APPENDIX

Some Agricultural practices can result in high risk to groundwater and drinking water supplies, while others present low risk-or virtually no risk at all. Drinking water is least likely to be contaminated when following the appropriate management procedures.

Farm-A-Syst is a series of 12 worksheets that will help you assess how effectively farmstead practices protect drinking water. Each worksheet contains two parts – one that assesses the risk and the second provides recommendations for reducing the risk of groundwater pollution.

The worksheets outline a series of questions about farmstead structures and activities. The answers provided will help identify how the structures and activities might be affecting well water.

Each worksheet also provides suggestions about how to modify farmstead activities, and resources for additional information and assistance.

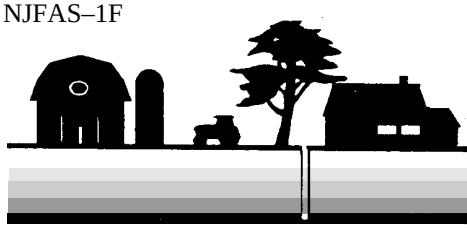
While field practices also have the potential to contaminate groundwater, the Farm-A-Syst series is not designed to address this concern. The specific focus of these worksheets is to outline the potential effect of **farmstead practices and structures** on drinking water supplies.

The twelve worksheets include:
#1: Drinking Water Well Condition
#2: Pesticide Storage and Handling
#3: Fertilizer Storage and Handling
#4: Petroleum Product Storage
#5: Hazardous Waste Management
#6: Household Wastewater Treatment
#7: Livestock Waste Storage
#8: Livestock Yards Management
#9: Silage Storage
#10: Milking center Wastewater Treatment

A separate site evaluation worksheet (#11) helps assess how soil and geologic features affect groundwater pollution potential on the farm.

An overall evaluation worksheet (#12) combines the results of all the worksheets, to allow:

- A look at each potential source of contamination in light of particular site conditions.
- A comparison of potential contamination sources to see where improvements are needed.
- A determination of where to spend time and money most effectively to protect the groundwater that provides drinking water supplies.



NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#1 Fact Sheet: Reducing the Risk of Groundwater Contamination by Improving Drinking Water Well Condition

1. Well location

Whether a well taps water just below the ground or hundreds of feet deep, its location on top of the ground is a crucial safety factor. Locating a well in a safe place takes careful planning and consideration of such factors as where the well is in relation to surface drainage and groundwater flow. A well downhill from a livestock yard, a leaking oil storage tank or a failing septic system runs a greater risk of contamination than a well on the uphill side of these sources of contamination.

Surface slope does not always indicate the direction a contaminant might flow once it gets into the ground. In shallow aquifers, groundwater flow is often in the same direction as surface water flow. If the aquifer supplying water to your farmstead well is deep below the surface, though, its slope may be different than that of the land surface. Finding out about groundwater movement on your farm (see Contacts and References) may require special monitoring equipment.

Separation distances

Many states encourage proper well location by requiring minimum separation distances from sources of potential pollution, thus using the natural protection provided by soil. However, state well codes may not mention some farmstead activities and structures. For example, in New Jersey, private well regulations ignore pesticide mixing, pesticide and fertilizer storage not occurring in tanks, vehicle maintenance and farm waste disposal areas. Milkhouse wastewater is not addressed unless it is handled in a soil absorption system or manure storage facility. When no distances are specified, provide as much separation as possible between your well and any potential contamination source—especially if your farmstead is on highly permeable soils or thin soil overlying limestone bedrock, or if the contamination source or activity presents a high risk of contamination.

Minimum separation distances regulate new well installation. Existing wells are required by law only to meet separation requirements in effect at the time of well construction. Make every effort, however, to exceed "old requirements," and strive to meet current regulations whenever possible.

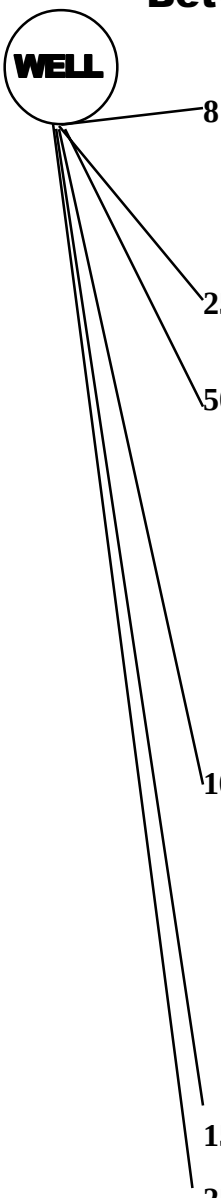
Both soil and slope can make siting a well a tricky business. Keep in mind that separation distances required by the state are minimums. You may want to choose greater separation distances in some cases, depending on factors at your site. This will help provide reasonable assurance that your well will not be polluted by farmstead activities in the future. Also consider contamination sources on adjacent properties.

Changing the location of your well in relation to contamination sources may protect your water supply, but not the groundwater itself. Any condition likely to cause groundwater contamination should be improved, even if your well is far away from the potential source. Whether or not drinking water is affected, groundwater contamination is a violation of New Jersey law.

For glossary, see page 2 of Worksheet #1.

Simply separating your well from a contamination source may reduce the chance of pollution, but it does not guarantee that the well will be safe. Stormwater and groundwater can carry bacteria, oil products and pesticides from one place to another. Wells located in the path of polluted water run a risk of contamination from overland flow washing into an improperly sealed well. Some wells become contaminated through polluted recharge at great distances, depending on the depth of the aquifer and the well intake.

Figure 1: Minimum Separation Distances Between Well and Potential Farmstead Sources of Contamination for New Well Installation



8 feet
- •pesticide or fertilizer storage tank (less than 1500 gallons; nonpotable wells only)
- •silage storage and transfer tube (plastic)
- •nonpotable well
- •cistern

25 feet
- •animal barn pen with concrete floor
- •sewage holding tank

50 feet
- **•septic tank**
- **•building sewer**
- **•distribution box**
- **•dry well**
- •animal shelter or yard
- •feed storage facility, glass-lined
- •manure hopper or reception tank, liquid-tight
- •silo with pit
- •silo without pit, but with concrete floor and drain
- •soil absorption unit (less than 8000 gallons/day)
- •filter strip

100 feet
- **•disposal field**
- **•seepage pit**
- •gasoline and other liquid petroleum products
  - •underground
  - •surface (more than 1500 gallons)
- •fuel oil tanks
  - •underground
  - •surface (more than 1500 gallons)
- •manure storage structure, fabricated, liquid-tight
- •pesticide or fertilizer storage tank (more than 1500 gallons)

150 feet
- **•cesspools**

250 feet
- •liquid waste disposal system
- •manure stack
- •manure storage structure, earthen or excavated
- •silage storage, earthen trench or pit

For sources not addressed: Provide as much separation as possible from well. These are distances in the well code. Local waste storage ordinances may require different separation distances.

General Reference: New Jersey Safe Drinking Water Act, NJ Administrative Code 7:10-12.1 et seq.
*(**boldface type**: represents standards of the New Jersey Safe Drinking Water Act)*

2. Well construction

Poor well design can allow groundwater contamination by allowing rain or snowmelt to reach the water table without filtering through soil. Wells located in pits, or without grout or a cap, can allow surface water to carry bacteria, pesticides, fertilizer or oil products into your drinking water supply. Proper well design reduces the risk of pollution by sealing the well from anything that might enter it from the surface.

The way in which a well was constructed, even if the design is sound, affects its ability to keep out contaminants. Several things that should be checked are described in the following sections. Well construction information may be available from the person who drilled your well, from the previous owner, or from the well construction report.

The construction of wells in New Jersey is affected by the geologic region in which the well is located. Figure 2 lists well construction requirements by region.

Region One (Coastal Plain) includes all of New Jersey south and east of a line drawn between Trenton and New Brunswick. Aquifers in this region are generally sand and/ or gravel, semiconsolidated rock, or shell beds.

Region Two (Piedmont) includes the part of New Jersey extending northwest of a line drawn between Trenton and New Brunswick and a line drawn between Clinton and Suffern, New York. Aquifers in this region are generally sandstone, argillite, shale, diabase, basalt, and sand and/or gravel.

Region Three (Highlands) is the part of New Jersey northwest of Region Two. Aquifers here are generally creviced granite, gneiss, schist, phyllite, limestone, dolomite, shaly limestone, creviced sandstone, shale and siltstone, and sand and/or gravel.

Figure 2: Summary New Jersey Well Construction Requirements (N.J.A.C. 7:10-12.15)

	Oversize Drill Hole		Casing		
	Diameter	**Depth**	**Diameter**	**Depth**	**Screen**
Region 1					
Water Table Well	Casing plus 4" (1)	Min. 10 ft.	Min. 2"	Preferable 50 ft. Minimum 15 ft.	Min. 1 1/4
Artesian Well	Casing plus 4" (1)	To base of confining layer immediately above aquifer used Minimum 30 ft.	Min. 2" (2)	To base of confining layer immediately above aquifer used Minimum 30 ft.	Min. 1 1/4
Region 2					
Water Table and Artesian Well	Casing plus 4"	Min. 20 ft. into unweathered rock	Min. 6"	Min. 20 ft. into unweathered rock	Not normally used
Region 3					
Water Table and Artesian Well	Casing plus 4"	Min. 20 ft. into unweathered rock	Min. 6"	Min. 20 ft. into unweathered rock	Not normally used
Cavernous Limestone	Casing plus 4"	Min. 50 ft.	Min. 6"	Min. 50 ft.	None

1. Except when casing is driven into an undersize hole. (See Section 7:10-12.16(a)1.i(1))

2. If the static level is greater than 25 feet below ground surface and/or the pumping level is greater than 150 feet below ground surface, a minimum casing diameter of 4 inches is required.

This overview of well construction and inspection can help you understand your drinking water contamination risk ranking. For more information, contact a registered well driller. Your local health department can help interpret construction requirements of the private well code.

Casing and well cap

The well driller installs a steel or plastic pipe called casing during construction to prevent collapse of the borehole. The space between the casing and the sides of the hole provides a direct channel for surface water (and pollutants) to reach the water table. To seal off that channel, the driller fills the space with grout (cement, concrete or a special type of clay called bentonite, depending on the geologic materials encountered). Both grout and casing prevent pollutants from seeping into the well.

You can visually inspect the condition of your well casing for holes or cracks at the surface, or down the inside of the casing with a light. If you can move the casing around by pushing against it, you may have a problem with your well casing's ability to keep out contaminants. In areas of shallow (less than 20 feet from surface) fractured bedrock, check on the condition of your well casing by listening for water running down into the well. (Pump should not be running.) If you do hear water, there could be a crack or hole in the casing, or you are not cased down to the water level in the well. Either situation is risky.

To prevent contaminants from flowing down inside of the well casing, the driller installs a tight-fitting, vermin-proof well cap to prevent easy removal by children, and entry by insects or surface water. The cap should be firmly installed, with a screened vent incorporated into it so that air can enter the well. Check the well cap to see that it's in place and tightly secured. Wiring should be in the conduit. If your well has a vent, be sure that it faces the ground, is tightly connected to the well cap or seal, and is properly screened to keep insects out. The well code requires a vermin-proof cap or seal for all private wells. (Not all wells have caps. Some may have pumping equipment attached at the surface.)

Casing depth and height

The depth of casing required by the state private well code for your well depends on the nature of the subsurface geologic materials. See Figure 2 for minimum casing depth requirements for wells in each geologic region. Meeting well code minimums does not, however, guarantee a safe water supply; you may want to exceed minimum casing depth.

Wells cased below the water level in the well can afford greater protection from contamination. Well casing extending at least 30 feet below the water level in your well can ensure that surface water is filtered through soil and geologic materials before entering the well. Deeper cased wells can provide greater sanitary protection but can also result in aesthetic water problems caused by dissolved solids, such as hardness and iron. Typically, the casing extends one to two feet above surrounding land, preventing surface water from running down the casing or on top of the cap and into the well. The private well code requires that at least 12 inches of casing pipe extend above the final grade of the land (N.J.A.C 7:10-12.22).

Well age

Well age is an important factor in predicting the likelihood of high nitrate concentrations. A well constructed more than 70 years ago is likely to be at the center of the farmstead; it may be a shallower well and is probably surrounded by many potential contamination sources. Older well pumps are more likely to leak lubricating oils, which can get into the well. Older wells are also more likely to have thinner casing that is corroded through. Even wells with modern casing that are 30 to 40 years old are subject to corrosion and perforation. If you have an older well, you may want to have it inspected by a qualified well driller.

Well depth

Shallow wells draw from the groundwater nearest the land surface, which may be directly affected by farmstead activities. Depending on how deeply the well casing extends below the water table, rain and surface water soak into the soil and may carry pollutants with it.

Local geologic conditions determine how long it takes for this to happen. In some places, this process happens quickly, in weeks, days or even hours. Areas with thin soil over fractured bedrock or sand and gravel aquifers are particularly vulnerable. Even thick sands over fractured bedrock represent a site vulnerable to contamination.

On the other hand, thick clay soils don't allow contaminants to reach the water table. They may prevent contamination or delay the day when a well "turns bad." If you have a deep well (more than several hundred feet below the water table), the groundwater supplying your well may have traveled a considerable distance underground over a long time, offering greater protection to the well.

3. Managing and maintaining existing wells

You wouldn't let a tractor run too long without an oil change. Your well deserves the same attention. Good maintenance means testing the water every year, keeping the well area clean and accessible, keeping pollutants as far away as possible, and periodically having a qualified well driller or pump installer check the well mechanics.

Better management of your existing well

Existing wells were most likely located according to traditional practice or regulations in place at the time of construction. While these wells are still legal, you may want to consider how well yours conforms to current standards, which incorporate new knowledge about groundwater contamination and well water. These standards can be found in the state private well regulations (N.J.A.C. 7:10-12.1 et seq.).

You should move such activities as pesticide mixing, tank rinsing or gasoline storage further from your well. You might want to upgrade wells, get rid of well pits, install caps or extend casings.

Changing the location of other practices may prove expensive. (You can't move a livestock yard or a silo overnight.) Until you can meet minimum separation distance requirements, change the way you manage such structures to control contaminants.

If your silo is too close to your well, for example, you may want to install a system for collecting any liquid draining from freshly ensiled forage. You could install concrete curbs to direct livestock yard runoff away from the well.

Short-term manure stacks are another example. They pose a risk of well contamination by bacteria or nitrates. Locate them on clay soil or, better yet, a concrete slab to reduce the chance of polluting your drinking water. Also, protect them from rain.

Other management changes you may want to consider include moving traffic areas and chemical or gasoline storage areas away from the well, and upgrading or better management of your septic system.

Backflow prevention

Backflow or backsiphoning from pesticide mixing tanks allows chemicals to flow back into the well through the hose. New Jersey law requires the use of an anti-backflow device when filling pesticide sprayer tanks to prevent the chemical mixture from flowing back into the well and contaminating groundwater. Inexpensive anti-backflow

devices for hoses used to fill farm sprayers may be available from irrigation or spray equipment suppliers.

> Consider purchasing an inexpensive plastic nurse tank. A nurse tank is filled with water at the well and then used to fill the sprayer away from the farmstead—and away from the well. (For more information about preventing well contamination from pesticide mixing and loading practices, see Worksheet and Fact Sheet #2, *Pesticide Storage and Handling*.)

You should also consider anti-backflow devices on all faucets with hose connections or maintain air gaps between hoses or faucets and the water level. Otherwise, you risk having contaminated water in laundry tubs, sinks, washing machines, pressure washers, outside hydrants and swimming pools flow back through plumbing to contaminate your water supply.

> Water supplies that have cross-connections between them (connections between two otherwise separate pipe systems, such as potable and non-potable) also put your drinking water at risk.

All backsiphon and spill events must be reported to the State Government. To report, and to receive advice and assistance in remedying backsiphonage, call the 24-hour Emergency Hotline of NJ Department of Environmental Protection, at (609) 292-7172.

Water testing

Keep an eye on water quality in existing wells by testing them annually. Although you cannot have your water tested for every conceivable pollutant, some basic tests can indicate whether or not other problems exist.

For existing wells, at a minimum, test your water annually for coliform bacteria, lead, and nitrate. Also consider tests for lead, volatile organic chemicals, hardness, sodium, corrosivity, radioactivity, mercury, and radon, depending on geologic conditions and local problems.

For new wells under New Jersey regulations and under local authority, a sample of raw water must be tested for coliform bacteria, nitrates, iron, manganese, and pH. It may also be advisable to include tests for lead, volatile organic chemicals, hardness, sodium, corrosivity, radioactivity, mercury, and radon. Additional testing may be required by the local board of health having jurisdiction. New Jersey regulations mention that local authorities may want to require testing for volatile organic chemicals and/or radon. The local board of health may also require additional treatment of the water. For example, residents of Ocean County should be aware of a County Board of Health regulation which requires additional testing before final certification of new wells. Other counties may have similar regulations. Testing must be done in a laboratory certified by NJDEP.

These test do not include contaminants that could be near your farm—the most commonly used pesticides in your area, for example. Test for contaminants that are most likely at your farmstead. Test for volatile organic chemicals (VOCs) if there has been a nearby use or spill of oil, petroleum or solvent. While testing for pesticides can be very expensive, the expense may be justified if:

- your well has nitrate levels over 10 mg/l (reported as nitrate-nitrogen, NO_3-N)
- a pesticide spill has occurred near the well, or backsiphonage has occurred
- your well is shallow, has less than 15 feet of casing below the water table, or is located in sandy soil and downslope from irrigated crop lands where pesticides are used

You can seek further advice on appropriate tests to run from your county Extension office (ask for Extension bulletin E185 "Interpreting Drinking Water Quality Analysis, What Do the Numbers Mean? 4th Edition") or local health department.

You should test your water more frequently if:

- there are unexplained illnesses in the family
- there are pregnancies in the family
- there are noticeable changes in livestock or poultry performance
- your neighbors find a particular contaminant in their water
- you note a change in water taste, odor, color or clarity
- you have a spill or backsiphonage of chemicals or petroleum products near your well or on your farmstead
- your well is near seawater, road salt storage or a heavily salted roadway
- your well is near a dump, junkyard, landfill, industry, or drycleaner
- you apply chemicals, manure or whey to your fields within 100 feet of your well
- your livestock operation inspectors require it

You can have your water tested by both public and private laboratories. A list of certified labs is available from Rutgers Cooperative Extension (see What to Read About section).

Follow the lab's instructions for water sampling to assure accuracy of results. Use only the container provided, and return samples promptly. Bacteria sample bottles are sterile and must be returned within specified time limits.

Because many materials, including bacteria and nitrate-nitrogen, are naturally present in minor amounts in groundwater or can vary seasonally, you may want to contact a specialist for help in interpreting test results.

Bacteria and nitrates are two important indicators. At excessive levels, they can cause health problems themselves and also may suggest problems with the well's location or construction. Hardness and pH indicate how corrosive the water may be to your plumbing system.

The chloride level also may indicate other problems. In New Jersey, most chloride comes from such human activities as road salts, salt water intrusion, and waste disposal.

Keep in mind that activities off your farm can affect your groundwater. Chemical spills, changes in land use and the presence of landfills can increase the chance of pollutants getting into your water. If your water has a high nitrate or bacteria level, you may want to talk with a specialist about the need for additional testing.

It is also important to record test results and to note changes in water quality over time. In addition to water analysis test results, you should keep records of a few other things to tell what is happening with your water system. These include well construction details, and dates and results of maintenance intervals for the well and pump.

Well maintenance

Well equipment doesn't last forever. Every 10 to 20 years, your well may require mechanical attention from a qualified well driller or pump installer. Follow these additional maintenance practices:

- Do not use gasoline or lawn and agricultural chemicals near your well.
- Do not mix pesticides, rinse sprayer equipment or discard empty pesticide containers near your well.
- Protect wells from household wastewater treatment systems that may back up.

4. New wells

New wells are expensive—but they are a good investment for the future. Getting the most from such an investment means locating the well away from contamination sources and working to maintain the quality of the well. Some simple principles:

- Follow the state recommended minimum separation distances. New Jersey Administrative Code 7:10-12.1 contains these separation distances and other requirements for drinking water wells. See Figure 1 for details.
- Locate your well on ground higher than such surrounding pollution sources as fuel tanks, livestock yards, septic systems or pesticide mixing areas. Where practical, locate the well as far as possible from pollution sources, but no closer than the minimum separation distances required by law.
- If necessary, build soil up around the well so that all surface water drains away from it.
- Avoid areas that are prone to flooding.
- Groundwater flow generally follows surface drainage patterns. Unless you know the exact direction of groundwater flow on your property, locate the well so that pollution sources are between the well and the nearest creek, river or lake. Groundwater generally flows from upland areas and discharges in a surface water body. In all cases, locate your well on ground higher than surrounding pollution sources such as fuel tanks, livestock yards or pesticide mixing areas.
- Make the well accessible for pump repair, cleaning, testing and inspection.
- Hire a competent, licensed well driller and pump installer. Make sure the driller disinfects the well with chlorine after construction and tests the water for bacteria after drilling (as required by state law), and provides you with detailed information about the well's depth and construction.

5. Unused wells

Most farms have unused wells. Old home sites or shallow wells once pumped by windmills are common. No one knows how many abandoned wells there are in New Jersey.

If not properly filled and sealed, these wells can provide a direct conduit for surface water carrying pollutants to groundwater without filtering through soil, or allow contaminant movement from one aquifer to another. One improperly sealed well was buried, and only a stone covered the top of the casing. This well allowed severe contamination of drinking water from a well on the same property. The unused well was near a livestock yard and an absorption field. It provided direct access for the entrance of animal wastes into the groundwater. In addition to these wells being a threat to groundwater, large open wells pose safety hazards for small children and animals.

New Jersey laws (N.J.S.A. 58:4A-4.1 et seq.) and governing regulations (N.J.A.C 7:9-9.1 et seq.) require property owners to seal wells upon abandonment. A licensed well driller who is certified to seal wells must be hired to seal such wells, since effective well plugging calls for experience with well construction materials and methods, as well as a working knowledge of the geology of the well site.

Special equipment is often required to remove old pumps and piping and to properly install sealing material inside the well. Use of inappropriate materials and methods can lead to well settling, collapse and continued groundwater contamination. If plugging materials are improperly installed in a well, patching up defective work is nearly impossible.

Pipes sticking out of the ground around the farmstead, or in an area where a farmstead used to be, or under an old windmill are the most obvious places for finding unused wells.

You may not know the history of your property, however, and unused well locations may not be obvious. A depression in the ground may indicate an old well. Also, wells were often drilled in basements of houses, or under front steps, or near old cisterns.

State well regulations (N.J.A.C. 7:9-9.1 et seq.) also require the well driller to submit reports of well plugging. These regulations also explain well-closing requirements.

Proper well closing takes time and money. Costs will vary with the well depth, diameter and geology of the area. Spending a few hundred dollars plugging an unused well near your home may prevent contamination of your drinking water.

CONTACTS AND REFERENCES

Who to call about...

General Contact

See Introductory Sheet

Certified well water testing laboratories

A listing is available (FS#343: Where to Get Your Drinking Water Tested in New Jersey) from your county Rutgers Cooperative Extension office or the Publications-Distribution Center at Cook College, Rutgers University, (908) 932-9762.

Interpreting well water test results

Your municipal or county health official or county Extension agent.

Drinking water quality standards

U.S. Environmental Protection Agency's Safe Drinking Water Hotline. Call toll free 1(800) 426-4791 from 8:30 A.M. to 5:00 P.M. Eastern time.

A listing is available from your county Rutgers Cooperative Extension office or the Publications-Distribution Center at Cook College, Rutgers University, (908) 932-9762.

Your municipal or county health officials.

Approved water treatment devices

A list is available from your county Extension agent.

Requirements for installation of treatment devices

Before installing treatment devices on water supplies contaminated with nitrates, heavy metals, VOCs, pesticides, microorganisms and other health-related contaminants in excess of enforcement standards, contact your municipal or county health department.

Well construction or inspection

Your local or county health department or registered well drillers (see telephone yellow pages).

Well abandonment (sealing)

Contact NJ Department of Environmental Protection's Bureau of Water Allocation, CN 426, 401 E. State Street, 3rd Floor, Trenton, NJ, 08625-0426 at (609) 292-2957.

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.)

Groundwater, groundwater flow

New Jersey's Water (Clean Water Information Series). 1992. NJ Department of Environmental Protection and Energy. (1)

How To Determine Groundwater Flow Direction. 1991. (4)

Wells, private water systems

Private Water Systems Handbook. 1979. Fourth Edition. 72 pages. MWPS-14. Includes information on wells, ponds, springs and other water supply systems; pumps, piping and water treatment. (Recommendations may not meet New Jersey codes.) (5)

Maintaining Your Home Well Water System. G3399. (2)
Provides a folder for keeping well condition, construction and maintenance records.

Water From Home Wells - Problems and Treatment. 1985. C594. (1)
Recommends water treatment methods that will help you provide palatable water and protect your distribution system.

Home Water Treatment. 1995. NRAES-48. (6)
A reference for common home water treatment devices.

Potable Water: Directions for Disinfecting a Well. 1980. C598. (1)
Describes procedures to disinfect a well with chlorine bleach.

Contamination, testing and interpretation

Interpreting Drinking Water Quality Analysis - What Do the Numbers Mean?. 1994. E185. (1)
Where to Get Your Drinking Water Tested in New Jersey. 1993. Fact Sheet # 343. (1)
Drinking Water Standards. 1994. Fact Sheet #433. (1)
Drinking Water: What Tests Do I Need? 1992. Fact Sheet #434 (1)
Drinking Water Treatment and Conditioning. 1989. Fact Sheet #435. (1)
Nitrates and Groundwater: A Public Health Concern. 1988. (3)

Well abandonment

New Jersey Administrative Code 7:9-9.4. (7)

Publications available from...

1. Your county offices of Rutgers Cooperative Extension (found in the blue pages of the phone book) or the Publications Distribution Center, Cook College, Rutgers University, PO Box 231, New Brunswick, NJ 08903, (732) 932-9762.

2. Agricultural Bulletin, Room 245, 30 N. Murray Street, Madison, Wisconsin 53715, (608) 262-3346. There may be charges for publications, postage and sales tax.

3. Freshwater Foundation at Spring Hill Center, 725 County Road 6, Wayzata, Minnesota 55391, (612) 449-0092.

4. Nutrient and Pest Management Program, 1575 Linden Drive, Madison, Wisconsin 53706, (608) 262-5200.

5. Midwest Plan Service Secretary, Agricultural Engineering Department, 460 Henry Mall, University of Wisconsin, Madison, Wisconsin 53706, (608) 262-3310.

6. Northeast Regional Agricultural Engineering Service, Cooperative Extension, 152 Riley-Robb Hall, Ithaca, NY, 14853-5701.

7. Your public library.

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The New Jersey Farmstead Assessment System is a cooperative project of Rutgers Cooperative Extension, the USDA Natual Resources Conservation Service, and New Jersey Department of Environmental Protection.

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This publication is available from your New Jersey county Extension office or from the Publications-Distribution Center, Cook College, Rutgers University, PO Box 231, New Brunswick, NJ 08903, (732) 932-9762.

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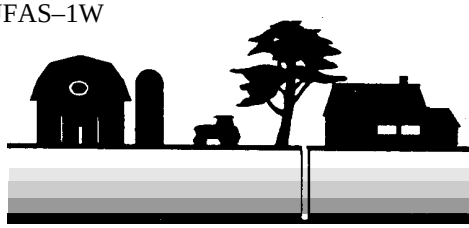

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#1 Worksheet: Assessing the Risk of Groundwater Contamination from

Drinking Water Well Condition

Why should I be concerned?

About 95 percent of this country's rural residents use groundwater to supply their drinking water and farmstead needs. Wells are designed to provide clean water. If improperly constructed and maintained, however, they can allow bacteria, pesticides, fertilizer or oil products to contaminate groundwater. These contaminants can put family and livestock health at risk.

There are documented cases of well contamination from farmstead activities near drinking water wells. The condition of your well and its proximity to contamination sources determine the risk it poses to the water you drink. For example, a cracked well casing allows bacteria, nitrates, oil and pesticides to enter the well more easily. A spill of pesticides being mixed and loaded right near the well could result in the contamination of your family's drinking water supply. Feedlots, animal yards, septic systems, fertilizer applications and waste storage areas could release large amounts of nitrate, contaminating your well.

Preventing well water contamination is very important. Once the groundwater supplying your well is contaminated, it is very difficult to clean up. The only options may be to treat the water, drill a new well, or obtain water from another source. A contaminated well can also affect your neighbors' wells, posing a serious health threat to your family and neighbors.

The goal of Farm•A•Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my drinking water?

- It will take you step by step through your drinking water well condition and management practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your drinking water well condition and management practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

Follow the directions at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

Focus on the well that provides drinking water for your home or farm. If you have more than one drinking water well on your farmstead, fill out a worksheet for each one.

Glossary

Drinking Water Well Condition

These terms may help you make more accurate assessments when completing Worksheet #1. They may also help clarify some of the terms used in Fact Sheet #1.

Abandoned well: An unused well that has been permanently closed according to New Jersey regulations.

Air gap: An air space (open space) between the hose or faucet and water level, representing one way to prevent backflow of liquids into a well or water supply.

Anti-backflow (anti-backsiphoning) device: A check valve or other mechanical device to prevent unwanted reverse flow of liquids back down a water supply pipe into a well.

Aquifer: Zone in which readily extractable water saturates the pores of the geologic formations.

Backflow: The unwanted reverse flow of liquids in a piping system.

Backsiphonage: Backflow caused by formation of a vacuum in a water supply pipe.

Casing: Steel or plastic pipe installed while drilling a well, to prevent collapse of the well bore hole and entrance of contaminants, and to allow placement of a pump or pumping equipment.

Cross-connection: A link or channel between pipes, wells, fixtures or tanks carrying contaminated water and those carrying potable (safe for drinking) water. Contaminated water, if at higher pressure, enters the potable water system.

Drilled wells: Wells not dug or driven, including those constructed by a combination of jetting or driving. These wells are normally 4 to 8 inches in diameter.

Driven-point (sand point) wells: Wells constructed by driving assembled lengths of pipe into the ground with percussion equipment or by hand. These wells are usually smaller in diameter (2 inches or less), less than 50 feet deep, and can be installed in areas of relatively loose soils, such as sand.

Dug wells: Large-diameter wells often constructed by hand.

Groundwater: Subsurface water in a zone of saturation.

Grout: Slurry of cement or clay used to seal the space between the outside of the well casing and the bore hole, or to seal an abandoned well.

Milligrams per liter (mg/l): The weight of a substance measured in milligrams contained in one liter. It is equivalent to 1 part per million in water measure.

Parts per million (ppm): A measurement of concentration of one unit of material dispersed in one million units of another.

Water table: The upper level of groundwater in a zone of saturation. Fluctuates with climatic conditions on land surface, and with aquifer discharge and recharge rates.

Well cap (seal): A device used to cover the top of a well casing pipe.

Worksheet #1

Drinking Water Well Condition: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.)
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for well management practices.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
LOCATION					
Position of drinking water well in relation to pollution sources	Upslope from all pollution sources. No surface water runoff reaches well. Surface water diverted from well.	Upslope from or at grade with pollution sources. No surface water runoff reaches well.	Downslope from most pollution sources. Some surface water runoff may reach well.	Settling or depression near casing. Surface water runoff from livestock yard, pesticide and fertilizer mixing area, fuel storage or farm dump reaches well.	____
Separation distances between well and farmstead contamination sources*	Meets or exceeds all state minimum required separation distances.	Meets most minimum separation distances.	Meets minimum separation distances only for sources required to be at least 100 feet from well.	**Does not meet all minimum separation distances for sources required to be at least 100 feet from well.****	____
Soil and/or subsurface potential to protect groundwater	Fine-textured soils (clay loams, silty clay). Water table or fractured bedrock deeper than 20 feet.	Medium-textured soils (silt loam, loam). Water table or fractured bedrock deeper than 20 feet.	Medium- or coarse-textured soils. Water table or fractured bedrock deeper than 20 feet.	Coarse-textured soils (sands, sandy loam). Water table or fractured bedrock shallower than 20 feet.	____
CONDITION***					
Condition of casing and well cap (seal)	No holes or cracks. Cap tightly secured. Screened vent.	No defects visible. Well vented but not screened.	No holes or cracks visible. Cap loose.	Holes or cracks visible. Cap loose or missing. Can hear water running.	____
Casing depth	Cased more than 100 feet below water level in your well.	Cased 31–100 feet below water level in your well.	Cased 10–30 feet below water level in your well.	Cased less than 10 feet below water level in your well. No casing.	____

Boldface type: Besides representing a higher-risk choice, this practice also violates New Jersey law.

*See page 2 of Fact Sheet #1, *Improving Drinking Water Well Condition.*

**Illegal for new well construction. Existing wells must meet separation requirements in effect at time of construction.

***See page 3 of Fact Sheet #1 for New Jersey's minimum construction requirements.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
Casing height above land surface	More than 18 inches above grade.	12–18 inches above grade.	At grade or up to 12 inches above.	Below grade or in pit or basement.	____
Well age	Less than 20 years old.	21–50 years old.	51–70 years old.	More than 70 years old.	____
Well type	_____	Drilled	Driven-point (sand point)	Dug well	____
MANAGEMENT					
Backflow prevention	Anti-backflow devices (such as check valves) installed on all faucets with hose connections. No cross-connections between water supplies.	Anti-backflow devices installed on some faucets with hose connections.	No anti-backflow devices. Air gap maintained.	No anti-backflow devices. Air gap not maintained. Cross-connections between water supplies.	____
Unused well	No unused, unsealed wells.	Unused wells capped and protected.	Unused, unsealed well in field. Not capped or protected.	Unused, unsealed well in farmstead. Not capped or protected.	____
Water testing	Consistent satisfactory water quality. Bacteria, nitrate and other tests meet standards.	Occasional deviation from standards with bacteria, nitrate and other tests.	Bacteria, nitrate and other tests mostly do not meet standards.	No water tests done. Water discolored after rainstorms or during spring melt. Noticeable changes in color, clarity, odor or taste.	____

TOTAL ☐

Use this total to calculate risk ranking on back page of worksheet.

What do I do with these rankings?

Step 1: Begin by determining your overall well management risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

_____ divided by _____ equals [ ]*
total of rankings; # of categories ranked; risk ranking

*Carry your answer out to one decimal place.

3.6–4=low risk, 2.6–3.5=low to moderate risk, 1.6–2.5=moderate to high risK, 1-1.5=high risk

This ranking gives you an idea of how your well management practices **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis.** Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed well management risk ranking on page 1 of Worksheet #12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock characteris tics), and Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:
- **Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- **Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- **Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- **High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly—projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #1, *Improving Drinking Water Well Condition,* and consider how you might modify your farmstead practices to better protect your drinking water.

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NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#2 Fact Sheet: Reducing the Risk of Groundwater Contamination by

Improving Pesticide Storage and Handling

We'll look at five areas of pesticide management on your farmstead: 1) pesticide storage practices; 2) mixing and loading practices; 3) spill cleanup; 4) container disposal practices; and 5) other management practices.

When handling pesticides, wear proper protective clothing at all times. Personal protection is not addressed in Farm•A•Syst, because its focus is groundwater and drinking water protection. The Contacts and References section provides some safety information sources.

1. Pesticide storage practices

If stored safely in a secure location, pesticides pose little danger to groundwater. Common sense suggests keeping them dry and out of the way of activities that might knock over a jug or rip open a bag. Short-term storage (during seasonal use) poses a lower risk than year-round storage, but **any** storage, regardless of length of time stored, poses a risk to groundwater.

If a spill does occur, an impermeable (waterproof) floor, such as concrete, should virtually eliminate any seepage of chemicals into the ground. Putting a curb around the floor will prevent chemicals from spreading to other areas.

Secondary containment provides an impermeable floor and walls around the storage area, which will minimize the amount of pesticide seeping into the ground if a bulk liquid pesticide storage tank should leak.

A mixing/loading pad provides for secondary containment during the transfer of pesticides to spraying equipment or nurse tanks.

Building a new storage facility

Building a new facility just for pesticide storage may be expensive, but generally it will be safer than trying to modify areas meant for other purposes.

When building a new facility, keep in mind a few principles of safe pesticide storage:

1. Locate the building downslope and at least 100 feet away from your well. Separation from the well should be greater if the site has sandy soils or fractured bedrock near the land surface. The risk of pesticide contamination of groundwater is influenced by properties of both the pesticide and the soil on which it is spilled or applied. (Worksheet #11, *Site Evaluation*, assists you in ranking your farmstead soils and geologic conditions according to their ability to keep pesticides and other con taminants out of groundwater.) In New Jersey, it is mandated that the actual storage area be kept separate from a living area and/or work area and that restricted-use pesticides be kept in structurally separate rooms.

2. In the event of a fire, contaminated surface water should drain to a confined area.

For glossary, see page 2 of Worksheet #2.

3.The mixing and loading area should be close to your storage facility, to minimize the distance that chemicals are carried.

4.The building foundation or secondary containment floor should be well drained and high above the water table. The finished grade should be 3 inches below the floor and sloped to provide surface drainage away from the building. The subsoil should have a low permeability.

5.Provide pallets to keep large drums or bags off the floor. Shelves for smaller con tainers should have a lip to keep the containers from sliding off. Steel shelves are easier to clean than wood if a spill occurs. Store dry products above liquids to prevent wetting from spills.

6.If you plan to store large bulk tanks, provide a containment area large enough to confine 125 percent of the contents of the largest bulk container, plus the displaced volume of any other storage tanks in the area.

7.New Jersey law mandates that the storage enclosure be locked. Preventing unauthorized use of pesticides reduces the chance of accidental spills or theft. Signs or labels (written in at least English and Spanish) must identify the cabinet or building as a pesticide storage area. Labels on the outside of the building give firefighters informa tion about pesticides during an emergency response for fire or a spill.

8.Provide adequate road access for deliveries and emergency equipment.

9.Keep pesticides separate to prevent cross-contamination. Herbicides, insecticides and fungicides should be kept on separate shelves or areas.

10. In New Jersey, ventilation must be sufficient to keep fumes from intruding into a living area.

11. For information on other factors to consider in the design of a storage facility—such as water access, temperature control and worker safety—contact your local NRCS district office (see introductory sheet).

Modifying an existing storage facility

Even if you decide to improve your current storage building, applying the above principles can be expensive. Compared to the cost of a major accident or a lawsuit, however, storage improvements are a bargain. (Items 5-10 above are also important points to remember for existing storage.)

The cheapest alternative you may have is to cut back on the amounts and types of pesticides stored. If that's not practical, consider how you can protect the pesticides you keep in storage. Sound containers are your first defense against a spill or leak.

> If a container is accidentally ripped open or knocked off a shelf, the spill should be confined to the immediate area and cleaned up promptly. The building should have a solid floor and, for liquid pesticides, a curb. The secondary containment space should be large enough to hold 125 percent of the contents of the largest full container, plus the displaced volume of any other storage tanks in the area.

Remodeling existing facilities that serve other uses may be less expensive than building a new facility, but remodeling can be complicated. When existing buildings must accommodate other activities, using them also to store pesticides could compro-mise the safety of people and the environment. Storing chemicals in a separate facility reduces the risk associated with fire or accidental spills. Never store pesticides inside a wellhouse or a facility containing an abandoned well.

You can reduce damages by anticipating emergencies. Fires in a storage area present a special hazard to people and the environment. If containers are damaged, the stored chemicals may be carried away by water and spread over a large area.

Windows and doors can be labeled to alert firefighters to the presence of pesticides and other products stored in the structure. NJ Department of Environmental Protection mandates that a listing of all stored pesticides must be kept in a separate location from the storage area.

If a fire should occur, consider where the surface runoff water will go and where it might collect. For example, a curb around a floor can help confine contaminated water.

In making the storage area secure, also make it accessible, to allow getting chemicals out in a hurry.

2. Mixing and loading practices

Groundwater contamination can result even from small spills in the mixing and loading area. Small quantities spilled regularly in the same place can go unnoticed, but the chemicals can build up in the soil and eventually reach groundwater. By mixing and loading on an impermeable surface, such as concrete, you can contain and reuse most spilled pesticides.

A mixing and loading pad

Containing pesticide spills and leaks requires an impermeable (waterproof) surface for mixing and loading. The pad should be large enough to contain leaks from bulk tanks, wash water from cleaning equipment, and spills from transferring chemicals to the sprayer or spreader. (See Figure 1.)

The size of the pad depends also on the equipment you use. It should provide space around the parked equipment for washing and rinsing. Having several separate rinsate (rinse water) storage tanks allows you to keep rinsate from different chemicals separate. That way, it can be used as mixing water on subsequent loads.

Locate the pad next to the storage area. Make sure that any water from the pad moves away from the well. At sites where runoff water could reach the well, construct a diversion so runoff is directed to a safe, stable area.

If you are considering constructing a mixing and loading pad, contact your local NRCS district office (see introductory sheet).

