Angelina & Neches River Authority

2012 Basin Highlights Report
For the Upper Portion of the Neches River Basin

Angelina & Neches River Authority
P.O. Box 387 • Lufkin, TX 75902
936-632-7795 • 800-282-5634
www.anra.org • info@anra.org

Introduction

The **2012 Basin Highlights Report** is intended to provide a brief overview of the previous year's events and ongoing programs in the upper and middle portions of the Neches River Basin that are relevant to the Clean Rivers Program (CRP). Activities described in this report include the surface water quality monitoring activities of the Angelina & Neches River Authority (ANRA), events that could effect water quality (such as the drought), and special projects in the basin. Additionally, the report identifies impaired water bodies in the basin, as well as public outreach efforts.

This Year's Highlights

In 2011, the drought that began in March of 2010 intensified and spread, reaching a peak in the first week of October 2011. At that time, the entire state of Texas was considered to be experiencing some level of drought, and nearly ninety percent of the state suffering "exceptional" drought, the highest intensity level that the U.S. Drought Monitor assigns.

As the drought continued throughout the year, several reservoirs in the basin reached historically low levels. Many streams and creeks went dry and receiving waters became more effluent-dominated. On several occasions, it was necessary to conduct routine monitoring from isolated pools. Not surprisingly, we have noticed some increases in the values for certain parameters, such as Specific Conductance, Total Suspended Solids, and Chloride, at several monitoring stations. However, the amount of data currently present is not enough to adequately evaluate the true impact of the drought on water quality. In order to better understand these issues, the TCEQ issued an interim guidance document addressing routine surface water quality monitoring activities during periods of extended droughts. This guidance (presented on page 7) includes additional parameters that could help to determine the extent of the drought effects.

During the past year, ANRA began using panoramic photography to document conditions at most of our monitoring sites. The panoramas are interactive, allowing a full 360° view of the monitoring stations. These images are available for viewing on our website at www.anra.org. (see page 12 for more details). ANRA also had the pleasure of giving a presentation at the 25th Annual Surface Water Quality Monitoring Workshop, in which we introduced this technique to other river authorities and monitoring entities throughout Texas. Currently, the panoramas are unique to ANRA's monitoring activities, but we are hoping to work with other entities to create panoramas for monitoring stations throughout the state.

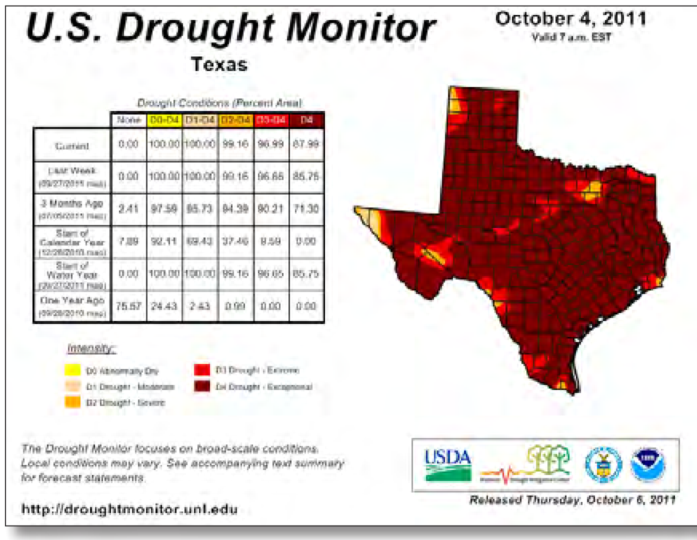
Three CRP monitoring sites were relocated in 2011. One site on the Angelina River was moved due to a newly installed wastewater outfall. A monitoring station on Sam Rayburn Reservoir had to be moved due to the low water levels caused by the drought. Also, a station monitored by the City of Tyler was changed to improve data accuracy (see page 18 for additional details).

About The Angelina & Neches River Authority

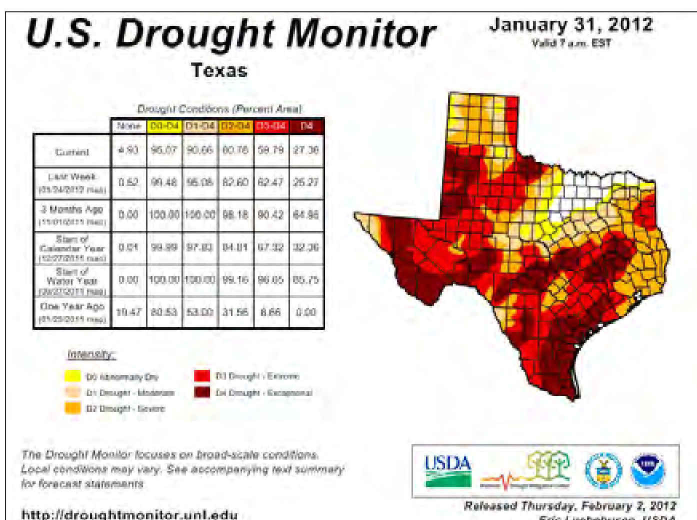
The Angelina & Neches River Authority (ANRA) was created in 1935 by the Texas legislature as a conservation and reclamation district. ANRA's office is located in Lufkin, Texas. ANRA's territorial jurisdiction consists of 8,500 square miles that lie wholly or in part of the following counties: Van Zandt, Smith, Henderson, Newton, Cherokee, Anderson, Rusk, Houston, Nacogdoches, San Augustine, Shelby, Angelina, Trinity, Sabine, Polk, Jasper, and Orange.

The Angelina & Neches River Authority has the responsibility for monitoring, protecting, and enhancing water resources in the Neches River Basin.

ANRA's functions in the basin include: water quality monitoring, drinking water and wastewater analysis, on-site sewage facility permitting, water and wastewater utilities, water resources development, regional wastewater/composting facilities, and other regional planning efforts.



U.S. Drought Monitor - October 4th, 2011



U.S. Drought Monitor - January 31st, 2012

This Year's Highlights *(cont.)*

In November of 2011, the EPA approved the 2010 Texas Integrated Report. This report is compiled every two years and includes the 303(d) list of impaired waters as required by the Clean Water Act (see page 19 for a list of impaired water bodies in the upper portion of the basin). Numerous water bodies in the basin are considered impaired, with most of those impairments being related to elevated bacteria levels.

A project is currently on-going in the basin to assess bacteria impairments in Attoyac Bayou. The primary goal of this project is to develop and implement a watershed protection plan to address these impairments. For more information, please refer to page 10.

Finally, the ANRA Environmental Laboratory, with assistance from the Clean Rivers Program, was able to purchase automated equipment for nutrient analysis. This equipment will significantly increase the laboratory's analytical capacity, and allow for much lower limits of quantitation, particularly for Total Phosphorus.

The 2011 Texas Drought

The one-year period from November 2010 through October 2011 was the driest in the state's history, according to State Climatologist John Nielsen-Gammon. It was also exceptionally hot. According to the National Weather Service, the months of June through August 2011 in Texas were the hottest three-month period ever reported by any state.

Due to the drought, the TCEQ curtailed junior water rights throughout a large portion of the basin in November 2011. Since December 2011, the situation in East Texas has improved considerably. Several months of above average rainfall have reversed the downward trend in our reservoir levels and brought our rivers back up to more normal levels. At the end of January of 2012, the situation had improved enough that the TCEQ released the suspension on most, but not all, of the previously suspended junior water rights. By April 4th the reservoir and river levels improved to the point that the TCEQ were able to remove all of the remaining restrictions.

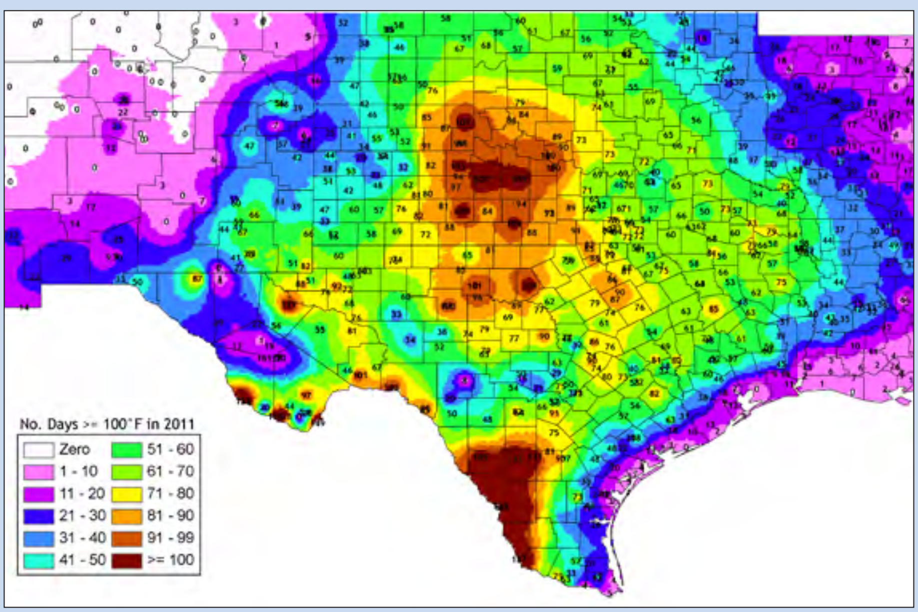
While the above average rainfall during the first half of the year has certainly helped refill reservoirs in the basin, full recovery from the drought is a slow process. Almost all reservoirs in the basin have returned to normal levels, but groundwater storage is still affected, and we will undoubtedly be studying the effects of the drought on water quality for years to come.

A drought information statement from the National Weather Service Shreveport Forecast Office published April 13th includes a list of cities in the area and how their rainfall from March of 2010 has compared to normal. At the time of the report, Lufkin, despite experiencing the second wettest March on record (dating back to 1907), was still 26.3 inches shy of normal rainfall, and Tyler was 31.22 inches below normal.

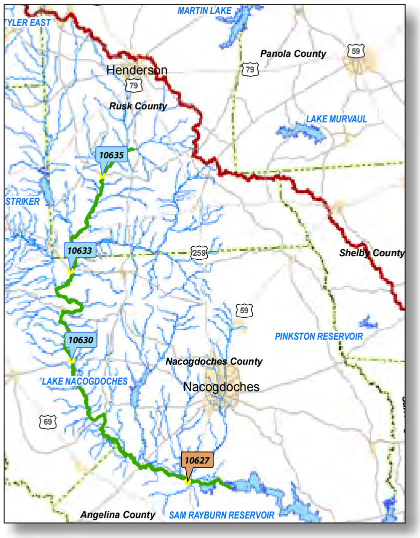
Throughout the basin, numerous municipalities and water supply corporations had to implement drought contingency measures due to diminishing water supplies. Some entities that normally depend upon surface water to meet their population's water needs are turning to drilling groundwater wells in order to supply a consistent and reliable source of water.

