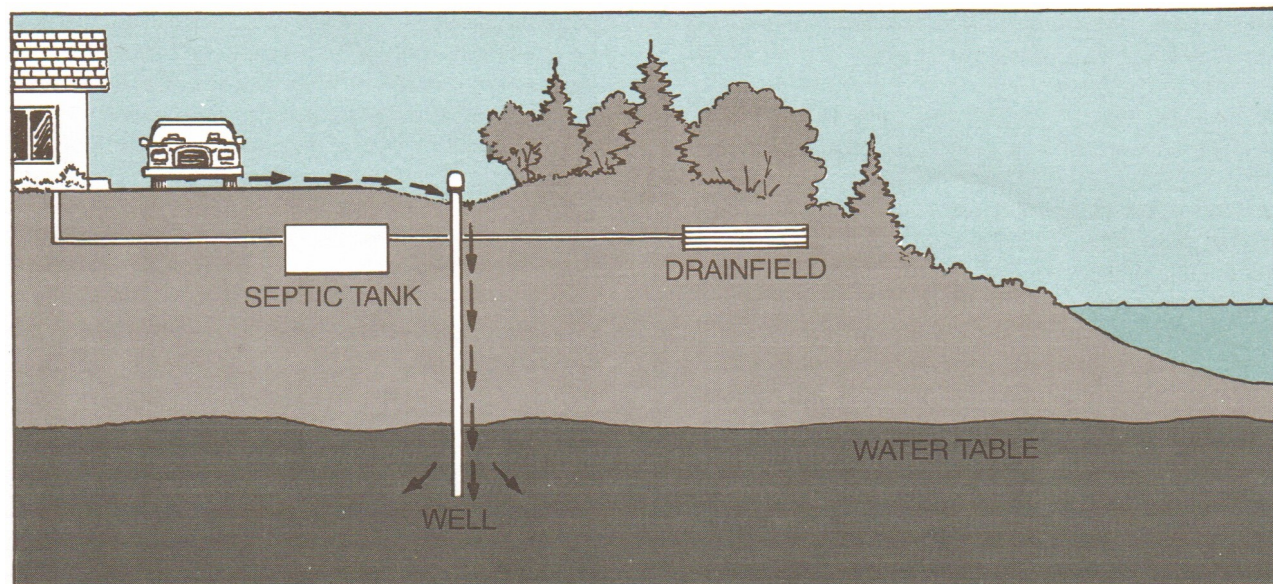


Lake Leelanau

Common Problems and Their Causes



Well Water Safety

If at any time your drinking water suddenly develops a strange color, smell or taste – stop drinking it immediately and get it tested! Your household water supply is nothing to fool around with—it’s your most serious and immediate vulnerability to water pollution. Virtually all residents in the Lake Leelanau watershed rely on wells that tap the groundwater to supply their homes, businesses and farms. Therefore, you act as your own water utility and bear the primary responsibility for protecting yourself and your family.

In general, the groundwater of the Lake Leelanau watershed is of exceptional quality. Layers of porous material, such as sand and gravel, lie beneath the surface of the land and hold large amounts of freshwater. These water-bearing formations act like giant sponges that hold the water in a subterranean reservoir. Like surface water, ground water flows, although at a much slower rate. The groundwater is recharged by rainfall and precipitation that soaks into the ground

and slowly migrates into the groundwater reservoir. Often, the groundwater reemerges as springs that replenish creeks and lakes. On the other hand, groundwater can remain underground for hundreds of years.

The process of precipitation hitting the surface and migrating to the deep reservoirs acts like a filtration system and removes impurities. In an environment where natural systems like wetlands and forests are still intact, the vegetation removes most of the impurities from moisture in the first few feet of soil and subsoil. In an area of dense human development, the moisture that enters the groundwater often bypasses natural filtration systems. For instance, the effluent from a properly operating septic system is broken down by biological activity in your septic tank and field. Nevertheless, the biological activity produces nutrients that begin the downward migration into the groundwater supply without passing through a “green” living filter such as a wetland. If too many septic fields load the groundwater in a concentrated area, the result can be unhealthy levels of compounds such as nitrogen (see page 13 for health risks related to nitrogen).

