of ingestion of water includes wading by children, swimming, water skiing, diving, and surfing. It is possible to swim in water that does not meet this standard without becoming ill; however, the probability of becoming ill is higher than it would be if bacteria levels were lower.

Fish Consumption Use - The standards associated with this use are designed to protect the public from consuming fish or shellfish that may be contaminated by pollutants in the water. The standards identify levels at which there is a significant risk that certain toxic substances dissolved in water may accumulate in the tissue of aquatic species. However, because these levels do not always predict when toxic substances will accumulate in fish to unsafe concentrations, the state also conducts tests on fish tissue to determine if there is a risk to the public from consuming fish caught in state waters.

General Uses - Water quality criteria for several constituents are established in the TSWQS to safeguard general water quality, rather than for the protection of a specific use. Water temperature, pH, chloride, sulfate, total dissolved solids (TDS), and Enterococci are the parameters in this grouping. The general use criteria established for classified segments do not apply to unclassified water bodies.

Primary Concerns - Methodology established by the TCEQ to identify indicators, such as dissolved oxygen, that are directly tied to support of designated uses and criteria adopted in the TSWQS. Tier 1 primary concerns are identified for indicators where less than 10 samples are available for assessment and some exceedances are reported. Tier 2 primary concerns are identified for indicators that support the designated use as determined by an adequate number of samples (minimum of 10), but a few reported exceedances indicate a potential water quality problem.

Secondary Concerns - Used by the TCEQ to identify indicators, such as nutrients, that are not tied to support of a designated use with a quantitative criterion and in some cases the narrative criteria may not be supported. Screening levels for these indicators have generally not been adopted as standards (with the exception of secondary drinking water standards). Water bodies with concerns are identified in the 305(b) report, but are not placed on the 303(d) list.

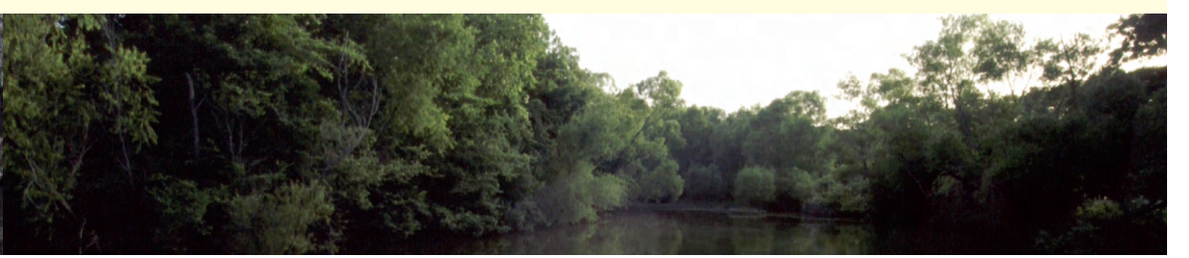
Dissolved Oxygen (DO) - The concentration of dissolved oxygen is a single, easy to measure characteristic of water that correlates with the occurrence and diversity of aquatic life in a water body. A water body that can support diverse, abundant aquatic life is a good indication of high water quality. A related problem is an excess of nutrients in water. Large quantities of nutrients in water can cause excessive growth of vegetation. This excessive vegetation, in turn, can cause low dissolved oxygen.

Fecal Coliform, E. coli, and Enterococci Bacteria - These indicator bacteria are measured to determine the relative risk of contact recreation use. A number of pathogenic (disease-causing) viruses, bacteria, and protozoans can enter a water body from the wastes of warm blooded animals. Directly testing for these pathogens is impractical since pathogens are rarely present in large numbers, and many are difficult to cultivate in the laboratory, therefore, microbiologists look for these "indicator" species. Their presence indicates that pathogens may be reaching a body of water from inadequately treated sewage, improperly managed animal waste from livestock, pets in urban areas, aquatic birds and mammals, or failing septic systems.

Beginning in 2001, the ANRA and TCEQ began analyzing *E. coli* bacteria in addition to fecal coliform at all monitoring stations in the basin to support the proposed Texas Surface Water Quality Standards. Since *E. coli* is considered a better indicator of potential human impacts, the TCEQ and CRP planning agencies, including ANRA, dropped fecal coliform analysis in FY 03-04 after adequate data was collected for the assessment period. Because *E. coli* and fecal coliform data are not easily comparable, *E. coli* was the only indicator bacteria that was assessed in the data review included in this report.

Dissolved Solids - High levels of dissolved solids such as chloride and sulfate can cause water to be unusable, or simply too costly to treat, for drinking water uses. Changes in dissolved solids concentrations also affect the quality of habitat for aquatic life.

Metals - High concentrations of metals such as cadmium, mercury, and lead pose a threat to drinking water supplies and human health. Eating fish contaminated with metals can cause these toxic substances to accumulate in human tissue, posing a significant health threat. Metals also pose a threat to livestock and aquatic life. Potentially dangerous levels of metals and other toxic substances are identified through chemical analyses of water, sediment, and fish tissue.



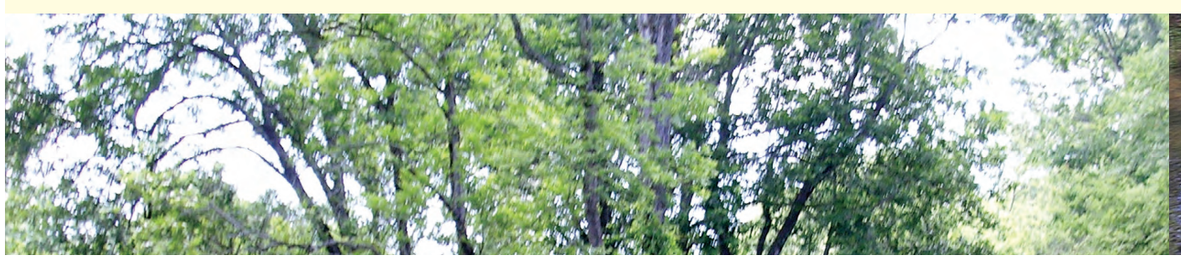
Organics - Toxic substances from pesticides and industrial chemicals, called organics, pose the same concerns as metals. Polychlorinated biphenyls (PCBs), for example, are industrial chemicals that are toxic and probably carcinogenic. Although banned in the United States in 1977, PCBs remain in the environment, and they accumulate in fish and human tissues when consumed.

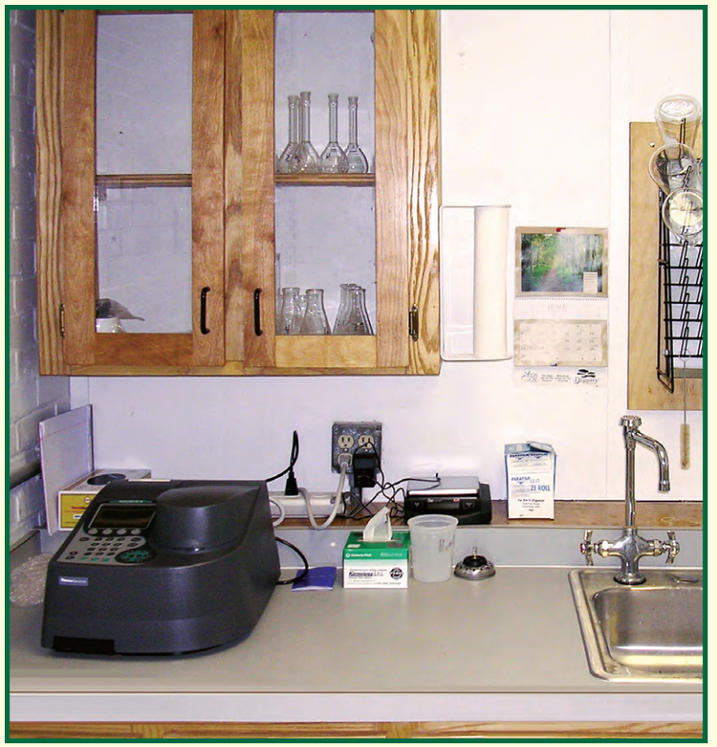
Nutrients - Any material that organisms take in and assimilate for growth and maintenance. In water, nutrients can act as fertilizing compounds and stimulate and sustain growth and development of aquatic plants and algae. These constituents are analyzed to determine water quality conditions since excessive levels of nutrients in a water body may cause eutrophication. Eutrophic waters provide ideal conditions for the growth of algae and over time may cause algal blooms which decrease dissolved oxygen levels.

