

# San Marcos River Data Report

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TEXAS  STATE  
UNIVERSITY  
SAN MARCOS



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# Table of Contents

Introduction .....	1
Water Quality Parameters .....	2
Water Temperature .....	2
Dissolved Oxygen .....	3
Conductivity.....	3
pH.....	4
Water Clarity .....	4
Bacteria - <i>E. coli</i> and Fecal Coliform .....	4
Nutrients – Orthophosphate and Nitrate-Nitrogen.....	5
San Marcos River Citizen Water Quality Monitor Site Locations Map .....	6
San Marcos River Citizen Water Quality Monitor Site Locations: Upper Portion Map.....	7
San Marcos River Citizen Water Quality Monitor Site Locations: Lower Portion Map .....	8
Data Analysis.....	9
San Marcos River Descriptive Statistics.....	10
San Marcos River Total Exceedances .....	11
San Marcos River Exceedances Since 2003.....	11
San Marcos River Nutrient Results & Screening Levels .....	11
Total # of Exceedances: Upstream to Downstream .....	11
Upper San Marcos River Descriptive Statistics .....	12
Upper San Marcos River Total Exceedances .....	12
Upper San Marcos River Exceedances Since 2003 .....	12
Upper San Marcos River Nutrient Results & Screening Levels .....	13
Lower San Marcos River Descriptive Statistics .....	13
Lower San Marcos River Total Exceedances .....	13
Lower San Marcos River Exceedances Since 2003 .....	13
Lower San Marcos River Nutrient Results & Screening Levels .....	14
San Marcos River Upstream to Downstream Trends .....	14

San Marcos River Trends Over Time .....	15
Upper San Marcos River Trends Over Time .....	17
Lower San Marcos River Trends Over Time .....	18
Site-by-Site Analyses .....	19
Sink Creek at Laurel St. (Aquarena Center) .....	20
Spring Lake Upstream of Dam Near Saltgrass .....	22
Sessom Creek at the San Marcos River.....	24
San Marcos River at Sewell Park .....	26
San Marcos River at City Park (Lions Club Tube Rental) .....	26
Purgatory Creek at the San Marcos River.....	27
San Marcos River at Rio Vista Park .....	28
San Marcos River at IH 35 East Frontage Road.....	31
San Marcos River at Thompson’s Island .....	33
San Marcos River at Fish Hatchery Outfall .....	35
San Marcos River at Cummings Dam .....	38
San Marcos River at Old Bastrop Highway .....	40
San Marcos River at Sculls Crossing West of Martindale .....	43
San Marcos River at Martindale Dam .....	46
San Marcos River at Bella Vista .....	48
San Marcos River at FM 1977 .....	49
San Marcos River at FM 20 .....	51
San Marcos River at Prairie Lea .....	54
<b>San Marcos River Supplemental Bacteria Data Analysis .....</b>	<b>58</b>
<i>E. coli</i> Bacteria .....	58
Dog Beach at CM Allen & University Dr Just Downstream of Stormwater Outfall .....	58
2007 Intensive <i>E. coli</i> Bacteria Survey.....	59

## Introduction

**Water Body Location:** The San Marcos River emerges from a variety of springs at the Aquarena Center in San Marcos, TX. These springs form a small lake known as Spring Lake before flowing downstream for seventy-five miles to the confluence with the Guadalupe River near Gonzales, TX.<sup>i</sup>



**Water Body Description:** The watershed contains 522 mi<sup>2</sup> of Edwards Plateau, Post Oak Savannah, and Texas Blackland Prairies in Hays, Guadalupe, Caldwell, and Gonzales Counties of central Texas.<sup>ii</sup> The constant temperature and flow from the springs provide a unique ecosystem for many endangered species including the Texas Wild Rice and the fountain darter. The exceptionally clean water accompanied by the extensive park system of San Marcos make the Upper San Marcos River a rare environment for contact recreation, attracting people from all over.

**Texas Stream Team:** Texas Stream Team is a volunteer based water quality monitoring program. In alignment with Texas Stream Team's core mission, monitors collect surface water quality data that may be used in decision-making processes to promote and protect a healthy and safe environment for people and aquatic inhabitants. Citizen monitoring occurs at set monitoring sites roughly the same time of day once a month. Citizen monitoring data provides a valuable resource of information supplementing professional data collection efforts where resources are limited. The data may be used by professionals to identify water quality trends, target additional data collection, identify pollution events, identify sources and causes of pollution, and show effectiveness of management measures towards improving water quality.

Texas Stream Team volunteer data, however, is not used by the state to assess whether water bodies are meeting the designated surface water quality standards. The primary reason for this is that Texas Stream Team volunteers use different methods than the professional water quality monitoring community. Different methods are utilized by Texas Stream Team due to higher equipment costs, training requirements, and stringent laboratory procedures that are required of the professional community. The Texas Stream Team methods have been chosen because of relative ease of performing the methods in the field, while providing reliable results at low costs. As a result, Texas Stream Team data does not have the same accuracy or precision as professional data and is therefore not directly comparable. However, Texas Stream Team data are valuable records often collected in portions of water body that professionals are not able to monitor or monitor as frequently. This long-term data set is available to and may be considered by the surface water quality professional community to facilitate management and protection of Texas' water resources. For additional information about water quality monitoring methods and procedures, see:

- [Texas Stream Volunteer Water Quality Monitoring Manual](#)
- [Texas Commission on Environmental Quality \(TCEQ\) Surface Water Quality Monitoring Procedures](#) for professional monitors

Information collected by Texas Stream Team volunteers is covered under a TCEQ approved quality assurance project plan (QAPP) to ensure a standard set of methods of known quality are used. All data used in data reports are screened by the Texas Stream Team for completeness, precision and accuracy where applicable, and scrutinized with data quality objective and data validation techniques.

The purpose of this report is to provide analysis of data collected by Texas Stream Team volunteers. The data presented in this report should be considered in conjunction with other relevant water quality reports prepared by the following programs in order to provide a holistic view of water quality in this water body:

- Texas Surface Water Quality Standards;
- Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) (or Texas Integrated Report; formerly the Texas Water Quality Inventory and 303(d) List);
- Texas Clean Rivers Program partners' reports such as Basin Summary Reports and Highlight Reports;
- TCEQ surface water quality special studies;
- TCEQ Total Maximum Daily Load reports;
- TCEQ and Texas State Soil and Water Conservation Board Nonpoint Source Program funded reports, including Watershed Protection Plans.

Questions about this report should be directed to the Texas Stream Team at (512) 245-1346.

## **Water Quality Terminology**

The following paragraphs under this section provide general information about types of data collected by Texas Stream Team volunteers, along with the importance of these parameters for aquatic and human health.

### **Water Temperature**

Water temperature, one of the simplest water quality measurements, is one of the most important to the health of an aquatic ecosystem (*A Guide to Freshwater Ecology*, TCEQ GI-034, August 2005). Water temperature influences physiological processes of aquatic organisms, and each species has optimum temperatures for survival. High water temperatures increase oxygen-demand for aquatic communities and can become stressful for fish and aquatic insects. Water temperature variations are most detrimental when they occur rapidly, leaving the aquatic community no time to adjust. Additionally, the ability of water to hold oxygen in solution (solubility) decreases as temperature increases.

Natural sources of warm water are seasonal as water temperatures tend to increase during summer and decrease in winter. Daily (diurnal) water temperature changes occur during normal heating and cooling patterns. Man-made sources of warm water include power plant effluent after it has been used for cooling or hydroelectric plants which release warmer water. Citizen monitoring may not identify fluctuating patterns due to diurnal changes or events such as power plant releases. While citizen data does not show diurnal temperature fluctuations, it may demonstrate the fluctuations over seasons and years.

## Dissolved Oxygen

Oxygen is necessary for the survival of organisms like fish and aquatic insects. The amount of oxygen needed for survival and reproduction of aquatic communities varies according to species composition and adaptations to watershed characteristics like stream gradient, habitat, and available stream flow. The TCEQ Water Quality Standards list daily minimum dissolved oxygen criteria for specific water bodies, and presume criteria according to flow status (perennial, intermittent with perennial pools, and intermittent), aquatic life attributes, and habitat. These criteria are protective of aquatic life and can be used for general comparison purposes.

Dissolved oxygen concentrations can be influenced by other water quality parameters such as nutrients and temperature. High concentrations of nutrients can lead to excessive surface vegetation growth, which may starve subsurface vegetation of sunlight and limit the amount of dissolved oxygen in water produced as a product of photosynthesis. This process, known as eutrophication, is enhanced when the subsurface vegetation dies and is decomposed by oxygen-consuming bacteria.



Low dissolved oxygen levels may also result from high groundwater inflows as groundwater is typically low in dissolved oxygen, high temperatures which reduce oxygen solubility, or water releases from deeper portions of dams where conditions are anoxic.

## Conductivity

Conductivity is measured to determine the amount of dissolved solids in the water. Conductivity is a measure of the ability of water to conduct electricity. The more dissolved solids a body of water has, such as inorganic salts (Ex. magnesium, calcium, chloride, and sulfate), the more electricity it conducts, or the more conductive it is. Conductivity is measured in microSiemens per centimeter ( $\mu\text{S}/\text{cm}$ ). To determine total dissolved solids (TDS) in water, the Texas Surface Water Quality Monitoring Procedures call for a conversion of specific conductance by 65%. Sources of TDS can include agricultural runoff, domestic runoff, discharges from wastewater treatment plants, groundwater inflows, or naturally saline conditions resulting from the local geology and arid climate.

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.

## 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; every 1 unit change means the acidity increased or decreased 10-fold. A pH of 7.0 is considered neutral. Values less than 7.0 are considered acidic; those greater than 7.0 are alkaline (basic).

The local geology in a watershed determines the general pH of water bodies. Underlying rock such as limestone dissolves and weathers easily, releasing minerals that buffer the water and cause a slight increase in pH (*A Guide to Freshwater Ecology*, TCEQ GI-034, August 2005). Harder, igneous bedrock tend to have less mineral content and lower pH. A typical pH range for buffered water bodies is 6.5 and 9. Regions of East Texas, with naturally acidic waters, have typical pH ranges from 5.5 to 9. Acidic contributions, indicated by a low pH level, can include runoff from acid-laden soils and acid rain. Sources that emit nitrogen oxide and sulphur dioxide into the atmosphere, such as car exhaust and coal power plants, contribute to acid rain.

## Water Clarity

Water clarity is the ability of sunlight to penetrate the water column, and is measured by a Secchi disk. The ability of light to reach submerged plants is impeded by reduced clarity, and can effect populations of beneficial phytoplankton, algae, and aquatic plants. This reduces the dissolved oxygen in the water due to reduced photosynthesis. Reduced visibility can also harm predatory fish or birds that depend on good visibility to find their prey.

Water clarity can be affected by natural as well as human activities. Watershed characteristics such as the potential for flooding, and loose soils contribute to reductions in water clarity through increasing sedimentation. Sedimentation can result from sediment washing away from construction sites, erosion of farms, mining operations, and waterway (riparian) disturbance. Reduced water clarity can also occur during algae blooms, which can be episodic or part of a longer term aging process, particularly in reservoirs.

## Bacteria - *E. coli* and Fecal Coliform

Pathogens are microorganisms, such as bacteria, viruses, and protozoans, that can cause illness in humans. Pathogens can be transmitted by drinking or swimming in water containing fecal waste of warm-blooded animals, primarily through ingestion. The EPA has determined *E. coli* bacteria to be the best indicator of the degree of pathogens in a water body. Water bodies naturally contain *E. coli*. *E. coli* levels are therefore monitored to determine if there is a significant risk to human health in relation to contact recreation. Sources of *E. coli* may include livestock, pets, failing septic systems and wastewater treatment plants, or wildlife around the water body.

Fecal coliform is the group of bacteria to which *E. coli* is a subset. Sources are the same as for *E. coli* bacteria except fecal coliform. *E. coli* is the preferred type of data, but fecal coliform data can be used if no *E. coli* data are available.

## Nutrients – Orthophosphate and Nitrate-Nitrogen

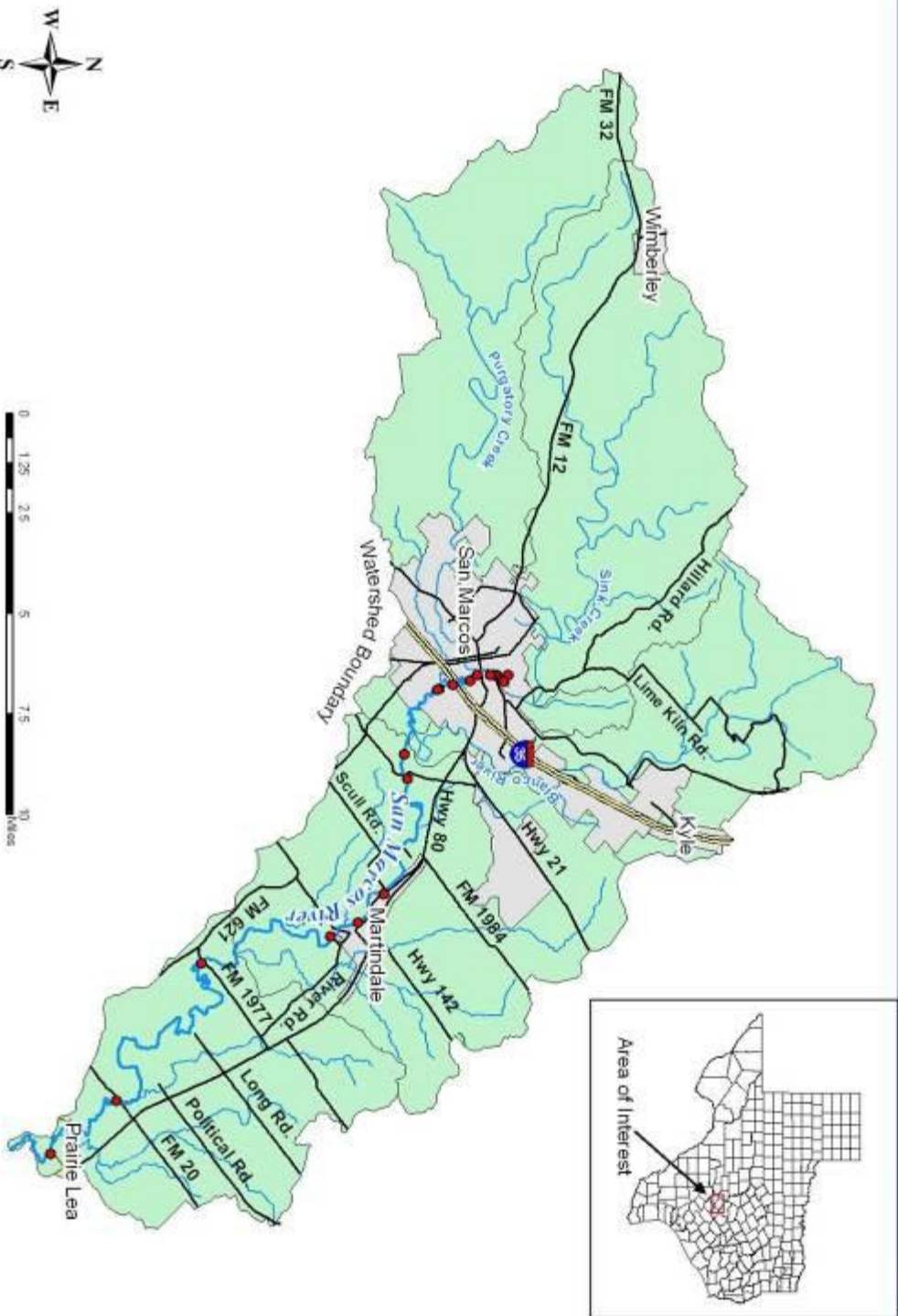
Nutrients are materials that are essential for animal and plant growth and maintenance. In water, nutrients fertilize, stimulating and sustaining growth of aquatic plants and algae. However, in high concentrations, nutrients can degrade water quality causing eutrophication as described under the Dissolved Oxygen section. Nitrogen and phosphorus compounds are the two most important nutrients.

Phosphorus almost always exists in the natural environment as phosphate, which continually cycles through the ecosystem as a nutrient necessary for the growth of most organisms. Orthophosphate is the phosphate molecule all by itself. Testing for orthophosphate detects the amount of phosphate in the water itself, excluding the phosphate bound up in plant and animal tissue. There are other methods to retrieve the phosphate from the material to which it is bound, but they are too complicated and expensive to be conducted by a volunteer monitors. Testing for orthophosphate gives us an idea of the amount of phosphate in a water body. Phosphorus inputs into a water body may be the weathering of soils and rocks, discharge from wastewater treatment plants, excessive fertilizer use, failing septic systems, livestock and pet waste, disturbed land areas, drained wetlands, water treatment, and some commercial cleaning products.

Nitrogen is present in terrestrial or aquatic environments as nitrates, nitrites, and ammonia. Just like phosphorus, nitrogen is a nutrient necessary for the growth of most organisms. Nitrogen inputs into a water body may be livestock and pet waste, excessive fertilizer use, failing septic systems, and industrial discharges that contain corrosion inhibitors. Nitrates dissolve more readily than phosphates, which tend to be attached to sediment, and therefore can serve as a better indicator of the presence of sewage or manure in the water body during dry weather.

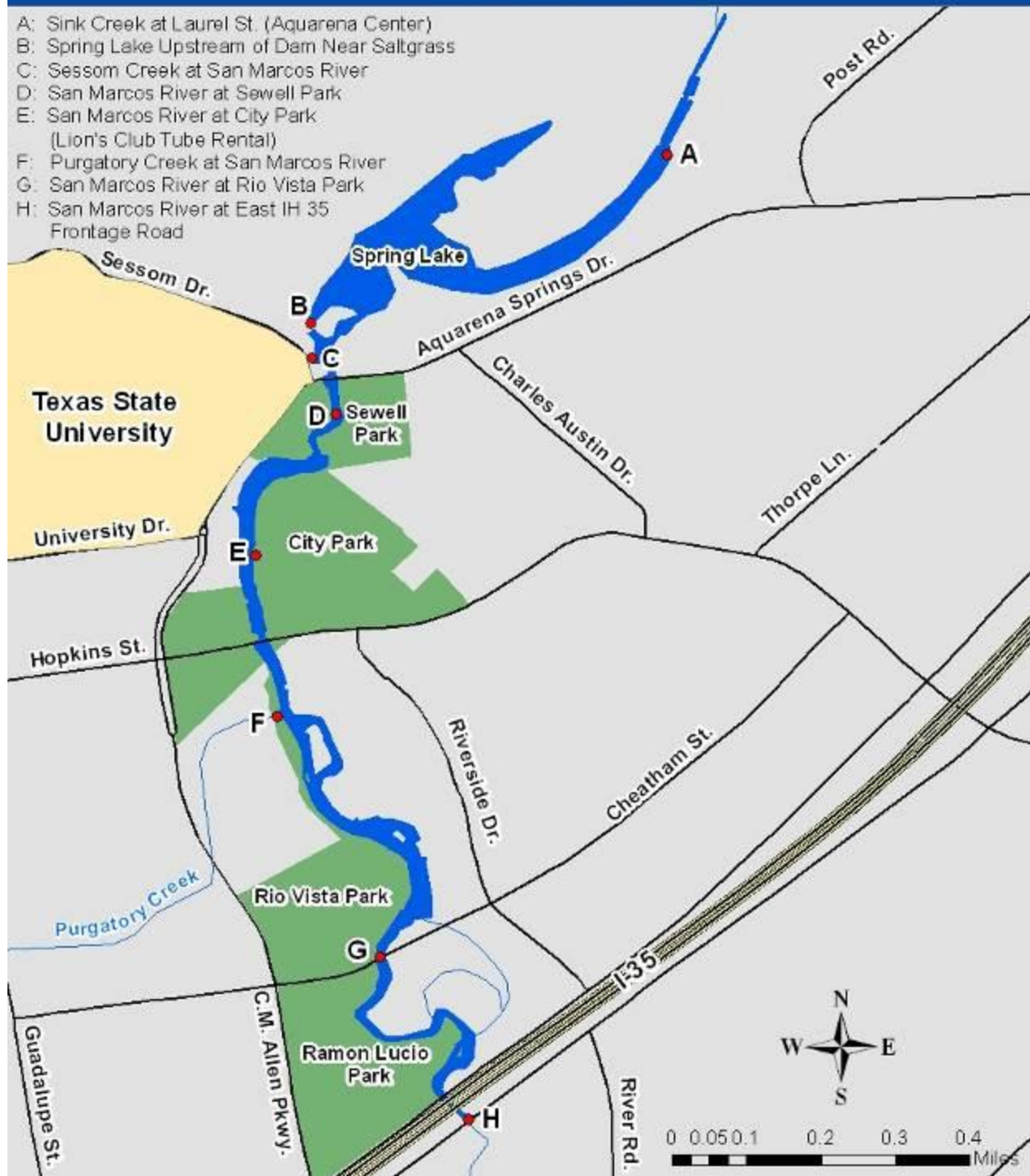


# San Marcos River Citizen Water Quality Monitor Site Locations

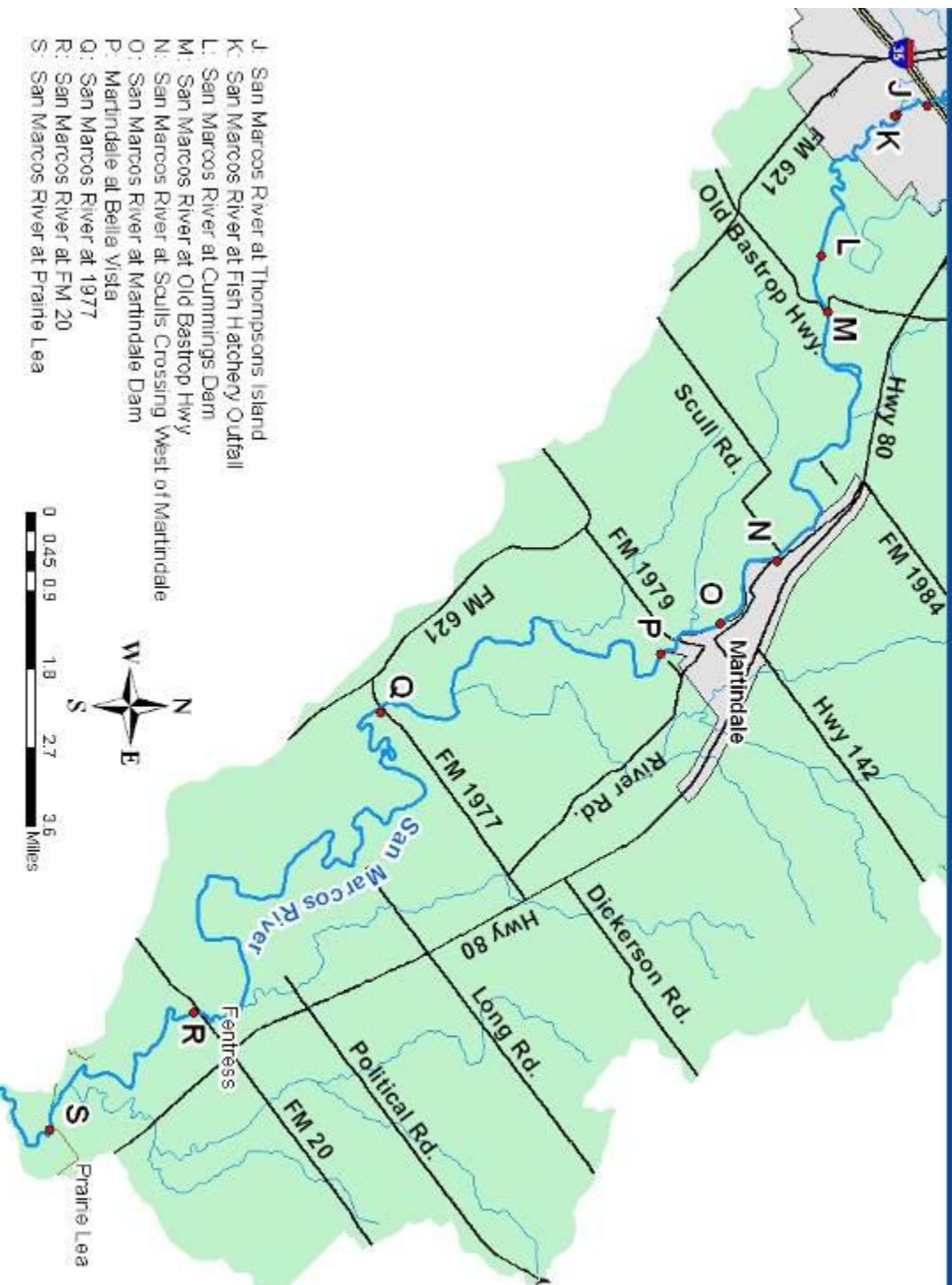


## San Marcos River Citizen Water Quality Monitor Site Locations Upper Portion

- A: Sink Creek at Laurel St. (Aquarena Center)
- B: Spring Lake Upstream of Dam Near Saltgrass
- C: Sessom Creek at San Marcos River
- D: San Marcos River at Sewell Park
- E: San Marcos River at City Park  
(Lion's Club Tube Rental)
- F: Purgatory Creek at San Marcos River
- G: San Marcos River at Rio Vista Park
- H: San Marcos River at East IH 35  
Frontage Road



# San Marcos River Citizen Water Quality Monitoring Locations Lower Portion



- J: San Marcos River at Thompsons Island
- K: San Marcos River at Fish Hatchery Outfall
- L: San Marcos River at Cummings Dam
- M: San Marcos River at Old Bastrop Hwy
- N: San Marcos River at Sculls Crossing West of Martindale
- O: San Marcos River at Martindale Dam
- P: Martindale at Bella Vista
- Q: San Marcos River at 1977
- R: San Marcos River at FM 20
- S: San Marcos River at Prairie Lea

## Data Analysis

This report covers data mostly collected by a group of citizen water quality monitors known as the San Marcos River Rangers. The San Marcos River Rangers formed in 1995 to collect data on water temperature, dissolved oxygen, conductivity, pH, orthophosphate, nitrate-nitrogen, and various field observations. They formed after a group of citizens attempting to track down water quality data for a wastewater permit hearing in the early to mid 1990s found limited data available. The River Rangers decided to collect their own data as record of the good water quality of the San Marcos in case pollution ever became a problem. Since their inception, the San Marcos River Rangers have collected data at 16 sites from Spring Lake in San Marcos Prairie Lea with monitors generally testing twice a month, resulting in an extensive body of data.

Data are compared to state standards and screening levels to enable readers to have a reference point for amounts/levels of parameters which may be of concern. The assessment performed by the TCEQ uses more complicated monitoring methods and oversight. Citizen water quality monitor data are not used in the assessment but are intended to inform stakeholders about general characteristics and assist professionals in identifying areas of concern.

For the Integrated Report, the TCEQ determines a water body to be impaired for core parameters if approximately 10% of at least ten samples taken over the last seven years exceed the standard for each parameter. If there are at least five samples in the seven year period, then it is acceptable to go back for more samples up to ten years. For contact recreation, a water body is determined to be impaired when 25% of at least ten samples taken over the last seven years exceed the standard for *E.coli* bacteria. When the observed value is over the standard, it is referred to as an exceedance. At least ten samples from the last seven years must be collected over at least two years with the same reasonable amount of time between samples for a data set to be considered acceptable for use in assessments. Similar rules exist for other standards to ensure that assessments are made using enough data to account for normal seasonal changes as well as variations in rainfall and other conditions from year to year.

The following data are divided into three sections: the entire river, the Upper San Marcos River, and the Lower San Marcos River. The TCEQ has applied different standards to the Upper San Marcos River than the Lower San Marcos River due to different characteristics of these portions. They define the Upper San Marcos as the segment from Spring Lake to a point 0.6 mi upstream of the confluence with the Blanco River. The Lower San Marcos River flows from that point to confluence with the Guadalupe River in Gonzales, TX. Tables are provided showing the # and % of exceedances for River Rangers data. The tables are divided into total exceedances and exceedances since 2003 to give the reader a better idea of present characteristics.