The drought and record heat were hard on the trees in Texas as well. The worst wildfire season on record occurred during 2011. Wildfires raged throughout the state, burning an estimated four million acres.

In its three month forecast for May through August 2012, the Climate Prediction Center anticipates that drought conditions will continue in West Texas, but they do not currently anticipate a resurgence of the drought in the eastern half of the state.



Number of days with maximum temperatures equaling or exceeding 100 °F in calendar year 2011 (through October 17, 2011). Graphic created by Brent McRoberts, Office of the State Climatologist, from Applied Climate Information System data. Excerpted from ***The 2011 Texas Drought, A Briefing Packet for the Texas Legislature*** *by John Nielsen-Gammon (October 31, 2011)*

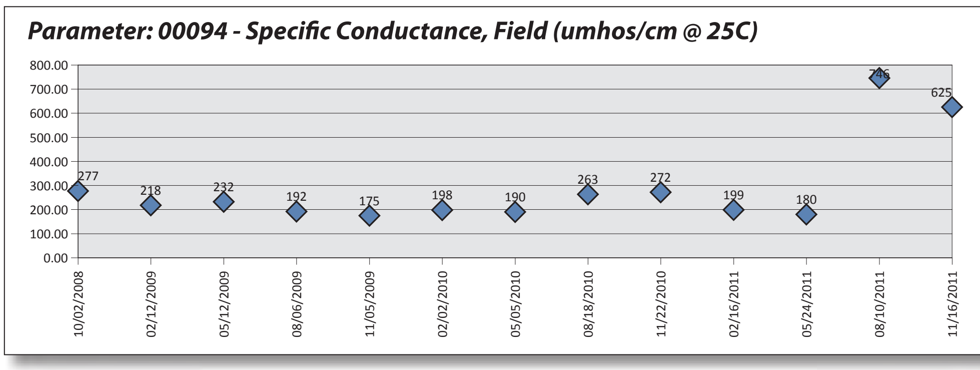


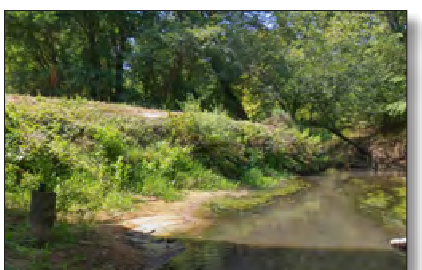
10635 - Angelina River at SH 1798

The Angelina River (Segment 0611) encompasses a length of 104 miles and extends from the Upper Angelina sub-basin to the Lower Angelina sub-basin. This segment originates from the aqueduct crossing 0.6 miles upstream of the confluence of the Paper Mill Creek in Angelina/Nacogdoches County to the confluence of Barnhardt Creek and Mill Creek at FM 225 in Rusk County.

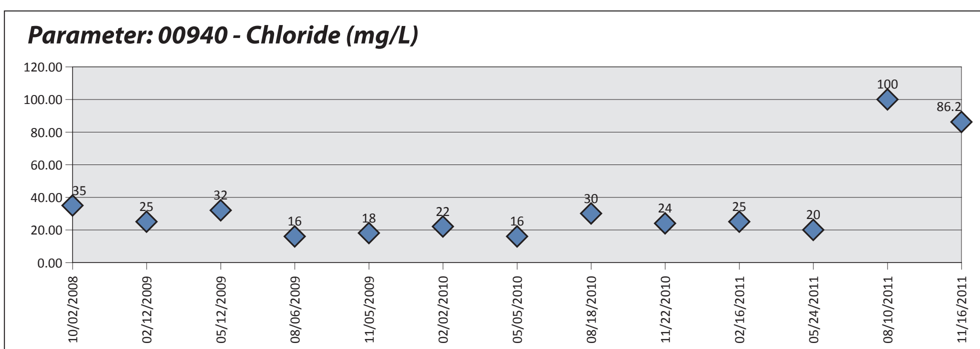
As the drought worsened, an increase was noted in Specific Conductance, Chloride, and Total Dissolved Solids at multiple stations along the segment. Shown below are the analytical results for routine monitoring samples collected at Station 10635 (Angelina River at SH 1798). Elevated values have been observed in the data collected at Station 10633 (Angelina River at SH 204) and Station 10630 (Angelina River at SH 21). The elevated Total Phosphorus results observed at 10635 is not seen at 10633 or 10630. However, there is an observed increase in the Chlorophyll-*a* values for Station 10630. Currently, there is not enough data to determine a cause for these increases, or to speculate on the duration of these elevated levels.

Angelina River at SH 1798
May 2011

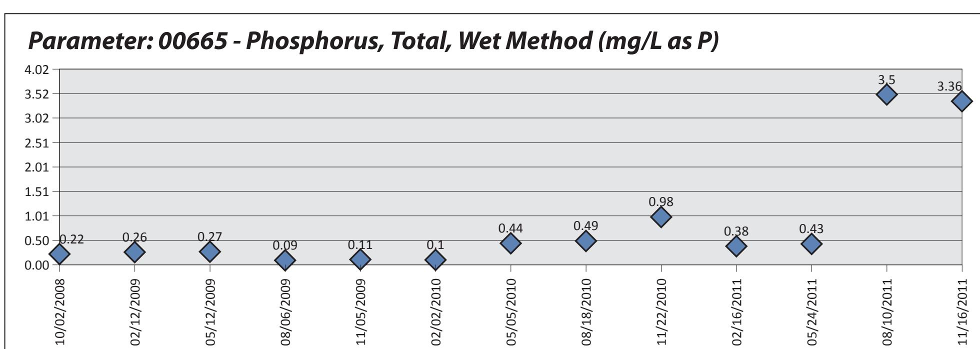




Angelina River at SH 1798
August 2011



Angelina River at SH 1798
November 2011



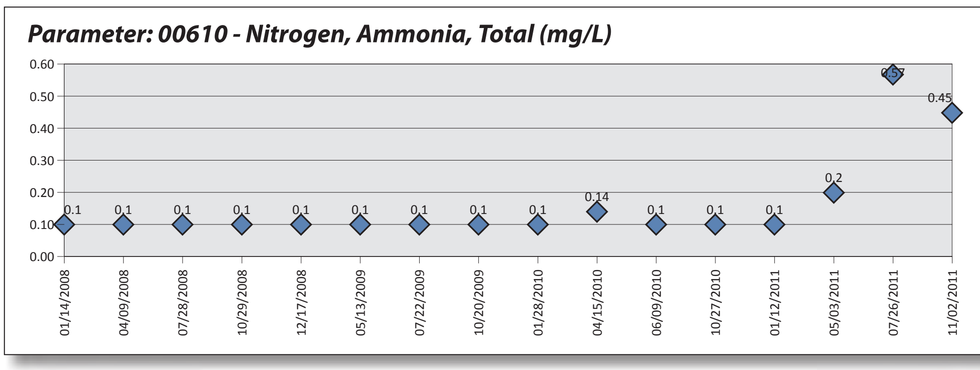
15361 - Ayish Bayou at SH 103

Ayish Bayou is a 32 mile-length freshwater stream extending from the confluence of Sam Rayburn Reservoir south of San Augustine in San Augustine County to the upstream perennial portion of the stream north of San Augustine in San Augustine County. This stream segment, including the upper, middle, and lower portions, is listed on the 303(d) list for bacteria. The first year this water body was listed for impairments was 2000.

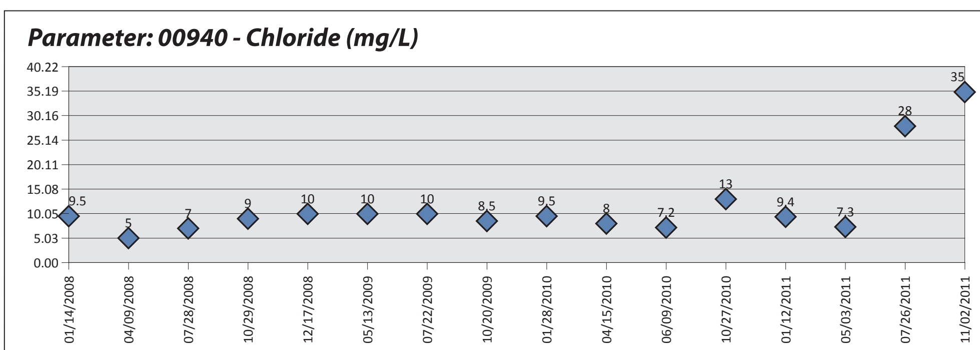
Routine monitoring in Ayish Bayou is indicating increases in Ammonia-Nitrogen, Chloride, Total Dissolved Solids, and Chlorophyll-*a* as the drought intensified. For Chlorophyll-*a*, values prior to July 2011 had been reported as <2 ug/L.

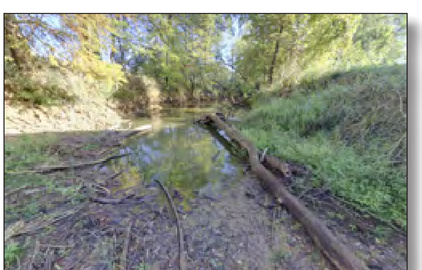
With a decrease in rainfall, this waterbody has become more effluent dominated. However, the discharge from the City of San Augustine's wastewater treatment plant is not enough to maintain flows in Ayish Bayou. On two occasions (July 2011 and November 2011), sampling was conducted from isolated pools.

