



CONNECTICUT DEPARTMENT  
OF ENVIRONMENTAL PROTECTION  
NATURAL RESOURCES CONSERVATION SERVICE



# ***MANUAL OF BEST MANAGEMENT PRACTICES FOR AGRICULTURE***

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***GUIDELINES FOR PROTECTING  
CONNECTICUT'S WATER RESOURCES***

**1993 Revised 1996**

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Sidney J. Holbrook, Commissioner,  
Connecticut Department of Environmental Protection

United States Department of Agriculture - Natural Resources Conservation Service

The Connecticut Council on Soil and Water Conservation

Development of this manual was funded in part by the United States  
Environmental Protection Agency under Section 319 of the Federal Clean Water Act.





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DEPARTMENT OF ENVIRONMENTAL PROTECTION



U.S. SOIL CONSERVATION SERVICE

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Connecticut Department of Environmental Protection**

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# **MANUAL OF BEST MANAGEMENT PRACTICES FOR AGRICULTURE**

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## **Foreword**

This manual describes a wide range of management practices designed to reduce the impact of agriculture on ground and surface water quality. It was written for agricultural specialists who must draft resources management plans for farms near public wells and for environmental regulators who must approve and enforce those plans. The authors hope that the manual will also prove useful to all farmers, agricultural support personnel, and others interested in agriculture and its impact on the environment.

Two major water quality programs came together to produce this handbook. The U.S. Environmental Protection Agency provided funding for this project under Section 319 of the 1987 Federal Clean Water Act, which aims to reduce nonpoint source water pollution. The Connecticut Department of Environmental Protection's Aquifer Protection Program provided the balance of funds and the guidance for the development of the manual. The Soil Conservation Service of the U.S. Department of Agriculture provided much of the technical expertise and coordinated the drafting of the manual.

### **How to Use this Manual**

Chapters 1 and 2 provide background information on water quality problems and programs in Connecticut, especially as they relate to agriculture. Chapters 3 and 4 focus on the specific requirements of the Aquifer Protection Area Act for agriculture. Chapter 5 contains the actual recommendations for best management practices (BMPs), and Chapter 6 has a list of agencies and people to contact for further information or assistance. The appendices include publications referred to in the body of the handbook.

The recommendations in Chapter 5 of this manual are voluntary, except where they become part of an approved farm resources management plan for a farm in an Aquifer Protection Area. They may also be incorporated into other farm management plans, such as those required for certain U.S. Department of Agriculture programs. Many of the practices and designs in Chapter 5 may be revised from time to time as new research suggests modifications. The loose leaf format of this manual allows updated recommendations to be inserted and old ones to be removed easily. Please check with the address below for revisions and additions to the manual.

### **Corrections and Comments**

The Department of Environmental Protection, with the help of federal and state agricultural support agencies, intends to update this manual periodically. We welcome your corrections and suggestions for improvement. Please send written comments to:

Division of Planning and Standards  
Bureau of Water Management, DEP  
79 Elm Street  
Hartford, CT 16106.

## ACKNOWLEDGEMENTS

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A portion of the funding for this manual was provided to the Connecticut office of the Soil Conservation Service by the Connecticut Department of Environmental Protection, using Non Point Source Implementation Project grant monies made available by Region I of the U.S. Environmental Protection Agency as part of Section 319 of the 1987 federal Clean Water Act.

The following individuals provided leadership to the Aquifer Protection Advisory Committee and Best Management Practices Manual Subcommittee.

Anthony D. Paone, Chairman,  
Aquifer Protection Advisory Committee

Allan Bennett and Diane Mayerfeld, Co-Chairs,  
Aquifer Protection Regulations Subcommittee (Agriculture)

Judith K. Johnson and Warren Herzig, Co-Chairs,  
BMP Manual Subcommittee

Diane Mayerfeld and Howard B. Denslow, Coordinators,  
BMP Manual Project

The BMP Manual Subcommittee Workgroups included the following organizations and individuals:

**Connecticut Association of Conservation  
Districts**

Denise Conkling  
Larry Johnston  
Bruce Morton  
Anthony D. Paone  
David Syme

**Connecticut Council on Soil and Water  
Conservation**

Allan Bennett  
Peter Faber

**Connecticut Clean Water Coalition**

Susan Merrow

**Connecticut Department of Agriculture**

George Malia  
Foster Mather

**Connecticut Department of Environmental  
Protection**

Kathy Alexander  
Fred S. Banach  
Scott Deshefy  
Warren Herzig  
Diane Mayerfeld  
Brad Robinson  
Mike Sullivan  
Joe Wettemann

**The University of Connecticut**

Roger Adams  
Richard Ashley  
Candace Bartholomew  
John Bartok  
Allen Botacchi  
Mark Brand  
Jack Clausen  
Edward Corbett  
Norman Gauthier  
Keith Goff  
Gary Griffin  
Roy F. Jeffrey  
John Kolega  
David Kollas  
Richard McAvoy  
Acie Murry  
Robert Peters  
Gary Robbins

**Water Utilities**

Cindy Alleman  
Tom Chaplik

**Connecticut Farm Bureau**

John Filchak  
Norma O'Leary

**USDA Soil Conservation Service**

Jeff Anliker  
Philip Christensen  
Tim Dodge  
Dwight Holman  
Judith Johnson  
Bill Ireland  
Pat Leavenworth  
Phil Morneault  
Joe Neafsey  
Scott Young  
Fran Zaik

**USDA Agricultural Stabilization and  
Conservation Service**

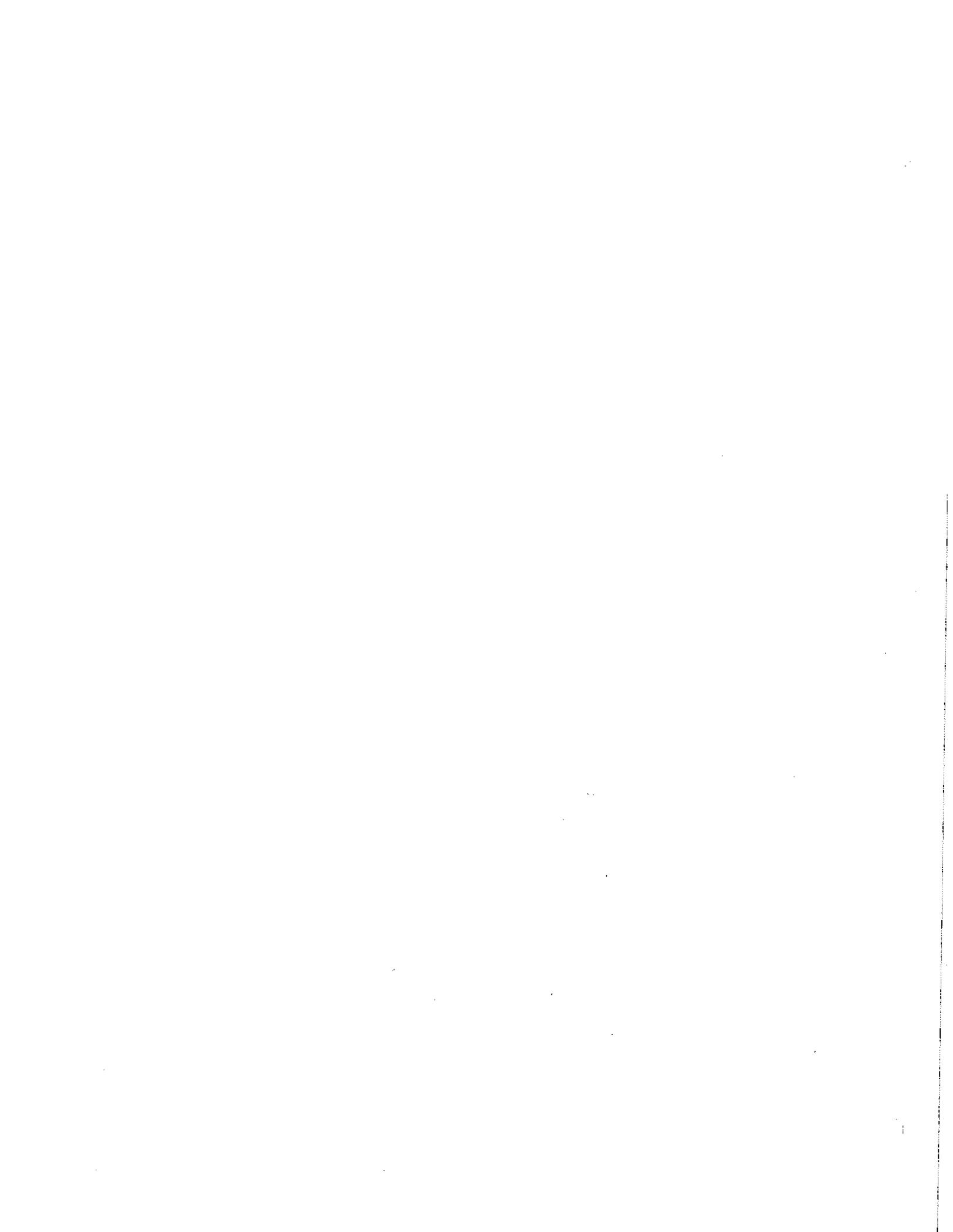
Dawn Pindall  
Mark Ruwet  
David Schrieber  
Jerry Wadsworth

**Connecticut Agricultural Experiment Station**

Charles Frink  
Thomas Rathier

**Agricultural Community**

Randolph Blackmer, Jr.  
Larry Carville  
Jack Collins  
Joe Fortin  
Steve Kaffka  
John Lyman III  
Frank Papandrea  
William Peracchio



## CHAPTER 1

### Introduction

#### Purpose and Background

The Manual of Best Management Practices for Agriculture (BMP Manual) was prepared to provide guidance in development of farm resources management plans for agricultural operations. The manual contains standards and specifications for agricultural best management practices (BMPs) to prevent, abate, or minimize pollution of surface and ground water. This chapter describes several state and federal legislative initiatives and administrative actions that provided the primary impetus for development of the Manual.

**Connecticut's Aquifer Protection Area Act** directs special attention to protection of certain aquifers which supply public drinking water. Agricultural operators in these areas must plan and implement best management practices in order to reduce the potential for contamination of ground water.

**Connecticut's Non Point Source Pollution Assessment and Management Plan**, prepared by the State Department of Environmental Protection (DEP) in compliance with the 1987 federal Clean Water Act, identified the following items needed to improve the non point sources (NPS) management programs for agriculture:

- a. Expand the state agricultural BMP cost-sharing funds for improved waste management.
- b. Implement the Aquifer Protection Act provisions.
- c. Provide guidance on implementation of pesticide management and nutrient management BMPs.

The July 1989 **USDA Water Quality Program Plan** to Support the President's Water Quality Initiative directed the U.S. Department of Agriculture (USDA) to cooperate with state agencies to develop and implement coordinated and cooperative programs to respond to agricultural non point source pollution.

#### Water Quality Concerns in Connecticut

Water pollution can be divided broadly into two categories. The first includes pollution arising from large, distinct discharges or point sources such as wastewater outfalls from factories and sewage treatment plants. The second category includes pollution from diffuse, small, intermittent, or mobile discharges such as acid rain, leaky septic systems, and agricultural chemicals. When viewed separately, each non point source may be small, but collectively, non point source pollution can have major impacts on the quality of ground and surface water.

Land use practices affect water quality, but the relationships between specific land uses and water quality impacts have been difficult to quantify because of the scattered and diffuse nature of non point sources of pollution. Connecticut has highly urbanized and industrialized coastal areas and river valleys. In addition, there are extensive agricultural areas in the Connecticut River Valley

and in the upland areas in the northwest, northeast, and southeast regions of the State. Activities associated with both urban and rural land uses have lowered water quality in rivers and streams, lakes, ponds, and wetlands. These land uses have also resulted in numerous cases of public and private well water contamination. Since 1980, ground water contamination has affected the water supplies of more than 250,000 people at one time or another. There were 1400 documented incidents of well pollution between 1980 and 1989. Ground water contamination has been found in every town, and 116 of the State's 169 towns have had instances of public or private well contamination. The contamination incidents that have occurred are associated with industry, underground petroleum storage, agriculture, landfills, urbanization, and other activities. Chapter 2 discusses the impacts of agriculture on surface and ground water in more detail.

### **Water Quality Goals and Priorities**

All of Connecticut's surface and ground waters are classified by intended use, and each classification is assigned water quality standards. These standards are designed to provide clear statement of existing and intended water quality and to create a framework for the general program to improve Connecticut's water resources. Special consideration is given to balancing demands for adequate potable water supplies, healthy aquatic environments, recreational uses, industrial and agricultural water demand, and allowances for waste assimilation.

Connecticut's plan for managing non point source pollution sets the following three highest resource priorities for surface and ground water protection:

1. Existing or potential public drinking water supplies whether surface or ground water.
2. Coastal watersheds which drain into the Long Island Sound estuary.
3. The major interstate rivers that flow through Connecticut, including the Housatonic River, the Connecticut River and the Thames River.

The Connecticut DEP's non point source water quality management program has established general priorities that are related to surface and ground water quality classifications. These are outlined in the "Non Point Source Pollution Assessment and Management Plan", and are as follows:

- 1st Priority - The elimination or control of water quality impacts that may affect present and future potable water supplies.
- 2nd Priority - The elimination or control of water quality impacts which prohibit attainment of water quality that will support water based recreation and a healthy aquatic habitat.
- 3rd Priority - The elimination or control of water quality impacts not compatible with a water quality goal adopted in the state's water quality classification.

### **DEP Authority for Protection of Water Resources in Connecticut**

Under Connecticut law, DEP has the authority to determine if agricultural or other activities pose an existing or potential contamination threat to the waters of the State. The Aquifer Protection Act expands this authority by giving DEP the mandate to require certain land uses, including agriculture, to take special action to prevent ground water pollution in aquifer protection areas.

## 1. Statewide Water Management Programs

Connecticut's Clean Water Act, embodied in Chapter 446k of the Connecticut General Statutes (CGS), and the State's Drinking Water Program, set forth under Chapters 368a and 474 of the CGS, provide the foundation for the state's surface and ground water quality management programs. The legislation establishes broad regulatory powers within the Department of Environmental Protection for the control of pollution, including the authority to protect surface waters and ground water; calls for the development of statewide water quality standards and classifications for surface water and ground water; and provides authority for enforcement actions against sources of pollution to surface and ground water; and within the Department of Health Services for use and protection of surface and ground water for potable supply.

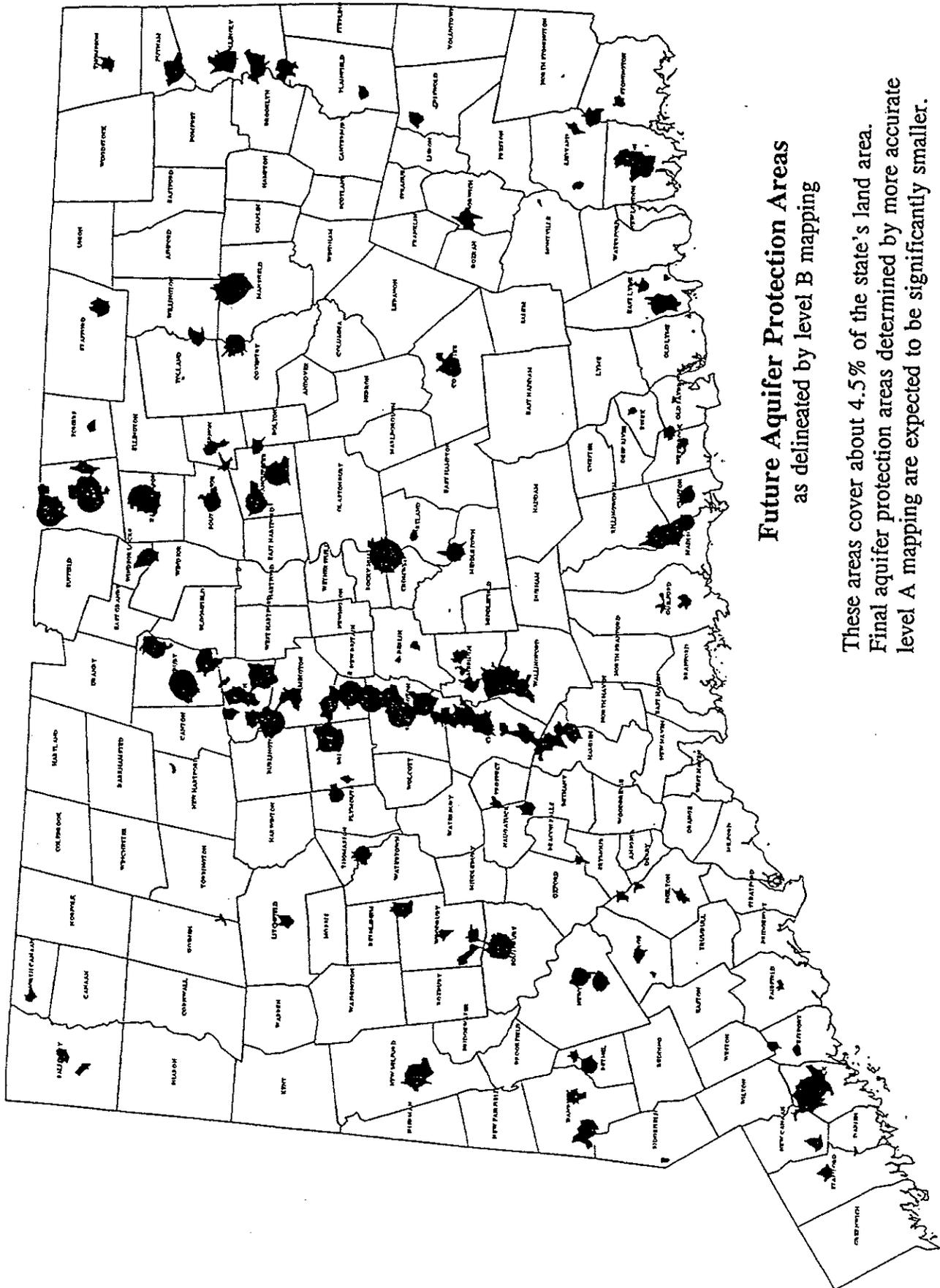
## 2. The Connecticut Aquifer Protection Area Act

The Connecticut Aquifer Protection Area Act is a landmark piece of ground water protection legislation. Farm operations in designated aquifer protection areas are to be regulated by the State rather than by the municipalities, partly because many farms cross municipal boundaries, and partly to draw on the expertise of various state and federal agencies that provide assistance to agriculture. Figure 1-1 shows the locations and approximate sizes of future aquifer protection areas as delineated by level B mapping.

Following is a summary of the Act's requirements for agriculture. These requirements are described in more detail in Chapter 3.

- a. An operator of an agricultural enterprise with land or activities within an aquifer protection area shall prepare and submit a farm resources management plan for such land to the commissioner of DEP for approval. Plans will be due no sooner than six months following the completion of Level A mapping, which is expected in 1996 for most areas.
- b. Plans are required of operators whose annual gross sales from agricultural products are \$2500 or more.
- c. A plan must outline the implementation of best management practices to address manure management, pesticide management including storage and handling, nutrient management, storage of fuel and oil, and equipment maintenance.
- d. The county soil and water conservation district where the aquifer protection area is located shall establish and coordinate a technical team to help an operator develop the plan. The team shall upon request include a representative of the municipality in which the land is located and a representative of any affected water company. The districts shall consult with selected staff of DEP, the College of Agriculture and Natural Resources at the University of Connecticut, the Connecticut Agricultural Experiment Station, the Soil Conservation Service, the Agricultural Stabilization and Conservation Service, and others the district deems appropriate.
- e. Plans shall include a schedule for implementation, and be periodically updated as required by DEP. The technical team shall consider economic as well as technical factors including the availability of public funds to assist a farmer with BMP implementation.

**FIGURE 1-1: Future Aquifer Protection Areas as delineated by level B mapping**



**Future Aquifer Protection Areas**  
as delineated by level B mapping

These areas cover about 4.5% of the state's land area.  
Final aquifer protection areas determined by more accurate level A mapping are expected to be significantly smaller.

For more information, call Bureau of Water Management, 566-7049.  
Map generated May, 1993 by DEP GIS.

## CHAPTER 2

# Agriculture and Water Quality

### Background

Connecticut has abundant ground and surface waters. Ground water supplies in Connecticut are usually of excellent quality, can generally be used without costly treatment, and are widely distributed, so many rural and suburban homes and community water systems inexpensively tap these resources. Despite this abundance, the quality and quantity of water resources in Connecticut may not always be adequate. Contamination can render the water unusable, and heavy demands can deplete surface and ground water supplies.

Ground water in Connecticut occurs in two basic hydrogeologic settings. One is fractured bedrock aquifers, in which ground water flows through the cracks and fissures in the rock. The other setting is unconsolidated surface sediments, typically sand and gravel accumulations deposited by glacial meltwaters in major river and stream valleys. These "stratified drift" deposits constitute the major high yield aquifers in the state. Both bedrock and stratified drift aquifers are replenished by precipitation that percolates through the soil to the underlying aquifer, and both normally discharge to surface water bodies in Connecticut.

Agriculture is one of many land uses that can degrade surface and ground water quality. Some of the specific water quality problems caused by agricultural practices are discussed below under "Water Quality Impacts." Since agricultural operations rely on an adequate supply of high quality water, as well as on good soil resources, farmers have a vested interest in minimizing potential water and soil degradation. To their credit, many farmers have voluntarily applied structural and management practices to protect soil and water.

Over the years, increased land and labor costs, new product demands, changing market conditions, unstable prices, and a reduced land base have resulted in more intensive agricultural operations. These factors, combined with technological advances that increased the efficiency of agriculture, led to higher production per acre, greater concentrations of confined animals, and increased use of agricultural chemicals. In the future, technological advances are expected to continue and further increases in production can be anticipated. The expected increases in production and intensity of land use may be accompanied by an increased potential for pollution, unless farmers adopt practices to minimize the likelihood of pollution.

### Water Quality Impacts

#### Surface Water

Runoff from agricultural operations may contain sediments, plant nutrients such as nitrogen and phosphorus, bacteria, pesticides, acid silage leachate, bacteria, petroleum products, and other pollutants. When such runoff reaches lakes, reservoirs, streams, and other wetlands, it can cause impacts to drinking water quality, fish kills, accelerated lake eutrophication, degradation of cold water fishery habitat, depletion of dissolved oxygen, reduced recreational uses, and other, less

dramatic problems. Losses of riparian areas (natural habitat buffers next to streams) can also result from land clearing or wetland drainage associated with agricultural operations. Riparian areas play an important role in protecting surface water quality.

### Ground Water

Except for sediments, agricultural pollutants which affect surface water can also degrade ground water resources. Between 1983 and 1988, the Connecticut departments of Environmental Protection and Health Services documented 87 private water supply wells with nitrate-nitrogen concentrations above the drinking water standard of 10 mg/liter. In many of these cases, the source of the nitrates is thought to be agricultural. More than 400 wells in the state have been contaminated by pesticides. The vast majority of these wells (356) are contaminated by ethylene dibromide (EDB), but 1,2 dichloropropane, dieldrin, dursban, and chlordane have also been found at concentrations above health advisory levels (personal communication, Bureau of Water Management, DEP). A study of ground water conditions at 59 agricultural and non-agricultural sites in Connecticut found concentrations of nitrate plus nitrite over 10 ppm in 35 percent of the samples from agricultural sites, while none of the samples from non-agricultural sites exceeded 10 ppm. Pesticides were detected in ground water beneath 78% of the agricultural sites and 56% of the non-agricultural sites in the study. Most of the agricultural sites studied are considered to be representative in terms of pesticide use, while the non-agricultural sites included primarily golf courses and heavily landscaped residential areas, which may represent higher than average use of fertilizers and pesticides for non-agricultural sites. Moreover, the pesticide found at at least one agricultural site is probably a residual from earlier agricultural use. Most of the pesticide detections were below federal and State health advisory levels or action levels (Report to the General Assembly on Pesticides in Ground Water).

### **Strategy for Minimizing Water Pollution from Agriculture**

Implementation of best management practices (BMPs) can minimize the potential for agricultural non point source water pollution. Selection of appropriate BMPs involves evaluation of the farmer's needs, threatening activities, resources that may be impacted, potential threats to the resources and existing management practices. To protect public wells, the Department of Environmental Protection will require farmers in Aquifer Protection Areas to develop and implement plans that will specify best management practices (BMPs) which reduce the risk of contamination of ground water resources by specific activities. The plan development process described in Chapters 3 and 4 can also help address other ground water or surface water quality concerns associated with agriculture.

Numerous agricultural activities can pollute water resources. Examples of potential agricultural pollution sources include processing wastewater discharges, manure collection and storage systems, runoff from concentrated animal feeding operations, or leachate from a corn silage bunker. Other potential pollution sources from agriculture include nutrients and/or pesticides applied to the land to enhance crop production.

Discharges are usually addressed at the point of origin with appropriate controls or treatment technology. Other pollution sources are more difficult to treat. Agricultural pollutants include sediments, nutrients, pesticides, organic wastes, bacteria, and petroleum products. Fertilizers and

pesticides are dispersed over fields, and pollution can result when rainfall or runoff water detaches or dissolves and then transports pollutants to surface water bodies or leaches dissolved materials into the ground water. Because these pollution sources are diffuse, they cannot be cleaned up by a treatment facility. This type of pollution can be addressed by managing the sites and potential sources of pollution. Examples of preventative management include proper timing and application of fertilizers and manure, employing proper conservation practices on cropland to reduce erosion to acceptable levels, managing pests and applying pesticides in an environmentally sound manner, and managing and utilizing agricultural wastes properly.

### **An Example**

Let us examine a free-stall dairy operation to illustrate how agricultural activities can pollute surface and ground water.

#### Surface water

Manure, milkroom and parlor process wastewater, runoff from cropland, runoff from livestock concentration areas, leachate from silage, and accidental leaks or spills of chemicals or fuels are all potential sources of pollution. Specific pollutants include sediment, nutrients (especially nitrogen and phosphorous compounds), pesticides, organic material (oxygen demanding wastes), microorganisms, or toxic materials such as fuel. If these substances are not properly controlled and managed, they can seriously degrade water quality.

Sediments can create turbid conditions, smothering aquatic life and depositing silt in wetlands, streams, or ponds. Sediments and runoff may also carry other pollutants, such as phosphorus or pesticides, that may impair water quality. Nutrients, such as phosphorus and occasionally nitrogen, can cause increased eutrophication, aquatic weed problems, and algal blooms. Pesticides adsorbed on soil particles or dissolved in runoff may also adversely affect surface water quality. The degree and extent of contamination depends on the chemical characteristics of the soil and the pesticides being used. When organic material such as manure enters a surface water body, it may use up the available dissolved oxygen in decomposition. Depletion of dissolved oxygen may cause fish kills. After lengthy and severe oxygen depletion, a stream can even become septic. Organic materials such as manure may also contain disease causing microorganisms which may reduce recreational opportunities.

#### Ground water

Agricultural activities can also affect ground water. In the example, feed for the dairy herd is grown on cropland. This production depends on inputs of fertilizers, pesticides, and fuel for farming equipment. Infiltration of rainfall can leach nitrates and pesticides through the root zone to the underlying soil and eventually into the ground water. The potential risk depends on many factors, including physical and chemical characteristics of the soil, the chemical(s) being used, timing of application, crop uptake, and precipitation events. Improper fuel storage or use, or careless maintenance practices for agricultural equipment can likewise cause ground water pollution. Nitrates may also leach into the ground water from improper manure handling and storage.

Agricultural operations such as greenhouses, nurseries, turf farms, feedlots, orchards, berry

farms, dairy farms, vegetable farms, and horse farms can all pose threats to water quality. As the intensity of production increases, the risk of pollution may also increase. It is possible however, through the proper planning, control and management of agricultural activities, to reduce, minimize, or eliminate the threats. As farmers conduct their operations, they need to review the various activities, determine how their operations may affect the environment, and then use best management practices (BMPs) to control or minimize the potential water quality threats. The planning process for developing farm resource management plans under the Aquifer Protection Areas Act is described in Chapters 3 and 4; standards and specifications for BMPs to be included in any farm resources management plan are contained in Chapter 5.

## CHAPTER 3

# Farm Resources Management Planning

### Overview

The Aquifer Protection Act requires all farms in Aquifer Protection Areas to operate under approved Farm Resources Management Plans (Plans). This chapter discusses the procedure for delineating aquifer protection areas, identifying the farms within them, and developing a Farm Resources Management Plan for each affected agricultural operation. Chapter 4 reviews the planning considerations and content requirements for Farm Resources Management Plans.

The first requirement of the Aquifer Protection Program is delineation of the areas to receive special protection. Every water company that serves more than 1,000 people must map the area around its wells in stratified drift (sand and gravel). Water companies must prepare two types of maps for DEP approval: a rough "Level B" map (due July 1990) and a more accurate "Level A" map (due January 1996).

The Department of Environmental Protection has approved all the Level B maps. Under contract with DEP, each soil and water conservation district has identified the agricultural land uses within the mapped aquifer protection areas and recorded the names and addresses of each operator and owner. This inventory of agricultural operators will allow DEP to notify farmers in aquifer protection areas of the need to comply with the new farm resources management plan requirements.

Once Level A maps have been completed and approved, DEP will notify the identified operators by letter of their responsibility to develop a Plan. Owners of rented cropland will be notified of the tenant operator's responsibility to develop a Plan for the land. Owners not operating the land themselves are not responsible for implementing a Plan.

The Department of Environmental Protection, with help from the districts, the Cooperative Extension System (CES), and the Agricultural Stabilization and Conservation Service (ASCS) will inform the agricultural community about the requirements of the Aquifer Protection Act. County-level meetings may be held to inform operators in affected aquifer protection areas of requirements and the planning process. Agency newsletters should periodically remind agricultural operators of their responsibility to develop and implement a Plan.

It is the agricultural operator's responsibility to contact the district and request a Plan. Districts will assemble technical teams to help develop each Farm Resources Management Plan. The district will coordinate planning efforts with agricultural operators and the technical teams. Plans for operators should be prepared by technical teams from the county district where the agricultural operation is located. The goal is to prepare a Plan that minimizes the potential for ground water pollution, that meets the approval of the operator, and that meets DEP standards. The planning procedure is explained in more detail below. An operator may choose to prepare

his or her own plan or to retain a private consultant if he or she prefers not to work with or wait for the technical team.

Operators who choose not to develop and implement a Plan will be subject to municipal aquifer protection regulations. Municipalities with aquifer protection areas must adopt regulations covering a wide range of land uses, including farming activities, which may threaten the ground water. Failure to comply with municipal regulations could result in fines or imprisonment. Municipalities may contact operators to learn if a Plan has been developed. The farm resources management planning process will not affect DEP's broad enforcement powers to abate existing pollution, but it gives the department new authorities to prevent potential pollution by requiring development and implementation of Plans in aquifer protection areas.

### Technical Teams

Each District will coordinate the formation of a technical team. The purpose of the technical team is to provide assistance to an operator in the development of a Farm Resources Management Plan (Plan). An important aspect of the technical team concept is cooperation among several different agricultural, municipal, and regulatory agencies at various levels of government, and the private water companies. The technical team concept utilizes existing local personnel and an existing technical services delivery system. This is beneficial since local agency staff will often be familiar with the agricultural operators, their farm operations, past assistance, and existing or potential ground water problems.

The technical team consists of professionals covering a wide range of disciplines within the fields of agriculture, natural resources and environmental protection. The principal participating agencies are:

- \* United States Department of Agriculture (USDA), Soil Conservation Service (SCS)
- \* USDA, Agricultural Stabilization and Conservation Service (ASCS)
- \* Soil and Water Conservation Districts (SWCD)
- \* University of Connecticut Cooperative Extension System (CES)
- \* Connecticut Department of Environmental Protection (DEP)
- \* Connecticut Department of Agriculture (DOA)
- \* Connecticut Agricultural Experiment Station (CAES)
- \* College of Agriculture and Natural Resources at University of Connecticut (UCONN)

The agricultural operator, a representative of the affected water company, and a representative of the municipal aquifer protection agency will be invited to participate. The composition of the teams will vary from one agricultural operation to another depending on the needs. For example, an entomologist may be needed to advise on the control of pests for specialty crops, while a nutrient or waste management specialist may be needed to advise on dairy operations. District personnel and personnel of participating agricultural agencies should decide on planning tasks and assignment of responsibilities for development of Plans requested.

## Planning Process

After Level A maps of the aquifer protection areas have been completed, DEP will notify identified operators of the requirement to develop a Farm Resources Management Plan and of the availability of planning help from the districts. DEP will also notify the appropriate districts when it contacts operators. The Districts may make follow-up contacts with operators who do not contact them within a reasonable time. The planning process begins with an operator's request, and proceeds as follows:

### Steps

1. The district coordinator invites a group of agricultural operators with parts of their farms in aquifer protection areas to an introductory meeting about the farm resources management planning process. Representatives of SCS, CES, ASCS, and DEP should also be present at the meeting, if possible, the same people who will serve on the technical team.
2. The district coordinator contacts appropriate agency representatives, a representative of the affected water company, a municipal representative, and the agricultural operator to set up a technical team meeting. (The municipal representative should be someone involved with local aquifer protection regulations.)
3. The district coordinator may identify a team member who has worked with the agricultural operator in the past, and designates that person the liaison with the agricultural operator.
4. The district coordinator and/or liaison person collects and reviews farm inventory data with the agricultural operator, explains the planning process, arranges for a team visit, and answers any relevant questions. He/she must check for existence of earlier plans, such as plans for agricultural waste management systems, or for erosion control on highly erodible land, as required under the Food Security Act (FSA). Status of implementation of these plans should be noted.
5. The district coordinator prepares a background information packet on the agricultural operation to distribute to team members and the operator either before or at the meeting. This information packet should include a description of the operation, any known ground water concerns, a soils map, an aerial photo with property, tract, and field boundaries, a map of aquifer protection area, and other relevant information.
6. Technical team members meet. Members should meet to review information and concerns before going to the field. Operators are welcome to attend. An on-site review and discussion with the operator will follow. Emphasis in the field should be on listening to the producer's objectives, verifying assembled information, considering hydrogeologic information, recognizing potential ground water threats, and selecting appropriate BMPs for the Plan. Existing field

conditions and cropping systems need to be evaluated, and alternative cropping systems should be considered. The focus of the visit should be ground water concerns associated with agricultural activities. However, it is not unusual for farmers to also engage in non-agricultural activities on the farm property. If such activities are regulated under local aquifer protection regulations, the team members should inform the operator of the applicable regulations and, if appropriate, the municipal, water company, or DEP representative should arrange a separate meeting to inspect or discuss the activity with the operator. The operator may choose to have other aquifer protection requirements explained in an attachment to the plan, so that all aquifer protection information is together in one set of documents.

7. Following the field review, the team members should discuss their findings and agree on the concerns to be addressed and a time frame for the development of a draft Plan. Some members may need to obtain additional data, such as field soil tests and nitrate tests, and the operator may need to confer with his or her lender about credit available for implementing certain BMPs.
8. The district coordinator or a qualified member of the technical team will assemble a final draft Plan and review it with the agricultural operator for his/her concurrence.
9. The final Plan is prepared with the concurrence of the operator, and the operator is given two (2) copies. The operator should send one (1) copy to DEP.
10. DEP reviews the Plan. A letter of approval with any operating conditions is returned to the operator, and a copy is sent to the District. If DEP does not approve the Plan, the department will send a letter explaining its concerns to the operator. The operator may then:
  - revise the plan according to DEP's suggestions,
  - meet with DEP to discuss and negotiate points of disagreement, or
  - prepare and implement a plan which satisfies the requirements of the municipal agency.

If the operator does not implement a plan approved by DEP or one which satisfies municipal requirements, he or she may become subject to municipal enforcement and civil or criminal penalties.

### **Plan Follow-up**

The appropriate agency specialists, usually the original team members who planned specific BMPs, will provide BMP implementation assistance upon request. The agricultural operator should contact either the district or agricultural agency for assistance. At least annually the district should review the Plan with the operator to assure understanding and promote implementation of scheduled BMPs. The District will maintain a file on each operator who has a Plan. Agency specialists who provide assistance on application of BMPs should encourage the operator to keep a record of their assistance. Once a year, each operator must submit a brief report on the implementation of the Plan to DEP.

In the event that an agricultural operator's enterprise changes significantly, for example, from a dairy farm to truck-crop vegetables, a new Plan will be required. The operator needs to communicate this need to the district. In some cases another technical team may need to be assembled to provide the planning process again.

Agricultural operations in aquifer protection areas are subject to inspection by water companies and by DEP officials. Inspectors are encouraged to notify operators and the district at least two days in advance of their visits to review implementation of Plans. Operators may wish to ask district or agricultural agency personnel if they can be available during such a visit.

## CHAPTER 4

### **Farm Resources Management Plan Considerations and Contents**

Chapter 3 presented the administrative process of developing a Farm Resources Management Plan. This chapter presents the points to be covered and considerations to be addressed in each plan, as well as the philosophical approach to be followed in preparing a plan. This chapter should be considered as general guidance supplementing the Department of Environmental Protection's regulations governing Farm Resources Management Plans in aquifer protection areas. The first part of the chapter presents general concepts to be considered while developing a plan, and the second part, Plan Contents, lists the elements to be included in each plan.

#### **Planning Considerations**

Farmers, government agencies, and environmentalists have long been concerned about the effects of agriculture on soil erosion and surface water quality. Many of the best management practices discussed in this manual have been recommended and used for many years in order to alleviate erosion and surface water degradation. More recently, it has become evident that certain agricultural activities may also pollute ground water. Some of the established conservation practices originally designed to control erosion and sedimentation have been adapted to also protect ground water. Although the names of the best management practices in Chapter 5 may be familiar, in many cases some of the considerations and specifications have been changed in order to address ground water quality concerns as well as minimize erosion and surface water pollution.

A problem may arise when a practice designed to reduce soil erosion or surface water pollution turns out to increase ground water pollution, and vice versa. For example, conservation tillage, one of the most effective practices developed for erosion control, may sometimes result in increased use of pesticides and increased movement of pesticides and nutrients to ground water, when protection of ground water is not considered. In general, when practices control erosion and protect surface water by promoting infiltration, additional care must be taken to minimize leaching of nutrients or pesticides to ground water.

Fortunately, it is usually possible to combine and adapt best management practices so that they can accommodate surface and ground water concerns, as well as erosion control. For example, when a conservation tillage practice such as mulch till is combined with integrated pest management and nutrient management, the combination of practices should minimize surface and ground water pollution, as well as soil erosion.

Since the purpose of Farm Resources Management Plans under the Aquifer Protection Act is to protect drinking water, the primary objective of each Plan developed for a farm in an aquifer protection area must be to minimize the risk of ground water pollution. However,

ground water protection should not result in soil loss or degradation of surface water. While maintaining or improving ground water quality must be the first goal of each Farm Resources Management Plan, Plans which meet this objective may also address other goals, both environmental and economic (for example, providing wildlife habitat or conserving energy), as desired by the farmer.

### **The Whole Farm Perspective**

Chapter 5 of this manual and the regulations governing Farm Resources Management Plans<sup>1</sup> discuss specific management practices. It is very important to evaluate the operation of the entire farm in the course of developing a Farm Resources Management Plan. It may not be sufficient to select the appropriate practices for each portion of an agricultural operation, set a schedule of implementation, and consider that an adequate Plan. Such an approach does not consider the agricultural operation as a whole. While it is not possible to list considerations, specifications, and standards for assessing a whole agricultural operation in the same way one can for a specific best management practice, the following paragraphs present some of the possible approaches for assessing the agricultural operation in its entirety.

### **Spatial Planning**

Many of the agricultural operations covered by the Aquifer Protection Act are only partially located in an Aquifer Protection Area. For such operations, one alternative is to locate high risk activities, such as pesticide mixing and storage, fuel storage, animal waste management facilities, and high input crops outside the aquifer protection area. While it may not be economical to immediately relocate existing structures, the Plan should consider the long-term feasibility of re-siting or eliminating high risk activities. Although development and implementation of a farm resources management plan is only mandatory for those parts of the farm in the aquifer protection area, the operator should be offered the opportunity to have voluntary plans prepared for portions of the farm outside the aquifer protection area. Even when an agricultural operation falls entirely within the boundaries of an aquifer protection area, high risk activities should be located as far as possible from the well.

### **Crop Selection**

In some cases, alternative crops may achieve the same goal for the farm operation as those currently grown, while requiring substantially lower inputs of pesticides and fertilizers and otherwise posing fewer threats to water quality. Thus, a mix of hay, alfalfa, and silage corn may offer adequate nutrition for a dairy herd, while offering many more opportunities for avoiding surface and ground water pollution than growing only silage corn. Similarly, a small fruit or vegetable operation might successfully break pest cycles or enhance soil qualities by changing crops. The decision to change crops is one that must be made individually for each

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<sup>1</sup> These regulations are being drafted as this manual is being written.

agricultural operation, but the possibility should be considered in framing a Farm Resources Management Plan.

### **Integrated Crop Management**

There is growing interest in approaches to farming that seek to minimize inputs of pesticides and fertilizers without sacrificing the economic viability of the farm, and to use the safest chemicals when chemicals are needed. Some of these approaches are known as "Sustainable Agriculture" and "Integrated Farm Management" or "Integrated Crop Management (ICM)." Integrated crop management essentially combines integrated pest management with nutrient management. The goals of the various systems are to minimize chemical inputs and maintain environmental quality and agricultural viability. **This approach, with special attention to ground water quality, should underlie Farm Resources Management Plans.** Information on sustainable agriculture and ICM is available for certain crops from the Cooperative Extension System.

### **Organic Farming**

In response to concerns about the use and long term effects of agricultural chemicals and demand from some consumers, a few farmers have chosen to avoid most pesticides and synthetic fertilizers altogether. Organic farming does not in itself prevent the possibility of water pollution; for example, nitrates and bacteria from improperly managed animal waste can contaminate ground water. Also, even organic farmers use tractors and heat their houses, with the associated risks of leaks from underground fuel tanks. When combined with appropriate best management practices, however, organic farming probably is the form of agriculture that poses the lowest threat to water quality. Organic farming is really one end of the continuum from conventional farming through ICM, and organic farmers can use many of the same IPM and nutrient management techniques as other farmers. While organic agriculture may not currently be economical for most farmers in Connecticut, some agricultural producers are operating organic farms and others may want to consider this option in the Farm Resources Management planning process as markets expand.

### **Areas of Concern to be Addressed by Farm Resources Management Plans**

Below is a checklist of areas of concern to be considered in developing each Farm Resources Management Plan. Some of the factors included do not apply to all farms; for example, silage leachate is not a concern for farms that do not have silage. However, this list can serve as a check that important issues are not overlooked. At least five (5) types of activity on the farm can threaten ground water. They are:

1. Agricultural waste management
2. Pest and pesticide management
3. Nutrient management
4. Fuel storage below and above ground
5. Vehicle and equipment maintenance and storage

A sixth area of concern, which is often a significant source of surface water pollution, is soil erosion and sedimentation resulting from cultural practices or heavy use by livestock or equipment.

The best management practices presented in Chapter 5 are designed to reduce the risk of water pollution from these activities. Primary considerations under each type of activity should include the following:

1. Agricultural waste management

- waste utilization
- agricultural waste storage
- waste water storage and treatment
- manure spreading
- composting
- runoff from livestock concentration area
- silo leachate
- stormwater runoff
- well locations
- neighboring property
- potential discharges to watercourses and wetlands
- record keeping and reporting requirements

2. Pest and pesticide management

- integrated pest management methods
- soil pesticide interactions
- application method and rate
- mixing/washdown procedure/location
- transportation of mixed products
- well locations
- banned chemicals stored on premises
- storage
- pesticide, rinseate, and container disposal
- record keeping and reporting requirements

3. Nutrient management

- specific crop needs and realistic yield goals
- site/field and soil assessment
- nitrogen soil test
- ground water nitrate test
- nutrient credits for previous manure applications
- cover crop uptake
- vegetative filters/riparian buffers
- irrigation water management
- controlling drainage
- record keeping and reporting requirements

4. Petroleum storage below/above ground
  - location of storage tanks
  - age, type, and status (in use, abandoned) of storage tanks
  - wells/watercourses
  - leakage/spill containment
  - management plan for tank maintenance and monitoring
  - gasoline vapors/safety
  - record keeping and reporting requirements
  - regulatory requirements
  
5. Vehicle and equipment maintenance and storage
  - disposal of waste oil, grease, antifreeze, etc.
  - storage of fuel, lubricants, solvents
  - surface and design of work area
  - provisions for spill or leak containment
  
6. Soil erosion and sedimentation
  - soil movement/loss
  - practice effect on infiltration and runoff
  - riparian zones
  - sediment delivery to water courses, surface waterbodies, or wetlands

The Plan need contain only BMPs which address the areas of concern identified by the technical team as an existing or potential threat to ground water and surface water at the operation in question. For example, agricultural waste management is needed only if there are wastes associated with livestock, or other wastes such as mycelium or composted materials used in the operation. The technical team needs to acknowledge current management practices that minimize potential pollution. Such practices should also be included in the schedule of implementation to ensure that they are continued under the Plan. When choosing BMPs and scheduling implementation, the technical team should consider economic as well as technical factors, including the availability of state and federal cost-sharing funds. The agricultural operator needs to agree to implement the Plan by applying the selected BMPs.

### Plan Contents

Each Plan should contain the following elements:

1. Background Information - including names and addresses of the person engaged in agriculture (and the land owner if different); the type of operation, the location of the operation (county, town, aquifer protection area, hydrologic unit, and watershed), and a brief history of the operation. The sample farm inventory form (Figure 4-1) should include all the background information.

2. Location map - showing general location of the operation at a scale of 1:24,000 or larger.
3. Plan Map - aerial photo (or high quality copy) or plan drawing showing cropland and/or farmstead operation in the aquifer protection area and aquifer protection area boundaries. Tract and field boundaries will be shown and numbered. Use ASCS records if available. Structural BMPs planned should be located. Scale should be 1 inch = 660 feet or greater.
4. Soils Map/Descriptions - county soil survey map with fields in aquifer protection area delineated. Appropriate map unit descriptions of soils noting approximate ground water depths should be included.
5. Discussion of Findings and Recommendations, including:
  - A. Threats to the Aquifer - a narrative identifying existing and potential threats to water quality posed by the agricultural operation. At a minimum the narrative should discuss:
    - Agricultural Waste Management
    - Pest & Pesticide Management
    - Nutrient Management
    - Equipment & Vehicle Maintenance
    - Fuel and Chemical Storage
  - B. Other purposes to be achieved by the Plan, such as energy conservation, wildlife habitat improvement, and Conservation Reserve Program compliance.
  - C. BMP Standards and Specifications - recommendations or requirements for application of vegetative, management, or structural BMPs, including new ones to be started, as well as existing ones to be continued. This section of the plan should include any required record-keeping sheets, and specific implementation information such as seeding mixes/rates, practice construction and maintenance information, and appropriate practice management techniques. BMPs should be tied to the water quality concerns and other goals identified above.
6. Summary and Schedule of BMPs Implementation - summarizes BMPs to be installed, where and when. Where appropriate, the location of each BMP should be noted, either by reference to the Plan Map, or by listing applicable field numbers with appropriate BMPs. This summary should be reviewed and signed by the agricultural operator and should be used by him/her to document progress in applying measures.
7. Technical Team Assistance Notes (District file copy only) - to record District assistance to the agricultural operator as a Plan is developed, or revised. Use Form SCS-CPA-6 or similar form.
8. A Listing of Technical Team Members - names and phone numbers, for future reference, and/or assistance.

9. Other information deemed necessary and appropriate by the operator, technical team, or DEP.
10. Farm Plan Folder/Binder - to contain assembled planning information.

### **Sample Plan**

A sample Plan is presented in the appendix.

Figure 4-1: sample farm inventory form

FARM INVENTORY DATA

Date: \_\_\_\_\_ Data collected by: \_\_\_\_\_

Ag Operator: \_\_\_\_\_

Address: \_\_\_\_\_

Phone No. \_\_\_\_\_

Owner (if other than operator): \_\_\_\_\_

Acres Owned \_\_\_\_\_ Cropland Owned (Ac) \_\_\_\_\_ Cropland Rented (Ac) \_\_\_\_\_

Type of Ag Operation \_\_\_\_\_

ASCS Home Tract No. \_\_\_\_\_ ASCS Aerial Photo No. \_\_\_\_\_

County \_\_\_\_\_

Rental Tracts (No./Owner) \_\_\_\_\_,

\_\_\_\_\_,

\_\_\_\_\_.

Aquifer Protection Area Designation \_\_\_\_\_

Tracts and Field (No./Acres) in Aquifer Protection Area - example: T 1142 # 3 / 21 ac.

T \_\_\_\_\_ # \_\_\_\_\_ / \_\_\_\_\_ ac., # \_\_\_\_\_ / \_\_\_\_\_ ac., # \_\_\_\_\_ / \_\_\_\_\_ ac., # \_\_\_\_\_ / \_\_\_\_\_ ac.,

T \_\_\_\_\_ # \_\_\_\_\_ / \_\_\_\_\_ ac., # \_\_\_\_\_ / \_\_\_\_\_ ac., # \_\_\_\_\_ / \_\_\_\_\_ ac., # \_\_\_\_\_ / \_\_\_\_\_ ac.,

T \_\_\_\_\_ # \_\_\_\_\_ / \_\_\_\_\_ ac., # \_\_\_\_\_ / \_\_\_\_\_ ac., # \_\_\_\_\_ / \_\_\_\_\_ ac., # \_\_\_\_\_ / \_\_\_\_\_ ac.,

\* Note: List any additional tracts/fields on back of sheet.

Total acreage in the aquifer protection area \_\_\_\_\_

3rd Order Watershed No. \_\_\_\_\_

USGS topographic quadrangle name \_\_\_\_\_

Soil Map No. \_\_\_\_\_, Plan Map Photo No. \_\_\_\_\_

Existing other Resource Management Plans (i.e. Ag waste, FSA, etc.) \_\_\_\_\_

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Any known, or potential, water quality problem \_\_\_\_\_

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Location of farm fuel storage and equipment maintenance areas \_\_\_\_\_

---

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Comments: \_\_\_\_\_

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## CHAPTER 5

# Best Management Practices

### Overview

The Aquifer Protection Regulations define a Best Management Practice (BMP) as any practice, procedure, installation or facility designed to prevent, minimize, or control spills, leaks, surface runoff, infiltration, or other releases of materials that pose a threat to the ground water in an aquifer protection area. BMPs can also prevent or minimize contamination threats to surface waters.

The BMPs in this chapter may be used to correct existing problems degrading water resources and to minimize the risk of future degradation of water resources.

Both existing and potential problems often require coordinated implementation of several BMPs. For example, contour planting, conservation tillage, plant nutrient management, and pest and pesticide management may all be needed to prevent erosion, and minimize potential surface water and ground water contamination from a sloping crop field.

Some BMPs provide one obvious function while others serve several purposes. The "Best Management Practice Guide to Water Quality Benefits" which follows indicates generally how effective various BMPs are in addressing surface water and ground water contamination problems associated with agriculture. No operation will need to implement all the BMPs presented here. Which BMPs are selected will depend on the nature of the operation, the judgement of the team members, and the preferences of the agricultural operator. Only those BMPs which will benefit ground water quality will be required in aquifer protection areas. BMPs to protect surface water quality are encouraged, but are not mandatory in Farm Resources Management Plans developed for farms in aquifer protection areas.

Many of the BMP standards in this chapter include a number of activities. Again, team members should follow their best professional judgement in determining which parts of a BMP must be implemented for that practice to be valid.

Specialists preparing a Farm Resource Management Plan for protection of ground water or surface water should plan treatment according to guidance in these BMPs. Several BMPs refer to additional technical information available from the SCS, CES, or other sources. References which are not included in the appendices are available for review and copying at the District offices. For information on a practice or treatment that is not presented as a BMP standard, consult the local soil and water conservation district for assistance. Also, specialists should alert landowners to possible need for local inland wetlands or other permits to apply certain BMPs, such as streambank stabilization.

The Schedule of Implementation in the Farm Resources Management Plan should record each BMP to be implemented. Application is recorded by whatever unit of measure is specified in the definition of each BMP.

The Best Management Practice Guide to Water Quality Benefits roughly indicates which water quality problems different practices can alleviate. There are 33 BMPs at this time, which are listed in the Index of Best Management Practices below.

BMPs will be revised and amended as needed under the guidance of the Connecticut Council on Soil and Water Conservation and the Connecticut Department of Environmental Protection. Suggestions for changes in these BMP standards, and for inclusion of new BMPs should be directed to either the Connecticut Council on Soil and Water Conservation or the Aquifer Protection Program, Planning and Standards Division of the Bureau of Water Management, DEP, 79 Elm Street, Hartford, CT 06106.

Professional team members who observe innovative, successful practices should discuss them with colleagues and bring them to the attention of DEP or the Council for inclusion in future versions of this manual.

## BEST MANAGEMENT PRACTICE GUIDE TO WATER QUALITY BENEFITS

This matrix provides a general guide to the effect on various aspects of water quality of the practices presented in this manual. This matrix should only be used as a rough guide. The actual effect of any BMP on water quality depends on site-specific conditions and the quality of BMP implementation, including management, maintenance, and interaction with other BMPs. In addition, the application of some BMPs can vary significantly; for example, crop rotation can be applied very differently, with very different effects, depending on whether the intent is to break pest build-ups, reduce erosion, or improve soil nutrients.

The numbers in this matrix are adapted for Connecticut. Some practices may be more or less beneficial for water quality in other parts of the country.