The routine nutrient parameters tested by ANRA include Ammonia-Nitrogen, Total Nitrate+Nitrite, Total Phosphorus, Ortho-phosphorus and Chlorophyll a. The results are then compared to screening levels established by the TCEQ which are statistically derived from long-term surface water quality monitoring (SWQM) data.

Ambient Toxicity - Ambient toxicity testing, as a water quality assessment tool, complements chemical monitoring by allowing observation of toxic effects on laboratory test species selected as surrogates for indigenous species. Ambient Toxicity tests involve biological analyses of a minimum of two different test organism species (per event) to measure survival and reproduction, or growth rates, upon exposure to water samples. The results of the tests are evaluated by comparing the number of lethal results to the total number of tests conducted. Results are also compared with other biological, physical, and chemical data to characterize aquatic community impairments resulting from conventional pollutants or habitat degradation that may overshadow effects of toxicants. Potential sources of toxicity include a variety of non-point and point sources, agricultural and urban runoff, hazardous waste sites, and municipal and industrial discharges.

In Texas, the Environmental Protection Agency's (EPA) Region 6 Ambient Toxicity Monitoring Program coordinates a program to identify waterbodies with the potential for aquatic life use impairment attributable to toxicants. The TCEQ participates in the program by periodically collecting samples at specified monitoring sites. Samples are tested in the EPA Region 6 Houston Laboratory, and results are sent to the Region 6 Water Quality Protection Division and the TCEQ. EPA and the TCEQ use this data to assess potential toxicity in Texas waterbodies as part of the 305(b) Water Quality Inventory Report, and to evaluate the effectiveness of implemented toxicity control measures. ANRA does not collect or analyze toxicity data, but has summarized results from the EPA's Ambient Toxicity Monitoring Program in this report.





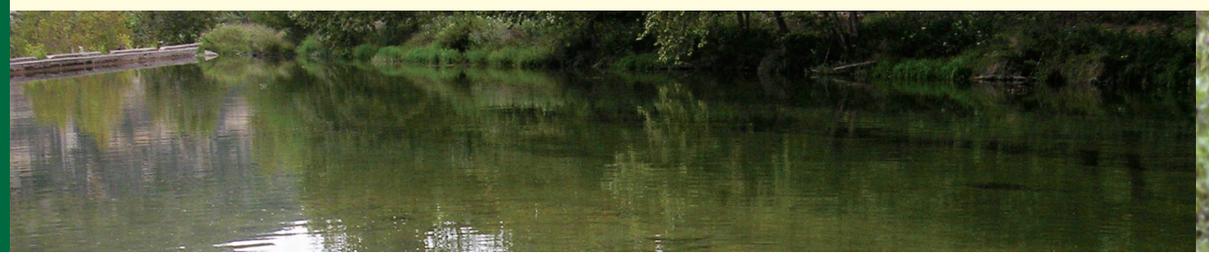
3.2 Technical Process

The data analysis methods used to evaluate the data were based on the general assessment methodology found in the TCEQ's *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data, 2002* for the data review and the *Clean Rivers Program Guidance and Reference Guide, FY 2004-2005* for the trend analysis. The segment specific criteria established in the 2000 Texas Surface Water Quality Standards, which are summarized in Table 3.2-1 for the classified segments in Upper Neches River Basin, were used to determine designated use support.

The data review process utilized surface water quality monitoring data stored in the TCEQ Regulatory Activities and Compliance System (TRACS) database for Basin 6 (Neches) which was downloaded from TCEQ's website. The database tables were imported into Microsoft Access software where they were queried by segment, station ID, date collected, time collected, depth, long description, storet code, units, and value. The main query table consisted of 161,863 records which included all segments in the basin. The data was then filtered for each of the nine segments in the Upper Neches Basin and exported by segment to Microsoft Excel spreadsheets. Each spreadsheet was filtered for the date range from September 1998 to August 2003 which is the five year period of record used for the data review. In cases where additional data was available and the period of record did not meet the minimum number of samples required (10), more recent data was included in the data review process to complete the dataset. The stations in each segment and the parameters included in the data review were filtered and tables were generated by parameter for each station. The parameters evaluated in this report included pH, Water Temperature, Dissolved Oxygen (DO), Ammonia-Nitrogen, Nitrate+Nitrite-Nitrogen, Total Phosphorus, Ortho-phosphorus, Sulfate, Chloride, Total Dissolved Solids (TDS), *E. coli*, Chlorophyll a, and 24-hour DO averages. Data review summary tables indicating the total number of samples, minimum value, maximum value, mean, applicable water quality criteria, data review results, and trend analysis results were developed and they are provided in Appendix B: ANRA Data Analysis Results.

The designated use support criteria and the water quality concerns criteria used for the data review are presented in Tables 3.2-2, 3.2-3, and 3.2-4 at the end of this section. A minimum of ten samples or measurements were required at a monitoring station for a parameter to be assessed. The tributaries or unclassified water bodies in each segment were assessed using the same criteria established for the classified segment. This differs slightly from TCEQ's guidance for assessing general uses and primary concerns which says the water temperature, pH, chloride, sulfate, and TDS criteria developed for classified segments do not apply to unclassified water bodies. Also, the primary concerns listed in the data review apply to sites where only 4 to 9 samples are available (Tier 1), and the binomial method utilized by TCEQ which is based on the process of analyzing error rates was not considered in ANRA's data review.

The trend analysis utilized surface water quality data provided by the TCEQ which included data from 1996 - 2003 with a total of 14,282 records. A minimum of 20 total data points were required for each parameter at a station. The parameters included in the trend analysis were DO deficit, Water Temperature, pH, Conductivity, TDS, TSS, Sulfate, Chloride, Ammonia, Nitrate+Nitrite, Ortho-phosphorus, T. Phosphorus, Chlorophyll a, Bacteria (fecal coliform), and seasonal flows. A simple linear regression was used to determine whether a potential trend exists. Microsoft Excel spreadsheet software was utilized for this effort. Spreadsheet tables for each



station and parameter included the following information: R-squared, t-ratio, P value, and Number of Records. Data sets with a t-ratio significantly different from zero (> or = |1|) and a P-value less than 0.10, indicated a possible trend, and were selected for further analysis. The larger the t-ratio and the smaller the P-value, the stronger the trend. The data and residuals were plotted versus time and normal probability plots were used. If the normal probability plots were significantly curved or many of the measurements did not follow the pattern, the data was transformed by taking a log and rerunning the regression. For those stations that showed a potential trend, regressions were run which accounted for flow and seasons. The results of ANRA's trend analysis are included in Appendix B: ANRA Data Analysis Results. Trend analysis results are also included in the watershed summaries section to provide additional information where a concern or use is not supported.

Maps in Section 5.0 are provided for each segment in the Upper Neches Basin. The maps include the locations of all monitoring stations and indicate if a trend or exceedence exists at the station. Each station on the map is labeled and a colored dot is assigned to each monitoring station based on the results of the data review and trend analysis. The following station information is depicted in the map legends: yellow dots indicate stations which have both a trend and exceedence; green dots are stations with only a trend; red dots are stations which have an exceedence(s) but no trend was identified; and black dots are monitoring stations with no trends or exceedances. In some cases, the stations with no trend or exceedence (indicated by the black dots on the maps) were not assessed based on limited data during the five year assessment period.

Spatial analysis was conducted using all available land use information and GIS coverages in the ANRA GIS database. The spatial analysis compared water quality impairments to possible sources of impairments. ANRA is continuing to build a geographical database of factors that can impact water quality. The data collected by GPS units is entered into a Geographic Information System (GIS) where it can be spatially analyzed by sub-watershed in reference to other water quality data. The GIS coverages include wastewater outfalls, stormwater outfalls, agriculture operations, on-site sewage facilities, oil and gas wells, groundwater wells, solid waste facilities, superfund sites, and other water quality complaints or investigations.

