

**SNOHOMISH COUNTY LAKE MONITORING PROGRAM:  
MONITORING MANUAL**

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Surface Water Management Division  
Public Works Department  
Snohomish County

## **Acknowledgements**

### Department of Ecology Centennial Clean Water Fund

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### Washington State Department of Ecology

Washington Department of Ecology. A Citizen's Guide to Understanding and Monitoring Lakes and Streams. November 1999.

The monitoring methods presented in this manual are also patterned after those used in the Department of Ecology's volunteer lake monitoring program during the 1990s.

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## **1.0 OVERVIEW OF SNOHOMISH COUNTY LAKE'S MONITORING PROGRAM**

Thank you for participating in Snohomish County's Citizen Lake Monitoring Project. Your efforts are valuable in helping all of us protect the lakes in Snohomish County. Regular monitoring provides the basic information about the condition of lakes in our county. With this information and understanding of our lakes we can make informed management decisions that enable us to protect and enhance conditions in our lakes.

The goal of the Snohomish County Lake Monitoring Program is to collect data that will allow short and long-term management decisions to be made that will ensure resource protections and build a foundation for us to understand the nature and character of the county's lakes. Specific objectives of the monitoring program are:

- to assess the current water quality status of our lakes,
- to identify long-term changes in lake water quality,
- to identify specific water quality problems at individual lakes, including which lakes need additional study or specific actions to solve the problem, and
- to help citizens learn more about protections their own lakes.

### **What is your role in this program?**

From May to October, you will regularly perform simple scientific measurements at your lake. Snohomish County staff will provide you with field equipment and training. Measurements include water clarity, temperature, and water level (some volunteers may also measure dissolved oxygen, pH, total phosphorus and chlorophyll-*a*). You will observe and record the water color, weather conditions, and other conditions in the lake and watershed (such as floating algae, scums, water weeds, land clearing, and watershed land-use development activity).

After recording your measurements and observations on the data sheet, you will mail the sheet to the County. We will enter the data in a computer database. At the end of the year, we will prepare a brief report for you and the public on the status of County lakes based on the results of your monitoring. This report will summarize the general condition of your lake and compare your lake with other lakes in Snohomish County. Of course, you may call the County staff at any time with questions about the data you are collecting or the conditions at your lake.

The County staff is eager to assist you because you are the key to the monitoring project. Your commitment to careful regular monitoring will determine the success of this project. If you are not able to continue the monitoring for any reason, please contact the County staff as soon as possible.

## **2.0 GENERAL INFORMATION ABOUT LAKES**

### **Lakes and Their Watersheds**

Lakes are standing bodies of water an acre or more in size . Lakes are closely linked to their surrounding watersheds. A watershed is simply the land that drains into a lake. Everything that happens in the watershed affects the lake in some way.

First of all, the watershed supplies the water that sustains the lake. Water enters the lake from precipitation that falls on the lake surface itself and, primarily, from precipitation in the watershed that runs off into the lake. Precipitation also percolates through the soil to the groundwater and may ultimately seep into the lake.

Second, watersheds affect the chemical and biological conditions of the lake water. Water from the watershed carries with it many chemicals and other materials. Runoff washes over plants, dirt, roads, and driveways, picking up materials, dissolved substances, and organic matter. These substances are deposited in the lake. Groundwater also transports dissolved chemicals into the lake. These substances affect the clarity of the water, the amount and types of algae, and rooted aquatic plants in the lake, and even the abundance of fish in lake. In addition, if pollutants are present in the watershed, the lake is likely to receive some of them and to suffer because of it.

The temperature of a lake, oxygen in a lake, and other chemical properties of the water also affect the lake condition. During spring and summer, the upper water in a lake is warmed by the sun. Because warmer water is less dense, it tends to float above cooler (more dense) water below, forming two distinct layers of water. During this period of solar warming, the lake may be stratified into two layers that do not mix. Fresh oxygen from the atmosphere is no longer supplied to the bottom waters because of the thermal separation and strong stratification. If there is an abundance of decaying matter on the lake bottom, the decaying process consumes oxygen, potentially reducing the oxygen content of the lower waters. This can threaten fish life and can introduce chemicals from the lake bottom that stimulate algal production.

Later in the fall, as the upper waters cool, the temperature difference between the lake layers decreases. Eventually, the wind and waves are able to overcome the density forces separating the two layers and the entire lake mixes again. This phenomenon is called fall turnover. During turnover, dissolved chemicals from the lake bottom are distributed throughout the lake. This can fertilize the growth of algae and cause algal blooms.

### **Lake Eutrophication**

Lakes, like all geographic formations, are not permanent features of the landscape. All lakes move through a cycle, from creation to dry land. This process, similar to aging, is

called eutrophication. Eutrophication, which literally means “well nourished,” occurs as lakes are enriched by excess nutrients and sediment, primarily from the surrounding watershed. The nutrients and sediment nourish plant and algae life in a lake. Given enough nourishment, plants will eventually take over the entire lake. Under natural conditions, this cycle takes tens or hundreds of thousands of years because undisturbed watersheds are relatively stable. However, human activity often dramatically accelerates this process by disturbing the soil and vegetation within the watershed, as well as directly contributing nutrients to the lake.

Most of the lakes in Snohomish County were formed by glaciers or by rivers. When the lakes were newly formed, they were crystal clear, with little plant or animal life because the level of nutrients was low. Nutrients are chemicals, like phosphorus and nitrogen, that are the basic food of algae and other plants. Some of the lakes in Snohomish County are still at this early stage of life, with very clear water and limited plants.

Over time, sediment and nutrients wash into a lake from the surrounding watershed. Algae, which are microscopic green plants suspended in the water, are the basis of the food pyramid. Microscopic animals called zooplankton feed on the algae, and the zooplankton in turn are eaten by fish. As a lake becomes richer in nutrients, more algae and more floating-leaved plants, such as lily pads, begin to grow in the water. The plants provide food and habitat for fish and other animals.

When the algae and plants die and sink to the bottom, they decompose, adding sediment to the lake. The lake gradually becomes more shallow. With more nutrients and plant growth in the lake, the water is no longer clear and pure. The lake is now in the middle stage of eutrophication. Some of our lakes in Snohomish County are at this stage.

When there is an excessive amount of nutrients available for plants, algae blooms may occur. Algae blooms are dramatic explosions of algae that can form scums and cloud the water. This usually happens during summer months when light and temperature are optimal for plant growth. But, blooms can also occur after the lake turns over in the fall or winter and nutrients become mixed throughout the water.

An excessive amount of nutrients in the water may also cause the algae species in a lake to change. Algae species that are eaten by zooplankton and fish are often replaced by blue-green bacteria (formally called blue-green algae) species, which are not often eaten by animals. Large populations of blue-green bacteria are usually indicators of polluted or threatened lakes.

When lakes reach the stage where they contain excess nutrients, especially phosphorus, and support vigorous growths of algae and plants, the lakes are considered to be “eutrophic” lakes. Eutrophic lakes often exhibit low levels of oxygen because decomposition of the great amount of dead plant matter collected on the bottom uses up oxygen. If a lake is stratified (divided into layers by temperature), this lack of oxygen may also allow the release of nutrients from the lake bottom back into the water to be

used again and again by plants and algae. Some lakes in Snohomish County are at this advanced stage of eutrophication.

### **Human Activities That Cause Water Quality Problems**

The natural life cycle of a lake takes thousands of years. However, human activities within a lake's watershed may introduce excess nutrients and sediment that greatly speed up the process of eutrophication. Activities that can affect lake water quality include:

- runoff from roads, driveways, rooftops, and other hard or paved surfaces;
- septic systems that are poorly maintained or improperly designed;
- land clearing and development that causes erosion into streams or the lake;
- the use of fertilizers and pesticides, especially in large quantities near the water;
- the use of detergents and household products containing phosphates and toxic chemicals;
- agricultural practices, including animal access to streams or the lake;
- excess waterfowl and pet wastes.

All of these activities add nutrients and/or sediment to the lake and hasten the process of eutrophication. These activities are difficult to control, however, because they involve almost every property in a watershed in some degree or another. This is why public stewardship of lake water quality is so important. Unless we all take steps to protect water quality, our lakes will suffer. Lake monitoring is one step in understanding the condition of our lakes. The results of lake monitoring can be used to identify problems and solutions that citizens and others can use to address these issues.

### **3.0 SIGNIFICANCE OF MONITORING DATA WHAT THE DATA TELL US**

#### **Water Clarity**

Volunteer monitors will use a Secchi disk to measure the clarity of the water. A Secchi disk is about 8 inches in diameter and is painted black and white in alternating quadrants. A rope (marked in tenths of meters) is attached to the disk. Volunteers lower the disk into the water and record the depth at which it can no longer be seen. This depth is called the secchi disk depth or transparency of the lake.

The Secchi disk is a convenient method for determining water quality. It measures how far light can penetrate through the water. (In actuality, light goes about two times the depth you can measure because, for you to see the disk, light must go through the water to the disk and reflect back through the water to your eye).

Secchi depth readings will vary with the clarity of the water. The more suspended material (like algae and sediment) in the water, the shallower the Secchi depth reading. The clearer the water, the deeper the Secchi desk can be seen.

The amount of suspended material in the lake may fluctuate during the monitoring season. During periods of heavy rain and runoff, silt and other soil particles may be washed into the lake, clouding the water. During summer, populations of algae may grow in response to the increased light and warmth. Water clarity (and the Secchi depth readings) will be reduced during such periods because of the amount of algae suspended in the water. In some lakes, the water is colored because the wetland and peat soils release natural tannins into the water. This will also reduce the Secchi depth readings.

