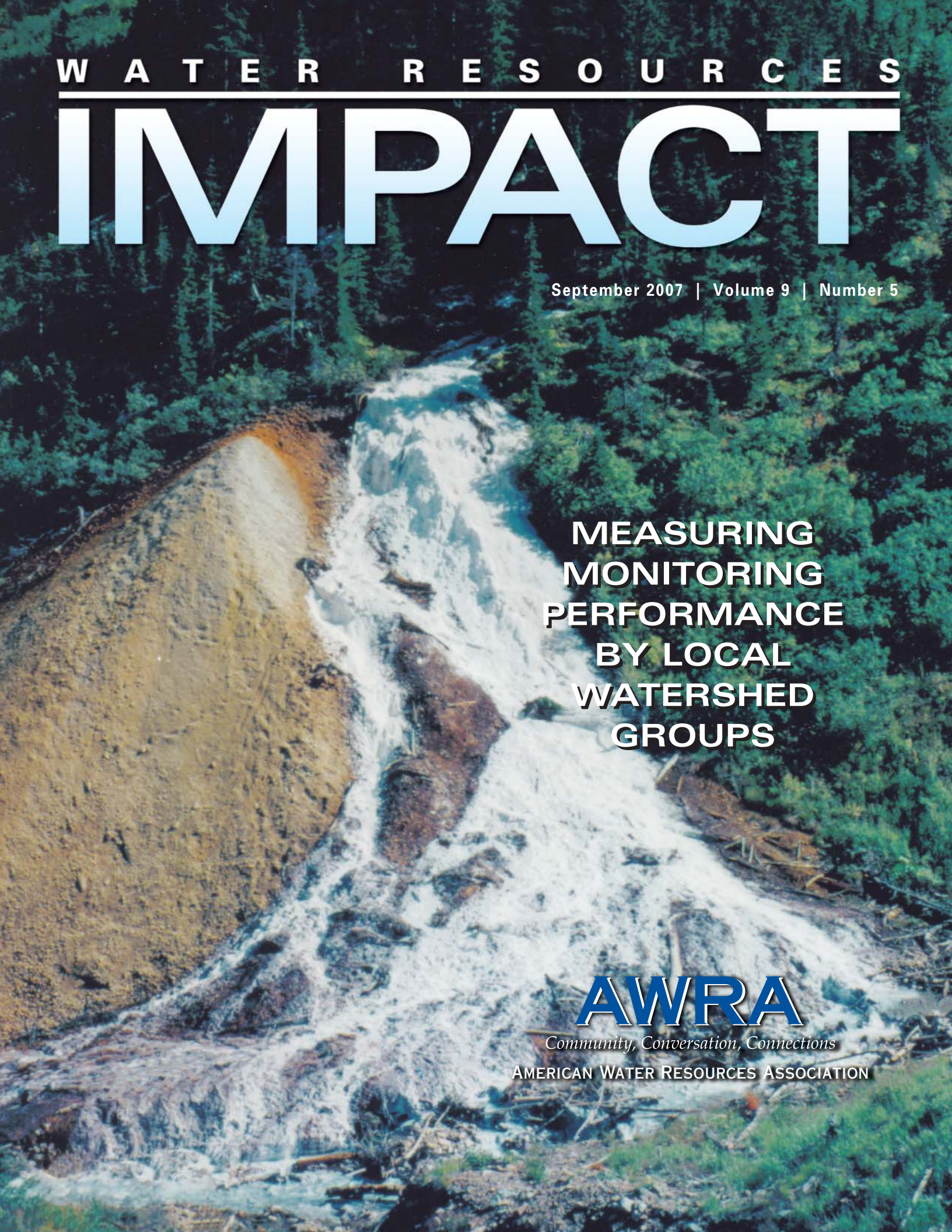

WATER RESOURCES

IMPACT

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MEASURING MONITORING PERFORMANCE BY LOCAL WATERSHED GROUPS

AWRA

Community, Conversation, Connections

AMERICAN WATER RESOURCES ASSOCIATION

MEASURING MONITORING PERFORMANCE BY LOCAL WATERSHED GROUPS

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In January 2006, the White House Office of Management and Budget released a memorandum indicating that the U.S. Environmental Protection Agency had not demonstrated results under the Clean Water Act Section 319 Program. The memorandum indicated a need to provide proof that water-quality and ecosystem improvements have been made through the efforts of watershed groups, and that the improvements are measurable. This issue of *Water Resources IMPACT* describes success stories from selected watersheds across the nation. The social aspects of volunteerism are placed into perspective, proposed legislation is described that could help clean up watersheds, and the importance of quality assurance is emphasized.