Table 3.2-1: Segment Specific Water Quality Standards

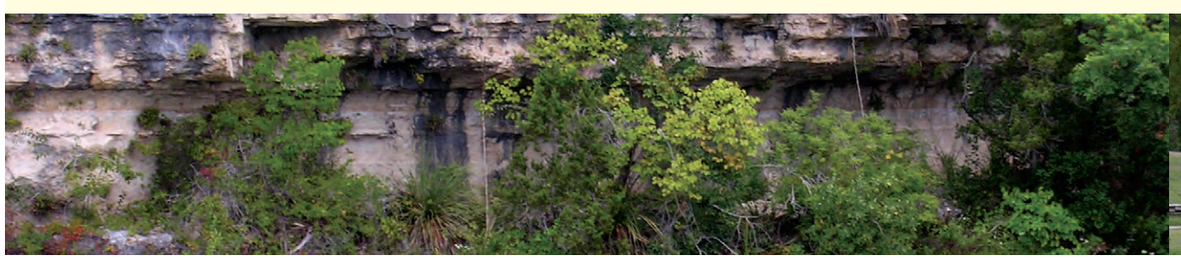
SEGMENT NUMBER	SEGMENT NAME	USES 1	2	3	CRITERIA 4	5	6	7	8	9	10
0604	Neches River Below Lake Palestine	CR	H	PS	50	50	200	5.0	6.0-8.5	126	91
0605	Lake Palestine	CR	H	PS	50	50	200	5.0	6.0-8.5	126	90
0606	Neches River Above Lake Palestine	CR	I	PS	100	50	300	4.0	6.0-8.5	126	95
0610	Sam Rayburn Reservoir	CR	H	PS	100	100	400	5.0	6.0-8.5	126	93
0611	Angelina River Above Sam Rayburn Reservoir	CR	H	PS	125	50	250	5.0	6.0-8.5	126	90
0612	Attoyac Bayou	CR	H	PS	75	50	200	5.0	6.0-8.5	126	90
0613	Lake Tyler / Lake Tyler East	CR	H	PS	50	50	200	5.0	6.5-9.0	126	93
0614	Lake Jacksonville	CR	H	PS	50	75	750	5.0	6.5-9.0	126	93
0615	Angelina River/Sam Rayburn Reservoir	CR	H	PS	150	100	500	5.0	6.5-9.0	126	93

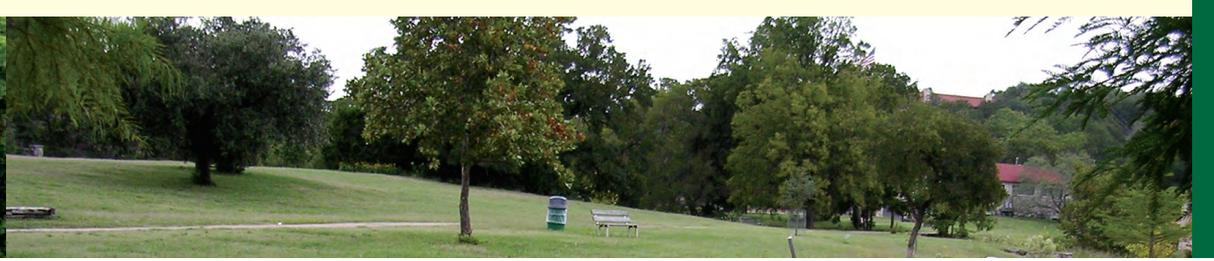
USES:

1. Recreation
   CR – Contact Recreation
2. Aquatic Life
   E – Exceptional
   H – High
   I – Intermediate
   L – Limited
3. Domestic Water Supply
   PS – Public Supply

CRITERIA:

4. Chloride (mg/L) - Annual average - Not to exceed
5. Sulfate (mg/L) - Annual average - Not to exceed
6. Total Dissolved Solids (mg/L) - Annual average - Not to exceed
7. Dissolved Oxygen (mg/L) - 24 hour average
8. pH Range (standard units)
9. E. coli (# /100 mL)
10. Temperature (^{0} F) - Not to exceed





The following tables contain the criteria used for the ANRA data review.

Table 3.2-2: Use Support Criteria

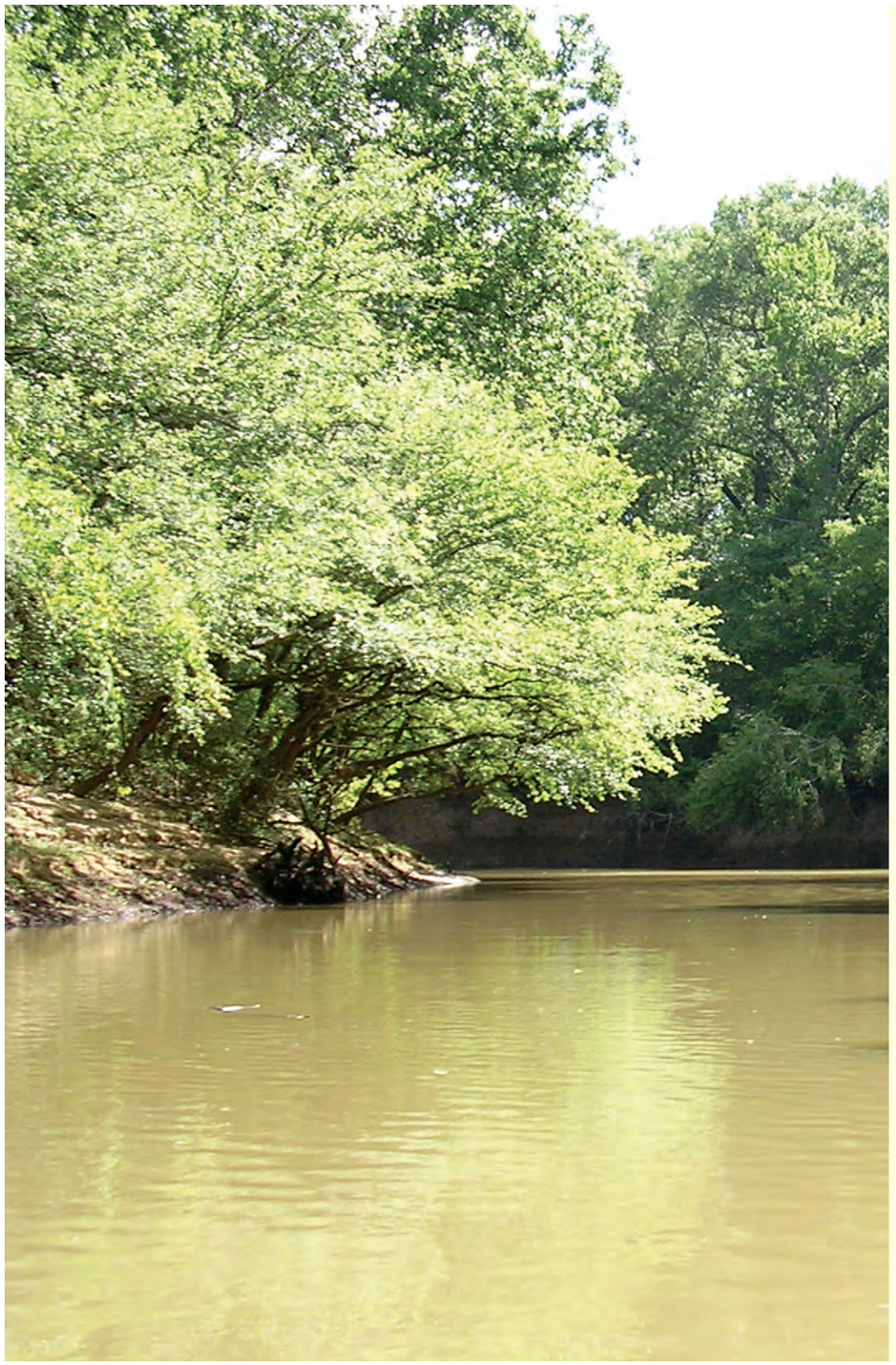
Use/Impact	Assessment Method	Fully Supporting	Partially Supporting	Not Supporting
Overall Use Support	Evaluation of Designated and General Uses	All uses are fully supported	One or more uses are partially supported and remaining uses are fully supported	One or more uses are not supported
Aquatic Life Support	Routinely Collected Instantaneous Dissolved Oxygen Measurements (Grabs) Compared to Absolute Minima in the TSWQS	10% or less of the time, concentrations are less than minimum criterion	Greater than 10% to 25% of the time, concentrations are less than minimum criterion	Greater than 25% of the time, concentrations are less than minimum criterion
	Acute and Chronic Exposure to Metals and Organic Substances in Water	10% or less of the time, for any individual parameter, concentrations are less than the acute criterion and/or the average is less than or equal to the chronic criterion.	Greater than 10% to 25% of the time, for any individual parameter, concentrations exceed the acute criterion	Greater than 25% of the time, for any individual parameter, concentrations exceed the acute criterion and/or the average is greater than the chronic criterion.
Contact Recreation	E. coli Geometric Mean -126 Single Sample - 394	Long-term geometric average is less than the criterion *and* 25% of the time or less, concentrations are greater than the single sample criterion.	Partial support is not assessed.	Long-term geometric average exceeds the criterion *and/or* greater than 25% of the time, concentrations are greater than the single sample criterion.

