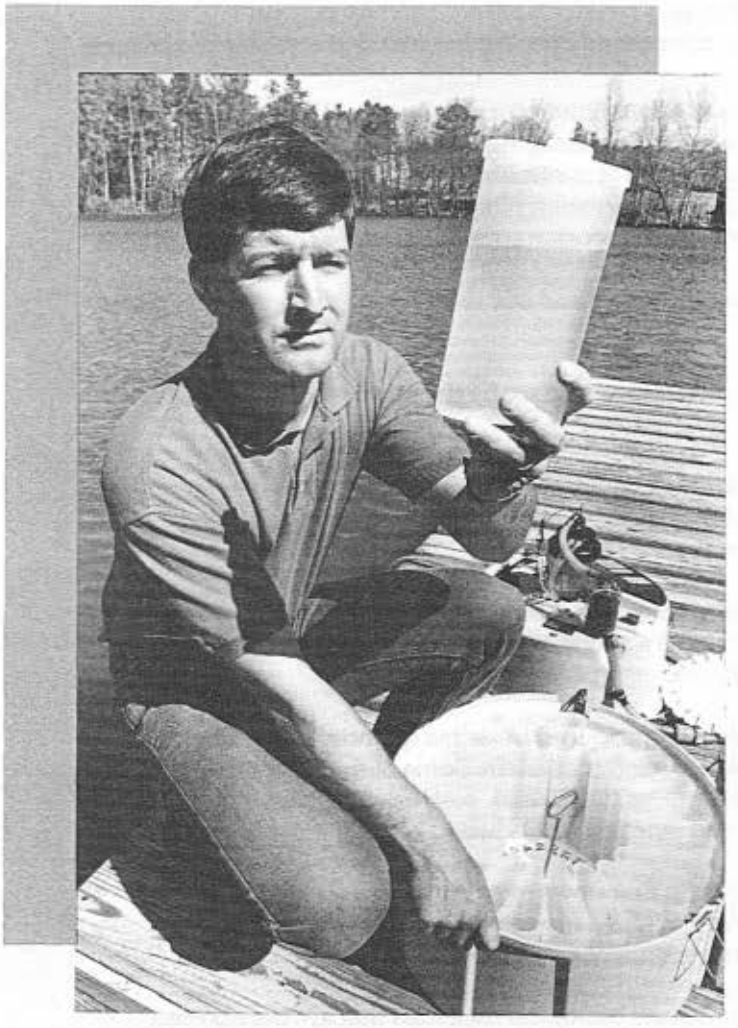

Land Use and Water Quality

A Guide to Understanding Nonpoint-Source Pollution and Creating Local Management Programs

North Carolina Cooperative Extension Service

North Carolina State University

Some Terms to Know

Best Management Practices (BMPs): Environmentally sound alternatives to customary but environmentally damaging practices of farming, forestry, or development. BMPs are aimed at controlling nonpoint-source pollution through practices such as conservation tillage, integrated pest management, stormwater runoff control, and erosion control practice at construction sites.

Estuary: An area of the sea at the lower end of a river where the ocean tide meets the river current.

Erosion: The wearing away of the land surface by the movement of water, wind, or ice.

Nonpoint-source (NPS) pollution: Environmental contamination that arises from diffuse areas and is carried in runoff water from a field, forest, or urban area into waterways.

Point-source pollution: Environmental contamination that originates from the discharge of pollutants from a single, readily identifiable source such as an industrial or sewage discharge pipe.

Pollutant: Any substance that is introduced in such a quantity as to damage or disrupt the natural balance of an ecosystem. Some of the most common pollutants include soil particles (sediment), pesticides, nutrients from animal waste, metals, and petroleum products.

Runoff: Water from precipitation that flows over the surface of land and ultimately reaches waterways, usually carrying pollutants such as nutrients, chemicals, and sediment.

Sediment: Particles of soil, rock, and biological materials that are transported into bodies of water or onto land. *Sedimentation* occurs when these particles settle into water or onto land.

Watershed: An area of land that drains into one or more specific streams, rivers, or other bodies of water.

Contents

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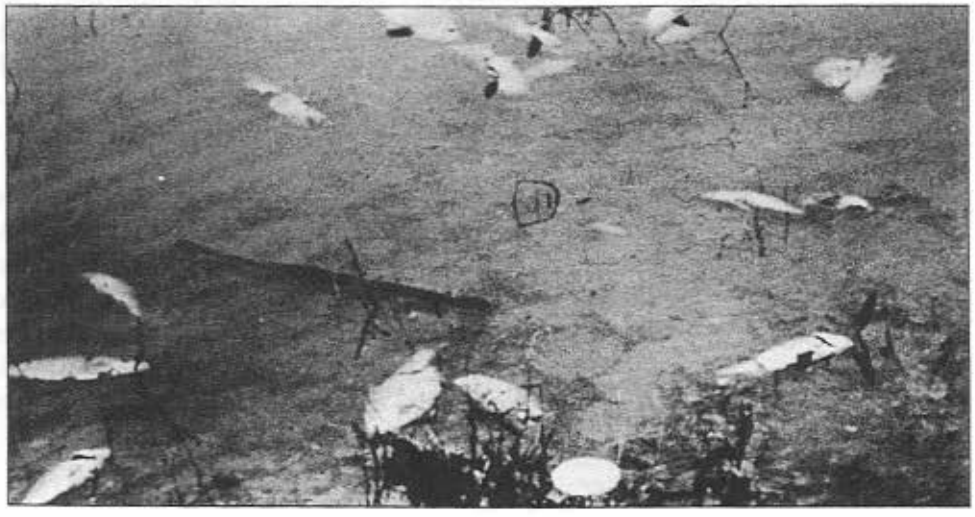
1. Introduction

In recent years people have become increasingly aware of the need to preserve the quality of water in our lakes, rivers, estuaries, and coastal waters. Our health, our economy, and our environment all depend on clean water resources. Furthermore, clean water is vital to wildlife and to recreational activities such as boating, fishing, and swimming. Unless measures are taken to control pollution, declining water quality will have far-reaching ecological, economic, and aesthetic consequences.

This manual has been developed to help landowners, local leaders, resource management professionals, and concerned citizens gain a better understanding of water pollution problems and methods for solving them. You may find certain chapters more relevant than others, depending on your background, interests, and responsibilities in the area of water quality.

Chapters 2 and 3 introduce the basic concepts of water quality and nonpoint-source pollution control for those who are not already familiar with these topics. Chapter 4 describes in detail the barriers that limit landowners' willingness and ability to control nonpoint sources of pollution. Chapter 5 provides a step-by-step planning procedure for targeting the most serious nonpoint-source pollution problems in a watershed. Chapter 6 presents guidelines for developing educational and citizen-involvement programs, based on a team approach. Finally, Chapter 7 should be useful to all readers because it describes many of the key organizations involved in nonpoint-source pollution control.



Fish kills provide dramatic evidence of water pollution.

Sources of Water Quality Problems

Water quality problems arise from a number of sources. Some can be attributed to *point sources.* Pollution from these sources enters the environment at single locations (such as a pipe or ditch) that can usually be detected quite easily. Discharges from industries and sewage treatment plants are typical point sources of pollution.

Nonpoint-source pollution, on the other hand, enters the environment from diffuse areas. Some of this pollution originates on land and travels to waterways. For example, the water that runs off of cropland or forestland may carry fertilizers, pesticides, and soil particles (sediment) to nearby lakes and streams. The area of land that drains into a specific body of water is called a *watershed.* Drainage from a watershed can carry harmful pollutants into that water body.

The origins of nonpoint-source pollution vary among geographic regions. Agricultural pollutants from cropland and from areas used for animal production are the most widespread. Urban sources, including storm drainage and runoff from construction sites, are next in importance. Forestry activities such as logging and replanting are significant nonpoint sources of pollution in some areas. Other pollutants come from shoreline erosion and atmospheric fallout. In some places, important nonpoint sources may include faulty septic systems and mining areas.

From the sources described, pollutants such as chemicals, sediment, and nutrients can be carried by runoff water into streams, rivers, lakes, and estuaries (the areas where freshwater rivers join the ocean). Even fresh water can be considered a pollutant when it is introduced into the water of estuaries because it can decrease salinity and threaten the nursery areas of various marine animals.

Controlling Water Pollution

The technical and institutional mechanisms needed to detect and control point-source pollution are well established. Pollution from nonpoint sources, however, is relatively difficult to isolate and control, partly because the sources are often hard to identify. Furthermore, the capability for controlling nonpoint-source pollution rests with many different individuals and organizations who control the use of land.

In some cases the owners or other persons responsible for these sources do not understand the need for better water quality management or the mechanisms available to achieve it. A great deal of coordination and teamwork is needed to identify nonpoint sources of pollution, provide information to those responsible, and encourage them to take corrective action. This manual focuses on practical methods for improving water quality management and ways of promoting the application of those methods.

2. The Water Pollution Problem

North Carolina's Water Quality

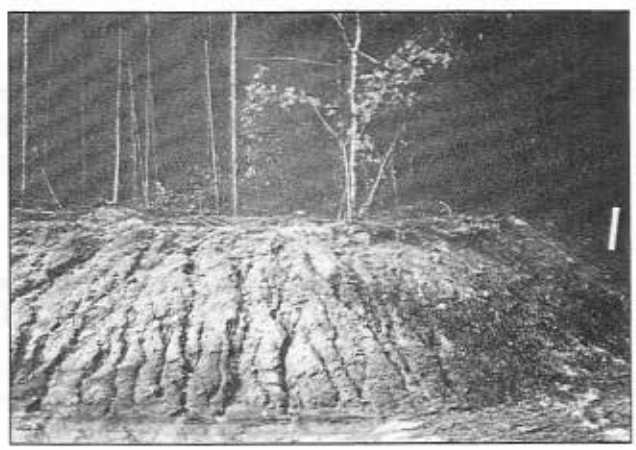
Types of Pollution

Before the 1970s, point sources were responsible for much of the degradation of water quality. However, because of improvements in wastewater treatment plants in the 1970s and 1980s, point sources that comply with permits are no longer the major cause of water pollution.

Nonpoint sources are now considered the most widespread contributor to the degradation of water quality. Typical nonpoint sources of pollution include runoff from cropland, animal production and waste management areas, urban areas, construction sites, and logging roads. The state has developed the N.C. Nonpoint Source Management Program to address the water quality impacts of pollutants from these nonpoint sources. The N.C. Division of Environmental Management (DEM) is the lead agency, with other agencies such as the Division of Forest Resources, the Division of Soil and Water Conservation, and the Division of Land Resources taking leading roles in specific areas.

Impacts of Nonpoint-Source Water Pollution

Nonpoint-source pollution can affect water quality in a number of ways. Most forms of nonpoint-source pollution are a result of runoff from land areas. Some runoff is normal, occurring naturally in undisturbed areas. However, human changes in land use increase runoff and nonpoint-source pollution. Runoff from rainfall and snowmelt carries a number of different substances that can result in water pollution, depending on the amounts and types of contaminants.



When steeply sloping land is unprotected, the flow of runoff water can carry large amounts of sediment and other contaminants into nearby bodies of water.

Sediment is by far the largest nonpoint-source pollutant by volume. Sediment comes mainly from erosion of areas such as cropland, construction sites, and stream banks. Sediment increases the turbidity (or cloudiness) of the water, directly harming fish and other aquatic life. In addition, other, more harmful compounds attach to the sediment and are carried with sediment particles into the water.