INTRODUCTION

FEATURE ARTICLES

Cover Photo: The Paradise Portal, an abandoned mine in Middle Fork Mineral Creek, upper Animas River watershed, known locally by scientists as the "White Death," discharges acid mine drainage with high concentrations of aluminum. The waste-rock pile is more than 100 feet high with thick deposits of aluminum hydroxysulfate mineral (basaluminite), which has precipitated from the mine drainage (photo by Win Wright).

WATER RESOURCES
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WATER RESOURCES IMPACT

VALIDITY AND APPLICATIONS OF CITIZEN VOLUNTEER WATER-QUALITY DATA: A CASE FROM ALABAMA

William Deutsch, Eric Reutebuch, and Serio Ruiz-Córdova

INTRODUCTION

Alabama Water Watch (AWW) is a citizen-volunteer, water-quality monitoring program that is coordinated from the Auburn University Fisheries Department, with primary funding from the Alabama Department of Environmental Management (ADEM) and the U.S. Environmental Protection Agency (USEPA) Region 4. AWW's mission is to improve both water quality and policy through citizen monitoring and action. AWW envisions a citizen monitor on every stream, lake, and bay in Alabama. Since 1992, more than 240 citizen groups have participated, cumulatively sampling more than 1,900 sites on 700 waterbodies and submitting more than 48,000 water-quality data records to the AWW database. Several groups have submitted water data for more than 10 years. For many Alabama waterbodies, citizen data are the primary or only source of water quality information.

For many waterbodies in Alabama, citizen data are the primary or only source of water quality information.

Quality assurance plans were developed, submitted to USEPA, and approved for water-chemistry testing in 1994 (with revision in 2004) and for bacteriological monitoring in 1999. These plans outline the procedures and requirements of the AWW Program in training and certifying volunteer monitors, maintenance of accurate sampling equipment, and data management to ensure quality data. Monitors regularly submit their water data to the AWW Program Office. In 2001, AWW developed a relational database that not only streamlined management of water-quality data, sample-site locations, monitor information, and certification records, but also enabled the development of online data entry for monitors and a suite of powerful web-based tools for analyses, graphing, and retrieval of water-quality data.

MAKING THE DATA ACCESSIBLE

AWW employs numerous web-based tools, as well as data-interpretation presentations and water-body reports to compile, analyze, interpret, and showcase citizen volunteer-monitoring data. These tools assist volunteer groups in highlighting local environmental issues and influencing policy to address pollution and other threats to their watersheds. The primary tools of monitors are the water-chemistry and bacteriological monitoring test kits, manuals, and training/certification by the program that empower them to collect credible data. After monitors are trained and certified, and begin monitoring a local water body (usually on a monthly basis), they are encouraged to enter their data online from the AWW program website (http://www.alabamawaterwatch. org, accessed July 12, 2007), where they can also access web-based tools.

Web-based tools assist volunteer groups in highlighting local environmentl issues and influencing policy to address pollution and other threats to their watersheds.

Web-based tools consist of maps, graphs, basic statistical analyses, comparisons with related data, and tutorials. Monitors can access local watershed maps that display streams and lakes, monitoring sites, recognized impairments (303d-listed waters), and other geographic features. Numerous map features can be identified via a menu. Monitors can also access site-specific topographic maps and aerial photographs through links to Topozone™, EPA EnviroMapper™, Google Maps™, and Terraserver USA™.

Simple yet powerful tools enable monitors to easily produce a variety of water-quality graphs. Line graphs of water-quality parameters (water temperature, dissolved oxygen, pH, alkalinity, hardness, turbidity, and Secchi disk depth) (Figure 1) and bar graphs of *E. coli* bacteria counts (Figure 2) can be plotted. A least-squares trend line can then be fitted to graphs to answer the basic question, "Is my water quality getting better or worse?" More sophisticated graphing tools include streamflow versus water-quality graphs, multi-parameter graphs, multi-site graphs, and graphs of a site variable versus average values of other sites within a hydrologic unit code (HUC average).

