X. Lake Restoration: What's Involved?

At some point a lake association may need additional help to effectively manage a serious water quality problem. In some instances, responsible management and preventive action may not be enough. Lake restoration, a more complex challenge, involves restoring a lake to a previous – and presumably better – state.

The financial resources of the association and the willingness of its members to participate are critical considerations in making a decision to pursue lake restoration. Lake restoration is not just a yearly process of adding chemicals to an affected lake. Restoration is complex and expensive, usually requiring financial capabilities and statutory authority beyond those available to a lake association.

Four initial steps in considering lake restoration should help prepare an association to decide how – or whether – to proceed.

1. Re-evaluate Goals

Before beginning lake restoration efforts, the lake association should complete a re-evaluation of the mission, including an assessment of the following:

- What are the goals of the association?
- What is the level of commitment of the members?
- What are the financial resources of the association?
- What does the available information tell us about the lake and its watershed?

2. Pursue a Higher Level of Organization

Sometimes a thorough search will reveal that data and possibly reports already exist for a lake. Check with the state natural resource agencies, county, city or township, watershed management organization, or nearby college. Some of this data is available on the web. It may be wise at this time to seek professional advice both to evaluate the data collected and to suggest how the association should proceed. Depending on the answers to these questions, a higher level of organization may be necessary to carry out the lake management process.

A variety of local governmental units exists that can help with lake and watershed management, including lake improvement districts, sanitary districts, watershed districts, and soil and water conservation districts. In addition, cities and counties may play a very important role either directly by taking the responsibility for this work, or indirectly by sponsoring or assisting in the establishment of a special-purpose local governing unit.

Once the association has decided that a higher level of organization may be necessary to manage the lake, a first step should be to contact local authorities (city and county) to determine whether any organization already exists to fulfill this task. If these local governing units exist, the lake association should seek to work with them closely, since they will likely have the statutory authority and serve as an additional source of funding to carry out a more complex study or project. Consultation with professionals at the MPCA and MDNR may also be helpful at this point.

3. Explore Financing Sources

Funding cannot be addressed in depth in this publication because the outside sources of funds, such as state and federal aid, are continually changing. It is important, however, to distinguish between the funds available to lake associations and those available to organizations such as lake improvement districts. The primary sources of funding for lake associations are generally voluntary contributions and fund-raisers. In contrast, such organizations as lake improvement districts and watershed districts have taxing authority and also are considered "grant-eligible bodies." This simply means that if state or federal funds are available for lake and watershed work, these organizations are eligible to apply for these funds. Among other recognized grant-eligible bodies are cities, counties, and regional planning agencies.

Consult with local and state officials, such as the MPCA and MDNR, to identify the current status of these programs and identify other programs that may be available for cost-sharing of projects. The list of funding sources and web sites at the end of this publication will be helpful.

4. Conduct a Lake Study

Before any lake restoration can take place, the lake and its watershed should be studied in detail. Such studies are often termed “diagnostic-feasibility” or “feasibility” studies. The study’s purpose is to accurately characterize the chemistry, biology, and hydrology of the lake and determine the amount and character of runoff from its watershed. Only after such a study is conducted can an assessment be made as to which restorative techniques, if any, may improve the quality of the lake. The study diagnoses the lakes problems and causes, much as a medical doctor diagnoses health problems. Typical elements of a diagnostic-feasibility study include the following:

In the lake

- Water chemistry, in particular phosphorus and nitrogen levels
- Dissolved oxygen and temperature
- Secchi disk transparency
- Chlorophyll a
- Phytoplankton (algae) and zooplankton identification
- Macrophyte (large aquatic plants) study
- Sediment characteristics
- Fish population

In the watershed

- Inlet and outlet flow
- Inlet water chemistry
- Land use – past, present, and future
- Soil erosion inventory
- Precipitation
- Vegetative cover
- Wastewater disposal system survey

Contact the MPCA or the Freshwater Society for information on conducting feasibility studies.

5. Prepare an Implementation Plan

After a diagnostic-feasibility study is conducted, information is available to prepare an implementation plan. The diagnostic study identifies sources and the magnitude of pollutants. An implementation plan is prepared to address prioritizing and reducing the sources of pollutants. Examples of implementation activities are included in Chapter XI.

