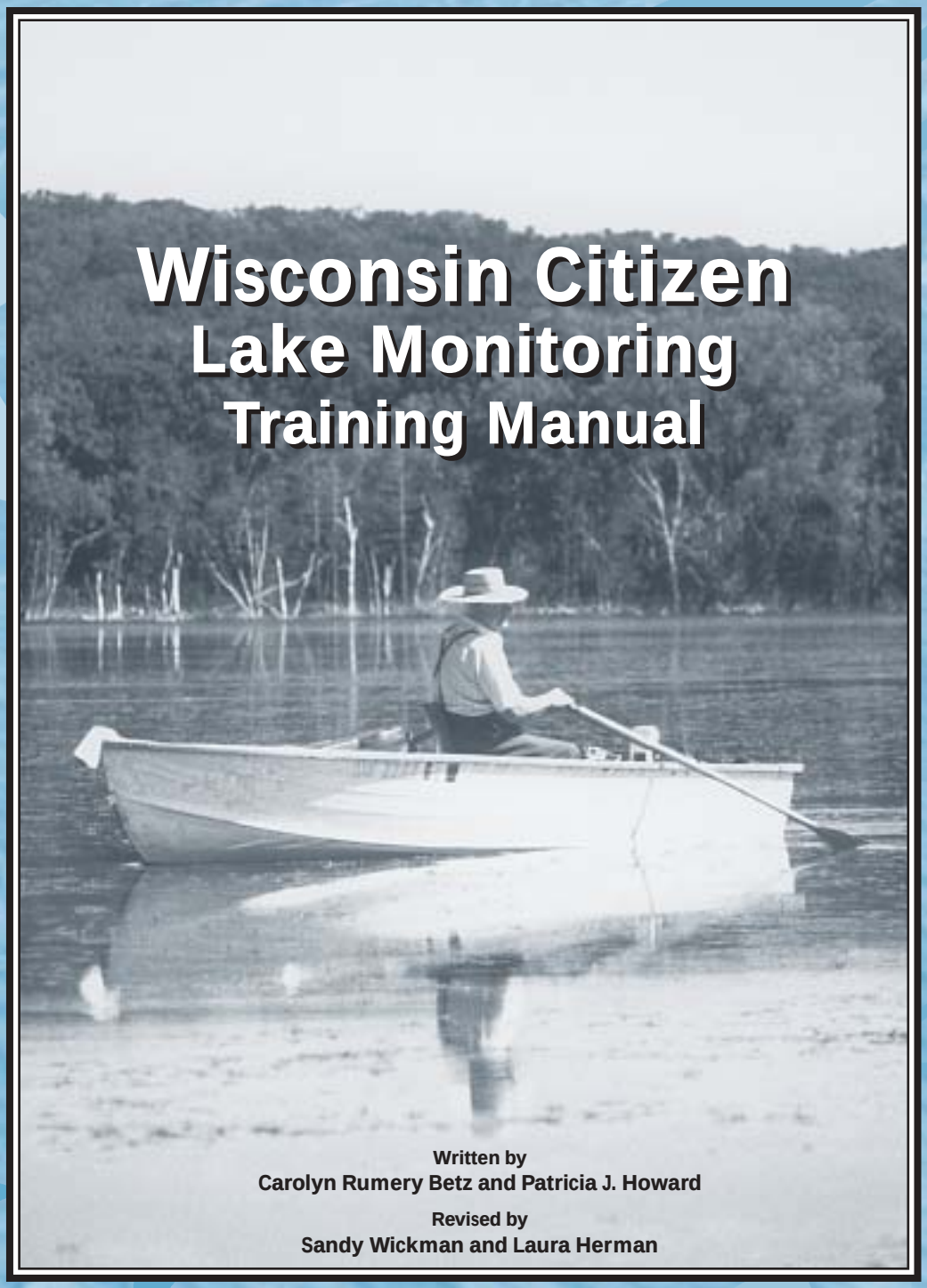
Wisconsin Citizen Lake Monitoring Training Manual



Written by
Carolyn Rumery Betz and Patricia J. Howard

Revised by
Sandy Wickman and Laura Herman

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Written by Carolyn Rumery Betz and Patricia J. Howard

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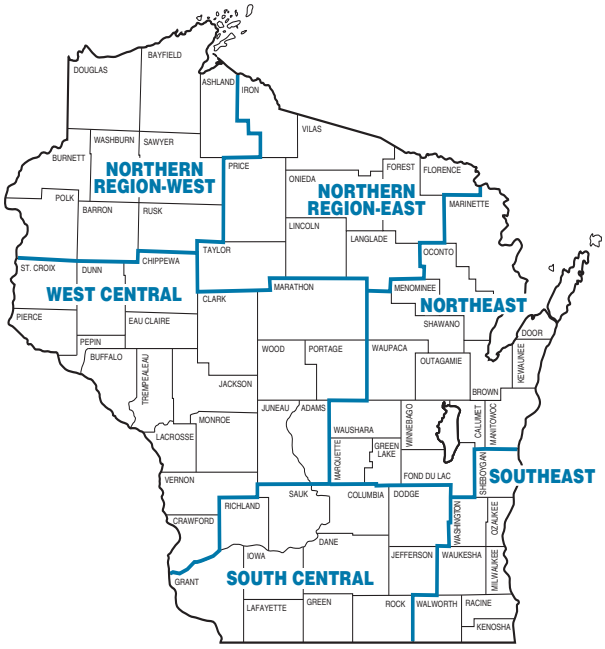
NOTES

Need Answers to Your Questions?

When questions arise please contact the appropriate people below. You may also be able to find answers to your questions on the Wisconsin DNR website at **dnr.wi.gov/org/water/fhp/lakes/selfhelp/** by choosing the link for FAQ under "Quick Links" on the right side of the page.

If you are interested in becoming a citizen lake monitoring volunteer, or have questions about training, refresher courses, or other monitoring opportunities, please contact Laura Herman, Citizen Lake Monitoring Network Educator, at (715) 346-3989 (Stevens Point) or (715) 365-8998 (Rhinelander), or by email **Laura.Herman@uwsp.edu**.

For questions about the database, reporting data, awards, or annual reports please contact Jennifer Filbert at (608) 264-8533 or toll free at (888) 947-3282, or by email **Jennifer.Filbert@wisconsin.gov**.



For questions about equipment, sampling procedures, or interpreting your data please contact your regional coordinator:

Location	Name	Phone Number	Email
Northern Region- West	Dave Blumer	(715) 635-4078	David.Blumer@wisconsin.gov
Northern Region- East	Sandy Wickman	(715) 365-8951	Sandra.Wickman@wisconsin.gov
Vilas County	Carolyn Scholl	(715) 479-3648	Cascho@co.vilas.wi.us
Northeast	Christina Hodge	(920) 303-5449	Christina.Hodge@wisconsin.gov
West Central	Deb Konkel	(715) 839-2782	Deb.Konkel@wisconsin.gov
Southeast	Heidi Bunk	(262) 574-2130	Heidi.Bunk@wisconsin.gov
South Central	Donna Sefton	(608) 275-3330	Donna.Sefton@wisconsin.gov

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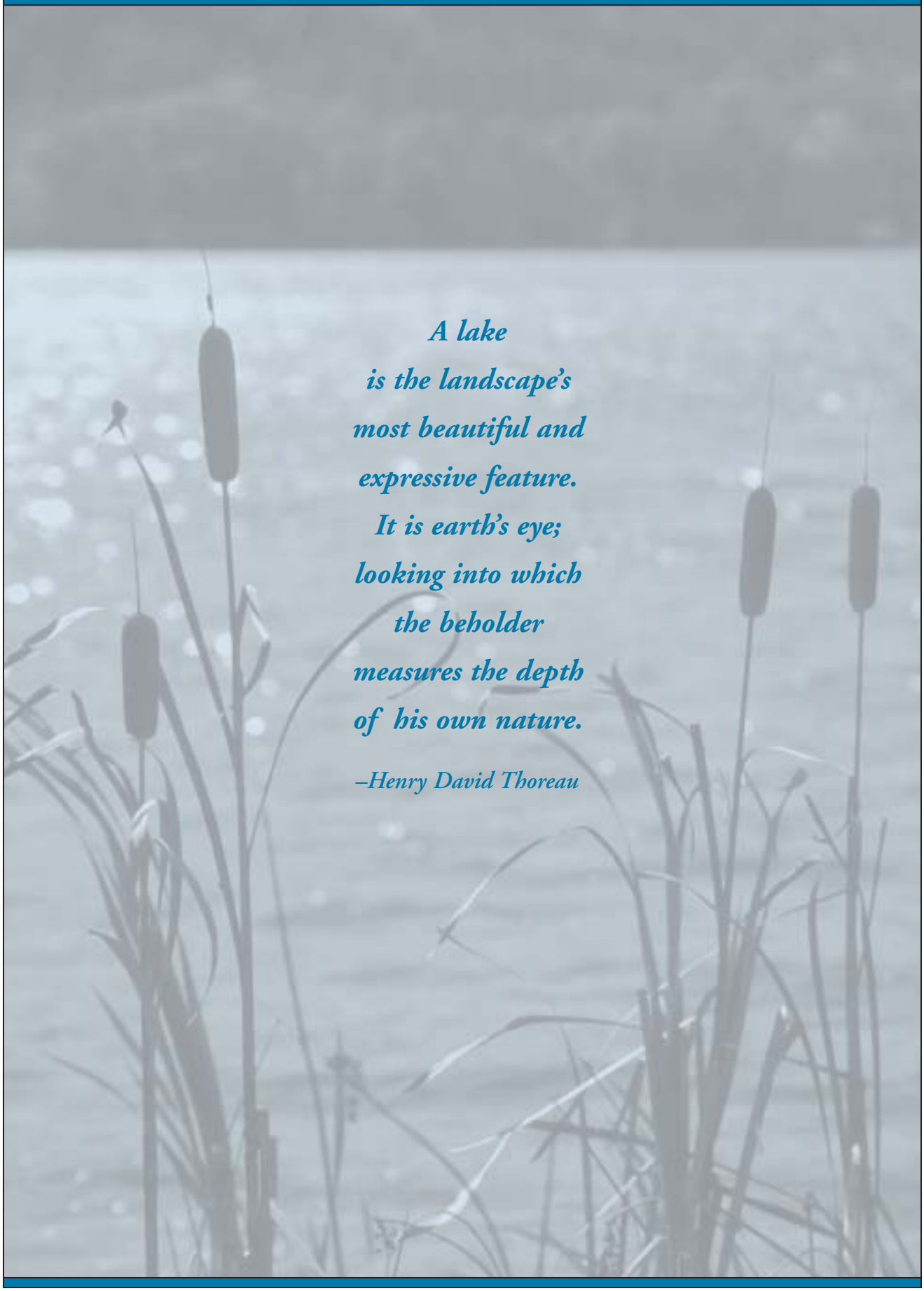


A lake is the landscape's most beautiful and expressive feature. It is earth's eye; looking into which the beholder measures the depth of his own nature.

–Henry David Thoreau

Introduction

THANK YOU for joining the Self-Help Lake Monitoring Network. You are one of over a thousand citizen volunteers currently monitoring Wisconsin's lakes. Over one million acres of Wisconsin is covered by water. Wisconsin's 15,000 lakes contribute significantly to the economy of individual communities and the state. In addition, these lakes offer diverse recreational opportunities and provide important habitat for fish, waterfowl, and other wildlife. The Self-Help Lake Volunteer Monitoring Network provides an opportunity for citizens to take an active role in maintaining quality water. Through this volunteer network, you can learn about your lake and help the Wisconsin DNR gain a better understanding of our state's lakes. More importantly, you can share your knowledge and the information you gather with your **lake association** and other lake residents.

The volunteer network partnering concerned citizens and the Wisconsin DNR was initiated in 1986 and is part of the Wisconsin Lakes Partnership. In the network's first year, volunteers throughout the state monitored 129 lakes. Since then, the network has grown to include over 1,200 volunteers monitoring more than 900 lakes statewide! Some volunteers may monitor more than one lake and in some cases larger lakes are monitored in more than one location. Many volunteers share monitoring responsibilities with a friend or a group of friends.

Self-Help Lake Monitoring allows you to collect many types of data. The types of data you collect will depend on what your concerns and interests are, as well as, the amount of time you want to spend monitoring. **Secchi disc** monitoring is the most common type of monitoring. Secchi volunteers collect water clarity information on their lakes beginning in the spring and finishing in the fall. After collecting Secchi data for one or more years, some volunteers choose to get involved in other types of monitoring. Chemistry volunteers collect **phosphorus** and **chlorophyll** samples five times a year *in addition to* collecting Secchi data. This more extensive volunteer monitoring allows Wisconsin DNR

A full glossary of highlighted terms is provided on page 46 of this manual.

LAKE ASSOCIATION • *A voluntary organization with a membership generally comprised of those who own land on or near a lake. The goals of lake associations usually include maintaining, protecting, and improving the quality of a lake, its fisheries, and its watershed. Membership can include all or a few of the people living on a lake and those not living on a lake.*

SECCHI DISC • *An 8-inch diameter plate with alternating quadrants painted black and white that is used to measure water clarity.*

PHOSPHORUS • *The major nutrient influencing plant growth in more than 80% of Wisconsin lakes. Soluble reactive phosphorus refers to the amount of phosphorus in solution that is available to plants. Total phosphorus refers to the amount of phosphorus in solution (reactive) and in particulate forms (non-reactive).*

CHLOROPHYLL • *Green pigment present in all plant life and necessary for photosynthesis. The amount of chlorophyll present in lake water depends on the amount of algae and is therefore used as a common indicator of water quality.*

DISSOLVED OXYGEN *• The amount of free oxygen absorbed by the water and available to aquatic organisms for respiration. The amount of oxygen dissolved in a certain amount of water at a particular temperature and pressure, often expressed as a concentration in parts of oxygen per million parts of water.*

ZEBRA MUSSEL *• A tiny bottom-dwelling mollusc native to Europe.*

ALGAE *• Aquatic plants that use sunlight as an energy source (e.g., diatoms, kelp, etc.). One-celled (i.e. phytoplankton) or multi-cellular plants, either suspended in water (i.e. plankton) or attached to rocks and other substrates (i.e. periphyton). Their abundance, as measured by the amount of chlorophyll a (green pigment) in a water sample, is commonly used to classify the trophic status of a lake. Algae are an essential part of the lake ecosystem and provides the food base for most lake organisms, including fish. Phytoplankton populations can vary widely from day to day, as life cycles are short.*

WHAT IS THE REMOTE SENSING PROGRAM?

The University of Wisconsin (UW) has been successful in predicting water clarity in lakes using satellite images. Every year the Wisconsin DNR receives this satellite data. Different atmospheric conditions (e.g. cloud cover) occur in each satellite photo, so in order to predict water clarity for all the lakes in any given satellite image, the UW needs volunteer Secchi data that correspond to the lakes in each satellite photo. As a Secchi volunteer, the Self-Help network will send you the dates that satellite photos will be taken of your lake. Try to obtain Secchi readings on as many of these satellite dates as you can. Just think, on a clear satellite date, your Secchi reading may translate into hundreds of others; almost as if you're monitoring hundreds of lakes at one time!

lake managers to assess the nutrient enrichment state for their lakes. In addition, some volunteers also collect temperature and **dissolved oxygen** (DO) data for their lakes. Other types of monitoring activities include **zebra mussel** monitoring, Eurasian water-milfoil watch, Purple loosestrife watch, curly-leaf pondweed watch, and other aquatic plant monitoring. Ideally, all volunteers will be able to find a level of involvement that suits their interests and abilities.

The partnership between the volunteer monitors and the Wisconsin DNR has resulted in an extensive volunteer monitoring database. Data collected by volunteers has been published in numerous reports and is frequently used by limnologists (scientists who study lakes) and water resource planners for a variety of purposes. In addition, volunteer data is reported to the U.S. Environmental Protection Agency (EPA) on a regular basis.

What Types of Monitoring Can I Participate In?

Sediment flowing into a lake may not have a uniform distribution. Likewise, on windy days **algae** can accumulate along the shoreline. Each piece of information about your lake requires its own tool and will help you learn more about its overall health. The Secchi disc is one of many tools you will use to collect data as a citizen volunteer. A Secchi depth reading is intended to give a general picture of your lake's water clarity. The types of data that the Self-Help network collects are selected to "get the most bangs for the buck". The sampling is easy to do and does not require sophisticated, high-maintenance equipment nor demand a background in science, chemistry, or engineering.

Secchi

If you are participating as a Secchi volunteer, you will observe and document your lake's water quality by measuring the clarity of your lake's water using a Secchi disc. A Secchi disc is an 8-inch black and white disc that is lowered into the water on a marked rope

until it can no longer be seen. The disc is then raised until you can just see it again and the average depth is recorded. Measuring the water clarity or transparency of your lake, provides a "pulse" on the health of your lake, and is a crucial record for long-range planning.

Water Chemistry

After one year of Secchi (water clarity) monitoring, you may be eligible to participate in water chemistry monitoring. Chemistry volunteers, in addition to measuring water clarity and temperature, **will collect water samples for analysis five times** a year. These samples will then be sent to the **State Laboratory of Hygiene** for analysis. The information you collect when monitoring water chemistry will be used to determine the **trophic state** of your lake. Training and equipment for this type of sampling are provided by the Wisconsin DNR. Secchi volunteers who have participated in the network for at least one sampling season and are interested in becoming a chemistry volunteer should contact their Self-Help regional coordinator.

Temperature and Dissolved Oxygen

If you decide to monitor the temperature and dissolved oxygen levels in your lake, you will be responsible for creating a sample profile. This data collection technique consists of measuring the temperature and dissolved oxygen of your lake from a variety of depths at a single sampling location. When doing this type of sampling, you will collect between 5 and 10 water temperature and dissolved oxygen samples from pre-determined depths based on the maximum depth of your lake. This sample technique will help you to understand the dynamics of your lake. The purpose behind collecting profile data is to show how water characteristics can change with depth. In general, you will sample a profile of your lake at its deepest point (the deep hole). Just as you measure your core body temperature when you are sick, the best indicator of lake health is measured at the core or deepest part of the lake.

Aquatic Invasives Monitoring

Aquatic plants can be good indicators of lake health. Over time, the types of vegetation and size of plant beds

PUBLIC PERCEPTION OF WATER QUALITY

As part of your Secchi data collection, the Self-Help network is interested in your opinion of the lake's water quality when you are sampling. Using these observations, a public opinion assessment of water clarity can be made. This information will help determine water quality standards for lakes. There is no right or wrong answer to these questions and your answer can change throughout the summer or in subsequent years. Specifically, citizen volunteers will be asked to note the algal content of the water. Is there so much algae that you want to shower after swimming? Do you not want to go swimming? In addition to the Secchi disc readings that you measure, the Self-Help network is concerned with your opinion of what constitutes good or poor water quality.

The Self-Help network predicts that the public opinion question will reveal that people living in one area of the state will have similar perceptions of what they consider to be acceptable water clarity. The network hopes to share this information with other states in anticipation of creating a regional map of public perceptions of water clarity.

STATE LABORATORY OF HYGIENE *• The State of Wisconsin's premier public health and environmental laboratory.*

TROPHIC STATE *• The extent to which the process of eutrophication has occurred is reflected in a lake's trophic classification or state. The three major trophic states are oligotrophic, mesotrophic, and eutrophic.*

EXOTIC SPECIES *• A non-native species of plant or animal that has been introduced into an ecosystem.*

TURION *• The bud of that breaks off from an aquatic plant and lies submerged and dormant until it produces a new plantlet.*

ADOPT-A-LAKE *• An inter-disciplinary program sponsored by the Wisconsin Lakes Partnership and UW-Extension Lakes Program. This program uses hands-on activities to encourage youth to learn about inland lakes in Wisconsin while actively working to protect those resources.*

Eurasian Water-milfoil

© Used with permission by University of Florida Center for Aquatic Plants (Gainesville).

Purple Loosestrife

may change in response to changes in water quality and human activity. Aquatic plant monitoring is tailored to your abilities, interest, and time commitment. Some volunteers choose to identify and map submergent, emergent, and floating aquatic vegetation on their lake; other volunteers may collect and press their lake's aquatic plants after identifying and mapping them. In addition, familiarizing yourself as to what aquatic vegetation is present in your lake is a great way to monitor for the presence of **exotic species**.

Eurasian Water-milfoil Watch

All volunteers are encouraged to watch for Eurasian water-milfoil. Eurasian water-milfoil is a non-native aquatic plant that continues to invade many lakes throughout the state. It can dominate lake habitats and displace native species. Watching for this exotic plant is not difficult. It involves inspecting shorelines and water surfaces for plant fragments and checking plant beds throughout the lake a few times during the summer. Early identification of this non-native invader makes it easier to control and potentially eradicate. If you are interested in monitoring Eurasian water-milfoil, please contact your Self-Help regional coordinator. Volunteers interested in participating in the Eurasian water-milfoil watch will receive a packet of information on how to identify the plant, reporting forms, a laminated plant sample, and instructions on when and where to look for the plant.

Purple Loosestrife Watch

Another exotic species that all volunteers are encouraged to watch for is purple loosestrife. Purple loosestrife is a beautiful but aggressive exotic plant that can displace native wetland vegetation. Because this exotic flowering plant is often confused with native wetland plants (e.g., pickerel weed and smartweed) volunteers are provided with materials to make identification easier. Once you are familiar with the plant, monitoring involves watching shorelines and surrounding areas in July looking for the characteristic bright magenta flowers of purple loosestrife. If a new infestation is found, you will send a report identifying its location to the Wisconsin DNR. For isolated, small infestations or new pioneering plants, volunteers may opt to use traditional control measures (i.e. cutting, pulling, or using chemical treatments). Larger infestations may require large-scale chemical or biological control efforts. In these cases, volunteers may

be recruited to rear and release *Galerucella* beetles that ingest purple loosestrife. Reporting forms and instructions for monitoring and control will be provided. If you are interested in monitoring purple loosestrife, please contact your Self-Help regional coordinator.

Curly-leaf Pondweed Watch

In Wisconsin, aquatic curly-leaf plants usually complete their life cycle by June or July. The over summering bud (called a **turion**) breaks off from the plant, falls to the bottom of the lake, and lies submerged and dormant. The turions begin to sprout late in the summer or fall, responding to the shortening day length and water temperature. The new plantlet continues to grow even under the ice of winter. Check plant beds on calm, clear days from ice off until mid-July a few of times a year. If you find something that you think may be curly-leaf pondweed, collect it, press it, and send it to your Self-Help regional coordinator for identification.

Zebra Mussel Watch

The Zebra mussel is an exotic species that has been recently introduced into Wisconsin's lakes. Once in a lake, this mussel species can spread rapidly and has the potential to alter natural lake communities. By watching for the zebra mussel, volunteers can help with our understanding of these organisms and hopefully slow their spread. Zebra mussels are able to attach themselves to almost anything including docks, boats, rocks, sticks, plants, and even other mussels. As a result, beautiful swimming areas can become a foul smelling mess of broken and discarded shells. As a volunteer you will complete shoreline surveys and brief inspections of docks, boats, and other places where zebra mussels are likely to be found. Surveys are done on the lake several times during the open-water season. You may even be asked to set up a bottom sampler on your lake at a designated location. The data that you collect will be sent to the Wisconsin DNR several times throughout the season. Contact your Self-Help regional coordinator for information on how to become a zebra mussel watch volunteer.

Additional Opportunities: Beyond the Self-Help Lake Monitoring Network

LoonWatch

In 1978, the Sigurd Olson Environmental Institute began a loon conservation program in Wisconsin. Later a similar program in Minnesota was started. In 1988, these two loon programs were combined into one program known as LoonWatch. It is estimated that the 20,000 loons in the Upper Great Lakes States of Minnesota, Wisconsin, and Michigan comprise nearly three-quarters of the loon population outside of Alaska. Although LoonWatch is not specifically part of the Self-Help Lake Monitoring Network, we encourage volunteers to get involved in this very worthwhile program. If you are interested in volunteering to help monitor these precious birds please contact the Sigurd Olson Environmental Institute at (715) 682-1220 or via email at **loonwatch@northland.edu**. More information on this program can be found via the internet at **www.northland.edu/soei/loonwatch.asp**.

Lake Monitoring Opportunities for Youth

The Self Help Lake Monitoring and **Adopt-A-Lake** networks have formed a partnership to provide youth with lake monitoring opportunities. Interested youth groups, school groups, teachers, lake association members, or other adult youth leaders can apply to monitor a lake in their community for these networks. Contact the Adopt-A-Lake coordinator at (715) 346-2116, or by email at **uwexlakes@uwsp.edu** for more information on youth volunteer opportunities. More information on the Adopt-A-Lake program can be found via the internet at **www.uwsp.edu/cnr/uwexlakes/Adopt-A-Lake/**.

Lake Facilitator

Citizen volunteers with at least one year of experience in the Self-Help network may be selected to assist regional Self-Help coordinators with training and equipment distribution. Additional duties of a lake facilitator include writing regional articles for newsletters, working with Adopt-A-Lake projects, and assisting with re-training sessions. Contact your Self-Help regional coordinator if you are interested in becoming a lake facilitator.

Children of a culture born in a water-rich environment, we have never really learned how important water is to us. We understand it, but we do not respect it.

–William Ashworth

LINDA POHLOD

Clean Boats, Clean Waters

Volunteers can be a valuable tool to lake managers in helping to stop the spread of invasive species across the state. Volunteers are trained to organize and conduct watercraft inspections at the boat landings in their communities. Trained volunteers then educate boaters on how and where invasive species are most likely to hitch a ride into water bodies. By performing boat and trailers checks, distributing informational brochures, collecting and reporting suspect specimens, volunteers can make a difference in helping to prevent the spread of invasive species. If you are interested in participating in this program please contact the Clean Boats, Clean Waters coordinator at (715) 346-3366 or (715) 365-2659 or by email at **Laura.Felda@dnr.state.wi.us**.

Water Action Volunteer Stream Monitoring

Water Action Volunteers is a statewide program for Wisconsin citizens who want to learn about and improve the overall quality of Wisconsin's streams and rivers. This program currently offers informational materials and support for citizen stream monitoring, as well as, storm drain stenciling, river cleanups, and other action-oriented water resource protection projects. If you are interested in learning how Water Action Volunteers can help your stream or river, contact Kris Stepenuck at (608) 265-3887 or by email at **kris.stepenuck@ces.uwex.edu.**

Wisconsin NatureMapping

This exciting wildlife survey provides fun for everyone. We all notice wildlife, but have never had a place to report our sightings... until now! Observe wildlife in the field and note its location on a map. Then go to the interactive website at **www.wisnatmap.org** and enter your observations. Anyone can view the data, and your contributions will help resource agencies with their planning and management decisions. Wisconsin NatureMapping is an outreach program that allows school children, citizens, community groups, and other city, county and state organizations to collect wildlife-related information that will be available to everyone. This program also provides an opportunity for students and volunteers to perform field studies that contribute to Wisconsin's various biological databases. More information on Wisconsin NatureMapping can be found via the internet at **www.wisnatmap.com**.

TEAMWORK EQUALS SUCCESS!

Self-Help Lake Monitoring is a team effort with three primary players:

1. **The citizen volunteers (You!)**
2. **The Wisconsin DNR Self-Help Regional Coordinator that works nearest to your lake.**
3. **The Wisconsin DNR Self-Help staff located in Madison.**

The citizen volunteer is the most important player in the lake monitoring network. You know your lake on a day-to-day basis. You know the best spots to fish and what birds visit or nest on the lake. You know when the lake freezes over, when the ice goes out, and you know your neighbors and friends who love and use the lake. You volunteer to participate because of your genuine concern for the lake and your desire to learn more about it. Collecting water quality data is a step in the right direction to gaining a better understanding of your lake.

The second group of players is the Wisconsin DNR Self-Help Regional Coordinators and local staff. Local staff are located in one of the regional offices around the state (see page iii). As a citizen volunteer, you may already know them or have worked with them in the past. If you have any questions about your lake and your monitoring duties, these are the first people you should contact to help answer your questions.

The third group of players is the Wisconsin DNR Self-Help staff located in Madison. The data you collect will be entered online (at **dnr.wi.gov/org/water/fhp/lakes/selfhelp/**) or phoned in to staff using the "Secchi line" (888-947-3282). All of the data you collect is entered by Self-Help staff into the volunteer monitoring database. These staff also help maintain and analyze the volunteer data, keep track of awards, mail out reports, and logistically keep the network running smoothly.

After the conclusion of the sampling season you can expect to receive a report about your lake. Reports can also be accessed online at the Wisconsin DNR web site. This annual report includes text, graphs, and pictures that help you understand how the data you collected in the past year relates to your lake. The report also includes a summary of previous years' data collected on your lake. A supplement may be included with the report that summarizes the data by region and from a statewide perspective. This supplement enables you to compare the data you collected with data collected from other lakes in Wisconsin similar to yours.

All citizen volunteers will receive *Lake Tides*, a quarterly newsletter published by the Wisconsin Lakes Partnership. The newsletter can also be viewed online at **www.uwsp.edu/cnr/uwexlakes/laketides/**. In each issue of *Lake Tides*, several pages are dedicated to topics of interest to Self-Help volunteers. This news covers current developments and maintains the volunteers' connection to one another.

WHO USES THE SELF-HELP DATA I COLLECT?

All citizen volunteers will receive periodic statewide reports in addition to annual data summaries for their lake. The data will be used by lake organizations, Wisconsin DNR fish and lake managers and researchers, and others interested in Wisconsin's lakes. The data will also be used to support Wisconsin DNR lake planning, protection, grant applications, and educational tools for those interested in learning more about lake water quality. All of the data collected by the Self-Help network is available via the Wisconsin DNR website (**dnr.wi.gov/org/water/fhp/lakes/selfhelp/**) and from staff at regional or central offices (see page iii for a staff list). Other users of Self-Help lake data may include county UW-Extension agents, land conservation district offices, fish managers, researchers, students, and teachers. Every two years the Self-Help lake data are also included in *Wisconsin's Biennial Water Quality Report to Congress*. Volunteer data has even been used to help counties with shoreland zoning and proposed **lake classification** systems! Since volunteers are able to monitor their lakes more frequently than Wisconsin DNR staff, the inclusion of Self-Help data enhances the understanding of each lake's natural, seasonal, and year-to-year variation.

