Red River Basin Highlights Report ~ 2007

RED RIVER AUTHORITY OF TEXAS

The Red River Basin Highlights Report was Prepared with and Financed through Grants from the Texas Commission on Environmental Quality

INTRODUCTION

In 1991, The Texas Legislature passed the Texas Clean Rivers Act (Senate Bill 818). The Act was intended to move Texas toward comprehensive water resources planning and management to ensure the integrity of the state's water supply over the long term.

The Act established the Texas Clean Rivers Program (CRP) under the Texas Water Commission (now the Texas Commission on Environmental Quality or TCEQ, after TWC's merger with the Texas Air Control Board in 1992).

The CRP has proven to be a huge success as it has evolved into an ongoing, systematic, quality-controlled monitoring system that helps protect and improve the surface water quality in Texas. It began by contracting with 15 partner agencies, which included twelve river authorities, one water district, one federal agency, and one council of government. For fifteen years, this group has successfully managed the surface water quality in Texas by developing monitoring programs and assessing the results of the monitoring.

CRP goals parallel those of the Red River Authority of Texas and the TCEQ and their mutual efforts to share this expertise with the public. Responding to the stakeholders, focusing on priority issues, and keeping abreast of regulatory mandates enables the Authority and the TCEQ to reach the CRP goals.

RED RIVER BASIN WATERSHED MANAGEMENT PROGRAM

To assist in planning, monitoring, geographically analyze, and disseminate data, the Authority divided the basin into five reaches **(see Figure 1)**. A five-year rotational approach was developed to adequately monitor the aquatic health of the basin. This rotational approach provides emphasis to be given to a different reach per year, ultimately intensively covering the entire basin over the five-year time span. Discussion of the water quality in each reach is included later in this report.

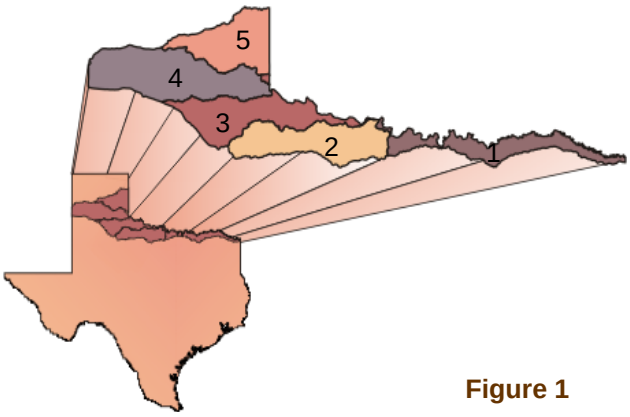


Figure 1

WATER QUALITY IN THE RED RIVER BASIN

The water quality in the Red River Basin is generally good and the majority of the basin supports aquatic life and recreational uses. Two issues that do affect the water quality are the continued ***drought*** conditions and excessive levels of ***chloride***.

Drought conditions have affected most of the State of Texas. While a burn ban was in effect for much of the state, low relative humidity and high winds produced massive wildfires in the early part of 2006 which scorched over **50,000** acres in the Ringgold area and over 750,000 acres in the Texas Panhandle. Lands scarred by fire can have a negative short-term impact on a river system's water quality.

McClellan Creek at SH 273, North of McLean

While the basin continues to experience drought conditions, much needed rainfall was received after the devastating wildfires. **Figure 2** shows a comparison of precipitation for 2005 and 2006. As shown, the Red River Basin received approximately 10 to 20 inches more rainfall in 2006 as compared to the 2005 totals. This increase has helped the drought conditions in the basin, as well as providing additional water in the basin's major reservoirs. **Table 1** shows the capacity of major reservoirs in the Red River Basin versus the current percentage of capacity as of December 2006.

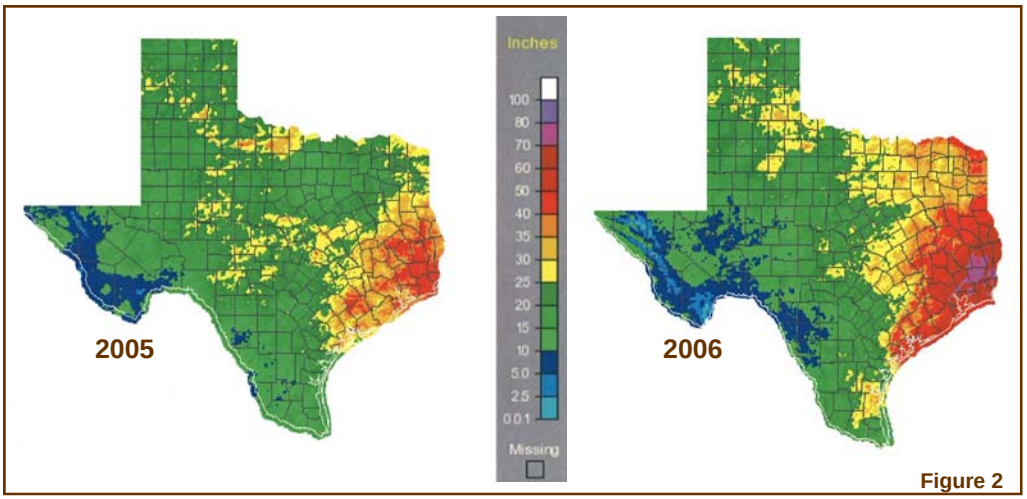


Figure 2

Courtesy of the Southern Regional Climate Center

Elevated chloride levels in the Red River Basin have been an ongoing issue in water quality. Historically, the Red River Basin was once part of an ancient inland sea. However, through geologic processes, this ancient sea became isolated and slowly evaporated over time. The salts from the prehistoric sea continue to plague the basin today. They occur naturally either through salt springs and seeps or from manmade events. As a result, the waters of the Red River, Wichita River, and Pease River systems contain excessive concentrations of chloride and sulfate.

In 1957, the federal government initiated a study which identified ten natural salt source areas located in the Red River Basin. These sources contribute a daily average of over 2,360 tons of the 3,540 tons per day of chloride that flow downstream and enter Lake Texoma in Grayson County. This equates to an amount greater than that consumed by every human and animal in the United States each year. The higher concentrated areas are located in Reaches II and III of the basin.

The Authority and the United States Army Corps of Engineers (USACE) have worked together since 1959 through the implementation of the Chloride Control Project to reclaim the water for beneficial uses for all living things. Since its beginning, this project has controlled more than 405 tons per day of chloride entering the river system without harming the environment. Three of the natural chloride sources are located in the Wichita River Basin (refer to **Figure 3**). To date, only one of the proposed chloride control facilities in the Wichita River Basin has been constructed and is operational. This low-flow dam structure on the South Wichita River retains low flows that are high in salts and diverts them via a pump station and pipeline to Truscott Brine Reservoir. Low-flow diversion dams were also planned several years ago for the Middle and North Wichita Rivers. If constructed, water high in chloride that would nor-

Table 1—Reservoir Capacities

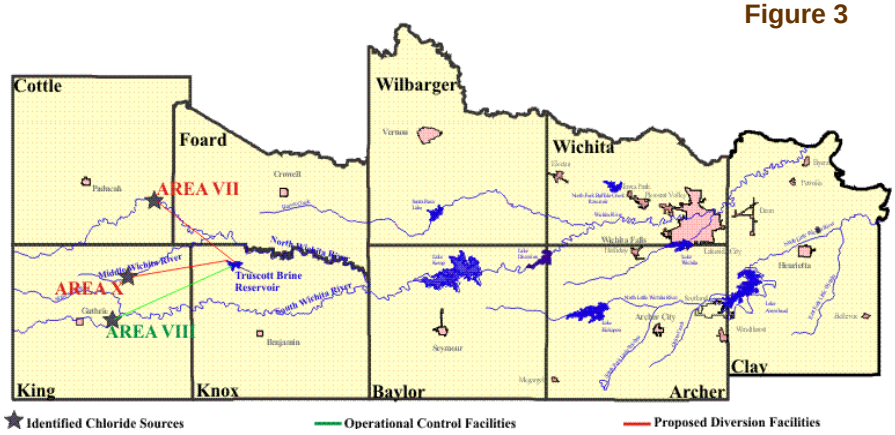
Reservoir	Conservation Storage Capacity (Ac/Ft)	Conservation Storage (Ac/Ft)
Lake Arrowhead	262,100	64%
Greenbelt Reservoir	58,200	32%
Lake Kemp	319,600	69%
Lake Kickapoo	106,000	65%
Lake Mackenzie	46,250	19%
Pat Mayse Lake	124,500	73%
Lake Texoma	2,722,300	87%

** as of December 2006 — Texas Water Development Board*

mally flow to Lakes Kemp and Diversion would be diverted to the Truscott Brine Reservoir. For additional information on the Chloride Control Project and/or the Wichita River Basin Chloride Control Project, please review the Authority's website at **www.rra.dst.tx.us** or the USACE's website at **www.swt.usace.army.mil**.

While regional activities impact the local watersheds, site specific problems are intensified by the larger scale influences of naturally occurring and man-made pollution to receiving waters. Watershed run-off from urban and agricultural activities are also major contributors of pollution. Control programs, such as storm water run-off monitoring and the inclusion of more stringent requirements in livestock permits, are being implemented to reduce adverse impacts to watersheds from these types of pollution.

Figure 3



SURFACE WATER QUALITY MONITORING

The collection, management, and assessment of water quality data within the Red River Basin are integral components of the Clean Rivers Program. The Authority holds a Coordinated Monitoring Meeting annually to coordinate sites, parameters of concern, and frequency of collection with other agencies and program participants that assist in planning, data collection, and analysis. This meeting allows for the development of a monitoring schedule that reduces duplicative efforts, which in turn maximizes the funds available for sampling. It is an essential element in the successful planning process of the basin and is open to any interested group or entity that would like to attend and/or participate in monitoring in the Red River Basin. A summary of the monitoring schedule for 2006 is listed in **Table 2** or a more detailed Coordinated Monitoring Schedule for the Red River Basin can be found at **www.cms.lcra.org**.

Selected physical, chemical, and biological parameters collected by the Environmental Services Division (ESD) of the Authority are analyzed either in the field or at the Authority's environmental laboratory. Within days of collection, the results of the analyses are entered into the data repository, which contains years of quality-assured water resource information in the Red River Basin.

