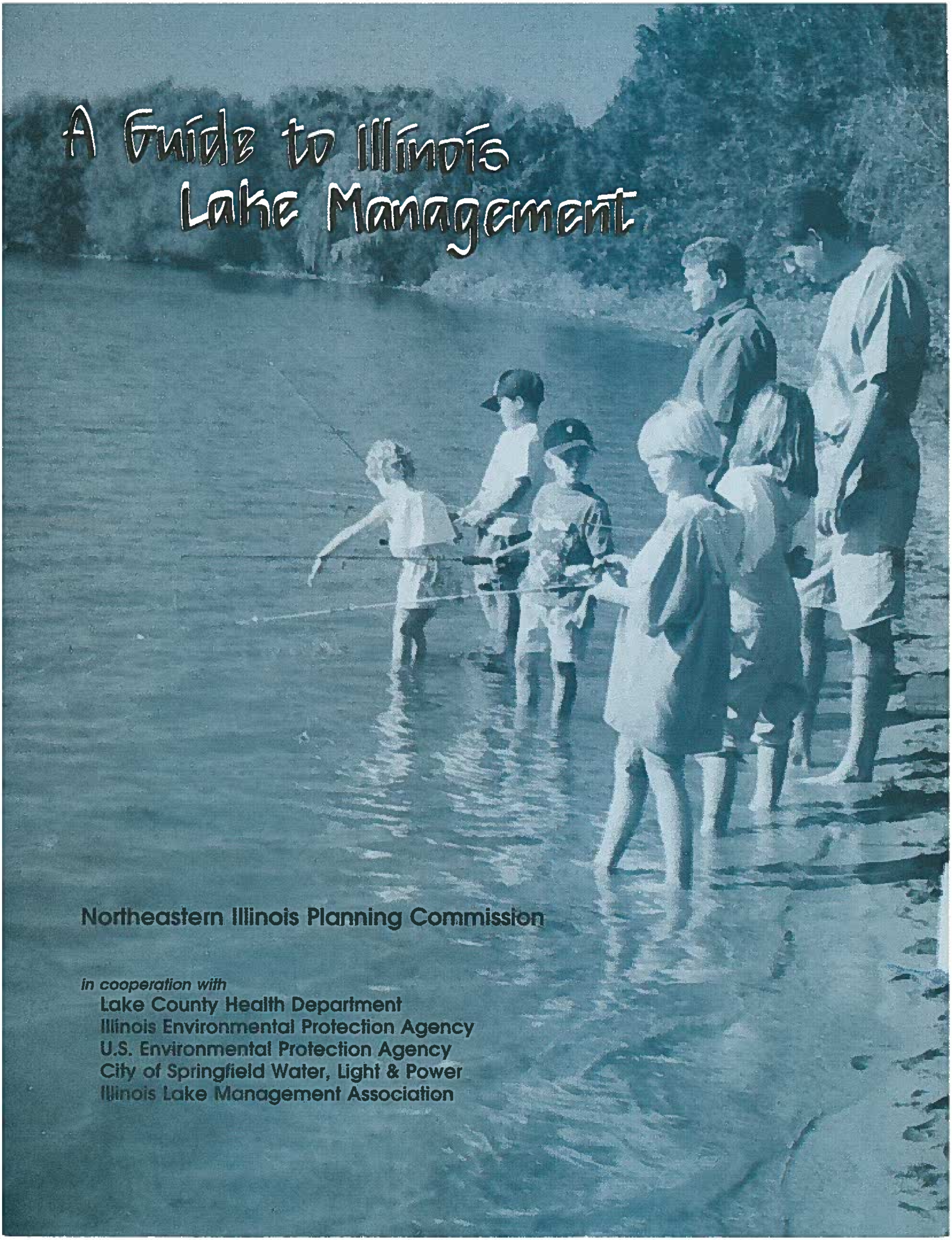

A Guide to Illinois Lake Management

Northeastern Illinois Planning Commission

in cooperation with

Lake County Health Department
Illinois Environmental Protection Agency
U.S. Environmental Protection Agency
City of Springfield Water, Light & Power
Illinois Lake Management Association

A Guide to Illinois Lake Management

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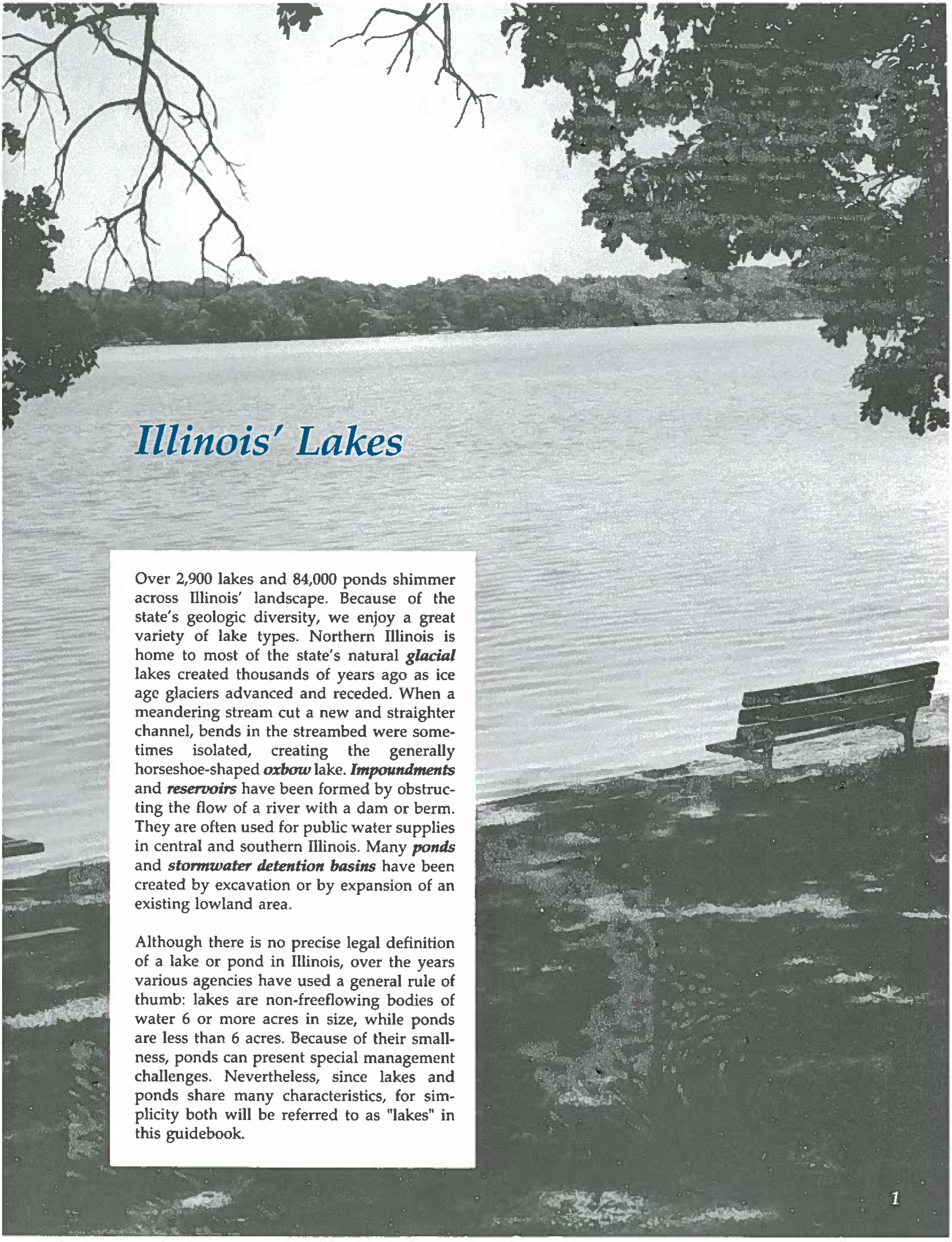
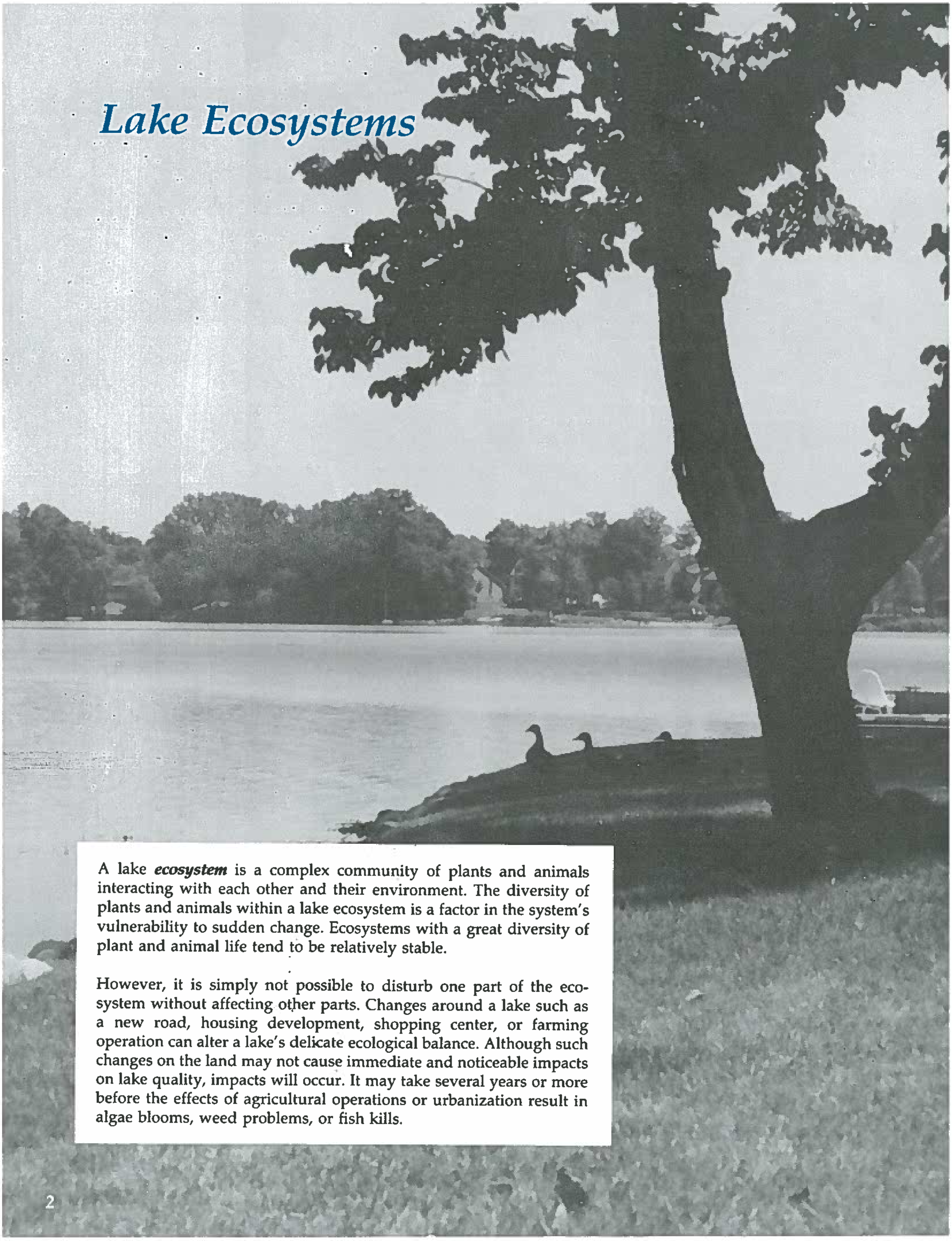


Illinois' Lakes

Over 2,900 lakes and 84,000 ponds shimmer across Illinois' landscape. Because of the state's geologic diversity, we enjoy a great variety of lake types. Northern Illinois is home to most of the state's natural ***glacial*** lakes created thousands of years ago as ice age glaciers advanced and receded. When a meandering stream cut a new and straighter channel, bends in the streambed were sometimes isolated, creating the generally horseshoe-shaped ***oxbow*** lake. ***Impoundments*** and ***reservoirs*** have been formed by obstructing the flow of a river with a dam or berm. They are often used for public water supplies in central and southern Illinois. Many ***ponds*** and ***stormwater detention basins*** have been created by excavation or by expansion of an existing lowland area.

Although there is no precise legal definition of a lake or pond in Illinois, over the years various agencies have used a general rule of thumb: lakes are non-freeflowing bodies of water 6 or more acres in size, while ponds are less than 6 acres. Because of their smallness, ponds can present special management challenges. Nevertheless, since lakes and ponds share many characteristics, for simplicity both will be referred to as "lakes" in this guidebook.

Lake Ecosystems

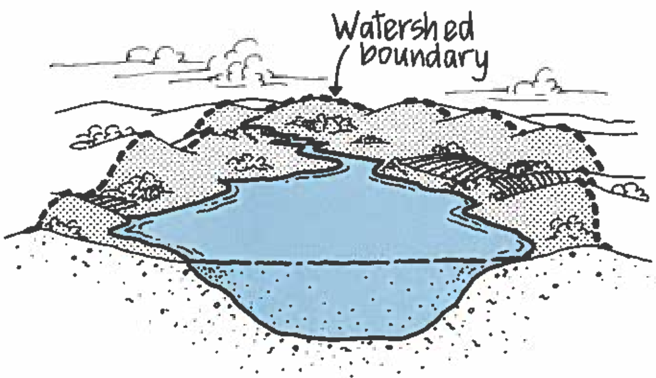


A lake ***ecosystem*** is a complex community of plants and animals interacting with each other and their environment. The diversity of plants and animals within a lake ecosystem is a factor in the system's vulnerability to sudden change. Ecosystems with a great diversity of plant and animal life tend to be relatively stable.

However, it is simply not possible to disturb one part of the ecosystem without affecting other parts. Changes around a lake such as a new road, housing development, shopping center, or farming operation can alter a lake's delicate ecological balance. Although such changes on the land may not cause immediate and noticeable impacts on lake quality, impacts will occur. It may take several years or more before the effects of agricultural operations or urbanization result in algae blooms, weed problems, or fish kills.

