Watershed Protection: A Project Focus

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Foreword

The Watershed Protection Approach (WPA) is a departure from the way the EPA has traditionally operated its water quality programs and how federal, tribal, and state governments have typically approached natural resource management. Resource management programs--programs for wetlands protection, wastewater discharge permitting, flood control, farmer assistance, drinking water supply, fish and game management, and recreation--have tended to operate as individual entities and occasionally at cross purposes.

We now generally recognize that the critical environmental issues facing society are so intertwined that a comprehensive, ecosystem-based approach is required. We also recognize that solving environmental problems depends increasingly on local governments and local citizens. Thus, the need to integrate across traditional program areas (e.g., flood control, wastewater, land use) and across levels of government (federal, state, tribal, local) is leading natural resource management toward a watershed approach.

This document focuses on one aspect of the Watershed Protection Approach--developing watershed-specific programs or projects. It provides a blueprint for designing and implementing watershed projects including references and case studies for specific elements of the process. The document illustrates how the broader principles of watershed management--including all relevant federal, state, tribal, local and private activities--can be brought to bear on water quality and ecological concerns.

This document is one of two guides to watershed protection designed for state water quality managers. A second guide, *Watershed Protection: A Statewide Approach*, describes an emerging framework for a statewide Watershed Protection Approach that focuses on organizing and managing state resource management programs around a state's major watersheds, or basins.

I trust this Watershed Protection Approach document will provide a useful guide for state water quality managers and others involved in watershed-based activities as they adopt, implement and evaluate watershed protection programs.

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Executive Summary

The Watershed Protection Approach is a strategy for effectively protecting and restoring aquatic ecosystems and protecting human health. This strategy has as its premise that many water quality and ecosystem problems are best solved at the watershed level rather than at the individual water body or discharger level. The Watershed Protection Approach has four major features: targeting priority problems, a high level of stakeholder involvement, integrated solutions that make use of the expertise and authority of multiple agencies, and measuring success through monitoring and other data gathering.

The Watershed Protection Approach accommodates the management and protection of ecosystems and human health at three levels: the state, the basin, and the watersheds within each basin. Some issues are best addressed at the watershed level, such as controlling nutrient loading to small lakes or restoring headwaters riparian habitat quality. Other issues may be best addressed at the basin level, such as phosphate detergent bans, wetlands mitigation banking, or nutrient trading. Still other activities and solutions are best implemented at the state level, including policies on toxics control or the operation of permit programs.

This document focuses on individual watershed projects. Watershed projects can be important components of the statewide approach that many state water quality programs use. These states have organized their traditional activities, such as permitting, planning, and monitoring, so that all water quality problems are dealt with in the context of very large drainage areas (river basins). Typically, each basin is studied, and a watershed plan developed, on a 5-yearcycle. A companion document, *Watershed Protection: A Statewide Approach* (EPA1995)discusses this way of doing business.

The EPA Office of Water prepared *Watershed Protection: A Project Focus* to promote watershed-level planning as envisioned under the Watershed Protection Approach. The document describes a logical process for planning and implementing watershed projects and presents some lessons learned in previous projects. The document emphasizes ecological integrity in watersheds by addressing chemical, physical, biological and habitat stressors in addition to the more traditional goal of protecting human health through chemical water quality criteria. It also encourages the targeting of watersheds for action and pooling resources and expertise with other government agencies and citizen groups.

Why Implement Watershed Projects?

Watershed projects promote understanding of the full range of stressors in a watershed—physical, chemical, and biological—that may be affecting aquatic life and human health. When all significant sources and stressors are understood, agencies are better able to focus on those controls that are more likely to produce measurable improvements in ecosystem health.

Administratively, watershed projects can be highly efficient. They encourage organizations to focus staff and financial resources on prioritized geographic locations and facilitate coordination of resources among interested parties. Also, they provide local agencies with an opportunity to take leadership roles in ecosystem protection.

Individual watershed projects can supply critical information to a state's major river basin plans, for example, as new models are developed and new watershed-level management approaches are tested.

Finally, watershed projects encourage local agencies and citizen groups to get involved—either by participating in state or federal projects or by starting their own watershed projects.

Who are the Stakeholders in a Watershed Project?

Stakeholders are individuals and organizations that have an interest in identifying and solving water quality problems and in monitoring the effectiveness of these solutions over time. Stakeholders of a single watershed project could include:

Municipal and county governments

Local councils of government

Local soil and water conservation commissions or districts

County boards of commissioners

Individual citizens

Local and national citizen action groups

Local industries

Water suppliers

State surface and ground water agencies

State agricultural, fisheries, and natural resources agencies

Indian Tribes and communities

Federal agencies

Local stakeholders are particularly important in targeting their local problems. They bring knowledge and concern for specific water bodies to the forefront. They serve as organizers in the area and keep interest alive and active. They are also effective in educating friends, neighbors, and government officials and putting action on the local, near-term agenda.

Are Watershed Projects Suitable where Ground Water Contamination is a Major Concern?

Ground water concerns are important in no point source watershed projects around the country. The Clean Water Act discourages no point source controls that protect surface waters at the expense of ground water. Watershed projects can be a good mechanism for taking into account all possible impacts on surface and ground water resources.

In some areas, ground water/surface water interactions are highly complex and may alter or preclude the delineation of watershed boundaries. For example, in karstland (limestone and dolomite terrain with sinkholes, subsurface streams, and caverns), ground water may discharge well beyond apparent watershed boundaries that are based on topography. Similarly, glaciated areas in the Northern United States and highly arid areas in the Southwest can have complex surface/ground water hydrology.

In such areas, agencies should carefully consider whether planning units should be watersheds (perhaps large watersheds) or administrative u nits such as counties or regions. In some cases, a dual approach with separate surface and subsurface water resource delineations may be appropriate. Ground water/surface water interactions should be understood and factored into all aspects of a watershed project.

What are the Elements of a Successful Watershed Project?

Most of this document discusses concepts and a logical framework for planning and implementing a watershed project. The many activities of a successful project can be divided into major topics or elements:

Building a Project Team and Public Support—developing effective institutional arrangements and ownership of the project by stakeholders (Chapter 4)

Defining the Problem—developing an inventory of the watershed and its problems and conducting baseline monitoring (Chapter 5)

Setting Goals and Identifying Solutions—developing project goals, a list of management measures, and a detailed plan for their implementation (Chapter 6)

Implementing Controls—obtaining funding, securing commitments, and installing controls (Chapter 7)

Measuring Success and Making Adjustments—documenting success in meeting goals, monitoring, changing management measures as needed, and ensuring project continuity (Chapter 8).

Chapter 1: The Watershed Protection Approach — Defining a Project Focus

What is the Watershed Protection Approach?

The Watershed Protection Approach (WPA) describes efforts within the U.S. Environmental Protection Agency (EPA) and other federal, state and local agencies to use a watershed-oriented approach to meeting water quality goals. The WPA is a comprehensive approach that takes into account all threats to human health and ecological integrity within specific watersheds. To some extent, this approach requires a departure from EPA's traditional focus on regulating specific pollutants and pollutant sources and instead encourages integration of traditional regulatory and nonregulatory programs to support natural resource management. Based on the success of comprehensive, aquatic ecosystem-based programs such as the Chesapeake Bay, Great Lakes, Clean Lakes, and National Estuary Programs, the EPA Office of Water is promoting similar approaches across the Nation in watersheds large and small, freshwater and marine, urban and rural.

The WPA can be described in many ways. For purposes of this document, the WPA is based on four key elements, listed below and described more fully in Figure 1-1:

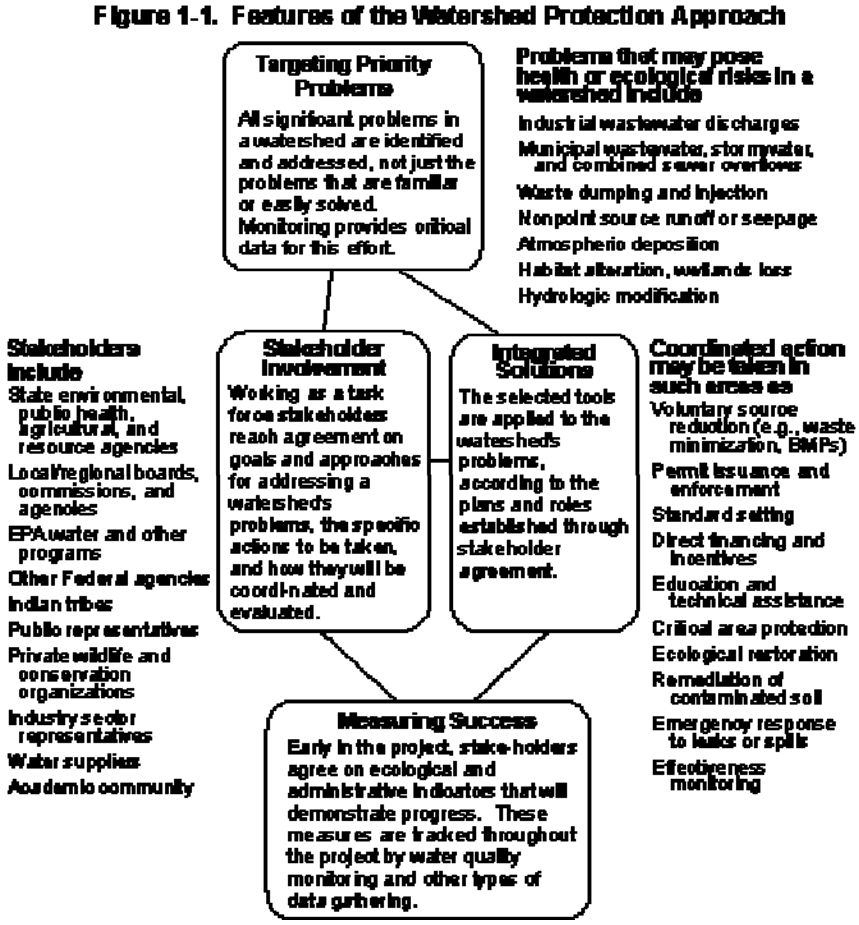
All priority problems in a watershed should be identified and addressed—problems posing the greatest risk to human health, ecological resources, desirable uses of the water, or a combination of these

All parties with a stake or interest in a specific watershed should participate in the analysis of problems and the creation and implementation of solutions

Actions taken in a watershed should draw on the full range of methods and tools available, integrating them into a coordinated, multi-organizational attack on the problems

Stakeholders should agree on measures of success early and monitor progress throughout the life of the project.

Figure 1. Features of the Watershed Protection Approach



The WPA helps to create water quality programs that have the following characteristics:

Feature watersheds or basins as the basic management units

Target priority watersheds for management action

Address all significant point and nonpoint sources

Address all significant pollutants or stressors

Set clear and achievable goals

Involve stakeholders during all stages of the program

Use the resources and expertise of multiple agencies

Are not limited by any single agency's responsibilities

Consider public health issues

Consider all aspects of ecosystem health including habitat

WPA projects also feature a strong monitoring and evaluation component. Using monitoring data, stakeholders identify stressors that may pose health and ecological risk in the watershed and any related aquifers, and prioritize these stressors. Monitoring is also essential to determining the effectiveness of management options chosen by stakeholders to address high-priority stressors. Because many watershed protection activities require long-term commitments from stakeholders, stakeholders need to know whether their efforts are achieving real improvements in water quality.

In addition, WPA projects must be consistent with state regulatory programs such as development of total maximum daily loads (TMDLs) and basinwide water quality assessments. In fact, a watershed may be selected for a special project because of the need for a complex TMDL involving point and nonpoint sources.

The appropriate scale for watershed projects is discussed in Chapter 2. In general, watershed projects under the WPA should be larger than demonstration size and should result in water quality improvement in significant, high priority water bodies. Most states delineate from 100 to 500 watersheds for planning purposes. The cover of this report depicts a river basin and one of its watersheds that might be selected for a watershed project.

What is the Relationship Between Individual Watershed Projects and Statewide Watershed Protection?

This document focuses on individual watershed projects, which can be components of the statewide watershed protection approach that many state water quality programs use. These states have organized their traditional activities, such as permitting, planning, and monitoring, so that all water quality problems are dealt with in the context of very large drainage areas (river basins). Typically, each basin is studied, and a basin plan developed, on a 5-year cycle.

A companion document, *Watershed Protection: A Statewide Approach* (EPA 1995) discusses how the principles of the WPA can be applied on larger geographic scales (i.e., statewide and basinwide) in ongoing state water quality programs.

There is merit in both concepts—focusing on individual watershed projects and the organization of state programs for statewide watershed management. States select their approaches to pollution control based on past history and other factors such as the

willingness and resources of local governments to contribute to a statewide approach versus an individual watershed project approach. For example, solving a state's water quality problems through many individual watershed projects may require greater local interest and resources than currently exist. The statewide approach may be more suitable and may help build a case for local action at the watershed level. In some cases, individual watershed projects may be used as examples to test the general concepts of watershed management or to give special attention to particularly difficult water quality problems.

The two approaches are compatible. For example, individual watershed projects can supply critical information to a state's basin plans as new models are developed and new watershed-level management approaches are tested.

How Does the WPA Differ from Other Watershed Initiatives?

Watershed-based projects are not new—hundreds of projects are ongoing at the federal, state and local levels. These projects usually have a specific slant or focus, as shown in Table 1-1. WPA seeks to build on previous watershed efforts; what is different is EPA's adoption of WPA as an operational approach. The EPA Office of Water is encouraging water quality agencies to orient their programs toward watersheds as management units and to begin comprehensive control projects in targeted watersheds.

Table 1. Examples of Types of Watershed Projects

Category of Project	Legislation or Other Authorization	Focus
Nonpoint Source Targeted Watershed Projects	CWA Section 319	Grants for small watershed demonstrations provided through Section 319(h) grants, with states encouraged to take advantage of U.S. Department of Agriculture Hydrologic Unit Area (HUA) projects or other large watershed-scale initiatives.
Clean Lakes Protection/Restoration Projects	CWA Section 314	Lake protection and restoration. Source of many techniques relevant to holistic watershed management emphasizing grassroots stakeholder involvement. Most projects focus

		on small lakes and reservoirs.
Great Lakes Remedial Action Plans	Treaty agreements with Canada, 1987 CWA and Amendments in Omnibus Water Resources Act of 1990.	Development of water quality-based restoration programs for Areas of Concern, usually to address toxicant problems on riverine estuaries.
U.S. Department of Agriculture (USDA) Hydrologic Unit Area (HUA) Projects	President's Water Quality Initiative and the Farm Bill Conservation Title	Provides for water quality-oriented USDA technical assistance and cost-sharing in selected special watershed units with documented surface or groundwater concerns related to agricultural practices.
USDA Forest Stewardship Incentives Program (SIP)	1992 Farm Bill, Title XII (dealing with nonindustrial private forestry)	Encourages partnership between USDA Forest Service with state forestry programs to improve management of up to 25 million acres of private woodlands and forests. Improvement can be targeted for riparian zones or wetlands.
Natural Resources Conservation Service (NRCS) Small Watershed Projects	PL-566, Upstream Flood Control and Critical Area Treatment	Encourages watershed planning to identify land treatment practices to reduce soil erosion and coastal flooding and to address other conservation needs.
USDA Demonstration Projects	President's Water Quality Initiative	Demonstrates practical technology which can be used as part of integrated resource management for water resource protection.
National Estuary Program	CWA Section 320	Promotes development of integrated management planning based on flexible regional stakeholder involvement and public outreach for 21 major estuaries and their associated

		watersheds.
U.S. Department of Interior (DOI) Bureau of Land Management (BLM) Fish and Wildlife 2000 Plan	An initiative under the BLM's riparian policies that places fish and wildlife values on an equal footing with other multiple uses of BLM leases	Starting in 1987, has led to numerous projects in western states to restore or protect riparian habitats. The recent Riparian-Wetlands initiative for the 1990s and the Bring Back the Natives Initiative are especially targeted at restoring ecological functions and protecting native fish stocks.
Corps of Engineers (COE) Environmental Enhancement Initiatives	Water Resources Development Acts of 1986 and 1990	In 1986, the Corps became a partner with the 8 States on the Upper Mississippi River in mitigating adverse ecological impacts from navigation works. Expanded in 1990 to cover all Corps projects. Examples include the Kissimmee River and the Everglades (Florida) and the Anacostia River (Maryland and the District of Columbia).
Incremental Flows Evaluations	Required by at least 15 States and relevant to Federal dam permit renewals, environmental impact work for COE and Bureau of Reclamation, and National Park Service assistance	Studies of instream flow needs in watersheds. Common in western states for operation of major dams. Also of importance elsewhere where rivers dammed for hydro-power or where issues with anadromous fisheries involved.
River Corridor Conservation Programs	Wild and Scenic Rivers Act, National Trails System Act, and Outdoor Recreation Act	In addition to the system for Wild and Scenic River designation, the National Park Service provides technical assistance to states for statewide river conservation programs or corridor protection

		projects on specific streams. Also many states or local governments have river greenbelt programs.

A number of EPA water quality programs already incorporate WPA principles to some degree (e.g., the Nonpoint Source Program, the Comprehensive State Ground Water Protection Programs, the National Estuary Program, the Clean Lakes Program, and Advanced Identification or Special Area Management Plans in the Wetlands Program). The WPA is not intended to replace any of these programs, but to further encourage a watershed orientation in them.

The WPA is not limited to EPA-sponsored programs. Indeed, one of the principal characteristics of the WPA is that it complements other environmental and natural resource management activities. The WPA, with its focus on specific water bodies, provides a way for traditional EPA and state programs to work much more closely with other agencies such as the U.S. Department of Agriculture (e.g., NRCS and the U.S. Forest Service), the U.S. Department of Interior (e.g., USGS, Bureau of Reclamation, Bureau of Land Management, and the U.S. Fish and Wildlife Service), and local and tribal governments. These working relationships are vital to the success of any WPA and, more importantly, to the restoration, maintenance, and protection of the Nation's ecosystems.

Purpose of this Document

This report is intended to promote watershed planning as envisioned under the WPA. The document describes a logical process for planning and implementing watershed projects and presents some lessons learned in previous projects.

In addition to promoting watershed-based planning, some key goals of the WPA and of this document are:

To emphasize ecological integrity in watersheds by addressing chemical, physical, biological and habitat stressors in addition to the more traditional goal of protecting human health through chemical water quality criteria

To encourage the targeting of watersheds for action, pooling resources and expertise with other government agencies and citizen groups

To encourage local agencies and citizen groups to get involved in state or federal projects or to start their own watershed projects

To help build a national base of successful watershed projects. Many of these projects will carried out under the supervision of state agencies that are also implementing other WPA-compatible programs statewide.

Audience

This document was developed to aid state, tribal, and local water quality managers in implementing watershed projects. A successful project typically involves staff from multiple agencies—federal as well as state and local—and these individuals may benefit as well. Members of environmental action groups and other informed citizens may also find this document helpful.

The Need for Partnerships and Concerted Actions

Section 101 of the Clean Water Act (CWA) establishes the physical, chemical and biological integrity of the Nation's waters as the primary goal of the national water quality program. Federal, state, tribal, and local governments, as well as industries and concerned citizens, have been working for over 20 years to achieve this goal. Their focus has been primarily on controlling the effects of municipal and industrial point source pollution through a federal permitting program (the National Pollutant Discharge Elimination System, NPDES) and a massive effort to make funds available to municipalities to construct and improve wastewater treatment plants. The success demonstrated by these efforts is a result of dedicated work and the concentration of resources, but also reflects the relative ease with which point sources can be identified and treated with existing technologies.

Nonpoint sources account for most of our remaining water quality problems. According to the 1990 and 1992 editions of the National Water Quality Inventory: Report to Congress (EPA, 1992a and 1994), the leading causes of impairment of our Nation's rivers and streams are siltation, excessive nutrients, and other pollutants from nonpoint sources. Nonpoint source pollution is generated from varied and diffuse sources—for example, runoff from farm fields carrying nutrients and pesticides, runoff from city streets carrying sediment and metals, and sediment-laden runoff from logging and construction activities. The impacts of these stressors may range from acute or chronic effects on humans and aquatic organisms to the physical degradation of aquatic habitat.

The CWA establishes a foundation of required actions that help prevent water quality impairments from point sources. These actions include technology-based controls, financial assistance, and point source permits. However, to control nonpoint sources, water quality programs must work in concert with other federal, state, tribal, and local initiatives. Examples include activities under the following programs and laws:

The President's Water Quality Initiative (USDA)

Conservation Title of the Farm Bill (the Farm Security Act of 1985 as amended)

Safe Drinking Water Act's Wellhead Protection Program

Rivers and Trails Conservation Program of the National Park Service

National Oceanic and Atmospheric Administration (NOAA) Sea Grant and the National Marine Sanctuaries Programs that support State Coastal Zone Management Programs

U.S. Fish and Wildlife Service efforts in wetlands acquisition and conservation under the Emergency Wetlands Resources Act of 1986

Bureau of Land Management and Forest Service initiatives to protect or rehabilitate watersheds on public lands and in national forests.

The benefits of watershed projects will usually be enhanced through a mix of many agencies' approaches, statutory authorities, and resources. Such a mix promotes the use of ecological principles and takes into account socioeconomic factors (e.g., through training and cost-sharing) to develop controls. EPA's Watershed Protection Approach emphasizes coordination among programs to achieve water quality goals.

Highlight 1 describes some major features of the Clean Water Act (CWA) that are relevant to a watershed-based approach to water quality management.

Highlight 1

Features of the CWA Relevant to Watershed Planning

Water Quality Standards. Water quality standards are the driving force behind State water quality programs. Water quality standards consist of three elements: the beneficial designated use(s) of a water body (e.g., fishing and swimming), the water quality criteria necessary to protect the use(s) of the water body (these can be numeric or narrative), and an antidegradation policy to maintain and protect existing uses and water quality. One goal of any watershed management plan is the ultimate attainment of water quality standards.

Wastewater Treatment Plant Construction Grants Program and State Revolving Funds. Since 1972, the federal government has provided billions of dollars in grants to states and local communities for the construction of sewage treatment systems. This program, in concert with the NPDES permitting program, has greatly reduced point source loadings to our Nation's surface waters. The 1987 Amendments of the CWA moved the responsibility for financing municipal treatment systems from the federal government to the states and local communities. Seed money was provided to establish state revolving [loan] funds (SRF) that are designed to become self-sustaining. If a state can first satisfy its sewage treatment construction needs, then revolving funds may be used for other activities including nonpoint source activities that are in accordance with Section 319 of the CWA. Thus, watershed projects may be eligible for SRF funding in certain cases.

National Pollutant Discharge Elimination System (NPDES). The NPDES system requires that each point source of wastewater (industrial and municipal) obtain a permit that regulates the facility's discharge of pollutants into U.S. waters. The CWA requires that point source dischargers comply with specified effluent limitations for conventional and nonconventional pollutants and priority toxic pollutants. The 1987 Amendments added Section 304(l) to place a special emphasis on the identification and control of waters that remain impaired by toxic pollutants even after the application of technology-based requirements. Of particular relevance to the WPA, EPA has recently developed an NPDES Watershed Strategy to integrate the NPDES program into each state's WPA.

Total Maximum Daily Loads (TMDLs). The CWA [Section 303(d)] requires that TMDLs be established for water bodies where water quality standards have not been met through technology-based effluent limitations alone. A TMDL can be defined as the sum of the "wasteload allocation" for point sources and the "load allocation" for nonpoint sources that a water body can assimilate and still meet water quality standards. The TMDL must also include a margin of safety, which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

The TMDL process, as described in Guidance for Water Quality-based Decisions: The TMDL Process (EPA, 1991a), consists of five steps: (1) identification of water quality-limited waters; (2) priority ranking and targeting; (3) TMDL development; (4) implementation of control actions; and (5) assessment of water quality-based control actions.

Most TMDLs do not involve the extensive planning, interagency coordination, and public participation described in this WPA document. However, some watersheds may be selected for WPA-type projects because of the need for TMDLs. For example, a watershed project may be appropriate in a complex situation where point and nonpoint sources are degrading a high priority lake, estuary or aquifer and local interest is high.

Clean Lakes Program. Section 314 of the CWA established a program for identifying publicly owned lakes in each state that are impaired by point and nonpoint sources and by such stressors as nutrients, metals, and acidity. Clean Lakes Grants are issued for diagnostic/feasibility studies, restoration/implementation projects, and post-restoration monitoring programs. From its inception in 1972, the Clean Lakes Program has had a watershed focus and has encouraged coordination among federal, state, and local agencies and grass-roots organizations. Building the institutional framework that involves all stakeholders is a major objective of Section 314. Over time, many states have developed the local support, legislation, and funding sources for self-sustaining lake programs.