Ayish Bayou at SH 103
May 2011

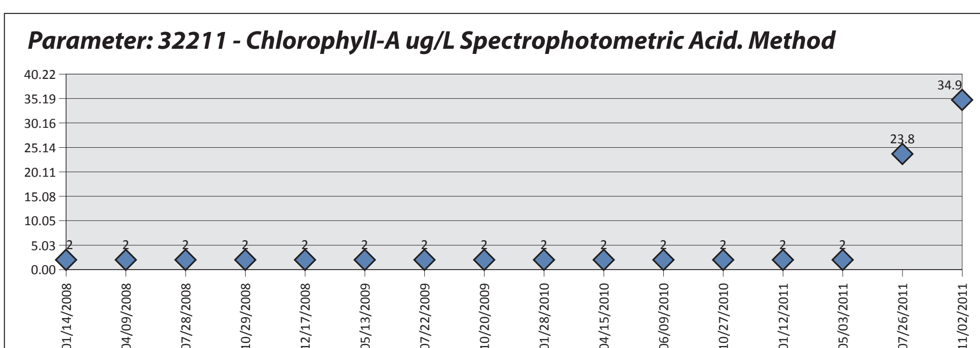


Ayish Bayou at SH 103
July 2011





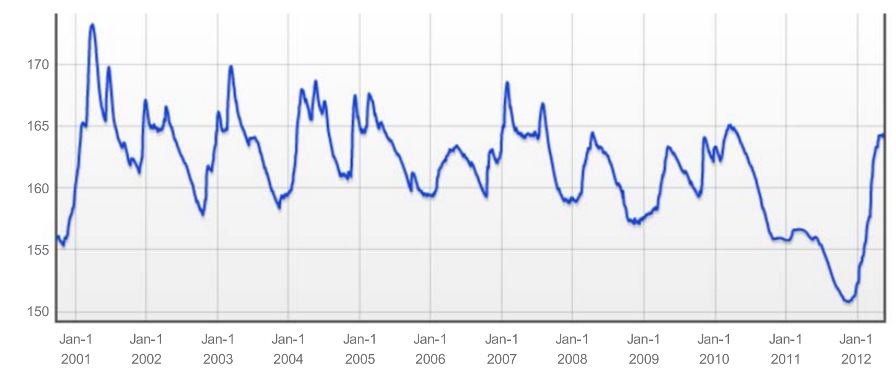
Ayish Bayou at SH 103
November 2011



Reservoir Levels During the Drought

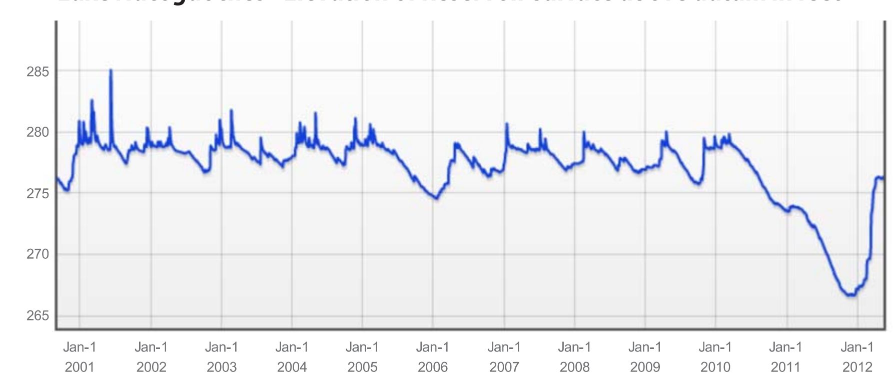
During the Drought of 2011, several reservoirs in the basin reached record or near record low levels. This impacted not only recreational uses of the water, but also jeopardized drinking water supplies for municipalities that depend upon surface water. On November 19, 2011, Lake Sam Rayburn reached a low of 150.80, nearly matching the record of 150.75 set August 10, 1996. According to Floyd Boyett of the US Army Corp of Engineers, the primary reason Sam Rayburn levels didn't break the record (probably in dramatic fashion) was the saltwater barrier in Beaumont. Prior to the completion of the barrier in 2003, releases from Sam Rayburn were required to keep saltwater from intruding upstream into the Neches. With the barrier in place, the Corp was able to retain much more water in the reservoir during Spring and Summer 2011, and even completely halt releases from November 2011 to May 2012. Since December 2011, above average rainfall has significantly improved pool levels of the Neches basin reservoirs, and as of mid-April, Lake Nacogdoches and Lake Tyler are the only two reservoirs in the basin that remain below normal pool. The National Weather Service anticipates further improvements to pool levels through the remainder of Spring.

Lake Sam Rayburn - Elevation of Reservoir surface above datum in feet



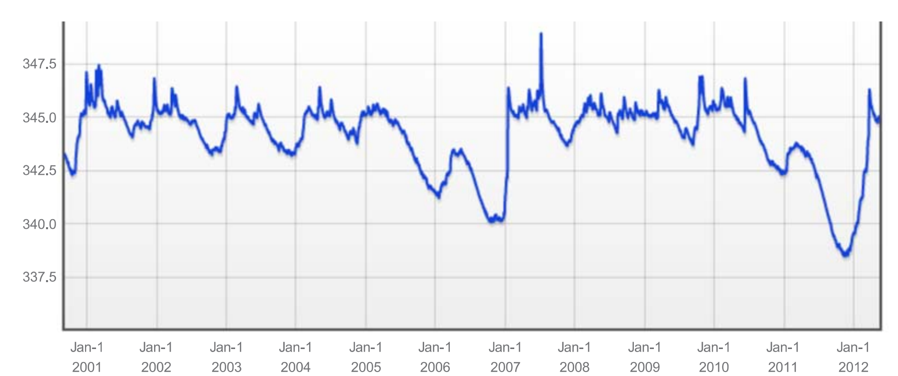
Sam Rayburn Reservoir at Marion's Ferry March 2011

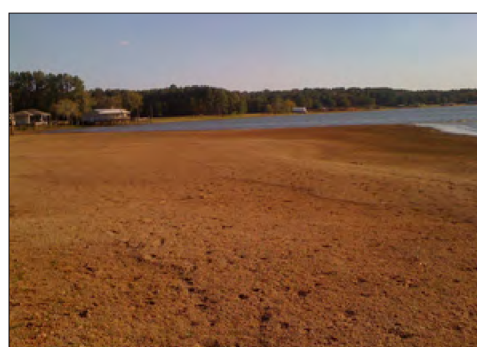
Lake Nacogdoches - Elevation of Reservoir surface above datum in feet



Lake Nacogdoches Main Pool November 2011

Lake Palestine - Elevation of Reservoir surface above datum in feet





Lake Palestine September 2011

(Photo by Upper Neches River Municipal Water Authority)

Interim Guidance for Routine Surface Water Quality Monitoring During Extended Drought

In response to the extended drought conditions, the Texas Commission on Environmental Quality released an interim guidance document in November 2011. This document details additional parameters to monitor in order to better evaluate water quality data collected during drought periods.

According to the guidance, monitoring entities should collect and report data according to the following guidelines:

- Schedule and travel to monitoring sites as you would normally do to meet routine commitments.
- Photo document flow conditions, even if the monitoring station is dry.
- If the monitoring site is on a lake or reservoir where it is possible to safely launch a boat, and navigate to within 400 meters of the established monitoring station, go ahead and collect routine water monitoring data (field, conventional water samples, etc.).
- If the monitoring site is a stream/river, and there is water present at the site within 400 meters of the established monitoring station, and minimum size meets dimensions as described below, go ahead and collect routine water monitoring data (field, conventional water samples, etc.). If possible, report total depth at the site where the sample is collected.
- Determine pool characteristics according to the following guidance:
    - A pool is defined as anything greater than or equal to 10 meters in length and greater than or equal to 0.4 meters in depth.
    - The total length of the reach upstream/downstream of a sample station to determine pool coverage should be between 500 and 800 meters.
    - A physical measurement is the preferred method for determining percent pool coverage, but a visual estimate can also be made.
    - Report the following pool characteristics:

      Maximum Pool Width (meters)

      Maximum Pool Depth (meters)

      Pool Length (in meters)

      Percent Pool Coverage in 500 meter reach
    - Report description of where the main pool is located in relation to the bridge crossing, as well as other pertinent details such as the presence of fish, mussels, or other wildlife.
- Record field data in the Surface Water Quality Monitoring Information System (SWQMIS), even if the station is dry.
- Note comments indicating drought conditions.

Piney Creek at FM 358
April 2011

Piney Creek at FM 358
November 2011

Using Google Earth to Monitor Drought Conditions Over Time

Google has updated their aerial imagery for approximately 5,300 square miles in the basin. The update is from November of 2011 and extends from Lake O' The Pines in the north to the City of Zavalla in the south. It includes area cities such as Lufkin, Nacogdoches, Henderson, and Longview. Of special interest is the coverage of Lake Nacogdoches and a large portion of Sam Rayburn Reservoir. Because the imagery was collected near the height of the drought in East Texas, when combined with the timeline feature in Google Earth, the images provide a powerful illustration of the effects that the drought has had on our area.

The following examples are from Google Earth. The images from January 2009 are copyright Google and the Texas Orthoimagery Program, and the images from November 2011 are copyright Google.

Lake Nacodoches East Park Boat Ramp and Swim Area
January 2009

Lake Nacodoches East Park Boat Ramp and Swim Area
November 2011

Shirley Creek Boat Ramp on Lake Sam Rayburn
January 2009

Shirley Creek Boat Ramp on Lake Sam Rayburn
November 2011

Attoyac Arm of Lake Sam Rayburn (Hwy 103 crossing) January 2009

Attoyac Arm of Lake Sam Rayburn (Hwy 103 crossing) November 2011

Development of a Watershed Protection Plan for Attoyac Bayou

The Attoyac Bayou is one of many rural watersheds in the state listed as an impaired water body on the Texas Water Quality Inventory and 303(d) List due to high levels of *E. coli*. Three monitoring stations managed by the Angelina & Neches River Authority, the U.S. Geological Survey, and the Texas Commission on Environmental Quality have provided water quality data on the bayou for a number of years. Beginning in 2000, data collected for *E. coli* have consistently shown elevated *E. coli* levels that exceed the applicable Texas Water Quality Standards.

Studies done to understand bacteria and nutrient loading in the area seem to justify the Attoyac's impairment listing, but the limited flow data documented make it difficult to calculate loading rates and identify sources of *E. coli* contamination. *The Development of a Watershed Protection Plan for Attoyac Bayou* project is collecting additional water quality and streamflow data that will help to develop a better understanding of *E. coli* loadings in the water body. Local stakeholder input will further facilitate the accurate identification of *E. coli* sources in the watershed and help develop an effective watershed protection plan to restore water quality.

Project Goals and Objectives

- To assess the current water quality conditions and impairments in the Attoyac Bayou watershed through targeted water quality sampling and analysis
- To conduct a watershed source survey and develop a comprehensive GIS inventory
- To analyze water quality data using Load Duration Curves and spatially explicit modeling
- To conduct bacterial source tracking and evaluate the sources of *E. coli* present in the watershed that are actually contributing to the Bayou's bacteria load
- To conduct a Recreational Use Attainability Analysis to determine the most appropriate water quality standard for the Attoyac Bayou
- To establish and provide direction for a stakeholder group that will serve as a decision making body in the assessment of the Attoyac Bayou and facilitate the development of a Watershed Protection Plan (WPP).

