

Soil Conservation Management

WHY BE CONCERNED?

Soil conservation protects a valuable resource and reduces the off-farm direct impacts of sediment or the indirect impacts of nutrients or pesticides that may be attached to eroded soil particles. A good soil management program has three goals: to protect the soil from erosion by water or wind; to reduce runoff from the land into surface water; and to maintain or improve soil quality.

Agricultural production activities such as tillage accelerate soil erosion by reducing vegetative cover, breaking down soil structure, and increasing soil compaction. Eroded soils are often less productive, and crops growing in these soils are subject to more stress during the growing season. Erosion removes the most valuable soil fractions and leaves soils that can require a long time or intensive management to restore.

Many conservation practices have been designed to reduce soil erosion. For example, cropland terraces and diversions reduce effective slope length and direct surface runoff to protected outlets; grassed waterways and other protected channels move water from the fields while protecting the soil from scouring; contour planting and conservation tillage are designed to slow runoff, hold the soil and nutrients in place, and reduce soil erosion; and field borders and grassed buffer zones trap soil before it leaves fields. More organic matter in the soil helps to prevent erosion by water and wind. It also helps to prevent crusting and surface soil compaction and to promote soil moisture holding capacity. Crop rotations, manure applications, and reduced tillage can build up or maintain soil organic matter, contribute to surface residue cover, improve soil structure, and help reduce soil degradation.

Runoff from agricultural land can be a major source of pollution in streams, lakes, and rivers. Excessive sediment from eroding cropland and overgrazed pastures can diminish fish and wildlife habitat and reduce the storage capacity of water reservoirs. Water treatment costs for human use are increased because of excess sediment. If pesticides, nutrients, or soil sediment reach a water source, they can reduce water quality, thus killing fish and other aquatic life. Nutrients such as phosphorus or nitrogen that enter water resources through surface runoff are a major cause of algal blooms, which can kill fish and other aquatic wildlife and make the water unfit for drinking or recreation.

Erosion rates can be calculated by conservation professionals using information from their years of experience and research-based soil loss equations. However, visual inspections and repeated observa-

tions of the same areas over time can provide clues to the extent of erosion that is taking place. The extent to which specific soil conservation practices are implemented can also provide some insight into the risk of soil degradation. This worksheet is designed to aid in a preliminary evaluation of soil conservation. It can be applied to an individual field or groups of fields on a farm depending on the differences in management or site conditions. If the potential for soil erosion or degradation is identified, professional assistance should be obtained to determine the extent of any problems and possible actions to reduce them.

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 surface water and groundwater contamination.
- You can rank the conditions and management practices on your operation according to how they might affect surface water or groundwater.
- 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 surface water and groundwater.

HOW TO COMPLETE THE WORKSHEET

Follow the directions as listed on page 1 of the worksheet. The evaluation should take 15–30 minutes for each evaluation site to complete and determine your ranking. Evaluate each place where soil is likely to erode on your farm. There are spaces provided to rank up to three sites. 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 #11: SOIL CONSERVATION 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. Allow 15–30 minutes to complete the worksheet for each evaluation site and to determine the level of surface water and groundwater protection that you are providing.

Crop Residue Management

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
					Site Identification #1 #2 #3
1. Tillage and planting	More than 50% crop residue cover when planting is completed.	30–50% crop residue cover when planting is completed.	15–30% crop residue cover when planting is completed.	Less than 15% crop residue cover when planting is completed.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
2. Harvesting	Crop residue covers over 80–100% of the surface.	Crop residue covers over 50–80% of the surface.	Crop residue covers less than 50% of the surface.	Crop residue harvested or removed.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Soil Erosion