Nonpoint Source Programs. Section 319 of the 1987 CWA amendments created a new program designed to control nonpoint source pollution and to protect groundwater as part of the overall effort. In general, this section requires each state to submit an assessment of state waters not expected to meet water quality standards because of nonpoint source pollution and a management program for controlling nonpoint source pollution.

Many watershed projects are sponsored under Section 319 grants. These projects range in size from small demonstration projects to full-scale watershed projects as envisioned under WPA.

Groundwater Protection. The CWA encourages steps to ensure that surface water programs do not achieve loading reductions at the expense of groundwater resources. For example, Section 319 nonpoint source management programs must demonstrate that their water quality best management practices (BMPs) are at least pollution neutral in terms of their impacts to groundwater. EPA has also worked with states to develop Groundwater Protection Strategies that coordinate the efforts of diverse federal programs. State Wellhead Protection Programs encouraged under the Safe Drinking Water Act also make use of pertinent CWA programs. Where states have adopted one or more of these approaches to groundwater protection, such tools as the TMDL process or the WPA may be useful in pursuing their groundwater objectives.

National Estuary Program (NEP). CWA Section 320 established the NEP to protect and restore the water quality and living resources of the Nation's estuaries. The NEP adopts a watershed approach by planning and implementing water quality management activities for an estuary and its entire drainage area. The Program has supported over 20 estuary projects. When an estuary is selected, EPA convenes a management conference with stakeholders from all interested groups (e.g., industry, agriculture, conservation organizations and state agencies) to more fully characterize the estuary's problems and seek solutions. The NEP is a national demonstration program in that only a fraction of U.S. estuaries can be targeted for action under NEP.

Chapter 2: Watershed Projects — The Broad Issues

Why is Watershed Planning the Right Thing to Do?

Watershed-based planning is not a new or exotic approach to water quality management. Some states and federal agencies (notably the Department of Interior and USDA) have sponsored watershed-based projects for many years, although water quality protection has not always been a primary goal of these projects. Watershed-based water quality management is the right thing to do because it protects, restores and maintains healthy ecosystems. It is an effective way to protect chemical water quality while at the same time protecting critical terrestrial and aquatic habitat, reducing soil erosion, and restoring aquatic communities. These benefits make the approach particularly useful for solving nonpoint source problems (or a combination of point and nonpoint problems); thus, it is applicable to the majority of the Nation's remaining water quality issues.

From a technical standpoint, watershed planning is grounded in an understanding of the full range of stressors in a watershed—physical, chemical, and biological—that may be affecting aquatic life and human health. When all significant sources and stressors are understood, agencies are better able to focus on those controls that are more likely to produce measurable improvements in ecosystem health.

Administratively, watershed planning is efficient. It encourages organizations to focus staff and financial resources on prioritized geographic locations and facilitates coordination and pooling of resources among interested parties. It also offers an opportunity for local agencies to take leadership roles in ecosystem protection.

Who are the "Stakeholders"?

Stakeholders are individuals and organizations that have an interest in identifying and solving water quality problems and in monitoring the effectiveness of these solutions over time. Stakeholders of a single watershed project could include:

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Local councils of government

Local soil and water conservation commissions or districts

County boards of commissioners

Individual citizens

Local and national citizen action groups

Local industries

Water suppliers

State surface and ground water agencies

State agricultural, fisheries, and natural resources agencies

Indian Tribes and communities

USDA agencies at the local level (NRCS, Agricultural Stabilization and Conservation Service, Forest Service)

Other Federal agencies (e.g., U.S. Fish and Wildlife Service, U.S. Geological Survey [USGS], Army Corps of Engineers)

EPA.

Local stakeholders are particularly important in targeting their local problems. They bring knowledge and concern for specific water bodies to the forefront. They serve as organizers in the area and keep interest alive and active. They are also effective in educating friends, neighbors, and local officials and putting action on the local, near-term agenda. Local interest and concern may, in fact, dictate which problems are dealt with first.

Why is Public Support So Necessary?

Experience has shown that the degree of public education and participation can determine the success of a watershed project. Without public support, projects may never get past the planning stage. Project implementation requires that local government and citizens have ownership of the project. For example, it can be impossible to implement best management practices (BMPs) for nonpoint source control without the support and cooperation of private land owners. In addition, a mid-course correction stage must be factored into the project. That is, the public needs to be prepared for the possibility that it may be necessary to alter or add additional point and nonpoint source management measures, if water quality goals are not being achieved part way through the project.

There are many ways to involve the public in watershed projects. For example, the formation of citizen review groups and technical committees has been shown to gain support from the diverse interests in a watershed and to provide an accessible core group of community leaders to keep the project going once agreements have finally been reached.

What is the Appropriate Scale for a Watershed Project under the Watershed Protection Approach?

One of the goals of the WPA is to produce a national set of watershed projects that illustrate the efficacy of the approach. The WPA does not mandate watershed size or scale. However, individual watershed projects should be larger than research or demonstration scale. Watersheds should be of sufficient size to achieve economies of scale, take advantage of local government and technical expertise, and be viable for long-term management (e.g., be at a scale that is feasible as more and more watershed projects develop around the state).

The following factors should be considered to determine an appropriate watershed size and set boundaries for watershed projects:

Nature and extent of the water quality problem

Existing administrative boundaries (e.g., counties)

National watershed delineations—e.g., USGS Cataloging Units, NRCS watersheds

Ecoregion boundaries—units reflecting homogeneous ecological systems, derived from analyses of such environmental factors as topography, land use, potential natural vegetation, and soils; the coterminous U.S. has 76 ecoregions (Omernik, 1986)

Water quality model limitations.

How are Watersheds Delineated?

Watersheds are delineated in a number of ways. Many states set watershed boundaries for planning purposes, and local governments or land management agencies may also delineate watersheds. Finally, concerned citizens or environmental groups may delineate a watershed of particular interest to them.

States—Several states have formally delineated their watersheds for planning purposes. Oklahoma has delineated approximately 300 watersheds, covering the entire State, for nonpoint source planning purposes. The Wisconsin Department of Natural Resources has delineated 330 watersheds for nonpoint source planning. The Ohio Environmental Protection Agency has divided the state into 93 “sub-basins” or component watersheds of roughly county size to match county-level water quality efforts by the NRCS and others. Within these sub-basins are approximately 1,000 watersheds at the level of fairly small streams.

North Carolina's Division of Environmental Management has delineated 17 river basins containing 135 sub-basin watersheds which average 250,000 acres in size. Figure 2-1 shows the sub-basins in the Tar-Pamlico River Basin. Currently, the basin is the unit for development of management plans on a 5-year, rotating cycle. The state is moving toward the targeting of controls on a sub-basin or watershed level; for example, in the Tar-Pamlico Basin, special data collection and modeling are under way by sub-basin to support point source/NPS source trading of nutrient loads.

Figure 2. The Tar-Pamlico River Basin, NC and its component watersheds

Figure 2-1. The Tar-Pamlico River Basin, NC and its component watersheds

Other agencies—Land management agencies such as NRCS, U.S. Fish and Wildlife Service, Bureau of Land Management, and National Park Service also delineate watersheds. For example, in Virginia, the NRCS has delineated approximately 500 "hydrologic units" averaging 53,000 acres in size for nonpoint source planning purposes. Boundaries are related loosely to prior Soil Conservation Service (now NRCS) watersheds and are subsets of USGS Cataloging Units. South Carolina has used NRCS Conservation Needs Inventory watersheds in delineating its 305(b) water bodies. The state contains approximately 320 NRCS watersheds.

Local government and citizens—Local governments, with the help of citizens, also delineate watersheds in order to mobilize resources and focus attention on particular

problems. In the Anacostia River Basin, Maryland, the District of Columbia, and local agencies have selected nine "priority sub-watersheds" for special management attention. For each, a sub-watershed action plan is prepared as a blueprint for restoration activities that are unique to the ecological needs of the area (see Restoration Accomplishments in Appendix A). In Virginia, the Chesapeake Bay Preservation Act authorizes the establishment of local boards that can identify watersheds as preservation areas. State agencies and programs can then be tapped to help local governments implement preservation plans.

How are Watersheds Ranked and Targeted?

Watersheds may be ranked and targeted for attention and action according to a number of criteria. These criteria may differ from state to state, local government to local government, and citizen group to citizen group. Most states use some type of formal process for prioritizing their water bodies or watersheds. The following criteria (adapted from Adler and Smolen, 1989) are especially appropriate to the example water body ranking/watershed targeting process depicted in Figure 2-2:

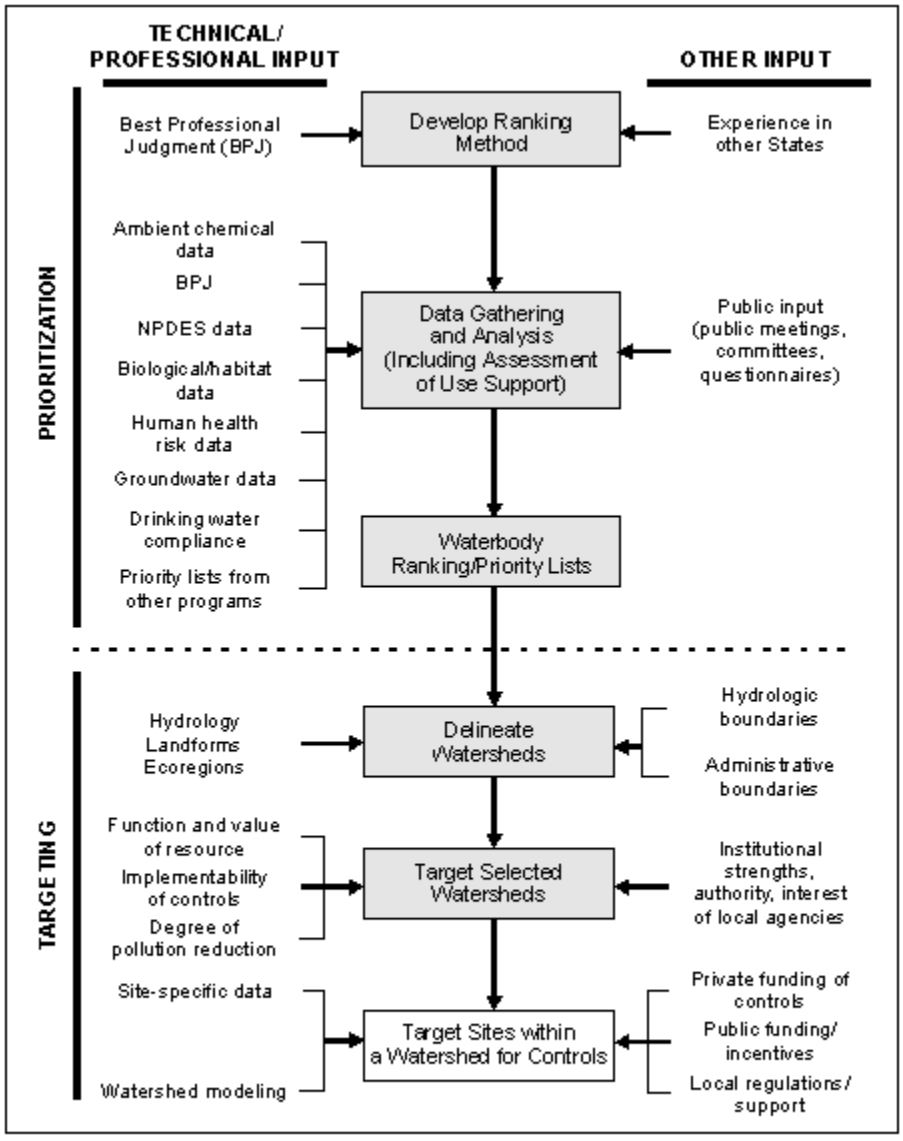
Severity or risk of impairment—Typically, the degree of impairment of designated uses as reported in state 305(b) reports or as determined through public input. This ranking criterion can ensure that waters most ecologically damaged, sensitive, or at risk get special consideration in the decision process.

Ecological value—This ranking criterion can ensure that waters of special ecological value get special consideration in the decision process. These waters might include cold water fisheries, primary nursery areas, and outstanding resource waters.

Resource value to the public—Many ranking systems assign high value to waters designated as public water supplies and recreational waters. This criterion ensures that waters most valued by the public or having the potential for public use receive consideration. Public support helps ensure funding and may indicate citizens' willingness to push for control efforts.

Data availability and quality—Rather than make water quality judgments based on insufficient information, some states establish minimum data requirements.

Figure 3. A water body ranking/watershed targeting process



Source: EPA, 1993a

Figure 2-2. A waterbody ranking/watershed targeting process.

Even watersheds that rank high according to the above criteria may not be the most suitable for intensive management efforts. A number of other factors are pertinent to targeting watersheds based on the ability to implement effective controls. These criteria include:

Resolvability of the problem—ability of existing management tools (e.g., BMPs) to solve the water quality problem expeditiously

Institutional feasibility—whether institutional arrangements are sufficient to put these tools in place (e.g., local governments have authority to pass needed ordinances)

Legal mandates—court-ordered TMDLs, for example, may propel watersheds to the top of statewide priority lists

State financial and human resources—availability of state resources for multiple watershed projects while still meeting regulatory obligations

Local financial and human resources—availability of funding or skilled personnel from various agencies. These resources may take the form of technical and management expertise or payments for controls to carry out a watershed management plan.

For further information on ranking and targeting approaches, see *Geographic Targeting: Selected State Examples* (EPA, 1993a).

Is Watershed Planning Suitable where Ground Water Contamination is a Major Concern?

Ground water concerns are important in nonpoint source watershed projects around the country. The Clean Water Act discourages nonpoint source controls that protect surface waters at the expense of ground water. Watershed projects can be a good mechanism for taking into account all possible impacts on surface and ground water resources.

In some areas, ground water/surface water interactions are highly complex and may alter or preclude the delineation of watershed boundaries. For example, in karstland (limestone and dolomite terrain with sinkholes, subsurface streams, and caverns), ground water may discharge well beyond apparent watershed boundaries that are based on topography. Point source or nonpoint source controls that change surface water quality in one area may actually have greater impact on the ground water and surface water of areas quite a distance away. Similarly, glaciated areas in the Northern United States and highly arid areas in the Southwest can have complex surface/ground water hydrology.

In such areas, agencies should carefully consider whether planning units should be watersheds (perhaps large watersheds) or administrative units such as counties or regions. In some cases, a dual approach with separate surface and subsurface water resource delineations may be appropriate. Surface/ground water interactions should be understood and factored into all aspects of a watershed project.

How do We Measure the Success of a Watershed Project?

It is not always easy to document or measure the success of a watershed project. Watersheds are dynamic systems that require years to restore equilibrium after controls are implemented, and monitoring for environmental success is technically difficult and resource intensive. Nonetheless, we want to know if water quality has improved or if fish populations have grown in abundance or diversity in a relatively short time period. Recognition of the time involved in measuring success is as important as determining what conditions will represent success. Fortunately, some institutional and programmatic measures of success require less time to show results than direct environmental measures. For example, tracking the number of stream miles monitored, the number of facilities installing BMPs, or the number of municipalities enacting zoning ordinances can indicate short-term progress toward long-term goals. Chapter 6 of this document discusses goals and environmental indicators for watershed projects.

Chapter 3: Elements of a Successful Watershed Project

Why is Watershed Planning the Right Thing to Do?

The remainder of this document discusses concepts and a logical framework for planning and implementing a watershed project. Figure 3-1 groups the many activities of a successful project into major topics or elements:

Building a Project Team and Public Support—developing effective institutional arrangements and local ownership of the project (Chapter 4)

Defining the Problem—developing an inventory of the watershed and its problems and conducting baseline monitoring (Chapter 5)

Setting Goals and Identifying Solutions—developing project goals, a list of management measures, and a detailed plan for their implementation (Chapter 6)

Implementing Controls—obtaining funding, securing commitments, and installing controls (Chapter 7)

Measuring Success and Making Adjustments—documenting success in meeting goals, monitoring, changing management measures as needed, and ensuring project continuity (Chapter 8).

Figure 3-1 is intended to show that the elements of a successful project are interconnected and that each element is important, not that they must occur in a particular order.

Figure 4. Some elements of a successful watershed project

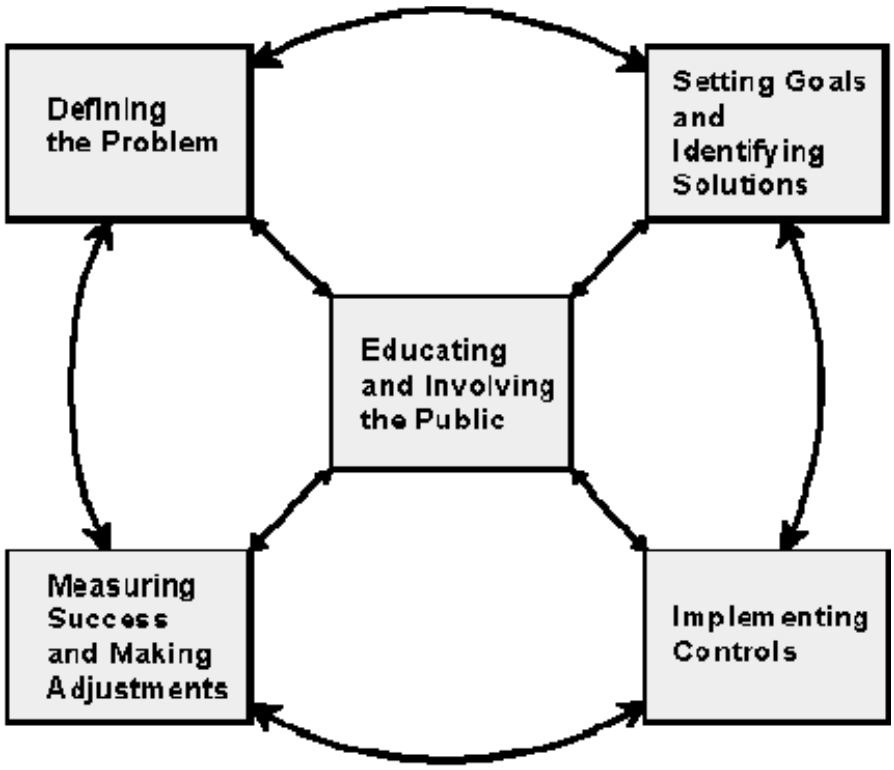


Figure 3-1. Some elements of a successful watershed project.

Figure 3-2 is an expanded version of the previous figure, and lists the individual activities that are discussed in the remaining chapters of this report. The goal for the remaining chapters is to provide insight into similarities among watershed projects. Of course, each watershed has its own specific problems, and management activities must be tailored to meet these needs. Some of the lessons learned in earlier projects will be useful to future watershed managers and the public.

Figure 5. Elements of a successful watershed project showing individual activities

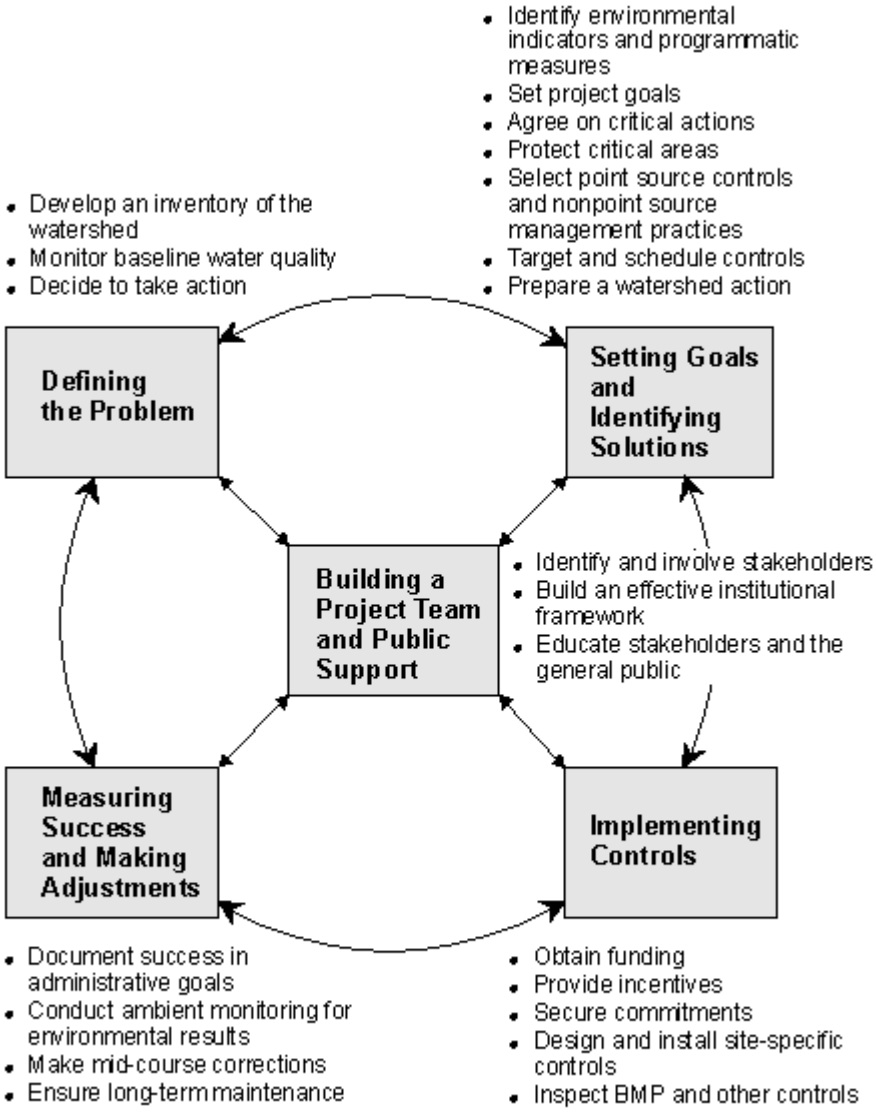
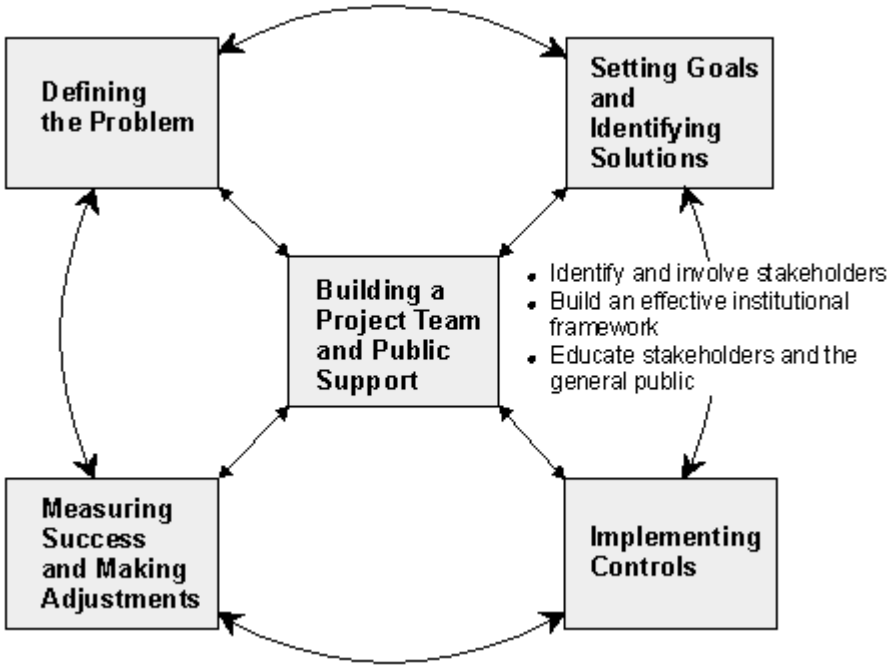


Figure 3-2. Elements of a successful watershed project showing individual activities.

Chapter 4: Building a Project Team and Public Support



Identify and Involve Stakeholders

Successful watershed projects bring together the public, citizen groups, researchers, and government agencies with an interest in the watershed and the project's outcome. Some representatives may have a special interest in protecting water resources, others in enhancing the socioeconomic aspects of quality of life (e.g., jobs, businesses, tourism).