Monitoring Stations for the Attoyac Bayou Watershed Protection Plan Project

Segment	Station ID	Station Name	Collected by	Frequency	Parameters
0612	10636	Attoyac Bayou at SH 21	SFASU	Biweekly	F, C, B, BST
0612	15253	Attoyac Bayou at SH 7	SFASU	Biweekly, Stormwater	F, C, B, BST
0612	20841	Attoyac Bayou at FM 138	SFASU	Biweekly	F, C, B, BST
0612	16073	Attoyac Bayou at US 59	SFASU	Biweekly	F, C, B, BST
0612	20842	Attoyac Bayou at US 84	SFASU	Biweekly	F, C, B, BST
0612B	16083	Waffelow Creek at FM 95	SFASU	Biweekly	F, C, B, BST
0612A	16084	Terrapin Creek at FM 95	SFASU	Biweekly	F, C, B, BST
0612	20843	Naconiche Creek at FM 95	SFASU	Biweekly	F, C, B, BST
0612	20844	Big Iron Ore Creek at FM 354	SFASU	Biweekly, Stormwater	F, C, B, BST
0612	20845	West Creek at FM 2319	SFASU	Biweekly	F, C, B, BST
0612	WWTF1	City of Garrison WWTF Effluent	SFASU	Quarterly	F, C, B, BST
0612	WWTF2	Chireno ISD WWTF Effluent	SFASU	Quarterly	F, C, B, BST
0612	WWTF3	Martinsville ISD WWTF Effluent	SFASU	Quarterly	F, C, B, BST
0612	WWTF4	City of Center Water Treatment Filter Backwash	SFASU	Quarterly	F, C, B, BST

Parameter Codes: F = Field, C = Conventionals, B = Bacteria , BST = Bacterial Source Tracking
Conventional Parameters are: Ammonia-N, Nitrate+Nitrite-N, Orthophosphorus, Total Phosphorus, and Total Suspended Solids

Project Partners

The Development of a Watershed Protection Plan for Attoyac Bayou project is a collaborative effort by several partner agencies. Funding for the project is provided by the Texas State Soil and Water Conservation Board (TSSWCB) through a Clean Water Act, Section 319(h) grant from the U.S. Environmental Protection Agency (EPA).

Special Projects - Development of a Watershed Protection Plan for Attoyac Bayou *(cont.)*

Preliminary Water Quality Results

In July 2010, Stephen F. Austin State University (SFASU) field personnel began collecting surface water samples and submitting them to the ANRA Environmental Laboratory for analysis of the following parameters:

- Ammonia-Nitrogen
- Nitrate+Nitrite-Nitrogen
- Total Phosphorus
- Dissolved Orthophosphorus
- Total Suspended Solids
- *E. coli*

A subset of samples is sent to Texas A&M University for bacterial source tracking analysis.

Sampling is performed biweekly at 10 routine stations, quarterly at 4 wastewater treatment facilities, and at 2 sites, additional stormwater sampling occurs in response to rainfall events.

Laboratory and field data from the study is being submitted to TSSWCB for inclusion in the TCEQ's Surface Water Quality Monitoring Information System (SWQMIS).

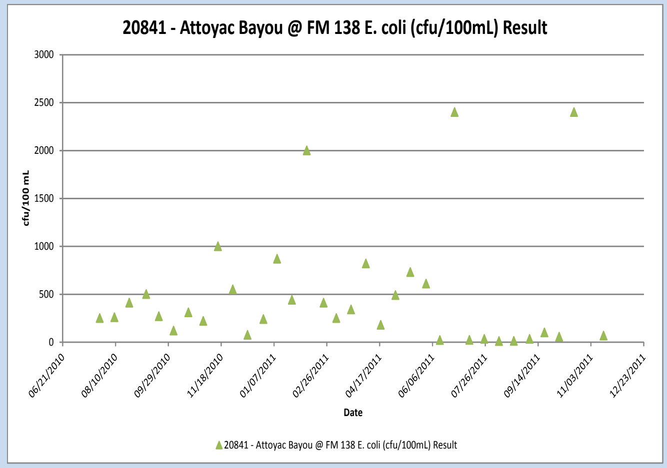
Although an in-depth statistical analysis has not yet been performed, a cursory overview of the data suggests that the drought is having an effect on the parameters being monitored. For several monitoring stations, data appears to show an increase in nutrient levels such as Phosphorus and Ammonia as the drought conditions worsen. Elevated Total Suspended Solids also appear more frequently as the flow diminishes and water bodies dry up. The reduced flow and lack of precipitation also appears to have had a positive impact on bacteria levels.

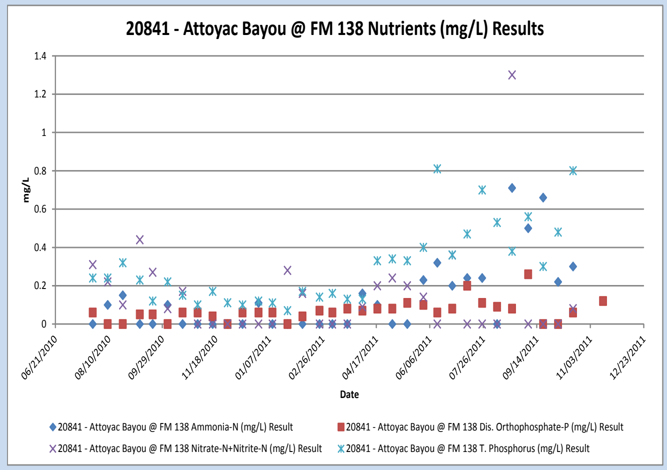
Following completion of the sampling and analysis portion of this project, SFASU and ANRA will corroboratively prepare the monitoring and assessment report for inclusion in the watershed protection plan.

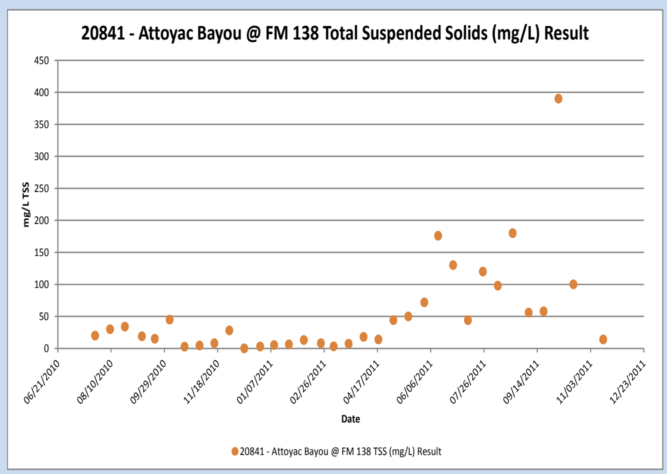
For more information on the project, please visit the project website at http://attoyac.tamu.edu or contact:

Anthony Castilaw
Watershed Coordinator
Castilaw Environmental Services, LLC
936-559-9991
acastilaw@castilawenvironmental.com

Example of Preliminary Water Quality Results







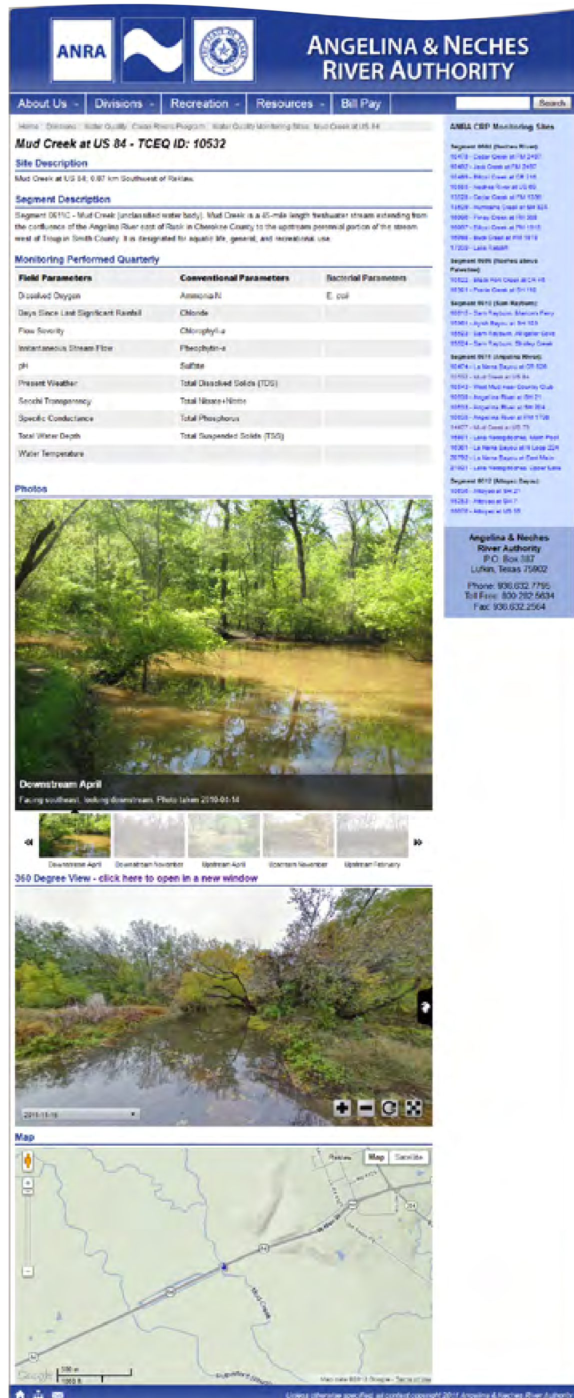
Project Partners (cont.)

Texas Water Resources Institute *make every drop count*
AgriLIFE RESEARCH & EXTENSION Texas A&M System
SFA
ANRA Angelina & Neches River Authority
CASTILAW Environmental Services, LLC

Incorporating Panoramic Photography into ANRA's Surface Water Quality Monitoring Program

Introduction

Beginning in the 2nd Quarter of FY11, ANRA Clean Rivers Program personnel began taking panoramic photographs of our monitoring stations. These images offer the viewer a full 360° view of the monitoring stations, allowing for an enhanced viewing experience as compared to traditional photographs.



Benefits and Potential Uses

There are numerous reasons for incorporating panoramic photographs into water quality monitoring programs. Some of the reasons are as follows:

- Panoramic photography allows for a 360° interactive presentation of environmental conditions associated with monitoring events.
- The photographs allow for the capture of upstream, downstream, left bank, right bank, canopy, and substrate views in one panoramic image.
- The interactive nature of the panoramas allows for rotating and zooming in order to better observe such things as weather/cloud coverage, pool reach, drought effects, pollution sources or illegal dumping, signs of contact recreation, etc.
- If each panorama is created in conjunction with a monitoring event, the panoramas can be used to demonstrate representativeness of monitoring conditions.
- If panoramas are captured from the same location, monitoring site conditions are easily compared over time.
- Integrated maps that indicate viewing direction and location can provide improved spatial awareness.

