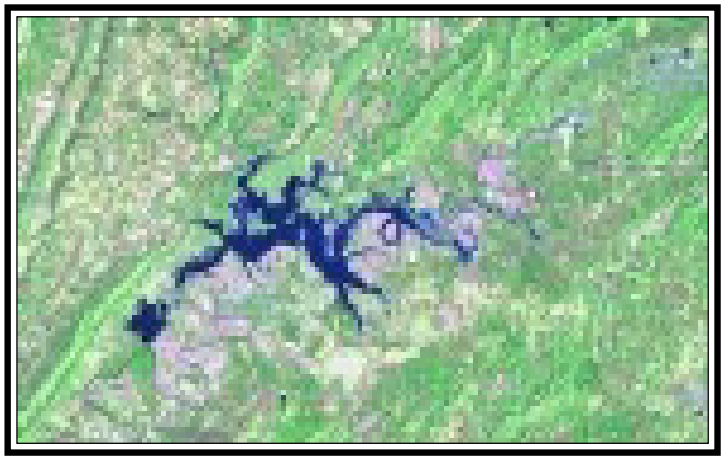
Citizen Volunteer Water Quality Monitoring of Alabama's Reservoirs



...special lakes worth protecting

Weiss Lake

Alabama Water Watch

July 2000

Introduction to the Alabama Water Watch Reservoir Series

Alabama has few natural lakes, but from the 1920s to the 1960s, about 40 large reservoirs were constructed on several major rivers throughout the state. These "man-made lakes" were primarily created for hydroelectric power, navigation, flood control and irrigation. Over the years, they also have become increasingly important for lakefront real estate, drinking water sources and recreation points for fishing, boating and other water sports. Because of their high economic, social and ecological value, Alabama's reservoirs have been extensively studied by power companies, governmental agencies, universities and others. Too often, however, this important information remains in technical reports that are not easily understandable or accessible to the general public and key decision makers.

Since 1993, many citizen groups have been voluntarily collecting water quality data on reservoirs as part of the Alabama Water Watch (AWW) program. Most of these groups are established lake associations or "Home Owner, Boat Owner" organizations (HOBOs) which have strong interests in the safety and quality of "their lake". The purpose of this report series is to present a summary of lake conditions and trends that have been found by AWW groups, along with identification of key issues that will lead to further discussion and action. Whenever possible, the citizen information is supplemented and compared with professional data to give a more complete picture of lake quality.

These reports are intended for policy makers, educators and all citizens who are concerned about our lakes. You are invited to read, ponder and comment on this information. Better yet, become an AWW water quality monitor and join a growing group of dedicated citizens who volunteer thousands of hours per year to learn about and protect our magnificent lakes!

Current Titles:

Volume 1 Lewis Smith Lake
Volume 2 Lake Martin
Volume 3 Weiss Lake

Future Titles:

Volume 4 Lake Logan Martin
Volume 5 Lake Mitchell
Volume 6 Lake Jordan
Volume 7 Lake Wedowee
Volume 8 Lake Guntersville
...and others!

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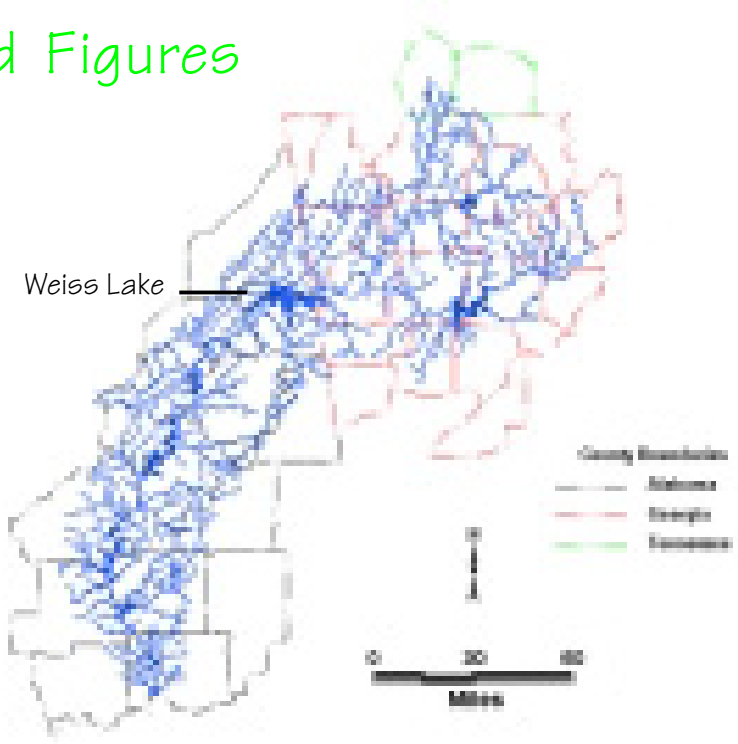
Cover photos: Top: Students conducting a stream bioassessment of the Little River using aquatic invertebrates, as part of a course entitled "Coosa River Basin: Past, Present and Future", co-sponsored by the Coosa River Basin Initiative; Bottom: Landsat satellite image of Weiss Lake, November 1999.

Weiss Lake...Facts and Figures

- Weiss Lake is located in Cherokee and DeKalb Counties of northeast Alabama and Floyd County, Georgia. The lake's watershed extends through much of northwest Georgia and into Tennessee (note: a watershed is the total land area which drains to a common point, such as a lake, a larger river or the ocean.)



Weiss Lake is in the Coosa River watershed

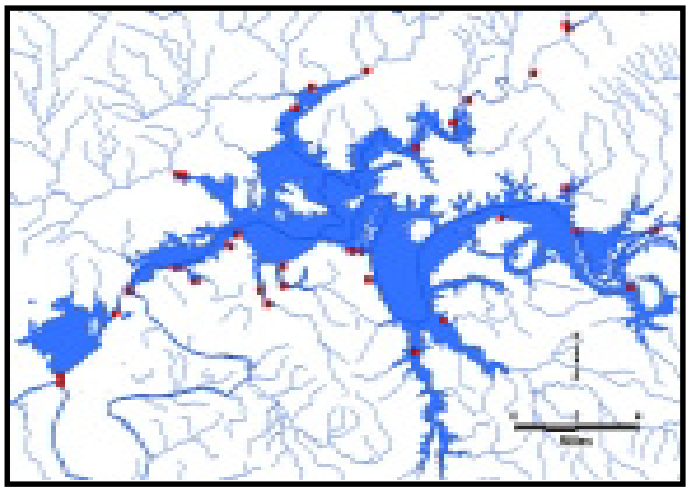
"Cherokee County depends heavily on Weiss Lake. Fishing and related businesses represent 40% of the income of the county."
Remell Williams, Executive Director, Cherokee County Chamber of Commerce

- The Weiss Lake dam was completed in 1961 and is 92 feet high. The lake is one of the shallowest in the state and has a retention time of only 18 days. It has a surface area of 30,200 acres and about 450 miles of shoreline.