Such a broad base of stakeholders creates a team that combines the expertise, authority, and interests of each organization. This can be especially important later in the project when help and cooperation are needed from several agencies or when gray areas of jurisdiction arise in which no agency has clear authority. Also, some critical management steps may rely on voluntary programs or may require mobilization of broad public support to secure funding.

The use of committees can be effective in involving stakeholders and providing the project team with valuable information. Citizen advisory committees may include representatives from local business groups, environmental groups, recreational organizations, and landowners associations. Representatives from government agencies, colleges, and universities, as well as other local experts may serve on technical

committees (Brichford and Smolen, 1990). Citizen monitoring groups may form to involve local students, teachers, and outdoors-oriented people in gathering useful data and identifying problems.

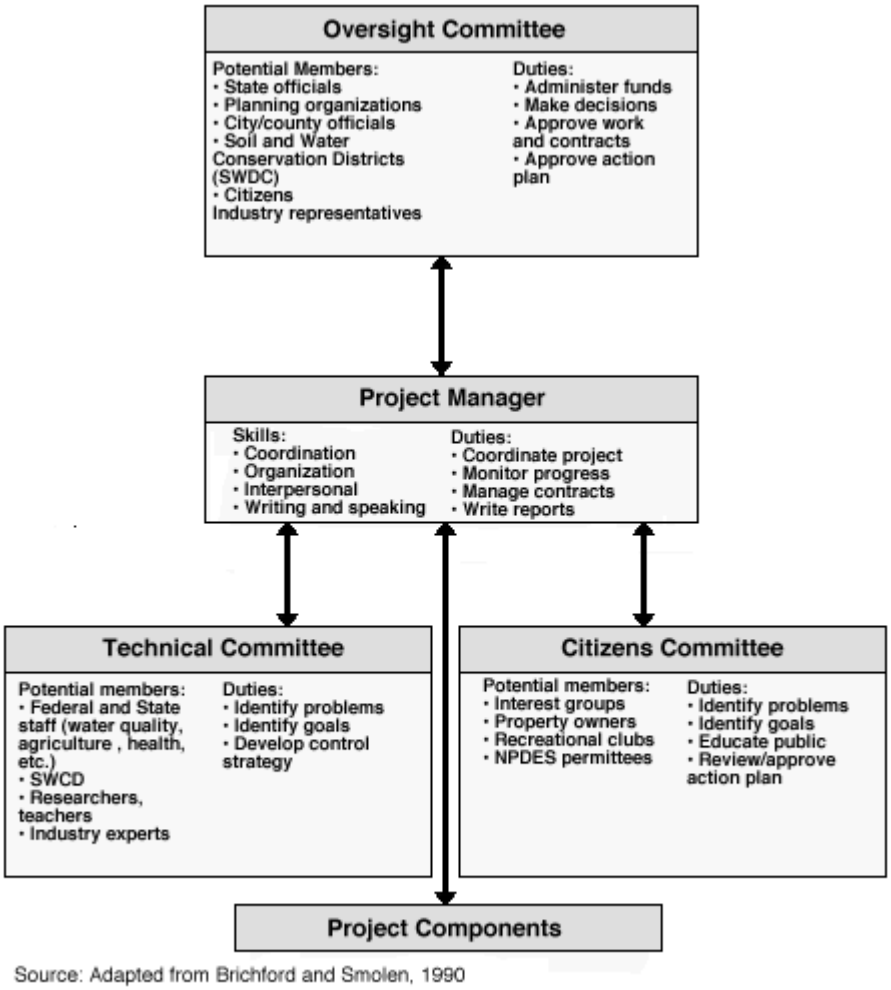
Highlight 2 describes efforts to locate stakeholders in Puget Sound watersheds. Highlight 3 lists the stakeholders in the innovative Anacostia River Restoration Project.

Build an Effective Institutional Framework

A common theme among successful watershed projects is involving personnel from multiple organizations in a decision-making role throughout the life of the project. However, just as watersheds exhibit different water quality problems, the structure that evolves to manage watershed projects can vary significantly. For example, project administration may be centralized, as in a state water quality agency, or run at the local level with the support of state or federal agencies. Institutional arrangements may be highly formalized or may depend more on informal networks of citizens and local officials to ensure coordination.

Figure 4-1 shows a type of administrative structure that has been used in some watershed projects and National Estuary Program projects. This is presented as an example, and is by no means the structure of choice for every watershed or every state. The main decision-making body, referred to in Figure 4-1 as the oversight committee, has overall responsibility for the success of the project, for administrative matters, and for coordination with the lead agency. The lead agency, typically the state water quality agency or a local organization, may maintain ultimate authority to approve the plans and recommendations of the oversight committee. Source: Brichford and Smolen, 1990.

Figure 6. Example administrative structure of a watershed project



Source: Adapted from Brichford and Smolen, 1990

Figure 4-1. Example administrative structure of a watershed project.

Highlight 2

Puget Sound Watershed Planning

Local Watershed Management Committees form the backbone of efforts to protect Puget Sound in the State of Washington from nonpoint source pollution. One of the first lessons learned from these committees follows.

Finding "Affected Parties" (Stakeholders): Affected parties can be determined by considering the point and nonpoint sources and beneficial uses in each watershed. Each source, from agriculture to septic systems, and each resource, from salmon to shellfish, is important to certain citizens and professionals. These individuals often have enough interest to participate in the watershed planning process. It is often helpful to work through existing organizations--a dairy group, a board of realtors, or an environmental organization--to identify potential members.

"To balance out our committee so that it wasn't all agency people," explains Becky Peterson, project manager of the Silver Creek early action watershed in Whatcom County, "we invited all the property owners within the watershed to participate by attending an initial meeting. At the meeting we decided to break this group into three smaller groups--businesses that were located in the watershed, farms in the watershed, and citizens' groups. Then the members of these three groups chose who they wanted on the committee. I think it was a good way for the residents to feel they were being adequately represented."

Source: Puget Sound Water Quality Authority, 1991.

In addition to local, state, and federal agency representatives, the oversight committee's membership should include a broader population of stakeholders--environmental groups, business groups, or other nongovernmental organizations (NGOs)--that are interested in the ecosystem. Committee size should represent a balance between the need for expertise and community representation and the need to have a manageable group.

The project manager coordinates and monitors all project activities and is critical to a smoothly running and focused project. The manager is responsible to the oversight committee and/or lead agency for tracking project expenditures and funding requests and for producing project documents such as watershed action plans and the final project report. The roles of the lead agency, committees, project manager, and staff can be formalized so that all participants know what to expect. See Appendix B for an example

protocol of participants' functions and responsibilities from a Puget Sound watershed project.

Highlight 3

The Anacostia River Restoration Project

The Anacostia River Restoration Project is featured in highlights throughout this document because it illustrates many of the principles being encouraged under EPA's Watershed Protection Approach.

Background: The Anacostia River is a tributary to the Potomac River and has a watershed of about 150 square miles. The watershed has a variety of pollution and habitat modification problems. Starting in the 1930s, construction projects along the Capitol Mall and Washington's central business district transferred much of the surface drainage of the Tiber River to the Anacostia. This created a substantial combined sewer overflow (CSO) problem on the lower, tidal portions of the river. In addition, approximately 75 percent of the Anacostia watershed's forest cover has been removed for urban development and agriculture, resulting in high stormwater flows and pollutant loadings.

From an early date, the Anacostia was targeted by Maryland as a Critical Area under the Chesapeake Bay program. With impetus from this program, the Anacostia Restoration Agreement was signed in 1987. The four principal signatories were the State of Maryland, Maryland's Montgomery and Prince George's Counties, and the District of Columbia.

Stakeholders: The Anacostia River Restoration Committee, the main oversight committee, consists of representatives from the signatory agencies:

District of Columbia Department of Public Works

District of Columbia Department of Consumer and Regulatory Affairs

Prince George's County Department of Environmental Regulation

Montgomery County Department of Environmental Programs

Maryland Department of Natural Resources

Maryland Department of the Environment.

Other stakeholders and participants inlcude:

Izaac Walton League

Anacostia Watershed Society

Alliance for Chesapeake Bay

U.S. Army Corps of Engineers

Washington Suburban Sanitary Commission
National Park Service
Interstate Commission on the Potomac River Basin
Metropolitan Council of Governments
U.S. Department of Agriculture
U.S. Environmental Protection Agency.

Source: Anacostia Restoration Team, 1991.

Another reason for the type of institutional framework shown in Figure 4-1 is that watershed projects often do not follow a neat "command and control" organizational structure. Reaching agreement often requires consensus--that is, each participant agrees with the group decision or at least agrees to support the group decision--or negotiating a constructive compromise position. The following was written about lake management in New York State, but applies to watershed management in general:

> *No one governmental entity has absolute power over lake management. This situation has its benefits and drawbacks. On the plus side of the ledger, every organization and constituency has some say over decisions which affect the lake and its watershed. The structure is disseminated and hence "democratic." On the other hand, it seems that decisions could be made more efficiently if each lake and its watershed had one omnipotent management agency...*
>
> *One fact is clear, government agencies seem to be quite capable of making decisions on issues where there is little disagreement between the major constituencies. If the land developers, the fishermen, the hotel owners, the lakeshore property owners, the academics and the elected officials all are either neutral or on the same side of an issue, then the only problem will be how to finance it. When constituencies disagree, the government decision process often breaks down* (New York Federation of Lake Associations, 1990).

The Watershed Protection Approach emphasizes finding solutions by bringing the constituencies together in a long-standing commitment to succeed.

Educate Stakeholders and the General Public

The purpose of education in a watershed project is to increase awareness of the natural system and of problems in the watershed and, where necessary, to elicit behavior changes in particular groups. Behavior changes by developers, farmers, loggers, municipal and

industrial permittees, local officials, and other groups are often crucial to successful watershed projects.

Education helps everyone living or working in a watershed understand the relative contributions of different types of pollution sources. For example, in the Albemarle-Pamlico Estuary drainage in North Carolina, the public initially perceived that toxicants from point sources were the major water quality problem. However, monitoring data and professional judgment indicated that nutrients were the primary cause of problems in the region. Highlight 4 describes a series of workshops in the Stillaguamish Watershed, Washington to educate the public about types of nonpoint sources. Further examples of public education programs are available (EPA, 1989).

Effective education and public involvement lead to workable and long-lasting answers to watershed problems--answers that are arrived at through a process that goes well beyond the one-way communication of the traditional public hearing approach. For these reasons, watershed projects should have explicit plans for involving and educating the public (Puget Sound Water Quality Authority, 1991).

A public education program is a set of activities, often with a specific purpose and a target audience. Effective education programs address each target audience in terms that are meaningful to that audience. Key target audiences include:

Oversight and citizen advisory committee members

Local elected officials

State and local agencies

Agencies providing incentives

Corporate and land use interests

Trade association

Environmental groups

News media

Highlight 4

Public Workshops in the Stillaguamish Watershed, Washington

To help Snohomish County develop plans for reducing pollution in the Stillaguamish Watershed and Warm Beach area, the county held a series of workshops in May 1988. The purpose of the workshops was to educate the public about the four types of nonpoint sources that had been identified by citizen groups as most important and to form workgroups to draft text for the Watershed Plan. The workshops were:

Workshop 1	Septic Systems and Household Waste: Impacts on Water Quality in the Watershed
Workshop 2	Agricultural Practices: Challenges and Solutions
Workshop 3	Forestry Practices in the Watershed: Historical and Future Perspectives
Workshop 4	Development and Stormwater Runoff: Impacts on Water Quality in the Watershed.

Source: Cole et al., 1990

Timing is an important factor in designing a public education program. Early in the watershed project, emphasis should be put on informing everyone about existing pollution problems and the nature of the upcoming planning process. Later in the project, emphasis should shift to the implications of different control strategies, actions, or BMPs expected of each target audience, and how success will be measured. Throughout the process, project accomplishments should be reported so that support and enthusiasm for the project are maintained.

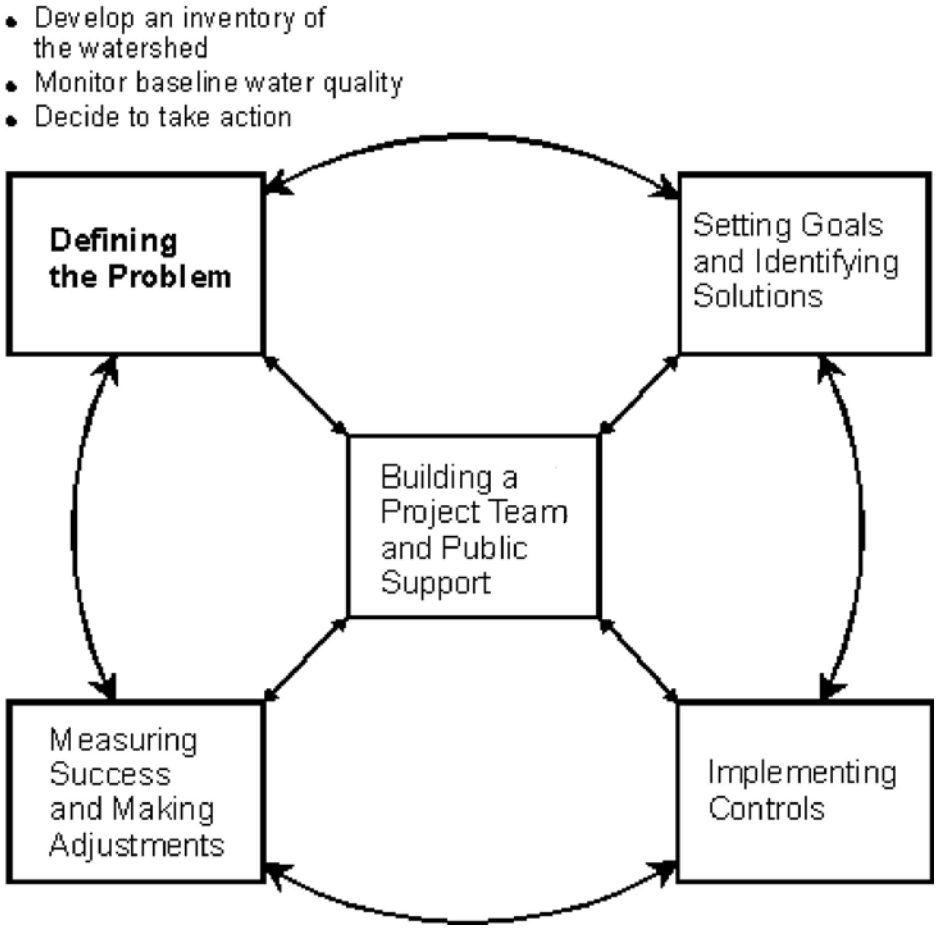
In addition to the audiences mentioned above, a project team may wish to cultivate an environmental ethic in target audiences that can affect policy well into the future. These long-term audiences include schoolchildren, teachers, and civic organizations. The project team must decide how to divide resources for education among the different types of audiences.

Some tried-and-true methods of public education include:

Newsletters, brochures
Mass media
Demonstration sites such as model farms
Signs
Meetings, workshops, and field trips
Self-completed checklists or inventories
Onsite technical assistance, inspections, or inventories
Citizens monitoring programs
Contests
Training and certification programs.

To help prepare for education of the public, it may be helpful to develop a list of target audiences, behaviors to be changed, groups or entities most respected by each target audience, and a strategy for how to approach these groups and work cooperatively with them.

Chapter 5: Defining the Problem



This chapter discusses the process of gathering available information about the watershed and its water quality problems. Preparing an inventory of the watershed and starting a baseline monitoring program are usually critical to the ultimate success of a project.

Develop an Inventory of the Watershed

An inventory of the watershed helps ensure that project team members have a consistent knowledge base and helps focus their attention on the most significant problems or ecosystem threats.

The inventory and assessment of baseline conditions and water quality problems is sometimes documented in a watershed assessment report; an example format is shown in

Figure 7. This report provides direct input to the goal-setting process and to preparation of a watershed action plan, discussed in Chapter 6.

Prior to beginning a watershed assessment report, writers should ensure that the product will be compatible with statewide databases and basin plans in both format and approach. For example, data analysis methods for assessing designated use support should follow methods used by the state for their biennial reports under CWA Section 305(b). Where possible, databases and hard copy reports should be suitable for inclusion in statewide or basinwide assessment databases and reports. State 305(b) Coordinators are often the key contacts for ensuring this type of compatibility.

Background Information on the Watershed

Most watershed projects are selected based on some type of geographic targeting, so considerable information about the resource and its problems usually exists. For example, water quality data on at least a portion of each watershed are needed to develop water body rankings. At the point when watersheds are targeted, information such as the following is often available from state Section 305(b) reports, State Water body System databases, and other public sources:

Sizes, locations and designated uses of all water bodies

Water bodies having impaired use support

Causes of impairment (e.g., pollutants, habitat limitations)

Physical/chemical and biological water quality

Locations and loadings from point sources

Categories of nonpoint sources and estimates of loadings

Groundwater quality

Sources impacting groundwater

Fish and wildlife surveys

Topographic and hydrologic maps

Crude land use maps.

Such readily available data can be supplemented by other data types needed for the critical steps to follow--goal-setting and selection of point and nonpoint source management measures:

Detailed soil survey

Locations of highly erodible soils

Locations of critical riparian areas

Locations of critical instream habitat areas

Locations of sensitive ground water areas (e.g., recharge zones)

Demographics and growth projections

Economic conditions--e.g., income, employment

Detailed existing and projected land use

Locations and sizes of animal operations

Locations of nonpoint source controls.

Figure 7. Topics for a watershed assessment

I. Watershed Description

A. Name, size, administrative boundaries
B. Geographic locators--Federal or State identification numbers
C. Maps

II. Physical Characteristics

A. Geology, topography,
B. Soils
C. Land use/land cover
D. Ecoregion(s)
E. Hydrology

III. Critical Areas

A. Surface water
- waters with endangered or threatened species
- critical fishery areas, outstanding resource waters
- critical riparian and instream habitat
- water supplies

B. Ground water
- water supplies
- recharge areas
- springs, other vulnerable areas

IV. Water Quality

A. Designated uses and use support

B. Watershed's water quality problems
- physical/chemical
- biological
- habitat (including flow needs)

- other problems or sources of stress
IV. Point and Nonpoint Sources
A. Point source locations, loadings (if applicable)
B. Nonpoint source locations, loadings (if applicable)
C. Control measures in place--types, locations, effectiveness
V. Information Needs
A. Baseline monitoring program
B. Other data gaps
C. Information management systems

Sources for these data include state surface and ground water databases and reports, local agency reports, state or local geographic information system (GIS) databases, and aerial photography. NRCS Field Office Technical Guides (county level) are excellent sources of information on soils, water, plants, animals, nonpoint source BMPs and other topics. Contact the NRCS Midwest National Technical Center at (402)437-5315 for more information.

Finally, and of great importance, decision makers and project staff should conduct a first-hand survey of the watershed--walking along streams to observe overall ecosystem health and driving around the watershed or flying over it to observe land uses and sources of pollution. During these forays, technical experts can describe to decision makers the impacts of traditional pollutants (e.g., sediments and nutrients) and of nontraditional stressors (habitat loss, bank erosion).

Problem Statement

Whether or not a watershed assessment report is written, a detailed statement of the watershed's water quality problems may be essential to the ultimate success of the project. Types of problems frequently identified in watershed projects include:

Excessive sediment or nutrients reaching sensitive water bodies

Reduced fish harvest

Reduced anadromous fish spawning range

High stream temperatures

Riparian habitat damage by timber harvests

Nitrate contamination of ground water.

The problem statement may include more problems than were identified in the statewide priority-setting process. For example, a watershed may be selected on the basis of a high priority for TMDL development because of nutrient enrichment of an estuary; upon more detailed study, ground water contamination and loss of riparian habitat may also become key issues.

A problem statement, agreed to by the various stakeholders, begins to merge their interests and helps to focus upcoming monitoring activities. The statement includes information about the type and location of threatened or existing water use impairments, pollutants, and sources, as well as economic impacts associated with the water quality problem. Problem statements may be developed for individual sub-watersheds if plans will be written at that scale.

Highlight 5

Sequim Bay's Solution to Problem Identification

"Rather than spend our time evaluating traditional sources of nonpoint pollution, our watershed management committee focused on goals and objectives," reports Katherine Baril, project manager of the Sequim Bay Water Quality Project. "This allowed us to avoid the traditional--and perhaps more adversarial--methods of analysis originally used to evaluate industrial sources of pollution.

"In this way, we could begin to look at common contributors and common solutions. For example, instead of looking at agriculture or forestry as a problem to be fixed, we recognized that all sectors of the community were potential contributors of bacteria, sediment, and other forms of nonpoint pollution. At the same time, we realized that there were certain things we all wanted--viable industries, open space, and good stewardship in our watershed."

At this stage, it may not be necessary to quantify pollutant loadings from specific sources. To keep momentum, the stakeholders might do better to agree that multiple sources

contribute to the problems rather than focusing blame on one or two sources (see Highlight 5, Sequim Bay, Washington).

Table 5-1 summarizes pollutants or stressors that may cause watershed impairments and their most likely sources (adapted from EPA, 1987). Nontraditional stressors such as habitat loss are not as well documented as chemical pollutants, but are the subject of recent investigations. See, for example, *Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy* (National Research Council, 1992) and *Entering the Watershed* (Doppelt et al., 1993).

Monitor Baseline Water Quality

Lack of baseline water quality data has been a problem in past watershed projects. If adequate data are not collected prior to implementation of a watershed action plan, the project team may be unable to document the improvements that result from controls or restoration. Therefore, baseline monitoring should begin during the early planning and goal-setting process.

Table 2. Sources and Causes of Water Quality Impairment

Pollutant or stressor	Possible sources
Sediment	Cropland Forestry activities Pasture Streambanks Construction activities Roads Mining operations Gullies Livestock operations Other land-disturbing activities
Nutrients	Erosion and runoff 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 (forest, pastures, urban/suburban areas, golf courses, waste disposal sites) Sites of historical usage (chlorinated pesticides) Urban runoff Irrigation return flows
Altered flow regime or habitat modification	Impoundments Urban runoff Artificial drainage Bank destruction Riparian corridor destruction

If possible, a water quality monitoring program should extend through the life of the project in a continuum that includes:

Baseline monitoring to show water quality conditions prior to implementation of controls

Interim and post-implementation monitoring to show effectiveness of individual controls and the overall watershed project.

Baseline monitoring programs are watershed-specific, and involve principles of monitoring design that are discussed in various texts and EPA publications such as:

Watershed Monitoring and Reporting for Section 319 National Monitoring Projects (EPA, 1991b)

Rapid Bioassessment Protocols for Use in Streams and Rivers (Plafkin et al., 1989)

Draft Surface Water Monitoring Program Guidance (EPA, 1990a)

Monitoring Guidance for the National Estuary Program (EPA, 1992b)

Draft Nonpoint Source Monitoring and Evaluation Guide (EPA, 1988)

Methods for Evaluating Stream Riparian and Biotic Conditions (Platts et al., 1983)

Appropriate Designs for Documenting Water Quality Improvements from Agricultural NPS Control Programs (Spooner et al., 1985).

In general, baseline monitoring (a) measures concentrations and loadings of the pollutants in main stems and tributaries prior to the implementation of controls; (b) includes biological monitoring (typically, for fish and macroinvertebrates) and habitat assessment; and (c) measures edge-of-field loadings in some areas where controls will be installed.

Some baseline monitoring sites should be selected to detect watershed-wide changes in water quality over time. Planners may make judgments about sites that will be useful in before-and-after analyses to show the effectiveness of controls--e.g., sites downstream of areas where stringent point source permit limits will be imposed or where BMPs will be installed. Before-and-after monitoring is often effective where point sources are involved, but can be difficult to implement for nonpoint sources. As discussed in Highlight 6, unless planners know exact locations where nonpoint source controls will be installed, a paired sampling approach may be more effective. Paired sampling sites are selected on separate small watersheds or catchments. Ideally, the two sites are in close proximity and have similar land uses, drainage area, hydrology, and other characteristics. Upstream of one paired site, however, controls will be installed, while the other site will not receive

additional controls. Automatic samplers and flow measurement devices are often used on both sites.

Watershed project managers should coordinate all monitoring with State-level monitoring programs, both to ensure compatibility of methods and to take advantage of state monitoring resources. While state agencies may not have sufficient resources to do intensive monitoring for every watershed project, monitoring stations and protocols may already be established under programs such as the following:

Fixed-station and rotating-station monitoring networks (e.g., under a statewide watershed approach of the state water quality agency)

Intensive surveys developed under point source wasteload allocation or nonpoint source programs

Fish community sampling by the state fish and game agency.

