LMVP Procedure Manual

(Feb 2020)

TABLE OF CONTENTS

INTRODUCTION TO THE LAKES OF MISSOURI VOLUNTEER PROGRAM

The Lakes of Missouri Volunteer Program (LMVP) trains and equips volunteers to collect and process water samples from Missouri lakes. Ongoing goals of the LMVP are:

1. To describe water quality in all participating lakes in terms of trophic status.
2. To monitor for changes in water quality over time.
3. To educate the public about lake ecology and water quality issues.

The Lakes of Missouri Volunteer Program was created in 1992 and began with four lakes in the Kansas City area. During 1997, volunteers collected samples from 35 sites on 11 public lakes throughout the state. The program is funded by the U.S. Environmental Protection Agency through the Missouri Department of Natural Resources and coordinated by the School of Natural Resources at the University of Missouri.

LMVP'S WATER QUALITY FOCUS

The LMVP is interested in measuring lake trophic status. Simply put, we want to measure the amount of algae in lakes and investigate the factors that regulate algal growth. Algae are an important part of a lake's ecology. These plant-like organisms supply dissolved oxygen and food for aquatic animals. While some algae are necessary for a healthy lake, too much algae can cause problems. These problems include toxin

production, a decrease in aesthetic beauty, disagreeable odors and taste in drinking waters, and changes in the temperature and oxygen structure of the lake that can affect aquatic life. The LMVP measures the photosynthetic pigment chlorophyll to estimate the amount of algae in the lake and the amount of algal toxin present in our lakes to identify lakes that present health problems to humans and animals.

Along with measuring algal chlorophyll and toxins, the LMVP monitors the levels of nitrogen and phosphorus in the lake. These two plant nutrients are often the limiting factor in algal growth. The lakes with the highest nitrogen and phosphorus concentrations have the most algae. These two nutrients occur naturally in Missouri lakes and often problems do not occur until human influences lead to increases in the amounts of these nutrients entering our lakes.

On some lakes the volunteers also sample for total suspended solids. These materials consist mostly of soil particles that have entered the lake as erosional runoff from surrounding land. Excessive soil materials in a lake can turn a lake turbid and give it a brown color. As the materials settle out of the water, they fill the lake bottom. Soil particles often have nitrogen and phosphorus bound to them so if large amounts of erosional inputs flow into a lake, nutrient levels can be elevated.

Volunteers also measure water clarity using a Secchi disk. This tool provides a simple way of gauging how much material is suspended in the water. In Missouri lakes, algae and inorganic suspended solids are the most common materials influencing water clarity.

VOLUNTEER RESPONSIBILITIES

The Lakes of Missouri Volunteer Program relies on people like you to collect lake water samples and make field observations to aid the program in determining the general characteristics of your lake. The three main areas of your responsibility will be:

1. Making field observations on your lake and recording them on a Data Sheet.
2. Collecting and processing lake water samples and recording information on the Data Sheet.
3. Proper storage of samples and equipment, and transfer of field data and samples to Program staff members for analysis at our laboratory.

Field Observations

Specifically, your work on the lake will involve finding a predetermined site by boat from which you will make these field observations:

- wave conditions
- sky conditions
- surface water temperature
- Secchi disk reading

We ask that you make field observations and take samples eight times in all, April through September, once every three weeks.

Collecting and processing work

You will also collect lake water samples when you make your field observations. In your home laboratory you will then process these water samples for later analysis at the limnology laboratory at the University of Missouri in Columbia.

The processing will involve:

- Filling a vial for cyanobacteria toxin analysis.
- Filling a nutrient bottle with lake water for analysis of nitrogen and phosphorus.
- Filtering lake water for total suspended solids analysis (on some lakes).
- Filtering lake water for chlorophyll analysis.
- Filling bottles with filtrate for analysis of nitrate and ammonium (dissolved nitrogen).

Storage and transfer

Processed water samples are stored frozen until LMVP staff pick them up. Pick-ups will occur during the middle of the summer and at the end of the season.