Another common type of nonpoint-source pollution is an increase in the amount of nutrients (such as nitrogen and phosphorus) that enter the water. Nutrients can attach to sediment or may be dissolved in the water. When these nutrients reach a water body, they stimulate plant growth, just as they do on land. Such plant growth (especially of undesirable algae or aquatic weeds) may cause significant changes in the aquatic environment. One of the most serious problems involves eutrophication, or overenrichment with nutrients. The algal blooms that develop can lead to a number of serious problems. When the algal blooms die off, the water's oxygen supply is depleted, resulting in fish kills and nutrient overenrichment.

Toxic chemicals that wash off the land surface are another form of nonpoint-source pollution. Even relatively small amounts of pesticides from cropland or urban lawns can lead to changes in ecological conditions. Urban runoff can carry heavy metals (such as lead) and oil. These toxic compounds often have subtle, long-term impacts. In some cases, these compounds can become concentrated in shellfish and finfish, posing potential risks to human health.

Other types of pollutants can also cause problems in certain water bodies. Bacteria or other pathogens (disease-causing organisms) can harm fish or even pose human health risks. Shellfish harvesting is forbidden when fecal coliform tests show the shellfish to be contaminated. Such contamination could be due to animal waste from livestock operations, human waste from malfunctioning septic tanks, or stormwater runoff. Organic matter from these same sources can reduce the oxygen content of the water. Reduced oxygen levels or the presence of microorganisms can lead to fish kills or diseases.

Water Quality Assessments

Programs have been under way for several decades to monitor and improve water quality. Section 305(b) of the federal Clean Water Act requires each state to prepare a biennial report to:

1. describe the quality of all waters of the state,
2. assess the extent to which these waters protect aquatic life and provide for recreational activities and other uses,
3. assess the extent to which the discharge of pollutants has been controlled to improve water quality, and

4. describe the nature and extent of nonpoint-source pollutants and ways in which this pollution can be controlled.

Much of the information in this publication on water quality ratings and water quality conditions is taken from the North Carolina Department of Environment, Health, and Natural Resources report entitled *Water Quality Progress in North Carolina, 1988-1989, 305(b) Report.* Further information is available from the N.C. Division of Environmental Management.

Water Quality Ratings

The state assigns classifications and associated standards to waters based on best usage in the interest of the public. Ratings are assigned to reflect the ability of a given water body to support its designated uses. A water body that fully supports its uses is rated as *supporting.* A water body rated as *support-threatened* is characterized by either improving or worsening water quality but continues to fully support its uses. A water body that supports some of its designated uses is considered to be *partially supporting.* If a water body does not support any of its designated uses, it is considered to be *nonsupporting.* When there are no data available on which to base a use support rating, it is listed as *nonevaluated.*

These ratings are assigned by considering a broad range of factors, such as biological and chemical monitoring data, information received from government agencies or the public, and best professional judgments by resource professionals. The following statements about water quality are largely judgments based on the best available data. They are intended to show the general pattern of the extent, causes, and sources of water pollution. Further in-depth study is necessary to more accurately describe the water pollution and determine management actions in a particular area.

Water Quality Conditions

The quality of water in North Carolina's streams and rivers is generally good. Much of the pollution control effort is therefore aimed at protecting our waters by preventing them from becoming polluted. Most waters (64%) fully support their uses, while 25% partially support and 6% do not support their uses. Five percent of our streams and rivers were not evaluated. Although agriculture is thought to be the most widespread contributor to stream degradation across most of the state, urban runoff and wastewater treatment plants have significant impacts on stream usage in several areas. Of the degradation in impaired waters, it is estimated that:

- agriculture is responsible for 47%,
- wastewater treatment plants for 14%,

- urban runoff for 8%, and
- other unidentified nonpoint sources for 31%.

The major types of degradation include sediment (30%), bacteria (6%), ammonia (4%), and other unidentified causes.

When comparing sources of degradation, it is important to keep in mind the severity of the impact. For example, while agriculture affects a relatively large number of stream miles compared to urban and construction runoff, the impact from agriculture is generally less severe. In general, bodies of water that are affected by agricultural activities are usually rated as partially supporting, whereas those that receive urban runoff are frequently rated as nonsupporting. Exceptions occur, however. The difference in severity can be explained partly by the types of pollutants generated from each source. Although agriculture and urban runoff are both sources of sediment, nutrients, and toxic chemicals, urban runoff generally has higher concentrations of oil, grease, and heavy metals.

The quality of water in North Carolina's lakes is also generally good. Of the estimated 1,500 lakes in the state, 144 are considered to be *significant*. Lakes are considered to be significant if they meet one of the three following conditions: (1) water quality assessments have been performed by DEM; (2) they are classified as drinking water supplies, or (3) they are greater than 100 acres in surface area and are accessible to the public.

In these significant lakes, 96% of the total acreage supports designated uses, 1% partially supports, and 3% does not support these uses. The water quality degradation in these lakes is estimated to result from:

- in-place contaminants (37%),
- industrial discharges (29%),
- municipal discharges (10%),
- agriculture (5%), and
- unspecified sources (19%).

The types of degradation in water quality include metals (75%), aquatic vegetation (15%), nutrients (5%), organic material (3%), and sedimentation (2%).

The quality of water in the state's estuaries is also generally good. Overall, 91% of the estuarine acreage fully supports designated uses, 9% partially supports, and less than 1% does not support these uses. The major sources of pollution of the degraded acreage are thought to be:

- agricultural runoff (35%),
- municipal wastewater treatment plant discharges (16%),
- natural runoff (primarily from forested land) (14%),
- urban runoff (10%),
- animal feedlot runoff (9%), and
- other nonpoint sources (16%).

The primary types of the degradation are thought to be eutrophication (77%), bacteria (12%), and low dissolved oxygen concentrations (5%).

Though the overall quality of coastal waters is good, the conversion of coastal forests to agricultural uses has affected areas critical to saltwater fishery resources. Extensive development along barrier islands is also having an impact on shellfishing areas. In addition, nonpoint-source impacts of coliform bacteria in agricultural and urban runoff, as well as from septic tanks in unsuitable soils, have contributed to the closure of some shellfishing waters.

Programs have been developed to help protect water bodies from these sources of pollution. The implementation of existing nonpoint-source pollution programs, expansion of stormwater regulations, improvement of classifications, and expansion of the Agricultural Cost Share Program should help to protect and improve water quality. However, since these actions generally address nonpoint-source pollution, which is more difficult to control than point-source pollution, progress will probably be slow.

Pollution Control Efforts

Previous pollution control efforts have emphasized point sources. Since the early 1970s, all point-source dischargers have been required to obtain a National Pollutant Discharge Elimination System (NPDES) permit from the Division of Environmental Management. In order to protect downstream water quality, limits are set on the amount and type of pollution that each point source is allowed to discharge. DEM continues to improve its point-source permit program through expanded monitoring, enhanced compliance tracking, effluent nutrient requirements, pollution reduction requirements, and municipal pretreatment activities.

While point-source discharges to surface waters are regulated solely by DEM, many different agencies are involved in controlling pollution from nonpoint sources. North Carolina, like other states, uses a combination of regulatory (mandatory) and nonregulatory (voluntary) programs for nonpoint-source pollution control. For example, sedimentation from construction sites and mining areas, as well as land

disposal of waste, is regulated by agencies at both the state and local levels. In contrast, the state administers a multimillion dollar agricultural cost-share program (targeting nonpoint-source pollution) in which participation is voluntary. Recent initiatives to minimize nonpoint-source pollution from development activities include mandatory stormwater controls in selected watersheds to protect valuable aquatic resources. As nonpoint-source pollution control gains importance both at the national and state levels, North Carolina's own program will continue to evolve and strengthen.

Origins of Nonpoint-Source Pollution

This section focuses on the most significant nonpoint-source pollution problems and identifies the major sources of this pollution.

Agriculture

Agricultural nonpoint-source pollution problems are many, varied, and often difficult to pinpoint. This type of pollution relates directly to how farmers use land. The primary pollutants from cropland are sediment, nutrients, and pesticides. The pollutants from land used for animal production include sediment, nutrients, organic matter, and microorganisms.

In terms of volume, sediment is the greatest nonpoint-source pollutant. Cropland is a major contributor of the sediment that enters surface waters. Not all cropland contributes equal amounts of sediment to surface waters. The potential for sediment to move from cropland to water bodies depends upon a number of factors, such as soil characteristics, slope, climate, and proximity to surface waters. Pollution generated on cropland also relates directly to crop type, tillage method, and other management practices. Excessive applications of fertilizers, manure, and pesticides to cropland can also lead to water pollution. Another water quality concern is freshwater drainage from agricultural land into saltwater nursery areas.

Forestry

The forestry industry generally produces a smaller volume of nonpoint-source pollutants than agriculture. However, forestry operations can cause major nonpoint-source pollution problems in areas where trees are being harvested, planted, or treated with pesticides.

The amount of pollution that forestry contributes to water quality depends upon the characteristics of the forestland (such as soil type and slope), climatic conditions, the forest management practices used, and the care with which the practices are carried out. Chemical pollutants can be introduced to water bodies through practices such as aerial spraying near a watercourse. As is the case with agricultural land, freshwater drainage from forestland can affect saltwater nursery areas.

By disturbing the soil and exposing it to the effects of precipitation, timber harvesting activities can contribute to the pollution of waterways.

Urban Sources

Urban runoff can cause significant local water quality effects. A large proportion of the pollutants in urban runoff consist of sediment and debris from pavements and buildings. These materials can clog waterways and degrade aquatic habitats. Heavy metals (such as lead) and inorganic chemicals from transportation activities, building materials, and other sources are also significant pollutants. Pesticides and fertilizers from lawns and gardens are often present in urban runoff.

The amount of pollution from urban runoff depends on the amount of paved area, slope of the land, type of storm management, and other considerations. Septic tanks, solid waste disposal sites, and mining can also contribute to nonpoint-source pollution.

3. Reducing NPS Pollution: Management Practices & Institutional Resources

Best Management Practices (BMPs)

Research into nonpoint-source (NPS) pollution has led to a better understanding of the ways pollutants move into waterways. It has also led to the development of *best management practices* (BMPs) — that is, methods of conducting everyday activities such as farming, forestry, construction, and waste disposal with minimum damage to the environment. These BMPs help keep runoff from leaving the land and carrying pollutants into bodies of water. Substantial water quality benefits can be achieved by carefully targeting those land areas and activities that cause the most pollution (see Chapter 5). Federal and state programs can assist in implementing BMPs. This section describes some of the BMPs currently available for reducing nonpoint-source pollution from farms, forestland, and urban areas.