Highlight 6

Monitoring in the Galena River Priority Watershed Project

The Wisconsin Department of Natural Resources (WDNR) has delineated 330 watersheds for its statewide nonpoint source program. Approximately one-fifth of the watersheds are targeted for priority watershed projects. Each of these projects includes evaluation monitoring to assess water quality improvement.

The Galena River Priority Watershed is a 154,800-acre watershed with largely agricultural land uses--row crops and beef and dairy farming. Early in the project, WDNR assumed that the level of landowner participation in BMP cost-sharing would be high and that measuring improvements in surface waters would not be a problem. Mainly biological data were collected at random sites throughout the watershed prior to installation of BMPs. The plan was to return to these same sites following BMP installation to collect data for comparison to pre-project data.

Unfortunately, the level of landowner participation was much lower than expected, and the original monitoring strategy was not successful. A paired-site monitoring approach was then adopted to ensure that the effects of BMP implementation were being measured and to account for meteorologic and hydrologic variability (Spooner et al., 1985). Paired monitoring sites were selected, one on a stream with installed BMPs and the other on a nearby stream without BMPs. The paired streams had similar landscape, flow, gradient, temperature and habitat features.

Monitoring included water chemistry, macroinvertebrates, habitat, and fish community sampling. In the paired sites, each type of data indicated at least slightly better conditions at the managed sites (downstream of BMPs) than at the unmanaged sites.

Source: Kroner et al., 1992

Decide to Take Action

The project team may never be able to gather enough data to satisfy all technical participants or to convince all stakeholders that a problem exists. At some point the team decides to proceed with the project based on best judgment, allowing flexibility for mid-

course corrections later on. Following are some clues that the time has come to move on to goal-setting and developing a watershed action plan:

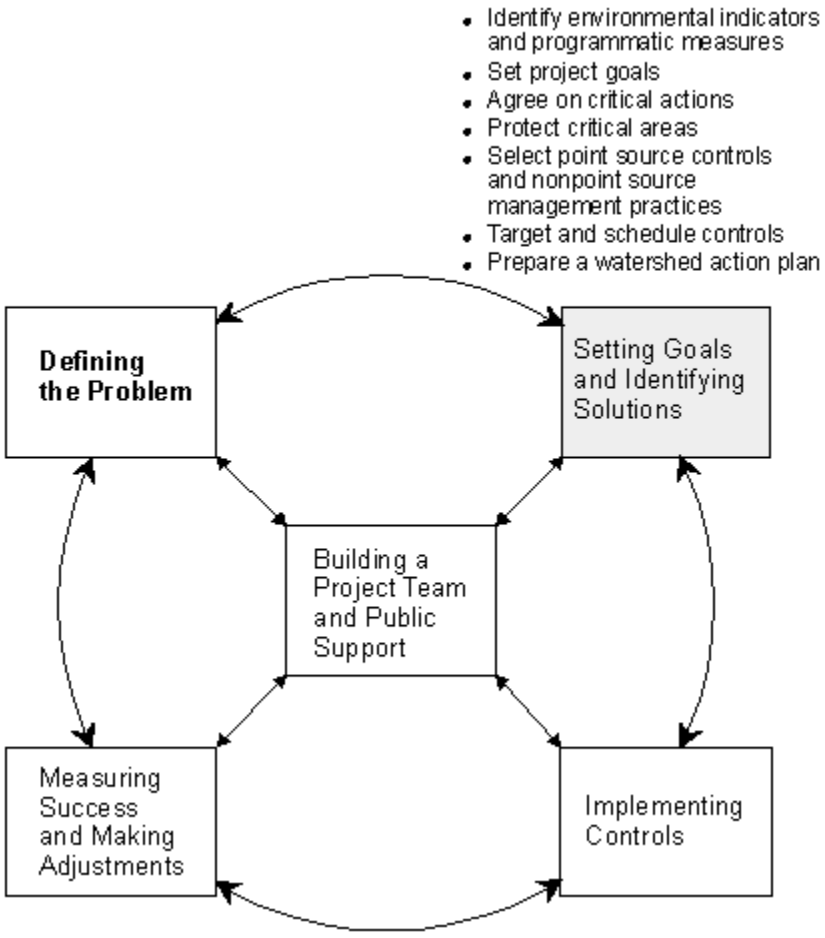
Technical experts believe that all significant problems in the watershed are known--problems in physical/chemical water quality, biological communities, instream and riparian habitat, and other factors required to meet designated uses.

If these problems were solved, ecological integrity of aquatic systems in the watershed could be achieved.

The nature of these problems is understood well enough that environmental indicators can be chosen to track progress in cleaning them up.

Sources of the problems are known or can be readily determined.

Chapter 6: Setting Goals and Identifying Solutions



This chapter describes activities that result in specific goals and objectives for the watershed project and the selection of management measures to achieve these goals. The end product of these activities is usually some form of action plan for the watershed.

Identify Environmental Indicators and Programmatic Measures

Environmental indicators are measures that can be used to characterize a particular watershed's condition and improvement (i.e., how well a watershed project is meeting its goals and objectives). By identifying the universe of potential indicators before setting goals, planners will ensure that no key aspect of the watershed's ecological and human health and welfare is overlooked.

Environmental indicators can range from measures of administrative or programmatic accomplishments (e.g., the number of TMDLs developed or BMPs implemented) to measures of true environmental improvements (e.g., the maintenance over a specific time period of healthy, reproducing populations of fish, macroinvertebrates, aquatic vegetation, and terrestrial wildlife). Agencies and the public are most interested in direct measures of a watershed's condition; however, in the early years of a watershed project measures usually will include a mix of direct environmental indicators and programmatic measures.

Table 6-1 shows one way of categorizing environmental indicators, along with examples (adapted from Urban Institute, 1992). Indicators in Table 6-1 represent a continuum from administrative or programmatic measures in the top row to direct measures of ecological health in the bottom row. EPA's Office of Water is currently working to develop a set of national environmental indicators for human health and ecological protection.

Set Project Goals

Identify Potential Solutions for Each Type of Water Quality Problem in the Watershed

Before Setting overall project goals (discussed below), it is useful to identify potential solutions for each type of problem identified in the watershed. This identification of problems and solutions will facilitate an exchange of ideas and make sure that no options are overlooked. For example, many people are oriented toward structural controls such as wastewater treatment systems or certain BMPs. But in reality, comprehensive watershed protection often requires structural BMPs *combined with* public education, economic incentives and, in some cases, regulations, land use controls, or habitat restoration.

Table 3. Examples of Environmental Indicators

Description of Indicator Type or Category	Examples of Indicators
Document the extent to which programmatic and regulatory actions have been taken	Number of permits reissued with new limits Number of point sources in substantial noncompliance Elapsed time from identification of serious discharge violations until correction Number of targeted facilities/properties that

	have implemented BMPs Amount of fertilizer sold or used Number of estuary acres monitored Number of communities enacting zoning or stormwater management ordinances Number of public water systems with source water protection Number of public outreach activities and citizens reached
Quantify the extent to which actions have led to reduction in threats to surface or ground water quality	Reduction in nutrient loadings from each type of point and nonpoint source Reduction in pollutant loadings to ground water from underground injection wells Stability and condition of riparian vegetation Percent imperviousness upstream General erosion rate upstream Amount of toxicants discharged in excess of permitted levels Amount discharged by spills; number of businesses and households that have altered behaviors or processes to reduce pollutants
Measure the extent to which ambient water quality has changed	Pollutant concentrations in water column, sediments, and ground water Frequency, extent and duration of restrictions on water uses--bathing, drinking, fishing, shellfishing Percent of stream miles or lake or estuary

	acres that support each designated use Percent with impaired or threatened uses Percent of citizens who rate major water bodies as usable for various recreational activities
Measure direct effects on the health of humans, fish, other wildlife, habitat, riparian vegetation, and the economy of the region	Aquatic community metrics Reductions in waterborne disease in humans Size of wetlands or riparian habitat lost or protected Size of commercial and recreational fish harvest Increased jobs and income due to recreation

Develop Overall Project Goals

Next, the project team should develop a set of general goals reflecting a vision of the watershed in 10 to 20 years. Each goal should be backed by specific and quantifiable objectives that use environmental indicators to express the degree to which pollution must be prevented or controlled by given dates. Examples of watershed goals and objectives include:

- Eliminate all fish consumption advisories in the watershed within 10 years
- Reduce or eliminate incidence of blue-green algal blooms in a lake: reduce total phosphorus concentrations by 30 percent; maintain lake transparency as measured by Secchi disk depth at a seasonal mean of 2 feet
- Reduce edge of field sediment delivery by 50 percent and nutrient and agrichemical use by 20 percent in the watershed (USDA Sycamore Creek Watershed Hydrologic Unit Area [HUA], Michigan)
- Reduce the number and levels of contaminants present in public drinking water supplies.

- Stabilize 70 percent of the mileage of eroding stream banks in the watershed to prevent sedimentation downstream
- Eliminate the "supporting uses but threatened" classification by reducing sediment inputs to the main stream by 50 percent and reducing nitrogen concentration from 13 to 4 mg/L (Herrings Marsh Run Demonstration Project, North Carolina)
- Protect from degradation all remaining stream reaches with undamaged habitat and balanced aquatic communities
- Restore habitat in specified lakes and streams so they will support a reproducing game fish population
- Provide 100-foot riparian buffers along 20 miles of stream to lower water temperatures, provide wildlife corridors, and increase recreation
- Reduce the potential for nitrate and pesticide contamination of ground water (USDA Upper Tippecanoe River Watershed HUA, Indiana)
- Achieve biological standards for macroinvertebrates and fish in all streams in the watershed
- Develop TMDLs for nitrogen, phosphorus and sediment in the watershed.

The goals of the Anacostia River Restoration Program are shown in Highlight 7. Highlight 8 presents selected goals and objectives from the Klamath River Basin Restoration Program.

Set Interim Goals

Once overall project goals are determined, it is also useful to develop a series of interim goals that will document progress at each step of the project. The reason for establishing interim goals is that overall water quality goals--such as major improvements in achievement of designated use -- may be impossible to document in less than 5 to 10 years (or more for larger water bodies). In the meantime, administrative and interim water quality goals can be used to measure progress toward success:

Program Goals are goals for changes in the policies of agencies or other organizations. As an example, a goal for the agency responsible for road construction might be to require that runoff from all new roads discharge into buffer zones or detention ponds rather than directly to streams.

Activity Goals are those actions that will be taken by various participants. These goals are often expressed in terms of the number of activities to be accomplished--e.g., "the Department of Health will conduct 3 seminars for county sanitarians on proper septic tank installation" and "sanitarians will monitor performance of all new septic tanks in the watershed."

BMP Goals define which pollution control measures or other environmental improvement practices will be put in place, and where. BMP goals can be set for structural or nonstructural measures. These goals must relate to the pollutant or problem of concern, e.g., "stabilize and revegetate with native plants 3 miles of stream banks on Washout Creek adjacent to fields planted in soybeans" is a goal for stream bank protection and control of sedimentation.

Interim Water Quality Goals can sometimes be set where activities will produce improvements in the early years of the project. For example, installation of a new wastewater treatment facility or a change in land use may enable the rapid achievement of water quality standards in a portion of the watershed. Similarly, removal of instream barriers to fish passage may bring about rapid return of fish populations.

Highlight 7

Goals of the Anacostia Watershed Restoration Committee

The Restoration Committee set the following goals in a 1987 agreement:

Dramatically reduce pollutant loads in the tidal estuary to measurably improve water quality conditions by the turn of the century through: sewage overflow controls, urban stormwater retrofits (ponds, marshes, and filter systems), urban BMPs for new development, and control of trash and debris.

Protect and enhance the ecological integrity of urban Anacostia streams to enhance aquatic diversity and provide for a quality urban fishery through: urban stream restoration (channel and stream bank restoration) and stream protection (land use controls and BMPs within sensitive watersheds).

Restore the spawning range of anadromous fish to historical limits through removal of fish barriers and habitat improvement.

Increase the natural filtering capacity of the watershed by sharply increasing the acreage and quality of tidal and non-tidal wetlands through: wetlands protection (no net loss of wetlands in the watershed), urban wetlands restoration, and urban wetlands creation (several hundred acres).

Expand the range of forest cover throughout the watershed and create a contiguous corridor of forest along the margins of its rivers and streams through: forest protection, watershed reforestation and riparian reforestation (10 linear miles along the Anacostia in 3 years as a first step).

Make the public aware of its key role in the cleanup of the river and increase volunteer participation in watershed restoration activities.

Source: Metropolitan Washington Council of Governments, 1992.

Highlight 8

Goals and Objectives of the Klamath River Basin Restoration Program

The Klamath River Basin was once one of the most productive anadromous fish spawning areas on the West Coast. Physical barriers, habitat destruction, and pollutant loads have severely damaged this important commercial and tribal fishery. The long-range plan of the Klamath Restoration Program uses a "step-down" approach with specific goals, objectives, and policies or project priorities. Following is an example of a goal and a single objective under this goal.

Goal 1:

> Restore, by 2006, the biological productivity of the basin in order to provide for viable commercial and recreational ocean fisheries and in-river tribal (subsistence, ceremonial, and commercial) and recreational fisheries.

Objective 1: Protect stream and riparian habitat from potential damage caused by timber harvesting and related activities.

> Improve timber harvesting practices through local workshops; develop habitat protection and management standards for agency endorsement; create a fish habitat database; view existing regulations as minimum expectations
>
> Contribute to evaluating the effectiveness of current timber harvest practices through: developing an index of habitat integrity; incorporating fish habitat and population data into state water quality assessments; monitoring recovery of habitat in logged watersheds
>
> Promote necessary changes in regulations--State Forestry Practice Rules; Forest Service Policies in Land Management Plans, BMPs
>
> Anticipate potential problems by requesting additional state monitoring programs and by modifying State Forest Practice Rules and Forest Service plans to protect highly erodible soils and give priority to protection of unimpaired salmonid habitat.

Source: Klamath River Basin Restoration Program, 1991

Agree on Critical Actions

With a number of water quality problems, goals, and solutions to choose from, and limited funds, how does one decide which actions to take and in what order? Dealing with one source of pollution at a time (e.g., dairy runoff or urban stormwater) may seem to be the simplest approach, especially if the agencies and groups represented on the project team tend to specialize in one type of land management activity. This approach also allows easier documentation of progress in installing controls or changing behavior. The problem is that the "one problem at a time approach" rarely results in clean water! Typically, when one problem is fixed, other problems masked by the first problem become evident; the public gets disillusioned, and support for the project evaporates.

Successful watershed projects address all key sources of pollution at the same time. Not only does this approach make sense ecologically, it also makes good political sense--treating all significant sources diffuses the "blame" for pollution problems among many responsible segments of society. Less time is wasted arguing over who is more to blame when all agree they are part of the problem.

The project team should strive to emphasize certain problems that present greater risk to human health and the ecological health of the watershed. From lists of pollutants and sources and simple calculations of pollutant loads, some sources or types of pollution may be seen to contribute relatively high loadings of the targeted pollutants. Review of cost data will show that some management measures are more cost effective, and discussions with agency professionals will show that some measures are more effective in controlling pollutants than others.

At this point, brainstorming sessions are recommended to list "what if" scenarios involving different control measures and to get an idea of how one measure effects others. For example, some members of the project team may want to require nutrient management plans of all agricultural land owners, while missing the impact of lawn fertilization by urban dwellers. Such brainstorming sessions can help clarify what can be achieved without adversely affecting the community. Some projects prove too complex or controversial at this point. However, it is important to identify all political, social, and technical challenges before committing any money for solutions that might never be acceptable in a watershed.

Predictive tools such as watershed models are also available for estimating the relative effectiveness of watershed management strategies (e.g., EPA, 1992c; RTI, 1994). Using all available data and tools and professional judgments, decide upon the critical actions that would be the most effective ways to meet each of the specific goals of the project.

Most important, ensure that the agencies, local governments, citizen groups, and others who will be responsible for the selected management actions are capable of and willing to complete the actions.

Protect Critical Areas

Point and nonpoint source controls alone often may not result in achieving a watershed's goals for ecological integrity. A high percentage of our Nation's watersheds have experienced major changes in land use and, consequently, aquatic habitats have been damaged and biological communities have been compromised or lost. Undamaged habitat and fully functioning aquatic communities may remain in only a small number of places in a watershed--areas that are large enough to maintain viable populations of biologically diverse communities and small, isolated patches of habitat that are able to support some portion of their original biological communities. These critical areas may include headwater streams and portions of larger streams that have been protected by land ownership but may be subject to development pressures in the future.

Because such sources of biodiversity may provide the best hope for repopulation of watersheds with balanced aquatic communities, the protection of remaining critical areas or refuges should have a high priority when implementing watershed projects. This type of protection, which may be carried out through local land use regulations for protecting riparian buffers and flood plains or the purchase of conservation easements, can be more cost-effective than solving future problems after they occur.

Some resources in a watershed may be of such importance as to warrant special attention when implementing watershed projects. Such resources would include public water supplies and valuable ecosystems. Critical areas of sufficient size to adequately ensure the integrity of important resources can be delineated and managed. For example, source water protection areas, because they are delineated to protect ground water and surface water sources of drinking water, are obvious candidates for critical area designation (see Highlight 9, Nantucket, Massachusetts).

The bibliography in Chapter 9 includes references on protecting critical areas and on ecological restoration.

Highlight 9

Nantucket's Water Resource Protection Areas

In response to a variety of threats to Nantucket's water supply, the Nantucket Land Council, a private, non-profit organization, commissioned the development of a water resource management plan. Activities under the plan included the delineation of 12 water resource protection areas as areas designated for priority protection. Among these areas were wellhead protection areas for the island's two principal public water supply wells, a larger aquifer protection area designated as a source of future water supplies, and the drainage areas for coastal and freshwater ponds. The designated areas will be protected by a combination of regulatory and non-regulatory measures, including overlay zoning districts that regulate land uses, subdivision and wetlands regulations, on-going water quality monitoring, and public education campaigns on the residential use of lawn fertilizer and household chemicals.

Select Point Source Controls and Nonpoint Source Management Practices

Pollution control measures for both point sources and nonpoint sources benefit society as a whole but often do not provide an economic benefit to the individual or organization that installs them. Point source dischargers are used to this situation. Selecting management measures for nonpoint sources is apt to lead to contention, with some arguing for the least costly methods and others for the most effective regardless of cost. Many watershed projects rely upon voluntary implementation of BMPs, and incentives must be provided to encourage installation. The situation is further complicated by the difficulty in determining which measures really are most effective in protecting water quality.

EPA's Office of Water has prepared a major compendium of nonpoint source controls, *Guidelines Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (EPA, 1992d). This document describes appropriate management measures and management practices for each major category of nonpoint source (agriculture, forestry, urban, etc). A management measure is an economically achievable system of nonpoint source control practices that reflects the greatest degree of pollutant reduction achievable. States with coastal management programs are required to implement these management measures; states are not required to implement specific management practices (often called BMPs), but watershed project teams may choose to do so. Example management measures and practices are given in Table 6-2.

For purposes of this *Project Focus* document, the term BMP applies to any type of nonpoint source management practice (structural, nonstructural, vegetative). There is a tendency for projects to select the most "palatable" measure (e.g., those BMPs most likely to be implemented on a voluntary basis). Unfortunately, at the end of some watershed projects the primary water quality problem has not been solved even after BMP-type goals have been achieved or exceeded. This can occur for many reasons; e.g., the water quality goal was inappropriate; the wrong BMPs were selected; BMPs or restoration techniques were installed in the wrong places.

Selection of BMPs is a site-specific activity and is beyond the scope of this document. The project team should rely on its own expertise, but should also seek advice from those who have faced these challenges in similar watersheds. Outside expertise may be especially important when nontraditional stressors such as aquatic habitat loss are involved. Following are some items to consider when choosing management practices (see also Highlight 10):

Evaluate the land use in the watershed. Is it likely to stay the same or change drastically because of changing economic or social conditions?

Realize that there are several types of management practices including structural, vegetative, and nonstructural (e.g., conservation tillage). The key to effective pollution control often is to use them in concert with education and, if appropriate, regulation. A single type of management practice is seldom sufficient to solve a watershed's problems.

Consider protecting buffer zones around receiving waters as a last line of defense between sources and water bodies. The U.S. Forest Service provides specifications in Riparian Forest Buffers: Function and Design for Enhancement in Water Resources (Welsch, 1992). A forest buffer less than 100 feet wide can protect water quality and enhance aquatic habitat.

Review published information about BMP design, installation, and effectiveness and obtain help from technical experts on the project team. See the bibliography in Chapter 9 for sources of information. Also refer to SCS Field Office Technical Guides (county-level) for watershed-specific information.

Prioritize the measures available for each source and pollutant/stressor and decide which should be implemented first. This decision should be based on the estimated water quality effectiveness of the measure as well as its cost.

Select priority BMPs and other measures for each source and pollutant/stressor of concern in the watershed so that they may be installed simultaneously.

Consider innovative approaches that link point and nonpoint source management, e.g., pollutant trading.

Table 4. Example Nonpoint Source Management Measures and Practices

Type of Nonpoint Source	Example Management Measure	Corresponding Management Practices
Confined Animal Facilities (small units)	Design and implement systems that collect solids, reduce contaminant concentrations, and reduce runoff to minimize discharge of contaminants in both facility wastewater and in runoff from up to a 25-year, 24-hour storm. Reduce groundwater loadings. Manage stored runoff and accumulated solids through an appropriate waste utilization system.	Waste storage ponds Waste storage structure Waste treatment lagoons Filter strips Grassed waterways Constructed wetlands Dikes Diversions Heavy use area protection Lined waterway/outlets Roof management systems Terraces Composting facility
Forestry	Streamside Management Areas (SMAs) Establish and maintain a streamside management area along surface waters, which is sufficiently wide and which includes a sufficient number of	Generally, SMAs should have a minimum width of 35 to 50 feet, increasing according to site-specific factors (e.g., slope, class of watercourse, depth to water table, type of soil and vegetation, and intensity of management)

	canopy species to buffer against detrimental changes in the temperature regime of the water body to provide bank stability, and to withstand wind damage. Manage the SMA in such a way as to protect against soil disturbance in the SMA and delivery to the stream of sediments and nutrients generated by forestry activities, including harvesting. Manage the SMA canopy species to provide a sustainable source of large woody debris needed for instream channel structure and aquatic species habitat.	Minimize disturbances that would expose the mineral soil of the forest floor. Do not operate skidders or other heavy machinery in SMA Locate all landings, sawmills, and roads outside the SMA Restrict mechanical site preparation in the SMA; encourage natural revegetation, seeding, and hand-planting Limit pesticide and fertilizer usage in the SMA. Buffers for pesticide application should be established for all flowing streams Directionally fell trees away from streams to prevent slash and organic debris from entering the water body Apply harvesting restrictions in the SMA to maintain its integrity
Agricultural Land (cropland, range and pasture, orchards, specialty crops, etc.)	Erosion and Sediment Control Management Measure Apply the erosion component of a Conservation Management System (CMS) as defined in the Field Office Technical Guide of the U.S. Department of Agriculture - Soil Conservation Service (See Appendix A of this chapter) to minimize the delivery of sediment from agricultural lands to surface waters, or	See EPA 1992d for detailed descriptions of these) Conservation cover on land retired from production Conservation cropping sequence Conservation tillage Contour farming Contour orchard an other fruit areas

	Design and install a combination of management and physical practices to settle the settleable solids and associated pollutants in runoff delivered from the contributing area for storms of up to and including a 10-year, 24-hour frequency.	Cover and green manure crop Critical area planting on highly erodible or critically eroding areas Crop residue to use to protect cultivated fields during critical erosion periods Delayed seed bed preparation Diversion Field border Filter strip Grade stabilization structure Grassed waterways Grasses and legumes in rotation Sediment basins Contour strip-cropping Field strip-cropping Terrace Water sediment control basin Wetland and riparian zone protection

Source: EPA, 1992d

Highlight 10

Watershed-wide Controls in the Anacostia

Water quality problems in the Anacostia are attributed to urban sources such as combined sewer overflows, stormwater runoff, and erosion from construction sites. In addition, widespread habitat destruction has occurred due to increased peak flow rates, channelization, sedimentation, and barriers to fish movement.

Efforts in the first few years of the Anacostia Restoration Program have focused on beginning improvements in nine priority sub-watersheds. Within each priority sub-watershed, a Sub-watershed Action Plan (SWAP) is prepared as a blueprint for restoration activities. SWAPs are prepared with input and participation of all local, State, and Federal agencies with an interest in the sub-watershed, and each plan is unique.

