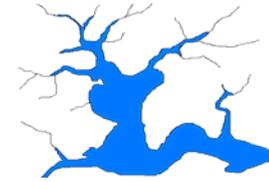




# Citizen Volunteer Water Monitoring on Wolf Bay

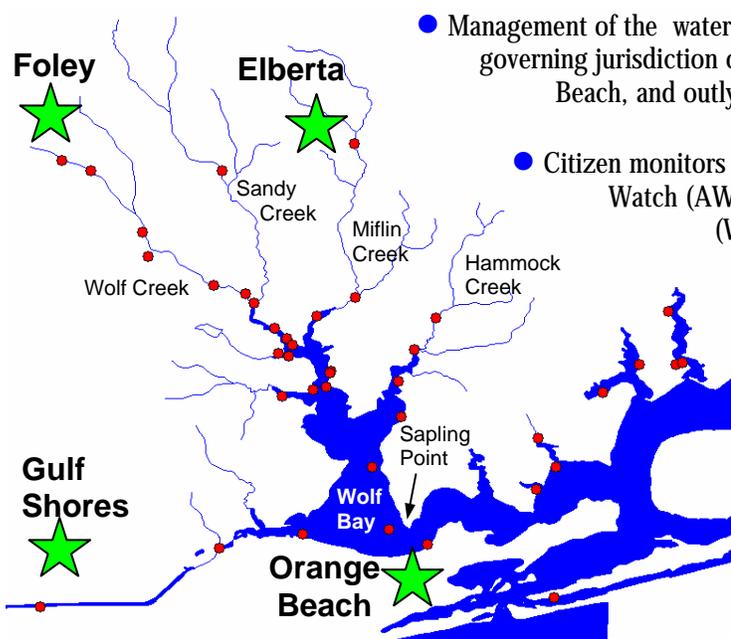


## Bay Facts and Figures

- Wolf Bay is located on the Gulf of Mexico in Baldwin County, Alabama, nestled between Perdido Bay to the east and Mobile Bay to the west.
- Wolf Bay is an estuary, where freshwater and saltwater mix and create a diverse environment that fosters a rich array of plant and animal life.
- The Wolf Bay watershed, the area of land that drains into Wolf Bay, covers about 44,700 acres, which is approximately 23% forest, 27% urban/suburban, 27% agricultural, 16% wetlands and 7% other uses (see map on page 5).
- Streams that flow into Wolf Bay include Wolf Creek, Sandy Creek, Mifflin Creek, Graham Creek, Owens Bayou, Moccasin Bayou, and Hammock Creek. Wolf Bay, in turn, flows into the Intracoastal Waterway, which flows into either Perdido Bay or Mobile Bay, depending on the moon, wind, and tide, and ultimately into the Gulf of Mexico.
- Wolf Bay and its watershed hosts a tremendous diversity of habitats that historically supported and may still support several Federally listed species including black bears, bald eagles, Florida manatees, sea turtles, Gulf sturgeons, red-cockaded woodpeckers, American alligators, Alabama red-bellied turtles and Eastern indigo snakes.
- Baldwin County experienced a 43% increase in population from 1990-2000 (second highest in Alabama). The watershed is undergoing dramatic changes as forested and agricultural lands are converted into residential and commercial developments. Along with these man-made changes, the watershed suffered substantial structural and ecological damage from Hurricane Ivan in September of 2004. Local recovery efforts continue.



Local residents of the bay



Wolf Bay Watershed Watch water quality sample sites (●)

- Management of the watershed as a whole is a challenge because it is located within the governing jurisdiction of the four municipalities: Foley, Elberta, Gulf Shores, Orange Beach, and outlying parcels of Baldwin County (see map at left).
- Citizen monitors have tested water in the watershed as a part of Alabama Water Watch (AWW) since 1996, and as monitors of Wolf Bay Watershed Watch (WBWW) since 1998 when the group was formed.
- WBWW volunteer monitors have taken over 2,700 water chemistry measurements and more than 2,300 bacteria measurements at 44 sites (see map at left) which have been entered into the AWW statewide database.

