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A Commitment to Watershed Protection

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Contents

Foreword v

Introduction 1

Lessons Learned from the Clean Lakes Program 6

Local Commitment = Success 6

Matching Funds Ensure Commitment 8

States Like Clear Regulations and Guidance 9

Flexibility Promotes Innovation 10

Lake Water Quality Assessments: A Valuable Tool 11

Volunteers Make It Work 13

Projects Must Be Evaluated 16

Watershed Management Approach Validated 17

Funding Uncertainty a Negative 19

Effects of the Clean Lakes Program 20

Leverage Multiplies Funding 20

Lake Investments Pay Social/Economic Returns 22

States Begin Lake Management Programs 26

Public Awareness of Water Quality Grows 27

Understanding of Lake Conditions Improves 28

Groups Work Together 28

Tribal Programs Strengthened 30

Lake Restoration Science Has Advanced 31
Academia Actively Involved 33
Technical Assistance Helps All 34
Conclusion 35

How it Came to Be: History and Structure 36
Structure 36
History 40
Funding 48

Resources 50

Tables

1. Annual financial assistance provided by EPA Clean Lakes Program to States and Tribes. 39
2. State and Tribal distribution of Clean Lakes funds. 41
3. Lake Restoration Management Techniques Used in the Clean Lakes Program, In-Lake Techniques 44
4. Lake Restoration Management Techniques Used in the Clean Lakes Program, Watershed Treatments 45

Figure

1. Total EPA funding for Clean Lakes assistance, 1976 to 1991. 49

Foreword

The principles of the Clean Lakes Program work. But their side effects have proven even more valuable. This program has created an important template for other initiatives and partnerships, particularly the Watershed Protection Approach now underway at the U.S. Environmental Protection Agency.

An all-encompassing drive to protect our Nation's waters, the Watershed Protection Approach involves us all — for we all live in watersheds, we all contribute to the pollution that drains from them into our lakes and streams and rivers.

And because of that simple, inescapable fact, the Watershed Protection Approach interacts with many local, State, and Federal programs as well as other EPA programs — from that first massive effort that built our sewage and waste treatment plants to the more recent nonpoint source program.

But the guidelines for watershed protection have been established by the Clean Lakes Program, now entering its 18th year with a solid record of accomplishments.

Achievement is not what makes Clean Lakes a model for watershed protection, however; it's the how and why Clean Lakes achieved its goals that define the path watershed protection will take.

That how and why speak clearly from the following pages — in the grass roots involvement, the scientific support, and the working partnership between citizens and government at all levels.

The Clean Lakes Program is the quintessential example of empowering citizens to work closely with their local, State and Federal governments in achieving common goals.

Robert H. Wayland III, *Director*
Office of Wetlands, Oceans and Watersheds

Introduction

Local involvement — and commitment — is a cornerstone for the Clean Lakes Program.

The first 17 years of the U.S. Environmental Protection Agency's Clean Lakes Program have been a resounding success, using relatively few Federal dollars. It has involved many thousands of enthusiastic volunteers, and dramatically improved the quality of several hundred lakes across the United States.

This review explains why the Clean Lakes Program has been so successful, and how the lessons learned from it can be applied to other environmental management initiatives. Four principles form the base for this success:

- Local involvement — and commitment,
- State management,
- Matching funds, and
- Good science.

These basic principles are reflected in the lessons learned by the Program in its first 17 years.

■ **Local commitment = success:** From the beginning, the Clean Lakes Program has been propelled by the enthusiastic and innovative efforts of local communities and organizations working closely with State and Federal officials to restore and manage publicly owned lakes.

Local citizens who care deeply about the condition of the lakes in their communities have thus formed the cornerstone for the Clean Lakes Program. Their commitment has been largely responsible for the Program's long-term success.

Joe Peterson, president of the Preservation Association of Devils Lake in Oregon, echoed the views of many of the citizens involved in Clean Lakes Program activities when he said in mid-1992,

> *The great thing about the Clean Lakes Program is that it pushes the government to work with citizens. And, we found out that these government agencies truly listen to what we have to say and they seem genuinely concerned. Yes, it took the citizens to push our local government into action, but the cooperation since then has been fantastic.*

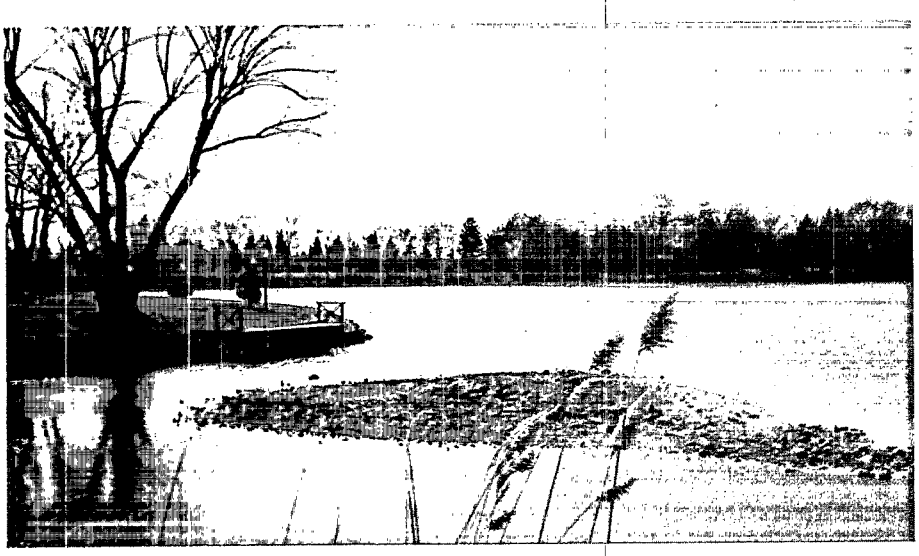
And Dave Olsen, director of the Carroll County Conservation Board (Swan Lake, Iowa) emphasized "The Clean Lakes Program saved this lake — there's no doubt about it."

■ **Matching funds ensure commitment:** Local matching dollars mean more than just helping the State meet the Federal requirement for cost sharing. By committing its own resources, a community buys into the project — that shared ownership translates into continued protection for the lake.

Realizing the importance of this local support, several States have developed Clean Lakes Programs based on the Federal model and require communities to match State grants with local dollars.

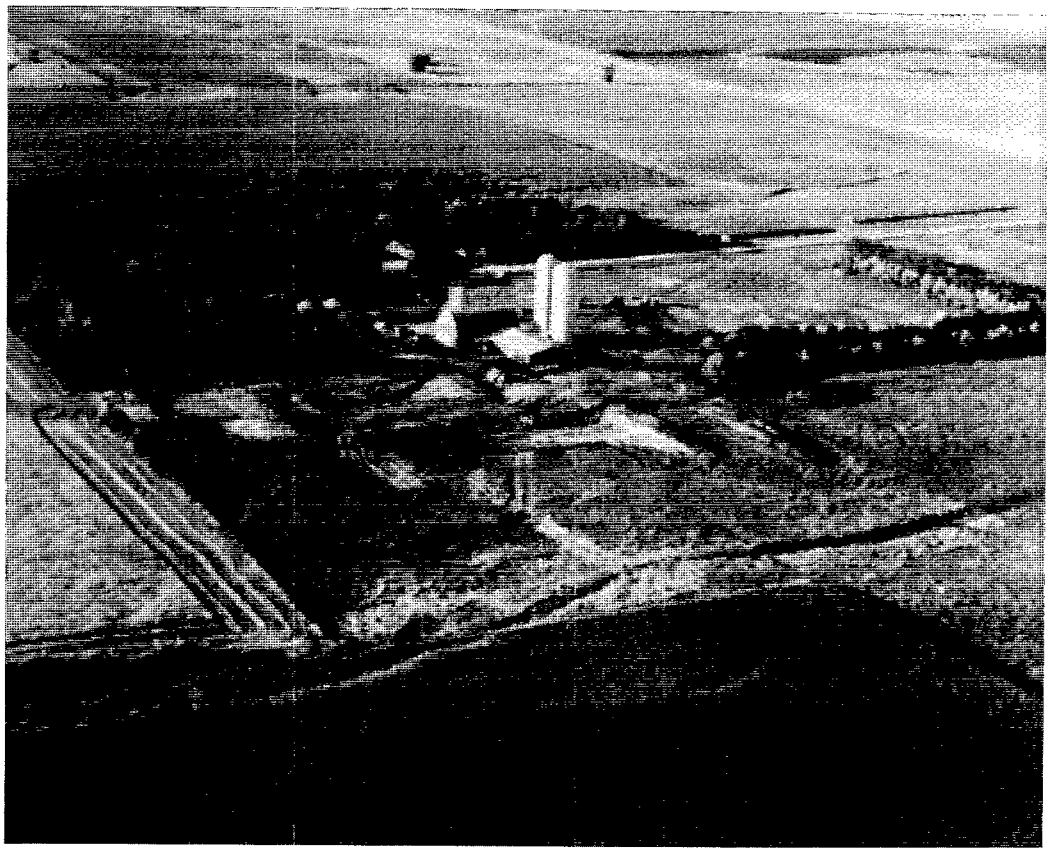
■ **States like clear regulations and guidance:** Clean Lakes Program requirements have changed very little over these 17 years. States appreciate the fact that they have remained clear, specific, relatively simple, and consistent. This management philosophy has produced a smooth, orderly program.

■ **Flexibility promotes innovation:** EPA has given States broad latitude in designing and instituting lake management strategies under the Clean Lakes Program. Because of its flexible nature, the Program primarily encourages local initiatives and supports them with technical and financial assistance. Today, Clean Lakes projects exist in 49 States, Puerto Rico, and on land owned by 15 Native American Tribes.



A variety of public and private organizations helped restore the recreational uses of Silver Lake, Delaware.

Citizen-initiated animal waste management systems in the Upper Minnesota River watershed improve the water quality of Big Stone Lake, Ortonville, Minnesota.



■ **Lake Water Quality Assessments: a valuable tool:** States and Native American Tribes are using these LWQA grants to collect data on everything from lakes they know nothing about to contaminated sediments. And the resulting data are not restricted to the Clean Lakes Program; they are used by local Soil and Water Conservation Districts, fisheries and recreational agencies, even transportation departments.

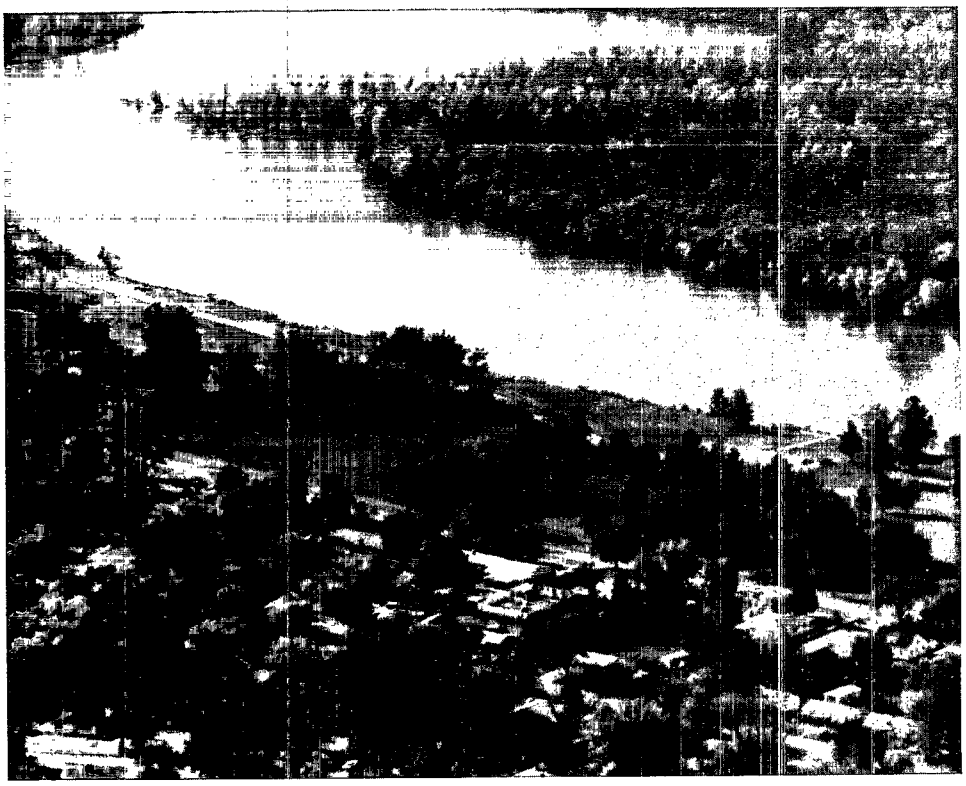
Assessment techniques are improving, fueled by the ever more sophisticated databases that help collate and assess the information collected. A major result: States are beginning to plan for improving water quality on a long-term, comprehensive basis.

■ **Volunteers make it work:** In recent years volunteer lake monitoring programs have multiplied throughout the Nation, as citizens become aware of their own responsibilities for protecting our water resources. Many are also forming lake associations, through which they actively participate in managing their lakes. A Clean Lakes project often begins with citizen concerns about the condition of their lake.

Recognizing this growing citizen interest, EPA's *Lake and Reservoir Restoration Guidance Manual* was written for the citizen audience. More than 30,000 copies of the manual (now in its second edition) have been distributed.

■ **Projects must be evaluated:** To determine the long-term effectiveness of lake restoration techniques, data must be systematically collected and evaluated. Although papers published on specific projects have enriched the sci-

The Clean Lakes Program goals — to restore public lakes and encourage sound lake management — transformed this state park in East St. Louis, Illinois.



ence, the addition of recent State and EPA Region review strategies and the Post-Restoration Monitoring Studies begun in 1989 will strengthen an already solid technical knowledge base about lake restoration.

■ **Funding uncertainty a negative:** The Clean Lakes Program has not enjoyed a consistent funding base since Federal grant funds have fluctuated from year to year. This uncertainty appears to discourage long-term projects because of the possibility they may not be funded to completion.

■ **Watershed management approach validated:** A lake collects drainage from its watershed, an area that may far transcend the county or State in which the lake lies. For that reason, many lake projects require multi-jurisdiction buy-in. Thus, Clean Lakes is a precursor to EPA's Watershed Protection Approach; its fundamental tenets are reflected in the Approach's three principles:

- targeting resources to watersheds where pollution poses the greatest risk to human health, ecological resources, desirable use of a body of water, or combinations thereof;
- involving all parties with a stake in the specific local situation; and
- using an integrated approach, drawing on the full range of organizations, methods, and tools available in a coordinated, multifaceted attack on the problems.

This targeted, integrated approach will protect lakes and their watersheds (including wetlands, critical habitat, and other valuable resources), but, as the Clean Lakes Program has so clearly demonstrated, it will succeed only if all concerned work together toward creative solutions. Such solutions are likely to be a combination of regulatory and voluntary measures.

This process has worked in the Clean Lakes Program. And the lessons learned in making Clean Lakes work can be used to great advantage by EPA as the Agency begins its Watershed Protection Approach to improving the environment.

Hence, this comprehensive review of the Clean Lakes Program, which covers information found in the published literature as well as in EPA program files. These materials have been validated and fleshed out by interviewing nearly 100 individuals who have been extensively involved with the Clean Lakes Program.

More than *how* it worked, this review looks at *why* the Program worked, and what its real effects have been on the Nation's lakes. Almost to the embarrassment of the reviewers (who could find few program flaws), the Clean Lakes Program has met its dual objectives of restoring degraded public lakes and encouraging sound lake management throughout the country.

The Clean Lakes Program has also demonstrated how to multiply funding by leveraging income from many sources to restore and protect lakes. The investment in Clean Lakes projects, however, has returned more social and economic benefits than its creators could have envisioned. This report describes several severely distressed lakes that became community assets when restored:

- **Swan Lake, Iowa:** Visits to the state park there were up 170 percent; concession income quadrupled; camping more than doubled; and fishing increased more than sevenfold to more than $1.75 million. Fishing alone is expected to pay for the project's cost within two years.

- **Lake Lashaway, Massachusetts:** Citizen use of the lake dramatically increased; towns bordering the lake established a new beach, and the lake association built a boat ramp to meet usage demands.

- **Frank Holten State Park, Illinois:** This area was transformed from a crime-ridden, trash-strewn park to an attractive family recreation center. Use of the park and lakes increased 20-fold on holidays; a boat rental concession and bait shop opened in 1988.

