

## **Little Cypress Bayou Special Study - Subwatershed 1.10**

Sabine River Authority of Texas

August 31, 2001

Prepared in Cooperation with the [Texas Natural Resource Conservation Commission](#)

Under the Authorization of the Texas Clean Rivers Act

# Special Study on Subwatershed 1.10 - Little Cypress Bayou

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## **Special Study on Subwatershed 1.10 - Little Cypress Bayou**

### ***Introduction***

Little Cypress Bayou (Subwatershed 1.10) is located in the coastal area of the Sabine River Basin within Segment 0501. The Subwatershed drains an area of approximately 18 square miles. The Little Cypress Bayou flows through the Blue Elbow Swamp, which includes the Tony Houseman State Park and Wildlife Management Area and enters the Sabine River near Interstate 10 in Orange, Texas. The flow in the Subwatershed is tidally influenced.

The Sabine River Authority (SRA) 1996 Assessment of Water Quality identified the Little Cypress Bayou Subwatershed as an area of concern due to poor water quality. Water quality concerns or possible concerns in this Subwatershed include dissolved oxygen, fecal coliform, and ambient toxicity. The water quality problems in Subwatershed 1.10 appear to be due to the impacts from the human population in the drainage area and the combined influence from point and nonpoint sources on a tidal waterbody with limited assimilative capacity. Tidal waterbodies typically have limited assimilative capacity, because of low flows and high dissolved solids.

### ***Background***

The Little Cypress Bayou Subwatershed is located north of the City of Orange in Orange County. The subwatershed is dominated by housing subdivisions with little industry. Little Cypress Mauriceville High School is also located adjacent to the bayou. There are four Wastewater Treatment Plants (WWTP) that discharge into the bayou.

Two of the three sample sites used in the study were established before 1999, with the southern most site having data back to 1995. Volunteers also monitor all three sites as a part of the Texas Watch program. Students from Little Cypress Mauriceville High School also monitor the site closest to the school as a part of their Environmental Science class.

An intensive study was initiated in October 1999 on the Little Cypress Subwatershed to identify the sources of water quality impairments. This study was concluded in August 2001. Monitoring included frequent sampling to document point and nonpoint sources of

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fecal coliform, ammonia, and oxygen depleting materials. Sampling was also conducted to substantiate non-compliance with Texas Surface Water Quality Standards (TSWQS).

### **Study Design**

The Little Cypress Bayou Subwatershed was sampled bimonthly (6 times per year) for biochemical oxygen demand (BOD), total organic carbon (TOC), chemical oxygen demand (COD), Ambient Toxicity (AT), nutrients, field parameters, and fecal coliform. All parameters were sampled on the first sampling day of the quarterly program. To determine which bacteria of the fecal coliform group were present, a differentiation was performed using verification media.

The field measurements were taken at three sites in Little Cypress Bayou.

Samples were collected from all three sites for ambient toxicity

Flow was measured at sites when possible. Flows were measured as close to the sampling event as possible.

### Little Cypress Bayou Sampling Sites

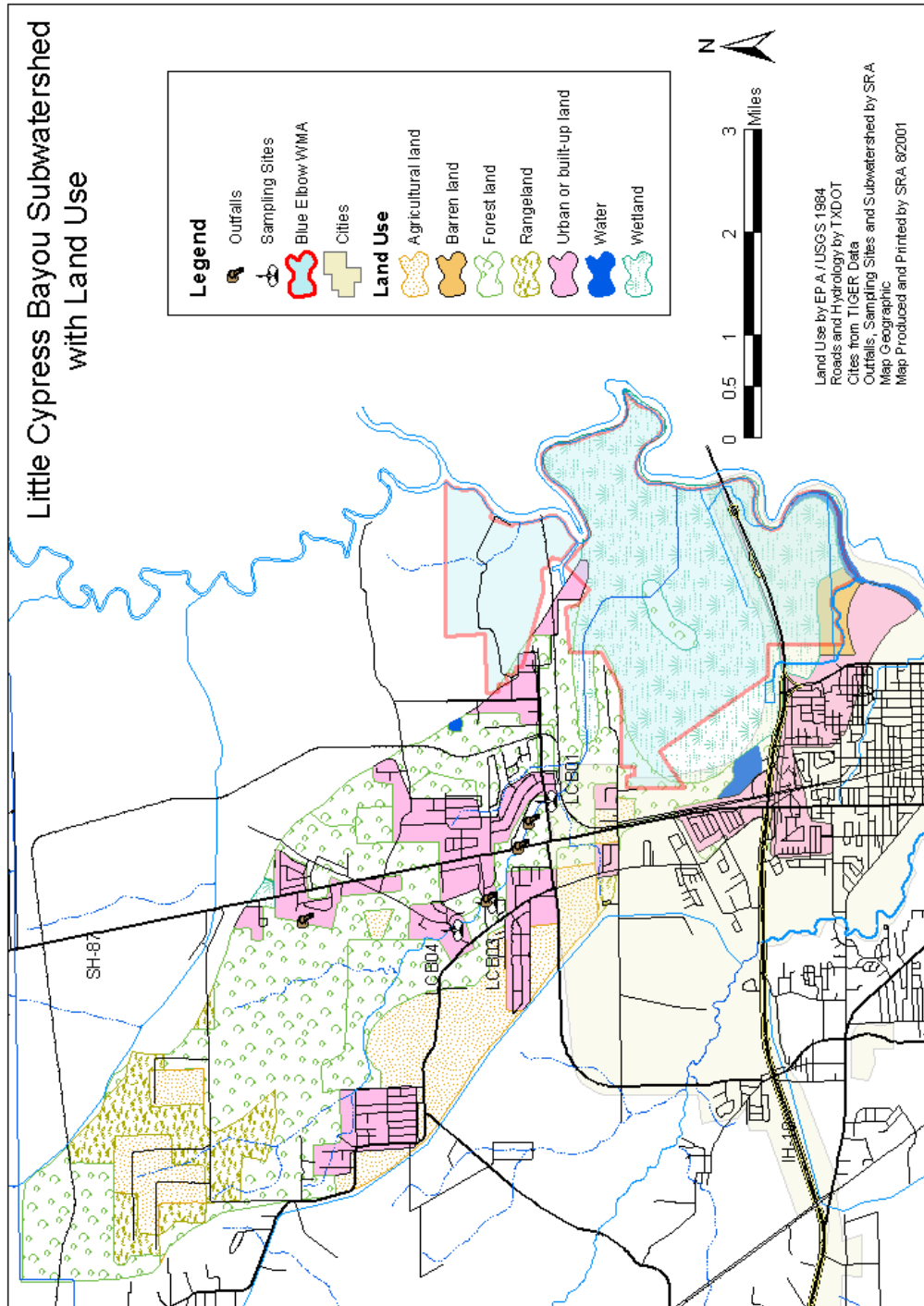
<b>SRA ID</b>	<b>Description</b>	<b>TNRCC #</b>	<b>Parameter Set</b>
LCB01	Little Cypress Bayou at FM 1130	14503	B, RF, AT
LCB03	Little Cypress Bayou at Bear Path Rd.	15520	B, RF, AT
LCB04	Little Cypress Bayou at Little Cypress Dr.	16690	B, RF, AT

Parameter Set Codes: B = Bimonthly Sampling, RF = Rainfall Event Sampling, AT = Ambient Toxicity Sampling

Due to tidal influence, sampling sites can be impacted by point sources that would ordinarily be considered downstream.