Table 2 – Overview of Coordinated Monitoring Schedule - 2006															
Agency	Reach	Cont Flow	24-Hr DO	Metals Water	Organ Water	Metals Sed	Organ Sed	Conv	Ind Bact	Instant Flow	Field	RT	IS	DI	SS
RRA	I							56	56	36	56	12	2		
TCEQ	I							34	74	52	34	11			2
Sherman	I								72	72	72		6		
USGS	I	365						4	4			1			
Total Reach I		365						94	206	160	162	24	8		2
RRA	II							16	48	36	48	4			
TCEQ	II		7	8		4		26	26	16	26	9		2	2
Sherman	II														
USGS	II	5,110		96	16			96			2,920	14			
Total Reach II		5,110	7	104	16	4		138	74	52	2,994	27		2	2
RRA	III							8	8	8	8	2			
TCEQ	III			2		2		20	20	20	20	5			1
Sherman	III														
USGS	III	1,095		12	2			12			365	3			
Total Reach III		1,095		14	2	2		40	28	28	393	10			1
RRA	IV							8	8	8	8	2			
TCEQ	IV		4	4				14	14	8	14	4		1	
Sherman	IV														
USGS	IV	1,460										4			
Total Reach IV		1,460	4	4				22	22	16	22	10		1	
RRA	V							12	12	12	12	3			
TCEQ	V					2		8	8	4	8	2			1
Sherman	V														
USGS	V	1,460						8	8		8	5			
Total Reach V		1,460				2		28	28	16	28	10			1
Basin Total		9,490	11	122	18	8	0	322	358	272	3,599	81	8	3	6

Cont Flow	Continuous Flow	Organ Water	Organics in Water	Ind Bact	Indicator Bacteria	RT	Routine Sampling
24-Hr DO	24-Hour Dissolved Oxygen	Metals Sed	Metals in Sediment	Instant Flow	Instantaneous Flow Measurements	IS	Intensive/Systematic Sampling
Metals Water	Metals in Water	Conv	Conventional Parameters	Field	Field Parameters	DI	Diurnal Sampling
						SS	Special Studies

**Continuous flow measurements by the USGS are recorded on an hourly basis.*

Regular monitoring is necessary to collect quality-assured data to complete an assessment of water quality conditions and impairments. There are four types of monitoring in the Red River Basin performed by the Authority, the City of Sherman, TCEQ, and USGS.

1. **Routine** monitoring is the traditional type of monitoring conducted at regular intervals every year at key sites.

2. **Systematic Watershed** (Intensive) monitoring is conducted at specific sites on the annual reach of focus.

3. **Permit Support** monitoring identifies specific areas where additional information on water quality and quantity is needed for the permitting process.

4. **Special Studies** on priority watersheds are conducted where special attention is required.

There are two primary types of data collected at each sampling site: *field and conventional*. Field parameters are collected and utilized as real time indicators of the water quality at each site. Conventional parameters are collected, preserved, and taken back to the laboratory for processing and analysis. **Table 3** provides a list of some of the field and conventional parameters that are currently being collected in the Red River Basin. In addition, the quality-assured data collected by the Authority are entered into the Authority's database and made available on the Authority's website at **www.rra.dst.tx.us**.

Table 3 — Collected Water Quality Parameters	
FIELD PARAMETERS *Collected and processed in the field laboratory. Results are expressed in mg/L except as noted.*	
Temperature	The temperature of water at the time of collection. An important physical relationship exists between the amount of dissolved oxygen in a body of water and its temperature. Simply put, the warmer the water, the less dissolved oxygen.
pH	The hydrogen-ion activity of water caused by the breakdown of water molecules and the presence of dissolved acids and bases. pH determines whether a water body is acidic, neutral, or basic. The pH of the water can affect the toxicity of many substances.
DO	Dissolved Oxygen (DO) – The oxygen that is freely available in water. DO is vital to fish and other aquatic life and the prevention of odors. Traditionally, adequate ranges of dissolved oxygen levels have been accepted as the single most important indicator of a water body's ability to support desirable aquatic life.
Conductivity	A measurement of the electrical current carrying capacity of water. Dissolved substances, such as salts, have the ability to conduct electrical current. Conductivity is a measure of how salty the water is. Salty water has a high conductivity. This can be used as an indicator of how much dissolved solids are polluting the water.
Turbidity	A measure of clarity of a water sample expressed in NTU's (Nephalometric Turbidity Units). The higher the turbidity, the muddier the water.
Flow	The velocity of the water body at the time of sampling, expressed in CFS (cubic feet per second) or how fast the water is moving. Flow combined with other parameters can be a good indicator of water quality.
Flow Measurement Method	The manner in which flow is measured, usually by gage or electrical device.
E. coli	The current indicator bacteria to determine if the water body is suitable for contact recreation. It is expressed in MPN (most probable number) per 100 mL of water. High results on the *E. coli* test can indicate a potential pollution problem. *E. coli* is used as an indicator because it can be potentially harmful to people.
Water Clarity	Clearness of the water as it appears in the water body at the time of sampling.
Water Odor	Odor of the water, if any. Odors can aid in discovering problems in a water body.
Weather	Listing of basic weather conditions at the time of sampling. This information is useful if a problem is weather related.
Days Since Last Significant Precipitation	The number of either estimated or actual days since the last beneficial rainfall event.
CONVENTIONAL PARAMETERS *Processed by the Authority's ESD and subcontract laboratories. Results are expressed in mg/L except as noted.*	
Alkalinity	A measure of the acid-neutralizing capacity of water.
Ammonia	Naturally occurring in surface and wastewater, and is produced by the breakdown of compounds containing organic nitrogen. Elevated ammonia levels are a good indicator of organic pollution.
Calcium	Dissolved metal associated with chloride, sulfate, and alkalinity.
Hardness	The sum of the calcium and magnesium concentrations in water and is expressed as calcium carbonate.
Chloride	One of the major inorganic ions in water and wastewater. Concentrations can be increased by industrial processes. High chloride concentrations can affect metallic objects, growing plants, and make water unsuitable for drinking. Chloride compounds, often known as salts, can be an indicator of natural or manmade pollution, as in the case of oil field brines.
COD	Chemical Oxygen Demand (COD) — A measure of the amount of oxygen required to oxidize all compounds in the water. COD is an indicator of how much organic load is placed on the oxygen in a water body.
Total Phosphorus	An essential nutrient to the growth of organisms and can be the nutrient that limits the primary productivity of water. In excessive amounts from wastewater, agricultural drainage, and certain industrial wastes, it also contributes to the eutrophication of lakes and other water bodies. Phosphorus is commonly known as a man made pollutant.
Sulfate	Usually dissolved into waters from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds. Sulfides are widely distributed in nature and in high concentrations, sulfate can affect drinking water.
TDS	Total Dissolved Solids (TDS) – A measure of solids, both organic and inorganic, dissolved in water.
TSS	Total Suspended Solids (TSS) – A measure of the total suspended solids in water, both organic and inorganic.
TOC	Total Organic Carbon (TOC) is all of the organic carbon portions, in a water body.
Chlorophyll *a*	A photosynthetic pigment which is found in all green plants. The concentration of chlorophyll a is used to estimate phytoplankton biomass in surface water. Results are expressed in µg/L (micrograms per liter).
Pheophytin	An important degradation product of chlorophyll a and interferes with the measurement of chlorophyll a. It is used to determine a more accurate measure of chlorophyll a. Results are expressed in µg/L (micrograms per liter).
Nitrate+Nitrite Nitrogen	Most of the time, it is a good indicator of the level of human caused pollution in a water body.
VSS	Volatile Suspended Solids (VSS) – A portion of the TSS that is lost after cooking at high temperatures. This represents the organic part of the TSS.

NELAC

In 2001, the 77th Texas Legislature passed HB 2912, requiring that all data used by TCEQ for commission decisions regarding permits or other authorizations, compliance matters, enforcement actions, or corrective actions be from an accredited environmental laboratory.

HB 2912 also transferred authority for environmental laboratory accreditation and drinking water certification from Texas Department of Health to the TCEQ and required that the state's environmental testing laboratory accreditation program be consistent with NELAC. This transfer of authority became effective on September 1, 2001.

Red River Authority's new facilities located at 3000 Hammon Road in Wichita Falls

Prior to NELAC, the existing state programs varied widely in scope and requirements. The NELAC Standard provides uniform requirements for accreditation of environmental laboratories to ensure that decisions being made are based on data that is scientifically accurate.

The deadline for all environmental laboratories that submit data to the TCEQ to become NELAC accredited is June 1, 2008. Since April of 2005, the Authority has been working diligently on obtaining its NELAC accreditation. To assist the Authority's Environmental Laboratory in becoming NELAC accredited, the Authority relocated its laboratory to our new facilities in Wichita Falls. The new facility expanded the capabilities of the Authority's Laboratory to meet the NELAC requirements. In addition, the Authority enlisted a consulting firm to conduct a NELAC-Readiness audit of the facilities. Laboratory personnel are continuing to attend NELAC training workshops to prepare for the NELAC accreditation. The Authority's Environmental Services Laboratory is also involved in a meticulous preparation process for the application, which includes the completion of proficiency testing for all parameters that are analyzed under the Clean Rivers Program and an on-site assessment by the TCEQ in the Authority's Environmental Laboratory.

WATER QUALITY DATA ASSESSMENT

The water quality data assessment is designed to compare conditions in Texas surface waters to established *water quality standards* set uniquely for classified stream segments in the state (see **Table 4** for a complete stream segment list of the Red River Basin). Water quality standards are set by the TCEQ in an effort to ensure water quality in Texas is consistent with public health and enjoyment, protection of aquatic life, and the operation of existing industries and economic development of the state. Information and a list of surface water quality standards for water bodies in Texas can be found at the TCEQ website at **www.tceq.state.tx.us./nav/eq/eq_swqs.html**.