The Water Itself

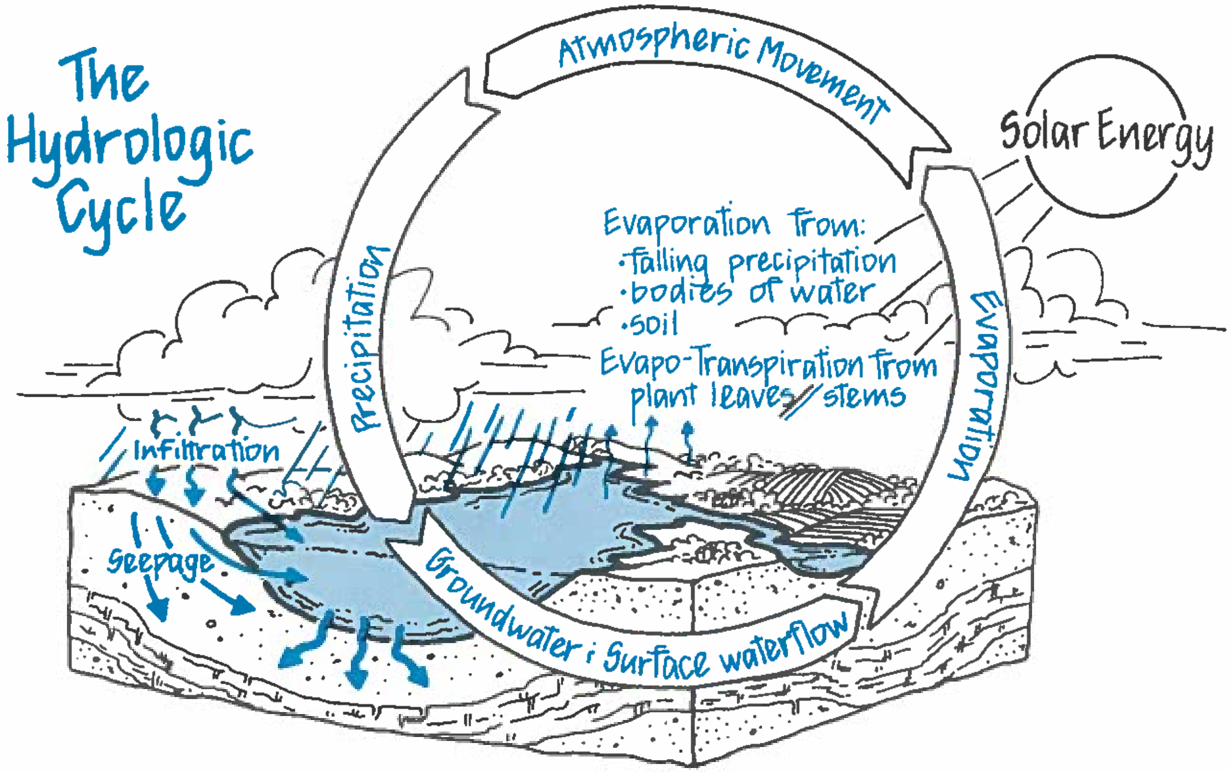
Lakes are the least permanent and perhaps most fragile part of Illinois' surface water system. Because water moves much more slowly through a lake than it does through a river or stream, lakes act as settling basins. Inflowing materials carried to the lake by precipitation, surface runoff, and groundwater can include solid and dissolved substances, both natural and synthetic. ***Seepage lakes*** ("spring-fed") are fed primarily by groundwater, while ***drainage lakes*** are fed primarily by surface runoff and ***tributary*** streams and rivers.



The concept of a ***watershed*** is extremely important to good lake management. A lake watershed consists of the lake and all of the surrounding land which drains toward the lake. Any area of land within the watershed — no matter how far away it is from the lake — may contribute water and associated pollutants to that lake.

The amount and quality of water entering a lake is determined primarily by the ***hydrologic cycle***. Rainfall reaching the earth can run off the land surface, be retained as soil moisture, or infiltrate into the groundwater. Eventually, portions of these surface and groundwater flows will reach the lake. Some water both from the lake and from land surfaces will return to the atmosphere by evaporation. Another portion will return to the atmosphere by ***evapotranspiration*** from the leaves and stems of plants. This airborne moisture becomes subject to atmospheric forces, and the whole cycle starts over when precipitation again falls back to the earth.

The hydrologic cycle changes from season to season and from year to year. "Wet" or "dry" seasons and years occur when the rate of precipitation differs greatly from the rate of evaporation. Often, lake users are particularly interested in the impact of extended dry periods on falling lake levels. Water levels in drainage lakes usually respond quickly to dramatic changes in precipitation since they are fed primarily by surface runoff.



Conversely, water levels in groundwater-fed seepage lakes may show little or no change during dry periods because groundwater levels tend to be rather stable. During prolonged droughts, however, even seepage lakes may experience drastic water level changes. It may take several years after the drought ends for groundwater and seepage lake levels to return to normal.

Changes in watershed land use also can affect a lake's water balance. Undeveloped land tends to act as a natural "sponge," absorbing rainfall and releasing it slowly to the groundwater. However, when the land is covered with ***impervious*** surfaces such as roads, buildings, and parking lots, precipitation cannot be absorbed. Instead it runs off directly to streams, rivers, and lakes. Rises in water levels during and immediately after rainstorms may be exaggerated in watersheds with large impervious areas. Localized flooding may even occur.

Lake Processes

An important early step in deciding how to best manage a lake is to develop a basic understanding of the lake's physical, biological, and chemical properties. These interacting properties—such as temperature, light, wind, nutrients, lake shape, and more—govern the lake and affect nearly every aspect of its plant and animal ***habitats.***

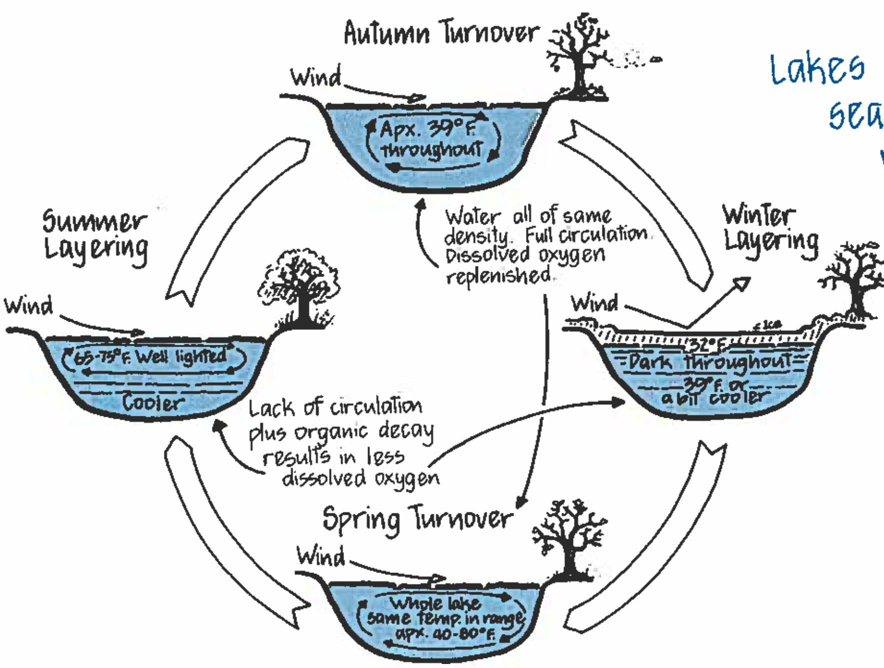
Physical Properties

Many of our lakes in Illinois are deep enough to ***stratify***, or form "layers" of water with different temperatures. Stratification occurs because the density (weight) of water changes depending on its temperature. Water is heaviest at about 39°F. Above and below this temperature, water becomes lighter (less dense).

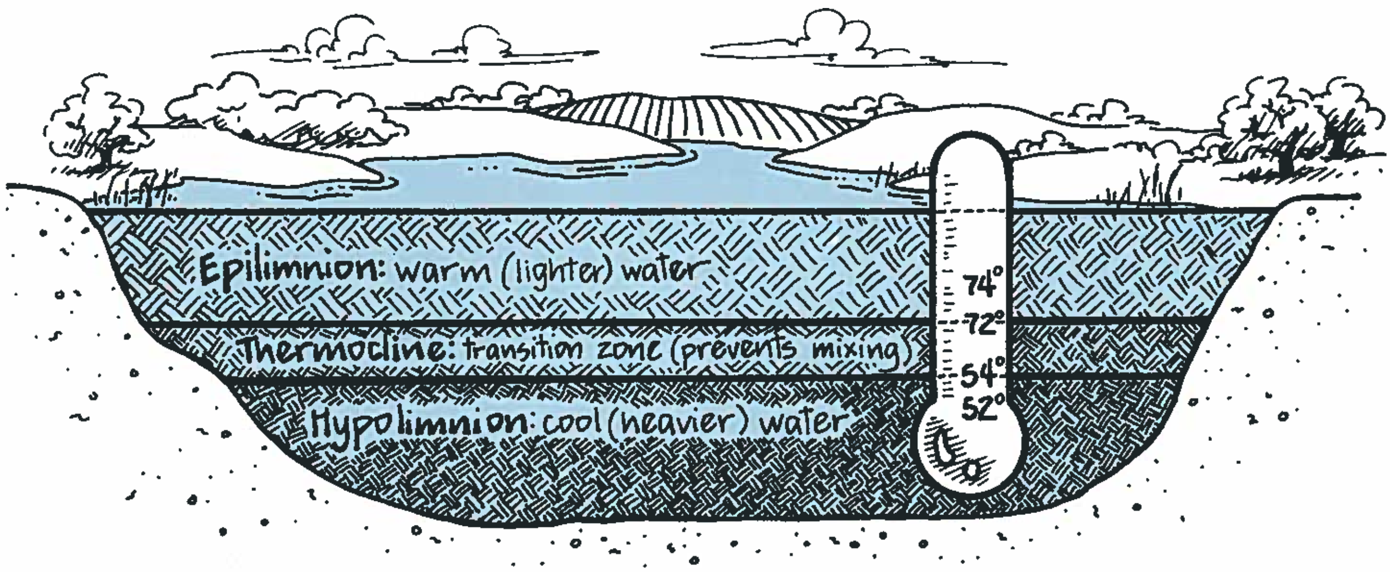
In very shallow lakes, wind and wave forces along the surface are strong enough to mix the water throughout and prevent temperature stratification. In deeper lakes, however, stratification develops because the forces of temperature become greater than those of the wind.

In the fall, chilly air temperatures cool the lake's surface until the water reaches 39°F. Because this chilled water is heavier, it sinks to the bottom. As the lake continues to cool into winter, the colder water (32°F) "floats" on the top, and forms ice. This is why a lake doesn't freeze from the bottom up!

As the weather moderates in spring, the ice melts and the surface waters begin to warm above 32°F. Wind action and the increasing density of the warming water cause this surface water to sink and mix with the deeper water—a process called ***spring turnover***. During this rather brief period of time, most of the lake water is at the same temperature, and surface waters mix freely with bottom waters.



Lakes are influenced by seasonal changes in water circulation patterns.



Thermal stratification in a lake

As the lake continues to warm in the late spring, the temperature differences between the surface and deeper waters increase. In lakes deeper than about 10 to 12 feet, the temperature differences eventually create a physical force strong enough to resist the wind's mixing forces, and the lake stratifies into three layers of water. The upper layer, called the ***epilimnion***, contains the warmest water. The epilimnion extends down about 8 to 15 feet from the water surface in many Illinois lakes.

Below the epilimnion is the rather narrow ***metalimnion***, or "middle" layer often referred to as the ***thermocline***. This layer is a transitional zone in which the temperature drops quite rapidly with increasing water depth. The thermocline is extremely resistant to wind mixing. Beneath the thermocline and extending to the lake bottom lies the coolest water in a layer called the ***hypolimnion***.

This summertime stratification continues until fall when surface waters are cooled to the same temperature as the waters in the hypolimnion. When the whole lake reaches a similar temperature, wind forces are once again strong enough to mix the lake from top to bottom in a process called ***fall turnover***.

The size and shape of a lake affect wave patterns and their impact on shoreline areas. Shorelines with gradually sloping beaches don't erode as rapidly as those that drop off steeply. In shallow water, most of the energy in waves is dissipated (absorbed) by the lake bottom before reaching shore. In deeper near-shore areas, however, there is little energy dissipation before the wave breaks on the shore. Shoreline areas particularly susceptible to erosion problems are located where waves are able to develop considerable energy by travelling a long distance, or ***fetch***, across the lake.

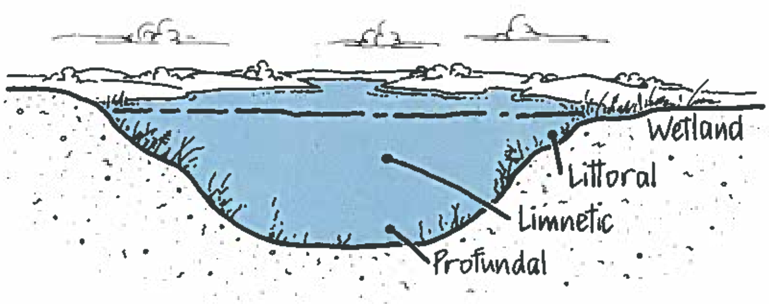
Lakes with many coves and peninsulas have far greater shoreline lengths, and consequently the potential for greater shoreline erosion, compared to round lakes with the same water area.

Bottom sediments are less likely to be resuspended by wind, waves, and recreational activities in deep lakes. Because the volume of water stored in a deep lake is larger, these lakes are also more able to dilute inflowing pollutants than are shallow lakes.

Biological Properties

Lakes can be divided into three biological zones or communities, each with a different mix of plants and animals. The ***littoral community*** extends into the lake from the shoreline. Usually, there is considerable plant and animal growth in this zone. Bottom-dwelling insects (***macroinvertebrates***) and bacteria share these shoreline areas with rooted aquatic plants (***macrophytes***), attached algae (***periphyton***), fish, frogs, and other critters.

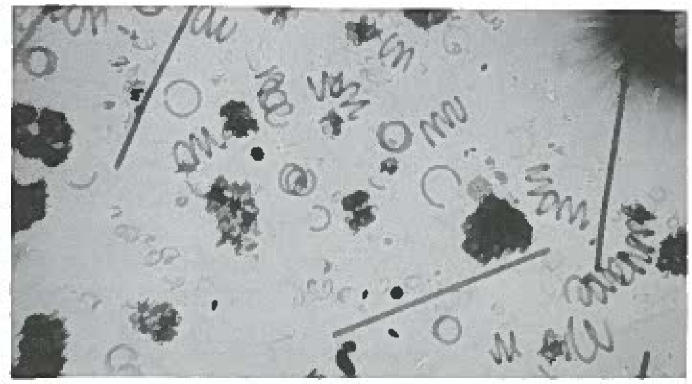
Macrophytes are generally classified as to whether their leaves are ***submergent*** such as pondweeds and watermilfoil, ***floating*** such as water lilies, or ***emergent*** such as cattails and arrowhead. ***Wetlands*** often border at least part of a lake's shoreline and usually are an important part of the lake ecosystem.



A lake ecosystem can be segmented into several communities.

A lake's "open" water area is called the ***limnetic community***. Living here are free-floating microscopic algae (***phytoplankton***), microscopic animals (***zooplankton***), and fish. The macrophytes, phytoplankton, and other types of algae found in the lake use their ***chlorophyll*** pigment to produce oxygen from water, carbon dioxide, and sunlight through ***photosynthesis***.

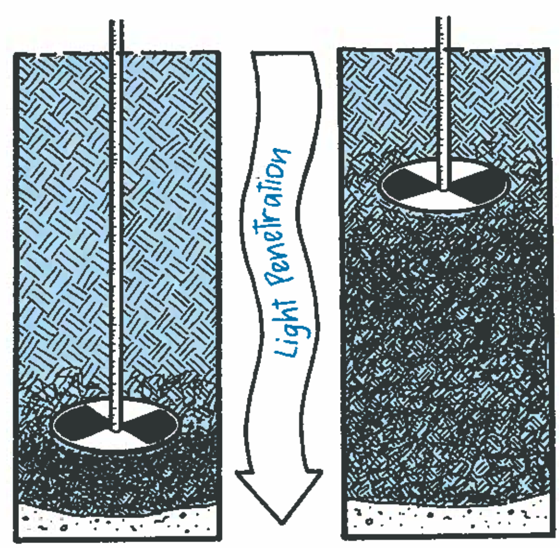
Because sunlight is essential to the photosynthetic process, oxygen can be produced in a lake only as deep as the sunlight penetrates (though wind mixing may carry diffused oxygen from the atmosphere to somewhat greater water depths). Thus, the lake's water ***transparency*** affects its oxygen levels, and hence the amount and rate of plant and animal ***productivity*** (growth). Transparency can be measured using a ***Secchi disc***. This disc is lowered into a lake on a calibrated rope; the water depth at which the disc is no longer visible is called the Secchi disc depth. Usually, sufficient sunlight for photosynthetic activity is limited to water depths less than 2 to 3 times the Secchi disc measurement.