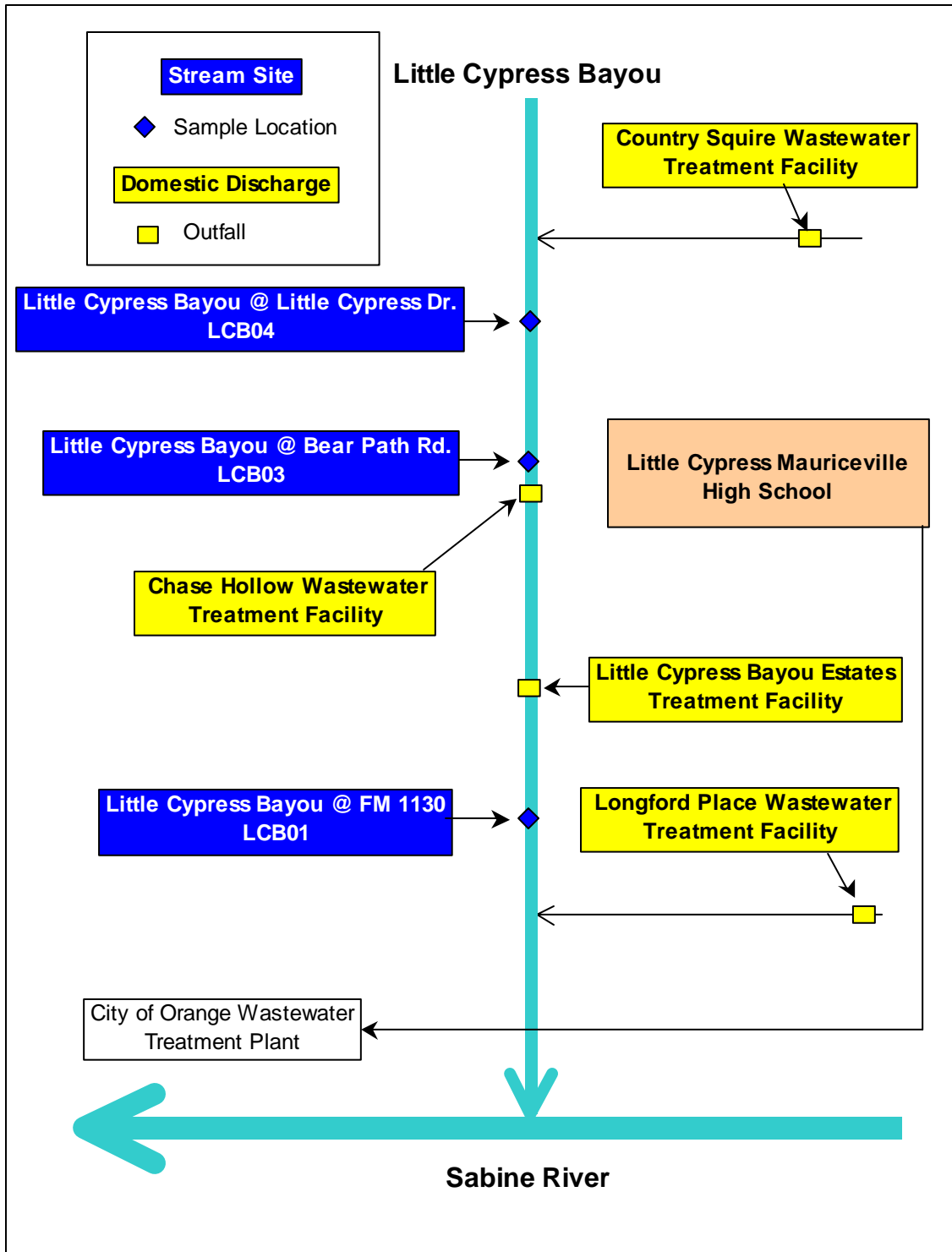
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Figure 1. Sample Locations and Land Use in the Little Cypress Bayou Watershed



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Figure 2. Schematic Diagram of Little Cypress Bayou Subwatershed

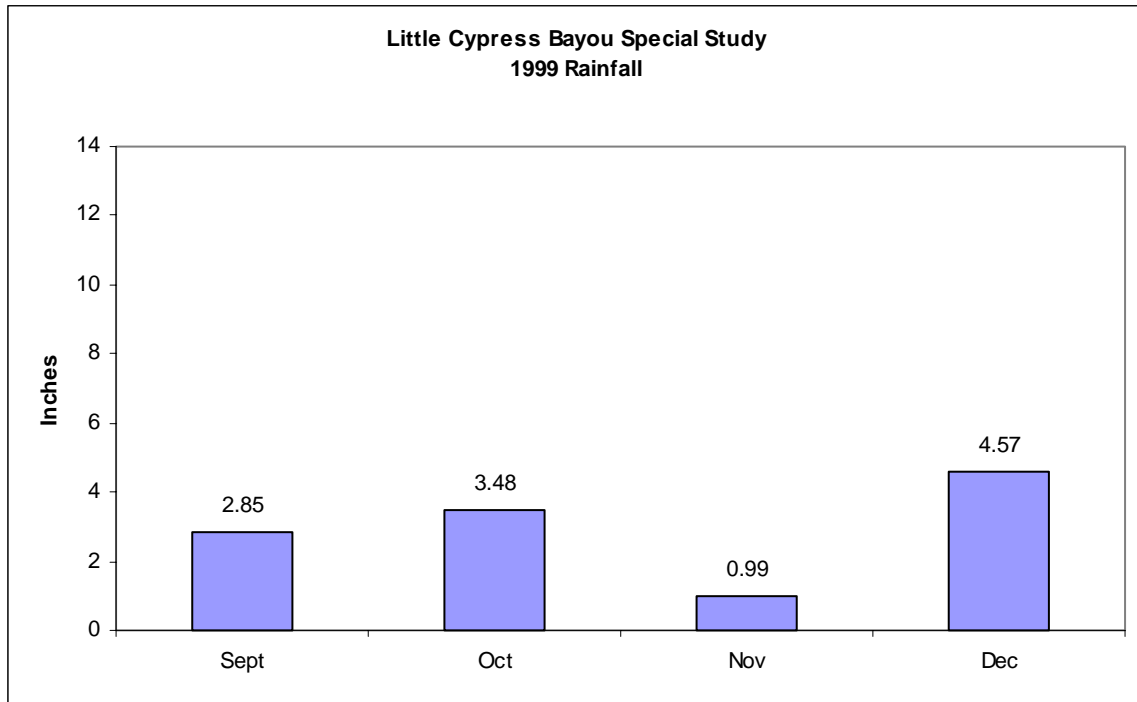


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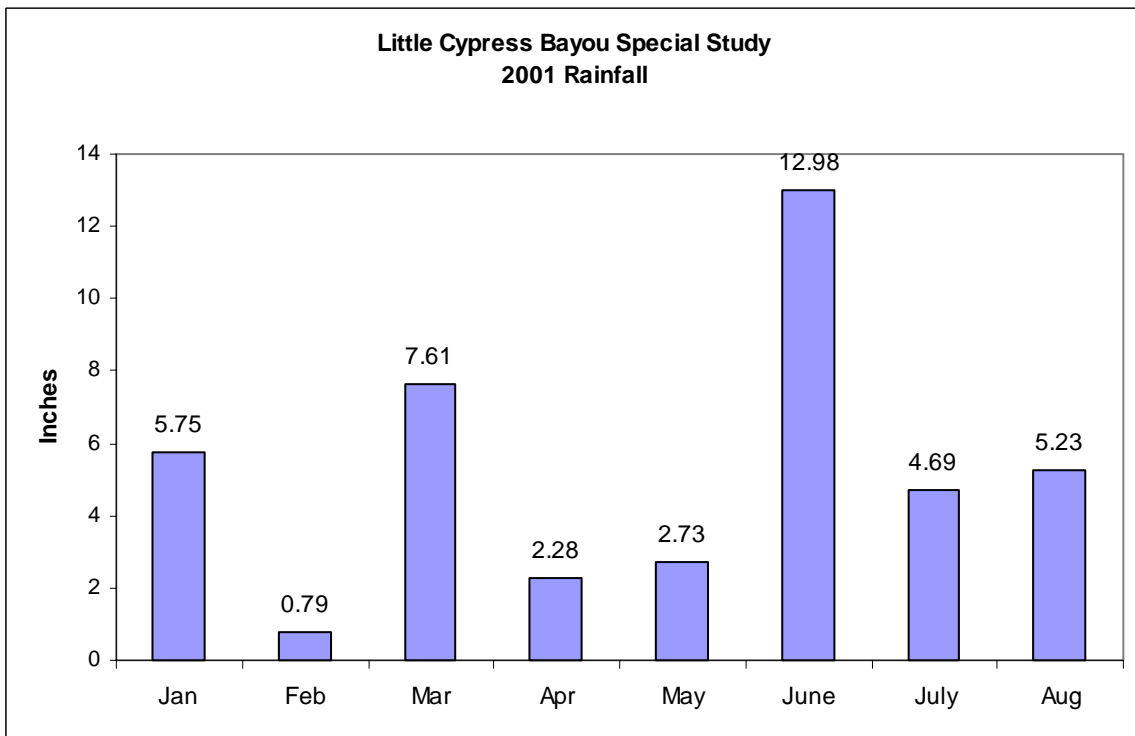
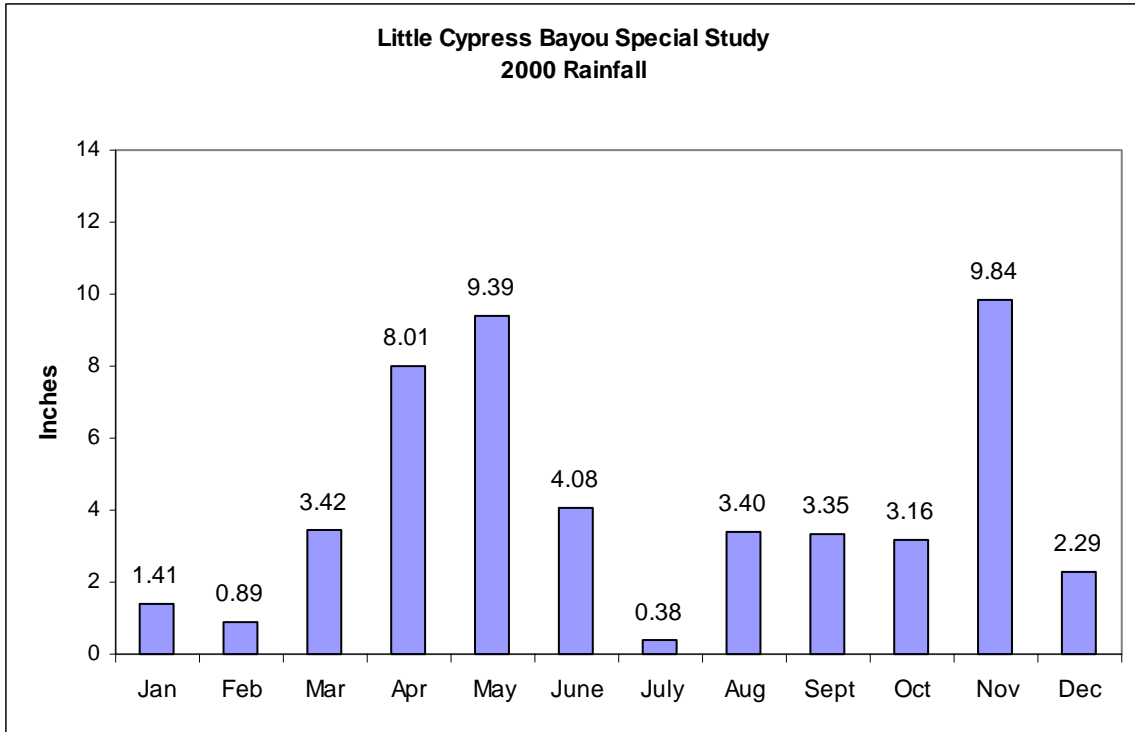
### ***Rainfall***

