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AGRICULTURE AND THE ENVIRONMENT

Information on and Characteristics of Selected Watershed Projects

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The Honorable Richard G. Lugar
Chairman
The Honorable Patrick J. Leahy
Ranking Minority Member
Committee on Agriculture, Nutrition, and Forestry
United States Senate

Recent federal, state, and local studies on water quality have identified agriculture as the United States' greatest source of nonpoint pollution—that is, pollution that cannot be traced to a specific point of origin. Agriculture contributes more than half the pollutants entering the nation's rivers and lakes. The threat to water quality posed by nonpoint sources of pollution has prompted renewed interest in watershed-based approaches to reducing such pollution.[1] With this in mind, you asked us to (1) determine the number, purpose, location, and funding of federal watershed projects that address pollution caused by agricultural production and (2) provide information on the lessons learned from selected innovative or successful watershed projects.

Results in Brief

Nationwide, 618 watershed-based projects aimed at agricultural sources of pollution were being planned or carried out through early 1995. The projects, ranging from as little as 5 acres to over 150 million acres in size, involved both surface water and groundwater resources and addressed a gamut of agricultural pollutants, such as animal waste, pesticides, and soil sediment. Through early 1995, these projects had received an estimated $514 million in federal funds.

While the lessons learned from the 9 innovative or successful projects we reviewed cannot be projected to the entire inventory of 618 watershed projects,[2] participants in all 9 echoed two key lessons learned: the need for (1) flexibility in the kinds of financial and technical assistance provided by federal agencies and (2) local tailoring of approaches to watershed management. Because watershed projects differ in characteristics such as

[1]A watershed is generally a geographic area in which water, sediments, and other dissolved materials drain to a common outlet.

[2]From a universe of projects that were cited as innovative or successful by U.S. Department of Agriculture, Environmental Protection Agency, or state officials, we judgmentally selected and reviewed nine: Huichica Creek and West Stanislaus County, California; Otter Lake, Illinois; Big Spring Basin, Iowa; Tar-Pamlico River Basin, North Carolina; Big Darby Creek, Ohio; Coos Bay-Coquille River, Oregon; Black Earth Creek, Wisconsin; and Lake Champlain, Vermont.

the type and source of pollutants, local agricultural practices, and the community's attitudes, participants believed that a prescriptive, one-size-fits-all approach would be inappropriate. At the local level, the projects' participants emphasized that the keys to reducing agricultural pollution include (1) building citizens' cooperation through education, (2) getting stakeholders to participate in developing the project's goals, and (3) tailoring the project's strategies, water quality monitoring, and regulatory enforcement efforts to local conditions.

Background

Water pollution comes from two types of sources: (1) specific, single locations, such as industrial waste pipes or sewage treatment plants, known as point sources, or (2) multiple dispersed sources over large areas, such as runoff from farms, ranches, logging operations, and urban areas, known as nonpoint sources. Federal officials believe that significant improvements in water quality can be achieved by reducing nonpoint-source pollution.

The watershed-based approach to reducing nonpoint-source pollution has been receiving increasing interest. Addressing nonpoint-source pollution throughout a watershed allows consideration of the entire hydrological system, including the quantity and quality of surface water and groundwater as well as all sources of pollution. Such an approach leads to a holistic treatment, as opposed to piecemeal efforts aimed at individual pollutants or pollution sources.

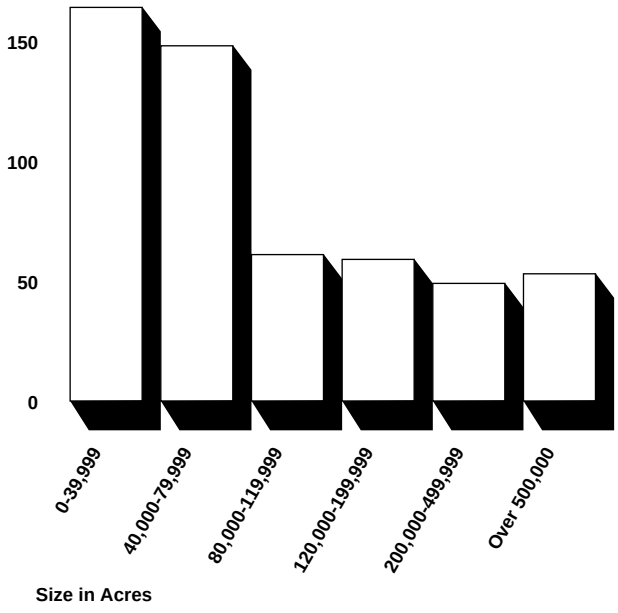
A number of federal agencies have primary roles in watershed projects involving agricultural sources of pollution. The U.S. Department of Agriculture (USDA), through its various agencies and programs, provides technical, financial, educational, and research support to a variety of watershed projects. These projects give farmers the knowledge and technical means they need to voluntarily improve water quality in their watersheds. The Environmental Protection Agency (EPA) also provides technical assistance and funds states' support for watershed projects and other efforts to reduce nonpoint-source pollution. The Department of the Interior's U.S. Geological Survey provides technical assistance to individual watershed projects, primarily in the areas of research, mapping, and water quality monitoring, while Interior's Fish and Wildlife Service enforces the Endangered Species Act, which provides for the protection and restoration of fish and wildlife habitats—two common goals of watershed projects. The Department of Commerce, through the National Oceanic and Atmospheric Administration and the National Marine

Fisheries Service, provides technical and financial assistance. Finally, the U.S. Army Corps of Engineers is responsible for issuing permits under the Clean Water Act for the discharge of dredged and fill materials into U.S. waters, including wetlands.[3]

Watershed Projects Vary in Size, Objectives, and Funding

Nationwide, federal agencies identified 618 watershed projects that had received federal funds through early 1995. The projects ranged in size from as few as 5 acres to over 150 million acres; about 60 percent covered less than 80,000 acres. Figure 1 shows the distribution of projects by size.

Figure 1: Distribution of Watershed Projects by Size



Note: Agencies did not report the size for 84 of the 618 projects.

The projects were geared toward solving various types of problems. As shown in figure 2, over half of the projects were aimed at surface water, about 7 percent at groundwater, and the remainder at both surface water

[3]The U.S. Fish and Wildlife Service makes advisory comments on applications for these permits.

and groundwater resources. More than 85 percent of the projects addressed multiple types of pollutants, while the rest addressed a single pollutant. As shown in figure 3, nutrients and sediments were the pollution problems most frequently addressed by the watershed projects.

Figure 2: Water Bodies Addressed by Watershed Projects

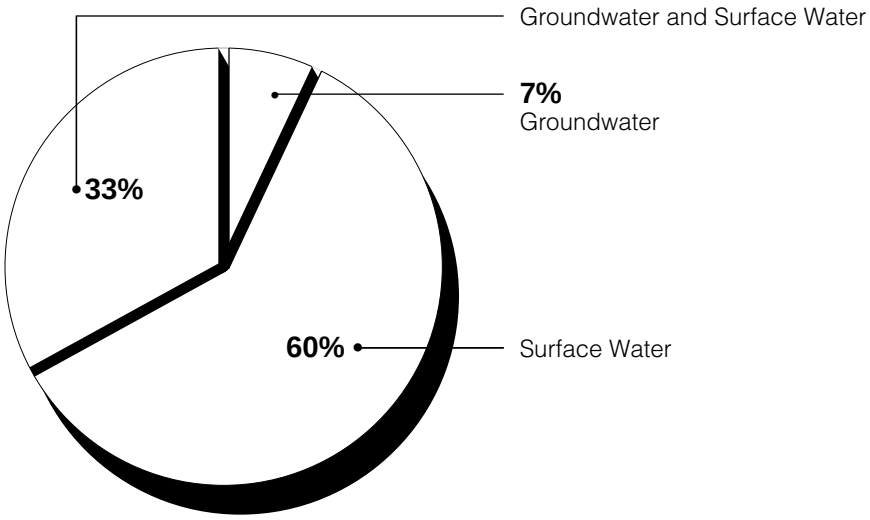
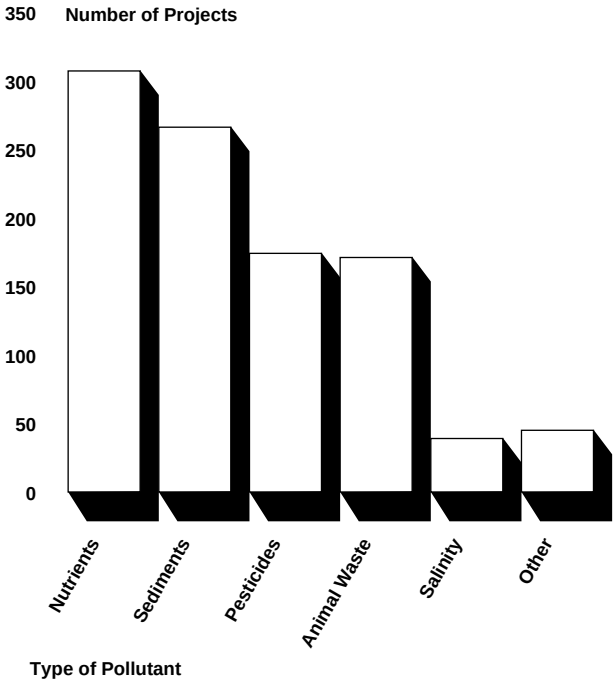


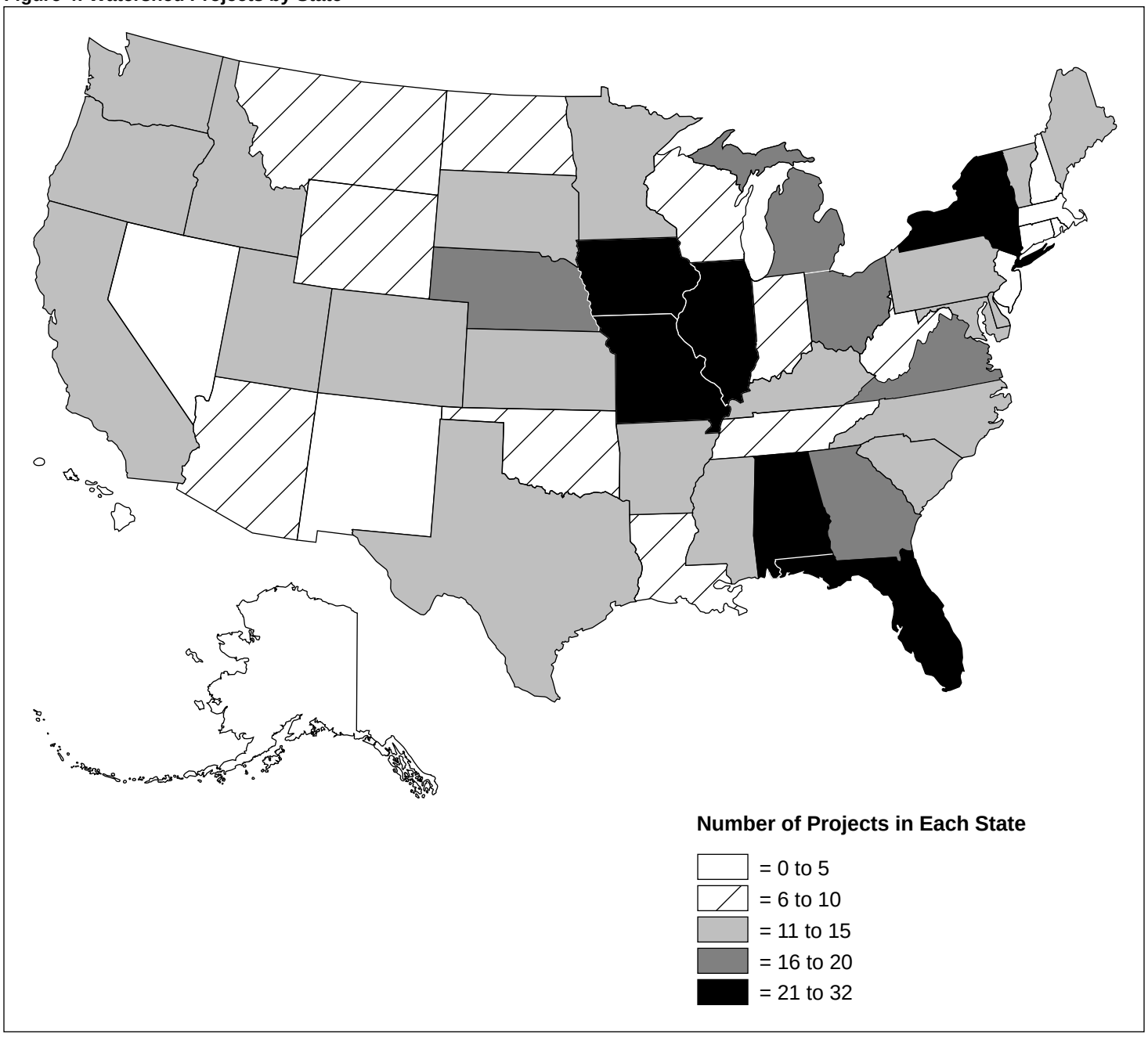
Figure 3: Pollutants Addressed by Watershed Projects



Note: The total exceeds 618 because some projects addressed more than one pollutant.