Striking as the results have been for communities, ultimately, the value of this citizen-government partnership has reached far beyond the Clean Lakes Program to serve as a model for improving the management of other environmental programs.

Lessons Learned from the Clean Lakes Program

The lessons learned from the Clean Lakes' experience — both positive and negative — point the way toward continual improvement for both the Clean Lakes process and environmental management itself. Those programs that depend on limited resources, such as the Watershed Protection Approach, can learn from this creative approach to generating voluntary support at State and local levels.

Local Commitment = Success

The basic premise of the Clean Lakes Program is that people physically closest to the lakes are best positioned to resolve lake water quality problems. The Program never intended to clean up all the lakes in the country, but rather to help States and communities learn how to manage their own lake problems.

This premise is well-founded; State and local officials agree that local support is a prerequisite to success, because many solutions to lake water quality problems depend on individuals' voluntary actions.

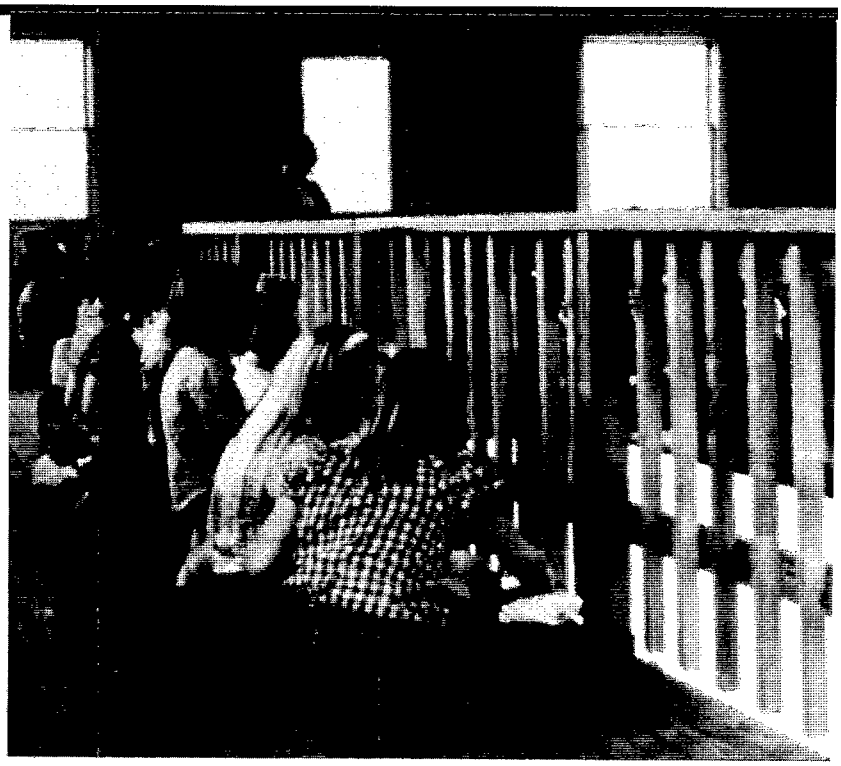
A number of Federal, State, and local officials said a lake restoration project's success depends largely on local agencies and organizations that focus and maintain public attention on the project. At Lake Washington in Mississippi, State water quality officials worked closely with local farm organizations to tell area farmers about State lake restoration plans, and thus enlisted the agricultural community's cooperation in installing best management practices (BMPs) vital to the project.

(left photo)

Residents and agencies closest to the lake are best positioned to resolve water quality problems.

(right photo)

Children on an observation deck in Swan Lake near Carroll, Iowa, learn how to keep water clean and safe for recreation.



According to local project participant Robert Seyforth, "Although there isn't really an organized citizens' group, the Lake Washington project has much local support. The lake is one of the largest in the state, and agriculture activities have always created a lot of problems. In fact, the lake had to be closed to commercial fishing in the 1970s because of the problems."

In another State, only one of three initial Phase I diagnostic studies moved into Phase II restoration — mostly because of a lack of strong local interest. As a result, that State will no longer begin a diagnostic study unless public support and participation are ensured and demonstrated.

Officials in several States said that public support for lake restoration in urban and suburban areas tends to be stronger than in rural areas. One believed it may be easier to mobilize residents to clean up lakes or rivers near cities where the bodies of water are scarce and highly visible to large numbers of people, in contrast to rural areas that have more outdoor recreational resources.

Rural residents may also believe water quality projects will cost them personal time and money, while their urban counterparts do not see such a direct link between their own resources and the projects in their areas. Because agricultural nonpoint source pollution is often targeted, many farmers and ranchers view these projects as affecting their bottom line.

Seyforth, however, describes a different rural experience:

> *The State fish and game agency noticed tremendous numbers of catfish in the lake, so it started encouraging people to fish for catfish. As a result, a lot of people started putting barrels in the lake to 'hand grab' the fish. A few years ago, the lake was drained and the low water level exposed*

all of these barrels — many of them were pesticide containers.

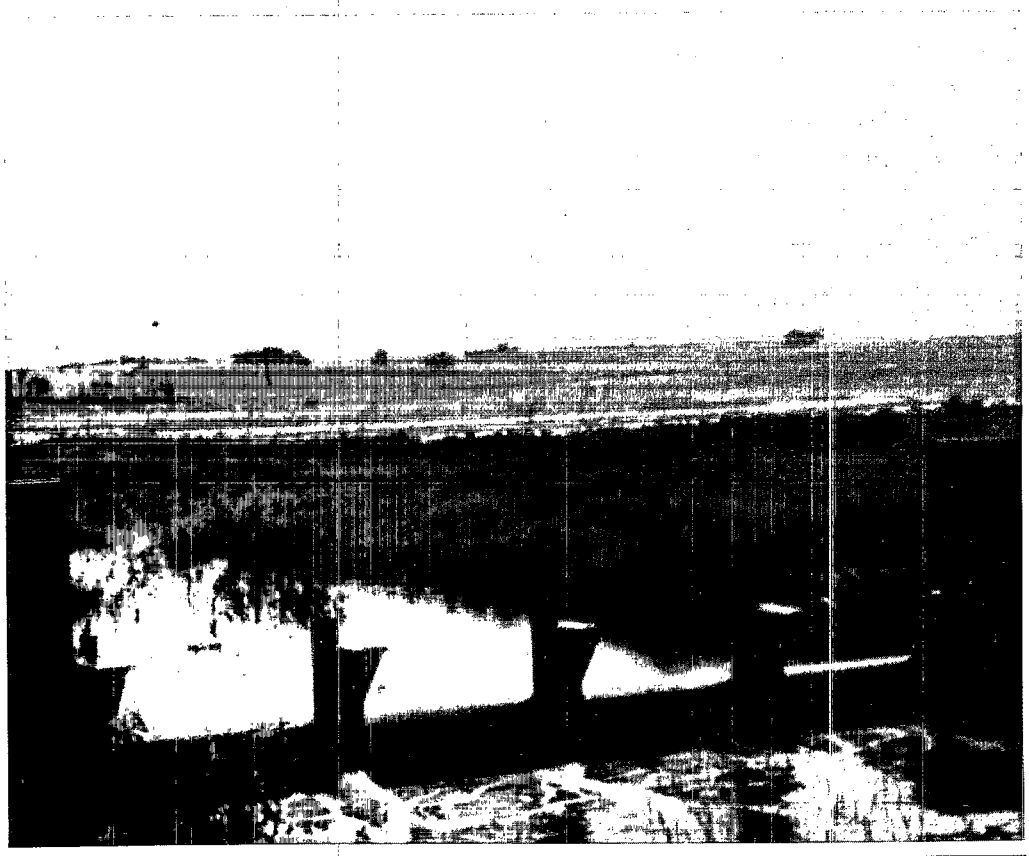
Lakeshore residents got really upset and that's when everything got started! The State began looking into the Clean Lakes Program and made an application for funds. The State legislature put up the matching funds. We've completed a Phase I study and are just getting started on some Phase II projects.

Matching Funds Ensure Commitment

Once a lake's water quality is improved or restored, it must be protected from degradation. By committing their own resources to provide the match for Federal Clean Lakes funds, local communities share ownership of the projects. The result: greater assurance that the lake will be protected after restoration is completed.

Fourteen of 16 State water quality management officials who commented on the matching requirements agreed that the requirements provide an incentive for localities to assume a share of responsibility for their lake projects. This view was shared by a representative of a private lake association that had contributed funds to a Phase II restoration project.

Wetland restoration projects are essential to sound lake management. Here, they prevent excessive nutrients from entering Big Stone Lake, Minnesota.



In the Lake Washington project, Seyforth pointed out "my only problem with the program is that the matching fund restrictions are often hard to deal with. We did run into some problems in that area but were able to work around them."

"But," Seyforth continued, "our project would have never gotten started without the Clean Lakes funding to do the initial studies. Right now, our biggest concern is that the money is continued because we still have a lot of work to do."

Connecticut, Illinois, Massachusetts, New Hampshire, Vermont, and Washington are among the States with Clean Lakes Programs modelled after the Federal program. They require local communities to provide matching funds for State grants, just as the Federal grants must be matched by State funds.

In two of the States, officials did not think such State programs were beneficial, citing a community's financial hardship outweighing any advantages. Another State official agreed that the match requirement helps the State gain local support for lake projects, but said the requirement causes some local government agencies to lean toward in-lake treatment approaches over watershed management controls because it is easier to see the direct benefits of local clean-up activities than to observe the more subtle successes of regional watershed management efforts.

More than half the $200,000 funding for the Phase II restoration project for Silver Lake in Dover, Delaware, has come from the local and State match: the City of Dover, the State legislature, local citizens, and civic interest groups. The latter two groups have raised $40,000, including

- contributions by Dover High School for shoreline stabilization,
- cost-sharing by farmers through the Kent (County) Conservation District,
- a cash contribution by the FishAmerica Foundation,
- cash donations by local merchants for converting detention basins to retention ponds, and
- in-kind services provided by the City of Dover.

States Like Clear Regulations and Guidance

Clean Lakes Program regulations and guidance generally received high marks for clarity, specificity, and relative simplicity. Respondents felt they understood program requirements; the relative ease of participation was a strong incentive for action. They said they had a sense of security about the program because the guidance and funding criteria had changed very little since the program began. Much of the smooth and orderly implementation

of Clean Lakes efforts can be traced to the States' high level of comfort with the program.

Program reporting requirements were usually considered reasonable. One respondent said he was pleased that EPA did not expand reporting requirements as a result of the Water Quality Act of 1987, other than the statutory obligation for States to include their Lake Assessment Reports with their biennial 305(b) reports.

Flexibility Promotes Innovation

Clean Lakes Program regulations were designed to allow States and localities to tailor solutions to their own situations. Most State agencies were satisfied with that flexibility, as demonstrated in the formal program structure and implementation through EPA Regions.

For example, in response to States' priorities, since 1988 EPA Region IV has shifted its Clean Lakes Program focus to concentrate on lakes with high recreational use, as measured by annual visitor-days. In another example, the startup of LWQA grants in response to the Water Quality Act of 1987 has given States and Native American Tribes the resources they need to assess their lakes, establish priorities for lake management activities, and conduct public outreach. One State agency representative said that instituting the LWQA grants clearly showed that a Federal agency was listening to the States.

Overall, State officials thought EPA Regions were positive and supportive. One official said the flexibility of EPA staff in Washington, D.C., and at the regional level was responsible for much of the success of his State's Clean Lakes program. Another said that one key to his State's effective Clean Lakes efforts has been that EPA has not "micromanaged" projects or unduly interjected itself into State and local decisionmaking.

Some criticisms did emerge during this review. Several State officials thought EPA's sampling requirements were too restrictive and represented quantity "overkill." In most projects cited, however, they thought the Regions had handled the requirements reasonably and with sufficient flexibility to allow the projects to proceed.

The $100,000 Federal limit on Phase I grants was also criticized. Several individuals expressed concern that the limit does not take into account increases in labor, equipment, and analytical costs that have occurred over time, resulting in increased costs for lake evaluations. Several commented that the limit also does not reflect the greater costs of evaluating larger lakes, such as impounded waters in the southwestern United States. One State agency official suggested that EPA consider using a sliding scale to decide appropriate grant amounts, based in part on lake acreage.

Lake Water Quality Assessments: A Valuable Tool

Lake Water Quality Assessment grants have provided assistance on a larger scale, allowing States and Native American Tribes to perform broad-based assessments of their lakes and associated watersheds to meet the requirements of section 314(a)(1) of the Clean Water Act. Several States said that through the LWQA grant program, they have learned about the conditions of many of their lakes for which they would otherwise have little or no information. In some States, officials said that without the targeted assistance provided by the LWQA, lake water quality evaluations would be extremely difficult to fund because of competing demands for scarce State water quality and natural resource management funds.

Data from streamflow monitoring on Delavan Lake, Wisconsin, contribute to water quality assessments and lake management decisions.

Increasingly, water quality data derived from Lake Water Quality Assessments are being integrated into lake management decisions based on Clean Water Act sections 314(a)(1) and 305(b). When combined with other factors (including local support for restoration projects), these data are useful in allocating resources. Several States are now setting water quality priorities using an ecoregion approach backed by LWQA data.

LWQA funding is also supporting some States as they characterize the nature and extent of their lakes' contaminated sediments. This information is critical to the States' and EPA's efforts to assess the extent and severity of contaminated sediments and thus to formulate strategies to address the health and environmental risks associated with this problem.

Lake Water Quality Assessments often spur communities to better control of stormwater flows and other contamination sources.

As part of its LWQA, **Indiana** is creating a computer database based on compilation of analyses of composite sediment samples collected from nearly 60 public lakes and reservoirs. Additional sampling is conducted as necessary to confirm the contamination sources. **Illinois** is conducting an in-depth review of all inland lake sediment data collected from more than 121 lakes since 1977, to determine whether correlations exist between observed contamination and variables such as land use, ecoregions, and watershed-to-lake surface area ratios.

The Clean Lakes Program has encouraged States to take a long-term, comprehensive view in planning for their water quality assessment needs. In FY 1991, EPA asked Region IV States to develop five-year plans for lake water quality monitoring — the first such plans they have ever put together. The improvements in lake monitoring expected to result from these five-year strategies should substantially improve the lake assessment sections of State 305(b) reports and make them more useful as planning documents.

Techniques to assess lakes are improving. In the mid-1980s, a lake classification system was developed by the **Illinois** EPA in cooperation with the State Watershed Priority Committee (composed of representatives from the major State and Federal agencies involved with watershed management) and the Illinois Department of Conservation to provide a basis for screening potential lake and watershed projects statewide.

Lakes were surveyed and evaluated in three major categories: current water quality, potential water quality through improvement/maintenance activities, and public benefits. Each lake received an overall classification rating that, when used by the State, helps set priorities that would produce the greatest benefits and cost-effectiveness. The ratings are used by

- Illinois EPA to screen candidates for the State's Clean Lakes Program assistance,
- the State Watershed Priority Committee and local Soil and Water Conservation Districts in ranking watershed land treatment projects for funding under various Federal and State agricultural treatment programs,
- the Department of Conservation for fisheries management and recreation use development purposes, and
- the Department of Transportation in managing bodies of water dedicated to public use.

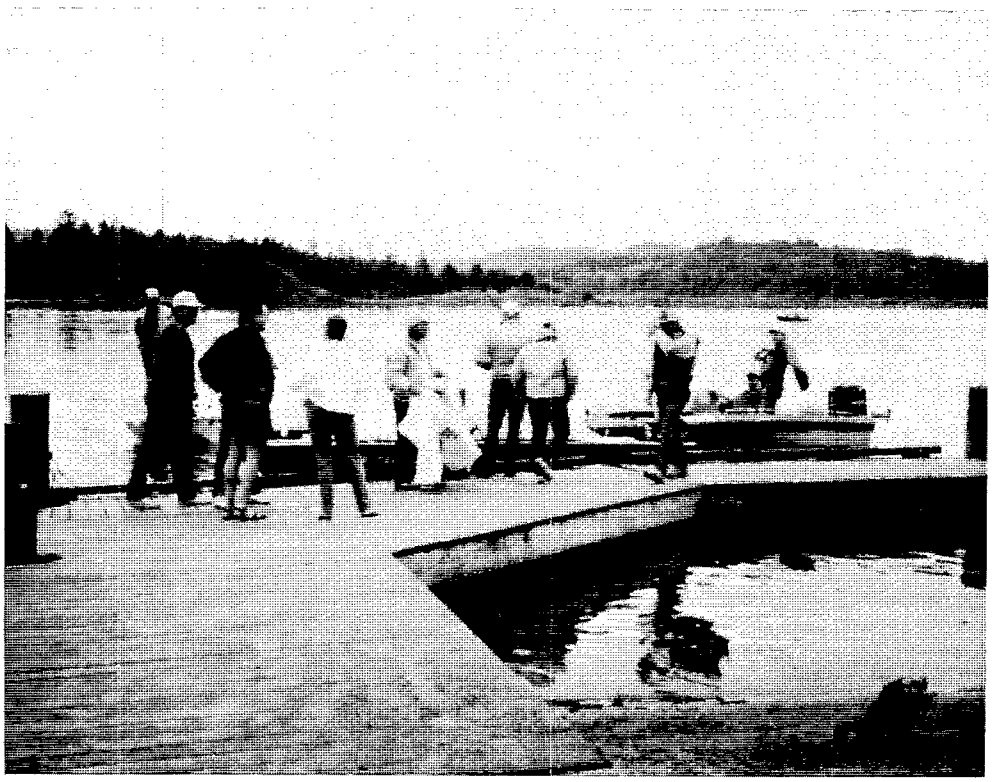
Volunteers Make it Work

"Our group's role is basically to help shape the projects," said Big Stone Lake's Will Hansen. "We have about 700 paid members who share their concerns. From time to time we have donated money, but we are not fundraisers. The States basically run the projects, but none of these projects would have been started without great local support from individuals, businesses, and the local governments."