Rainfall was measured at the SRA Gulf Coast Division Office near Orange, Texas.

Rainfall event sampling was performed only when the field biologists determined runoff from rainfall had occurred. Rainfall sampling events are noted with the dates in the results graphs. The August 2001 rainfall totals include amounts through 8/28/01.



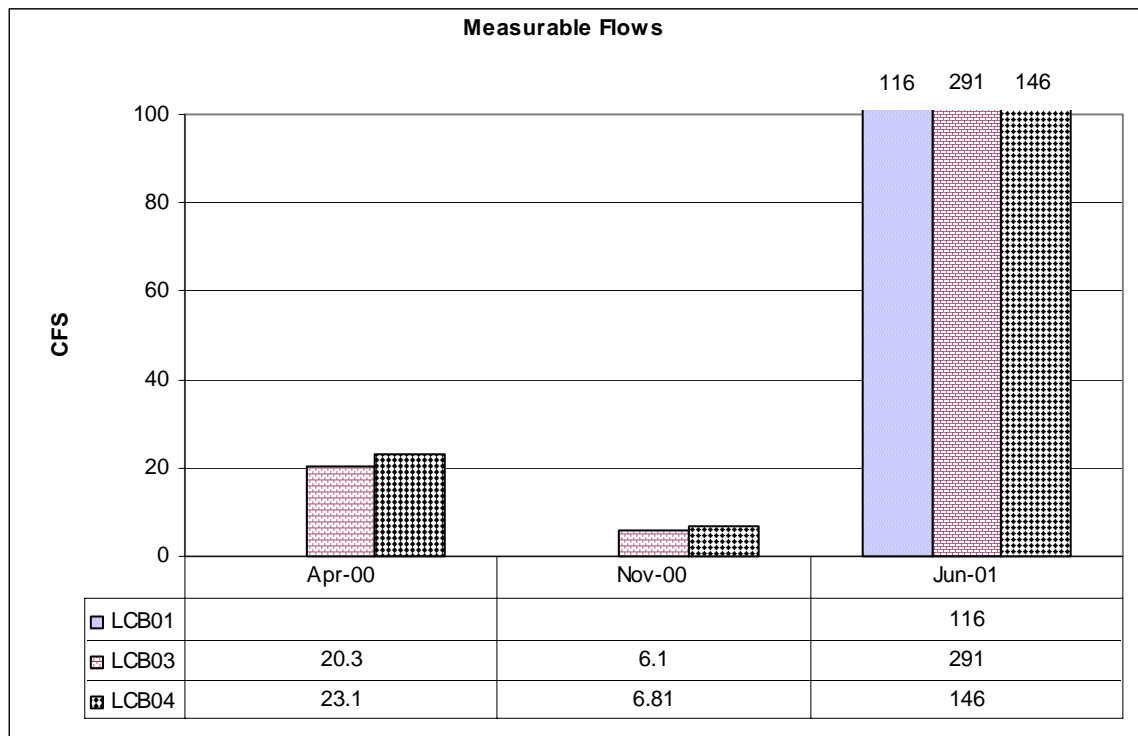
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### Flow

Flow measured at stream sites ranged from 291 cubic feet per second (cfs) at LCB03 to less than 1 cfs, which was measured at each site during the study. Flows were measured during rainfall events at sites where flow was obvious. Measurable flows were only found at the study sites three times during the study period with site LCB01 only showing a positive flow during the largest rain event in June 2001. In tidally influenced streams, flow alternates direction unless runoff from rainfall is sufficient to overcome the tide.