BMPs for Agriculture

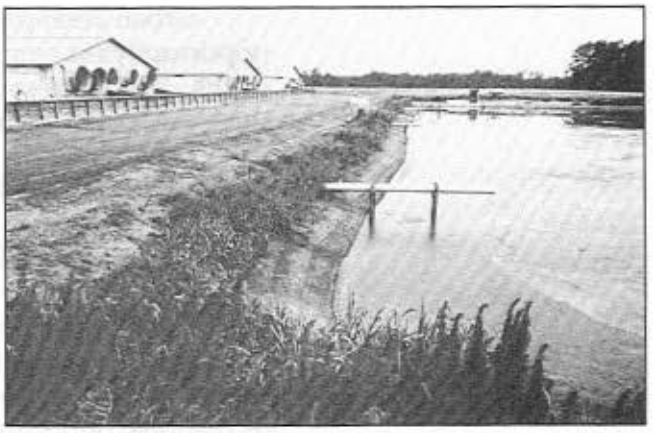
Many BMPs have been developed to control pollutants from agricultural areas. A sample of available BMPs is given in Table 1. These may be used individually or in combination. There are many other specific BMPs

Table 1. Examples of Best Management Practices for Agriculture

Problem	Best Management Practices
Sediment from cropland	Conservation tillage Contour strip cropping Terracing Grassed waterways
Excessive pesticide pollution of water	Integrated pest management Following label directions Careful pesticide handling, storage, and container disposal
Water quality degradation from animal wastes	Exclusion of livestock from water bodies Following soil test recommendations Feedlot waste management systems Nutrient use management
Excessive nutrient pollution of water	Nutrient use management Practices described above for control of sediment pollution from cropland

as well as modifications of the ones listed, such as integrated crop management for both pesticides and fertilizers. Many of these BMPs benefit production agriculture while helping to conserve natural resources.

Most BMPs for cropland aim to reduce soil erosion and minimize runoff. They are designed to catch pollutants, keeping them from moving away from the site and into the water. The BMPs for livestock waste generally involve containing the material and applying it to the land in order to recycle nutrients and organic matter to the soil.



When effectively managed, animal waste lagoons make it possible to recycle nutrients and organic matter, preventing pollution of water resources.

BMPs for Forestland

Effective BMPs have been developed for forestry. Sediment is the most important potential pollutant. Thus, emphasis is placed on protecting forest soils with practices that reduce erosion to acceptable levels. Such practices include minimizing soil disturbance during forestry activities; maximizing the distance between large areas of bare soil; dispersing surface water flow across natural buffer areas; and establishing streamside management zones during timber harvesting.

Each site must be evaluated to determine the combination of techniques that best suit its characteristics. As in agriculture, the adoption of certain BMPs may often be to the advantage of the owner or operator. For example, proper construction of logging roads intended for long-term use may lower operation and maintenance costs. In some instances, however, BMPs are not in the economic interest of the owner or operator. Some BMPs, for example, require costly specialized equipment or extra time and labor (see Chapter 4).

BMPs for Urban Areas

Structural and nonstructural methods are available to control urban runoff. Structural methods provide a means of controlling polluted water and diverting it from major waterways. Such control structures include runoff retention basins, in-line storage, and in-line screens. These devices

retain water and solids within basins and conveyance systems. They also allow water to percolate into the ground to reduce peak flows and the amount of pollutants that reach receiving waters.

Nonstructural BMPs include maintenance, cleanup, and sound land-use planning. Some of these BMPs are as simple as following label directions when using pesticides or other chemicals. Also, soil tests can be conducted to determine nutrient needs instead of randomly applying fertilizers or lime to lawns and shrubbery. Proper disposal of motor oil is another example of a nonstructural BMP that is simple but significant in controlling nonpoint-source pollution.

Urban areas that are under development have the greatest opportunity for employing a full range of structural and nonstructural BMPs. Nonpoint-source pollution can be prevented for the least cost in these areas. For example, good land-use planning can reduce future runoff and pollution. Communities in the development stages can readily incorporate structural measures to reduce long-term urban runoff. In the initial planning and construction stages, these communities can also integrate BMPs for soil erosion control.

The costs of most BMPs are borne by landowners and the public (through government programs). However, these practices yield many benefits to the taxpayers and society. BMPs can protect or restore recreational opportunities, preserve or restore commercial fishing and shellfishing opportunities, and maintain land values by improving the appearance of receiving waters. In addition, these practices reduce damage to drainage systems, obstruction of navigation channels and harbors, and the frequency and severity of floods. To enhance these benefits, a number of laws have been enacted to control pollution.

Proper disposal of household chemicals and petroleum products is a best management practice that can significantly reduce nonpoint-source pollution from urban areas.

Institutional Resources for Solving Water Quality Problems

Water Quality Legislation

Many laws have been passed at federal and state levels to help control pollution of our state's waterways. Two major federal laws provide the principal directives for state and local actions. These are the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) and the Water Quality Act of 1987. The overall objective of P.L. 92-500 was to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." Section 208 of the act required the development of plans that would include processes to reduce or control nonpoint-source pollution from various land-use activities.

The 1987 Water Quality Act reauthorized the 1972 bill. This act places greater emphasis on nonpoint-source pollution control by requiring each state to develop strategies for managing nonpoint-source pollution (Section 319).

A foundation for the water quality management strategies in North Carolina is the policy adopted by the General Assembly to "achieve and maintain for the citizens of the state a total environment of superior quality" (G.S. 143-211). This builds on Article XIV, Section 5, of the state Constitution, known as the North Carolina "Environmental Bill of Rights," which mandates that the state take an active role in controlling and limiting water pollution. The State Environmental Policy Act also declares that the state will seek to attain the widest range of beneficial uses of the environment without degradation (G.S. 113A-3).

A fundamental tenet of North Carolina's environmental management efforts is its antidegradation policy. The basic principle is to protect water quality from further deterioration. This policy also stipulates that every effort must be made to improve existing water quality.

Agencies and Programs

Nonpoint-source pollution, by its nature, is very complex. Thus, the identification of the sources and the establishment and management of programs to address these sources involve many participants. In North Carolina, the Water Quality Section of the Division of Environmental Management coordinates the Nonpoint Source Management Program. Other state agencies and organizations have important roles in this program.

Organization	Designated Area of Responsibility
Division of Environmental Management	General water quality and urban runoff
Division of Soil and Water Conservation	Agriculture
Division of Land Resources	Construction
Division of Environmental Health	On-site wastewater treatment
Division of Forest Resources	Forestry
Department of Transportation	Transportation

In addition to these management agencies, several state and federal agencies, local governments, and environmental programs also have a role in nonpoint-source pollution control. Their work complements existing statewide efforts or is concentrated in specific geographic areas. These organizations and programs include:

- N.C. Cooperative Extension Service (CES)
- N.C. Department of Agriculture (NCDA)
- U.S. Environmental Protection Agency (EPA)
- U.S. Department of Agriculture (USDA)
  - Soil Conservation Service (SCS)
  - Agricultural Stabilization and Conservation Service (ASCS)
  - Forest Service (FS)
- National Oceanic and Atmospheric Administration (NOAA)
- U.S. Geological Survey (USGS)
- Albemarle-Pamlico Estuarine Study (APES)
- Water Resources Research Institute (WRRI)
- Pollution Prevention Pays (PPP) program
- Sea Grant program
- Stream Watch program
- Keep America Beautiful program
- N.C. Conservation Tax Credit program

These agencies and programs are described in NCDEHNR report 89-02, *North Carolina Nonpoint Source Management Program,* April, 1989. Several of the key organizations are described in Chapter 7 of this manual.

Key local agencies, including those with federal or state affiliation, also play major roles. These include:

- Soil and water conservation districts
- Cooperative Extension Service (CES)
- County commissioners
- Municipal boards

Private groups also play a vital role in assisting the nonpoint-source pollution control effort. Several of these groups are listed along with their addresses in Chapter 7.

In addition, the faculties of North Carolina State University and other institutions conduct research and educational programs to develop and disseminate knowledge that can help other agencies and individuals in their efforts to improve land management and water quality.

Effective implementation of water quality policies and programs ultimately depends on local agencies and their interaction with landowners. Cooperative teamwork among these agencies is vital to the success of any water quality effort (see Chapter 6).

Incentives and Assistance Programs

Section 319 of the 1987 Water Quality Act amendments authorized $400 million in federal grants for implementing nonpoint-source pollution management programs and protecting groundwater quality nationally. However, only $89 million was appropriated for 1990 and 1991.

The N.C. Agriculture Cost-Share Program is a highly successful incentive program to promote water quality. It is administered by the Division of Soil and Water Conservation of the Department of Environment, Health, and Natural Resources. Initiated in 1984 as a pilot project in three nutrient-sensitive watersheds (Falls Lake, Jordan Lake, and the Chowan River), the program has expanded statewide with an annual budget of approximately $8 million. Under the program, the 94 local Soil and Water Conservation District (SWCD) boards, administered by the Soil and Water Conservation Commission, are responsible for:

- identifying treatment areas,
- allocating resources,
- signing contractual agreements with landowners,
- providing technical assistance for the planning and implementation of BMPs, and
- encouraging the use of appropriate BMPs to protect water quality.

By funding the cost-share program, North Carolina has taken a significant step toward addressing the water pollution problems that result from agricultural activities. Because the program emphasizes water quality, it stimulates interest and support for other local, state, and federal water quality programs.

The ASCS provides significant cost-share funding for agricultural conservation programs. State and federal funding for specific projects is provided by other pollution control programs.

Implementing BMPs can provide other benefits to farmers because BMPs that control nonpoint-source pollution are also consistent with sound agricultural practices. For example, BMPs that control soil erosion and its associated pollutants can increase the long-term productivity of a land site.

Other Institutional Approaches

The North Carolina Sedimentation Pollution Control Act was passed in 1973 to prevent NPS pollution that is caused by sediment. This act requires BMPs to be installed and maintained during land-disturbing activities (such as construction) in order to prevent erosion and sedimentation. The act is performance based — that is, the BMPs used for a construction site *must be effective* in controlling erosion and meet four mandatory standards of performance. Therefore, this law is flexible because it allows landowners and developers to draw from a variety of BMPs and tailor the erosion control system to fit each site. The North Carolina Division of Land Resources administers this program.

The initial version of the Sedimentation Pollution Control Act provided a blanket exemption for agriculture and forestry. However, 1989 amendments to the act specify nine performance standards that the forestry industry must now meet. These performance standards are comprehensive in that they cover all phases of forest management and involve a variety of specific BMPs. They are mandatory in the sense that they must be met to maintain the exemption from the act. The North Carolina Division of Forest Resources is responsible for determining whether a forestry activity is in compliance with the performance standards. Monetary penalties are possible for violations.

Agriculture remains exempt under the act. But changes in federal farm programs and policy are meant to discourage traditionally accepted practices that are now recognized as contributing to nonpoint-source pollution. For example, the 1985 and 1990 Food Security Acts (that is, farm bills) require farmers who continue to farm highly erodible land to develop and implement an approved conservation farm plan in order to remain eligible for certain federal farm program benefits. Such financial *disincentives* can also be used to achieve nonpoint-source pollution control.

4. Barriers to the Adoption of Best Management Practices

Controlling nonpoint-source pollution in a watershed depends on the adoption of BMPs by the owners and managers of the watershed's land areas. Before these individuals will be willing and able to employ new practices, however, they must have access to the necessary information as well as technical assistance, financial incentives, and social support.

Many barriers can limit people's willingness or ability to adopt BMPs. An understanding of these barriers makes it possible to develop and implement local programs that will enable people to obtain the help they need and encourage them to use BMPs. This chapter discusses technical, educational, social, institutional, and economic barriers to the adoption of BMPs. The discussion includes examples for the four largest categories of land use: cropland, animal production sites, forestland, and urban areas.

For simplicity, the term *landowner* will be used to designate not only those who own land, but also those responsible for the activities that take place on it, even if they do not hold ownership. Included, for example, are tenant farmers, logging companies that harvest timber, and construction contractors involved in urban land development.