Table 4—Red River Basin Segment Descriptions

Segment	Detailed Description
0201	Lower Red River - From the Arkansas State Line in Bowie County to the Arkansas-Oklahoma State Line in Bowie County.
0201A	Mud Creek (unclassified water body) - From the confluence of the Red River to the upstream perennial portion of the stream northwest of De Kalb in Bowie County.
0202	Red River Below Lake Texoma - From the Arkansas-Oklahoma State Line in Bowie County to Denison Dam in Grayson County.
0202A	Bois D' Arc Creek (unclassified water body) - From the confluence of the Red River to the upstream perennial portion of the stream southwest of Bonham in Fannin County.
0202C	Pecan Bayou (unclassified water body) - From the confluence with the Red River in northeast Red River County to the upstream perennial portion northeast of Clarksville.
0202D	Pine Creek (unclassified water body) - From the confluence of the Red River to the upstream perennial portion of the stream west of Paris in Lamar County.
0202E	Post Oak Creek (unclassified water body) - From the confluence of Choctaw Creek southeast of Sherman to the upstream perennial portion of the stream northwest of Sherman in Grayson County.
0202F	Choctaw Creek (unclassified water body) - From the confluence with the Red River east of Denison to the upstream perennial portion near the intersection of SH 56 and SH 289 in Grayson County.
0202G	Smith Creek (unclassified water body)- From the confluence with Pine Creek north of Paris to the upstream portion of the stream in north Paris in Lamar County.
0203	Lake Texoma - From Denison Dam in Grayson County to a point immediately upstream of the confluence of Sycamore Creek in Cooke County, up to the normal pool elevation of 617 feet (impounds Red River).
0203A	Big Mineral Creek (unclassified water body) - From the confluence of Lake Texoma to the confluence of North/Middle/South Big Mineral Creeks north of Whitesboro in Grayson County
0203C	Mustang Creek (unclassified water body)- From the confluence with Big Mineral Creek upstream to headwaters approximately 3.3 km southeast of Whitesboro.
0203D	Deaver Creek (unclassified water body)- From the confluence with Big Mineral Creek upstream to headwaters approximately 6.5 km WSW of Southmayd
0204	Red River Above Lake Texoma - From a point immediately upstream of the confluence of Sycamore Creek in Cooke County to the confluence of the Wichita River in Clay County.
0204B	Moss Lake (unclassified water body) - From Fish Creek Dam to spillway elevation of 715 feet (impounds Fish Creek).
0205	Red River Below Pease River - From the confluence of the Wichita River in Clay County to the confluence of the Pease River in Wilbarger County.
0206	Red River Above Pease River - From the confluence of the Pease River in Wilbarger County to a point immediately upstream of the confluence of Buck Creek in Hardeman County.
0206A	Groesbeck Creek (unclassified water body) - From the confluence of Prairie Dog Town Fork Red River north of Quanah in Hardeman County to the upstream perennial portion of the stream east of Childress in Childress County.
0206B	South Groesbeck Creek (unclassified water body) - From the confluence of Groesbeck Creek NNW of Quanah in Hardeman County to the upstream portion 7.8 miles (12.6 Km) southwest of Childress
0207	Lower Prairie Dog Town Fork Red River - From a point immediately upstream of the confluence of Buck Creek in Hardeman County to a point 100 meters (110 yards) upstream of the confluence of Salt Fork Creek in Armstrong County.
0207A	Buck Creek (unclassified water body) - From Oklahoma State Line east of Childress in Childress County to the upstream perennial portion of the stream west of Wellington in Collingsworth County.
0208	Lake Crook - From Lake Crook Dam in Lamar County up to the normal pool elevation of 476 feet (impounds Pine Creek).
0209	Pat Mayse Lake - From Pat Mayse Dam in Lamar County up to the normal pool elevation of 451 feet (impounds Sanders Creek).
0210	Farmers Creek Reservoir (Lake Nocona) - From Farmers Creek Dam in Montague County up to the normal pool elevation of 827 feet (impounds Farmers Creek).
0211	Little Wichita River - From the confluence with the Red River in Clay County to Lake Arrowhead Dam in Clay County.
0212	Lake Arrowhead - From Lake Arrowhead Dam in Clay County up to the normal pool elevation of 926 feet (impounds the Little Wichita River).

Table 4—Red River Basin Segment Descriptions (continued)	
Segment	Detailed Description
0213	Lake Kickapoo - From Kickapoo Dam in Archer County up to the normal pool elevation of 1045 feet (impounds North Fork Little Wichita River).
0214	Wichita River Below Diversion Lake - From the confluence with the Red River in Clay County to Diversion Dam in Archer County.
0214A	Beaver Creek (unclassified water body) - From the confluence of the Wichita River west of Wichita Falls in Wichita County to the upstream perennial portion of the stream south of Vernon in Wilbarger County.
0214B	Buffalo Creek (unclassified water body) - From the confluence of the Wichita River west of Wichita Falls in Wichita County to the upstream perennial portion of the stream east of Electra in Wichita County.
0214C	Holliday Creek (unclassified water body) - From the confluence of the Wichita River in Wichita Falls in Wichita County to the Lake Wichita dam.
0215	Diversion Lake - From Diversion Dam in Archer County to a point 1.5 kilometers (0.9 mile) downstream of the confluence of Cottonwood Creek in Baylor County, up to the normal pool elevation of 1051 feet (impounds Wichita River).
0216	Wichita River Below Lake Kemp - From a point 1.5 kilometers (0.9 mile) downstream of the confluence of Cottonwood Creek in Baylor County to Lake Kemp Dam in Baylor County.
0217	Lake Kemp - From Lake Kemp Dam in Baylor County to a point 9.4 kilometers (5.8 miles) downstream of the confluence of Crooked Creek in Baylor County, up to the normal pool elevation of 1144 feet (impounds Wichita River).
0218	Wichita/North Fork Wichita River - From a point 9.4 kilometers (5.8 miles) downstream of the confluence of Crooked Creek in Baylor County to a point 8.5 kilometers (5.3 miles) downstream of the most upstream crossing of FM 193 in Dickens County.
0218A	Middle Fork Wichita River (unclassified water body) - From the confluence of the North Wichita River southwest of Crowell in Foard County to the upstream perennial portion of the stream northeast of Guthrie in King County.
0219	Lake Wichita - From Lake Wichita Dam in Wichita County up to the normal pool elevation of 980.5 feet (impounds Holliday Creek).
0219A	Holliday Creek above Lake Wichita - From the headwaters of Lake Wichita to the upstream perennial portion of the stream southwest of Holliday in Archer County.
0220	Upper Pease/North Fork Pease River - From the confluence with Canal Creek at the Hardeman-Foard county line to 6.0 kilometers (3.7 miles) upstream of the confluence of Dick Moore Canyon in Floyd County.
0221	Middle Fork Pease River - From the confluence with the North Fork Pease River in Cottle County to the confluence of Boggy Creek and Mott Creek in Motley County.
0222	Salt Fork Red River - From the Oklahoma State Line in Collingsworth County to Greenbelt Dam in Donley County.
0222A	Lelia Lake Creek (unclassified water body) - From the confluence of the Salt Fork Red River north of Hedley in Donley County of the upstream perennial portion of the stream west of Hedley.
0223	Greenbelt Lake - From Greenbelt Dam in Donley County up to the normal pool elevation of 2664 feet (impounds Salt Fork Red River).
0224	North Fork Red River - From the Oklahoma State Line in Wheeler County to a point 4.0 kilometers (2.5 miles) upstream of FM 2300 in Gray County.
0225	McKinney Bayou - From the Arkansas State Line in Bowie County to a point 100 meters (110 yards) upstream of the most upstream crossing of FM 1397 near King Lake in Bowie County.
0226	South Fork Wichita River - From the confluence with the North Fork Wichita River in Knox County to a point 15.0 kilometers (9.3 miles) upstream of US 82 in Dickens County.
0227	South Fork Pease River - From the confluence with the Middle Fork Pease River in Cottle County to the confluence of Wolf Creek and Rustler Creek in Motley County.
0228	Mackenzie Reservoir - From Mackenzie Dam in Briscoe County up to the normal pool elevation of 3100 feet (impounds Tule Creek).
0229	Upper Prairie Dog Town Fork Red River - From a point 100 meters (110 yards) upstream of the confluence of Salt Fork Creek in Armstrong County to Lake Tanglewood Dam in Randall County.
0229A	Lake Tanglewood (unclassified water body) - From Randall County Dam up to normal pool elevation south of Amarillo (impounds Prairie Dog Town Fork Red River).
0229B	Tierra Blanca Creek (unclassified water body) - From the confluence with Palo Duro Creek in Randall County to the New Mexico State Line in Deaf Smith County.
0230	Pease River - From the confluence with the Red River in Wilbarger County upstream to the confluence with Canal Creek at the Hardeman-Foard county line.
0230A	Paradise Creek (unclassified water body) - From the confluence with the Pease River east of Vernon to the upstream perennial portion near Thalia in Foard County.
0299A	Sweetwater Creek (unclassified water body) - From the Oklahoma State Line in Wheeler County to the upstream perennial portion of the stream northwest of Wheeler in Wheeler County (tributary of North Fork Red River).

Water quality is reviewed in accordance with the *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data*. The results are then analyzed and evaluated for the assessment. The assessment occurs every two years utilizing the previous five year's data. The results are then published periodically in the *Texas Water Quality Inventory and 303(d) List*, as required by Sections 305(b) and 303(d) of the Federal Clean Water Act. These reports are also available online at **www.tceq.state.tx.us/compliance/monitoring/water/quality/data/04twqi/04_summary.html**.