As illustrated in figure 4, the watershed projects were distributed fairly evenly across the states. Iowa had 32 projects, while Alaska and Nevada had no ongoing projects; the rest of the states averaged 12 projects each.

Figure 4: Watershed Projects by State



The 618 projects had been operating for between 5 months and 33 years, with an average of 4 years. Over the years, these 618 projects have received federal watershed funding totaling $514 million as of early 1995. The estimated funding averaged about $800,000 per project, ranging from a low of $8,000 to a high of $75 million. In addition, some projects received additional funds from other federal programs, such as USDA's Conservation Reserve Program, which also contribute to water quality goals but are generally not considered components of watershed projects.

Federal Flexibility and Locally Driven Approaches Are Key to Managing Nine Agricultural Watershed Projects

The common experiences of the nine projects we looked at suggest that achieving success in watershed-based approaches depends on (1) the flexible application of federal assistance and (2) the ability of local officials to enlist broad support and to craft solutions customized to their local needs. At the federal level, participants believed that financial and technical assistance tailored to locally established goals was more effective than prescriptive solutions. At the local level, they identified education, stakeholders' involvement, and a customized approach to improving water quality as the keys to a successful project.

Participants Favor Flexible Federal Role

Since each watershed project has unique local characteristics, participants emphasized that federal agencies should adopt a flexible approach, providing funding and technical assistance without prescriptive solutions. In some cases, inflexible federal rules hampered the funding and execution of solutions to watershed problems.

Each project we reviewed combined and addressed such characteristics as the type and source of the pollutant, local agricultural practices, impacts, and the community's attitudes. For example, both the Big Spring Basin and the Tar-Pamlico River Basin projects were initiated to reduce pollution resulting from nutrients.[4] However, the Big Spring Basin project addresses groundwater contamination from agricultural sources, while the Tar-Pamlico River Basin project addresses surface water contamination from municipal and industrial sources in addition to agricultural sources. An approach to mitigating agricultural discharges that would improve water quality at Big Spring Basin would likely have to be modified in the Tar-Pamlico River Basin to mitigate municipal and industrial discharges

[4]Excessive nutrients are caused by point-source dischargers, such as municipal sewage treatment plants, and by agricultural nonpoint sources of pollution, such as the nitrogen contained in animal manure and the chemical fertilizers applied to croplands. Excessive nutrients cause algae and plants to grow too rapidly. When the plants die and decompose, the dissolved oxygen in the water required by fish and other species is consumed.

and would have to take into account that pollutants reach surface water and groundwater in different ways. Similarly, both the Coos Bay-Coquille River and West Stanislaus County watersheds faced problems resulting from erosion. In the Coos Bay-Coquille River project, the erosion was caused by a combination of timber and agricultural practices, while in West Stanislaus the erosion was caused by the runoff of irrigation water. As a result, the two projects need different strategies to reduce erosion. In addition, the Coos Bay-Coquille River project addressed other problems, such as elevated water temperatures, that were not present in West Stanislaus.

Because of these combinations of various characteristics, the projects' participants said that flexible program implementation is crucial to achieving watershed goals. Watershed projects frequently depend on multiple sources of funding and technical assistance obtained through different state and federal programs, each with different requirements. Federal assistance to the nine projects represented about half of the projects' resources. Agency staff involved in most of the projects we reviewed demonstrated flexibility in working with other participants to meet project goals. For example, USDA and EPA representatives involved in the Huichica Creek project emphasized that they had to find creative ways to work within their respective agencies' regulations to devise effective strategies and encourage participation by producers. Similarly, participants in the West Stanislaus project said that a key to putting together an effective program was the willingness of federal officials to focus on the overall goal of the watershed project rather than their individual programs.

However, in several of the projects we reviewed, the participants also pointed out a need for increased levels of and greater flexibility in the financial assistance provided to farmers. For example:

- Participants in the West Stanislaus County, Lake Champlain, and Tar-Pamlico River Basin projects said that changes are needed to (1) provide additional funding to farmers for adopting practices that reduce nonpoint-source pollution and (2) separate funding for improving water quality from funding for agricultural conservation. According to participants, the annual $3,500-per-farmer maximum placed on Agricultural Conservation Program funding is inadequate to support some of the structural measures needed to reduce nonpoint-source pollution. Furthermore, as currently structured, provisions for cost-sharing cover a variety of agricultural conservation practices, including those, such as

leveling land for irrigation and building irrigation canals, that may be more related to water conservation and increased crop production than to efforts to improve water quality. Farmers could apply the $3,500 to practices that increase their yield rather than to practices that reduce agricultural pollution but are of no financial benefit. Efforts to reduce nonpoint pollution from agricultural sources can be hindered when competing conservation goals result in applying cost-sharing funds to practices that have little or no direct relationship to water quality.

- Participants in the Huichica Creek project pointed out that USDA's Small Watershed Program, which is primarily geared toward flood control, provides funding for solutions that are unnecessarily complex. For the problems at Huichica Creek, the solutions eligible for funding would cost far more than the simpler solutions the participants used. For example, USDA staff and landowners wanted to stabilize stream banks to minimize erosion, but they believed USDA's solution of lining stream banks with rocks was too expensive. Instead, they found that planting young saplings low on the exposed stream bank and interweaving their branches to create a living reinforcement was a much cheaper approach.
- Participants in the West Stanislaus project said the funds received under USDA's Hydrologic Unit Area program cannot be used for monitoring water quality, and participants in the Coos Bay-Coquille River and the Otter Lake projects noted that funds received under section 319 of the Clean Water Act could not be used for the planning and additional demonstration activities they needed.

The projects' participants also stressed the need for flexibility in the role federal agencies play in providing technical assistance to help farmers implement pollution-reduction practices. USDA staff served on the technical advisory committee for the Otter Lake project, although the overall approach was set by the project's resource planning committee. In the West Stanislaus County project, USDA staff took a more active role, writing the project plan that established the implementation approach as well as identifying an innovative technical solution: using polymers in irrigation systems to reduce sediment runoff. In addition, USDA provided a sociologist to help develop approaches that would maximize voluntary participation.

However, inflexible federal processes were also cited by some participants. For example, in voicing concern over rigid agency procedures and operating methods, Coos Bay-Coquille River project and state government officials said it took 9 months to obtain a permit from the Army Corps of Engineers (which regulates the disposal of dredged and fill material from wetlands) to build an off-channel pond and to spread the

few cubic yards of earth removed in the process over a pasture. Project officials said they could not understand why it took so long to get a permit for such a simple project.

Participants Favor Locally Driven Approach

The nine innovative or successful projects we reviewed were able to adopt a locally driven approach to achieving the goals for the watersheds. Key elements in a local approach were educating prospective participants about how water quality improvements would benefit them; achieving consensus among these stakeholders in selecting a project's goals and approaches; and tailoring the project's strategy, water quality monitoring, and regulatory enforcement to local conditions.

Educating Prospective Participants

Education and public outreach played an important role in encouraging cooperation in many of the projects we reviewed. Farm demonstration projects and myriad educational activities were used to familiarize farmers and the general public with the relationship between agricultural or other activities and water quality problems and to encourage the adoption of practices designed to reduce these problems.

The Big Spring Basin project in Iowa, for example, used an intensive strategy of public education and farm demonstration projects to introduce farmers to management practices that would improve their efficiency and profitability while also reducing the impacts of agriculture on water quality in the watershed. According to participating farmers, the opportunity to observe—through a manure management demonstration project on a neighbor's farm—that nutrients could be reduced gave them the knowledge and confidence they needed to change their own manure management practices.

In the Lake Champlain project, a great deal of effort is being expended to inform the public about the water quality problems affecting the lake and to encourage the community's involvement. Educational and outreach activities include public meetings, the formation of grassroots environmental groups, videos, newsletters, school presentations, and water quality fairs. Similarly, the Coos Bay-Coquille River project, recognizing the role of future generations, has developed a high school curriculum to help students better understand the watershed they live in and the potential impact their activities have on water quality.

Public education can also involve less structured efforts. For example, the Coos Bay-Coquille River and Huichica Creek project staffs noted that they

spent a lot of time meeting with potential participants informally, answering questions and concerns over a cup of coffee.

Achieving Consensus Among Stakeholders

In addition to achieving public awareness, projects need to solicit stakeholders' consensus on goals and approaches, according to participants. Watershed projects typically involve a variety of stakeholders, often having different views about a project's appropriate scope, approach, and management. The stakeholders may include the government agencies responsible for environmental issues or land management; agricultural, timber, fishery, mining, or other commercial industries; recreational users; municipalities; and urban homeowners. For most of the projects we reviewed, participants agreed that broad-based participation by stakeholders is critical in breaking down barriers and building trust among groups. We noted in several projects that respected community leaders with strong interpersonal skills were instrumental in bringing the stakeholders together.

One example of successful consensus building is the Coos Bay-Coquille River project, which was managed by associations comprising representatives of timber companies, private landowners, federal land management agencies, state agencies with water and habitat responsibilities, and other interested parties. According to association members, inclusion of the agricultural community in the watershed associations helped members of that community overcome their general distrust of government regulation and negative attitudes about "environmental" initiatives, emanating from federal activities to protect the spotted owl and salmon, which local citizens blamed for harming the local economy.

Projects that impose solutions without getting stakeholders' buy-in have a greater difficulty in achieving success, as illustrated by the experiences of the Tar-Pamlico River Basin project in North Carolina. The project used a two-phase process to address nutrient pollution. The project's organizers used public hearings to obtain input from those in the watershed and negotiation and consensus to reach agreement on the implementation strategy and water quality goals. Although this worked well for the first phase, the process broke down during the negotiations in the second phase. The state ultimately approved phase two of the project over the objections of environmental and community groups, which disagreed with (1) the goals for reducing nutrients, (2) the allocation of most of the burden for the reduction to nonpoint sources, and (3) the revised formula used to determine the amount of funds that point-source dischargers

would contribute to reduce nonpoint-source pollution in an innovative nutrient credit trading program. Under this program, point-source dischargers agreed to contribute to a nutrient credit trading fund whenever they exceeded the discharge limits. The fund would be used to finance more cost-effective actions to reduce nutrient pollution from agricultural nonpoint sources. However, environmental and community groups felt that concessions made to point-source dischargers in the agreement in phase two shifted too much of the financial burden of improving water quality to the agricultural community. Unless steps are taken to address the misgivings of these groups, a key stakeholder is contemplating a lawsuit against the state to block this phase of the project.

Tailoring Strategies, Monitoring, and Enforcement to Local Conditions

The experiences of successful projects illustrate that strategies, water quality monitoring, and regulatory enforcement efforts vary, depending on local conditions. For instance, while all the projects generally engaged in some form of planning to ensure that stakeholders agreed on the causes of the problem and the corrective actions needed, they devoted different levels of time, effort, and funding to developing such plans. For example, the Lake Champlain project staff spent significant time identifying the cause of that area's water quality problem before developing a watershed strategy. They systematically monitored the water quality in rivers and streams feeding into the lake, which allowed them to gradually pinpoint the sources of the problem. In contrast, for the Coos Bay-Coquille River project, which is smaller and has less complex problems, a lengthy planning process was not necessary. The community agreed that sediment and riparian (riverbank) destruction in the Coquille watershed were impeding fish spawning and that the salmon fishery was a resource they wanted to save. They quickly established goals for improving the salmon population and measured progress using fish counts.

Similarly, implementation strategies varied according to local conditions and preferences. The Big Spring Basin project, for example, heavily emphasized demonstration and educational activities, whereas the Big Darby Creek project undertook relatively few demonstration projects, preferring instead to provide funds to support individual farmers' practices. The Big Darby Creek project also took advantage of a state program that provides low-interest loans to those who implement solutions for nonpoint-source pollution. The Tar-Pamlico River Basin project developed the innovative nutrient credit trading program described previously, which meets the overall goal for reducing the discharge of nutrients by allowing the point-source dischargers to finance the reduction of discharges from nonpoint sources.

While all participants agreed on the importance of evaluating a project's performance, they tailored the rigor of their evaluations to the project's goals. The Coos Bay-Coquille River projects used fish counts to monitor progress, and the West Stanislaus project used sediment assessments, which were easily accomplished by viewing the color of the farms' agricultural drain water. In contrast, the Big Spring Basin project had over 50 sites to monitor groundwater flow, conductivity, alkalinity, temperature, nitrates, and pesticides.

The projects' participants pointed out, however, that even given rigorous monitoring, demonstrating a link between changes in land use and diminished chemical pollution is difficult, if not impossible, especially within a short time frame. For example, participants in the Lake Champlain, Tar-Pamlico River Basin, and Big Darby Creek projects noted that current science can demonstrate only a tenuous link between land use practices and water quality, and it may take years for their projects to produce chemical improvements in water quality. Similarly, participants in the Big Spring Basin project said that climatic variations, such as droughts followed by years of heavy rainfall, and other factors have made it difficult to establish a link between changes in farming practices and groundwater quality, despite more than 10 years of monitoring and analysis.