THE SELF-HELP LAKE MONITORING NETWORK HAS TEN PRIMARY GOALS:

1. Quality and Accessible Data.

Following collection protocols will enable you to collect quality data on your lake. Recording your Secchi disc readings and water chemistry data carefully, regularly and according to procedures, will provide valuable information about your lake. When you report your data to the network, it is readily available through a database on the internet. The Wisconsin DNR relies on your data. Without your help, a lot less lakes would be monitored.

2. Shared/Useful Results.

The network's aim is to document water quality changes over time by summarizing the data that you collect and sharing that data with other volunteers and organizations. This is particularly important for those lakes where little or no data exists. You will be collecting baseline data that cannot be captured again in the future; and that will be used for decades to come. You will be able to compare your lake to hundreds of others using the statewide Self-Help Summary Report. After several years of monitoring, your Self-Help regional coordinator can work with you or you or your Lake Association to determine whether or not your lake should receive more intensive monitoring or management attention.

3. Educated and Informed Citizen Monitors.

The network's goal is to help you learn more about basic **limnology**. By collecting, summarizing, and reviewing your data, you will increase your understanding of your lake's overall water quality and will be able to share this information with your Lake Association or other lake residents. The information you collect can be used to help make decisions about your lake (e.g., use restrictions, **watershed** management decisions, aquatic plant management, etc.).

4. Greater Number and Frequency of Lakes Monitored.

The Wisconsin DNR relies on citizen volunteers for much of its data. In a given year, Wisconsin DNR staff can only get out to a limited number of lakes, and often only get to these lakes once a year or once every five years. Your help allows many more lakes to be monitored on a much more frequent basis.

5. Enhanced Participation in Cross-media Statewide Network of Volunteer Monitors.

The Self-Help network is exploring the possibility of forming a statewide network with other Wisconsin monitoring efforts, such as, LoonWatch, Water Action Volunteer Stream Monitoring, and others.

6. Quality Support.

Support staff, located in Madison, are available to help you with database or data reporting questions and questions regarding awards and annual reports. Each region of the state has a Self-Help regional coordinator who is in charge of training volunteers and answering questions about equipment and sampling procedures.

7. Reduced Administrative Overhead (state, community, and citizen).

Volunteer help reduces the Wisconsin DNR's operating costs and helps streamline workflow. By having volunteers sample lakes that need to be monitored, the Wisconsin DNR saves time and money involved in having staff travel to those lakes in order to collect the data. Those staff can in turn concentrate their efforts on other lakes. It is a win-win situation. Additionally, it is the network's goal to keep monitoring and data reporting as simple and efficient as possible for the citizen volunteer.

8. Engage Others in Support of the Network.

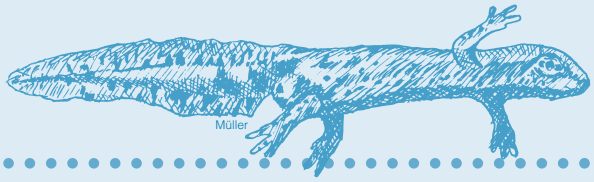
The Self-Help network is supported through a partnership, not just the Wisconsin DNR. The University of Wisconsin-Extension, Wisconsin Association of Lakes, and private entities are engaged in providing support and services to the statewide network.

9. Tie-in to National Lake Research and Monitoring.

Self-Help data is often used for lake research. For example, volunteer data has been used to successfully derive water clarity data on thousands of lakes from satellite imagery. You can see the results of this effort and learn more about satellite imagery and water clarity at **www.lakesat.org** or **dnr.wi.gov/org/water/fhp/lakes/selfhelp/shlmremo.htm**. Self-Help volunteers are also annual participants in the "Secchi Dip-in", an international effort to monitor lakes. Visit **dipin.kent.edu** online for more information.

10. Recognize and Appreciate Citizen Involvement.

At the end of each monitoring season, the Self-Help network provides awards to volunteers who have monitored for 5, 10, or 15 years, or volunteers who have taken 100 or 500 Secchi readings on their lake!



LAKE CLASSIFICATION *• A way of placing lakes into categories with management strategies best suited to the types of lakes found in each category. For example, lakes can be classified to apply varying shoreland development standards. They can be grouped based on hydrology, average depth, surface area, shoreline configuration, as well as, sensitivity to pollutants and recreational use.*

LIMNOLOGY *• The study of inland lakes and waters. The study of the interactions of the biological, chemical, and physical parameters of lakes and rivers.*

WATERSHED *• The area of land draining into a specific stream, river, lake or other body of water. These areas are divided by ridges of high land.*

What Will be Expected of Me?

As a **Secchi volunteer**, you will determine how the water clarity of your lake compares to similar lakes statewide and watch for long-term changes. As a **Chemistry volunteer**, you will continue to collect water clarity (Secchi disc) data every other week in addition to conducting more involved water chemistry sampling. If possible, you will collect water chemistry data four times a year; once during spring turnover (approximately two weeks after ice out), and once in June, July, and August. The Self-Help network will provide all of the equipment that you will need to collect your data.

Chemistry monitoring requires a minimal expense on your part. You will be responsible for providing your own distilled water for cleaning and filtering samples and also responsible for providing your own fuel for your boat. However, chemistry monitoring does require a substantial time commitment. Although Secchi disc sampling may only take a few minutes, lake chemistry sampling may take up to several hours to complete. The exact amount of time involved will depend on the size and depth of your lake and your familiarity with the sampling procedures. Like anything else, the more experience you have sampling, the smoother it will go. Volunteers who participate in chemistry monitoring will be asked to participate periodically in refresher sessions. These sessions ensure that everyone is familiar with current procedures and that all monitoring equipment is in good condition. Refresher sessions also provide an opportunity to meet other volunteers and to ask Wisconsin DNR staff questions about monitoring and lake issues.

There are three things that may influence your enjoyment when participating as a citizen volunteer: your overall health, the type of boat you use, and whether or not you have a sampling partner. While the sampling duties are not too physically demanding, you should be in good overall health. A fishing-type boat or pontoon boat is ideal for sampling work and will be safer and more comfortable than a canoe. A sampling partner will make your job safer, easier, and faster as one person can record data while the other collects samples.

Sample Schedule

A typical year of volunteer monitoring may look something like this:

February
All current volunteers will receive an annual report containing the data from the previous year. At this time, some volunteers will also receive awards for their service, including awards for 5, 10, 15, and 20 years of monitoring; and for 100 or 500 Secchi readings taken.

March
Monitoring equipment and supplies begin to be mailed out to volunteers.

April
The annual Wisconsin Lakes Convention. Volunteers begin monitoring approximately 2 weeks after ice out. Chemistry volunteers take a phosphorus sample. Secchi volunteers continue taking readings every 10-14 days throughout the open water season.

May
New volunteers are trained. (Chemistry volunteers take a phosphorus sample, if not taken in April.)

June
Chemistry volunteers take a chlorophyll and phosphorus sample during the last 2 weeks of the month.

July
Secchi readings are taken in conjunction with satellite dates. Chemistry volunteers take a chlorophyll and phosphorus sample during the last 2 weeks of the month.

August
Secchi readings are taken in conjunction with satellite dates. Chemistry volunteers take a chlorophyll and phosphorus sample during the last 2 weeks of the month.

September
Secchi readings are taken in conjunction with satellite dates.

October
Volunteers wrap up secchi monitoring for the season.

November
Volunteers ensure that all data has been submitted to WDNR staff in the Madison office.

December
Volunteers send any comments or needs to their regional coordinator.

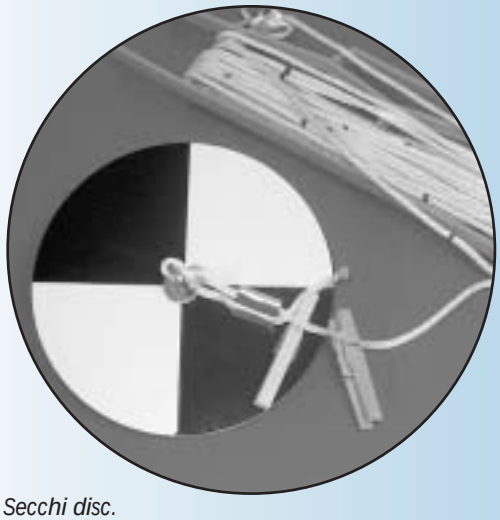
About the Data You Will be Collecting

Secchi

As discussed earlier, if you are participating in the network as a Secchi volunteer, you will observe and document lake water quality by measuring water clarity with a Secchi disc. This 8-inch black and white disc is lowered into the water on a marked rope until it can no longer be seen and then the depth at where the disc disappears is recorded. This procedure measures the water clarity or transparency of the lake, provides a "pulse" on the health of the lake, and is a crucial record for long-range planning.

Many factors can affect water clarity, such as, suspended sediment, algae (microscopic plants naturally found in all lakes), and natural coloring. Suspended sediment may be the result of land use activities in the watershed including erosion from cropland and **runoff** from barnyards, construction sites, and city streets. Sediment may also enter the lake from a river or stream. In a shallow lake, sediment from the lake bottom can be suspended throughout the water column during heavy winds. Additionally, certain fish species (e.g., carp) may stir up bottom sediments and make the lake appear muddy. A lake with a lot of sediment will appear cloudy, muddy, or brown and, as a result, the Secchi disc may disappear from view within a few feet of the water's surface.

Algae affect water clarity since some lakes contain more algae than others. **Phytoplankton** (a type of free-floating algae) is a vital part of the food chain in aquatic systems. They provide the food base for **zooplankton** (microscopic animals) that eventually are eaten by fish, ducks and other animals. However, too much phytoplankton can disrupt the natural balance of a lake ecosystem, make the lake unsightly, and make swimming and other activities less enjoyable. Certain kinds of blue-green algae, which are sometimes classified as bacteria, can cause noxious odors when it decays and can also produce natural toxins that can be dangerous to animals (including cows and dogs) and humans if ingested. If your lake has little turbidity due to sediment, the Secchi disc data you provide will give a relative estimate of how much algae is present in your lake.



Secchi disc.

RUNOFF *• Water from rain, snow melt, or irrigation, that flows over the ground surface and into to streams or lakes.*

PHYTOPLANKTON *• Very small free-floating aquatic plants, such as one-celled algae. Their abundance, as measured by the amount of chlorophyll a in a water sample, is commonly used to classify the trophic status of a lake.*

ZOOPLANKTON *• Plankton that is made up of microscopic animals, for example, protozoa, that eat algae. These suspended plankton are an important component of the lake food chain and ecosystem. For many fish, they are the primary source of food.*

However, it will not reveal what types of algae are present. In addition to algae, other natural factors can affect water clarity, including water color, wind, waves, and sun. Also, variance in eyesight and experience between volunteers may result in slightly different readings.

Water Color versus Secchi Measurements

Some lakes may naturally appear stained brown like tea. This is an indication that the water contains tannic acids, a product of decay. Since light does not penetrate as well through dark-colored water, Secchi depth may be low although algae may be less abundant. Keeping this in mind, a low Secchi disc reading in a stained lake does not necessarily indicate that the lake has a lot of plant growth. Plant densities may actually be lower in stained lakes since sunlight is not able to penetrate very deep into the water column. You may also notice a change water color over the sampling season. Seasonal color changes most likely reflect changes in algae productivity. If your lake turns unusually green, brown, or orange for a few weeks during the summer months, the change is probably the result of an algae bloom. To fully understand variations in Secchi depth, water color observations over time must be recorded.

PHOTIC ZONE • *The surface and underwater lighted zone in a lake that usually has a depth around 1.7 times the Secchi reading.*

PHOTOSYNTHESIS • *The process by which plants convert carbon dioxide and hydrogen into simple carbohydrates (sugars) for growth using the energy captured by chlorophyll or other organic cellular pigments from radiant sources such as the sun. The by-product of this process is oxygen.*

DECOMPOSITION • *The act of breaking down organic matter from a complex form to a simpler form, mainly through the action of fungi and bacteria.*

Light Penetration versus Secchi Measurements

Secchi disc measurements can indicate the depth at which your lake contains enough oxygen to support fish and other aquatic life. In general, sunlight can penetrate to a depth 1.7 times greater than your recorded Secchi depth. For example, if your Secchi disc reading is 12 feet deep, that means the sunlight can actually penetrate 20 feet deep. The depth at which sunlight can penetrate is called the **photic zone**. It is within this zone that **photosynthesis** occurs and oxygen is produced by algae and other aquatic plants. Plant life is important to provide necessary habitat for fish and invertebrates. In deep, productive lakes, oxygen may become depleted below the photic zone as a result of bacterial **decomposition** of dead plants and animals. Without oxygen, phosphorus and other nutrients may be released from the lake sediments and during the lake's mixing periods be circulated to the surface water. This internal cycling of nutrients can trigger algae blooms, aquatic plant growth, and odor problems.

Variation in Secchi Data

Taking just one Secchi disc reading may not have much value since it measures the water clarity of the lake only on that one occasion. The time you sampled might have been during an algae bloom or it could have been after a heavy rainfall; both of which do not represent typical conditions. Secchi data collected regularly over time at or near the same location will provide the most accurate picture of your lake. Your data should vary over time because a lake is an ever-changing system. By taking regular measurements during the ice-free period you can determine the normal seasonal variations for your lake and its overall condition. After a few years of collecting Secchi data, you will be able to answer two major questions about your lake.

1. *What is the trophic state of my lake based on water clarity data alone? (Is my lake generally more* ***eutrophic****,* ***mesotrophic****, or more* ***oligotrophic****?)*
2. *Is the water quality of my lake is improving, declining, or remaining the same over time?*

Phosphorus and Chlorophyll

Phosphorus is a nutrient that is important for the growth of plant life in freshwater lakes. Under certain conditions, excess phosphorus can cause algae to grow out of control or "bloom", making a lake look like pea soup. In lakes, phosphorus can occur either as dissolved or particulate forms. Dissolved phosphorus is the form that is biologically available and is used by phytoplankton (floating algae) and **macrophytes** (rooted plants) for growth. In freshwater systems, phosphorus is often the "limiting" nutrient because it is rapidly recycled and can change quickly to the particulate form that is unavailable for plants to use. The phosphorus found in lakes can originate from a variety of sources. Many of these sources are related to human activity such as lawn fertilizer, agricultural run-off, and erosion from building sites. The water samples that you collect to analyze for phosphorus will help answer important questions like, "How phosphorus enriched is my lake?" The results will also help predict if your lake is susceptible to nuisance algae blooms.

Chlorophyll is the pigment found in all green plants (including phytoplankton) that is responsible for

EUTROPHIC *• Lakes characterized by high nutrient inputs, high productivity, often experiencing algal blooms and abundant weed growth. This term can also refer to a nutrient-rich lake, as large amounts of algae and weeds characterize a eutrophic lake.*

MESOTROPHIC *• Lakes characterized by their moderately fertile nutrient levels. Falls in between the oligotrophic and eutrophic levels of nutrient enrichment.*

OLIGOTROPHIC *• Lakes characterized by low nutrient inputs and low productivity. They are generally deep with high water clarity. This term also refers to a body of water with low nutrient levels and low biological productivity. Such lakes typically have very clear water.*

MACROPHYTE *• A multi-celled plant (large enough to be studied and observed using the unaided eye) growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is usually related to shallow water depth and high nutrient levels.*

THE NATURAL AGING OF LAKES

Lake enrichment levels for Wisconsin lakes can range from being oligotrophic (lakes that experience low levels of productivity) to eutrophic (lakes that are highly productive). A natural aging process occurs in all lakes, causing them to change from oligotrophic to eutrophic over time, and eventually filling in (Figure 1). However, human activity can accelerate this aging process. The term "**cultural eutrophication**", coined by ecologists, defines the human activity impact on a lake's trophic state.

Lakes can be divided into three categories based on trophic state: eutrophic, mesotrophic, and oligotrophic. Eutrophic lakes (very productive or fertile lakes) contain an overabundance of algae and may appear green in color. The water clarity of a eutrophic lake is low, meaning the Secchi disc disappears when submerged only a few feet. A eutrophic lake is not necessarily an unhealthy lake, but often has abundant plant growth or algae blooms. Eutrophic lakes often support large fish populations but can be susceptible to oxygen depletion. In contrast, a less productive lake is referred to as oligotrophic. In oligotrophic lakes, the Secchi disc may be visible to great depths, indicating high water clarity. Oligotrophic lakes generally contain little algae, fewer plants, and often have low fish densities. Mesotrophic lakes categorize the state between the oligotrophic and eutrophic stages. Mesotrophic lakes often have low dissolved oxygen levels in late summer. The hypolimnion (cold, bottom water) in these lakes limits coldwater fish populations and causes phosphorus cycling from the sediments.

By examining Secchi data over time, general lake productivity can be estimated. But in order to estimate the trophic state of your lake, you must have enough data collected over several years; particularly in the summer months when algae blooms are most prevalent.

Figure 1. *(Taken from Shaw et al. 2000 "Understanding Lake Data")*

CULTURAL EUTROPHICATION • *Accelerated eutrophication that occurs as a result of human activities in the watershed. These activities increase nutrient loads in runoff water that drains into lakes.*

their green color. This pigment is responsible for capturing the light energy needed for photosynthesis. Since chlorophyll is found in lake algae, collecting water samples to analyze for this pigment can be used to estimate how much algae (phytoplankton) is in your lake. In addition, the water samples you collect to test for phosphorus and chlorophyll, along with your Secchi data, will be used to estimate the trophic state of your lake.

Temperature and Dissolved Oxygen

Measuring the temperature of the lake at different depths will determine the influence it has on the physical, biological, and chemical aspects of your lake. Lake temperature affects the rate of decomposition, nutrient recycling, lake **stratification**, and dissolved oxygen concentrations near the lake bottom. Changes in water temperature can also affect the distribution of fish in a lake. Some fish (e.g., trout and Cisco) prefer colder water. It is important to these fish species that the deeper water stays cold to ensure their survival. Water temperature can also influence the mixing and stratification patterns in your lake. When a lake becomes stratified (forms distinct temperature layers) the circulation of nutrients and other chemicals is restricted within those layers. When a lake mixes, the cold bottom water is brought to the surface and the warm surface water is mixed downward. Nutrients that were at one time restricted to the bottom of the lake are brought upward into the water column. During mixing there is very little temperature variation between the top and bottom waters. Shallow lakes can be mixed all year round from top to bottom due to wind and wave action. However, deep lakes (generally greater than 20 feet deep) usually mix in the spring and fall. You will be able to determine whether your lake mixes or stratifies when you sample a temperature profile of your lake.

Dissolved oxygen is an important characteristic of lakes because the level of oxygen in the water influences the lake's biological, chemical and physical properties. The amount of oxygen in the water at various depths is directly influenced by temperature, atmospheric pressure and the interaction of aquatic plant production (releasing oxygen) and **respiration** (consuming oxygen). The bottom water of productive lakes that stratify can become oxygen-depleted as temperatures rise and bacterial respiration increases. With insufficient oxygen, fish

STRATIFICATION • *The layering of water due to differences temperatures of water having different densities.*

RESPIRATION • *The complex process that occurs in the cells of plants and animals in which nutrient organic molecules, such as glucose, combine with oxygen to produce carbon dioxide, water, and energy. It is the reverse reaction of photosynthesis, as respiration consumes oxygen and releases carbon dioxide. This process also takes place during decomposition as bacterial respiration increases.*

kills can occur. Fish kills can also occur in shallow unstratified lakes during winter when ice cover prevents mixing of dissolved oxygen. The oxygen concentration at representative depths can be measured using a chemical test (Winkler titration), colorimetric analysis, or an electronic meter. The Self-Help network uses the chemical test or the colorimetric analysis due to their relatively low cost. However, the chemical test does require more time. As with any chemicals, your dissolved oxygen test kit should be used carefully and according to directions. The network provides you with safety gloves and safety goggles; please use them! If you choose to use a calibrated dissolved oxygen meter, please indicate this on your data sheets.

Mixing and Stratification

A lake's water quality and ability to support fish are affected by the extent to which the water mixes. The depth, size, and shape of a lake are the most important factors influencing mixing; although climate, lakeshore topography, inflow from streams, and vegetation also play a role (Shaw et al. 2000).

Water density peaks at 39°F. It is lighter at both warmer and colder temperatures. Variations in water density caused by different temperatures can prevent warm and cold water from mixing (Shaw et al. 2000). When lake ice melts in early spring, the temperature and density of lake water will be similar from top to bottom. This uniform water density allows the lake to mix completely, recharging the bottom water with oxygen and bringing nutrients to the surface (Shaw et al. 2000). This mixing process is called spring overturn. As surface water warms in the spring, it loses density. Due to physics, wind and waves can only circulate the warmed water 20 to 30 feet deep, so deeper areas are not mixed. If the lake is shallow (less than 20 feet), however, the water may stay completely mixed all summer (Shaw et al. 2000).

During the summer, lakes more than 20 feet deep usually experience a layering called stratification. Depending on their shape, small lakes can stratify even if they are less than 20 feet deep. In larger lakes, the wind may continuously mix the water to a depth of 30 feet or more. Lake shallows do not form layers, though deeper areas may stratify. Summer stratification, as pictured in Figure 2, divides a lake into three zones:

EPILIMNION • *The uppermost circulating layer of warm water that occurs in stratified lakes because of the differences in water density. Water's greatest density occurs at 39°F. In lakes that stratify, as water warms during the summer, it remains near the surface while the colder water remains near the bottom. The depth of the epilimnion is determined by wind and usually extends about 20 feet below the surface.*

METALIMNION • *Sometimes referred to as the thermocline. The narrow transition zone between the epilimnion and the hypolimnion that occurs in stratified lakes because of the differences in water density. Water's greatest density occurs at 39°F. In lakes that stratify, as the water warms during the summer it remains near the surface (epilimnion), while the colder water (hypolimnion) remains near the bottom.*

HYPOLIMNION • *The lower and colder layer of water in a lake remaining at a constant temperature that occurs in stratified lakes because of the differences in water density. Water's greatest density occurs at 39°F. In lakes that stratify, as the water warms during the summer, it remains near the surface while the colder water remains near the bottom.*

epilimnion (warm surface layer), thermocline or **metalimnion** (transition zone between warm and cold water), and **hypolimnion** (cold bottom water). Stratification traps nutrients released from the bottom sediments in the hypolimnion (Shaw et al. 2000).

In the fall, the surface cools until the water temperature evens out from top to bottom, which again allows mixing (fall overturn). A fall algae bloom often appears when nutrients mix and rise to the surface. Winter stratification, with a temperature difference of only 7°F (39°F on the lake bottom versus 32°F right below the ice), remains stable because the ice cover prevents wind and waves from mixing the water (Shaw et al. 2000).

The lake's orientation to prevailing winds can affect the amount of mixing that occurs. Some small, deep lakes may not undergo complete mixing in the spring or fall if there is not enough wind action. The mixing that takes place in the bays of a large lake will more closely resemble that of a small lake because the irregular shoreline blocks the wind (Shaw et al. 2000). Because mixing distributes oxygen throughout a lake, lakes that don't mix may have low oxygen levels in the hypolimnion, which can harm fish. Some fish species require lake stratification. The cold water in the hypolimnion can hold more oxygen than the warmer water in the epilimnion and thus provide a summer refuge for cold water fish (e.g., trout). If the lake produces too much algae that falls onto the lake bottom to decay, however, oxygen in this part of the lake will become depleted since the steep temperature gradient in the metalimnion will prevent any surface water with dissolved oxygen from reaching the bottom (Shaw et al. 2000).

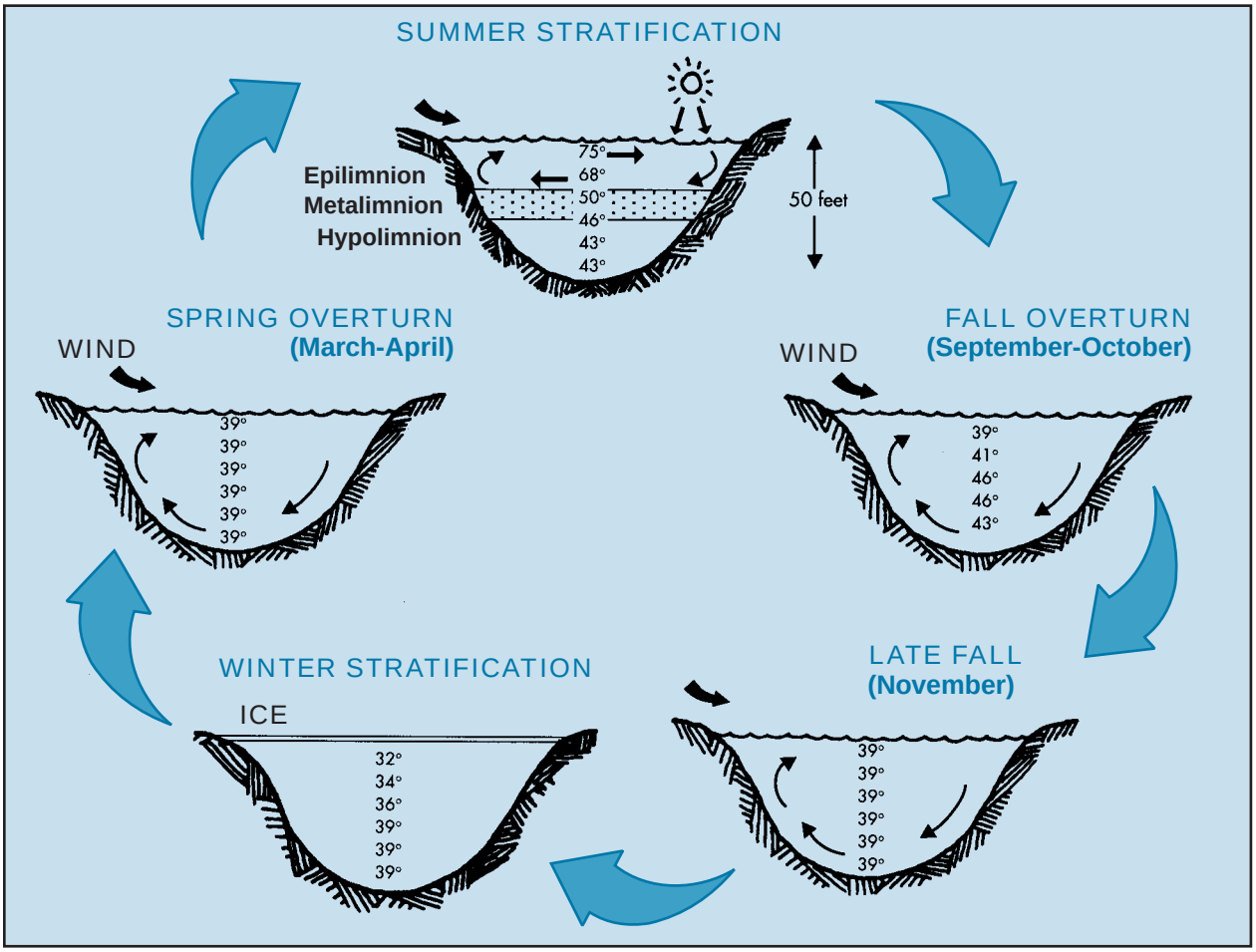


Figure 2. *Seasonal Stratification of lakes. (Taken from Shaw et al. 2000 "Understanding Lake Data")*

Invasive Species

DNR PHOTO

Eurasian Water-milfoil

DAVE BRENNER

Zebra Mussel

DAVE BRENNER

Purple Loosestrife

(*D. Brenner photos provided with permission by Michigan Sea Grant* **www.miseagrant.umich.edu**).

Eurasian Water-milfoil (*Myriophyllum spicatum*)

Invasive species disrupt the stability of natural ecosystems and threaten biodiversity. One invasive species of special concern is Eurasian water-milfoil. Eurasian water-milfoil was introduced into the U.S. in the 1940's and has spread to numerous water bodies across the nation. During the 1960's this aggressive submersed plant found its way to Wisconsin waters. For a current list of water bodies infested with Eurasian water-milfoil visit the Wisconsin DNR website at **dnr.wi.gov/invasives/**.

Eurasian water-milfoil threatens native aquatic plant communities by forming dense underwater beds of tangled stems and vast canopies of thick mat-like vegetation at the water's surface. These dense beds can cause loss of plant diversity, degrade water quality, and can reduce habitat for fish, invertebrates, and wildlife. They also hinder boating, swimming, and fishing. Many lake organizations and local governments devote much of their time and money to control this invasive plant. Eurasian water-milfoil is an affliction that costs citizens of Wisconsin millions of dollars in plant control and lost tourism revenue annually.

This prolific plant can grow up to 2 inches a day and spreads by shoots and runners that creep along the beds of lakes and rivers. A single stem fragment can take root and form a new colony. Fragments can be transported from one water body to another on boats, trailers, SCUBA gear, water skis, or waterfowl.

Eurasian water-milfoil is most successful in water disturbed by cultural developments such as shoreline development, watershed runoff, aquatic invasive species control, or heavy boat traffic. It also has a competitive advantage in waters that are stressed by pollution and has difficulty becoming established in waters with healthy populations of native plants. A healthy ecosystem and preservation of native plants is good protection against an invasion by this plant.

Eurasian water-milfoil is one of eight water-milfoil species found in Wisconsin and the only one that is not native. The most common *native* water-milfoil found in Wisconsin lakes is the Northern or Common water-milfoil (*Myriophyllum sibericum*). It bears a strong resemblance to Eurasian water-milfoil but it is not prone to the rapid growth or canopy formation that

make Eurasian water-milfoil a nuisance. Since there are many species of water-milfoil, it is important to be able to distinguish Eurasian water-milfoil from similar aquatic plants. Eurasian water-milfoil is a submersed aquatic plant with feather-like leaves arranged in whorls (circles) on the stem. There are usually 12 to 21 pairs of leaflets per leaf and the leaves have a distinct feather-like appearance, with the lower leaflet pairs about half the length of the midrib. Stem tips are tassel-like and branching is abundant in waters 3 to 10 feet deep.

Zebra Mussel (*Dreissenia polymorpha*)

The zebra mussel is a tiny 1/8 inch to 2 inch bottom-dwelling mollusk native to Europe. The mussel takes its name from its dark and light striped shell. Zebra mussels were introduced into the Great Lakes system in the mid-1980's and were first found in Wisconsin waters of Lake Michigan in 1989. They spread throughout the Great Lakes and are now found in a number of inland Wisconsin waters. For current infestation maps please visit **dnr.wi.gov/invasives/**. Resource managers are particularly concerned about the zebra mussel's potential impact to aquatic food chains, native clams, and Wisconsin's fisheries.