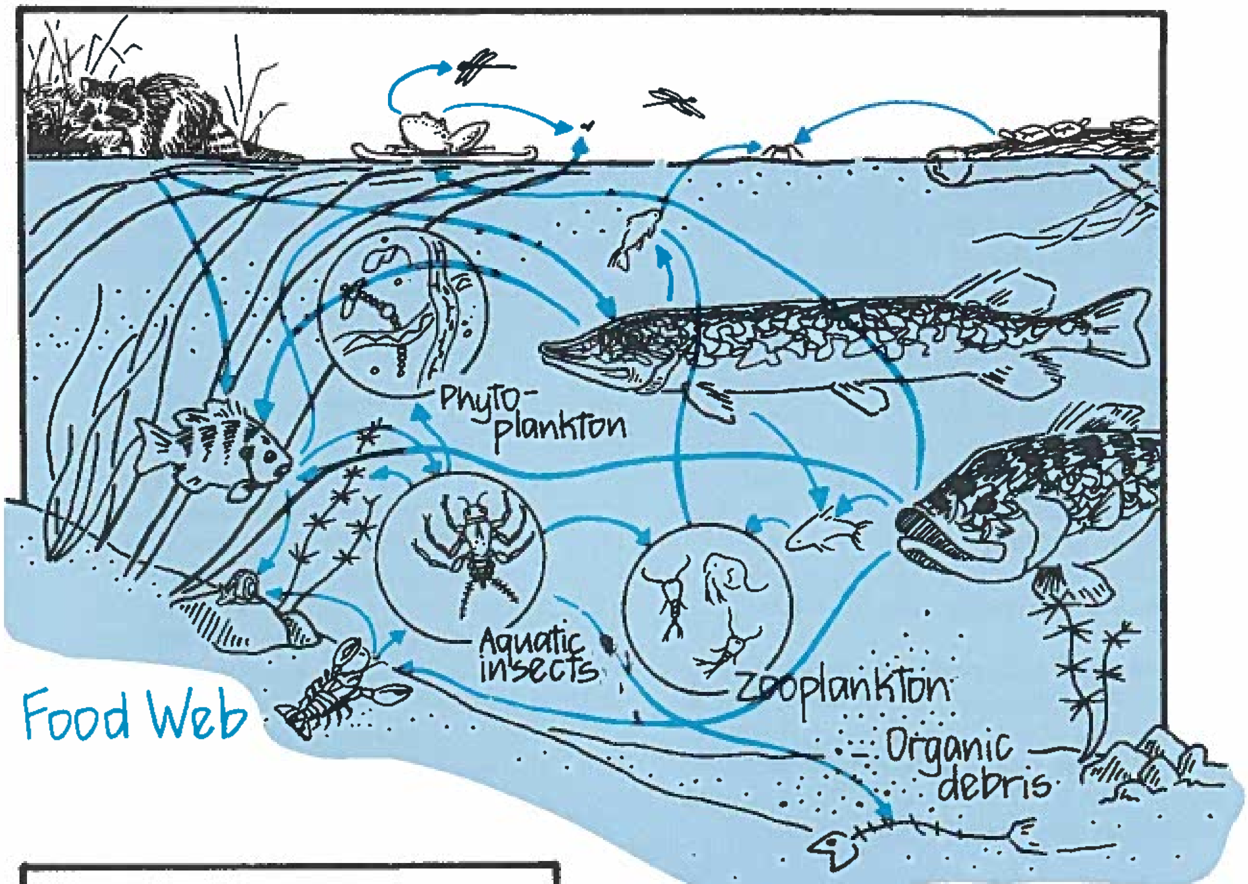


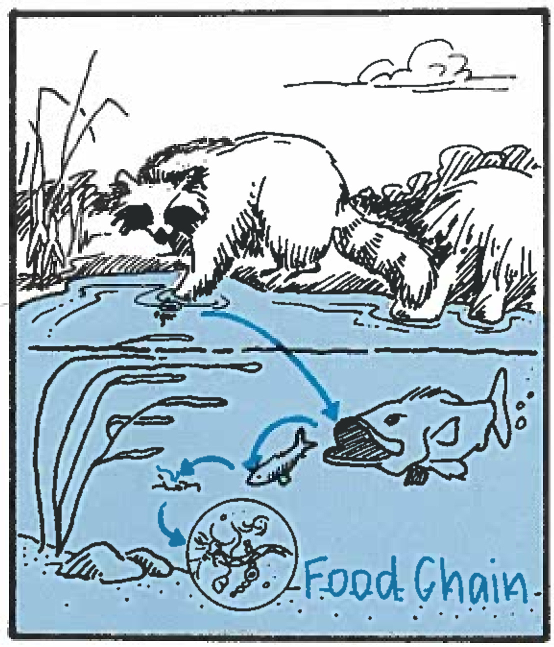
phytoplankton (algae)

Beneath the limnetic zone in deeper lakes is the ***profundal community***. This zone receives little if any sunlight and therefore is dominated by oxygen ***respiration*** (consumption) rather than oxygen production. In many lakes the profundal community corresponds roughly to the hypolimnion. Oxygen-consuming organisms such as bacteria and fungi live here and feed off decomposing plant and animal matter which rains down from the biologically-active waters above. Because the hypolimnion is often dominated by oxygen-consuming rather than oxygen-producing organisms, the oxygen levels in this layer can be extremely low.

A Secchi disc is used to measure water transparency (clarity)







Food web (top) and food chain (bottom) contrasted. The arrows point in the direction of predatory or "grazing" pressure. A chain-like system may produce more of certain fish we desire, but a break in one link may severely disrupt the ecosystem. The web-like system has many more parts and is therefore more stable and more productive in total — but not necessarily of the fish which anglers most appreciate.

The plants and animals within these ecological lake communities interact within a complex ***food web***. Complexity, or ***diversity***, in a lake adds stability to the ecosystem. Even with a few breaks in the predator-prey relationships, other pathways are available for the relationships to continue. Lake management activities that favor only a few species undermine natural diversity and may lead to a breakdown in the lake's natural balances. It's more effective to deal with the entire lake community than to attempt management of just a particular plant or animal.

The conditions and materials important for a plant's or animal's survival defines its ***niche***. Usually, a particular plant or animal population will continue to grow and multiply until some factor — be it food supply, sunlight, available spawning area, or ***predation*** by another organism — acts to limit further growth.

Among plants (including both phytoplankton and macrophytes), the factor limiting their growth is often ***phosphorus*** — an essential plant nutrient. Addition of phosphorus to a lake from sewage treatment plants, failing septic systems, urban and agricultural fertilizers, and dense waterfowl populations can stimulate excessive plant growth and upset the lake's natural food web interactions.

Fish, too, have special habitat needs. For example, northern pike need wetland areas to spawn in and weeds or other structure to hide behind while waiting in ambush for their next prey. Walleye, on the other hand, have particularly keen eyesight and can capture a meal even at night. However, walleyes reproduce only on gravel bars and may swim far upstream along a tributary in search of an acceptable spawning area.

Bass, bluegill, and crappie spawn by clearing the silt along the shoreline to expose a small circular area of sand or pebbles. Their spawning efforts are upset, though, if the nests are stepped on by swimmers or obliterated by motorboat propellers or large waves.

Chemical Properties

Numerous chemical parameters influence lakes. Those summarized below are most frequently studied in lake management because of their usefulness in measuring overall water quality and conditions that affect plant and animal survival.

Dissolved Oxygen

The amount of oxygen gas dissolved in lake water has a dramatic effect on the lake's ability to support life. Most aquatic plants and animals need oxygen to survive, though some species require higher concentrations than others. Oxygen enters a lake two ways: by ***diffusion*** from the atmosphere across the lake surface, and by photosynthetic production from macrophytes and algae.

Factors that affect dissolved oxygen levels in a lake include photosynthetic activity, wind and wave mixing across the lake surface, the amount of decomposing organic matter, and temperature stratification.

In spring when the lake is well-mixed, oxygen generally is present at all depths. However, as deeper lakes stratify during the summer, the lack of oxygen production in the dark hypolimnion and intense ***decomposition*** (which consumes oxygen) in the bottom sediments may depress oxygen concentrations to very low levels. If the hypolimnion's dissolved oxygen falls too low, fish and other oxygen-dependent organisms are confined to the upper waters where oxygen levels are still adequate. With cooler temperatures and strong winds in the fall, the lake stratification breaks down and turnover replenishes oxygen to the bottom waters.

Wintertime can be a particularly stressful period for a lake's aquatic life. Ice cover seals off the lake from atmospheric oxygen. Though some plants and algae usually continue living right through the winter, a heavy blanket of snow covering the ice may restrict light penetration so severely that these oxygen-producers begin to die. Decomposition of this dead plant matter by bacteria further reduces oxygen levels in the lake, potentially causing oxygen concentrations to fall so low that a fish ***winterkill*** occurs.

Clearing snow from an area of the lake can help sustain plant growth and oxygen production. This is especially effective on smaller lakes, and during years with unusually heavy snowfall.

Suspended Solids

A measurement of ***total suspended solids*** (TSS) represents the concentration of all organic and inorganic materials suspended in the lake's ***water column***. Typical inorganic components of TSS originate from weathering and erosion of rocks and soils in the watershed, and resuspension of lake sediments. The organic portion of TSS is called ***volatile suspended solids*** (VSS). VSS are composed mainly of algae and decaying plant and animal matter.

Turbidity

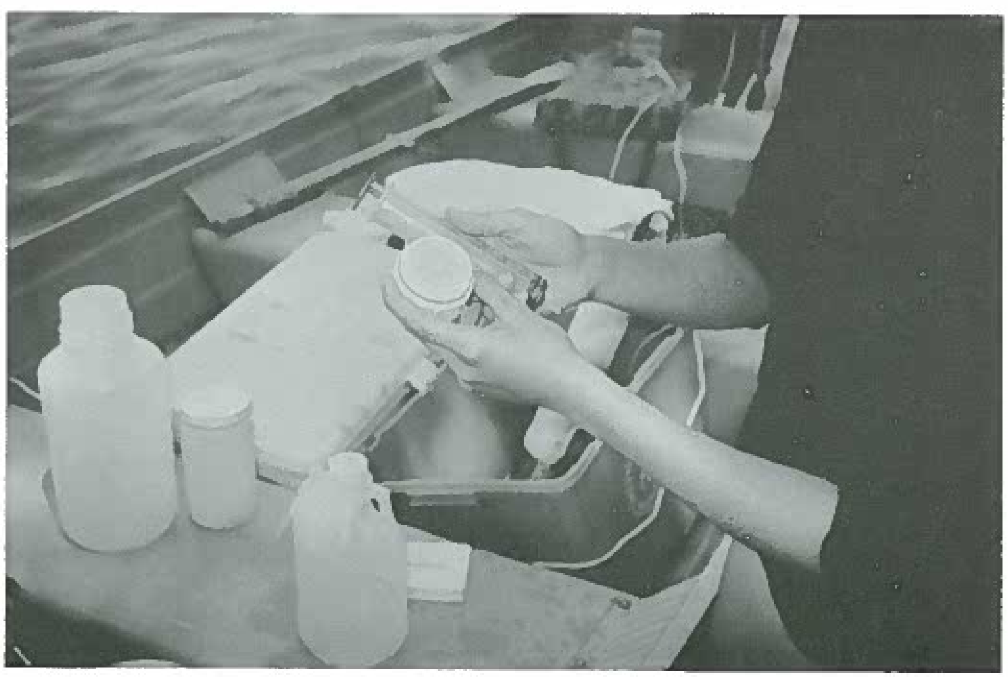
Turbidity in water is caused by the presence of dissolved substances (which may "color" the water), and suspended solids such as soil particles in surface runoff, resuspended bottom sediments, and microscopic algae.

Phosphorus

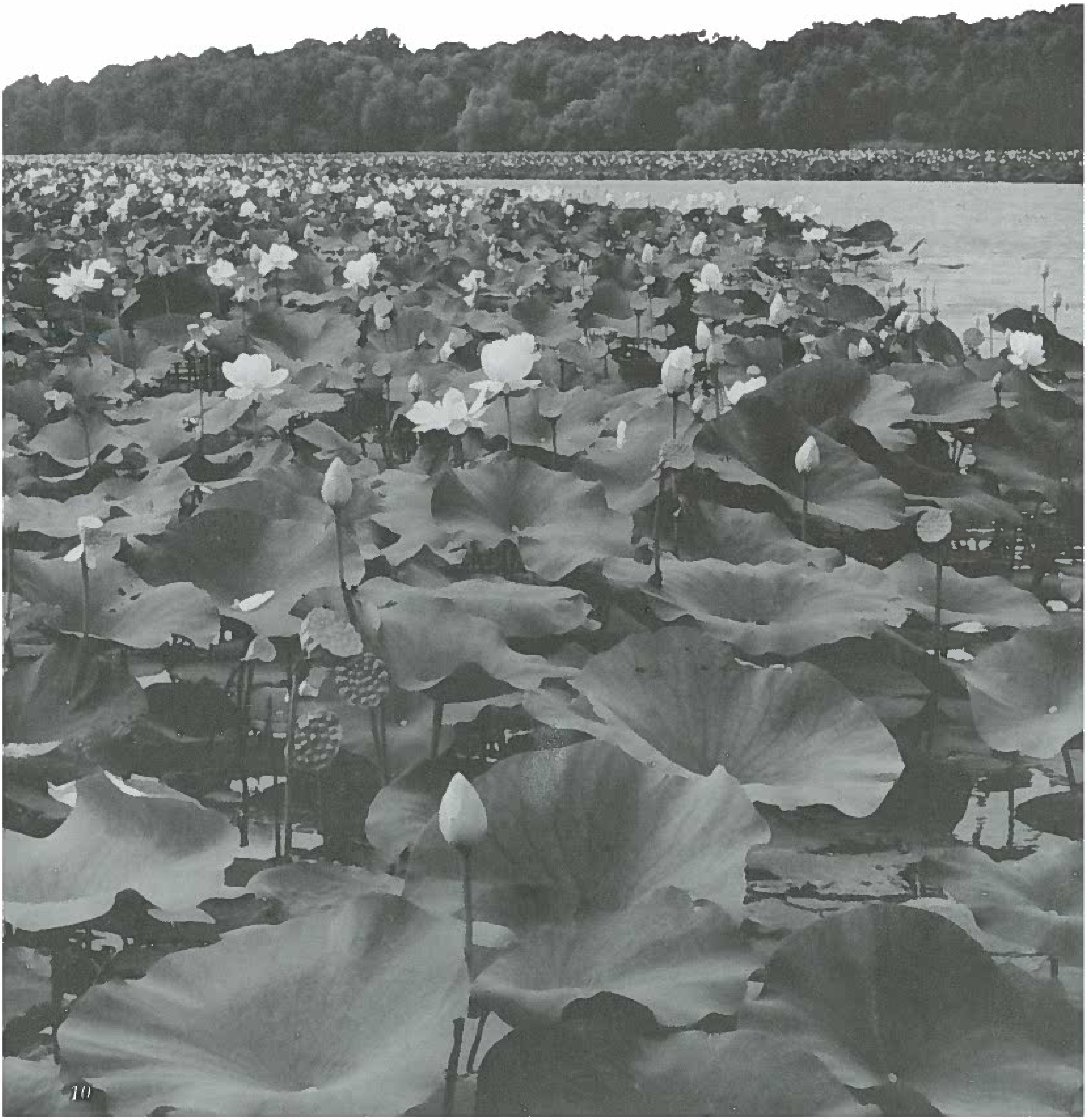
In many lakes, phosphorus is the least available nutrient; therefore, its abundance—or scarcity—controls the extent of plant growth. If more phosphorus is added to a lake from sewage treatment plants, lawn and farm fertilizers, failing septic systems, or resuspended phosphorus-rich bottom sediments, more algae and macrophytes usually will result.