Data interpretation presentations are regularly conducted by AWW staff at the request of monitoring groups that have monitored for at least two years. During these presentations, long-term trends in the group's data are analyzed relative to state water-quality standards. Causes of improving or degrading water-quality conditions are investigated relative to land-use maps, land management practices, and point and nonpoint sources of pollution. The groups are then engaged in discussing citizen action strategies to protect the local watersheds and address water degradation, if present.

After these presentations, the groups are asked to consider working with the AWW staff to produce a water-body report. Several lake, stream, and coastal groups have collaborated with AWW in the production of these reports. The reports build on the data interpretation presentations by presenting a monitoring group's history and activities, watershed facts, local water-quality issues, and what the citizen water-quality data indicate. Water-body reports are used by groups for environmental education, promoting group efforts, and influencing

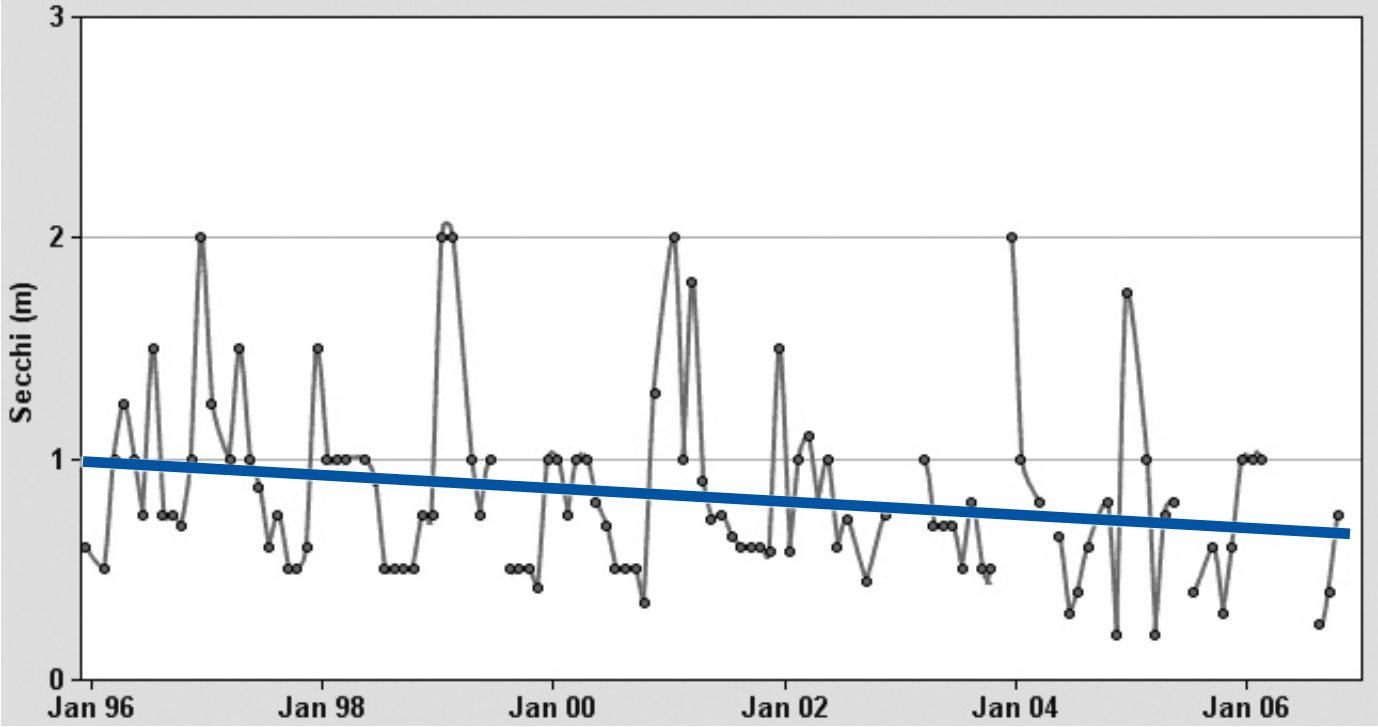

Figure 1. Example of a Multi-Year Water-Quality Trend Graph. Multi-year trend (blue line) showing declining Secchi disk depth measured monthly on Weiss Lake near Centre, Alabama, by a citizen monitor of the Coosa River Basin Initiative.