Zebra mussels look like small clams with a yellowish or brownish "D-shaped" shell, usually with dark and light-colored stripes. They can be up to 2 inches long, but most are less than 1 inch. Zebra mussels usually grow in clusters containing numerous individuals and are generally found in shallow (6 to 30 feet deep), algae-rich water. Zebra mussels are the only freshwater mollusk that can firmly attach themselves to solid objects (e.g., submerged rocks, dock pilings, boat hulls, water intake pipes, etc.) (University of Wisconsin Sea Grant Institute 1992).

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife is an invasive plant, generally found in wetlands. But since it is such a hardy plant, it can also be found along roadsides and in ditches. Purple loosestrife blooms from July through September, so August is the most ideal time to look for this plant.

Purple loosestrife is a perennial herb 3 to 7 feet tall with a dense bushy growth of 1 to 50 stems. The stems, which range from green to purple, die back each year. Showy flowers vary in color from purple to magenta and possess 5 to 6 petals aggregated into numerous long spikes. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. Purple loosestrife has a large, woody taproot with fibrous rhizomes that form a dense mat.

Purple loosestrife may be confused with the native plant winged loosestrife (*Lythrum alatum*) found in moist prairies or wet meadows. Winged loosestrife has a winged, square stem, and solitary paired flowers in the leaf axils. It is generally a smaller plant than purple loosestrife. For more information on purple loosestrife please visit the Wisconsin DNR website at **dnr.wi.gov/invasives/**.

Curly-leaf Pondweed (*Potamogeton crispus*)

Curly-leaf pondweed is an aquatic plant native to the freshwaters of Europe, Asia, Africa, and Australia. This species first found its way to the United States in the mid 1800's and is thought to have made its way to Wisconsin in 1905 with fish imported from Europe.

Curly-leaf pondweed is recognized by its wavy edges resembling miniature lasagna noodles. When the plant dies, it can cause floating mats of dying vegetation. These rotting mats can affect dissolved oxygen levels and release excess nutrients increasing the chance of an algal bloom. This non-native plant can easily displace native vegetation since it is tolerant of disturbances and can grow in most environmental conditions. For more information on curly-leaf pondweed please visit the Wisconsin DNR website at **dnr.wi.gov/invasives/**.

ROBERT H. MOHLENBROCK, USDA-NRCS PLANTS DATABASE

Curly-leaf Pondweed

NOTES

1. SECCHI (Water Quality) MONITORING

Before you start sampling, be sure to read the following pages to familiarize yourself with the equipment and the procedures that you will be using. *All of the procedures that you will follow in sampling your lake are done for specific reasons. It is very important that you follow the sampling procedures exactly as they are laid out in the following pages to ensure good, consistent, high quality data. The following pages will provide you with sufficient background on the design of the equipment and proper procedures to use.*

DNR PHOTO

After sampling, it is very important to rinse and air dry thoroughly all of the equipment that you used. As always keep paperwork and envelopes separate from equipment.

What Equipment Will You Need?

At your training session, your Self-Help regional coordinator will outline and provide all of the equipment that you will need to successfully monitor your lake.

- ☑ Secchi Disc (with rope and holder)
- ☑ Two clothespins
- ☑ Lake map with sampling site marked
- ☑ Life jackets (you provide)
- ☑ Anchor and rope (you provide)
- ☑ Field data sheets
- ☑ Pencil and waterproof pen

SHOULD I COLLECT SECCHI DATA IN THE WINTER?

Secchi measurements taken through the ice are highly variable depending on the amount of snow on the ice and the ice clarity (i.e. did it freeze fast or was there slush on the lake that froze and created "cloudy" ice). These are the main factors determine the amount of light that can get through the ice which allow you to take accurate measurements. Since algae production is at a minimum under the ice, there is no real value to the data for the network to use.

WBIC (Waterbody Identification Code) • *A unique identification number the DNR uses to identify each water body in the state. Every one of the 15,000 plus lakes in Wisconsin has a unique WBIC number. All data from that lake is tied to that WBIC. This system is in place since there are many lakes with the same name. Did you know that there are 116 Mud Lakes in Wisconsin? Without the WBICs it would be hard to tell which Mud Lake was being monitored.*

STORET • *STORET stands for STORage and RETrieval. It is a database system that is overseen by the U.S. Environmental Protection Agency. Every sample point on a lake has a unique STORET number.*

VOLUNTEER ID • *An identification number that the Self-Help network uses to uniquely identify each volunteer. All data is tied to the individual volunteer ID number.*

How Do You Prepare to Sample?

The Day You Sample

On the day you plan to sample, complete the top portion of your field data sheet by filling in the "**WBIC**", "**STORET**", and "**Volunteer ID**" sections. If you do not know what these numbers are contact your Self-Help regional coordinator. Before you launch your boat, make sure you have an anchor, sufficient gas, and personal flotation devices (life jackets) in your boat before proceeding to your sampling site.

Sampling Overview

When to Take Your Secchi Readings

The weather can affect the depth at which you can no longer see the Secchi disc. Wind-generated waves, sun position, and cloud cover are major weather factors that can affect the accuracy of your readings. For these reasons, your Secchi disc reading should be taken on clear, calm days between 10 AM and 4 PM. Waves and clouds should not interfere with your reading. Secchi disc readings are taken on the shady side of the boat. Remember to remove your sun glasses! It is a good idea to anchor the boat. Ideally, you should take your Secchi disc reading once a week, but no less than once every two weeks and no more often than once every five days.

To make sampling regular and convenient, try to make it a part of your weekly routine. You can include it as part of your weekend fishing trip or family outing on the lake. The most important time to collect your Secchi data is between the months of June and August. These are the prime months for lake recreation and the time when algae blooms are the most prevalent. In addition, Secchi analysis statewide relies on information for these months. Since your Secchi disc data cannot be averaged over the entire year due to seasonal variations, averages of Secchi data recorded between June and August will appear in your statewide summary report.

The Secchi readings you take in the spring and fall will tell a story about your lake. These readings can tell you when spring run-off occurs in your lake or when there are algal blooms. For this reason, some Secchi volunteers may start collecting data in April and continue through November. But for a variety of reasons other volunteers may choose to start in June and only continue sampling through September.

If you are unable to sample during your normally scheduled sampling time, do not worry about it! Just try to sample as soon as possible after that time. However, if you think that you will not be able to continue monitoring your lake due to illness, schedule conflicts, or other problems, please contact your Self-Help regional coordinator as soon as you can.

ON LAKE PROCEDURES

How to Use the Secchi Disc

STEP 1. Before going out to take your Secchi disc readings, be sure the conditions are right for sampling. Ideal weather conditions include sunny or partly sunny/cloudy skies; wind-calm to breezy (there should be no whitecaps on the lake). The best time of day to do your Secchi measurements is between 10 am and 4 pm.

STEP 2. Using a lake map with your sampling site(s) marked; proceed to your first site.

STEP 3. Anchor your boat at your sampling site. ***Remove your sunglasses.*** Unwind the Secchi disc rope from the holder.

STEP 4. Lean over the shady side of the boat and slowly lower the Secchi disc into the water until you can no longer see it. If you are sampling in a pontoon boat, be sure to kneel down on the floor of the boat when you take your readings so you are closer to the surface of the water.

STEP 5. When the Secchi disc barely disappears from your view, mark the rope at the water level with a clothespin.

DNR PHOTOS

ON LAKE PROCEDURES

How to Use the Secchi Disc (continued)

STEP 6. After you have marked this spot with the clothespin, lower the disc a few more feet into the water. Slowly raise the disc. When the Secchi disc reappears, mark the rope at the water level with the second clothespin. The clothespins marks may be several inches or a foot apart. The purpose of lowering the Secchi disc and raising it back into view is so your eyes become accustomed to looking into the water.

DNR PHOTO

STEP 7. Bring the Secchi disc back into the boat.

STEP 8. Average your two Secchi disc readings by forming a loop between the two clothespins. Slide one clothespin into the center of the loop to mark it. Remove the other clothespin. The remaining clothespin mark will be your Secchi reading.

STEP 9. Carefully measure the number of feet from the disc until you reach your clothespin mark. Round off to the nearest quarter foot.

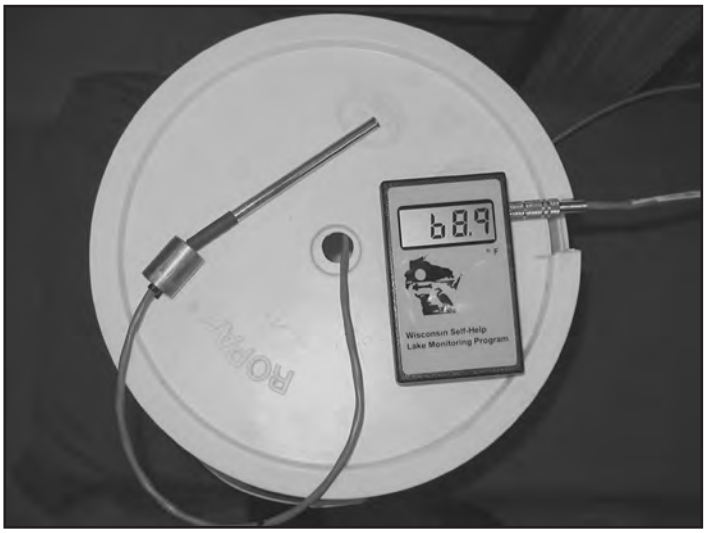
STEP 10. Record this measurement on your data sheet and then fill out the rest of your data sheet. If you are unsure of how to do this see the "Taking Care of Data" section on page 21.

STEP 11. If you are taking Secchi readings at more than one site or lake, proceed to your next location and repeat steps 1-10 above.

2. TEMPERATURE MONITORING:

Using a Digital Meter

Before you start sampling, be sure to read the following pages to familiarize yourself with the equipment and the procedures that you will be using. *All of the procedures that you will follow in sampling your lake are done for specific reasons. It is very important that you follow the sampling procedures exactly as they are laid out in the following pages to ensure good, consistent, high quality data. The following pages will provide you with sufficient background on the design of the equipment and proper procedures to use.*



DNR PHOTO

After sampling, it is very important to rinse and air dry thoroughly all of the equipment that you used. As always keep paperwork and envelopes separate from equipment. Be sure to turn off your meter and store out of direct sunlight.

What Equipment Will You Need?

At your training session, your Self-Help regional coordinator will outline and provide all of the equipment that you will need to successfully monitor your lake.

- ☑ Manual
- ☑ Lake map with sampling site marked
- ☑ Digital temperature meter and probe
- ☑ Lifejackets (you provide)
- ☑ Anchor and rope (you provide)
- ☑ Field data sheets
- ☑ Pencil and waterproof pen

How Do You Prepare to Sample?

The Day You Sample

On the day you plan to sample, complete the top portion of your field data sheet by filling in the "WBIC", "STORET", and "Volunteer ID" sections. If you do not know what these numbers are contact your Self-Help regional coordinator. Before you launch your boat, make sure you have an anchor, sufficient gas, and personal flotation devices in your boat before proceeding to your sampling site.

Sampling Overview

Temperature Readings

Some limnologists believe that lake temperature profile data are very important to document the effects of global warming. Keep this in mind, as the accuracy of the data you collect is critical; especially if the data will be used to document overall climate change in our environment. Temperature readings are fairly easy to take. When using a digital temperature meter, a measured cable with a probe is lowered into the water and a hand-held digital meter records the temperature. The cable is pre-marked for your convenience. Your regional coordinator will give you the depths at which the temperature should be recorded for your particular lake.

ON LAKE PROCEDURES

Temperature Monitoring

Temperature Probe Method

STEP 1. Your regional coordinator will assign to you 5 to 10 depths at which you should sample the temperature of your lake. List these pre-determined depths on your field data sheet.

STEP 2. Plug cable into unit.

STEP 3. Lower the probe to your assigned depths and note the corresponding temperature from the meter onto your data sheet.

DNR PHOTO

STEP 4. Once you are finished, raise probe and unplug the cable from unit to conserve the battery. Be sure to store the digital meter out of direct sunlight.

3. TEMPERATURE MONITORING:

Using a Van Dorn Water Sampler with a Thermometer

Before you start sampling, be sure to read the following pages to familiarize yourself with the equipment and the procedures that you will be using. *All of the procedures that you will follow in sampling your lake are done for specific reasons. It is very important that you follow the sampling procedures exactly as they are laid out in the following pages to ensure good, consistent, high quality data. The following pages will provide you with sufficient background on the design of the equipment and proper procedures to use.*

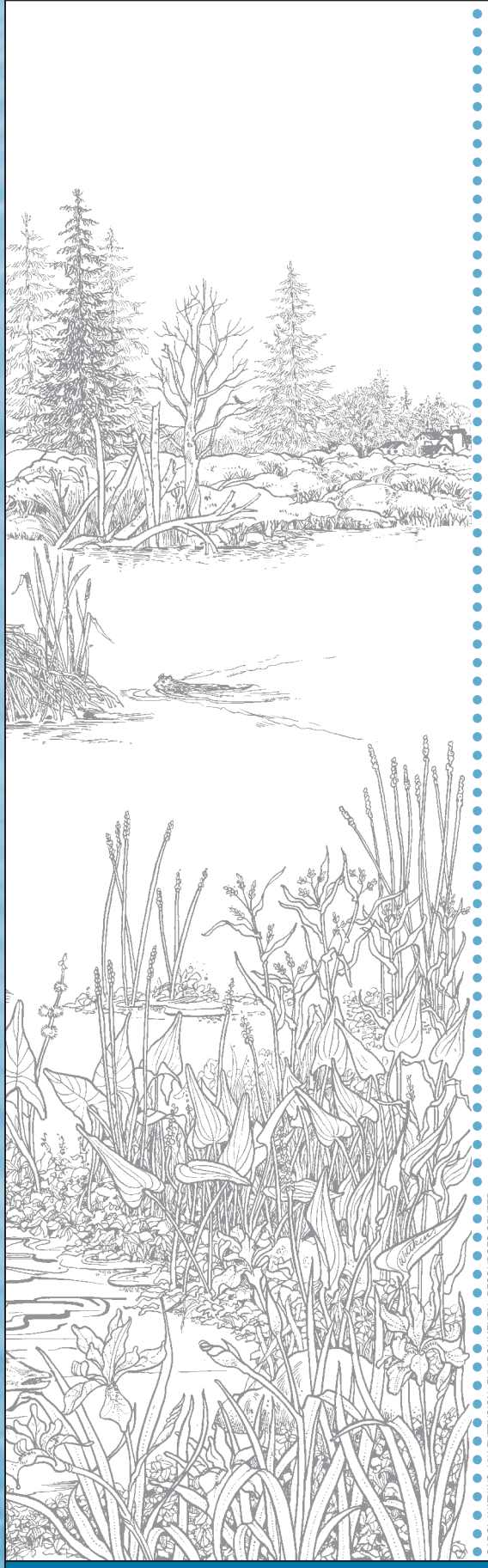
DNR PHOTO

After sampling, it is very important to rinse and air dry thoroughly all of the equipment that you used. As always keep paperwork and envelopes separate from equipment.

What Equipment Will You Need?

At your training session, your Self-Help regional coordinator will outline and provide all of the equipment that you will need to successfully monitor your lake.

- ☑ Manual
- ☑ Lake map with sampling site marked
- ☑ Van Dorn water sampler with thermometer
- ☑ Lifejackets (you provide)
- ☑ Anchor and rope (you provide)
- ☑ Field data sheets
- ☑ Pencil and waterproof pen



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How Do You Prepare to Sample?

The Day You Sample

On the day you plan to sample, complete the top portion of your field data sheet by filling in the "WBIC", "STORET", and "Volunteer ID" sections. If you do not know what these numbers are contact your Self-Help regional coordinator. Before you launch your boat, make sure you have an anchor, sufficient gas, and personal flotation devices in your boat before proceeding to your sampling site.

Sampling Overview

Temperature Readings

Some limnologists believe that lake temperature profile data are very important to document the effects of global warming. Keep this in mind, as the accuracy of the data you collect is critical; especially if the data will be used to document overall climate change in our environment. Temperature readings are fairly easy to take. Your regional coordinator will give you the depths at which the temperature should be recorded for your particular lake. When using this method you will use a regular thermometer to take the temperature of the water you collect using a Van Dorn water sampler.

ON LAKE PROCEDURES

How to Collect Water Samples

A variety of Van Dorn samplers have been used throughout the history of Self-Help network. Through the years samplers have been modified, but the method of using each type is the same. There are currently several types of water samplers being used by the Self-Help network: horizontal tug-release sampler, horizontal messenger-release sampler, and the vertical messenger release sampler. The following instructions are for the vertical messenger release sampler. Please contact your regional coordinator if you need instruction on using other models or if your sampler fails to work properly. Please be sure to anchor your boat before collecting your water sample(s). If the boat is drifting, the release mechanism may not work properly.

STEP 1. Prepare the sampler by pulling the sealing balls out of the ends of the tube and hooking the lines over the release pins. Loop the cable from the top cap under the release mechanism support arm and hook onto pin. Hook the bottom cable onto the other pin. Be very careful to keep the top sealing cap away from the release mechanism so that it does not interfere with the messenger when it is released. Make sure the clamp is closed on the release valve.

STEP 2. Hold the sampler line in one hand and the brass messenger securely in your other hand.

STEP 3. Holding the rope waist-high, lower the sampler to the desired depth using the marks on the rope for reference.

DNR PHOTOS

ON LAKE PROCEDURES

How to Collect Water Samples (continued)

STEP 4. Once the sampler is at the appropriate depth, hold the line straight up and down with one hand. With your other hand, drop the brass messenger into the water. You should feel a "thump" when the messenger reaches the sampler.

STEP 5. Bring the now closed sampler to the surface. Read thermometer. Empty the sampler and repeat steps 1-5 for each depth.

STEP 6. After sampling it is very important to thoroughly rinse and air dry all of the equipment that you used. Don't forget to rinse your Van Dorn water sampler with distilled water. Place pencils or popsicle sticks in either end so the sampler will dry out. Also, open up or remove the hose clamp so the hose can dry out. Don't forget to remove pencils/popsicle sticks when sampler is dry.

DNR PHOTOS

4. DISSOLVED OXYGEN MONITORING:

Using a Dissolved Oxygen Meter

Before you start sampling, be sure to read the following pages to familiarize yourself with the equipment and the procedures that you will be using. *All of the procedures that you will follow in sampling your lake are done for specific reasons. It is very important that you follow the sampling procedures exactly as they are laid out in the following pages to ensure good, consistent, high quality data. The following pages will provide you with sufficient background on the design of the equipment and proper procedures to use.*

DNR PHOTO

After sampling, it is very important to rinse and air dry thoroughly all of the equipment that you used. As always keep paperwork and envelopes separate from equipment. Be sure to turn off your meter and store out of direct sunlight.

What Equipment Will You Need?

At your training session, your Self-Help regional coordinator will outline and provide all of the equipment that you will need to successfully monitor your lake.

- ☑ Manual
- ☑ Lake map with sampling site marked
- ☑ Digital dissolved oxygen meter and probe (you provide)
- ☑ Lifejackets (you provide)
- ☑ Anchor and rope (you provide)
- ☑ Field data sheets
- ☑ Pencil and waterproof pen

How Do You Prepare to Sample?

The Day You Sample

On the day you plan to sample, complete the top portion of your field data sheet by filling in the "WBIC", "STORET", and "Volunteer ID" sections. If you do not know what these numbers are contact your Self-Help regional coordinator. Before you launch your boat, make sure you have an anchor, sufficient gas, and personal flotation devices in your boat before proceeding to your sampling site.

Before using your dissoved oxygen meter, be sure to read the owner's manual. In order to get accurate data from your meter, you should learn how to calibrate your meter and use your meter properly. Please keep a Calibration Log (see Appendix 2) to ensure good data.

Sampling Overview

Dissolved Oxygen Meter

The Self-Help network allows volunteers to use their own dissolved oxygen meter to take your readings. If you choose to collect your dissolved oxygen data using this method, it is important to remember that the meter *must* be calibrated every time it is used. A calibration log and tips for using a meter is included in Appendix 2. The calibration log will keep you in tune with the performance of you meter, which ultimately will help you collect quality data. Please follow all instructions for care and maintenance found in the operation manual for your particular model as maintenance of the meter is imperative to get good data. If you choose this method you must inform your Self-Help coordinator so they can flag the database with this information. At this time, the Self-Help network does not provide dissolved oxygen meters for volunteer use.

ON LAKE PROCEDURES

Dissolved Oxygen Monitoring

Dissolved Oxygen Meter

STEP 1. Your regional coordinator will assign 5 to 10 depths to sample for dissolved oxygen. Your meter will also record temperature. You will collect dissolved oxygen and temperature data at the same depths.

STEP 2. Follow manufacturer's instruction for calibration and use.

STEP 3. Lower the probe to the assigned depth. Record temperature and dissolved oxygen reading from the meter onto your data sheet.

5. DISSOLVED OXYGEN MONITORING:

Using the Colorimetric Method

Before you start sampling, be sure to read the following pages to familiarize yourself with the equipment and the procedures that you will be using. *All of the procedures that you will follow in sampling your lake are done for specific reasons. It is very important that you follow the sampling procedures exactly as they are laid out in the following pages to ensure good, consistent, high quality data. The following pages will provide you with sufficient background on the design of the equipment and proper procedures to use.*

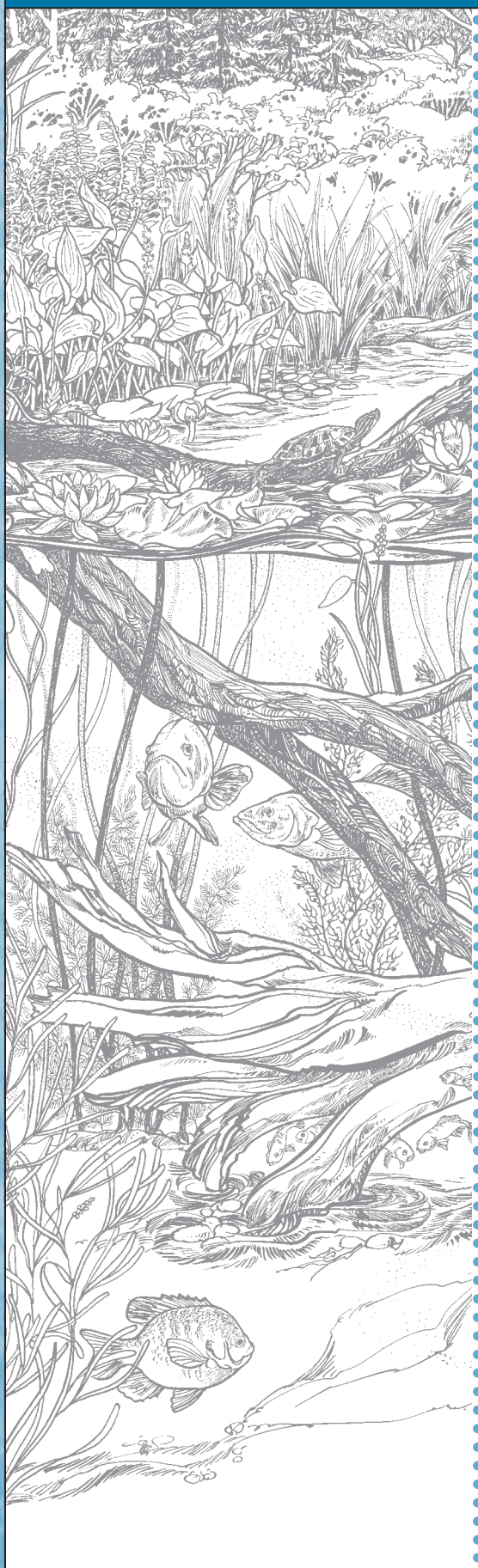
DNR PHOTO

Please remember to keep all sampling equipment and chemicals out of the reach of children. Many of the chemicals you will be using are hazardous (see Appendix 1). After sampling, it is very important to rinse and air dry thoroughly all of the equipment that you used. As always keep paperwork and envelopes separate from equipment.

What Equipment Will You Need?

At your training session, your Self-Help regional coordinator will outline and provide all of the equipment that you will need to successfully monitor your lake.

- ☑ Manual
- ☑ Lake map with sampling site marked
- ☑ Lifejackets (you provide)
- ☑ Anchor and rope (you provide)
- ☑ Field data sheets
- ☑ Pencil and waterproof pen
- ☑ CHEMets® water test kit
- ☑ Van Dorn water sampler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How Do You Prepare to Sample?

The Day You Sample

On the day you plan to sample, complete the top portion of your field data sheet by filling in the "WBIC", "STORET", and "Volunteer ID" sections. If you do not know what these numbers are contact your Self-Help regional coordinator. When using the colorimetric method to determine the dissolved oxygen in your lake, mark the ampules in the CHEMets® Water Test Kit with your pre-determined depths. Once this is done, you can begin to load all of your sampling equipment into the boat. Before you launch, make sure you have an anchor, sufficient gas, and personal flotation devices in your boat before proceeding to your sampling site.

Sampling Overview

Colorimetric Method (CHEMets® Dissolved Oxygen Kit)

Sampling the dissolved oxygen in your lake can be tricky since oxygen in the air can easily contaminate your water sample. To create your dissolved oxygen profile, you will collect water samples at specified depths and measure the oxygen content of the water. Since you have no alternative but to bring your samples to the surface to measure the oxygen, you must take precautions to ensure that your samples do not get contaminated.

When using the colorimetric method to create your dissolved oxygen profile, the CHEMets® water test kit is fast and easy to use, but may be less accurate then alternative methods. Use of the Van Dorn water sampler is necessary for collecting water samples for dissolved oxygen since it retrieves the samples from the desired depth to be tested.

ON LAKE PROCEDURES

How to Collect Water Samples

A variety of Van Dorn samplers have been used throughout the history of Self-Help network. Through the years samplers have been modified, but the method of using each type is the same. There are currently several types of water samplers being used by the Self-Help network: horizontal tug-release sampler, horizontal messenger-release sampler, and the vertical messenger release sampler. The following instructions are for the vertical messenger release sampler. Please contact your regional coordinator if you need instruction on using other models or if your sampler fails to work properly. Please be sure to anchor your boat before collecting your water sample(s). If the boat is drifting, the release mechanism may not work properly.

STEP 1. Prepare the sampler by pulling the sealing balls out of the ends of the tube and hooking the lines over the release pins. Loop the cable from the top cap under the release mechanism support arm and hook onto pin. Hook the bottom cable onto the other pin. Be very careful to keep the top sealing cap away from the release mechanism so that it does not interfere with the messenger when it is released. Make sure the clamp is closed on the release valve.

STEP 2. Hold the sampler line in one hand and the brass messenger securely in your other hand.

STEP 3. Holding the rope waist-high, lower the sampler to the desired depth using the marks on the rope for reference.

DNR PHOTOS

ON LAKE PROCEDURES

How to Collect Water Samples (continued)

STEP 4. Once the sampler is at the appropriate depth, hold the line straight up and down with one hand. With your other hand, drop the brass messenger into the water. You should feel a "thump" when the messenger reaches the sampler.

DNR PHOTOS

STEP 5. Bring the now closed sampler to the surface. To obtain the water for your sample, let go of the hose clamp on the rubber tube with your thumb and release the vacuum by cracking the top seal. Empty water into the sample bottle and repeat steps 1-5 for each depth.

ON LAKE PROCEDURES

Colorimetric Method (CHEMets® Dissolved Oxygen Kit)

STEP 1. Your regional coordinator will assign to you 5 to 10 depths at which you should sample for dissolved oxygen. These depths will be the same as the ones you measure for water temperature.

STEP 2. Mark your CHEMets® ampules with the corresponding depths given to you by your regional coordinator.

STEP 3. Use the Van Dorn water sampler (see previous section) to collect samples at your pre-determined depths.

STEP 4. Drain a small amount of water from the sampler to rinse the drain hose. Insert the tube into your dissolved oxygen sample bottle and fill it to the 25 ml mark with your water sample. If you have been provided with an eye dropper, use the dropper to add or remove water to accurately measure 25 ml.

STEP 5. Using the ampule marked with the depth of your water sample, place the ampule in your sample bottle. Snap off the tip of the ampule by pressing it against the insert at the bottom of the bottle. As a result of capillary action, the ampule will fill with water, leaving a small air bubble to help with mixing.

STEP 6. Mix the contents of the ampule by inverting the ampule several times, allowing the bubble to travel from one end to another each time. Wipe all liquid from the exterior of the ampule and wait for the color to change. It will take a few minutes for the color to fully change. The color will last up to 12 hours, so you can read and record the results later on shore.

DNR PHOTOS

STEP 7. Repeat steps 3 through 6 for each of your pre-determined lake depths.

ON SHORE PROCEDURES

Colorimetric Analysis (CHEMets® Dissolved Oxygen Kit)

Before you begin analyzing your samples on shore, here is a quick checklist to make sure that you have everything you will need.

- ☑ Manual
- ☑ Field Data Sheets
- ☑ Pencil and waterproof pen
- ☑ Safety gloves
- ☑ Safety goggles
- ☑ CHEMets® dissolved oxygen kit along with the colored ampule samples you prepared on the lake

Assemble all of your ampules labeled with the depths at which you took your dissolved oxygen samples. By this time they should have had sufficient time for the color to change completely.

STEP 1. While standing directly beneath a bright light, hold the color comparator in a horizontal position. Place your ampule between the color standards in the comparator and move it left and right until the best color match is found. Record the dissolved oxygen reading listed directly below the closest match standard. It may be helpful to use a white piece of paper and cover all but one color standard when comparing your ampule to the standard.

DNR PHOTO

STEP 2. If the color of your ampule falls in-between two of the color standards on the comparator, record an estimate of the dissolved oxygen concentration.

STEP 3. Fill in your data sheet with dissolved oxygen reading.

STEP 4. Repeat steps 1 through 3 for each of your ampules labeled with the depths at which you collected you dissolved oxygen samples.

STEP 5. Once you are done recording you dissolved oxygen data, you can dispose of your ampules. The ampules can be disposed in the trash by placing them in a separate container so they do not puncture the trash bag or cut anyone. Don't forget to rinse your Van Dorn water sampler with distilled water. Place pencils or popsicle sticks in either end so the sampler will dry out. Also, open up or remove the hose clamp so the hose can dry out. Don't forget to remove pencils/popsicle sticks when sampler is dry.