All nine watershed projects we reviewed are striving to promote voluntary participation by farmers, but several felt it was also necessary to provide for regulatory enforcement in case cooperation was lacking. Three states—Wisconsin, North Carolina, and Illinois—and two projects have included regulatory components in their watershed management strategies. Wisconsin has enacted statutes that provide for state enforcement actions, such as revoking cost-share agreements, against uncooperative individuals. North Carolina requires the adoption of certain best management practices. Illinois allows public water suppliers to use watershed management strategies to comply with safe drinking water standards, but if compliance is not accomplished within specified time frames, contingency measures must be implemented. In the West Stanislaus project, one water district, which is responsible for managing irrigation canals and maintaining water quality within its jurisdiction, can withhold irrigation water from farmers who refuse to adopt practices that reduce sedimentary runoff from their fields. In the Huichica Creek project, participants voluntarily developed additional restrictions on the use of certain pesticides, which EPA approved for inclusion on the labels of pesticides sold in the Huichica Creek area. At some projects, such regulatory provisions were considered unnecessary and in fact

counterproductive. For example, the environmental members of the Coos Bay-Coquille River and the Lake Champlain projects said voluntary efforts were the most feasible way of reducing nonpoint-source pollution, given their communities' resistance to regulatory enforcement.

Agency Comments

We discussed the facts in this report with USDA officials, including the Special Assistant, Strategic Natural Resources Issues Staff, Natural Resources Conservation Service, and with EPA officials, including the Deputy Director, Assessment and Watershed Protection Division, Office of Water. They fully agreed with the information presented, and we have included their comments where appropriate.

We performed our review between December 1994 and June 1995 in accordance with generally accepted government auditing standards.

To compile an inventory of federal watershed projects, we contacted officials at USDA, EPA, the Tennessee Valley Authority, and the Department of the Interior headquarters and regional offices to obtain their internal inventories of federal watershed projects addressing water quality problems caused by agricultural production. While we reviewed and refined these lists to eliminate duplication and clarify the descriptive information provided, we did not verify the data provided.

To obtain information on the lessons learned at innovative or successful watershed projects, we judgmentally selected and reviewed nine projects from a universe of innovative or successful watershed projects identified by USDA, EPA, and state water quality officials. These nine projects were chosen to reflect a variety of project sizes, locations, agricultural sectors, water quality problems, and management and technical approaches. We cannot make generalizations based on our analysis of these projects since they were judgmentally selected and represent only a small portion of the more than 600 projects nationwide that receive federal funds. We visited each site and discussed the project's activities in detail with federal, state, and local government officials as well as with the project's participants. We also reviewed project documents, such as management plans, status reports, and the results of water quality monitoring. Appendixes I through IX discuss each project's location and problem, genesis and management, planning and funding, key approaches and observations, and accomplishments.

We are sending copies of this report to interested congressional committees, the Secretaries of Agriculture and the Interior, and the Administrator of the Environmental Protection Agency. We will also make copies available to others upon request.

Please call me at (202) 512-5138 if you or your staff have any questions about this report. Major contributors to this report are listed in appendix X.

John W. Harman
Director, Food and
Agriculture Issues

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Figures

Abbreviations

EPA	Environmental Protection Agency
GAO	General Accounting Office
USDA	U.S. Department of Agriculture

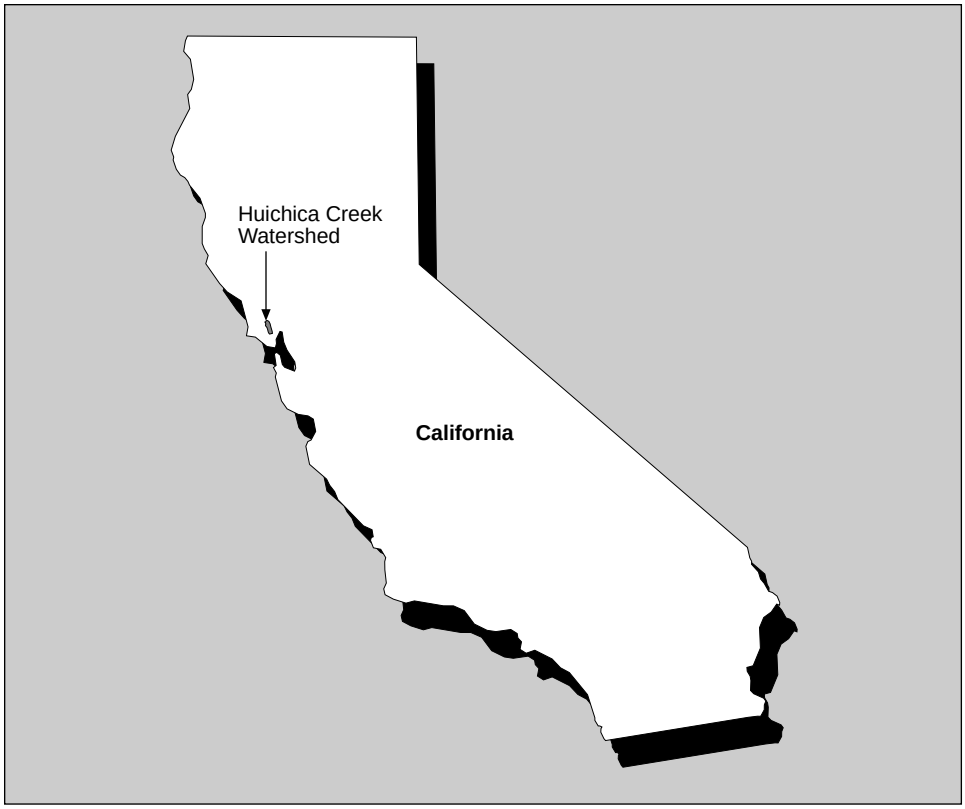
Huichica Creek Watershed

The major lessons of the Huichica Creek watershed project were that (1) federal program guidelines and financial assistance need to be more flexible and (2) involving stakeholders in project planning can result in a high level of participation and motivate landowners to voluntarily seek tougher regulatory restrictions to head off an environmental crisis before it occurs.

Project's Location and Problem

The Huichica Creek watershed represents about 4,500 acres of rolling to steep hills in California's Napa Valley, as shown in figure I.1. Huichica Creek drains into the Napa River, which eventually empties into San Francisco Bay. The watershed is primarily vineyards and dairy pasture land.

Figure I.1: Location of the Huichica Creek Watershed



The Huichica Creek area, historically considered unsuitable for vineyards, was used primarily for dairy operations and pasture lands. Vintners began to recognize the potential for growing grapes in the Huichica Creek watershed as a result of additional viticultural research and the increasing use of new grape varieties.

Project's Genesis and Management

In 1988, staff from the Napa County Resource Conservation District[5] and the U.S. Department of Agriculture (USDA) began to contact the landowners in the Huichica Creek watershed to discuss the need for a long-range resource management plan. Landowners and vineyard managers were very receptive to this concept, and some had already begun efforts along this line. In 1991, agency staff and landowners joined together in a partnership called the Huichica Creek Land Stewardship. Participants describe the stewardship as a "land use ethic" rather than an organization. The Napa County Resource Conservation District acts as a focal point for stakeholder communication and coordination, and the stakeholders hold meetings when they believe it is necessary.

Project's Planning and Funding

The stewardship issued the Huichica Creek Watershed Natural Resource Protection and Enhancement Plan in May 1993, about 2 years after they began the project. The plan emphasizes (1) advice and information on practices that landowners can use to farm in the watershed without negatively affecting water quality and wildlife habitat and (2) low-tech approaches, such as planting "cover crops" between the rows of grape vines to reduce erosion. Participants are also replacing chemical approaches to pest control with biological ones, such as installing housing to attract insect-eating bats or roosts to attract predator birds that keep the rodent population in check.

As shown in table I.1, the Environmental Protection Agency (EPA) and the state were the major government funding sources. However, conservation district staff said that landowners had contributed far more in labor, materials, and funds than the federal and state agencies, although they were unable to estimate the community's total contribution.

[5]Resource conservation districts are local governmental organizations that implement programs for the conservation, use, and development of soil, water, and related resources.

Table I.1: Huichica Creek Watershed Funding

Funding source	Amount
USDA	$11,000
EPA	88,000
State	95,000
Sonoma Valley Vintners and Growers Association	4,000
Total	**$198,000**

Source: Napa County Resource Conservation District.

Key Approaches and Observations

Agency staff and participating landowners said that federal watershed program guidelines were too restrictive and inflexible. For example, they said that programs such as USDA's Small Watershed Program, while beginning to move away from a strong tradition of construction and flood control, were still using a pre-selected menu of engineered practices instead of creative solutions developed specifically for each site. They felt this approach was not sufficient to preserve and enhance the diversity of plants and wildlife in a way compatible with agricultural operations. Furthermore, they believed the solutions arrived at through that process were overengineered for their situation. Agency staff and landowners wanted to stabilize stream banks to minimize erosion, but they believed USDA's solution of lining stream banks with rocks was too complex and expensive. They found that they could reinforce stream banks by planting young saplings low on the exposed bank and interweaving their branches to create a living reinforcement. This approach cost a fraction of the cost of installing rocks.

Participants identified several reasons for the high level of participation in the stewardship and for landowners' quick acceptance of the Huichica Creek implementation plan—they adopted practices suitable for their operations even before the plan was complete. First, landowners were heavily involved in developing the plan and were therefore disposed to implement the recommended practices. Second, having 90 percent (63 of 70) of the Huichica Creek landowners involved in the stewardship facilitated communication and fostered a sense of community. Third, some vintners were also motivated by market concerns, such as potential consumer reactions to pesticide use or the endangerment of a protected species.

Stakeholders' involvement and high participation rates were instrumental in the stewardship's reaching consensus to seek tougher regulations regarding the use of certain pesticides in the Huichica Creek watershed. These additional regulations, sought by the landowners with technical support from county, state, and federal agencies, were approved by EPA in 1992. As a result, Huichica Creek farmers must comply with 12 additional handling and use requirements on certain pesticides that are potentially toxic to the California fresh-water shrimp.

Finally, although the stewardship focuses on getting commitment to changing practices rather than achieving a particular goal, it recognizes the need to monitor results. Therefore, the project includes a number of quantifiable measures to monitor the condition of the watershed. These include monitoring soil structure and quality, endangered species habitat, use of irrigation water, water quality, and the stability of stream banks and channels.

Accomplishments

The Huichica Creek project's accomplishments include (1) enlisting 63 of the 70 local landowners to participate in the watershed stewardship, (2) restoring and stabilizing 800 feet of stream banks, (3) planting at least 10,000 trees to revegetate stream banks and the upper reaches of the watershed, (4) planting four demonstration sites to show the suitability of different cover crops to various soil-hydrology combinations, and (5) completing a water survey to estimate the average runoff from each watershed section to help landowners and managers stabilize stream flows.

West Stanislaus County Watershed

The major lessons of this project were that (1) involving local stakeholders is key to getting voluntary participation, (2) financial assistance limits and inflexible requirements hindered efforts to reduce nonpoint-source pollution, and (3) the threat of regulation can help motivate farmers to take action.

Project's Location and Problem

The West Stanislaus watershed is located about 70 miles southeast of San Francisco, California, as shown in figure II.1. The watershed occupies 134,000 acres, of which approximately 122,000 acres are irrigated farmland, such as row and field crops, orchards, and vineyards. The watershed encompasses about 400 farms.

Figure II.1: Location of the West Stanislaus County Watershed

Eight creeks flow across the watershed and drain into the San Joaquin River. During the arid summer months, the water in the creeks is composed entirely of agricultural runoff, primarily from furrow irrigation. This irrigation method usually results in some erosion, but the highly erodible soil in the West Stanislaus watershed exacerbates the problem. The average level of sediment in the irrigation runoff is 1,500 milligrams of soil per liter, although erosion in some areas reaches as high as 9,000 milligrams of soil per liter. USDA officials describe the irrigation runoff as being chocolate brown in color.

Such high levels of sediment have a number of impacts on the San Joaquin River. Of particular concern are organochlorine pesticide residues, especially DDT (dichloro-diphenyl-trichloro-ethane) residues, which persist in the soil for decades. In addition to having a negative impact on fish and other aquatic life, the sediment increases needed maintenance for the river, drainage ditches, and canals, which have to be periodically dredged to remove built-up sediment.

Project's Genesis and Management

After almost 20 years of study, the farmers in West Stanislaus decided it was in their best interests to solve the sediment problem voluntarily rather than have a regulatory agency dictate a solution. The state of California is considering a water quality strategy that includes three levels of implementation—voluntary implementation of conservation practices; regulatory or institutional encouragement of conservation practices, such as waiving requirements concerning discharges if practices are implemented; and regulation, such as issuing permits that specify the type, amount, and concentration of pollutants that may be discharged.

The West Stanislaus Resource Conservation District sponsored the watershed project and worked closely and cooperatively with USDA staff to establish the overall goals and implementation strategy for reducing erosion. An additional 25 federal, state, and local agencies provided financial and technical support, including EPA, the California EPA Department of Pesticide Regulation, and the Central Valley Water Quality Control Board.

