HORSESHOE LAKE MANAGEMENT COMMITTEE AGENDA

5:00 P.M. - THURSDAY, MAY 10, 2012
Woodland Council Chambers
100 Davidson Avenue – Woodland, WA 98674

I. Call to Order

II. Minute Approval - April 12, 2012

III. Continued Business
- a. Pump Update
- b. Water Quality and Sampling - Council Input
- c. Decoys
- d. Otter Population
- e. Budget
- f. Goals & Priorities - Updated
- g. Agency Contact Information -Updated
- h. Walt's Wholesale Meats - Groundwater Monitoring

IV. New Business
- a. Shoreline Master Plan Update
- b. State Department Requests

V. Other
- a. Local Newspaper Articles
- b. A Citizen's Guide to Lake Protection

VI. Adjourn - Next Meeting June 14, 2012 at 5:00 P.M.

CITY OF WOODLAND
HORSESHOE LAKE COMMITTEE MINUTES
APRIL 12, 2012

The regular meeting of the Horseshoe Lake Management Committee was held on April 12, 2012, at the Woodland City Hall Council Chambers, 100 Davidson Avenue, Woodland, WA 98674.

Vice-Chair Walt Church called the meeting to order at approximately 5:02 p.m. Roll call found the following:

COMMITTEE MEMBERS:

Tom Golik, Chairman (arrived 5:30)
Walt Church
Mike Curry
Terry Jones
Francis Patnode
Pat Rychel
Neil Van Horn
Jeff Sullivan (Absent)

MAYOR/COUNCIL:

Scott Perry, Councilmember

STAFF:

Jody Bartkowski, Secretary

MINUTES

The March 8, 2012 minutes were approved as presented.

CONTINUED BUSINESS

1. **Lake Pump:** Discussion ensued regarding the latest letter from the Washington State Department of Transportation (WSDOT). Staff reported that calls have been made to check the part status and have not been returned.

   A review was conducted of the January 2010 WSDOT inlet/outlet inspection and discussion was held regarding the materials used, seals, sediment, valves, and which direction the photos were taken from.

   Council Member Perry reported that a City Council presentation by WSDOT is scheduled for Monday, April 16, 2012 at 7:00 p.m and invited the Committee to attend and comment.

   Staff was directed to make sure that Mayor Laseke and Bart Stepp, Director of Public Works are aware of the Federal Highway letter dated July 20, 1956 regarding responsibility for alleviating stagnation.

2. **Water Sampling:** Discussion ensued regarding contacting Stacie Kelsey at the Washington State Department of Fish and Wildlife and requesting an exact date for when Lake sampling and testing will begin.

3. **Decoys:** Discussion ensued regarding adding additional decoys.

4. **Otter Population:** It was reported that one was seen near Walt's Meats the week of February 26, 2012.

5. **Budget:** Staff reported that no changes have been made.

6. **Goals & Priorities:** A review was conducted of the goal & priority recap. Open discussion was held regarding the priority rankings, the combining of pollution and erosion control, the combining of public involvement/education with signage, the addition of a cormorant study, and the return of osprey.

   Further discussion ensued regarding where do we go from here, splitting the projects into two lists (one of items that we can accomplish and the other of items out of our control), City Council (reports, ways to provide information, and requesting assistance, stormwater systems going to the Lake, runoff near the skate park (from the parking lot, Lakeshore Drive, and I-5), and who is responsible for testing runoff.

NEW BUSINESS

1. **Agency Contact List.** Chairman Golik read a proposed letter to be sent to local agencies regarding contact information. It was discussed and unanimously agreed that the letter would be sent and that a follow-up letter would be sent after the contact information is received.

2. **Letter to Department of Ecology regarding Groundwater.** Staff reported that the Public Works Director had reviewed Walt's Wholesale Meats, Department of Ecology (DOE), National Pollutant Discharge Elimination System (NPDES) permit and determined that the letter was not necessary because groundwater monitoring is not required. Discussion ensued regarding the pipe discharging into the lake and where the foam comes from, how the ponds work, whether they are using city or well water, and their history of discharge. Walt Church will contact Walt's Wholesale Meats for additional information.

OTHER

- Council Member Perry and staff reported that Carolyn Johnson, Community Development Planner has some experience with water quality. She is reviewing the proposed WSDOT sampling plan and will be placed on an upcoming agenda to provide input on this as well as grant funding opportunities from the Washington State Recreation and Conservation Office (RCO) and assistance provided by the Cowlitz Wahkiakum Council of Governments (CWCOG).

- Discussed local newspaper articles and problems with Vancouver and Silver Lakes.

ADJOURNMENT

The meeting was adjourned at approximately 6:30 p.m. The next regular meeting will be held Thursday, May 10, 2012, at 5:00 p.m. at the Woodland City Hall Council Chambers.

_____ _____

Tom Golik - Chairman Date

_____ _____

Jody Bartkowski - Secretary Date

Jody Bartkowski

From: Bart Stepp
Sent: Monday, May 07, 2012 8:07 AM
To: London, Mike; hancocc@wsdot.wa.gov
Cc: Jody Bartkowski
Subject: RE: Horseshoe Lake Level

Will do.

Thanks,

Bart Stepp, PE
City of Woodland
Public Works Director
PO Box 9; 300 E. Scott Ave.
Woodland, WA 98674
(360) 225-7999
(360) 225-7476 (fax)

From: London, Mike [mailto:LondonM@wsdot.wa.gov]
Sent: Friday, May 04, 2012 5:49 PM
To: Bart Stepp; hancocc@wsdot.wa.gov
Subject: Re: Horseshoe Lake Level

The pump is now shut off. Let us know when you would like it back on again.

Sent from my Verizon Wireless Droid

-----Original message-----
From: Bart Stepp <SteppB@ci.woodland.wa.us>
To: hancocc@wsdot.wa.gov, londonm@wsdot.wa.gov
Sent: Fri, May 4, 2012 22:54:33 GMT+00:00
Subject: Horseshoe Lake Level

Chad and Mike,

We have had the outlet valve to Horseshoe Lake wide open since about Monday and the water level is still rising, partly because of the high water level and all the rain. We would like to have the pump shut off for a couple of days to let the water drop some as the lake is above it's typical high water mark.

