

A Conservation **CATALOG**

**Practices for the Conservation
of Pennsylvania's Natural Resources**



Introduction

Pennsylvania is a land of great natural resources and Pennsylvania's farmers have always worked as stewards of the land to improve and protect those resources. The Pennsylvania Conservation Catalog is a cooperative effort of the Pennsylvania Conservation Partnership which supports farmers in those efforts. The Catalog identifies practices which may assist you in caring for the land while maintaining your economic viability and protecting farming as a way of life.

While this Catalog is meant to help you plan for your land, additional assistance is also available. Local county conservation districts and the USDA Natural Resources Conservation Service provide one-on-one technical assistance. Federal and state agencies such as Farm Service Agency, Penn State Cooperative Extension, PA Department of Environmental Protection, PA Department of Agriculture and PA Department of Conservation and Natural Resources also provide information and are available to help, or have cost-share to assist in the implementation of practices. Private consultants are another source to help you plan what's best for you. Some conservation efforts may require specific permits. Ask your conservation professional where to go for permit information.

About This Catalog

The Pennsylvania Conservation Catalog describes conservation practices to reduce soil erosion and enhance and protect water quality. The Catalog also addresses other resource concerns. It explains how each practice works, gives tips on installing and managing practices and suggests how practices may be combined to form a conservation system. You may be interested in comparing the economics of different practices on pages 26-27.

Silt is the most common pollutant of our surface waters. Controlling sheet and gully erosion on all land is the first step in reducing sediment and improving water quality. Since erosion control practices both assure the continued productivity of our cropland and protect water quality, they are listed first in this publication. Practices that specifically address water quality and other resource concerns are found in the latter portion of the Catalog.



Assistance is available to help you plan what's best.

Why Plan for the Whole Farm?

By addressing all of the concerns on your farm together, you are selecting practices that can be combined into a system. This ensures that one practice does not cancel the benefits of or conflict with another and that they all work together for the greater good of the land. This system of practices should be documented in a conservation plan.

Watershed Planning

Just as you are planning for your entire farm, many communities and cities are planning for entire watersheds. Check with your local conservation district to see if watershed planning is taking place in your area. Watershed planning is everyone working together for the good of the resources. It means remembering "We all live downstream." Sometimes groups of farmers work together to improve a length of stream in a watershed. In larger watersheds, townships and cities work together to improve the resources. Additional cost-share monies may be available to help you install your conservation practices. Watershed planning is most often completed by local people determining and prioritizing the issues, and deciding what works best for them. Agriculture, industry and residents all benefit from watershed planning.

How To Get Started

Establish personal goals and objectives for your farm operation. Look at where you are now and think about where you want to be. Talk to family members and consider the future. You may want to talk to neighbors to determine if you share similar goals. Then look at the resources.

1. Walk each acre of your property, preferably in early spring before plants green up.
2. Evaluate the quality of your soil.
3. Observe the color and nature of runoff during snowmelt and rainfall. Consider the sources of runoff and sediment.
4. Observe areas where surface runoff may flow through pollutants such as manure.
5. Look at existing conservation practices to be sure they are functioning properly.
6. Develop a plan with the goals and objectives you have identified above in mind.
7. Monitor results and modify plan as needed.

Additional Guidelines

1. It is suggested that some type of aerial photography be used to identify specific areas of concern.
2. Use the Conservation Catalog as a reference in listing practice options to treat identified concerns.
3. Use the economic section of this publication to help you select practice options. Consider both short- and long-term objectives and solutions to problems.
4. Ask for help. Your local conservation district or NRCS office will help develop alternatives so you can choose what's best for you. They may suggest others who can provide you with specific guidance. They can also help find cost-share funding to install specific practices and improve and protect the future of your land.

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Crop Residue Management

Crop residue management is the planned use of crop residue to protect the soil surface.

Crop residue management is one of the most cost-effective conservation practices. Crop residues may include corn or soybean stalks, small grain straw or the residue from vegetables and other crops. Although there are many benefits from leaving crop residue to protect the soil surface, one of the most common is to reduce soil erosion.

Any level of residue can help reduce soil erosion. In some situations, levels in excess of 50%-75% may be needed. USDA recognizes conservation tillage only when surface residues exceed 30% after planting.



Benefits:

- Increased water absorption
- Reduced volume and velocity of surface runoff
- Improved soil moisture from mulching effects
- Improved biological activity from populations of earth worms, night crawlers and other forms of soil life

Tillage Makes a Difference

There is a direct relationship between the amount of tillage done and the amount of crop residue left on the surface after planting. The most effective method to maximize surface residue is to use no-till planting. Many of today's producers use complete cropping systems with no tillage at all. This maximizes the residue amounts accumulated on the surface through a complete crop rotation. Continuously maintaining soil cover levels of 50-75% or more tends to improve the effectiveness of no-till systems and soil quality.

Other producers mix no-till and reduced-till with the use of a moldboard plow. These combinations will increase, to some extent, the amount of crop residue when compared to the singular use of a moldboard plow. Continuous use of a moldboard plow represents maximum tillage and the smallest amount of surface residue left to protect the soil and build soil organic matter.

Producer Guidelines

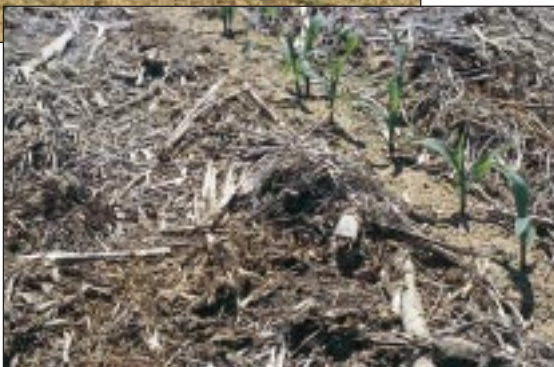
- Use complete no-till systems whenever possible or combine no-till with other systems that increase residue on the surface.
- Reduce the number of tillage passes.
- Select tillage implements that leave more residue. Chisels and field cultivators with straight points or sweeps will maximize surface residues as compared to disks and equipment with twisted shanks.
- Operate tillage tools at shallower depths (3"- 4") to increase residue and save fuel.
- Do fall tillage only when necessary and when the surface is left rough with residues over 50%. If tillage leaves low residue amounts, consider planting a winter grain for cover.
- Use cover crops to supplement low residue crops such as soybeans and vegetables or to replace removed residue.
- Spread all residue evenly at harvest.
- Chop corn stalks in the spring just prior to planting to allow the soil to warm more quickly or only when more even distribution is necessary to protect the soil.
- Fall chopping provides better winter soil protection.
- No-till planting into corn stalks helps retain surface residue for 2 years.
- Surface applied manure in no-till systems can supplement surface cover especially when bedded manure is used.