The Clean Lakes Program has always emphasized the importance of active citizen participation in restoring and protecting their lakes, and recognizes this factor as essential to the long-term success of lake management programs. In every region of the country, citizens' concern for the conditions of their lakes has resulted in volunteer action.

A 1991 survey of States showed that volunteer lake monitoring programs have been established in 19 States, 12 of them partially funded by the Clean Lakes Program, mostly through LWQA grants. State and local governments, citizens, and other private sources also contribute to these volunteer programs. The information collected by volunteers is valuable to State water quality officials during lake assessment and classification efforts.

In **Illinois,** more than 750 citizens have been involved in the Volunteer Lake Monitoring Program, checking the condition of nearly 300 lakes. Through the program, the Illinois Environmental Protection Agency works with citizens, lake managers, and local governments to promote better understanding of lake conditions and to encourage comprehensive management of lake resources, primarily through local initiatives.

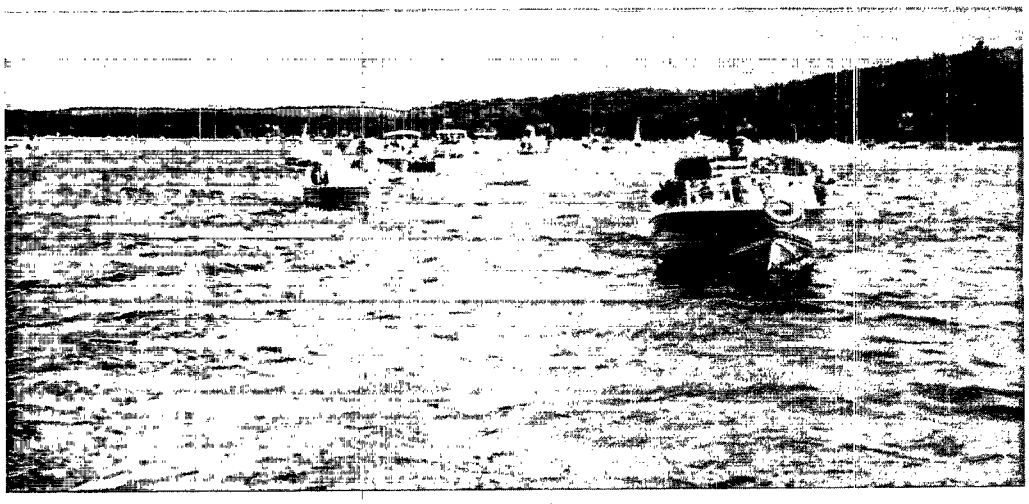


Residents gather for Volunteer Lake Cleanup Day, an annual event on Devils Lake, Oregon.

The program is coordinated by the Illinois EPA in cooperation with the State's three area-wide planning commissions, designated under section 208 of the Clean Water Act. Educational activities include developing and distributing newsletters, supporting the program itself and Illinois Lake Management Association conferences and workshops, and conducting on-site training and followup visits. The State's understanding of its lake conditions has increased substantially.

Baseline water quality and sediment data have been collected from more than 180 Illinois lakes. Volunteers are collecting water samples at 50 of those lakes for analysis at State laboratories, including testing for total phosphorus, nitrates and nitrites, and total suspended solids. Nearly half of the data collected by the State for its 305(b) reports is based on volunteer efforts.

In **New Hampshire**, the State's Volunteer Lake Assessment Program is a cooperative program between lake residents and the New Hampshire Department of Environmental Services. As of December 1991, 101 lake associations participated in the program. Through the program, many lakes are sampled several times a year to discern long-term water quality trends. New Hampshire has recently prepared a teacher's guide and a workbook for public education programs. New Hampshire schools will be given these materials this year.



Boat parades and other recreational activities on Lake Candlewood in Connecticut encourage public awareness of water quality issues and increase support for the Lake Authority.

Another active Clean Lakes participant, the Candlewood Lake Authority in **Connecticut**, found, according to Herman Phelps, its former chairman, that "the Clean Lakes Program grant provided financial resources for our association to hire a full-time professional lake manager to accomplish the projects we identified during the Phase I study. It also provided the resources needed to initiate important public relations/public education proj-ects like the watershed newsletter, a slide show, and water quality reports."

Candlewood's Phase I diagnostic study heightened public awareness of lake water quality issues, and the Association began a lake education program for schools around the lake that reaches students from kindergarten through high school. The association also instituted a citizens' monitoring program in cooperation with Western Connecticut University and Connecticut College.

Today residents perceive the Candlewood Lake Authority as an environmentally oriented agency and an indispensable source for lake information.

"As a result of these and other management efforts," Phelps observed, "the local public's perception of the Candlewood Lake Authority as an environmentally oriented agency was vastly increased. The surrounding towns became more willing to fund our annual budget requests, and people began to look at the Authority as an indispensable source for lake information."

Other lake associations have also become interested in improving their own lakes, and the interest generated by these activities has contributed to the formation of other lake associations in Connecticut.

But "most important," Phelps emphasized, is that "most of the management activities or improvements initiated under the Clean Lakes grant are still in operation today and funded by 100 percent local dollars. In this perspective, the Candlewood Lake Protection and Restoration Project grant represented the seed money needed to get the projects off the drawing board and into practice."

The **Massachusetts** Water Watch Partnership is also playing a major role in actively involving citizens in lake water quality monitoring and management — and even more difficult for the long term, maintaining ongoing monitoring programs. To make these programs work, the Partnership recognizes local needs as well as problems common to all lakes and rivers. The group is currently preparing a training manual containing information on water quality issues, watershed management practices, and specific sampling and analysis procedures.

Individuals involved in citizen volunteer programs suggested several key ingredients for successful volunteer programs:

- Program organizers must assure participants that their efforts are worthwhile and that the information they generate will actually be used for managing lakes.

- Technical assistance and equipment must be supplied if citizen groups are to succeed.
- Training sessions and demonstration sampling exercises are essential to producing good volunteer monitors.
- Regularly scheduled followup sessions are important for encouraging citizens to continue their involvement and for maintaining quality assurance and quality control procedures.

State agencies play an important role in helping local volunteer groups communicate with their counterparts around the State. Such contacts improve monitoring efforts overall, and maintain momentum for future volunteer programs. Under the **Texas** Watch volunteer monitoring program, the Texas Water Commission publishes a bimonthly newsletter about activities of volunteer groups around the State, and volunteer opportunities within those groups. An important information-sharing forum for local groups, the newsletter identifies and praises local efforts, thereby helping maintain enthusiasm for existing volunteer programs and encouraging other citizens to join.

Projects Must Be Evaluated

Hundreds of lake restoration and watershed management projects partially funded under the Clean Lakes Program have been completed or are under way. Many more lakes have been restored solely by States and local communities. These projects constitute a treasure of technical knowledge, from the effectiveness of assessment methodologies to the longevity and effectiveness of in-lake treatment techniques and watershed protection measures. Clean Lakes projects, in particular, have used state-of-the-science methods that need evaluation.

Even within the past decade, restoration experience and related technical data have advanced the science of lake restoration and offered practical guidance to lake managers. This experience will become increasingly valuable as completed projects are evaluated systematically to assess their effectiveness. In a 1985 EPA review of Clean Lakes Program projects, only 66 of 158 funded projects had been completed and documented. At that time, reviewers suggested that project results would provide a valuable information base for the scientific community and others undertaking restoration projects. They also suggested that a comprehensive evaluation of projects be conducted as more projects were completed.

The Clean Lakes Program has recently begun setting up a system for managing and evaluating lake project data, designed to benefit from past projects' experience. Quantitative scientific data on long-term project effectiveness will become increasingly available through Post-Restoration Monitoring Studies being conducted under Phase III grants begun in 1989.

In addition, several States and EPA Regions have initiated strategies for systematically reviewing results of their lake projects. EPA Region I is conducting an in-depth evaluation of 14 Phase II projects completed in the Region. The evaluation measures each project's degree of success by reviewing its objectives and environmental results, and by reviewing the technical and implementation lessons learned.

The North American Lake Management Society (NALMS) and the Terrene Institute of Washington, D.C., have recently produced a guidance document under a grant from the Clean Lakes Program that points the way to such a strategy. In *A Strategy for Evaluating In-Lake Treatment Effectiveness and Longevity*, the authors suggest that scientists and lake managers collect at least three to five years of pre- and posttreatment monitoring data and enter all data into the EPA data management system, STORET. The authors also recommend that lake managers and scientists pay more attention to studying and understanding lake processes, and move from a lake restoration approach based principally on in-lake cleanup toward one based on the scientific understanding of lakes and their environments.

Advancing lake restoration and management techniques depends on disseminating information about the effectiveness of those strategies. Technical forums, such as conferences and lake workshops sponsored by EPA and others, are crucial to distributing information.

One State agency suggested that Clean Lakes grant recipients should prepare capsule project summaries, including information on project objectives, technical approach, and projected results. The capsule summaries could then be included in the Clean Lakes Clearinghouse database so that lake managers could find all available information on specific implementation measures.

A researcher commented that EPA should study the regional differences that can affect the application and results of ecosystem models developed by EPA and by researchers, and then communicate this information to users.

Watershed Management Approach Validated

Since the program structure was formally established in 1980, the Clean Lakes Program has emphasized using watershed management measures. A longstanding program policy gives greater consideration to applicants who propose restoration and protection techniques that control pollutants at the source through watershed-wide management, rather than dealing with symptoms in the lake. Review respondents strongly supported that policy.

State and local Clean Lakes officials have been using the watershed management approach for more than a decade. The Clean Water Act requirement [section 314(a)(1)] for States to assess their lakes, combined with resources provided by LWQA cooperative agreements, has resulted in innovative priority-setting techniques.

An example is the management conference established under the Clean Water Act for Lake Onondaga in **New York**. Conference participants include the New York Attorney General's office, the New York Department of Environmental Conservation, the Mayor of Syracuse, the Onondaga County Executive, EPA Region II, and the U.S. Army Corps of Engineers, Buffalo District. The conference has a 20-member citizens' action committee whose members represent ordinary citizens, environmental groups, and industry and business interests.

The conference's technical review committee deals with surface and groundwater quality, habitat protection, and nonpoint source pollution controls. A number of Federal agencies, including EPA, are members of this committee. The USDA's Soil Conservation Service, the U.S. Geological Survey, and the Fish and Wildlife Service are participating in a technical review committee working group addressing nonpoint source pollution concerns. Academic institutions, including the State University of New York and Syracuse University, are also part of this effort. Through an interagency agreement, the U.S. Geological Survey (USGS) is conducting water quality monitoring in lake basin streams, and the U.S. Army Corps of Engineers is evaluating restoration options.

Watershed concerns often cross geographic and political boundaries and may require interstate solutions in some cases. For example, Big Stone Lake and its contributing watershed are spread over parts of **Minnesota and South Dakota**, and are found in five counties, one watershed district, two EPA Regions, and several local governments' and government agencies' jurisdictions.

As Will Hansen, president of Citizens for Big Stone Lake, noted, "The lake has always been central to life in this area because it's a major recreation spot. Citizens' groups began forming in the 1960s, but the major hurdle was that the lake was located in two States — it was hard to get the two governments to work together. The local residents decided to form Citizens for Big Stone Lake in the 1970s to voice their concerns and seek action."

The Citizens for Big Stone Lake came up with the matching funds for the 1981 Phase I study administered by the South Dakota Department of Water and Natural Resources (SD DWNR). "When I joined the group, most members thought our only job was to get the Federal and State governments involved," Hansen said. "Well, we were wrong. We found that we had to spearhead any action. A study by a private firm was finally completed, which gave us the ammunition to start seeking Clean Lakes funding."

Phase I established the informational base for designing needed watershed protection measures. "The lake has always been fragile," Hansen observed, "especially since the 1930s when it was made into a reservoir during the drought. The lake started to gradually worsen because of runoff and sedimentation."

After reviewing the Phase I study of the Big Stone Lake project, EPA Regions V and VIII provided Phase II grants, which the two States used in a coordinated effort.

In South Dakota, the Phase II project was first sponsored by the State's DWNR, with local implementation by Roberts County. In Minnesota, the project sponsor was the Upper Minnesota River Watershed District.

Implementation involved many local and State organizations and, at the Federal level, EPA Regions V and VIII, USDA's Soil Conservation Service and Agricultural Stabilization and Conservation Service, the Fish and Wildlife Service, and the U.S. Army Corps of Engineers. Volunteer efforts and in-kind contributions, including those of the Citizens for Big Stone Lake and the South Dakota National Guard, were crucial to the project's success.

Now, according to Hansen, "Everyone is very happy. The lake's tests indicate that water quality has improved. We still have some bluegreen algae,

but that simply says that efforts must continue. Our focus now is on nonpoint source pollution, and the group is currently working with local communities to get new wastewater treatment systems."

Because pollution from nonpoint sources is a major cause of most lakes' water quality problems, a coordinated effort under sections 314 and 319 of the Water Quality Act is critical to solving those problems. Diagnostic/feasibility studies performed under section 314 provide data that can be used to perform restoration and lake management activities under the Clean Lakes Program or other programs. And nonpoint source programs can be implemented under section 319, using information gained through section 314 activities.

A proposed project for Lake Pittsfield in **Illinois** illustrates such integration. The Illinois Environmental Protection Agency is looking at a combination of restoration measures, including both lake shoreline stabilization and in-lake treatment as well as ways to reduce the influx of pollutants from a creek that flows into the lake. These proposed measures include the construction of sediment basins on the watershed's major tributaries and on the lake's upper end, under the section 319 program.

The Lake Pittsfield project is an example of how the Clean Lakes Program's success in getting people to look at the wider issue of a lake's watershed to find solutions to lake water quality problems has led to EPA's Watershed Protection Approach. Just as in Clean Lakes, Watershed Protection targets resources to the most immediate pollution threat, integrating all means available to attack the problem. And, again as in Clean Lakes, Watershed Protection relies on the involvement of all stakeholders in the local situation.

Funding Uncertainty a Negative

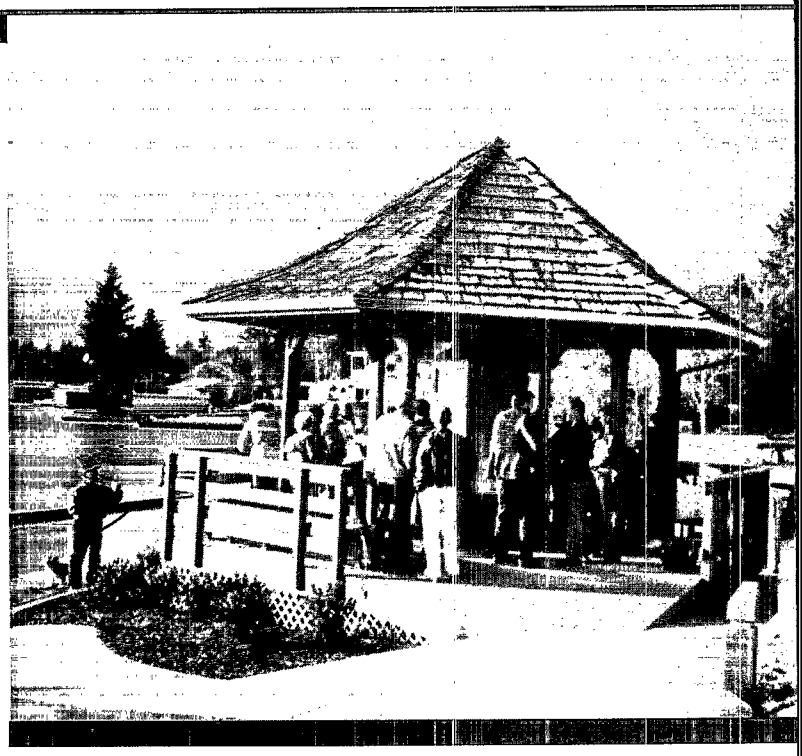
Clean Lakes funding has been uncertain since 1980, and annual appropriations have varied widely. Several State water quality agency officials said that this continual funding concern is their only major criticism of the program.