6. DISSOLVED OXYGEN MONITORING:

Using the Titration Method

Before you start sampling, be sure to read the following pages to familiarize yourself with the equipment and the procedures that you will be using. *All of the procedures that you will follow in sampling your lake are done for specific reasons. It is very important that you follow the sampling procedures exactly as they are laid out in the following pages to ensure good, consistent, high quality data. The following pages will provide you with sufficient background on the design of the equipment and proper procedures to use.*

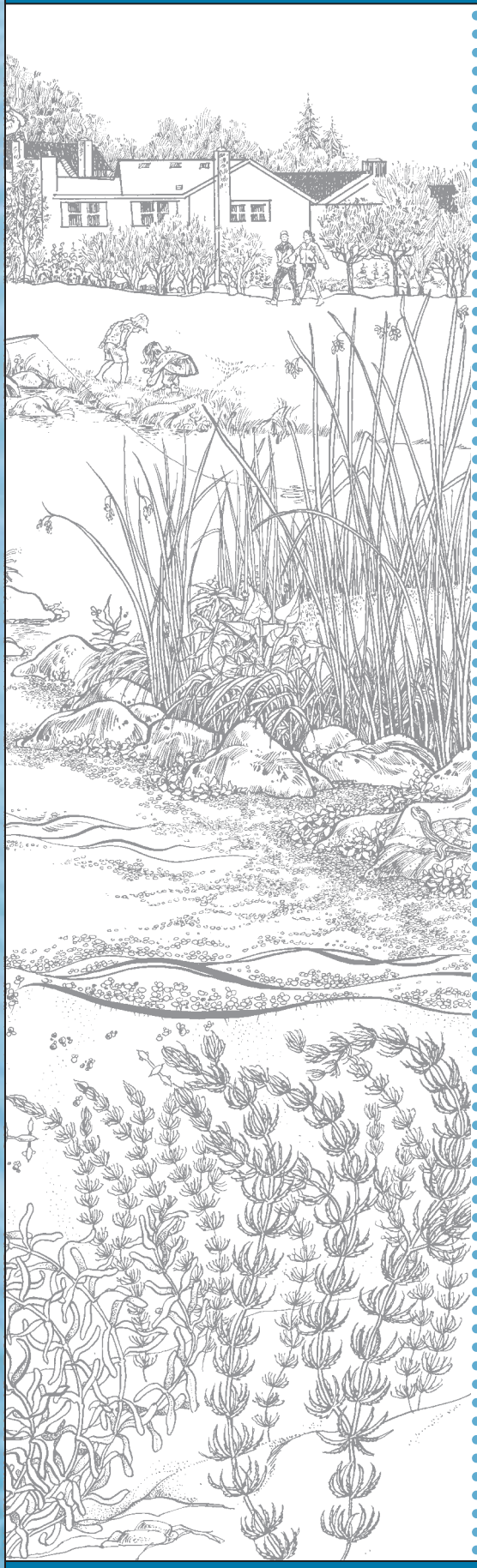
DNR PHOTO

Please remember to keep all sampling equipment and chemicals out of the reach of children. Many of the chemicals you will be using are hazardous (see Appendix 1). After sampling, it is very important to rinse and air dry thoroughly all of the equipment that you used. As always keep paperwork and envelopes separate from equipment.

What Equipment Will You Need?

At your training session, your Self-Help regional coordinator will outline and provide all of the equipment that you will need to successfully monitor your lake.

- ☑ Manual
- ☑ Lake map with sampling sites marked
- ☑ Life jackets (you provide)
- ☑ Anchor and rope (you provide)
- ☑ Field data sheets
- ☑ Pencil and waterproof pen
- ☑ Van Dorn water sampler
- ☑ Safety gloves
- ☑ Safety goggles
- ☑ Chemicals and equipment in the LaMotte® titration kit to determine dissolved oxygen using the Winkler titration method (**Note:** All chemicals except sulfuric acid should be replaced every two years): manganous sulfate, alkaline potassium iodide azide, sulfuric acid, sodium thiosulfate (keep refrigerated), starch indicator solution, syringe and clipped needle, 25 ml graduated cylinder, eye dropper, dissolved oxygen sample bottles (labeled with appropriate depths) and rack, glass vial with plastic lid.



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How Do You Prepare to Sample?

The Day You Sample

On the day you plan to sample, complete the top portion of your field data sheet by filling in the "WBIC", "STORET", and "Volunteer ID" sections. If you do not know what these numbers are contact your Self-Help regional coordinator. If you are using the LaMotte® titration kit to measure dissolved oxygen, mark the bottles with appropriate pre-determined depths. Once this is done, you can begin to load all of your sampling equipment into the boat. Before you launch, make sure you have an anchor, sufficient gas, and personal flotation devices in your boat before proceeding to your sampling site.

Sampling Overview

Winkler Titration Method (LaMotte® Dissolved Oxygen Kit)

Sampling the dissolved oxygen in your lake can be tricky since oxygen in the air can easily contaminate your water sample. To create your dissolved oxygen profile, you will collect water samples at specified depths and measure the oxygen content of the water. Since you have no alternative but to bring your samples to the surface to measure the oxygen, you must take precautions to ensure that your samples do not get contaminated. When filling your collection bottles with your water samples, make sure that you allow the bottle to overflow at least 2 seconds before quickly capping the bottle. This will make certain that no air will get trapped in the bottle and contaminate your sample.

The LaMotte® kit uses the Winkler titration method for determining dissolved oxygen. With this method, reagents react with chemicals in your water sample causing a color change. The amount of reagent needed to create this color change helps you determine what your dissolved oxygen reading is. Use of the Van Dorn water sampler is necessary for determining your dissolved oxygen profile since it retrieves water samples from the desired depth to be tested.

ON LAKE PROCEDURES

How to Collect Water Samples

A variety of Van Dorn samplers have been used throughout the history of Self-Help network. Through the years samplers have been modified, but the method of using each type is the same. There are currently several types of water samplers being used by the Self-Help network: horizontal tug-release sampler, horizontal messenger-release sampler, and the vertical messenger release sampler. The following instructions are for the vertical messenger release sampler. Please contact your regional coordinator if you need instruction on using other models or if your sampler fails to work properly. Please be sure to anchor your boat before collecting your water sample(s). If the boat is drifting, the release mechanism may not work properly.

STEP 1. Prepare the sampler by pulling the sealing balls out of the ends of the tube and hooking the lines over the release pins. Loop the cable from the top cap under the release mechanism support arm and hook onto pin. Hook the bottom cable onto the other pin. Be very careful to keep the top sealing cap away from the release mechanism so that it does not interfere with the messenger when it is released. Make sure the clamp is closed on the release valve.

STEP 2. Hold the sampler line in one hand and the brass messenger securely in your other hand.

STEP 3. Holding the rope waist-high, lower the sampler to the desired depth using the marks on the rope for reference.

DNR PHOTOS

ON LAKE PROCEDURES

How to Collect Water Samples (continued)

STEP 4. Once the sampler is at the appropriate depth, hold the line straight up and down with one hand. With your other hand, drop the brass messenger into the water. You should feel a "thump" when the messenger reaches the sampler.

DNR PHOTOS

STEP 5. Bring the now closed sampler to the surface. To obtain the water for your sample, let go of the hose clamp on the rubber tube with your thumb and release the vacuum by cracking the top seal. Empty water into the sample bottle and repeat steps 1-5 for each depth.

ON LAKE PROCEDURES

Winkler Titration Method (LaMotte® Dissolved Oxygen Kit)

STEP 1. Your regional coordinator will assign to you 5 to 10 depths at which you should sample for dissolved oxygen and will help you mark your sample bottles accordingly. These depths will be the same as the ones you measure for water temperature.

STEP 2. Use the Van Dorn water sampler (see previous section) to collect samples at your pre-determined depths.

STEP 3. Remove the cap of the appropriate dissolved oxygen sample bottle. Place cap top side down to avoid contamination.

STEP 4. If you did not already record a temperature profile of your lake using a digital probe, now is the time to record the water temperature using a regular thermometer. After recording the water temperature of your first sample, let out a small amount of water from the sampler to rinse out the rubber tube. Insert the rubber tube all the way to the bottom of your sample bottle. Open the hose clamp, release the vacuum and allow the water you collected to flow into your sample bottle overfilling the bottle for at least 2 seconds.

STEP 5. While the water is still flowing, slowly remove the tube allowing your sample bottle to overfill. Water will actually appear above the top of the bottle.

STEP 6. Quickly cap your sample bottle. There is a nipple in the cap. This nipple will displace water in the bottle making room for you to add chemicals for your analysis.

STEP 7. Put on your gloves and safety goggles.

DNR PHOTOS

ON LAKE PROCEDURES

Winkler Titration Method (LaMotte® Dissolved Oxygen Kit) (continued)

STEP 8. Remove the cap from the sample bottle you just filled with lake water and add eight drops of the manganous sulfate solution from the squeeze bottle. Make sure to hold the squeeze bottle completely vertical (i.e. not at an angle) for consistent drop size and to avoid splatter.

STEP 9. Then add eight drops of the alkaline potassium iodide azide solution. Once again, make sure to hold the squeeze bottle completely vertical (i.e. not at an angle) for consistent drop size and to avoid splattering.

STEP 10. Cap your dissolved oxygen bottle and mix your sample by inverting the bottle 10 to 20 times. Put the bottle in the sample tray and allow the precipitate (e.g. the solid substance that is forming in your bottle due to a chemical reaction) to settle. This process may take a few minutes.

DNR PHOTOS

Winkler Titration Method (LaMotte® Dissolved Oxygen Kit) (continued)

STEP 11. Once the precipitate has settled, re-mix your sample by inverting the sample bottle another 10 to 20 times. Put the bottle in the sample tray and allow the precipitate to settle again.

STEP 12. Once the precipitate has settled for a second time, add eight drops of sulfuric acid (H_2SO_4) from the squeeze bottle. Cap your sample bottle and invert to mix. Continue mixing the bottle for several minutes until all the precipitate has dissolved. The sample is now "fixed", meaning that the dissolved oxygen concentration cannot change.

DNR PHOTOS

STEP 13. Repeat steps 1-12 for each predetermined depth that you are collecting a water sample.

Note: *Your fixed D.O. sample will retain its dissolved oxygen level for up to 8 hours if refrigerated and kept in the dark. However, for best results, the sample should be titrated as soon as you return to shore.*

Before you start sampling, be sure to read the following pages to familiarize yourself with the equipment and the procedures that you will be using. *All of the procedures that you will follow in sampling your lake are done for specific reasons. It is very important that you follow the sampling procedures exactly as they are laid out in the following pages to ensure good, consistent, high quality data. The following pages will provide you with sufficient background on the design of the equipment and proper procedures to use.*

MENISCUS • *The curved upper surface of a still liquid in a tube caused by surface tension; concave if the liquid wets the walls of the container, convex if it does not.*

ON SHORE PROCEDURES

Winkler Titration Analysis (LaMotte® Dissolved Oxygen Kit)

Before you begin analyzing your samples on shore, here is a quick checklist to make sure that you have everything you will need.

- ☑ Manual
- ☑ Field Data Sheets
- ☑ Pencil and waterproof pen
- ☑ Safety gloves
- ☑ Safety goggles
- ☑ Chemicals and equipment in the LaMotte® titration kit to determine dissolved oxygen using the Winkler titration method (**Note:** All chemicals except sulfuric acid should be replaced every two years): manganous sulfate, alkaline potassium iodide azide, sulfuric acid, sodium thiosulfate (keep refrigerated), starch indicator solution, syringe and clipped needle, 25 ml graduated cylinder, eye dropper, dissolved oxygen sample bottles (labeled with appropriate depths) and rack, glass vial with plastic lid

Set up your LaMotte® dissolved oxygen kit in a place that has plenty of room and is convenient place to work. You should have already added eight drops of the manganous sulfate solution and eight drops of the alkaline potassium iodide azide solution to each of you samples in the field.

NOTE: If you did not "fix" your samples in the field (as outlined in step 12 on page 6.7), **make sure that you do it now** by adding the eight drops of sulfuric acid (H_2SO_4) to each of the dissolved oxygen samples you took. Invert the bottles enough to mix the acid and dissolve the precipitate.

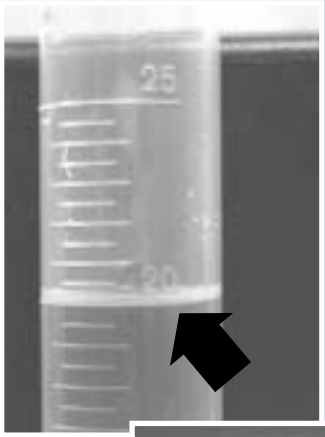
ON SHORE PROCEDURES

Winkler Titration Analysis (LaMotte® Dissolved Oxygen Kit)

STEP 1. Rinse the 25 ml graduated cylinder and the small glass vial with the center-hole plastic lid with distilled water.

STEP 2. Take out your first "fixed" dissolved oxygen sample. Uncap your sample bottle and fill the graduated cylinder with 20 ml of your "fixed" sample.

Due to the adhesive nature of water molecules, when you look at the water level from the side, the liquid in the graduated cylinder will not be flat. Instead the liquid will sag downward. This curved surface is called the meniscus. Always read from the bottom of the ***meniscus*** *when measuring the volume of liquid that you want. In this case you want the bottom of the meniscus to line up with the 20 ml mark on the graduated cylinder. You may have to use the eye dropper to precisely measure this volume.*



STEP 3. Pour the 20 ml sample that you just measured from the graduated cylinder into the small glass vial. Cap the glass vial with the center-hole plastic lid. Please note that even though the glass vial may have volume measurement markings on it, the graduated cylinder is a more accurate measure of volume than pouring your "fixed" sample directly into the small glass vial.

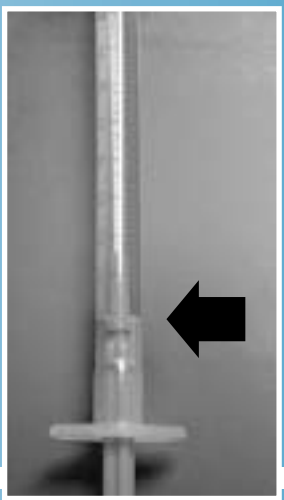
STEP 4. Insert the tip of the syringe into the sodium thiosulfate solution. Turn the bottle and syringe upside down and slowly draw the solution into the syringe past the line marked "0". Remove any air trapped in the syringe by pushing liquid back into the bottle until the bubbles are expelled. You may need to tap the syringe while it is upside down to move the bubbles towards the tip. Remove the syringe. Store the sodium thiosulfate solution in a cool, dry place.

DNR PHOTOS

ON SHORE PROCEDURES

Winkler Titration Analysis (LaMotte® Dissolved Oxygen Kit) (continued)

STEP 5. Pushing the plunger of the syringe and expelling any extra solution onto the ground, match up the top of the plunger with the line on the syringe marked "0" (see "Reading the Syringe" on page 6.13).



STEP 6. Insert the syringe into the hole in the cap of your glass vial containing your "fixed" sample. Very slowly, add the sodium thiosulfate solution drop by drop by pushing on the plunger of the syringe. Gently swirl your sample after each drop. It is possible to add as little as 0.1 units (half the distance between the lines on the syringe) with each addition.

STEP 7. Add the sodium thiosulfate solution until the color of your water sample has changed to a very faint straw yellow. To clearly see the color, it may be helpful to hold a sheet of white paper behind your sample vial after each addition. The exact color is not that important. The object is to add drops to lighten the color, but to stop before the sample becomes clear. The amount of sodium thiosulfate that you add will vary between your samples depending on the amount of dissolved oxygen that is in each sample.

Note: *If the dissolved oxygen content of your sample is very high, it may not become a faint yellow color even after you have added the entire contents of the syringe! In this case, you will need to refill the syringe with the sodium thiosulfate solution by repeating steps 4 and 5. Make sure you note this on your data sheet!*

DNR PHOTOS

Winkler Titration Analysis (LaMotte® Dissolved Oxygen Kit) (continued)

STEP 8. When you have achieved the straw yellow color, carefully remove the syringe from the vial and set the syringe aside. Do not empty the contents of the syringe!

STEP 9. Remove the center-hole plastic lid from the glass vial.

STEP 10. Add eight drops of the starch indicator solution to your 20 ml sample in the glass vial.

Put the lid back on. Gently mix your sample by swirling the vial. Your sample will turn dark blue or black.

STEP 11. Reinsert the syringe that you set aside in step 8 into your sample vial. The syringe should still contain the sodium thiosulfate from steps 4 through 8.

DNR PHOTOS

ON SHORE PROCEDURES

Winkler Titration Analysis (LaMotte® Dissolved Oxygen Kit) (continued)

STEP 12. Very slowly, add the sodium thiosulfate solution to your sample one drop at a time. Take care to swirl the contents of the glass vial between drops. Add the sodium thiosulfate solution drop by drop until the blue or black color of your sample disappears when you swirl it. Swirling the contents of your sample vial allows time for the color to change between drops! Every drop counts so proceed slowly.

STEP 13. When your sample has turned clear, remove the syringe. Before expelling the remainder of the sodium thiosulfate solution in the syringe, read and record the volume of solution that you used (see "Reading the Syringe" on page 6.13).

This step is very important, as it is the "answer" to the dissolved oxygen content of your water sample! Once you have recorded the volume of solution that you used, you can discard the remaining solution by flushing it down a drain with lots of water. Do not return it to the bottle!

DNR PHOTOS

STEP 14. Rinse the syringe with distilled water and wipe it off before repeating steps 1 through 13 for your next sample. Remember, since this analysis only uses 20 ml of your "fixed" sample, if at any time you feel that you made a mistake you should have enough "fixed" sample water remaining to repeat the analysis.

Note: *all chemicals should be stored out of the reach of children. Chemicals should be replaced every two years (except sulfuric acid).*

STEP 15. Be sure to rinse all of your equipment when you are finished.

READING THE SYRINGE

Once your sample in the glass vial has changed from blue to clear (steps 12 to 13 on page 6.12), the dissolved oxygen titration is complete. To determine the amount of dissolved oxygen in your sample, record the position of the plunger in your syringe. The syringe is marked in 0.2 (two-tenths) intervals.

***Example 1*:** The tip of the plunger is flush with the number 6.0 after step 12 (page 6.12). Since you started adding the solution when the plunger was flush with the number 0 (step 5 on page 6.10), your sample contains 6 **parts per million (ppm)** of dissolved oxygen.

***Example 2*:** Suppose you had to refill the syringe once with the sodium thiosulfate solution before your sample changed color to a faint straw yellow (step 7 on page 6.10). After adding the sodium thiosulfate solution for a second time (step 12 on page 6.12), the color of your sample changes from blue to clear. At this point the plunger is flush with the number 3.2. Therefore, the dissolved oxygen content of your sample is 13.2 ppm (10 ppm from the first syringe of sodium thiosulfate solution when the entire contents were added, plus 3.2 ppm from the second syringe of sodium thiosulfate solution).

PARTS PER MILLION (ppm) • *An expression of concentration indicating weight of a substance in a volume of one liter. Milligrams per liter (mg/l) is an equivalent unit.*

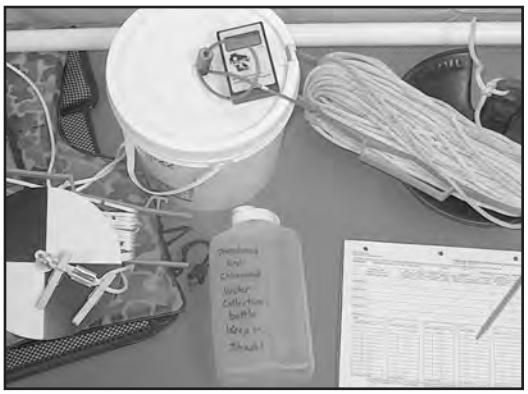
CAROL WATKINS, UW-EXTENSION, ENVIRONMENTAL RESOURCES CENTER

NOTES

7. CHEMISTRY MONITORING:

Phosphorus and Chlorophyll

Before you start sampling, be sure to read the following pages to familiarize yourself with the equipment and the procedures that you will be using. *All of the procedures that you will follow in sampling your lake are done for specific reasons. It is very important that you follow the sampling procedures exactly as they are laid out in the following pages to ensure good, consistent, high quality data. The following pages will provide you with sufficient background on the design of the equipment and proper procedures to use.*



DNR PHOTO

Please remember to keep all sampling equipment and chemicals out of the reach of children. Many of the chemicals you will be using are hazardous (see Appendix 1). After sampling, it is very important to rinse and air dry thoroughly all of the equipment that you used. As always keep paperwork and envelopes separate from equipment.

What Equipment Will You Need?

At your training session, your Self-Help regional coordinator will outline and provide all of the equipment that you will need to successfully monitor your lake. If you are participating in the Self-Help network as a chemistry volunteer you will receive the same equipment that a Secchi volunteer uses to determine water clarity. In addition, you will also receive equipment and chemicals for your water chemistry (phosphorus and chlorophyll) analysis. This list includes everything that you will need while you are on and off the lake.

- ☑ Manual
- ☑ Lake map with sampling site marked
- ☑ Integrated water sampler
- ☑ A large plastic tub containing: 500 or 1000 ml flask, filter cup, pump and tube, squirt bottle (to be filled with distilled water that *you* provide), juice jug for collecting phosphorus chlorophyll water samples, filter membrane, 250 or 500 ml graduated cylinder, sulfuric acid vial, "acid added" stickers, safety goggles and gloves, pH testing paper, waxed paper, mailing tape, pencils, and a waterproof pen.
- ☑ Life jacket (you provide)
- ☑ Anchor and rope (you provide)
- ☑ Field data sheets
- ☑ Pencil and waterproof pen
- ☑ 3 trays of ice cubes

The following supplies will be provided to you by the Self-Help network to send your collected water samples to the State Laboratory of Hygiene for analysis:

- ☑ Styrofoam® mailer
- ☑ 250 ml bottle for the phosphorus sample
- ☑ Zip-lock bag for phosphorus bottles
- ☑ Chlorophyll tube and baggies for ice cubes
- ☑ Carbonless data forms
- ☑ Postage paid envelopes for mailing
- ☑ Chlorophyll sample stickers
- ☑ Phosphorus sample stickers
- ☑ State Laboratory of Hygiene analysis forms
- ☑ Merchandise return labels for mailers
- ☑ Priority mail stickers

How Do You Prepare to Sample?

The Day Before You Sample

The day before you are planning to sample your lake, you should always check to see that your equipment is in good condition. Make sure you have three trays of ice cubes available and your squirt bottle is filled with distilled water. Distilled water can be purchased at your local grocery store but be sure it is labeled *"distilled* water" **not** *"drinking* water" or *"pure* water". Try and plan to sample two weeks after ice out and once during the last two weeks of June, July, and August. Do not take your chlorophyll sample two weeks after ice out as algae will not be growing yet. Sampling early in the week (e.g., Monday through Wednesday) is advised as it allows your samples to arrive at the State Laboratory of Hygiene in a timely fashion.

The Day You Sample

On the day you plan to sample, complete the top portion of your field data sheet by filling in the "WBIC", "STORET", and "Volunteer ID" sections. If you do not know what these numbers are contact your Self-Help regional coordinator. Before you launch your boat, make sure you have an anchor, sufficient gas, and personal flotation devices in your boat before proceeding to your sampling site.

Sampling Overview

Water Sampling

To collect water samples for phosphorus and chlorophyll, you will use one of two types of water samplers. Currently, the Self-Help network uses both an integrated water sampler and a Van Dorn water sampler to collect samples for analysis.

The integrated water sampler is a six and a half-foot PVC pipe that serves as a collection tube. At the bottom of the tube there is a PVC ball that acts as a water-locking mechanism. To take your sample, slowly lower the tube as straight as possible vertically into the water to the tape wrapped on the tube (a depth of six feet). After lifting the tube, you will have collected an *integrated* sample that is a *mix* of water from the surface to six feet deep in the water column. The water in the integrated sampler will be released when the integrated sampler is placed on top of the water collection bottle. The ball will be displaced by the bar on the neck of the juice jug, releasing the water. Contamination can occur if you touch the end of the integrated sampler or if it lies in the bottom of your boat and touches oil or gas. Please keep your integrated water sampler clean. The collection end should be rinsed with distilled water prior to storing. The water sample in the juice jug will be used to fill your State Laboratory of Hygiene phosphorus sample bottle. The remainder of the water in the juice jug will be used for your chlorophyll analysis. Your regional coordinator will train you in how to use the integrated water sampler properly. When the sampler is not in use, it is very important to store the sampler upside down to dry. Storing the sampler vertically upside down between use prevents possible algae and bacteria growth which could contaminate future samples.

Some volunteers still take one sample at a depth of three feet with the Van Dorn sampler to collect water for phosphorus or chlorophyll analysis. The Van Dorn water sampler is different type of sampler than the integrated sampler. The Van Dorn sampler is a plastic collection bottle with rubber stoppers at each end. This type of sampler is able to collect water at a specific depth- not a mix of water from multiple depths like the integrated sampler. When the Van Dorn sampler is lowered into the lake, water will enter the plastic bottle. Once the sampler is at the appropriate depth, a brass "messenger" is dropped down the line to snap the sampler closed with the water sample inside. Although the Van Dorn sampler works well to collect water for chemistry analysis, for consistency purposes, the network hopes to have all volunteers using the integrated water sampler to collect water samples for phosphorus and chlorophyll testing.

Phosphorus Sampling

As discussed above, the water you collect for your phosphorus samples will be analyzed by the State Laboratory of Hygiene. Since phosphorus is measured in very small amounts, it is important that "clean" sampling techniques be used. *Be careful not to touch the inside of the State Laboratory of Hygiene sample bottles or caps or the water as it is being poured from the sampler into the bottle as your fingers may have some phosphorus residue on them.* Phosphorus contamination can come from a variety of sources, including soaps, dishwashing detergents, or lawn fertilizers. To further reduce possible contamination, make sure the sample bottle caps rest upside down as you fill the bottles.

Before mailing your phosphorus sample to the State Laboratory of Hygiene for analysis, it must be preserved (or "fixed") by adding sulfuric

acid. Once the acid is added, the sample is stabilized. You must check the pH of your "fixed" phosphorus sample before sending it to the State Laboratory of Hygiene. To do this, after adding the sulfuric acid, mix the sample and pour a few drops into the lid of the bottle. Then pour the few drops from the lid onto a sheet of waxed paper. Withdraw and tear off approximately 2 inches of litmus paper and dip in solution on the waxed paper. Remove and promptly compare with specimen colors on dispenser to determine corresponding pH. A properly mixed sample will have a pH of 2 or less. Remember to always wear your safety goggles and gloves when handling sulfuric acid to prevent injury to your hands or eyes and flush any spilled acid with water (see Appendix 1 for further detail on sulfuric acid).

Chlorophyll Sampling

Your chlorophyll sample should be collected once during the last two weeks of June, July, and August. Since there is little algal growth in early spring, there is no need to sample chlorophyll until June. The integrated water sampler will collect a sample from the first 6 feet of the water column. This depth contains algae that are representative of species that live in the upper layers of the water column. After collecting your sample, transfer the water to the clean plastic juice jug provided for your use. Since the green chlorophyll pigment degrades quickly in sunlight, it is essential that you place the juice jug in a cool, shady spot as soon as you can. In addition, all processing of the sample should be conducted on shore and out of direct sunlight.

The amount of water that you will filter is directly dependent on what the Secchi depth of your lake was on the day you sampled. As discussed starting on page 11, measuring Secchi depth is one way to estimate the concentration of algae in the water. The deeper you can see the Secchi disc, the fewer algae there is in the water and vice versa (i.e. the shallower the Secchi disc reading, the more algae there is). An exception to this would be lakes with turbid or naturally stained water. Since there is a proportional relationship between Secchi depth and the amount of chlorophyll present, the deeper the Secchi reading, the more water you will have to filter to collect enough algae to measure (see table on page 7.11). Once you have determined the volume of water that you will need to filter, you will pour that volume from the plastic juice jug into your graduated cylinder for a precise measurement. Note that although the upper cup of the filtering apparatus can be used to measure water volume, it is not an accurate measuring device and should not be used to measure the volume of water you need to filter. It is important that you not put place your fingers on the filter paper or in the water sample as the natural oils found on your skin may degrade the chlorophyll in the samples. Use the tweezers provided to place the filter on and to remove the filter paper from the filtering device. Be sure to only use the white filter paper and not the blue filter divider sheets. After the water has been filtered to extract the algae, the filtered water may be discarded. Only the residue on the filter paper will be analyzed. After you are done filtering, the filter paper sample must be kept in the freezer until you send it to the State Laboratory of Hygiene to be analyzed.

ON LAKE PROCEDURES

How to Collect Water Samples

Integrated Water Sampler

Please note that although the Van Dorn sampler has been used in the past to collect water for chemistry analysis, for consistency purposes, the network hopes to have all volunteers using the integrated water sampler to collect water samples for phosphorus and chlorophyll testing.

STEP 1. The lake that you are sampling should be at least 10 feet in depth in order to use the integrated sampler. Rinse the integrated sampler with lake water. Fill the sampler with lake water and empty the water out of the top of the sampler. This will clean out any dirt or dust that may have gotten in the sampler during transport or storage.

STEP 2. Open the juice jug and place it in an accessible spot. Always place the cap top-side down to prevent contamination.

STEP 3. While holding onto the rope end (top) of the integrated water sampler, slowly lower the collection end (bottom) of the sampler tube into the water column until the water level reaches the six-foot mark on the sampler. Try and keep the sampler as vertical as possible when lowering it into the water. Raise the sampler out of the water.

STEP 4. Drain the integrated water sampler by touching the collection end of the sampler to the rod in the juice jug neck. Water will drain from the integrated water sampler tube into the juice jug. This water will be used for your phosphorus and chlorophyll samples.

STEP 5. To prepare your phosphorus sample, remove the cap from your 250 ml State Laboratory of Hygiene bottle. Always place cap topside down to prevent contamination. Pour water from the juice jug into the bottle. Avoid touching the mouth of the juice jug and the phosphorus bottle lip to prevent contamination. Replace the cap. Complete the information on a phosphorus sticker using a pencil and attach the completed sticker to the bottle.