					Site Identification #1 #2 #3
3. Historic erosion	Soil on knolls and slopes similar in color to the rest of the field. Crop growth and yield uniform across field.	Soils on knolls and slopes similar in color to the rest of the field. Slight difference in crop growth or yield compared to the rest of the field.	Soil on knolls and slopes lighter in color than the rest of the field. Crops shorter on knolls or slopes. Yield less on a small portion of the field.	Soil on knolls and slopes lighter in color than the rest of the field. Crop stands, height, and yields greatly reduced on large areas of the field.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
4. Active sheet and rill erosion	Soil surface well-protected with no evidence of soil movement. No sediment deposited in low areas of fields after rains.	Few areas with evidence of sheet and rill erosion and soil detachment. Sediment rarely deposited in low areas of fields after rains.	Many areas with readily visible evidence of sheet and rill erosion and soil detachment. Sediment sometimes deposited in low areas of fields after rains.*	Extensive areas with readily visible evidence of sheet and rill erosion and soil detachment. Sediment frequently deposited in low areas of fields after rains.*	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
5. Gully erosion	No gully erosion evident.	Few areas with ephemeral gully erosion.	Many areas with ephemeral gully erosion. Some more serious gullies developing.*	Gully erosion evident in many areas. These gullies can not be easily crossed during field operations.*	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Site Identification #1. _____

#2. _____

#3. _____

*These conditions may indicate the presence of critical runoff problem areas as defined in Pennsylvania's Nutrient Management Act, Chapter 83, subchapter D; 83.201. Definitions, 83.321. Stormwater runoff control, and 83.431. Stormwater runoff control.

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
Soil Erosion (continued)					Site Identification
					#1 #2 #3
6. Concentrated flow runoff protection	All field waterways are protected with permanent vegetation or other materials to resist erosion.	Many field waterways have permanent vegetation. Annual crops are no-till planted through some unprotected concentrated flow areas.	Few field waterways have permanent vegetation. Most unprotected concentrated flow areas are tilled and annual crops planted.*	No field waterways have well-established permanent vegetation. Unprotected concentrated flow areas are tilled and annual crops planted.*	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
7. In-field damage frequency	No on-site damage (rill formation, scouring, or sedimentation) occurring.	On-site damage occurs less than 1 out of 10 years.	On-site damage occurs less than 1 out of 5 years.	On-site damage occurs at least once every 2 years.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
8. Off-site damage frequency	No off-site damage (scouring or sedimentation) occurring.	Off-site damage occurs less than 1 out of 10 years.	Off-site damage occurs less than 1 out of 5 years.	Off-site damage occurs at least once every 2 years.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
9. Stream protection	All streams have a permanent vegetative buffer strip greater than 50 feet to intercept field runoff and emerging groundwater flow.	Most streams have a permanent vegetative buffer strip from 10 to 50 feet.	Few streams have a permanent vegetative buffer strip from 1 to 10 feet.	No permanent vegetative buffer strips on streams.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
10. Crop rotation	Perennial forages grown more than 75% of the time.	Perennial forages or small grain grown 50–75% of the time.	Perennial forages or small grain grown 25–50% of the time.	Perennial forages or small grain grown less than 25% of the time.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
11. Winter cover crops	Always planted after low residue crops like soybeans, corn silage, or vegetables.	Always planted after corn silage and sometimes after other low residue crops like soybeans or vegetables.	Sometimes planted after corn silage, but not after other low residue crops like soybeans or vegetables.	Not planted after corn silage or low residue crops like soybeans or vegetables.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
12. Permanent pasture	Pasture height greater than 5 inches for tall-growing forage and 3 inches for short-growing forage. Excellent soil cover. No bare areas where animals concentrate.	Pasture height greater than 4 inches for tall-growing forage and 2 inches for short-growing forage. Good soil cover. Few bare areas where animals concentrate.	Pasture height greater than 2 inches for tall-growing forage and 1 inch for short-growing forage. Fair soil cover. Few bare areas where animals concentrate.	Pasture height less than 2 inches for tall-growing forage and less than 1 inch for short-growing forage. Fair soil cover. Many bare areas where animals concentrate.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Soil Quality

					Site Identification
					#1 #2 #3
13. Organic additions	Manure, compost, or organic materials (other than crop residue) added continuously (more than 8 years in 10) but not in excess of crop nutrient requirements.	Manure, compost, or organic materials (other than crop residue) added frequently (4 to 8 years in 10) but not in excess of crop nutrient requirements.	Manure, compost, or organic materials (other than crop residues) added rarely (less than 4 years out of 10), but not in excess of crop nutrient requirements	No manure, compost, or other organic additions.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

*These conditions may indicate the presence of critical runoff problem areas as defined in Pennsylvania's Nutrient Management Act, Chapter 83, subchapter D; 83.201. Definitions, 83.321. Stormwater runoff control, and 83.431. Stormwater runoff control.