The question of continuous financial support appears to discourage States and local communities from investing in restoration projects that may never be funded to completion; in other words, this factor limits long-range planning. State officials also report that uncertain Federal funding affects staff morale and undermines project efforts.

One State official cited a fish tissue study that had been completed as part of a lake water quality assessment. Without continued funding to complete other necessary assessment components, the study data alone did not provide a meaningful picture of the lake's condition.

As this last lesson demonstrates, the lessons learned from several hundred Clean Lakes projects are both negative and positive. The information gleaned from them, however, when incorporated with the program's effects described in the next chapter, presents experiences of compelling value for other environmental management scenarios.

Effects of the Clean Lakes Program



Obviously, the Clean Lakes Program can be measured by counting the lakes across the United States that have been restored and protected. But the program's effects extend well beyond these tangible numbers. Knowledge and expertise gained from Clean Lakes have translated to State, regional, and local levels to improve the institutions and proc-esses for managing lakes. And understanding and cooperation have grown among public and private organizations involved with lakes.

Leveraging Multiplies Funding

The most obvious effect of the Clean Lakes Program can be seen in the number of impaired lakes for which restoration/implementation projects have been completed — a much larger number than would have been possible with Federal funding alone. In EPA Region VII States, 15 lakes have been restored or are currently being restored. This work has been done with about $7 million in Federal Phase II grant funds — but that's less than half the total. States and other non-Federal entities provided an additional $8.1 million (about 54 percent of the total funding).

Around the country, Federal-State-local funding has created many environmental success stories:

■ By the early 1980s, **Devils Lake**, a 679-acre lake on the central Oregon coast, was rapidly losing its recreational, aesthetic, and economic value because of accelerating eutrophication.

(left photo)

Voters formed a special district and used a multifaceted approach to restore the recreational uses of Devils Lake, Oregon.

(right photo)

Before the program, Devils Lake was choked with aquatic plants — "because of detergents and fertilizers, among other things, the lake was nothing more than a glorified weed patch!"

A combination of dairy farm runoff, detergent and fertilizer use, improperly maintained septic tanks, and urban runoff had stimulated heavy weed growth. In response to information provided by a Phase I diagnostic and feasibility study completed in 1983, area voters approved a measure to form the Devils Lake Water Improvement District to restore and maintain the lake.

"We found out the only way to get grants (funding) was to form a Special District, which has to do with Oregon law," said Joe Peterson, president of the Preservation Association of Devils Lake. The Association got started, recalled Peterson, "after homeowners around the lake were sick and tired of the lake being a glorified weed patch. Forming the District allowed us to raise money and apply for grants."

Several years later, voters approved a three-year serial levy to provide matching funds and operating expenses for a Clean Lakes Phase II grant for lake restoration and watershed management. The multifaceted approach included in-lake restoration techniques, septic tank maintenance, watershed land use management measures, and public education regarding detergent and lawn fertilizer use. As a result, the lake's surface vegetation has been greatly reduced and recreational use has increased.

The Association, which numbers about 230 families (at $100 per year dues), has continually monitored the District's activities, according to Peterson, "to make sure it was doing the right things to clean up the lake.

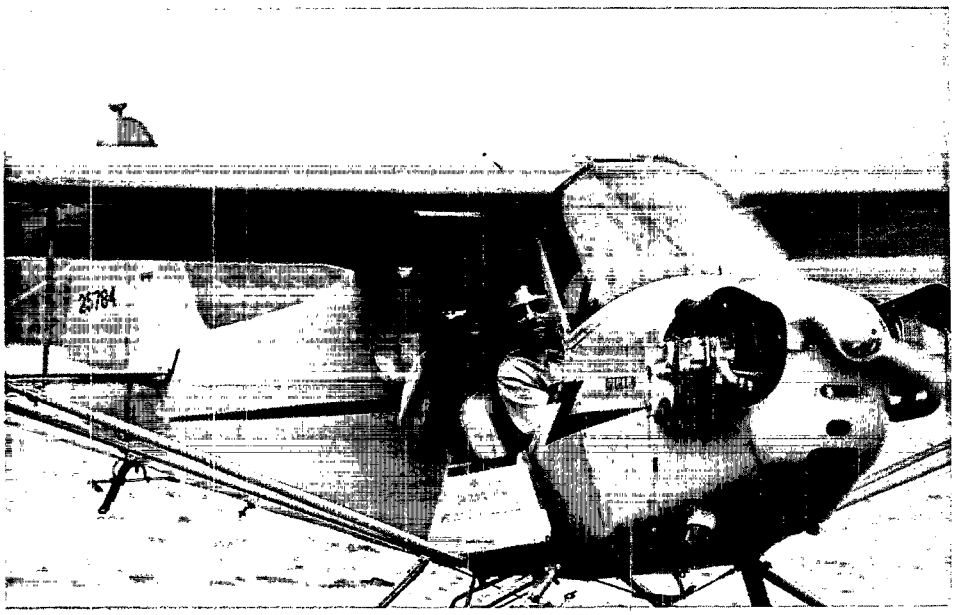
The Association really hasn't donated money to the Clean Lakes Program projects, but we do supply many volunteers. These volunteers have taken water samples and joined in some of the lake's studies."

■ The **Bijou-Wildwood** implementation project in the **Lake Tahoe basin, California,** improved road shoulders and stream zones, and installed underground drainage systems, storm runoff retention basins, and slope protec-

tion measures to control nonpoint source pollutant migration. In addition to $1.1 million in Clean Lakes funds, the Burton-Santini Federal fund was used, as were monies from the City of South Lake Tahoe, the California Tahoe Conservancy, mitigation fees, and a State assistance program that provided $1.2 million.

■ During the late 1970s, residents near **Maine's Threemile Pond** were disturbed by the rapid decline of the lake's water quality. The lake — an important recreational asset for central Maine — was plagued by noxious algal blooms. The lake's managers decided to use agricultural BMPs to control external phosphorus sources, and inject aluminum salts into the lake to deal with the internal nutrients.

Under a Clean Lakes grant, alum and sodium aluminate were applied during 1988. The results: decreased algal bloom, lower phosphorus levels, and better trophic indicators. Local lake association volunteers raised funds, helped apply alum, completed a detailed shoreline survey, and kept the lake shores free from refuse. Landowners are now pursuing a program of technical assistance and cost-sharing to ensure that lake protection measures continue.



Landowners seek funds and technical assistance to continue lake protection measures at Threemile Pond, Maine.

Lake Investments Pay Social/Economic Returns

In addition to Clean Lakes projects' environmental improvements, participants have gained many social and economic benefits over the last 17 years.

■ Until a Phase II restoration project was implemented in the early 1980s, **Iowa's Swan Lake** suffered from turbidity, sedimentation, nuisance algal blooms, and frequent fishkills. The project used a combination of in-lake

"The Swan Lake project is a shining example of how the Clean Lakes Program can really work."

treatment and agricultural BMPs, including drainage and deepening, aeration, installation of shoreline erosion controls, and the set-aside of highly erodible lands under USDA's Conservation Reserve Program.

These measures significantly reduced sedimentation and turbidity in Swan Lake and ensured survival of the lake's fish populations. And the economic benefits were almost startling:

- In 1990, visits to Swan Lake State Park were up 170 percent from 1986 levels, and camping in the park more than doubled during the same period.
- Between 1982 and 1989, the number of anglers at the lake increased more than sevenfold — an increase estimated by the State to offset the project's cost in only two years.
- From 1987 through 1990, the value of fishing at Swan Lake exceeded $1.75 million.
- Between 1986 and 1990, concession income at the park quadrupled.
- Camping receipts in 1990 were 2.5 times higher than those of 1986.

Dave Olsen, the director of the Carroll County Conservation Board, recalled:

> *The problems with Swan Lake go way back to the 1950s, when the Conservation Board was formed. The lake was 130 acres and never very deep. Fishing was always limited because of fishkills and winterkills. In 1977, the area suffered a major drought and a very bad winter. Both events affected the lake and increased the problems of dead fish. As a result, the local people and the board started looking for help. EPA ended up telling the State to do some studies.*

Swan Lake made the Top 10 list of lakes needing immediate attention. In 1981, the Department of Natural Resources started the Phase I study. In 1982, a Phase II dredging project began. The lake is now 14 feet deep in places.

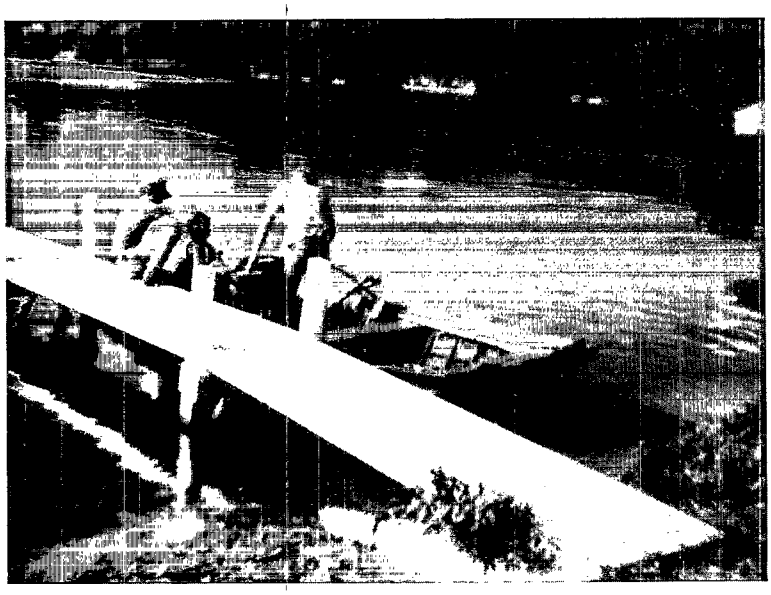
Local funds were raised through a county property tax, which most people supported because they benefited from using the park. The board has been active in seeking and getting local support for the lake projects.

The Clean Lakes Program saved this lake — there's no doubt about it. We haven't had a fishkill in years, and fishing as a sport continues to grow each year. I have nothing but praise for the Clean Lakes Program. The government people have been easy to work with and have responded to our concerns. Locally, support continues to be strong. My only criticism is the uncertainty of funding from year to year. But, all in all, the Swan Lake project is a shining example of how the Clean Lakes Program can really work.

■ In **East St. Louis, Illinois, Frank Holten State Park** was literally stagnating in the early 1970s. Its three lakes were filling with sediment and aquatic weeds. Associated low dissolved oxygen and turbidity caused fishkills and algal blooms that degraded the fishery to rough fish and made boating difficult. Trash strewn throughout the park and a high crime rate made the area a center of urban blight.

In the early 1980s, a combination of Clean Lakes restoration and interstate highway funds contributed to the park's transformation. A new park supervisor began a major improvement program. The weed-filled lakes were replaced by aesthetically pleasing bodies of water. The park is now an attractive recreational area that draws families. Use of the park and lakes increased 20-fold on holiday weekends — enough to support a bait shop and boat rental concession, which opened in 1988.

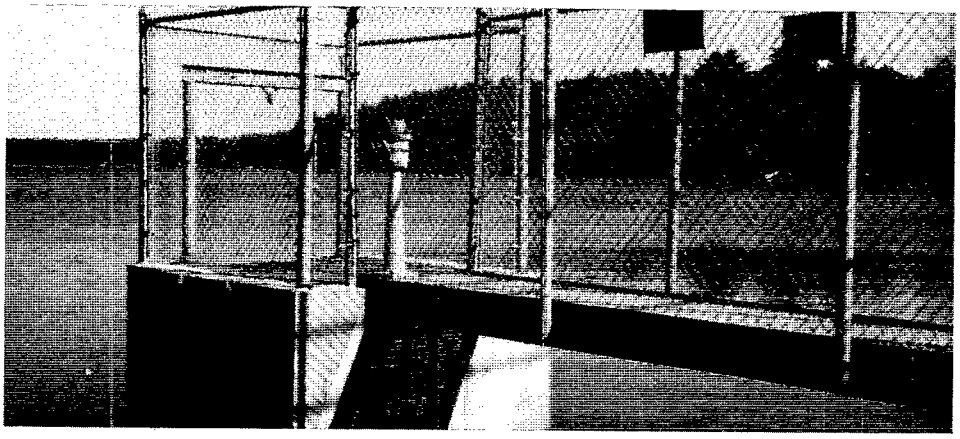
Citizens who live near Lake Delavan, Wisconsin, and government agencies work together toward a common goal: to protect our environment and our natural water.



■ **In Massachusetts,** during the same time period that Illinois' Frank Holten State Park suffered a major decline, **Lake Lashaway** gradually filled with tangled masses of vegetation. Lakeside homeowners even dragged old bedsprings along the shoreline in futile attempts to remove the snarled plants. The vegetation resulted mostly from nutrient loading and suspended solids washed into the water from the lake's shore and its large watershed.

By 1978, the lake's beauty was so diminished and the possibility of recreation so limited that the Lake Lashaway Community Association and the two towns bordering the lake joined to fund a eutrophication study. Under a Clean Lakes Phase I study award in 1980 and a Phase II implementation project awarded in 1981, a lake-level drawdown structure was constructed.

The drawdown structure's effect on the lake was dramatic. During the first six continuous years of winter drawdown, Lake Lashaway remained free of nuisance macrophytes, and aesthetic and recreational activities rebounded. In 1985, the two towns bordering the lake established a new beach, and the lake association built a permanent boat ramp two years later.



This winter drawdown structure, now in its sixth year of use, helps keep Lake Lashaway, Massachusetts, free of nuisance macrophytes. Photo courtesy of Bob Haynes.

■ **In Wisconsin, Lake Delavan** had algae problems for decades. But in the mid-1980s, the problem suddenly got much worse, and the Wisconsin Department of Natural Resources told area residents the algae could be toxic. Lakeshore residents mobilized to form a local committee. The Lake Committee became part of the Town Board, and then began seeking State resources that could be used for the lake.

Through the Department of Natural Resources and the area Sanitary District office, the committee found out about the national Clean Lakes Program. A strong citizen initiative raised local funds through a new hotel room tax to match Clean Lakes Program funds. Miller Upton of the Lake Committee said:

> *Citizen support for the Clean Lakes Program has been tremendous. I personally cannot think of any natural resource more important to the environment than water — we must protect the environment, and the way to do that is to first protect our natural water. . . . I can't imagine a more successful program than the Clean Lakes Program because it involves citizens and government agencies working together toward one common cause. But none of it would have happened without the original push from citizens who lived on the lake.*

States Begin Lake Management Programs

Under the Clean Lakes Program, 21 States have established lake management programs to protect, enhance, and restore their lakes — Connecticut, Florida, Georgia, Idaho, Illinois, Indiana, Maine, Massachusetts, Michigan, Minnesota, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, South Dakota, Vermont, Wisconsin, and Washington.

A few States, such as Wisconsin, had strong lake programs before the national Clean Lakes Program was instituted. But even those States have found that assistance and encouragement at the national level help maintain State and local momentum for strong lakes programs.

Several States have also adapted the Clean Lakes Program model to meet their own needs, as shown in the following examples:

■ In 1989, the **Nebraska Department of Environmental Control** (NDEC) received three Clean Lakes grants, two Phase I grants, and a statewide LWQA award. Prior to that time, Nebraska's lake monitoring and assessment activities were minimal. But the 1989 grants helped stimulate development of a State Clean Lakes Program, which resulted in comprehensive seasonal monitoring on 64 lakes across the State. Additional LWQA funding two years later enabled Nebraska to start an Ambient Lake Monitoring Network.