STEP 6. The remainder of water will be used for your chlorophyll analysis. It is important to keep the chlorophyll sample cool and out of direct sunlight until you return to shore.

STEP 7. Store your integrated sampler top side down. This will prevent algal growth between the ball and the collection end of the sampler.

ON LAKE PROCEDURES

How to Collect Water Samples

Van Dorn Water Sampler

A variety of Van Dorn samplers have been used throughout the history of Self-Help network. Through the years samplers have been modified, but the method of using each type is the same. There are currently several types of water samplers being used by the Self-Help network: horizontal tug-release sampler, horizontal messenger-release sampler, and the vertical messenger release sampler. The following instructions are for the vertical messenger release sampler. Please contact your regional coordinator if you need instruction on using other models or if your sampler fails to work properly. Please be sure to anchor your boat before collecting your water sample(s). If the boat is drifting, the release mechanism may not work properly.

STEP 1. Prepare the sampler by pulling the sealing balls out of the ends of the tube and hooking the lines over the release pins. Loop the cable from the top cap under the release mechanism support arm and hook onto pin. Hook the bottom cable onto the other pin. Be very careful to keep the top sealing cap away from the release mechanism so that it does not interfere with the messenger when it is released. Make sure the clamp is closed on the release valve.

STEP 2. Hold the sampler line in one hand and the brass messenger securely in your other hand.

STEP 3. Holding the rope waist-high, lower the sampler to a depth of 3 feet using the marks on the rope for reference.

DNR PHOTOS

ON LAKE PROCEDURES

How to Collect Water Samples (continued)

Van Dorn Water Sampler *(continued)*

STEP 4. Once the sampler is at 3 feet, hold the line straight up and down with one hand. With your other hand, drop the brass messenger into the water. You should feel a "thump" when the messenger reaches the sampler.

DNR PHOTOS

STEP 5. Bring the now closed sampler to the surface. To obtain the water for your sample, let go of the hose clamp on the rubber tube with your thumb and release the vacuum by cracking the top seal. Empty water into the juice jug. This water will be used for your phosphorus and chlorophyll sample.

STEP 6. To prepare your phosphorus sample, remove the cap from your 250 ml State Laboratory of Hygiene bottle. Always place cap topside down to prevent contamination. Pour water from the juice jug into the bottle. Avoid touching the mouth of the juice jug and the phosphorus bottle lip to prevent contamination. Replace the cap. Complete the information on a phosphorus sticker using a pencil and attach the completed sticker to the bottle.

STEP 7. The remainder of water will be used for your chlorophyll analysis. It is important to keep the chlorophyll sample cool and out of direct sunlight until you return to shore.

Before you start sampling, be sure to read the following pages to familiarize yourself with the equipment and the procedures that you will be using. *All of the procedures that you will follow in sampling your lake are done for specific reasons. It is very important that you follow the sampling procedures exactly as they are laid out in the following pages to ensure good, consistent, high quality data. The following pages will provide you with sufficient background on the design of the equipment and proper procedures to use.*

ON SHORE PROCEDURES

Before you begin analyzing your water samples and preparing them for the State Laboratory of Hygiene, here is a quick checklist to make sure that you have everything you will need.

- ☑ Manual
- ☑ Field Data Sheets
- ☑ State Laboratory of Hygiene slip for your phosphorus and chlorophyll samples
- ☑ Pencil and waterproof pen
- ☑ Safety gloves
- ☑ Safety goggles
- ☑ Phosphorus sample sticker
- ☑ Chlorophyll sample sticker
- ☑ "Acid added" stickers (optional)
- ☑ Three trays of ice cubes
- ☑ Styrofoam® mailer kit
- ☑ Ziploc® bags
- ☑ Packaging tape
- ☑ Merchandise return label and priority mail stickers
- ☑ Integrated water sampler
- ☑ Magnetic Filter Funnel (2 pieces)
- ☑ Chlorophyll tube
- ☑ Hand pump with plastic tubing
- ☑ 500 or 1000 ml plastic flask
- ☑ 250 or 500 ml graduated cylinder
- ☑ Membrane filters
- ☑ Test tubes
- ☑ Tweezers
- ☑ Paper towels
- ☑ Squeeze bottle filled with distilled water
- ☑ Acid vial
- ☑ Waxed paper
- ☑ Litmus paper and color chart
- ☑ Phosphorus sample
- ☑ Water sample in the 2-quart juice jug

ON SHORE PROCEDURES

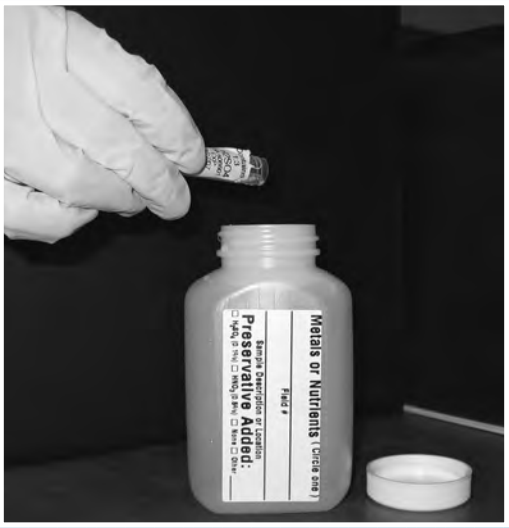
Phosphorus Sample Preparation

Be sure to put on your gloves and safety goggles before beginning your phosphorus sample preparation!

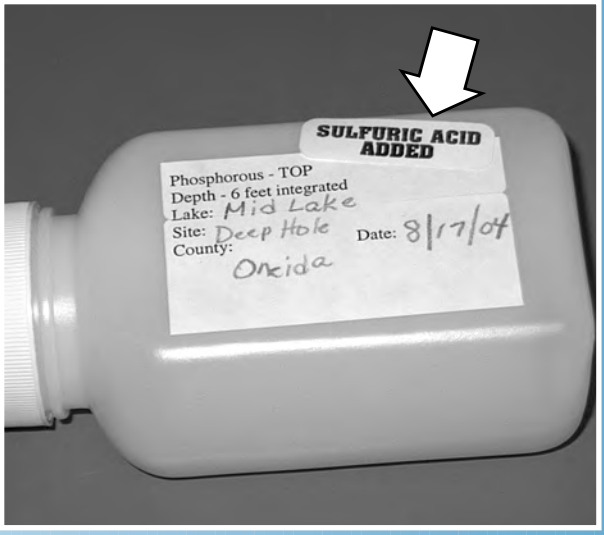
STEP 1. Take out your phosphorus sample.

STEP 2. Remove the sulfuric acid vial from your kit.

STEP 3. Uncap your phosphorus bottle and empty contents of one acid vial into your phosphorus sample. This will "fix" your sample by inhibiting bacterial growth and keeping the phosphorus from sticking to the sides of the bottle.



STEP 4. Replace lid on acid vial and the cap on your phosphorus sample. Mix your sample by inverting the bottle several times. As an option, you can place a sticker on the plastic phosphorus bottle, stating that acid has been added.



DNR PHOTOS

ON SHORE PROCEDURES

Phosphorus Sample Preparation (continued)

Because all water samples differ, it is important to check the acidity of your phosphorus sample. The amount of sulfuric acid you just added to "fix" your sample may not have been enough to acidify your sample.

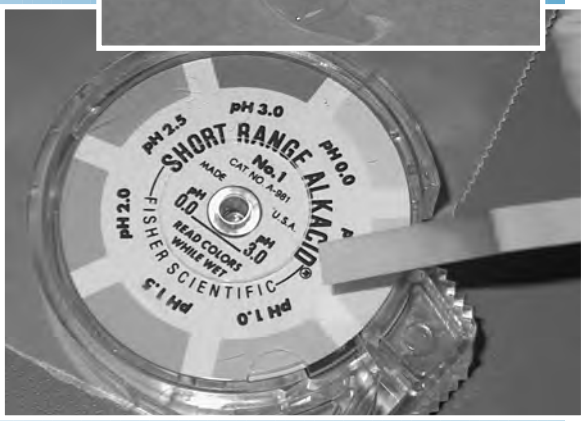
To check the acidity of your phosphorus sample:

STEP 5. Open your sample bottle a second time. Take out a sheet of waxed paper. Pour several drops of your sample into the phosphorus bottle lid. Pour this small amount of your sample from the lid onto the piece of wax paper.

STEP 6. Tear off a two-inch piece of litmus paper and dip one end in the water sample on the wax paper. You should see the litmus paper change colors. Be careful with the litmus paper and the water drop on the wax paper. The color will stain!

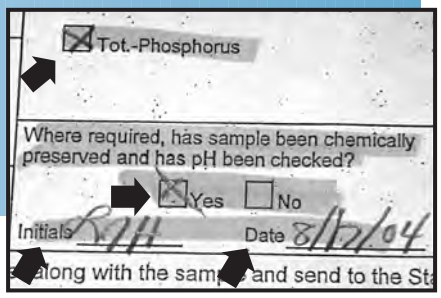
DNR PHOTOS

STEP 7. Compare the color change on the litmus paper to the color chart. If the color of the litmus paper matches the shade on the chart listed at 2.0 or less, your sample is ready to mail.



STEP 8. If the color of the litmus paper matches the shades on the chart listed at 2.5 or higher, add one more vial of sulfuric acid to your sample bottle. Replace cap and invert the bottle several times to mix the sample again. Repeat steps 5 to 7.

STEP 9. When you are done adding the sulfuric acid, rinse and dispose of the used vials in the garbage. Store unused vials out of the reach of children!



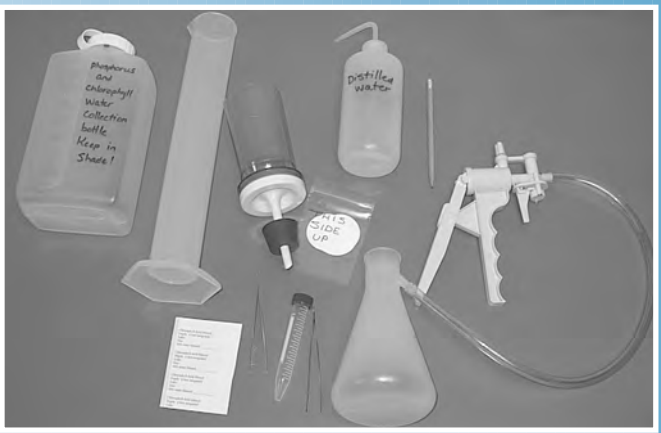
DON'T FORGET to fill in the following areas on your lab sheet: Check the "*Tot. Phosphorus*" box in the "*Nutrients Bottle 250 ml*" section. Check "*Yes*" in the box asking if the pH (acidity) has been checked. Add your initials and the date.

ON SHORE PROCEDURES

Chlorophyll Sample Preparation

Since light can cause the algae to grow and alter your sample, this on shore procedure for preparing your chlorophyll sample should be conducted in the shade and out of direct sunlight.

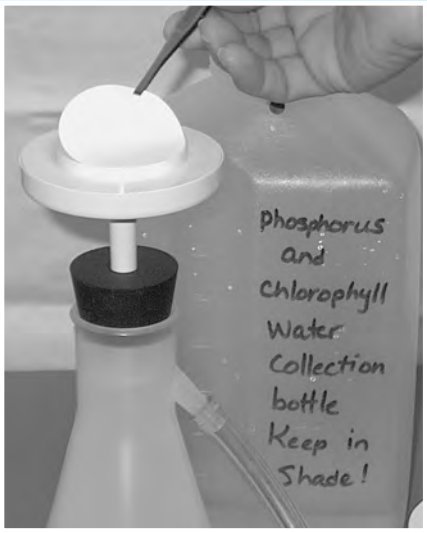
STEP 1. Place all the parts of your chlorophyll filtering equipment at your work area.

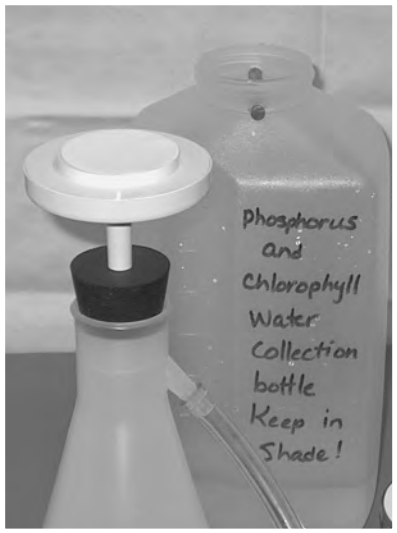


STEP 2. Attach the plastic tubing of the hand pump to the spout of the 500 or 1000 ml plastic flask.

STEP 3. Insert the bottom part of the filtering cup into the flask. You may want to moisten the stopper first to ensure a good seal.

STEP 4. Use the tweezers to pick up one membrane filter and place it on the center of the filter cup base (i.e. the black screen). Note that filters are white and the divider sheets are blue. Make sure you use a white filter and not a blue divider sheet!





DNR PHOTOS

ON SHORE PROCEDURES
Chlorophyll Sample Preparation (continued)

STEP 5. Squirt a small amount of distilled water on the filter in the center of the black base to keep it in place. Never touch the filter with your fingers! Always use tweezers when removing it from the Ziploc® bag or when placing it on the black screen.

Since there is no marking on the actual filter, your Ziploc® bag containing the chlorophyll filters is marked "This Side Up". The water will filter faster and easier if you keep the top side up when placing the filter in the base. If you by mistake place the filter upside down, it will still filter. However, it may take longer and be harder to filter your entire water volume.

STEP 6. Carefully place the magnetic cup on top of the filter base. Be sure that the filter does not move! If the filter moves, wrinkles, or tears, remove the filter cup and repeat steps 4 and 5 to put a new filter on the black base.

DNR PHOTOS

STEP 7. Using the table on the right, look up the Secchi depth you measured earlier in the day to determine the volume of water that you need to filter to obtain your chlorophyll sample. Please be aware that this amount may change each time you sample. In general, the better the water clarity (i.e. deep Secchi depth), the fewer algae there is in the water, and the more water you need to filter in order to collect enough algae for analysis.

Volume of water to filter as determined by Secchi depth.

Secchi Depth (ft)	Volume of Water to Filter (ml)
Less than 1	50
1 to 1.5	100
Greater than 1.5	200

ON SHORE PROCEDURES

Chlorophyll Sample Preparation (continued)

STEP 8. Take out the plastic juice jug filled with water for your chlorophyll sample. Gently mix the water in the jug by turning it upside down several times. Fill your 250 ml or 500 ml graduated cylinder with the appropriate volume of water needed to filter your sample (Refer to step 7). *Note that although the upper cup of the filtering apparatus can be used to measure water volume, it is not an accurate measuring device and should* ***not*** *be used to measure the volume of water you need to filter.*

STEP 9. To begin filtering, pour some of the measured water from the graduated cylinder into the filter apparatus. You don't want to pour the full amount into the filter cup all at once. If your lake contains lots of algae or sediment, the filter will become clogged and you will not be able to empty the filter cup easily.

STEP 10. Squeeze the hand pump to move the water through the filter. Once all the water has been filtered, wash down the sides of the filter cup with distilled water to ensure that all of the algae are washed onto the filter paper.

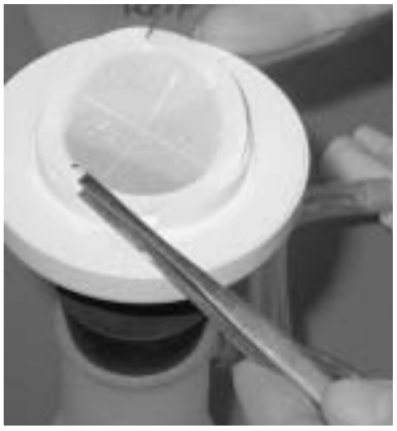
DNR PHOTOS

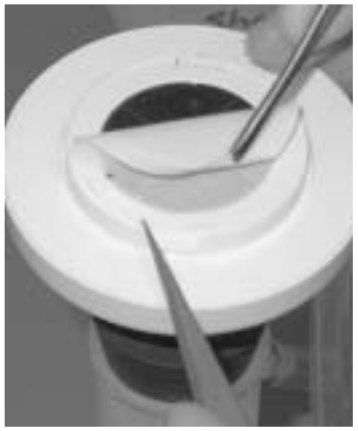
ON SHORE PROCEDURES

Chlorophyll Sample Preparation (continued)

STEP 11. After you have filtered the appropriate volume of water, separate the filter apparatus by removing the top cup from the filter base.

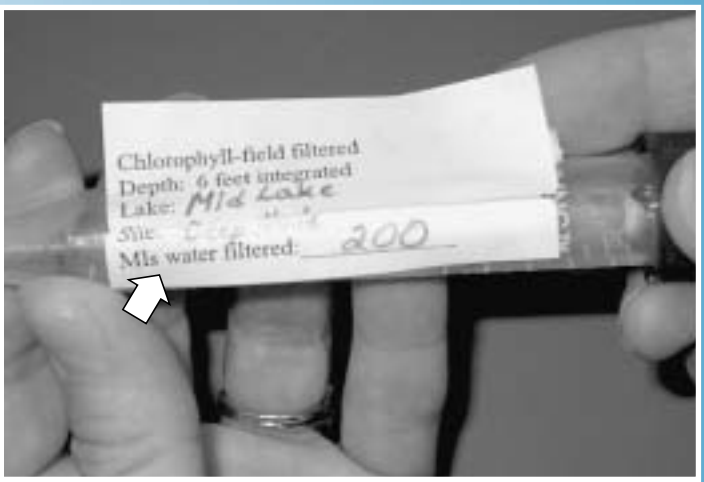
STEP 12. Using tweezers, place the filter into the chlorophyll tube that came in the mailer from the State Laboratory of Hygiene.





STEP 13. Fill out the chlorophyll label and place it on the tube containing your chlorophyll sample. Be sure to include the volume filtered (mls) on the label.

STEP 14. Don't forget to write the volume of water that you filtered for your chlorophyll sample on your lab slip.



DNR PHOTOS

IT IS BEST TO MAIL YOUR SAMPLE ON THE DAY YOU COLLECT IT. But, if it has to be mailed the next day, don't forget to place your bagged chlorophyll sample in the freezer until you're ready to mail it!

How to Fill Out Your Lab Sheet

When filling out your lab sheet, please make sure the following information listed is completed.

- ☑ ***WBIC*** (should already be pre-filled in on your lab sheet)
- ☑ ***STORET*** (should already be pre-filled in on your lab sheet)
- ☑ ***Collected By*** (name or names of all who sampled)
- ☑ ***Phone*** (your phone number)
- ☑ ***Begin or Grab Date*** (the date your sample was collected)
- ☑ ***Begin Time*** (list this time in 24 hour or military time)
- ☑ ***Depth of Sample or Sample Location*** (6 feet if you used the integrated water sampler; 3 feet if you used the Van Dorn sampler.)
- ☑ ***mls filtered*** (amount of water filtered for your chlorophyll sample in mls)

Do not forget to fill in the "*Tot. Phosphorus*" area of the lab sheet. Check "*Yes*" in the box asking if the pH (acidity) has been checked. Add your initials and the date. Enclose the completed lab sheet in your sample mailer box. The State Laboratory of Hygiene address is pre-printed on the postcard provided with your mailer. Be sure that the proper address is displayed on the mailer before sending your samples.

Mailing Your Samples

For the lab to get an accurate analysis of the phosphorus and chlorophyll in your lake, your samples must be handled and shipped properly. Try to collect your samples early in the week so that you are able to put them in the mail on a Monday, Tuesday, or Wednesday. Ideally, you want your samples to reach the State Laboratory of Hygiene by Friday so they do not sit in the post office over the weekend. If for some reason you collect your samples on a Friday, Saturday, or Sunday put your chlorophyll sample in the freezer and keep your phosphorus sample in the refrigerator until you are able to mail them on Monday. ***Do not put your phosphorus sample in the freezer!*** Keep in mind that the sooner the lab is able to analyze your samples, the more accurate your results will be. The following steps are an efficient way to make sure that your samples are packaged properly and prepared to ship to the State Laboratory of Hygiene safely.

MAILING YOUR SAMPLES

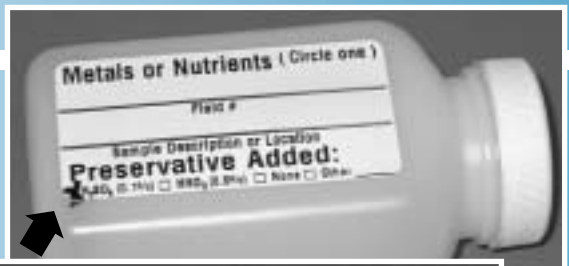
STEP 1. Complete the laboratory data sheet for your phosphorus and chlorophyll samples. All information must be complete for the lab to analyze the samples. If you are unsure of how to fill out your data sheet see the previous section "How to Fill Out Your Lab Sheet".

STEP 2. Gather all the materials you will need to mail your samples: Styrofoam® mailer, completed lab sheet, merchandise return label (mailing label), three trays of ice cubes, one sandwich-size Ziploc® bag, 2 one-gallon Ziploc® bags, and Priority Mail® stickers.

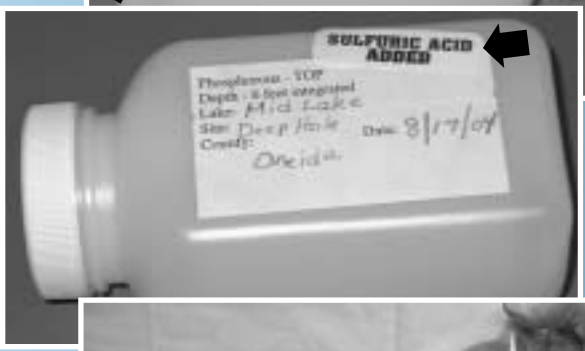
DNR PHOTOS

MAILING YOUR SAMPLES (continued)

STEP 3. Prepare to mail your chlorophyll sample by making sure that the chlorophyll sticker is filled out completely and attached to the tube. Don't forget to include the volume of water that you filtered! Put your chlorophyll filter tube in the gallon Ziploc® bag.



STEP 4. Prepare to mail your phosphorus sample by making sure that your sample was preserved with sulfuric acid and that you've checked the acidity. Attach the completed label with the name of your lake, site, county, and date. Don't forget to mark on your bottle that it is preserved with H_2SO_4 (sulfuric acid), or as an option, attach the acid-added sticker to your bottle.



STEP 5. Place your phosphorus sample in the sandwich-size Ziploc® bag and then put it in a one-gallon Ziploc® bag with three trays of ice cubes. Make sure the bag is sealed tightly.

STEP 6. Put your completed lab sheet in the one-gallon Ziploc® bag with your chlorophyll tube.

DNR PHOTOS

MAILING YOUR SAMPLES (continued)

STEP 7. Place your bagged phosphorus sample containing the ice in the Styrofoam® mailer. Then place the bagged lab sheet with your chlorophyll sample and tube in the inside of the Styrofoam® mailer. Make sure that the chlorophyll sample is against the ice in the bag with your phosphorus sample!

STEP 8. Gently fold the bagged lab sheet over the ice, close the Styrofoam® lid, and tape the cardboard mailing box shut.

STEP 9. Tape once around the cardboard sleeve. Attach the 4 inch x 6 inch white merchandise return label to the top of the mailer. Attach *one* priority mail sticker to the top of the package and *one* to the bottom. Verify that the mailer card shows the address for the State Laboratory of Hygiene.

STEP 10. Put your samples in the mail with your regular outgoing mail or at the post office. The mailing label is postage paid, so you will not need any stamps.

STEP 11. Once the State Laboratory of Hygiene has received your samples, they will send you a new mailer to use for your next collection of samples.

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Clean-up

After you have prepared your samples for mailing to the State Laboratory of Hygiene, there are only a few things left for you to do. Rinse out your water sampler, graduated cylinder, plastic juice jug, and filtering apparatus with tap water. If you analyzed dissolved oxygen, you should thoroughly rinse all your dissolved oxygen bottles and the glass vial and syringe with tap water. It is okay for the contents of these items to be rinsed down the sink with a continuous flush of water. Do not use soap when cleaning your sampling supplies! After you have rinsed everything with tap water make one final rinse with distilled water. Be sure to let all of your equipment air dry before storing them. Once everything has air dried, store your sampling equipment in the plastic tub where it can stay dry and be out of the reach of children! Remember, there are chemicals that no one should touch except in connection with the Self-Help sampling network. Make sure the lid to the plastic tub is tight to keep dust and rodents out. Store your data sheets, labels, filters, and litmus paper separately from your equipment. When storing the integrated water sampler, make sure that it is vertical with the rope end down. This will allow for the water to drain from the tube and prevent potential algae and bacterial growth.

Taking Care of Data

Once you are back on-shore, transfer all your data to the carbonless data form. This form will make it easier to enter your data using the Secchi line phone system or to enter your data online. The web address to enter your data online is: **dnr.wi.gov/org/water/fhp/lakes/shlmsubm.htm**. Choose the "Submit Data" link located on the left side of the page. If you want to enter your data using the Secchi line phone system, the toll-free number is (888) 947-3282. Notes that you wrote in the "observations" section of your datasheet can be entered online, but not using the Secchi line. Observations will be entered by Self-Help network staff directly from the data sheets that you mail to the central office. If at any time you have problems trying to enter your data using the Secchi line phone system,

HELPFUL HINTS FOR USING THE SECCHI LINE PHONE SYSTEM

When the prompt allows, you may press '9' to leave a message at the beginning or end of a call. Press the '#' (pound) key to indicate that you are finished entering a number for each field or to skip an optional field. Optional fields include all fields except *Volunteer ID*, *Waterbody Number (WBIC)*, *STORET number*, *sample date*, and *sample time*. If you do not want to listen to the announcement at the beginning of each call, you can skip it by pressing the '#' (pound) key. The '✳' (star) key is used to indicate a decimal point.

HOW TO REPORT ICE ON/OFF INFORMATION

Sometimes a lake freezes and thaws a few times and then thaws and freezes a few more times. You should record the data of all of these changes. You can report these dates in the "comments" or "observations" part of your data sheet. When entering this information online, you can make a separate entry and just write comments about ice on or ice off. Alternatively, you can email this information to Jennifer Filbert at Jennifer.Filbert@dnr.state.wi.us. For historical analyses, the official ice on date should be the first date of complete ice cover and the official ice off date should be the last breakup before the summer opening appears. It is important to document the details since these dates may be difficult to verify.

HOW TO FILL OUT YOUR FIELD DATA SHEET

State of Wisconsin
Department of Natural Resources

Wisconsin Self-Help Lake Monitoring - Secchi & Chem
Form 3200-099 (R 12/01)

Information is collected under s. 33.02, Wis. Stats. Personally identifiable information, including names of volunteers, will be broadly distributed in conjunction with lakes data.

Waterbody #	Storet # (Use separate form for each site)	Lake Name	County	Year

Toll-free Secchi Line Phone: 1-888-947-3282

Volunteer ID #s for each volunteer who sampled on each date	Date Use 4 digits, e.g., May 19 is 0519	Time Round to nearest hour	Secchi Depth Round to nearest quarter of a foot	Hit Bottom 1=Yes 2=No	Lake Level 1=High; 2=Low; 3=Normal; 4=Gauge	Lake Level If gauge, enter numerical level	Appearance 1=Clear 2=Murky	Water Color 1=Blue; 2=Green; 3=Brown; 4=Red; 5=Yellow	Percep-tion 1 - 5	Date Called In
Observations:										
Observations:										
Observations:										
Observations:										
Observations:										

Date:			Date:			Date:			Date:			Date:		
Depth	Temp. F	D.O.	Depth	Temp. F	D.O.	Depth	Temp. F	D.O.	Depth	Temp. F	D.O.	Depth	Temp. F	D.O.
No spring chl sample			Vol. filtered for chl:		m/s	Vol. filtered for chl:		m/s	Vol. filtered for chl:		m/s	Vol. filtered for chl:		m/s

After calling in the data or entering it on the web, mail the original (blue) copy in the postage paid envelope (or to Self-Help Lake Monitoring, WI DNR, PO Box 7921, Madison, WI 53707) **by November 1**. The Self Help Web address is: http://www.dnr.state.wi.us/org/water/fhp/lakes/shlmmain.htm.

The following descriptions represent the portions of your data sheet that should be filled out while you are on the water at your sampling site so the observations are fresh in your mind.

Waterbody #, STORET #, and Volunteer ID

During your training session, you should have received a waterbody identification code (WBIC), STORET number, and volunteer ID number. The WBIC is a number assigned to your lake and allows the Self-Help network to know exactly which lake you are monitoring. The STORET number is assigned to the specific monitoring site on your lake and the data that you collect is tied to that specific number. If you decide to change your sampling site, it is very important that you contact your regional coordinator right away so a new STORET number can be assigned for that site. Each volunteer is also given their own ID number. Knowing what all of these numbers are is very important. If you do not know your WBIC and STORET numbers, or volunteer ID, please contact your regional coordinator or central office staff to obtain it. It is very important that these numbers are recorded on all data sheets, so the data you collect can be linked to a specific location within a specific lake and a specific volunteer.

While you are sampling on your lake, record all of your data on the white "Field Data Form". You can use this same form for repeated sampling days until it is filled up, or too wrinkled from wind and water to use anymore. However, if you change sampling site locations within a lake or change lakes, you must use a new form!

Date

When recording the date it is only necessary to use 4 digits. For example, if you sampled on May 19th, you would record this on your data form as "0519"; July 6th would be "0706", etc. You do not need to include the year since your data is submitted annually.

Time

Record the time you started your sampling. If you are going to report your data using the Secchi line, you should record it in "military" time (e.g., 1:05 P.M. is 1305 hours). If you are reporting your data online, you can record your "civilian" time as you normally would by using A.M. and P.M.

Secchi Depth

When recording your Secchi disc reading, round off to the nearest quarter foot. Record fractions of a foot as a decimal since this is how it will be entered in the Secchi line phone system or online. For example, 12 ¼ feet is 12.25 feet. **Note**: The "✱" (star) button on your telephone key pad serves as the decimal point when entering your data into the Secchi line phone system.

It is possible that the Secchi disc will be visible even when it is resting on the bottom of the lake. If this

is the case, record the depth as you always would, but make sure you record a "1" in the "Hit Bottom" field of your data sheet.

Lake Level

Record the water level on your lake. It helps to use the shoreline or your pier as a guide to indicate whether your lake level is high, low, or normal. If you are able to determine the water level using a staff gauge on the lake, indicate this on the data sheet and record the numerical value in the space provided.