DATA SHEETS

The Data Sheets are in the field notebook and are printed on a special paper that resist water (in other words, if your Data Sheet gets wet it will not disintegrate). If you are sampling one site, you will only need to use the front of the Data Sheet. If you are

sampling multiple sites, you can record data for up to three sites on one Data Sheet.

Information recorded while in the field

- Lake Name – Please write the name of the lake that you are sampling in the space provided. Without this information, we cannot keep track of Data Sheets.
- Site Number – Record your site number here.
- Date – This information is essential! Use the MM/DD/YY format, if possible.
- Time – Write down the time you start your field work.
- Volunteers – Record the names of all people involved in sample collection or processing.
- (1) Water Temperature – Measure and record the temperature of the surface water to the nearest degree (see Field Procedures Section for step-by-step instructions).
- (2) Secchi Depth – Measure and record the Secchi depth to the nearest inch (see Field Procedures Section for step-by-step instructions).
- (3) 2 Liter Water Sample – Check the "Y" box after the sample bottle is filled.
- (4) Cyanotoxin Sample – Check the "Y" box after the sample is collected.
- (5) Wave Condition – Please circle the term that best describes the wave action at the time of your sampling. This is subjective but please try to be consistent in your classification. Wave action will influence your Secchi disk reading and we will use this information to help explain Secchi readings from your lake that seem out of the ordinary.

Information recorded while processing your water sample
(see Lab Procedures for step-by-step instructions)

- (1) Cyanotoxin Vial – After you have filled the vial (halfway!), check the "Y" box to indicate that this task has been completed.
- (2) Nutrient Bottle – After you have rinsed and filled the nutrient bottle, check the "Y" box to indicate that this task has been completed.
- (3) TSS Filters – If you are processing total suspended solids filters you will record the filter numbers and volumes in the appropriate lines.
- (4) Chlorophyll Filters – Record the volume of water passed through each of the chlorophyll filters.
- (5) and (6) Nitrate and Ammonium Bottles – After filling these bottles with

chlorophyll filtrate, check the corresponding “Y” boxes on the data sheet.

Other important information

- Comments - This section is provided so you can write down any information that you feel might be important for us to know. Weather related information such as recent rains may help us interpret data from that sample date. Other items worth noting would be algal blooms within the lake, lake levels, and any activities in the watershed that might influence water quality. You can also use this space to write down questions that come to mind while sampling.
- Miles – Please record the number of miles driven to the lake (*round trip*).
- Hours – Please record the total time spent collecting and processing your samples. This includes time spent packing, travelling, and cleaning up. Multiply this time by the number of volunteers involved to calculate the total amount of time spent for the project. This information is used to determine funding for the program. It is very important.

FIELD PROCEDURES

Equipment needed for sample collection

- Field notebook with data sheets, calendar of sampling dates, and condensed sampling procedures
- Pencil
- Secchi disk, tape ruler and two clothes pins
- 2 liter sample bottle (if not processing TSS, 1 liter is OK)
- 500 ml composite container
- Cyanobacteria toxin monitoring tool
- Thermometer (or Fish Hawk)
- Boat (you supply)
- Anchor (you supply)
- Cooler with ice packs or ice (you supply)

Site Location

Please collect your sample from the same location (your site) every time.

Once you have arrived at your site, anchor your boat. This will prevent you from drifting away from your site.

Data Sheets

Fill out a Data Sheet with the appropriate information (see the Data Sheet section for details).

Water Temperature

Surface Temperature: You will take a water surface temperature reading at each site you sample. If you use the supplied alcohol thermometer, do not remove the case. You can measure water temperature and read the thermometer accurately while it is in the case.

Step-by-step instructions:

1. If you are using the supplied alcohol thermometer you will hang the thermometer over the side of the boat so that the top of the thermometer is just under the surface of the water. The water temperature reading should be a measurement of surface water at your site on your lake.
2. Wait at least two minutes before reading the thermometer. You can secure the thermometer and continue with other field work before taking the reading.
3. Record, on your Data Sheet, the temperature to the nearest degree Fahrenheit.