Poor water clarity affects fish and aquatic life in several ways. First, sunlight may be blocked from reaching submerged aquatic plants. These plants need light for photosynthesis. If photosynthesis is restricted, the plants will produce less oxygen for fish and aquatic life. Second, suspended matter in the water can clog the gills of fish and shellfish and can also interfere with animals that are dependent on visibility to find food.

Most importantly, water clarity is a measure of the water quality of a lake. Shallow Secchi depth readings may indicate that there is an excess of algae and/or sediment in the water. And, progressive declines in Secchi depth may tip us off to problems at a stage when the problems can still be solved. We can also use Secchi depth measurements to scientifically classify the condition of a lake in regard to the eutrophication process. Lakes with poor water clarity are often “eutrophic” and suffering from nutrient enrichment. However, this conclusion should be confirmed by chemical analysis of the water quality.

## **Temperature**

Temperature is a simple measurement. However, it is one of the most important parameters to monitor in a lake. Temperature dramatically affects the rates of chemical reactions and biological activity in the water, which in turn affect water quality. Warmer water generally increases the rates of plant and algae growth, as well as that of many animals. On the other hand, warm water is able to hold less oxygen than cold water. Cold-water fish, such as trout and salmon, cannot survive in very warm water. Warm water also accelerates the decay of organic matter in a lake, using up even more oxygen in the water.

Volunteer monitors will measure the surface temperature of their lakes. This will give an indication of how warm or cool the lake becomes and how quickly the water temperature changes through the seasons.

A few monitors will have equipment allowing them to measure the temperature at different depths within the lake. This is especially important information for lakes. It provides information about conditions in the lake that may affect oxygen levels and algae growth as well as how the lakes mix.

During the spring and summer months, the surface waters of a lake will be warmer than deeper waters because of heating by the sun. During this period, the two layers of water will not mix because colder water is more dense than warmer water. The greater the temperature difference, the stronger the separation of water layers. While a lake is stratified (divided into layers), oxygen from the atmosphere cannot reach the lower waters. If there is sufficient decaying matter in the lake, the oxygen content of the lower waters will soon be depleted. This can threaten fish and animal life (some of whom must stay in the colder bottom waters to survive). Lack of oxygen can also release nutrients from the bottom sediments that fuel the growth of undesirable algae.

In the fall, the upper waters cool until the entire lake is close to the same temperature. Then, wind and waves will mix (turn over) the lake from top to bottom. Oxygen will be restored to the bottom waters, but nutrients accumulated during the period of stratification will now be available for rapid algae growth. Temperature measurements by volunteers will provide information about the timing and strength of lake stratification and turnover.

Volunteers will be measuring temperature with thermometers marked in degrees Celsius (Centigrade) or with electronic temperature probes (thermistors). Using the Celsius scale will make the data you collect comparable to data from other monitoring programs and more useful for scientists. For your information, however, the monitoring instructions contain a table showing the comparison between degrees Celsius and degrees Fahrenheit.

## **Dissolved Oxygen**

Dissolved Oxygen (DO) is one of the most important measurements for lake water quality. Oxygen dissolved in the water is essential for all plants and animals in the lake. When oxygen levels in the water fall below 3-5 mg/L, many fish and other animals cannot survive. When oxygen levels fall below 2 mg/L, a chemical reaction can occur that releases nutrients from the bottom sediments.

Oxygen enters the water at the surface of a lake from the atmosphere. The mixing action of wind and waves assists oxygen transfer from the atmosphere to the water. Oxygen is introduced into lake water also by aquatic plants as a by-product of photosynthesis.

Dissolved oxygen levels in a lake will vary over time and with depth. For example, in a productive lake, oxygen levels increase during the daytime as aquatic plants release oxygen during photosynthesis. Then at night, the plants take up oxygen as they respire, which lowers oxygen levels in the water. Oxygen levels may increase after a storm with strong winds and waves. Also, oxygen levels in nearly all lakes increase during the winter when the entire lakes are well-mixed.

On the other hand, oxygen levels will decrease in bottom waters during spring and summer because stratification prevents oxygen from being re-supplied from the atmosphere. Oxygen is also consumed by the bacteria that decompose organic matter on the lake bottom. This low oxygen condition will persist throughout the summer until fall turnover provides fresh oxygen from the atmosphere. However, in some lakes, oxygen levels may actually decrease after fall turnover because of the huge oxygen deficit that has been created through the rapid decomposition of organic matter in the lake bottom during the summer.

Another fact to know is that warm water holds less oxygen than cold water. The following table indicates the maximum amount of oxygen that water can hold at different water temperatures (also known as 100% saturation).

<b>Solubility of Dissolved Oxygen in Water (mg/L)</b>	
<b>Temperature, °C</b>	<b>Dissolved Oxygen (mg/L)</b>
0	14.6
4	13.1
8	11.9
12	10.9
16	10.0
20	9.2
24	8.6
28	7.9

Snohomish County staff will normally visit your lake at least once during the year to measure dissolved oxygen and temperature levels in your lake. Some volunteers will also use chemical kits and meters to measure the amount of oxygen at different depths in the lake. Together with temperature information, data on dissolved oxygen will provide an indication of the biological and chemical conditions in the lake.

**pH**

Hydrogen ion activity, or pH, is a measure of the relative acidity of a liquid. The pH of water is measured on a scale of 0 to 14. A pH of 0 is extremely acidic. A pH of 14 is extremely basic. A pH of 7 is considered neutral. Distilled water has a pH of about 7. Rainwater is closer to 6.

The pH scale is exponential. That is, a change of one whole number on the scale is a ten-fold change in acidity. So a pH change of one whole number would mean significant change in the chemical composition of the lake water. The following table shows the relative pH of common substances.

**pH of Common Substances:**

Very Basic	14.0	Lye
	13.0	Bleach
	12.0	
	11.0	Ammonia
	10.0	
	9.0	
	8.0	Sea water
	7.0	Distilled Water
	6.0	Rainwater
	5.0	
	4.0	Orange Juice
	3.0	Vinegar
	2.0	
	1.0	
Very Acidic	0.0	Battery Acid

Measurement of pH is important because pH affects biological and chemical activity in a lake. First of all, extremes of acid or base threaten living organisms. Most animals cannot survive if pH is greater than 9 or less than 5. Measurement of pH is also important because pH can be an indicator of water quality. pH can be affected by activities in the lake and the watershed. Photosynthesis by aquatic plants increases pH. Sediment from soil erosion can change pH depending on the types of soils and rocks

found in the watershed. Also, agricultural practices, fertilizers, pesticides, septic system effluent, and runoff from developed areas can affect the pH of the water.

Another property of lake water quality that is related to pH is alkalinity. Alkalinity is a measure of a lake's ability to resist changes in pH. This is known as the buffering capacity of the lake. Low alkalinity reduces a lake's resistance to changes. A lake with low buffering capacity (soft water) is more susceptible to pollution than one with a high buffering capacity (hard water) because only small changes in chemistry are needed to affect the lake water quality.

County staff will measure pH in the public lakes whenever they perform the monitoring, usually at least once a year. In addition, some volunteers may have an instrument to measure pH in their lakes.

### **Total Phosphorus**

Phosphorus is an essential nutrient for the growth of both plants and animals. Phosphorus occurs naturally in the soil and rock and can be found in all plant and animal tissue as well as on particles in the atmosphere.

Phosphorus enters a lake via multiple pathways. Phosphorus can be deposited from the atmosphere directly onto the surface of the lake. It can be released from the watershed by the weathering of rocks and soils, and transported by surface runoff and streams to the lake. Human impacts in the watershed can increase the amount of phosphorus in runoff. Sources of phosphorus include lawn fertilizers, agricultural fertilizers, waste products from pets and farm animals, poorly maintained septic systems, land clearing and soil erosion, and runoff from roads, roofs, and paved areas.

Phosphorus is important to algae growth and is usually the limiting factor in primary productivity in a lake. Excess amounts of phosphorus in a lake can lead to nuisance algae blooms, and lake eutrophication. A eutrophic lake can have multiple water quality issues associated with the excess amount of primary productivity caused by an over-enrichment of phosphorus in the system. These could include taste and odor problems, interference with recreational activities and boating, a decline in fish and wildlife habitat, and aesthetic problems (it just looks bad).

It is important to know the concentration of phosphorus in a lake to assess the degree of eutrophication. Snohomish County staff and/or volunteers will collect monthly samples at different depths in most lakes to measure the phosphorus concentrations.

### **Chlorophyll-*a***

Chlorophyll-*a* is the photosynthetic pigment present in all algae and aquatic plants. In the process of photosynthesis, chlorophyll-*a* captures light energy, using it to combine carbon dioxide and water into sugar, and storing the energy as chemical energy.

Because chlorophyll-*a* is present in all algae and is such an important component of algae growth, it is used as a measure of algae biomass in lakes.

Knowing the concentration of chlorophyll-*a* in a lake will provide a good estimation of the amount of algae in the water column. Chlorophyll-*a* concentrations are usually high in the spring and summer months when there is a lot of light and nutrients are available for growth. Chlorophyll-*a*, like phosphorus, is an indicator of the condition of the lake and is used to determine if the lake is eutrophic.

Snohomish County staff and/or volunteers will collect samples from some lakes to be analyzed for chlorophyll-*a* during the summer months.

