

PERFORMANCE REPORT

As required by

FEDERAL AID IN FISHERIES RESTORATION ACT

Federal Aid Project F-30-R-4

Statewide Fishery Management Recommendations

Job A: Existing Reservoir and Stream Management Recommendations
Statewide Minimum Streamflow Recommendations

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F-30-R-4
Performance Report
Job A, Statewide

Objective: To recommend habitat improvement, fisherman information, fish population manipulation, vegetation control, pollution control, fisherman access and facility development and fishing regulations for existing and proposed public waters of Texas.

I. Summary: Literature on assessing streamflow needs was reviewed. Recommendations from two of the methodologies described were combined to develop minimum flows needed to maintain Texas stream fisheries. These flows were 40 percent of the median monthly flows October-February and 60 percent March-September.

To validate these flows, a field evaluation was conducted on the Guadalupe River below Canyon Reservoir. Results suggest that the above minimum flows are valid for Texas stream fisheries.

II. Significant Deviations: All scheduled project work was completed.

III. Cost: \$2,500

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Date: October 16, 1979

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INTRODUCTION

Texas had 157 major reservoirs with capacities of 5,000 acre-feet or greater at the end of 1969 (Texas Almanac 1970). The Texas Water Plan proposes an additional 68 reservoirs be built to help meet water needs by the year 2020. To date, little attention has been given to releasing sufficient water from these reservoirs to maintain stream fisheries in Texas. However, concern for maintaining instream flows has become increasingly evident in other parts of the United States. Work done by Tennant (1976), Robinson (1969), Bovee (1975), Stalnaker and Arnette (1976) and others, has resulted in the formation of an Instream Flow Group under the direction of the United States Fish and Wildlife Service. Formation of this group has focused the attention of state conservation agencies on the need of maintaining instream flows.

Most of the initial work on instream flow methodologies was done in the mountainous western states. There, the annual flow regime depends on snowmelt in spring and early summer to support predominately coldwater fisheries. In Texas, spring and (to some extent) fall rains account for the majority of streamflow necessary to support warmwater fisheries. Revision of existing methodologies was deemed necessary to fit Texas' climatic conditions and warmwater fisheries. This study was initiated to determine minimum streamflows needed to support Texas stream fisheries.

METHODS AND MATERIALS

To establish minimum flow requirements for Texas stream fisheries, available literature on assessing streamflow needs was reviewed. Flow percentages used by Tennant (1976) and the use of median monthly flows recommended by Robinson (1969) were combined to provide a basis for the minimum flows used in this study. Flows chosen for study were 40 percent of the median monthly flows October-February and 60 percent March-September. Monthly flows were chosen to mimic natural discharge patterns. Sixty percent values were chosen to provide more flow during critical spring and summer months.

To validate these flows, a field evaluation was conducted on the Guadalupe River below Canyon Reservoir. In the field evaluation, median monthly flows for the gaging station above the reservoir were determined by the Department's Data Processing Branch using daily flow data compiled by the United States Geological Survey. The gaging station above the reservoir was used in order to provide proportions of the actual inflow to the reservoir.

Bovee (1975) and Stalnaker and Arnette (1976) have reviewed current streamflow methodologies and have pointed out desirable characteristics of each. A methodology should be expedient, inexpensive, reliable, easy to use, realistic, usable on all sizes of streams, adaptable to a particular fishery, meaningful and capable of mimicking natural flow patterns. Use of the minimum flows described in this paper meets the above criteria for Texas stream fisheries.

Streamflow recommendations should be made monthly in order to mimic natural flow patterns. To minimize the effects of reduced flows during critical periods for Texas stream fisheries, recommended streamflows should provide a proportionately higher percentage of the normal flow during the spring and summer. Minimum flows used in this report should provide needed flow during critical periods and maintain adequate aquatic habitat.

Field evaluation on the Guadalupe River suggests the minimum flows used in this paper are valid recommendations for Texas stream fisheries.