General Management Considerations:

- Current planters and drills do an excellent job of planting directly into high levels of residue and create a smooth, uniform seedbed even in uneven soil conditions.
- When beginning high residue and/or no-till planting, it is best to plant a small amount of acreage until you are familiar with the operation and adjustment of the planting equipment.
- Used planters and drills are available for purchase and can save a producer money.
- It is essential to find a producer or equipment dealer familiar with the equipment when getting started. All equipment is similar but each may require slightly different adjustment techniques.
- If you tried no-till planting in the past and were not successful, don't be afraid to try it again. There are improved products today such as better seed varieties, weed control, equipment, etc.
- Whether a system is no-till or reduced-till, a continual surface of 50% residue with cover crop as needed provides excellent erosion control and will provide an effective mulch to improve water absorption and preserve moisture in the soil.
- All field crops and many specialty crops such as vegetables can be no-till planted. Cover crops, oats, wheat and forages are quite easy to no-till and offer a good starting point for beginners.



Residue is managed in many ways.



No-till corn into manure, soybean residue and previous corn residue.



No-tilling vegetables into cover crop.

What is No-Till?

No-till is the planting of crops directly into existing crop residue or cover crops without using tillage. Soil disturbance is limited to a narrow band which can be as wide as 8-10 inches in zone tillage or may be barely visible. In no-till planting, soil is commonly disturbed using 1-3 coulters which may differ in size and configuration. Deep tillage which does not disturb the soil surface may be used occasionally with no-till to reduce soil compaction. Other forms of conservation tillage which leave the USDA required 30% or more residue include using combinations of chisels, disks and field cultivators, etc., as well as specialized equipment to accomplish ridge tillage.

Measuring Residue

Residue is generally measured following planting. Residue measurements after harvest determine residue losses from tillage. To measure crop residue, stretch a line or tape with equally spaced points, usually at 1 foot or 6 inch increments, diagonally across the rows and count the number of marks which have residue directly under them. The total number of marks in the line divided by the number of marks with residue directly beneath them will provide the percentage of residue. This procedure should be repeated on 3-5 representative locations within the field. Contact NRCS, Cooperative Extension or your county conservation district for assistance.

Crop residue management works very well with contour and cross slope farming and the use of grassed waterways. Stripcropping and cropland terraces may also be used with this practice.

Contour Farming

Contour farming involves conducting tillage, planting and harvesting operations around a hill or slope as near to the contour as is practical to reduce erosion.



Contour farming is most effective on moderate slopes of 3-8% when there are measurable ridges left from tillage and/or planting operations. These small ridges (usually 1-3 inches high) serve as miniature terraces to slow runoff and increase water absorption into the soil.

Contour farming is more effective where some form of tillage is used because tilling results in more numerous and larger ridges. However, there are benefits from using contour farming in no-till planting.

Contour farming is typically used on moderate slopes when land is intensively cropped. The practice is most effective on shorter slopes or on longer slopes with cropland terraces.

Benefits:

- Reduced water runoff
- Increased moisture absorption into the soil
- Improved water quality
- Reduced soil erosion



Producer Guidelines

- The shape and steepness of your land determines the row pattern for your contours. Land with uniform, gentle slopes will result in well-rounded, gentle lines for farming operation. In these instances, contouring can start from a single contour baseline near the middle of the slope.
- On land more rolling in nature, several baselines and some point rows will be needed to retain conformance close to the contour. It is generally suggested that you request assistance from NRCS or your local conservation district to establish a contour system.
- Deviation from the contour should not exceed a 4% row grade for a minimum distance of 150 feet. This amount of variance is allowed on fields with irregular slopes or rolling topography.
- Contour farming can be combined with high residue tillage or no-till systems and/or crop rotations with small grains/forages to reduce soil loss and improve water quality.
- Grassed waterways should be used in areas where runoff concentrates. They are needed more commonly in concentrated flow areas that are deep and narrow and drain more acres.
- In some instances, row direction cannot meet the minimum guidelines for contour farming due to extremely irregular slopes. In these instances, a practice referred to as cross-slope farming may be used. Due to a greater deviation from the contour, the use of grassed waterways becomes even more important in areas of concentrated water flow.



Contour Stripcropping

Contour stripcropping is a system of growing crops in strips or bands on or near the contour to reduce soil erosion.

Contour strips are generally an even width although uneven widths may improve “farmability” in areas with rolling or irregular topography. Uneven width correction strips may also be used. Strip widths generally range from 90 to 120 feet in width, based on the land slope and cropping system being used.

Traditionally, stripcropping was defined as alternating strips of row crop with strips of either small grain or hay. Today, strips with high levels of residue on the surface (>50%) may be used as substitutes for alternate hay or small grain strips.

When land is very irregular or rolling and contour strips cannot be used, either field strips or contour farming may be more appropriate. When field strips are used on irregular land, they are less effective in controlling soil erosion and retaining surface runoff for absorption into the soil because they deviate more from the contour. The use of field strips may also require more grassed waterways because the rows will lead water toward swales or drainageways. Contour farming would be more effective in these instances, but would result in uneven width fields with some short rows.



Benefits:

- Reduced soil erosion
- Reduced water runoff
- Improved water quality
- Improved air quality

Producer Guidelines

- Contour strips are generally established by running a contour baseline somewhere near the middle of the slope. After the base contour line is run, even-width strips will be measured until the field is finished or the contour line is too far from the contour.
- For contour strips to be effective, strips of hay, small grain or heavy residue must be alternated with strips of row crop or crop with low residues.
- When all strips have similar crop or residue cover, they provide no additional protection against sheet and rill erosion. They do provide the flexibility to use tillage on alternate strips.
- Stripcropping may be combined with conservation tillage and residue management as well as the use of hay and small grains in rotation.
- Stripcropping is commonly supported by grassed waterways and diversions.
- Contour stripcropping may reduce the potential for gully erosion.

Conservation Buffers

Conservation buffers are areas or strips of land maintained in permanent vegetation to help control pollutants and manage other environmental problems.

Conservation buffers of permanent vegetation, including trees and shrubs, can address a number of environmental concerns. Buffers enhance our environment by removing sediment from runoff and providing wildlife habitat. They can also provide a natural and pleasing divider between agricultural production and urban industrial/residential development.