### **Water Color**

Each volunteer monitor will observe and describe the water color of their lake each time they take a Secchi measurement. Because observation of water color is a subjective judgment, volunteers will choose from a list the color that best matches their perception of the lake water color.

Water color is generally not a water quality concern. However, color can be a factor influencing the interpretation of other data collected on a lake. For example, the water in some lakes may be brown, amber, or even black because of the lake's proximity to natural bogs that release dissolved humic material or tannins into the water. The color does not indicate pollution, but does reduce the ability of light to penetrate the water. At many Snohomish County lakes, natural water color affects the Secchi readings and may complicate the interpretation of the relationship between Secchi depth and lake water quality.

In other cases, water color may indicate the presence of suspended algae (which come in various colors) or fine silt in the water. Accordingly, the color of the water may change based on the amount of algae production and the recent history of rainfall and erosion.

### **Water Level**

Volunteers will also measure the level of the lake surface. This indicates both the amount of water in the lake and the balance between water flowing in from precipitation or groundwater and water leaving by evaporation or outflow. Of course, lakes in our region will be highest in early spring and lowest in late summer and fall.

The importance of lake level is to indicate the seasonal effects of the water balance in the lake. When the level is low, there is less water entering the lake to help dilute and flush out pollutants. Also, less oxygen is being introduced into the lake from in-flowing streams. A high lake level sometimes indicates a plugged outlet.

## **Weather Conditions**

Weather conditions will affect measurements of Secchi depth, temperature, dissolved oxygen, lake level, and other aspects of lake condition. Therefore, monitors will record recent weather conditions when they collect monitoring data.

Since Secchi measurements rely on light and the eyesight of the volunteer, the amount of cloud cover, smoothness of the water surface, and time of day will affect the readings. In addition, recent storms may have washed sediment into the lake creating temporary turbidity (cloudiness) in the water.

Water temperature and dissolved oxygen are also affected by weather. Windy, rainy conditions will add oxygen to the water and may mix the lake unless the lake is strongly stratified. In contrast, a succession of warm, sunny, calm days provides conditions that are ideal for algae and plant growth.

## **Other Observations**

Volunteer monitors are also asked to record other observations about the lake and the watershed. This includes floating algae, odors, muddy water, dead fish, waterfowl, oil on the water surface, land clearing, a rapid increase in the abundance of aquatic plants, or any other conditions that the monitors consider significant.

These observations, though sometimes subjective, provide clues about possible water quality problems and may indicate potential causes of the problems. Observant and concerned citizens serve a valuable role in protecting lakes and alerting the community to water quality problems. If agencies and citizens learn about problems in time, there are greater opportunities to address the problems before they permanently damage the lake.

## **4.0 VOLUNTEER MONITORING SAFETY PROCEDURES**

### **Safety**

Safety is the most important concern of the volunteer monitoring project. Please take adequate precautions to protect your health and safety. Do not take risks just to complete your monitoring.

### **GENERAL PRECAUTIONS**

- Read all the instructions in this manual to become familiar with the correct monitoring procedures. Please do not skip any safety precautions. Do not attempt the monitoring without receiving instructions from County staff. Instructions from another volunteer may not be complete.
- Do not try to collect monitoring data during a storm or when the water is rough.
- If you drop equipment overboard, be careful in retrieving it. Don't fall overboard trying to save equipment.
- Keep all equipment and chemicals out of the reach of children.
- In the event of an accident, please call 9-1-1 for immediate assistance or get treatment from your physician or hospital. Afterward, please contact Snohomish County Surface Water Management to let us know about the problem.
- You are an official volunteer for Snohomish County. Therefore, you are covered by a form of Workmen's Compensation insurance while you are involved in lake monitoring. However, the best insurance is to exercise caution as a volunteer monitor.

### **BOATING SAFETY**

- Be sure your boat is in good condition. Do not use a boat that leaks or has broken equipment like oars, paddles, seats, or motor.
- Be extremely careful if you use a canoe or kayak. Do not lean far over the water to perform the monitoring. We prefer that you use a rowboat rather than a canoe or kayak if possible.
- Always wear a life jacket or vest. Be sure that there is a Coast Guard approved personal floatation device for each person.
- Obey all safety regulations while operating your boat.

## **SAFETY WITH CHEMICALS**

- Always wear safety goggles or glasses when handling water testing chemicals.
- Wear plastic gloves when using water testing chemicals. Wash your hands after working with any chemicals.
- Avoid contact between chemicals and skin, eyes, nose or mouth.
- If there is a suspected poisoning, immediately call the Poison Center at 1-800-732-6985 or call your physician. Be prepared to give the name of the chemical and its code number.
- If you are using chemicals for water testing, read the labels each time prior to use. Some of the labels contain safety precautions or antidote information.
- Use the bottle cap, not your fingers, to cover the bottle during shaking and mixing.
- When dispensing a chemical from a plastic squeeze bottle, hold the bottle vertically upside-down (not at an angle) and gently squeeze it. If a gentle squeeze is not sufficient, the hole in the bottle may be plugged.
- Wipe up any chemical spills (liquid or powder) immediately. Rinse the area with a wet sponge and then dry.
- Tightly close all chemical containers immediately after each use. Do not have more than one container open at a time. Be careful not to interchange caps from different containers.
- Avoid prolonged exposure of equipment and chemicals to direct sunlight. Protect from freezing temperatures or extremely high temperatures.
- Dispose of used chemicals properly. Used chemicals from the dissolved oxygen testing should be poured into a container holding kitty litter. After several months of tests, seal the container, wrap in a plastic bag, and dispose in regular garbage.

## 5.0 VOLUNTEER MONITORING TASKS AND PROCEDURES

The following pages describe in detail the tasks and steps you will follow. Please read these pages over before you begin monitoring and carry out the monitoring in the order described. The instructions are broken down into “Tasks” (the major activities that you are to complete) and “Sub-Tasks” (the procedures necessary to sample each parameter you will monitor). You will not be performing all the monitoring sub-tasks every time you monitor your lake. Please refer to the monitoring schedule for your lake and instructions from Snohomish County SWM staff to confirm the monitoring you will perform. Additional informational notes specific to the monitoring procedures are included in the “General Guidelines” for each sub-task.

### Task 1: CONFIRM MONITORING DAY AND TIME

- Monitoring should be performed according to the monitoring schedule at the end of this manual (the end of Appendix A in the *Quality Assurance Project Plan: Snohomish County Lake Management Program*). Begin monitoring as soon as you receive the equipment and training. Then, repeat the monitoring approximately every two weeks. Monitoring that is spaced at even intervals will give a more accurate indication of lake conditions than irregular monitoring.
- Choose a day every two weeks that is convenient for you. Try to choose the same day of the week each time. Allow yourself at least one hour to have enough time to monitor safely. Then mark these dates in your own personal calendar.
- Monitoring for dissolved oxygen and temperature at depths should be performed every four weeks (or every second monitoring period). On these dates, allow an extra hour or two to complete the monitoring.
- Monitoring for phosphorus and chlorophyll *a* samples should be performed every month from June through September on a weekend designated by Snohomish County SWM staff. Please combine this monitoring with your regular bi-weekly and dissolved oxygen and temperature monitoring once each month.
- If your lake is shallow and is used extensively for motor boating on weekends, it is best to perform the monitoring during the week or on a weekend morning (phosphorus and chlorophyll *a* monitoring need to be completed on Saturday or Sunday of the designated weekends). Especially on weekends, boat wakes, stirred sediments, and motor oil on the water may affect water clarity and the Secchi depth.
- Because of weather conditions or other time commitments, it may not always be possible for you to monitor on the day you have planned. Except for phosphorus and chlorophyll *a*, that’s O.K. Just try to complete the monitoring within two days of your scheduled date. Or it may be possible for your back-up monitor to perform the monitoring for you. Even if you miss the date by more than two

days, you should still perform the monitoring. Late or early data are better than no data. (The only exception is for phosphorus and chlorophyll *a* sampling. If you cannot collect these samples on the designated weekend, please contact SWM staff.) Please remember that regular monitoring is needed to accurately document any changes in lake condition. If you skip a monitoring date, we will not know if the lake was better or worse during that period. Please call County staff if you have questions about scheduling.

- Also, try to perform the monitoring at the same time of day each time, if possible. The ideal time is between 10 a.m. and 2 p.m. when the sun is high. This is because the accuracy of the Secchi disk reading will depend on good visual conditions. The amount and angle of sunlight, cloud cover, and smoothness of the water surface will affect your reading.
- If you would like to perform the monitoring more frequently, such as every week, please do so. We can provide you with more data sheets and stamped envelopes.

### **Task 2: CHECK WEATHER AND LAKE CONDITIONS**

- Check the current and forecasted weather conditions and decide if conditions allow for safe monitoring. Check the lake for waves and rough water. Do not go out in stormy or dangerous conditions. Also, Secchi readings will be more accurate in calm weather.

### **Task 3: COLLECT AND LOAD YOUR EQUIPMENT**

- You will need the following equipment each time:
  - Bucket
  - Secchi disk
  - Thermometer
  - Clothespin
  - Data Sheet
  - Map of lake
  - Pencil or pen, and clipboard if you have one
  - Watch
  - Life Jacket
  - Boat anchor
- When performing chemical testing you also need:
  - Water sampler
  - Sample bottles (if collecting Total phosphorus and chlorophyll-*a* samples)
  - Cooler
  - Dissolved oxygen test kit
  - Glass sample bottles for dissolved oxygen

- Safety glasses
- Vinyl gloves
- Paper towels
- Plastic jar or bucket for waste paper or chemicals

#### **Task 4: LOCATE YOUR MONITORING SITE**

Take your boat out in the middle of the lake and verify your position at the deepest point by using the shoreline landmark method described below.

