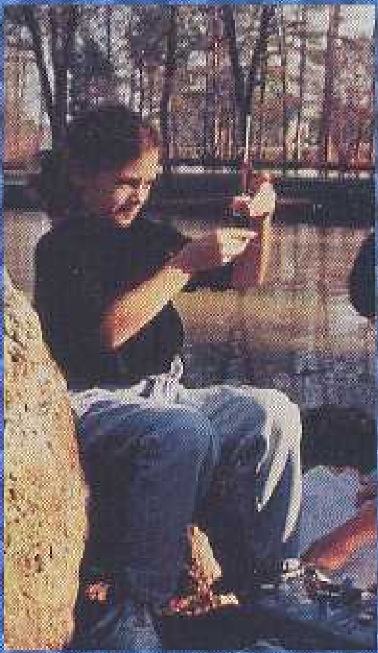
Alabama Water Watch

Water Chemistry Monitoring



In 1819, when Alabama entered the Union, its leaders designed a great seal that featured the state's waterways. In adopting this symbol, they affirmed their belief that the future of Alabama lay with its rivers. It did and it still does.

Harvey Jackson, III, ***Rivers of History***

Alabama Water Watch

1992-2002

Tenth Anniversary Edition

This workbook provides an introduction to the principles and practice of citizen-based water quality monitoring.

Workshop participants will be oriented to the mission and goals of Alabama Water Watch and get "hands-on" experience using a portable test kit to measure water quality of a stream or lake.

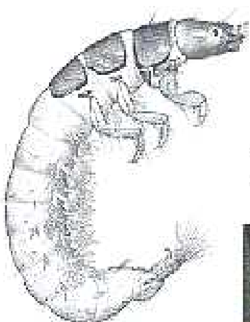
The Alabama Water Watch Program is funded, in part, by the Alabama Department of Environmental Management, Office of Education and Outreach and the U.S. Environmental Protection Agency, Region 4, through a Clean Water Act, Section 319 grant.

The Alabama Water Watch Logo

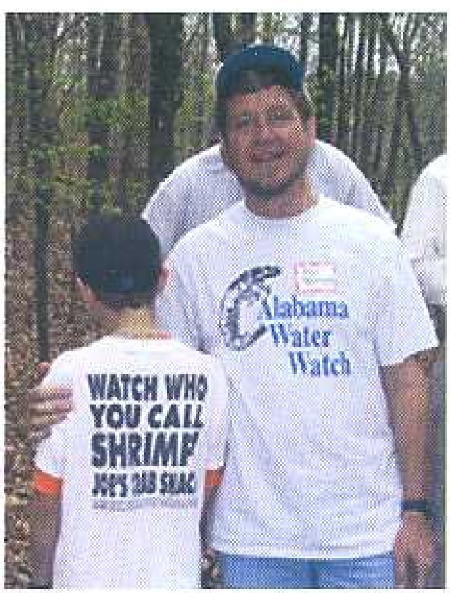
Our logo is an aquatic insect called a CADDISFLY. This particular caddisfly is named HYDROPSYCHE, and is an important member of stream communities throughout Alabama.

The name **Hydro*psyche** means **Water*Spirit**.

It is, therefore, a fitting symbol of the growing "spirit" of involvement, enthusiasm and concern for Alabama's water resources that citizens have shown through Alabama Water Watch.



It's not a shrimp...
it's a ***Water Spirit***!



The Flow of Alabama Water Watch

1992
- AWW Program begins

1993
- 1st AWW Workshop
- AWW Association forms
- 5 Active Groups

1994
- 1,000th data record received
- Data Quality Coordinator hired
- EPA approves chemistry protocols

1995
- *Outstanding Planning Project Award* (American Planning Association)
- 1st Training of Trainer Workshop
- AWWA Citizen Advisory Council formed

1996
- Monitor & Education Coordinators hired
- *E. coli* testing as a new parameter
- BIO-ASSESS©

1997
- *Environmental Education Organization of the Year* (Legacy, Inc.)
- *319 Success Story* (U.S. EPA)
- AWWareness Listserve

1998
- *Conservation Organization of the Year* (Alabama Environmental Council)
- 10,000th data record received
- AWW website

1999
- AWW *Living Downstream Video*
  - *Silver Telly Award*
  - *Videographer Award*
- 1st Volume of Reservoir Series
- EPA approves AWW bacteria protocols

2000
- AWW *Living Downstream Video*
  - *Communicator Award*
  - *Bronze Award* (Houston Film Festival)
- 2nd & 3rd Volumes of Reservoir Series
- 70 Active Groups

2001
- 20,000th data record received
- 1st & 2nd Volumes of Coastal Series
- Relational Database

2002
- 30th Anniversary of Clean Water Act
- 10th Anniversary of AWW

TABLE OF CONTENTS

ALABAMA WATER WATCH

Alabama Water Watch is a citizen volunteer, water quality monitoring program covering all of the major river basins of Alabama and watersheds shared with neighboring states.

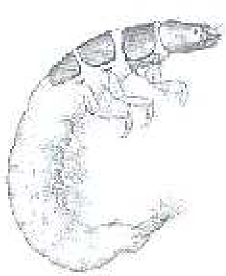
The goals of Alabama Water Watch are primarily accomplished by:

- **educating** citizens about water issues in Alabama and the world,
- **training** citizens to use standardized equipment and techniques to gather credible water information under strict quality assurance protocols,
- **challenging** citizens to make a positive impact and potentially improve both water quality and policy by actively participating in determining long-term water quality trends and specific problems that need attention.

ALABAMA WATER WATCH

PROGRAM

- University-based (Auburn University)
- Grants from ADEM/EPA Region 4
- Provides training resources, database and technical support



ASSOCIATION

- Incorporated, nonprofit, 501.c.3 organization
- Funded by grants and membership dues
- Supports program and monitors

CERTIFICATIONS

AWW offers several types of water quality monitoring certifications. Each certification carries Continuing Education Unit (CEU) credit with Auburn University.

Water Chemistry Certification for monitoring chemical characteristics of water.

Six water quality parameters are measured with a customized test kit: temperature, pH, dissolved oxygen, total alkalinity, total hardness and turbidity. These parameters form the core of the statewide, citizen database.

Bacteriological Monitoring for detecting concentrations of *E. coli* and other bacteria in water, as indicators of contamination.

Monitors are trained in bacteriological testing, water quality standards, plate techniques, bacterial counts, and site selection. Bacteriological monitoring information is compiled in the statewide, citizen database.

Bioassessment for assessing stream macroinvertebrate populations as pollution indicators.

Training combines the use of the game, BIO-ASSESS, field collection and evaluation of stream macroinvertebrate communities to assess the quality of a stream.

Recertification is conducted by the AWW Data Quality Coordinators or Citizen QA Officers. After monitoring for a year, Water Chemistry monitors are required to attend a Recertification Session to review techniques and procedures and replace chemicals or any broken equipment in their test kits.

Legacy

Legacy, Inc., Partners in Environmental Education, provides a grant to the AWW Association to cover part of the cost of chemical refills for active monitors.

One of the most important aspects of a citizen monitoring program is to **"keep the data credible"** through an effective Quality Assurance (QA) Program. A Quality Assurance/ Quality Control Manual for statewide Citizen Volunteer Water Quality Data was approved by the U.S. Environmental Protection Agency (EPA) in September 1994 (as one of the first statewide citizen data QA protocols in the U.S.).

Citizen monitoring groups who secure funding for water quality test kits are also encouraged to budget for annual chemical refills for each kit. Information for ordering AWW test kits and refills is found on page 79.

NOTE: All certifications will be confirmed by letter and a certification card from AWW. Please contact the office if you do not receive an official confirmation within 30 days after your workshop.

CONTINUING EDUCATION UNITS

CEUs are available for all workshops. You may obtain a CEU form from an AWW trainer or the AWW office. Forms should be completed and returned to the AWW office.

ON THE FRONT SIDE OF THE CEU FORM, ALL AREAS ARE TO BE COMPLETED EXCEPT FOR THE SECTIONS LABELED PROGRAM TITLE AND PROGRAM NUMBER.

Front

Auburn University Continuing Education Unit Registration

For CEU Transcript ordering instructions, see back

PLEASE PRINT CLEARLY

PROGRAM TITLE **Do Not Write** PROGRAM NUMBER **Do Not Write**

Name ______________________ Social Security Number ____________

Address ____

City ______________________________ State_____ Zip__________

Telephone: Home ( )__________ Business ( ) __________ Fax ( ) ______

Email: ______________________ Gender: ( )M ( )F

DO NOT WRITE BELOW THIS LINE

- -

APPROVED FOR CEU AWARD: ( ) YES ( ) NO By______________________

Program Chair

ONLY COMPLETE THE BACK SIDE IF YOU WISH TO GET A COPY OF YOUR TRANSCRIPT. A TRANSCRIPT COSTS $5.00.

Back

CEU Transcript Order Form

Approved participants of Auburn University continuing education activities are eligible to receive the continuing education unit (CEU) award stated for each program. All approved CEU awards are filed in each participant's continuing education record.
To order an official CEU transcript of your CEU award record, complete the following information:

FEDERAL LAW REQUIRES COMPLETION OF BELOW BEFORE TRANSCRIPT CAN BE RELEASED.

__ Yes, I authorize the release of my CEU transcript to the address listed below. I understand there is a $5.00 per copy charge which will be billed to me, payable immediately upon receipt.

__ Number of transcripts requested Signature ______________ Date __________

Send to (**PLEASE PRINT CLEARLY**): ______________________

____

____

____

( ) This is a business address

BECOMING A TRAINER

Experienced citizen monitors may complete additional **Training of Trainer Workshops:**

- **Water Chemistry Trainer** - to conduct Water Chemistry Certification workshops
- **Bacteriological Trainer** - to conduct Bacteriological Monitoring workshops
- **Bioassessment Trainer** - to conduct Bioassessment workshops
- **QA Officer** - to conduct Recertification Sessions

In order to become an AWW Trainer, you should:

- Attend an AWW Water Chemistry Certification workshop, and become certified in the workshop(s) in which you will be a trainer.
- Actively monitor (regularly submit data forms to the AWW Program for at least one year prior to becoming a trainer).
- Receive a recommendation from an AWW Certified Trainer.
- Commit to conducting at least two workshops per year in your area or statewide.
- Coordinate all workshops with the AWW Program Office and maintain regular contact for updates, advice and needs.

Exceptions to these requirements are at the discretion of the AWW Program Office.

All trainers are required to attend **Trainer Refresher Courses** at least once every two years to keep their certifications active.

Many AWW citizen groups have Certified Trainers and QA Officers among their members, so that training workshops and recertification sessions are easier to schedule in their area.

THE WATER ENVIRONMENT

The World's Water Supply

- If all the Earth's water fit into a **one liter** container or 1000mL, **970 mL** of the container would be saltwater.

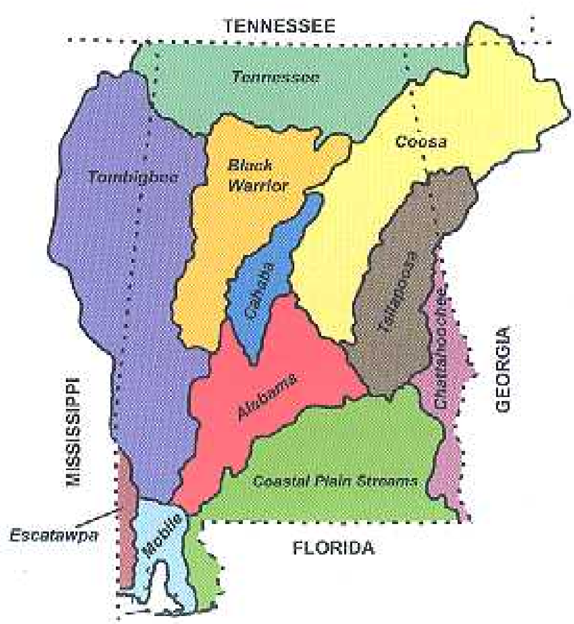
- Only **2 drops** of freshwater would be in lakes and rivers!

- **30 mL** (nail polish container) would be freshwater which is in the atmosphere, polar ice caps, and groundwater.

What is a Watershed?

A **watershed** is the total land area that drains to a common point, such as a river, a lake or the ocean. Watersheds come in many sizes.

Very large watersheds are also called **drainage basins**. For example the Alabama, Black Warrior, Cahaba, Coosa, Tallapoosa and Tombigbee watersheds are all part of the greater Mobile Basin. We all live in a watershed, no matter how far we are from a river or lake.



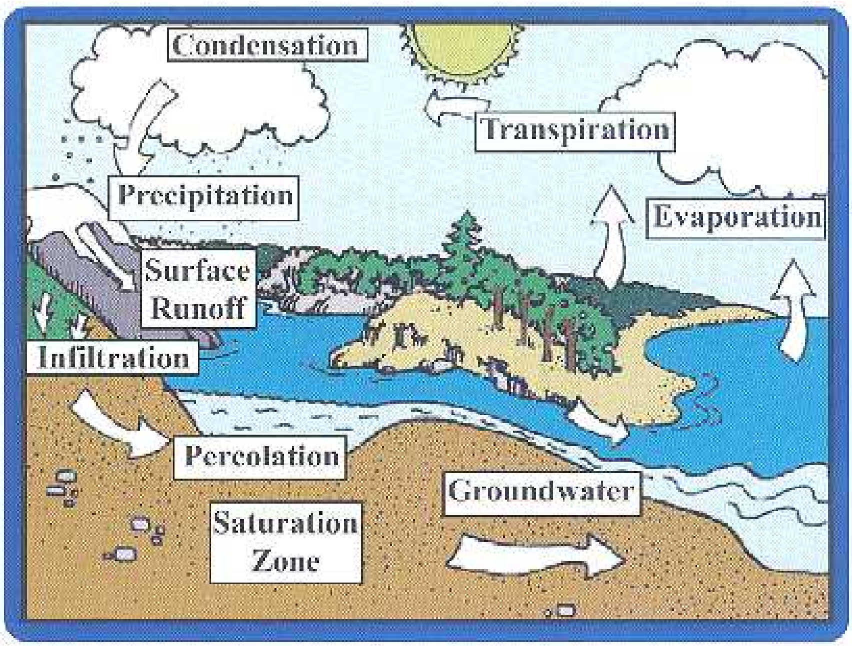
Alabama's 11 major watersheds.

The Mobile Basin is the largest watershed in Alabama, draining 3/4 of the state.

Reference: MOBILE BAY NATIONAL ESTUARY PROGRAM

Alabama's Rich Water Resources

- Alabama contains more than 77,000 miles of streams, 3.6 million acres of wetlands and 560,000 acres of lakes, ponds and reservoirs.
- Alabama has longer stretches of navigable rivers (1,438 miles) than any other state.
- The Mobile River system is the fourth largest watershed in North America, exceeded only by the Mississippi, Yukon and Columbia river systems.
- About 8% of the freshwater in the continental U.S. originates in or flows through Alabama.



The Hydrologic Cycle, or the Water Cycle, links land, air and water within a watershed.

Internet reference: http://www.und.nodak.edu/instruct/eng/fkarner/pages/cycle.htm

Nature's Water Recycling Program

When rain falls to the earth, it sinks into the ground (**infiltration**), returns to the air (**evaporation** and **transpiration**) or flows over the land (**surface runoff**). Surface runoff carries dissolved and suspended substances, such as chemicals and sediment. Landuse activities in a watershed directly affect both water *quality* and *quantity*. Water supplies are not limitless. Water is never created, it only recycles.

Nonpoint Source Pollution

A stream or lake acts as a collection area when rain falls onto a watershed and flows downhill. The pollutants that are washed from diffuse areas of urban or rural land, either in surface runoff or groundwater, contribute to **nonpoint source (NPS) pollution**.

In highly developed areas with **impervious surfaces**, such as parking lots, roads, sidewalks and rooftops, much of the rainfall becomes surface runoff and quickly flows into streams, lakes or other catchment areas instead of soaking into the ground. In more vegetated, forested and less developed areas, rainfall more readily infiltrates into the ground, becoming groundwater. These watersheds usually have better water quality and more stable stream flows than cleared or developed watersheds.

NPS pollutants include:

- runoff from agricultural fields and residential areas containing excess manure, fertilizer, herbicides and pesticides
- stormwater runoff from urban landscapes, which may include oil, metals and toxic chemicals
- sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks
- bacteria and nutrients (nitrogen and phosphorus) from livestock, pet wastes, boat sewage and faulty septic systems

Photo: Ken Hammond

Livestock in water are a primary source of *E. coli* and other bacteria downstream.

What can be done about NPS pollution?

A first step is to characterize the amount and kind of pollution in a stream or lake and identify its source. An important source of this information in Alabama comes from citizen volunteer water quality monitors.

Regulatory agency enforcement, litigation and legislation are important components of an overall pollution abatement strategy, but these are usually more effective with point source pollution than with nonpoint source pollution.

Nonpoint source pollution is largely addressed in Alabama through "Best Management Practices."

> **Best Management Practices (BMPs)** are voluntary or required practices designed to lessen the environmental damage from nonpoint sources.

BMPs include:

- Erosion control and runoff management with regular maintenance from urban developments, agriculture, forestry and mining sites
- Riparian or streambank restoration
- Fertilizer and waste management
- Education, planning, design and maintenance

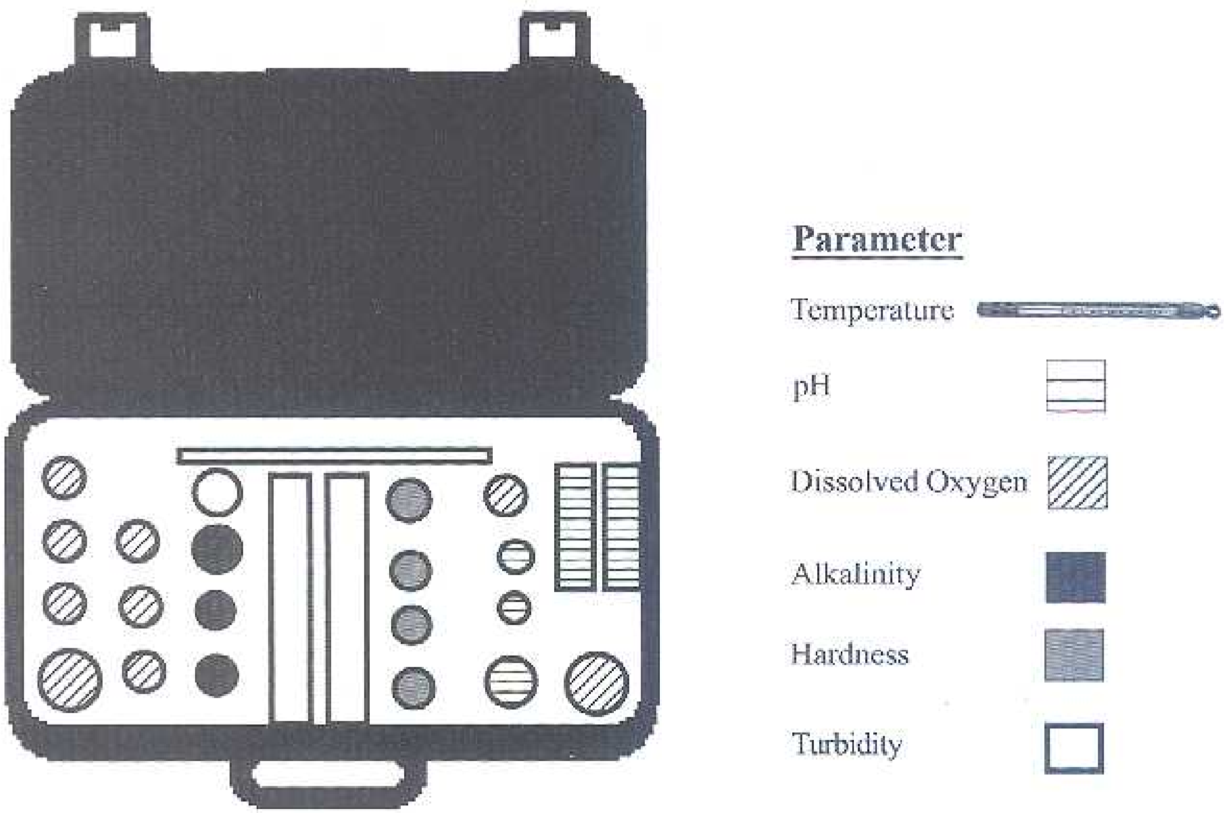
A failing silt fence results in sediment pollution to stream.

Water Chemistry Test Kit

TEST KIT AND MAINTENANCE

General location of test kit reagents and glassware, by parameter.

Note: A kit diagram may be found for each parameter in the text, with the location of specific reagents and supplies in black. There are slight variations among test kits.



Kit Maintenance

- Keep reagent bottles and glassware in their proper place in the kit.
- Store the thermometer in the angled hole with the eyelet up.
- Tighten all reagent bottle caps after use; recheck caps before closing kit.
- Keep kit clean - rinse the glass bottles and tubes after each use with stream or lake water. Occasionally clean glassware with tap water, but do not use soaps or detergents.
- Avoid extremes in temperature. Do not allow kit to freeze or be stored in very hot environments (e.g. trunk of car in summertime).