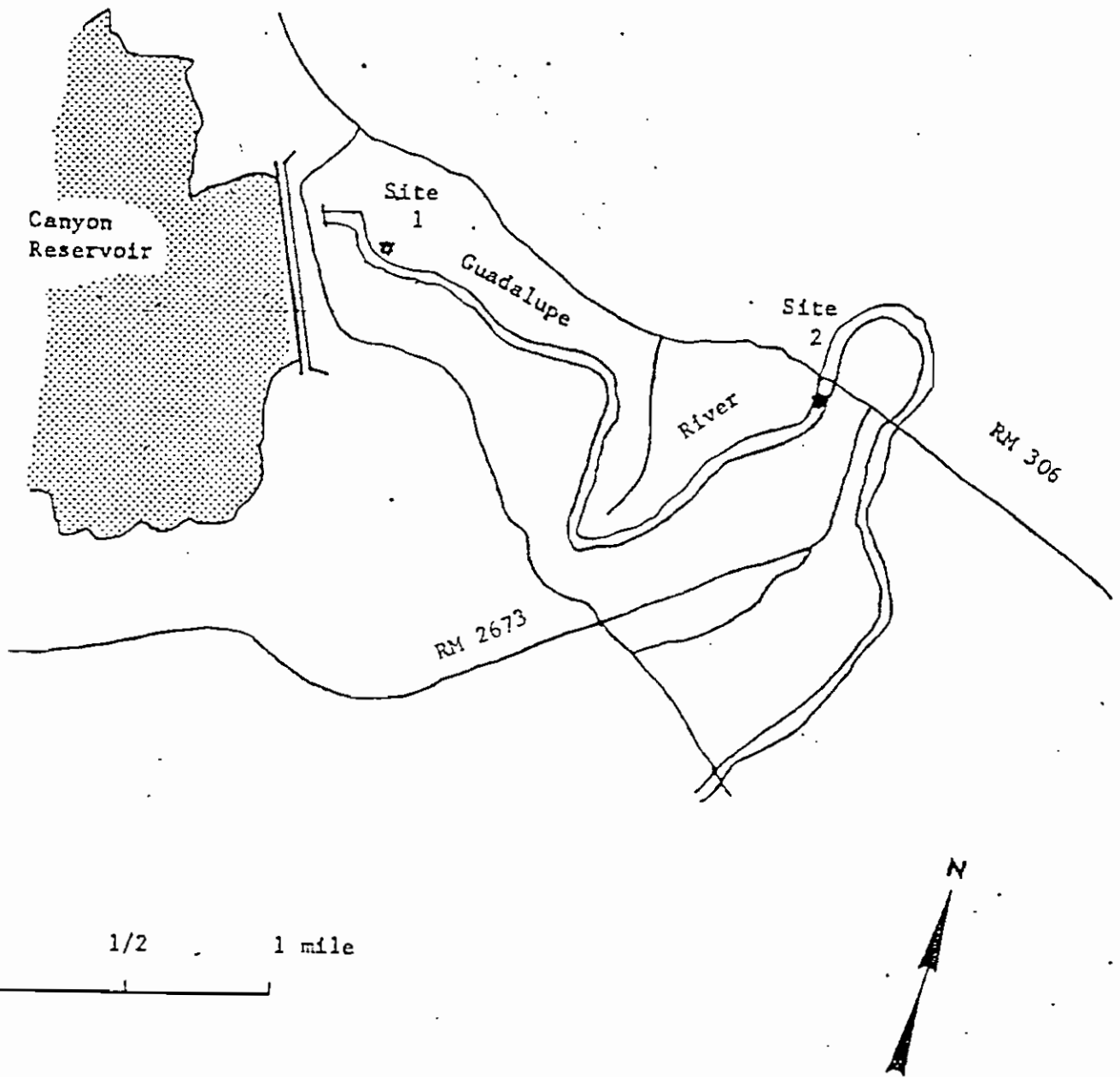


Figure 1. Sampling sites, Guadalupe River, 1977.

With the aid of the Guadalupe River Authority and the United States Army Corps of Engineers, discharge from Canyon Reservoir was halted for approximately 4 h on February 2, 1977. This allowed transect measurements of depth, width, and velocity to be made at various flows at two stations below the reservoir (Fig. 1). Measurements of depth were made with a meter stick, width with a surveyor's tape and velocity with a General Oceanics® flow meter (Model 2030) and a stopwatch. Measurements were taken every 4.4 ft across the stream channel. Median flow percentage (Tables 1 and 2) were calculated by comparing measured flows with the February median monthly flow at the gaging station above Canyon Reservoir.

From the data collected, percent wetter substrate (measured width divided by estimated normal width) was calculated and the point of greatest inflection was assumed to approximate the minimum flow needed to maintain aquatic habitat (Tennant 1976).

RESULTS

In the field evaluation conducted on the Guadalupe River below Canyon Reservoir, flows ranging from 9 cubic feet per second (cfs) to 784 cfs were observed. The point of inflection at Site 1 occurred between 13 and 62 percent of the median flow (Table 1). Slower dewatering at Site 2 allowed a more precise estimate of the inflection point which was estimated to occur between 33 and 44 percent of the median flow (Table 2).

Results obtained at Site 2 suggest 40 percent of the median monthly flow would be needed to maintain aquatic habitat for Texas stream fisheries. However, to insure suitable spawning habitat and to offset large areas of slack water, which could become stagnant during warmer months, flows greater than 40 percent would be required during the months of March-September.

DISCUSSION

Reduced streamflow may adversely affect aquatic habitat in the following ways: (1) alter temperature regimes; (2) lower dissolved oxygen concentrations due to decreased waste assimilation capacity; (3) decrease sediment load capacity; and (4) increase concentrations of toxic materials. Undesirable species such as carp, buffalo, and river carpsucker, which have relatively high tolerances for poor water quality, would be favored (Bovee, 1975). Other factors affected by reduced streamflows include spawning success, species composition and food production.

Table 1. Results of reduced streamflow on various parameters, Guadalupe River, Site 1, February 2, 1977.

Measured Flow (cfs)	Percent Median Flow	Measured Width (ft)	Percent Wetted Substrate
784	564	99	110
512	368	96	107
251	181	93	103
86	62	89	99
18	13	66*	73(41)
9	6	38**	42(39)

* Includes 29 ft of slack water (no flow)

** Includes 3 ft of slack water (no flow)

Percentages in parenthesis do not include slack water area.

Table 2. Results of reduced streamflow on various parameters, Guadalupe River, Site 2, February 2, 1977.

Measured Flow (cfs)	Percent Median Flow	Measured Width (ft)	Percent Wetted Substrate
723	520	120	162
623	448	125	169
350	252	79	107
280	201	77	104
196	141	76	102
154	111	74	100
96	69	74	100
72	52	73	98
61	44	71	96
46	33	71*	96(83)
35	25	70**	95(74)

* Includes 7 ft of slack water (no flow)

** Includes 13 ft of slack water (no flow)

Percentages in parenthesis do not include slack water area.

LITERATURE CITED

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GUADALUPE RIVER

U.S.G.S.

Average Flow

Median Flow

Recommended Flows By Months

Stream	County	Station Number	Recommended Flows By Months												Yearly	
			J	F	M	A	M	J	J	A	S	O	N	D		
Guadalupe River at Hunt	Kerr	08165500	65	43	40	40	40	48	38	31	34	45	46	53	48	42
Johnson Creek near Ingram	Kerr	08166000	17	17	16	24	29	23	19	20	27	18	21	19	21	21
Guadalupe River at Comfort	Kendall	08167000	161	90	93	100	124	80	53	44	55	80	83	83	80	80
Guadalupe River near Spring Branch	Comal	08167500	285	114	139	167	212	154	94	63	74	99	107	109	115	140
Rebecca Creek near Spring Branch	Comal	08167600	5	46	56	100	85	62	56	38	44	40	43	44	58	58
Guadalupe River at Sattler	Comal	08167800	351	3	3	3	3	2	1	1	1	2	2	2	3	2
Guadalupe River at New Braunfels	Comal	08168500	384	199	221	270	292	269	170	108	138	158	151	164	183	183
Comal River at New Braunfels	Comal	08169000	292	80	88	162	175	161	102	65	83	63	60	66	92	92
Blanco River at Wimberley	Hays	08171000	120	122	123	189	191	188	181	174	174	118	116	122	152	152
Blanco River near Kyle	Hays	08171300	150	46	50	54	79	64	41	27	33	36	36	37	44	44
San Marcos River at Luling	Caldw- Guada- lupe	08172000	356	18	20	32	47	38	25	16	20	14	14	15	22	22
				80	111	104	129	90	47	29	28	36	51	64	56	56
				32	44	62	65	77	54	17	17	14	20	26	28	28
				200	239	226	269	273	183	163	172	173	182	204	191	191
				80	96	136	161	164	136	98	101	69	71	82	97	97

APPENDIX A
Recommended Flows by River System*

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* All flows rounded to nearest whole number.
Use gaging station above reservoir to recommend flows.

