Virginia Cooperative Extension

PUBLICATION 442-912

VIRGINIA FARM*A*SYST

Virginia Farmstead Assessment System

Fact Sheet/Worksheet No. 12

Silage Storage and Management

www.ext.vt.edu

Produced by Communications and Marketing, College of Agriculture and Life Sciences, Virginia Polytechnic Institute and State University, 2009

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:

Fact Sheet/Worksheet No. 1 - Site Evaluation: Groundwater, Soils & Geology

Fact Sheet/Worksheet No. 2 - Well and Spring Management

Fact Sheet/Worksheet No. 3 - Household Wastewater Treatment and Septic Systems

Fact Sheet/Worksheet No. 4 - Hazardous Waste Management

Fact Sheet/Worksheet No. 5 - Petroleum Products Storage

Fact Sheet/Worksheet No. 6 - Fertilizer Storage, Handling, and Management

Fact Sheet/Worksheet No. 7 - Pesticide Storage, Handling, and Management

Fact Sheet/Worksheet No. 8 - Livestock and Poultry Yard Management

Fact Sheet/Worksheet No. 9 - Livestock Manure Storage and Treatment Facilities

Fact Sheet/Worksheet No. 10 - Poultry Litter Management and Carcass Disposal

Fact Sheet/Worksheet No.11- Milking Center Wastewater Treatment and Management

Fact Sheet/Worksheet No. 12 - Silage Storage and Management

Worksheet No. 13 - Overall Risk Assessment

Fact Sheet/Worksheet No. 14 - Management of Irrigation Systems

ACKNOWLEDGMENTS

Fact Sheet and Worksheet No. 14 were adopted from material provided by the Georgia Farm *A* Syst Program. Material for the balance of the Virginia Farm *A* Syst package was developed by revision of Farm *A* Syst material from the University of Wisconsin Cooperative Extension Service, University of Minnesota Extension Service and the National Farmstead Assessment System Program. The format and style for the Virginia package was based on TEX *A* Syst published by Texas Agricultural Extension Service, Texas A&M University System.

This publication was 50% funded by the Virginia Department of Conservation and Recreation in coordination with the Virginia Coastal Resources management program at the Department of Environmental Quality through Grant #NA970Z0181-01 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its subagencies. Funding for the development of the original Virginia Farm *A* Syst package was provided by the EPA 319 Program, through the Virginia Department of Conservation and Recreation-Division of Soil and Water Conservation (DCR-DSWC).

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Silage Storage and Management

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Silage can be made from corn, grain, or alfalfa, or from canning wastes, such as those resulting from sweet corn processing. The amount of leachate (silage juices) produced varies with the material stored, its moisture and nitrogen content, and handling and storage conditions. Of these, moisture content is the most crucial.

Most harvested silage can be characterized as low-moisture because the crop is usually allowed to wilt to the proper moisture content before chopping to ensure proper ensiling. In general, silage put into horizontal silos is typically at a higher moisture content. Haylage stored in tower silos has been reported to produce significant amounts of silage juice. In Virginia, corn silage storage and associated leachate is regulated as an agricultural waste. Farmers must take steps to assure that discharge does not occur to surface or groundwaters. (See Figure 1).

I. SILAGE MOISTURE CONTENT

Research indicates that silage stored at 65 percent moisture content or higher can produce leachate. For grass silage, the amount produced varies from a trickle at 75 percent moisture content to 79 gallons per ton at 85 percent moisture content. About three-quarters of the-leachate is produced in the first three weeks of storage, although it can continue to flow for up to three months.

Several methods are available to reduce leachate production from silage. The most effective of these is to allow the crop to wilt for 24 hours. Although this may not always be possible in Virginia's humid climate, available data shows that the practice can reduce silage moisture content by 10 percent and leachate production by 100 percent. Other leachate control methods include varying cutting and harvesting times, cutting or crimping the materials, or adding moisture-absorbent materials to the silage during storage.

Adding absorbent materials not only reduces leachate, but it also raises the nutrient value of the silage. Absorbent materials that can be used include oat meal, dried sugar beet pulp, dried corn cobs, ground corn, newsprint and bentonite clay. Most of these materials can absorb moisture at one to three times their weight. To be effective, enough material must be added to absorb the anticipated leachate

II. SILAGE STORAGE LOCATION

To prevent possible groundwater contamination, silos should be located as far away from wells and springs as practical. State regulations require that plastic storage tubes be at least 8 feet away from a well, and that new glass-lined silos be at least 50 feet away from a well. Silos with a pit, or without a pit but with a concrete floor and drain, must also be at least 50 feet from a well. Earthen trenches or pits must be at least 250 feet away from a well. Minimum separation distances regulate new well installations. Existing wells are required by law only to meet separation requirements in effect at the time of well construction.