Maintain fresh chemicals

- Chemicals should be replaced as needed as part of the AWW QA/QC protocols. This is done at Recertification Sessions and by individual monitors and groups.

- To determine the **"freshness"** of your chemicals, you need to know the shelf-life of each reagent by reading the **manufacture date**.

- The manufacture date is coded in the first three digits of the lot number, located in the lower left corner on each reagent's container label. The first two digits specify the week, and the third digit specifies the year the reagent was made (e.g. 2=2002).

Remember: Only active monitors, who submit data at least nine months per year, receive free chemical refills from AWW.

The **manufacture date** for this example lot number is the 32nd week in 2002 (early August, see the approximate week chart below). The reagent should be replaced by the <u>expiration date</u> according to its shelf-life (refer to p. 20).

January	February	March	April
week 1	week 6	week 10	week 14
week 2	week 7	week 11	week 15
week 3	week 8	week 12	week 16
week 4	week 9	week 13	week 17
week 5			week 18
May	**June**	**July**	**August**
week 19	week 23	week 27	week 32
week 20	week 24	week 28	week 33
week 21	week 25	week 29	week 34
week 22	week 26	week 30	week 35
		week 31	
September	**October**	**November**	**December**
week 36	week 40	week 44	week 48
week 37	week 41	week 45	week 49
week 38	week 42	week 46	week 50
week 39	week 43	week 47	week 51
			week 52

- In addition to working with your Citizen QA Officer and the AWW Data Quality Coordinators, **all monitors should take responsibility for making sure reagents are fresh and the kit is well maintained.**

- It is important to check the shelf life of **EACH** reagent. It is unlikely that all of the chemicals will have the same expiration date.

You, the monitor, are an important part of the AWW QA Plan! Please maintain your kits and follow instructions carefully.

Shelf Life for Alabama Water Quality Monitoring Kit

Kit Modules	Reagent Name	Code	Shelf Life
Dissolved Oxygen	Manganous Sulfate Solution	4167-G	3 Years
	Alkaline Potassium Iodide Azide	7166-G	3 Years
	Sulfuric Acid 1:1	6141WT-G	3 Years
	Sodium Thiosulfate 0.025N	4169-H	1 Year
	Starch Indicator	4170WT-G	18 Months
Alkalinity	BCG-MR Indicator Tablets	T-2311-J	18 Months
	Alkalinity Titration Reagent B	4493PS-H	2 Years
Turbidity	Standard Turbidity Reagent	7520-H	2 Years
Wide Range pH	Wide Range Indicator	2218-G	2 Years
Total Hardness	Hardness Reagent #5	4483-E	1 Year
	Hardness Tablets #6	4484-J	3 Years
	Hardness Reagent #7	4487WT-H	3 Years

Remember that the Shelf Life starts from the manufacture date (coded Lot Number on bottle).

Contact the AWW office or a Citizen QA Officer with any questions about chemicals, codes or supplies.

DISPOSAL OF USED AND EXPIRED CHEMICALS

Used Chemicals

The amount and concentrations of chemicals used during a sampling session are of negligible threat to the environment. Avoid disposing chemicals directly into a stream or lake, and use one of the following options:

a) Pour residual chemicals on the ground in a vegetated area.

b) Pour residual chemicals into a waste container and later discard the mixture into a sink or toilet with running water. This method is not recommended if you are on a septic system.

Expired Chemicals

If a test kit is properly managed, there should be a relatively small amount of expired chemicals to dispose of. It is far better to use chemicals to collect good data than to let them go to waste!

However, expired chemicals are best discarded by pouring the contents of each bottle onto the ground or in a sink, while diluting with lots of water.

MONITORING WATER QUALITY

One goal of AWW is to develop long-term data sets that are useful for determining water quality **trends**. Proper interpretation and understanding of environmental conditions, causes, and trends require consistent and careful monitoring.

Trend monitoring is designed to identify changes in the aquatic system over time. Since there are natural changes occurring over time, we can only identify and document degradation or recovery if we collect data for several months or years at the **same place,** at approximately the **same time of day,** and in the **same way**.

Chemical monitoring is done using a LaMotte Company water quality test kit that has been customized for AWW and measures six water quality parameters:

1. temperature
2. dissolved oxygen
3. pH
4. total alkalinity
5. total hardness
6. turbidity

Valid water quality data is properly collected and recorded by:

- using proper testing techniques
- maintaining fresh chemical reagents in the test kit
- replacing faulty or broken equipment in the kit
- completely and legibly filling out the data reporting form
- returning the data form to the AWW office in a timely manner
- proofing the summary data graph and table prepared for monitors annually

Remember...

*"**No** information is better than **wrong** information!"*

If you are not confident with your test results, redo the test or seek assistance from another certified monitor (possibly verify results by using a different kit). Do not submit questionable data without first discussing this with your QA Officer or the AWW Program office.

REMOTE SAMPLER

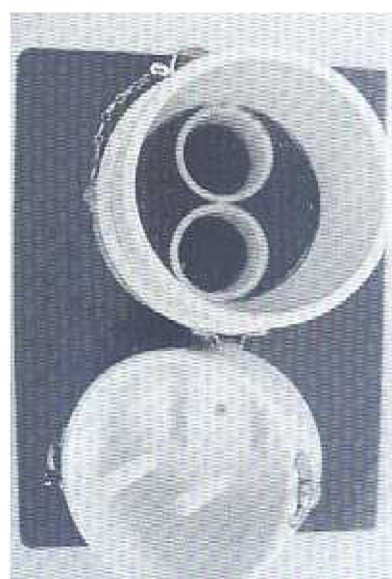
Most monitors collect their samples directly from a stream or lake, about 6-12 inches deep. Occasionally, a remote sampler is required because it may be difficult to directly reach the site. The remote sampler may be used to collect water for all tests except for bacteria (AWW bacteria samples must be taken directly from the water surface using the sterile pipette normally used for this test.). To obtain a remote sampler refer to page 79.

Do not use a bucket, jar or other container to collect water for testing. For sampling where you cannot reach the water surface directly (from docks, bridges, boats, etc.), only use an approved, AWW Remote Sampler. Do not store the sampler in extreme temperatures, and allow the sampler to reach ambient temperature before collecting your sample.

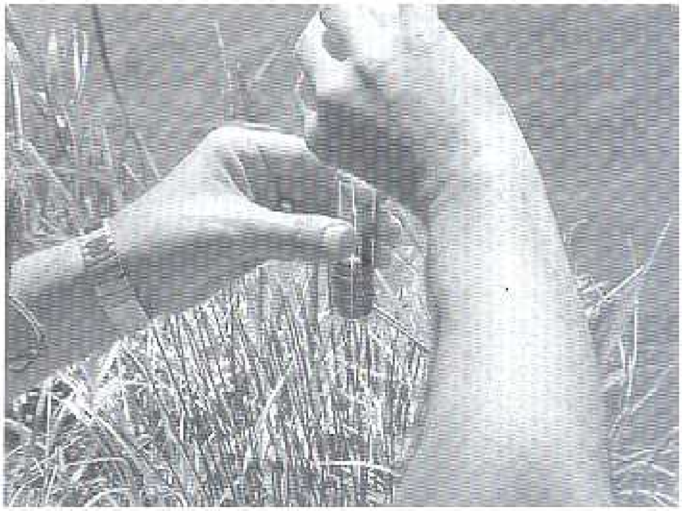
The Remote Sampler may also be used for sampling "depth profiles" in a lake, up to 10 ft. deep. State agencies (e.g. ADEM) sample lakes for dissolved oxygen measurements at 5 ft. deep.

To use the remote sampler, rinse the inside of sampler and DO bottles with lake or stream water. Latch sampler with bottles in place (tubes extending into uncapped bottles) and quickly submerge to desired depth (pre-marked on the cord). Wait for bubbles to stop before retrieving sampler. Measure temperature of the water inside the sampler immediately after retrieval. Carefully cap DO bottles underwater, remove for testing and use remaining water in sampler chamber for measuring other water quality variables. If you cannot reach the water surface (e.g. from a bridge), use the remote sampler to collect water for rinsing glassware before collecting water for your tests.

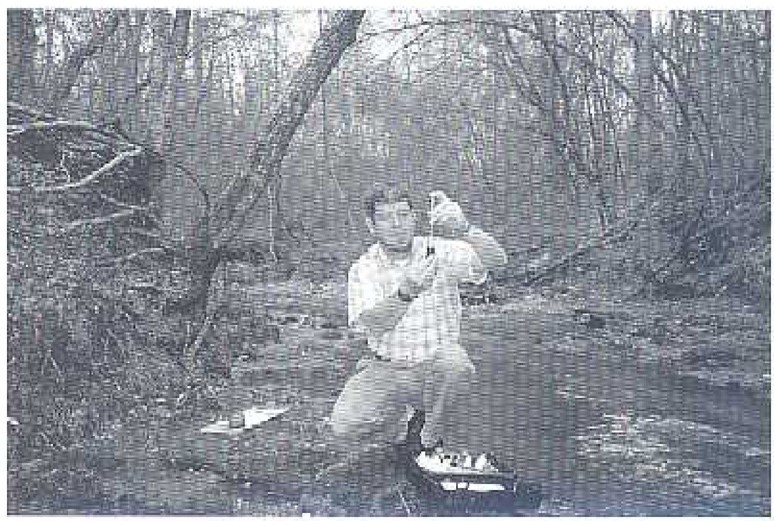
Side View

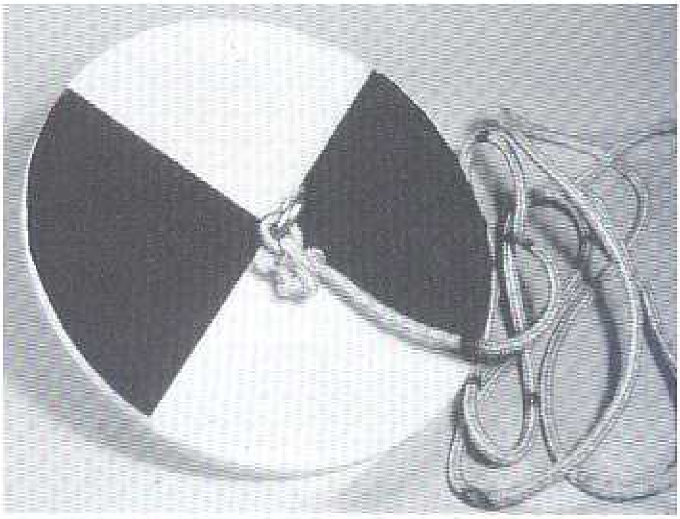


Top View, Open



Principles and Practice of Water Chemistry





TEMPERATURE: Principles

Temperature is measured using a thermometer with a Centigrade (or Celsius) scale (°C). 

General relationship between the Centigrade and Fahrenheit scales

°C	0	10	15	20	25	30	35
°F	32	50	59	68	77	86	95

To convert from °F to °C, use the formula C – (F-32) x 5/9

- Temperature affects the physical and chemical properties of water and greatly influences aquatic organisms by affecting their feeding, reproduction, and metabolic rates.

- Temperature affects how much oxygen water can hold (see p. 36) and how quickly nutrients will be cycled through aquatic systems.

- Water can form layers (strata) of different temperatures in reservoirs, lakes and ponds.

- Water temperatures may be increased by discharges of industrial manufacturing or power generating plants. Runoff from heated impervious surfaces can also increase water temperatures. "Thermal pollution" is a problem in some streams and lakes.

- Stream water temperatures are often lower than air temperature because of groundwater inflows or the shade of streamside vegetation.

- Most aquatic organisms can tolerate gradual changes in temperature, but drastic changes can cause thermal stress. Temperatures above 32 °C may be lethal to many aquatic organisms.

- Water temperature regulations in Alabama are found on page 64.

TEMPERATURE: Practice

Temperature is measured with a thermometer (0 - 50 °C) protected by a plastic case. This is an alcohol-based thermometer, without mercury, so it is environmentally friendly.

Air Temperature (record **before** measuring water temperature):

1. Place the dry thermometer in the shade until the temperature stabilizes (usually 2-3 minutes).

2. Record the temperature (°C) to the nearest 0.5 degree.

Water Temperature:

3. Submerge the thermometer in the waterbody until the temperature stabilizes.

4. After removing the thermometer from the sample water, record the water temperature (°C) to the nearest 0.5 degree.

♦ A cord may be tied through the eyelet of the thermometer and attached to a stable object to prevent loss in strong currents, turbid water or deep water.

Note: Do not touch the bulb end of the thermometer before or while reading.

♦ Sample water temperature (and all parameters) in a representative spot at your site. For example, do not sample water temperature in a shallow, backwater area. The best area is the main channel.

Note: Check the thermometer for bubbles before using. Bubbles may often be removed by putting the thermometer into a bath of crushed ice and salt for several minutes. If the bubble cannot be removed, return the thermometer to the AWW office for a replacement.

DISSOLVED OXYGEN: Principles

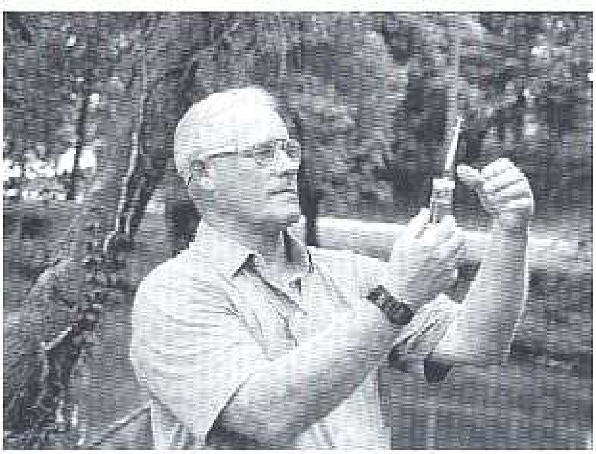
- Like land organisms, aquatic animals and plants need oxygen to live.

- Oxygen enters water in several ways:
  - when aquatic plants and algae release oxygen during photosynthesis
  - diffusion from the atmosphere

- Oxygen from the atmosphere enters water more readily where there are wind, waves, riffles or waterfalls.

- Dissolved oxygen (DO) is naturally at least 10,000 times more concentrated in air than in water!

- Organic matter, both natural and as pollution, can create high biological oxygen demands (BOD) and remove oxygen from water. This may cause "fish kills" and otherwise alter aquatic organism communities.

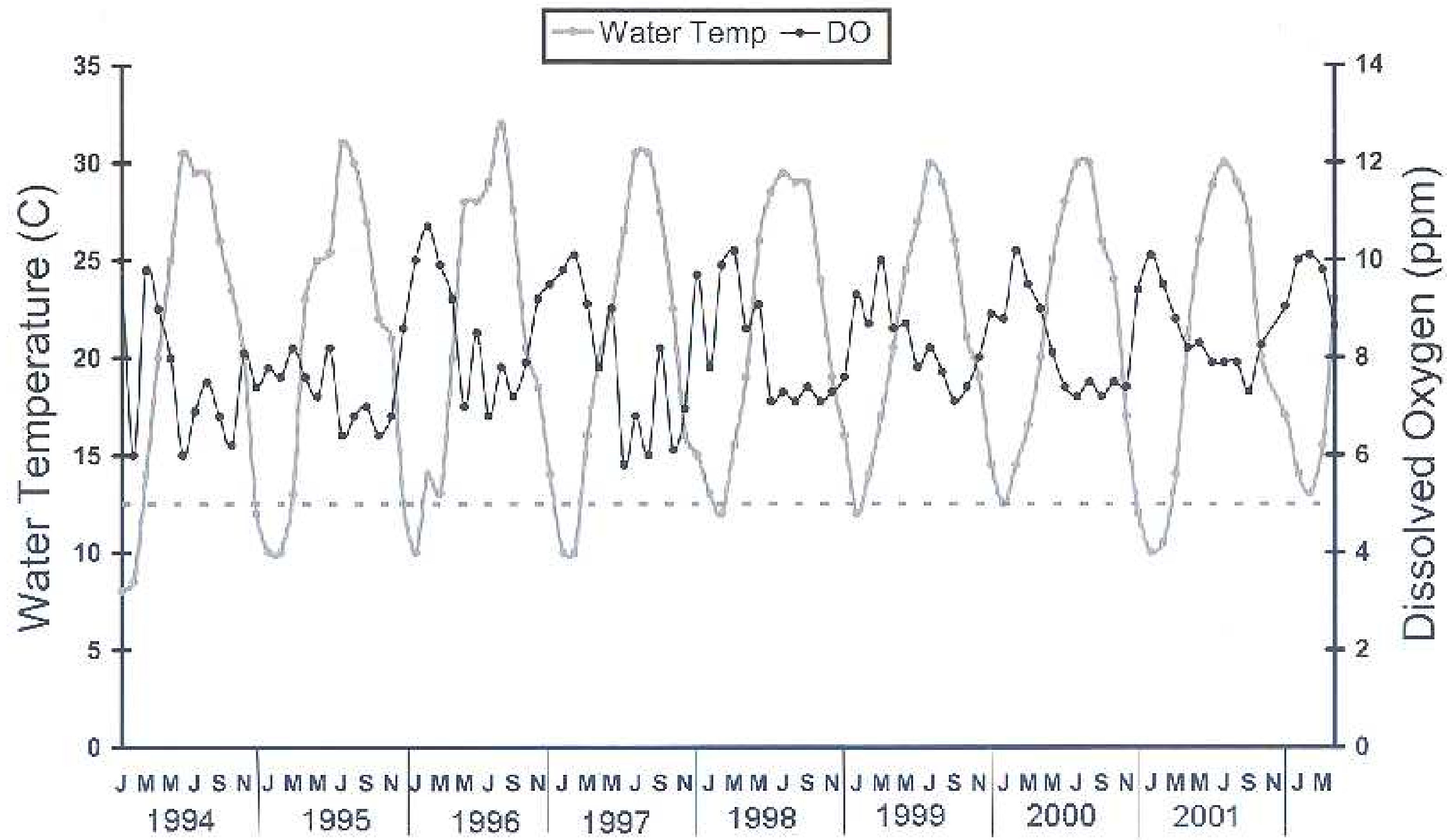


- A DO value of at least 5.0 ppm is desirable for most aquatic organisms, and is required for streams classified as "Fish and Wildlife" or higher (p. 64).

- **Dissolved oxygen decreases with increasing temperatures**, so you would expect DO values to be higher during the winter and lower during the summer.

- **Dissolved oxygen usually decreases with increasing depths**, so you would expect DO values to be higher at the surface of a lake and lower toward the bottom.

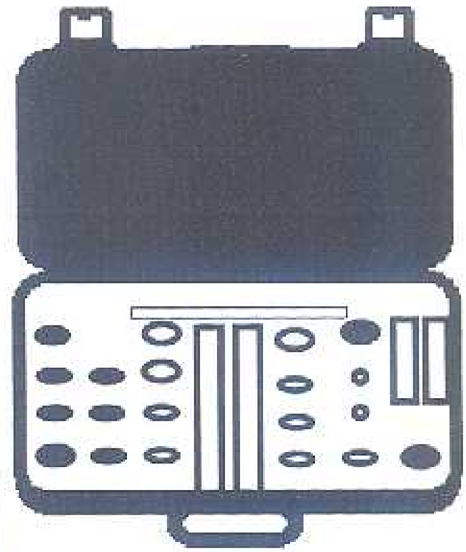
- Especially in lakes and ponds with high nutrient concentrations, DO can change dramatically throughout the day because of photosynthetic activity of aquatic plants.



Water temperature and dissolved oxygen data from Lake Watch of Lake Martin (Bay Pine Island, AWW Site Code 07001003), illustrating the inverse relationship of these two parameters.

Dissolved oxygen is higher in winter and lower in summer (opposite of temperature) because the solubility of oxygen is greater in colder water.

DISSOLVED OXYGEN: Practice



Measuring oxygen in water requires three steps:
A) collecting the sample, **B)** "fixing" the sample and
C) titrating the sample.

Step A - Collecting the Sample

Procedures 1 through 5 below describe proper sampling techniques at the water surface. For remote sample collection, a special water sampling apparatus is required (see p. 23).

> **Note**: Two replicate samples for dissolved oxygen must be taken to insure precision. *Replicates* are two samples collected at the same time and place. Use both water sample bottles in your kit.

1. **Rinse the Water Sampling Bottles (code 0688-DO) 2-3 times with sample water.**

2. **Hold the bottles upright in the same hand and submerge them 6-9 inches below the water surface. Avoid disturbing the bottom of shallow streams.**

3. **Allow the bottles to fill while completely underwater.**

4. **Tap the sides of the submerged bottles to dislodge any air bubbles. Invert caps underwater and cap the bottles while they are still submerged.**

> **Note**: Be sure the plastic cones are inside the bottle caps.

5. **Remove the bottles from the water and invert the capped bottles to make sure that no air bubbles are trapped inside.**

If air bubbles are present (even if they are only in one bottle), **empty both sample bottles** and refill them with water again. Once a satisfactory sample has been collected, proceed immediately with the next steps.