Table 3.2-3: General Use Criteria

Parameter	Units/Criteria	Fully Supporting	Partially Supporting	Not Supporting
Water Temperature	°F, segment-specific	10% or less of the time, measurements are less than the criterion	Greater than 10% to 25% of the time, the criterion is exceeded	Greater than 25% of the time, the criterion is exceeded
pH	Standard units, segment-specific (minimum and maximum criteria must be met)	10% or less of the time, measurements are outside the pH range	Greater than 10% to 25% of the time, values are outside the pH range	Greater than 25% of the time, values are outside the pH range
Chloride	mg/L, segment-specific	Segment average less than or equal to criterion	Partial support is not assessed	Segment average exceeds criterion
Sulfate	mg/L, segment-specific	Segment average less than or equal to criterion	Partial support is not assessed	Segment average exceeds criterion
Total Dissolved Solids (TDS)	mg/L, segment-specific	Segment average less than or equal to criterion	Partial support is not assessed	Segment average exceeds criterion

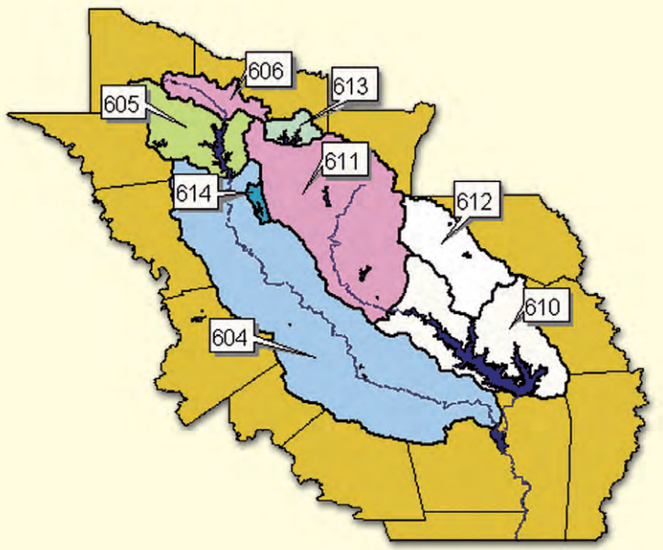
Table 3.2-4: Criteria for Nutrients in Water

Category	Parameter	Screening Levels	No Concern	Concern
Freshwater Streams	NH_3-N	0.17 mg/L	For any one parameter, the screening level is exceeded 25% or less of the time.	For any one parameter, the screening level is exceeded greater than 25% of the time.
	NO_2-N+ NO_3-N	2.76 mg/L		
	Ortho Phos.	0.5 mg/L		
	Total Phos.	0.8 mg/L		
	Chl a	11.6 ug/L		
Reservoirs	NH_3-N	0.106 mg/L	For any one parameter, the screening level is exceeded 25% or less of the time.	For any one parameter, the screening level is exceeded greater than 25% of the time.
	NO_2-N+ NO_3-N	0.32 mg/L		
	Ortho Phos.	0.05 mg/L		
	Total Phos.	0.18 mg/L		
	Chl a	21.4 ug/L		



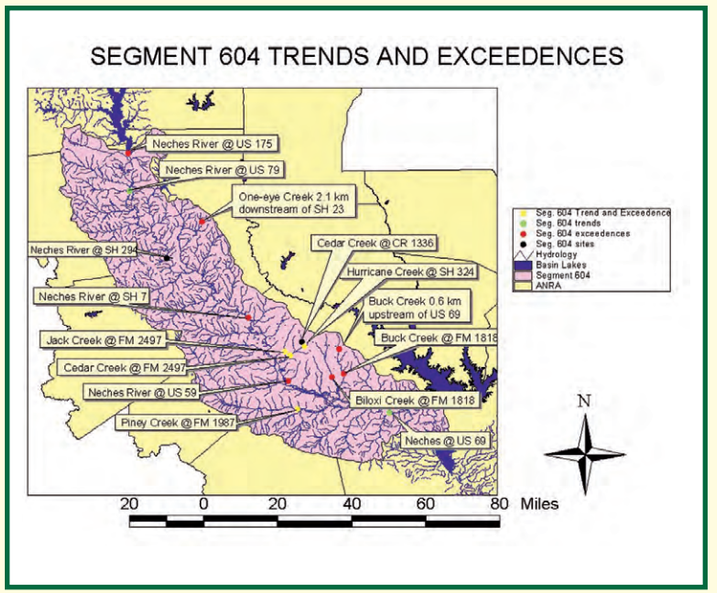
3.3 WATERSHED SUMMARIES

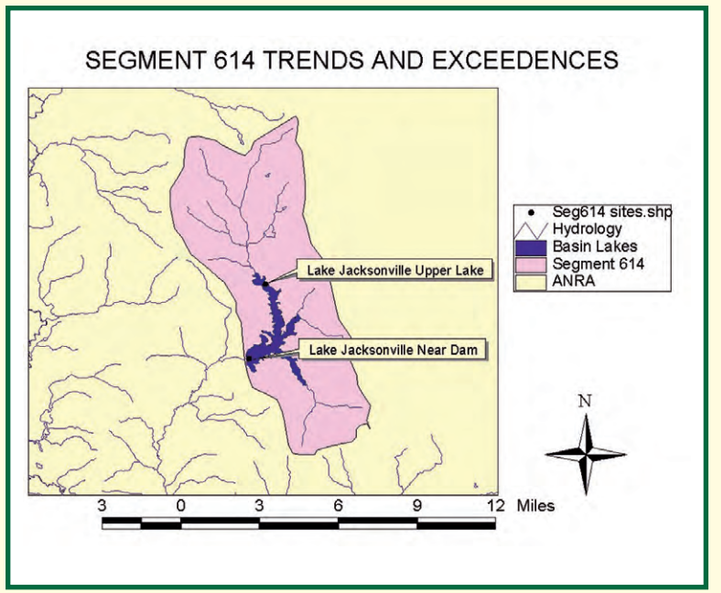
The following watershed summaries are provided to give an overview of the Upper Neches River Basin designated segments and their drainage areas which include tributaries or unclassified water bodies and subwatersheds. The data review results are summarized in tables located in each of the watershed summaries which are divided into the following six watersheds: Neches River below Lake Palestine, Lake Palestine, Neches River above Lake Palestine, Sam Rayburn Reservoir, Angelina River above Sam Rayburn, and Attoyac Bayou.



Neches River below Lake Palestine

Segments 0604 & 0614





Watershed Overview

This watershed includes two classified segments designated by the Texas Surface Water Quality Standards, Segment 0604 and 0614. Segment 0604 begins at the Blackburn Crossing Dam in Anderson/Cherokee County and extends to a point immediately upstream of the confluence of Hopson Mill Creek in Jasper/Tyler County. The segment extends for approximately 231 miles making it one of the largest segments in Texas. Lake Jacksonville, Segment 0614, impounds Gum Creek from the Buckner Dam in Cherokee County up to the normal pool elevation of 200 feet. The segment extends for approximately five miles with a surface area of 1,312 acres.

The watershed drainage area is 3,464 square miles and includes all or part of eight counties and eighteen municipalities including the Cities of Palestine, Jacksonville, and Lufkin. Since April 2000, the counties located in the watershed have experienced slight increases in population with the exception of Polk County. From April 2000 to July 2003, Polk County's population increased by 10.2% which is greater than the state average.

Fourteen endangered species inhabit the area including the Bald Eagle, Bachman's Warbler, Black Bear, Louisiana Pine Snake, Paddlefish, and Red-cockaded Woodpecker and seven threatened species such as the American Swallow-Tailed Kite, Blackside Darter, Bluehead Shiner, and Creek Chubsucker may also be found in the watershed.

The watershed is primarily located in the South Central Plains Ecoregion with the northwest portion located in the East Central Texas Plains Ecoregion. The natural subregions are Mixed Pine-Hardwood Forest and Longleaf Pine Forest. The major vegetation types in the area include Pine-Hardwood Forest, Loblolly Pine-Sweetgum, Young Forest/Grassland, Willow Oak-Water Oak-Blackgum Forest, Bald Cypress-Water Tupelo Swamp, and Other Native/Introduced Grassland.

The soil is generally loamy with sandy and clayey portions with nearly level to gently sloping soils. The natural drainage ranges from moderately well to somewhat poorly drained soils and the permeability ranges from very slow to moderate. Finally, this watershed segment is characterized by slightly to moderately acidic soils with regions of strongly acidic soils.