SWAPs typically detail the locations and timing of a combination of measures--retrofitting of urban stormwater controls to modern designs that reduce pollutant loads, improvements to instream habitat, and restoration of wetlands or riparian buffers. Early projects in sub-watersheds are described below:

Sligo Creek Sub-watershed (Wheaton Branch)--construct an extended detention pond/marsh system to remove pollutants and reduce magnitude of destructive flood events. Downstream, stabilize banks and create structural habitat instream using boulders, notched log drop structures to create pools, stone wing deflectors to create riffles; also, reforest the flood plain.

Indian Creek Sub-watershed--retrofit an existing dry stormwater facility to create a dry, extended detention facility to control runoff from 1.65 square miles.

Paint Branch Sub-watershed--Restore the main stem portion of Paint Branch including riparian reforestation and a series of in-stream fish habitat improvements, initially involving 2000 linear feet of stream.

Sources: Metropolitan Washington Council of Governments, 1990

Target and Schedule Point and Nonpoint Source Controls

This is the "heart and soul" of the developing watershed action plan. It involves reaching agreement to implement point source controls and nonpoint source management measures within a certain time frame. These practices include critical BMPs and other control and restoration practices in particular areas (e.g., near critical aquatic habitat or in areas contributing the most pollutant loads). Management measures also may involve seeking local ordinances or redirecting agency resources and programs.

In this stage of the project, planners often fear that the agreements secured from stakeholders will evaporate. However, committing to a specific schedule is essential; allow additional negotiating time on this step to make sure everyone involved in the project is clear and in agreement to the extent possible.

Agencies and local government are the keys to this activity because they must agree to focus activities and funds on discrete areas. If agreement is difficult:

Seek to reach consensus on at least one critical redirected action for each agency and special interest group on the project team.

Encourage early (1 year) implementation of some measures by each responsible or designated agency or group. It is vital that the public know "that someone is finally doing something," and it is important that the agencies establish a precedent for action.

The project team may want to consider seeking "bad-actor" regulations at the local level at this point. In most watershed projects, individuals are given incentives (technical assistance, cost-share funds, tax advantages) to install certain BMPs. If the BMPs are not installed and it is determined by the local committee or agency that the property is still causing a water quality problem, then bad-actor regulations can require that fines or other penalties be assessed.

It is important to stress that watershed projects do not operate in a vacuum; management measures should be compatible with other water quality programs to the extent possible (e.g., statewide watershed management efforts).

Prepare a Watershed Action Plan

A watershed action plan documents everything that has been learned and agreed upon prior to actually implementing management measures. The primary topics are usually the watershed inventory, water quality problems and their sources, indicators, goals, agreed-upon actions, a funding plan, and commitments from participating agencies.

Some type of formal action plan is important because it clarifies for those outside the decision-making process (and even for the decision makers themselves) exactly what needs to be done in the watershed and how it will be accomplished. A useful side benefit of a plan is that affected parties (e.g., industrial dischargers, farm groups, urban developers) see that they are not the only individuals who are being asked to help improve water quality. Further, an action plan demonstrates to the public and political interests that there is a broad-based commitment to progress.

Local committees and agencies often do not have all the required expertise to prepare watershed plans. Some states provide technical assistance for watershed planning. Highlight 11 discusses efforts by state and federal agencies to provide support to local watershed committees in the State of Washington. Highlights 12 and 13 show contents of watershed action plans from Puget Sound and Wisconsin.

Highlight 11

Interagency Technical Assistance Teams in Puget Sound

In the Puget Sound basin, local committees seeking funding for watershed projects are required to prepare action plans for control of nonpoint sources. The Washington Department of Ecology (DOE) formed the Interagency Technical Assistance Team to support these committees. The team consists of representatives from over 20 State agencies with expertise in: Agricultural and forestry BMPs Technical transfer to the agricultural community Surface water quality monitoring and assessment Groundwater protection Stormwater management Shellfish protection Public involvement strategies Wildlife management Habitat protection.

In addition, a Puget Sound Cooperative River Basin Study Team was formed with representatives from the Soil Conservation Service, the Forest Service, the Washington Department of Fisheries, and DOE. This team helps evaluate land use water quality problems within watersheds through field and literature investigations, provides management alternatives, and produces reports and maps based on watershed information.

Source: Puget Sound Water Quality Authority, 1991.

Highlight 12

Developing an Action Plan

The Puget Sound Water Quality Authority's Nonpoint Rule requires watershed management committees to include, at a minimum, the following elements in their action plans:

A watershed characterization, including information such as watershed maps, geographic and biological information, and sources of data on the watershed.

A water quality assessment identifying nonpoint sources of pollution and evaluating water quality, beneficial uses, and the biological health of the watershed.

A problem definition indicating the extent of existing and potential water quality problems and effects on beneficial uses from nonpoint sources in the watershed.

Goals and objectives for prevention and correction of these nonpoint pollution concerns.

Specific source control programs to address the problems identified and justification for the management actions proposed in each of these programs. Source control programs can apply to stormwater and erosion, agriculture, on-site sewage disposal systems, forest practices, boats and marinas, and other nonpoint sources.

An implementation strategy identifying specific actions required, the responsibilities of each implementing agency or entity, and project milestones, costs, and funding sources.

Highlight 13

Black Earth Creek Priority Watershed Plan

The Wisconsin Department of Natural Resources (WDNR) works with other State agencies and local governments to target watersheds for intensive nonpoint source management. Once they have been targeted, Priority Watershed Plans are developed by local agencies in cooperation with WDNR.

The Black Earth Creek Watershed Plan was prepared in cooperation with the Dane County Land Conservation Department and approved by the County Board of Supervisors in 1989. Trout Unlimited, the Black Earth Watershed Association, USGS, and SCS also provided input to the plan.

Contents of the Priority Watershed Plan included:

- Letters of approval by agencies
- Introduction, purpose, and legal status
- Physical description of the watershed
- Water resources conditions, objectives, and control needs (by sub-watershed)
- Point sources
- Nonpoint source control activities
- Fish management and related activities (e.g., habitat protection)
- Coordination activities among agencies
- Detailed program for implementation
- Evaluation and monitoring program.

The bulk of the plan is a section on water resources conditions, objectives, and control needs. This section presents detailed information for each sub-watershed in the Black Earth Creek watershed. For example, in one sub-watershed, nonpoint source control needs include:

Cropland management--control erosion on 1,820 acres of land having high erosion rates

Stream bank management--control bank slumping on three small sites

Animal lot management--achieve a 79 percent reduction in phosphorus loading by

additional controls at six of the eight livestock operations

Manure management--prepare manure spreading management plans for the eight livestock operations

Cropland management--purchase and retire from crop production an area having high organic soils and excessive phosphorus losses

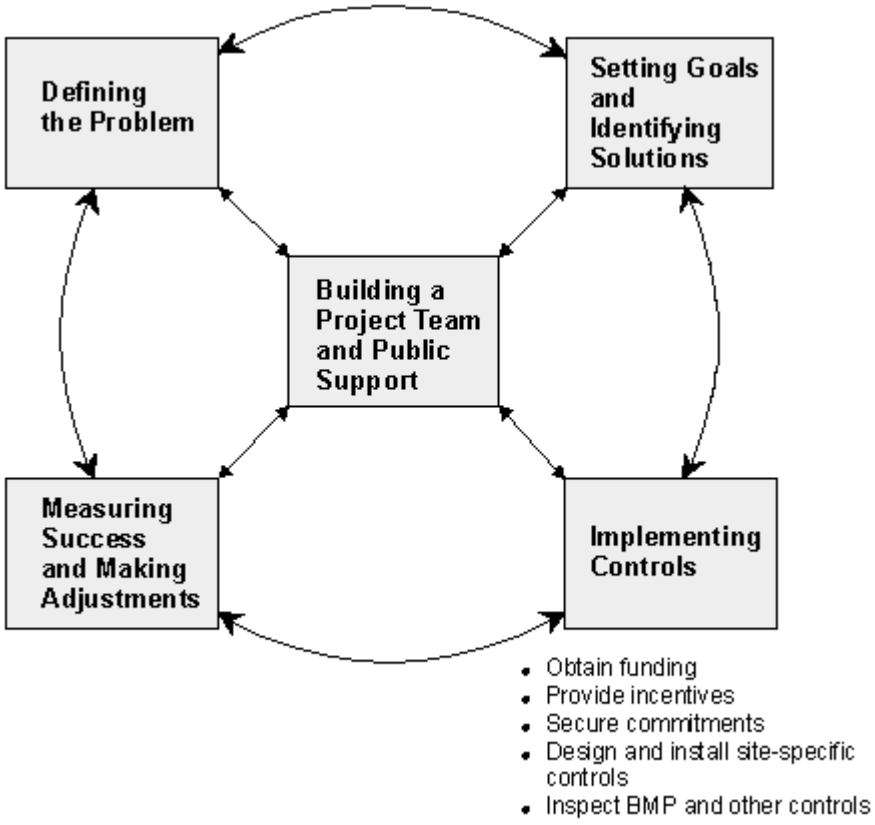
Urban lands management--have builders comply with existing construction regulations; ensure that new industrial development includes additional controls such as wet basins

Ground water protection--protect lands adjoining a major spring area via acquisition, rental, or easement

Fishery management--improve stream habitat (excessive sediment and aquatic vegetation) in a stretch of about 1 mile supporting a trout fishery.

Source: WDNR and Dane County Land Conservation Department, 1989.

Chapter 7: Implementing Controls



This chapter discusses implementing the controls and restoration activities called for in a watershed action plan. Implementing pollution controls is actually a two-stage process. The first stage is political--reaching agreement among participating organizations that there is a problem and that solutions exist, and achieving commitments from agencies and others to adjust their priorities to implement these solutions. The second stage is both technical and administrative--making sure that agreed upon actions are carried out; controls are designed, installed, and operated correctly; funds are accounted for properly; implementation is proceeding on schedule; the public is aware of the project's progress; and effectiveness monitoring is being done properly.

If the watershed project has a project manager, he or she is ultimately responsible for the success of these technical and administrative tasks, as well as for leading efforts to secure funding. The manager must be knowledgeable about environmental conditions in the

watershed; knowledgeable about point and nonpoint source controls and restoration measures; aware of the policies and missions of the various cooperating agencies, citizen groups, and local governments; and supportive of all programs that are part of the project (not just the easy-to-implement or high-profile ones). To acquire this unique combination of knowledge and skills, the project manager should have access to a network of other watershed project managers through professional conferences and ongoing training.

Obtain Funding

Few watershed projects come complete with sufficient federal and state funding for all phases of the project. Most of the activities discussed in this document require funding and often are funded by multiple sources. One way to organize the search for funds is to divide activities listed in the watershed action plan into categories, then to seek the type of funds that match each category. Not all activities require "cash" funding; some may be completed by the work of cooperating agency staff.

Fund raising is a time-consuming activity. Each type and source of funds has its own application criteria, procedures, and deadlines. Project managers must allow sufficient time and resources for acquiring funds and in-kind assistance.

Early in the project, or as part of the watershed action plan, it may be helpful to establish a schedule for obtaining funds and in-kind support for the entire project. The schedule should document, for example: possible funding sources, application dates, dates funding is needed, and work to be done to obtain funding. The schedule can be organized by funding categories: educate, plan, install, monitor, and enforce.

A complete discussion of funding mechanisms and their requirements would have to be state-specific and therefore is beyond the scope of this report. Some broadly available funding sources are listed below. In working to obtain funding, it is important to recognize that it is difficult to obtain sufficient funds initially to carry out an entire watershed project. The best approach is to begin with the available resources, do an exemplary job on initial tasks, and clearly document success. Additional funds tend to become available to projects that have shown results and are organized so that results can be carried forward. Further, many watershed projects are successful because, in addition to new funding, existing resources are maximized. Highlight 14 describes how resources are maximized for Anacostia River Restoration Projects.

State and local funding sources include:

State General Assembly appropriation

State income tax credit

Bonds--general revenue and special purpose

State taxes--income, sales, luxury

Grants

Easements

Lotteries

Loans

Fees--hunting/fishing licenses; NPDES permit fees.

Some federal funding sources are described in Appendix C. More complete coverage of funding sources can be found in *State and Local Funding of Nonpoint Source Control Programs* (EPA, 1992e) and *Watershed Protection: Catalog of Federal Programs* (EPA, 1993b).

Provide Incentives

In watershed projects, most nonpoint source controls are installed on private property, yet the effects of these practices often do not directly benefit the discharger or landowner. To ensure that controls are implemented, some type of incentive is usually provided by society. Various types of incentives available across the country are listed in Table 7-1.

For many years, cost-sharing has been viewed as the most effective method of securing landowner cooperation in a voluntary program. Cost-share rates have traditionally been set at 50 to 75 percent of the average cost of a BMP. State agriculture agencies and USDA agencies have extensive experience in implementing cost-share programs.

Evaluations of completed watershed projects have shown that:

Without vigorous, targeted, and effective education programs, technical assistance and cost-sharing alone often will not secure adequate BMP implementation

Regulatory programs can be effective. They often provide more equitable solutions and achieve clear results much faster than voluntary programs; however, regulatory programs that are poorly enforced or that do not contain effective education are only marginally more effective than voluntary cost-share programs.

The most successful projects appear to have used a mix of voluntary and regulatory incentives to achieve water quality results. The most effective of these offer variable cost-share rates, market-based incentives, and regulatory back-up coupled with support services (private and governmental) to keep the controls maintained and operating properly. Highlight 15 describes tax incentives in the Puget Sound area.

Table 5. Types of Incentives for Installation of Controls in Watershed Projects

Type of Incentive or Motivational Factor	Description of Key Factors
Education	Programs that target key audiences and tailor the message to the audience are most effective in eliciting a behavior change. Can include technical education about operation and benefits of controls.
Technical assistance	One-on-one interaction between the professional water quality staff and the affected citizen, with recommendations about BMPs appropriate for the specific site in question. Includes on-site engineering or agronomic work during the installation of BMPs.
Tax advantages	Can be provided through state and local taxing authorities or by a change in the federal taxing system that rewards those producers who install BMPs.
Cost-share to individuals	Direct payment to individuals for installation of specific BMPs (e.g., terraces) has been effective where the cost-share rate is high enough to elicit widespread participation
Cross-compliance among existing programs	Generally a type of quasi-regulatory incentive/disincentive that conditions benefits received on meeting certain requirements or performing in a certain way. Currently in effect through the 1985 and 1990 Farm Bills.
Direct purchase of riparian corridors or of lands causing the greatest problems	Direct purchase of special areas for preservation has been used extensively by groups such as the Nature Conservancy; community-owned greenbelts in urban areas are another variation. Costs of direct purchase are generally high but effectiveness can also be exceptional. Sometimes used to obtain control of critical areas whose owners are unwilling to install BMPs.
Nonregulatory site inspections	A site visit by staff of local or state agencies can be a powerful incentive for voluntary installation of BMPs.
Peer pressure	Social acceptance by one's peers can be a motivational factor for installation of BMPs by some individuals. For example, if a

	community values the use of certain agricultural BMPs, producers in those communities are more likely to install them.
Direct regulation of land use and production activities	Regulatory programs that are simple, direct, and easy to enforce are quite effective. Such programs can regulate land use (through zoning ordinances) or the kind and extent of activity allowed (e.g., pesticide application rates), or can set performance standards for a land activity (such as retention of the first inch of runoff from urban property).
Incentives from private enterprises	Watersheds with successful nonpoint source projects often are backed by private enterprises that support the implementation and operation of the recommended BMPs. These companies supply services and equipment that individuals cannot afford to own or acquire. Without these services or equipment there is a tendency to neglect BMP maintenance once the financial incentive expires. Some examples include: firms specializing in animal waste lagoon pumpout and land application, companies that specialize in prescribed burning for brush control and range management, and professional associations skilled in integrated pest management techniques.

Highlight 14

Securing Funding for Anacostia Restoration Projects

The Anacostia Watershed Restoration Committee annually seeks funding for many restoration projects. In FY91, more than 50 projects were funded by over a dozen local, state, and federal agencies. Funding sources are matched with appropriate watershed projects. In about half a dozen cases, special funding came from federal agencies (the Corps of Engineers, USDA, and EPA). The overwhelming majority of projects, however, involved a skillful coordination of existing sources of support from state and local governmental programs combined with additional help from nongovernmental organizations such as Trout Unlimited and from other citizen volunteers. The signatory agencies (the District of Columbia, Prince George's and Montgomery Counties, and the state of Maryland) fund most of the stormwater retrofit, monitoring, and demonstration projects and public participation activities.

A key element in maximizing resources from existing programs is the organization of special technical assistance teams for priority sub-watersheds. Sub-watershed Action Plan (SWAP) coordinators carry out public education and outreach efforts, but also assist in comparing management needs for their sub-watersheds with activities of local government. Because many of the problems in the Anacostia relate to urban stormwater runoff, many infrastructure projects can have a bearing on restoration needs. Where such infrastructure projects are identified, SWAP coordinators pursue ways to involve them in the Anacostia program and to obtain funding from them for retrofit and management objectives.

The Anacostia Watershed Restoration Committee is also in a position to coordinate with large-scale projects (and funding) by such stakeholders as the state of Maryland and the Corps of Engineers. Careful coordination with existing programs and resources is one key to the success of the Anacostia program.

Source: MWCOG, 1990.

Highlight 15

Tax Incentives in the Puget Sound Basin

Tax Incentives in the Puget Sound Basin

Several counties in Washington state have adopted open space tax plans to give citizens incentives to designate land for conservation. In Kitsap County, for example, landowners may be eligible for up to 90 percent tax reductions for voluntarily setting aside wetlands, stream corridors, and other sensitive areas on their property.

Source: Puget Sound Water Quality Authority, 1991

Secure Commitments

Two types of commitments are needed for effective watershed protection:

Commitments with the agencies, groups, and businesses that will be funding and carrying out programs that involve controls and restoration activities

Commitments with individuals, businesses, municipalities, etc., that will actually install the controls and other measures.

The fundamental question is "How do you make people honor their commitments?" The reality is that people and organizations often have different views on what constitutes "acceptable," and unforeseen circumstances sometimes alter the ability of participants to fulfill commitments. Two tools that have proven effective in securing (and keeping) commitments are formal written agreements and public accountability.

Formal agreements--To avoid disappointment and misunderstanding, agreements on all topics (no matter how trivial) are best documented in writing. Agencies often use a formalized process known as the Memorandum of Understanding (MOU) or Memorandum of Agreement (MOA) to document commitments and positions on certain topics. Such agreements should be specific as to the actions to be taken by each party, should include a conflict resolution process in the event of misunderstandings, and should include definitions of terms that may mean different things to different people.

Keeping the project moving often involves compromise--each participant agreeing to one or two small commitments without an accompanying increase in funding. Sometimes larger commitments follow after success has been demonstrated in meeting the smaller commitments.

Public accountability--One of the best ways to keep work focused on the watershed project's critical actions is through public accountability of all participants in the project. For example, once written commitments are secure, arrange to have periodic public meetings at which participants present detailed updates on the progress being made on each specific task.

Design and Install Site-specific Controls

The design and installation of *point source controls* is well-established after decades of wastewater treatment plant construction. *Nonpoint source controls, critical area protection,* and *habitat restoration measures* must be tailored to factors such as hydrology, geology, topography, soils, capability of the landowner, and resource to be protected. Discussion of specific controls is beyond the scope of this report, but a compendium of management practices for most categories of nonpoint sources is available (EPA, 1992d).

In addition, technical reports by federal, state, and local agencies are good sources of information on the design, installation, and operation of BMPs and restoration measures. Reports on appropriate control techniques are available from USDA agencies and state nonpoint source control agencies. Figure 6-1 lists a few references on the selection and installation of nonpoint source BMPs. In designing site-specific controls, technical support from agency experts is essential. For example, NRCS, state soil and water agencies, state agricultural agencies and land-grant universities have decades of experience applying agricultural BMPs.

Timing is also crucial--project teams should be sure to schedule enough time for this labor-intensive step. The availability of agency staff or contractors is often a limiting factor and planners must consider this factor when scheduling BMP or restoration measure implementation, especially in areas with a high seasonal demand for these services. Again, the project manager and committees should have access to reports and feedback from staff at other watershed projects that have dealt with similar technical and institutional issues. Each project team should be allowed to make its own mistakes, without repeating the mistakes already made by others.

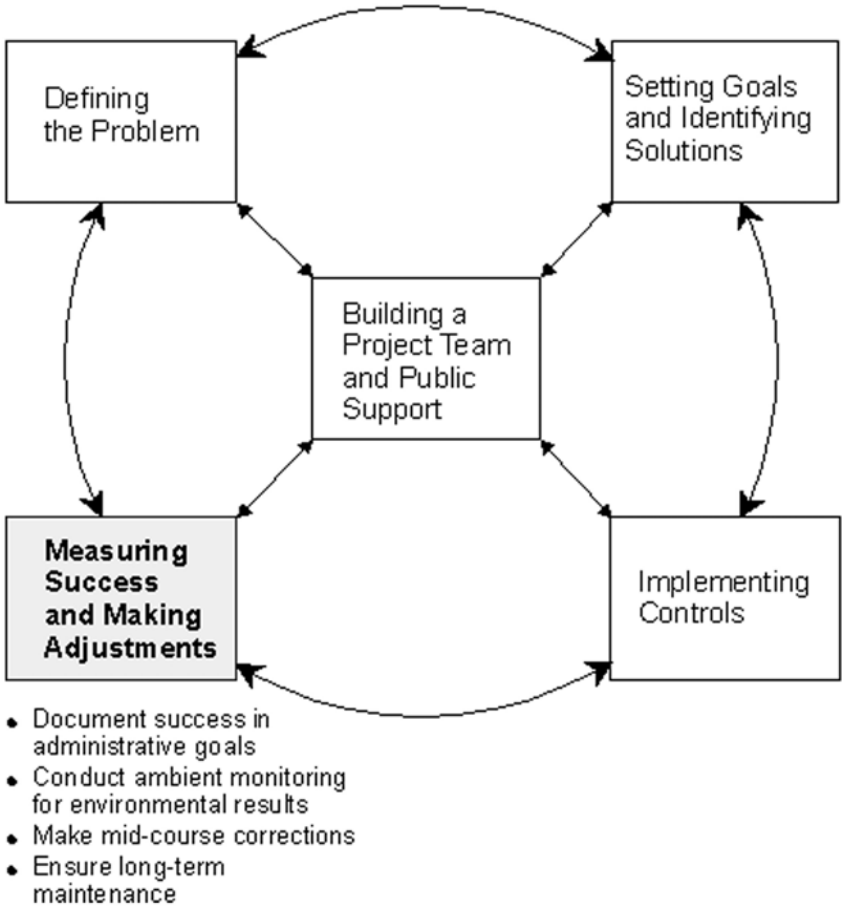
Inspect BMPs and Other Controls

Assuming the correct BMPs and other controls have been selected and are well designed, they will still be ineffective if not properly installed. In fact, poor installation can make matters worse by concentrating flow or causing some other hydrologic disruption. Inspection by qualified professionals during and after construction is therefore essential. In this regard, many nonpoint source control programs are inadequate and water quality problems persist unnecessarily. However, even professionals sometimes disagree as to the adequacy of BMP installation, so reaching agreement on what constitutes a properly installed and operated BMP or restoration measure and who will do the inspections is important.

In addition to post-construction approvals, a permanent inspection program is needed to ensure proper maintenance of controls. Most BMPs for urban and rural runoff are subject to severe loss of effectiveness if not properly maintained. For example, urban stormwater control structures require periodic unclogging and cleaning out of sediments and debris; lagoons for animal operations require removal of waste.

One approach that has worked well during forestry BMP inspections has been the formation of multidisciplinary, multiagency teams of government foresters, logging representatives, and biologists to randomly spot check BMP installation on all types of forest land (public, corporate and individually owned). At other times, each agency or industry checks BMPs within its normal jurisdiction. This type of quality assurance/quality control activity has two benefits: (1) it builds confidence in unbiased and equitable installation of BMPs; and (2) it serves as a way diverse individuals can arrive at a common definition of adequate BMPs.

Chapter 8: Measuring Success and Making Adjustments



This chapter discusses the importance of documenting the success of a watershed project and making mid-course corrections based on these measurements. Funding agencies, landowners, and the general public want to know that the goals of the watershed project will be achieved if they invest in pollution control and restoration. Proving effectiveness is one of the most difficult tasks in a watershed project.