XI. Lake Restoration: What Can Be Done?

Lake restoration includes both in-lake treatment techniques and watershed techniques for the purpose of "restoring" a lake. It is critical to remember, though, that the watershed is usually the key to helping a lake recover its long-range vitality. The term "restoration" is probably a misnomer. A lake can never be completely restored to its original complex physical, chemical, and biological conditions. However, lake conditions can be improved.

The selection of restoration techniques will vary from lake to lake depending on results from the feasibility study and available funding. In general, a well-designed restoration plan will include at least some work in the watershed to stem the flow of nutrients and sediment to the lake. In fact, in-lake techniques may not be necessary since the lake may filter itself over time if external nutrient sources are reduced. In-lake techniques, though, may speed up the natural process.

It is important to remember that most if not all of the techniques mentioned require a permit and in some cases will require working directly with MPCA, MDNR, watershed district, or other government agencies.

In-Lake Techniques

In-lake techniques are those that are conducted in the lake itself and may include physical, chemical, and biological measures.

1. Physical Measures

Aeration and circulation are techniques that involve moving the water and adding oxygen, which increases dissolved oxygen levels. This may prevent fish kills and create a larger habitat for fish and microscopic animal communities. Aeration can also slow the tapping of phosphorus from bottom sediments. Results, however, are not always predictable.

Dredging removes sediment, which can be a major source of phosphorus in the water and can hinder recreational use of the lake. Sediment removal, however, is costly. Disposal of the dredged sediment is often a problem.

Dilution and flushing introduces nutrient-poor water and flushes out nutrient-rich water, decreasing the concentration of pollutants and thus the potential for algal growth.

On-shore treatment techniques involve pumping water on-shore, water treatment, and then allowing the treated water to re-enter the lake. Options for such treatment include artificial waterfalls for aeration and using the water to irrigate and fertilize field crops or wetlands, which removes nutrients from the water before it drains back into the lake.

Drawdown lowers water in an impoundment and can sometimes control weeds by exposing them to drying or freezing. Exposing the littoral zone may also result in shrinkage of soft muck, thus deepening the lake without expensive dredging. This process may also cause erosion of the shoreline. Drawdown can be useful in encouraging growth of plants beneficial to waterfowl.

Harvesting removes nutrients from the system by eliminating algae, plants, and fish. In eutrophic lakes, however, only relatively small amounts of nutrients are removed by mechanical harvesting. It is primarily considered a cosmetic improvement, like mowing a lawn.

Bottom sealing cuts off sediment as a potential source of nutrients through the application of such chemicals as alum (aluminum sulfate) or calcium nitrate.

Shading uses a dye to color the water and prevent penetration of light into the water column. The light limitation may inhibit the growth of plants and algae. Dye must be reapplied periodically. This method is used mainly in ponds or very small lakes.

2. Chemical Measures

Algal toxins (algaecides and barley straw) are a means of quickly and briefly controlling severe nuisances, such as algal blooms, that interfere with recreation. The treatment does not remove nutrients from the lake, and repeated treatment may be necessary in the same season. After repeated treatments, chemicals and metals such as copper may build up in the sediments and fish.

Algaecides, pesticides that are effective on algae, are usually broad-spectrum, killing many plants and animals in the lake as well as the algae. Use of the water by humans is restricted for a time following the application of such chemicals.

Barley straw has been used to treat small lakes and ponds. Natural toxins in the straw inhibit the growth of algae in the water. The straw is placed in netting bags and staked in multiple locations around the lake.

Application of algal toxins, treats the symptoms inadequately, does little to solve the problem, and may lead to a buildup of undesirable chemicals and metals in the lake. These techniques are seldom incorporated into a comprehensive lake restoration plan and should be considered only for short-term treatment of symptoms. However, in some cases these procedures may be the only feasible approach.

Direct nutrient control reduces internal loading of phosphorus by binding the phosphorus in the sediments. Chemicals used for this process include ferric chloride or, more commonly, alum or calcium nitrate. These chemicals are expensive to apply and their effect is limited in duration.

Plant control uses herbicides (plant-killing chemicals) toxic either to a broad group of plants or to specific plants, but not to other non-targeted plants or animals. This is a temporary treatment that must be repeated annually or more frequently.