Land use conversions to intensive agricultural production and intensive urban and industrial development have led to public concern for water quality, wildlife habitat and other ecological conditions. Well-planned conservation buffers can play a role in addressing problems associated with these trends.



Benefits:

- Improved water quality
- Stable and productive soils
- Improved wildlife populations
- Improved recreational opportunities
- Improved aesthetics and sustainable landscapes

Producer Guidelines

The selection of an appropriate buffer for your farm or tract of land is a reflection of your objectives in treating the resource concern. Each type of buffer can be tailored to fit your situation. Below are some typical situations.

1. Your concern is soil erosion. Your farm operation includes the production of corn and soybeans with conservation tillage (chisel and field cultivator). Your objective is to control the erosion without making significant changes in your farm operation and with minimal costs. Contour buffer strips would be an excellent choice in this situation. This practice would be cost-effective and require the conversion of a minimal amount of cropland to grass or a grass/legume mixture.
2. Your concern is soil erosion on the headlands of some fields as well as the loss of crops along the field edge due to shading and wildlife feeding. Your selection could be a field border of grass or grass/legume. This practice would address the erosion concern and provide a field border to help minimize wildlife damage to annual crops.
3. Your concern is sediment coming from a farm lane which is already protected by small diversions at appropriate intervals. The runoff flows across a small section of a field before entering a small stream. You are also interested in providing habitat for pheasants and rabbits. You select a filter strip as the conservation buffer to address your concerns. The proper selection of grasses and legumes allow the filter to trap the sediment while also providing wildlife habitat.
4. You own a property with cropland immediately adjacent to a trout stream. Even with conservation treatment on the cropland, sediment occasionally reaches this stream. In certain locations, the streambank itself is unstable. A forested riparian buffer would provide multiple benefits in this instance. Plantings to stabilize the streambank and a combination of trees, shrubs and grasses next to the cropland and adjacent to the stream will reduce sediment and other attached pollutants entering the stream. The trees will eventually provide shade and reduce the stream temperature during the summer months improving the aquatic habitat.
5. Your cropland includes a limestone soil with frequent shallow areas and rock outcrops. Erosion has been reduced through field stripcropping and a crop rotation but still occurs during periods of intense runoff. Diversions and terraces cannot be constructed due to rock outcrops and the lack of a suitable outlet. A cost-effective solution is the use of a vegetative barrier. This barrier would significantly reduce the potential for soil erosion.

Types of Conservation Buffers

- 1. Contour Buffer Strips** — permanently vegetated strips which are located between larger crop strips on sloping land.
- 2. Field Borders** — bands or strips of permanent vegetation established at the edge of a cropland field.
- 3. Filter Strips** — strips or areas of permanent vegetation used to reduce sediment, organic materials, nutrients, pesticides and other contaminants from runoff.
- 4. Riparian Forest Buffers** — areas of trees and/or shrubs located adjacent to streams, lakes, ponds or wetlands.
- 5. Vegetative Barriers** — a narrow permanent strip of stiff-stemmed, tall, dense perennial vegetation established in parallel rows perpendicular to the dominant field slope.
- 6. Windbreaks** — a planting of single or multiple rows of trees and/or shrubs that are established to protect sensitive plants, livestock and structures, and to create or enhance wildlife habitat.



Filter Strips



Riparian Forest Buffers



Contour Buffer Strips



Vegetative Barriers



Field Borders



Windbreaks

Crop Rotations

Crop rotations are a planned sequence of different crops on the same field.

Crop rotations may be a simple 2-year rotation of corn and soybeans, or an 8-year rotation of 4 years of silage corn and 4 years of hay. It could include a mixture of crops such as corn, small grain, soybeans and forages spread over 6-8 or more years. Crop rotations are typically used on most cropland in Pennsylvania.



Benefits:

- Improved soil nutrient balance
- Improved soil quality
- Reduced threat of insects or diseases
- Reduced soil erosion
- Reduced use of pesticides

Producer Guidelines

- Consider alternating grass and legume crops since legumes add nitrogen to the soil.
- Rotations offer more alternatives for weed, insect and disease control as they reduce the risks commonly associated with a monoculture such as continuous corn.
- Alternating high and low residue-producing crops is helpful when using no-till or reduced tillage. If crops are planted into high levels of residue from the prior crop, a cover crop may not be necessary after harvesting.
- Crop rotations may need to be modified from time to time due to weather conditions, economics or needed crop management strategies. Sometimes residue is removed contrary to the plan. That removal can be offset by using a cover crop to replace the removed residue. Cover crops can also protect soil if a low level of residue was produced.
- If a low residue crop is used to replace a high residue one, a cover crop may be used or the crop should be no-tilled to retain as much residue as possible.
- The use of hay and pasture, especially when it includes a grass or grass/legume mix, can further reduce soil loss as well as improving soil health.

Cover Crops

Cover crops reduce soil erosion and add organic matter to the soil.



Cover crops are annual or perennial crops that protect the soil from erosion and offer the opportunity for additional forage production and an additional income source. They can improve soil health, take up excess plant nutrients and reduce weed pressures which may reduce herbicide use. It is important to consider the purpose of the cover crop when selecting the plant specie(s).

Benefits:

- Reduced soil erosion
- Improved water quality
- Reduced nutrient loss following primary crop harvest
- Reduced potential for weeds
- Increased soil organic matter
- Improved soil structure and porosity

Producer Guidelines

- Mixtures provide benefits over single species.
- Seed in time to achieve desired plant growth.
- Use cover crops as a supplemental forage (Harvest or use as pasture).
- Cover crops provide rotational effects when growing continuous corn.
- Consider the long- and short-term benefits – economics.
- Select plant specie(s) and variety(ies) based on primary and secondary purpose.
- For winter soil protection, plants should cover 50% of the soil surface or be at least 4 inches high.
- No-till planting of cover crops retains existing crop residue and soil moisture to achieve maximum soil cover.
- Cover crops are particularly effective following crops which produce low amounts of residue (vegetables or soybeans) or when crop residues are removed (corn silage).

Soil Quality

Agricultural soil health or quality is the ability of the soil, using its chemical, physical and biological properties, to support plant life and to maintain and/or enhance water and air quality.

Soil is a living, dynamic resource made of different-size particles (sands, silts and clays), organic matter and numerous species of living organisms. Soil biological, chemical and physical properties may change constantly in response to both natural conditions and the activities of man.



Benefits:

- Improved water quality
- Reduced soil erosion and sedimentation
- Improved nutrient balance and retention
- Increased soil moisture for plant growth
- Conversion of carbon dioxide to organic carbon in the soil
- Increased profits from reducing inputs and/or increasing production



Producer Guidelines

Do an initial evaluation of your soil to establish baseline data. Use the soil test results, including soil organic matter content, and the Pennsylvania soil health card to evaluate easy-to-measure soil health indicators. Contact your local Cooperative Extension or NRCS office for more specific information.

