Sulphur River Watershed Data Report

March 30, 2010

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PREPARED IN COOPERATION WITH THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY AND U.S. ENVIRONMENTAL PROTECTION AGENCY

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This data summary report includes general basin volunteer monitoring activity, general water quality descriptive statistics, tables and graphs, and comparisons to stream standards as determined by the Texas Commission on Environmental Quality (TCEQ).

In alignment with Texas Stream Team's core mission, monitors attempt to collect data that can be used in decision-making processes, to promote a healthier and safer environment for people and aquatic inhabitants. While many assume it is the responsibility of Texas Stream Team to serve as the main advocate for volunteer monitor data use, it has become increasingly important for monitors to be accountable for their monitoring information and how it can be infused into the decision-making process, from "backyard" concerns to state or regional issues. To assist with this effort, Texas Stream Team coordinates with monitoring groups and government agencies to propagate numerous data use options.

Among these options, volunteer monitors can directly participate by communicating their data to various stakeholders. Some options include: participating in the Clean Rivers Program (CRP) Steering Committee Process (see box insert on this page); providing information during "public comment" periods; attending city council and advisory panel meetings; developing relations with local Texas Commission on Environmental Quality and river authority water specialists; and, if necessary, filing complaints with environmental agencies; contacting elected representatives and media; or starting organizing local efforts to address areas of concern.

The Texas Clean Rivers Act established a way for the citizens of Texas to participate in building the foundation for effective statewide watershed planning activities. Each CRP partner agency has established a steering committee to set priorities within its basin. These committees bring together the diverse interests in each basin and watershed. Steering committee participants include representatives from the public, government, industry, business, agriculture, and environmental groups. The steering committee is designed to allow local concerns to be addressed and regional solutions are recommended. For more information about participating in these steering committee meetings and to contribute your views about water quality, contact the appropriate CRP partner agency for your river basin at: http://www.tceq.state.tx.us/compliance/monitoring/crp/partners.html.

Currently, Texas Stream Team is working with various public and private organizations to facilitate data and information sharing. One component of this process includes interacting with watershed stakeholders at CRP steering committee meetings. A major function of these meetings is to discuss water quality issues and to obtain input from the general public. While participation in this process may not bring about instantaneous results, it is a great place to begin making institutional connections and to learn how to "work" the assessment and protection system that Texas agencies use to keep water resources healthy and sustainable.

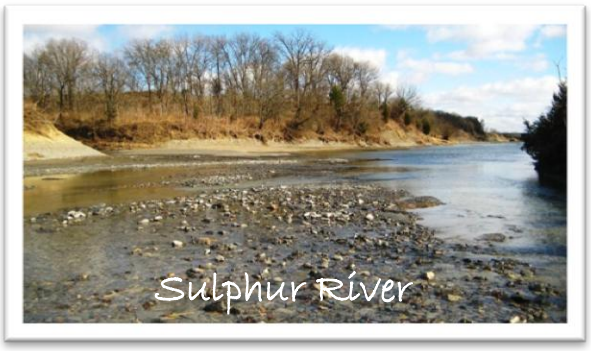
In general, Texas Stream Team efforts to use volunteer data may include the following:

1. Assist monitors with data analysis and interpretation
2. Analyze watershed-level or site-by-site data for monitors and partners
3. Screen all data annually for values outside expected ranges
4. Network with monitors and pertinent agencies to communicate data
5. Attend meetings and conferences to communicate data
6. Participate in CRP stakeholder meetings

7. Provide a data viewing forum via the Texas Stream Team Data Viewer
8. Participate in professional coordinated monitoring processes to raise awareness of areas of concern

Information collected by Texas Stream Team volunteers utilizes a TCEQ and EPA approved quality assurance project plan (QAPP) to ensure data are correct and accurately reflects the environmental conditions being monitored. All data are screened for completeness, precision and accuracy where applicable, and scrutinized with data quality objective and data validation techniques. Sample results are intended to be used for education and research, baseline, local decision making, problem identification, and others uses deemed appropriate by the data user.

Introduction



The Sulphur River begins in east Delta County, two miles south of Cunningham, in far northeast Texas and flows through Bowie, Morris, and Cass Counties for 183 miles before its confluence with the Red River in Arkansas, draining an area of approximately 3,558 mi^2 (9,215 km^2) (See map below).[123] The river has been dammed up in its middle reaches in order to form Wright Patman Lake five miles northeast of Coopers Chapen in Titus County and Lake Texarkana five miles southwest of Cassett. The surrounding topography is mostly flat with clay and sandy loams that support water-tolerant hardwoods, conifers, and various grasses.[4]

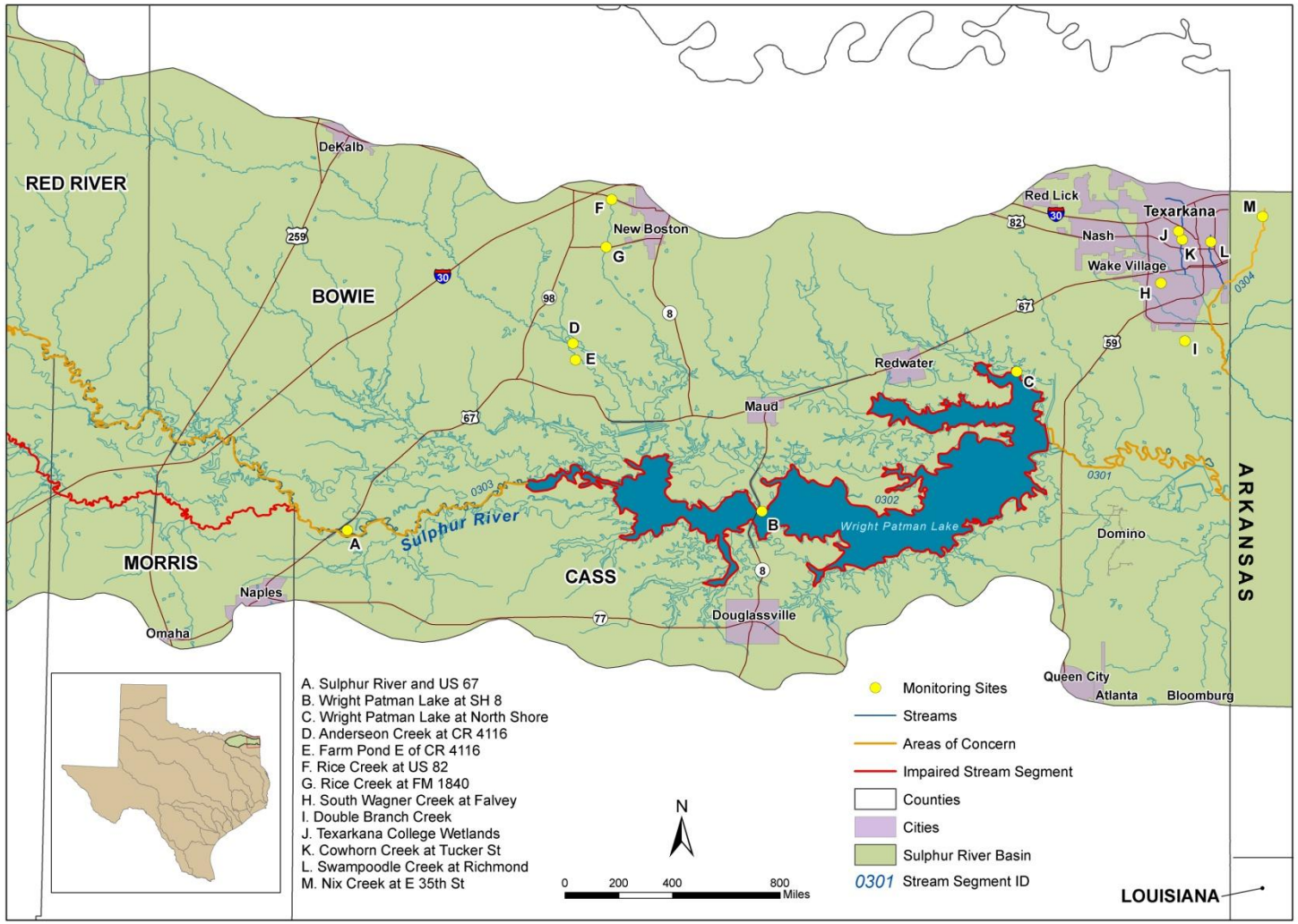
This report covers all Texas Stream Team (TST) data that has been collected in the Sulphur River watershed. It is divided into two sections: data from the last seven years and the last sixteen years of data. This is because the TCEQ references the last seven years of data when considering impairments.

