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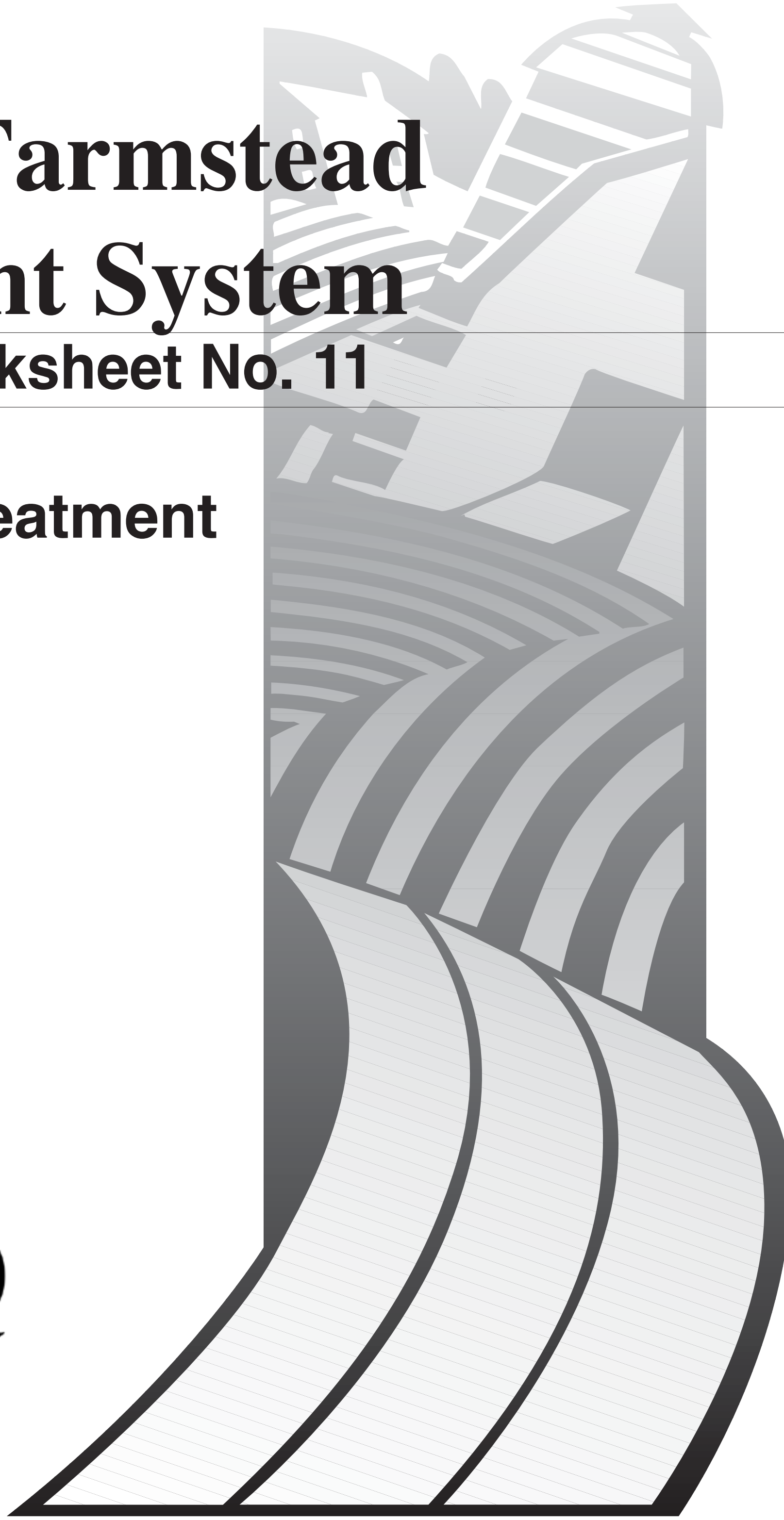
VIRGINIA FARM*A*SYST