<b>CONNECTICUT BEST MANAGEMENT PRACTICES GENERAL GUIDE TO WATER QUALITY BENEFITS</b>  0 MAY INCREASE LOADING IN SOME CASES 1 NO CONTROL 2 LOW TO MEDIUM EFFECTIVENESS 3 MEDIUM TO HIGH EFFECTIVENESS	SURFACE WATER							GROUND WATER		
	Sediment	Soluble Nutrients	Adsorbed Nutrients	Soluble Pesticides	Adsorbed Pesticides	Oxygen - Demanding Substances	Bacteria	Nitrogen Loss to Ground Water	Pesticide Loss to Ground Water	Petroleum Contamination
<b>MANAGEMENT PRACTICES</b>										
Irrigation Water Management	2	2	2	2	2	1	1	1	1	1
Pest and Pesticide Management	1	1	1	3	3	1	1	1	3	1
Plant Nutrient Management	1	3	3	1	1	1	1	3	1	1
Silage Leachate/High Strength Organic Waste Management	1	3	1	1	1	3	3	3	1	1
Waste Management System	1	3	3	1	1	3	3	3	1	1
Waste Utilization	1	3	3	1	1	2	1	3	1	1
<b>VEGETATIVE/TILLAGE PRACTICES</b>										
Conservation Cropping System	3	2	3	2	3	1	1	1	2	1
Conservation Tillage System	3	1	3	0	3	1	1	0	0	1
Contour Farming	3	2	3	2	3	2	1	1	1	1
Cover and Green Manure Crop	2	2	2	1	2	1	1	1	1	1
Crop Residue Management	2	2	1	2	1	1	1	1	1	1

*NOTE: The benefit to water quality of any BMP depends on the quality of implementation which includes application, management, maintenance, and coordination with other BMPs.*

CONNECTICUT BEST MANAGEMENT PRACTICES GENERAL GUIDE TO WATER QUALITY BENEFITS	SURFACE WATER							GROUND WATER		
	Sediment	Soluble Nutrients	Absorbed Nutrients	Soluble Pesticides	Absorbed Pesticides	Oxygen - Demanding Substances	Bacteria	Nitrogen Loss to Ground Water	Pesticide Loss to Ground Water	Petroleum Contaminants
0 MAY INCREASE LOADING IN SOME CASES										
1 NO CONTROL										
2 LOW TO MEDIUM EFFECTIVENESS										
3 MEDIUM TO HIGH EFFECTIVENESS										
Crop Rotation	2	2	2	2	2	1	1	2	2	1
Mulching	2	1	2	2	2	1	1	1	2	1
Pasture and Hayland Planting	3	2	3	2	3	2	1	2	1	1
Pasture and Hayland Management	2	1	2	1	1	2	1	1	1	1
Riparian Buffer	3	2	3	2	3	2	2	1	1	1
Stripcropping, Contour	3	2	3	2	3	2	1	1	1	1
<b>STRUCTURAL PRACTICES</b>										
Agricultural Waste Composting	1	2	1	1	1	2	2	2	1	
Dead Poultry Composting Facility	1	2	1	1	1	1	2	2	1	1
Diversion	2	1	2	1	2	1	1	1	1	1
Grassed Waterway or Outlet	2	1	2	1	2	1	1	1	1	1
Heavy Use Area Protection	3	2	2	1	1	1	1	1	1	1
Roof Runoff Management	1	3	1	1	1	3	3	1	1	1
Streambank Protection	3	1	1	1	1	1	1	1	1	1
Terrace	3	2	3	2	3	2	1	0	0	1
Vegetated Filter Area	2	1	2	1	2	2	2	1	1	1
Waste Storage Field Stacking	1	2	2	1	1	3	3	0	1	1
Waste Storage Structure	1	2	3	1	1	3	3	0	1	

NOTE: The benefit to water quality of any BMP depends on the quality of implementation which includes application, management, maintenance, and coordination with other BMPs.

CONNECTICUT BEST MANAGEMENT PRACTICES GENERAL GUIDE TO WATER QUALITY BENEFITS	SURFACE WATER							GROUND WATER		
	Sediment	Soluble Nutrients	Adsorbed Nutrients	Soluble Pesticides	Adsorbed Pesticides	Oxygen - Demanding Substances	Bacteria	Nitrogen Loss to Ground Water	Pesticide Loss to Ground Water	Petroleum Contamination
0 MAY INCREASE LOADING IN SOME CASES										
1 NO CONTROL										
2 LOW TO MEDIUM EFFECTIVENESS										
3 MEDIUM TO HIGH EFFECTIVENESS										
Water and Sediment Control Basin	3	1	3	1	3	1	1	0	0	1
<b>MISCELLANEOUS PRACTICES</b>										
Equipment and Vehicle Maintenance	1	1	1	1	1	1	1	1	1	3
Forest Land Erosion Control System	3	1	2	1	1	1	1	1	1	1
Milk House/Parlor Waste Water Treatment	1	2	1	1	1	3	2	0	1	1
Petroleum Products Storage	1	1	1	1	1	1	1	1	1	3

*NOTE: The benefit to water quality of any BMP depends on the quality of implementation which includes application, management, maintenance, and coordination with other BMPs.*

Adapted from USDA, Agricultural Information Bulletin No. 598, Water Quality Education and Technical Assistance Plan - 1990 Update, July 1990.

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## Agricultural Waste Composting

### Definition

A process of controlled and accelerated aerobic biodegradation and stabilization of organic wastes. "Amount planned" in schedule of implementation is measured in number of units.

### Scope

This standard establishes the minimum acceptable requirements for the composting process and the design, construction, and operation of composting facilities. Waste organic material for composting may include livestock and poultry manure, food processing wastes where food is processed as part of normal farming operation, and leaves. Municipal sludge, solid waste, and other non-farm type wastes, except for leaves, are not included in this standard.

### Purpose

To reduce the risk of water contamination or disease through biological treatment of organic waste materials and to produce a humus-like material that can be safely used as a soil amendment.

### Where Used

This practice applies where: 1) waste organic material is generated by agricultural production or processing; 2) composting is needed to stabilize nutrients reduce any pathogens and make the organic waste material safe to use; and 3) an overall waste management system plan accounts for the end use of the composted material.

### Water Quality Impacts

Properly conducted, composting destroys pathogens and stabilizes the nutrients in agricultural wastes so they can be stored and used without leaching nutrients to ground water. Because it is relatively stable, compost is less likely to leach nutrients, especially nitrogen, to surface or ground water than fresh manure or chemical fertilizer. Improperly managed or inadequately monitored composting may leach nutrients, salts, or acids to ground water. Thus, it is important that composting be conducted according to the criteria in this BMP.

### Planning Considerations

#### Composting Methods

There are three types of composting methods covered in this standard: windrows, static aerated piles, and in-vessel. Sheet leaf composting is also briefly discussed below. Passive composting with no provisions to allow aeration and maintain moisture levels is not acceptable composting for organic wastes high in nitrogen.

*Windrows* are long linear piles of composting material which are turned periodically by power equipment to provide aeration. The width and depth of a windrow are limited by the turning equipment, aeration, and compaction of the material. Depths of 4 to 6 feet and widths of 6 to 10 feet are common.

Daily turnings at the start of the process give way to weekly turnings as the process is monitored. Mixing and turning can be accomplished with a front end loader when done on a small scale. On a larger scale, a windrow turner is needed. It is pulled by at least a 100 horsepower tractor. A windrow turner straddles the windrow. This type of turner costs approximately \$20,000. Larger more expensive self-driven turners are available. Windrows may be hundreds of feet long, depending on volumes of material and site conditions.

*Static Aerated Piles* are initially mixed to a homogeneous condition and not turned again throughout the composting process. Pile dimensions are limited by the air flow allowed into the pile and stacking characteristics of the material. Piles may be 8 to 15 feet high and shall have a base width of at least twice their height. Piles must have the proper moisture content and bulk density to allow interior air movement. Perforated plastic pipes are normally installed beneath a pile to serve as air ducts which supply oxygen from a blower. A simple aerated pile system including a blower, timer, temperature probe, and piping may cost approximately one thousand dollars. However, costs can escalate with construction of a permanent concrete or asphalt composting pad, which is usually recommended. A front end loader is also needed for this method.

The static pile method is a more concentrated method of composting. It usually has a shorter composting period. It allows higher, broader piles than with a windrow, and therefore requires less land. Most farm operations, however, use windrowing because land is not limiting, and composting can be done in the field where the processed material will be used.

*In-Vessel* composting is carried out in a totally enclosed structure with a blended organic material under conditions where temperature and air flow are controlled and monitored. In-vessel composting also includes naturally aerated processes where organic materials are layered in the vessel in a specified sequence. Small animal carcasses such as dead chickens are best composted through this method (see Dead Poultry Composting Facility BMP). Layered, in-vessel types are usually turned once to facilitate the process. Vessel dimensions must be consistent with equipment to be used for management of compost. In-vessel composting is faster and more controlled than either static pile or windrow composting. Composting structures or containers may be farmer-built or in some cases commercially purchased.

*Sheet Leaf Composting* is the incorporation of a thin layer of leaves into the soil over an entire field. Because the leaves are applied in a thin layer (no more than six inches per year), this practice does not pose a threat to ground water quality. However, it is important to follow DEP's composting guidelines and/or regulations to ensure that nutrient management is properly adjusted to compensate for the nitrogen demands of the composting process and that no extraneous materials are mixed with the leaves.

### Process

Composting is accomplished by mixing an energy source (carbonaceous material) with a nutrient source (nitrogenous material) in a prescribed manner to meet aerobic microbial metabolic requirements. The process is carried out within specific ranges of moisture, pH, temperature, carbon-nitrogen ratio and oxygen over a period of time. Correct proportions of the various compost ingredients are essential to minimize odors and to avoid attracting flies, rodents, and other small pests.

### Carbon Source

A dependable source of carbonaceous material must be available. The material should have a high carbon content and high carbon to nitrogen ratio (C:N). Wood chips, sawdust, straw, corn cobs, bark, leaves, and well bedded horse manure are good sources of carbon.

### Moisture Control

Large amounts of water evaporate during the composting process because operating temperatures drive off water. A source of water must be available for compost pile moisture control from start-up through completion. Proper moisture facilitates the composting process and helps control odors. A 40-60% moisture content should be maintained.

### Equipment Needs

Appropriate equipment must be available for initial mixing, turning, and hauling of composted material and carbonaceous material. Appropriate long stem thermometers should be available for monitoring the temperature of the composting material.

### Bulking Materials

Bulking materials may be added to enhance air flow within the composting material. Piles that are too compact will inhibit the composting process. The carbonaceous material can be considered as a bulking agent. Where it is desirable to salvage carbonaceous material, provisions for removing the material, such as screening, must be made.

### Management

Composting operations require close management. Management capabilities of the operator and availability of labor should be assessed as part of the planning and implementing process.

### Economics

Benefits associated with the ultimate use of the composted material should be compared to the capital expenditure and operating costs of the composting operations. A valuable organic soil amendment will be produced, and waste disposal costs can be avoided. Benefits can include environmental protection, improved handling, disposal of dead poultry carcasses, odor control, and reduced need for storage volume.

### Regulatory Requirements

The operator should contact the Connecticut Department of Agriculture for information on any permit requirements when planning to compost processed food wastes. The operator should also contact DEP for information on any registration or regulatory requirements for composting operations. Generally, composting operations involving manure should be reviewed by the Bureau of Water Management as part of an overall agricultural waste management plan, while pure leaf-composting operations should be reviewed by the Bureau of Waste Management.

### Use, Sale, or Disposal of Composted Material

If more compost will be produced than can be used on the farm, arrangements must be made for the off-farm use of the compost, including identifying potential users (garden center, etc.), providing needed storage, and final processing of the compost.

For on-farm use, compost may be spread at any time during a growing season when size of crop is not a limiting factor. When applied to soil, compost should be incorporated soon after application to retain nutrient value. Ideally, compost should be applied as soon after being finished (cured) as possible.

### **Design Criteria**

#### Site Soils and Drainage

Divert surface drainage away from the area of composting operations. An impervious surface pad of concrete or asphalt should be designed and installed for composting operations in aquifer protection areas. Such an impervious pad can greatly facilitate operations, particularly in wet weather, for all composting operations. Topsoil could be removed and replaced with compacted gravel on areas designated for long term composting. All composting operations shall be located at least five feet above bedrock and the water table.

The compost site is best located on land with slopes less than four percent. Windrows should run up and down a slope to allow between-row drainage. The site shall not be located in an area subject to inundation by a 25-year frequency storm event.

Runoff from a compost pad or area should be directed as sheet flow through a vegetated filter area or collected, stored, and land applied.

#### Carbon-Nitrogen Ratio

Calculate the amounts of the various ingredients to establish the desired carbon-nitrogen ratio (C:N) of the mix to be composted. The C:N should be between 25:1 and 40:1. Use the higher range of C:N for organic materials that decompose at a high rate or are highly unstable with associated high odor production, such as livestock carcasses.

Where more than two ingredients are to be blended, the two main ingredients are to be used

in the analysis for the desired C:N and mixed accordingly. Adding up to 50 percent by weight of other ingredients to improve workability and air movement is permissible as long as the C:N of the added ingredient does not exceed the target C:N of the compost. Refer to Chapter 4 of the SCS Ag Waste Management Field Handbook for C and N content of ingredients.

### Odor

Select carbonaceous material that, when blended with the nitrogenous material, will result in the desired pH. The blended material should have a pH at or slightly below neutral for best odor control. Where odors do not present a problem, a pH of eight to nine is acceptable, but strong ammonia and amine related odors will be present for up to the first two weeks.

Keep compost well aerated to minimize odors, and locate composting operations where prevailing winds will normally carry odors away from neighbors. Buffer areas, vegetative screens, and natural landscape features can help to minimize the effects of odors.

### Area Requirements

The composting area size depends on the daily production of materials and the composting method used. Refer to references noted at end of BMP.

### Moisture

The moisture content of the blended material at start-up of the composting process should be approximately 60 percent (wet weight basis) and maintained between 40 and 60 percent during the composting process. The composting process becomes inhibited when moisture falls below approximately 40 percent. Use carbonaceous materials that will help satisfy the moisture holding requirements. The material should feel moist to the touch, but it should not be possible to squeeze out water.

### Pile Shape and Size

Compost piles for windrowed and static piles should be triangular to parabolic in cross-sectional form with a base width to height ratio of about two to one. Windrows should not exceed six (6) feet in depth and fourteen (14) feet in width for best results. Static piles can range from eight (8) to fifteen (15) feet in depth, and approximately twice their depth in width. Increased surface area favorably affects evaporation and natural aeration and increases the area exposed to infiltration from precipitation in uncovered stacks. Align windrows up and down the slope to prevent trapping and ponding runoff. Generally smaller piles or windrows aerate better and are easier to turn as necessary. Size will depend somewhat on room available and equipment used.

### Storage

A composting area does not need to be covered. However if control of odors, visual screening, moisture control and/or extended storage or additional processing is necessary, an

inexpensive pole building or greenhouse structure may be considered.

### Separation Distances

The following separation distances apply to composting sites: From neighboring residences and businesses - 300 feet, from property lines - 100 feet, from watercourses - 200 feet, above high water table or bedrock - five feet, from private wells - 200 feet, from public wells - 500 feet.

### Operation Criteria

#### Temperature

For best results, operating temperature of the composting material should be 135°F to 170°F once the process has begun. It should reach operating temperature within about seven days and remain elevated for up to 14 days to facilitate efficient composting. The material should remain at or above 110°F for the remainder of the designated composting period. If temperature falls significantly during the composting period and odors develop, or if material does not reach operating temperature, investigate piles for moisture content, porosity, and thoroughness of mixing. Compost managed at the proper temperatures will favor destruction of any pathogens and weed seeds.

#### Composting Period

The time needed for completion of the process varies with the material and must continue until the material reaches a stability level at which it can be safely stored without creating undesirable odors and poor handling features. Acceptable stability occurs when microbial activity diminishes to a low level which is indicated by a final reduction in temperature after several turning processes. Stability can be obtained in about 21-28 days but can require up to 60 days to produce the desired quality. Depending on the degree of aeration, moisture content, the materials, and the method of composting, the time to produce a useable product will vary between three and eight weeks. Visual inspection and temperature measurements (110°F minimum) will provide needed evaluation of compost status. Finished compost should be loose, crumbly, and black-brown in color. It should smell like good earth. A bad odor indicates that microbial action is still occurring. A windrow should not reheat significantly after turning when the process is near completion.

#### Aeration

Heat generated by the process causes piles to dehydrate. As the process proceeds, material consolidates, and the volume of voids through which air flows decreases. Materials selected for the composting mix should provide for adequate air movement throughout the composting process. Periodically turning the pile and maintaining proper moisture levels for windrows will normally provide adequate aeration. The compost should be turned when the temperature falls below 110°F or exceeds 140°F.

### Curing Period

A "curing" period of about 30 days usually follows the active composting stage. While curing, the compost continues to stabilize but at a much slower rate. Compost can be stockpiled without turning or aeration, and without odor problems during this time.

### Nutrients

Nitrogen will be lost during the composting process, but the amount lost can be minimized by proper regulation of aeration, carbon:nitrogen ratio, and pH.

Keep compost well-aerated to minimize odors and nitrogen loss by denitrification; however, as aeration promotes nitrogen loss as ammonia, avoid excessive aeration. Keep pH at neutral or slightly lower to minimize nitrogen loss by ammonification. High amounts of available carbon will aid nitrogen immobilization. Include compost nutrients in nutrient management plans.

### Testing Needs

Test compost material for carbon, nitrogen, moisture, and pH if compost fails to reach desired temperature or if odor problems develop.

Before applying or marketing compost, check that compost is fully stabilized and cured to avoid fungus or phytotoxicity problems.

### **Plans, Specifications, and Operation and Maintenance**

Plans and specification for composting shall be in keeping with this standard. The volume of material to be composted will be calculated to determine area requirements. A written operation and maintenance plan shall be developed with full knowledge and input of the owner-operator and included with the documents provided to the owner-operator.

### **References**

Additional information on planning an agricultural composting system is presented in CES publication: On-Farm Composting Handbook by Robert Rynk, et.al., Northeast Regional Agricultural Engineering Service, Ithaca, NY, 1992; the SCS Ag-Waste Management Field Handbook, and SCS-NNTC, ECOL. SCI. Environmental Quality Tech. Note No. N2 (2-7-90).

Additional information on leaf composting is presented in Compost - Send Your Leaves to a Mulch Better Place, CT DEP, January, 1989.



## Conservation Cropping System

### Definition

An adapted system of growing crops in association with needed structural and agronomic practices. "Amount planned" in schedule of implementation measured in number of acres.

### Scope

This standard gives guidelines for planning and establishing a system of crops and management.

### Purpose

Conservation cropping systems improve or maintain physical, chemical, and biological conditions of the soil; minimize the risk of soil erosion; maximize water use efficiency; promote efficient energy use; and improve water quality. This practice may also benefit wildlife.

### Where Used

On all land where agricultural crops are grown.

### Water Quality Impacts

Soil conserving crops will assist in minimizing erosion and improving or maintaining surface water quality.

Proper use of nutrients and pesticides will minimize the potential pollution to both ground and surface waters.

Water and erosion control structures can safely store, divert, and carry away excess water during periods of precipitation and runoff events. The improved soil infiltration will allow for more effective use of water needed during the crop growing season. However, increased percolation may leach excess agricultural chemicals to groundwater.

A combination of crop rotation, conservation tillage practices, and pest and plant nutrient management practices can minimize potential degradation of ground or surface water.

### Planning Considerations

The system selected shall include components that will attain sound soil and water conservation to prevent surface and ground water quality degradation, minimize offsite soil

erosion, yet provide optimum economic efficiency. Components of the system may include the following associated practices:

1. Cover and Green Manure Crop
2. Conservation Tillage
3. Contour Farming
4. Crop Residue Use
5. Crop Rotation
6. Diversion
7. Grassed Waterway
8. Stripcropping
9. Terrace
10. Pasture and Hayland Planting
11. Pasture and Hayland Management
12. Pest and Pesticide Management
13. Plant Nutrient Management

### **Design Criteria**

Where crop mix permits, legumes shall be included in the cropping system to improve soil nitrogen content for succeeding crops. Use legume nitrogen credits as recommended by the Cooperative Extension System (CES) or UCONN soil testing facilities. Refer to the Plant Nutrient Management BMP.

Maintain soil pH at the proper level for the planned crops according to the CES guidelines.

Plan the cropping system to control persistent, site-specific weed, insect and disease pests with a minimum use of chemicals.

Determine the cropping system needed to minimize potential threats to ground water while adequately controlling erosion. Use the Universal Soil Loss Equation to determine erosion control needs. Refer to Section I-C of the SCS Field Office Technical Guide (FOTG).

### **Specifications**

The SCS FOTG standards and related BMP's contain specific guidelines for determining minimum design criteria for achieving an adequate level of soil resource protection.

The CES publishes Grower IPM (Integrated Pest Management) Guides, manuals, and fact sheets, and nutrient management guides which contain information and recommendations on the use of systems to control pest infestations. See the Pest and Pesticide Management BMP and Plant Nutrient Management BMP for specific information and references.

## Conservation Tillage

### Definition

Any tillage and planting system which minimizes physical disturbance of the soil and leaves at least 30 percent of the surface covered by plant residue after planting. "Amount planned" in schedule of implementation measured in number of acres.

### Scope

This standard discusses constraints on the use of conservation tillage in aquifer protection areas, as well as the requirements for the planning and management of conservation tillage systems including mulch-till, ridge-till, strip-till, no-till, and reduced-till. It applies primarily to agronomic annual crops (corn). For information on conservation tillage in forage and hay plantings, refer to the Pasture and Hayland Planting BMP. Conservation tillage is closely related to crop residue management, which is discussed as a separate BMP.

### Purpose

To reduce runoff and soil erosion, help maintain and build good soil tilth, and allow for efficient soil moisture use.

### Where Used

Primarily on sloping, highly erodible cropland where vegetation is to be established or reestablished, and where adequate plant residues are produced. Applies to rotations that include fallow periods as well as annual cropping. In aquifer protection areas some tillage or cultivation (mulch-till, ridge-till) is normally preferable to no-till to reduce use of herbicides and insecticides which may threaten ground water. On upland shallow-to-bedrock soils or very stony soils, no-till direct seeding may be useful to avoid disturbing surface stones and eliminate the need to pick rocks before planting.

### Water Quality Impacts

Conservation tillage reduces erosion and sedimentation by as much as 90 percent in certain circumstances. It also reduces runoff and so can reduce the amount of nutrients and pesticides delivered to surface water. Because it increases infiltration through development of soil macropores and relies on herbicides to replace any cultivation, no-till may increase the risk of ground water pollution by both fertilizer and pesticides. Other conservation tillage practices with some soil disturbance disrupt the continuity of soil macropores and may rely less heavily on herbicides, thereby reducing risk of ground water contamination in comparison to no-till. Bacterial degradation of surface-applied pesticides may increase as the organic matter content of the soil increases. All conservation tillage is generally beneficial to surface water quality, provided herbicide applications are not increased unduly.

## Planning Considerations

Fields selected for conservation tillage should not have severe drainage problems, and should have soils with a favorable pH range of 5.5 to 7.5 (or favorable range for the crop), should be free of perennial weed problems, and have few surface irregularities.

Select crop varieties adapted to growth under reduced tillage situations. Select for cold tolerance, good germination, and excellent seedling vigor.

Heavy crop residues may act as a mulch and suppress weed growth, however, they can also create conditions favorable for insect pests.

The type of conservation tillage used depends on the soil type, the crop residues on the site, weed and pest problems present, soil temperature, drainage, tillage equipment available, and other factors related to the specific tillage practice.

Conservation tillage methods are applicable to all high residue crops such as ear corn. They are also applicable to low residue crops such as corn silage, provided winter cover crops, and/or mulches are used to meet minimum residue requirements. This practice may also be used for grass and legume seedings.

At planting time, the ridge-till method will allow the ridges to warm up faster and provide better drainage in the row than in other tillage methods. This may be advantageous in cooler, heavy or wet soils. However, ridge-till requires specialized equipment, unlike mulch-till. When planting early, do so after the soil temperature reaches 50 degrees Fahrenheit for corn, and 40 degrees Fahrenheit for small grain (temperature at two inch depth at 8:00 AM).

Bring deep-rooted weeds under control before using conservation tillage. Shallow cultivation does not disturb deep-rooted rhizomes.

Soil compaction problems caused by tillage and wheel traffic will be reduced, especially with the ridge-till and no-till methods. However, wet field conditions at harvest time may create compaction problems needing correction by tillage before planting the following year.

The formation of macropores and the increase in infiltration of precipitation may lead to leaching of nitrates to the ground water. It is especially important to fertilize in accordance with the Plant Nutrient Management BMP when practicing conservation tillage.

Substituting herbicide applications for cultivation as a means of controlling weeds may lead to pollution of ground water. It is critical to manage pests in accordance with a pest management plan which draws on integrated pest management techniques when using conservation tillage (see Pest and Pesticide Management BMP). Generally smaller amounts of herbicides are needed with ridge-till than with other conservation tillage methods.

Follow the Plant Nutrient Management BMP to prevent excess fertilizer applications, which could lead to leaching or runoff of nutrients.

**Planning and Management Criteria: MULCH-TILL**

Description

The total soil surface is disturbed by tillage prior to planting. Tillage tools such as chisels, field cultivators, disks, and sweep blades are used. Weed control is accomplished with cultivation and herbicide application. At least 30 percent residue cover must be left on the soil surface immediately following crop planting.

Where Used

Mulch-till is appropriate for continuous or rotational row crop operations where plant residues are sufficient. It is applicable to land capability Classes I and II, and Subclasses IIIe, IIIs, IVe, and IVs. Subclass IIIw land may be used if artificially drained.

Considerations

Keep tillage operations to a minimum for maximum erosion protection from the residues on the surface. Control tillage depth to a maximum of four inches. More than a single disking may eliminate residue sufficient to meet the 30% requirement.

Plant when soil conditions exist that will give good seed coverage. Do not plant when the ground is too wet. Plant on the contour on sloping land for erosion control. Use a planter designed to operate in heavy residues.

Follow the Pest & Pesticide Management BMP for pest control. Cultivation can be used as the major weed control method. Pre-plant incorporated and pre-emergence residual herbicides may be required as in conventional full tillage operations.

With fertilizer and pesticide applications, be responsive to the need to minimize risk to ground water and surface water.

**Planning and Management Criteria: STRIP-TILL**

Description

Narrow strips are tilled to plant rows of seeds or transplant seedlings while leaving surface residues undisturbed between the strips. Row tillage may be by an in-row chisel, row cleaner, or a rototiller. Normally about one-third of the field area surface is tilled at planting time. Weed control is accomplished with a combination of cultivation and/or herbicide application. Strip-till may be combined with ridge-till.

Where Used

Strip-till is appropriate for vegetable and small fruit crops. It may be used on land capability Classes I and Subclasses IIe and IIIe.

### Considerations

On sloping land run the strips as close as possible to the contour.

The strip-till system can be used with or without ridges. If the ridge system is not used, cultivation is needed only for emergency weed control. The large single sweep or rolling cultivator can be used. If the ridge system is not used, and there is not cultivation, the following year's crop can be planted between the previous year's rows with the sweep. If land is cultivated or ridges are used, plant next year's crop in this year's crop rows.

Control weeds and insect pests in accordance with the Pest and Pesticide Management BMP. Select only herbicides that are recommended for no-till or ridge-till systems and that will control your specific weed problems. Calibrate and operate the sprayer equipment properly, being sure to have the correct nozzles and having proper coverage and penetration. Always turn off sprayer and lift machinery when off the strips. Preplant incorporated herbicides cannot be used for strip-till systems.

### **Planning and Management Criteria: RIDGE-TILL**

#### Description

Ridges are initially established, usually by plowing them six to eight inches high before planting a field, or during a last cultivation the previous year between rows where the ridges are built against a tolerant crop (e.g. corn). Then the ridges are planted year after year. Ridge-till may be practiced without any cultivation after the initial establishment of the ridges, or it may be combined with strip-till. At least 30 percent field residue cover must be present after planting.

#### Where Used

Ridge-till is appropriate primarily for continuous row crop operations, however vegetables/fruits may be grown on low ridges as part of a conservation cropping sequence. Land capability Classes I and II and Subclass IIIe up to 12 percent slopes are suitable for ridge-till. Subclasses IIIw and IVw may also be cultivated using ridge-till, if artificially drained. The system may be used in fields that are too wet or where soil temperatures warm too late for timely seed germination with other tillage systems. Where it can be used, ridge-till may offer considerable erosion control with less dependence on herbicides than no-till. To date, ridge-till has been used very little in Connecticut due to lighter soils and the need for specialized equipment.

#### Considerations

Ridges normally dry and warm earlier in the spring, allowing for earlier planting unless wheel-travel troughs between ridges are too wet to travel.

Ridges may be made a year before ridge planting begins, in fallow land for example, using a ridge-till cultivator.

Use a ridger and planter with the same number of rows, and make sure that ridge centers are exactly the same width as planter rows. Improperly adjusted disk hillers may not move soil equally on both sides of the ridge.

Ridges should be across slopes of more than 4-5%, even with corn residues present. On nearly level soils with poor internal drainage, make sure that ridges do not interrupt natural drainage ways, causing ponded water in furrows.

In corn fields, ridges may be made when the plants are about 18 inches tall. If soil is moist, slow the tractor speed so that soil "slabs" will not injure plants. One cultivation is required to build ridges. If two cultivations are made, throw soil out with first cultivation, and throw soil in to build the ridges with the second cultivation. Use extra stabilizing guide coulters or tires "snugged" against ridges to help keep the planter centered on ridge tops. This is especially important on pull-type planters and with narrow rows (30 inches) where ridge tops are narrower.

Ridges can be made after corn harvest if the harvester has left residues evenly distributed and the ridger has coulters in front of sweeps. Ridges made at this time will be more irregular, possibly leading to lower germination at planting. Ridging corn at "lay by" time is a better alternative, if possible. Keep harvester and all other wheel traffic in row middles (ditches) to avoid compacting ridges, once they are made. For many farmers, this will mean spaced dual wheels on their tractor and combine and avoiding custom application of fertilizers and pesticides, unless the applicators have properly spaced wheels also.

Fertilize according to the Nutrient Management Plan. Manure may be applied but not incorporated.

Normally there is no need to apply a contact herbicide on the ridges, since germinated weeds are skimmed off by the planter. Any pesticides applied between ridges to augment cultivation should be according to recommendations in the Pest and Pesticide Management BMP.

#### **Planning and Management Criteria: NO-TILL**

##### Description

No-till is a method of planting in prior crop residue, in winter cover crops, or in a perennial sod crop where the surface of the field is left undisturbed with at least 30% residue prior to planting. Planting is completed in a narrow seedbed or slot created by the planter or drill. Weed and insect control is accomplished primarily by pesticides.

##### Where Used

No-till is most appropriate for continuous row crop operations in fields where a high degree of erosion control is needed. It is applicable to land capability Classes I and II, and Subclasses IIe, IIs, IVe, and IVs, and Subclass IIIw if the latter is artificially drained. It presents a greater threat to ground or surface water only if additional amounts of pesticides

are applied over those used in other tillage/planting operations. Use of no-till in aquifer protection areas needs to be carefully evaluated based on any additional pesticide needs.

#### Considerations

Soils warm up more slowly in the spring with no-till. Check soil temperature before planting. Soil temperature should be 50 degrees Fahrenheit or higher at seed depth at 8:00 AM.

If necessary, destroy perennial weeds and alfalfa with approved herbicides, in accordance with a Pesticide Management Plan before planting.

Use seed treated with fungicide to minimize rot problems.

Since long term no-till results in an increase in macro-pores which may increase infiltration of chemicals to groundwater, a no-till field should be lightly disked every few years to break-up the macro-pores, i.e. apply a mulch-tillage planting.

Plant crops on the contour to reduce runoff and conserve water. Select a planter that will plant in heavy residues. Slow down planting speed to 3-4 MPH. Check seeding depth regularly. Make sure of proper seeding depth for kind of crop being seeded. Make sure seeds are properly covered.

#### **Planning and Management Criteria: REDUCED-TILL**

##### Description

Any tillage system other than mulch-till, ridge-till, strip-till, or no-till, that meets the minimum 30 percent residue requirement and general planning considerations of conservation tillage. Application and management must be responsive to minimizing threats to ground and surface water through proper nutrient and pesticide application.

#### **Operation: all conservation tillage systems**

##### Fertilization

Apply fertilizer and lime according to soil test analysis recommendations for the crop utilization needs based on realistic crop yield goals and soil potentials. Refer to the Plant Nutrient Management BMP. Delay sidedress nitrogen applications until after taking a pre-sidedress soil nitrate test (June nitrate test). Top dress with urea just before a light rain, if possible, but avoid any fertilizer application less than 24 hours before a predicted heavy rain. Apply P and K partly through a starter fertilizer, with the balance broadcast and incorporated. (For row crops, place the starter two inches to the side and two inches below the seed for optimum use). Do not broadcast urea N during hot weather unless immediately incorporated into the soil.

### Pest Management

Follow a pest management plan prepared in accordance with the Pest and Pesticide Management BMP. Use crop rotations, integrated pest management systems (see CES Integrated Weed Management in Field Corn), and cultivation, if possible, to minimize insect, weed, disease, nematode, bird and rodent problems.

### Cover Crops

Cover crops of small grain, if used, should be mechanically or chemically killed before heading out of the grain occurs.

### Planter Operation

Planters shall be properly set to insure good seed-to-soil contact and seed is sown at proper depth. Often, with conservation tillage fewer seeds are properly covered by mineral soil than with conventional tillage. As a general rule of thumb, it is wise to sow about 10 percent more seeds when using conservation tillage than with conventionally tilled fields. Even with the poorer rate of seed coverage expected with conservation tillage, however, for large seeded crops, no more than 10 percent of the seeds sown should be visible at the surface after planting.

### Post Harvest Operations

After harvest, assess the amount of crop residue available in each field and plan tillage practices to preserve that crop residue for soil protection during the next season's crop.

### Tillage Operations

Select tillage equipment, depth, and operational speed to minimize surface residue disturbance, yet meet the objectives of this tillage practice.

### Additional Specifications

Refer to additional technical guidance in the SCS Conservation Tillage Standard No. 329, and other current applicable SCS and CES recommendations.



## Contour Farming

### Definition

Performing tillage, planting, and harvesting operations across slope on the contour to reduce surface runoff and the transport of pesticides, nutrients, and sediments. "Amount planned" in schedule of implementation measured in number of acres.

### Purpose

To reduce runoff and erosion, and increase infiltration.

### Where Used

On sloping agricultural land where there is a need to reduce soil erosion and control water loss. It is most applicable to row crops.

### Water Quality Impacts

Contour farming improves surface water quality by reducing runoff of sediment, nutrients, and pesticides. Increased infiltration may promote better crop growth. It may, however, cause an increase in the movement of nitrates and pesticides to ground water. Therefore, contour cropping should always be practiced in conjunction with the best management practices for pest and pesticide management and nutrient management. Because there is less chance for nutrients and pesticides to be carried off-site, it may be possible to reduce the total quantity applied to the crop with contour farming. When less fertilizer and pesticides are applied, the risk of ground water contamination will be reduced.

### Planning Considerations

Existing watercourses should be left in sod, and where necessary, grassed waterways should be established and maintained to remove water accumulations in areas of concentrated flow.

Use Plant Nutrient Management and Pest and Pesticide Management BMPs.

Use contour or row gradient markers to assist long-term management of the field on the contour. These identifying features may include diversions, terraces, contour field boundaries, or an established marker row.

Prior to laying out contour fields, ensure that all obstructions within the area are removed.

Where feasible, consider establishing or maintaining hedgerows or field borders for wildlife in the odd areas of the field not being cropped.

Formation of ridges by cross-slope tillage slows runoff and increases infiltration, which may improve crop growth.

### **Design Criteria**

The effective slope length and steepness shall not exceed those in Table 1.

When conditions exceed the limits in Table 1, reduce the slope length through installation of erosion control and water management practices as needed.

If this practice creates wetness and drainage problems that may restrict the growth of the intended crops, provide supplemental drainage to overcome these limitations, as described in the Diversion or Grassed Waterway BMPs and/or in SCS Subsurface Drainage Standard No. 606.

### **Specifications**

Establish guidelines as near on the contour as practicable. Deviation from the contour is allowed for row drainage and for the practical operation of equipment, but shall not exceed one percent on well drained soils and up to two percent on moderately well to poorly drained soils. In no case shall the guidelines or row gradient exceed four percent for a maximum of 150 feet in any one direction.

Do not conduct water along graded rows for a distance greater than 500 feet. For gradients beyond this distance, intercept the water and convey off-site through use of surface or subsurface water conveyance measures (see Diversion and Grassed Waterway BMPs and SCS Subsurface Drainage Standard No. 606).

### **Operation and Management**

Conduct tillage and planting operations parallel to established guidelines. Existing water management practices may be used as guidelines.

Maintain ridges and furrows during critical erosion and runoff periods.

Maintain contour markers to ensure continuance of farming operations on the contour.

### **Supporting Data and Documentation**

Field and contour location.

Slope length and steepness.

Maximum deviation of slope or length of slope from the contour.

Ridge and furrow dimensions and spacing of rows.

Critical erosion and runoff periods.

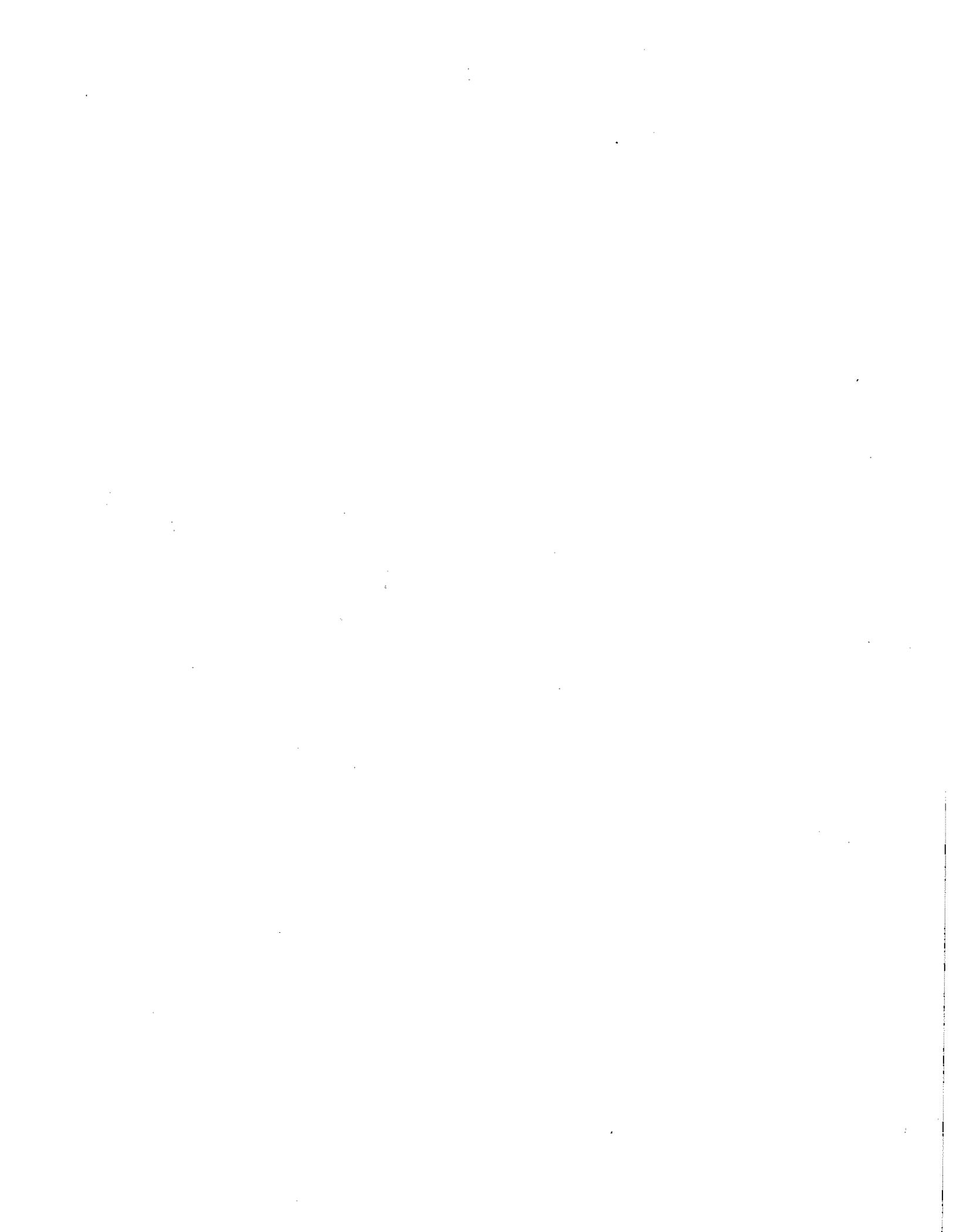
TABLE 1  
P-VALUE <sup>1</sup> AND SLOPE LENGTH LIMITS FOR CONTOURING

Land Slope Percent	P-Value	Maximum Length Feet <sup>2, 3</sup>
1 to 2	0.60	400
3 to 5	.50	300
6 to 8	.50	200
9 to 12	.60	120
13 to 16	.70	80
17 to 20	.80	60

<sup>1</sup> P-Value is a cultural practice factor, or the ratio of soil loss with a certain conservation practice to that of straight row farming up and down slope. It is a factor of the Universal Soil Loss Equation (SCS Field Office Technical Guide, Sec. 1-C).

<sup>2</sup> Limit may be increased by 25 percent when conservation tillage is used and residue cover exceeds 50 percent at time of crop seeding.

<sup>3</sup> When slope lengths exceed these limits, use slope reduction practices such as diversions or terraces.



## Cover And Green Manure Crop

### Definition

A crop of close-growing grasses, legumes, or small grain grown primarily for seasonal protection and soil improvement. It usually is grown for one year or less, except where there is permanent cover as in orchards. "Amount planned" in schedule of implementation measured in number of acres.

### Purpose

To control erosion during periods when the major crops do not furnish adequate cover; add organic material to the soil; improve infiltration, aeration, tilth; and provide wildlife habitat.

### Where Used

On cropland, certain recreation and wildlife areas, nurseries, orchards, vineyards, and small fruit areas.

### Water Quality Impacts

Cover crops can improve surface water quality by preventing erosion and sedimentation. They may also take up residual pesticides and nutrients left in the soil after the main crop is harvested, reducing the risk of leaching to ground water. Leguminous cover crops fix nitrogen and should be given credit in a nutrient management plan.

### Planning Considerations

Apply lime on the basis of need as determined by a soil test. In lieu of a soil test, apply lime based upon the needs of the main crop to follow. Take cover crop's nutrient value into account when planning nutrient management.

### Specifications

Annual Cover (planted after main annual crop, e.g., corn)

#### Seeding Methods

When conditions warrant seedbed preparation, conduct minimum soil disturbance during and after seeding to reduce potential soil erosion yet ensure adequate contact for seed germination.

Direct seeding after crop harvest may be done by use of no-till drills.

Broadcasting after crop harvest may be done by use of hand-operated cyclone seeder,

aerial equipment, or tractor mounted seeder without seedbed preparation, if adequate moisture is present. When moisture is lacking, consider broadcasting seed during crop harvesting operations to provide better soil-seed contact from equipment usage.

When applying seed aerially before crop harvest, increase rate per acre by 50 percent and seed within 30 days of harvest to prevent poor stand vigor and damage of the cover by harvesting equipment.

#### Soil Amendments

When using manure, compost, or other soil amendment, either incorporate prior to seeding, or apply after the crop is well established and at low enough rates to prevent smothering. Apply amendments in accordance with the Plant Nutrient Management and Waste Utilization BMPs.

#### Plant Selection

Crops most commonly used for cover are included in the following tables. The crops should be seeded no later than the dates shown to provide adequate cover for the periods indicated. When seeding rye later than the listed dates, increase the seeding rates accordingly.

#### Seedbed Preparation for Main Crop

Encourage conservation tillage techniques which leave crop residues covering at least 30 percent of the soil surface at the time of seeding of the main crop. Refer to the Conservation Tillage and Crop Residue Management BMPs.

#### Perennial Cover (planted in orchards, vineyards, nurseries)

##### Seeding Methods

When establishing cover conventionally, prepare a fine, firm seedbed by the use of tillage and smoothing equipment. Provide a medium conducive to good seed germination and to minimize weed competition.

When establishing cover on slopes, consider using direct seeding equipment, and, if necessary, control weeds in accordance with a pest management plan.

When establishing cover after main crop is planted, use suitable equipment and seeding methods to avoid harming the main crop.

##### Soil Amendments

When using manure for crop establishment prior to planting main crop, incorporate during seedbed preparation in accordance with Plant Nutrient Management and Waste Utilization BMPs.

TABLE 1  
PLANTS AND LATEST SEEDING DATES FOR ESTABLISHING  
ADEQUATE ANNUAL COVER ON CROPLAND

Plant	Seeding Rates Pounds/Acre	Period Protected		
		Winter	Summer	Fall
Annual Ryegrass	25-35	Sept. 15	May 01	July 15
Field Bromegrass	10	Sept. 01	July 15	
Big Flower Vetch (Woodford)	30	Sept. 01		
Hairy Vetch	30	Sept. 01		
Wheat	120	Oct. 01		
Oats	96	Sept. 15	May 01	
Sudangrass	25-35			June 15
Buckwheat	50-75			July 15
Rye	See Table 1A			

TABLE 1A  
LATEST SEEDING DATES FOR ESTABLISHING  
RYE COVER

Seeding Rates/Acre		Seeding Dates*
Pounds	Bushels	
112	2	Up to September 30
168	3	September 30 to October 15
Not Effective		After October 15

\* When using non-certified rye, use rates as listed but move up planting date at least one week.

#### Plant Selection

Select plants (Table 2) to complement the objectives of the main crop, including erosion control or weed control.

TABLE 2  
PLANTS AND SEEDING DATES FOR ESTABLISHING  
PERENNIAL COVER

Plants	Seeding Rate		Main Crop
	Lbs/Acre	Seeding Dates	
Tall Fescue	10-15	Before May 1 or between Aug. 1 and Sept. 5	Orchard
Creeping Red Fescue	20	Before May 1 or between Aug. 1 and Sept. 5	Vineyard or Nursery
White Clover	5	Before May 1 or between Aug. 1 and Sept. 5	Vineyard or Nursery
Creeping Red Fescue	15		
Creeping Red Fescue	20	Before May 1 or between Aug. 1 and Sept. 5	Vineyard or Nursery
Perennial Ryegrass	5		
Kentucky Bluegrass	10	Before May 1 or between Aug. 1 and Sept. 5	Orchard
Creeping Red Fescue	15		

#### Management

To discourage rodent populations in orchards, mow the vegetation at least twice annually.

To reduce competition for moisture and nutrients in vineyards and nurseries, cultivate or, if necessary, chemically treat a strip alongside each row. Mow the aisles annually.

Green Manure Crop (used as part of a Plant Nutrient Management Plan.)

#### Seeding Methods

When establishing a crop conventionally, prepare a bare ground seedbed, with firm soil conducive to good seed germination and to minimizing weed competition.

When establishing a crop with use of no-till equipment, provide adequate weed control.

**Soil Amendments**

When using manure for crop establishment prior to planting main crop, incorporate during seedbed preparation in accordance with Plant Nutrient Management and Waste Utilization BMPs.

**Plant Selection**

Select plants based upon objectives for soil improvement or addition of nitrogen to the soil. Table #3 presents three of the most common crops.

**Management**

Unless the main crop is to be planted by direct seeding into the cover crop, plow or disc in the green manure crop just before planting the main crop, so as to minimize the time the soil is unprotected. Where direct seeding is used, refer to the Conservation Tillage and Pasture and Hayland Planting BMPs.

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TABLE 3  
PLANTS AND SEEDING DATES FOR GREEN MANURE CROPS

Plant	Seeding Rates Pounds/Acre	Seeding Dates
Red Clover	8-12	April to May 15 or Aug. 1 to Sept. 5
Millet	20-30	May 1 to June 30
Annual Ryegrass	20-25	April 1 to May 30 or Aug. 1 to Sept. 5

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## Crop Residue Management

### Definition

Managing plant residues to protect cropped fields from erosion. "Amount planned" in schedule of implementation measured in number of acres.

### Purpose

To conserve soil moisture, increase infiltration, reduce soil loss, and improve soil tilth with increased organic matter.

### Where Used

On lands where adequate crop residues are produced.

### Water Quality Impacts

This practice improves surface water quality by reducing surface water runoff and the associated transport of nutrients, sediments, and pesticides. Because it increases the content of organic matter in the soil, this practice may also slow the movement of nutrients and pesticides from the soil surface to ground water, as both nutrients and pesticides are tightly bound by organic matter. However, it is important to conduct this practice together with the Plant Nutrient Management and Pest and Pesticide Management BMPs.

### Planning Considerations

Evenly distribute plant residues for greatest reduction of erosion and ease of farming. If water erosion is a serious threat, more residue on the surface is beneficial. If wind erosion or plant damage from wind is a serious threat, residue left standing or anchored at the surface is most beneficial.

### Specifications

#### What is Crop Residue?

Crop residue is the remains of previous crop plants after harvest or termination. Residues are frequently left in the field to supply organic matter to the soil and help cover the soil surface, which reduces erosion.

Crop residue protects the soil from erosion by reducing raindrop impact and reducing runoff velocities. The percentage of crop residue cover on the field determines the degree of soil loss reduction. This practice provides effective erosion control when crop residues cover more than 30 percent of the soil surface after tillage but before emergence of the new crop.

### Residue Amounts

Crop residue shall be left on the soil surface after harvest. A 30 percent cover at the time of planting is considered necessary to control erosion to acceptable levels. At least a 65 percent combined residue cover is necessary before tillage to leave a 30 percent residue cover after tillage (see "Time and Manner of Incorporating Crop Residues into the Soil," below, and also conservation tillage BMP).

Residues from potatoes, other vegetables and corn for silage are not adequate for erosion control. Protect these fields with cover crops or mulching. Small grains and corn for grain generally produce adequate residues from the straw and stover.

### Methods for Managing Crop Residues

Management of crop residues shall be done so as to protect the soil surface during critical erosion periods.

#### Silage Corn

Follow the Cover and Green Manure Crop BMP for establishment into silage corn or after corn harvest.

In the springtime, prior to planting silage corn, use one of the following methods to inactivate the cover crop:

1. For maximum residues, kill the cover crop using an approved herbicide and plant with a no-till corn planter.
2. When using tillage equipment, use only a light disk no more than twice over the field, or a straight shank chisel to perform the least soil and residue disturbance while still preparing an adequate seedbed.

#### Grain Crops

Shred, disc, or chisel the stalks or straw as soon after harvest as is practical.

#### Small Grain Nurse Crop

Chop and evenly distribute or, if stubble alone provides at least 30 percent cover, remove straw as soon after harvest as is practical to prevent damage to new seedlings. Ignore new seedling canopy when estimating mulch cover amounts.

#### Small Grain Followed by Summer Seeding

Leave four to eight inches of standing grain stubble after combining. Distribute or remove surplus straw to leave at least 30 percent cover until preparing land for the next crop. When using tillage equipment after grain harvest, use only a light disc or straight shank chisel to perform the least soil and residue disturbance.

Time and Manner of Incorporating Crop Residues into the Soil

Incorporation of residues reduces mulch cover. The amount of residue which remains varies with the tillage equipment used and the residue cover on the ground before incorporation. Use of a heavy disc on a sod crop with 100 percent cover could leave the minimum 30 percent residue on the soil surface. Yet light disking on a rye cover crop of only 40 percent cover would leave 28 percent, or less than the minimum 30 percent residue on the soil surface (see Table 1). Use the fewest operations practical to meet the tillage needs yet maintain an adequate residue during critical erosion periods up to time of planting the next crop.

Refer to the Conservation Tillage BMP for guidance on tillage operations which leave a relatively large portion of the crop residue on the soil surface. If standard tillage is needed, do it as close to the planting date as possible, to minimize the amount of time when the soil surface is inadequately covered by crop residue.

Overwinter losses from fall harvested crop stubble must be taken into account to assure that minimum residues are maintained during the following planting season.

Unacceptable Practices

Removal of crop residue by burning, grazing, or harvesting for silage (see Cover Crop BMP).

Any tillage operation or combination of tillage operations which reduce the residues below the acceptable minimum during critical erosion periods.

Moldboard plowing during critical erosion periods or fall plowing without establishing a cover crop.

Wildlife Considerations

For wildlife, leave crop residues to provide food and cover.

TABLE 1  
PERCENT OF EXISTING RESIDUES REMAINING AFTER TILLAGE OPERATIONS

Tillage Operation	Percent of Existing Residues Remaining
Fluted Coulter (No-Till)	90
V-Sweep Plow	90
Light Disc	70
Chisel Plow (Straight Shank)	65
Coultered Chisel (Twisted Shank)	40
Heavy Disc	30
Moldboard Plow	10



## **Crop Rotation** (Grasses and Legumes in Rotation)

### **Definition**

Crop rotation is the successive planting of different crops in the same field. Rotations are the opposite of continuous cropping, which involves successively planting the same crop in the same field. "Amount planned" in schedule of implementation measured in number of acres.

### **Purpose**

The primary purpose of establishing a crop rotation on a field is crop diversification. The advantages of diversification can include reduction of soil erosion, improved soil fertility or tilth, increased yields as a result of rotational effects, reduced need for nitrogen fertilizer (in cases using legumes in crop rotations), and elimination or reduction of certain diseases or pests, which may result in reduced need for pesticide applications.

### **Where Used**

On all land where agricultural crops are grown.

### **Water Quality Impacts**

Crop rotations which include small grain and/or grass legume crops can minimize the risk of soil erosion, sediment loss, and losses of dissolved- and sediment-adsorbed nutrients and pesticides to surface water.