Technical Barriers

Lack of technical information can be a serious barrier. Local officials rarely have adequate data on the location and severity of nonpoint-source pollution problems, thus impeding their efforts to focus assistance on sites where the problems are most severe. It is also difficult to determine the origin of the most serious pollution sources when a large area is affected and many different tracts of land are involved. Problems often start far upstream from the polluted body of water. Where sources such as individual farms or forestlands are close together, it may be impossible to determine which ones are responsible for the water quality problems. In addition, it is difficult to determine natural background levels of contamination and distinguish them from increased levels caused by human activity.

Natural conditions may also pose barriers to the use of BMPs. Climate and topography affect the need for BMPs and influence their effectiveness. For example, erosion control BMPs are not as important on

flat lands as they are in rolling or mountainous terrain. Recommended BMPs also differ because of the diversity of activities in an area. Some practices are not compatible with certain activities — for example, no-till farming techniques cannot be used for peanut production. Therefore, no single management plan will work for all situations. Individual plans must be developed for each parcel of land in a watershed based on its characteristics and use. Possible future changes in land use must also be considered when developing a plan. This is a time-consuming process, involving extensive discussion with landowners.

Barriers also result from a lack of available technology and other resources. Livestock producers, for example, face obstacles in implementing BMPs. The large volume of animal waste produced is normally applied to agricultural fields, but the amount of land available to many livestock producers is inadequate, particularly if a large number of animals are concentrated in a small area. Sometimes the soils are not suitable for the application of wastes. In many cases the problem is compounded by the need to store the waste until the optimum time for application. Excessive rainfall can cause stored wastes to overflow into nearby waterways.

New animal production technologies can help in management of nonpoint-source pollution. Because so many cows are housed in this one barn, it is possible to collect wastes automatically and dispose of them without jeopardizing water quality.

In urban areas it is frequently difficult and expensive to solve nonpoint-source pollution problems. For example, retention ponds help remove contaminants from urban runoff, but often there is not enough open land on which to build them. Technologies for trapping storm runoff and recycling it for other uses have not been fully developed. Furthermore, many communities have old sanitary sewer systems that allow excessive infiltration during storms. If the municipal wastewater treatment plant is unable to handle the added volume, poorly treated (or untreated) wastewater is discharged into waterways

Educational Barriers

A lack of basic knowledge about nonpoint-source pollution and methods for controlling it, as well as indifferent or negative attitudes toward the proble, can be considered educational barriers. These obstacles can be addressed by educational efforts directed at changing people's attitudes and behaviors.

Some landowners and managers are unconcerned about nonpoint-source pollution because they do not perceive the total scope and complexity of water quality problems. They do not understand how land use and water quality are linked. Many landowners are not fully aware of conditions on their own land that give rise to nonpoint-source pollution problems. Some of the more subtle problems are not readily visible. For example, farmers may not think they have an erosion problem until they see obvious signs (such as gullies) in their fields. They may find it very hard to understand sheet erosion, which leaves very little visible evidence. In developed areas, local officials are often not aware how much pollution is caused by urban runoff because this source of pollution is more difficult to identify and control than point sources.

Even if landowners are aware of erosion problems and solutions, they may lack the technical information or managerial skills needed to adopt BMPs successfully. Some landowners are unaware of the many BMPs available for controlling nonpoint-source pollution and are unfamiliar with the types and sources of technical and financial assistance available. Some livestock producers, for example, do not fully understand how to manage livestock waste in ways that will prevent pollution. Some of those in the forest industry do not understand the procedures they must follow to avoid pollution. Landowners do not always understand the advantages and disadvantages associated with each BMP, and the available technical information is sometimes not presented in ways that landowners find understandable.

Negative attitudes can also be considered as educational barriers to the acceptance of BMPs. These attitudes include *traditionalism,* or the belief that time-honored methods are better than new ones; *independence,* or the belief that individuals should handle their own problems without government involvement; *aversion to risk,* or the unwillingness to take the chances involved in trying new methods; and *individualism,* or the desire to maintain control over one's own land-use decisions. Many landowners believe they should be free to do what they want with their own land. Some landowners hold negative attitudes toward certain management practices, viewing them as too complex or as incompatible with other aspects of their operation.

Lack of broader public understanding can be an important obstacle, too. Most citizens do not understand the practices used in farming, forestry, and urban waste management. They may not recognize that certain tools and practices (such as chemical pest control) are necessary.

In discussing pollution concerns, the mass media sometimes inadvertently misinform the public about land-use practices and their relation to water quality.

Social Barriers

Social barriers are obstacles related to the interaction of landowners with other people, including family members, neighbors, and others in their community. Also involved is the landowners' sense of responsibility to the community and to society at large.

Some landowners are reluctant to accept responsibility for nonpoint-source pollution problems arising on their land. As previously noted, the conditions giving rise to nonpoint-source pollution may be scarcely noticeable, and there is a natural inclination to place the blame elsewhere. Furthermore, some landowners are concerned that they may be fined or prosecuted if they admit that conditions on their land are contributing to pollution problems. In some cases, economic factors override social concerns. Some landowners tend to view land management strictly from an economic point of view, giving insufficient attention to the effects of management practices on soil, water, and wildlife. To meet economic pressures, foresters, farmers, and developers of urban land often do only enough to comply with regulations.

Accepting responsibility for nonpoint-source pollution and modifying practices to reduce it requires support from others. The support of family members is particularly important. Sometimes, however, a family's other needs take priority over the adoption of BMPs for nonpoint-source pollution control. Also, older family members may resist change and oppose the adoption of new practices by younger members.

Landowners and managers also need support from their peers and community leaders. Local opinion leaders play a vital role in shaping attitudes and behavior. Even the most independent landowners look to their peer group for advice and support. If local norms and customs discourage the adoption of certain BMPs, landowners will be less likely to use them.

Friends, neighbors, and local leaders can help landowners change attitudes and adopt best management practices.

People other than the landowner are often involved in decisions that affect land management practices. In the case of forestland, for example, the owner is often viewed as being

responsible for pollution control, but timber buyers and loggers are also involved in harvesting activities. They may not recognize their responsibilities or know how to implement BMPs. Similar situations arise in contracting for the development of urban land.

Some forms of land tenure present barriers. Lack of cooperation between landlords and tenants can be a serious problem. Many landlords do not even discuss BMPs with their tenants. If they do, they are likely to disagree about who is responsible for bearing the costs. Longer-term leases may alleviate the problem to some extent, but in many situations a long lease is not in the best interest of the landlord. In addition, absentee landownership is common today, and absentee landlords are often unfamiliar with land management or the associated nonpoint-source pollution problems.

Social change and demographic trends can be barriers. Farmers make up only a small percentage of our population today, and consequently many citizens do not understand farming, farm problems, or land management methods. In some urban areas, growth is rapid. Development involves a large number of different groups and organizations. Pressures for growth and development may override concerns for environmental quality.

Institutional Barriers

Government regulations, programs, and agencies can present barriers to the implementation of BMPs. Potential problems include conflicting policy goals, lack of motivation, inadequate resources, poor coordination among agencies, and landowners' distrust of government programs.

Some policies employ financial incentives that encourage maximum food production or economic development, objectives that can work against pollution control.

Even where government nonpoint-source pollution control policies exist, they may not be translated into action programs unless there is the political will to make them work. Without widespread public support for nonpoint-source pollution control, especially at the local level, government leaders focus their attention on more immediate and visible priorities. Pressure for economic growth may reduce commitment to pollution control.

Shortages of funding and staff may impede the efforts of agencies seeking to alleviate nonpoint-source pollution. Most government agencies find that the need to provide assistance to farmers and other landowners is increasing, while the resources available are decreasing. A common outcome is a failure to enforce regulations and an inability to assist landowners in making decisions and complying with regulations.

When regulations are not enforced and upheld in courts, landowners are less inclined to take them seriously.

Inadequate coordination and communication among organizations with related responsibilities may also be a problem. Many decisions are made at the state or national level rather than the local level. As a result, the responsibilities of the various agencies are not always clearly delineated. Too much fragmentation of agency responsibility may limit cooperation. Landowners may become confused and discouraged by the growing scope and number of governmental regulations, many of which involve complex paperwork. Conflict among agencies and organizations at various levels of government is sometimes a problem. If the landowner becomes the victim of poor coordination or outright conflict between agencies, it can lead to frustration and a lack of cooperation with nonpoint-source pollution control efforts.

Coordination is especially important in dealing with a problem such as nonpoint-source pollution that affects an entire watershed and therefore crosses political boundaries. Although the effects of nonpoint-source pollution are most clearly observed at the downstream end of a watershed, land-use activities in upland areas may contribute substantially to the problem. Pollution problems therefore cannot be solved without strong regional cooperation among organizations.

Landowner attitudes toward government programs and prior experience with these programs can also present an obstacle. Some landowners distrust government programs and policies. They are also concerned that new regulations will become increasingly stringent, making it economically impossible for them to continue their farming, livestock, forestry, or urban development operations. Some farmers, for example, are concerned that land their family has farmed for generations may be designated a wetland, requiring that it be taken out of production. Such concerns cause fear and reduce landowners' confidence in institutions.

In addition, perceived inequities contribute to distrust of government programs. Sometimes a practice is allowed in one place but not on an adjacent tract of land, leading people to believe that regulations are being inconsistently enforced. Also, special interests are sometimes perceived as having too much influence over political decisions.

Economic Barriers

The economic costs of implementing BMPs can be a serious obstacle to nonpoint-source pollution control. Conservation and pollution control efforts have relied heavily on stewardship as an incentive. However, economic barriers can deter even the best-intentioned landowners from adopting BMPs.

Most BMPs provide little or no direct, short-term economic benefit to the landowner. It is therefore difficult to convince landowners to invest in them unless assistance is available from a government cost-sharing program. Even the most conscientious farmers, forest landowners, and urban developers have a legitimate concern that adopting BMPs will reduce their profits.

Some landowners simply do not make enough money to invest in new practices or equipment. During economic downturns, private investments in BMPs are often more difficult to justify. Adopting and maintaining agricultural BMPs require an investment of labor, which is in shorter supply on today's farms than in the past.

With the exception of a small number of BMPs that return immediate economic benefits, money spent on these conservation practices must be considered a long-term investment. Many landowners do not have the patience or the capital to invest in something that will pay dividends a long time in the future, if ever. Furthermore, in many cases society, not the individual landowner, reaps the benefits of improved land management practices. It is therefore necessary for landowners and citizens to understand more fully the true value of water quality.

Sometimes it is not possible for landowners to obtain the information needed to compare the benefits and costs of different BMPs. In the case of livestock production, for example, the value of animal wastes is not always clear. Although spreading the waste on agricultural lands can help recover nutrients and thus reduce expenditures for

Contour strip cropping is an effective and economical way to slow the rate of runoff from cropland, thus limiting the amount of sediment, nutrients, and pesticides that reach nearby water bodies.

commercial fertilizers, the cost of the labor and equipment needed for waste handling sometimes exceeds the savings.

Government cost-share programs, where available, help ease the economic burden on individual landowners by shouldering part of the cost of BMPs. Some BMPs are not economically feasible without such assistance. Even with cost-sharing programs, however, landowners may not have the cash flow or credit line to cover their share of the expense. Individuals with high debt loads may be unable or unwilling to obtain additional credit for BMP investments. In some cases, landowners have come to expect cost-sharing and are unwilling to install BMPs without assistance.