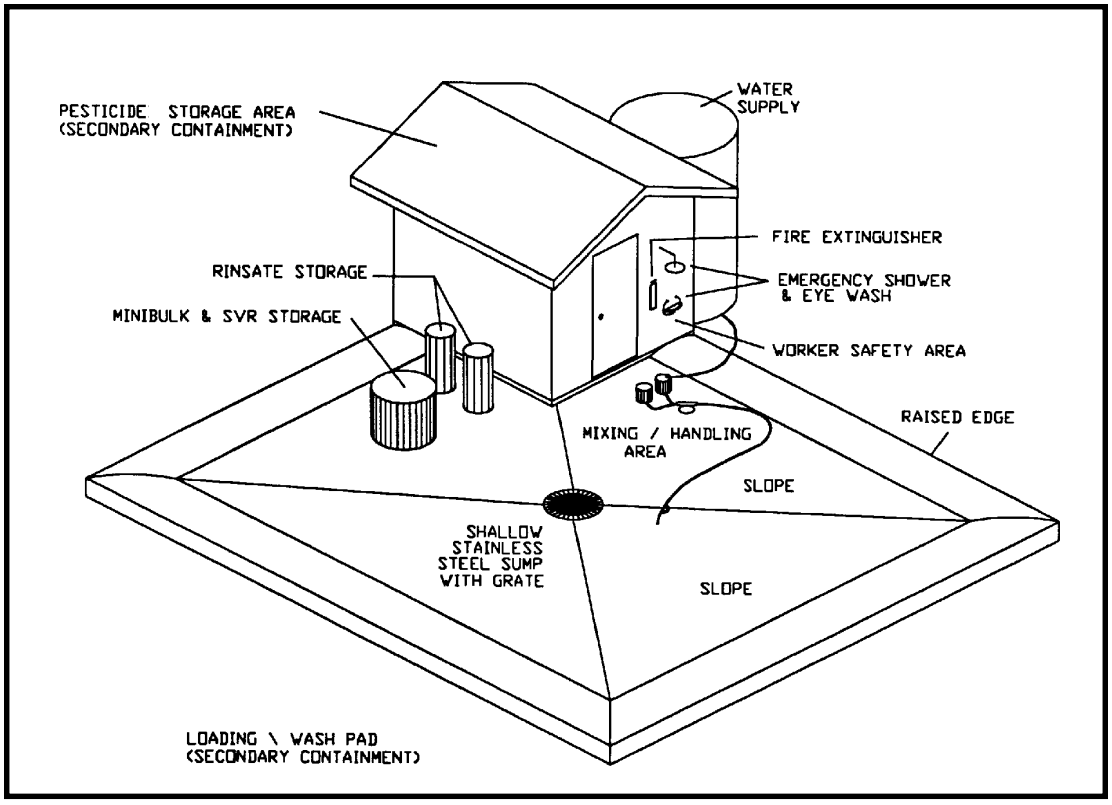

Figure 1: Farm-sized pesticide facility. *Source: Farm-Sized Mixing/Loading Pad and Agri-chemical Storage Facility, by D.W. Kammel and D. O'Neil, presented at Summer Meeting of the American Society of Agricultural Engineers, June 24-27, 1990.*

Better management on your existing mixing and loading site

Spills and leaks are bound to occur from time to time. Even if you don't have an impermeable mixing and loading pad, you can minimize contamination by following some basic guidelines:

- Avoid mixing and loading pesticides near your well. One way to do this is to use a nurse tank to transport water to the mixing and loading site. Ideally, the mixing site should be moved each year within the field of application.

- Avoid mixing and loading on gravel driveways or other surfaces that allow spills to sink quickly through the soil. A clay surface is better than sand.

- New Jersey law requires a backsiphon prevention device (antibackflow device) on the well or hydrants to prevent reverse flow of liquids into the water supply. Never put the hose in the sprayer tank.

- Always supervise sprayer filling. For restricted-use pesticides, a trained and certified applicator must supervise operations.

- Consider a closed handling system, which transfers the pesticide directly from storage container to applicator equipment (through a hose, for example). Humans and the environment are never inadvertently exposed to the pesticide.

- Use rinsate for mixing subsequent loads. Spray the last rinsate load on the labeled crop.

3. Spill cleanup procedures

For dry spills, promptly sweep up and reuse the pesticide as it was intended. Dry spills are usually very easy to clean up.

For liquid spills, recover as much of the spill as possible and reuse as it was intended. It may be necessary to remove and field apply some contaminated soil.

On the soil or on a mixing and loading pad, report spills greater than l pound of dry active ingredient or 1 gallon of liquid. Report spills of smaller quantities if they may cause damage because of the specific compound or spill location.

> Registered pesticide applicators are required by state law to immediately report a spill to the NJ Department of Environmental Protection (N.J.A.C. 7:30-9.14). To report, call the 24-hour Emergency Hotline of New Jersey Department of Environmental Protection at (609) 292-7172 or the Pesticide Control Program at (609) 530-4132.
>
> Remove the spilled material and contaminated soil no matter what the quantity, and dispose of according to recommendations you receive when you report the spill.

Have an emergency response plan for the site. Know where the runoff water will go, how to handle your particular chemicals, and whom to call for help.

4. Container disposal practices

Unwashed and improperly stored containers can lead to groundwater contamination by allowing chemical residues to leak onto the ground. Some basic guidelines can help avoid similar problems:

> • As often as possible, use returnable containers and minibulks and take them back to the dealer.
>
> • Pressure-rinse or triple-rinse plastic containers immediately after use, since residue can be difficult to remove after it dries. Pour rinse water into the spray tank. Puncture or crush containers and store them in a covered barrel until you can take them to a permitted landfill.
>
> • Recycle plastic and metal containers whenever possible.
>
> • Shake out bags, bind or wrap them to minimize dust, and take them to a permitted landfill.
>
> • Do not bury or burn pesticide containers or bags on the farm.

Your drinking water is least likely to be contaminated if you follow appropriate management procedures or dispose of wastes in any location that is **off the farm site.** However, proper offsite disposal practices are essential to avoid risking contamination that could affect the water supplies and health of others.

(For more detailed information about proper disposal of pesticide containers, refer to Worksheet and Fact Sheet #5, *Hazardous Waste Management*. Fact Sheet #5 also discusses the risks of burning these containers.)

Atrazine at 40,000 Parts Per Billion: A Case Example

Staff of the Wisconsin Department of Agriculture, Trade and Consumer Protection determined that careless disposal of atrazine containers might have contaminated the water supply of a dairy farm. The atrazine concentration in the well water was above the state groundwater standard of 3.5 micrograms per liter, or parts per billion (ppb). Upon visiting the farm, the staff found a box of empty 2.5 gallon liquid atrazine containers discarded outside and beneath the drip line of a farm building. Concentrate residues were visible on the outside of the containers. Surface runoff from the livestock yard flowed past the containers, discharging near the well field. Samples of surface soil in the drainageway near the containers contained atrazine at a concentration of **more than 40,000 ppb.** Such disposal incidents greatly increase the likelihood of groundwater contamination.

5. Other management practices

Reducing pesticide waste makes financial as well as environmental sense, but it means more than just reducing spills. It also means not buying more than you need to apply, keeping records of what you have on hand, and using older products first.

• Buying only what you need makes long-term storage unnecessary. In addition, you avoid cold weather problems, which can make some pesticides useless.

• Recordkeeping may seem like a task unrelated to groundwater contamination, but knowing what you've used in the past and what you have on hand allows you to make better purchasing decisions.

In New Jersey, farmers certified and registered as private pesticide applicators are mandated to keep records of pesticide applications (N.J.A.C. 7:30 - 8.8) Keep records of application locations and dates, the brand or trade name of the pesticide used, the amount of pesticide used, and the dosage or rate of each pesticide used. Along with field records, you can add information such as the manufacturer's name and address, chemical types and handling precautions. This information can be important if you must respond quickly to an accident.

• Using older products first keeps your inventory current and effective. Before using chemicals that have been stored for a few years, though, check with your county Extension agent about possible restrictions on their use. (Worksheet and Fact Sheet #5, *Hazardous Waste Management*, provide information on how to safely and legally dispose of unwanted and banned pesticides.)

CONTACTS AND REFERENCES

Who to call about...

General contacts

See introductory sheet

General pesticide information

National Pesticide Telecommunication Network, 1 (800) 858-PEST (-7378). Answered 24 hours a day, 365 days a year. Provides information on recognizing and treating pesticide poisoning; pesticide products, cleanup and disposal; contacts for animal poison centers; certification and training programs; and pesticide laws.

Health effects of pesticides in water

The Pesticide Control Program, NJ Department of Environmental Protection, 380 Scotch Rd., CN 411, Trenton, NJ 08625, (609) 530-5070 (automated attendent) or (609) 530-4124. With specific questions, contact your county Extension agent, county health department, or Natural Resources Conservation Service staff.

Drinking water quality and treatment and Health Advisories

EPA Safe Drinking Water Hotline, Monday through Friday, 8:30-5:00 P.M. Eastern Standard Time. Call 1(800) 426-4791.

Health and safety information on chemicals

Chemical Referral Center, sponsored by the Chemical Manufacturers Association. Call 1 (800) CMA-8200. The Center does not answer questions but does serve as a central contact point in non-emergency situations.

Plans and recommendations for pesticide mixing and loading pads

Contact your local NRCS district office (see introductory sheet).

Pesticide spills

The 24-hour Emergency Hotline of NJ Department of Environmental Protection and Energy, at (609) 292-7172 or The Pesticide Control Program at (609) 530-4132.

Proper disposal of soil contaminated by a pesticide spill

Contact the NJ Department of Environmental Protection's Division of Solid and Hazardous Waste, Advisement and Waste Classification Unit at (609) 292-8341.

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.)

Groundwater and pesticides in groundwater

New Jersey's Water (Clean Water Information Series). NJ Department of Environmental Protection and Energy. (1)

Health effects

The product label. Read your product labels carefully for specific information on pesticide health effects.

Health Advisory Summaries. 1989. U.S. Environmental Protection Agency, Washington, D.C. (2)
Specifies maximum acceptable levels of pesticide concentrations in drinking water and describes health effects that might be caused by particular pesticides in drinking water.

Pesticide handling and management

Fertilizer and Pesticide Containment Facilities Handbook. 1991. MWPS-37. (4)

Pesticide Storage Facilities. Rutgers Cooperative Extension Fact Sheet #603.(1)

Storage of Pesticides and their Containers. Rutgers Cooperative Extension Fact Sheet #320. (1)

Toxicity of Pesticides. Rutgers Cooperative Extension Fact Sheet #197.(1)

Disposal of Pesticides. Rutgers Cooperative Extension Fact Sheet #198.(1)

Cleaning Spray Equipment. Rutgers Cooperative Extension Fact Sheet #628. (1)

A Consumer's Guide To Safer Pesticide Use. 1987. (2)
Free 25-page special reprint from the EPA Journal.

Pesticides: A Community Action Guide. 1985. Concern, Inc., Washington, D.C. (3)

Chemicals in Your Community: A Guide to Emergency Planning and Right To Know Act. 1988. (2)
Contains information on implications of this law for farmers.

Citizen's Guide to Pesticides. 1989. (2)
Free 24-page publication contains information on handling, storage and disposal of pesticides, reducing exposure to pesticides and what to do in a pesticide emergency. Also provides addresses and phone numbers for EPA regional pesticide offices and state pesticide agency contacts.

Publications available from...

1. Your county offices of Rutgers Cooperative Extension (found in the blue pages of the phone book) or the Publications Distribution Center, Cook College, Rutgers University, PO Box 231, New Brunswick, NJ 08903, (732) 932-9762.

2. U.S. Environmental Protection Agency (EPA), Office of Pesticide Programs (TS-766C), 401 M Street S.W., Washington, D.C. 20460.

3. Concern, Inc., 1794 Columbia Road N.W., Washington, D.C. 20009, (202) 328-8160.

4. Midwest Plan Secretary, Agricultural Engineering Department, 460 Henry Mall, University of Wisconsin, Madison, Wisconsin 53706, (608) 262-3310.

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NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#2 Worksheet: Assessing the Risk of Groundwater Contamination from
Pesticide Storage and Handling

Why should I be concerned?

Pesticides are showing up where they're not wanted—in our drinking water. If pesticides are not handled carefully around the farmstead, they can seep through the ground after a leak or spill, or they can enter a well directly during mixing and loading.

Pesticides play an important role in agriculture. They have increased farm production, and they have enabled farmers to manage more acres with less labor. Taking voluntary action to prevent pesticide contamination of groundwater will help assure their continued availability for responsible use by farmers.

Pesticides work by interfering with the life processes of plants and insects. Pesticides are also toxic to people. If pesticides enter a water supply in large quantities—as can happen with spills or backsiphonage accidents—acute health effects (toxic effects apparent after only a short period of exposure) can range from moderate to severe, depending on the toxicity of the pesticide and the amount of exposure. Contaminated groundwater used for drinking water supplies may result in chronic exposure (prolonged or repeated exposure to low doses of toxic substances), which may be hazardous to people and livestock.

When found in water supplies, pesticides normally are not present in high-enough concentrations to cause acute health effects, which can include chemical burns, nausea and convulsions. Instead, they typically occur in trace levels, and the concern is primarily for their potential for causing chronic health problems from prolonged exposure.

Your drinking water is least likely to be contaminated if you follow appropriate management procedures or dispose of wastes in any location that is off the farm site. However, proper offsite disposal practices are essential to avoid risking contamination that could affect the water supplies and health of others.

The goal of Farm•A•Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my drinking water?

- It will take you step by step through your pesticide handling, storage and disposal practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your pesticide handling, storage and disposal practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

Follow the directions at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

Glossary
Pesticide Storage and Handling

These terms may help you make more accurate assessments when completing Worksheet #2. They may also help clarify some of the terms used in Fact Sheet #2.

Air gap: An air space (open space) between the hose or faucet and water level, representing one way to prevent backflow of liquids into a well or water supply.

Anti-backflow (anti-backsiphoning) device: A check valve or other mechanical device to prevent the unwanted reverse flow of liquids back down a water supply pipe into a well.

Backflow: The unwanted reverse flow of liquids in a piping system.

Backflow prevention device: (See **anti-backflow device**.)

Backsiphonage: Backflow caused by formation of a vacuum in a water supply pipe.

Closed handling system: A system for transferring pesticides or fertilizers directly from storage container to applicator equipment (through a hose, for example), so that humans and the environment are never inadvertently exposed to the chemicals.

Cross-connection: A link or channel between pipes, wells, fixtures or tanks carrying contaminated water and those carrying potable (safe for drinking) water. Contaminated water, if at higher pressure, enters the potable water system.

Micrograms per liter: The weight of a substance measured in micrograms contained in one liter. It is equivalent to 1 part per billion in water measure.

Milligrams per liter (mg/l): The weight of a substance measured in milligrams contained in one liter. It is equivalent to 1 part per million in water measure.

Parts per billion (ppb): A measurement of concentration of one unit of material dispersed in one billion units of another.

Parts per million (ppm): A measurement of concentration of one unit of material dispersed in one million units of another.

Rinsate: Rinse water from pesticide or fertilizer tank cleaning.

Secondary containment: Impermeable floor and walls around a chemical storage area that minimize the amount of chemical seeping into the ground from a spill or leak.

Worksheet #2

Pesticide Storage and Handling: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.)
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for pesticide storage and handling practices.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
PESTICIDE STORAGE					
Amount stored	No pesticides stored at any time.	Less than 1 gallon or less than 10 pounds of each pesticide.	More than 1 gallon or more than 10 pounds of each pesticide.	More than 55 gallons or more than 550 pounds of each pesticide.	_____
Types stored: (ie: general-use pesticide, restricted use pesticide, fumigant)					
Leachability*	No chemicals stored.	Chemicals classified as having low leaching potential.	Chemicals classified as having medium leaching potential.	Chemicals classified as having high leaching potential.	_____
Liquid or dry formulation	No liquids. All dry.	Some liquids. Mostly dry.	Mostly liquids. Some dry.	All liquids.	_____
Spill or leak control in storage area	Impermeable surface (such as concrete) does not allow spills to soak into soil. Curb installed on floor to contain leaks and spills.	Impermeable surface with curb installed has some cracks, allowing spills to get to soil. OR impermeable surface without cracks has no curb installed.	Permeable surface (wooden floor) has some cracks. Impermeable surface has no curb. Spills could contaminate wood or soil.	Permeable surface (gravel or dirt floor). Spills could contaminate floor.	_____
Containers	Original containers clearly labeled. No holes, tears or weak seams.	Original containers old. Labels partially missing or hard to read.	Containers old but patched. Metal containers show signs of rusting.	Containers have holes or tears that allow chemicals to leak. **No labels.**	_____

Boldface type: Besides representing a higher-risk choice, this practice also violates New Jersey law.

*See attached Pesticide Leachability Chart.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
PESTICIDE STORAGE (continued)					
Security	Fenced or locked area separate from all other activities.	Fenced area separate from most other activities.	Open to activities that could damage containers or spill chemicals.	**Open access to theft, vandalism and children.***	_____
MIXING AND LOADING PRACTICES					
Location of well in relation to mixing/ loading area with no curbed and impermeable containment area	100 feet or more downslope from well.	50-100 feet downslope from well.	10-50 feet downslope from well, or 100-500 feet upslope.	Within 10 feet downslope or within 100 feet upslope from well.	_____
Mixing and loading pad (Spill containment)	Concrete pad with curb keeps spills contained. Sump allows collection and transfer to storage.	Concrete pad with curb keeps spills contained. No sump.	Concrete pad with some cracks keeps some spills contained. No curb or sump.	No mixing/loading pad. Permeable soil (sand). Spills soak into ground.	_____
Backflow prevention on water supply	Anti-backflow device installed or 6-inch air gap maintained above sprayer tank.	Anti-backflow device installed. Hose in tank above waterline.	**No anti-backflow device. Hose in tank above waterline.**	**No anti-backflow device. Hose in tank below water line.**	_____
Water source	Separate water tank.	Hydrant away from well.	Hydrant near well.	Obtained directly from well.	_____
Filling supervision	Constant	_____	Frequent	Seldom or never.	_____

Boldface type: Besides representing a higher-risk choice, this practice also violates New Jersey law.
* Illegal for restricted use pesticides (N.J.A.C. 7:30-9.4[a])

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
MIXING AND LOADING PRACTICES (continued)					
Handling system	Closed system for all liquid and dry product transfers.	Closed system for most liquids. Some liquid and dry product hand poured. Sprayer fill port easy to reach.	All liquids and dry product hand poured. Sprayer fill port easy to reach.	All liquids and dry product hand poured. Sprayer fill port hard to reach.	_____
Sprayer cleaning and rinsate (rinse water) disposal	Sprayer washed out in field. Rinsate used in next load and applied to labeled crop.	Sprayer washed out on pad at farmstead. Rinsate used in next load and applied to labeled crop.	Sprayer washed out at farmstead. Rinsate sprayed less than 100 feet from well.	Sprayer washed out at farmstead. Rinsate dumped at farmstead or in field.	_____
CONTAINER DISPOSAL					
Disposal location	Triple-rinsed containers returned to dealers or taken to licensed landfill or municipal incinerator. Bags returned to supplier or hazardous waste collection service used.	Unrinsed containers and empty bags taken to licensed landfill, municipal incinerator or dump.	Disposal of unrinsed containers or empty bags on farm. Disposal of triple-rinsed containers on farm. **Burying or burning containers.**	Disposal of partially filled plastic or paper containers on farm.	_____

Boldface type: Besides representing a higher-risk choice, this practice also violates New Jersey law.

TOTAL ☐

Use this total to calculate risk ranking on back page of worksheet.

PESTICIDE LEACHABILITY CHART

The pesticides listed on this chart are identified by **brand name, common name and rating for movement by leaching (low, medium or high).** Identify the pesticides stored on your farmstead from the listing below. Note the "leachability factor" for each pesticide you store. Then give yourself an overall "leachability ranking" (nominal, small, medium or large), based on which ranking best represents the pesticides you store. Then use this ranking to complete the "Leachability" section on the assessment worksheet.

'D-D'	1,2-Dichloropropane	Large
2 Plus 2	mecoprop (MCPP) dimethylamine salt	Large
A-rest	ancymidol	Large
Aaprotect	ziram	Medium
Aatrex, Atratol, Atrazine	atrazine	Large
Abate	temephos	Small
Acaraben, Akar	chlorobenzilate	Small
Acaristop, Apollo, Apolo	clofentezine	Small
Accelerate, Aquathol Des-i-cate, Hydrothol	endothall (AKA endothal)	Medium
Accent	nicosulfuron	Large
Acclaim, Whip	fenoxaprop-ethyl	Nominal
Accothion, Cytel, Cyfen Folithion, Sumithion	fenitrothion	Small
Actellic	pirimiphos-methyl	Small
Agrisil, Agritox, Phytosol	trichlornat	Large
Alanap	naptalam sodium salt	Large
Alar, B-nine	daminozide	Large
Aliette	fosetyl-aluminum	Small
Ally, Escort	metsulfuron-methyl	Large
Ambush, Pounce	permethrin	Small
Amdro	hydramethylnon (AKA amdro)	Small
Amiben	chloramben	Large
Amid-Thin	1-naphthaleneacetamide	Medium
Amitrol T, Amizol	amitrole (AKA aminotriazole)	Medium
Ammate, Amicide	ams (AKA ammonium sulfamate)	Large
Ammo, Cymbush, Demon	cypermethrin	Small
Ansar, Bueno, Daconate	msma	Small
Ansar, Bueno, Daconate, Clout	dsma (AKA methyl-larsonic acid disodium salt)	Small
Anticarie, Ceku, No Bunt	hexachlorobenzene (AKA hcb)	Small
Antor	diethatyl-ethyl	Small
Api-Luster, Arbotect, Merteect, TBZ, Tecto, RPH, Thibenzole	thiabendazole	Small
Apron, Ridomil, Subdue	metalaxyl	Large
Aqua 8 Parathion, Phoskil	parathion (AKA ethyl parathion)	Small
Aqua Ethion, Ethion	ethion	Small
Aqua Kleen, Weedone, Emulsamine	2,4-d esters or oil-sol amines	Medium
Aqualin, Aqualine, Magnacide	acrolein	Large
Aquazine, Princep	simazine	Large
Aresin	monolinuron	Large
Argold, Cinch	cinmethylin	Medium
Arsenal, Chopper	imazapyr isopropylamine salt	Large
Arsenal, Chopper	imazapyr acid	Large
Arsonate, Bueno, MSMA, DSMA	methanearsonic acid sodium salt	Small
Asana	esfenvalerate	Small
Aspon		-
		-
Assert	imazamethabenz-methyl (p-isomer)	Large
Assert	imazamethabenz-methyl (m-isomer)	Large
Assure	quizalofop-ethyl (AKA quizalofop ethyl)	Medium
Asulox	asulam sodium salt	Medium
Avadex	di-allate	Medium
Avenge	difenzoquate methyl-sulfate salt	Small
Azodrin	monocrotophos	Large
Balan, Balfin	benefin (AKA benfluralin)	Small
Banvel, Trooper	dicamba salt	Large
Barricade, Endurance	Prodiamine	Small
Basagran	bentazon sodium salt	Large
Basalin	fluchloralin	Small
Basamid	dazomet	Medium
Bavistin, Derosol, Delsend	carbendazim (mbc)	Large
Baygon	propoxur	Large
Bayleton	triadimefon	Medium
Baytan	triadimenol	Medium
Baytex, Baycid	fenthion	Small
Beacon, Tell, Rifle	primisulfuron-methyl	Large
Beam, Bim, Blascide, Beam	tricyclazole	Small
Benlate, Tersan	benomyl	Small
Benzyfluroline, Chryson	resmethrin	Small
Betanal	phenmedipham	Small
Betanex	desmedipham	Small
Bidrin	dicrotofos (AKA dicrotophos)	Large
Bladex	cyanazine	Medium
Biotic, Safrotin	propetamphos	-
Bolero	thiobencarb	Small
Bolstar	sulprofos	Small
Bonzi, Clipper, Cultar, Parfar	paclobutrazol	Large
Botran	DCNA (AKA dicloran)	Small
Bravo, Daconil	chlorothalonil	Small
Brom-O-Gas, Meth-O-Gas, Terr-O-Gas	methyl bromide	Large
Bromofume, Dowfume 85	EDB (ethylene dibromide)	
Bromofume, Dowfume 85	ethylene dibromide (AKA EDB)	Large
Broot	trimethacarb	Medium
Buctril	bromoxynil butyrate (AKA bromoxynil butyrate ester)	Small
Buctril	bromoxynil octanoate	Nominal
Butyrac	2,4-DB dimethylamine salt	Medium
Butyrac Ester	2,4-DB butoxyethyl ester	Small
Calirus	benodanil	Small

Caparol	prometryn	Medium
Capsolane 35, Eradicane, Surpass	dichlormid	Medium
Carbamate	ferbam	Medium
Carbamult	promecarb	Medium
Carbon Disulfide	carbon disulfide	Small
Carbyne	barban	Small
Carzol	formetanate hydrochloride salt	Small
Casoron	dichlobenil	Medium
Cerone, Ethrel, Florel, Prep	ethephon	Small
Chem Hoe	propham (IPC)	Small
Chlor-O-Pic, Telone C-17	chloropicrin	Small
Cidial, Elsan	phenthoate	Small
Classic	chlorimuron ethyl	Large
Cobex	dinitramine	Small
Cobra	lactofen	Nominal
Comite, Omite	propargite	Small
Command	clomazone (AKA dimethazone)	Medium
Cotoran	fluometuron	Large
Cotton Aide HC, Moncido, Montar, Ansar, Phytar	dimethylarsinic acid (AKA cacodylic acid)	Small
Cotton Aide HC, Moncido, Montar, Ansar	cacodylic acid (dimethylarsicic)	-------
Counter	terbufos	Small
Crossbow	triclopyr ester	Medium
Curacron	profenofos	Small
Cygon	dimethoate	Medium
Cyprex	dodine acetate	Small
Cythion, Malathion	malathion	Small
D.Z.N. Diazinon, Knox-Out	diazinon	Small
Dacamine	2,4-D acid	Medium
Dacthal	DCPA (AKA chlorthal-dimethyl)	Small
Dalapon	dalapon sodium salt	Large
Danitol, Herald, Meothrin	fenpropathrin	Nominal
Dasanit, Terracurp	fensulfothion	Medium
Dechlorane	mirex	Small
Ded-Weed	2,4,5-T acid	Large
Dedevap, Nogos, Nuvan, Vapona	dichlorvos (DDVP)	Small
Derris	rotenone	Nominal
Desiccant L-10	arsenic acid	Small
Destun	perfluidone	Large
Devrinol	napropamide	Medium
Di-Syston	disulfoton	Medium
Dibrom, Ortho Fly Killer	naled	Small
Dimilin	diflubenzuron	Small
Dioxacarb	dioxacarb	Small
Diquat, Tag	diquat dibromide salt	Small
Dithane Z-78, Tiezene, Parzate	zineb	Small
Dithane Z-78, Tiezene, Parzate	zinc	Small
Dithane, Maneb	maneb	Small
Dithane, Manzate	mancozeb	Small
Drinox, Heptagran, Heptamul, Heptox	heptachlor	Small
Drop-Leaf, Drexel Defol	sodium chlorate	Large
Dropp	thidiazuron	Medium
Du Ter, Duter, Suzu H, Triple Tin Tubotin	triphenyltin hydroxide	Small
Dual	metolachlor	Large
Dybar	fenuron	Large
Dyfonate	fonofos	Small
Dylox, Masoten	trichlorfon	Large
Dynamec	abamectin (aka avermectin)	Small
Dyrene	anilazine	Small
Elgetol	DNOC sodium salt	Large
Embark, Vistar	efluidide	Small
Embutuox, Decamine	2,4-DB acid	Small
Endrex, Hexadrin	endrin	Small
Enide	diphenamid	Medium
Enilconazole, Bromazil, Freshgard	imazalil	Small
EPN	EPN	Small
Eptam, Eradicane, Eradicane Extra	EPTC	Small
Etazine	secbumeton	Large
Evik	ametryn	Medium
Evisect	thiocyclam-hydrogen oxalate	Small
Evital, Zorial, Solicam	norflurazon	Medium
Express Herbicide	tribenuron methyl	Medium
Far-Go	triallate	Small
Fenatrol, Fenavar, Fenamine	fenac (aka chlorfenac) salt	Large
Fernex	pirimiphos-ethyl	Medium
Ficam, Rotate, Multamat,Niomil, Seedox, Tattoo	bendiocarb	Small
Final, Total, Hoe	glufosinate ammonium salt (aka glufosinate-ammonium)	Small
Folex, Def	tribufos	Small
Fruitone CPA	3-CPA sodium salt	Medium
Fruitone, NAA-800	NAA sodium salt	Medium
Fundal, Galecron	chlordimeform hydro-chloride	Small
Funginex, Ortho Triforine	triforine	Small
Furadan	carbofuran	Large
Fusilade	fluazifop-butyl	Small
Fusilade Super	fluazifop-p-butyl	Small
Galben	benalaxyl	Small
Gallery, Knock Out	isoxaben	Small
Gardona	tetrachlorvinphos	Small
Gesarol, Guesarol, Neocid	DDT	Large
Glean, Telar	chlorsulfuron	Large
Goal	oxyfluorfen	Small
Gramoxone, Prelude, Surefire	paraquat dichloride salt	Small
Guthion	azinphos-methyl	Small
Gy-bon	simetryn	Large
Haipen	captafol	Small
Harmony	thifensulfuron-methyl	Medium
Harvade	dimethipin	Large
Hoelon	diclofop-methyl	Small
Hyvar	bromacil acid	
Hyvar	bromacil (lithium salt)	Large
Igran	terbutryn	Small
Imidan	phosmet	Small
Degradation product of DDT	DDE	Large
Isotox, Lindane	lindane	Medium
Karate	lambda-cyhalothrin	
Karathane, Crotothane	dinocap	Small

Karmex	diuron	Medium
Kelthane	Dicofol	Small
Kerb	pronamide (propyzamide)	Large
Kloben, Neburea, Neburex	Neburon	Small
Kocide	cupric hydroxide	------
Krenite	fosamine ammonium salt	Small
Kuron, Fruitgnet, (Silvex)	silvex amine salt	------
Kuron, Fruitone T	fenoprop (aka 2,4,5-tp) (aka silvex)	Medium
Kyocide, Prokil	cryolite	mall
Lambast, Rasay-anclchlor, Machete	butachlor	Small
Lambda, Cyhalothrin	cyhalothrin	Small
Lannate, Nudrin, Lanox	methomyl	Large
Larvin	hiodicarb	Small
Laser, Baythroid	cyfluthrin	Small
Lasso	alachlor	Medium
Lesan	fenaminosulf	Small
Lexone, Sencor	metribuzin	Large
Logic	fenoxycarb	Small
Londax	bensulfuron methyl	Small
Lontrel	clopyralid amine salt	Large
Lorox, Hoe	linuron	Medium
Lorsban	chlorpyrifos	Small
Maloran	chlorbromuron	Medium
Many	toxaphene	Nominal
Marlate	methoxychlor	Small
Matacil	aminocarb	Small
Mavrik	fluvalinate	Small
Mesurol, Slug-Geta	methiocarb (aka mercaptodimethur)	Medium
Metasystox, Metasystox 55	demeton-s-methyl	------
Metasystox-R	oxydemeton-methyl	Large
MH-30	maleic hydrazide acid	Medium
Milcurb	dimethirimol	Large
Milogard	propazine	Large
Mitac	amitraz	Small
Mocap	ethoprop (aka ethoprophos)	Large
Modown	bifenox	Nominal
Monitor	methamidophos	Medium
Morestan	oxythioquinox (aka quinomethionate)	Small
Nserve	Nitrapyrin	Small
Napthalene	napthalene	Small
Nemacur	fenamiphos	Large
Nemagon, Nemafume	DBCP	Large
Nortron, Tramat	ethofumesate	Medium
Octalene, HHDN, Aldrex, Aldrite, Aldrasol	aldrin	Small
Octalox	dieldrin	Small
Octo-Klor	chlordane	Small
Oftanol, Amaze	isofenphos	Medium
Ordram	molinate	Medium
Orthene	acephate	Small
Ortho Metaldehyde	metaldehyde	Small
Ortho Sevin, Sevin	carbaryl	Small
Orthocide, Captanex, Botec	captan	Small
Oust	sulfometuron-methyl (aka sulfometuron methyl)	Medium
Paarlan	isopropalin	Small
Pano-ram	fenfuram	Medium
Pay-Off, Aastar	flucythrinate	Small
Penncap-M	methyl parathion	Small
Pentac	dienochlor	Medium
Pentacon	PCP (pentachlorophenol)	-----
Pentacon	pentachlorophenol	Large
Phosdrin	mevinphos	Small
Phygon	dichlone	Small
Pipron	piperalin	Small
Pirimon, Aphox	pirimcarb	Medium
Pix	mepiquat chloride salt	Small
Plantvax	oxycarboxin	Medium
Pilctran	cyhexatin	Small
Poast, Fervinol	sethoxydim	Small
Polyram	metiram	Small
Pramitol	prometon	Large
Prefar	bensulide	Medium
Premerge	dinoseb	Large
Premerge, Dinitro, Dynamyte	dinoseb phenol	Small
Premerge, Dinitro, Dynamyte	dinoseb salts	Large
Previcur N, Banol	propamocarb (aka propa-mocarb hydrochloride)	Small
Prime	flumetralin	Small
Probe	methazole	Small
Prowl	pendimethalin	Small
Pursuit	imazethapyr (aka AC 263, 499)	Large
Pydrin	fenvalerate	Small
Pyramin	pyrazon (aka chloridazon)	Medium
Pyrethrum, Py	pyrethrins	Small
Ramrod	propachlor	Small
Randox	CDAA (aka allidochlor)	Medium
Reflex, Flex	fomesafen sodium salt	Large
Reldan	chlorpyrifos-methyl	Small
Reward, Surpass, Vernam	vernolate	Small
Rhothane, DDD	DDD (aka TDE)	Small
Rizolex	tolclofos-methyl	Small
Ro-Neet	cycloate	Medium
Ronilan, Ornalin	viniclozolin	Medium
Ronstar, Chipco Ronstar G	oxadiazon	Small
Roundup, Rodeo	glyphosate isopropylamine salt (aka glyphosate amine salt)	Small
Rovral	iprodione	Small
Royal MH, Royal Slo-Gro	maleic hydrazide potassium salt	Large
Rubigan	fenarimol	Large
Sancap 80W	dipropetryn	Small
Savey	hexythiazox	Small
Scepter	imazaquin acid	Large
Scepter, Chopper, Image	imazaquin ammonium salt	Large
Scout	tralomethrin	Small
Serinal, Manderol	chlozolinate	Nominal
Sinbar	terbacil	Large
Sonalan	ethalfluralin	Small
Sonar	fluridone	Small
Spike	tebuthiuron	Large
Sportak	prochloraz	Medium
Sprout Nip	chlorpropham (aka CIPC)	Medium
Stam	propanil	Small
Standak	aldoxycarb (aka aldicarb sulfone)	Large
Sumisclex, Sumilix	procymidone	Small
Supracide, Somanil, Suprathion, Ultracide	methidathion	Small
Surflan	oryzalin	Small
Sutan, Genate	butylate	Small

Swat	phosphamidon	Large
Systhene, Nova, Rally	myclobutanil	Medium
Systox	demeton	Medium
Tackle, Blazer	acifluorfen sodium salt	Medium
Talstar, Capture	befenthrin	Small
Tandem	tridiphane	Small
Telone II, Vortex, Telone C-17	1,3-dichloropropene	Medium
Telvar	monuron	Large
Temik	aldicarb	Large
Tenoran	chloroxuron	Small
Terractor, Turfcide	PCNB	Small
Terraneb	chloroneb	Small
Terrazole	etridiazole	Small
Thimet	phorate	Small
Thiodan	endosulfan	Small
Thiram	thiram	Small
Thistrol	MCPB sodium salt	Large
Tillam	pebulate	Small
Tilt, Orbit	propiconazole	Medium
Tok, Tokkron	nitrofen	Small
Tolban, Pregard	profluralin	Small
Topsin, Fungo	thiophanate-methyl	Small
Tordon	picloram salt	Large
Tre-Hold	NAA ethyl ester	Small
Treflan	trifluralin	Small
Trifmine	triflumizole	Medium
Trigard, Larvadex	cyromazine	Large
Trithion	carbophenothion	Small
Triumph, Brace, Miral	isazofos	Large
Tupersan	siduron	Medium
Turflon	triclopyr amine salt	Large
Vapam	metham (metam) sodium salt	Medium
Varitox	TCA	Large
Velpar	hexazinone	Large
Vendex	fenbutatin oxide	Small
Verdict, Gallant	haloxyfop-methyl	Large
Vitavax, Abravit	carboxin	Small
Volck oils, White oils	petroleum oil	Small
Vorlex	methyl isothiocyanate	Large
Vydate	oxamyl	Small
Weedar	2,4-D dimethylamine salt	Medium
Weedar, Veon, Brush-Rhap	2,4,5-T amine(o) salts	Large
Weedone	dichlorprop (2,4-DP) ester	Small
Weedone, LO-VOL 4T, Estron 245, Brush-Rhap LV-OXY-4T	2,4,5-T esters	Large
Weedone, Weedar, Promene	MCPA soluble salt	-----
Weedone, Weedar, Rhomene	MCPA dimethylamine salt	Large
Weedone, Weedar, Rhonox, Stampede (with propanil)	MCPA ester	Small
Zectran	mexacarbate	Small
Zolone	phosalone	Small

Adapted from Becker, R.L., et al. 1990, **Pesticides: Surface Runoff, Leaching, and Exposure Concerns.** Minnesota Extension Service. Data were derived from U.S. Dept. of Agriculture SCS/ARS Pesticides Properties Data Base, Version 1.9, August 1989, developed by R.D. Wauchope et al., and ratings derived by D.W. Goss.

Chart modified annually. Contact your Natural Resources Conservation Service or county Extension office for the most recent version.

What do I do with these rankings?

Step 1: Begin by determining your overall pesticide management risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

_____ divided by _____ equals [ ]*

total of rankings | # of categories ranked | risk ranking

*Carry your answer out to one decimal place.

3.6–4=low risk, 2.6–3.5=low to moderate risk, 1.6–2.5=moderate to high risk, 1–1.5=high risk

This ranking gives you an idea of how your pesticide management practices **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis.** Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed pesticide management risk ranking on page 1 of Worksheet #12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock characteristics), and Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:

- **Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- **Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- **Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- **High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly— projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #2, *Improving Pesticide Storage and Handling*, and consider how you might modify your farmstead practices to better protect your drinking water.

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Written by David W. Kammel, Department of Agricultural Engineering, University of Wisconsin-Madison, and University of Wisconsin-Extension, Cooperative Extension.

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Technical review provided by George Hamilton, Ph.D., Extension Specialist in Pesticides, Rutgers Cooperative Extension and Areta Wowk, Research Scientist, New Jersey Department of Environmental Protection, Pesticide Control Program.

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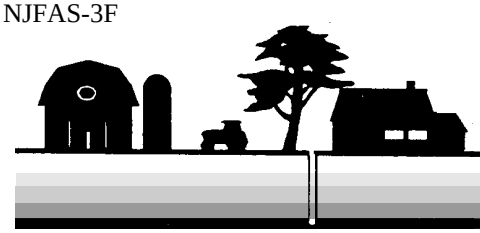

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A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#3 Fact Sheet: Reducing the Risk of Groundwater Contamination by

Improving Fertilizer Storage and Handling

1. Fertilizer storage practices

If stored safely in a secure location, fertilizers pose little danger to groundwater. Common sense suggests keeping fertilizer dry and out of the way of activities that might rip open a bag or allow rain to enter a bulk container.

In the event of such an accident, an impermeable (waterproof) floor, such as concrete, helps to prevent fertilizer seeping into the ground and leaching to groundwater. A curb built around liquid fertilizer storage areas will prevent contaminants from spreading to other areas.

Secondary containment provides an impermeable floor and walls around the storage area, which will minimize the amount of fertilizer seeping into the ground if a bulk liquid fertilizer storage tank should leak.

A mixing/loading pad provides for secondary containment during the transfer of liquid fertilizer to application equipment or nurse tanks. Store piles of dry bulk fertilizer on an impermeable surface under cover or in a building. Treat dry fertilizer impregnated with a pesticide as a pesticide. Store under cover or protected from rain.

Building a new storage facility

While a new facility just for fertilizer storage may be expensive, it may be safer than trying to adapt areas meant for other purposes. Keep these simple principles in mind:

1. Locate the dry storage building or liquid secondary containment downslope and at least 100 feet away from the well. Separation from the well should be greater in areas of sand or fractured bedrock. Worksheet #11, *Site Evaluation*, can assist you in ranking your farmstead soils and geologic conditions according to their ability to keep contaminants out of ground water.
2. In the event of a fire, contaminated surface water should drain to a confined area.
3. The mixing and loading area should be close to your storage facility, to minimize the distance that chemicals are carried.
4. The building foundation or secondary containment floor should be well drained and located above the water table. The finished grade should be 3 inches below the floor of the storage area and sloped away from the building to provide surface drainage. The subsoil should have a low permeability.
5. Provide pallets to keep bags off the floor. Store dry products separate from liquids to prevent wetting from spills.

For glossary, see page 2 of Worksheet #3.

6. If you plan to store large bulk tanks, provide a large-enough containment area to confine 125 percent of the contents of the largest bulk container, plus the displaced volume of any other storage tanks.
7. A locked storage cabinet or building provides security. Preventing unauthorized use of fertilizer reduces the chance of accidental spills or theft. Provide signs or labels indicating that the cabinet or building is a fertilizer storage area. Labels on the outside of the building give firefighters important information about fertilizers during an emergency response for a fire or spill.
8. Provide adequate road access for deliveries and emergency equipment.
9. For information on factors to consider in the design of a storage facility, such as ventilation, water access, temperature control and worker safety, contact your NRCS district office.

Modifying an existing storage facility

You may find the above principles to be expensive and difficult to apply to your current storage, but, compared to the cost of a major accident or even a lawsuit, storage improvements are a bargain. Items 5–8 above are also important points to remember for existing storage.