Document Success in Administrative Goals

Progress in achieving goals must be reported clearly and regularly to sponsoring agencies and organizations and the public to stay on target, make the most efficient use of resources, and maintain public support. Of course, improving or protecting water quality

is the major goal in most watershed projects, but detecting trends in ambient water quality can take 10 years or more. In the meantime, administrative goals can be important interim measures of success.

Four types of administrative goals were outlined in Chapter 6: program goals, activity goals, BMP goals, and interim water quality goals. Following are several approaches that can be used to monitor results.

Type of Goal	Approach
Program goals	Periodic written reports, public meetings, and financial records (documentation of shifts in time and resources).
Activity goals	Simple tracking forms or data files for each responsible agency to report progress by activity (e.g., educational presentations, irrigation system evaluations, septic tank installation inspections).
BMP goals	Reports, maps and photographs of specific controls and restoration devices installed(e.g., animal waste lagoons, restored streambank, stormwater detention ponds).
Interim water quality goals	Qualitative and quantitative results of instream quality goals monitoring and BMP effectiveness monitoring. Trends in chemical or biological metrics can sometimes be dramatic (even if not at a high confidence level statistically). Visual documentation of water body improvements can also be convincing.

Highlight 16 discusses ways in which the Anacostia River Restoration Program communicates progress toward environmental goals.

Conduct Ambient Monitoring for Environmental Results

Water quality monitoring is done for several purposes during the life of a typical watershed project:

- to assess baseline conditions
- to detect trends in ambient (e.g., instream) water quality
- to measure the pollutant-removal efficiencies of controls
- to demonstrate the effectiveness of restoration measures
- to monitor the long-term maintenance of controls.

Highlight 16

Reporting Progress in Anacostia River Restoration

The Anacostia Restoration Program communicates progress through an excellent series of publications and through direct contact with the public. Examples include:

A detailed annual progress report, The State of the Anacostia, presenting results of the year's monitoring efforts, installation of CSO and stormwater controls, stream restoration projects, riparian corridor protection, public participation, and many other features. The reports are written for a lay audience with some science background. Selected pages from the 1989 Status Report are included in Appendix A of this document.

Slide presentations to civic associations, environmental groups, and community leaders by part-time coordinators in 9 sub-watersheds; the coordinators also lead stream walks and distribute literature

A series of sub-watershed educational documents, the first of which was "Restoring Watts Branch."

A quarterly newsletter devoted to restoration and citizen accomplishments in the watershed.

Source: MWCOG, 1990

Monitoring design is critical; however, a detailed discussion is beyond the scope of this document. Several references are listed in the bibliography (Chapter 9); below are several key considerations for monitoring in watershed projects.

It is not necessary to prove the effectiveness of every control device or restoration effort in the watershed. Rigorous monitoring of selected areas is better than widely scattered efforts. For example, the efficiency of certain BMPs may have been proven already in other, similar watershed studies; if so, monitoring resources can be best spent in other areas such as biological monitoring.

Because of cost, monitoring design should limit the number of parameters for study. These parameters are driven by the environmental indicators, goals, and quantifiable objectives of the watershed project.

Watershed monitoring should include physical and chemical parameters as well as more direct measures of aquatic health--measures of fish population and community structure, bottom-dwelling organisms (e.g., benthic macroinvertebrates), and habitat quality.

Regarding Item 3, most projects have a major goal of attaining aquatic life uses in their water bodies. Historically in watershed projects, physical and chemical parameters alone were considered sufficient to show this attainment--e.g., parameters such as water temperature and concentrations of sediment, dissolved oxygen, nitrogen and phosphorus. These are the typical parameters or pollutants controlled by wastewater treatment and nonpoint source BMPs. The Watershed Protection Approach, on the other hand, promotes a broader view--that ecological integrity is attainable when physical and chemical integrity and biological/habitat integrity occur simultaneously (Figure 8-1). Therefore, watershed monitoring should include biological and habitat measures of aquatic life in Item 3 above. Figure 8-2 lists some of the parameters used to measure aquatic health in the Anacostia Restoration Project, which has a progressive biological monitoring program. Highlight 17 relates monitoring in the Anacostia watershed to the program's goals.

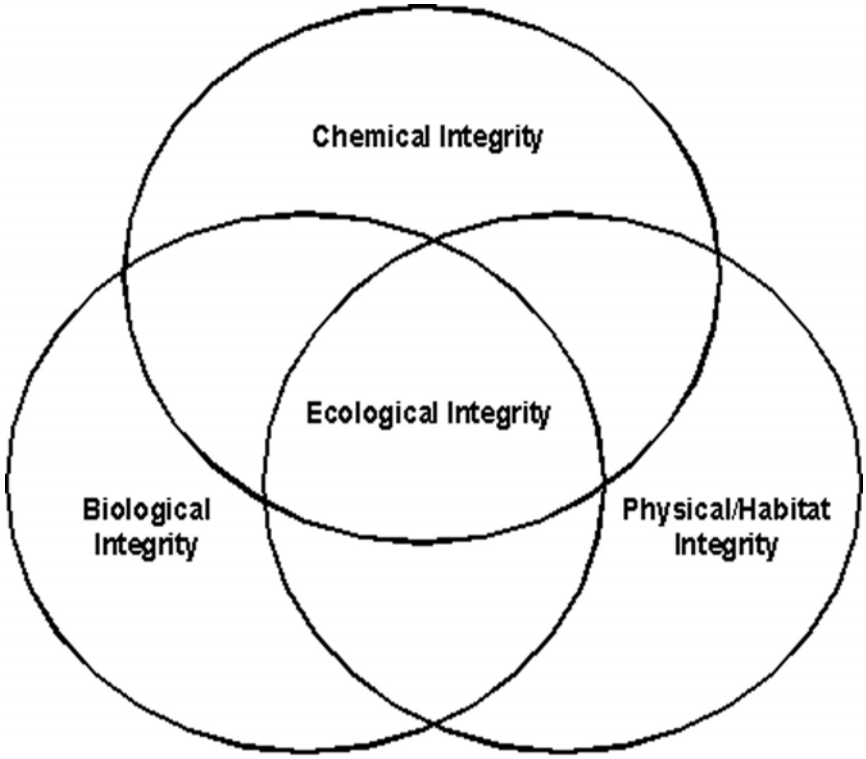


Figure 8-1. Elements of ecological integrity in aquatic systems (adapted from EPA, 1991c).

Routine physical and chemical sampling (grab sampling) is generally done at least monthly. Nonpoint source special studies often emphasize storm event sampling to measure effectiveness of controls. Storm event sampling is expensive, however, and in most cases requires installation of automatic sampling devices. Biological/habitat monitoring can be done much less frequently; seasonal or annual sampling is normally adequate. This type of monitoring does require the help of expert biologists, who are often available through state water quality and fisheries agencies and through universities.

Citizen Monitoring

Citizens can provide valuable support to the project by collecting water quality samples, identifying water quality problems, and gathering photographic documentation. Citizen monitoring programs have reached a new level of sophistication in recent years, including certification programs for volunteers and preparation of quality assurance

management plans. Citizen monitoring programs have also moved into the realm of biological monitoring with training from experts. Guidance and technical transfer information is available from EPA Headquarters (EPA, 1990b) and may be available at the state level. For example, the states of Kentucky, Illinois, Minnesota, and Texas have well-developed citizen monitoring programs.

Figure 8. Biological and habitat monitoring measures in the Anacostia River Restoration Project

Stream Habitat Measures	Bottom substrate/instream cover Embeddedness Flow Canopy cover Channel alteration Bottom scouring and deposition Pool-to-riffle ratio Lower bank channel capacity Upper bank stability Degree of bank vegetative protection Streamside cover Riparian vegetative zone width
Macroinvertebrate Measures	Taxa richness--total number of number of species or genera Hilsenhof Biotic Index--a measure of pollution tolerance of the organisms present Number of mayfly, stonefly, and caddisfly taxa (pollutant-intolerant insects) % contribution of the dominant taxon to total organisms Ratio of mayfly, stonefly, and caddisfly individuals to Chironomids (pollution-tolerant worms) Ratio of the number of detritus-shredding organisms to total organisms

	Ratio of scrapers to filter collectors--indicates relative dominance of particular feeding types
Fish Measures	Total number of species Number of darter, sculpin and madtom species (sensitive to siltation and oxygen depletion) Number of sunfish species Average size of principal gamefish Number of intolerant fish species Proportion of carp, white suckers, northern creek chub and blacknose dace (pollution-tolerant) Proportion of omnivorous/generalist individuals (increases as conditions deteriorate) Proportion of fish having disease/anomalies--depicts the health of individual fish

Highlight 17

Monitoring in the Anacostia Watershed

The Anacostia River Restoration Program conducts water quality monitoring in support of four of the program's six goals. Results are summarized both in technical publications and in detailed annual status reports for lay readers (e.g., MCOG, 1990). Following are some elements of the Anacostia monitoring effort as related to these program goals.

Goal 1 - Reduce pollutant loads Baseline water chemistry monitoring throughout sub-watersheds prior to BMPs or stream restoration activities Performance monitoring of nonpoint source controls (pollutant removal) Automatic sampling stations at the base of selected sub-watersheds to measure storm loads of phosphorus, nitrogen, sediment, organic carbon, trace metals and hydrocarbons
Goal 2 - Protect and restore ecological integrity of urban streams An annual water quality index based on 15 stations in the Coordinated Anacostia Monitoring Program (multiple agencies participate) Intensive biological and habitat surveys (baseline and post-implementation) of over 40 sites in selected sub-watersheds; generally follow EPA's Rapid Bioassessment Protocols for macroinvertebrates and fish Special studies of urban impacts (e.g., temperature effects of urbanization; watershed imperviousness vs. fish diversity)
Goal 3 - Restore spawning range of anadromous fish Monitoring of fish spawning runs Routine fish sampling
Goal 6 - Increase public awareness and participation Stream walks, photographic documentation of water quality conditions and habitat improvements

Make Mid-course Corrections

Midway through a watershed project, it is likely that at least one of the following problems will occur:

Monitoring indicates that the wrong problem is being solved

Solving one problem unmasks another problem that is more difficult to control

The project reaches some program or activity goals but may not be effective enough to reach the water quality goals

Quantifiable objectives (e.g., pollutant load reduction) were set too low to solve the problem.

These unpleasant realizations occur due to data gaps; most projects do not have access to extensive land use and water quality databases and mapping and modeling tools. It is important for the project team to recognize this possibility from the outset and to build into the project yearly evaluations and an agreed-upon halfway point where all aspects of the project can be revised if necessary. Highlight 18 presents mid-course corrections in the Rock Creek, Idaho watershed.

Citizens and funding agencies tend to feel misled if they are surprised to learn at the end of a project that it is not going to work out as planned, especially if someone has promised them a total solution. Regular evaluations can help detect problems early. Different groups should evaluate each portion of the project independently using the same evaluation criteria that were agreed upon before the project began. At a minimum, an annual meeting of all evaluators should be held to compare notes and reach consensus on:

Overall project performance

List of actions and controls that must be changed and the process and timetable to do so.

Evaluation questions that have helped other watershed projects make mid-course corrections include:

Are the correct controls/restoration measures being installed in the target areas first?

Are they being installed correctly and on schedule?

Do the controls appear effective?

What visual evidence is there to support this?

What do the water quality data show?

How are biological systems responding?

Are all cooperators meeting commitments for time, funds, labor, and other resources?

Highlight 18

Mid-course Corrections at Rock Creek, Idaho -- A Management Effort in Three Acts

Rock Creek is a tributary to the Snake River in an arid area of southern Idaho. The headwaters for Rock Creek lie in the Sawtooth National Forest, and the middle and lower reaches of the system feature intensive irrigation farming. Water is diverted from the Snake River, and the irrigation systems create the potential for impacts from irrigation return flows in addition to soil erosion and habitat alterations from cropping practices and livestock grazing.

Starting in the early 1980s, Rock Creek was the focus of a Rural Clean Water Program (RCWP) project with an active monitoring component. The RCWP period, which ended in 1991, can be viewed as the second of three "acts" in a long process of environmental improvements. Each stage overcame major pollution problems and paved the way for additional goals to restore fully the integrity of Rock Creek.

ACT I: Overcoming a Heritage of Neglect

By the 1960s, state and federal natural resource agencies began to document severe impacts from point source discharges and crop and livestock agriculture. Domestic rubbish and even car bodies were being dumped in Rock Creek. The fishery resource was in poor condition and fecal coliform levels showed frequent violations of public health standards. In the 1970s, most significant point source discharges were diverted to avoid the system, leaving agriculture as the main source of water quality problems.

ACT II: Applying BMPs to Agricultural Land Uses

By the late 1980s, 182 landowner management plans had been developed and implemented. Site-specific variations of nine agricultural BMPs were stressed including: permanent vegetative cover, animal waste control systems, conservation tillage, stream protection at critical erosion points, permanent vegetative cover on highly erosive areas, sediment detention and erosion structures, improved irrigation water conservation, fertilizer management, and pesticide management.

A well-designed monitoring program documented substantial reductions in the loadings of such parameters as phosphorus and suspended solids. Despite these gains, monitoring and bioassessment work showed that additional improvements were still needed to make sure the stream was safe for primary body contact recreation and to further lower sediment inputs to restore a self-sustaining salmonid fishery.

ACT III: Lessons Learned and Work for the Future

The final barriers to meeting the goals set forth under the RCWP project have to do with habitat conditions. The RCWP BMPs had focused on mitigating the impacts of agricultural land uses, and particularly the inputs of pollutants from the irrigation return flows. However, during monitoring, processes such as streambank erosion were found to contribute two to three times the sediment loadings as cropped land surfaces or irrigation ditches. To reduce these loadings, it will be necessary to carry out protection and restoration measures in the riparian zones. As the streambanks are stabilized and riparian vegetation cover is re-established, the fecal coliform concerns should also be ameliorated. Stakeholders in the RCWP project have pledged to continue the implementation of needed management measures. At the end of Act III, the goal of restoring Rock Creek to a condition supporting fishing and swimming now looks attainable.

Source: Rock Creek Project Board, 1991.

Ensure Long-term Maintenance

One of the least discussed and most difficult parts of a project is maintenance. Many projects have failed when outside funding ended or when the perceived problems were solved. A watershed action plan must provide for regular and ongoing maintenance in order to ensure success.

The concept of long-term maintenance is difficult for project managers, because there can often be no assurance of funding for maintenance after the life of the project. However, if

at all possible, institutional and financial arrangements should be made that have a high probability of extending past the end of the funding period.

Cooperators should agree to perform the management measures and to continue operation and maintenance on structural and vegetative BMPs even if the economics of the situation change. New growth (new housing developments, animal operations, highways, etc.) should be held to the BMPs and pollution control measures used in the project (or a higher level of treatment if needed) without expecting compensation via cost-share or other grant monies. These newcomers should include pollution control as a part of the cost of doing business. Some key points to consider are:

Education and training of newcomers and continuing education and reinforcement for current cooperators is essential.

Maintenance programs should be self supporting whenever possible. Individuals and businesses, as well as municipalities and natural resource agencies, should be aware of the long-term need to provide for maintenance of controls.

A project that has developed and encouraged private-enterprise support services for BMP maintenance is much more likely to succeed.

Local regulations can be helpful to maintain water quality gains; demonstration of success may be needed first.

Project managers should contact their counterparts in well-established programs such as the Anacostia, Chesapeake Bay, Puget Sound, and Rock Creek Projects to gain insight on maintaining support for a watershed project. Contacts for these programs can be obtained through the EPA Regions and the EPA Office of Wetlands, Oceans, and Watersheds in Washington, DC. See Chapter 9 for references from the literature.

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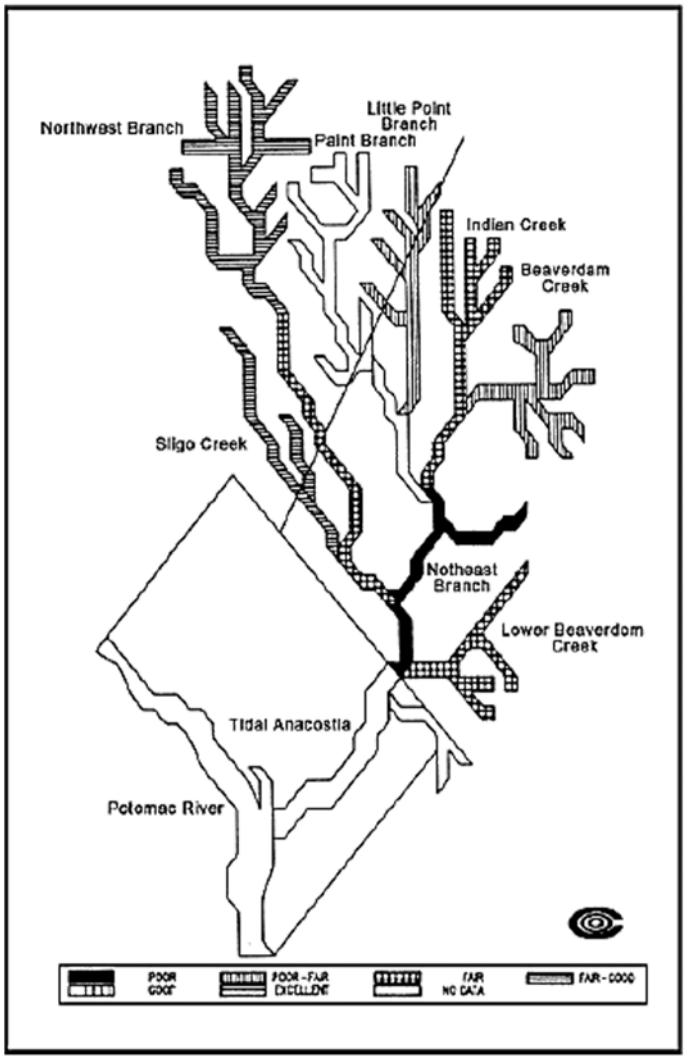
Appendix A: Selected Pages from the State of the Anacostia - 1989 Status Report

Current Environmental Conditions: Tributary Water Quality Index for 1988

A water quality index has been prepared to compare overall conditions within the tributary watersheds of the Anacostia. The index was based upon observed monthly monitoring data collected at over 15 stations by the CAMP program. The index includes data on water quality temperature, nutrients, pH, and water clarity. during 1988, water quality in the Anacostia tributaries did not change sharply from previous years.



As can be seen, the stream with the poorest water was the heavily channelized Northeast branch, followed by lower Beaverdam Creek, and Little Paint branch. In comparison to recent years, water quality conditions appeared to improve in the Indian Creek and declined slightly in the Upper Northwest Branch.

Water quality conditions within the tributary systems reflect the broad spectrum of land uses encountered in the watershed. Major water quality problems found throughout the tributary system include high concentrations of sediment

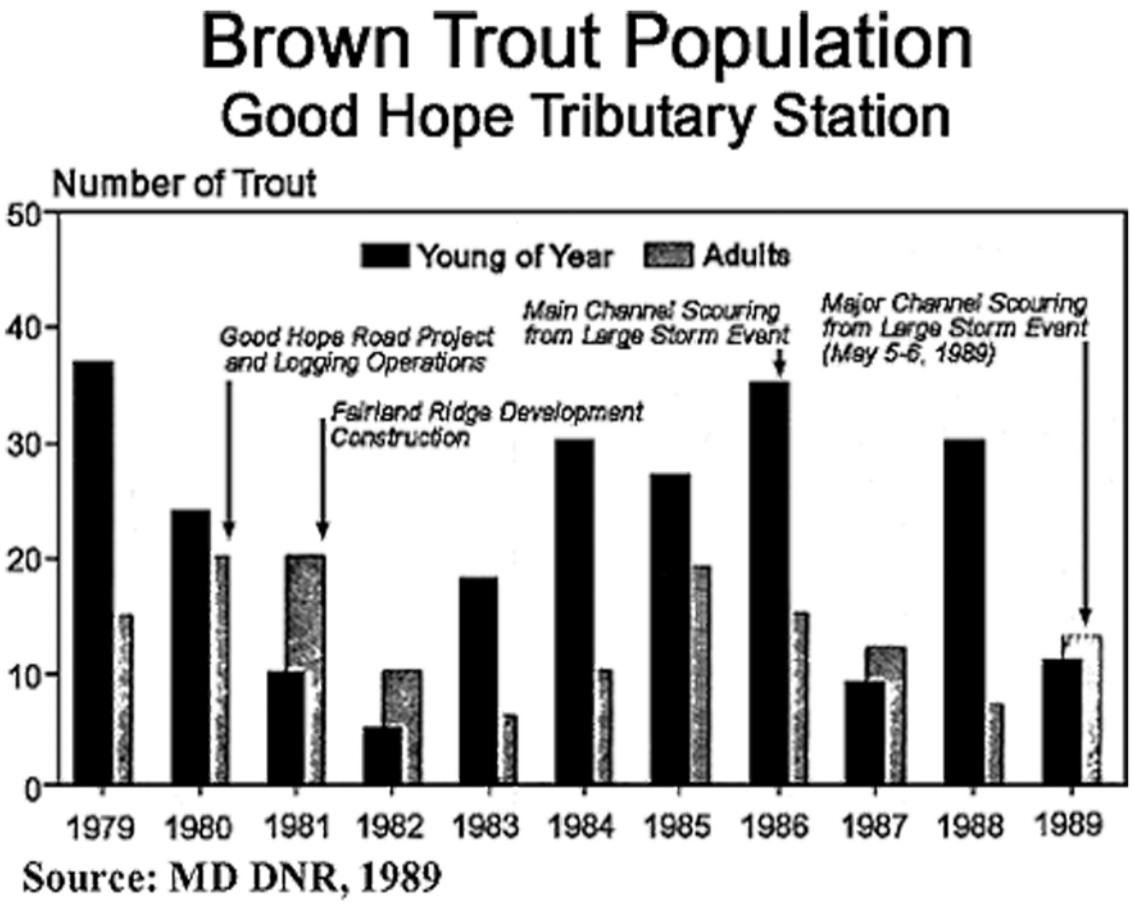
and bacteria, and elevated water temperatures. Localized water quality problems associated with high nutrient or toxic contaminants also exist within the tributary system..

Current Environmental Conditions: Urbanization and the Fragile Paint Branch Trout Fishery

Overall, Paint Branch's resident trout population remained relatively stable in 1989. However, the inherent resiliency of this trout-supporting system is being severely tested, both by channel scouring storm events, and increased sediment loads to key spawning and nursery tributaries. Of major concern is the gradual deterioration of physical habitat conditions within Paint Branch's principal trout-producing stream, the Good Hope tributary.

Good Hope Tributary

Since 1986, the stream channel erosion, turbidity, and sediment deposition have increased steadily in the Good Hope tributary. While the origins of these problems are many and complex, watershed development activities continue to exert the greatest negative influence. As illustrated in the adjoining chart, the fluctuating Good Hope trout population has historically been very responsive to natural and anthropogenic events, such as flooding and sediment pollution. Recent surveys suggest that aquatic habitat conditions necessary for the continued maintenance of a health Good Hope trout population may be at or near the critical threshold level. .



Brown trout population observed in Paint Branch fluctuate greatly as a result of land disturbances that create increased sediment loadings.

Upper Gum Springs Tributary

Fortunately, not all Paint Branch news was bad in 1989. Among the bright spots are the excellent number of young-of-year trout surveyed in the Upper Gum Springs tributary. Because of its relatively small size and limited number of quality pool areas, the Upper Gum Springs does not support large numbers of adult trout. In an attempt to improve adult habitat conditions and numbers in the stream, several pool-forming check dams were installed. This joint project among trout unlimited, Maryland Department of Natural Resources, and Maryland National Capital Park and Planning Commission will be continued in 1990.

Restoration Accomplishments: Coordination of the Watershed Restoration Effort

Due to its multi-jurisdictional character, the Anacostia watershed can only be fully restored if federal, state, and local government cooperate together to develop and implement watershed restoration projects. More than sixty different agencies are directly involved in some aspect of the restoration program. Their participation is coordinated through a series of policy and technical committees, as well as special work groups, supported by COG.

Anacostia Restoration Fund

The Anacostia Watershed Restoration Committee (AWRC) approved the concept of an Anacostia Restoration Fund (ARF) at their October 5, 1989 meeting. The fund supports the regular Anacostia coordination and management activities in addition to providing support for special basin-wide projects. The Fund formalizes and replaces prior funding arrangements that exist through various local, state, and federal grants.