- Weiss Lake is noted for its excellent fishing and is known as the "Crappie Capital of the World". A black crappie, *Pomoxis nigromaculatus*, is pictured on the lower right of the cover page and throughout this report.

- The lake and its tributaries are part of the Coosa River watershed. The Coosa River joins the Tallapoosa River just north of Montgomery, AL to form the Alabama River. This three-river system is called the "ACT Basin". The waters of Weiss Lake eventually flow to the Gulf of Mexico through Mobile Bay.

- The Little River is a main tributary of Weiss Lake and is one of only three water bodies in Alabama that is classified as "Outstanding National Resource Water" because of its excellent condition and ecological importance.


Coosa River Basin Initiative water quality sampling sites

- Citizen volunteers of the Coosa River Basin Initiative (CRBI) are the primary water monitors of Weiss Lake and its tributaries. CRBI began participating in AWW in late 1993, and over the last seven years, has monitored 84 sites and submitted more than 1,350 data records for entry into the statewide database. Much of this information is being summarized and posted on the AWW internet website (www.auburn.edu/aww).

What Do Volunteers Do?

- Citizen volunteers attend one or more AWW workshops to become certified monitors of water quality. In the workshops, participants learn simple techniques for measuring various chemical, physical and biological characteristics of water, such as dissolved oxygen and bacterial concentrations (Deutsch et al. 1998a).

Ray Kelley and Beth Fraser (standing) conduct an AWW training workshop for residents of the upper Coosa River watershed

> "Perhaps the most important ingredient in the recipe for a cleaner, healthier, economically viable body of water is an aware, active organization of citizens...In the upper Coosa watershed in Georgia and Alabama, the Coosa River Basin Initiative, Inc. is such an organization. Citizen volunteers, for nearly a decade, have been testing water, asking polluters questions, raising public awareness, filing lawsuits, offering solutions to problems and, in so doing, have effected measurable, positive changes in the quality of the waters above, in and below Weiss Lake."
> **Jerry Brown**
> **founding CRBI President, 1994-97**

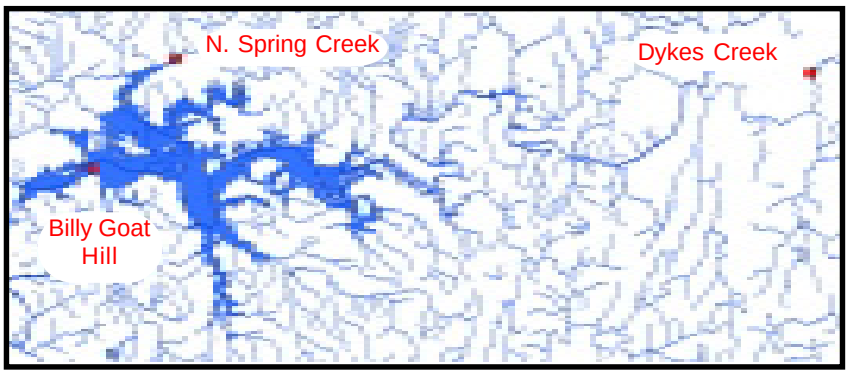
- All monitors attend an annual refresher course to maintain good sampling techniques and replenish their test kits with fresh chemical reagents. The volunteers help the AWW program keep accurate water quality data, and present the information to watershed residents, regulatory agencies, policy makers and other interested citizens. The citizen data set has become one of the most important sources of water quality information for Weiss Lake.

- CRBI has educated the general public by setting up environmental displays at events such as the annual "Heritage Days" festival in Rome, GA, and since 1996, has co-sponsored an annual Continuing Education course through Floyd College entitled "Coosa River Basin: Past, Present and Future". Two CRBI monitors are teachers who test water quality with their elementary and middle school students.

"The ultimate in watershed protection!" Butch Cohenour carries a model of the Coosa and Tallapoosa watersheds for a CRBI display at Heritage Park in Rome, GA

In addition to water quality sampling, several CRBI members are active in environmental education, lake and stream cleanups and advocacy for greater awareness of lake issues.

What Have Volunteers Found?