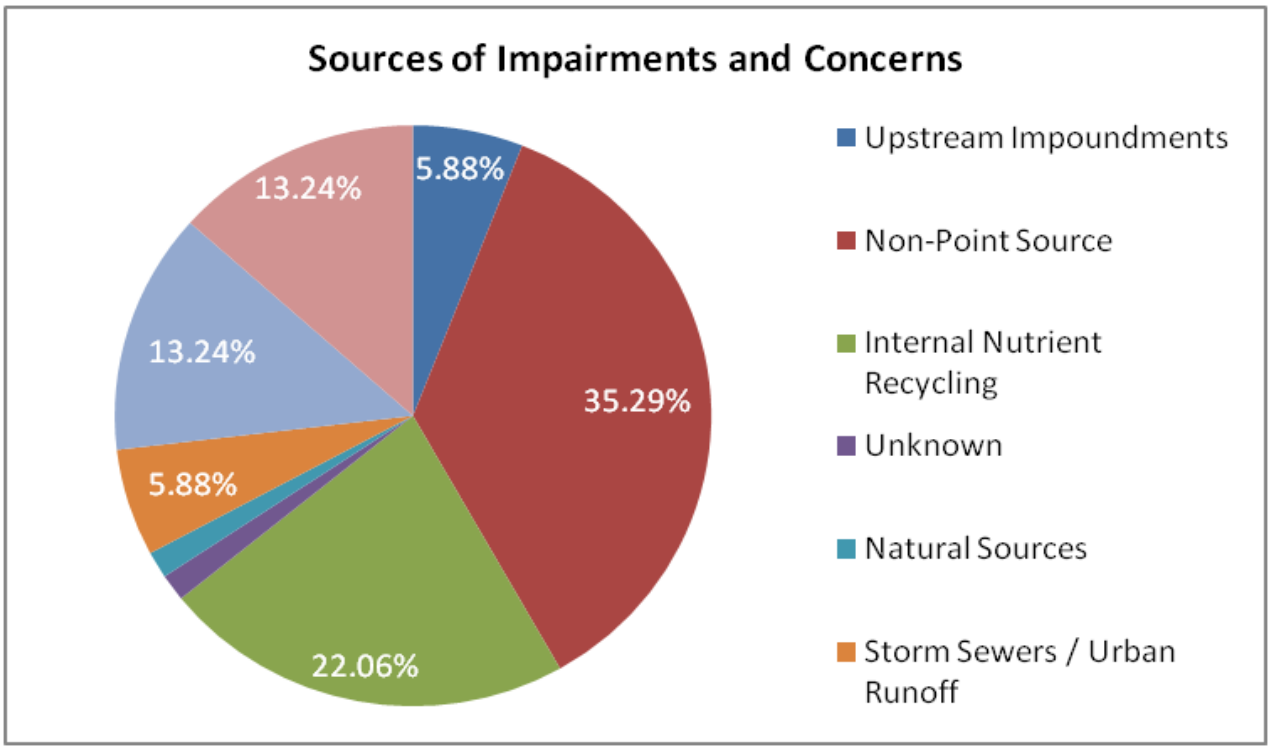
The water bodies evaluated by Texas Stream Team volunteer monitors in the Sulphur River Basin are the Sulphur River, Rice Creek, Wright Patman Lake, Swampoodle Creek, Anderson Creek, Nix Creek, Cowhorn Creek, Double Branch Creek, and South Wagner Creek. The impairments and concerns indentified by the TCEQ in the 2008 Water Quality Inventory and 303(d) list for these water bodies are presented in the following table. For all impairments within the Sulphur River Basin, visit http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/305_303.html. A Total Maximum Daily Load Program (TMDL), which sets a cap on pollution, is being planned for Wright Patman Lake. More data needs to be collected before the TCEQ proceeds with a TMDL for Swampoodle Creek and Cowhorn Creek.[5]

Ammonia, chlorophyll-a, and orthophosphorus are listed as concerns for most of Wright Patman Lake. These are nutrients that can originate in fertilizers or fecal matter and are transported to the water body via storm-water runoff, waste-water treatment plant discharges, or leaking septic tanks. Chlorophyll-a can cause adverse affects such as wide diurnal fluctuations of dissolved oxygen and depletion of dissolved oxygen near the bottom due to decomposition of dead algae.[6] These nutrients also cause a problem known as eutrophication, which lowers the dissolved oxygen and could have led to the depressed dissolved oxygen impairments. This process is described below under the "Dissolved Oxygen" section. High levels of these nutrients can also threaten health and cause taste and odor problems in drinking water.[7] The contaminated sediments in Days Creek are polynuclear aromatic hydrocarbons (PAHs), which are the most common small compounds found in oil.[89]

TCEQ research has identified the sources of most of these impairments and concerns. The results are shown in the pie chart below. Non-point source pollution is contamination originating from all over the watershed instead of from a discrete source. Internal nutrient recycling exacerbates this problem because the sediments are moved from the sediment on the lake bed to the surface of the water via the processes of the biotic community. The high pH impairments can result from storm water runoff high in dissolved limestone increasing the alkalinity of the water. The impaired fish and macrobenthic communities can result from low dissolved oxygen or toxic substances occurring in the water body.

Texas Stream Team Volunteer Water Quality Monitoring
Sulphur River Basin





TCEQ 2008 303(d) List and Water Quality Inventory				
Segment	**Area**	**Impairment**[10]	**Concern**[11]	**Source**[12]
Sulphur River Below Wright Patman lake	Lower 9 miles		chlorophyll-a	upstream impoundments / non-point source
	Upper 10 miles		chlorophyll-a	
Wright Patman Lake	800 acres near dam		chlorophyll-a	non-point source / internal nutrient recycling
	300 acres at International Paper intake	depressed dissolved oxygen, high pH	ammonia, chlorophyll-a	
	500 acres in the northeast corner of lake	high pH	ammonia, chlorophyll-a	pH: unknown nutrients: non-point source / internal nutrient recycling
	200 acres in northwestern tip of lake	high pH		non-point source / internal nutrient recycling
	Big Creek arm	high pH	chlorophyll-a	
	4000 acres mid-lake	high pH		non-point source / internal nutrient recycling
	1600 acres in upper mid-lake	high pH		
	5000 acres mid-lake, below Hwy 8		chlorophyll-a	
	4000 acres in upper portion of lake	depressed dissolved oxygen	chlorophyll-a, orthophosphorus	DO: natural sources, non-point source, internal nutrient recycling nutrients: non-point source / internal nutrient recycling

TCEQ 2008 303(d) List and Water Quality Inventory				
Segment	**Area**	**Impairments**	**Concern**	**Source**
Sulphur/South Sulphur River	Lower 25 miles		chlorophyll-a	upstream impoundments / non-point source
	Middle 25 miles		chlorophyll-a	
Cowhorn Creek	From the confluence of Wagner Creek in southern Texarkana in Bowie County to the upstream perennial portion of the stream in northern Texarkana in Bowie County	impaired fish community, impaired macrobenthic community		urban runoff/storm sewers, non-point source
Days Creek	From the Arkansas State Line in Bowie County to the confluence of Swampoodle Creek and Nix Creek in Bowie County.		naphthalene in sediment	industrial point source discharge / contaminated sediments
			acenaphthene in sediment	
			pyrene in sediment	
			phenanthrene in sediment	
			nitrate	
			floranthene in sediment	
			chrysene in sediment	
			benz(a)antracene in sediment	
			benzo(a)pyrene in sediment	
Swampoodle Creek	From the confluence of Days Creek in central Texarkana in Bowie County to the upstream perennial portion of the stream in northern Texarkana in Bowie County	impaired fish community, impaired macrobenthic community		urban runoff/storm sewers, non-point source

Water Quality Parameters

Water Temperature

Fish are cold-blooded and therefore depend on the temperature of water to be able to carry out processes such as metabolism and reproduction. Sources of warm water include powers plants' effluent after it has been used for cooling or hydroelectric plants which release warmer or cooler water (depending on the time of year) near the point of release. On a yearly scale, the amount of dissolved oxygen in the water decreases as temperatures increase, and vice versa, because warmer, less dense water can hold less oxygen molecules than cooler, more dense water. However, on a daily scale, the amount of dissolved oxygen in the water increases as temperatures increase, and vice versa, because of photosynthesis adding oxygen to the water body. Water temperature variations are most detrimental when they occur rapidly, leaving the biotic community no time to adjust.

Dissolved Oxygen

Oxygen is necessary for the survival of most organisms. Too little oxygen will lead to asphyxiation of aquatic organisms. Too much oxygen (supersaturation) can cause bubbles to develop in cardiovascular systems, which could be fatal. Dissolved oxygen (DO) levels below 2 mg/L can lead to asphyxiation, and levels above 20 mg/L can lead to supersaturation. The most suitable aquatic environment exhibits levels above 5 mg/L. High concentrations of nutrients can lead to excessive surface vegetation growth, which may starve subsurface vegetation of sunlight, and therefore limit the amount of dissolved oxygen in a water body due to limited photosynthesis. This process is enhanced when the subsurface vegetation dies and consumes oxygen when decomposing. They may also result from high groundwater inflows as groundwater is typically low in dissolved oxygen due to minimal aeration or high temperatures which reduce oxygen solubility.

pH

pH is a measure of acidity or alkalinity. The scale measures the concentration of hydrogen ions on a range of 0 to 14 and is reported in standard units (su). The range is logarithmic. Therefore, every 1 unit change means the acidity increased or decreased 10-fold. Sources of low pH (acidic) can include acid rain and runoff from acid-laden soils. Acid rain is mostly caused by coal power plants with minimal contributions from the burning of other fossil fuels and other processes such as volcanic emissions. Soil-acidity can be caused by excessive rainfall leaching alkaline materials out of soils, acidic parent material, crop decomposition creating hydrogen ions, or high-yielding fields which have drained the soil of all alkalinity. Sources of high pH include geologic composition as in the case of limestone increasing alkalinity and the dissolving of carbon dioxide in water. Carbon dioxide is water soluble, and as it dissolves it forms carbonic acid, an alkaline molecule. The most suitable range for healthy organisms is 6.5-9.

Specific Conductivity

Specific conductivity is a measure of the ability of a body of water to conduct electricity. A body of water is more conductive if it has more dissolved materials such as nutrients and salts, which indicate poor water quality if they are abundant. High concentrations of nutrients lower dissolved oxygen, the process of which was described in the previous section. High concentrations of salt can inhibit water absorption and limit root growth for vegetation, lead to an abundance of more drought tolerant plants, and cause dehydration of fish and amphibians. Sources of total dissolved solids (TDS) can include agricultural runoff, domestic runoff, or discharges from wastewater treatment plants.

Secchi Depth and Total Depth


Secchi Disk

The Secchi Disk is used to determine the clarity of the water, a condition known as turbidity. The disk shown on the right is lowered into the water until it is no longer visible, and the depth is recorded. Highly turbid waters pose a risk to wildlife by clogging the gills of fish, reducing visibility, and carrying contaminants. Reduced visibility can harm predatory fish or birds that depend on good visibility to find their prey. Contaminants are most commonly transported in sediment rather than in the water. Average Secchi Depth readings below Total Depth readings indicate highly turbid water. Readings that are equal to total depth indicate clear water. Low total depth observations have a potential to concentrate contaminants.