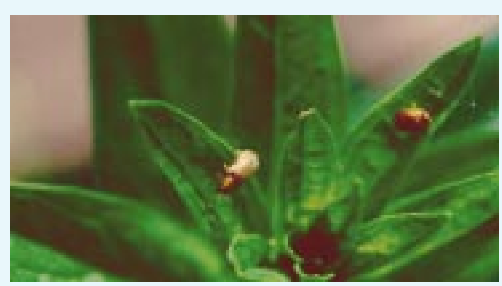
Fish control uses pesticides such as rotenone that are toxic to fish. These toxins are usually specific for fish. This may be conducted by the MDNR when a lake has become dominated by undesirable fish. Restocking with game fish generally follows.

3. Biological Measures

Biological controls represent a relatively new effort to control the growth of algae and weeds through manipulation of the lake's ecological inter-connections. Although great potential exists in this area, the ecology of lakes is not yet sufficiently understood for such approaches to be used routinely.

Biomanipulation is the term used for a restoration technique that shows some promise. In this technique, attempts are made to adjust the fish species composition of a lake in order to encourage the growth of the **zooplankton** population. If successful, these tiny animals are able to reduce algae by eating them. This technique is often coupled with aeration, which creates a larger zone for the zooplankton, and the destruction of the existing fish population with a subsequent restocking of fish species that do not generally feed on zooplankton, such as largemouth bass.

Introduction of control species has been used to control exotic plant species. One example of this is use of the Galerucella beetle to control purple loosestrife. The beetles feed on the leaves and affect the growth and seed production of the plants. Similarly, a species of weevil feeds on *Eurasian watermilfoil* and is a potential control species for introduction to lakes to control this nuisance plant.



Galerucella beetle feeds on purple loosestrife.

Watershed Management Techniques

Watershed management techniques focus on best management practices and include on-site best management practices, off-site techniques, and non-structural practices.

A lake is fed by its watershed, so it is very important that restoration efforts also address the surrounding land areas. In the recent past, visual surveys were relied upon to identify obvious problems like gullies or feedlots. Today, computerized pollution models are available to identify the less obvious but important problems. Once problem spots are inventoried, it is possible to identify the best management practices necessary to protect the lake. Best management practices are the most effective and practical means of preventing and abating non-point polluted runoff. These management practices can stop pollutants at the site or at strategic points in the watershed.

1. On-site Best Management Practices

On-site BMPs are those that take place at the site where the pollution originated.

a. Agricultural Pollutants

BMPs for controlling agricultural pollutants are directed at keeping soil and nutrients on farms and out of our lakes, where they are pollutants. Practices include:

- Conservation tillage
- Crop rotations
- Manure management
- Grassed waterways
- Terracing
- Contour farming
- Fencing
- Fertilizer and pesticide management
- Animal feedlot runoff controls
- Rotational grazing
- Nutrient management
- Filter strips and vegetated buffers
- Water and sediment control basin
- Livestock exclusion (fencing out of waterways and lakes)

b. Urban Pollutants

Best management practices for controlling urban pollution are directed at controlling runoff from streets, parking lots, and other paved areas from which leaves, chemicals, oils, sediment, and nutrients are washed into lakes. Practices include:

- Detention and infiltration basins to collect runoff from paved areas
- Yard waste cleanup
- Storm sewer and catch basins cleaning
- Rain gardens or native plantings
- Catch basin filters
- In-line stormwater treatment devices
- Pet waste clean up
- Lawn aeration
- Impervious surface reduction or disconnection
- Low impact development
- Septic system upgrades for rural homes

c. Erosion and Sedimentation

Best management practices for controlling erosion from construction sites are directed at keeping the exposed soil and attached pollutants out of lakes. Practices include:

- Planning, implementing, and maintaining erosion control practices on construction sites
- Limiting the area exposed and stabilizing it with surface cover
- Directing runoff to temporary or permanent holding areas to prevent sediment and other pollutants from leaving the site
- Inspection and reporting program

Watershed management techniques rely on stewardship and cooperation of all individuals in a lake watershed. Frequently, individuals are unaware that their activities are causing water problems. They may be quite willing to take corrective action if they understand what to do and why. Education is an important part of watershed management – it can encourage land use practices that will preserve and protect our lakes.