● What can *YOU* do to help protect Wolf Bay for future generations?

## Time Line of AWW and WBWW



Life on the bay



What can those aquatic critters tell us?



Educating the kids



Educating the rest of us

- The Flow of WBWW and Alabama Water Watch*
- 1992 ➤ AWW Program begins
  - 1993 ➤ First AWW Workshop to train citizen monitors in water chemistry testing  
➤ AWW Association forms  
➤ Five AWW monitoring groups form
  - 1994 ➤ EPA approves AWW water chem. protocols  
➤ AWW receives 1,000<sup>th</sup> water chem. record
  - 1995 ➤ First AWW Training of Trainers Workshop
  - 1996 ➤ AWW introduces *E. coli* testing  
➤ Volunteer monitoring begins in Wolf Bay watershed
  - 1998 ➤ AWW launches website (see page 8)  
➤ AWW receives 10,000<sup>th</sup> water chem. record  
➤ Wolf Bay Watershed Watch forms
  - 1999 ➤ EPA approves AWW bacteria protocols  
➤ WBWW participates in first annual Coastal Clean-up
  - 2000 ➤ Auburn University offers Continuing Education Units for AWW workshops
  - 2001 ➤ AWW develops relational database for online data entry and data access  
➤ WBWW begins informal petition to ADEM for Outstanding Alabama Waters upgrade
  - 2002 ➤ AWW publishes 2<sup>nd</sup> Coastal Series Waterbody Report featuring Wolf Bay  
➤ WBWW develops Strategic Plan  
➤ WBWW starts PALS Adopt-A-Stream Program
  - 2003 ➤ WBWW participates in 1<sup>st</sup> Derelict Crab Trap Removal Day
  - 2004 ➤ AWW receives 30,000<sup>th</sup> water chem. record  
➤ AWW completes five volumes of Citizen Guides to Alabama Rivers  
➤ WBWW starts PALS Adopt-A-Mile, Adopt-A-Campus
  - 2005 ➤ AWW conducts its 1,000<sup>th</sup> workshop  
➤ WBWW participates in 1<sup>st</sup> Baldwin County Water Festival  
➤ Wolf Bay Watershed Management plan is completed and published
  - 2006 ➤ AWW publishes 12<sup>th</sup> Waterbody Report  
➤ WBWW appoints its first Executive Director  
➤ WBWW co-hosts 14<sup>th</sup> Annual AWW Meeting and Picnic at Wolf Bay, interacts with 14 Global Water Watch trainees from 5 countries
  - 2007 ➤ AWW begins teacher training in the *Discovering Alabama's Living Streams* curriculum  
➤ AWW publishes Stream Bioassessment Manuals  
➤ Wolf Bay is granted Outstanding Alabama Water classification by ADEM

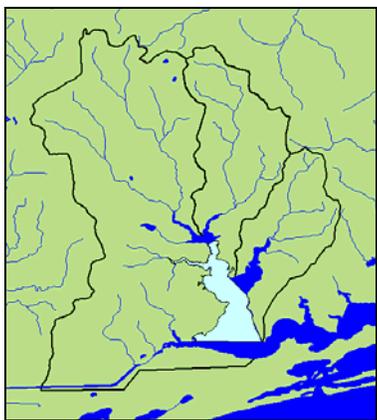
## Wolf Bay – Outstanding Alabama Water!

● Estuaries are among the earth's most productive and valuable natural systems and sustain a remarkable diversity of life forms. Alabama has very little estuarine waters that haven't already been polluted. Wolf Bay and its surrounding waters are probably the most pristine estuarine waters in the state, and need to be protected.