There are three main aspects of the water quality assessment performed by the TCEQ:

1. The ***2004 Texas 303(d) List*** identifies water bodies for which effluent limitations are not stringent enough to implement water quality standards. The TCEQ also develops a schedule identifying Total Maximum Daily Loads (TMDLs) that will be initiated in the next two years for priority impaired waters. Water quality permitting in 303(d)-listed water bodies is described in the TCEQ regulatory guidance document *Procedures to Implement the Texas Surface Water Quality Standards*. Water bodies in the Red River Basin which are listed on the *2004 Texas 303(d)* List include:

Segment	Water Body	Parameter(s)
0201A	Mud Creek	Bacteria
0202D	Pine Creek	Bacteria
0202E	Post Oak Creek	Bacteria
0203A	Big Mineral Creek	Bacteria
0207A	Buck Creek	Bacteria
0211	Little Wichita River	Depressed Dissolved Oxygen, Total Dissolved Solids
0214A	Beaver Creek	Depressed Dissolved Oxygen
0218	Wichita/North Fork Wichita River	Selenium (chronic) in Water
0218A	Middle Fork Wichita River	Selenium (chronic) in Water
0229	Upper Prairie Dog Town Fork Red River	Depressed Dissolved Oxygen, Bacteria
0299A	Sweetwater Creek	Bacteria

2. The ***2004 Water Quality Inventory Summary of Water Bodies with Concerns for Use Attainment Report*** lists water bodies with concerns identified for indicators, such as dissolved oxygen. These indicators are directly tied to support of designated uses and criteria adopted in the *Texas Surface Water Quality Standards.* Water bodies in the Red River Basin which were identified with use attainment concerns include:

Segment	Water Body	Use Concern	Parameter(s) of Concern
0201A	Mud Creek	Aquatic Life Use	Depressed Dissolved Oxygen
0202D	Pine Creek	Aquatic Life Use	Depressed Dissolved Oxygen
0203A	Big Mineral Creek	Contact Recreation Use	Bacteria
0220	Upper Pease/North Fork Pease River	General Use	Temperature

3. The ***2004 Water Quality Inventory Summary of Water Bodies with Water Quality Concerns*** identifies water quality concerns in water bodies with indicators such as nutrients that are not tied to support of a designated use with a quantitative criterion. Screening levels used to identify these concerns have generally not been adopted as standards with the exception of secondary drinking water standards. Water bodies in the Red River Basin which are included on the summary of water bodies with water quality concerns are:

Segment	Water Body	Use Concern	Parameter(s) of Concern
0202D	Pine Creek	Nutrient Enrichment	Ammonia, Orthophosphorus
0202E	Post Oak Creek	Narrative Criteria	Excessive Algal Growth
0203	Lake Texoma	Public Water Supply	Chloride, Sulfate, and Total Dissolved Solids in Finished Drinking Water Increased Costs due to Demineralization
0204	Red River Above Lake Texoma	Algal Growth	Excessive Algal Growth
0205	Red River Below Pease River	Algal Growth	Excessive Algal Growth
0211	Little Wichita River	Algal Growth	Excessive Algal Growth
0214	Wichita River Below Diversion Lake Dam	Algal Growth Nutrient Enrichment Sediment Contaminants	Excessive Algal Growth, Ammonia, Orthophosphorus, Total Phosphorus Nickel in Sediment
0214A	Beaver Creek	Nutrient Enrichment	Ammonia
0216	Wichita River Below Lake Kemp Dam	Nutrient Enrichment	Ammonia
0220	Upper Pease/North Fork Pease River	Nutrient Enrichment	Ammonia
0226	South Fork Wichita River	Nutrient Enrichment	Ammonia
0229	Upper Prairie Dog Town Fork Red River	Nutrient Enrichment	Nitrate+Nitrite Nitrogen, Orthophosphorus, Total Phosphorus
0229A	Lake Tanglewood	Algal Growth Nutrient Enrichment	Excessive Algal Growth, Nitrate+Nitrite Nitrogen, Orthophosphorus, Total Phosphorus

For more information about the evaluation of water quality data for the Texas Water Quality Inventory Assessment, please see the TCEQ's *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data, 2004* at **www.tceq.state.tx.us/assets/public/compliance/monops/water/04twqi/04_guidance.pdf** .

Reach I of the Red River Basin begins at Texarkana in Bowie County and ends upstream inside Clay County, east of Wichita Falls. This area consists of several communities including the Sherman and Denison area, which has recently become one of the fastest growing areas in the state due to the expansion of the Dallas/ Fort Worth Metroplex. Other cities within **Reach I** include Bonham, Bowie, Clarksville, Nocona, Texarkana, Paris, and Gainesville.

Reach I contains 42 municipal and industrial waste water dischargers, 42 solid waste disposal sites, of which eight sites are currently active. Additionally in this reach there are over 1,200 groundwater wells and two hazardous waste sites. Also, based on recent permit data, there are no permitted concentrated animal feeding operations in this reach.

Farms and ranches in this reach produce mainly wheat, hay, soybeans, corn, milo, cotton, sorghum, turf grasses, wholesale nursery greenery, plus pecans, peaches, melons, peanuts, beef cattle, poultry, goats, dairy cattle, and horses. Mining of limestone, gravel, lignite, bituminous coal, sand, and gravel is also conducted in this reach of the basin.

During the reference period of September 1, 2005 through August 31, 2006, the Authority conducted 56 monitoring events and collected approximately 1,624 parameters from 14 water quality monitoring stations. The TCEQ conducted 74 monitoring events and collected about 922 parameters from 13 water quality monitoring stations and the City of Sherman conducted 72 monitoring events and collected approximately 1,008 parameters from six water quality monitoring stations. In addition the USGS monitored one station in **Reach I**. **Figure 4** illustrates the monitoring coverage of **Reach I**, where each monitoring station is designated by a five digit numeric code.

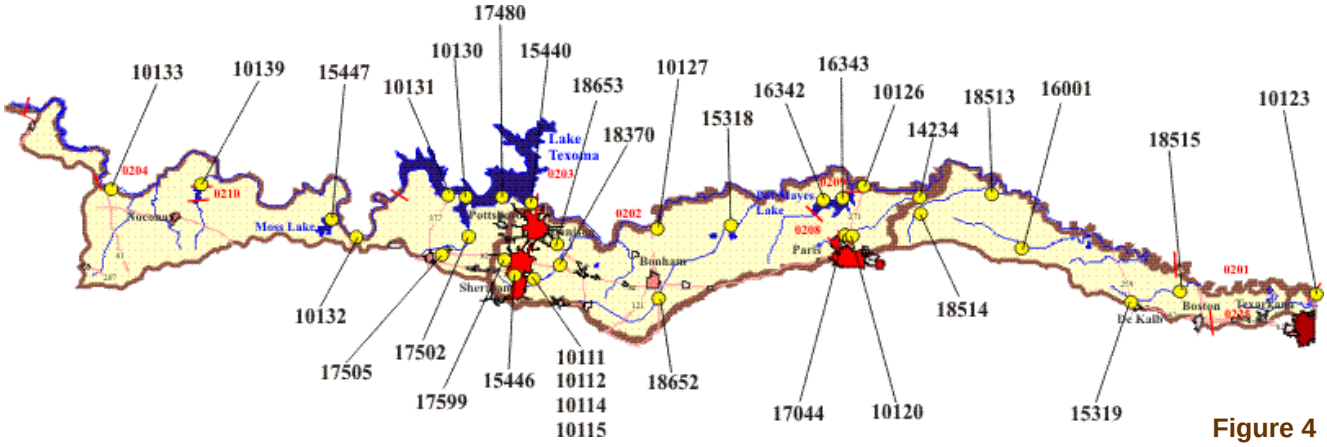


Figure 4

Segments contained in **Reach I** include:

0201 - Lower Red River
0201A - Mud Creek
0202 - Red River below Lake Texoma
0202A - Bois D' Arc Creek
0202C - Pecan Bayou
0202D - Pine Creek
0202E - Post Oak Creek
0202F - Choctaw Creek
0203 - Lake Texoma
0203A - Big Mineral Creek
0204 - Red River above Lake Texoma
0204B - Moss Lake
0208 - Lake Crook
0209 - Pat Mayse Lake
0210 - Farmers Creek Reservoir
0225 - McKinney Bayou

Segment 0201, Lower Red River, is the lowest segment in the drainage of the Red River Basin. The *2004 Texas Water Quality Inventory* lists this segment as fully supporting its overall uses and meeting its criteria. The Authority's review of the current data revealed elevated chlorophyll *a* levels which could possibly lead to

a nutrient enrichment concern for excessive algal growth. Since the mainstem of the Red River receives drainage from both Texas and Oklahoma, this segment is influenced by factors from both sides of the river. Coordination and cooperation from regulatory agencies of both states is recommended to manage the water quality in the mainstem.

Segment 0201A, Mud Creek is a minor tributary of the Red River and is listed on the *2004 Texas Water Quality Inventory* and the *2004 Texas 303(d) List* for not supporting contact recreation use due to elevated bacteria levels. In addition, it is listed for not supporting aquatic life use due to depressed oxygen levels. The Authority's review of the data agreed with the inventory and also found that Mud Creek has also experienced elevated levels of ammonia and chlorophyll *a*. Usually, when high levels of ammonia are found in natural waters, it is an indication of sanitary pollution, animal waste byproducts, or fertilizer run-off. Mud Creek has been classified as a perennial stream (one that flows continuously), but as a result of the ongoing drought and increasing beaver activity in the creek, Mud Creek has become intermittent with perennial pools. The sampling site for Mud Creek is located in a small stagnant pool that has become covered with duck weed. Only the return of normal seasonal rainfall would improve the condition of this water body.

The *2004 Texas Water Quality Inventory* lists **Segment 0202, Red River below Lake Texoma**, as currently fully supporting its overall uses and meeting its criteria. However, the Authority's review of the current data revealed elevated chlorophyll *a* levels which exceeded the screening criteria. Since there is run-off and drainage into not only Texas, but also from Oklahoma, a cooperative effort will be required from both states to resolve this issue.

The *2004 Texas Water Quality Inventory* lists **Segment 0202A, Bois D'Arc Creek**, as meeting its overall uses and criteria. The Authority's review of the data agreed with the inventory. However, additional data should be collected to continue the assessment of this water body since this segment is the site of a proposed water supply/flood control lake.

Segment 0202C, Pecan Bayou was not assessed according to the *2004 Texas Water Quality Inventory.* This generally means that there were not enough data on file during the listed assessment period for the segment to be assessed and that sample collections should continue until enough data sets are collected. Since the Authority has started monitoring Pecan Bayou in early 2001, it has used this water body as a reference stream. A reference stream is a stream that has few or no known water quality problems. However, review of the current data by the Authority has indicated that Pecan Bayou is now experiencing depressed dissolved oxygen levels, elevated ammonia and chlorophyll *a* levels. As the drought has affected other areas of the Red River Basin, this watershed is no exception. Run-off from sporadic rainfall events and animals and wildlife congregating near the creek could be the causes of these elevated values.

The *2004 Texas 303(d) List* and the *2004 Texas Water Quality Inventory* lists **Segment 0202D, Pine Creek**, as not meeting its contact recreation use due to elevated bacteria levels. In addition, it is listed for a nutrient enrichment concern for elevated levels of ammonia nitrogen and orthophosphorus.