Common Soil Quality Indicators:

1. Physical indicators -- depth of topsoil, porosity, aggregate stability, soil organic matter, compaction and crusting. Physical indicators primarily affect seedling emergence, plant vigor, water movement and the moisture-holding capacity of the soil.
2. Chemical indicators -- pH, cation exchange capacity (CEC) and concentrations of soil nutrients and potentially toxic materials. These conditions usually

affect soil-plant relationships and the availability of nutrients to plants or soil organisms.

3. Biological indicators -- micro- and macro-organisms, their activity, and end- or by-products. The microorganisms (ones we cannot see with the naked eye) far outnumber those which we can see such as earthworms, night crawlers and nematodes.

Common management techniques to improve soil health and quality include: crop residue management, conservation tillage and no-till planting, the use of cover crops and crop rotations which provide significant plant biomass (including roots), as well as the addition of organic matter such as manure, compost and biosolids. Contact your local conservation district or NRCS for assistance.

Managing Your Soil's Health

There has been much interest and research in soil quality over the years, especially related to the physical and chemical aspects of soil health and quality. There is currently much interest in relating biology in the soil to the physical and chemical aspects.

There also appears to be a very close link between soil quality and the effectiveness of continuous no-till planting systems. A common link between the two appears to be the continuous maintenance of a high degree of soil cover which results in a successful no-till system as well as a soil that reflects the properties representative of good health and quality. Contact your local Conservation District, Cooperative Extension or NRCS office for more information.



Common Management Activities to Improve Soil Health and Quality

Common management activities to improve soil health and quality may be placed into two categories:

1. Tillage to retain maximum amounts of plant biomass (surface residue plus roots) and organic matter within the soil. To retain plant biomass and soil organic matter:
 - a) Modify or reduce tillage operations. Each tillage pass causes existing soil organic matter and decaying residue to further break down and produce carbon dioxide. The first tillage pass results in the largest single loss.
 - b) The use of no-till planting with a narrow band of disturbed soil will result in maximum reductions in the loss of plant biomass and soil organic matter. This will increase the potential for building organic matter in the soil.
 - c) Leave as much plant residue as possible on the surface after harvesting.
2. Organic matter management to add plant biomass and organic matter to the soil to supplement existing amounts of the same. To add organic matter or plant biomass:
 - a) Use cover crops to provide additional roots and surface biomass. Consider above-ground biomass as well as root mass and characteristics. Mixtures of cover crops will provide diversity in biomass and root production. Even if cover crops are harvested, they have still provided soil cover, some surface residue and all of the root mass.
 - b) Use manure to provide both nutrients and soil organic matter. Rates of application should be based on existing soil nutrient levels as well as nutrient requirements to grow the specific crop or crops. The greater the amount of bedding with the manure, the greater the amount of organic matter added. If used in a no-till system, manure can help supplement surface cover and residue. If incorporated into the soil, the addition can help offset potential losses of carbon due to tillage.
 - c) Use compost and other organic sources such as bio-solids to provide organic matter to the soil. Since compost is already in the process of being broken down, it does not provide microbes their normal opportunity to do the initial breakdown of plant residues. However, the advantage of compost over raw organic matter is that nutrients and organic residues will be available to plants more quickly. Producers using bio-solids and other organic materials should have them tested for nutrient content as well as contaminants such as heavy metals.
 - d) Modify cropping systems to produce more biomass that will be left on the field after harvest. For example, add small grain to a corn/soybean rotation or use 2 years of corn/grain and 1 year of soybeans. The addition of a grass or grass/hay to alfalfa/hay will result in more fibrous roots to produce underground biomass as grasses generally produce more biomass on the soil surface throughout the year. In other words, substitute a high residue-producing crop for a low one. Even certain varieties of corn, for example, will produce more stalks and leaves than other varieties.

Establishing Permanent Vegetation on Areas Subject to Erosion

Soil in all areas can be protected from erosion by using vegetation.

Using vegetation to reduce soil erosion and sedimentation is a commonly accepted practice in both agriculture and urban situations. The key to using vegetation is properly selecting the plant(s) and using proper techniques to establish them. In most instances, the cost of establishing vegetation will compare very favorably with other possible solutions. The following guidelines are applicable to establishing cover on sloping areas subject to erosion, conservation practices needing to be seeded, conservation buffers, filter strips and other areas.



Benefits:

- Reduced soil erosion
- Improved water quality
- Reduced sedimentation
- Reduced cost of treatment
- Enhanced wildlife habitat
- Improved aesthetics

Producer Guidelines

Evaluate the primary and secondary purposes in establishing vegetation. Even when reducing soil erosion is the primary purpose, there may be other benefits that can be achieved by selecting the proper plant specie(s).

Site Considerations:

1. What are the soil characteristics such as drainage, subjectivity to drought, slope, or aspect?
2. Is the area subject to concentrated water flows?
3. Does the area receive surface water from a large drainage area?
4. Is there a sensitive area such as a spring or high quality stream downslope?

Key Steps in Establishing Cover:

1. Select proper plant species and varieties for the site and desired objectives.
2. Limit site preparation to the least amount of soil disturbance necessary to establish the cover. Use a no-till drill to minimize soil disturbance and retain existing soil cover when possible.
3. Temporarily divert concentrated flows from the area or use jute netting to protect the site from scouring.

4. Seed at the proper time. A temporary cover such as a small grain or millet can be used to protect any disturbed area until the proper time to establish the permanent cover. Since seed and mulching is expensive, this will reduce the potential need for reseeding the permanent cover.
5. Mulching is an essential part of establishing vegetation. Mulch that is free from weed seeds should be used. The extra cost of mulching is nominal compared to other seeding costs and the risks associated with not using mulch.
6. On sloping areas with concentrated flows or areas subject to wind, anchor the mulch with netting or other methods to insure the establishment of a good vegetative cover.

For additional information, refer to publications such as the current *Pennsylvania State University Agronomy Guide* for agricultural seeding, and *Erosion Control and Conservation Plantings on Non-Cropland* for urban areas. Contact your local NRCS, Conservation District or Cooperative Extension office for additional assistance.

Integrated Pest Management

Integrated Pest Management is a “common sense” approach to managing pests that combines methods to provide effective, environmentally friendly control.

