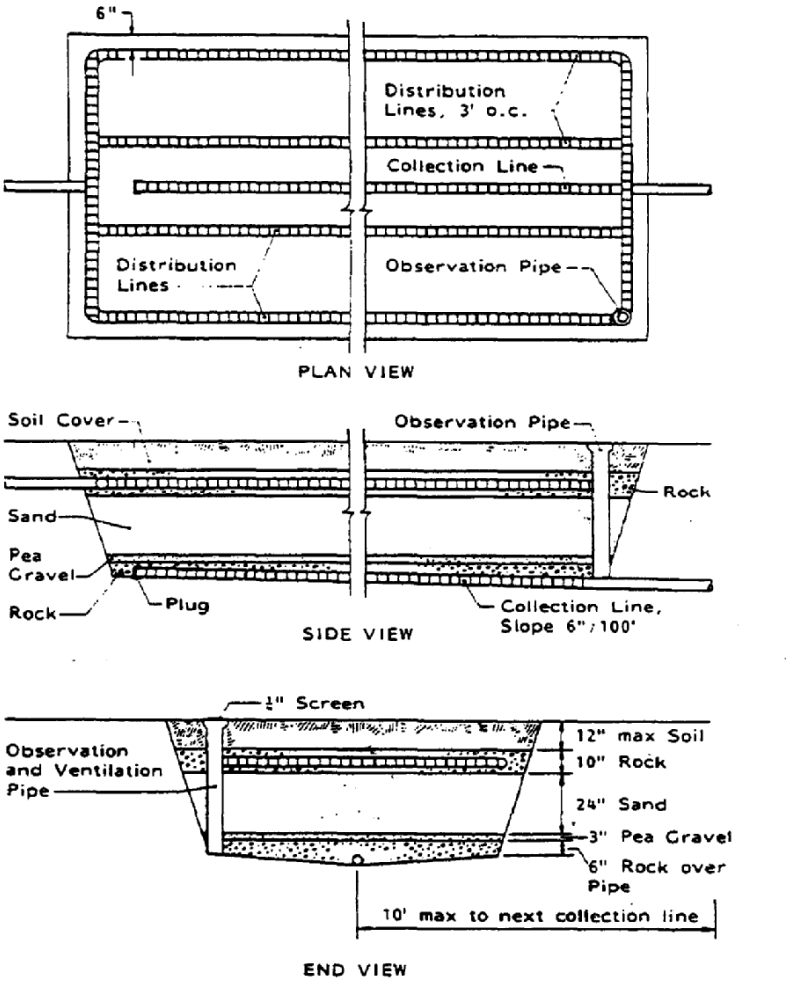

Figure 4: Buried sand filter. *Source: Onsite Domestic Sewage handbook MWPS-24, Midwest Plan Service, 1982.*

Disposal of wastewater and pumpage

Strategy: Disperse wastes, take advantage of additional treatment afforded by contact with soils and minimize opportunity for waste to contaminate water supplies.

Off site disposal is usually handled by septic tank pumpers who take it to licensed sites for proper disposal.

Application of wastewater to the soil surface (spray irrigation) provides an opportunity to recycle nutrients and to further reduce the contaminant content of wastewater in a safe manner. Spray irrigation is an infrequently used alternative to conventional septic systems. This option is more costly than subsurface wastewater disposal and must be permitted by the Maine Department of Environmental Protection.

Consider the following site characteristics when selecting a site:

- Soil
- Slope
- Climate
- Weather
- Land use
- Hydrogeology
- Depth to groundwater

Subsurface treatment and disposal using soil absorption (trenches, beds, leaching device) is the common practice for household wastewater after pretreatment in a septic tank. Deep, well-drained, well-developed, medium-textured soils (such as sandy loam and loam) are desirable soil absorption sites. There

are stringent requirement for newly developed sites, however replacement septic systems are allowed on poorer sites than new homes. These systems must be designed by licensed site evaluators and permits obtained from the local Plumbing Inspector for installation.

Soils and separation from the water supply are important factors. Unsaturated soils allow movement of air, helping keep the wastewater aerobic. A minimum of one foot of unsaturated soils is recommended for removal of bacteria (two feet for sandy soils). Finer-textured soils (clay loams and clay) retain water better, allowing plant roots to take up wastewater and nutrients and allowing increased die-off of microorganisms but their slow permeability may cause overflow or backup problems. Coarse, sandy soils allow effluent to flow quickly downward to groundwater, and may not provide adequate time for filtering solids and pathogens from the liquid. Medium textured soils are preferable. Disposal sites that are more distant and downslope from the well increase the isolation of your water supply from the contaminated wastewater.

Disposal of pumpage from septic tanks and other treatment systems onsite must follow Maine Department of Environmental Protection (DEP) rules and regulations.

Assistance with failing systems or new designs

If you suspect your household wastewater treatment system is backing up or your distribution system is clogged, first contact a site evaluator or your local plumbing inspector, who may have suggestions for correcting the problem. Your local plumbing inspector is the person to see for permits to repair or replace your wastewater treatment system.

Do not use septic tank cleaners that contain degreasing solvents like TCE (tricbloroethylene). They can contaminate groundwater.

Do not place more soil over a surfacing soil absorption field unless instructed by a professional. This usually does not fix the system and it will soon surface again.

Do not pipe the sewage to the road ditch, storm sewer, stream or farm drain tile. This pollutes surface water and creates a health hazard.

Do not run the sewage into a sink hole or drainage well; this pollutes the groundwater. Do not wait for the system to fail before pumping the septic tank. Once a system fails, it is too late to pump the tank. Pump every 2- 5 years.

A properly designed, constructed and maintained septic system can effectively treat wastewater for many years. For more information on septic systems, contact the Department of Human Services, Division of Health Engineering (207-287-5338).