The Authority's review of the data concurs with the TCEQ's assessment. However, it also revealed elevated total phosphorus levels. The monitoring site on Pine Creek, where most of the data has been collected, is approximately 1.5 stream miles from the spillway of Lake Crook. Smith Creek, a tributary and a major contributor to this portion of Pine Creek, receives run-off from the watershed of the northwest section of the City of Paris' industrial district. Further investigation and supplemental sampling has revealed that the use support and concerns are most likely originating from Smith Creek. The Smith Creek monitoring site is located a short distance upstream from its confluence with Pine Creek. Both the Pine and Smith Creeks' monitoring sites are on State Highway 271, just north of the City of Paris. Generally, Pine Creek does not have a significant flow since the creek has been impounded to form Lake Crook. However, when Pine Creek is actively flowing, samples collected from monitoring sites on both Pine Creek and Smith Creek suggest the elevated levels are originating in the Smith Creek tributary, not Pine Creek. Although both creeks are in the same watershed, there have been many instances when the data collected from both sites on the same day will vary

Pine Creek at US 271

significantly, with Smith Creek exhibiting greater values than Pine Creek.

If the data from Pine and Smith Creeks are separated and compared, the data from Pine Creek will reveal a nutrient enrichment concern for ammonia and chlorophyll *a*. Additionally, the data from Smith Creek also reveals low dissolved oxygen levels, elevated bacteria levels, and nutrient enrichment concerns for ammonia nitrogen, orthophosphorus, total phosphorus and chlorophyll *a*.

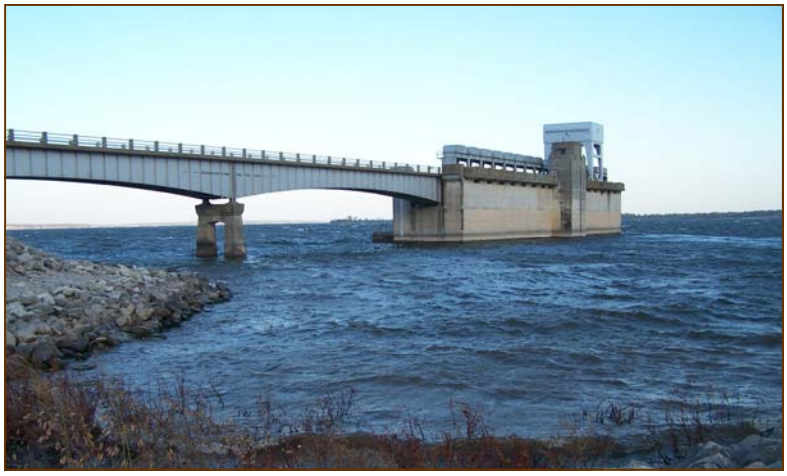
Rectifying the water quality issues in this segment will be difficult. To bring this watershed back into compliance, cooperation from local entities will be essential to bring about the changes that are necessary to restore the Pine Creek watershed. Plans by the TCEQ to separate the Smith Creek subwatershed from the Pine Creek parent watershed and assign it with its own designation would allow the TCEQ to assess the available data and focus resources on the restoration of this watershed.

Segment 0202E, Post Oak Creek is listed on the *2004 Texas 303(d) List* and the *2004 Texas Water Quality Inventory* as not meeting its contact recreation use due to elevated bacteria levels. In addition, it also is listed for excessive algal growth. Post Oak Creek meanders from a point Northwest of the City of Sherman, draining the city diagonally through to the southeast part of the city. It is basically a storm drainage creek for much of the city and generally only has a significant flow after rainfall events.

The Authority's review of the more recent data indicates that Post Oak Creek can exhibit high bacterial spikes after rainfall events, but the review of the current data shows that the creek does not exceed the standard. In the review of the data, only chlorophyll *a* exceedance was observed. This can be expected from the type of drainage that flows through the city. The Authority and its cooperating partner, the City of Sherman, are working jointly to more effectively monitor the health of Post Oak Creek.

Segment 0202F, Choctaw Creek is currently fully supporting its overall use criteria according to the *2004 Texas 303(d) List and the 2004 Texas Water Quality Inventory*. The Authority's review of the data revealed that Choctaw Creek has experienced elevated nitrate+nitrite nitrogen, total phosphorus, and orthophosphate levels. The elevated nutrients may be a result of treated waste water effluent from a wastewater treatment plant located in the upper portions of the creek. Although the wastewater treatment plant is discharging within its permitted guidelines, the effluent is still higher than the criteria and standards set for this creek. This situation is not unusual and is the case for most wastewater treatment plants.

The *2004 Texas Water Quality Inventory* lists **Segment 0203, Lake Texoma** as supporting its overall uses and meeting its criteria. However, the lake is listed as having overall public water supply concerns for increased costs due to demineralization for elevated levels of chloride, sulfate, and total dissolved solids in finished drinking water. The Authority agrees with this



Lake Texoma at Denison Dam

assessment and also finds the data reveals elevated nutrients, including ammonia-nitrogen, chlorophyll *a* and orthophosphorus.

These public water supply concerns on Lake Texoma will not be resolved without full cooperation of both Texas and Oklahoma, Federal environmental agencies, and any other interest groups in this project.

Until the Chloride Control Project is completed and the rivers and the lake are flushed of the chloride and sulfate components, Lake Texoma will continue to be listed as having an overall public water supply concern on the *Texas Water Quality Inventory*.

Segment 0203A, Big Mineral Creek is listed on the *2004 Texas 303(d) List* and the *2004 Texas Water Quality Inventory* for not meeting its contact recreation use due to elevated bacteria levels. Review of the limited data sets revealed that Big Mineral Creek has exceedances in ammonia nitrogen, orthophosphorus and chlorophyll *a*. More data is needed to discern the problem in this creek.

The *2004 Texas 303(d) List* and the *2004 Texas Water Quality Inventory* lists **Segment 0204, Red River above Lake Texoma**, with an algal growth concern due to elevated chlorophyll *a* levels.

The Authority's review of the available data concurs with this assessment. Additionally, there were elevated total phosphorus and orthophosphorus levels discovered as well. The data sets were limited and additional data will be needed to assess this portion of the Red River mainstem properly.

Without having data and physical observations from the Oklahoma side of the watershed, it is difficult to form any findings or postulate any theories as to the nature of the elevated chlorophyll *a* levels. Chlorophyll *a* is almost always found as a result of some kind of human exploitation of the watershed, such as fertilizer runoff, leakage from aging septic systems, or from wastewater treatment plants. In addition, chlorophyll *a* can be used as an indirect indicator of nutrient levels or the eutrophication of river or lakes.

Segment 0209, Pat Mayse Lake, is listed on the 2004 Texas Water Quality Inventory as fully supporting its public water supply and general uses. The aquatic life, contact recreation and fish consumption uses were not assessed. The Authority's review of the available data revealed elevated chlorophyll a levels on data collected from the lower half of the lake. Data collected on the upper half showed slightly elevated levels, but they did not exceed the criteria at this time.

Segments 0204B—Moss Lake, 0208—Lake Crook, 0210—Farmers Creek Reservoir, and **0225—McKinney Bayou** were not assessed for the *2004 Texas Water Quality Inventory*. This generally means there were not enough data sets on file during the listed assessment period for proper assessment and water quality monitoring should continue until enough data are available.

Reach II represents the Wichita River and Little Wichita River watersheds from the confluence of the Red River to their headwaters, which begins in Clay County and continues westward to Dickens County. The largest city within this reach is Wichita Falls, with a population of 104,200.

Reach II is a large, diverse area with most of the large population centers located in the eastern portion, while the western portion contains some of the largest ranches in the state, including the W.T. Waggoner Estate, Four Sixes Ranch, and several others.

Segments contained in **Reach II** include:

0211 - Little Wichita River
0212 - Lake Arrowhead
0213 - Lake Kickapoo
0214 - Wichita River below Diversion Lake
0214A - Beaver Creek
0214B - Buffalo Creek
0214C - Holliday Creek
0215 - Diversion Lake
0216 - Wichita River below Lake Kemp
0217 - Lake Kemp
0218 - Wichita/North Fork Wichita River
0218A - Middle Fork Wichita River
0219 - Lake Wichita
0219A - Holliday Creek above Lake Wichita
0226 - South Fork Wichita River

There are approximately 1,600 groundwater wells in **Reach II** located primarily in the Seymour and Trinity Aquifers. However, in the far western portion of the reach, the Ogallala Aquifer is the primary supply. There are 18 wastewater outfalls, six permitted concentrated animal feeding operations, and 45 solid waste disposal sites, of which seven sites are active. Farming and ranching within the ten-county area include wheat, grains, hay, alfalfa, sorghum, cotton, pecans, peanuts, peaches, watermelons, beef cattle, cow/calf operations, dairies, horses, and some swine and goats.

In portions of **Reach II**, oil and gas fields dominate the landscape. In other areas of the reach, farming or pasture lands are predominate. Natural resource industries include some surface mining for copper, building stone, sand, gravel, volcanic ash, bituminous coal, and components for tile and ceramics.

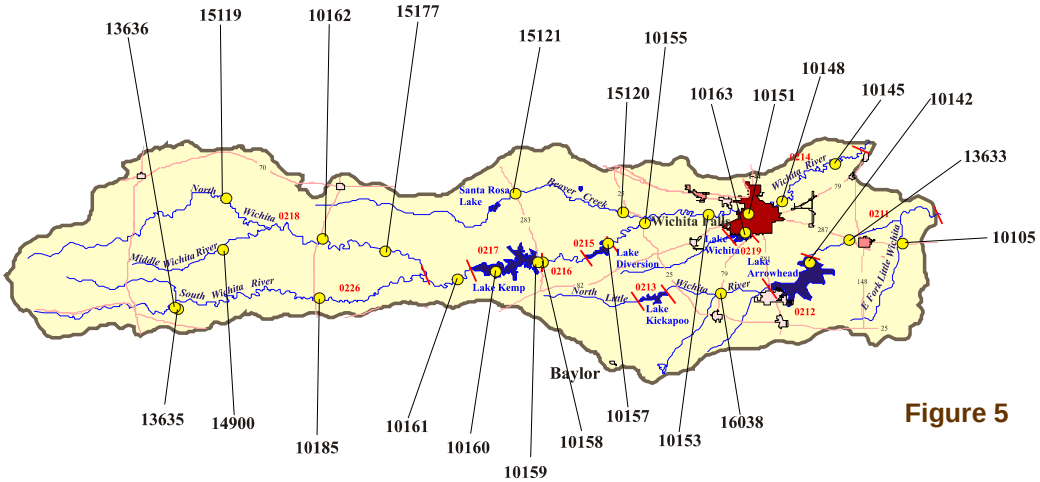


Figure 5

During the reference period of September 1, 2005 through August 31, 2006, the Authority conducted 48 monitoring events and collected approximately 912 parameters from four water quality monitoring stations. The TCEQ conducted 26 monitoring events and collected around 669 parameters from nine water quality monitoring stations. In addition, the USGS monitored 14 sites. **Figure 5** illustrates the monitoring coverage of **Reach II**, where each monitoring station is designated by a five digit numeric code.