● Armed with a growing body of watershed-level water quality data collected by citizen monitors, WBWW began the daunting task of pursuing "Outstanding Alabama Water" (OAW) classification for the bay in 2001. OAW is the highest of seven levels of waterbody classifications established by the Alabama Department of Environmental Management (ADEM). OAW classification signifies "high quality waters that constitute an outstanding Alabama resource of exceptional recreational and ecological significance."

● Under OAW classification, the bay would be protected by higher water quality standards including more stringent restrictions on wastewater discharges and toxic substances into the bay, a higher minimum dissolved oxygen level (5.5 mg/L compared to 5.0 mg/L required by the Fish and Wildlife classification), and a lower level of acceptable year-round pathogen concentration. All of these requirements mean that less pollution would be allowed to enter the bay.

● AWW provided ADEM with 10 years of WBWW monitoring data from throughout the watershed that documented water quality trends in the bay and its tributary streams. WBWW also submitted additional data to ADEM from other agencies, worked to develop a watershed management plan - the *Wolf Bay Plan*, conducted numerous education/outreach activities, and garnered support for the upgrade to OAW from both the Baldwin County Legislative Delegation and the City of Foley.



● In April 2007, after a decade of citizen effort, Wolf Bay was granted OAW status by ADEM. Wolf Bay joined only four other waterbodies statewide and was the first bay in Alabama to attain OAW classification. OAW status extends from the Intracoastal Waterway to Moccasin Bayou (light blue area on map at left). The WBWW Executive Director credited the achievement to years of citizen water data that verified the bay was deserving of OAW designation. According to the Chief of the Water Quality Branch of ADEM, "WBWW 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."

● The beautiful waters are what attract most people to coastal Baldwin County. The prolific life supported by healthy estuarine habitats contributes greatly to the economic base of coastal communities through tourism, commercial and recreational fishing and aquaculture. Stakeholders believe that the OAW upgrade, along with implementation of the *Wolf Bay Plan* will focus priorities on watershed protection and smart growth, thereby protecting the water quality of the bay. WBWW is currently working with the City of Foley, Baldwin County and developers to implement the *Wolf Bay Plan*.



An osprey looking for a meal



Insect-eating pitcher plant



Enjoying the solitude of the bay

# Citizen Action for Watershed Protection

- Several WBWW volunteers have attended 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 water temperature, dissolved oxygen (DO), alkalinity, hardness, turbidity, pH and bacterial concentrations. Monitors attend refresher courses to maintain proper sampling techniques and replenish their test kits with fresh chemical reagents.



Watershed residents attending an AWW water chemistry workshop

- Volunteer monitors assist the AWW program in maintaining accurate water quality data and presenting the information to watershed residents, regulatory agencies, policy makers and other interested citizens. The AWW citizen data set has become one of the most important sources of water quality information for Wolf Bay, Baldwin County, and for Alabama.

- In addition to water quality monitoring, WBWW volunteers participate in:



WBWW hosts 14 Global Water Watch trainees from five countries at the Alabama Water Watch 2006 Annual Meeting and Picnic

- Building* public awareness of the value of coastal waters through public meetings, the media and information booths

- Sponsoring* environmental education programs

- Sponsoring* and promoting various bay, roadside and campus cleanups throughout the watershed

- Publishing* a quarterly newsletter, *Wolf Prints*

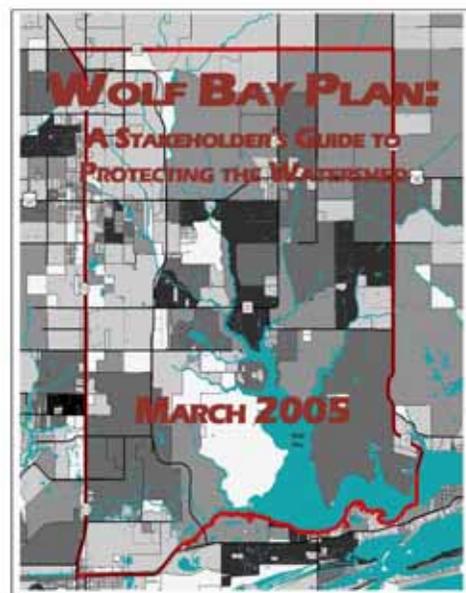
- Maintaining* a website, [www.wolfbaywatch.org](http://www.wolfbaywatch.org)