Thanks,

Bart Stepp, PE
City of Woodland
Public Works Director
PO Box 9; 300 E. Scott Ave.
Woodland, WA 98674
(360) 225-7999
(360) 225-7476 (fax)

Jody Bartkowski

From: Scott Perry [ScottPerry@CNI.Net]
Sent: Thursday, April 26, 2012 11:15 AM
To: Jody Bartkowski; Francis and Char Patnode; Jeff & Monique Sullivan; Jody Bartkowski; Mike & Marcia Curry; Niel Vanhorn ; Pat Rychel; Terry & Karen Jones; Tom Golik; Walt Church
Subject: Lake Grants

At our planning session on Saturday I mentioned the need to address the lake's water quality as one of our biggest assets. The discussion was relatively short with a general comment that "we have addressed and provided the resources the committee has brought to us." I suggested we start reserving funds as the pump is only one part of water quality issue and there are many indicators mayor funding will be required to clean up the lake sooner or later. The attitude was more well when the Lake Committee gives us their input or recommendation we can act.

The following link is to a web-site that has different organizations and grants that might be worth looking into. If I had more time I would but my political involvement is at a maximum.
http://www.rco.wa.gov/doc_pages/app_materials.shtml#other

Scott Perry
WOODLAND Real Estate
Call anytime being available is part of my service.
(360) 921-2306

HORSESHOE LAKE MANAGEMENT COMMITTEE
GOALS & PRIORITIES
APRIL 2011

ITEM	RANK	IN OUR CONTROL	OUT OF OUR CONTROL	OTHER
Pump repairs by WSDOT	1.0			
Testing by WDFW - phosphorus, nitrate, etc. (per sampling plan, as budgeted)	2.8			
Testing by WDFW - carp count, fish health, plant typing	3.4			
Testing by WDFW - e-coli (not budgeted)	5.1			
Pollution & erosion control - runoff, storm drainage, shoreline rebuild, etc.	6.5			
Milfoil monitoring	7.6			
Grant applications - contact CWCOG for assistance	7.8			
Contact list for ex-officio members	8.6			
Extend inlet pipe further into the Lake - 1,650' per alum study	8.6			
Septic tank monitoring - involve Clark & Cowlitz Counties as necessary	9.6			
Otter removal	11.0			
Public involvement, education, signage (consolidate, replace, new)	11.3			
Geese damage monitoring	12.7			
Aeration device installation	14.3			
Cormorant study	17.0			

Purpose:
~ Effectively focus and direct Committee efforts based upon which issues are deemed to be the most pressing and/or important. Eliminate discussing the same thing time and again with little movement toward resolution.

What's next?:

~ Document the steps to be taken and resources necessary to complete each project.

~ Create a timeline for each project.

~ Reassess priorities based on what can and cannot be accomplished.

~ Track each project and evaluate progress to date as necessary.

Comments:

~ It seems to me that all priorities should be placed below establishing a consistent flow of water into Horseshoe Lake.

~ Consider making two priority lists. One of things "we can control" and do with our own resources and the other of things "we can't control" and have to rely on others to accomplish -OR- even consider a third list of items that are cost related such as aeration, pipe extension, or e-coli testing and include grant funding with it.

~ Could long term projects be divided up and have specific committee members assigned to work on them? One committee member could make a progress report at the monthly meeting if any progress has been made.

~ Can monthly agendas and meeting conversations be limited to project progress to limit discussions on things we can not change, allowing for more work time? For example, limit otter removal and erosion control discussion to only when needed, hold discussions regarding public involvement, geese monitoring, and septic tank monitoring to annually.

~ The introduction of grass carp into the lake was a mistake, they represent a real threat to the beneficial aquatic vegetation that is important to the lake's overall health.

HORSESHOE LAKE MANAGEMENT COMMITTEE

Effective - May 4, 2012

Members							
Tom Golik, Chair	225-7485		goliktom@yahoo.com	130 Vineyard View Drive	Woodland	WA	98674
Walt Church	225-8897		124church@comcast.net	124 Truth Street	Woodland	WA	98674
Mike Curry	225-3138		mmsoccerfan@yahoo.com	120 South Pekin Road	Woodland	WA	98674
Terry Jones	225-9629		tjswimdad@aol.com	400 Lake Avenue	Woodland	WA	98674
Francis Patnode	225-3939		patnodes@teleport.com	334 Island Aire Drive	Woodland	WA	98674
Pat Rychel	225-7232		prychel@pacifier.com	PO Box 293	Woodland	WA	98674
Jeff Sullivan	225-1750		sullij099@msn.com	130 South Pekin Road	Woodland	WA	98674
Neil Van Horn	225-7445		neilvh02@gmail.com	PO Box1852	Woodland	WA	98674

Ex-Officio (Nonvoting) Members							
Dept Transportation, SW Region							
Doug Ficco, Asst Regional Admin for Maint & Ops	360-905-2020		ficcod@wsdot.wa.gov	PO Box 1709	Vancouver	WA	98682
Gene Dotson, Region Wide Maint Supervisor	360-905-2200		dotsong@wsdot.wa.gov	PO Box 1709	Vancouver	WA	98682
Mike London	390-905-2206		londonm@wsdot.wa.gov	PO Box 1709	Vancouver	WA	98682
Dept Fish & Wildlife, Region 5							
John Weinheimer, Regional Biologist	360-906-6746		weinhjmw@dfw.wa.gov	2108 Grand Boulevard	Vancouver	WA	98661
Stacie Kelsey, Scientific Technician 3	360-906-6706	360-601-1168	stacie.kelsey@dfw.wa.gov	2108 Grand Boulevard	Vancouver	WA	98661
Dept of Natural Resources, Pacific Cascade Region							
Eric Wisch, Region Manager	360-575-5001		eric.wisch@dnr.wa.gov	PO Box 280	Castle Rock	WA	98611
Dept of Ecology, SW Region							
Sally Toteff, Director	360-407-6307		stot461@ecy.wa.gov	PO Box 47775	Olympia	WA	98504
Cowlitz County Health Department *							
Audrey Shaver, Environmental Health Specialist	360-414-5599 x 6440		shavera@co.cowlitz.wa.us	900 Ocean Beach Hwy, S	Longview	WA	98632
Public Health of Clark County**							
John Wiesman, Director	360-397-8000		public.health@clark.wa.gov	PO Box 9825	Vancouver	WA	98666
Clark County							
Axel Swanson, Board of County Commissioners	360-397-2232		axel.swanson@clark.wa.gov	1300 Franklin Street	Vancouver	WA	98666
Cowlitz County							
Board of County Commissioners-George Raiter, Cha	360-577-3020		cowlitz@co.cowlitz.wa.us	207 4th Avenue North	Kelso	WA	98626
Cowlitz County Conservation District							
Darin Houpt, District Manager	360-425-1880		ccddmgr@teamelect.com	2125 8th Avenue	Longview	WA	98632

*Cowlitz-Wahkiakum Health District - Dissolved about 12-years ago. Now both Cowlitz and Wahkiakum have their own health departments.
**SW Washington Health District - Dissolved in 2002. Public Health is now a department of Clark County.