GUADALUPE RIVER (Cont.)

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flow Recommended Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
San Antonio River near Falls City	Karnes	08183500	357	209	234	210	217	225	200	163	146	167	177	182	199	191
Cibolo Cr. near Falls City	Karnes	08186000	120	84	94	126	130	135	120	98	88	100	69	73	80	96
				25	26	24	26	27	26	16	17	18	22	24	22	
San Antonio River at Goliad	Goliad	08188500	608	10	10	14	16	16	16	12	10	10	7	9	10	11
				272	298	281	290	335	293	194	240	238	256	272	260	
				109	119	169	174	201	176	136	116	144	95	102	109	130

SAN BERNARD RIVER

San Bernard River near Boling	Wharton-Fort Bend	08117500	508	47	58	32	29	60	67	94	76	113	52	20	24	53
				118	146	53	48	100	112	156	126	189	130	51	59	106

TRINITY RIVER

Big Sandy Creek near Bridgeport	Wise	08044000	74	8	12	13	13	21	9	0	0	0	1	4	7	5
West Fork Trinity R. near Boyd	Wise	08044500	220	3	5	8	8	13	5	0	0	0	0	2	3	3
				27	23	22	30	132	166	102	43	20	30	26	44	
Clear Fork Trinity R., Benbrook	Tarrant	08047000	72	11	9	13	18	79	100	61	93	26	8	12	10	22
				1	1	1	3	8	5	2	1	1	1	1	1	1
Clear Fork Trinity R., Fort Worth	Tarrant	08047500	97	0	1	1	2	5	3	1	1	0	0	0	0	1
				10	14	12	17	24	13	6	4	5	6	9	10	9
West Fork Trinity R., Fort Worth	Tarrant	08048000	378	4	6	7	10	14	8	4	2	3	2	4	4	5
				51	59	99	109	181	80	30	15	20	24	25	39	42
West Fork Trinity R., Grand Prairie	Dallas	08049500	547	20	24	59	65	109	48	18	9	12	10	10	16	21
				131	158	210	184	294	180	110	89	99	109	105	125	130
				52	63	126	110	176	108	66	53	59	44	42	50	65

GUADALUPE RIVER (Cont.)

U.S.G.S.

Station Number

Average Flow

Median Flow

Recommended Flows By Months

Stream	County	Station Number	Average Flow	Median Flow Recommended Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
Plum Creek at Lockhart	Caldwell	08172400	49	5	7	6	4	3	3	0	0	0	0	1	4	2
Plum Creek near Luling	Caldwell	08173000	100	2	3	4	2	2	2	0	0	0	0	0	2	1
Peach Creek below Dilworth	Gonzales	08174600	150	14	19	15	12	12	9	5	3	4	5	7	10	8
Sandies Creek near Westhoff	De Witt	08175000	125	6	8	9	7	7	5	3	2	2	2	3	4	4
Guadalupe River at Cuero	DeWitt	08175800	1923	10	15	11	7	12	6	0	0	2	4	5	5	5
Guadalupe River at Victoria	Victoria	08176500	1739	4	6	7	4	7	4	0	0	1	2	2	2	3
Coleta Creek near Schroeder	Goliad-Victoria	08177000	92	12	16	11	7	8	7	4	3	5	7	9	7	7
San Antonio River at San Antonio	Bexar	08178000	54	5	608	828	747	1047	1029	554	436	557	383	372	428	580
Salado Cr. at San Antonio	Bexar	08178800	39	976	1140	1100	1120	1340	1180	900	673	780	832	835	942	936
Medina R. near Pipe Creek	Bexar	08179000	133	390	456	660	672	804	708	540	404	468	333	334	377	468
Medinn R at San Antonio	Bexar	08181500	145	10	18	16	12	15	11	6	4	6	7	6	9	9
				4	7	10	7	9	7	4	2	4	3	2	4	5
				25	33	34	34	41	28	24	24	25	26	24	25	27
				10	13	20	20	25	17	14	14	15	10	10	10	14
				20	21	18	20	21	18	11	14	16	17	18	19	18
				8	8	11	12	13	11	7	8	10	7	7	8	9
				46	50	60	61	81	57	34	22	26	55	54	56	78
				18	20	36	37	49	34	20	13	16	22	22	22	39
				73	82	68	74	76	71	59	53	60	68	70	75	68
				29	33	41	44	46	43	35	32	36	27	28	30	14

TRINITY RIVER (Cont.)

U.S.G.S.

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flow Recommended Flows By Months												Yearly	
				J	F	M	A	M	J	J	A	S	O	N	D		
Mountain Creek near Cedar Hill	Dallas	08049600	53	3	6	4	4	5	1	0	0	0	0	0	0	2	1
Mountain Creek at Grand Prairie	Dallas	08050100	107	1	2	3	2	3	1	0	0	0	0	0	0	1	1
Elm Fork Trinity R., Sanger	Denton	08050500	153	1	1	1	1	2	1	1	1	1	1	0	1	1	1
Isle du Bois Creek near Pilot Point	Denton	08051000	120	26	38	42	34	50	32	10	5	8	14	14	15	18	18
Clear Creek near Sanger	Denton	08051500	82	10	15	25	20	30	19	6	3	5	6	6	6	9	9
Elm Fork Trinity R. near Lewisville	Denton	08053000	605	4	7	9	9	15	5	0	0	0	1	1	2	2	2
Denton Creek near Justin	Denton	08053500	86	2	3	5	5	9	3	0	0	0	0	0	1	1	1
Denton Creek near Grapevine	Denton	08055000	149	2	21	17	17	28	17	2	0	0	5	8	11	9	9
Elm Fork Trinity R. near Carrollton	Dallas	08055500	788	1	8	10	10	17	10	1	0	0	2	3	4	5	5
Trinity R. at Dallas	Dallas	08057000	1512	122	118	138	153	210	279	256	236	190	144	140	132	171	171
Trinity R. Below Dallas	Dallas	08057410	1940	49	47	83	92	126	167	154	142	114	58	56	53	86	86
				11	21	19	18	34	20	1	0	0	2	7	9	8	8
				4	8	11	11	20	12	1	0	0	1	3	4	4	4
				39	34	28	47	60	75	66	58	44	19	18	22	40	40
				16	14	17	28	36	45	40	35	26	8	7	9	20	20
				96	100	124	225	266	247	153	89	83	101	98	113	125	125
				38	40	74	135	160	148	92	53	50	40	59	68	63	63
				241	272	348	560	989	615	226	140	146	175	156	207	284	284
				96	109	209	336	593	369	136	84	88	70	62	83	142	142
				567	620	574	787	2395	1275	491	431	479	491	461	511	551	551
				227	248	344	472	1437	765	295	259	287	196	184	204	276	276