Integrated Pest Management (IPM) uses common sense and a combination of genetic, biological, cultural and/or chemical methods as well as current pest information to control pests in an environmentally friendly manner. IPM systems depend on the regular inspection of fields during critical growth periods and the recording of observations and/or results of pest control actions taken. IPM systems are compatible with soil and water conservation systems with many practices providing dual benefits.



Benefits:

- Increased profits from reduced costs
- Reduced buildup of resistance in target pests
- Improved knowledge of pest problems
- Healthy, safer environment
- Reduced use of pesticides

Integrated Weed Management

Pennsylvania has several species of noxious weeds which should be managed for the health of the land, your crops and your livestock. Contact your local conservation district, county extension agent or the Pennsylvania Department of Agriculture for assistance in identifying and treating the weeds on your farm.

Producer Guidelines

- Learn the common pests affecting the crops on your farm—what they look like, their biology and what control options are available.
- Prevent pests by using certified seed or pest-free plant material and crop rotations, and varying between-row spacing, in-row spacing and the time of planting.
- Monitor crop fields to recognize the build up or decline of pest pressures.
- Compare observations against established target pest numbers (thresholds) to determine if treatment is necessary.
- Practice pesticide resistance management by using several different control methods in combinations.
- Use the most effective, least toxic and least environmentally disruptive management tools and tactics available.
- Record observed pest problems, control tactics employed and results of actions taken.
- Use good management practices for soil conservation, water use, and soil and plant nutrition.
- Follow safety guidelines and legal requirements on pesticide labels. Calibrate sprayers and attend pesticide training updates.
- Analyze records at the end of the season to plan next season's control program.
- Follow a “systems” approach in implementing all of the above actions.

Grassed Waterways

Grassed waterways are natural or constructed swales where water usually concentrates as it runs off a field.

Grassed waterways slow runoff water and guide it from a field preventing gully erosion. Before establishing grass, you should know the watershed—the land draining into your waterway. Waterways with large drainage areas or steep slopes should be carefully designed and constructed. Your NRCS or conservation district office can tell you whether major land shaping is needed. Smaller waterways on gentle slopes can be shaped and seeded by the farmer. Charts are available to help you design and lay out your waterway.



Benefits:

- Improved water quality
- Reduced erosion
- Improved field conditions
- Provides an outlet for terraces or diversions

To Shape and Seed a Small Waterway:

Begin preparing the seedbed slightly above the point where the gully begins and end it where water spreads out and no longer cuts a gully. Shape the waterway as a broad, rounded swale, keeping in mind that you want the water to run down the center of the grassed area. Lime and fertilize according to recommendations. Plant grass seed $\frac{1}{4}$ to $\frac{1}{2}$ inch deep in a firm seedbed. (If your footprint is less than a half inch deep, you've got a firm seedbed.) The best row direction is diagonally across the channel. If you broadcast, cover the seed lightly with a harrow or culti-pack.

The waterway should be mulched to protect the soil until a seeding is established. If a waterway is constructed after optimum spring or fall seeding dates, establish a small grain cover and no-till plant the permanent vegetation when next appropriate.

Producer Guidelines

Proper maintenance will protect your investment in a grassed waterway. The following tips will help keep it working well.

- Lift implements out of the ground as you cross the waterway.
- Bring crop row patterns perpendicular to the waterway where possible. If the waterway is firm, use it as a turn area. Don't plant end rows along the sides of the waterway unless using no-till planting.
- Mow and fertilize periodically to maintain proper grass height and plant density.
- Inspect the waterway frequently for areas that are eroding and need reseeding. Repair problems immediately. Small depressions and gullies can be filled with stones.
- Maintain the width of the grassed waterway when tilling and planting surrounding fields.
- Herbicide applications should NOT be applied within the waterway.
- Don't use the waterway as a road. Vehicle tire tracks can become gullies.

Terraces and Diversions

Terraces and diversions are earthen channels that intercept runoff on slopes.

Terraces and diversions transform long slopes into a series of shorter slopes to reduce the rate of runoff and allow soil particles to settle out. The resulting cleaner water is carried off the field in a non-erosive manner.

Terraces are cross-slope channels that control erosion on cropland and are usually built so crops can be grown on the terrace. They handle areas of concentrated flow where ephemeral gullies may form. The middle photo at right shows a terrace under construction.

There are two types of terraces. Storage terraces collect water and store it until it can be absorbed into the soil or released to stable outlet channels or through underground outlets. Gradient terraces are designed as cross-slope channels to collect runoff water and carry it to a stable outlet like a waterway.

Diversions are cross-slope channels that are permanently vegetated with grass. They are used on steeper slopes where a terrace would be too expensive or difficult to build, maintain or farm. Diversions can also be used on non-cropped land to protect a farmstead or barnyard from runoff water.

Terraces and diversions are most effective when used in combination with other practices such as crop residue management, contour farming, crop rotation, and field borders.

Benefits:

- Reduced erosion
- Improved water quality
- Improved soil absorption
- Reduced runoff to structures below



Producer Guidelines

Several important factors should be considered when planning and designing a terrace system or diversion:

- Terraces and diversions must generally fit the contour of the land. Deviations from the contour must be limited and are used only when necessary to obtain good alignment.
- If terraces or diversions are planned to outlet into a grassed waterway, the waterway should be fully vegetated before the terraces or diversions are built.
- Terraces should be cropped parallel to the terrace channel and ridge. Care must be taken to maintain the ridge height by not straddling the ridge top with planting or tillage equipment.
- Diversions should be mowed and fertilized to maintain a vigorous sod cover over the entire channel and ridge.
- Tillage, planting, and herbicide applications should be conducted parallel to and outside the diversion.
- Vehicle traffic should not cross over a terrace or diversion unless a roadway is designed and built as part of the practice.

Pasture and Hayland Planting

Pasture and hayland planting is the successful establishment of a forage selected to meet the producer's specific objectives.

Pasture and hayland plantings are becoming more common as livestock farmers reduce feeding costs by establishing rotational grazing systems on improved pastureland or plant hay or legumes to use as feed for their livestock. Plantings may be cool or warm season species and may consist of a mixture of grasses or legumes or mixtures of both. Establishing crops as part of crop rotations provides feed for livestock as well as protecting soil from erosion and adding nitrogen to the soil base.



Benefits:

- Improved soil organic matter levels
- Improved soil health
- Reduced need for pesticides and fertilizer
- Disruption of disease, insect and weed pressures
- Reduced feed costs
- Improved water quality

Producer Guidelines

- Drill seed uniformly to the recommended depth.
- Do not mix cool and warm season grasses.
- Leave the residue and till on the contour.
- Use no-till whenever possible, especially on steeper hills.
- Graze or closely clip, and apply a burndown herbicide to current pasture or hayland before inter-seeding.
- Consider soil conditions.
- Consult the current Penn State Agronomy Guide for recommended species, varieties, seeding rates and establishment guidelines or contact your local NRCS or conservation district office.