Watershed Data Summary

Wright Patman Lake[1] (2003-2009)				
Parameter	**Observed**	**Standard**	**% Exceedance**	**# Exceedence**
Water Temperature (°C)	13-23	32 (max.)	0	0/48
Dissolved Oxygen (mg/L)	7.7-9.75	3 (min.)	0	0/48
pH (su)	7-8	6-8.5	0	0/48
Specific Conductivity (µS/cm)	213.33 (avg.)	615 (avg.)		

Days Creek Watershed (2003-2009)				
Parameter	**Observed**	**Standard**	**% Exceedance**	**# Exceedence**
Water Temperature (°C)	7-34	32 (max.)	9.38	3/32
Dissolved Oxygen (mg/L)	4.1-13.7	3 (min.)	0	0/32
pH (su)	6-9.8	6-8.5	6.25	2/32
Specific Conductivity (µS/cm)	231.29 (avg.)	1308 (avg.)		

Site-by-Site Data Analysis

The section explains how to interpret the data shown below**.** The red lines shown on the graphs are based on the 2000 Texas Water Quality Standards for the watersheds which the sites fall within. At least ten samples from the last seven years with approximately the same interval between sampling events are required for a data set to be considered adequate. 10% of these samples must then exceed the standard for the water body to be considered impaired. 25% of E. *coli* samples must exceed the single grab standard for the water body to be considered impaired. [13] The water temperature, E. *coli* bacteria, orthophosphorus, and nitrate standards are maximum amounts. The conductivity standard is a maximum average amount. The dissolved oxygen standard is a minimum amount, and the pH standards are a range.

The following sites at Wright Patman Lake, Rice Creek, Anderson Creek, and the Farm Pond are within the Wright Patman Lake Watershed, which drains 478 mi^2 (1,238 km^2) in Bowie, Cass, and Red River Counties. Therefore, the standards referenced are for Wright Patman Lake. New Boston, DeKalb, Maud, Redwater, and Douglassville make up the urban concentration in the area. Land use is mostly forest. Agriculture makes up only 1/3 of the area. Vegetation spans from a pine-hardwood region in the east and grasses in the west, and Anderson Creek runs through an area with portions of willow and water oak forest. Wright Patman Lake, which was originally created for flood control, is now used for water supply for Texarkana and surrounding communities.[14] The TCEQ has designated this area high aquatic life use, fish consumption use, general use, public water supply use, and recreation use.[15] The standards for each water body are developed according to these uses and the pre-existing nature of the water body.

Swampoodle Creek and the Texarkana College Wetlands are located within the Days Creek watershed, a small watershed within the Lower Sulphur River watershed, which drains 164 mi^2 (425

[1] It is important to note that the amount of exceedance is only for reference. Regulatory action by the TCEQ is based on more/different data than that of the Texas Stream Team.

km^2) in Bowie and Cass Counties. Therefore, the standards referenced are for Days Creek. Texarkana and Queen City make up the urban concentration of this area. Vegetation consists of mostly a Pine-Hardwood Forest, and the land use is mostly rural except in the vicinity of Texarkana.[16] Swampoodle Creek has been designated high aquatic life use, general use, and recreation use.[17] Days Creek into which the Texarkana College Wetlands drain has been designated intermediate aquatic life use, fish consumption use, general use, and recreation use.[18]

Last Seven Years of Data

Wright-Patman Lake at SH 8 (2003)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	2	100	15:30	15:47	16:05	0:24
Total Depth (m)	2	100	1	1	1	0
Secchi Depth (m)	2	100	1	1	1	0
Water Temperature (^oC)	2	100	13	17.5	23	6.36
Specific Conductivity (µS/cm)	2	100	170	220	270	70.71
Dissolved Oxygen (mg/L)	2	100	7.7	8.6	9.5	1.27
pH (su)	2	100	7	7.25	7.5	0.35

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (^oC)	32 (max.)	0	0/2
Dissolved Oxygen (mg/L)	3 (min.)	0	0/2
pH (su)	6-8.5	0	0/2
Specific Conductivity (µS/cm)	615 (avg.)	0	0/2

No graphs are provided because there are only 2 sampling events.

Data collected by: David Lester

Wright Patman Lake at North Shore (10/6/2004)	
Parameter	**#**
Sample Time	14:40
Total Depth (m)	Not Recorded
Secchi Depth (m)	Not Recorded
Water Temperature (^{o}C)	26
Specific Conductivity (µS/cm)	200
Dissolved Oxygen (mg/L)	9.75
pH (su)	8

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (^{o}C)	32 (max.)	0	0/1
Dissolved Oxygen (mg/L)	3 (min.)	0	0/1
pH (su)	6-8.5	0	0/1
Specific Conductivity (µS/cm)	615 (avg.)	0	0/1

There is only one sample on record for this site.

Data collected by: Diane Atkinson

Rice Creek at US 82 (2004 & 2006)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	2	100	8:50	13:12	17:35	6:11
Total Depth (m)	2	100	1.4	1.4	1.4	0
Secchi Depth (m)	2	100	0.7	1.05	1.4	0.49
Water Temperature (^{o}C)	2	100	23	24.5	26	2.12
Specific Conductivity (µS/cm)	2	100	560	605	650	63.64
Dissolved Oxygen (mg/L)	2	100	7.6	7.6	7.6	0
pH (su)	2	100	7.6	7.675	7.75	0.11

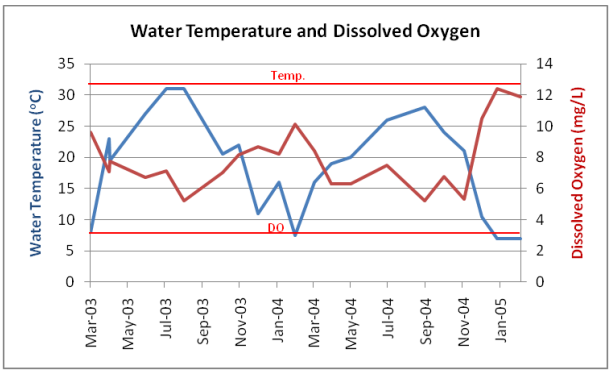
Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (^{o}C)	32 (max.)	0	0/2
Dissolved Oxygen (mg/L)	3 (min.)	0	0/2
pH (su)	6-8.5	0	0/2
Specific Conductivity (µS/cm)	615 (avg.)	50	1/2

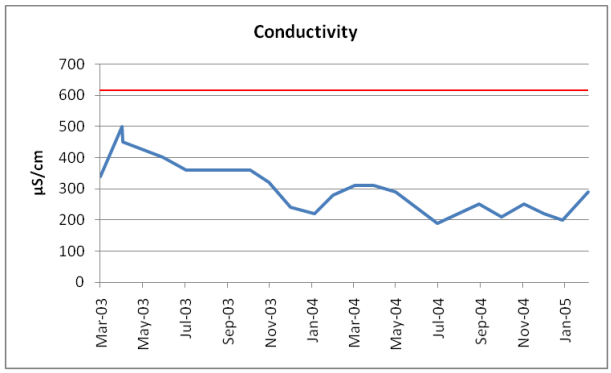
No graphs are provided because there are only 2 sampling events.

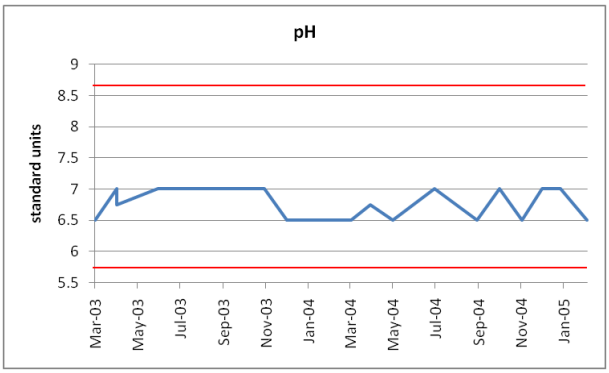
Data collected by: David Fisher and Maureen Hurst

Farm Pond Approximately 500 Meters East Of Cr 4116 1.4 Km South Of Anderson Creek In Bowie County (2003-2005)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	21	100	9:30	12:02	15:30	1:39
Total Depth (m)	21	100	0.8	1.23	1.5	0.15
Secchi Depth (m)	21	100	0.3	0.84	1.4	0.36
Water Temperature (°C)	21	100	7	18.81	31	7.86
Specific Conductivity (µS/cm)	21	100	190	302.38	500	82.94
Dissolved Oxygen (mg/L)	21	100	5.2	7.91	12.4	2.04
pH (su)	21	100	6.5	6.76	7	0.24

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (°C)	32 (max.)	0	0/21
Dissolved Oxygen (mg/L)	3 (min.)	0	0/21
pH (su)	6-8.5	0	0/21
Specific Conductivity (µS/cm)	615 (avg.)	0	0/21