Things to do:

- Arrange to have your well water tested periodically (your health department provides this service). It may have been decades since it was last tested—and don't rely on the test results of a neighbor! Two water wells side by side could be tapping two different water-bearing formations, with two very different water quality results.
- Always work with reputable, licensed well drillers that secure the proper permits. Ask for references and check with the Health Department if you have any doubts.
- Identify the location of your water well and septic field. The well shaft should be sealed around the perimeter to stop surface water from working its way down the side of the well shaft and directly into the groundwater (not just in dry conditions, but also during rainstorms). **THIS IS A COMMON WAY THAT WELLS BECOME TAINTED!** (See figure on page 16.) Make certain that the well is far enough away from the septic field that effluent from the septic system has no opportunity to work its way into the groundwater alongside the well shaft. In general, make certain that your septic field is in proper working order. See page 34 on Waste Water Management and page 32 on Stormwater Controls.
- Never dispose of toxic chemicals, such as gasoline, motor oil, antifreeze, solvents, etc., in your drain (and thereby into your septic system) or by spreading on the ground or driveway. These chemicals can migrate deep into the earth and a small amount can taint huge quantities of groundwater. See page 36 on Hazardous Material Disposal.

Who to contact for help:

- See page 48 for the Environmental Health Department.

Septic System Maintenance

Virtually every home on Lake Leelanau uses some form of a septic system or holding tank to dispose of wastewater. The drain pipes of the household plumbing system lead to a large concrete tank buried near the house. Solids settle to the bottom of the tank. Greases and oils float to the surface. Anaerobic bacteria (bacteria that thrive without oxygen) in the tank decompose the wastes into by-products such as carbon dioxide, methane and water. If the system is a holding tank, the tank is regularly pumped out and the wastes is usually spread in agricultural fields.

Most septic systems use a drain field. The drain field is a grid of perforated drain pipes buried in gravel and is covered with several feet of soil. The septic tank is designed so that as wastes in the septic tank break down into liquids, the wastewater moves through an outflow pipe and flows into the drain field. There, the waste waters soak into the gravel and migrate into the soil. In the drain field, another form of bacteria (aerobic, or oxygen-using) continues to break down compounds in the wastewater.

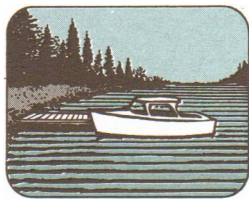
Septic systems do an excellent job of eliminating dangerous organisms such as coliform bacteria. Although a properly operating septic system will not necessarily protect the watershed from phosphorus and nitrogen, it will do a lot better job than a out-dated or faulty system. Thus, the need to maintain the system properly—for your family's health and the lake's health.

Things to do:

- Read and carefully follow the BMPs on pages 34-35.

Who to contact for help:

- See page 48 – Environmental Health Department
- See page 48 – Michigan State University Extension (for literature)



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Lake Water Clarity and Weeds

Twenty people will probably have twenty different opinions on what exactly constitutes good water quality. Most would agree that colorless clear water, free of suspended solids would be the first qualification. For those folks who have spent most of their lives in the south, or even downstate Michigan, the clarity of northern lakes such as Lake Leelanau is breathtaking. On the other hand, long time residents know or suspect that the lakes aren't as clear as they used to be. Something is changing in Lake Leelanau.

Seasonal changes and weather conditions can also have an impact on clarity. A sustained wind can churn up loose sediment in shallows and cloud the water, as can the biannual temperature inversion that causes a flip-flop between bottom and surface water. The cold winter freeze can set back the advance of weed beds and biological activity temporarily, but where the conditions are right, weeds and aquatic plants will grow quickly in northern lakes.