- Sharing* community-based watershed management strategies with a Global Water Watch group from Veracruz, Mexico, with plans to partner in Gulf of Mexico conservation efforts

- Developing* and implementing a watershed management plan, (below) with assistance of the Alabama Coastal Foundation and stakeholder input

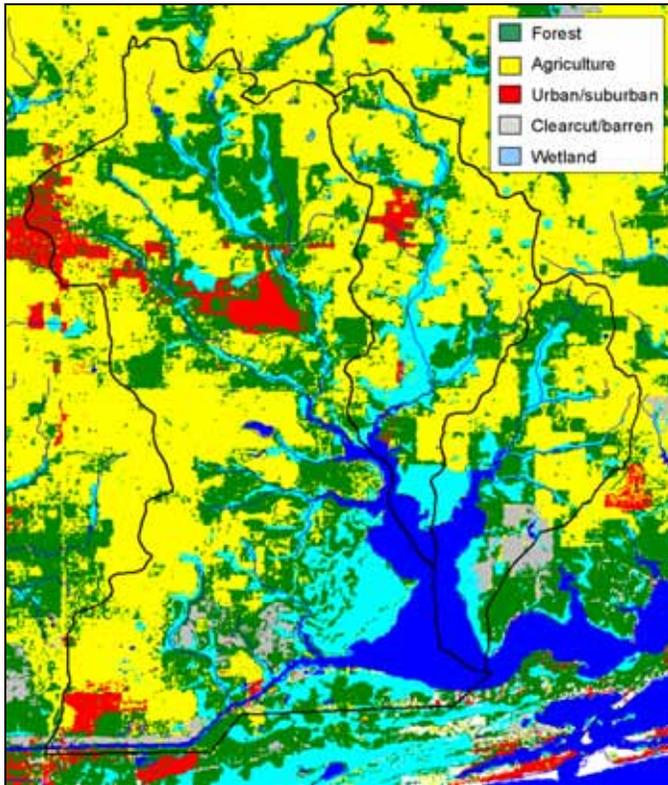
The mission statement of the *Wolf Bay Plan* is, “to develop and implement a plan to protect and improve the natural resources of the Wolf Bay watershed.” Major goals of the Plan are:

- To classify Wolf Bay and its tributaries as Outstanding Alabama Waters,
- To acquire land in the watershed for an environmental education facility,
- To reduce nonpoint source pollution from residential, agricultural, construction, and other land clearing activities, and
- To ensure protection of fish and wildlife habitats.

