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Stream Monitoring and Educational Program in the Red River Basin, Texas, 1996–97

U.S. Department of the Interior
U.S. Geological Survey

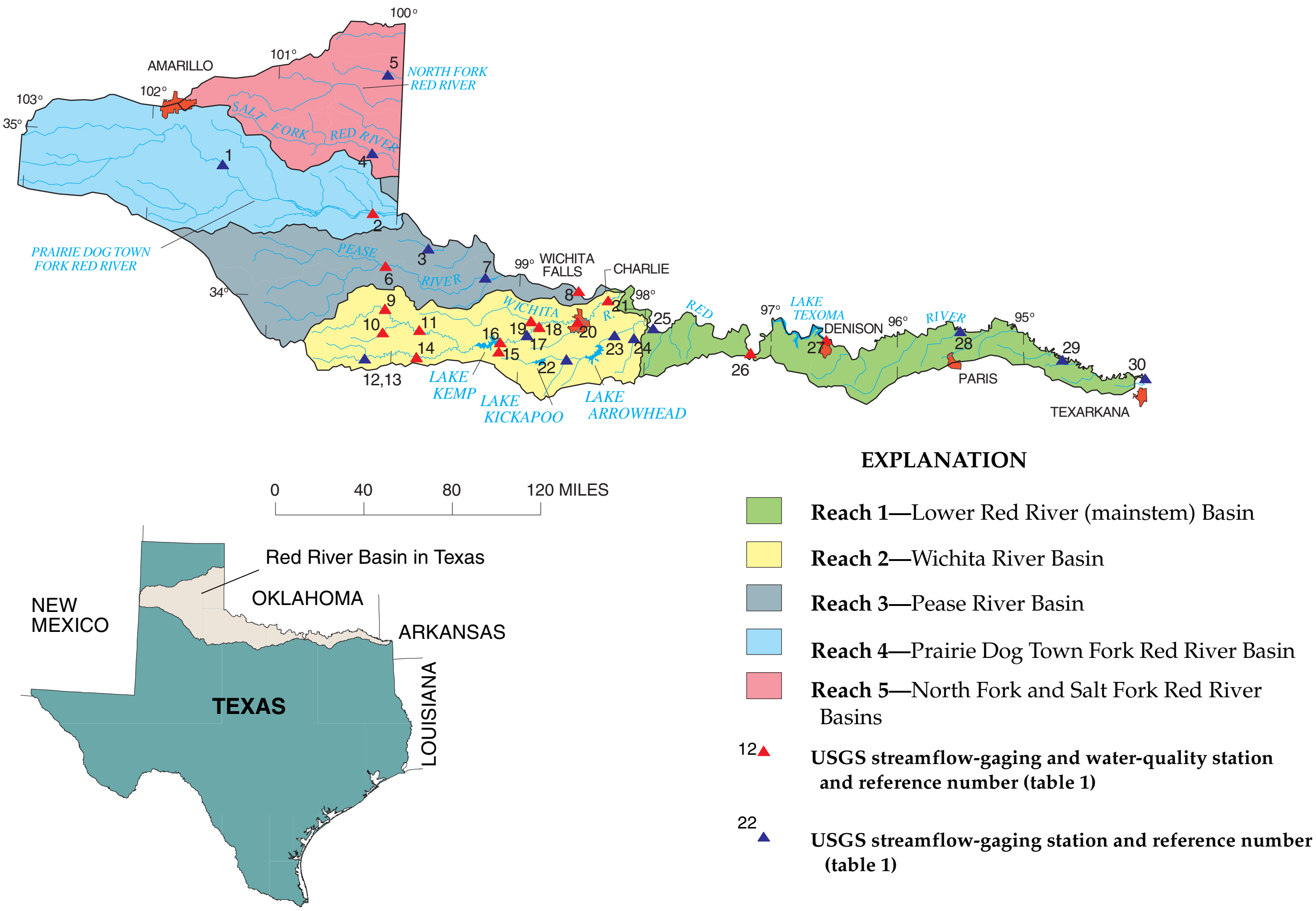


Figure 1. Location of Red River Basin, Texas, and stream-monitoring stations.

This fact sheet presents the 1996–97 stream monitoring and outreach activities of the U.S. Geological Survey (USGS), the Red River Authority of Texas, the U.S. Army Corps of Engineers, the City of Wichita Falls, the Wichita County Water Improvement District No. 2, and the Texas Water Development Board. The fact sheet was prepared by the USGS in cooperation with the Red River Authority of Texas.