Nitrogen Like phosphorus, ***nitrogen*** is an essential plant nutrient. In some cases, nitrogen may be the nutrient controlling plant growth, but usually another factor (such as phosphorus or light availability) limits growth. If the lake water doesn't contain enough nitrogen, some species of blue-green algae are able to use nitrogen directly from the atmosphere. ***Ammonia***, a form of nitrogen produced during organic decomposition, can be toxic to aquatic life.

pH The acidity of water is measured on the ***pH*** scale. Under natural conditions, most Illinois lakes have a pH between 6.5 and 9.0. A pH of 7.0 is exactly "neutral;" pH values below 7.0 are "acidic," while values above 7.0 are "basic" or alkaline. Although rain water in Illinois is acidic (about 4.4), most of our lakes are able to offset this acidic input by an abundance of natural buffering compounds in the lake water and the watershed. ***Alkalinity*** measures the concentration of these buffering agents in a lake. Lakes in other parts of the country which do not have high alkalinity levels are particularly susceptible to ecological imbalances brought about by ***acid rain***.



Common Lake Problems



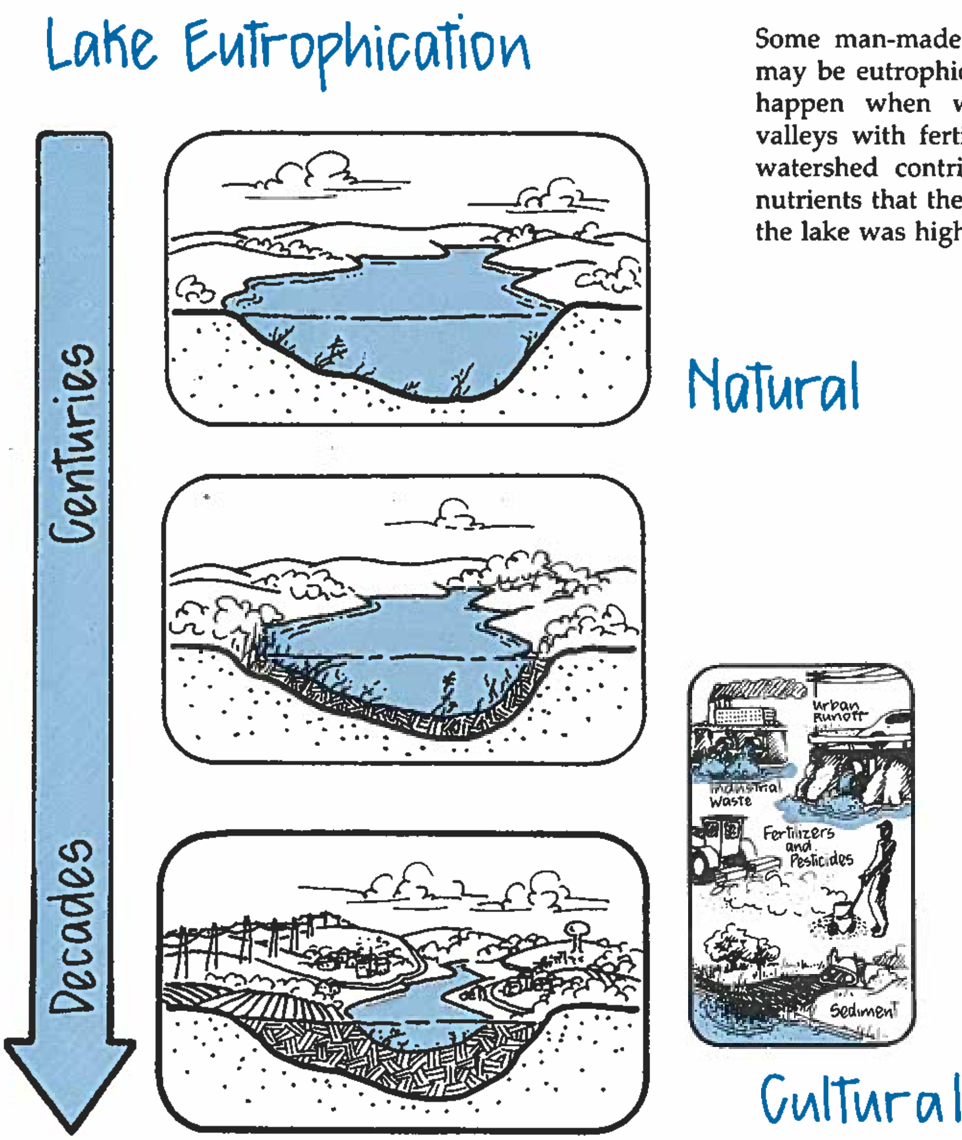
Eutrophication

Eutrophication (from the Greek word meaning "well nourished") describes the process in which a lake becomes enriched with nutrients. These nutrients usually stimulate more and more plant growth. Over time, decaying plants together with eroded materials from the lake's watershed cause the lake to fill in. Some call this an "aging" process because every lake eventually vanishes from the landscape.

Although eutrophication is a natural process, all lakes don't age at the same rate. Left alone from any disturbance by humans, eutrophication of many natural lakes would take thousands of years. However, most human activities on a lake or in its watershed will have at least some impact on nutrient levels. ***Cultural eutrophication*** describes the accelerated aging process brought about by human activities. Rapid soil erosion and over-nourishment from phosphorus are the most common contributors to cultural eutrophication.

Lakes with little nutrient enrichment generally have clear water, few rooted plants and algae, and a limited fishery. Such lakes are termed ***oligotrophic***. Lakes with moderate nutrient levels are called ***mesotrophic***, while fertile lakes with extensive plant production are ***eutrophic***. Further yet, ***hypereutrophic*** lakes have extreme levels of nutrients and nuisance plant growth, often as a result of cultural eutrophication.

Some man-made lakes and impoundments may be eutrophic from their birth. This can happen when waters are impounded in valleys with fertile soils, or when the lake watershed contributes such high levels of nutrients that the water which initially filled the lake was highly enriched.



For regulatory and practical purposes, we commonly speak of two major types of pollutants based on their source. Specific locations such as factories and sewage treatment plants that discharge nutrients, sediments, and other pollutants to a lake are called ***point sources*** of pollution. They're easy to identify, and often comparatively easy to control through treatment or diversion projects.

In contrast, pollution from generalized areas are known as ***nonpoint sources*** of pollution. Examples of nonpoint sources are stormwater running off the land, failing septic systems, waterfowl and livestock waste, and atmospheric fallout. Nonpoint source pollution is often difficult to manage because it can originate almost anywhere in the watershed. Nonpoint pollutants can enter a lake at numerous, widely spread-out sites. Consequently, most nonpoint problems are best controlled at the originating source.

Sedimentation

A lake problem closely associated with eutrophication is ***sedimentation*** — a process by which a lake fills in with decomposing plants and animals that lived in the lake as well as materials washed in from its watershed. Though it is a naturally occurring process, human activities in the watershed may greatly increase the sedimentation rate.

Management of lakes is often more complex than for streams and rivers. Unlike flowing waterbodies, lakes tend to trap most inflowing pollutants and sediments.

Activities that clear the land and expose bare soil, such as some agricultural practices and urban development, lead to high rates of soil erosion during rainfall. While some of this eroded material may settle in small pools or otherwise be trapped nearby on the land, large volumes of silt-laden stormwater may flow directly into the lake or indirectly via the lake's tributary streams and rivers. As stormwater slows down upon entering a lake, much of its silt load settles out and remains in the lake — forever.

Lake sedimentation can also have internal sources. Decomposing aquatic plants, algae, and animals are often the source of organic "muck" found on the lake bottom. The nutrients in these decaying plants and animals do not disappear; large amounts may recycle back to the overlying lake water through ***nutrient regeneration***. Decomposing organic material can also contribute to low dissolved oxygen levels in the lake.

Bacteria

Bacterial contamination of lakes can be caused by discharge of improperly or untreated sewage, and even wildlife and pet waste. Swimming may be prohibited if bacterial concentrations are high enough to suggest the presence of disease-bearing organisms.

Shoreline Erosion

Another common lake problem is ***shoreline erosion***. Disturbance of shoreline vegetation and disruption of the natural, tightly woven plant root/soil matrix make shorelines vulnerable to erosion. Re-grading of shoreland slopes into steep embankments, removal of natural shoreline protectors such as rocks and vegetation, and large waves can increase the rate of shoreline loss.

Taste/Odor

Some water supply impoundments may experience ***taste and odor*** problems in the finished drinking water. Often, these are caused by release of gases from an oxygen-deficient hypolimnion, or from an overabundance of nuisance ***blue-green algae***.

Exotic Species

Natural aquatic plant and animal communities may be severely disrupted by the presence of non-native ***exotic species***. The common carp, introduced to Illinois waters in the 1870s from Europe, spends much of its life churning through bottom sediments in search of food. Large numbers of carp in a lake uproot submergent plants and can make the water quite turbid. Besides causing a serious ecological imbalance among the lake's aquatic life, the lake may also take on a murky, unattractive appearance.

Eurasian watermilfoil is a particularly troublesome exotic plant species found throughout Illinois. Watermilfoil often grows so densely that whole areas of a lake become unusable for recreation. The plant usually crowds out native aquatic plants that don't have such nuisance growth habits, thereby lessening the diversity within the lake ecosystem. Watermilfoil spreads easily to uninfested areas because plant fragments (often broken off by motorboat propellers) are capable of sprouting roots.

Toxicants

Heavy metals, persistent organic compounds, and other ***toxicants*** also can impair a lake. These substances originate from all sorts of industrial, agricultural, and residential activities. Some compounds affect aquatic organisms in concentrations as low as one part per **trillion** or less. Though we now know much more about the potential toxicity of these substances than even a few years ago, we still have a great deal to learn about their long-term effects on lake environments. One particularly dangerous impact is ***bioaccumulation***, or build-up, of contaminants in fish flesh. If the contaminant's concentration is high enough or if the fish is not prepared properly, toxic or carcinogenic effects may be passed on to humans eating the fish.

One part per trillion is equivalent to a grain of sand laid on a football field!

Other Human Impacts

Still other lake problems may be related to human activities occurring directly on the water. These may include excessive or unsafe boat operation, human intrusion into sensitive aquatic habitats, direct or indirect discharge of human wastes, lake use conflicts, sediment resuspension, noise pollution, and alteration of natural lakeshore aesthetics.

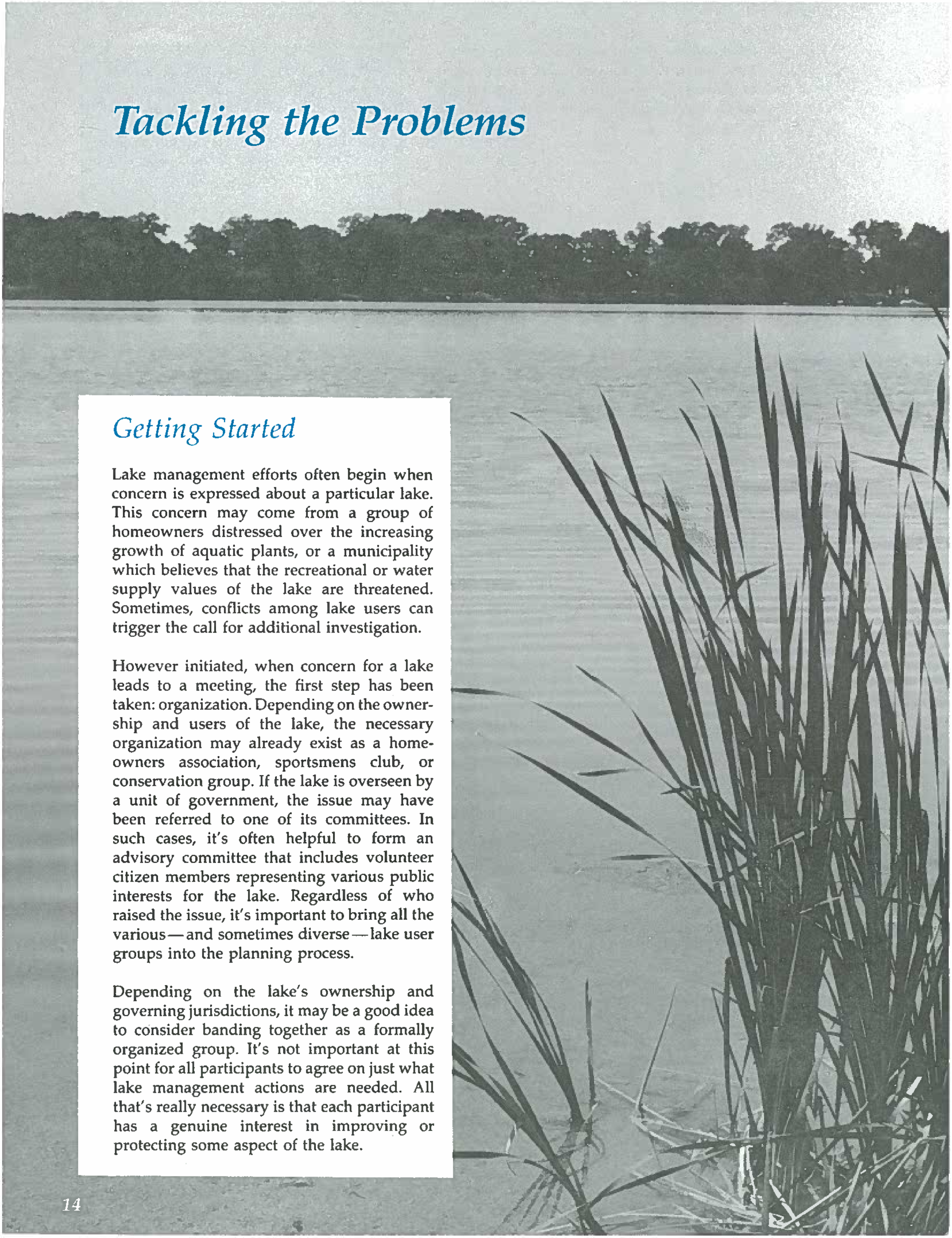
In 1977, four Illinois agencies — the Department of Public Health, the Department of Conservation, the Department of Agriculture, and the Illinois Environmental Protection Agency — began gathering information about fish tissue that could be contaminated by toxic chemicals.

The investigations center on the organochlorine compounds used to make pesticides and polychlorinated biphenyls (PCBs). This group of chemicals can contaminate fish and, in turn, potentially threaten the health of those who regularly eat contaminated fish.

Sport fish health advisories are issued when contaminants in fish tissue samples reach a level that may be a public health concern. Although the effects of long-term, low-level exposure to these toxicants are generally unknown, some of the chemicals included in the testing program are suspected carcinogens. In addition, some chemicals are thought to cause reproductive problems or affect the development of newborns and infants.

Special methods for fish preparation can reduce the risk of exposure to contaminants. Fat-soluble contaminants can be reduced by removing the skin and any fatty tissue beneath the skin near the belly or dorsal area of large fish. Although the evidence is not conclusive, it appears that contamination is lower in cooked fish because cooking melts some of the fat where pollutants have accumulated. Therefore, it is recommended that fish be barbecued, broiled, or baked on an elevated rack which allows the fat to drip away from the finished meal. Boiling or poaching are also acceptable ways to cook fish but the broth should be discarded.

Sport fish contaminant advisories are issued each year. More information about the Illinois Fish Contaminant Monitoring Program is available from the Illinois EPA, Division of Water Pollution Control, P.O. Box 19276, Springfield, IL, 62794-9276; telephone 217/782-3362.



Tackling the Problems

Getting Started

Lake management efforts often begin when concern is expressed about a particular lake. This concern may come from a group of homeowners distressed over the increasing growth of aquatic plants, or a municipality which believes that the recreational or water supply values of the lake are threatened. Sometimes, conflicts among lake users can trigger the call for additional investigation.