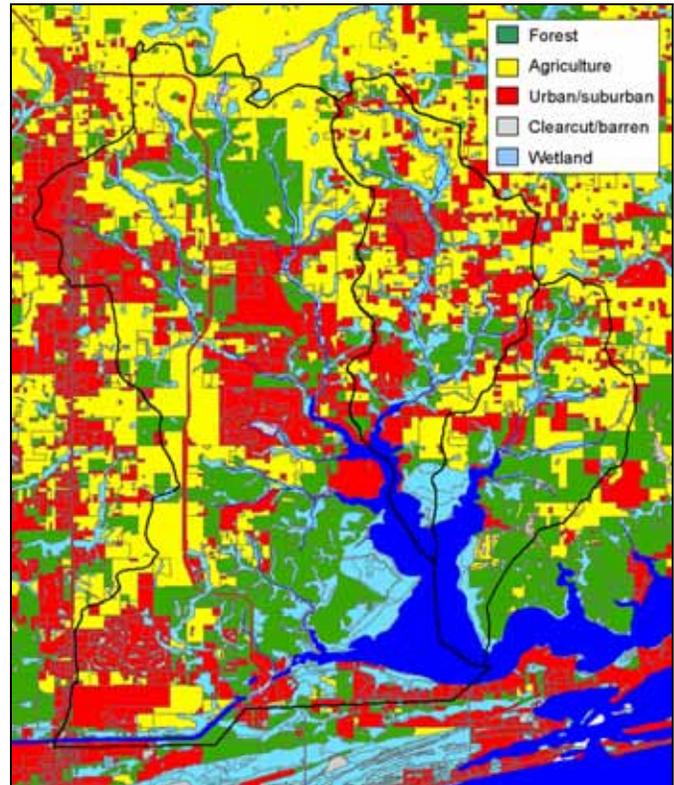


# Changes and Challenges in the Watershed

Examination of the land use maps below shows that the Wolf Bay watershed has undergone dramatic changes over the last several years. The biggest change has been a dramatic increase in urban/suburban developments (red areas) in the watershed at the expense of agricultural lands (yellow areas) and forests (green areas). Urban/suburban areas increased from 4% to about 27% of the watershed, while agricultural lands declined from 46% to 27% and forests declined from 32% to 23% of the watershed. How are these land use changes affecting the aquatic environment of streams, bayous and bays of the watershed?



**Land use map of Wolf Bay watershed circa 1992**  
USGS/EPA National Land Cover Data



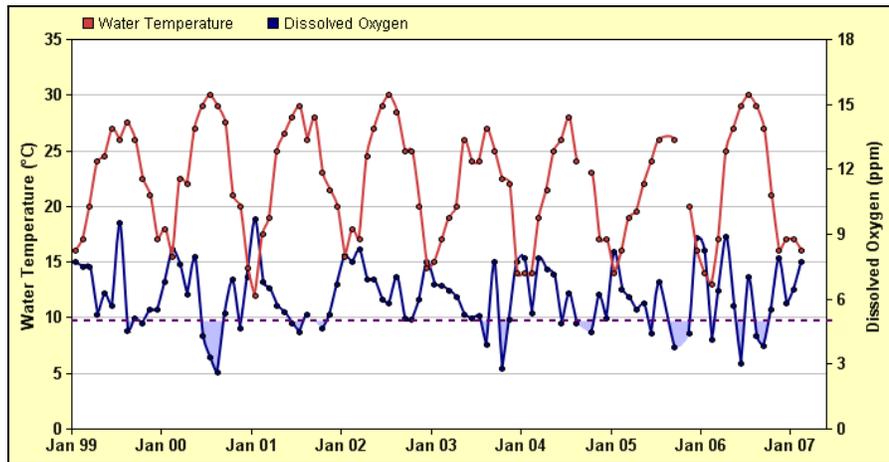
**Land use map of Wolf Bay watershed circa 2005**  
Courtesy of the Baldwin County Commission

- **Urban Impacts** – As the value of land in the watershed continues to rise (which was inflated even more in the aftermath of hurricanes Ivan and Katrina), farms are sold off and forests are cleared for commercial and residential development. In 2006, the number of building permits issued by the City of Foley exceeded those of 2005, indicating that development continues at an accelerated rate. This rapid expansion of urban/suburban development contributes increasing amounts of both point source and nonpoint source pollutants to tributary streams and to the bay. Pollutants include eroded soils from construction sites, an increase in the volume of municipal wastewater discharge, lawn chemicals, and oil from parking lots.
- **Agricultural Impacts** – Agricultural impacts include nonpoint source pollutant runoff from fields that contains agricultural fertilizers, chemicals and livestock waste. There has been a significant shift from row crops to sod farms in recent years. The impacts of this shift in land use to the watershed are uncertain, but WBWW plans to expand into nutrient monitoring in local streams to evaluate changes in water quality.
- **Other Impacts** – Construction of new roads and bridges in the watershed continues to open more areas up for development which will increase the amounts of potential pollutants to the waters of the bay.
- **Increased pollution does not have to be viewed as inevitable.** Environmental impacts can be controlled with education and adoption of wise watershed management policies, such as those presented in the *Wolf Bay Plan*.