Project's Planning and Funding

USDA staff took the lead in developing a strategy to achieve the chosen goal of reducing sediment to 300 milligrams of soil per liter of drain water, an 80-percent reduction in average erosion. USDA issued the West Stanislaus Sediment Reduction Plan in February 1992, after it had been reviewed and

approved by the resource conservation district. The strategy for reaching the project's goal is to (1) develop and conduct a comprehensive information and education program, (2) provide cost-sharing assistance, (3) provide technical assistance, and (4) provide for monitoring and evaluation. The plan describes 17 conservation practices that reduce erosion, outlines each practice's advantages and disadvantages, and estimates the costs and reductions in erosion. It then provides detailed work sheets to help farmers identify the most cost-effective combination of practices, given their soil and crops. According to USDA staff, the plan does not include a detailed water quality monitoring strategy because the funds received under USDA's Hydrologic Unit Area program cannot be used for water quality monitoring.

As shown in table II.1, most of the government funding came from USDA, but farmers also contributed a significant amount in labor and materials.

Table II.1: West Stanislaus County Watershed Funding

Funding source	Amount
USDA	$1,391,000
Department of the Interior	268,000
State	407,000
Farmers	4,000,000
Total	**$6,066,000**

Source: USDA Natural Resources Conservation Service.

Key Approaches and Observations

Several factors were considered influential in gaining participation in a watershed project. First, USDA staff and the project's participants agreed that the involvement of the members of the Conservation District's Board of Directors, who are well-known and respected farmers, was a key to garnering local support. If outsiders come into the community with solutions, local farmers are skeptical, because they believe each farm is unique in its combination of crops, soils, and management techniques. Second, to discover how to motivate local farmers to participate in the project, a USDA sociologist was used to develop enlistment strategies and estimate the farmers' participation rates. Although participants were initially skeptical, many felt that the sociologist was very helpful in understanding the social and economic currents that contributed to the project's success. Third, participants' ability to see reductions in erosion with their own eyes helped increase participation. USDA staff developed a guide that shows the color of irrigation drain water at three sediment

levels: 300 milligrams of soil per liter, 1,000 milligrams of soil per liter, and 9,000 milligrams of soil per liter. Farmers can easily determine whether they are meeting the goal of 300 milligrams, as well as observe whether their neighbors are meeting it.

Financial assistance also helped increase participation, but cost-sharing ceilings and inflexible requirements limited its usefulness. USDA staff noted that farming is viewed as a financially risky occupation; thus, farmers are reluctant to adopt new, unproven practices that could threaten their profit margin. They said that USDA's cost-sharing program helped mitigate the financial impact of new practices, but farmers are limited to $3,500 per year in cost-sharing assistance. Some farmers told us that this hindered the effectiveness of the program because many of the practices recommended by the USDA technical experts, such as installing irrigation piping that can control water flow, require significant financial outlays.

After the plan was developed, USDA staff learned of a new technique that could help reduce sediment but is not eligible for cost-sharing funding. Adding a polymer to the irrigation water causes the sediment to settle out much faster, reducing erosion runoff from the fields. The polymer has been used in water treatment plants for years but has not yet been approved for agricultural use. Participants obtained permission to test the polymer, which costs about $10 per acre, for agricultural uses in West Stanislaus County but had to proceed without federal cost sharing because this treatment is not authorized in USDA's program guidance.

Although the project's participants were motivated in part by a desire to avoid regulation, some felt that encouraging voluntary participation by itself was insufficient to ensure that the project's goals are achieved. One of the water districts[6] in the watershed decided to require that farmers reduce the sediment in their runoff to 1,000 milligrams per liter to receive water for irrigation, under the threat of halting water deliveries. The water district, which covers 25 percent of the watershed, has never had to cut off water deliveries, and 90 percent of its farmers are in compliance.

Accomplishments

Structural and managerial best practices have been adopted on about 20 percent of the watershed, or 25,000 acres. USDA estimates that the project has reduced the sediment reaching the San Joaquin River by about 340,000 tons since the project began and thereby reduced the DDT reaching

[6]Water districts are responsible for operating the irrigation and drainage canals and maintaining the water quality in their districts.

the river by about 620 pounds. Another benefit of changing irrigation techniques is that farmers have reduced the amount of irrigation water they use by 18 percent, saving about 11,000 acre-feet of water.

Otter Lake Watershed

The major lessons of the Otter Lake watershed project were that (1) a holistic approach is important for successful watershed management and (2) federal financial assistance can be instrumental in improving water quality.

Project's Location and Problem

Otter Lake covers 765 acres in southern Illinois, as shown in figure III.1. Built in 1968, Otter Lake is one of eight lakes contributing to the public water supply of Macoupin County and provides drinking water and recreational uses for about 14,000 people in seven communities. The lake's water supply is recharged by runoff water drained from the 12,250-acre watershed, 87 percent of which is agricultural land.

Figure III.1: Location of the Otter Lake Watershed

Excess sedimentation, caused by cropland and shoreline erosion, is a primary cause of the declining water quality in Otter Lake. Sediment has increased turbidity (murkiness), which has reduced aquatic vegetation. It may also be impairing the levels of dissolved oxygen, harming fish reproduction and overall health. All of these factors, in turn, may force a shift in the fish species that populate the lake.

Pesticide residues and other organic materials in farm runoff are also impairing the water quality in the lake. In 1993, Otter Lake was one of three public water supply lakes in the county found to have atrazine levels exceeding the standard established by EPA under the Federal Safe Drinking Water Act. Atrazine, an herbicide commonly used on corn, is a potential carcinogen for humans; it is water soluble and takes 15 to 20 years to break down.

Project's Genesis and Management

Responding to a 1990 USDA request to identify and prioritize concerns about water resources, the Macoupin County Soil and Water Conservation District board selected five lakes that contribute to the public water supply for priority attention, including Otter Lake because of its high sediment levels.[7] After the Otter Lake Resource Planning Committee was formed in June 1992, preliminary evidence of atrazine problems in the Otter Lake was discovered.

Responsibilities for managing the project are shared by three organizations representing community, state, and federal agencies—a commission, a resource planning committee, and a technical advisory committee. The commission, a quasimunicipal corporation that sells water to seven communities in the watershed, has decision-making authority for all matters related to the lake and surrounding property. The resource planning committee, comprising members from the agricultural community such as farmers and agribusiness leaders, provides local input to define resource concerns and leadership during the development and implementation of the watershed plan. The technical advisory committee, comprising representatives from the Illinois Environmental Protection Agency, Department of Conservation, and Department of Agriculture as well as the U.S. Department of Agriculture, advises the planning committee throughout the project.

[7]In Illinois, Soil and Water Conservation Districts are county-level entities responsible for guiding and implementing a local conservation program and are supported by grants from the Illinois Department of Agriculture.

Project's Planning and Funding

With guidance from the technical advisory committee, the planning committee decided to pursue funding to implement sediment control measures, recognizing that some of those measures could also be used for atrazine control. However, in August 1993 the Illinois EPA placed Otter Lake on its restricted status list for atrazine. This designation generally prohibits further development and requires compliance within a period of time that varies with the compliance strategy chosen. Otter Lake may choose from among the following compliance strategies: (1) apply water treatment technologies (e.g., activated charcoal treatment), (2) locate a new source of drinking water, (3) blend water from the current source with water from alternative sources, and (4) implement watershed management measures.

The atrazine finding encouraged the planning committee to shift from single-issue planning to broader watershed planning and, eventually, to comprehensive "ecosystem" planning. In ecosystem planning, an inventory of regional concerns is developed in addition to an inventory of local community concerns. Best management practices recommended for one resource area must be evaluated to confirm that they do not impair others. Although a final ecosystem plan has not yet been approved, the project aims to encourage (1) management changes on 75 to 80 percent of all acres in the watershed and (2) widespread installation of structural measures, such as sediment control basins and artificial wetlands.

Otter Lake has received most of its project funding to date from USDA, as shown in table III.1.

Table III.1: Otter Lake Watershed Funding

Funding source	Amount
USDA	$201,000
EPA	54,000
Landowners	25,000
Local contributions	12,000
Total	**$292,000**

Source: USDA Natural Resources Conservation Service.

Key Approaches and Observations

Otter Lake has used federal financial and technical assistance to help farmers design, demonstrate, and implement various structural and management practices aimed at reducing nonpoint-source pollution in the watershed. For example, the project funded the implementation of certain

management practices, such as integrated crop management, a practice designed to minimize pesticide use; the planting of pasture and hay land to reduce erosion; and animal waste management to control nutrients. Furthermore, with the help of state and federal staff, a demonstration project to construct 14 water and sediment control basins and 2 permanent wetlands structures was designed to show how such containment structures, combined with plantings, can remove atrazine and other pollutants from the water system. According to project staff, some farmers have expressed interest in implementing similar structures, but it is uncertain how funding will be secured to meet this demand. According to EPA officials, funding for the additional demonstration projects requested by the farmers is unlikely because such structures would duplicate those already in place in the Otter Lake project area.

In addition to financial assistance, flexibility is also important for monitoring a project's results. A USDA official said that some water quality monitoring is needed if a watershed project has numerical goals (e.g., 3 parts per billion for atrazine in Otter Lake), but it does not have to be extensive. The official said that information about water quality helps to educate and motivate farmers. In addition, the official believes that water quality is a good indicator of overall health of the watershed. At Otter Lake, the Illinois EPA and a chemical manufacturer are sampling and analyzing the lake water, and the water commission is sampling and analyzing the tap water.

Accomplishments

Monitoring results have shown acceptable atrazine levels in Otter Lake for the last three quarterly test periods. According to a USDA official, the behavior of atrazine in natural systems, including the reasons for fluctuations in Otter Lake itself, are not well understood, so these results are inconclusive. Furthermore, after obligating its fiscal year 1995 funds, the project is expected to reach its acreage goal for implementation of management practices.

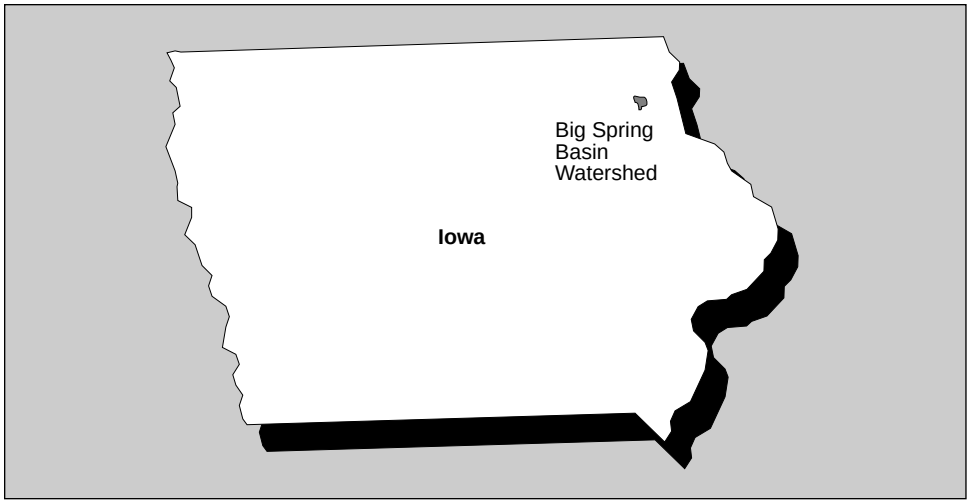
Big Spring Basin Watershed

The major lessons of the Big Spring Basin watershed project are that (1) education is key to a project's success and (2) the relationship between changes in land use and chemical improvements in water quality may be difficult to demonstrate.

Project's Location and Problem

Big Spring Basin covers about 66,000 acres of northeastern Iowa's Clayton County, as shown in figure IV.1. The area is heavily agricultural, primarily cropland planted in corn and alfalfa and livestock operations. About 220 farmers live in the watershed.

Figure IV.1: Location of the Big Spring Basin Watershed



In Big Spring Basin, groundwater aquifers (natural underground reservoirs) that supply drinking water are close to the land surface and are thus vulnerable to contamination from surface activities, particularly agricultural operations. The primary concern about water quality is nitrate contamination of the groundwater, which can occur through downward percolation of nitrogen from manure or chemical fertilizers applied to cropland or from surface runoff that enters the groundwater system through sinkholes or other passageways. Some herbicides and insecticides also have been detected in the Big Spring Basin's groundwater.

Project's Genesis and Management

In Big Spring Basin, data on water quality dating back to 1961 showed strong correlations between the use of nitrogen fertilizers and the concentration of nitrates in the groundwater. During the next 2 decades, the use of nitrogen fertilizer in the watershed more than doubled, while nitrate concentrations in Big Spring tripled. In 1981, the Iowa Geological Survey began extensive, continuous water quality monitoring in Big Spring; by 1983, the survey had documented a steady decline in the quality of the groundwater in the watershed. At the same time, numerous meetings were held, educational activities conducted, and task forces convened to discuss the problem. In late 1983, the Northeast Iowa Conservancy District and the Iowa Cooperative Extension Service formed the Ad Hoc Karst Committee,[8] later renamed the Iowa Consortium on Agriculture and Groundwater Quality, to design a multiagency, tiered research and demonstration project for the Big Spring Basin.

The Consortium, with representatives from numerous federal and state agencies, developed the Big Spring Basin watershed proposal, which provided a broad outline for project activities. The project's day-to-day activities were managed by local project coordinators with the Iowa State University Extension. Educational, technical, and financial assistance is provided by various federal, state, and local agencies, such as USDA and EPA, Iowa's Departments of Natural Resources and Agriculture, and Iowa State University.