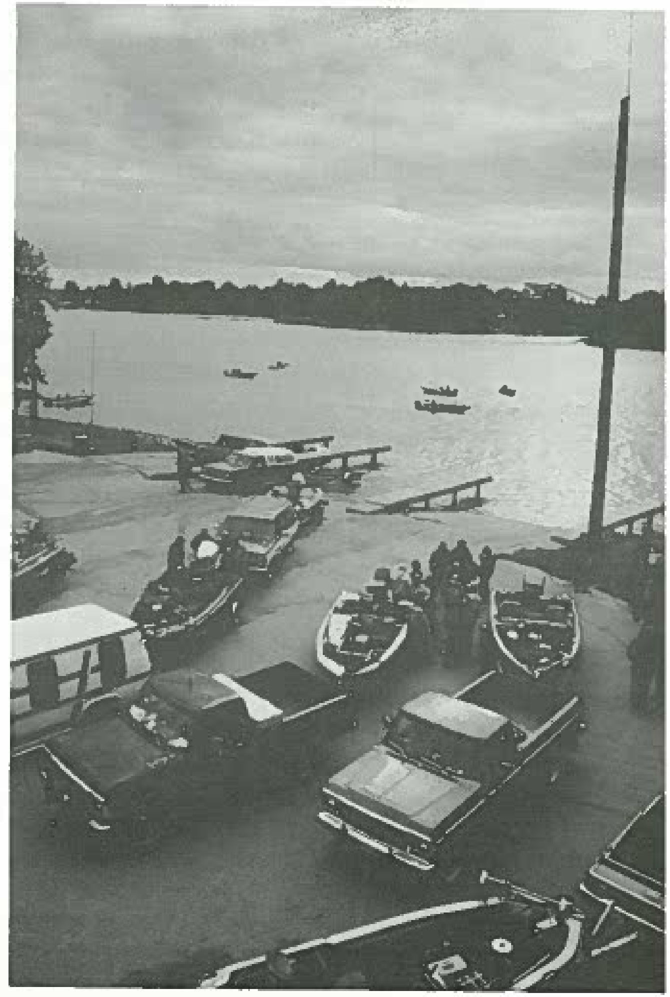
However initiated, when concern for a lake leads to a meeting, the first step has been taken: organization. Depending on the ownership and users of the lake, the necessary organization may already exist as a homeowners association, sportsmens club, or conservation group. If the lake is overseen by a unit of government, the issue may have been referred to one of its committees. In such cases, it's often helpful to form an advisory committee that includes volunteer citizen members representing various public interests for the lake. Regardless of who raised the issue, it's important to bring all the various—and sometimes diverse—lake user groups into the planning process.

Depending on the lake's ownership and governing jurisdictions, it may be a good idea to consider banding together as a formally organized group. It's not important at this point for all participants to agree on just what lake management actions are needed. All that's really necessary is that each participant has a genuine interest in improving or protecting some aspect of the lake.

Details about Special Service Areas and River Conservancy Districts can be obtained from the Northeastern Illinois Planning Commission (see "Where to Go for More Information" at the end of this guidebook).

Various options exist for organization. For lakes where the lakebed has multiple owners, a lake association incorporated as a not-for-profit organization, a ***Special Service Area***, or a ***River Conservancy District*** may be appropriate. Lakes with at least some public access historically have been favored candidates for help from state and federal assistance programs. It's important also to remember that the **water** in lakes is "waters of the state" and hence belongs to everyone.

Regardless of whether or not a more formalized lake organization is established, there's no substitute for good ***lake stewardship*** on the part of each person who uses or affects the quality of the lake. Lake stewardship is basically an ethic — one that recognizes the vulnerability of lake ecosystems and attempts to protect the resource for future generations. As we'll see later, there are many activities which individuals and groups can undertake to promote good lake stewardship.



Five Initial Steps

Once the various lake interests have been organized, there are five initial steps which can help guide your efforts.

1. ESTABLISH GOALS Lake user groups may have very different ideas about how the lake should look, how it should be used, or how it should be managed. Some lake users — swimmers for example — often prefer a "weed-free" lake bottom and crystal clear water. Anglers, though, know that a moderate amount of vegetation is needed for good sport fishing. Powerboaters and waterskiers usually prefer unobstructed cruising lanes, while sailboaters like to be able to travel wherever the wind might take them. And to ardent wildlife enthusiasts, the best lake might be one which reveals hardly any signs of human activity.

Because of these differences, the first step is to determine just what uses the lake should (or needs to) support. Many successful lake management projects have developed a ***lake use plan***. This plan spells out, in words and in graphics, lake use goals. These goals are derived as a consensus from the varied—and sometimes conflicting — community of lake users. The key element to success is often **compromise**. Community meetings led by an impartial moderator can often help identify lake use issues and improve communication and cooperation among participants.

At a later stage, you may need professional guidance to determine whether the desired goals are feasible for your lake. Nonetheless, it is a good idea to determine early on what lake users **want** to achieve.

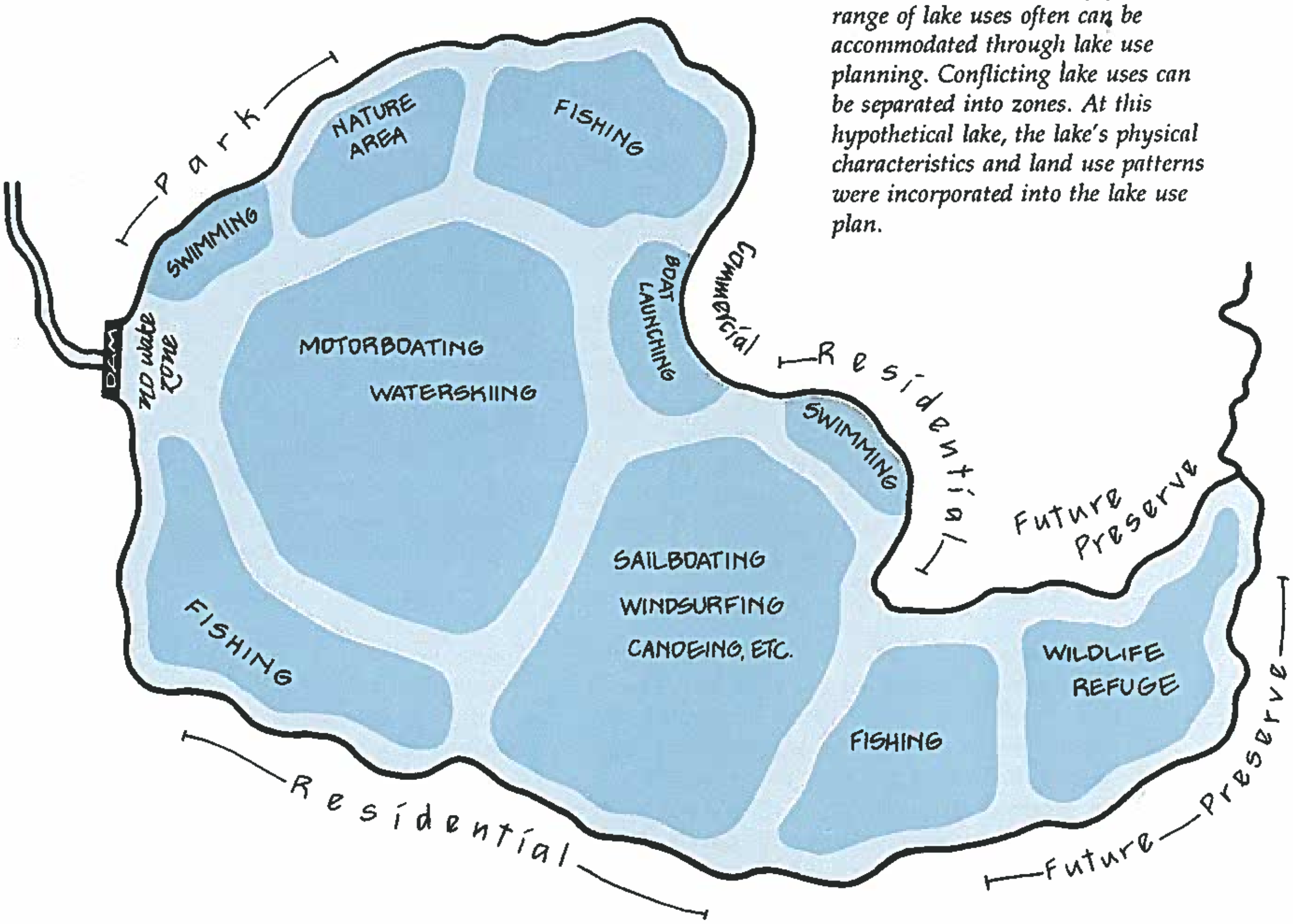
The more people in a community involved with lake planning, the more likely that the final management plan will be accepted.

A lake use plan may specify where and even when certain uses of the lake will be encouraged. By not attempting to accommodate all lake uses in all parts of the lake, it is often possible to manage for more uses at a higher level of quality, while still keeping project costs reasonable. Fundraising for lake projects is made easier when the viewpoints of all lake user groups have been considered.

Development of a lake use plan at the onset of a lake management investigation will give the effort a clear direction and serve as a project blueprint. As we'll see in the next section, this plan needs to be flexible. The goals and user expectations need continuous review as information is gathered and as technical and financial realities become more apparent.

A Lake Use Plan

A more diverse—and enjoyable—range of lake uses often can be accommodated through lake use planning. Conflicting lake uses can be separated into zones. At this hypothetical lake, the lake's physical characteristics and land use patterns were incorporated into the lake use plan.



2. ASSESS LEVELS OF COMMITMENT

Determine early on what levels of commitment the group and each of its participants are willing to make. If all the work is done by only a few, chances are that the end product will be accepted by only a few. Try to see beyond the initial enthusiasm to predict how much excitement will remain once the management effort moves into high gear. Assess what financial resources might be available to implement an action plan. Even though less promising funding sources shouldn't be ruled out at this stage, it's important that the group work within realistic bounds.

It is very important that the participants accept responsibility for keeping the commitment alive. Lake projects can take a long time. Too many closed meetings, too many volunteers never called on, too little communication can cause the effort to lose vital support.

3. ACQUIRE BACKGROUND KNOWLEDGE AND ASSEMBLE EXISTING INFORMATION

Encourage group participants to become familiar with the basic principles of lakes. Explore the important relationships between a lake and its watershed. Request group members to gather any information they know of relating to the lake. Local soil and water conservation districts and county, regional, and state environmental agencies often will have historical data on the lake and watershed, and they may be able to help with technical and organizational questions. State and national lake management organizations can help steer you towards technical expertise and get you in touch with others involved in local lake management.

4. DETERMINE CURRENT LAKE PROBLEMS AND CONDITIONS

Use your lake use plan to identify ***impaired*** lake uses. For example, if swimming is a desired use, what conditions detract from or threaten this use? If high bacteria counts cause the impairment, where do the bacteria come from? If there are too many "weeds" or algae, what nutrient sources may be feeding this growth? For each lake use identified in your plan, you may wish to construct an outline of existing or potential problems affecting that use, what the causes might be, and a plan for further investigation.

A ***diagnostic study*** documents existing lake conditions and problems, then determines the causes and sources for each problem identified. The information gathered during the diagnostic study is used to evaluate management approaches and develop an action plan.

In-Lake

- ❑ water chemistry (nutrients, suspended solids, etc.)
- ❑ dissolved oxygen and temperature profiles
- ❑ Secchi disc transparency
- ❑ chlorophyll (an indicator of algae growth)
- ❑ plants (macrophyte and algae types and abundance)
- ❑ fish populations
- ❑ macroinvertebrates, birds, and other animals
- ❑ mapping of water depths and accumulated sediments
- ❑ sediment characteristics
- ❑ lake level recording

Watershed

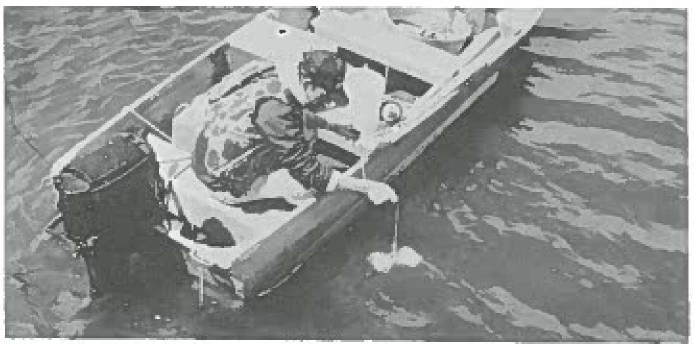
- ❑ inlet water chemistry
- ❑ inlet water flows
- ❑ current and future land use analysis
- ❑ location of "point" sources of pollution such as wastewater treatment plants, industrial discharges, etc.
- ❑ assessment of "nonpoint" sources of pollution from agricultural areas, urban stormwater runoff, streambank erosion, etc.
- ❑ precipitation amount and quality

Groundwater

- ❑ general movement and quality
- ❑ septic system inventory

Shoreline Erosion

Your investigations may be "desktop" information-gathering, or they may include actual monitoring and assessment of lake and watershed conditions. Participation in the **Illinois Volunteer Lake Monitoring Program** can provide basic information about your lake's quality, while helping to identify watershed problems. The Illinois Environmental Protection Agency can also provide you with information about more intensive monitoring programs.



Volunteer Lake Monitoring Program

Citizens interested in collecting data on Illinois lakes can participate in the Volunteer Lake Monitoring Program. Volunteers record water transparency and other lake characteristics at several sites on a lake of their choosing. Measurements are taken twice per month from May through October.

The Illinois EPA administers the program, with the help of several regional planning agencies around the state. Volunteers are provided with all monitoring equipment and forms. All that's needed is a desire to know more about your lake and a commitment to take the measurements on a regular basis.

Interested? Call the Illinois EPA at 217/782-3362 for more details.

If your group expects to be making long-term, potentially expensive management choices, a comprehensive analysis of the lake is often warranted. At this point, retaining a qualified professional consultant to help collect and analyze the information may be appropriate. A modest investment in a good scientific investigation will usually reap much larger savings by producing a more effective and efficient implementation program.