Public resources for planning, monitoring, and enforcement programs are also limited. Often these resources are inadequate to address even the most serious problems. As the federal government has reduced staff and funding, state and local governments have been unable to take up all of the slack. Given limited resources, adequate funding for complete nonpoint-source pollution control is often unavailable at any level of government. Priorities, therefore, must be set.

5. The Planning Stage: Setting Priorities for NPS Pollution Control

There are not enough public funds to address all of the significant water pollution problems even though high-quality water resources are important to our economic welfare and are valued by the public. In one of the earliest water quality demonstration projects, the 1972 Black Creek Project in Indiana[1], it was found that nearly $1 million in cost-share funding was not sufficient to address all of the pollution problems in a 10,000-acre agricultural watershed. That project and others (such as the Rural Clean Water Program) suggest that the answer to the lack of economic resources in controlling nonpoint-source pollution is to select (target) critical areas for intervention. Priorities must be set so that available funds can be used to address the most critical nonpoint-source pollution concerns.

In addition to being more economical, targeting state responsibilities to a limited geographic region improves the chance of achieving visible water quality improvement[2]. Furthermore, demonstrating water quality benefits will make the public become more supportive of nonpoint-source pollution control programs and more closely attuned to overall water quality goals. This change of attitudes coupled with an increase in pollution control knowledge and skill can lead to long-term water quality resource protection.

This chapter describes a step-by-step procedure for analyzing the pollution problems in a watershed and targeting control efforts toward those areas that will provide the greatest improvement in water quality for a given level of funding. The process is illustrated using an agricultural area as an example, although the same method applies to the control of nonpoint-source pollution from other areas such as forestland or urban sites.

Targeting at the State and Watershed Level

At the state level, *targeting* is the ranking of water quality needs according to their severity and considering the resources available for addressing those needs. The resources are then directed toward the water quality problems that can be addressed with the greatest probability of success. Achieving visible success is important for building public support and individual responsibility for pollution control.

Once the water bodies have been prioritized, it is possible to determine whether available resources are sufficient to achieve the water quality objectives. If not, the prioritizing procedure can be repeated to target subwatersheds or water resources with definable water quality problems that can be solved.

Targeting at the watershed level involves identifying the predominant pollutant sources, prioritizing these sources, and then treating first those sources that impair water quality the most. A targeting program designed to treat the major pollutant sources first can hasten the achievement of water quality goals.

Setting Priorities

Six basic steps are involved in prioritizing water quality needs. These steps are explained in the following sections of this chapter:

1. determining agency responsibilities,
2. setting realistic program goals,
3. establishing a realistic time frame,
4. developing a watershed profile,
5. establishing selection criteria, and
6. selecting a critical area.

Step 1: Determining Agency Responsibilities

It is vital when establishing a state water resource priority program to determine clearly which agencies have the responsibility to perform certain tasks. Otherwise, efforts may be duplicated, conflicts among agencies may develop, and tasks may be omitted, reducing the effectiveness of the program. All appropriate agencies should be encouraged to contribute to the water resource prioritization program. Because the causes and impacts of water quality problems are diverse, a wide selection of agencies should be involved. Appropriate state agencies and organizations may include those with interests in:

- water resource planning,
- natural resource protection,
- land-use planning,
- point-source pollution control,
- nonpoint-source pollution control,
- economic evaluation,
- health and welfare, and
- education.

Step 2: Setting Realistic Program Goals

Once a network of agencies has been established and agency commitments have been clearly specified, program goals should be developed. To the extent possible, goals should be clearly stated in quantitative, measurable terms so that progress and accomplishments can be assessed. Flexibility should be allowed so that goals can be modified as additional knowledge of the water resource problem is obtained.

Quantifiable goals may be stated in terms of meeting water pollution standards, pollutant concentrations, the restoration of biological resources, or the amount of land or sources treated. A typical quantitative goal might be to meet state standards for a designated use — in shellfish waters, for example, not to exceed the allowable maximum fecal coliform concentration and frequency. On the other hand, a goal for a specific project might be to achieve a certain condition, such as a specified average concentration of nitrate nitrogen. Or the project goal might be to reduce the input of some pollutant such as sediment or phosphorus.

Many nutrient and sediment control projects focus on reducing the concentration of a pollutant by a certain percentage. Such goals should be based upon the estimated magnitude of reduction necessary to achieve a perceptible change in water quality. Progress toward these quantifiable goals can be measured through the achievement of *operational goals* — that is, goals expressed in terms of adopting specific land treatment practices. For example, an operational goal might be to achieve the use of conservation tillage on a specified percentage of targeted cropland. Another such goal might be that a specified number of livestock producers will implement runoff controls. Operational goals provide a practical way to measure success in project implementation. These goals should be very specific, distinguishing treatment of critical areas from general conservation needs.

Step 3: Establishing a Realistic Time Frame

In establishing program goals, the time frame for project implementation and the water resource response should be considered. Some types of water resource problems respond quickly to intensive treatment, whereas others require extensive treatment and involve long response times. Certain types of water bodies respond more rapidly to treatment than others. For example, a small stream will respond more quickly than a lake or estuary[3]. In establishing a time frame it is important to remember that the impairment probably developed over a long period of time and that it may therefore also take a long time to see the effects of any corrective measures.

Step 4: Developing a Watershed Profile

A watershed profile should be developed to augment land-use maps. This profile should include a list of the many potential pollutant sources throughout the watershed. It can serve as a data base as well as provide direction for defining critical areas. Discharges can be monitored or NPDES permit data can be obtained from the state water quality agency to develop estimates of pollutant inputs from point sources. Such estimates need to be made for only those pollutants known or suspected to cause the identified water quality problems. Some of the potential nonpoint sources that should be considered are shown in Table 2. Based on the information contained in a watershed profile, the major sources of pollution can be identified, BMP options developed, and implementation goals established.

Table 2. Pollutants and Their Most Likely Sources to Consider in Developing a Watershed Profile

Pollutant	Possible Sources
Sediment	cropland forestry activities pasture streambanks construction activities roads mining operations existence of gullies livestock operations other land-disturbing activities
Nutrients	erosion from fertilized areas urban runoff wastewater treatment plants industrial discharges septic systems animal production operations cropland or pastures where manure is spread
Bacteria	animal operations cropland or pastures where manure is spread wastewater treatment plants septic systems urban runoff wildlife
Pesticides	all land where pesticides are used (cropland, forest, pastures, urban/suburban areas, golf courses, waste disposal sites) sites of historical usage (organochlorines) urban runoff irrigation return flows

Step 5: Establishing Selection Criteria

There are two distinct perspectives to consider when identifying a critical area: the land-resource perspective and the water-resource perspective[4]. From the land-resource perspective, critical areas are those lands on which soil loss exceeds the rate at which soil can be replaced by natural processes. Although areas of severe soil loss often are the most critical for treatment of agricultural nonpoint-source pollution, this is not always the case.

From the water-resource perspective, critical areas are those land areas or sources for which the greatest improvement to an impaired water resource can be obtained with the least investment in BMPs. To determine critical areas, it is necessary to consider such factors as the type of water quality impairment, the dimensions and dynamics of the impaired water resource, the hydrology of the watershed (the way in which water is distributed and moves within the area), the magnitude of pollution source areas, and the investment in BMPs that would be required to alleviate the problem. Implied in this approach is the concept of treatability of the resource, which is a basic consideration in any agricultural nonpoint-source pollution control project.

Although each specific pollution control project requires the development of unique criteria, there are general guidelines that can be applied to most situations. Criteria that can be used in selecting critical areas for nonpoint-source pollution control include:

1. type of water resource impairment,
2. erosion rate,
3. manure sources,
4. fertilizer rates and timing,
5. pathogen source magnitude,
6. distance to nearest watercourse,
7. distance to impaired water resource,
8. present conservation status,
9. planning timeframe,
10. designated high-priority subbasins, and
11. on-site evaluation.

Step 6: Selecting a Critical Area

Finding critical areas within a watershed for pollution control treatment can be difficult because of the many different land uses, the complexity of the dynamics of water bodies, and the variability that occurs naturally in land and water. The type of water resource problem, its severity, and uncertainties about the magnitude of the sources or causes add to the

difficulty. However, the following eight steps can greatly assist in selecting a critical area:

1. **Characterize the nature and extent of the water resource impairment.**
2. **Characterize the hydrologic dynamics of the water resource.**
3. Use all available information to **estimate the pollutant reductions needed** to protect, improve, or restore the impaired water body.
4. Use point-source discharge information and all available water quality data to **make initial estimates of relative point- and nonpoint-source contributions to the water quality problems.** From these estimates, determine whether a nonpoint-source pollution control project can successfully reduce the water resource impairment or whether additional point-source control is needed.
5. **Rank the magnitude of pollution from the nonpoint sources.**
6. **Consider the proximity of the source of pollution to the impaired water resource.** The distance to the nearest watercourse appears to be a good first cut because it is important to control the pollution nearest to a water resource. Certain contaminants, such as nitrogen (in its nitrate form), will travel long distances in runoff and must be controlled close to their sources. On the other hand, distance of the pollution source from the impaired water can work in favor of reducing the impact of certain nonpoint-source pollutants such as sediment, pathogens, and phosphorus that dissipate with flow distance.
7. **Consider the conservation status and management practices being used** in areas adjacent to watercourses because they can greatly affect pollutant delivery. **Consider also the possible timeframes** for planning, implementation, and response.
8. Visit the site, if necessary, to **determine which areas actually meet the selection criteria and whether proposed management practices are appropriate** to meeting the water quality needs.

Example of the Targeting Process

In the following example, the watershed shown in Figure 1 is used to illustrate how to select a critical area for treatment using these eight steps.

1. **Characterize the impairments:** Excessive sedimentation has greatly reduced storage capacity in the lake, which serves as a water supply reservoir. Frequent algal blooms in the spring are unsightly and have been associated with declines in the fish populations.
2. **Characterize the water resource:** During runoff conditions, the streams vary from fast flowing and erosive in the areas with over a 5 percent slope to slow flowing and sediment loaded in areas with little slope near the lake. There is extensive sediment deposi-