- Monitoring should be performed at the deepest point in the lake. This location provides the best indication of the overall condition of the lake. Be sure to conduct your monitoring at the same spot in the lake every time. This will provide consistency in the data and make the results more scientifically valid.
- Your map indicates the approximate location of the deepest spot in the lake. County staff will also help you locate this point before you begin the monitoring and will mark your map with shoreline landmarks. These landmarks will consist of two sets of features that line up together and form an imaginary “X” when you are at the correct location in the lake. (An alternative method is to anchor a buoy at the appropriate location. A buoy works best in a small, shallow lake with little boat traffic.

Once you have located the correct spot, anchor your boat if possible. This is helpful to keep from drifting into shallow water.

- If your lake is shallow, avoid re-positioning the anchor once it is dropped. Moving the anchor may stir up sediment and affect your monitoring results.

#### **Task 5: RECORD YOUR MONITORING RESULTS CORRECTLY**

Fill in the spaces on the data sheet with information on the lake name, date, time and your name. Then, record data and observations on the sheet as you move through the monitoring steps. Do not rely on your memory and fill out the sheet later.

#### **Task 6: CONDUCT THE MONITORING ACTIVITIES**

After you have completed Tasks 1-5, you can begin to conduct the monitoring activities that you and Snohomish County have agreed upon for your lake. The specific monitoring procedures for each parameter are located in the following pages. Only follow those procedures for parameters that have been assigned to you, in the order in which they appear in the following pages. Some volunteers in the program may monitor and collect samples for more or less parameters than you will be doing for your lake. Appendix B of the *Quality Assurance Plan: Snohomish County Lake Management Program* contains specific information, including lake maps and specific monitoring schedules for your lake.

**Sub-Task 1**  
**Sampling Procedures for SECCHI DISK DEPTH (WATER CLARITY)**

**General Guidelines**

- **Be sure the Secchi disk is securely attached to the measured rope. If your disk does not have a float fixed to the end of the line, you might want to tie the rope to something in the boat to prevent losing the disk in the lake.**

**Specific Sampling Instructions:**

1. **Remove** your sunglasses and lean over the shaded side of the boat. This is important to reduce sun glare and provide optimum conditions for looking into the water.
2. Lower the Secchi disk into the water **slowly** until the disk just disappears from view. Then, slowly raise the disk until you can barely see it again. Move the disk carefully up and down a few inches until the exact vanishing/re-appearing point is found. Make sure the rope is **vertical** when you take the reading. Take your time because your view of the disk will be very faint.

Note: If the disk disappears into the weeds, move a short distance away from the weeds. If you have to move more than a few feet because of weeds, take the Secchi reading at the new location, note the problem, and call County staff.

3. Without moving the disk again, place a clothespin on the rope at the point where the rope touches the water surface. (You might want to have the clothespin in one hand while you raise and lower the Secchi disk with the other).
4. **Slowly** pull the Secchi disk completely out of the water. Determine the Secchi disk depth by reading the distance between the Secchi disk and the clothespin. Read the distance to the nearest **tenth (0.1)** of a meter. The rope is marked in **red** for each meter and in **black** for each tenth of a meter.
5. Record this reading on the data sheet as the “1<sup>st</sup> Secchi reading”. Please record to the nearest tenth (0.1) of a meter. If it is exactly on the meter mark, record “0” tenths, such as “4.0” meters. If the disk hit the lake bottom before disappearing from view, write down the depth and check the appropriate box on the form.
6. Remove the clothespin from the line and repeat the Secchi disk depth measurement by following steps 2-4. If the second reading is more than **one tenth (0.1)** meter difference from the first, please do a third reading.

7. Record the second reading on the data sheet. If you had to do three or more readings to get two within 0.1 meters, please enter the two readings that were the closest.

**Sub-Task 2**  
**Procedures for COMPLETEING THE OBSERVATIONS ON THE SHEET**

**General Guidelines**

- **In each step, check the box on the observation sheet that best describes the conditions you observe.**

**Specific Sampling Instructions:**

1. Record the percentage of cloud cover. “0%” means the sky is completely sunny. “100%” means the sky is completely overcast.
2. Describe the extent of rain within the last two days. If there has been rain, use your judgment to determine how much rain there was. You may also write in observations about recent weather, such as describing a brief but heavy downpour that produced lots of runoff.
3. Describe the current wind conditions. Windy conditions will disturb the lake surface and affect the monitoring results.
4. Describe the color of the lake water. There are two ways to make this observation, however, if you are also using a numbered color chart, you **must** follow the first method. It may be difficult with either method to determine the color of the water, especially if the color is faint. Use your best judgment and select the color on the data sheet that best matches the color you observe. If none of the colors on the data sheet is close, write in your own description.
  - a. **Method A**—Lower the secchi disk into the water about half way to the point where the disk disappears from view. While looking at the white part of the disk, determine the color of the water.
  - b. **Method B**—Using the white bucket, scoop about 1/3 bucketful of water out of the lake. Estimate the color of the water against the white background of the bucket. (Caution: Never use this method if you are in a boat that can tip over, like a canoe or kayak. Also, do not hurt your back).

### Sub-Task 3

#### Procedures for MEASURING THE SURFACE WATER TEMPERATURE

##### **Specific Sampling Instructions:**

1. Remove the thermometer from its case. Be sure the string is attached securely to the cork floats.
2. Hold the thermometer about 6 to 12 inches below the surface of the lake. Wait **two minutes** for the thermometer to stabilize.
3. Pull the thermometer out of the water and read the temperature **quickly but accurately**. It is important to read the temperature quickly because the thermometer will start changing immediately in response to air temperature and wind.
4. Record the surface temperature to the nearest ½ degree C. That is the smallest division on the thermometer. The next longer marks are for each degree. The longest marks are for every five degrees. Please note that the “5” between 10 and 20 is for 15 degrees and the “5” between 20 and 30 is for 25 degrees.

For your information, the following chart compares Celsius temperatures and Fahrenheit temperatures.

<u>Celsius</u>	<u>Fahrenheit</u>	<u>Celsius</u>	<u>Fahrenheit</u>
0	32	16	61
1	34	17	63
2	36	18	64
3	37	19	66
4	39	20	68
5	41	21	70
6	43	22	72
7	45	23	73
8	46	24	75
9	48	25	77
10	50	26	79
11	52	27	81
12	54	28	82
13	55	29	84
14	57	30	86
15	59		

**Sub-Task 4**  
**Sampling Procedures for MEASURING TEMPERATURE PROFILES**

**General Guidelines**

- **Temperature profiles should only be performed every four weeks and only if Snohomish County has instructed you to perform this procedure.**
- **There are three different sets of procedures for measuring the temperature profile in the lake, depending on what equipment you are using, 1) LaMotte sampler procedures; 2) Vertical sampler procedures and 3) Temperature probe procedures. All three sets of procedures are described below.**

**Specific Sampling Instructions:**

**LaMotte Sampler Procedures**

You will use a water sampler to retrieve water samples from different depths in order to develop a temperature profile of the lake. Samples will be collected at **one meter intervals down to 10 meters and every two meters thereafter** to the lake bottom.

1. Check to be sure that the thermometer is firmly inserted in its hole inside the LaMotte sampler and the scale is facing outward. If you use the same thermometer that you used in Sub-Task 3 to measure surface water temperature, remove the string and cork floats before firmly inserting the thermometer into its hole in the sampler. Please be sure to take care with the thermometer so you do not drop it or lose it in the water.
2. Close the bottle by placing the gray top securely on the bottle, being sure that the ropes are lined up correctly and not tangled. Then, snap the metal clip in place over the top. Be sure the clip sits evenly in the grooves and that the top is fastened properly
3. Hold the sampling bottle upright by the rope to be sure that all parts are aligned. Then, insert the stopper into the larger center hole at the top of the sampler. Be sure it is firmly in place, but not too firm. You want the stopper to come out when you jerk on the rope, but not before.
4. **Slowly** lower the water sampling bottle to the desired depth. Count out the meter marks as you lower the sampler to the desired depth. Watch carefully to be sure that no bubbles begin to rise indicating that the stopper has come out. Also, watch to see if the rope is close to vertical in the water. It should be vertical in order for you to collect water from the correct depth.
5. When the sampling bottle reaches the desired depth, give the rope a short sharp jerk to release the stopper. You should observe bubbles rising to the

surface within a few seconds. If no bubbles appear, try tugging the rope again but more sharply.

6. Hold the rope at the desired depth until the bubbles stop rising. It may take a minute or more. It helps to jiggle the rope up and down slightly to help the air escape. Wait **about one minute more** to be sure that the bottle is full and the temperature has stabilized.
7. Pull up the water sample **quickly** and read the thermometer **as quickly as possible** without opening the bottle.
8. Record the temperature and depth on the data sheet.
9. Repeat this procedure until you have measured the water temperature at all the depths indicated on the data sheet.