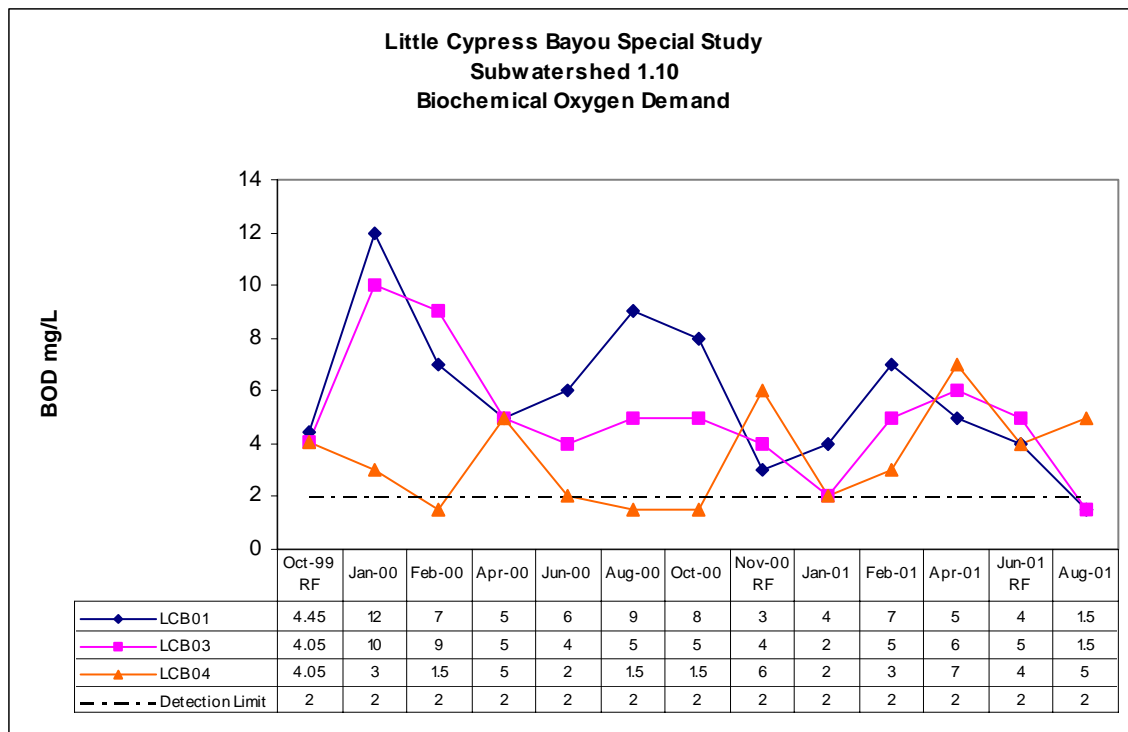


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### Results

#### Biochemical Oxygen Demand

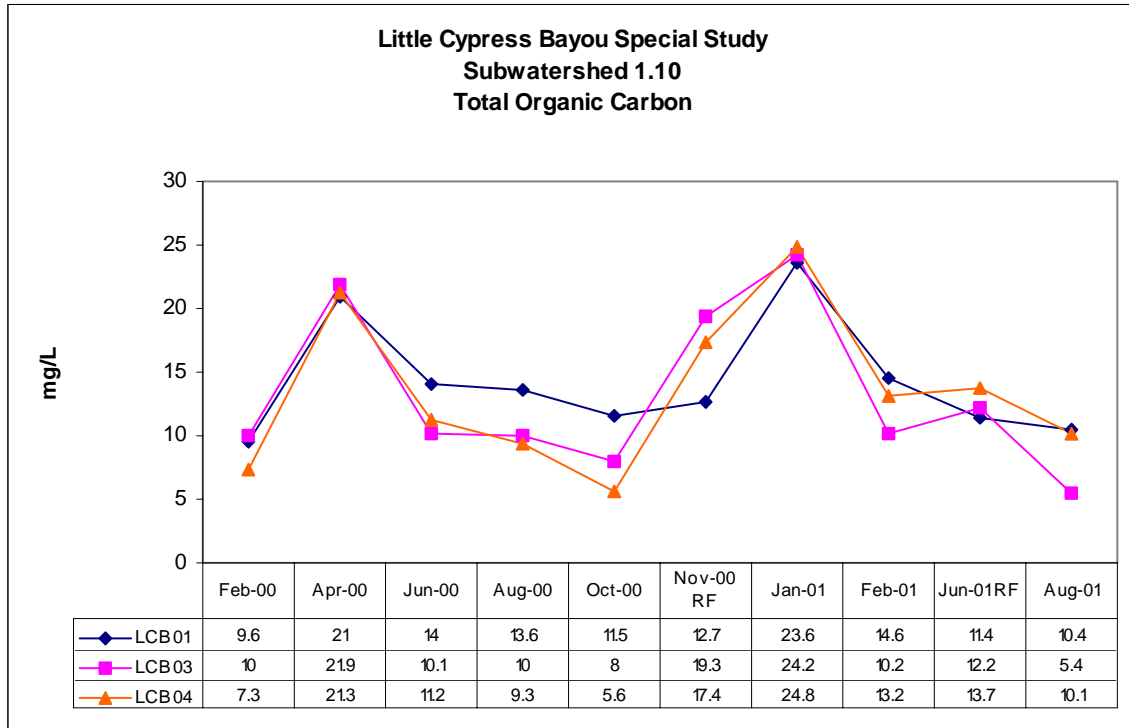
The biochemical oxygen demand (BOD) is a measure of the amount of oxygen removed from aquatic environments by aerobic microorganisms for their metabolic requirements. BOD is used to determine the level of organic pollution of a stream or lake. Stream sites typically have low BOD values, usually less than 5 mg/L. The BOD ranged from 12 mg/L at Station LCB01 to less than 2 mg/L at several sites. Slightly elevated values of 3 mg/L or higher were observed at all stream sites during at least one of the sampling events. BOD appeared to decline as rainfall increased.



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### Total Organic Carbon

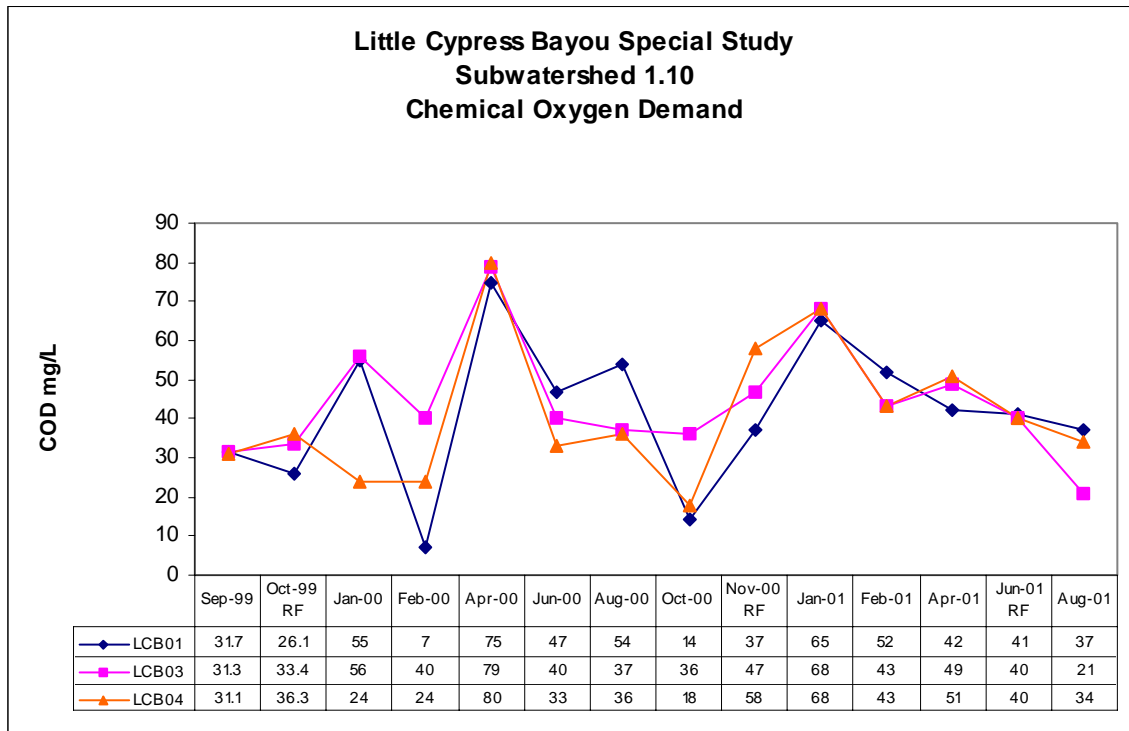
Total organic carbon (TOC) is another measure of organic material in water. Stream values are usually less than 10 mg/L. The TOC values at the stream sites ranged from 24.8 mg/L at LCB01 to 5.4 mg/L at LCB03. The TOC values did not show any significant increase during rainfall events, but TOC values were generally higher in wetter periods. The impact on TOC from the discharges and surrounding land use activities appears to be evenly distributed at most of the stream sites.