Mayor / Council / Staff							
Grover Laseke, Mayor	360-772-0371	360-225-9022	lasekeg@ci.woodland.wa.us	307 Buckeye	Woodland	WA	98674
Scott Perry, Councilmember	360-921-2306		perrys@ci.woodland.wa.us	180 South Pekin Road	Woodland	WA	98674
Bart Stepp, Public Works Director	360-225-7999		steppb@ci.woodland.wa.us				
Jody Bartkowski, Engineering Tech.	360-225-7999	360-600-7252	bartkowskij@ci.woodland.wa.us				

Jody Bartkowski

From: Carolyn Johnson
Sent: Tuesday, April 17, 2012 12:05 PM
To: Jody Bartkowski
Subject: Park Board and HLMC

Hi Jody,

At some point over the next 6 months, the consultant helping with the shorelines master plan update would like to speak with the Park Board and the Horseshoe Lake Management Committee. Can I put you down as the contact for the consultant to schedule agenda space?

Thanks, Carolyn

Carolyn Johnson MCP
Community Development Planner
City of Woodland
(360) 225-1048 Office
(360) 225-7336 Fax

Jody Bartkowski

From: Jody Bartkowski
Sent: Wednesday, April 25, 2012 11:41 AM
To: Francis Patnode (patnodes@teleport.com); Jeff Sullivan (sullij099@msn.com); Mike Curry (mmsoccerfan@yahoo.com); Neil Van Horn (neilvh02@gmail.com); Pat Rychel (prychel@pacifier.com); Terry Jones (tjswimdad@aol.com); Tom Golik (goliktom@yahoo.com); Walt Church (124church@comcast.net)
Cc: Bart Stepp (steppb@ci.woodland.wa.us); Dennis Ripp; Grover B. Laseke; Scott Perry
Subject: HSLMC - May Agenda

Hello everyone -

Tom Golik stopped by and asked me to share the following with you:

Should we consider asking the City to officially make requests of State Departments to address and correct water quality problems, i.e.

1. *Pollution control - stop and divert storm runoff from freeway and highway.*
2. *Extend inlet pipe further into Lake to improve flow.*
3. *Septic tank testing.*
4. *E-coli testing.*

This would create a stir, but would put our problems on the table and hopefully start some people working on them.

Let's discuss at next meeting!

Tom Golik

I will add a new agenda item titled "State Department Requests".

JODY

Jody Bartkowski
Engineering Technician
Woodland Public Works
P O Box 9
Woodland, WA 98674
(360) 225-7999

State takes another shot at keeping Horseshoe Lake clean, less green

By Marqise Allen / The Daily News | Posted: Thursday, April 19, 2012 8:45 pm

WOODLAND — Horseshoe Lake is one of the town's "biggest assets," but Lance Spencer needs only two words to describe it come summer time — "green and gross."

"It gets bad," the 38-year-old Woodland resident said Thursday while fishing there. "You don't want your kids swimming in it."

Algae eventually takes over lake, typically prompting Spencer to stop fishing there in May.

"You don't want to eat the fish," he said. "Who knows what kind of slime is on it?"

A state project, however, aims to make the 85-acre lake cleaner and more usable.

Last week, the Washington State Department of Transportation finished installing a new $13,000 pump that will force about 5,000 gallons of water a minute into Horseshoe Lake from the nearby North Fork of the Lewis River. The old pump delivered only 3,000 gallons a minute.

The lake is an old "oxbow" bend of the Lewis River. It was cut off from the river in 1940 during construction of Highway 99, now Interstate 5. A new river channel was dug east of the freeway, and the isolated old oxbow turn became a lake. WSDOT agreed to maintain the lake, but keeping it and clean has been a challenge because it has no significant natural source of fresh water.

Transportation officials said it will take a few months before they know whether the new pump is improving the water. If it doesn't work, the next step would be costly, they warn.

"If we still have water quality issues, we'll need a two-pump system," said Chad Hancock, Southwest Washington traffic engineer for WSDOT.

The early estimate for replacing the entire system and adding a new pump is $270,000. Rather than fixing a single pump, WSDOT officials would have to do a complete rebuild and overhaul of the system. The project could take up to two years, Hancock said.

Woodland City Councilman Scott Perry said the new pump is an important step to restore one of Woodland's "biggest assets." In some respects, Horseshoe Lake is to Woodland what Lake Sacajawea is to Longview, though its shores are ringed by houses instead of a large urban park.

"Without good circulation, we don't have a prayer," Perry said.

The new pump is the second recent initiative aimed to improving water quality in the lake. The city released grass carp into the lake two years ago in hopes they would eat milfoil and other aquatic weeds that choked it every summer. The carp haven't cleared as much algae as expected.

Lydia Casey is pulling for the new pump system to make a difference.

The 72-year-old Vancouver resident comes to Woodland once a week to visit her grandchildren and remembers when the lake was in better shape.

"Thirty years ago, this lake used to be a lot cleaner," and Casey used to swim there, she said. "There's a lot less people now. I'd bring my grandchildren out here if it wasn't so mucky. ... It's terribly important to clean up the lake."

KATU.com - Portland, Oregon
Print this article

Salmon-gobbling cormorants to join sea lions on hit list?

Originally printed at http://www.katu.com/living/outdoors/Salmon-gobbling-cormorants-to-join-sea-lions-on-hit-list-149132185.html

By JEFF BARNARD AP Environmental Writer April 26, 2012

Oregon officials were successful in getting permission to kill sea lions that feed on protected salmon trying to swim upriver to spawn.

Now they want federal approval to shoot double-crested cormorants that eat millions of baby salmon trying to reach the ocean.

In an April 5 letter to the U.S. Fish and Wildlife Service obtained by The Associated Press, Oregon Wildlife Chief Ron Anglin says harassment has "proved insufficient" to control cormorants, and they want the option of killing some of the birds.

Oregon needs federal approval to start shooting double-breasted cormorants because they are protected under the Migratory Bird Treaty Act.

Anglin wrote that the birds are threatening restoration of wild fish protected by the Endangered Species Act, as well as hatchery fish important to sport and commercial fishing.

Council approves $241,000 for flushing Lake Sacajawea

By Amy M.E. Fischer / The Daily News | Posted: Thursday, April 12, 2012 11:37 pm

The Longview City Council on Thursday approved a $241,000 engineering contract to design facilities to continue flushing Lake Sacajawea with river water.