Nitrogen losses to ground water can be reduced by deep-rooted sod crops which may use nutrients from deep in the soil profile. In the process, these plants may bring the nutrients to the surface, making them available to a subsequent shallow-rooted crop if crop residue is not removed. In addition, leguminous sod crops fix atmospheric nitrogen which can reduce level of fertilizer inputs needed by subsequent row crops. Crop rotations also tend to encourage healthy root systems which are effective at retrieving nutrients from the soil, thus minimizing leaching to ground water.

Crop rotations can disrupt the build-up of insect populations and disease life cycles, and to a certain extent weeds. Thus, a diverse cropping system can reduce the need to apply chemical pesticides and so reduce the risk of ground water contamination by pesticides. In addition, increases in soil organic matter increase the adsorptive capacity of the soil, which can reduce the pesticide soil leaching potential.

Crop diversification can be accomplished for a number of cropping situations but is most beneficial when used in row crop systems.

Rotations may range between 5 and 10 years (sometimes more) in length and generally involve planting a row crop such as field corn or tobacco, followed by a hay crop such as a grass, grass and legume mixture, a straight legume seeding (usually alfalfa), or a small grain crop such as oats, barley, wheat, or rye. Vegetable or small fruit crops are usually planted in rotation with different crops in sequence or with annual grasses or small grain crops such as rye or oats as cover crops.

A number of factors affect what type of crop rotation will be most environmentally beneficial for each agricultural operation:

1. Consider the problems to be addressed:
  - a. Erosion from row crops can be reduced by rotations of hay and forage crops or small grains, especially when combined with conservation tillage, cover cropping, and residue management.
  - b. Pest problems can be forestalled or controlled by changes in crop types. Refer to IPM and CES recommendations for specific suggestions on crop rotations to control pests. In rare cases, certain pest problems may be exacerbated by rotation to alternate crops which fit into an insect's life cycle. Crop rotations can help control pests cost effectively for vegetables, small fruit, and tobacco growers, as well as producers of silage and grain.
2. Consider associated benefits of crop rotation and diversification, which can include increased soil fertility and organic matter, improved soil structure, and improved crop yields.
3. Determine length and complexity of rotational cycle. Rotational cycles can range from a simple 2 year rotation of two crops such as vegetable and small grain to multi-year rotations involving several different crop types. The type of cycle chosen will depend on the major crops produced and the objective of crop rotation, as well as the land available.
4. Consider nitrogen added by leguminous crops when developing a nutrient management plan.
5. Integrate crop rotation with other best management practices such as stripcropping and integrated pest management (IPM).
6. Consider the resource concerns or problem areas and benefits desired. Rotations designed for control of soil erosion may differ from rotations planned as components of pesticide management and/or nutrient management plans. Hay and forage crops or closely sown grain crops, such as cereal rye, winter wheat, or oats are commonly used to provide erosion control benefits in rotations with row crops. Other economic and environmental benefits, collectively referred to as the rotational effect, are inherent to all rotations; some depend on the crops planted and the length of the

rotation while others depend on the types of tillage, cultivation, fertilization, and pest control practices used in the rotation. Rotational effect benefits include increased soil organic matter, improved crop yields, increased availability of nutrients, and most importantly pest and disease control benefits. It should be noted that when rotations involve hay crops, on-farm livestock or a local hay market are generally required to make the hay crop profitable.

7. Plan tillage practices to maximize erosion control when row crops are planted in rotations. Conservation tillage, contour farming, or contour stripcropping are practices that can provide erosion control benefits when annual row crops are planted.
8. Integrate crop rotation sequences with other practices being planned such as nutrient management, or pesticide management.
9. Consider other erosion control practices being planned. For example, on highly erodible fields or on fields where soil erosion is a concern, the practice of contour strip cropping row crops with a hay crop is a common practice to reduce erosion rates. Planning rotations within row crop strips or rotating sod strips with row crop strips may be required to meet both erosion control and water quality concerns.

#### **Specifications**

The SCS Field Office Technical Guide Section I-C contains specifications for planning crop rotations to achieve soil erosion objectives.

The Cooperative Extension System publishes Grower IPM (integrated pest management) Guides, manuals, and fact sheets and nutrient management guides which contain information and recommendation on the use of rotations to control pest infestations. See the Pest and Pesticide Management BMP and the Plant Nutrient Management BMP for specific information and references.

#### **References**

Alternative agriculture / Committee on the Role of Alternative Farming Methods in Modern Production Agriculture, Board on Agriculture, National Research Council, 1989.



## Dead Poultry Composting Facility

### Definition

A facility for the composting of the normal daily accumulation of dead birds from a poultry operation. "Amount planned" in schedule of implementation measured in number of units.

### Scope

This standard establishes the requirements for design, construction, operation and maintenance of a composting facility for normal daily accumulation of dead birds. It does not apply to a facility with the capacity to accommodate catastrophic losses associated with epidemics, excessively high temperatures, collapse of buildings, etc., or poultry processing wastes. In case of a catastrophic event, contact the DEP Bureau of Water Management.

### Purpose

To biologically treat poultry carcasses by composting and to protect the environment by stabilizing nutrients, destroying pathogens, and producing an odorless, humus-like material which is useful as a fertilizer substitute and a soil amendment.

### Where Used

This practice applies where: 1) composting is needed to treat and manage chicken carcasses; 2) adequate area is available for installation of a facility; 3) a facility can be located to minimize an environmental threat to water resources; 4) sufficient cropland is available for proper compost utilization; 5) state and local laws allow composting of poultry carcasses; and 6) an approved animal waste management system plan has been developed.

### Water Quality Impacts

Properly conducted composting of dead poultry destroys pathogens and viruses and stabilizes nutrients in the compost waste mix (carcasses, manure, straw) so potential leaching of contaminants to ground water is minimized. Because it is relatively stable, compost used from a facility is less likely to leach nutrients to ground water or contaminate surface water runoff. Composting of dead birds should be conducted according to criteria in this BMP to avoid degradation of ground water or surface water.

### Planning Considerations

#### Location

In locating dead poultry composting facilities, consideration needs to be given to each of the following:

## Dead Poultry Composting Facility - 1993

1. **On-farm traffic patterns and the location of application sites(s):** Locate the composting facility in a convenient area close to the source of dead birds and manure to minimize labor and reduce handling.
2. **Wind direction and odors:** Improperly managed compost facilities may generate offensive odors. Locate a composting facility where prevailing winds will not carry odors towards neighboring residences. Buffer areas of vegetation and/or other natural landscape features can help minimize affects of odors.
3. **Topography and drainage:** Avoid locating composting facilities on slopes greater than four percent or in drainageways, floodplains, or areas of high water table or low areas that concentrate surface runoff. Consider need to divert or exclude runoff or floodwater.
4. **Wells:** When possible, locate the composting facility down-gradient and at minimum separating distances from private or public wells (see Design Criteria).
5. **Foundation materials and soils:** Locate the compost facility on stable foundation materials. Consider the need for an impervious facility based over highly permeable soil (see Design Criteria).

### Sizing

In sizing composting facilities, in addition to obvious volume sizing for number and weight of dead birds, consideration needs to be given to each of the following:

1. **Equipment:** Determination of composting facility dimensions should consider the size of existing and future loading, mixing, and hauling equipment.
2. **Future operation size:** Landowner's current and future production objectives should be assessed when sizing the compost facility.

### Operation

Consideration needs to be given to the following operational aspects of the composting facility:

1. **Management:** Composting operations require close management. Management capabilities of the operator and availability of labor should be assessed.
2. **Carbon Source:** A dependable and economic source of carbonaceous material must be available for use as a compost mix amendment. This material should have a carbon nitrogen ratio greater than 30:1. Wood chips, bark, sawdust, straw, and leaves are examples of carbon sources.
3. **Bulking Materials:** A dependable and economic source of bulking materials may be needed. Bulking agents provide structure and porosity to the compost mix and may

also be a source of carbon. Wood chips, straw, leaves, and bark can be used as bulking agents.

4. **Equipment:** Equipment should be available for initial mixing, turning, and hauling composted material and carbonaceous material. Long stem thermometers should be available for measuring the temperature of the composting material.

#### Economics

Consideration needs to be given to the following economic factors:

1. **Utilization:** Economic benefit of using the composted material as a soil amendment to improve soil tilth, or possibly processing the compost for sale, needs analysis.
2. **Capital and operating costs:** The cost of installing and managing the compost facility, including hauling, mixing, turning, monitoring, and equipment costs, should be evaluated. A composter may cost \$3,000 - \$5,000 including a concrete base pad. Commercially made composting cribs are available. When deciding whether to buy or build a composting unit, the operator should consider whether seller will install the unit and provide operator assistance, in addition to considering the cost of the facility.

#### Environmental Effects

Composting of dead birds with manure offers the following environmental advantages:

Decreased nitrate leaching and volatilization resulting from the land application of compost versus raw manure.

Decreased odor resulting from the application of dead bird compost versus raw manure and improper disposal of dead birds.

Reduced pathogens in surface runoff resulting from the application of compost versus raw manure and improper disposal of dead birds.

#### **Design Criteria**

The design and operation of a dead poultry composting facility shall comply with any federal, state, and local laws, rules, and regulations. The poultry producer is responsible for securing approval from the Connecticut Department of Agriculture and the Connecticut Department of Environmental Protection for the composting facility.

#### Rainfall and Runoff Exclusions

The composting facility shall be roofed and guttered to exclude rain water and roof runoff from the compost mixture. Surface water runoff shall be diverted away from the compost facility. The compost facility should be located to prevent inundation from a 25-year

frequency flood event. In the event that this is not feasible, the facility shall be provided with clear access and protected from a 25-year frequency flood event.

Volume and Size

The dead bird composting facility shall be designed as a two-stage unit. The primary stage or digester shall be contained in separate bin(s). The secondary stage or digester may consist of separate bins or it may be one bin of the size equivalent to the sum of the individual bins. The volume of each stage in the composting unit shall be based on the mortality rate during the end of the life cycle. Each stage of the composting unit shall provide, at a minimum, a volume equal to the following:

$$\text{Vol} = B \times (M/T) \times \text{WB} \times 2.5/100$$

- Where:
- Vol = Volume in cubic feet for each stage
  - B = Number of birds in poultry operation
  - M = Mortality expressed as a percent loss over the life of the flock
  - T = Flock life in days
  - WB = Average market weight of bird in pounds
  - 2.5 = Rule of thumb - Volume in cubic feet for each stage of composter per pound of dead bird at maturity. Units = Cu.ft./(lb./day)

The planned width across the front of a composting bin shall be sized to accommodate the loading and mixing equipment and shall be no less than five feet. The height of a composting bin shall be no greater than six feet and no less than one half the width. The distance from the front of a composting bin to the back shall be no less than half the width and should be no more than the width.

The number of bins in stage one is equal to the volume required divided by the planned volume of each bin.

$$\text{No. of Bins} = \frac{\text{Volume Required}}{\text{Volume of a Bin}}$$

The number of bins necessary shall be calculated to the nearest whole number. The second stage may consist of like bins or one bin or alley of equal or greater volume than stage one.

Materials and Structure Design

Materials and structural design of the composting facility shall conform to the Waste Storage Structure BMP. Normally the bins are constructed of treated wood and wire cloth, or other pre-fabricated materials.

A concrete pad should be installed if heavy equipment is used in the operation of the compost

facility.

If a concrete pad is not used, an impervious liner is required if the soil permeability is greater than six inches/hour.

#### Separation Distances

The following separation distances apply to compost facility sites: From neighboring residences and businesses - 250 feet, from property lines - 100 feet, from watercourses - 200 feet, above high water table or bedrock - 5 feet, from private wells - 200 feet, and from public wells - 500 feet.

#### **Operation and Maintenance**

##### Operation and Maintenance Plan

If the composting unit is purchased, the operator shall obtain written operation and maintenance instruction for the composting component of the waste management system from the seller. If the operator designed and built the composting unit, he or she should prepare an operation and maintenance plan. At a minimum, the instructions or plan should detail the mix(es) to be composted, moisture content and temperatures to be achieved, schedules for aerating/turning the material and the end use(s) of the finished compost.

##### Compost Mix

The loading or initial mixing operation shall follow Table 1 for composting of broilers or birds of like size. It should not be used for other sizes of birds or carbon sources.

The carbon to nitrogen ratio of the initial combination of dead birds, manure, carbon source and bulking agents should be within the range of 13 to 14:1 and shall be no greater than 30:1 and no less than 12:1.

The right amount of water is critical to the success of the composting process. Enough water should be added to ensure that the mixture is moist but not saturated. The moisture content of the compost mix should be maintained in the range of 45-55 percent by weight but shall not be less than 40 percent or greater than 60 percent.

The porosity of the initial compost mix shall be sufficient to maintain aerobic conditions throughout the compost process with minimal maintenance. This is normally accomplished by layering dead birds, manure and straw.

##### Loading the Primary Composter

The following is recommended:

1. One foot of dry manure should be placed on the floor of the bin to soak up excess moisture. This is not a part of the recipe in Table 1.

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2. A six inch layer of loose straw is placed on top of the manure to aid aeration under the carcasses.
3. A uniform layer of carcasses is added on top of the straw with six to eight inches of manure added next to the side walls to keep carcasses away from the sidewalls.
4. A minimum of four inches of manure is immediately added to cover the top of the carcasses.
5. Water is sprinkled uniformly on top of the manure as needed or prescribed to maintain minimum moisture content of 40%.
6. The second and each subsequent combination of straw, carcasses, and manure (batch) starts with a layer of straw, then a layer of carcasses and then a layer of manure added in proportion required in the prescribed mix. Water should be sprinkled on each batch as needed or prescribed.
7. When the loading of the primary composting bin is complete, add an additional four inch cap of manure to the top of the compost pile. The four inches is in addition to the manure that was added to the top of the last batch. This four inch cap of manure is not included in the Table 1 design mix. Figure 1 is an illustration of the recommended layering of dead bird composting.

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Table 1

Ingredient	Volumes (Parts)	Weights (Parts)
Straw	1.0	0.1
Dead birds	1.0	1.0
Manure	2.0	1.5
Water*	0.5	0.75

\* More or less water may be necessary depending on the moisture content of the straw and manure.

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Aeration

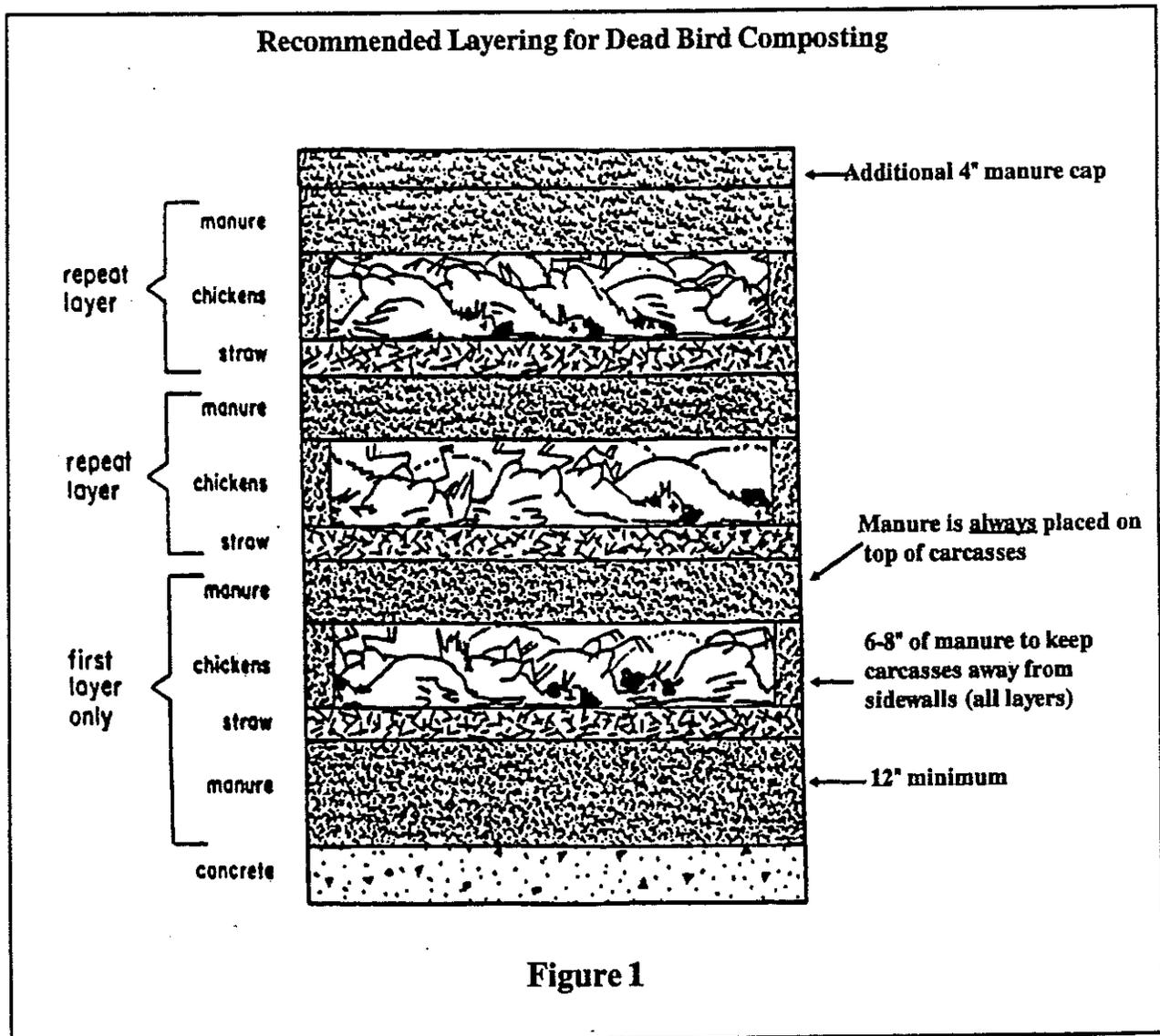
Aeration shall be provided during the composting process by unloading the first stage bins and loading the second stage bin(s), alley or pad. The contents of primary composter should be unloaded and transferred to the secondary composter as peak temperatures in the primary composter begin to decline, optimally at 10 days.

Temperature

Temperatures in the primary and secondary stages shall be monitored and recorded on a daily bases. A temperature probe of sufficient length and with protective covering should be used to monitor the internal compost temperature. If internal compost temperatures exceed 170°F, the following measures should be taken to reduce the temperature.

The compost should be removed from the bin, spread on the ground to a depth not to exceed six inches in an area away from buildings, and, if necessary, saturated with water to prevent spontaneous combustion.

FIGURE 1: Recommended Layering for Dead Bird Composting



Final Disposition

The final compost removed from the secondary composter after approximately 10 days is ready for land application or other use in accordance with Waste Utilization or Plant Nutrient Management BMPs. Best results will be achieved with storage or "resting" in a covered area for 30 days before land application. Storage depth shall not exceed seven feet to reduce the potential for spontaneous combustion. In addition, it shall not come into contact with any manure stored in the same facility.

Testing

The landowner/operator should, on a periodic basis, test the nutrient content of the finished compost and make any necessary adjustments in the operation's plant nutrient management plan.

Land Application

Any land application of the compost shall be in conformance with the Waste Utilization BMP and the Plant Nutrient Management BMP. It shall be documented in the Waste Management System Plan and/or Plant Nutrient Management Plan. If internal temperatures in the first and second stages of the compost process fail to achieve 130°F, the compost shall be incorporated during or immediately after land application or reused as a compost carbon source.

Inspection

At a minimum the compost facility shall be inspected at least twice yearly when the facility is empty. Replace any broken or badly worn wooden parts or hardware. Patch concrete floors and curbs as necessary to assure water tightness, and repair gutter and roof structures as needed.

**References**

Agricultural Waste Management Field Handbook, USDA, Soil Conservation Service, Revised 1991.

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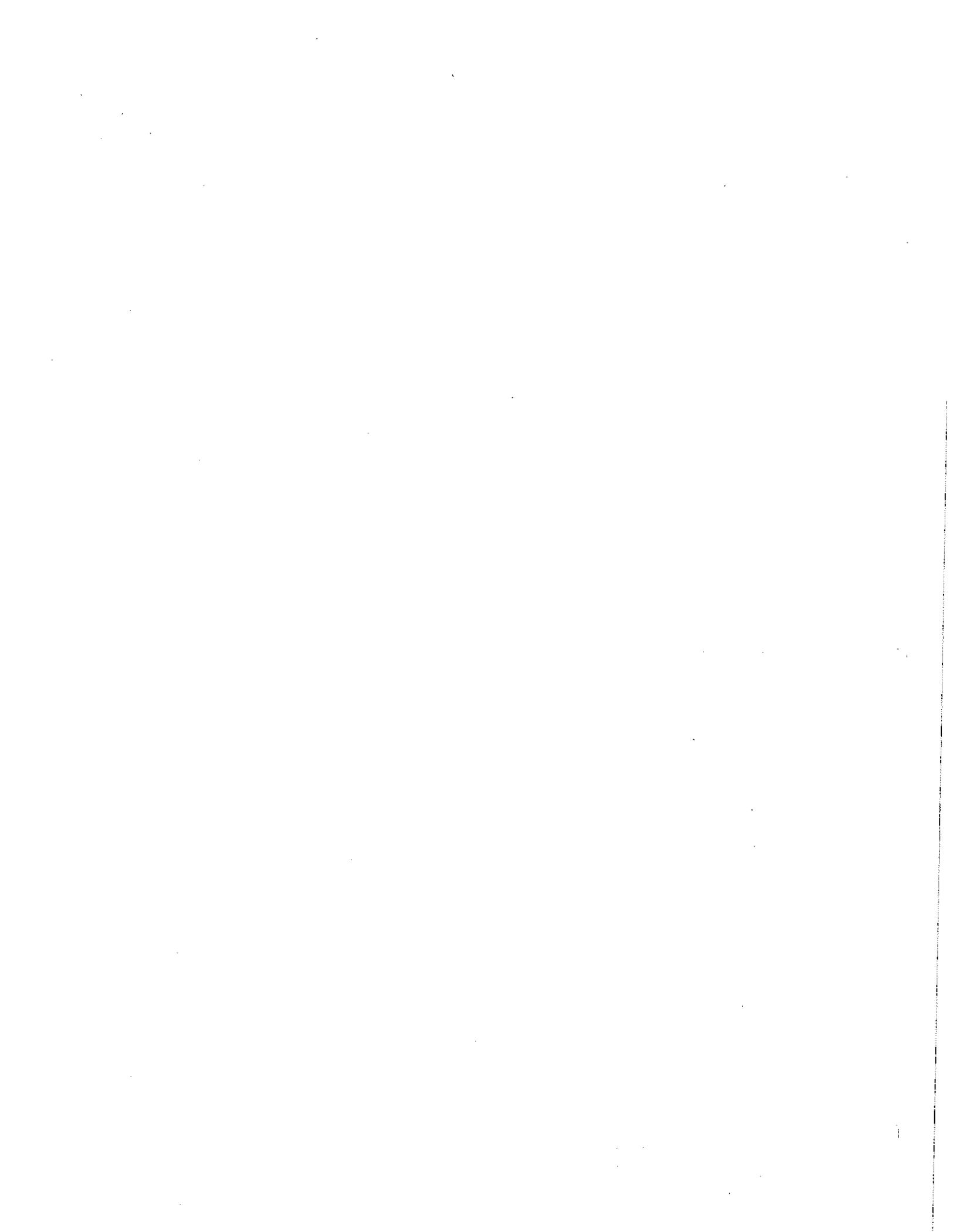
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Guide for Dead Poultry Composting, Virginia Engineering Note No. 1, USDA Soil Conservation Service, November 8, 1990.

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Northeast Interim Standard Dead Poultry Composting Facility, USDA Soil Conservation Service, March 1991.



## **Diversion**

### **Definition**

A drainageway constructed across a slope to divert surface runoff. "Amount planned" in schedule of implementation measured in number of feet.

### **Scope**

This standard applies to the installation of permanent diversions to protect cropland, barnyard, and other areas used for agricultural purposes.

### **Purpose**

The purpose of this practice is to divert water from areas where it is in excess to sites where it can be disposed of safely.

### **Where Used**

This practice applies in areas where the following conditions exist:

1. Runoff from higher lying areas may damage cropland or conservation practices such as terraces or stripcropping.
2. Surface and/or shallow subsurface flow caused by seepage is causing erosion.
3. Runoff is in excess and can be diverted and used on nearby sites.
4. Stormwater would otherwise flow through an area high in potential water pollutants, such as a barnyard or equipment maintenance area.
5. Proper implementation of another BMP such as contour farming or waste management calls for installation of a diversion.

Diversions shall not be substituted for terraces on land requiring terracing for erosion control.

Diversions shall not be used below high sediment producing areas unless land treatment practices or structural measures, designed to prevent damaging accumulations of sediment in the channel, are installed with or before the diversions.

### **Water Quality Impacts**

Diversions benefit surface water quality by 1) reducing sedimentation by breaking up slope length and reducing erosion; 2) diverting polluted runoff away from lakes and streams to

treatment facilities, including vegetated filter areas and sediment basins; and 3) diverting clean surface water runoff around pollution sources such as barnyards and equipment maintenance areas. Diversions which keep clean runoff away from polluted areas can also prevent those contaminants from leaching to ground water.

**Design Criteria**

Runoff capacity

Refer to SCS Engineering Field Manual Chapter 2 for calculating peak flows.

Capacity and Freeboard

The minimum capacity shall be that required to confine the peak runoff from the design storm plus required freeboard. The design storm and freeboard shall be as follows:

Diversion Type	Typical Area of Protection	Design Storm	
		Frequency (24-Hour)	Freeboard Required
Permanent	Agricultural Land, Ag Pollution Abatement System	10 years	0.3 feet

Velocity

The maximum permissible velocity ( $V_p$ ) for design flow will be determined by the soil texture and the type of vegetation expected and maintained in the channel. The following table will be used in selecting maximum permissible velocities:

VELOCITY TABLE

Soil Texture	Maximum Permissible Velocity ( $V_p$ ) in Ft./Sec.			
	Bare Channel	Density of Channel Vegetation <sup>1</sup>		
		Poor	Fair	Good
Sand, silt loam, sandy, loam, loamy sand, loam and muck (all Connecticut soils)	2.0	2.0	2.5	3.5

<sup>1</sup> The anticipated vegetative stand will be designated good, fair, or poor depending on the soil, seedbed preparation with fertilizer and lime, seeding mix and application rate, moisture, mulch applied, and maintenance.

The design velocities for bare channels shall be determined using an "n" value of 0.03. The design velocities for vegetated channels shall be determined using vegetative retardance factors. A poor vegetative stand of continuous low height allows the least retardance. Refer to SCS Engineering Field Manual Chapter 9 for design size based on velocity and vegetative retardance. The following table shall be used in selecting vegetative retardance factors which relate to capacity and stability respectively:

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RETARDANCE TABLE

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Maximum and minimum height  
of vegetation

Vegetative Retardance Factors

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Good (Dense) Stand

between 6" and 2" use	D & E
between 10" and 6" use	C & D
between 24" and 6" use	B & D

Fair or Poor (Sparse) Stand

between 10" and 2" use	D & E
between 24" and 10" use	C & D
between 30" and 10" use	B & D

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Cross Section

The channel shape shall be such that the diversion can be properly maintained with modern equipment. The channel may be parabolic, v-shaped, or trapezoidal.

The side slopes for permanent diversions shall not be steeper than 2:1 (horizontal to vertical) and preferably 4:1 for maintenance purposes. Where frequent crossings are expected, slopes should be flatter. The back slope of the berm ridge is not to be steeper than 2:1. The ridge shall include a settlement factor equal to at least five percent of the height. The minimum top width of the diversion ridge after settlement is to be 4.0 feet at the design water elevation.

The top of the constructed ridge shall not be lower at any point than the design elevation plus the specified overfill for settlement.

Location

Diversion location shall be determined by outlet conditions, topography, land use, cultural operations, soil type, and length of slope. Diversions shall be as parallel as possible to each other. In a cultivated field they must be aligned to permit use of modern farm equipment.

When diversions are used to reduce the length of slope, the maximum horizontal interval shall be determined using the universal soil loss equation (USLE). Refer to SCS Field Office Technical Guide.

#### Drainage

Subsurface drainage (see SCS Standard No. 606), or stone center lining (see SCS Standard No. 468) shall be provided for sites having a continuous low flow, high water table, or seepage problems. All areas shall be graded to provide drainage toward the diversion. Water-tolerant vegetation such as reed canarygrass may be an alternative on some wet sites.

#### Grade

Channel grade may be uniform or variable; uniform grades are normally better. The allowable velocity for soil type and vegetative cover will determine maximum grade. Level diversions with blocked ends may be used with adequate underground outlets.

#### Protection against sedimentation

If the movement of sediment into the channel during the planned life of a diversion is a significant problem:

1. Land treatment or structural measures should be installed to stabilize the source of sediment or trap the sediment.
2. If it is not possible to stabilize the source or trap the sediment, a vegetated filter area of close-growing grass shall be maintained above the diversion channel. The filter area width measured from the center of the channel shall be at least one-half the channel width plus 15 feet.

#### Outlet

Each diversion must have an adequate, stable outlet. The outlet may be a grassed, stone center or lined waterway; a vegetated or paved area; a grade stabilization structure; a stable watercourse; or an underground outlet.

In determining diversion outlets, consideration shall be given to the effects caused by changing natural watercourses and putting additional flow into a watercourse.

*The outlet, in all cases, must be stable for the design storm and convey runoff to a point where the runoff will not cause damage. Vegetative outlets needed must be established prior to diversion construction to ensure establishment of protective vegetative cover in the outlet channel.*

Underground outlets in combination with temporary flood storage must have the capacity to handle the design storm volume and provide the freeboard required. The release time shall not exceed 48 hours for the design storm. Shorter periods are necessary for some crops.

The design elevation of the water surface in the diversion shall not be lower than the design elevation of the water surface in the outlet when both are operating at design level.

### Vegetation

#### Permanent Cover:

It is necessary to seed and establish a vegetative cover on all graded portions of a diversion, except when a stone or other protective channel lining is used, or bare channel is planned. Vegetation shall extend from the downhill toe of the berm to the upslope side of the channel, plus any required vegetated filter area above. Vegetation shall be established in accordance with the SCS Critical Area Planting Standard No. 342, or Pasture and Hayland Planting BMP. Adjacent disturbed areas may be cropped. Where there is the possibility of triazine herbicides washing into the diversion, consideration should be given to a seeding of triazine resistant grasses. Additional guidance on this subject is provided in SCS Tech Note Plant Materials No. 6, dated March 23, 1981.

#### Seeding Time:

Schedule completion of construction early enough to allow seeding and establishment of a sufficient vegetative cover before fall and winter. More moisture is normally present with a spring seeding (April 15 - June 15).

#### Erosion Protection:

All diversions designed to have a permanent vegetative cover will be provided protection from erosion until the permanent vegetative cover is established. Follow guidance in the SCS Critical Area Planting Standard No. 342 and the Mulching BMP. On sites where there is the danger of the mulch being washed out, it shall be anchored by the peg and twine, mulch netting, or liquid mulch binder method of mulch anchoring.

### Maintenance

A maintenance program should be established to maintain diversion capacity, storage, ridge height, and the adequacy of the outlet. Diversion ridges can be hazardous for farming operations or mowing. Any hazards should be brought to the attention of the responsible person.

An Operation and Maintenance (O&M) plan shall be developed to maintain diversion capacity, vegetative cover, and the outlet. The following items should be considered when developing the O&M plan:

1. After the sod is well established, controlled grazing may be considered.
2. Avoid grazing when diversion is wet.
3. Avoid crossing with farm machinery when diversion is wet.

4. Mow at least annually to control weeds and encourage development of a dense sod.
5. Remove any heavy clumpy growth that could smother grass-legume stand.
6. Eroded areas should be reseeded or sodded promptly.
7. Fertilize as indicated by a soil test. If results are not available, make 4 applications of 10 lbs. of 10-20-20 fertilizer or equivalent per 1,000 ft.<sup>2</sup> to diversions during the second growing season.
8. Do not permit spraying with herbicides that kill grass.

### **Plans and Specifications**

Plans and specifications for installing diversions shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. Use SCS Engineering Design Drawing Sheet CT-RI Eng-7.

The following Connecticut - Rhode Island SCS Construction Specifications may be applicable: 1 - Clearing; 2 - Clearing and Grubbing; 21 - Excavation; 23 - Earthfill; 607A - Seeding; and 484 - Mulching.

### **Construction Concerns**

All ditches or gullies shall be filled, and trees and other obstructions shall be removed before construction begins or shall be part of the construction.

Topsoil shall be skimmed off and stockpiled for later respreading to facilitate revegetation.

The diversion shall be constructed to planned alignment, grade, and cross section. If underground conduits are located under diversion ridges, mechanical compaction, water packing, and installation and backfill of conduit trenches shall be made in advance to allow adequate settlement. The materials used for the inlet and conduit shall be suitable for the purpose intended and shall meet the requirements of the SCS Subsurface Drain Standard No. 606. Diversion ridges constructed across gullies or depressions shall be compacted by machinery travel or other means sufficient to insure proper functioning of the diversion. The surface of the finished diversion shall be a reasonably smooth seedbed.

## Forest Harvesting Erosion Control System

### Definition

Application of one or more erosion control measures on forest land during logging operations. An erosion control system may include the use of vegetation to hold the soil, cultural practices, and erosion control structures on disturbed forest land. "Amount planned" in schedule of implementation measured in number of acres.

### Purpose

To minimize erosion in woodlands and sedimentation of watercourses, resulting from disturbance of mineral soil by logging and other silvicultural activities.

### Where Used

Applies to forest and woodland areas which are harvested for wood.

### Water Quality Impacts

This practice benefits surface water quality by reducing erosion and sedimentation of watercourses from forest management practices, particularly logging. It should have little impact on ground water quality, because common ground water contaminants such as fertilizers, pesticides, petroleum substances, etc., are not generally used in forest lands. However, if regrowth does not occur on clear cut areas, nitrogen may be released to ground water over time.

### Planning Considerations

Prepare a comprehensive harvesting plan, which addresses amount of timber to be removed, trees to be left, and future of the stand, including plans for regeneration, if appropriate. Certified foresters can help prepare a forest management plan, and DEP district foresters and Cooperative Extension foresters can review and advise on forest management and harvesting plans. The harvesting plan should also provide for the following:

1. Minimize the area used for roads, trails, landing area, and stream crossings.
2. Locate and construct roads, trails, landing area, and stream crossings so as to minimize erosion and sedimentation.
3. Restore and replant disturbed areas after logging is over.

Secure local town Inland Wetland Commission permit when planning to cross wetlands or any streams before commencing any logging operation. Installation of large culverts or bridges to

## Forest Harvesting Erosion Control System - 1993

cross watercourses will require state and possibly federal government permits. Comply with all state and local ordinances and regulations.

Exercise care in use of petroleum products and their containers.

Refer to A Practical Guide for Protecting Water Quality While Harvesting Forest Products prepared by the Connecticut RC&D Forestry Committee, 1990. This publication is available from DEP's Forestry Division.

### Design Criteria

Plan access and processing areas to minimize the land used for roads and stream crossings:

Roads, trails, and log landings should be placed along the least steep areas and across the slopes wherever possible. Avoid placing near watercourses without adequate measures to divert surface runoff. Install erosion control measures whenever needed to reduce off-site problems.

If watercourse crossings cannot be avoided, keep them to a minimum and place them where the stream is narrow and streambanks are not too steep or high, in order to avoid erosion/sedimentation.

Ensure that vehicular traffic is prevented from travelling over riparian buffers used to protect nearby watercourses. The use of temporary fences or construction tape may be appropriate.

Restore disturbed areas such as landing areas and stream crossings sufficiently to prevent erosion and sedimentation:

Cut or chip slash into smallest practicable size to spread over the area and break down readily.

Grade and smooth out the disturbed areas enough to allow seeding with appropriate grasses/legumes. Ensure that topsoil and litter are evenly distributed.

Fertilize and lime areas to be reseeded according to soil test, and nutrient needs of grasses/legumes being planted. Refer to Critical Area Planting Standard no. 342 in SCS Field Office Technical Guide or RC&D Timber Harvesting and Water Quality in Connecticut (1990) guide book.

Use fertilizer sparingly or avoid use in areas next to watercourses.

### Specifications

#### Locating Haul Roads, Skid Trails, and Log Landings

Use soils, topographic, aerial, and conservation plan maps to assist in preliminary layout.

(Southern exposures are generally best.)

Avoid level ridge tops and wet floodplain soils where drainage is difficult to establish.

Locate log landings at least 200 feet from streams and on level to gently sloping and moderately well to well drained soils. Where appropriate, construct diversions to divert runoff coming from uplands.

Skid roads can be on grades up to 15 percent (short segments may reach 20 percent if necessary).

#### Riparian Buffer

Leave a forested riparian buffer at least 25 feet wide along watercourses, where no logging is allowed and where the forest floor shall not be disturbed. On slopes steeper than 1%, increase the width of the riparian buffer proportionately to at least 65 feet for 30% slopes and to a minimum of 150 feet for 70% slopes.

Within 100 feet of a watercourse, leave at least 50% canopy coverage (e.g. do not clearcut), do not install roads, trails, or landing areas, and take special care to prevent erosion.

#### Design and Construction of Roads, Trails, Landings, and Stream Crossings

Proper design and construction of roads, landings, and stream crossings is critical for preventing excessive erosion from logging operations. Refer to Timber Harvesting and Water Quality in Connecticut by Connecticut's RC&D Forestry Committee, 1990, and SCS technical guides for design information and construction specifications.

#### Seeding of Landing Area and Skid Trails after Logging is Done

Seeding should be done at the first good opportunity for establishment after harvesting. Follow specifications in the Critical Area Planting standard in the SCS Field Office Technical Guide concerning recommended timing and seed mix. Apply mulch to disturbed areas according to the mulching BMP if immediate reseeding is not recommended.

Where desired, leave slash in roads to act as a mulch and to deter vehicular traffic, e.g. all terrain vehicles.

Exclude livestock and/or wildlife from new seedings. If fencing is needed, refer to SCS fencing standard No. 382 in the Field Office Technical Guide for specifications.

#### **Operation and Maintenance**

Inspect logging operations at least weekly to ensure that contractors are following the harvesting plan.

## Forest Harvesting Erosion Control System - 1993

Reshape, if necessary, and reseed any waterbar areas that have not become established or have lost their cover.

Inspect riparian buffers for eroded areas. Fill, seed, and mulch when needed.

Maintain any fencing to ensure that the woodlands are protected from livestock.

Inspect roads, trails, and landings periodically for signs of damage from runoff. Repair where needed.

Maintain water control measures in good condition. Rebuild or repair when needed. Ensure that any culverts are free flowing and do not become clogged with debris or sediment.

### REFERENCES

Timber Harvesting and Water Quality in Connecticut - A Practical Guide for Protecting Water Quality While Harvesting Forest Products, by Connecticut RC&D Forestry Committee, 1990. (Contains practice specifications, seed mixtures, etc.)

Haussman, R.F., and Pruett, E.W., "Permanent Logging Road for Better Woodlot Management", 1973, USDA Forest Service, State and Private Forestry, Upper Darby, PA.

Hartung, R.D., and Kress, J.M., "Woodlands of the Northeast, Erosion and Sediment Control Guides", 1977, USDA, Soil Conservation Service, Northeast Technical Service Center, and Forest Service State and Private Forestry, Broomall, PA.

Critical Area Planting, Standard No. 342, SCS Field Office Technical Guide, Connecticut.

## Grassed Waterway and Outlet

### Definition

A natural or constructed channel or outlet, shaped or graded, and vegetated with a suitable grass/legume mix for the controlled disposal of runoff. "Amount planned" in schedule of implementation measured in number of acres.

### Scope

This standard applies to natural or constructed channels that are planted to grass and used for water disposal. Grassed waterways with stone centers are also included.

### Purpose

To provide a stable outlet for the disposal of excess surface water from diversions or natural concentrations without causing erosion or flooding, and to improve water quality.

### Where Used

On sites where additional runoff capacity, vegetative protection, or stone center lining is required to control erosion resulting from concentrated runoff, usually from diversions or terraces.

### Water Quality Impacts

The grass in the waterway slows runoff and filters out sediments, prevents erosion of the channel, and may remove nutrients and some pesticides. All these processes help maintain surface water quality. Grassed waterways have little impact on ground-water quality.

### Design Criteria

#### Capacity

The minimum capacity shall be that required to confine the peak runoff expected from a 10-year frequency, 24-hour duration storm. When the adjacent land slope is less than one percent, out-of-bank flow may be permitted where such flow will not cause erosion. The minimum capacity in such cases shall be the capacity required to remove water before crops are damaged. Refer to SCS Engineering Field Manual Chapter 2 for calculating peak flows.

#### Velocity

The maximum permissible velocity ( $V_1$ ) for the design flow will be determined by the soil texture and the type and density of grass/legume established. The following table will be used in selecting maximum permissible velocities.

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**VELOCITY TABLE**


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Maximum Permissible Velocity ( $V_D$ ) in Ft./Sec.

Soil Texture	Density of Channel Vegetation <sup>1</sup>			
	Poor	Fair	Good	Stone <sup>2</sup> Center
Sand, silt loam, sandy loam, loamy sand, loam and muck (all Connecticut soils)	2.0	2.5	3.5	8.0

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<sup>1</sup> The anticipated vegetative stand will be designated good, fair, or poor depending on the soil, seedbed preparation with fertilizer and lime, seeding mix and application rate, moisture, mulch applied, and maintenance.

<sup>2</sup> If design velocities exceed the maximum permissible velocities, use the SCS Lined Waterway or Outlet Standard No. 468.

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The design velocities shall be determined using vegetative retardance factors. A poor vegetative stand of continuous low height allows the least retardance. (See SCS Engineering Field Manual, Chapter 7 for design size based on velocity and vegetative retardance). The following table shall be used in selecting vegetative retardance factors which relate to capacity and stability respectively:

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**RETARDANCE TABLE**


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Maximum and minimum height of vegetation	Vegetative Retardance Factors
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Good (Dense) Stand

between 6" and 2" use	D & E
between 10" and 6" use	C & D
between 24" and 6" use	B & D

Fair or Poor (Sparse) Stand

between 10" and 2" use	D & E
between 24" and 10" use	C & D
between 30" and 10" use	B & D

---

### Dimensions

The dimensions of the waterway will be based on: 1) the amount of runoff to be handled, the channel slope, the permissible velocity, the vegetation; 2) ease of crossing and maintenance; and 3) site conditions such as water table or depth to bedrock.

The minimum top width of waterway will be 10 feet. The maximum design top width shall not exceed 100 feet. Consideration must be given to width and depth as it affects crossing by farm or maintenance equipment. Tables in Chapter 7 of the SCS Engineering Field Manual give alternative widths and depths for parabolic waterway.

The minimum depth of a waterway receiving water from diversions or other tributary channels shall be that required to keep the design water surface in the waterway at, or below, the design water surface in the tributary channel at their junction, when both are flowing at design depth.

### Drainage

Subsurface drainage (see SCS Standard No. 606), or stone center lining (see SCS Standard No. 468) shall be provided for sites having continuous low flow, a high water table, or seepage problems. All areas shall be graded to provide drainage toward the waterway. Water-tolerant vegetation such as reed canarygrass may be an alternative on some wet sites.

### Outlet

At a minimum, the outlet shall be able to carry the 2-year, 24-hour storm discharge. The outlet must also handle the waterway design flow without flood damage and must be stable for the 10-year, 24-hour storm discharge. (See Chapter 2 of the SCS Engineering Field Manual.)

### Vegetation

#### Permanent Cover

A permanent vegetative cover shall be established on grassed waterways in accordance with the Pasture and Hayland Planting BMP or the SCS Critical Area Planting Standard No. 342. Seed the finished, graded waterway so that dense vegetative growth is established before winter. All seedings will extend to at least the design top width. All disturbed areas that will not be cropped shall be seeded to permanent vegetation. Where triazine herbicides may wash into the waterway, seed triazine resistant grasses. Additional guidance on this subject is provided in SCS Technical Note Materials No. 6, dated March 23, 1981.

#### Seeding Time

Schedule completion of construction early enough to allow seeding and establishment of a sufficient vegetation cover before fall and winter. A spring seeding, between April 15 and June 15, is preferable, because of normally greater soil moisture, to a late summer seeding, between August 15 and September 15. A spring seeding allows for more establishment time before the fall.

### Erosion Protection

All waterways will be provided protection from erosion until the permanent vegetative cover is established. Follow guidance in the SCS Critical Area Planting Standard No. 342. During the dormant season the erosion protection shall be a mulch in accordance with the Mulching BMP. On sites where there is danger of the mulch being washed out, it shall be anchored by the peg and twine, mulch netting, or liquid mulch binders method of mulch anchoring.

Waterway vegetation should be well established before large flows are permitted in the channel.

### Plans and Specifications

Plans and specifications for installation of Grassed Waterways or Outlets shall be in keeping with this standard and shall describe the requirements for application of the practice to achieve its intended purpose. Use SCS Engineering Design Drawing Sheet CT-RI-ENG-8.

The following Connecticut SCS Construction Specifications may be applicable: 1 - Clearing, 2 - Clearing and Grubbing, 21 - Excavation, 23 - Earthfill, and 607A - Seeding.

### Construction Concerns

All ditches or gullies shall be filled, and trees and other obstructions shall be removed before construction begins or shall be part of the construction.

Topsoil shall be skimmed off and stockpiled for later respreading to facilitate revegetation.

The waterway shall be constructed to planned alignment, grade, and cross section.

If underground conduits are located under waterways, mechanical compaction, water packing, and installation and backfill or conduit trenches shall be made in advance to allow adequate settlement. The materials used for the inlet and conduit shall be suitable for the purpose intended and shall meet the requirements of the SCS Subsurface Drain Standard No. 606. Waterways constructed across gullies or depressions shall be compacted by machinery travel or other means sufficient to insure proper functioning of the waterway. The surface of the finished waterway shall be a reasonably smooth seedbed.

### Operation and Maintenance

A maintenance program shall be established to maintain waterway capacity, vegetative cover, and the outlet. Vegetation damaged by livestock, machinery, herbicides, or erosion must be restored promptly.

An Operation and Maintenance (O&M) plan shall be developed to maintain waterway capacity, vegetative cover, and the outlet. The following items should be considered when developing the O&M plan:

## Grassed Waterway and Outlet - 1993

1. After the sod is well established, controlled grazing may be considered.
2. Avoid grazing when waterway is wet.
3. Avoid crossing with farm machinery when waterway is wet.
4. Mow at least annually to control weeds and encourage development of a dense sod.
5. Remove any heavy clumpy growth that could smother grass-legume stand.
6. Eroded areas should be reseeded or sodded promptly.
7. Fertilize as indicated by a soil test. If results are not available, make 4 applications of 10 lbs. of 10-20-20 fertilizer per 1,000 ft.<sup>2</sup> to waterways during the second growing season.
8. Do not permit spraying with herbicides that kill grass.



## Heavy Use Area Protection

### Definition

Protecting heavily used areas from degradation by installing semi-impervious or hard impervious surfaces. "Amount planned" in schedule of implementation measured in number of acres.

### Purpose

To stabilize areas intensely used by livestock, vehicles, or equipment, and to allow for collection, management, and utilization of agricultural wastes.

### Where Used

On barnyard areas or other frequently and intensely used agricultural areas that require special treatment to protect them from erosion, trampling, rutting, or other deterioration.

### Water Quality Impacts

Areas subject to heavy use by livestock, equipment, or other farm operations may be vulnerable to erosion and may collect pollutants, which can be washed into surface waters or leached to ground water. Stabilizing these areas with a compacted gravel surface or hard impervious surface can prevent erosion and subsequent sedimentation of surface waters. If impervious surfaces are used and the runoff is treated, this practice may also prevent pollution of groundwater.

### Planning and Design Considerations

#### Drainage and Runoff

Direct clean runoff from surrounding areas, including any roof runoff, around the heavy use area (see Diversion BMP).

If necessary, control ground water with subsurface drainage in order to provide a stable foundation. (Refer to SCS Subsurface Drainage Standard No. 606.)

As necessary, provide treatment such as a vegetated filter area for contaminated runoff from the paved area in accordance with an agricultural waste management plan.

Exclude livestock from sensitive areas, such as wells and watercourses. See Riparian Buffer BMP. Construct fencing in accordance with SCS Standard #382 in the Field Office Technical Guide.

### Surface Treatment

For livestock areas, concrete or asphalt paving will be necessary if runoff is to be collected for treatment. Compacted gravel or other earth materials may otherwise be sufficient to stabilize the ground surface, for example in a horse paddock. Areas used heavily by vehicles and farm equipment may be stabilized by concrete, asphalt, or gravel, depending on support and resistance to traffic wear needed, and need to minimize a water quality risk.

The thickness of the asphalt course, the kind and size of aggregate, the type of proportioning of bituminous materials, and the mixing and placing of these materials shall be in accord with good highway practice for the expected loading.

The quality and thickness of concrete and the spacing and size of reinforcing steel shall be appropriate for the expected loading and in accord with the SCS Engineering Field Manual and related SCS information.

### Base Course

All areas to be paved shall have a six-inch base course of gravel, crushed stone, or other suitable materials. The soil material in place may be used if it is adequate.

Areas that support vehicle traffic shall be designed for a wheel load of at least 4,000 lbs.

### Structures

All structures related to the new surface (for example, a watering trough or fencing) shall be designed according to appropriate BMPs or SCS Standards and Specifications, and SCS Engineering Field Manual guidance.

### **Plans and Specifications**

Plans and specifications for heavy use area protection shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

## Irrigation Water Management

### Definition

Determining and controlling the rate, amount, and timing of irrigation water in a planned and efficient manner. "Amount planned" in schedule of implementation measured in number of acres.

### Purpose

To efficiently apply irrigation water to crops in a manner to conserve water, prevent soil erosion, and minimize leaching and runoff transport of nutrients and/or pesticides to ground water and surface water respectively.

### Where Used

This practice should be followed whenever irrigation is used to meet the moisture requirements of crops being grown.

### Water Quality Impacts

Improper irrigation can result in serious degradation of surface and ground water quality. Careful irrigation management can minimize leaching and reduce the potential for pesticide and nutrient contamination of ground water, and decrease runoff, erosion, and transport of nutrients and pesticides to surface water.

### Planning Considerations

The first step in planning an irrigation system is the development of a water budget and water balance for the crop to be irrigated. The Soil Conservation Service (SCS) and/or the Cooperative Extension System (CES) can provide assistance. Sources of water, various adaptable irrigation systems, and the economics of operation need to be considered.

An irrigation system may be portable, or it may be established on the land to be irrigated. System components may include wells, a storage reservoir, a conveyance system, a sprinkler or trickle application system, suitable pumps, and a recycle storage pond to capture irrigation water down slope of the operation. Refer to Standards and Specifications for these components in the SCS Field Office Technical Guide (FOTG), Chapter 15 in the Engineering Field Manual, and the Conservation Irrigation Guidelines for Massachusetts (SCS).

If fertilizers and/or pesticides are to be applied through irrigation systems (chemigation) consult with CES specialists for guidance. A chemigation system must be developed and operated with extreme care to prevent contamination of source water drawn from wells. Chemigation can allow nutrients and pesticides to be timed according to crop needs rather

than physical application constraints, but the ease of application may also lead to overuse. It is critical, therefore, that plant nutrients applied through chemigation only be used in accordance with an approved plant nutrient management plan. Likewise, pesticides applied through chemigation must only be used in accordance with an approved pest and pesticide management plan, which incorporates the principles of integrated pest management.

To minimize potential contamination of ground and surface water by irrigation consider the following:

1. Location of watercourses, wells, and wetlands relative to area irrigated, and need for vegetated separating distances. Vegetated separating distances between irrigated areas and wetlands should be at least 25 feet. On sloping land and next to sensitive or pristine wetlands, the separating distance should be increased.
2. Permeability of soils and leaching potential to ground water.
3. Runoff potential to transport nutrients or pesticides to surface waters.
4. Best management practices needed to control surface runoff, curtail erosion, and minimize leaching. Refer to the Plant Nutrient Management and Pest and Pesticide Management BMPs to determine nutrient and pesticide needs and application timing.
5. Use of an irrigation system such as trickle or drip irrigation, which allows the operator to precisely control the amount and timing of water delivery to the crop. A system which prevents excess delivery of water will minimize leaching of chemicals.

Consider water source quality (possible testing), capacity volume, and availability in late summer months.

### **Planning Criteria**

The irrigator shall have the knowledge and capability to manage and apply irrigation water in such a manner that the objectives mentioned under "Purpose" can be reasonably attained. The knowledge should include:

1. Knowledge and ability to develop and use water budgets and water balances for each crop grown.
2. How to adjust stream size, application rate, or irrigation time to compensate for changes in such factors as intake rate or the amount of water to be applied.
3. How to recognize erosion caused by irrigation.
4. How to estimate the amount of irrigation runoff from an area.
5. How to evaluate the uniformity of water application.

Install backflow prevention devices on all systems.

The operator needs to apply for and secure any local, state, or federal permits needed for a

storage reservoir before construction.

The operator needs to apply for and secure a state Water Diversion Permit for water withdrawals of more than 50,000 gallons during any 24-hour period, or for construction of any pond which will receive its water supply from a wetland or watercourse. The Division of Inland Water Resources in DEP's Bureau of Water Management is responsible for issuing diversion permits.

#### **Plans and Specifications**

An irrigation water management plan needs to be developed and shall be in keeping with the purpose and principles in this standard. Any permits as noted above, must be secured.

SCS will provide technical assistance on planning and designing components of an irrigation system.