Scientists measure clarity with a Secchi disk. The Secchi disk is a small black and white plate that is lowered into the water on a line. The technician

determines the depth at which the disk can no longer be seen and established a numerical rating. Other important indicators are the phosphorous and chlorophyll-a levels. Both compounds are directly related to biological activity which produces particulates and clouds water. Just a few parts per billion of phosphorous and chlorophyll-a can determine the difference between a coffee-colored backwater and clear trout lake.

Water clarity as measured with a Secchi disk is simply a technical formulation of what we can all see for ourselves. The Secchi disk readings from North Lake Leelanau suggest that water clarity has been improving slightly over a nineteen year period. Nevertheless, wide annual swings demonstrate the need for many years of data to distinguish year to year changes from long term trends.

Old timers around Lake Leelanau will identify weed beds that have expanded over recent years or appeared where there were none before. Like the microbiological activity, the weeds too, benefit from the exploding amounts of available nutrients in the water. "Treating" (which is actually poisoning) weedbeds only treats the symptoms, not the cause, and can lead to wider problems in the ecosystem.



At left, a volunteer with the local self-help Secchi disk water clarity test program sponsored by the Michigan Lakes and Streams Association prepares to lower the disk into the water. At right, Walt Nielsen measures a tributary's stream flow with a pygmy current meter in a program sponsored by the Leelanau Watershed Council.



Over long periods of time, lakes slowly fill with sediment and accumulate nutrients from thousands of generations of plants and animal life. This process is known as eutrophication and is the natural aging process, or succession of lakes. Given enough time, all lakes will eventually become more and more like a swamp. When human populations move into a lake watershed, the aging process accelerates dramatically. What may take a lake thousands of years to deteriorate in a natural system, can occur in a matter of decades, or less, with human residents.

Why do humans age a lake so quickly? The answer is simple: our activities upset the balance and accelerate the movement of nutrients into the water system at a fast pace. On the other hand, a few simple alterations to behavior can greatly slow the aging process of the lake.

The root cause of murky water is the microscopic aquatic plant growth that is accelerated by the nutrient phosphorous. Therefore, all the solutions to water clarity focus on reducing or eliminating phosphorous from the water system.

Things to do:

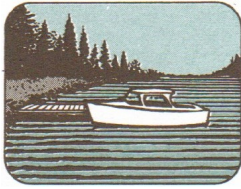
- Avoid the use of fertilizers within 20 feet of the shorelines of the lake or tributaries. If possible, switch to landscape techniques that need no artificial chemical stimulation. If you must use fertilizer, use one that contains phosphorous only if a soil test confirms that the compound is necessary. A 20-20-20 fertilizer is high in phosphorous. A 20-0-20 fertilizer contains no phosphorous. See page 27 for landscaping and lawn care.
- Avoid the use of household products, such as detergents, that contain phosphorous. When phosphates (a phosphorous compound common in detergent) enter the septic system, they easily migrate into the drain field and can seep into the lake water. A properly designed and installed septic field will protect you from harmful bacteria, but it will not stop the entry of nutrients into the

Water system – only you can, by not using phosphorous in the first place. See page 34 for Waste water management.

- Divert runoff from impervious surfaces like roofs and driveways into vegetated areas where the sediment can settle and plants can absorb the nutrients. Nutrients will attach themselves to common sediments and follow runoff. See page 32 for Stormwater Runoff.
- Avoid installing seawalls at the lake shore. The action of waves at a seawall create turbulence and stir up sediments in the shallows that cloud the water and release nutrients. Seawalls are also poor filters for nutrients in surface runoff. Maintain the natural vegetation and you will be rewarded by cleaner lake water. See page 33 for Shoreline Stabilization.
- Never attempt to “treat” aquatic weed beds on your own. Weed treatment is a technically complicated process that impacts everyone that uses the lake and it’s illegal without a permit. It’s a process that should be used only as a last resort and only after a community consensus.

Who to contact for help:

- See page 44 – Lake Leelanau Lake Association
- See page 45 – Leelanau Conservation District
- See page 47 – Natural Resource Conservation Service
- See page 49 – Michigan Lakes and Streams Association.