RON WINCH

2. Off-site Watershed Management Techniques

Off-site watershed management techniques are best management practices that intercept pollutants between their origin and the lake.

a. Wetland Protection

Wetlands should not be altered or drained. Wetlands are now commonly recognized as serving a vital role not only for fish and wildlife, but also for pollution filtration and flood control. When runoff water carrying nutrients and sediment circulates through a wetland, the sediment settles and the plants take up and use the nutrients before they can run into a lake.

b. Wetland Restoration

In some watersheds it may be valuable to re-establish wetlands that have been drained in the past or even create new wetlands to treat water before it enters the lake. Such projects will require specific engineering plans, funds to buy the land or to purchase an easement, and an organization to manage the wetland.

c. Stormwater treatment ponds

Stormwater treatment ponds are designed and constructed specifically to allow water carrying a suspended load of fine particles to reduce speed and allow the solid particles and nutrients to settle out.

d. Alum injection

Alum injection has been used to remove phosphorus from the water (e.g. storm water) before it enters the lake. An physical alum injection device is constructed and a specific dose of alum is injected into the water as it flows by to bind and remove the phosphorus. From there the water often flows to a sedimentation basin to allow the alum to settle prior to entering the lake. This basin may need to be periodically dredged to remove accumulated sediment.

The capacity of a wetland or sediment basin to handle pollutants is limited. If either is overburdened by sediment and nutrients, it may not improve water quality and may even fill in. That is why on-site best management practices must be used in conjunction with the off-site management techniques to maximize lake protection.

3. Non-structural Best Management Practices

a. Education efforts

In the long term, education of the general public, lake association members, local officials, and children will be helpful to improve the way we manage our lakes and land. Some examples of education efforts include:

- Storm drain marking
- Newsletters
- Newspaper articles
- Workshops, conferences, and presentations
- Events such as watershed festivals
- Web sites

b. Ordinances and regulations

Often a combination of ordinances and education is needed to positively change land management practices. Whether local, state, or federal, these ordinances or regulations set minimum standards for land and water protection. Ordinances may include:

- Erosion and sediment control
- Stormwater management
- Vegetated buffers
- Shoreland setbacks
- Feedlot regulations
- Limitations on the use of phosphorus in fertilizers

c. Conservation Easements and Land Protection programs

Sometimes the best way to prevent a site from continuing to contribute pollutants to a lake, or increase pollutant loading due to a change in land use, is to take the land out of use. Land protections programs such as easements and purchases can permanently maintain the land in a non-degrading land use. These programs should target the ecologically high priority sites and those most beneficial to the lake, such as undeveloped shoreline. For new developments or redevelopments, encourage use of plans that minimize pollutant loading by limiting impervious surfaces, keeping open space, reducing runoff, etc.

- Perpetual or long-term easements or set-aside programs
- Purchase or transfer of development rights (PDR & TDR) programs
- Low impact development

XII. What Are the Benefits of Lake Protection?

Clean Water – and More

The benefits of lake management differ from community to community. Some benefits may spread across more than one generation. For these reasons, the actual value of a lake management project can't be calculated.

Many communities were built around a lake or mill pond. The visual quality of these communities is highly dependent on the condition of the water body and the lakeshore. The natural beauty of the lake is part of the quality of life for lakeshore property owners and the entire community.

A properly managed lake provides recreational opportunities for fishing, swimming, and boating. A lake and its adjacent wetlands provide habitat for game fish and other wildlife. The quality of a lake directly affects community property values and, therefore, the local tax base. A study conducted on northern Minnesota Lakes confirmed that lake water quality affects property values. For a one meter decrease in water clarity, prices were reduced up to $594 per shoreline foot. For a one meter increase in clarity, prices increased up to $423 per shoreline foot (Krysel et. al., 2002). Studies conducted elsewhere in the country show similar results. This can be a significant financial loss or gain to a community as well as the individual homeowner.

Effective, long-term lake management is a complex undertaking that must deal with sociology as well as biology. It is an exercise in compromise, balancing the needs of nature with the needs of civilization. Lake management requires choices: between sandy bottoms for swimmers and weed beds for fishermen; between groomed lawns and control of nutrients and pesticides in the lake; and, among the needs of agriculture, industry, taxpayers and the tourist bureau.