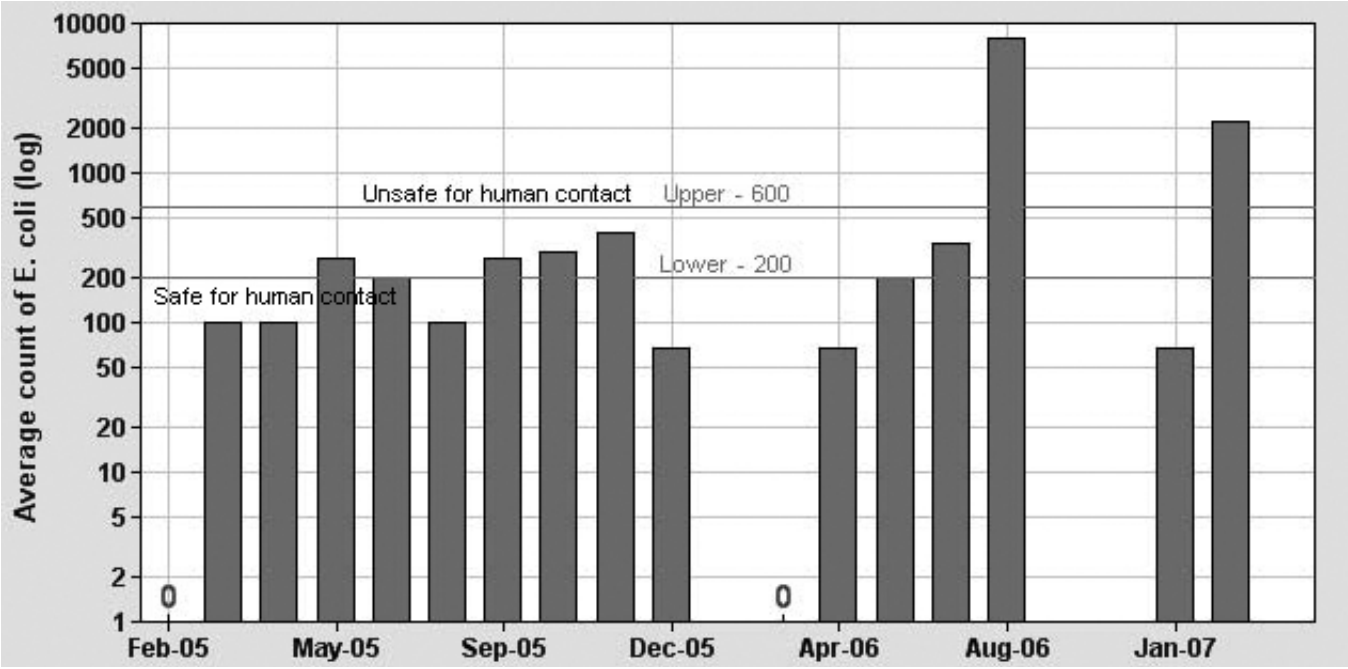

Figure 2. Example of a Multi-Year Graph of *E. coli* Concentrations. Multi-year trend showing increasing levels of *E. coli* measured monthly in Saugahatchee Creek near Auburn, Alabama, by a citizen monitor of Save Our Saugahatchee. The Lower line (200 *E. coli* colonies per 100 ml) is the maximum allowable concentration for waters designated for frequent human contact, and the Upper line (600 *E. coli* colonies per 100 ml) is the maximum allowable concentration for waters designated for infrequent human contact.

local watershed management policies. Thousands of copies of each report are printed for distribution to monitors, educators, and policy makers, and free downloads are available at the AWW Program website within the Monitor Resources → Publications section.

APPLICATIONS OF CITIZEN DATA

AWW monitoring groups have used their data in a variety of ways. Following are two examples, one from a coastal monitoring group, Wolf Bay Watershed Watch, and the other from a stream monitoring group, Save Our Saugahatchee. The coastal monitoring example is an illustration of a long-term watershed-level effort, while the stream monitoring example is an example of a rapid resolution of a specific pollution problem by an individual monitor.

The results of regular monthly monitoring of bacteria and water chemistry over several years indicated that the aquatic flora and fauna of the ecologically rich bay were threatened by rapid encroachment of development.