Anacostia Retrofit Strategy

The AWRC endorsed the concept of developing a long-term basin-wide urban retrofit strategy. the AWRC reached a consensus agreement calling for the adoption of detailed Sub-Watershed Action Plans (SWAPs) as part of the urban retrofit strategy. This action will help in streamlining the approval of individual restoration projects and define interagency roles and responsibilities with regard to implementation.

Federal Participation in the Clean-Up Effort

COG staff acting upon a directive from the AWRC has coordinated with federal agencies to enlist greater federal support and participation in the Anacostia restoration effort.

Third Annual Work Plan

The AWRC adopted the final version of the 3rd Annual Work plan at their June 12th committee meeting. This plan covers the period between October 1, 1990 to September 30, 1991, and contains more than *50 local, state, and federal initiatives*. Although some initiatives continue previous programs, a significant number represent an increased emphasis on project implementation.

Sub-Watershed Action Planning Process

A sub-watershed action plan (SWAP) is intended to be a detailed blueprint for restoration activities within a priority area in the Anacostia. SWAP plans spell out where and when urban retrofit and stream restoration projects will be carried out. SWAP plans are to be prepared with the input and participation of all local, state and federal agencies with an interest in the watershed. Each SWAP plan will be different so as to address the unique problems of each stream in a comprehensive manner. The AWRC has endorsed the preparation of SWAP plans within nine priority sub-watersheds as a critical element of the overall restoration effort. The key components of a SWAP plan are listed on the following page.

Restoration Accomplishments: Eight Steps of a Sub-Watershed Action Plan

1. An in-depth analysis of the water quality and aquatic community within the sub-watershed.

2. The definition of specific target(s) or goals to guide the restoration effort in the sub-watershed.

3. A detailed inventory of the opportunities for stormwater retrofit and stream restoration projects.

4. Priority ranking of the restoration projects, based on feasibility, cost, and ability to meet sub-watershed targets.

5. Long-term agreements to design, review, permit, construct, maintain, and monitor the priority restoration projects.

6. Development of plans to increase wetland and forest cover in the sub-watershed.

7. Identify other actions that can be taken to protect the sub-watershed beyond restoration projects.

8. Specify a long-term monitoring program to assess progress made in achieving water quality and biological habitat improvements.

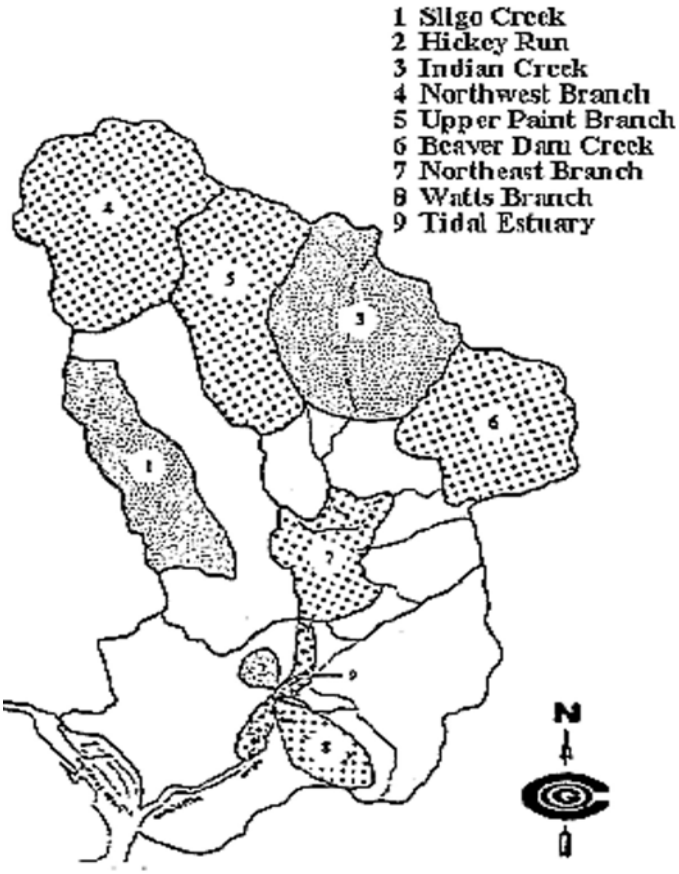
Priority Sub-Watersheds

Nine watersheds have been selected from SWAPS and three will be prepared during the coming year.

SLIGO CREEK: Flowing through densely populated sections of Montgomery and Prince George's counties, Sligo Creek is one of the most heavily urbanized Anacostia tributaries. Although bordered by a thin buffer of parkland managed by M-NCPPC, periodic parkland and roadway flooding, in addition to severe streambank erosion are the major problems affecting the stream. As a result, Sligo Creek supports few fish and other forms of aquatic life.

HICKEY RUN: Located entirely within the District of Columbia, this 1070 acre watershed is heavily polluted from upstream commercial and industrial land uses. Hickey Run has a fifty year history of chronic oil spills and stormwater runoff of oil and grease. In addition, water quality problems include violations of bacteria, BOD, trace metals, pH, DO and phosphates.

INDIAN CREEK: Originating in the sparsely developed upper reaches of the basin, the character of Indian Creek changes as it meanders through numerous active and abandoned sand and gravel mining areas. It is there that numerous abandoned sand and gravel mines contribute large amounts of sediment to the river. In its lower reaches, Indian Creek passes through a highly urbanized, commercial and residential corridor. At its confluence with Paint Branch, the stream is a concrete lined flood control channel with little or no vegetative buffer.



This map indicates the locations of the nine priority sub-watersheds located within the Anacostia basin.

Non-Point Source Storm Monitoring Network Established

In addition to the CAMP network, a system of storm monitoring stations became operational during 1989 (figure omitted). The storm monitoring network was established to measure pollutant loadings delivered to the tidal estuary, as well as to assess the impact of urban stormwater runoff on stream water quality.

During 1989, four storm monitoring stations were operated in the watershed. These monitoring stations neatly fall within two distinct categories: watershed monitors and performance monitors.

Watershed Monitors

The Northwest Branch Storm Monitor: This monitor was installed by MDE and COG within the existing USGS stream gauging station house at Queens Chapel Road in Hyattsville, Maryland. This station gathers storm-flow water quality data from 49 square miles of Piedmont drainage in the western portion of the Anacostia watershed.

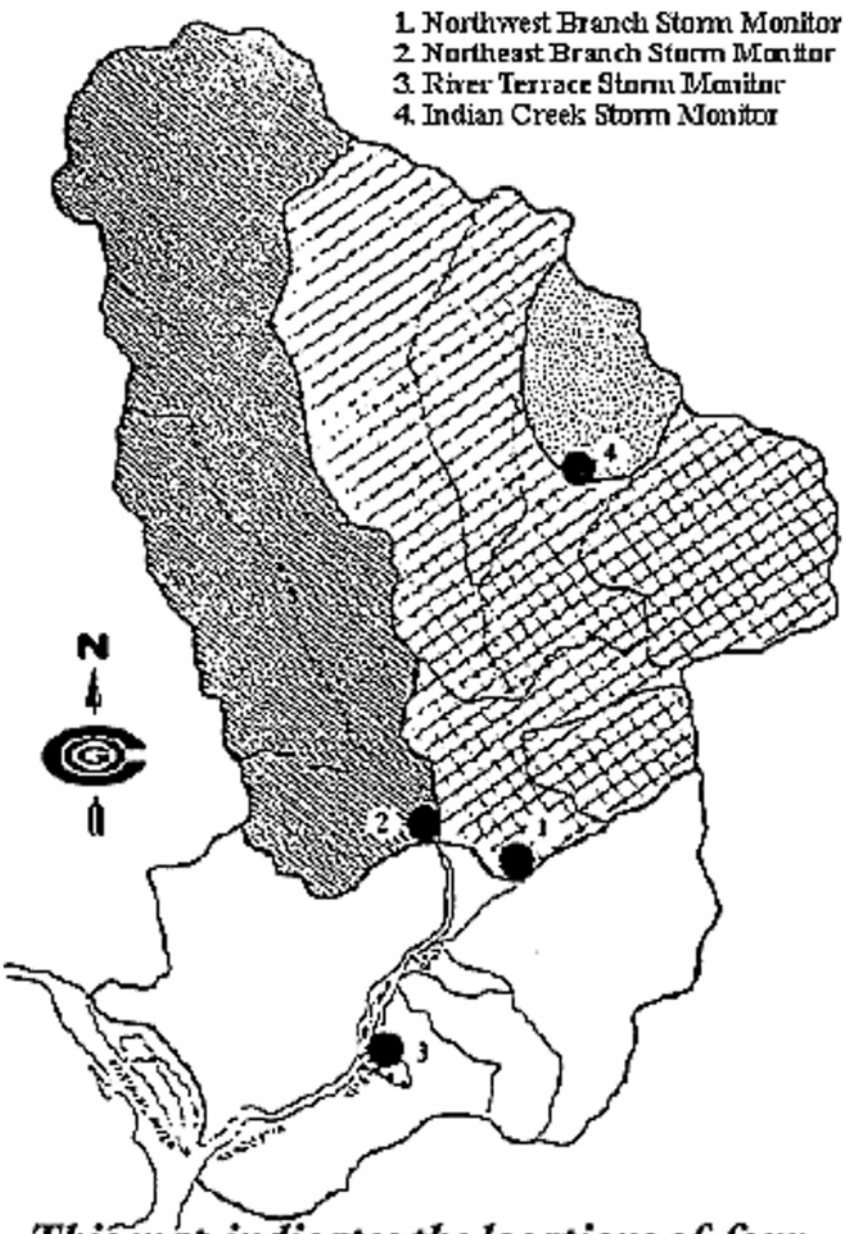
The Northeast Branch Storm Monitor: This monitor was installed by the Natural Resources Division of PG-MNCPPC at the stream gauging station house at Riverdale Road in Riverdale, Maryland. This station gathers storm-flow water quality data from 72.8 square miles that drain to it through the eastern portion of the free-flowing Anacostia watershed.

Both monitors work in tandem, gathering information from the two main tributaries that form the Anacostia River when they merge just upstream of the Bladensburg Marina. At their confluence lies the head of tide which signals the transition of the watershed from free-flowing upland drainage to the tidally-influenced estuary.

Performance Monitors

The River Terrace Storm Monitor: This monitor is located at the terminus of C Street, NE in a heavily urbanized portion of downtown Washington DC. The monitor measures pollutant levels within the storm drain system of an industrial and residential area before they are discharged into the Anacostia.

The Indian Creek Storm Monitor: This monitor measures pollutant levels within upper Indian Creek. Land use within the seven-square mile watershed includes new development, forest cover, and abandoned sand and gravel mines. The monitor is operated by PG-MNCPPC and will be used to assess the effectiveness of three large urban retrofit projects.



This map indicates the locations of four storm monitors located within the Anacostia watershed.

Restoration Accomplishments: Implementation of Basin-Wide Controls

Water quality problems in the Anacostia can be largely attributed to urban nonpoint sources of pollution. Major nonpoint sources in the basin include combined sewer overflows, urban runoff from developed areas and erosion from construction sites and surface mining operations. Within certain areas of the basin, point sources of pollution also have major negative impacts on water quality. To improve water quality within the basin, pollution from each of these areas must be addressed and minimized.

During the third year of the restoration effort, a number of basin-wide controls were implemented to improve both water quality and stream habitat. The following list summarizes the accomplishments achieved in this area.

CSO Abatement Program in the Anacostia - About one third of the District's drainage area (12,500 acres) is served by combined sewer systems that date back to the late 19th century. Most of the CSO discharge points are concentrated along the Anacostia near RFK stadium. Phase I of a 400 million-gallon-per-day Swirl concentrator facility near the RFK Stadium outfall is complete and should be operational by summer of 1990. Progress on Phase II of the program includes completion of a CSO benefit study in addition to obtaining necessary operational permits.

Basin-wide Implementation of the Retrofit Program - The Anacostia Watershed Urban Retrofit Directory lists 26 projects in the District of Columbia, Prince George's County, and Montgomery County that have been approved for funding, are in the design phase, or are under construction. Approximately $5 million has been committed to these projects. Construction has been completed on the Wheaton Branch Stormwater Retrofit in Montgomery County. This project represents one of the first generation Maryland State Cost-Share projects treating 824 acres of a 55% impervious watershed area.

Point Source Controls - The State of Maryland has required the Mineral Pigments Plant at Indian Creek to abide with new discharge restrictions for toxic metals contained within surface runoff from the site. This action has dramatically reduced nitrogen levels within the stream. Processing waste is now treated at the Blue Plains Treatment Plant. In addition, the Hickey Run METRO site has also been required to treat oil byproducts at the Blue Plains Treatment Plant.

Enhanced Controls On New Development - Local governments are continuing efforts to mitigate the impact of new development on the Anacostia, through stringent stormwater/sediment control land-use and site design review. Both

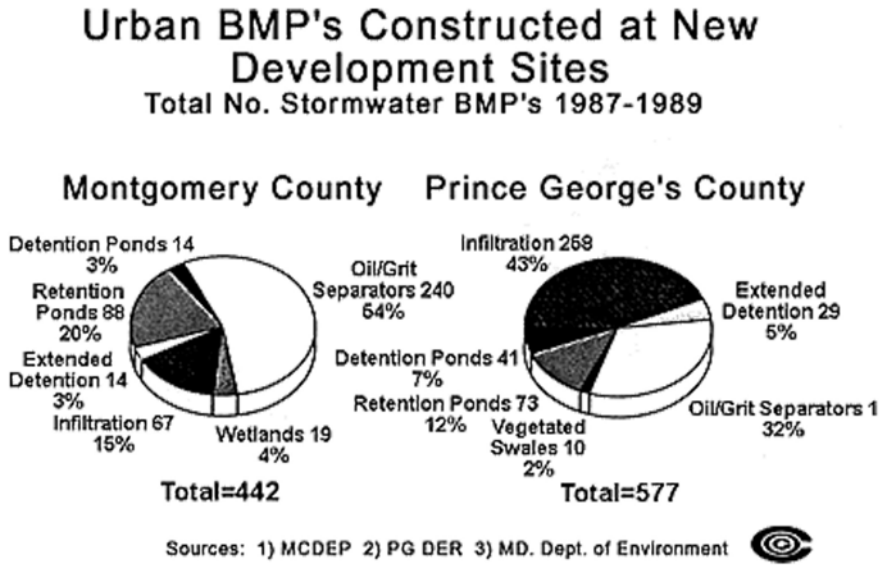
Prince George's and Montgomery counties have passed Tree Preservation ordinances for the protection of trees, woodland, and wildlife habitat from the impacts of land development. In 1989, more than 20 acres of land were reforested in the Anacostia watershed. More of these projects are planned for 1990.

Surface Mine Reclamation: Cleanup at the Magruder/Rawlins Site - Reclamation work at the Magruder/Rawlins abandoned sand and gravel facility is nearly 80% complete. Much of the work to-date has included regrading, sludging, and seeding the north and south portions of the site. In an effort to complete all of the scheduled reclamation work, the Maryland Department of Natural Resources, Surface Mining Division, has granted a permit extension through October of 1990 for surface grading, sludging, and seeding for the remainder of the site.

Restoration Accomplishments: Sediment/Stormwater Controls for New Development

Development activity was strong throughout the Anacostia basin during 1989, reflecting a six-year-long boom in the building industry. Local governments worked to institute tight controls on the new urban and suburban development so as to minimize the impact on streams. These controls include tough requirements to reduce sediment generated during the construction stage of development, as well as requirements to construct urban BMPs to control stormwater runoff. Urban BMPs include wet ponds, extended detention ponds, created wetlands, infiltration trenches, and oil/grit separators.

County-wide statistics compiled during 1987 to 1990 underscore the significant efforts made in Montgomery and Prince George's Counties to protect urban streams (no data was available to assess the District of Columbia's stormwater and sediment control programs). As can be seen in the chart below, more than 1,000 urban BMPs were constructed in both counties during the three-year period. A majority of these BMPs were capable of removing urban pollutants and controlling frequent flooding. An increase in the use of certain kinds of BMPs such as infiltration systems, wet ponds, created wetlands, and oil/grit separators was seen.



Similar improvement was noted during 1989 for construction site sediment control. Recent statistics generated by MDE indicate that more than 30 square miles of land in the two counties saw new construction in 1989. Local governments responded by increasing

the number of sediment control inspectors, and enforcing more stringent sediment control plans at construction sites. Nearly 1,800 sediment control permits were issued with an average load of about 100 permits for each inspector. While the inspectors remained overloaded, this represented an encouraging drop in the inspection burden from the previous year. A number of initiatives are to be undertaken to further improve local stormwater and sediment control programs, which are described in the Third Annual Workplan.

Restoration Accomplishments: Recreating Lost Wetlands

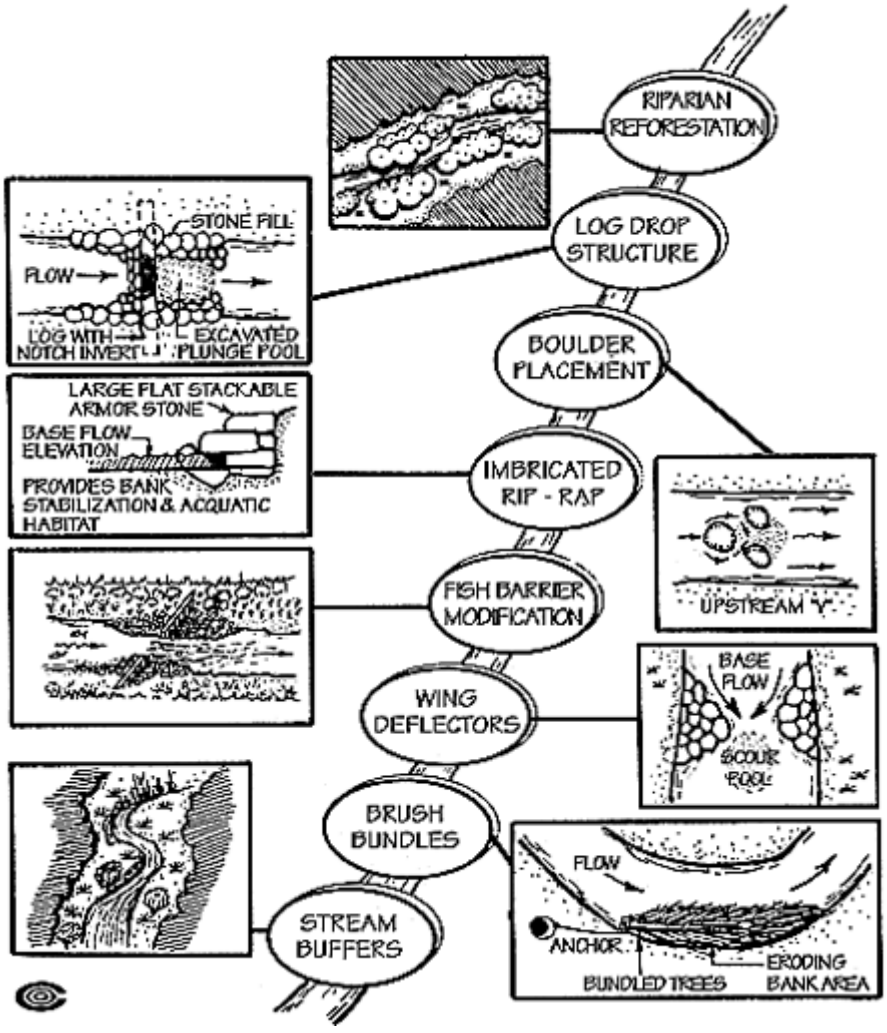
Tidal and nontidal wetlands have been destroyed in many portions of the Anacostia watershed. Experimental work was performed during 1989 to re-create wetlands lost to human actions. COG staff planted the margins and shore line zones of five stormwater ponds on Montgomery County with emergent wetland plants, such as wild rice, bulrush, arrow arum, wild celery, and sweet flag. Most of the wetland survived to the next year.

Another wetland planting experiment was conducted on the shore line margins of the tidal Anacostia River in 1989. The University of Maryland planted eight species at two sites along the tidal zone to determine which wetland plants will fare the best in the demanding environment of the Anacostia.

Lessons learned from both planting efforts will be used to develop better planting strategies to recreate the lost wetlands of the Anacostia.

Restoration Accomplishments: Urban Stream Restoration Techniques

Part of the process of restoring an urban watershed such as the Anacostia involves rebuilding or the re-creation of its streams that have become damaged or severely altered by years of urbanization and agriculture. The following eight stream restoration techniques are being used in the Anacostia.



Restoration Accomplishments: Living Resources

The following section reports on progress made toward improvement of Living Resources as part of the overall program of watershed restoration in the Anacostia.

Fish Passage Modification

During 1989, the ICPRB organized a Migratory Fish Barrier Working Group to serve as a subset of the Maryland and Chesapeake Bay Migratory Fish Working Group. The Work Group established three goals in response to recent biological monitoring conducted in the Northeast and Northwest Branches and the Lower Anacostia River: (1) Remove/modify barriers to fish passage, (2) improve water quality, and (3) restore fish habitat.

The Work Group identified three sites where barriers to herring migration exist: (1) Northeast Branch weir structure behind PG-MNCPPC offices, (2) Northwest Branch 38th Street dam in Hyattsvilles, and (3) Northwest Branch sewer encasements located 200 yards upstream from the 38th Street dam. The Work Group is optimistic that work will begin to modify the weir structure in the Northeast branch during the summer of 1990. .

Riparian Reforestation Effort

As with most urban areas, the Anacostia watershed has experiences tremendous loss of tree cover due to watershed development. increased urbanization and the resultant need for flood control protection have both increased the loss of forested areas. Of particular concern is the loss of tree cover adjacent to rivers and streams. Tree cover along streams not only provides essential habitat, shading and forage for both aquatic and terrestrial species, but also can protect surface and ground water quality. Forested stream buffers also provide wildlife corridors essential for survival in the urban environment.

In the recent inventory of restoration opportunities in the Anacostia, more then ten linear miles of reforestation projects were identified in the watershed. Concepts developed for these projects typically include the use of mixed-age, native plant and tree species in an attempt to mimic the historical streamside ecosystem. In areas of intensive recreational use or high visibility, different planting strategies may be needed.

The reforestation of the Anacostia stream corridor is an ambitious task, and due to constraints such as land ownership or incompatible existing land uses, it may not be possible to create a totally connected forested corridor. With the help of both local staffs and volunteers, however, tremendous improvements can be made.

Restoration Accomplishments: Public Participation

During 1989, the ICPRB program continued to strengthen and expand its efforts in the following areas:

Eight sub-basin coordinators covering nine sub-basins promoted public involvement for the Anacostia restoration effort to more than 1,000 people. This was accomplished by oral-slide presentations to civic associations, environmental groups, and community leaders, in addition to conducting educational stream walks and distributing related printed literature. The part-time coordinators have continued to walk and photograph their designated streams while advising appropriate agencies of problems. A photographic library of the tidal river and upstream tributaries now includes more than 1,000 slide transparencies.

The ICPRB published and distributed four issues of "In the Anacostia Watershed," an 8-page quarterly newsletter devoted to restoration and citizen accomplishments in the Anacostia watershed. In 1989, 8,500 free copies of the publication were distributed, doubling the previous year's circulation.

Volunteers for the Anacostia were sought and encouraged to join the organization(s) of their choice, and to adopt segments of tributary streams.

In an effort to train the public about stream habitat and clean-up efforts, a series of educational workshops for volunteers were held in the spring of 1989.

1989 saw the publication of "Restoring Watts Branch", the first of a series of 8-page, sub-basin educational documents.

ICPRB continued to provide support for agencies engaged in restoration efforts.

Getting Involved - Volunteers:

For general volunteer information on the Anacostia restoration effort and involved organizations.

Interstate Commission on the Potomac River Basin (ICPRB): Beverly Bandler, Suite 300, 6110 Executive Boulevard, Rockville, MD 20852. (301) 984-1908.

Annual Tidal Anacostia Clean-Up: Howard Gasaway, 2806 32nd Street, SW, Washington, DC 20020. (202) 544-7333.

Adopt A Stream: The Interstate Commission on the Potomac River Basin (ICPRB), Maryland Save Our Streams, 5531 Bosworth Avenue, Baltimore, MD 21207. (301) 448-1979; Izaak Walton League Save Our Streams, 1401 Wilson Boulevard, Level B Arlington, VA 22209. (703) 528-1818.

Join an organization such as the Alliance for the Chesapeake Bay, Anacostia Watershed Society, Audubon Naturalist Society, Chesapeake Bay Foundation, Izaak Walton League, League of Women Voters, and Maryland save our Streams.