DISSOLVED OXYGEN: Practice

Step B - "Fixing" the Sample

> **Note:** Each of the following procedures should be done for both samples simultaneously.

Precaution: Reagents marked with an asterisk (*) are considered hazardous substances. Children using these chemicals should be carefully supervised. Safety glasses and gloves may be required by some schools.

1. **Add 8 drops of *Manganous Sulfate (code 4167-G) to each sample bottle.**

2. **Add 8 drops of *Alkaline Potassium Iodide Azide (code 7166-G).**

3. **Cap and mix by inverting bottles several times.**

   A tan, cloudy precipitate will usually form.

4. **Allow the precipitate to settle below the shoulder of the bottle.**

5. **Add 8 drops of *Sulfuric Acid, 1:1 (code 6141WT-G).**

6. **Cap and repeatedly invert the sample bottle to mix until most of the dark-brown flecks have dissolved.**

   Be patient, this may take 5-10 minutes, especially with colder water.

The sample is now "fixed," meaning that the oxygen in the sample is chemically "trapped" and contact between the water sample and the atmosphere will not affect the test result.

Monitors have the *option* of holding or transporting fixed samples for up to two hours before further analysis. This is rarely necessary but may be useful in cases of extreme weather, where the monitor may complete the rest of the DO test under shelter.

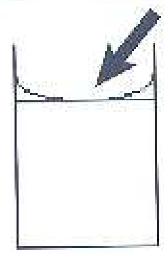
DISSOLVED OXYGEN: Practice

Step C - Titrating the Sample

1. **Rinse the titration tube (code 0299 or 0608) 2-3 times with 3-5 mL of "fixed" sample water.**

2. **Fill the titration tube to the 20 mL line with the "fixed" sample from one of the two sample bottles (rep #1 on the data form). Some titration tubes have gradations in addition to the 20 mL line that should be ignored.**

> **Note:** Liquids in vials and tubes often form a concave surface called a **meniscus**. The bottom of the meniscus should touch the designated line of the vial or tube.

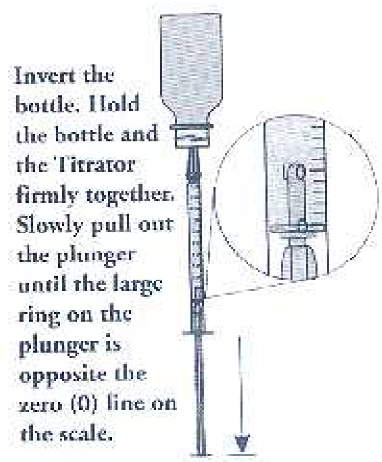


3. **Add 8 drops of Starch Indicator (4170WT-G) to the tube and gently swirl to mix.**

The sample should turn dark-blue to black.

4. **Place the titration tube cap (with hole in center) on tube.**

5. **Insert the Direct Reading Titrator (code 0377) with plunger depressed into the hole in the top of the Sodium Thiosulfate bottle (code 4169-H), invert both bottle and Titrator, and draw out titrant until the large ring on the plunger is opposite the 0 line on the scale. <u>Keep the pink tip on</u> the titrator to draw and dispense the Sodium Thiosulfate. Make sure there are no air bubbles in the Titrator! Glass titrators have been discontinued from new kits, but may be used.**



6. **Insert the filled Titrator into the center hole of the titration tube cap.**

DISSOLVED OXYGEN: Practice

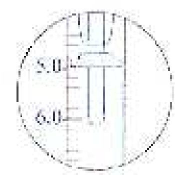
Step C (continued)

7. **Add <u>one drop at a time</u> from the titrator, gently swirling the tube between drops (you do not need to count the drops for this test).**

8. **Continue titrating (adding drops) until the dark-blue/black solution turns clear.**

> **Note:** Hold the tube against a white background to be sure that solution is clear and not faint blue.

Test Result: 5.0 ppm



9. **Read the number on the titrator where the widest part of the plunger meets the line on the scale (see diagram at right).**

10. **Each minor division on the titrator scale equals 0.2 ppm. Record value to the nearest 0.2 ppm.**

If the plunger tip reaches the bottom line on the titrator scale (10 ppm) before the endpoint color change occurs, refill the Titrator to the 0 line with additional sodium thiosulfate and continue the titration. To determine the oxygen concentration, add the original 10 ppm to the second ppm value and record the value.

11. **Repeat the procedures of Step C for the second sample bottle (rep #2 on the data form).**

> **If the two DO results are not within 0.6 ppm of each other, retest the fixed sample in the first bottle. If results still vary by more than 0.6 ppm, repeat the procedure with a new sample of water from the site.**

Leftover titrant (sodium thiosulfate) in the titrator should be **discarded** and not returned to the bottle.

DISSOLVED OXYGEN PERCENT SATURATION: Principles

The amount of oxygen that water can hold is affected by physical factors such as:

- temperature
- elevation
- salinity

Green plants in water can sometimes produce oxygen through photosynthesis at a faster rate than the oxygen can diffuse from the water to the air.

This process may lead to **"supersaturation"** of oxygen in water, when DO concentrations exceed 100% of the amount that can be dissolved by physical mixing alone.

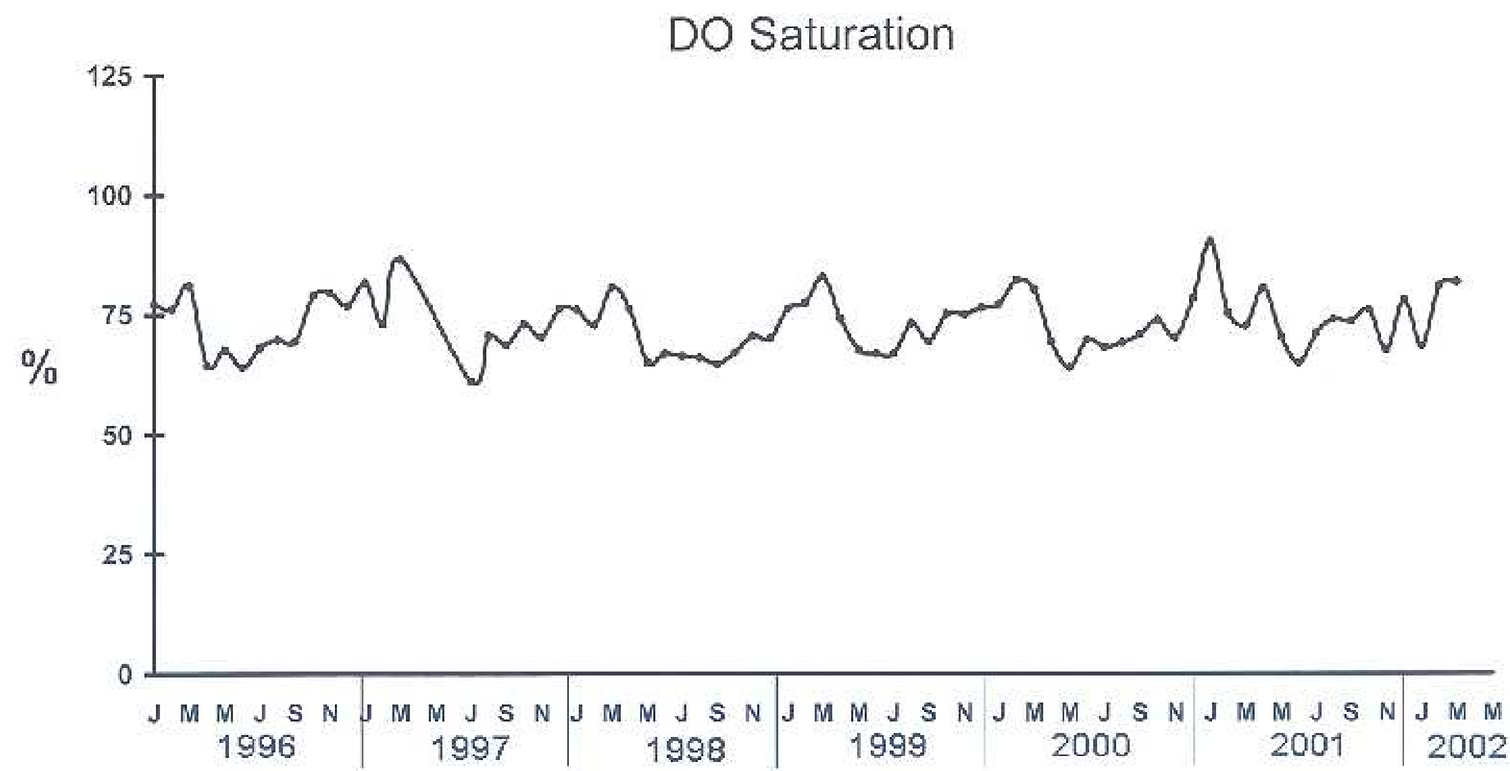
- Water that is supersaturated in the daytime often has very little oxygen at night.

- Water that is frequently supersaturated with DO usually has unnaturally high levels of the nutrient phosphorus and/or nitrogen.

This *"nutrient enrichment"* may be intentional (such as in fertilized fish ponds) or unintentional (such as in polluted runoff from land with excess fertilizers, animal wastes, etc.).

General Guide for Interpreting Oxygen Data

Concentration	
0-2 ppm	not enough oxygen to support life
2-4 ppm	only a few kinds of fish and insects can survive
4-7 ppm	good for most kinds of aquatic animals, acceptable for warm water fisheries, low for cold water fisheries
7-11 ppm	very good for most stream animals
Percent saturation	
Below 60%	poor; water too warm, or bacteria are using up the DO
60-79%	acceptable for most stream animals
80-125%	excellent for most stream animals
125% or more	too high, may be dangerous to fish



Dissolved oxygen saturation (%) data from Weeks Bay Water Watch (Weeks Bay, at the mouth of Eslava Creek, AWW Site Code 06003003), illustrating seasonal variability in DO saturation (higher in the winter and lower in the summer).

DISSOLVED OXYGEN PERCENT SATURATION: Practice

To calculate DO (%) Saturation for freshwater, use the Water Temperature to find the corresponding DO Saturation (ppm) value on the chart below.

Equation: (DO average/ DO Saturation)*100 = % Saturation

Example: DO = 5.7, Water Temperature = 29 (DO Saturation value from chart = 7.58)

(5.7/7.58)*100 = 75.2 % Saturation

Water Temperature	DO Saturation (ppm)	Water Temperature	DO Saturation (ppm)
4.0	13.12	20.5	8.97
4.5	12.96	21.0	8.88
5.0	12.81	21.5	8.78
5.5	12.66	22.0	8.69
6.0	12.51	22.5	8.60
6.5	12.37	23.0	8.51
7.0	12.22	23.5	8.42
7.5	12.08	24.0	8.34
8.0	11.94	24.5	8.25
8.5	11.80	25.0	8.17
9.0	11.66	25.5	8.09
9.5	11.52	26.0	8.01
10.0	11.39	26.5	7.94
10.5	11.26	27.0	7.86
11.0	11.13	27.5	7.79
11.5	11.00	28.0	7.72
12.0	10.87	28.5	7.65
12.5	10.74	29.0	7.58
13.0	10.62	29.5	7.51
13.5	10.50	30.0	7.45
14.0	10.38	30.5	7.39
14.5	10.26	31.0	7.33
15.0	10.14	31.5	7.27
15.5	10.03	32.0	7.21
16.0	9.91	32.5	7.16
16.5	9.80	33.0	7.10
17.0	9.69	33.5	7.05
17.5	9.58	34.0	7.00
18.0	9.48	34.5	6.95
18.5	9.37	35.0	6.90
19.0	9.27	35.5	6.86
19.5	9.17	36.0	6.82
20.0	7.65	36.5	6.77

A **"DO Saturation Nomogram"** may also be used to calculate the percent saturation of dissolved oxygen in freshwater (p. 38).

For brackish waters (salinity influenced) use the following chart and equation.

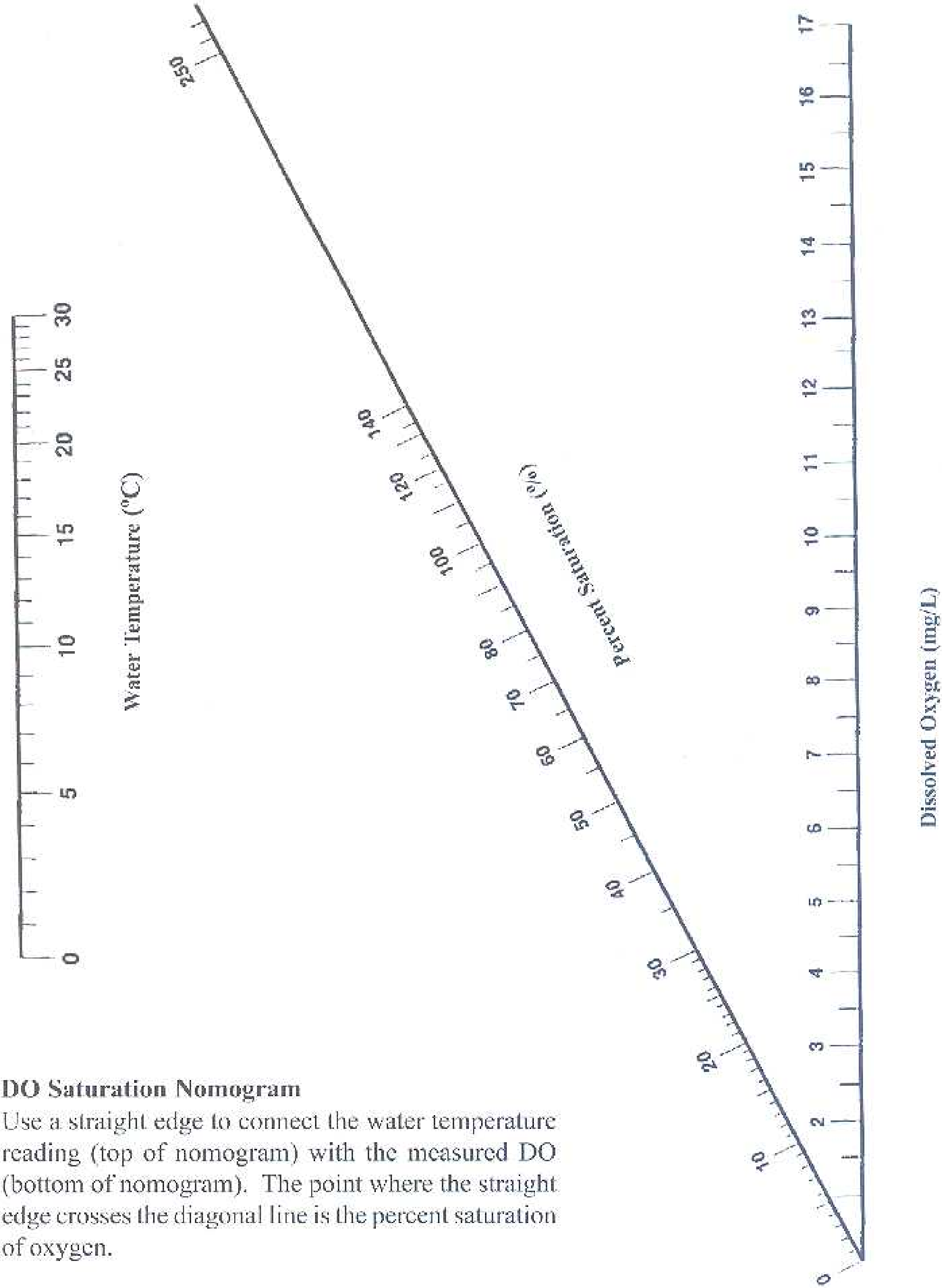
Monitor measurements
A = Water Temperature (C)
B = Average DO (ppm)
C = Salinity (ppt)

Information Provided
D = Saturation Concentration (ppm)
E = Adjusted Salinity (ppt)
F = DO at Saturation
G = % Saturation

A Water Temperature	D Saturation Concentration	E Adjusted Salinity
0	14.16	0.08405
1	13.77	0.08153
2	13.40	0.07908
3	13.05	0.07671
4	12.70	0.07440
5	12.37	0.07218
6	12.06	0.07002
7	11.76	0.06795
8	11.47	0.06595
9	11.19	0.06402
10	10.92	0.06217
11	10.67	0.06039
12	10.43	0.05869
13	10.20	0.05706
14	9.98	0.05551
15	9.76	0.05404
16	9.56	0.05263
17	9.37	0.05130
18	9.18	0.05005
19	9.01	0.04887
20	8.84	0.04777
21	8.68	0.04674
22	8.53	0.04579
23	8.38	0.04491
24	8.25	0.04410
25	8.11	0.04338
26	7.99	0.04272
27	7.86	0.04214
28	7.75	0.04164
29	7.64	0.04121
30	7.53	0.04085

Equation 1. **F = D - (E * C)** Example: A=10, B=9.75, C=15
F = 10.92 - (0.06217 * 15) = 9.99

Equation 2. **G = (B * 100)/F** Example: G = (9.75 * 100)/9.99 = **98%**



DO Saturation Nomogram

Use a straight edge to connect the water temperature reading (top of nomogram) with the measured DO (bottom of nomogram). The point where the straight edge crosses the diagonal line is the percent saturation of oxygen.

pH: Principles

- pH is a measure of how acidic or basic water is. pH of 7.0 is neutral. Values less than 7 are acidic, and those more than 7 are basic.

- Weak organic acids lower pH slightly. pH is affected by carbon dioxide (CO_2) because CO_2 in water forms a weak organic acid called carbonic acid. Strong mineral acids (e.g. sulfuric, nitric and hydrochloric acid) can lower the pH to lethal limits for aquatic life.

- pH of water can change throughout a season or even within a day.

- The optimal pH range for aquatic life is 6.5 to 8.5. pH less than 4.0 or more than 10.0 is usually lethal to fish and other organisms.

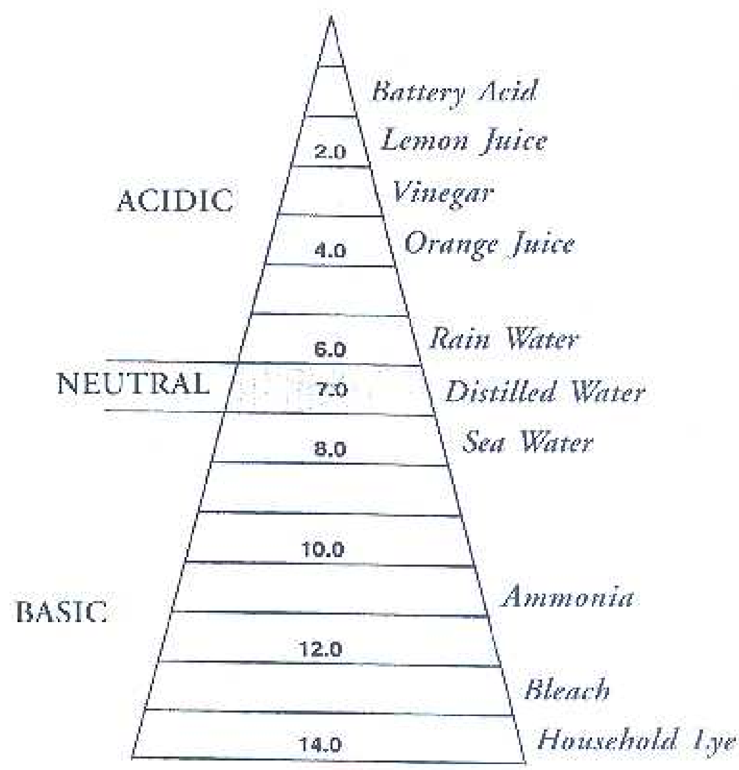
- Natural waters reflect the pH of the soils they have moved through or across.

- Industrial, municipal or agricultural waters may have significantly higher or lower pH than natural waters.

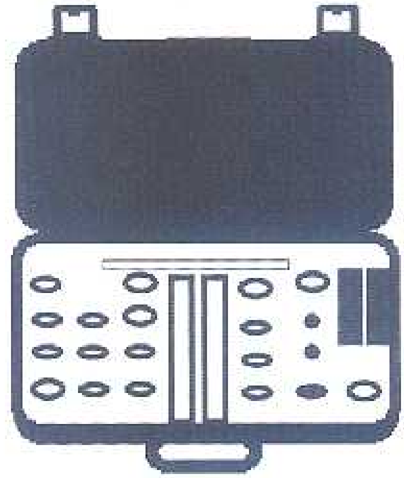
- Decreases in pH could indicate acid rain, runoff from acid soils (e.g. acid mine drainage) or contamination from livestock waste.

- pH regulations in Alabama are found on page 64.

The pH Scale of Common Liquids



pH: Practice



1. **Rinse tube (code 0230) 2-3 times with sample water.**
2. **Fill to line with sample water (overfill and "flick" excess water out).**
3. **Add 10 drops of Wide Range Indicator (WR Ind) (code 2218-G).**

> **Note:** Hold the dropper bottle vertically to dispense uniformly-sized drops of reagent.