Project's Planning and Funding

The planning process for Big Spring Basin was informal, and participants did not produce a formal watershed management plan. The Consortium targeted key problem areas and developed a nonregulatory model for the Big Spring Basin Demonstration Project. Its objectives were to (1) reduce the potential environmental impacts of agricultural practices and (2) enhance the efficiency and profitability of farm management. These objectives would be met through a 7-year, integrated education, demonstration, research, and monitoring effort focused primarily on nitrogen management. Technical and financial assistance would be provided to participating farmers.

When the project officially began in 1986, participants had difficulty securing funding because federal and state funding sources were geared toward protecting surface water, not groundwater. Because of the limited funding, project leaders targeted the 1,005-acre Bugenhagen Subbasin, a

microcosm of the larger basin, for the project's initial effort. Like Big Spring Basin, the subbasin drains to a single outlet—a sinkhole—which provided good conditions for monitoring.

Over time, the project received funding from numerous sources, as shown in table IV.1. According to project staff, total financial support for the demonstration project was larger than it was for many watershed projects because of the scope and intensity of the education and monitoring conducted.

Table IV.1: Big Spring Basin Watershed Funding

Funding source	Amount[a]
Federal—education and technical assistance	$394,000
Federal—monitoring and other studies	1,051,000
State—education and technical assistance	2,456,000
State—monitoring and other studies	2,593,000
Federal and state—special cost sharing	625,000
Total	**$7,119,000**

[a]Figures include only funds specifically earmarked for the demonstration project for the fiscal years 1982-93.

Source: University of Iowa.

Key Approaches and Observations

Farmers and project staff alike gave enormous credit to the project's coordinators for its success. The coordinators selected for the project had a long-standing involvement in the area as county staff providing technical assistance to the agricultural community. As a result, they were regarded as credible and trustworthy, which was a critical factor in encouraging farmers' participation in the project. The coordinators drew on their familiarity with farming conditions and practices in the watershed to identify solutions that would be compatible with the farmers' needs and abilities.

Demonstration projects and other educational activities were deemed important because the project had no regulatory component and depended on voluntary participation. In the Bugenhagen Subbasin, project staff worked one-on-one with farmers to provide more intensive education and technical assistance. Demonstration projects involved nitrogen management, soil erosion, pest management, weed control, conservation

tillage, and energy conservation. Project staff provided education and technical assistance to farmers for specific practices, such as establishing realistic yield goals, soil sampling, and soil nitrate testing. Publicity and outreach activities, ranging from public meetings and field days to publications in newspapers and newsletters, were used to increase the community's awareness about the project.

The project employed an extensive network of over 50 monitoring stations to generate detailed information on the changes in water quality that accompanied improved farm management (e.g., water flow, conductivity, alkalinity, temperature, nitrates, and pesticides). Surveys of farmers' practices were conducted both in the subbasin and throughout the basin.

Showing a link between overall declines in nitrogen use and chemical changes in the groundwater is difficult. According to project staff, the effects of reducing nitrogen levels over 10 years cannot be isolated from the effects of other factors, particularly climatic variations. For example, the resulting changes in water volume caused by drought conditions in 1988 and 1989, followed by exceptionally wet conditions in subsequent years, affected the nitrate concentrations. Other factors complicating an analysis of effects on water quality include changes in application rates and in land use and cropping patterns. Project staff acknowledge that measuring the project's impact is generally difficult because much is still unknown about the movement and disposition of contaminants in groundwater systems. Recognizing the need to improve the understanding of how changes in land management eventually affect water quality, USDA is applying a computer modeling program called AGNPS (Agricultural Nonpoint Source) to the extensive data collected in Big Spring Basin so the agency can estimate how reductions in the rates of pesticide and fertilizer application eventually affect water quality.

Accomplishments

Throughout the basin, more than 200 farmers voluntarily decreased their use of nitrogen as a result of the project. The average amount of nitrogen fertilizer used for corn production between 1981 and 1991 decreased by 33 percent, with no loss of yields. By contrast, the county and statewide rates of nitrogen use declined by 20 percent during the same period. Cumulatively, Big Spring Basin farmers reduced nitrogen use by nearly 1-1/2 million pounds from 1981 to 1991, for estimated cost savings of about $266,000.

In the subbasin, 9 of 11 farmers, controlling 98 percent of the total acreage, entered into 7-year contracts for soil and water conservation. From 1987 through 1991, annual soil savings of 64 percent were recorded for about 900 acres of cropland and permanent pasture. Some form of best management practices for pesticides and nutrients were implemented on all acres in the subbasin. The rates of nitrogen use in the subbasin were reduced by about 10 percent.

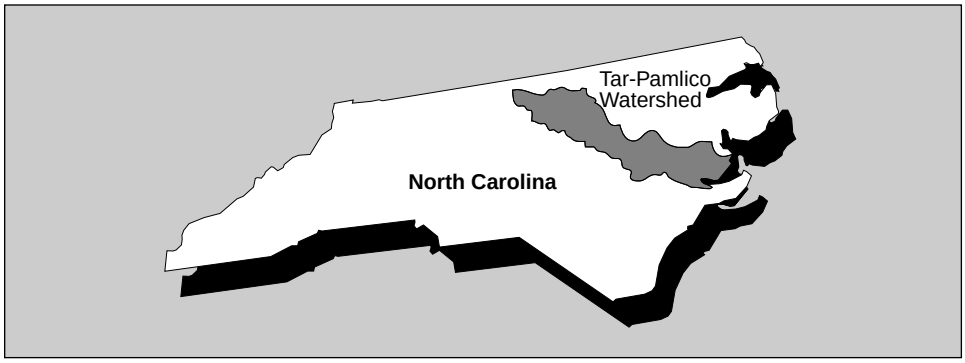
Tar-Pamlico River Basin Watershed

The major lessons of the Tar-Pamlico River Basin watershed project are that (1) flexible and innovative approaches—in this case, pollutant trading—may offer more cost-effective alternatives for improving water quality and (2) the consensus process is essential for maintaining cohesion between stakeholder groups and keeping them committed to the project's goals.

Project's Location and Problem

North Carolina's Tar-Pamlico River Basin watershed, comprising about 3.5 million acres, stretches 180 miles southeast from the state's hilly north central portion, through the coastal plain region, to empty into Pamlico Sound, as shown in figure V.1. The watershed, which is relatively undeveloped land, encompasses about 365,000 residents, at least nine threatened or endangered freshwater mussel species, and all or part of three national wildlife refuges.

Figure V.1: Location of the Tar-Pamlico River Basin Watershed



Water quality problems in the Tar-Pamlico River Basin watershed have been known for a number of years. About 22 percent of the fresh-water streams in the watershed are impaired by sediment, acidity, and high fecal coliform bacteria counts; several lakes suffer from excessive nutrients; and more than 50,000 acres near the mouth of the Pamlico River are periodically stricken with algae blooms, fish kills, crab and fish diseases, and closed shellfish waters.

Both municipal and industrial point sources, as well as nonpoint sources that include agriculture, contribute nutrients to the Tar and Pamlico Rivers. Point sources, such as waste treatment plants and industrial factories, discharge waste water that contains nutrients such as nitrogen and phosphorous. The primary sources of nutrient pollution from agricultural nonpoint sources are animal manure and chemical fertilizers applied to cropland.

Project's Genesis and Management

In response to a petition by a local citizens' group—the Pamlico-Tar River Foundation—and recommendations made by the state's Division of Environmental Management, North Carolina designated the entire Tar-Pamlico River Basin as "nutrient sensitive waters" in September 1989. This designation required the development of a comprehensive strategy to reduce pollution in the watershed. In developing this strategy, the North Carolina Division of Environmental Management worked with three industry and community groups that represented the various stakeholders—the Tar-Pamlico Basin Association, a point-source dischargers group; the North Carolina Environmental Defense Fund, a nonprofit environmental group; and the Pamlico-Tar River Foundation.

Project's Planning and Funding

The state initially proposed several steps to reduce the nutrients entering the river system. To reduce the municipal and industrial contribution, the state proposed including nutrient limits in the permits it issues to point-source dischargers. To reduce the agricultural contribution, the state planned to rely on North Carolina's Agriculture Cost Share Program to financially assist farmers in voluntarily addressing nonpoint nutrient pollution from cropland and concentrated animal operations.

The Tar-Pamlico Basin Association estimated it would cost point-source dischargers $50 million in plant and equipment upgrades to comply with the state's proposed discharge limits. Instead, the environmental, citizens', and point source groups proposed an alternative that had two major phases. First, association members (i.e., point-source dischargers) would have engineering studies performed on their facilities and would make the operational changes and minor investments found necessary to optimize the removal of nutrients from their discharges. In connection with this aspect of the agreement, the members as a group would reduce the nutrient content of their discharges by at least 25,000 kilograms each year

to reach a group limit of 425,000 kilograms per year by the end of 1994. Second, rather than requiring expensive plant and equipment upgrades in order to achieve their nutrient limits, the North Carolina Environmental Defense Fund proposed that point source association members be allowed to instead contribute to an innovative nutrient credit "trading" fund. The fund would be used to finance more cost-effective actions to reduce nutrient pollution from agricultural nonpoint sources. Association members agreed to contribute $56 to the fund for every kilogram of nutrients discharged in excess of their group's limits.

In December 1989, the state approved and adopted the plan, which is now known as the Tar-Pamlico Nutrient Sensitive Waters Implementation Strategy. The major stakeholders agreed that the details of the two-phase plan would be spelled out in an agreement that would periodically be reviewed and updated. Successful consensus building led to smooth implementation of phase one, resulting in goals for reducing nutrients that were accepted by all parties and an updated phase-one agreement that was signed by all three participating organizations in February 1992.

The funding for phase one, which ended in December 1994, is shown in table V.1. The Tar-Pamlico Association's contribution includes a $750,000 grant obtained from EPA under the Clean Water Act.

Table V.1: Tar-Pamlico River Basin Watershed Funding

Funding source	Amount[a]
EPA	$1,409,000
USDA	3,711,000
State	5,590,000
Tar-Pamlico Basin Association	1,400,000
Voluntary participants (farmers)	2,047,000
Total[b]	**$14,157,000**

[a]Amounts shown are for funding through September 30, 1994.

[b]Totals are approximate and may not include the value of farmers' in-kind labor, funds raised by local watershed groups, or the cost of activities provided by various federal and state agencies under other programs.

Source: The Tar-Pamlico River Basinwide Water Quality Management Plan and Implementation Strategy and personnel from the North Carolina Division of Environmental Management.

However, problems that emerged during the planning of phase two portend future difficulties for the program. The consensus began to break down during phase two, which began in January 1995 and is scheduled to end in December 2004. A study performed in phase one indicated the need for a goal of a 45-percent reduction in nitrogen levels in phase two. However, because of uncertainties about the accuracy of the model used in the study, the state decided to institute an interim reduction goal for nitrogen of 30 percent (a reduction of 583,000 kilograms per year) and maintain the current discharge limits for phosphorous. Most of the 30-percent reduction goal for nitrogen was allocated to nonpoint sources. Half of the nonpoint allocation is to come from agricultural sources. Also, under phase two, the nutrient credit trading rate that association members would be required to pay was reduced from $56 to $29 for every kilogram over the limit on the basis of the results of a study. The state also agreed to credit the association for the amount of its contribution that had not been spent in phase one. About $450,000 of the association's contribution to the nutrient credit trading fund had not been spent by the end of phase one, so state officials recomputed the amount of the remaining nutrient credit this figure represented on the basis of the new $29 rate. Thus, the association started phase two of the project with a nitrogen credit of over 22,000 kilograms.

The major stakeholders could not reach a consensus on the overall phase-two reduction goals and the allocation of reductions between the point and nonpoint sources. State officials nevertheless approved phase two because they felt it was a good compromise between the positions of the point sources and of the environmental and citizens' groups. In addition, state officials said phase two had to be coordinated with the state's 5-year cycle for reviewing its basinwide watershed management plans and the concurrent basinwide approval of all point-source discharge permits.

Although the state's action may have been expedient, it could have a significant impact on the project's future. The North Carolina Environmental Defense Fund and the Pamlico-Tar River Foundation refused to sign the phase-two agreement. These two organizations believed that the concessions made to the point-source dischargers undermine the effectiveness of nutrient credit trading and shift too much of the financial burden for reducing pollution to the nonpoint sources. An official from the North Carolina Environmental Defense Fund said that the

Fund may file a lawsuit against the state unless the state develops a workable plan for achieving the large reductions in nutrients that are to come from nonpoint sources.

Key Approaches and Observations

The project's participants recognized that success depended on including local citizens and officials in the planning process. During phase one, the state and the North Carolina League of Municipalities sponsored two public workshops in 1994 to familiarize the public with the plan, solicit comments, and broaden stakeholders' education and participation. Priorities compiled from these meetings included the need to increase public education and stakeholders' participation, improve the control of nonpoint-source pollution, identify and target problem areas and resources in the river basin, consider land use planning and property rights, improve data on water quality, improve funding and regulatory enforcement, and consider cost-benefit relationships.