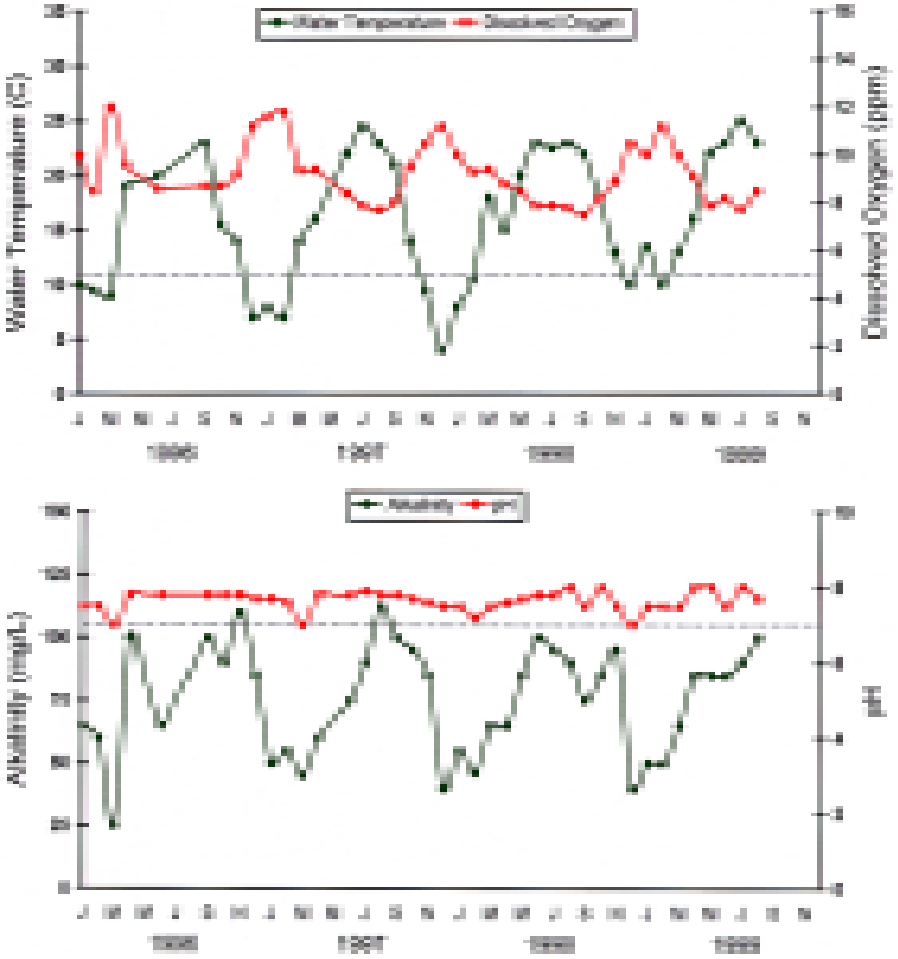


- After several years of monitoring a particular site, a valuable record of water quality trends is established. The seven graphs on pages 6-9 document seasonal changes in water temperature, dissolved oxygen, alkalinity, pH (all measured at less than 0.5 m) and Secchi disk visibility (water clarity) for a six-year period at a stream (Dykes Creek), embayment (North Spring Creek) and lake site (Billy Goat Hill). This valuable information also reflects the dedication and concern of the CRBI volunteers who did *all* the testing!

In a Stream...

Site 36 (05004036) - Dykes Creek in Floyd County, GA

Citizen Monitor: Leslie Carroll

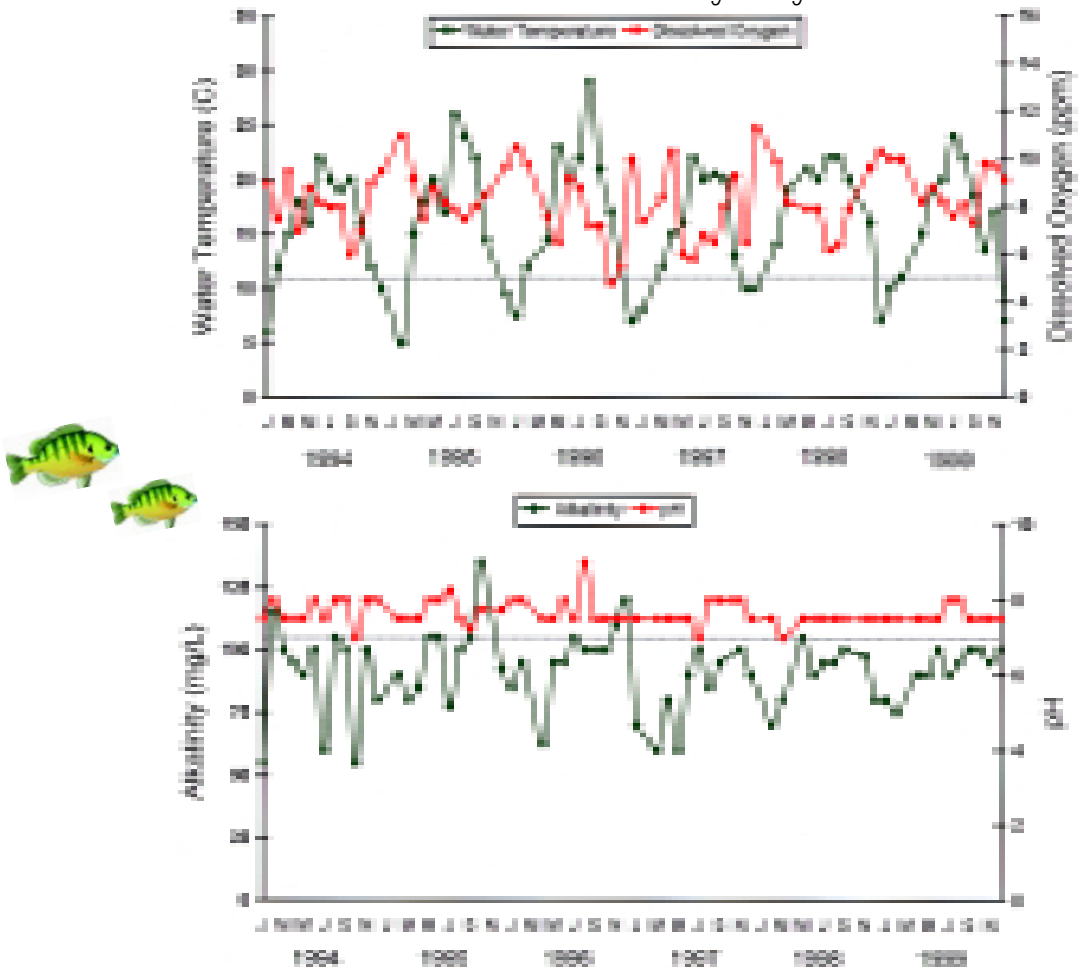


The gray, dashed line on the temperature/dissolved oxygen graph represents the minimum standard of dissolved oxygen (5 ppm) for waterbodies classified as "Fish and Wildlife". The gray, dashed line on the alkalinity/pH graph represents a neutral pH (7.0 SIUs). Sources of all data on pages 6 through 9: Deutsch et al. 1995, 1996, 1998b, 1998c, 1999, 2000 (publication dates).

In an Embayment...

Site 23 (05004023) - Weiss Lake at North Spring Creek Embayment

Citizen Monitor: Ray Kelley



- The AWW water quality information revealed distinct differences among the stream, embayment and lake sites, underscoring the importance of sampling at several sites in a watershed for the best assessment of conditions. Water quality frequently varies from place to place because of both natural factors and pollution.