# What Does the Citizen Water Quality Data Tell Us?

Citizen monitors began monitoring the waters of Wolf Bay as part of AWW in 1996. Below are water quality trends measured by local monitors at several sites on Wolf Creek and downstream at a site near the mouth of Wolf Bay.

● **Wolf Creek.** The graph below is an eight-year trend of water temperature (red line) and dissolved oxygen, or DO (blue line) at a WBWW sample site on Wolf Creek just above its confluence with Sandy Creek (site #3 on map below). Wolf Creek is one of four major tributary streams that flow into Wolf Bay (along with Sandy, Mifflin and Hammock creeks). Oxygen dissolves better in cold water, so its concentration tends to naturally rise in winter and decline in summer. Since 1999, local monitors have measured several summertime DOs below 5 parts per million (ppm, violet dashed line on graph) at this site. DO below 5 ppm stresses fish and may result in reduced aquatic biodiversity because fish and most other aquatic creatures depend on oxygen from water. ADEM regulations require a DO level of at least 5 ppm (unless low DO occurs from natural causes) in waters that are classified as "Fish and Wildlife," as is Wolf Creek, and at least 5.5 ppm for OAW, the recently acquired designation for part of Wolf Bay.

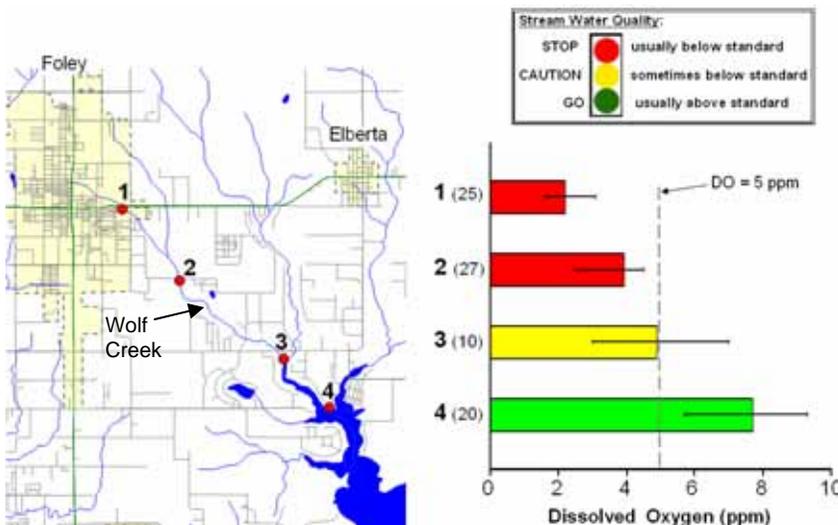


Water temperature and DO of Wolf Creek (WBWW site 04012010)  
Citizen monitor: Bob Wilson



Bob Wilson collecting a sample from Wolf Creek for analysis.  
Courtesy of Fanfare Photography

Recent growing season (May-October, 2005-2006) DO averages measured in Wolf Creek by WBWW volunteers indicate that water quality was poor (average DO = 2.2) in the headwaters of the creek in the City of Foley, but recovered (average DO = 7.7) downstream at the mouth of the creek where it empties into Wolf Bay (see map and graph below, site numbers in parentheses correspond to WBWW site numbers). This pattern of DO was similar to that found in a survey in 2000.