TRINITY RIVER (Cont.)

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flow Recommended Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
East Fork Trinity R. near McKinney	Collin	08059000	116	28	37	30	34	57	24	3	0	0	3	6	10	11
Sister Grove Cr. near Princeton	Collin	08059500	69	20	28	26	28	40	20	4	0	0	2	6	8	9
East Fork Trinity R. near Lavon	Collin	08061000	400	1	10	12	10	147	26	0	9	0	0	0	1	1
Duck Creek near Garland	Dallas	08061700	27	1	4	7	6	88	15	0	0	0	0	0	0	1
East Fork Trinity R. near Grandall	Kaufman	08062000	639	6	6	6	6	5	2	1	0	1	2	3	5	3
Trinity R. near Rosser	Ellis-Kaufman	08062500	2633	2	3	4	3	3	1	1	0	0	1	1	2	2
Richland Creek near Dawson	Navarro	08063100	165	64	122	153	136	489	301	45	27	24	41	38	43	66
Richland Creek near Richland	Navarro	08063500	391	26	49	92	82	293	181	27	16	14	16	15	17	33
Chambers Creek near Corsicann	Navarro	08064500	457	618	974	932	1270	2540	1825	540	430	401	430	477	519	641
Trinity R. near Oakwood	Anderson-Freestone	08065000	4860	247	390	559	762	1524	1095	324	258	241	172	191	208	321
Trinity R. near Crockett	Houston-Leon	08065350	6009	9	11	9	8	7	8	7	0	0	2	4	10	6
				4	4	5	5	4	5	4	0	9	1	2	4	3
				26	52	38	43	82	31	7	0	0	0	3	15	13
				10	21	23	26	49	19	4	0	0	0	1	6	7
				59	123	116	105	182	68	8	0	1	5	16	40	29
				24	49	70	63	109	41	5	0	1	2	6	16	15
				1700	2230	2595	2500	5750	2925	687	455	466	585	746	1130	1230
				680	892	1557	1500	3450	1755	412	273	280	234	298	452	615
				1895	3290	3250	3475	9730	5800	862	755	885	1460	2405	2760	1910
				758	1316	1950	2085	5838	3480	517	453	531	584	962	1104	955

TRINITY RIVER (Cont.)

U.S.G.S.

Average

Median Flow

Recommended Flows By Months

Stream	County	U.S.G.S. Station Number	Average Flow												Yearly	
			J	F	M	A	M	J	J	A	S	O	N	D		
Trinity R. near Goodrich	Polk-San Jacinto	08066250	8010	4530	4430	5570	3885	10600	6195	2120	1230	1110	1180	2655	4205	2750
				1812	1772	3342	2331	6360	3717	1272	738	666	666	472	1593	1682
Trinity R. at Romayor	Liberty	08066500	4860	1700	2230	2595	2500	5750	2925	687	455	466	585	746	1130	1230
				680	892	1557	1500	3450	1755	412	273	280	234	299	452	615

ARKANSAS RIVER

Canadian River at Tascosa, TX	Oldham	07227470	187	20	20	11	6	9	5	40	145	62	40	26	22	22
				8	8	7	4	5	3	24	87	37	16	10	9	11
Canadian River near Amarillo	Potter	07227500	380	20	22	13	10	23	58	102	183	49	22	18	18	25
				8	9	8	6	14	35	61	110	29	9	7	7	13
Canadian River near Canadian	Memphis	07228000	413	62	69	31	7	12	28	5	10	2	4	17	38	25
				25	28	19	4	7	17	3	6	1	2	7	15	13

COLORADO RIVER

Colorado River at Colorado City	Mitchell	08121000	49	2	2	1	0	3	2	0	0	1	1	1	1	1
				1	1	0	0	2	1	0	0	0	0	0	0	1
Deals Cr. near Westbrook	Mitchell	08123800	25	2	2	2	1	3	2	1	0	2	2	2	2	2
				1	1	1	1	2	1	0	0	1	1	1	1	1
Colorado River at Robert Lee	Coke	08124000	156	2	2	2	1	10	22	5	4	6	3	2	2	3
				1	1	1	1	6	13	3	4	2	4	1	1	1
Colorado River at Ballinger	Runnels	08126500	307	12	11	9	16	95	71	38	28	46	40	19	15	19
				5	4	5	10	57	43	23	17	28	16	16	8	9
South Concho R. at Christoval	Tom Green	08128000	33	14	15	14	14	12	12	10	8	9	11	12	13	12
				6	6	8	8	7	7	6	5	5	4	5	5	5

COLORADO RIVER (Cont.)