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### Chemical Oxygen Demand

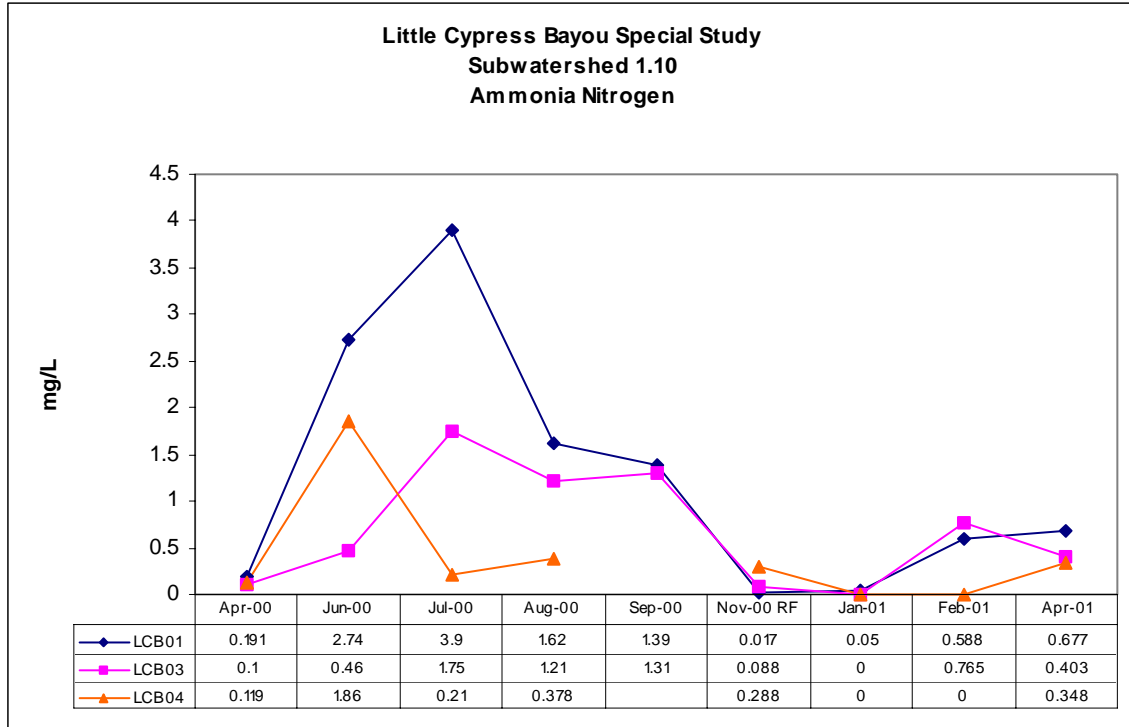
Chemical Oxygen Demand (COD) is a measure of the amount of organic substances in water or wastewater. COD values are typically higher than BOD values, and COD values in streams are normally less than 50 mg/L. The COD values in Little Cypress Bayou ranged from 80 mg/L at LCB04 to 7 mg/L at LCB01 with a median value of 40 mg/L. The highest COD values at all sites were recorded in April 2000. This sampling event occurred one day after a significant rainfall, which had been preceded by an extended dry period.



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### Ammonia

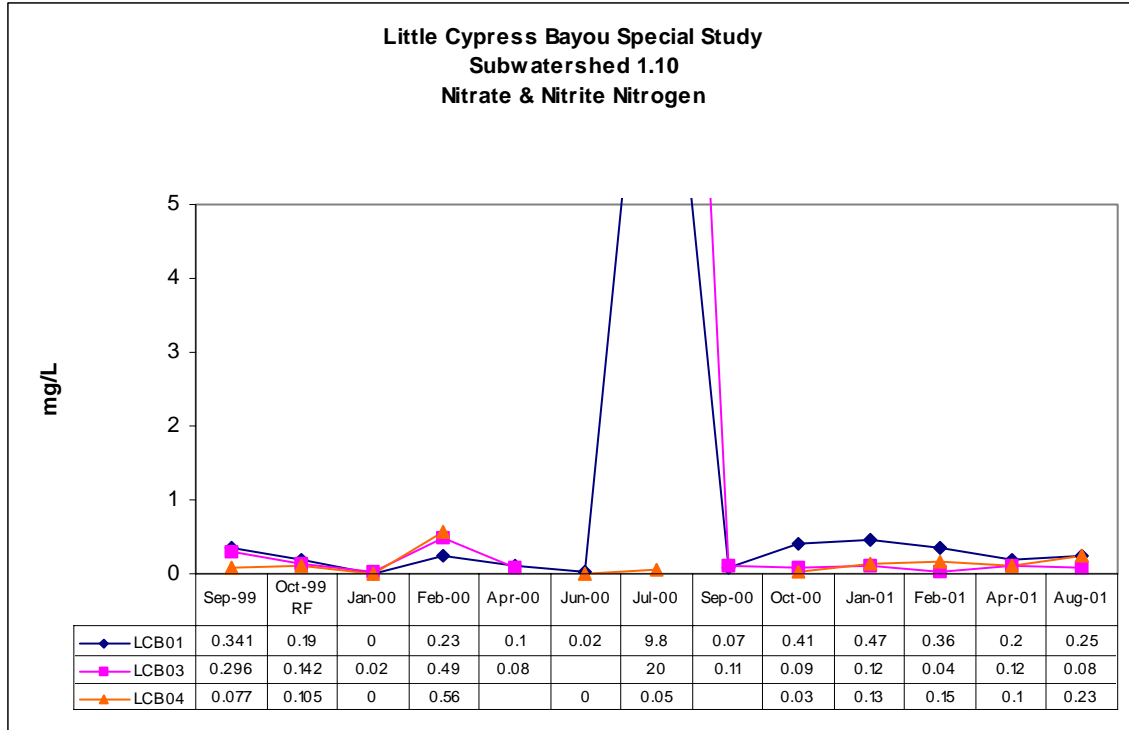
The toxicity is dependent on pH and it increases as pH increases. Values for pH in the Little Cypress Bayou Subwatershed are usually neutral to somewhat acidic. Stream values from natural sources of ammonia are rarely above 1 mg/L. Ammonia levels at the stream sites ranged from 3.9 mg/L at LCB01 to less than measurable amounts at LCB03 and LCB04. Ammonia values appeared lowest in wet periods and higher in dry periods.



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### Nitrate and Nitrite

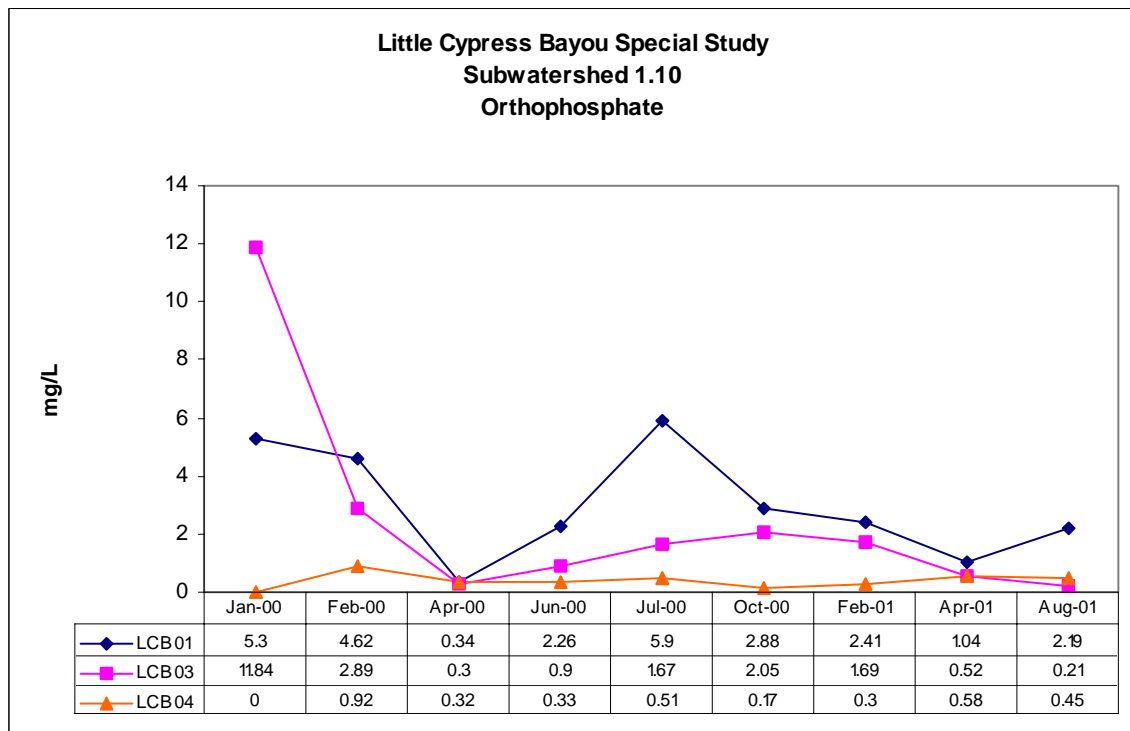
The primary concern for nitrogen compounds in water is nutrient enrichment that can lead to excessive growth of unwanted plants. High nitrites can also cause toxicity in fish. Levels of nitrate and nitrite in streams should not exceed 10 mg/L, although no limits are listed in TSWQS. The stream values were generally low with the exception of the July 2000 sampling event when site LCB03 recorded a value of 20 mg/L and site LCB01 recorded a value of 9.8 mg/L. The driest period of the study was in July 2000. Site LCB03 is immediately upstream of a WWTP discharge and LCB01 is downstream of this discharge.