The future of some lakes is better left to nature. The natural process by which lakes evolve into marshes and wetlands creates much needed wildlife habitat. The decision to restore or protect a particular lake must be based on a thorough study of the lake, its watershed, and the commitment of time and money necessary for long-term management.

Protection of a lake may be as simple as the care exercised by lake property owners and others who use and enjoy the lake. Lake restoration, on the other hand, can be a complex, expensive, time-consuming, and often frustrating effort.

The reasons for undertaking lake management programs are as varied as the concerns of the citizens who undertake them. Each lake is unique, and each management process is as complex as the concerns it addresses. But the ecological, social, and economic benefits of a well-managed lake can span generations. And a commitment to stewardship of our water resources makes us responsible for protecting and preserving our lakes – not only for ourselves, but for those who follow as well.

CATHERINE PECHACEK

GLOSSARY

Acid rain: rain with a pH below the normal range of 5.0 – 5.6 due to sulfur sulfuric and nitrogen nitric acids, which, mixing with cloud moisture can make lakes devoid of fish Atmospheric deposition of sulfuric acid may increase mercury contamination of fish even when the lake is not acidified.

Algal bloom: an unusual or excessive abundance of algae

Alkalinity: capacity of a lake water to neutralize acid

Best Management Practices (BMPs): actions taken or structures installed to prevent or reduce nonpoint source pollution

Bioaccumulation: build-up of toxic substances in fish flesh, may be passed on to humans eating the fish

Biomanipulation: adjusting the fish species composition in a lake as a restoration technique

Catch basin: a structure with a surface grate inlet, installed along the curbs to capture stormwater runoff and deliver it to the stormsewer system

Cultural eutrophication: is the accelerated aging of a lake as a result of human activities

Dimictic: lakes that thermally stratify and mix (turnover) once in spring and fall.

Dissolved oxygen: amount of oxygen in water

Ecoregion: areas of relative homogeneity, EPA ecoregions have been defined for Minnesota based on land use, soils, landform, and potential natural vegetation

Ecosystem: a community of interaction among animals, plants, and microorganisms, and the physical and chemical environment in which they live

Epilimnion: the upper layer of a lake characterized by warmer and lighter water

Erosion: erosion is the wearing away of land surfaces due to water, wind, or ice action

Eutrophication: the aging process by which lakes are fertilized with nutrients

Eutrophic lake: a nutrient-rich lake, usually shallow, “green” and with limited oxygen in the bottom layer of water

Fall turnover: cooling surface waters, activated by wind action, sink to mix with lower levels of water, all water is now at the same temperature

Hydraulic Residence Time: the amount of time it takes to exchange the entire volume of lake water with new inflowing water

Hypolimnion: the bottom layer of lake water during the summer months, much denser and colder than the water in the upper two layers

Internal loading: release of pollutants, such as phosphorus, from the lake sediments and into the water

Lake management: a process that involves study, assessment of problems, and decisions on how to maintain a lake as a thriving ecosystem

Lake restoration: actions directed toward improving the quality of a lake

Lake stewardship: an attitude that recognizes the vulnerability of lakes and the need for citizens, both individually and collectively, to assume responsibility for lake care

Limnetic community: the area of open water in a lake providing the habitat for phytoplankton, zooplankton, and fish

Littoral community: the shallow areas around a lake’s shoreline, dominated by aquatic plants which produce oxygen and provide food and shelter for animal life

Mesotrophic lake: midway in nutrient levels between the eutrophic and oligotrophic lakes

Natural eutrophication: will very gradually change the character of a lake over thousands of years

Nonpoint source: nutrients and pollution sources not discharged from a single point: e.g. runoff from agricultural fields or feedlots

Oligotrophic lake: a relatively nutrient- poor lake, clear and deep with bottom waters high in dissolved oxygen

pH scale: a measure of acidity or alkalinity based on the concentration of hydrogen ions, ranges from 1 – 14. Anything below 7 is acidic and above 7 is alkaline.