Temperature/Depth Profiles: If you are collecting temperature data at depth, please see the instructions for your particular device. Record data on the sheet provided to you for this purpose.

Secchi Disk Reading

Secchi disk measurements are one of the most widely used measurements of water clarity. Water clarity, or transparency, is often used as a simple indication of water quality. The transparency of a lake's water is directly related to the amount of material suspended in the water. The types of material that could be suspended in your lake are: algae and microscopic animals (organic suspended solids) and eroded soil and silt (inorganic suspended solids).

It is important that your boat is not drifting while you take the Secchi reading. If you are

drifting, the Secchi disk will not be straight below you but at an angle, which will result in an inaccurate reading. **Always take the Secchi reading on the shaded side of the boat**. If you are taking the reading at high noon and there is no shaded area of water at the side of the boat, you will have to make your own shade with your hand or body. Doing the reading on the shaded side is important, because sun glare off the water will affect the accuracy of your reading. Please do not use any physical aids such as diving masks at the water surface to take your reading; this will make your Secchi readings non-comparable to readings from other lakes. Please remove sunglasses when taking Secchi reading.

Step-by-step instructions:

1. Lower the Secchi disk into the water just until you cannot see it anymore. The disk will be very indistinct; probably all you will see is a faint white blur just before it disappears completely. At this point, you will place a clothespin on the line/tape at the water's surface to mark the depth.
2. Lower the Secchi disk a foot or two deeper, then start to raise it back slowly until you can just see it. The disk will, again, be very indistinct, so take your time and watch for it carefully. Mark this depth with a clothespin at the surface of the water.
3. The average of these two depths is your Secchi reading. Average the two depths (or note the distance exactly between the two measurements. Record this value in the appropriate space on your Data Sheet.

One additional note: The angle of the sun can affect the accuracy of the Secchi reading. This is why we ask you not to sample right after dawn or just before dusk. However, anytime between two hours after sunrise and two hours before sunset is perfectly fine to do your readings.

Water Sample Collecting

A large plastic bottle will be used to collect the lake water sample. The plastic bottle is either 1 or 2 liters in volume depending on which lake you are sampling and is referred

to as a Sample Bottle. Sample Bottles for lakes with multiple sites are already labeled with the appropriate site number. The lake water collected in the bottle(s) will be processed once you return home. Instructions for processing the lake water are provided in the Laboratory Procedures section. We will test these processed water samples for chlorophyll, total suspended solids, nitrogen (total and dissolved) and phosphorus at the University laboratory.

Step-by-step instructions for how to take a *COMPOSITE SAMPLE* of lake water:

1. Rinse the *Sample Bottle* and the *Composite Container* three times in the lake water. This step is important to condition the bottle and container, removing any tap water that might still be in the bottle from its previous cleaning. If you sample more than one site make sure you are using the appropriate Sample Bottle.
2. With the side of the *Composite Container*, quickly swish and sweep the surface of the water to move away any possible scum or other floating material.
3. Then, holding the *Composite Container* upside down (opening downward), plunge it straight down in the lake to elbow depth.
4. Under water, turn the bottle upward to allow it to fill with water.
5. When the Sample Bottle has filled with water, bring it above the surface of the water and pour it into the *Sample Bottle*.
6. Repeat steps 2 through 5 until the *Sample Bottle* is nearly full, taking lake water from different locations around your boat. Try to take these samples from water that has not flowed under the hull of your boat to lessen the chance of contamination.
7. Cap the Sample Bottle and store in a cooler with ice or ice packs. Keeping the water samples cool is important, since direct sun and dramatic increases in temperature in your lake water samples can unnaturally affect chlorophyll, phosphorus and nitrogen measurements.