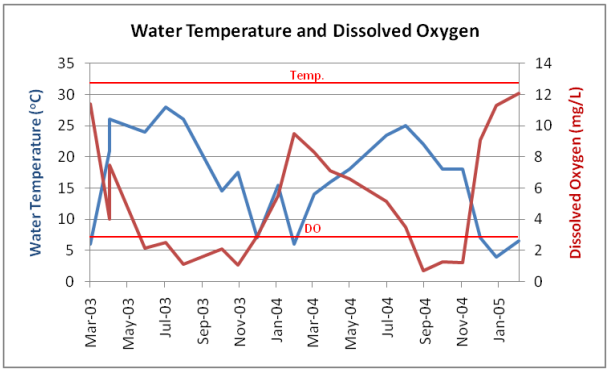


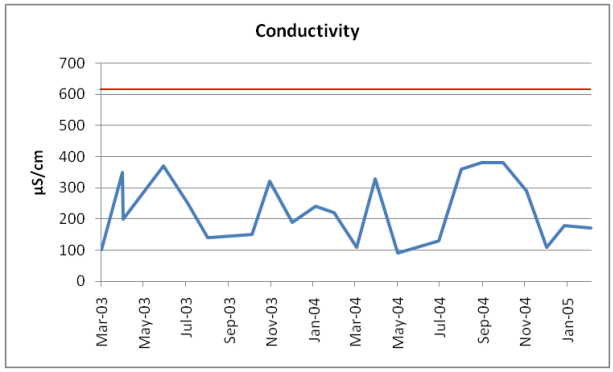


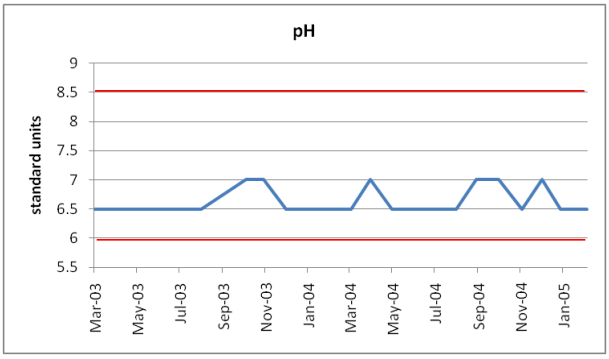
Data collected by: Greg Hunt

Anderson Creek At Cr 4116 In Bowie County (2003-2005)						
Parameter	#	% Complete	Min.	Mean.	Max.	Std. Dev.
Sample Time	22	100	8:35	10:58	14:35	1:42
Total Depth (m)	22	100	0.3	0.90	5	1.02
Secchi Depth (m)	22	100	0.25	0.70	6.3	1.26
Water Temperature (°C)	22	100	4	16.52	28	7.61
Specific Conductivity (µS/cm)	22	100	90	230.00	380	101.56
Dissolved Oxygen (mg/L)	22	100	0.7	5.27	12.1	3.77
pH (su)	22	100	6.5	6.64	7	0.23

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (°C)	32 (max.)	0	0/22
Dissolved Oxygen (mg/L)	3 (min.)	40.91	9/22
pH (su)	6-8.5	0	0/22
Specific Conductivity (µS/cm)	615 (avg.)	0	0/22



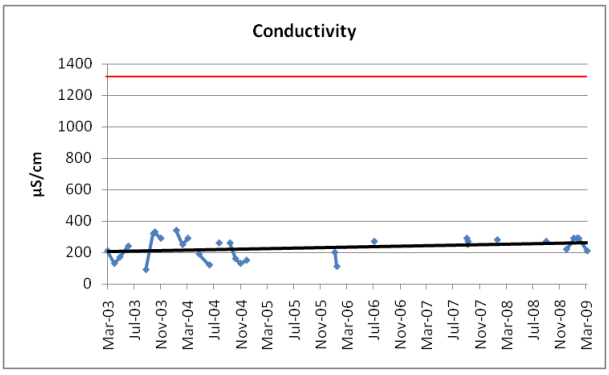


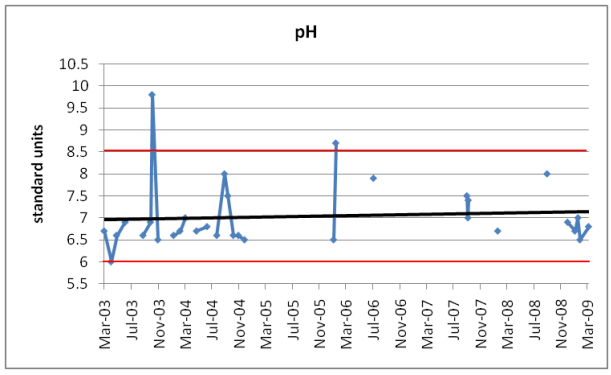


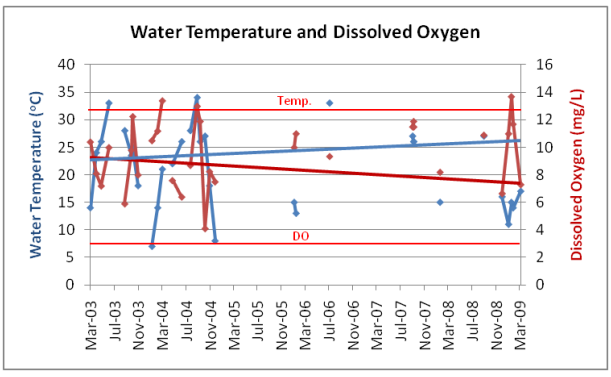
Data collected by: Greg Hunt

Swampoodle Creek at Richmond (2003-2009)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	32	100	11:10	13:28	16:50	1:16
Total Depth (m)	31	97	0.05	0.25	0.6	0.11
Secchi Depth (m)	31	97	0.05	0.23	0.4	0.09
Water Temperature (^{o}C)	32	100	7	21.17	34	7.32
Specific Conductivity (µS/cm)	31	97	90	231.29	340	69.80
Dissolved Oxygen (mg/L)	32	100	4.1	9.65	13.7	2.37
pH (su)	32	100	6	7.04	9.8	0.76

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (^{o}C)	32 (max.)	9.38	3/32
Dissolved Oxygen (mg/L)	3 (min.)	0	0/32
pH (su)	6-8.5	6.25	2/32
Specific Conductivity (µS/cm)	1307.69 (avg.)	0	0/32



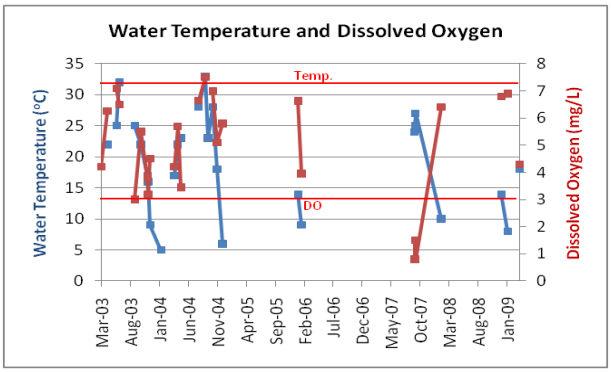


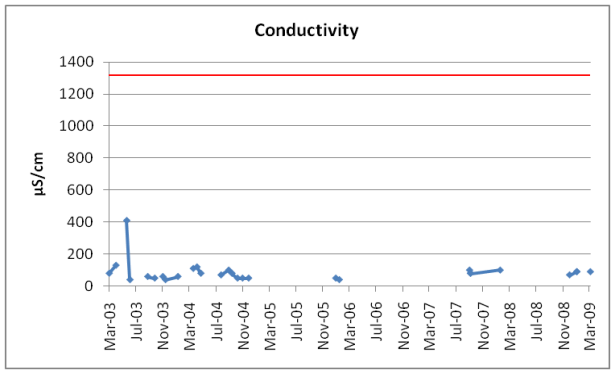


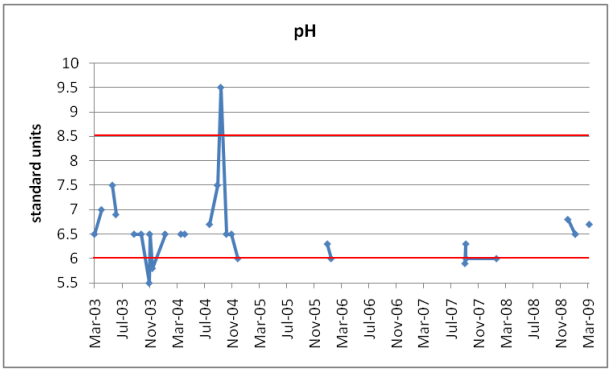
Data collected by: Devon Armstrong, Heather Bishop, Kathryn Bunn, Jake Chichester, Catie Cox, Wendell Dixon, Joseph Dollarhide, Heather Gilley, Elizabeth Graves, Richard Graves, Kasey Hagar, Steve Hart, Leah Eden Hirschy, Lindsey Hudson, Greg Hunt, Francesca Invernizzi, Kirk Killett, Sergio Kochergin, Frank Lang, Danelle Lawyer, Billy Lee, Meranda Massey, Martin Mcbee, Delores Mccright, Marilyn Merriman, Craig Miller, Leslie Miller, Stephanie Nedly, Jennifer Platz, Amanda Raley, Felix Reinhold, Britton Ritter, Robyn Ross, Catalina Segura, David Singleton, Nitiwat Songwasin, William H Stanley, John Bradley Thacker, Jo Tucker, D'angelo Walker, Joe Whinery, William Young.