The Red River Basin comprises parts of five states: New Mexico, Oklahoma, Texas, Arkansas, and Louisiana. The basin covers about 94,500 square miles, of which approximately 24,500 square miles are in Texas (fig. 1). The river flows from eastern New Mexico, across the Texas Panhandle, and becomes the Texas-Oklahoma boundary. It then flows through southwestern Arkansas and into Louisiana, where it joins the Atchafalaya River.

The land-surface features of the Red River Basin in Texas vary from the nearly level prairie and farmland west of Amarillo, to rugged canyons and ridges east of Amarillo, to rolling plains and prairie in the Wichita Falls area and, finally, to the gently rolling, wooded hills in northeast Texas. Rainfall increases appreciably across the basin from an average of about 15 inches near the Texas-New Mexico border to about 48 inches near the Texas-Arkansas border. Four major reservoirs with impoundment capacities greater than 200,000 acre-feet are in the basin (fig. 1): Lake Kemp, Lake Kickapoo, Lake Arrowhead, and Lake Texoma.

Amarillo is the largest city in the Texas part of the basin, with an estimated 1997 population of about 174,000 (Texas A&M University, 1997). Wichita Falls is the second largest, with an estimated 1997 population of about 102,000. The next largest Texas cities—Burkburnett, Canyon, Denison, Hereford, Paris, Sherman, and Vernon—all have estimated 1997 populations in the 10,000-to-40,000 range. The major industries in the region are oil and gas production, agriculture, ranching, manufacturing, and tourism.

Table 1. Active stream-monitoring stations, Red River Basin, Texas, 1996–97

Reference number (fig. 1)	USGS station number	Station name	Drainage area (square miles)	Continuous 2-parameter monitors[1]	Period of record	
					Streamflow	Water quality
1	07297910	Prairie Dog Town Fork Red River near Wayside, Tex.	4,211		1967–97	
2	07299540	Prairie Dog Town Fork Red River near Childress, Tex.	7,725	X	1964–97	1994–97
3	07299670	Groesbeck Creek at State Highway 6 near Quanah, Tex.	303		1961–97	
4	07300000	Salt Fork Red River near Wellington, Tex.	1,222		1952–97	
5	07301410	Sweetwater Creek near Kelton, Tex.	287		1961–97	1969–85
6	07307800	Pease River near Childress, Tex.	2,754	X	1959–62 1967–97	1968–82
7	07308200	Pease River near Vernon, Tex.	3,488		1959–82 1992–97	1967–81
8	07308500	Red River near Burkburnett, Tex.	20,570	X	1959–97	1968–81 1994–97
9	07311600	North Wichita River near Paducah, Tex.	540	X	1961–82 1994–97	1994–97
10	07311630	Middle Wichita River near Guthrie, Tex.	50	X	1994–97	1994–97
11	07311700	North Wichita River near Truscott, Tex.	937	X	1959–97	1954–59 1968–92 1994–97
12	07311782	South Wichita River at Low Flow Dam near Guthrie, Tex.	223	X	1984–85 1987–97	1984–97
13	07311783	South Wichita River below Low Flow Dam near Guthrie, Tex.	223		1985–97	1987–89
14	07311800	South Wichita River near Benjamin, Tex.	584	X	1952–57 1959–97	1967–97
15	07311900	Wichita River near Seymour, Tex.	937	X	1960–79 1997	1969–92 1997
16	07312100	Wichita River near Mabelle, Tex.	2,086	X	1959–97	1968–97
17	07312110	South Side Canal near Dundee, Tex.	2,194		1971–97	
18	07312130	Wichita River at State Highway 25 near Kamay, Tex.	2246	X	1996–97	1996–97
19	07312200	Beaver Creek near Electra, Tex.	652	X	1960–97	1968–70 1996–97
20	07312500	Wichita River at Wichita Falls, Tex.	3,140	X	1938–97	1981–89 1996–97
21	07312700	Wichita River near Charlie, Tex.	3,439	X	1967–97	1967–81 1996–97
22	07314500	Little Wichita River near Archer City, Tex.	481		1932–56 1966–97	
23	07314900	Little Wichita River above Henrietta, Tex.	1,037		1953–97	1952–56 1959–66 1968–85
24	07315200	East Fork Little Wichita River near Henrietta, Tex.	178		1963–97	
25	07315500	Red River near Terral, Okla.	28,723		1938–97	1967–97
26	07316000	Red River near Gainesville, Tex.	30,782	X	1936–97	1994–97
27	07331600	Red River below Denison Dam, Tex.	39,720	X	1997	1997
28	07335500	Red River at Arthur City, Tex.	44,531		1905–11 1936–97	
29	07336820	Red River near De Kalb, Tex.	47,348		1967–97	1968–97
30	07337000	Red River at Index, Ark.	48,030		1936–97	1997

[1] Specific conductance and temperature recorded hourly.

