

Animal Waste Land Application Management

WHY BE CONCERNED?

Managing the land application of animal waste to protect water quality depends on applying rates based on crop requirements and soil conditions, knowing the composition of the animal waste, avoiding runoff from recent applications, and protecting the application areas from runoff and soil erosion. Runoff from fields and water leaching through soil can carry plant nutrients, soil, microorganisms, and other potential pollutants from the fields to surface water or groundwater.

Animal wastes, if not managed properly, can become a source of nitrate and disease-causing organisms to both surface water and groundwater. Nitrogen from animal waste can also be a source of nitrates in groundwater. Nitrate levels above the federal and state drinking water standard 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. This condition in infants is often described as methemoglobinemia (blue baby syndrome). Nitrates can also affect adults, but evidence of the consequences is much less certain. In addition, young livestock are susceptible to health problems from high nitrate-nitrogen levels, especially in combination with high levels of nitrate-nitrogen from feed sources.

Phosphorus from animal waste that enters surface water and nitrate-nitrogen from groundwater that flows into surface water can supply algae and aquatic plants with essential nutrients that stimulate their growth. When this excessive growth dies and begins to decay, the dissolved oxygen level in the water will go down, and if it gets too low, fish and other water dwelling organisms will die. In addition, other species of algae that are stimulated by plant nutrients reproduce quickly, creating toxic algal blooms. Algae can also compete for resources with other aquatic species and contribute to reduced habitat quality.

Fecal bacteria in animal waste can contaminate surface and groundwater, causing such infectious diseases as dysentery, typhoid, and hepatitis. Typical water purification practices such as chlorination are not effective in controlling some of the pathogens found in animal waste. The best protection is to limit the possibility of them reaching the water resources.

Sometimes management practices to protect groundwater can conflict with practices to protect surface water because the transfer of nitrate-nitrogen and phosphorus are so different in most Pennsylvania soils. Specific site knowledge and evaluation may be necessary to determine which practices should have the highest priority in a management program.

Not only the possible water quality impacts of land applying animal waste, but considering other consequences or perceptions of the

practices by neighbors can be part of a successful land application program. Being aware of holidays, weekends, or other special occasions in the neighborhood and not scheduling applications during those times can promote good community relations. Special care to not apply animal waste too close to property lines or to incorporate applications to reduce odors and pests can also be part of comprehensive land application management. Losses of nitrogen to the atmosphere from surface applied animal waste will probably be a management consideration in the future.

The goal of Pennsylvania Farm•A•Syst is to help you protect groundwater and surface water, shared resources which are important to everyone.

HOW TO RANK GROUNDWATER AND SURFACE WATER PROTECTION USING THIS WORKSHEET

- You can select from a wide range of conditions and management practices that are related to potential groundwater and surface water contamination.
- You can rank your operation conditions and management practices according to how they might affect groundwater and surface water.
- Based on your overall ratings, you can determine which of your conditions or practices are reasonably safe and effective, and which might require modification to better protect groundwater and surface water.

HOW TO COMPLETE THE WORKSHEET

Follow the directions as listed on page 1 of the worksheet. The evaluation should take 15–30 minutes to complete and determine your ranking. Evaluate each land application site on your farm. There are spaces provided to rank up to three sites. A site will usually be a group of fields that are on the same farm and generally are managed the same. Different sites might be farms other than where the animals generating the waste are located or rented farms. If you have more than three sites, please use another worksheet. If you are unfamiliar with any of the terms used, refer to the glossary provided with this worksheet.

Information derived from Farm•A•Syst worksheets is intended only to provide general information and recommendations to farmers regarding their own farm and farmstead practices or conditions. It is not the intent of this educational program to keep records of individual results. However, the results may be shared with others who will help you develop a resource management plan.