Wolf Bay Watershed Watch (WBWW) began monitoring water chemistry in the Wolf Bay Drainage in 1996. Wolf Bay is located on the Alabama Gulf Coast about 20 miles east of Mobile Bay. In 1998, the group became interested in AWW's bacteria monitoring protocol, and expanded monitoring for *E. coli* from one to ten sites. The results of regular monthly monitoring of bacteria and water chemistry over several years indicated that the aquatic flora and fauna of the ecologically-rich bay were threatened by rapid encroachment of development. Certain sites exhibited trends of increasing bacteria contamination, low dissolved-oxygen concentrations, and declining Secchi disk depth.

Armed with a growing body of watershed-level water quality data, WBWW began the daunting task of pursuing "Outstanding Alabama Waters" (OAW) classification for their bay in 2001. If successful, Wolf Bay would be the first bay in Alabama to be upgraded to OAW, and the bay would be protected by more stringent water-quality standards and restrictions on development. WBWW provided ADEM with thousands of data records from more than 40 sites monitored throughout the watershed that documented water-quality trends in the bay and its tributary streams. With the assistance of AWW, various data analyses have been performed for data interpretation presentations and for two volumes of a Wolf Bay water-body report.

Geographic analysis of repeated occurrences of high levels of *E. coli* bacteria (greater than 600 colonies per 100 ml of water) indicated that contamination was mainly concentrated in a single tributary, Wolf Creek (Figure 3).

A longitudinal analysis of water chemistry data indicated that water quality was poor in the headwaters of Wolf Creek near the city of Foley; average dissolved-oxygen concentrations were 2.2 mg/l (milligrams per liter). Water-quality conditions recovered downstream at the mouth of the creek where it empties into Wolf Bay (Figure 4); average dissolved-oxygen concentrations were 7.7 mg/l. Low dissolved-oxygen concentrations in Wolf Creek were likely the result of a combination of causes – natural (spring water and coastal black water effects) and human-induced (waste-water loads).

According to the chief of the Water Quality Branch of ADEM, "the Wolf Bay Watershed Watch water-quality data was used to pinpoint where the Department needed to focus its monitoring efforts and to highlight areas with potential water quality concerns. In addition, since the WBWW data had highlighted bacteria as a potential parameter of concern, the Department was able to concentrate on collecting bacteriological data for evaluation against the OAW criteria. This allowed us to clearly

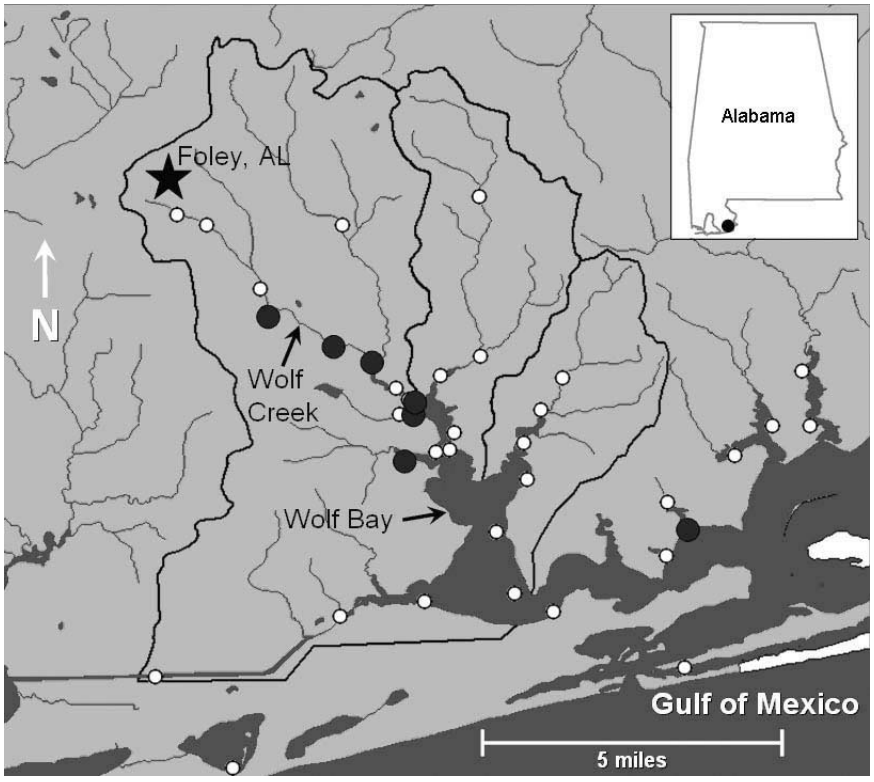

Figure 3. Geographic Analysis of Locations of High *E. coli* Counts in the Wolf Bay Watershed. Citizen sites (large dots – 7 of 30 sites monitored) in Wolf Bay Watershed near Foley, Alabama, with multiple occurrences of *E. coli* concentrations above 600 colonies per 100 ml. There were 715 measurements from 2003-2005, and *E. coli* ranged from 0-25,000 colonies per 100 ml.