The cheapest alternative you may have is to cut back on the amounts stored. If that option is not practical, consider how you can protect the fertilizers you keep on hand.

Sound containers are your first defense against a spill or leak. Should a bag be accidentally ripped, fertilizers should be confined to the immediate area and promptly recovered.

> That means having a solid floor and, for liquid fertilizers, a curb. The secondary containment space should have enough volume to hold 125 percent of the contents of the largest container, plus the displaced volume of any other storage tanks in the area.

Ideally, your fertilizer storage area should be separate from other activities. If the building must also serve as a machine shed or as housing for livestock, you may find it difficult to meet all the requirements for safe storage.

Stored fertilizers can pose a danger to firefighters and to the environment. Reducing the fire risk in the storage area may be the first step, but other things can be done.

> You can reduce the damages by anticipating such emergencies. If a fire should occur, consider where the water will go and where it might collect. In making the storage area secure, also make it accessible, allowing you to get fertilizers out in a hurry.
>
> If fertilizer containers are damaged, the stored nutrients may be carried away by water and spread over a large area.
>
> Label windows and doors to alert firefighters to the presence of fertilizer stored in the structure.
>
> A curb around the floor can help confine contaminated water.

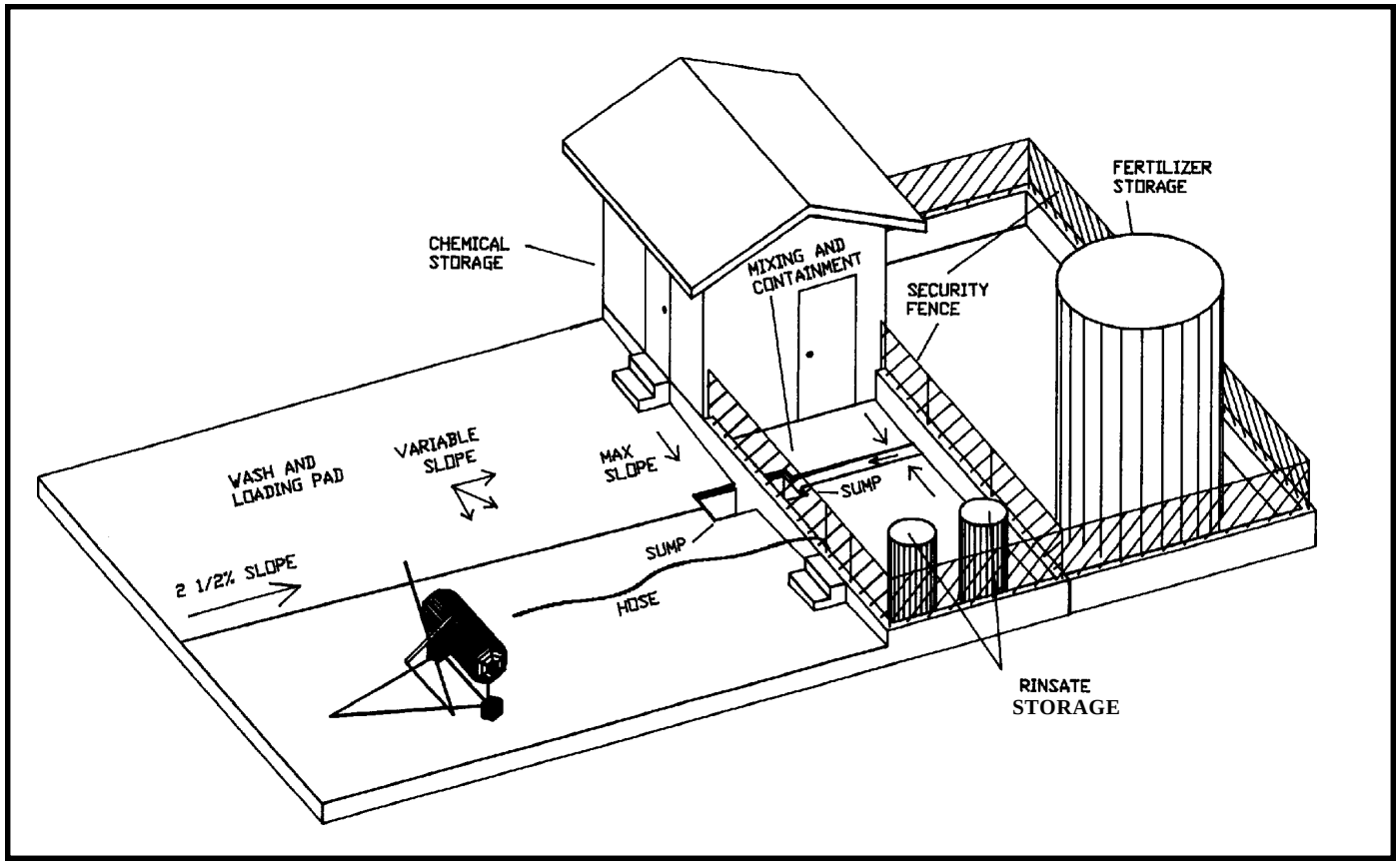

Figure 1: Farm-sized fertilizer facility. *Source: Modular Concrete Wash/Containment Pad for Agricultural Chemicals , by R.T. Noyes and D.W. Kammel. American Society of Agricultural Engineers Paper Number 891613.*

2. Mixing and loading practices

Groundwater contamination can result from small quantities spilled regularly in the same place. Spills of dry fertilizer should be promptly and completely cleaned up and placed immediately into the application equipment. Cleaning up spills of liquid fertilizers can be much more difficult.

A liquid fertilizer mixing and loading pad

Containing liquid fertilizer spills and leaks requires an impermeable surface (such as concrete) for mixing and loading. A concrete pad should be large enough to accommodate your equipment and to contain leaks from bulk tanks, wash water and spills from transferring fertilizers to the sprayer.

Locate the pad adjacent to the storage area. Make sure that water from the well moves away from the well. At sites where runoff could reach the well, construct a diversion to direct runoff to another area.

The size of the pad depends on the equipment you use. It should provide space around the parked equipment for washing and rinsing. The fertilizers and rinse water should have a confined area, such as a sump, for settling before transfer to rinsate storage tanks. Having several separate rinsate storage tanks allows you to keep rinse water from different fertilizer chemical mixes separate. That way, it can be used for mixing water on subsequent loads.

If you are considering constructing a mixing/loading pad, more detailed information is available your NRCS district office.

Better management of your existing mixing and loading site

Liquid fertilizer spills and leaks are bound to occur from time to time. Even if you don't have an impermeable mixing and loading pad, you can minimize contamination by following some basic guidelines:

- Avoid mixing and loading fertilizers near your well. One way to do this is to use a nurse tank to transport water to the mixing and loading site. Ideally, the mixing site should be moved from year to year within the field of application.
- Avoid mixing and loading on gravel driveways or other surfaces that allow spills to sink quickly through the soil. A clay surface is better than sand.
- Anti-backsiphon devices are required by New Jersey law on the well or hydrants. Never put the hose in the sprayer tank. Provide an air gap of 6 inches between the hose and the top of the sprayer tank.
- Always supervise sprayer filling.
- Consider using a closed handling system, in which the fertilizer is directly transferred from the storage container to the applicator equipment, such as by a hose. Humans and the environment are never inadvertently exposed to the chemical.
- Use rinsate for mixing subsequent loads.

Effective Spill Response: A Case Example

The Wisconsin Department of Natural Resources (DNR) recently responded to a spill of liquid fertilizer on a farm. The 4500-gallon spill occurred from a tank that had been filled a few days earlier. The bottom of the storage container was observed to be leaking and the remaining 28-0-0 was quickly transferred to a different tank. The liquid that leaked from the tank drained into the farmer's paved cattle yard. The farmer, through his fertilizer dealer, contacted DNR and obtained advice on containment methods. Dried manure already formed a berm along the lower edge of the paved lot, and straw and sawdust were used to absorb the liquid. The material was then landspread at normal application rates for the fertilizer.

Prompt discovery, location of the tank such that it drained to a paved and contained area, and immediate reporting and recovery of the spill allowed the farmer to protect his water supply and reuse the spilled fertilizer.

In other cases, extremely high nitrates have been detected in private wells near sites where small amounts of liquid or solid fertilizers have repeatedly been spilled and not cleaned up.

3. Spill cleanup

For dry spills, promptly sweep up and reuse the fertilizer as it was intended. Dry spills are usually very easy to clean up. Dry impregnated fertilizer is considered a pesticide and, if spilled, should be recovered and applied to the target crop as it was intended.

For liquid spills, recover as much of the spill as possible and reuse as it was intended. Some contaminated soil may be required to be removed and field applied if possible.

Report spills of any amount to streams or lakes. Report spills of more than 50 gallons on the soil or a mixing/loading pad. Smaller quantities of liquid or dry products should

be reported if they could cause damage because of the nature of the specific compound or spill location.

To report, call the 24-hour Emergency Hotline of New Jersey Department of Environmental Protection at (609) 292-7172.

Remove the spilled material and contaminated soil no matter what the quantity, and dispose according to NJDEP recommendations.

Have an emergency response plan for the site. Know where the runoff water will go, how to handle your particular fertilizers, and whom to call for help.

4. Container disposal practices

Bulk deliveries of anhydrous ammonia, liquid fertilizers and dry bulk fertilizers have reduced the need to dispose of containers. Many farmers do, however, use bagged fertilizers and burn the bags in the field. **Burning bags is illegal**. Bundle bags and dispose of them in an approved landfill.

Your drinking water is least likely to be contaminated by your disposal practices if you follow appropriate management procedures or dispose of wastes in any location that is off the farm site. However, proper offsite disposal practices are essential to avoid risking contamination that could affect the water supplies and health of others.

5. Other management factors

Reducing fertilizer waste makes financial as well as environmental sense, but it means more than just reducing spills. It also means not buying more than you need to apply and keeping records of what you do have on hand. Buying only what you need makes long-term storage unnecessary.

Keeping records may seem like a task unrelated to groundwater contamination, but knowing what you've used in the past and what you have on hand allows you to make better purchasing decisions. Keep records of past field application rates and their effectiveness.

CONTACTS AND REFERENCES

Who to call about...

General Contacts

See Introductory Sheet

Plans and recommendations for fertilizer mixing and loading pads

Your local NRCS district office (see Introductory Sheet).

Fertilizer spills

The 24-hour Emergency Hotline of New Jersey Department of Environmental Protection at (609) 292-7172.

Proper disposal of soil contaminated by a fertilizer spill

The NJ Department of Environmental Protection's Division of Solid Waste and Hazardous Waste, Advisement and Waste Classification Unit at (609) 292-8341.

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

The product label. Read your product labels carefully for specific information on fertilizer health effects.

Nitrate: its effect on families and livestock, Special Circular 308. The Pennsylvania State University. (1)

Nitrates and Groundwater. Freshwater Foundation. (2)

Fertilizer handling and management

Managing Agricultural Fertilizers. NJ Clean Water Information Series (3)

Chemicals in Your Community: A Guide to the Emergency Planning and Right To Know Act. 1988. U.S. Environmental Protection Agency.
Pages 26-27 contain information on implications of this law for farmers. (4)

Fertilizer storage

Fertilizer and Pesticide Containment Facilities Handbook. Midwest Plan Service, Ames, Iowa. MWPS-37. (5)

Publications available from...

1. Rutgers Cooperative Extension, 80 Nichol Ave.,Cook College, New Brunswick, NJ 08903, (732) 932-9634.

2. Freshwater Foundation at Spring Hill Center, 725 County Road 6, Wayzata, Minnesota, (612) 449-0092.

3. Your county offices of Rutgers Cooperative Extension (found in the blue pages of your phone book) or the Publications Distribution Center, Cook College-Rutgers University, New Brunswick, NJ 08903, (732) 932-9762.

4. U.S. Environmental Protection Agency (EPA), Office of Pesticide Programs (TS-766C), 401 M Street S.W., Washington, D.C. 20460.

5. The Midwest Plan Service Secretary, Agricultural Engineering Department, 460 Henry Mall, University of Wisconsin, Madison, Wisconsin 53706, (608) 262-3310.

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NJFAS–3F *Reducing the Risk of Groundwater Contamination by Improving Fertilizer Storage and Handling* 12/95

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#3 Worksheet: Assessing the Risk of Groundwater Contamination from Fertilizer Storage and Handling

Why should I be concerned?

Fertilizers play a vital role in agriculture. Over the years, they have increased farm production dramatically. Commercial fertilizer is, however, a major source of nitrate. Nitrate-nitrogen levels exceeding the public health standard of 10 milligrams per liter (mg/l; equivalent to parts per million for water measure) nitrate-nitrogen (as N) have been found in many drinking water wells. The other major components of commercial fertilizer, phosphorus and potassium, are not generally a groundwater contamination concern.

Nitrate levels in drinking water above federal and state drinking water standards of 10 mg/l nitrate-nitrogen (as N) can pose a risk to some infants. Infants under 6 months of age are particularly susceptible to health problems from high nitrate-nitrogen levels, including the condition known as methemoglobinemia (blue baby syndrome). Nitrate can also affect adults, but the evidence is much less certain.

Young livestock are also particularly susceptible to health problems from high nitrate-nitrogen levels. While livestock may be able to tolerate several times the 10 mg/l nitrate-nitrogen level, levels of 20-40 mg/l may prove harmful, especially in combination with high levels (1,000 ppm) of nitrate-nitrogen from feed sources.

Farmstead handling of fertilizers can affect groundwater by allowing materials containing nitrogen to seep through the ground after a leak or spill. Other potential farmstead sources of nitrate are septic systems, livestock yards, livestock waste storage facilities and silage storage.

Your drinking water is least likely to be contaminated if you follow appropriate management procedures or dispose of wastes **off the farm site.** However, proper offsite disposal practices are essential to avoid risking contamination that could affect the water supplies and health of others.

The goal of Farm•A•Syst is to help you protect your groundwater that supplies your drinking water.

How will this worksheet help me protect my drinking water?

- It will take you step by step through your fertilizer handling, storage and disposal practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your fertilizer handling, storage and disposal practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require some modification to better protect your drinking water.

How do I complete the worksheet?

Follow the direction at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

Information derived from Farm•A•Syst worksheets is intended only to provide general information and recommendations to farmers regarding their own farmstead practices. It is not the intent of this educational program to keep records of individual results.

Glossary

Fertilizer Storage and Handling

These terms may help you make more accurate assessments when completing Worksheet #3. They may also help clarify some of the terms used in Fact Sheet #3.

Air gap: An air space (open space) between the hose or faucet and water level, representing one way to prevent backflow of liquids into a well or water supply.

Anti-backflow (anti-backsiphoning) device: A check valve or other mechanical device to prevent the unwanted reverse flow of liquids back down a water supply pipe into a well.

Backflow: The unwanted reverse flow of liquids in a piping system.

Backflow prevention device: (See **anti-backflow device**.)

Backsiphonage: Backflow caused by formation of a vacuum in a water supply pipe.

Closed handling system: A system for transferring pesticides or fertilizers directly from storage container to applicator equipment (through a hose, for example), so that humans and the environment are never inadvertently exposed to the chemicals.

Cross-connection: A link or channel between pipes, wells, fixtures or tanks carrying contaminated water and those carrying potable (safe for drinking) water. Contaminated water, if at higher pressure, enters the potable water system.

Milligrams per liter (mg/l): The weight of a substance measured in milligrams contained in one liter. It is equivalent to 1 part per million in water measure.

Parts per million (ppm): A measurement of concentration of one unit of material dispersed in one million units of another.

Rinsate: Rinse water from pesticide or fertilizer tank cleaning.

Secondary containment: Impermeable floor and walls around a chemical storage area that minimize the amount of chemical seeping into the ground from a spill or leak.

Worksheet #3

Fertilizer Storage and Handling: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.)
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for fertilizer storage and handling practices.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
FERTILIZER STORAGE					
Dry formulation					
Amount stored	None stored at any time.	Less than 1 ton.	Between 1 and 20 tons.	More than 20 tons.	____
Type of storage	Covered on impermeable surface (such as concrete or asphalt). Spills are collected.	Covered on clay soil. Spills are collected.	Partial cover on loamy soils. Spills not collected.	No cover on sandy soils. Spills not collected.	____
Liquid formulation					
Amount stored	None stored at any time.	Less than 55 gallons.	Between 55 and 1500 gallons.	More than 1500 gallons.	____
Type of storage	Concrete or other impermeable secondary containment does not allow spill to contaminate soil.	Clay-lined secondary containment. Most of spill can be recovered.	Somewhat permeable soils (loam). No secondary containment. Most of spill cannot be recovered.	Permeable soil (sand). No secondary containment. Spills contaminate soil.	____
Containers	Original containers clearly labeled. No holes, tears or weak seams. Lids tight.	Original containers old. Labels partially missing or hard to read.	Containers old but patched. Metal containers showing signs of rusting.	Containers have holes or tears that allow fertilizers to leak. No labels.	____

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
FERTILIZER STORAGE (continued)					
Security	Fenced or locked area separate from all other activities, or locks on valves.	Fenced area separate from most other activities.	Open to activities that could damage containers or spill fertilizer.	Open access to theft, vandalism and children.	____
MIXING AND LOADING PRACTICES					
Location of well in relation to mixing/ loading area with no curbed and impermeable containment area	100 or more feet downslope from well.	50 to 100 feet downslope.	10 to 50 feet downslope or 100 to 500 feet upslope.	Within 10 feet downslope or 100 feet upslope.	____
ADDITIONAL MIXING AND LOADING PRACTICES FOR LIQUID FERTILIZER					
Mixing and loading pad (spill containment)	Concrete mixing/loading pad with curb keeps spills contained. Sump allows collection and transfer to storage.	Concrete pad with curb keeps spills contained. No sump.	Concrete pad with some cracks keeps some spills contained. No curb or sump.	No mixing/loading pad. Permeable soil (sand). Spills soak into ground.	____
Water source	Separate water tank.	Hydrant away from well.	Hydrant near well.	Directly obtained from well.	____
Backflow prevention on water supply	Anti-backflow device installed or 6-inch air gap maintained above sprayer tank.	Anti-backflow device installed. Hose in tank above waterline.	***No anti-backflow device.*** Hose in tank above waterline.	***No anti-backflow device.*** Hose in tank above waterline.	____
Filling supervision	Constant	_____	Frequent	Seldom or never	____

Boldface type: Although these practices are legal for fertilizers in New Jersey, they are illegal for pesticides. Therefore, if the same area is used for both pesticide and fertilizer handling, these conditions are illegal.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
ADDITIONAL MIXING AND LOADING PRACTICES FOR LIQUID FERTILIZER (continued)					
Handling system	Closed system for all liquid product transfers.	Closed system for most liquids. Some liquids hand poured. Sprayer fill port easy to reach.	All liquids hand poured. Sprayer fill port easy to reach.	All liquids hand poured. Sprayer fill port hard to reach.	____
CLEANUP AND DISPOSAL PRACTICES					
Sprayer cleaning and rinsate (rinse water) disposal	Sprayer washed out in field. Rinsate used in next load and applied to labeled crop.	Sprayer washed out on pad at farmstead. Rinsate used in next load and applied to labeled crop.	Sprayer washed out at farmstead. Rinsate sprayed less than 100 feet from well.	Sprayer washed out at farmstead. Rinsate dumped at farmstead or in nearby field.	____

TOTAL ☐

Use this total to calculate risk ranking on back page of worksheet.

What do I do with these rankings?

Step 1: Begin by determining your overall fertilizer management risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

_____ divided by _____ equals [ ]*
total of rankings; # of categories ranked; risk ranking

*Carry your answer out to one decimal place.

3.6–4=low risk, 2.6–3.5=low to moderate risk, 1.6–2.5=moderate to high risk, 1–1.5=high risk

This ranking gives you an idea of how your fertilizer management practices **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis.** Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed fertilizer management risk ranking on page 1 of Worksheet #12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock charac teristics), and Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:
- **Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- **Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- **Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- **High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly—projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #3, *Improving Fertilizer Storage and Handling*, and consider how you might modify your farmstead practices to better protect your drinking water.

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#4 Fact Sheet: Reducing the Risk of Groundwater Contamination by Improving Petroleum Product Storage

1. Storage tank location

Large numbers of underground storage tanks exist in New Jersey that federal and state regulations do not cover. Commonly, this group consists of residential heating oil tanks, non-residential tanks of less than 2000 gallons for storing heating oil, and farm or residential tanks of less than 1100 gallons storing motor fuel. State and federal regulations apply to the underground storage of heating oil for non-residential onsite consumptive use if the aggregate capacity is over 2000 gallons, motor fuel tanks over 1100 gallons for farm or residential use, and the underground storage of hazardous substances and hazardous waste, including waste oil. **This publication only addresses *unregulated* storage tanks.** Whether your tank is regulated or not, it is important to comply with recommended groundwater protection practices.

The most important aspect of your liquid petroleum storage tank location is how close it is to your drinking water well. It is recommended that petroleum storage tanks be located at least 100 feet from a drinking water well.

Even though diesel fuel and fuel oil are more dense than gasoline and move more slowly through the soil, they, too, will eventually reach groundwater.

Every site has unique geologic and hydrologic conditions that can affect groundwater movement. How quickly the petroleum product reaches groundwater will also depend upon local soils. The more permeable the soil (sands and gravels, for example), the faster the rate of downward movement to groundwater.You may choose to locate a new tank more than 100 feet away from your well, to provide reasonable assurance that subsurface flow or seepage of contaminated groundwater will not reach your well. If possible, the tank should also be located downslope from the well. Figure 1 illustrates petroleum product seepage into soils.

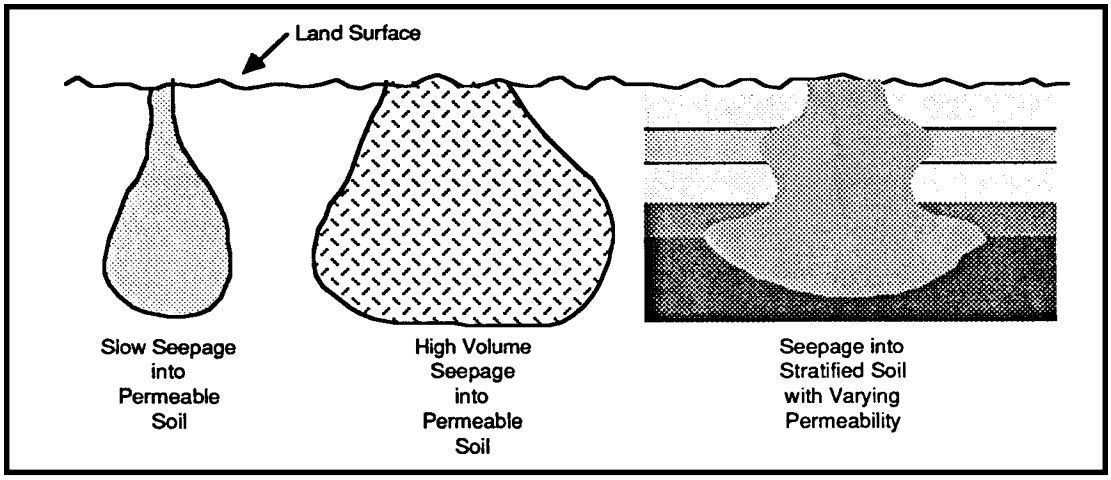

Figure 1: Petroleum product seepage into soils. *Source: Underground Tank Corrective Action Technologies, EPA/625/6-87-015, January 1987.*

For glossary, see page 2 of Worksheet #4.

If you have an above-ground tank, follow existing regulations for underground storage tanks as a guide. To protect against explosion and fire, do not locate tanks (especially above-ground tanks) closer than 25 feet to existing buildings. Previous regulations for siting above-ground storage tanks were concerned more with the explosion potential of tanks than the groundwater pollution potential. State agencies have revised above-ground storage tank regulations to better protect groundwater.

New storage tank location

Along with maintaining adequate distance from your drinking water well, choose a location for a new tank based on the following considerations:

- **Soil characteristics.** Highly corrosive clays, wet soils, cinders and acid (low pH) soils can significantly speed up the rate of corrosion of underground metal tanks and piping. Using industry recommended backfill, such as pea gravel or 1/2" to 1/4" crushed rock or clean washed sand during installation can decrease the negative effects of surrounding soils.

- **Soil stability.** Assess the ability of the underlying soil to support both underground and above-ground tanks. For special tank locations, such as hillsides, be sure to properly anchor and hold tanks in place. Be sure that pipes cannot twist or break if the tank is bumped or disturbed. Connect piping to tanks using "flexible connectors" to reduce chance of leakage.

  Regardless of soil conditions, locate above-ground tanks over an impermeable liner made of concrete or one of the newer synthetic fabrics (required on farms for tanks with capacities of greater than 1100 gallons). Build a collection device for spills.

- **Current and previous land use.** Sites that contain abandoned pipes and tanks, agricultural drainage tiles or waste materials pose special installation problems. Any metal already in the ground at your chosen site will increase corrosion rates for the new tank.

- **Traffic.** Assess traffic patterns around the tank. Determine whether the location of the tank or dispenser will block movement of farm vehicles during refueling or cause special problems if any work needs to be done on the tank. Protect piping from collisions with farm and fuel vehicles.

- **Depth to groundwater.** Floodways or areas where the water table is close to the surface are poor locations for storage tanks. Tanks placed in such areas require special installation. To reduce pollution potential, an above-ground tank may be preferable to an underground tank.

2. Tank design and installation

Whenever you install a fuel storage tank, carefully follow the manufacturer's recommended practices for installation. Proper installation is one sure way to minimize the leaking potential of the tank or the piping connected to it. Even scratches in a metal tank caused by careless installation can increase corrosion and tank deterioration.

Underground tanks

It is recommended that all new underground petroleum storage tanks and related piping must be constructed of non-metallic materials such as fiberglass reinforced plastic or steel wrapped with polyethylene, or have corrosion protection. Double-walled tanks and piping can provide added protection at a higher cost. Methods of corrosion protection include interior lining and "sacrificial anodes."

A sacrificial anode is a special material connected to the tank with a greater tendency to corrode than the tank material. The anode will typically protect the tank for up to 30 years although tanks may fail sooner depending on the soil conditions. Interior lining is made of noncorrosive synthetic materials. Interior lining is unaffected by small corrosion holes in the tank shell. Anytime metal piping is use with a metal tank, the piping should be electrically isolated from the tank using dielectric isolation bushings. Metal piping should also be corro sion protected.

Other recommended protective equipment includes spill and overfill protection and daily or continuous discharge monitoring systems. Spill protection typically consists of a catch basin for collecting spills when the tank is filled. Overfill protection is a warning or prevention of an overfill such as an automatic shutoff or buzzer. Spill and overfill protection are important; they can prevent a number of small releases over a long period of time from polluting the groundwater.

Above-ground tanks

Construction codes for above-ground tank installation seek to reduce the potential for both pollution and fire. Requirements include 1) enclosing the tank within a secure 6-foot fence or well-ventilated building constructed of noncombustible material; and 2) constructing a fire wall between the fuel dispensing area and the tank.

To decrease pollution potential, place farm tanks within a secondary containment structure consisting of a dike and a pad (required for tanks with capacity greater than 1100 gallons). All piping should be above ground within the dike or may go over the dike wall, but it must be placed below ground within 10 feet of the dike wall. Above-ground piping must be made of steel and coated to prohibit corrosion. Any below-ground piping may be either steel or fiberglass, but steel must be coated and cathodically protected. Above ground storage tanks are now manufactured which are secondarily contained - fulfilling the requirements for a contained area and a firewall.

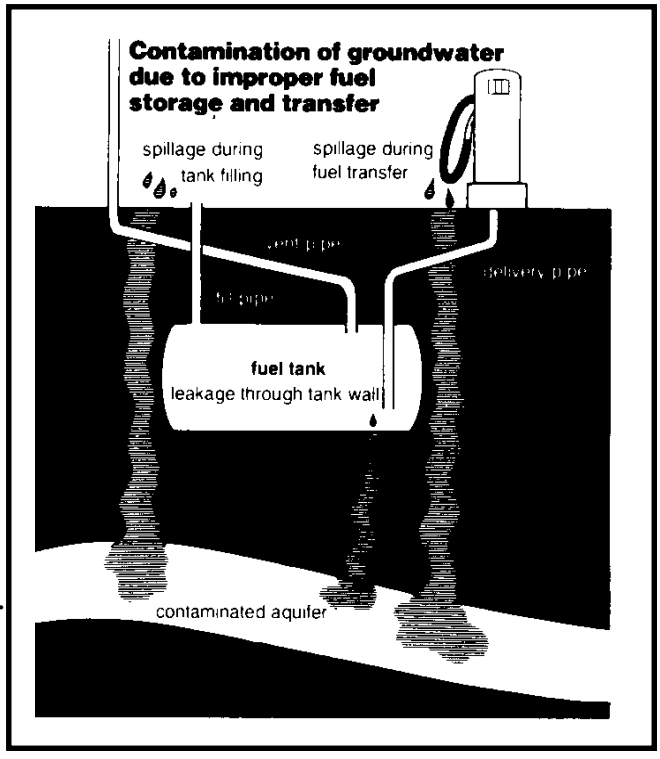

Figure 2: Contamination of groundwater due to improper fuel storage and transfer. *Source: Handling and Underground Storage of Fuels, Cooperative Extension Service, Michigan State University, Extension Publication WQ01. Reprinted February 1986.*

3. Monitoring

Leak detection is essential for the identification of a leak and the minimization of contamination of ground and surface waters. Rapid detection hastens cleanup operations and reduces owner liability and costs. Select the tank location carefully to ensure ease of installation and reliability of chosen leak-detection methods. Test the tank and piping periodically for leaks, and measure the tank inventory on a monthly (or more frequent) basis to help detect leaks before major problems develop. Some signs of a leaking tank system are obvious without any form of monitoring. These signs include: unusual amounts of water in the tank, unusual odors in water supplies, petroleum products in basements or drainage areas in homes, dead or stressed vegetation, and an unusual increase in fuel usage.

Since cleanup of gasoline leaks is always costly and often not totally effective, it is important to constantly monitor underground tank systems containing petroleum products. If you already have a petroleum storage tank on your farm, be especially aware of the age of your tank as well as the need to establish a leak-detection program. Figure 2 shows how groundwater can be contaminated by underground tanks.

> Since most tanks used on farmsteads are bare steel, tank corrosion or piping problems will cause leaks sooner or later. If your tank is more than 20 years old, or if you don't know its age, make a special effort immediately to determine whether leaks exist.

You can test tank integrity by such methods as precision testing/tightness testing and volumetric analysis. It is recommended that tightness tests be performed on new installations and on unregulated tank systems periodically, especially those in sensitive areas and for older tanks.

Even when a tank has been tested and proven tight, good practice requires that you have a method for regularly detecting leaks.

> You may install such internal or external monitoring methods as groundwater monitoring wells, vapor monitoring, automatic tank gauging or other methods.
>
> Measuring tank inventories is an inexpensive and easy way to help detect leaks. Leakage is apparent when there is any decrease in level over time without any withdrawal of fuel or an increase in water in the tank. While inventory measurement will not detect very small leaks, it will at least provide a warning that further investigation may be necessary.
>
> If you use a measuring stick to measure tank liquid level, be sure that the stick does not puncture or damage the bottom of the tank. New tanks should have a "striker plate" used for "sticking" to prevent damage.

The closer the tank is to the farmstead's drinking water well, the more important it is to quickly identify a leaking tank system.

Leaks and spills

If you find a leak or spill from any tank—whether it be above or below ground, or even a vehicle-mounted tank—state law requires that you immediately notify the 24-hour hotline of New Jersey Department of Environmental Protection (609-292-7172), your local fire department, and your local health department. By law, unreported discharges are liable for penalties. Take whatever actions are necessary to remedy the problem, according to recommendations you receive when you report the spill or leak.

4. Tank closure

Tanks no longer in use can cause problems for owners and operators many years later. They will continue to corrode and, if they still contain gas or oil, will likely contaminate groundwater.

> Try to determine the location of any unused tanks on your property. Also, try to find out whether the tanks still hold product or have holes. According to the National Fire Prevention Code and New Jersey Uniform Construction code, unregulated, nonoperational underground storage can be left in the ground if properly abandoned. Local construction code officials should be contacted prior to closure of a tank for information on local ordinances and permits. Proper abandonment of the tank includes draining the tank and piping of product, cleaning to remove residues and degassing. If left in place, the abandoned tank should be filled with an inert substance, such as sand, foam, or a cement slurry. However, it is recommended that tank owners choose tank removal rather than abandonment in place.

Before pulling a tank, always notify your local fire department at least one month before you have the tank pulled, to ensure that precautions are taken to prevent an explosion or other problem. Deaths have occurred due to improper closure.

If you are concerned that your unused tank has been leaking, consult the NJDEP - Bureau of Field Operations to determine if further investigation is warranted. If there is groundwater pollution in your area, your neighbors will be sure to suspect the tank as its cause.

CONTACTS AND REFERENCES

Who to call about...

EPA regulations

EPA Hotline, 1-800-424-9846

Petroleum product storage, tank testing methods and suppliers

NJDEP - Bureau of Field Operations, CN 028, 401 E. State Street, Trenton, NJ 08625, (609) 633-0708.

Petroleum product spills

NJDEP 24-hour Environmental Action Hotline, (609) 292-7172.

The following list of NJDEP regional offices can provide information and advise on the managment of underground storage tanks. NJDEP regional offices:

Northern district (Hunterdon, Morris, Passaic, Somerset, Sussex, and Warren counties): 1259 Rt. 46, Bldg 2, Parsippany, NJ 07054, (201) 299-7570.

Metro district (Bergen, Essex, Hudson, and Union counties): 2 Babcock Place, West Orange, NJ 07052, (201) 669-3960

Central district (Burlington, Mercer, Middlesex, Monmouth, and Ocean counties): 300 Horizon Center, Route 130 South, Robbinsville, NJ 08691, (609) 426-0700.

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.)

Tank design, installation and site selection

Underground Storage Tanks. Rutgers Cooperative Extension Fact Sheet 522. (1)

Petroleum product storage and handling

Handling and Underground Storage of Fuels. 1986. Cooperative Extension Service, Michigan State University. Extension Bulletin WQ01. (4)

Tank regulations, tank testing, tank closure, financial responsibilities

Groundwater Protection Practices for Unregulated Underground Storage Tanks. 1992. NJ Department of Environmental Protection. (3).

UST Inventory Control and Manual Tank Gauging. 1993. US Environmental Protection Agency. EPA/908-B-93-001. (2).

Publications available from...

1. Your county offices of Rutgers Cooperative Extension (found in the blue pages of your phone book) or the Publications Distribution Center, Cook College, Rutgers University, PO Box 231, New Brunswick, NJ 08903, (732) 932-9762.

2. Public Information Center, U.S. Environmental Protection Agency, 401 M Street S.W., Washington, D.C., 20460., (202) 260-2080.

3. New Jersey Department of Environmental Protection, Bureau of Water Supply Planning, CN 029, Trenton, NJ 08625, (609) 633-1179.

4. Michigan State University Cooperative Extension Service, MSU Bulletins, 10B Agricultural Hall, Michigan State University, East Lansing, MI, 48824-1039, (517) 355-0240.

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The New Jersey Farmstead Assessment System is a cooperative project of the USDA Natural Resources Conservation Service, Rutgers Cooperative Extension, and New Jersey Department of Environmental Protection.

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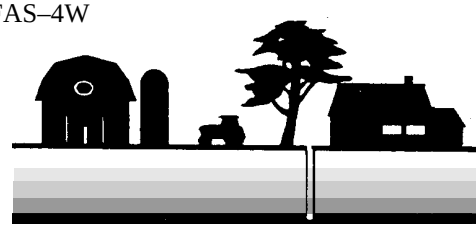

NEW JERSEY
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A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#4 Worksheet: Assessing the Risk of Groundwater Contamination from Petroleum Product Storage

Why should I be concerned?

Above-ground and underground storage of liquid petroleum products such as motor fuel and heating fuel presents a threat to public health and the environment. Nearly one out of every four underground storage tanks in the United States may now be leaking, according to the U.S. Environmental Protection Agency. If an underground petroleum tank is more than 20 years old, especially if it's not protected against corrosion, the potential for leaking increases dramatically. Newer tanks and piping can leak, too, especially if they weren't installed properly.

Even a small gasoline leak of one drop per second can result in the release of about 400 gallons of gasoline into the groundwater in one year. Even a few quarts of gasoline in the groundwater may be enough to severely pollute a farmstead's drinking water. At low levels of contamination, fuel contaminants in water cannot be detected by smell or taste, yet the seemingly pure water may be contaminated to the point of affecting human health.

Preventing tank spills and leaks is especially important because of how rapidly gasoline, diesel and fuel oil can move through surface layers and into groundwater. Also, vapors from an underground leak that collect in basements, sumps or other underground structures have the potential to explode. Selling property with an old underground tank may also be difficult.

Petroleum fuels contain a number of potentially toxic compounds, including common solvents, such as benzene, toluene and xylene, and additives, such as ethylene dibromide (EDB), methyl tertiary butyl ether (MTBE) and organic lead compounds. EDB is a carcinogen (cancer-causer) in laboratory animals, and benzene is considered a human carcinogen.

This worksheet focuses on storage of gasoline, kerosene and liquid heating fuels. It does not apply to LP (liquid propane) gas, since leaks vaporize quickly and do not threaten groundwater.

The goal of Farm•A•Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my groundwater?

- It will take you step by step through your petroleum product storage practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your petroleum product storage practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

Follow the directions at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

Information derived from Farm•A•Syst worksheets is intended only to provide general information and recommendations to farmers regarding their own farmstead practices. It is not the intent of this educational program to keep records of individual results.

Glossary

Petroleum Product Storage

These terms may help you make more accurate assessments when completing Worksheet #4. They may also help clarify some of the terms used in Fact Sheet #4.

Cathodic protection: One of several techniques to prevent corrosion of a metal surface by reversing the electric current that causes corrosion. A tank system can be protected by sacrifical anodes or impressed current. (See **sacrificial anodes** and **impressed current**.)

Corrosion: Deterioration of a metallic material ("rust") due to a reaction with its environment. Damage to tanks by corrosion is caused when a metal underground tank and its underground surroundings act like a battery. Part of the tank can become negatively charged, and another part positively charged. Moisture in the soil provides the connecting link that finally turns these tank "batteries" on. Then, the negatively charged part of the underground tank system—where the current exits from the tank or its piping—begins to deteriorate. As electric current passes through this part, the hard metal begins to turn into soft ore, holes form, and leaks begin.

Corrosion protection: One method of corrosion protection is cathodic protection. Steel tanks can be protected by coating them with a corrosion-resistant coating combined with "cathodic" protection. Steel underground tanks can also be protected from corrosion if they are bonded to a thick layer of noncorrosive material, such as fiberglass-reinforced plastic. Also, the corrosion problem can be entirely avoided by using tanks and piping made completely of noncorrosive material, such as fiberglass.

Galvanized: The result of coating an iron or steel structure with zinc. Galvanized materials do not meet corrosion protection requirements.

Impressed current: This protection system introduces an electric current into the ground through a series of anodes that are not attached to the underground tank. Because the electric current flowing from these anodes to the tank system is greater than the corrosive current attempting to flow from it, the underground tank is protected from corrosion.

Interior lining: A lining for petroleum storage tanks made of noncorrosive synthetic materials that can be effective in protecting metal tanks.

Inventory control: Measuring and comparing the volume of tank contents regularly with product delivery and withdrawal records to help detect leaks before major problems develop.

Sacrificial anodes: Pieces of metal attached directly to an underground tank that are more electrically active than the steel tank. Because the anodes are more active, electric current runs from the anodes rather than from the tank. The tank becomes the cathode (positive electrode) and is protected from corrosion. The attached anode (negative electrode) is "sacrificed" or consumed in the corrosion process.

Secondary containment: A system such as a sealed basin and dike that will catch and hold the contents of a tank if it leaks or ruptures.

Soil permeability: The quality that enables soil to transmit water or air. Low permeability soils have fine-textured materials like clays that permit only slow water movement. Moderate or high permeability soils have coarse-textured materials like sands that permit rapid water movement.

Spill and overfill protection: Spill protection usually consists of a catch basin for collecting spills when the tank is filled. Overfill protection is a warning or prevention of an overfill, such as an automatic shutoff or buzzer. These precautions can prevent a number of small releases over a very long period of time from polluting the groundwater.

Tank tightness testing: A procedure for testing a tank's ability to prevent accidental release of any stored substance into the environment, or intrusion of groundwater into an underground tank.