WORKSHEET #10: ANIMAL WASTE LAND APPLICATION MANAGEMENT

Use a pencil, in case you want to change an answer later. For each feature listed on the left that is appropriate for your farm, read across to the right and circle the statement that most closely describes conditions on your farm. Skip and leave blank any features that don't apply to your farm. Then look at the description you circled to find your "rank number" (4, 3, 2, 1) and enter that number in the blank under "RANK." Directions

for overall scoring appear at the end of the worksheet. You may have more than one farm, groups of fields, or different areas that are managed the same. These can be identified and ranked separately. Allow 15–30 minutes to complete the worksheet and to determine the level of surface water and groundwater protection that you are providing.

Soil and Animal Waste Sampling Practices

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
					Site Identification #1 #2 #3
1. Soil testing frequency	At least every 3 years or when change in crops if less than 3 years.	Every 3 years.	Every 4 to 5 years or only when change in crops.	Less frequently than every 5 years.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
2. Soil sampling patterns	Individual fields or different areas within fields sampled.	Groups of fields with similar management history sampled.	Groups of fields sampled regardless of management history.	Fields sampled in no consistent pattern or sequence.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
3. Animal waste sampling	Multiple composite samples based on greater than 10 subsamples taken each time as the animal waste storage is emptied for field application. Variation accounted for in determining actual application rates.	A single composite sample based on greater than 10 subsamples taken each time the storage is emptied for field application.	A single sample based on a few subsamples or a single grab sample taken one time.	No animal waste samples collected.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Site Identification #1. _____

#2. _____

#3. _____

Waste Application Rates

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
					Site Identification #1 #2 #3
4. Basis of nutrient management	No nitrogen or phosphorus applied in excess of crop requirements for the year of application.	Nitrogen-based applications modified by the Phosphorus Index evaluation.	Nitrogen-based applications not modified to account for phosphorus management concerns.	Crop requirements and animal waste nutrient contributions not considered.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
5. Allocation to fields	Calculate planned application rates based on soil tests, crop nutrient utilization information, and animal waste analysis.	Calculate planned application rates based on soil tests and crop nutrient utilization information, but book values used for animal waste nutrient content.	Calculate planned application rates based on book values for crop nutrient utilization and animal waste nutrient content.	Rates based on disposal of available manure. Crop nutrient utilization and animal waste nutrient content not considered.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
6. Use of records	Most or all records reviewed at least annually, summarized, and used to improve next year's nutrient management plan.	Some records reviewed at least annually, summarized, and used to improve next year's nutrient management plan.	Records maintained but historical data are not used or useful.	No records are available to be used in developing next year's nutrient management plan.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
7. Actual application rates	Specific rates for individual fields or for groups of very similar fields based on the calculated planned application rates.	Only a few average rates based on major differences in the calculated planned application rates.	One rate based on an average calculated planned application rate for the farm.	One rate or an unknown variable rate not based on a calculated planned application rate.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
8. Supplemental fertilizer	Fertilizer application rate adjusted based on each animal waste application rate.	—	Fertilizer application rate adjusted based on whether or not animal waste is applied, but not adjusted for each actual application rate.	Fertilizer application rate not adjusted for animal waste application.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Land Application Equipment

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
					Site Identification #1 #2 #3
9. Calibration of application equipment	Animal waste application equipment calibrated to proper application rate before each application period and checked at least once during the period, or animal waste applied by custom waste hauler and applicator with known calibration of equipment.	Animal waste application equipment calibrated before each application period but not rechecked.	Animal waste application equipment calibrated only once a year.	Animal waste application equipment never calibrated or custom applicator not asked about calibration.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Management of Land Application Areas