U.S.G.S. Station Number

Average Flow

County

Stream

Median Flow Recommended Flows By Months

Stream	County	U.S.G.S. Station Number	Average Flow	J	F	M	A	M	J	J	A	S	O	N	D	Yearly
Dove Creek at Knickerbocker	Tom Green	08130500	12	5	5	4	4	5	2	2	2	4	4	4	4	4
North Concho R. at San Angelo	Tom Green	08135000	27	2	2	2	2	3	1	1	1	2	2	2	2	2
Concho R. at San Angelo	Tom Green	08136000	128	2	3	3	3	4	2	2	0	1	1	1	2	2
Concho R. at Paint Rock	Concho	08136500	176	1	1	2	2	2	0	0	0	1	0	0	1	1
Colorado River at Winchell	McCulloch Brown	08138000	579	30	19	19	15	21	6	3	2	6	14	18	24	10
Pecan Bayou at Brownwood	Brown	08143500	148	12	8	11	9	13	4	2	1	4	6	7	10	5
San Saba River at Menard	Menard	08144500	64	37	32	25	20	36	16	3	1	11	23	26	29	21
San Saba River at San Saba	San Saba	08146000	243	15	13	15	12	22	10	2	1	7	9	10	12	11
Colorado River near San Saba	San Saba Lampasas	08147000	1266	60	62	51	60	275	188	50	40	74	92	65	61	72
North Llano River near Junction	Kimble	08148500	69	24	25	31	36	165	113	30	24	44	37	26	24	36
Llano River near Junction	Kimble	08150000	191	3	3	2	2	9	4	1	0	1	2	2	3	2

COLORADO RIVER (Cont.)

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flow Recommended Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
Llano River at Llano	Llano	08151500	354	145	152	137	136	185	109	75	79	111	127	131	136	128
Pedernales River near Johnson City	Blanco	08153500	169	58	61	82	82	111	65	45	47	67	51	52	54	64
				43	55	50	54	82	45	19	13	23	29	36	43	38
Colorado River at Austin	Travis	08158000	2385	17	22	30	32	49	27	11	8	14	12	14	17	19
				700	680	810	1115	1800	1800	1260	935	928	836	712	680	1110
Colorado River at Smithville	Bastrop	08159500	2724	280	272	486	669	1080	1080	756	561	557	334	427	408	555
				1120	1220	1060	1475	2220	2285	2060	1780	1470	1050	1095	1020	1630
Colorado River at Columbus	Colorado	08161000	2958	448	632	693	966	1425	1428	1272	1122	960	464	504	476	900
				1265	1580	1155	1610	2375	2380	2120	1870	1600	1160	1260	1190	1800
Colorado River at Wharton	Wharton	08162000	2763	506	632	693	966	1425	1428	1272	1122	960	464	504	476	900
				1400	1790	1300	1530	2040	1710	1350	1180	1275	1220	1460	1380	1430
Colorado River at Bay City	Matagorda	08162500	2421	560	716	780	918	1224	1026	810	708	765	488	584	552	715
				1060	1350	990	870	1480	930	595	501	900	838	1080	1050	924
				424	540	594	522	888	558	357	301	540	335	432	420	462

CHOCOLATE BAYOU - OYSTER CREEK

Chocolate Bayou near Alvin	Brazoria	08078000	122	21	17	12	38	52	70	84	65	42	16	12	14	40
Oyster Creek near Angleton	Brazoria	08079000	181	8	7	7	23	31	42	50	39	25	6	5	6	20
				139	129	124	131	142	128	135	128	120	130	131		
				56	52	74	79	85	80	77	77	81	51	48	52	66

BRAZOS RIVER

Double Mtn. Fork Brazos River near Aspermont	Stone-wall	08085000	168	1	1	0	1	16	22	4	4	12	8	3	2	3
				0	0	0	0	10	13	2	2	7	3	1	1	

BRAZOS RIVER (Cont.)

U.S.G.S.

Average
Flow

Median Flow
Recommended Flows By Months

Stream	County	Station Number	Median Flow												Yearly	
			Average Flow	J	F	M	A	M	J	J	A	S	O	N		D
Salt Fork Brazos River near Aspermont	Stone-wall	08082000	121	6	4	3	2	11	23	3	1	2	5	5	6	5
Brazos River at Seymour	Baylor	08082500	394	21	19	17	20	91	155	36	20	46	50	30	27	30
Clear Fork Brazos River at Nugent	Jones	08084000	130	9	8	10	10	26	20	8	5	12	11	10	9	11
Clear Fork Brazos R., Ft. Griffin	Shackelford	08085500	225	5	6	8	8	35	29	8	4	7	6	5	5	8
Clear Fork Brazos Elinsville	Young	08087300	362	18	20	16	32	121	84	18	6	32	29	25	18	26
Brazos River near South Bend	Young	08088000	867	7	8	10	19	73	50	11	4	19	12	10	7	11
Brazos R. near Palo Pinto	Palo Pinto	08089000	1054	60	57	51	69	298	434	110	70	114	122	88	68	91
Palo Pinto Creek near Santo	Palo Pinto	08090500	78	24	23	31	41	179	260	66	42	68	49	35	27	46
Brazos River near Glen Rose	Somerwell	08091000	1444	134	104	108	123	359	672	537	379	284	230	136	114	199
Paluxy River at Glen Rose	Somerwell	08091500	68	54	42	65	74	215	403	322	227	170	92	54	46	100
Nolan River at Blum	Hill	08092000	82	1	2	1	2	7	6	3	1	1	1	1	1	2

BRAZOS RIVER (Cont.)

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flow Recommended Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
Brazos River near Aquilla (Whitney)	Bosque	08093100	1397	870	1515	1145	603	447	937	746	809	223	390	797	643	650
Aquilla Creek near Aquilla	Hill	08093500	121	4	606	687	362	268	562	448	485	134	156	319	257	325
North Bosque R. near Clifton	Bosque	08095000	199	26	41	49	72	93	44	14	5	8	10	11	21	21
North Bosque R. at Valley Hills	Bosque	08095200	263	10	16	29	43	56	26	8	3	5	4	4	8	11
Middle Bosque R. near McGre-got	McLen-nan	08095300	90	36	44	51	30	29	21	4	0	1	14	19	36	19
Hog Creek near Crawford	McLen-nan	08095400	38	14	18	31	18	17	13	2	0	1	6	8	14	10
Bosque River near Waco	McLen-nan	08095600	461	13	18	22	14	10	8	2	1	0	2	4	12	7
Brazos River at Waco	McLen-nan	08096500	2462	5	7	13	8	6	5	1	0	0	1	2	5	3
Cow Bayou at Moore-ville	Falls	08097000	36	86	214	100	64	110	35	7	2	2	5	20	80	29
Leon River near De Leon	Comanche	08099100	52	34	86	60	38	66	21	4	1	1	2	8	32	15
Sabana River near De Leon	Comanche	08099300	39	539	514	613	927	2230	1800	788	566	705	540	375	409	756
				216	206	368	556	1338	1080	473	360	423	216	150	164	378
				12	24	20	13	9	8	2	1	1	2	6	11	5
				5	10	12	8	5	5	1	1	1	1	2	4	3
				3	9	6	5	10	6	0	0	0	0	2	2	2
				1	4	4	3	6	4	0	0	0	0	1	1	1
				3	4	3	3	5	5	1	0	0	1	2	2	2
				1	2	2	2	3	3	1	0	0	0	1	1	1

BRAZOS RIVER (Cont.)