Several tributaries to the Red River appear fairly turbid and generally have visible suspended-sediment concentrations during low flow, as can be seen at the stream-monitoring station Wichita River near Charlie, Tex. (photo A). Water in the mainstem of the Red River reflects the River's namesake (photo B). During low flow the Red River appears fairly turbid, as can be seen at the stream-monitoring station Red River near Burkburnett, Tex. (photo B).

Salinity is the greatest limitation on water use in the Red River Basin and is largely the result of naturally occurring salt springs in parts of the upper reaches of the basin (Keller and others, 1988). The salt sources contribute water with large (relative to potable water) concentrations of dissolved solids, principally chloride. At certain times and locations, the salinity of streams in the basin exceeds that of seawater (Keller and others, 1988).

In 1957, when Congress directed the improvement of water quality in the Red River Basin, the U.S. Army Corps of Engineers began studying the problem of salt removal from 10 salt-spring areas in the Red River Basin. Eight of these source areas were selected by the Corps of Engineers to have structural controls installed to reduce salt loads reaching the mainstem of the Red River (Keller and others, 1988) (fig. 2).

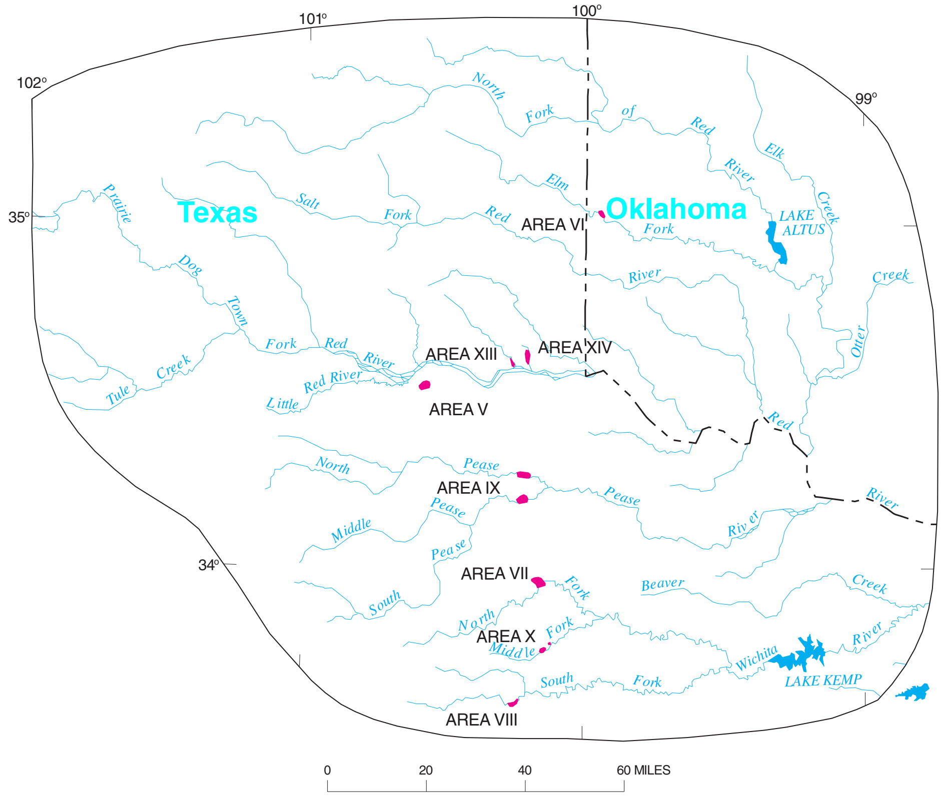


Figure 2. Location of salt-spring areas in the Red River Basin, Texas and Oklahoma (Keller and others, 1988).

The Water Resources Development Act of 1974 provided funding for the construction of water-control structures in Area VIII in the Wichita River Basin. A water-control structure in Area VIII on the South Wichita River (photo C) creates a pool behind an inflatable dam during low flow, which is the most saline. Water from the pool is pumped by way of the Bateman pump station through a 23-mile pipeline north to Truscott Brine Lake, where the water evaporates (Keller and others, 1988). Construction of Bateman pump station and Truscott Brine Lake began in 1976, and the diversion of low flow began in May 1987. The Corps of Engineers also has completed the chloride control structure for Area V, Estelline Springs (Keller and others, 1988).