Appearance

To determine if the water appearance is clear or murky, hold your Secchi disc one foot under the surface of the water and observe how the white part of the disc appears. If the white part still looks white, water appearance is "clear"; if it does not look white, water appearance is "murky".

Water Color

The water color is determined at your site using the Secchi disc as a guide. After lowering the disc about a foot into the water, ask yourself the question, "Does the white part of the Secchi disc look white, or does it appear green or brown?" If it appears white, then the water color is "blue". If it appears green, then the water color is "green" and so on. If you are using color cards to determine the color of your lake water, then the white part of the disc would be compared to the colors on the card and a numeric value assigned to the color. Be aware that the Secchi line phone system will only accept one color, so, for instance, if the water appears "bluish-green", you will have to select the one color (blue or green) that best describes your water color.

Perceptions

Indicate your perception of the water quality for your lake. **Refer only to the condition of the water itself.** You can record information on aquatic plants around the shoreline or other problems you perceive in the observation section of the data sheet. On a scale of 1 to 5 (1 being the best and 5 being the worst), your perception of the water should reflect how much algae is in the water.

Observations

In the observation section of the data sheet, you can include any comments about the weather, water conditions, wildlife sightings, plant densities, or other information you want to include that you think will help to better understand your lake. If you need more data sheets, have questions or problems, you may also include those comments in this section. Feel free to attach additional observations on a separate sheet of paper. You can enter as much information as you'd like. The Self-Help database is capable of holding a very long entry.

press 9 to speak to someone in the central office. After entering your data, either online or by phone, check the column labeled "*Called In?*" on your data form. This will allow you to keep track of what data you have already entered.

Your data should be mailed as soon as possible so your lake observations and comments can be entered into the database. Keep the pink copy of the data form for yourself and use the business reply envelope provided to you to send the blue copy to the Madison Self-Help Office. All data for the year must either be entered into the Secchi line phone system or online by November 1st to guarantee that it will be included in your printed Annual Report. If you find data that has not been entered after this date you can still enter your data online or you can mail your data sheets to the Madison office at: Wisconsin DNR Self-Help Lake Monitoring, 101 S. Webster St., PO Box 7921, Madison, WI 53707-7921. Self-Help staff will make sure that your data is entered into the database. The earlier your data is received, the sooner your data can be analyzed and the sooner your annual report will be mailed back to you. We will use the data sheet we receive from you in the mail to verify the information you may have entered online or by using the Secchi line phone system.

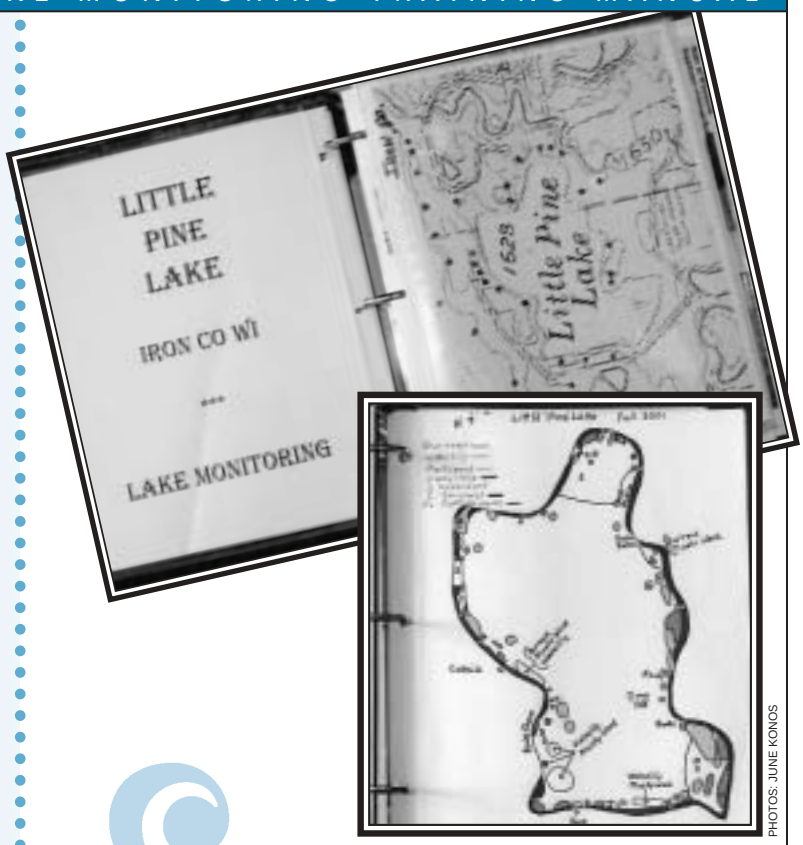
The data that you collect will be summarized in an annual report that you will receive after your sampling season is over. Limnologists suggest that after eight years of collecting Secchi data, one can begin to determine if water clarity is getting better, worse, or staying the same. Your annual report will show the dates you sampled, and your Secchi disc readings measured in feet and meters. Always check your annual report with a copy of your original data sheet to verify your data. You will also receive a summary report of water clarity representing the mean summer clarity and the minimum and maximum reading for your summer sampling period. A graph will summarize your average summer Secchi depth readings.

SECCHI DIP-IN

The Secchi Dip-In is an annual event coordinated by Kent State University, where individuals from all over the world take a Secchi reading sometime between the end of June and the middle of July each year. You should report your data from these dates to the Self-Help network, and optionally, you can also report them to the Secchi Dip-In online. For more information on this annual event please visit dipin.kent.edu/ or email dipin@kent.edu.

REMOTE SENSING

Since 1999, Self-Help volunteers have assisted in a collaborative research effort with University of Wisconsin Environmental Remote Sensing Center by taking Secchi readings on dates when the satellites were over their lakes. The volunteers' participation has allowed the University to successfully calibrate computer programs that use satellite imagery to predict Secchi disc depth and other water quality parameters on lakes. The ultimate goal is to put the satellite data into everyday use by making the water clarity data derived from the satellite imagery available to the Wisconsin DNR and to the public. As a volunteer, the Self-Help network will send you a postcard with the dates that satellite photos will be taken of your lake. Take Secchi readings on as many of the dates as you can. If you collect data on "satellite dates", you don't need to do anything special to report it. The network will automatically include your data in the analysis of the satellite imagery. Just think, on a clear satellite day, your Secchi reading may translate into hundreds of others; almost as if you're monitoring hundreds of lakes at one time!



PHOTOS: JUNE KONOS

Record-Keeping

Keeping a "Lake Log"

As a Self-Help lake monitoring volunteer, you are considered a record-keeper of your lake's overall health. The Secchi visibility data, water chemistry information, and observations that you supply, help with current management activities and also provide a basis for future management. The information that you collect in the field, as well as, the summary results presented in Self-Help reports, should be used to create a "lake log" (i.e. a long-term record of your lake's overall history and health).

The field data sheet copies of your water clarity and chemistry information can be used as basic information for starting your lake log. Eventually you can add graphs, news clippings, lake history, maps, wildlife sightings, land use records, etc., to make your log complete. The sky's the limit! But don't take on this responsibility alone. You can share record-keeping responsibilities by enlisting the help of lakeshore residents, lake association members, and youth or school groups to help collect and compile information. For a *basic* lake log, the following items are recommended:

a lake map (maps of many lakes are available from the Self-Help website), copies of your field data sheets and notes, and your annual data summary sheets. In addition to the items listed above, if you would like to compile a more comprehensive lake log the following items are recommended.

- ☑ Graphs of your results
- ☑ General lake ecology information (e.g., Self-Help reports, *Understanding Lake Data*, etc.)
- ☑ Statewide Self-Help data summary sheets
- ☑ Planning and protection grant information
- ☑ Precipitation and other weather information
- ☑ Ice-on and ice-off dates
- ☑ Wildlife sightings
- ☑ Illustrations and photographs
- ☑ Aquatic plant information
- ☑ Lake history notes from interviews with long-time residents
- ☑ Historical maps showing watershed development
- ☑ Video or photos of shoreline development runoff, plants, algal blooms, etc.
- ☑ Any other data or information collected about your lake

Assembling the Basics

As discussed above, to make your lake log successful, a few basic items are necessary. But how do you obtain these items? Currently, the Wisconsin DNR has maps for many lakes in Wisconsin available online at **dnr.wi.gov/maps/**. Your local library or university may also have lake maps available. If you don't already have a map for your lake, check with your regional coordinator. They may be able to assist you in obtaining one. When you sample, make careful observations. Your initial observations are important since they can help you remember (and others understand) what is happening in and around your lake. In addition, taking careful field notes can provide a better understanding of the water quality and ecosystem conditions on your lake. Always remember to keep copies of your Secchi and field data sheets, as well as, the annual data summary sheets for your lake and the statewide data summaries. The easiest way to do this is to three-hole punch them and add them to your lake log binder. Graphs that you create showing Secchi visibility, water chemistry, and your lake's trophic

DNR PHOTO

state index will provide a good visual image of what is happening in your lake over time. Keep in mind that if you create your graphs using the same scale (i.e. axis size and numbering) you will be able to physically place your graphs side by side to visually compare your results from year to year.

Graphing Your Results

Several graphs will be included with your annual report. However, here are some basic instructions for making your own graphs. These are instructions for making them by hand on graph paper, although creating them on the computer would be similar. A tutorial on how to create lake data graphs using Microsoft® Office Excel can be found on the Self-Help Website at **dnr.wi.gov/org/water/fhp/lakes/selfhelp/**.

Secchi Visibility Graph

To create your Secchi visibility graph (Fig. 3), mark the X-axis (horizontal axis) along the bottom of the graph with each date that you collected data. Your graph will make the most sense if you start with your early spring dates at the far left and continue to your autumn dates on the right. On the Y-axis (left vertical axis), you will mark the water depth in feet. To do this, write in the numeral 0 in the upper left corner (top) of the Y-axis. This will represent 0 feet (i.e. the lake's surface). Then proceed to label the Y-axis in 1 foot increments down the left side until you reach the number that corresponds to the depth of your lake. Now that your both your axes are labeled correctly, your graph is ready for the data. On each date that you collected Secchi data draw a vertical line from the top of your graph (0 feet) to the Secchi depth you got that day. If you like, you can put a short horizontal bar at the bottom of each line to represent the Secchi disc.

Phosphorus and Chlorophyll Graph

This graph (Fig. 4) will be similar to the one you just made for your Secchi data. Just as you did for your Secchi visibility graph, along the bottom of the graph mark the X-axis with each date that you collected data. Since you have two sets of data, this graph will have two Y-axes; a left and a right. Your left Y-axis will represent your phosphorus data and the right Y-axis will represent your chlorophyll data. On the left Y-axis, write the numeral 0 at the bottom left corner representing no phosphorus. Then mark your phosphorus units (i.e. µg/L) on the left axis increasing as you move up towards the top of the graph. The scale that you use will depend on the range of your phosphorus results. For example, you may decide to mark every 5 µg/L or every 15 µg/L. The right Y-axis will be created the same as the left. On the right Y-axis, write the numeral 0 at the bottom right corner representing no chlorophyll. Then mark your phosphorus units (i.e. µg/L) on the right axis increasing as you move up towards the top of the graph. Once again, the scale that you use will depend on the range of your test results. Now that all your axes are labeled correctly, your graph is ready for the data. Plot your phosphorus results first. Once plotted, connect the data points with a solid line or colored pen. Next, plot your chlorophyll results. Connect the chlorophyll data points with a dashed line or different color pen.

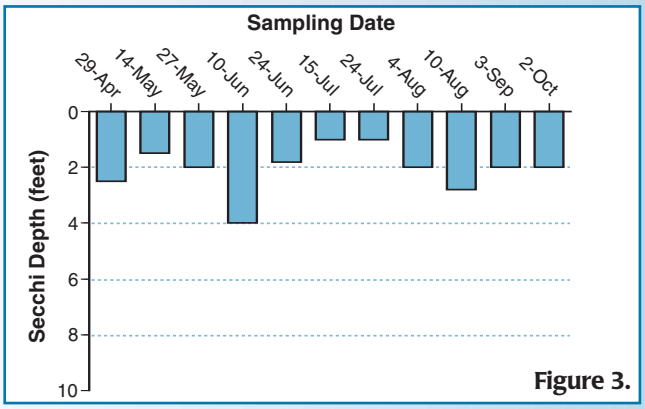
Temperature and Dissolved Oxygen Graph

Unlike the earlier graphs you may have made, each graph you make for these particular data will represent *one* day of sampling. So depending on how many days you sampled you may generate anywhere from four to twelve graphs. If you have dissolved oxygen data, your graph will have two X-axes; a top and a bottom (Fig. 5). If you do not have dissolved oxygen data your graph will only have a bottom X-axis. To create you graph, mark the bottom X-axis with your temperature scale. Your temperature scale for the day that your are graphing should range from ten degrees colder than your coldest water temperature recorded for that day up to ten degrees above your warmest water temperature. Your Y-axis should be labeled the same way you labeled the Y-axis on your Secchi visibility graph. Once all your axes are labeled correctly your graph is ready for the data. Plot your temperature data for that day for each depth you sampled. Connect the dots with a solid line or colored pen to make your temperature profile. If your line for that date is straight that indicates your lake was mixed from the surface to the

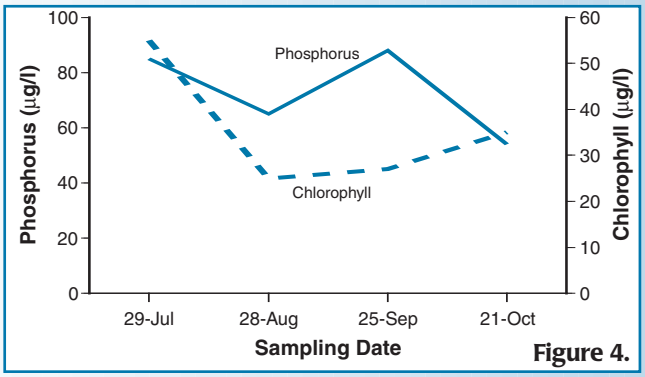
bottom. If your line for that date bends dramatically, that indicates your lake was stratified. The portion of the line that shows the greatest change in temperature represents the thermocline of your lake. The thermocline is a layer of water where there is an abrupt change in temperature that separates the warmer surface water from the colder deep water. To add your dissolved oxygen data, add a second X-axis at the top of the graph. The scale for dissolved oxygen should start at 0 and go at least 1 to 2 parts per million (ppm) above your highest recorded number for that day. Plot your dissolved oxygen results for each depth you sampled. Connect these data points with a dashed line or a different color pen. Repeat these steps to generate a water temperature and dissolved oxygen graph for each date that you sampled.

Trophic State Index (TSI) Graph

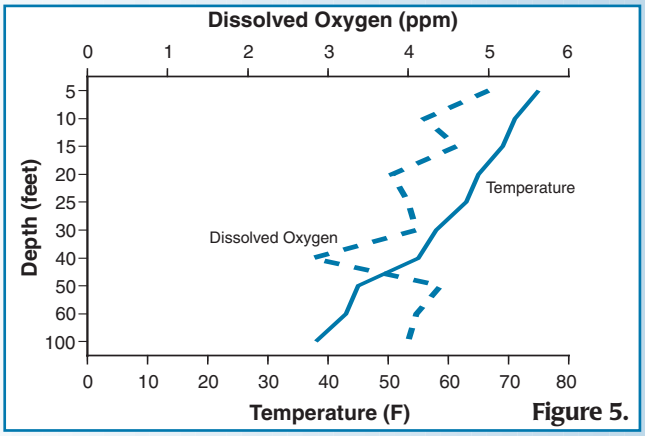
Some of the data that you collected (Secchi depth, phosphorus, and chlorophyll) will be used to calculate the trophic state of your lake. This trophic state, or TSI, is an index of how nutrient-enriched your lake is. To graph your lake's TSI values, mark your sampling dates along the X-axis and mark the TSI range from 0 to 100 on the Y-axis (Fig. 6). Since most of Wisconsin lakes have a range of TSI values from 20 to 60, you have the option of marking this smaller range on the Y-axis. However, using a smaller range of TSI values on the Y-axis will spread your results out over the entire graph. Once all your axes are labeled correctly your graph is ready for the data. ***The TSI data for your lake will be listed on your annual report.*** Plot the TSI values generated from your Secchi depth results and connect the data points with a solid line. Plot the TSI values generated from you chlorophyll data and connect the data points with a dashed line or different color pen. Finally, plot the TSI values generated from your phosphorus results and connect the data points with a dotted line or a third color pen.



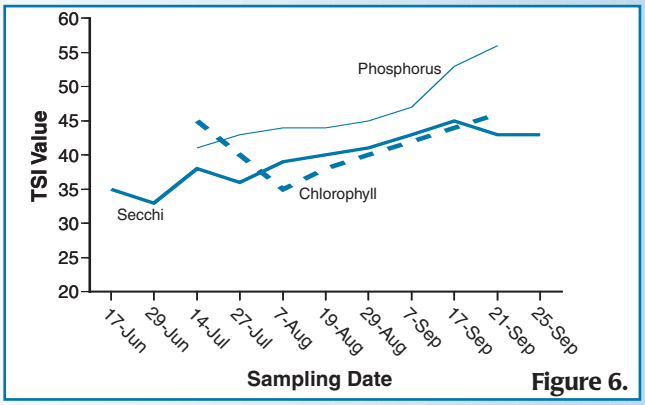
*Secchi Visibility Graph, data represents **1 season**.*



*Phosphorus and Chlorophyll Graph, data represents **1 season**.*



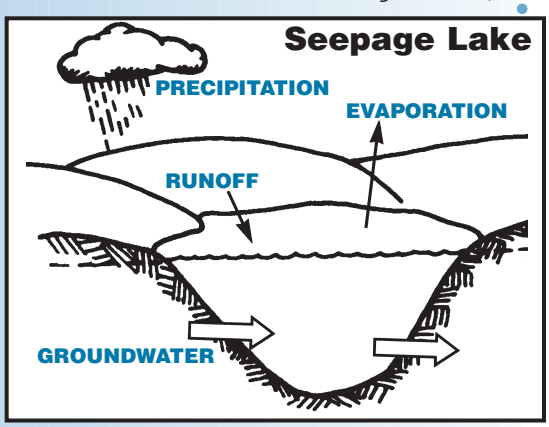
*Temperature and Dissolved Oxygen Graph, data represents **1 day**.*

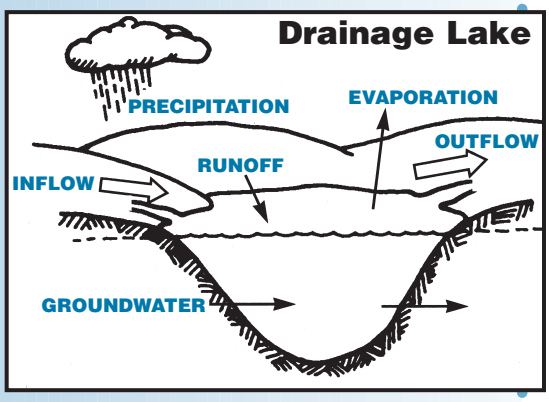


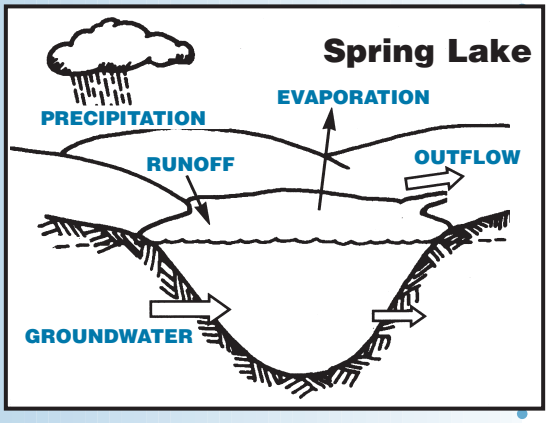
*TSI Graph, data represents **1 season**.*

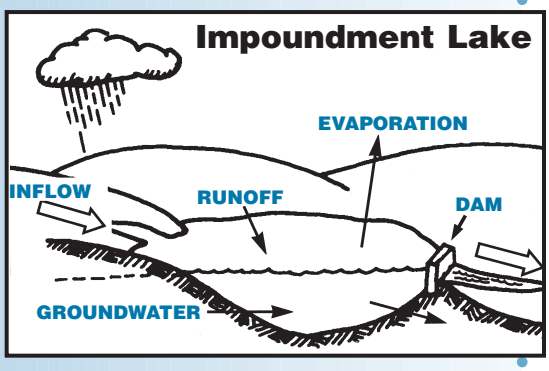
Understanding Your Data

Lake Types. *Major water inputs and outflows of different lake types. Large arrows indicate heavy water flow.* *(Taken from Shaw et al 2000 "Understanding Lake Data")*









When you receive your annual report in the spring, the first thing you should do is check for errors. The easiest way to do this is to compare your report to your original records. If you find an error, please notify the Self-Help staff in the Madison office at (888) 947-3282 or (608) 264-8533 or email **Jennifer.Filbert@dnr.state.wi.us**. You can also send your corrections to: Wisconsin DNR Self-Help Lake Monitoring, 101 S. Webster St., PO Box 7921, Madison, WI 53707-7921.

Before you review your results there are some basic things you should note about your lake: the lake type and lake **georegion**. This information can be found at the very top of your annual report. Since lakes of the same type located in the same georegion are usually comparable to one another, this information is important when comparing your lake to others.

Lake Types

The physical characteristics of a lake can greatly influence its water quality. Two factors are especially important: the primary source of the lake's water along with its flushing rate and whether or not the lake is stratified in the summer.

Seepage lakes are fed mainly by precipitation and runoff, supplemented by groundwater from the immediate drainage area. These lakes do not have an inlet or permanent outlet. Seepage lakes are the most common lake type in Wisconsin. Many seepage lakes are low in nutrients, acidic, and susceptible to acid rain. These lakes usually have small watersheds.

Drainage lakes are fed by streams, groundwater, precipitation, and runoff. These lakes have an inlet and an outlet, and the main water source is stream drainage. Most major rivers in Wisconsin have drainage lakes along their course. Water quality in drainage lakes can be highly variable. These lakes often have large watersheds.

Spring lakes are fed by groundwater, precipitation, and limited runoff. Spring lakes have a permanent outlet, but no inlet. The primary source of water for spring lakes is groundwater flowing into the bottom of the lake from inside and outside the immediate surface

drainage area. Spring lakes are located at the headwaters of many streams and are a fairly common type of lake in northern Wisconsin. These lakes are usually well buffered against acid rain and contain low to moderate amounts of nutrients. These lakes have small watersheds.

Drained lakes have no inlet but, like spring lakes, have a continuously flowing outlet. Drained lakes are not groundwater fed. Their primary source of water is from precipitation and direct drainage from the surrounding land. Frequently, water levels in drained lakes will fluctuate depending on the water supply. Under severe conditions, the outlets from drained lakes may become intermittent. Drained lakes are the least common lake type found in Wisconsin.

Lake Georegions

Wisconsin's lake georegions first originated from a grouping of lakes made in the early 1980's by Wisconsin DNR senior limnologists. These first groupings were based on the best professional judgment of the scientists most familiar with Wisconsin's lake resources. Currently, the georegions roughly reflect "hydro-chemical lake regions" which are based on the state's bedrock geology, glacial geology, and soil type; and more recently described ecoregions which are based on geological characteristics and dominant vegetation (Fig. 7)

The ***northwest georegion*** is lake-rich. Most of the lakes found here are relatively small (i.e., less than 100 acres). They are usually natural lakes and many have extensive wetlands. Many "stained" lakes are found in this georegion. In general, the lakes in this georegion have low phosphorus levels and are moderately free of sediment. However, lakes in Polk, St. Croix, and Barron counties tend to be shallow and more eutrophic. For this reason, chlorophyll concentrations and water clarity both vary considerably in northwest georegion lakes.

Thirty seven percent of Wisconsin's lakes are found in the ***northeast georegion***. Most are natural "stained" lakes and tend to be clustered with extensive wetlands. Lake size varies considerably. Lakes in the northeast georegion tend to be deeper than lakes in other georegions As a group, northeastern lakes have low phosphorus and chlorophyll levels and tend to have the greatest water clarity when compared to lakes in the other four georegions.

The ***central georegion*** forms a distinct lake group in Wisconsin. In a large part of this georegion, lakes are

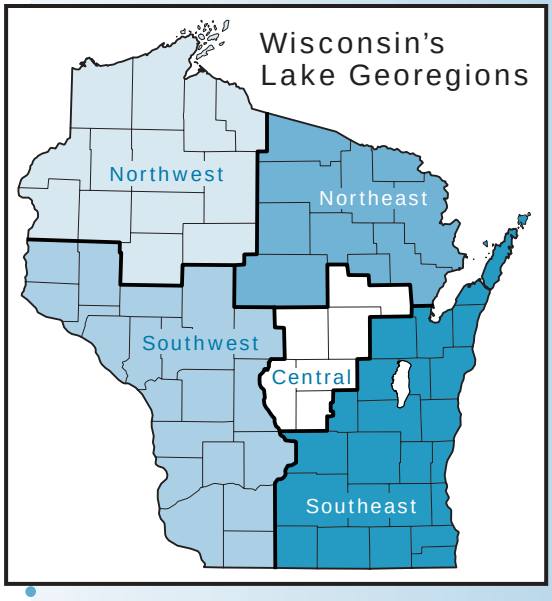
Average summer TSI values for different lake types in the Northeast georegion. *Averages were calculated from Secchi measurements recorded in July and August 2004.*

Lake Type	TSI Value
Seepage	39
Drainage	45
Spring	41
Drained	42

Average summer TSI values for different lake georegions. *Averages were calculated from Secchi measurements recorded in June, July, and August 2004.*

Lake Georegion	TSI Value
Northwest	45
Northeast	43
Central	44
Southwest	58
Southeast	49

Figure 7. *Wisconsin's lake georegions.*



GEOREGION • *Wisconsin's lake "georegions" originated from a grouping of lakes made in the early 1980's by Wisconsin DNR senior limnologists. These groupings are based on the best professional judgment of the scientists most familiar with Wisconsin's lake resources. The georegions roughly reflect "hydro-chemical lake regions" which are based on the state's bedrock geology, glacial geology and soil type, and the more recently described "ecoregions" which are based on geological characteristics as well as the dominant vegetation.*

WATER SOURCE

The source of a lake's water supply is very important in determining its water quality and in choosing management practices to protect that quality. If precipitation is a major water source, (e.g., a seepage lake) the lake will be acidic, low in nutrients, and susceptible to acid rain (Shaw et al. 2000).

If groundwater is the major water source, the lake is usually well buffered against acid rain and contains low to moderate amounts of nutrients. Local septic systems or other groundwater contamination could cause problems. Water exchange is fairly slow creating long residence times for nutrients. (Shaw et al. 2000).

If streams are the major source of lake water, nutrient levels are often high and water exchange takes place more rapidly. These lakes have the most variable water quality depending on the amount of runoff and human activity in the watershed (Shaw et al. 2000).

Managing the watershed to control the amount of nutrients and soil that enter a lake is essential to protecting water quality. Controlling runoff (water that runs from the land's surface into the lake) is important for drainage lakes and impoundments, and some seepage and groundwater lakes. Protecting groundwater quality is particularly important for seepage and groundwater drainage lakes (Shaw et al. 2000).

Watershed management becomes especially critical in impoundment lakes. If a stream is dammed the natural movement of water will be restricted, causing soil and nutrients to collect in the impoundment (Shaw et al. 2000).

Lake managers will measure the inflow and outflow of a lake to determine its water budget. As shown in the formula below, a water budget consists of several elements. The average precipitation in Wisconsin is 30 inches per year. Evaporation depends on the type of summer weather, but is usually about 21 inches. Groundwater flow is more difficult to measure, but can be estimated (Shaw et al. 2000).

The water budget can be expressed in percent or volume. A typical water budget for a drainage lake may look something like this:

Groundwater inflow (30%)
+ Precipitation (10%)
+ Surface runoff (60%)
= Groundwater inflow (5%)
+ Evaporation (11%)
+ Stream outlet (84%).

scarce due to the nature of the underlying soil and bedrock. Most central georegion lakes are small (i.e., less than 100 acres) and tend to have small watersheds. Most have low phosphorus, low chlorophyll concentrations, and high water clarity.

Large, shallow, eutrophic lakes and impoundments are found in the ***southwest georegion***. Natural lakes are scarce because of the topography and geological history since much of this georegion lies in the driftless area (a highly eroded and unglaciated landscape). Most lakes in this georegion are shallow and do not stratify in the summer. Lakes in the southwestern georegion tend to have high phosphorus and chlorophyll levels, and as a result, low water clarity.

Lakes and bogs are common in the ***southeast georegion***. This georegion has more large lakes (i.e., greater than 1000 acres) than the other four georegions and also many shallow lakes. Lakes in the southeastern georegion tend to exhibit high phosphorus and chlorophyll levels along with low water clarity.

What Do My Secchi Readings Mean?

On a statewide level, a Secchi reading of greater than 20 feet is considered excellent water clarity. A reading of less than 3 feet is considered very poor. However, the water clarity that can be expected of a lake varies widely depending on the location, lake type, and historical conditions. For example, if the data shown in the following table was presented in your annual report, a good way to describe your water clarity might be to say that "The 2002 average summer water clarity on Lake Seventeen in Oneida County was 12 feet. Lake Seventeen was slightly less clear than other stratified lakes in the northeast georegion since the northeast georegion summer water clarity average was 13 feet."

Average summer Secchi values for different lake georegions. *Averages were calculated from Secchi measurements recorded in July and August 2004.*

Georegion	Average Secchi depth (ft.) for mixed lakes	Average Secchi depth (ft.) for stratified lakes
Northwest	6.5	10.7
Northeast	7.4	12.8
Central	8.1	10.8
Southwest	3.4	4.7
Southeast	3.6	4.7

What Affects Secchi Depth?

Secchi depth is used to measure the water clarity of a lake. Three factors may affect your Secchi depth: planktonic algae, suspended sediment, and stained water color. Measuring Secchi depth helps determine if algae are present in low numbers, or if a bloom is occurring. Algal blooms are generally considered to decrease the aesthetic appeal of a lake because people prefer clearer water to swim in and look at. Algae are always present in a balanced lake ecosystem. They are the photosynthetic basis of the food web. Algae are eaten by zooplankton, which are in turn eaten by fish. You will know algae are causing reduced Secchi depth if the water generally appears green when you assess the color against the white background of the Secchi disc.