4. **Cap and invert tube 2-3 times to mix.**
5. **Match sample color by inserting the tube into the appropriate Color Comparator. Record pH to the nearest 0.5 units.**

ALKALINITY: Principles

- Alkalinity is a measure of the **buffering capacity** of water.

  Higher alkalinity in a body of water provides a "buffer" against rapid changes in pH, making it more stable for aquatic life.

  If a body of water has low alkalinity (very little buffering), it is susceptible to rapid changes in pH caused by additions of acids or bases.

  Higher alkalinity water usually has a higher pH.

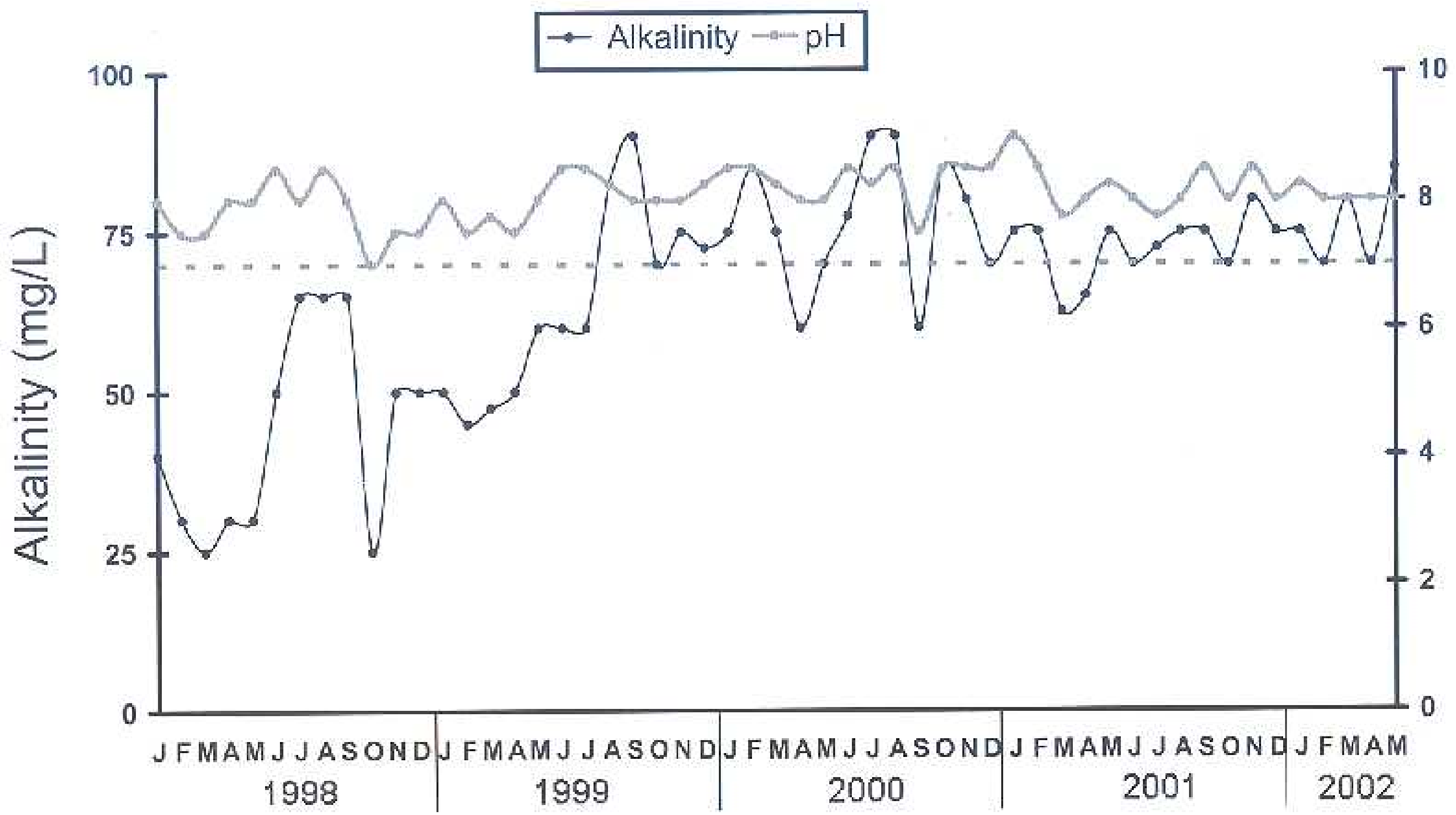
- Alkalinity of natural water in Alabama primarily comes from carbonates and bicarbonates leached from soil and rocks.

  Limestone is a natural source of alkalinity, with the chemical name, calcium carbonate ($CaCO_3$) or calcium magnesium carbonate ($CaMgCO_3$).

  When limestone dissolves in water, carbonates and bicarbonates are produced, and alkalinity rises.

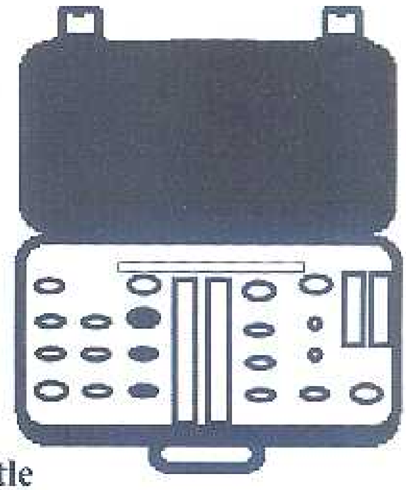
Alkalinity values across Alabama range from 10 mg/L or less in parts of the Coastal Plain to 200 mg/L and more in regions with limestone formations and outcrops, such as in the Upper Coosa River Basin.

Brackish water or seawater typically has alkalinity of 100 to 125 mg/L.



Total alkalinity and pH data from Wolf Bay Watershed Watch (West Shore of Wolf Bay at Griggs Dock, AWW Site Code 04012006). The increase in alkalinity from 1998 to 2000 reflects a multi-year drought, when freshwater inflows were reduced and carbonates and bicarbonates were concentrated.

ALKALINITY: Practice



1. Rinse the alkalinity test tube (code 0289 or 0970-S-NC) 2-3 times with sample water.

2. Fill to 10 mL line with sample water (overfill and "flick" water out).

3. Add one BCG-MR Tablet (code T-2311-J) to the sample, cap and shake to dissolve the tablet. A blue to blue-green color will develop.

Caution: Tablets are very soluble. Use cap of tablet bottle to dispense a single tablet before it is placed in sample. Do not allow any water to enter tablet bottle.

> **Note:** If a pink or pink-gray color develops, there is no measurable alkalinity and the alkalinity value should be recorded as 0 mg/L.

4. Fill plastic dropper with the orange bulb (code 0352 or no code #) with Alkalinity Titration Reagent B (code 4493PS-H). Hold the filled dropper <u>vertically</u> and add one drop at a time to the water sample in the tube.

5. Swirl to mix after each drop, counting the number of drops added, until the green-blue color changes to pink.

The endpoint (final color change) of the alkalinity test is best determined by adding titration reagent drops until <u>no</u> additional color change is observed. The second-to-last number of drops is then used in the calculation. Do not count the last drop if there is no color change.

> **Note:** Allow more time for reaction to occur during colder weather.

6. Multiply the number of drops added by 5 to calculate an alkalinity value in milligrams per liter (mg/L).

Number of Drops added x 5 = Total Alkalinity (mg/L)

HARDNESS: Principles

- Hardness in water is primarily a measure of the amount of dissolved calcium and magnesium.

- Limestone ($CaCO_3$ or $CaMgCO_3$) is a natural source of hardness.

- Animals and plants require calcium and magnesium for life.

  Calcium is an important component of cell walls, shells and bones of many aquatic organisms.

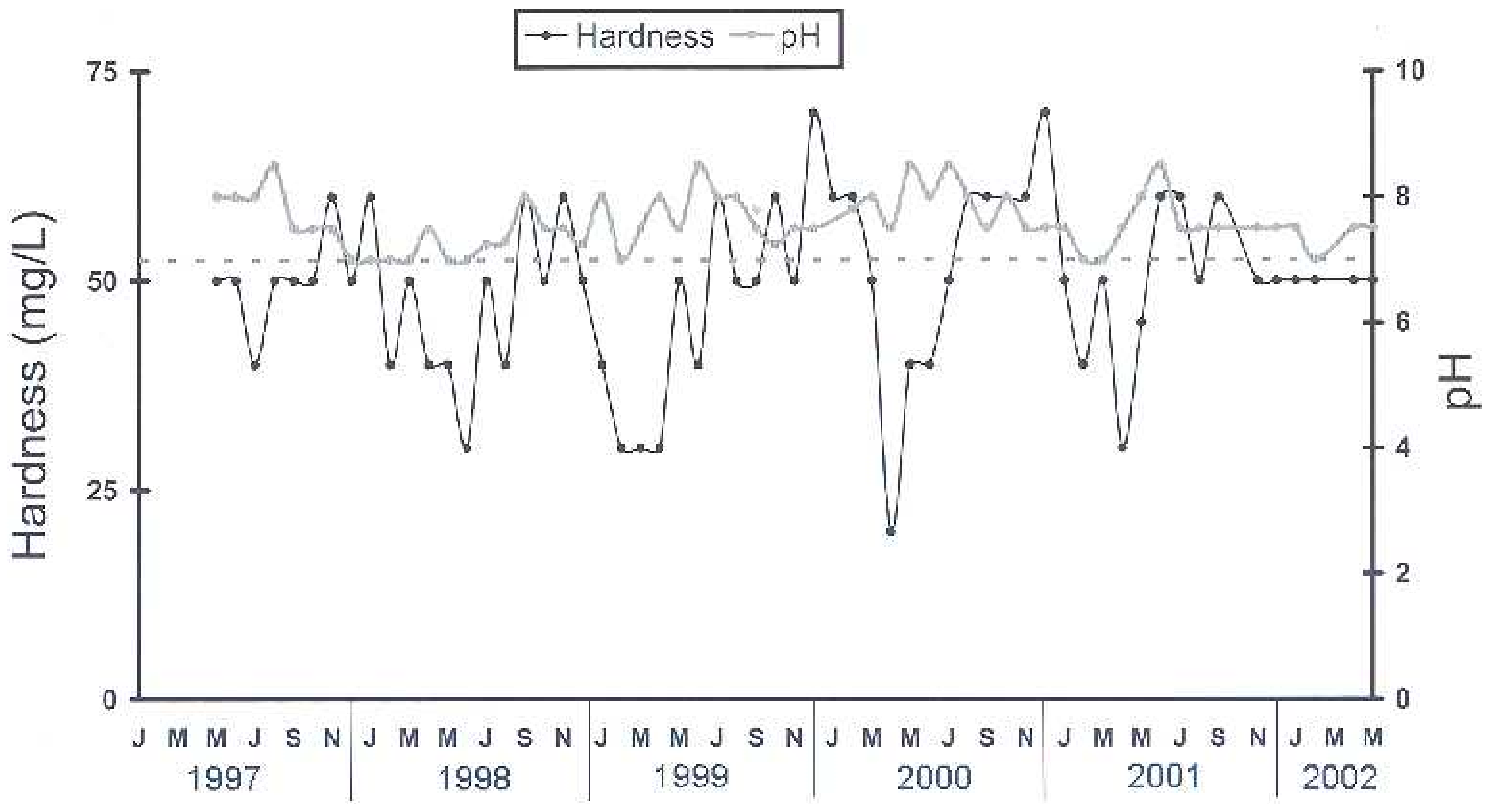
  Magnesium is a component of chlorophyll, which is necessary for photosynthesis in green plants.

- Hard water can cause problems by leaving scaly deposits in pipes and appliances, and decreasing the cleaning action of soap and detergent.

- In unpolluted water of Alabama, hardness values are usually similar to alkalinity values.

- Hardness of seawater is 6,000 mg/L or more.

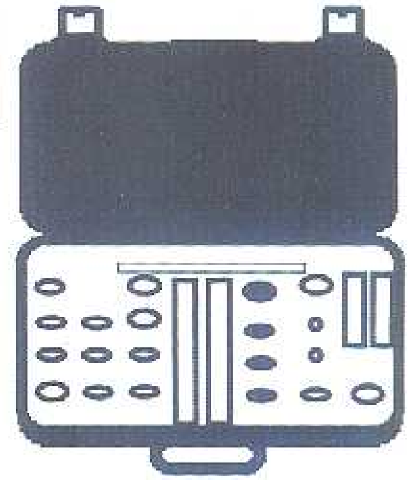
Water Hardness (mg/L as $CaCO_3$)	
Soft	0-20
Moderately Soft	20-60
Moderately Hard	61-120
Hard	121-180
Very Hard	>180



Total hardness and pH data from Lake Jordan Home Owners and Boat Owners Association (Lake Jordan, Bonners Point Slew, AWW Site Code 05008018). Seasonal cycles indicate that hardness is often highest in November - December and lowest in March - May at this site.

HARDNESS: Practice

Note: If monitoring in coastal waters, proceed with the salinity test first (p. 55). If salinity is detected, do not perform the hardness test.



1. **Rinse the hardness tube (code 4488) 2-3 times with sample water.**

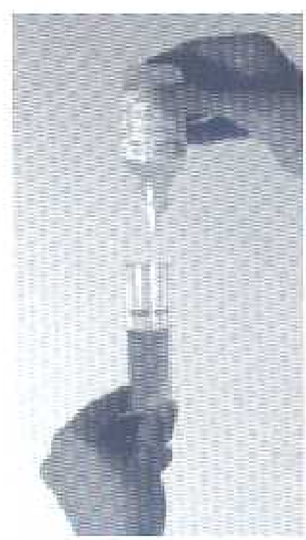
2. **Fill to the 10 parts per million (ppm) mark with sample water (overfill and "flick" excess water out).**

3. **Add five drops of Hardness Reagent #5 (code 4483-E) and mix.**

4. **Add one Hardness Reagent #6 Tablet (code 4484-J), cap and shake until tablet dissolves. A pink color will develop.**

Caution: Tablets are very soluble. Use cap of tablet bottle to dispense a single tablet before it is placed in sample. Do not allow any water to enter tablet bottle.

Note: If a blue color develops, there is no measurable hardness and the hardness value should be recorded as 0 mg/L.



5. **Hold the Hardness Reagent #7 (code 4487WT-H) bottle vertically and add one drop at a time.**

6. **Swirl to mix after each drop, counting the number of drops added, until the pink color changes to blue. Do not count the last drop if there is no color change.**

Note: Allow more time for reaction to occur during colder weather.

7. **Multiply the number of drops added by 10 to calculate a hardness value in milligrams per liter (mg/L).**

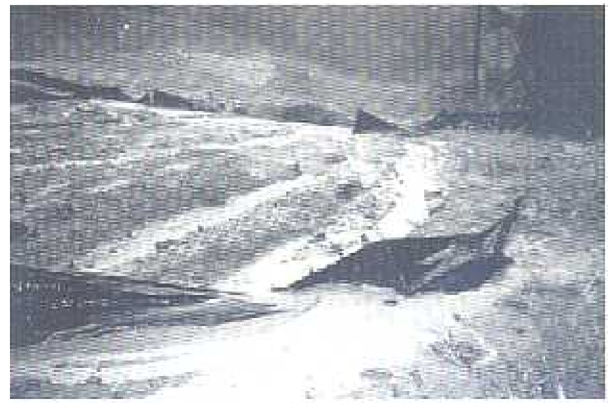
Number of Drops added x 10 = Total Hardness (mg/L)

TURBIDITY AND SECCHI DEPTH: Principles

- Turbidity is a measurement of water **"cloudiness"** caused by suspended matter.

- Turbidity can result from soil erosion and runoff that causes water to be *brown*; this is called **"clay turbidity."**

- Turbidity can also result from tiny suspended plants in water (algal blooms) that causes water to be *green*; this is called **"plankton turbidity."**



High clay turbidity in runoff water from bare soil at a construction site.

- High turbidity limits sunlight penetration in water, inhibits growth of aquatic plants, and can upset aquatic ecosystems.

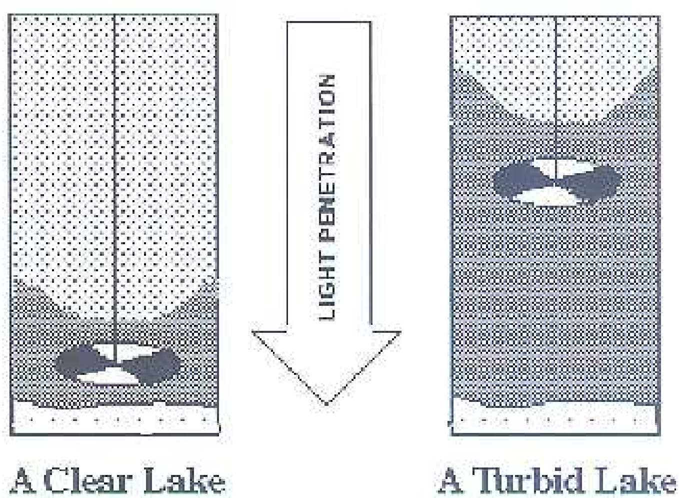
- High clay turbidity is an indication of soil erosion which leads to sedimentation of streams, lakes and reservoirs. This is Alabama's number one water pollution problem!

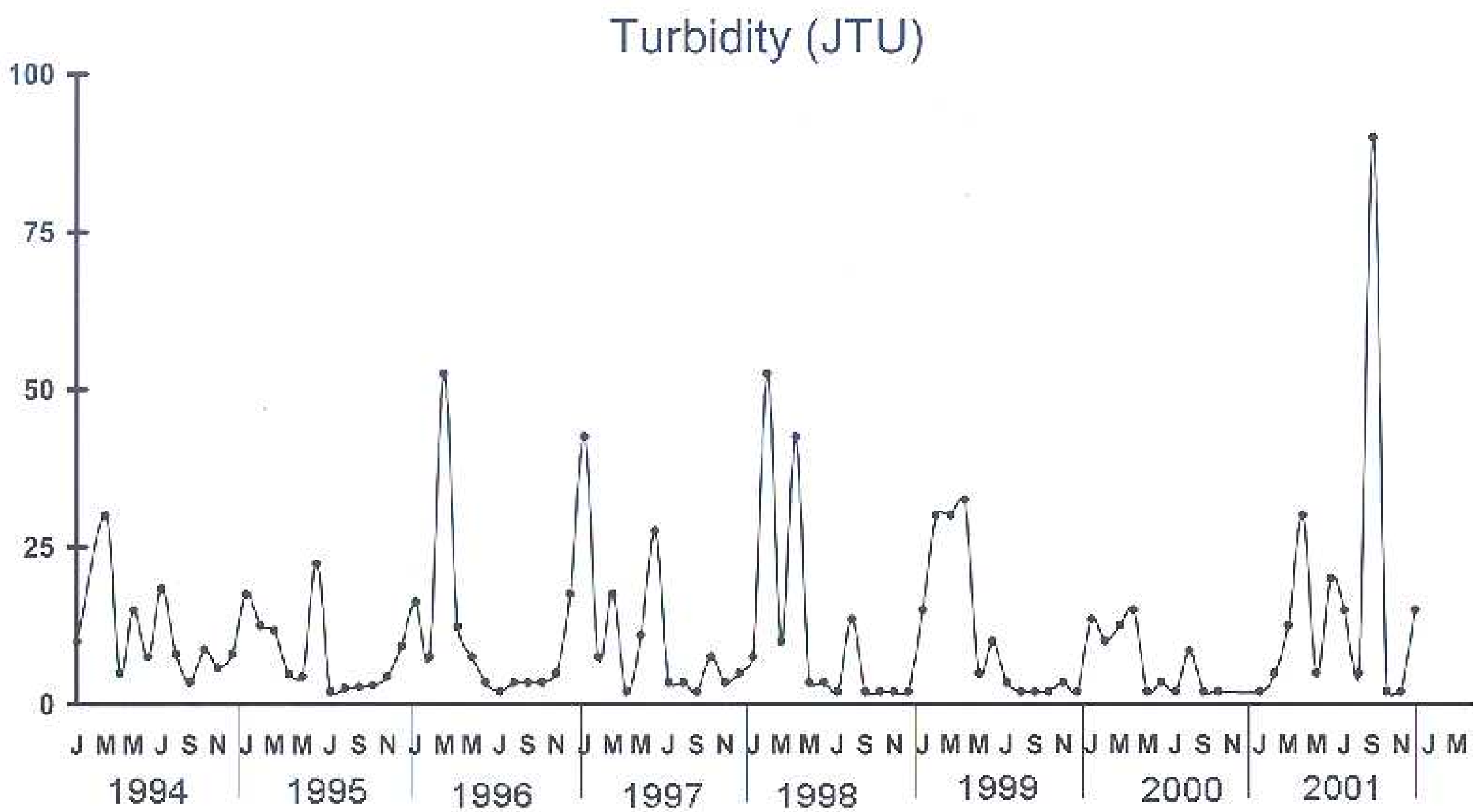
The AWW test kit measures turbidity in Jackson Turbidity Units (JTUs). Other instruments may be used to measure turbidity in Nephelometric Turbidity Units (NTUs). ADEM turbidity standards are in NTUs. There is not a direct relationship between JTUs and NTUs.