For years, the city has used its water treatment plant on Fisher's Lane to pump Cowlitz River water into the lake to prevent it from stagnating in the summer. However, the city will shut down the plant this fall when its new groundwater well system goes on line at the Mint Farm.

Engineers have determined that the best way to keep the lake from stagnating is to continue pumping water to the lake from the Fisher's Lane plant. However, equipment upgrades to comply with stricter environmental standards will cost roughly $1 million.

After that, maintenance and operations would run about $35,000 a year.

In part, the Fisher's Lane project will entail the following work:

The water intake structure's old pumps and piping will be removed because they're too large and aren't configured properly for lake flushing only. Fish screens with a finer mesh size will be installed to comply with new fish protection regulations. The plant also will get three new pumps. Several automated systems will be added to monitor the water's turbidity (cloudiness), activate the intake pumps based on the water level, and open and close the slide gates at the north end of the lake. A weather station will signal the pumps to stop if it starts to rain.

The City Council awarded Longview engineering firm Gibbs & Olson the $241,000 engineering contract Thursday.

Engineers anticipate the project, which will be put out for bid after it's designed, will take about 10 months. Because smelt were included on the endangered species list in 2010, the permitting process for modifying the intake structure and dredging the riverbed for maintenance will move slowly. If the permits are approved, the work probably will begin in April 2013 and finish by February 2014, according to Longview Public Works Director Jeff Cameron.

In the meantime, the city hopes the state Department of Ecology and Department of Fish and Wildlife will allow use of the Fisher's Lane plant for one season of lake flushing next year without modifying the fish screens, Cameron said. If not, the city can cancel its design contract, he said.

Because the city budgeted only $170,000 to design the facility, not yet realizing the extent of its permitting challenges, the excess money will have to be made up in utility customers' future rates, he said.

Last year, the city tested and rejected what would have been the least costly option for keeping the water fresh. The experiment involved rapidly lowering the lake by opening the outlet gates, then letting the lake refill with groundwater. The city aborted the mission when the lake didn't refill as expected after two drawdown cycles, and citizens complained the water was turning brown and smelly.

These were among the other alternatives Gibbs & Olson engineers studied:

• Drilling a new well into the aquifer near R.A. Long High School and pipe water in at the north end of the lake. Initial cost: $3.2 million. Ongoing costs: $31,000 a year.

• Tapping into the existing 20-inch water main near the railroad tracks north of Ocean Beach Highway, dechlorinate and aerate the water, then discharge it into the lake using Ditch 6. Initial cost: $1.1 million. Ongoing costs: $700,000 a year. (The state prohibits discharging chlorinated water into the stormwater system.)

A Citizen's Guide to Lake Protection

What Is a Lake?

It's not as simple as it may sound. A like is a body of water, but it is also much more. A lake is an ecosystem, a community of interaction among animals, plants, microorganisms, and the physical and chemical environment in which they live. Critical to any lake ecosystem is the lake's watershed, the surrounding land area that drains into that particular lake.

A complex interdependence has evolved among the organisms in a lake community. If one part of the ecosystem is disturbed, it affects other parts. A road, a housing development, a drainage project, a forest fire, acid rain or other such changes in the watershed can alter the delicate balance of the lake ecosystem.

Well-balanced lake ecosystems, however, do change from season to season and from year to year. Short-term events, like a single algal bloom (an unusual or excessive abundance of algae), may not necessarily signal a long-term problem. On the other hand, changes in land use in the watershed may not immediately have a visible effect on the lake. It may take a decade or more, for example, for changes in agricultural practices or urbanization to result in weed problems or fish kills.

Lakes Begin…And End

Most lakes were created by past geologic events. The vast lake-dotted and marshy landscapes found in North America were formed by glaciation in the relatively recent geologic past-10,000 to 20,000 years ago. Glaciers formed lake basins by gouging holes in loose soil or bedrock, by depositing material across streambeds or by leaving buried chunks of ice whose melting shaped lake basins. More recently, humans and other animals have created lakes by damming rivers.

Lakes constantly are undergoing slow evolutionary change, reflecting the changes that occur in their watersheds. Most are destined to fill in with sand, silt and topsoil washed in by floods and streams. These gradual changes in the physical and chemical components of the lake affect the development, competition and succession of many different plants and animals.

The natural process by which lakes form, evolve and disappear takes thousands of years. Human activities, however, can change these lakes-for better or worse-in less than a single generation.

How Do Lakes Work?

A necessary prerequisite for deciding how to protect a lake is developing a basic understanding of the physical, biological and chemical properties of a lake. These physical, biological and chemical properties-such as light, temperature, wind, precipitation and nutrients-affect plants, animals and the lake itself.

1. A Physical Look at Lakes

Lakes Form Layers

Lakes in temperate climates tens to stratify of form layers, especially during summer. This happens because the density of water changes as its temperature changes.
Water is most dense at 39°F. Both above and below that temperature, water expands and becomes less dense. This means that in the spring, just before the ice melts, the water near the bottom will be at 39°F. Water above that will be cooler, approaching 32°F just under the ice. As the weather warms, the ice melts and the surface waters begin to heat up. Wind action and increasing density cause this surface water to sink and mix with the deeper water, a process called spring turnover.

As summer progresses, the temperature difference (and thus density difference) between upper and lower water becomes more distinct, and most lakes form three separate layers. The upper layer, the epilimnion, is characterized by warmer (lighter) water. The epilimnion is roughly equivalent to the zone of light penetration, where the bulk of productivity, or growth, occurs.

Below the epilimnion is another layer, the thermocline, in which the temperature declines rapidly. The thermocline is a narrow band of transition which helps to prevent mixing between the layers.

Below the thermocline lies water much colder than the epilimnion, called the hypolimnion. The hypolimnion is the zone of decomposition, where plant material either decays or sinks to the bottom and accumulates.

These temperature conditions will continue until fall. Then surface waters cool until they are as dense as the bottom waters and wind action mixes the lake. This is the fall turnover.

Lakes in the temperature climates tend to form layers. The epilimnion is roughly equivalent to the zone of light penetration where the bulk of productivity, or growth, occurs. The thermocline is a narrow band of transition which helps to prevent mixing between the layers. The hypolimnion is the zone of decomposition, where plant material either decays or sinks to the bottom and accumulates.