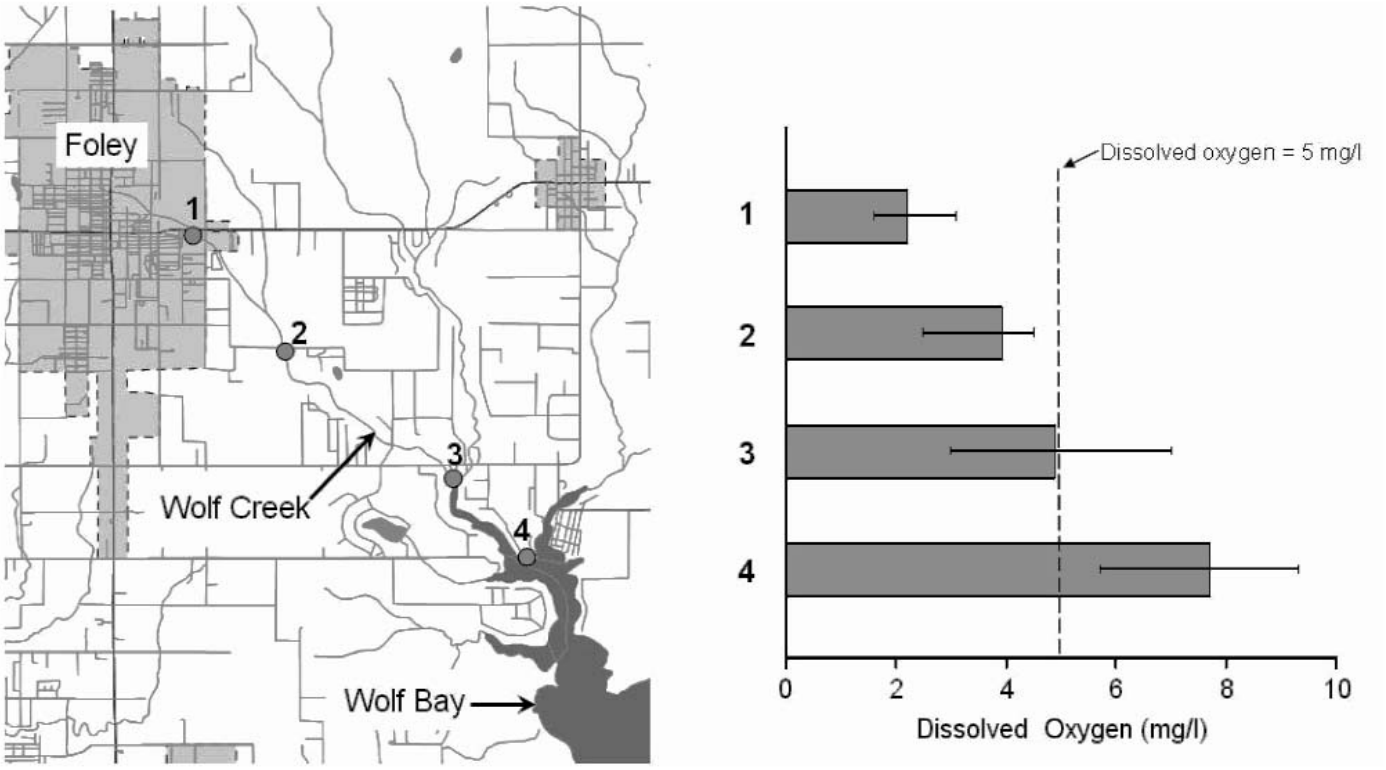

Figure 4. Longitudinal Analysis of Dissolved Oxygen Levels of Wolf Creek. Growing season (May-October 2006) average dissolved-oxygen concentrations were measured at four sites by the Wolf Bay Watershed Watch citizen monitors. The dashed line represents the minimum standard of dissolved oxygen (5 mg/l) for water bodies classified by the state as "Fish and Wildlife."

understand where the OAW classification should be applied."

