

TRAVEL TIME FOR SOLUTES, UPPER SABINE RIVER BASIN, TEXAS, APRIL 16-30, 1972

The U.S. Geological Survey, in cooperation with the Sabine River Compact Administration, conducted time-of-travel studies in the Sabine River Basin on April 16-30, 1972. One study was made on the main stem of the Sabine River in four reaches from Lake Tawakoni to Toledo Bend Reservoir, a distance of 219 miles. Two other studies were made on reaches of Lake Fork Creek and Big Sandy Creek. The purpose of these studies was to provide travel-rate data to be used by the Sabine River Authority of Texas in constructing a hydrologic model of the basin.

Travel rates were determined by injecting a 20-percent solution of Rhodamine WT dye (a fluorescent tracer) into the streams and noting the downstream movement with a fluorometer at selected sampling points. The equipment and methods used were similar to those described by Wilson (1968) and Kilpatrick, Martens, and Wilson (1970).

The plans were to obtain travel rates at Q<sub>90</sub> (the discharge that will be equalled or exceeded 90 percent of the time), but during the first of April, flow had receded to near Q<sub>60</sub> and was continuing to recede. Because the rainy season was approaching, the study was made at the existing flow.

The streams were divided as follows: Sabine River, four reaches; Lake Fork Creek, one reach; and Big Sandy Creek, two reaches. These divisions are shown on figure 1 (sheet 1). Dye was injected at the upstream end of each reach. The map (fig. 1) also shows the sites at which the dye cloud was measured as it passed through each reach. The arrival times of the leading and trailing edges and the peak concentration of the dye were determined at each site.

On April 27, after all dye had been injected, a cool front passed through the area and produced rainfall over the entire basin. Streamflow gained from near Q<sub>70</sub> to Q<sub>56</sub> on the Sabine River at Gladewater and from Q<sub>67</sub> to Q<sub>52</sub> on Big Sandy Creek near Big Sandy. Flow conditions were relatively stable on the Sabine River while the dye clouds were measured, but small rises occurred on both tributaries before the dye clouds reached the downstream ends.

The average velocity in the Sabine River showed an overall increase from 0.33 fps (foot per second) in the upstream reach to 0.81 fps at the downstream end, even though the velocity fluctuated between adjoining reaches. The data on figure 2 (sheet 1) indicate why the velocity fluctuated. For example, the subreach from S.H. 149 to S.H. 43 contains a long pool formed by the outcrop of a coal vein that crosses the streambed. The location of this vein can be identified by the change in the thalweg elevation profile. The pool apparently produces a lower average velocity. The increase in the average velocity for the overlap subreach from S.H. 43 to U.S. 59 is the result of an increase in discharge.

Average velocities in the tributary streams ranged from 0.08 fps to 0.30 fps. The higher velocities occurred after runoff from the storm on April 27 entered the streams. The runoff probably did not affect the dye-cloud velocity in either Lake Fork Creek upstream from S.H. 182 or Big Sandy Creek upstream from F.M. 2869, but it did increase the dye-cloud velocity downstream from these points.

Table 1 gives the flow conditions during the period of study and gives the results of the dye injection. The graphs on sheet 2 show the shape of the dye-cloud hydrograph at each measuring site as the cloud traveled downstream. Some water-quality observations were made at several sites on the Sabine River. The results of these observations are given in table 2.