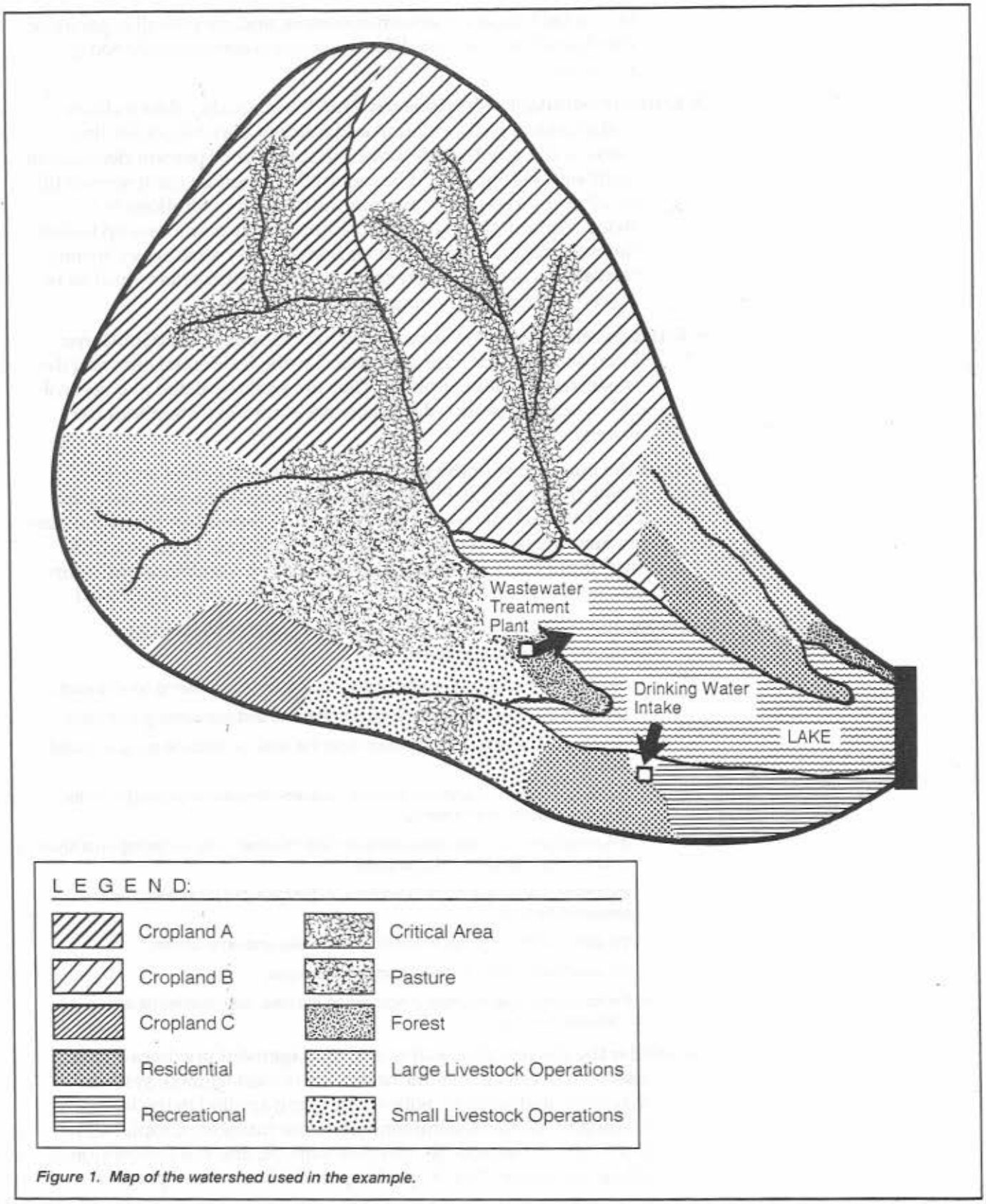


Figure 1. Map of the watershed used in the example.

tion in the lake at the stream entrances, and the overall capacity of the short-detention-time lake / reservoir is continuously being reduced.

3. **Estimate pollutant reductions needed:** Water quality data indicate that excessive sedimentation and nutrient enrichment are the cause of the problems described in step 1. A 50 percent decrease in sediment buildup would be required to lengthen the reservoir life by 20 years. Tests show average nutrient concentrations to be twice the natural level, with enrichment concentrations up to five times the natural nutrient levels immediately after heavy spring rainfall. An overall 30 percent reduction in nutrients would be required to approach average natural levels.

4. **Estimate relative point-source and nonpoint-source contributions:** Point-source discharges are limited to the residential area and the wastewater treatment plant. They are well regulated and controlled. Nonpoint-source discharges are common throughout the watershed.

5. **Rank the magnitude of the pollution from the nonpoint sources:** Using the best available data, the amount of contamination per acre from each of the sources needs to be estimated. From these estimates, the largest sources can be identified on a per-acre and total input basis. The relative impact of point and nonpoint sources and the ability to treat these sources can then be evaluated.

6. **Determine the proximity of the pollution sources to impaired streams and embayments:**
   - cropland A is a large area removed from the lake but bordering on a stream;
   - cropland B is a large area bordering on the lake and surrounding a stream;
   - cropland C is a small area removed from the lake; no streams are associated with it;
   - the large livestock operations are in a medium-sized area removed from the lake but surrounding streams;
   - the small livestock operations are in a medium-sized area bordering on a small embayment and surrounding a stream;
   - the residential area is small; it borders on the lake, but no streams are associated with it;
   - the pasture area is small; it borders on the lake and on a stream;
   - the wastewater plant is located on the lakeshore;
   - the forestland area is small; it borders on the lake, but no streams are associated with it.

7. **Consider the conservation status and management practices being used:** All livestock operations use waste management systems that have no discharge, with waste being applied to the land according to soil test recommendations for nitrogen. Cropland A has a 3 to 9 percent slope, receives manure, and has conventional tillage and some filter strips. Cropland B has a 0 to 7 percent

slope, receives manure, and has conventional tillage and no filter strips. Cropland C has a 0 to 3 percent slope with filter strips and conservation tillage. The pasture is maintained as a natural open space. The residential area is sparsely developed, with extensive open spaces and woods.

8. **Determine which areas actually meet the selection criteria and whether proposed management practices are appropriate:** The final selection is made through a two-stage process of elimination:

   First Stage: The forest, pasture, and residential areas are eliminated because they are small and well managed with low erosion rates. Cropland C is eliminated because it is far from the water body; also, good conservation practices that minimize erosion and nutrient loss have been used. Cropland A and portions of cropland B closest to the streams and both the large and small livestock operation areas are targeted as potentially critical areas.

   Second Stage: A *site evaluation* reveals that all large livestock production and waste management systems are operated and maintained properly. Areas surrounding streams in Cropland A with slopes greater than 5 percent should be designated as a critical area; conservation tillage and filter strips need to be implemented to reduce sediment and nutrient loss. Portions of Cropland B with slopes greater than 5 percent near streams should be designated as a critical area; conservation tillage and filter strips need to be implemented to reduce sediment and nutrient losses. One portion of the small livestock operation area should be designated as a critical area because animal waste is being applied in excess of nitrogen recommendations and because of its proximity to the stream and drinking water intake.

Determining the Amount of Pollutant Reduction Needed

Determining how much the pollutant inputs must be reduced in order to achieve water quality goals is an essential part of the targeting and implementation effort. The required pollutant reduction affects both the selection of nonpoint-source pollution control measures and the extent of areas or number of sources that must be treated. In general, the larger the pollutant reduction needed, the larger the critical area or the greater the number of sources that must be targeted. Within the critical area the largest and most intense sources should be given first priority. An important part of this process is to determine the relative importance of pollutant contributions from point and nonpoint sources for the entire watershed.

Once critical areas have been targeted for nonpoint-source pollution control, landowners must be encouraged to adopt BMPs in these areas. As discussed in the previous chapter, however, certain factors may discourage the use of BMPs. To make pollution control a practical alternative, these barriers must be addressed.

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6. Implementing Effective NPS Pollution Control Programs

Techniques for Implementation

Once a watershed plan has been developed, it will be necessary to put the plan into action. Implementation is a vital but challenging component of nonpoint-source (NPS) pollution control. During this stage, many groups and organizations must team up to develop educational programs that will reach a variety of target audiences. Citizens can play an important role in successfully implementing local nonpoint-source pollution control programs. This chapter first describes the role of education in nonpoint-source pollution control. Second, it discusses the role of citizen involvement. Finally, it advocates teamwork as a means for ensuring efficient and effective progress toward meeting water quality goals.

Education for Nonpoint-Source Pollution Control

Education is central to implementing effective nonpoint-source pollution control programs. Landowners and others must receive information and assistance before they will be able to adopt BMPs. Other citizens should also be informed about what they can do to help. Successful educational campaigns require careful planning and implementation of several interrelated activities. Figure 2 depicts the educational planning process described in this chapter. The first step is to select a specific objective so that educational activities can be developed to meet that objective. The second step is to select and analyze the target audience. Next, specific

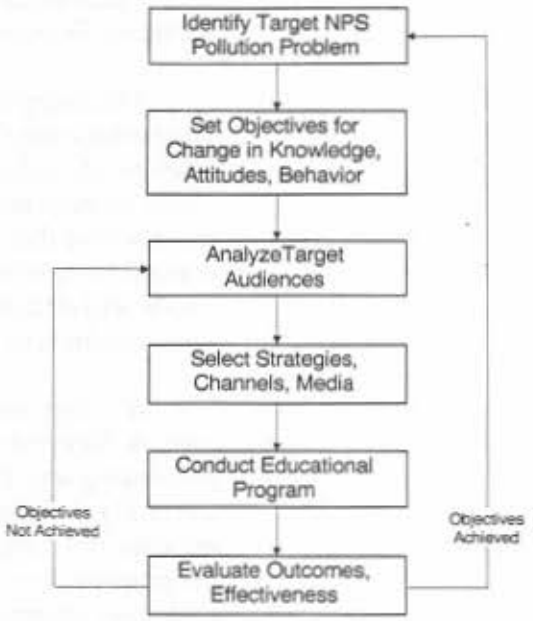

Figure 2. Steps in planning, implementing, and evaluating an educational program.

educational messages must be developed. Finally, appropriate communication channels and educational approaches should be selected.

Establishing Objectives. The first step is to identify clearly a nonpoint-source pollution problem that can be addressed by educational efforts. Specific and realistic educational objectives should be set in terms of desired changes in the knowledge, attitudes, and behavior of specific target audiences. Based on these objectives, an educational plan with specific action items, a realistic timetable, and a description of responsibilities can be developed. Types and sources of necessary resources, such as money, information, and talent, must then be identified.

The objectives of the educational campaign should be aimed at overcoming some of the educational barriers described earlier. These objectives could include:

1. increasing landowner and public awareness of nonpoint-source pollution problems;
2. improving the understanding and use of the available assistance and information;
3. increasing appreciation of the benefits of nonpoint-source pollution control;
4. building the prestige of people who are working to control nonpoint-source pollution.

Local organizations (such as the Extension Service) are already working on many of these objectives.

Defining the Audience. After selecting one or two objectives for your educational efforts, the next step is to plan an integrated program. Start by identifying and describing one or more target audiences. They could include landowners, local leaders, educators, school children, and members of the general public. To promote nonpoint-source pollution control more effectively, it is necessary to address the unique information needs and attitudes of different audiences. Improved knowledge of the target audiences will increase effectiveness of educational efforts.

It is very useful to develop a profile of landowners and other groups. Key individuals and organizations can play a vital role in promoting and supporting local nonpoint source control efforts. Carefully defining a specific target audience is a critical element in any educational campaign. This process is similar to that of targeting geographical areas, as described in the previous chapter. It is ineffective to deliver information only through mass outlets to the general public.

Developing Messages. Next is the development of messages aimed at changing attitudes, improving knowledge, or influencing behavior of

the target audiences. The message content should be based on the needs of the specific target audiences and educational goals. Messages may focus on the costs of nonpoint-source pollution and benefits of sound resource management. Other messages can be aimed at explaining programs and policies, emphasizing their relevance for the target audiences. Social influence strategies can be used to help build prestige to motivate landowners and others. Tap the expertise of the mass media and other creative people to develop clear and concise messages written in a popular, nonthreatening style. Messages can illustrate problems, solutions, policies, or issues. Be sure to stress the availability of information and assistance.

Selecting Communication Methods. The next step is to select one or more specific communication methods to carry the messages to the target audiences. Different approaches should be used for different purposes. Mass media are useful for informing a large audience, creating awareness, or reinforcing messages. Mass media cannot, however, provide detailed answers to specific questions and are generally not very effective in motivating people. Posters and direct mail can be used to announce new programs or policies. Interpersonal communication is most effective for changing values or behavior. People rely on their neighbors and friends for information. Wherever possible, promote informal interaction through meetings, tours, and other events.