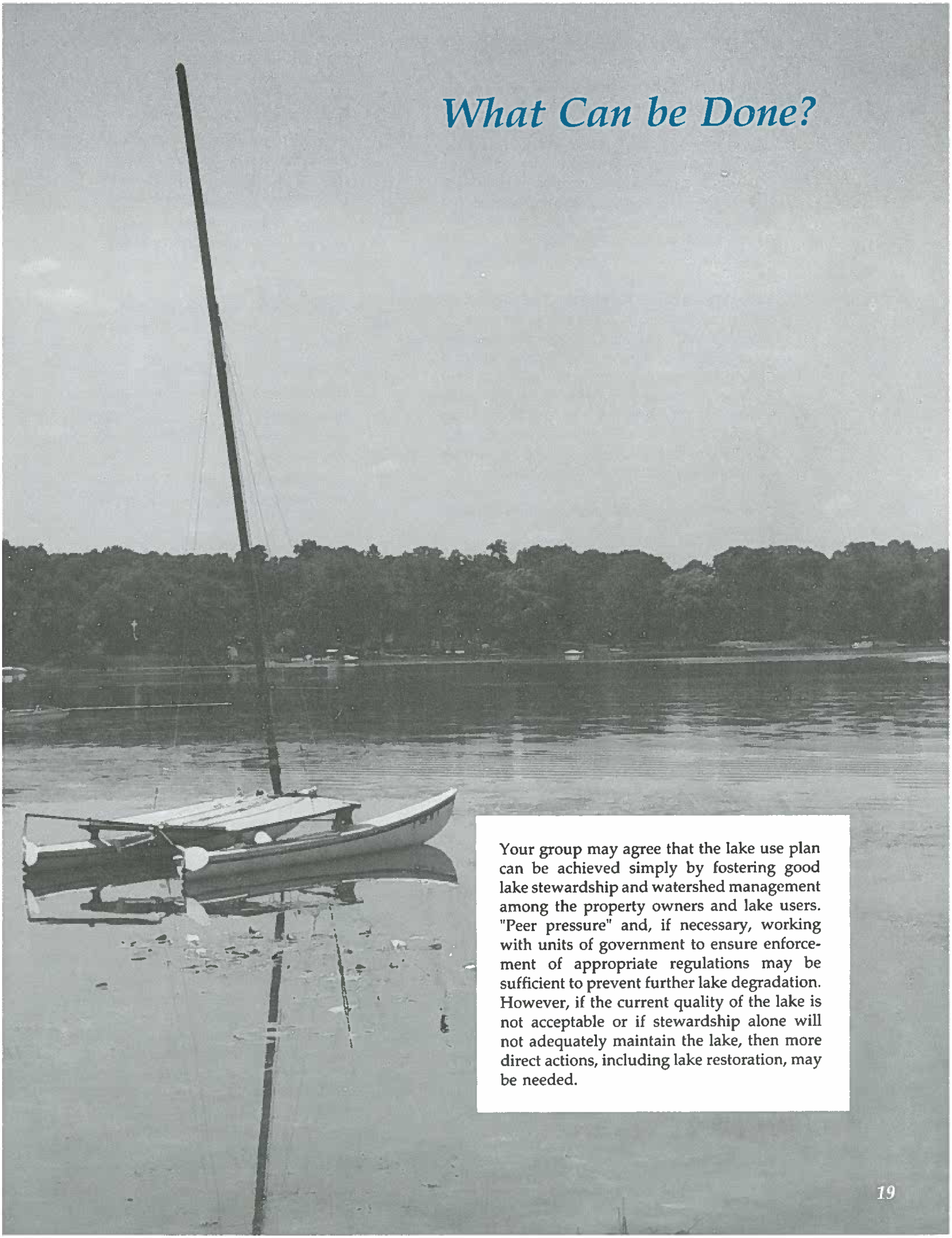
5. SET A COURSE OF ACTION Once the group has completed the four previous steps, it should be able to determine the level of management which the group can realistically implement. Everyone involved up until now should also have a much better understanding of lake processes and a keener appreciation for the challenges facing any lake management effort.

Lake management actually involves two main areas of activity. The first is called ***watershed management***. An example of watershed management would be practices which reduce soil erosion and silt-laden runoff from agricultural fields and urban construction sites. Here, as is the case with most other forms of watershed management, lake ***protection*** is being implemented because pollutants are being stopped before they reach the lake.

The second area of lake management, ***in-lake management***, focuses on lake problems and solutions which exist in the lake itself. A good example of this is dredging, which is often undertaken to remove sediment that has accumulated in the lake. Such corrective actions are often called lake ***restoration*** activities because their intent is to restore the lake's previous quality and uses. It's important to realize, though, that most lake restoration activities are merely "band-aids" — they treat the symptoms of lake problems (for example, shallow water depths) but do not address the underlying cause (excessive erosion in the watershed).

Of course, all forms of lake management, including restoration, should strive to provide long-term protection for the lake as well. The goal should be to reduce or even eliminate the need for additional restoration activities in the future.

What Can be Done?



Your group may agree that the lake use plan can be achieved simply by fostering good lake stewardship and watershed management among the property owners and lake users. "Peer pressure" and, if necessary, working with units of government to ensure enforcement of appropriate regulations may be sufficient to prevent further lake degradation. However, if the current quality of the lake is not acceptable or if stewardship alone will not adequately maintain the lake, then more direct actions, including lake restoration, may be needed.

Watershed Management

Many activities in a lake watershed have the potential to increase the amount of pollutants and erosional materials that enter the lake. Implementing ***best management practices*** (BMPs) on problem areas in the watershed can protect the lake from nonpoint sources of pollution. These management practices can stop the pollutants right at the site, or intercept them at a point further along in the watershed—but before reaching the lake.

Agricultural Pollutants

The most common agricultural pollutant in Illinois is eroded soil. While the soil particle, by itself, can damage a downstream lake by filling it in, other pollutants such as nutrients and pesticides become attached to the soil particles and "hitch a ride" to the lake. Some pollutants dissolve readily in water and may be carried to the lake by surface or groundwater flows through the watershed.

Some of the more common agricultural BMPs include:

- ❑ **conservation tillage** (minimal or no surface plowing)
- ❑ **contour farming** across steep slopes (rather than up and down) and **terracing** (re-grading steep slopes into a series of steps)
- ❑ **crop rotation** to include grasses and dense soil-shielding vegetation
- ❑ re-routing or treatment of **animal feedlot drainage**
- ❑ **manure management**, particularly to reduce manure spreading near waterways or on frozen ground
- ❑ field drainage through non-erosive **grassed waterways**
- ❑ vegetated **buffer strips** atop streambanks to filter runoff from fields
- ❑ **fencing** along streambanks to reduce livestock trampling and preserve shoreline vegetation
- ❑ careful management of **fertilizer and pesticide application** and rates

Urban Pollutants

Pollutants from urban areas may include soil eroded from construction and development sites, oils and atmospheric particles from engines, and nutrients from lawn fertilizers and pet/wildlife waste. Urban BMPs include:

- ❑ **erosion and sediment control practices** which minimize erosion and sediment contributions from construction sites (these practices can be mandated by local ordinance)
- ❑ **detention, infiltration, and presedimentation basins** to slow water flows and trap pollutants through settling and biological processes
- ❑ **natural drainage practices** which use open channels stabilized with vegetation (as opposed to storm sewer pipes)
- ❑ **septic system maintenance** and replacement or elimination of failing systems
- ❑ elimination of **illegal sanitary sewer** connections to storm sewer systems
- ❑ **litter removal** to prevent leaves and other organic debris from washing into the lake
- ❑ **pet waste control** to keep pet waste from being carried away by stormwater
- ❑ **storm sewer maintenance** to keep catch basins clean and functional
- ❑ **diversion** of sanitary and storm sewer flows away from the lake
- ❑ **development restrictions** that preserve environmental features providing natural protection for lakes, such as wetlands and floodplains
- ❑ **lawn fertilizer management** to reduce the amount of unnecessary fertilizer usage
- ❑ proper **household hazardous waste disposal**

In-Lake Management

Dredging

removes organic and inorganic sediments that have accumulated in the lake. Dredging is often performed to make a lake deeper for boating as well as to improve fish habitat. Removal of "muck" sediments can improve swimming, water clarity, as well as aquatic plant and animal habitats. Deepening nearshore areas so that sunlight does not penetrate all the way to the bottom in the littoral zone can reduce growth of rooted plants. Removal of nutrient-rich sediments can also reduce the amount of phosphorus that is released from the sediment to the overlying lake water. Finding a socially- and environmentally-suitable disposal site for the dredged material is often a difficult problem. A buildup of toxicants in the lake sediments may necessitate special handling procedures. Dredging is an expensive restoration strategy and should always be accompanied by management efforts which reduce sedimentation rates over the long term.

Aeration and circulation systems can increase the oxygen concentration in the lake water. More oxygen can reduce the likelihood of fish kills, slow the rate of nutrient release from the bottom sediments, and expand the habitat available to aquatic organisms. Shallow lakes that don't stratify may not benefit from aeration during the summer because wind mixing across the lake surface maintains adequate dissolved oxygen levels. Wintertime aeration, however, may be appropriate in shallow lakes to prevent complete ice-over and the possibility of a fish kill. Aeration and circulation systems in combination with algae control measures have been very effective in reducing taste and odor problems in some water supply reservoirs.

An aerator system may provide little benefit for a shallow lake, if only operated during the summer. Aerators should always be elevated above the lakebed away from easily-resuspended bottom sediments.

Nutrient inactivation is a technique to reduce the availability of nutrients in lakes. A chemical called alum (aluminum sulfate) can be added to lake water to settle out phosphorus, but this technique usually only works well in deeper lakes where the "treated" water is not rapidly flushed out by stormwater. Nutrients in the bottom sediments, notably phosphorus, also can be inactivated or "sealed off" from lake water by the addition of chemicals. These forms of treatment are still considered by some to be experimental.

Drawdown If the lake level can be drawn down by lowering the dam or by pumping, growth of nuisance aquatic vegetation in shoreline areas can be reduced by drying and/or freezing. Some shrinkage and hardening of exposed organic muck sediments also may occur. However, shoreline structures and retaining walls may be damaged by slumping and freezing, and the draining may harm perimeter wetlands and wildlife habitats around the lake.

Harvesting of nuisance plant growth can improve lake aesthetics and recreation. Areas to be harvested can be exactly defined, ensuring against overtreatment into protected vegetation areas. Most harvesting machinery only cut to a depth of about 5 feet, and larger machines have difficulty making tight maneuvers around docks and rafts. Though removal of plants from the lake does represent an "export" of organic materials and nutrients from the lake system, some scientists believe that the relative amount of nutrients removed is actually rather small. Because harvesting may do little to correct the cause of excessive plant growth (an overabundance of nutrients), it is considered a cosmetic approach — much like mowing a lawn.

Chemical control of nuisance plants is also quite common, particularly for algae. Various chemical liquids, powders, and granules have been developed, some of which are especially effective against particular plant species. Chemicals can kill an entire plant, including the roots. However, because the dead plants remain in the lake, this technique too is only a "band-aid" for the lake's nutrient enrichment problem. And, not all researchers are in agreement regarding the potential long-term health risks associated with some chemical compounds.

Dyes color the water and reduce its transparency, potentially limiting the growth of rooted plants and some algae. Small lakes with low ***flushing rates*** are the most appropriate for this treatment.

Dilution adds water that is nutrient-poor (often groundwater) and flushes out lake water that is nutrient-rich.

Blanketing the lake bottom with various types of fabric or sheeting can reduce aquatic plant growth. The covering must be removed periodically to clean off accumulated sediment. Because of the relatively high cost, this practice is often limited to small, high-use shoreline areas such as around docks and rafts.

Fish management may take on several forms. Careful stockings can help restore balanced predator-prey communities, or they can be designed to improve game fish populations. Sometimes, a lake's fishery may be seriously degraded by the abundance of "rough" fish such as carp. The only effective management option may be the complete elimination of all fish by using a chemical called ***rotenone***. Restocking with game fish and ***forage species*** usually follows.

Local, state, or federal permits may be needed to implement some lake management practices. While permit programs may appear at times to be unnecessary, they are intended to protect both public and private interests. For example, wetlands existing near the perimeter of lakes are often suggested as the most economical place to dispose of dredged material. However, alteration or destruction of these wetlands could undermine the lake management effort by degrading wildlife habitat or the quality of water flowing into the lake. Review staff at permitting agencies are familiar with these conflicts and may be able to suggest practical alternatives which will not cause permitting problems.

Shoreline Management

Shoreline management literally exists at the edge between "watershed" and "in-lake" management. A shoreline's land/water interface is particularly important for aquatic plants and animals; it also is an area of concentrated human activity.

A shoreline's environmental and aesthetic values can co-exist with limited alterations and development. Vegetation plantings, as well as rocks and other structural barriers can reduce waves' erosive impact. Also, regrading nearshore land areas to more gradual slopes reduces the velocity of runoff and consequent erosion.

Shoreline wetlands help to remove pollutants from runoff before they reach the lake. They are richly diverse in aquatic life. Floodplains also are home to many plant and animal species, and they function as a natural cushion for fragile shorelands in times of high water. Because of their importance to the lake ecosystem as well as to the protection of shoreline property, some communities have adopted regulations which limit floodplain and wetland alterations.

Lake organizations sometimes purchase wetlands within their lake's watershed to help protect lake water quality into the future.

Local governments can adopt other strategies that provide further protection for lake quality and aesthetics. Ordinances can establish a minimum setback for buildings and septic systems from the lake, set reasonable design criteria for docks and piers, restrict unnecessary land disturbance on lakefront developments, and limit removal of trees and vegetation on near-shore lands.

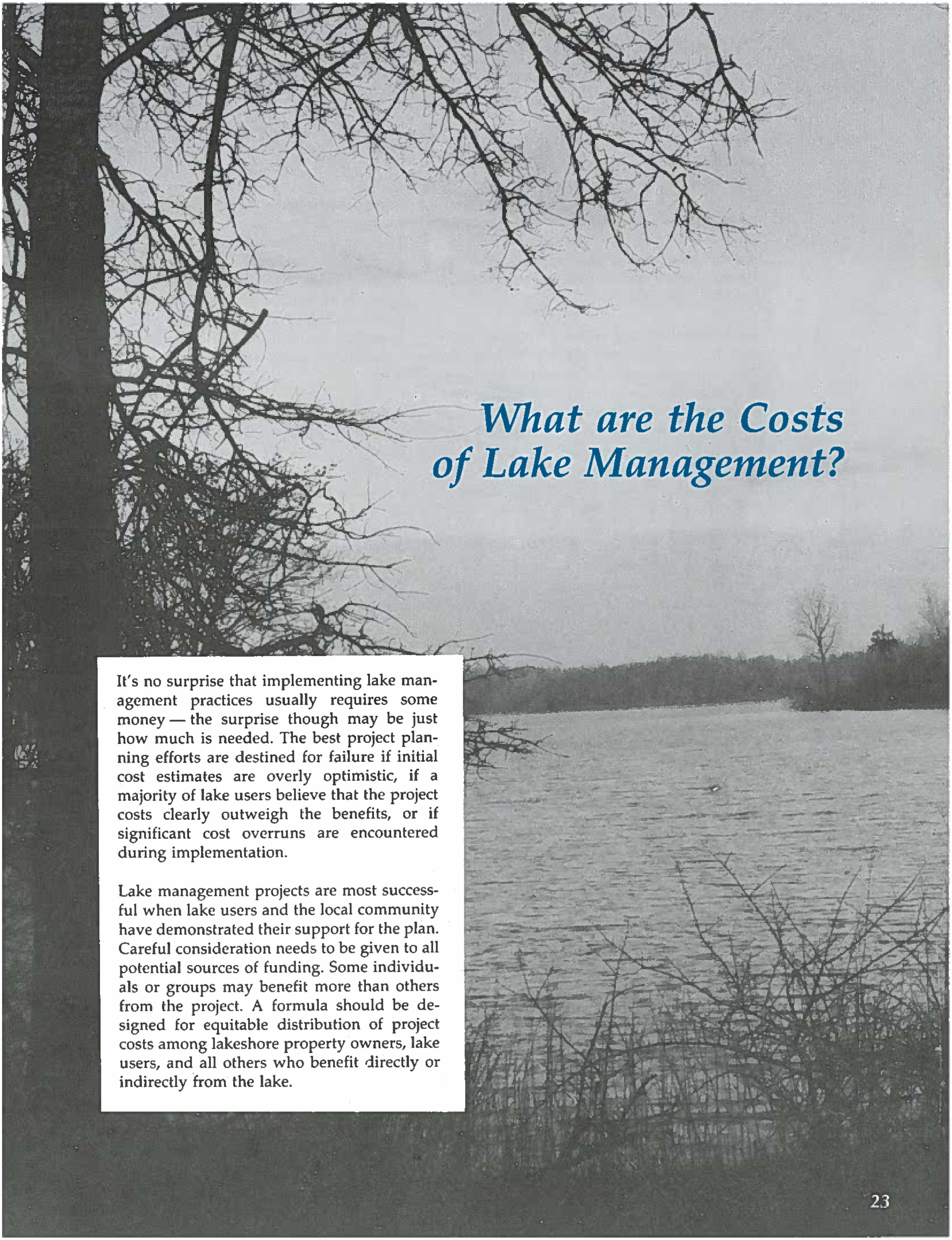
Lake Use Controls

Lake degradation is not limited to a decline in the lake's water quality or aquatic life. It also includes deteriorating recreational opportunities or conflicts among lake users. For example, excessive or improper use of powerboating may cause adverse environmental impacts and interfere with nonmotorized forms of recreation.