Where to View the Panoramas

All panoramas are available on ANRA's website at the following address:

http://www.anra.org/divisions/water_quality/crp/monitoring_sites/

Panoramas for different monitoring stations can be selected from either a list or a map. At stations where several panoramas have been created, the panoramas can be selected by date from a pull-down menu in the image viewer. This allows the user to compare site conditions on various dates to see seasonal variations.

Neches River at US 69
April 2011

http://www.anra.org/divisions/water_quality/crp/monitoring_sites/10585.html

An example illustrating changing water levels in Lake Ratcliff During the Drought

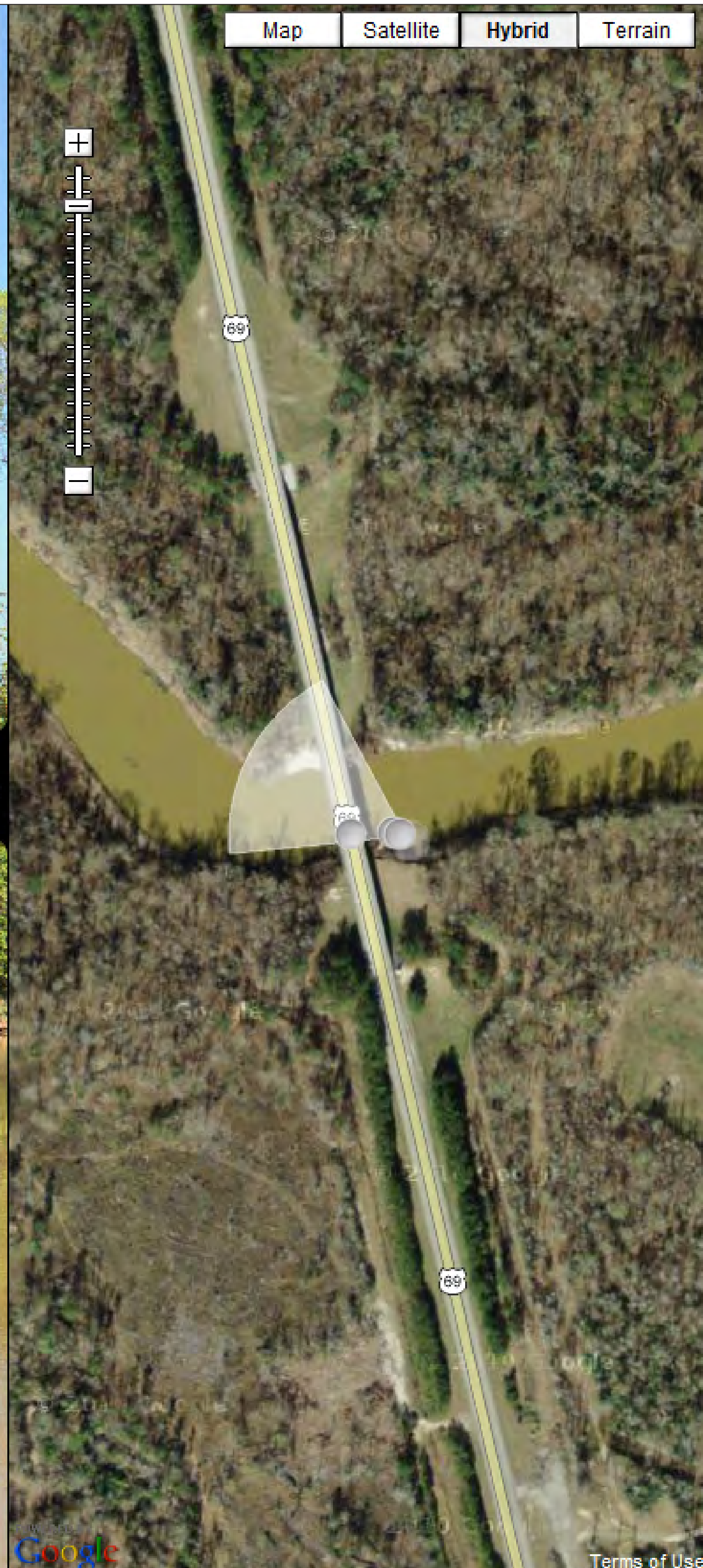
Lake Ratcliff at the height of the drought
November 2011

http://www.anra.org/divisions/water_quality/crp/monitoring_sites/17339.html

Lake Ratcliff after above average Spring rains
March 2012

http://www.anra.org/divisions/water_quality/crp/monitoring_sites/17339.html

Neches River at US 69 - April 2011 (Showing Integrated Google Map Feature)



http://www.anra.org/divisions/water_quality/crp/monitoring_sites/10585.html

ANRA Water Quality Monitoring Sites in the Neches Basin for Fiscal Year 2012

ANRA Reported CRP Monitoring Stations In the Upper Neches River Basin by Segment

Segment	Station ID	Station Name	Collected by	Frequency	Parameters
0604	10585	Neches River At US 69	ANRA	Quarterly	F, C, B
0604A	13528	Cedar Creek At CR 1336	ANRA	Quarterly	F, C, B
0604A	10478	Cedar Creek At FM 2497	ANRA	Quarterly	F, C, B
0604B	13529	Hurricane Creek At SH 324	ANRA	Quarterly	F, C, B
0604C	10492	Jack Creek At FM 2497	ANRA	Quarterly	F, C, B
0604D	16096	Piney Creek At FM 358	ANRA	Quarterly	F, C, B
0604M	10499	Biloxi Creek At Angelina CR 216	ANRA	Bimonthly	F, B
0604M	16097	Biloxi Creek At FM 1818	ANRA	Quarterly	F, C, B
0604N	16098	Buck Creek At FM 1818	ANRA	Quarterly	F, C, B
0604T	17339	Lake Ratcliff	ANRA	Quarterly	F, C, B
0606A	18301	Prairie Creek At SH 110	City of Tyler	Quarterly	F, C, B
0606D	10522	Black Fork Creek At Smith CR 46	City of Tyler	Quarterly	F, C, B
0610	15524	Sam Rayburn Near Shirley Creek	ANRA	Quarterly	F, C, B
0610	15523	Sam Rayburn Adjacent To Alligator Cove	ANRA	Quarterly	F, C, B
0610	21100	Sam Rayburn Near Marion's Ferry	ANRA	Quarterly	F, C, B
0610A	15361	Ayish Bayou At SH 103	ANRA	Quarterly	F, C, B
0611	10635	Angelina River At FM 1798	ANRA	Quarterly	F, C, B
0611	10633	Angelina River At SH 204	ANRA	Quarterly	F, C, B
0611	10630	Angelina River At SH 21	ANRA	Quarterly	F, C, B
0611B	16301	La Nana Bayou At Loop 224 North	ANRA	Quarterly	F, C, B
0611B	10474	La Nana Bayou At Nacogdoches CR 526	ANRA	Quarterly	F, C, B
0611B	20792	La Nana Bayou Upstream Of East Main	ANRA	Quarterly	F, C, B
0611C	14477	Mud Creek At US 79	ANRA	Quarterly	F, C, B
0611C	10532	Mud Creek At US 84	ANRA	Quarterly	F, C, B
0611D	18302	West Mud Creek East Of US 69	City of Tyler	Quarterly	F, C, B
0611D	10542	West Mud Creek Upstream of WWTP	City of Tyler	Quarterly	F, C, B
0611Q	15801	Lake Nacogdoches In Main Pool	ANRA	Quarterly	F, C, B
0611Q	17818	Lake Nacogdoches Upper Lake	ANRA	Quarterly	F, C, B
0612	10636	Attoyac Bayou At SH 21	ANRA	Quarterly	F, C, B
0612	15253	Attoyac Bayou At SH 7	ANRA	Quarterly	F, C, B
0612	16076	Attoyac Bayou At US 59	ANRA	Quarterly	F, C, B

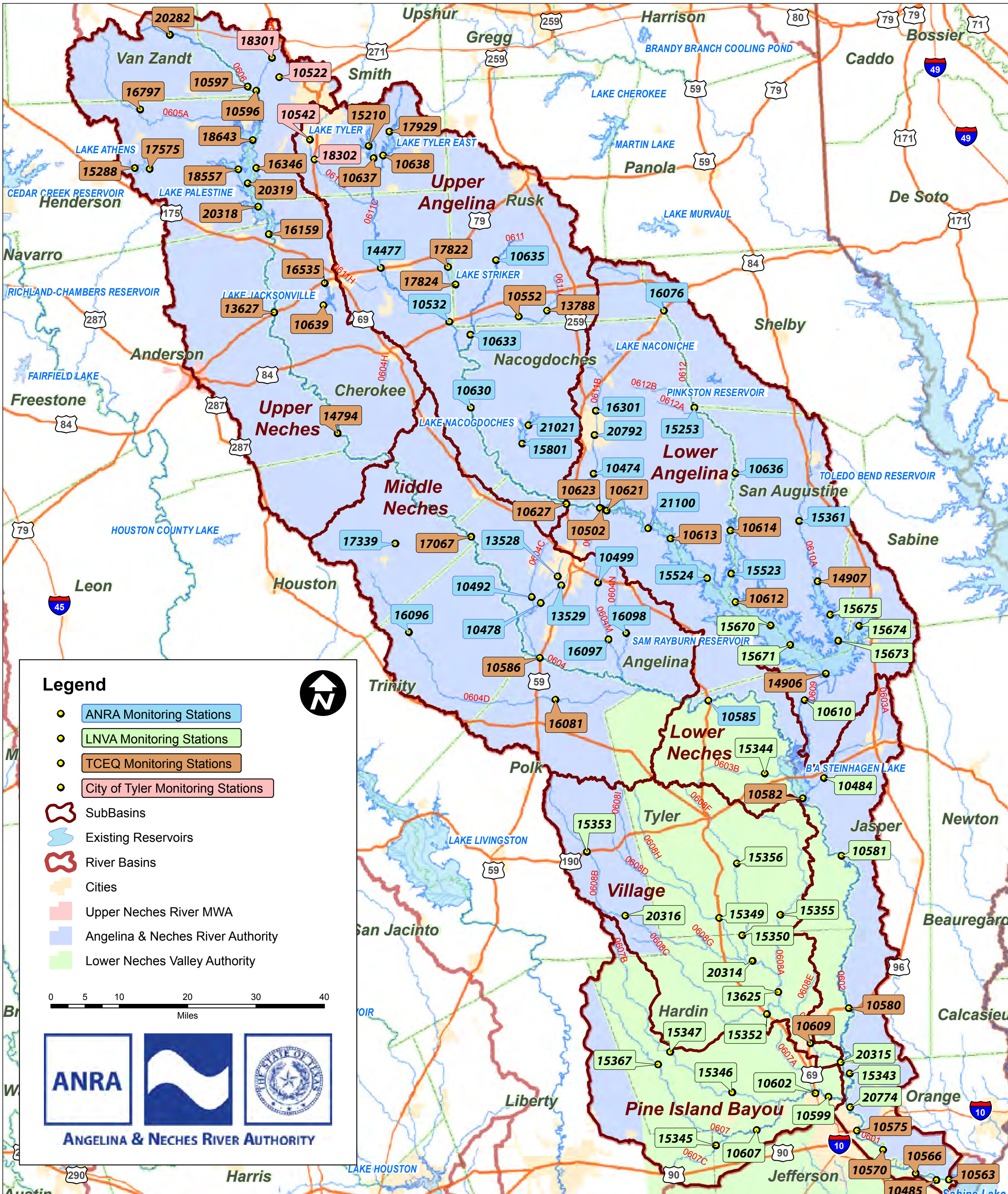
Parameter Codes: F = Field, C = Conventionals, B = Bacteria (See table below for a list of the parameters included in each set)