REFERENCES CITED

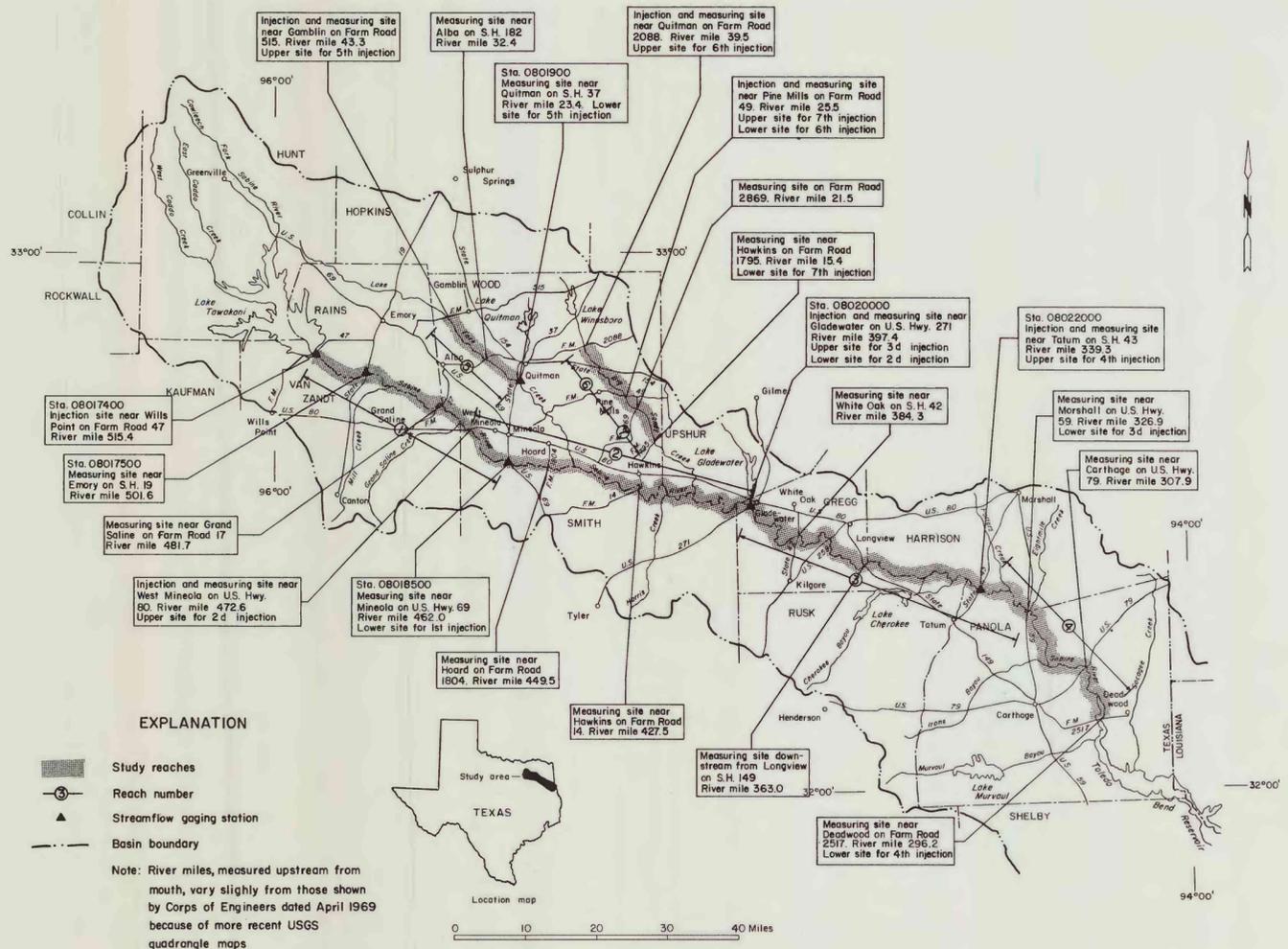
- Kilpatrick, F. A., Martens, L. A., and Wilson, J. F., Jr., 1970, Measurement of time of travel and dispersion by dye tracing: U.S. Geol. Survey, Techniques of water resources inv., book 3, chap. A9, 25 p.
- Wilson, J. F., Jr., 1968, Fluorometric procedures for dye tracers: U.S. Geol. Survey, Techniques of water resources inv., book 3, chap. A12, 31 p.

Table 1. -- Summary of dye studies for the Sabine River basin, April 16-30, 1972

No.	Description	Distance (river miles)	From (Hwy.No.)	To (Hwy.No.)	Distance (river miles)	Q (cfs)	Q <sub>50</sub> (percent)	Dye cloud						Dye recovery (percent)
								Leading edge	Peak	Trailing edge	Travel time (hr)	Average velocity (fps)	Travel time (hr)	
SABINE RIVER														
1	From Farm Road 47 to Wills Point to U.S. Hwy. 69 at Mineola.	53.4	FM 47	SH 19	13.8	26	-	54	0.38	61	0.33	70	0.29	67
			SH 19	FM 17	19.9	47	-	64	.31	98	.30	102	.29	34
			FM 17	US 80	9.1	17	-	38	.35	37	.36	59	.23	30
			US 80	US 69	10.6	43	59	55	.28	62	.25	53	.29	25
2	From U.S. Hwy. 80 at West Mineola to U.S. Hwy. 271 at Gladewater.	75.2	US 80	US 69	10.6	36	61	97	.28	66	.24	75	.21	63
			US 69	FM 1804	12.5	50	-	50	.37	53	.35	58	.32	53
			FM 1804	FM 14	22.0	90	-	78	.41	82	.40	91	.36	37
			FM 14	US 271	30.1	244	64	109	.41	102	.43	91	.49	24
3	From U.S. Hwy. 271 at Gladewater to U.S. Hwy. 59 at Marshall.	70.5	US 271	SH 42	13.1	218	-	40	.48	47	.41	55	.35	76
			SH 42	SH 149	21.3	250	-	53	.59	56	.56	62	.51	65
			SH 149	SH 43	23.7	220	78	82	.42	87	.40	99	.35	45
			US 59	US 59	12.4	-	-	26.5	.69	34.5	.53	33	.56	40
4	From State Hwy. 43 to Farm Road 2517 at Deadwood.	43.1	SH 43	US 59	12.4	334	72	22	.82	27	.68	33	.56	79
			US 59	US 79	19.0	398	-	38	.73	42	.66	45	.62	68
			US 79	FM 2517	11.7	374	-	22	.78	21	.81	24	.71	62
LAKE FORK CREEK														
5	From Farm Road 515 to State Hwy. 37.	19.9	FM 515	SH 182	10.9	8.1	60	92	0.17	107	0.15	129	0.32	44
			do	do	10.9	18.4	-	46	-	49	-	51	-	30
			SH 182	SH 37	9.0	23	52	-	-	-	-	-	-	-
BIG SANDY CREEK														
6	From Farm Road 2088 to Farm Road 49.	14.0	FM 2088	FM 49	14.0	9.7	58	90	0.21	100	0.20	122	0.17	60
			do	do	14.0	29.6	-	-	-	-	-	-	-	-
7	From Farm Road 49 to Farm Road 1795.	10.1	FM 49	FM 2869	4.0	13	60	64	0.09	73	0.08	98	0.06	36
			do	do	4.0	20.8	-	24	-	30	-	35	-	31
			FM 2869	FM 1795	6.1	51.3	54	-	-	-	-	-	-	-