### Vertical Sampler Procedures

1. Check the thermometer that is permanently attached to the inside of your sampler. See if there are any gaps in the red liquid inside the thermometer. Also, please compare the temperature reading of this thermometer with the temperature shown by the separate thermometer you use for measuring surface temperature. Do this by drying the second thermometer and dangling it inside the sampler for about two minutes. The two thermometers should read within 0.5 degrees Celsius. If there are any gaps in the attached thermometer, or if it reads more than 0.5 degrees different from the other thermometer, please perform Steps 2 through 4 and then follow the alternative method in Step 6 below to measure the temperature profile.
2. Prepare the water sampler by pulling the top rubber ball (with the loop) out of the tube. Using one hand to depress the copper rod, simultaneously insert the loop into the hole near the bottom of the white block. Release the copper rod to catch the loop. Then, pull out the bottom ball (with the clip) and clip the brass shackle around both sides of the loop you just inserted in the white block. Make sure the wires are secure. Be careful; do not pinch your hands or fingers. Close the white clip valve on the discharge tubing.
3. Hold the round brass messenger in one hand and slowly lower the water sampler to the desired depth. Count out the meter marks on the rope as you lower the sampler.
4. When the water sampler has reached the desired depth, **wait at least one minute** for water from that depth to fill the sampler and for the temperature to stabilize. Then, while holding the rope vertically, release the messenger to slide down the rope. Wait for a slight tug on the rope indicating that the sampler has snapped shut. Then, pull up the water sample **quickly**.

5. Set the full sampler down in the boat, with the top end up. **As quickly as possible** read the temperature of the attached thermometer through the clear sampler, being sure to note the temperature to the nearest ½ degree (the smallest marks on the thermometers).
6. Alternative method: If you are using the second (non-attached) thermometer, open the top of the sampler as soon as you get it into the boat and quickly drop the thermometer inside. Be sure not to drain the water out of the sampler. Wait a full two minutes. Take the thermometer out and read it as quickly as possible to the nearest ½ degree.
7. Record this temperature reading and depth on the data sheet.
8. Repeat this procedure until you have measured the water temperature at all the depths indicated on the data sheet.

#### Temperature Probe Procedures

1. Switch the dial on the instrument (if necessary) to Temperature C and lower the probe to the desired depth in the water column, counting the meter marks on the rope/cord as you lower the probe.
2. Once the probe has reached the desired depth, hold the rope/cord steady for approximately **one minute** to allow the temperature at that depth to stabilize on the probe display.
3. Once the temperature has stabilized, record that temperature and depth on the data sheet.
4. Repeat this procedure until you have measured the water temperature at all the depths indicated on the data sheet.

Sub-Task 5  
Sampling Procedures for MEASURING DISSOLVED OXYGEN PROFILES

**General Guidelines**

- **Dissolved oxygen (DO) will be measured at four or more depths in the lake. The near-surface sample can be collected by hand. The other samples require the use of a water sampler.**
- **Depending on the equipment you have to measure DO you will either need a chemical kit or a DO probe (if using a DO probe, follow the procedures for “Measuring Dissolved Oxygen Profiles with a DO Meter” located at the end of the chemical kit procedures).**
- **The chemical kit employs a titration method. Titration is simply dripping a precisely measured amount of chemical into a solution until you achieve a chemical reaction. Because the titration requires you to be very precise, you will test a duplicate sample from one of the depths as a check on your precision.**
- **Remember to wear safety glasses and plastic gloves when performing these tests, both at home and in the boat.**

**Specific Sampling Instructions:**

Collecting and Fixing A Dissolved Oxygen Sample from the Water Surface

1. Before beginning the sampling, select one of the four depths (surface, 3 meters, 6 meters or near bottom) for performing the duplicate testing. The first month that you measure DO, choose any one of the depths for the duplicate. In each following month, rotate the depth at which the duplicate test is performed.
2. Remove the cap from the small clear water sampling bottle labeled #A. Reach into the lake and thoroughly rinse the bottle and cap **twice** with the water to be sampled. Be careful not to let the bottle slip from your hand.
3. Tightly cap the bottle and submerge it with both hands to a depth of about **6 inches**. Holding the bottle under water, remove the cap and allow the bottle to fill.
4. Tap the sides of the submerged bottle several times underwater to dislodge any air bubbles trapped inside. Replace the cap while the bottle is still submerged.

5. Pull the bottle out of the water. Examine it carefully to ensure that no air bubbles are trapped inside. If there are, repeat steps 3 and 4 to get an acceptable sample.
6. If you are duplicating the near-surface sample, repeat steps 2-5 with the sample bottle marked “**Dupe**”. Then, complete steps 7-13 on both bottles simultaneously.
7. Place the sampling bottle on a flat surface in your boat and remove the cap. Add **8 drops** of **Manganous Sulfate Solution** (the pink Chemical #1) to the sample. (Remember to hold the chemical reagent bottle vertically upside-down and squeeze **gently**.) Cap the chemical bottle before going to Step 8.
8. Add **8 drops** of the **Alkaline Potassium Iodide Solution** (clear Chemical #2) to the sample. Again, cap the chemical bottle.

Note: The Manganous Sulfate and Alkaline Potassium Iodide are added in excess. So, if you accidentally dispense 9 or 10 drops, it’s OK. Do not start over. But you must put the Manganous Sulfate in first.

9. Cap the bottle labeled #A and mix by inverting gently several times. Set the bottle back down and allow the precipitate that has formed to settle below the shoulder of the bottle. This takes 4 to 5 minutes.
10. Invert the bottle several times again and allow the precipitate to settle below the shoulder again. This will take another 4 to 5 minutes.
11. Uncap the sample bottle and use the white measuring spoon to add **1 gram** of **Sulfamic Acid Powder** to the sample. This is **one level spoonful**. Cap the sample bottle and shake gently to mix. Continue mixing several minutes until the chemical and the precipitate have completely dissolved. The sample will now look clear yellow to brown-orange. (The Sulfamic Acid Powder is also added in excess. So, if you drop a few crystals, it is not critical. While adding the powder and other chemicals, be careful not to introduce air bubbles into the sample.)
12. Check to see if all of the precipitate is dissolved. Sometimes all of the grains of acid do not dissolve and bits of organic matter or sediment in the water may not dissolve. That’s OK. Continue with the test.
13. The sample is now “fixed”. Take the bottle back to your home to complete the rest of the steps of the titration. However, **do not wait more than 8 hours to complete the test**. You also no longer have to worry about adding air bubbles to the sample.

## Collecting and Fixing Additional Samples

Using the LaMotte Sampler:

14. Place the glass sampling bottle marked #B in its holder inside the LaMotte sampler and close the sampler carefully as described in Sub-Task 4. Be sure the tubing is positioned inside the glass sample bottle. Then, lower the LaMotte sampler and retrieve a sample of water from **3 meters** deep. Check to be sure that all the bubbles escape from the sampler before pulling the sampler back into the boat. Keep the sampler vertical and check to be sure that the water level is above the top of the small dissolved oxygen bottle. Carefully remove the metal clip. Be sure the rope is out of the way so that the metal clip will open all the way out.
15. Reach in and grasp the dissolved oxygen bottle by the neck and lift it out of the sampler **slowly**. Place the bottle on a flat surface to perform the testing. Go back and repeat steps 7-13 to “fix” the dissolved oxygen sample.
16. Repeat steps 14 and 15 and 7-13 to collect and fix a sample from **6 meters** deep (#C). Also, repeat this process for **1 meter above the bottom** (#D) and for the **duplicate (Dupe)**.

Using the Vertical Sampler:

17. Use the vertical sampler to retrieve a sample of water from **3 meters** deep. Be sure that the white clip valve is closed on the discharge tube.
18. After retrieving the sampler, place the discharge tubing into the empty glass sampling bottle marked #B. Release the white clip and pull slightly on the upper ball (or open the white stopper on the side of the sampler) to let in air and allow the water to flow out of the sampler. Rinse the bottle and the cap **twice** with the sample water and discard the water.
19. Insert the discharge tubing **all the way to the bottom** of the sampling bottle. **Slowly** release water to fill the bottle without introducing air into the sample. The end of the tubing should not rise above the level of the water in the bottle during filling. As the water begins to overflow the bottle, slowly withdraw the tubing while continuing to release water. When you are finished, the sample bottle should be completely full with no air bubbles. Tap the sides to be sure. If air bubbles are present, empty the bottle and try again.
20. Repeat steps 7-13 to add the chemical reagent and “fix” the sample. Take the fixed sample back to your house to complete the titration.

21. To collect water samples from **6 meters** (bottle #C) repeat steps 17-19. Then repeat steps 7-13 to fix the samples. Repeat this process for the sample from **1 meter above the bottom** (#D) and **duplicate** (Dupe) samples.

Complete the Dissolved Oxygen Titration (back in your home)

22. Set the sample bottles and the chemical kit on a large flat surface. A kitchen counter is great. Work over the sink when dispensing chemicals. Do not contaminate the food preparation area. You may want to lay out a newspaper underneath to absorb any spills.
23. Remove the plastic top from the glass test tube. Pour **20 ml** of the fixed sample from sample bottle **#A** into the glass test tube. The amount of sample you pour into the test tube is critical. Make sure that the **bottom** of the meniscus is even with the white 20 ml line. (A meniscus is the concave curve that forms at the top of a liquid when it is in a tube).
24. Replace the plastic top on the test tube. Be careful not to tip over the test tube. If you do, there will still be enough fixed sample in the sample bottle to refill the test tube.
25. Fill the syringe with tap water to lubricate it. Expel the water from the syringe. Pump and shake the syringe to remove all the water droplets. Then, fill the syringe to the "0" mark with **Sodium Thiosulfate Solution** (the larger clear chemical #4). Do this by pushing the tip of the syringe into the Sodium Thiosulfate Solution bottle and inverting the bottle. **Slowly** withdraw the plunger until the tip of the black syringe plunger is even with the "0" mark. (If an air bubble gets into the syringe, just push the chemical back out until the bubble escapes. Then, continue filling the syringe.
26. Insert the filled syringe into the cap of the glass test tube containing 20 ml of the sample. **Add 1 drop** of Sodium Thiosulfate to the test tube. **Swirl** the test tube to mix the solution. Add another drop of Sodium Thiosulfate and swirl the tube. Continue this titration process **one drop at a time** until the color of the solution **just begins** to fade or get lighter. It will probably be a light yellow.
27. For the moment, set aside the syringe with Sodium Thiosulfate. **DO NOT empty the syringe.**
28. Add **8 drops** of **Starch Indicator Solution** (dark chemical #5) to the test tube. (Insert the dropper into the hole of the top of the test tube). Swirl the tube to mix. The solution should turn from yellow to dark blue. (Exactly when and how much Starch Indicator to add is not critical, as long as the sample turns blue. The Starch Indicator serves to amplify the color change

indicating when the dissolved oxygen has been completely used up. Use the Starch Indicator in the sink because it may stain).