## Milk House And Milk Parlor Wastewater Treatment

### Definition

A facility for collection, treatment, and disposal of wastewater generated in milk houses and milking parlors. The facility may consist of a settling/treatment tank, a distribution line, and a disposal/filter field or an impoundment made by excavation or earthfill. "Amount planned" in schedule of implementation measured in number of units.

### Scope

This standard establishes the minimum acceptable requirements for planning, design, construction, and operation of milking parlor and milk house wastewater treatment and disposal facilities. Wastewater is limited to that from washing tanks, pipelines, milking machines, miscellaneous equipment, wash water from parlor floors, and water for cow preparation. It does not include the manure excreted by the cows in the parlor, nor the other solids, which should be shoveled out of the parlor.

### Purpose

To physically and biologically treat and dispose of wastewater and minimize potential contamination of surface and ground water.

### Where Used

This practice applies where: 1) there is a discharge of milking parlor or milk house wastewater that threatens water quality; 2) an overall waste management system for the farm has been planned; 3) disposal and treatment of this wastewater is best accomplished with this practice.

### Water Quality Impacts

This practice reduces the risk of contamination of surface water by eliminating direct discharge of milk house and milk parlor wastewater. This type of wastewater treatment should not contaminate ground water, provided the criteria in this BMP are followed.

### Planning Considerations

Consider which method is best for managing milk house and milk parlor wastewater for the individual operation. A thorough review of the volume and strength of the wastewater is necessary.

Systems are designed for normal wastewaters; rejected loads of milk shall not be discharged into treatment systems. Sanitary wastewater flow shall be segregated from the system.

**Planning and Design Criteria: SUBSURFACE DISPOSAL**

Location

The wastewater filter disposal field shall not be sited in a floodplain inundated by a 10-year 24-hour-Type-III storm event or in a drainageway. It shall be located at least 75 feet away from private wells and 50 feet from watercourses and wetlands and shall conform to requirements for septic systems in the state health code and requirements in other applicable state and local regulations. Approval of the site, design, and installation of the treatment system must be obtained from the DEP Water Management Bureau. Where possible, the system should be sited where wastewater can be delivered to it by gravity flow, rather than by pumping.

Design Flows and Loads

Design flows and loading shall be determined using the SCS Agricultural Waste Management Field Manual, unless on-site data are available and proper safety factors are applied.

The subsurface field shall be designed and sized by the "Long Term Acceptance Rate" (Wastewater Engineering Design for Unsewered Areas", Dr. Rein Laak, Ann Arbor Science Publishers, Inc.) procedure and this area shall be multiplied by a strength factor to accommodate the agricultural waste loading.

$$\text{Strength Factor} = ((\text{BOD}_5 + \text{SS}) / 250)^{1/3}$$

BOD<sub>5</sub> (biochemical oxygen demand for five days) and SS (suspended solids) are in mg/l or PPM and are found in Chapter 4 of the SCS Agricultural Waste Management Field Manual.

Soils

Soil permeability rates shall be determined by the procedures established in DEP Bulletin #7, Hydraulic Analysis and Pollutant Renovation for Land Treatment Systems by Healey and May.

The bottom of the leaching system shall be at least two feet above seasonal high water table and four feet above bedrock, or as specified in the state health code.

Fat Separator and Settling Tanks

Two tanks in sequence at the head of the system are required to remove solids that either settle or float. The minimum tank size shall be 1,000 gallon capacity or the combined capacity of both tanks shall provide for five day detention time, whichever is greater. The outlet invert shall be 3" below the inlet invert of the tank. The inlet will be baffled to prevent flow short-circuiting through the tank. A water sealed trap and vent or similar device shall be provided on lines from enclosed buildings that discharge to the fat separator. The outlet of the tank shall be baffled to prevent settled or floating solids from being carried over into the outlet pipeline. The amount of total solids in the effluent from the settling tank is critical. Best guidance is that they should be less than 0.5%. The liquid storage depth shall be a

minimum of 3.0' deep to the outlet invert. A manhole riser to grade for access inspection and monitoring shall be provided for those tanks installed below ground.

#### Leaching Field

A subsurface leaching field can be a stone-filled leaching trench with piping or a leaching structure with stone. A manhole-type riser or capped observation pipe shall be installed to the ground surface to allow access for monitoring and inspection. If distribution is provided, access to the distribution box shall be provided.

#### **Operation and Maintenance**

A detailed, specific Operation and Management Program (O&MP) shall be prepared and followed and shall provide for the following.

All solids and waste shall be brushed and shoveled out of the milking parlor, floor, gutters, walkways, etc. before washing down. The amount of wash water used in washing the equipment floors, walls, etc. shall be kept to the amount for which the practice is designed.

The tank shall be inspected every three months and the solids cleaned out as needed. Special attention shall be paid to the floating solids (fat cake). These shall be removed from the tank when the fat cake becomes 6"-10" thick.

The material pumped out of the fat separator and settling tank shall be spread with the other manure or wastes or disposed of by other acceptable methods. If the tanks are pumped by a septage hauler, the pumper shall obtain all necessary local approvals and permits.

Inspect the subsurface field every three months for the first year. After a year of operation, the owner should arrange to have SCS personnel inspect the operation of the system annually. Vegetative cover over the field and tank area should be mowed to allow easy observation of the ground.

#### **Planning and Design Criteria: TREATMENT LAGOON**

##### Types

Waste treatment lagoons are of three general types - anaerobic, naturally aerobic, and mechanically aerated. *Anaerobic* lagoons are septic and will give off odors. *Naturally aerobic* lagoons are relatively odor free but require large surface areas per animal unit and may require aerating facilities at certain periods of the year in order to retain aerobic conditions. *Mechanically aerated* lagoons maintain aerobic conditions by the use of mechanical aerators. They have the advantage of requiring smaller surface areas than aerobic lagoons but require energy for aeration.

### Location

Waste storage structures shall be as close to the source of waste and polluted runoff as practicable. Due consideration shall be given to economics, the overall waste management plans, and health and safety factors. The structures shall be located where prevailing winds, vegetative screening, and building arrangement minimize odor and visual resource problems. They will be a minimum distance of 200 feet from a private well or spring and at least 500 feet from a public well. Distance from property lines and public roads will be 200 feet or comply with local planning, zoning, wetlands, and health regulations. Distance from an occupied building other than the owner's should be at least 300 feet. Waste storage structures shall not be located on floodplains unless they are protected from inundation or damage from a 100-year storm event. Where possible site outside an aquifer protection area, or as far from a well as possible.

### Soils and Foundation

Locate on soils that will maintain a working liquid level in the lagoon, or seal the structure by use of: 1) installing rigid linings (concrete, steel, wood, plastic, asphalt); 2) compacted in-place or imported soils; 3) bentonite; and 4) impermeable membranes, or a combination of the methods listed above. Construct structure at least two feet above seasonal high water table and at least four feet above bedrock. Drainage may be installed to lower the groundwater. An initial on-site soils investigation will be conducted for each site. Soil characteristics to a depth of at least four feet will be recorded.

### Solids Removal

To reduce sludge buildup, remove solids from wastes of animals, such as dairy cattle, fed high roughage rations. A solids trap or a separator may be provided between the waste sources and the lagoon. This may be a concrete structure that can be emptied periodically and maintained. A minimum of three days storage should be provided.

### Waste Production

Waste treatment lagoons are designed on the basis of five-day biochemical oxygen demand (BOD<sub>5</sub>) or volatile solids (VS) loading. Design loading shall be determined based on information provided in Chapter 4 of the SCS Agricultural Waste Management Field Manual. Reliable local determinations should be used if available.

### Naturally Aerobic Lagoon

Naturally aerobic lagoons are designed on the basis of daily BOD<sub>5</sub> loading per acre of lagoon surface. Allowable loading shall be as indicated in Figure 1 (see end of BMP).

### Depth

The minimum operating depth shall be two feet and the maximum operating depth shall be five feet. An additional one foot of freeboard shall be provided above the maximum operating depth.

Volume

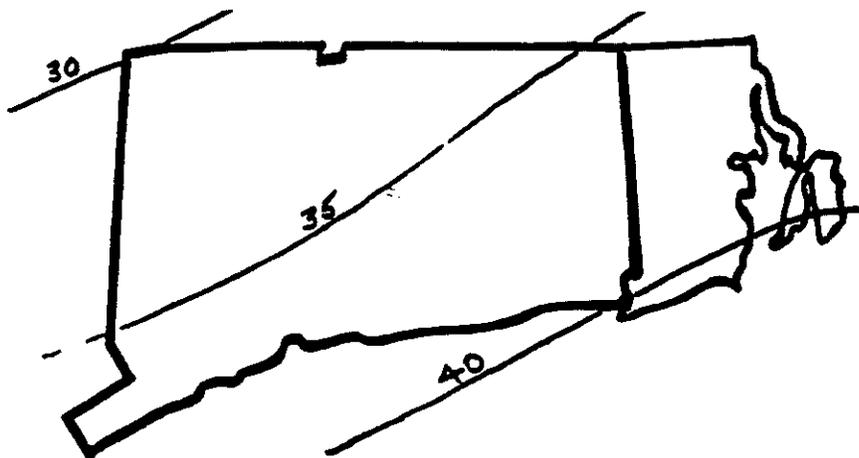
In addition to having the required surface area, naturally aerobic lagoons shall have between the minimum and maximum operating depths volume adequate to provide at least five months storage. This storage is the sum of the following:

1. Waste and wastewater accumulated between periods of drawdown.
2. Four inches per month of rainwater on the lagoon surface. (Normal rainfall for the period of storage.)
3. Five and one-half inches of rainwater on the lagoon surface (25-year, 24-hour storm).
4. Solids accumulation for the period between solids or sludge removal.

Evaporation from the lagoon surface may be considered in the design for the four-inch monthly rainfall using the procedures in the SCS Agricultural Waste Management Field Manual, Chapter 12, pink sheets.

The maximum operating level should be marked with an appropriate staff gage set in the lagoon or marked by other means to indicate when drawdown is needed. Normally the drawdown should be in October and April.

FIGURE 1: Aerobic lagoon loading rate (lbs. of BOD<sub>5</sub>/acre/day)



### Mechanically Aerated Lagoon Size

Mechanically aerated lagoons can be used for odor control or for treatment of wastes.

Mechanically aerated lagoons are designed on the basis of BOD - <sub>5</sub> or ultimate BOD loading and on the basis of the equipment manufacturer's performance data for oxygen transfer and mixing. If used for odor control, aeration equipment shall provide a minimum of one pound of oxygen for each one pound of BOD<sub>5</sub> contributed daily. For treatment refer to the design procedure provided in Chapter 12 of the Agricultural Waste Management Field Manual. A mechanically aerated lagoon requires about five percent of the surface area of a naturally aerobic lagoon.

The minimum operating depth shall be six feet. The maximum operating depth is dictated by site and equipment. A mechanically aerated lagoon shall meet the volume requirements of a naturally aerobic lagoon.

### Temperature

The temperature of lagoon waters affects the rate of biological activity. Lagoons operate best at temperatures of 70° to 130°F. Ice and snow cover on aerobic lagoons reduces sunlight penetration and associated algae growth necessary for providing oxygen. Under such conditions there is limited biological activity.

### Embankment Lagoons

For embankment lagoons, the earth embankment and foundation cutoff shall meet the earth embankment and foundation cutoff requirements in the SCS Pond Standard (378), Embankment Pond.

### Excavated Lagoons

For excavated lagoons the excavation shall meet the side slope requirement (not steeper than two horizontal to one vertical) and placement of excavated material requirements in the SCS Pond Standard (378), Excavated Pond.

### Bottom and Edges

The bottom of aerobic lagoons shall be approximately level. The edges of all lagoons below the planned water line shall be constructed as steep as soil conditions and safety permit to reduce areas of shallow water and to inhibit weed growth.

### Inlet

The inlet shall consist of a pipe with a minimum diameter of four inches and minimum slope of one percent. The inlet pipe should terminate a sufficient distance from the shoreline to assure good distribution. It should be far enough below the surface to avoid freezing or be provided with other protective measures. Access shall be provided to the pipe for rodding in case of blockage. A water-sealed trap and vent or similar device shall be provided on pipe lines from enclosed buildings that discharge into enclosed settling tanks or beneath the lagoon

surface to prevent gases from entering the building. Inlet lines shall be of materials that will not separate at the joints, that will be watertight, and that can withstand sunlight, weather, earth and traffic loading.

#### Outlet

Waste treatment lagoons shall not discharge directly to surface waters. Lagoons may overflow to a vegetated filter area or to another approved area as a diffuse nonpoint discharge.

The effluent from lagoons may be further treated by additional lagoons or held in holding ponds prior to final disposal. Final disposal shall be in accordance with a waste utilization and/or management plan and may be by liquid spreading systems, irrigation systems, or other land application measures.

#### Protection

If the location of the lagoon will create a safety hazard, the lagoon shall be fenced and warning signs posted to prevent children and others from using it for purposes other than intended.

#### Vegetation

All areas disturbed by construction of the lagoon shall be seeded in accordance with the SCS Critical Areas Planting Standard No. 342. Vegetative screens or other materials can be used to shield lagoons from public view.

#### Loading

The lagoon shall be filled with water to the minimum operating depth. The first loading should be gradual. Daily loading results in best operations.

#### Floating Material

Provisions shall be made to keep bedding materials, straw, grass clippings, oil and other floating material out of the lagoon, as such material may interfere with proper aeration.

#### **Operation and Maintenance**

A written operation and maintenance plan must be prepared. Such plan shall include:

1. Emptying frequency.
2. Disposal methods.
3. Periodic inspection and maintenance to include:
  - a. Annual mowing of grasses and weeds.

- b. Repair of dike erosion.
- c. Rodent control.
- d. Maintenance of safety fences, signs, etc.

### Plans and Specifications

Plans and specifications for installing subsurface treatment and disposal facilities or wastewater treatment lagoons shall be in keeping with this standard and shall describe the requirements and design quantities for applying the practice to achieve its intended purpose.

### Minimum Documentation

- 1. Overall waste management plan for the farm.
- 2. Location of wells, water supplies, and streams.
- 3. Site investigation (test pits, permeability samples).
- 4. Survey and design information.
- 5. Location and elevation of fat separator, settling tank, and leaching field or of treatment lagoon.
- 6. Elevation of Milk Parlor and/or Milk Room drain, etc.
- 7. Construction and Material specifications.
- 8. Operation and maintenance plan.
- 9. Layout, inspection, and construction notes.
- 10. As-built design drawing.

## Mulching

### Definition

Applying plant residues or other suitable materials to the soil surface. "Amount planned" in schedule of implementation measured in number of acres.

### Purpose

To conserve moisture; prevent surface compacting or crusting; reduce runoff and erosion; control weeds; and help establish plant cover.

### Where Used

On critically eroding and/or bare areas to allow vegetation to establish itself; to provide cover where vegetation is not possible or desired; or in association with certain row crop or nursery stock.

### Water Quality Impacts

Mulching benefits surface water quality by preventing erosion and sedimentation and promoting infiltration. Although infiltration may increase the movement of pesticides and nutrients to ground water, mulches can reduce the need for herbicides by suppressing weeds, thereby lessening potential ground water contamination. They also introduce organic matter into the soil, which helps retain nutrients and pesticides in the root zone longer, where they are subject to uptake by plants and biodegradation.

### Planning Considerations

On areas subject to critical erosion, consider installation of all necessary erosion control measures within areas to be mulched.

Provide adequate surface and/or subsurface drainage where needed to prevent soil wash or slippage.

### Design Criteria

Refer to Table 1: Guide to Mulch Materials.

Determine specific use for the mulch material selected - whether for erosion control, seedbed protection, plant moisture conservation, or weed control. Refer to Remarks column in Table 1.

Determine whether desired effect is for temporary or permanent use.

Evaluate kinds and quality of materials available, relative cost, and logistics of transporting and spreading onto the site.

Consider durability and biodegradation of mulch and need for anchor material. If mulch anchor materials are needed, refer to Mulching Standard in the Connecticut Guidelines for Soil Erosion and Sediment Control.

Ensure that any selected mulch material is evenly distributed on an area to provide adequate protection.

#### **Operation and Maintenance**

Monitor the site periodically to ensure that adequate cover is maintained. Provide additional mulch coverage or tiedown protection when required.

Re-establish protective cover on any areas that have sustained damage from washouts, or other events.

Provide for removal and disposal of non-biodegradable mulch like plastic netting, or other material, once vegetation is established.

#### **Supporting Data and Documentation for Practice**

1. Kinds of material used.
2. Application rate.
3. Anchoring method used, if applicable, and compatibility with mulching material.

TABLE 1. GUIDE TO MULCH MATERIALS

Mulch Material	Quality Standards	Per 1000 Sq. Ft.	Application Rates		Remarks
			Per Acre		
Hay or Straw	Air-dried; free of undesirable seeds and coarse materials	70-90 lbs. or 2 bales	1.5-2.0 tons or 90-100 bales		Use straw where mulch effect is to be maintained for more than 3 months. Subject to wind blowing, unless kept moist or tied down. Good for critical area erosion control. Spread uniformly, leave 10-20% of ground exposed. Excellent for seedbed protection until vegetation is established.
Cornstalks, Shredded or Chopped	Air-dried, shredded into 8" to 12" lengths	150-300 lbs.	4-6 tons		Effective for erosion control, relatively slow to decompose. Excellent for mulch on crop field. Some value as a cover crop. Resistant to wind blowing.
Compost or Manure	Well shredded, free of excessive coarse material	400-600 lbs.	8-10 tons		Use strawy manure where erosion control is needed. May create problem with weeds. Excellent moisture conservation. Resistant to wind blowing. Avoid using close to streams or water courses. Consider nutrient content of compost or manure.
Wood Chips or Shavings	Green or air-dried. Free of objectionable coarse materials	480-520 lbs.	10-20 tons		Spread uniformly about 4 inches deep. Often used alone. Protect from mashing on steep slopes. Excellent mulch around trees and shrubs; add small amounts of 10-10-10 fertilizer to stimulate growth. Potential termite problem adjacent to wood structures.
Wood Excelsior	Green or air-dried burred wood fibers .024" x .031" x 4"	90 lbs. (1 bale)	2 tons		Effective for erosion control. Tie down usually not required. Decomposes slowly. Subject to some wind blowing. Packaged in 80-90 lb. bales. Extra nitrogen fertilizer may be required.

continued on next page

TABLE 1. GUIDE TO MULCH MATERIALS (Continued)

Mulch Material	Quality Standards	Application Rates		Remarks
		Per 1000 Sq. Ft.	Per Acre	
Sawdust, Green or Composted	Free from objectionable coarse material	83 cu. ft. for each 1" depth	--	Effective as a mulch around ornamentals, small fruits, and other nursery stock. Special application rates: fruit trees 5-7"; blueberries 6"; vegetables and flowers 2-3"; blackberries and raspberries 4-7"; strawberries 3". Resistant to wind blowing. Requires 30-35 lbs nitrogen per ton to prevent N deficiency while decaying. One cu. ft. weighs 12-24 lbs.
Gravel or Crushed Stone	Washed Sized 3B or 3A	9 cu. yds.	--	Excellent permanent mulch often used alone for short slopes or around woody plants and ornamentals. Use 2B where subject to foot traffic.
Plastic	2-4 mils	Rolls vary up to 50 feet wide		Use black for weed control; use clear for seeding establishment without organic mulch. Remove plastic after seeding is established. Consider possible reuse. Effective moisture conservation and weed control for small fruits.
Autumn Leaves	Free of plastic bags and other objectionable wastes	550 to 640 lbs.  1100 to 1280 lbs	12 to 14 dry tons  24 to 28 dry tons	Useful for temporary erosion control during periods poor for seeding, such as fall or winter. Spread uniformly 3" deep. Increases organic matter content and water retention after incorporation into soil. Slow to break down. Shredding speeds decomposition and reduces tendency to blow away or mat. Extra manure or nitrogen may be needed to offset nitrogen demands of decomposition. If farmer accepts leaves from off-farm, he or she should contact DEP. Quantities are reportable under recycling law.  Spread uniformly 6" deep for long term weed control. See comments above. Tannic acids may be toxic to some plants. If farmer accepts leaves from off-farm, he or she should contact DEP. Quantities are reportable under recycling law.

NOTE: A number of manufactured mulches are available. Refer to the Mulching Standard in the Connecticut Guidelines for Erosion and Sediment Control.

## Pasture And Hayland Management

### Definition

Proper treatment and use of pasture or hayland. "Amount planned" in schedule of implementation measured in number of acres.

### Purpose

To prolong life of desirable forage species, to maintain or improve the quality and quantity of forage, to protect soil and watercourses, conserve water, and optimize the use of fertilizers and pesticides so to minimize adverse effects on ground water and surface water.

### Where Used

On all pasture and hayland.

### Water Quality Impacts

Properly managed pasture and hayland pose very low threats to surface water, as the field is completely covered by vegetation year round, and so is very resistant to erosion. When a pasture is overgrazed or poorly maintained, erosion may result. This practice is designed to keep pasture and hayland productive and in good condition, without excess application of nutrients or pesticides that could threaten ground water quality.

### Planning Considerations

#### Pasture Management

High quality pastures grow rapidly and contain both grasses and legumes. Good pasture management seeks to retain both types of forages. As a guide, one acre of improved pasture can support one cow (1000 lb. animal unit) annually.

Rotational grazing of short duration, such as the "Voisin" method, provides a rest period for regrowth of grasses and legumes, and so prevents overgrazing, and prolongs the grazing season. Detailed information on the Voisin grazing management system is found in SCS Technical Note Agronomy No. 26.

### Specifications

#### Soil Testing

An annual soil testing program is a key to quality management of pastures and hayland. Soil tests should be carried out at least every three years.

### Lime

Apply lime according to periodic soil tests to maintain pH between 6.0 and 6.5 or apply two tons of ground limestone per acre every third year.

### Fertilization

Apply manure and any additional nutrients according to recommendations in the Plant Nutrient Management BMP and periodic soil tests. The timing of manure applications should be in accordance with the Waste Utilization BMP. Manure applied should be well flailed and uniformly distributed. Droppings should be harrowed or dragged to scatter.

### Weed and Brush Control

Mowing pastures prior to seed formation will reduce weed invasions. Herbicides may be required to kill some weeds. Identify weed species and apply herbicides according to a plan developed using the guidance in the Pest and Pesticide Management BMP. Observe labeled grazing limitations if herbicides are used. All pastures should be mowed at least once a year. Leave grass three inches tall after mowing, do not turn animals into the mown pasture until regrowth is at least five inches. Mowing in June eliminates old growth and new growth is more nutritious. However, if pasture is not needed for forage, delaying mowing at least until mid-July can help the nesting success of grassland birds.

### Grazing

Avoid grazing in early spring on soils that are wet and soft. If grazed when wet, root systems are damaged or destroyed and poor growth results. No grazing should occur before spring growth reaches five inches. Use rotational grazing following the "Voisin" system, or one where adequate regrowth of forages can occur. See SCS Agronomy Tech Notes 25, 26, and 27. Also see SCS Technical Reference File 1.26 - Forage Management. Grazing systems will require fencing of either a permanent or temporary type or both to manage animals and allow for proper regrowth of forages.

Exclude livestock from critical areas and watercourses (see Riparian Buffer BMP and SCS Fencing Standard #382, Field Office Technical Guide for information on fence construction).

### Hayland Management

To maximize yields of hay, haylage, or green chop, a lime and fertilization program based on the Plant Nutrient Management BMP is necessary. To the extent possible, use manure rather than commercial fertilizer. The feeding value of hay decreases one percent a day from June 1st to July 4th. Digestibility and palatability each decline about one-half percent each day that cutting is delayed. Animals will eat only about 60 percent as much digestible dry matter from forage harvested July 4th as from that harvested June 1st.

### Harvest

If conditions allow, harvest first cutting of hay by June 1st. Use Table 1 as a guide to the proper plant growth stage before cutting or grazing.

Store haylage under cover to prevent spoilage and minimize leachate generation. Refer to the Silage Leachate BMP.

TABLE 1  
Grazing and Harvesting Guidelines

Species	Growth Stage to Begin Grazing or Cutting	Successive Grazing or Cuttings	Minimum Height Grazing or Cutting
Bluegrass	When 4-5" high	After 4-5" growth	1-2"
Orchardgrass or Tall Fescue	8" high and from boot to early head	After 8-10" growth	2-3"
Smooth Brome, Reed Canary, Timothy	Before jointing <sup>1</sup> and between early to full head. (Except Brome-medium to full head)	Before jointing <sup>2</sup> and when basal sprouts appear at soil surface	2-3"
Alfalfa <sup>3</sup>	Early bud	Full bud or after 5-6 week period <sup>4</sup>	1-2"
Birdsfoot <sup>3</sup> Trefoil (upright)	Early bud	1/4 bloom or after 6-8 week period	2-3"
Ladino Clover	Early bud	1/4 to 1/2 bloom <sup>5</sup> or 8-10" high	2"
Red and Alsike Clover	Early bud	1/4 bloom	2"
Crownvetch	Early bloom	After 5-week period	2"

<sup>1</sup> "Jointing" is the development of distinct nodes and internodes on a grass stem.

<sup>2</sup> After the second harvest, plants usually do not joint; therefore, sprouts are the primary guide.

<sup>3</sup> These species perform best under rotational grazing and quick removal of forage.

<sup>4</sup> Do not remove top growth of alfalfa by mowing or grazing between September 10 and October 15.

<sup>5</sup> Last harvest should not be taken until after first hard freeze.



## Pasture And Hayland Planting

### Definition

Establishing, reestablishing, or renovating long-term stands of perennial, biennial, or reseeding forage plants. "Amount planned" in schedule of implementation is measured in number of acres.

### Purpose

To reduce erosion and produce high quality forage.

### Where Used

On poor quality pasture or hayland or on land that is being converted from other uses.

### Water Quality Impacts

Replanting existing pastures or hayland, or planting previously tilled cropland to a permanent vegetative stand, contributes to surface water quality by reducing soil erosion, increasing infiltration, and improving nutrient and pesticide utilization. In rotation with an annual crop, establishing a hay crop to remain for several years will help to rebuild an eroded soil base with organic matter. This practice is designed to establish a productive pasture or hayland without excess application of nutrients or pesticides that could threaten ground water quality.

### Planning Considerations

Trees, brush, and stones or other obstructions that would interfere with the practical management of the field may need to be removed.

A seedbed for conventional seedings can be done readily following a silage corn crop. After disking or plowing, a firm seedbed should be prepared using a cultipacker or roller. The small seeded forage crop seed should be planted no deeper than 1/4 to 1/2 inch deep. If an old sod is to be renovated using conventional methods, plowing or repeated diskings will be needed to prepare a good seedbed. Any conventional seeding will be subject to competition from weeds, especially during the seeding year. Control should be by clipping or by herbicides as recommended in the latest New England Weed Control Recommendations by CES (see Manual Appendix).

Conservation tillage seeding of forages are referred to as *direct seedings*. Such seedings are made into an undisturbed soil after corn or into old sods. Direct seedings are particularly suitable for sloping and/or rocky fields. Since there is no mechanical disturbance of the existing vegetation in direct seedings, a knock-down herbicide normally must be used to subdue the existing vegetation. The two materials registered for this purpose are glyphosate

and paraquat. Used properly, upon contact with the soil these two materials become so strongly adsorbed by the soil colloids that they should not be subject to leaching. Because of their tendency to be adsorbed by soil, these two herbicides are considered unlikely to leach into the ground water. These knock-down herbicides are needed to suppress old sod stands to allow establishment of good stands of alfalfa or birdsfoot trefoil. However, reasonable stands of red clover and grass can be established without herbicides following heavy grazing or close clipping which weaken an old sod. Annual weeds are less likely to be a problem in direct seedings made into old sods than seedings made in clean-tilled ground.

Replanting alfalfa into a runout stand in the same field where the sod is killed should normally be avoided. The dying alfalfa roots give off a toxin which retards seedling growth. The field should best be planted to a small grain or corn for a year before reseeding to alfalfa.

Consider the need to divert or slow any substantial upslope runoff drainage which could wash away the seed, fertilizer, lime, and any herbicide before vegetation is established. Seeding alternate stripped widths of a sloping field in alternate years should be considered to slow runoff.

### Specifications

Prepare a seedbed as discussed in the Planning Considerations.

Apply manure, lime and commercial fertilizer in accordance with a soil test and the Plant Nutrient Management BMP. Soil pH must be 6.5 or higher for successful alfalfa and trefoil seedings.

Apply pesticides according to recommendations from the Pest and Pesticide Management BMP and CES New England Chemical Weed Control recommendations.

Seed grasses and legumes adapted to the soil conditions and adequate for the planned use. Refer to Perennial Forage Mixtures for Southern New England by CES in Manual Appendix. The newest and best producing varieties of a particular grass or legume should be used.

Inoculate all legume seed with the correct inoculant.

Seed should be applied uniformly and covered with 1/4 - 1/2 inch of soil. Seed may be placed deeper in lighter textured soils but in no case deeper than 3/4 - 1 inch. Seed may be broadcast or drilled. The seedbed should be firmed by rolling after seeding.

Seeding dates are April 15th to June 15th, and August 15th through September 15th. In coastal areas where the growing season is longer, the fall seeding dates may be extended to October 1st. Spring seedings may be established as early as April 1st if conditions permit.

Exclude livestock from newly planted pasture and hayland. Refer to SCS Fencing Standard No. 382 in the Field Office Technical Guide for information on fence construction or consult with CES for information on temporary fencing.

## **Pest and Pesticide Management**

### **Definition**

Managing agricultural pest infestations (including weeds, insects, and diseases) to maintain crop yield and quality and manage pesticides to protect environmental resources and public health. An integrated pest management system (IPM) is the use of a variety of pest control methods designed to achieve needed pest control with the most judicious use of pesticides. IPM is a dynamic approach to pest management and will vary from farm to farm. Pesticide management is the safe handling, mixing, application, storage, and disposal of pesticides. "Amount planned" in schedule of implementation measured in number of acres.

### **Scope**

This section presents the basic concepts of a pest and pesticide management program which includes IPM principles.

### **Purpose**

To provide guidance for the development of environmentally acceptable pest and pesticide management plans consistent with crop production goals.

### **Where Used**

On all agricultural lands where pest management is needed and/or pesticides are used or stored.

### **Water Quality Impacts**

Implementation of plans developed using these guidelines can reduce the potential for pesticide pollution of surface and groundwater by minimizing the quantity of pesticides stored, handled, and applied, and by providing safe procedures for storing, handling, and using pesticides.

### **Planning Considerations**

#### **Crop, Pest, and Integrated Pest Management Considerations**

Consider all appropriate methods to reduce or eliminate pesticide use and ensure the safe use of necessary pesticide applications. The adoption of integrated pest management practices shall be considered as the most appropriate means of pest control. Consider the economics of pesticide use and non-chemical alternatives.

Consider the effect of adequate plant nutrients and soil moisture, favorable pH, and good soil condition to reduce plant stress and improve plant vigor and pest resistance.

Consider the use of appropriate soil and crop management practices to decrease the potential for crop damage from pests. The most recent Growers' Guides (New England Recommends) available from the University of Connecticut Cooperative Extension System (UCONN CES) publications office provides guidelines for soil and crop management.

#### Pesticide Selection and Use Considerations

Select pesticides which are least likely to cause contamination from surface runoff or leaching. (Several methods to evaluate these are under development.) To estimate site specific water quality risk, the chemical and physical properties of a pesticide must be considered in relation to soil, water, and topographic characteristics.

The following pesticides have been detected in a relatively high proportion of wells tested in nationwide and state studies of pesticides in ground water:

alachlor	dicamba	oxamyl
aldicarb	diuron	picloram
atrazine	methamidophos	prometon
carbofuran	metolachlor	simazine
DCPA	metribuzin	terbacil

Other pesticides of concern include 1,3-Dichloropropene, which may have a mobile and toxic metabolite for which as yet there is no good detection procedure, and the sulfonyleurea herbicides, which have some tendencies to leach and are highly toxic to plants.

Determine soil/pesticide leaching potential and soil/pesticide surface loss potential using a ranking system based on current and appropriate literature. The National Pesticide/Soils Database and User Decision Support System for Risk Assessment of Ground and Surface Water Contamination (NPURG) is an example of such a model. NPURG is based on the USDA-ARS Soil Pesticide Interaction Rating System.

#### Soil and Water Management Considerations

Consider soil and water conservation practices that reduce the movement of pesticides off target sites. These include practices that reduce the loss of chemicals in solution, suspension or adsorbed to soil particles. Recognize that BMPs used to control surface losses of pesticides may increase leaching losses.

Consider the physical and chemical properties of soils when selecting a pesticide. Soils are evaluated on infiltration rate, organic matter content, thickness of the surface layer, erodibility, and slope.

Consider installing irrigation, surface, and/or subsurface drainage designed to enhance nutrient uptake and plant growth where these practices may reduce the leaching or runoff of pesticides.

Consider the use of ground covers for nutrient and/or soil moisture retention, or to minimize nutrient or pesticide losses to surface runoff.

### **Planning and Design Criteria**

Determine surface and ground water quality concerns, including location of nearby public and private wells and water courses.

Identify fields or facilities located in an aquifer protection area. (Refer to level "A" mapping.)

Develop a pest management plan for each crop or land use. As a minimum, address proper identification of the pest problem(s), and determine what integrated pest management components can be implemented (See section on IPM Methods and Concepts below). The most recent UCONN CES - Grower IPM Guides, manuals, and fact sheets can also be used as guidelines for developing and implementing an IPM program. List the references or guidelines used in developing the plan.

Evaluate pesticide handling practices with regard to surface and groundwater concerns. Develop a pesticide management plan which as a minimum addresses storage, mixing/loading, application, disposal, equipment calibration and maintenance, and record keeping. The Pesticide Applicator Training Manual and fact sheets can be used as guidelines for developing and implementing a pesticide management plan.

Implementation of IPM practices shall be documented in the record keeping system. Maintain accurate records of all pesticide applications. Use form provided at the end of this practice for record keeping.

### **Specifications**

Accurately determine the areas to be planned. Use the Agricultural Stabilization and Conservation Service aerial photos and maps, where available, to determine tract and field numbers, crop(s), and acreage(s).

Specify, by field, soil series, texture class, depth of water table, organic matter content, slope, and pH, if known.

Specify, by field, water quality concerns such as location of wells, water courses, pesticide storage, mixing/loading sites.

Specify, for each field, crop rotations to be followed or list alternative crops as appropriate.

Identify and evaluate past pest control practices and pesticide use.

Develop an IPM plan or other appropriate pest management program to be followed for each crop or land use. Specify the pest management methods (IPM or conventional) to be used,

and include as many IPM methods and concepts as appropriate in developing the pest management plan. (See below)

Where chemical pest controls are needed, use the appropriate Grower's Guides (New England Recommends) or IPM Manuals as published by University of Connecticut Cooperative Extension System and pesticide labels for selection of pesticides.

For crops or other land uses that have specific integrated pest management (IPM) guidelines available from the UCONN CES, develop a specific IPM plan for each crop or land use according to the guidelines for the specific crop(s) or land use(s).

Evaluate pesticides proposed for use based on potential for surface or groundwater contamination. If the evaluation indicates a high risk, consider slope, foliar coverage, and other risk reducing site factors or management practices such as method of application, target of controls, efficiency of equipment, till versus no-till fields etc., which may be appropriate, and select pesticides with the lowest risk.

## **Operation and Maintenance**

### General

Report all accidental releases of pesticides immediately to the Connecticut Department of Environmental Protection, (203) 566-3338 (number in operation 24 hours a day).

Pesticide users must operate according to the safety guidelines in the Pesticide Applicator Training Manual(s). Read and follow all label directions as well as state and federal regulations pertaining to pesticide use. Obtain Material Safety Data Sheets when pesticides are purchased; these provide additional information about the pesticide.

Purchase only the amount of pesticide needed for the job/season to avoid unnecessary storage of pesticides.

Mix only the amount of pesticide necessary to do the job, avoiding left-over tank mix. Use any left over tank mix according to label directions, i.e. spray on labeled crops or sites (also spray on field edge of labeled crops), making sure that the maximum application rate is not exceeded. Do not store leftover tank mix.

Ensure that the pesticide applicator knows the exact location of the area to be treated and the potential hazard of spray drift or other pesticide movement to surrounding areas.

Minimize applicator exposure to chemicals, wear protective clothing, and use safety equipment as specified on the pesticide label. Formulate a safety plan complete with information about locations of emergency treatment centers for personnel exposed to chemicals.

Ensure that contracts with commercial pesticide applicators conform to this plan.

IPM Methods and Concepts

IPM is recognized as an optimum approach to effective, economical, and environmentally responsible pest management. A good IPM program helps the decision maker consider the costs, risks, and benefits associated with a given course of action. Include as many of the following IPM methods and concepts as appropriate in developing the pest management plan. Other appropriate IPM methods that are not listed below may also be used.

- A. Start with clean, pest-free plant material.
- B. Select the proper site for crops to be grown, and prepare site well before planting.
- C. Provide optimum growing conditions for crops to minimize stress so that they are best able to resist pest attack or competition.
- D. Provide good crop or site sanitation using the following methods:
  - 1. Destroy crop residues following signs of infestation by pests or diseases
  - 2. Remove virus infected plants when they are young.
  - 3. Remove infested portions of plants when practical and possible, and destroy heavily infested plants if damage is considerable and control of the pests will be extremely difficult, especially if they are not specimen or high value plants.
  - 4. Destroy alternate hosts, abandoned, and volunteer plants.
  - 5. Pasteurize potting media and bench soils in greenhouses.
  - 6. Keep equipment clean.
  - 7. Remove pest breeding and overwintering sites.
- E. Know the identification, life cycles, and damage caused by key pests. Identify the weak-link stages in life cycles to best target controls.
- F. Quarantine new plants and observe for infestations. Control any infestations before introducing with other plants.
- G. Conduct periodic inspection (scouting) of plants to detect problems or early infestations.
- H. Use insect traps (with or without pheromones) and other sampling tools (sweep nets, limb jarring, etc.) to monitor pest occurrence and numbers.
- I. Practice pest exclusion techniques, including row covers, screening, netting, fencing.
- J. Use resistant varieties.
- K. Change or rotate crops to interrupt pest life cycles or prevent pest population build-ups.

- L. Use cover crops and living mulches for weed management where practical. Use other mulches such as gravel, plastic, and organic mulches.
- M. Use tilling, cultivation, and hoeing, to enhance weed control and to expose insects to desiccation and predators.
- N. Use hand weeding and mowing.
- O. Adjust planting and harvest dates to avoid crop losses from pests.
- P. Monitor weather for disease management decision-making.
- Q. Hand pick certain pests.
- R. Practice water management: avoid over- or under-watering, minimize wetting of foliage when watering, or irrigate at times when foliage will dry before evening to discourage disease infections.
- S. Use action thresholds, where available, to determine if or when treatments are needed.
- T. Avoid calendar date schedule pesticide applications whenever possible. Use the minimum number of applications with timing based on information presented above, (i.e. scouting, trapping, action thresholds, etc.), to achieve needed pest control. 100% pest control is usually not needed. Trying to achieve 100% eradication of all infestations will usually result in excessive sprays and resistance problems.
- U. Biological controls: Encourage the build up of natural enemies such as predators, parasites, and diseases of pests. Low toxicity selective pesticides will have less damaging effects on biocontrol organisms. Consider introducing biocontrol organisms for management of pests. Natural enemies must generally be introduced before pest numbers are out of control. Periodic releases are usually needed.
- V. Use the most effective material with the lowest mammalian toxicity whenever possible. Use the lowest effective dosage of pesticides where possible. Some low toxicity materials include: dormant and summer oils, pesticidal soaps, sulfur, and biological insecticides such as *Bacillus thuringiensis* (B.t.).
- W. Use spot treatments for localized pest problems. Use band applications rather than broadcast where possible.
- X. Alternate the use of effective pesticides, when possible, to reduce the potential for pest resistance.
- Y. Obtain good coverage of any pesticide treatments. Use spreader-sticker adjuvants when appropriate. Use the most appropriate pesticide formulation for the job. Calibrate equipment for precise application.

- Z. Minimize pesticide drift to non-target areas.
- AA. Record and evaluate the effectiveness of pest management methods and treatments.
- BB. Other appropriate IPM methods, list and justify the use.

#### Storage and Handling

Store pesticides in the original, labeled containers away from food and feed in a closed building with appropriate warning signs. If possible, locate pesticide storage areas outside aquifer protection areas and away or downgradient from wells. (See UCONN Natural Resources Management & Engineering, Publication SEG-93, Pesticide Storage).

Where possible, locate chemical mixing and equipment rinsing station outside aquifer protection areas and/or as far away from wells or surface water bodies as possible.

Prevent contamination of water supplies by keeping the filler hose or pipe out of the spray tank at all times, even when adding water to a spray mixture. Ensure that backflow prevention devices are installed and operating properly on all water supply systems used to fill spray tanks.

Where chemigation is used, be aware that ease of application may encourage excess or unnecessary use of nutrients and pesticides. Ensure that backflow prevention devices are installed and operating properly on all water supply systems and that pesticides are only applied in accordance with the pest management plan.

Consider installation or use of an impermeable roofed and bermed pad to contain spills and facilitate clean-up, especially in aquifer protection areas. For information on design and construction, contact the UCONN Cooperative Extension System. Alternatively, consider use of a closed system for mixing and loading pesticides.

Collect spills and wash water for use in later tank make-up.

Consult with the UCONN Cooperative Extension System or DEP concerning the best way to dispose of unwanted, unusable or unregistered pesticides.

#### Equipment

Maintain mechanical equipment in good working condition. Replace worn, damaged, or faulty parts.

Calibrate equipment at the beginning of each season and each time pesticides or application rates are changed. Since nozzle wear can increase application rate and change spray patterns, calibration rates should be checked during the spray season.

### Weather

Avoid pesticide application when weather conditions are adverse for proper placement or retention. This includes spraying under windy conditions, surface application before high intensity rainfall and application on saturated soil. Consult the label.

For volatile pesticides, avoid application under high-temperature conditions. Consult the label.

Consider effect of temperature on pesticide efficacy on target pests. Consult the label.

For soil fumigants, avoid application under saturated and/or cold soil conditions. Consult the label.

Use weather data to predict pest infestations and determine timing of pest control, if appropriate.

### **Pesticide Laws and Regulations**

Pesticides must be applied according to the product label.

Applicators must be certified in the appropriate category to purchase and use restricted-use pesticides.

Pesticide applicators must abide by Federal and State laws and regulations (See pertinent Connecticut General Statutes, and the Pesticide Applicator Training Manual).

Become familiar with state and federal regulations on endangered or threatened species and adjust pesticide selection accordingly. (Endangered and Threatened Wildlife and Plants. 50 CFR 17.11 and 17.12. USF&WS, Washington, DC, 1/89).

### **Supporting Data and Documentation**

Map showing limits of aquifer protection area(s) or other environmentally sensitive areas.

Pest Management Plan for each crop or land use, using IMP for crops or land uses for which IPM guidelines are available or pest management plans which draw on the IMP techniques listed under the section entitled, "Integrated Pest Management Methods and Concepts", for other crops or land uses.

Soils map and list of map units showing soil pesticide leaching potentials and soil pesticide surface loss potentials.

Pesticide Management Plan to include records of equipment calibration, description of pesticide storage facilities, procedures for cleaning up and reporting spills of hazardous materials.

Record keeping system and instructions. Maintain a record of all crop scouting results, trap captures and pesticides applications. Use form shown on next page for record keeping.

These items and supporting documentation are required for determining satisfactory application of the practice. Record keeping and documentation of decisions are the responsibility of the operator.

### References

National Pesticide/Soils Database and User Decision Support System for Risk Assessment of Ground and Surface Water Contamination. (NPURG)

New England and Northeast Recommends Guides. See the University of Connecticut, Cooperative Extension System (CES), List of Publications, for appropriate guides.

Endangered and Threatened Wildlife and Plants. 50 CFR 17.11 and 17.12. USF&WS, Washington, DC, 1/89.

Pesticide Applicator Training Manuals, Cornell University Press. Available through the University of Connecticut, Cooperative Extension System.

Pesticide Storage, University of Connecticut, NRM&E SEG-93.

University of Connecticut, CES, IPM Guides.

Private Applicator Training Manuals, State of Connecticut, Department of Environmental Protection, Pesticide Management Unit.



## Petroleum Storage

### Definition

"Storage tank" in this best management practice refers to a system of interconnected tanks, pipes, pumps, vaults, fixed containers, monitoring devices, and appurtenant structures, singly or in any combination, which are used or designed to be used for the storage, transmission, or dispensing of oil or petroleum liquids.

### Scope

This best management practice discusses the design, construction, installation, maintenance, reporting, and monitoring requirements for underground and aboveground tanks used for the storage of petroleum products, including gasoline, diesel fuel, and home heating oil (number 2 fuel oil). It does not address storage of hazardous wastes. The latter materials must be stored and disposed of in accordance with state and federal hazardous waste management regulations, see 40 CFR Parts 260 through 271.

### Purpose

To allow for the storage of petroleum products in a manner that minimizes the chance for a leak or spill to ground water and also minimizes the risk of fire and other threats to human safety.

### Where Used

On all agricultural operations where petroleum products are stored.

### Water Quality Impacts

Gasoline and other petroleum products are common ground water contaminants throughout the state. Underground tanks are a particularly significant problem, because when a leak occurs, it can continue undetected for a long time. The practices described here are designed to ensure that underground tanks are replaced before they leak and that unused tanks are properly abandoned or removed, thus reducing a significant source of ground water pollution. Aboveground tanks present less of a threat of ground water contamination, as leaks are likely to be detected and stopped quickly, before the material gets into the ground. However, these tanks must be carefully designed and constructed to minimize the risk of fire and to contain any leaked or spilled material until it is detected and cleaned up.

### Planning Considerations

Determine whether the farm is in compliance with all the requirements of state law for petroleum

storage (see Current Requirements below).

Determine when existing petroleum storage tanks will need to be replaced.

Assess types and quantities of petroleum used.

Gasoline is much more mobile in soil and sand and gravel than diesel or number 2 fuel oil. Consider eliminating gasoline storage on the farm.

Consider whether aboveground storage is feasible for the operation.

Consider the pros and cons of steel versus fiberglass tanks.

If the petroleum storage is located in an aquifer protection area, it must also comply with aquifer protection area requirements listed below.

### **Current Statewide Requirements**

State law already provides for strict regulation of underground storage of petroleum products:

- o All underground petroleum storage tanks which are not used exclusively for residential heating purposes must be registered with DEP. Connecticut law regulates agricultural tanks, even though federal regulations do not regulate farm tanks smaller than 1,100 gallons (40 CFR Part 280).
- o All underground storage tanks must be properly abandoned, removed, or monitored for leaks, before they reach five years beyond their life expectancy. Life expectancy is either
  - fifteen years after original installation of the tank, or
  - the time on the manufacturer's corrosion warrantee.(If the date of installation is not known, state regulations require tank replacement by September 1989.) Monitoring requirements are generally burdensome; in most cases it makes more sense to replace a tank once it reaches life expectancy than to monitor for leaks.
- o If oil or gasoline is present in the soil (from leaks or spills), it must be reported to DEP's Oil and Chemical Spill Unit, which will investigate the site and refer the site to the appropriate unit in DEP to recommend the best clean-up action to be taken.
- o New tanks must meet strict design, construction, and installation requirements:
  - tanks may be fiberglass reinforced plastic (FRP) equipped with contact plates under fill and gauge openings, and have a manufacturer's warranty certifying compatibility with the contained liquid OR
  - steel with corrosion prevention covering, cathodic protection, and cathodic protection monitoring devices and have contact plates under fill and gauge openings OR

- be equally protected against corrosion through cathodic protection or materials which are non-corrosive.
  - Installation must be in accordance with manufacturers instructions and DEP's regulations, and the owner or operator must submit to DEP within 30 days documentation signed by the installer certifying proper installation procedures.
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- o Unused tanks must be properly abandoned or removed, and the landowner must provide documentation of the removal or abandonment to DEP within 30 days.
  - o All cathodic protection systems must be tested annually according to a procedure described in the regulations.
  - o Daily records of amount in tank and amounts added and removed must be reconciled weekly, according to an inventory procedure set forth in DEP's regulations. In case of abnormal loss or gain, the owner or operator must investigate the cause, and if an abnormal loss or gain has taken place, it must be reported to the state police. A discrepancy of more than 1/2 percent of the total tank volume constitutes an abnormal loss or gain.

#### **Aquifer Protection Area Requirements**

- o New underground storage of petroleum products, other than number 2 fuel oil used for residential heating only, is prohibited in aquifer protection areas. New underground storage of number 2 fuel oil for residential heating is only prohibited within 500 feet of a public well.
- o Replacement underground storage tanks must, in addition to meeting all statewide and NFPA 30 requirements, have double-walled construction and interstitial monitoring. These special requirements do not apply to underground tanks for the storage of number 2 fuel oil located more than 500 feet from a public water supply well.

#### **Other Recommended Practices**

Storage of number 2 fuel oil used strictly for residential heating is not currently regulated by DEP, but has caused well contamination where tanks are located in shallow bedrock areas.

- o Consider aboveground, in-house storage, especially if the tank is located in an area that is shallow to bedrock. A tank located in a basement is considered an aboveground tank if the entire tank, including piping, is raised above the basement floor and open to view. If the above ground tank is located outdoors, it should be protected from precipitation by a roof and should be placed on an impermeable, bermed surface, capable of containing up to 110 percent of the tank's volume.
- o Remove or replace tanks that are more than 15 years old, or that have exceeded the manufacturer's life expectancy rating.

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- o Comply with the provisions of NFPA 31 (National Fire Prevention Association, Inc. Standard for the Installation of Oil Burning Equipment) and with any local fire code requirements.
- o If possible, locate any new underground or outdoor petroleum storage tank at least 200 feet from the closest well or watercourse. If possible, locate new tank downgradient of closest well.

## Plant Nutrient Management

### Definition

Managing the amount, form, placement, and timing of application of plant nutrients.  
"Amount planned" in schedule of implementation measured in number of acres.

### Scope

This standard applies to the application and management of plant nutrients associated with manures and other organic wastes, commercial fertilizers, legume crops, and other crop residues. Procedures for managing manures and other organic wastes before application are given in the Waste Management System BMP.

### Purpose

To supply plant nutrients for optimum crop or forage yield and quality; to minimize entry of nutrients to surface and ground waters; and to maintain or improve soil physical and chemical conditions.

### Where Used

All agricultural operations where nutrients are applied.

### Water Quality Impacts

Nitrate is a leading ground water contaminant, both in Connecticut and nationwide. Commercial fertilizer and manure applications are a significant source for nitrate in ground water, as well as nitrate and phosphate in surface waters. Nitrate-N in drinking water above 10 ppm can cause blue baby syndrome (methemoglobinemia), which may be fatal to infants. Excess nutrients in surface waters promote algal blooms, and the subsequent decomposition of plant material can deplete the oxygen content of the water to levels inadequate for aquatic life.

Nitrogen (N) management practices must balance crop growth requirements with water quality concerns. When N inputs to the soil from fertilizers and/or manures exceed plant needs, nitrate can leach to ground water. On the other hand, when plant-available forms of N in the soil are too low, crop growth suffers. The economic consequences of reduced crop yield and/or quality due to insufficient N can be disastrous to growers. The key to successful management of N, therefore, is to apply in a timely manner only the amount of N the crop needs to grow well.

This practice helps match the nutrient needs of crops with fertilizer applied to prevent excess fertilization and reduce the potential for water pollution.

**Planning Considerations**

Plan to utilize manure and other agricultural wastes before applying chemical fertilizers. Consider timing of manure application and incorporation and condition of manure. Consider waste storage and treatment needs for proper timing of manure applications, as well as land area requirements for best utilization. Refer to the Waste Utilization BMP and Waste Management System BMP.

Consider the cropping and tillage sequence and past fertilizer and manure applications.

Evaluate the use of a vegetated filter area or riparian zone to remove sediment and attached nutrients from runoff before discharge into watercourses or wetlands (see Vegetated Filter Area BMP).

Evaluate the potential need for riparian zone (see BMP) establishment to aid in denitrification of subsurface flow entering nearby streams or watercourses.

**Design Criteria**

Identify areas where nutrient inputs to ground and surface water are of critical concern, e.g. fields near wells, in aquifer protection areas, slopes near watercourses. For areas of critical concern, recommend crops or crop sequences that minimize input from nutrients and prevent nutrient losses to surface and ground water.

Evaluate the amounts and kinds of manure and other organic waste resources used on the farm. Estimate application rates for individual fields (see Pages 5-6 in CES Publication No. 90-4, "Nitrogen Management Guide for Connecticut" found in the Appendix of this document) or consult farm records. If appropriate, develop a waste utilization plan that is consistent with nutrient management objectives (see Waste Utilization BMP).

Consult the appropriate nutrient management guideline(s) for the crop(s) and develop specific fertilizer recommendations and soil testing procedures.

**Specifications**

Nutrient management plans at a minimum will specify by field and for each crop within a field, the crop nutrient/fertilization program that addresses water quality concerns and is environmentally, economically, and agronomically sound.

Have at least one soil sample for each field and crop type tested for phosphorus, potassium, pH, and any other nutrients of concern for the planned crop. Provide realistic yield goals and appropriate management information to the lab making the soil test result-based fertilizer recommendations (see the soil sample information sheets produced by CES in the Appendix). For lime and nutrients other than nitrogen, follow recommendations made by the CES at UCONN, the Connecticut Agricultural Experiment Station, or an approved lab.

For nitrogen, follow the crop-specific recommendations presented in this BMP, except as

revised by more current Cooperative Extension System (CES) recommendations. Use the June soil nitrate test (also known as the pre-sidedress soil nitrate test) where developed for a particular crop. See the specific crop recommendations which follow.

Establish, especially for field corn, realistic yield goals for crops based on historical yield data, climatic conditions, available moisture and soil map unit.