Worksheet #4

Petroleum Product Storage: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.)
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for petroleum product storage practices.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
LOCATION (all tanks)					
Position of tank in relation to drinking water well	Tank downslope more than 100 feet from well in medium- or fine-textured soils (silt loam, loam, clay loams, silty clay) with low permeability.*	Tank downslope more than 100 feet from well in coarse-textured soil (sands, sandy loam) with high permeability.*	Tank at grade or upslope more than 100 feet from well in medium- or fine-textured soils (silt loam, loam, clay loams, silty clay) with low permability.*	Tank at grade or upslope less than 100 feet from well in coarse-textured soil (sand, sandy loams) with high permeability.*	____
Tank location and local land use (leakage potential)	Well-drained soils. Water table always beneath tank. Above-ground tank more than 50 feet from buildings.	Moderately well-drained soils. Only occasionally high water table.	Located more than 50 feet from buildings. Medium- or fine-textured soils (silt loams, loam, clay loams, silty clay) saturated seasonally.	Located near buildings and in area with fine-textured soils (clay loams, silty clay) often saturated.	____
DESIGN AND INSTALLATION (all tanks)					
Type and age of tank/corrosion protection	Non-metallic tank, tank clad with non-corrosive material or tank protected from rust by cathodic protection.	Steel tank less than 20 years old, coated with paint or asphalt.	Coated steel tank 20 or more years old OR bare steel tank less than 20 years old.	Bare steel tank 20 or more years old.	____
Spill and tank overfill protection	Impermeable catch basin plus automatic shutoff.	Impermeable catch basin plus overfill alarm.	Impermeable catch basin or concrete catch pad.	No protection.	____

* Low permeability soils, like clay, allow water to flow through slowly. High permeability soils, like sand and gravel, allow much faster water movement.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
DESIGN AND INSTALLATION (all tanks) (cont.)					
Piping	Piping protected from rust by cathodic protection and electrically isolated from tank, sloped back to tank. Check valve at pump (not at tank).	Piping galvanized but not electrically isolated from tank. Pipe drains back to tank. Check valve at pump.	Pipe galvanized, not electrically isolated or bare. Piping sloped back to tank, but check valve is located at tank (foot valve).	Piping and tank not isolated and of dissimilar metallic materials or unisolated pipe bare, cannot drain freely to the tank or all pressure pipe systems.	_____
Tank installation	Installed by state-certified installer and installed according to recommendations provided with new tank by seller.	Installed according to recommendations provided with new tank by seller.	No information on installation.	Installed without backfill, setback, secondary containment, anchors and other protections, or by untrained individual.	_____
DESIGN AND INSTALLATION (above-ground tanks only)					
Tank enclosure	Tank surrounded by 6-foot tall noncombustible building or fence with lock. Building well-ventilated. Fire-wall in place if setbacks do not conform to code.	Tank surrounded by low fence with lock. Fire wall in place if setbacks do not conform to code.	Tank surrounded by low fence. No lock. No firewall.	No enclosure.	_____
Secondary containment	Tank placed within concrete or synthetic dike with pad able to hold 125% of tank capacity.	Tank placed within dike and pad made of low permeability soils*, able to hold 125% of tank capacity.	Tank placed on pad.	No secondary containment.	_____

* Low permeability soils, like clay, allow water to flow through slowly. High permeability soils, like sand and gravel, allow much faster water movement.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
MONITORING (all tanks)					
Tank integrity testing and leak detection monitoring	Regular (monthly) leak monitoring.	Daily inventory control and annual tank tightness testing.	Occasional inventory control and periodic tank tightness testing.	No inventory control, testing or monitoring.	____
TANK CLOSURE (underground tanks)					
Unused tank	Tank taken from ground. Excavation checked for evidence of contamination.	Tank filled with inert material and excavation checked for evidence of leaking.	Tank removed or filled with inert material. Excavation not checked for contamination.	Tank left in ground and not properly abandoned.	____

TOTAL ☐

Use this total to calculate risk ranking on back page of worksheet.

What do I do with these rankings?

Step 1: Begin by determining your overall petroleum product storage risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

_____ divided by _____ equals [ ]*
total of rankings; # of categories ranked; risk ranking

*Carry your answer out to one decimal place.

3.6–4=low risk, 2.6–3.5=low to moderate risk, 1.6–2.5=moderate to high risk, 1–1.5=high risk

This ranking gives you an idea of how your petroleum product storage **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis.** Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed petroleum product storage risk ranking on page 1 of Worksheet 12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock characteristics), and Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:

- **Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- **Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- **Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- **High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly—projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #4, *Improving Petroleum Product Storage,* and consider how you might modify your farmstead practices to better protect your drinking water.

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NEW JERSEY
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A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

5 Fact Sheet: Reducing the Risk of Groundwater Contamination by Improving Hazardous Waste Management

Two key steps to minimizing the pollution potential on your farm from farmstead, household and farm wastes are to minimize the amount of wastes and recycle when possible.

Some hazardous materials, such as lubricating oils or solvents for cleaning metal parts, are an unavoidable part of farm life. Take some time, though, to examine your activities that involve use of hazardous materials, to make sure that you really need all the products you are using. Keep in mind that hazardous waste generated from farm business activities must be managed in accordance with state and federal rules.

When you are certain that you are purchasing and using only essential products, carefully consider how to use the products safely, recycle or reuse them when possible, and dispose of remaining products in a way that will not pose a risk to your drinking water. A few simple management principles apply in every situation:

- Use hazardous products away from your well (150 feet or more), even when all your spills and drips will be contained.
- Return excess product, spills or drips to the original activity. For example, reuse filtered waste antifreeze as water in other radiators; contain oil or grease drips and use for future lubrication needs; dispose of pesticide container rinse water by spreading on fields at the proper application rate for the pesticide.
- Contain any unusable wastes, spills and drips for appropriate disposal.

1. Farm and household trash

This category of potentially hazardous substances includes:

- **Ash and sludge** from burned farm home and garage trash and waste oil
- **Plastic wraps and containers**
- **Personal care products**, such as spot removers; dry cleaning fluids; moth balls; and shoe and leather polishes
- **Hobby products,** such as pesticides used in pet care; artist paints and solvents; undiluted photography and swimming pool chemicals; strong acids
- **Home cleaning and repair products,** such as air fresheners and pest strips; furniture and wood polishes and waxes; lead-based paint; other paints; stains and finishes; paint and finish preparation products; wood-preserving products.
- **Farm business hazardous waste**, including unusable or waste cleaners, solvents, pesticides and other hazardous chemicals that are generated from cleaning, maintaining or general use of farm equipment or farming procedures.

For glossary, see page 2 of Worksheet #5.

Due to the rural location of farms, many farmers have traditionally disposed of their wastes on the farm site. Common disposal methods have included open air, barrel or domestic incineration of garbage and trash; or simply piling or burying trash in a ditch on the "back 40."

Health concerns, toxicity and the increased volume of waste guarantees that a new approach to disposal practices is necessary to ensure that safe drinking water supplies are available for farm families and their neighbors.

Updated local, state and federal laws also reflect the increased concern with many disposal practices. For example, new rules require that environmentally protective conditions be met before some disposal practices are permitted. Other previously common disposal practices are now illegal because of their potential risks to human health and the environment.

This new approach suggests several changes in traditional practices:

The typical farm burning site should be eliminated for all but a limited number of needs. Disposal of trash on the farm should be eliminated, with the exception of organic waste that can be composted (such as household garbage, leaves and straw).

Uncontaminated trash should be taken to a recycling facility, a licensed landfill or a municipal incinerator whenever possible.

Farm and household hazardous waste should be separated from general trash and saved for a hazardous waste collection program where available. If not available, approved alternative management recommendations should be followed. (See Contacts and References.)

Household hazardous waste is excluded from hazardous waste management regulations and is often included with regular trash disposal. But neither household hazardous waste nor hazardous waste from the farm business can be safely disposed of in a "pollution-free manner" on the farm site. Disposal of hazardous wastes, with the exception of properly disposed waste pesticides, from the farm business on the farm site is a violation of state law.

Household waste vs. farm business waste

New Jersey divides hazardous waste into two management categories: wastes produced from products used in the home, and wastes produced as part of the farm business.

Any amount of hazardous wastes generated by a household is exempt from regulation under state and federal law. Household hazardous wastes may be safely disposed of at household hazardous waste collection events sponsored by some communities.

For information about locations and dates of collection events, call your county household hazardous waste/solid waste coordinator.

Hazardous waste from the farm business must be disposed of with a permitted hazardous waste disposal contractor. For more information about hazardous waste contractors, contact New Jersey Department of Environmental Protection's (NJDEP) Bureau of Techinical Assistance at (609) 984-6620.

Burning

Researchers estimate that ground-level concentrations of 2,3,7,8–TCDD dioxin due to burning household trash in a burn barrel are 7000 times the amount formed during trash burning in a municipal incinerator. Ash and sludge resulting from on-farm burning also contain significant amounts of such toxic substances as lead, cadmium, chromium, dioxin and furan compounds.

New Jersey regulations prohibit open burning of household garbage, wet combustible rubbish, oily substances, asphalt, plastic or rubber products, as per N.J.A.C. 7:27-2.3.

2. Building and wood maintenance cleaners and chemicals

This category of potentially hazardous substances includes:

- **Solvent-based building and wood cleaners,** including wood polishes and products for wood floor and panel cleaning. (Detergent-based cleaners do not pose a threat to groundwater.)
- **Equipment maintenance products**, such as stripping and finishing products, stains and paints, products for brush or spray gun cleaning, and adhesives such as glues and caulk. Also includes solvents as used in degreasers and paint thinners; stains and varnishes; and wood-preservative compounds.

Disposing of these products by dumping them on the ground or in a septic system could allow hazardous constituents to leach to groundwater. Avoid on-farm disposal of these liquids whenever possible.

(For information about proper septic system management, see Worksheet and Fact Sheet #6, *Household Wastewater Treatment.*)

The best disposal method for these products is to use up leftovers or share unused products with others. Dispose of any remaining hazardous liquid or sludge with a hazardous waste contractor or on a household hazardous waste collection day.

Some products, such as paint thinners, can be filtered and reused. Other products, such as wood preservatives and lead-based paints, need to be labeled and saved for disposal by a hazardous waste contractor or on a household hazardous waste collection day.

Because of the volume of these products used on the farm, even spills and drips can add up to a problem for groundwater. Avoid maintenance activities within 150 feet of your well. Generally, conduct maintenance activities in a location where spills and drips can be contained.

3. Leftover or unusable pesticides and container disposal

This category of potentially hazardous substances includes all types of pesticides and pesticide containers, including those used for indoor plants and yard care.

Handle all categories of pesticides as directed on the label to prevent health and environmental problems. Pay particular attention to pesticides classified as "restricted use." Pesticide labels and regulations concerning their use often change over time. Remember that pesticides might not have current warning labels, and some may even have been banned since the time of purchase.

The only acceptable management practices for pesticides are to use the pesticide according to current label directions or arrange for disposal with a hazardous waste contractor. When the EPA bans a pesticide it provides a "buy-back" and disposal

program for a period of time. Pesticides purchased in mini-bulk tanks or returnable containers allow the return of excess chemical to the cooperative or retail store. For leftover pesticides that cannot be disposed of in any of these ways, store them safely until they can be disposed of through a community hazardous waste collection program or a hazardous waste contractor. However, waste pesticides generated by farmers from their own use and disposed of on-site in a manner consistent with label instructions are exempt from the hazardous waste regulations (N.J.A.C. 7:26-8.2(a)25 and 9.1(c)5).

Pesticide waste includes empty pesticide containers as well as leftover pesticides. Pesticides come in mini-bulk tanks, five-gallon plastic containers, or paper containers. Mini-bulk tanks are returned to the place of purchase when application has been completed. Some five-gallon plastic containers can be returned to the place of purchase for disposal. Paper containers should be bundled and taken to a licensed solid waste facility. Check with your local cooperative or retail store to learn whether container disposal opportunities have been arranged.

> If you cannot return plastic containers to the place of purchase, triple-rinse the containers, return the rinse water to the spray tank and apply following labeled instructions. Take the rinsed containers to a licensed landfill. However, because of liability concerns, some landfills will not accept even triple-rinsed containers. Triple-rinsed pesticide containers may still contain enough pesticide residue that they should not be used for any other purpose.

(For more detailed information about the management and storage of pesticides on the farm, see Worksheet and Fact Sheet #2, *Pesticide Storage and Handling.*)

4. Vehicle maintenance chemicals

This category of potentially hazardous substances includes:

- Vehicle maintenance products, such as antifreeze, oil and grease
- Solvents for oil and grease removal and disposal
- Engine, parts and equipment cleaners
- Lubricants
- Rust removers
- Paints and paint preparation products
- Brush or spray gun cleaners
- Lead acid battery replacement

It is strongly recommended, when possible, that waste material be recycled. Waste oil, batteries, refrigerants, and antifreeze are the commonly recycled substances associated with motor vehicle maintenance.

Solvents used for cleaning metal parts, oils and fuels include toxic ingredients. Fortunately, good recycling opportunities exist for both solvents and waste oil. Consider contracting with a solvent recycler to rent a parts washer. Old solvents are picked up by the recycler and you are provided with clean solvent. To recycle waste oil from farm equipment, contract with a waste oil transporter.

Do not dump antifreeze into your own drain if you have a septic tank. It may kill the organisms that the system depends on to break down wastes in the tank. Collect used antifreeze in a clean, labelled container to minimize the possibility of cross-contamination. Bring used antifreeze to a household hazardous waste collection day in your community.

If you find yourself doing a lot of painting of vehicles or other farm equipment, use a paint booth. Some booths are structured to collect excess paint and spray gun cleaners

for later disposal with a solvent recycler. Note that filters used with a paint booth may be considered a hazardous waste when discarded.

The design and location of the equipment maintenance area is important. Some farmers use a grease pit. Others allow drips and spills to collect on the shed floor. In both cases, the area is generally "cleaned" through periodic flushing.

If you prefer to keep your shed floor clean through flushing, you will need a system to contain waste liquids so that they will not be flushed onto soil. Flushing to a **paved** outdoor area is an acceptable method of disposal. Using sawdust to soak up drips and spills is another common practice. Burning of these substances can produce air emission deposits that have the potential to contaminate groundwater.

All fluids should be drained from abandoned farm machinery or vehicles to reduce the leaching hazard as the equipment corrodes.

5. Storage of chemicals and hazardous waste

Some farmstead activities may result in leftover or used chemicals, such as waste oil and solvents, that need to be stored until disposal. Locate the storage area for these chemicals and their wastes at least 150 feet from your well. Dike storage areas to prevent well contamination from spills.

Store chemicals in clearly labeled containers designed to contain that hazard category (flammables, poisons or corrosives). Provide a well-ventilated, flame-free area with sturdy shelving for storage of labeled containers in the building where you commonly use them. When choosing the storage location, keep indoor air quality, safety and flammability considerations in mind. Be sure that the area is adequately vented to prevent buildup of fumes from leftover products. As a rule of thumb, if you can smell your products, ventilation is inadequate to protect your health. Also, be sure that the storage area provides a means to segregate flammables, poisons and corrosive wastes, to minimize accidental release due to chemical interactions.

Hazardous wastes generated in the course of maintaining farm equipment, such as solvents and parts washer solution, should be collected and placed in closed containers and labeled with the words "hazardous waste," the name of the waste, and the date the waste was put into the container. Solvents that are hazardous for the characteristic of ignitability only (such as mineral spirits) may be mixed with used oil, as long as the solvent content is less than 10 percent of the total volume of the solvent-oil mixture.

Hazardous wastes generated from household vehicle maintenance should be stored safely until they can be taken to a household hazardous waste collection site. Evaporation of household hazardous wastes is not recommended due to the potential for spills, contact by children, and fire. If you're not sure whether a particular waste is hazardous, contact the NJDEP's Bureau of Technical Assistance (609-984-6620).

Outdoor storage of wastes and products, especially liquids, should be on surfaces surrounded by berms or curbs and constructed of materials that will contain any spills. For example, batteries may be stored in a plastic-lined area, but some solvents could dissolve a plastic liner. Spilled solvents may also be able to penetrate concrete or asphalt if they are not cleaned up quickly.

Store flammable chemicals and batteries in an area that will be shaded from direct sunlight. Rags used to clean up solvent spills may also be a fire hazard. Store them with the same care as hazardous materials.

Inspect all storage areas regularly for detection of spills or leaks, proper labeling, and to see that containers are in good condition, closed and not bulging. For more information on proper storage methods, contact the NJDEP's Bureau of Technical Assistance (609-984-6620).

6. Laws regulating disposal of wastes from farms

Disposal of hazardous wastes from farms is regulated under federal statutes in RCRA (Resource Conservation and Recovery Act) and in New Jersey under New Jersey Administrative Code Title 7, Chapter 26.

RCRA Subtitle D provides restrictions for land burial of trash not falling into hazardous waste categories. Open burning and on-farm incineration of trash is prohibited and regulated under the Air Quality Regulations (N.J.A.C 7:27 et seq). On-farm burial of containers and other trash is regulated under the Solid Waste Regulations (N.J.A.C 7:26).

Under state hazardous waste regulations , farms may be considered “small quantity generators.” An operation is a “small quantity generator" (SQG) if it generates less than 1 kilogram of **acutely hazardous waste** or less than 100 kilograms of **hazardous waste** per month and never accumulates more that those amounts on-site at any given time. SQGs are not required to obtain an EPA identification number or a manifest form for disposal. The SQG can dispose of waste through a licensed hazardous waste transporter to a commercial hazardous waste treatment, storage, or disposal facility. If the SQG transports their own waste, they must register with NJDEP as a soild waste transporter (call the Bureau of Registration and Permits at 609-530-4004 for details). Other disposal options include the recycling or reuse of the waste. Also, SQGs should contact their county Solid Waste Coordinator directly to determine if their county has any additional requirements and/or programs pertaining to SQG waste.

> “Acutely hazardous” and “hazardous” wastes are listed in federal and state regulations. Aldicarb and heptachlor, for example, are acutely hazardous pesticides.
>
> A word of caution: Because some pesticides commonly used by farmers are listed as acutely hazardous waste in federal statutes, farmers with leftover pesticides may not be “small quantity generators.” Farmers who accumulate more than 1 kilogram of acutely hazardous waste per month need to acquire an EPA identification number and use the manifest system to dispose of those wastes.

Disposal of veterinary medical wastes might present a problem on some farms. Ask your veterinarian for advice on specific wastes (such as antibiotic containers).

CONTACTS AND REFERENCES

Who to call about...

General Contacts

See Introductory Sheet.

Health concerns

Your local health department or the New Jersey Department of Health at (800) 367-6543.

A specific product

Contact the company that makes the product. The company's phone number is frequently on the label. Or, call the Chemical Referral Center, at 1(800) CMA-8200. Sponsored by the Chemical Manufacturers' Association, this number will refer you to a specific manufacturer for answers about product questions.

Identification and disposal of hazardous wastes

New Jersey Department of Environmental Protection Bureau of Technical Assistance, (609) 984-6620.

Hazardous waste transporters

To obtain a listing of hazardous waste transporters, contact the New Jersey Department of Environmental Protection, Transportation Oversight Unit, (609) 984-7907.

Chemicals and their disposal in your county

Your county Extension agent or your county office of recycling or solid waste (found in the "Blue pages" of your telephone book).

Pesticides and other agricultural chemicals

Your county Extension office or the NJDEP's Pesticide Control Program, 380 Scotch Rd., CN 411, Trenton, NJ, 08625, (609) 530-5070 (automated attendant) or (609) 530-4124.

Human poisoning

Your physician or the New Jersey Poison Information and Education System at (800)962-1253.

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.)

General information on hazardous waste

Hazardous Chemicals in Your Home: Proper use and disposal. Rutgers Cooperative Extension Fact Sheet #271. (1)

Toxics in the Home. NJ Department of Environmental Protection. (2)

Health and environmental effects of hazardous wastes

Household Cleaning Products: Making Informed Purchasing Decisions to Help Protect the Environment, Rutgers Cooperative Extension Fact Sheet #581. (1)

Household hazardous waste alternatives

Household Cleaners: Suggestions for Environmentally Safer Alternatives, Rutgers Cooperative Extension Fact Sheet #582. (1)

Hazardous pesticides, pesticide waste minimization and disposal

Toxicity of Pesticides, Rutgers Cooperative Extension Fact Sheet #197. (1)

Disposal of Pesticides, Rutgers Cooperative Extension Fact Sheet #198. (1)

Motor oil recycling

Recycling Used Motor Oil in New Jersey. Rutgers Cooperative Extension Fact Sheet #417. (1)

Motor Oil (Clean Water Information Series). NJ Department of Environmental Protection. (1)

Composting

Using Leaf Compost. Rutgers Cooperative Extension Fact Sheet #117. (1)

Publications available from...

1. Your county offices of Rutgers Cooperative Extension (found in the blue pages of your phone book) or directly the Publications Distribution Center, Cook College, Rutgers University, PO Box 231, New Brunswick, NJ 08903, (732) 932-9762.

2. NJ Department of Environmental Protection, Bureau of Hazardous Waste Regulation, 401 East State St., Trenton, NJ 08625, (609) 292-8341.

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RUTGERS

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NJFAS–5F *Reducing the Risk of Groundwater Contamination by Improving Hazardous Waste Management* 12/95

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NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#5 Worksheet: Assessing the Risk of Groundwater Contamination from
Hazardous Waste Management

Why should I be concerned?

Consider the variety of products commonly used in households and on farms: paints, solvents, oils, cleaners, wood preservatives, batteries, adhesives and pesticides. In addition, some common disposal practices not only threaten groundwater but also may be illegal.

Small, unusable amounts often wind up spilled, buried, dumped or flushed onto farm property. Minimizing the amounts of these substances used on the farm, along with practicing proper disposal practices, can reduce both health risks and the potential for groundwater contamination. Farmers and their families are generally familiar with the hazards of pesticides commonly used in the farm operation, but they may be less aware of the hazards of other chemicals that make many tasks around the home and farm easier or more efficient.

Improper use of hazardous products may cause toxic health effects. Improper storage may allow chemicals to leak, causing potentially dangerous chemical reactions, toxic health effects or groundwater contamination. Improper disposal allows these dangerous chemicals to enter directly into drinking water through surface water or groundwater.

Your drinking water is least likely to be contaminated by your hazardous wastes if you follow appropriate management procedures or dispose of wastes in any location that is **off your farm site**. However, proper offsite disposal practices are essential to avoid risking contamination that could affect the water supplies and health of others.

The goal of Farm•A•Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my drinking water?

- It will take you step by step through your hazardous waste management practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your hazardous waste management practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

Follow the directions at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

Information derived from Farm•A•Syst worksheets is intended only to provide general information and recommendations to farmers regarding their own farmstead practices. It is not the intent of this educational program to keep records of individual results.

Glossary

Hazardous Waste Management

These terms may help you make more accurate assessments when completing Worksheet #5. They may also help clarify some of the terms used in Fact Sheet #5.

Burn barrel: Any on-farm system of open burning, such as burning in a barrel. (See **incinerator**.)

Dump: A local landfill that is not designed to prevent leaching and offers little groundwater protection.

Hazardous waste contractor: A hazardous waste collection service offered by businesses with vehicles licensed to transport hazardous waste to licensed hazardous waste facilities.

Household hazardous waste: Any waste material (including garbage, trash and sanitary waste in septic tanks) derived from households, including single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas.

Household hazardous waste collection program: A special program in which a community collects waste for disposal in a specially constructed hazardous waste landfill or incinerator.

Incinerator (municipal): A community incinerator specifically engineered to burn municipal quantities of home waste.

Incinerator (on-farm): Any home-built incinerator or any incinerator purchased for home use.

Licensed landfill: A landfill specifically designed to protect groundwater through the use of a high quality clay or clay/impermeable film liner, accompanied by a system of buried pipes to collect any liquids generated. Meets current state standards.

On-farm disposal: Any method of burning, dumping or land spreading of wastes on the farm. Also includes use of the septic system for disposal.

Recycling: Reusing waste materials to develop another product.

Solvent recycler collection service: A pick-up service provided by businesses that reprocess used solvents.

Worksheet #5

Hazardous Waste Management: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.)
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for hazardous waste disposal practices.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
ASH DISPOSAL					
From farm burn-barrel or incinerator	Ash collected and disposed of at licensed hazardous waste facility.	***Disposal of ash from dry combustibles only, on farm or at dump, or spread on fields.***	***Disposal of ash from mixed trash at dump or on farm away from well.***	Disposal of ash from *mixed trash* ***on farm*** in consistent location near well.	_____
BUILDING/WOOD MAINTENANCE PRODUCTS					
Adhesives, such as caulk and solvent-based glues	Used up or shared with someone else. Hazardous waste contractor collection service used for leftover adhesives.	Liquid evaporated in open air.* Sludge or leftover product taken to licensed landfill or municipal incinerator.	***Disposal at dump.***	***Disposal on farm.***	_____
Brush or spray gun cleaners (solvent based)	Cleaned in contained, ventilated area. Solvent recycler collection service used for leftover cleaners.	Cleaned in contained, ventilated area. Filtered cleaning solvents reused or evaporated in open air.* Sludge taken to licensed landfill or municipal incinerator.	Cleaned in uncontained, ventilated area and ***used cleaning solvents disposed of at dump.***	***Disposal of left-over cleaning solvents on farm.***	_____
Lead-based paint	Hazardous waste contractor collection service used.	Liquid evaporated in open air.* Paint or sludge taken to licensed landfill or municipal incinerator.	***Disposal of sludge or paint at dump.***	***Disposal on farm.***	_____

Boldface type: These actions **are not legal** for wastes generated from the farm business. (Household wastes are exempt from regulation.) If you are unsure of how to dispose of specific wastes, contact NJDEP Bureau of Technical Assistance at (609) 984-6620.

*These actions require a permit from NJDEP. Contact the Air Quality Permitting Program at (609) 984-6721 for further information.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
BUILDING/WOOD MAINTENANCE PRODUCTS (continued)					
Paint or stain (no lead)	Used up or shared with someone else. Hazardous waste contractor used for leftover paint or stain.	Liquid evaporated in open air.* Paint or sludge taken to licensed landfill or municipal incinerator.	***Disposal of oil-based paints or stains at dump. Latex paint disposal on farm away from well.***	***Disposal of oil-based paints or stains on farm.***	_____
Stripper or thinner for paint/finish	Spills contained. Unused products used up. Hazardous waste contractor collection service used for leftover stripper or finish.	Liquid evaporated in open air.* Stripper or stripper sludge taken to licensed landfill or municipal incinerator.	***Disposal of sludge, stripper or thinner at dump.***	***Disposal on farm.***	_____
Surface cleaners (solvent based)	Used up or shared with someone else. Hazardous waste contractor collection service used for leftover cleaners.	Liquid cleaners evaporated in open air.* Cleaners or sludge taken to licensed land-fill or municipal incinerator.	***Disposal of sludge or cleaners at dump.***	***Disposal on farm.***	_____
CONTAINER DISPOSAL					
Paper/cardboard pesticide container	Returned to supplier or hazardous waste collection service used.	Empty container taken to licensed landfill, municipal incinerator or ***dump***.**	Disposal of triple-rinsed empty container on farm.	***Disposal of partially filled container on farm.***	_____
Plastic pesticide container	Triple-rinsed container returned to retail store for reuse, or taken to licensed landfill or municipal incinerator. Rinsate applied to appropriate crop.	***Unrinsed container disposed of at licensed landfill, municipal incinerator or dump.****	***Disposal of empty but unrinsed container on farm.*** Disposal of triple-rinsed container on farm.	***Disposal of partially filled container on farm.***	_____

Boldface type: These actions **are not legal** for wastes generated from the farm business. (Household wastes are exempt from regulation.) If you are unsure of how to dispose of specific wastes, contact NJDEP Bureau of Technical Assistance at (609) 984-6620.

* These actions require a permit from NJDEP. Contact the Air Quality Permitting Program at (609) 984-6721 for further information.
** Solid waste may only be disposed of at a permitted solid waste facility. Check with your county office of solid waste for specific regulations.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
CONTAINER DISPOSAL (continued)					
Plastic container for oil or other vehicle product	Product used up and container recycled.	***Any remaining ingredients evaporated in safe conditions.*** Empty container taken to licensed landfill or municipal incinerator.	***Disposal of empty container at dump or on farm.***	***Disposal of partially filled container on farm.***	_____
Hazardous household product containers	Taken to recycling facility or reused for similar product.	Empty container taken to licensed landfill, municipal incinerator or ***dump***.	***Disposal of empty container on farm.***	***Disposal of partially filled container on farm.***	_____
PESTICIDES					
Unwanted or banned pesticides	Participation in EPA banned pesticide buy-back program if available. Unused pesticides returned to place of purchase. Hazardous waste contractor collection service used.	Pesticides sold for restricted or general purposes used up or ***taken to licensed landfill or municipal incinerator.***	***Disposal of unused pesticides at dump.***	Disposal of unused pesticides on farm.	_____
VEHICLE/METAL EQUIPMENT MAINTENANCE PRODUCTS					
Used antifreeze	Saved and taken to antifreeze recycling facility, or filtered and reused as water in other radiators.	Collected and disposed of at municipal sewage treatment drain with permission of municipality. Taken to licensed landfill, municipal incinerator or ***dump***.	***Disposal on farm away from well (including in septic system).***	***Dumped near well.***	_____

Boldface type: These actions **are not legal** for wastes generated from the farm business. (Household wastes are exempt from regulation.) If you are unsure of how to dispose of specific wastes, contact NJDEP Bureau of Technical Assistance at (609) 984-6620.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
VEHICLE/METAL EQUIPMENT MAINTENANCE PRODUCTS (continued)					
Waste oil and grease	Collected by a hazardous waste contractor.	Reused for lubrication. ***Burned for heat in an residential incinerator***, or collected and disposed of at licensed hazardous waste facility.	***Disposal at dump.***	***Disposal on farm.***	_____
Waste oil sludge (left over after burning)	Hazardous waste contractor services used.	Collected and disposed of at licensed hazardous waste facility.	***Disposal at dump.***	***Disposal on farm.***	_____
Spent organic solvent/parts cleaner	Solvent recycler collection service used for leftover cleaners.	Filtered in ventilated area and reused or ***evaporated in open air.*** Sludge taken to licensed landfill or municipal incinerator.	***Disposal of solvents or sludge at dump.***	***Disposal of solvents or sludge on farm.***	_____
Rust-removal products	Used up or shared with someone else. Hazardous waste contractor services used.	***Taken to licensed landfill, municipal incinerator or dump. ****	***Disposal of leftover product on farm.***	***Disposal of used product on farm.***	_____
Lead acid battery	Taken to battery recycler or battery store.	***Used batteries taken to licensed landfill or municipal incinerator;*** or stored away from well.	***Used batteries taken to dump*** or stored near well.	***Disposal on farm near well.***	_____

Boldface type: These actions **are not legal** for wastes generated from the farm business. (Household wastes are exempt from regulation.) If you are unsure of how to dispose of specific wastes, contact NJDEP Bureau of Technical Assistance at (609) 984-6620.

* Illegal if the substance meets the definition of a hazardous waste.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
VEHICLE/METAL EQUIPMENT MAINTENANCE PRODUCTS (continued)					
Vehicle maintenance drips and spills	Contained on paved area with sawdust. Contaminated sawdust disposed of at licensed landfill or municipal incinerator.	Contained on paved area with sawdust. ***Contaminated sawdust disposed of at dump.***	***Occasional flushing onto farm property near well.***	***Frequent flushing onto farm property near well.***	_____
WOOD PRESERVING					
Application drips and spills	Drips and spills contained. ***Applicator and drop cloths disposed of at licensed landfill or municipal incinerator. ****	Drips and spills contained. ***Applicator and drop cloths disposed of at dump.***	Application without containment more than 150 feet from well. ***Applicator and drop cloths disposed of on farm.***	Application without containment within 150 feet of well.	_____
Disposal of unused preservatives	Used up or shared with someone else. Hazardous waste contractor collection service used for leftover preservatives.	***Disposal at licensed landfill or municipal incinerator.***	***Disposal at dump.***	***Disposal on farm.***	_____

Boldface type: These actions **are not legal** for wastes generated from the farm business. (Household wastes are exempt from regulation.) If you are unsure of how to dispose of specific wastes, contact NJDEP Bureau of Technical Assistance at (609) 984-6620.

* Illegal if the substance meets the definition of a hazardous waste.

TOTAL ☐

Use this total to calculate risk ranking on back page of worksheet.

What do I do with these rankings?

Step 1: Begin by determining your overall hazardous waste risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

_____ divided by _____ equals	*
total of rankings / # of categories ranked	risk ranking

*Carry your answer out to one decimal place.

3.6–4=low risk, 2.6–3.5=low to moderate risk, 1.6–2.5=moderate to high risk, 1–1.5=high risk

This ranking gives you an idea of how your hazardous waste practices **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis.** Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed hazardous waste risk ranking on page 1 of Worksheet #12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock characteristics), and Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:

- **Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- **Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- **Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- **High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly—projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #5, *Improving Hazardous Waste Management,* and consider how you might modify your farmstead practices to better protect your drinking water.

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The New Jersey Farmstead Assessment System is a cooperative project of the USDA Natural Resources Conservation Service, Rutgers Cooperative Extension, and New Jersey Department of Environmental Protection.

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Materials adapted for New Jersey use from the Wisconsin-Minnesota Farm-A-Syst Program by Susan Lance, Program Associate in Water Quality, Rutgers Cooperative Extension; Fred Kelly, Resource Conservationist, USDA Natural Resources Conservation Service; Theodore B. Shelton, Extension Specialist in Water Resources Management.

Technical review provided by Robin Heston, NJ Department of Environmental Protection, Bureau of Hazardous Waste Regulation.

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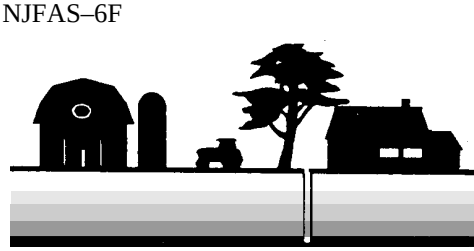

NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#6 Fact Sheet: 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, New Jersey Department of Environmental Protection's Standards for Individual Subsurface Sewage Disposal Systems (N.J.A.C. 7:9A-1 et. seq.) regulate private sewage systems.

At a minimum, follow the codes. But also consider whether the minimum requirement is sufficient for your site.

Septic tank/soil absorption system: The most common system

The most common form of onsite wastewater treatment is a septic tank/soil absorption system. In this system, wastewater flows from the household sewer into an underground septic tank.

- There the 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 liquify the solids.
- Baffles are placed in the tank to provide maximum retention of solids and scum, 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 series of parallel trenches (fingers), each containing a distribution pipe or tile embedded in drainfield gravel or rock.
- The effluent leaks out through holes in the pipe or seams between tile sections, then down through the drainfield gravel or rock and into the soil.
- The soil filters out remaining minute solids and pathogens (disease-producing microorganisms), and dissolved substances slowly percolate down to groundwater.

For glossary, see page 2 of Worksheet #6.

Figure 1 shows a typical household system for wastewater generation, collection, treatment and disposal. While systems for many farmsteads may be very similar (groundwater supply, septic tank, subsurface treatment and disposal), note the lists of options below each part of the diagram. You may wish to circle the parts found in your system. 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, involving 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—as well as 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 wastewaters and sludge through the treatment system.

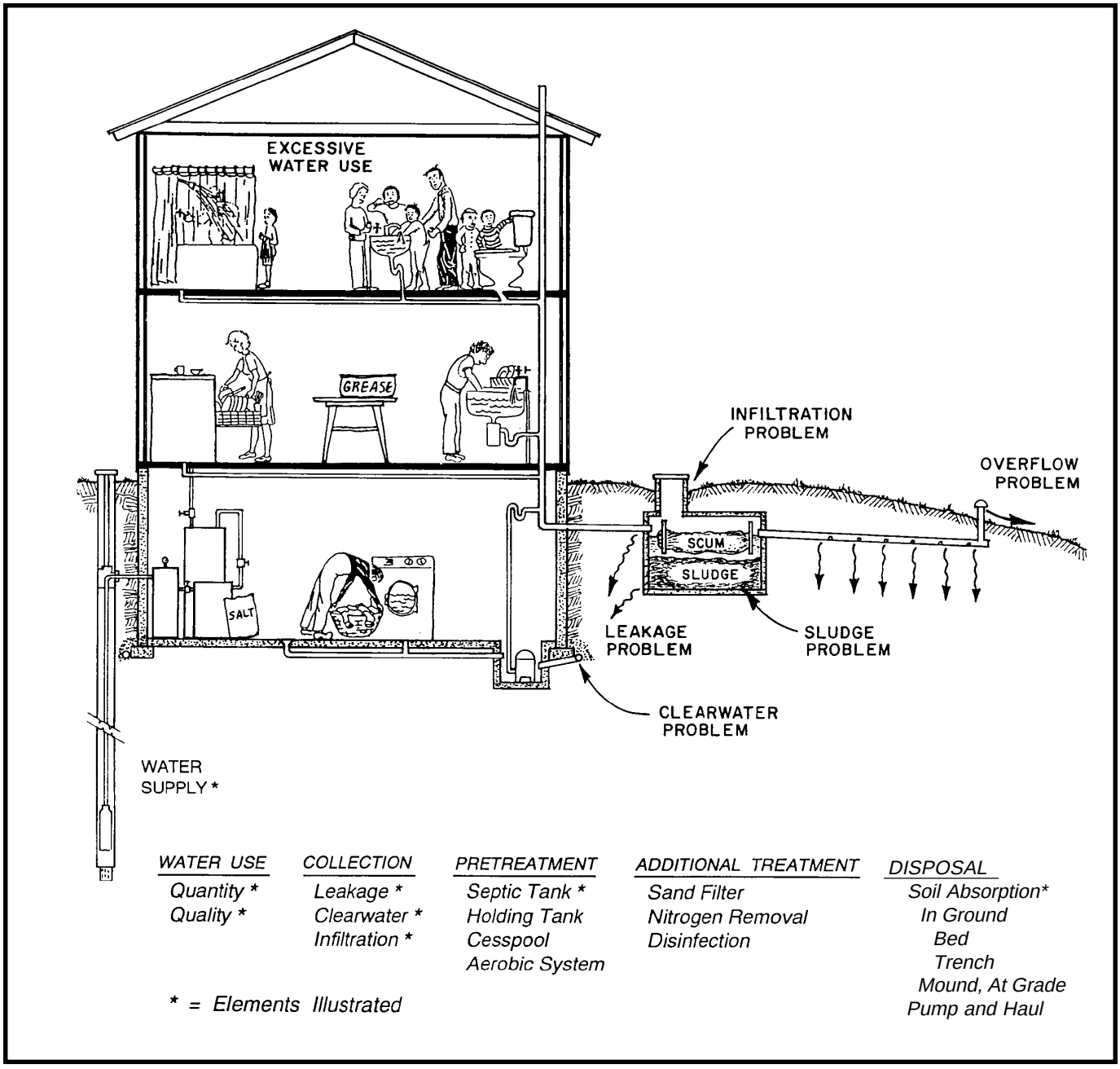

Figure 1: Typical household wastewater treatment system with problems. *Illustration by Andy Hopfensperger, University of Wisconsin-Madison Department of Agricultural Engineering.*

1. Quantity of wastewater

Strategy: Minimize the volume of household wastewater.

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. For holding tanks, less volume reduces costs by reducing the number of times the tank has to be emptied.

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. Average water use in a single family home is 75 gallons per person per day. With low-use 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 the treatment by increasing the time the waste spends in the system, thus providing more time for settling, aeration and more soil contact.

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.)

- Consider which actions use the most water. Toilet flushing usually ranks highest. Low-flow models could decrease water use by more than half. In the United States, 35-40 percent of the population has plumbing codes that require 1.5-gallon-or-less toilets on all new construction. 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, 0.5-2.0 gallons per minute (gpm) showerheads, faucets of 1.5 gpm or less, and front-loading washing machines of 20 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. Proper adjustment and timing of the softener's regeneration mechanism can reduce excessive water use.

- 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*	Gal. used
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

2. Quality of wastewater

Strategy: Minimize the amount and complexity of contaminants in the waste water.

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. These microorganisms are large enough to be removed by settling, or through filtration in beds or soil. Many will die from the adverse conditions or aging in the system.
- **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, food wastes (vegetable or fruit skins or pulp, pro duce) and garbage grindings have high oxygen demand. Aeration and digestion processes, in the presence of oxygen and organisms, produce stable, low-odor wastewater when given enough time. Wastewater with excess oxygen demand can cause problems for soil absorption fields, groundwater, streams and lakes by reducing levels of oxygen.

- **Organic solvents** from cleaning agents and fuels may not be degraded or removed through treatment and can pass along with the wastewater back into the water supply. In addition to these chemicals being illegal in septic systems, they can have significant impact upon septic tank performance by damaging its microbial flora.

- **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 overfertilizes surface water.

Consider the following ways to improve wastewater quality:

- Minimize 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 clog septic tanks (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. (This does not include using bleach to disinfect laundry or to wash clothing worn for pesticide applications.)

- Do not use chemicals 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.

3. Collection of wastewater

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

Leaking piping or treatment tanks ("leakage losses") can allow wastewater to return to the local water supply without adequate treatment. Infiltration of clear water overloads the system and dilutes the wastes. 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 house, well and wastewater treatment system.

4. 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 and compact the sludge. The partially treated water moves on to additional treatment or disposal (for example, 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 and filter screens or inclined-plate settling units 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. For a three-bedroom home, a 1,000-gallon-capacity septic tank is required. For a four-bedroom home, a 1,250-gallon tank is required. Pumping the tank before it is more than one-third filled with scum and sludge improves functioning of the system. 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, improving solids separation, releasing volatile chemicals and reducing sludge volume. These systems are, however, more expensive to operate and maintain and are more subject to problems caused by changes in wastewater quality or environmental conditions.

Holding tanks collect and hold the entire wastewater flow. Use of holding tanks in New Jersey is only approved as a temporary means of waste disposal, for a period not to exceed 180 days, when an existing system is being repaired. Permanent use of a holding tank must be permitted by NJDEP. Disposal is generally done by a licensed contractor who hauls the waste to a municipal waste treatment facility. When pumped, the tank should be checked for leaks.