Numerous parks and recreational areas are located in the watershed. They include the Rusk/Palestine State Park, Texas State Railroad State Historical Park, Caddoan Mounds State Historic Site, Mission Tejas State Park, and Ratcliff Lake Recreation Area in the Davy Crockett

National Forest which is located west of the Neches River in Houston and Trinity County. This 161,497 acre National Forest proclaimed in 1936 and operated by the U.S. Forest Service contains a National Recreation Trail for hikers, canoe trails, wilderness areas, and the 14,500 acre Alabama Creek Wildlife Management Area along the Neches River. A portion of the Angelina National Forest is located in the extreme southern portion of the watershed along the Neches River in Angelina and Jasper County. The area includes the Upland Island Wilderness Area and the Boykin Spring and Bouton Lake Recreation Areas.

Segment 0604 is classified as effluent limited and the designated water uses are Contact Recreation, High Quality Aquatic Life Use, and Public Water Supply. Segment 0614 is classified as water quality limited and the designated water uses are Contact Recreation, High Quality Aquatic Life Use, and Public Water Supply. There are approximately 38 outfalls in this watershed (18 municipal, 11 industrial, 9 stormwater) with an estimated total discharge of 16.24 MGD. The elevation ranges from 650 feet MSL to 100 feet MSL and the principal tributaries of the segment are Piney Creek, Buck Creek, Biloxi Creek, and Cedar Creek. The watershed is heavily forested with some pasture land and urban development.

Data Review

The data review for the watershed is summarized in Table 3.3-1. The table includes the classified and unclassified water bodies within the watershed with sufficient data to complete the analysis, and the associated monitoring stations are listed with each water body. The water quality in the two classified segments, the Neches River (0604) and Lake Jacksonville (0614), are fully supporting all designated uses, although there are water quality concerns identified. There is a primary concern for bacteria (*E. coli*) at two stations on the Neches River and a water quality concern for Chlorophyll a at one station on the Neches River. In the unclassified segments or tributaries, the general use criteria are either not supporting or partially supporting the segment criteria for pH, TDS, sulfate, or chloride at seven stations. The contact recreation use is not supported at five stations and there are concerns for nutrients at five stations. Additional monitoring activities at Lake Jacksonville has provided sufficient data to complete the data review for this segment, and no water quality concerns are identified.

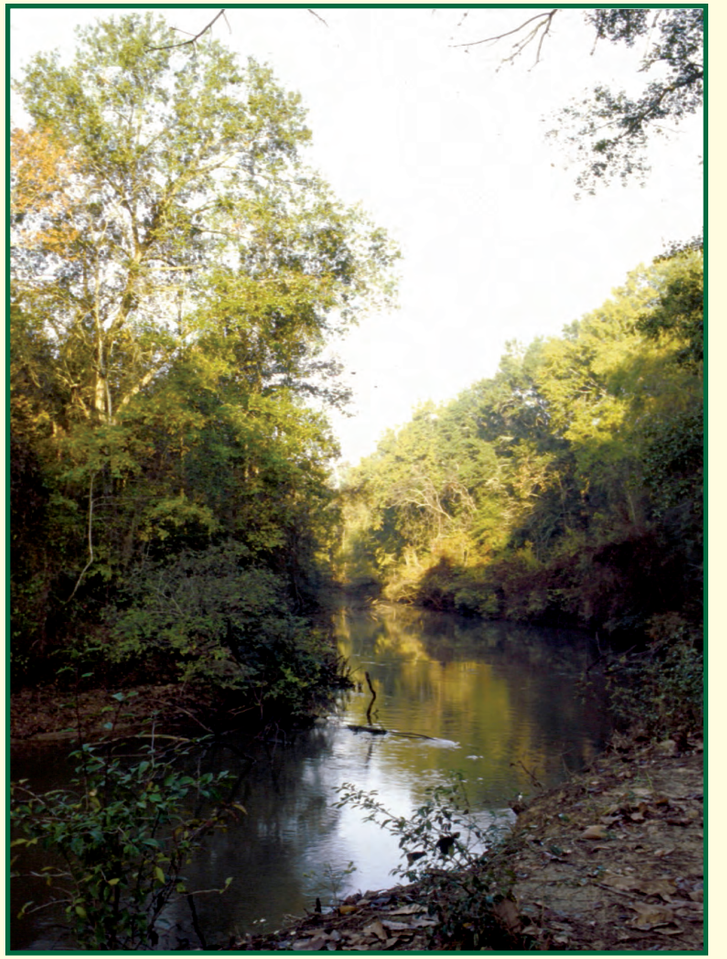


Table 3.3-1: Summary of Data Review for the Neches River below Lake Palestine

Segment	Waterbody	Stations*	Results of ANRA's Data Review
0604	Neches River	10585	Fully Supporting, No Concerns
		10586	Fully Supporting, Primary Concern (E. coli)
		10591	Fully Supporting, Concern (Chl a)
		13627	Fully Supporting, No Concerns
		14794	Fully Supporting, No Concerns
		17067	Fully Supporting, Primary Concern (E. coli)
0604A	Cedar Creek	10478	Not Supporting (TDS, Chloride, Sulfate, E. coli) Concern (Ammonia-N, Nitrate+Nitrite, Total Phosphorus, Ortho Phosphorus)
0604B	Hurricane Creek	13529	Not Supporting (TDS, Chloride, Sulfate, E. coli) Concern (Ammonia-N)
0604C	Jack Creek	10492	Not Supporting (TDS, Chloride, Sulfate, E. coli) Concern (Ammonia-N, Nitrate+Nitrite, Total Phosphorus, Ortho Phosphorus)
0604D	Piney Creek	16081	Not Supporting (Sulfate) Partially Supporting (pH, DO) Concern (Ammonia-N) Primary Concern (24 Hr. DO)
0604M	Biloxi Creek	10499	Not Supporting (Chloride, Sulfate, TDS, E. coli) Concern (Ammonia-N)
		16097	Not Supporting (TDS, Sulfate, E. coli) Primary Concern (24 Hr. DO)
0604N	Buck Creek	16098	Not Supporting (Sulfate, Chloride, TDS)
0614	Lake Jacksonville	10639	Fully Supporting, No Concerns
		16535	Fully Supporting, No Concerns

*Note: Station Descriptions/ Locations are included in the Data Review Tables in Appendix B

The data review results indicate there are elevated levels of *E. coli* bacteria in five out of seven streams monitored in the watershed. Five out of ten monitoring stations with the minimum number of samples required (10), exceed the criteria and are not supporting the contact recreation use. Of these five stations, three are exceeding the long-term geometric mean (126 colonies/100 ml) and two stations are exceeding both the long-term geometric mean and the single sample criterion (394 colonies/100 ml). These two stations are Hurricane Creek at SH 324 (13529) and Biloxi Creek at FM 1818 (16097).

There are two stations on the Neches River which exceed the criteria for *E. coli*, but they do not have the minimum number of samples required. Stations 17067 and 10586 are both located in the lower half of the segment at the State Highway 7 and U.S. Highway 59 crossings respectively, and the bacteria (*E. coli*) samples have only been collected since February 2002. Both stations are identified as having a primary concern for bacteria and will continue to be monitored. The other three monitoring stations upstream on the Neches River (10591, 13627, 14794) have geometric means of 26, 61, and 39 respectively.

The trend analysis of historical data for bacteria showed a decreasing trend at station 10492 which is one of the stations that is exceeding the long-term geometric mean for *E. coli*. Hopefully, this trend will continue and there will be improvements in the bacteria levels at this station and others in the segment. The reason for the elevated concentrations of bacteria in the segment is likely attributable to non-point sources (i.e. agricultural runoff, urban stormwater runoff, failing on-site sewage facilities, defective wastewater collection systems). ANRA recommends that *E. coli* monitoring continue at these stations and efforts be made by the stakeholders in these watersheds to address the potential sources of pollution.

The data review identified seven stations that are not supporting the general use criteria for TDS, sulfate, and chloride. The criteria are based on the segment average compared to the segment-specific criterion. For the data review, all samples for each station were averaged and compared to the criterion. The seven stations identified were all tributaries in the segment, and five of the stations exceeded all three parameters. The segment-specific criteria was primarily established for the classified segment and all six

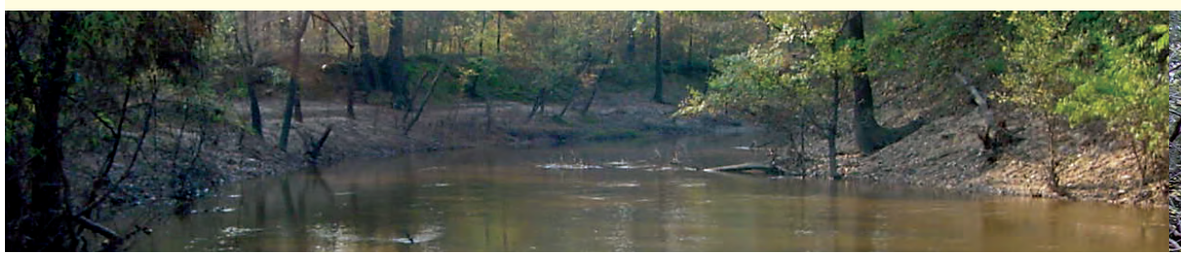
stations on the Neches River segment are fully supporting the criteria. Since the criteria was established for and applies to the classified segments, it is likely the criteria is not appropriate for the unclassified segments. ANRA recommends that general use criteria be established for the unclassified segments. ANRA's data review included these parameters and applied the segment-specific criteria to the unclassified water bodies for screening purposes only.