Parameters for quarterly monitoring

Field Parameters	Conventional Parameters	Bacterial Parameters	Drought Parameters
Dissolved Oxygen Days Since Last Significant Rainfall Flow Severity Instantaneous Stream Flow pH Present Weather Secchi Transparency Specific Conductance Total Water Depth Water Temperature	Ammonia-N Chloride Chlorophyll-*a* Pheophytin-*a* Sulfate Total Dissolved Solids (TDS) Total Nitrate+Nitrite Total Phosphorus Total Suspended Solids (TSS)	*E. coli*	These parameters are collected in drought situations. **If sampling from an isolated pool:** Max Pool Width Max Pool Depth Pool Length Percent Pool Coverage **If sampling in a reservoir:** Reservoir Not Accessible Reservoir Stage Reservoir Percent Full

For a full discussion of the parameters, including potential sources, please refer to pages 18 - 21.
The summary report can be found online at: http://www.anra.org/divisions/water_quality/crp/

Water Quality Monitoring Sites in the Neches Basin for Fiscal Year 2012



Water Quality Monitoring in the Upper Neches Basin

In FY 2012, the Angelina & Neches River Authority monitors 26 sites quarterly for field, conventional parameters and bacteria, with an additional site being monitored bimonthly for bacteria. The City of Tyler has 4 monitoring stations within the Upper Neches Basin. The Texas Commission on Environmental Quality (TCEQ) also has a robust sampling program in the basin, with monitoring being conducted by both Region 5 (Tyler) and Region 10 (Beaumont) staff.

Number of Routine Monitoring Sites in the Upper Neches River Basin

Sampling Entity	Field	Conventional	Bacteria	Metals in Water	Metals in Sediment	Organics in Water
ANRA	26 quarterly		26 quarterly 1 bimonthly			
City of Tyler	4 quarterly		4 quarterly			
TCEQ	42 quarterly			5 quarterly 1 5X/year	8 quarterly 4 annually	2 quarterly

In addition to the Routine Monitoring above, the TCEQ is performing Biased Monitoring at three sites in the basin. One site will be visited five times to sample Metals in Water. The second will have a single visit to sample Aquatic Habitat and Nekton. The third will have two visits to sample Field, 24 hour DO, Aquatic Habitat, Benthics, and Nekton. There is also a site that was scheduled for quarterly Metals in Water last year that was not completed due to the drought. The final visit to that site has been carried over to this year.

Monitoring sites that have been relocated

10615 - Sam Rayburn at Marion's Ferry
Due to the drought, it became necessary to create a new monitoring location near Marion's Ferry to replace site 10615. 10615 is located directly at the boat ramp, which is not on the river channel, so as the reservoir receeded, sampling became impossible. The new monitoring site (21100) was created three quarters of a kilometer downstream of the boat ramp on the main river channel. This location should serve us well in the future even in times of drought.

10633 - Angelina at SH 204
In order to stay out of the mixing zone of a newly installed wastewater outfall, this site was moved approximately 340 meters upstream.

10543 - West Mud Creek Near Holly Trees Country Club
Site 10542 (West Mud Creek upstream of WWTP) has been determined to be a better match for where this monitoring has actually been taking place. The physical location of the monitoring will not change, but in the future, data will be reported for site 10542 rather than 10543. A data correction request has been submitted to the TCEQ to have past data moved to site 10542.

Map of Site 10542: West Mud Creek upstream of WWTP

Aerial imagery of Marion's Ferry - October of 2005

Aerial imagery of Marion's Ferry - November of 2011

Impaired Water Bodies in the Upper Neches Basin

Numerous water bodies in the Upper Neches Basin are listed as impaired due to bacteria (*E. coli*). There are also concerns for nutrient parameters and depressed dissolved oxygen for several segments.

Impairments in the Upper Neches Basin *(As listed in the 2010 Texas integrated Report*)*

Segment	*Segment Name*	*Impairments*	*Concerns*
0604	Neches River Below Lake Palestine	mercury in edible tissue	ammonia, chlorophyll-a
0604A	Cedar Creek (unclassified water body)	bacteria	ammonia, nitrate, orthophosphorus, total phosphorus
0604B	Hurricane Creek (unclassified water body)	bacteria	ammonia
0604C	Jack Creek (unclassified water body)	bacteria	ammonia, depressed dissolved oxygen, nitrate, orthophosphorus, total phosphorus
0604D	Piney Creek (unclassified water body)	depressed dissolved oxygen	ammonia, depressed dissolved oxygen
0604M	Biloxi Creek (unclassified water body)	bacteria, depressed dissolved oxygen	ammonia, bacteria, depressed dissolved oxygen
0604N	Buck Creek (unclassified water body)		ammonia
0604T	Lake Ratcliff (unclassified water body)	mercury in edible tissue	
0605	Lake Palestine	pH	chlorophyll-a, depressed dissolved oxygen, manganese in sediment
0605A	Kickapoo Creek in Henderson County (unclassified water body)	bacteria, depressed dissolved oxygen	ammonia, chlorophyll-a, depressed dissolved oxygen, orthophosphorus, total phosphorus
0606	Neches River Above Lake Palestine	bacteria, depressed dissolved oxygen, pH, zinc in water	depressed dissolved oxygen, nitrate, orthophosphorus
0606A	Prairie Creek (unclassified water body)	bacteria	ammonia
0606D	Black Fork Creek (unclassified water body)		ammonia
0610	Sam Rayburn Reservoir	mercury in edible tissue	ammonia, arsenic in sediment, iron in sediment, manganese in sediment, mercury in edible tissue, nitrate
0610A	Ayish Bayou (unclassified water body)	bacteria	ammonia, depressed dissolved oxygen
0611	Angelina River Above Sam Rayburn Reservoir	bacteria	ammonia, depressed dissolved oxygen
0611A	East Fork Angelina River (unclassified water body)	bacteria	
0611B	La Nana Bayou (unclassified water body)	bacteria	ammonia, nitrate, orthophosphorus, total phosphorus
0611C	Mud Creek (unclassified water body)	bacteria	ammonia, depressed dissolved oxygen
0611D	West Mud Creek (unclassified water body)	bacteria	ammonia, nitrate, orthophosphorus, total phosphorus
0611Q	Lake Nacogdoches (unclassified water body)		ammonia
0611R	Lake Striker (unclassified water body)		ammonia
0612	Attoyac Bayou	bacteria	ammonia, bacteria
0615	Angelina River/Sam Rayburn Reservoir	bacteria, depressed dissolved oxygen, impaired fish community, mercury in edible tissue	depressed dissolved oxygen, orthophosphorus, total phosphorus
0615A	Paper Mill Creek (unclassified water body)	bacteria	depressed dissolved oxygen

**Approved November 18, 2011 by the EPA*

ANRA Water Quality Monitoring Parameters for Fiscal Year 2012

The following sections summarize the various field and conventional parameters monitored, as well as potential impacts and possible sources.

Field Measurements

Field measurements are collected on-site by direct monitoring in the water body. Field data collected by multiprobe instruments include such parameters as Water Temperature, pH, Dissolved Oxygen, and Specific Conductance. Other field measurements include Flow and Secchi-Disk Transparency.

pH

Why is it monitored?
pH is a measure of whether water is acidic or basic. Most aquatic organisms are adapted to live within a specific pH range. pH can also affect the toxicity of many substances, which generally increase in solubility as pH decreases. The ability of water to resist changes in pH (its buffering capacity) is essential to aquatic life.

What could cause unusual levels?
pH can be affected by industrial and wastewater discharges, runoff, and accidental spills. Natural variation in seasons may also affect pH.

Specific Conductance

Why is it monitored?
Specific Conductance is the measure of the water's capacity to carry an electrical current and is indicative of the amounts of dissolved solids present in a water body.

What could cause unusual levels?
Dissolved salt-forming substances such as sulfate, chloride, and sodium increase the conductivity of the water.

Temperature

Why is it monitored?
Water temperature affects the oxygen content of the water (dissolved oxygen). Temperature also has an impact on cold-blooded animals.

What could cause unusual levels?
Water temperature may be affected by alterations to the riparian zone, changes in ambient temperature, and discharges.

Dissolved Oxygen (DO)

Why is it monitored?
DO is a measure of the amount of dissolved oxygen that is available in the water. DO is vital for aquatic organisms to live. Where DO is too low, aquatic organisms may have insufficient oxygen to live.

What could cause unusual levels?
DO is temperature-dependent, with water being able to hold more dissolved oxygen at lower temperatures due to the solubility of gases increasing as the temperature decreases. The amount of oxygen present usually decreases with depth, rising temperatures, and with the oxidation of organic matter and pollutants. Bacteria and algal blooms may cause DO to decrease as decomposition of organic matter consumes oxygen in the water, resulting in hypoxic (low oxygen) areas.

Measurement of pH, DO, Specific Conductance, and Temperature using a multiprobe instrument

Field Parameters (cont.)

Flow

Why is it monitored?

Flow is a measurement of the velocity of the water, measured in cubic feet per second (CFS). Aquatic species are adapted to specific flow patterns. If the usual seasonal patterns are disrupted in a water body it can be detrimental to those species. In addition to its use as a standalone parameter, Flow is also used as a qualifier for other parameters. An elevated *E. coli* during a high flow event can indicate a very different source than it would during a low flow event.

What could cause unusual levels?

Flow can be affected by both natural sources such as heavy rainfall, beaver dams, fallen trees, and man-made sources such as wastewater discharges, broken water lines, debris, or even runoff from washing cars and watering lawns.