Photosynthesis: process by which green plants produce oxygen from sunlight, water, and carbon dioxide

Phytoplankton: algae – the base of the lake’s food chain, also produces oxygen

Piscivorous fish: fish that feed on other fish

Point sources: specific sources of nutrient or polluted discharge to a lake: e.g. wastewater treatment plant discharges

Polymictic: a lake that does not thermally stratify in the summer, but tends to mix periodically throughout summer via wind and wave action

Profundal community: the area below the limnetic zone where light does not penetrate This area roughly corresponds to the hypolimnion layer of water and is home to organisms that break down or consume organic matter.

Respiration: oxygen consumption by living plants and animals

Runoff: water that flows off the land after a precipitation event or snowmelt

Secchi disk: a device measuring the depth of light penetration in water

Sedimentation: the deposition of soils in lakes and waterways, part of the natural aging process that makes lakes shallower, but can be greatly accelerated by human activities

Spring turnover: warming surface water sinks to mix with deeper water. At this time of year all water is the same temperature.

Storm sewer: a system of pipes that carry water, that flows off of the land, to a downstream water resource

Stormwater: water resulting from a precipitation event

Trophic status: the level of growth or productivity of a lake as measured by phosphorus content, algae abundance, and depth of light penetration

Transpiration: the passing of water vapor into the atmosphere from living plants

Thermocline: during summertime, the middle layer of a lake

Turbidity: particles in solution (e.g. soil or algae) which scatter light and reduce transparency

Water density: water is most dense at 39º F (4º C) and expands (becomes less dense) at both higher and lower temperatures

Watershed: the surrounding land area that drains into a lake, river, or river system

Zooplankton: microscopic animals living in the water

Appendix

Checklist of Stewardship Practices for Lake Protection

Use this checklist to test how you are doing as a lake steward. Check the practices you use. Review those that you don't use and think about adding them. Periodically review this list to see if you have improved as a lake steward.

Boating and other Recreation

____ Use a 4-cycle boat engine or a non-motorized boat.

____ Use lead-free weights and tackle.

____ Limit clearing of shoreline to only the area needed for access and recreation.

____ Adjust boat speed to reduce wake and minimize wave damage to shore.

____ Stop washing dishes, laundry, and self in lake while camping.

____ Properly dispose of wastewater when boating and ice fishing.

Runoff Reduction

____ Reduce paved areas (e.g. use paving stones rather than concrete).

____ Sweep driveways and walks instead of washing them with water.

____ Redirect downspouts away from paved areas.

____ Drain your sump pump through the lawn rather than directly out to the street.

____ Re-establish or preserve a vegetative buffer along the shore and on top of bluffs.

____ Do not remove ice ridges that form along the shoreline.

Yard Care

____ Use 0 phosphorus fertilizer unless soil test results show phosphorus is needed.

____ Don not use fertilizers within 10 feet of a lake, wetland, stream, or storm drain.

____ Sweep fertilizer, grass clippings and soil off of your driveway and the street.

____ Replace lawn with native trees, shrubs, grasses, sedges, and wildflowers.

____ Pick up pet waste.

____ Minimize use of salt and sand on walkways and driveways during the winter.

Exotic Species

____ Learn how to identify and control exotic species.

____ Inspect boats and equipment for exotics before taking them to other waters.

____ Never dump bait buckets or live fish from one water body into another.

Septic Systems

____ Eliminate use of garbage disposal when using an on-site septic system.

____ Pump septic tank annually, through the manhole, not through inspection port.

____ Don't use septic tank additives.

References and Additional Sources of Information

Heiskary, S., R. Anhorn, T. Noonan, R. Norrgard, J. Solstad, and M. Zabel. 1994. Minnesota Lake and Watershed Data Collection Manual. Environmental Quality Board-Lakes Task Force, Data and Information Committee. Minnesota Lakes Association.

Henderson, C., C. Dindorf and F. Rozumalski. 1999. Lakescaping for Wildlife and Water Quality. Minnesota's Bookstore, St. Paul, MN.

Krysel, C., Marsh-Boyer, E., Parson, C. and P. Welle. 2002. Lakeshore Property Values and Water Quality: Evidence From Property Sales in the Mississippi Headwaters Region. Bemidji State University and Minnesota Lakes Association.

Lakes Coordinating Committee. 1996. Developing a Lake Management Plan. Minnesota Environmental Quality Board Lakes Task Force.

McComas, S. 2002. Lake and Pond Management Guidebook. Lewis Publishers.