Virginia Farmstead Assessment System

Fact Sheet/Worksheet No. 11

Milking Center Wastewater Treatment



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VIRGINIA STATE UNIVERSITY

INTRODUCTION TO THE VIRGINIA FARMSTEAD ASSESSMENT SYSTEM

Water wells and springs are the most common sources of private household water for rural homesites and farmsteads in Virginia. However, activities related to these environments may contribute to contamination of the groundwater which so many rural residents depend upon for household water. For example, farm facilities such as chemical and fuel storage tanks, livestock and poultry holding areas, irrigation systems, and septic systems are sometimes located near the farmstead well or spring. Retail agribusinesses and enterprises such as nurseries, greenhouses and direct farm markets are unique operations that may have production, storage, and sales areas close to a water well which may be also exposed to the general public. Inadequate maintenance of well-head and farmstead facilities and/or poor farmstead management practices can contribute to contamination of groundwater and drinking water supplies. Rural residents need to be aware of threats to water quality and of measures that will reduce or eliminate contamination of household water supplies.

To meet these challenges, as a part of a nationwide effort, the Virginia Farmstead Assessment System (Virginia Farm *A* Syst) was developed. This voluntary, educational/technical program is mainly a preventive program designed to: (1) provide safe, drinking water and thereby protect the health of Virginia's rural residents; (2) reduce potential land owner liability due to groundwater contamination which may result from farmstead or retail agribusiness activities; and (3) maintain or enhance farm property values throughout Virginia.

The Farm *A* Syst program is designed to guide an individual through a step-by-step evaluation of factors such as soils and geologic properties of the site, well-head or spring condition, and farmstead management practices that may impact the quality of his/her groundwater/drinking water supply. The program participant can identify potential pollution sources, and make an assessment of pollution risks to existing water supplies. Based on identified risks, corrective measures and/or management practices can be selected to reduce the likelihood of contamination.

This assessment is conducted by using a series of fact sheets and worksheets. A fact sheet /worksheet set deals with a specific pollution factor or source such as household wastewater, chemical storage, etc. Fact sheets are explanatory materials that contain background information on factors that affect groundwater quality, and legal requirements which address water quality and environmental protection. Worksheets are provided to determine ranking of potential pollution risks for each problem described in the fact sheets.

Each worksheet consists of a series of questions related to a specific farmstead feature or management practice such as well-head condition, fertilizer/chemical use, soils and geology of the site, etc. Based on the response to each question, a numerical ranking which indicates relative groundwater pollution risks is calculated. These rankings can then be used as a guideline to identify and prioritize corrective measures that will reduce or eliminate the potential for groundwater/drinking water pollution.

Users of this package need only to select those fact sheets/worksheets which are applicable to his/her activities or specific situations. For example, those evaluating rural, non-farm, homesite water supplies may select Fact Sheets/ Worksheets No. I -No. 5. Fact sheets/worksheets that will be important to many agribusinesses are No. 1 - No. 7. Some farming operations may relate to all worksheets. It is strongly recommended that the fact sheet corresponding to each worksheet be reviewed before using the worksheet itself. After developing a good understanding of each fact sheet, it will take about 15-30 minutes to complete each worksheet except for Worksheet No. 1 (Soils and Geology). To accomplish the task one needs only a pencil and a simple calculator. Each worksheet provides directions for completing the task. In addition, all users will need Worksheet No. 13 (Overall Risk Assessment). Fact Sheet/Worksheet No. 14 (Management of Irrigation Systems) was developed as an addendum chapter to the original Virginia Farm *A* Syst package and can be used in a stand alone manner or incorporated into the Overall Risk Assessment (Worksheet No. 13) as part of a complete farm assessment.

The Virginia Farm * A * Syst package contains the following Fact Sheets and Worksheets:

ACKNOWLEDGMENTS

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Milking Center Wastewater Treatment

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Wastewater from the dairy milking center includes wastes from the milking parlor (manure, feed solids, hoof dirt) and milk house (bulk tank rinse water and detergent used in cleaning). The amount of wastewater generated varies with milking preparation, equipment use, and the number of cows. A milking center for a 100-cow free-stall operation may use anywhere from 100 to 1000 gallons of water per day, and sometimes more.