There are no specific numerical standards assigned for orthophosphate and nitrate. Instead the TCEQ uses "screening levels," which are levels at which a concern may exist in a given water body. Using a method known as the "binomial method," the TCEQ determines that 20% of observations must exceed the screening level before a concern is identified. Please note that the following percentages were not calculated using the binomial method and therefore should not be directly compared to this "screening level." They are provided, however, to enable readers to put values in context.

The tests for orthophosphate and nitrate can only record values  $>0.1$  and  $>1$ , respectively. For that reason, values which appear to be zero are recorded as  $<0.1$  and  $<1$  because there may be nutrients



in the sample the test cannot detect. In the following analysis, values recorded as <0.1 or <1 were changed to 0 in order to display the values on graphs and calculate statistics. Therefore, the graphs and statistics for nutrients are not completely accurate due to the detection limits of these tests. Nutrient results are compared to days since last significant precipitation because stormwater runoff is a well known contributor of nutrients to water bodies.

Citizen Water Quality Monitor data for the San Marcos River show it to be a suitable environment for aquatic life. Only 1 out of 1,532 dissolved oxygen observations fell below the standard at the site at Prairie Lea. Only 18 out of 1,553 water temperature observations were above the standard, and most of these exceedances occurred during warm summer months. Three water temperature exceedances occurred in the winter when air temperature was less than 80 °F at the site at Thompson’s Island. This indicates something other than air temperature to be affecting water temperature at that site. Only 1 out of 1,551 pH observations were outside of the range established in the standards. Details are shown below.

Unlike the other parameters, the conductivity values must be converted to TDS to be compared to a standard, and this standard is based on a segment-wide average over the assessment period. The standard for both the Upper San Marcos River and the Lower San Marcos River after it has been converted to conductivity is 615 µS/cm. The average of 571 conductivity observations at 7 sites from 11/2003 to 11/2010 in the Upper San Marcos River is 614.5 µS/cm. The average of 476 observations at 8 sites in the Lower San Marcos River for the same assessment period is 578.4 µS/cm. The Upper San Marcos River is on the TCEQ 2010 Draft 303(d) List of Impaired Water Bodies for high levels of total dissolved solids, which means professional data show conductivity over 615 µS/cm from December 2001 to November 2008. Data from most sites as well as the overall average data for all sites show a steady increase in conductivity values over the last seven years, and average conductivity values decrease from upstream to downstream.

### San Marcos River Descriptive Statistics

San Marcos River 1992-2010						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	1566	98	44	71	95	6.4
Dissolved Oxygen (mg/L)	1545	97	2.8	8.1	11.8	1.1
Conductivity (µS/cm)	1406	88	180	595	1260	108
pH	1564	98	6.9	7.9	9.8	0.3
Secchi Disk Transparency (m)	1381	87	0.1	1.3	7.7	0.6
Total Depth (m)	1411	89	0.25	2	8	1.2
Orthophosphate (mg/L)	475	30	<0.1	0.3	8.8	0.7
Nitrate (mg/L)	467	29	<1	0.6	13.2	1.4
Sample Time	1576	99	6:30 AM	12:36 PM	10:40 PM	3:14

### San Marcos River Total Exceedances

San Marcos River Total Exceedances			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	80 & 90 °F	18/1553	1.16
Dissolved Oxygen	3 & 4 mg/L	1/1532	0.07
pH	6.5-9	1/1551	0.06

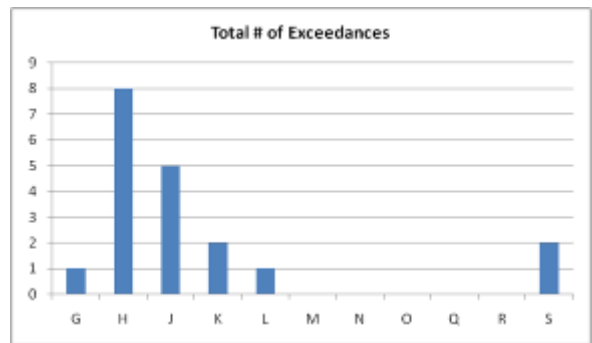
### San Marcos River Exceedances Since 2003

San Marcos River Exceedances Since 2003			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	80 & 90 °F	14/779	1.8
Dissolved Oxygen	3 & 4 mg/L	0/756	0
pH	6.5-9	0/776	0

### San Marcos River Nutrient Results & Screening Levels

San Marcos River Nutrient Results & Screening Levels 1996-2005					
Parameter	Screening Level	Over Screening Level		Significant Precipitation in Preceding 3 Days	
		#	%	#	%
Orthophosphate	0.37 mg/L	122/475	27	37	30
Nitrate	1.95 mg/L	38/467	8	11	30

### Total # of Exceedances: Upstream to Downstream



The letters on the x-axis above are those on the main channel of the river with a substantial data set which refer to the letters provided on the maps above. You can see here the majority of exceedances occurred at IH 35 and Thompson's Island.

### Upper San Marcos River Descriptive Statistics

Upper San Marcos River <sup>1</sup> 1995-2010						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	723	99	52	72	95	4.4
Dissolved Oxygen (mg/L)	715	98	5	8.2	10.3	0.9
Conductivity (µS/cm)	639	87	180	616	1260	116
pH	726	99	7	7.77	9.8	0.3
Secchi Disk Transparency (m)	593	81	0.1	1.7	3.5	0.6
Total Depth (m)	635	87	0.25	1.8	5.5	0.6
Orthophosphate (mg/L)	141	19	<0.1	0.1	1.6	0.2
Nitrate (mg/L)	144	20	<1	0.4	4.4	0.8
Sample Time	730	100	6:30 AM	1:10 PM	10:40 PM	3:06

### Upper San Marcos River Total Exceedances

Upper San Marcos River Total Exceedances <sup>2</sup>			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	78 & 80 <sup>3</sup> °F	18/938	1.9
Dissolved Oxygen	4 mg/L	2/928	0.2
pH	6.5-9	1/939	0.1

### Upper San Marcos River Exceedances Since 2003

Upper San Marcos River Exceedances Since 2003			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	80 °F	14/520	2.7
Dissolved Oxygen	4 mg/L	0/512	0
pH	6.5-9	0/522	0

<sup>1</sup> Spring Lake data are omitted from this table so that readers can observe any influence it may have on the river.

<sup>2</sup> Spring Lake data are included in these tables.

<sup>3</sup> The 78 °F standard applies to Spring Lake and the area upstream of the confluence with Sessom Creek. The 80 °F standard applies to the rest of the segment.

**Upper San Marcos River Nutrient Results & Screening Levels**

Upper San Marcos River Nutrient Results & Screening Levels 1996-2005					
Parameter	Screening Level	Over Screening Level		Significant Precipitation in Preceding 3 Days	
		#	%	#	%
Orthophosphate	0.37 mg/L	19/141	13	3	16
Nitrate	1.95 mg/L	6/144	4	0	0

**Lower San Marcos River Descriptive Statistics**

Lower San Marcos River 1992-2010						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	828	96	44	71	95	7.7
Dissolved Oxygen (mg/L)	815	95	2.8	8.0	11.8	1.2
Conductivity (µS/cm)	752	87	300	576	1190	97
pH	823	96	6.9	7.95	8.9	0.3
Secchi Disk Transparency (m)	773	90	0.1	1	7.7	0.6
Total Depth (m)	761	88	0.31	2.2	8	1.5
Orthophosphate (mg/L)	334	39	<0.1	0.3	8.8	0.8
Nitrate (mg/L)	323	37	<1	0.7	13.2	1.6
Sample Time	845	98	7:05 AM	12:07 PM	9:00 PM	3:16

**Lower San Marcos River Total Exceedances**

Lower San Marcos River Total Exceedances			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	2/830	0.24
Dissolved Oxygen	3 mg/L	1/817	0.12
pH	6.5-9	0/825	0

**Lower San Marcos River Exceedances Since 2003**

Lower San Marcos River Total Exceedances Since 2003			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	1/395	0.25
Dissolved Oxygen	3 mg/L	0/380	0
pH	6.5-9	0/391	0



## Lower San Marcos River Nutrient Results & Screening Levels

Lower San Marcos River Nutrient Results & Screening Levels 1996-2005					
Parameter	Screening Level	Over Screening Level		Significant Precipitation in Preceding 3 Days	
		#	%	#	%
Orthophosphate	0.37 mg/L	103/334	31	34	33
Nitrate	1.95 mg/L	38/323	12	11	29

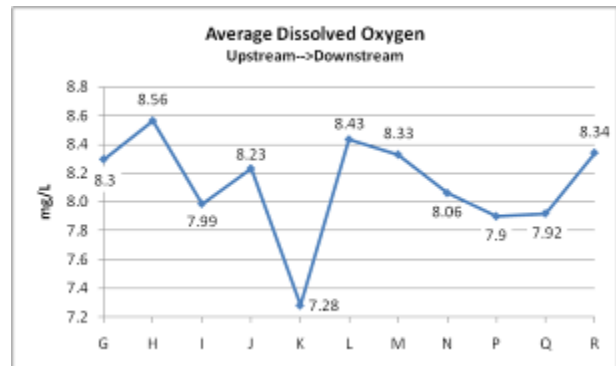
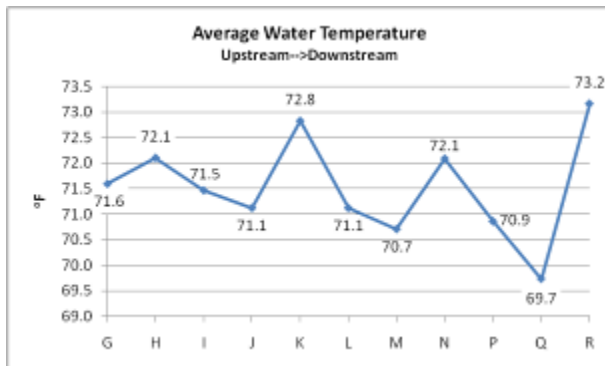
### San Marcos River Upstream to Downstream Trends

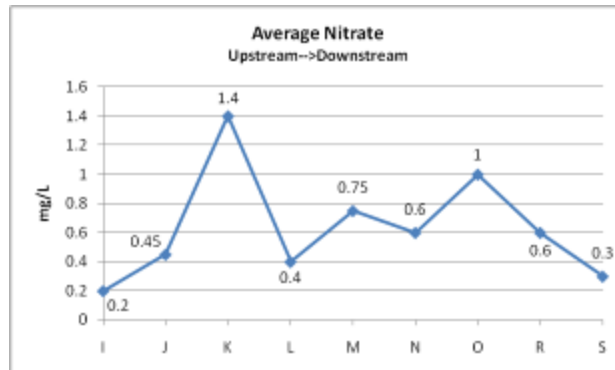
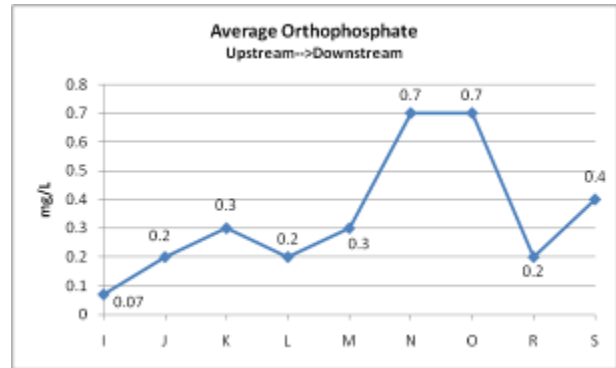
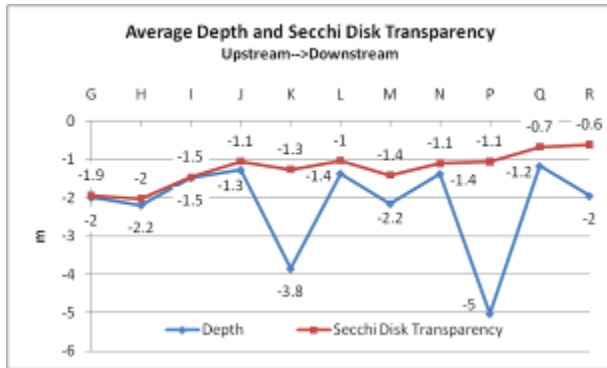
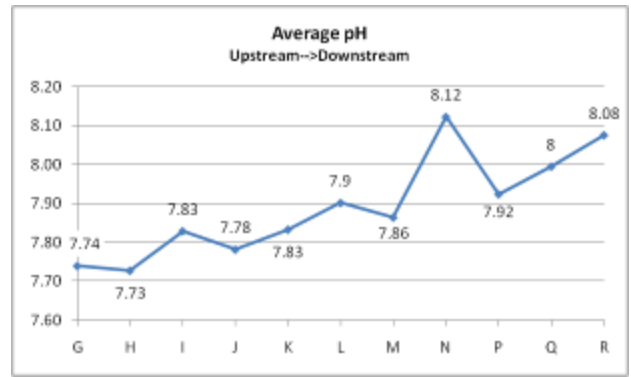
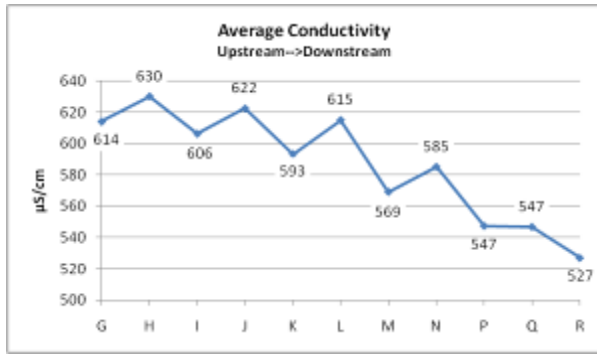
The following graphs show averages for most sites on the San Marcos River. Some sites were omitted due to minimal data, being in a tributary or in Spring Lake. The x-axis references the maps above. The Upper San Marcos River portion includes sites G-K. The Lower San Marcos River portion includes sites L-R.

Water temperature varies between 69.7 °F and 73.2 °F with no significant trends. Conductivity trends downward from upstream to downstream with the highest value being observed at the IH 35 Frontage Rd. and the lowest being at FM 20. This could possibly be attributed to the fact that spring water can have high conductivity due to dissolved aquifer material such as calcium carbonate.

Dissolved oxygen varies between 7.28 mg/L and 8.56 mg/L with no significant trend. pH trends upward from upstream to downstream with the lowest value being at the IH 35 Frontage Rd. with the highest value being at Sculls Crossing West of Martindale. The average depth and Secchi Disk transparency graph is presented in such a way as to depict "0" as the water surface and the y-axis represents the distance from there.

It can be seen in the "Average Depth and Secchi Disk Transparency" chart below that visibility decreases downstream of Thompson's Island. Average orthophosphate mostly increased from upstream to downstream until the site at Old Bastrop Hwy and, for the most part, exhibits lower values downstream of the Martindale Dam. Average nitrate is highly variable with the highest average value at the site downstream of the fish hatchery outfall.

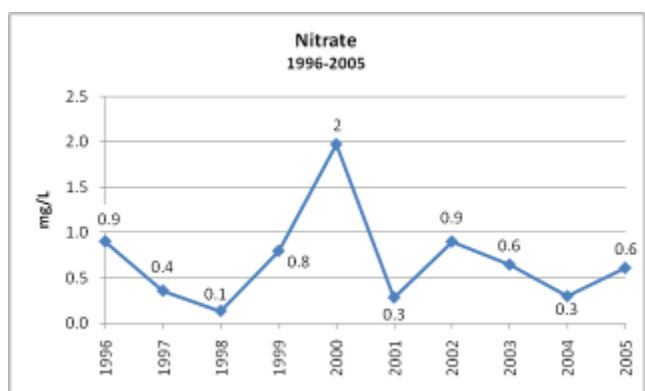
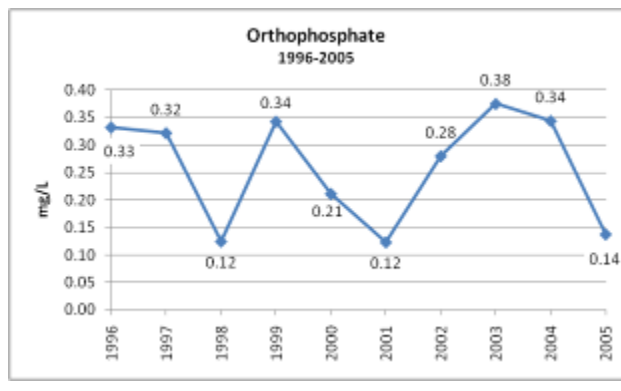
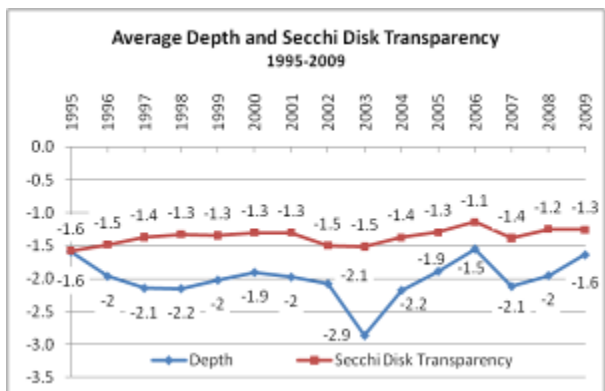
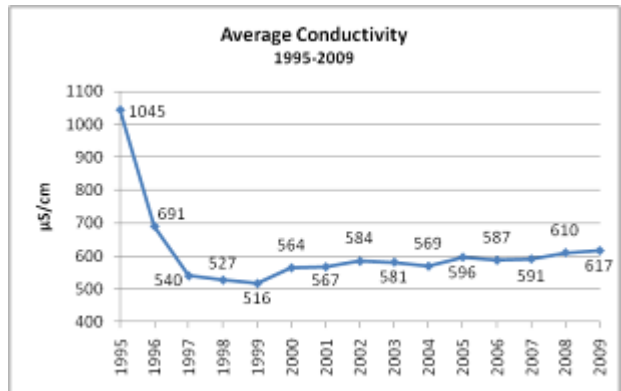
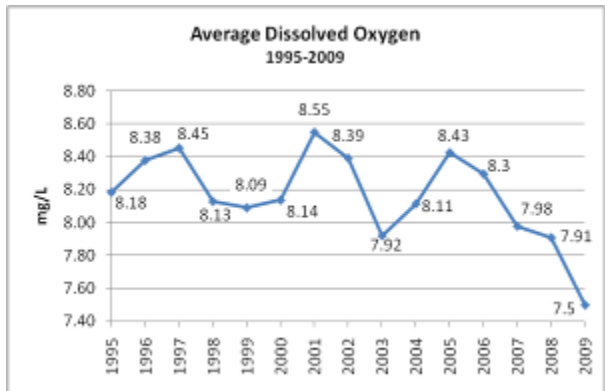
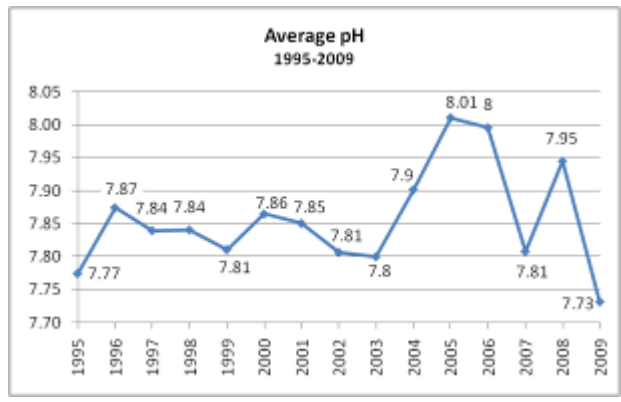
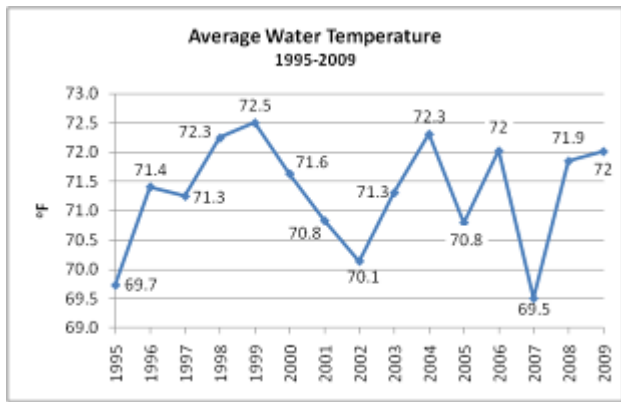




### San Marcos River Trends Over Time

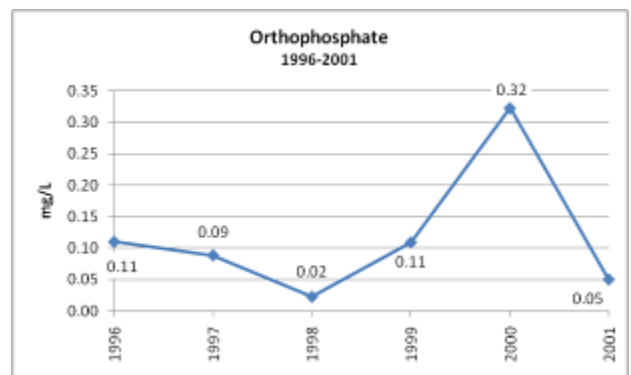
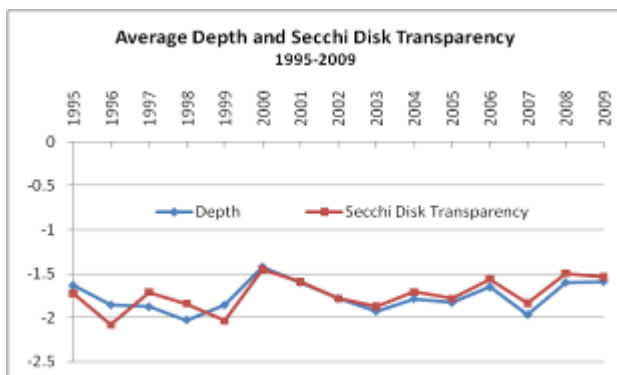
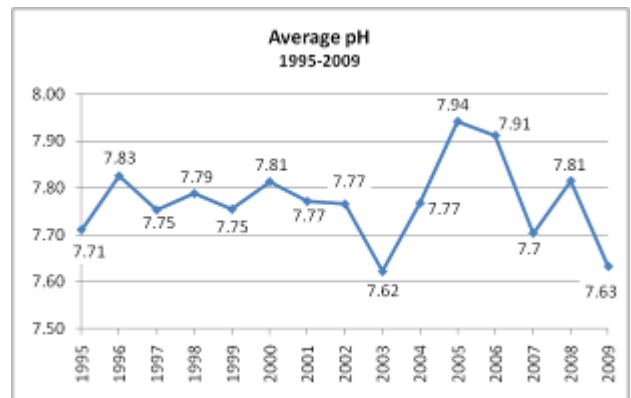
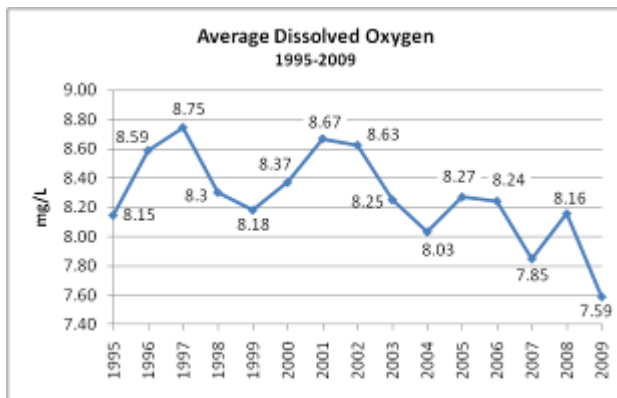
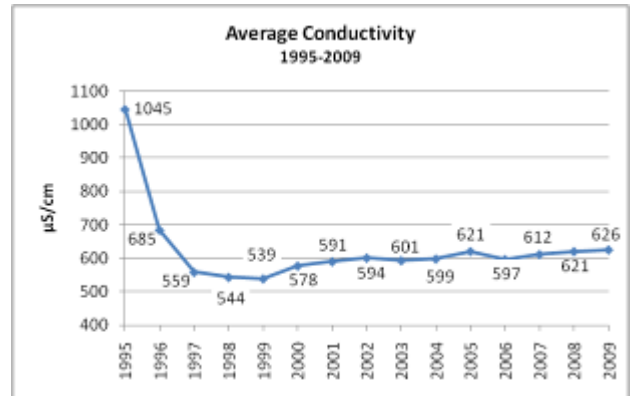
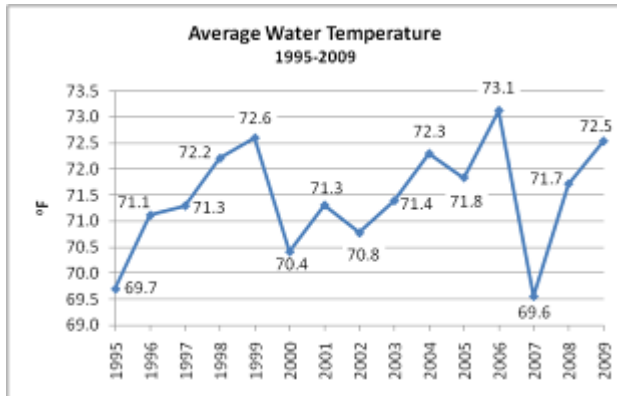
The following graphs show data from all sites on the main channel of the river for each year from 1995-2009. Water temperature varied from 69.5 °F to 72.5 °F with no significant trends. pH varied from 7.73 to 8.01 with the highest values being observed in 2005, 2006, and 2008. These variations do not indicate any significant change or threat to the river.

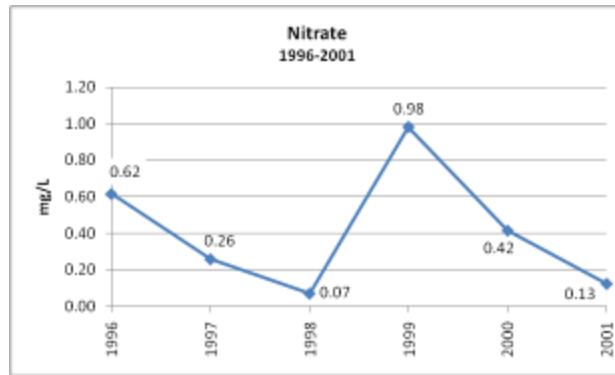
Dissolved oxygen varied between 7.5 mg/L and 8.55 mg/L and while the values are not considered a concern, a gradual decrease from 2005 to 2009 from 8.43 mg/L to 7.5 mg/L was observed. Conductivity dropped dramatically from 1995 to 1997, then trended slightly upward until 2009. Secchi Disk transparency stayed mostly consistent. Depth varied between 1.6 m and 2.9 m. Orthophosphate varied steadily between 0.12 mg/L and 0.38 mg/L. Nitrate varied steadily between 0.1 mg/L and 2 mg/L.



## Upper San Marcos River Trends Over Time

Water temperature varied between 69.6 °F and 73.1 °F with no significant trends. Conductivity followed the same trends as the data for the entire river. It dropped dramatically from 1995 to 1997 then trended slightly upward until 2009. Dissolved oxygen varied between 7.5 mg/L and 8.75 mg/L with a general downward slope. pH varied steadily from 7.62 to 7.94. Secchi Disk transparency and total depth were almost always equal, indicating very clear water. Orthophosphate varied steadily between 0.02 mg/L and 0.32 mg/L.