29. Now, with the remaining Sodium Thiosulfate still in the syringe, continue the titration process. Add **one drop** at a time to the sample and swirl after each drop to mix the solution. Refill the syringe with Sodium Thiosulfate as described in step 25 if needed. Continue until the sample solution turns from **blue to clear**. Then **STOP**. Holding the test tube over a white sheet of paper is helpful in determining when the blue color disappears. (The amount of titration is critical. So, proceed slowly, swirling after each drop. The initial change to a clear solution is the stopping point. If the solution turns back to blue, ignore it).
30. Use the scale on the side of the syringe to determine the dissolved oxygen content of the water sample in milligrams per liter (mg/L). Read the number on the scale directly opposite the bottom of the black plunger tip. Each line on the scale equals 0.2 mg/L. If you had to refill the syringe for more Sodium Thiosulfate, add the number of mg/L that you read from the second syringe to the 10 mg/L that you used in the first syringe to get the total amount of dissolved oxygen. (As you will see, if the oxygen content is low, only a small amount of Sodium Thiosulfate is needed to complete the titration. If the oxygen content is high, more Sodium Thiosulfate is needed.)
31. Record the results in the appropriate blank on the data sheet.
32. Empty the contents of the test tube into a container with kitty litter. Do not flush into a septic system. Rinse the test tube with distilled water and dry. Empty the remainder of the Sodium Thiosulfate from the syringe into the kitty litter container. (If the container is large enough, keep it for several months testing. Then, seal the container, wrap in a plastic bag, and dispose in the regular garbage).
33. Repeat steps 22-32 on each of the remaining “fixed” samples, recording the results on the data sheet for 3 meters (#B), 6 meters (#C), 1 meter above the bottom (#D), and Dupe. Clean the sink and counter area, the test tube, and all of the sample bottles. Store the dissolved oxygen kit away.

#### Measuring Dissolved Oxygen Profiles with a DO Meter

1. (Be sure the DO meter has been properly calibrated prior to its use.) Switch the dial on the instrument (if necessary) to Dissolved Oxygen (mg/L) and lower the DO probe into the lake, keeping the rope/cord vertical. Lower the probe until it is at **1 meter** depth.
2. Keep the probe at the desired depth for at least a minute to allow for the meter to stabilize.

3. Record the DO reading on the display in mg/L and the depth on the data sheet.
4. If you have time, repeat at 1 meter intervals all the way to the bottom of the lake. At a minimum, repeat for depths of **3 meters, 6 meters, and 1 meter above the bottom** of the lake.

**Sub-Task 6**  
**Sampling Procedures for MEASURING pH PROFILES**

**General Guidelines**

- **Volunteers should only measure pH profiles in their lakes if they have received the proper equipment and training from Snohomish County staff.**
- **At a minimum, pH measurements will be taken near the water surface, at 3 meters, at 6 meters and/or 1 meter from the bottom of the lake.**

**Specific Sampling Instructions:**

1. (Be sure the pH meter has been properly calibrated prior to its use.) Lower the pH probe into the water column approximately 6 inches below the surface of the lake to take the pH measurement at the water surface.
2. Hold the rope/cord on the probe vertical in the water column to ensure the probe is at the desired depth and to help in the accuracy of the measurement.
3. Wait for at least one minute for the pH meter to stabilize.
4. Record the pH measurement from the probe display (to the nearest 0.1 unit) and the depth on the data sheet.
5. Repeat this procedure for depths of 3 meters, 6 meters, and/or 1 meter from the bottom of the lake. Use the meter marks on the rope/cord to locate the desired depth. Measurements may be taken at more frequent intervals, such as every meter, if desired.

**Sub-Task 7**  
**Sampling Procedures for MEASURING CONDUCTIVITY PROFILES**

**General Guidelines**

- **Volunteers should only measure conductivity profiles in their lakes if they have received the proper equipment and training from Snohomish County staff.**
- **At a minimum, conductivity measurements will be taken near the water surface, at 3 meters, at 6 meters and/or 1 meter from the bottom of the lake.**

**Specific Sampling Instructions:**

1. (Be sure the conductivity probe has been properly calibrated prior to its use.) Lower the conductivity probe into the water column approximately 6 inches below the surface of the lake to take the conductivity measurement at the water surface.
2. Hold the rope/cord on the probe vertical in the water column to ensure the probe is at the desired depth and to help in the accuracy of the measurement.
3. Wait for at least one minute for the conductivity meter to stabilize.
4. Record the conductivity measurement from the probe display (to the nearest whole number) and the depth on the data sheet.
5. Repeat this procedure for depths of 3 meters, 6 meters, and/or 1 meter from the bottom of the lake. Use the meter marks on the rope/cord to locate the desired depth. Measurements may be taken at more frequent intervals, such as every meter, if desired.

**Sub-Task 8**  
**Sampling Procedures for TOTAL PHOSPHORUS (TP)**

**General Guidelines**

- **If collecting field duplicates for TP, as instructed by Snohomish County staff, please follow the procedures in Sub-Task 9 titled “Sample Procedures for Collecting Field Duplicates of Total Phosphorus” located immediately following these procedures.**
- **Please conduct your regular monitoring and temperature/dissolved oxygen profiles on the same day that you collect samples for TP. Make sure you conduct all other monitoring (except chlorophyll *a*) before you collect the TP samples.**
- **Before taking the TP samples, be sure you know the depth of the lake at the sampling site. This is important because the hypolimnion sample should be taken about 1 to 1.5 meters above the bottom of the lake.**
- **Do not measure the lake depth when you collect the TP sample. The bottom sediments could be stirred up and are likely to contaminate the sample. You should know the lake depth at the sampling site from previous trips.**
- **Please try to use the same depths for each time you collect samples for TP, so it is important to return to the same sampling spot each month.**
- **Bring a small cooler containing cold packets or ice with you in the boat to store the samples.**
- **Also, follow these procedures for collecting Soluble Reactive Phosphorus (SRP) samples. SRP samples must be taken to the lab for filtration within 24 hours of collection.**

**Specific Sampling Instructions:**

1. Prior to going out on the lake, please label the two sample bottles with the **date** and approximate **time** of the sample collection. Also, add the **lake name** and the **depth** of the sample on each bottle next to SAMPLE ID:

For example, your two bottles should be labeled like this:

Bottle 1:  
SAMPLE ID: Lake Armstrong—1 meter  
DATE: 12/2/02 TIME: 11:00 am

Bottle 2:  
SAMPLE ID: Lake Armstrong—7 meters  
DATE: 12/2/02 TIME: 11:30 am

2. After anchoring your boat at the sampling location, open the LaMotte or vertical sampler and rinse it thoroughly **3** times with lake water.
3. Prepare the samplers: the LaMotte sampler should be closed with the stopper in place but **without** a bottle inside; for the vertical sampler, be sure the hoops are hooked open properly and the clip on the discharge tubing is closed. Lake water will be collected in a sampler and then poured into the sample bottles.
4. Lower the sampler to a depth of **1 meter** below the water surface of the lake and collect a water sample.
5. Rinse the bottle labeled “**Your Lake Name--1 meter**” and the bottle cap **3** times with the water collected from the lake at the sampling depth. Be careful not to touch the inside of the cap or bottle with your hands.
6. Fill the “**1 meter**” bottle with the remaining water in the sampler and cap the bottle. If there is not enough water left to completely fill the bottle, you will need to lower the sampler again to **1 meter** and take another water sample to fill the bottle.
7. Place the full “**1 meter**” bottle in the cooler.
8. Rinse the LaMotte or vertical sampler again **3** times with surface water from the lake.
9. In the same manner used to collect the “1 meter” sample, collect a sample from **1 meter above the bottom** of the lake.
10. Check to see if the sample collected is cloudy with sediments. If it is, discard the sample, rinse the sampler again, and collect a sample from the other side of the boat.
11. With water from the near-bottom sample, rinse the second bottle (labeled according to the depth of your lake) and the bottle cap **3** times.
12. Fill the second bottle with the remaining water in the sampler and cap the bottle. If there is not enough water left to completely fill the bottle, you will need to lower the sampler again to **1 meter above the bottom** of the lake and take another water sample to fill the bottle.
13. Place the full sample bottle in the cooler.