Grazing Management

Grazing management is the designed harvesting of forages by a grazing or browsing animal.

The use of a managed grazing system allows grazed pastures to rest and forages to replenish their energy reserves. A well-managed and maintained grazing system allows very little, if any, soil erosion. Water quality is protected both on the farm and downstream. In addition to improving the land, many social and economic benefits are derived from a prescribed grazing system.



Forage Utilization

A prescribed or planned grazing system incorporates one or more grazing options such as fenced paddocks and achieves effective forage utilization to enhance the animal's performance. Grazing options are managed to improve or maintain the health and vigor of selected plants for a stable and desired plant community and to help the producer achieve specific goals.

Benefits:

- Increased profits from reduced feed costs
- Improved quality of life
- Improved animal health and productivity
- Improved food and cover for grazing animals
- Improved water quality and quantity
- Reduced soil erosion and improved soil condition

Producer Guidelines

A managed grazing system is designed with the following considerations in mind:

- Tailor paddock sizes so available forage is utilized in 3 days or less. This limits the re-grazing of new growth.
- Rest paddocks long enough for forage plants to replenish energy reserves.
- Establish and maintain the desired plant species by tailoring your grazing plan to utilize plants as well as allow for their regrowth.
- Limit forage utilization to prevent overgrazing and the depletion of forage stands which leads to soil erosion.
- Provide an adequate supply of clean water for grazing livestock.
- Design and install proper fencing and watering systems as key components to a proper functioning grazing system.

Streambank Protection

Better water quality results from reducing the amount of nutrients, chemicals, animal waste and sediment entering the stream.

Streams are protected by excluding livestock and establishing buffer zones or vegetation to filter runoff. Fencing prevents cattle from trampling banks, destroying vegetation and stirring up sediment in the streambed. Stable crossings may be constructed to allow for movement across streams and access to water. A prescribed grazing system that limits livestock access to streambanks for short periods (24 hours or less) can provide the same beneficial results as fencing. A buffer zone of vegetation adjacent to the streambank filters runoff and may also absorb excess nutrients and chemicals. Riprap and gabions can be installed along the edges of a stream to buffer the banks from heavy stream flow and reduce erosion. Streambanks should be covered with rocks, grass, trees, shrubs or other vegetation to reduce erosion.



Benefits:

- Improved water quality
- Improved animal health
- Reduced soil erosion
- Additional wildlife and aquatic habitat

Producer Guidelines

- Fence livestock out of streams or provide adequate fencing for a prescribed grazing system.
- Provide stream crossings for livestock and/or farm equipment.
- Limit livestock access to streambanks to 24 hours or less when prescribed grazing is used in lieu of streambank fencing.
- Remove streamside-watering systems in the winter to prevent damage from potential flooding and install again in the spring.
- Smooth streambanks to provide an adequate seedbed when planting.
- The vegetation area along streambanks should be 15-25 feet wide.
- Remove fallen trees, stumps and debris that might cause turbulence in the stream and increase chances of flooding. Leaving natural items in safe areas can provide excellent aquatic habitat.
- Remove trees and brush that adversely affect the growth of desirable bank vegetation.
- Avoid damaging buffer zones with herbicides from surrounding cropland.

Nutrient Management

Nutrient management is the planned use of organic and inorganic materials to provide adequate nutrients for crop production while protecting water quality

Nutrient management plans are developed to help producers apply the proper rate and type of inorganic and organic sources of nutrients at the proper time. These plans are prepared by properly trained individuals involved in agribusiness or private consulting and, in some instances, conservation district staff or representatives from other agencies. A nutrient management plan will help a producer maximize the use of nutrients available on the farm and can reduce the need for purchased nutrients. Nutrient management plans need to be written according to the Pennsylvania Department of Environmental Protection Manure Management Manual. In some cases, plans must be written by a certified Nutrient Management Specialist and may fall under Pennsylvania's Nutrient Management Act (Act 6). Contact your local conservation district for more information.



Benefits:

- Maximized use of existing organic and inorganic nutrients for plant growth
- Reduced need and cost for some purchased nutrients
- Improved water quality
- Improved balance of soil nutrients

Producer Guidelines

To improve the efficiency of manure application (in accordance with your nutrient management plan), consider the following:

- Use soil nitrate testing, plant tissue tests, credits for past manure applications and nitrogen credits from legumes to estimate nitrogen application rates.
- Set realistic crop yield goals for your farm. Consider soil type and other conditions which impact yields.
- Obtain soil test every 3 years to determine recommendations for Nitrogen, Potassium and Phosphorus.
- Do not use application rates which continuously build up P and K.
- Calibrate manure and fertilizer spreaders so materials can be accurately applied.
- Nutrient management may be successfully implemented in no-till systems.
- Apply manure as close as possible to the time it is needed by plants.
- Apply manure uniformly just as you would fertilizer.
- Apply manure on fields of low fertility first.
- For fall or winter applications, spread manure according to the following priorities:
 1. Live perennial and annual crops
 2. Heavy surface residue such as corn stalks or small grain
 3. Low residue crop with cover crop established
 4. Low residue crop without cover crop
 5. Bare soil (application of manure or other source of nutrients is not recommended)
- Avoid spreading manure:
 - On steep slopes until just prior to tillage or planting.
 - Immediately adjacent to streams or open water.
 - Immediately up-slope from sinkholes.
 - When rutting or soil compaction may occur
- Nutrient management should be used in conjunction with other practices to adequately address soil erosion and water quality concerns.

Barnyard Runoff Control

Barnyard runoff control reduces the amount of runoff water from a barnyard, feedlot or other animal concentration area and keeps it from affecting clean surface or ground water.

The first step in planning barnyard runoff control is to evaluate existing practices, including livestock management and manure handling and collection. This evaluation will help identify problems that could cause pollution of surface or groundwater, contamination of your well, and/or animal health problems. The Pennsylvania Farm-A-Syst worksheet for Barnyard Conditions and Management is a good self-evaluation tool to help you through this process. It is available from your local Cooperative Extension and Conservation District offices. All livestock operations are required to follow the minimum requirements in the Pennsylvania Department of Environmental Protection Manure Management Manual to keep contaminated runoff out of surface waters. Some producers are subject to additional requirements and permits may be required. Contact your local Conservation District for information on these requirements.