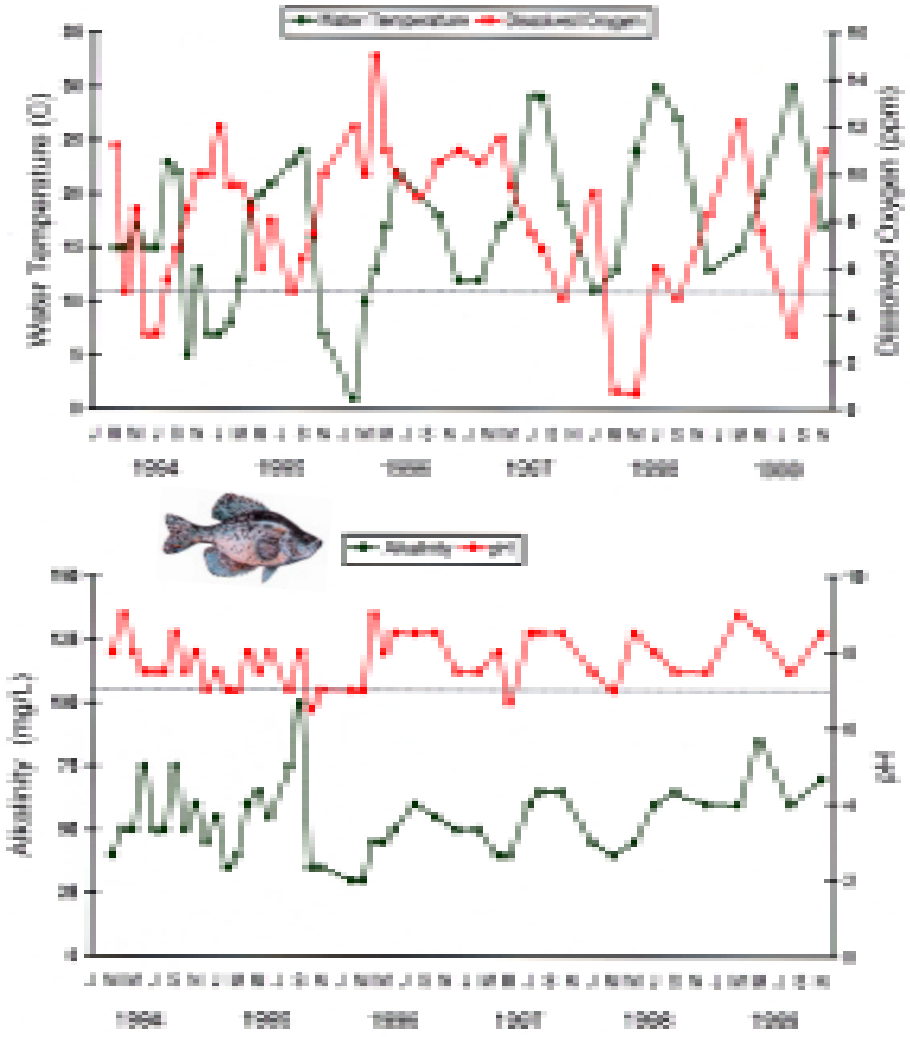
- In Dykes Creek (Site 36), dissolved oxygen concentrations (DO) had a consistent seasonal pattern, varying from about 8 to 12 parts per million (ppm), and DO consistently remained in the range of a "Fish and Wildlife" classification indicating a healthy stream. Water temperature varied inversely with oxygen (as expected) and pH remained steady in the mildly alkaline range (7.5-8.0). Alkalinity varied seasonally, from 50 to 125 mg/L, in a pattern similar to that of water temperature. This pattern in alkalinity was probably because low stream flows in summer concentrated dissolved substances (especially carbonates and bicarbonates of limestone) that increase alkalinity.

- At the North Spring Creek Embayment of Weiss Lake (Site 23), DO was generally less than in Dykes Creek, but still above the minimum required (5 ppm) for the "Fish and Wildlife" classification. Annual fluctuations in water temperature, pH and alkalinity were similar to those of the Dykes Creek site, although alkalinity had a less distinct seasonal pattern.

At a Lake Site...

Site 29 (05004029) - Weiss Lake at Billy Goat Hill

Citizen Monitor: Richard Priebe

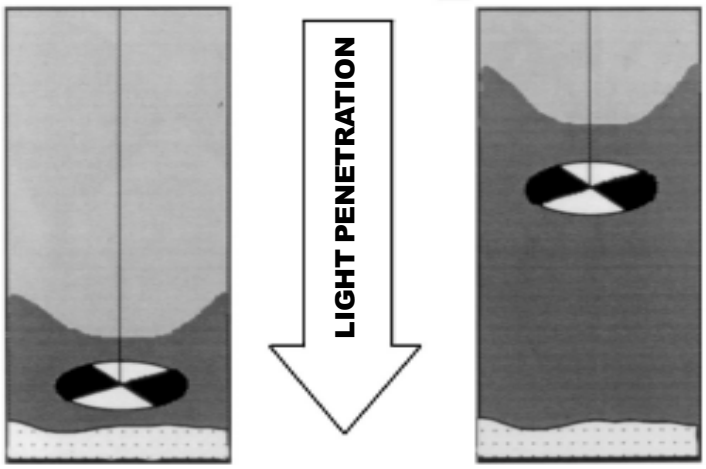


- In Weiss Lake at Billy Goat Hill (Site 29), DO and pH were more variable than in the creek or embayment sites, and DO was often at or below the minimum of 5 ppm required for the "Fish and Wildlife" classification, especially in the warmer months.

- The large variation in DO (1-16 ppm) over a six-year period is indicative of organic pollution and "blooms and crashes" of tiny aquatic plants (phytoplankton) that are stimulated by excess fertilizers and other nutrients in the water. Fluctuations in DO and pH may also be caused by relatively rapid exchanges of water with varying quality (Weiss Lake has a short retention time).

- The Billy Goat Hill site had lower alkalinity than Sites 23 or 36, suggesting that less buffered water from other parts of the watershed diluted the relatively high concentrations of carbonates and bicarbonates that come from streams like Dykes Creek. Trends in alkalinity at Billy Goat Hill since 1996 indicated a seasonal pattern similar to Dykes Creek (higher in summer, lower in winter).

Embayment vs. Lake Water Clarity...