Stream Monitoring

The Red River Basin in Texas has been intensely monitored with two-parameter (specific conductance and temperature) water-quality monitors and streamflow-gaging stations (fig. 1; table 1). Water-quality samples for inorganic constituents, nutrients, trace elements, and pesticide analyses are being collected at all two-parameter monitor sites.

Basinwide Monitoring Plan

The Clean Waters Act of 1991 (Texas Senate Bill 818) directed the Texas Natural Resource Conservation Commission (TNRCC) to assess and manage the water quality of Texas surface water and generate a biennial comprehensive assessment of all river basins in Texas. The program implementing the act is called the Clean Rivers Program. Subsequently, the TNRCC contracted with planning agencies of the State to perform the necessary assessment and monitoring for each river basin. The Red River Authority of Texas is the planning agency contracted to perform these duties for the Red River Basin. The USGS is cooperating with the Red River Authority to collect and interpret streamflow and water-quality data.

The basin was divided into five reaches (fig. 1) for the purpose of designing an efficient sampling plan within the limited budget available. The reaches are ranked so that monitoring can be scheduled according to Clean Rivers Program priorities. Each reach was ranked on the basis of the combined ranking of the segments in the reach (segments were ranked in accordance with the TNRCC procedure (Brazos River Authority, written commun., 1995)), the total number of domestic and industrial discharges in the reach, and the total volume of effluent discharged in the reach. The schedule for focused monitoring (high-intensity sampling during 1 of the 5 years and low-intensity sampling during the other 4 years) reflects the ranking of the five reaches:

Year 1 (fiscal years 1996–97)—Reach 2 Wichita River Basin

Year 2 (fiscal years 1997–98)—Reach 1 Lower Red River (mainstem) Basin

Year 3 (fiscal years 1998–99)—Reach 4 Prairie Dog Town Fork of the Red River Basin

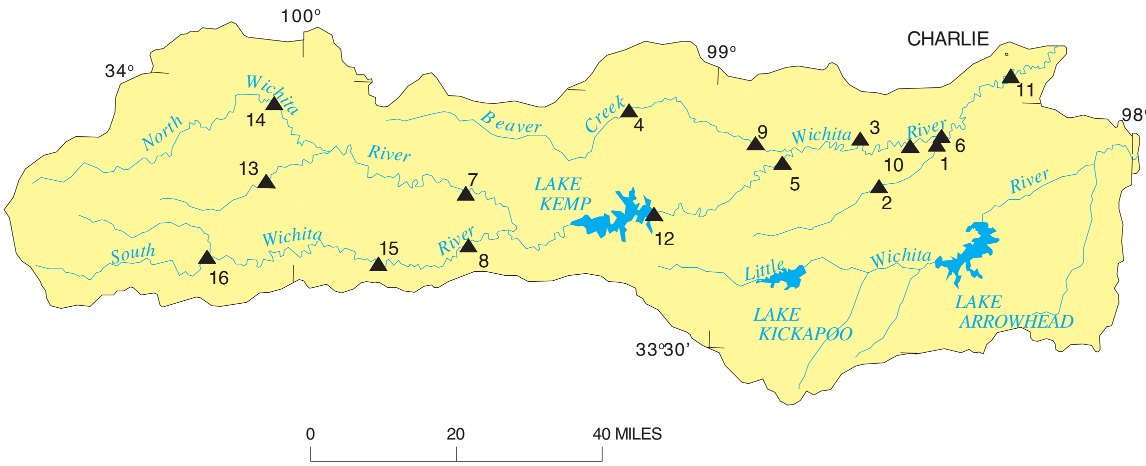
Year 4 (fiscal years 1999–2000)—Reach 3 Pease River Basin

Year 5 (fiscal years 2000–2001)—Reach 5 North Fork and Salt Fork of the Red River Basins

The monitoring plan for the reaches in the Red River Basin includes the computation of salt loading for the major tributaries to identify sources of salinity and to determine to what extent these sources contribute to the elevated dissolved solids concentrations. In addition, biological sampling will be done during the high-intensity sampling in each reach during the 5-year cycle of the basinwide monitoring plan, which allows for biological assessment across the entire basin. The assessment results can be related to the chemical and physical characteristics of each reach and also can be used to characterize a “generic” reference site for comparison to the results of future sampling.