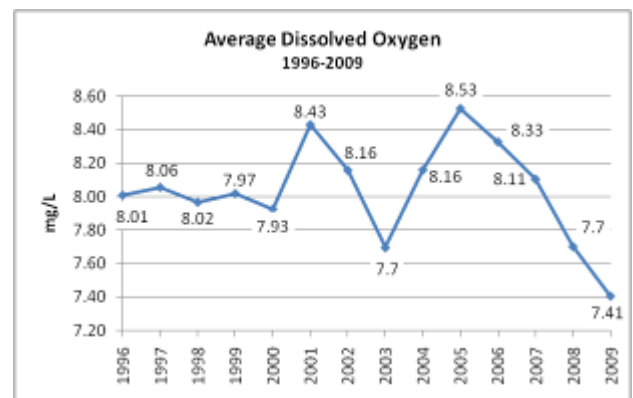
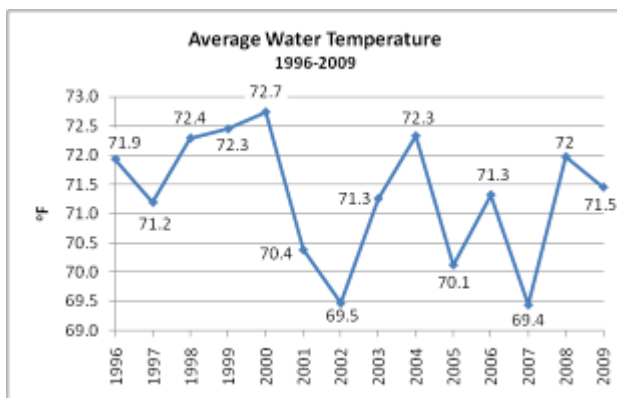


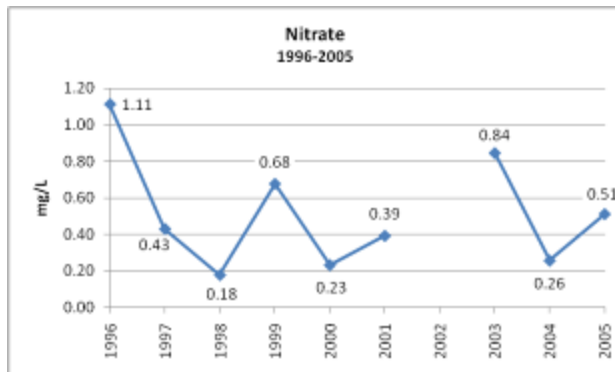
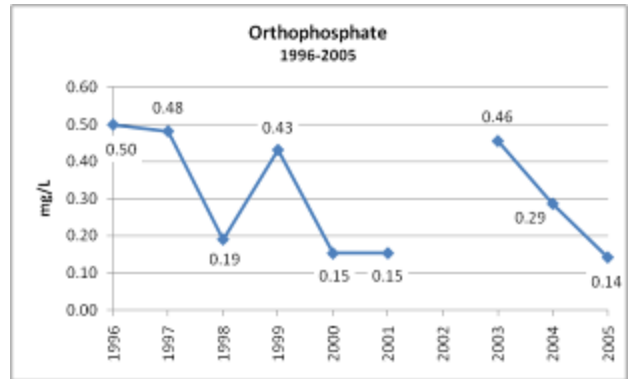
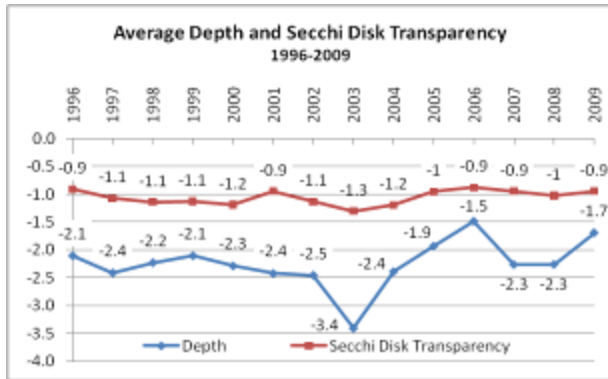
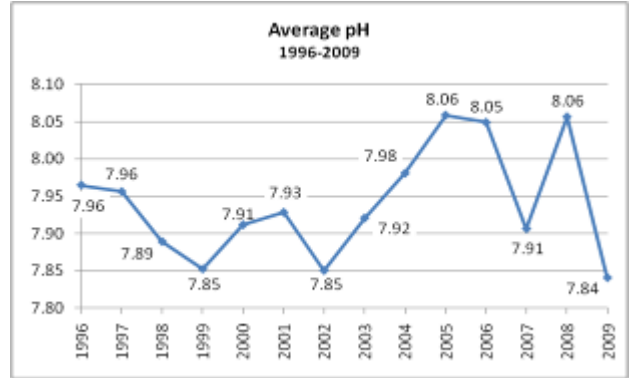
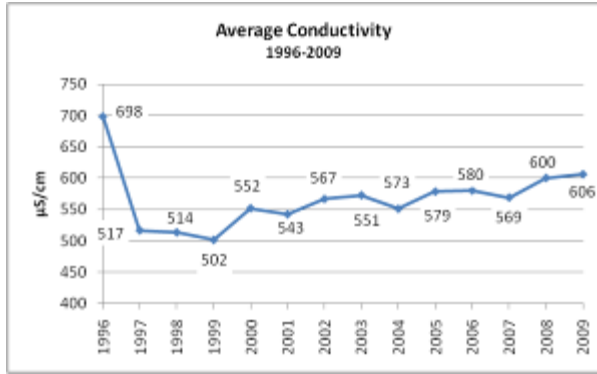


### Lower San Marcos River Trends Over Time

Water temperature varied between 69.4 °F and 72.7 °F with no significant trend. Conductivity followed the same trends as the data for the entire river. It dropped dramatically from 1995 to 1997 but this drop was less dramatic than the upstream portion. After 1997, the conductivity trended slightly upward until 2009.

Dissolved oxygen varied between 7.41 mg/L and 8.53 mg/L with a steady downward trend from 2005 to 2009. The entire period does not follow the same general downward slope observed on the upper portion. pH varied between 7.84 and 8.06 with higher values being observed in 2005, 2006, and 2008. These variations do not indicate any significant change or threat to the river. It can be seen on the average depth and Secchi Disk transparency graph below that the visibility for this portion is much less than the visibility in the upper portion. Orthophosphate varied steadily between 0.14 mg/L and 0.5 mg/L. Nitrate varied steadily between 0.18 mg/L and 1.11 mg/L.





### Site-by-Site Analysis

The 2010 Water Quality Standards for the Upper San Marcos River and the Lower San Marcos River are shown in red on the graphs below. The screening levels for freshwater streams are shown in orange. The water temperature standard is a maximum level. The dissolved oxygen standard is a minimum amount. The pH standard is a range. The conductivity standard is shown on the graphs as a reference point, but it does not apply to particular observations. The orthophosphate and nitrate screening levels are maximum amounts.

**Site A: Sink Creek at Laurel St. (Aquarena Center)**

Site A: Sink Creek at Laurel St. (Aquarena Center) 1995-2010						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	193	97	45	69	90	7.4
Dissolved Oxygen (mg/L)	188	94	0.5	6	13.7	2.8
Conductivity (µS/cm)	166	83	270	611	1190	101
pH	194	97	6.7	7.5	8.5	0.3
Secchi Disk Transparency (m)	165	83	0.1	0.7	2	0.2
Total Depth (m)	181	91	0.2	0.8	3	0.3
Sample Time	196	98	7:15 AM	1:46 PM	8:40 PM	3:22

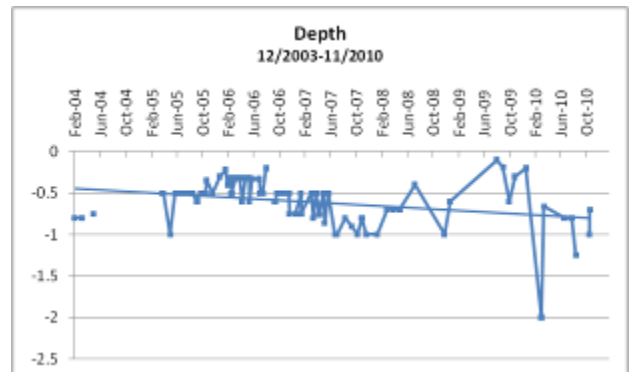
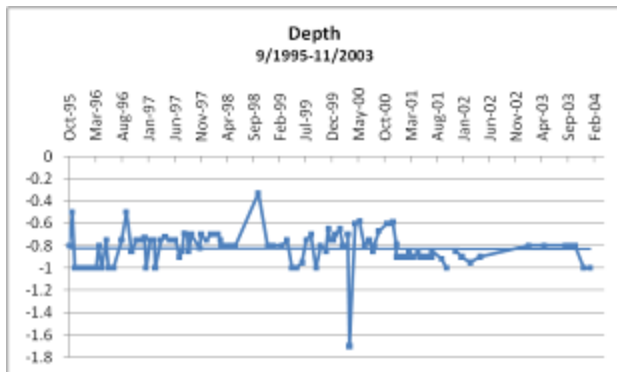
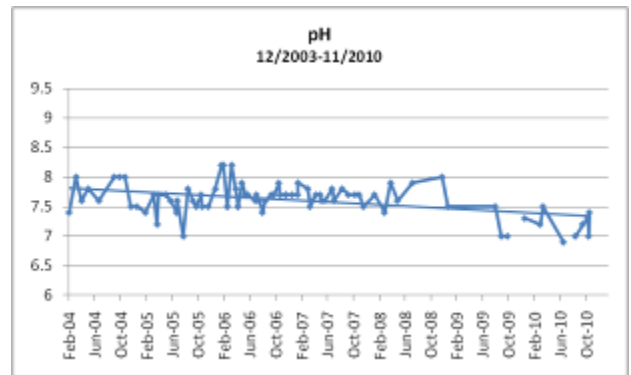
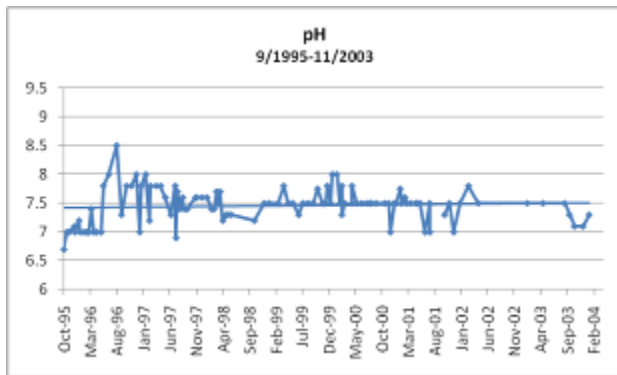
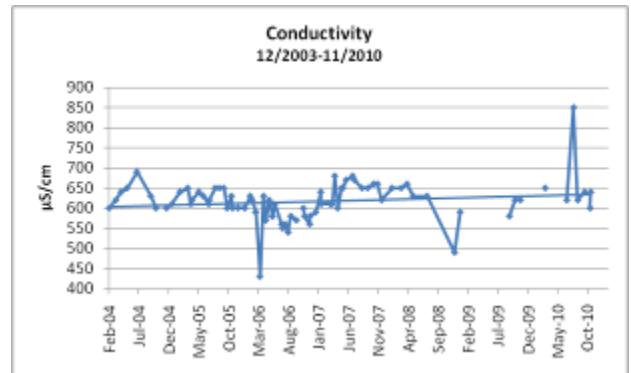
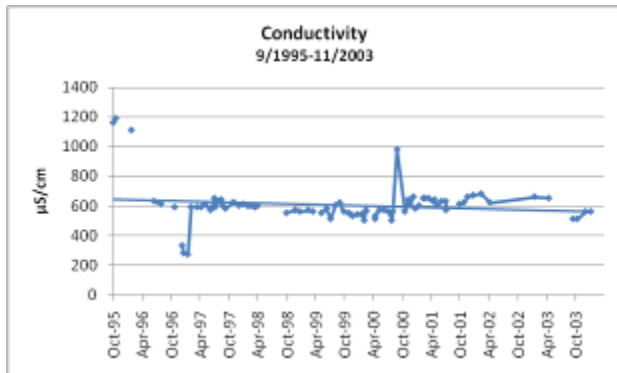
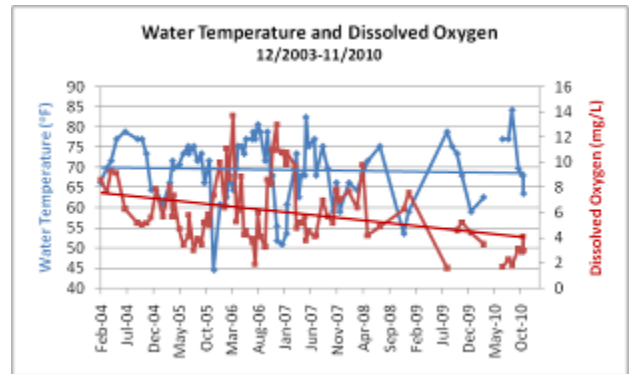
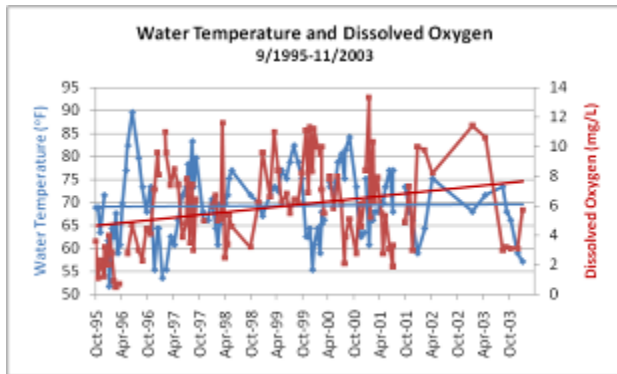
Data at this site were collected by James and Lisa Arcenau, Mark Pillon, Karen Glover, Alissa Andersen, Sandra and Tyler Ellison, Lauren Bilbe, Mary Waters, Rut Vargas, Juana Gomez, Santiago and John Demaree, Alex Larue, Everett Romano, Clay Williams, Nancy Carl, Sara Flores, Brandon Charlie Burton, Chance and Kathy Navarette, Steve Boles, Mary Rocamora, Karen Starnes, Rachel Sanborn, Mary Beth Garrett, and Mo Tangestani with the San Marcos River Rangers. There have been extreme fluctuations in water temperature and dissolved oxygen with very low values such as 0.5 mg/L and abnormally high values such as 13.7 mg/L. The lowest of these values occurred in 1995. These values fluctuated between each monitoring event with no definite trends. The trend line shows dissolved oxygen increasing from 1995 to 2003 then decreasing from 2003 and 2010, but with such extreme fluctuations, these are very rough estimates. Monitors noted an abundance of algae (>90% coverage) at this site. Fluctuations in dissolved oxygen may be caused by the growth or death of algae.

Water temperature mostly followed seasonal changes with minor changes between monitoring events. It varied steadily around 69 °F. Dissolved oxygen mostly decreased when water temperature increased and vice versa, indicating that these changes were caused by water temperature (a natural process).

Conductivity stayed between 600 µS/cm and 700 µS/cm most of the time. Strangely enough, the monitors noted red water and a fishy odor both for the 3 lowest conductivity measurements and the 3 highest conductivity measurements when the water normally had no color or odor. For the three highest conductivity measurements, monitors noted “most of the grass and water hyacinth are brown and decaying,” which could be the cause of the red water. Another well known cause of red water is iron in sediment.

pH has mostly stayed between 7 and 8, which means the water is slightly alkaline. The pH appears to have been decreasing since 2008 to values closer to 7. Secchi Disk transparency and total depth were equal almost all of the time, indicating clear water. A graph showing Secchi Disk transparency along with total depth was omitted because the lines were almost identical. Monitors noted an abundance of water hyacinth, surface algae, and elephant ears from 1995 to present.

Two orthophosphate and nitrate measurements were taken: one in 1996 and one in 2005. In 1996, orthophosphate and nitrate measurements were both 1 mg/L. In 2005, the orthophosphate measurement was 2 mg/L, and the nitrate measurement was 1 mg/L. Both orthophosphate observations were over the screening level, and there had not been precipitation in the preceding 3 days.





**Site B: Spring Lake Upstream of Dam Near Saltgrass**

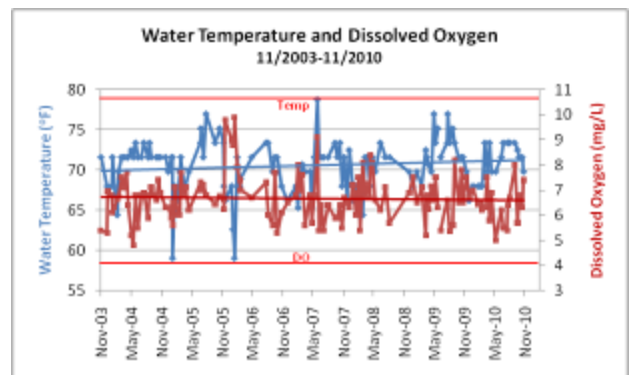
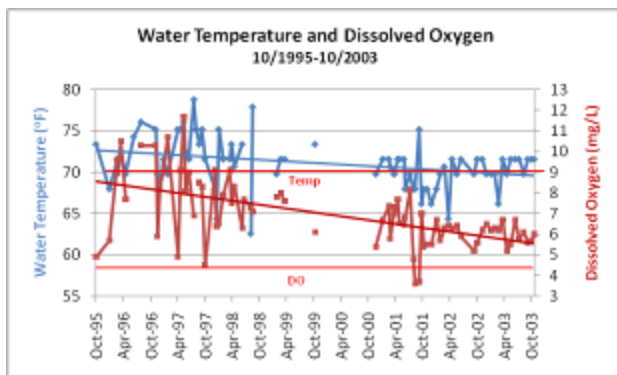
Site B: Spring Lake Upstream of Dam Near Saltgrass 1995-2010						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	214	98	59	71	79	3.1
Dissolved Oxygen (mg/L)	213	98	3.6	6.8	11.7	1.2
Conductivity (µS/cm)	191	88	310	615	1180	69
pH	213	98	6	7.31	8	0.2
Secchi Disk Transparency (m)	200	92	0.2	1.8	4	0.6
Total Depth (m)	201	92	0.2	1.8	4	0.6
Sample Time	217	100	6:00 AM	12:51 PM	7:50 PM	3:08

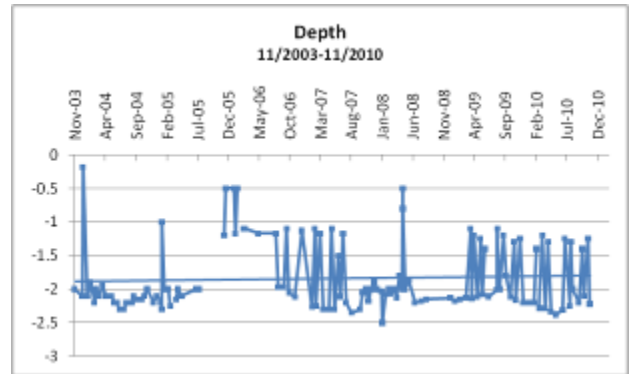
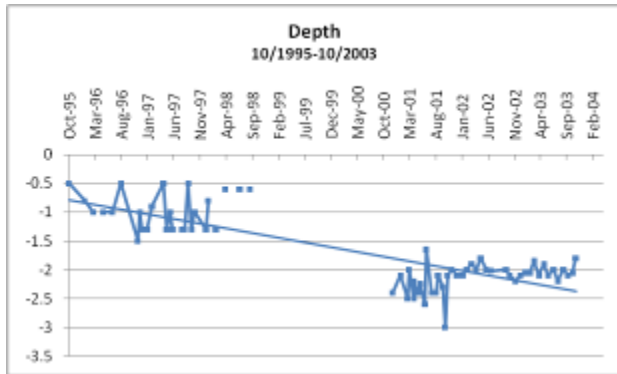
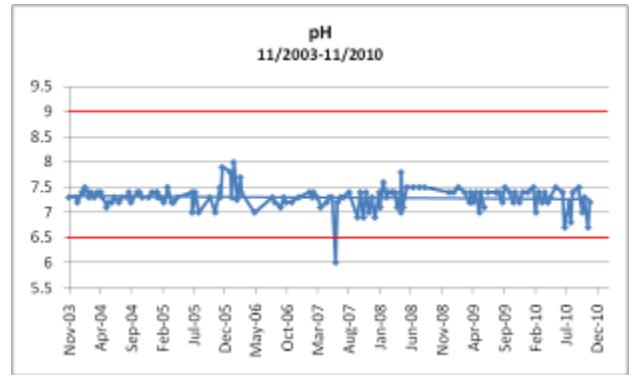
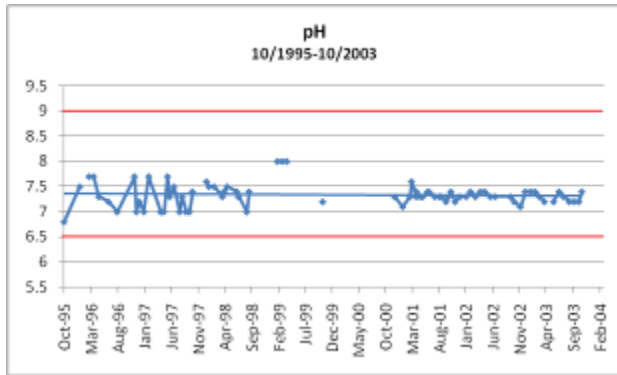
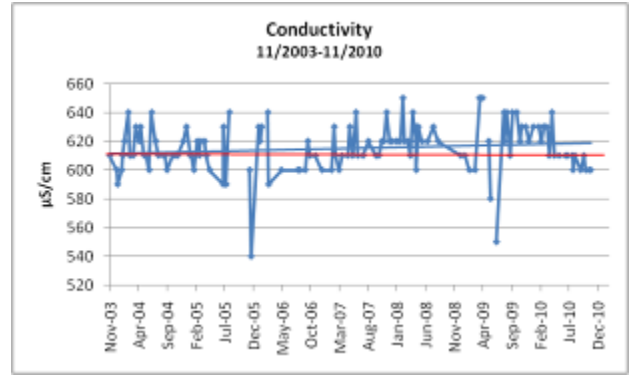
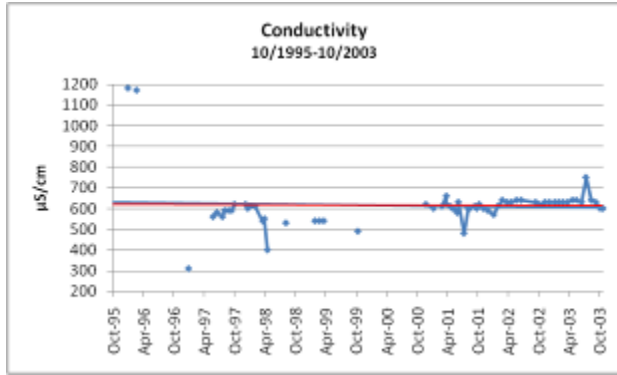
Data at this site were collected by Joe Piazza, Cydney and Pari Piersol, Sara Stefka, Ivy Seifert, Cindy Hoffmaster Fox, Melissa Masterson, Kate Yow, Alex Larue, Clay Williams, Rosaleda Duenez, Santiago and John Demaree, Luiz Morris, Jason Pinchback, James Campbell, Mary Rocamora, Deborah Lane, Stuart Thomas, Shannon Britton, Alana Carpenter Moore, Mo Tangestani, Eric Rabel, and Summer Star Howard with the San Marcos River Rangers. Water temperature does not appear to follow seasonal fluctuations, for the most part, possibly due to the influence of spring flow of a constant temperature emerging just upstream from this site. It did not divert from the average 70 °F very much.

Dissolved oxygen mostly decreased from 1995 to 2003 then varied steadily around 6.5 mg/L. Aside from two very high conductivity measurements in 1995, conductivity has varied steadily around 610 µS/cm. pH mostly stayed between 7 and 8, indicating slightly alkaline water. Secchi Disk transparency was always equal to total depth, indicating clear water. For that reason, a graph showing Secchi Disk transparency was omitted.

Depth increased from 1997 to 2000. Following that it fluctuated between monitoring events, possible due to changing spring flow. Monitors consistently noted an abundance of submerged vegetation, turtles, waterfowl, insects, and aquatic life. They have also commented on how good the Texas Wild Rice looks at this site.

Two orthophosphate and nitrate tests were performed at this site: one in 1996 and one in 2001. The test in 1996 yielded a 0.3 mg/L for orthophosphate and a 1 mg/L for nitrate. The test in 2001 yielded a <0.1 for orthophosphate and a <1 for nitrate. Both of these observations were under the screening level.





**Site C: Sessom Creek at the San Marcos River**

<b>Site C: Sessom Creek at the San Marcos River 1995-2010</b>						
<b>Parameter</b>	<b>#</b>	<b>% Complete</b>	<b>Min.</b>	<b>Avg.</b>	<b>Max.</b>	<b>Std. Dev.</b>
Water Temperature (°F)	195	98	64.4	73	85	5.2
Dissolved Oxygen (mg/L)	193	97	5.9	7.7	12	1
Conductivity (µS/cm)	182	91	350	626	1210	81
pH	198	99	5.3	7.5	8.5	0.3
Secchi Disk Transparency (m)	183	92	0.1	0.8	3	0.5
Total Depth (m)	186	93	0.1	0.8	3	0.5
Sample Time	199	100	8:00 AM	2:50 PM	7:45 PM	2:58

<b>Nutrient Testing Results</b>		
<b>Date</b>	<b>Orthophosphate (mg/L)</b>	<b>Nitrate (mg/L)</b>
2/27/96	0.4	<1
6/22/96	<0.1	1
10/14/96	<0.1	<1
11/10/96	<0.1	<1
12/8/96	<0.1	<1
2/5/97	<0.1	<1
6/2/97	<0.1	<1
7/28/97	<0.1	<1
10/12/99	<0.1	<1
9/18/00	<0.1	<1

Data at this site were collected by Joe Piazza, Sara Stefka, Cydney Piersol, Kevin Ryan, Amber Navarette, John Owens, Chi Franklin, Eleanore Whitworth, Susannah Reilly, Melissa Masterson, Bradley Spencer, Scott Etzel, Carissa Belsky, Lauren Bilbe, Lisa Korth, David Fisher, Marcus Lopez, Rachel Sanborn, John Schimidt, Carolyn Kelly, Brandon Charlie Burton, Melissa Chesser, Nora Alicia Pena, Jonathan Hager, Simone O'Donahue, Mark Palmie, April Burkett, Mo Tangestani, John Demaree, Gretchen Janzow, and Jody Dodd with the San Marcos River Rangers. The red lines showing the Texas Surface Water Quality Standards on the graph are for the San Marcos River. That standard is provided so that one may put the data in context because this testing is performed in the Sessom Creek channel just before the confluence with the San Marcos River. Water temperature did not follow seasonal fluctuations much, possibly due to the water of a constant temperature emerging from springs just upstream of this site. It stayed pretty close to 70 °F.