In most cases it is best not to rely on only one mode of communication. Plan to use more than one approach over time. Recognize, however, the trade-offs between the effectiveness of a method and the effort it takes to use that method well. For example, one-on-one communication is very effective but takes a lot of time and effort. Members of the target audiences can readily identify what sources of information they find most trustworthy, accurate, and relevant. Identify and recruit individuals and organizations that should be involved with the educational campaign. Encourage local opinion leaders to serve as credible channels for nonpoint-source control messages.

Implementing and Evaluating. After the educational campaign has been planned, it must be carried out. It may be best to start with a pilot project in a small area. Monitor the effectiveness of the various activities. Enlist volunteers to help carry out the campaign. Follow the plans developed in the previous steps, but be ready to improvise. In particular, build in mechanisms for obtaining information from landowners and other target audiences about their understanding of important messages.

Determine ways to evaluate and refine the program to monitor progress. This evaluation could be formal, such as an opinion survey before and after the activity. In most cases, however, the evaluation will be less formal, based on the opinions and experiences of knowledgeable

individuals (such as local leaders, landowners, or mass media representatives). Refine plans as necessary based on the evaluation and informal feedback received. Remember that an educational campaign should be a carefully planned, ongoing process, not a series of unrelated public relations events.

Citizen Involvement

Citizen involvement is a vital element of any nonpoint-source pollution control program. People have a vested interest and important roles to play in land and water resource management. Members of the public who should be involved in nonpoint-source pollution control include landowners, public officials, the business community, and other concerned citizens. Many of these groups should also be encouraged to play an expanded role in policy decisions and watershed planning.

Widespread public support and interest are vital to local efforts to control nonpoint-source pollution. In recent years, many people have wanted to become more directly involved in decisions about environmental issues. Citizen involvement allows more people to express their views to government officials. If properly carried out, it assures that government agencies will give due consideration to public concerns, values, and preferences when decisions are made. In a democratic society the public has a right to be consulted, particularly those people who will be directly affected by public decisions.

Citizen involvement is especially important when controversy arises. Some types of land and water management decisions can generate considerable public interest and potential controversy. Public controversies, at least in part, result from inadequate public participation or education. Education and citizen involvement programs are most effective when based on adequate understanding of public attitudes and knowledge about the technical issues and policy alternatives. Such understanding can be obtained through public participation.

Open, two-way communication and interaction between interest groups, affected parties, concerned citizens, and decision makers is essential for effective nonpoint-source pollution control. Citizen involvement is an effective way of gathering information to be used in the planning process. It helps decision makers determine the priorities, alternatives, and potential negative impacts of possible actions early in the process. Interested parties can make valuable contributions to the decision process. Decision makers can gain considerable insight into the concerns, needs, and preferences of affected groups.

A wide variety of mechanisms are available for increasing citizen involvement in nonpoint-source pollution control programs. Many are already being used and include some combination of education and public participation. For example, meetings and workshops could be

conducted to inform and involve people in local decisions. These events could be aimed at planning and implementation. The process described in the previous section on education can promote more active citizen involvement. In particular, local media coverage is vital to ensuring involvement. Citizen advisory groups can also play an important role. The next section on team building presents ideas on how to develop and work with such groups.

The Team Approach to Nonpoint-Source Pollution Control

Given the variety of activities in an effective nonpoint-source control program, it is clear that local officials cannot do everything themselves. Citizens need opportunities to become actively involved, especially in the educational process. Local programs will be most successful if a team approach is used. Teamwork can help enlist outside talent and broaden community support. A local team should be better able to design and carry out an integrated nonpoint-source pollution control program. Team members can contribute knowledge, time, talent, and even financial resources to enhance local efforts. Possible contributions of various team members are listed in Table 3 on the next page.

One very important team responsibility is to inform local officials about the needs and interests of the public. Through this process the team becomes an ongoing mechanism for citizen involvement in local program planning and implementation, making the programs and policies more responsive to local priorities. Influential team members, such as business and political leaders, increase credibility and visibility of nonpoint-source pollution control efforts.

Team building is an ongoing activity that involves cooperation among individuals working together for a common purpose. No single formula can be followed in all cases. However, some basic strategies can be used to help develop effective local teams. Most resource professionals and local officials already work with other groups and organizations. These existing relationships can form the basis of community support for water quality improvement programs.

Team building begins with local resource management professionals and elected officials. The Soil and Water Conservation District (SWCD) system was established to provide leadership and insight into local needs and priorities. Each county has a locally elected board of SWCD supervisors. Along with their staff and the USDA Soil Conservation Service (SCS), these supervisors represent the focal point for nonpoint-source pollution control. A team could be developed by the conservation district and Extension Service staff, but other forms of teamwork are also possible.

Successful team building should foster increased involvement of a variety of other individuals and groups that have the interest and

resources to help promote water quality (See Table 3). Many individuals and groups will be willing to help once they learn about nonpoint-source pollution control and how they can be an important part of local efforts. Many of these private groups have a stake in water quality. An initial

Table 3. Possible Team Members and Their Potential Contributions

Team member	Potential Contributions to Team
Mass media representatives	Coverage of events Human interest stories Understanding of local information needs Ability to get information out quickly
Landowners	Trustworthy information sources Role models, prestige building
Bankers	Influence over management decisions Linkage with landowners Credibility and support for team
Business persons	Display posters and distribute information Sponsor field days and demonstrations Donate equipment and services
Civic organization members	Ongoing program activities Interest in and concern for community Fund-raising skills and mechanisms Credibility and visibility
Environmental group members	Compatible, broader goals Committed and knowledgeable membership Different target audiences
Students	Influence over future efforts Motivation and resources
Women's group members	Influence over family decisions High level of interest and concern Ability to mobilize and motivate members
Religious leaders	Commitment to soil stewardship Ability to appeal to higher values Credibility and legitimacy
Retired persons	Time and talent for teamwork Understanding of local conditions Credibility in community
Government agencies	Expertise and resources Legal responsibility

step, therefore, is to identify and contact these groups and individuals. Hold a planning meeting involving as many of these groups as possible.

No standard team organization or structure will work in every case. Local leaders and professionals should determine how formal the team will be. Team members could meet on a regular basis or be contacted only as needed. Build on existing community groups or organizations wherever possible. Leadership is often shared among team members. Group decision-making and consensus should be the norm. There are various options for encouraging shared leadership and responsibility for team goals.

Develop objectives that require teamwork and cooperation. Provide opportunities for team members to assist each other in their activities. It will be important to share information and create a climate of trust. Team members must understand how they fit into the overall mission. Make sure all team members are recognized for their efforts.

Team members can help make sure that objectives are accomplished and projects are carried out. They can also provide a wealth of new ideas. Teams should be built around citizens' interests and capabilities. Labor should be divided and responsibilities delegated in a way that takes advantage of complementary resources and expertise. For example, some people may be responsible for public outreach and others for gathering valuable information. Others may become involved in local Stream Watch programs that monitor water quality in the local area. Some team members can become spokespersons, giving talks and meeting with other organizations. Other team members may have technical knowledge, as well as an understanding of local needs and opportunities.

All team members should feel a sense of ownership in the team so that each member will have a stake in the team's success. Share responsibility for team decisions and actions as well as for successes. The greater the trust and communication among team members, the more effective the team will be. All members should be encouraged to express their opinions and offer constructive criticism.

Several subcommittees could be appointed to carry out different tasks, such as handling media relations, raising funds, recruiting volunteers, distributing posters, or conducting special projects (for example, demonstrations). Subcommittees could represent certain geographical areas (such as communities or watersheds). Subcommittees could also be organized to deal with specific nonpoint-source pollution problem areas, such as cropland erosion, forestland management, and urban runoff. Teamwork may also help to coordinate efforts with neighboring districts for large watershed projects or when water quality problems result from upland management in a different county. Many

districts already work together to sponsor large-scale educational campaigns such as multicounty demonstrations and other programs.

Establishing teamwork may require effort at first, but it will pay off quickly through increased program effectiveness and more efficient use of local resources. However, the team approach is not necessary for all activities. Local officials should be responsible for program management. Teamwork is important whenever time, staff, or money are limited. When resource management requires community support, teamwork is also called for.

Strategies for Promoting BMPs

Innovative strategies will be required to successfully implement needed BMPs. These strategies, in turn, require teamwork and citizen involvement. This section describes four general strategies for encouraging landowners to use BMPs.

1. Promote awareness of nonpoint-source pollution problems and available BMPs.
2. Build prestige of landowners who use BMPs.
3. Promote informal interaction among landowners to encourage communication and support.
4. Provide assistance to facilitate adoption and maintenance of BMPs.

These strategies are based on the recognition that BMPs have technical, economic, educational, social, and institutional dimensions. Promotional strategies should be part of an integrated educational program, rather than an afterthought.

Promote Awareness of Problems and Solutions

Landowners must understand the causes and consequences of their own nonpoint-source pollution problems and be shown the potential value of implementing BMPs. One way to increase awareness is to document the on-site and off-site costs of nonpoint-source water pollution. For example, off-site costs include damage to water supplies, irrigation systems, and recreation areas. On-site costs include reductions in crop yield, degradation of resources, and problems in production.

It is important to use a variety of methods, such as the mass media, posters, and public meetings. Pictures of dramatic nonpoint-source pollution in newspapers or displayed as posters can help call attention to the problem. Localized demonstrations and tours should be conducted to promote awareness and interest. An effective way to develop public informational messages is to use case histories and testimonials of local landowners. These will be seen as credible and applicable to local situations. Another useful technique is to incorporate nonpoint-source

pollution control messages into other educational programs. It is also necessary to increase awareness among government officials, local leaders, businesses, and the general public.

Build Prestige of Landowners Who Use BMPs

Along with pointing out the impacts of nonpoint-source pollution on water quality, it is also important to stress the benefits that result from using BMPs both for the landowner and society. Some BMPs have been shown to benefit landowners by reducing production costs, allowing more precise management, allowing more flexibility, and reducing off-site damages. Landowners also can benefit psychologically from the recognition that they are helping society by protecting water quality.

One way to build recognition is to present awards to landowners. These need not be elaborate and could include names on display in public places, signs on farm fields, patches for hats or clothing, or some sort of recognition at a special ceremony. Be sure to provide mass media coverage of those landowners who employ BMPs. Stories could have a recurring theme, such as "Resource Manager of the Month."

Family members often have great influence on landowners' decisions. Work with schools to educate and motivate children. They have a stake in their parents' decisions and can encourage resource management. Spouses are very influential in land management decisions, and their input is important for successful nonpoint-source control efforts as well.

Children who learn the importance of good resource management will make better land-use decisions when they become adults. They may also have an important influence on their parents' decisions.

Promote Informal Interaction Among Landowners

Interpersonal networks serve as important sources of encouragement and education in the use of BMPs. Family members and friends represent accessible and trusted sources of information. Experienced landowners are generally considered the local "experts" on implementing the BMPs that work best under local conditions. They often know how to modify practices for optimum performance in terms of both production and resource management.

There are several ways to promote interaction among landowners. One way is to develop and use a referral network. Such informal networks already exist in most areas. The object is to link landowners who have questions about nonpoint-source pollution control with those who have the answers. Circulate this list among landowners and other interested parties. Landowners who are currently using BMPs could also be featured at tours, meetings, and demonstrations. Another way to encourage informal interaction among farmers is to set up an informal organization. Peer groups provide opportunities to share experiences and ideas about resource management. Small group sessions in a particular community can be both informative and persuasive.