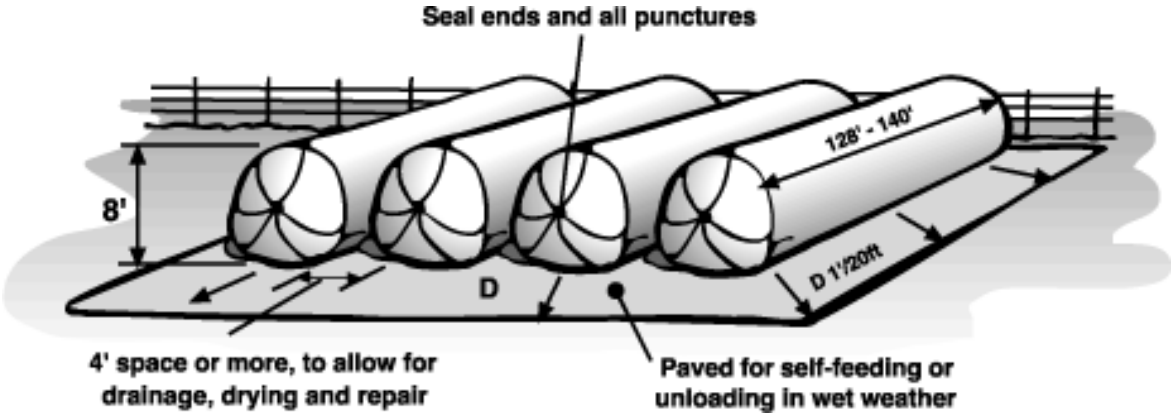

Figure 1. Chart of silage moisture content. (Source: Beef Housing and Equipment Handbook, MWPS-6, Fourth Edition, 1987, Midwest Plan Service, Ames, Iowa.)

Sweet corn silage storage sites must meet soil absorption criteria and be located at least 1000 feet from a community well or 250 feet from a private well. Stacks must also be at least 5 feet above the water table and located on slopes of less than 2 percent. Any leachate from the stacks must be managed to prevent surface or groundwater contamination. Storage sites should be located outside of environmentally sensitive areas such as those of fractured bedrock, high water tables, or in close proximity to streams, ponds and springs. The DEQ has authority to require groundwater monitoring. These standards do not apply to stacks of less than 150 tons.

III. SILO DESIGN AND CONSTRUCTION

Silo construction for most agricultural uses is not regulated in Virginia. 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 spill out when opened. Horizontal trench silos excavated into the ground may affect groundwater, especially in coarse soils when close to the water table. Properly compacted clay soils and concrete floors can limit leachate seepage.

The type of silo often has less effect on the 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, preserve a quality silage, and reduce the potential for producing leachate. Horizontal silos are covered with a plastic sheet and old 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.

IV. 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. Horizontal silos use channels to direct seepage into a collection area. Contact your county Extension office for assistance with design.

The most cost-effective leachate disposal method is land spreading. Nitrogen in leachate has significant fertilizer value that can be used if applied during the growing season. Because of its high nitrogen and organic content, leachate can burn plant tissue and deplete soil oxygen. Farmers who consider land spreading should consult a soil specialist to determine how much leachate can be safely spread on each field. Contact your local Natural Resources Conservation Service or county Extension office for assistance.

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.

WORKSHEET NO. 12 SILAGE STORAGE AND MANAGEMENT

How will this worksheet help you protect your drinking water?

- It will take you step by step through your drinking water well or spring condition and management 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" to your drinking water well or spring.
- 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.

SILAGE MOISTURE

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
Moisture content	Below 65%.	Between 65% and 70%	Between 71% and 85%	Over 85%	

SILAGE STORAGE LOCATION

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
Location relative to well or spring	At least 100 feet downslope from well or spring (silos, grass-lined feed storage, plastic tubes). At least 500 feet downslope (earthen trench). Water drains away from storage to field or pasture.	At least 150 feet downslope from well or spring (silos, grass-lined feed storage, plastic tubes). At least 250 feet downslope (earthen trench). Water drains to field or pasture.	Within 100 feet upslope from well or spring (silos, grass-lined feed storage, plastic tubes). Within 500 feet upslope (earthen trench). Water pools or stands near storage.	Within 50 feet of well or spring (silos, grass-lined feed storage, plastic tubes). Within 250 feet (earthen trench). Water pools on soil surface.	

SILO DESIGN AND CONSTRUCTION					
	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
Floor or surface condition	Concrete or asphalt surface. No cracks.	Concrete or asphalt surface has some cracks.	Surface ha some permeable soils (silt loam) and some cracks.	Surface has permeable soil (sand), not compacted.	
Cover condition	Cover tight fitting. No leaks.	Cover tight fitting. Minor leaks repaired.	Cover, but many large leaks not repaired.	No cover.	
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 AND DISPOSAL					
	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
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.	
		Use this total to calculate risk rank:		Rank Number Total:	

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.