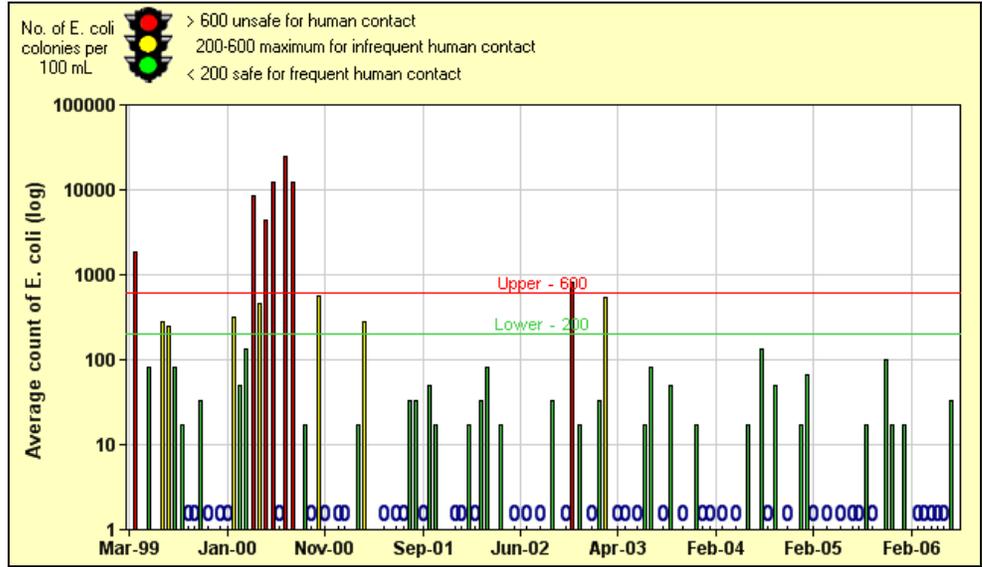


Low DOs measured in Wolf Creek are most likely the result of a combination of causes, both natural (contributions from spring water which is devoid of DO, and Wolf Creek being a black water stream with naturally occurring lower DOs) and human-induced (discharge from waste water treatment plants, which depletes DO as organic matter in the discharge decomposes). As residential and commercial development spreads across the watershed, DO levels and the aquatic organisms in the Wolf Bay watershed will be adversely impacted unless wise watershed management policies are adopted.

WBWW began bacteriological monitoring in 1998 at numerous sites throughout the watershed, using the AWW test that detects *Escherichia coli* (*E. coli*) and other coliform bacteria (see image below). *E. coli* is monitored in surface waters as an indicator of contamination by sewage or animal waste, and certain strains of this bacterium can make people very sick if ingested. As with chemical monitoring, consistent sampling over several months can determine the trend of bacterial contamination at a site. Bacteriological monitoring at WBWW site 10 on Wolf Creek (graph below) indicates that *E. coli* levels have declined from unsafe levels (above 600 colonies/100 mL of water, red bars) in 1999-2002 to levels safe for frequent human contact (below 200 colonies/100 mL of water, green bars) since April 2003.

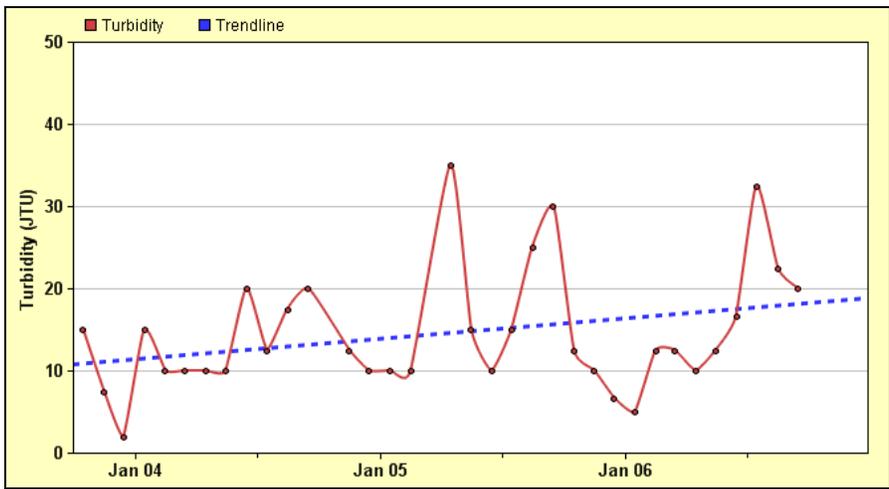


An incubated plate showing *E. coli* (purple/blue) and other coliform bacteria (pink/red) colonies