In the upper middle portion of the segment, from Highway 21 to US Hwy. 84, the TCEQ's Draft 2004 Texas Water Quality Inventory Report lists the segment as not supporting the aquatic life use for dissolved lead (chronic) in water. Based on the site specific hardness values, the freshwater chronic criteria is 0.73 ug/L. Two samples in the database are above this chronic criteria and the other three samples are below the detection limits which are still above the chronic criteria. Since the TCEQ Region 5 office currently has responsibility for monitoring this site, additional sampling and testing for dissolved lead at the lower detection limits (i.e. 0.1 ug/L) will be necessary to determine the extent of a potential problem.

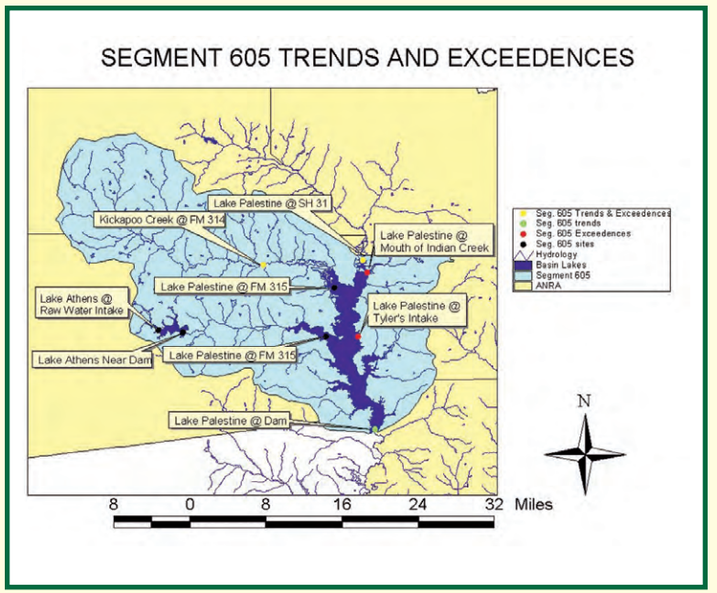
In the 1999 Basin Summary Report, ANRA recommended that Piney Creek be re-classified as an intermittent stream in the upper portions of the watershed. This was based on subwatershed monitoring conducted in 1998 in which several stations had intermittent flows during the summer months. The water quality data was collected in perennial pools and a few stations went completely dry.

The current data review indicates that Piney Creek is partially supporting the aquatic life use for depressed dissolved oxygen values since 25% of the samples exceed the criteria. The trend analysis results showed an increasing trend in the oxygen depletion which corresponds to a decreasing trend in dissolved oxygen values. The Draft 2004 305b Report lists Piney Creek as not supporting the aquatic life use based on depressed dissolved oxygen. The 24 hour dissolved oxygen averages collected since 2001, have all been below the 5.0 mg/L criteria. The highest average was 4.0 mg/L in May 2001. Additional 24 hour monitoring data will need to be collected on Piney Creek to determine the extent of the problem. New stations may need to be added upstream and downstream to locate the extent of the potential problem area. If the depressed levels continue, a Use Attainability Analysis (UAA) may need to be completed in order to ensure that the high aquatic life use criteria is appropriate for this unclassified water body.

Photo courtesy of Connie Thompson.



Lake Palestine
Segment 0605



Watershed Overview
Lake Palestine impounds the Neches River from the Blackburn Crossing Dam in Anderson/Cherokee County to a point 4.2 miles downstream of FM 279 in Henderson/Smith County, up to the normal pool elevation of 345 feet MSL. Lake Palestine is classified as Segment 0605 and extends for approximately 21 miles with a watershed drainage area of 714 square miles. The watershed contains all or part of four counties and nine towns and cities.

The population of Smith County has increased by 5.3% since April 2000. With an estimated population of 184,015 it is the most populated county in the basin. Henderson County has experienced a 5.5% population increase and considerable development is expected to continue in the Lake Palestine area.

The watershed is located in the East Central Texas Plains Ecoregion. The natural subregions are Mixed Pine-Hardwood Forest and Oak Woodlands. The major vegetation types include Shortleaf Pine-Post Oak-Southern Red Oak, Willow Oak-Water Oak-Blackgum Forest, Post Oak Woods, and Other Native/Introduced Grasses.

The soils are generally loamy with small portions of sandy areas. The slope of this segment ranges from gently sloping to moderately steep. This watershed segment is characterized by mostly well to moderately well drained soils and moderately to moderately slow permeability. This segment contains slightly to moderately acidic soils.

Nine endangered species may be found in the watershed including the Whooping Crane and the Ivory-billed Woodpecker. Six threatened species also inhabit the area including the American Alligator and Timber Rattlesnake.

The segment is classified as water quality limited and the designated water uses are Contact Recreation, High Aquatic Life Use, and Public Water Supply. There are approximately 12 outfalls in this segment (5 municipal, 5 industrial, 2 storm water) with a combined total discharge of 1.58 MGD. The elevation ranges from 620 feet MSL to 345 feet MSL and the major tributaries are Kickapoo Creek and Flat Creek. The watershed also includes Lake Athens. The land use in the watershed is predominately agricultural with some heavily forested areas.

The GIS land use coverage shows the majority of the watershed to be cropland and pasture. Mixed forest land and deciduous forest land are prevalent in many areas. There is also scattered areas of evergreen forest land, mixed rangeland, mixed urban, transitional areas, and residential areas.

Data Review
The Lake Palestine watershed is partially supporting the aquatic life use and general use criteria due to low dissolved oxygen levels in Kickapoo Creek and high pH values in Lake Palestine. The contact recreation use is fully supported at all stations on the lake but is not supported at Kickapoo Creek because of high bacteria levels. The general use criteria is not supported for TDS in both Lake Palestine and Kickapoo Creek. There are also concerns for nutrients in the upper portion of the lake and Kickapoo Creek. A map of the Lake Palestine watershed which includes the monitoring stations is located in Section 5.0.

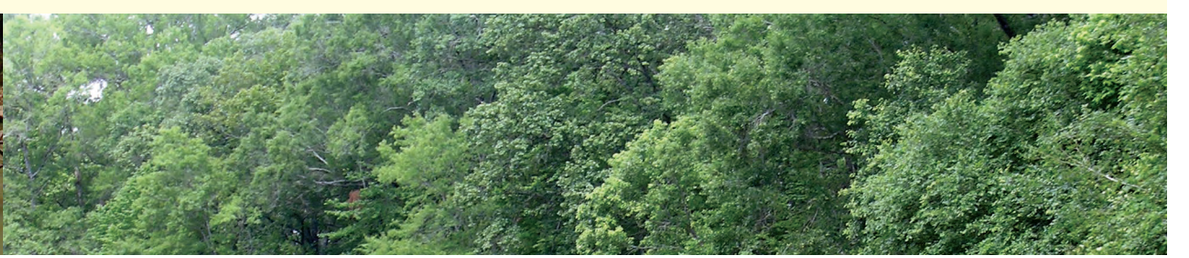


Table 3.3-2: Summary of Data Review for the Lake Palestine Watershed

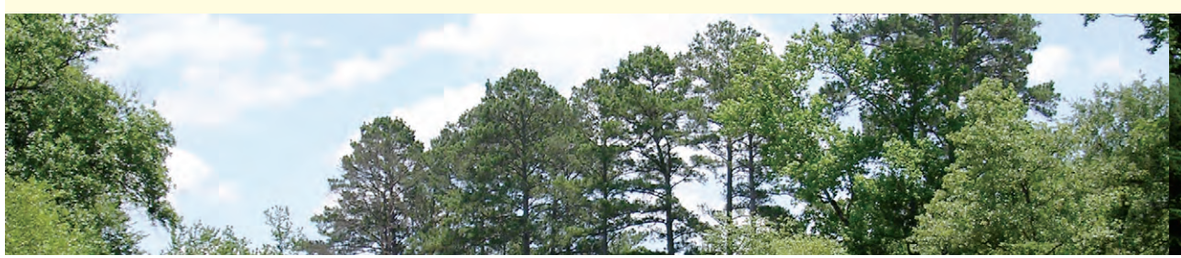
Segment	Waterbody	Stations*	Results of ANRA's Data Review
0605	Lake Palestine	10595	Not Supporting (TDS) Concerns (Ammonia-N, Nitrate+Nitrite, Total Phosphorus, Ortho Phosphorus)
		16345	Not Supporting (TDS) Concerns (Ammonia-N, Nitrate+Nitrite, Total Phosphorus, Ortho Phosphorus)
		16346	Partially Supporting (pH) Concern (Chl a)
		16159	Fully Supporting, No Concerns
0605A	Kickapoo Creek	10517	Not Supporting (TDS, E. coli) Partially Supporting (DO) Concerns (Ammonia-N) Primary Concern (24 Hr. DO)