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
	Site Identification				
	#1 #2 #3				
10. Application areas*	All animal wastes applied more than 100 feet upslope from open sinkholes, springs, drinking water sources ⁺ , surface waters, or surface water conveyances, or applied more than 200 feet if slope is greater than 8% ⁺ . No application in vegetated or non-vegetated concentrated water flow areas.	Animal wastes applied within 100 feet upslope from open sinkholes, springs, or drinking water sources ⁺ but incorporated within 24 hours. Applied within 100 feet of surface waters or surface water conveyances, or within 200 feet if slope is greater than 8% ⁺ , or within vegetated concentrated water flow areas but not when soil is frozen, snow covered, or saturated. No application in non-vegetated concentrated water flow areas.	Animal wastes applied within 100 feet upslope from open sinkholes, springs, or drinking water sources ⁺ but not incorporated within 24 hours. Applied sometimes within 100 feet of surface waters or surface water conveyances, or within 200 feet if slope is greater than 8% ⁺ , or within vegetated concentrated water flow areas when soil is frozen, snow covered, or saturated. Sometimes applied in non-vegetated concentrated water flow areas.	Animal waste applied over all areas regardless of sinkhole, spring, drinking water sources, surface water, surface water conveyances, or concentrated water flow areas.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
11. Record keeping	Complete records kept on field applications of nutrients and harvested crop yields.	Partial records kept on field applications of nutrients and harvested crop yields.	Few records kept on field applications of nutrients, but no records kept of harvested crop yields.	No records kept.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
12. Uniformity of land applications	Uniform application over entire suitable area.	Generally uniform application on suitable areas with some areas skipped or some areas overlapped.	Many suitable areas not covered or overlapped more than once.	No effort made to apply waste uniformly over area.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
13. Timing of application (particularly for groundwater protection)	Animal wastes applied during spring or summer to actively growing crops or where crops will be planted within 30 days.	Animal wastes applied during spring or summer with a significant amount also applied in the fall to actively growing crops, crop residue with greater than 50% cover, or where cover crops have been established or will be planted within 30 days.	Animal wastes applied to dormant crops or crop residue with greater than 25% cover.	Usually land apply animal wastes when most convenient, regardless of crop or ground cover.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
14. Timing of application (particularly for surface water protection)	Always check weather forecasts. Never apply wastes on frozen or saturated soil or when rain is expected.	Usually check weather forecasts. Seldom apply when soil is wet or when rain is expected.	Sometimes apply when soil is frozen or wet.	Usually land apply animal wastes when most convenient, regardless of soil conditions or weather.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

* Considers Pennsylvania's Act 6, Nutrient Management Rules and Regulations, section 83.294 (5) and 83.404 (5).

⁺Unless other State or Federal laws or regulations require a greater distance or no application for public water sources.

Management of Land Application Areas (continued)

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
					Site Identification #1 #2 #3
15. Treatment after application (particularly for surface water protection)	Animal waste mechanically incorporated within 24 hours especially with little residue disturbance.	Animal waste mechanically incorporated 1 to 3 days after application especially with little residue disturbance.	Animal waste not mechanically incorporated on growing crop or on an area with greater than 25% residue cover.	Animal waste not mechanically incorporated. Less than 25% residue cover.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
16. Concentrated field runoff protection	All field waterways are protected with permanent vegetation or other materials to prevent erosion.	Many field waterways have permanent vegetation; annual crops are planted through the other unprotected concentrated flow areas.	Few field waterways have permanent vegetation; annual crops are planted through the unprotected concentrated flow areas.	No field waterways have permanent vegetation; annual crops are planted through the concentrated flow areas.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
17. Perennial stream protection	Permanent vegetative buffer strip greater than 30 feet in width is in place along all perennial streams to intercept field runoff and emerging groundwater flow.	Some perennial stream areas with a permanent vegetative buffer strip in place.	Few perennial stream areas with a permanent vegetative buffer strip in place.	No permanent vegetative buffer strips in place.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
18. Conservation plan	Up-to-date soil conservation plan developed and fully implemented.	Up-to-date compliance plan to meet tolerable soil losses only on designated highly erodible land.	Soil conservation plan developed, but not fully implemented, or out of date, or compliance plan does not meet tolerable soil loss on highly erodible land.	No soil conservation or compliance plan developed for the farm. Visible evidence of soil erosion.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
TOTAL					<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Use this total to calculate overall performance ranking.					