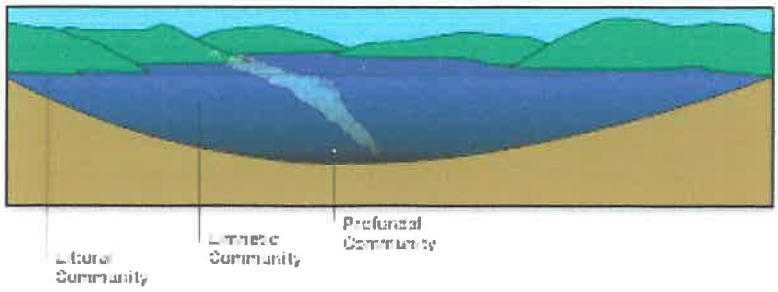
2. A Biological Look at Lakes

A lake can be divided into zones, or communities, of plants and animals. Extending from the shoreline is the littoral community, where aquatic plants are dominant. The size of this community depends on the extent of shallow areas around the lake. Water lilies, duckweed and submerged plants are abundant. These plants play an important role in the overall aquatic community by producing oxygen and providing food and shelter for insects, crustaceans, frogs, turtles and fish.

The area of open water is the limnetic community. This area is the habitat of phytoplankton (algae), zoopplankton (microscopic animals), and fish. The phytoplankton are very important, serving as the base of the lake's food chain and producing oxygen.

The process by which green plants (including algae) produce oxygen from sunlight, water and carbon dioxide is photosynthesis. A pigment produced by the plants, chlorophyll, speeds this process. Since sunlight is very important to photosynthesis, oxygen will be produced only as deep as the sunlight penetrates. The depth of light penetration can be measured using a secchi disc.

Below the limnetic zone is the profundal community, where light does not penetrate. This zone or community is dominated by respiration, or oxygen consumption, rather than oxygen production. This zone corresponds roughly to the hypolimnion layer. The community in this zone consists of such organisms as bacteria and fungi. These organisms break down or consume (decompose) dead plants and animals that settle out of the waters above. This process consumes oxygen.



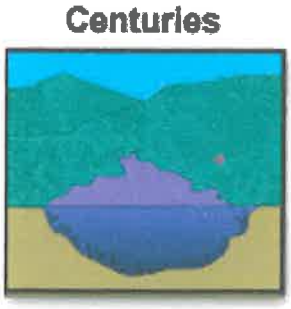
A lake can be divided into zones or communities. Extending from the shoreline is the littoral community, where aquatic plants are dominant. The area of open water is the limnetic community, the habitat of algae, microscopic animals and fish. The profundal community, where light does not penetrate, is the habitat of bacteria and fungi.

WHAT CAN GO WRONG IN LAKES?

1. Eutrophication: The Weeds Take Over

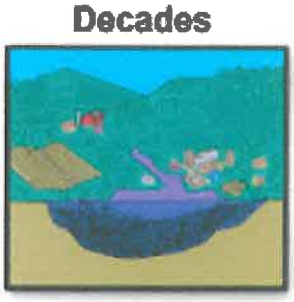
Eutrophication is the process by which lakes are fertilized with nutrients (chemicals absorbed by plants and used for growth). It is a natural aging process, but human activities can speed it up, with more algae and weeds the result.

As nutrients such as nitrogen, phosphorus and potassium wash into lakes in runoff water or by soil erosion, they fertilize the lake, allowing algae and weeds to grow. As plants die and decompose, they accumulate on the lake bottom as muck. After hundreds or thousands of years of plant growth and decomposition, the character of a lake may more closely resemble a marsh or a bog. This aging is called natural eutrophication.



Lakes also can obtain nutrients from various human activities, which can literally make a lake "old" before its time. This accelerated aging is called cultural eutrophication. Nutrients washed from agricultural areas, storm water runoff from urban areas, municipal and industrial wastewater, runoff from construction projects and even recreational activities contribute to cultural eutrophication. When human activities increase the rate of nutrient and sediment enrichment of a lake, pollution is taking place.

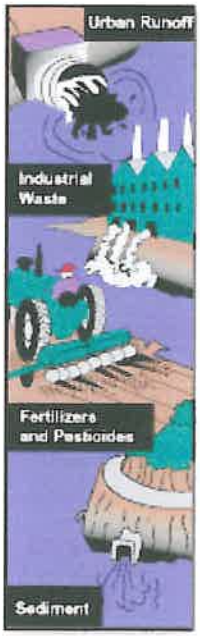
Nutrient and pollution sources discharged to a lake from specific locations, like municipal and industrial wastewater outlets, urban stormwater outlets or other point sources are easy to identify, relatively easy to control through treatment projects, and have been the focus of much of the water pollution control work to date.



Nutrients and pollution sources that are not discharged from a pipe, but instead are washed off the land or seep into groundwater, are known as nonpoint sources of pollution or polluted runoff. These include runoff from agricultural fields and feedlots, leakage from septic tanks, nutrients from wetland drainage and storm water runoff, and others. Polluted runoff is best controlled through wise land use practices.

As shown in the diagram in the upper right, the natural process by which lakes form, evolve and disappear takes thousands of years. Human activities, however, can change these lakes -- for better or worse -- in less than a single generation.

2. Sedimentation: The Lake Fills In



Closely associated with eutrophication is sedimentation. Wind and water move soils from the surrounding watershed down into a lake. These soils settle on the bottom of the lake, and the lake becomes increasingly shallow. This process is again a natural part of lake aging, governed by gravity and the forces of rain and wind.

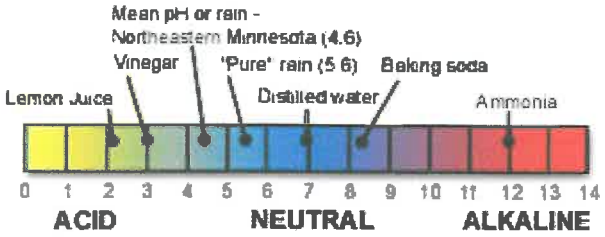
Sedimentation is greatly accelerated, however, by human activities that leave the soil exposed without vegetation for extended periods. Construction activities that leave soils bare, and intensive agricultural activities, such as plowing near lakes and streams of farming steep slopes, leave soils vulnerable to erosion.

This problem is best controlled through soil and water conservation practices and maintaining vegetation on soils.

3. Acidification: Air Pollution Affects Lakes

Acid rain occurs when air pollution from power plants, factories and cars mixes with cloud moisture to form acidic compounds, which eventually fall to earth as rain, snow or dust. Acid rain can change the chemical balance of a lake, sometimes with sever consequences. In Canada, New England and Scandinavia, thousands of lakes are now too acidic to support fish and other aquatic life.

The rain in northeastern Minnesota, the region of the state containing the majority of acid-sensitive lakes, is about 10 times more acidic than "normal" rain. Although no "acid-dead" lakes have been found yet in Minnesota, some appear to be showing the early effects of acidification. Approximately 2,500 to 3,700 Minnesota lakes are considered sensitive to acid rain. Of these lakes, 500 to 1,000 are extremely sensitive due to their very low alkalinities. (For more information on acid rain, contact the Minnesota Pollution Control Agency.)