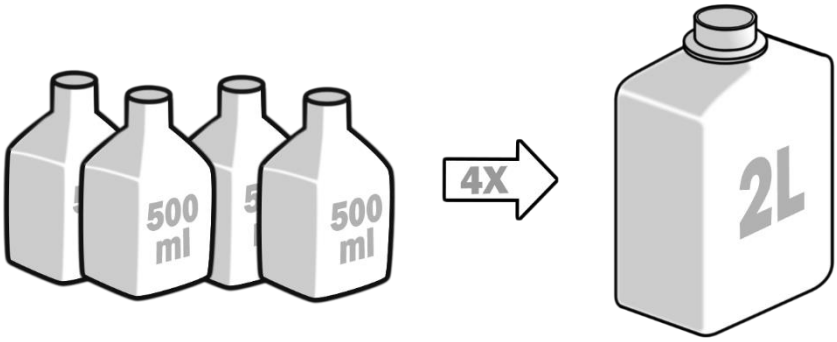


Image: Composite sample collection

Step-by-step instructions for how to take a *Cyanotoxin sample*:

1. Rinse the *500 ml Composite Container* and the *Cyanotoxin Sampling Tube* three times in the lake water.
2. Slowly insert the Tube into the lake, valve first, until top of sampler is nearly under the lake's surface.
3. Lift sampler out of lake and pour sample from the top of the sampling device into the *500 ml Composite Container*.
4. Repeat steps 2 & 3 twice more (total of 3 times).
5. Check the "Y" box for *(4) Cyanotoxin (bluegreen algae) Sample Collected* on your field data sheet.
6. Using a sharpie, record lake name, site, and date on 60mL *Cyanotoxin Sample* bottle. Remove vial from inside the bottle, fill vial halfway with water from the composite container, cap vial and return to bottle. Be sure vial is only half full!
7. Freeze bottle on its side. This is to prevent vial breakage. Once frozen, bottle may be stored in the freezer in any orientation.
8. Steps 6 and 7 may be done at home, if desired. Keep composite bottle in cooler until processed.

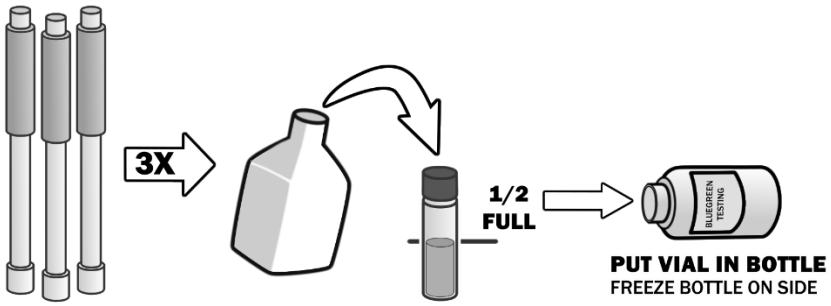


Image: Bluegreen algal toxin monitoring

LABORATORY PROCEDURES

Equipment needed for your home laboratory

- Data Sheet
- waterproof lab marker
- stapler and extra staples
- pencil (no pens, please)
- 250 mL graduated cylinder
- 500 mL graduated cylinder (if you process TSS filters)
- filter funnel assembly
- receiving flask
- hand pump
- chlorophyll filters
- total suspended solids filters (some lakes)
- forceps (aka: tweezers)
- nutrient bottles (60 mL)
- nitrate and ammonium bottles (30 mL each)
- filter storage can with desiccant
- freezer (you supply)

General Information

After collecting lake water in one or more sample bottles you will need to process the water for University laboratory analysis. You do not have to process the water right after you get back from sampling but remember to keep the water samples cool and out of direct sunlight. However, processing needs to be done **on the same day that you collect the water**. It is best that you do the processing in your kitchen as you will need a clean, flat surface with enough room to lay out your filtering equipment and a sink with running water.

For each site you are sampling on your lake, you will be processing:

- One *Cyanotoxin Sample* (1)
- One *Nutrient Bottle* (2)
- Two *Chlorophyll* filters (3)
- Two *Total Suspended Solids* filters (except at a few lakes) (4)
- One *Nitrate* bottle (5) and one *Ammonium* bottle (6)

(1) Cyanotoxin Sample

Some species of bluegreen algae (or cyanobacteria) produce toxins. These toxins can be harmful to humans, pets and wildlife.