Milking center wastewater contains organic matter, nutrients, chemicals, and microorganisms. Poorly designed or mismanaged waste disposal systems can contaminate surface and groundwater with ammonia, nitrate, phosphorus, detergents and disease-causing organisms.

It is illegal under Virginia Department of Environmental Quality (DEQ) regulations to allow milking center wastewater to be discharged off the property or into state waters. Water supplies are least likely to be contaminated if appropriate management procedures are followed.

Proper handling and disposal practices are essential to avoid risking water contamination and health problems. From an environmental perspective, delivery of milking center wastewater to a manure storage facility, if available for treatment and eventual land application, makes the most sense. Common methods for milking center wastewater treatment and management are described below.

I. COMBINED WASTE MANAGEMENT METHOD

Combining milking center wastewater with manure allows the use of a common disposal system for both type of wastes. A liquid manure storage facility, properly constructed and sized, provides the flexibility of storing milking center wastewater until it can be applied at the right time to an appropriate site. While this method may result in increased transportation and application costs, nutrients from milking center wastewater can be used to supply crop nutrient requirements and costs. Further, at certain timesof year, the extra dilution water may make the manure slurry more manageable. This option is limited, however, to operations where manure is handled in slurry form, or in treatment lagoons.

Risk to groundwater contamination from land application of milking center wastewater combined with manure is low if nitrogen application rates do not exceed crop nitrogen needs. Care must be taken, however, that phosphorus levels in soil do not reach excessive levels.

Milking center wastewater combined with feedlot runoff or leachate (from manure storage) can be stored in a detention pond. The contents of the pond can be applied to fields when conditions are appropriate.

II. PRETREATMENT METHODS

While soil has a high capacity to absorb and degrade wastes, pretreatment of wastewater to remove some pollutants before application to the soil can extend the effective life of a land application site. Pretreatment usually consists of a settling tank or basin that will hold the wastewater long enough for heavier particles to settle and lighter solids to float on the surface.

Milking center wastes should not be pretreated in an underground septic tank and disposed of in a soil absorption field. Soil absorption fields become plugged for one or more of the following reasons:

- Increased volumes of water may not allow adequate detention time in the septic tank.
- Milk solids and fats, or manure solids may plug the absorption field.
- Sanitizers used in cleaning may reduce bacterial action in the septic tank.
- Solids are not removed from the tank regularly and frequently.

When underground systems fail, wastewaterwill most likely surface elsewhere: in a ditch, farmyard, or a field. It is illegal under DEQ regulations to allow wastewater to be discharged off your property.

When a settling tank or basin is used, it should be cleaned every few months (or more frequently!). Otherwise the accumulated material may eventually move to the soil absorption area, clog the spaces between soil particles, and cause wastewater to collect on the surface. Manure and excess feed can be treated like (and combined with) other livestock wastes. Removing these and other waste products before washing into a settling tank requires additional effort, but it reduces the rate of solids accumulation, which can extend the period between tank cleanouts.

A settling tank also provides an opportunity for bacteria to decompose some wastes before the material is applied to the soil absorption area. This process causes a scum to form on the tank water surface. Removing the scum layer every few weeks can keep the system operating more efficiently.

Passing wastewater through a shallow treatment pond results in a more thorough pretreatment. Algae growing in the pond generate oxygen, which can help decompose organic compounds without producing obnoxious odors. Solids that settle to the bottom of the pond are decomposed by anaerobic bacteria in the absence of oxygen.

To prevent groundwater contamination, ponds and lagoons must be lined with an impervious material such as packed clay, concrete or a synthetic liner.

In some cases, wastewater can be discharged to a treatment lagoon without first going throughpretreatment in a settling tank. The material from these lagoons is best applied at low rates to croplands. However, waste decomposition processes may generate obnoxious odors, making them generally unattractive.