Segment 0211, Little Wichita River, is located below the dam of Lake Arrowhead to the confluence of the Red River. The *2004 Texas 303(d) List* and the *2004 Texas Water Quality Inventory* lists the Little Wichita River as not supporting its general use due to elevated total dissolved solids levels. In addition, it does not meet aquatic life use criteria due to depressed dissolved oxygen levels. The Authority's review of recent data indicates that the elevated level of total dissolved solids is now falling within standards. However, the data also revealed elevated chlorophyll *a* levels which could result in a future excessive algal growth con-

cern. The ecosystem and habitat of this river are dictated by a lack of continuous flow in the river. Essentially the river has no continuous or sustainable flow. The City of Henrietta has a contract with the City of Wichita Falls to divert water into the river so that Henrietta, who has a low water dam, can capture the flow and pump it into a small city lake for drinking water purposes. During other times the only inflow into the river is from seepage from the lake and naturally occurring springs and small tributaries. The nature of the Little Wichita River, with the protracted periods of little or no rainfall, combined with possible intrusions of oil field brine, could be the reason for the elevated total dissolved solids. However, since the region has been receiving much needed rainfall, these total dissolved solid levels have been diluted and dropped. The elevated chlorophyll *a* levels can be attributed to periods when the river does not have significant flow, which allows algae to multiply rapidly in the stagnant water, utilizing the nutrients that become trapped in the sluggish river.

The *2004 Texas Water Quality Inventory* lists **Segment 0212, Lake Arrowhead**, as fully supporting its overall uses and meeting its criteria. The Authority's recent data review revealed elevated levels of total phosphorus and orthophosphate. Although the criteria for these nutrients are more stringent on lakes than in river systems, the exceedances on Lake Arrowhead may be attributed to run-off from several dairy farms located in the upper portions of the watershed. In most reservoirs, total phosphorus is the nutrient that is generally elevated, but in Lake Arrowhead, orthophosphate is also elevated. Lake Arrowhead is one of two major sources of drinking water for the City of Wichita Falls.

Segment 0213, Lake Kickapoo, is located upstream of Lake Arrowhead, and is also a primary source of drinking water for the City of Wichita Falls. Although recent data are limited on this segment, the *2004 Texas Water Quality Inventory* lists Lake Kickapoo as fully supporting its overall uses and meeting its criteria. Additional data are needed on Lake Kickapoo to conduct a complete assessment on this water body.

Wichita River at FM 810

Segment 0214, Wichita River below Lake Diversion, is listed on the *2004 Texas Water Quality Inventory* as having an overall nutrient enrichment concern and a concern for excessive algal growth. This portion of the Wichita River meanders from the dam of Lake Diversion to its confluence with the Red River. The Authority's review of the available data also indicated elevated bacteria and nutrient levels. The elevated bacteria levels, the nutrient enrichment, and the concerns for excessive algal growth which occur up and down the river are most likely a result of run-off from the more densely populated areas of the watershed. Possible sources include; a large fish hatchery, some mid-sized cattle ranching operations, five permitted dischargers, thousands of acres of farm land, and numerous septic tanks of undetermined age and condition which could leach and/or drain directly into the river. More intensive monitoring to identify and locate the sources of the bacteria and nutrients is the first step in resolving theses issues.

Segment 0214A, Beaver Creek, is listed on the *2004 Texas 303(d) List* and the *2004 Texas Water Quality Inventory* as not meeting its aquatic life use for depressed dissolved oxygen. Although recent data indicate an improvement, Beaver Creek will remain on the *303(d) List* until a sufficient number of 24-hour measurements are available to demonstrate support of the criteria. The Authority's review of the data from Beaver Creek indicates there have been exceedances for bacteria and chlorophyll a in this segment. The area surrounding the creek is open pasture with oilfield activities. The farmland is mainly dry-land with a few irrigated

fields. Although stock tanks scatter the landscape, livestock and wildlife still use the creek as a water source. Run-off from the fields and pastures are likely the source of these problems.

The *2004 Texas Water Quality Inventory* lists **Segment 0214B, Buffalo Creek**, as fully supporting its overall uses and criteria. Since there have been no data collected on this water body since early 1999, the Authority included Buffalo Creek in its 2007 water quality monitoring schedule. A preliminary look at the limited data is similar to that of most creeks that receive treated waste water effluent. A more detailed analysis of the data will be performed next year.

Lake Diversion

Segment 0214C, Holliday Creek, flows from the Lake Wichita Dam down through the City of Wichita Falls to its confluence in the city. Although there is no recent data to assess, the *2004 Texas Water Quality Inventory* lists Holliday Creek as fully supporting its overall uses and meeting its criteria.

The *2004 Texas Water Quality Inventory* lists **Segment 0215, Lake Diversion**, as not assessed. This generally means there were not enough data on file during the listed assessment period for that segment to be assessed properly. Sample collections should continue until enough data are collected and a proper assessment can be performed.

Lake Diversion is unique in that it was constructed as a flood control impoundment and a source for irrigation and drinking water supply. When work on the lake was completed, the vast network of irrigation canals and ditches that crisscrossed Archer and Wichita Counties were able to supply landowners with a low cost irrigation source. Over time the build up of chloride and sulfate in the lake has rendered it almost useless as a viable water supply. Reduction of salts in Lake Diversion would revitalize the watershed and allow the reservoir to be utilized as a water supply without some form of pre-treatment.

Segment 0216, Wichita River below Lake Kemp, is listed on the *2004 Texas Water Quality Inventory* as fully supporting its overall uses, but having a nutrient enrichment concern for elevated ammonia-nitrogen. This segment of the Wichita River is located between the dam of Lake Kemp and the headwaters of Lake Diversion. Usually, when high levels of ammonia are present in natural waters, it is an indication of sanitary pollution, animal waste byproducts, or fertilizer run-off. This may not be the case here. Throughout the Red River Basin, instances of elevated ammonia nitrogen levels have been associated with elevated salts like those found in this portion of the Wichita River.

The *2004 Texas Water Quality Inventory* lists **Segment 0217, Lake Kemp**, as fully supporting its overall uses and meeting its criteria. The Authority's recent review of the data reveals no exceedances in the waters of Lake Kemp. Lake Kemp, like Lake Diversion, was built as a water supply and flood control lake and is operated and maintained by the Wichita County Water Improvement Water District Number Two.

Over time the build up of chloride and sulfate in the lake has rendered it almost useless as a viable water supply. Reduction of the salt in Lake Kemp would revitalize the watershed and would allow the reservoir to be utilized as a water supply. The implementation of the Chloride Control Project would be advantageous for this water body.

Segments 0218 - Wichita/North Fork Wichita River and **0218A - Middle Fork Wichita River** are listed on the *2004 Texas 303(d) List* and the *2004 Texas Water Quality Inventory* for not supporting their aquatic life uses for elevated selenium (chronic) in water. Selenium is an essential trace element that is required in human and animal nutrition. However, the average levels found in these two forks of the Wichita River are well above the criteria established for fresh waters.

The conductivity of these water bodies is very comparable to that of sea water and makes the water brackish (a mixture of salty and fresh water). The criteria the TCEQ set for tidal water is 136 mg/L, as opposed to 5 mg/L for fresh waters. The fresh water standard does not adequately describe the nature of these two water bodies. A review of the standards for these segments on how selenium relates to brackish waters should be initiated and perhaps the standards changed for segments in this region.

The *2004 Texas Water Quality Inventory* lists **Segment 0219, Lake Wichita,** as not assessed. This means there were not enough data on file during the listed assessment period to be assessed properly. Sample collections should continue until enough data are collected for a proper assessment. The Authority's review of the current data concurs.

Segment 0219A, Holliday Creek above Lake Wichita, is listed on the *2004 Texas Water Quality Inventory* as fully supporting its overall uses and criteria. There have been no data collected on this water body since August of 1997. Since Holliday Creek is the headwaters of Lake Wichita, the Authority included it in its 2007 Water Quality Monitoring Schedule. Early sampling attempts at this site were discouraging as this site was dry. However, recent rainfall in the watershed has filled the creek which will enable the Authority to conduct sampling of the creek.

Holliday Creek at FM 2650 — October 2006

Holliday Creek at FM 2650 — December 2006

Segment 0226, South Fork Wichita River, is listed on the *2004 Texas Water Quality Inventory* with a nutrient enrichment concern due to elevated ammonia levels. The Authority's review of the data agrees with this assessment. The source of the ammonia is most likely the result of naturally occurring salt springs in this watershed.

Reach III begins in northern Wichita County and proceeds westward toward Floyd and Briscoe Counties, involving the Pease River watershed from the confluence of the Red River to its headwaters. It includes the Red River main stem from the confluence of Cache Creek upstream to the confluences of Buck Creek and the Red River. The cities of Vernon and Burkburnett with populations of 11,700 and 11,000, respectfully, are the largest within the reach. The reach's total population is only about 26,000.

Reach III contains 14 wastewater dischargers, 25 solid waste disposal sites, six of which are active. Based on recent permit data, there are no permitted concentrated animal feeding operations in this reach. Additionally, approximately over 3,600 groundwater wells utilize water from the Seymour, Blaine, and Ogallala Aquifers.

Comprised mainly of agribusiness and oil and gas production, **Reach III** is predominately rural in nature. The farms and ranches in the area produce cotton, wheat, hay, feed products, guar, alfalfa, soybeans, sorghum, peanuts, sunflowers, beef cattle, horses, hogs, poultry, and sheep.