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flow Recommended Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
Leon River near Hesse	Comanche	08099500	141	11	16	13	22	53	25	14	4	2	3	4	9	10
Leon River near Hamilton	Hamilton	08100000	158	4	6	8	13	32	15	8	2	1	1	2	4	5
Leon River at Gatesville	Coryell	08100500	273	17	33	30	34	96	37	13	4	5	10	12	17	18
Cowhouse Creek at Pidcoke	Coryell	08101000	625	7	13	18	20	58	22	8	2	3	4	5	7	9
Leon River near Belton	Bell	08102500	95	27	51	59	64	187	78	23	9	11	23	25	23	31
Lampasas River at Youngsport	Bell	08104000	281	11	20	35	38	112	47	14	5	7	9	10	9	16
Little River at Cameron	Milam	08106500	1744	90	120	172	288	448	324	88	23	20	29	47	60	88
Brazos River near Bryan	Brazos-Burleson	08109000	5276	36	48	103	173	269	194	53	14	12	12	19	24	44
Yegua Creek near Somerville	Burleson	08110000	293	9	12	17	20	27	10	1	1	1	5	11	10	7
Navasota River near Easterly	Leon-Robertson	08110500	425	4	5	10	12	16	6	1	0	1	2	4	4	3
Navasota River near Bryan	Brazos-Madison	08111000	539	48	71	85	113	153	89	33	19	23	28	32	41	47
				19	28	51	68	92	53	20	11	14	11	13	16	24
				388	591	645	1050	1435	952	408	174	197	201	268	296	452
				155	236	387	630	861	571	245	104	118	80	107	118	226
				1600	1950	1950	2870	5285	4270	1650	1070	1170	1340	1140	1300	1800
				640	780	1170	1722	3171	2562	990	642	702	536	456	520	900
				29	52	42	32	36	14	1	0	0	1	5	14	10
				12	21	25	19	22	8	1	0	0	0	2	6	5
				67	92	86	77	86	28	7	2	4	4	14	32	24
				27	37	52	46	52	17	4	1	2	2	6	13	12
				98	185	124	118	143	38	8	4	7	11	43	80	48
				39	74	74	71	86	23	5	2	4	4	17	32	24

BRAZOS RIVER (Cont.)

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flow Recommended Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
Brazos River near Hempstead	Washington Waller	08111500	6737	2580	3590	2900	3560	7440	5060	2140	1340	1435	1670	1695	2440	2450
				1032	1436	1740	2136	4464	3036	1284	804	861	668	678	976	1225
Brazos River at Richmond	Fort Bend	08114000	7355	3070	4440	4220	4090	6925	5340	2200	1335	1500	1820	1985	2400	2860
				1228	1776	2532	2454	4155	3204	1320	801	900	728	794	960	1430

LAVACA RIVER

Lavaca River at Hallettsville	Lavaca	08163500	48	7	10	9	8	7	5	3	2	3	3	4	6	5
				3	4	5	5	4	3	1	2	1	2	2	1	2
Lavaca River near Edna	Jackson	08164000	311	59	82	71	65	76	71	41	27	36	27	37	48	51
				24	33	43	39	46	43	16	22	11	15	19	19	26
Navidad River near Hallettsville	Lavaca	08164300	159	34	52	47	39	48	34	13	8	15	17	20	24	25
				14	21	28	23	29	20	5	9	7	8	10	10	13

RED RIVER

Red River near Quanah	Hardeman	07299570	152	10	11	9	4	5	34	2	2	16	4	9	10	8
				4	4	5	2	3	20	1	10	2	4	4	4	4
Groesbeck Creek near Quanah	Hardeman	07299670	15	3	3	3	2	3	3	1	1	2	3	3	3	3
				1	1	2	1	2	2	1	1	1	1	1	1	1
Salt Fork Red River Near Wellington	Collingsworth	07300000	60	22	24	18	10	14	17	6	5	7	10	15	19	13
				9	10	11	6	8	10	3	4	4	3	6	6	8
Pease River near Childress	Cottle	07307800	68	7	5	11	4	6	16	2	2	7	8	8	7	7
				3	2	7	2	4	10	2	4	4	3	3	3	4
Pease River near Vernon	Wilbarger	07308200	111	11	10	13	8	12	35	2	0	23	14	17	13	11
				4	4	8	5	7	21	1	14	6	7	5	6	

RED RIVER (Cont.)

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flow Recommended Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
				156	202	232	197	320	690	149	94	300	222	231	169	
Red River near Burkburnett	Wichita	07308500	838	62	81	139	118	192	414	89	56	180	89	92	169	212
North Fork Wichita R. Truscott	Foard-Knox	07311700	64	16	16	17	16	15	19	7	8	18	17	18	17	16
South Fork Wichita R. Benjamin	Knox	07311800	42	8	7	6	6	7	9	1	1	11	7	12	9	7
Wichita R. near Seymour	Baylor	07311900	175	3	3	3	4	4	5	1	1	7	3	5	4	4
Wichita R. at Wichita Falls	Wichita	07312500	285	26	25	23	26	38	53	19	14	61	39	41	32	30
Red River near Terral Okla.	Jefferson (Okla.)	07315500	2198	10	10	14	16	23	31	11	8	37	16	16	13	15
Red River near Gainesville	Love (Okla.)	07316000	2725	50	50	59	79	124	123	136	147	108	87	70	57	88
Red River near Denison.	Grayson	07331600	3931	20	20	35	47	74	74	82	88	65	35	28	23	44
Red River at Arthur City	Choctaw	07335500	8156	375	420	425	539	1340	1790	632	392	379	525	476	400	492
Red River at Index Arkansas	Miller	07337000	11935	150	168	255	323	804	1074	379	235	227	210	190	240	246
South Sulphur River Cooper	Hopkins Delta	07342500	415	464	547	615	788	1870	2620	858	480	460	731	609	493	664
				186	219	369	473	1122	1572	515	288	276	292	244	197	332
				3180	2660	2050	2740	2760	3500	3480	3070	2365	2670	2515	2605	2820
				1272	1064	1230	1644	1656	2100	2088	1842	1419	1068	1006	1042	1410
				3560	3800	3770	5100	7640	6680	4075	3010	2790	3005	2790	3340	3700
				1424	1520	2262	3060	4584	4008	2445	1806	1674	1202	1116	1336	1850
				5760	7160	7600	9150	13400	8300	4750	3490	3260	3480	2780	4100	5180
				2304	2864	4560	5490	8040	4980	2850	2094	1956	1392	1112	1640	2590
				19	30	31	19	31	12	1	0	0	1	5	11	8
				8	12	19	11	19	7	1	0	0	0	2	5	4