III. LAND APPLICATION METHODS

Treatment of milking center wastewater by conventional methods for direct discharge to a stream or lake is generally too expensive for most dairy farms, and is not allowed by the DEQ. As an alternative, land application usually provides the most cost-effective wastewater treatment method. In a land application system, soil assimilates some pollutants and crops use some of the nutrients, thus preventing or reducing the amount which may enter groundwater or surface water bodies. A suitable land application area should be located at least 150 feet downslope from a well or spring. Suitable land application options may fall into one of three categories:

- Direct cropland application with liquid manure
- Direct cropland application through irrigation
- Overland flow surface infiltration

Direct irrigation and overland flow infiltration must be carefully designed and installed, and carefully managed. Most often they are appropriate only for smaller dairies.

A. DIRECT CROPLAND APPLICATION

Where milking center wastewater is added tothe farm manure storage system, it can be field applied to crops and pastures using large irrigation equipment or liquid manure spreaders. Routine manure testing will provide guidance to permit farmers to include manure/wastewater nutrients in planning for nutrient needs and utilization by crops. Adequate storage can be provided to hold all wastes until they can be appropriately spread as a crop fertilizer.

B. LOW-RATE SPRINKLER APPLICATION

Pretreated milking center wastewater can be applied to cropland and pastures using small scale irrigation equipment. Where milking center wastewater will be applied without combining with other wastes, pipes with sprinklers can be permanently installed to consistently apply wastewater over dedicated grassed absorption areas. Wastewater application rates can be determined from the wastewater percolation rate in the soil; and the nutrient uptake by vegetation or crops. It is important that this system be designed by an expert to assure low-rate application, and to provide a sufficient number of application areas to allow "resting" between applications.

To properly manage the above system, the crop or other vegetation should be harvested and removed from the field. Harvested vegetation can be fed to livestock, if appropriate, or used as bedding. If harvested material is left on the ground, nutrients may leach into groundwater. Application areas should be rested for about a week prior to harvesting to help prevent compaction and damage to the absorption area. Similarly, avoid grazing cattle, if possible, on dedicated continuous application areas to prevent hoof compaction.

C. OVERLAND FLOW SURFACE INFILTRATION

An overland flow system is somewhat simpler than a sprinkler application system. Thismethod may be appropriate for small operations and suitable sites.

Pretreated wastewater is applied uniformly across the top of a gently-sloping grassed absorption area in a thin sheet using a perforated pipe header or level application strip. The ideal soil for overland flow systems will have a good infiltration rate, high water-holding capacity, and good nutrient holding capacity. Soils should also be deep and not excessively permeable to the water table. Best results will be obtained on well-drained loamy soils with at least 3 feet of depth to bedrock or groundwater table. This will provide good filtering, and will be capable of supporting high forage yields for maximum nutrient removal. The application areas should be designed so that runoff is minimized during heavy rain or snow melt.

Alternating application areas may be desirable as described in the previous section. Management practices similar to those described for sprinkler application areas are necessary. It is necessary to harvest and remove vegetation from the site so that nitrogen and phosphorus are not released when the vegetation dies.

Uncontrolled gravity systems, such as an open drain pipe, should not be used because the application area remains wet, making mechanical harvesting of vegetation difficult. Also, because of the heavy concentration of flow from the drain pipe, wastewater will be channelized to nearby streams and ditches which is not allowed by the DEQ. By controlling the flow with a pump, wastewater can be uniformly applied and then the area can be allowed to dry out between applications. Alternating applications between several infiltration areas is another way to allow an area adequate time to dry out.

Applying wastewater intermittently in an overland flow surface infiltration system mayrequire a large retention tank or a holding pond and the land area should be large enough to handle large volumes of milking center wastes.

When operated improperly, overland flow surface infiltration systems pose a high risk of groundwater contamination by nitrate, ammonia and other soluble compounds, such as detergents.