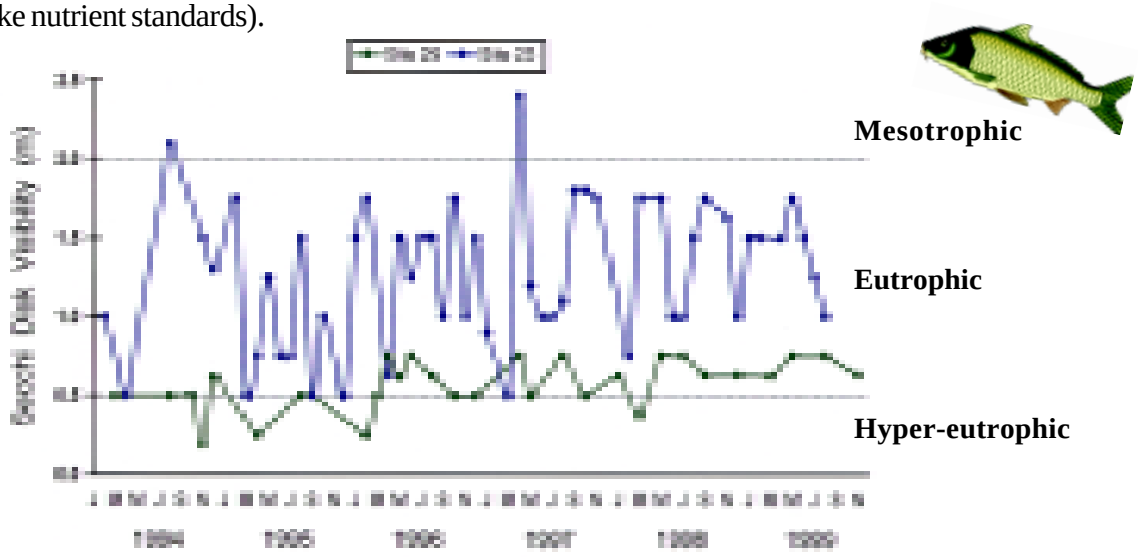
- Water clarity is often expressed in terms of Secchi disk visibility. The Secchi disk is a 8-inch (20 cm) diameter disk that is lowered into the water on a cord until it disappears to the naked eye (see diagram at left).

- Visibility decreases as a lake becomes turbid with suspended materials such as phytoplankton or eroded soils. Excess fertilizers and other nutrients (especially phosphorus) in a lake stimulate unnaturally high phytoplankton blooms which decrease visibility and turn the water green.

- Secchi disk visibilities of 2 to 4 meters (m) in green waters usually indicate moderate nutrient levels (mesotrophic lakes). Visibilities of 0.5 to 2 m are associated with high nutrient levels (eutrophic lakes) and visibilities of less than 0.5 m represent extremely high nutrient levels (hyper-eutrophic lakes).

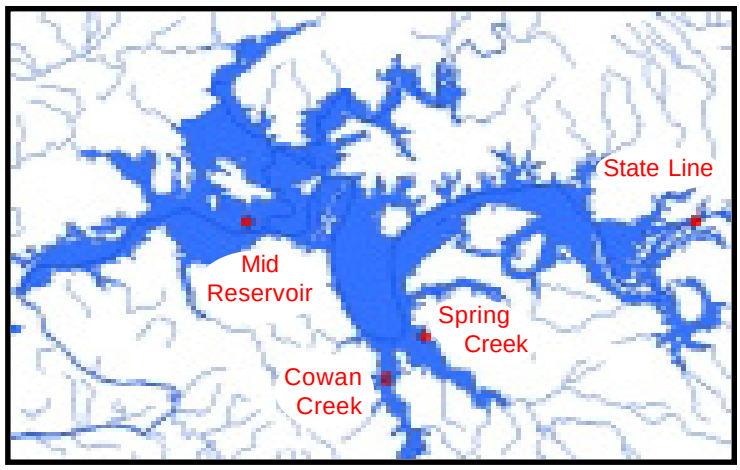
- At the Billy Goat Hill lake site (**green** line in the graph below), the Secchi disk visibilities were consistently low, which indicated eutrophic and hyper-eutrophic lake conditions. The North Spring Creek Embayment (**blue** line) had more variable Secchi disk readings with a much higher average visibility. Large fluctuations in visibility in the embayment may have been because of variations in flow from the relatively clear Spring Creek.

- The Secchi disk is a simple but important sampling tool that citizens can use to monitor the condition of Weiss Lake and evaluate the effectiveness of watershed restoration projects and water quality regulations (e.g. lake nutrient standards).



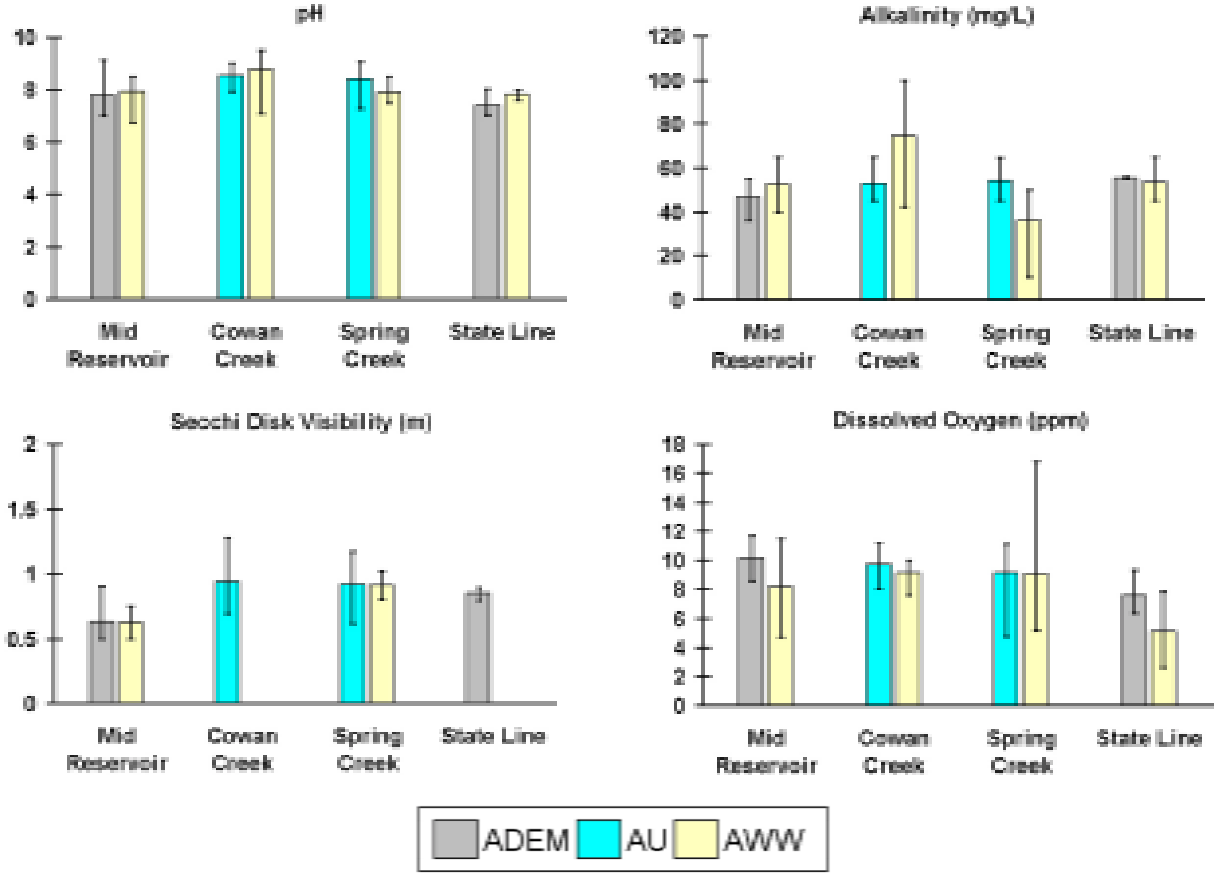
Secchi disk visibilities at Billy Goat Hill (Site 29) and the North Spring Creek Embayment (Site 23) on Weiss Lake, 1994-99.