As a result of the state's glacial history, much of northeastern Minnesota and parts of north central Minnesota have thin soils and exposed bedrock. Most of the state's acid-sensitive lakes are in these areas. Moreover, these areas receive an average rainfall of pH 4.6, ten times more acidic than normal rain (pH 5.6). In contrast, agricultural lands in southern and western Minnesota receive rain with a close-to-normal pH and also have a low sensitivity to acid rain.

4. Toxic Contamination: Excess Chemicals Contaminate Lakes

Several types of toxic substances may contaminate lakes: (1) industrial chemicals such as PCBs (polychlorinated biphenyls), metals, and solvents from point sources or runoff; (2) pesticides from agricultural runoff; (3) urban storm runoff containing metals and pesticides; and (4) air-deposited chemicals.

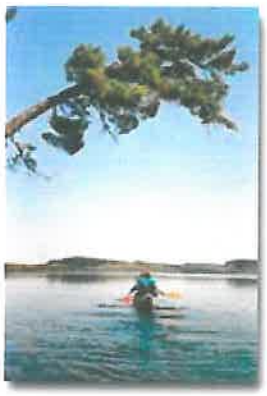
Toxic contamination may be dramatic-such as fish kills that eliminate part or all of a lake's fish population. Less obvious impacts may include decreased reproduction or slower growth rates in fish.

One particularly dangerous impact is the bioaccumulation or build-up of toxic substances in fish flesh. The toxic effects may be passed on to humans eating the fish.

What Can You Do to Take Care of Your Lake?

"Taking care of" your lake may require lake stewardship, lake management, lake restoration, or a combination of all three. These three terms-stewardship, management and restoration-are related but not interchangeable.

1. Lake Stewardship: An Attitude



Lake stewardship really is an attitude-it is the first important step in protecting a lake. Stewardship reflects an understanding that what we do on land and in the water affects the lake.

Stewardship centers on thoughtful consideration of the intricate lake ecosystem and the interdependence between the lake and its surrounding watershed. It takes into account the need to better balance our lives and lifestyles with the needs of our lakes.

In short, it is a recognition that lakes are vulnerable-that in order to make them thrive, we, both individually and collectively, must assume responsibility for their care.

2. Lake Management: A Process

Lake management is a process, and the second major step in lake protection. It reflects a willingness to study a lake, to assess its status and its needs, and to determine how best to maximize its potential as a thriving ecosystem.

Lake management can be as simple as fostering the practices of stewardship among lake homeowners and other interested individuals. Or it can include taking an active role in altering certain ecological relationships within the lake and its watershed to make a lake healthy and keep it healthy. Lake management can also include protecting the health of a lake ecosystem through a plan of preventive action.

Lake management, to be effective, requires the coordinated efforts of a group of individuals in the form of a lake association, sportsmen's or conservation club, or some other organization.

3. Lake Restoration: Corrective Action

Lake restoration is an action directed toward a lake to "make it better." It is one example of a lake management technique. The complexity and expense of this activity requires an organization with some authority over the lake and its watershed, such as lake improvement district or watershed district.

Lake Stewardship: What Can an Individual Do?

Good stewardship by the individual, whether a lake homeowner or simply a lake user, can do much to enhance the lake environment and serve as a beginning for sound lake management. Although most of the following comments are directed to lake homeowners, many also apply to those who live anywhere within a lake's watershed. One of the most important things an individual can do is to get involved with other concerned citizens. Your collective efforts will yield the greatest dividends for you and the lake.

Here's what you can do to protect and improve a lake by minimizing polluted runoff into the lake. Many of these suggestions are based on shoreland management laws, such as those in Minnesota.

1. Siting the House and Other Facilities

- Don't let your house intrude upon the lake. Locate a new house and any future additions to meet horizontal setback and vertical elevation requirements and to avoid damage if the lake rises dramatically in the future. Preserve as much natural vegetation as possible between the house and the lake to filter sediments and nutrients out of surface runoff.
- You'll also need to consider other facilities, particularly wells and septic systems, when siting your house. The septic system should receive priority since adequate soil conditions are necessary for its proper functioning. Site evaluators and many sewage system installers can conduct soil borings and percolation tests and consult soil maps and data to determine the best location on your lot. Wells should be located upslope from sewage systems and be deep and cased whenever possible. A site sketch of your lot, drawn to scale, will help you decide the best locations for all facilities and is often required when obtaining permits.
- Contact your county zoning officer to determine what permits will be needed and what standards must be met. Take a personal interest in meeting the regulations. Don't leave the arrangements entirely to your contractors.
- If a standard septic tank and drainfield system is unsuited for your lot, you may have to use an approved alternative system such as a mound system. On some lots a holding tank may be the only feasible system.
- Make sure your contractors know which trees you want to save. Fence off areas to protect trees and roots from construction damage.
- Don't put a road or wide path down to the lake. Curve any path you do build to the lake. Consider a wooden stairway rather than a road if you need access along a steep slope.

2. Altering the Waterfront

- If you want a sandy beach for swimming, try to buy a lot with a natural beach. Sand dumped on the shore to create a beach can seriously affect the habitat of fish birds, frogs and aquatic insects.
- Make waterfront equipment such as docks and boat houses as unobtrusive as possible. Avoid structures that require much tree clearing, excavating or filling.

3. Modifying Yard Care

- Think twice before putting in a lawn-you may not need one in a lake setting. Maintain as wide a buffer zone of natural vegetation as possible between the lawn and the water's edge.
- Minimize the use of pesticides, herbicides and fertilizers, which can harm the lake.
- Don't burn brush or leaves on a slope from which ashes can wash into the lake.

4. Taking Care of Your Septic System

- Don't let your septic system pollute the lake. Have your septic tank checked every other year and pumped when necessary.
- Use nonphosphate detergents, wash only full loads of clothes, and use water-saving showers and toilets to avoid stressing your septic system. (In Minnesota, phosphates in household laundry detergents have been banned since 1977.)
- Do not use a garbage disposal, and keep solvents, plastics, paper diapers and other similar products out of your septic system.

Lake Management: What is it?

Lake management requires a general knowledge of lake ecology, the causes of natural and cultural water quality problems, the techniques for restoring and protecting the lake, the legal and financial realities to be considered, and the administrative and technical

resources available to concerned citizens.

Lake management begins with ecological awareness. Just as the art of the landscape painter begins with an understanding of the relationship between elements in the landscape, so must a lake be seen as part of an interdependent system of surface and subsurface flowing water and of plant and animal habitats that relate to, and rely on, each other.