The Phase I projects have forged new partnerships among many entities: Federal agencies, including EPA, USDA, and the Army Corps of Engineers; State agencies, such as the NDEC, University of Nebraska, and the Nebraska Game and Parks Commission; Natural Resource Districts and county, city, and local governments; and lake users, watershed landowners, and the private sector. In 1991, the State initiated a pilot citizen volunteer lake monitoring program for 35 of its lakes.

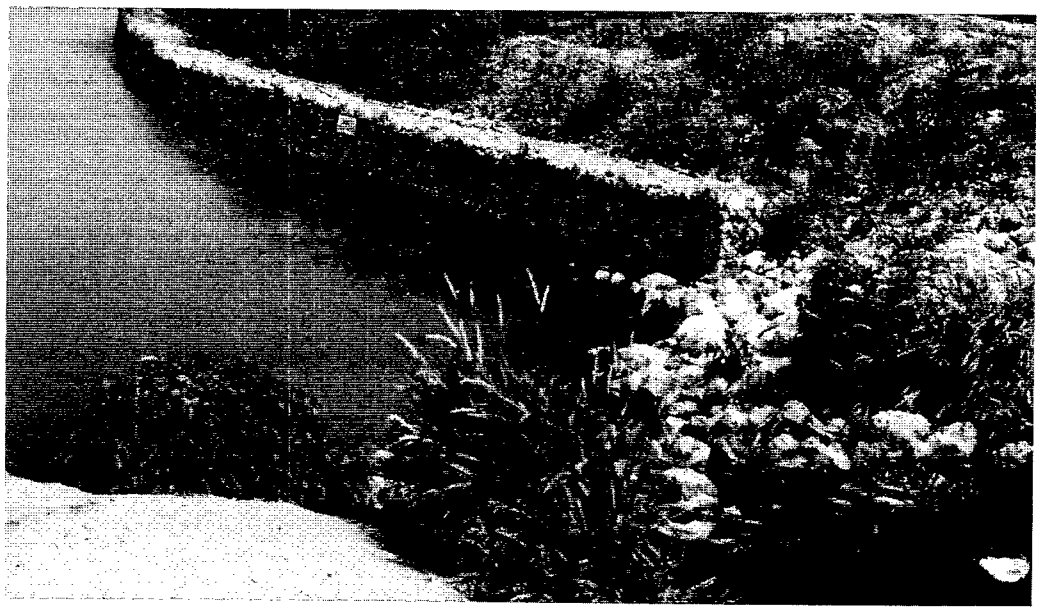
■ In 1977, the **Illinois Environmental Protection Agency** (IEPA) began a lakes program in response to citizen concerns and Federal mandates under sections 208 and 314 of the Clean Water Act. Program components have included monitoring and lake classification; development and implementation of public lakes' water quality and watershed management plans (under the Federal Clean Lakes Program); and education, technology transfer, technical assistance, and coordination to promote initiatives funded by other sources.

In 1989, the State legislature passed the Illinois Lake Management Program Act, which directs the IEPA to implement a program patterned after the Federal Clean Lakes Program. Under the Act, IEPA awards grants to lake owners for diagnostic and feasibility studies on a 50/50 matching basis and for restoration and water quality maintenance programs with up to 50 percent of the match.

■ The **Minnesota Clean Water Partnership,** created by the State legislature in 1987, also used Clean Lakes as a template. Through the partnership,

local governments receive technical and financial assistance to protect and improve lakes, streams, and groundwater degraded by nonpoint source pollution. Funding is given in two phases. Local project sponsors can receive financial assistance for up to 50 percent of project costs.

Without assistance and encouragement from the Federal level, State and local programs may lose the momentum that propels strong lake programs.



Public Awareness of Water Quality Grows

Clean Lakes activities — and the information from their projects — have been credited with creating a greater public awareness of lake water quality issues. In many cases, this interest has increased citizen involvement in lake management programs (such as volunteer monitoring) and encouraged government agencies to place a higher priority on lake issues.

One example is the EPA Region VI Clean Lakes Program sponsorship of a **Regional Citizen Monitoring Workshop in Dallas, Texas** (July 1991) — it drew participants from several citizen monitoring groups and Federal, State, and local agencies in the region.

Funding from LWQA grants and a major effort by the Texas Water Commission have substantially increased volunteer citizen monitoring activities in Texas. Public support for these programs is exemplified by the 1991 opening of the **Office of Texas Watch,** which the public has embraced to a degree that surprised even the office's most optimistic founders.

The group's monthly newsletter was launched with only 100 subscribers but drew over 1,000 just five months later. More than 2,000 citizens were contacted through meetings and presentations within the first two months of program operation. The Texas Watch program estimates that about 30 citizens groups are now active in the State, with roughly 500 people involved in volunteer monitoring activities.

Understanding of Lake Conditions Improves

During the Clean Lakes Program's first 17 years, significant progress has been made in techniques for assessing lake conditions and in understanding the relationships between lake water quality and natural and man-made pollutant sources in lake watersheds. Information gathered through the 305(b) process is building a technical base that will enable water quality officials at all government levels to assess lake conditions, establish priorities for action, and evaluate the effectiveness of ongoing or potential Clean Lakes strategies.

This approach is particularly evident in recent advances in lake classification methodologies. In 1985, to better understand regional patterns in lake conditions, **Minnesota** began lake monitoring based on the ecoregion framework developed by the EPA Research Laboratory in Corvallis, Oregon. Minnesota monitors 50 to 150 lakes per year in different parts of the State, with 30 to 40 selected for monitoring three to four times during the summer. This information provides insight into expected ranges in water quality for lakes in a given region. Minnesota has used the ecoregion approach to define seven regions across the State, four of which contain 98 percent of Minnesota's 12,034 lakes.

Compiling lake and watershed information along with the water quality data provides a means for understanding lake-watershed interactions and determining attainable trophic status for lakes, as well as for developing lake water quality criteria on a regional or lake-specific basis. Chemical and biological data from trend monitoring are combined with data collected through the State's voluntary citizens' monitoring program to identify long-term trends in water quality.

In 1980, **Iowa State University** researchers created a criteria ranking system to classify the State's lakes. With funding from the Clean Lakes Program, University researchers began collecting environmental and socioeconomic data on 107 of Iowa's publicly owned lakes. The criteria ranking system looked at the lake's water quality, the expected effectiveness of restoration, and its potential public benefit. The State then established a restoration priority for each lake, targeting resources to the projects with the greatest potential for environmental, social, and economic payoff.

This system has become an integral component of Iowa's lake restoration program. An LWQA award is now being used to update ranking data, with the results compiled into a database that will become a tool for local lake managers.

Groups Work Together

The Clean Lakes Program has emphasized an integrated approach to lake problems involving the public, the business community, and government agencies at the local, regional, State, Tribal, and Federal levels. By focusing on watershed environmental problems, comprehensive solutions to water

quality problems have been formulated that effectively integrate the capabilities and responsibilities of public and private organizations in the watershed.

According to many people involved with Clean Lakes projects, relationships between the participants definitely improved as a result of their common involvement with the projects.

- In **Vermont**, the U.S. Geologic Survey worked in a coordinated effort with the State on a Phase I diagnostic study of Lake Morey. USGS conducted a hydrologic assessment of the lake basin, including stream gauging on the major tributaries, precipitation analysis, and installation of piezometers and groundwater monitoring wells in the watershed. The State collected and analyzed groundwater samples. Project results were used to design diagnostic studies of Lake Champlain and other lakes in Vermont.

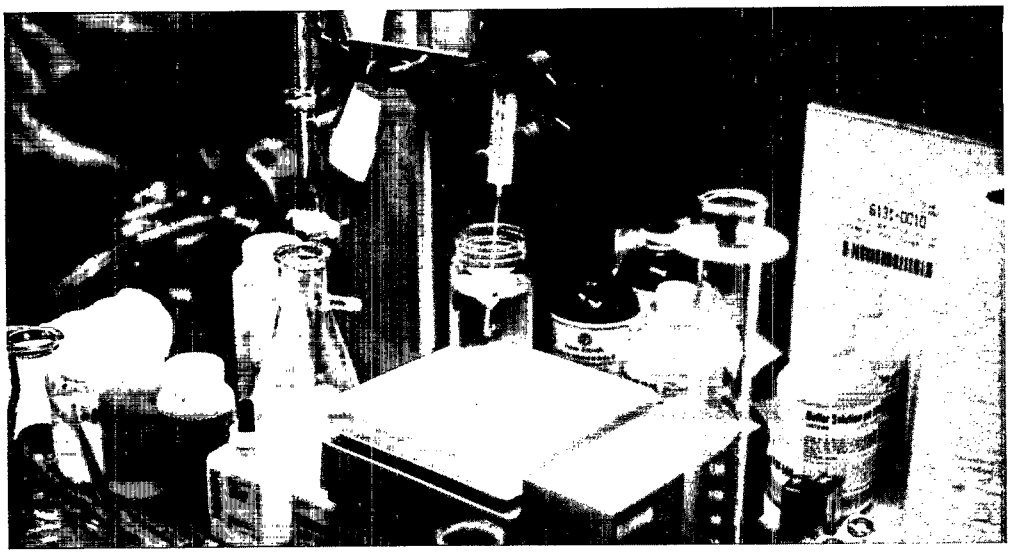
- In some States, lakes projects are managed under contract with or cooperative agreement between several State or local agencies, and/or with universities and research institutions. **North Carolina's Division of Parks and Recreation** is administering two Phase II projects on lakes in William B. Umstead State Park. Matching project funds came from the Division's land acquisition monies, because part of the project involved buying lands in the watershed. One of the State's Phase I studies is currently being administered under contract to a local government agency.

- Encouraged by the national Clean Lakes Program, local and regional planning organizations have assumed a greater role in management of lake water quality efforts. During the late 1980s, the 30-year-old **Lake George Park Commission in New York** assumed a much greater role in the lake's water quality management. Previously, the commission's focus was on parks and recreational management activities, such as boat patrols.

  In 1987, the New York legislature directed the commission to develop a plan for controlling wastewater and stormwater discharges into the lake. The commission now plays an active role in planning, establishing requirements for dischargers to the lake, and enforcing discharge requirements. The commission was a coapplicant with the New York Department of Environmental Conservation for Phase I and II Clean Lakes Program grants.

- Lake Sidney Lanier (northeast of **Atlanta, Georgia**), and West Point Lake and Lake Walter F. George (downstream of Atlanta on the Georgia/Alabama boundaries) are impoundments created by the U.S. Army Corps of Engineers on the Chattahoochee River from the 1950s through the 1970s. To address the serious water quality problems plaguing these lakes and the river basin, commissions (with representatives from Georgia and Alabama) have been established for both Lake Walter F. George and for Lake West Point. Phase II projects have been funded by both States.

The Clean Lakes Program's assistance to Tribes is tailored to their needs, such as proper laboratory equipment and techniques.



At West Point, work is being performed with partial funding from the Clean Lakes Program and the U.S. Army Corps of Engineers. LaGrange College has coordinated the effort. At Lake Lanier, the University of Georgia is conducting water quality monitoring studies under contract with the State's Environmental Protection Division. EPA and the Georgia Environmental Protection Division conducted studies under the Clean Lakes Program in 1986 and 1987. Since that time, the Clean Lakes Program has assisted Georgia with water quality monitoring through LWQA grants.

Tribal Programs Strengthened

Under its American Indian Policy, EPA has committed to work with American Indian Tribes in a direct government-to-government relationship. Section 518(e) of the Water Quality Act of 1987 authorized EPA to treat Tribes as States for certain programs (including the Clean Lakes Program), subject to eligibility requirements. The Clean Lakes Program has placed a high priority on meeting its commitment to Tribes by providing technical and financial assistance to Tribal governments tailored to their needs.

Since enactment of section 518(e), EPA has provided 13 LWQA grants totalling about $744,000 to eligible Tribes and has encouraged other Tribes to participate. Four Phase I grants have been awarded to Tribes, totalling about $253,000; and one Phase II grant has been awarded. Many Tribes have used the Clean Lakes Program as the foundation for assuming other water quality programs such as those under sections 319 or 106.

In EPA Region X, the **Klamath Tribe** comanaged a Phase I study of Klamath Lake with Oregon in the early 1980s. Klamath received a LWQA grant in 1990 to add to information collected during the initial study. One current activity being financed by this grant is development of a nutrient loading budget for the lake. The Tribe is working closely with the State and with the Federal Bureau of Reclamation and the U.S. Forest Service on watershed management.

In June 1991, EPA Region VIII and the **Confederated Salish and Kootenai Tribes of the Flathead Nation** cosponsored a Tribal workshop on water quality monitoring. Technical information was exchanged, and general information provided to the Tribes on Clean Water Act sections 314 and 106 — including discussions of the eligibility process for Tribal governments to be treated as States. Seventeen Tribes were represented.

Region VIII also provided assistance to the Tribes on the **Wind River** reservation on analytical techniques and quality assurance/quality controls for managing water samples. During regular planning sessions with Tribal representatives, Region VIII actively solicits input from Tribes on the types of training and technical assistance they need.

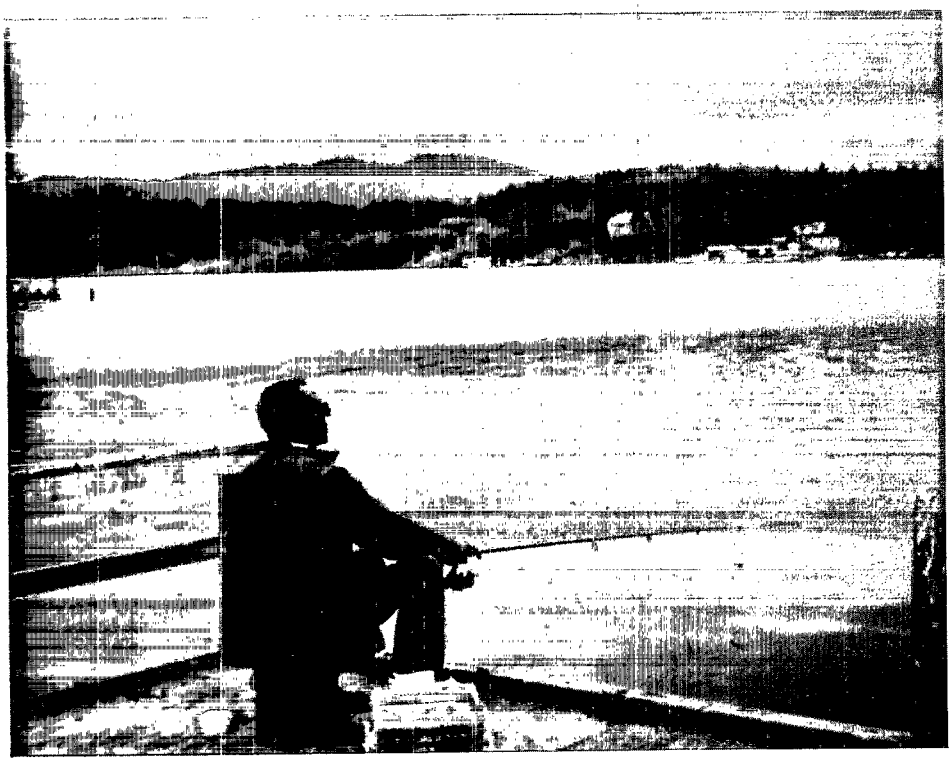
EPA Region V has worked with the Red Lake, White Earth, and Mille Lacs Bands of the **Minnesota Chippewa Indian Tribes** to develop laboratory quality assurance programs for Lake Water Quality Assessments.

A strong outreach effort by EPA Region IX's Water Management Division senior staff brought Tribes in the Region into the Clean Lakes Program. In 1990, the **Colorado River** and the **Fort Mojave** Tribes applied for and received approval to be treated as States. They then qualified for direct awards for Phase I studies on their lakes. To further support the Tribes' efforts, Region IX has established a Native American work group to improve coordination among EPA offices and the Tribes.

Native Americans on the Wind River Reservation (Wyoming) practice quality assurance/quality control techniques for managing water samples.

Lake Restoration Science Has Advanced

Clean Lakes Program projects around the Nation have generated a wealth of scientific and technical information about lake assessment, restoration, and management methods. Many projects have involved methods and procedures that had never been applied to lake problems, and the results have encouraged continual improvement.



Understanding the lake's ecosystem and structure pays aesthetic and recreational dividends to all lake uses.