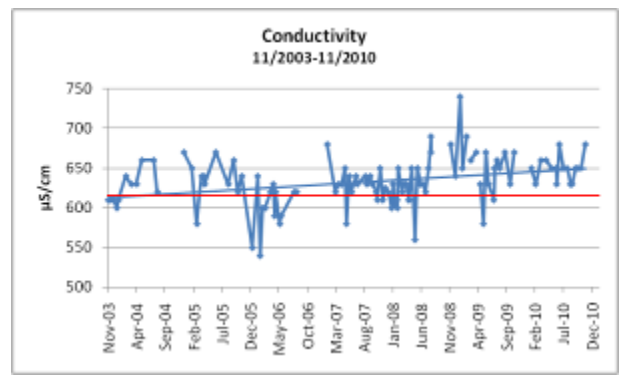
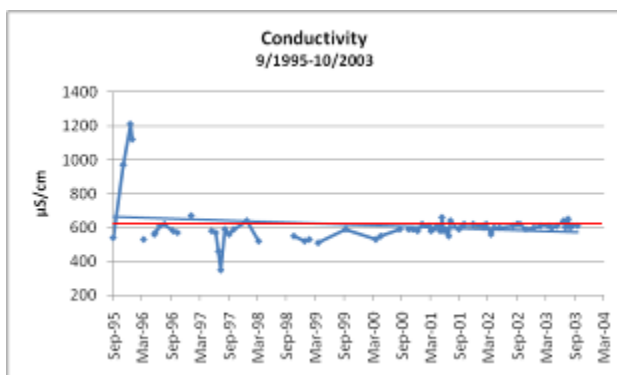
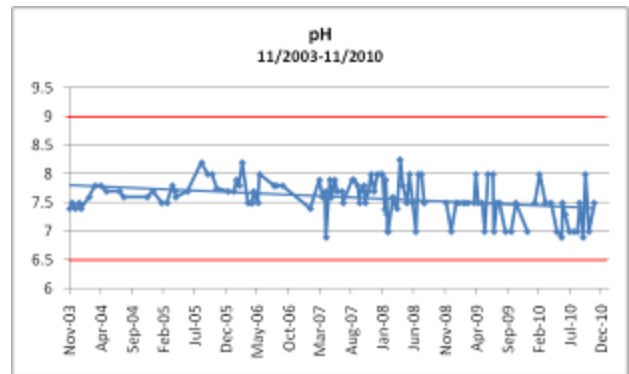
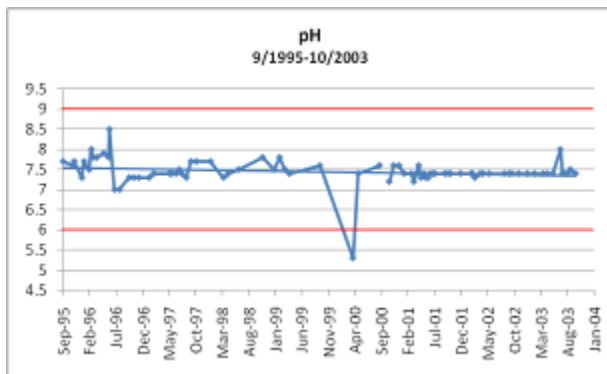
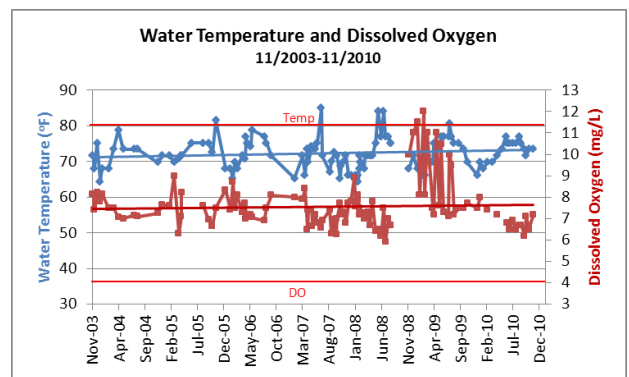
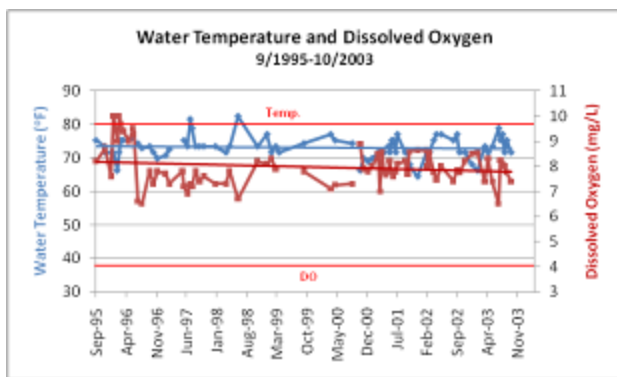
Dissolved oxygen stayed near 8 mg/L with major fluctuations occurring between December 2008 and August 2009. Conductivity stayed near 600 µS/cm until 2004 when it started increasing to values close to 650 µS/cm. pH stayed near 7.5 with a drop to 5.3 occurring when monitors noted red water in August 2000. Water was recorded as clear for most other observations. After 2003, pH began to vary between 7 and 8 more extremely.

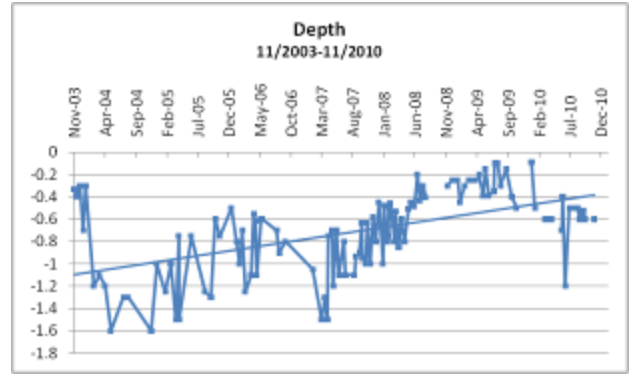
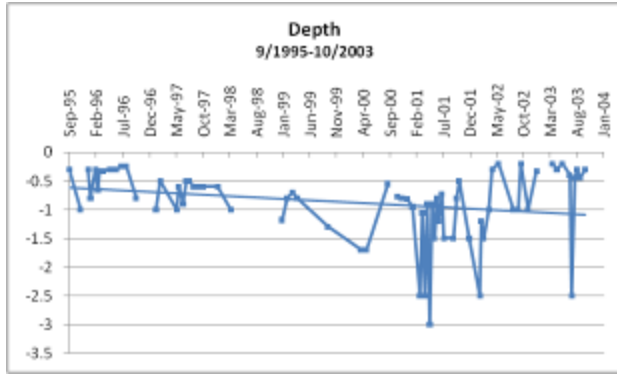
Secchi Disk transparency was always equal to total depth, indicating clear water. Depth has varied extremely but has been mostly decreasing since 2003. One out of ten orthophosphate

observations exceeded the screening level, and no nitrate observations exceeded the screening level. It had been 60 days since significant precipitation when the 0.4 mg/L of orthophosphate was observed.

Monitors have noted an abundance of aquatic vegetation, birds, turtles, insects, and fish at this site as well as people and dogs. They point out that Texas Wild Rice grows at this site and have noted murky and trash laden water being contributed by Sessom Creek. One monitor said “every rain event causes gravel and street trash to accumulate on the banks and in the river (from Sessom Creek).”

Monitors commented on the deposition of 4-5 inches of silt at the test site in March of 2010 and have claimed contact recreation at this site has been impacting the aquatic vegetation. In 2005, monitors began noting the presence of hyacinth as patches. Following observations referenced the presence of hyacinth.





**Site D: San Marcos River At Sewell Park**

Site D: San Marcos River At Sewell Park 1999, 2004, & 2005						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	4	100	70	72	73	1.3
Dissolved Oxygen (mg/L)	3	75	7	7.5	7.7	0.4
Conductivity (µS/cm)	4	100	530	590	630	45
pH	4	100	7.5	7.6	7.7	0.1
Secchi Disk Transparency (m)	4	100	1.1	2.3	3	0.8
Total Depth (m)	4	100	1.1	2.3	3	0.8
Sample Time	4	100	2:00 PM	3:43 PM	4:50 PM	1:13

Data at this site were collected by Natalie Bell, Izzy Polycyn, Gwen Brunet, and Dan Carlisle with the San Marcos River Rangers. All observed values were within the water quality standards.

**Site E: San Marcos River At City Park (Lion's Club Tube Rental)**

Site E: San Marcos River At City Park (Lion's Club Tube Rental) 2003 & 2004						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	4	100	71	73	76	2.2
Dissolved Oxygen (mg/L)	4	100	7.2	7.77	8.9	0.8
Conductivity (µS/cm)	4	100	610	612	619	5
pH	4	100	7.1	7.4	7.6	0.2
Secchi Disk Transparency (m)	4	100	1	1.2	1.5	0.2
Total Depth (m)	4	100	1	1.2	1.5	0.2
Sample Time	4	100	10:45 AM	1:17 PM	4:00 PM	2:22

Data at this site were collected by Jason Pinchback and Ian MacDonald. All observed values were within the water quality standards.

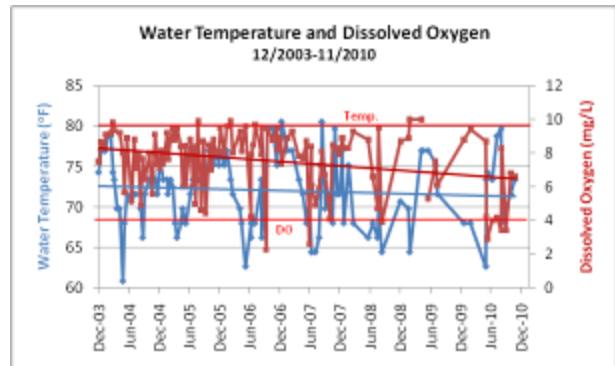
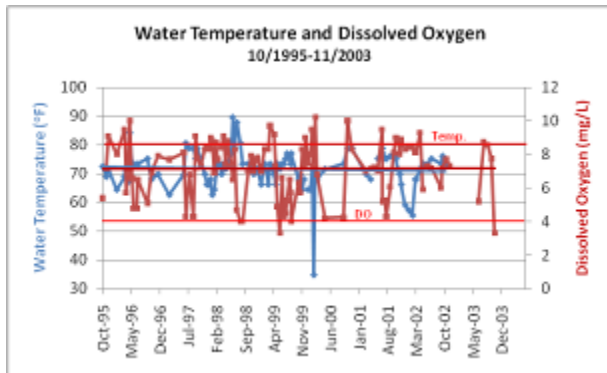
**Site F: Purgatory Creek at the San Marcos River**

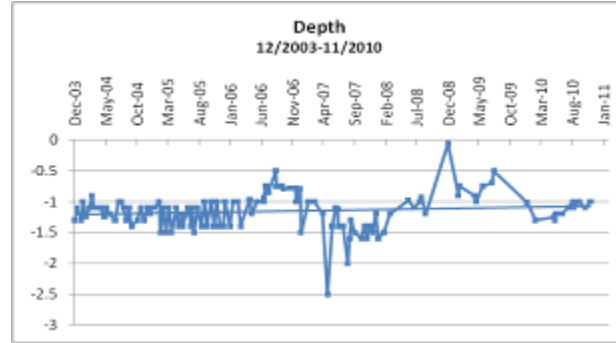
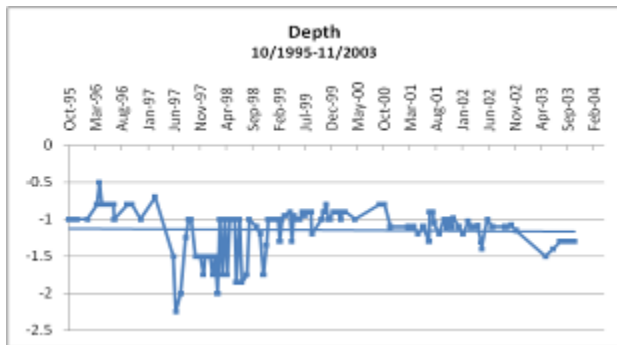
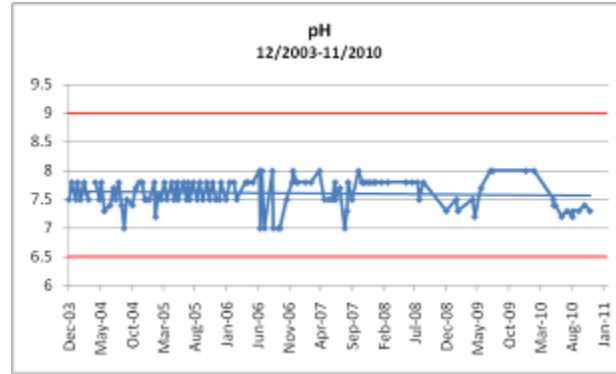
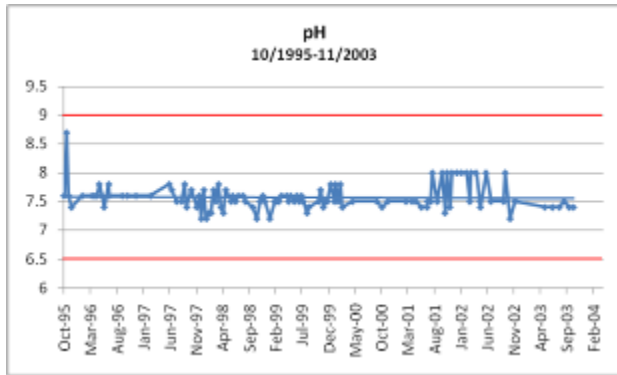
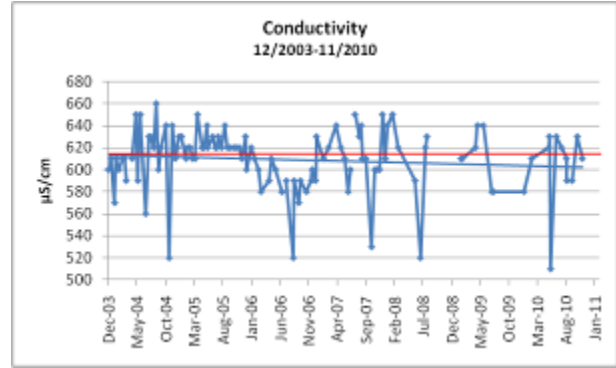
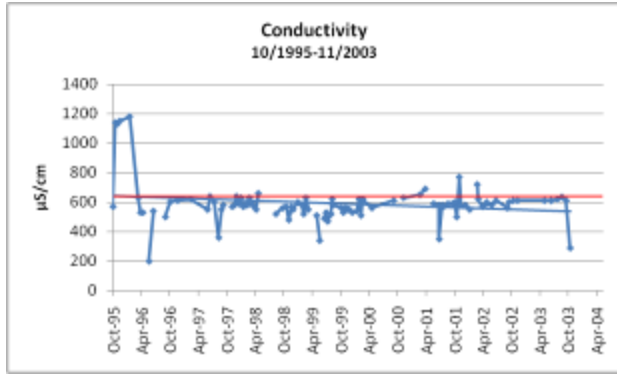
Site F: Purgatory Creek at the San Marcos River 1995-2010						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	230	99	35	73	90	24.6
Dissolved Oxygen (mg/L)	227	97	2.3	7.4	10.2	1.8
Conductivity (µS/cm)	212	91	200	601	1180	97
pH	232	100	7	7.6	8.7	0.2
Secchi Disk Transparency (m)	230	99	0.1	1.1	2.5	0.3
Total Depth (m)	231	99	0.1	1.1	2.5	0.3
Sample Time	232	100	6:20 AM	1:23 PM	8:00 PM	3:41

Data at this site were collected by Mo Tangestani, Mary Beth Garrett, Gretchen Janzow, Rachel and Hanna Sanborn, Mary Rocamore, Carolyn Kelly, Sandy Collard, Stewart Adams, Cecilia Kelley, Alexander Baker, Brian Slone, Tyler and Sandra Ellison, and Tuuka Toivonen with the San Marcos River Rangers.

The red lines are shown on the graphs to put the data in context because these standards apply to the San Marcos River, not Purgatory Creek. Water temperature did not vary seasonally and trended around 73 °F. The high value of 90 °F was observed in May 1998 when the air temperature was 95 °F, and the high value of 88 °F was observed in June 1998 when the air temperature was 88 °F. Dissolved oxygen trended around 7 mg/L with a slight downward trend since 2003. Conductivity stayed between 500 µS/cm and 680 µS/cm varying around 600 µS/cm with a slight downward trend. pH stayed close to 7.5, indicating slightly alkaline water. Secchi Disk transparency was always equal to total depth, indicating very clear water. Depth stayed around 1 m with various fluctuations.

Monitors noted murky water being carried by Purgatory Creek into the San Marcos River as well as an abundance of vegetation such as elephant ears and water hyacinth and wildlife/aquatic life including turtles, sunfish, and minnows. They say this site is frequented by fishermen, and occasionally, monitors reported sheen on the water surface. One test was performed for orthophosphate and nitrate. The results were 0.4 mg/L for orthophosphate and 1 mg/L for nitrate. It had been 4 days since significant precipitation when the 0.4 mg/L of orthophosphate was observed.





**Site G: San Marcos River At Rio Vista Park**

Site G: San Marcos River At Rio Vista Park						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	188	98	57	72	84	4
Dissolved Oxygen (mg/L)	188	98	5	8.3	10.1	1
Conductivity (µS/cm)	172	90	260	614	1130	100
pH	191	99	7	7.7	8.5	0.2
Secchi Disk Transparency (m)	189	98	0.2	1.9	3.5	0.5
Total Depth (m)	189	98	1.1	2	3.5	0.4
Sample Time	191	99	7:00 AM	1:15 PM	9:25 PM	3:02

Nutrient Testing Results		
Date	Orthophosphate (mg/L)	Nitrate (mg/L)
1/28/96	0.2	
2/10/96	<0.1	
3/8/96	<0.1	2
3/13/98	<0.1	0.5
4/15/98		0.5
6/13/98	<0.1	<1

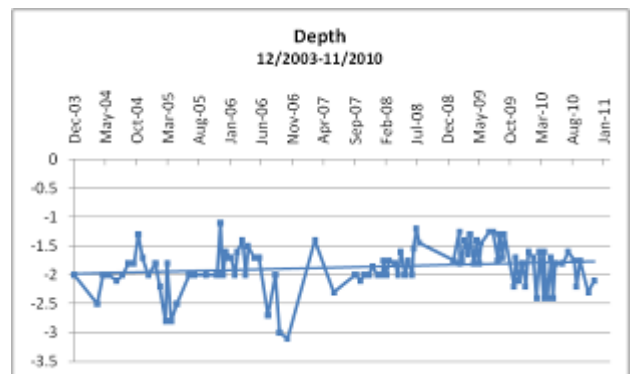
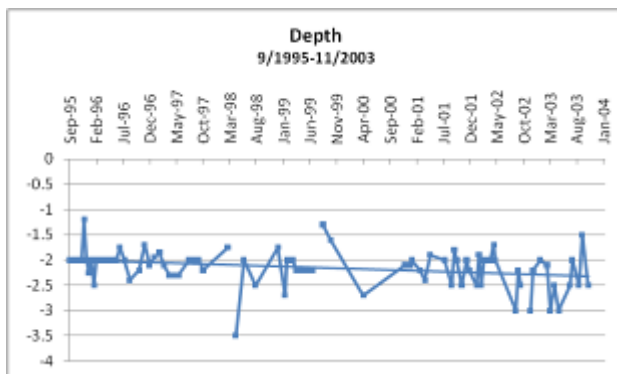
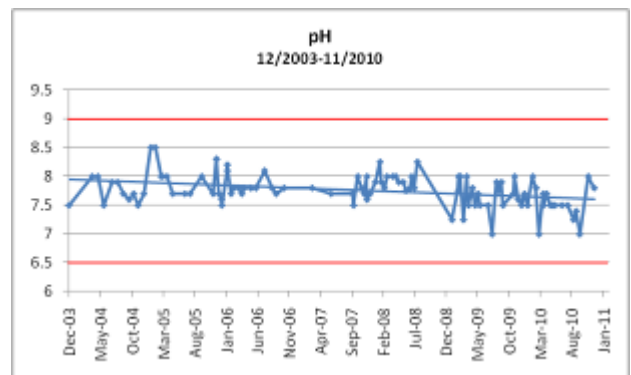
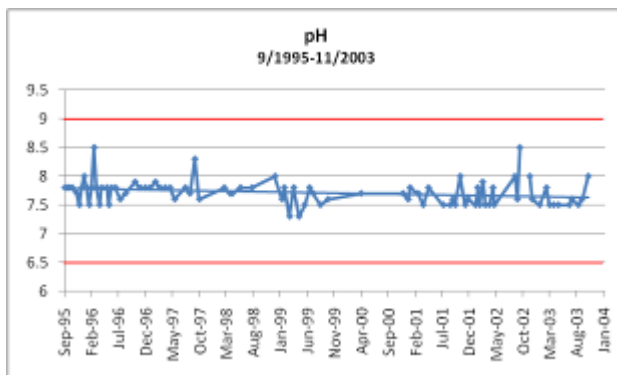
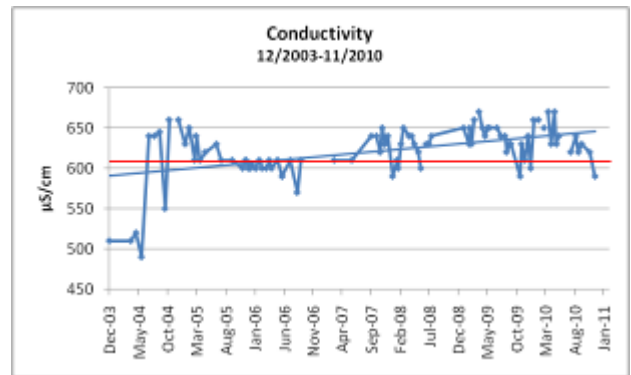
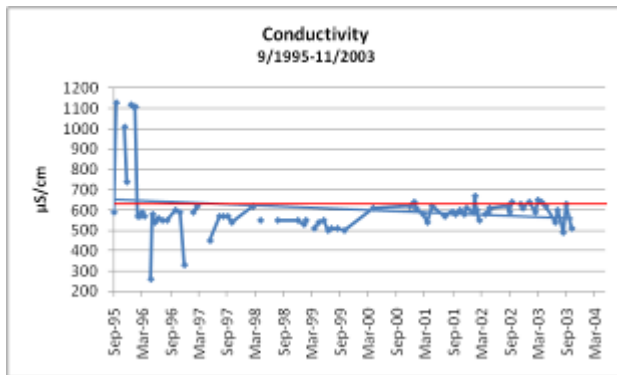
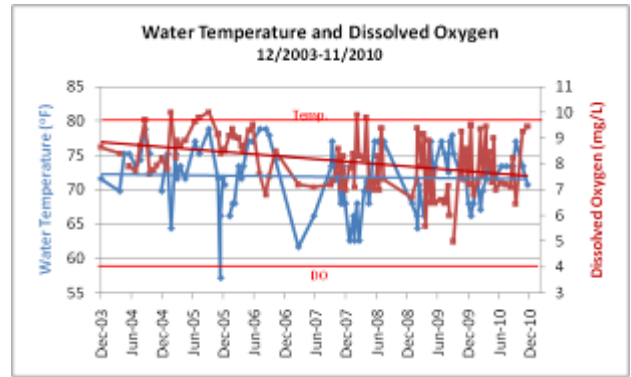
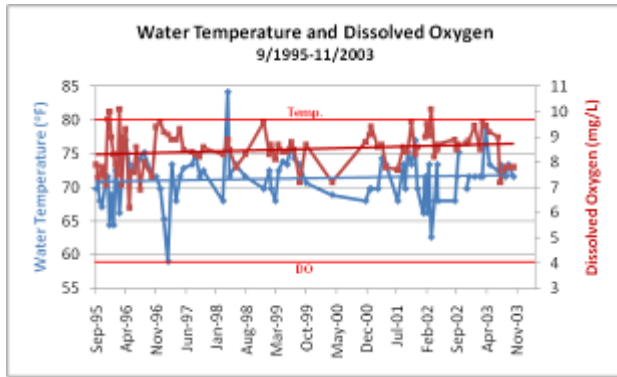
Total Exceedances			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	80 °F	1/188	0.5
Dissolved Oxygen	4 mg/L	0/188	0
pH	6.5-9	0/191	0

Exceedances Since 2003			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	80 °F	0/101	0
Dissolved Oxygen	4 mg/L	0/102	0
pH	6.5-9	0/104	0

Data at this site were collected by Sandy Howard, Mary Ann Hopkins, Mary Beth Garrett, Paul Bain, Rian Cobb, Tamara Boettcher, Kelly Green, Chris North, Hugh McDonnell, Louise Mullins, Cat Wilsford, Patricia Phillips, Clint Taylor, Stephanie Smith, Jianqing Liu, Christa Castro, Nicholas Maloukis, Pamela Vining, Gary Aalen, and Angelika Fuller with the San Marcos River Rangers.

Water temperature and dissolved oxygen did not vary seasonally probably due to the constant temperature emerging from spring water upstream. Water temperature varied steadily around 72 °F. The one water temperature exceedance of 84 °F was observed April 1998 when the air temperature was 88 °F. Dissolved oxygen has trended slightly downward since 2003. Conductivity stayed mostly around 600 µS/cm until 2003 when values began to increase to observations close to 650 µS/cm. pH mostly stayed between 7.5 and 8 until 2009 when observations around 7 began to be recorded. Secchi Disk transparency was almost always equal to total depth, indicating very clear water. Depth stayed close to 2 m. None of the orthophosphate observations were above the screening level, and 1/4 nitrate observations were above the screening level. It had been 15 days since significant precipitation when the 2 mg/L of nitrate was observed. Monitors noted water being stirred up by swimmers upstream as well as an abundance of floating aquatic vegetation and aquatic life such as turtles and insects.