Analyze waste from livestock or other sources before land application to establish nutrient credits and determine application rates. Application rates should not exceed those specified in the Waste Utilization BMP.

Use soil erosion and surface water runoff control BMPs to reduce dissolved and attached nutrient losses from soil erosion and surface runoff. Be aware that practices that control surface runoff losses of nutrients may increase leaching of nitrogen.

Establish cover crops as soon as possible after crop harvest and in non-crop areas to take up and conserve residual nutrients.

Use water budgets to determine the most likely periods of high runoff and/or leaching potentials, and where possible, avoid applying nutrients during those periods.

#### Record keeping

Maintain accurate records of soil test results, fertilizer applied, crop yields, field rotations, and cover crops. Example copies of record forms for specific crops are attached to the appropriate nutrient BMP recommendation sheets. Keep records for at least five years.

Records of fertilizer applied should include time of manure application, time elapsed between spreading and incorporation, physical condition of the manure and rates of manure applied in previous years. Records should include any supplemental chemical fertilizer application of nitrogen or phosphorus and be retained as a guide in determining future practices or in answering questions concerning management practices.

#### Operation, Safety, and Maintenance

Develop an operation, safety, and maintenance plan that provides for the following:

1. Calibrate manure and fertilizer application equipment (including fertilizer application equipment used in nurseries and greenhouses) to ensure that recommended rates of fertilizers are being applied.
2. Protect commercial fertilizer and agricultural waste storage facilities from weather. Make provisions to contain any accidental leakage or spillage that may result in undesirable effects on soil, water, or plants. (See Waste Management System BMP.)
3. When cleaning equipment after nutrient application, exercise extreme care to avoid

contaminating wells by maintaining at least a 150 foot separating distance and do not allow runoff to enter nearby streams, stormwater runoff areas, ponds, or other water bodies. When the system (tank) is flushed, use water to rinse and dilute the contents, and spray it on cropland where possible, or dispose of according to state and local regulations if applicable.

4. Follow safety procedures when storing and handling fertilizer. Minimize operator exposure to manure gases in a confined area, and chemical fertilizers. Wear protective clothing when appropriate. In an unventilated space, (e.g. an enclosed manure storage facility or recently pumped out tank) manure gases can result in asphyxiation and can be explosive.

### Supporting Data and Documentation

#### Nutrient Management BMP Components

A plan for nutrient management prepared as part of a farm resources management plan should be consistent with the format presented under Plan Contents (Section C of Chapter 4 of the BMP Manual) and should include the following items:

1. A plan map using ASCS aerial photo base, or drawings at 1" = 600' showing the location of fields where the BMPs will be applied. Fields should be identified using the ASCS tract and field numbers, and acreage, if available, and cross referenced with the farm operator's informal field names. The nutrient management plan may refer to the plan map prepared for the entire farm resources management plan.
2. Soil map and map unit descriptions. Again, the nutrient management plan may refer to the soil map and unit descriptions prepared for the entire farm resources management plan.
3. Recommendations for nutrient management that include:
  - a. Purpose and scope statement, including yield goals and waste utilization and pollution prevention objectives.
  - b. Background information and present situation statement, including all soil test reports and results of manure analysis.
  - c. Discussion of water resource concerns and opportunities with respect to management of nutrients and expected benefits.
  - d. Specific management recommendations or requirements for individual fields or areas.
  - e. Operation, safety, and maintenance responsibilities.
4. Appropriate record keeping system(s) and instructions.
5. Schedule of BMP implementation noting the planned date of implementation of nutrient management for specific fields.

**Nutrient Management Guidelines For Specific Crops**

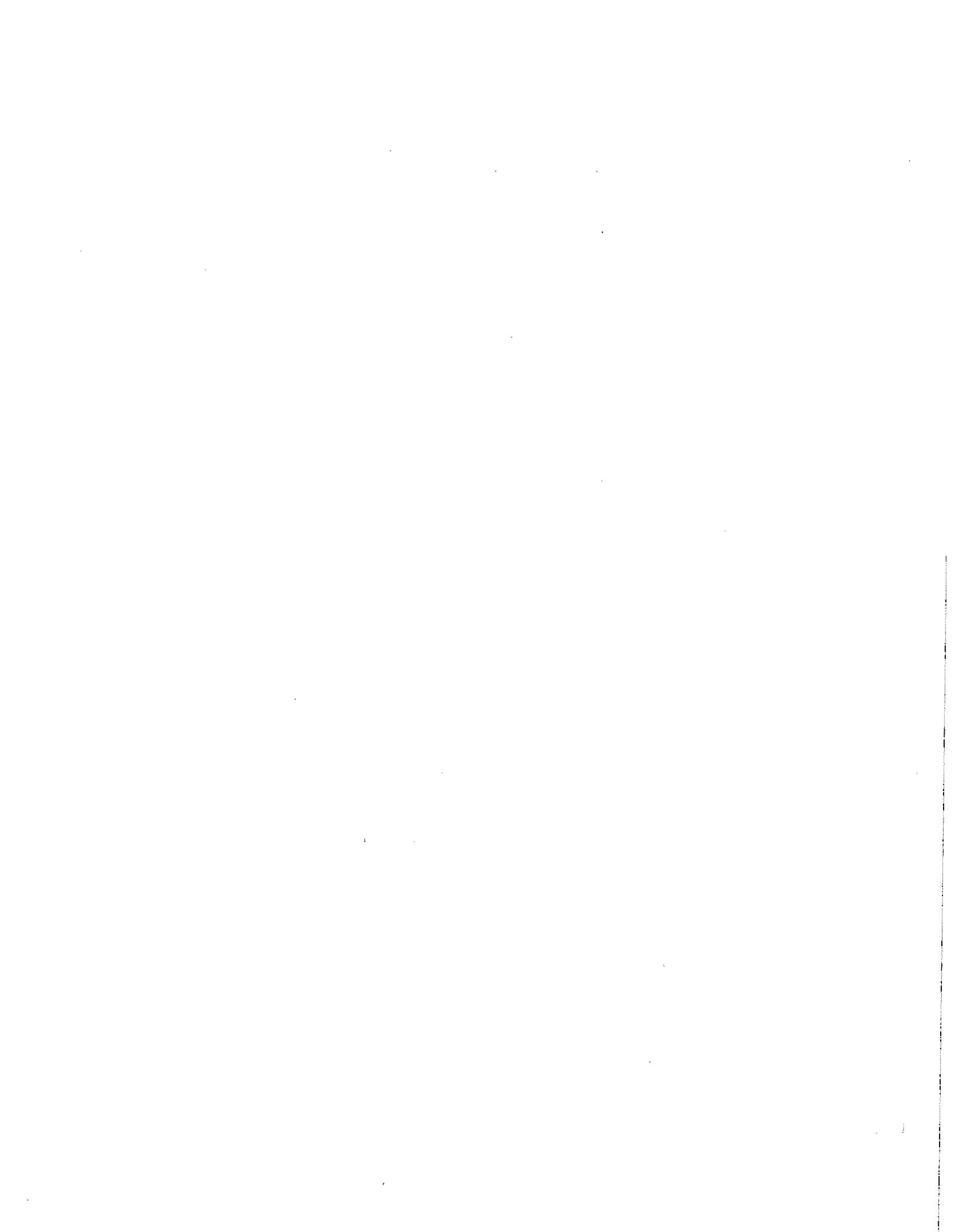
The nutrient management guidelines for individual crops are limited almost entirely to nitrogen (N). Practices and recommendations will be amended and updated in a timely fashion when warranted on the basis of new research data. All management specifications shall be consistent with state water quality policies, standards, and regulations.

The nitrogen fertilizer rates and application times presented for individual crops are based on the results of research studies that have dealt with crop response to different rates of N from chemical and natural organic fertilizers, crop recovery of N added from various sources, crop response to N applied at different times and in various forms throughout the growing season, and development of chemical soil tests that predict soil N availability to corn.

References to research reports and other publications dealing with N management are listed for individual crops. The names of individuals who provided the bulk of the information on individual crop BMPs for N are in most instances given after "CONTACT".

Nutrient management guidelines are provided for the following crops:

- Agronomic crops (corn, grasses, legumes)
- Fruit crops
- Greenhouse crops
- Nursery crops (field-grown and container-grown)
- Tobacco
- Turf
- Vegetable crops



**Nutrient Management Guide For Nitrogen (N): Corn (Silage or Grain)****Manure Rates:**

Do not exceed the rates of manure listed in Table 1 below.

**TABLE 1**  
**RATES OF MANURE FOR CORN GROWN FOR SILAGE OR GRAIN**

Manure	Amount not to exceed per acre per year
Dairy	
Solid	25 T or 750 bu or 920 cu ft
Liquid	8500 gal
Poultry, Cage Layer	
Wet, sticky (including fresh), (25% D.M.)	8 T or 230 bu or 290 cu ft
Moist, crumbly to sticky (50% D.M.)	6 T or 220 bu or 270 cu ft
Crumbly (70% D.M.)	4 T or 190 bu or 240 cu ft
Dry (85% D.M.)	3 T or 160 bu or 200 cu ft
Poultry Litter	4 T or 190 bu or 240 cu ft
Mycelium (fermentation residues; 35% D.M.)	40 T or 1190 bu or 1460 cu ft

**Commercial Synthetic N Fertilizer:**

Apply preplant N fertilizer only to those fields that received no manure within seven months of planting. The total preplant rate, including the N applied as a starter, should not exceed 80 lbs. N per acre.

Use the June soil nitrate test to assess the N availability status of the soil before sidedressing or topdressing N fertilizer. (See CES Publication No. 93-17, Water Quality Fact Sheet #12, for additional information on this test.)

Rates of N sidedressed or topdressed should not exceed rates recommended by the Cooperative Extension System at the University of Connecticut and should be based on a current June soil nitrate test and appropriate manure management practices. These recommendations must be obtained each year before any N fertilizer is sidedressed or topdressed.

**Comments**

It is important that growers keep good records on all aspects of manure and its management. Especially important are application rates and times, time elapsed between spreading and incorporation, and description of the physical condition of the manure. (See page 5 in CES Publication 90-4, "Nitrogen Management Guide for Connecticut" for suggestions on estimating amounts of manure produced on the farm and application rates. This guide is included in the Appendix.)

**References**

DeRoo, H.C. 1975, Agricultural and horticultural utilization of fermentation residues. Conn. Agr. Exp. Sta. Bull. 750, 47p.

Griffin, G.F. 1990, Nitrogen Management Guide for Connecticut. Conn. Coop. Ext. Sys. Pub. No. 90-4, 19p.

Magdoff, F.R., D. Ross and J. Amadon. 1984. A soil test for N availability to corn. Soil Sci. Soc. Am. J. 48:1301-1304.

Magdoff, F.R., W.E. Jokela, R.H. Fox and G.F. Griffin. 1990. A soil test for nitrogen availability in the northeastern U.S. Commun. Soil Sci. Plant Anal. 21:1103-1115.

Morris, T.F. 1988. Effect of nitrogen source on the yield and nitrogen recovery of corn and the use of June soil nitrate level as a nitrogen availability index. M.S. Thesis. University of Connecticut, Storrs. 115p.

**Contact**

Assigned Extension Specialist, Soils and Plant Science Department, University of Connecticut;  
Tel: 486-6384.

**Nutrient Management Guide For Maintenance Nitrogen (N):  
Perennial Grasses and Legumes**

**Topdress Rates**

Do not exceed the topdress rates for N listed in Table 2 below.

TABLE 2 RATES OF N FOR MAINTENANCE OF PERENNIAL GRASSES AND LEGUMES*		
Crop	Topdress Lbs N/Acre	Time of application
Alfalfa	0	
Legumes other than alfalfa	0	
Grass hay	50	Early spring
	50	After 1st cutting
Orchardgrass, reed-canarygrass, tall fescue or ryegrass	50	Early spring
	50	After 1st cutting
	50	After 2nd cutting
Mixed legume-grass pasture	0	
Grass pasture, including horse pasture	40	Early spring
	40	Early June
	40	Late August

\* Manure added as a topdressing must be applied at rates that furnish no more N than the amounts specified in Table 2. Apply manure at rates that do not exceed those recommended by the CES for the specific crop. If manure is applied, reduce topdressed N from fertilizers according to CES recommendations.

**Comments**

It is essential that growers obtain and report to public agencies making N fertilizer recommendations accurate information about all aspects of manure and its management. Especially important are application rates and times, time elapsed between spreading and incorporation, and description of the physical condition of the manure.

**References**

Griffin, G.F. 1990. Nitrogen Management Guide for Connecticut. Connecticut Cooperative Extension System Publication No. 90-4.

Griffin, G.F. and W.W. Washko. 1983. Computerized lime and fertilizer recommendations for agronomic crops. Connecticut Cooperative Extension Service Publication No. 83-3.

**Contact**

Assigned Extension Specialist, Soils and Plant Science Department, University of Connecticut;  
Tel: 486-6384.

NUTRIENT MANAGEMENT RECORD-KEEPING FORM FOR AGRONOMIC CROPS

Farm Operator: \_\_\_\_\_ ASCS Tract # \_\_\_\_\_ Field<sup>1</sup> # \_\_\_\_\_

Field Name: \_\_\_\_\_ Acres: \_\_\_\_\_

Soil Phase(s)<sup>2</sup> \_\_\_\_\_

YEAR			
Crop(s) or crop groups grown <sup>3</sup>			
Yield goal and units			
Soil test results <sup>4</sup> : date tested			
Testing lab <sup>5</sup>			
pH			
P			
K			
Ca			
Mg			
Lime/fertilizer recommendations <sup>6</sup> : crop to be used for			
N (lbs/acre)			
P <sub>2</sub> O <sub>5</sub> (lbs/acre)			
K <sub>2</sub> O (lbs/acre)			
lime (tons/acre)			
Past year crop yields			
Other			

Continued on next page

<sup>1</sup> through <sup>6</sup> see explanatory notes on page 7 for details.

Farm Operator: \_\_\_\_\_

ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

YEAR			
Fertilizer actually applied (lbs/acre N, P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O): preplant			
date			
starter			
date			
topdress			
date			
Lime (tons/acre)			
Other (lbs/acre)			
Manure applied: Kind <sup>7</sup>			
Rate (tons/acre)			
Date(s) applied			
Date(s) incorporated			
June soil nitrate test for corn: Date			
Test result			
N recommended			
N applied			
Type of cover crop used following row crop (if none, so indicate) and date of planting			

<sup>7</sup> See explanatory notes on page 7 for details.

## EXPLANATORY NOTES FOR AGRONOMIC CROP RECORD-KEEPING FORMS

1. Use separate log sheet for each field or crop.
2. Provide soil series name (e.g. Agawam) plus slope or map symbol (e.g. PbB or AfA).
3. Present crop or crop to be grown. Examples: silage corn, alfalfa, grass pasture, orchardgrass, timothy, etc. If possible, provide estimate of percentage of legumes in mixed stands (e.g. 50% alfalfa - 50% grass).
4. Soil test results used for making lime and fertilizer recommendations. For P and K and other nutrients, give lbs/A, if available, or rating such as VL, L, MH, or H.
5. Laboratory where soil was tested.
6. Recommendations accompanying soil test results.
7. The species of animal and the manure's physical condition. Examples:

Cow (C);

Liquid cow (LC)

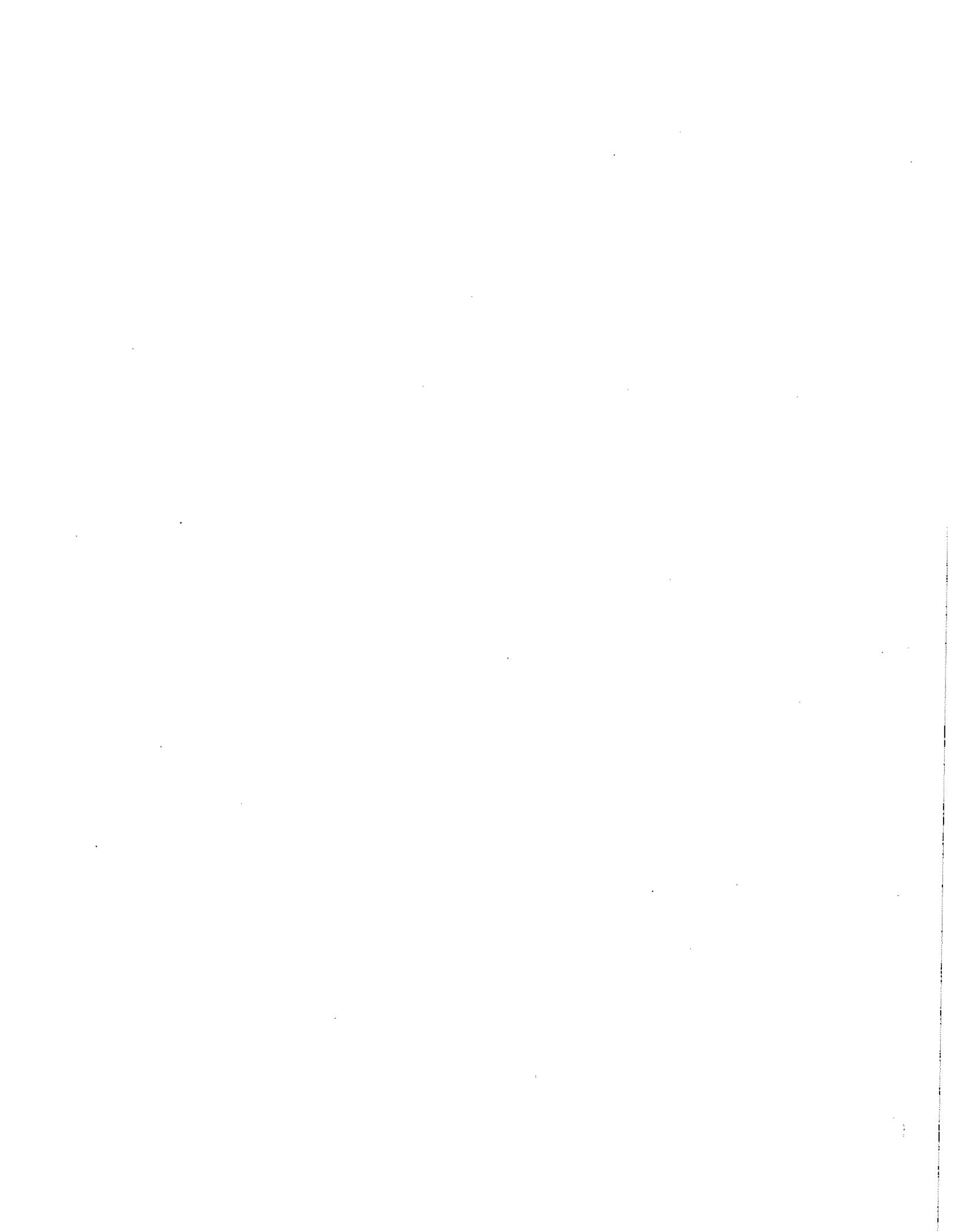
Poultry, cage layer: (PW for wet/sticky = 25% D.M.)  
 (PM for sticky/crumbly = 50% D.M.)  
 (PC for crumbly = 70% D.M.)  
 (PD for dry - 85% D.M.)

Poultry, liquid (LP)

Poultry litter (PLIT)

Mycelium (MY)

Other:



### Nutrient Management Guide For Nitrogen: Fruit Crops

Do not exceed the rates for N listed in Table 5 below.

TABLE 5  
RATES AND TIMING OF N APPLICATIONS FOR FRUIT CROPS

Crop	Lbs of N per acre per application not be exceeded*			
	First Application		Second Application	
	Rate	Time	Rate	Time
Apple, pear	30	Before bloom	30	After fruit set in mid to late May
Stone fruits	40	Before bloom	30	After fruit set in mid to late May
Grape	35	April	35	Early June
Brambles, gooseberry, currant	30	April	40	4 to 6 weeks after first application
Blueberry	45	Bud-break	45	4 to 8 weeks after first application
Strawberry	60	By early July	40	Late August

\* Do not exceed the rate indicated for either the first or second application. For example, for apples, apply no more than 30 lbs N per acre before bloom and no more than 30 lbs. N per acre after fruit set.

Apply N at rates that are no more than 50% greater than those listed above if needed for breakdown of undecayed mulch.

#### Comments

Because fruit quality and winter survival of plants suffer if N is excessive, growers are unlikely to use rates in excess of those above. In some cases, especially on soils that have relatively high nitrogen supplying capacities, rates lower than those listed above will save money and may result in better fruit quality.

**Reference**

Kollas, D.A. 1980. Fruit growers' fertilizer recommendations. Connecticut Cooperative Extension Service Publication No. 80-7.

**Contact**

D.A. Kollas, Associate Professor and Extension Fruit Specialist, Plant Science Department, University of Connecticut; Tel: 486-1944.

NUTRIENT MANAGEMENT RECORD-KEEPING FORM FOR FRUIT CROPS<sup>1</sup>

Farm Operator \_\_\_\_\_ ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

Crop: \_\_\_\_\_

Year: \_\_\_\_\_ Field name and description: \_\_\_\_\_

Date	Fertilizer	Analysis <sup>2</sup>	Amount of fertilizer applied per acre <sup>3</sup>	Method of application (where placed)

<sup>1</sup> See sample record-keeping forms on pages 5 and 6.

<sup>2</sup> Type of fertilizer and limestone applied (indicate guaranteed analysis of commercial fertilizers and limestones. For animal manures, indicate an estimate of nitrogen content).

<sup>3</sup> Indicate whether amount is per field acre (FA) or treated acre (TA), if not spread on all areas.

FACTORS CONSIDERED IN DEVELOPING FERTILIZER PROGRAM LISTED ABOVE

CONSIDERATIONS	Comments
Soil analysis	
Tissue analysis	
Most recent previous nitrogen application	
Plant growth last year	
Fruit set this year	
Pruning severity this year	
Time of pruning	
Herbicide influence	
Mulch influence	
Cover crop influence	
Special objectives	
Recommendations from Extension or consultant	

## SAMPLE NUTRIENT MANAGEMENT RECORD-KEEPING FORM FOR FRUIT CROPS

Farm Operator: Jim Smith ASCS Tract # 109999 Field # 01Crop: ApplesYear 1990; field name and description: North Block, planted 1976; MM106 at 12 ft x 12 ft

Date	Fertilizer	Analysis	Amount applied per acre	Method of application
4/15/90	Muriate of potash	0-0-60	250 lbs	6 ft band for each tree row
5/27/90	Solubor	20% Boron	2 1/2 lbs	Tree spray, in 1st cover
5/28/90	Ammonium Nitrate	34-0-0	45 lbs	6 ft band for each tree row
6/3/90	Zinc chelate	9% Zinc	1 qt	Tree spray, 2nd cover
7/10/90	Solubor	20% Boron	2 1/2 lbs	Broadcast, in Roundup
11/1/90	Limestone	30% CA, 20% Mg	2 tons	Broadcast
11/8/90	Gypsum	20% Ca	2 tons	Broadcast

## FACTORS CONSIDERED IN DEVELOPING FERTILIZER PROGRAM LISTED ABOVE

CONSIDERATIONS	Comments
Soil analysis	At 6" depth, pH = 5.5; K = 60 lbs (UCONN soil test, 12/1/89)
Tissue analysis	Empire: Ca = 0.95%; N = 2.1%; K = 1.2%; B = 35 ppm; Zn = 8ppm (Cornell, 1/15/90)
Most recent previous nitrogen application	See 1989 Fertilizer Record
Plant growth last year	Adequate
Fruit set this year	Heavy, as of (5/25/90)
Pruning severity this year	Moderate
Time of pruning	December through February
Herbicide influence	Killed ground cover late August; 100% of orchard floor
Mulch influence	No mulch
Cover crop influence	Weeds will be allowed to grow to late August
Special objectives	Calcium deficiency of fruit is a major problem with some varieties
Recommendations from Extension or consultant	UConn soil analysis report, 12/1/90; Cornell leaf analysis report, 1/15/90

### Nutrient Management Guide For Nitrogen: Greenhouse Crops

Apply up to 250 ppm nitrogen on a constant liquid feed basis (1 to 3 days interval). Use low rates on seedlings, young plants, new transplants or light feeding species. Use higher rates on established plants, heavier feeders and under conditions which favor rapid growth or less frequent irrigation. Do not apply more nitrate than required by the crop.

Apply up to 600 ppm nitrogen as a periodic feed (7 to 10 day interval). Use low rates on seedlings, young plants, new transplants or light feeding species. Use higher rates on established plants, heavier feeders and under conditions which favor rapid growth or less frequent irrigation.

Do not apply additional nitrogen as a liquid feed when the full label rate of slow release fertilizer is used. Use 1/4 to 1/2 the liquid feed rate when a half rate of a slow release fertilizer is used.

Limit leachate (drainage water) from growing containers to 10% of the total volume of solution applied at each irrigation.

Test growing medium before planting and then periodically at 2 to 3 month intervals, during the life of the crop. Apply nitrogen fertilizer according to crop needs based on soil test results (consult CES and/or CAES for recommendations).

Use back flow preventers on all water outlet ends which may be submerged or which supply water for mixing or dispensing fertilizers or pesticides.

#### Comments

Protecting aquifers from nitrate nitrogen contamination requires minimizing both the quantity of nitrate in waste water and the quantity of waste water (leachate) originating from the greenhouse. Use the recommended guidelines to accomplish these goals.

#### References

Bedding Plants. A Penn State Manual. By J.W. Mastalerz. 1976. Available from PA Flower Growers, 103 Tyson Bldg., Univ. Park, PA 16802.

Geraniums III. A Penn State Manual. By Mastalerz, J.W. and E.J. Holcomb. 1982. Available from Pennsylvania Flower Growers, 103 Tyson Bldg., Univ. Park, PA 16802.

Greenhouse Operation and Management. By P.V. Nelson. 1981. Reston Publ., Reston, VA.

Holland Bulb Forcers Guide. By A.A. KeHertogh. 1985. Netherlands Flower-Bulb Institute, 90 West St., NY, NY 10006.

Introduction to Floriculture. By R.A. Larson. 1980. Academic Press, Inc. 111 Fifth Avenue, New York, NY 10003.

Nutrition of Greenhouse Crops. Prepared by the Connecticut Greenhouse Crop Production Task Force. 1985. Cooperative Extension System, College of Agriculture and Natural Resources, University of Connecticut, Storrs, CT 06269.

The Poinsettia Manual. By P. Ecke, Jr., O.A. Matkin, and D.E. Hartley. 1990. Paul Ecke Poinsettia, Encinitas, CA 92024.

### Contact

Richard J. McAvoy, Assistant Professor and Extension Specialist, Greenhouse Crops Plant Science Department, University of Connecticut, (203) 486-0627;  
FAX #(203) 486-4128.





**Nutrient Management Guide For Nitrogen: Nursery Crops****Container-Grown Crops**

Use slow-release fertilizers such as prilled or tablet types to provide primary nitrogen (N) nutrition.

Do not exceed application rates described on the label as moderate, i.e. rates that will provide moderate levels of fertility.

Split annual fertilizer applications so that half of the N is provided in April and half in June.

Supply liquid supplemental fertilization according to soil test results and recommendations from the Cooperative Extension System (CES) at the University of Connecticut or the Connecticut Agricultural Experiment Station (CAES). Supplemental liquid feeding frequency and rate must not exceed CES or CAES recommendations and must be based on currently recommended practices for liquid feeding.

Use back flow preventers on all water outlet ends which may be submerged or which supply water for mixing or dispensing fertilizers or pesticides.

**Field-Grown Crops**

Do not apply more than 120 lbs N per acre annually.

Split annual N fertilizer applications according to species as shown in Table 4.

Provide a significant portion of the fertilizer in slow release forms such as urea-formaldehyde, resin-coated prilled fertilizer, or natural organic materials.

Apply fertilizer in bands down the nursery row or only in the root zone. Avoid broadcasting N containing fertilizers to the entire field.

Grow cover crops between nursery rows and in alleyways.

**Reference**

Rathier, T.M. and C.R. Frink. 1989. Nitrate in runoff water from container grown Juniper and Alberta Spruce under different irrigation and N fertilization regimes. *J. Environ. Hort.* 7(1):32-35.

**Contacts**

Dr. Mark Brand, Extension Nursery Specialist, Department of Plant Science, University of Connecticut, 1376 Storrs Road, Storrs, CT 06269-4067.

Dr. Thomas Rathier, Assistant Soil Scientist, The Connecticut Agricultural Experiment Station, Valley Laboratory, Box 248, Windsor, CT 06095.

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TABLE 4  
RATES OF N FERTILIZER FOR FIELD-GROWN NURSERY CROPS

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Species Growth Characteristic(s)	Rate, Lbs N/acre	Application time
Single, early season growth flush each year	40-60 60-80	Late April - Early May June
Continuous growth or multiple growth flushes each year	40 40 40	Late April - Early May June Mid-late October

---

NUTRIENT MANAGEMENT RECORD KEEPING FORM FOR CONTAINER-GROWN NURSERY CROPS

Farm Operator: \_\_\_\_\_ ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

Crop ID: \_\_\_\_\_

Crop Grown<sup>1</sup>: \_\_\_\_\_

Container Size & Type From \_\_\_\_\_ To \_\_\_\_\_

Composition of the Growing Medium (parts by volume) \_\_\_\_\_

Year \_\_\_\_\_

GROWING MEDIUM TEST RESULTS

Date Tested				
Testing lab				
pH				
NO <sub>3</sub> <sup>-</sup>				
NH <sub>4</sub> <sup>+</sup>				
P				
K				
Mg				
Ca				
<b>LIME/FERTILIZER RECOMMENDATIONS</b>				
Dolomitic lime (lbs/cu yd or rate per pot)				
Gypsum (lbs/cu yd or rate per pot)				
Sulfur (lbs/cu yd or rate per pot)				

Form continued on next page

<sup>1</sup> Use a separate log sheet for each crop produced in a field or portion of a field.

Farm Operator \_\_\_\_\_ ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

LIME/FERTILIZER RECOMMENDATIONS FOR CONTAINER-GROWN CROPS,  
continued

Phosphorus (form, lbs/cu yd or rate per pot)				
Slow release prilled fertilizer (form, lbs/cu yd or rate per pot)				
Liquid fertilizer (form, rate in parts per million N, frequency)				
Other				

LIME/FERTILIZER APPLIED

Dolomitic lime (lbs/cu yd or rate per pot)				
Gypsum (lbs/cu yd or rate per pot)				
Sulfur (lbs/cu yd or rate per pot)				
Phosphorus (form, lbs/cu yd or rate per pot)				
Slow release prilled fertilizer (form, lbs/cu yd or rate per pot)				
Liquid fertilizer (form, rate in parts per million N, frequency)				

NUTRIENT MANAGEMENT RECORD KEEPING  
FOR FIELD-GROWN NURSERY CROPS

Farm Operator: \_\_\_\_\_ ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

Acres: \_\_\_\_\_

Soil Phase(s) (series name, slope, map symbol) \_\_\_\_\_

Crop Grown<sup>1</sup> \_\_\_\_\_

YEAR				
SOIL TEST RESULTS Date Tested				
Testing Lab				
pH				
P				
K				
Ca				
Mg				
LIME/FERTILIZER RECOMMENDATIONS				
N (lbs/1000 sq ft)				
P <sub>2</sub> O <sub>5</sub> (lbs/1000 sq ft)				
K <sub>2</sub> O (lbs/1000 sq ft)				
Dolomitic lime (lbs/1000 sq ft)				
Gypsum (lbs/1000 sq ft)				
Sulfur (lbs/1000 sq ft)				
Other				

<sup>1</sup> Use a separate log sheet for each crop produced in a field or portion of a field.

Farm Operator \_\_\_\_\_

ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

**LIME/FERTILIZER ACTUALLY APPLIED for field-grown crops**

YEAR				
Lime actually applied Type				
Rate (lbs/1000 sq ft)				
Date and method of application				
Gypsum actually applied Rate (lbs/1000 sq ft)				
Date and method of application				
Sulfur actually applied Rate (lbs/1000 sq ft)				
Date and method of application (lbs/1000 sq ft)				
Fertilizer actually applied formulation				
Rate (lbs/1000 sq ft)				
Date and application method (lbs/1000 sq ft.)				

**Nutrient Management Guide For Nitrogen: Tobacco**

Do not exceed a total preplant plus sidedress application rate of 300 lbs N per acre in any year.

Crop rotation should be practiced, with tobacco grown on fields for 2 to 4 years and unfertilized, harvestable crops grown for 1 to 2 years.

Limit preplant applications of N from all sources to 150 lbs N per acre or 50% of the total applied.

Any N applied in addition to preplant N should be sidedressed, as follows:

1. Make two or more separate sidedress applications of natural organic fertilizers and/or solid synthetic fertilizers, OR
2. Apply small amounts (less than 40 lbs N per acre) of soluble N, such as calcium nitrate, through irrigation at times corresponding to the N needs of the growing crop.

Plant a winter cover crop immediately after harvest to take up excess nitrogen in the soil.

**Comments**

Connecticut tobacco requires large amounts of nitrogen and is dependent on both yield and leaf quality for crop value.

*Shade tobacco* grows over a period of 90-100 days on fields that have had tobacco crops for many years. Beginning about 30 days after transplant, plants are tied to wire supports, which prevents access to the fields by farm machinery. About 55 days after transplant and every 7-10 days thereafter, the 3 bottom-most leaves are harvested from each plant. Twenty to twenty-two leaves per plant are harvested in a typical year. At the end of harvest, the remaining portions of the plants - stalks, small leaves and flowers (which contain 60-70% of N taken up) - are plowed down and a cover crop of winter rye is usually planted.

*Broadleaf tobacco* is similar to shade tobacco, except that the average crop takes 60 days to grow, the crop is not tied to supports, and the entire plant is removed from the field at harvest. Thus there is not a large residual supply of organic N from plant remains. The same management practices employed for shade tobacco would be appropriate for broadleaf tobacco, if adjustments are made to accommodate the differences in the rate of growth for the two crops.

For both shade-grown and broadleaf tobacco, uptake of N takes place largely after the crop has been in the ground for 30 days. Logistical concerns, such as fragile leaves and plant support systems (shade grown) limit mechanical applications of dry fertilizer to the first 30 days. Thus, it is necessary to provide large amounts of N to the crop when it is physically difficult to do so.

Growers have traditionally succeeded by using natural organic types of nitrogen such as

cottonseed meal and castor pomace. These materials may be incorporated as much as 7 to 10 days before planting and applied as sidedressings within the first 30 days at annual rates of 250 to 300 lbs. N per acre. The organic N is then mineralized to ammonium, which soil microorganisms convert to nitrate in time for the plants' largest need. Under this system, a large pool of nitrate may be available in the root zone and subject to leaching by heavy rainfall before plant uptake.

Availability of nitrate-N can be delayed by limiting preplant organic N rates to 50% of the total applied and incorporating it immediately before planting. The remaining N can be applied in 2 to 3 sidedressings in the first 30 days. This should more closely coordinate N availability with plant needs. Ideally, a test for available nitrate in the soil profile should be made before fertilizing and planting in the spring.

An alternative fertilization method for shade tobacco applies soluble N sources such as calcium nitrate through irrigation at times corresponding to the N needs of the plant. While this method may allow tobacco to be grown at lower annual rates of applied N, it is not yet capable of producing a crop that is comparable to those grown with conventional nutrient applications. This system may be useful as a means of applying sidedress nitrogen to conventionally fertilized crops.

Despite efforts to more closely coordinate N applications with crop needs, the potential for nitrate leaching may remain high for tobacco. It may be necessary to limit the tobacco acreage in any given aquifer. If the non-tobacco acreage is restricted to unfertilized or non-leaching crops, the dilution effect may offset nitrate lost from tobacco. It also may be necessary to limit tobacco culture to areas outside a zone immediately around public wells.

Another potential for N loss exists for the shade grown crops from the large amount of unharvested plant portions (60 to 70 % of N taken up). This residue is plowed down at the end of the growing season and can increase the pool of organic N in the soil. Although this residue does not mineralize as rapidly as meal fertilizers do, some of it can become available during ensuing growing seasons, especially in annually cropped fields. One method of limiting residual pools of organic N would be to rotate tobacco off fields after 2 to 4 seasons and to grow unfertilized, harvestable cover crops such as silage corn, grains, or legumes for 1 to 2 years. There is little concern for residual N with broadleaf tobacco, because the entire plant is harvested.

## References

- Rathier, T.M., C.R. Frink and G.S. Taylor. 1984. Metered applications of calcium nitrate in overhead irrigation: Effects on yield and quality of shade grown cigar wrapper tobacco. *Tob. Sci.* 28:3-6.
- Rathier, T.M. and C.R. Frink. 1986. Efficiency of nitrogen fertilizer use by shade tobacco improved by timed applications. *Agron. J.* 78:459-464.

## Contact

Dr. Thomas Rathier, Assistant Soil Scientist, The Connecticut Agricultural Experiment Station, Valley Laboratory, Box 248, Windsor, CT 06095.

NUTRIENT MANAGEMENT RECORD-KEEPING FORM FOR TOBACCO CROPS

Farm Operator: \_\_\_\_\_ ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

Acres: \_\_\_\_\_ Soil Phases(s)<sup>1</sup>: \_\_\_\_\_

YEAR				
Crop grown (shade or broadleaf)				
Soil test results <sup>2</sup>				
Date tested				
Testing lab <sup>3</sup>				
pH				
P				
K				
Ca				
Mg				
Nitrate test results				
Other				
Lime and fertilizer recommendations <sup>4</sup>				
N (lbs/acre)				
P <sub>2</sub> O <sub>5</sub> (lbs/acre)				
K <sub>2</sub> O (lbs/acre)				
Lime (tons/acre)				
Other				

Note: Use a separate log sheet for each crop produced in a field or portion of a field.

<sup>1</sup> through <sup>4</sup> See the explanatory notes on page 5.

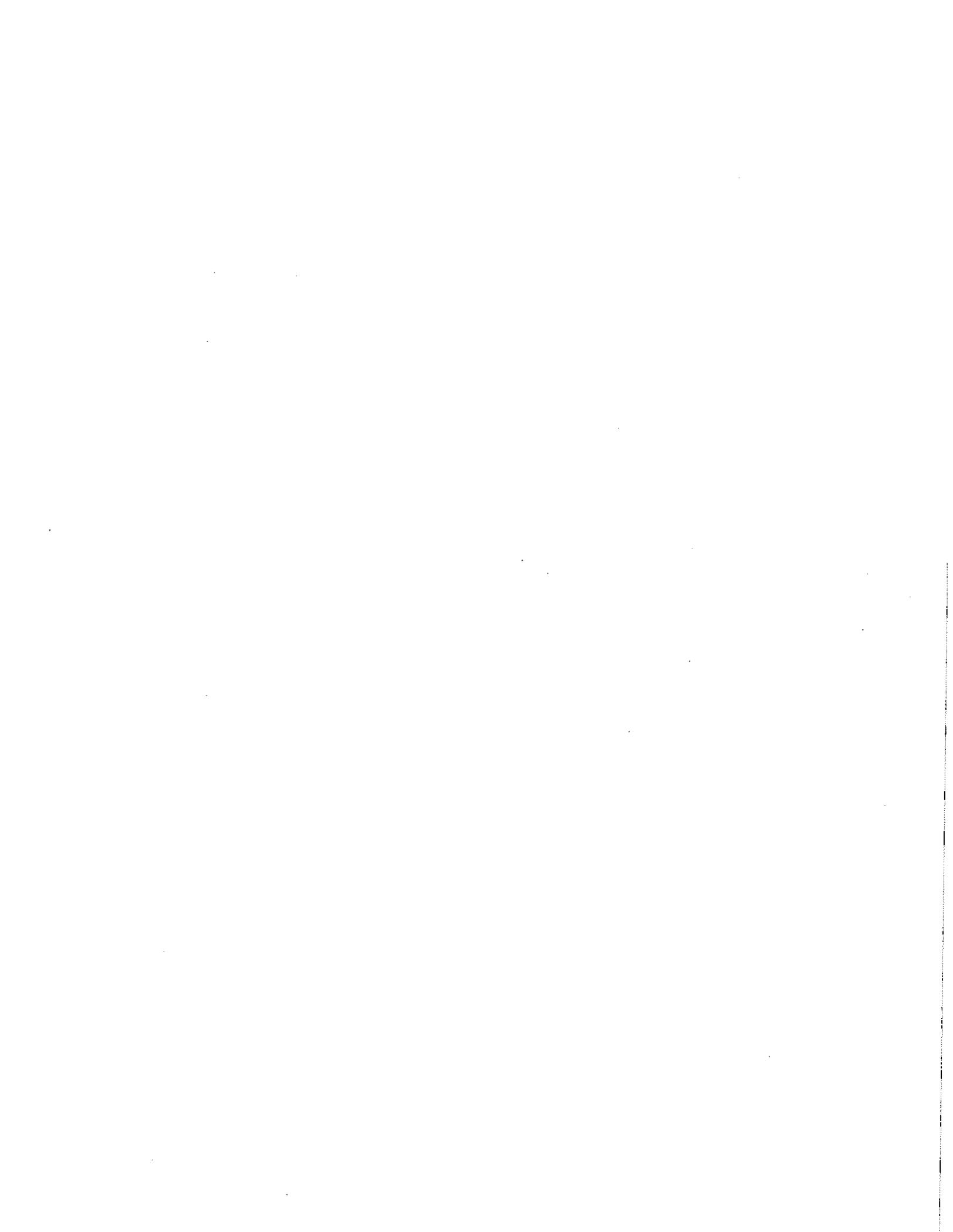
Farm Operator: \_\_\_\_\_ ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

Lime/fertilizer actually applied	Year	Year	Year	Year
Lime (tons/acre)				
Date				
Natural organics <sup>5</sup>				
Preplant (lbs N/acre)				
Date				
Sidedress: Date and lbs N/acre				
Date and lbs N/acre				
Date and lbs N/acre				
Date and lbs N/acre				
Solid Synthetics				
Preplant (lbs N/acre)				
Date				
Sidedress: Date and lbs N/acre				
Date and lbs N/acre				
Date and lbs N/acre				
Date and lbs N/acre				
Soluble N applied through irrigation				
Date and lbs N/acre				
Date and lbs N/acre				
Date and lbs N/acre				
Date and lbs N/acre				

<sup>5</sup> Materials such as cottonseed meal and castor pomace.

EXPLANATORY NOTES FOR TOBACCO CROP RECORD-KEEPING FORM

1. Provide predominant soil series name(s) (e.g. Agawam) plus slope or map symbol (e.g. PbB or Afa).
2. Soil test results used for making lime and fertilizer recommendations. For P and K and other nutrients, give lbs/A, if available, or rating such as VL, L, MH, or H.
3. Laboratory where soil was tested.
4. Recommendations accompanying soil test results.



**Nutrient Management Guide For Nitrogen: Turf**

Do not exceed a total annual application rate of 220 lbs N per acre.

Split annual applications so that no more than 44 lbs N per acre is applied in any one month.

Apply no fertilizer containing N between October 16 and April 1.

**References**

DeRoo, H.C. 1980. Nitrate fluctuations in groundwater as influenced by use of fertilizer. The Connecticut Agricultural Experiment Station. Bulletin 779.

Gold, A.J., W.R. DeRagon, W.M. Sullivan, and J.L. Lemunyou. 1990. Nitrate-nitrogen losses to groundwater from rural and suburban land use. J. Soil and Water Cons. (in press).

Morton, T.G., A.J. Gold, and W.M. Sullivan. 1988. Influence of overwatering and fertilization on nitrogen losses from home lawns. J. Environ. Qual. 17:124-130.

**Contact**

Dr. William M. Dest, Associate Professor, Plant Science Department, University of Connecticut. Tel: 486-0189.

NUTRIENT MANAGEMENT RECORD KEEPING FORM FOR TURF CROPS

Farm Operator: \_\_\_\_\_ ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

Acres: \_\_\_\_\_ Soil Phase(s)<sup>1</sup>: \_\_\_\_\_

SOIL TEST RESULTS<sup>2</sup>

YEAR			
Date tested			
Testing lab <sup>3</sup>			
pH			
P			
K			
Ca			
Mg			
Other			
LIME AND FERTILIZER RECOMMENDATIONS <sup>4</sup>			
N (lbs/acre)			
P <sub>2</sub> O <sub>5</sub> (lbs/acre)			
K <sub>2</sub> O (lbs/acre)			
Lime (tons/acre)			
Other			

1. Provide soil series name (e.g. Agawam) plus slope or map symbol (e.g. PbB or AfA).
2. Soil test results used for making lime and fertilizer recommendations. For P and K and other nutrients, give lbs/A, if available, or rating such as VL, L, MH, or H.
3. Laboratory where soil was tested.
4. Recommendations accompanying soil test results.

Farm Operator: \_\_\_\_\_ ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

**LIME AND FERTILIZER APPLIED**

YEAR			
Lime (tons/acre)			
Date			
FERTILIZER	N P <sub>2</sub> O <sub>5</sub> K <sub>2</sub> O	N P <sub>2</sub> O <sub>5</sub> K <sub>2</sub> O	N P <sub>2</sub> O <sub>5</sub> K <sub>2</sub> O
Date			
Rate (lbs/acre)			
Date			
Rate (lbs/acre)			
Date			
Rate (lbs/acre)			
Date			
Rate (lbs/acre)			
Date			
Rate (lbs/acre)			
Date			
Rate (lbs/acre)			
OTHER NUTRIENTS Material, date, and rate of application			



### Nutrient Management Guide For Vegetable Crops

Apply phosphorus, potassium, calcium, and magnesium according to soil tests and recommendations made by the Cooperative Extension System (CES), the Connecticut Agricultural Experiment Station (CAES), or an approved laboratory. Apply any needed phosphorus and potassium when planting or during final seedbed preparation. Incorporate broadcast fertilizers shallowly.

When manure is used, determine application rates and keep good records of times of manure application. Manure added within seven months of planting must be applied at rates that furnish no more N than the amounts listed under 'Total' in Table 3. Consult the CES for rates of different manures that should not be exceeded for specific crops. If manure has been applied within seven months of planting, or if cow manure has been applied in previous years, reduce broadcast rates of N or both broadcast and sidedress rates of N according to CES recommendations. Provide accurate information on both current and previous manure management practices to those making N fertilizer recommendations.

Apply nitrogen (N) as a combination of broadcast, planter and sidedress applications. Do not exceed the broadcast/planter application rates of N shown in Table 3. If less than the rate listed for broadcast/planter is applied, increase sidedress rates, but do not exceed the rate listed under 'Total' in Table 3.

Crops which leave considerable residual N must be followed by another vegetable crop or cover crop (See Table 3). Apply no N for the second crop unless it is recommended by the CES. This must be done on a crop by crop basis in double cropping systems.

#### Comments

Fertilizer management for vegetable crops depends on the successful manipulation of several management practices. Many vegetable crops such as lettuce or radish have a small, shallow root system and are not good foragers for nutrients. Others make efficient use of soil nutrients but only a small percentage is removed from the field in the harvested product. With broccoli, for example, only 12% of the N taken up by the crop is removed when the head is cut. The remainder is returned to the soil when the plants are plowed under. Therefore, in order to effectively manage fertilizer applications for vegetable crops, we must use the proper amount and grade of fertilizer at the proper time and, with many vegetable crops, follow with a second vegetable crop or cover crop to take up residual nutrients.

#### Contact

Richard A. Ashley, Department of Plant Science, UCONN, 486-3435.

Table 3. Rates of nitrogen required in the absence of manure for vegetable crops, situations where follow-up vegetable or cover crops are needed, and vegetable crops that can be used as follow-up crops.

Crop	Nitrogen Required, lbs N/A		Should be followed by Vegetable OR Cover Crop	Can be used as a Follow-up Vegetable Crop
	Broadcast/ Planter	Sidedress		
Asparagus	0	75	NO	NO
(established)				
Beans, Snap	50	30	YES	YES
Beets	70	50	YES	NO
Broccoli	100	50	YES	NO
Cabbage	100	50	YES	NO
Carrots	50	30+30 <sup>1</sup>	YES	NO
Cauliflower	100	30	NO	NO
Celery	100	40+40	NO	YES
Cucumbers	90	40	NO	NO
Eggplant	80	30	NO	NO
Endive	90	50	YES	NO
Lettuce	90	30	YES	NO
Muskmelon	100	30	NO	NO
Onion	80	50	NO	NO
Parsnips	100	30	NO	NO
Peas	75	--	YES	NO
Peppers	40	40+40	NO	NO
Potatoes	80	60	NO	NO
Pumpkins	90	40	NO	NO
Radish	50	--	YES	YES
Spinach	60	30	YES	NO
Squash	90	40	YES	YES
Sweet Corn	40	120	YES	NO
Tomatoes	80	30+30	YES	YES
Turnips <sup>2</sup>	50	--	NO	NO
Watermelon	100	30	NO	YES

<sup>1</sup> Refers to split applications.

<sup>2</sup> Turnips, grown as a follow-up crop are excellent at utilizing residual nitrogen.

NUTRIENT MANAGEMENT RECORD-KEEPING FORM FOR VEGETABLE CROPS

Farm Operator: \_\_\_\_\_ ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

Acres: \_\_\_\_\_ Year: \_\_\_\_\_

Soil Phase(s)<sup>1</sup>: \_\_\_\_\_

	Crop 1	Crop 2	Crop 3	Crop 4
Crops grown in sequence <sup>2</sup>				
Soil test results <sup>3</sup>				
Date tested				
Testing lab <sup>4</sup>				
pH				
P				
K				
Ca				
Mg				
Other (test and results)				
Lime/fertilizer recommendations <sup>5</sup>				
N(lbs/acre)				
P <sub>2</sub> O <sub>5</sub> (lbs/acre)				
K <sub>2</sub> O (lbs/acre)				
Lime (tons/acre)				
Past year crop yields				
Other				

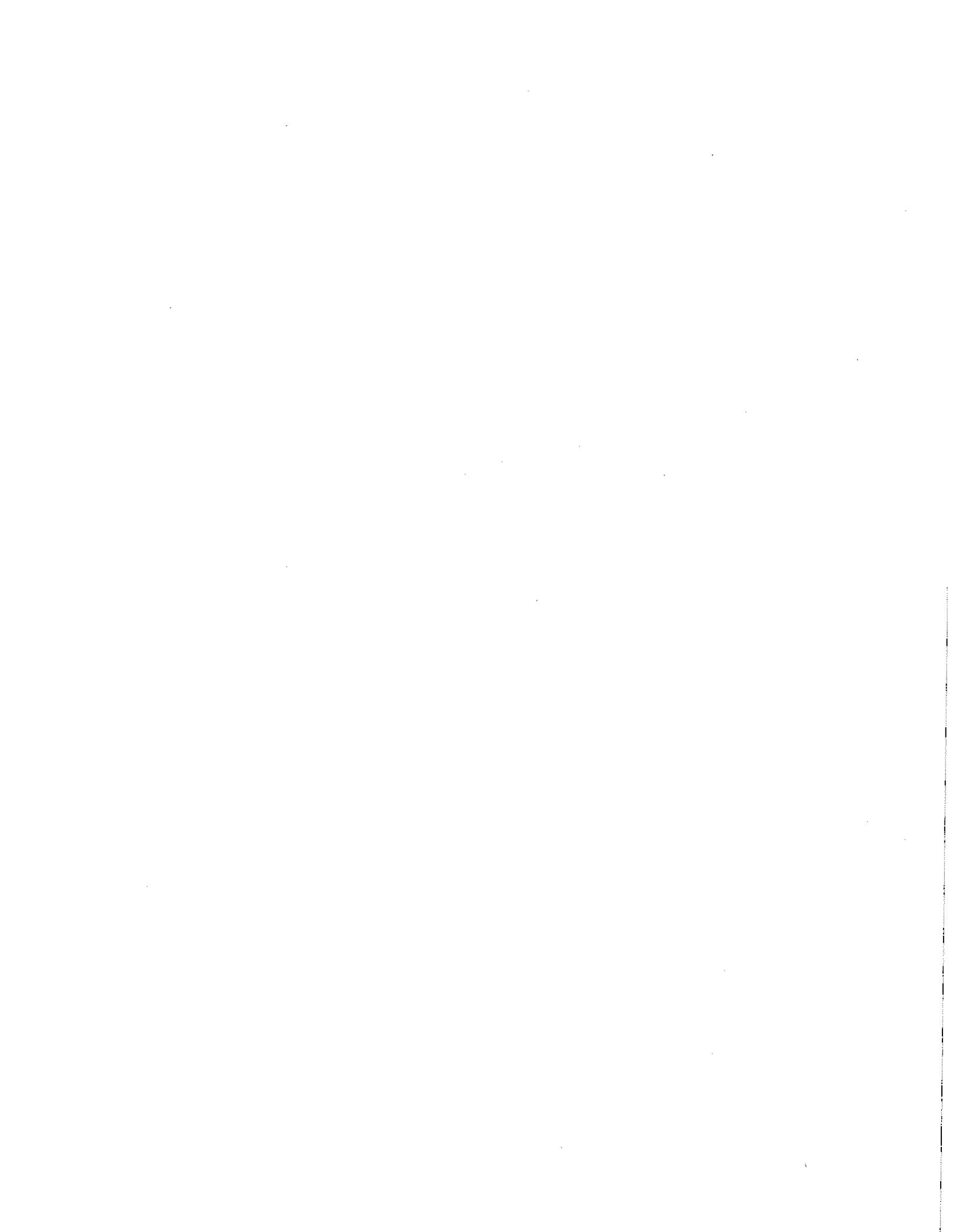
<sup>1</sup> through <sup>5</sup> See explanatory notes on page 5.