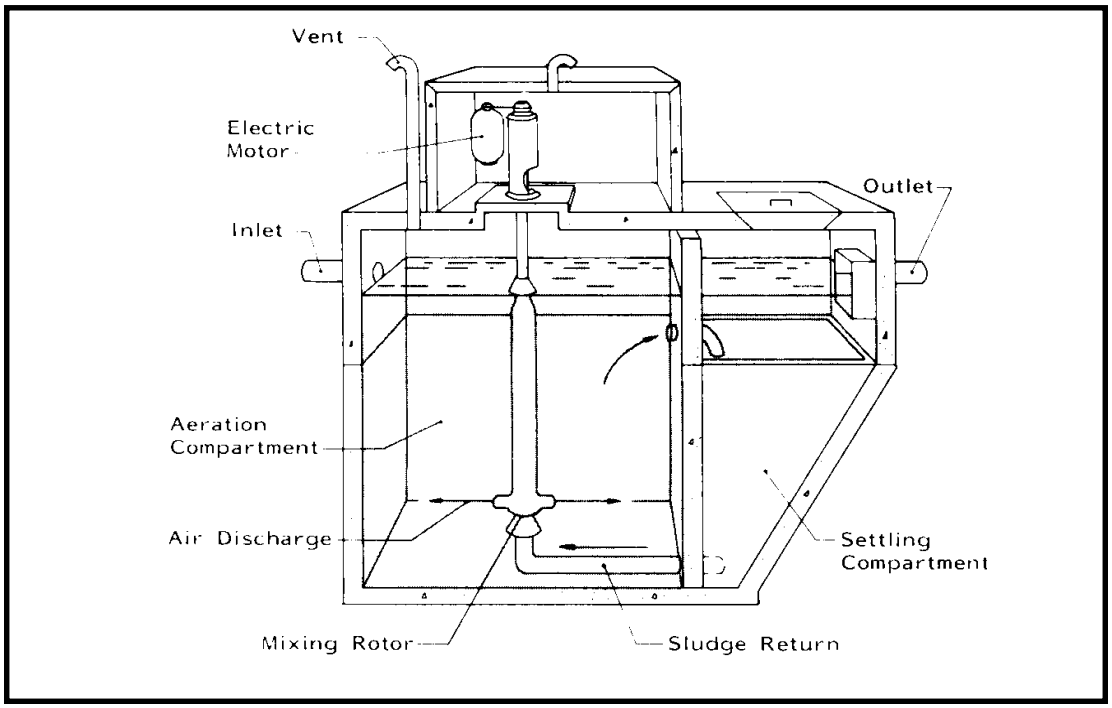

Figure 3: Aeration tank of a household aerobic treatment system. *Source: Onsite Domestic Sewage Disposal Handbook, MWPS-24, Midwest Plan Service, 1982.*

5. Additional treatment

Strategy: Reduce concentration and amount of contaminants in the wastewater to expand options for appropriate disposal.

Aerobic systems, described in the previous section, may be used for additional treatment of septic tank effluent, yielding a better quality effluent suitable for more disposal options.

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 recirculated 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.

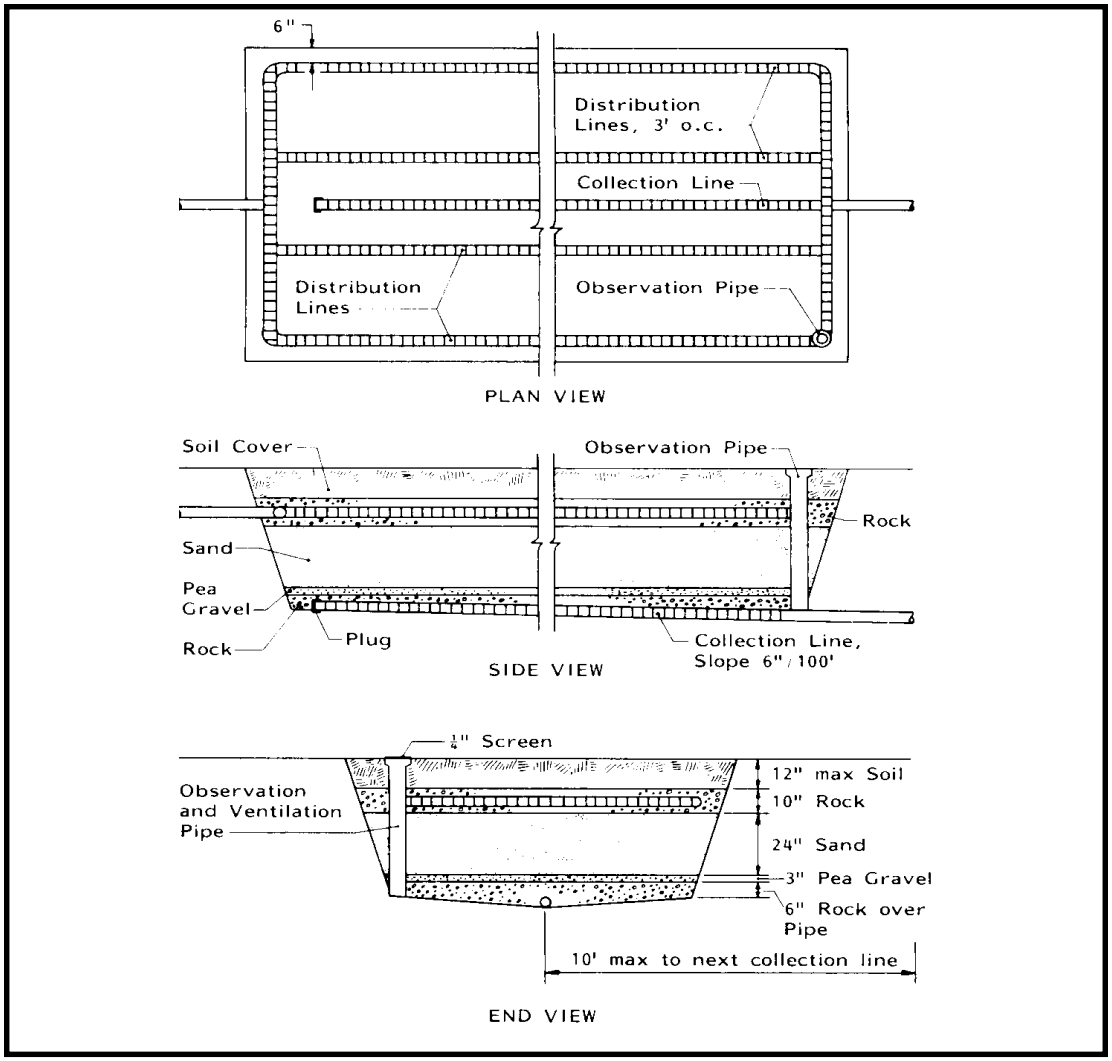

Figure 4: Buried sand filter. *Source: Onsite Domestic Sewage Handbook, MWPS-24, Midwest Plan Service, 1982.*

Pretreatment and quality of wastewater, hydraulic loading rate, depth and type of filter media, dosing frequency, temperature and distribution, and collection systems are all important considerations in designing filters. Maintenance includes resting, occasional raking, removal of clogged and crusted surface media, filter media replacement and attention to dosing equipment.

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. Denitrification and ion exchange processes are not used extensively at this time, as they are quite expensive to install, operate and maintain.

Disinfection systems kill disease-causing microorganisms in wastewater and are used where discharge to surface water is permitted. 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.

> Disinfection of holding tank waste prior to land spreading has been studied, but it is not in common use. Disinfection with lime is feasible.

Many of the listed treatment units may require permitting by NJDEP and you should contact your local health official for guidance.

6. 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 of wastewater, by hauling to a municipal treatment facility, can help protect the local farmstead water supply. Discharging treated wastes to surface water from private systems is not permitted in New Jersey. Improper waste management off the farm site can endanger the health of others in your community. Also, it may eventually contribute to poor water quality at your well.

Subsurface treatment and disposal using soil absorption (trenches, beds, mounds, at-grade and gravelless) is the common practice for household wastewater after pretreatment in a septic tank or aerobic system. There are, however, sites where soil absorption systems are not acceptable because of high or low soil permeability, depth to bedrock or the saturated zone, or other factors. Deep, well-drained, well-developed, medium-textured soils (such as silt loam and loam) are desirable soil absorption sites.

Soils and separation from the water supply are important factors. Unsaturated soils allow movement of air, helping keep the wastewater aerobic. A minimum of four feet of unsaturated soils is required by New Jersey law for removal of bacteria. Loams, sandy loams, and sandy clay loams are the optimum soil texture for wastewater treatment and disposal. Disposal sites that are more distant and downslope from the well increase the isolation of your water supply from the contaminated wastewater.

7. 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 your plumber or treatment system installer, who may have suggestions for extending the life of your system. Your local health official 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; they are illegal in New Jersey and can contaminate groundwater.

Do not place more soil over a surfacing soil absorption field; this does not fix the system, and it will soon surface again.

Do not just pipe the sewage to the road ditch, storm sewer, stream or farm drain tile; this is illegal in New Jersey, pollutes the water and creates a health hazard.

Do not run the sewage into a sink hole or drainage well; this is illegal in New Jersey and 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.

A properly designed, constructed and maintained septic system can effectively treat wastewater for many years. For more information on septic systems, contact your local health department.

If you need advice on alternative wastewater treatment systems, such as mounds, at-grades, gravelless systems, sand filters and aerobic units, or if you would like to explore experimental systems, contact the National Small Flows Clearinghouse, at 1 (800) 624-8301.

CONTACTS AND REFERENCES

Who to call about...

General Contacts

See Introductory Sheet

Household wastewater treatment and local regulations

Your county health department.

Statewide regulation of private sewage systems

New Jersey Department of Environmental Protection, Division of Water Quality at (609) 292-4543.

Septic haulers and pumpers

New Jersey Department of Environmental Protection, Division of Solid and Hazardous Waste at (609) 530-8591.

Small and alternative wastewater treatment technologies

National Small Flows Clearinghouse, West Virginia University, P.O. Box 6064, Morgantown, West Virginia 26506-6064, or call 1 (800) 624-8301.

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 and maintenance of onsite sewage systems

Septic System Care. 1994. Rutgers Cooperative Extension, 16 pages. E-167. (1)

A Homeowner's Manual for Septic Systems. 1995. New Jersey Department of Environmental Protection, 14 pages. (5)

Design Manual: Onsite Wastewater Treatment and Disposal Systems. 1980. U.S. Environmental Protection Agency. EPA Technology Transfer 625/1-80-012. (2)
391 pages. Contains information on site evaluation procedures, wastewater characteristics, onsite treatment and disposal methods, and management of onsite systems.

Groundwater Protection Practices for Septic Systems, 1992. New Jersey Department of Environmental Protection Bureau of Water Supply Planning. (3)
40 pages. Includes information on septic tanks, soil absorption systems, site selection, distribution systems and such other systems as aerobic treatment and holding tanks.

Water-saving toilets and showerheads

"How To Save Water," *Consumer Reports*, July 1990, pages 465-473. (4)

Publications available from...

1. Your county office of Rutgers Cooperative Extension (found in the blue pages of your telephone book) or directly from Publications-Distribution Center, Cook College, Rutgers University, PO Box 231, New Brunswick, NJ 08903, (732) 932-9762.

2. U.S. Environmental Protection Agency, 401 M Street S.W., Washington, D.C., 20460.

3. New Jersey Department of Environmental Protection Bureau of Water Supply Planning, CN 029, Trenton, NJ 08625, (609) 633-1179.

4. Consumer Reports, 256 Washington St., Mount Vernon, NY, 10553, (914) 667-9400 or your local library.

5. New Jersey Department of Environmental Protection, Division of Water Quality, CN 029, Trenton, NJ, 08625, (609) 292-4543.

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Technical review provided by John Roe, Supervising Geologist, Bureau of Operational Ground Water Permits, New Jersey Department of Environmental Protection and Theodore B. Shelton, Ph.D., Extension Specialist in Water Resources Management

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#6 Worksheet: Assessing the Risk of Groundwater Contamination from Household Wastewater Treatment

Why should I be concerned?

Virtually all farms use a septic system or similar onsite wastewater treatment system. While these systems are generally economical and safe, household wastewater can contain contaminants that degrade water quality for such uses as drinking, stock watering, food preparation and cleaning.

Potential contaminants in household wastewater include disease-causing bacteria, infectious viruses, household chemicals, and excess nutrients, such as nitrate. Viruses can infect the liver, causing hepatitis. They can also infect the lining of the intestine, causing gastroenteritis (vomiting and diarrhea). If coliform organisms (a group of indicator bacteria) are found in your well water, they show that the water is potentially dangerous for drinking and food preparation. Your septic system is one potential source, along with livestock yards and others.

The **quantity** of wastewater can also present an environmental concern. Too much water entering the home treatment system reduces the efficiency of the system and can shorten its life.

Your drinking water is least likely to be contaminated if you follow appropriate management procedures or dispose of wastewater in any location that is **off the farm site**. However, proper offsite disposal practices are essential to avoid risking contamination that could affect the water supplies and health of others.

The goal of Farm•A•Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my drinking water?

- It will take you step by step through your household wastewater treatment practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your household wastewater treatment practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

Follow the directions at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

Information derived from Farm•A•Syst worksheets is intended only to provide general information and recommendations to farmers regarding their own farmstead practices. It is not the intent of this educational program to keep records of individual results.

Glossary

Household Wastewater Treatment

These terms may help you make more accurate assessments when completing Worksheet #6. They may also help clarify some of the terms used in Fact Sheet #6.

Cesspool: Covered excavation in the ground that receives sewage directly from a building's sanitary drainage system. It is designed to retain the organic matter and solids and permit liquid to seep into soil cavities. New cesspools are prohibited in New Jersey. Existing cesspools which are not malfunctioning or not being expanded are legal.

Clear water infiltration: Entry of water into a system that does not need treatment, such as rainfall or tile drainage, through unsealed joints, access ports and cracks.

Design capacity: Maximum volume of liquid that can be treated in a particular wastewater treatment system. For systems that include subsurface wastewater disposal and distribution, capacity is also based on the soil's ability to accept and treat sewage effluent. In filling out the worksheet, if you don't know the design capacity of your system, use 150 gallons per bedroom per day as an estimate.

Effluent: Liquid discharged from a septic tank or other treatment tank.

Holding tank: An approved watertight receptacle designed for the collection and storage of sewage or septic tank effluent.

Hydraulic loading rate: The volume of waste discharged per unit area per unit time.

Off-site disposal: Disposal of wastewater or sludge off the farm, as at a municipal treatment plant or approved disposal site.

Scum: Floatable solids, such as grease and fat.

Seepage pit: Underground receptacle constructed to permit disposal of septic tank effluent, treated wastes or clear wastes by soil absorption through its bottom and walls.

Sludge: Settleable, partially decomposed solids resulting from biological, chemical or physical wastewater treatment.

Worksheet #6

Household Wastewater Treatment: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.) For categories separated by "OR," choose only one category.
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for household wastewater treatment practices.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
Quantity of wastewater	Conservative water use (less than 20 gallons per person per day). Good maintenance of water-conserving fixtures. Whole house use is less than design capacity.*	Moderate water use (20-60 gallons per person per day). Fair maintenance of fixtures. Some water conservation fixtures. Water softener recharges twice a week or less. Whole house use is near design capacity.*	High water use (60-120 gallons per person per day). Poor maintenance of fixtures. Water softener recharges more than twice a week. Whole house use occasionally exceeds design capacity.*	Excessive water use (greater than 120 gallons per person per day). Leaking fixtures. No water-conserving fixtures. Whole house use frequently exceeds design capacity.*	_____
Quality of wastewater					
Settleable solids	No use of garbage disposal unit in kitchen sink.	Minimal use of garbage disposal unit (1-2 times per week).	Moderate use of garbage disposal unit (3-5 times per week).	Daily use of garbage disposal unit.	_____
Dissolved solids	Minimal use of household chemicals (cups per week). No disposal of solvents and toxic cleaning agents. No water softener, or not recharged on site.	Careful use of household chemicals (pints per week). Minimal disposal of solvents and toxic cleaning agents. Water softener used, recharged on site.	Moderate use of household chemicals (quarts per week). Moderate disposal of solvents and toxic cleaning agents.	Extensive use of household chemicals (gallons per week). Extensive disposal of solvents and toxic cleaning agents.	_____
Floatable solids	No disposal of grease or oils into sewer. Domestic wastes only.	Minimal disposal of grease or oils. Oil and grease wiped from cooking utensils before washing.	Moderate disposal of grease or oils. No attempt to reduce disposal of grease and oil from household, but little generated.	Extensive disposal of grease or oils.	_____

* If design capacity of your treatment system is unknown, estimate at 150 gallons per bedroom per day.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
Collection of wastewater	All wastewater collected for treatment. No clear water collected. No leakage loss of water that should be treated. No settling of soil near tank or collection system. Collection system (pipe) more than 50 feet from well.	All wastewater collected for treatment. Some clear water collected. No leakage loss of water that should be treated.	Some wastewater diverted, or some leakage of water that should be treated, and clean water infiltration.	Clear water infiltration. Leakage loss of water that should be treated. ***Collection system (pipe) less than 25 feet from well.*****	_____
Pretreatment system:					
Cesspool	_____	_____	_____	***Any cesspool or direct discharge of water.***	_____
OR					**OR**
Septic tank	_____	Serial tanks or added solids retention system. No leakage. Pumped at least every 3 years and maintained. Baffles checked. Tanks checked; no leakage.	Single tank. Pumped at 4-6 year intervals.	Leakage losses. Seldom pumped out (greater than 7-year interval). ***Less than 50 feet from well.***** Less than 3 feet from saturation or bedrock.	_____
OR					**OR**
Packaged aerobic system	Maintenance program followed. Loaded at less than design capacity.*	No mechanical failures. Loaded near design capacity.*	Occasional failures.	Frequent system failure. Load exceeds design capacity.*	_____
OR					**OR**
Holding tank	Excess capacity for usual pumping interval. More than 50 feet down- slope from well. Tanks checked; no leakage.	Excess capacity for pumping interval. More than 50 feet up- slope from well. Tanks checked; no leakage.	Occasional overflow or leakage.	***Less than 50 feet from well.***** Leakage losses. Upslope from well.	_____

Boldface type: Besides representing a higher-risk choice, this practice also violates New Jersey law.

* If design capacity of your treatment system is unknown, estimate at 150 gallons per bedroom per day.

**Illegal for new well installation. Existing wells must meet separation requirements in effect at time of construction.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
Additional treatment (all systems)	Aeration, denitrification, filtration and disinfection.	Aeration and/or denitrification.	Filtration and/or disinfection.	No additional treatment.	_____
Disposal of wastewater					
Subsurface application (septic system or other treatment systems)	Offsite disposal.	Pressure or gravity-fed distribution to trench system.	Bed or seepage pit.	***Field or silo tile drainage system. Pipe to surface.***	_____
OR					**OR**
Surface application (holding tank wastes)	Offsite disposal.	Sufficient storage to accommodate best application time. Incorporated. Approved disposal site.	Frequent application. No incorporation. Approved disposal site.	Pit, agricultural field or ***surface drainage system; or outlet pipe or holes in holding tank.***	_____
Horizontal separation of wastewater disposal site from water supply (subsurface or surface)	Offsite disposal.	Subsurface disposal downslope more than 50 feet from well. Surface disposal more than 200 feet from well.	***Subsurface disposal downslope less than 50 feet from well. Surface disposal less than 200 feet from well.***	Upslope from well.	_____
Vertical separation of wastewater disposal site from water supply (subsurface)	Offsite disposal.	More than 6 feet to saturated soil or bedrock.	More than 3 feet to saturated soil or bedrock.	***Less than 3 feet to saturated soil or bedrock.***	_____
Subsurface application rate (septic system or other treatment systems)	Offsite disposal.	_____	Below design capacity.	At or above design capacity.	_____
OR					**OR**
Surface application rate (holding tank wastes)	Offsite disposal.	Less than 170 gallons per acre per week. Vegetation harvested. Nitrogen application doesn't exceed plant uptake and harvesting.	Less than 170 gallons per acre per week. Vegetation harvested. Nitrogen application exceeds plant uptake and harvesting.	***More than 170 gallons per acre per week.*** No vegetation harvesting.	_____

Boldface type: Besides representing a higher-risk choice, this practice also violates Wisconsin law.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
Disposal of wastewater (continued)					
Soils	Offsite disposal.	Medium- or fine-textured soils (silt loam, loam, clay loams, clays).	Medium- to coarse-textured soils (sandy loam, sands).	Very coarse sands or gravel.	____
If you have only a holding tank for wastewater disposal, skip to the bottom of the page and total your score.					
Disposal of pumpage from septic tanks and other treatment systems, except holding tanks.					
Surface application	Offsite disposal.	Sufficient storage to accommodate best application time. Incorporated. Approved disposal site.	Frequent spreading. No incorporation. Approved disposal site.	***Non-approved site.***	____
Horizontal separation from water supply	Offsite disposal.	Downslope more than 200 feet.	***Downslope less than 200 feet.***	Upslope from water supply.	____
Vertical separation from water supply	Offsite disposal.	____	More than 3 feet to saturated soil or bedrock.	***Less than 3 feet to saturated soil or bedrock.***	____
Soils	Offsite disposal.	Medium- or fine-textured soils (silt loam, loam, clay loams, clays).	Medium- to coarse-textured soils (sandy loam, sands).	Very coarse sands or gravel.	____
Surface application rate	Offsite disposal.	Less than 85 gallons per acre per week. Vegetation harvested. Nitrogen application does not exceed plant uptake and harvesting.	Less than 250 gallons per acre per week. No vegetation harvested. Nitrogen application exceeds plant uptake and harvesting.	***More than 250 gallons per acre per week.*** No vegetation harvested.	____

Boldface type: Besides representing a higher-risk choice, this practice also violates Wisconsin law.

TOTAL ☐

Use this total to calculate risk ranking on back page of worksheet.

What do I do with these rankings?

Step 1: Begin by determining your overall household wastewater risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

_____ divided by _____ equals [ ]*
total of rankings; # of categories ranked; risk ranking

*Carry your answer out to one decimal place.

3.6–4=low risk 2.6–3.5=low to moderate risk 1.6–2.5=moderate to high risk 1–1.5=high risk

This ranking gives you an idea of how your household wastewater practices **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis.** Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed household wastewater risk ranking on page 1 of Worksheet #12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock characteristics), and Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:

- **Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- **Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- **Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- **High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly—projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #6, *Improving Household Wastewater Treatment*, and consider how you might modify your farmstead practices to better protect your drinking water.

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The New Jersey Farmstead Assessment System is a cooperative project of Rutgers Cooperative Extension, the USDA Natual Resources Conservation Service, and New Jersey Department of Environmental Protection.

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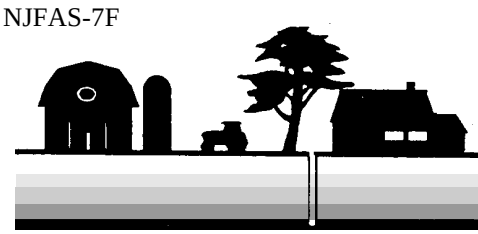

NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#7 Fact Sheet: Reducing the Risk of Groundwater Contamination by

Improving Livestock Waste Storage

Storage of livestock wastes involves simply accumulating wastes in some type of structure until the wastes 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) the proper land application of the manure once it leaves the storage jacility
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

Waste storage is an important management option available to livestock producers. Stored manure can be applied to the soil at those times of the year 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 the farmer of the 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 easily 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.) This information, combined with a knowledge of the amount of manure applied per acre, enables a farmer to determine whether additional commercial fertilizer is needed to meet realistic crop production goals.

Waste storage also reduces the need for land application during winter months when soil is frozen. This 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.

1. Long-term storage

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

For glossary, see page 2 of Worksheet #7.

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

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.

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. Groundwater contamination will result if the subsurface materials do not have sufficient ability to break down contaminants contained in the leachate. Evidence suggests that the design life for earthen pits is probably 10 years.

While seepage from inground waste storage facilities is not always easy to recognize, there are some tell-tale 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.)

What Can Happen if a Soil Liner is Damaged?

A damaged soil liner in a liquid manure pit resulted in groundwater contamination that ultimately polluted a nearby spring. When the pit liner was damaged, it exposed the fractured limestone bedrock and allowed liquid manure to move to the spring source. The contaminated spring water was dark in color and smelled like cattle manure. Investigators determined that both groundwater and surface water were contaminated.

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 filter strips help remove remaining pollutants in runoff water. These systems should not be considered on sites with coarse-textured soils, creviced bedrock or shallow water tables. Care must be taken to ensure that the system is not overloaded.

Both systems require maintenance. With grass filter strips, it is important to ensure that the highly concentrated wastes do not "burn" vegetation in the filter 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 filter 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. Roofed storage systems require adequate bedding to absorb and retain the liquid portion of the waste.

2. Short-term storage

Short-term storage (usually 30-90 days) is an important option available to farmers. It allows them to hold livestock wastes 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.

Short-term storage systems may be applicable for those farmers who often find themselves having to **stack manure in fields,** particularly during periods of bad weather. This is not a recommended practice. No matter how it is done, it poses a contamination threat to surface water and groundwater. 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.

3. Waste storage location

The location of livestock waste storage in relation to any well is an important factor in protecting the farm water supply. For temporary manure stacks and earthen storage facilities, the recommended minimum separation distance is 250 feet. For liquid-tight manure storage structures, the recommended minimum separation distance is 100 feet.

Minimum separation distances regulate new well installation or the distance from existing wells to new waste storage facility construction. Existing wells are required by law only to meet separation requirements in effect at the time of well construction. Make every effort, however, to exceed "old regulations,"and strive to meet current regulations whenever possible.

Observing these separation distances when siting a new facility is a good way to help protect your drinking water. Locating manure storage facilities downslope from of the well is also important for protection of your 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, *Drinking Water Well Condition*.)
While observing these well separation minimum distances may be helping to 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, as well as possible drinking water supplies for future generations.

Depth to seasonal high water table or fractured bedrock, along with soil type at the waste storage location, is another important factor. These are among the site vulnerability characteristics in Worksheet #11, *Site Evaulation.*

Depth to water table is sometimes available in the county soil survey, but this varies from county to county. Your county Extension agent or the Natural Resources Conservation Service may also be able to help you gather this information.

4. 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.

CONTACTS AND REFERENCES

Who to call about...

General Contacts

See introductory sheet.

Waste storage needs, designing appropriate structures

Your county office of Rutgers Cooperative Extension or your Soil Conservation District office.

Cost-sharing funds

Financial assistance for animal waste management practices, including waste storage, may be available as part of a priority watershed plan, through the Agricultural Conservation Program administered by the Consolidated Farm Services Administration; and other federal and state programs. Contact your Soil Conservation District 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

Nitrate, Groundwater and Livestock Health. University of Wisconsin-Extension. G3217. (1)

The Nitrate Problem in Dairy Cattle. Rutgers Cooperative Extension Fact Sheet 118. (3)

Handling, management and storage of livestock waste

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

Farm Animal Waste Management Systems. Rutgers Cooperative Extension Fact Sheet 255. (3)

Planning and design of livestock waste storage facilities

Livestock Waste Facilities Handbook. 1985. 112 pages. Midwest Plan Service. (2) 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.

Circular Concrete Manure Tanks. 1983. 4 pages. Midwest Plan Service. TR-9. (2)

Liquid Manure Tanks: Rectangular, Below Grade. Midwest Plan Service. MWPS-74303. (2)

Land application of livestock waste

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

Publications available from...

1. Agricultural Bulletin, Room 245, 30 N. Murray Street, Madison, Wisconsin, 53715, (608) 262-3346. There may be charges for publications, postage and sales tax.

2. The Midwest Plan Service Secretary, Agricultural Engineering Department, 460 Henry Mall, University of Wisconsin, Madison, Wisconsin 53706, (608) 262-3310.

3. Your county office of Rutgers Cooperative Extension (found in the blue pages of your phone book) or the Publications-Distribution Center, Cook College-Rutgers University, PO Box 231, New Brunswick, NJ 08903, (732) 932-9762.

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NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#7 Worksheet: Assessing the Risk of Groundwater Contamination from Livestock Waste Storage

Why should I be concerned?

Storing livestock waste allows farmers to spread manure when conditions are right for nutrient use by crops. Accumulating manure in a concentrated area, however, can be risky to the environment and to human and animal health.

Facilities for manure stored in liquid form on the farmstead sometimes leak or burst, releasing large volumes of pollutants. Manure in earthen pits can form a semi-impervious seal of organic matter that does limit leaching potential, but seasonal filling and emptying can cause the seal to break down. Short-term solid manure storage and abandoned storage areas can also be sources of groundwater contamination by nitrates. Manure can contribute nutrients and disease-causing organisms to both surface water and groundwater.

Nitrate levels in drinking water above federal and state drinking water standards of 10 milligrams per liter (mg/l; equivalent to parts per million for water measure) nitrate-nitrogen can pose health problems for infants under 6 months of age, including the condition known as methemoglobinemia (blue baby syndrome). Nitrate can also affect adults, but the evidence is much less certain.

Young livestock are also susceptible to health problems from high nitrate-nitrogen levels. Levels of 20-40 mg/l in the water supply may prove harmful, especially in combination with high levels (1,000 ppm) of nitrate-nitrogen from feed sources.

Fecal bacteria in livestock waste can contaminate groundwater, causing such infectious diseases as dysentery, typhoid and hepatitis. Organic materials that lend an undesirable taste and odor to drinking water are not known to be dangerous to health, but their presence does suggest that other contaminants are flowing into groundwater.

The goal of Farm•A•Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my drinking water?

- It will take you step by step through your livestock waste storage practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your livestock waste storage practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

Follow the directions at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

Glossary

Livestock Waste Storage

These terms may help you make more accurate assessments when completing Worksheet #7. They may also help clarify some of the terms used in Fact Sheet #7.

Concrete stave storage: A type of liquid-tight animal waste storage structure. Located on a concrete pad, it consists of concrete panels bound together with cable or bolts and sealed between panels.

Earthen basin or pit: Clay-lined manure storage facility constructed according to specific engineering standards. Not simply an excavation.

Engineering standards: Design and construction standards available at USDA Natural Resources Conservation Service (NRCS). These standards may come from NRCS technical guides, state regulations or land grant university engineering handbooks.

Filter strip: A gently sloping grass plot used to filter runoff from the livestock yard and some types of solid manure storage systems. Influent waste is distributed uniformly across the high end of the strip and allowed to flow down the slope. Nutrients and suspended material remaining in the runoff water are filtered through the grass, absorbed by the soil and ultimately taken up by plants. Filter strips must be designed and sized to match the characteristics of the livestock yard or storage system.

Glass-lined steel storage: A type of liquid-tight, above-ground animal waste storage structure. Located on a concrete pad, it consists of steel panels bolted together and coated inside and outside with glass to provide corrosion protection.

Poured concrete storage: A type of liquid-tight animal waste storage structure. Located on a concrete pad, it consists of poured concrete reinforced with steel.

Water table depth: Depth to the upper surface of groundwater. This depth is sometimes indicated in the county soil survey, but this varies from county to county. This information may be available from your well construction report or from hydrogeological reports and groundwater flow maps of your area. Your county Rutgers Cooperative Extension agent or NRCS specialist may also be able to help you gather this information.

There are two types of water table: (1) the water table typically noted in a well log as an indication of usable water supply; and (2) the seasonal high water table. The seasonal high water table is most important in regard to construction of livestock manure storage facilities, because it may present facility construction problems.

Worksheet #7

Livestock Waste Storage: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.) For categories separated by "OR," choose only one category.
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for livestock waste storage practices.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
LONG-TERM STORAGE (180 days or more)					
Steel, glass-lined (liquid-tight design, above ground)	Designed and installed according to accepted engineering standards and specifications. Properly maintained.	Designed and installed according to accepted engineering standards and specifications. Not maintained.	Leaking tank on medium-textured soils (silt loam, loam).	Leaking tank on coarse-textured soils (sands, sandy loam). Water table or fractured bedrock shallower than 20 feet.	_____
OR					**OR**
Concrete stave (liquid-tight design)	Designed and installed according to accepted engineering standards and specifications. Properly maintained.	Designed and installed according to accepted engineering standards and specifications. Not maintained.	Concrete cracked, medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Concrete cracked, coarse-textured soils (sands, sandy loam). Water table or fractured bedrock shallower than 20 feet.	_____
OR					**OR**
Poured concrete (liquid-tight design)	Designed and installed according to accepted standards and specifications. Properly maintained.	Designed and installed according to accepted engineering standards and specifications. Not maintained.	Concrete cracked, medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Concrete cracked, coarse-textured soils (sands, sandy loam). Water table or fractured bedrock shallower than 20 feet.	_____
OR					**OR**
Earthen waste storage pit (below ground)	_____	Designed and installed according to accepted engineering standards and specifications. Properly maintained.	Not designed to engineering standards. Constructed in medium- or fine-textured dense materials (silt loam, loam, clay loams, silty clay). Water table deeper than 20 feet. Earthen lining eroding.	Not designed to engineering standards. Constructed in coarse-textured materials (sands, sandy loam). Fractured bedrock or water table shallower than 20 feet. More than 10 years old. Earthen lining perforated.	_____

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
SHORT-TERM STORAGE (usually 30-90 days; in some cases, up to 180 days)					
Stacked in field (on soil base)	_____	_____	Stacked on high ground. Medium- or fine-textured soils (silt loam, loam, clay loams, silty clay). Water table is deeper than 20 feet.	Stacked on high ground. Coarse-textured soils (sands, sandy loam). Fractured bedrock or water table shallower than 20 feet.	_____
Stacked in yard	Covered concrete yard with curbs, gutters and settling basin.	Concrete yard with curbs and gutters. Grass filter strips installed and maintained.	Earthen yard with medium- or fine-textured soils (silt loam, loam, clay loams, silty clay). Water table deeper than 20 feet.	Earthen yard with coarse-textured soils (sands, sandy loam). Fractured bedrock or water table shallower than 20 feet.	_____
Water-tight structure designed to accepted engineering standards and specifications	Designed and installed according to engineering standards. All liquids retained.	Designed and installed according to engineering standards on medium- and fine-textured soils (silt loam, loam, clay loams, silty clay). Water table deeper than 20 feet.	Designed and installed according to engineering standards on coarse-textured soils (sands, sandy loam). Water table or fractured bedrock shallower than 20 feet.	Designed and installed according to engineering standards. Not properly maintained. Water treatment and diversion and terrace structures allowed to deteriorate.	_____
Stacked in open housing	Building has concrete floor, protected from surface water runoff. Adequate bedding provided.	Building has earthen or concrete floor on medium- or fine- textured soils (silt loam, loam, clay loams, silty clay), protected from surface water runoff. Water table deeper than 20 feet.	Building has earthen or concrete floor on medium- or fine-textured soils (silt loam, loam, clay loams, silty clay), subject to surface water runoff. Water table or fractured bedrock shallower than 20 feet.	Building has earthen floor on coarse-textured soils (sands, sandy loam), subject to surface water runoff. Water table or fractured bedrock shallower than 20 feet.	_____

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
LOCATION					
Location of livestock waste storage in relation to drinking water well	Manure stack or earthen waste storage pit more than 250 feet downslope from well. Manure storage structure (liquid tight) more than 100 feet downslope from well.	Manure stack or earthen waste storage pit more than 250 feet upslope from well. Manure storage structure (liquid tight) more than 100 feet upslope from well.	Manure stack or earthen waste storage pit less than 250 feet downslope from well. Manure storage structure (liquid tight) less than 100 feet downslope from well.	Manure stack or earthen waste storage pit less than 250 feet upslope from well. Manure storage structure (liquid tight) less than 100 feet upslope from well.	____

TOTAL ☐

Use this total to calculate risk ranking on back page of worksheet.

What do I do with these rankings?

Step 1: Begin by determining your overall livestock waste risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

_____ divided by _____ equals [ ]*
total of rankings — # of categories ranked — risk ranking

*Carry your answer out to one decimal place.

3.6–4=low risk, 2.6–3.5=low to moderate risk, 1.6–2.5=moderate to high risk, 1–1.5=high risk

This ranking gives you an idea of how your livestock waste practices **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis.** Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed livestock waste risk ranking on page 1 of Worksheet #12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock characteristics), and Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:

- **Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- **Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- **Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- **High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly—projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #7, *Improving Livestock Waste Storage*, and consider how you might modify your farmstead practices to better protect your drinking water.

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The New Jersey Farmstead Assessment System is a cooperative project of the USDA Natural Resources Conservation Service, Rutgers Cooperative Extension, and New Jersey Department of Environmental Protection.

New Jersey Farm•A•Syst team members: **Susan Lance Scibilia,** Program Associate in Water Quality, Rutgers Cooperative Extension and **Fred Kelly,** Resource Conservationist, USDA Natural Resources Conservation Service.

Written by Fred Madison, Wisconsin Geological and Natural History Survey and Department of Soil Science, University of Wisconsin-Madison.

Materials adapted for New Jersey use from the Wisconsin-Minnesota Farm-A-Syst Program by Susan Lance, Program Associate in Water Quality, Rutgers Cooperative Extension; Fred Kelly, Resource Conservationist, USDA Natural Resources Conservation Service; Theodore B. Shelton, Extension Specialist in Water Resources Management.

Technical review provided by Fred Kelly, Resource Conservationist, USDA Natural Resources Conservation Service.

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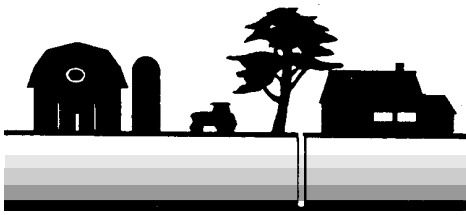


NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#8 Fact Sheet: Reducing the Risk of Groundwater Contamination by

Improving Livestock Yards Management

Besides addressing the potential of livestock yards to pollute groundwater, other good reasons for improving management practices include improved herd health, ease of maintenance and quality milk or meat production.

1. Distance from well

Wells should be located in an elevated area upslope of the livestock yard, so that runoff will not drain into the vicinity of the well. The recommended minimum separation between existing livestock yards and new wells is 50 feet. With good farmstead planning, livestock facilities would be 300-400 feet from the house. Since the well is often near the house, it is likely that there would be more than 200 feet between the well and the livestock yard.

Minimum separation distances regulate new well installations, as well as the distance from existing wells to new sources of contamination. Existing wells are required by law only to meet separation requirements in effect at the time of well construction. Make every effort, however, to exceed old requirements, and strive to meet current regulations whenever possible.

2. Site characteristics

If groundwater protection is a major consideration in siting a livestock yard, soil characteristics are the most important factor. Important soil characteristics include surface and subsoil texture, soil depth, permeability and drainage class. The best site has a deep, well-drained silt loam/clay loam soil with low permeability. A very poor site has shallow soil, or a high water table, or a very sandy/gravelly soil with excessive drainage and high permeability. (For more assistance in assessing your site's vulnerability to groundwater contamination, see Worksheet #11, *Site Evaluation.*)

For existing livestock yards on poor sites, the best options for protecting groundwater might be eliminating the yard and using total confinement for the livestock or providing paved yards and liquid-tight basins to store yard runoff.

3. Clean water diversion

One way of reducing water pollution from livestock yards is to reduce the amount of clean water entering the yard. In all cases, these structures need to be maintained.

* Waterways, small terraces and roof gutters direct water away from livestock yards.
* An earthen ridge or terrace can be constructed across the slope upgrade from a livestock yard to prevent runoff from entering the yard.
* In some areas, if a diversion terrace is not practical, a catch basin with a tile outlet could be installed above the livestock yard.

For glossary, see page 2 of Worksheet #8.

4. Runoff control systems

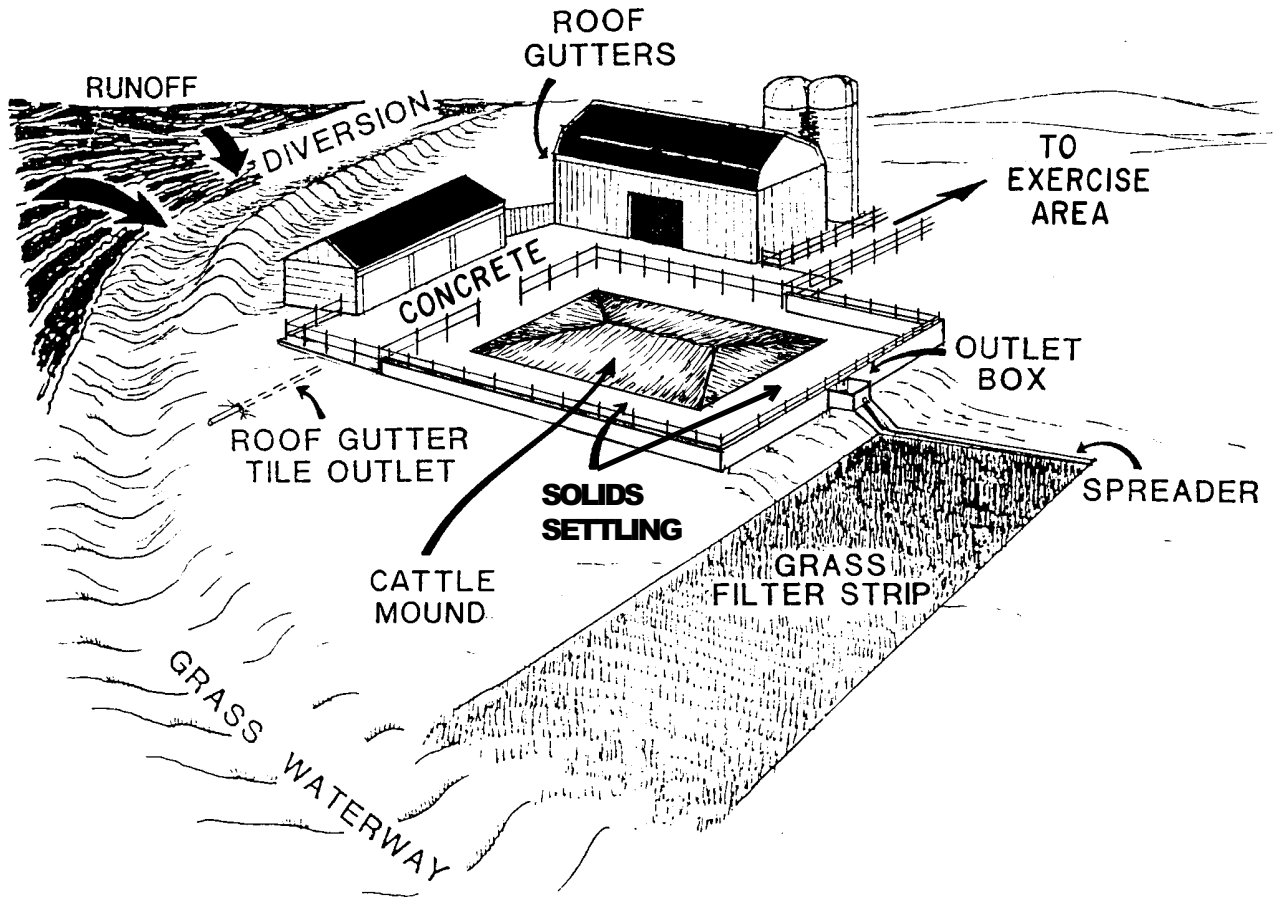
A livestock yard without a runoff control system typically has an earthen surface compacted by animal traffic. This surface is not shaped for water drainage, so it is sometimes dry and sometimes muddy. Manure typically accumulates on the surface, and decaying manure is mixed into the soil by animal traffic.