In **Connecticut**, a cooperative research program funded by EPA, the Connecticut Department of Environmental Protection, and the Lake Waramaug Task Force (a local citizens group) focuses on the microbiology of the lake and treatment technologies, the importance of predator-prey, food-web interactions, and lake ecosystem structure and function. In addition, several innovative restoration concepts are in various stages of research and development, including anaerobic aeration, layer aeration, alum surrogates for nutrient inactivation, and biomanipulation by improving habitat.

In **Iowa,** as noted earlier in the Swan Lake description, many manmade lakes created in the 1940s and 1950s were poorly designed for maintaining longer-term, high quality water conditions. By conducting restoration projects on these lakes, the State has gained a comprehensive understanding of how nonpoint source pollution affects water quality and recreational values of lakes in the watershed. As a result, the problems of the manmade lakes can be avoided in the future.

Clear Lake, located in southern **Minnesota**, had become severely eutrophic because of the inflow of nutrient-rich urban runoff from the city of Waseca. Under a Clean Lakes project completed in 1981, 50 percent of the hydraulic load and 55 percent of the phosphorus load to the lake were diverted to a peat marsh to remove phosphorus by percolation. The filtered water was then pumped into Clear Lake.

The total quantity of phosphorus removed in 1982 amounted to 40 percent of the lake's average annual load. Mean orthophosphate, total phosphorus, and chlorophyll a concentrations in Clear Lake decreased significantly, as did the frequency and intensity of algal blooms. Recreational use of the lake has increased.

Academia Actively Involved

In addition to meeting today's environmental needs, it is important that our Nation build a strong base of environmental professionals for the future. The involvement of universities and colleges in local environmental projects is one way to give students and researchers an opportunity to expand their skills and knowledge while contributing significantly to their communities. In addition, participation in lake projects offers an opportunity to conduct applied research. Many State agencies draw on the services of their universities and colleges to support their Clean Lakes efforts, realizing mutually beneficial results.

During FY 1991, States in Region IV subcontracted Clean Lakes grants or portions of grants to 12 universities and colleges in the region. In addition to underwriting the collection and analysis of data, this funding is helping build strong limnological programs in these institutions. In **Kentucky,** Murray State University is working under a LWQA grant to assess several lakes in western Kentucky, and has worked with the Department for Environmental Protection on a statewide lake classification project.

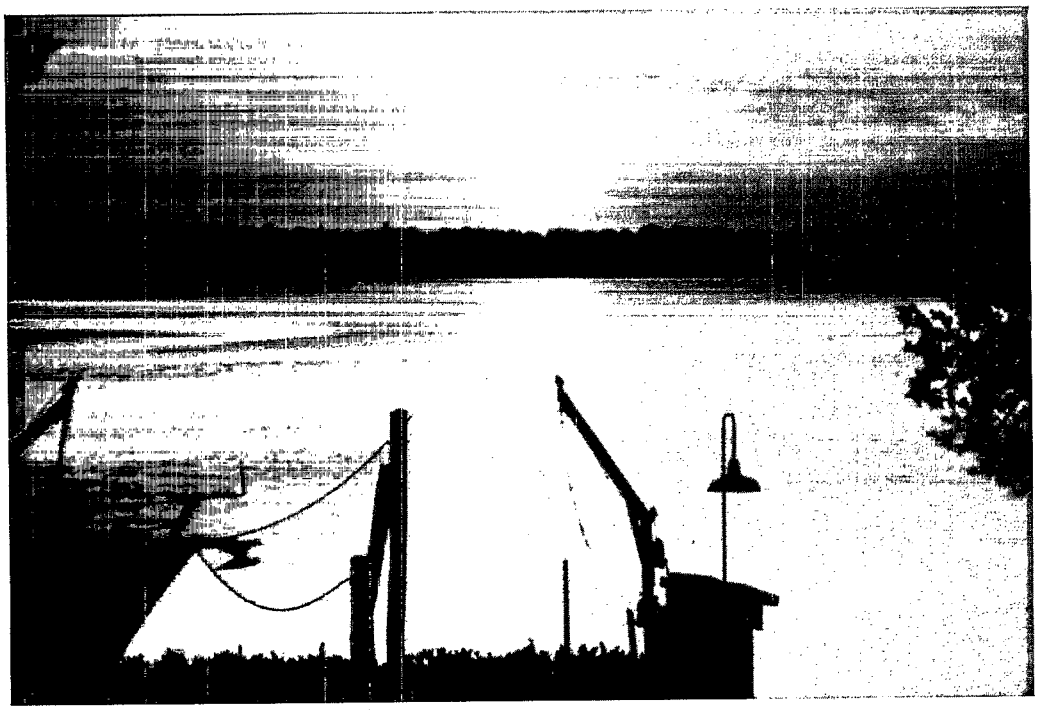
In **Vermont,** Middlebury College is working under a State contract with partial funding provided by the Clean Lakes Program to examine the effects of insects on Eurasian watermilfoil. Another State school is working as a subcontractor.

In **Washington State**, several universities actively work with the State's Department of Ecology on lake assessment and restoration projects, including the University of Washington, Washington State University, and Eastern Washington University.

At Lake Waramaug in Connecticut, summer student interns computerized a method to quantify thermal stratification that is now used nationally.

Clean Lakes grants to colleges and universities contribute significantly to community programs and help build a core of environmental professionals for the future.

An evening on the intercoastal waters near Sarasota, Florida: Seventeen years and hundreds of projects later, the Clean Lakes Program is a proven success.



Technical Assistance Helps All

The Clean Lakes Program provides technical assistance to States and local communities to help them strengthen and maintain their lake management capabilities. As discussed in earlier chapters, EPA Headquarters and individual Regions have sponsored workshops on a variety of technical subjects to help lake managers and citizens improve their skills. Since 1988, EPA has sponsored annual conferences focusing on enhancing State, Tribal, and local agencies' lake and watershed management capabilities.

Representatives of those agencies contacted during this review were very supportive of EPA's outreach activities. Several noted that such workshops and gatherings are among the limited channels of communication available to them for keeping up to date on technical and management aspects of lake restoration and protection. However, because of State travel funding restrictions, it is not possible for many agencies to send the staff who could most benefit.

Technical materials provided by the Clean Lakes Program, particularly the *Lake and Reservoir Restoration Guidance Manual* (LRRGM) and its technical supplements, are widely used by State and local agencies, nongovernmental organizations, and individuals. Individuals contacted during this review said their greatest single use of the *LRRGM* is as a tool to educate lake associations and citizens about lake restoration techniques, while the technical supplements are used to keep lake management professionals abreast of lake restoration's technical aspects. Demand for the manual is high — the entire first edition (20,000 copies published in 1987) were dis-

tributed nationwide. In response to this demand, EPA updated the manual in 1990 and distributed an additional 10,000 copies.

The **Clean Lakes Clearinghouse** is another important technical assistance tool created by EPA. Managed by the Terrene Institute, the Clearinghouse is a bibliographic database of over 3,000 lake-related documents, including books, program and technical reports, conference proceedings, and journal articles. Several thousand articles will be added in 1993, as the Clearinghouse is continually updated. Since it became available in 1989, the Clearinghouse has responded to numerous requests for data searches and has also sent out more than 900 copies of the database on diskettes.

About half of the individuals contacted for this review who are directly involved in lake restoration said that the Clearinghouse is a useful tool for their work. Most of the others were not familiar with it but were interested in learning about it; several said they would like to try using the Clearinghouse.

The Clearinghouse's success has encouraged the development of two communications tools to help address nonpoint source pollution issues: an electronic bulletin board system (the NPS BBS) and *Nonpoint Source News-Notes,* an occasional publication circulated to nearly 10,000 readers.

Conclusion

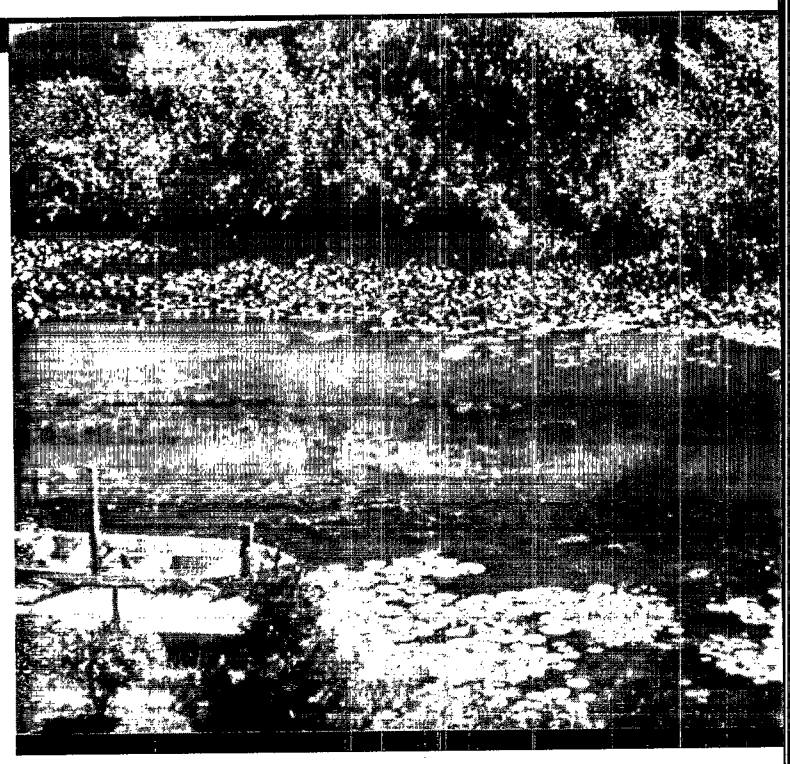
Communication — and cooperation — form the base for the Clean Lakes Program. A Clean Lakes project begins with citizens expressing concerns about their lake: they communicate among themselves, within their community and local government, then with their state agencies — and then, with their EPA Region, which recommends their project for a Clean Lakes grant.

Then, following the Phase I analysis and the follow-up Phase II project, the communication reverses. It becomes a flow of data and observations; of technical, scientific information that will be used to further lake restoration and protection throughout the world.

Seventeen years and hundreds of projects later, the Clean Lakes Program has proven that this process works. Fifteen Native American Tribes and people living in 49 States (plus Puerto Rico) have joined with their local and State governments to make the Clean Lakes Program work for their lakes. And the information gained from these efforts has immeasurably enriched the science of lake restoration.

But the Clean Lakes Program has also become the blueprint for environmental protection that works. Its lessons are now being applied to other environmental programs, particularly the Watershed Protection Approach. Not everybody lives beside a lake, but everybody *does* live in a watershed. A holistic program, to be sure, the watershed approach will depend even more on the twin principles of communication and cooperation so aptly demonstrated by the Clean Lakes Program.

How it Came to Be: History and Structure



The Clean Lakes Program was created to stop or at least slow cultural eutrophication — the human contribution to a lake's natural aging process. Lakes eutrophy naturally by accumulating nutrients and silt, thereby evolving from lakes to wetlands to dry land. This natural eutrophication process normally takes hundreds of years, but with human "help," lakes have been destroyed within a decade. Recognizing this growing problem, section 314 of the Federal Water Pollution Control Act of 1972 (the Clean Water Act) established the Clean Lakes Program, which was first funded by a congressional appropriation of $4 million in Fiscal Year 1975.

Structure

From the beginning a grass-roots program based on State initiative, the Clean Lakes Program has always funded local lake projects undertaken as part of State lake management activities. Through the Clean Lakes Program, EPA gives financial and technical assistance to States, Tribes, and local communities that apply to the Agency. Participation is voluntary.

EPA provides financial assistance through four types of cooperative agreements: Phase I: Diagnostic Feasibility Study, Phase II: Implementation Project, Phase III: Postrestoration Monitoring Study, and Lake Water Quality Assessment.

Phase I: Diagnostic and Feasibility Study

This two-part study analyzes a lake's condition and determines the causes of that condition, then recommends procedures necessary to restore and protect lake quality. Phase I funds can be awarded for a lake after a State's assessment process determines that lake to be a top priority within the

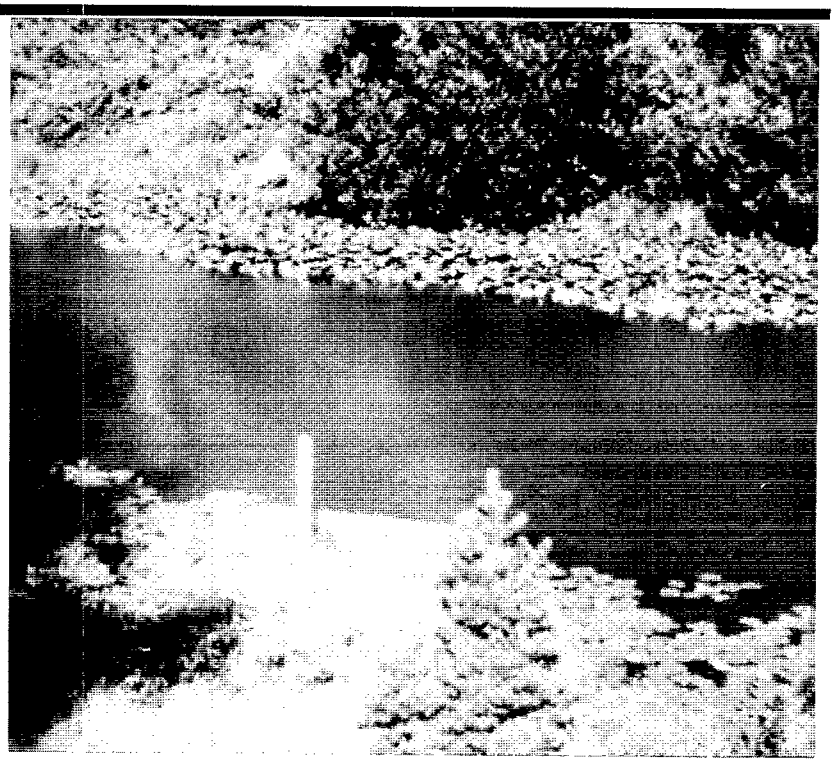
(left photo)

A side channel of Devils Lake before its restoration.

(right photo)

And the same channel a year later.

The Clean Lakes Program helps slow the eutrophication process.



State. Phase I awards reach a maximum of $100,000 and require a State and/or local match of at least 30 percent.

The City of **Bemidji, Minnesota** is a Phase I funds' recipient. From the mid-1970s on, two northern Minnesota lakes, Bemidji and Irving, received increased loading from nonpoint sources of pollution, as well as discharges into Lake Bemidji from the city's wastewater treatment plant.

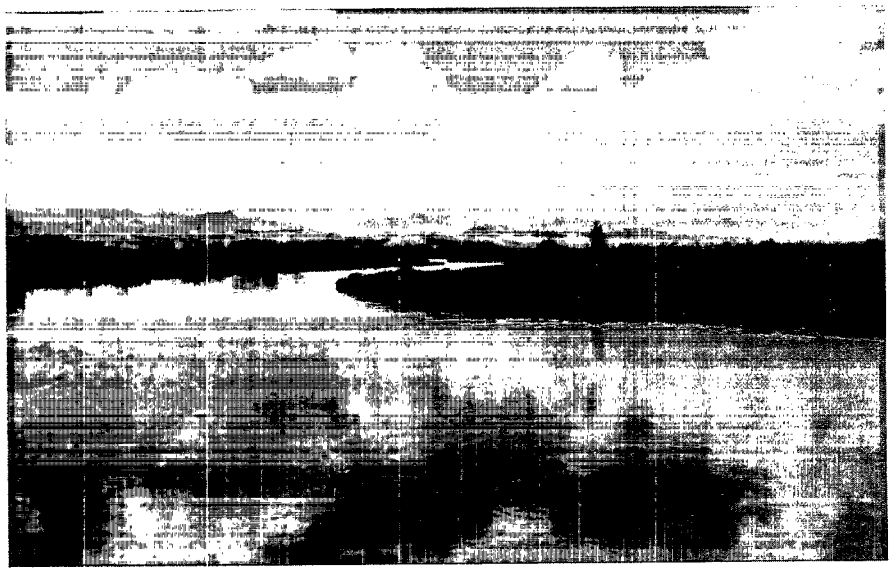
In addition to local citizens' use and enjoyment, Lake Bemidji is a major tourist draw in the area. Research showed that a noticeable decline in the lake's water quality would mean a loss of at least $3 billion in tourism revenues.

To reverse the decline of both lakes, Beltrami County, the City of Bemidji, Northern Township, the Mississippi Headwaters Board, the Headwaters Regional Development Commission, Bemidji State University, the Clearwater and Hubbard County Soil and Water Conservation Districts, the Minnesota Department of Natural Resources, the Minnesota Pollution Control Agency, and the U.S. Geological Survey cooperated to prepare a Phase I study.