14. Rinse the sampler with surface water and allow to air dry.
15. Refrigerate the two samples immediately upon returning to your home.
16. Fill out the **Chain of Custody** form at the places marked with an asterisk \*. At the top, please write the **date of the sampling** and **your name**. Under the heading "Sample ID" on the left, write the **lake name** and **depth** just as it appears on each bottle. Then, write in the **date** and **time** for the two samples just as you wrote them on the bottles. Finally, **print and sign your name** in the spaces near the bottom of the sheet and enter the **date and time** that you will set out the samples for pick-up.
17. On **Pick-Up-Day**, bright and early, place your samples in a **cooler**, with ice or cold packs, the Chain of Custody form, and your regular sampling form, and leave it on your front porch to be picked up by us. (Or call us at 425-388-3464 x4640 or x4563 to make other arrangements) Make sure the forms are in a zip-loc bag.

**Sub-Task 9**  
**Sampling Procedures for COLLECTING FIELD DUPLICATES OF TOTAL PHOSPHORUS (TP)**

**General Guidelines**

- **If you are instructed by Snohomish County to collect field duplicates of TP this month, follow these procedures; if not, follow the procedures titled, “Sampling Procedures for Total Phosphorus” located on the previous pages.**
- **Please conduct your regular monitoring and temperature/dissolved oxygen profiles on the same day that you collect samples for TP.**
- **Make sure you conduct all other monitoring (except chlorophyll *a*) before you collect the TP samples.**
- **Be sure you know the depth of the lake at the sampling site. This is important because the hypolimnion sample should be taken about 1 to 1.5 meters above the bottom of the lake.**
- **Do not measure the lake depth when you collect the TP sample. The bottom sediments could be stirred up and are likely to contaminate the sample. You should know the lake depth at the sampling site from previous trips.**
- **Please try to use the same depths for each time you collect samples for TP, so it is important to return to the same sampling spot each month.**
- **Bring a small cooler containing cold packets or ice with you in the boat to store the samples.**

**Specific Sampling Instructions:**

1. Prior to going out on the lake, please assemble four sample bottles. On these four bottles write the **date** and the approximate **time** you plan to take the samples. Then, label one bottle with a SAMPLE ID of your lake name and 1 meter. Label the second bottle with your lake name and 1 meter duplicate. The sample IDs should read, for example, “Lake Armstrong—1 meter” and “Lake Armstrong—1 meter DUPE”. Label the third and fourth bottles for the appropriate depth of approximately one meter above the bottom; for example, “Lake Armstrong—7 meters” and “Lake Armstrong—7 meters DUPE”.
2. After anchoring your boat at the sampling location, open the LaMotte or vertical sampler and rinse it thoroughly **3** times with lake water. Then, pull out the two sample bottles labeled for the near-surface sample, for example, “**Armstrong—1 meter**” and “**Armstrong—1 meter dupe**”. It is **extremely important** that you use the bottles in pairs exactly as described on this sheet.

3. Prepare the samplers: the LaMotte sampler should be closed with the stopper in place but **without** a bottle inside; for the vertical sampler be sure the hoops are hooked open properly and the clip on the discharge tubing is closed. Lake water will be collected in a sampler and then poured into the sample bottles.
4. Lower the sampler to a depth of **1 meter** below the water surface of the lake and collect a water sample.
5. Rinse **both** bottles and the bottle caps **3** times with the water collected in the sampler. Be careful not to touch the inside of the caps or bottles with your hands.
6. Tip the sampler back and forth a couple of times to mix the water in the sampler.
7. **Slowly fill both bottles simultaneously** with the remaining water in the sampler. Do this by letting a small amount of water flow into the first bottle and then switching the drain tube to the second bottle to add a small amount. Switch back and forth between the sample bottles until they are both full. You should move the drain tube back and forth between the two bottles at least 7 or 8 times to be sure that the two samples are as close to being duplicates as possible. If there is not enough water in the sampler to rinse and completely fill both bottles, you will need to rinse with the first sample and grab a second sample from **1 meter** to fill the two bottles.
8. Cap both bottles and place them in the cooler.
9. Take out the bottles for the near-bottom sample labeled, for example, **“Armstrong—7 meters”** and **“Armstrong—7 meters dupe”**. Rinse your sampler **3** times again with water from the lake surface and then collect a sample from **1 meter above the bottom** of the lake. Follow the procedures in **Steps 5-8 exactly** to rinse and fill both bottles simultaneously with water from near the lake bottom. If the sample is cloudy with sediments, take the sample again from the other side of the boat.
10. Refrigerate all four samples immediately up returning to your home.
11. Fill out the **Chain of Custody** form at the places marked with an asterisk \*. At the top, please write the **date of the sampling** and **your name**. Under the heading “Sample ID” on the left, write the **lake name** and **depth** just as it appears on each bottle. Then, write in the **date** and **time** for the four samples just as you wrote them on the bottles. Finally, **print and sign your name** in the spaces near the bottom of the sheet and enter the **date and time** that you will set out the samples for pick-up.

- 12.** On **Pick-Up-Day**, bright and early, place your samples in a **cooler**, with ice or cold packs, the Chain of Custody form, and your regular sampling form, and leave it on your front porch to be picked up by us. (Or call us at 425-388-3464 x4640 or x4563 to make other arrangements) Make sure the forms are in a zip-loc bag.

**Sub-Task 10**  
**Sampling Procedures for CHLOROPHYLL-*a* (ALGAE)**

**General Guidelines**

- **If collecting field duplicates for chlorophyll-*a*, as instructed by Snohomish County staff, please follow the procedures titled “Sample Procedures for Collecting Field Duplicates of Chlorophyll-*a*” in Sub-Task 11 located immediately following these procedures.**
- **Chlorophyll-*a* samples are good only a short time, so it is important to collect the samples on Saturday or Sunday of the designated weekend for pick-up the following Monday.**
- **Please also conduct your regular monitoring, including temperature/dissolved oxygen profiles and TP on the same date.**
- **Conduct your regular monitoring and TP sample collection BEFORE you collect the chlorophyll-*a* samples.**
- **Bring a small cooler containing a cold packet or ice with you in the boat to store the samples.**

**Specific Sampling Instructions:**

1. Prior to going out on the lake, please label the large one-liter sample bottle with the **date** and approximate **time** you will be collecting the sample. Also, next to “SAMPLE ID” write the **lake name** and “1 meter”.

For example, the bottle label should look like this:

SAMPLE ID Lake Armstrong—1meter  
DATE: 12/2/02 TIME: 11:00 am

2. **DO NOT RINSE** the sample bottle. The bottle contains a small amount of liquid—Magnesium carbonate—which is used to preserve the chlorophyll-*a* in the sample. **DO NOT POUR OUT** the liquid. If by accident you empty or dilute this preservative, discard the sample bottle and use another 1 liter sample bottle.
3. After you have completed all of your regular monitoring and TP sample collection, open the LaMotte or vertical sampler and rinse it again thoroughly **3** times with water from the lake surface.
4. Lower the sampler and collect a water sample at **1 meter** depth.

5. Fill the bottle (**do not rinse**) to about  $\frac{1}{4}$  to  $\frac{1}{2}$  inch from the top. Be careful not to touch the inside of the cap or bottle with your hands. If there is not enough water in your sampler to fill the bottle, you will need to lower the sampler again to **1 meter** and collect another water sample to fill the bottle.
6. Replace the cap on the sample bottle and **immediately** place the bottle in the cooler. It is extremely important to keep the chlorophyll-*a* sample **cold and in the dark** until it reaches the laboratory. The chlorophyll-*a* measurement can change dramatically if the sample sits in sunlight at air temperature in your boat for even a few minutes.
7. As soon as you return to shore, please place the chlorophyll-*a* sample (as well as your TP samples) in the refrigerator until Monday pick-up. (**Do not** put the samples in the freezer, because freezing will damage the samples and change the results).
8. Fill out the **Chain of Custody** form for both chlorophyll-*a* and TP samples. At the top, please write the **date** of sampling and **your name**. Under the heading "SAMPLE ID" on the left, write the **lake name** and **depth** just as it appears on each bottle. Then write the **date** and **time** for the samples just as you wrote them on the bottles. Finally **print and sign your name** in the spaces near the bottom of the sheet and enter the **date** and **time** that you will set out the samples for pick-up.
9. On **Pick-Up-Day**, bright and early, place your samples in a **cooler**, with ice or cold packs, the Chain of Custody form, and your regular sampling form, and leave it on your front porch to be picked up by us. (Or call us at 425-388-3464 x4640 or x4563 to make other arrangements) Make sure the forms are in a zip-loc bag.

**Sub-Task 11**  
**Sampling Procedures for COLLECTING FIELD DUPLICATES OF**  
**CHLOROPHYLL-*a* (ALGAE)**

**General Guidelines**

- **If you are instructed by Snohomish County to collect field duplicates of chlorophyll-*a* this month, follow these procedures; if not, follow the procedures titled, “Sampling Procedures for Chlorophyll-A” located on the previous pages.**
- **Chlorophyll-*a* samples are good only a short time, so it is important to collect the samples on Saturday or Sunday of the designated weekend for pick-up the following Monday.**
- **Please also conduct your regular monitoring, including temperature/dissolved oxygen profiles and TP on the same date.**
- **Conduct your regular monitoring and TP sample collection BEFORE you collect the chlorophyll-*a* samples.**
- **Bring a small cooler containing a cold packet or ice with you in the boat to store the samples.**

**Specific Sampling Instructions:**

1. Prior to going out on the lake, please find the two one-liter sample bottles that are already labeled with the name of your lake. The labels should read, for example, “**Armstrong—1 meter**” and “**Armstrong—1 meter dupe**”. On these bottles, write the **date** and the approximate **time** you plan to take the samples.
2. **DO NOT RINSE** the sample bottles. The bottles contain a small amount of liquid—Magnesium carbonate—which is used to preserve the chlorophyll-*a* in the sample. **DO NOT POUR OUT** the liquid. If by accident you empty or dilute this preservative, discard the sample bottle and use another 1 liter sample bottle.
3. After you have completed all of your regular monitoring and TP sample collection, open the LaMotte or vertical sampler and rinse it again thoroughly **3** times with water from the lake surface.
4. Lower the sampler to a depth of **1 meter** below the water surface of the lake and collect a water sample.
5. Tip the sampler back and forth a few times to mix the water in the sampler.