The project's participants said these meetings also helped break down barriers and misperceptions between various competing groups. People began to acknowledge that they all contributed to water quality problems in one way or another and that protecting the watershed was in everyone's best interests.

Also during phase one, the state began a demonstration project in the Chicod Creek Subbasin to reduce agricultural discharges. Farmers in that area were encouraged to participate in a voluntary program to implement various agricultural best management practices in order to reduce nutrient runoff. State officials said that demonstration projects greatly increase voluntary participation in watershed projects because farmers generally stay with practices that are "tried and true." They tend to wait to see what experience their peers have with a new practice before they adopt it, even if the practice is said to be financially beneficial.

However, some participants in the project thought that most farmers want to be good stewards of the land and would make the needed changes if they had the funds and expertise. Thus, the availability of financial and technical assistance is important to the farmer. Participants noted that supplemental funding sources, such as the state cost-sharing program, are important to watershed projects because sufficient federal funding may be hard to obtain. They said that USDA's funding for improvements in water

quality at individual farms is severely constrained because actions to improve water quality are considered just one of several competing practices subject to an overall annual cap of $3,500 per farmer for projects funded under the Agricultural Conservation Program. State officials believe that the targeted 50-percent reduction in nitrogen pollution from agricultural sources in the watershed will cost about $8.5 million and have recommended that funding for the state Agriculture Cost Share Program be increased.

State officials also said that watershed projects would benefit greatly from increased communication, coordination, and cooperation between the states and all the federal agencies. For instance, USDA staff encourage farmers to plant grasses at the edge of cultivated fields that serve as buffer zones for runoff. However, better coordination between USDA and the U.S. Fish and Wildlife Service would ensure that grasses planted also provide good wildlife habitat.

State officials said that accomplishments have not yet been reflected in the results of water quality monitoring for the estuary and may not be measurable for many years. They believed that other indicators, such as a growth in fish populations, may be better short-term indicators of success. These officials feared that if federal agencies measure success on the basis of short-term water quality monitoring data alone, future funding could be in jeopardy.

Agency officials and participants both preferred voluntary programs to control nonpoint agricultural discharges over regulation. They believed that people would continue to take the day-to-day actions necessary to improve water quality only if they are truly committed to them. However, some state officials, as well as one farmer we spoke to, believed that there must also be a regulatory enforcement component to encourage early action and to take care of polluters who do not comply.

Accomplishments

As a result of engineering studies performed early in phase one, point-source dischargers in the Tar-Pamlico Basin Association reduced their nutrient discharges below the state limits through relatively inexpensive equipment upgrades and operational changes. In fact, point-source nutrient discharge levels have been below the state's limits

for nitrogen and phosphorous for every year since the phase-one agreement was signed.

By April 1993, the end of the sign-up period for the Chicod Creek demonstration project, 27 of the 32 confined animal operations located in the subbasin had agreed to implement management practices to reduce nonpoint-source pollution. Waste management plans had been written for 6 of the 12 highest-priority operations, and construction of the various containment structures required had begun at 2 of these sites.

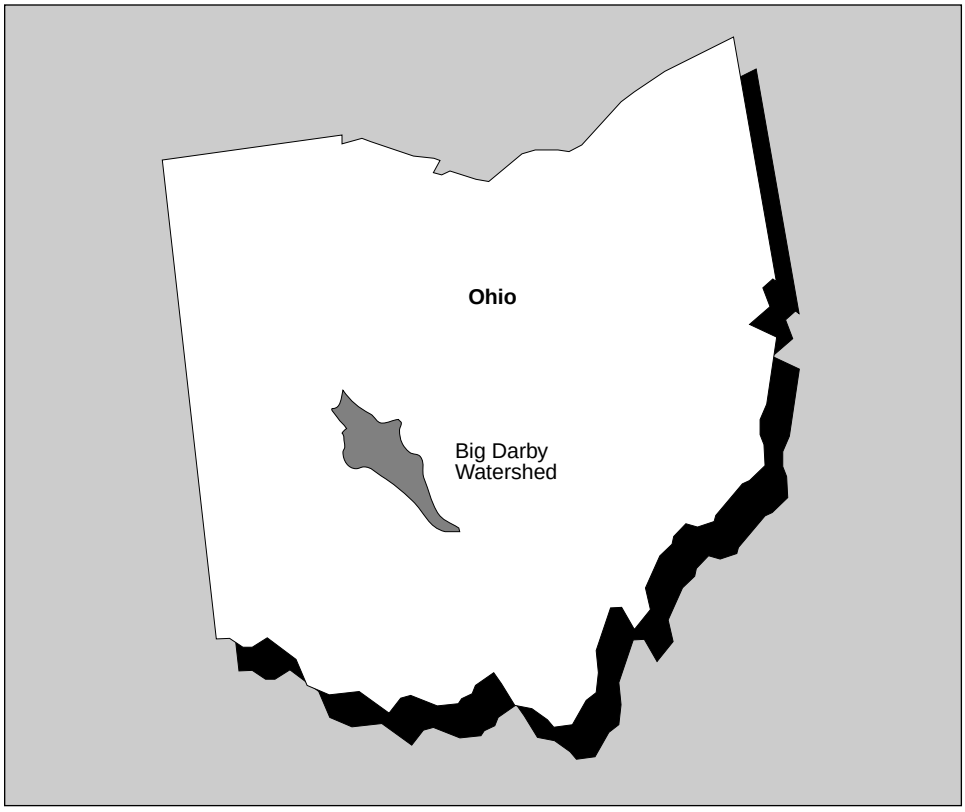
Big Darby Creek Watershed

The major lessons of the Big Darby Creek watershed project are that (1) in the absence of an immediate water quality crisis, financial incentives can be useful in stimulating participation in a project and (2) the link between changes in land use and improvements in water quality may be difficult to demonstrate in a large watershed.

Project's Location and Problem

The Big Darby Creek watershed covers about 371,000 acres of Ohio's central lowlands on the eastern edge of the Corn Belt, as shown in table VI.1. The terrain is generally flat land and gently rolling hills. About 1,170 farms are located in the watershed, with the steeper upper portion containing small farms of about 60 acres and the flatter lower portion containing larger farms of about 300 acres. More than 80 percent of the land in the watershed is devoted to crops, and there is some livestock pasturing.

Figure VI.1: Location of the Big Darby Creek Watershed



The two major threats to water quality in the Big Darby Creek watershed are agricultural and urban nonpoint-source pollution. The major agricultural pollutant is sedimentation, caused by the widespread use of conventional tilling practices and stream bank erosion. Increased sediment has impaired stream habitat and the feeding and spawning activities of fish and other aquatic life. Agriculture also has created limited nutrient and pesticide problems in the creek. Experts estimate that although the watershed is now one of the healthiest in the Midwest, up to 25 percent of Big Darby's aquatic species may be lost in the near future if land management practices are not changed.

Project's Genesis and Management

The Big Darby project was conceived jointly by the Ohio chapter of the Nature Conservancy and USDA.[9] Before the project began, the Conservancy spearheaded the creation of the Darby Partners, an association designed to facilitate closer communication and coordination among all the stakeholders in the watershed. The Partners now comprise more than 40 public and private organizations committed to working together to protect the creek. The Darby Partners review and assist in the implementation of the Big Darby project. For example, the Partners identify practices and funding sources appropriate for farmers, serve as a clearinghouse for funding applications, and use committees and subcommittees to coordinate individual farmers' projects.

Project's Planning and Funding

In 1990, USDA approved a proposal to include Big Darby Creek in its Hydrologic Unit Area program, which targets areas facing significant threats to water quality from agricultural nonpoint sources. The program provides technical and financial assistance to encourage landowners to voluntarily adopt best management practices.

Under this program, the objective is to maintain or improve the unique, high-quality stream and its watershed by using innovative approaches to reduce sedimentation and levels of nutrients and pesticides while maintaining a viable agricultural economy. The specific goals of the project are to (1) reduce sediment in the creek by 40 percent, (2) protect 3,200 acres of riparian corridor, (3) reduce nutrient and pesticide levels, and (4) protect 21 miles of stream banks. Following Big Darby's selection as a hydrologic unit area, the Nature Conservancy designated Big Darby as

[9]The Nature Conservancy is an international nonprofit membership organization committed to the preservation of biological diversity.

one of its 12 "Last Great Places," which enabled it to begin funding, conducting, and coordinating environmental conservation programs there.

The Partners did not create a formal watershed management plan but relied instead on three basic documents to guide their work: (1) the original hydrologic unit area project proposal, (2) a Forest Service watershed inventory, and (3) the Nature Conservancy's watershed plan, which focused more on urban issues. Project staff we met with acknowledged the importance of planning but stressed that it must lead to action, not to documents that sit on a shelf.

Collectively, the Soil and Water Conservation Districts in the six counties in the watershed identified the following problem areas: (1) soil erosion and sedimentation from croplands, (2) the widespread lack of management of nutrients and pesticides, (3) poor management of animal wastes, and (4) livestock's access to streams. USDA identified a general list of best management practices to be implemented by the project and estimated the level of funding needed for these practices—about $9 million over 3 years. Almost half of Big Darby's funding has come from USDA, as shown in table VI.1.

Table VI.1: Big Darby Creek Watershed Funding

Funding source	Amount
USDA	$2,367,000
EPA	650,000
Department of the Interior	349,000
State	387,000
State-local matching funds	313,000
Local government	85,000
Ohio Nature Conservancy	716,000
Kellogg Corporation (grant to Operation: Future Association)	278,000
Total	**$5,145,000**

Source: Ohio Nature Conservancy.

Key Approaches and Observations

The Big Darby project provides financial and technical assistance and educational opportunities to encourage and facilitate farmers' implementation of best management practices in all six counties in the watershed. Since Big Darby is not facing an immediate crisis in water quality, the project's leaders recognized that some farmers need incentives

to participate in the watershed project. According to project staff, financial assistance has helped make nonpoint-source pollution more of a priority for some people.

One approach to providing financial assistance is Ohio's recently established low-interest loan program for qualifying individuals and private organizations that want to implement projects to control nonpoint-source pollution. Under this program, an applicant who has received a certification of qualification from a conservation district can take the certification to a participating bank. If the bank approves the loan, the interest rate will be discounted, usually by 3 percent, from the normal lending rate.

Regarding technical assistance, project staff noted that it is important to understand farmers' needs and find practices that are compatible with those needs. Different programs have different purposes and requirements, and farmers need flexibility to choose among a program's tools or even expand the toolbox.

An assortment of educational and outreach activities, such as farm tours, workshops, canoe trips, expositions, videos, the use of mass media, and school events, are being directed to the general public and to landowners to increase their awareness of water quality and encourage interest in the Big Darby watershed. Although some farm demonstration projects have been conducted, project staff prefer to use funding for farmers' specific projects, estimating that the cost of 1 demonstration could pay for about 10 farmers' projects.

Assessments of the biological, physical, and chemical aspects of water quality are being conducted in Big Darby Creek. According to state officials, biological monitoring may be the best method for assessing problems with nonpoint-source pollution. They stressed that such monitoring should be a separate element and in place before individual watershed projects are begun. However, a project's performance can be validly assessed using other indicators, such as fish counts, best management practices adopted, and farmers' attitudes, according to project staff.

Water quality monitoring in Big Darby is not tied directly to farmers' implementation activities. According to project staff, farmers are sometimes frustrated by data limitations and the project's inability to show results. They acknowledged that a better link between monitoring and

day-to-day project activities could help show participants that their activities are having a positive effect. They cautioned, however, that current science can demonstrate only a tenuous link between land use practices and the chemical aspects of water quality.

Some sociological data also has been collected. Focus groups showed that farmers were generally enthusiastic about collaborating with agencies to achieve a greater goal and that their primary concerns were the protection of stream corridors and control of suburban encroachment.

Accomplishments

During the last 3 years, the biological integrity of the watershed's streams has remained constant, while sediment, pesticide, and nutrient levels have fluctuated. The Big Darby project has reached 57 percent of its goal of reducing sediment by 50,000 tons per year, and 98 producers have installed one or more structural enhancements or implemented management practices in 1994 to reduce nonpoint-source pollution.

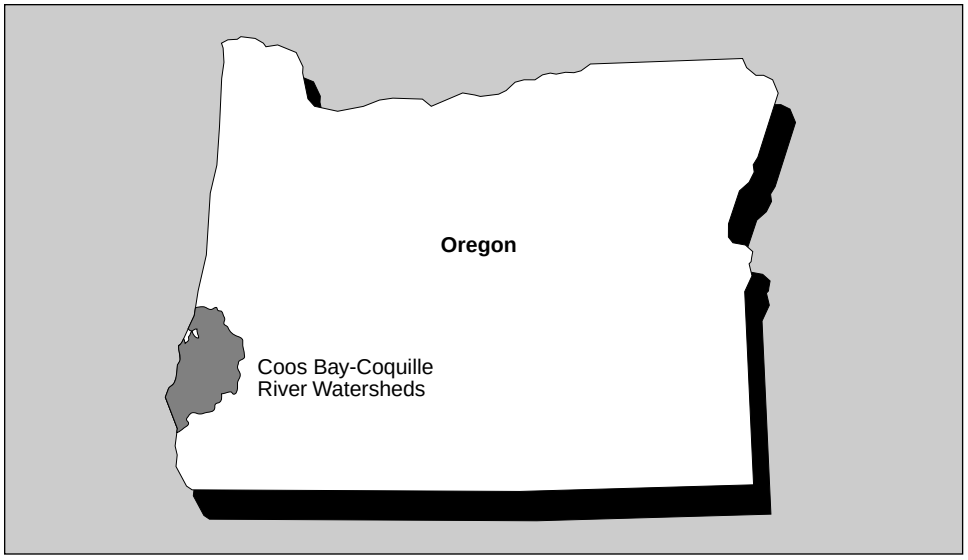
Coos Bay-Coquille River Watersheds

The major lesson of the Coos Bay and Coquille River watershed projects is that involving local stakeholders in planning and implementing a project can help overcome a community's suspicion of government-sponsored initiatives and result in a cooperative partnership of community interests and government agencies.