The study determined that several sources of nonpoint pollution (as well as the wastewater treatment plant) were contaminating the lakes, and proposed a comprehensive plan to deal with each source.

Phase II: Implementation Projects

Phase II cooperative agreements support lakes' restoration and protection, as identified during Phase I or through a similar study; restoration/protection measures may include control and reduction of nonpoint source pollutants from the watershed, in-lake techniques to restore water quality, or a combination of the two. There is no maximum dollar amount for Phase II awards, but they require a State and/or local matching share of at least 50 percent of the cost of restoration.



Scientific knowledge on the longevity and effectiveness of the projects begins with postrestoration assessment and monitoring programs.

The community surrounding Vancouver Lake, near **Vancouver, Washington**, applied for and received Phase II project monies. By the late 1970s, the lake had become highly eutrophic with nutrient-enriched sediments, and was very shallow. This greatly decreased its recreational possibilities. Because of the need to dredge the sediments, restoration required a substantial investment, including Clean Lakes Program funding of more than $7 million and local funding of $10.3 million. Completed in the early 1980s, the restoration is projected to reap benefits of more than $19 million for owners of lakeside properties and businesses, as well as the local community as a whole.

Phase III: Postrestoration Monitoring Studies

Through postrestoration assessment and monitoring, Phase III cooperative agreements are designed to increase the scientific base of knowledge on the longevity and effectiveness of restoration and protection methods conducted under Phase II projects. A maximum of $125,000 is available, with a State and/or local matching share of at least 30 percent required.

In 1978, **New Hampshire's** Kezar Lake was determined to be eutrophic. Under a Clean Lakes grant, in 1984 the lake was treated with aluminum sulfate and sodium aluminate to inactivate sediment phosphorus. Using Phase III funds, a four-year monitoring program was then conducted to evaluate the short- and long-term effectiveness of this treatment approach.

Immediate treatment effects, verified by monitoring, included reduction in hypolimnetic biological oxygen demand and dissolved oxygen deficit, lower chlorophyll *a* and phosphorus concentrations, improved transparency, and the elimination of noxious blue-green phytoplankton blooms.

For two to three years after treatment, these effects exhibited less variability and had improved values over pretreatment conditions, warranting an upgrade of the lake's trophic status from eutrophic to mesotrophic. Water quality began to decrease after four years, but information from the monitoring program provided a useful information base for the approach that was subsequently used to treat phosphorus inactivation.

Lake Water Quality Assessment

Under sections 314(a)(1) and 305(b) of the Clean Water Act, States must assess the conditions of their publicly owned lakes and submit their findings to EPA every two years. LWQA grants — the only grants under the program that are not lake-specific — can be used to fund in-lake water quality sampling and analysis, volunteer citizens monitoring programs, regional lake water quality assessments, development of data management systems, and other activities that help support a State lake program. LWQA grants reach a maximum of $50,000 annually and require a State and/or local match of at least 50 percent.

Using an LWQA grant, the Oklahoma Water Resources Board and the Oklahoma Conservation Commission worked together to classify the State's lakes. The two organizations used a combination of LANDSAT remote-sensing data (collected under a cooperative agreement with the U.S. Department of Agriculture's Agricultural Research Service), in-lake sampling, and literature reviews. With that information, Oklahoma was able to classify a greater percentage of its lakes than would have been possible otherwise.

The various types of Clean Lake Program cooperative agreements and their annual funding are summarized in Table 1. The table also contains information on Lake Classification Survey grants. From 1976 to 1981, EPA awarded Survey grants on a one-time basis to help States evaluate and classify lake conditions. The "Phase II" column shows funding provided for new Phase II implementation projects.

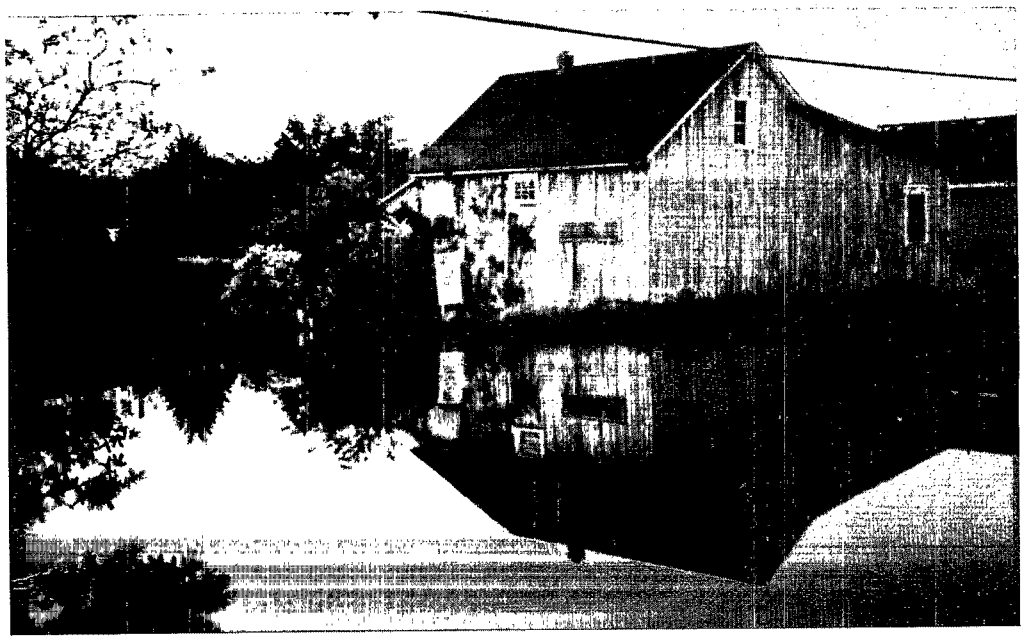
Table 1.—Annual financial assistance provided by EPA Clean Lakes Program to States and Tribes.

YEAR	CLASSIFICATION	PHASE I	PHASE II	PHASE III	LWQA	TOTAL*
1975	0	0	23,250	0	0	23,250
1976	0	8,183	7,614,633	0	0	7,622,816
1977	100,000	0	9,789,402	0	0	9,889,402
1978	100,000	49,077	10,506,727	0	0	10,655,804
1979	1,709,253	48,824	4,369,746	0	0	6,127,823
1980	1,341,599	4,658,245	13,518,290	0	0	19,518,134
1981	493,744	3,349,692	12,288,814		0	16,132,250
1982	0	127,000	7,691,814	0	0	7,818,814
1983	0	0	2,703,780	0	0	2,703,780
1984	0	65,750	4,832,368	0	0	4,898,118
1985	0	0	5,120,597	0	0	5,120,597
1986	0	0	4,822,988	0	0	4,822,988
1987	0	2,022,716	2,477,284	0	0	4,500,000
1988	0	0	0	0	0	0
1989	0	2,556,224	2,321,746	286,957	3,959,487	9,124,414
1990	0	4,386,323	6,649,002	439,875	685,066	12,160,266
1991	0	2,674,919	1,992,706	265,924	2,066,451	7,000,000
TOTAL	3,744,596	19,946,953	96,723,147	992,756	6,711,004	

* NOTE: The total amount awarded may vary from annual Congressional appropriation as a result of "carry-over" from one year to the next.

EPA has substantially supported its Clean Lakes Program in all 10 EPA Regions, 49 States, Puerto Rico, and on land owned by 15 Tribes. Forty classification surveys, 288 Phase I's, and 208 Phase II's have been funded in partnership with States and Native American Tribes (see Table 2). With funding for Lake Water Quality Assessments and Phase III studies available only since 1989, EPA has funded LWQAs in 46 States and 13 Tribes, and 11 Phase III's. Total annual Clean Lakes funding has fluctuated but since the early 1980s has averaged around $5 million per year (see Fig. 1).

Initial funding for demonstration grants and a one-time only survey gave many states their first comprehensive picture of their lakes' condition.



History

Since its initial funding in 1975, the Clean Lakes Program's evolution can be described in three phases.

■ **1975 to 1979: Research and development on lake restoration techniques and evaluation of lake conditions.** Early in the program, EPA encountered problems fulfilling section 314's mandates. Existing technology was inadequate for assessing lake eutrophication and pollution problems; this led to concerns about the cost effectiveness of a national Clean Lakes Program.

Also, many experts at that time believed lake quality would be protected or improved through other Clean Water Act pollution controls — in particular, aggressive implementation of the National Pollutant Discharge Elimination System (section 402) and the construction of municipal wastewater treatment plants (section 201). Therefore, EPA assigned a low priority to the Clean Lakes Program from 1972 through 1975.

When Congress appropriated $4 million in FY 1975 to develop a program implementing section 314, EPA was still uncertain about the feasibility and scope of a national Clean Lakes Program because of the lack of existing scientific expertise on lake restoration. So the Agency chose to use the initial funds for demonstration grants.

Table 2.—State and Tribal distribution of Clean Lakes funds.

STATE	CLASSIFICATION	LWQA	PHASE I	PHASE II	PHASE III	TOTAL
Alaska	0	0	211,922	0	0	211,922
Alabama	0	160,000	242,585	0	0	402,585
Arkansas	100,000	0	564,000	0	0	664,000
Arizona	87,400	100,000	300,000	0	0	487,400
California	0	100,000	739,872	6,845,998	0	7,685,870
Colorado	100,000	56,842	599,658	280,000	0	1,036,500
Connecticut	100,000	160,000	80,124	1,385,552	0	1,725,676
Delaware	69,388	160,000	150,769	101,202	0	481,359
Florida	97,325	160,000	421,444	2,325,193	0	3,003,962
Georgia	100,000	110,000	580,000	0	0	790,000
Iowa	100,000	160,000	161,699	5,598,611	75,250	6,095,560
Idaho	99,661	100,000	373,114	470,344	0	1,043,119
Illinois	200,000	160,000	775,461	2,871,277	250,000	4,256,738
Indiana	0	160,000	544,583	573,467	0	1,278,050
Kansas	0	160,000	346,230	859,990	0	1,366,220
Kentucky	99,943	160,000	100,000	0	0	359,943
Louisiana	92,309	0	100,000	1,775,000	0	1,967,309
Massachusetts	100,000	160,000	444,694	5,550,328	0	6,255,022
Maryland	46,831	30,000	199,400	2,250,935	0	2,527,166
Maine	100,000	160,000	274,988	2,857,055	68,348	3,460,391
Michigan	100,000	167,845	532,608	4,572,465	36,957	5,409,875
Minnesota	100,000	164,000	828,943	7,554,905	0	8,647,848
Missouri	93,111	130,000	594,310	823,500	0	1,640,921
Mississippi	57,688	160,000	300,000	50,000	0	567,688
Montana	88,185	0	129,975	232,400	0	450,560
North Carolina	100,000	160,000	259,218	924,720	0	1,443,938
North Dakota	0	30,000	17,304	325,250	0	372,554
Nebraska	55,167	160,000	352,929	0	0	568,096
New Hampshire	100,000	159,938	697,443	96,600	121,577	1,175,558
New Jersey	100,000	125,513	390,077	4,239,028	0	4,854,618
New Mexico	58,572	100,000	82,296	0	0	240,868
Nevada	0	150,000	50,000	968,342	0	1,168,342
New York	100,000	100,000	1,383,754	8,515,847	0	10,099,601
Ohio	53,921	164,692	189,037	261,200	124,950	793,800
Oklahoma	100,000	160,000	1,605,439	1,269,567	65,674	3,200,680
Oregon	100,000	183,876	460,699	1,013,795	0	1,593,249
Pennsylvania	98,110	0	402,600	1,092,539	0	1,303,227
Puerto Rico	92,712	115,396	100,000	399,039	0	707,147
Rhode Island	0	160,000	472,613	26,127	0	658,740
South Carolina	92,244	160,000	240,048	496,770	0	989,062
South Dakota	100,000	130,000	472,455	2,241,265	0	2,943,720
Tennessee	84,000	160,000	478,365	0	0	722,365
Texas	100,000	160,000	400,000	1,913,706	0	2,573,706
Utah	100,000	130,000	602,965	655,788	0	1,488,753
Virginia	98,939	82,500	225,952	2,416,145	0	2,823,536
Vermont	100,000	160,000	501,866	856,642	0	1,618,508
Washington	99,769	155,301	614,126	14,168,134	125,000	15,162,330
Wisconsin	100,000	160,000	198,184	6,410,862	125,000	6,994,046
West Virginia	0	99,759	166,950	0	0	266,709
Wyoming	79,321	0	0	0	0	79,321
Subtotal (States)	**3,844,596**	**6,045,662**	**19,960,699**	**95,269,588**	**992,756**	125,658,158

(Continued on next page)

Table 2.—Continued.

TRIBES	CLASSIFICATION	LWQA	PHASE I	PHASE II	PHASE III	TOTAL
Poarch Band of Creek Indians (AL)	0	10,000	15,000	0	0	25,000
Ft. Mojave (CA)	0		100,000	0	0	100,000
Southern Ute (CO)	0	7,200	0	0	0	7,200
Coeur D'Alene (ID)	0	90,000	100,000	0	0	190,000
Nez Perce (ID)	0	51,375	0	0	0	51,375
Chippewa (MN)	0	0	67,750	0	0	67,750
Mille Lacs Chippewa (MN)	0	140,967	0	0	0	140,967
Red Lake Chippewa (MN)	0	100,000	0	0	0	100,000
White Earth (MN)	0	100,000	0	0	0	100,000
Blackfeet (MT)	0	41,000	0	0	0	41,000
Eastern Band of Cherokee (NC)	0	15,000	0	9,975	0	24,975
Turtle Mountain Band of Chippewa (ND)	0	22,365	0	0	0	22,365
Narragansett (NH)	0	30,000	0	0	0	30,000
Klamath (OR)	0	61,360	70,000	0	0	131,360
Wind River/Shoshone and Arapaho (WY)	0	74,936	0	0	0	74,936
Colorado River (CA)	0	0	100,000	0	0	100,000
Pueblo of Acoma (NM)	0	0	0	799,107	0	799,107
Subtotal (Tribes)	**0**	**744,203**	**452,750**	**809,082**	**0**	**2,006,035**
TOTAL	**3,844,596**	6,789,865	**20,413,449**	**96,078,670**	**992,756**	**127,664,193**

EPA distributed $35 million from FY 1975 to FY 1978 as research and development grants for demonstration projects aimed at investigating potential lake restoration techniques. The demonstration projects succeeded in proving that techniques did exist to restore degraded lakes, and that lake restoration should become an integral part of a national water quality management strategy.

In 1978, EPA began to award one-time-only Lake Classification Cooperative Agreements to States to help them evaluate lake conditions. The agreements provided up to 70 percent of costs to a maximum of $100,000. During the next three years, 35 States and Puerto Rico performed classification surveys on more than 6,000 lakes at a cost of $3.8 million in Federal funds. The surveys gave many State water quality management agencies their first comprehensive picture of their lakes' water quality, enabling the agencies to identify and rank lakes according to trophic conditions.

The demonstration projects and information on lake conditions established an information base for developing a national Clean Lakes Strategy, as well as a baseline for evaluating future lake conditions.

During this same period, the National Eutrophication Survey (conducted from 1972 to 1977) found that 68 percent of the 800 lakes studied were eutrophic to some degree, emphasizing the need for urgent attention.

■ **1980 to 1987: Establishment and implementation of the National Clean Lakes Strategy — focus on lake restoration.** In 1980, the Clean Lakes Program's focus changed from research and development to lake restoration. In August of that year, EPA issued its Clean Lakes Program Strategy and regulations (40 CFR Part 35, Subpart H) for the national program's administration. These moved the program direction from research and development to an operational program of financial and technical assistance.

The regulations stipulated that only States were eligible to receive the Federal Clean Lakes awards. But in response to initial concerns, EPA allowed States to arrange financing of the non-Federal share of project costs through agreements with other entities, including municipalities, businesses, individual citizens, citizen organizations, and lake associations.

In the Clean Lakes Program Strategy, EPA established more specific program goals. The Agency realized it did not have enough resources to apply to all lakes. So one new goal was aimed at protecting at least one lake with water quality suitable for recreational purposes, within 25 miles of every U.S. population center (usually a Standard Metropolitan Statistical Area [SMSA]). The goal included restoring a degraded lake to recreational use, if necessary.

EPA also announced five program objectives:

1. Select projects to maximize public benefits;
2. Follow an integrated program approach;
3. Emphasize watershed management;
4. Develop active State involvement and maintain a Federal–State partnership; and
5. Conduct continuous program and project evaluation.