Water running off concrete pads located near barn doors and clean water from roofs and upslope areas can flush manure from the yard and create mudholes.

> Such a yard is difficult to manage, and the absence of runoff controls may lead to water quality problems. Contaminated runoff from an active feedlot that accumulates in areas adjacent to the lot may flow through the soil and threaten groundwater quality. This risk is particularly high on sites with high infiltration and percolation rates, such as sandy soils and other soils with good to moderate drainage.

Runoff control systems can remedy such problem situations. These systems collect livestock yard runoff, settle out manure solids, and direct the remaining water to open fields or filter strips, away from streams, ditches, waterways and areas of permeable soils and creviced bedrock. Another option is to collect and store runoff for later land application. Figure 1 shows a typical livestock yard runoff control system.

Figure 1: Typical Livestock Yard Runoff Management System



Adapted from Barnyard Runoff Management, Wisconsin Department of Natural Resources and Department of Agriculture, Trade and Consumer Protection, 1987. Adapted by Leonard Massie, with graphic assistance by Andy Hopfensperger, University of Wisconsin-Madison Department of Agricultural Engineering.

5. Yard cleaning or scraping

Clean livestock yards regularly. The amount of manure on a livestock yard depends on the number of animals and the hours per day animals spend on the lot. Cleaning and scraping at least once per week is preferable. Heavy concentrations of animals may require solids removal more often. Concrete surfaces are easier to clean than earthen lots. Earthen yards are cleaned when dry, so solids may be removed less frequently.

6. Concentration of animals and type of yard surface

The area needed per animal for minimizing the risk of groundwater contamination depends on the type of lot surface. The amount of concrete surface area needed is much less than that required for an earthen lot.

> The concrete area needed is a balance between traffic on the lot and resting area provided for animals. Too large an area results in manure freezing to the surface for long periods, while too small an area will result in animals having difficulty moving about.

For dairy operations, the best protection for groundwater is to confine animals to a free-stall barn or roofed yard. Where a yard is needed, 75 square feet of fenced concrete per cow is recommended (400 square feet of earthen surface) and roughly 2000 square feet of exercise area, if one is used. Direct runoff water carefully from the concrete onto the earthen area. Curbs will keep runoff from flowing off the edges of the concrete lot.

Yard management involves considerations other than surface and groundwater protection. A combination of yard surfaces can offer the most flexibility in adapting to weather conditions. Livestock location can be chosen based on the amount of mud in the yard: on concrete in sloppy conditions, on an earthen surface in dry weather, and on a mound in intermediate conditions.

The type of surface also affects management. Earthen yards, for example, might be cleaned only once or twice per year.

If bedrock is close to the surface where your livestock yard is located, pave the surface with concrete, or totally confine livestock.

7. Livestock storage and waste utilization

In addition to the condition of your livestock yards, your farm animal waste management should consider waste storage and utilization. (Worksheet and Fact Sheet #7, *Livestock Waste Storage*, provide guidelines for minimizing impact on groundwater.)

Ranging should be part of a crop rotation. Crop production on rangelands is designed to remove accumulated nutrients. High nutrient concentrations that are possible from poultry make this especially important.

Animal waste can be a valuable fertilizer and soil conditioner. When managed properly, the nutrients in manure can be substituted for commercial fertilizers, saving money and protecting groundwater and surface water. Matching nutrient applications to crop nutrient needs is critical.

8. Abandoned livestock yards

With active feedlots or yards, the layer of organic matter mixed with soil at the surface lies over compacted subsurface soil, forming a layer through which water moves very slowly. Therefore, leaching of nitrate and bacteria through the surface seal and compacted layers is not likely within the livestock yard. If livestock yard runoff is discharged to permeable soils or bedrock, leaching may occur. Studies have found little nitrate in the soil of active feedlots.

Nevertheless, abandoned yards can pose a particular groundwater contamination risk. As the manure pack breaks up from lack of use, water can leach through and reach the groundwater.

If you have a permanently abandoned yard, dig it up, spread the manure and soil combination on fields, and refill the former yard with other material. Another option is to till and plant the yard to a high-nitrogen-using crop, which will use the nitrogen released by soil and the manure decomposition process. Remove manure from a feedlot that will not be used for an extended period. Otherwise, cracks developing in the surface may allow leaching of nitrates.

CONTACTS AND REFERENCES

Who to call about...

Design assistance and technical standards for runoff control systems

Your Natural Resources Conservation Service office or Extension office.

Financial and technical assistance in remedying a risky situation

Your Natural Resources Conservation Service office or Extension office.

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.)

Nitrate contamination of groundwater

Bacterial Contamination of Drinking Water. Wisconsin Department of Natural Resources. PUBL-WS-003.86REV. (2)

Nitrate in Drinking Water. Wisconsin Department of Natural Resources. PUBL-WS- 001.86REV. (2)

Health effects of nitrate in groundwater

Nitrate, Groundwater and Livestock Health. University of Wisconsin-Extension. G3217. (1)

Nitrates and Groundwater: A Public Health Concern. 1988. Freshwater Foundation. (4)

Management of livestock yards

Barnyard Runoff Management. 1987. Wisconsin Department of Natural Resources and Department of Agriculture, Trade and Consumer Protection. (2)

Design criteria and general information

Beef Housing and Equipment Handbook. Midwest Plan Service. MWPS-6 (3)
Sheep Housing and Equipment Handbook. Midwest Plan Service. MWPS-3. (3)
Swine Housing and Equipment Handbook. Midwest Plan Service. MWPS-8. (3)
Dairy Housing and Equipment Handbook. Midwest Plan Service. MWPS-7. (3)
Livestock Waste Facilities Handbook. Midwest Plan Service. MWPS-18. (3)

Publications available from...

1. Agricultural Bulletin, Room 245, 30 N. Murray Street, Madison, Wisconsin 53715, (608) 262-3346. There may be charges for publications, postage and sales tax.

2. Wisconsin Department of Natural Resources, Bureau of Water Supply, P.O. Box 7921, Madison, Wisconsin 53707, (608) 266-0821.

3. The Midwest Plan Service Secretary, Agricultural Engineering Department, 460 Henry Mall, University of Wisconsin, Madison, Wisconsin 53706, (608) 262-3310.

4. Freshwater Foundation at Spring Hill Center, 725 County Road 6, Wayzata, Minnesota 55391, (612) 449-0092.

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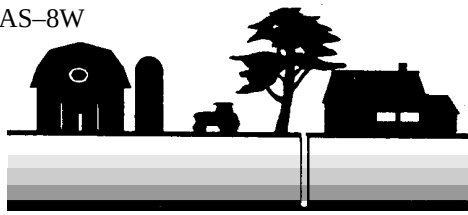

NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#8 *Worksheet: Assessing the Risk of Groundwater Contamination from*
Livestock Yards Management

Why should I be concerned?

Livestock yards, such as barnyards, holding areas and feedlots, are areas of concentrated livestock wastes. They can be a source of nitrate and bacteria contamination of groundwater. This is especially true if there is no system to 1) divert clean water flow from the livestock yard or 2) collect polluted runoff from the yard for diversion to an area where its effect on surface water or groundwater is minimal. The potential for livestock yards to affect groundwater is greatest if the yard is located over coarse-textured permeable soils, if the water table is at or near the surface, if bedrock is within a few feet of the surface, or when polluted runoff is discharged to permeable soils and bedrock.

Nitrate levels in drinking water above federal and state drinking water standards of 10 milligrams per liter (mg/l; equivalent to parts per million for water measure) nitrate-nitrogen can pose health problems for infants under 6 months of age, including the condition known as methemoglobinemia (blue baby syndrome). Nitrate can also affect adults, but the evidence is much less certain.

Young livestock are also susceptible to health problems from high nitrate-nitrogen levels. Levels of 20-40 mg/l in the water supply may prove harmful, especially in combination with high levels (1,000 ppm) of nitrate-nitrogen from feed sources.

Fecal bacteria in livestock waste can contaminate groundwater if waste seeps into nearby wells, causing such infectious diseases as dysentery, typhoid and hepatitis. Organic materials, which may lend an undesirable taste and odor to drinking water, are not known to be dangerous to health, but their presence does suggest that other contaminants are flowing directly into groundwater.

The goal of Farm•A•Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my drinking water?

- It will take you step by step through your livestock yards management practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your livestock yards management practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

Follow the directions at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

Glossary

Livestock Yards Management

These terms may help you make more accurate assessments when completing Worksheet #8. They may also help clarify some of the terms used in Fact Sheet #8.

Filter strip: A gently sloping grass plot used to filter runoff from the livestock yard. Influent waste is distributed uniformly across the high end of the strip and allowed to flow down the slope. Nutrients and suspended material remaining in the runoff water are filtered through the grass, absorbed by the soil and ultimately taken up by the plants. Filter strips must be designed and sized to match the characteristics of the livestock yard.

Infiltration: The downward entry of water through the soil surface.

Percolation: The downward movement of water through the soil.

Runoff control system: A combination of management practices that can be used together to prevent water pollution from livestock yard runoff. Practices may include diversion of runoff from the yard, roof runoff systems, yard shaping, settling basins, and filter strips or buffer areas.

Soil drainage class: The conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soils, as opposed to human-altered drainage. Different classes are described by such terms as excessively drained, well-drained, and poorly drained.

Soil permeability: The quality that enables the soil to transmit water or air. Slowly permeable soils have fine-textured materials, like clays, that permit only slow water movement. Moderately or highly permeable soils have coarse-textured materials, like sands, that permit rapid water movement.

Soil texture: The relative proportions of the various soil separates (clay, sand, silt) in a soil. Described by such terms as sandy loam and silty clay.

Worskheet #8

Livestock Yards Assessment: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.)
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for livestock yards management.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
LOCATION					
Distance from drinking water well	More than 200 feet.	100-200 feet.	50-100 feet.	Less than 50 feet.	_____
SITE CHARACTERISTICS					
Soil depth and permeability	Well-drained medium- or fine-textured soils (loam, silt loam, clay loams, clays). With low permeability (silt and clay). More than 40 inches deep with low permeability (silt and clay).	Well-drained or moderately well-drained medium- or fine-textured soils (loam, silt loam, clay loams, clays). 30-40 inches deep with moderate permeability (loamy).	Moderately well-drained coarse-textured soils (sands, sandy loam). Shallow (20-30 inches) and/or high permeability (sandy).	Excessively well-drained coarse-textured soils (sands, sandy loam) to gravel, and/or somewhat poorly drained soil to poorly drained soils. Very shallow (less than 20 inches) and/or very high permeability (coarse sand).	_____
DESIGN AND MANAGEMENT					
Surface water diversion	All upslope and roof water diverted.	Most upslope surface and roof water diverted.	No surface water diverted. Some roof water collected and redirected.	All water (surface and roof water) runs through the yard.	_____
Lot runoff control system	No yard runoff (either barn or roofed area).	All runoff collected from curbed lot. Solids separated. Water directed onto filter strip.	Most of lot runoff collected. Some solids removed. No filter strip.	Lot runoff uncontrolled.	_____
Yard cleaning and scraping practice	No yard (animals confined).	Once per week.	Once per month.	Rarely.	_____

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
CONCENTRATION OF ANIMALS ON YARD [square feet per animal (sf/a)]*					
Dairy cows	No yard. Confined to barn or roofed yard.	75 sf/a or more on fenced, curbed concrete pad and/or 400 sf/a on graded earthen surface. More than 1800 sf/a in exercise area.	50 sf/a or more on concrete and/or 200-300 sf/a on earthen surface. More than 1200 sf/a in exercise area.	Some concrete (less than 50 sf/a) and earth (less than 100 sf/a).	_____
Dairy replacements	No yard. Confined to barn or roofed yard.	More than 40 sf/a on fenced, curbed concrete pad and/or 150-200 sf/a on earthen yard.	More than 20 sf/a on concrete and/or more than 75 sf/a on earthen surface.	Less than 75 sf/a on earth.	_____
Beef feeders	No yard. Confined to barn with slotted floor.	Barn and/or paved lot more than 50 sf/a. Earthen lot with mound more than 300 sf/a, or without mound more than 500 sf/a.	No shelter and paved lot 40-50 sf/a. Earthen with mound more than 150 sf/a or earthen without mound less than 250 sf/a.	Paved less than 30 sf/a, or earthen less than 150 sf/a.	_____
Beef cows/heifers	Barn or roofed lot.	Barn with paved lot more than 60 sf/a. Earthen with mound more than 400 sf/a. Earthen without mound more than 600 sf/a.	Paved lot more than 30 sf/a. Earthen with mound more than 200 sf/a. Earthen without mound more than 300 sf/a.	Earthen without mound less than 200 sf/a.	_____
Sheep/ewes	No yard. Confined to barn or roofed yard.	Barn and paved lot more than 20 sf/a. Earthen more than 40 sf/a.	Barn and paved lot less than 15 sf/a. Earthen less than 25 sf/a.	Earthen less than 10 sf/a.	_____
Feeder lambs	No yard. Confined to barn.	Barn and paved lot more than 10 sf/a. Earthen more than 25 sf/a.	Barn and paved lot more than 5 sf/a. Earthen more than 10 sf/a.	Earthen less than 10 sf/a.	_____

*Animal concentrations derived from Midwest Plan Service publications and other sources.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
CONCENTRATION OF ANIMALS ON YARD [square feet per animal (sf/a)]*					
Hogs/sows	No yard. Confined to barn.	Shed and paved lot more than 30 sf/a.	Shed and earthen lot less than 15 sf/a.	Shed and earthen lot less than 10 sf/a.	____
Pigs: growing/ finishing	No yard. Confined to barn.	Shed and paved lot more than 15 sf/a.	Shed and earthen lot more than 15 sf/a.	Shed and earthen lot less than 10 sf/a.	____
Horses	No yard. Confined to barn or on pasture.	Earthen exercise lot more than 2500 sf/a. No pasture.	Earthen lot more than 1500 sf/a. No pasture.	Earthen lot less then 1000 sf/a. No pasture.	____
Chickens:					
Broilers	No lot. In building with watering system in good working order. Runoff protected.	No lot. In building with watering system in good working order. Inadequate runoff protection.	Earthen lot of 2 sf/a or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot of 2 sf/a or more, on coarse-textured soils (sands, sandy loam). Water table shallower than 20 feet.	____
Layers	No lot. In building with watering system in good working order. Runoff protected.	No lot. In building with watering system in good working order. Inadequate runoff protection.	Earthen lot of 4 sf/a or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot of 4 sf/a or more, on coarse-textured soils (sands, sandy loam). Water table shallower than 20 feet.	____
Turkeys	No lot. In building with watering system in good working order. Runoff protected.	No lot. In building with watering system in good working order. Inadequate runoff protection.	Earthen lot of 8 sf/a or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot of 8 sf/a or more, on coarse-textured soils (sands, sandy loam). Water table shallower than 20 feet.	____
Ducks	No lot. In building with watering system in good working order. Runoff protected.	No lot. In building with watering system in good working order. Inadequate runoff protection.	Earthen lot of 4 sf/a or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot of 4 sf/a or more, on coarse-textured soils (sands, sandy loam). Water table shallower than 20 feet.	____

*Animal concentrations derived from Midwest Plan Service publications and other sources.

TOTAL ☐

Use this total to calculate risk ranking on back page of worksheet.

What do I do with these rankings?

Step 1: Begin by determining your overall livestock yards risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

_____ divided by _____ equals [ ]*
total of rankings; # of categories ranked; risk ranking

*Carry your answer out to one decimal place.

3.6–4=low risk, 2.6–3.5=low to moderate risk, 1.6–2.5=moderate to high risk, 1–1.5=high risk

This ranking gives you an idea of how your livestock yards management practices **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis.** Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed livestock yards management risk ranking on page 1 of Worksheet #12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock characteristics). Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:

- **Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- **Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- **Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- **High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly—projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #8, *Improving Livestock Yards Management*, and consider how you might modify your farmstead practices to better protect your drinking water.

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9 Fact Sheet: Reducing the Risk of Groundwater Contamination by Improving Silage Storage

1. Silage - makeup, moisture, and leachate

Silage is more than a nutrient-rich foodstuff: It is also a pollutant! The silage-making and -storing process can result in liquid effluents, or leachate, gases, malodors, undesirable microorganisms, and waste or spoiled silage. Most owners, managers, and designers of silage-processing and -storing systems do not usually consider the potential harmful effects that silage can have on the environment. The most common problems are with groundwater and surface water contamination. These problems can occur when silage leachate forms in too wet silage or precipitation flows through silage and dissolves the nutrients and other chemicals found in silage (Graves, et al, 1993).

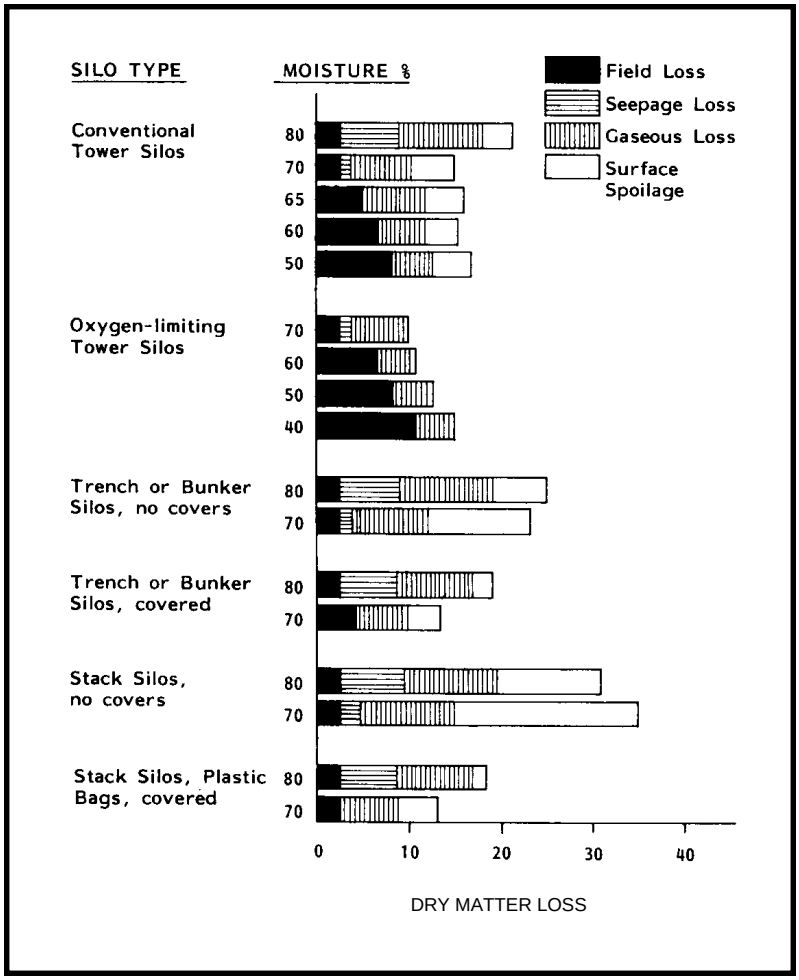

Figure 1: Chart of silage moisture content.
Source: Beef Housing and Equipment Handbook, MWPS-6, Fourth Edition, 1987, Midwest Plan Service, Ames, Iowa.

Silage can be made from corn, sorghum, legumes, grasses, other whole plant forages and canning company wastes, such as from sweet corn processing. Approximately two-thirds of the cropland in the northeast United States is devoted to forage production as hay or silage. (Pitt, 1990)

Fresh forage contains approximately eighty percent moisture. Soluble sugars are dissolved in the forage liquid, and this liquid provides the ideal medium for the growth of yeasts, molds and bacteria as well as for the rapid activity of plant enzymes.

The fundamental strategy in making silage is to exclude oxygen and reduce the pH rapidly through bacterial fermentation. On ensiling, the sugars present in the plant sap are transformed by bacterial action to form organic acids. These acids are essential for the proper preservation of the silage. During the silage making process, concentrated leachates can form. The prevention of silage leachate formation through proper forage harvesting and ensiling techniques is essential. If prevention techniques fail, these leachates need to be properly managed to preclude degradation of the water quality.

When moisture content is in excess of 70% or when rainfall infiltrates a silage pile, leachate is produced. Acids and sugars in the leachate are corrosive to exposed concrete and metal surfaces and can kill vegetation. The corrosiveness is due to the presence of organic acids, primarily lactic and acetic, found in the silage leachate.

Silage leachate can be generated with any of the following types of farm storage facilities:

Conventional tower silos
Oxygen limiting tower silos
Trench or bunker silos
Stack silos
Plastic wrapped or bagged large round bales
Plastic bag silos

Leachate represents a significant surface water and groundwater quality problem due to its high biochemical oxygen demand. The organic strength of silage leachate is on the order of 200 times stronger than raw domestic sewage (Bloxham, 1992).

In groundwater, silage leachate can cause severe public health related problems. In some cases, silage leachate may enter the groundwater through sink holes, cracked well casings, or fractures in the bedrock. When this occurs, the groundwater can be degraded for a long period of time due to the lack of natural aeration. Groundwater contaminated with silage leachates has a disagreeable odor and shows increased levels of acidity, ammonia, nitrates, iron and manganese.

There is potential for silage leachate to enter surface waters. Once released, it can use up vast amounts of dissolved oxygen. For example, as little as one gallon of silage leachate can lower the oxygen content of 10,000 gallons of river water below the level required for the survival of fish. If the silage leachate enters surface waters during periods when the flow is low and

water temperatures are warm, the oxygen depletion is further aggravated, since the dilution potential is extremely limited.

In order to mitigate the pollution risk of silage leachate entering surface waters, adequate forage harvest techniques, control and storage should be provided. The USDA Natural Resources Conservation Service recommends a minimum cubic foot (7.48 gallons) of leachate storage capacity for each ton of material placed in storage if and when containment becomes necessary. Silage leachate production varies based on crop, moisture content, silo type and silo cover. It is extremely important to harvest the forage to be ensiled at the proper maturity and moisture content to reduce or eliminate silage leachate formation.

2. Silage Leachate Considerations

If the dry matter content of the forage placed in the silo is maintained above 30 percent (%) for bunker or trenches, 40 percent (%) for haylage and 35 percent (%) for towers, then the silage leachate production will be substantially reduced, if not eliminated.

The following recommended guidelines will prevent the production of excess quantities of silage leachate:

✓ **Recommended proper growth stages for harvesting forage:**

Crop	Recommended Proper Growth Stages for Harvesting Forage
Corn	Early dent to 2/3 milk line stage of kernel maturity
Sorghum	Medium to hard dough stage of kernel maturity
Alfalfa (Est.), first cut	Mid-bud to early bloom
Alfalfa (Est.), later cuts	Late bud to early bloom
Alfalfa (New)	Early bloom
Red Clover, first cut	1/4 to 1/2 bloom
Red Clover, later cuts	1/4 bloom
Perennial grasses, first cut	Heads emerging from boot stage
Perennial grasses, later cuts	5 to 6 weeks after last harvest
Small grain	Early head emergence
Sorghum - sudan, hybrid multiple cuts	Height of 3 to 5 feet, before boot
Sorghum - sudan, hybrid, one cut system	Boot to early bloom
Grass - legume mixture	Based on legume maturity

✓ **Recommended moisture level for placement of forage into silos:**

Wilted Hay Crops- Conventional tower silo, 60 to 65 percent moisture. Oxygen-limiting, 40 to 55 percent moisture. Trench, bunker, or stack, 65 to 70 percent to ensure adequate packing. Round bale or bagged, 40 to 60 percent mois ture.

Corn or Sorghum- Conventional tower, 63 to 68 percent moisture. oxygen-limiting, 55 to 60 percent moisture for mechanical reasons. Trench,bunker, or stack, 65 to 70 percent to ensure adequate packing. Baled (wrapped or bagged), 65-70 percent moisture.

Note: Drying-type moisture testers or microwave oven weighing and drying procedure should be used to determine forage moisture levels before and during the harvest of forage silages.

✓ Use the proper cut setting on the forage chopper. Set shear-plate for a 3/8 to 3/4 inch theoretical cut. Keep knives well sharpened. Keep 15 to 20 percent of the forage particles at 1.0 to 1.5 inches. Do not use re-cutters or screens unless moisture levels are below those recommended;

✓ Use and maintain a silo that excludes both air and water and has no holes or cracks that allow leachate to leave the facility unless diverted to a collection channel or pipe;

✓ Fill the silo rapidly, pack thoroughly, and distribute evenly. Use a wetter material on top to facilitate packing. Bunker, trench, and stack silos require packing with heavy machinery on a continuous basis while filling. Pack periodically for two to three days after final fill;

✓ Seal the top of the silo with an air tight material such as 6 mil black plastic. If exposed to wind, weight it down in numerous places to prevent any lifting of the plastic;

✓ Bacterial contamination can be minimized by good sanitation of the silo and adjacent areas and ensiling forages with dry matter content greater than 30 percent;

✓ Design the leachate collection system and install a cover to minimize the entry of clean rain water from the top of the cover into the leachate collection system.

3. Silo location

In order to preclude groundwater contamination, silos should be located as far away from wells as practical. Typical isolation distances range from 50 to 250 feet and preferable down slope of a private rural well depending on geology, soil type, well type and silo type. In highly permeable soils and fractured bedrock longer horizontal isolation distances should be considered. With silos that are tightly sealed, a reduction in the horizontal isolation distances may be considered.

In the case of community wells, larger isolation distances should be considered due to the degree of risk involved. These distances can be as high as

1000 feet or more and located preferable down gradient from a community well.

In some cases, vertical separation distances and maximum slopes for ensilage locations are considered. Some general "rules of thumb" are as follows:

- ✓ Locate the silage pile at least five feet above the seasonal high ground water table;
- ✓ Locate the silage pile on slopes less than two percent (two feet of fall in 100 feet);
- ✓ Divert stormwater around the silage pile to prevent stormwater mixing with silage leachate.

4. Silage storage

Most harvested grasses, legumes or grass-legume mixtures are characterized as low-moisture haylage. Permit the plant material to wilt to the proper moisture content prior to chopping to ensure optimum ensiling. Corn and sorghum silage, for example, are direct cut and ensiled at the moisture content found in the standing forage. Compaction with machinery is necessary in order to reduce oxidation of the silage. This silage must be wetter to compact well.

Direct cut grass silage stored in tower silos has been reported to produce significant amounts of silage leachates due to compression of the silage. However, most grass, legumes and grass-legumes ensiled in the United States are wilted first and made as haylage. This virtually eliminates silage leachate.

Typically, silage that is stored in horizontal silos has a higher moisture content. Trench or stack silos with earthen floors pose the greatest threat to the groundwater resource. Particularly in areas where ensiling has taken place in the same area for many years, the soil in that area cannot act as an effective biological filter since there has been a toxic build-up from the silage leachate.

5. Silo design and construction

Silo construction for most agricultural uses is not regulated in New Jersey. Most silos being built today have interiors made of concrete or, in the case of oxygen-limiting silos, a glass-like coating over steel. Silage stored in glass-lined silos typically has a lower moisture content and poses a low risk of groundwater contamination. It is possible, though, for some liquid to leak out.

Silo bags generally store silage of higher moisture content. Liquid can pool in the bag and leak out when it is opened.

Horizontal trench silos excavated into the ground may affect groundwater, especially in coarse soils and sites close to the water table. Properly compacted clay soils and concrete floors can limit leachate seepage.

The type of silo on your farm often has less effect on its potential to contaminate groundwater than the condition of the silo. For example, an old wooden silo with an earthen floor poses a higher risk than a concrete horizontal silo with a concrete floor (see Figure 2). Older structures can be relined to make them relatively watertight.

Silo caps or covers keep rain water from entering the silage, preserving a quality silage, but alsoreducing the potential for producing leachate. Horizontal silos am covered with a plastic sheet. Tires are used to keep the cover in place.

It is important to divert clean water away from new and existing silage storage structures. For both vertical and horizontal silos, diverting clean water away from silage can protect both groundwater and surface water.

6. Leachate collection and disposal

Leachate can be collected from tower and horizontal silos by channeling the liquid into a water retention structure, usually a pond lined with concrete, clay or plastic. Drain tiles

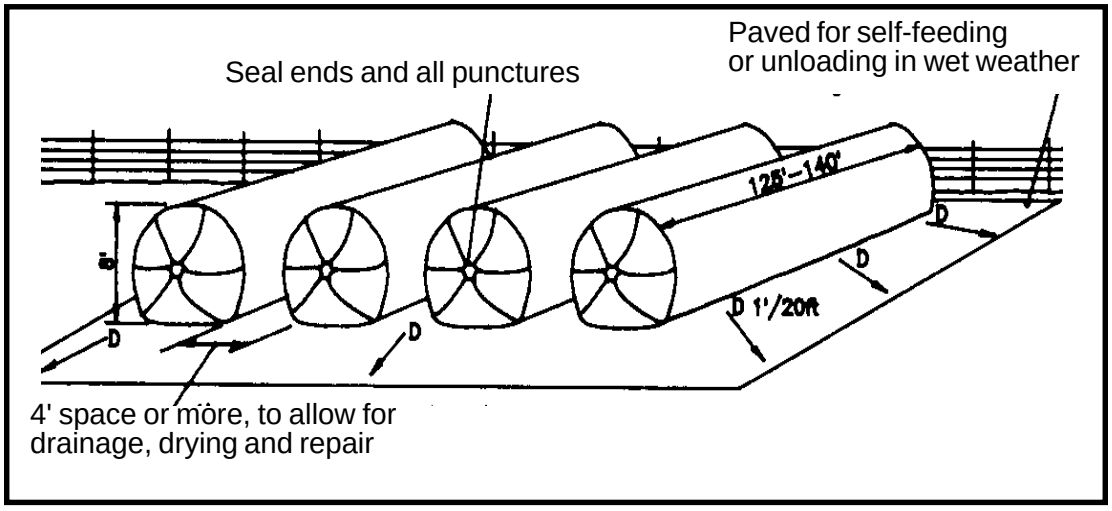

Figure 2: Horizontal silo. *Source: Beef Housing and Equipment Handbook, MWPS-6, Fourth Edition, 1987, Midwest Plan Service, Ames, Iowa.*

around tower silos can be used to collect any seepage from the silo. Horizontal silos use channels to direct seepage into a collection area. Contact your county Extension office or NRCS for assistance with design.

The most cost-effective disposal method is land spreading. Nitrogen in leachate has significant fertilizer value if applied during spring or early summer.

Because of its high organic content, leachate can burn grasses and remove oxygen from the soil. Farmers who consider land spreading should consult a soil specialist to determine how much leachate can be safely spread on each field.

CONTACTS AND REFERENCES

Who to call about...

General Contacts

See introductory sheet

Silo design and construction

Your Soil Conservation District office.

Silo construction guidelines

Available for tower silos from the International Silo Association, 8725 Rosehill, Suite 210, Lenexa, Kansas 66215, (913) 599-1919.

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 nitrates

Nitrate, Groundwater and Livestock Health. University of Wisconsin-Extension Bulletin G3217. (1)

Nitrate in Dairy Cattle. Rutgers Cooperative Extension Fact Sheet 118. (2)

Design criteria and general information

Dairy Housing and Equipment Handbook. Midwest Plan Service. MWPS-7. (3)

Farm and Home Concrete Handbook. Midwest Plan Service. MWPS-35. (3)

Silo Capacity Reference Chart. NJ Dairyman. L547. (2)

Publications available from...

1. Agricultural Bulletin, Room 245, 30 N. Murray Street, Madison, Wisconsin 53715, (608) 262-3346. There may be charges for publications, postage and sales tax.

2. Your county office of Rutgers Cooperative Extension (found in the blue pages of your phone book) or the Publications-Distribution Center, Cook College - Rutgers University, New Brunswick, NJ 08903, (732) 932-9762.

3. The Midwest Plan Service Secretary, Agricultural Engineering Department, 460 Henry Mall, University of Wisconsin, Madison, Wisconsin 53706, (608) 262-3310.

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NJFAS–9F *Reducing the Risk of Groundwater Contamination by Improving Silage Storage* 12/95 Printed on recycled paper

NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#9 Worksheet: Assessing the Risk of Groundwater Contamination from
Silage Storage

Why should I be concerned?

Silage is an essential feed for livestock-based agriculture. When properly harvested and stored, silage poses little or no pollution threat, but improper handling can lead to a significant flow of silage juices (or leachate) from the silo. Leachate is an organic liquid that results from pressure in the silo or from extra water entering the silo. It is usually a problem only when silage is fresh, or just after storage. This loss of leachate represents a major loss of nutrient value from the silage. Canning company wastes, which are often used for silage, frequently contain excess moisture, which increases the potential for leachate to cause groundwater contamination.

Silage liquid is often highly acidic and can be corrosive to concrete and steel. If it enters a stream, its high organic content feeds bacteria that rob the water of oxygen. Groundwater contaminated with silage juices has a disagreeable odor and shows increased levels of acidity, ammonia, nitrates and iron.

Along with the pollutants found in silage leachate, an even greater potential threat is that the low pH created by the presence of acids in silage leachate can free up and release naturally occurring metals in the soil and aquifer, which can increase their concentrations in groundwater. Leachate from 300 tons of high-moisture silage has been compared to the sewage generated daily by a city of 80,000 people.

Nitrate is the most important potential contaminant to consider. Levels of 20-40 milligrams per liter (mg/l; equivalent to parts per million in water measure) can cause livestock problems, especially if feed contains more than 1,000 ppm nitrate-nitrogen. Water with levels over 100 mg/l nitrate-nitrogen should not be used for livestock. Water with over 10 mg/l nitrate-nitrogen should not be used for infants under 6 months of age.

The goal of Farm•A•Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my drinking water?

- It will take you step by step through your silage storage practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your silage storage practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

Follow the directions at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

Worksheet #9

Silage Storage: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.)
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for silage storage practices.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
Silage moisture content*	Below 65%	Between 65% and 70%	Between 71% and 85%	Over 85%	___
Silage storage location	At least 100 feet downslope from well (silos, glass-lined feed storage, plastic tubes). At least 500 feet downslope (earthen trench). Water drains away from storage to field or pasture.	At least 50 feet downslope from well (silos, glass-lined feed storage, plastic tubes). At least 250 feet downslope (earthen trench). Water drains to field or pasture.	Within 100 feet upslope of well (silos, glass-lined feed storage, plastic tubes). Within 500 feet upslope (earthen trench). Water pools or stands near storage.	Within 50 feet of well (silos, glass-lined feed storage). Within 250 feet (earthen trench). Water pools on soil surface.	____
Silage storage floor or surface condition	Concrete or asphalt surface. No cracks.	Concrete or asphalt surface has some cracks.	Surface has some permeable soils (silt loam) and has some cracks.	Surface has permeable soil (sand), not compacted.	____
Silage storage cover condition	Cover tight fitting. No leaks.	Cover tight fitting. Minor leaks repaired.	Cover, but many large leaks not repaired.	No cover.	____
Silage storage lining	New or relined in last 5 years.	Relined 6 to 25 years ago.	Relined 26 to 40 years ago.	Relined more than 40 years ago.	____
Leachate collection system	Designed system in place and maintained.	Designed system in place but not maintained.	No system in place. Leachate moves to waterway.	No system in place. Leachate collects in low area.	____

*For this worksheet, categories on the left are listed in order with the most important factor for groundwater contamination listed first.

TOTAL ☐

Use this total to calculate risk ranking on back page of worksheet.

What do I do with these rankings?

Step 1: Begin by determining your overall silage storage risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

_____ divided by _____ equals [ ]*
total of rankings; # of categories ranked; risk ranking

*Carry your answer out to one decimal place.

3.6–4=low risk, 2.6–3.5=low to moderate risk, 1.6–2.5=moderate to high risk, 1–1.5=high risk

This ranking gives you an idea of how your silage storage practices **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis.** Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed silage storage risk ranking on page 1 of Worksheet #12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock characteristics), and Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:

- **Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- **Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- **Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- **High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly—projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #9, *Improving Silage Storage,* and consider how you might modify your farmstead practices to better protect your drinking water.

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#10 *Fact Sheet: Reducing the Risk of Groundwater Contamination by* Improving Milking Center Wastewater Treatment

Wastewater from the dairy milking center, including wastes from the milking parlor (manure, feed solids, hoof dirt) and milkhouse (bulk tank rinse water and detergent used in cleaning), is commonly disposed of in an underground tank and soil absorption field. Most soil absorption fields have plugged up for one or more of the following reasons:

- Increased volumes of water don't allow adequate detention time in the septic tank.
- Milk solids and fats or manure solids plug the absorption field.
- Sanitizers used in cleaning may reduce bacterial action in the septic tank.
- Solids are not removed from the tank regularly.

When these systems fail, wastewater will most likely surface elsewhere, in a ditch or a cropped field.

From an environmental perspective, delivery of milking center wastewater to a manure storage facility, if available, makes the most sense. Discharge options, from most to least desirable, are: field application, overland flow, slow surface infiltration, below-ground absorption fields and rapid surface infiltration. Except for below-ground absorption fields, these discharge methods are uncommon.

Your drinking water is least likely to be contaminated if you follow appropriate management procedures or dispose of wastewater in any location **off the farm site.** However, proper offsite disposal practices are essential to avoid risking contamination that could affect the water supplies and health of others.

1. No discharge by combining wastes

Combining milking center wastes with manure has the advantage of allowing a common disposal system for both types of waste. A liquid manure storage facility, properly constructed and sized, provides the additional flexibility of storing wastes until they can be applied at the right time to the right sites. (See Figure 1a.)

This option is limited, however, to farmers who handle their manure in slurry form. While it adds to transportation and spreading costs, nutrients from dairy wastewater can be used to meet crop requirements, thus reducing fertilizer costs.

Applying milking center wastes with manure to fields at rates that do not exceed crop needs for nitrogen is least risky for groundwater contamination from both wastes. Care must be taken, however, to keep soil phosphorus levels from accumulating to levels that will harm crops.

Milking center wastewater combined with seepage (from solid manure storage or livestock yard runoff) can be stored in a detention pond. (See Figure 1b.) The contents of the pond can be applied to fields when conditions are appropriate.

For glossary, see page 2 of Worksheet #10.