In lakes, ponds and estuaries, the **Secchi disk** is used to measure water clarity.

- The Secchi disk is a 20 centimeter (8 inch) diameter disk with black and white quadrants and an attached line marked in pre-measured increments of meters and half-meters.

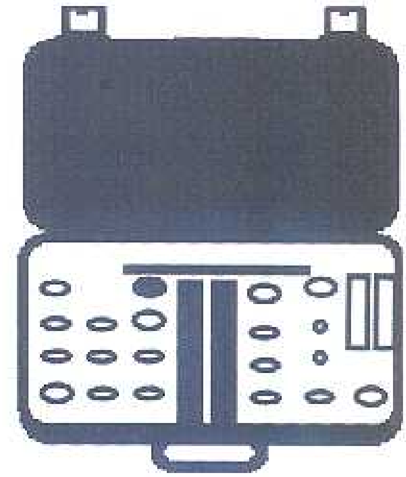
- Secchi Depth is the distance (in meters) from the water surface to the greatest depth at which the disk is still visible.





Turbidity data from Friends of the Locust Fork River (Taylor Ford Shoals, AWW Site Code 10001001). High variability of turbidity over several years indicates a relatively clear stream that periodically becomes turbid after rainfall events.

TURBIDITY: Practice



1. **Fill one turbidity column (code 0835) to the 50 mL line with sample water.**

   If the black dot on the bottom of the tube is not visible when looking down through the column, empty and refill the tube to the 25 mL line with the sample water. If the dot is still not visible, record turbidity as THTM (too high to measure).

2. **Fill the second turbidity column (code 0835) with the same amount of bottled, distilled or tap water. This will be the "control" column.**

   > **Suggestion:** Label one of the turbidity columns "**sample**" and the other "**control**" to avoid confusion.

3. **Vigorously shake the Standard Turbidity Reagent (7520-H) and then add 0.5 mL of the reagent to the "control" column** (some test kit bottle caps have a built-in dropper and others have a separate dropper marked at 0.5 mL).

4. **Mix the contents of both columns with the stirring rod, tapping the rod to remove excess water between stirrings.**

5. **Place the two columns side-by-side on a firm, level surface and look down through them to compare the "clarity" or "fuzziness" of the black dots (do not consider water color).**

   If only one addition of Turbidity Reagent makes the control tube dot more fuzzy than the sample tube, record the turbidity as 2 JTUs.

6. **If the control dot is less fuzzy than the sample, continue to add 0.5mL of Turbidity Reagent to the control column, noting the number of additions.**

   > **Important:** Vigorously shake the Turbidity Reagent bottle before each 0.5 mL addition.

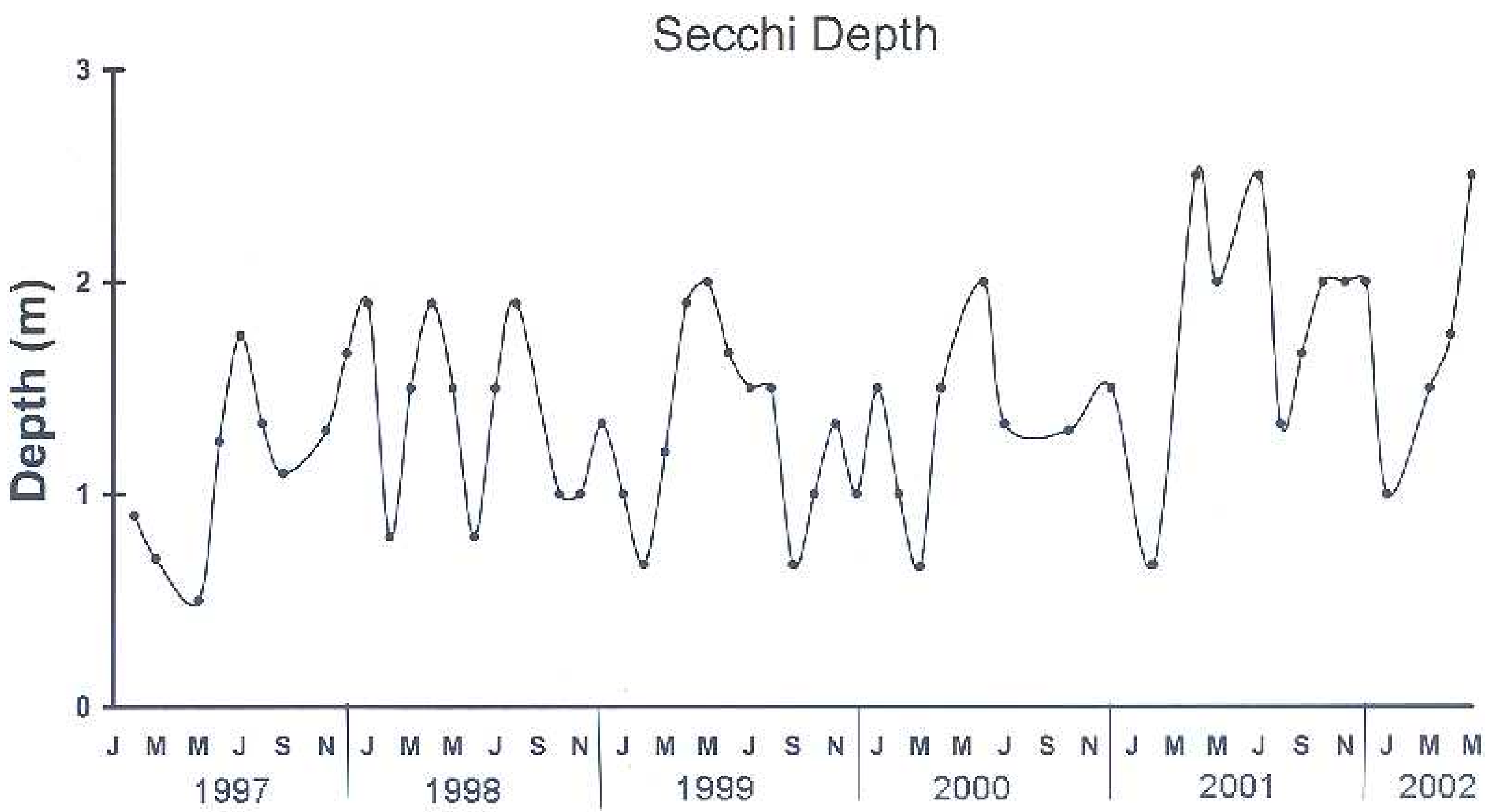
TURBIDITY: Practice

7. **Use the number of measured additions of turbidity reagent to find the corresponding turbidity value on the chart below.**

   Be sure to read from the JTU column that corresponds to the original sample volume (50 mL or 25 mL).

TURBIDITY TEST RESULTS

Number of Measured Additions	50 mL Graduation	25 mL Graduation
0	2 JTU	
1	5 JTU	10 JTU
2	10 JTU	20 JTU
3	15 JTU	30 JTU
4	20 JTU	40 JTU
5	25 JTU	50 JTU
6	30 JTU	60 JTU
7	35 JTU	70 JTU
8	40 JTU	80 JTU
9	45 JTU	90 JTU
10	50 JTU	100 JTU
15	75 JTU	150 JTU
20	100 JTU	200 JTU



Secchi Depth data from Smith Lake Environmental Preservation Committee (Smith Lake, Berry Dock, AWW Site Code 10011001). An upward trend of Secchi Depth suggests that water is becoming clearer at this site over the last several years.

SECCHI DEPTH: Practice

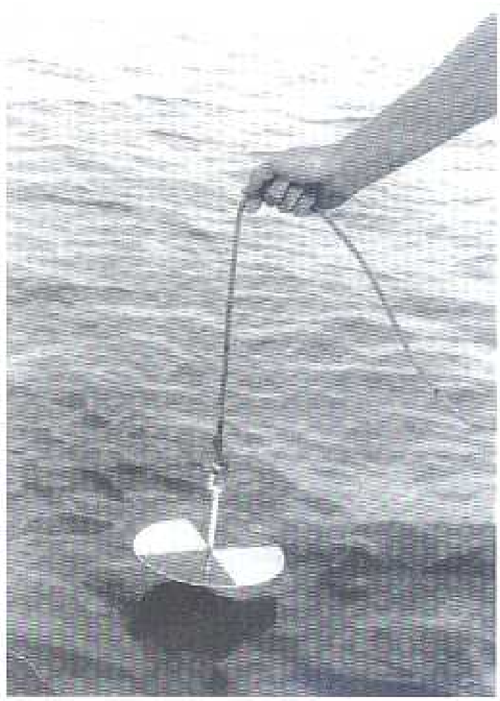
1. Lower the Secchi disk into the water until it disappears from sight.

Move the disk up and down slightly to be sure that you have determined the point at which the disk reappears/disappears.

> **Note:** If the disk reaches the bottom before disappearing, the Secchi Depth is greater than the water depth and cannot be measured. When this occurs, move to deeper water to measure Secchi Depth, or record water depth and note that Secchi Depth was not measured.

2. Pinch the line at the surface of the water and raise the disk. Measure the length of the cord from where you have pinched the cord (the water surface) to the disk. It is recommended to mark the cord in 1-meter increments (with smaller measurements marked at tenths of a meter). Record total length as Secchi Depth.

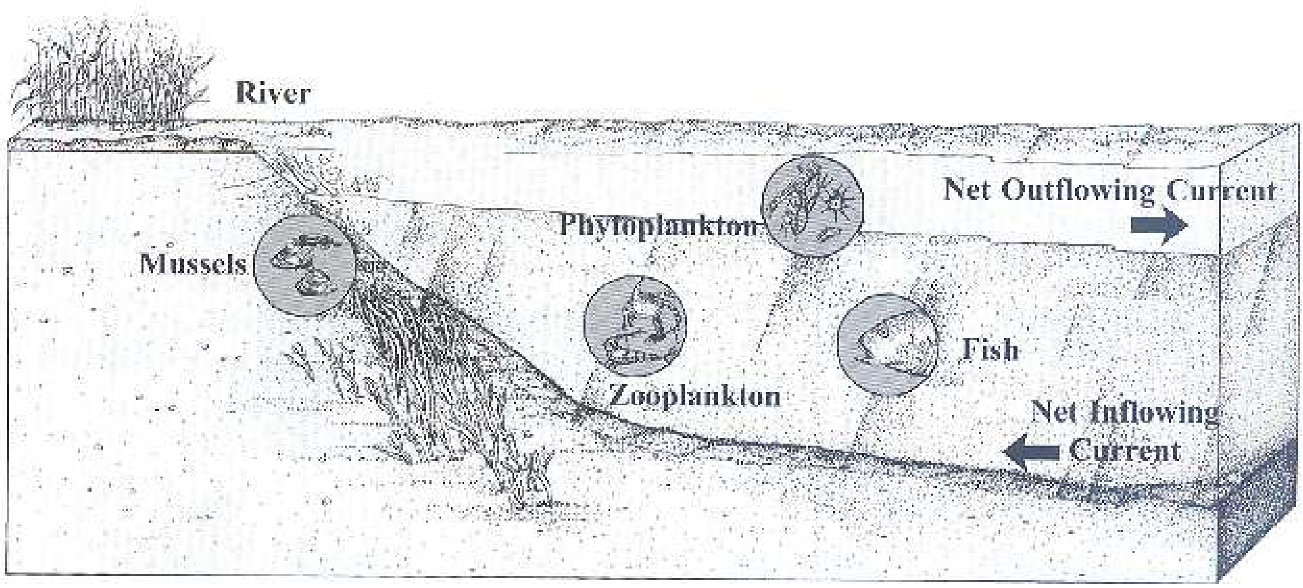
> **Note:** Take Secchi disk measurements on the shady side of the boat or pier. **Do not** wear sunglasses, so that all readings among monitors are standardized.



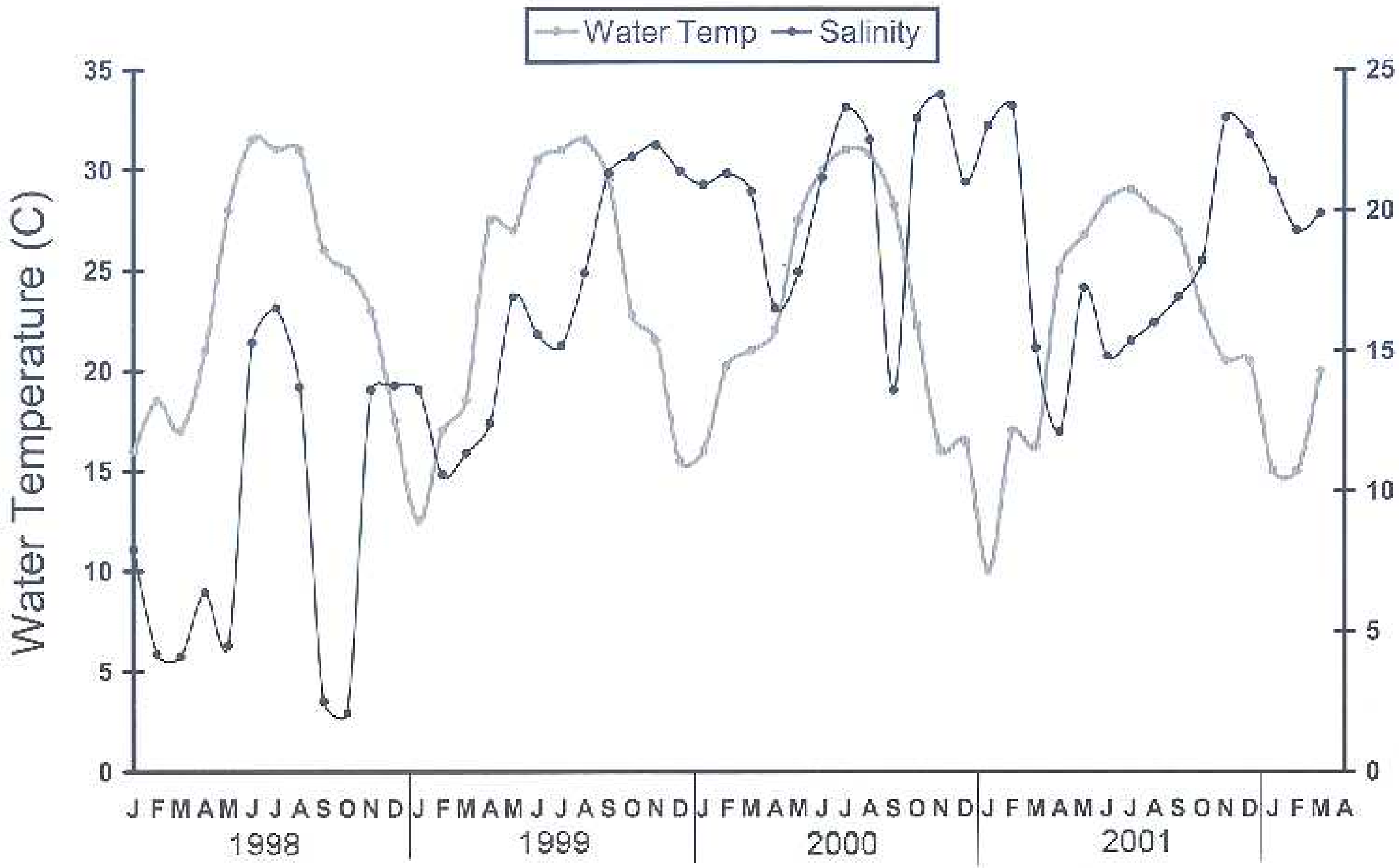
Brackish Water Sampling: Principles

Most AWW monitors have testing sites in freshwater. Monitors living in the coastal areas may be sampling in **brackish water** (a mixture of fresh and saltwater) or seawater. **Estuaries** are the region between the river and ocean where tidal action and river flow create a mixing of fresh and saltwater. They are unique and complex aquatic habitats with a wide range of salinity and other water quality parameters. This presents a challenge to those monitoring water quality in estuaries.

The **salinity** in an estuary can range from 0 to 32 ppt (32 parts per thousand). The salinity in coastal areas should be measured first because it can affect the concentration of the other parameters in the AWW kit. For example, monitors in brackish water may not be able to test for total alkalinity and hardness.



Longitudinal section through a typical estuary from the river to the sea.



Temperature and Salinity from Wolf Bay Watershed Watch (West Shore of Wolf Bay at Griggs Dock, AWW Site Code 04012006). Whereas seasonal temperature fluctuations were relatively stable from year-to-year, salinity increased from 1998 through 2000. Increasing salinities are generally correlated with the drought cycle which resulted in a reduced freshwater inflow to the bay. More seasonable rains in 2001-2002 seem to have stabilized salinity values.

SALINITY: Practice
(For Brackish and Marine Water)

1. **Fill the hydrometer jar (250 mL graduated column) about 3/4 full with sample water.**

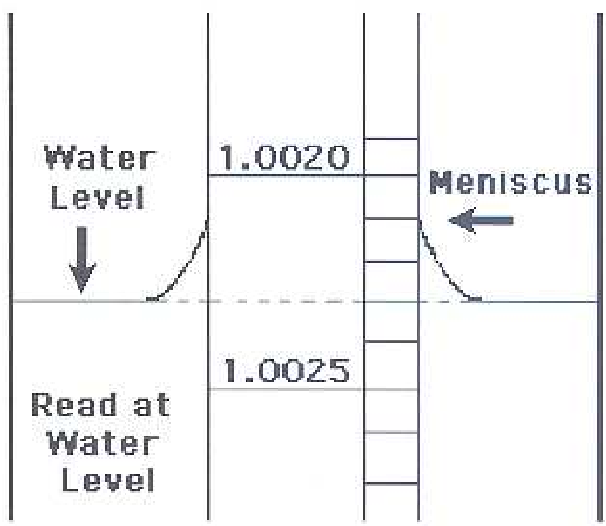
2. **Completely submerge the thermometer in the jar, making sure that it does not interfere with the hydrometer's movement.**

3. **Lower the hydrometer carefully into the jar, allowing it to float freely.**

4. **After 1-3 minutes, view the thermometer through the clear jar and record the water temperature.**

5. **Read and record the specific gravity from the scale in the hydrometer stem at the point where the scale crosses the surface of the water sample in the jar, NOT at the top of the meniscus.**

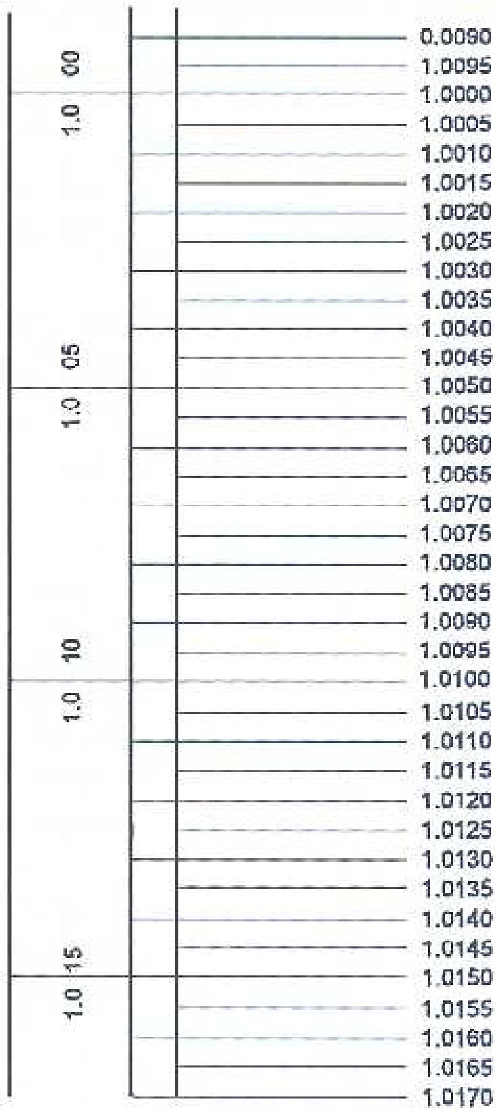
6. **The specific gravity should be read to the fourth decimal place (1.0023 in the example below). Record this value on the line "SG" in the Salinity section of the data form.**



7. To use the Conversion Table for determining Salinity, find the "Hydrometer Reading" in the left hand column and the "Water Temperature ("C)" in the top row. The point of intersection of this row and column represents the salinity of the sample in parts per thousand (ppt). Record this value next to the "ppt" line on the data form.

The Conversion Table for Determining Salinity can be found on the following five pages. You may access a larger version of this table on the AWW website or by contacting the AWW office.