Farm Operator: \_\_\_\_\_ ASCS Tract # \_\_\_\_\_ Field # \_\_\_\_\_

Fertilizer and/or lime actually applied	LBS/ACRE N, P <sub>2</sub> O <sub>5</sub> AND K <sub>2</sub> O ACTUALLY APPLIED											
	Crop 1 N P <sub>2</sub> O <sub>5</sub> K <sub>2</sub> O			Crop 2 N P <sub>2</sub> O <sub>5</sub> K <sub>2</sub> O			Crop 3 N P <sub>2</sub> O <sub>5</sub> K <sub>2</sub> O			Crop 4 N P <sub>2</sub> O <sub>5</sub> K <sub>2</sub> O		
Preplant												
Date												
Starter												
Date												
Topdress or Sidedress												
Date												
Lime (tons/acre) Date												
Other: material, date, and rate of application												
Manure applied												
Kind <sup>6</sup>												
Rate												
Date(s) applied												
Date(s) incorporated												
Type of cover crop used (if none, so indicate)												

<sup>6</sup> See explanatory note on page 5.





## **Riparian Buffer**

### **Definition**

An area of trees and other vegetation located on land next to and upgradient from water courses, water bodies, and associated wetlands. "Amount planned" in schedule of implementation measured in number of feet.

### **Purpose**

To maintain or improve surface water quality by removing or buffering the effects of sediment, nutrients, organic matter, and some pesticides from surface runoff, subsurface flow, and near root-zone ground water. Additional purposes may include natural streambank stabilization, preservation or improvement of wildlife habitat, providing shade to moderate stream temperatures, and improvement of aquatic habitat.

### **Where Used**

This practice is used along watercourses, waterbodies, and wetlands where water quality is threatened. For agriculture it is most often applicable downslope from cropland, hayland or pasture.

The riparian buffer will be most effective when used as a component of an applied cropland resource management system, including nutrient and pesticide management, runoff control, and sediment and erosion control practices. Use of this BMP without these management and control practices can result in adverse impacts on riparian buffer vegetation and stream hydraulics including high maintenance costs, the need for periodic replanting, and the movement of excess nutrients and sediment through the riparian buffer by concentrated flows.

### **Water Quality Impacts**

Riparian buffers properly established and managed, can improve surface water quality by preventing streambank erosion, removing sediment, absorbing and adsorbing nutrients and pesticides, allowing better nutrient uptake, and enhancing denitrification.

### **Planning Considerations**

Evaluate the type and quantity of potential pollutants that will be derived from the contributing drainage area.

Evaluate the existing vegetative cover and potential for regrowth of native species with exclusion of livestock and heavy equipment.

If development by planting vegetation is necessary, consider the following:

1. Species adapted to soil and site factors present in the riparian buffer.
2. Nearby natural riparian areas to determine vegetative species compatible with adjacent land uses.
3. Need to establish trees early in the dormant season for maximum viability.
4. Visual aspects, wildlife habitat, and native species diversity in selection of any plant materials.
5. Providing shade to moderate water temperatures.

When planting a streambank subject to flooding by high velocity flows refer to the Streambank Protection BMP.

Consider sources of plant materials, cost, shipping, etc. if necessary.

Consider pairing the riparian buffer with an upgradient vegetated filter area. If possible, delay mowing the vegetated filter area until late in July to avoid disturbing any ground-nesting birds. Controlled grazing may be acceptable in the vegetated filter area when it is dry and firm. Refer to the Vegetated Filter Area BMP.

Riparian buffer width and effectiveness will vary depending on the slope, soil drainage class, hydrologic soil group, roughness, and type of vegetative growth. See Buffer Width below.

Consider installing a fence to exclude livestock and farm equipment from a riparian buffer and a vegetated filter area.

Consider eligibility for Conservation Reserve Program payments.

## Design Criteria

### General

Riparian buffers will be designed to filter and maximize detention times of surface runoff which occurs as sheet flow, and downslope subsurface flow which occurs as shallow ground water. For this BMP shallow ground water is defined as saturated conditions which occur near or within the root zone of trees and other woody vegetation and at relatively shallow depths where bacteria, oxygen, and soil temperature contribute to denitrification. Riparian buffers will be designed to encourage sheet flow and infiltration and prevent formation of concentrated flow channels.

The riparian buffer will begin at the edge of the stream or wetland and vary in width depending on the factors discussed below. It may be paired with a vegetated filter area.

Runoff to be slowed and filtered will be limited to sheet flow and shallow subsurface flow only. Except for existing streams and watercourses, concentrated flows should be converted if possible to sheet flow or subsurface flows before entering the buffer. Outflow from subsurface drains should not be allowed to pass through the buffer in pipes or tile, thus circumventing the treatment processes. Subsurface drain outflow must be converted to sheet flow or shallow ground water flow for treatment by the riparian buffer.

Livestock should be excluded from the buffer except for approved stream crossings and approved watering sites. Refer to the SCS Fencing Standard No. 382.

#### Buffer Width

The width of a riparian buffer should be determined based on the area slope, soil drainage class and hydrologic group, and on the upslope watershed size, land use, and ground surface roughness.

The minimum width will be 50 feet from the edge of a watercourse or wetland when the soils are well drained or of hydrologic group A or B, the slope is five percent or less, and the existing vegetation cover is good, or is anticipated to be good when planted and established. The width may be increased up to 150 feet as the slope increases, or the vegetation cover is sparse, or the soils are of hydrologic groups C and D, or the watershed size and its land use present a significant runoff/erosion potential. Increasing the width will require thorough evaluation and good judgement. Such judgement may consider making the riparian buffer as much as one third of the distance from the streambank or wetland edge to the top of the pollutant source area if such area cannot be treated to reduce current runoff pollution.

Any increase in width may be reduced up to 50 percent by establishing a vegetative filter area as part of the buffer, just below the cropland, pasture, or feedlot. The purpose of the vegetative filter area is to provide sediment filtering, nutrient uptake and the space necessary to convert concentrated flow to uniform, shallow, sheet flow through the use of techniques such as grading, and shaping, and devices such as diversions, basins, and level lip spreaders. See Vegetated Filter Area BMP.

#### Buffer Vegetation

When possible encourage native grasses, shrubs, and trees to grow in the buffer area.

Planted vegetation should consist of native species if available. Any species recommended for the riparian buffer depend on the geographic location of the buffer. Suggested species to plant will be given by the Soil Conservation Service in collaboration with other agencies. Species lists should include a diversity of trees, shrubs, and grasses. Site preparation techniques and cultural practices should be included. Fertilizer, if used, must be used with caution, and based on a soil test. Application of nitrogen is generally not recommended.

#### Filter Area Vegetation

Vegetation in a filter area should consist of perennial grasses. Controlled grazing with

fencing if necessary may be allowed during dry periods as long as it is monitored to assure maintenance of a vigorous vegetative stand. Refer to the Vegetated Filter Area BMP.

## **Operation and Maintenance**

### General

The riparian buffer should be inspected annually and following severe storms for evidence of sediment deposits, erosion or concentrated flow channels. Prompt corrective action should be taken to stop erosion and restore sheet flow.

In a buffer area do not use fertilizers, pesticides, or any other chemicals to promote growth, i.e. allow natural growth, succession.

Buffer area vegetation should remain largely undisturbed.

Exclude vehicles and any livestock from a buffer except for approved stream crossings and controlled watering sites.

If a vegetated filter area is established, it may require periodic reshaping of earth structures, removal or grading of accumulated sediment and reestablishment of vegetation to ensure effectiveness of the downslope riparian buffer area. It should be maintained in accordance with the Vegetated Filter Area BMP.

## Roof Runoff Management

### Definition

A facility for collecting, controlling, and disposing of runoff water from roofs. "Amount planned" in schedule of implementation measured in number of units.

### Scope

This standard establishes the requirements for design, construction, and operation of roof management facilities. Such facilities include, but are not limited to erosion-resistant channels or subsurface drains installed along building foundations immediately below eaves, roof gutters, downspouts, and appurtenances.

### Purpose

To prevent clean roof runoff water from flowing into or across concentrated waste areas, barnyards, livestock or equipment laneways, equipment storage or maintenance areas, or other areas where roof runoff could increase the amount of water needing treatment or wash contaminants into surface or ground waters.

### Where Used

This practice applies where: 1) Roof runoff management is included as part of an approved waste management system plan; 2) roof runoff causes soil erosion or may come in contact with wastes; or 3) barnyard flood protection or improved drainage is needed.

### Water Quality Impacts

Collecting and diverting roof runoff from flowing through an area with organic waste or potentially erodible soil will lessen transport of contaminants to a watercourse, wetland, or to ground water.

### Planning Considerations

When planning Roof Runoff Management consider the following:

1. What and where are the areas of potential contamination (barnyard, waste storage or treatment areas, tilled fields)?
2. Where should roof runoff go? Consider diverting runoff to permanent pasture, grassed waterway, or a vegetated recharge basin. Limited amounts of clean roof runoff may be discharged to ground water via a dry well, provided the ground can assimilate the quantity of recharge and contaminated water cannot reach the dry well.
3. Use of roof water for livestock watering.

4. Needed size of gutters, downspouts, and outlet pipes (see Design Criteria below).
5. Need for fencing livestock out of disposal/dispersal area, for example, from a vegetated filter area.
6. Stabilizing the outlet location.

### Design Criteria

#### Materials

Roof gutters and downspouts may be made of aluminum, galvanized steel or plastic. Aluminum gutters and downspouts shall have a nominal thickness of at least 0.027 and 0.020 inch, respectively. Galvanized steel gutters and downspouts shall be at least 28 gage. Plastics shall contain ultraviolet stabilizers. Dissimilar metals shall not be in contact with each other to avoid corrosive reaction. For example, do not put aluminum nails through a steel roof, or aluminum gutters against galvanized roofing.

#### Type and Size

Refer to SCS engineering standard drawing for gutter installations which are resistant to damage from roof snow and ice.

Aluminum or steel gutters shall be box type of "OGEE" type with a five inch minimum width. Vinyl gutters shall have 3-1/2 inch minimum width.

#### Supports

Gutter supports shall have a maximum spacing of 48 inches for galvanized steel and 32 inches for aluminum or plastic. Hangers shall be nailed to the roof sheathing or fascia board at rafter locations wherever possible. Where needed, as on open ended rafters, a wedge shaped stringer can be installed parallel to the roof edge for gutter support.

The spike for spike and ferrule support shall be at least two inches longer than the gutter width on 24 inch or closer centers, and nailed into at least a two inch thick support board.

Downspouts shall be securely fastened at the top and bottom with intermediate supports.

#### Expansion Joints

Expansion joints shall be used on straight runs of 40 feet or more or on any other condition where normal movement due to expansion and contraction is restricted. Expansion joints for plastic gutters shall not be more than 25 feet apart.

#### Downspouts

The number and cross-sectional area of the downspouts used determines the runoff water capacity of the gutter system. They shall be spaced according to design flow to adequately handle the roof runoff volume. Downspouts of the following materials and sizes shall be located to drain no more than:

**Aluminum or Steel**

650 square feet of roof area for a 2 inch x 3 inch downspout; or  
1,300 square feet of roof area for a 3 inch x 4 inch downspout; or  
108 square feet of roof area per one square inch of downspout area.

**Vinyl**

400 square feet of roof area for a two inch diameter round downspout; or  
130 square feet of roof area per one square inch of downspout area.

**Underground Outlet**

If downspouts are connected to an underground outlet, the cross-sectional area of the underground outlet shall be at least as large as the total cross-sectional area of the downspouts connected to the outlet. The minimum underground outlet diameter shall be six inches. The underground outlet shall meet the requirements of the SCS Underground Outlet Standard No. 620. Outlets shall be located so as not to cause an erosion problem from the flow.

**Protection**

Downspouts and outlets shall be protected against damage from livestock and equipment by using heavy pipe or by protecting the pipe. Where needed, snow and ice guards can be installed on roofs and gutters can be installed below the projection of the roof line.

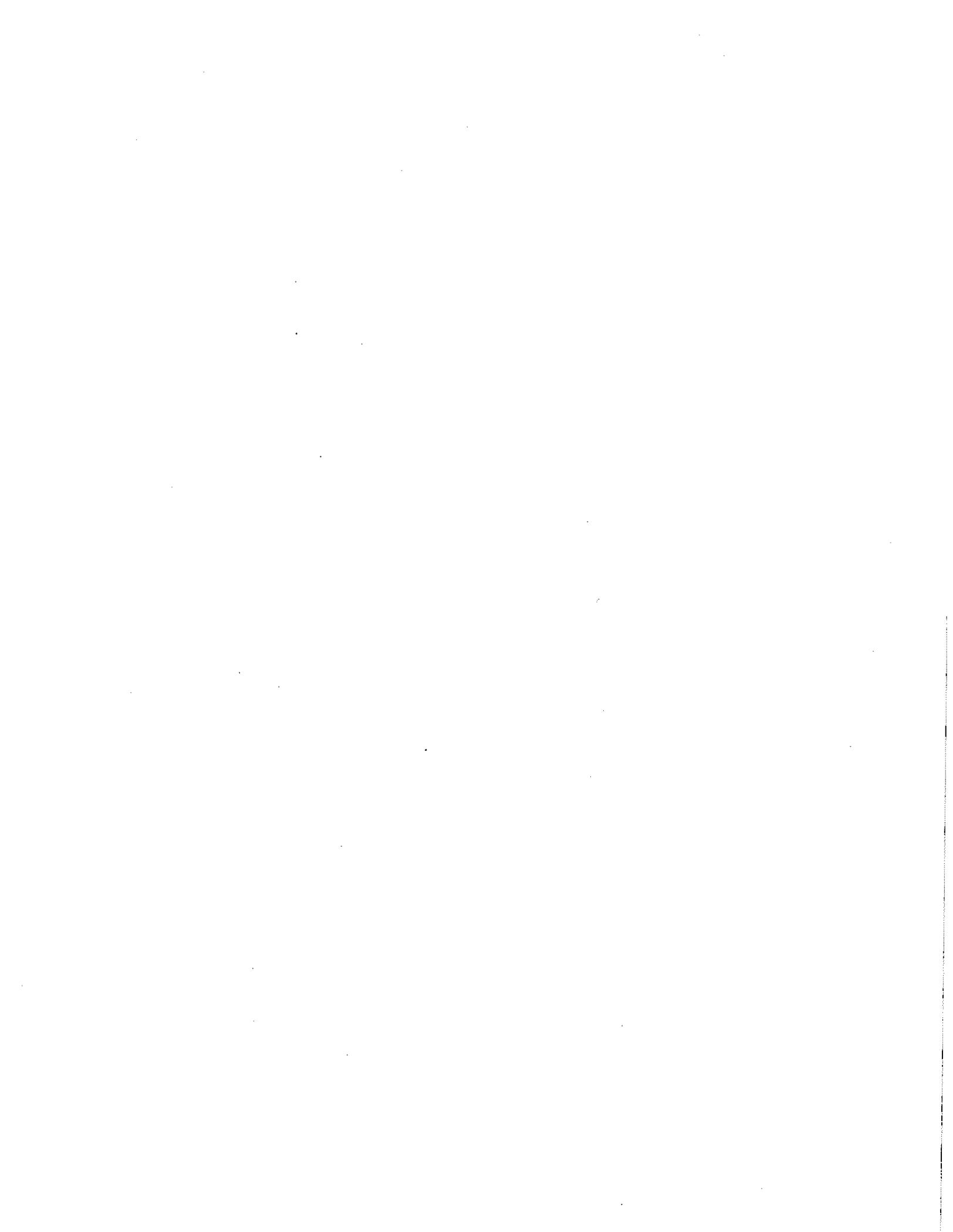
**Plans and Specifications**

Plans and specifications for installing roof runoff management facilities shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

**Maintenance**

Roof runoff management facilities need to be maintained in good operating condition. The following items should be part of a maintenance program for roof runoff management:

1. Clean leaves and debris from gutters semi-annually (fall and spring).
2. Keep downspouts clear.
3. Paint steel gutters and downspouts.
4. Repair damage or replace damaged gutters or downspouts as soon after damage as possible.
5. Clear any surface blockage to allow free outlet flow of downspouts - into channels, storm drains, etc.
6. Properly maintain associated facilities (e.g. grassed waterway, vegetated recharge basin).



## **Silage Leachate / High Strength Organic Waste Management**

### **Definition**

A planned system for the collection, storage, and disposal of liquid organic wastes high in biochemical oxygen demand (BOD), from agricultural operations in an environmentally acceptable manner. "Amount planned" in schedule of implementation measured in number of units.

### **Scope**

This standard provides guidelines for the collection, storage, and disposal of liquid high strength organic wastes. Such wastes include effluent from the storage or curing of corn or hay silage or other ensiled forages or supplements, manure storage facilities, or other high strength wastes on farms, or food processing plants.

### **Purpose**

To minimize production of high strength liquid agricultural wastes and to collect, store, and dispose of high strength liquid agricultural wastes in a manner that minimizes threats to ground water or surface water resources.

### **Where Used**

On farms or other land where silage leachate and / or high-strength organic wastes are produced.

### **Water Quality Impacts**

Silage leachate is an extremely strong organic waste. Reported biochemical oxygen demand (BOD) values range from 12,500 to 66,400 parts per million (ppm) or milligrams per liter (mg/l). The sugars and other compounds in silage effluent are decomposed rapidly when released into surface waters, using up large amounts of dissolved oxygen in the process.

One gallon of silage leachate can reduce the oxygen content of 10,000 gallons of stream water to a critical level for the survival of fish and other aquatic organisms. The effluent itself does not contain toxic materials. The cause of fish kills and destruction of benthic life is usually oxygen depletion.

When allowed to infiltrate into the soil in large quantities, silage leachate can deplete oxygen in the soil. The high oxygen demand, high reducing potential, and low pH of the effluent in contact with soil and/or bedrock can cause iron, manganese and other minerals to become soluble and leach into ground water. These minerals and effluent have the potential to contaminate well water supplies.

## Silage Leachate / High Strength Organic Waste Management - 1993

Most silage leachate is produced in the fall when flow rates in rivers and streams are at seasonal lows and water temperatures are at seasonal highs. The sudden release of silage leachate into surface water under these conditions can have a devastating effect on aquatic life. For surface water bodies and streams with low flow rates, discharge of silage effluent can result in destruction of aquatic life. Small feeder streams, wetlands, and ponds are particularly vulnerable to this type of pollution. Heavy growths of grey or white fungal mats which can tolerate anaerobic conditions are indicators of pollution from high strength organic wastes such as silage leachate.

It is important that farmers be aware of the nature and extent of the damage that can be caused by silage leachate entering groundwater or surface water. Farmers need to plan and install practices to prevent the release of this contaminant.

### Planning Considerations

Treatment to produce an effluent suitable for discharge is not recommended because of costs and size of the treatment facilities required. Disposal by concentrated infiltration is not recommended because of the potential for contamination of ground-water supplies. The goal is to prevent or minimize formation of silage leachate and to safely store and dispose of leachate generated.

The amount of silage leachate produced is directly influenced by the moisture content of the forage ensiled and the degree of compaction to which the forage is subjected. Silage leachate generated is also influenced by ground water, surface water runoff, and precipitation entering the storage structure.

Minimize ground-water seepage or surface water flow into the silage by subsurface drainage and/or diversion.

Minimize rain water infiltration by covering or roofing. Make sure covering is adequately secured.

Adding dry feed materials to the silage pile may reduce leachate. Alfalfa cubes, beet pulp, and chopped dry hay have been used successfully when added to the lower layers as the silo is being filled. In two reported cases, one farmer added 220 tons of alfalfa cubes to 3,000 tons of corn silage, another added 200 tons of alfalfa cubes to 2,000 tons of corn silage. Neither reported leachate problems.

The normal system is collection, storage, and land application of the liquid wastes alone or in a mixture with stored manure.

Site any new silage storage structures well above the water table and away from any surface water drainage. Location on well drained soils is recommended.

## Specifications

### General

Where rain water, surface water and subsurface water are eliminated from the silage, size the collection facilities for silage leachate, allowing for at least one cubic foot (7.5 gallons) capacity for each ton of forage harvested at 25 percent dry matter and placed in storage. Design for less capacity is needed for greater percent dry matter, and greater capacity is needed for less dry matter.<sup>1</sup>

Minimize silage leachate by:

1. Harvesting forage at a moisture content that will not result in excessive silage leachate production. At 28 percent dry matter, research shows no ensilage leachate. This may require planting a shorter season corn to ensure maturity at harvest date or wilting a grass silage in the field to reduce the moisture content before ensiling.
2. Covering the silage pile to eliminate rain infiltration and leaching.
3. Installing subsurface drains and/or diversions to separate ground water and surface water runoff from the ensiled forage. Drains installed too close or beneath the storage structure could be contaminated by leachate, unless separated by a watertight barrier.

### Collection

The collection system should be a watertight and corrosion resistant system to convey the leachate to either a tank, manure storage facility, or waste storage pond. Refer to the Waste Storage Structure BMP for guidance.

Clean surface runoff and rainfall should be excluded from the collection system.

### Storage

Design the storage in accordance with the Waste Storage Structure BMP. The storage may be for only leachate or for leachate and other agricultural wastes. Mixing may be desirable for dilution.

The tank or waste storage pond should have at least six months of storage capacity. The capacity should be based on estimates of juice production for the storage period, plus a rainfall factor, plus a safety factor to ensure no discharges. (Refer to the SCS Waste Storage Structure standard No. 313 and the SCS Waste Storage Pond standard No. 425 in the SCS Field Office Technical Guide.)

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<sup>1</sup> Consult CES dairy specialists for research results and recommendations

## Silage Leachate / High Strength Organic Waste Management - 1993

### Land Application

Characteristics of silage leachate:

Total Nitrogen	-	1000	to	5000 mg/l
Total Phosphorus	-	140	to	1400 mg/l
Potassium	-	800	to	4100 mg/l
pH	-	3.0	to	4.0
BOD	-	12,500	to	66,400 mg/l

The USDA, Soil Conservation Service, Agricultural Waste Management Field Manual provides typical characteristics for other high strength wastes.

Silage leachate, when mixed with manure, can be spread on cropland at the same rate as manure alone. Leachate should be spread in accordance with a waste utilization plan and nutrient management plan. See the Waste Utilization BMP and the Plant Nutrient Management BMP for guidance.

If silage leachate is stored alone, it can be spread on cropland at rates equivalent to daily manure, or about 8,500 gallons per acre. For hayland, apply at 1,250 gallons per acre or less. Depending on the strength of the leachate, mixing may be necessary prior to spreading to avoid burning vegetation.

## Streambank Protection

### Definition

Stabilizing and protecting banks of streams, lakes, or excavated channels from scour and erosion, using vegetative or structural means. "Amount planned" in schedule of implementation measured in number of feet.

### Purpose

To stabilize or protect streambanks for one or more of the following purposes: 1) to prevent the loss of land or damage to utilities, roads, buildings, or other facilities adjacent to the banks; 2) to maintain the capacity and/or stability of the channel; 3) to control channel meander that would adversely affect downstream facilities; or 4) to reduce sediment loads causing downstream damages and/or pollution.

### Where Used

Vegetative or structural streambank protection measures should be applied when riparian buffer vegetation is not sufficient to prevent bank erosion or when channel crossings need stabilization. Streambank protection is normally applied up to the elevation of the average annual flow condition.

### Water Quality Impacts

Stabilizing a bank will prevent immediate erosion of plant and soil materials into surface waters. Vegetation established on the bank can help filter upslope runoff, and reduce transport of sediments to the surface water. Impact on ground water is minimal.

### Planning Considerations

Investigate causes of streambank erosion, and evaluate alternative control practices, such as establishing riparian buffers upstream to reduce sediment - carrying high velocity flows.

Analyze the impacts of existing conditions versus the impacts of alternative planned practices.

When considering structural controls, weigh costs of such controls (including materials and labor, erosion, sedimentation, and habitat disturbance from construction) against costs of erosion associated with less intrusive or no control.

Consider all requirements of federal, state, and local government permitting agencies, as well as their long term planning goals.

Measures planned should be compatible with current and future uses of the watercourse,

adjacent land, and any structures.

Existing bank grade and the slope of land above must be considered. Upslope runoff may need to be diverted before applying stabilization measures.

Temporary sediment control measures such as silt fence or staked hay bales may need to be installed as sediment barriers at the toe of the bank during construction of any structural measures on the bank.

Streambank protection work shall be started and ended at a stabilized or controlled point on the stream.

Any channel clearing activities to remove stumps, fallen trees, sand bars, and foreign debris that cause the streamflow to scour the streambank shall be carefully evaluated. This is part of a hydraulic analysis. Evaluation may conclude that natural obstructions should not be removed, since they are integral components of the riparian system and slow the streamflow.

Changes in channel alignment shall be considered only after an evaluation of environmental effects.

When evaluation and analysis of streamflow velocity shows structural measures are needed, refer to appropriate SCS engineering standards for design.

Any structural measures must be effective for the design flow and be able to withstand greater floods without serious damage.

Extend vegetative stabilization to protect the upper parts of eroding banks, especially on areas that are within the riparian buffer.

Attention shall always be given to maintaining or improving habitat for aquatic and terrestrial wildlife.

#### Streambank Protection Measures

The following is a partial list of elements that may be included in a plan for streambank protection:

1. Removal of trees and brush only if they threaten the growth of desirable bank vegetation. Native vegetation should remain to the extent possible.
2. Grading and shaping of the slopes of streambanks if necessary to provide a suitable condition for vegetative protection or for the installation of structural bank protection.
3. Removal of fallen trees, stumps, debris, and sand and gravel bars that cause excessive scour. However, keep in mind that such obstructions may provide important aquatic habitat and may also slow streamflow, thus reducing overall erosion.

4. Placed or dumped heavy stone, properly underlaid with a filter blanket, if necessary, to provide armored protection for streambanks.
5. Deflectors constructed of rock, or other materials that project into the stream to protect banks at curves and reaches subjected to impingement by high velocity currents.
6. Structures, such as gabion stone baskets, built on or parallel to the stream to prevent scouring streamflow velocities adjacent to the streambank.
7. Fencing to protect native vegetation or new plantings, or to protect critical areas from damage from livestock or equipment traffic. Refer to SCS Fencing Standard # 382.

#### Vegetative Stabilization

Consider the impact to the stream of grading required to vegetatively stabilize a streambank. Grade eroded or steep slopes to a maximum slope of 3 to 1 (3 horizontally to 1 vertically). Remove overhanging bank edges. Topsoil should be saved for reuse. Existing shrubs and trees and other vegetation should be saved (or transplanted) where possible.

#### Establishing Grass Vegetation

Water tolerant species should be grown where wet soils are present. Suitable grass mixes are:

.4 lbs./1,000 sq. ft. Reed canarygrass, and  
.1 lbs./1,000 sq. ft. Redtop  
.5

or

.35 lbs./1,000 sq. ft. Reed canarygrass  
.10 lbs./1,000 sq. ft. Redtop  
.25 lbs./1,000 sq. ft. Bird's-foot trefoil with inoculant  
.70

Reed canarygrass (*Phalaris arundinacea*) seed can be sown on very damp bank soil, provided that the seeded surface is not covered by water for six months after sowing. Do not confuse Reed canarygrass with Canary grass (*Phalaris canariensis*), which is not native and should not be used.

Seedings should be made April 1st through June 15th, or August 15th through September 15th. These mixes are not suitable for mid-summer seedings.

Reed canarygrass can be planted from slips (cuttings) taken from existing beds during the dormant season. Rhizomes and shoots are carefully removed from the earth without bruising the buds or the tips of the sprouts. Place in holes or narrow trenches, along the line of the average summer water level, so that only the stem

sprouts are showing above the soil.

Streambank vegetation can be planted in conjunction with riprap or other stone facing by planting clumps, rhizomes or shoots in the crevices and gaps along the line of the average summer water level.

Mulch should be used with permanent seedings.

### Establishing Shrub Vegetation

Shrubs provide protection, and can be established relatively quickly. Shrubs hold the soil with their root systems and reduce water velocities. They also protect tree trunks from damage caused by breaking ice and help to prevent the formation of strong eddies around large trees during flood flows. See Figure 1 for species to plant.

When selecting shrub species to plant, recognize any established streambank shrubs which are providing protection. Use native species, if possible. Do not plant invasive non-native species which crowd out native plants (e.g. Kudzu, Multiflora Rose, Asiatic Bittersweet, Autumn Olive, Winged Euonymus, European Buckthorn, "Rem Red" Amur or Japanese Honeysuckle).

Shrub willows, shrub dogwoods, and other shrubs can be planted as cuttings, slips, or stems.

Willows can be planted as one-year-old nursery-grown rooted cuttings or as fresh hardwood cuttings gathered from local mother-stock plantings. Dogwoods and alders should be nursery-grown seedlings one or two years old. Fresh cuttings should be 3/8- to 1/2-inch thick and 12 to 18 inches long. They should be kept moist. If not used at once, they should be stored in cool, moist sand.

Streambanks are often difficult to plant, even when they are well-sloped. This is especially true in gravel or on steep banks. Where mattocks or shovels are unsatisfactory tools, a stiff steel bar, such as a crowbar, is better. The best tool for this purpose is a planting dibble, which is a heavy metal tool with a blade and a foot pedal. It is thrust into the ground to make a hole for the plant.

Rooted cuttings should be planted vertically in the bank with one or two inches of wood protruding above the ground surface. They should be planted in a hole large enough to accommodate the root system when well spread. The plant roots must be maneuvered into the bottom of the hole so they will grow down instead of up. The roots should not be twisted, nor should they be exposed above the ground surface. After the plant is placed, the dibble bar can be installed a few inches away from the plant to close the hole. Slow-release fertilizer should be applied on the surface, not in the hole. The soil should be tamped adequately to provide complete contact between the soil and the cutting. Cuttings should be planted six to eight feet on center in at least two rows, middle and bottom of the streambank. Plantings should be made early in the spring to ensure adequate moisture for growth.

Nursery grown plants may be planted for evergreen ground covers.

Since shrubs are generally not effective for the first two years, grasses should be seeded and mulch applied immediately following shrub planting to provide initial streambank protection.

#### Vegetation Maintenance

Streambanks are always vulnerable to new damage. Repairs are needed periodically. Banks should be checked after every high-water event is over. Gaps in the vegetative cover should be filled with new plants, and mulched if necessary. Fresh cuttings from other plants on the bank can be used, or they can be taken from mother-stock plantings if they are available.

#### Structural Stabilization

When evaluation and analysis of streamflow velocity shows structural measures are needed, refer to appropriate SCS standards and technical design information.

#### Fish and Wildlife

Special attention shall be given to maintaining or improving habitat for fish and wildlife.

#### **Design Criteria**

Because each reach of channel, watercourse, or shoreline is unique, protection planned and designed must be adapted to the specific site. Refer to the SCS Field Office Technical Guide (FOTG), Engineering Field Manual, and related SCS engineering guidance. Designs and specifications shall be prepared accordingly.

The landowner must apply for, and secure, any required local inland wetland agency permit, as well as applicable state and/or federal permits before commencing work.

FIGURE 1. RECOMMENDED SHRUBS FOR STREAMBANK PROTECTION

Common Name ( <i>Botanical Name</i> )	How to Plant	Years to Provide Cover	Mature Height (ft.)	Fertility Needs <sup>1</sup>	Acidity Needs <sup>2</sup>	Soil Texture <sup>3</sup>	Drought Tolerance <sup>4</sup>	Shade Tolerance <sup>5</sup>
<b>WILLOWS</b>								
Pussy willow ( <i>Salix discolor</i> )	Rooted or unrooted cuttings	2-4	10-18	M	A	C, L, S	P	G
Silky willow ( <i>Salix sericea</i> )								
<b>DOGWOODS</b>								
Grey dogwood ( <i>Cornus racemosa</i> )	Container grown or bare root							
Silky dogwood ( <i>C. amomum</i> )	seedlings plant 2 ft. apart	3-5	8-12	M	SA	C, L, S	F	F
Red osier ( <i>C. stolonifera</i> )								
<b>VIBURNUM</b>								
Amer. cranberry ( <i>V. trilobum</i> )	2-year old seedlings plant 4 ft. apart	4-5	6-7	M	SA	C, L, S	P	F
Witherod ( <i>V. cassinoides</i> )								
Nannyberry ( <i>V. lentago</i> )								

<sup>1</sup> Fertility Needs: M = Moderate and L = Low

<sup>2</sup> Acid Needs: A = Acid and SA = Slight Acid

<sup>3</sup> Soil Texture: C = Clay, L = Loam and S = Sand

<sup>4</sup> Drought Tolerance: P = Poor, F = Fair, and G = Good

<sup>5</sup> Shade Tolerance: F = Fair and G = Good

Source: U.S. Department of Agriculture, Soil Conservation Service, Storrs, Connecticut and Connecticut Geological and Natural History Survey, Hartford, Connecticut

## **Stripcropping, Contour**

### **Definition**

Stripcropping is defined as growing annual and perennial crops in a systematic arrangement of strips or bands. When the system is planted on the contour, it is called contour stripcropping. "Amount planned" in schedule of implementation measured in number of acres.

### **Purpose**

To reduce runoff and erosion on sloping cropland.

### **Where Used**

On cropland where slopes are usually less than 12 percent and where the topography is uniform enough to permit tilling and harvesting operations.

### **Water Quality Impacts**

Stripcropping can reduce the volume of surface runoff by as much as 85 percent compared to up and downhill row crop farming. The practice improves surface water quality by reducing erosion, promoting infiltration, and reducing the amount of sediment and associated agricultural chemicals that would otherwise be carried from the field in surface runoff. The impact of the practice on ground-water quality has not been well evaluated. As water infiltration is enhanced, there is a potential for increased leaching of excess soluble fertilizers and pesticides to ground water; however the presence of sod strips in permanent vegetation may increase utilization of nutrients and reduce the potential for leaching, especially between harvest and planting.

### **Planning Considerations**

Stripcropping should be performed in conjunction with plant nutrient management and pest and pesticide management practices to prevent leaching of excess chemicals.

Consider the livestock feed requirements of a farm operation when deciding crops to be grown and cropping sequences.

Strip widths of crops should accommodate planting, harvesting, and cultivation equipment. Row crop strips should contain an even number of rows for efficient operation.

Permanent or temporary markers may be needed for visual reference by equipment operators.

Where planting on the contour is not possible within the guidance of this standard, consult with SCS for other field stripcropping options.

## Specifications

### Guideline Alignment and Row Gradient

Where there are no existing guidelines, they will be established. The first (top) guideline will be located one terrace spacing down from the crest of the hill. If additional guidelines are needed to meet row gradient, they will be spaced at the appropriate terrace interval (Refer to SCS Terrace Standard No. 600).

The gradient of the guidelines will not exceed two percent (2%) for more than 150 feet in any one direction. In no case will the guideline gradient exceed four percent (4%).

### Row Gradient and Tillage Direction

Rows and tillage will follow existing terraces, diversions, or established guidelines.

#### Conventional Tillage

The row gradient will not exceed two percent (2%) for more than 150 feet in any one direction. In no case will the row gradient exceed four percent (4%). All tillage will follow the row gradient.

#### Conservation Tillage

The row gradient will not exceed two percent (2%) for more than 150 feet in any one direction. All tillage will generally follow the row gradient.

### Tillage and Planting

All tillage and planting operations will be done parallel to the guidelines. Cover crops should be established on row crop strips to provide at least 3,500 pounds of residue per acre over winter. See Cover Crop and Green Manure BMP.

### Establishment of Strips

Strips will be established by measuring from staked-out guidelines. The field may also be contoured the first year, parallel rows counted, and odd areas or correction areas seeded into the sod strips the second year. If the sod strips vary in width, the strips will need to be adjusted when rotated to keep row crop strips with parallel rows.

Where practical, the strips need not be rotated as long as the cropping system and strips are designed to meet the soil loss tolerance value "T" (see Section I-C, of the SCS Field Office Technical Guide, (FOTG)). Re-establishment of sod strips can be done by interseeding. Sod strips should be retained on the steeper more erodible slopes.

### End Rows or Headlands

End rows exceeding three percent (3%) slope should be seeded to permanent vegetation.

### Water Control Practices

Where water collects in draws or creates rill erosion, appropriate water control practices (waterways, diversions, terraces) will be installed.

### Calculating Maximum Strip Widths

#### Equal Width Alternates of Row Crop and Sod or Small Grain (Practice A or P<sub>2</sub>)

Strip widths for row crops shall be calculated in accordance with the Universal Soil Loss Equation (USLE), as described in Section I-C, SCS FOTG and Table 1, with such deviations as necessary to conform to topography, accommodate farm equipment, and control erosion. To use Table 1:

- 1) Use the USLE to calculate the estimated soil loss for the existing cropping system;
- 2) Establish the desired soil loss target
- 3) Adjust the USLE cropping factor "C factor" for the proposed cropping system. (For strips of equal width, this value is equal to one-half of the "C factor" without stripcropping);
- 4) Solve the USLE to determine the maximum practice factor ( $P_{max}$ ) that will meet the soil loss target for the proposed cropping system ( $P_{max} = A/RKLSC$ );
- 5) Using Table 1, read across the appropriate land slope line and ensure that  $P_{max}$  equals or exceeds  $P_a$ ;
- 6) If  $P_{max}$  is less than  $P_a$ , consider a cropping system with a lower "C" factor or adjust the soil loss target higher until  $P_{max}$  exceeds  $P_a$ ;
- 7) If the proposed  $P_{max}$  meets the requirement of Table 1, continue to read across the land slope percent line to determine the maximum row crop strip width and maximum allowable slope length for the stripcropping system.

Seeded strips shall be at least as wide as the row crop strips. Seeded strips can vary in width, as long as the narrowest section is at least as wide as the row crop strip. Strips of row crops will be parallel, and should have an even number of rows adjusted to planter width.

Seeded strips should contain the row correction areas.

#### Buffer Stripcropping - Strips of Row Crops and Narrower Strips of Sod (Practice B or P<sub>3</sub>)

Buffer stripcropping is not applicable on slopes greater than 12 percent.

Strip widths for row crops shall be calculated in accordance with the Universal Soil Loss Equation (USLE), as described in Section I-C, SCS FOTG and Table 2 with such deviations as necessary to conform to topography and farm equipment and to control erosion. The location of the sod strips is determined by the width and arrangement of adjoining strips to be cropped in the rotation and by the location of steep, or severely eroded areas on slopes.

To use Table 2:

- 1) Use the USLE to calculate the estimated soil loss for the existing cropping system;
- 2) Establish the desired soil loss target
- 3) Adjust the USLE cropping factor "C factor" for the **proposed** cropping system. (Multiply the current "C factor" by the percent of the field that will remain in row crops, for example, if the field is to be converted from 100% row crops to 60% row crops and 40% sod buffer strips, multiply the "C factor" by 0.6.)
- 4) Solve the USLE to determine the maximum practice factor ( $P_{max}$ ) that will meet the soil loss target for the proposed cropping system ( $P_{max} = A/RKLS C$ );
- 5) Using Table 2, read across the appropriate land slope line and select  $P_b$  based on the percent of the field proposed to be converted to sod buffer strips and ensure that  $P_{max}$  equals or exceeds  $P_b$ ;
- 6) If  $P_{max}$  is less than  $P_b$ , consider a cropping system with a lower "C" factor or increase the percent of sod buffer strips proposed or adjust the soil loss target higher until the recalculated  $P_{max}$  exceeds  $P_b$ ;
- 7) If the proposed P factor value meets the requirement of Table 2, use Tables 3-a through 3-d to determine the buffer strip widths based on the proposed row crop strip width and  $P_b$  value.

Row crop strips will be parallel with an even number of rows adjusted to planter width. Sod strips can vary in width, but the narrowest section must meet the minimum width requirement. Sod strips should contain the row correction areas.

### Operation and Maintenance

All farming operations must be conducted parallel to any established markers. Sediment build-up at adjacent strip interfaces should be removed to allow for uniform flow of runoff and reduce the potential for concentrated flow.

TABLE 1

 $P_{max}$  must equal or exceed  $P_a$  value

Land Slope Percent	Equal Widths Row Crops and Sod	Equal Widths Row Crops and Small Grain	Maximum Row Crop Strip Width <sup>2</sup> (ft)	Maximum Slope Length (ft)
	$P_a$ -Value <sup>1</sup>			
1 to 2	0.30	0.60	130	800
3 to 5	0.25	0.50	100	600
6 to 8	0.25	0.50	100	400
9 to 12	0.30	0.60	80	240
13 to 16	0.35	0.70	80	160
17 to 20	0.40	0.80	60	120

<sup>1</sup> P-Values (Practice factor of Universal Soil Loss Equation, Section I-C, FOTG):

<sup>2</sup> Adjust strip width, generally downward, to accommodate farm equipment.

TABLE 2

 $P_{max}$  must equal or exceed  $P_b$  value

Land Slope Percent	Maximum Width Row Crop (ft)	$P_b$ Values Based on Percent of Field in Sod Buffer Strips				Maximum Slope Length (ft)
		20%	30%	40%	50%	
1 to 2	120	0.50	0.40	0.35	0.30	600
3 to 5	100	0.40	0.35	0.30	0.25	450
6 to 8	90	0.40	0.35	0.30	0.25	300
9 to 12	70	0.50	0.40	0.35	0.30	180

TABLE 3

## Buffer Strip Widths For Varying Row Crop Widths

TABLE 3-a: 1 to 2 Percent Slopes

Row Crop - Strip Width	"P <sub>b</sub> " Values			
	0.50	0.40	0.35	0.30
(ft)	(ft)	(ft)	(ft)	(ft)
120	30	52	80	120
110	28	48	74	110
100	25	43	67	100
90	23	39	60	90
80	20	34	54	80
70	18 <sup>3</sup>	30	47	70
60	18	26	40	60

TABLE 3-b: 3 to 5 Percent Slopes

Row Crop - Strip Width	"P <sub>b</sub> " Values			
	0.40	0.35	0.30	0.25
(ft)	(ft)	(ft)	(ft)	(ft)
100	25	43	67	100
90	23	39	60	90
80	20	34	54	80
70	18 <sup>3</sup>	30	47	70
60	18	26	40	60

<sup>3</sup> Minimum buffer strip width

TABLE 3-c: 6 to 8 Percent Slopes

Row Crop - Strip Width	"P <sub>b</sub> " Values			
	0.40	0.35	0.30	0.25
(ft)	(ft)	(ft)	(ft)	(ft)
90	23	39	60	90
80	20	34	54	80
70	18 <sup>3</sup>	30	47	70
60	18	26	40	60

TABLE 3-d: 9 to 12 Percent Slopes

Row Crop - Strip Width	"P <sub>b</sub> " Values		
	0.40	0.35	0.30
(ft)	(ft)	(ft)	(ft)
70	30	47	70
60	26	40	60

<sup>3</sup> Minimum buffer strip width.



## Terrace

### Definition

An earth embankment, a channel, or a combination of ridge and channel constructed across the slope and capable of being cropped . "Amount planned" in schedule of implementation measured in number of feet.

### Scope

This standard applies to the planning and design of all types of terraces. It does not apply to diversions.

### Purpose

Terraces are used to: 1) reduce slope length; 2) reduce erosion and sedimentation; 3) intercept and conduct surface runoff at a non-erosive velocity to a stable outlet; 4) retain runoff for moisture conservation; 5) regrade the land surface for easier farming; and 6) reduce downstream flooding.

### Where Used

This practice applies where:

1. Cropland and runoff cause soil erosion.
2. There is a need to conserve water.
3. The soils and topography are such that reasonably uniform terraces can be constructed and farmed without undue effort.
4. A suitable outlet can be provided.
5. Runoff and sediment damage land or improvements downstream or impair surface water quality.

### Water Quality Impacts

Terraces can improve surface water quality by reducing soil erosion and trapping sediment and associated pollutants. However, by collecting runoff and efficiently conveying it to an outlet, terraces may concentrate discharges of pollutants to receiving streams or wetlands. Generally, terraces have little impact on ground water quality; however, because they increase infiltration, level or storage terraces may increase delivery of dissolved pollutants to ground water.

### **Planning Considerations**

Terraces must be planned and installed as part of a resource management system that includes at a minimum plant nutrient management and pest and pesticide management.

Consider the need for other practices such as conservation tillage or contouring to minimize water quality degradation.

Consider the outlet location. Use a vegetated filter area, grassed waterway, or water and sediment control basin, if necessary, to treat runoff.

### **Design Criteria**

The design and installation shall be based on adequate surveys, investigations and computations.

#### Spacing

When determining terrace spacing, try to allow for an even number of trips for anticipated row crop equipment and the maximum opportunity for changing row widths and number of rows per equipment.

Terrace spacing shall be calculated in accordance with the Universal Soil Loss Equation (USLE) as described in Section I-c, SCS Field Office Technical Guide (FOTG) and the criteria in the SCS Terrace Standard No. 600.

#### Alignment

Terraces shall be designed to be parallel to the contours and as parallel as practical to each other. Curves should be long and gentle to accommodate farm machinery. Minimize the use of point rows as much as possible. Land forming, extra cut or fill along the terrace line, multiple outlets, variations in grade, channel blocks, and other methods can be used to achieve good alignment.

#### Outlets

All terraces must have adequate outlets. The outlet requirements vary with different types of terraces. Vegetated outlets shall be used for open-end terraces. Such an outlet may be a grassed waterway or a vegetated filter area. Riprap or other structural measures may also be used to provide a non-erosive outlet. The outlet must convey runoff water to a point where no erosion or flooding damage will occur.

Soil infiltration may be used as the outlet for level ridged closed-end terraces, except in aquifer protection areas. Soil infiltration must permit draining the design storm from the terrace channel within a reasonable period so that crops are not significantly damaged by standing water. Blind inlets may be used where they are effective, usually in well-drained soils.

Combinations of different types of outlets may be used on the same system to provide for economical installation of a more farmable system.

A stable outlet shall be provided before the terrace is constructed. The water surface in the terrace shall not be lower than the water surface in the outlet at their junction when both are operating at design flow.

#### Other Design Criteria

Capacity, cross section, end closures, channel grade, terrace length, and outlets shall be designed and constructed in accordance with SCS Terrace standard No. 600.

#### Vegetation

All areas to be vegetated (steep front and back slope terraces) shall be established to grass as soon as practicable after construction. The sod shall be maintained and trees and brush controlled by annual mowing.

#### **Safety and Maintenance**

A maintenance program shall be established for checking and maintaining the terrace capacity, storage, ridge height, outlets, and the proper functioning of the system. Each inlet for underground outlets must be kept clean, and sediment build-up must be redistributed so that the inlet is in the lowest place in the channel. Inlets damaged or cut off by farm machinery must be replaced or repaired immediately. Immediate maintenance is also required after any damaging storm. Failure of one terrace frequently results in serious field erosion and failure of terraces downhill.

Terrace ridges, especially those with steep back slopes can be very hazardous. For this reason some farmers prefer steep front slopes, thus keeping machinery away from the steep back slopes. All cut and fill slopes that are to be farmed must be no steeper than 6 to 1. Normally they should be 8 to 1 or flatter for satisfactory operation of farm equipment. Any hazards must be brought to the attention of the responsible person.

#### **Terrace Restoration**

Existing terraces are considered to be nonfunctional when either of the following exists:

1. The existing terrace system has horizontal spacings that will not permit the allowable soil loss to be attained using the producer's normal cropping sequence and residue management program; or
2. The existing cross sectional area is less than 67 percent of the minimum cross sectional area described in this standard.

Supporting information should be prepared to show whether the system is functional in accordance with the above criteria. Restored terraces shall be designed in accordance with this BMP and SCS Terrace standard No. 600.

## **Plans and Specifications**

Plans and specifications for installing terraces shall be in keeping with this BMP and SCS Terrace standard No. 600 and shall describe the requirements for applying the practice to achieve its intended purpose.

Construction operations shall be carried out in such a manner that erosion and air and water pollution will be minimized.

Construction drawings and specifications shall show the location, cut and fill requirements, channel grade, constructed cross section, and where each terrace is to outlet. Sufficient copies of the drawings and specifications shall be provided to the landowner or land operator and the contractor.

## **Terrace Specifications**

### Location

The location of the terraces shall be as shown on the plans or as staked in the field.

### Site Preparation

Vegetation and unsuitable materials shall be removed from the work area. The original ground surface below the terrace ridge shall be scarified to provide a good bond between it and the fill material. Woody materials, rocks (larger than 6-inches in diameter), and trash shall not be allowed in the terrace fill material. All dead furrows, ditches, or gullies shall be filled before constructing the terrace or shall be part of the construction. All old terraces, fence rows, hedge rows, trees, and other obstructions shall be removed, as necessary, to install a farmable system.

### Construction

The terraces shall be constructed to the planned alignment, grade, and cross section as staked in the field.

Materials for earth fills shall be obtained from the required channel excavation or other designated areas and shall be of suitable materials.

Any ditch or depression at the toe of the back slope shall be filled and smoothed so that drainage will be away from the terrace and not parallel to it. Terrace ridges constructed across gullies or depressions shall be compacted by construction equipment travel or by other suitable means to insure proper density and functioning of the terrace.

Topsoil shall be stockpiled and spread over excavations and other areas to facilitate restoration of productivity. If vegetation is required, seedbed preparation, fertilizing, seeding, and mulching shall comply with specifications in the applicable BMPs.

Outlets

Provisions must be made to prevent piping if underground conduits are located under terrace ridges. The trench sidewalls beneath the ridge shall be sloped 2:1 or flatter before back filling unless the outlet is installed early enough to allow adequate settlement before the terrace is built, usually a minimum of six months.

Each earthen terrace outlet cross section shall be equal to or greater than the designed terrace cross section. The surface of the finished terrace shall be reasonably smooth and present a workmanlike finish.



## Vegetated Filter Area

### Definition

An area of vegetation planted and maintained to slow runoff and remove sediment and organic matter and associated structures to remove solids. "Amount planned" in schedule of implementation measured in acres for filter areas to treat agricultural wastewater and runoff from barnyards and is measured in feet for filter areas to treat runoff from cropland.

### Scope

This standard establishes the minimum requirements for design and operation and maintenance of vegetated filter areas for removing sediment and organic matter from runoff or waste water.

### Purpose

To remove sediment and other pollutants from runoff or waste water by filtration and deposition.

### Where Used

This practice applies: 1) on cropland at the lower edge of fields or upgradient of conservation practices such as terraces or diversions, or on fields next to wetlands, streams, ponds, and lakes and 2) in areas requiring vegetated filter areas as part of a waste management system to treat polluted runoff or waste water.

### Water Quality Impacts

Vegetated filter areas can improve surface water quality by removing sediments and adsorbed phosphorus and pesticides from runoff. Vegetated filter areas generally have little impact on ground water quality, except that filter areas which incorporate stone-lined trenches may increase leaching of nutrients and pesticides.

### Planning Considerations

Evaluate type and quantity of pollutant, slopes and soil characteristics, grass/legume species to be established, time of year for proper establishment of vegetation, visual aspects, fire hazards, and other special needs.

If vegetated filter areas are to be used in treating waste water or polluted runoff from concentrated livestock areas, the following must be considered:

## Vegetated Filter Area - 1993

1. Facilities (basin or trenches) to remove solids before directing the flow through the filter area.
2. Selection of plant species suitable to soil drainage and exposure conditions. Refer to the SCS Critical Area Planting Standard No. 342 for best vegetative cover.
3. Provisions for preventing continuous or daily discharge of liquid waste, unless the area is adequate for infiltrating all daily applied effluent. Enough rest periods to maintain or re-establish an aerobic soil profile. Storage or alternate filter areas may be desirable.
4. Reduced effectiveness of vegetated filter areas under snow or frozen conditions.
5. Provisions for excluding roof water and unpolluted surface runoff.
6. Filter area slopes less than five percent are more effective; steeper slopes require a much greater area to remove sediment.
7. The use of dosing mechanisms and level spreaders or sprinklers to distribute flow uniformly across the top of the filter strip.
8. Stone berms or stone-filled trenches with berms placed perpendicular to the flow line to re-establish sheet flow throughout the length of the strip.
9. Provision to keep the polluted water in filter strips away from streams, ditches, grassed waterways and other concentrations of unpolluted water.

Vegetated filter areas by themselves will not satisfy the "no-discharge" requirement applicable to the large operations requiring permits under the National Pollutant Discharge Elimination System. More stringent pollution abatement measures may be necessary to protect receiving waters.

### Design Criteria

Plant the filter area in accordance with the SCS Critical Site Planting Standard No. 342.

#### Vegetated filter areas for sediment and related pollutants

These criteria apply to filter strips on cropland at the lower edge of fields, on fields, on pastures, or in manure spreading areas adjacent to streams, ponds, and lakes, and above conservation practices such as terrace or diversions.

Vegetated filter areas are not suitable for treating runoff from slopes steeper than 10% or from fields with erosion rates above ten tons per acre per year.

The width of the vegetated filter area, which is equal to the flow length of runoff, shall be sized proportionately as follows:

<u>Slope of contributing cropland</u>	<u>Filter Area Width</u>
Less than 1%	15 ft.
10%	50 ft.

Recommended strip widths are for situations where erosion from upgradient cropland is within acceptable soil loss limits, usually between three and five tons/acre/year.

Filter strips for runoff from concentrated livestock areas

These criteria apply to filter strips for feedlot and barnyard runoff.

Settling basin

A settling basin shall be provided between the waste source and vegetated filter area. The minimum storage volume for the settling basin, in cubic feet, shall be determined by multiplying the peak inflow rate in cubic feet per second resulting from a 2-year, 24-hour rainfall by 900 seconds (15 minutes).

Two or more inches of rain in 24 hours are considered a significant runoff event. Removed sediment and/or organic solids should be disposed of in the same manner as manure. If the settling area is not cleaned after each significant rainfall event, additional storage for solids shall be provided equal to at least 0.1 inches per month from the contributing drainage area.

Vegetated Filter Area

The filter area shall be sized to accommodate both the maximum hydraulic loading rate and the minimum detention time specified below.

The maximum hydraulic loading rate shall be 2 inches per week, based on the volume of runoff from the highest long term average monthly precipitation from the contributing drainage area. A maximum hydraulic loading rate of 1 inch per week is desirable.