**Site H: San Marcos River At IH 35 East Frontage Road**

<b>Site H: San Marcos River At IH 35 East Frontage Road 1995-2010</b>						
<b>Parameter</b>	<b>#</b>	<b>% Complete</b>	<b>Min.</b>	<b>Avg.</b>	<b>Max.</b>	<b>Std. Dev.</b>
Water Temperature (°F)	149	99	52	72	84	4.7
Dissolved Oxygen (mg/L)	144	95	5.1	8.6	10.3	0.9
Conductivity (µS/cm)	134	89	500	630	1180	125
pH	151	100	7	7.7	8.5	0.3
Secchi Disk Transparency (m)	146	97	0.3	2	3.5	0.5
Total Depth (m)	148	98	0.73	2.2	5.5	0.5
Sample Time	150	99	6:30 AM	1:35 PM	8:00 PM	3:03

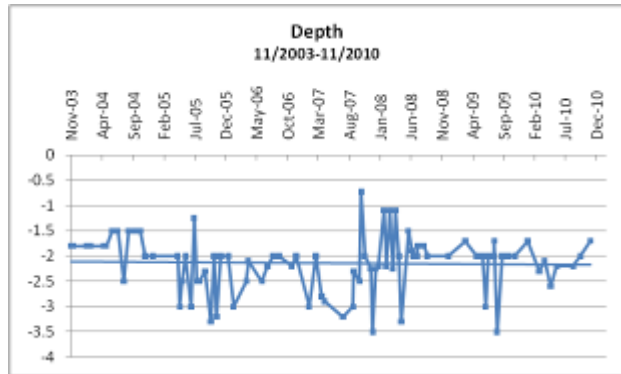
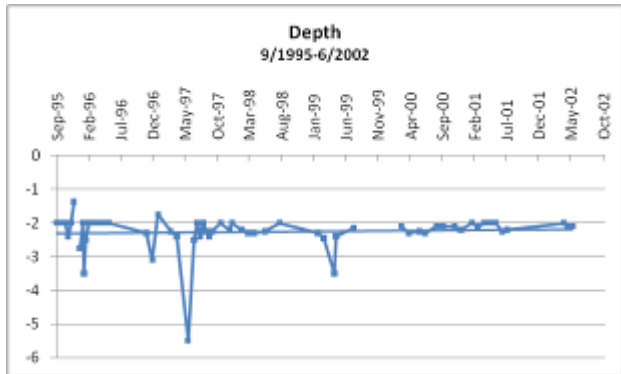
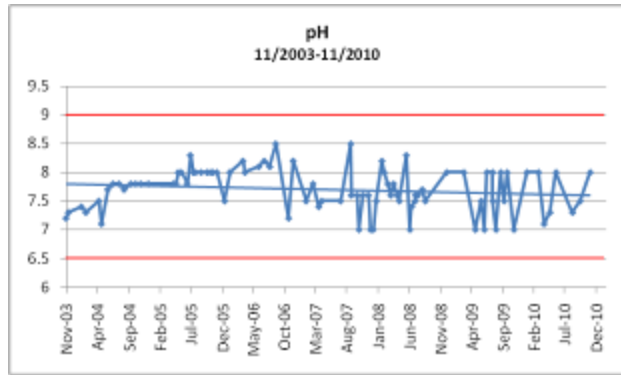
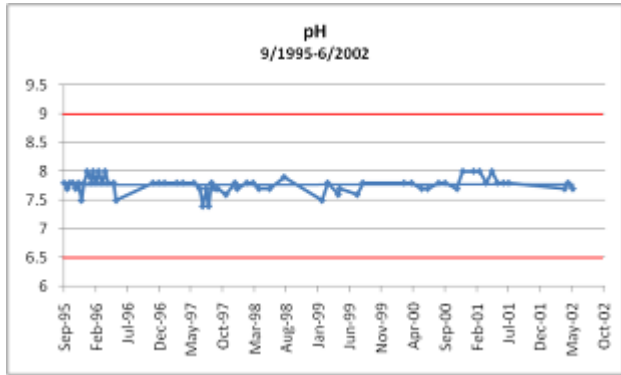
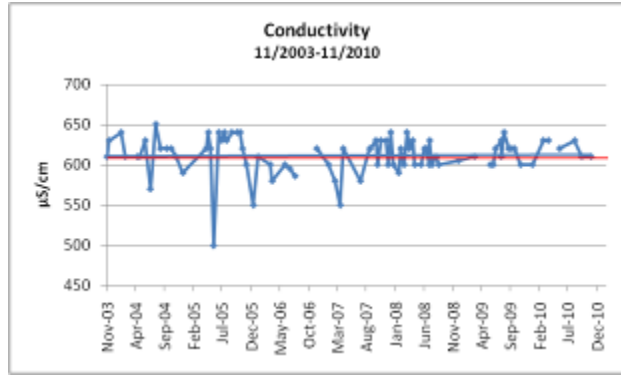
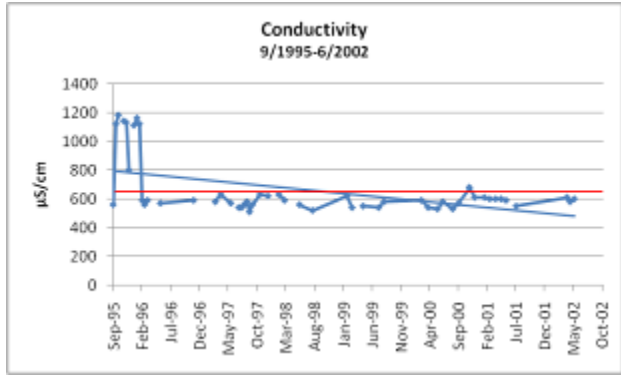
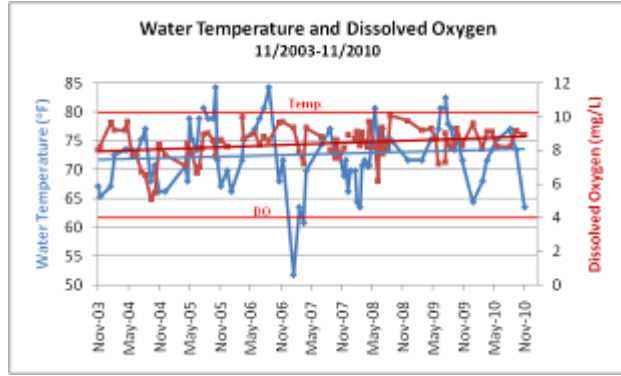
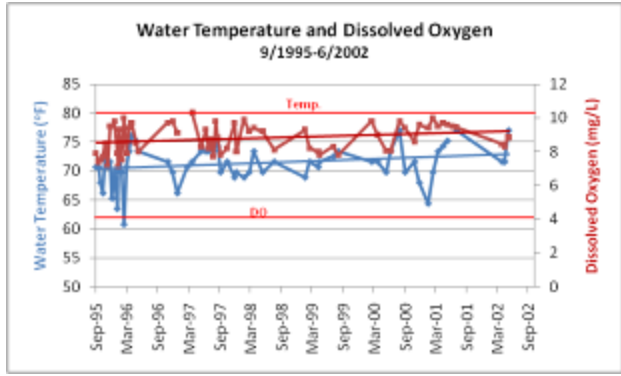
<b>Nutrient Testing Results</b>		
<b>Date</b>	<b>Orthophosphate (mg/L)</b>	<b>Nitrate (mg/L)</b>
1/28/96	0.2	
2/10/96	<0.1	
3/8/96	<0.1	1
6/8/97		0.5
8/18/97		1.5

<b>Total Exceedances</b>			
<b>Parameter</b>	<b>Standard</b>	<b># Exceedance</b>	<b>% Exceedance</b>
Water Temperature	80 °F	8/149	5.4
Dissolved Oxygen	4 mg/L	0/144	0
pH	6.5-9	0/151	0

<b>Exceedances Since 2003</b>			
<b>Parameter</b>	<b>Standard</b>	<b># Exceedance</b>	<b>% Exceedance</b>
Water Temperature	80 °F	8/86	9.3
Dissolved Oxygen	4 mg/L	0/81	0
pH	6.5-9	0/87	0

Data at this site were collected by Sandy Howard, Mo Tangestani, Mary Beth Garrett, Charles Ploetz, Paul Bain, Jonathan Weaver, Mary Rocamore, Michael Cruz, Mic Grogan, Alex Garcia, Marion Couvillion, John Cassidy, Jorge Salinas, Barbara Grahmann, Cindy Luongo Cassidy, Kate Shayler, Keegan Taylor, and Neal Denton with the San Marcos River Rangers.

Water temperature and dissolved oxygen slightly followed seasonal trends. Water temperature varied around 72 °F and dissolved oxygen varied around 9 mg/L. All of the water temperature exceedances occurred between Site May and October when the air temperature was above 84 °F. Conductivity varied around 610 µS/cm. Secchi Disk transparency was almost always equal to total depth. Depth varied between monitoring events but stayed mostly close to 2 m. None of the nutrient results were above the screening level. Monitors noted the presence of elephant ears, hydrilla, trash on the banks, fish, turtles, and insects.



**Site I: San Marcos River At Thompson's Island**

<b>Site I: San Marcos River At Thompson's Island 1995-2010</b>						
<b>Parameter</b>	<b>#</b>	<b>% Complete</b>	<b>Min.</b>	<b>Avg.</b>	<b>Max.</b>	<b>Std. Dev.</b>
Water Temperature (°F)	232	99	61	72	95	4.3
Dissolved Oxygen (mg/L)	231	98	5.6	8	10.2	0.9
Conductivity (µS/cm)	203	86	180	606	1250	98
pH	232	99	7	7.8	8.5	0.2
Secchi Disk Transparency (m)	174	74	0.4	1.5	3	0.4
Total Depth (m)	186	79	0.9	1.5	3	0.4
Orthophosphate (mg/L)	58	25	<0.1	0.07	0.5	0.12
Nitrate (mg/L)	60	26	<1	0.2	1	0.4
Sample Time	234	100	7:15 AM	1:19 PM	10:40 PM	3:23

<b>Total Exceedances</b>			
<b>Parameter</b>	<b>Standard</b>	<b># Exceedance</b>	<b>% Exceedance</b>
Water Temperature (°F)	80	5/232	2.2
Dissolved Oxygen (mg/L)	4	0/231	0
pH	6.5-9	0/232	0

<b>Exceedances Since 2003</b>			
<b>Parameter</b>	<b>Standard</b>	<b># Exceedance</b>	<b>% Exceedance</b>
Water Temperature	80 °F	3/141	2.1
Dissolved Oxygen	4 mg/L	0/140	0
pH	6.5-9	0/140	0

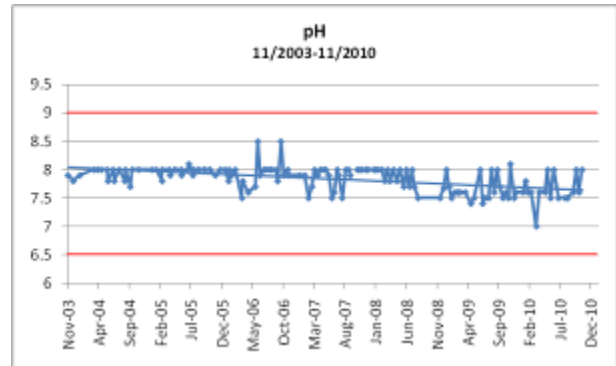
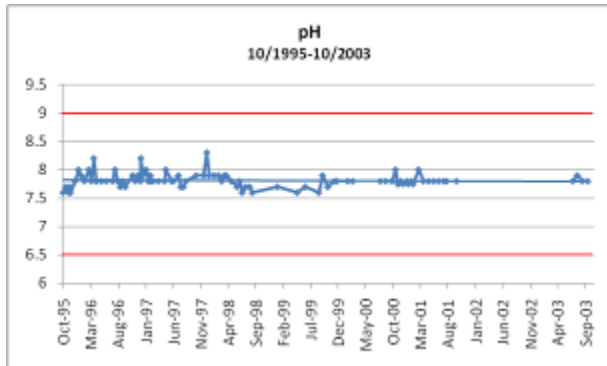
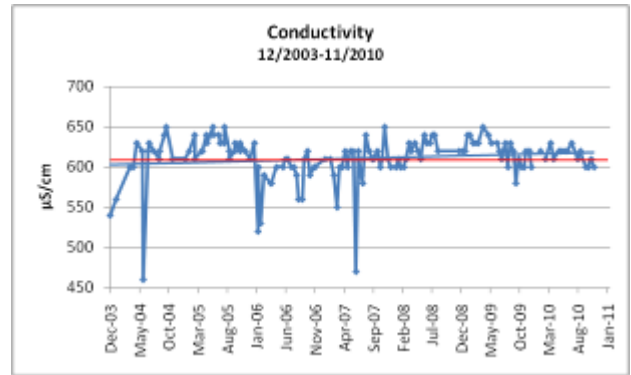
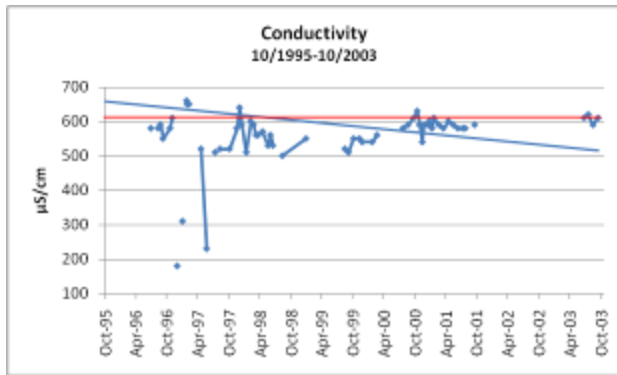
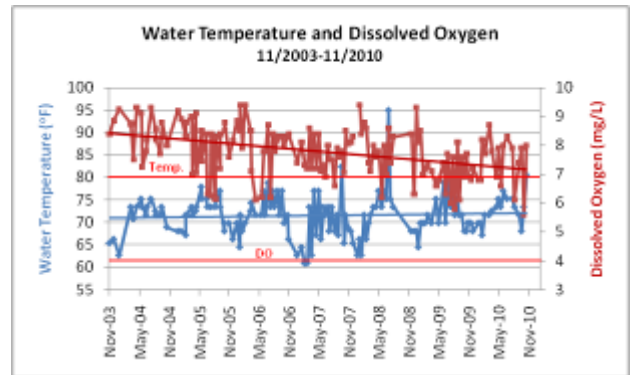
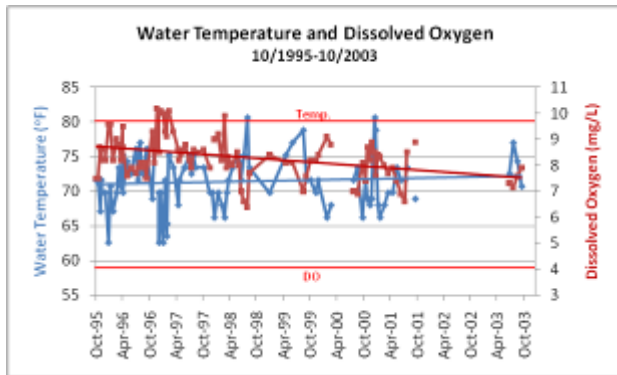
<b>Nutrient Results &amp; Screening Levels 1996-2004</b>					
<b>Parameter</b>	<b>Screening Level</b>	<b>Over Screening Level</b>		<b>Significant Precipitation in Preceding 3 Days</b>	
		<b>#</b>	<b>%</b>	<b>#</b>	<b>%</b>
Orthophosphate	0.37 mg/L	2/58	3	1 <sup>4</sup>	50
Nitrate	1.95 mg/L	0/60	0	N/A	N/A

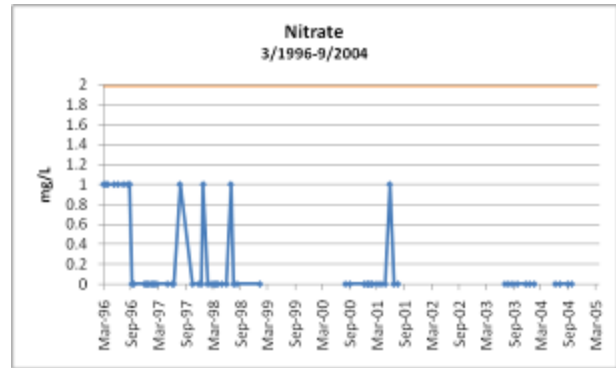
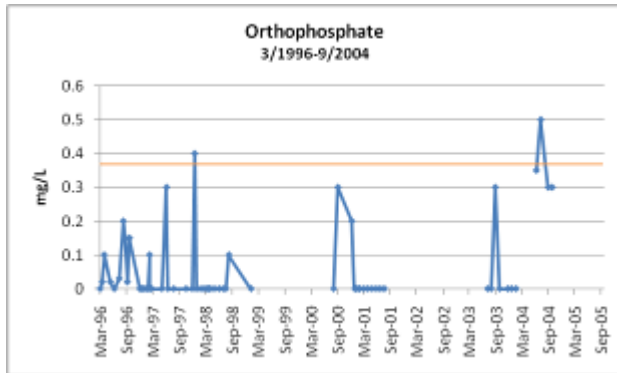
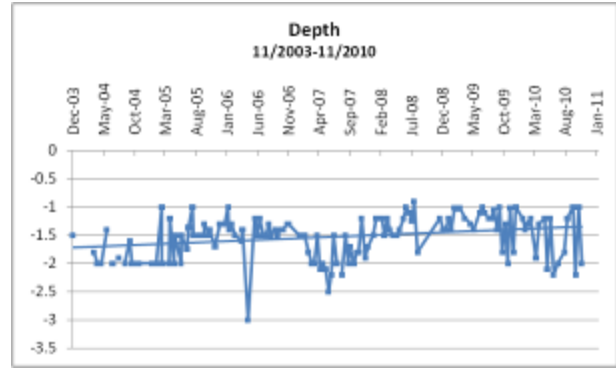
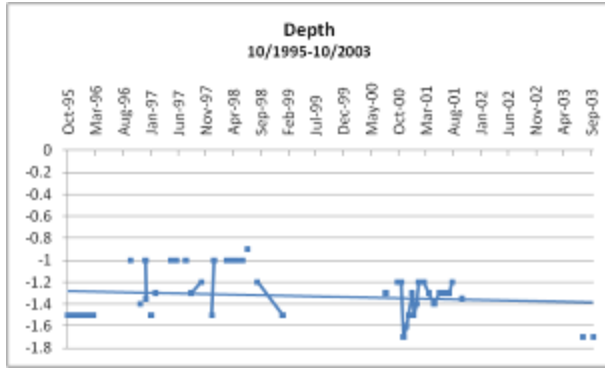
Data at this site were collected by Deborah Lane, Jim Morrow, Beth Trout, Corrie Smith, Jason Baldwin, Mo Tangestani, John Demaree, Melanie Murray, Marti Swanson, Mary Rocamore, Shea Mccright, Cathy Anderson, Steve Boles, Margaret Patay, Michael Cruz, Antonio Federici, Pat Stroka, Eleanore Whitworth, Carol and Mike Rhoades, and Meredith and Paul Murray with the San Marcos River Rangers. Water temperature mostly varied seasonally around 72 °F. Three of the water temperature exceedances occurred in winter months when air temperature was less than 80 °F.

Dissolved oxygen did not necessarily follow the seasonal trend and has been decreasing since 2003 from values around 8 mg/L to values around 7 mg/L. Values decreased from 1995-2003, for the most part, as well. Conductivity values varied around 610 µS/cm, the converted TDS standard, with a slight increase since 2003. pH was mostly around 7.5 until 2003 when it was mostly closer to 8. Many

<sup>4</sup> Monitor did not record precipitation values for the 2<sup>nd</sup> observation over the screening level.

observations have been closer to 7 since 2009. Monitors noted an abundance of trash and algae, the occasional foam on the water, people swimming in what they called “the swimming area.” Most of the time, they reported that the river looked fine.





**Site J: San Marcos River at Fish Hatchery Outfall**

Site J: San Marcos River at Fish Hatchery Outfall 1995-2010						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	146	99	59	71	82	4.8
Dissolved Oxygen (mg/L)	145	99	6	8.2	10.2	0.8
Conductivity (µS/cm)	122	83	260	622	1260	152
pH	144	98	7	7.8	9.8	0.3
Secchi Disk Transparency (m)	75	51	0.1	1.1	2.5	0.4
Total Depth (m)	98	67	0.1	1.3	3	0.7
Orthophosphate (mg/L)	75	51	<0.1	0.2	1.6	0.3
Nitrate (mg/L)	77	52	<1	0.45	4.4	1
Sample Time	147	100	7:40 AM	12:19 PM	7:15 PM	2:40

Total Exceedances			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	80 °F	2/146	1.4
Dissolved Oxygen	4 mg/L	0/145	0
pH	6.5-9	1/144	0.7

Exceedances Since 2003			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	80 °F	2/52	3.8
Dissolved Oxygen	4 mg/L	0/50	0
pH	6.5-9	0/50	0

Nutrient Results & Screening Levels 1996-2005					
Parameter	Screening Level	Over Screening Level		Significant Precipitation in Preceding 3 Days	
		#	%	#	%
Orthophosphate	0.37 mg/L	17/75	23	2 <sup>5</sup>	12
Nitrate	1.95 mg/L	5/77	6	0	0

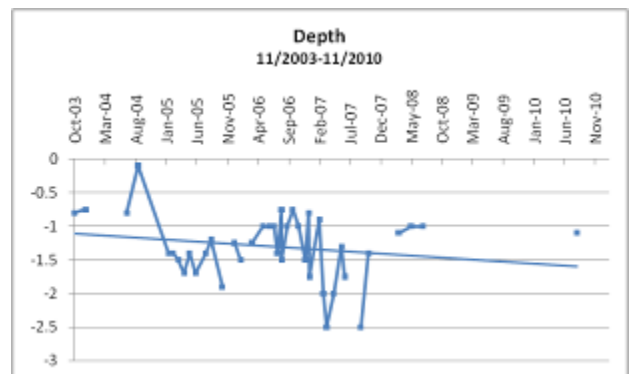
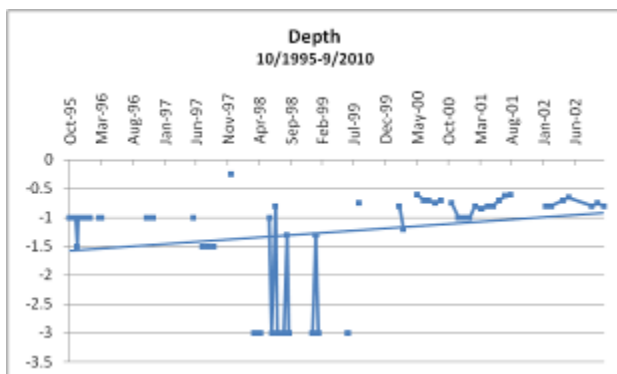
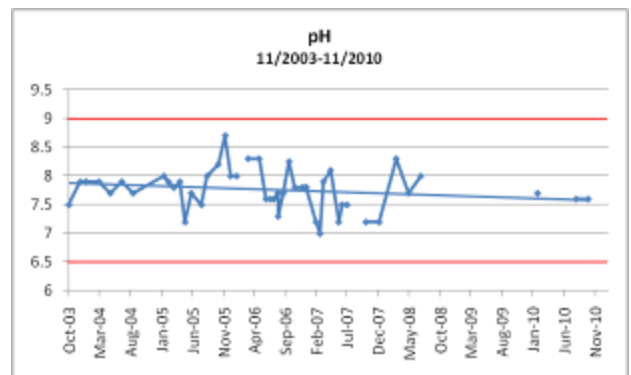
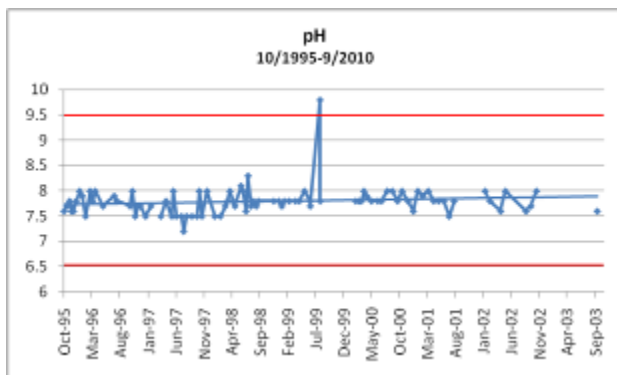
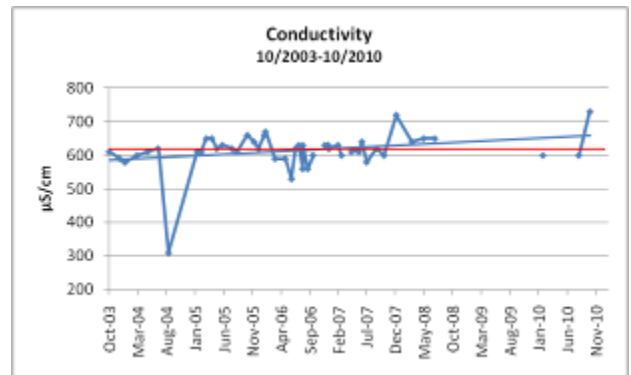
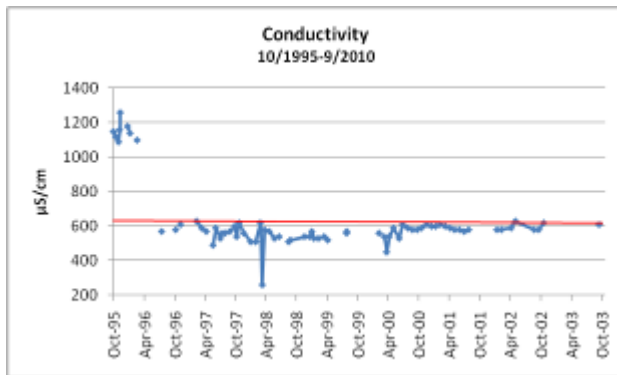
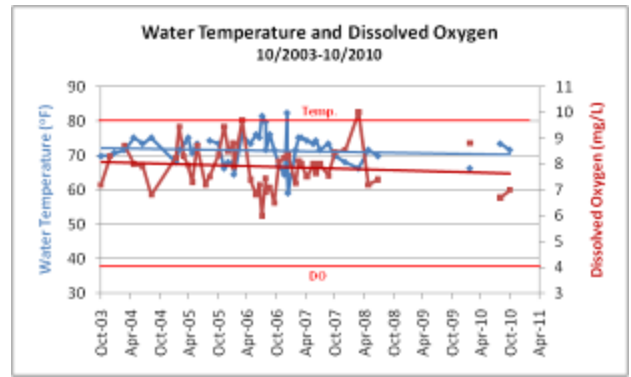
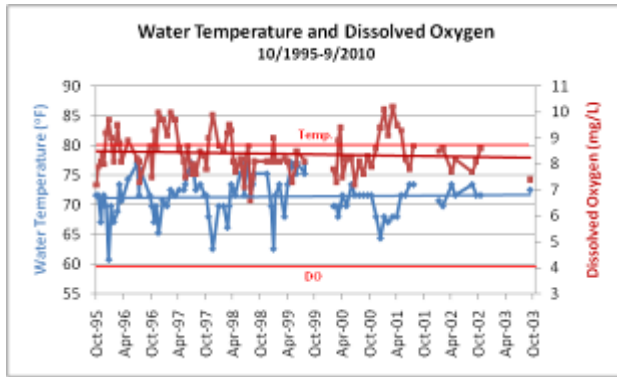
Data at this site were collected by Nancy Wilson, Megan Combs, Andre Sanborn, Jessica Spangler, Melody Mullen, Rebecca Shively, Michael Cruz, Laura Brock, Steve Boles, Rita Setser, Eileen Trainor, Mary Rocamora, Rachel Sanborn, John Demaree, Mo Tangestani, Michael Mullen, Jason Baldwin, Corrie Smith, Beth Trout, Jim Morrow, and Sandy Howard with the San Marcos River Rangers. Water temperature and dissolved oxygen mostly varied seasonally. Water temperature stayed near 70 °F, and dissolved oxygen stayed near 8 mg/L. Both water temperature exceedances occurred when the air temperature was above 80 °F. Conductivity mostly stayed near 600 µS/cm with a slight increase since 2003.

pH mostly stayed between 7.5 and 8, indicating the water to be slightly alkaline. Nothing abnormal was noted in the field observations or comments fields when the pH exceedance occurred. Secchi Disk transparency was almost always equal to total depth, indicating the water to be clear. Depth varied immensely with no definite trend. The deeper measurements did not occur when it has rained within 3 days of the monitoring event. It is possible increased depths were caused by releases from the fish hatchery. Monitors noted “fast flow from hatchery and high water level.”

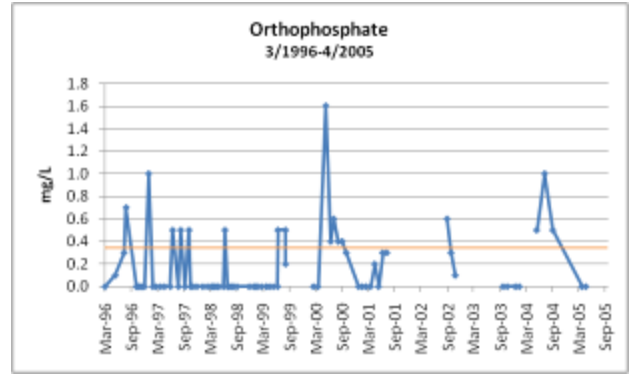
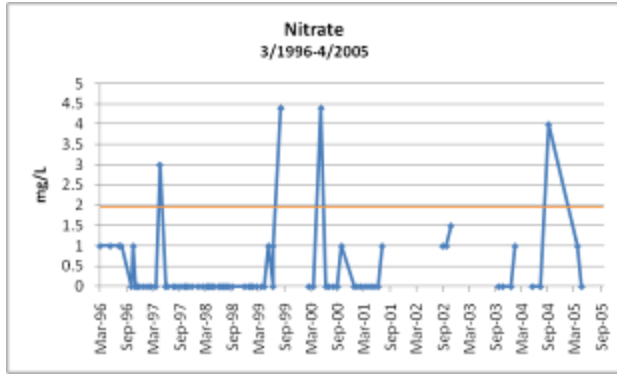
According to comments from monitors, this site occasionally has a strong sewage or fishy smell. Some monitors have commented that the water has no odor but the air does. At times, monitors reported the outfall flow as clear and at other times as yellow or green. Many observations included reports of foam. One monitor wrote “fish hatchery discharge causing foam.” Another wrote “some white foam coming from outfall.” They say this area is used by fishermen and kayakers and that people swim upstream. Their comments include reports of abundant trash and that the water is generally cloudy. Many observations included reports of an orange slime growing on the bank. They also point out the presence of elephant ears, fish, and insects.