RED RIVER (Cont.)

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flow Recommended Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
Wichita River near Mabelle	Baylor	07312100	158	6	4	10	102	14	93	368	263	14	12	9	8	14
Beaver Cr. near Electra	Wichita	07312200	63	2	2	6	61	8	56	221	158	8	5	4	3	7
North Sulphur River, Cooper	Delta-Lamar	07343000	252	2	3	3	3	5	7	6	7	10	4	3	3	4
				1	1	2	2	3	4	4	4	6	2	1	1	2
				22	26	22	25	22	8	1	0	1	2	6	13	9
				9	10	13	15	13	5	1	0	0	1	2	5	4
Sulphur River near Talco	Red River Titus	07343200	1535	99	120	183	100	183	102	14	5	8	26	64	90	65
				40	48	110	60	110	61	8	3	5	10	26	36	33
White Oak Creek near Talco	Titus	07343500	474	74	120	93	63	60	23	9	3	5	11	24	46	31
				30	48	56	38	36	14	5	2	3	4	10	28	16
Big Cypress near Pittsburg	Camp-Titus	07344500	338	210	229	264	170	109	49	16	8	10	16	43	106	63
				84	92	158	102	65	29	10	5	6	6	17	42	32
Boggy Cr. near Dain-gerfield	Morris	07345000	80	50	58	64	42	26	9	1	0	0	0	6	21	13
				20	23	38	25	16	5	1	0	0	0	2	8	7
Littly Cypress Cr., Jefferson	Harrison Marion	07346070	548	465	648	676	568	592	149	31	12	13	18	82	233	167
				186	259	406	341	355	89	19	7	8	7	33	93	84

NUECES RIVER

Nueces R. at Laguna	Uvalde	08190000	148	72	72	74	73	78	70	60	42	47	92	79	78	70
				29	29	44	44	47	42	36	25	28	37	32	31	35
Nueces R. below Uvalde	Nueces	08192000	141	14	14	14	15	16	19	18	16	17	18	15	14	16
				6	6	8	9	10	11	11	10	10	7	6	6	8

NUECES RIVER (Cont.)

U.S.G.S.

Median Flow

Average Flow

Recommended Flows By Months

Stream	County	Station Number	Average Flow	Median Flow												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
Frio River at Concan	Uvalde	08195000	107	61	24	60	67	69	60	43	38	39	60	57	64	57
Dry Frio River near Reagan Wells	Uvalde	08196000	34	14	16	13	14	14	11	10	7	15	21	18	16	14
Hondo Creek near Tarpley	Medina	08200000	37	7	13	10	10	18	14	9	7	11	15	11	10	11
Frio River at Callham	McMullen	08207000	260	5	6	8	11	17	14	5	3	7	9	5	4	7
Atascosa River at Whitsett	Live Oak	08208000	137	15	16	14	13	18	14	8	7	9	10	12	13	13
Nueces River near Three Rivers	Live Oak	08210000	858	6	36	34	58	265	176	53	21	89	125	39	23	56
Nueces River near Mathis	San Patricio Jim Wells	08211000	867	9	14	20	35	159	106	32	13	53	50	16	9	28
				77	78	89	97	131	170	141	117	115	135	105	87	108
				31	31	53	58	79	102	85	70	69	54	42	35	54

SABINE RIVER

Sabine River near Mineola	Smith	08018500	1071	244	371	396	424	724	194	21	6	9	17	87	113	99
Lake Fork Cr. near Quitman	Wond	08019000	437	98	148	238	254	434	116	13	4	5	7	35	45	50
Big Sandy Cr. near Big Sandy	Upshur	08019500	183	114	167	154	136	109	32	5	1	2	3	20	50	36
				45	67	92	81	65	19	3	0	1	1	8	20	18
				153	171	186	163	153	66	31	23	27	31	58	120	75
				61	68	112	98	92	40	19	14	16	12	23	48	38

SABINE RIVER (Cont.)

U.S.G.S. Station Number

Average Flow

Median Flows By Months

Yearly

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
Sabine River near Gladewater	Gregg	08020000	1949	1100	1440	1610	1560	1730	594	142	65	92	127	322	594	472
Sabine River at Tatum	Panola	08022000	2555	1690	2430	2550	2235	3070	1145	307	121	166	192	610	1030	822
Murvaul Bayou near Gary	Panola	08022300	87	36	60	40	33	40	10	6	5	9	10	15	20	17
Sabine River at Logansport La.	De Soto Parish-Shelby	08022500	3212	2800	4075	4680	3890	4055	1240	536	215	203	192	453	120	1060
Tenna Cr. near Shelbyville	Shelby	08023200	79	28	47	46	32	19	7	2	1	1	1	5	15	11
Sabine R. near Burkeville	Newton	08026000	4972	2400	5620	4645	3860	6490	2230	1105	595	670	367	460	1600	1590
Sabine R. near Iron Wier	Newton	08028500	6766	960	2248	2787	2316	3894	1338	663	357	402	147	184	640	795
Big Cow Creek near Newton	Newton	08029500	109	80	91	84	68	56	40	35	31	30	31	43	71	53
Sabine R. near Rolliff	Newton	08030500	8337	11000	12300	11300	9715	9520	4440	2410	1470	1310	1040	1655	3960	3910
				4400	4920	6780	5829	5712	2664	1446	882	786	416	662	1584	1955

SAN JACINTO RIVER

West Fork San Jacinto River near Conroe	Montgomery	08068000	495	200	209	157	130	133	60	32	24	26	27	47	129	69
				80	84	94	78	80	36	19	14	16	11	19	52	35

SAN JACINTO RIVER (Cont.)