Texarkana College Wetlands (2003-2009)						
Parameter	#	% Complete	Min.	Mean.	Max.	Std. Dev.
Sample Time	29	100	9:15	12:58	16:05	1:44
Total Depth (m)	27	93	0.1	0.82	2	0.47
Secchi Depth (m)	26	90	0.05	0.66	1.5	0.40
Water Temperature (^{o}C)	28	97	5	18.86	33	8.03
Specific Conductivity (µS/cm)	28	97	40	86.79	410	67.99
Dissolved Oxygen (mg/L)	27	93	0.8	4.98	7.5	1.96
pH (su)	28	97	5.5	6.57	9.5	0.73

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (^{o}C)	32 (max.)	3.57	1/28
Dissolved Oxygen (mg/L)	3 (min.)	11.11	3/27
pH (su)	6-8.5	14.29	4/28
Specific Conductivity (µS/cm)	1307.69 (avg.)	0	0/28





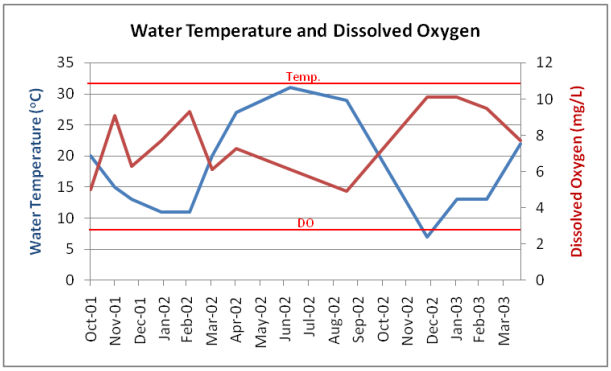


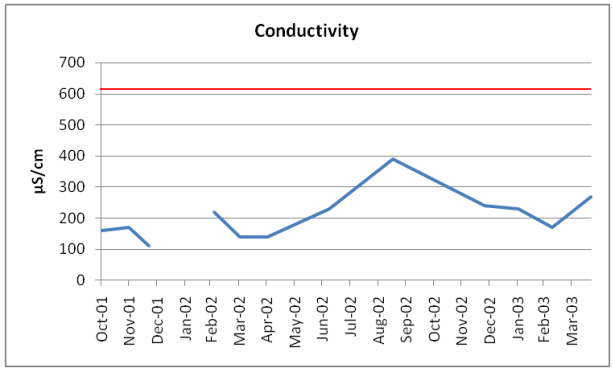
Data collected by: Randall H. Bell, Kathryn Bunn, Kathryn Bunn, Tamara Coker, Nicole Estelle Donaghy, Eric Ethridge, Holli Faulknor, Leah Eden Hirschy, Daniel Kessler, Tameka King, David Lester, Jennie Mcduffie, Marilyn Merriman, David Mitchell, Jessica Cydney Planto, Jennifer Platz, Cody Stearman, Heather Teer, D'angelo Walker, and Joe Whinery.

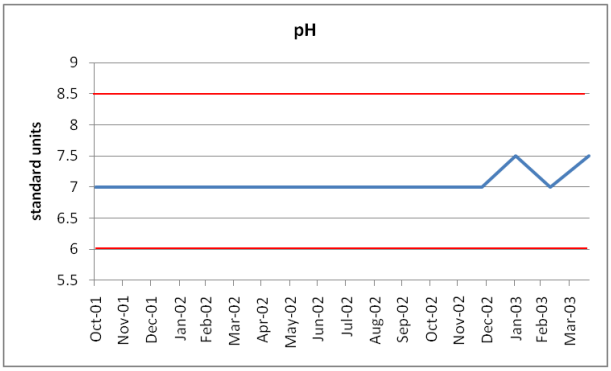
All of the Data

Wright-Patman Lake at SH 8 (2001-2003)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	10	76.92	10:15	14:18	16:05	2:01
Total Depth (m)	12	92.31	1	1	1	0
Secchi Depth (m)	12	92.31	1	1	1	0
Water Temperature (°C)	13	100	7	17.85	31	7.63
Specific Conductivity (µS/cm)	12	92.31	110	205.83	390	75.73
Dissolved Oxygen (mg/L)	13	100	4.9	7.63	10.1	1.86
pH (su)	13	100	7	7.08	7.5	0.19

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (°C)	32 (max.)	0	0/13
Dissolved Oxygen (mg/L)	3 (min.)	0	0/13
pH (su)	6-8.5	0	0/13
Specific Conductivity (µS/cm)	615 (avg.)	0	0/13



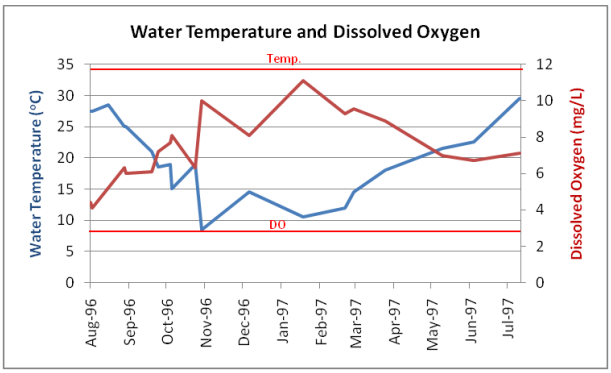


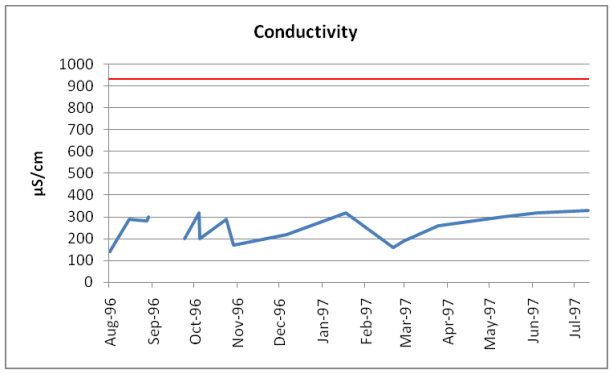


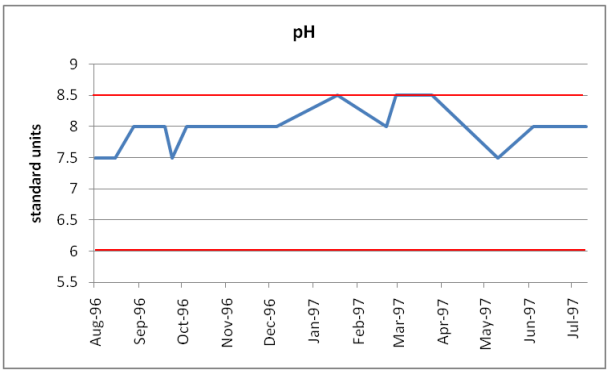
Data collected by: David Lester

Sulphur River at US 67 (1996-1997)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	19	100	11:00	13:29	16:00	1:52
Total Depth (m)	17	89.47	1.75	5.06	8.62	2.25
Secchi Depth (m)	19	100	0.18	0.37	2.2	0.45
Water Temperature (°C)	19	100	8.5	19.87	29.5	6.30
Specific Conductivity (µS/cm)	18	94.74	140	246.67	330	66.95
Dissolved Oxygen (mg/L)	19	100	4.1	7.32	11.1	1.88
pH (su)	19	100	7.5	7.95	8.5	0.33

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (°C)	34 (max.)	0	0/19
Dissolved Oxygen (mg/L)	3 (min.)	0	0/19
pH (su)	6-8.5	0	0/19
Specific Conductivity (µS/cm)	923.08 (avg.)	0	0/19



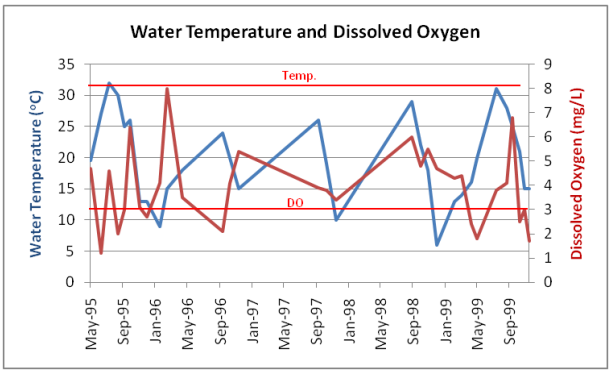


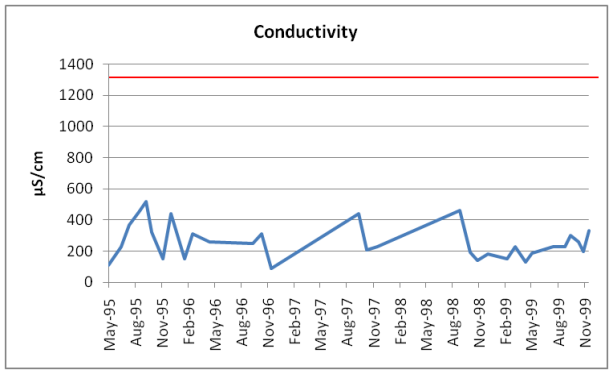


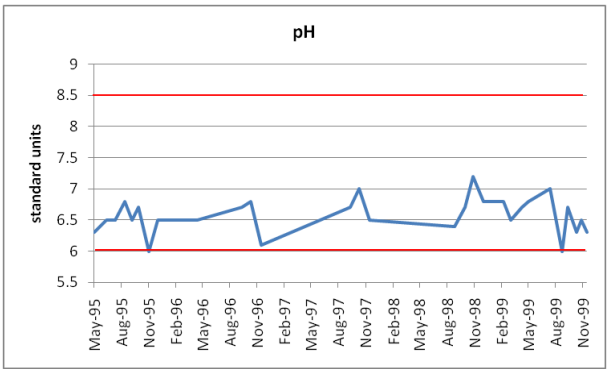
Data collected by: James Barron

S. Wagner Creek at Falvey (1995-1999)						
Parameter	#	% Complete	Min.	Mean.	Max.	Std. Dev.
Sample Time	31	100	2:38	7:35	7:55	1:10
Total Depth (m)	31	100	0.11	1.27	1.9	0.35
Secchi Depth (m)	31	100	0.11	0.49	0.85	0.19
Water Temperature (°C)	31	100	6	19.82	32	6.90
Specific Conductivity (µS/cm)	31	100	90	260.10	520	112.69
Dissolved Oxygen (mg/L)	31	100	1.2	3.93	8	1.59
pH (su)	31	100	6	6.57	7.2	0.28

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (°C)	32 (max.)	3.13	1/31
Specific Conductivity (µS/cm)	1307.69 (avg.)	0	0/31
Dissolved Oxygen (mg/L)	3 (min.)	32.26	10/31
pH (su)	6-8.5	0	0/31