Measuring Flow

ANRA Water Quality Monitoring Parameters for Fiscal Year 2012

Conventional Parameters

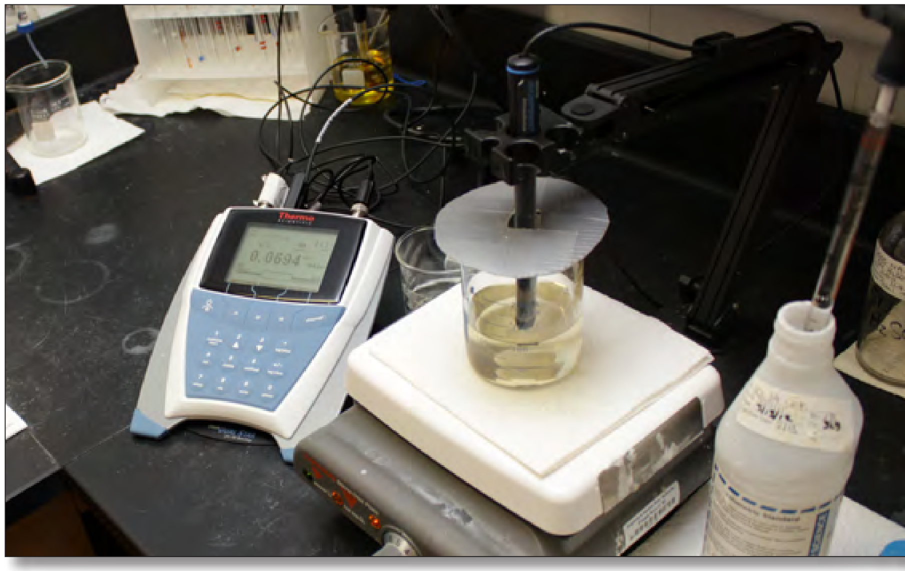
Conventional parameters are also evaluated as part of the monitoring plan. During routine monitoring events, water samples are collected for laboratory analysis of conventional parameters. Conventional parameters include nutrients, minerals, and particulates.

For the conventional parameters, all analyses, with the exception of Chlorophyll-*a*, are conducted in-house at ANRA's Environmental Laboratory. Samples for Chlorophyll-*a* are analyzed by the Lower Colorado River Authority (LCRA) Environmental Laboratory Services (ELS).

Ammonia-Nitrogen

Why is it monitored?
Ammonia, which is produced from the breakdown of nitrogen-containing compounds, is found naturally in waters. In excess, algal blooms may occur. Elevated ammonia levels are indicative of organic pollution. These elevated levels can cause stress on aquatic organisms, as well as damage to tissue and gills.

What could cause unusual levels?
Ammonia enters into a body of water via excretion of nitrogenous wastes, decomposition of plants and animals, and runoff. Ammonia is an ingredient in many fertilizers. It is also present in sewage, wastewater discharges, and storm water runoff.



Analysis of Ammonia-Nitrogen by Ion Selective Electrode

Nitrate + Nitrite-Nitrogen

Why is it monitored?
Elevated levels of nitrite and nitrate can produce nitrite toxicity in fish ("brown blood disease") and methemoglobinemia ("blue baby syndrome") in infants by reducing the oxygen-carrying capacity of blood. In surface water, high levels of nitrates can lead to excessive growth of aquatic plants. High levels of nitrates are also indicative of human-caused pollution.

What could cause unusual levels?
As part of the nitrogen cycle, nitrogenous compounds are converted from ammonia to nitrite and then to nitrate by bacterial and chemical processes. Potential sources include effluent discharges from wastewater treatment plants, fertilizers, and agricultural runoff.

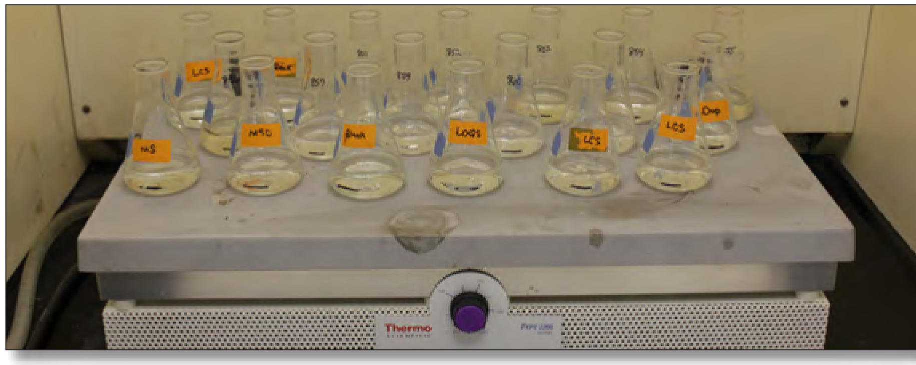
Analysis of Nitrate+Nitrite-Nitrogen by Cadmium Reduction

Conventional Parameters (cont.)

Total Phosphorus

Why is it monitored?
Phosphorus is essential to the growth of organisms, and is considered a growth-limiting nutrient. Elevated levels in water may stimulate the growth of photosynthetic aquatic macro- and microorganisms. Elevated phosphorus levels contribute to eutrophication and may cause algal blooms.

What could cause unusual levels?
Phosphorus is commonly known as a man-made pollutant. It is present in industrial and domestic wastewater discharges, as well as agricultural and storm water runoff. It is an ingredient in soaps and detergents, and is used extensively in the treatment of boiler waters. Phosphates are also used by some water supplies during treatment.



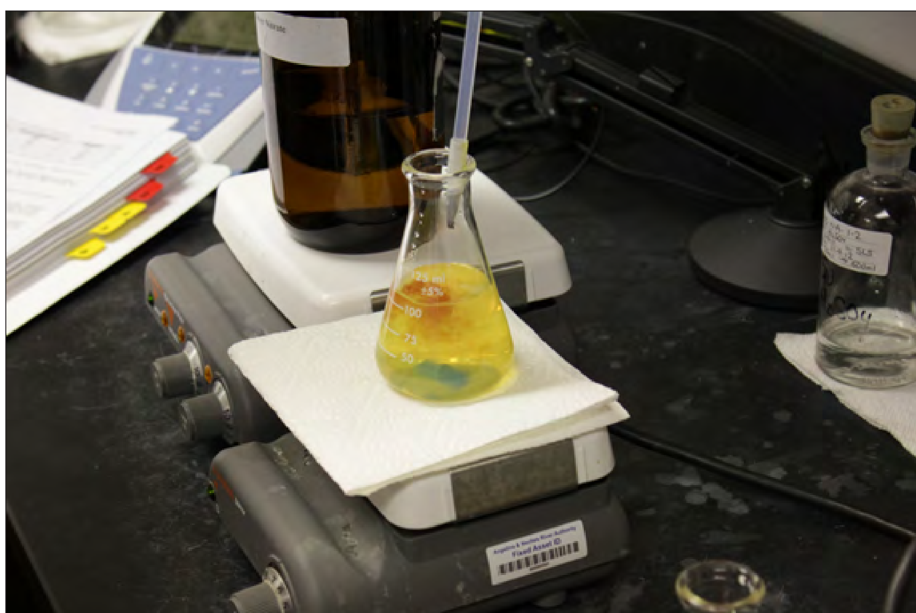
Digestion of samples for Total Phosphorus analysis

Analysis of Total Phosphorus

Chloride

Why is it monitored?
Chloride is one of the major inorganic ions in water and wastewater. It is an essential element for maintaining normal physiological functions in all organisms. Elevated chloride concentrations can adversely affect survival, growth, and/or reproduction of aquatic organisms.

What could cause unusual levels?
An elevated chloride concentration can be indicative of natural or man-made pollution. Natural sources of chloride include the weathering and leaching of sedimentary rocks, soils, and salt deposits. Other possible sources include oil exploration and storage, sewage and industrial discharges, and landfill runoff.



Analysis of Chloride by Titration

Conventional Parameters (cont.)

Sulfate

Why is it monitored?
Sulfate is essential for plant growth, and low levels (under 0.5 mg/L) can be detrimental to algal growth. Excessive levels of sulfate can form strong acids and change the pH of the water. Excessively high levels may be toxic to cattle and other animals. Sulfate can also affect drinking water.

What could cause unusual levels?
Sulfate occurs in almost all natural waters due to an abundance of elemental and organic sulfur in the environment. It usually enters into water bodies by water passing over rock or soil containing minerals like gypsum, as well as runoff from agricultural lands, industrial discharges, and sewage treatment plant discharges. Sulfate can also enter water bodies from atmospheric deposition from such sources as burning fossil fuels.

Chlorophyll-a

Why is it monitored?
Chlorophyll-*a* is an indicator of algal biomass in a water body. Increased concentrations indicate potential eutrophication or nutrient loading. Diurnal shifts in DO and pH resulting from increased photosynthesis and respiration can cause stress to aquatic organisms.

What could cause unusual levels?
Chlorophyll-*a* is a photosynthetic pigment that plays a vital role in photosynthesis. It is found in most plants, cyanobacteria, and algae. When Chlorophyll-*a* levels are consistently high or variable, this may be indicative of algal blooms.

Total Dissolved Solids (TDS)

Why is it monitored?
TDS, reported in mg/L, is a measure of the total dissolved particles in water. Typically, it is comprised of chlorides, sulfates, and other salt-forming anions. TDS is an important measure of drinking water quality.

What could cause unusual levels?
TDS can occur naturally from dissolution of carbonate and salt deposits in rocks and soils. Other sources include agricultural and storm water runoff, effluent discharges from industrial and domestic wastewater treatment plants, and oil exploration.

Total Suspended Solids (TSS)

Why is it monitored?
TSS, reported in mg/L, is a measure of the total suspended particles in water. High levels of TSS increase the turbidity of the water, reducing light penetration which subsequently decreases oxygen production by plants.

What could cause unusual levels?
Elevated TSS can result from multiple point and non-point sources. Soil erosion and runoff are two primary sources.