In April 2007, after a decade of citizen efforts including water-quality monitoring, developing a watershed management plan, and public outreach, Wolf Bay was granted OAW status by the Alabama Environmental Management Commission. The WBWW executive director credited the achievement to years of citizen water data that verified the bay was deserving of OAW designation.

Save Our Saugahatchee (SOS) is a stream-monitoring group in east-central Alabama. SOS formed in 1997 to address local impacts to the Saugahatchee Creek Watershed, and began monitoring water chemistry at about 10 sites. Saugahatchee Creek originates near the city of Opelika, Alabama, and flows westward to the Tallapoosa River. In 2006, interest in bacteria monitoring greatly increased after a few monitors reported high *E. coli* levels in a couple of streams in the watershed. Several citizen monitors were trained and certified by AWW in bacteria monitoring. A retired school teacher began monitoring at multiple sites, particularly city parks that had streams flowing through them (Figure 5). She measured high levels of *E. coli* at a city park in Auburn, Alabama, that is a popular playground area for local children. Investigations in the upstream watershed revealed an underground sewer leak oozing from a suburban roadside slope, and flowing into the stream that drained to the city park. Bacteria testing verified that this water was indeed highly contaminated. Armed with the *E. coli* data, the citizen monitor contacted local city authorities, who were pleased with the citizen monitor effort in detecting and sourcing the contamination. The city promptly fixed the sewer leak, which resolved the bacteria contamination in the city park downstream.

These two examples demonstrate how local citizens use water monitoring and data analysis tools. The first involved nearly a decade of effort to establish long-term trend data necessary to influence watershed management policy, which resulted in upgrading the classification of Wolf Bay. The second example occurred over a period of a few weeks, and illustrates the power of a local citizen watchdog who was trained in monitoring and diagnosing water-quality problems. Like WBWW, the SOS monitoring group has also been actively involved in the drafting and implementation of a watershed management plan (the Saugahatchee Watershed Management Plan). An excerpt from the Mid-Coosa River Basin Watershed Management Plan underscores the increasing use of citizen-water data in water resource management: "Citizen volunteer monitoring, assessments, public education, and outreach are essential components of this Plan and may be the most effective management practices."

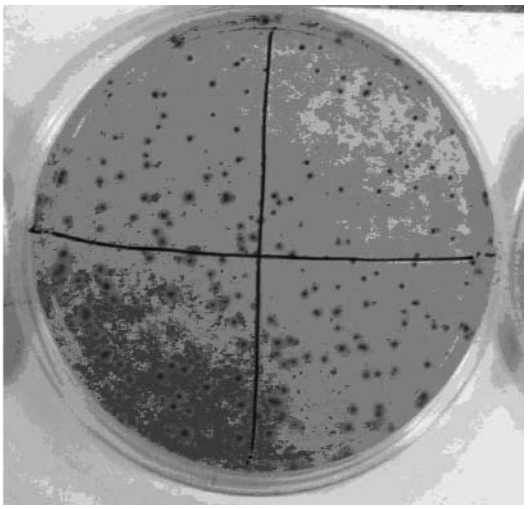

Figure 5. Volunteer Monitor Measuring Bacteria in a Local Stream. Save Our Saugahatchee citizen monitor testing local stream for *E. coli* (left), and results of incubated sample (right) showing extensive *E. coli* contamination.

In conclusion, volunteer monitor water data have become a valuable source of information for many waterbodies and a foundation for improving water policy in Alabama. The sustainability of the AWW approach is based on teaching citizens about water-testing methods that they can easily master and that yield meaningful and credible results. Group-monitoring sustainability is reinforced through online and personal feedback concerning the meaning and use of their data. To learn more about AWW and for contact information, visit the AWW Program website at www.alabamawaterwatch.org. Program staff would be pleased to discuss partnerships with other projects and programs in the U.S. or internationally.

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William Deutsch, the Director of Alabama Water Watch, holds a Ph.D. in Aquatic Ecology and has been a Research Fellow for 17 years. He also directs Global Water Watch, a worldwide network of community-based water monitoring groups. He often travels internationally to assist in environmental assessment and community-based watershed stewardship in several countries, including the Philippines, Thailand, Ecuador, Brazil, and Mexico.

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