a/ Number of reach corresponds to the reaches numbered on figure 1.  
 b/ The percent of time that discharge in previous column is equalled or exceeded.  
 c/ Using a continuous gage-height record, the average flow at downstream site was computed for the period the dye cloud was in the subreach.  
 d/ Rise began near mid-morning on April 27, 1972.  
 e/ Q<sub>50</sub> determined at State Highway 43.  
 f/ Q<sub>50</sub> determined at State Highway 37.  
 g/ Big Sandy Creek near Big Sandy, Texas, was used to determine Q<sub>50</sub>.

FIGURE 1. - LOCATION OF DATA-COLLECTION SITES



EXPLANATION

- Study reaches
- Reach number
- Streamflow gaging station
- Basin boundary

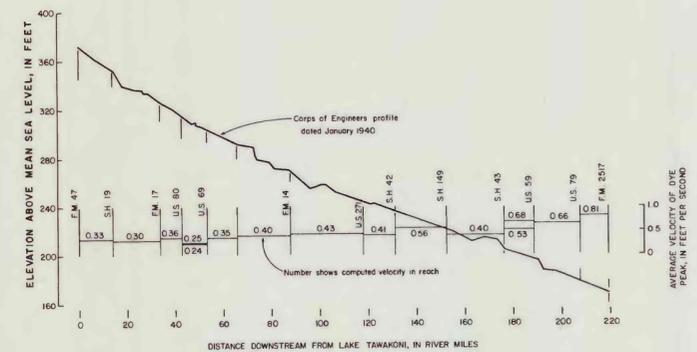
Note: River miles, measured upstream from mouth, vary slightly from those shown by Corps of Engineers dated April 1969 because of more recent USGS quadrangle maps

Table 2. -- Water-quality field observations, Sabine River, April 16-21, 1972

Site	Date	Time	Specific conductance (microsiemens at 25° C)	T (°C)	Dissolved oxygen (mg/l)	pH	Streamflow (cfs)
State Hwy. 19	16	1015	180	20.0	7.4	6.5	22
do	16	1900	181	21.5	7.0	6.8	22
do	19	0905	200	23.0	7.0	7.0	28
do	19	1545	198	23.0	7.8	7.0	28
Farm Rd. 17	20	1400	318	23.5	6.5	6.8	47
U.S. Hwy. 80	20	1230	540	23.5	7.3	6.9	30
U.S. Hwy. 69	18	1200	448	22.0	7.3	6.7	35
do	18	1900	453	22.0	7.4	6.7	34
do	19	0745	450	22.0	6.3	6.6	35
do	19	1345	470	22.0	6.6	6.7	35
do	19	1430	490	23.0	6.9	6.7	36
do	19	1830	445	23.0	7.0	6.8	36
do	20	0745	453	22.0	5.6	6.8	37
Farm Rd. 14	20	1100	440	22.5	7.7	6.6	93
U.S. Hwy. 271	17	1100	330	22.0	7.9	6.0	225
State Hwy. 42	18	0945	360	22.0	7.1	6.8	No gage
do	18	1720	380	23.0	9.0	6.6	218
do	19	0830	380	22.0	7.3	6.4	No gage
do	19	1610	360	24.0	9.1	6.7	No gage
U.S. Hwy. 259	20	0845	400	23.0	7.2	6.3	No gage
I.S. Hwy. 20	20	0910	480	23.5	7.1	6.3	270
State Hwy. 149	21	1035	450	23.0	5.4	6.6	250
State Hwy. 43	17	0920	469	22.0	8.0	6.0	310
State Hwy. 59	18	1100	560	23.0	10.8	6.7	334
State Hwy. 79	19	1330	460	24.5	11.7	6.7	No gage
do	20	1000	530	24.0	9.1	6.5	398
do	20	1600	540	24.5	10.7	6.7	No gage
Farm Rd. 2517	20	1225	500	24.0	9.2	6.5	374
do	21	0800	520	23.0	6.8	6.5	No gage

1/ Measured Apr. 22, 1972  
 2/ Estimated  
 3/ Measured Apr. 25, 1972  
 4/ Measured at time of observation  
 5/ Measured Apr. 19, 1972

FIGURE 2. - PROFILE AND AVERAGE VELOCITY OF DYE PEAKS



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