Is the Volunteer Information Reliable?



- It is important to compare the citizen data of AWW volunteers with research data of universities and governmental agencies in order to determine its reliability. The graphs below compare CRBI/ AWW data with Alabama Department of Environmental Management (ADEM) and Auburn University (AU) data for four water quality variables at two lake sites (Mid Reservoir and State Line) and two tributary embayment sites (Cowan Creek and Spring Creek).

- In virtually every case, citizen data compared favorably with research data, supporting its reliability for use by lake managers and regulatory agencies. Of note was the similarity of AWW and professional data in describing variations in pH among sites. Also, citizen and professional data both indicated higher Secchi disk visibilities in Spring Creek Embayment than at Mid Reservoir, and higher DOs in Cowan Creek and Spring Creek embayments than at the State Line site.

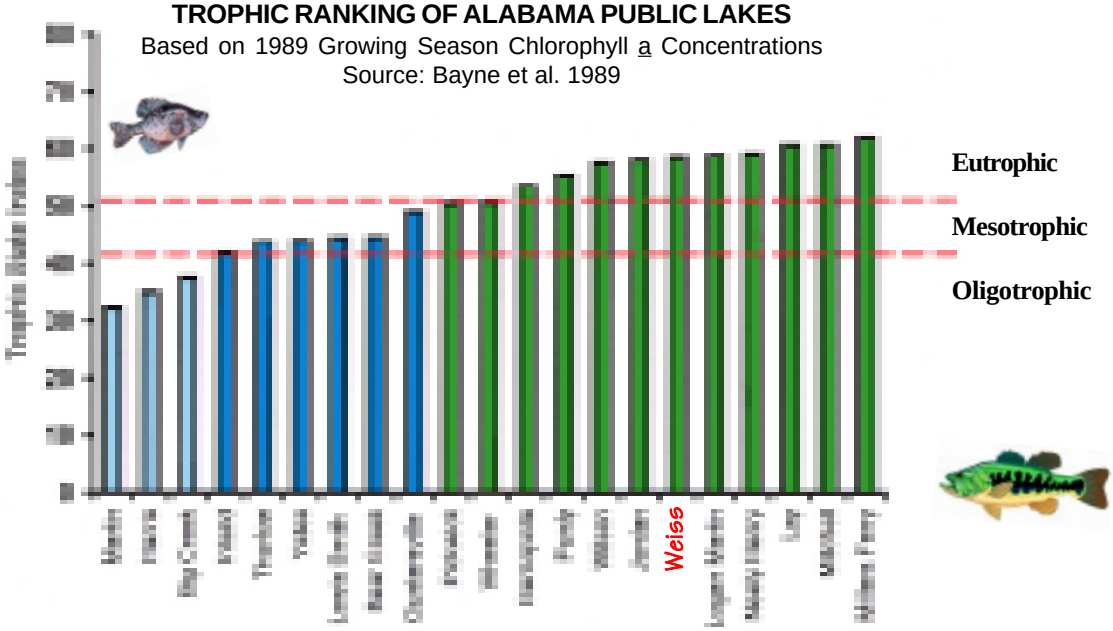


Weiss Lake water quality information was collected at Mid Reservoir by ADEM and CRBI (1997 data), at Cowen Creek Embayment by AU (1992) and CRBI (1994), at Spring Creek Embayment by AU (1992) and CRBI (1994), and near the Alabama-Georgia State Line by ADEM and CRBI (1998). A bar represents the growing season average (April through September) of a variable, and the vertical line at the top of a bar represents the range of readings. Each bar represents about six monthly readings for each variable.

What Does the Information Mean?

- Lakes are commonly rated and compared according to their "trophic state." This is related to algal densities stimulated by the amount of nutrients received from the watershed. "Oligotrophic" lakes have low levels of nutrients, "mesotrophic" lakes have moderate levels, and "eutrophic" lakes have high levels (AFA 1998).

TROPHIC RANKING OF ALABAMA PUBLIC LAKES
Based on 1989 Growing Season Chlorophyll a Concentrations
Source: Bayne et al. 1989

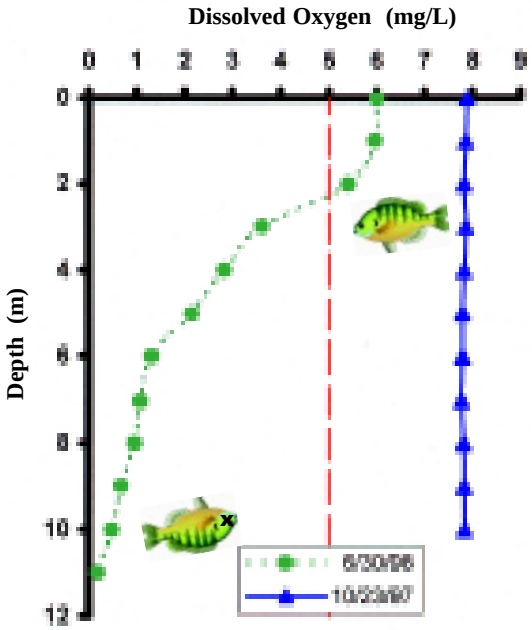


- It is generally believed that concentrations of an aquatic plant pigment called "chlorophyll a" is the best indicator to use for calculating the Trophic State Index (TSI, Carlson 1997). When TSIs are above 50 (eutrophic), this usually means that a lake is becoming polluted by too many fertilizers and other nutrients. In general, eutrophic lakes have larger fluctuations in algal blooms, dissolved oxygen concentrations and other water quality variables. This, in turn, stresses fish and can lead to fish kills.