Benefits:

- Improved water quality
- Improved animal health
- Cleaner cows
- Easier manure management



Before



One year later

Producer Guidelines

- Keep clean water clean.
- Adjust barnyard size for type and frequency of use.
- Provide durable surface for livestock, vehicles and manure scraping.
- Direct barnyard runoff to storage or treatment.
- Routinely scrape barnyard and manage treatment systems to keep them operating properly.

So What Should You Do?

The most cost-effective action in correcting barnyard runoff problems is to “**Keep clean water clean.**” The following practices may be appropriate, depending on your situation:

- A diversion (see page 17) up-slope of the barnyard to exclude the clean water.
- Roof runoff management including gutters or drip-line drains that connect to underground outlets.
- Water control structures including storm drains, surface inlets or culverts.
- Subsurface drainage to remove clean groundwater.

Analyze the barnyard for type and frequency of use. Provide adequate room for the intended use. If cows are confined in an outside holding area prior to milking, that area should be paved and provide about 15 square feet per cow. In barnyards or exercise lots where the livestock will be held for more than a couple hours at a time, provide about 75 square feet per cow on a paved surface or 350 square feet per cow on bare earth.

If a rotational exercise lot system is used, the sacrifice lot should be about the same size as an unpaved exercise lot and a minimum of three vegetated lots should each provide about 2200 square feet per cow.

Adjust the barnyard shape and dimensions to provide a uniform surface for comfortable cow traffic and easier manure scraping. Access to manure storage, spreader loading and other traffic should also be considered. The final surface should be firm and able to withstand the intended use. If milk trucks or silage wagons will drive through the barnyard, stronger paving will be needed. The choice of surface material should be based on the expected intensity of use, the equipment that will be cleaning the barnyard, and the cost. Concrete costs twice as much as a bare earth surface, and rolled stone is about midway between bare earth and concrete. Durability, repair and replacement costs should also be considered.

The manure-laden runoff from the barnyard should be collected and directed to storage or treatment



facilities. Install curbing along the lower portion of the barnyard to direct the runoff to a collection or storage tank, or temporarily store the runoff on a portion of the barnyard where the solids can settle out before the water is released to a vegetated filter area or constructed wetland.

Improved facilities can improve herd health and water quality, but management is critical to keeping the facilities working as intended. All improved barnyards require routine scraping of manure. Barnyards that drain to storage facilities do not need as much management as those that depend on treatment systems. To keep excess solids out of treatment facilities, you may need to operate and clean screen boxes, settling tanks and pumps, and scrape the barnyard more frequently.

Manure Storage

A manure storage facility holds manure and wastewater until they can be used in a controlled manner.



Benefits:

- Improved water quality
- Improved animal health
- Better utilization of manure for crops
- Improved aesthetics
- Happier neighbors

Manure storage helps you make optimum use of manure nutrients while protecting water quality. Several types of storage facilities exist, including earthen or lined ponds, above-ground or in-ground tanks, containment under livestock confinement facilities and open or roofed stacking facilities.

Select the type of storage facility based on your livestock operation, manure handling system and method of field application. Other design considerations include topography, soil conditions and the depth to groundwater and bedrock.

Manure can be pumped, flushed, scraped and hauled, or pushed directly into a storage facility or gravity flow pipe. The means of loading depends on the type of manure, how it's handled in the barn, how far you have to move it and the elevation difference from the livestock housing to the storage facility.

All manure storage facilities should be designed by engineers. Manure storage facilities must meet State requirements as stated in the Pennsylvania Manure



Management Manual. In some cases, additional permits may be required. Designers should be familiar with these requirements. Contact your local conservation district for more information.

Producer Guidelines

- Manure is managed as a useful resource rather than something without value.
- Allow for field application when conditions are right.
- Storage periods should be determined from the Nutrient Management Plan. Empty at least twice a year and apply whenever possible to growing crops according to your Plan.
- Divert clean runoff from surrounding areas away from storage facility.
- If manure is stored as a stackable solid, it should be protected from precipitation.
- Consider wind direction and odors when selecting a storage location.
- Storage facilities should be fenced for livestock and human safety. Signs should warn about drowning and hazardous gases.

Additional Conservation Practices

Ponds

Ponds are constructed by building an embankment, excavation or more commonly, by a combination of the two. Farm ponds may provide one or many of the following benefits or uses: livestock water, fire protection, gully control, recreation, water supply for farm operations, water conservation or to provide fish and wildlife habitat. Considerations in planning a pond include soil suitability, adequate quality and quantity of water source, minimization or elimination of silt, and site suitability for the size of pond desired. Ponds also require extensive management depending on the planned use.



Wildlife Habitat (Upland and Wetland)

Wildlife habitat management involves creating, maintaining or improving an area's food and cover for wildlife. Upland areas are protected from grazing by livestock. Specific plants are chosen for specific wildlife. Options include nesting cover, winter cover, travel lanes, food plots and water sources. Habitat management is applicable on odd, non-farmable areas; fence rows; field edges; wetlands and other land with wildlife or aquatic habitat as a primary concern.



Wetlands

Wetlands can remove sediment and other forms of pollution from water as well as provide food, water and cover for a wide variety of wildlife. Farmers can protect or restore wetlands to improve water quality and provide fish and wildlife habitat on their land. Earthmoving activities in wetlands usually require a permit. State or federal cost-share monies may be available to assist in your efforts. Contact the local conservation district for more information.



Forestry/Tree Plantings

Forestry or tree plantings are the establishment of woody plants, including shrubs, by planting or seeding. The plantings can provide wood products, control erosion, beautify the area, protect the watershed, provide wildlife habitat, and/or reduce air pollution.

Farmland Preservation/Conservation Easements

While technically not a conservation practice, farmland preservation through conservation easements allows continued farming while preventing the land from being developed for non-agricultural use. Owners of land protected by an easement can develop and implement a conservation plan with the knowledge that future generations will benefit from their stewardship of natural resources. A variety of local, county, and private organizations as well as state and federal agencies have farmland protection programs that pay landowners the value of their conservation easements while maintaining open space and providing an aesthetically appealing community.



Will It Pay Off?

A Study of Economics

Conservation practices are meant to protect the natural resources while maintaining or improving the economic viability of the farmer. So what kind of return can you expect on your investment when you install these conservation practices? There are qualitative and quantitative ways to answer that question. The following approach (with an example) will help you.



Your Dollar Costs

1. How much will the practice cost you up-front? \$14,000
2. What are the annual costs? \$500

Your Dollar Returns

3. How much do you make (after expenses) annually with the existing practice (under your current operations)? \$34,000
4. How much do you expect to make (after expenses) annually with the new practice? \$30,000
5. Subtract Line 3 from Line 4 and enter the answer here. \$4,000

How Do Your Dollar Costs and Dollar Returns Compare?