6. **Slowly fill both bottles simultaneously** with the water in the sampler. Do this by letting a small amount of water flow into the first bottle and then switching the drain tube to the second bottle to add a small amount. Switch back and forth between the sample bottles until they are both full. You should move the drain tube back and forth between the two bottles at least 15 to 20 times to be sure that the two samples are as close to being duplicates as possible. Be sure not to touch the inside of the cap or bottle with your hands. Fill the bottles up to about  $\frac{1}{4}$  to  $\frac{1}{2}$  inches from the top. If there is not enough water in the sampler to completely fill both bottles, you will need to grab a second sample from **1 meter** and continue filling both bottles simultaneously.
7. Cap these two bottles **immediately** and place them in the cooler. It is extremely important to keep the samples **cold and in the dark**.
8. As soon as you return to shore, please place the chlorophyll-*a* samples (as well as your TP samples) in the refrigerator until Monday pick-up. (**Do not** put the samples in the freezer, because freezing will damage the samples and change the results).
9. Fill out the **Chain of Custody** form for both chlorophyll-*a* and TP samples. At the top, please write the **date** of sampling and **your name**. Under the heading "SAMPLE ID" on the left, write the **lake name** and **depth** just as it appears on each bottle. Then write the **date** and **time** for the samples just as you wrote them on the bottles. Finally **print and sign your name** in the spaces near the bottom of the sheet and enter the **date** and **time** that you will set out the samples for pick-up.
10. On **Pick-Up-Day**, bright and early, place your samples in a **cooler**, with ice or cold packs, the Chain of Custody form, and your regular sampling form, and leave it on your front porch to be picked up by us. (Or call us at 425-388-3464 x4640 or x4563 to make other arrangements) Make sure the forms are in a zip-loc bag.

**Sub-Task 12**  
**Procedures for OBSERVING LAKE AND WATERSHED CONDITIONS**

**General Guidelines**

- **Remember to retrieve your boat anchor when you are finished with all of your monitoring and sample collection.**

**Specific Sampling Instructions:**

1. After you have retrieved your anchor, please row, paddle or motor around part or all of the lake to look for conditions that might affect water quality. If you see floating algae, muddy water, large new growths of aquatic plants, or other things of interest, please note them on the appropriate place on the data sheet.
2. Also, please observe current activities in the watershed, such as land clearing or recent ditch erosion, and describe them on the data sheet. If you believe an activity to be illegal or you see a water quality condition of serious concern, please contact Snohomish County staff.

**Sub-Task 13**  
**Sampling Procedures for MEASURING AIR TEMPERATURE AND LAKE**  
**LEVEL**

**General Guidelines**

- **If it is more convenient, you can take these measurements before you go out in the boat to conduct your monitoring. In any case, make sure to take the air temperature and lake level during the same part of the day that you perform the lake monitoring.**

**Specific Sampling Instructions:**

1. Dry the thermometer and hang it on a tree or bush out of the direct sun and away from any large objects that can radiate heat.
2. Wait two to three minutes to allow the thermometer to stabilize at the correct temperature.
3. Read the thermometer and record the value on the data sheet to the nearest  $\frac{1}{2}$  degree C.
4. Using a tape measure or yardstick, measure the distance between the permanent mark on your dock and the water surface. (County staff will help you locate a permanent mark from which to measure).
5. Record the distance from the mark down to the water in inches on the data sheet.

## **TASK 7: STORE EQUIPMENT AND MAIL IN DATA SHEETS**

Once you have completed your lake monitoring activities for the day you will need to clean and dry the monitoring equipment. Then, store it in a dry spot. Make sure that fragile equipment, such as the thermometer, will not be crushed in the storage location. Please store thermometers in an upright position (including the vertical samplers which contain thermometers attached inside). This will prevent the liquid inside the thermometers from separating. Also, do not leave the vertical samplers in an open position because it will stretch the internal tubing and make the sampler difficult to close in the future.

Look over your data sheet and make sure it is complete. Copy your results onto one of the colored data sheets provided by Snohomish County. This will be a copy for you to keep for your own information and will serve as a back-up in case the original sheet gets lost in the mail. Enclose the original data sheet in one of the stamped envelopes and mail it to Snohomish County Surface Water Management. Please mail the data sheet without delay to avoid losing it or forgetting to mail it.

**Table A-1. Monitoring Schedule for Snohomish County Lake Monitoring Program.**

Lake	Observations*	Secchi Depth	Temperature Surface	Lake Level	Temperature Profile	Dissolved Oxygen Profile	pH Profile	Conductivity Profile	Phosphorus Total	Phosphorus Soluble Reactive	Chlorophyll a Phaeophytin	Monitor
Armstrong	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff— 1 visit)
Beecher	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep			Volunteer (Staff— 1 visit)
Blackman	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff— 1 visit)
Bosworth	Monthly Jun-Sep	Monthly Jun-Sep			Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep		Monthly Jun-Sep	Staff
Bryant	Annually in the Summer	Annually in the Summer			Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer		Annually in the Summer	Staff
Cassidy	Monthly Jun-Sep	Monthly Jun-Sep			Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep		Monthly Jun-Sep	Staff
Chain	Monthly Jun-Sep	Monthly Jun-Sep			Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep		Monthly Jun-Sep	Staff
Cochran	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff— 1 visit)

**Table A-1. Monitoring Schedule for Snohomish County Lake Monitoring Program.**

Lake	Observations*	Secchi Depth	Temperature Surface	Lake Level	Temperature Profile	Dissolved Oxygen Profile	pH Profile	Conductivity Profile	Phosphorus Total	Phosphorus Soluble Reactive	Chlorophyll a Phaeophytin	Monitor
Crabapple	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff—1 visit)
Echo	Monthly Jun-Sep	Monthly Jun-Sep			Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep		Monthly Jun-Sep	Staff
Flowing	Monthly Jun-Sep	Monthly Jun-Sep			Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep		Monthly Jun-Sep	Staff
Goodwin	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff—1 visit)
Howard	Monthly Jun-Sep	Monthly Jun-Sep			Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep		Monthly Jun-Sep	Staff
Kayak	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep			Volunteer (Staff—1 visit)
Ketchum	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep **Nov-Apr	Monthly **Nov-Apr	Monthly Jun-Sep	Volunteer (Staff—winter + 1 visit)
Ki	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff—1 visit)

**Table A-1. Monitoring Schedule for Snohomish County Lake Monitoring Program.**

Lake	Observations*	Secchi Depth	Temperature Surface	Lake Level	Temperature Profile	Dissolved Oxygen Profile	pH Profile	Conductivity Profile	Phosphorus Total	Phosphorus Soluble Reactive	Chlorophyll a Phaeophytin	Monitor
Loma	Monthly Jun-Sep	Monthly Jun-Sep			Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep		Monthly Jun-Sep	Staff
Lost	Monthly Jun-Sep	Monthly Jun-Sep			Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep		Monthly Jun-Sep	Staff
Martha N.	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff—1 visit)
Martha S.	Monthly Jun-Sep	Monthly Jun-Sep			Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep		Monthly Jun-Sep	Staff
Meadow	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep			Volunteer (Staff—1 visit)
Nina	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep			Volunteer (Staff—1 visit)
Panther	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff—1 visit)
Riley	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff—1 visit)

**Table A-1. Monitoring Schedule for Snohomish County Lake Monitoring Program.**

Lake	Observations*	Secchi Depth	Temperature Surface	Lake Level	Temperature Profile	Dissolved Oxygen Profile	pH Profile	Conductivity Profile	Phosphorus Total	Phosphorus Soluble Reactive	Chlorophyll a Phaeophytin	Monitor
Roesiger	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff—1 visit)
Rowland	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep			Volunteer (Staff—1 visit)
Ruggs	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep			Volunteer (Staff—1 visit)
Serene	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff—1 visit)
Shoecraft	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Annually in the Summer	Annually in the Summer	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff—1 visit)
Stickney	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff—1 visit)

**Table A-1. Monitoring Schedule for Snohomish County Lake Monitoring Program.**

Lake	Observations*	Secchi Depth	Temperature Surface	Lake Level	Temperature Profile	Dissolved Oxygen Profile	pH Profile	Conductivity Profile	Phosphorus Total	Phosphorus Soluble Reactive	Chlorophyll a Phaeophytin	Monitor
Storm	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff— 1 visit)
Sunday	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Bi-weekly May-Oct	Monthly May-Oct	Monthly May-Oct	Annually in the Summer	Annually in the Summer	Monthly Jun-Sep		Monthly Jun-Sep	Volunteer (Staff— 1 visit)
Wagner	Monthly Jun-Sep	Monthly Jun-Sep			Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep	Monthly Jun-Sep		Monthly Jun-Sep	Staff

\*Observations include: algae in water, algae scum, aquatic plants, cloud cover, water color, rain, wind, and waterfowl.

\*\*Inflowing streams only (by staff).