IV. CONSTRUCTED WETLANDS

There is considerable interest in development of constructed wetlands to make use of vegetation to remove nutrients from wastewater. This method may be appropriate for treating less concentrated and diffuse waste materials. However, constructed wetlands have not undergone sufficient longterm testing to warrant recommendation for treatment of milking center and other livestock wastes. Contact your Cooperative Extension or Natural Resources Conservation Service office for additional information.

CONTACTS AND REFERENCES

For review of construction plans and regulatory requirements, contact the Regional Office of the Virginia Department of Environmental Quality (DEQ).

To design a land application/wastewater treatment system, contact the Natural Resources Conservation Service (NRCS), private consultants, or the Biological Systems Engineering Department at Virginia Tech, Blacksburg, VA.

GLOSSARY

These terms may help you make more accurate assessments when completing Worksheet No. 11. They may also help clarify some of the terms used in Fact Sheet No.11.

Sprinkler: Method of field application using pressurized sprinkler nozzles to broadcast

Application: wastewater in droplet form to the soil.

Field application: Application of wastewater to croplands and pastures by irrigation ditches or equipment.

Overland flow surface irrigation: Application of wastewater to level or gently sloping fields to provide nutrients for actively growing crops.

Slab separator: A type of settling tank used for removing fine particles and sand from wastewater prior to pumping into a holding tank or lagoon.

Soil permeability: The quality that enables the soil to transmit water or air. Fine (heavy) soils such as clay are lowly permeable. Coarse (light) soils such as sand are highly permeable.

Solids separator: A screen apparatus over which milkhouse wastewater slurry is passed, allowing liquids and fine particles to pass through while retaining larger solids.

WORKSHEET NO. 11 MILKING CENTER WASTEWATER TREATMENT

Read Fact Sheet No. 11, Milking Center Wastewater Treatment, before completing this worksheet.

How will this worksheet help you protect your 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.
- It will provide you with easy-to-understand rankings that will help you analyze the "relative 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.

Follow the directions below.

Note: You will probably want to make a print-out of this worksheet to complete it.

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.)
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 rank.

COMBINED WASTE MANAGEMENT (No Discharge)					
	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
All waste water to manure storage with waste applied to fields*	Wastesater delivered directly to liquid manure storage. No discharge expected.	--------	--------	Wastewater delivered to leaking manure storage.	

PRETREATMENT METHODS

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
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 sometimes poured down drain. Manure excess feed usually removed before washdown.	Waste milk frequently poured down drain. Manure and excess feed often washed down drain.	All waste milk poured down drain. Manure and excess feed frequently washed down drain.	
Storage/settli valign=top ng tank liner	Concrete or plastic lined.	Clay liner.	Cracked or porous liner.	No liner to prevent seepage.	
Settling tank cleanout	Tank cleaned every 3-4 months, or more frequently.	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.	

*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.

LAND APPLICATION METHODS	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
Direct cropland application OR	Total land application system professionally designed and constructed. Nitrogen levels of waste mixture regularly checked and credited to crop nutrient management plan. Applied to growing crop on a regular basis. Vegetation regularly harvested and removed.	Land application system professionally designed and constructed. Nitrogen levels sometimes checked and credited to crop nutrient management plan. No seasonal application plan. Vegetation harvested regularly.	Not a professionally designed system. Nitrogen levels not regularly checked or credited to crop nutrient management plan. No seasonal application plan. Vegetation occasionally harvested.	Not a professionally designed system. Nitogen levels not checked or credited to crop nutrient management plan. No seasonal application plan. Vegetation not harvested.	
Low-rate sprinkler irrigation	System professionally designed and installed. High level pretreated wastewater discharged to a heavy grass sod on a medium- or fine-textured soil (silt loam, loam, clay loam, or clay), more than 10 feet to water table or bedrock. Gentle slope (5% or less). Application rate of 6,000 gallons per acre or less per week. Multiple application areas, with rest period between loadings. Application areas more than 150 feet and downslope from wells and springs. Vegetation harvested and removed.	System professionally designed and installed. High level pretreated wastewater discharged to a heavy grass sod on a medium- or fine-textured soil (silt loam, loam, clay loam, or clay), more than 3 feet to water table or bedrock. Gentle slope (5% or less). Application rate of 6,000 gallons per acre or less per week. Multiple application areas, with rest period between loadings. Application areas more than 150 feet and downslope from wells and springs. Vegetation harvested and removed.	System not professionally designed. Pretreated wastewater applied to a heavy grass sod on a medium- or fine-textured soil (silt loam, loam, clay loam, or clay), more than 3 feet to water table or bedrock at 6,000-12,000 gallons per acre per week. Gentle slope (5% or less). Application area not tested. Bedrock or water table within 2 to 3 feet from surface. Application areas closer than 150 feet and downslope from wells and springs. Vegetation occasionally harvested.	No pretreatment. Wastewater consistemtly applied to same area at more than 8,000 gallons per acre per week. Medium-textured soils above bedrock or high water table within 2 feet or less of ground surface. Slopes not more than 5%. Application areas within 150 feet of wells and springs and upslope. Vegetation not harvested.	