*E. coli* testing of Wolf Creek (WBWW site 04012010)

● **The Bay.** Below is a three-year graph of turbidity (red line) at a WBWW sample site near Sapling Point at the mouth of Wolf Bay (see map on page 1). The trend in turbidity is increasing (blue dashed line), which is indicative of increased particulate matter in the water. This turbidity is most likely from a combination of eroded soils washing off of the watershed into the bay and increased levels of nutrients (nitrogen and phosphorus) flowing into the bay, which stimulate the growth of algae that turn the water green. Increased turbidity can interfere with aquatic life by limiting light penetration into the water and can adversely affect the recreational and aesthetic value of the bay. Watershed management practices that minimize erosion and nutrient pollution need to be implemented to reverse this trend.



Turbidity of Wolf Bay near Sapling Point (WBWW site 04012041)  
Citizen monitors: Nancy and Thomas Dukes



The Dukes conducting their monthly water quality sampling. Courtesy of Fanfare Photography

# Alabama's Rich Water Resources and AWW

Alabama has over 75,000 miles of streams, including more navigable river miles than any other U.S. state. If these streams could be connected end-to-end, they would extend three times around the Earth! Alabama streams and rivers convey about 8% of the surface water that flows through the continental United States.

Along with this wealth of freshwater, the state has numerous estuarine and near-shore waters on its 50-mile coastline with the Gulf of Mexico. Not only are our streams, lakes, coastal bays and bayous abundant, but they also vary tremendously in physical, chemical and biological characteristics.

Alabama's waters cut through Appalachian valleys and ridges, prairie soils of the Black Belt, sandy soils of

the Coastal Plain and other physiographic provinces. All of this physical diversity leads to an impressive biological diversity. Alabama waters have been described as a "biodiversity hotspot" because they have some of the largest variety of fishes, snails, mussels and other "aquatic critters" in the world.



Sunset over Wolf Bay at McCamish dock

Some of these organisms occur only in Alabama.

Human health, environmental health and quality of life are increasingly threatened by pollution. Citizens have a right and responsibility to become actively involved in protecting and restoring Alabama's water resources. Since 1993, more than 240 groups have participated in AWW and have collected data from about 700 waterbodies statewide.

The goal of this report series is to feature AWW groups, describe their activities and concerns, document the importance of their water data and invite you, the reader, to join in community-based action strategies for management and protection of your watershed.

Concerned citizens now have a powerful, new tool to answer the fundamental questions of water testing: *Is my waterbody getting better or worse, and why?* Hundreds of summary graphs and maps of water data, training opportunities, special meetings and other aspects of water monitoring are available via the AWW website at [www.alabamawaterwatch.org](http://www.alabamawaterwatch.org). Certified monitors can enter their data online, and custom graphs and statistical trends of statewide water quality data can be easily generated. Timely dissemination of quality-assured data in clear and meaningful ways is a vital element of a successful volunteer monitoring program. It is important to apply water quality information collected by citizen volunteers to local activities such as environmental education, protection and restoration activities, and development of watershed management plans. You are welcome to become a part of AWW and a local water monitoring group. Contact us!



**Alabama Water Watch is a citizen volunteer water quality monitoring program that provides training, data management, information exchange and other means of support for the public to become personally involved in water issues. AWW is funded in part by the U.S. Environmental Protection Agency (Region 4), the Alabama Department of Environmental Management, the Alabama Agricultural Experiment Station and the Alabama Cooperative Extension System.**

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