It's important to recognize all of a lake's user groups when developing the lake use plan. With a bit of compromise, it may be possible to satisfy most — if not all — lake users. If needed, local governments can adopt regulations which separate conflicting uses to certain areas or to certain times. Such "space" and "time" zoning can actually help reduce the cost of lake management because it eliminates the need to manage **all** of the lake for **all** of the desired uses.

What can an individual property owner do?

- ✔ *reduce soil erosion by seeding or mulching exposed soil; steer runoff to lowlying areas away from the lake*
- ✔ *minimize fertilizer use; stick to only low- or no-phosphorus fertilizer*
- ✔ *don't burn leaves on a slope from which nutrient-rich ash can wash into the lake*
- ✔ *protect shorelines from erosion using vegetation, re-grading, and other "non-structural" approaches*
- ✔ *encourage vegetation growth in shoreland areas — trees and plants help retain the shoreline's scenic beauty, while their roots grip shoreline soils tightly and absorb nutrients before they enter the lake*
- ✔ *avoid piling yard waste near the lake*
- ✔ *pump septic tanks when filled halfway with sludge (average is every 2 to 3 years); avoid flushing strong cleaning agents, paints, and chemicals down the drain*
- ✔ *reduce waste (avoid garbage disposals), conserve water, and use nonphosphate laundry & dish detergents*
- ✔ *talk with your neighbors about working together to protect the lake!*



What are the Costs of Lake Management?

It's no surprise that implementing lake management practices usually requires some money — the surprise though may be just how much is needed. The best project planning efforts are destined for failure if initial cost estimates are overly optimistic, if a majority of lake users believe that the project costs clearly outweigh the benefits, or if significant cost overruns are encountered during implementation.

Lake management projects are most successful when lake users and the local community have demonstrated their support for the plan. Careful consideration needs to be given to all potential sources of funding. Some individuals or groups may benefit more than others from the project. A formula should be designed for equitable distribution of project costs among lakeshore property owners, lake users, and all others who benefit directly or indirectly from the lake.

Estimating Management Costs

The costs of lake management vary depending on the nature and scope of the proposed project. Project costs typically fall into one of the following major categories:

Local organization Basic costs associated with maintaining the planning effort may include newsletters, postage and printing, meeting space and refreshment costs, and financial recordkeeping.

Data collection and technical study Sufficient information about the condition of the lake and watershed may be readily available, but sometimes additional monitoring and investigation are needed. Local and state agencies can help guide these activities and they may be able to provide direct monitoring or analysis assistance. More intensive assessments involve specialized technical knowledge and may warrant the help of a consultant.

Evaluation of management alternatives The complexity of a lake's problems will determine the resources needed to analyze all management options and select a technically-feasible and socially-acceptable plan of action. Again, local and state agencies can help you define options and determine whether specialized consultant assistance is appropriate.

Drawing up project specifications If your project includes major activities such as earthmoving, dredging, or machinery installation, a set of detailed construction specifications may reduce the contractors' bid costs submitted on your project. Good specifications will also help you predict project costs more accurately. Engineering, landscape architecture, or environmental expertise may be needed to develop these specifications.

Direct implementation costs Many lake stewardship activities involve only minor costs which are usually absorbed by each participating individual. Larger-scale projects involving major construction or equipment are often released for competitive bid. Bidding guidelines and review criteria should be carefully spelled out so that only affordable bids from qualified and reputable companies need be accepted. Be wary of "open-ended" contracts which don't specify a minimum level of work or place an upper limit on costs.

Project oversight Smaller projects can be easily coordinated by the local organization. The responsibilities for managing a large project, however, may exceed the time commitment or the expertise of volunteers. In this case, it is advisable to hire at least a part-time project manager who takes policy direction from the organization, but who also has the authority to make day-to-day project decisions.

Contingency fund Even if conservative cost estimates were used in developing the project's budget, it's often a good idea to set aside some reserve funds for unanticipated work. Building a small amount of flexibility into a budget can allow a project to seize unforeseen opportunities discovered during the implementation stage.

Other costs Some lake projects are bitterly debated in the local community. Some people may disagree with the project's management strategy or claim that they did not have an opportunity to participate in the planning process. Lawsuits can result. Also, attempts by project planners to avoid local, state, or federal regulations can lead to costly delays and further divide the community.

Who Will Pay?

It is logical to expect that those benefitting from lake management should pay most of the costs. Private lake organizations that offer no opportunities for public use or access may need to raise a majority of funds from amongst their members. Publicly-owned lakes or lakes with at least some public access will be more likely to be sponsored, at least in part, by a unit of government. When determining how to allocate lake management costs, it's useful to remember that regardless of who owns the lake bottom, the lake water belongs to the state—and hence to everyone. And, public benefits accrue even when private lakes are properly managed because wildlife, groundwater, and downstream waters often are improved.

Local Sources Voluntary lake associations and some formalized lake organizations have raised funds by sponsoring fishing derbies, bake sales, raffles, social functions, or other local events. Members may also agree that each should make a voluntary special contribution. Deed-restricted associations (usually on private lakes) may levy one or several special assessments on their members. Units of government may impose boat launching fees or surcharges, or issue boat registration stickers.

In several recent lake management projects, watershed problems were successfully controlled through direct financial assistance to upstream private landowners. The costs of dredging sediment from the lakes were found to be higher than the amount of money needed to induce upstream farmers (through cost-sharing) to implement soil erosion control practices. By preventing soil erosion at the source, a "win-win" situation resulted. The lake users were able to lower their lake management costs, and the farmers received financial help in conserving fertile topsoil on their lands.

It is often less expensive to prevent lake pollution than it is to restore a degraded lake.

Special Service Area and River Conservancy District organizations can impose special assessments or use their bonding authority to raise funds. Units of government can use their general revenue funds or issue bonds specifically targeted for the lake management project. Local, county, and regional agencies may be able to offset at least part of the project costs through the donation or cost-sharing of personnel.

State and Federal Assistance Various state agencies are in a position to assist lake management efforts. This guidebook's "Where to Go for More Information" section on page 31 highlights the assistance available. The Illinois Environmental Protection Agency provides educational and technical information and can assist in lake monitoring programs. Fisheries management agreements with the Illinois Department of Conservation enable participating lakes to receive fish management expertise and fish stockings from the state.

A milestone for Illinois' lakes was reached in November 1989 when the legislature enacted the Illinois Lake Management Program Act. This important legislation outlines a state-sponsored program for enhanced public education, technical assistance, monitoring and research as well as financial incentives for local lake management activities. At the time of this guidebook's preparation, the program's administrative guidelines were being finalized. Legislative appropriations on an annual basis may be needed to implement this state initiative.

Publicly-owned lakes or lakes with extensive public access may be eligible for cost-share grants under the U.S. Environmental Protection Agency's Clean Lakes Program. Phase I diagnostic/feasibility study grants and Phase II implementation grants under this federal program are administered by the Illinois Environmental Protection Agency and awarded on an annual basis. However, the annual appropriations for this program have been both limited and unpredictable.

Cost-share funding under state and federal agricultural programs have given priority to soil erosion control measures which also result in downstream water quality improvements. The Illinois Department of Agriculture coordinates a number of such programs which can be especially useful for addressing pollutant sources in lake watersheds. However, annual appropriations for these programs also have varied significantly in recent years. In some years, no funds may be available.

What are the Benefits of Lake Management?

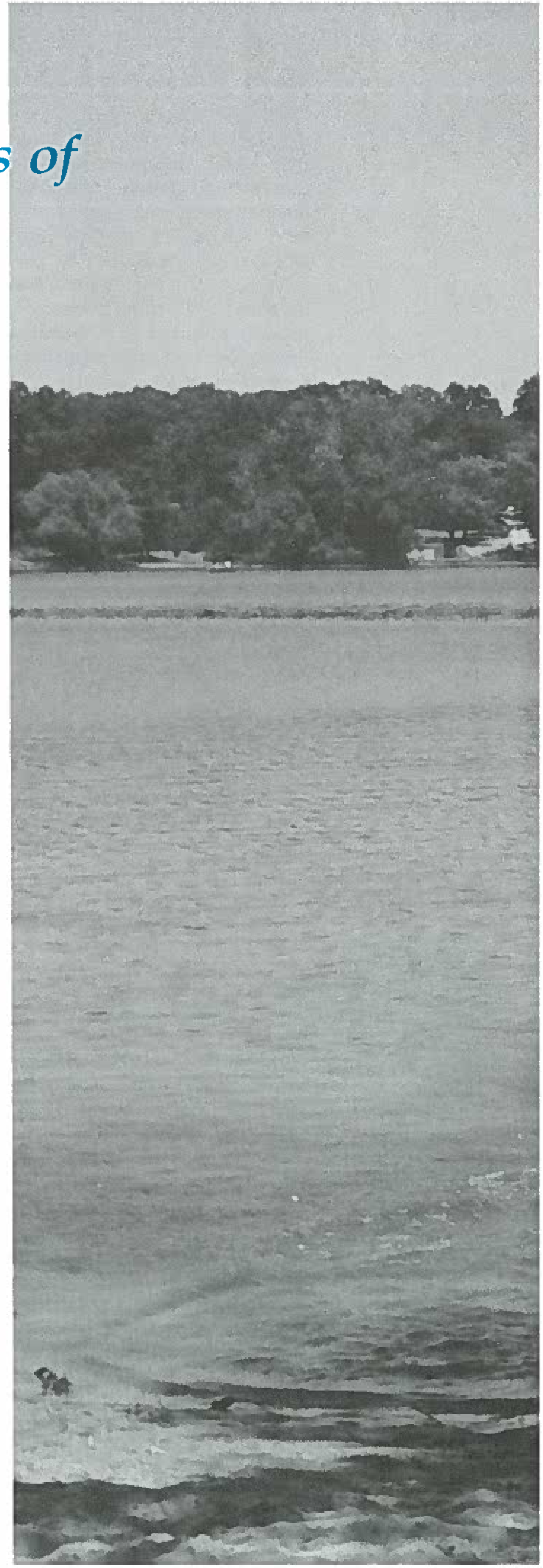
Each lake has its own unique social, environmental, and economic values. Likewise, improvement and protection strategies will vary from lake to lake. Oftentimes, the enhancement of private property values alone can be shown to clearly exceed the cost of lake management. Other economic or environmental benefits, such as increased tourism or improved wildlife habitat, can make the case for lake management even stronger.

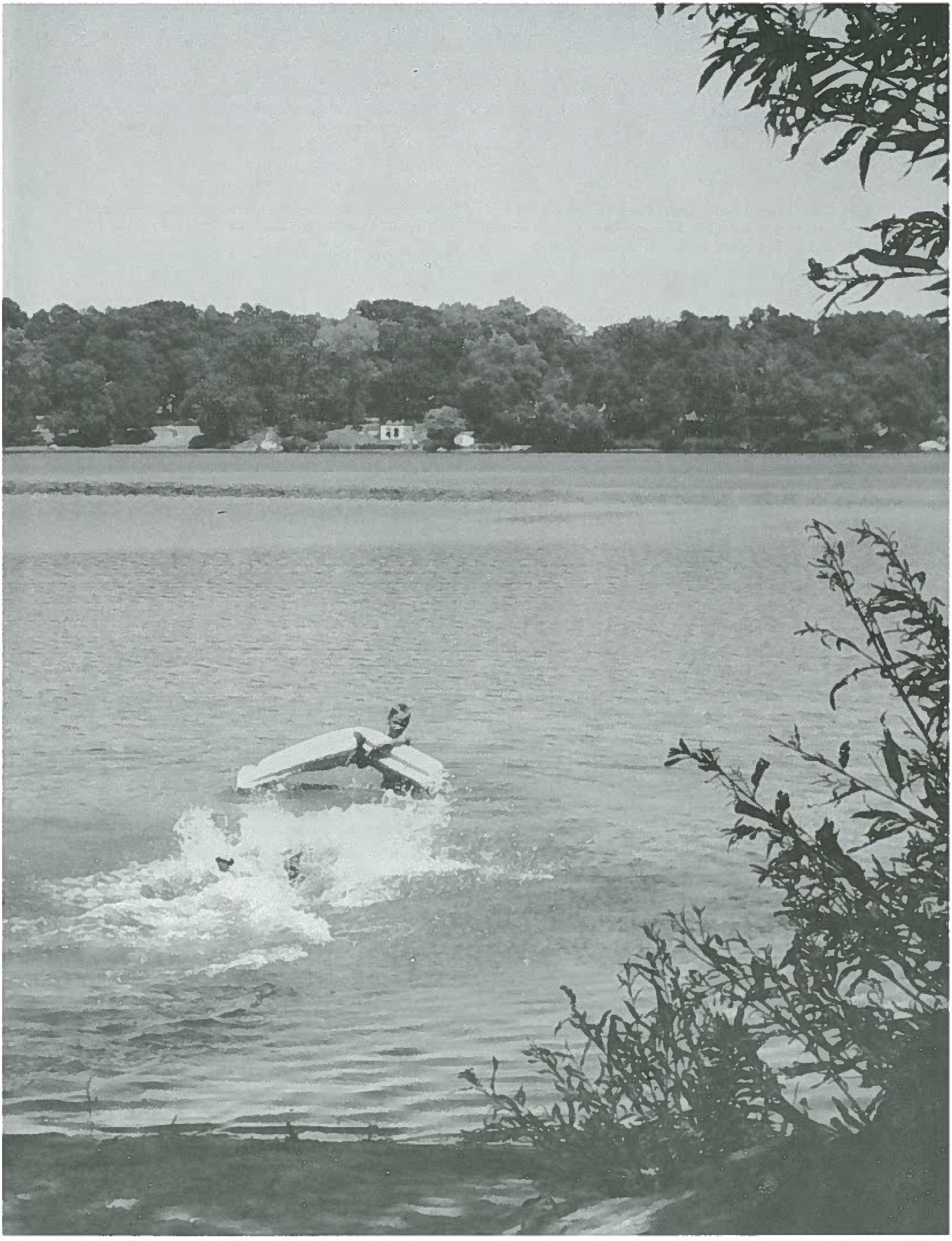
Perhaps the question "What are the benefits of lake management?" should also be studied in the converse: "What are the **costs** of **not** practicing lake management?" In both contexts, you could consider the value of:

- ❑ the lake's recreational opportunities
- ❑ community property values and the local tax base
- ❑ the community's image and the effect on economic growth
- ❑ habitat for game and nongame wildlife
- ❑ uses that consume water such as irrigation and drinking water supply
- ❑ the impact on other surface and groundwater resources
- ❑ kindling a community's spirit of cooperation through a project of widespread interest

Care—and neglect—for a lake are infectious in a local community. Lake management can be initiated by anyone. It all starts with communication and some learning.

Illinois' lakes need a commitment from its citizens. Our lakes are but a borrowed resource from future generations. We have an obligation to ensure the enjoyment and beauty of a healthy lake to those who follow us.





Glossary

Acid Rain: Exceptionally acidic precipitation caused by combustion of fossil fuels and resultant formation of sulfuric and nitric acids in the atmosphere *(p. 9)*.

Alkalinity: A measurement of a lake's capacity to neutralize acidic inputs *(p. 9)*.

Ammonia: A form of nitrogen produced during decomposition of organic matter *(p. 9)*.

Bacterial Contamination: A concentration of bacteria high enough to indicate the presence of animal/human waste products in water *(p. 12)*.

Best Management Practice (BMP): An action or technique which most effectively prevents or minimizes pollution *(p. 20)*.

Bioaccumulation: The accumulation of toxic compounds in the tissue of organisms as a result of repeated intake or exposure *(p. 13)*.