- The graph above indicates that in 1989, Weiss Lake was already in a eutrophic condition, as were many other reservoirs in the Coosa River Basin (Neely Henry, Lay, Mitchell, Logan Martin, Jordan). By comparison, all of the lakes in the Tallapoosa River Basin (Harris, Martin, Yates, Thurlow) were in the oligotrophic or mesotrophic condition, with much lower concentrations of nutrients.

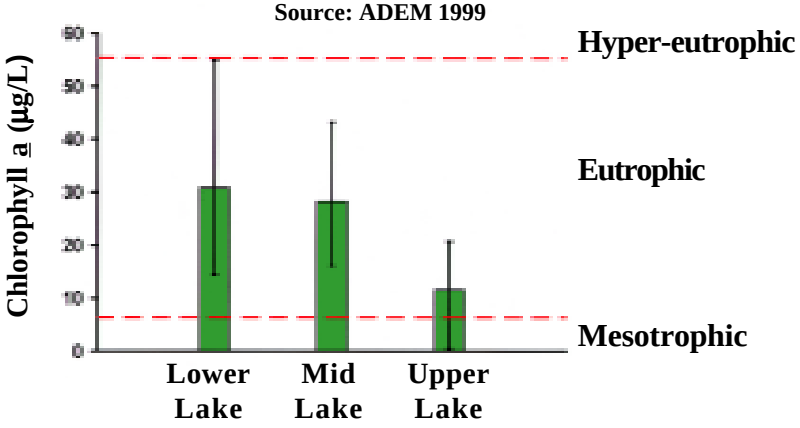
- Oxygen concentrations in eutrophic lakes often decrease sharply with increasing depth during the summer months when phytoplankton are most abundant. The graph at right illustrates that this occurred in Weiss Lake in June 1998. Lake oxygen levels were at 6 mg/L near the surface, then dropped to about 1 mg/L at 6 m and approached zero below 8 m. During that period, less than 20% of the lake's water at the dam (only the upper 2 m) was in the desirable range to support healthy fish populations. In contrast, oxygen levels remained high throughout the water column in October 1997.

WEISS LAKE OXYGEN PROFILE AT DAM
Fall of 1997 and Summer of 1998
Source: ADEM 1999 and personal communication



What Are the Water Quality Trends of Weiss Lake?

WEISS LAKE CHLOROPHYLL a CONCENTRATIONS
1997 Growing Season
Source: ADEM 1999



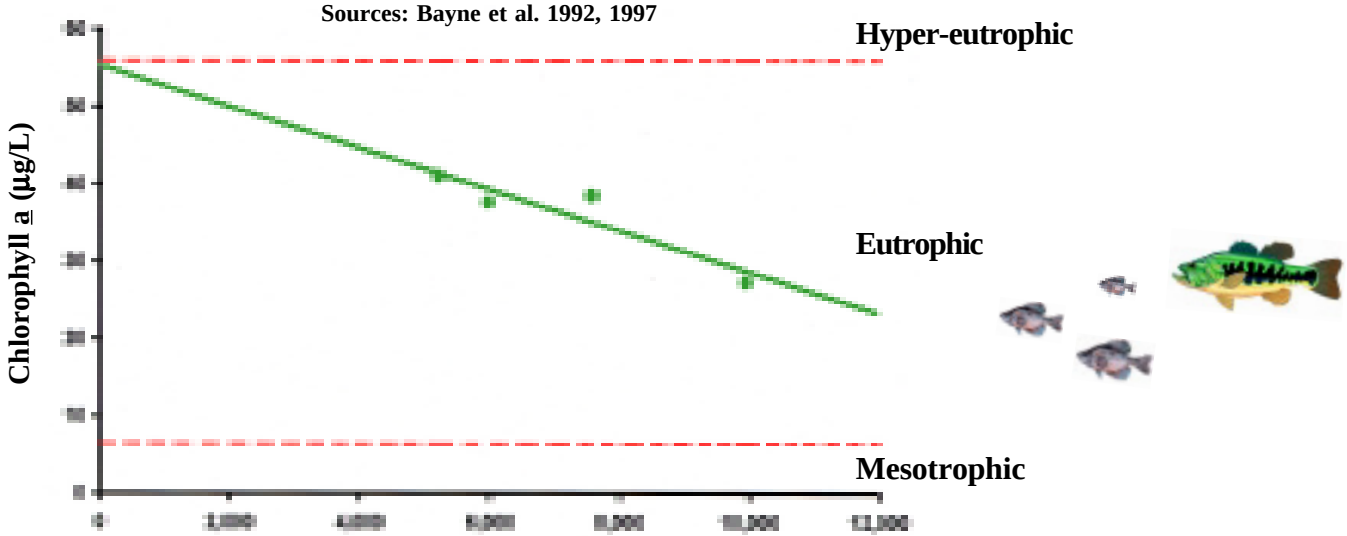
- Chlorophyll a concentrations, measured by ADEM from April through October 1997, steadily increased from the upper lake to the lower lake (see graph at right). This indicated that conditions conducive to algal growth reached a maximum near the dam. Chlorophyll a concentrations in the lower lake occasionally reached hyper-eutrophic levels. This spatial pattern is the opposite of that found in Lake Martin (Tallapoosa River), where chlorophyll a was most concentrated in the headwaters and decreased toward the dam (Deutsch, et al. 2000).

- A four-year study of chlorophyll a concentrations and water discharge rates at Weiss Lake demonstrated how low flows contribute to lake eutrophication and degraded water quality (see graph below). With discharges around 10,000 cubic feet per second (cfs) per day, the lake remained at a mid-eutrophic state. With decreased flows, eutrophication intensified and water quality deteriorated.

- This information indicates that water quality is directly related to water quantity. Drought or water diversions from the Weiss Lake watershed (Georgia/Alabama "Water Wars") could have negative effects by concentrating lake nutrients and other pollutants, which lead to degraded water quality and fish kills.