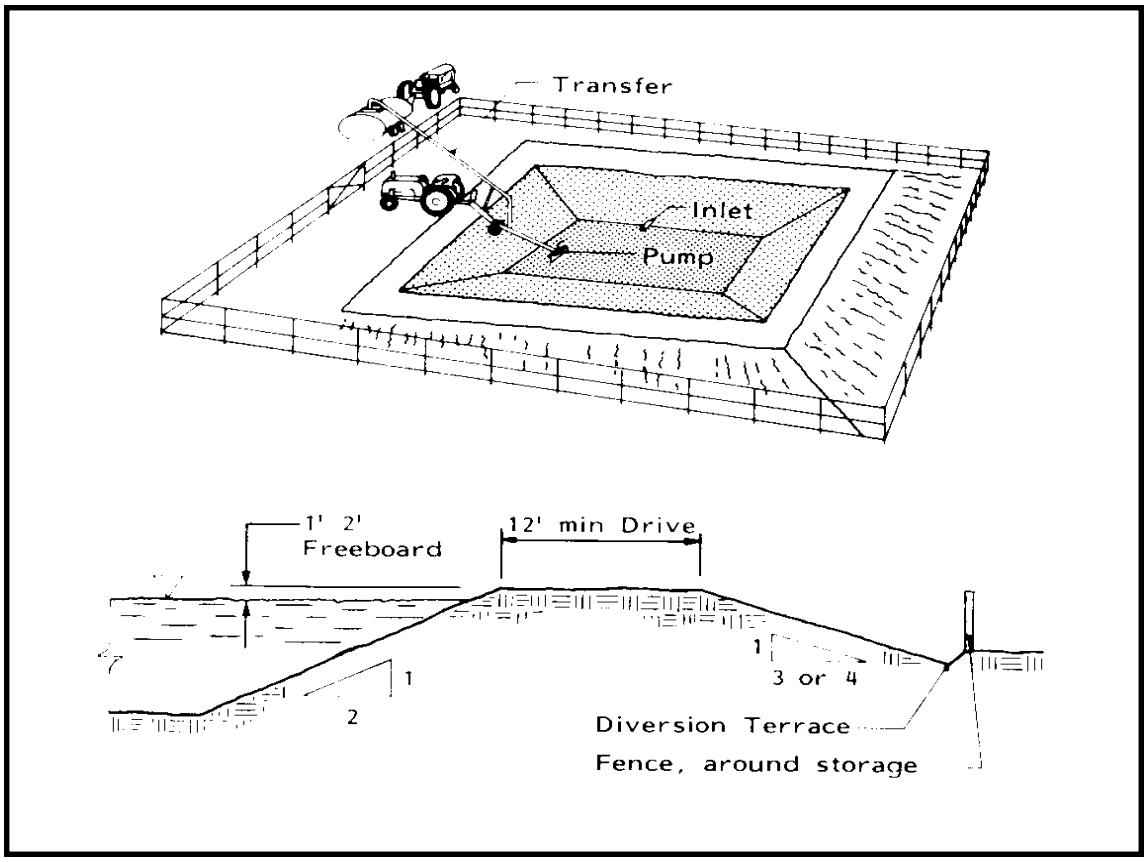

Figure 1a: Earth basins for manure and dairy wastewater storage. *Source: Dairy and Equipment Housing Handbook, MWPS-7, Midwest Plan Service, Ames, Iowa.*

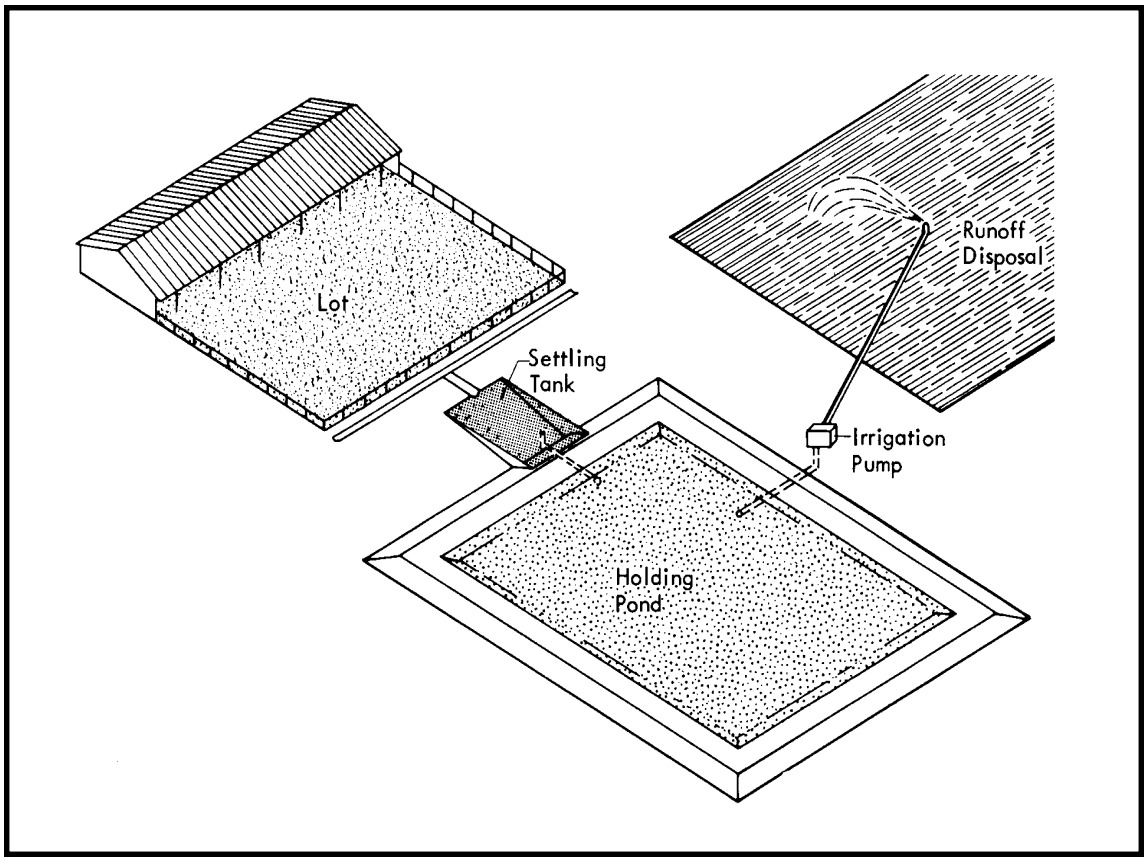

Figure 1b: Detention pond for storage of dairy wastewater and livestock yard runoff. *Source: Dairy Housing and Equipment Handbook, MWPS-7, Midwest Plan Service, Ames, Iowa.*

2. Treatment before discharge

While soil has a large capacity to absorb and degrade wastes, treating wastewater to remove some wastes before it gets into the soil can extend the effective life of a soil application area. Such pretreatment usually consists of a tank that holds the wastewater long enough for heavier particles to settle and lighter solids to float. (See Figure 2.)

Be sure to clean these materials out of the tank every few months, or they will eventually get into the soil absorption area, clogging the spaces between soil particles and causing wastewater to collect on the surface.

A settling tank also provides a place for bacteria to decompose some wastes before they enter the soil absorption area. This process causes a scum to form on top of the water in the tank. Removing the scum layer every few weeks can keep the system operating more efficiently and allow for annual removal of solids.

Removing waste products before washing into a settling tank requires extra effort, but it reduces the rate of solids accumulation, which can extend the period between tank cleanouts.

> Manure and excess feed, for example, can be treated like - and thus combined with - other livestock wastes.

Passing wastewater through a shallow treatment pond (also called a facultative lagoon) results in a more thorough pretreatment. Algae growing in the pond generate oxygen, which can help decompose organic compounds without obnoxious odors.

Solids that settle to the bottom of the pond usually decompose in the absence of oxygen. To prevent groundwater contamination, such ponds must be built of an impervious material such as packed clay, concrete or synthetic liner.

> In some cases, wastewater can be discharged to a lagoon without first going through a settling tank. After settling, the wastes are best applied at low rates to croplands. Be aware that decomposition processes in this arrangement may generate odors.

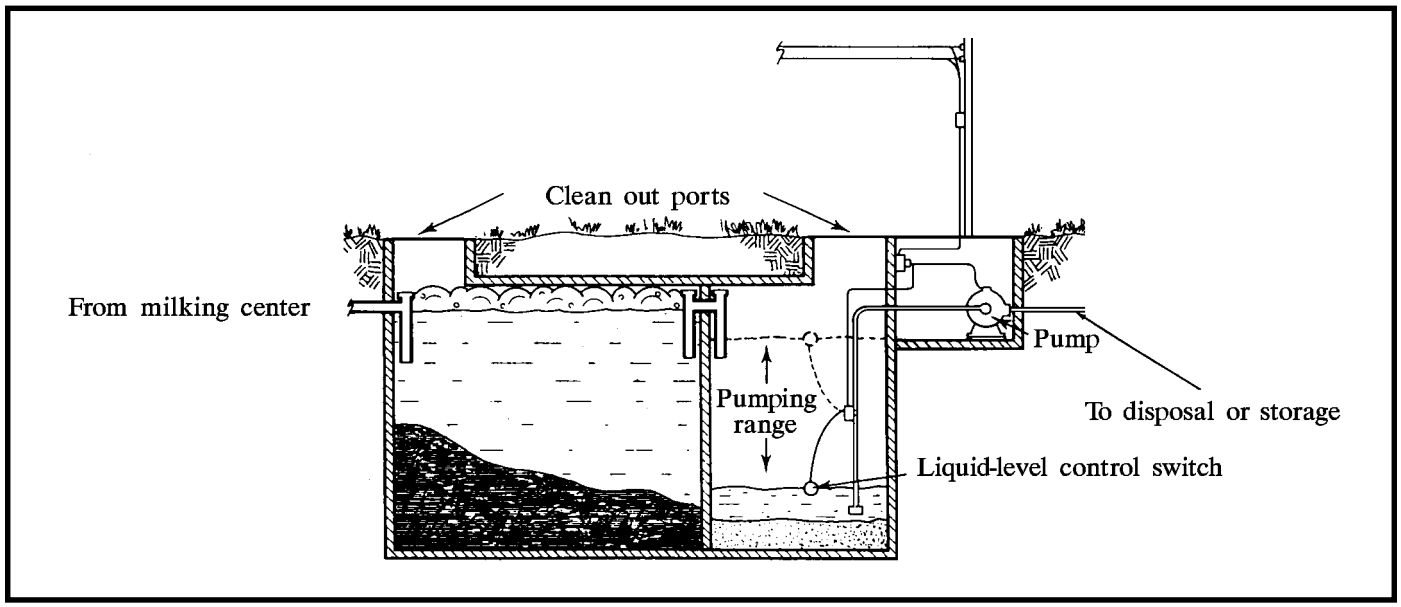

Figure 2: Settling tank with pump to distribution pipes. *Adapted from Wastewater Management and Disposal for Milking Centers, CES Special Circular 207, Pennsylvania State University.*

3. Discharge methods

Treating wastewater for direct discharge to a stream or lake is generally too expensive for most dairy farms. The soil provides the most cost-effective place for disposal, and most options fall into one of five categories:

- subsurface absorption
- rapid surface infiltration
- slow surface infiltration
- slow overland flow
- direct cropland application

Application of wastewater to cropland, at low application rates, poses the least danger to groundwater or surface water. The soil can assimilate the dispersed wastes and crops can use some of the nutrients, thus preventing them from entering groundwater or surface water.

Other treatments, in decreasing order of effectiveness, are surface flow, slow surface infiltration, below-ground absorption and rapid surface infiltration.

Any of these discharge methods that involve application of wastes to the soil surface should be tied to a soil analysis and a plan for utilization of these wastes by crops. These applied nutrients should be credited in your fertilizer program.

Field application

Dairy wastewater can be applied to croplands and pastures by portable irrigation equipment or a liquid manure spreader. Pipes with sprinklers can also be permanently installed to spray wastewater over certain areas consistently. Determine application rate by 1) the soil's ability to absorb wastes; and 2) the utilization of nutrients by vegetation with periodic removal of the crop produced. Do not saturate areas that can allow rapid percolation to groundwater or runoff to surface water.

Milking center wastewater applied to cropland at low rates poses little danger to groundwater, due to filtering by the soil or plant uptake of potential contaminants. To maximize the efficiency of this system, harvest the crop or other vegetation.

> **Vegetation removal**: After harvesting the vegetation, feed it to livestock, if appropriate, or use as bedding. If left on the ground, nutrients remain available to move toward groundwater. Forest, windbreak or woodlot application may also be suitable, in which case harvest is not needed.

Surface flow

Allowing wastewater to run slowly in a sheet (uniform layer) over a relatively impervious clay soil might reduce the chances of groundwater contamination. (See Figure 3.) At the same time, though, it can pose problems for streams, lakes or wetlands. Vegetation removes nutrients that develop on top of the soil. The system is designed like a slow infiltration area, but water flowing across the soil eventually flows from it, especially in winter or wet weather.

It is necessary to remove vegetation from the site so that nitrogen and phosphorus are not released when the vegetation dies. (See "Vegetation Removal" under "Field Application" section above.)

While this system poses a low risk of groundwater contamination from any milking center wastewater pollutant, it has a higher risk of contaminating surface water than some other systems.

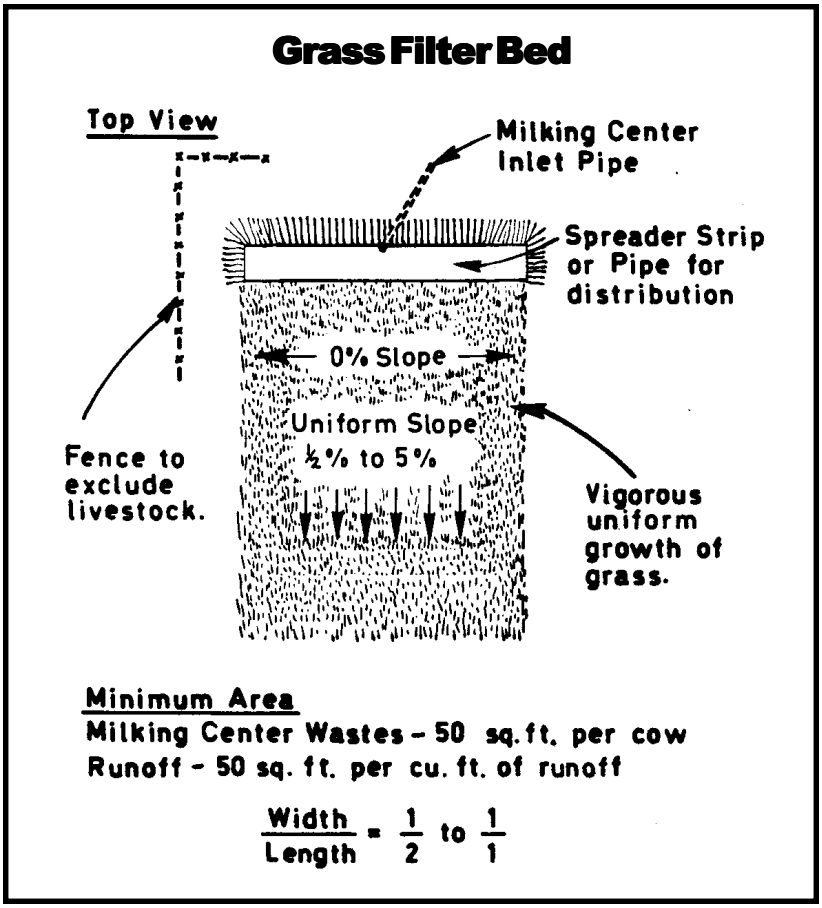

Figure 3: Surface flow (overland). *Source: Dairy ManureManagement-Handling Milk Center Wastes, Northeast Dairy Practices Council 27.B. October 1977.*

Slow surface infiltration

Wastewater can be applied at one end of a gently sloping grass filter strip or terrace. By spreading pretreated wastewater over a vegetated soil surface, organic compounds and bacteria can be treated or filtered out as wastes flow in sheet form over the sloped, vegetated soil surface and percolate through the soil. (See Figures 4a and 4b.) This system works best on well-drained loamy soils with at least 3 feet to bedrock or groundwater. The area should be designed to minimize runoff during heavy rain or snowmelt.

Harvesting the infiltration area is needed to keep vegetation from decomposing and releasing nutrients that could seep down to the groundwater. (See "Vegetation Removal" in "Field application" section on page 4.)

> With an uncontrolled gravity system, the area remains wet, making mechanical harvesting of vegetation difficult. By controlling the flow with a pump, wastes can be applied and then the area can be allowed to dry out.
>
> Administering wastewater intermittently may require that the retention tank and disposal area be large enough to handle several days' production of milking center wastes. Alternating between two infiltration areas is another way to allow an area to dry out.

Properly operated, a slow infiltration system poses a moderate risk of groundwater contamination by nitrate and other soluble compounds. There is a low risk of contamination by organic matter, pathogenic (disease-causing) microorganisms, phosphorus and detergents.

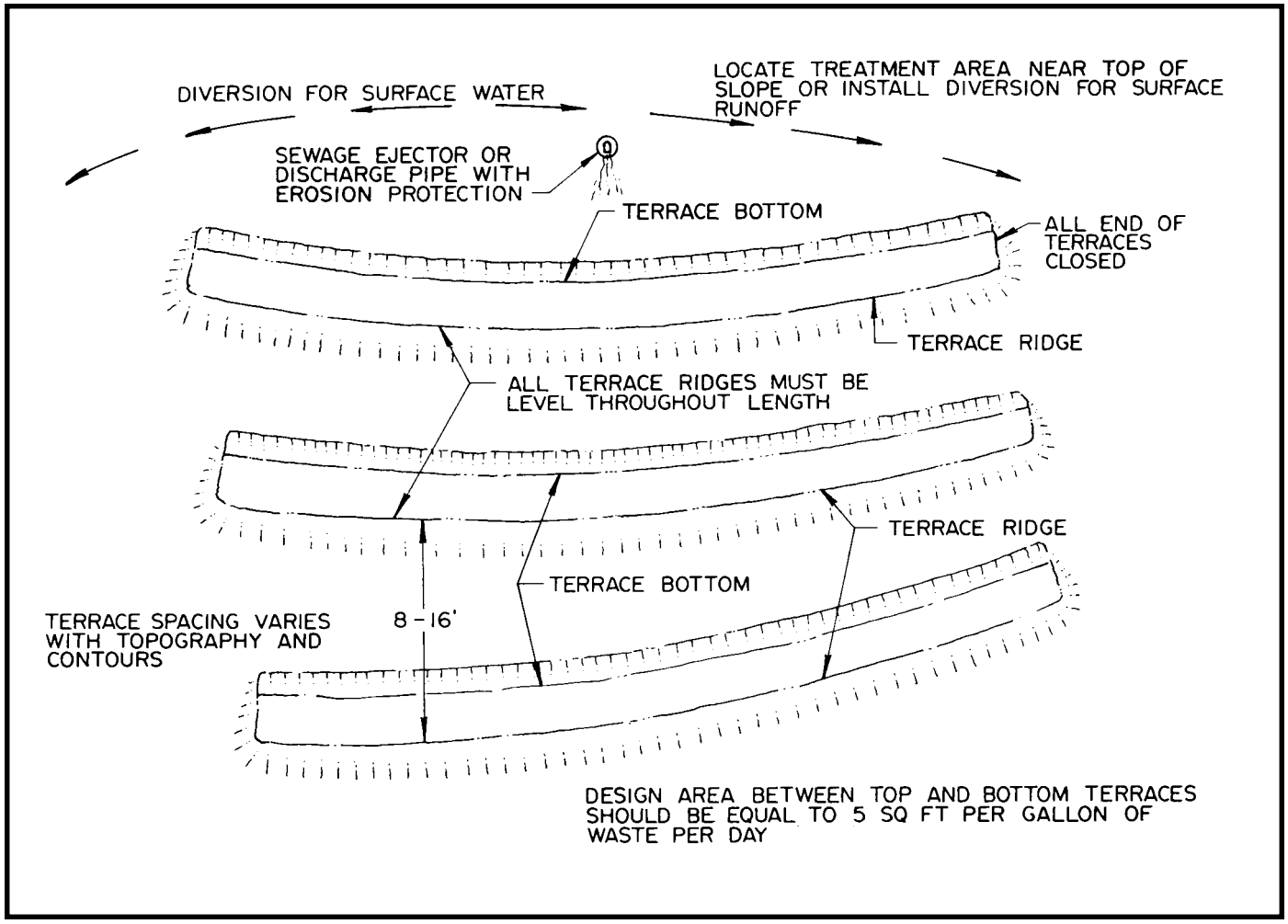

Figure 4a: Contour terraces. *Source: Treatment and Disposal of Milkhouse and Milking Parlour Wastes, D.W. Bates and R.E. Machmeier, University of Minnesota Agricultural Extension Service, M-159, 1977.*

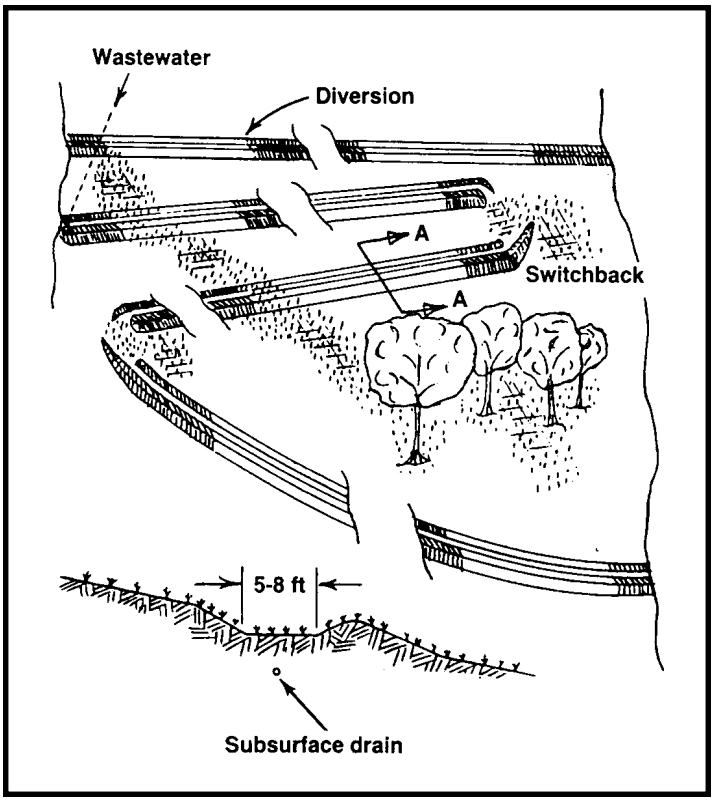

Figure 4b: Infiltration terrace. *Source: Milking Center Wastewater Disposal, Manure Management for Environmental Protection, Document DM7, Pennsylvania Department of Environmental Resources, October 1986.*

Below-ground absorption field

While below-ground absorption (see Figure 5) has been recommended in the past, experience has shown that these systems often fail.

Natural processes, failure to remove solids from the wastewater, or releasing large quantities of milk into the system can cause the soil to become clogged and allow wastes to back up through the drains. The wastewater may collect on the surface until it evaporates or flows into a field or watercourse. Surface discharge could violate both dairy sanitation regulations and surface water quality standards.

Subsurface absorption systems treat wastewater best in loam soils with at least 4 feet to groundwater or bedrock. Allowing air to enter the subsurface can help speed organic matter decomposition and keep soil pores open.

> Aeration can occur by having two absorption fields and switching between them at intervals of six months or less.
>
> A settling tank with capacity to store the flow for several days before being emptied by pump or dosing siphon is another way to allow absorption bed aeration. It is important to provide air inlets to the area. Waste milk should not be discharged to these sites.

Even when these systems are operating properly, there is a risk of groundwater contamination by nitrate. As a result, there is no "low-risk" practice associated with this category. If these systems are working properly, there is a low risk of contamination by suspended solids, disease-causing bacteria and detergents.

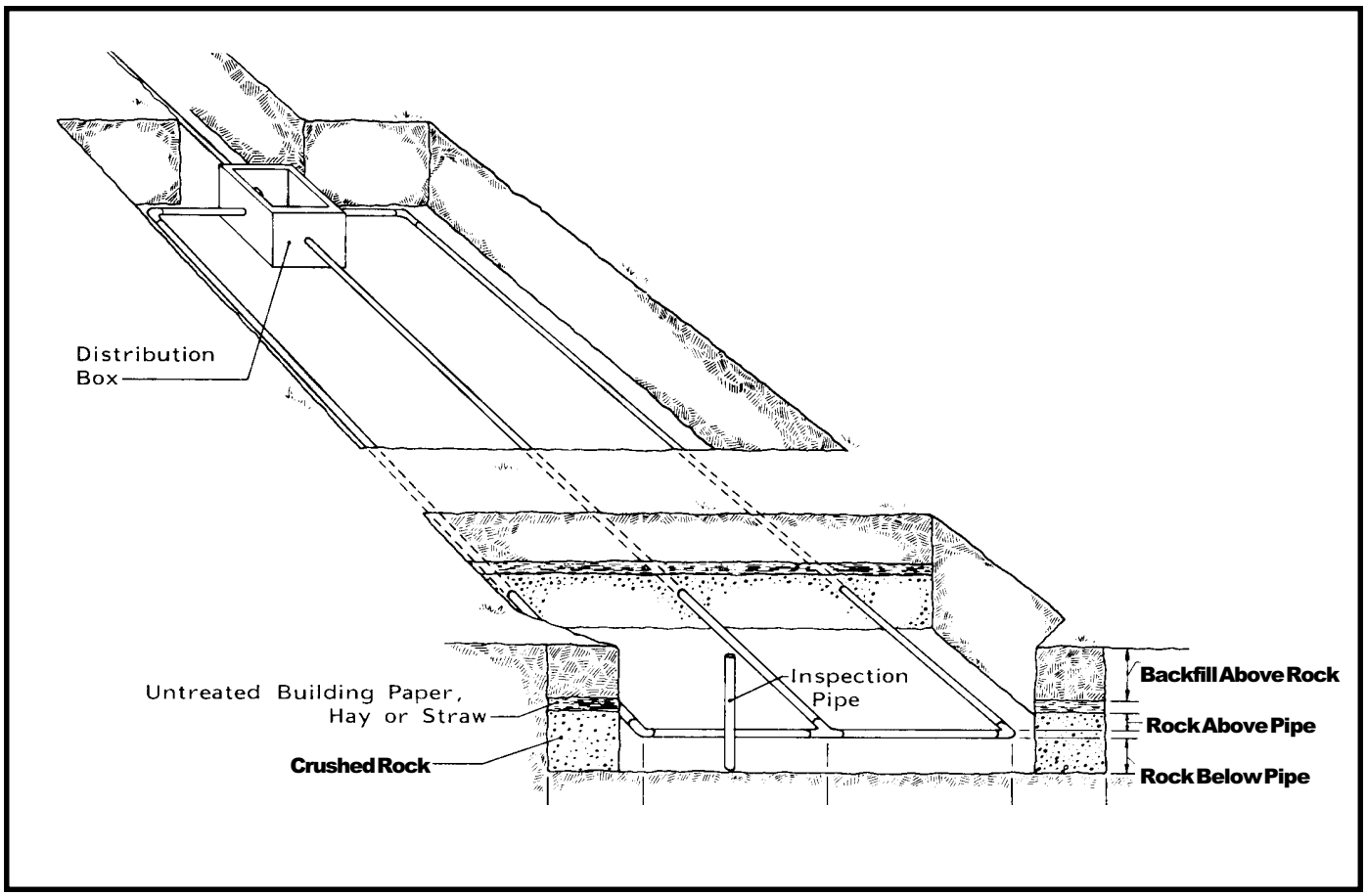

Figure 5: Absorption bed. *Source: Onsite Domestic Sewage Disposal Handbook, MWPS-24, Midwest Plan Service, First Edition, August 1982.*

Rapid surface infiltration

When operating properly, these systems pose a high risk of groundwater contamination by nitrate, phosphorus, ammonia and other soluble compounds, such as detergents. The Wisconsin Department of Natural Resources has collected data on use of these systems that show a high incidence of groundwater contamination and operational failure. Sandy soils should not be used, since microorganisms and organic compounds will not be adequately filtered or decomposed by soil bacteria before the wastewater reaches groundwater.

Encouraging wastewater to drain quickly through the soil requires thorough pretreatment to remove solids and decompose organic compounds. These systems must be located on sandy loam or loamy sand soils. Arrange them either in a level bed surrounded by soil berms or in a ridge and furrow pattern. Lush vegetation will grow on the ridges and berms, which should be removed regularly to remove nutrients and keep organic water from obstructing flow. Be sure that such systems are designed for easy harvest, with fences located so as not to obstruct harvest.

Because water percolates rapidly through the soil, depth to bedrock or groundwater should be at least 12 feet. As with a subsurface absorption system, allowing air to enter the soil will speed decomposition and keep soil pores open.

CONTACTS AND REFERENCES

Who to call about...

Potential groundwater contamination from your milking center wastewater

Your Soil Conservation District office.

Financial assistance for the cost of new control facilities

Your county Consolidated Farm Services Agency or Soil Conservation District office.

Review of construction plans

To be sure that sanitation and water quality regulations are being met, contact your local health department.

Designing wastewater treatment systems

Your Soil Conservation District office.

What to read about...

Design criteria and general information

Dairy Housing and Equipment Handbook. Midwest Plan Service. MWPS-7. (1)

Livestock Waste Facilities Handbook. Midwest Plan Service. MWPS-18. (1)

Publications available from...

1. The Midwest Plan Service Secretary, Agricultural Engineering Department, 460 Henry Mall, University of Wisconsin, Madison, Wisconsin 53706, (608) 262-3310.

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New Jersey Farm•A•Syst team members: **Susan Lance Scibilia,** Program Associate in Water Quality, Rutgers Cooperative Extension and **Fred Kelly,** Resource Conservationist, USDA Natural Resources Conservation Service.

Written by Brian J. Holmes, Department of Agricultural Engineering, University of Wisconsin-Madison, and University of Wisconsin-Extension, Cooperative Extension.

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NJFAS–10F *Reducing the Risk of Groundwater Contamination by Improving Milking Center Wastewater Treatment* 12/95

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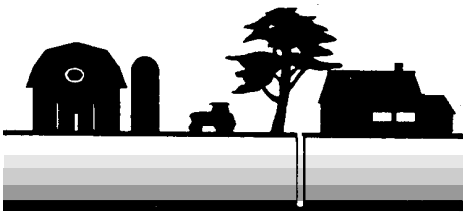

NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

10 *Worksheet: Assessing the Risk of Groundwater Contamination from* Milking Center Wastewater Treatment

Why should I be concerned?

Dairy wastewater is usually considered a dairy sanitation problem. If not carefully managed, however, dairy wastewater can contaminate both groundwater and surface water.

The amount of wastewater generated varies with milking preparation, equipment used and the number of cows. A 100-cow free-stall operation may use anywhere from 100 to 1000 gallons of water per day in the milking center alone.

Milking center wastewater is contaminated with organic matter, nutrients, chemicals and microorganisms. Poorly designed or mismanaged waste disposal systems can contaminate water with ammonia, nitrate, phosphorus, detergents and disease-causing organisms. If not managed properly, these contaminants can be carried directly to a well or cause groundwater or surface water contamination. Surface water can also be affected by manure, milk solids, ammonia, phosphorus and detergents.

The goal of Farm•A•Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my drinking water?

- It will take you step by step through your milking center wastewater treatment practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your milking center wastewater treatment practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

Follow the directions at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

Glossary

Milking Center Wastewater Treatment

These terms may help you make more accurate assessments when completing Worksheet #10. They may also help clarify some of the terms used in Fact Sheet #10.

Below-ground absorption field: A wastewater treatment system that applies septic tank effluent to the soil through a trench, bed or pit.

Field application: Application of wastewater to croplands and pastures by irrigation equipment or a liquid manure spreader.

Rapid surface infiltration: Application of wastewater to coarse-textured soils to encourage rapid percolation of water into the soil. Treated effluent drains rapidly to surface water or groundwater. A much greater portion of the applied wastewater percolates to groundwater than in other discharge methods.

Slow surface infiltration: Application of wastewater at one end of a gently sloping grass filter strip or terrace, so that it is treated as it slowly flows through the plant-soil system. A portion of the flow percolates to groundwater, and some is used by vegetation.

Soil permeability: The quality that enables the soil to transmit water or air. Slowly permeable soils have fine-textured materials, like clays, that permit only slow water movement. Moderately or highly permeable soils have coarse-textured materials, like sands, that permit rapid water movement.

Surface (overland) flow: The process of allowing wastewater to run slowly in a uniform layer over a grass-covered slope and relatively impervious clay soil. There is little percolation into the soil with this method because of the impervious soil. Water eventually flows into runoff collection ditches (for subsequent discharge).

Worksheet #10

Milking Center Wastewater Treatment: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.) For categories separated by "OR," choose only one category.
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for milking center wastewater treatment practices.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
NO DISCHARGE METHODS					
All wastewater to manure storage with waste applied to fields *	Wastewater delivered directly to liquid manure storage. No discharge expected.	_____	_____	Wastewater delivered to leaking manure storage.	____
**If using this practice, do not complete the rest of this worksheet. Put ranking for above section in the "total" box at the end of this chart.*					
PRETREATMENT (before discharge to soil absorption bed/field)					
Milking cleanup practices	First pipeline rinse captured and added to barn manure. Waste milk never poured down drain. Manure and excess feed removed from parlor before wash-down.	Waste milk poured down drain 10% of the time. Manure and excess feed usually removed before wash-down.	Waste milk poured down drain 50% of the time. Manure and excess feed often washed down drain.	All waste milk poured down drain. Manure and excess feed frequently washed down drain.	____
Storage/settling tank liner	Concrete or plastic lined.	Clay lined.	Cracked or porous liner.	No liner to prevent seepage.	____
Settling tank cleanout	Tank cleaned as needed or every 3-4 months.	Tank cleaned every 6 months.	Annual cleaning.	Tank never cleaned.	____
Liquid storage period following settling	9-12 months.	1 week to 9 months.	Less than 1 week.	No storage/settling. Wastewater discharged directly to soil as generated.	____
LOCATION OF DISCHARGE					
Distance from drinking water well	More than 250 feet downslope from well.	More than 250 feet upslope from well.	Less than 250 feet downslope from well.	Less than 250 feet upslope from well.	____

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
DISCHARGE METHODS *					
Field application	Applied to growing crops at 27,000 gallons per acre or less per week. Vegetation removed regularly.	Applied to uncropped fields at less than 27,000 gallons per acre per week. Vegetation removed occasionally.	Applied to cropped or uncropped fields at 27,000–54,000 gallons per acre per week. Vegetation never removed.	Applied consistently to same area at more than 54,000 gallons per acre per week. Vegetation never removed.	____
OR					**OR**
Surface flow	Applied in sheet to slowly permeable soil. Vegetation regularly removed.	Applied in sheet to slowly permeable soil. Vegetation sometimes removed.	Applied in sheet to slowly permeable soil. Vegetation not removed.	Applied in sheet to moderately or highly permeable soil. Vegetation not removed.	
OR					____
Slow surface infiltration	Combined with high-level pretreatment. Medium- or fine-textured soil (silt loam, loam, clay loams, clay) more than 10 feet to water table or bedrock. Extended rest period between loadings. Vegetation removed.	Combined with high-level pretreatment. Medium- or fine-textured soil (silt loam, loam, clay loams, clay) more than 3 feet to water table or bedrock. Extended rest period between loadings. Vegetation removed.	Some pretreatment. Medium- or fine-textured soil (silt loam, loam, clay loams, clay) more than 2 to 3 feet over bedrock or high water table. Vegetation not removed.	No pretreatment. 1 foot of medium- or fine-textured soil (silt loam, loam, clay loams, clay) above bedrock or high water table. Vegetation not removed.	**OR**
OR					____
Below-ground absorption field	No low-risk practice. System has at least a moderate risk of nitrate pollution.	Located on medium-textured soils (silt loam, loam) at least 3 feet thick. Soil dries out every few weeks.	Located on coarse-textured soil (sands, sandy loam) more than 5 feet thick. Soil stays wet year around. No air allowed to enter subsoil.	Located on medium or coarse-textured soil (silt loam, loam, sands, sandy loam) less than 5 feet to water table or creviced bedrock. No air allowed to enter subsoil.	**OR**
OR					____
Rapid surface infiltration	____	____	Combined with high-level pretreatment. Sandy loam or loamy sand soil 5 or more feet thick. Vegetation removed regularly.	No pretreatment. Sandy loam or loamy sand soil less than 5 feet thick. Vegetation not removed.	____
				TOTAL	

*Discharge methods are listed in order, beginning with the most effective treatment.

Use this total to calculate risk ranking on back page of worksheet.

What do I do with these rankings?

Step 1: Begin by determining your overall milking wastewater risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

_____ divided by _____ equals [ ]*
total of rankings; # of categories ranked; risk ranking

*Carry your answer out to one decimal place.

3.6–4=low risk, 2.6–3.5=low to moderate risk, 1.6–2.5=moderate to high risk, 1–1.5=high risk

This ranking gives you an idea of how your milking center practices **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis.** Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed milking wastewater risk ranking on page 1 of Worksheet #12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock characteristics), and Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:
- **Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- **Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- **Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- **High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly—projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #3, *Improving Milking Center Wastewater Treatment*, and consider how you might modify your farmstead practices to better protect your drinking water.

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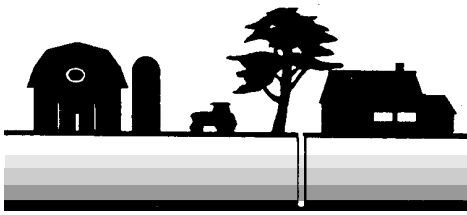

NEW JERSEY
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#11 Worksheet

Site Evaluation

Why is the site evaluation important?

How such farmstead practices as pesticide handling or manure management affect groundwater depends in part on the physical characteristics of your farmstead site: soil type, bedrock characteristics and depth to groundwater. That's why evaluating the soils and geologic characteristics of your farmstead is such an important step in protecting the groundwater you drink.

What's involved in completing this evaluation?

This evaluation has four parts:

Part 1: Evaluating your soil type and depth
Part 2: Evaluating subsurface and geologic materials, along with depth to groundwater
Part 3: Determining your overall site evaluation ranking (combining parts 1 and 2)
Part 4: Doing a farmstead diagram (optional)

Getting the information to complete parts 1 and 2 will require assistance from outside sources, such as your county Soil Conservation District or Extension office. How long this takes will vary depending on availability of information in your county. Once you have the information, though, it should take about an hour to complete the first three parts of Worksheet #11. (The farmstead diagram will take additional time.)

If some of the information you need isn't readily available, the worksheet contains instructions on how to proceed. The more information you can get, the better; but some information is better than no information.

How do soils affect the potential for groundwater contamination?

Soil characteristics are very important in determining whether a contaminant breaks down to harmless compounds or leaches into groundwater. Because most breakdown occurs in the soil, there is a greater potential for groundwater contamination in areas where contaminants are able to move quickly through the soil.

- Sandy soils have large "pore" spaces between individual particles, and the particles provide relatively little surface area for "sorption," or physical attachment of most contaminants. Large amounts of rainfall can percolate through these soils, and dissolved contaminants can move rapidly down through the soil and into groundwater.

For glossary, see page 15.

- Clay soils, on the other hand, are made up of extremely small particles that slow the movement of water and dissolved contaminants through the soil. Contaminants also stick tightly to clay surfaces.

While held securely to soil particles, contaminants are broken down by bacteria and other soil organisms and by chemical reactions with minerals and natural chemicals in the soil. Most of this chemical and biological breakdown takes place in the loose, cultivated surface layers, where the soil tends to be warm, moist, high in organic matter and well aerated.

Finally, soil organic matter is important in holding contaminants. Soils high in organic matter provide an excellent environment for chemical and biological breakdown of these contaminants—before they reach groundwater.

The natural purification capability of the soil is limited. Under certain conditions, heavy rainfall and chemical spills may exceed the soil's purification capacity, allowing leaching to occur. In such cases, the subsurface geologic material and the distance a contaminant must travel to groundwater are important factors in determining whether a contaminant actually reaches the groundwater.

How do subsurface and geologic materials affect the potential for groundwater contamination?

New Jersey soils were formed over sediments consisting of glacial till and outwash, weathered and disintegrated bedrock materials, and bedrock. The depth of these surficial deposits ranges from zero to hundreds of feet.

Depth to groundwater is important primarily because it determines not only the depth of material through which a contaminant must travel before reaching an aquifer but also the time during which a contaminant is in contact with the soil. As a result, where soil and surficial deposits are fairly deep, contaminants are less likely to reach groundwater.

Bedrock geology influences groundwater pollution when the water table is below the bedrock surface. Sedimentary rocks have a wide range of permeability—from highly permeable fractured dolomite to nearly impermeable shales and crystalline formations. Movement of pollutants in fractured limestone or dolomite is unpredictable, and pollutants can readily spread over large areas. Where bedrock material contains significant cracks and fractures, the depth and characteristics of soil and surficial geologic deposits largely determine the potential for groundwater contamination.

A word of caution

As with the results of the previous 10 assessment worksheets, use the rankings from this worksheet cautiously. Many factors affect whether or not a contaminant will leach to groundwater. There is no guarantee that a "low-risk" site will be uncontaminated—or that groundwater will become contaminated at a a "high-risk" site. The type of contaminant involved, how you handle and store potential contaminants (such as pesticides and manure), the location and maintenance of your well, and many other factors can affect the potential for groundwater contamination.

Part 1: Evaluating the Soil on Your Farmstead

To complete your soil evaluation, you will need a copy of your county's soil survey report. This report is available at most county offices of your Soil Conservation District, or Extension Service.

Step 1: Start by locating your farmstead on the aerial photos in the soil survey, note the soil mapping unit indicated on the photo, and look up information related to that soil in the written sections of the soil survey report.

If you have more than one soil mapping unit on your farmstead, rank each soil individually using this worksheet. Transfer soil mapping unit boundary lines from the soil survey to the farmstead diagram on page 14.

These rankings describe soil in native, undisturbed conditions. If your farmstead soil has been altered by human activities such as tiling or ditching, contact your county Extension agent or your SCD office for assistance.

Don't skip any parts of the worksheet. If you are not familiar with using soil surveys, you may need help completing Part 1. Ask your county Extension agent or your SCD specialist to help you find the following information:

- Location of your farmstead on the map and aerial photographs provided in the soil survey report.
- The soil mapping unit and soil series from the legend provided in the soil survey report.
- The soil series and/or soil mapping unit, including the profile description, as well as any other information in the report regarding depth to bedrock, depth to water, or organic matter content.
- The classification of the soil series, including family, subgroup and order.

Step 2: With this information in hand, you are ready to rank your soil according to seven characteristics. For each of the seven characteristics in the left column, find information about your soils in the soil survey. Then, match your soil description to the description in the middle column to determine your score. (For example, if the soil survey tells you that the texture of your soil is a clay loam, your score for that category would be 8.) Enter your score(s) in the space(s) indicated.

SOIL CHARACTERISTICS

For characteristics 1–6a that follow, consult the soil profile description and text, and the soil mapping unit text in the "Description of the Soils" section of your county soil survey.