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Erosion Control and Shoreline Stabilization

After paying the market rate for Lake Leelanau waterfront property, who can blame a lake dweller for their panic as they watch wind-driven waves slowly eat away at their shoreline. Typically, the first reaction is to build a physical barrier and stop the erosion immediately and permanently. The fact is, that shoreline erosion is bad for the health of the lake as well as the landowner. The challenge is coming up with a solution that satisfies the needs of the landowner and preserves the integrity of the water quality at the same time.

In general seawalls generate as many problems as they solve. Seawalls are often installed after natural shrubs and trees have been removed, and thereby indirectly increase the nutrient load in the lake. The more seawalls around the lake, the more quickly the lake's water deteriorates. Also, the wave action against a seawall generates a turbulence that loosens sediment, clouds the water and frees up nutrients. When seawalls replace overhanging vegetation and shore plants in the shallows, the immature fry of game fish species and bait fish have nowhere to hide and feed and eventually, the native reproduction of fish will diminish.

Another popular feature for the waterfront is a sandy beach for swimming. If the sandy beach doesn't occur naturally, many people will simply truck in a few loads of sand and make one. Unfortunately, it's probably the worst thing a homeowner can do from the standpoint of water quality. The sandy slope will attract runoff from a wide area during rainstorms and channel the runoff straight into the lake. Sand beaches do not filter nutrients. Remember, water will always follow the path of least resistance.

The biggest generator of erosion is construction. When the typical forest cover of the Lake Leelanau watershed is cleared for a building, the disturbed soil will erode 2000 times faster than when it was intact!



An undercut bank shows signs of shoreline erosion.

As a result, Leelanau County strictly enforces the Soil Erosion and Sedimentation Control Law (Part 91 of Act 451 of 1994) which requires a permit for any earth change within 500 feet of a lake or stream, or that disturbs one or more acres. To receive a permit, the applicant must submit an approved plan and take precautions to minimize erosion. In Leelanau County, P.A. 347 is administered by the Leelanau Conservation District. Don't forget, construction projects may require zoning permits, building permits, and even wetland permits as well. Check with your local authorities before you break ground. For more information see page 42 for a summary of permit requirements.

Unfortunately, we can't have it both ways. The more we develop our waterfronts like swimming pools, the more the lake will become like a swimming pool—and we'll need the pool chemicals to keep it usable. A more constructive approach is to establish (or reestablish) a green buffer at the shoreline between the water and the soil. A combination of rock, temporary barriers, and plantings can quickly become an effective deterrent to shoreline erosion and more esthetically pleasant in the bargain.

Things to do:

- If you already have a breakwall at your shoreline, establish a green buffer behind it. A 20 foot width is recommended for the green buffer.

- Leave and improve the natural vegetation on shorelines and along creeks whenever possible. The root systems of the shrubs and trees are often many times larger than the portion of the plant above ground and act to strengthen the bank against wave or current action. See page 27 for Green Buffers.

- Contact the Leelanau Conservation District before starting any construction projects at or near the lake shores and creeks. The earlier you learn the regulations the easier it will be to design your project. The district offers advice and can put you into contact with builders if necessary. The alternative is a possible penalty and/or fine. Note: zoning and building permits may also be necessary for certain construction projects. See page 46 for the Leelanau Conservation District.



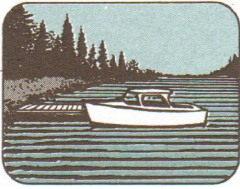
The Lake Leelanau Fishery

We know from the records of bygone days that a substantial naturally propagating populations of trout once inhabited the waters of Lake Leelanau. Natives and early settlers relied heavily on fish for sustenance. When the dam was constructed in Leland, fish access back and forth to Lake Michigan was halted. No doubt, the shoals of Lake Leelanau and its tributaries were an important spawning grounds for lake run trout among other species. Once landlocked, Lake Leelanau became a radically different fish habitat.