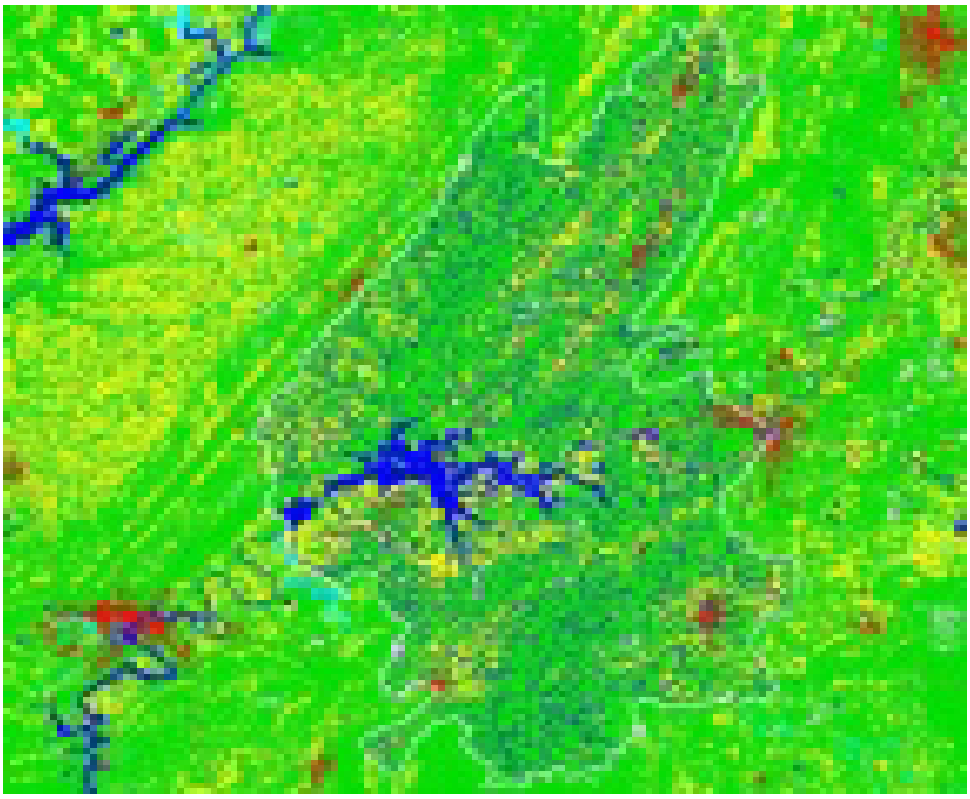
- Weiss Lake needs adequate flows of good quality water to reverse degradation and insure its productivity and use for future generations.

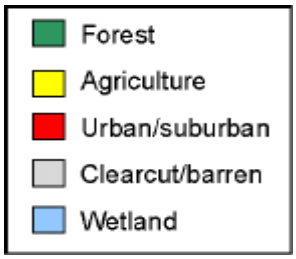
WEISS LAKE CHLOROPHYLL a CONCENTRATIONS
1989-92 Growing Seasons
Sources: Bayne et al. 1992, 1997



Mean Daily Discharge (cfs) through Weiss Lake Dam for May through September

A Summary of Key Water Quality Issues





A land use map generated from a Landsat Satellite image of Weiss Lake's watershed (white line), from the beginning of the Coosa River in Rome, GA to the Weiss Lake dam

1. Eutrophication

- How can excess nutrients entering Weiss Lake from industry, agriculture and municipalities be reduced to prevent further water quality degradation?
- What are the optimal nutrient standards for Weiss Lake, and how can they be implemented and enforced by both Georgia and Alabama?

2. Water Allocation and Flow

- What are the impacts of existing and proposed water diversions from the upper watershed on the water quality and quantity of Weiss Lake?

3. Fishing and Water Recreation

- How can the valuable lake fishery and water recreation be managed and promoted to enhance the economy of Cherokee County and the region?
- How can low oxygen levels, toxins and other pollutants be minimized to protect fish populations and fish consumers (fish advisories)?

4. Stakeholder Action

- How can policy makers and the public be made aware of the condition and changes in Weiss Lake?
- What is the role citizens play in lake protection?

5. Lakefront and Watershed Development

- Who plans watershed development and what additional information is needed to make wise decisions?

Current and future land use of Weiss Lake's watershed will determine the future condition of Weiss Lake. What will be the long-term effect of our land and water use decisions?

Why Is Volunteer Monitoring Important?

"The Weiss Lake Improvement Association applauds Alabama Water Watch for its work in monitoring our State's waterways. Current events regarding water flows and pollution make their conservation efforts even more important. Our organization's 2,500+ members will continue to work with and support Alabama Water Watch and especially it's efforts for the benefit of Weiss Lake."
Jerry Culberson, Treasurer and Past President, Weiss Lake Improvement Association

Several citizens want to be personally involved with lake monitoring and protection, to determine lake quality near their homes or favorite swimming and fishing sites, and to be a part of lake and watershed development decisions...they have a *stake* in their *lake*!

CRBI, the Weiss Lake Improvement Association, the Cherokee County Chamber of Commerce and others share a common goal of enhancing the environment and economy of the Weiss Lake region. Partnerships of these private and governmental groups have a high potential for restoring degraded areas and protecting lake quality.

Advantages of Local, Citizen-Based Water Monitoring

- large number of sampling sites
- frequent and consistent sampling
- "eyes and ears" for lake changes and polluters
- fast response time to detect and measure polluted runoff
- local awareness and public outreach
- neighbor-to-neighbor persuasion of polluters
- important data supplement to agency and research studies
- leads to science-based, citizen-involved action plans

"Water Women" Leslie Carroll (CRBI), Tina Laidlaw (AWW), Beth Fraser (CRBI Executive Director), Martha Little (GAAS) and Cheryl Garner (CRBI) at the 1st Annual Georgia-Adopt-A-Stream and AWW Meeting of Water Monitors, Dahlonega, GA, 1997

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- CRAFTMASTER Printers, Inc.

This report is dedicated to Ray Kelley... veteran water monitor and Weiss Lake advocate

For further information...

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"CRBI's work is as important as ever. We have the issues of smart growth, water wars and public awareness of environmental concerns to tackle as we move into the next century. The health of our waters will continue to be an issue for regional, state and local authorities. CRBI's goal is to keep the people of the Coosa River Basin involved and informed about the decisions that affect our rivers."
Jerry Jennings, President 1999-2000, CRBI

CRBI water monitors at an AWW Recertification Session

Alabama Water Watch

Alabama Water Watch is a citizen volunteer water quality monitoring program centered at Auburn University that provides training, data management, information exchange and other means of support for the public to become personally involved in water issues. The AWW Association is a nonprofit affiliation of water monitoring groups and other interested citizens that promotes the AWW program and advocates better water quality and water policy in Alabama.

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