Wichita River Basin

Between June 1996 and September 1997, streamflow and water-quality monitoring in Reach 2 (fig. 3) of the Wichita River Basin were emphasized. Water quality in the Wichita River watershed is characterized by high salinity for much of the surface and ground water. A major effort of the monitoring program (table 2) is directed toward recording and computing salt loads at selected gaging stations in the Wichita River Basin.



EXPLANATION

▲ 12 Wichita River Basin sampling site and reference number (table 2)

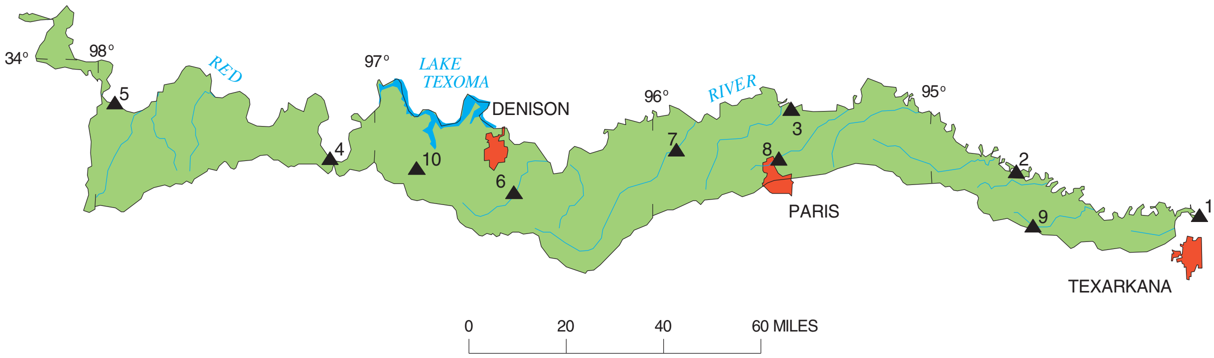
Figure 3. Sampling sites in the Wichita River Basin, Texas, 1996–97.

Table 2. Monitoring program in the Wichita River Basin, Texas, 1996–97

W - Weekly
M - Monthly
Q - Quarterly
Y - Yearly
9/YR - Nine times per year

Standard - streamflow, specific conductance, pH, temperature, and dissolved oxygen
Productivity - a dissolved oxygen reading taken in the morning hours, as well as evening hours, to record diurnal swings in dissolved oxygen
Bacteriological - fecal coliform and *Escherichia* coli
Inorganic constituents - calcium, magnesium, sodium, alkalinity, sulfate, chloride, and dissolved solids
Rapid bio-assessment - a synoptic survey of benthic macroinvertebrates and fish to assess biological impairment of a water body

Reference number (fig. 3)	Station description	Station ID		Standard	Productivity	Bacteriological	Inorganic constituents	Rapid bio-assessment
		TNRCC	USGS					
1	Holliday Creek at Harding Street	10095		W		9/YR	Q	
2	Holliday Creek at Sisk Road (Farm Road 2650)	15122		W		9/YR	Q	
3	Buffalo Creek at Farm Road 1814	10097		W		9/YR	Q	Y
4	Beaver Creek at U.S. Highway 283	15121		W		9/YR	Q	
5	Wichita River at State Highway 25	10155			9/YR	9/YR	Q	Y
6	Wichita River at River Road	10149			9/YR	9/YR	Q	
7	North Wichita River at Farm Road 267	15177						Y
8	South Wichita River at Waggoner Ranch Road	15178						Y
9	Beaver Creek near Electra	15120	07312200			9/YR	Q	Y
10	Wichita River at Wichita Falls (Loop 11)	10151	07312500			9/YR	Q	
11	Wichita River at Charlie	10145	07312700		9/YR	9/YR	Q	
12	Wichita River near Mabelle at U.S. Highway 183/283	10158	07312100				M	
13	Middle Fork Wichita River near Guthrie	14900	07311630				M	
14	North Wichita River near Paducah	15119	07311600				M	
15	South Wichita River at State Highway 283 North of Benjamin	10185	07311800				M	
16	South Wichita River at Low Flow Dam near Guthrie	13636	07311782				M	



EXPLANATION

8
▲ Sampling site and reference number (table 3)

Figure 4. Sampling sites in the lower Red River (mainstem) Basin, Texas, 1996–97.