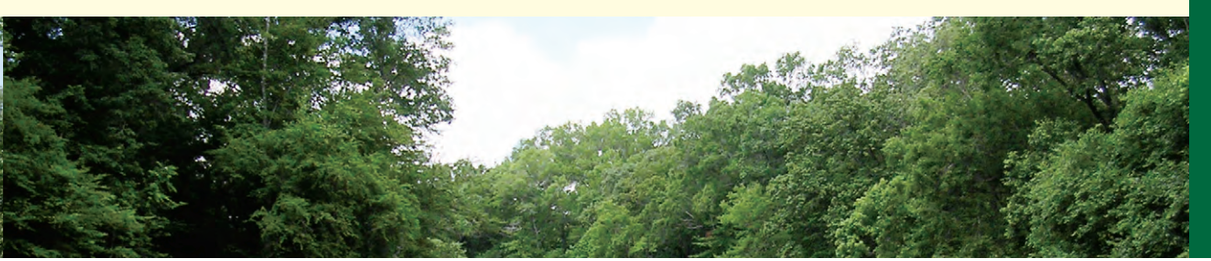
*Note: Station Descriptions/ Locations are included in the Data Review Tables in Appendix B.

Lake Palestine is fully supporting the aquatic life use criteria for dissolved oxygen at all monitoring stations. The general use criteria for pH is only partially supported at one monitoring station which is due to high pH values that exceed the standard (6.0-8.5) 25% of the time. The general use criteria is not supported for TDS at two stations in the upper part of the reservoir. The averages for both stations (232.5 mg/L and 234.6 mg/L) exceed the segment-specific criteria of 200 mg/L. These two stations (10595 and 16345) are also exceeding the screening levels for the nutrient parameters. In addition, the chlorophyll a values are above the screening levels at the raw water intake structure. The trend analysis indicates a decreasing trend for Ammonia-Nitrogen at the uppermost monitoring station (10595) located at SH 31 near Chandler. It is unclear exactly what is causing the elevated levels of TDS and nutrients in the reservoir, but the affected stations are concentrated in the upper end of the lake near the Neches River which is a likely source. ANRA recommends additional intensive monitoring in this area to determine the severity of the problem and the potential sources.

Periodically, high pH and chlorophyll a measurements at station 16346 on Lake Palestine have been recorded during the late summer and early fall months. This is likely caused by the presence of algae, however nutrient data does not suggest a level to support an abundance of algae at this time. In addition, Geosmin has been detected in this area of the lake as well as other lakes in the Northeast Texas region. Geosmin is a byproduct of some species of blue-green algae and actinomycete fungi which are either excreted or released into the water as the algae or fungi die and decompose.

The Kickapoo Creek monitoring station at FM 314 near Brownsboro is not supporting the contact recreation use and is listed in the Draft 2004 305b Report. The long-term geometric mean for eleven *E. coli* samples exceeds the criterion of 126 colonies/100 ml, but only 18% of the samples exceeds the single sample criterion of 394 colonies/100 ml. The dissolved oxygen levels are historically low at this monitoring station and the data review indicates the aquatic life use is only partially supported. The dissolved oxygen levels are below the minimum criteria 22.2% of the time. In addition, the 24 hour monitoring data collected at this station is routinely below the 24 hour dissolved oxygen average established for this segment (5.0 mg/l). The nutrient parameter Ammonia-Nitrogen is also a concern and the general use criteria for TDS is not supported. The trend analysis indicates an increasing trend for conductivity (TDS) at the monitoring station.





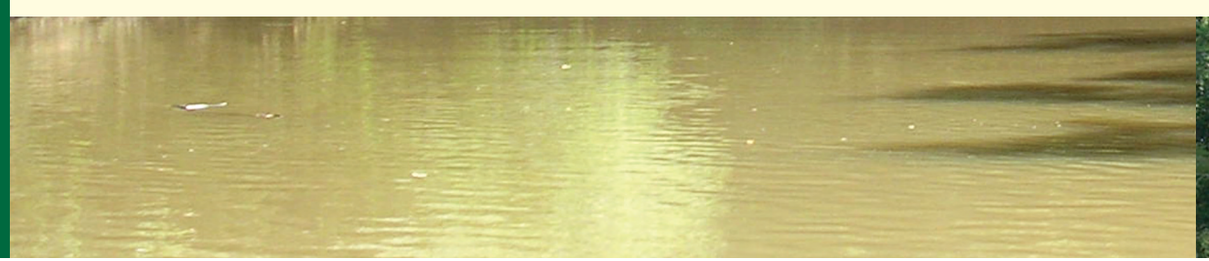
The spatial analysis of the watershed indicates a wastewater outfall immediately upstream of the sampling station on Kickapoo Creek and another outfall less than ten miles upstream. The predominant land use in the Kickapoo Creek subwatershed is cropland and pastures. The cause of the exceedances may be attributed to these factors. In addition, the sampling location is a large, shallow pool with low flow and extensive aquatic vegetation during the summer months which may contribute to the low dissolved oxygen levels found at this location.

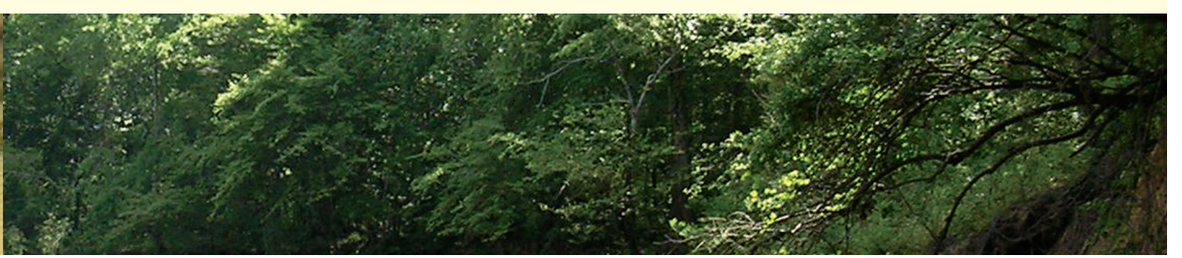
During fiscal year 2000, ANRA conducted an intensive subwatershed monitoring effort in the Kickapoo Creek watershed. Monitoring stations were established at nine locations in the subwatershed including three on Kickapoo Creek in addition to the routine station at FM 314. The other stations were located on the larger tributaries of Kickapoo Creek. The quarterly sampling included the collection of field parameters, bacteria, nutrients, and metals in water and sediment. Annual biological monitoring was also completed. The subwatershed is characterized by rural areas with few permitted outfalls. There are only three municipal dischargers in the entire segment. The land is devoted primarily for agriculture, including cattle and dairy operations. Results of the data analysis showed elevated levels of Ammonia-Nitrogen in the watershed, and the chloride and TDS values were at or near the segment-specific criteria. Since the Ammonia-Nitrogen levels are elevated in the watershed it is likely caused by non-point source pollution. ANRA will continue to monitor Kickapoo Creek at the routine monitoring station located at FM 314 near Brownsboro.

ANRA conducted biological monitoring at two stations in the watershed which included habitat assessments and the collection of aquatic organisms. The results of the monitoring effort based on the scoring criteria used by the TCEQ are presented in the following table.