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flow Recommended Flows By Month												Yearly				
				J	F	M	A	M	J	J	A	S	O	N	D					
				58	75	58	50	54	34	21	16	18	17	25	39		33			
Spring Cr. near Spring	Harris-Montgomery	08068500	206	23	30	35	30	32	20	13	10	16	18	7	10	16	17	25	39	33
Cypress Creek near Westfield	Harris	08069000	147	23	26	9	6	13	9	8	6	6	14	10	8	20	10	8	20	10
East Fork San Jacinto River near Cleveland	Liberty	08070000	221	9	10	5	4	8	5	5	4	4	8	4	3	8	4	3	8	5
Caney Creek near Splendora	Montgomery	08070500	73	94	112	96	72	62	33	22	18	13	18	19	27	56	19	27	56	40
Peach Creek near Splendora	Montgomery	08071000	73	38	45	58	43	37	20	13	11	11	11	8	11	22	8	11	22	20
Buffalo Bayou near Addicks	Harris	08073500	203	35	46	40	33	30	20	15	13	7	14	15	20	26	14	18	26	22
Whiteoak Bayou at Houston	Harris	08074500	75	14	18	24	20	18	12	9	8	8	8	6	7	10	6	7	10	11
Brays Bayou at Houston	Harris	08075000	105	41	52	47	36	32	18	14	12	12	14	15	20	30	15	20	30	24
Slms Bayou at Houston	Harris	08075500	72	16	21	28	22	19	11	8	7	7	10	6	8	12	6	8	12	12
Greens Bayou near Houston	Harris	08076000	51	42	48	14	13	23	24	42	42	42	66	42	19	28	42	19	28	33
Halls Bayou at Houston	Harris	08076500	25	17	19	8	8	14	14	25	25	25	40	17	8	11	17	8	11	17
				22	18	10	9	9	8	9	7	7	10	6	8	13	6	8	13	10
				9	7	6	5	5	5	5	4	4	6	2	3	5	2	3	5	5
				36	34	23	20	23	23	22	20	20	23	15	25	27	15	25	27	24
				14	14	14	12	14	14	13	12	12	14	6	10	11	6	10	11	12
				21	23	16	16	17	17	17	17	17	17	13	16	20	13	16	20	18
				8	9	10	10	10	10	10	10	10	10	5	6	8	5	6	8	9
				11	11	7	5	6	6	7	7	7	8	4	5	8	4	5	8	7
				4	4	4	3	4	4	4	4	4	5	2	2	3	2	2	3	3
				8	9	5	4	4	4	4	3	3	4	3	4	5	4	4	5	4
				3	4	3	2	2	2	2	2	2	2	1	2	2	1	2	2	2

SAN JACINTO RIVER (Cont.)

Stream	County	U.S.G.S. Station Number	Average J-flow	Median Flow Recommended Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
Clear Creek near Pearland	Harris-Brazoria	08077000	36	4	7	3	5	10	8	10	8	11	4	2	3	6
				2	3	2	3	6	5	6	5	7	2	1	2	3

NECHES RIVER

Neches R. near Neches	Anderson Cherokee	08032000	742	630	833	902	720	773	286	94	39	53	68	197	393	280
				252	333	541	432	464	172	56	23	32	27	79	157	140
Neches R. near Alto	Houston Cherokee	08032500	1198	982	1415	1510	1285	1385	575	181	87	106	116	305	604	485
				393	566	906	771	831	345	109	52	64	46	122	242	243
Neches R. near Diboll	Angelina Polk	08033000	1643	1520	2080	2020	1720	1850	909	234	100	107	142	356	810	632
				608	832	1212	1032	1110	545	140	60	64	57	142	324	316
Neches R. near Rockland	Tyler	08033500	2280	2210	3010	3010	2580	2790	1060	356	182	135	119	298	860	814
				884	1204	1806	1548	1674	636	214	109	81	48	119	344	407
Mud Creek near Jacksonville	Cherokee	08034500	258	204	260	242	195	158	60	21	7	12	17	55	106	72
				82	104	145	117	95	36	13	4	7	7	22	42	36
Angelina River near Alto	Nacogdoches Cherokee	08036500	726	800	846	824	731	476	308	114	65	82	90	249	425	256
				320	338	494	439	286	185	68	39	49	36	100	170	128
Angelina River near Lufkin	Angelina Nacogdoches	08037000	1186	1260	1520	1600	1210	1140	378	137	64	66	78	206	530	419
				504	608	960	726	684	227	82	38	40	31	82	212	210
Attoyac Bayou near Chireno	Nacogdoches San Augustine	08038000	426	377	502	412	306	288	112	61	40	46	49	108	192	143
				151	201	247	184	173	67	37	24	28	20	43	77	72
Aylsh Bayou near San Augustine	San Augustine	08039100	82	73	75	69	47	27	8	3	2	4	4	9	33	17
				29	30	41	28	16	5	2	1	2	2	4	13	9

NECHES RIVER (Cont.)

Stream	County	U.S.G.S. Station Number	Average Flow	Median Flow Recommended Flows By Months												Yearly
				J	F	M	A	M	J	J	A	S	O	N	D	
Neches R. at Town Bluff	Jasper-Tyler	08040500	4461	2440	4460	4410	4620	4990	2070	1480	968	704	583	788	1390	1870
				896	1784	2646	2772	2994	1242	888	581	422	233	315	556	935
Neches R. at Evadale	Jasper-Hardin	08041000	6073	6085	8230	7820	7430	6800	3260	1540	884	633	514	936	1940	2560
				2434	3292	4692	4458	4080	1956	924	530	380	206	374	776	1280
Village Cr. near Kountze	Hardin	08041500	808	750	838	680	514	390	230	165	124	112	113	195	421	284
				300	335	408	308	234	138	99	74	67	45	78	168	142

MISSION RIVER

Mission River at Refugio	Refugio	08189500	115	8	9	9	8	9	10	6	4	9	6	7	8	8
				3	4	5	5	5	6	4	5	2	3	3	4	