		Score
1. Texture of surface (A horizon)	loam, silt loam, sandy clay loam, silt	9
	clay, sandy clay, silty clay, clay loam, silty clay loam	8
	loamy fine sand, loamy very fine sand, fine sandy loam, very fine sandy loam	4
	sand, loamy sand, sandy loam, organic materials (all "O" horizons), and all textural classes with coarse fragment class modifiers (such as "gravelly loam")	1
	Your score(s)	soil #1 _____ soil #2 _____ soil #3 _____

2. Texture of subsoil (B horizon. If there is no B horizon, consider the character of materials within approximately 2 feet below the A horizon.)	clay, sandy clay, silty clay, silt	10
	sandy clay loam, loam, silt loam, clay loam, silty clay loam	7
	loamy fine sand, loamy very fine sand fine sandy loam, very fine sandy loam	4
	sand, loamy sand, sandy loam, organic materials, and all textural classes with coarse fragment modifiers (such as "gravelly loam")	1
	Your score(s)	soil #1 _____ soil #2 _____ soil #3 _____

		Score
3. pH-Surface (A horizon)	6.6 or greater (the A horizon description will include one of the following terms: neutral, mildly alkaline, moderately alkaline or strongly alkaline)	6
	less than 6.6 (the A horizon description will include one of the following terms: slightly acid, moderately acid or strongly acid)	4
	Your score(s)	soil #1 _____ soil #2 _____ soil #3 _____
4. Depth of soil solum (depth of A and B horizons, minus inches of erosion from surface layer noted in soil survey description)	greater than 60 in.	10
	40-60 in.	8
	30-40 in.	5
	less than 30 in.	1
	Your score(s)	soil #1 _____ soil #2 _____ soil #3 _____
5. Soil drainage class	well drained	10
	well to moderately well drained	7
	moderately well drained	4
	somewhat poorly, poorly, and very poorly drained; somewhat excessively and excessively drained	1
	Your score(s)	soil #1 _____ soil #2 _____ soil #3 _____

6. Permeability of subsoil horizon

a. If your soil series description indicates that bedrock is found within 20 inches of the surface, or if bedrock is present in the soil mapping unit within 40 inches of the surface, use the following ranking:

bedrock at 20–40 inches	3
bedrock within 20 inches	1

(Record score on next page.)

For 6b and 7, consult the table "Classification of Soil Series" in your soil survey.

b. For soils other than those listed in 6a, look in the "family" column of the "Classification of Soil Series" table. To determine permeability of the subsoil horizon, use the particle-size class in this column and find the rank for it below. If there is more than one particle-size class (such as "fine silty" over "sandy" or "sandy-skeletal"), choose the underlying material (such as "sandy" or "sandy-skeletal").

moderately low, low to very low (fine, very fine, clayey, clayey-skeletal)	10
moderate (fine loamy, fine silty, coarse silty, loamy-skeletal)	8
high (sandy or sandy-skeletal, coarse loamy)	3
very high (coarse sand, fragmental, sandy; or psammentic suborder)	1

Your score(s) _____ _____ _____
soil #1 soil #2 soil #3

7. Organic matter content Ap horizon or 0–6" depth from surface

a. If the "Classification of Soil Series" table classifies your soil series as Histosols, Aquic suborder, or Lithic, Aquollic and Aquic subgroup, use the ranking "1." (These are organic soils, wet soils or soils with less than 20 inches of material over bedrock. See a county specialist if your soil falls into one of these categories.)

OR

b. If your soil does not fall into the above groups, obtain the organic matter percentage from a soil test report for your farm, the chart of "Soil Properties Significant to Engineering" found in some soil surveys, or your county SCD office.

Organic matter (%)	
high (4-10%)	10 8
medium (2-4%)	7
moderately low (1-2%)	5
low (0.5-1%)	3
very low (less than 0.5%)	1

Your score(s) _____ _____ _____
soil #1 soil #2 soil #3

(Lower your score by one level if the soil mapping unit description in the soil survey indicates erosion, unless you take organic matter from soil test results.)

Step 3: Add your seven scores together for each soil you ranked.

TOTALS _____ _____ _____
soil #1 soil #2 soil #3

Step 4: In the box below, find your score in the listed ranges in the left column. Then identify your soil's "potential to protect groundwater" and find the rank number assigned to your score.

Total Score	Soil's Potential To Protect Groundwater	Rank
51+	Best	4
41-50	Good	3
31-40	Marginal	2
0-30	Poor	1

Step 5: Enter rank number(s) here:

SOIL #1 RANK ☐

SOIL #2 RANK ☐

SOIL #3 RANK ☐

Step 6: Understand your soils ranking(s).

A soil with more than 50 points (ranking #4) probably is a deep, medium- or fine-textured, well-drained soil which contains 4-10 percent organic matter. Potential contaminants move slowly through the soil, allowing them to become attached to soil particles. Sunlight, air and microorganisms then have the potential to break down the contaminant into harmless compounds. The groundwater contamination risk level is low.

A soil with a score of 30 or less (ranking #1) is probably a coarse, sandy, extremely well-drained soil with less than 1 percent organic matter. Such a soil would enable most contaminants to move rapidly down toward the water table.

Overall, the higher your ranking number, the more likely that your soil conditions **will help to reduce** the risk of groundwater contamination from farmstead practices.

Part 2: Evaluating Subsurface and Geologic Materials on Your Farmstead

This part looks at the subsurface and geologic materials beneath your farmstead's soils. Completing the worksheet will give you a much clearer picture of your site's potential for keeping pollutants out of groundwater.

For example, the soil evaluation might have indicated a moderate potential for protecting groundwater. However, if the soils are fairly shallow and lie over fractured bedrock, the potential for groundwater contamination at the site is probably higher than indicated by the soil evaluation alone.

This part requires only two items of information: your site's subsurface geologic material and depth to groundwater. Unfortunately, information on subsurface geologic material, as well as depth to water, is often difficult to obtain:

- It is sometimes available from the soil survey report, although this differs from county to county.

- You can also obtain it from your well construction report. If the well installer filled out the report correctly it should be on file with the NJ Department of Environmental Protection.

- You can find additional information from other well construction reports in your area, hydrogeological reports and groundwater flow maps for some counties, which are also available from the Geological Survey. These are generalized maps, though, and may not accurately reflect the depth to groundwater or direction of flow at your farmstead.

- Published geological reports for your county may show the type of geologic material in your area.

Try not to skip any steps in this part. Ask your county Extension agent or your NRCS or SCD specialist to help you gather the information and provide assistance in completing Part 2.

If the information for this part is not available, though, you may skip to Part 3 on page 10. The instructions will tell you how to proceed without it.

Step 1: Find the information you need—from the soil survey and well construction reports—to identify 1) the geologic materials beneath your farmstead; and 2) depth to groundwater.

Step 2: Match the information on your site's geology to one of the descriptions in the left column below. (You will be choosing **only one description** from the entire table that follows.)

If your well construction report describes more than two types of geologic material below 5 feet, ask for help in filling out this section from your county Extension, NRCS or SCD office.

Step 3: When you have chosen the description that best matches your site's geology, read across to the right until you get to the appropriate "depth to groundwater" for your site and circle that score for your farmstead.

For example, you may determine from your well construction report that geologic material beneath your farmstead consists of 30 feet of coarse-textured, unconsolidated material over fractured limestone bedrock, and that depth to groundwater is 15 feet. Looking down the left column to find your category, and then going across to the right, you see that your rank is "1."

Geological Material (more than 5 feet below ground)	Depth to Groundwater (in feet)			
	0-10'	11-30'	31-50'	More than 50'
•Fine-textured materials (more than 45' of materials)				
silt, clay or shale	3	3	4	4
•Till (more than 45' of materials)				
dense- or fine-textured till (unsorted)	3	3	4	4
medium- to coarse-textured till (unsorted)	1	2	3	4
•Unweathered or unfractured metamorphic, igneous, limestone or sandstone	2	2	3	4
•Medium- to fine-textured, unconsolidated materials over fractured bedrock				
33–45' of materials	2	2	3	3
21–32' of materials	1	1	2	3
6–20' of materials	1	1	2	2
0–5' of materials	1	1	1	1
•Coarse-textured, unconsolidated materials over fractured bedrock				
33–45' of materials	1	1	2	2
21–32' of materials	1	1	1	2
0–20' of materials	1	1	1	1
•Sand and gravel (more than 45' of materials)				
greater than 12% silt or clay (sorted)	1	1	2	2
less than 12% silt or clay (sorted)	1	1	1	1
•Karst, highly permeable or fractured rock (more than 45' of materials)	1	1	1	1

There may be other situations that do not fall into the above categories (such as unconsolidated materials over limestone/shale/sandstone sequence). Determining a ranking for such situations requires a judgment call.

Step 4: Enter your circled number here: SUBSURFACE RANK ☐

Step 5: Understand your subsurface and geology ranking. The table below shows what your rank means.

Rank	Level of Risk of Groundwater Contamination
4	Low
3	Low/moderate
2	High/moderate
1	High

A ranking of "4" shows that the subsurface material has the best potential to protect groundwater. This material has small pore spaces, groundwater is at least 10 feet from the soil surface, and the risk of groundwater contamination is low.

A ranking of "1" indicates a material with poor potential to protect groundwater. Its large pore spaces allow contaminants to move downward easily, increasing the risk of groundwater contamination. In highly fractured rock or in very coarse-textured, unconsolidated materials, the depth to groundwater doesn't seem to matter, because some contaminants will flow through the pore spaces with very little slowdown.

Overall, the higher your ranking number, the more likely that your farmstead's geologic conditions and depth to groundwater **will help to reduce** the risk of groundwater contamination from farmstead practices.

Part 3: Combining Your Farmstead's Soil and Subsurface/Geologic Rankings

Combining the rankings from parts 1 and 2 will provide you with a good overall ranking of your farmstead site's potential to keep pollutants from moving down to groundwater.

Step 1: Transfer your boxed rankings from the soil evaluation (Part 1, page 7) and the subsurface/geologic evaluation (Part 2, above) to the boxes below:

Soil #1 Rank ☐ Subsurface Rank ☐

Soil #2 Rank ☐

Soil #3 Rank ☐

Step 2: The table below shows the overall level of groundwater contamination risk associated with your farmstead site conditions. Find your two numbers **written in the correct sequence (soils rank-subsurface rank)** and circle the sequence.

LEVEL OF RISK

Low Risk (Rank 4)	Low-Moderate Risk (Rank 3)	High-Moderate Risk (Rank 2)	High Risk (Rank 1)
1-4	1-3	2-2	1-1
2-3	3-2	4-1	1-2
2-4	4-2		2-1
3-3			3-1
3-4			
4-3			
4-4			

Step 3: Look above the sequence you circled to find your risk level and your ranking. (For example, if your numbers are 3-2, your site is in the low-moderate risk column and your ranking is 3.)

Step 4: Enter your combined ranking here. (If you calculated more than one soils ranking, calculate a combined ranking for each soils ranking.)

COMBINED RANKING #1 ☐

COMBINED RANKING #2 ☐

COMBINED RANKING #3 ☐

Step 5: Understand your combined ranking.

In general, a site with a combined ranking of 4 (low groundwater pollution risk) will have a soil with a good capacity to hold and break down contaminants. Its subsurface conditions will also keep contaminants from reaching the water table. Under certain conditions, however, such as spills, poor management and heavy rainfall, contaminants may reach groundwater.

On the other hand, if you carefully manage a site with a combined ranking of 1 (high groundwater pollution risk), you may not affect your drinking water. **Both site characteristics and your management practices are of equal importance.**

Your three site ranking numbers (soils ranking, subsurface ranking and combined ranking) will be used again in Worksheet #12. They will be combined with your risk rankings for specific activities from the 10 assessments (such as pesticide handling) to give you a more accurate assessment of potential groundwater contamination on your farmstead.

If you have more than one soil on your farmstead, you will need to transfer individual soil rankings and combined rankings to Worksheet #12. It will be especially important for you to complete Part 4 of this worksheet if you have more than one soil on your farmstead, so that you can link particular site vulnerability with each farmstead activity.

You may now proceed with Part 4 of this worksheet, or you may go directly to Worksheet #12.

Part 4: Learning More About Your Site

Sketching a diagram of your farmstead can provide useful information to help you understand how the physical layout and site characteristics of your farmstead may contribute to—or lessen—the effects of possible contaminants reaching your drinking water.

The diagram can show the location of wells, septic drainfields, manure storage areas, direction of groundwater flow, surface water, buildings, and other activities that may contribute potential contaminants. Along with the soil and subsurface evaluations, the diagram will help point out aspects of your farmstead that may present a hazard to your drinking water.

Step 1: Begin by looking at the sample diagram on page 13.

Step 2: Then diagram your farmstead on the blank grid provided on page 14. Include all of the following that apply to your farmstead:

- all buildings and other structures (home, barn, machine shed)
- wells and unused wells
- septic system (tank, dry well, absorption field and/or ditch)
- cowyard/livestock yard
- manure storage (temporary and permanent)
- underground petroleum storage tank
- above-ground petroleum storage tank
- pesticide and fertilizer storage, handling and mixing areas
- silage storage
- milkhouse waste disposal system (tank, field and/or ditch)
- farm dumps
- vehicle maintenance areas
- liquid disposal areas
- tiles, surface intakes and open ditches

You can use the same diagram to indicate surface water (ponds and streams), direction of landslope, groundwater flow, and the different soil types found around your farmstead. Generally, groundwater follows surface topography and moves downhill towards surface water. (For more information on determining groundwater flow direction at your farmstead, see *How To Determine Groundwater Flow Direction* from the Nutrient and Pest Management Program, 1575 Linden Drive, Madison, Wisconsin 53706.)

Step 3: Use your diagram to note which activities or structures on your farmstead have a greater likelihood of allowing contaminants to reach groundwater. This information should help prepare you to make better decisions about your farmstead activities and structures and how they might be affecting your drinking water.

When you've completed the diagram of your farmstead, go on to Worksheet #12.

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RUTGERS

The New Jersey Farmstead Assessment System is a cooperative project of the USDA Natural Resources Conservation Service, Rutgers Cooperative Extension, and New Jersey Department of Environmental Protection.

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NJFAS–11 *Site Evaluation* 10/95

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Glossary

Site Evaluation

These definitions may help clarify some of the terms used in Worksheet #11.

Igneous: Rock formed by cooling and solidification of liquid parts of the rock portion of the earth.

Karst: Topography formed over limestone or dolomite where there are sinkholes, caverns and lack of surface streams.

Metamorphic: Rock formed by recrystalization of igneous or sedimentary rock under great pressure and heat, and by means of chemical reactions.

Organic matter: Matter containing compounds of plant or animal origin, measured by organic carbon content.

Permeability: The quality that enables soil to transmit water or air.

Soil classification: A shorthand system to provide detailed soil descriptions. Includes such groupings as *order, suborder, subgroup* and *family*.

Soil drainage class: The conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soils, as opposed to human-altered drainage. Different classes are described by such terms as *excessively drained, well-drained* and *poorly drained.*

Soil horizon: A layer of soil, approximately parallel to the surface, that has distinct characteristics, such as color, structure and texture. Described in shorthand form by letters, such as *A, B* and *C*.

Soil mapping unit: A soil or combination of soils delineated on a map and, where possible, named to show the taxonomic unit or units included.

Soil series: The basic unit of soil classification, consisting of soils that are essentially alike in all major profile characteristics.

Soil solum: The upper and most weathered part of the soil profile, consisting of the *A* and *B* horizons.

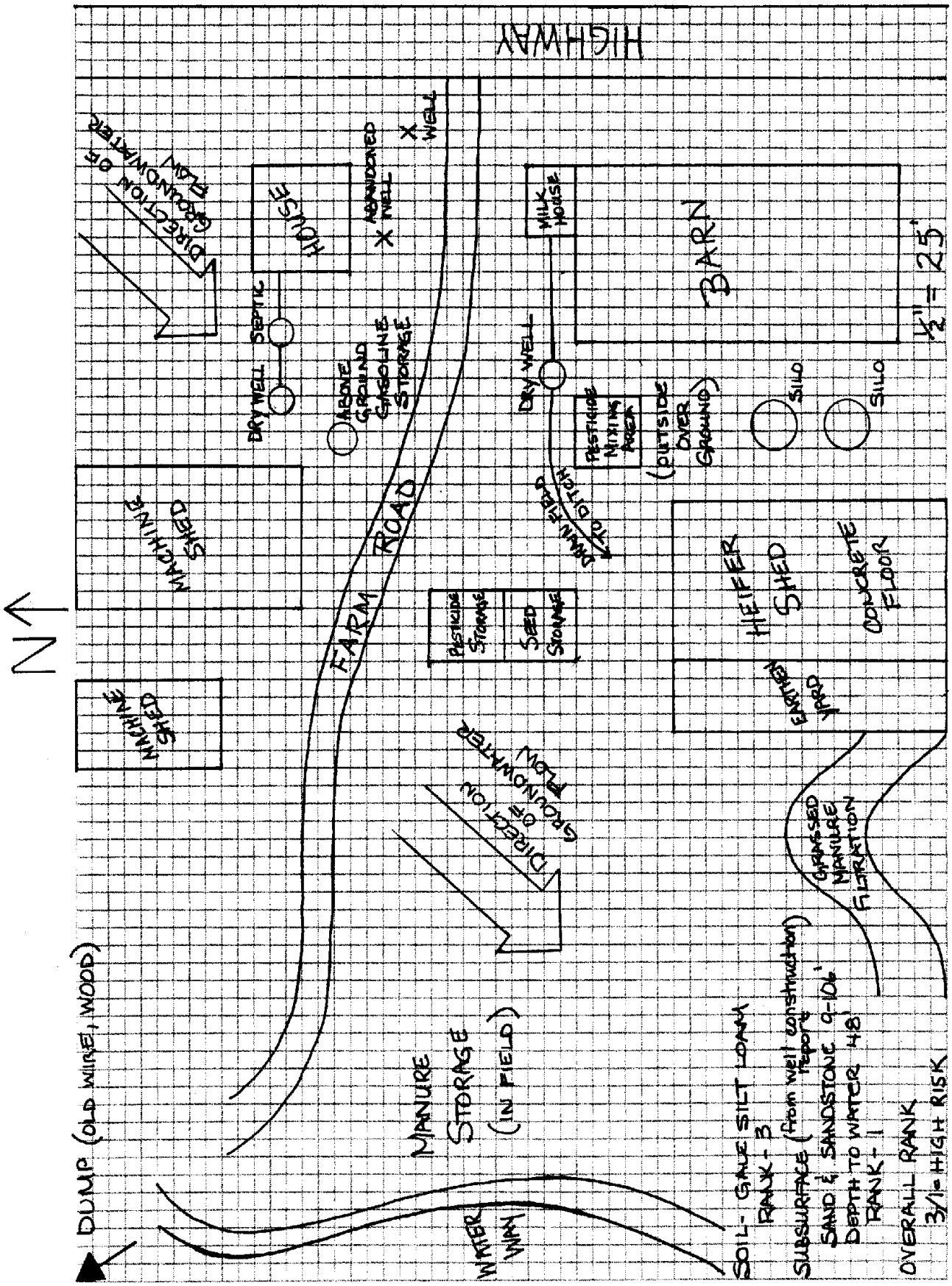
Soil texture: The relative proportions of the various soil separates (sand, silt and clay) in a soil. Described by such terms as *sandy loam* and *silty clay*.

Solum: The layer of soil which lies above the parent material in which the natural processes of soil formation take place.

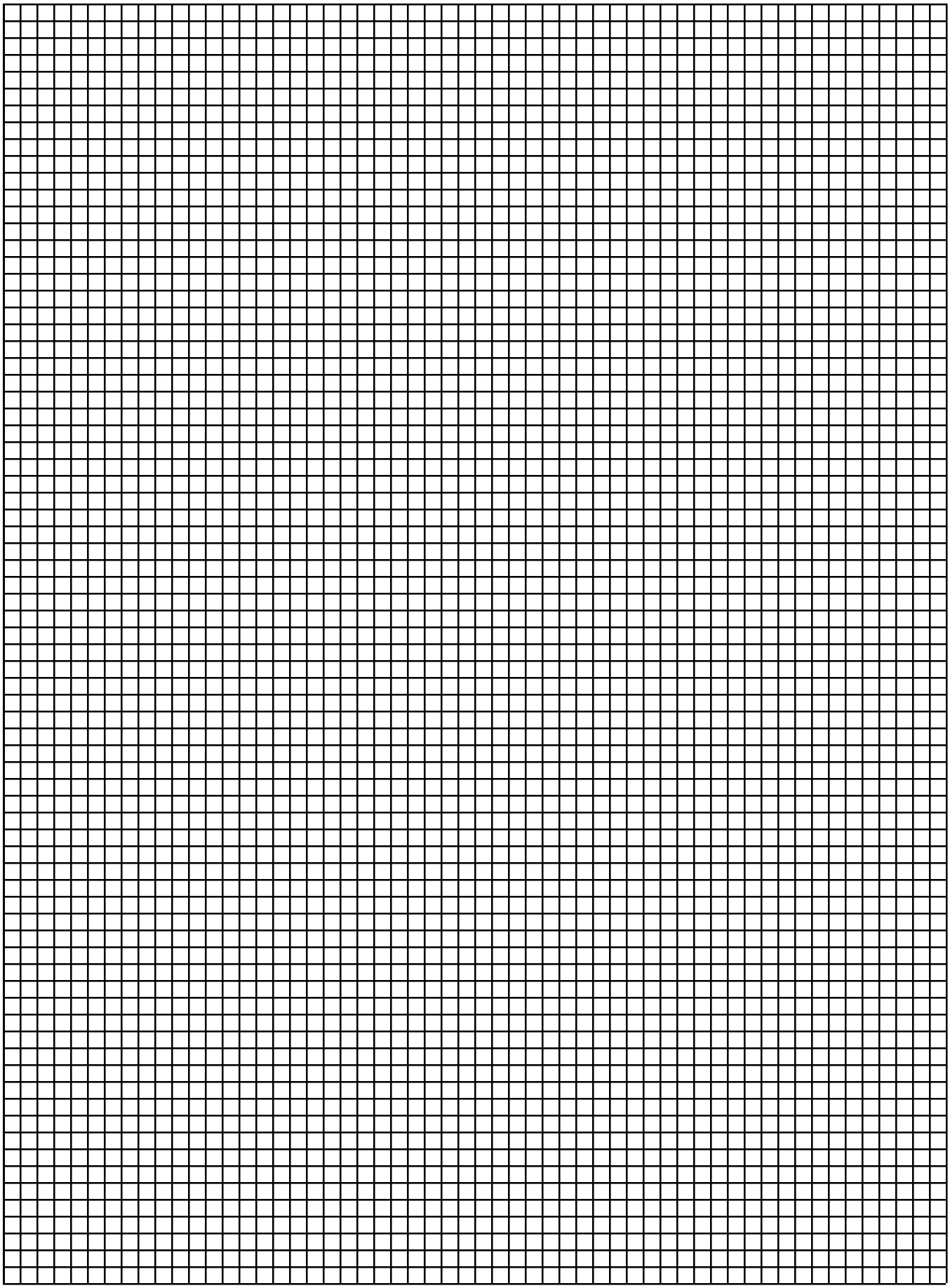
Subsoil: The *B* horizon, roughly the part of the solum below the depth of plowing.

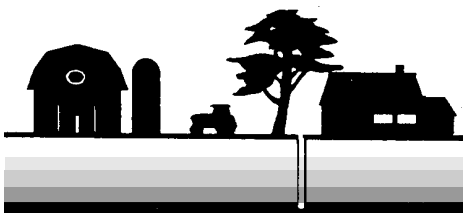
Till: Unstratified glacial drift deposited by ice and consisting of clay, silt, sand, gravel and boulders, intermingled in any proportion.

SAMPLE FARMSTEAD DIAGRAM



YOUR FARMSTEAD DIAGRAM





NEW JERSEY
FARM-A-SYST
A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#12 Worksheet

Overall Farmstead Assessment

As an overall summary of the work you've already done to assess your farmstead structures and activities, this worksheet has two parts:

Part 1: Your first step will be to combine the individual risk rankings for various farmstead structures and activities (from Worksheets 1-10) with your soils ranking and subsurface geologic ranking from Worksheet #11. Combining these rankings will give you a much more accurate picture of the groundwater contamination risk of your various farmstead practices as they are affected—for better or worse—by your particular site conditions.

Part 2: Your second step will be to list any individual farmstead activities from your 10 worksheets that you ranked with 1's (high risk). You've probably been adding to this list as you've completed each worksheet. In this part, you will be looking at individual concerns, giving you very specific information about the groundwater contamination risk of particular farmstead practices.

Getting Started

If you have not already done so, take the boxed risk rankings from the top of the scoring sheet of each of the 10 worksheets you completed and transfer them into the box below. **(For the worksheets you did not complete, leave the boxes blank.)**

Then take your three site evaluation rankings from Worksheet #11 (soils ranking, subsurface ranking and combined ranking) and transfer them into the box below, too. (If you have fewer than three site rankings, just record the ones you have and leave the others blank.) **The figures in this box are all you need to complete parts 1 and 2 of this worksheet.**

FARMSTEAD RISK RANKINGS (from Worksheets 1-10)		SITE RANKINGS (from Worksheet #11)	
#1: Well condition	_____	Soils ranking #1	_____
#2: Pesticide handling	_____	Soils ranking #2	_____
#3: Fertilizer handling	_____	Soils ranking #3	_____
#4: Petroleum storage	_____		
#5: Hazardous waste management	_____	Subsurface ranking	_____
#6: Household waste-water treatment	_____	Combined ranking #1	_____
#7: Livestock waste	_____	Combined ranking #2	_____
#8: Livestock yards	_____	Combined ranking #3	_____
#9: Silage storage	_____		
#10: Milking center waste-water	_____		

Part 1: Combining Risk Rankings with Site Rankings

Step 1:To calculate overall risk rankings for each of the 10 worksheets you completed, take your farmstead risk rankings from the box on page 1, add them to the appropriate lines below, and calculate the average of the two numbers.

In some cases, you will use the combined site evaluation rank. In other cases, you will use only the subsurface ranking (for example, when you are calculating the risk associated with a septic system's soil absorption field or an in-ground manure storage pit).

If you don't have a combined site or subsurface rank for your farmstead, use the soil rank. Although subsurface information, either by itself or in a combined site rank, gives a more accurate picture of your site's ability to hold and break down contaminants, **soil rank is an acceptable substitute for the combined site rank** if subsurface information for your site is unavailable.

If you have more than one soil on your farmstead—and therefore more than one soils ranking or combined ranking to transfer—you may need to refer to your farmstead diagram in Worksheet #11 to see which soil is associated with each farmstead structure or practice. For each category below, use the appropriate soil ranking or combined ranking.

#1: DRINKING WATER WELL CONDITION

Rank from Worksheet #1 _____ = _____ Overall Drinking Water Well Risk Ranking
(Do not use a site rank.)

#2: PESTICIDE STORAGE AND HANDLING

Rank from Worksheet #2 _____
Combined Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Pesticide Risk Ranking

#3: FERTILIZER STORAGE AND HANDLING

Rank from Worksheet #3 _____
Combined Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Fertilizer Risk Ranking

#4: PETROLEUM PRODUCT STORAGE

(Select **one or both** categories below, as appropriate to your site.)

ABOVE-GROUND STORAGE

Rank from Worksheet #4 _____
Combined Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Above-Ground Storage Risk Ranking

BELOW-GROUND STORAGE

Rank from Worksheet #4 _____
Subsurface Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Below-Ground Storage Risk Ranking

#5: HAZARDOUS WASTE MANAGEMENT

Rank from Worksheet #5 _____
Combined Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Hazardous Waste Risk Ranking

#6: HOUSEHOLD WASTEWATER TREATMENT

(Select **one or both** categories below, as appropriate to your site.)

SURFACE APPLICATION (includes holding tanks)
Rank from Worksheet #6 _____
Combined Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Surface Household Wastewater Risk Ranking

SUBSURFACE APPLICATION
Rank from Worksheet #6 _____
Subsurface Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Subsurface Household Wastewater Risk Ranking

#7: LIVESTOCK WASTE STORAGE

(Select **one or both** categories below, as appropriate to your site.)

ABOVE-GROUND STORAGE
Rank from Worksheet #7 _____
Combined Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Above-Ground Livestock Waste Storage Risk Ranking

BELOW-GROUND STORAGE
Rank from Worksheet #7 _____
Subsurface Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Below-Ground Livestock Waste Storage Risk Ranking

#8: LIVESTOCK YARDS MANAGEMENT

Rank from Worksheet #8 _____
Combined Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Livestock Yard Management Risk Ranking

#9: SILAGE STORAGE

(Select **one or both** categories below, as appropriate to your site.)

ABOVE-GROUND STORAGE

Rank from Worksheet #9 _____
Combined Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Above-Ground Silage Storage Risk Ranking

BELOW-GROUND STORAGE

Rank from Worksheet #9 _____
Subsurface Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Below-Ground Silage Storage Risk Ranking

#10: MILKING CENTER WASTEWATER TREATMENT

(Select **one or both** categories below, as appropriate to your site.)

ABOVE-GROUND DISPOSAL

Rank from Worksheet #10 _____
Combined Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Above-Ground Milking Center Wastewater Treatment Risk Ranking

BELOW-GROUND DISPOSAL

Rank from Worksheet #10 _____
Subsurface Site Rank _____
TOTAL _____ divided by 2 = _____ Overall Below-Ground Milking Center Wastewater Treatment Risk Ranking

Step 2: Interpret and compare your overall risk rankings. For each ranking in the blanks above, use the box below to assess your overall groundwater contamination risk from that area of activity on your farmstead. This infor mation should give you a general idea of areas of concern that need addressing.

INTERPRETING YOUR SCORES

Ranking	Groundwater Contamination Risk
3.6–4	Low
2.6–3.5	Low-Moderate
1.6–2.5	Moderate-High
1–1.5	High

Keep in mind, however, that each of these rankings is based on an averaging of many individual activities and structures—such as all of your specific pesticide storage and handling practices in Worksheet #2. Don't use these overall rankings to assess or predict the amount—if any—of actual groundwater contamination on your farmstead. An actual determination of groundwater contamination requires an intensive onsite investigation.

The rankings do provide an overall assessment of the risk level of various farmstead activities and how site conditions affect these levels of risk. Part 2 focuses on specific activities or structures that you ranked as 1's on your individual worksheets.

Part 2: Identifying Specific High-Risk Activities

Step 1: If you haven't already done so, go back to each of the 10 worksheets you completed and identify any individual activities or structures that you ranked as 1's (high risk). You may have already done this as you completed each worksheet.

Step 2: List each activity of concern on the chart on pages 6 and 7. Begin by filling in the first three blanks (to the left of the double vertical line on the chart). Do this for each of the 10 worksheets you completed.

Step 3: Then, for each activity that you listed, fill in the "response options" and "taking action" sections to the right of the double vertical line on the chart.

- **Response options**: Check one of the two boxes: either "immediate action possible" or "further planning required." This should be a quick assessment of whether a change in practice requires major effort and money (like relocating a well or building a pesticide storage facility) or whether it "just" requires a change in practice (like cleaning a livestock yard more often or being sure that stored pesticides are clearly labeled).

- **Taking action:** Decide right now on a possible first step to take to begin to address each concern listed. It might be patching old pesticide containers, or cleaning your milking center settling tank right away, or making a first phone call to get information about relocating and redesigning your pesticide storage area.

The first step for a concern that you identified as "immediate action possible" should, of course, be easier than a first step for a major or costly project. But, whatever the area of concern, what's an initial step you can take to begin to address each of the high-risk concerns you have listed?

Step 4: Keep this list handy and refer to it often. It provides important information for you as you plan how to begin to more effectively protect the groundwater that provides drinking water to you and your family.

A Few Final Words

After doing all you can to reduce the risk of groundwater contamination on your farmstead, you may still have well test results showing high levels of some contaminants.

- One factor could be activities away from the farmstead. Nitrates could be leaching from your fields, for example.

- Problems could originate in more distant areas, too. Depending on the geology of an area, activities miles away can result in groundwater contamination flowing slowly toward your property and the groundwater you drink. It may take years for a spill on someone else's land to show up in your well. Leaking petroleum tanks, farm dumps and waste pits away from your property all have the potential to affect your drinking water—**just as activities on your farmstead have the potential to affect the drinking water of your neighbors and even others living miles away from you.**

You may want to keep track of potential sources of groundwater contamination beyond your farmstead. You may also want to encourage your neighbors to use this farmstead assessment.

On the other hand, despite the fact that results of your farm well water quality tests are quite good, your worksheet results may show the need for changes. Your well may be upslope from your farmstead, so the water drawn from that area is not affected by your activities. That doesn't mean, however, that contaminants are not entering the groundwater and affecting someone else's drinking water. You need to be as careful as you can about farmstead management, especially if your farmstead is on land vulnerable to groundwater contamination.

You may have quite a few "high-risk" pollution potential rankings. You may also be concerned about your well water quality test results and want to know more about how your farmstead activities might have influenced them. If so, after completing the Farmstead Assessment System, you may want to ask an expert to conduct a detailed site analysis and look more closely at potential sources to determine the causes of the contamination.

For further information about potential sources of groundwater contamination on your farmstead, contact your county Extension, Natural Resources Conservation Service or your Soil Conservation District office.

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The New Jersey Farmstead Assessment System is a cooperative project of the USDA Natural Resources Conservation Service, Rutgers Cooperative Extension, and New Jersey Department of Environmental Protection.

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High-Risk Activities

A listing of individual activities or structures that ranked "1" on your Farm•A•Syst worksheets

After completing **each** of the 10 assessments appropriate to your farmstead, list **any individual activities or structures** that you ranked as "1" (high risk). Fill in the worksheet number, the worksheet name and the individual activity of concern. Don't fill in the blanks to the right of the double line. You'll do that later, when you're completing Worksheet #12.

Work-sheet number	**Worksheet name**	**Individual activity identified as being high risk (1)**	**Response Options** (check one)		**Taking Action** (proposed first step to address concern)
			Immediate action possible (change in practice only; cost not a factor)	Further planning required (requires major structural improvement or relocation; involves major effort or high cost)	

(Continue listing on next page as necessary.)

Work-sheet number	**Worksheet name**	**Individual activity identified as being high risk (1)**	**Response Options** (check one)		**Taking Action** (proposed first step to address concern)
			Immediate action possible (change in practice only; cost not a factor)	Further planning required (requires major structural improvement or relocation; involves major effort or high cost)	

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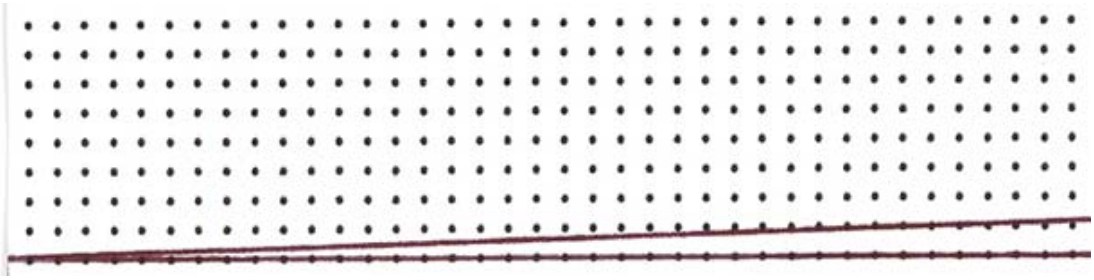
Determining Slope:

How to estimate slope classes for your Animal Waste Management Plan

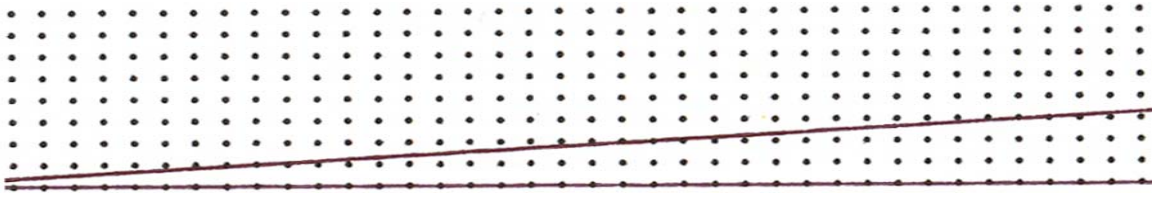
A) **Slight** - Less than 3 feet rise or fall in each 100 feet or 0-3% slope. This is not a limiting factor.
B) **Moderate** - 3 to 8 feet in each 100 feet or 3-8%. ***This could be is a limiting factor.***
C) **High** - 9 to 12 feet in each 100 feet or 9-12%. ***This could be a limiting factor.***
D) **Extreme** - More than 12 feet in each 100 feet or over 12%. ***This is a serious limiting factor.***

Examples;

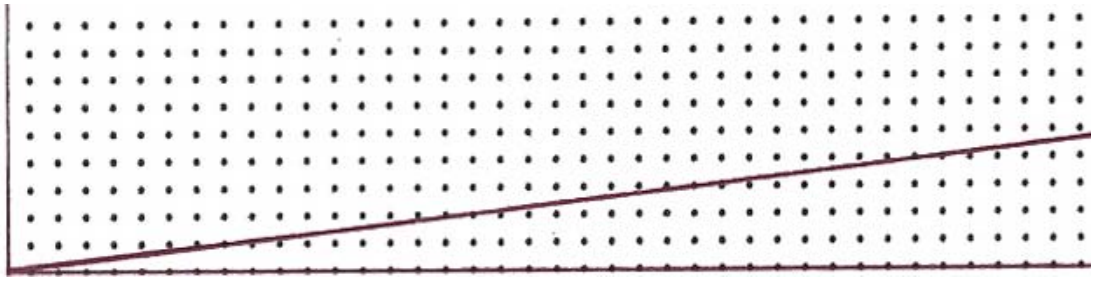
1. It is possible to "eyeball" your slopes according to the following grids which may allow you to make a relative estimate of slope. Remember that it may be difficult to compare the slopes on your farms with the small graphs shown here.



3% Slope



8% Slope

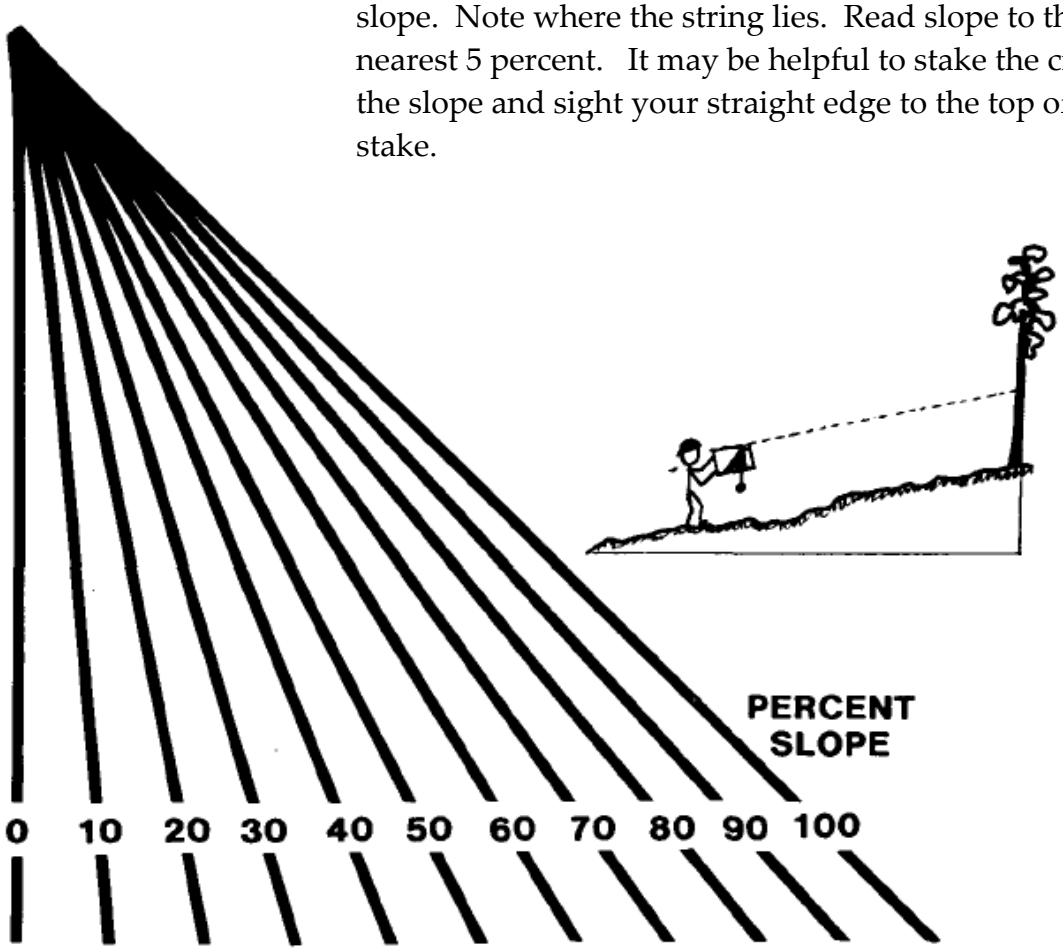


12% Slope

2. The following tool may be useful in determining field slope. It is probably accurate to about 5%.

Attach a copy of this diagram to a board or straight edge. Notch the board where the lines converge. Hang a plumb line from the notch.

Sight along the edge of the straight edge parallel to the slope. Note where the string lies. Read slope to the nearest 5 percent. It may be helpful to stake the crest of the slope and sight your straight edge to the top of the stake.



(*Fire Management Notes. 1988. United States Department of Agriculture. Forest Service. Volum 49. No. 3.*)

3. Estimates based on soil maps.
http://websoilsurvey.nrcs.usda.gov/app/