Soil Quality (continued)

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)		
	Site Identification						
	#1 #2 #3						
14. Soil structure	Soil very crumbly with lots of pore space. No sign of crusting or soil compaction. Roots grow freely in the soil.	Soil crumbly with good pore space. No sign of crusting or soil compaction. Good root growth.	Soil breaks into clods. Pores less visible. Soil sometimes crusts. Some compaction. Fair root growth.	Soil breaks into large clods. Very little pore space. Crusting and compaction evident. Poor root growth and poor crop stands.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Soil disturbance with tillage and planting	Less than 15% disturbed (as in no-till corn planting).	15–30% disturbed.	30–100% disturbed with no more than two tillage passes.	100% disturbed with three or more tillage passes (as in conventional tillage).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Soil compaction	No evidence of soil compaction.	Soil compaction evident in a few areas creating problems during part of the year. Some limitation to crop growth or field traffic.	Soil compaction is a problem in many areas. Limitations to crop growth or field traffic are common.	Soil compaction is a problem in all areas, limiting crop growth or field traffic.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Surface water	Surface water infiltrates readily, little ponding occurs.	Surface water infiltrates, but some ponding occurs.	Surface water infiltrates slowly, some ponding is common up to 24 hours after rainfall.	Surface water ponds even after small rainfall events, large ponds remain after 24 hours.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Soil drainage (natural and tile)	Water table is deep below the crop root zone. Does not affect crop growth. Crop growth is uniform.	Water table near the surface for short periods of time in the spring. Crop growth is uneven in some sections of the field.	Water table near the surface for at least a month in the spring. Crop is uneven across most of the field.	High water table, near the surface. Crop yield often below the county average due to saturated soil conditions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Soil Conservation Planning/Implementation

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)		
	Site Identification						
	#1 #2 #3						
19. Soil conservation plan development	Up-to-date soil conservation plan* that does not allow tolerable soil loss to be exceeded for all cropland fields.	Up-to-date compliance plan to meet tolerable soil losses only on designated highly erodible land.	Soil conservation plan developed, but 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.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. Soil conservation plan implementation	Soil conservation plan* fully implemented.	Compliance plan fully implemented.	Soil conservation plan or compliance plan not fully implemented.	Soil conservation or compliance plan with no implementation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Soil Conservation Planning/Implementation (continued)

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
	Site Identification				
	#1 #2 #3				
21. Soil conservation practice maintenance	All soil conservation practices fully maintained.	Most soil conservation practices fully maintained.	Few soil conservation practices fully maintained.	No soil conservation practices fully maintained.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

*Defined by Pennsylvania Clean Streams Law, Chapter 102; USDA-NRCS Conservation Planning Handbook.

TOTAL
 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 soil conservation 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

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.

GLOSSARY

Buffer Strip: A permanent strip of vegetation at least 10 feet wide along the side of a watercourse that helps to reduce soil erosion, runoff speed so sediment is deposited, and water pollution. Some regulations for concentrated animal feeding operations may require buffer strips of 30–100 feet for manure application.

Compliance Plan: Establishes the minimum level of conservation treatment needed to meet conservation compliance requirements for USDA farm program benefits, but 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) generally grown between principal crop production periods, especially over winter, to protect soil from erosion when crop residues are low or removed for feed or bedding and to capture or hold residual nutrients (including nitrogen), thus reducing potential loss of nutrients. In the case of vetch or other legumes, nitrogen may be produced for subsequent crops.

Critical Runoff Problem Areas: Where nutrients and/or sediment discharge directly into surface water or groundwater and are identified as part of Pennsylvania's Nutrient Management Act, Chapter 83.

Crop Residue: Plant material left in fields that is not harvested for feed or removed for bedding and other uses.