Projects' Location and Problem

Coos Bay and the Coquille River are adjacent watersheds covering about 2,000 acres along the southern Oregon coast, as shown in figure VII.1. The terrain is composed of steep, heavily timbered hills interspersed with pasture land leading to pastures on drained wetlands along various rivers and creeks. The local economy depends heavily on timber, commercial fishing, and agriculture.

Figure VII.1: Location of the Coos Bay-Coquille River Watersheds



The Coos Bay-Coquille River area is an important spawning and winter rearing habitat for salmon and other anadromous fish.[10] The fish spawn in the gravel-covered stream beds near the headwaters of the creeks, and the

[10]Anadromous fish hatch in fresh water, journey downstream to the ocean to mature, and return to their place of birth to spawn. Anadromous species in the Coos Bay-Coquille River watersheds include coho salmon, fall and spring chinook salmon, winter steelhead trout, and sea-run cutthroat trout.

juvenile fish linger in the cool, heavily shaded areas downstream until they are mature enough to head out to sea.

The salmon population has severely declined for several reasons, including the impact that timber and agricultural activities have had on the spawning and rearing habitat. Sediment from timber runoff and eroding banks in pasture land has silted over the gravel spawning grounds and decreased the amount of dissolved oxygen available to the fish. Destruction of habitat—by, for example, straightening streams—causes juvenile fish to be swept out to sea before they are mature enough to survive ocean conditions. Finally, temperatures in parts of the Coquille River reach 80 degrees, much warmer than the 50 to 60 degree temperature suitable for fish.

Projects' Genesis and Management

The initial effort was a 1991 demonstration project on Larson and Palouse Creeks, tributaries of Coos Bay, that was funded through EPA's Near Coastal Waters Program. The effort was prompted by a complaint from owners of one of the Coos Bay oyster beds, which had been closed because of fecal contamination. In addition, the state identified these creeks as dangerous for recreation because of the high fecal coliform count. The project's goal was to reduce the coliform count from 16,000 per 100 milliliters to 200 per 100 milliliters.

The government agencies involved in the project called a community meeting to elicit citizens' concerns about water quality. The potential listing of the coho salmon as an endangered species was a major concern for landowners along the creeks. Attendees also identified drinking water quality, access to creeks in order to water livestock, land loss due to erosion, and suitability for recreational use as their primary concerns.

The community organized two watershed associations, one focusing on the Coos Bay watershed and the other on the adjacent Coquille River watershed. Each association has an executive council that sets the overall policy and direction for the project. Watershed members include timber companies; private landowners; federal land management agencies, such as the Bureau of Land Management and the Forest Service; state agencies with water and habitat responsibilities, such as the Oregon Department of Environmental Quality; and other interested parties, such as local seaport operators and environmental groups.

Projects' Planning and Funding

Both associations issued an action plan in 1994 after spending less than a year planning and developing their overall approach. The plans include quantifiable goals and a monitoring strategy. For example, the Coquille River watershed plan identified three goals: (1) meeting the Clean Water Act's standards, (2) enhancing fish survival and production, and (3) creating understanding and acceptance in the community of the need for sustainable economic activities that are compatible with long-term resource conservation. The evaluation strategy includes monitoring a variety of parameters, such as stream temperature, stream flow, and fish spawning and juvenile populations. Both plans emphasize voluntary participation and community education, and both advocate simple, low-technology approaches like (1) installing fencing to minimize damage to streambanks caused by livestock and thus reduce erosion, (2) planting shade trees along the creeks to reduce the water temperature, and (3) building small pools, called off-channel ponds, alongside the creek to provide a rearing habitat for juvenile fish.

EPA staff told us that they could not help fund the planning activities for the Coos Bay-Coquille River projects because, at that time, funds received under section 319 of the Clean Water Act could only be used for implementation, not planning.

The Coos Bay project is funded almost equally by federal and state agencies, whereas the Coquille River project is funded primarily by federal agencies, as shown in tables VII.1 and VII.2.

Table VII.1: Coos Bay Watershed Funding

Funding source	Amount
Department of Commerce	$250,000
Department of the Interior	33,000
State	300,000
Total	**$583,000**

Source: Oregon Department of Environmental Quality.

Table VII.2: Coquille River Watershed Funding

Funding source	Amount
Department of the Interior	$1,300,000
Department of Commerce	250,000
EPA	150,000
State	619,000
Landowners' contributions (estimated)	100,000
Total	**$2,419,000**

Source: Oregon Department of Environmental Quality.

Key Approaches and Observations

The projects' participants emphasized that getting the local community to agree that a water quality problem existed and needed to be addressed was critical in making the project viable. The local community is suspicious of government regulation and very protective of private property rights. The community is particularly resistant to projects with an environmental slant, because many blame federal and state efforts to protect the spotted owl and salmon population for high unemployment in the timber and fishing industries. Participants believed that public education and outreach was a major factor in overcoming this resistance. Because many in the community were suspicious of the projects, participants spent a great deal of time making formal and informal contact with members of the community to explain the scope and approach of the projects and reassure the public about the projects' intent. Members of the Coquille River Watershed Association are also developing a high school curriculum to improve students' understanding of the watershed they live in and how their activities affect water quality.

Emphasizing stakeholders' involvement capitalized on the fact that many landowners really wanted to help their neighbors by improving water quality and revitalizing the salmon population. Participants said involving stakeholders helped ensure that all economic interests were represented and considered when defining the problem and developing a solution. Representatives of the timber, fishery, and agricultural sectors explained their operations and needs, and these were taken into consideration in developing the projects' strategy. Participants emphasized that the projects could not progress until stakeholders move beyond blaming each other for the current problem and begin concentrating on the solution.

Involving stakeholders also helped the government agencies to move beyond focusing on their own missions to focusing on the overall

condition of the watershed. Historically, government personnel had seldom communicated with each other. For example, one agency official noted that the state was doing studies and building in-stream structures, such as inserting logs, old trees, and other woody debris to slow the stream flow; the U.S. Army Corps of Engineers was dredging canals and sloughs to improve drainage; the Bureau of Land Management was undertaking projects on federal land, such as reengineering access roads to minimize erosion; and USDA was working with private landowners to reduce erosion and runoff from animal wastes. However, the agencies were not looking at how these efforts related to each other. The watershed associations have given the agencies a forum for sharing information, and coordination among them has greatly improved.

Coos Bay and Coquille River project staff, participants, and state government officials voiced concerns about inflexible federal processes. For example, project staff and state government officials said it took 9 months to obtain a permit to build an off-channel pond and spread the few cubic yards of earth removed across a pasture. A permit had to be obtained from the Army Corps of Engineers because it has authority over disposal of dredge and fill materials into U.S. waters and wetlands. Participants in the project said they could not understand why it would take 9 months to issue a permit for such a simple project.

Accomplishments

The Coos Bay project on Larson Creek has reached its goal of lowering the fecal coliform count to 200 bacteria per 100 milliliters, allowing the oyster beds that had been closed for 13 years because of fecal contamination to be reopened. In addition, the number of adult fish returning to spawn in the tributaries of Coos Bay has doubled over the previous year. However, project staff noted that factors other than the project, such as overall ocean conditions, can also affect the number of fish returning to spawn. About 20 of the 2,500 landowners along the Coquille River are participating in the program. Participants estimate that the Coquille River project has fenced and replanted about 45 miles of streambanks and built five off-channel ponds.

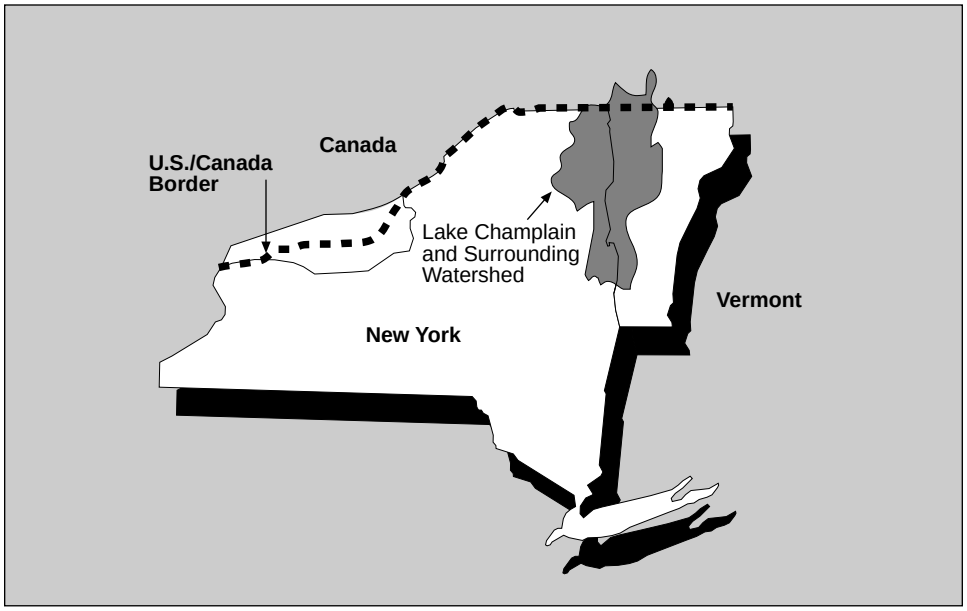
Lake Champlain Basin Watershed

The major lessons of the Lake Champlain Basin Watershed Project are that (1) project management must be flexible enough to span multiple jurisdictions, (2) watershed efforts must be driven by stakeholders' concerns and supported by local participation, and (3) diversified funding sources and good communication with state and provincial legislatures are essential to sustained success.

Project's Location and Problem

The Lake Champlain basin spans about 5.3 million acres of mostly rural land, of which about 56 percent is located in Vermont, 37 percent in New York, and 7 percent in Québec, Canada, as shown in figure VIII.1. The watershed is home to a population of over 600,000 people. Lake Champlain and its basin abound with historic and Native American cultural artifacts and was designated part of a biosphere reserve by the United Nations in 1989.

Figure VIII.1: Location of the Lake Champlain Basin Watershed



Overall, Lake Champlain is considered healthy from the standpoint of water quality. However, various sections of the lake are experiencing problems caused by excessive nutrients, particularly phosphorous.

Phosphorous acts as a fertilizer, causing algae and plants to grow more rapidly. When excessive weeds and algae die and decompose, they use up the dissolved oxygen in the water required by fish and other species. Data indicate that the phosphorous levels in the lake need to be reduced by 200 metric tons per year to address the problems associated with accelerated plant growth and that 68 percent of this reduction should come from nonpoint sources of pollution, such as agricultural land. Other problems include (1) annual beach closings in both New York and Vermont because of high counts of fecal coliform bacteria and the presence of pathogens; (2) the presence of toxins, such as mercury and PCBs (polychlorinated biphenyls); (3) nuisance aquatic plants, such as water chestnuts, that discourage recreational use; and (4) nonnative species, such as zebra mussels and sea lamprey, that threaten native mussel and fish species.

Project's Genesis and Management

Water quality problems in Lake Champlain were recognized as far back as 1905 by the U.S. Geological Survey. However, attempts to establish a long-lived institution for the management of Lake Champlain and its watershed have been unsuccessful. The most recent effort, the Lake Champlain Special Designation Act of 1990, elevated Lake Champlain to a protection category shared by only a few national lakes and estuaries. Under the act, EPA was required to establish a management conference tasked to develop, within 5 years, a comprehensive pollution prevention and control and restoration plan for Lake Champlain and its watershed.

The Lake Champlain Basin Program was established to coordinate the activities envisioned under the Lake Champlain Special Designation Act. The Basin Program, jointly administered by EPA, the states of New York and Vermont, and the New England Interstate Water Pollution Control Commission, serves as an umbrella for the numerous cooperating agencies, organizations, and individuals working to develop the plan. Altogether, some 227 regional, state, provincial, or federal entities are involved in the planning effort for Lake Champlain and its watershed.

The Lake Champlain Management Conference is the Basin Program's primary decision-making body. It is a 31-member board representing a broad spectrum of stakeholders' interests within the watershed from both New York and Vermont, including local residents; environmentalists; farmers; marina owners; fishery specialists; scientists; industry and business representatives; and local, state, and federal government officials. Although it has an independent function, the Joint New York-Vermont-Québec Lake Champlain Steering Committee also

participates in the planning process, which involves both regional policies and cooperation with Québec.