Suspended sediment (i.e., turbidity) refers to tiny particles of soil or organic matter that are suspended in the water. Secchi depth is severely limited if suspended sediments are high. Shallow lakes are often turbid because wind can stir up sediment from the bottom. High suspended sediments are often found in flowages and impoundments where precipitation runoff from the watershed transports solids via an incoming stream. Suspended sediments can make your lake water look opaque and brown; like mud shaken up in a jar with water.

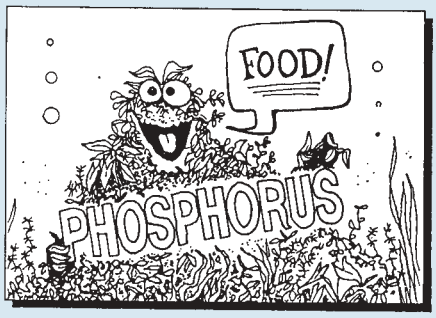
In addition to algae and suspended sediment, "stained" water can influence Secchi depth. The water color of "stained" lakes is caused by a brown pigment from organic matter, called **tannins**. Tannins are natural and not a result of pollution. Tannins can easily be differentiated from suspended sediment in the water. If your lake is high in tannins the water will look like tea-brown and clear. Tannins are important for decreasing light penetration into the water and decreasing algal growth. Even though tannins are not harmful to the environment, lakes with high tannin levels are often not perceived as aesthetically pleasing as clear water lakes.

DID YOU KNOW?

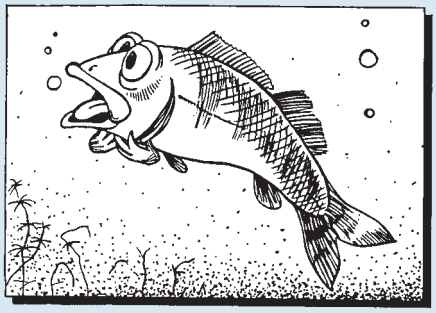
Usually, light can penetrate the surface of a lake to about 1.7 times the recorded Secchi depth. This light penetrating zone is called the photic zone. In this zone, plants and algae produce oxygen. Aquatic plants provide good habitat for fish and invertebrates. This zone also provides good habitat for fish and other vertebrates, because the light enables them to see better under water when searching for prey.

TANNINS • *Natural pigments found in organic matter such as leaves and bark.*

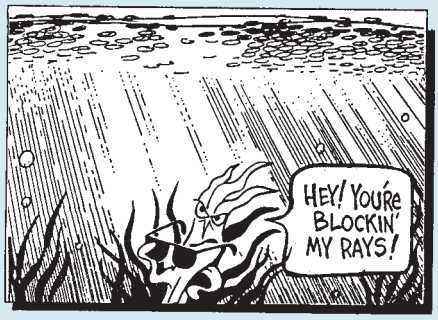
FAMILIAR SIGNS OF RUNOFF POLLUTION: PART I



Nutrients, such as phosphorus and nitrogen, come from sediments, manure, pet wastes, improperly maintained septic systems, and misapplication of fertilizers on lawns or farm fields. Phosphorus contributes to the **eutrophication** (over-fertilization) of lakes. This leads to an increase in undesirable weed and algae growth. Excess weeds and algae are harmful to fish and make a lake less attractive for swimming, boating, and other activities (UW Extension 2001).

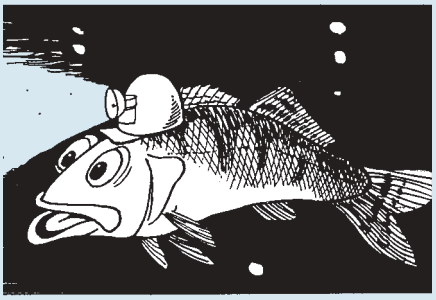


When algae and aquatic weeds die they are broken down by bacteria. Bacteria consume oxygen during decomposition and make it difficult for fish and other aquatic life to survive. Excess weeds also contribute to winter fish kills in shallow lakes (UW Extension 2001).



Excess algae can reduce populations of bottom-rooted plants by blocking sunlight. Bottom-rooted plants provide food and habitat for fish and waterfowl (UW Extension 2001).

FAMILIAR SIGNS OF RUNOFF POLLUTION: PART II



Sediments can cause water to become cloudy, or "turbid", making it difficult for fish to see and feed properly. Sediments can also damage fish gills and impair the feeding and breathing processes in aquatic insects (UW Extension 2001).

Sediments cloud the water and cover plant leaves, reducing sunlight penetration and inhibiting photosynthesis. Without photosynthesis, desirable plant populations are reduced, leaving fewer habitats for fish and small organisms (UW Extension 2001).

EUTROPHICATION *• The process by which lakes and streams are enriched by nutrients causing an increase in plant and algae growth. This process includes physical, chemical, and biological changes that take place after a lake receives inputs for plant nutrients (mostly nitrates and phosphates) from natural erosion and runoff from the surrounding land basin. The extent this process occurs is reflected in a lake's trophic classification. Lakes can be classified as being oligotrophic (nutrient poor), mesotrophic (moderately productive), or eutrophic (very productive and fertile).*

NITROGEN *• One of the major nutrients required for the growth of aquatic plants and algae. Various forms of nitrogen can be found in water: organic nitrogen, most of which eventually decomposes to ammonia; ammonia, produced from organic decay by bacteria and fungi; nitrite, produced from ammonia by nitrite bacteria; and nitrate, the form which is most readily available for use by plants. Nitrate is produced from nitrous oxide by nitrate bacteria. In some ecosystems, nitrogen is the nutrient that limits algae growth.*

What Can I Learn From the Variation in My Secchi Readings?

Was your lake was clearest in the spring and gradually became murky as the summer progressed? This trend might suggest that the lake is receiving a constant supply of nutrients, either from the watershed or from the lake sediments. This nutrient supply could be what is fueling the algal growth you are seeing throughout the summer.

If your lake water became clearer as the monitoring season went on, nutrients might be coming into the lake mainly in the spring with snowmelt. But as the summer progresses, there is no nutrient supply and algal growth is slowed.

If you see a sharp increase in your lakes water clarity in May or June, it may be that tiny grazing animals, called zooplankton, are eating the algae. When zooplanktons are abundant, they can actually be seen as tiny dark dots swimming over the white part of the Secchi disc when it is submerged. These animals help decrease the amount of algae in the water, but are grazed on by minnows and other fish (e.g., bluegills, perch, crappie, etc.). If fish species that eat zooplankton become too abundant, often due to over-fishing of predator fish (i.e. bass), then the zooplankton population can decrease and the algae can become more abundant. The reason why zooplankton are more abundant in the spring is because fish that feed on them are not as active in the cooler water.

What Do My Phosphorus and Chlorophyll Readings Mean?

Phosphorus is a nutrient that plants and algae need to grow. Phosphorus and chlorophyll are measured in **micrograms per liter (µg/L)**, which is equivalent to parts per billion (ppb). The samples that you collected were analyzed at the State Laboratory of Hygiene in Madison, Wisconsin. Your samples were measured for total phosphorus. Phosphorus can be in the water in various forms and may not always be in a form available for biological productivity. Therefore, total phosphorus shows the potential productivity of your lake. The results of your phosphorus analysis will enable you to answer the question, "Is my lake potentially susceptible to algae blooms?" Lakes that have more than 20 µg/L of total phosphorus and impoundments that have more than 30 µg/L of total phosphorus may experience noticeable algae blooms.

LAKE WATER LEVELS

Lake levels can fluctuate naturally due to precipitation which varies widely from season to season and year to year. While some lakes with stream inflows show the effect of rainfall almost immediately, others may not reflect changes in precipitation for months. For example, heavy autumn rains often cause water levels to rise in the winter when rain enters the lake as groundwater (Shaw et al. 2000).

Water level fluctuations can affect your lake water quality. Low levels may cause stressful conditions for fish and increase the number of nuisance aquatic plants. High water levels can increase the amount of nutrients entering the lake due to runoff and increase the amount of sediment due to erosion. When groundwater levels are high, older septic systems that are located near lakes may flood (Shaw et al. 2000).

MICROGRAMS PER LITER OR µg/L • *An expression of concentration indicating weight of a substance in a volume of one liter. Parts per billion (ppb) is an equivalent unit.*

Average summer chlorophyll values for different lake georegions.
Averages were calculated from chlorophyll measurements recorded in July and August 2004.

Lake Georegion	Average Chlorophyll Value (µg/L)
Northwest	13
Northeast	7
Central	9
Southwest	45
Southeast	14

TABLE 1. ***The Trophic State Index (TSI) continuum.***

TSI less than 30
Classic oligotrophic lake characterized by clear water, many algal species, oxygen throughout the year in bottom water, and cold water oxygen-sensitive fish species in deep lakes. Excellent water quality.

TSI 30-40
Deeper lakes will still be oligotrophic, but the bottom waters of some shallower lakes may become oxygen-depleted during the summer.

TSI 40-50
Classic mesotrophic lake. characterized by moderately clear water, but increasing chance of low dissolved oxygen in deep water during the summer.

TSI 50-60
Lake becoming eutrophic characterized by decreased clarity, fewer algal species, and oxygen-depleted bottom waters during the summer. Plant overgrowth evident, supporting only warm-water fisheries.

TSI 60-70
Becoming very eutrophic. Blue-green algae may become dominant with possible algal scums. Extensive plant overgrowth problems likely.

TSI 70-80
Lake becoming hypereutrophic characterized by heavy algal blooms throughout summer, dense plant beds limited by light penetration.

TSI > 80
Hypereutrophic lake with very poor water quality, algal scums, summer fish kills, and few plants.

Chlorophyll is the pigment that makes algae green. When you filtered water as part of your on shore sample preparation, you were extracting algae from the water. The filter sent to the State Laboratory of Hygiene was used to quantify how much algae was in the water. Comparing the chlorophyll analysis with your Secchi readings for the same day, you can determine if your water clarity is due to algae or tannins. If the chlorophyll measurements are low but your Secchi depth indicated poor water clarity, the poor clarity was probably caused either by suspended sediments or tannins. On a statewide level, a chlorophyll reading of less than 5 µg/L is very good or excellent. A chlorophyll reading of greater than 30 µg/L is very poor.

What Is Trophic State?

Lake enrichment states for Wisconsin lakes can range from being oligotrophic (i.e., lakes that experience low levels of productivity) to eutrophic (i.e., lakes that are highly productive). A natural aging process occurs in all lakes, causing them to change from oligotrophic to eutrophic over time, and eventually filling in (Fig. 1, see page 14). However, human activity can accelerate this aging process. "Cultural eutrophication" is a term coined by ecologists to define the human activity impacts on a lake's trophic state.

Your Secchi depth results, along with phosphorus and chlorophyll data (if available), allow a determination of the level of nutrient enrichment of the lake (i.e., trophic status). The Trophic State Index (TSI) is a continuum scale of 0 to 100, corresponding with the clearest and most nutrient poor lake possible, to the least clear and most nutrient rich lake (Table 1). Lakes can be divided into three main levels of nutrient enrichment categories. Oligotrophic, or nutrient poor lakes are characterized by very high Secchi depths, plenty of oxygen in deep water, and may have cold-water fish species living in them. Mesotrophic lakes fall in the middle of the continuum from nutrient-poor to nutrient-rich. They have moderately clear water, and may experience low to no oxygen concentrations in bottom waters. Nutrient-rich lakes are called eutrophic. They have decreased Secchi disc readings and experience low to no oxygen in the bottom waters during the summer. These lakes would only be habitable for warm water fish. They may also experience

blue-green algae blooms. Lakes that are super-enriched fall into a fourth category termed hypereutrophic. These lakes experience heavy algae blooms throughout the summer, and may even experience fish kills. Rough fish dominate in hypereutrophic lake systems.

Although trophic states are labeled for the purposes of discussion, keep in mind that in nature, the categories make smooth transitions into each other. Data from one date may show your lake as being eutrophic, and the next date as being mesotrophic.

If your lake has many rooted aquatic plants and relatively clear water, the TSI could be a mischaracterization of the true nutrient status of your lake. Lakes dominated by aquatic plants tend to have high amounts of phosphorus in the bottom sediments and relatively low amounts phosphorus in the water column. On the other hand, lakes that grow mostly algae have high amounts of phosphorus in the water column. The TSI only measures the portion of nutrients that are found in the water column, as evidenced by the amount of algae. So if most of the nutrients are held in the sediments and the lake is loaded with aquatic plants, the true, total nutrient status would not be accurately measured using the TSI.

How Do My TSI Values Relate to One Another?

If you measured Secchi, chlorophyll, and phosphorus, you can learn a lot about your lake by looking at the relationships of these values to each other (Table 2). You will need a graph of your TSI data. A TSI graph showing summer averages over time is usually provided with your annual report. You can also create your own TSI graph showing the reported TSI values throughout the season. To create your own TSI graph, please see the "Graphing Your Results" section beginning on page 26.

TABLE 2. ***Relationships between Secchi, chlorophyll, and phosphorus TSI values.***

Relationship	Chlorophyll = Phosphorus = Secchi
Meaning	It is likely that algae dominate light attenuation.
Relationship	Chlorophyll > Secchi
Meaning	Large particulates, such as *Aphanizomenon* flakes, dominate.
Relationship	Phosphorus = Secchi > Chlorophyll
Meaning	Non-algal particulate or color dominate light attenuation.
Relationship	Chlorophyll = Secchi > Phosphorus
Meaning	The algae **biomass** in your lake is limited by phosphorus.
Relationship	Phosphorus > Chlorophyll = Secchi
Meaning	If this happens once or twice during the monitoring season, it suggests that a peak of zooplankton might have eaten much of the algae and made the lake clear. However, the nutrients would still be there in the lake. If your total phosphorus was greater than your chlorophyll and Secchi throughout the entire season, it suggests that total phosphorus may have been coming heavily into the lake, but the algae were limited by nitrogen or some other nutrient. This is often due to septic pollution.

BIOMASS • *Total mass of all living organisms present (e.g., the total quantity of plants and animals in a lake). Measured as organisms or dry matter per cubic meter, biomass indicates the degree of a lake system's eutrophication or productivity.*

Dissolved Oxygen

The amount of dissolved oxygen available in a lake, particularly in the deeper parts of the lake, is critical to its overall health. The amount of dissolved oxygen in the water is determined by water temperature (e.g., cold water holds more oxygen than warm water), atmospheric pressure, and biological productivity. Plants and algae are important for producing oxygen in the water, but when they die, the situation is reversed when bacteria associated with decomposition consume oxygen. In general, cold-water fish species (e.g., trout) need at least 5 parts per million of oxygen to survive. In contrast, warm-water fish species need 3 parts per million of oxygen to survive.

Low dissolved oxygen levels can increase the mineral content (i.e., iron and manganese) in drinking water. This will create a more expensive drinking water by forcing citizens to pay more to remove the excess minerals. Low dissolved oxygen levels can also cause a release of phosphorus and sediments into the water column. In extreme cases, low dissolved oxygen can result in the elimination of the cold-water fishery and other bottom-dwelling animals.

Temperature

Temperature is another critical factor to keep in mind when trying to understanding your lake. Just as cold-water fish need lots of oxygen to survive, they also need cold water temperatures, generally less than 72°F. If the water gets too warm, or oxygen is not available, a fish kill may result. Conversely, most fish species can tolerate warm water temperatures. Bluegills, for example, can survive in water upwards of 80°F.

Your temperature profile data will tell you whether your lake mixes or stratifies. Typically, shallow lakes mix constantly through normal wind and wave action, allowing water that had been at the bottom to move to the top and vice versa. Because of this mixing, temperature and dissolved oxygen values remain about the same form surface to bottom. In contrast, deep lakes usually stratify or divide into distinct temperature layers during the summer months. The warm water stays at the top and the cold water stays at the bottom. The zone at which the temperature changes most abruptly is called the thermocline. Water below the thermocline is usually much colder and does not mix with the water at the top of the lake. The reason you must take the temperature of the water at different depths is so you do not miss the thermocline.

Normally, deep lakes stratify during the summer months and mix during the spring and fall. As the air temperature gets cooler at the end of the summer and early fall, the surface of the water cools. The cooler, denser water begins to sink, destroying the summer stratification and initiating a complete mixing of the water column. In the winter, when ice on the surface prevents circulation of the water column, the lake will have a uniform temperature. Once the ice melts in the spring, the water is once again exposed to wind action, and begins mixing. The spring overturn will continue until the lake stratifies on a calm, warm day in the summer.

The dissolved oxygen and temperature values you collect are related to one another. When looking at your temperature data you see that there is a thermocline, you know that your lake stratifies. Once you determine the depth at where the thermocline is, you can usually predict that the dissolved oxygen concentration will decline at the same point. This pattern is typical for deep lakes. If the dissolved oxygen concentration declines to the point where it is zero, chemical reactions can take place that would otherwise not occur in an oxygen-rich environment. Specifically, in an anoxic (zero oxygen) environment, phosphorus that had previously been chemically bound to bottom sediments are released into the colder layers of the water column. This may result in algae blooms after your lakes next mixing event.

In shallow lakes, there is usually no thermocline, and dissolved oxygen concentrations stay fairly high. However, shallow lakes that are constantly mixing may be more sensitive to nutrient loading from the watershed. These nutrient inputs can come from various non-point sources of pollution (e.g., agricultural or urban runoff). When nutrients are added to a shallow lake, they may be

Water Quality Parameter Guide for Selected Fish Species

Adapted from Post 1988. Note that the minimum required dissolved oxygen levels may be less in the winter if the aquatic organisms have acclimated to their environment.

Fish Species	Water Temperature Range(°F)	Water Type	Water Clarity	Minimum Oxygen Requirement (ppm)	pH
Bluegill	65 - 80	Eutrophic to Mesotrophic. Warmwater streams, rivers, and ponds.	Less turbid waters.	3.0 - 5.0	5.5 - 9.0
Channel catfish	75 - 85	Eutrophic. Warmwater streams, rivers, and ponds.	Clear to turbid; can adapt to waters most fish can't tolerate.	3.0	4.5 - 9.0
Common carp	55 - 80	Eutrophic. Warmwater streams, rivers, and ponds.	Clear to turbid; can adapt to waters most fish can't tolerate.	0.8	4.0 - 9.5
Freshwater drum	55 - 75	Eutrophic. Warmwater rivers.	Clear to turbid.	3.0 - 5.0	4.5 - 9.0
Northern pike	45 - 75	Mesotrophic to Oligotrophic. Coolwater lakes, large rivers, and reservoirs.	Clear with moderate amounts of aquatic vegetation.	4.0	6.0 - 9.0
Rainbow trout	40 - 60	Mesotrophic to Oligotrophic. Coldwater streams, rivers, and deep lakes.	Clear with some to very little fertility and moderate vegetation.	6.0	6.5 - 8.5
Walleye	35 - 80	Mesotrophic. Large coolwater lakes and streams.	Clear, sometimes turbid waters with good fertility.	5.0	6.0 - 9.0
White bass	55 - 78	Eutrophic to Mesotrophic. Warmwater rivers and lakes.	Clear, sometimes turbid waters.	5	5.5 - 9.0
White sucker	40 - 65	Oligotrophic. Coolwater lakes and streams.	Clear with scant fertility and aquatic vegetation.	4.0	6.5 - 8.5

GET TO THE ROOT OF THE PROBLEM

Suppose that your lake is not as clear as others in the area, and that there is some indication of clay turbidity in the spring and after rainstorms. However, the color of your lake is green indicating that algae, not clay, is affecting water clarity. What do you do now?

First, do some detective work.

Your data have given you some clues as to the sources and cycles of nutrients and erosion materials. Drive through the watershed, preferably after a recent rain and observe the condition of the streams entering your lake. Are some more turbid than others? Look upstream and try to track down the sources of turbidity. If you're lucky, you may find some point sources (e.g., pipes) or specific locations such as a field or housing development that is the source of the problem. If you aren't lucky, you may find that there are numerous contributors to stream turbidity. Are there any sewage treatment plants discharging into the river or are houses in the watershed using septic tanks? Sewage in any form is high in nutrients and septic systems sometimes fail or are deliberately by-passed. By the time you have done several of these surveys you might have a better idea of the sources of your lake's problems. It might even be necessary to obtain a detailed map that includes the watershed and start mapping problem streams and sources.

Second, take more Secchi measurements in your lake.

Even though the Self-Help network requires you to collect data every other week, you can sample more often if you think it is important. Make a point to sample your lake after rainstorms to see if there is any relationship between rainfall and your lake's turbidity. You may also want to sample more sites on your lake, preferably near the mouths of streams that you think may be causing turbidity. To make these new sites "official" contact your Self-Help regional coordinator. If you think weekend watercraft use may be affecting your water clarity, try sampling the lake during the week and again on the weekend (Don't forget to make a note of this on your data sheet!). Volunteers have even used their Secchi data to detect the consequences of leaking septic systems by monitoring decreases in transparency near houses. Be sure to write down all of your observations and report your data to the Self-Help network. We really do want to know more about your lake, too!

constantly available to feed weeds or algae. In a deep lake, the nutrients may become isolated in the deep, cold water (the hypolimnion), where they are unavailable to be used again until the lake mixes.

How Does My Lake Compare to Others?

To examine how your lake quality compares to others around the state, the summary reports generated by the Self-Help network contain graphs that chart the Secchi TSIs for each lake type in each georegion. You can find these reports online at **dnr.wi.gov/org/water/fhp/lakes/selfhelp/lakedata.asp**.

What if Your Data is Better Than Average

If your Secchi readings and other data are better than average for your lake type and georegion, you will want to work to protect your lake and keep it the way it is. One way to help protect your lake is through a Lake Protection Grant. Qualified lake associations, **lake districts**, as well as, counties, towns, cities, or villages are eligible to receive lake planning and protection grant funding. Through these 75% cost-share grants (75% grant/25% local share), money is available for lake and watershed data collection, development of local lake management plans, land acquisition, and other lake protection activities. For more information on lake grants, contact your Self-Help regional coordinator or a UW-Extension lake specialist. The Wisconsin DNR also has excellent information on lake grants online at **dnr.wi.gov/org/water/fhp/lakes/lkgrants.htm**.

Another way to protect your lake is to keep invasive species out by

getting involved with the Clean Boats, Clean Water program as a watercraft inspector. Through this effort, volunteers are trained to organize and conduct watercraft inspections at the boat landings in their communities. Trained volunteers also educate boaters on how and where invasive species are most likely to hitch a ride into water bodies. By performing boat and trailers checks, distributing informational brochures, and collecting and reporting suspect specimens, volunteers can make a difference in helping to prevent the spread of invasive species. For more information on how to become a watercraft inspector please call (715) 346-3366 or email **Laura.Felda@dnr.state.wi.us**.

What if Your Data is Worse Than Average

If your Secchi readings are lower than average for your lake type and georegion, the first step is to try to figure out what is causing the low readings. If your water appears clear and brown, chances are that your lake is "stained" and that the problem is natural. However, with this kind of lake, you may want to get involved in chemistry monitoring which can give you more information about the trophic status of your lake.

If your water appears murky and brown, the problem may be sediment. In this case, you will want to investigate where the problem is coming from. Sediment in the water can be due to erosion along the lake shore, or erosion coming from streams that flow into lakes. Sediment in your lake could also be a result of Carp or boat traffic stirring up the bottom.

Clear and green, or murky and green water may suggest that algae are impacting your Secchi readings. In this case, working with people that live and work around your lake to reduce nutrient inputs is one thing you can do. If your lake is surrounded by farms, farm owners can apply best management practices to reduce the amount of nutrients that flow into your lake. Convincing others to plant natural vegetation along their lakeshore is another great way to reduce the amount of nutrients that enter your lake. If your lake is in an urban area, work to convince landowners to use less fertilizer on their lawns. In urban areas, rain gardens are another great way to reduce pollution. Rain gardens are small depressions in your yard, landscaped with native plants and wildflowers. These water-loving plants help capture runoff, allowing more water to infiltrate into your soil, rather than running down the pavement into the storm drain and ultimately your lake.

WHERE DOES THE STORM WATER GO?

If you look in the street outside of your home or office and search the parking lots around town, you will probably find storm sewer inlets. Did you ever wonder where they go?

A common misconception about storm sewers is that they go to a waste-water treatment plant. This is not the case. Storm sewers transport stormwater (rain and melting snow) to the nearest river, lake, stream, or wetland. Stormwater often contains materials found on streets and parking lots such as oil, antifreeze, gasoline, soil, litter, pet wastes, fertilizers, pesticides, leaves, and grass clippings. When these materials enter lakes and streams, they become pollutants that kill fish, reduce the aesthetics of the water, and may even close beaches. (UW Extension 1991)

What can I do?

You can:

- ☑ Plant trees, shrubs or ground covers,
- ☑ Maintain a healthy lawn,
- ☑ Redirect down spouts from paved areas to vegetated areas,
- ☑ Use a rain barrel to catch and store water for gardens,
- ☑ Install gravel trenches along driveways or patios,
- ☑ Use porous materials such as wooden planks or bricks for walkways and patios,
- ☑ Have the driveway and walkways graded so water flows onto lawn areas, and
- ☑ Wash your car on the lawn, not the driveway. (UW Extension 1991)

LAKE DISTRICT • *A special purpose unit of government with the cause of maintaining, protecting, and improving the quality of a lake and its watershed for the mutual good of the members and the lake environment.*

All volunteers are encouraged to report their annual findings at a lake association meeting or publish results in your organization's newsletter. The following is an example of a simple summary that you can follow when generating your own report.

Found Lake 2000 Water Quality Report

This year, Secchi disc readings show that the average water clarity on Found Lake is about 5.25 feet. The deepest clarity reading was 7 feet deep on May 7th. The shallowest clarity reading was 4 feet deep, which happened only a few days earlier on May 3rd. Rainstorms, windy days, or boat traffic can cause the clarity of the lake to fluctuate. This is normal and happens on most lakes. One thing that is important to look for is if the water quality is changing over time. This doesn't seem to be the case for Found Lake. For the last four years the average water clarity readings were 4.75 feet in 1999, 5.0 feet in 1998, 8.3 feet in 1997, and 5.7 feet in 1996.

These historical water clarity readings show that Found Lake is a eutrophic lake. This was verified by the phosphorus and chlorophyll levels in the lake. Although the phosphorus and chlorophyll results from 2000 are not back from the lab yet, the results from 1999 indicate that Found Lake is a eutrophic lake.

A eutrophic lake is a lake that is high in nutrients and supports a large amount of plants and animals. Eutrophic lakes are often weedy and can sometimes have algae blooms. They often support large fish populations, but they are also susceptible to oxygen depletion. 2000 was the first year that oxygen levels were measured on the lake. Oxygen levels were measured once in May and once in August. In Found Lake there was plenty of oxygen for fish to survive in most of the water column, except below 21 feet in May and below 12 feet in August. This oxygen depletion most likely occurs because the plant and algae decomposition during the summer months use up oxygen. The more plants and algae you have, the more that die, and the more oxygen they use up when they decompose. Reducing the amount of nutrients that get into a lake to allow for excessive plant and algae growth will generate less plant matter to decompose and will help keep oxygen levels from getting too low. One way to reduce the amount of nutrients entering the lake is to not fertilizing lawns, reduce erosion, and keep (or restore) a natural shoreline.

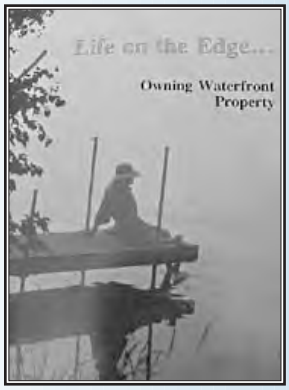
In the case of sediment or algae having a negative impact on your lake, you may want to apply for a Lake Planning Grant. Your lake association can use the grant to prepare a long-term management plan. For more information on Applying for a Lake Planning Grant contact your Self-Help regional coordinator or a UW-Extension lake specialist. The Wisconsin DNR website also provides excellent information on lake grants at **dnr.wi.gov/org/water/fhp/lakes/lkgrants.htm**.

If you don't have a lake association, form one. Lake associations are organizations of individuals who own land on or near a lake. Dealing with the broad range of issues and concerns that face our lakes can be overwhelming for one person. Working as an organized group that shares a common goal can make even the most difficult problems easy. For more information on forming a lake association or other ways to organize, please contact: Lake Specialist, UW-Extension, College of Natural Resources, UW-Stevens Point, Stevens Point, WI 54881-3897. Or, visit **www.uwsp.edu/cnr/uwexlakes/organizations/**.

If you already part of a lake association, you can share your data by doing a presentation or writing an article for the newsletter.

The best way to help solve your lake's problems is through education. Try planning a lake fair or event. A lake fair is a good way to help lake property owners and users become involved with lake issues. A lake fair is an educational and social event that blends a sense of discovery and entertainment. These events provide an opportunity for participants to get hands-on experience, talk with lake experts in an informal setting, meet lake neighbors, and build relationships. For more information on organizing a lake fair, please contact: Lake Specialist, UW-Extension, College of Natural Resources, UW-Stevens Point, Stevens Point, WI 54881.

Another great opportunity to further your limnology skills is to attend the Lake Leader Institute. The Institute's seminars are designed to stretch the minds by exploring new ideas about lakes management and the human use of lakes. The Institute also seeks to develop networks to share experiences and to encourage participants to learn from each other. The core curriculum is offered every other year. For more information on the Lake Leader Institute, please visit **www.uwsp.edu/cnr/uwexlakes/lakeleaders/**.



FOR MORE INFORMATION ON HOW TO PROTECT AND ENHANCE YOUR LAKES,
obtain a copy of

Life on the Edge… Owning Waterfront Property.

The 22 chapters give an overview of various topics such as living with wildlife, shore savers, or plant control. Copies are $10 each and can be ordered online at www.uwsp.edu/cnr/uwexlakes/publications/edge/default.asp or by calling (715) 346-2116.

Aquatic weevil feeding on Eurasion water-milfoil.
(*Photo provided with permission by Cornell University* **www.forestryimages.org**).

What if My Lake Has Invasive Species?