The following computations use an 8% interest rate and assume the practice will last 10 years. Your individual situation may vary somewhat from the assumptions contained here. The format is intended to help you generate rough or general estimates.

- A. Multiply Line 1 by "0.15", enter here: \$2,100
Average Annual Value of Upfront Costs
- B. Add Line 2 and Line A, enter sum here: \$2,600
Average Annual Value of Costs
- C. Subtract Line B from Line 5, enter here: \$1,400*

*If this figure is positive, the practice makes money. If it is negative, the practice loses money. If it is zero, the practice breaks even. There may be other qualitative reasons for implementing a practice even if it does not make money. Please read "Other Considerations."

Other Considerations

Many things are considered when making conservation practice decisions. You may like the idea of having a pond or a stand of trees on your property. Such improvements may improve the aesthetics of the land and have a definite value if the land were sold. You may see a heritage value in providing these improvements for your family and heirs. Conservation improvements can also pay off by improving relations with neighbors or by forestalling future government regulations.

You may also identify long-term subtle effects on the land that are difficult to quantify. Allowing the soil resource to deteriorate will eventually result in

increased fertilizer costs or reduced yields that will affect your quality of life. Common sense improvements such as laneways and pastures have a real potential for reducing disease-related expenditures. Check your records to determine the amount of cost reduction necessary to justify any conservation practice.

Selecting a conservation practice that does not pay off in actual dollars means that there are other considerations that are valued as much or more. Those qualitative considerations have just as much value as the quantitative calculations when you make your final decision.

Estimated Practice Costs

This chart may be used for “ballpark” estimates for the installation costs of some conservation practices. Actual costs will vary according to land slope, earthwork required, soil types, type of seed or trees

used, as well as locality. The estimates are total cost for installation. Cost sharing may be available. Check with your local NRCS or conservation district office for more information.

PRACTICE	AVERAGE COSTS	COMMENTS
Barnyard Runoff Control (per square foot)	\$3.00	Includes concrete curb, roof gutters and collection tank based on a 5,000 square foot barnyard.
Buffer Strip (per mile)	\$180.00	Includes machinery, seed mixture (with legumes), fertilizer and chemicals.
Contour Farming (per acre)	\$3.00	Includes time, machinery and labor to lay out contour lines.
Contour Stripcropping (per acre)	\$12.00	Includes time, machinery and labor to lay out strips.
Cover Crops (per acre)	\$20.00	Includes machinery cost and seed.
Diversion (per linear foot)	\$2.10	Includes total construction cost at an average of \$1.00 per cubic yard.
Gradient Terrace (per acre protected)	\$375.00	Includes only earthwork at a cost of \$1.60-\$1.80/linear foot. Estimate 1 mile of terrace to protect 20 acres.
Field Border (per mile)	\$500.00	Includes machinery cost, a legume/grass mix, fertilizer and chemicals.
Filter Strip (per acre)	\$300.00	Includes machinery, a legume/grass seed mix, fertilizer and chemicals.
Grass Waterway (per acre)	\$1,500.00	A typical waterway is 1.5 feet deep and 30 feet wide. Cost includes construction, seeding, lime and fertilizer.
Grazing Management (per acre)	\$220.00	Includes cost of fence and charger.
Manure Storage (per cubic foot)	\$0.20	Includes earthen pond with fence. Based on 50,000 cubic feet of manure.
Nutrient management (per acre)	\$7.50	Initial cost of plan development.
Pasture & Hayland Planting (per acre)	\$500.00	Includes machinery, a legume/grass seed mix and fertilizer.
Planting for Wildlife (per acre)		
Grass	\$150.00	Includes machinery, a legume/grass seed mix and fertilizer.
Shrubs	\$2,000.00	Includes shrubs planted on a 4' x 4' spacing.
Pond (each)	\$4,000.00	Includes total cost of construction for a typical pond with a surface water area of less than one acre.
Residue Management (per acre)	*	*Cost is dependent on machinery needed.
Storage Terrace (per acre protected)	\$600.00	Includes total construction cost, generally \$2.00-\$2.50/linear foot. Estimate 1 mile of terrace to protect 20 acres.
Stream Protection (per linear foot)	\$25.00	Includes bioengineering with minimal rock for 3-foot high steambank.
Tree Planting (per acre)		
Conifers	\$750.00	Typical 8'x8' spacing or 750 plants per acre at \$1.00 per plant.
Hardwoods	\$750.00	Typical 7'x7' spacing or 1,000 plants per acre at \$0.75 per plant.
Water and Sediment Control Basin (per treated acre)	\$560.00	A typical basin is 400 feet long with a construction cost of \$1,200.
Windbreaks (per 1000 feet of row)	\$275.00	Includes land preparation and cost of seedlings.

Conservation Planning And You



Most farmers have a conservation plan which outlines the decisions they have made to care for the land. For each defined area, the plan defines which conservation practices will be used and when they will be applied.

It is also important to maintain conservation practices so they function as they were originally planned. Long-term stewardship improves the environment, provides better water quality and

helps you maintain financial stability for an improved quality of life.

Conserving and improving our natural resources is the responsibility of all Pennsylvanians. Over the years, farmers have done much to insure clean water, clean air and a healthy environment for the future. As you begin planning for your land, you are congratulated for continuing that tradition.

Whole Farm Planning — Some Basic Questions

- What are the natural resources on my farm?
- What are the crops I want to grow?
- Have I minimized runoff and soil erosion?
- Am I using crop rotations to reduce disease and pest problems?
- What type of wildlife do I want on my farm?
- Does any practice interfere with or cancel out another practice?
- Can I use wetlands or buffer/filter strips to filter nutrients from runoff water?
- Am I making the best use of animal manure as nutrients for plants?
- Have I protected water quality for myself and my neighbors?
- Am I maintaining or improving the quality of my soil?

Acknowledgments

The Pennsylvania Conservation Catalog is a cooperative effort of the Pennsylvania Conservation Partnership. The Catalog was written, produced and funded by the following organizations:

- USDA Natural Resources Conservation Service
- Pennsylvania State University
 - Department of Agronomy
 - Department of Agricultural & Biological Engineering
- Pennsylvania Department of Agriculture
- Pennsylvania Department of Environmental Protection
- Pennsylvania Association of Conservation Districts
- Pennsylvania Chesapeake Bay Education Office
- Penn State Cooperative Extension
- Chesapeake Bay Program

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