The Clean Lakes Program goals and objectives established during this timeframe have continued to provide guidance to States when preparing cooperative agreement applications, and to EPA in evaluating the applications.

The North American Lake Management Society was also formed during this period, receiving its charter in September 1980 during an international symposium cosponsored by EPA and the European Organization for Economic Cooperation and Development. Created to promote better understanding for the protection, restoration, and management of lakes and their watersheds as ecological units, NALMS has worked closely with EPA to further the objectives of lake protection and restoration.

National and regional NALMS conferences have provided opportunities for Federal, State, and local water quality management officials, members of the academic and consulting communities, and the public to come together to share technical information and experience.

From 1982 to 1987, EPA published the proceedings of NALMS' annual conferences in partial fulfillment of the Clean Water Act, section 304(j), which requires EPA to publish a report every two years on the protection and restoration of the Nation's freshwater lakes.

■ **1987 to present: Implementation of the National Clean Lakes Strategy under the expanded mandates of the 1987 Water Quality Act.** A significant redirection of the Clean Lakes Program occurred under the 1987 Water Quality Act, which amended the 1972 Clean Water Act. This redirection placed new demands on States and EPA. Under the new act's section 314, each State wishing to remain eligible for Clean Lakes funding had to submit information once every two years on its lakes' conditions, as part of a mandated water quality report. The report was to include

- a revised Lake Classification Report;
- a list of threatened and impaired lakes and lakes not meeting water quality standards or that will require controls to maintain standards;
- lake pollution control procedures, restoration plans for degraded lakes, and methods and procedures to mitigate the harmful effects of acidity in lakes; and
- an assessment of the status and trends of lake water quality.

Tables 3 and 4 show the lake restoration and protection management techniques planned or implemented by Clean Lake Projects. The tables classify each technique as an in-lake technique (Table 3) or a watershed treatment (Table 4). The relative percent frequency of each management technique is also shown.

Table 3.—Lake Restoration Management Techniques Used in the Clean Lakes Program, In-Lake Techniques

TECHNIQUE/DESCRIPTION	RELATIVE % OF USE OF ALL IN-LAKE *TECHNIQUES*
Excess ***sediments removed/dredged***	34%
Water level ***drawn down*** to desiccate and/or remove aquatic plants	11%
Aquatic macrophytes harvested to remove nuisance growths of plants	10%
Phosphorus precipitated/inactivated with aluminum salts to control phosphorus	7%
Herbicides applied to control aquatic plants	7%
Sand or other filters used to clarify water	3%
Bottom barriers installed to control nutrient cycling in lake	3%
Lake water ***destratified***	3%
Nutrient rich waters ***diluted*** by flushing	3%
Hypolimnion (bottom) aerated to seal phosphorus in bottom sediments	2%
Food chain manipulated	1%
Oxygen-depleted ***hypolimnion water withdrawn***	1%
Non-native species introduced to control nuisance aquatic macrophyte growth (e.g., grass crap)	1%
Other in-lake treatment applied	21%

Table 4.—Lake Restoration Management Techniques Used in the Clean Lakes Program, Watershed Treatments

TECHNIQUE/DESCRIPTION	RELATIVE % OF USE OF ALL *WATERSHED TREATMENTS*
Shoreline erosion controls implemented, including ***riprapping***	20%
Best management practice installed (unspecified type)	18%
Sediment pond or ***detention basis*** installed to trap sediment before entering lake	17%
Erosion control practice installed (unspecified type)	11%
Water ***diverted*** from lake to treatment system	10%
Conservation tillage used	3%
Animal waste management practices installed or improved	2%
Road or skid trails managed to control erosion and/or runoff	1%
Land surface roughened to control erosion	1%
Redesigned streets or parking lots to reduce runoff	<1%
Integrated pest management practices applied	<1%
Porous pavement used	<1%
Other watershed controls	15%

The Water Quality Act also required EPA to develop a lake restoration guidance manual for distribution to the States (to be updated biennially) and to establish a Clean Lakes demonstration program. Section 518(e) authorized EPA to treat qualified Native American Tribes as States, thereby making them eligible for direct assistance under the Clean Lakes Program.

The 1987 amendments also added a new program to address nonpoint source pollution of streams and rivers. Under section 319, States were required to assess navigable waterways significantly polluted by nonpoint sources, and to implement management programs to address nonpoint source pollution. A watershed approach was to be used, if practicable. The integration of the 314 and 319 programs is becoming a key ingredient to resolving many U.S. lakes' environmental problems.

To meet the new amendment mandates, EPA convened a Clean Lakes Work Group in May 1987. At that meeting, representatives of States, Tribes, NALMS, EPA, and others developed the Clean Lakes Program Guidance. The Guidance advocates an integrated program approach and the development of a State Clean Water Strategy incorporating a State's lake management program into its overall water quality management. The Guidance stresses the need for Clean Lakes projects to be developed and implemented on a watershed basis, and authorizes EPA to issue Lake Water Quality Assessment grants (to help States meet section 314 obligations) and Phase III Post-Restoration Monitoring grants (to advance lake restoration science).

As part of the Clean Lakes Program redirection, EPA began to place a greater emphasis on technical assistance to State lake water quality managers to help them assess, restore, and maintain their lakes' quality. Working

Since 1980, the North American Lake Management Society has sponsored local and regional conferences to help protect and restore North American lakes.

with NALMS, then with the Terrene Institute, EPA published two editions of the *Lake and Reservoir Restoration Guidance Manual*, followed by the technical supplement *Monitoring Lake and Reservoir Restoration*, and a voluntary monitoring manual for citizens. Two more technical supplements will be published in 1993 — one on fisheries management in lakes and reservoirs, the other on toxic substances in lakes and reservoirs. EPA also gave NALMS grants to conduct a series of regional and State workshops for lake water quality managers.

During this period, work began on developing the Clean Lakes Clearinghouse, a bibliographic database of up-to-date information on lake restoration and protection techniques. The Clearinghouse began operations in 1989, moving to Terrene the following year as part of a partnership to continue the development and marketing of the database.

In FY 1988, Congress did not appropriate any funds for Clean Lakes assistance to States. The halt in funding — the only one in the Program's history — was a major setback for States and Tribal governments that were ready to start new assessment and restoration projects. Without Federal funding for new grant initiatives, Clean Lakes efforts focused on ongoing restoration projects and technical assistance begun in 1987.

In May 1988, EPA cosponsored the first National Conference on Enhancing States' Lake Management Programs. The largely nontechnical conference allowed Federal, State, local, and Tribal water quality managers to share valuable information. The conference has been held annually since then, under EPA cosponsorship.

The funding situation changed dramatically in 1989, when Congress appropriated $12.5 million for the Clean Lakes Program. This allowed the program to move beyond just funding projects for individual lakes to providing assistance for assessing restoration techniques and to conducting broad-

based studies of lake conditions. Citizens were encouraged to play a more direct role in caring for their lakes. For the first time, three Phase III grants were awarded to States to conduct post-restoration monitoring studies of completed restoration projects.

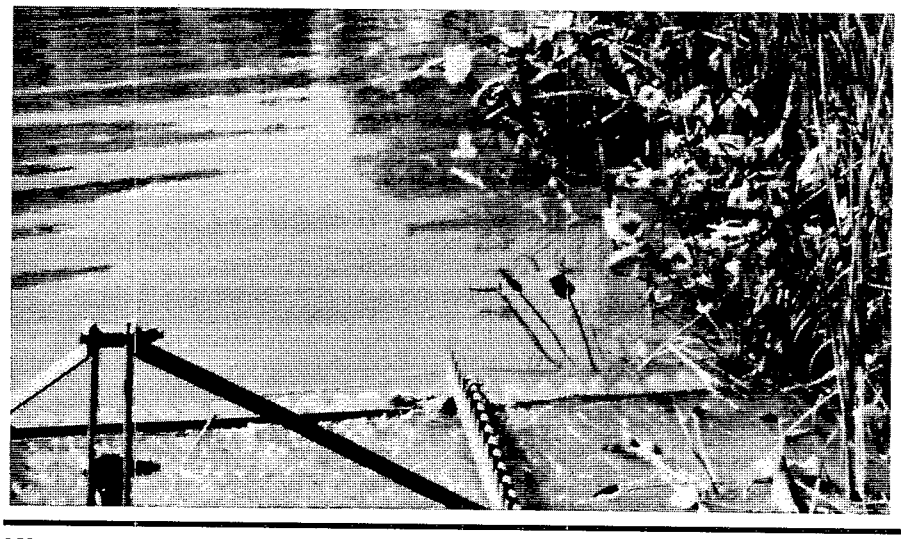
The first LWQA grants — totalling more than $3.9 million — were awarded, to 40 States and three Tribes. About $2.6 million was also awarded in 42 Phase I grants. Several public workshops were conducted around the country to encourage and help citizens actively participate in the management of their lakes.

The Clean Lakes Program moved into the 1990s with a much clearer vision of how to support total lake and watershed management, from initial diagnosis through post-restoration monitoring. In 1990, 44 States, one territory, and 15 Tribes received financial assistance totalling slightly more than $12 million.

- More than half of the total funding (55 percent) went to Phase II Implementation projects, and 90 percent of the Phase II amount went to new projects.
- Grants for Diagnostic/Feasibility Studies constituted more than half of the agreements, and about 36 percent of total funding.
- Fourteen awards were given for Lake Water Quality Assessments and Post-Restoration Monitoring (Phase III), with 77 percent of the LWQA awards given to Tribes.

Citizen involvement in lake management was also supported in FY 1990, through EPA-NALMS cosponsored workshops in Georgia, Pennsylvania, and Michigan. As had been true at prior meetings in Virginia, Ohio, and Washington, the workshops led to the formation of State lake associations.

In FY 1991 and FY 1992, Congress appropriated $7 million each year. In FY 1991, the funds went to 113 awards — 45 for Diagnostic/Feasibility Studies (Phase I), 23 new Implementation (Phase II) projects, and 42 LWQA agreements. Several EPA Regions funded voluntary citizen monitoring programs through LWQA grants and sponsored training workshops. The Clean Lakes Clearinghouse also received funds, which were used to make its data available on floppy disks on a subscription basis.



Citizens involved in lake management can often put old tools to new work: the Hackney sickle bar was introduced to farmers in 1903.

Funding

As this description has clearly demonstrated, the Clean Lakes Program has not enjoyed a consistent funding base over time. State funding assistance dropped from $20.3 million in FY 1980 to $3.4 million in FY 1983, rose in FY 1984, dropped slightly in FY 1985, and so on (see Fig. 1).

As knowledge of the Nation's lake water quality conditions has advanced and as the needs of States and local communities have changed, the allocation of Clean Lakes Program funds has changed considerably. The program initially focused on research and gathering information, but as Clean Lakes has evolved, water quality restoration and protection measures have received more resources.

From 1981 to 1986, funding restrictions limited Clean Lakes assistance largely to cooperative agreements for lake restoration projects. Little funding was available to strengthen lake management programs and research, and funding virtually stopped for Phase I studies and classification activities. A brief summary of those years follows:

- **FY 1981:** EPA gave $11.1 million to States for lake diagnostic and restoration projects — $3.1 million for Phase I studies and $8.0 million for Phase II restoration projects. It was the last year of funding for lake classification surveys.

- **FY 1982:** Congress appropriated $9.4 million for the Clean Lakes Program but directed EPA to allocate funds to complete work on ongoing Phase II projects only. For this year, EPA funded Phase II work to complete 25 ongoing lake implementation projects.

- **FY 1983:** The program received $3 million in appropriations. EPA was directed to give highest priority to completion of ongoing Phase II projects. EPA received 34 applications for assistance, totalling more than $9 million.

- **FY 1984:** Congress appropriated $5 million for State Clean Lakes assistance, with $1 million more earmarked for lake management research. EPA directed most of this funding to Phase II projects, after receiving 32 applications totalling $7.7 million. One Phase I award was to perform a diagnostic/feasibility study on the Chippewa Tribe Lakes in Region V as part of EPA's Indian Initiative Program.

- **FY 1985:** EPA requested $2.5 million for the Clean Lakes Program; Congress appropriated $5 million. All funding was directed to Phase II projects.

- **FY 1986:** EPA provided about $5.1 million in assistance for 22 Phase II projects; 10 were new restoration projects.

In recent years, EPA has provided assistance for comprehensive assessments of lake water quality under the Water Quality Act of 1987, and for the evaluation of the effectiveness of lake restoration projects.

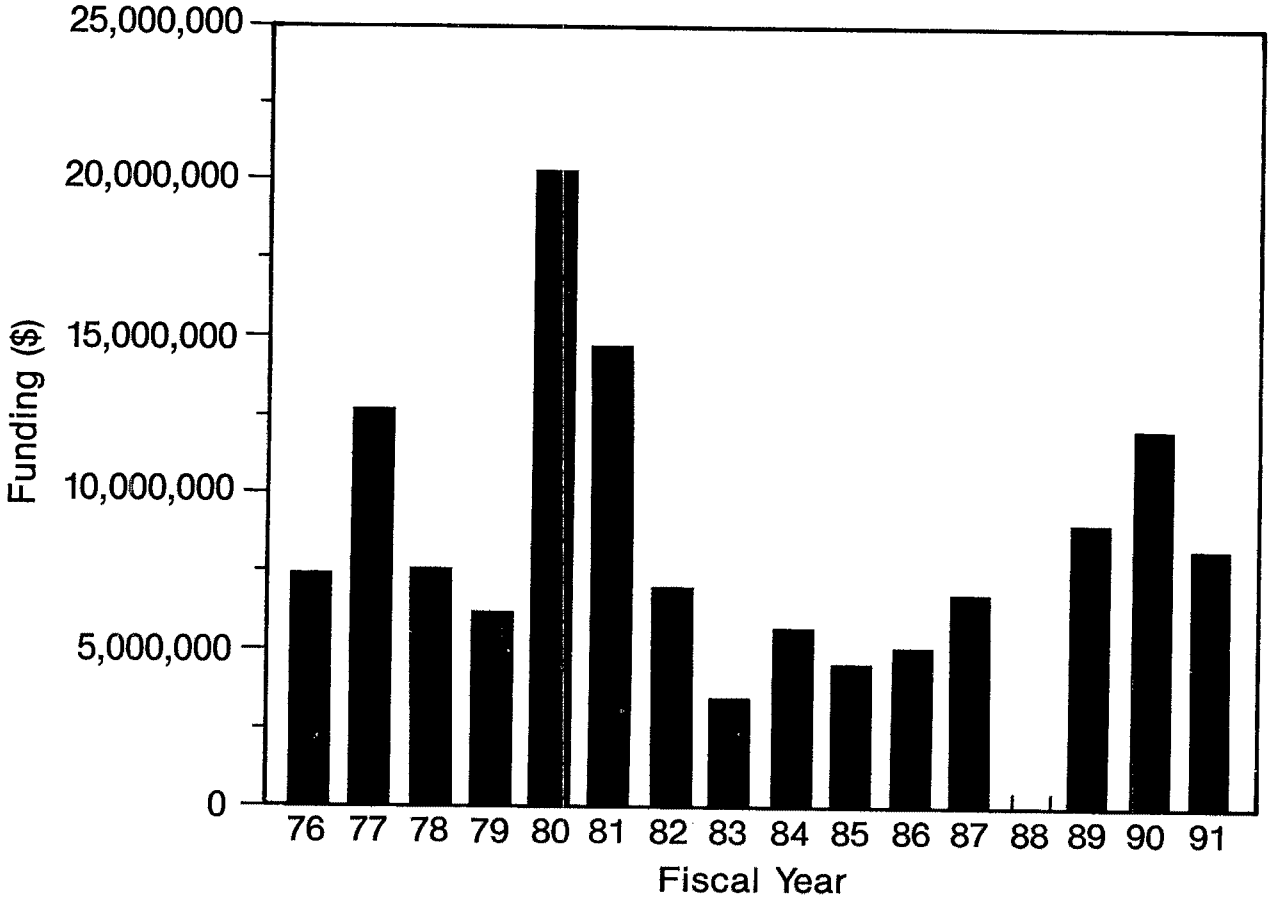


Figure 1.—Total EPA funding for Clean Lakes assistance, 1976 to 1991.

Conclusion

As the Clean Lakes Program approaches its second decade, the program has remained fundamentally unchanged in its underlying philosophy: effective lake and watershed management must be based on participation and commitment at local and State levels and on addressing the causes of environmental problems rather than the symptoms alone.

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