Two Areas of Concern

Every lake is ecologically unique. Every management group will have a unique set of management objectives and a unique strategy for attaining them.

Lake management planners seeking the most effective way to arrest or reverse eutrophication face two general areas of concern:

The first addresses biological symptoms that arise in the lake-primarily from activities in the lake's watershed. "Nutrient-rich" lakes can be made less "productive" through the use of watershed management practices. The cost depends on the extent of the problem.

In the second area of concern, the lake has reached a critical level. Nutrients accumulated in the lake continue to maintain excess productivity even with watershed management. The restoration of such a lake may require in-lake treatment as well as watershed management. The cost may be high.

Two Philosophies of Lake Management

Lake management approaches can be divided into two categories. One is the "quick-fix" approach. The other is long-term environmental management.

The "Quick-Fix" Approach

The "quick fix" in lake management is a short-term "solution," such as the application of aquatic herbicides to quickly kill unwanted algae. Such chemical applications can go on year after year, becoming increasingly less effective if the underlying causes of the algal growth are ignored.

The "quick fix" treats the biological symptoms of a lake problem, but plant and fish productivity are directly dependent on the chemical and physical processes going on in and around the lake as well. These underlying factors must be the principal consideration in any plan to change the biology of a lake.

Long-Term Lake Management

Long-term lake management considers all of the environmental, cultural and biological factors affecting the lake and sets a higher priority on finding lasting solutions than on pursuing quick, cosmetic treatment of symptoms.

A high quality, financially efficient environmental project takes time and begins with long-range planning. If immediate in-lake rehabilitation techniques are necessary, the community will need to be sure that such immediate rehabilitation efforts are followed by appropriate long-term management techniques.

Lake Management: What Can Be Done?

Lake management often begins with concern for a particular lake. The lake no longer lives up to someone's expectations, whatever they might be.

Deteriorated lakes can be restored, but the task is difficult. Understanding of lake ecosystems is incomplete, and, even when technical answers are available, they may be expensive to apply. Further, the results of a lake restoration project may not be apparent for years.

For these reasons, preventive action should be the first priority of most lake communities. If the lake is a valuable recreational asset, the primary objective should be to prevent further deterioration. Lake deterioration can be prevented by managing the watershed and by protecting the shoreline.

Action to protect and restore a lake may be taken by individual lake property owners and by lake association, usually with the assistance of one or more government units.

When concern over a lake's condition leads to a meeting of concerned citizens, the first step has been taken: formation of a lake association. The association may already exist as a local conservation club, a rod-and-gun club, the chamber of commerce, or another concerned group. An effective lake association includes not only lakeshore property owners but also people who have various other interests in the lake. If lake management is initiated by a municipality or other government unit, it is a good idea to form an advisory group on interested citizens by seeking volunteers from the association or other concerned civic groups.

Four Initial Steps

1. Set Goals

Where does a lake association begin? The first order of business is to set goals. The goals of a lake management program are set according to what the members of the association expect the lake to be. These goals are usually based on social judgments and definitions of values. Throughout the planning process, these expectations require continual review and modification as information is

gathered and as environmental, technical, institutional and financial realities become more clear.

2. Assess Levels of Commitment

Know what financial and time commitments the group is willing and able to make. It is easy to overlook these factors in an initial eagerness to get results, but realistic assessments of available time and finances are critical to success.

3. Acquire Background Knowledge

Get acquainted with the principles of lakes. Understand the direct and critical relationship between a lake and its surrounding shoreline. The better you understand the relationship of a lake to its watershed, the more likely you'll be to make effective management choices. You can find help with this in your local community. A high school or community college science teacher may be able to help residents better understand the lake. The county planning and zoning office can provide information on present and future land use in the watershed.

The soil and water conservation district can provide information on soils and assist in mapping the area draining into the lake. The Freshwater Society and the Gray Freshwater Biological Institute can help you better understand the interdependence of land use practices and lake protection.

4. Determine the Current Status of the Lake

It is important to determine the current water quality or trophic status of the lake. This will provide a baseline for assessing changes in water quality over time and determining the effectiveness of management practices. This may be as simple as getting involved in the Citizen Lake-Monitoring Program. Or, if major management choices are to be made, a complete water quality study of the lake and its watershed may be necessary. This is a good point at which to seek professional advice. Water quality data may be available from either the Minnesota Pollution Control Agency (MPCA) or Minnesota Department of Natural Resources (MDNR). The MPCA can help determine if an extensive study is needed. In such cases a professional consultant may need to be retained.

Deciding How To Proceed

After the association has gone through these initial steps, it will have a basis for determining the level of management that is reasonable for the group to tray to attain. This management may be as basic as fostering the concepts of stewardship among its members and others who live near the lake. To be effective it may require that the association work closely with city, county or state officials to seek enforcement of any existing regulations protecting the lake, as the association has no statutory authority of its own. This level of management may be adequate for preserving the existing quality of the lake.

In cases where the existing quality of a lake is not acceptable, more direct measures may be necessary. Many times these measures are directed at the biological symptoms of the problem such as algal blooms or excessive weed growth, with chemical treatment and weed harvesting being common responses. While these treatments do provide short-term relief from these symptoms, they do not address the underlying cause, which is generally tied to land-use activities in the watershed of a lake that promote excess runoff of nutrients and sediment. The association should seek to address the causes as well as the symptoms of such problems.

Even with good stewardship and concerted efforts by a lake association, the water quality of a lake may have deteriorated to the point where basic management of the lake and its shoreline is insufficient to create acceptable conditions. Lakes at this advanced stage of eutrophication are often characterized by fish kills, excessive weed growth and frequent algal blooms. At this point, restoration may be necessary.

Lake Restoration: What's Involved?

At some point a lake association may need more 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. 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-evaluating Goals

This would be a good time for re-evaluation of the mission of the lake association, 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. Pursuing a Higher Level of Organization

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, it may be decided that a higher level of organization is 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 exist 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. Exploring Financing Sources

Funding cannot be addressed in depth in this publication because the outside sources of funds (such as state and federal aid) and funding levels are continually changing. It is important, however, to distinguish between the funding available to lake associations and that 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 would be eligible to apply for these funds. Among other recognized grant-eligible bodies are cities, counties and regional planning agencies.

Consult with local and state official (such as the MPCA and MDNR) to identify the current status of these programs that may be available for cost-sharing of projects.