If not processed in the field:

1. Using a sharpie, record lake name, site, and date on 60mL *Cyanotoxin Sample* bottle.
2. Remove vial from inside the bottle, fill vial halfway with water from the composite container, cap vial and return to bottle.
3. Freeze bottle on its side. This is to prevent vial breakage. Once frozen, bottle may be stored in the freezer in any orientation.

(2) Nutrient Bottle

Two of the most important nutrients involved with lake fertility are nitrogen and phosphorus. The water from the nutrient bottles will be analyzed by University staff for total nitrogen and total phosphorus.

Step-by-Step Instructions:

1. Fill out information on bottle label using a waterproof marker (Sharpie).
2. Shake the *2 Liter Sample Bottle* to mix well.
3. Rinse the nutrient bottle three times with lake water from its corresponding *2 Liter Sample Bottle*.
4. Fill the *Nutrient Bottle* to the fill line (to prevent rupture during frozen storage). Please do not overfill.
5. Cap the *Nutrient Bottle* tightly and check the "Y" box on your Data Sheet.

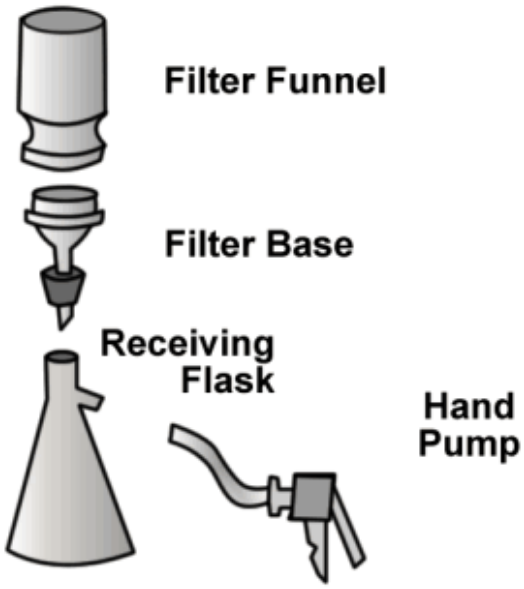
(3) Total Suspended Solids (TSS) Filtering

The water in your lake contains many floating particles. Most of the particles are algae or small pieces of silt and soil. The amount of particles that are suspended in the water plays a role in determining how turbid your lake looks. Total suspended solids analysis measures the amount of material that accumulates on a filter when lake water is filtered through it. The procedure for filtering suspended solids is very similar to filtering chlorophyll. However, the filters used for each procedure are different types, so please do not mix them up.

<u>Step-by-Step Instructions:</u>

1. Rinse the *Filter Funnel* and both the 250 and 500 ml *Graduated Cylinders*.
2. Set out two TSS filters. You prepare two TSS filters for each site monitored. **<u>Note that TSS filter</u>**s are **<u>numbered</u>**. It is **VERY** important that record this number.

3. Set up the filter apparatus by placing the rubber stopper end of the funnel base into the receiving flask; make sure it is firmly seated. Next attach the hose between the hand pump and the side arm of the receiving flask