Segments contained in **Reach III** include:

0205 - Red River below Pease River
0206 - Red River above Pease River
0206A - Groesbeck Creek
0220 - Upper Pease/North Fork Pease River
0221 - Middle Fork Pease River
0227 - South Fork Pease River
0230 - Pease River
0230A - Paradise Creek

During the reference period from September 1, 2005 through August 31, 2006, the Authority conducted eight monitoring events and collected approximately 232 parameters from two water quality monitoring stations. The TCEQ conducted 20 monitoring events and collected around 504 parameters from five monitoring stations. In addition, the USGS monitored three sites in the reach. **Figure 6** illustrates the monitoring coverage of **Reach III**, where each monitoring station is designated by a five digit numeric code.

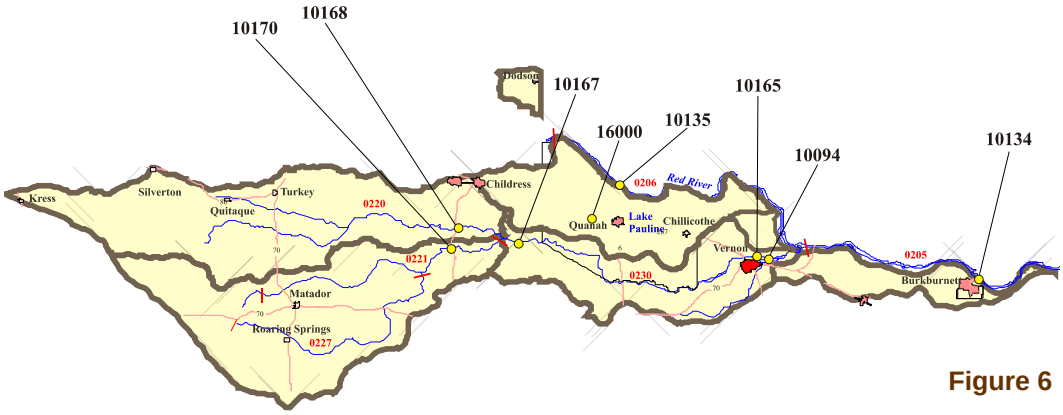


Figure 6

Segment 0205, **Red River below Pease River** is listed on the *2004 Texas Water Quality Inventory* as fully supporting its overall uses and meeting its criteria. The Authority's review of the current data found elevated chlorophyll *a* levels. This is indicative of what is found up and down the Red River.

The *2004 Texas Water Quality Inventory* lists **Segment 0206, Red River above Pease River,** as not assessed. This generally means that there were not enough data on file during the listed assessment period for that segment to be properly evaluated. The Authority's review of the data found sufficient data for assessment and no anomalies.

Segment 0206A, Groesbeck Creek is listed on the *2004 Texas Water Quality Inventory* as fully supporting its overall uses and meeting its criteria. The pastures and fields surrounding the creek are utilized by local ranchers as a place to graze cattle. The Authority's review of the data found this segment to have elevated bacteria, nitrate+nitrite nitrogen, and chlorophyll *a* levels. Increased farming, ranching and natural wildlife activity are likely causes. In addition, the elevated nitrate+nitrite nitrogen could be from naturally occurring sources in the area that are upwelling into the creek through springs.

Segment 0220 the Upper Pease/North Fork of the Pease River is listed on the *2004 Texas Water Quality Inventory* as fully supporting its overall uses and meeting its criteria. However, the *2002 303(d) List and Water Quality Inventory* lists this segment as having a use concern for temperature and a nutrient enrichment concern for ammonia. The temperature issue is naturally occurring and most likely the ammonia is from salt springs in the watershed. The Authority's review of the data found that bacteria exceeded contact recreation standards. Although much of the area is cultivated, many areas along and near the river are rugged and broken and largely inaccessible. Although this portion is not suitable for agriculture, it is suitable for ranching as the river can supply the necessary water for the livestock. Recent investigations in similar other rural areas found that concentrated numbers of wildlife such as wild hogs, deer and turkey can contribute to the elevated bacterial problems.

The *2004 Texas Water Quality Inventory* lists **Segments 0221-Middle Fork of the Pease River and 0227-South Fork of the Pease River** as not assessed. There were insufficient data from these segments to make any significant assessments. These forks of the Pease River have not had sustained significant flows for a long period of time.

Segment 0230, Pease River is listed on the *2004 Texas Water Quality Inventory as* fully supporting its overall uses and meeting its criteria. This segment was split off of Segment 0220, the Upper Pease/North Fork of the Pease River, after it was determined that there was a significant difference in distance and in water quality. The Authority's review of the current data revealed elevated levels of ammonia. The source of the ammonia is most likely the result of naturally occurring salt springs in this watershed, or other unknown sources.

Pease River at FM 104

Reach IV begins in Childress County at the Texas/Oklahoma state line and continues through the Panhandle to Deaf Smith and Parmer Counties at the New Mexico state line. It encompasses the Prairie Dog Town Fork of the Red River from the confluence of Buck Creek. The uppermost part of the reach dissects the City of Amarillo, which is also the largest city in the Red River Basin. The towns of Hereford and Canyon have populations of over 14,600 and 12,900 respectively. Approximately 66 other towns and communities are located in **Reach IV** including Childress, Dimmitt, Friona, Tulia, Wellington, and Claude.

Segments contained in **Reach IV** include:

0207 - Lower Prairie Dog Town Fork of the Red River
0207A - Buck Creek
0228 - Mackenzie Reservoir
0229 - Upper Prairie Dog Town Fork of the of the Red River
0229A - Lake Tanglewood

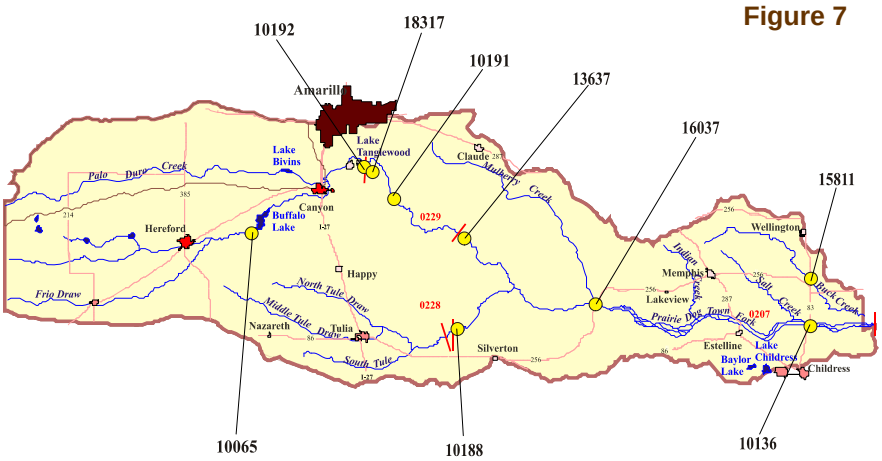
The Ogallala Aquifer lies below the western area of this reach, and provides water for over 5,600 groundwater wells. Included in this watershed are seven wastewater outfalls and 30 solid waste disposal sites, seven of which are active. In addition, **Reach IV** includes one industrial hazardous waste site, and 63 permitted concentrated animal feeding operations.

Estelline Salt Springs is a group of natural brine springs located less than a mile east of Estelline, Texas in east-central Hall County on the flood plain of the Prairie Dog Town Fork of the Red River. The springs became active in the late 1800's and washed out a funnel in the alluvium. In 1964 the United States Army Corps of Engineers (USACE) built a dike around the springs to contain the flow and prevent the salt from entering the river system. Since then, the spring water has become more saline.

Cattle ranching plays a significant role in this area of the state, **Reach IV** contains many farms and ranches that produce beef cattle, cotton, wheat, corn, sugar beets, soybeans, sorghum, and potatoes.

During the reference period from September 1, 2005 through August 31, 2006, the Authority conducted eight monitoring events and collected approximately 232 parameters from two water quality monitoring stations, while the TCEQ conducted 14 monitoring events and collected around 358 parameters from four monitoring sites. In addition, the USGS monitored four sites in this reach. **Figure 7** illustrates the water quality monitoring coverage of **Reach IV**, where each monitoring station is designated by a five digit numeric code.

Figure 7



The *2004 Water Quality Inventory Summary of Water Bodies with Water Quality Concerns* identifies **Segment 0207**, **Lower Prairie Dog Town Fork of the Red River,** as supporting all uses and not experiencing any nutrient enrichment or excessive algal growth concerns. However, the Authority's review of recent data revealed elevated bacteria and chlorophyll *a* levels. This portion of the river flows through some very broken, rough country and is largely uninhabited. Although this region is not very suitable for agriculture it is suitable for ranching as the river can supply the necessary water for the livestock. Run-off from fields and pastures can contribute to the elevated nutrient and bacterial levels. Additionally, recent field investigations have found that the elevated bacteria levels may also be attributed to large numbers of wildlife such as feral hogs, deer and turkey that cohabitate in the watershed. It is also possible that contributing flow from Segment 0229, Upper Prairie Dog Town Fork (UPDTF) of the Red River could be influencing sample results for this segment.

Buck Creek at US 83

Segment 0207A, Buck Creek is listed on the *2004 Texas 303(d) List,* for not supporting its contact recreation use due to elevated bacteria levels. The Authority's review of the data available in the TRACS database agrees with the TCEQ assessment. Currently, a *Bacterial Monitoring Study* on Buck Creek is being conducted by the Texas State Soil and Water Conservation Board (TSSWCB) to ascertain the elevated bacteria levels found in the creek. The Authority's data review also revealed elevated nitrate+nitrite nitrogen levels in Buck Creek. This, in conjunction with the elevated bacteria levels, could be caused by watershed run-off after precipitation events, or it could be an indication of interference or activity resulting from inadvertent human pollution activities. Since the TSSWCB's study includes genotyping of the elevated bacterial levels, it is possible the results of their study will reveal the source of pollution in this stream. Recent field investigations have found that the elevated bacteria levels may be attributed to large numbers of wildlife such as feral hogs, deer and turkey that cohabitate in the watershed. The Texas Water Resources Institute (TWRI) maintains a website containing information about the project and can be viewed at **http://twri.tamu.edu/buckcreek**.

The *2004 Texas 303(d) List* identifies **Segment 0229, Upper Prairie Dog Town Fork of the Red River,** for not supporting its contact recreation use due to elevated bacterial levels. It also lists this segment for not supporting aquatic life use due to depressed dissolved oxygen. In addition, Segment 0229 is listed on the *2004 Water Quality Inventory* as having a nutrient enrichment concern due to elevated levels of nitrate+nitrite nitrogen, orthophosphorus, and total phosphorus. Recent review of the data by the Authority has revealed the data for grab dissolved oxygen meets the criteria. However, the standard is based on 24-hour test data and until sufficient data are collected, this site will remain listed for depressed dissolved oxygen. Possible sources for this concern could be from nutrient-rich discharge from Lake Tanglewood and/or from treated effluent from a local municipal wastewater treatment plant. Additionally, the Authority's data review revealed elevated chlorophyll *a* and pH levels.