Blue-Green Algae: Algae in the *Cyanophyta* phylum; most often responsible for nuisance algal blooms with scum and odors *(p. 12)*.

Chlorophyll: A pigment which enables plants to carry out photosynthesis *(p. 6)*.

Cultural Eutrophication: Acceleration of the natural aging process in a lake as a result of human activities *(p. 11)*.

Decomposition: Breakdown of organic matter, primarily by bacteria and other microorganisms *(p. 8)*.

Diffusion: Movement of a substance from areas with higher concentrations to areas with lower concentrations *(p. 8)*.

Diversity: A measurement of the number of different plants and animals which are present in an area *(p. 7)*.

Drainage Lake: A lake fed primarily by surface runoff *(p. 3)*.

Ecosystem: A community of plants and animals interacting with each other and their physical/chemical environment *(p. 2)*.

Emergent: A rooted aquatic plant with parts normally extending above the water surface *(p. 6)*.

Epilimnion: The upper, usually warmer, circulated zone of water in a temperature-stratified lake *(p. 5)*.

Eutrophic: Waters which are rich in plant nutrients and capable of supporting high amounts of plant and animal growth *(p. 11)*.

Eutrophication: Lake aging through nutrient enrichment and sedimentation *(p. 11)*.

Evapotranspiration: The release of moisture into the atmosphere from plant leaves and stems *(p. 3)*.

Exotic Species: A non-native plant or animal introduced from another geographic area *(p. 12)*.

Fall Turnover: Complete mixing of a lake in the fall when the water is at a uniform temperature from top to bottom *(p. 5)*.

Fetch: The linear distance across a lake; often used in relation to the maximum distance on a lake across which wind-generated waves can travel *(p. 5)*.

Floating: Aquatic plants with leaves floating on the water surface *(p. 6)*.

Flushing Rate: A mathematical estimate of the amount of time needed for a lake's inflows to completely replace or "flush" the lake's existing water volume *(p. 21)*.

Food Web: The transfer of food energy and materials within a community of interacting organisms *(p. 7)*.

Forage Species: Smaller fish species which serve as a food supply for larger predatory fish *(p. 21)*.

Glacial: Lakes formed by the actions of glaciers *(p. 1)*.

Habitat: The physical, chemical, and biological environment in which an organism lives *(p. 4)*.

Heavy Metal: Natural metallic elements including cadmium, copper, lead, and zinc; heavy metals can be toxic to some organisms *(p. 13)*.

Hydrologic Cycle: The cycling of water between the earth and atmosphere *(p. 3)*.

Hypereutrophic: A lake with extreme levels of nutrients and nuisance plant growth, often as a result of human activities *(p. 11)*.

Hypolimnion: The lower, relatively cold, noncirculated zone of water in a temperature-stratified lake *(p. 5)*.

Impaired: In relation to lake use, a use which has been degraded, damaged, or eliminated due to pollution or other causes *(p. 17)*.

Impervious: Land cover which does not allow water infiltration, such as roadways and rooftops *(p. 4)*.

Impoundment: A standing body of water created by the blockage of a flowing watercourse, as with a berm or dam *(p. 1)*.

In-Lake Management: Lake restoration and protection activities which focus on problems and solutions that exist in the lake itself (as compared to those existing in the watershed) *(p. 18)*.

Lake Stewardship: An attitude that recognizes the importance of lakes, and the need for citizens to assume active responsibility for their care *(p.15)*.

Lake Use Plan: A graphic and/or narrative description of lake use goals *(p. 15)*.

Limnetic Community: The area of open water in a lake *(p. 6)*.

Littoral Community: The relatively shallow areas around a lake's shoreline *(p. 6)*.

Macroinvertebrate: Animals without backbones that are visible to the unaided eye *(p. 6)*.

Macrophyte: Plants that are visible to the unaided eye *(p. 6)*.

Mesotrophic: Waters intermediate in eutrophy between oligotrophic and eutrophic *(p. 11)*.

Metalimnion: The middle layer in a temperature-stratified lake; also referred to as the thermocline *(p. 5)*.

Niche: The conditions important for a plant's or animal's survival *(p. 7)*.

Nitrogen: A nutrient essential for plant growth *(p. 9)*.

Nonpoint Source: Pollution from generalized areas such as stormwater runoff, failing septic systems, and atmospheric fallout *(p. 12)*.

Nutrient Regeneration: Recycling of sediment-bound nutrients back to the overlying lake water *(p. 12)*.

Oligotrophic: Waters with low concentrations of plant nutrients and hence relatively low amounts of plant and animal growth *(p. 11)*.

Oxbow: A generally horseshoe-shaped lake formed when a meandering stream cuts a new and straighter channel *(p. 1)*.

Periphyton: Algae which grow attached to surfaces such as stems, logs, or pier posts *(p. 6)*.

Persistent Organic Compound: Chemicals, often pesticides, which break down very slowly in the environment *(p. 13)*.

pH: A measurement of a lake's acidity *(p. 9)*.

Phosphorus: An essential plant nutrient; its relative abundance in lake environments often controls the amount of plant and animal growth *(p. 8)*.

Photosynthesis: The process by which green plants use sunlight, water, and carbon dioxide to produce oxygen and energy *(p. 6)*.

Phytoplankton: Microscopic plants (algae) that float or are suspended in the water of lakes and rivers *(p. 6)*.

Point Source: Sources of pollution with specific locations such as factories and sewage treatment plants *(p. 12)*.

Ponds: Non-freeflowing bodies of water less than 6 acres in size *(p. 1)*.

Predation: To consume another organism *(p. 7)*.

Productivity: The rate at which organic material and energy is produced and transferred through organisms in an ecosystem *(p. 6)*.

Profundal Community: The area below the limnetic zone where light usually does not penetrate *(p. 6)*.

Protection: Lake management strategies that minimize or prevent additional lake degradation *(p. 18)*.

Reservoir: An impoundment often used for water supply or flood control *(p. 1)*.

Respiration: Oxygen consumption by organisms *(p. 6)*.

Restoration: Lake management strategies which attempt to return a lake to a less-degraded condition *(p. 18)*.

River Conservancy District: Chapter 42, § 383 et seq. (1984) of the Illinois Revised Statutes; authorizes formation of districts for purposes including conservation, recreation, and protection of fish life *(p. 15)*.

Rotenone: A natural chemical compound which is toxic to fish; often used to eradicate rough fish and rehabilitate sport fisheries *(p. 21)*.

Secchi Disc: Named after its Italian inventor Pietro Angelo Secchi, the disc is a black and white round plate used to measure water clarity *(p. 6)*.

Sedimentation: The process by which a lake fills in with organic and inorganic materials *(p. 12)*.

Seepage Lake: Lakes fed primarily by groundwater; sometimes called "spring-fed" *(p. 3)*.

Shoreline Erosion: The erosional loss of shoreline, often from waves and land runoff *(p. 12)*.

Special Service Area: Article 7, Section 7[6] of the Illinois Constitution, and Chapter 120, § 1301 et seq. of the Illinois Revised Statutes; authorizes formation of districts for specialized purposes *(p. 15)*.

Spring Turnover: Complete mixing of a lake in the spring when the water is at a uniform temperature from top to bottom *(p. 4)*.

Stormwater Detention Basin: A waterbody designed to detain stormwater runoff and reduce flooding *(p. 1)*.

Stratify: The division of a lake into water layers with different temperatures *(p. 4)*.

Submergent: Aquatic plants that live and grow entirely below the water surface *(p. 6)*.

Taste and Odor: Problems sometimes encountered at drinking water supply reservoirs; often caused by the presence of blue-green algae or the release of gases from oxygen-deficient lake bottom sediments *(p. 12)*.

Thermocline: The zone in a temperature-stratified lake between the epilimnion and the hypolimnion, also referred to as the metalimnion *(p. 5)*.

Total Suspended Solids: Organic and inorganic materials suspended in the water column *(p. 8)*.

Toxicant: Substances that when present at sufficient concentrations can adversely affect living organisms *(p. 13)*.

Transparency: The clarity of lake water; often measured with a Secchi disc *(p. 6).*

Tributary: Any stream, river, or other watercourse that flows into another waterbody *(p. 3).*

Volatile Suspended Solids: The organic portion of total suspended solids *(p. 8).*

Water Column: Usually refers to the water found in the "open" area of a lake; i.e., an imaginary "column" of water extending from the lake surface down to the lake bottom *(p. 8).*

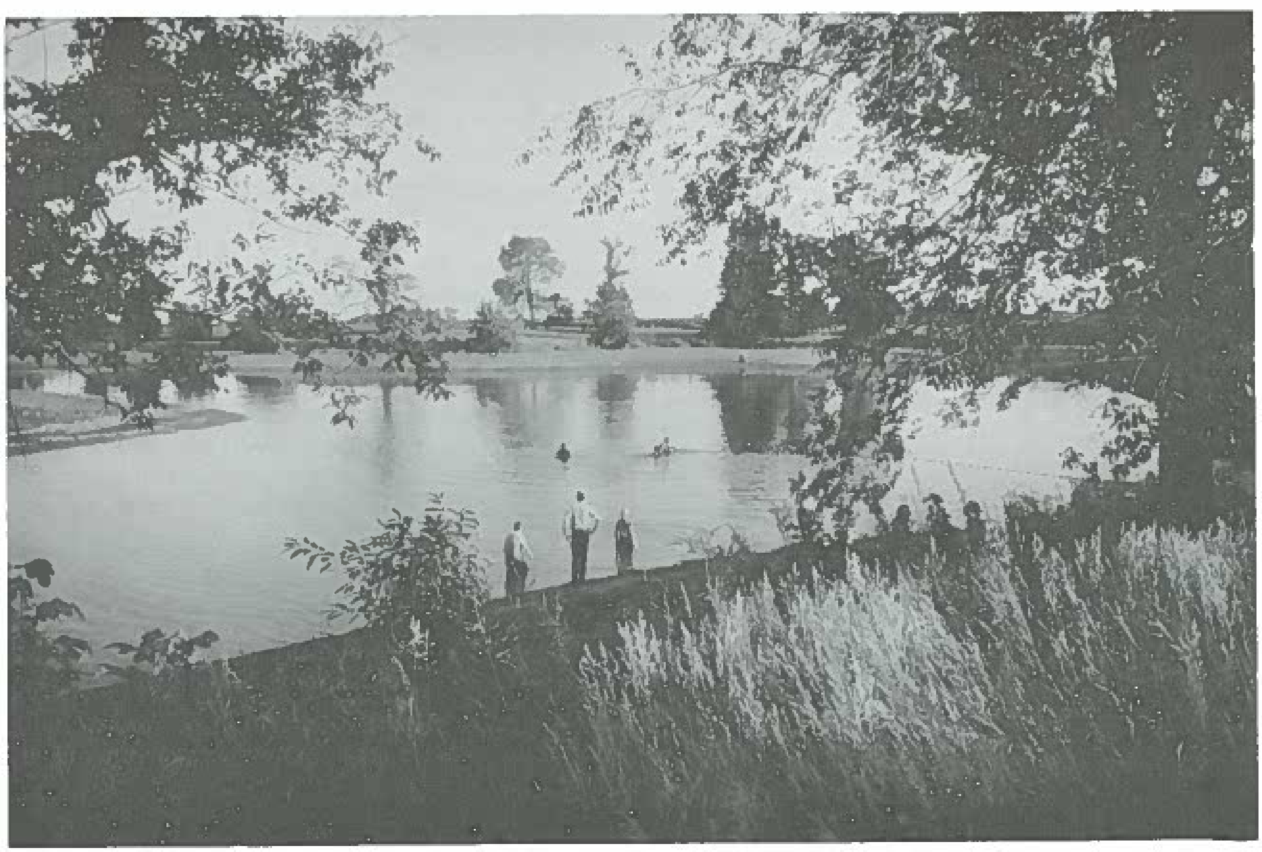
Watershed: The surrounding land area that drains into a lake, stream, or river *(p. 3).*

Watershed Management: Activities conducted in the watershed to reduce transport of soil, nutrients, and other pollutants to groundwater and surface waters *(p. 18).*

Wetlands: Areas which at least periodically have standing water, and which have soil types and plant growth typically found in saturated conditions *(p. 6).*

Winterkill: A die-off of fish caused by low concentrations of dissolved oxygen in a lake covered by ice *(p. 8).*

Zooplankton: Microscopic animals found in the water of lakes and rivers *(p. 6).*



Where to Go for More Information

Organizations

- **County and Regional Planning Commissions;** in northeastern Illinois contact Northeastern Illinois Planning Commission, 222 S. Riverside Plaza, Suite 1800, Chicago, IL, 60606; 312/454-0400.
- **County and Local Health Departments;** in Lake County contact Lake County Health Department, 3010 Grand Avenue, Waukegan, IL, 60085; 708/360-6748.
- **Illinois Environmental Protection Agency,** Division of Water Pollution Control, P.O. Box 19276, Springfield, IL, 62794-9276; 217/782-3362. Regional offices also in Marion (618/997-4392), Maywood (708/531-5900), and Springfield (217/786-6892).
- **Illinois Department of Natural Resources,** Division of Fisheries, 600 N. Grand Ave. West, Suite 5, Springfield, IL, 62701-1787; 217/782-6424. Regional offices in Alton (618/462-1181), Benton (618/435-8138), Champaign (217/333-5773), Spring Grove (815/675-2385), Sterling (815/625-2968), and Yorkville (708/553-6680).
- **Illinois Department of Agriculture,** Division of Natural Resources, State Fairgrounds, P.O. Box 19281, Springfield, IL, 62794-9281; 217/782-6297.
- **Soil & Water Conservation Districts** located in most counties throughout the state.
- **U.S. Environmental Protection Agency,** Region 5 - Water Division, 77 W. Jackson Blvd., Chicago, IL, 60604; 312/353-2147.
- **U.S. Fish and Wildlife Service,** 1000 Hart Rd., Suite 180, Barrington, IL, 60010; 708/381-2253. Offices also in Marion (618/997-5491) and Rock Island (309/793-5800).
- **Illinois Lake Management Association,** P.O. Box 20655, Springfield, IL, 62708; 217/544-4561.
- **North American Lake Management Society,** P.O. Box 5443, 610 Walnut St., WARF Bldg. Room 1036, Madison, WI, 53705-5443; 608/233-2836.
- **Association of Illinois Soil and Water Conservation Districts,** 40 Aldoff Ln., Suite 2, Springfield, IL, 62703; 217/529-7788.

Publications

- ***Management of Small Lakes and Ponds in Illinois.*** 1986. Illinois Department of Natural Resources, Division of Fisheries.
- ***Lake Notes.*** A series of "fact sheet" publications that address issues confronting Illinois' Lake resources. Illinois Environmental Protection Agency.
- ***The Lake and Reservoir Restoration Guidance Manual.*** 1990. North American Lake Management Society.
- ***Monitoring Lake and Reservoir Restoration.*** 1990. North American Lake Management Society.
- ***Your Lake & You.*** 1995. North American Lake Management Society.
- ***Lake Management Publications.*** 1988. Illinois Lake Management Association.
- ***Directory of Illinois' Lake Associations and Organizational Lakes.*** 1990. Illinois Lake Management Association.
- ***Restoration and Management of Lakes and Reservoirs.*** 1993 (2nd Edition). G. Dennis Cooke, Eugene B. Welch, Spencer A. Peterson, and Peter R. Newroth. Lewis Publishers/CRC Press, 2000 Corporate Blvd. N.W., Boca Raton, FL, 33431; or check your local library (ISBN 0-87371-397-4).
- ***Limnology.*** 1983 (2nd edition). Robert G. Wetzel. Saunders College Publishing, Holt, Rinehart, and Winston, Inc., Orlando, FL, 32887; or check your local library (ISBN 0-03-057913-9).

Notes