Hydrometer Specific Gravity Scale



Conversion Table for determining Salinity in parts per thousand (ppt)

Hydrometer Reading	Water Temperature (°C)									
	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5
0.9980	-3.3	-3.3	-3.3	-3.3	-3.2	-3.2	-3.2	-3.1	-3.1	-3.0
0.9985	-2.7	-2.7	-2.7	-2.6	-2.6	-2.6	-2.5	-2.5	-2.4	-2.4
0.9990	-2.1	-2.0	-2.0	-2.0	-2.0	-1.9	-1.9	-1.8	-1.8	-1.7
0.9995	-1.4	-1.4	-1.4	-1.3	-1.3	-1.3	-1.2	-1.2	-1.1	-1.1
1.0000	-0.8	-0.8	-0.7	-0.7	-0.7	-0.6	-0.6	-0.5	-0.5	-0.4
1.0005	-0.2	-0.1	-0.1	-0.1	0.0	0.0	0.1	0.1	0.2	0.2
1.0010	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.9
1.0015	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.5
1.0020	1.7	1.8	1.8	1.8	1.9	1.9	2.0	2.0	2.1	2.1
1.0025	2.4	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.7	2.8
1.0030	3.0	3.0	3.1	3.1	3.2	3.2	3.3	3.3	3.4	3.4
1.0035	3.7	3.7	3.7	3.8	3.8	3.8	3.9	3.9	4.0	4.1
1.0040	4.3	4.3	4.4	4.4	4.4	4.5	4.5	4.6	4.7	4.7
1.0045	4.9	5.0	5.0	5.0	5.1	5.1	5.2	5.2	5.3	5.4
1.0050	5.6	5.6	5.6	5.7	5.7	5.8	5.8	5.9	5.9	6.0
1.0055	6.2	6.2	6.3	6.3	6.4	6.4	6.5	6.5	6.6	6.6
1.0060	6.8	6.9	6.9	6.9	7.0	7.0	7.1	7.2	7.2	7.3
1.0065	7.5	7.5	7.5	7.6	7.6	7.7	7.7	7.8	7.8	7.9
1.0070	8.1	8.1	8.2	8.2	8.3	8.3	8.4	8.4	8.5	8.6
1.0075	8.7	8.8	8.8	8.9	8.9	9.0	9.0	9.1	9.1	9.2
1.0080	9.4	9.4	9.5	9.5	9.5	9.6	9.7	9.7	9.8	9.9
1.0085	10.0	10.0	10.1	10.1	10.2	10.2	10.3	10.4	10.4	10.5
1.0090	10.6	10.7	10.7	10.8	10.8	10.9	10.9	11.0	11.1	11.1
1.0095	11.3	11.3	11.4	11.4	11.5	11.5	11.6	11.6	11.7	11.8
1.0100	11.9	12.0	12.0	12.1	12.1	12.2	12.2	12.3	12.4	12.4
1.0105	12.5	12.6	12.6	12.7	12.7	12.8	12.9	12.9	13.0	13.1
1.0110	13.2	13.2	13.3	13.3	13.4	13.4	13.5	13.6	13.6	13.7
1.0115	13.8	13.9	13.9	14.0	14.0	14.1	14.1	14.2	14.3	14.4
1.0120	14.5	14.5	14.5	14.6	14.7	14.7	14.8	14.9	14.9	15.0
1.0125	15.1	15.1	15.2	15.2	15.3	15.4	15.4	15.5	15.6	15.7
1.0130	15.7	15.8	15.8	15.9	15.9	16.0	16.1	16.1	16.2	16.3
1.0135	16.4	16.4	16.5	16.5	16.6	16.6	16.7	16.8	16.9	16.9
1.0140	17.0	17.0	17.1	17.2	17.2	17.3	17.4	17.4	17.5	17.6
1.0145	17.6	17.7	17.7	17.8	17.9	17.9	18.0	18.1	18.1	18.2
1.0150	18.3	18.3	18.4	18.4	18.5	18.6	18.6	18.7	18.8	18.9
1.0155	18.9	19.0	19.0	19.1	19.1	19.2	19.3	19.4	19.4	19.5
1.0160	19.5	19.6	19.6	19.7	19.8	19.8	19.9	20.0	20.1	20.2
1.0165	20.2	20.2	20.3	20.3	20.4	20.5	20.6	20.6	20.7	20.8
1.0170	20.8	20.9	20.9	21.0	21.1	21.1	21.2	21.3	21.4	21.4
1.0175	21.4	21.5	21.6	21.6	21.7	21.8	21.8	21.9	22.0	22.1
1.0180	22.1	22.1	22.2	22.3	22.3	22.4	22.5	22.6	22.6	22.7
1.0185	22.7	22.8	22.8	22.9	23.0	23.0	23.1	23.2	23.3	23.4
1.0190	23.3	23.4	23.5	23.5	23.6	23.7	23.8	23.8	23.9	24.0
1.0195	24.0	24.0	24.1	24.2	24.2	24.3	24.4	24.5	24.6	24.7
1.0200	24.6	24.7	24.7	24.8	24.9	25.0	25.0	25.1	25.2	25.3
1.0205	25.3	25.3	25.4	25.5	25.5	25.6	25.7	25.8	25.9	25.9
1.0210	25.9	26.0	26.0	26.1	26.2	26.2	26.3	26.4	26.5	26.6
1.0215	26.5	26.6	26.7	26.7	26.8	26.9	27.0	27.1	27.1	27.2
1.0220	27.2	27.2	27.3	27.4	27.4	27.5	27.6	27.7	27.8	27.9
1.0225	27.8	27.9	27.9	28.0	28.1	28.2	28.2	28.3	28.4	28.5
1.0230	28.4	28.5	28.6	28.6	28.7	28.8	28.9	29.0	29.1	29.2
1.0235	29.1	29.1	29.2	29.3	29.4	29.4	29.5	29.6	29.7	29.8
1.0240	29.7	29.8	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5
1.0245	30.3	30.4	30.5	30.6	30.6	30.7	30.8	30.9	31.0	31.1
1.0250	31.0	31.0	31.1	31.2	31.3	31.4	31.4	31.5	31.6	31.7
1.0255	31.6	31.7	31.8	31.8	31.9	32.0	32.1	32.2	32.3	32.4
1.0260	32.2	32.3	32.4	32.5	32.6	32.6	32.7	32.8	32.9	33.0
1.0265	32.9	33.0	33.0	33.1	33.2	33.3	33.4	33.5	33.6	33.7
1.0270	33.5	33.6	33.7	33.7	33.8	33.9	34.0	34.1	34.2	34.3
1.0275	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0
1.0280	34.8	34.9	34.9	35.0	35.1	35.2	35.3	35.4	35.5	35.6
1.0285	35.4	35.5	35.6	35.7	35.7	35.8	35.9	36.0	36.1	36.2
1.0290	36.1	36.1	36.2	36.3	36.4	36.5	36.6	36.7	36.8	36.9
1.0295	36.7	36.8	36.9	36.9	37.0	37.1	37.2	37.3	37.4	37.5
1.0300	37.3	37.4	37.5	37.6	37.7	37.8	37.9	38.0	38.1	38.2
1.0305	38.0	38.0	38.1	38.2	38.3	38.4	38.5	38.6	38.7	38.8
1.0310	38.6	38.7	38.8	38.9	38.9	39.0	39.1	39.2	39.3	39.5

Conversion Table for determining Salinity in parts per thousand (ppt)

Hydrometer Reading	Water Temperature (°C)									
	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5
0.9980	-3.0	-2.9	-2.8	-2.8	-2.7	-2.6	-2.5	-2.5	-2.4	-2.3
0.9985	-2.3	-2.2	-2.2	-2.1	-2.0	-2.0	-1.9	-1.8	-1.7	-1.6
0.9990	1.7	-1.6	-1.5	-1.5	-1.4	-1.3	-1.2	-1.2	-1.1	-1.0
0.9995	-1.0	-1.0	-0.9	-0.8	-0.7	-0.7	-0.6	-0.5	-0.4	-0.3
1.0000	-0.4	-0.3	-0.2	-0.2	-0.1	0.0	0.1	0.1	0.2	0.3
1.0005	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0
1.0010	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.4	1.5	1.6
1.0015	1.6	1.6	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.3
1.0020	2.2	2.3	2.3	2.4	2.5	2.6	2.7	2.7	2.8	2.9
1.0025	2.8	2.9	3.0	3.1	3.1	3.2	3.3	3.4	3.5	3.6
1.0030	3.5	3.6	3.6	3.7	3.8	3.9	4.0	4.1	4.1	4.2
1.0035	4.1	4.2	4.3	4.4	4.4	4.5	4.6	4.7	4.8	4.9
1.0040	4.8	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6
1.0045	5.4	5.5	5.6	5.6	5.7	5.8	5.9	6.0	6.1	6.2
1.0050	6.1	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9
1.0055	6.7	6.8	6.9	6.9	7.0	7.1	7.2	7.3	7.4	7.5
1.0060	7.4	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2
1.0065	8.0	8.1	8.2	8.2	8.3	8.4	8.5	8.6	8.7	8.8
1.0070	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5
1.0075	9.3	9.4	9.4	9.5	9.6	9.7	9.8	9.9	10.0	10.1
1.0080	9.9	10.0	10.1	10.2	10.3	10.4	10.5	10.6	10.7	10.8
1.0085	10.6	10.7	10.7	10.8	10.9	11.0	11.1	11.2	11.3	11.4
1.0090	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9	12.0	12.1
1.0095	11.9	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7
1.0100	12.5	12.6	12.7	12.8	12.9	13.0	13.1	13.2	13.3	13.4
1.0105	13.2	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9	14.0
1.0110	13.8	13.9	14.0	14.1	14.2	14.3	14.4	14.5	14.6	14.7
1.0115	14.4	14.5	14.6	14.7	14.8	14.9	15.0	15.1	15.2	15.3
1.0120	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9	16.0
1.0125	15.7	15.8	15.9	16.0	16.1	16.2	16.3	16.4	16.5	16.6
1.0130	16.4	16.5	16.6	16.7	16.7	16.9	17.0	17.1	17.2	17.3
1.0135	17.0	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9
1.0140	17.7	17.8	17.8	17.9	18.0	18.1	18.3	18.4	18.5	18.6
1.0145	18.3	18.4	18.5	18.6	18.7	18.8	18.9	19.0	19.1	19.3
1.0150	19.0	19.0	19.1	19.2	19.3	19.4	19.6	19.7	19.8	19.9
1.0155	19.6	19.7	19.8	19.9	20.0	20.1	20.2	20.3	20.4	20.6
1.0160	20.2	20.3	20.4	20.5	20.6	20.7	20.9	21.0	21.1	21.2
1.0165	20.9	21.0	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.9
1.0170	21.5	21.6	21.7	21.8	21.9	22.0	22.2	22.3	22.4	22.5
1.0175	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9	23.0	23.2
1.0180	22.8	22.9	23.0	23.1	23.2	23.3	23.5	23.6	23.7	23.8
1.0185	23.5	23.6	23.7	23.8	23.9	24.0	24.1	24.2	24.3	24.5
1.0190	24.1	24.2	24.3	24.4	24.5	24.6	24.8	24.9	25.0	25.1
1.0195	24.8	24.9	25.0	25.1	25.2	25.3	25.4	25.5	25.7	25.8
1.0200	25.4	25.5	25.6	25.7	25.8	25.9	26.1	26.2	26.3	26.4
1.0205	26.0	26.1	26.2	26.4	26.5	26.6	26.7	26.8	27.0	27.1
1.0210	26.7	26.8	26.9	27.0	27.1	27.2	27.4	27.5	27.6	27.7
1.0215	27.3	27.4	27.5	27.7	27.8	27.9	28.0	28.1	28.3	28.4
1.0220	28.0	28.1	28.2	28.3	28.4	28.5	28.7	28.8	28.9	29.0
1.0225	28.6	28.7	28.8	28.9	29.1	29.2	29.3	29.4	29.6	29.7
1.0230	29.3	29.4	29.5	29.6	29.7	29.8	30.0	30.1	30.2	30.3
1.0235	29.9	30.0	30.1	30.2	30.4	30.5	30.6	30.7	30.9	31.0
1.0240	30.6	30.7	30.8	30.9	31.0	31.1	31.3	31.4	31.5	31.7
1.0245	31.2	31.3	31.4	31.5	31.7	31.8	31.9	32.0	32.2	32.3
1.0250	31.8	32.0	32.1	32.2	32.3	32.4	32.6	32.7	32.8	33.0
1.0255	32.5	32.6	32.7	32.8	32.9	33.1	33.2	33.3	33.5	33.6
1.0260	33.1	33.2	33.4	33.5	33.6	33.7	33.9	34.0	34.1	34.3
1.0265	33.8	33.9	34.0	34.1	34.2	34.4	34.5	34.6	34.8	34.9
1.0270	34.4	34.5	34.6	34.8	34.9	35.0	35.2	35.3	35.4	35.6
1.0275	35.1	35.2	35.3	35.4	35.5	35.7	35.8	35.9	36.1	36.2
1.0280	35.7	35.8	35.9	36.1	36.2	36.3	36.5	36.6	36.7	36.9
1.0285	36.4	36.5	36.6	36.7	36.8	37.0	37.1	37.2	37.4	37.5
1.0290	37.0	37.1	37.2	37.4	37.5	37.6	37.8	37.9	38.0	38.2
1.0295	37.6	37.8	37.9	38.0	38.1	38.3	38.4	38.5	38.7	38.8
1.0300	38.3	38.4	38.5	38.7	38.8	38.9	39.1	39.2	39.3	39.5
1.0305	38.9	39.1	39.2	39.3	39.4	39.6	39.7	39.8	40.0	40.1
1.0310	39.6	39.7	39.8	39.9	40.1	40.2	40.4	40.5	40.6	40.8

Conversion Table for determining Salinity in parts per thousand (ppt)

Hydrometer Reading	Water Temperature (°C)									
	18.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5
0.9980	-2.2	-2.1	-2.0	-1.9	-1.8	-1.7	-1.5	-1.4	-1.3	-1.2
0.9985	-1.5	-1.4	-1.3	-1.2	-1.1	-1.0	-0.9	-0.8	-0.6	-0.5
0.9990	-0.9	-0.8	-0.7	-0.6	-0.5	-0.3	-0.2	-0.1	0.0	0.2
0.9995	-0.2	-0.1	0.0	0.1	0.2	0.3	0.4	0.6	0.7	0.8
1.0000	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.2	1.4	1.5
1.0005	1.1	1.2	1.3	1.4	1.5	1.6	1.8	1.9	2.0	2.1
1.0010	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	2.7	2.8
1.0015	2.4	2.5	2.6	2.7	2.8	2.9	3.1	3.2	3.3	3.5
1.0020	3.0	3.1	3.3	3.4	3.5	3.6	3.7	3.9	4.0	4.1
1.0025	3.7	3.8	3.9	4.0	4.1	4.3	4.4	4.5	4.7	4.8
1.0030	4.3	4.5	4.6	4.7	4.8	4.9	5.1	5.2	5.3	5.5
1.0035	5.0	5.1	5.2	5.3	5.5	5.6	5.7	5.8	6.0	6.1
1.0040	5.7	5.8	5.9	6.0	6.1	6.2	6.4	6.5	6.6	6.8
1.0045	6.3	6.4	6.5	6.7	6.8	6.9	7.0	7.2	7.3	7.4
1.0050	7.0	7.1	7.2	7.3	7.4	7.6	7.7	7.8	8.0	8.1
1.0055	7.6	7.7	7.8	8.0	8.1	8.2	8.3	8.5	8.6	8.8
1.0060	8.3	8.4	8.5	8.6	8.7	8.9	9.0	9.1	9.3	9.4
1.0065	8.9	9.0	9.2	9.3	9.4	9.5	9.7	9.8	9.9	10.1
1.0070	9.6	9.7	9.8	9.9	10.1	10.2	10.3	10.5	10.6	10.7
1.0075	10.2	10.3	10.5	10.6	10.7	10.8	11.0	11.1	11.3	11.4
1.0080	10.9	11.0	11.1	11.2	11.4	11.5	11.6	11.8	11.9	12.1
1.0085	11.5	11.7	11.8	11.9	12.0	12.2	12.3	12.4	12.6	12.7
1.0090	12.2	12.3	12.4	12.6	12.7	12.8	13.0	13.1	13.2	13.4
1.0095	12.8	13.0	13.1	13.2	13.3	13.5	13.6	13.8	13.9	14.1
1.0100	13.5	13.6	13.7	13.9	14.0	14.1	14.3	14.4	14.6	14.7
1.0105	14.2	14.3	14.4	14.5	14.7	14.8	14.9	15.1	15.2	15.4
1.0110	14.8	14.9	15.1	15.2	15.3	15.5	15.6	15.7	15.9	16.0
1.0115	15.5	15.6	15.7	15.8	16.0	16.1	16.3	16.4	16.5	16.7
1.0120	16.1	16.2	16.4	16.5	16.6	16.8	16.9	17.1	17.2	17.4
1.0125	16.8	16.9	17.0	17.1	17.3	17.4	17.6	17.7	17.9	18.0
1.0130	17.4	17.5	17.7	17.8	17.9	18.1	18.2	18.4	18.5	18.7
1.0135	18.1	18.2	18.3	18.5	18.6	18.7	18.9	19.0	19.2	19.3
1.0140	18.7	18.9	19.0	19.1	19.3	19.4	19.5	19.7	19.9	20.0
1.0145	19.4	19.5	19.6	19.8	19.9	20.1	20.2	20.4	20.5	20.7
1.0150	20.0	20.2	20.3	20.4	20.6	20.7	20.9	21.0	21.2	21.3
1.0155	20.7	20.8	20.9	21.1	21.2	21.4	21.5	21.7	21.8	22.0
1.0160	21.3	21.5	21.6	21.7	21.9	22.0	22.2	22.3	22.5	22.7
1.0165	22.0	22.1	22.3	22.4	22.5	22.7	22.8	23.0	23.2	23.3
1.0170	22.6	22.8	22.9	23.1	23.2	23.3	23.5	23.7	23.8	24.0
1.0175	23.3	23.4	23.6	23.7	23.9	24.0	24.2	24.3	24.5	24.6
1.0180	24.0	24.1	24.2	24.4	24.5	24.7	24.8	25.0	25.1	25.3
1.0185	24.6	24.7	24.9	25.0	25.2	25.3	25.5	25.6	25.8	26.0
1.0190	25.3	25.4	25.5	25.7	25.8	26.0	26.1	26.3	26.5	26.6
1.0195	25.9	26.1	26.2	26.3	26.5	26.6	26.8	27.0	27.1	27.3
1.0200	26.6	26.7	26.8	27.0	27.1	27.3	27.5	27.6	27.8	27.9
1.0205	27.2	27.4	27.5	27.6	27.8	28.0	28.1	28.3	28.4	28.6
1.0210	27.9	28.0	28.2	28.3	28.5	28.6	28.8	28.9	29.1	29.3
1.0215	28.5	28.7	28.8	29.0	29.1	29.3	29.4	29.6	29.8	29.9
1.0220	29.2	29.3	29.5	29.6	29.8	29.9	30.1	30.3	30.4	30.6
1.0225	29.8	30.0	30.1	30.3	30.4	30.6	30.7	30.9	31.1	31.3
1.0230	30.5	30.6	30.8	30.9	31.1	31.2	31.4	31.6	31.7	31.9
1.0235	31.1	31.3	31.4	31.6	31.7	31.9	32.1	32.2	32.4	32.6
1.0240	31.8	31.9	32.1	32.2	32.4	32.6	32.7	32.9	33.1	33.2
1.0245	32.4	32.6	32.7	32.9	33.1	33.2	33.4	33.6	33.7	33.9
1.0250	33.1	33.2	33.4	33.6	33.7	33.9	34.0	34.2	34.4	34.6
1.0255	33.8	33.9	34.1	34.2	34.4	34.5	34.7	34.9	35.0	35.2
1.0260	34.4	34.6	34.7	34.9	35.0	35.2	35.4	35.5	35.7	35.9
1.0265	35.1	35.2	35.4	35.5	35.7	35.8	36.0	36.2	36.4	36.5
1.0270	35.7	35.9	36.0	36.2	36.3	36.5	36.7	36.9	37.0	37.2
1.0275	36.4	36.5	36.7	36.8	37.0	37.2	37.3	37.5	37.7	37.9
1.0280	37.0	37.2	37.3	37.5	37.7	37.8	38.0	38.2	38.3	38.5
1.0285	37.7	37.8	38.0	38.1	38.3	38.5	38.7	38.8	39.0	39.2
1.0290	38.3	38.5	38.6	38.8	39.0	39.1	39.3	39.5	39.7	39.9
1.0295	39.0	39.1	39.3	39.5	39.6	39.8	40.0	40.1	40.3	40.5
1.0300	39.6	39.8	40.0	40.1	40.3	40.5	40.6	40.8	41.0	41.2
1.0305	40.3	40.4	40.6	40.8	40.9	41.1	41.3	41.5	41.7	41.8
1.0310	40.9	41.1	41.3	41.4	41.6	41.8	41.9	42.1	42.3	42.5

Conversion Table for determining Salinity in parts per thousand (ppt)