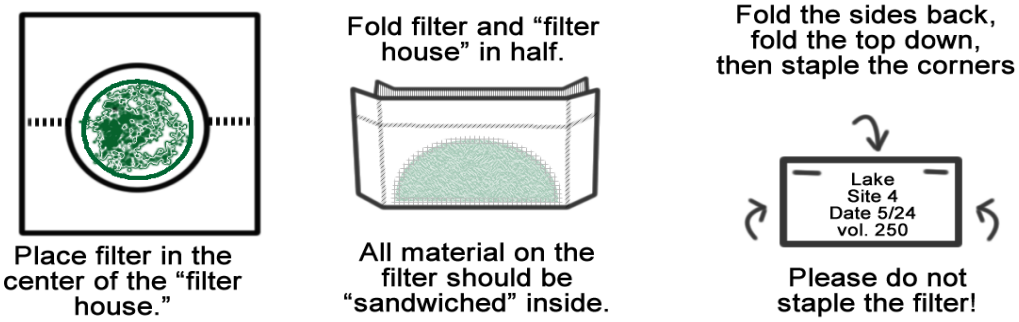


4. With your forceps, place the TSS filter into the filter. Never touch this filter with your hands. If you do at any time during this procedure, discard the filter (and its "house") and start over using another one.
5. Shake the *Sample Bottle* to mix well.
6. You will filter 500 mL for TSS. Pour lake water into the 500 mL graduated cylinder. Make sure the cylinder is standing on a flat surface and check the measurement at eye level.
7. Pour half the water into the assembled filter funnel (the funnel only holds 300mL). Build up a vacuum in the receiving flask by working the hand pump. When most of the water has flowed out of the funnel, swirl the remaining water in the graduated cylinder to mix it and add it to the funnel. Continue to work the hand pump. The water flow through the TSS filter into the receiving flask may begin to slow considerably if the lake water has many suspended particles, but be patient and continue to work the hand pump. Also, see ***Special Instructions*** (at the end of this section).
8. After all of the water has passed through the filter and into the receiving flask, **write down the number of the filter in the appropriate spot on your Data Sheet and record the volume filtered.** Remember, recording the number of these filters is important because they are all pre-weighed.
9. Remove the filter funnel. Using the forceps, remove the filter from the funnel base and place it in the open filter house. Fold both in half, using the forceps to help. Fold the sides of the filter house back, fold the top down and staple each side once to ensure that the filter will not fall out. Please, do not staple through the filter.

10. Make sure that the filter is secure in the filter house and that all the appropriate information has been filled out on your Data Sheet. At this point, place the filter house into the storage can containing drying desiccant and replace the lid of the can. Keep this storage container as light tight as possible.
11. Remove the funnel base from the mouth of the receiving flask and dump the filtered water down the drain of your sink.
12. Filter the water through the second TSS filter for your site as you did for the first TSS filter, following steps 2-10..

******Special Instructions******

If the lake water is very turbid and you cannot filter 500 mL through the TSS filter, even after much patience, discard the filter and the water in the filter funnel. Then measure out 250 mL of lake water (instead of 500 mL) and filter this amount through a new TSS filter. Make sure you mark down 250 mL on your Data Sheet. Also write down in the comments section that you have thrown away TSS filter #XX.



Chlorophyll Filtering

Chlorophyll is the primary photosynthetic pigment found in plants, including algae. You will pass a measured amount of water through a filter. The filter will catch all of the algae in the water. These filters will then be analyzed at the University to determine the total amount of chlorophyll on the filter. This determination will give us an idea of the amount of algae in a given amount of water from your lake.

You will notice when you take the chlorophyll filter out of its filter house that the two sides look different: one has a regular pattern to it and is relatively smooth and one is bumpy and irregular. Place the smooth side down on the filter base with the rough side facing up toward you.

Step-by-Step Instructions:

1. Set out two chlorophyll filters in their houses.
2. Set up the filter apparatus by placing the black stopper end of the funnel base into the receiving flask; make sure it is firmly seated. Next attach the hose of the hand pump to the side arm of the receiving flask.
3. Remove the funnel from the funnel base by pulling straight up. Using your forceps, remove a chlorophyll filter from a filter house. Place it (rough side up, smooth side down) directly in the center of the funnel base. Place the funnel straight down on the funnel base until it magnetically attaches. Placing the funnel straight down (not at an angle) ensures you do not push the filter out of position.
4. Shake the Sample Bottle to make sure the water is well mixed. Yes, you must do it again! Always shake just before you pour water for a sample or filtering because particles can settle out rapidly.
5. You will filter 250 mL of lake water for chlorophyll. Pour lake water into the 250 mL graduated cylinder. Use the plastic dropper to add or remove small amounts of water. Make sure the cylinder is on a flat surface and check the measurement at eye level.
6. Pour water into the funnel of your assembled filtering apparatus and build up a vacuum in the receiving flask by working the hand pump. Continue to pump until all the water has flowed through the filter.
7. After all the water has passed through the filter and into the receiving flask, fill out the chlorophyll filter house in pencil with the appropriate information (site, date, volume filtered). You also need to write the volume of water filtered through the filter in the appropriate place on your Data Sheet.
8. Remove the funnel. Using your forceps, remove the filter from the funnel base. Open the filter house and place the filter in the middle. Using the forceps to help, fold the filter and the house in half together. Fold the ends of the filter house to the back. Please, do not fold the ends forward and cover the writing on the front. Fold the top of the filter house down toward the back. This will need to be a small fold that does not fold the filter inside. Then staple each side once to ensure that the filter will not fall out. Please, do not staple through the filter (see diagram).
9. Make sure that the filter is secure in the filter house and that all the appropriate

information is filled out on the filter house and the Data Sheet. At this point, place the filter house (with the filter inside) into the storage can containing drying desiccant and replace the lid on the can.

10. Follow the above steps for filtering for chlorophyll a second time (always filter for chlorophyll twice).
11. **Do not discard filtrate** (water in filter funnel). You will use this water in the next step.

Nitrate and Ammonium Samples

1. Label Nitrate and Ammonium bottles as outlined in *Nutrient Bottle* section.
2. Triple rinse with water remaining in the Receiving Flask following Chlorophyll filtration
3. Fill bottles to shoulder with Chlorophyll filtrate, cap tightly and place bottles in freezer.
4. Check the appropriate boxes on the field sheet. Discard remaining filtrate.

Algal Toxin Sample

1. If not previously done in the field, label plastic bottle (containing the glass vial) with sharpie, remove vial from bottle and fill halfway with water from the 0.5 liter Bluegreen Algal Toxin composite container. Cap vial and return to bottle.
2. Freeze bottle (with vial inside) on its side. This is to prevent vial breakage. Once frozen, bottle may be stored in the freezer in any orientation.
3. Circle “Yes” in the Algal Toxin field on your field data sheet.

Continued Processing

You have now finished the processing needed for the water in your sample bottle. If you are sampling more than one site on your lake, you will repeat all procedures for the next Sample Bottle. For each Sample Bottle you should have a nutrient bottle filled, two chlorophyll filters, two total suspended solids filters, one nitrate bottle, one ammonium bottle, and one algal toxin sample.

Storage

All samples should be stored in a freezer. Place all the nutrient bottles and the storage can with desiccant containing chlorophyll filters and TSS filters in their houses into the freezer. Keep samples there until they are picked up by Program staff members.

Clean Up

Before emptying the Sample Bottle recheck to make sure you have completed all of the processing. After verifying that you are finished with all the laboratory procedures, shake and dump the remaining lake water from the Sample Bottles.

Now rinse your equipment with tap water. NEVER use soap or detergent on any of the field or laboratory equipment. Soaps and detergents contain phosphates and could contaminate future samples. Also, NEVER put any of your field or laboratory equipment in the dishwasher. Rinse the sample bottles by filling them a third full with tap water. Replace the lids and shake the bottles to rinse away any silt that may be stuck to the inside of the bottle. Dump the water out and repeat the rinse procedure, making sure to shake as much of the excess water out of the bottle as possible after the second rinse. Place the bottle upside down in a dish drainer or on a towel to dry. After all of the bottles have air dried, cap them and place them in the field crate for storage until the next time you go out to sample.

The two graduated cylinders, funnel, funnel base and the receiving flask should also be rinsed twice with tap water. These items should be air dried upside down. Once dried, return rinsed equipment to the covered storage container. This will help keep equipment dust-free. Forceps, marker and unused filters should also be placed in the storage box for safekeeping.

Water Sample Collection and Processing Diagram