Minnesota Department of Natural Resources. 2002. Restore Your Shore Cd-Rom. www.minnesotasbookstore.com

Minnesota Extension Service. 1997. Septic System Owner's Guide. Publication number PC-6583-S.

Minnesota Extension Service. 1998. Protecting Our Waters: Shoreland Best Management Practices. Publication number MI-6946.

Minnesota Lakes Association & University of Minnesota Center for Urban and Regional Affairs. 2000. Sustainable Lakes Planning Workbook: A Lake Management Model. Available through MLA as hard copy or on their web site: www.mnlakes.org.

Minnesota Pollution Control Agency. 2002. Acid Rain in Minnesota. Air Quality Fact Sheet #1.11, January 2002.

Web Sites

Board of Soil and Water Resources:
www.bwsr.state.mn.us

Environmental Protection Agency:
www.epa.gov

Water: www.epa.gov/ebtpages/water.html
Surf Your Watershed: www.epa.gov/surf3
Volunteer Monitoring:
www.epa.gov/owow/monitoring/vol.html

Freshwater Society: www.freshwater.org

MN Shoreland Management Resource Guide:
www.shorelandmanagement.org

Minnesota Lakes Association: www.mnlakes.org
Sustainable Lakes Workbook

Minnesota Pollution Control Agency:
www.pca.state.mn.us/water/

Environmental Data:
www.pca.state.mn.us/data/eda/
Volunteer Surface Water Monitoring Guide:
www.pca.state.mn.us/water/monitoring-guide.html

Minnesota Department of Natural Resources:
www.dnr.state.mn.us

Lake data:
www.dnr.state.mn.us/lakefind/index.html
Shoreland management:
www.dnr.state.mn.us/shorelandmgmt/index.html

Minnesota Extension Service:
www.extension.umn.edu

Understanding your Septic System:
www.extension.umn.edu/distribution/naturalresources/dd7439.html
Shoreland Best Management Practices:
www.extension.umn.edu/distribution/naturalresources/DD6946.html

Minnesota Sea Grant-Exotic Species Resources:
www.seagrant.umn.edu/exotics/index.html

Natural Resources Research Institute:
Understanding Lake Ecology:
www.wow.nrri.umn.edu/wow/under/primer

North American Lake Management Society:
www.nalms.org

Rivers Council of Minnesota: www.riversmn.org

University of Minnesota Water Resources Center:
www.wrc.coafes.umn.edu

Organizations

Need more information or assistance? Here are some organizations that can help.

Board of Water and Soil Resources (BWSR), One West Water Street, Suite #200, St. Paul, MN 55107. (651) 297-3767.

Freshwater Society, 2500 Shadywood Road, Excelsior, Minnesota, 55331, 952-471-9773. Email: freshwater@freshwater.org.

Minnesota Lakes Association (MLA), 19519 Highway 371 N, Brainerd, Minnesota 56401. 800-515-5253, 218-824-5565, Email: lakes@mnlakes.org.

Minnesota Department of Natural Resources (MDNR), 500 Lafayette Road, St. Paul, Minnesota, 55155, 612-296-6157.

Minnesota Pollution Control Agency (MPCA), 520 Lafayette Road, St. Paul, Minnesota, 55155-4194, 612-296-6300 or 1-800-657-3864.

North American Lake Management Society (NALMS), PO Box 5443, Madison, Wisconsin, 53705. (608) 233-2836. Email: nalms@nalms.org.

Watershed Management Organizations and Soil and Water Conservation Districts – find you local organization through the Board of Soil and Water Resources.

Funding Sources

Funding sources will vary from year to year. There are public agencies that offer funding as well as private foundations and non-profit organizations. Funding can be in the form of a grant, loan or in-kind services.

Minnesota Pollution Control Agency offers Clean Water Partnership Grants.

Department of Natural Resources offers Environmental Partnership Grants.

Board of Water and Soil Resources offers cost-share funds for lake management plans, feedlot improvements and other conservation efforts. These are usually administered through Soil and Water Conservation District's and Counties.

Natural Resource Conservation Service

Soil and Water Conservation Districts offer cost-share programs for erosion control and other projects.