The minimum filter area flow through time shall be 15 minutes at a maximum flow depth of 1/2 inch or 30 minutes at a maximum flow depth of 6 inches. The filter area shall be sized for the peak outflow from the settling basin for a 2-year, 24-hour storm from the total contributing area.

Filter area slopes shall not exceed 15%. Slopes less than 5% are desirable. Filter areas shall have stone-filled trenches with berms placed perpendicular to the flow line at 50 foot intervals or less. As slope increases, the distance between level spreaders shall decrease.

Distance to bedrock and ground water will be evaluated on a case by case basis, taking into account the waste waters to be treated and the point of environmental concern (wells, surface water). Wells that may be affected by the filter area shall be shown on a map of the site.

The width of the vegetated filter area shall not exceed 100 feet.

Sheet flow shall be established in the vegetated filter area through the use of trenches with berms, berms alone, above-ground dosed perforated pipe, or sprinklers. Sheet flow shall be maintained in the filter area through the use of level spreaders (trenches with berms or berms alone). Level spreaders shall be spaced at 50 foot intervals or less. Level spreaders shall be constructed of 2 inch D.O.T. stone with a minimum stone height of 6 inches.

Vegetated filter areas for controlled overland flow treatment of liquid wastes

These criteria apply to vegetated filter areas for waste water from milk parlors, milking centers, waste treatment lagoons, limited food processing<sup>1</sup>, and animal waste storage facilities.

If significant solids are present in the wastewater, provide a storage area with a minimum of one day detention time for removal of solids.

The maximum hydraulic loading rate shall be 2 inches per week. A hydraulic loading rate of 1 inch per week is desirable.

Filter area slopes shall not exceed 15%. Slopes less than 5% are desirable. Filter areas shall have stone-filled trenches with berms placed perpendicular to the flow line at 50 foot intervals or less. As slope increases, the distance between level spreaders shall decrease.

Distance to bedrock and ground water will be evaluated on a case by case basis, taking into account the waste waters to be treated and the point of environmental concern (wells, surface water). Wells that may be affected by the filter area shall be shown on a map of the site.

Daily application times shall not exceed six hours, and shall be decreased to two hours for more concentrated wastes such as that from animal waste storage facilities. Filter areas should be rested at least two days each week.

The width of the vegetated filter area shall not exceed 100 feet.

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<sup>1</sup> This standard does not apply to food processing wastewaters in excess of ??? gallons per day or to wastewaters from food processing operations which normally handle food not produced on the agricultural operation.

### **Operation and Maintenance**

The vegetated filter area must be established before initial use. Where possible, grass filters should not have sediment laden water applied to them for one year.

A narrative plan will be prepared for operation and maintenance of the vegetated filter area. It will cover:

1. Inspection after major storm events, and at least quarterly. (Two or more inches of rain in 24 hours should be considered a major storm event.)
2. Timely repair of any erosion rills or channels to restore even sheet flow.
3. Management of the vegetation covering the filter area. Grassed filter areas on well-drained soils should be mown and raked at least once a year to maintain quality of growth and remove undesirable vegetation. Wetland plants should be allowed to grow on filter areas where establishment of a constructed wetland will provide treatment of waste water.
4. Maintenance of a dense vigorous vegetative stand throughout the year.
5. Removal of any sediments, organic solids, or debris which may interfere with the filtering function.
6. Cleaning of the settling basin at frequencies determined by the design.
7. Exclusion of livestock, with fencing if necessary.

### **Specifications**

Plans and specifications for filter strips shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.



## Vehicle and Equipment Storage and Maintenance

### Scope

This standards covers the storage, maintenance, and repair of all agricultural equipment, including vehicles. It also covers the disposal of used equipment and parts.

### Purpose

To minimize the risk of water pollution from leaks or spills associated with routine maintenance, repair, and storage of farm equipment and vehicles by ensuring the safe use, collection, and proper disposal of petroleum products and other potential pollutants, such as degreasing fluids and cleaning solvents, associated with equipment maintenance and repair.

### Where Used

On all agricultural operations where equipment or vehicles are repaired, maintained, or stored.

### Water Quality Impacts

Maintenance and repair of vehicles and machinery can result in ground water contamination because petroleum products, solvents, brake fluid, coolant, and other potential ground water contaminants can leak or spill onto the ground, and also because proper disposal may be expensive or inconvenient, or the operator may simply not know all the requirements. Implementation of this BMP can minimize the chance of spills, allow for cleanup in the event of a spill or leak, and minimize the amount of chemicals used and wastes generated.

### Planning Considerations

Ensure that vehicles and equipment are well-maintained and that any leaks are promptly repaired.

Conduct an inventory of vehicle and equipment maintenance and repair activities on the farm. Worksheet 1 appended to this BMP can be used as a guide in assessing the amount and types of maintenance and repair being done.

Conduct an assessment of the existing facilities for equipment maintenance and repair, using Worksheet 2.

In general, operations doing maintenance and repair on more than one truck and one tractor should do such work in a workshop as described below. Consider having maintenance and repairs done off the farm at a properly equipped garage if the amount of service required does not warrant the cost of constructing such a workshop.

## Vehicle and Equipment Storage and Maintenance - 1993

Conduct an inventory of potential water pollutants associated with equipment maintenance and repair on the farm. Use Worksheet 3 to identify typical materials of concern, including wastes. How are wastes disposed of?

Consider substituting water-based cleaners and detergents for solvents and caustic solutions.

### Workshop design

With the exception of minor and emergency repairs (hose and belt replacements) done in the field, maintenance and repairs done on the farm should be done in a workshop designed for safe chemical storage, spill containment, and worker safety. This workshop should meet the following design criteria:

1. It should be big enough to accommodate any vehicle or piece of equipment on the farm, with doors allowing easy access.
2. The workshop should be protected from the weather with walls and roof. It should have an impervious floor (concrete or asphalt, sealed with a material impervious to petroleum and solvents), which is kept in good repair (no cracks or holes through which chemicals can reach the ground). There should be NO floor drains unless connected to a holding tank; however, the floor should be sloped to permit collection of liquids in a containment trough and/or sump, which can be pumped out easily.
3. It should be adequately ventilated to ensure worker safety from fumes and to allow for comfortable working conditions during summer, and there should be a safe heat source to allow for comfortable working conditions during cold weather.
4. The workshop should provide for good natural and artificial lighting.
5. The workshop should be located in an area with convenient access.
6. The workshop should be located away from storm runoff and flooding.
7. The building should contain a safe storage area for lubricants, solvents, and other chemicals used for equipment maintenance and repair, as well as for wastes generated in the course of maintenance and repair.
8. The workshop must meet local zoning, building, and fire codes.

### Materials and Waste Handling Procedures

Do not purchase or store more chemicals than will be used in one year. Store petroleum products, other vehicle maintenance chemicals, and wastes in clearly labeled, covered containers, with any material safety instructions clearly displayed.

Always have absorbents and containers available to clean up spills. Use drip pans when

## Vehicle and Equipment Storage and Maintenance - 1993

changing fluids to catch any drips. Any spill of one (1) gallon or more of oil or petroleum products must be reported. Report spills over the reportable threshold to DEP's Oil and Chemical Spills Unit, tel. 566-3338.

Provide adequate fire control for the combustible fluids normally present in the workshop, including the gas tanks of vehicles which may be in the workshop for repairs or maintenance. Arrange for a yearly inspection by the fire marshall for fire and safety hazards.

Have emergency phone numbers for fire, ambulance, poison control center, and DEP oil and chemical spills unit readily available.

Perform all routine maintenance in the workshop, if there is one. Otherwise perform maintenance on an impermeable surface, such as a paved driveway or containment pad. It may be costly and time-consuming to transport equipment back to a central workshop for all repairs. However, because spill containment in the fields is not practical, repairs involving parts cleaning or other use of solvents or replacement of hydraulic fluids or petroleum products should be done in a central workshop.

Consider contracting for a self-contained aqueous parts cleaner, if parts cleaning is normally done on the farm. Minimize the number of different cleaners used.

Store wastes in separate containers, if possible in original container with the label intact. Waste oil and other waste chemicals can not be recycled when mixed with other materials.

Place leaking containers in larger containers that do not leak, clearly labeled with the product name.

If possible, use up all raw materials, or give them to someone who can.

Check with the local sanitarian or recycling coordinator concerning municipal facilities for the disposal of batteries and waste oil and other waste chemicals. Most towns have recycling or hazardous waste handling facilities which will accept waste oil and/or other waste chemicals; however, some towns may not accept such waste from non-residential sources. If there is no facility or collection program available, it may be necessary to arrange for commercial hauling and/or disposal of wastes. Dispose of wastes and used batteries promptly.

Never pour waste oil or hazardous wastes on the ground or down the drain. Never apply waste oil to driveways or access roads for dust or weed control.

Do not burn waste oil, except in accordance with Connecticut's hazardous waste management regulations. Contact DEP's Bureau of Waste Management for information. DEP's Bureau of Air Management requires a permit for any operation which burns more than 30 gallons per hour of oil which includes waste oil.

To dispose of oil filters, first remove oil from the filter by puncturing the filter case and gravity draining for more than 24 hours or crushing, either pneumatically or hydraulically. A

## Vehicle and Equipment Storage and Maintenance - 1993

combination of draining and crushing would be best. Next, recycle the collected drain oil as waste oil, or in some other manner consistent with state and federal regulations. Dispose of the drained or crushed filter cases in a solid waste landfill. Perform crushing in a protected area, such as a properly designed workshop.

Return used parts to the dealer, if possible. Contact a metal recycler or the town for other disposal options if parts cannot be returned to the dealer. Store parts and equipment to be discarded under cover, with all fluids drained, and on an impervious floor if one is available. Dispose of unused equipment; do not simply abandon out of sight on the farm. Sooner or later, abandoned equipment will break down and leak.

Prevent cross connections. Never let water hose go into containers holding other fluids. Install backflow preventers.

Use only water for vehicle washing.

Worksheet #1: Vehicle Inventory and Repair and Maintenance Activities

VEHICLE DESCRIPTION	MAINTENANCE OPERATIONS	Oil Change	Oil Filter Change	Hydraulic Fluid Change	Transmission Fluid Change	Brake Fluid Change	Fuel Filter Change	Differential Gear Fluid Change	Lubrication Services	Radiator Flushing	Coolant Replacement	Other	REPAIR OPERATIONS	Engine Overhaul	Transmission Rebuilding	Hydraulic System	Radiator Repair	Drive Train	Parts Cleaning	Brake Drum Turning	Battery Replacement	Body Repair	Preparation for Painting	Painting	Machine Shop Operations	Other		
1.																												
2.																												
3.																												
4.																												
5.																												
6.																												
7.																												
8.																												
9.																												
10.																												

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Worksheet #2: Shop Assessment

Size

Floor (Indicate type and if condition is Good, Fair, or Poor)

Concrete  
Asphalt  
Wood  
Dirt  
Other

How Cleaned? (Swept, Vacuumed, Flushed)

Lubrication Pit Present

Yes

Drain Present

No Drain

No

How cleaned?

Floor Drains

Yes

Holding Tank or Containment Trough

Yes

No

No

Walls

Yes

No

Roof

Yes

No

**Worksheet #3: Storage of Materials**

Replacement Products Stored in Shop; indicate approximate quantities

- Oil
- Gasoline
- Diesel
- Transmission Fluid
- Greases
- Coolants / Antifreeze
- Brake Fluid
- Hydraulic Fluid
- Parts Cleaning Solvents
- Rust Removal Products
- Paints and Paint Preparation Products
- Brush or Spray Gun Cleaners
- Lead Acid Battery Replacement
- Other:

Waste Product Storage; indicate approximate quantities

- Oil
- Oil Filters
- Transmission Fluid
- Transmission Filters
- Antifreeze
- Coolant
- Brake Fluid
- Hydraulic Fluid
- Contaminated Fuel
- Contaminated Parts Cleaning Solvents
- Contaminated Rags
- Contaminated Absorbent
- Contaminated Rust Removal Product
- Contaminated or Old Paint
- Contaminated Brush or Spray Cleaner
- Contaminated Paint Solvents
- Used Batteries
- Used Containers
- Waste Oil Sludge (if waste oil is burned)
- Other:



## Waste Management System

### Definition

A planned system of selected practices to manage agricultural waste, including runoff from concentrated waste areas, and off-farm wastes such as leaves, grass clippings, spent mushroom compost, and waste from municipal treatment plants. "Amount planned" in schedule of implementation measured in number of units.

### Scope

This standard establishes the minimum acceptable requirements for planning and operating waste management systems. It does not cover the design and installation of the specific practice components.

### Purpose

To manage agricultural wastes such as manure, milking parlor effluent, and other wastes generated or used on the farm in a manner that prevents or minimizes degradation of air, soil, and water resources, and protects public health and safety.

### Where Used

This practice applies where 1) waste is generated by an agricultural operation; or 2) waste from municipal treatment plants or other off-farm wastes are used in agricultural production.

### Water Quality Impacts

Manure and other agricultural wastes can leach nitrates to ground water and can pollute surface water with a variety of nutrients, bacteria, and organic matter. Waste management systems are planned and designed to prevent these pollutants from reaching surface or ground water by instead delivering nutrients to crops which need them, containing leachate and runoff, and/or treating the waste to reduce nutrients and pathogens. Waste management systems can also reduce the risk of water quality impacts from wastes (such as municipal sewage sludge or leaf waste) generated off the farm but used or treated on the farm.

### Planning Considerations

#### General

A waste management system for a given enterprise shall include all the practice components necessary to properly manage waste and prevent degradation of air, water, soil, and plant resources. A system may consist of a single practice, such as a vegetated filter area, or may consist of several components. Components shall not be installed until an overall waste management system has been planned. The system shall be planned according to the

coordination process in the Memorandum of Agreement for Interagency Assistance on Agricultural Waste Management Systems in Connecticut (see BMP Manual appendix). A written Waste Management Plan shall be prepared specifying at a minimum:

1. Title page in accordance with the Memorandum of Agreement for Interagency Assistance on Agricultural Waste Management System planning.
2. List of all component BMPs.
3. Number of animal units for designed system, and volume estimate of other waste types produced/brought in.
4. Number of areas required and available for waste disposal.
5. Plans, if applicable, for disposing of excess waste off the farm.
6. Order of component installation as appropriate.
7. Plan sketch showing the location of the proposed component practices and farm facilities.
8. Equipment required for transporting and spreading wastes.
9. For storage facilities, storage durations.

#### Components

Components of complete waste management systems may include but are not limited to the following practices:

Access Road	Plant Nutrient Management
Composting	Roof Runoff Management
Critical Area Planting	Surface Drain
Diversion	Subsurface Drain
Fencing	Waste Storage Area (Field Stacking)
Vegetated Filter Area	Waste Storage Structure
Grassed Waterway	Waste Treatment Lagoon
Heavy Use Area Protection	Waste Utilization

Design of individual components shall be consistent with best management practices in this BMP Manual and standards in the SCS Field Office Technical Guide (FOTG), Section IV. The design of components not included in the FOTG shall be consistent with sound engineering principles.

#### Waste Utilization

Waste shall be used to the fullest extent possible for its nutrient and soil conditioning values to replace commercial fertilizer. If very little land is available, treatment may be necessary, using practices such as lagoons, oxidation ditches, and composting.

Three periods are often critical for land disposal: 1) the winter when weather and land conditions create operational and environmental restrictions; 2) the early spring when frost is coming out and wet soil conditions permit formation of ruts from hauling equipment; and 3) the summer when crops occupy the application area. Storage volume needed will be planned based on these restrictions.

#### Storage

Waste shall be collected and treated or stored until it can be safely spread on land or otherwise disposed of. Adequate storage must be provided to allow spreading during favorable weather and at times compatible with crop management and available labor.

Daily land application consistent with the Waste Utilization BMP is acceptable and may eliminate the need for a storage facility. Storage facilities require concentrated labor at emptying time (normally spring planting season and fall after harvest), and normally require different equipment than used for daily spreading.

#### Clean Water Excluded

Clean water shall be excluded from concentrated waste areas to the fullest extent practical. Roof Runoff Management practices and applicable diversions will be fully utilized to divert uncontaminated runoff.

#### Manure

The volume of manure produced shall be calculated using data found in Chapter 4 of the SCS Agricultural Waste Management Field Manual (AWMFM), unless on-site data are available. Chapter 4 provides guidance on weights of different livestock and wastes produced. The composition of livestock manure shall be considered and calculated according to categories in Chapter 4, unless on-site data are available.

#### Bedding

The volume of bedding shall also be calculated using the data in Chapter 4 of the AWMFM, unless on-site data are available. On-site data shall be used, if possible. Sand bedding may cause excessive wear on pumps for liquid waste storage facilities. If sand bedding is used with a liquid storage facility, the storage facility shall be designed to allow vehicle access, so that the sand which settles to the bottom can be cleaned out periodically.

#### Milk House and Milk Parlor Wastes

The composition shall be calculated using the data in Chapter 4 of the AWMFM, unless on-site data are available. Then minimum volume for milking parlor waste water should be calculated by using three gal./cow per day for two milkings per day. On-site data shall be used, if possible, in computing volume and content of all waste types.

### Off-Farm Wastes

When considering uses of off-farm wastes:

1. Comply with any local and state regulatory requirements such as registration with DEP for leaf utilization, and a DEP permit for municipal sludge and effluent utilization. Municipal sludge shall not be applied in aquifer protection areas.
2. Consider pollutants of concern as required in the Waste Utilization BMP and the permit process.
3. Consider volumes and nutrient composition.

### Polluted Runoff

Polluted runoff and seepage from concentrated waste areas shall be intercepted and directed to storage or treatment facilities for future disposal or be directly applied to land in an acceptable manner. A concrete or treated wooden curb around a feedlot or barnyard may be needed to direct polluted runoff to the storage or treatment area/facility.

Disposal of polluted runoff may be on grass or crop areas adjacent to the feedlot/barnyard, as long as such areas are large enough to process the nutrients and any pathogens. A settling basin may be needed to settle out solids to prevent a buildup of solids in the disposal area. Installation of a vegetated filter area may be in order.

### Drainage and Erosion Control

Adequate drainage, erosion control, and other soil and water management practices shall be incorporated to prevent system-related problems.

### Land Application Methods

Appropriate waste handling equipment shall be available for effective operation of the system. Several methods of transferring waste to the land are:

1. *Manure Spreader and Tank Wagons:* This is a common method but it has a high labor requirement. Calculate the number of trips and time required to spread the manure to determine if it is a feasible method to use. The owner may need an agitator pump to load spreader or tank wagon.
2. *Vegetated Filter Area:* This method can be used to apply small volumes of wastes with few solids such as feedlot runoff or milking center waste. To maintain vigorous grass growth and filter effectiveness, intermittent flows are preferred. Settled solids must be removed regularly. (See Vegetated Filter Area BMP.)
3. *Sprinkler Irrigation:* This method can handle large or small quantities of liquids. The waste may have to be diluted to get solids content low enough to be handled by the sprinkler equipment. This method has a low labor requirement.

Adequate Land Area

The overall system shall include enough land for proper use or disposal of waste at locations, times, rates, and volumes that maintain desirable water, soil, plant, and other environmental conditions. If adequate land area is not available, the system shall provide for the removal of nutrients by treatment practices. Use of lagoons, oxidation ditches, and composting may be appropriate. If these practices do not remove enough nutrients, the plan must provide for responsible off-farm utilization, such as use by another farmer who has adequate land or commercial or retail sale. See the Waste Utilization BMP.

Location

Storage structures shall be located so as to minimize an unpleasant odor or visual problem to the farmstead or neighboring properties in compliance with local planning and/or zoning regulations.

Practice Installation

System components shall be planned and installed in a sequence that insures that each will function as intended without being hazardous to others or to the overall planned system.

Safety

Safety features such as fences and signs shall be included in waste management systems, as appropriate, to protect livestock and humans from drowning, dangerous gases, and other hazards.

**Operation and Maintenance**

The owner or operator shall be responsible for operating and maintaining the system. Written Operation and Maintenance plans or guidelines shall be prepared for each component practice according to the BMP standards.

A brief overall operation and maintenance schedule shall be prepared for the Waste Management System.



## Waste Storage Field Stacking Area

### Definition

A temporary waste stacking area located in a field. "Amount planned" in schedule of implementation measured in number of units.

### Scope

This standard establishes the minimum acceptable design, construction, and operation requirements for the field storage of solid and semi-solid manure or similar waste. Solid manure contains bedding materials that absorb the manure liquids, or it is a manure that has had the liquids removed.

### Purpose

A field stacking area serves as a component of a waste management system and is used to temporarily stockpile manure for at most six months in a location where ground and surface water will be least threatened by contamination. Field stacking is not a substitute for a waste storage structure. Where these facilities are needed, field stacking may be appropriate to supplement the storage volume.

### Where Used

This practice applies where a planned waste management system includes the spreading of manure and daily access to fields for spreading may be temporarily prevented by weather or field conditions, or manure must be stacked for spreading after harvest of a crop. A waste storage field stacking area shall only be used as part of a planned and approved waste management system.

### Water Quality Impacts

A properly located waste storage field stacking area may facilitate the timely application of stored manure, which reduces water quality impacts. It can also reduce water quality impacts from overloaded permanent waste storage systems at the site of waste generation. A poorly designed, sited, or maintained field stacking area may, however, result in increased surface or ground water pollution.

### Planning and Design Considerations

The following factors must be considered in selecting a site for field stacking areas: location of the stacking area, access routes, site slope, containment dikes, earth grading necessary, and auxiliary practices such as access roads, diversions, and vegetation.

Location

Field stacking areas:

1. Should normally be located in or near the field receiving the manure.
2. Should generally be small in area to minimize site preparation and contaminated runoff potential.
3. Should be sited on relatively flat land with little or no contributing drainage area.
4. Should be located away from occupied buildings to minimize odor problems.
5. Should consider diversion of upslope runoff and any building roof water, away from the area.
6. Shall be located outside any natural drainageway.
7. Shall not be located within the floodplain of a 25-year frequency, 24-hour duration storm.
8. Shall be accessible during periods of wet weather and deep snow.
9. Shall be located in accordance with any applicable local planning, zoning, wetlands, and health regulations.
10. Shall be located at least 200 feet from occupied buildings, unless owned by the farm operator.
11. Shall be located at least 200 feet from a private spring or well, and at least 500 feet from a public well as defined by the State Department of Health.
12. Shall be located at least 100 feet from the closest down-gradient watercourse. However, runoff from a stacking area must be diverted to an outlet located at least 200 feet from a down-gradient watercourse.

Soils and Foundation

The field stacking area shall be located to avoid contamination of ground water. Avoid soils that have rapid or very rapid permeability. A geologic investigation may be required to determine site suitability.

The field stacking area shall be at least 18 inches above seasonal high water table, and at least four feet above bedrock - two feet of which is native soil.

The foundation area should be graded only where the ground surface slope prevents proper equipment operation and efficiency or where needed to construct containment dikes for

semi-solid manure. Side slopes for excavation and earthfill shall be no steeper than two (2) horizontal to one (1) vertical.

Gravel, cement, or asphalt may be used on roads or the field stacking area to ensure access during wet periods. Bituminous or concrete paving meeting SCS standards may be used on the stacking site, and designs will be provided by SCS on a site-specific basis.

#### Screening and Buffering

Consider screening waste field stacking areas from view.

#### Runoff

Runoff from field stacking areas should be maintained as sheet flow. When, and if, collected it should be disposed of so as to avoid surface or ground water contamination, and avoid creating any nuisance conditions. Consider need for vegetated filter areas or reestablishing sheet flow.

#### Size

The field stacking area or areas shall have sufficient capacity to store accumulated waste for the period of time that waste cannot be spread due to weather, soil, or crop rotation restrictions. If the field stacking area is part of a system with other facilities for storage, then the capacity of these facilities should be considered in providing the required storage. Chapter 4 of the SCS Agricultural Waste Management Field Manual can be used as a guide to determine waste production and storage requirements.

#### **Operation and Maintenance**

A written plan shall specify required operation and maintenance for a field stacking area. Waste shall be removed from storage and used in accordance with the plant nutrient management plan. Waste shall not be stored for longer than six months in a field stacking area.

#### **Construction Drawings and Specifications**

Construction drawings and specifications for stacking areas shall be in keeping with this standard and shall adequately describe the development of this practice.

A copy of the applicable construction and material specifications shall be attached to the construction drawings for each individual job prior to construction.



## Waste Storage Structure

### Definition

A permanent structure for temporary storage of animal wastes or other organic agricultural wastes. Structures may be earthen impoundments (ponds) or storage areas constructed of concrete, wood, steel, plastic, etc. "Amount planned" in schedule of implementation measured in number of units.

### Scope

This standard establishes the minimum acceptable requirements for planning, designing, constructing, operating, and maintaining waste storage structures. Waste storage structures include storage tanks, stacking facilities, and earthen embankments. Storage tanks are used for liquid and slurry wastes and may be: 1) open or covered; 2) within or outside an enclosed housing; or 3) beneath slotted floors. Stacking facilities are used for wastes that behave as a solid and may be open or roofed. Embankments are limited to an effective height of 20 feet or less, and hazard class (a)<sup>1</sup>. This standard does not apply to waste treatment lagoons.

### Purpose

To temporarily store liquid or solid wastes as part of a pollution-control or nutrient- or energy-utilization system, and to protect the environment.

### Where Used

This practice applies where: 1) the structure is a component of an overall approved waste management system; 2) temporary storage is needed for organic wastes generated by agricultural production or processing to facilitate farm management and/or minimize contamination threats to water resources; 3) the structure can be located without polluting air or water resources; and 4) soils and topography are suitable for construction of the structure.

### Water Quality Impacts

An adequate waste storage structure properly managed prevents contaminants from manure and other stored wastes from leaching to ground water or running off to surface water. Sufficient waste storage capacity allows the farmer to apply the manure at a time when the crops can best use the nutrients, which lessens the chance of nutrients leaching to groundwater or being transported to surface waters by runoff. Direct benefits depend on locating a structure so as to collect and contain wastes from entering watercourses or leaching to ground

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<sup>1</sup> Reference SCS Technical Release No. 60.

water. Nutrients, pathogens, and organic materials are thus prevented from contaminating water resources. If improperly designed or managed, however, a waste storage structure can cause both surface and ground water pollution.

### **Planning and Design Considerations**

#### Location

Waste storage structures shall be as close to the source of waste and polluted runoff as practicable. Due consideration shall be given to economics, the overall waste management plans, and health and safety factors. The structures shall be located where prevailing winds, vegetative screening, and building arrangement minimize odor and visual resource problems. They will be a minimum distance of 200 feet from a private well or spring and at least 500 feet from a public well. Distance from property lines and public roads will be 200 feet or comply with local planning, zoning, wetlands, and health regulations. Distance from an occupied building other than the owner's should be at least 300 feet. Waste storage structures shall not be located on floodplains, unless they are protected from inundation or damage from a 100-year storm event. Where possible, site outside an Aquifer Protection Area.

#### Soil and Foundation

Locate on soils of low permeability (two inches per hour or less) or seal the structure by use of: 1) installing rigid linings (concrete, steel, wood, plastic, asphalt); 2) compacted in-place or imported soils; 3) bentonite; or 4) impermeable membranes, or a combination of the methods listed above. Construct structure at least two feet above seasonal high water table or bedrock. If within four feet of seasonal high water table or bedrock, the structure must be sealed regardless of permeability. Drainage may be installed to lower the ground water. An initial on-site soils investigation will be conducted for each site. Soil characteristics to a depth of at least four feet will be recorded.

#### Non-Polluted Runoff

Non-polluted runoff shall be excluded to the fullest extent possible. Roof drains and diversions will be utilized to divert non-polluted runoff away from the waste storage structure.

#### Loading and Unloading

Adequate maneuvering space shall be provided for operating loading and unloading equipment. Pushoffs must be structurally sound and must be provided with railings, safety bars, or other devices to prevent humans, animals, and equipment from falling into the facility.

#### Disposal Facilities

Equipment shall be available for removing wastes in a liquid, slurry, or solid form, from the storage structure and for applying them to the land at the locations, times, and rates shown in the Waste Utilization, and Plant Nutrient Management plans.

Where polluted runoff is stored, liquids shall be removed promptly to insure that sufficient capacity is available to store runoff from subsequent storms. The maximum allowable emptying time shall be based on the chance of overflow from subsequent storms and capacity of the disposal area. Provisions for overflow to a vegetated filter area or to another approved area for diffuse nonpoint discharge should be made.

Provision shall be made for removal of solids from storage ponds to preserve the storage capacity. The method of solids removal must be considered in planning, particularly in determining the size and shape of the pond. With ponds built to store runoff and wastewater, an entrance ramp with a slope of 4:1 or flatter may be used. With those built to store slurry and solid waste, some type of emptying facility must be provided. This can be a dock, pumping platform, retaining wall, or a ramp with a slope of 7:1 or flatter.

#### Service Life and Durability

Planning, design, excavation, and construction shall insure that the structure is sound and of durable materials commensurate with the anticipated service life (10 year minimum), initial and replacement costs, planned maintenance and operation costs, and safety and environmental considerations.

Guidance in evaluating the service life of various structural materials is presented in the SCS Waste Storage Structure Standard No. 313.

#### Design Criteria

For specific design criteria and specifications refer to the SCS Waste Storage Structure Standard No. 313, and the Waste Storage Pond Standards No. 425 in the SCS Field Office Technical Guide (FOTG).

#### Vegetation

All ground areas disturbed by construction of the waste storage structure shall be seeded in accordance with the SCS Critical Area Planting Standard No. 342. Shrubs and trees shall be planted as appropriate for visual screening and odor buffering. No trees shall be planted in an impoundment dike.

#### Safety

Entrance ramps to structures shall be no steeper than eight horizontal to one vertical. Warning signs, ladders, ropes, bars, rails, and other devices shall be provided, as appropriate, to insure the safety of humans and livestock. Ventilation and warning signs must be provided for enclosed waste holding structures, as necessary, to prevent explosions, poisoning, or asphyxiation. Pipelines from enclosed buildings shall be provided with a water-sealed trap and vent or similar devices to control gas entry into the buildings. Fencing shall be provided to prevent livestock and children from entering the facility.

### **Operation and Maintenance**

A written operation and maintenance plan shall be prepared. It shall include:

1. Storage period and emptying frequency.
2. Disposal methods.
3. Periodic inspection and maintenance to include:
  - a. Annual clipping of grasses and weeds.
  - b. Repair of dike erosion.
  - c. Rodent control.
4. Maintenance of safety fences, signs, etc.

### **Plans and Specifications**

Plans and specifications for waste storage structures shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. Excavation and embankments for ponds shall meet the requirements of the SCS Pond Standard No. 378.

### **Minimum Documentation for Practice**

Overall waste management plan for the farm.

Location of wells, water supplies, and any streams.

Geologic foundation investigation (soils, drainage, bedrock).

Survey and design information.

Location and elevation of barn floors, lot areas, storage structure, etc.

Layout and inspection notes.

Construction and material specifications.

As-built design drawing.

Operation and maintenance plan.

## Waste Utilization

### Definition

Using agricultural waste or other wastes on land in an environmentally acceptable manner while maintaining or improving soil and plant resources. "Amount planned" in schedule of implementation measured in number of units and acres.

### Scope

This standard provides guidelines for utilizing agricultural waste and certain other wastes to improve soil fertility in a manner that minimizes threats to groundwater and surface water. Wastes covered by this BMP include by-products from farms, feedlots, dairy operations, municipal treatment plants, and food processing plants, and other wastes of animal, human or natural origin.

### Purpose

To utilize agricultural or in some cases treatment plant wastes to provide fertility for crop, forage, or fiber production, or as a soil amendment to improve or maintain soil structure, prevent erosion, and protect water quality.

### Where Used

On cropland where waste generated by or received by the farm can be applied in a manner that benefits soil and plant resources without degrading water quality. This practice is a component of an agricultural waste management system.

### Water Quality Impacts

Waste utilization allows agricultural crops to use plant nutrients which might otherwise contaminate groundwater. With proper safeguards, waste utilization offers one of the best means of disposing of wastes, one which protects water quality and also enhances agricultural productivity. This BMP will minimize the potential for leaching and runoff of nutrients and other contaminants to ground and surface waters.

### Planning Criteria

#### Waste Utilization Plan

A waste utilization plan is an essential component of an agricultural waste management system. The waste utilization plan schedules and allocates waste application to specific fields based on environmental factors.

Coordinate development of waste utilization plans with plant nutrient management plans.

### Permits

*The owner or operator is responsible for securing all required permits and approvals and for performance in accordance with federal, state, and local laws, rules and regulations. The DEP Water Management Bureau, Engineering and Enforcement Division regulates and permits treatment, disposal, and utilization of wastes from agricultural processing and treatment plants, including municipal sewage sludge. The DEP Waste Management Bureau regulates and permits disposal and utilization of municipal leaves and yard wastes.*

Waste will not be applied to land near water bodies, water courses, or wetlands during periods when runoff is likely such as when soils are saturated or frozen. On land subject to flooding, wastes will not be applied during periods when flooding is likely.

### Field Evaluation for Water Quality

Use the decision flow chart as explained below to develop a waste application schedule and allocation for each field being considered. This flow chart will relate field conditions to water quality concerns. Wastes should be applied on fields where water quality is least threatened and on other fields during periods when threats are minimized. Fields proposed for waste application should be evaluated based on the following criteria:

1. Soil test for P indicates excess?
2. Owner allows waste application (Yes or No)
3. Manure storage capacity (Months or None)
4. Potential water quality threats. Evaluate the site, consider the following factors, and use professional judgement:
  - a. Is the dominant slope in the field greater than six percent?
  - b. Evaluate the pollutant delivery potential. The pollutant delivery factor (PDF) is based on an evaluation of the distance to surface water and the degree of development of the drainage pattern. This factor is determined by evaluating the potential threat manure or waste laden runoff poses to surface water. The threat increases as the distance from the field edge to the water resource decreases. It is modified by a drainage pattern factor that increases with the degree of development of the drainage pattern from the field edge to the water resource. Chapter 3, Section 3.5.2, of the SCS Agricultural Waste Management Field Manual provides additional guidance on development of pollutant delivery potentials.
  - c. Depth to water table. The risk of groundwater contamination increases as depth to water table decreases.
  - d. Depth to bedrock. The risk of groundwater contamination increases as depth

to bedrock decreases.

- e. Dominant hydrologic soil group (HSG) A, B, C, or D. Soils with high runoff potential (D) have an increased risk for surface water contamination. Soils with high infiltration rates (A) have an increased threat for groundwater contamination.
  - f. Are there wetland soils in the field? Many wetland soils used for crop production have seasonal water tables at or near the surface during November through April. Waste applications during these periods are not recommended.
  - g. Is field subject to flooding? Soils subject to seasonal flooding have a high potential for surface water contamination if waste is applied during periods when flooding is likely. Waste applied to tilled fields should be incorporated within two days of application to minimize threats.
5. Ground cover. Year round ground covers include hay and pasture. They do not include corn, vegetables, or clean tilled nursery.

The evaluation will result in assigning each field to one or more of the following categories:

- 1. Field OK for winter spreading if no storage available.
- 2. Field OK for summer spreading.
- 3. Field OK for spring or fall spreading.
- 4. Field not available for spreading.

#### Application Guidance

The following guidelines maximize waste utilization and reduce nutrient losses:

Refer to the Plant Nutrient Management BMP for waste application rates. Do not exceed the recommended rates.

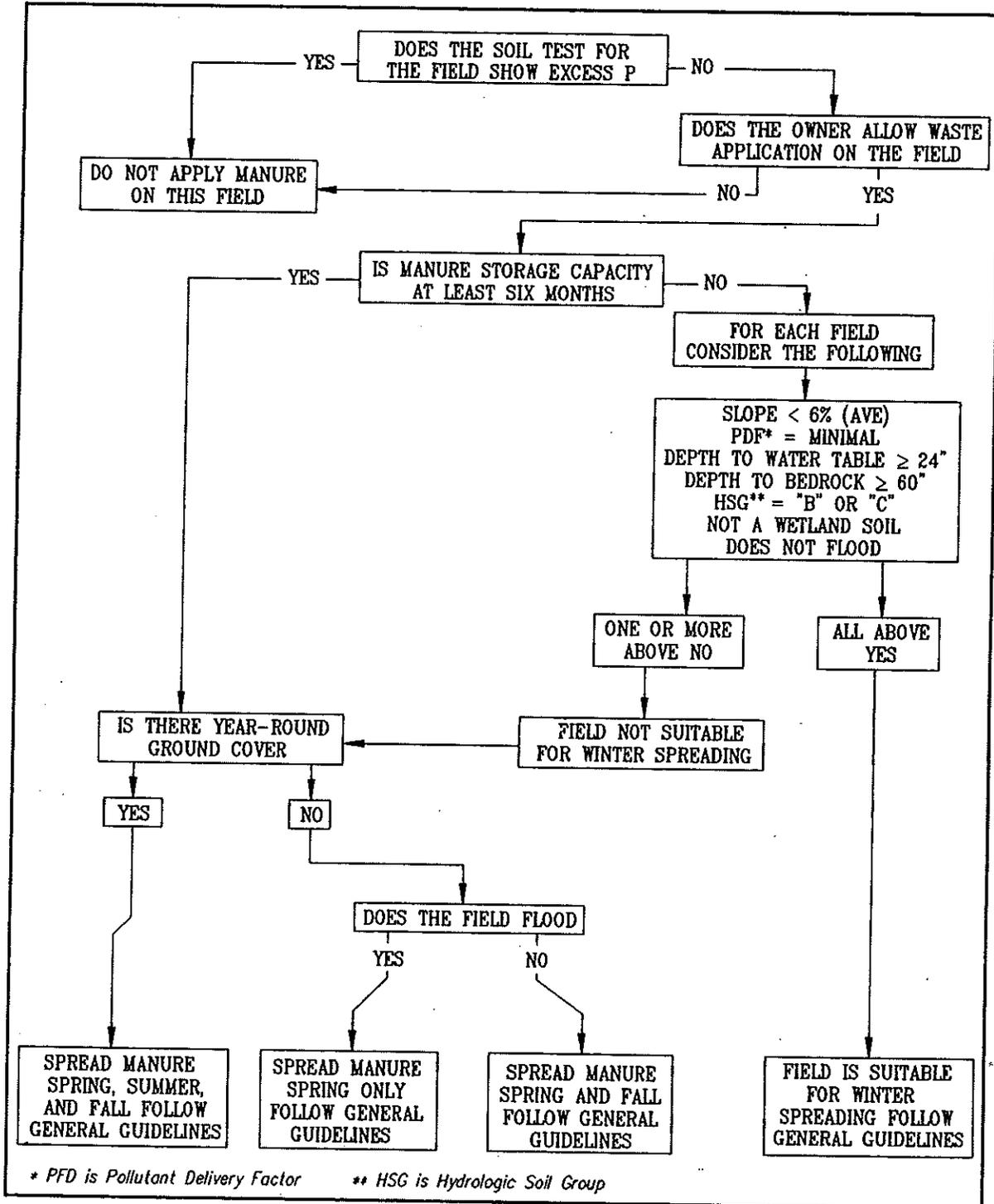
Follow seasonal recommendations below for fields categorized from decision flow chart:

*Fall:* Apply manure to those fields containing the greatest amount of vegetation or crop residues - grass hay, small grain stubble, chopped corn stalks, or winter cover. Avoid spreading on fields with a high pollutant delivery potential or on fields that have inadequate winter cover or residue.

*Winter:* Spread in November or early December, prior to the beginning of continuous snow cover. For daily spreading programs, use areas having

FIGURE 1 Decision Flow Chart

WASTE UTILIZATION CATEGORIES FOR WASTE APPLICATION  
BASED ON WATER QUALITY CONCERNS



limited access early in the season. Spreading on snow greatly increases the potential for transport of pollutants. If there is insufficient acreage suitable for winter spreading, adequate manure storage facilities or appropriate field stacking should be considered.

*Spring:* Apply on fields that are to be plowed or disked. Incorporate manure as soon as possible after spreading to minimize nutrient losses. For no-till fields, spread before planting onto those with the most residue. If manure is spread on meadows, select grass hay fields or legumes in the last year of production.

*Summer:* Apply to corn in the early season, grass meadows after harvest, grain stubble, leguminous sod in its last year of production, and unused pasture areas. On growing crops apply waste in a manner that will cover no more than 25 percent of the leaf surface with solids.

Leave a separation distance between the area of waste application and the edges of watercourses and water bodies. Refer to Riparian Buffer BMP.

#### Non-Farm Wastes

##### Sludge Application

If land application of municipal sludge is being considered refer to DEP Guidelines on Land Application of Municipal Sludge to Cropland. Contact the DEP Water Management Bureau.

Land application of municipal sewage sludge or industrial by-products is not allowed in aquifer protection areas.

The quantity of municipal and industrial waste applied is dependent on the crop yield potential of the soil, nitrogen and heavy metal content of the waste material, and the heavy metal composition of crops grown where the waste is spread.

Annual monitoring for nitrogen and heavy metals in crops, waste material, and the soil is essential. Should tests reveal heavy metals in excess of the tolerance levels established by the State DEP, the waste is no longer an acceptable source of nutrients to be applied on that soil.

Do not apply to land that is to be used within three years for tobacco, root vegetables, or vegetables which are not to be cooked.

Exclude dairy animals for two months after application.

Do not apply to land subject to flooding, excessive runoff, or erosion unless injected.

### Mycelium Utilization

If land application of mycelium is planned, contact the DEP Water Management Bureau for guidance and requirements.

In general:

1. The application of mycelium to farmland for the purpose of growth enhancement will be limited to the extent practical to 40 tons per acre per crop.
2. Mycelium should be spread and/or harrowed in as applicable.
3. Storage of mycelium should be in accordance with the Waste Storage BMP and DEP requirements.
4. Location of mycelium storage shall be greater than 750 feet from a potable water supply.
5. Location of mycelium storage will be greater than 150 feet from wetlands or surface waters.
6. A plan for transport, storage and use of mycelium received on the farm must be approved by DEP.

### Leaf Utilization

Leaves may be used in a composting process, as noted in the Agricultural Waste Composting BMP, used for sheet leaf composting, or used as a ground mulch.

If leaves from a municipality or other source outside of the agricultural operation are to be used, contact the DEP Waste Management Bureau, Recycling Program for guidance.

An operator practicing sheet leaf composting should follow these general guidelines:

1. Leaves should be delivered/received unbagged.
2. Any extraneous materials shall be removed and disposed of prior to field application.
3. The source of leaves needs to be considered, i.e. leaves from industrial or commercial areas might contain residual pollutants.
4. Leaves shall be spread onto a field within fourteen (14) days of delivery in a layer no deeper than six (6) inches.

5. No field shall receive more than six (6) inches of leaves annually. This corresponds to a spread rate of 25 dry tons/acre or 80 wet tons/acre.
6. Layer leaves shall be incorporated into the soil no later than the next tillage season unless the leaves are to remain on the surface as a ground mulch.
7. The ability of the leaves to utilize nitrogen shall be considered; however, do not apply excessive fertilizer which might threaten ground or surface waters.
8. When leaves are used for mulch use applicable considerations as for sheet composting (c). Leaves will need to be layered at least three (3) inches deep to continue to suppress weed growth.

## Grass Clipping Utilization

Grass clippings may be managed as agricultural wastes in accordance with the Waste Management System BMP. Practices for the agronomic beneficial use of grass clippings include: Direct Cropland Application, Incorporating Grass Clippings into an Agricultural Composting Operation, and Incorporating Grass Clippings into a Waste Storage Facility. Guidelines for these practices are listed below.

### A. Direct Cropland Application of Grass Clippings

A farmer practicing Direct Cropland Application shall follow these general guidelines and meet the requirements of a Plant Nutrient Management Plan.

1. Only those lands that are actively devoted to agricultural or horticultural use shall be eligible for direct cropland application.
2. A farm shall possess the following attributes and equipment to be eligible for direct cropland application:
  - a. An Agricultural Waste Management Plan and a Plant Nutrient Management Plan addressing the direct cropland application of grass clippings.
  - b. A current Agricultural Sales Tax Exemption Number.
  - c. Equipment necessary to properly apply and mulch the grass including a front end loader and manure spreader.
  - d. Good access roads and access controls.
3. A farm shall meet the following standards to be eligible to directly apply grass clippings to cropland:
  - a. Grass shall be delivered to the farm unbagged.
  - b. Any extraneous materials shall be removed and properly disposed prior to direct field application.
  - c. Within twenty-four (24) hours after delivery, the grass shall be land applied at a rate no higher than one (1) inch or fifteen (15) tons per acre. Until additional data are available, a field should not receive more than 20 tons per acre within any 5 year period. Different loading rates may apply pursuant to a Plant Nutrient Management Plan.
  - d. Grass shall be incorporated into the soil by the next crop growing season pursuant to a Plant Nutrient Management Plan.
  - e. A farm shall not apply grass clippings within 50 feet of the property line. A buffer of at least 150 feet shall be provided to the nearest sensitive receptor (any human use or occupancy).
  - f. Reports shall be submitted as necessary to comply with the reporting requirements for recycling facilities pursuant to Section 22a-208e(c) of the Connecticut General Statutes. Contact the DEP Waste Management Bureau Recycling Program at (203) 424-3365 for guidance.
  - g. The operator shall keep records in accordance with the Plant Nutrient Management Plan.

4. Direct cropland application of grass clippings shall cease and acceptance of grass clippings at the farm shall terminate if any of the following occurs:
  - a. The operator fails to obtain any applicable permits or approvals required by the state or municipality.
  - b. The operator fails to comply with the above policy on direct cropland application of grass clippings.
  - c. The Department determines that direct land application of grass clippings on farmland poses a threat to public health, safety, or the environment.

**B. Incorporating Grass Clippings into an Agricultural Composting Operation**

A farmer composting grass clippings with agricultural manure or other off-farm organics shall incorporate these guidelines.

1. Only those lands actively devoted to agricultural or horticultural use shall be eligible to incorporate grass clippings into an agricultural composting operation.
2. A farm shall possess the following attributes and equipment on site to be eligible for incorporating grass clippings into an agricultural composting operation:
  - a. An Agricultural Waste Management Plan which includes composting.
  - b. A Plant Nutrient Management Plan that addresses on-farm application of compost.
  - c. A current Agricultural Sales Tax Exemption Number.
  - d. Equipment necessary to properly maintain a composting operation pursuant to the Agricultural Waste Composting BMP, including at a minimum a front end loader.
  - e. Good access roads and access controls.
3. A farm shall meet the following standards to be eligible to incorporate grass clippings into an agricultural composting operation:
  - a. Agricultural composting operations shall be sited, operated and maintained pursuant to the Planning Considerations, Design Criteria and Operation Criteria set forth in the Agricultural Waste Composting BMP and in accordance with the Agricultural Waste Management Plan.
  - b. Grass shall be delivered to the farm unbagged.
  - c. Any extraneous materials shall be removed and properly disposed of prior to the incorporation of grass clippings into windrows.
  - d. Within twenty-four (24) hours after delivery, the grass shall be mixed with appropriate bulking agents, and formed into active composting windrows.
  - e. Reports shall be submitted as necessary to comply with the reporting requirements for recycling facilities pursuant to section 22a-208e(c) of the Connecticut General Statutes. Contact the DEP Waste Management Bureau, Recycling Program at (203) 424-3365, for guidance.

4. The acceptance of grass clippings shall cease and composting operations shall terminate if any of the following occurs:
  - a. The operator fails to obtain any applicable permits or approvals required by the state or municipality.
  - b. The operator fails to comply with the above policy on incorporation of grass clippings into an agricultural composting operation.
  - c. The Department determines that composting grass clippings poses a threat to public health, safety, or the environment.

**C. Incorporating Grass Clippings into a Waste Storage Facility**

A farmer incorporating grass clippings into a waste management system shall follow these guidelines and meet the requirements of a Plant Nutrient Management Plan.

1. Only those lands that are actively devoted to agricultural or horticultural use shall be eligible to incorporate grass clippings into a Waste Storage Facility.
2. A farm shall possess the following attributes and equipment on site to be eligible for incorporating grass clippings into a Waste Storage Facility.
  - a. An Agricultural Waste Management Plan which includes a Waste Storage Facility.
  - b. Nutrient Management Plan.
  - c. A current Agricultural Sales Tax Exemption Number.
  - d. Adequate capacity in the Waste Storage Facility to accommodate volumes of grass clippings.
  - e. Good compliance history, available acreage, proper application rate management and soil testing programs demonstrating additional nutrients can be properly utilized in accordance with a Plant Nutrient Management Plan.
  - f. Good access roads and access controls must be maintained.
3. A farm shall meet the following standards to be eligible to incorporate grass clippings into a Waste Storage Structure:
  - a. Grass shall be delivered to the farm unbagged.
  - b. Any extraneous materials shall be removed and properly disposed of prior to the incorporation of grass clippings into a Waste Storage Facility.
  - c. Within twenty-four (24) hours after delivery, the grass shall be incorporated into the Waste Storage Facility.
  - d. The structure shall be maintained not to exceed design capacity.
  - e. Reports shall be submitted as necessary to comply with the reporting requirements for recycling facilities pursuant to section 22a-208e(c) of the Connecticut General Statutes. Contact the DEP Waste Management Bureau, Recycling Program at (203) 424-3365, for guidance.

4. Incorporating grass clippings into a Waste Storage Facility shall cease and acceptance of grass clippings at the farm shall terminate if any of the following occurs:
  - a. The operator fails to obtain any applicable permits or approvals required by the state or municipality.
  - b. The operator fails to comply with the above policy for incorporating grass clippings into a Waste Storage Facility.
  - c. The Department determines that incorporating grass clippings into a Waste Storage Facility poses a threat to public health, safety, or the environment.

## Water and Sediment Control Basin

### Definition

An earthen basin constructed to intercept sediment-laden runoff and to trap and retain the sediment. "Amount planned" in schedule of implementation measured in number of units.

### Purpose

To slow runoff and trap transported sediment, reduce watercourse and gully erosion, reduce downstream runoff, and improve downstream water quality.

### Where Used

This practice may apply in the following situations:

1. Basins are needed as part of a terrace system.
2. Watercourse and gully erosion are a problem.
3. Sheet and rill erosion are controlled by other conservation practices.
4. Runoff and sediment damage land and improvements.
5. Soil and site conditions are suitable.
6. Adequate outlets are available or can be provided.

### Water Quality Impacts

Basins can improve surface water quality by trapping sediments and transported nutrients. If runoff is high in nutrients or contains pesticides, basins may promote leaching of these to ground water. Therefore proper plant nutrient management and pesticide management must be used to minimize potential ground water contamination through basins.

### Planning and Design Criteria

Water and sediment control basins can be used in coordination with practices such as terraces, contouring, a conservation cropping system, conservation tillage, crop residue management, and plant nutrient and pesticide management.

A total resource management system must reduce soil loss in the interval above and below the basin to prevent excessive sediment build-up and maintenance problems in and around the basin.

The embankment and basin size shall be designed according to SCS Engineering Field Manual criteria.

Spacing

Water and sediment control basins shall generally be spaced at terrace intervals. Refer to the Terrace BMP. The grade of the watercourse between basins shall be considered, and the spacing shall be set to prevent watercourse or gully erosion. The drainage of each basin shall be rapid enough so duration of flooding does not damage crops or create other problems.

The system of basins and row arrangements shall be parallel when possible and spaced to accommodate farm machinery widths. Consideration shall be given to embankment slope lengths, top width, and inlet location when determining spacing.

Alignment

The embankment orientation and row direction shall be approximately perpendicular to the land slope to permit contouring as much as possible. The arrangement should permit cultivation without excessively short point rows or sharp curves. Field boundaries and row length should also be considered when determining basin location and row direction.

Cross Section

Embankment slopes shall not be steeper than two horizontal to one vertical. The effective top width and height shall be at least as wide as shown in the following:

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Fill Height (Ft.)	Effective Top Width (Ft.)
0 - 5	3
5 - 10	6
10 - 15	8

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The constructed height of the embankment shall be at least five percent greater than the designed height to allow for settlement. The maximum settled height shall be 15 feet measured from the natural ground at the centerline of the embankment. Slopes may be vegetated or may be flattened to permit cropping.

Capacity

The basin shall be large enough to control the runoff from a 10-year, 24-hour frequency storm without overtopping. The capacity of basins designed to provide flood protection or to function with other structures may be larger and shall be adequate to control the runoff from a storm of a frequency consistent with the potential hazard. The basin also shall have the capacity to store the anticipated 10-year sediment accumulation, unless provisions are made for periodic sediment removal from the basin to maintain the design capacity.

The basins shall have the ends closed to the elevation needed for the design capacity. A maximum of one foot of freeboard may be added to the design height to provide for an emergency spillway around one or both ends of the basin. The emergency spillway must not contribute runoff to a lower basin in series that does not have an emergency spillway.

#### Outlets

Water and sediment control basins shall have underground outlets that meet the requirements for the Terrace BMP and SCS Underground Outlet Standard No. 620.

#### Vegetation

Slopes and disturbed areas that are not to be farmed shall be established to suitable erosion-resistant vegetation. Environmental quality and wildlife food and habitat may be considered in selecting the species of vegetation. Seedbed preparation, fertilizing, seeding, and mulching shall be in accordance with the SCS Critical Area Planting Standard No. 342 and the Mulching BMP.

#### **Maintenance**

A maintenance job sheet or maintenance plan shall be provided for the practice. The maintenance plan for a water and sediment control basin shall include maintenance requirements for the embankment, design capacity, vegetative cover, and the outlet. Maintenance should include inspection of inlets for clogging and embankment failure after each large storm. Failures should be corrected as soon as possible to prevent major damages.