In 1988, a DNR study described the “natural recruitment” (reproduction) of lake trout as “nil”. Of the seventeen lake trout collected in a gill net, virtually all of them had been planted. Brown trout, too, showed a serious decline. According to the Lake Leelanau Lake Association’s Fish Committee, in the 1950s the lake was known as the “Brown Trout Capital of Michigan”.

At the same time, Lake Leelanau has a fine self-sustaining smallmouth bass population and a variety of other gamefish such as panfish, pike and perch. Aggressive planting programs have established schools of walleye. Lake trout and brown trout continue to be planted each year, and even an experimental planting of whitefish has been tried.

The species that are declining in Lake Leelanau are species best adapted to oligotrophic lakes—the relatively young cool, deep lakes, that are free of nutrients build-up. Low nutrients means plentiful quantities of dissolved oxygen. When nutrient levels increase, so does the microscopic aquatic animal life. The aquatic animals compete for the same supply of dissolved oxygen that the trout need. Trout have a low tolerance for low amounts of dissolved oxygen. Other fish species, such as pike and bass,



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56 boats with some 113 anglers took part in the 1996 Walleye Festival competition

pike and bass, can tolerate much lower levels of dissolved oxygen than trout, and so they gain a competitive edge. Usually, the succession of species is gradual and parallels a general decline in the water quality.

The lack of natural reproduction in fisheries and weak populations can also be linked to other factors. Shoreline wetlands are critically important as spawning grounds and nurseries for the small fry of game fish. The fry of some species may spend the entire first season of their lives hiding in the reeds at the lake shore. When wetlands are replaced by seawalls or solid fill, the entire reproduction cycle can be choked off in an perfect fish habitat. Wetlands also provide plenty of forage for the food chain: insects, bait fish and crustaceans.

Heavy sediment deposits that settle on the lake bottom from erosion problems can also bury important feeding and spawning grounds where fish need ready gravel.

Things to do:

- Take no more fish than you need and observe creel limits. The collective impact of human fishermen can devastate a fish population. Humans are the only predator that methodically takes the strongest and largest individuals from the population.
- Maintain a natural lake shore thick with vegetation and minimize disturbances to overhanging branches. Protect the natural shoreline nursery grounds. Take precautions to stop nutrients from entering the watershed.
- If you launch in other lakes besides Lake Leelanau, clean your boat thoroughly and flush your bait boxes and motors before launching in Lake Leelanau. Zebra mussels and other exotic species can't reach Lake Leelanau except as hitchhikers on watercraft.



Cladophora

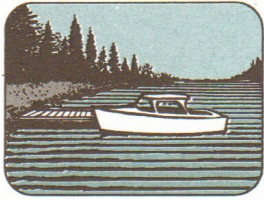
Be on the lookout for this peculiar mossy looking aquatic weed. Specifically, cladophora is a genus of relatively large forms of algae with about a dozen species that inhabit the Lake Leelanau environs. It grows on rocks or other hard-surfaced bottom material on which it can anchor, and it needs at least a moderate amount of wave action. Most importantly, it needs a rich source of nutrients—a lot of nutrients, and its presence around the shore of Lake Leelanau can identify a localized phosphorous source. The plant will thrive especially in a spot that has a continuous rich stream of phosphorous input from a faulty septic system, animal wastes, fertilizer, etc.

The plant is usually green and characteristically waves and undulates freely in the current. The branches are tufts of about eight to ten inches in length that can thickly carpet entire areas or occur in isolated clusters. Upon closer inspection, the

tufts are comprised of a main axis and finer filaments that branch off.

Don't panic at the sight of cladophora in the shallows, but take it as a sign. Cladophora growth can help to pinpoint problem areas. It could indicate a septic problem, chronic fertilizer over-application or even a soil erosion problem—and point the way to remedial action. If you do find it on your shore or downstream, you should closely evaluate your own practices.

For more information contact the Lake Leelanau Lake Association (page 44) or the Leelanau Conservation District (page 46).