Hydrometer Reading	Water Temperature (°C)									
	23.0	23.5	24.0	24.5	25.0	25.5	26.0	26.5	27.0	27.5
0.9980	-1.0	-0.9	-0.8	-0.6	-0.5	-0.3	-0.2	0.0	0.2	0.3
0.9985	-0.4	-0.2	-0.1	0.1	0.2	0.4	0.5	0.7	0.8	1.0
0.9990	0.3	0.4	0.6	0.7	0.9	1.0	1.2	1.3	1.5	1.7
0.9995	1.0	1.1	1.2	1.4	1.5	1.7	1.9	2.0	2.2	2.3
1.0000	1.6	1.8	1.9	2.1	2.2	2.4	2.5	2.7	2.8	3.0
1.0005	2.3	2.4	2.6	2.7	2.9	3.0	3.2	3.4	3.5	3.7
1.0010	2.9	3.1	3.2	3.4	3.5	3.7	3.9	4.0	4.2	4.4
1.0015	3.6	3.7	3.9	4.0	4.2	4.4	4.5	4.7	4.9	5.0
1.0020	4.3	4.4	4.6	4.7	4.9	5.0	5.2	5.4	5.5	5.7
1.0025	4.9	5.1	5.2	5.4	5.5	5.7	5.9	6.0	6.2	6.4
1.0030	5.6	5.7	5.9	6.0	6.2	6.4	6.5	6.7	6.9	7.0
1.0035	6.3	6.4	6.6	6.7	6.9	7.0	7.2	7.4	7.5	7.7
1.0040	6.9	7.1	7.2	7.4	7.5	7.7	7.9	8.0	8.2	8.4
1.0045	7.6	7.7	7.9	8.0	8.2	8.4	8.5	8.7	8.9	9.1
1.0050	8.2	8.4	8.5	8.7	8.9	9.0	9.2	9.4	9.5	9.7
1.0055	8.9	9.1	9.2	9.4	9.5	9.7	9.9	10.0	10.2	10.4
1.0060	9.6	9.7	9.9	10.0	10.2	10.4	10.5	10.7	10.9	11.1
1.0065	10.2	10.4	10.5	10.7	10.9	11.0	11.2	11.4	11.6	11.7
1.0070	10.9	11.0	11.2	11.4	11.5	11.7	11.9	12.0	12.2	12.4
1.0075	11.6	11.7	11.9	12.0	12.2	12.4	12.5	12.7	12.9	13.1
1.0080	12.2	12.4	12.5	12.7	12.9	13.0	13.2	13.4	13.6	13.8
1.0085	12.9	13.0	13.2	13.4	13.5	13.7	13.9	14.1	14.2	14.4
1.0090	13.5	13.7	13.9	14.0	14.2	14.4	14.5	14.7	14.9	15.1
1.0095	14.2	14.4	14.5	14.7	14.9	15.0	15.2	15.4	15.6	15.8
1.0100	14.9	15.0	15.2	15.4	15.5	15.7	15.9	16.1	16.2	16.4
1.0105	15.5	15.7	15.9	16.0	16.2	16.4	16.5	16.7	16.9	17.1
1.0110	16.2	16.4	16.5	16.7	16.9	17.0	17.2	17.4	17.6	17.8
1.0115	16.9	17.0	17.2	17.4	17.5	17.7	17.9	18.1	18.3	18.4
1.0120	17.5	17.7	17.8	18.0	18.2	18.4	18.5	18.7	18.9	19.1
1.0125	18.2	18.3	18.5	18.7	18.9	19.0	19.2	19.4	19.6	19.8
1.0130	18.8	19.0	19.2	19.3	19.5	19.7	19.9	20.1	20.3	20.5
1.0135	19.5	19.7	19.8	20.0	20.2	20.4	20.6	20.7	20.9	21.1
1.0140	20.2	20.3	20.5	20.7	20.9	21.0	21.2	21.4	21.6	21.8
1.0145	20.8	21.0	21.2	21.3	21.5	21.7	21.9	22.1	22.3	22.5
1.0150	21.5	21.7	21.8	22.0	22.2	22.4	22.6	22.7	22.9	23.1
1.0155	22.2	22.3	22.5	22.7	22.9	23.0	23.2	23.4	23.6	23.8
1.0160	22.8	23.0	23.2	23.3	23.5	23.7	23.9	24.1	24.3	24.5
1.0165	23.5	23.7	23.8	24.0	24.2	24.4	24.6	24.8	25.0	25.2
1.0170	24.1	24.3	24.5	24.7	24.9	25.0	25.2	25.4	25.6	25.8
1.0175	24.8	25.0	25.2	25.3	25.5	25.7	25.9	26.1	26.3	26.5
1.0180	25.5	25.6	25.8	26.0	26.2	26.4	26.6	26.8	27.0	27.2
1.0185	26.1	26.3	26.5	26.7	26.9	27.0	27.2	27.4	27.6	27.8
1.0190	26.8	27.0	27.1	27.3	27.5	27.7	27.9	28.1	28.3	28.5
1.0195	27.5	27.6	27.8	28.0	28.2	28.4	28.6	28.8	29.0	29.2
1.0200	28.1	28.3	28.5	28.7	28.8	29.0	29.2	29.4	29.6	29.8
1.0205	28.8	29.0	29.1	29.3	29.5	29.7	29.9	30.1	30.3	30.5
1.0210	29.4	29.6	29.8	30.0	30.2	30.4	30.6	30.8	31.0	31.2
1.0215	30.1	30.3	30.5	30.7	30.8	31.0	31.2	31.4	31.6	31.9
1.0220	30.8	30.9	31.1	31.3	31.5	31.7	31.9	32.1	32.3	32.5
1.0225	31.4	31.6	31.8	32.0	32.2	32.4	32.6	32.8	33.0	33.2
1.0230	32.1	32.3	32.5	32.7	32.8	33.0	33.2	33.4	33.7	33.9
1.0235	32.8	32.9	33.1	33.3	33.5	33.7	33.9	34.1	34.3	34.5
1.0240	33.4	33.6	33.8	34.0	34.2	34.4	34.6	34.8	35.0	35.2
1.0245	34.1	34.3	34.5	34.6	34.8	35.0	35.2	35.5	35.7	35.9
1.0250	34.7	34.9	35.1	35.3	35.5	35.7	35.9	36.1	36.3	36.6
1.0255	35.4	35.6	35.8	36.0	36.2	36.4	36.6	36.8	37.0	37.2
1.0260	36.1	36.3	36.4	36.6	36.8	37.0	37.3	37.5	37.7	37.9
1.0265	36.7	36.9	37.1	37.3	37.5	37.7	37.9	38.1	38.3	38.6
1.0270	37.4	37.6	37.8	38.0	38.2	38.4	38.6	38.8	39.0	39.2
1.0275	38.1	38.2	38.4	38.6	38.8	39.0	39.3	39.5	39.7	39.9
1.0280	38.7	38.9	39.1	39.3	39.5	39.7	39.9	40.1	40.4	40.6
1.0285	39.4	39.6	39.8	40.0	40.2	40.4	40.6	40.8	41.0	41.2
1.0290	40.0	40.2	40.4	40.6	40.8	41.0	41.3	41.5	41.7	41.9
1.0295	40.7	40.9	41.1	41.3	41.5	41.7	41.9	42.1	42.4	42.6
1.0300	41.4	41.6	41.8	42.0	42.2	42.4	42.6	42.8	43.0	43.3
1.0305	42.0	42.2	42.4	42.6	42.8	43.0	43.3	43.5	43.7	43.9
1.0310	42.7	42.9	43.1	43.3	43.5	43.7	43.9	44.2	44.4	44.6

Conversion Table for determining Salinity in parts per thousand (ppt)

Hydrometer Reading	Water Temperature (°C)										
	28.0	28.5	29.0	29.5	30.0	30.5	31.0	31.5	32.0	32.5	33.0
0.9980	0.5	0.7	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
0.9985	1.2	1.4	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1
0.9990	1.9	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8
0.9995	2.5	2.7	2.9	3.1	3.3	3.5	3.6	3.9	4.1	4.3	4.5
1.0000	3.2	3.4	3.6	3.7	3.9	4.1	4.3	4.5	4.7	4.9	5.2
1.0005	3.9	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8
1.0010	4.5	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.1	6.3	6.5
1.0015	5.2	5.4	5.6	5.8	6.0	6.2	6.4	6.6	6.8	7.0	7.2
1.0020	5.9	6.1	6.3	6.4	6.6	6.8	7.0	7.2	7.4	7.7	7.9
1.0025	6.6	6.7	6.9	7.1	7.3	7.5	7.7	7.9	8.1	8.3	8.6
1.0030	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.8	9.0	9.2
1.0035	7.9	8.1	8.3	8.5	8.7	8.9	9.1	9.3	9.5	9.7	9.9
1.0040	8.6	8.8	8.9	9.1	9.3	9.5	9.7	10.0	10.2	10.4	10.6
1.0045	9.2	9.4	9.6	9.8	10.0	10.2	10.4	10.6	10.8	11.1	11.3
1.0050	9.9	10.1	10.3	10.5	10.7	10.9	11.1	11.3	11.5	11.7	12.0
1.0055	10.6	10.8	11.0	11.2	11.4	11.6	11.8	12.0	12.2	12.4	12.6
1.0060	11.3	11.4	11.6	11.8	12.0	12.2	12.5	12.7	12.9	13.1	13.3
1.0065	11.9	12.1	12.3	12.5	12.7	12.9	13.1	13.3	13.6	13.8	14.0
1.0070	12.6	12.8	13.0	13.2	13.4	13.6	13.8	14.0	14.2	14.5	14.7
1.0075	13.3	13.5	13.7	13.9	14.1	14.3	14.5	14.7	14.9	15.1	15.4
1.0080	13.9	14.1	14.3	14.5	14.7	14.9	15.2	15.4	15.6	15.8	16.0
1.0085	14.6	14.8	15.0	15.2	15.4	15.6	15.8	16.1	16.3	16.5	16.7
1.0090	15.3	15.5	15.7	15.9	16.1	16.3	16.5	16.7	17.0	17.2	17.4
1.0095	16.0	16.2	16.4	16.6	16.8	17.0	17.2	17.4	17.6	17.9	18.1
1.0100	16.6	16.8	17.0	17.2	17.4	17.6	17.9	18.1	18.3	18.5	18.8
1.0105	17.3	17.5	17.7	17.9	18.1	18.3	18.5	18.8	19.0	19.2	19.5
1.0110	18.0	18.2	18.4	18.6	18.8	19.0	19.2	19.4	19.7	19.9	20.1
1.0115	18.6	18.8	19.0	19.3	19.5	19.7	19.9	20.1	20.3	20.6	20.8
1.0120	19.3	19.5	19.7	19.9	20.1	20.4	20.6	20.8	21.0	21.3	21.5
1.0125	20.0	20.2	20.4	20.6	20.8	21.0	21.3	21.5	21.7	21.9	22.2
1.0130	20.7	20.9	21.1	21.3	21.5	21.7	21.9	22.2	22.4	22.6	22.9
1.0135	21.3	21.5	21.7	21.9	22.2	22.4	22.6	22.8	23.1	23.3	23.5
1.0140	22.0	22.2	22.4	22.6	22.8	23.1	23.3	23.5	23.7	24.0	24.2
1.0145	22.7	22.9	23.1	23.3	23.5	23.7	24.0	24.2	24.4	24.7	24.9
1.0150	23.3	23.5	23.8	24.0	24.2	24.4	24.6	24.9	25.1	25.3	25.6
1.0155	24.0	24.2	24.4	24.6	24.9	25.1	25.3	25.5	25.8	26.0	26.3
1.0160	24.7	24.9	25.1	25.3	25.5	25.8	26.0	26.2	26.5	26.7	26.9
1.0165	25.4	25.6	25.8	26.0	26.2	26.4	26.7	26.9	27.1	27.4	27.6
1.0170	26.0	26.2	26.5	26.7	26.9	27.1	27.3	27.6	27.8	28.1	28.3
1.0175	26.7	26.9	27.1	27.3	27.6	27.8	28.0	28.3	28.5	28.7	29.0
1.0180	27.4	27.6	27.8	28.0	28.2	28.5	28.7	28.9	29.2	29.4	29.7
1.0185	28.0	28.3	28.5	28.7	28.9	29.1	29.4	29.6	29.8	30.1	30.3
1.0190	28.7	28.9	29.1	29.4	29.6	29.8	30.1	30.3	30.5	30.8	31.0
1.0195	29.4	29.6	29.8	30.0	30.3	30.5	30.7	31.0	31.2	31.5	31.7
1.0200	30.1	30.3	30.5	30.7	30.9	31.2	31.4	31.6	31.9	32.1	32.4
1.0205	30.7	30.9	31.2	31.4	31.6	31.8	32.1	32.3	32.6	32.8	33.1
1.0210	31.4	31.6	31.8	32.1	32.3	32.5	32.8	33.0	33.2	33.5	33.7
1.0215	32.1	32.3	32.5	32.7	33.0	33.2	33.4	33.7	33.9	34.2	34.4
1.0220	32.7	33.0	33.2	33.4	33.6	33.9	34.1	34.4	34.6	34.9	35.1
1.0225	33.4	33.6	33.9	34.1	34.3	34.6	34.8	35.0	35.3	35.5	35.8
1.0230	34.1	34.3	34.5	34.8	35.0	35.2	35.5	35.7	36.0	36.2	36.5
1.0235	34.8	35.0	35.2	35.4	35.7	35.9	36.1	36.4	36.6	36.9	37.1
1.0240	35.4	35.7	35.9	36.1	36.3	36.6	36.8	37.1	37.3	37.6	37.8
1.0245	36.1	36.3	36.6	36.8	37.0	37.3	37.5	37.7	38.0	38.2	38.5
1.0250	36.8	37.0	37.2	37.5	37.7	37.9	38.2	38.4	38.7	38.9	39.2
1.0255	37.4	37.7	37.9	38.1	38.4	38.6	38.9	39.1	39.4	39.6	39.9
1.0260	38.1	38.3	38.6	38.8	39.0	39.3	39.5	39.8	40.0	40.3	40.5
1.0265	38.8	39.0	39.2	39.5	39.7	40.0	40.2	40.5	40.7	41.0	41.2
1.0270	39.5	39.7	39.9	40.2	40.4	40.6	40.9	41.1	41.4	41.6	41.9
1.0275	40.1	40.4	40.6	40.8	41.1	41.3	41.6	41.8	42.1	42.3	42.6
1.0280	40.8	41.0	41.3	41.5	41.7	42.0	42.2	42.5	42.7	43.0	43.3
1.0285	41.5	41.7	41.9	42.2	42.4	42.7	42.9	43.2	43.4	43.7	44.0
1.0290	42.1	42.4	42.6	42.9	43.1	43.3	43.6	43.8	44.1	44.4	44.6
1.0295	42.8	43.0	43.3	43.5	43.8	44.0	44.3	44.5	44.8	45.0	45.3
1.0300	43.5	43.7	44.0	44.2	44.4	44.7	44.9	45.2	45.5	45.7	46.0
1.0305	44.2	44.4	44.6	44.9	45.1	45.4	45.6	45.9	46.1	46.4	46.7
1.0310	44.8	45.1	45.3	45.5	45.8	46.0	46.3	46.6	46.8	47.1	47.4

WHAT NEXT?

How do you get started monitoring after attending the Water Chemistry Certification workshop?

1. **Become part of a monitoring group or start your own group.**
   The AWW Program can provide information on existing monitoring groups near you who may already have a sampling strategy in place and available test kits.

2. **Get a water quality test kit.**
   Joining an existing group is the best way to get access to a test kit. Many groups have raised money to purchase kits or have found "inactive" kits from individuals who no longer monitor. Kits can be shared and rotated on different days during the month for individuals in the group.

Possible sources of funding for kits are:

♦Legacy, Inc. grants
♦Civic clubs
♦Local government offices (City Planner, County Commissioner, etc.)
♦State and Federal Agencies (Natural Resource Conservation Service, Resource Conservation & Development Councils, Soil and Water Conservation Districts)
♦Teacher grants
♦AWW Program, AWWA and other non-profit organizations

Possible sources for borrowing a kit:

♦Natural Resource Conservation Service
♦Alabama Cooperative Extension System
♦Health Department
♦Local Groups
♦AWW Program and AWW Association

3. **Choose a waterbody you want to monitor.**
   Most individuals who complete the Water Chemistry Certification workshop live close to a waterbody they want to monitor. It's natural to be curious about a stream near your property or the lake where you live. New monitors may check with an established AWW group or the AWW office to get advice on where to monitor.

MONITORING OBJECTIVES

The basic objective of water quality monitoring is to collect credible data that will be used for the **Protection** or **Restoration** of a stream or lake.

Virtually every stream or lake is changing from both natural and human-induced ("anthropogenic") causes. Monitors should ask...

"Is my waterbody getting better or worse?"

♦ For waterbodies that are either improving or are already clean, monitoring information is important to build a case for needed stream upgrades and protection.

♦ For waterbodies getting worse, it is important to collect information to correct pollution problems that need immediate attention.

Consistent monitoring is the only way to establish a **baseline** for determining conditions and changes.

Selecting sites at strategic locations along a stream, such as above and below an obvious point or nonpoint source of pollution is a good approach for assessing a watershed.

Selecting a site on a stream, lake or estuary that has few to no impacts from point or nonpoint sources is important to provide a standard or **reference site** for water quality that would be typical of the best conditions for that watershed.

Monitors may compare their data from other sites on the watershed to the reference site in order to determine levels and rates of **degradation** or **recovery**.

Alabama Water Use Classification and Standards (ADEM 2001)

Classification	pH	Water Temperature °C	Dissolved Oxygen ppm
Outstanding National Resource Waters	No new discharge, Mandatory BMP	No new discharge, Mandatory BMP	No new discharge, Mandatory BMP
Outstanding Alabama Waters	6.0-8.5	32° (30°), 2.8 R	5.5
Swimming	6.0-8.5	32° (30°), 2.8 R	5.0
Shellfish Harvesting	6.0-8.5	32° (30°), 2.8 R	5.0
Public Water Supply	6.0-8.5	32° (30°), 2.8 R	5.0
Fish and Wildlife	6.0-8.5	32° (30°), 2.8 R	5.0
Limited Warm Water Fishery	6.0-8.5	32° (30°), 2.8 R	3.0 (May-Nov), 5.0 (Dec-Apr)
Agricultural and Industrial Water Supply	6.0-8.5	32° (30°), 2.8 R	3.0

- Some streams and lakes in the Tennessee, Cahaba and Warrior watersheds have been designated by the Alabama Department of Conservation and Natural Resources (ADCNR) as supporting certain cool water fisheries and should not exceed 30°C.

- 2.8 R indicates that no more than a 2.8°C rise above the normal (or ambient) stream temperature is permitted (not to exceed 32°C or 30°C).

The 303(d) List and TMDLs

Section 303(d) of the Federal Clean Water Act requires that states report waterbodies that do not meet water quality standards for their designated water use classification.

The resulting inventory of **impaired** waterbodies, called the **303(d) list**, provides a basis for decisions related to restoring and protecting water quality.

The TMDL is the maximum quantity of a pollutant (from point and nonpoint sources) that can enter a waterbody without adversely affecting the designated uses of the waterbody.

The U.S. Environmental Protection Agency requires that "**total maximum daily loads**" or **TMDLs** be developed by ADEM for waterbodies on the 303(d) list.

www.epa.gov/owow/tmdl/policy.html

AWW citizen monitoring data has become a useful supplement to agency and research data for developing TMDLs and identifying waterbodies that should be on the 303(d) list or upgraded to higher use classifications.

If possible, add sites on 303(d) stream segments to your monitoring plan. To determine the location of a 303(d) listed stream near you, call the AWW office or check the AWW website.

STREAMWALK ACTIVITIES

What is a streamwalk?

A streamwalk is a periodic (seasonal) **visual assessment** of a stream and its watershed. It's done by walking along the stream and exploring the watershed, noting key features and how they may change over time. The visual assessment portion of the STREAMWALK form is presented on pages 68-69.

Many people may not even be aware that there is a stream near their home, much less what type of land practices may be influencing water quality.

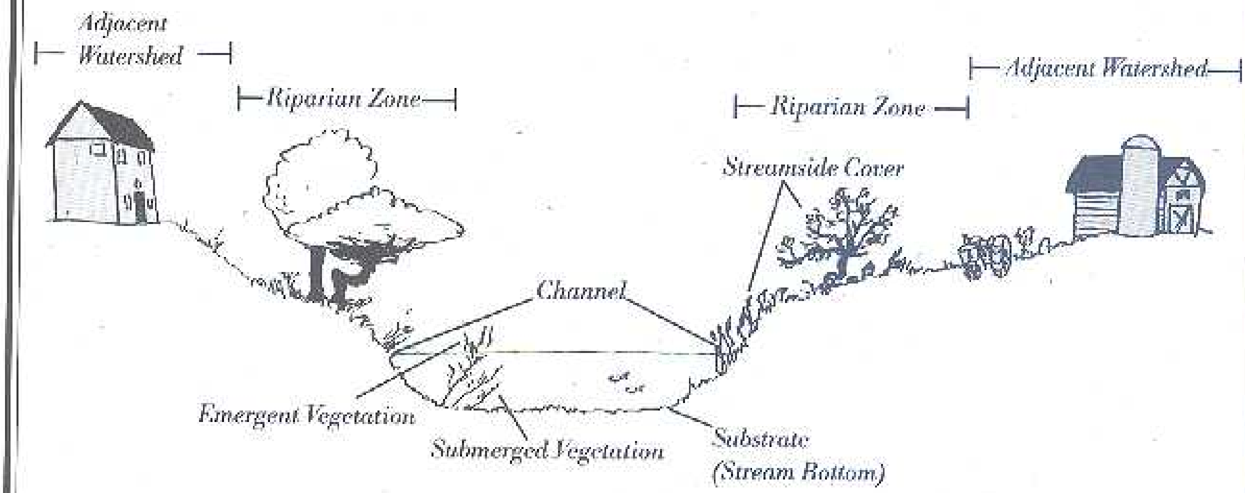
To do a survey you must get out and look around with this question in mind:
What's happening on the watershed that may be affecting this stream or lake?