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<sup>5</sup> Monitor did not record precipitation values for one observation over the screening level.







**Site J: San Marcos River at Cummings Dam**

Site J: San Marcos River at Cummings Dam 1995-2010						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	113	95	54	73	95	7.3
Dissolved Oxygen (mg/L)	112	94	5.7	7.3	9.5	0.8
Conductivity (µS/cm)	108	91	310	593	1190	146
pH	112	94	6.9	7.8	8.9	0.3
Secchi Disk Transparency (m)	107	90	0.1	1.3	2.1	0.4
Total Depth (m)	108	91	1.33	3.8	5	0.6
Orthophosphate (mg/L)	53	45	<0.1	0.3	3	0.5
Nitrate (mg/L)	51	43	<1	1.4	13.2	2.7
Sample Time	116	97	8:00 AM	12:34 PM	8:00 PM	3:38

Total Exceedances			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	1/113	0.8
Dissolved Oxygen	3 mg/L	0/112	0
pH	6.5-9	0/112	0

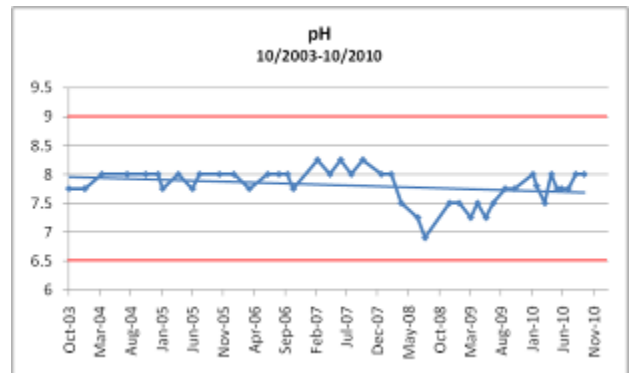
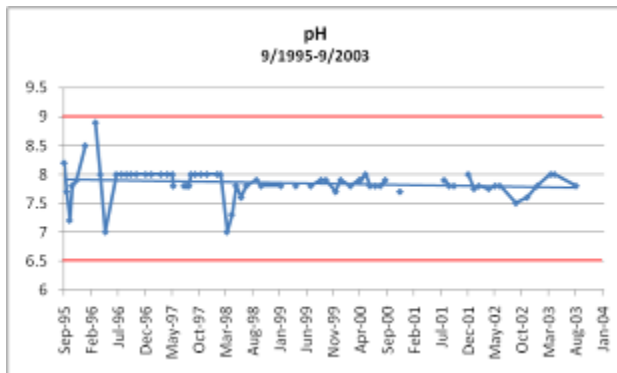
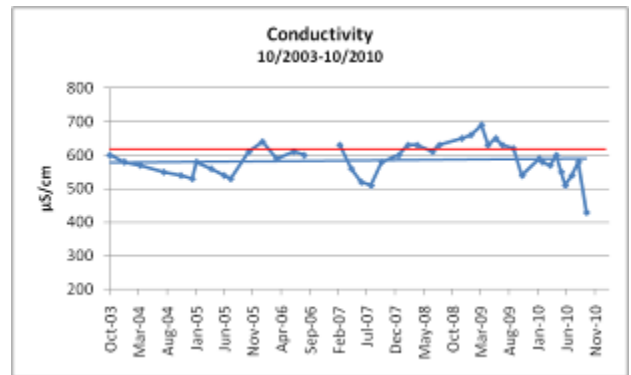
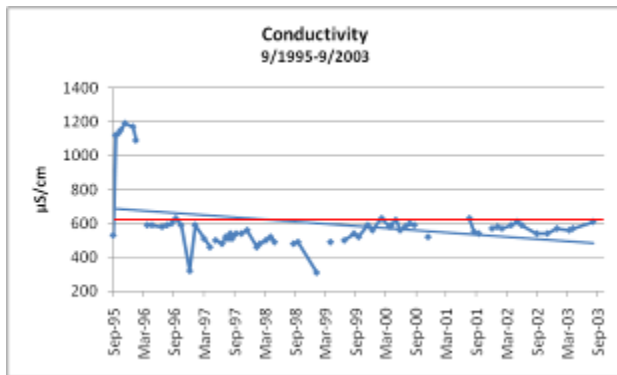
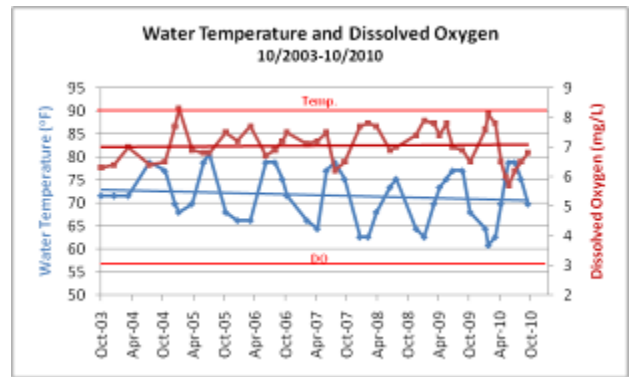
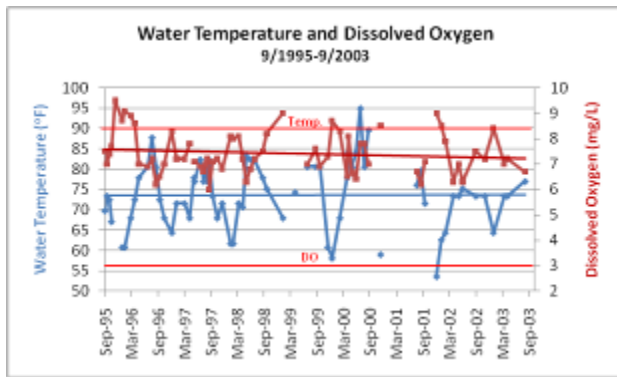
Exceedances Since 2003			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	0/45	0
Dissolved Oxygen	3 mg/L	0/45	0
pH	6.5-9	0/45	0

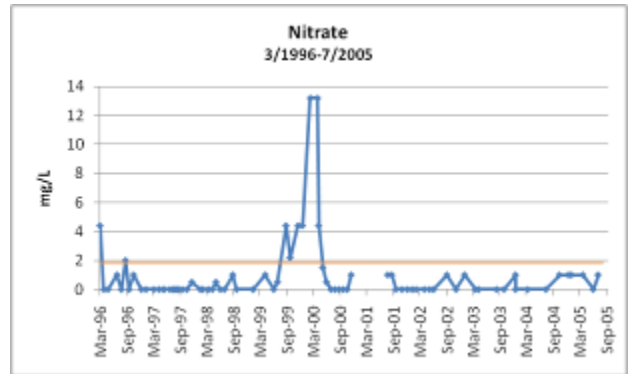
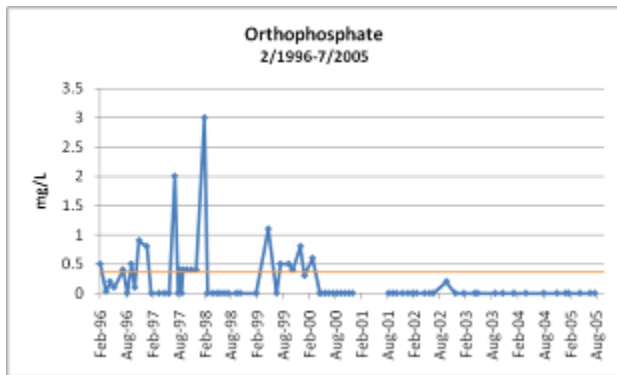
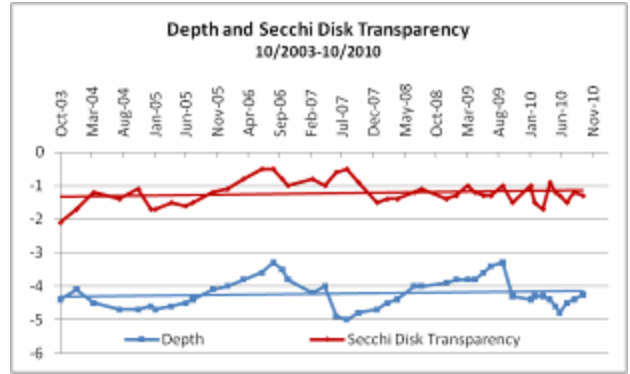
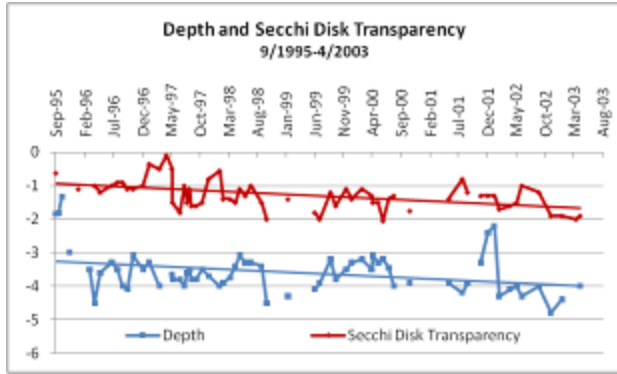
Nutrient Results & Screening Levels 1996-2005					
Parameter	Screening Level	Over Screening Level		Significant Precipitation in Preceding 3 Days	
		#	%	#	%
Orthophosphate	0.37 mg/L	18/53	34	7 <sup>6</sup>	39
Nitrate	1.95 mg/L	9/51	18	2	22

<sup>6</sup> Monitors did not record precipitation data for five observations above the screening level.

Data at this site were collected by Pat Stroka, John Mchmidt, David Leder, Joyce Davis, Shea and Alex Thomas, Tosca Cesaretti, and Deborah Lane with the San Marcos River Rangers. Water temperature and dissolved oxygen varied seasonally. Water temperature varied around 74 °F with a slight decrease since 2003. The one water temperature exceedance occurred in July 2000 when the air temperature was 99 °F. Dissolved oxygen trended around 7 mg/L. Conductivity trended around 600 μS/cm.

pH trended around 8 with a slight decrease to values between 7 and 7.5 between January 2008 and April 2009. Secchi Disk transparency was, on average, 2 m less than total depth, indicating the water is not very clear here. Depth increased since 1995 from values between 3 m and 4 m to values just over 4 m. Monitors reported an abundance of cow patties in the area as well as insects, fish, waterfowl, and aquatic vegetation such as elephant ears, water lilies, as well as brownish-green algae along the banks and the dam.





**Site K: San Marcos River At Old Bastrop Hwy**

Site K: San Marcos River At Old Bastrop Hwy 1995-2010						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	155	98	54	71	86	6.2
Dissolved Oxygen (mg/L)	152	96	5	8.4	10.55	1
Conductivity (µS/cm)	148	94	300	615	1190	153
pH	153	97	6.9	7.9	8.5	0.3
Secchi Disk Transparency (m)	144	91	0.25	1	3.1	0.4
Total Depth (m)	147	93	0.66	1.4	3.1	0.4
Orthophosphate (mg/L)	60	38	<0.1	0.2	0.8	0.2
Nitrate (mg/L)	53	34	<1	0.4	2	0.6
Sample Time	158	100	7:57 AM	12:30 PM	8:25 PM	2:54

Total Exceedances			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	0/155	0
Dissolved Oxygen	3 mg/L	0/152	0
pH	6.5-9	0/153	0

Exceedances Since 2003			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	0/93	0
Dissolved Oxygen	3 mg/L	0/91	0
pH	6.5-9	0/92	0

Nutrient Results & Screening Levels 1996-2005					
Parameter	Screening Level	Over Screening Level		Significant Precipitation in Preceding 3 Days	
		#	%	#	%
Orthophosphate	0.37 mg/L	15/60	25	9 <sup>7</sup>	60
Nitrate	1.95 mg/L	2/53	4	1 <sup>8</sup>	50

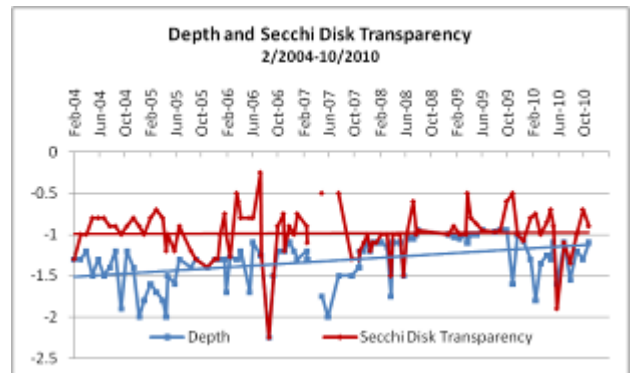
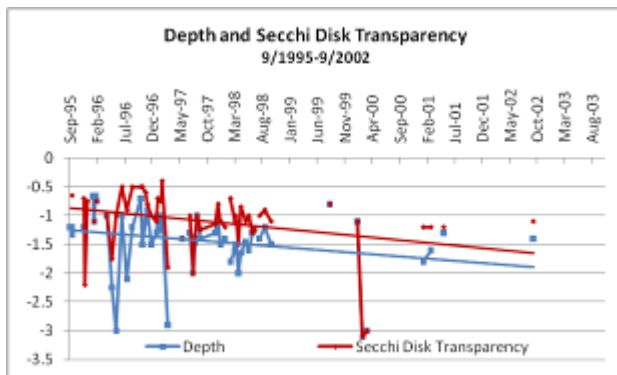
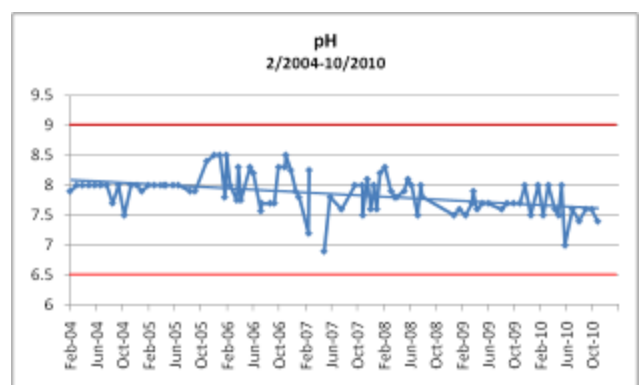
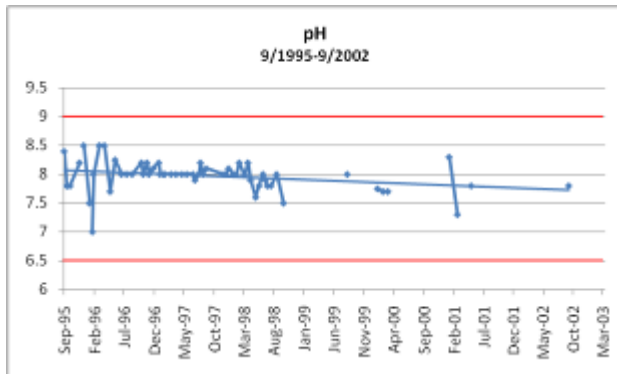
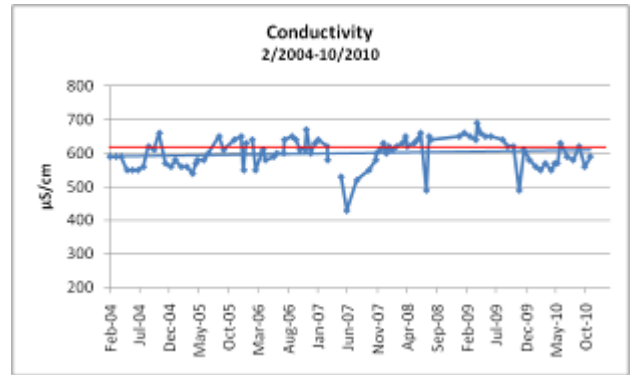
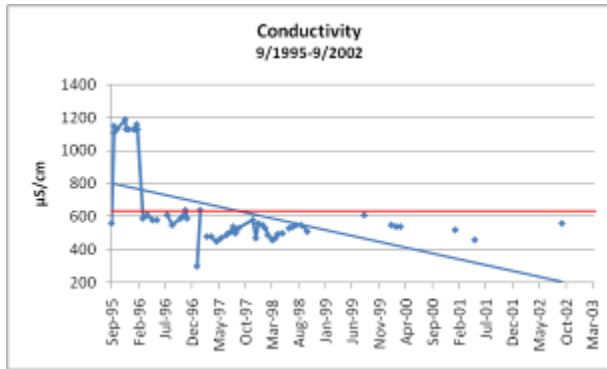
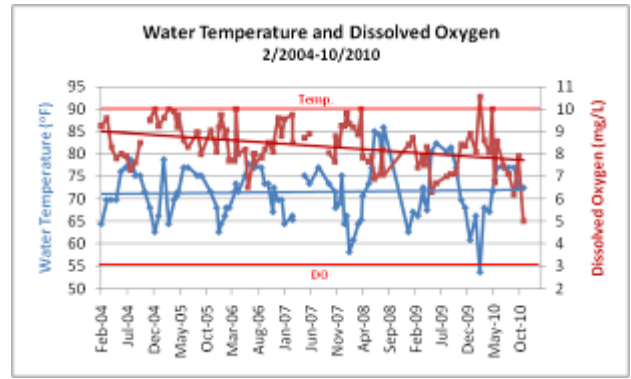
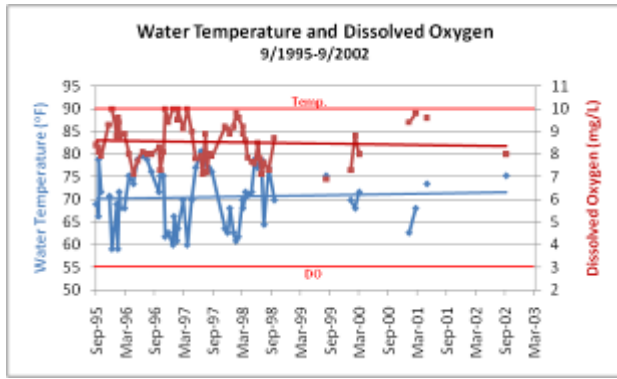
Data at this site were collected by Deborah Lane, Mary Ann Hopkins, Alex Thomas, Mo Tangestani, Jeff Duffy, John Demaree, Shea Thomas, Melanie Murray, Rachel Sanborn, Brad Reichert, Mary Rocamore, Hanna Sanborn, Dan Kowal, Paul Cohen, Steve Benson, Liz Young, Kate Yow, Maureen Hurst, Andre Sanborn, and Paul Murray with the San Marcos River Rangers. Water temperature and dissolved oxygen varied seasonally. Water temperature varied around 70 °F, and dissolved oxygen varied around 8.5 mg/L with a noticeable decrease with 2003. Conductivity varied around 600 µS/cm. pH mostly stayed around 8 until 2006 when observations of 7 became common.

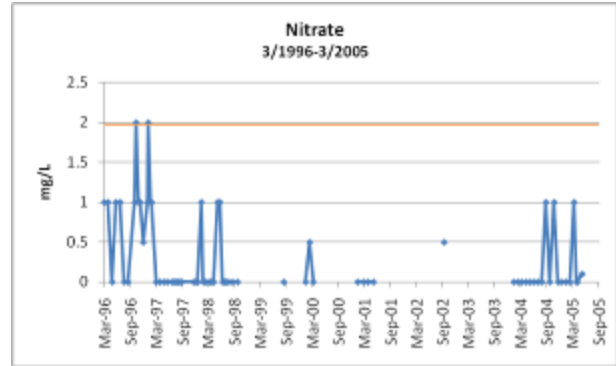
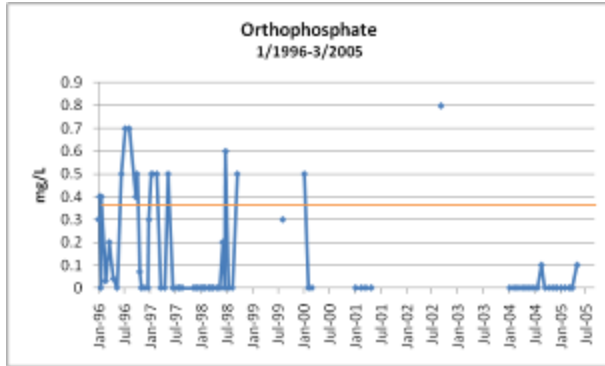
Secchi Disk transparency and total depth are highly variable and average a difference of 0.4 m, indicating that the water here exhibits minor issues with visibility. Depth was highly variable but mostly stayed within 1 to 2 m. Monitors consistently reported the presence of fish, birds, turtles, and aquatic vegetation such as Texas Wild Rice and elephant ears as well as the presence of litter. They reported this area to be used by fishermen and kayakers. Foam with a foul smell was consistently reported from 1995-2008. In August 2006, the monitor noted a smell of chlorine. In April and May 2006, the monitor noticed pumping equipment in the water and could not determine if pumping was going into the river or out of it. There have also been many reports of algae at this site.

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<sup>7</sup> No precipitation data were collected for five of the observations above the screening level.

<sup>8</sup> No precipitation data were collected for the other observation above the screening level.





**Site L: San Marcos River at Sculls Crossing West of Martindale**

Site L: San Marcos River at Sculls Crossing West of Martindale 1996-2010						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	152	97	52	71	84	7.5
Dissolved Oxygen (mg/L)	148	95	5.4	8.3	11.8	1.3
Conductivity (µS/cm)	130	83	390	569	640	45
pH	152	97	7	7.9	8.5	0.2
Secchi Disk Transparency (m)	130	83	0.4	1.4	3.5	0.4
Total Depth (m)	124	79	1.1	2.2	5	0.6
Orthophosphate (mg/L)	83	53	<0.1	0.3	4	0.5
Nitrate (mg/L)	81	52	<1	0.75	6.6	1.3
Sample Time	153	98	7:05 AM	12:12 PM	7:40 PM	3:29

Total Exceedances			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	0/152	0
Dissolved Oxygen	3 mg/L	0/148	0
pH	6.5-9	0/152	0

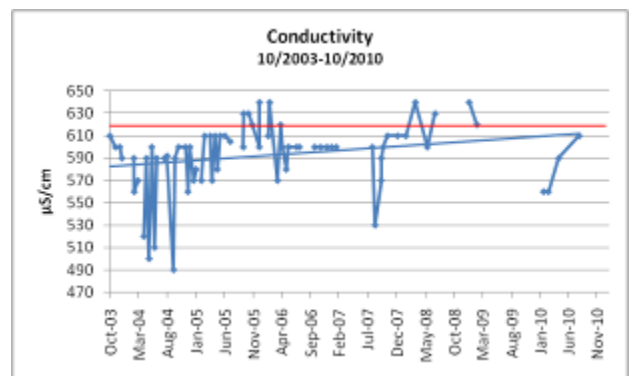
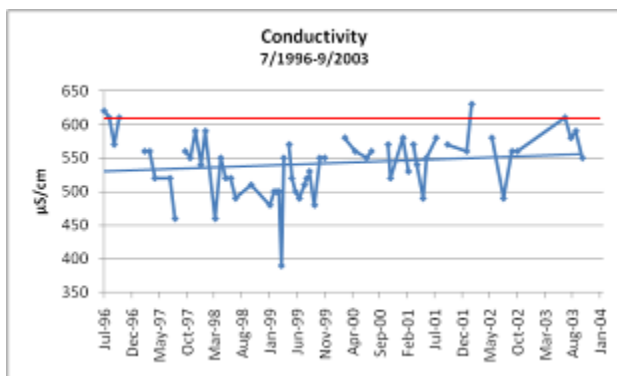
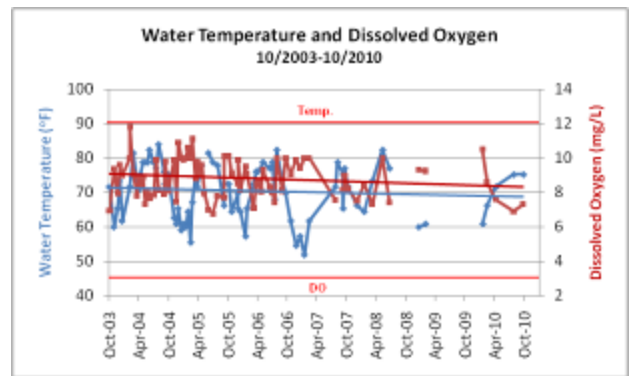
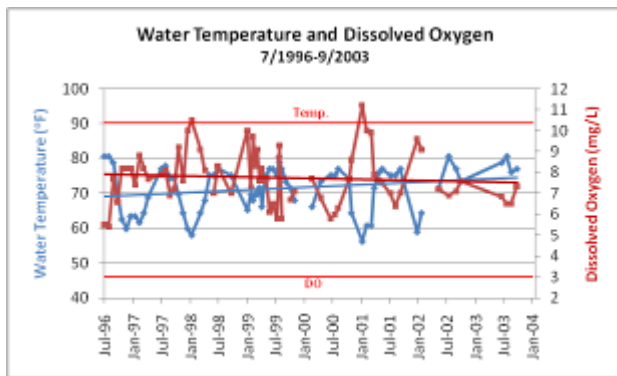
Exceedances Since 2003			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	0/83	0
Dissolved Oxygen	3 mg/L	0/81	0
pH	6.5-9	0/83	0

Nutrient Results & Screening Levels 1996-2005					
Parameter	Screening Level	Over Screening Level		Significant Precipitation in Preceding 3 Days	
		#	%	#	%
Orthophosphate	0.37 mg/L	27/83	33	2 <sup>9</sup>	7
Nitrate	1.95 mg/L	10/81	12	2	20

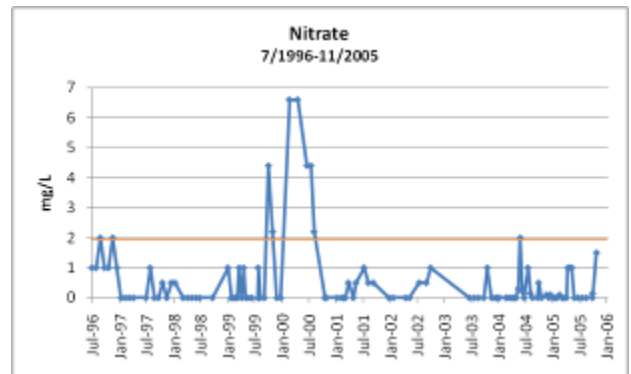
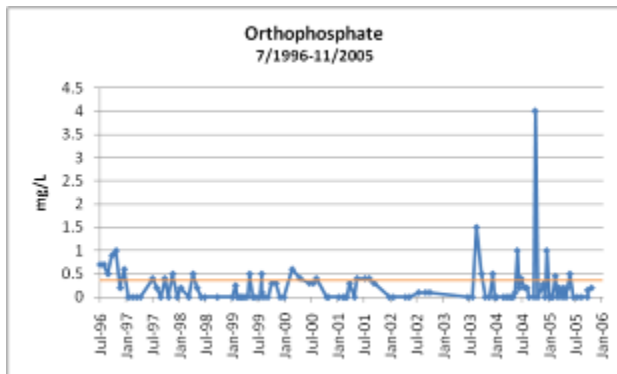
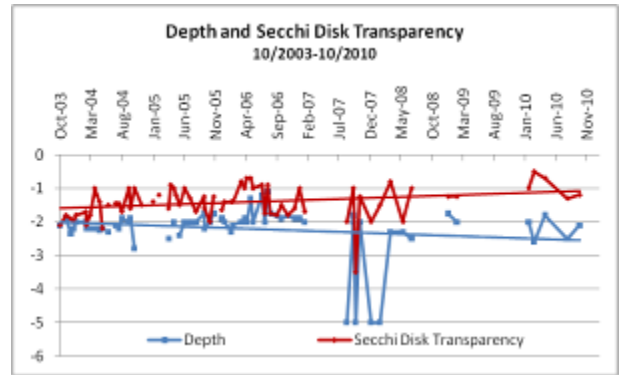
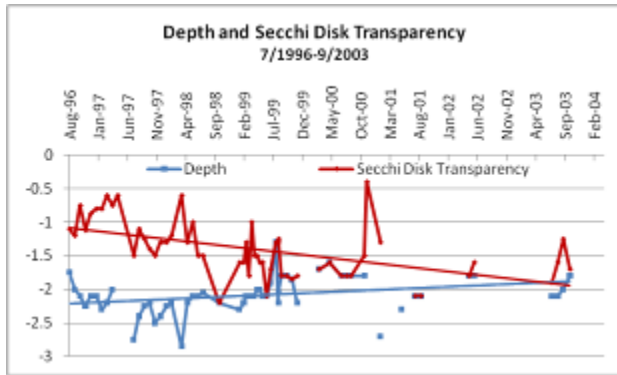
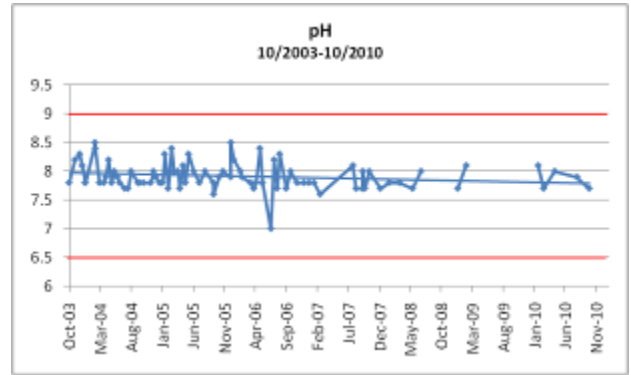
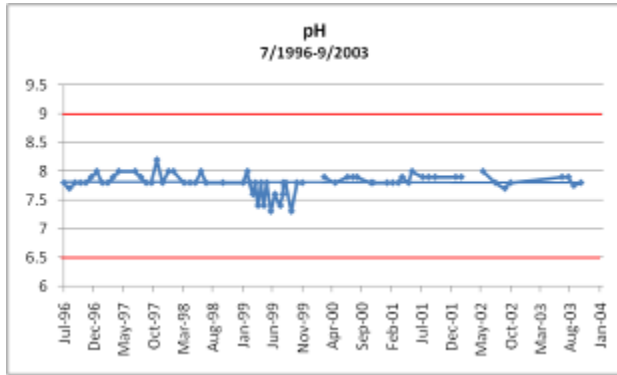
<sup>9</sup> No precipitation data were collected for five observations above the screening level.