Provide Assistance to Facilitate Trial and Adoption

Field trials and demonstrations are a vital part of any assistance and educational program. The current knowledge and experience of local landowners should not be neglected; many effective BMPs may already be used locally. Different groups of landowners require varying levels of assistance and information. It may be necessary to spend more time with those landowners who are most resistant to change.

Field trials and demonstrations are proven ways to convince people to adopt new practices.

Once public awareness and interest in nonpoint-source pollution control has been raised, the actual adoption and maintenance of BMPs requires one-on-one technical assistance. Because the use of BMPs often entails learning new management skills, success will be limited unless proper instruction and support are provided. Individual landowners often need a custom-designed set of alternatives rather than a standardized plan. The SWCD and SCS develop such plans for landowners.

7. Accepting the Challenge

It is important to realize that pollution control is a never-ending challenge. Even though many water bodies still support their primary uses, increasing growth and development pressures threaten their continued viability. Ongoing programs of monitoring and maintenance will be needed even after BMPs have been employed. The most effective approach to addressing any type of pollution control is to prevent pollution in the first place. It is usually more difficult to clean up pollution and restore water quality than it is to prevent pollution. This is particularly true for nonpoint-source pollution, which is more difficult to identify, control, and monitor than point-source pollution.

Effective nonpoint-source pollution control programs and pollution prevention programs are already under way in many places. Many farmers are seeking better ways to reduce fertilizer and pesticide use. The goal of these efforts is to ensure that agricultural production methods protect on-farm and off-farm resources and can be sustained indefinitely. This approach, known as *sustainable agriculture,* not only helps protect the environment but can also save farmers money. This effort parallels the increasing attention being given to preventing point-source pollution rather than controlling it through "end-of-pipe" treatment. In fact, North Carolina has an innovative "Pollution Prevention Pays" program to provide assistance to industry and others.

We do not of course have all of the answers to the many tough questions raised about nonpoint-source pollution control. More research is needed in a number of areas, especially in the development of more cost-effective technologies that can help all landowners reduce nonpoint-source pollution. These methods will be critically important for small-scale, part-time farmers who often lack the resources and management needed to adopt the more complex and costly BMPs. Social science research is also needed to evaluate public policies and programs, as well as to ensure more effective and equitable citizen involvement in resource management decisions.

All citizens have a vested interest in protecting North Carolina's important natural resources. These resources provide the basis for our farming, forestry, and tourism industries. The integrity of our natural environment also shapes the quality of our lives. We all enjoy and benefit from clean water and wildlife habitat. Furthermore, we have an important responsibility to protect these resources for our children and

grandchildren. To ensure a sustainable future for our state's resources, all citizens will have to be willing to contribute time and money to the private and public sector programs that are working to protect the environment. Soil and Water Conservation District and Cooperative Extension Service professionals in every county can provide information and assistance to anyone interested in becoming more involved with these ongoing programs.

The team approach described in the previous section makes it possible to use everyone's resources and ideas effectively in working to control nonpoint-source pollution. The next section describes some valuable sources of information and assistance.

Sources of Information and Assistance

A variety of government agencies and other groups have an interest in and responsibility for controlling pollution and managing natural resources. This section briefly describes some of the major organizations and ways to contact them. We have chosen to list only a few key organizations from each level of government and from the nonprofit sector. Citizens and public officials can contact these sources listed below to request more information and begin building nonpoint-source pollution control teams. A number of other organizations (see Chapter 3) also play a role in natural resource management and pollution control programs.

County Organizations

Cooperative Extension Service (CES). This agency is the educational arm of the U.S. Department of Agriculture and the College of Agricultural and Life Sciences at North Carolina State University (NCSU) and North Carolina A & T State University (NC A&T). Extension educational programs are designed to apply research-based information to issues of local importance. This system provides citizens and organizations with a wide range of educational opportunities in areas such as agriculture and natural resources, home economics, 4-H and youth development, and community and rural development. State extension faculty members at NCSU and NC A&T support county extension agents who specialize in one or more of these program areas. The county Extension Service office provides citizens with newsletters, publications, and advice on a number of topics. The address and phone number of the county office is listed in the government section of the telephone book under "Government Offices — County." The office may be listed under the former name of Agricultural Extension Service.

Soil and Water Conservation District (SWCD). Each North Carolina county has a Soil and Water Conservation District charged with promoting the wise use and protection of soil, water, and related natural resources. The Conservation District Board of Supervisors is composed of five members who serve (without pay) for staggered four-year terms.

These boards are supported by a paid staff of technicians, administrators, and secretaries as well as by resource management professionals from the USDA Soil Conservation Service (see "Federal Organizations"). District and SCS staff members provide landowners and other interested citizens with information about natural resource conditions and technical assistance in resource management. Districts can also provide newsletters, notice of meetings, and publications. The address and phone number of the local Soil and Water Conservation District office is listed in the government section of the telephone book under "Government Offices — County."

State Organizations

Division of Environmental Management (DEM). This division of the Department of Environment, Health, and Natural Resources (DEHNR) is responsible for comprehensive planning and management of the state's air and water resources. DEM has primary responsibility for implementation and enforcement of the state's environmental quality programs. This responsibility is delegated to North Carolina by the U.S. Environmental Protection Agency, authorized by state law, and enacted through regulations of the Environmental Management Commission. Major DEM responsibilities include issuance of permits, monitoring, and enforcement. The agency also compiles inventories of natural resource and environmental conditions. The DEM is the lead agency for nonpoint-source pollution control in the state of North Carolina.

Division of Environmental Management
512 N. Salisbury St.
P.O. Box 29535
Raleigh, NC 27626-0535
(919) 733-5083 (Water Quality Section)
(919) 733-3221 (Groundwater Section)

Division of Forest Resources. This division of DEHNR is responsible for developing and maintaining the productivity of the state's forest resources, which include timber, watersheds, wildlife habitat, soils, and outdoor recreation. The division provides technical, administrative, and forest management assistance to landowners and other groups. It also provides planning services in community and urban forestry.

Division of Forest Resources
512 N. Salisbury St.
P.O. Box 27687
Raleigh, NC 27611
(919) 733-2162

Division of Land Resources. This division of DEHNR is responsible for programs that survey, evaluate, conserve, protect, and plan the use of the state's land, mineral, and related resources. Regulatory

functions include the administration and enforcement of North Carolina's laws on mining, sedimentation control, dam safety, and related topics.

Division of Land Resources
N.C. Department of Environment, Health, and Natural Resources
512 N. Salisbury St.
P.O. Box 27687
Raleigh, NC 27611
(919) 733-3833

Division of Soil and Water Conservation. This division of DEHNR is responsible for promoting the wise use and conservation of the soil and water resources of the state. It works with the state's 93 Soil and Water Conservation Districts to support local efforts to control and prevent soil erosion, prevent flood and sediment damages, promote water and land conservation, and develop the soil and water resources of the districts.

Division of Soil and Water Conservation
N.C. Department of Environment, Health, and Natural Resources
512 N. Salisbury St.
P.O. Box 27687
Raleigh, NC 27611
(919) 733-2302

North Carolina Department of Agriculture (NCDA). The NCDA administers programs such as registration of all pesticide brands; examination of pesticide labels for accuracy of contents; operation of state farms where research is conducted by NCSU personnel; examination of fertilizers that may harm crops; evaluation of animal, municipal, and industrial wastes and advice on their uses; certification of pesticide applicators and regulation to ensure that consumer products are safe.

N.C. Department of Agriculture
1 W. Edenton Street
Raleigh, NC 27611
(919) 733-7125 (Administration)
(919) 733-3556 (Pesticide Emergency Reaction Team)

Federal Organizations

Environmental Protection Agency (EPA). This agency provides national leadership for controlling pollution in the areas of air, water, solid waste, pesticides, radiation, and toxic substances. Its mandate is to mount a coordinated attack on pollution in cooperation with state and local governments. The EPA is responsible for implementing and enforcing most federal environmental protection laws. In North Carolina, the EPA has delegated most of its authority for management to the Division of Environmental Management. The EPA can provide information and publications on a variety of topics.

U.S. Environmental Protection Agency
Region IV
345 Courtland Street
Atlanta, GA
(404) 347-3004 (Office of Public Affairs)
1-800-241-1754 (outside of Georgia)

Soil Conservation Service (SCS). The Soil Conservation Service, an agency of the U.S. Department of Agriculture, is responsible for developing and carrying out a national soil and water conservation program in cooperation with a number of individuals, groups, and agencies. The SCS provides technical assistance to locally organized soil and water conservation districts (see "Local Organizations"). The SCS implements programs to reduce erosion, floodwater, and sediment damage; conserve and manage soil and water; and reduce nonpoint-source pollution. The local SCS resource managers can be contacted through the county Soil and Water Conservation District.

Agricultural Stabilization and Conservation Service (ASCS). Also an agency of the U.S. Department of Agriculture, the ASCS administers commodity and related land-use programs designed for voluntary production adjustment; resource protection; and price, market, and farm income stabilization. The ASCS also administers the Resource Conservation Program, the Agricultural Conservation Program, the Forestry Incentives Program, and many other farm benefit programs including the cost-share programs that encourage the implementation of BMPs. The ASCS can be contacted through their local county office.

Private Organizations

Many private, nonprofit organizations are actively involved with natural resource and environmental issues. These groups can provide publications and other information resources for interested citizens. Many are also involved in lobbying or other forms of political action that represent a range of citizen interests before state and local government. While it is not possible to list all the state and local groups, the following are several of the major organizations. They can provide information about other groups within the state.

The North Carolina Wildlife Federation
1020 Washington St.
P.O. Box 10626
Raleigh, NC
(919) 833-1923

The North Carolina Environmental Defense Fund
128 E. Hargett St., Suite 202
Raleigh, NC 27601
(919) 821-7793

The North Carolina Coastal Federation
Hadnot Creek Farm
3223-4 Hwy 58
Swansboro, NC 28584
(919) 393-8185

The Pamlico-Tar River Foundation
P.O. Box 1854
Washington, NC 27889
(919) 946-7211

Suggestions for Further Reading

The following publications are available from the organizations described in the previous section.

For more information about government regulations and public policies:

North Carolina Coastal Federation. 1991. *A Citizen's Guide to Coastal Resource Management through Local Government.* Swansboro, N.C.

For more information about general environmental conditions:

North Carolina Department of Environment, Health, and Natural Resources. 1989. *State of the Environment Report.* Division of Environmental Management, Raleigh, N.C.

For more information about nonpoint-source pollution control:

North Carolina Department of Environment, Health, and Natural Resources. 1989. *North Carolina Nonpoint Source Management Program.* Report 89-02. Division of Environmental Management, Raleigh, N.C.

For more information about water quality conditions:

North Carolina Department of Environment, Health, and Natural Resources. 1990. *Summary Report: Water Quality Progress in North Carolina, 1988-1989 305(b) Report.* Division of Environmental Management, Raleigh, N.C.

For more information about forestry BMPs:

Forestry Best Management Practices Manual. 1989. North Carolina Division of Forest Resources, Department of Environment, Health, and Natural Resources, Raleigh, N.C.

Each county office of the Cooperative Extension Service maintains several notebooks of information on nonpoint-source water pollution, drinking water protection, and other water quality topics. They also have numerous publications about agricultural, forestry, and urban BMPs.

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