Examples of land uses that should be noted:

- types of agriculture and grazing
- failing septic systems
- point source discharges
- landfills, dumps and litter
- types of construction sites and practices
- chemical spills
- types of lawn and garden care
- forest management and logging practices

Symptoms of possible water pollution

- sediment-clogged streams or lake embayments
- dead fish or fish "gulping" at the water surface
- fish advisories caused by bacteria or toxic wastes
- excessive aquatic plant growth
- floating "scum" or algal mats
- few fish or other aquatic organisms
- bad odors
- litter in streams



Components of the Stream System and surrounding landuse.

Streamwalks can be very useful for selecting AWW monitoring sites.

STREAMWALK

Visual Assessment

Stream Name:____
Location:____
Date:________________

Weather Conditions at time of Stream Walk: (check one)
___clear ___cloudy ___rainy ___other

What color is the water? (check all that apply)
___clear ___oily ___black ___foamy ___green ___muddy
___brown ___other

How does the water smell?
___no odor ___rotten egg ___gasoline or oil ___chemical ___chlorine
___sewage ___rotting ___fishy

What is the composition of the stream bottom? (check all the types of material that you see)
___sand ___gravel ___boulders ___limestone marl ___silt ___other

What materials form most of the stream bottom? (in the blanks write 1 for the most common bottom material, 2 for the second most common, etc.)
___sand ___gravel ___boulders ___bedrock ___silt ___other

How fast is the water in the stream moving? ___very fast ___fast ___slow ___not at all

Are algae present? (algae are a variety of aquatic photosynthetic organisms, check all that you see)
___not present ___present in spots ___attached to rocks
___everywhere ___floating ___matted on the streambed

If present, what color are the algae? (check all that you see)
___light green ___dark green ___brown ___red ___orange

Do you see any fish in the stream? ___absent ___moderately abundant ___abundant

How many different types of fish do you see? ___1 ___2-3 ___more than 3

Did you see any amphibians or reptiles? ___yes ___no

If the sun was directly above the stream, how much of the stream would be shaded? (This question refers to an estimate of the average amount of tree cover over the stream.)
___fully exposed (0-25% of the stream is shaded from the sun)
___partially exposed (25-50% of the stream is shaded)
___partially shaded (50-75% of the stream is shaded)
___fully shaded (75-100% of the stream is shaded)

Facing upstream, how much of the streambank is covered by plants, rocks and logs?
Stream edge to 25 feet back from stream:

Left Bank:	Right Bank:
___70-100% covered	___70-100% covered
___30-70% covered	___30-70% covered
___less than 30% covered	___less than 30% covered

25 to 100 feet back from stream:

Left Bank:	Right Bank:
___70-100% covered	___70-100% covered
___30-70% covered	___30-70% covered
___less than 30% covered	___less than 30% covered

What are the landuses in the watershed in the areas adjacent to and immediately upstream from your sampling site? (check all used observed)

___farming/crops	___forest	___residential	___poultry/swine
___pasture/grazing	___stores/malls	___mining	
___construction	___factories	___logging	

What are the three most common landuses in the watershed (of the stream segment surveyed) in terms of acreage involved?
1.____________________ 2.____________________ 3.____________________

What are the local uses of the stream?

___drinking water supply	___recreation	___swimming	___fishing
___industrial water supply	___agriculture	___irrigation	___livestock watering
___other			

Are there any pipes emptying directly into or near the stream?___yes ___no
If yes, is there a discharge?___yes ___no

Are there barriers in the stream?___dams ___bridges ___woody debris ___waterfalls

Is there any trash in or immediately adjacent to the stream?
___absent ___moderately abundant ___abundant

For complete STREAMWALK forms, contact the AWW office or website.

SITE SELECTION

General criteria for good sampling sites are:

1) **Safe and Accessible**

Being able to reach your site quickly is better than needing long hikes to remote areas (especially on hot summer days!). Choose a site that is not too difficult or dangerous to access. Bridge crossings generally provide easy access to streams. At bridge crossings, sample the upstream side of the bridge whenever possible.

2) **Legal**

Obtain permission from a landowner if you want to cross private property. In most cases, the bottom of the creek is owned by the adjacent property owners, and the water is public property.

3) **Strategic**

Your water quality test site should meet your sampling objectives in an efficient manner. Sites are usually spaced throughout the watershed of concern to accommodate the interests and availability of the monitors and provide water quality information from several points on the waterbody.

STREAM SITES

Chemical measurements will be useful regardless of the stream size, but it's important to be aware that the larger the waterbody, the more difficult it is to discern pollution impacts.

Most monitors sample stream sites that are relatively shallow and wadable. Whenever possible, sample in water currents that are at least 30 cm/s (one foot per second) so that your measurements are representative of the stream channel. Avoid sampling quiet backwaters or in heavily vegetated areas of streams.

LAKE SITES

Lake sites are often selected that represent tributary inflows, embayments and points of open water. Some groups sample lakes in depth profiles to understand seasonal variations and lake "turnovers." Measurements taken at 5 ft. deep are more comparable to State Agency measurements (see how to sample using a remote sampler, p. 23).

Use of Maps

County maps are good for identifying road crossings on waterbodies of interest.

Topographic maps provide more physical detail and are also useful in helping to delineate the boundaries of the watershed. These maps can usually be found in outdoor recreation stores.

Global Positioning System units (GPS units) are available to borrow from the AWW office for determining latitude, longitude and elevation of a site. The AWW office will use your site description to assign a unique 8-digit site code and to produce maps that locate your site on the watershed.

DATA COLLECTING TIPS

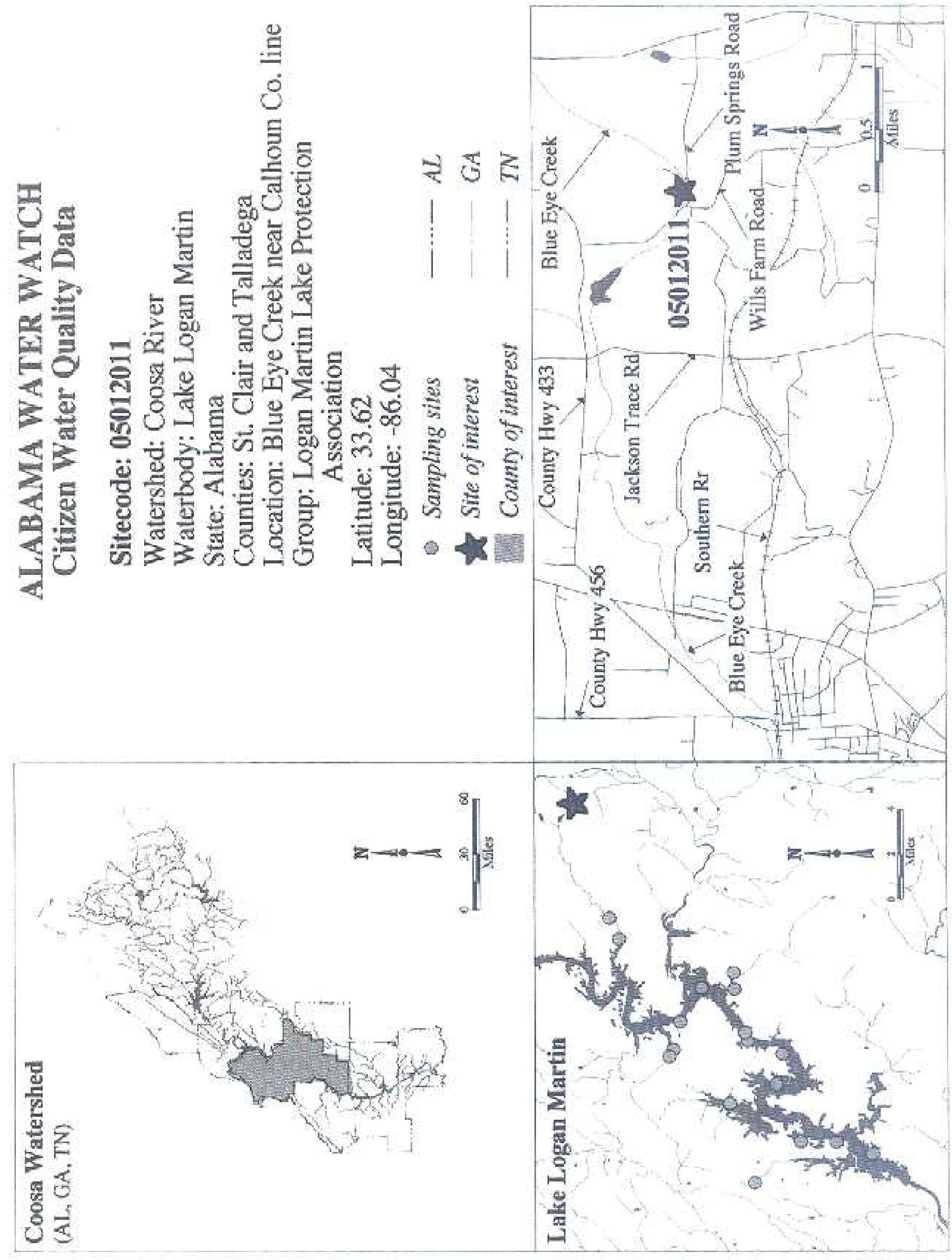
- Sampling directions may be copied and laminated for use at sampling site.
- Sampling monthly at a few sites is much better than intermittent sampling at many sites. Groups should carefully plan their monitoring strategy to collect the most complete data that their time and numbers of monitors and kits will allow.
- Monitors should always try to find a substitute (another **certified** monitor) to test their site if they are not able to sample in a given month.
- Monitoring should be done at about the same time of the month and day whenever possible. It is recommended that "monthly" samples at a given site are taken at least two weeks apart, and that sampling be conducted between 10 a.m. and 2 p.m.
- Chemical reagent bottles may be numbered or color-coded for easy reference.

If you are unable to sample your site because it is dry:

- Measure the Air Temperature
- Fill out the top portion of the data form and submit to AWW
- Note the conditions of your site in the Comments section of the data form

A record of the frequency and duration of drought (dry sites) is valuable for the AWW statewide database.

Example AWW Sampling Site Map



DATA REPORTING

Proper recording of data is an essential component of monitoring. **A copy of the data reporting form (p. 75) should be filled out in the field at the time of sampling.** Don't rely on your memory to fill in details later.

Guidelines for Proper Data Form Completion

- The data reporting form provides three carbonless copies. The original white sheet should be mailed to the AWW Program after each sampling. One copy should be kept by the monitor, and the third copy should be kept by the citizen monitoring group.

  It's important for the monitor to maintain a copy of these data records because they may be needed later for quality assurance and data checks. It's also safer to keep the original data in more than one location (with the monitor, group and AWW office).

- Write **legibly**. Block printing is preferred.

- Record your **Group Name**. If it's your first time monitoring, please call the AWW office to discuss an appropriate group name (e.g. Friends of Lucky Creek, or Lonesome Lake Water Watch).

- Record the **Collector**. This is the monitor who actually samples the waterbody and who should sign the data reporting form. Names of up to four monitors are allowed for team sampling.

- Record the **Contact Name**. This person may be the Group Leader or a person within the group designated to handle all data collected by the group. If you are a "group of one," it's not necessary to fill this out. The AWW Program will usually contact the collector for any questions regarding the actual data.

- Record the **Date** and **Time** (use military time, e.g. 9 a.m. = 0900; 1:30 p.m. = 1330) the data was **collected,** not the date it was signed and mailed to the AWW Program.

- Record a **Group Site Code** if your group has assigned a number or code to your sites. This is optional, but may be helpful if there is more than one site on the same waterbody (e.g. C-1, C-2, C-3).

- Carefully record the 8-digit, **AWW Site Code** (assigned by the AWW Program when you send in your first data reporting form). This is very important!

- Record a consistent **"Sampling Site Location"** description each time you monitor a particular site. Don't leave the AWW Program guessing where you sampled. It's helpful to include a landmark such as a County Road or bridge crossing (e.g. 30 feet upstream of bridge crossing on CR 159). Please complete a Sampling Site Form (p. 77) for each new site.

> **Note**: Monitors should also send in a signed copy of the AWW Liability Release Form (p. 81) when submitting their first data form.

- Record the **major watershed** of the waterbody being tested (see p. 12 or ask the AWW Program if you are unsure).

- Record the **waterbody**. The AWW Program can help if you do not know. Record "Unnamed tributary" if you are sampling a small stream that is not labelled on your map or does not have a recognized local name.

- Record the **County** the data was collected in (not necessarily the county where you live). The AWW Program has all the county maps of Alabama and can provide assistance if needed.

- Circle the **weather condition** that most closely reflects the conditions at the time of your sampling.

- Circle the **water level** that most closely reflects the level (relative to an annual, average level) at the time of your sampling.

The AWW Program is initiating the option of data entry via the internet. Regardless of whether monitors submit data online or mail in data forms, it is important that they keep a hard copy of the data form for possible future reference.

ALABAMA WATER WATCH
DATA REPORTING FORM

AWW WATER CHEMISTRY REPORTING FORM

Web Database
Date Entered:

Group Name: ______
Address: ______ Collector(s): ______
City: ______ State: ______ Zip: ______ Contact Phone:
Date (mmddyy): ______ Time (ex: 1330): ______ Group Code: ______ AWW Site Code: ______
Watershed: ______ Waterbody Name: ______ County: ______ State: ______
Sampling Site Location: ______

(Be consistent. If the location has changed since the site was last sampled, note change in reference to earlier description.)

Weather Conditions (Circle One)	1 = Clear 2 = Cloudy 3 = Partly Cloudy 4 = Drizzle 5 = Rain 6 = Other ______
Water Conditions (Circle One)	Inland Waterbodies (Streams/Rivers/Lakes): 1 = Below Normal 2 = Normal 3 = Above Normal Level (ft) ______
	Tidally Influenced Streams and Rivers: 1 = Rising Tide 2 = Falling Tide

Parameter	Value	Comments
Air Temperature	______ °C	Reminder: Take air temperature first.
Water Temperature	______ °C	Avoid touching thermometer bulb.
pH	______ SU	Be sure to hold the dropper straight up and down.
Dissolved Oxygen (DO)	Rep#1 ______ ppm Rep#2 ______ ppm	Redo entire test if two results are not within 0.6 ppm of each other.
% Saturation	______ %	Use the chart found in the AWW manual (DO & Water Temp values).
Total Alkalinity	______ # drops x 5 = ______ mg/L	Drop until no more color change.
Total Hardness	______ # drops x 10 = ______ mg/L	Drop until no more color change.
Turbidity	______ # of 0.5 ml additions x 5 (50ml) = ______ JTU ______ # of 0.5 ml additions x 10 (25ml) = ______ JTU	If < 5 JTUs, put 2.
Secchi Depth	______ meters	Check incremental measurements and rope length often.
Salinity	______ S.G. ______ ppt	Record both Specific Gravity & ppt.
Other Chemistry Tests		

Collector Comments/Observations:	This space reserved for AWW Office use:

My AWW Chemical Monitoring Certification is current and I have confirmed the freshness of each reagent used for these tests.

Signature ______

NEW SAMPLING SITE FORM

It is essential to know the precise location of a monitoring site for full use of the data. Please carefully describe your site information.

Monitors ____________________

Contact Phone Number ____________________

AWW Group Affiliation (e.g. Bubba River Watch) ____________________

Waterbody ____________________

County and State Where Site Is Located ____________________

Site Location Description: Be very detailed. Include information such as the name or number of the nearest road. Indicate if it is upstream or downstream of a bridge, etc. Please submit a map, a photo (optional) and a georeference. Call the AWW office for assistance.

____

____

____

Latitude ____________

Longitude ____________

****

Do not write below this line. AWW office use only.

AWW Site Code Number* ____________________

*** An 8-digit number will be assigned by the Water Watch office when the above information is submitted.**

ORDERING WATER QUALITY EQUIPMENT AND SUPPLIES

Alabama Water Quality Monitoring Kit:

LaMotte Company
P.O. Box 329
Chestertown, Maryland 21620
Phone: 800-344-3100 (to place orders or request additional information)
Fax: 410-778-6394
E-mail: www.lamotte.com

Complete Kit
Catalog number 9844-01, about $215 (Standard Kit)
Catalog number 9844-02, about $275 (Kit with Secchi disk)

Refill Chemicals
Catalog number R-9844-01, about $65

Orders can be made with a credit card, C.O.D. or purchase order number.

Hydrometer: (for coastal water monitoring of salinity)

LaMotte Company hydrometer (1.000/1.070), code 3-0011, about $28

Remote Sampler:

Alabama Water Watch
203 Swingle Hall
Auburn University, AL 36849
Toll free: 888-844-4785
Website: www.alabamawaterwatch.org
Email: aww@acesag.auburn.edu

Alabama Water Watch Certified Water Chemistry Monitor Information Form

Personal Information (please print clearly)

Name: ______________________________

Phone (h): ______________ Phone (w): ______________ Fax: ______________

Mailing Address: ______________________ E-mail: ______________________

City: ______________ State: ____ Zip: ____________ County: ____________

Workshop Date(s): ______________ Workshop Location: ______________

Trainer(s): ______________________

I prefer to receive AWW information (check one): ☐ by regular mail ☐ by e-mail ☐ no information, please

☐ Yes! I want to be subscribed to the AWW Listserve (you may unsubscribe/resubscribe at any time)

☐ Yes! I want to become an AWW Association member ☐ I joined AWWA at this workshop

☐ Yes! I would like to be on the mailing list for the Newsletter, Tech Conference, Annual Meeting, etc.

I am a member of the following **water monitoring** groups (check all that apply):

☐ a stream group ☐ a lake group ☐ an educational institution (circle one: elementary, secondary, college)

☐ a school group (teacher supervised monitoring) ☐ an environmental organization

☐ not a member of any citizen group or organization that monitors water

I intend to test water quality as an AWW certified monitor: ☐ Yes! ☐ No ☐ Undecided

I would like information on AWW groups near me: ☐ Yes! ☐ No

My age group is: ☐ 10-20 ☐ 21-40 ☐ 41+

I have completed the entire workshop and have received my certification card:

Signature of Monitor: ______________________ **Signature of Trainer:** ______________________

✂- -

Workshop Evaluation

Please rate the following on a scale of 1 (poor) to 5 (excellent) by circling the appropriate number:

1. This workshop was informative	1 2 3 4 5
2. This workshop was enjoyable	1 2 3 4 5
3. The trainer (s) presented information clearly	1 2 3 4 5
4. The workbook was clear and helpful	1 2 3 4 5
5. I understand the goals of AWW	1 2 3 4 5
6. I feel confident that I can monitor water quality	1 2 3 4 5

Thank you for completing this form and becoming a certified AWW monitor!

ALABAMA WATER WATCH

Liability

I recognize and understand the potential for injury or loss of property to myself and others under my control or direction arising out of any accident which may result from volunteer activities conducted with Alabama Water Watch's Volunteer Water Monitoring Program. Auburn University, Alabama Water Watch, and Alabama Water Watch Association intends that volunteers expressly assume all risks and liability for any injuries to, or caused by volunteers under this program.

Liability Release

In consideration of the foregoing, I for myself, my heirs, and executors do hereby release and discharge Auburn University, Alabama Water Watch, Alabama Water Watch Association and all supporting organizations for all claim, damages, demands, actions and whatever in any manner arising or growing out of my participation in said monitoring program.

Monitor's full name and address (please print)

____

____

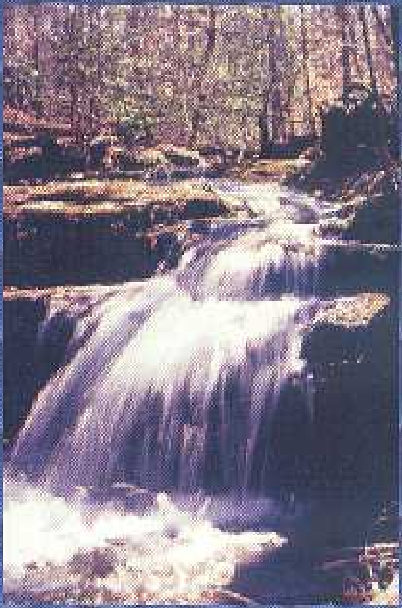
____

____

Check one ☐ adult monitor

☐ parent or legal guardian

Signed: ______________________________ Date: ________________



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**For more information,
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fax: 334-844-9208
website: www.alabamawaterwatch.org**

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