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### Orthophosphate

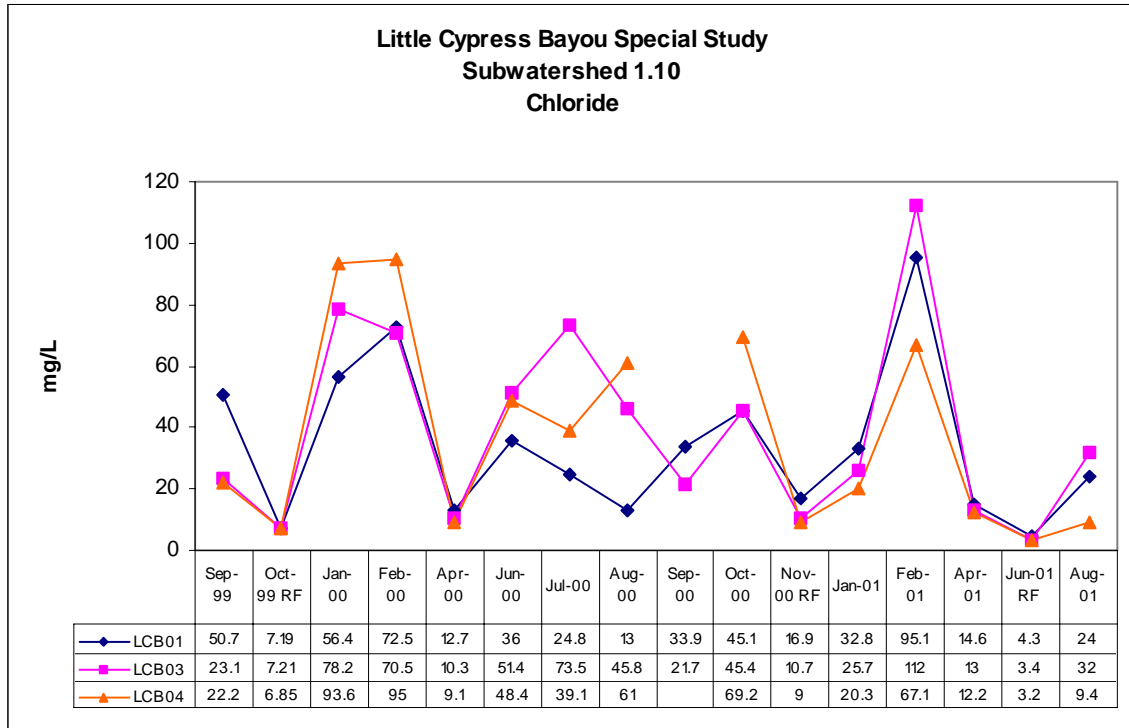
The presence of even small amounts (1 mg/L) in water can lead to excessive growth of aquatic weeds and algae. Levels of orthophosphate ranged from 11.8 mg/L at LCB03 to less than 0.3 mg/L at LCB04. Median orthophosphate values increased as you progress downstream. Site LCB04, the northern most site, had a median value of 0.45 mg/L followed by LCB03 with 1.68 mg/L and finally LCB01 at 2.65 mg/L. The orthophosphate values were lowest during periods of higher rainfall. Treated wastewater often has elevated levels of orthophosphate.



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### Chloride

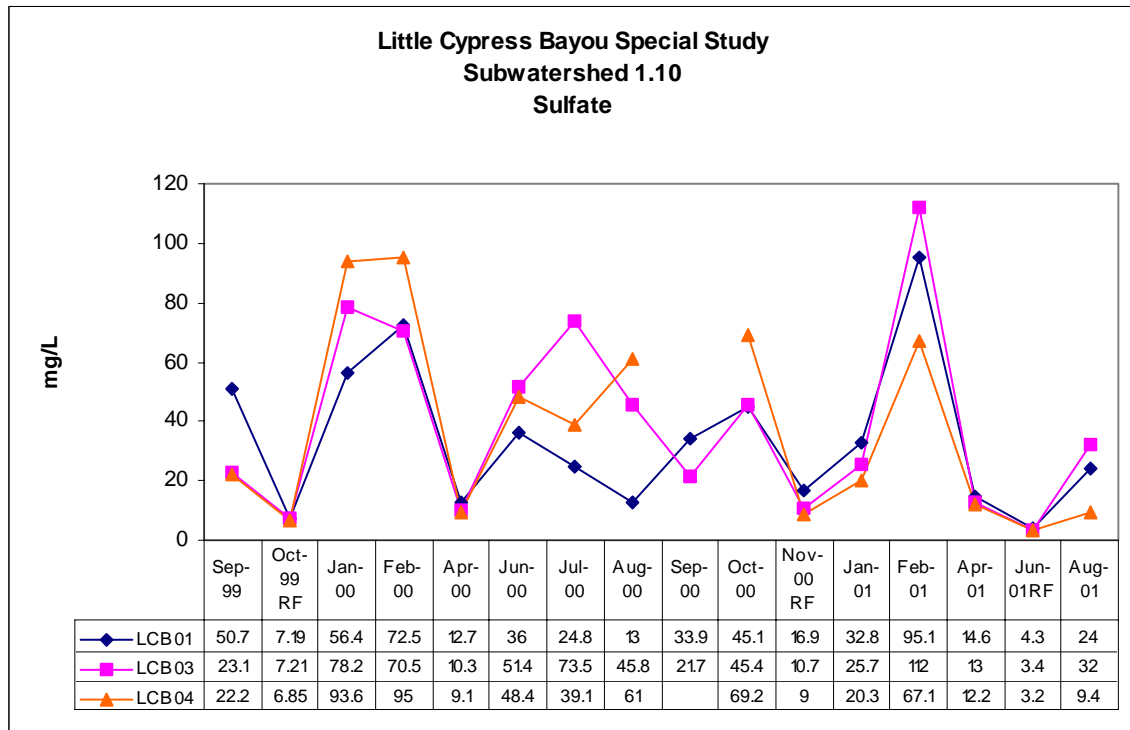
No limits for chloride levels are set in TSWQS for tidally influenced segments. High levels of chlorides (600 mg/L) can negatively impact freshwater streams and higher levels (1200 mg/L) can be toxic to fish. Fluctuating levels of chlorides are normal in estuarine systems and the aquatic community is adapted for these conditions. No value at any site came close to the 600 mg/L level. The values ranged from 112 mg/L at LCB03 in February of 2001 to 3.2 mg/L at LCB04 in August of 2001.



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### Sulfate

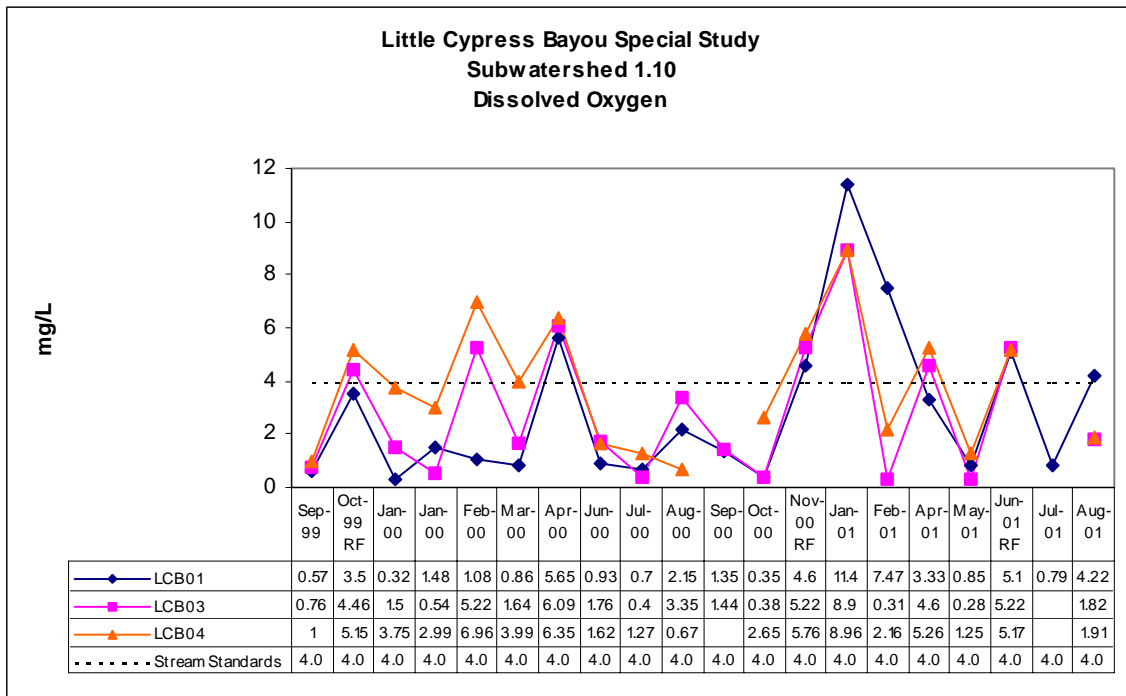
Sulfate limits are not set in TSWQS for tidally influenced segments. Sulfates are not considered toxic to plants or animals at normal concentrations. Levels of sulfate in Sabine Basin streams are generally well below 100 mg/L. Higher levels in streams can result from the breakdown of detritus washed into the stream. Values for sulfate in the stream sites were generally below 100 mg/L, but levels were detected close to or slightly above during at least two sampling events.