4. Conducting 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 "feasibility" studies. Their 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 one assess which restorative techniques, if any, may improve the quality of the lake. Typical elements of a feasibility study include the following:

In the Watershed

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

In the Lake: Biological Productivity

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

Contact the MPCA or the Gray Freshwater Biological Institute for information on conducting feasibility studies.

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 selection of techniques will vary from lake to lake depending on results form 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 "cleanse" 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, or other government agencies.

In-Lake Techniques

In-lake techniques include physical measures, chemical measures and biological measures.

1. Physical Measures

Aeration and circulation increase dissolved oxygen levels, prevent fish kills and create a larger zone of habitation for fish and microscopic animal communities. Aeration can also slow the tapping of phosphorus from bottom sediments. Results, however, are not always predictable.

Dredging is used to remove 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 dredge spoils is often a problem.

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

Onshore treatment techniques involve pumping water onshore, treating it and them allowing it 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 marshlands (which will remove nutrients from the water before it drains back into the lake).

Drawdown (lowering water in an impoundment) 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. It may also cause slumping of the shoreline. Drawdown can also be useful in encouraging growth of plants beneficial to waterfowl.

Harvesting removes nutrients form the system by removing 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.

2. Chemical Measures

Algal toxins (algicides)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 treatment, chemical and metals such as cooper may build up in the sediments and fish. Such chemical are usually broad-spectrum, killing many plants and animals in the lake as well as the algae. Use of the water by humans in restricted for a time following the application of such chemicals.

Application of algicides treats the symptoms inadequately, does little to solve the problem, fails to address the underlying causes, and may lead to buildup of undesirable chemicals and metals in the lake. This technique is seldom incorporated into a lake restoration and should be considered only for short-term treatment of symptoms.

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.

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.

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 rough 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 ecological connections within a lake. 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 (or refuge) 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.

Watershed Management Techniques

Watershed management techniques focus on best management practices and include on-site techniques and off-site 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 nonpoint polluted runoff. These management practices can stop pollutants at the site or at strategic points in the watershed.

1. On-Site Best Management Practices

Agricultural Pollutants

Best management practices for controlling agricultural pollutants are directed at keeping soil and nutrients of farms, where they are important components of production, 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

Urban Pollutants

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

- Detention and infiltration basins to collect runoff from paved areas
- Sweeping leaves and dirt from streets
- Cleaning storm sewers and catch basins

Erosion and Sedimentation

Best management practices for controlling erosion from construction sites where natural land cover is removed are directed at controlling erosion and sedimentation to lakes. Practices include:

- Erosion control practices as part of the planned construction project required before a building permit is issued.
- Limiting the area exposed and stabilizing it with surface cover.
- Directing runoff to holding areas to prevent sediment and other pollutants form leaving the site.

On-site 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.

2. Off-Site Watershed Management Techniques

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

- Where wetlands exist, they should not be altered or drained. It is now recognized that wetlands serve 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 out and the plants take up and use the nutrients before they can run into a lake.
- 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 and an organization to manage the wetland.
- Sediment basins are important to allow water carrying a suspected load of fine particles to reduce speed and allow the solid particles and nutrients to settle out.

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.

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 that one generation. For these reasons, the actual value of a lake management project can't be calculated into one neat number.

Many communities were built around a lake or millpond. 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. The quality of a lake directly affects community property values and, therefore, the local tax base. Effectively managed, a lake and its adjacent wetlands provide habitat for game fish and other wildlife.

Effective, long-term lake management is a complex undertaking that must deal with sociology as well as biology. If is an exercise in compromise, balancing the needs of wildlife with the needs of civilization. Lake management requires choices: between sandy bottoms for swimmers and weedbeds for fishermen; between groomed lawns and control nutrients and pesticides in the lake; 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 up responsible for protecting and preserving our lakes-not only for ourselves, but for those who follow as well.

Glossary

Acid Rain: Rain with a higher than normal acid range. Caused when polluted air mixes with cloud moisture. Can make lakes devoid of fish.

Algal bloom: An unusual of excessive abundance of algae.

Alkalinity: Capacity of a lake to neutralize acid.

Bioaccumulation: Build-up of toxic substances in fish flesh. Toxic effects may be passed on to humans eating the fish.

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

Ecosystem: A community of iteration among animals, plants, and microorganisms, and the physical and chemical environment in which they live.

Epilimnion: Most lakes form three distinct layers of water during summertime weather. The epilimnion is the upper layer and is characterized by water and lighter water.

Eutrophication: The aging process by which lakes are fertilized with nutrients. Natural eutrophication will very gradually change the character of a lake. Cultural eutrophication is the accelerated aging of a lake as a result of human activities.

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. As in spring turnover, all water is now at the same temperature.

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

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 recognized the vulnerability of lakes and the need for citizens, both individually and collectively, to assume responsibility for their 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. The plants produce oxygen and provide food and shelter for animal life.

Mesotrophic Lake: Midway in nutrient levels between the eutrpophic and oligotrophic lakes.
Nonpoint Source: Polluted runoff-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, it is clear and deep with bottom waters high in dissolved oxygen.

pH Scale: A measure of acidity.

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

Phytoplankton: Algae-the base of the lake's food chain, it also produces oxygen.

Point Sources: Specific sources of nutrient of polluted discharge to a lake: e.g. stormwater outlets.

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

Respiration: Oxygen consumption

Secchi Disc: A device measuring the depth of light penetration in water.

Sedimentation: The addition of soils to lakes, a part of the natural aging process, makes lakes shallower. The process can be greatly accelerated by human activities.

Spring Turnover: After ice melts in spring, warming surface water sinks to mix with deeper water. At this time of year, all water is the same temperature.

Thermocline: During summertime, the middle layer of lake water. Lying below the epilimnion, this water rapidly loses warmth.

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

Water Density: Water is most dense at 39°F and expands (becomes less dense) at both hither and lower temperatures.

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

Zooplankton: Microscopic animals

Appendix

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

Lake management and restoration, lake studies, pollution, how to form a lake association, acid rain
Minnesota Pollution Control Agency (MPCA)
520 Lafayette Road, St. Paul, Minnesota 55155
(612) 296-6300

Water quality assessment, lake management practices
Freshwater Foundation
2500 Shadywood Road, Box 90, Navarre, Minnesota 55392
(612)471-8407

Water quantity and quality concerns, lake management, lake stewardship, public information/education materials
Freshwater Foundation
Spring Hill Center, 725 County Road 6, Wayzata, Minnesota 5391
(612)449-0092

Shoreland management laws, fisheries management, aquatic nuisance control, lake aeration, lake survey information, lake mapping, lake level management
Minnesota Department of Natural Resources (MDNR)
500 Lafayette Road, St. Paul, Minnesota 55146
(612)296-6157