Segment 0229A, Lake Tanglewood is listed on the *2004 Texas Water Quality Inventory* for a nutrient enrichment concern due to elevated levels of nitrate+nitrite nitrogen, orthophosphorus and total phosphorus. In addition, it is listed with an excessive algal growth concern due to elevated chlorophyll *a* levels. The Authority's recent review of the current data from Lake Tanglewood agrees with the inventory listings. However, exceedances for chloride, pH and ammonia nitrogen levels were also revealed. Possible sources of the nutrient and algal growth could be from run-off from rainfall events or leaks from aging septic tanks in the community that surround the lake. It is interesting to note that the available chloride data are showing the values decreasing in early 2005 and then climbing back in 2006. This is more than likely due to dilution due to increased precipitation around the lake. The pH issues will likely be elevated as long as the excessive algal growth concerns remain. In most cases, elevated phosphorus levels are an indication of some kind of human pollution activities and in combination with high levels of nitrogen, it is usually an indication of sanitary pollution, animal waste by-products or fertilizer run-off.

The *2004 Texas 303(d) List* and the *2004 Texas Water Quality Inventory* indicates **Segment 0228, Lake Mackenzie** is meeting all its standards and criteria.

Reach V of the Red River Basin begins at the eastern edge of the Texas Panhandle in Hemphill, Wheeler, and Swisher Counties and extends westward to Amarillo for about 100 miles. The reach contains the North Fork of the Red River upstream to the headwaters of McClellan Creek, including the headwaters of the Salt Fork of the Red River, Elm Fork of the Red River, and the Washita River. The eastern edge of the City of Amarillo is located in **Reach V.** In addition, the towns of Panhandle, Clarendon, Wheeler, and White Deer are located in this reach.

The largest reservoir in the reach is Greenbelt Lake located in Donley County. Lake McClellan, a small lake, also in the reach, is underlain by the Ogallala Aquifer in the northern and western areas.

Segments contained in **Reach V** include:

0222 - Salt Fork of the Red River
0222A - Lelia Lake Creek
0223 - Greenbelt Lake
0224 - North Fork of the Red River
0299A - Sweetwater Creek

Reach V contains four wastewater outfalls, 17 solid waste disposal sites, of which five sites are active. There are14 permitted concentrated animal feeding operations, one superfund site, and four industrial hazardous waste sites. In addition, there are more than 3,100 groundwater wells located in this reach.

Farms and ranches predominate **Reach V** primarily raising cattle, while the farming consists of cotton, grain sorghum, wheat, corn, oats, barley, and alfalfa.

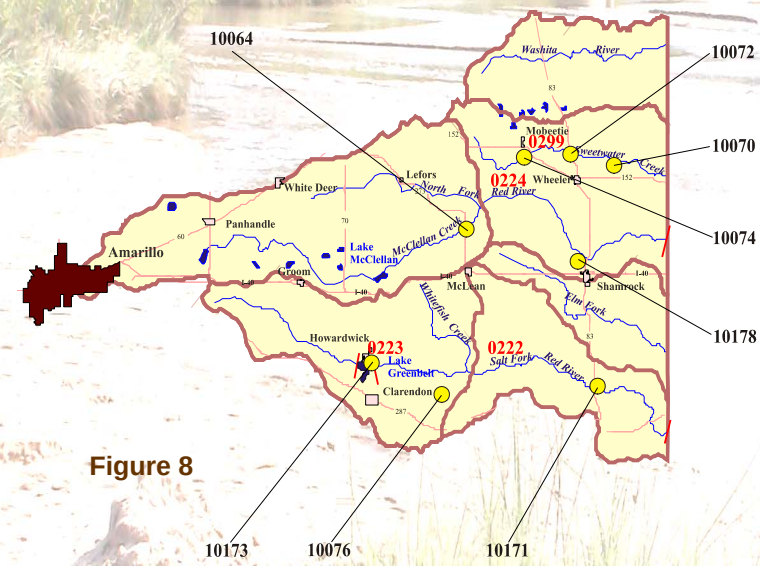


Figure 8

During the reference period from September 1, 2005 through August 31, 2006, the Authority conducted 12 monitoring events and collected approximately 348 parameters from three water quality monitoring stations. The TCEQ conducted eight monitoring events and collected around 202 parameters from two water quality monitoring stations. In addition, the USGS monitored two sites in this reach. **Figure 8** illustrates the monitoring coverage of **Reach V**, where each monitoring station is designated by a five digit numeric code.

Water quality conditions have improved in **Reach V**. The increase of precipitation has helped the region by providing pasture and watering for livestock. However, most of the concerns in this reach are still drought related.

Segment 0222-The Salt Fork of the Red River, 0224 - Segment The North Fork of the Red River, Segment 0222A- Lelia Lake Creek, and **Segment 0223- Greenbelt Lake** are all listed on the *2004 Texas Water Quality Inventory, May 13, 2005* as fully supporting their overall uses and criteria. The Authority's review of the data agrees with the assessment of these water bodies.

Sweetwater Creek, Segment 0299A is listed on the *2004 Texas 303(d) List* and the *2004 Texas Water Quality Inventory, May 13, 2005* for not supporting its contact recreation use due to elevated bacterial levels. Although the source is not known, the elevated bacteria could possibly related to the numerous concentrated animal feeding operations in the watershed of the creek or it could be due to wild animals living along the creek. Increased rainfall and run-off into the creek have likely increased the concentrations. More data needs to be collected to ascertain the nature of this problem.

PUBLIC PARTICIPATION AND OUTREACH

One very successful component of the Clean Rivers Program is public participation. This enables the general public to broaden their awareness of water quality conditions, share knowledge and expertise of many, and cooperatively pursue avenues to rectify problems. The reflection of service with an emphasis on good science is fundamental to the Authority's purpose.

Steering Committee

Originally conceived as a grass-roots project, the Clean Rivers Program established a format for the citizens of Texas to participate in effective statewide watershed planning activities. Each Clean Rivers Program partner agencies developed a steering committee which set priorities within its own individual basin. These committees bring together the diverse and unique interests within each basin. Steering committee participants include representatives from the public, municipal, county, state, and federal government, industry, business, agriculture, environmental, education, civic organizations, and others.

As one of the most successful components of the Clean Rivers Program within the Red River Basin, the Steering Committee has guided this program through the years. The committee provides valuable assistance and guidance concerning water quality issues.

The Steering Committee and Basin Advisory Committee are one and the same. When originally formed, the Steering Committee was created to meet when it was not been possible for the entire Basin Advisory Committee to meet. However, through the years, the two committees have evolved into one, which serves its purpose very well.

Basin Advisory Committee Meetings are held at least once per year and are designed to be open, friendly, casual, and informative. They are designed to provide in-depth technical information look regarding project work plans, monitoring schedules, reports, and any other relevant topics. Committee members are encouraged to ask questions and voice their ideas at the meetings, are encouraged to contact the Authority as well as throughout the year.

Volunteer Environmental Monitoring

The Texas Rivers Project, in its 16th year, provides an opportunity for area students from junior high through high school to actively collect and analyze samples from their own unique monitoring sites. More than 12 schools have participated in the program since it was initiated. However, due to budget restrictions and time restraints, educators are not able to participate in the Texas Rivers Project as they have done in the past. The Authority is currently exploring ways to revitalize the program.

Earth Day

The Authority is proud to be associated with local Earth Day celebrations. Earth Day is celebrated in cooperation with River Bend Nature Works, an environmental educational center located in Wichita Falls that provides hands-on environmental programs to children and adults. Last year more than 750 school children participated in the event. The Authority's ESD staff provided presentations on water quality and conservation to the students. Teachers were also provided with environmental educational materials for their students.

Education

Authority personnel also provide presentations to various organizations, clubs, and civic groups to spark interest and awareness in local natural resource issues. Additionally, the Authority provides all types of information and articles that appear regularly in newspapers throughout the basin.

Another program sponsored by the Authority is the distribution of educational materials. The *Major Rivers* and *Think Earth* curricula are provided to all schools upon request. These two publications are favored by teachers and students alike. Last year over 100 boxes of water quality educational material was provided to schools in the Red and Canadian River Basins.

Red River Authority of Texas Website

The Authority maintains an enthusiastic commitment to provide up-to-date scientifically correct information on the website at **www.rra.dst.tx.us**. The website provides a virtual on-line encyclopedia of information and resources. The home page allows the user to locate information about the Authority and historically research the Red River Basin, and much more.

A popular feature on the Authority's website is the *Public Information Repository,* which guides one to a wealth of information. Facts and data on almost any aspect of the Red River Basin are just a few clicks away. Other information available include: data inventories, digital mapping, general information, legislation, environmental sites, and historical weather data. The Authority also maintains an online publication library that includes reports and studies prepared by the Authority.

SUGGESTIONS FOR FUTURE WORK IN THE RED RIVER BASIN

The Authority continues to monitor sites, analyze the data collected, determine trends, and assist in the development of Best Management Practices to maintain and/or improve the water quality in the Red River Basin.

The Clean Rivers Program has not received an increase in program fees since its beginning in 1991. With rising costs for services and supplies, monetary restrictions have been implemented. This has forced Clean Rivers Program partner agencies to reduce sampling events and parameters collected. Since the number of monitoring sites and parameters needed to meet the Clean Rivers Program goals are far more than can actually be sampled, an increase of continuous monitoring stations should be implemented to provide a constant, reliable source of water quality data. In addition, it is the Authority's opinion that water bodies associated with the greatest risks of not attaining its water quality standards should receive the greatest attention.

As an agency of the state, and in compliance with its mission, the Authority provides financial assistance as much as possible to alleviate some of the budget shortfalls, and also contributes to the Clean Rivers Program by payment of fees assessed to fund TCEQ's water programs. The Authority supports itself through contractual agreements with governmental and non-governmental entities, limiting the additional funding required to adequately monitor the basin's many water resources. Nevertheless, the Authority will continue to work toward full attainment of the Clean Rivers Program goals.