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### Dissolved Oxygen

Adequate dissolved oxygen is necessary for a healthy aquatic community and to provide for aerobic life forms that carry on natural stream purification processes. As dissolved oxygen levels in water drop below 5.0 mg/L, aquatic life is stressed. Oxygen levels that remain below 1-2 mg/L for a few hours can result in large fish kills. Stream standards for dissolved oxygen are set as the minimum average value for a 24-hour period. The daily average set in TSWQS is 4.0 mg/L with a minimum instantaneous value of 3.0 mg/L. The dissolved oxygen values were generally low at stream sites and ranged from 11.4 mg/L at LCB01 to less than 1.0 mg/L during at least one sampling event at each site. At Station LCB01 the dissolved oxygen values were only above the 4 mg/L standard three times during the monitoring period. Dissolved oxygen readings observed during rainfall events closely followed the values observed during the bimonthly monitoring. Dissolved oxygen values were higher during wetter periods.



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### Fecal Coliform

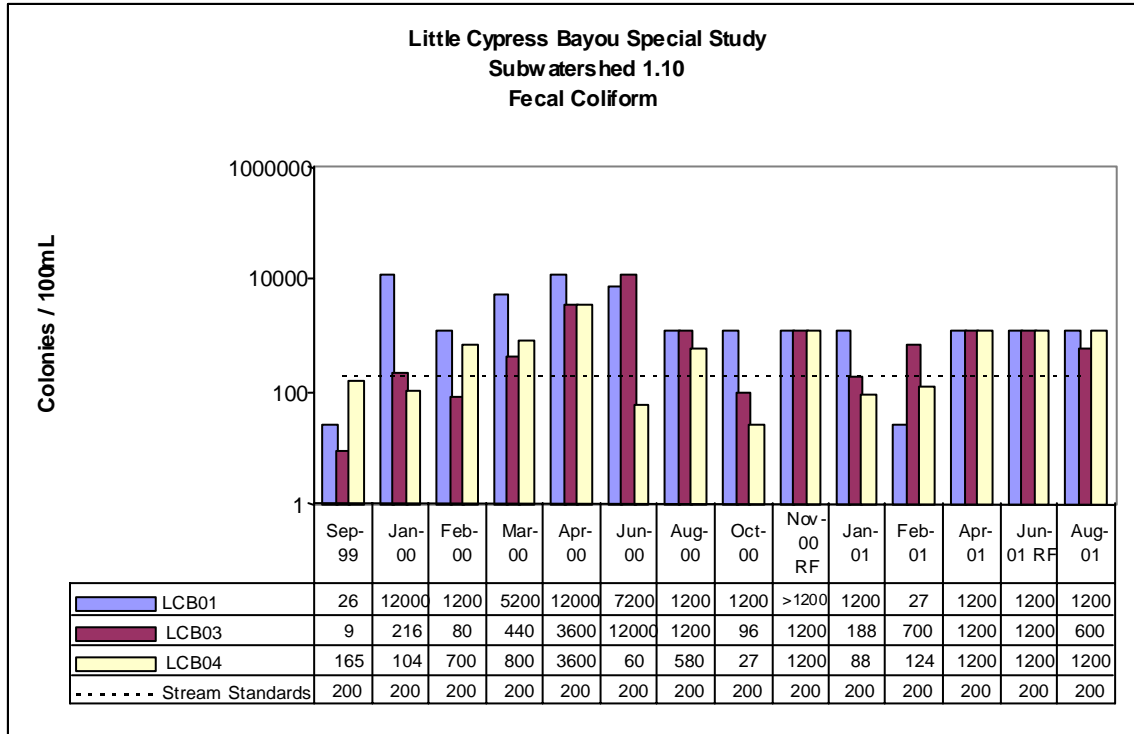
Coliform bacteria are a collection of relatively harmless microorganisms that live in large numbers in the intestines of man and warm- and cold-blooded animals. The presence of fecal coliform bacteria in aquatic environments indicates contamination with the fecal material of man or other animals. The water may also be contaminated by pathogens or disease producing bacteria or viruses, which can exist in fecal material. Some waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis and hepatitis A. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water due to the overflow of domestic sewage or nonpoint sources of human and animal waste.

The TSWQS fecal coliform limit in water used for contact recreation is 200 colonies per 100 mL of water. Violations of the stream standards occurred at all of the stream sites during almost every sampling event. Out of a total of fourteen sampling events, site LCB01 was less than the 200 colonies per 100 mL of water only twice. Many of the results were greater than could be accurately counted and therefore only approximations are presented on the graph. LCB03 was below the limit four times, while LCB04 was less than six times. The results from the differentiation tests indicated that all of the bacteria present from the fecal coliform group were *Escherichia coli*. These results indicate sewage contamination is present throughout the Little Cypress Bayou Subwatershed.

### Fecal Coliform - Rainfall Events

Rainfall events typically cause an elevation of fecal coliform levels in streams due to contaminated runoff. Values during rainfall events closely matched results from routine sampling. Fecal coliform levels at each site exceeded 200 colonies per 100 mL in every rainfall-sampling event.

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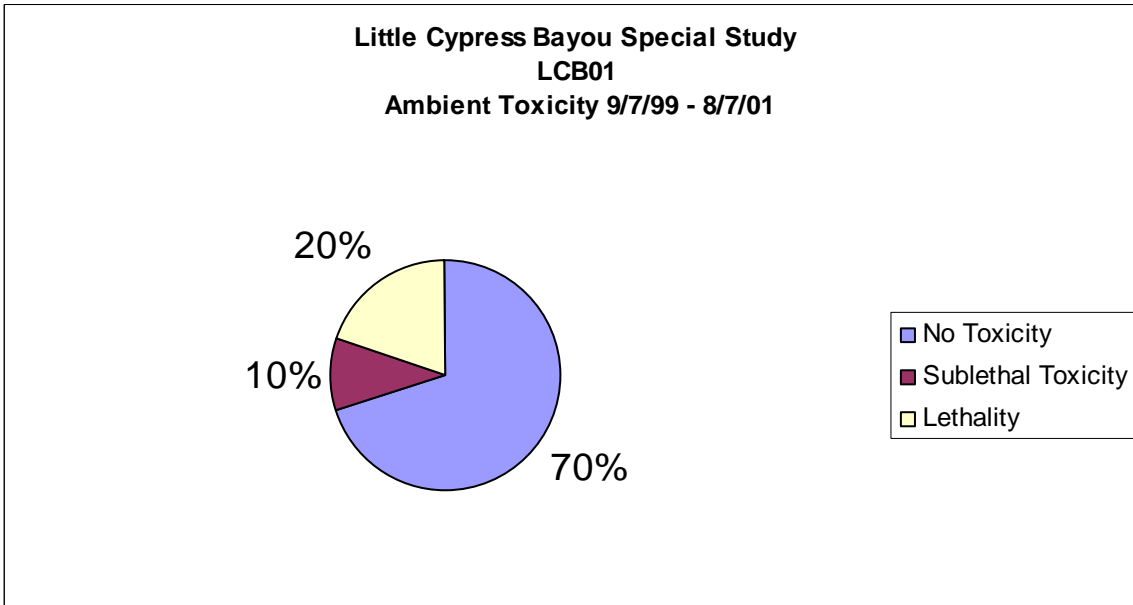
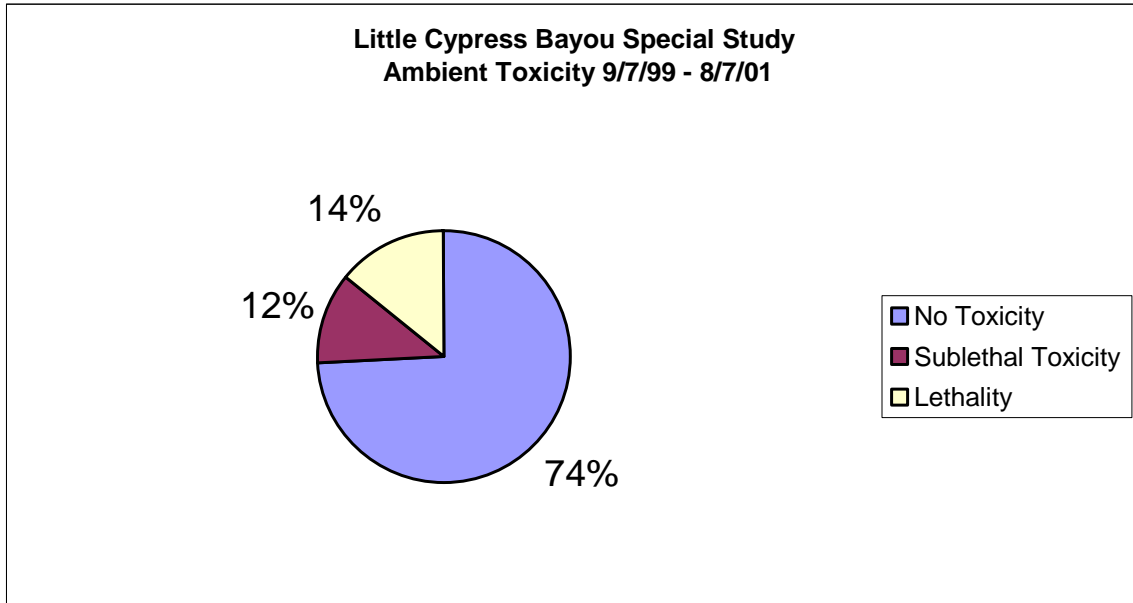
Some of the large values are estimates only.