The sediment and design capacity shall be maintained by cleaning the basin or by raising the embankment height. Excavated material spread on the cropland shall be placed so as not to divert normal grade flow. Fill material for increasing the embankment height shall be obtained in a manner that enhances topography and maintains productivity of the cropland. The vegetation shall be maintained to prevent sheet and rill erosion or gulying of the embankment. Trees and shrub cover create problems on embankments, and should be removed.

#### **Plans and Specifications**

Plans and specifications for installing water and sediment control basins shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

Water and sediment control basins shall be constructed to the line, grade, and dimensions staked in the field. If deep cuts expose an unfavorable subsoil, the topsoil shall be stripped, stockpiled, and replaced. Construction operations shall insure that erosion and air and water pollution are minimized.



## CHAPTER 6

**Resources Available for Implementation Assistance**

Connecticut's Aquifer Protection Areas Act, the Connecticut Clean Water Act, and the federal Clean Water Act all call for reduction in non point sources of water pollution. Agricultural operations will have to continue to re-examine and improve their management practices to prevent pollution of ground and surface water. Because new practices are constantly being developed and because short written standards cannot convey all the information needed to implement best management practices, it is important to work with the technical agencies responsible for environmental protection and agricultural support.

This chapter provides names and addresses of resource agencies that can help farmers adopt best management practices, prepare farm resources management plans, and comply with the Aquifer Protection Act.

**Lead Agencies**

Soil and Water Conservation Districts - Primary contact for farmers and agencies on aquifer protection planning on agricultural lands. Responsible for coordination of technical assistance and educational resources involved in this effort. There are eight soil and water conservation districts in Connecticut:

Fairfield County SWCD, Extension Center, 67 Stony Hill Road, Bethel, CT 06801-9629, tel: (203) 744-6108.

Hartford County SWCD, 627 River Street, Windsor, CT 06095-3003, tel: (203) 688-7725.

Litchfield County SWCD, Agricultural Center, Litchfield, CT 06758, tel: (203) 567-8288.

Middlesex County SWCD, Extension Center, Haddam, CT 06438-0070, tel: (203) 345-3219.

New Haven County SWCD, Agricultural Center, 322 North Main Street, Wallingford, CT 06492, tel: (203) 269-7509.

New London County SWCD, 562 New London Turnpike, Norwich, CT 06360, tel: (203) 887-4163

Tolland County SWCD, Agricultural Center, 24 Hyde Avenue, Vernon, CT 06066, tel: (203) 875-3881.

Windham County SWCD, Post Office Box 112, Wolf Den Road, Brooklyn, CT 06234, tel: (203) 774-0224.

Connecticut Department of Environmental Protection - DEP is the agency which coordinates water quality protection programs for the state through the Bureau of Water Management. The Water Bureau's Planning and Standards Division oversees the aquifer protection program. The Permits, Engineering, and Enforcement Division provides technical assistance, in addition to issuing permits and enforcing Connecticut's water quality laws.

Department of Environmental Protection, 79 Elm Street, Hartford, CT 06106  
 For information concerning: Aquifer protection - 566-7049  
 Water quality - 566-1932  
 Pesticide regulations and registration - 566-5148  
 Underground storage tanks - 566-4630

### Resource Agencies

Agricultural Stabilization and Conservation Service (ASCS) - Provides cost-sharing to farmers for implementing soil, water, woodland, and wildlife conservation practices or BMPs on farmlands now in agricultural production. For assistance and information on currently eligible practices, contact your local county ASCS office.

Fairfield County ASCS Office, 67 Stony Hill Road, Bethel, CT 06801-9802, (203) 743-6129.

Hartford County ASCS Office, 627 River Street, Windsor, CT 06095-1325, (203) 688-3559.

Litchfield County ASCS Office, PO Box 276, Litchfield, CT 06759-0276, (203) 567-8457.

Middlesex County ASCS Office, Agricultural Center, PO Box 70, Rte 154, Haddam, CT 06438-0070, (203) 345-8442.

New Haven County ASCS Office, 322 North Main Street, Wallingford, CT 06492-3774, (203) 269-6665.

New London County ASCS Office, 562 New London Turnpike, Norwich, CT 06360-6599, (203) 887-9941.

Tolland County ASCS Office, 24 Hyde Avenue, Vernon, CT 06066-4503, (203) 875-9770.

Windham County ASCS Office, PO Box 399, Brooklyn, CT 06234-0399, (203) 774-8397.

Connecticut Agricultural Experiment Station - Established in 1875, this agency does research regarding plants, plant pests and diseases, soil and water, and their interactions. Current related research includes biological control of insects and pests, integrated pest management (IPM), and the transport and effect of fertilizers and pesticides on surface and groundwater quality. Informs public of its findings through scientific papers, bulletins and speakers on research findings.

Contact: Abigail Maynard, CAES, Dept. of Soil and Water, PO Box 1106,  
New Haven, CT 06504-1106 (203) 789-7237

Connecticut Department of Agriculture - This state agency supports and regulates agricultural activities within the state. Provides financial assistance on animal waste management systems.

Contact: Deputy Commissioner, Connecticut Department of Agriculture  
165 Capitol Avenue, Room 275, Hartford, CT 06106  
(203) 566-4268

The University of Connecticut, College of Agriculture and Natural Resources - provides research and information on agricultural best management practices including integrated pest management, nutrient management, integrated crop management and pasture management.

Storrs Campus Contact - Storrs Experiment Station - (203) 486-3535

Cooperative Extension System - Acts as the educational agency for the U.S. Dept. of Agriculture and the land grant universities. Extension professionals develop and present educational programs based on research. They provide technical assistance to farmers regarding use of pesticides or IPM techniques, and other agricultural practices such as nutrient management.

General Contact:

Roy Jeffrey, Water Quality Programs Coordinator  
Extension Center, 562 New London Turnpike, Norwich, CT 06360  
(203) 887-1608

Greenhouse and Nursery Crops:

Leanne Pundt, Commercial Horticulture  
Extension Center, 1066 Old Saybrook Rd., Box 70, Haddam, CT 06438  
(203) 345-4511

Vegetable and Fruit Crops

Norm Gauthier, Phd., Commercial Vegetables and Small Fruits  
Extension Center, 24 Hyde Ave., Vernon, CT 06066  
(203) 875-3331

Dairy and Livestock

Joyce Meader (Eastern Connecticut), Dairy and Livestock  
Extension Center, 139 Wolf Den Road, Brooklyn, CT 06234  
(203) 774-9600

Richard A. Meinert (Western Connecticut), Dairy and Livestock  
Extension Center, 29 West Street, Litchfield, CT 06759  
(203) 567-9447

USDA Soil Conservation Service (SCS) - Technical assistance to evaluate soil erosion and agricultural waste concerns as they affect water quality and to plan best management practice (BMP) solutions as part of the farm resource management plan (FRMP). SCS will work in conjunction with the Extension System to develop nutrient and pesticide management BMPs for FRMPs. Design and implementation assistance will be provided for selected BMPs. For assistance contact your local county SCS office.

Fairfield County SCS Field Office, (203) 744-6108  
Extension Center, 67 Stony Hill Road, Bethel, CT 06801-9629

Hartford County SCS Field Office, (203) 688-7725  
627 River Street, Windsor, CT 06095-3003

Litchfield County SCS Field Office, (203) 567-8288.  
Agricultural Center, Litchfield, CT 06758

Middlesex County SCS Field Office, (203) 345-3219  
Extension Center, Haddam, CT 06438-0070

New Haven County SCS Field Office, (203) 269-7509  
Agricultural Center, 322 North Main Street, Wallingford, CT 06492

New London County SCS Field Office, (203) 887-4163  
562 New London Turnpike, Norwich, CT 06360

Tolland County SCS Field Office, (203) 875-3881.  
Agricultural Center, 24 Hyde Avenue, Vernon, CT 06066

Windham County SCS Field Office, (203) 774-0224.  
Post Office Box 112, Wolf Den Road, Brooklyn, CT 06234

## GLOSSARY

<b>Absorption</b>	The process plants use to take in or assimilate certain nutrient or pesticide ions.
<b>Adsorption</b>	The attraction of ions or compounds to the surface of a soil particle. Soil colloids adsorb large amounts of ions and water.
<b>Aerobic</b>	Living or active only in the presence of oxygen.
<b>Aquifer</b>	A sand, gravel, or rock formation capable of storing or conveying large quantities of recoverable water beneath the ground surface.
<b>Aquifer Protection Area</b>	An area consisting of a well field(s), areas of contribution and recharge areas as designated on maps approved by the state DEP.
<b>Available Nitrogen</b>	Form of nitrogen which is immediately available for plant growth ( $\text{NO}_3^-$ ) or ( $\text{NH}_4^+$ ).
<b>Best Management Practice (BMP)</b>	A practice, procedure, structure, or combination thereof that is planned and implemented to prevent, minimize or control point or nonpoint source pollution of ground or surface water.
<b>Biological Oxygen Demand (BOD)</b>	An indirect measure of the concentration of biologically degradable material present in organic wastes. It is the amount of free oxygen utilized by aerobic organisms that attack the organic matter in an aerobically maintained environment at a specified temperature ( $20^\circ\text{C}$ ) for a specific time period (usually five days). It is usually expressed in milligrams of oxygen utilized per liter of liquid waste volume (mg/l).
<b>BMP Standard</b>	Criteria prepared to guide implementation of a best management practice.
<b>Denitrification</b>	The process by which nitrates or nitrites in the soil or organic deposits are converted to gaseous forms of nitrogen.
<b>Dissolved Oxygen</b>	The oxygen dissolved in water and readily available to aquatic organisms. It is usually expressed in milligrams per liter or as the percent of saturation.
<b>Effluent</b>	The discharge of a pollutant, or pollutants, in a liquid form from a containing space.

<b>Eutrophication</b>	Natural or artificial process of nutrient enrichment whereby a water body becomes filled with aquatic plants and is low in oxygen content.
<b>Farm Resources Management Plan</b>	A plan prepared specifying best management practices to be implemented to address agricultural waste management, pest and pesticide management, nutrient management, fuel storage, and vehicle and equipment management as applicable in aquifer protection areas.
<b>Ground Water</b>	The subsurface water supply in the saturated zone below the water table.
<b>Half-life</b>	The time required for one-half of a specified substance to disappear.
<b>Infiltration</b>	The downward entry of water into the soil.
<b>Inorganic</b>	Materials not derived from hydrocarbons.
<b>Leaching</b>	The removal of nutrients and/or pesticides from the soil by water movement through the soil profile.
<b>Mineralization</b>	The microbial conversion of an element from an organic to an inorganic state.
<b>Nitrification</b>	The biochemical transformation of ammonium to nitrite and thence to nitrate.
<b>Nonpoint Source</b>	Entry of effluent into ground or surface water in a diffuse manner with no definite point of entry and where the source is not readily discernible.
<b>Operator</b>	A person engaged in agricultural activities to produce an agricultural crop or product.
<b>Organic Matter</b>	Residue of plant or animal origin.
<b>Pathogens</b>	Disease-causing organisms.
<b>Persistence</b>	The resistance to degradation measured by the period of time required for complete degradation of a material (see Half-life).
<b>Pesticide</b>	Any chemical or biological agent that kills plant or animal pests. Herbicides, insecticides, fungicides, nematocides, miticides, rodenticides, plant growth regulators, and desiccants are all considered pesticides.

<b>Point Source</b>	The release of an effluent from a pipe or discrete conveyance into ground or surface water leading to a body of water.
<b>Pollutant</b>	A substance of such character and in such quantities that when it reaches a body of water, soil, or air, it is degrading in effect so as to impair the usefulness of the water, soil, or air, or render it offensive.
<b>Riparian Buffer</b>	An area of trees and/or other vegetation located on land next to and upgradient from watercourses, water bodies, and associated wetlands.
<b>Runoff</b>	That portion of the precipitation or irrigation water which leaves the field over the surface and appears in surface streams or water bodies.
<b>Sediment</b>	The solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface either above or below sea level.
<b>Silage Leachate</b>	Liquid released from ensilage of forage crops during the fermentation process or as a result of precipitation entering the ensilage.
<b>Sorption</b>	The process of taking up and holding by either absorption or adsorption.
<b>Technical Team</b>	A group of technical experts from existing agricultural agencies coordinated by the local soil and water conservation district to help develop a farm resources management plan.
<b>Toxicity</b>	The degree to which a chemical detrimentally affects an organism.
<b>Universal Soil Loss Equation (USLE)</b>	A method of estimating the average soil loss from sheet and rill erosion that might be expected to occur over an extended period under specified conditions of soils, vegetation, climate, cultural operations, and conservation measures.
<b>Volatilization</b>	The loss of a substance through evaporation or sublimation.
<b>Wastes</b>	Animal wastes or other organic wastes generated by, or used in conjunction with, agricultural activities. Generally the goal is to utilize such waste for nutrient benefits or as soil amendments and prevent or minimize the pollution potential of wastes.
<b>Water Table</b>	The upper level of a saturated zone below the soil surface.



## APPENDIX

### Farm Resources Management Plan \*

#### Sample Farm - John and Jane Brown

July 1, 1993

#### 1. Background Information

- o Person engaged in agriculture  
Name: John and Jane Brown

Address: 1234 Cheshire St.  
Cheshire, CT 06410

Phone: 123-4567

Landowner:  
Name: Same as above

Address:

- o Type of Operation  
Mixed - Strawberries and Sweet Corn Grown for Farm Stand Sales

- o Location of Operation  
Address: 1234 Cheshire St.  
Cheshire, CT 06410

- o ASCS Tract Number 999224

- o Aquifer Protection Area: South Central Connecticut Regional Water Authority - North Cheshire Wellfield

The farm operation is located almost entirely within the aquifer protection area for the South Central Connecticut Regional Water Authority's North Cheshire Wellfield on Black's Road. Ninety-five (95) of the farm's total 151 acres fall within the level A aquifer protection area boundaries. All of the cropland (27.5 acres) falls within the aquifer protection area boundaries.

The ground water quality classification in this area is GAA. This classification means that the designated use of the ground water is public drinking water supply. The ground water is presumed suitable for direct human consumption without need for treatment. The goal is to maintain the drinking water classification GAA.

- o Surface Water Hydrologic Unit: Quinnipiac River - 5200

The farm is located within the Department of Environmental Protection's (DEP) Natural

\* This sample plan is provided for guidance. Plan requirements for farms in aquifer protection areas may change slightly, depending on final adoption of regulations pursuant to Connecticut General Statutes (CGS) 22a-354m. Each farm has different circumstances. Descriptions and recommendations may be substantially different for different types of operations.

Drainage Basin 5200. The Quinnipiac River is near the western boundary of the farm. The drainage area of the Quinnipiac to the farm is about 5000 acres. The Quinnipiac River has a C/Bc surface water quality classification rating along the segment near the farm. This means that the river is not presently meeting water quality criteria for one or more designated uses due to pollution.

An unnamed tributary of the Quinnipiac river flows through the farm. This tributary has a drainage area of about 500 acres. Land use in the watershed of this tributary is predominantly forest and residential.

#### o Brief History of Operation

The 157 acre farm is located on the west and east side of Cheshire Street. There are about 53 acres of cropland, of which about 35 acres are leased to others. The farm has been in operation since 1697. It was purchased by the present owner's family in 1864, was a dairy operation from 1900 to 1930, and has been a vegetable and small fruit operation since 1930. Strawberries have been a major crop but the operation has diversified to include vegetables, primarily sweet corn. Currently, sweet corn and strawberries are the only crops grown by the owner. The owner leases land to Smith dairy farm for silage corn, and to Henry Jones for alfalfa hay. Frank Lewis and Tim Carter rent 3000 square feet of the greenhouse for bedding plants, the remaining 2000 square feet are not used. During 1991, the owner grew seven acres of strawberries, and 21 acres of sweet corn on four fields.

The farm is situated within an agricultural area of the Town of Cheshire. The Quinnipiac River is near the western boundary of the farm and forms the eastern boundary of the South Central Regional Water Authority's wellfield property. Residential and forest land uses occur along the eastern farm boundary, which is primarily within the secondary recharge areas. Connecticut Light and Power Company transmission lines cross this area, and herbicides may be applied to control vegetation within the right of way.

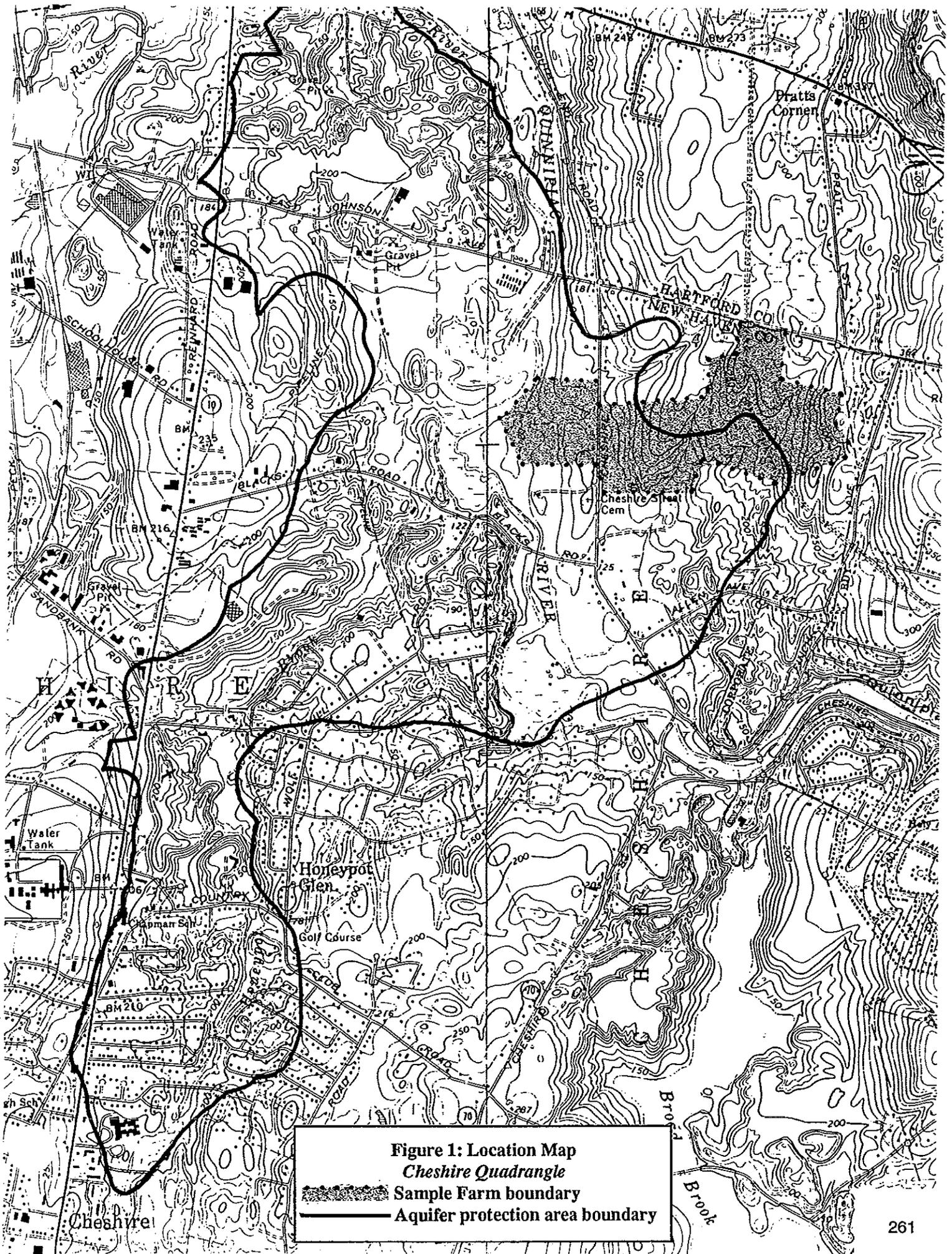
The farmhouse and buildings are situated about 2700 feet from the wellfield. There is a buffer of about 100 feet between the edge of Field #4 and the Quinnipiac River. A 20 foot wide buffer is maintained between fields 4, 4a, and 2 and the unnamed tributary. The farm well is located about 50 feet south of the farmhouse in the front yard near the windmill. A new on-site sewage disposal system was installed in 1989. The farm well was tested for bacteria and nitrates by the CHESPROCOTT Health District in 1986 and met drinking water standards for all categories tested.

#### 2. Location Map

The operation is located on the Meriden and Southington U.S. Geological Survey (USGS) Quadrangles. See Figure 1 - Map of the aquifer protection area.

#### 3. Plan Map

Figure 2 shows the location of the operation on a 1986 aerial photo with fields outlined and numbered. The owner operates only Fields 2, 4, 4a, and 4b, and rents the remaining fields to others. The rented fields and greenhouse operation will be covered in separate farm resources management plans prepared for the operators involved.



**Figure 1: Location Map**  
**Cheshire Quadrangle**  
 ■■■■■ Sample Farm boundary  
 ————— Aquifer protection area boundary

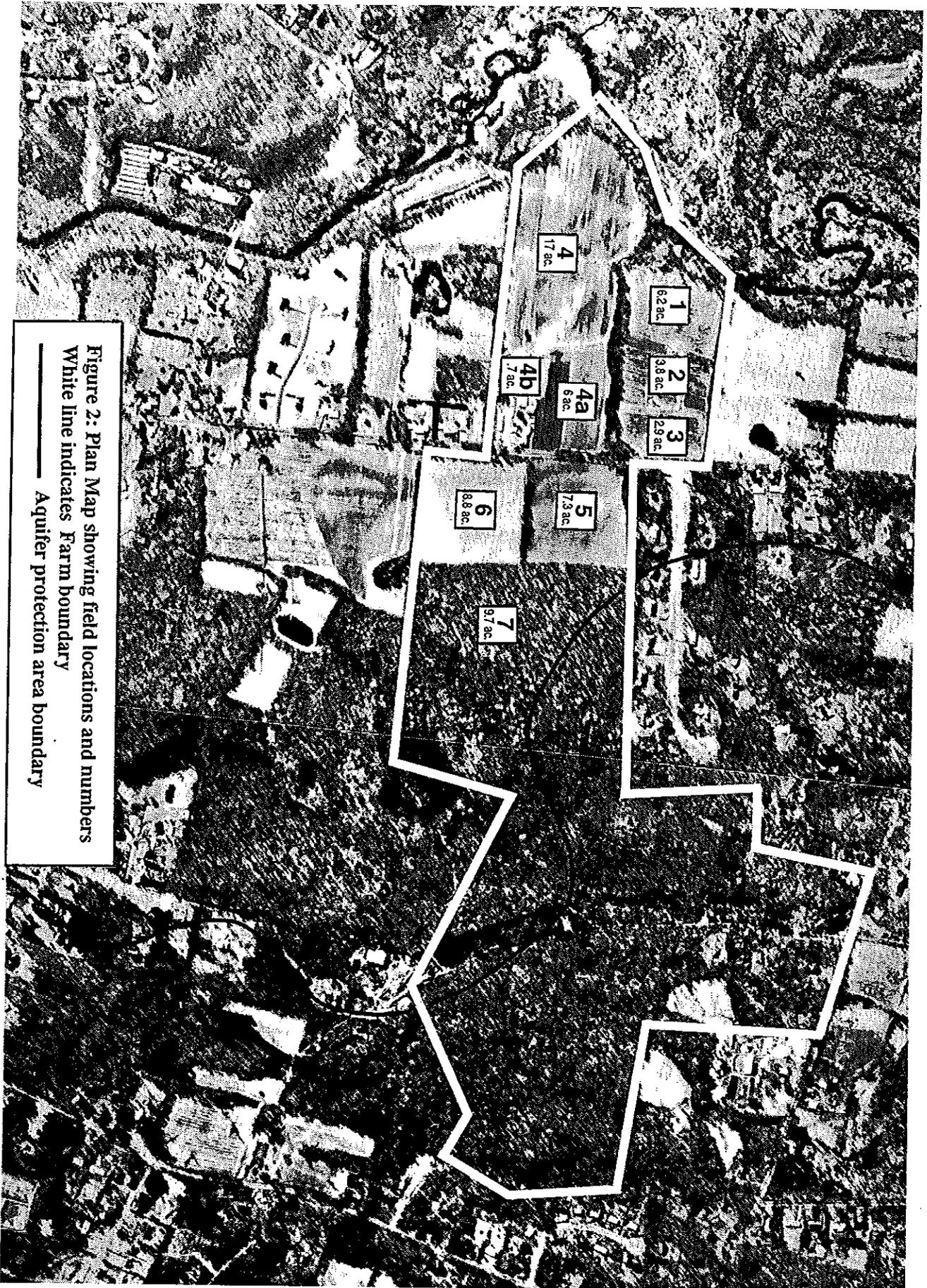


Figure 2: Plan Map showing field locations and numbers  
White line indicates Farm boundary  
Aquifer protection area boundary

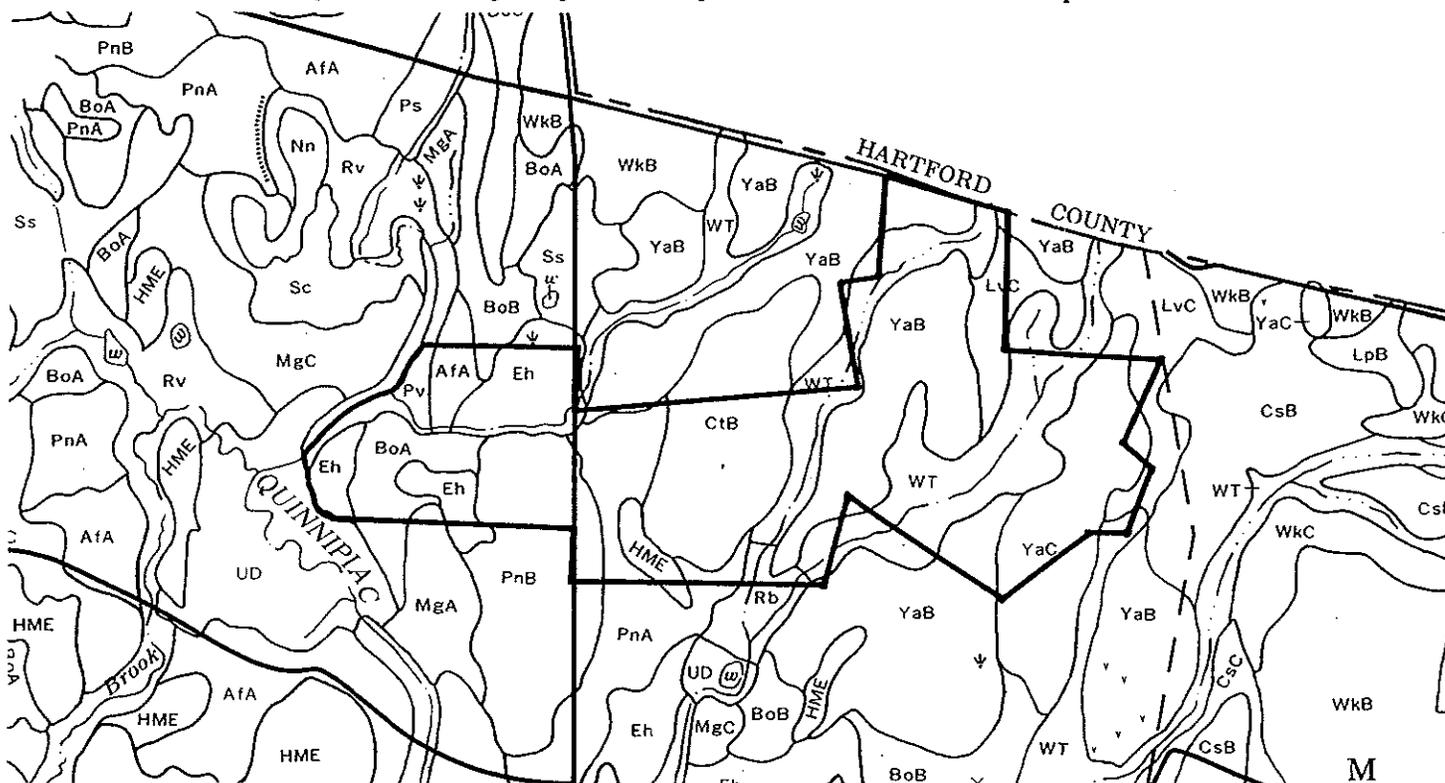
#### 4. Soils Information

Soils on the farm were mapped by the USDA - Soil Conservation Service (SCS). Figure 3 is a copy of Field Sheet #13 from the Soil Survey of New Haven County with the tract and field boundaries delineated. Table 1 lists soil map units and selected soil properties. All cultivated fields on the farm are of concern with respect to ground water contamination because of intermediate to high soil leaching potentials. In addition, Fields 2, 3, and part of 4 have seasonally high water tables (November to April).

#### Cropland Fields, Soils, and Land Use - 1991 Crop Year

Field #	Dominant Map Unit	Crop / Land Use <sup>1</sup>	Depth to Ground water
2	BoB	Sweet Corn	> 72 inches
2	Eh	Sweet Corn	18 to 30 inches
4	Eh	Sweet Corn	18 to 30 inches
4	BoA	Sweet Corn	> 72 inches
4a	PnB	Strawberries	> 72 inches
4b	PnB	Melons, Tomatoes	> 72 inches
H	PnB	Farmstead	> 72 inches

<sup>1</sup> Crops as of the 1991 growing season. Crops are rotated but not in a scheduled pattern.



**Figure #3: Soils Map**  
 ————— Sample Farm boundary  
 Refer to Table 1 for brief description of units

Table 1: Soil Map Units and Selected Properties – Sample Farm – Cheshire, CT

Map Unit Symbol	Map Unit Name	Farmland Class <sup>1</sup>	Capability Class <sup>2</sup>	Hydrologic Soil Group	Drainage Class <sup>3</sup>	Min. Depth to Water Table (feet)	Depth to Bedrock (inches)	Organic Matter % <sup>4</sup>	USDA SLP <sup>5</sup>	USDA SLP <sup>6</sup>
AfA	Agawam fine sandy loam, 0-3%	P	1	B	WD	>6.0	>60	4	I	I
BoB	Branford silt loam, 3-8%	P	2E	B	WD	>6.0	>60	5	I	I
CtB	Cheshire very stony fsl, 3-8%	O	5S	B	WD	>6.0	>60	4	I	I
Eh	Ellington silt loam, 0-3%	P	2W	B	MWD	1.5-2.5 Nov-Apr	>60	5	I	I
HmE	Hinckley and Manchester complex, 15-35%	O	7S	A	XD	>6.0	>60	2	H	N
MgA	Manchester gravelly sandy loam, 0-3%	S	3S	A	XD	>6.0	>60	2	H	N
PnA	Penwood loamy sand, 0-3%	S	3S	A	XD	>6.0	>60	2	H	N
PnB	Penwood loamy sand, 3-8%	S	3S	A	XD	>6.0	>60	2	H	N
Pv	Podunk variant (Blash) silt loam, 0-3%	P	3W	C	SPD	0.5-1.5 Dec-May	>60	5	N	N
Yab	Yalesville fine sandy loam, 3-8%	S	2E	C	WD	>6.0	20-40	2	N	I

1/ - P = Prime  
 S = Statewide Importance  
 O = Other Non Farmland

2/ - Class Modifiers  
 E = Erosion hazard  
 W = Wetness  
 S = Droughty

3/ - WD = Well drained  
 MWD = Moderately well drained  
 XD = Excessively drained  
 SPD = Somewhat poorly drained

4/ - Organic Matter percent is estimated. A soil test is recommended to determine actual value.

5/ - SLP = Soil Leaching Potential (USDA)  
 H = High  
 I = Intermediate  
 N = Nominal (Low)

6/ - SLP = Soil Surface Loss Potential (USDA)  
 H = High  
 I = Intermediate  
 N = Nominal (Low)

## 5. Summary and Discussion of Findings

This section contains a discussion of existing farm management followed by a narrative that identifies threats to ground water quality posed by the agricultural operation and recommends Best Management Practices (BMPs) to address the concerns or threats identified.

### Existing Farm Management

#### General:

1. Sweet corn and strawberries are rotated on Fields 2, 4, 4a, and 4b. There is no scheduled pattern for the rotation.
2. No irrigation is used on the farm.
3. Diesel fuel for equipment is stored in a small shed away from the house in a 275 gallon above ground tank on legs. The shed has a dirt floor.
4. Farm chemicals are stored in a heated room attached to the house. The floor is linoleum over concrete.
5. Mixing of chemicals and rinsing of the sprayer and containers is done on a crushed stone pad near the shed.
6. The propane gas fuel storage tank for the greenhouse is situated above ground on cement slabs.
7. Fuel for the house is oil and is stored separately in the basement.
8. Waste oil is stored in 55 gallon drums located in the maintenance shed. The shed has a concrete floor. The drums are picked up periodically by a waste oil hauler. The drums are located on oak pallets so leaks can be detected.
9. Woodland on the farm is unmanaged.
10. The producer did not want to consider alternative crops or organic farming at this time.
11. The producer expressed an interest in participating in Integrated Crop Management.

#### Sweet corn:

Sweet corn is rotated on Fields 2, 4, 4a, and 4b. For the 1991 crop year, sweet corn was grown in Fields 2 and 4.

#### Fertilizer:

1. Fertilizer is applied at planting. A custom applicator performs soil testing and prepares fertilizer mix for the crop.

#### Herbicides:

	<u>PLP</u> <sup>1</sup>	<u>DEP LIST</u> <sup>2</sup>
1. Bicep 6L (Atrazine + Metolachlor)	Large	YES
2. Atrazine plus oil	Large	YES

<sup>1</sup> PLP is the Pesticide Leaching Potential as listed in the USDA ARS/SCS/CES Pesticide Selected Properties Database #2.031 dated June 1, 1991

<sup>2</sup> **DRAFT STATEMENT** DEP LIST indicates that the compound is of concern to the Connecticut Department of Environmental Protection because it has been detected in a relatively high proportion of wells tested for pesticides in state studies and nationwide. Farm Resources Management Plans should, if practical, propose alternative strategies that will reduce or eliminate use of these compounds in aquifer protection areas. See the Pest and Pesticide Management BMP in the Manual of Best Management Practices for Agriculture or contact DEP for information on pesticides of concern.

Sweet Corn: (continued)

	<u>PLP</u> <sup>1</sup>	<u>DEP LIST</u> <sup>2</sup>
<b>Insecticides:</b>		
1. Ambush 2E (Permethrin)	Extra Small	NO
2. Lannate 4L (Methomyl)	Large	NO
<b>Other:</b>		
1. A winter cover crop is planted on the corn fields.		
2. Subsurface drainage was installed in field 2 in 1977. SCS designed the drainage system.		
3. A field border is planned between fields 4 and 4a on either side of an access road to protect field 4a from erosion caused by excess runoff.		

Strawberries:

Strawberries are rotated on fields 2, 4, 4a, and 4b. For the 1991 crop year strawberries were grown on field 4a. Strawberries are not mulched. There is erosion evident in the portion of field 4a that slopes toward the west.

**Fertilizer:**

1. Fertilizer is applied at planting. A custom applicator performs soil testing and prepares fertilizer mix for the crop.

	<u>PLP</u> <sup>1</sup>	<u>DEP LIST</u> <sup>2</sup>
<b>Herbicides:</b>		
1. Sinbar 80W (Terbacil)	Large	YES
2. Dacthal 75W (DCPA - Chlorthal-Dimethyl)	Small	YES
3. Tenoran (Chloroxuron)	Small	NO
4. Formula 40 (2,4 D soluble amine salt)	Medium	NO
5. Devrinol (Napropamide)	Medium	NO
6. Fusilade (Fluazifop-P-Butyl)	Small	NO

	<u>PLP</u> <sup>1</sup>	<u>DEP LIST</u> <sup>2</sup>
<b>Fungicides:</b>		
1. Thiodan (Endosulfan)	Small	NO

<sup>1</sup> PLP is the Pesticide Leaching Potential as listed in the USDA ARS/SCS/CES Pesticide Selected Properties Database #2.031 dated June 1, 1991

<sup>2</sup> **DRAFT STATEMENT** DEP LIST indicates that the compound is of concern to the Connecticut Department of Environmental Protection because it has been detected in a relatively high proportion of wells tested for pesticides in state studies and nationwide. Farm Resources Management Plans should, if practical, propose alternative strategies that will reduce or eliminate use of these compounds in aquifer protection areas. See the Pest and Pesticide Management BMP in the Manual of Best Management Practices for Agriculture or contact DEP for information on pesticides of concern.

## **Recommendations for BMPs:**

### **Agricultural Waste Management**

**Technical Team Member: John Smith, SCS**

**Concern or Threat Identified: None**

o - No threats to ground water were observed during the field inspection. No animals are housed. Currently, no wastes are stored or utilized. If the operator decides to use or store agricultural wastes, an agricultural waste management plan and appropriate BMPs will be developed and incorporated into this plan.

### **Pest and Pesticide Management**

#### **Pest Management**

**Technical Team Member: Mary Tyler, CES**

**Concern or Threat Identified**

o - Leaching losses of pesticides applied on a scheduled basis represent a threat to ground water quality. **Of particular concern are the application of atrazine and metolachlor on sweet corn and terbacil and DCPA on strawberries.**

The pest management program will strive to either reduce or eliminate the use of these compounds through the use of Integrated Pest Management (IPM) techniques or use of alternative compounds.

1. Recommendation: The producer will contact the Cooperative Extension System (CES); and, within available resources, CES will work with the producer to design an (IPM) plan. Only commodities for which CES has developed IPM education programs will be considered in the IPM plan. IPM programs currently exist for weed and insect control in sweet corn and for insect control in strawberries. If IPM programs become available for other pest types or crops relevant to this operation, the producer with CES will likewise design the appropriate IPM plan and incorporate into it the appropriate BMPs. The implementation of this plan will be documented by the producer in an approved record keeping system.

2. Recommendation: Where IPM education programs are unavailable, CES, within available resources, will work with the producer to design a pest management plan that incorporates as many IPM methods and concepts as appropriate. Where chemical pest controls are needed, the producer will use the appropriate Grower's Guides (New England Recommends) or IPM manuals as published by the University of Connecticut CES and pesticide labels for selection of pesticides. The implementation of this plan will be documented by the producer in an approved record keeping system.

## **Pest and Pesticide Management (Cont.)**

### **Pesticide Management**

**Technical Team Member: Mary Tyler, CES**

#### **Concern or Threat Identified**

o - Pesticide storage was identified as a threat to ground water quality. Of particular concern are the storage and management of atrazine, metolachlor, terbacil, and DCPA.

The pesticide management plan will strive to either reduce or eliminate the use of these compounds through the use of IPM techniques or use of alternative compounds.

1. Recommendation - Install an approved pesticide storage cabinet or construct a separate building. It should have a lock, ventilation, heat, warning sign, and containment area.
2. Recommendation - Construct an impermeable pad or utilize a portable pad for mixing pesticides, rinsing containers, and rinsing equipment. Inspect pad before and after each use for cracks or leaks.
3. Recommendation - Install a backflow prevention device on the water supply that is used to fill spray tanks or provide rinse water.

### **Nutrient Management**

**Technical Team Member: Sara Johnson, CES**

#### **Concern or Threat Identified**

o - Losses of nitrogen applied on a scheduled basis represents a threat to ground water quality.

1. Recommendation: The producer will follow recommendations developed from the Plant Nutrient Management BMP and will contact CES to develop and implement a plant nutrient management program for the crops produced. The producer will apply nutrients according to recommendations based on current soil tests and realistic yield goals for each field and crop. For sweet corn, the pre-sidedress soil nitrate test (June N test) will be used to determine nitrogen application rates. The implementation of this practice will be documented by the producer in an approved record keeping system. The producer does not have a practical source of manure. If the producer decides to utilize a manure source, provisions for utilization will be developed and incorporated into this plan.

2. Recommendation: Continue to establish cover crop/catch crop following harvest of sweet corn to scavenge excess nitrogen and control erosion. Apply cereal rye or other small grain at a rate of 112 pounds per acre as soon as possible after harvest, but no later than September 30.

## **Nutrient Management - Fertilizer Storage**

**Technical Team Member:** Sara Johnson, CES

### **Concern or Threat Identified: None**

o - Fertilizer is applied by a commercial applicator, there is no storage of fertilizers on the farm.

No potential threats to ground water were observed during the field inspection.

If the operator decides to store fertilizers, a plan will be developed and appropriate BMPs incorporated into it.

## **Vehicle and Equipment Storage and Maintenance**

**Technical Team Member:** Joe Connors, DEP

### **Concern or Threat Identified**

o - No threats to ground water were observed during the field inspection. The only maintenance done on the farm are regular oil changes for one tractor and one truck and equipment washing\*. Oil changes and washing are done on a paved driveway. All other maintenance and repairs are done off the farm at Bob's Garage.

1. Recommendation: Tanks in the shed which store used oil should be inspected for leaks on a regular basis. Continue to have licensed hauler remove used oil. Inspect the concrete floor under the waste oil storage tank for signs of spills or overflows. Inspect the concrete floor for cracks every spring. Dispose of used oil filters in accordance with the recommendations in Vehicle and Equipment Storage and Maintenance BMP.

2. Recommendation: Continue having all maintenance except oil changes and equipment washing done off the farm.

## **Petroleum Storage**

**Technical Team Member:** Joe Connors, DEP

### **Concern or Threat Identified**

o - No signs of existing pollution were observed during the field inspection.

1. Recommendation: Inspect the diesel fuel tank for leaks or signs of corrosion on a regular basis.

2. Construct an impermeable concrete pad under the diesel fuel tank. Inspect the concrete floor under the tank for signs of spills or overflows. Inspect the concrete floor for cracks every spring.

\* Note - normally, especially for large operations, plan preparers should use the worksheets provided in the Vehicle and Equipment Storage and Maintenance BMP to assess concerns or threats.

## Soil Erosion and Sediment Control

**Technical Team Member:** John Smith, SCS

### Concern or Threat Identified

o - Cropland erosion on Fields 2, 4, 4a, and 4b produces sediment laden runoff. The following recommendations are supporting practices primarily for the protection of surface water resources and are not mandatory under CGS Section 22a-354m.

1. Recommendation: Apply mulch on strawberry fields to control weeds and reduce erosion. Apply straw mulch at a rate of 1.5 to 2.0 tons per acre.

2. Recommendation: Continue to establish cover crop/catch crop following harvest of sweet corn to scavenge excess nitrogen, control erosion, and add organic matter to the soil. Apply cereal rye or other small grain at a rate of 112 pounds per acre as soon as possible after harvest, but no later than September 30.

o - Concentrated flow erosion on edges of Fields 2, 4, 4a, 4b, and the access road produces sediment laden runoff.

3. Recommendation: Establish 20 foot wide field borders for sediment on either side of the access road between fields 4, 4a, and 4b. Select an appropriate seed mix from the SCS Critical Area Planting Standard and Specification #342. See plan map for location.

4. Recommendation: Regrade the access road between Fields 4 and 4b and construct water bars to prevent surface water runoff from causing erosion of the road.

## 6. Summary and Schedule of BMP Implementation

John and Jane Brown Farm  
Sample County Soil and Water Conservation District

Page 1 of 5  
July 15, 1993

### Sample Farm Farm Resources Management Plan

### SCHEDULE FOR IMPLEMENTATION

Assisted by Interagency Technical Team

Field No.	Planned		Applied		Narrative Record
	Amount	Date	Amount	Date	
Tract Number	999224				<p><b>CROPLAND</b></p> <p><b>STRAWBERRY/SWEET CORN ROTATION</b> - Losses of applied nutrients and pesticides were identified as the primary threats to ground water for this crop. The practices described below are included in under the Farm Resources Management Plan for the purpose of protecting ground water resources in the aquifer protection area.</p> <p><b>328 - CONSERVATION CROPPING SEQUENCE</b> - Follow a cropping sequence of strawberries and sweet corn in rotation. Establish cover crop following sweet corn. Apply mulch to strawberries to reduce herbicide applications and control erosion.</p> <p><b>685 - PEST MANAGEMENT</b> - Contact Cooperative Extension System to plan and implement an Integrated Pest Management plan for these crops. Document implementation of IPM practices on the record keeping form.</p> <p><b>328A - CROP ROTATION</b> - Rotate crops to achieve Integrated Pest Management objectives. Schedule of rotation to be determined through evaluation.</p> <p><b>484 - MULCHING</b> - Apply 1.5 to 2.0 tons of straw mulch per acre to strawberries to control weeds and reduce the need for herbicides.</p>
Conservation System	D: APA1				
2GW	3.8 Ac.	94			
4GW	17.0 Ac.	94			
4aGW	6.0 Ac.	94			
4bGW	0.7 Ac.	94			
2GW	3.8 Ac.	94			
4GW	17.0 Ac.	94			
4aGW	6.0 Ac.	94			
4bGW	0.7 Ac.	94			
2GW	3.8 Ac.	94			
4GW	17.0 Ac.	94			
4aGW	6.0 Ac.	94			
4bGW	0.7 Ac.	94			

Sample Farm  
 Farm Resources Management Plan

**SCHEDULE FOR IMPLEMENTATION**

Assisted by Interagency Technical Team

Field No.	Planned		Applied		Narrative Record
	Amount	Date	Amount	Date	
2GW	3.8 Ac.	94			<p><b>680 - NUTRIENT MANAGEMENT</b> - Follow the recommendations in the Plant Nutrient Management Best Management Practice and coordinate with the Cooperative Extension System to develop and implement nutrient management practices for these crops. Document practice implementation on the record keeping form. Include soil test reports, manure applications, and fertilizer applications in the documentation.</p>
4GW	17.0 Ac.	94			
4aGW	6.0 Ac.	94			
4bGW	0.7 Ac.	94			
2GW	3.8 Ac.	94			<p><b>340 - COVER AND GREEN MANURE CROP</b> - Following sweetcorn harvest, plant a winter cover crop of small grains, legumes, or other grasses to scavenge excess nitrogen and reduce erosion. Plant cover at a rate of 112 pounds per acre as soon as possible, but before September 30.</p>
4GW	17.0 Ac.	94			
4aGW	6.0 Ac.	94			
4bGW	0.7 Ac.	94			
Conservation System ID: APA2					<p><b>OTHER LAND</b></p> <p><b>FARMSTEAD</b> - Pesticide storage, mixing of pesticides, rinsing of containers, and protection of the farm water supply were identified as the primary threats to ground water. The recommendations described below are required under the Farm Resources Management Plan for the purpose of protecting ground water resources in the aquifer protection area.</p>

Sample Farm  
 Farm Resources Management Plan

**SCHEDULE FOR IMPLEMENTATION**

Assisted by Interagency Technical Team

Field No.	Planned		Applied		Narrative Record
	Amount	Date	Amount	Date	
H1GW	1 Number	94			<p>997 - PESTICIDE MANAGEMENT - 1) Install an approved pesticide storage cabinet or building (see attached information). It should have a lock, ventilation, heat, sign, and containment area. 2) Construct a permanent pad or utilize a portable pad for mixing pesticides, rinsing containers, or rinsing equipment. 3) Install backflow prevention devices on all water supplies used to fill spray tanks, or rinse containers or equipment.</p> <p><b>OTHER LAND</b></p> <p>FARMSTEAD - Oil tanks in the shed were identified as a primary threat to ground water. The practice(s) described below are required under the Farm Resources Management Plan for the purpose of protecting ground water resources in the aquifer protection area.</p>
Conservation System ID: APA3					
H2GW	1 Number	94			<p>999 - STORAGE TANK MANAGEMENT - Construct an impermeable concrete pad under the tank. Inspect floor underneath tank for signs of spills or overflows. Inspect concrete floor for cracks every spring. Tanks which store diesel fuel or used oils should be inspected for leaks and spills on a weekly basis.</p>
H2GW	1 Number	94			<p>000 - VEHICLE AND EQUIPMENT MAINTENANCE - Continue having all service, except oil changes, done off the farm. Continue having waste oil removed by a licensed hauler.</p>

Sample Farm  
 Farm Resources Management Plan

**SCHEDULE FOR IMPLEMENTATION**

Assisted by Interagency Technical Team

Field No.	Planned		Applied		Narrative Record
	Amount	Date	Amount	Date	
	Conservation System ID: 3				<b>CROPLAND</b>
4aSW	400 Ft.	93			<p><b>STRAWBERRY/SWEET CORN ROTATION</b> - Soil erosion and sediment control, and losses of applied nutrients and pesticides were identified as the primary concerns for contamination of surface water resources. The practice(s) described below are primarily for the protection of surface water resources and are not mandatory under CGS Section 22a-354m.</p> <p><b>386 - Field Border</b> - Establish and maintain a 200 foot wide sod field border to protect and control erosion along the edges of fields used as travel lanes for farm machinery. Field borders will protect Fields 4, 4a, and 4b from excess surface runoff and sediment.</p>

Sample Farm  
Farm Resource Management Plan

SCHEDULE FOR IMPLEMENTATION

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CERTIFICATION STATEMENT

I/We concur in the Best Management Practices (BMPs) and schedule for implementation indicated in this farm resources management plan for protection of ground water in designated aquifer protection areas. I/We understand that when this plan is approved by the Commissioner of the Department of Environmental Protection (DEP), it will obligate me/us to apply and maintain continually the BMPs for ground water summarized in the schedule for implementation and described in the body of the plan. I/We understand that I/we am/are obligated to submit progress reports to the Commissioner of the DEP, as specified in the approval letter. I/We understand that DEP may make periodic inspections of the farm operation(s) covered by this plan to determine compliance with the provisions of the Aquifer Protection Act, as amended. I/We agree to contact the preparer of this plan and DEP if any changes occur in the farm operation, not specifically covered by this plan. I/We further understand that nothing in this agreement shall affect the authority of the Commissioner of DEP to institute any proceedings to abate or prevent pollution.

Person(s) engaged in agriculture  
Signed:

Date:

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Landowner concurrence  
Signed:

Date:

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The above farm resources management plan was developed in accordance with the requirements of the Aquifer Protection Act, as amended.

SWCD interagency technical team coordinator, consultant, or other plan preparer

Signed:

Date:

**SWCD / Interagency Technical Team Assistance Notes  
for Aquifer Protection Areas**

Operator	Address	Location of Operation
John and Jane Brown	1234 Cheshire Street Cheshire, CT. 06040  Phone: 203-123-4567	Same as address

**Aquifer Protection Area: South Central Regional Water Authority  
North Cheshire Wellfield**

Include notes of significant assistance provided, alternatives considered, decisions reached, BMPs implemented or modified, and follow up provided.

Date	Initials	Notes
5/1/93	IBD	Copy of DEP notification to operator received.
5/15/93	IBD	Follow up contact with Jane Brown.
5/17/93	AXF	John Brown phoned to request SWCD planning assistance. Discussed planning meeting and plan requirements.
5/21/93	BTW	Brown's invited to introductory meeting on 6/1/93 at county agricultural center.
5/26/93	BTW	Ordered photo maps for Brown farm, assembled soil survey data, met with ASCS for crop history, tract and field information.
6/1/93	BTW	Jane Brown attended introductory meeting and signed up to meet with technical team on 6/20/93.
6/10/93	BTW	Contacted the following agencies to participate on the technical team for the Brown Farm. SCS - John Smith ASCS - Bill Allen CES - Mary Tyler CES - Sara Johnson DEP - Joe Connors DOA - Pam Sullivan CAES - Pete Walker SWCD Coordinator - Barbara Wilson South Central Regional Water Authority - Mark Jones Town of Cheshire - Susan Martin
6/15/93	BTW	Visited farm to collect background information and verify map boundaries. Owner only operates fields 2,4,4a, and 4b. Smith Dairy Farm rents land for silage corn. Henry Jones rents land for alfalfa hay. Part of the greenhouse (3 sq.ft.) is rented to Frank Lewis and Tim Carter. The remaining 2000 sq.ft. is not used. Strawberries and sweet corn are the only crops grown by the Browns.

**SWCD / Interagency Technical Team Assistance Notes  
for Aquifer Protection Areas (cont.)**

Date	Initials	Notes
		<p>They rotate crops but not in a scheduled pattern. Strawberries usually last 3 to 4 years between replanting. The acreage and type of sweet corn planted depends on an estimate of market conditions made in June. Walked through farm operation with the Browns. Jane cares for the crops, and schedules fertilizer applications, and pesticide applications. John prepares fields, plants crops, mulches, repairs equipment and vehicles, and mixes and applies pesticides. Discussed and documented existing conditions on assessment forms. Discussed ground water quality concerns that the plan will address and the planning process.</p>
6/20/93	BTW	<p>a.m. Met with the technical team to distribute resource information package, discuss concerns, review information, and assign responsibilities to agency technical representatives. SCS will handle animal waste and soil erosion and sediment control, CES will handle pest and pesticide management, and nutrient management. DEP will handle vehicle and equipment maintenance and repair and petroleum storage. Listed concerns were discussed and clarified, no additional concerns were mentioned.</p> <p>p.m. The technical team met with the Brown's at the farm. John and Jane Brown discussed the farm operation and objectives with team members. Smith, Tyler, Johnson, and Connors met individually with the Brown's to schedule follow up meetings to discuss and plan BMPs. Concerns to be addressed in the plan were discussed with the Browns and agreed upon. Agreed at post review meeting that ground water concerns to be addressed in the Farm Resources Management Plan by category and agency responsibility are:</p> <ul style="list-style-type: none"> <li>Pest Management - CES</li> <li>Pesticide Management - CES</li> <li>Nutrient Management - CES</li> <li>Vehicle and Equipment Storage and Maintenance - DEP</li> <li>Petroleum Storage - DEP</li> <li>Soil Erosion and Sediment Control - SCS (non mandatory support practices)</li> </ul> <p>Agencies agreed to provide reports by 7/6/93</p>
7/8/93	BTW	Draft plan prepared. Scheduled meeting with Browns and technical team members for 7/12/93.
7/12/93	BTW	Met with Browns at farm. Reviewed and discussed plan. Several revisions made.
7/16/93	BTW	Prepared final plan for signature and delivered to Jane Brown.