Crusting: A solid layer of soil that may form on the surface after a heavy rain. A soil crust makes it harder for plants to emerge from the soil.

Ephemeral Gully: Well-defined converging channels in the soil that result from water runoff. Ephemeral gully channels are deeper than rills, can be crossed by field equipment with some difficulty, and/or can be repaired with common field operations.

Eroded Soil: Soil from which most or all of the topsoil has been lost.

Gully Erosion: Soil detachment and movement causing converging channels in the soil as a result of water runoff. They are well developed converging channels that form in the soil as a result of water runoff and cannot be crossed by farm equipment. Gullies are deeper and more pronounced than ephemeral gullies. Field equipment alone cannot be used to repair the damage. Once gullies form, they generally continue to grow longer, deeper, and wider.

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 (Food, Agriculture, Conservation, and Trade Act). These areas can be identified upon request by USDA Natural Resources Conservation Service staff.

Perennial Stream: Surface water course that carries water most, if not all year, usually with well-defined stream banks, streambed, and often have adjacent floodplains.

Rill Erosion: Small, parallel channels that form in the soil as a result of water runoff. Farm equipment is able to easily cross these small channels and fill them.

Sheet Erosion: The loss of a uniform layer of soil by water. Signs of sheet erosion include: (1) exposed plant roots; (2) stones

uncovered by moving water; (3) stones supported by protected pedestals of soil; and (4) sediment deposition in low lying areas.

Soil Compaction: Loss of pore space in the soil due to equipment and animals. Compaction makes it difficult for air and water to move through the soil.

Soil Conservation Practices: The implemented soil conservation practices that should be routinely maintained include waterways, terraces, diversions, tile outlets, sediment control basins, and the boundaries for strip cropping and contour farming.

Soil Conservation Plan: Addresses conservation and sustained soil use by documenting gully, rill, and sheet erosion control needs to meet tolerable soil loss levels and the requirements to minimize sediment loss from fields. This plan will address water quality concerns for sediment and meet the Pennsylvania Clean Streams Law, Chapter 102, requirements for erosion and sediment control.

Soil Degradation: Reduction in soil quality that results in poor crop growth.

Soil Drainage (Natural): The frequency and length of time when the soil is free of excessive water. For example, water drains quickly through well-drained soils. In poorly drained soils the root zone is water logged for long periods of time unless some form of artificial drainage is installed.

Soil Erosion/Soil Loss: The movement of soil particles from one place to another by water or tillage.

Soil Quality: This is a measure of soil health. A good quality soil has: adequate pore space—not compacted (for air and water movement); a good supply of nutrients; high levels of organic matter; good drainage; and an active soil life (earthworms, fungi, bacteria). Good quality soil resists erosion and nutrient loss.

Soil Structure: Soil particles stick together into clumps called aggregates. A soil that has lots of stable aggregates, lots of pore space, and does not crust has good soil structure.

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 per acre per year. Tolerable soil loss rates have been determined for local soil mapping units by the USDA Natural Resources Conservation Service and are available in the published soil survey.

Water table: Zone of free water in soil, geologic material, or bedrock. There are two types of water tables: (1) the water table typically noted in a water well log as an indication of a usable water supply; and (2) the seasonal high water table. The seasonal high water table is usually within the crop root zone. It may be a perched, temporary zone or a persistent saturated zone where subsurface water flows converge throughout much of the year. It is the most important water table for soil water management and crop growth.

Waterways: Areas where runoff concentrates and flows across fields. These areas may require special management to control scouring and to reduce sediment transport from the field. If these areas are unprotected, gullies may develop that restrict field operations and that are sources of sediment in runoff.

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 Wastewater Treatment System
- Worksheet #4—Barnyard Conditions and Management
- Worksheet #5—Milkhouse Waste Management
- Worksheet #6—Stream and Drainageway Management
- Worksheet #7—Petroleum Storage and Handling
- Worksheet #8—Silage Storage Management
- Worksheet #9—Animal Waste Storage and Management
- Worksheet #10—Animal Waste Land Application Management
- Worksheet #11—Soil Conservation Management
- Overall Farmstead Ranking

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