Additional monitoring is being directed toward investigating eutrophication and high bacteria levels. The water quality of the waterways in the Wichita River Basin is being assessed and compared, and a data base of biological information is being established for future reference. Bacteria monitoring is intended to determine whether the bacteria criteria of the Texas Surface Water Quality Standards (Texas Natural Resource Conservation Commission, 1995) are being achieved.

Lower Red River (Mainstem) Basin

In 1997, streamflow and water-quality monitoring in Reach 1 of the Red River Basin were emphasized (fig. 4). Dissolved oxygen, dissolved solids, nutrients, trace elements, and pesticides (table 3) are being monitored in this reach. As in the Wichita River Basin, indicators of eutrophication and high bacteria levels are being investigated, the water quality of the waterways in the Lower Red River is being assessed, and a data base of biological information is being established for future reference. Both fish and nekton (free-swimming, aquatic animals) are being sampled at eight sites within this reach.

Additionally, sampling for TNRCC-permitted pollutants is planned for two sites. The permitted pollutants comprise a list of chemical compounds and trace elements, including chlorinated pesticides, organophosphorus pesticides, volatile organic compounds, and herbicides.

Table 3. Monitoring program in the lower Red River (mainstem) Basin, Texas, 1996–97

M - Monthly
Q - Quarterly
B - Twice a year during summer and/or spring months
Y - Yearly

Standard - streamflow, specific conductance, pH, temperature, Secchi-disk transparency, and dissolved oxygen
Productivity - hourly readings of dissolved oxygen for a 24-hour period to record diurnal swings in dissolved oxygen
Bacteriological - fecal coliform and *Escherichia* coli
Inorganic constituents - calcium, magnesium, sodium, alkalinity, sulfate, chloride, dissolved solids, and suspended solids
Nutrients - ammonia nitrogen, nitrite plus nitrate nitrogen, and orthophosphorus
Trace elements - (dissolved in water and total in sediments for each) aluminum, arsenic, cadmium, chromium, copper, lead, nickel, selenium, silver, zinc, mercury. Additionally, acid volatile sulfides will be analyzed with each trace element (sediment) sample
Pesticides (sediment) - chlorinated pesticides. Additionally, total organic carbon will be analyzed with each pesticides sample

Reference number (fig. 4)	Station description	Station ID		Standard	Productivity	Bacteriological	Inorganic constituents	Nutrients	Trace elements	Pesticides (sediment)
		TNRCC	USGS							
1	Red River at U.S. Highway 71	10123	07337000	B	Y	M	Q	B	B	B
2	Red River at U.S. Highway 259	10125	07336820	B					B	B
3	Red River at U.S. Highway 271	10126		B	Y		Q	B	B	B
4	Red River at I–35	10132	07316000	B	Y	M		B		
5	Red River at U.S. Highway 81	10133	07315500	B		M			B	B
6	Choctaw Creek at Farm Road 1753	10108		M	Y	M	Q	Q	B	B
7	Bois D'Arc Creek at Farm Road 100	15318		M	Y	M	Q	Q	B	B
8	Pine Creek at Farm Road 2648	10120		M	Y	M	Q	Q	B	B
9	Mud Creek at U.S. Highway 259	15319		M	Y	M	Q	Q	B	B
10	Big Mineral Creek at Farm Road 901	15320		M	Y	M	Q	Q	B	B

A. Wichita River near Charlie, Tex.

B. Red River near Burkburnett, Tex.

C. Water-control structure in Area VIII, Tex.

D. Texas Rivers Project site visit.

Educational Program—The Texas Rivers Project

In addition to water-resource monitoring, another major work effort is underway in the Wichita River Basin. It is an educational program for elementary, middle school, and high school students known as the Texas Rivers Project. The Texas Rivers Project, developed by the Red River Authority of Texas and the River Bend Nature Works in Wichita Falls, offers teachers and students a unique learning experience by enhancing science or biology curricula with the application of environmental monitoring and reporting at a minimal expense to the school district. Texas Rivers Project monitoring consists of monthly visits to a nearby stream site where students can measure specific conductance, pH, temperature, Secchi-disk transparency, and dissolved oxygen, as well as make visual observations of the site (photo D). The data being collected by the students are used by the Red River Authority of Texas to characterize the water quality of sites where very little information exists.

The program offers real-world science, mathematics, and social study as students learn to evaluate the effects of natural and anthropogenic factors on our natural resources. In addition, teachers can become better equipped to help students join society as well-informed, active, and scientifically literate citizens.

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