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Swimmer's Itch

Swimmer's itch is a little like poison ivy: not everyone exposed develops a reaction, and you can take measures to avoid it. Eradicating it altogether in Lake Leelanau is probably not feasible.

The problem starts when swimmers encounter the larvae of a tiny flatworm. The larva, called cercaria, is about 1/32 of an inch long and is a parasite looking for a host body in which to burrow and grow. When cercaria encounter a human and burrow into the skin, the larvae soon dies since humans aren't a suitable host. The swimmer may develop an allergic reaction to the dead parasite in the form of reddened skin and intense itching. The discomfort is usually gone in a couple days and poses little serious threat to the victim's well-being. It may come as little comfort to the afflicted, but less than half of the people that encounter cercaria are prone to the allergic reaction.

At the stage where the cercaria latches onto a human, the larva is searching for a waterfowl host, such as duck or goose. If it finds the proper host, the larva burrows into the animal's tissue and grows into a mature schistosome flatworm. Eventually, the mature flatworm lays eggs which reenter the lake by way of the bird's droppings and hatch into another form of larva called a miracidia. The miracidia needs to find a snail host in which to burrow and generate cercaria, and when the cercariae leave the snail host in search of waterfowl host, the cycle becomes complete.

At least nine different species of flatworms that produce the swimmer's itch reaction inhabit Lake Leelanau, and each one requires a different waterfowl and snail host combination to complete its life cycle. Several strategies of swimmer's itch control are currently in the experimental stage. These focus on treating waterfowl with a drug that will kill the flatworms but leave the bird unharmed.

Traditionally, copper sulfate was used to chemically control the problem by poisoning the snail hosts. Unfortunately, copper sulfate is an indiscriminate poison that kills a wide array of aquatic plants and animals which are critical to the general health of the lake. Also, the chemical is relatively ineffective in deeper water, and in a short period of time the flatworms and the host snails recolonize the treated areas. Note that strict laws control the use of copper sulfate: application of the chemical into the lake requires a permit issued by the Department of Environmental Quality.

A study in 1990 through 1992 by Dr. Harvey Blankespoor and sponsored by the Leelanau Conservancy in cooperation with local lake associations surveyed the extent of swimmer's itch in area lakes and experimented with control techniques. Interestingly, mute swans and common mergansers showed the highest rates of infection by flat worms, while geese and other ducks were infected at much lower rates. During the study period, the Conservancy set up a swimmer's itch hotline to receive reported incidents of the malady. Of the 128 calls in 1990, all but seven originated from Lake Leelanau and showed the problem was geographically widespread. Some individuals examined by Dr. Blankespoor had over 200 welts on their bodies.

Due to the high degree of infection in the common merganser, the Lake Leelanau Lake Association employees volunteers in powerboats to harass this species of duck during the spring migratory season. The birds are chased and annoyed by firing of blank shotgun shells to encourage them to continue moving north in hopes that they will next where the water is too cold to support the flatworm. Landowners can help by sealing the merganser's preferred nesting site in 3-5 inch holes in beech trees.

Things to do:

- Towel off vigorously after swimming and change into clean dry clothes. It can take 10-30 minutes for the cercariae to burrow into the skin after contact. The larvae cannot tolerate dry conditions and will die immediately.
- Avoid swimming at midday when the cercaria are most active and in areas exposed to prolonged onshore winds (the larvae drift near the surface and accumulate in a wind).
- Swim in deeper water where the snails are unlikely to occur.
- Apply an oily substance such as baby oil or a waterproof sunscreen before entering the water.

- Avoid feeding waterfowl and attracting them into your swimming area. Their presence will only exacerbate an existing problem.
- In case of exposure, some feel that application of topical antihistamine, such as Benadryl, will relieve the itch.

For More Information:

- Contact the Leelanau Conservancy for a copy of the swimmer's itch study, see page 45 for the Leelanau Conservancy, or see page 44 for the Lake Leelanau Lake Association.