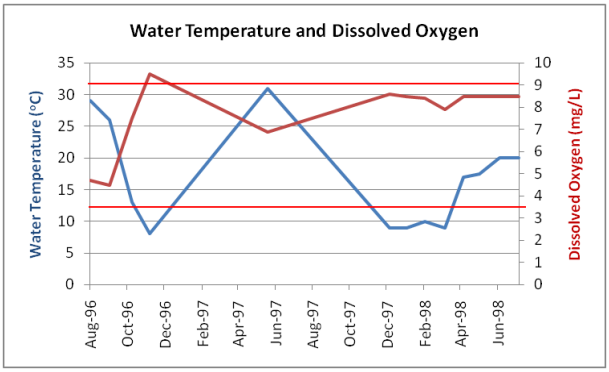


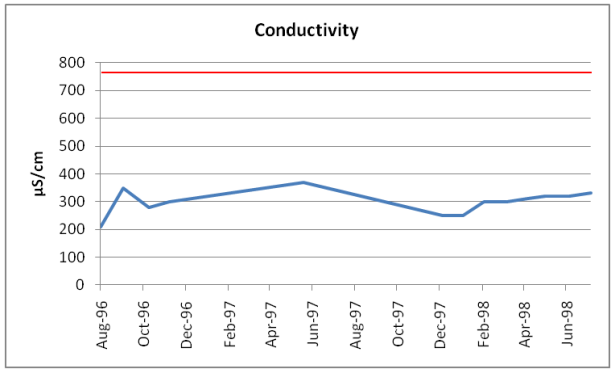


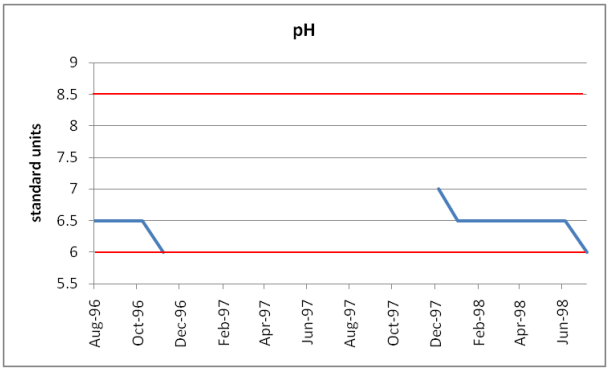
Data collected by: Dr. David W. Allard and Mike Brisco

Double Branch Creek (1996-1998)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	13	100	8:50	14:28	17:45	2:16
Total Depth (m)	11	84.62	0.05	0.17	0.5	0.21
Secchi Depth (m)	13	100	0.05	0.22	0.5	0.23
Water Temperature (^{o}C)	13	100	8	16.81	31	8.05
Specific Conductivity (µS/cm)	13	100	210	299.23	370	43.49
Dissolved Oxygen (mg/L)	13	100	4.5	7.73	9.5	1.52
pH (su)	12	92.31	6	6.46	7	0.26

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (^{o}C)	32 (max.)	0	0/13
Dissolved Oxygen (mg/L)	3 (min.)	0	0/13
pH (su)	6-8.5	0	0/13
Specific Conductivity (µS/cm)	769.23 (avg.)	0	0/13



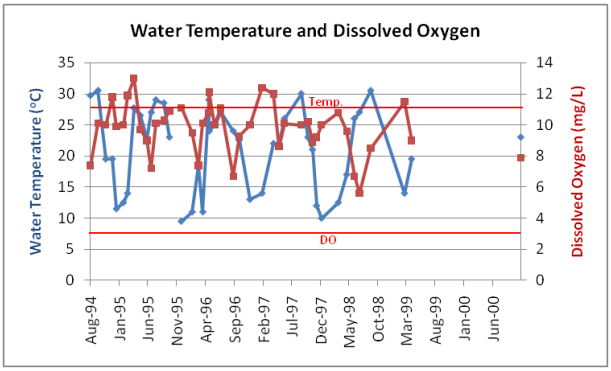


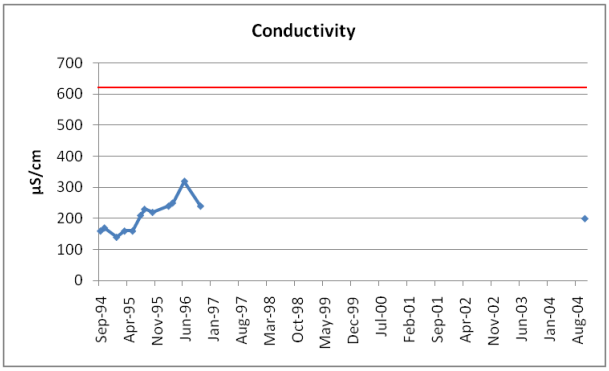


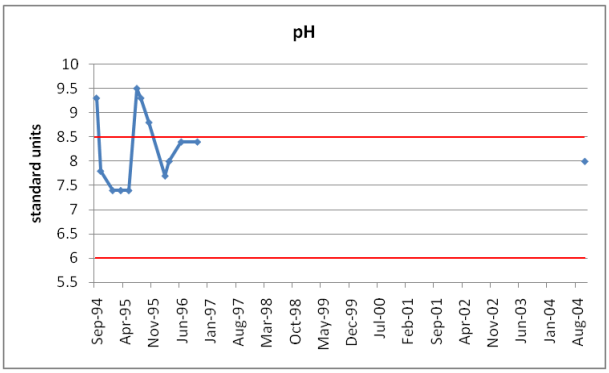
Data collected by: Cameron Braswell

Wright Patman Lake at North Shore (1994-2004)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	13	100	12:35	14:45	17:00	1:01
Total Depth (m)	12	92.31	0.02	0.46	1	0.25
Secchi Depth (m)	12	92.31	0.2	0.46	1	0.23
Water Temperature (°C)	13	100	15	25.58	36	6.16
Specific Conductivity (µS/cm)	13	100	140	207.69	320	50.03
Dissolved Oxygen (mg/L)	13	100	6.9	10.03	12.3	1.67
pH (su)	13	100	7.4	8.26	9.5	0.76

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (°C)	32 (max.)	23.08	3/13
Dissolved Oxygen (mg/L)	3 (min.)	0	0/13
pH (su)	6-8.5	30.77	4/13
Specific Conductivity (µS/cm)	615 (avg.)	0	0/13



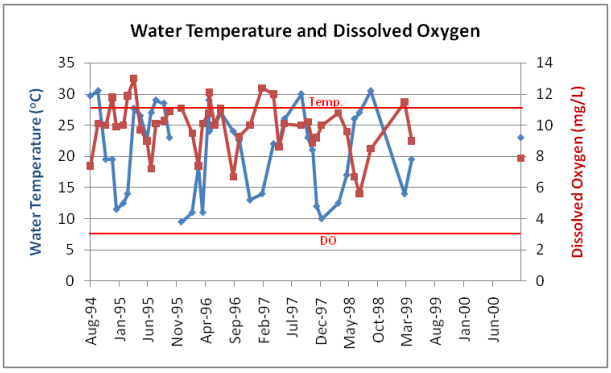


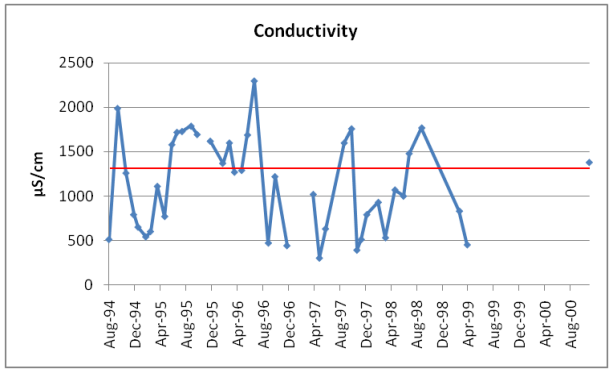


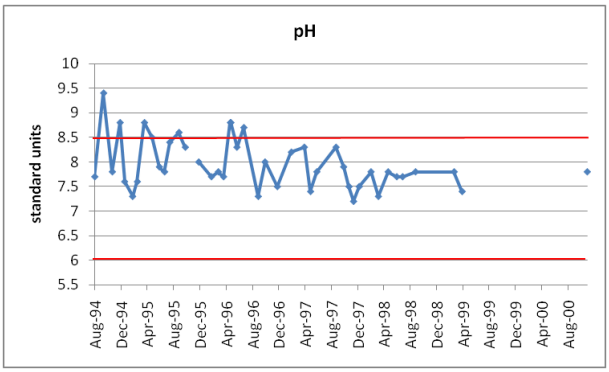
Data collected by: Diane Atkinson

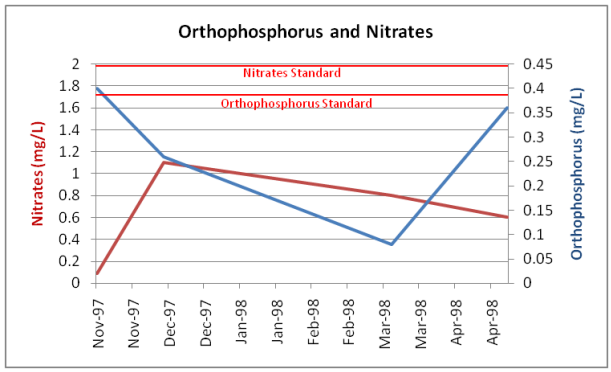
Cowhorn Creek at Tucker Street (1994-2000)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	44	100	8:40	13:24	17:23	2:02
Total Depth (m)	42	95.45	0.1	0.23	0.4	0.07
Secchi Depth (m)	40	90.91	0.04	0.23	0.4	0.08
Water Temperature (°C)	43	97.73	9.5	20.99	30.5	6.61
Specific Conductivity (µS/cm)	41	93.18	300	1132.80	2300	530.59
Dissolved Oxygen (mg/L)	43	97.73	5.6	9.80	13	1.63
pH (su)	43	97.73	7.2	7.96	9.4	0.51
E. *coli* Bacteria (cfu/100mL)	1	2.27	130	130	130	N/A
Orthophosphorus (mg/L)	4	9.09	0.08	0.03	0.36	0.14
Nitrates (mg/L)	4	9.09	0.6	0.65	1.1	0.42