Overland flow surface infiltration	System professionally designed and installed. High level pretreated wastewater discharged to a heavy grass sod on a medium- or fine-textured soil (silt loam, loam, clay loam, or clay), more than 10 feet to water table or bedrock. Gentle slope (5% or less). Application rate of 6,000 gallons per acre or less per week. Multiple application areas, with rest period between loadings. Application areas more than 150 feet and downslope from wells and springs. Vegetation harvested and removed.	System professionally designed and installed. High level pretreated wastewater discharged to a heavy grass sod on a medium- or fine-textured soil (silt loam, loam, clay loam, or clay), more than 3 feet to water table or bedrock. Gentle slope (5% or less). Application rate of 6,000 gallons per acre or less per week. Multiple application areas, with rest period between loadings. Application areas more than 150 feet and downslope from wells and springs. Vegetation harvested and removed.	System not professionally designed. Pretreated wastewater applied to a heavy grass sod on a medium- or fine-textured soil (silt loam, loam, clay loam, or clay), more than 3 feet to water table or bedrock at 6,000-12,000 gallons per acre per week. Gentle slope (5% or less). Application area not tested. Bedrock or water table within 2 to 3 feet from surface. Application areas closer than 150 feet and downslope from wells and springs. Vegetation occasionally harvested.	No pretreatment. Wastewater consistemtly applied to same area at more than 8,000 gallons per acre per week. Medium-textured soils above bedrock or high water table within 2 feet or less of ground surface. Slopes not more than 5%. Application areas within 150 feet of wells and springs and upslope. Vegetation not harvested.

LOCATION OF LAND APPLICATION

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
Distance from drinking water	More than 150 feet downslope from well or spring.	More than 150 feet upslope from well or spring.	**Less than 150 feet downslope from well or spring.****	**Less than 150 feet upslope from well or spring.****	

Bold Face Type: Besides representing a higher-risk choice, this practice violates Virginia law.

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

CALCULATE RISK RANK

Step 1:

Sum up the rankings for the categories you completed and divide by the total number of categories ranked. Carry your answer out to one decimal point.

Rank Number Total _______ ÷ No. of categories ranked _______ = Risk Rank _______

Risk Categories
3.6-4.0 = low risk
2.6-3.5 = low to moderate risk
1.6-2.5 = moderate to high risk
1.0-1.5 = high risk

This ranking gives you an idea of how your well or spring management practices as a whole might be affecting your drinking water. Later you will combine this risk ranking with other farmstead management rankings in Worksheet No. 13, "Overall Risk Assessment." This ranking should serve only as a very general guide, not a definitive indicator of contamination. 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.).

Step 2:
Look over your ranking for each category:

- 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.

Any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be a major-or costly-project, requiring planning and prioritizing before you take action. Note the activities that you identified as 1's to be listed later under "High-Risk Activities" in Worksheet No. 13.