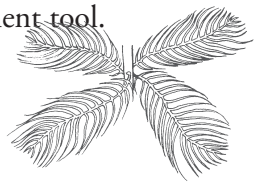
Eurasian Water-milfoil

Early detection of Eurasian water-milfoil growth is critical in stopping the plant from becoming a widespread problem. The best chance to halt these non-native invaders is when they first appear on the scene. Eurasian water-milfoil often appears near boat landings, high use areas (fishing hot spots), and at disturbed sites.

New colonies are best removed before they expand. Hand pulling and removal from the water is a simple and effective control method for small areas. Harvesting, raking, or screening the bottom also works well. Eurasian water-milfoil can be effectively treated with selected chemicals early in the summer before plants flower. A permit is required from the Wisconsin DNR for chemical treatment, mechanical harvesting, or bottom screening. Whole-lake herbicide treatment is not generally permitted because of the potential to disrupt lake ecosystems by eliminating both invasive and beneficial native plants.

For lakes dominated with beds of Eurasian water-milfoil, control efforts must be focused on reducing its spread. Mechanical harvesting can open areas for boating and swimming. Harvesting encourages growth of native plants while removing Eurasian water-milfoil canopies that limit native plant growth.

Biological control of Eurasian water-milfoil is still uncertain. A small aquatic weevil (*Euhrychiopsis lecontei*) is known to feed on Eurasian water-milfoil and actually prefers this plant over other plants. Fortunately, weevils are found in many Wisconsin lakes. To locate one, look in Eurasian water-milfoil stems for signs of damage. The small holes or weak spots in the stems point to weevil damage. These holes, caused by the weevils, allow water to enter the stem, expose the plant to bacterial infection, and decrease the plant's buoyancy. As a result, the plant will drop lower into the water column and cannot spread out on the surface. Over time, weevils may be able to impact populations of Eurasian water-milfoil, but complete eradication is unlikely. Additional research and development is needed before biological control with weevils can be considered an effective management tool.



Purple Loosestrife

There are several methods of controlling purple loosestrife, depending on how widespread the problem is. If there is a large area dominated by the plant, you might want to consider releasing beetles that eat the plant. You can find out more on purple loosestrife and how to control it by visiting the Wisconsin DNR website at **dnr.wi.gov/invasives** or by contacting Brock Woods at (608) 221-6349.

Zebra Mussel

Whenever you leave a body of water transporting a boat, drain all bilge water, live wells, and bait buckets before leaving areas infested with zebra mussels. Do not transport leftover bait from infested waterways to other waters. Thoroughly inspect your boat's hull, outdrive, trim plates, trolling plates, prop guards, transducers, trailers, and other parts exposed to infested waters. If surfaces feel grainy, tiny zebra mussels may be attached. If possible, these "hitchhiking" mussels should be scraped off. Thoroughly flush hulls, outdrive units, live wells (and pumping systems), bilge, trailer frames, anchors and anchor ropes, bait buckets, raw water engine cooling systems, and other boat parts and accessories that typically get wet. When rinsing these parts use water that is 140°F or hotter. A pressurized steam cleaner or high pressure power washer is very effective to rinse parts quickly. After rinsing, allow boats and trailers to dry in the sun before transporting them other waterways. If you are entering another waterway via the water, try to avoid leaving your outdrive in the down position. Hulls and drive units should be inspected regularly, as zebra mussels can attach and cover water intakes leading to clogging, engine overheating, and damage to cooling system parts. For more information on how to stop the spread of zebra mussels please visit **www.seagrant.wisc.edu/zebramussels/help_stop.html.**

HOW CAN I HELP STOP THE SPREAD OF INVASIVE SPECIES?

Wisconsin law prohibits launching a boat or placing a trailer or boat equipment in navigable waters if it has invasive aquatic plants or zebra mussels attached. The main way Eurasian water-milfoil is moved between water bodies by small fragments transported on recreational equipment. It is commonly transported by boats, trailers, bait buckets, live wells, and fishing equipment. To help prevent the spread of Eurasian water-milfoil and other invasive species, please take the following steps.

- ☑ Inspect and remove any visible mud, plants, fish or animals before transporting.
- ☑ Drain water from equipment (e.g., boat, motor, trailer, live wells, etc.) before transporting.
- ☑ Dispose of unwanted live bait in the trash.
- ☑ Ensure that all boat landings on your lake are posted with Eurasian water-milfoil signs that describe the plant and instruct boaters to remove all plant fragments from their boats and trailers before launching.
- ☑ Help establish a plant disposal station at boat landings for plant fragments that are removed from water craft.
- ☑ Learn to easily recognize Eurasian water-milfoil. Monitor boat landings, marinas, and inlets on a regular basis for the first sign of an invasion. Report new sightings to your nearest Wisconsin DNR office.
- ☑ Work with your local lake association to develop an aquatic plant management program for your lake including contingency plans in case Eurasian water-milfoil is found in the lake.
- ☑ Help others understand the benefits of native plants and use discretion in their control.

What if?...

Frequently Asked Questions

Q: What if I get to the post office too late on Thursday afternoon and they are closed. What should I do with my samples?

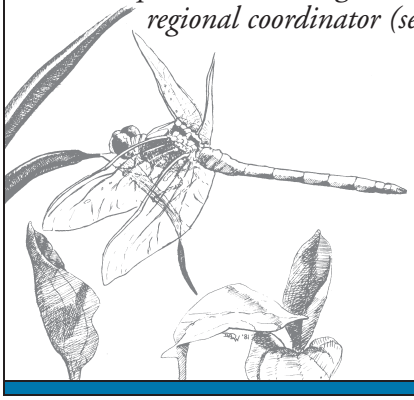
A: *It's okay! Just unpack your box, put the chlorophyll sample in the freezer and phosphorus sample in the refrigerator until Monday. Dispose of the ice and re-package again on Monday.*

Q: What if I get to the post office and I have not put the pre-paid merchandise return label on the package?

A: *The best option is to return home and get the label for the package. Very few WDNR offices have petty cash available to refund the cost of shipping. If you pay for the cost of shipping yourself, it may be difficult to be reimbursed.*

Q: What if I test my phosphorus sample with the pH paper and the pH is greater than 2?

A: *Check to make sure that you added one vial of sulfuric acid (H_2S0_4) to your sample. If you have not, add 1 vial of H_2S0_4 to your sample, mix, and then test the pH again with a new strip of litmus paper. If the pH is still greater than 2, add a second vial of H_2S0_4 to your sample, mix, and test again with a new strip of litmus paper. If the pH of your sample is still 2.5 or greater, contact your regional coordinator (see page iii).*



Q: What if my Van Dorn water sampler breaks while I am collecting water samples.

A: *Unfortunately, these types of water samplers seem to break when it is the most inconvenient. If you are unable to make a repair on the spot, you will need to contact your regional coordinator and make arrangements for a new sampler. If you are unable to complete that sampling session, just record the information that you have and make a note of what happened.*

Q: What if I don't receive a Styrofoam® mailer back from the State Laboratory of Hygiene before I am ready to collect my next sample?

A: *If you need a mailer, call (800) 442-4618 at least one week before you plan to take your next sample. This toll-free number is a general number for the State Laboratory of Hygiene. Ask them to transfer you to the shipping department to request a new mailer.*

Q: What if the water in the magnetic filter cup isn't filtering through the filter? It seems like I have been using the hand pump for a long time and nothing is happening.

A: *First, check to make sure that you have a good seal between the rubber stopper and the flask. Sometimes it helps to press down on the rubber stopper to make sure that it is in the flask as far as it will go. Check the clear tubing; is there a good connection between the flask and the hand pump? If your equipment is not the problem, you may have a lot of algae, sediment, or other material in your water that is making it hard to filter. If you are able, filter the remaining water in the filter cup, remove the filter and record just the amount that you were able to filter. Another option is to transfer the remaining water to your empty graduated cylinder, remove the first filter and place it in the mailing tube. Put another filter on the base and filter the remaining water in the cylinder. Both filters can be placed in the tube and mailed to the State Laboratory of Hygiene.*

Q: What if my digital temperature recorder is not responding and a message displaying "897" is all that appears on the screen?

A: *Your digital temperature meter is trying desperately to spell "BAT" but is doing it using numbers. This message means that a new battery is needed. Most of the digital temperature meters require a 9 volt battery. If you don' want to buy one yourself, you can contact your regional coordinator for a new one. The battery compartment is a small door located on the back of the meter; just remove the door and slip in a new battery.*

Q: What if I forget to place my lab slip in my mailer with my samples before I send them to the State Laboratory of Hygiene?

A: *Contact your Self-Help regional coordinator by email or by phone and as soon as you can. Tell the coordinator your name, WBIC number, STORET number, the name of your lake, and the amount of water you filtered for your chlorophyll sample. Your regional coordinator will contact the State Laboratory of Hygiene directly with your information.*

Q: What if I just took my Secchi reading closer to my house instead of the deepest part of the lake (the location assigned to me by my Coordinator)?

A: *All of the data collected at a specific site is tied back to that site through the STORET number. Usually, Secchi disc readings are taken at the deepest part of the lake to get data that best represents the lake as a whole. Large lakes or lakes with distinct lobes may have more than one area sampled. If you think a new sampling spot will yield good data, talk to your regional coordinator to have a new STORET number assigned to that location.*

Q: What if I use the Winker titration method to determine my dissolved oxygen? Is there any way for me to know what's going on with all these color changes?

A: *The first step in a dissolved oxygen titration is the addition of 8 drops of manganous sulfate solution and 8 drops of alkaline potassium iodide azide solution. These reagents react to form a precipitate of manganous hydroxide. Immediately upon formation of the precipitate, the oxygen in the water oxidizes an equivalent amount of the manganous hydroxide to brown-colored manganic hydroxide. For every molecule of oxygen in the water, four molecules of manganous hydroxide is converted to manganic hydroxide.*

To "fix" the sample, 8 drops of sulfuric acid is added to the sample. The acid converts the manganic hydroxide to manganic sulfate. At this point the sample is considered "fixed" and any concern for additional oxygen being introduced into the sample is reduced. Simultaneously, iodine (from the potassium iodide in the alkaline potassium iodide azide solution) is oxidized by manganic sulfate, releasing free iodine into the water. Since the manganic sulfate for this reaction is a result of the reaction between the manganous hydroxide and oxygen, the amount of iodine released is directly proportional to the amount of oxygen present in your original sample. The release of free iodine is indicated by your sample turning a yellow-brown color.

The final stage in the Winkler titration is the addition of sodium thiosulfate. The sodium thiosulfate reacts with the free iodine to produce sodium iodide. When all the iodine has been converted, your sample changes from yellow-brown to colorless. Since the yellow-to-clear color change is very hard to see, it is necessary to add the starch indicator solution. Starch turns blue in the presence of iodine. Once all the iodine has been titrated out, the starch turns clear.

Glossary

Adopt-A-Lake. An inter-disciplinary program sponsored by the Wisconsin Lakes Partnership and UW-Extension Lakes Program. This program uses hands-on activities to encourage youth to learn about inland lakes in Wisconsin while actively working to protect those resources.

Algae. Aquatic plants that use sunlight as an energy source (e.g., diatoms, kelp, etc.). One-celled (i.e. phytoplankton) or multi-cellular plants, either suspended in water (i.e. plankton) or attached to rocks and other substrates (i.e. periphyton). Their abundance, as measured by the amount of chlorophyll *a* (green pigment) in a water sample, is commonly used to classify the trophic status of a lake. Algae are an essential part of the lake ecosystem and provides the food base for most lake organisms, including fish. Phytoplankton populations can vary widely from day to day, as life cycles are short.

Biomass. Total mass of all living organisms present (e.g., the total quantity of plants and animals in a lake). Measured as organisms or dry matter per cubic meter, biomass indicates the degree of a lake system's eutrophication or productivity.

Chlorophyll. Green pigment present in all plant life and necessary for photosynthesis. The amount of chlorophyll present in lake water depends on the amount of algae and is therefore used as a common indicator of water quality.

Cultural eutrophication. Accelerated eutrophication that occurs as a result of human activities in the watershed. These activities increase nutrient loads in runoff water that drains into lakes.

Decomposition. The act of breaking down organic matter from a complex form to a simpler form, mainly through the action of fungi and bacteria.

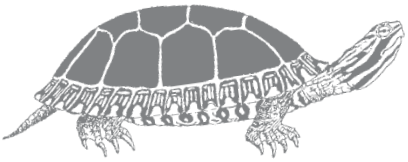
Dissolved oxygen. The amount of free oxygen absorbed by the water and available to aquatic organisms for respiration. The amount of oxygen dissolved in a certain amount of water at a particular temperature and pressure, often expressed as a concentration in parts of oxygen per million parts of water.

Drainage lakes. Lakes fed primarily by streams and with outlets into streams or rivers. They are more subject to surface runoff problems but generally have shorter residence times than seepage lakes. Watershed protection is usually needed to manage lake water quality.

Drained lakes. These lakes have no inlet, but have a continuously flowing outlet. Drained lakes are not groundwater-fed. Their primary source of water is from precipitation and direct drainage from the surrounding land. Frequently, the water levels in drained lakes will fluctuate depending on the supply of water. Under severe conditions, the outlets from drained lakes may become intermittent. Drained lakes are the least common lake type found in Wisconsin.

Epilimnion. The uppermost circulating layer of warm water that occurs in stratified lakes because of the differences in water density. Water's greatest density occurs at 39°F. In lakes that stratify, as water warms during the summer, it remains near the surface while the colder water remains near the bottom. The depth of the epilimnion is determined by wind and usually extends about 20 feet below the surface.

Eutrophic. Lakes characterized by high nutrient inputs, high productivity, often experiencing algal blooms and abundant weed growth. This term can also refer to a nutrient-rich lake, as large amounts of algae and weeds characterize a eutrophic lake.



Eutrophication. The process by which lakes and streams are enriched by nutrients causing an increase in plant and algae growth. This process includes physical, chemical, and biological changes that take place after a lake receives inputs for plant nutrients (mostly nitrates and phosphates) from natural erosion and runoff from the surrounding land basin. The extent this process occurs is reflected in a lake's trophic classification. Lakes can be classified as being oligotrophic (nutrient poor), mesotrophic (moderately productive), or eutrophic (very productive and fertile).

Exotic species. A non-native species of plant or animal that has been introduced into an ecosystem.

Georegion. Wisconsin's lake "georegions" originated from a grouping of lakes made in the early 1980's by Wisconsin DNR senior limnologists. These groupings are based on the best professional judgment of the scientists most familiar with Wisconsin's lake resources. The georegions roughly reflect "hydro-chemical lake regions" which are based on the state's bedrock geology, glacial geology and soil type, and the more recently described "ecoregions" which are based on geological characteristics as well as the dominant vegetation.

Hypolimnion. The lower and colder layer of water in a lake remaining at a constant temperature that occurs in stratified lakes because of the differences in water density. Water's greatest density occurs at 39°F. In lakes that stratify, as the water warms during the summer, it remains near the surface while the colder water remains near the bottom.

Lake association. A voluntary organization with a membership generally comprised of those who own land on or near a lake. The goals of lake associations usually include maintaining, protecting, and improving the quality of a lake, its fisheries, and its watershed. Membership can include all or a few of the people living on a lake and those not living on a lake.

Lake classification. A way of placing lakes into categories with management strategies best suited to the types of lakes found in each category. For example, lakes can be classified to apply varying shoreland development standards. They can be grouped based on hydrology, average depth, surface area, shoreline configuration, as well as, sensitivity to pollutants and recreational use.

Lake district. A special purpose unit of government with the cause of maintaining, protecting, and improving the quality of a lake and its watershed for the mutual good of the members and the lake environment.

Limnology. The study of inland lakes and waters. The study of the interactions of the biological, chemical, and physical parameters of lakes and rivers.

Macrophyte. A multi-celled plant (large enough to be studied and observed using the unaided eye) growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is usually related to shallow water depth and high nutrient levels.

Meniscus. The curved upper surface of a still liquid in a tube caused by surface tension; concave if the liquid wets the walls of the container, convex if it does not.

Mesotrophic. Lakes characterized by their moderately fertile nutrient levels. Falls in between the oligotrophic and eutrophic levels of nutrient enrichment.

Metalimnion. Sometimes referred to as the thermocline. The narrow transition zone between the epilimnion and the hypolimnion that occurs in stratified lakes because of the differences in water density. Water's greatest density occurs at 39°F. In lakes that stratify, as the water warms during the summer it remains near the surface (epilimnion), while the colder water (hypolimnion) remains near the bottom.

Parts per million (ppm). An expression of concentration indicating weight of a substance in a volume of one liter. Milligrams per liter (mg/l) is an equivalent unit.

Nitrogen. One of the major nutrients required for the growth of aquatic plants and algae. Various forms of nitrogen can be found in water: organic nitrogen, most of which eventually decomposes to ammonia; ammonia, produced from organic decay by bacteria and fungi; nitrite, produced from ammonia by nitrite bacteria; and nitrate, the form which is most readily available for use by plants. Nitrate is produced from nitrous oxide by nitrate bacteria. In some ecosystems, nitrogen is the nutrient that limits algae growth.

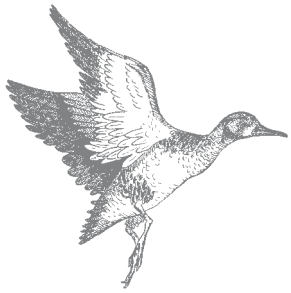
Oligotrophic. Lakes characterized by low nutrient inputs and low productivity. They are generally deep with high water clarity. This term also refers to a body of water with low nutrient levels and low biological productivity. Such lakes typically have very clear water.

Phosphorus. The major nutrient influencing plant growth in more than 80% of Wisconsin lakes. Soluble reactive phosphorus refers to the amount of phosphorus in solution that is available to plants. Total phosphorus refers to the amount of phosphorus in solution (reactive) and in particulate forms (non-reactive).

Photic zone. The surface and underwater lighted zone in a lake that usually has a depth around 1.7 times the Secchi reading.

Photosynthesis. The process by which plants convert carbon dioxide and hydrogen into simple carbohydrates (sugars) for growth using the energy captured by chlorophyll or other organic cellular pigments from radiant sources such as the sun. The by-product of this process is oxygen.

Phytoplankton. Very small free-floating aquatic plants, such as one-celled algae. Their abundance, as measured by the amount of chlorophyll *a* in a water sample, is commonly used to classify the trophic status of a lake.



Respiration. The complex process that occurs in the cells of plants and animals in which nutrient organic molecules, such as glucose, combine with oxygen to produce carbon dioxide, water, and energy. It is the reverse reaction of photosynthesis, as respiration consumes oxygen and releases carbon dioxide. This process also takes place during decomposition as bacterial respiration increases.

Runoff. Water from rain, snow melt, or irrigation, that flows over the ground surface and into to streams or lakes.

Secchi disc. An 8-inch diameter plate with alternating quadrants painted black and white that is used to measure water clarity.

Seepage lakes. Lakes without a significant inlet or outlet, fed by rainfall and groundwater. Seepage lakes lose water through evaporation and groundwater moving on a down gradient. As a result, lake levels can fluctuate with local groundwater levels Lakes with little groundwater inflow tend to be naturally acidic and most susceptible to the effects of acid rain. Seepage lakes often have long water residence times and, as a result, water quality is directly affected by groundwater quality and the use of land on the shoreline.

Spring lakes. Lakes that have no inlet, but have an outlet. The primary source of water for spring lakes is groundwater flowing into the bottom of the lake from inside and outside the immediate surface drainage area. Spring lakes are found at the headwaters of many streams and are a fairly common type of lake in northern Wisconsin.

State Laboratory of Hygiene. The State of Wisconsin's premier public health and environmental laboratory.

STORET. STORET stands for STORage and RETrieval. It is a database system that is overseen by the U.S. Environmental Protection Agency. Every sample point on a lake has a unique STORET number.

Stratification. The layering of water due to differences temperatures of water having different densities.

Tannins. Natural pigments found in organic matter such as leaves and bark.

Thermocline. Sometimes referred to as the metalimnion. The narrow transition zone between the epilimnion and the hypolimnion that occurs in stratified lakes because of the differences in water density. Water's greatest density occurs at 39°F. In lakes that stratify, as the water warms during the summer it remains near the surface (epilimnion), while the colder water (hypolimnion) remains near the bottom.

Trophic state. The extent to which the process of eutrophication has occurred is reflected in a lake's trophic classification or state. The three major trophic states are oligotrophic, mesotrophic, and eutrophic.

Turion. The bud that breaks off from an aquatic plant and lies submerged and dormant until it produces a new plantlet.

µg/L or **micrograms per liter.** An expression of concentration indicating weight of a substance in a volume of one liter. Parts per billion (ppb) is an equivalent unit.

Volunteer ID. An identification number that the Self-Help network uses to uniquely identify each volunteer. All data is tied back to the individual volunteer ID number.

Watershed. The area of land draining into a specific stream, river, lake or other body of water. These areas are divided by ridges of high land.

WBIC (Waterbody Identification Code). A unique identification number the DNR uses to identify each water body in the state. Every one of the 15,000 plus lakes in Wisconsin has a unique WBIC number. All data from that lake is tied to that WBIC. This system is in place since there are many lakes with the same name. Did you know that there are 116 Mud Lakes in Wisconsin? Without the WBICs it would be hard to tell which Mud Lake was being monitored.

Zebra mussel. A tiny bottom-dwelling mollusc native to Europe.

Zooplankton. Plankton that is made up of microscopic animals, for example, protozoa, that eat algae. These suspended plankton are an important component of the lake food chain and ecosystem. For many fish, they are the primary source of food.

Appendix 1: CHEMICAL SAFETY INFORMATION

General Precautions for Using the LaMotte® Dissolved Oxygen Test Kit

1. Read all instructions to familiarize yourself with the test procedures before you begin.
2. Read the label on each LaMotte® reagent container prior to use. Some containers include precautionary notices and first-aid information.
3. Keep all equipment and reagent chemicals out of the reach of children!
4. In the event of an accident or suspected poisoning, immediately call the Poison Center phone number located in the front of your local telephone directory or call your physician. Be prepared to give the name of the reagent in question and its LaMotte® code number. All LaMotte® reagents are registered with POISINDEX®, a computerized poison control information system available to all local poison control centers.

To protect yourself and your equipment, use proper analytical techniques:

1. Avoid contact between reagent chemicals and your skin, eyes, nose, and mouth.
2. Always wear safety goggles or glasses when handling the reagent chemicals.
3. Use the test tube caps or stoppers, not your fingers, to cover test tubes during shaking or mixing.
4. When dispensing a reagent from a plastic squeeze bottle, always hold the bottle vertically upside-down (i.e. not at an angle) and gently squeeze it. If a gentle squeeze does not produce the reagent then the dispensing cap or plug may be clogged.
5. Immediately wipe up any reagent chemical spills, liquid or powder. Rinse the area with a wet sponge and then dry it.
6. Before and after each test, thoroughly rinse all test tubes. Don't forget to dry your hands and the outside of the tube.
7. Tightly close all reagent containers immediately after use. Do not interchange caps from different reagent containers.

Chemical Safety Procedures

Manganous Sulfate Solution- POISINDEX® Code #4167

Health Hazard Data: May irritate skin and eyes.

Eye Contact: Immediately flush eyes with water for at least 15 minutes. Consult a physician.

Skin Contact: Flush with water, remove affected clothing and flush and flush skin for 15 minutes.

Ingestion: Induce vomiting immediately, consult a physician.

Spills and Cleanup: Mop up carefully and flush down drain with excess water.

Alkaline Potassium Iodide Azide- POISINDEX® Code #7166

Health Hazard Data: Severe burns, may be fatal if swallowed.

Eye Contact: Immediately flush eyes with water for at least 15 minutes. Consult a physician.

Skin Contact: Immediately flush with water, remove affected clothing and flush skin for 15 minutes. Consult a physician.

Ingestion: Do not induce vomiting! Rinse mouth, drink a glass of water, and consult a physician.

Spills and Cleanup: Neutralize with 6-MHCL, if available, and flush down drain with excess water.

Sulfuric Acid- POISINDEX® Code #6141

Health Hazard Data: Severe burns, may be fatal if swallowed

Eye Contact: Immediately flush eyes with water for at least 15 minutes. Consult a physician.

Skin Contact: Immediately flush with water for 15 minutes. Consult a physician.

Ingestion: Do not induce vomiting! Rinse mouth, drink a glass of water, and consult a physician

Spills and Cleanup: Cover with sodium bicarbonate (baking soda) or soda ash-calcium hydroxide mixture. Scoop up and wash down drain with excess water.

Sodium Thiosulfate- POISINDEX® Code #4169

Health Hazard Data: Large doses orally can cause purging. Human toxicity is low.

Eye Contact: Immediately flush eyes with water.

Skin Contact: Flush thoroughly with water.

Ingestion: Drink water and consult a physician.

Spills and Cleanup: Mop up and wash down the drain.

Starch Indicator Solution- POISINDEX® Code #4170

Eye Contact: Immediately flush eyes with water.

Skin Contact: Flush thoroughly with water.

Ingestion: Drink water and consult a physician.

Spills and Cleanup: Mop up and wash down the drain with excess water.

Appendix 2:

HOW TO CALIBRATE YOUR OXYGEN METER

The following information contains helpful calibration tips for YSI® hand-held oxygen meters. Be sure to read and follow the manufacturer's manual for a complete description of operating procedures. Calibration must be conducted anytime the meter is turned off for more than 5 minutes.

Pre-calibration

Probe/calibration chamber. The sponge within this chamber should be kept moist (not soaking wet) at all times. Pour out any excess water within the chamber. Accurate calibration values will not be obtained if the sensor is in direct contact with water.

Sensor. Shake or blow off excess water on the sensor. Check for fouling or damage to the sensor, especially check for holes or tears in the membrane. Check for air bubbles beneath the membrane. If any of these things exist, replace the solution and membrane. When changing a membrane, note the condition of the silver anode and gold cathode. If they are tarnished, refer to the owner's manual for cleaning instructions.

Warm-up. Turn the meter on and watch the dissolved oxygen output; it must display a positive number and decrease to a value close to the calibration value (for Wisconsin this value is the 90's). Allow the meter to warm-up for at least 30 minutes. The warm-up and calibration procedures should take place where the meter has been stored. For example, do not take it from an air- conditioned house and calibrate it in a hot garage. The sensor is stored deep within the meter housing, and the temperature may not stabilize in the warm-up period if the meter is moved. Never calibrate the meter in direct sunlight on a hot day.

Location altitude. These meters require altitude (in feet) input for dissolved oxygen calibration. You can find your local altitude by using a *Wisconsin Atlas and Gazetteer* or a USGS topographic map. In the *Gazetteer*, elevations appear scattered throughout every page. Elevations may appear in meters. You can convert meters to feet by multiplying the meter value by 3.28. Elevations in USGS topographic maps are typically listed in feet.

Post-calibration

How do you know if you calibrated the meter to the correct value? Calibrate the meter in the dissolved oxygen mode. During calibration, after entering the proper altitude, the letters "CAL" will display in the lower left corner of the screen. The calibration value (e.g., 94.2) will display in the lower right corner, and the current dissolved oxygen reading will be seen on the main display. Note the calibration value; immediately after completing calibration, the dissolved oxygen value should be equal to the calibration value.

Post calibration drift. After calibration, check the meter reading for drift. This is a check to see how well the meter is holding its calibration. Leave the meter where you calibrated it and walk away for 5 minutes. Upon returning, if the dissolved oxygen value has changed by more than four tenths (0.4), you should change the solution and membrane and repeat all calibration procedures.

D.O. Calibration Log

Observer	Date	Time	Warm-up Time (min)	Temp (C or F)	Altitude (ft)	Pre Calibration value after warm-up (mg/l and % sat.) [1]	Calibration value (% sat.)	Post Calibration value (mg/l and % sat.)	Comments

[1] % sat. = percent saturation

Additional Resources

The booklet ***Understanding Lake Data*** will help you understand how lakes work and what your data means for your lake. The Self-Help web site can also provide links to other lake information **dnr.wi.gov/org/water/fhp/lakes/selfhelp/**. Additional titles you may find helpful include:

Wisconsin Lakes [PUBL-FM-800 91]
This book published by the Wisconsin DNR lists Wisconsin's lakes, their area, depth, if they have public access, and what fish species they support.

Life on the Edge: Owning Waterfront Property
This book was written by Michael Dresen and Robert Korth and published by the University of Wisconsin in 1995. It is an easy to read guide for waterfront owners and covers topics like septic systems, wells, and shoreline development. Copies are available for $10 from University of Wisconsin Extension Lakes Partnership, College of Natural Resources, University of Wisconsin Stevens Point.

Limnology
This book was written by Charles Goldman and Alexander Horne and published in 1983 by McGraw Hill, Inc, New York. It is a basic college limnology text that covers both lakes and streams.

Limnology
This book was written by Robert G. Wetzel and published in 1983 by Saunders College Publishing, Philadelphia. It is a slightly technical college text which covers many topics in great detail.

Through the Looking Glass... A Field Guide to Aquatic Plants
This book was written by Susan Borman, Robert Korth and Jo Temte and published in 1997 by the University of Wisconsin. It is available from University of Wisconsin Extension Lakes Partnership, College of Natural Resources, University of Wisconsin Stevens Point.

The titles listed above and many other limnology related books can be found at your local or University library. Used text books often can be found at college bookstores for a reduced price.

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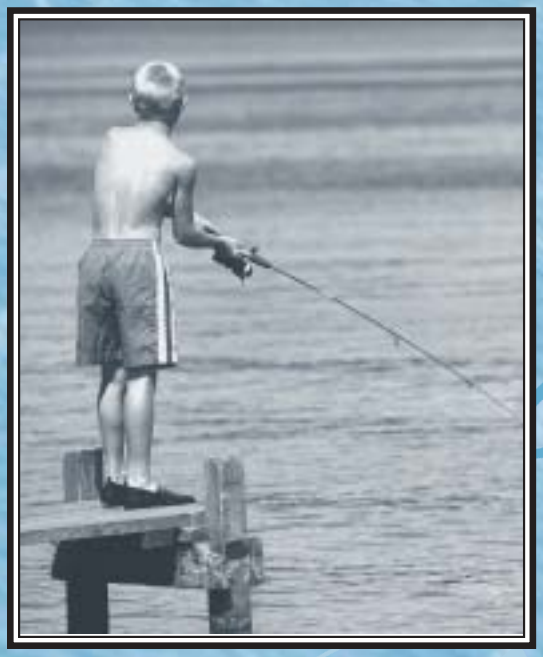

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