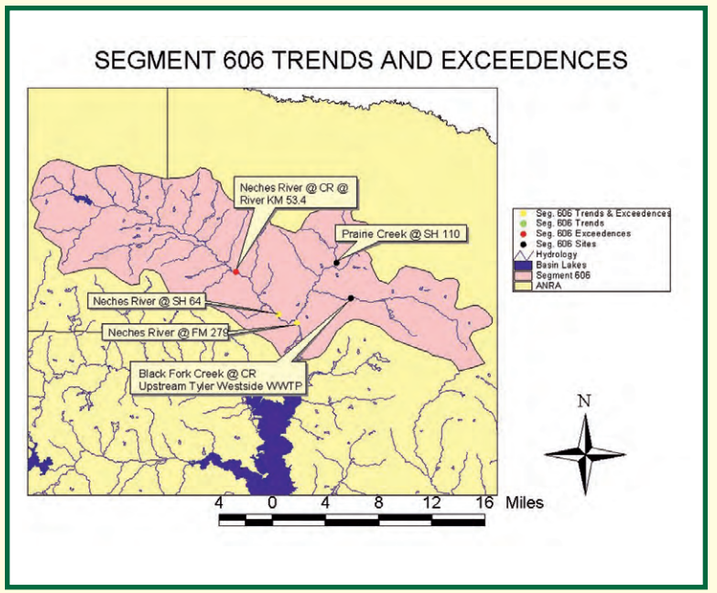
Table 3.3-3: Biological Monitoring Results and Scoring Criteria for Kickapoo Creek

Location	Habitat Assessment	Benthic Macroinvertebrates	Fish/Nekton
Kickapoo Creek at FM 773	Intermediate - 18	High - 30	Intermediate - 44
Kickapoo Creek at FM 2909	High - 20	Intermediate - 23	Intermediate - 42
Scoring Criteria	Exceptional (26-31) High (20-25) Intermediate (14-19)	Exceptional (>36) High (29-36) Intermediate (22-28)	Exceptional (58-60) High (48-52) Intermediate (40-44)





Neches River above Lake Palestine
Segment 0606



Watershed Overview
The watershed consists of the segment of the Neches River from a point 4.2 miles downstream of FM 279 in Henderson/Smith County to Rhines Lake Dam in Van Zandt County. Segment 0606 extends for approximately 27 miles with a drainage area of 264 square miles. The watershed includes portions of three counties (Henderson, Smith, Van Zandt) and all or part of three cities including the northern half of the City of Tyler. Tyler is the largest city in the basin and is located in Smith County. The population of Van Zandt County has increased by 5.2% since 2000. All three counties located in the watershed have experienced population increases greater than 5% since April 2000. This area is expected to continue growing at a modest rate.

The watershed is located in the East Central Texas Plains Ecoregion. The natural subregions are Oak Woodlands and Mixed Pine-Hardwood Forest. The major vegetation types found in the watershed include Post Oak Woods-Forest-Grassland Mosaic, Pine-Hardwood Forest, Willow Oak-Water Oak-Blackgum Forest, and Other Native/Introduced Grassland. The wildlife in the watershed includes seven endangered species and six threatened species including the Northern Scarlet Snake.

The soil is characterized by mostly loamy and sandy soils that are gently sloping to moderately steep. This segments natural drainage is characterized mainly by well and moderately well drained soils. The permeability is moderately slow to moderate. This segment contains moderate to slightly acidic soils.

The segment is classified as water quality limited and the designated water uses are Contact Recreation, Intermediate Aquatic Life Use, and Public Water Supply. There are 9 permitted outfalls in this segment (7 municipal and 2 industrial) with a combined total discharge of 13.54 MGD. The elevation ranges from 620 feet MSL to 360 feet MSL and the major tributaries are Prairie Creek and Black Fork Creek. The land use of the watershed is both agricultural and forested with some urban development.

The GIS land use coverage demonstrates that the primary land use is cropland and pasture. Deciduous forest land and mixed forest land are significant in areas along the Neches River and it's tributaries. The majority of the eastern sections of the watershed are identified as residential, commercial and services, industrial, and mixed urban areas. An interstate highway corridor crosses the northern edge of the watershed, several forested wetland areas are along the river, and a large orchard or nursery is located near a major tributary.

Data Review
In this watershed, the data review indicates the Neches River is not supporting the aquatic life use criteria for dissolved oxygen and the general use criteria for pH and sulfate. The contact recreation use is not supported at one station on the Neches River due to elevated bacteria levels. There is also a concern for nitrogen and TCEQ's Draft 2004 305b Report indicates the aquatic life use is not supported from Prairie Creek to river mile 7.0 due to the dissolved zinc (acute) in water. The following table is a summary of the results from ANRA's data review. A map of the watershed and the monitoring stations is available in section 5.0.

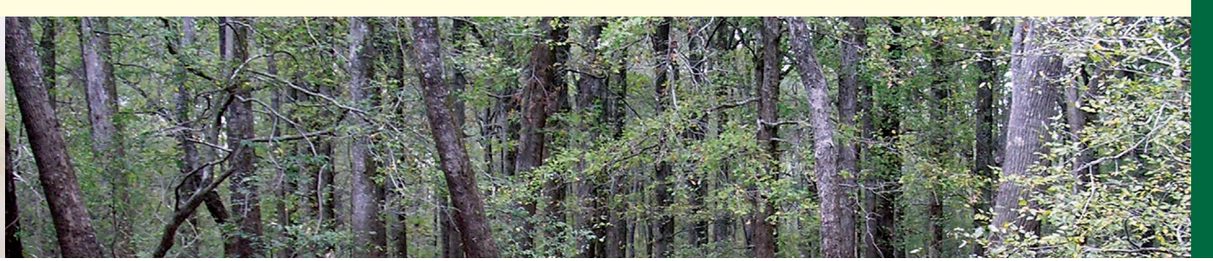


Table 3.3-4: Summary of Data Review for the Neches River above Lake Palestine

Segment	Waterbody	Stations*	Results of ANRA's Data Review
0606	Neches River	10596	Not Supporting (E. coli) Concern (Nitrate+Nitrite)
		10597	Not Supporting (DO) Partially Supporting (pH) Primary Concern (24 Hr. DO)
		10598	Not Supporting (pH, Sulfate) Primary Concern (24 Hr. DO)

*Note: Station Descriptions/ Locations are included in the Data Review Tables in Appendix B.

The Neches River above Lake Palestine is classified with an intermediate aquatic life use in the TSWQS, which corresponds to a moderately diverse habitat, very low abundance of sensitive species, and a moderate level of diversity. Water bodies with an intermediate aquatic life use classification have a DO criterion of 4.0 mg/L daily average and 3.0 mg/L minimum. The intermediate aquatic life use criteria is not supported on the Neches River at SH 64 west of Tyler due to the depressed dissolved oxygen levels and the concentrations of dissolved zinc in water. The dissolved oxygen values are below the minimum criterion in 8 out of the 20 measurements in the database. There is also four out of five 24-hour dissolved oxygen measurements with averages below the intermediate aquatic life use criteria (4.0 mg/l). There are no concerns for the nutrient parameters at this location, but additional information indicates that intermittent flows and no flows are periodically reported at this monitoring station.

In reviewing the dissolved zinc in water data, there are 12 measurements in the database for station 10597 (Neches River at SH 64 West of Tyler). Two samples exceed the freshwater acute criteria of 44.5 ug/L based on a hardness value of 32 mg/L. The database includes four hardness values for station 10597 and the average concentration is 52.5 mg/L as CaCO3. Using the site-specific hardness values, the freshwater acute criteria is 66.3 ug/L and the freshwater chronic criteria is 60.6 ug/L. Comparing the data against the criteria based on the site-specific hardness, only two samples would exceed this criteria as well. Based on these numbers, the aquatic life use is partially supporting the criteria whether or not it is based on site-specific hardness values. The mean of all samples at the station is 29.4 ug/L, which falls below the chronic criterion. There does not appear to be an immediate concern for zinc at this station. Continued monitoring, including the collection of hardness data, will aid in identifying any concern in the future. It is unknown exactly what caused the elevated levels of zinc in water during January and March 2000, but the normal flow of trace element-loaded sediment caused by land disturbance and the zinc plating of pipes, gutters, and culverts can add greatly to zinc levels in streams.

The low pH values at two monitoring stations on the Neches River has resulted in the partial support (station 10597) and non-support (station 10598) of the segment-specific criteria (6.0-8.5). The average pH value at station 10597 based on 20 measurements over the five year assessment period is 6.5, and the minimum value is 5.0. The average pH value at station 10598 based on 10 measurements is 6.3, and the minimum value is 5.4. The acidic soils in the area must be considered in determining a cause for the low pH values being reported.

In addition, the average sulfate value at station 10598 (Neches River at river KM 53.4) is 55.1 mg/L which slightly exceeds the segment-specific criteria (50 mg/L). The average sulfate values at the two other stations on this segment, which are located downstream, are considerably less. Therefore, the increased concentration of sulfate appears to be an isolated occurrence,