Data at this site have been collected by Nancy Wilson, John Johnson, Sandy Irvin, Kelley Coker, Mason Cradit, Thomas and Steve Uzzell, Michelle Guardiola, Carolyn Kelly, Phillip Hicks, and Rachel Sanborn with the San Marcos River Rangers. Water temperature varied seasonally around 70 °F. Dissolved oxygen varied seasonally most of the time, but many times in 1999 and from 2003-2006, dissolved oxygen did not follow the seasonal trend. It varied around 7.5 until 2004, when values began to stay closer to 9. Conductivity values mostly varied around 550 µS/cm until 2005 when they began to stay closer to 600 µS/cm.

pH consistently stayed close to 8. Secchi Disk transparency and total depth were highly variable but averaged 0.8 m of difference, indicating the clarity to be limited here. Depth stayed close to 2 m. For the four readings of 5 m depth, the monitors did not record the flow severity as high. It would be safe to assume they slightly changed monitoring locations. Monitors comment that this site is frequented by canoers and fishermen, elephants ears grow on the banks, and occasionally trash was reported.







**Site M: San Marcos River at Martindale Dam**

<b>Site M: San Marcos River at Martindale Dam 1996-1998 &amp; 2004-2010</b>						
<b>Parameter</b>	<b>#</b>	<b>% Complete</b>	<b>Min.</b>	<b>Avg.</b>	<b>Max.</b>	<b>Std. Dev.</b>
Water Temperature (°F)	111	95	59	72	88	6.4
Dissolved Oxygen (mg/L)	111	95	5.9	8.1	11.1	1.1
Conductivity (µS/cm)	94	80	430	585	640	37
pH	110	94	7.5	8.1	8.7	0.3
Secchi Disk Transparency (m)	108	92	0.2	1.1	7.7	0.8
Total Depth (m)	109	93	0.31	1.4	7.7	0.9
Orthophosphate (mg/L)	23	20	<0.1	0.7	6	1.3
Nitrate (mg/L)	22	19	<1	0.6	2	0.7
Sample Time	116	99	7:40 AM	1:39 PM	9:00 PM	3:16

<b>Total Exceedances</b>			
<b>Parameter</b>	<b>Standard</b>	<b># Exceedance</b>	<b>% Exceedance</b>
Water Temperature	90 °F	0/111	0
Dissolved Oxygen	3 mg/L	0/111	0
pH	6.5-9	0/110	0

<b>Exceedances Since 2003</b>			
<b>Parameter</b>	<b>Standard</b>	<b># Exceedance</b>	<b>% Exceedance</b>
Water Temperature	90 °F	0/102	0
Dissolved Oxygen	3 mg/L	0/101	0
pH	6.5-9	0/100	0

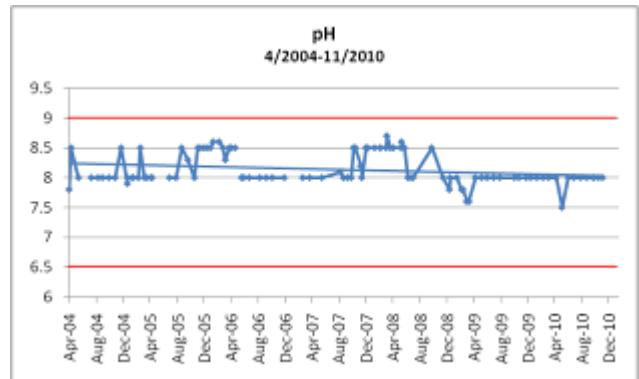
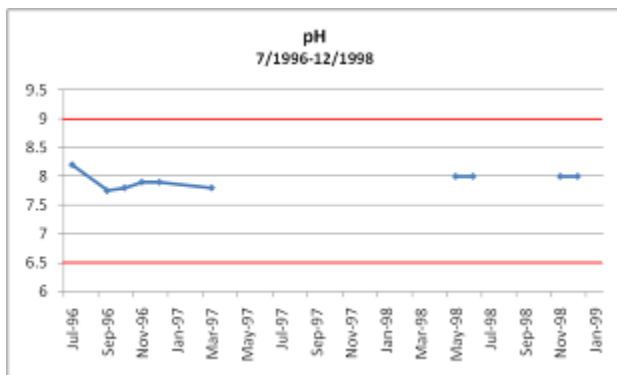
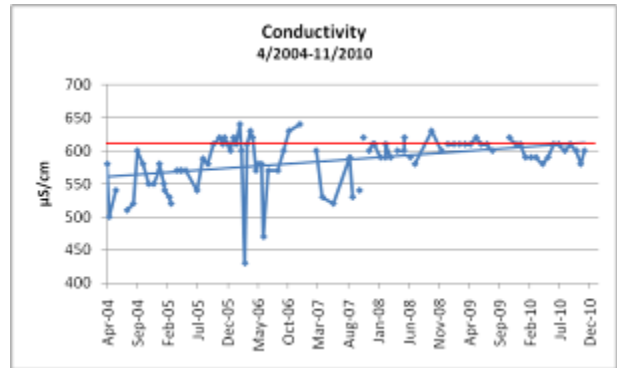
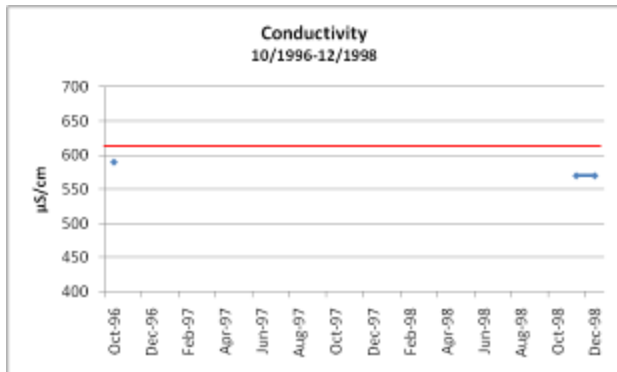
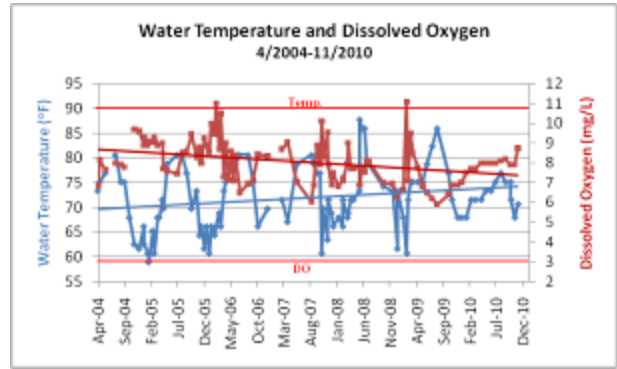
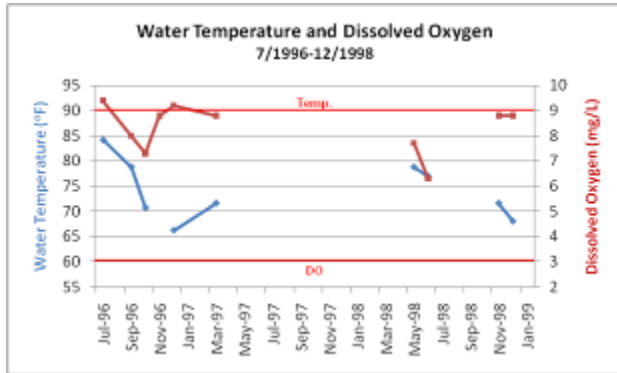
<b>Nutrient Results &amp; Screening Levels 1996-2005</b>					
<b>Parameter</b>	<b>Screening Level</b>	<b>Over Screening Level</b>		<b>Significant Precipitation in Preceding 3 Days</b>	
		<b>#</b>	<b>%</b>	<b>#</b>	<b>%</b>
Orthophosphate	0.37 mg/L	9/23	39	6 <sup>10</sup>	67
Nitrate	1.95 mg/L	3/22	14	3	100

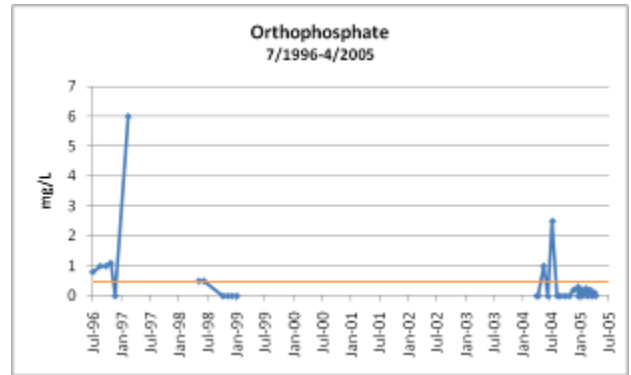
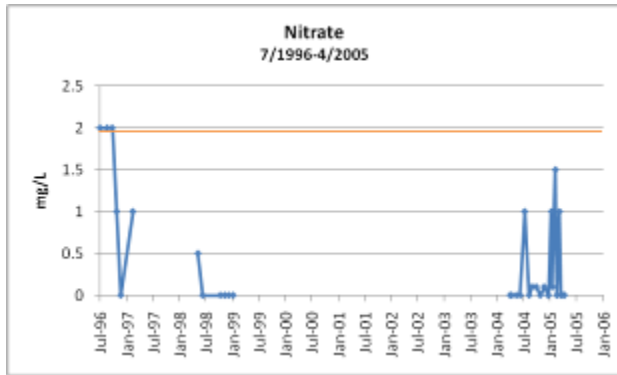
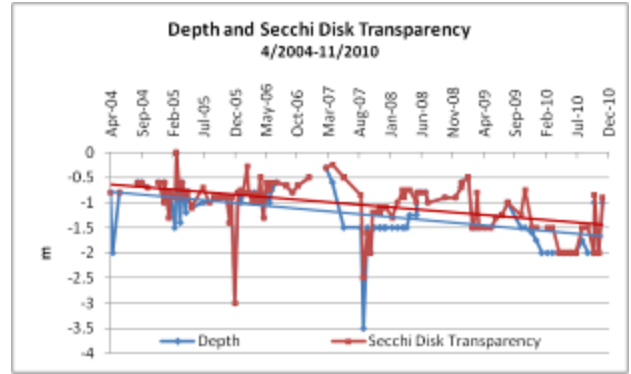
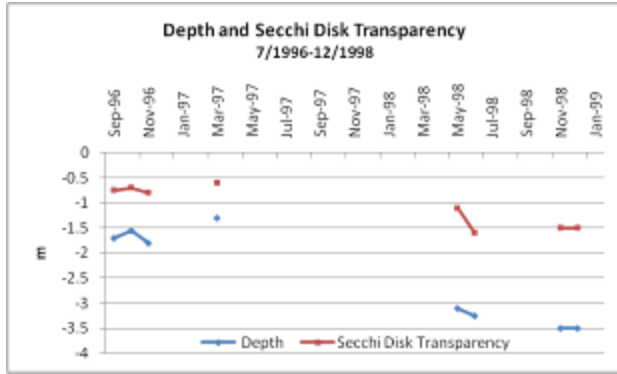
Data were collected by Leah Laszewski, Amanda Kubesch, Doug Shomette, Patricia Phillips, Dolf Carlstrand, Shea and Alex Thomas, Deborah Lane, and Jeff Lowe with the San Marcos River Rangers. Water temperature varied seasonally, for the most part, with a slight upward trend from values around 70 °F to values closer to 74 °F. Dissolved oxygen had some minor deviations from seasonal variance with a slight downward trend from values around 8 mg/L to values around 7 mg/L. Conductivity values stayed close to 600 µS/cm with a slightly upward trend since 2003. pH mostly stayed between 8 and 8.5 with a slight downward trend since 2003.

Secchi Disk transparency and depth were equal most of the time, indicating the water here to be clear, and both have decreased since 2003. Total depth has increased since 2004. Monitors have reported that this site used to be frequented by swimmers but later no trespassing signs were put up. No comments followed about swimmers. There is possibly little to no contact recreation at this site

<sup>10</sup> Precipitation data were not recorded for one observation above the screening level.

now. Monitors have reported an abundance of elephant ears as well as the presence of lily pads, turtles, insects, and birds at the site. A few times, foam was reported, and it appears there has consistently been an abundance of algae.





**Site N: San Marcos River in Martindale At Bella Vista**

Site N: San Marcos River in Martindale At Bella Vista 2008						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	3	100	67	71	78	6
Dissolved Oxygen (mg/L)	3	100	7.6	8.4	8.9	0.7
Conductivity (µS/cm)	3	100	570	580	590	10
pH	3	100	7.3	7.7	8.2	0.5
Secchi Disk Transparency (m)	0	0	N/A	N/A	N/A	N/A
Total Depth (m)	2	67	0.6	0.8	0.9	0.2
Sample Time	3	100	11:00 AM	1:24 PM	5:30 PM	3:34

Data at this site were collected by Jon Lasser. All observed values were within the water quality standards.

**Site O: San Marcos River at FM 1977**

<b>Site O: San Marcos River at FM 1977 1996-1997 &amp; 1999-2010</b>						
<b>Parameter</b>	<b>#</b>	<b>% Complete</b>	<b>Min.</b>	<b>Avg.</b>	<b>Max.</b>	<b>Std. Dev.</b>
Water Temperature (°F)	86	96	50	71	86	9.2
Dissolved Oxygen (mg/L)	84	93	5.5	7.9	10.8	1.1
Conductivity (µS/cm)	78	87	90	547	790	78
pH	87	97	7	7.9	8.75	0.3
Secchi Disk Transparency (m)	86	96	0.2	1.1	6.5	0.7
Total Depth (m)	86	96	1.8	5	8	1.3
Orthophosphate (mg/L)	44	49	<0.1	0.7	8.8	1.4
Nitrate (mg/L)	44	49	<1	1	4	1
Sample Time	87	97	8:20 AM	2:17 PM	6:53 PM	2:59

<b>Total Exceedances</b>			
<b>Parameter</b>	<b>Standard</b>	<b># Exceedance</b>	<b>% Exceedance</b>
Water Temperature	90 °F	0/86	0
Dissolved Oxygen	3 mg/L	0/84	0
pH	6.5-9	0/87	0

<b>Exceedances Since 2003</b>			
<b>Parameter</b>	<b>Standard</b>	<b># Exceedance</b>	<b>% Exceedance</b>
Water Temperature	90 °F	0/43	0
Dissolved Oxygen	3 mg/L	0/41	0
pH	6.5-9	0/43	0

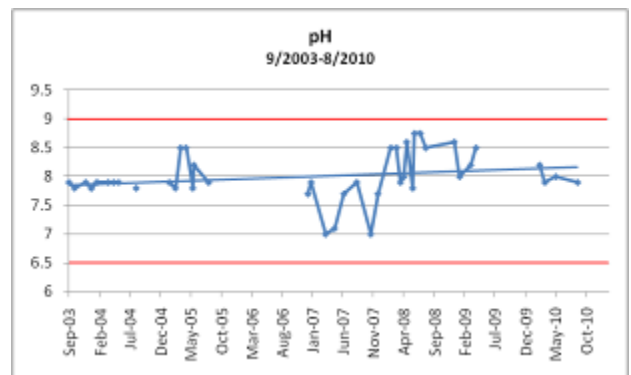
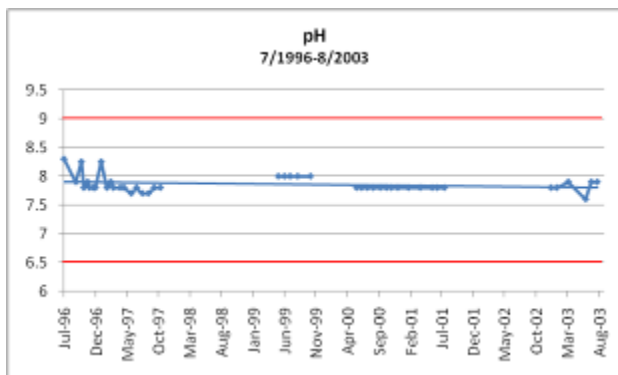
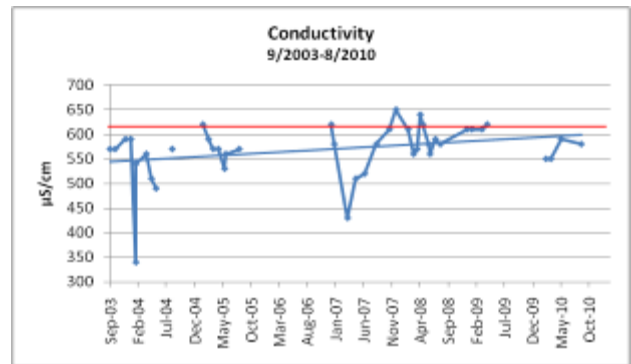
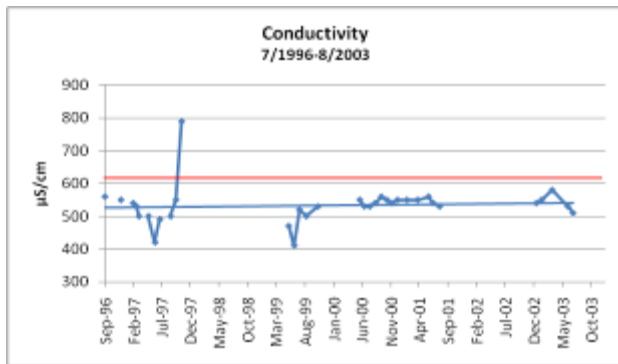
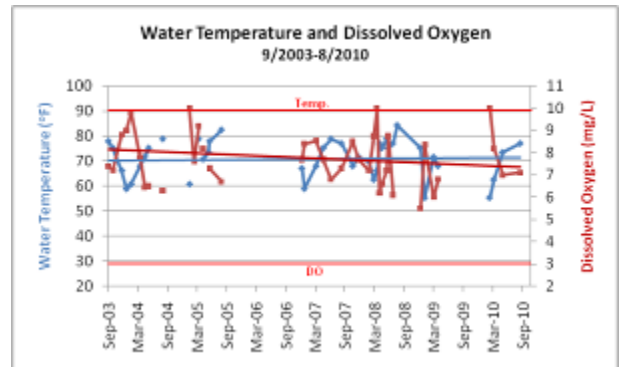
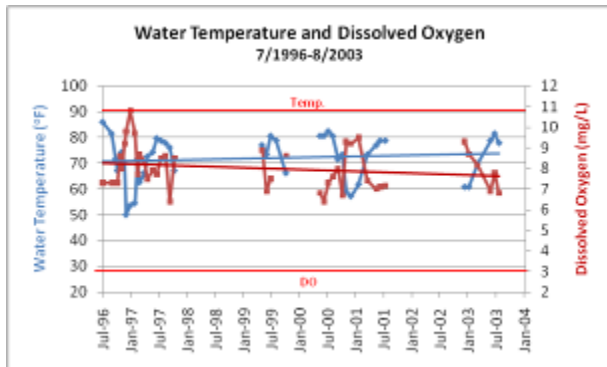
<b>Nutrient Results &amp; Screening Levels 1996-2005</b>					
<b>Parameter</b>	<b>Screening Level</b>	<b>Over Screening Level</b>		<b>Significant Precipitation in Preceding 3 Days</b>	
		<b>#</b>	<b>%</b>	<b>#</b>	<b>%</b>
Orthophosphate	0.37 mg/L	24/44	55	5 <sup>11</sup>	21
Nitrate	1.95 mg/L	10/44	23	3	30

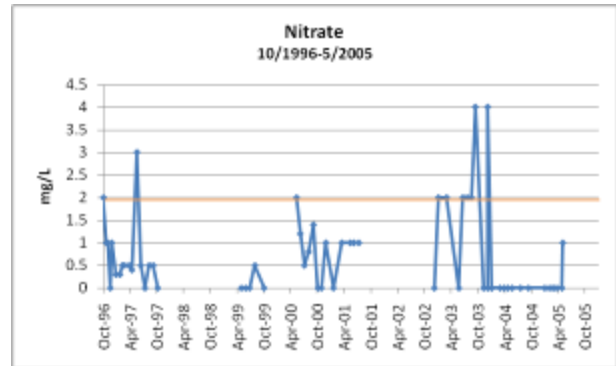
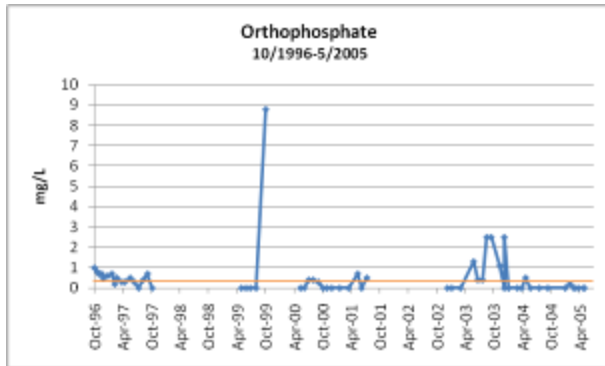
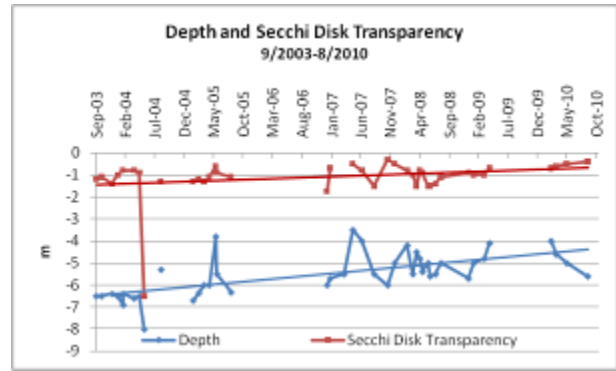
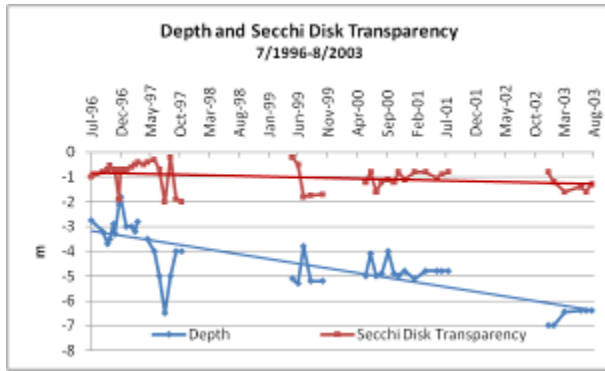
Data at this site were collected by Nancy Wilson, McCoy and Mark Genfan, Andre and Rachel Sanborn, Sandy Goynes, Laura Brock, John Schmidt, Charlie Adams, and Shea and Alex Thomas with the San Marcos River Rangers. Water temperature followed a seasonal trend while varying around 70 °F. Dissolved oxygen deviated from this trend a few times and varied around 7.7 mg/L. Conductivity trends increased in time from values close to 550 µS/cm to values closer to 600 µS/cm. pH mostly stayed near 8 until 2007 when values began to waver between 7 and 8.75.

Secchi Disk transparency and total depth values averaged a difference of 3.9 m, indicating visibility to be an issue at this site. Depth trended upward from 1995-2003 and then trended downward from 2003-2010. Monitors noted the site to be used by swimmers and boaters as well as the presence

<sup>11</sup> Precipitation data were not recorded for one observation above the screening level.

of lily pads, elephant ears, and banana trees. There were consistent reports of trash and a few reports of foam, scum, and sheen. A fair amount of debris flows through this portion as well, according to monitors.