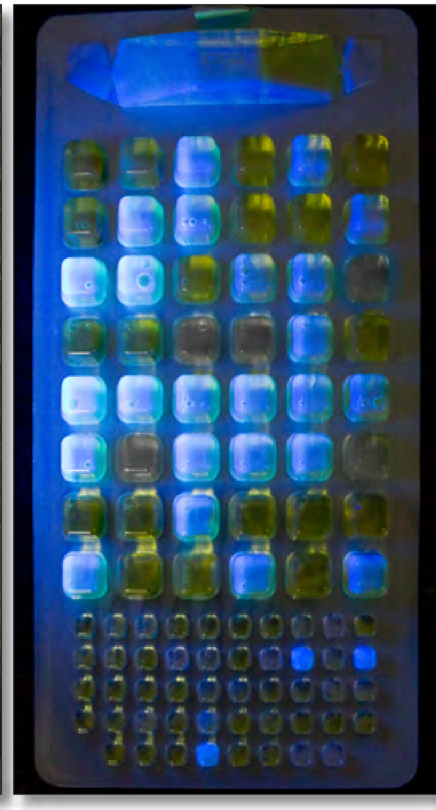
Analysis of Total Suspended Solids

Bacteriological Parameters

Escherichia coli (E. coli) Bacteria

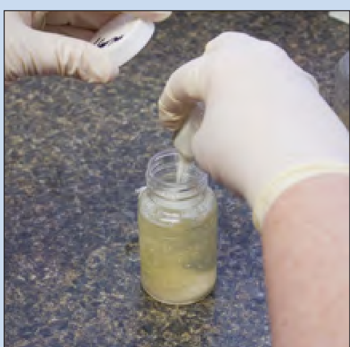
Why is it monitored?
E. coli is an indicator of fecal contamination. Fecal contamination is a health concern to the general public, and its presence indicates a risk for contact recreation. The presence of *E. coli* in the water indicates that pathogenic organisms may be present.

What could cause unusual levels?
E. coli is abundant in the gastrointestinal tract of warm-blooded animals. Elevated bacterial levels are indicative of a potential pollution problem. Reasons for the presence of fecal coliforms such as *E. coli* include failing septic systems, animal wastes, and inadequately treated sewage.



Using Colilert® media (IDEXX), total coliform bacteria will exhibit a yellow color (Left). Sample wells that are positive for E. coli bacteria will fluoresce (Right). Bacteria counts are derived statistically using a Most Probable Number table.

Overview of the analysis steps for enumeration of *E. coli* bacteria using Colilert® media (IDEXX)



1.
Add Colilert to sample

2.
Pour sample/Colilert Mixture into quanti-tray

3.
Seal tray and incubate 24 hours

4.
Count positive wells and refer to MPN table

ANRA Environmental Laboratory

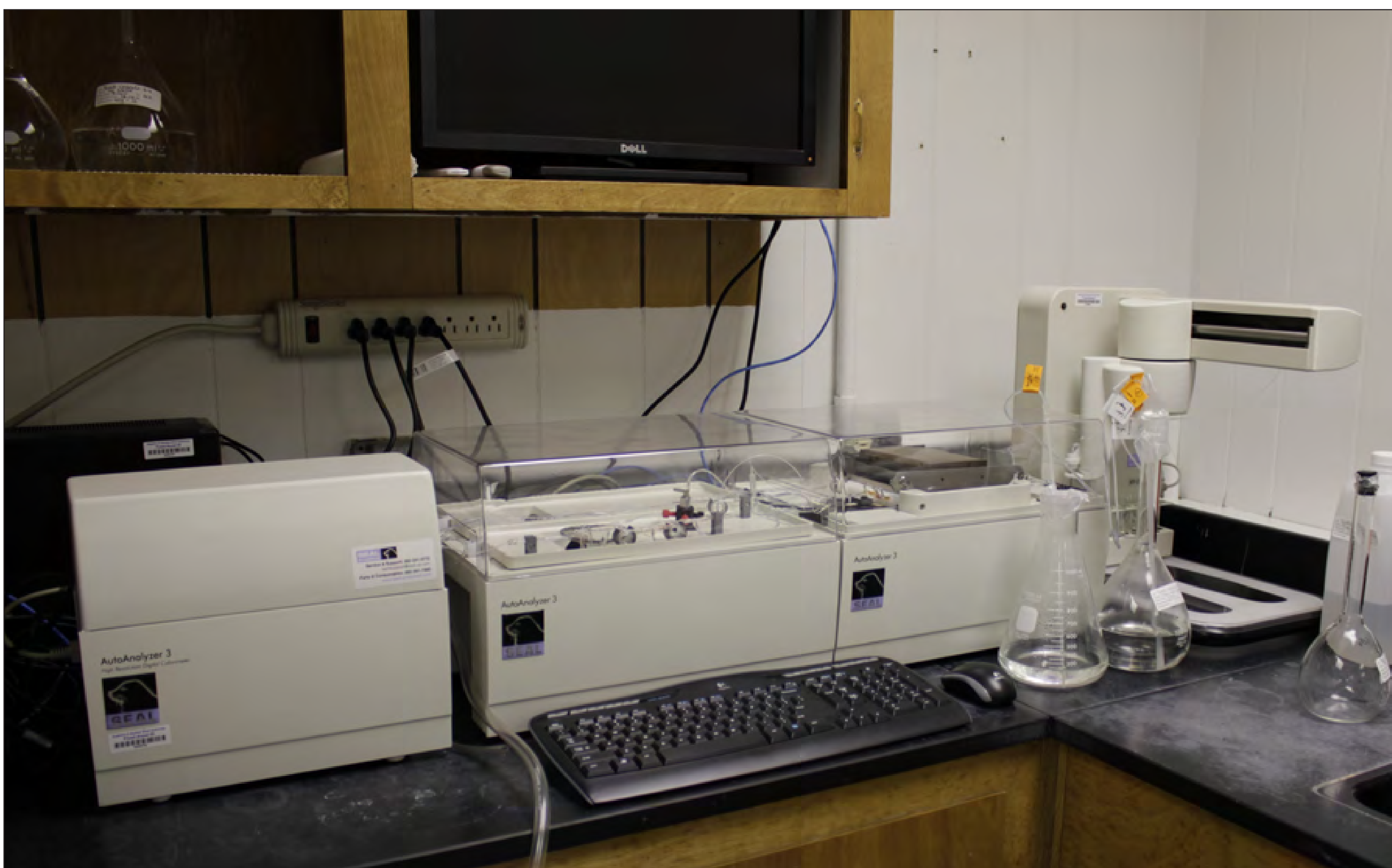
For water samples collected by ANRA and the City of Tyler, analysis of conventional parameters is performed by the ANRA Environmental Laboratory. The ANRA Environmental Laboratory is certified by the National Environmental Laboratory Accreditation Program (NELAP) for the chemical and microbiological analysis of potable and non-potable water. The laboratory performs analysis of drinking water, wastewater, and surface water samples for numerous entities and private individuals in the basin, including the Clean Rivers Program.

For more information regarding ANRA's analytical testing services, please contact:

Trey Reeves, R.S.	Brian Sims
Laboratory Manager	Environmental Division Manager / Laboratory Quality Assurance Officer
(936)-633-7542	(936)-633-7527
treeves@anra.org	bsims@anra.org

Automated Nutrient Analysis

At the end of FY 2011, the ANRA Environmental Laboratory, with assistance from the Texas Clean Rivers Program, was able to purchase a SEAL AutoAnalyzer 3. The AutoAnalyzer 3 is a fully automated Continuous Flow Analyzer for the determination of nutrients in environmental waters. This system is capable of running multiple methods for numerous parameters, offers high sample through-put and an autosampler for unattended analysis, and can reach detection limits that are much lower than we are able to achieve with our current instruments. The AutoAnalyzer will allow the ANRA Environmental Laboratory to reach the lower detection limits for Total Phosphorus being proposed by the TCEQ (0.02 mg/L, vs the current limit of 0.06 mg/L).



Seal AutoAnalyzer 3 for automated nutrient analysis

Stakeholder Participation, Public Outreach & More Information

Public Information

The Angelina & Neches River Authority provides the public with information concerning water quality issues on our website (www.anra.org), which is updated frequently. The ANRA website provides public access to information on the Clean Rivers Program, current and historical Basin Summary and Basin Highlights reports, meeting agendas and minutes, maps, and water quality data. Numerous pamphlets, brochures, and other educational and informational literature on such topics as water quality, conservation, and on-site septic facilities are available to the public at ANRA's offices. ANRA supports the TPWD invasive species awareness campaign "Hello Giant Salvinia, Goodbye Texas Lakes" by making informational pamphlets available to the public.

Basin Steering Committee

The steering committee's role is advisory in nature and involves assistance with the review of local issues and creation of priorities for the Upper Neches river basin. Committee members assist with the review and development of work plans, reports, basin monitoring plans, allocation of resources, and basin action plans. CRP steering committee meetings are held annually each Spring. The committee is made up from a diverse group of stakeholders. One of the objectives of the CRP Long-Term Plan is to engage and inform stakeholders. The Steering Committee process gives stakeholders an opportunity to contribute their ideas and concerns through steering committee meetings, public meetings, and other forums. The process also allows for the communication of issues related to water quality so that priorities may be set which consider local, regional, state, and federal needs. The Steering Committee aids in increasing opportunities for citizens to identify pressing issues and concerns, contribute ideas to the CRP process, and functions to expand the public's role in water quality management issues.

Texas Stream Team

ANRA serves as the Texas Stream Team (formerly known as Texas Watch) regional partner for the Upper Neches Basin and provides training, monitoring kits, and replacement reagents to the volunteer monitors in the basin. ANRA supports a number of water quality monitors in the basin. The largest and most active group is comprised of members of the Greater Lake Palestine Council (GLPC). GLPC consists of a group of representatives from each Property Owner's Association surrounding Lake Palestine. The GLPC is concerned about protecting water quality in Lake Palestine and making other improvements in the area.

For more information on Texas Stream Team, please visit their website at txstreamteam.rivers.txstate.edu

Additional Information and Resources

The Texas Clean Rivers Program
www.texascleanrivers.org

Coordinated Monitoring Schedule
cms.lcra.org

EPA's Surf Your Watershed
cfpub.epa.gov/surf/locate/index.cfm

Attoyac Bayou WPP Project
attoyac.tamu.edu

Texas Stream Team
txstreamteam.rivers.txstate.edu

The Surface Water Quality Monitor
www.tceq.texas.gov/compliance/monitoring/water/newsletter.html

US Drought Monitor
http://droughtmonitor.unl.edu/

Texas Drought Information
http://www.tceq.texas.gov/response/drought

ANRA Website

The Angelina & Neches River Authority web page contains additional information on the activities of the river authority, including the Clean Rivers Program, the Environmental Laboratory, On-Site Sewage Facilities program, and water/wastewater utilities. ANRA's web site can be found at www.anra.org.

Contact Information

For more information on ANRA's Clean Rivers Program, please contact:

Brian Sims
Environmental Division Manager
Angelina & Neches River Authority
210 Lufkin Ave
Lufkin, TX 75901
Phone: 936-633-7527
Fax: 936-632-7799
Email: bsims@anra.org

ANRA

2012 Upper Neches Basin Highlights Report

The 2012 Basin Highlights Report was prepared by the Angelina & Neches River Authority
in cooperation with the Texas Commission on Environmental Quality (TCEQ)
under the authorization of the Texas Clean Rivers Act.