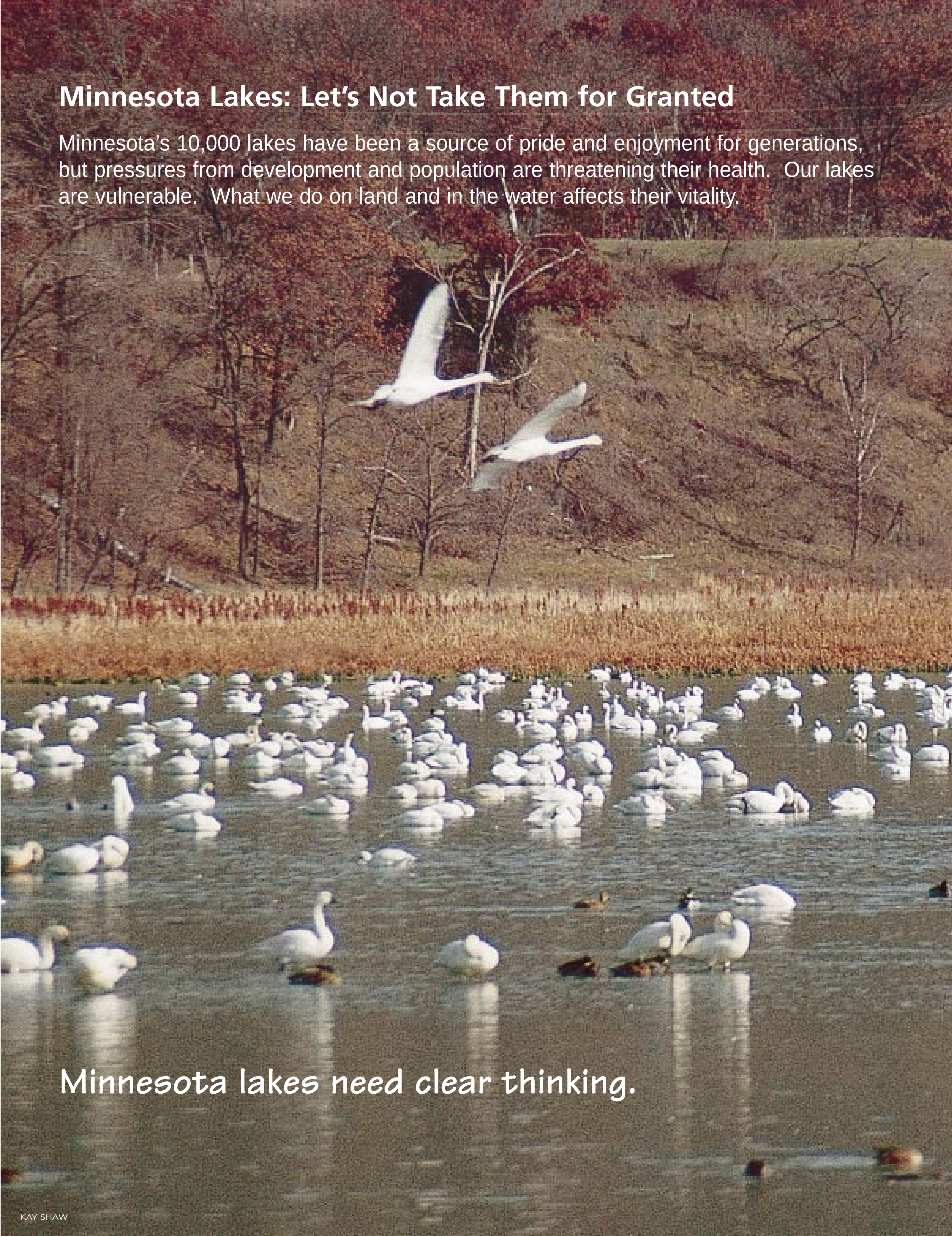
U.S. EPA

Watershed Management Organizations – Often local watershed districts may have funds for education efforts or implementation projects.

Other potential sources of funding include private foundations, non-profits, and state organizations.

Minnesota Lakes: Let's Not Take Them for Granted

Minnesota's 10,000 lakes have been a source of pride and enjoyment for generations, but pressures from development and population are threatening their health. Our lakes are vulnerable. What we do on land and in the water affects their vitality.



Minnesota lakes need clear thinking.

KAY SHAW