Project's Planning and Funding

The Management Conference allotted considerable funding to priority research for the first 2 years. Other funds were spent on data management efforts, demonstration projects, education and outreach efforts, and administration of the Lake Champlain Basin Program. Projects were also funded in four major areas: water quality; living natural resources, such as threatened and endangered fish and wildlife; human activities, such as recreation and cultural, economic, and health concerns; and support studies, such as data gathering and monitoring. All projects require a 25-percent minimum in matching funds from anyone undertaking the work. The Lake Champlain Management Conference is scheduled to "sunset" (i.e., terminate under its authorizing legislation) in March 1996, upon completion of the final management plan, which must be approved by the governors of New York and Vermont and the Administrator of EPA.

Under the Lake Champlain Special Designation Act of 1990, the Congress tied financial support for Lake Champlain to a clear timetable—up to $5 million per year for 5 years. As shown in table VIII.1, funding for Lake Champlain has come from several sources.

Table VIII.1: Lake Champlain Watershed Funding

Funding source	Amount[a]
USDA[a]	$9,936,000
EPA[a]	8,000,000
Department of the Interior[a]	2,834,000
Department of Commerce[a]	980,000
Voluntary participants (farmers)[a]	3,279,000
Contractors and others[b]	750,000
New York[c]	903,000
Vermont[b]	275,000
Total[d]	**$26,957,000**

[a]Amounts shown are for funding through September 30, 1994.

[b]Amounts shown are through March 31, 1995.

[c]Amount shown is through June 30, 1994.

[d]Totals are approximate and may not include the value of farmers' in-kind labor, funds raised by local watershed groups, or the cost of activities provided by various federal and state agencies under other programs.

Source: Lake Champlain Basin Program Annual Reports for 1991-1994; the Lake Champlain Basin Program draft plan entitled Opportunities for Action, October 1994; personnel from the Lake Champlain Basin Program; and personnel from the New England Interstate Water Pollution Control Commission.

Key Approaches and Observations

Recognizing that a regulatory program would likely polarize stakeholder groups, the project's participants agreed that the project should adopt a voluntary approach. Lake Champlain Basin Program officials believe that public education, support, and participation are crucial to getting voluntary action. In this regard, public meetings and other forums were used to break down the barriers between stakeholder groups so that constructive dialogue could take place. Basin program officials also believe that building on existing community organizations results in more effective, less costly, more creative solutions than would result from an inflexible, prescriptive approach.

Because many of the farms in New York and Vermont are marginal, family-owned dairy operations, the farmers and USDA officials we spoke to said that financial assistance is essential to the project's success. The financial assistance available to farmers has often been insufficient, and many farmers could not afford the cost share required of them. Furthermore, the $3,500 annual cap placed on all farm practices that fall

under the Agricultural Conservation Program serves to deter farmers from implementing pollution-mitigating structures and practices.

While more research is still needed, studies and monitoring efforts undertaken throughout the watershed have provided valuable information about water quality issues, such as phosphorous pollution in the lake, that helped set the framework for the management plan. Data from monitoring have not shown a noticeable water quality improvement, however, and additional information needs to be developed on how pollutants such as phosphorous are introduced into, travel through, and dissipate from the lake.

Accomplishments

From the agriculture/water quality standpoint, a few of the most significant accomplishments include the following:

- The states of New York and Vermont and the province of Québec signed a water quality agreement in 1993, which endorsed uniform interim goals for phosphorous management for Lake Champlain.
- A Lake Champlain Agricultural Advisory Council was established to help address agricultural issues relating to water quality throughout the watershed and ensure that farmers' needs for information are met.
- Two demonstration projects dealing with manure management were undertaken, and 70 farmers participated in manure management workshops designed to reduce the nutrient runoff entering Lake Champlain and its tributaries.
- Finally, more than 500 farmers in the watershed have agreed to participate in water quality projects sponsored by USDA.

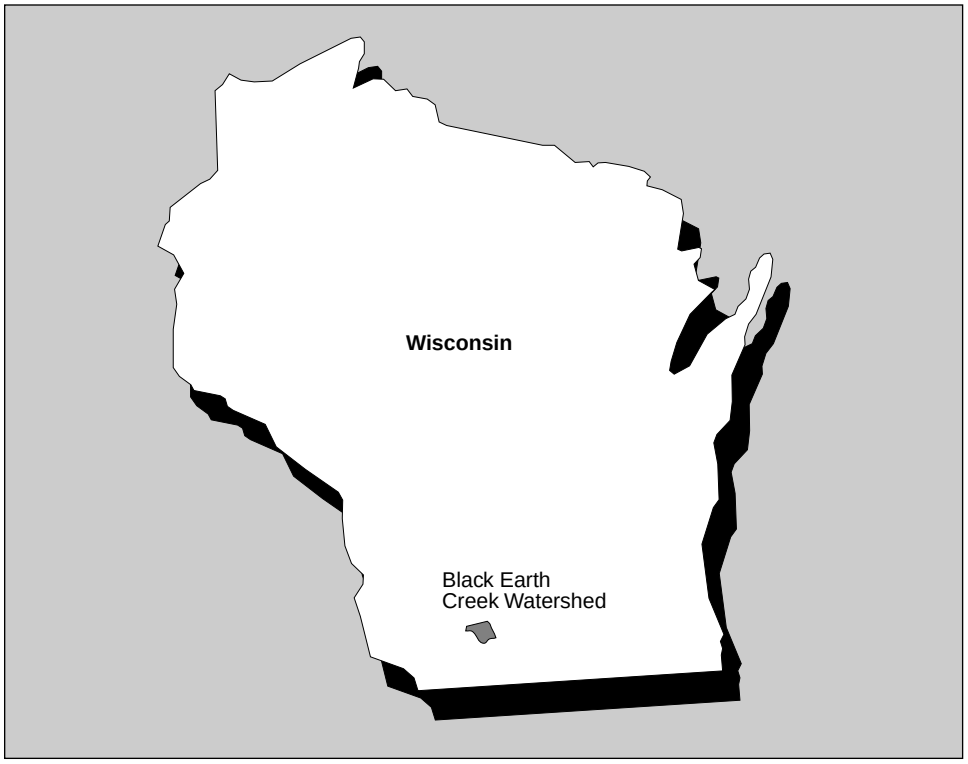
Black Earth Creek Watershed

The major lessons of the Black Earth Creek watershed project are that (1) broad involvement by stakeholders is critical to a project's success and (2) education is needed to promote long-term stewardship of a watershed.

Project's Location and Problem

The Black Earth Creek watershed covers about 64,000 acres, primarily in Dane County, Wisconsin, as shown in figure IX.1. Black Earth Creek and its tributaries support one of the state's top recreational trout fisheries. Approximately 56 percent of the watershed is agricultural land, most of whose approximately 380 farmers operate dairy farms. Other agricultural businesses in the watershed include hog and beef cattle operations and farms devoted to cash crops such as soybeans.

Figure IX.1: Location of the Black Earth Creek Watershed



In response to anecdotal evidence of deteriorating stream conditions, the U.S. Geological Survey began a study of Black Earth Creek in 1984 to

assess the hydrology, aquatic life, and water quality of the creek and its tributaries. The Survey collected data from sites along two of the creek's tributaries and found problems with animal waste runoff, high sediment levels, and low dissolved oxygen levels. The extent of these problems was greater than originally anticipated.

Project's Genesis and Management

On the basis of local support and interest from Dane County and the local chapter of Trout Unlimited, a national sportsmen's organization, the Wisconsin Department of Natural Resources designated Black Earth Creek a priority watershed in 1985. The Black Earth Creek project formally began in 1986. The project is being implemented under the Wisconsin Nonpoint Source Water Pollution Abatement Program, also known as the Priority Watershed Program. The program provides state matching funds to encourage farmers to implement best management practices to reduce nonpoint-source pollution. The program targets critical landowners in each watershed, and participation is voluntary, although the state retains some enforcement authority.

The project staff is drawn from a number of agencies and organizations, including Wisconsin's Department of Natural Resources, the University of Wisconsin Extension, the Dane County Land Conservation Department, and USDA's Natural Resources Conservation Service. Another active participant in the project has been the Black Earth Creek Watershed Association, a citizens' group formed when the project began to provide a mechanism for local input. The watershed association's charter is to "advocate the stewardship and sound management of land and water resources in the watershed and to serve as an information clearinghouse" for interested parties.

Project's Planning and Funding

The watershed plan for Black Earth Creek was prepared jointly by the Department of Natural Resources; the county conservation department; and representatives from other federal, state, and local community organizations. The project focuses on surface water issues and covers both rural and urban sources of nonpoint pollution. On the rural side, the plan's goals include (1) a 50-percent reduction in sediment and manure runoff and (2) habitat restoration in selected stream segments. To accomplish these goals, cropland management practices are needed on about 11,500 critical acres, barnyard runoff controls at 65 of the livestock operations, and intensive stream bank work on two segments of Black

Earth Creek. On the urban side, the plan requires that a management plan for storm water be developed for one portion of the watershed.

The Black Earth Creek watershed project has received funding from a variety of state, local, and other sources, as shown in table IX.1, but no direct federal funding.[11] Farmers have also used other state and federal funds (i.e., funds not tied specifically to the project) to implement conservation and other environmental practices in the watershed.

Table IX.1: Black Earth Creek Watershed Funding

Funding source	Amount[a]
State	$2,536,000
County	404,000
Nonprofit organizations and others	305,000
Total	**$3,245,000**

[a]Amounts shown are as of January 1, 1995.

Source: Dane County Land Conservation Department.

Key Approaches and Observations

According to the project's participants, early involvement by all watershed stakeholders was very important in facilitating understanding and consensus. To this end, the watershed association played a critical role. The association provided a forum for discussion, and its perceived neutrality was key to cutting through intransigence and bureaucracy and achieving consensus on issues to be addressed and actions to be taken. The watershed association also helped to alleviate farmers' concerns that they were the only ones being "targeted" in the watershed. County staff also emphasized the importance of starting simple and building trust with the local community. Despite prior experience working with county staff on conservation planning, the farmers did not feel comfortable with the project until after repeated visits from county staff and word-of-mouth communication.

The Black Earth Creek project provides financial and technical assistance to participating farmers who sign long-term agreements to install and maintain certain practices. In general, project staff have emphasized management solutions over structural ones. Where structural solutions are necessary, the staff have encouraged simple, less expensive structures.

[11]The state receives $2.5 million per year from EPA under section 319 of the Clean Water Act, which is used to support state agency staff, not individual watershed projects. Black Earth Creek is one of 65 watershed projects in Wisconsin.

For example, a $10,000 to $40,000 barnyard structure that catches solid waste runoff and drains liquids into a grassy filter strip is preferable to a 100-percent containment structure that would require more planning and cost tens of thousands of dollars more.

Project staff said that education is also an important component of the Black Earth Creek project and will be critical to its long-term success. An early challenge faced by the watershed association and project staff was to boost community interest in the creek. A variety of mechanisms, including audiovisual programs, printed materials, exhibits, media events, tours, demonstration activities, signs, workshops, meetings, youth education, recreational clinics, and fund raisers, have been used to boost the public's awareness and provide information about the watershed.

Two farm demonstration projects have been implemented in Black Earth Creek. Dane County project staff said that while it takes 2 or 3 years before farmers will implement demonstrated practices in their own operations, such projects can be good vehicles for generating cooperation, especially if they are relatively simple and successful. One such demonstration project combined techniques to simultaneously protect fish habitat and stabilize a stream bank. The project used a USDA-approved practice, called rip-rap (the positioning of rocks to stabilize and shape the stream bank), to reduce erosion. However, since rip-rap alone would have destroyed the cave-like spaces in which certain fish hide and spawn, wooden boxes called "lunkers" were built into the stream bank to imitate the natural habitat. According to county staff, this demonstration project catalyzed partnerships among agencies and between agencies and farmers. They attributed all the stream bank work undertaken so far in the watershed to the success of this one demonstration project.

Although water quality monitoring in Black Earth Creek has been more intensive than it has in other watershed projects in the state because of the state's priorities, Black Earth Creek staff said that extensive monitoring is not always necessary. Project staff said that decisionmakers should adjust their expectations and look to indicators of success other than chemical changes in water quality when evaluating watershed projects. Other measures, such as the level of farmers' participation, level of community support, and monitoring of plants and aquatic life forms, are also valid indicators of a project's success.

Project staff favor a voluntary approach to watershed management, but acknowledged that regulation to establish minimum standards for farm

management may be needed to deal with egregious behavior. The Wisconsin Department of Natural Resources retains certain enforcement authorities that it can use against participants who violate their cost-sharing agreements, or other uncooperative individuals. For example, if landowners violate the terms of their cost-sharing arrangement, the state may revoke its offer of cost sharing and substitute a low-interest loan. For critical sites in a watershed project, the state can issue compliance orders.

Accomplishments

Preliminary monitoring data (collected up to 1992) show significant decreases in nitrates and sediment in one subwatershed of Black Earth Creek. In addition, the fish population has increased at the stream bank restoration demonstration site, but Department of Natural Resources officials could not attribute this improvement solely to the project's activities. Thus far, 103 Black Earth Creek landowners have signed county cost-sharing agreements to implement environmentally friendly management practices. County staff said that only about two dozen farmers have taken no action, and of those, only a few have serious problems.

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