**Site P: San Marcos River at FM 20**

Site P: San Marcos River at FM 20 1998-2010						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	180	95	44	70	85	9.2
Dissolved Oxygen (mg/L)	178	94	5.5	7.9	11.5	1.2
Conductivity (µS/cm)	173	92	460	547	730	38
pH	181	96	7	8	8.5	0.1
Secchi Disk Transparency (m)	177	94	0.1	0.7	1.6	0.2
Total Depth (m)	174	92	0.7	1.2	2.6	0.4
Orthophosphate (mg/L)	70	37	<0.1	0.2	2.5	0.4
Nitrate (mg/L)	71	38	<1	0.6	8.8	1.6
Sample Time	184	97	7:15 AM	9:35 AM	3:00 PM	1:14

Total Exceedances			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	0/180	0
Dissolved Oxygen	3 mg/L	0/178	0
pH	6.5-9	0/181	0



Exceedances Since 2003			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	0/115	0
Dissolved Oxygen	3 mg/L	0/114	0
pH	6.5-9	0/116	0

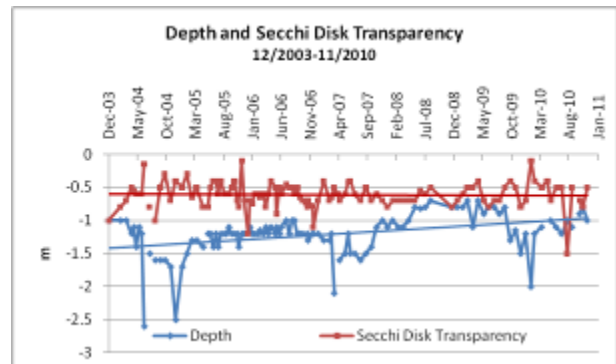
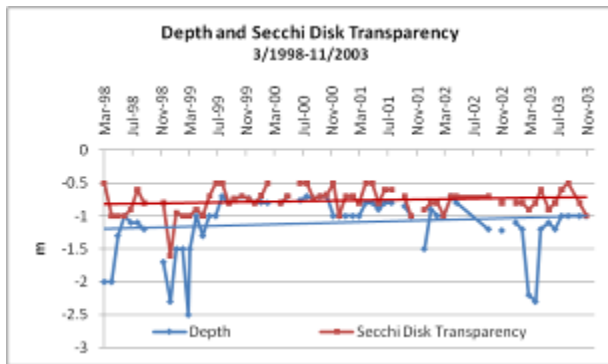
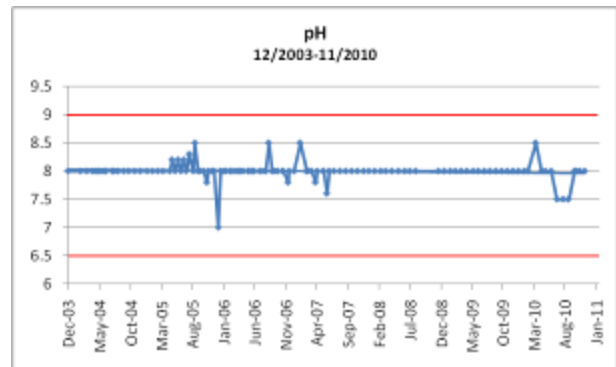
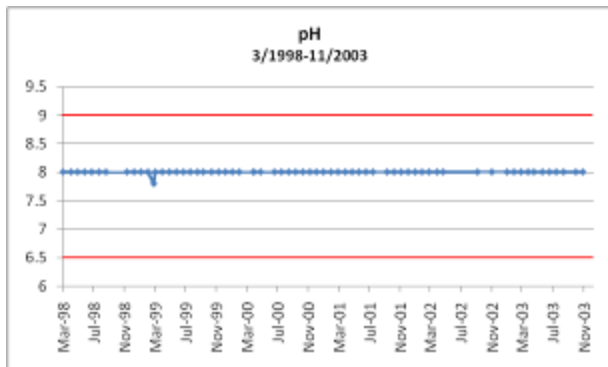
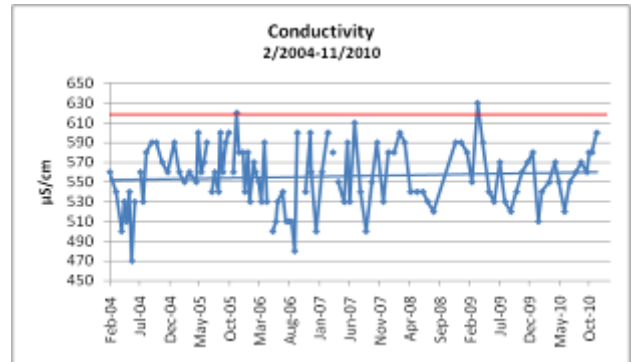
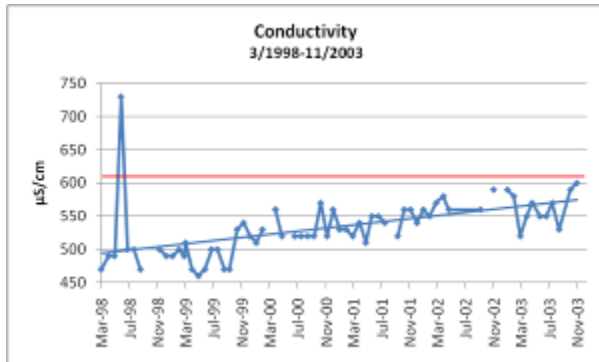
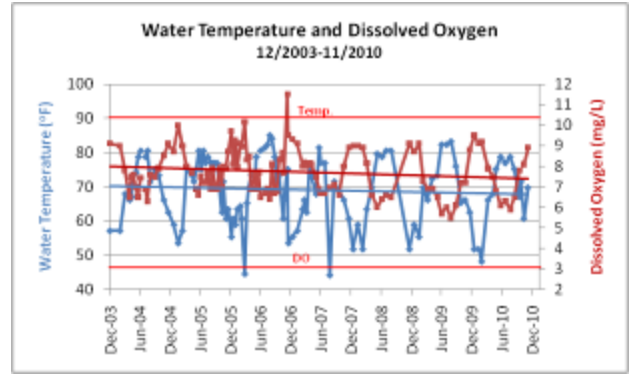
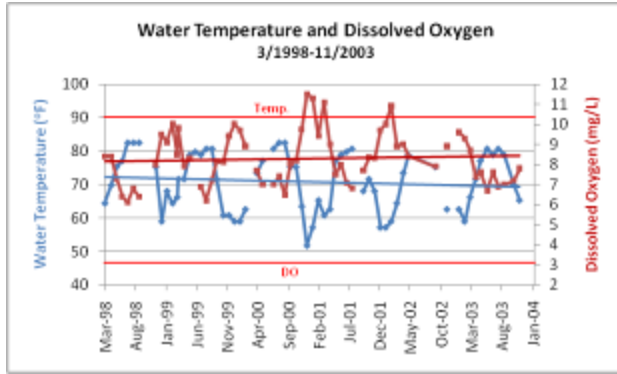
Nutrient Results & Screening Levels 1998-2005					
Parameter	Screening Level	Over Screening Level		Significant Precipitation in Preceding 3 Days	
		#	%	#	%
Orthophosphate	0.37 mg/L	13/70	19	5 <sup>12</sup>	38
Nitrate	1.95 mg/L	3/71	4	0 <sup>13</sup>	0

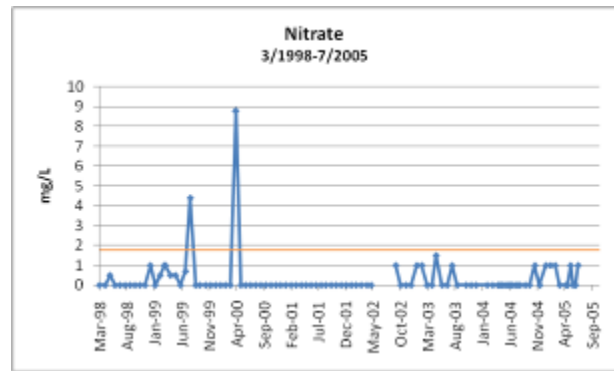
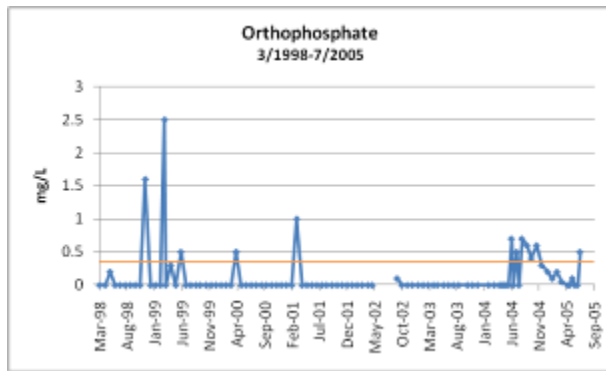
Data at this site were collected by M. Lee Brown, Doub Shomette, Ann Boulon, Stan Ulcak, Carolyn Kelly, Deborah Lane, and John Friesenhahn with the San Marcos River Rangers. Water temperature and dissolved oxygen followed seasonal fluctuations. Water temperature varied around 70 °F. Dissolved oxygen varied around 8.5 mg/L until 2003 and trended around 7.5 mg/L until present. Conductivity trended upward from values around 500 µS/cm to values around 570 µS/cm from 1995-2003. From 2003-2010, conductivity values varied between monitoring events with a trend near 550 µS/cm.

pH consistently stayed near 8. Secchi Disk transparency and total depth averaged a difference of 0.5 m, indicating this site to have some water clarity issues. Depth varied between monitoring events and has trended downward since 2003. Secchi Disk transparency has stayed consistently around 0.7 m. Monitors noted the presence of elephant ears, lily pads, and elodea as well as insects, fish, and birds. They have commented that people fish and kayak at this site as well. At times, there has been heavy algal growth. Between February and September 2010, a log jam led to the accumulation of sediment where vegetation has now taken root.

<sup>12</sup> Precipitation data were not recorded for one observation above the screening level.

<sup>13</sup> Precipitation data were not recorded for one observation above the screening level.





**Site Q: San Marcos River at Prairie Lea**

Site Q: San Marcos River at Prairie Lea 1992, 1997, 1999-2001 & 2004-2006						
Parameter	#	% Complete	Min.	Avg.	Max.	Std. Dev.
Water Temperature (°F)	57	97	58	73	93	7.6
Dissolved Oxygen (mg/L)	56	95	2.8	8.3	10.1	1.2
Conductivity (µS/cm)	40	68	400	527	590	43
pH	55	93	7	8.1	8.5	0.3
Secchi Disk Transparency (m)	51	86	0.1	0.6	1.5	0.3
Total Depth (m)	40	68	0.7	2	4	0.9
Orthophosphate (mg/L)	31	53	<0.1	0.4	4	0.7
Nitrate (mg/L)	31	53	<1	0.3	2	0.5
Sample Time	58	98	8:25 AM	12:51 PM	6:30 PM	3:16

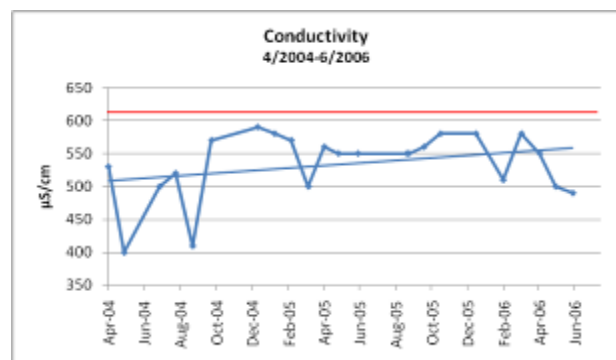
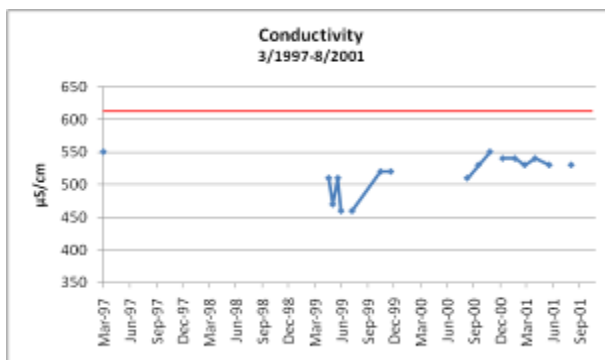
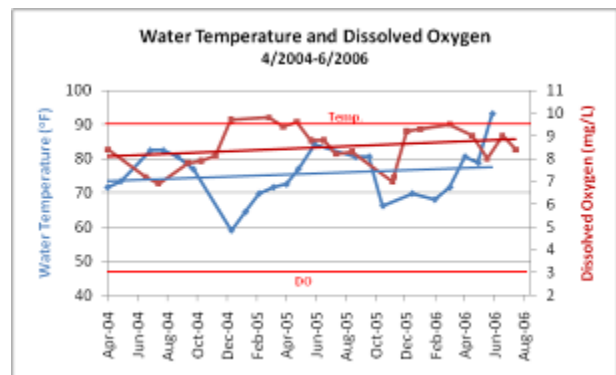
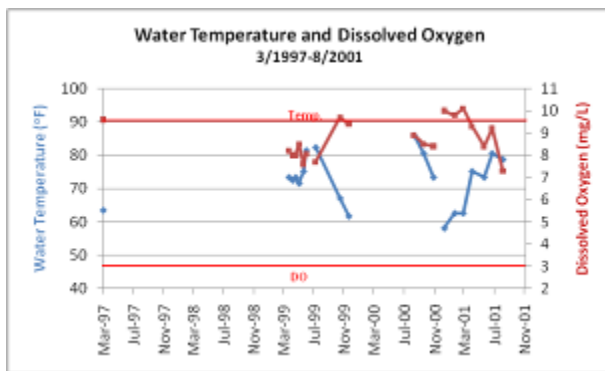
Total Exceedances			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	1/57	1.8
Dissolved Oxygen	3 mg/L	1/56	1.8
pH	6.5-9	0/55	0

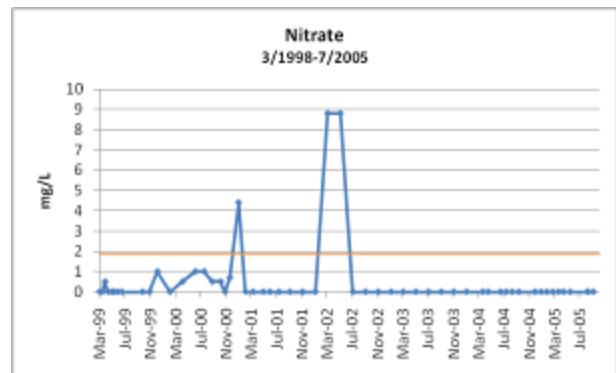
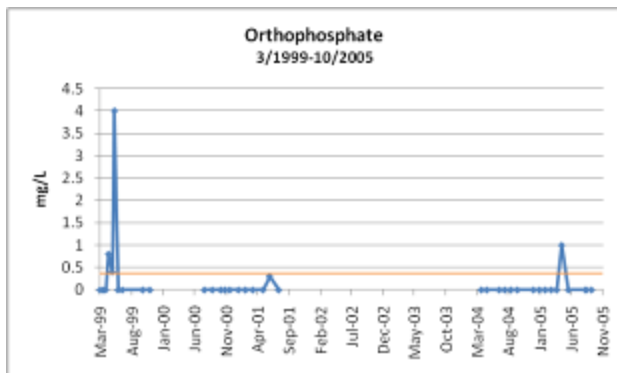
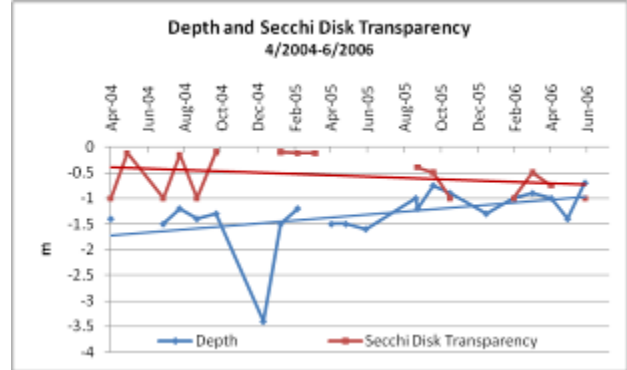
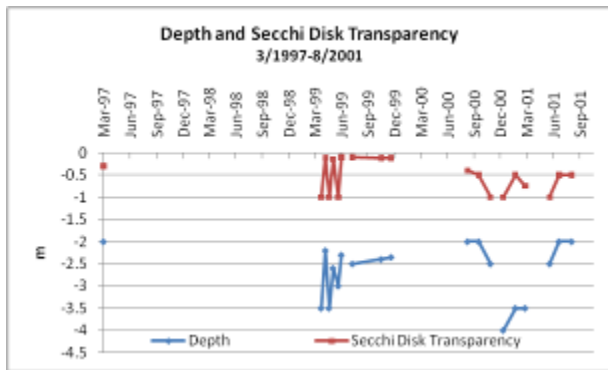
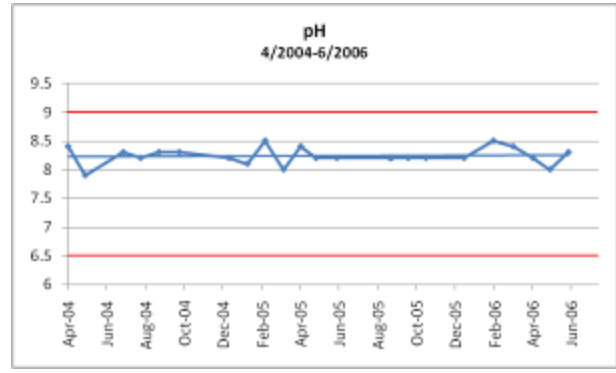
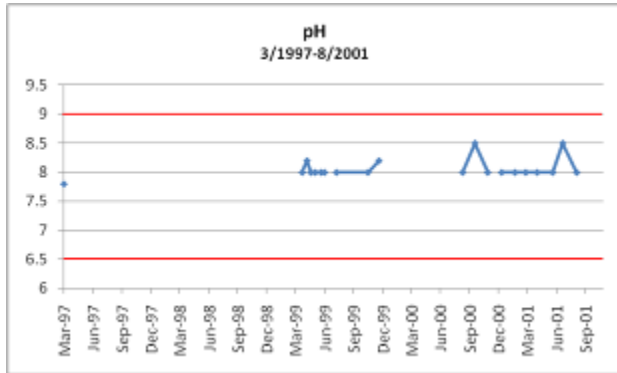
Exceedances Since 2003			
Parameter	Standard	# Exceedance	% Exceedance
Water Temperature	90 °F	1/23	4.3
Dissolved Oxygen	3 mg/L	0/23	0
pH	6.5-9	0/23	0

Nutrient Results & Screening Levels 1998-2005					
Parameter	Screening Level	Over Screening Level		Significant Precipitation in Preceding 3 Days	
		#	%	#	%
Orthophosphate	0.37 mg/L	4/31	13	0	0
Nitrate	1.95 mg/L	1/31	3	0	0

Data at this site were collected by M. Teresa and Howard Berg, Louise Mullins, Stan Ulcak, Deborah Lane, and David Pringle with the San Marcos River Rangers. Water temperature and dissolved oxygen varied seasonally. Water temperature trended around 72 °F with a slight upward trend since 2004, and dissolved oxygen trended around 8.5 mg/L with a slight upward trend since 2004 as well. No other parameters, field observations, or comments were unusual when the one dissolved oxygen exceedance was recorded in February 1992. The water temperature exceedance occurred in June 2006 when the air temperature was 108 °F.

Conductivity trended upward from values around 500 µS/cm to values to values around 550 µS/cm. pH stayed close to 8.2. Secchi Disk transparency and total depth averaged a difference of 1.4 m, indicating the water here to have limited visibility. Depth has decreased from values around 1.5 m to values around 1 m since 2004. Monitors reported that this site is used by fishermen and sun bathers. Trash and debris were the most commonly reported sightings. A few times, the monitors noted the presence of foam. They have also commented on the presence of fish and birds.





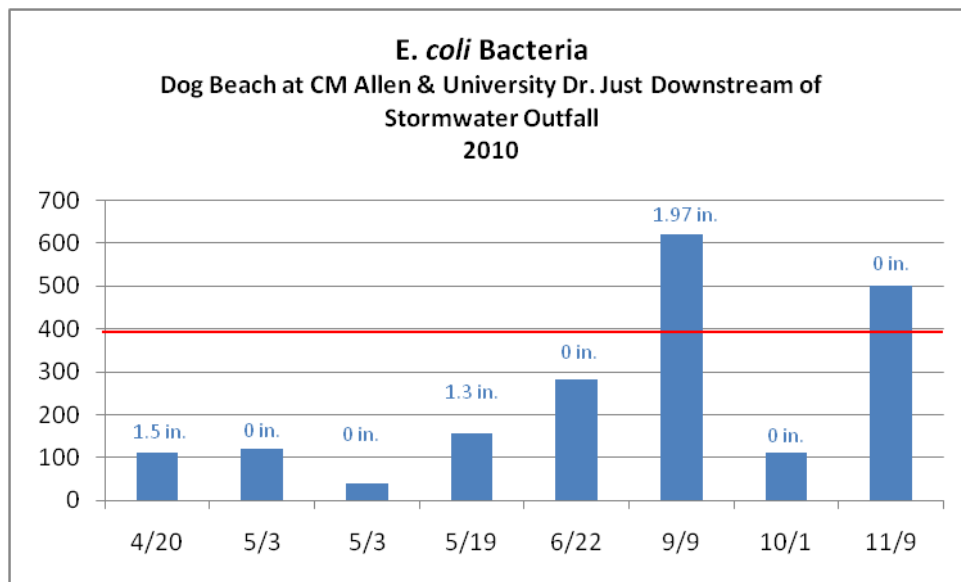
## Supplemental Bacteria Data Analysis

The following *E. coli* and fecal coliform bacteria data show the San Marcos River to be a suitable environment for contact recreation. The Fecal Coliform Bacteria % of Exceedance graph on the next page shows percentage far below the required 25% of samples which would lead to an impairment with professional data. The single sample standard for fecal coliform is 400 cfu/100mL. The geometric standard is 200 cfu/100mL. The majority of the rare high values were observed when there had been significant precipitation in the previous 3 days, and it is well known that stormwater runoff makes water bodies unsuitable for contact recreation temporarily.

### *E. coli* Bacteria

#### Dog Beach at CM Allen & University Dr. Just Downstream of Stormwater Outfall

In order to bring bacteria samples to citizen water quality monitor trainings, Texas Stream Team staff collected the following samples at Dog Beach across from City Park at CM Allen & University Dr. just downstream of a stormwater outfall which was identified as a possible point of concern in the 2007 Intensive Bacteria Survey. The results are shown on the graph below. The values shown in blue are the amount of rainfall in the 3 days preceding the monitoring event. These are shown so the reader can determine the possible influence of stormwater runoff on these values. The geometric mean of these eight monitoring events is 173 cfu/100mL, which is over the geometric standard. However, for the TCEQ assessment (Integrated Report) more samples would have to be collected by professional monitors.



## 2007 Intensive Bacteria Survey

On October 17, 2007, Texas Stream Team coordinated with Texas State University's Common Experience to perform an Intensive Bacteria Survey on the San Marcos River. 41 samples were collected on the river; 33 samples were collected on tributaries; and 19 samples were collected on Spring Lake roughly every 100 m. The test used cannot positively confirm readings of 0 cfu/100mL. However, to present this data with graphs and statistics, values which appeared to yield 0 cfu/100mL were recorded as zeros. Therefore, averages are higher than they would be if a more accurate test was used because zeros cannot be included in averages.

The results showed an increase of bacteria levels between Rio Vista Park and downstream of Thompson's Island for the most part, but values were well below the standard (394 cfu/100mL), with a maximum of 70 cfu/100 mL except for one sample taken from the river just below the stormwater outfall across the street from City Park where results were too numerous to count. The values recorded at the Wastewater Treatment Plant pipe and just downstream from there yielded no bacteria growth.

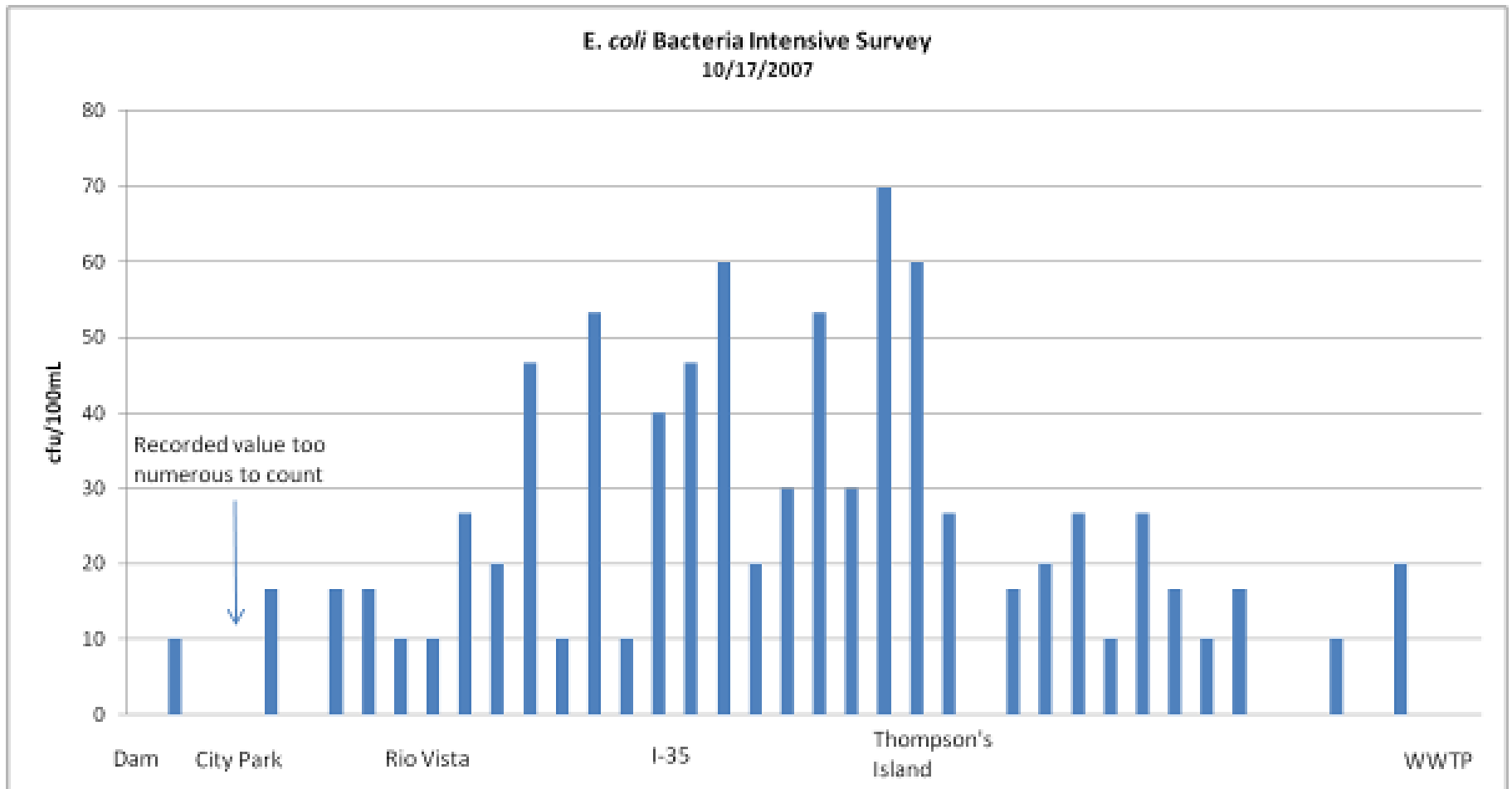
The following table shows statistics for the data collected on Spring Lake and San Marcos River tributaries. The unnamed tributary runs along Aquarena Springs Dr. by the Texas State University Football stadium, the dog park, and the San Marcos Public Library before entering the river just north of Hopkins St. It can be seen that no tributaries exhibit characteristics which may threaten the contact recreation on the river. However, one sample taken on Willow Springs Creek yielded results too numerous to count. It also yielded the highest average value. All samples on Willow Springs Creek yielded some *E. coli* colony growth. This is the creek just south of Purgatory Creek, which can be seen on the map on pg. 8. This creek meets the river just north of Cape Rd. at Thompson's Island.

<b>San Marcos River, Spring Lake, and Tributaries</b>						
	<b>#</b>	<b>% Complete</b>	<b>Min</b>	<b>Avg</b>	<b>Max</b>	<b>Std Dev</b>
San Marcos River	41	100	0	21	TNTC <sup>14</sup>	19
Spring Lake	19	100	0	5	37	9
Sink Creek	8	100	0	29	87	30
Sessom Creek	7	100	0	53	150	58
Unnamed Tributary	4	100	0	29	73	33
Purgatory Creek	8	100	0	65	160	55
Willow Springs Creek	6	100	10	114	TNTC	80

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<sup>14</sup> TNTC=Too numerous to count





<sup>i</sup> Texas State Historical Association, *San Marcos River*, available from <http://www.tshaonline.org/handbook/online/articles/rns10>; accessed 1 January 2011.

<sup>ii</sup> Guadalupe Blanco River Authority, *San Marcos River Watershed*, available from <http://www.gbra.org/documents/publications/basinsummary/2008h.pdf>; accessed 1 January 2011.