HOW TO USE THESE RANKINGS

- Step 1:** Now that each feature has been ranked, add all these rankings together and put that value in the “Total” box at the end of the worksheet. Transfer that number to the box below.
- Step 2:** Divide the value in the “Total” box by the number of features ranked.
- Step 3:** Repeat for the remaining sites. Calculate the average ranking for all sites combined.

_____	divided by _____	equals _____
(total of rankings)	(# of features ranked)	(average ranking)*
*carry your answer out to one decimal place		

- Step 4:** Evaluate the overall management practices and site conditions.
- 3.6–4.0 = best management
2.6–3.5 = good management
1.6–2.5 = fair management
1.0–1.5 = poor management
- This ranking gives an idea of how animal waste land application management **as a whole** might affect water quality. This ranking should serve only as a **very general guide, not a precise diagnosis**. Since it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1s and 2s) that should be of concern.

- Step 5.** Look over the rankings for individual features of **each** site:

Best (4s): the current ideal; should be the goal despite cost and effort

Good (3s): provides reasonable surface and ground-water protection

Fair (2s): inadequate protection in many circumstances

Poor (1s): poses a high risk of polluting surface water or groundwater

Regardless of the overall ranking, any individual rankings of “1” should receive immediate attention. Some concerns can be taken care of right away; others could be major or costly projects, requiring planning and prioritizing before taking action.

- Step 6.** Consider how to modify farm management practices or site conditions to better protect water quality. Contact the local **conservation district, Cooperative Extension office**, or the **USDA Natural Resources Conservation Service** for ideas, suggestions, or guidance. Guidelines that comply with Department of Environmental Protection regulations concerning field application of manure are available in the *Pennsylvania Manure Management Manual for Environmental Protection* and its supplements. Land application of animal waste on the most intensive animal operations is regulated in Pennsylvania under Act 6, Pennsylvania’s Nutrient Management Law. For more details or to determine if you qualify, contact any of the agencies listed above.

GLOSSARY

Animal waste: A combination of manure, bedding, feed, soil, and water or composted organic materials.

Compliance plan: Establishes the minimum level of conservation treatment needed to meet conservation compliance requirements for USDA farm program benefits and may not meet other state and federal soil erosion and sedimentation control laws and regulations.

Cover crops: Densely seeded crops (typically rye, oats, wheat, vetch) grown between principal crop production periods to protect soil from erosion and to capture residual nitrogen, thus preventing potential leaching loss. In the case of vetch or other legumes, nitrogen may be produced for subsequent crops.

Highly erodible land (HEL): Cropland fields with a high potential for soil erosion that are required to be farmed according to an approved conservation compliance plan as specified in the 1985 Farm Bill (Food Security Act) and the 1990 Farm Bill (FACTA). These areas can be identified upon request by USDA Natural Resources Conservation Service staff.

Leaching: The removal of soluble substances from soils or other material by water.

Nutrient: Those elements necessary for plant growth, especially the macronutrients—nitrogen (N), phosphorus (P), and potassium (K). Current water quality concerns are focusing on the impacts of nitrogen and phosphorus losses to surface water and groundwater resources.

Nutrient management plan: A site-specific plan to manage the amount, placement, form, and timing of nutrient and soil amendment applications including fertilizer, animal manures, animal mortalities, and other nutrient sources. These plans will often be developed to meet the specific goals of providing the nutrients needed for crop production and of incorporating management practices to protect water quality.

Phosphorus Index: A standardized evaluation tool to rank a site for potential phosphorus loss based on soil test phosphorus, distance of the application areas to a stream, plus other source and transport factors.

Additional information is available from local USDA Natural Resources Conservation Service and Cooperative Extension staff.

Soil conservation plan: Addresses conservation and sustained soil use by documenting gully and rill erosion control needs to meet tolerable soil loss levels and the requirements to prevent sediment from leaving the property.

Tolerable soil loss: The maximum erosion that that can take place without loss of soil productivity. Tolerable soil loss rates vary among soil types; however, the majority of rates are from 3 to 5 tons/acre/year. Tolerable soil loss rates can be determined by the local conservation district or USDA Natural Resources Conservation Service staff.