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (°C)	32 (max.)	0	0/44
Dissolved Oxygen (mg/L)	3 (min.)	0	0/43
pH (su)	6-8.5	16.28	7/43
Specific Conductivity (µS/cm)	1307.69 (avg.)	39.02	16/41
E. *coli* Bacteria (cfu/100mL)	394 cfu/100mL	0	0/1
Orthophosphorus (mg/L)	0.37 mg/L	0	0/4
Nitrates (mg/L)	1.95 mg/L	0	0/4





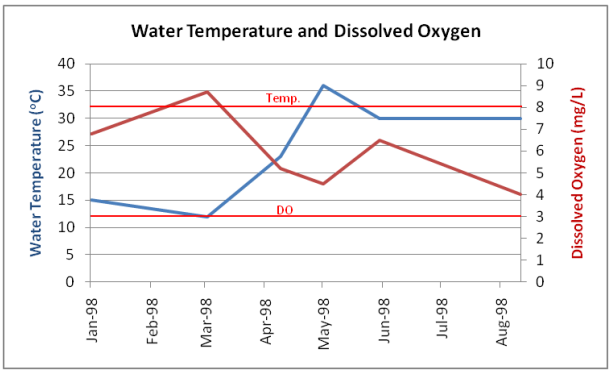


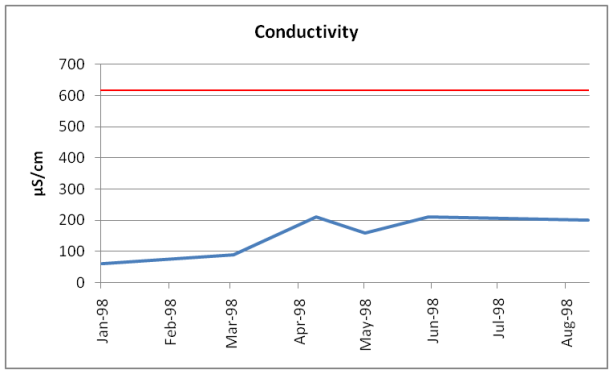


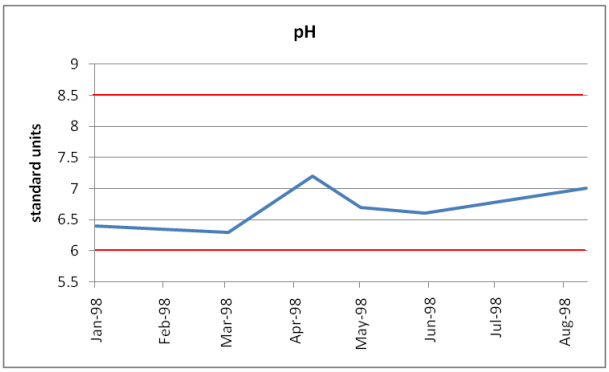
Data collected by: Mike Buttram, Patti Harman, William C. Power, and Jessica Barker

Rice Creek at FM 1840 West of Boston (1998)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	6	100	15:00	15:45	17:00	0:52
Total Depth (m)	6	100	0.21	0.60	2	0.70
Secchi Depth (m)	6	100	0.2	0.25	0.3	0.04
Water Temperature (^{o}C)	6	100	12	24.33	36	9.40
Specific Conductivity (µS/cm)	6	100	60	155.00	210	65.35
Dissolved Oxygen (mg/L)	6	100	4	5.95	8.7	1.74
pH (su)	6	100	6.3	6.70	7.2	0.35

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (^{o}C)	32 (max.)	16.67	1/6
Dissolved Oxygen (mg/L)	3 (min.)	0	0/6
pH (su)	6-8.5	0	0/6
Specific Conductivity (µS/cm)	615 (avg.)	0	0/6







Data collected by: Calvin Pierce

Nix Creek at E. 35th St., Texarkana (2000)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	2	100	10:10	13:32	16:55	4:46
Total Depth (m)	2	100	0.11	0.19	0.26	0.11
Secchi Depth (m)	2	100	0.11	0.19	0.26	0.11
Water Temperature (^{o}C)	2	100	13	16.50	20	4.95
Specific Conductivity (µS/cm)	2	100	70	115.00	160	63.64
Dissolved Oxygen (mg/L)	2	100	7.75	8.08	8.4	0.46
pH (su)	2	100	6.5	6.5	6.5	0

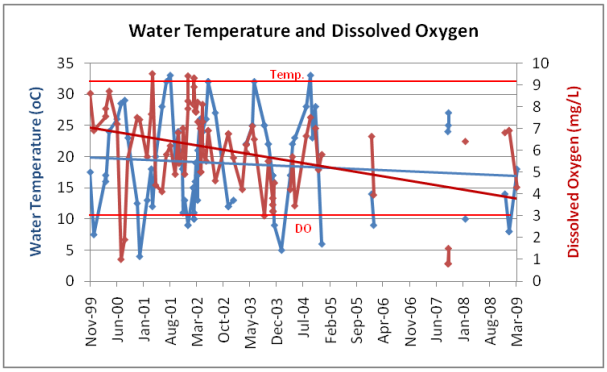
Parameter	**TCEQ Standard**	**% Exceedance**	**# Exceedance**
Water Temperature (^{o}C)	32 (max.)	0	0/2
Dissolved Oxygen (mg/L)	3 (min.)	0	0/2
pH (su)	6-8.5	0	0/2
Specific Conductivity (µS/cm)	1307.69 (avg.)	0	0/2

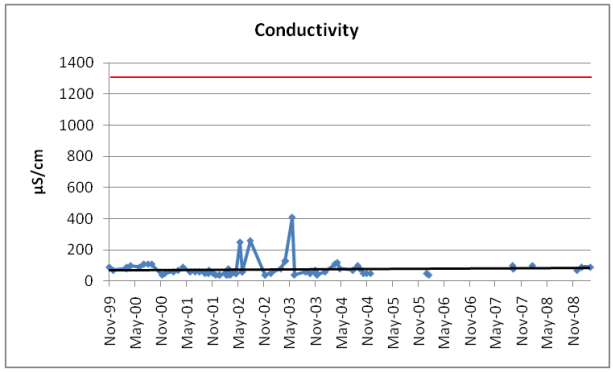
Graphs were omitted because there are only two sampling events. This site is actually in Arkansas, so TCEQ standards do not apply. They are shown here for a reference point.

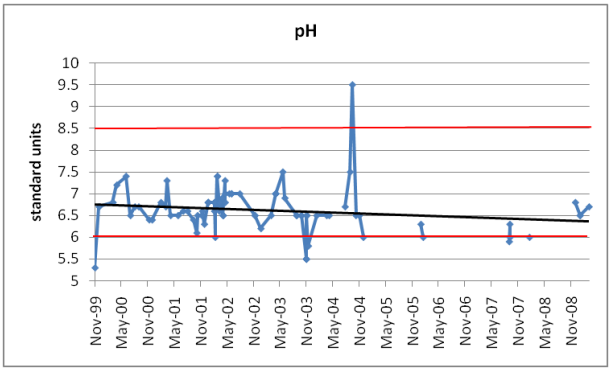
Data collected by: Mike and Anita Brisco

Texarkana College Wetlands (2000-2009)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	95	97.94	8:30	12:38	16:35	1:34
Total Depth (m)	90	92.78	0.1	0.91	2.9	0.62
Secchi Depth (m)	89	91.75	0.05	0.60	1.8	0.42
Water Temperature (^{o}C)	95	97.94	4	18.85	33	7.03
Specific Conductivity (µS/cm)	91	93.81	40	75.38	410	50.95
Dissolved Oxygen (mg/L)	93	95.88	0.8	5.93	9.5	2.03
pH (su)	95	97.94	5.3	6.62	9.5	0.53

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (^{o}C)	32 (max.)	2.1	2/69
Dissolved Oxygen (mg/L)	3 (min.)	5.38	5/93
pH (su)	6-8.5	8.42	8/95
Specific Conductivity (µS/cm)	1307.69 (avg.)	0	0/91



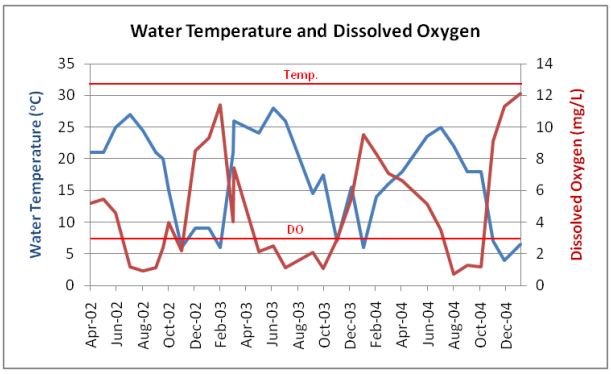


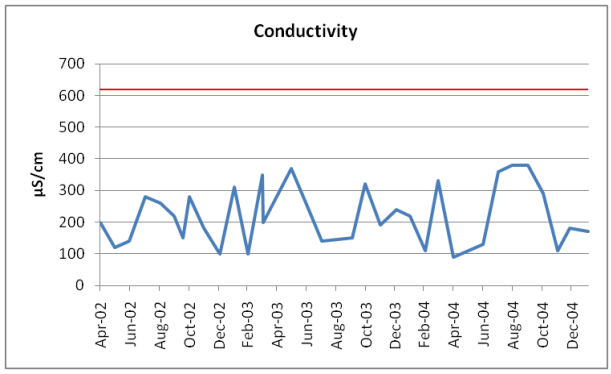


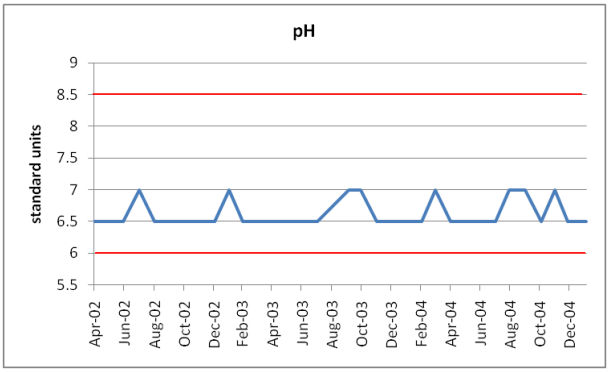
Data collected by: Randall H. Bell, Mike Brown, Kathryn Bunn, Kathryn Bunn, Debbie Burns, Tamara Coker, Nicole Estelle Donaghy, Niki Dossey, Eric Ethridge, Holli Faulknor, Leah Eden Hirschy, Daniel Kessler, Tameka King, David Lester, Jennie Mcduffie, Lacy Lynn McKinley, Judith McKinley, Marilyn Merriman, Eric Minkley, David Mitchell, Jessica Cydney Planto, Jennifer Platz, Paul Quaid, Robyn Ross, Cody Stearman, Heather Teer, Ashli Thomas, Jonathan Trammell, Jo Tucker, D'angelo Walker, and Joe Whinery