One Million Marylanders for the Bay is a state-wide effort aimed at getting groups actively involved in projects to improve the bay, including: tree planting, habitat enhancement, stream and shoreline clean-up, and shoreline erosion control. Write: One Million Marylanders for the Bay, Office of the Governor, State House, Annapolis, MD 21401.

The Soil Conservation Service's Earth Team Program offer a variety of opportunities. Contact the appropriate District Conservationist in the District of Columbia (576-6951), Prince George's County (952-3903), and Montgomery County (590-2855).

Appendix B: Organizational Protocol From A Puget Sound Watershed Project

Stillaguamish River Early Action Watershed Management Plan

DRAFT PROTOCOL
WATERSHED MANAGEMENT COMMITTEE

Lead Agency Functions and Responsibilities

The Snohomish County Department of Public Works will function as the lead agency for the Stillaguamish River Early Action Watershed Plan. In accordance with WAC 400-12-400 (2), the Department of Public Works, as the lead agency, is responsible for the following:

a. Coordinate activities necessary to develop and implement the watershed action plan.

b. Coordinate all activities of the Watershed Management Committee.

c. Submittal of the action plan to the Department of Ecology for approval.

d. Administration of the grant to develop the action plan.

e. Coordinate the SEPA review process.

f. Carry out implementation provisions of the approved watershed action plan.

Watershed Management Committee Functions and Responsibilities

The Watershed Management Committee is responsible for developing the Watershed Action plan for the Stillaguamish River. The use of consensus in making decisions is strongly encouraged. The Snohomish County Department of Public Works will coordinate and function as staff for the Watershed Management Committee. Specific functions and responsibilities include:

a. Prepare and review a detailed work plan, schedule, and budget for the development of the Stillaguamish River Action Plan.

b. Develop a strategy for public participation and involvement in the planning process.

c. Prepare a statement of water quality goals and objectives, involving the public and affected parties through consultations, public meetings, or document review.

d. Develop a draft Action Plan for the Stillaguamish River.

e. Regularly provide written information on action plan development to local government legislative authorities, federal and state governmental entities with jurisdiction within the watershed, planning and health agencies with jurisdiction within the watershed, tribes in the watershed, and the public and affected parties.

f. Ensure that the action plan is technically and functionally sound.

g. Provide and encourage public review and involvement in the planning process.

h. Ensure that federal agencies, local entities, and state agencies that either have jurisdiction over any property or facility, or are engaged in any activity resulting in nonpoint pollution in the watershed, are aware of their responsibility to comply with local requirements for pollution control.

Qualifications of Watershed Management Committee Members

The general qualifications of Watershed Management Committee members are:

a. Watershed Management Committee members should be able to speak for and represent the full range of interests within their local governmental entity, tribe, or interest group.

b. Watershed Management Committee members should have a grasp of statewide, county, and basin issues with respect to nonpoint source pollution.

c. Watershed Management Committee members should be of a high enough level within their organization to be able to make decisions at the WMC meetings with a high degree of confidence that the decision will be upheld and accepted by their respective entity, tribe, or interest group.

d. Watershed Management Committee members should possess the technical knowledge to review and comment on detailed work plans, project schedules, and ensure that the action plan is accurate and technically and functionally sound.

e. Watershed Management Committee members must be willing to respect, listen to, and understand other interests.

f. Watershed Management Committee members will be expected to meet at least once a month, possible more often, during 1988. Attendance at all WMC meetings is imperative.

If a member is unable to attend a WMC meeting, then it is the responsibility of that member, as a representative of a governmental entity, tribe, or interest group, to designate an alternate to attend the meeting.

Watershed Management Committee Meetings

a. Watershed Management Committee meetings are designed to be more like work sessions than formal meetings, therefore, it is not generally necessary to abide by parliamentary procedures.

b. All Watershed Management Committee meetings will have an agenda. The agenda will be reviewed and revised as necessary at the start of each meeting. The project manager from the Department of Public Works, or his/her designee, will facilitate all meetings.

c. The facilitator is responsible for ensuring that the committee moves through the agenda, and that each committee member has the opportunity to speak on agenda items and that the discussions stay germane to the agenda items.

d. All decisions made by the Watershed Management Committee will be made by consensus. When decisions are required, the facilitator will make sure that the decision is understood by all committee members and that the consensus has been achieved.

e. Each Watershed Management Committee meeting will end with a short evaluation of the meeting and the status of the project as a whole and a summary of the consensus decisions reached at the meeting.

f. Each Watershed Management Committee meeting will be taped and notes taken by Public Works staff. A summary of each meeting will be prepared and distributed to all Watershed Management Committee members and others who have expressed an interest in receiving a summary of meetings.

g. Watershed Management Committee members are responsible for reviewing the meeting summaries and briefing their respective elected officials, tribal councils, or affected party constituents prior to the next scheduled Watershed Management Committee meeting.

h. All Watershed Management Committee meetings will be open to the public.

Worksheet on Forming Watershed Management Committees*

(* Worksheet prepared by the Puget Sound Water Quality Authority for use by lead agencies for Early Action Watersheds.)

POTENTIAL COMMITTEE MEMBERS

Each Watershed Management Committee will be somewhat unique, depending in the nature of the watershed. Use this worksheet as a guide for selecting potential committee members. IT IS NOT MEANT TO BE INCLUSIVE OR PRESCRIBE MEMBERS, but rather to lay out the range of parties that could be involved in a nonpoint planning process.

COUNTY GOVERNMENT AND AGENCIES (What is the most appropriate mix of staff and officials?)

Planning _____

Health _____

Public Works _____

Council/Commission _____

County Executive _____

Planning Commission _____

Conservation District _____

Cooperative Extension _____

CITY GOVERNMENT (Who are the most appropriate representatives from city government?)

Planning _____

Public Works _____

City Manager _____

City Council _____

Mayor _____

_____ _____

TRIBES (Do any tribes have jurisdiction in the watershed?)

_____

_____

_____ _____

AFFECTED PARTIES (What groups have a direct interest in nonpoint pollution in the watershed?)

Agriculture (commercial-dairy, cattle, crop; non-commercial) _____

Developers/Realtors _____

Environmental _____

Recreation _____

Commercial/Industry _____

Residents "At Large" _____

Other _____

SPECIAL PURPOSE DISTRICTS (Which special purpose districts should be involved in developing a watershed action plan?)

Drainage _____

Diking _____

Flood Control _____

Ports _____

River Improvement _____

Sewer _____

Other _____

COUNCIL OF GOVERNMENTS _____

STATE AGENCIES (Do any state agencies own land in the watershed? Should others be included in an advisory capacity?)

Dept. of Natural _____

Resources

Dept. of Fisheries _____

Dept. of Social and Health Serv. _____

Dept. of Ecology _____

Dept. of Transportation _____

Parks and Recreation _____

Dept. of Agriculture _____

FEDERAL AGENCIES (Do any federal agencies own land in the watershed? Should others be included in an advisory capacity?)

Natural Resources Conservation Service _____

U.S. Forest Service _____

U.S. Dept. of Transportation _____

U.S. Park Service _____

Military Installations _____

U.S. EPA _____

Other _____

Questions about Committee Formation

What process will we use to recruit members?

What committee structure should we use?

What is a manageable committee size?

Who should be asked/urged to participate from local government?

How do we ensure the representation of "affected parties"?

Under what conditions should we use an advisory committee (citizen, technical, or policy)?

At what points in the process will we involve the general public and how will this be done?

Appendix C: Programs That Can Be Useful For Control Of Nonpoint Source Pollution

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
US Environmental Protection Agency (EPA) Located in 10 Regional Offices. Headquarters in Washington DC	Provides environmental assessments, water quality monitoring, regulations and regulatory oversight, education, planning, technical assistance, grants and loans for pollution control.	Staff, information and data, laboratories and research facilities, grants and loans for pollution control, educational materials, monitoring equipment.
EPA - Permits	NPDES permits for confined animal feeding operations, enforcement for non-compliance	Staff for technical assistance with modeling and permit drafting, site inspections and compliance monitoring. Funds for special studies or projects.
EPA- Pesticides	Regulation of pesticide labeling and registration, which includes application rates, allowable crops and pests, environmental and human health cautions, disposal procedures. Licensing of restricted use pesticide applicators.	Staff for review of research results, assistance with strategic planning, education and training, oversight of enforcement procedures of States. Funds for special projects and studies.
EPA - Surface water quality management (multiple programs)	Overall water quality management planning and management through the following programs: *Nonpoint Source Control* — Program which oversees and approves State development of	Staff for technical assistance to State and local agencies, review and approval of State programs, research and special studies. Grants to States for most water quality protection activities, educational

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
	water quality assessments and management programs. Directs funds to high priority watershed projects. *Clean Lakes* — Program provides funds to restore or enhance publicly owned lakes. *Coastal Programs* — A number of programs designed to assess and protect coastal waters, including the National Estuary program *Wetlands* — Oversight of the Corps of Engineers on wetlands dredge and fill permits, takes enforcement actions for illegal wetlands filling, technical support for wetlands delineations. *Water Quality Standards* — Programs provides technical assistance in developing numeric, narrative and biological criteria and standards to protect water quality and its use.	materials and programs. Funds for special studies or projects.
EPA - Monitoring and surveillance	Environmental assessment, data analysis, oversight of State monitoring programs, special studies and agency research, EPA laboratory and Office of Research and Development coordination.	Staff for technical assistance to States and citizens on monitoring programs and projects; special studies and data analysis upon request; water quality monitoring at select

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
		locations.
EPA - Drinking Water	Regulates public drinking water supplies and suppliers, special studies on human health and risk, develops drinking water criteria and MCLs (maximum contaminant levels). Administers a special program that encourages watershed projects to decrease pollution loads to drinking water supplies if installation of BMPs is less expensive than the water treatment. Provides technical and programmatic assistance to State wellhead protection programs. Supports an initiative to expand community-based source water protection efforts.	Staff for technical assistance in setting drinking water standards, special studies, oversight and compliance monitoring of public water supplies and suppliers.
EPA - Ground water	Administers the Sole Source Aquifer Protection Program and provide technical and programmatic assistance to Comprehensive State Groundwater Protection Programs.	Staff for technical assistance; funds for special studies.
EPA - Office of Research and Development (ORD)	Conducts basic and applied research to support EPA mission including biological and physical studies on fate and transport of environmental contaminants and ecosystems at large.	Reports, data, maps, monitoring equipment, study and demonstration sites, staff for technical assistance in interpreting research results.
US Department of	Stabilize and support the	Staff, technical assistance,

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
Agriculture (USDA) Unless otherwise indicated each agency has field offices located in almost every county or parish, State offices in each State and a Washington, D.C. office.	efficient production, marketing and distribution of food and fiber. In addition to commodity and public welfare programs, administers a number of conservation programs designed to assist private and federal land owners or managers in natural resource conservation and multiple use management. Works mainly with private individuals on improving resource management.	information and data, educational materials, cost-share funds, engineering equipment.
USDA - Multiple agency administration of 1985 and 1990 "Farm Bill" programs:	Conservation Reserve Program (CRP) — Program to conserve/protect highly erodible or other environmentally sensitive land from production by putting it in permanent vegetative cover through 10 year easements and annual rental payments Wetlands Reserve Program — Program available only in pilot States to return drained wetlands to wetland status and protect existing wetlands. Uses same easement/payment method as CRP. Sustainable Agricultural Research and Education Program — A practical research, education grant program to promote lower input methods of farming.	In most cases responsibilities within these programs are divided between departments of USDA as follows: NRCS — technical assistance in planning, design, and implementation of BMPs. ASCS — Administrative oversight of program and cost-share funding disbursement. CES — Education and information about the variety of conservation and economic choices available. CSRS — Research, data, and the results of demonstration field trials of

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
	Conservation cross compliance (sodbuster and swampbuster) — A quasi-regulatory program that denies subsidy payments to farmers who plow highly erodible land or drain wetlands. Water Quality Incentives Program — A watershed treatment program designed to improve or protect soil and water resources in watersheds impacted or threatened by NPS pollution.	new technologies
USDA - Natural Resources Conservation Service (NRCS) formerly Soil Conservation Service (SCS)	Technical assistance on the planning, site specific design and installation and management of soil and range conservation, animal waste, and water quality management systems and special land and water resource assessments and inventories. Cost-share funds for installation of BMPs on private lands are available from some of the programs listed below.	Staff and equipment in field offices for technical assistance including engineering designs, survey work, and planning for water resource protection.
USDA-NRCS-Small Watershed Program (PL-566)	Evaluation and treatment of small agricultural watersheds with multiple resources to protect. Includes land and natural resource inventories and assessments, basin-wide planning and targeting of resources, technical assistance and educational programs.	Staff for technical assistance to landowners and decision-makers in the basin, funds for demonstration projects, reconnaissance and intensive inventories of resources.

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
USDA-NRCA-Great Plains Conservation Program (GPCP)	Intensive conservation treatment for individual farms located within the Great Plains ecoregion through long-term agreements (3-10 year contract) with farmers.	Technical assistance, cost-share funds up to 75% of the average cost of selected high priority conservation practices.
USDA-NRCS-Resource Conservation and Development Program (RC&D)	Voluntary program to promote economic development and to intensify resource protection in priority areas through the use of public participation in RC&D councils.	Planning assistance for small communities for community-wide resource protection.
USDA-NRCS-Natural Resource Assessment Programs: Soil Survey, Natural Resources Inventory, River Basin Studies	Various programs to map and assess the condition of natural resources (generally soil, water, vegetation and wildlife) and conservation treatments.	Maps, reports, data information, statistical analysis.
USDA-Agricultural Stabilization and Conservation Service (ASCS)	Provides administrative oversight and cost sharing for approved conservation practices from ASCS and other USDA administered programs. Tracks crop production and other statistics. Distributes crop subsidy and deficiency payments.	Maps, conservation practice status information, cost-share funds
USDA-ASCS-Agricultural Conservation Program (ACP)	Cost-sharing on an annual basis for a number of soil conserving, production efficiency improving and water quality practices.	Funds for cost share, generally limited to $3,500 per farm per year.
USDA-ASCS-	Cost-sharing on an annual basis	Funds for cost share of high

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
Emergency Conservation Program (ECP)	to replace conservation treatments (mainly structural) that were destroyed in areas designated as disaster areas due to an act of nature.	priority conservation practices.
USDA-ASCS-Water Bank Program	Designed to improve and restore wetland areas through financial compensation for 10 year easements on private property	Funds for easement compensation on eligible lands in participating States.
USDA-ASCS-Colorado River Salinity Control Program (CRSCP)	Financial assistance for farm projects which seek to control salinity levels delivered to the basin, primarily irrigation water management.	Funds, reports, data on level of conservation treatment, demonstration sites, funds for cost-share, monitoring and education.
USDA-ASCS-Forestry Incentives Program (FIP)	Cost-share to re-vegetate and improve timber stands on private lands	Cost-share funds
USDA-Cooperative Extensive Service (CES)	Educational programs and information to aid individuals in the selection, operation, and maintenance of the most beneficial conservation treatments. Economic analysis and data for each farm or ranch. Provides technical assistance in integrated pest management. Programs generally carried out in cooperation with State land grant universities.	Staff for educational programs and technical assistance, personalized economic analysis, and coordinating small scale demonstrations on local farms. Educational materials.
USDA-Cooperative State Research Service (CSRS)	Applied research, usually at State experiment stations on agricultural production and soil and water conservation,	Reports, data, equipment. Occasionally funds for joint/special projects outside the normal research

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
	generally using demonstration plots. Conducts the Sustainable Agriculture Research and Education program (SARE). Many projects in cooperation with State land grant universities.	agenda. Grants for Agriculture in Concert with the Environment (ACE) program.
USDA-Forest Service (USFS) Field offices located in each national forest, Regional offices located in 9 areas. Headquarters in Washington, DC.	Management of national forests and grasslands for sustained production and multiple use. Works with individuals, industries and other agencies.	Staff, maps, reports, equipment for construction and monitoring, educational materials, occasionally funds for special projects.
USDA-USFS-Permit program	Management of national forests and grasslands for sustained production and multiple use. Works with individuals, industries, and other agencies.	Staff for technical assistance and compliance monitoring.
USDA-USFS-Air and Watershed Programs	Overall environmental planning and technical support for forest management decisions. Special studies and watershed demonstration projects in certain areas.	Funds for special studies and watershed demonstration projects. Natural resource inventories and reports, water quality/habitat monitoring, and environmental analysis of resource trends and conditions.
USDA-USFS-Forest Stewardship Initiative	Technical assistance and cost share to private inholdings or lands adjacent to National Forest lands for installing BMPs.	Funds and technical assistance to individuals.

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
USDA-Farmers Home Administration (FmHA)	Loans and loan guarantees to eligible producers for operating expenses, land purchase and conservation measures.	Funds and loans for property improvement and conservation treatment installation and water conservation practices.
USDA-Agricultural Research Service (ARS) Research stations located throughout each State: most specialize in particular types of investigations.	Basic and applied research on agricultural production and conservation measures, including fertilizers, pesticides and BMP effectiveness.	Reports, BMP effectiveness and environmental fate and transport data, demonstration sites; occasionally funds for joint sponsored projects.
US Department of the Interior (USDOI) Offices located in regional centers, field offices in numerous management areas; headquarters in Washington, DC.	Oversight, management, or monitoring of National natural resources, including land, water, and wildlife.	Staff, maps, reports, demonstration sites, educational materials, monitoring equipment.
USDOI-Geological Survey (USGS)	Long term baseline monitoring of water resources (quantity and quality), hydrologic and geologic investigations and data, special intensive short term studies.	Maps, data, and information on hydrology and water quality status and trends. Staff for technical assistance in designing a monitoring plan.
USDOI-Fish and Wildlife Service	Oversight and regulation of the Nation's wildlife resources. Management of national wildlife reserves, enforcement of federal game and fish laws, cooperative	Staff for environmental analysis and trend evaluation on BLM land, technical assistance and oversight. Funds for special

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
	administration of national wetlands program with COE and EPA. Cooperative projects to enhance wildlife habitat, special studies (especially fisheries investigations).	studies and cost-share for permitees for certain conservation practices (generally grazing/range management). Funds for range improvement, riparian area management, and recreational area development projects. Maps.
USDOI-Bureau of Indian Affairs (BIA)	Technical assistance to tribes on tribal lands mainly for social services. Some assistance for conservation work and educational programs. Natural resource inventories and monitoring of ground and surface water.	Maps, natural resource inventories of Indian and tribal lands. Funds for special projects. Staff for technical assistance to tribes.
USDOI-Bureau of Reclamation	Administers, constructs, and oversees water supply facilities in western States. Regulates discharge from these facilities. Joint administration of the Colorado river Salinity Control program with many agencies to set consistent salinity standards and manage public and private lands within the basin. New initiative to reclaim lands damaged by federal irrigation projects.	Staff for oversight of projects and management of federal property and facilities, assessment of water quality around reservoirs as part of the national irrigation water quality program. Maps, reports, and data.
USDOI-National Park Service	Administers and manages national parks for preservation of natural resources.	Staff for oversight and administration. Funds for special studies and occasionally cooperative

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
		projects on land adjoining park boundaries.
USDOI-Office of Surface Mining	Regulates the removal and reclamation of surface mined minerals, mostly coal on private lands.	Staff for oversight and technical assistance in mining operations and reclamation efforts, for engineering studies, and for vegetative site inspections and monitoring of resources. Educational materials, data and reports.
US Department of Defense-Army Corps of Engineers (COE) Field offices located in various districts throughout the States	Oversees construction and operation of large flood control and public water supply reservoirs, conducts water quality monitoring on lakes within their jurisdiction. Regulates in-lake activities and shoreline development. Cooperatively administers the wetlands dredge and fill permit program with EPA and USFWS. Can enforce permit requirements for BMPs or other mitigation.	Maps, special studies, monitoring data. Staff and funds for improvement of existing projects. Staff for review and oversight of 404 (wetlands) permits.
US Department of Commerce-National Oceanic and Atmospheric Administration (NOAA)	Administers programs in cooperation with States to inventory and manage coastal resources. funds and performs basic research and assessments relating to coastal eutrophication. Maintains database for pesticides and nutrient loadings.	Funds to State coastal programs. Staff for technical assistance. Data, reports, educational materials. Occasionally funds for special demonstration projects.
USDOC-NOAA-	In cooperation with EPA,	Staff for technical

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
Coatsal Zone Management Act (CZMA) programs	administers a quasi-regulatory coastal protection program that specifies management measures for control and prevention of NPS pollution in coastal areas for all land use activities.	assistance. Funds for plan development.
State Water Quality Agencies	Administers many programs (similar to USEPA's) for protection of water quality in ground and surface water, including the NPDES permit program, water quality standards regulations, the NPS program, ambient statewide monitoring programs.	Staff for technical assistance to local governments and individuals in BMP application. Water quality monitoring, data and reports. Funds for pollution control projects, educational materials, and programs.
State Natural Resource Agencies	Administer programs for wetlands and coastal protection programs.	Staff for technical assistance to local governments. Monitoring of natural resource trends. Reports, data, educational materials, and programs.
State Department of Agriculture	Regulates pesticide registration and use, administers marketing and rural development programs. Sometimes issues permits for fertilizer or feedlots.	Staff for oversight of applicators and other regulatory functions.
State Cooperative Extension Services	Provide training and technical assistance to landowners in nonpoint source control.	Staff for education, technical assistance, and research.
State Department of Health	Administer septic tank and public drinking water regulatory programs. Monitor water supplies. Provide technical	Staff for technical assistance to local governments, monitoring, and educational programs.

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
	assistance to local governments.	Data, reports, and educational materials.
State Soil and Water Conservation Commission	Administer cooperative programs with the USDA SCS to conserve soil and water resources on private lands. Provide technical assistance to individuals.	Staff for technical assistance to individuals, engineering or construction equipment, services and supplies that support BMP implementation. Some States have cost-share funds for BMPs.
State Fish and Game Agencies	Regulate the harvest of fish and wildlife resources by individuals and commercial operations. Responsible for cost recovery to State of lost fish and wildlife due to environmental contamination.	Staff for enforcement of State fish and game laws and for technical assistance in wildlife and fisheries management for private individuals. Educational materials, natural resource inventory data, and fish monitoring support.
State Water Rights Agency	Responsible for allocation of water rights (mostly in western States). Regulates consumptive use of water resources.	Staff for permit writing and oversight. Data and reports on water flow.
Local Planning and Zoning boards, City Planning Commissions, County Planning Boards	Specify land use zoning and boundary determinations, general community planning, oversight of program operation.	Maps, long range plans, inventory of local resources, special reports, budget information, staff for technical assistance.
Local School Boards and School Administrations	Oversees public education within jurisdictional boundaries. Can set local curricula requirements and priorities. Taxing authority, bond issuing	Information on status of current educational programs, assistance in developing new initiatives.

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
	authority.	
Local Municipal Utilities Districts	Oversees construction and maintenance of public works projects for water and sewer (occasionally energy). Taxing and bond issuing authority.	Information and special reports on water issues. Funds for special projects to enhance system operation and reduce costs.
Regional River Authorities	Manage and coordinate activities within their basin for flood control, water quality protection, energy development. Taxing authority.	Data, reports, maps, water quality monitoring. Staff for technical assistance to local government and other agencies or groups. Funds for special projects.
Regional Planning Commissions and Councils of Government	Assist in the coordination of activities of all governments within council areas. Provide technical assistance, information, and promotes special projects.	Staff for technical assistance to local governments, occasionally water quality monitoring, reports and data about local conditions. Funds for special projects.
Others-Commodity Groups	Various groups usually formed to improve marketing and lobbying capabilities for specific crops or livestock interests. Almost every major crop has at least one such group.	Staff for data gathering and analysis, public education campaigns, technical support to growers, legislative and market analysis. Funds from members for special projects.
Environmental Organizations	Various groups formed to protect, conserve, or preserve the environment in general or to address a specific issue. Lobby for environmental laws and programs, as well as funding.	Staff and volunteers for assistance with local projects, occasionally funding for cooperative work. Educational materials and programs. Reports and

Agency and Program	Program Descriptions and Agency Responsibilities	Resources Available and Possible Roles
	Many perform volunteer services such as water quality monitoring or natural resource rehabilitation work.	data on environmental conditions and trends.
Social and Service Clubs	Formed for reasons other than resource protection, most do local projects that enhance or beautify the community.	Staffed with volunteers, these organizations can provide labor, supplies and equipment on mutually beneficial projects as well as insight into the community.