ACKNOWLEDGMENTS

The Pennsylvania Farm•A•Syst package contains the following worksheets:

- Introduction
- Farmstead Map
- Preliminary Screening Quiz
- Worksheet #1—Water Well Condition and Construction
- Worksheet #2—Pesticides and Fertilizer Storage and Handling
- Worksheet #3—Household Waste Treatment
- Worksheet #4—Barnyard Management
- Worksheet #5—Milkhouse Waste Management
- Worksheet #6—Stream and Drainageway Management
- Worksheet #7—Petroleum Storage Management
- Worksheet #8—Silage Storage Management
- Worksheet #9—Animal Waste Storage Management
- Worksheet #10—Animal Waste Land Application Management
- Overall Farmstead Ranking

Material for the Pennsylvania Farm•A•Syst package was developed by revision of Farm•A•Syst material from the University of Wisconsin Cooperative Extension Service, Virginia Cooperative Extension, and the National Farm•A•Syst/Home•A•Syst Program. Additional format and style features for the Pennsylvania package were adapted from the Ontario Environmental Farm Plan published by Ontario Farm Environmental Coalition, Ontario, Canada.

Partial funding for the development of the Pennsylvania Farm•A•Syst package was provided by USDA-EQIP funds from the USDA-NRCS.

Preparation: **Les Lanyon**, professor of soil science and management, Penn State, Department of Crop and Soil Sciences.

Project Coordinators: **Barry Frantz**, USDA-Natural Resources Conservation Service; **Les Lanyon**, Department of Crop and Soil Sciences, Penn State.

Advisory Committee: **Fran Koch**, environmental planning supervisor, Bureau of Watershed Conservation, Department of Environmental Protection; **Larry Martick**, district manager, Adams County Conservation District; **Tom McCarty**, multi-county water quality agent, Penn State Cooperative Extension; **Kelly O'Neill**, agricultural policy analyst, Chesapeake Bay Foundation; **Jerry Martin**, Penn State Cooperative Extension, Nutrient Management Education Program.

Technical Review: **Doug Goodlander**, State Conservation Commission; **Doug Beegle**, professor of agronomy, Penn State; **Joel Myers**, state agronomist, USDA-Natural Resources Conservation Service.

Additional Technical Assistance provided by: **Therese Pitterle**, Department of Crop and Soil Sciences, Penn State.

PENNSTATE



College of Agricultural Sciences • Cooperative Extension

Visit Penn State's College of Agricultural Sciences on the Web: www.cas.psu.edu

Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

This publication is available from the Publications Distribution Center, The Pennsylvania State University, 112 Agricultural Administration Building, University Park, PA 16802. For information telephone 814-865-6713.

Where trade names appear, no discrimination is intended, and no endorsement by the Cooperative Extension Service is implied.

Issued in furtherance of Cooperative Extension Work, Acts of Congress May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and the Pennsylvania Legislature. T. R. Alter, Director of Cooperative Extension, The Pennsylvania State University.

This publication is available in alternative media on request.

Issued in furtherance of Cooperative Extension Work, Acts of Congress May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and the Pennsylvania Legislature. T. R. Alter, Director of Cooperative Extension, The Pennsylvania State University.

The Pennsylvania State University is committed to the policy that all persons shall have equal access to programs, facilities, admission, and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by University policy or by state or federal authorities. The Pennsylvania State University does not discriminate against any person because of age, ancestry, color, disability or handicap, national origin, race, religious creed, sex, sexual orientation, or veteran status. Direct all affirmative action inquiries to the Affirmative Action Director, The Pennsylvania State University, 328 Boucke Building, University Park, PA 16802-5901; tel. 814-863-0471; TDD 814-865-3175.

© The Pennsylvania State University 2003

Produced by Information and Communication Technologies in the College of Agricultural Sciences CAT UC179 5M203ps UCT4171