Source Water Protection/Wellhead Protection Area

This section applies primarily to undeveloped sites, not existing sites.

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.

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

D. Wastewater and Solid Waste

Major potential problems:

1. Domestic and municipal wastewater: Domestic and municipal wastewater is high in organic matter in the process of decomposition. It is treated most commonly by aeration in a lagoon, and/or by land disposal via a septic system leachfield (drainfield). Soils are usually excellent for removing very high concentrations of bacteria within a few hundred feet from a septic system. However, leachfields are common sources of nitrate-rich leachate in groundwater.

BMPs for wastewater and solid waste:

2. Septic systems and sewer pipes shall be prohibited in Zone 1 WHPAs (Zone 1 is 300 ft in many cases).
3. Sewer pipes shall preferably be relocated outside WHPAs. Alternatively, pipes may be lined internally where buried within Zone 2 WHPAs.

CONTACTS AND REFERENCES

Who to call about…

Household wastewater treatment and local regulations
Your local plumbing inspector, site evaluator, or code officer.

Statewide regulation of private sewage systems
Health Engineering, Plumbing Program (207) 287-5338

Requirements for land application

For more information on requirements for legal land application of pumpage from holding tanks, septic tanks and other treatment systems, contact the wastewater specialist of the nearest DEP district office:

Central Maine Regional Office - Augusta	(207)287-2651; 800-452-1942
Northern Maine Regional Office - Presque Isle	(207)764-0477; 888-769-1137
Southern Maine Regional Office - Portland	(207)822-6300; 888-769-1036
Eastern Maine Regional Office - Bangor	(207)941-5470; 888-769-1137

Small and alternative wastewater treatment technologies

National Small Flows Clearinghouse, West Virginia University, P.O. Box 6064, Morgantown, West Virginia 26506-6064, or call (800) 624-8301

Small Scale Waste Management Project, University of Wisconsin-Madison, 1450 Linden Drive, Madison, Wisconsin 53706, (608) 262-0853 or (608) 262-6968

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.)

Design, installation, use

Your Septic System. University of Maine Cooperative Extension Water Quality Fact Sheet #12. Bulletin #7080. (1)

What To Do If Your Septic System Fails UMCE Water Quality Fact Sheet #13. Bulletin #7081. (1)

What to Know About Septic Systems When You Buy or Sell a House. UMCE Water QualityFact Sheet #16. Bulletin #7084. (1)

Septic Systems: Considerations When Building or Remodeling a Home. UMCE Water Quality Fact Sheet #17. Bulletin #7085. (1)

Design Manual: Onsite Wastewater Treatment and Disposal Systems. 2002. U.S. Environmental Protection Agency. EPA/625/C-02/017. Contains information onsite evaluation procedures, wastewater characteristics, onsite treatment and disposal methods, and management of onsite systems.

Onsite Domestic Sewage Disposal Handbook. First Edition. 1982. Midwest Plan Service. MWPS-24. 40 pages. Includes information on septic tanks, soil absorption systems, site selection, distribution systems and such other systems as aerobic treatment and holding tanks. (3)

Water-saving toilets and showerheads

“How To Save Water,” Consumer Reports, July 1990, pages 465-473.

Publications available from...

1. Your University of Maine Cooperative Extension County office or the State Publications Office, University of Maine Cooperative Extension, 5741 Libby hall, Orono, ME 04469-5741.
2. U.S. Environmental Protection Agency, 401 M Street S.W, Washington, D.C. 20460.
3. Your county Extension office or directly from Agricultural Bulletin, Room 245,

30 N. Murray Street, Madison, Wisconsin 53715, (608) 262-3346. There may be charges for publications, postage and sales tax.

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

Maine DEP's Bureau of Land & Water Quality's Wastewater Treatment page:
http://www.maine.gov/dep/blwq/engin.htm

University of Maine's Cooperative Extinction Septic System Publications
http://www.umext.maine.edu/waterquality/publications/septic%20system%20publications.htm

EPA's Onsite Wastewater Treatment Systems Manual available for free at:
http://www.epa.gov/nrmrl/pubs/625r00008/html/625R00008.htm

A Homeowners Guide to Septic Systems
http://www.epa.gov/owm/septic/pubs/homeowner_guide_short.pdf

Live near the coast: "An Act to Protect shellfish Waters and Shellfish Resources from Coastal Pollution"
http://janus.state.me.us/legis/LawMakerWeb/externalsiteframe.asp?ID=280027815&LD=2160&Type=1&SessionID=7

Small wastewater treatment technologies from the National Small Flows Clearinghouse
http://www.nesc.wvu.edu/nsfc/nsfc_index.htm

Small-Scale Waste Management Project from the University of Wisconsin-Madison
http://www.soils.wisc.edu/sswmp/

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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Revision Editors of Farm-A-Syst Fact Sheet #6: Megan Wooster, AVSWCD; Susan Gammon, AVSWCD; Andrews Tolman, State of Maine CDC Drinking Water Program; David Rocque, Maine Soil and Water Conservation Commission; Susan Breau-Kelley, Maine Rural Water Association. 2008.

Original Farm-A-Syst team members: John M. Jemison, Jr., University of Maine Cooperative Extension; Marianne DuBois, Maine Department of Environmental Protection: Tammy Gould. Board of Pesticides Control; Chris Jones, Natural Resources Conservation Service; Lisa Krall, Natural Resources Conservation Service; Craig Leonard, Maine Department of Agriculture; Craig Neil, Maine Geological Survey; David Rocque, Maine Soil and Water Conservation Commission; and David Lytle. University of Maine Cooperative Extension.
Original Fact Sheet #6 Adapted by David Rocque, Maine Soil and Water Conservation Commission. 1995.