Anderson Creek at CR 4116 in Bowie County (2002-2004)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	33	100	8:35	11:33	14:35	1:42
Total Depth (m)	31	93.94	0.3	0.91	5	0.94
Secchi Depth (m)	30	87.88	0.25	0.63	0.75	1.08
Water Temperature (°C)	33	100	4	17.03	28	7.40
Specific Conductivity (µS/cm)	33	100	90	221.21	380	92.42
Dissolved Oxygen (mg/L)	33	100	0.7	4.87	12.1	3.51
pH (su)	33	100	6.5	6.62	7	0.22

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (°C)	32 (max.)	0	0/33
Dissolved Oxygen (mg/L)	3 (min.)	42.42	14/33
pH (su)	6-8.5	0	0/33
Specific Conductivity (µS/cm)	615 (avg.)	0	0/33



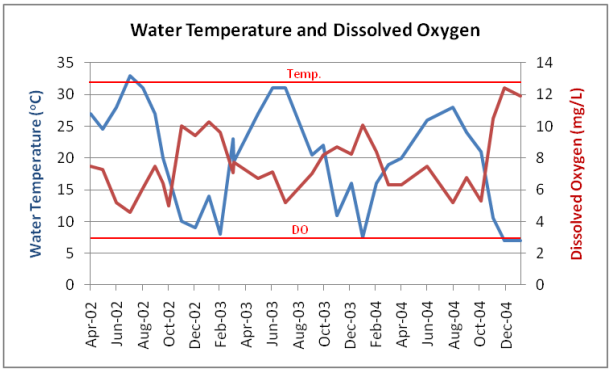


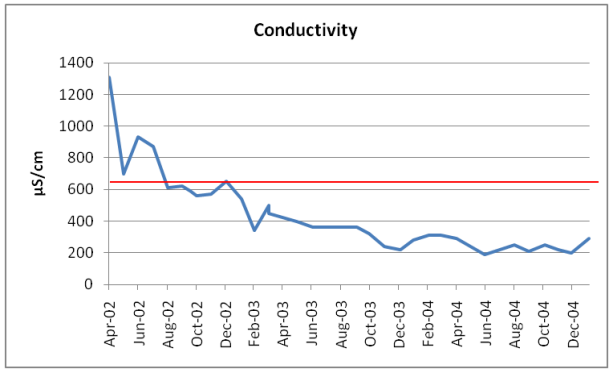


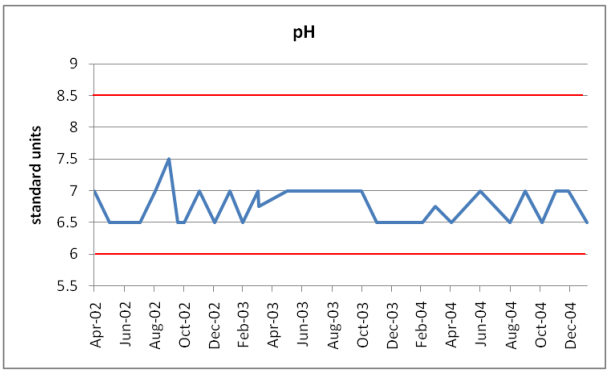
Data collected by: Donald D. Lewis

Farm Pond Approximately 500 Meters East Of Cr 4116 1.4 Km South Of Anderson Creek In Bowie County (2002-2004)						
Parameter	**#**	**% Complete**	**Min.**	**Mean.**	**Max.**	**Std. Dev.**
Sample Time	31	100	9:30	12:30	15:30	1:38
Total Depth (m)	32	100	0.8	1.26	1.5	0.14
Secchi Depth (m)	32	100	0.3	0.87	1.4	0.37
Water Temperature (^{o}C)	32	100	7	19.86	33	8.04
Specific Conductivity (µS/cm)	32	100	190	446.88	1310	250.97
Dissolved Oxygen (mg/L)	32	100	4.6	7.67	12.4	2.02
pH (su)	32	100	6.5	6.77	7.5	0.28

Parameter	TCEQ Standard	% Exceedance	# Exceedance
Water Temperature (^{o}C)	32 (max.)	3.13	1/32
Dissolved Oxygen (mg/L)	3 (min.)	0	0/32
pH (su)	6-8.5	0	0/33
Specific Conductivity (µS/cm)	615 (avg.)	18.75	6/32







Data collected by: Donald D. Lewis

References

[1] Texas State Historical Association, *The Handbook of Texas Online: Sulphur River*, n.d., available from http://www.tshaonline.org/handbook/online/articles/SS/rns19.html; Internet, accessed 4 March 2010.
[2] Sulphur River Basin Authority, n.d., available from http://www.sulphurriverbasinauthority.org; Internet, accessed 4 March 2010.
[3] Texas Parks and Wildlife, *An Analysis of Texas Waterways*, 16 June 2008, available from http://www.tpwd.state.tx.us/publications/pwdpubs/pwd_rp_t3200_1047/05_e_tx_angelina.phtml; Internet, accessed 4 March 2010.
[4] Texas State Historical Association, *The Handbook of Texas Online: Sulphur River*, n.d., available from http://www.tshaonline.org/handbook/online/articles/SS/rns19.html; Internet, accessed 4 March 2010.
[5] Texas Commission on Environmental Quality, *2008 Texas 303(d) List*, 19 March 2008, available from http://www.tceq.state.tx.us/assets/public/compliance/monops/water/08twqi/2008_303d.pdf; Internet; accessed 4 March 2010, 8.
[6] Environmental Protection Agency, *Water Quality Handbook: Chapter 2: Designation of Uses*, 15 September 1993, available from http://www.epa.gov/waterscience/standards/handbook/chapter02.html; Internet, accessed 4 March 2010, 22.
[7] Sulphur River Basin Authority, *Sulphur River Basin Highlights Report 2008*, n.d., available from http://www.sulphurr.org/Reports/bhl/BasinHighlightsReport2008.pdf; Internet, accessed 4 March 2010, 7.
[8] GBC Scientific Equipment Pty Ltd, *Determination of PAHs by Gradient Separation and UV Detection*, September 1995, available from http://www.gbcscientific.com/appnotes/HPLC_app_note_022.pdf; Internet, accessed 8 March 2010, 1.
[9] Prince William Sound Regional Citizen's Advisory Council, *Glossary*, 15 December 2008, available from http://www.pwsrcac.org/resources/glossary.html; Internet, accessed 8 March 2010.
[10] Texas Commission on Environmental Quality, *2008 Texas 303(d) List*, 19 March 2008, available from http://www.tceq.state.tx.us/assets/public/compliance/monops/water/08twqi/2008_303d.pdf; Internet; accessed 4 March 2010.
[11] Texas Commission on Environmental Quality, *2008 Water Quality Inventory: Water Bodies with Concerns for Use Attainment and Screening Levels*, n.d., available from http://www.tceq.state.tx.us/assets/public/compliance/monops/water/08twqi/2008_concerns.pdf; Internet; accessed 4 March 2010.
[12] Texas Commission on Environmental Quality, *2008 Water Quality Inventory: Sources of Impairments and Concerns*, n.d., available from http://www.tceq.state.tx.us/assets/public/compliance/monops/water/08twqi/2008_sources.pdf; Internet; accessed 4 March 2010.
[13] Texas Commission on Environmental Quality, *2008 Guidance for Assessing and Reporting Surface Water Quality in Texas*, 19 March 2009, available from http://www.tceq.state.tx.us/assets/public/compliance/monops/water/08twqi/2008_guidance.pdf; Internet, accessed 30 March 2010.
[14] Sulphur River Basin Authority, *Sulphur River Basin Highlights Report 2008*, n.d., available from http://www.sulphurr.org/Reports/bhl/BasinHighlightsReport2008.pdf; Internet, accessed 4 March 2010, 21.
[15] Texas Commission on Environmental Quality, *2008 Texas Water Quality Inventory - Basin Assessment Data By Segment: Wright Patman Lake*, 19 March 2008, available from http://www.tceq.state.tx.us/assets/public/compliance/monops/water/08twqi/2008_basin3.pdf, 1.
[16] Sulphur River Basin Authority, *Sulphur River Basin Highlights Report 2008*, n.d., available from http://www.sulphurr.org/Reports/bhl/BasinHighlightsReport2008.pdf; Internet, accessed 4 March 2010, 23.
[17] Texas Commission on Environmental Quality, *2008 Texas Water Quality Inventory - Basin Assessment Data By Segment: Swampoodle Creek*, 19 March 2008, available from http://www.tceq.state.tx.us/assets/public/compliance/monops/water/08twqi/2008_basin3.pdf, 1.
[18] Texas Commission on Environmental Quality, *2008 Texas Water Quality Inventory - Basin Assessment Data By Segment: Days Creek*, 19 March 2008, available from http://www.tceq.state.tx.us/assets/public/compliance/monops/water/08twqi/2008_basin3.pdf, 1.