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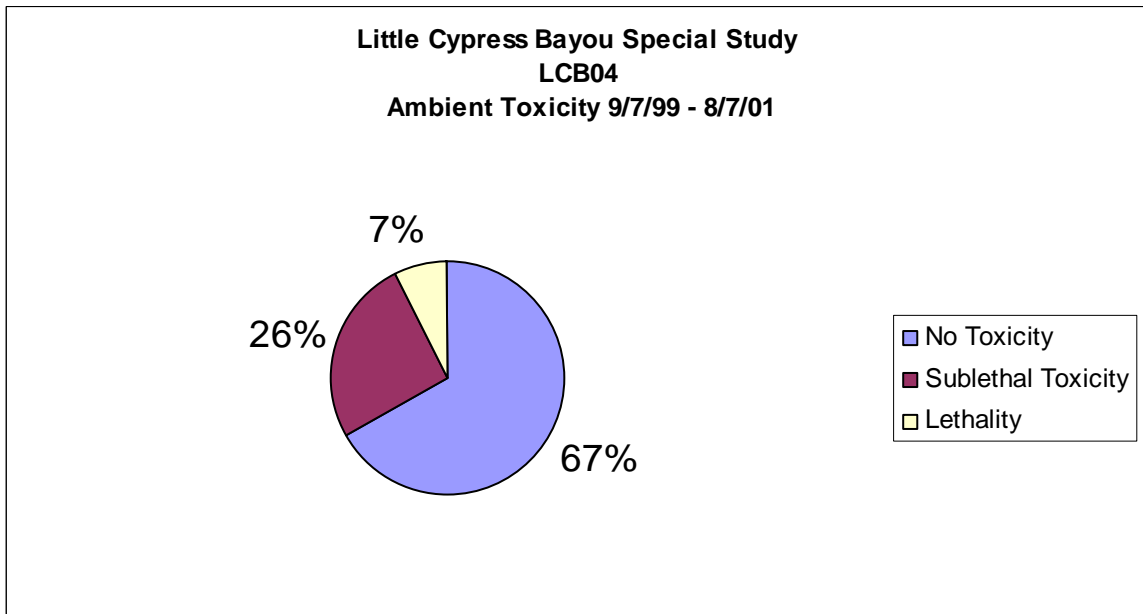
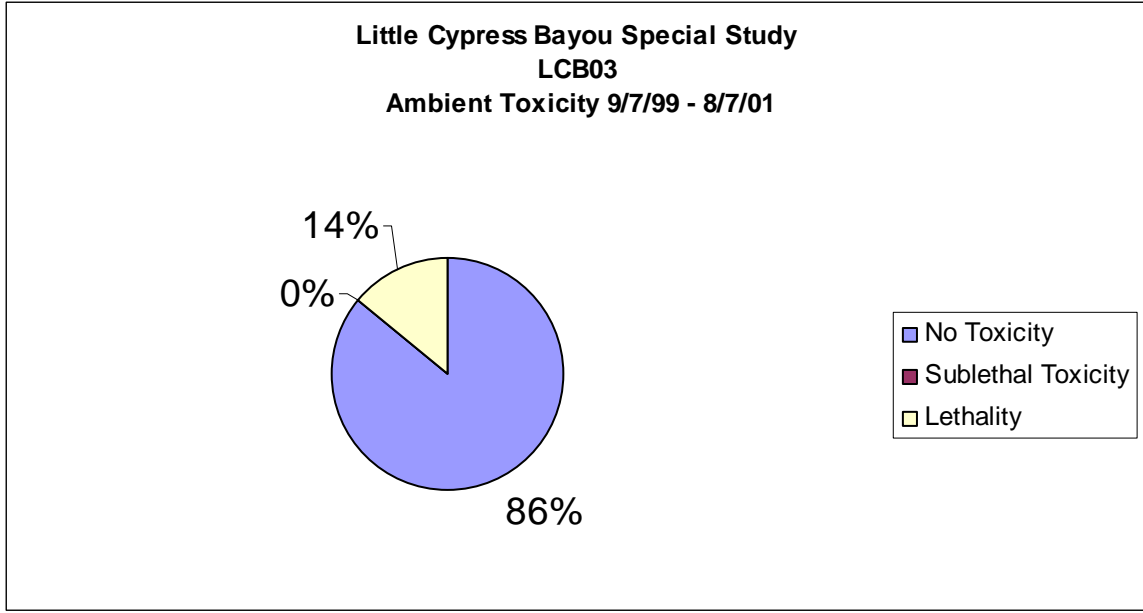
### **Ambient Toxicity**

The TNRCC guidelines for screening and assessing water quality data consider waterbodies with toxicity in less than 10% of the samples tested as fully supporting aquatic life. The results of the ambient toxicity testing in Little Cypress Bayou showed lethality in 14% of the samples. Sublethality was observed in 12% of the samples. Ambient toxicity tests were performed on all sites during the study. Site LCB01 was tested thirty times and showed lethality six times and sublethality three times. LCB03 was tested twenty-eight times and four results showed lethality. Twenty-seven tests were conducted on samples from LCB04 and the results showed lethality twice and sublethality seven times.

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## **Special Study on Subwatershed 1.10 - Little Cypress Bayou**

### ***Conclusions and Recommendations***

Impairments in water quality in the Little Cypress Bayou Subwatershed include consistently elevated levels of fecal Coliform bacteria and depressed levels of dissolved oxygen. Elevated nutrients and organic loading also indicate poor water quality conditions. Water quality in the Little Cypress Bayou Subwatershed shows improvements during periods of rainfall and deteriorates with periods of dry weather. This would indicate pollutant loading from point sources exceeds the assimilative capacity of the water body. If the primary source of water quality problems were from nonpoint sources, then the water quality would decline as rainfall runoff carried additional pollutants into the stream. Water quality in the Subwatershed is limited due to the tidal influence in the coastal area. This tidal influence severely limits the ability of the water body to assimilate pollutants. Due to the natural conditions in the Subwatershed, the present wastewater systems in the Little Cypress Bayou watershed are not adequately preventing water quality degradation in the stream. The impact on Little Cypress Bayou ultimately impacts the Blue Elbow Swamp including the Tony Houseman State Park and Wildlife Management Area.

Improvements to the current treatment systems would be beneficial, but to sufficiently reduce the impact on Little Cypress Bayou the area should be served by a system large enough to eliminate the stress on the natural system, such as a regional system for the greater Orange County area.

A regional wastewater system should also address discharge of treated wastewater into a constructed wetland to further reduce any impact to the receiving stream. Artificial wetlands have been shown to function well in southeast Texas. Constructed wetlands such as the city of Beaumont's not only improve water quality in the stream, but also offer an eco-tourism bonus to the area.