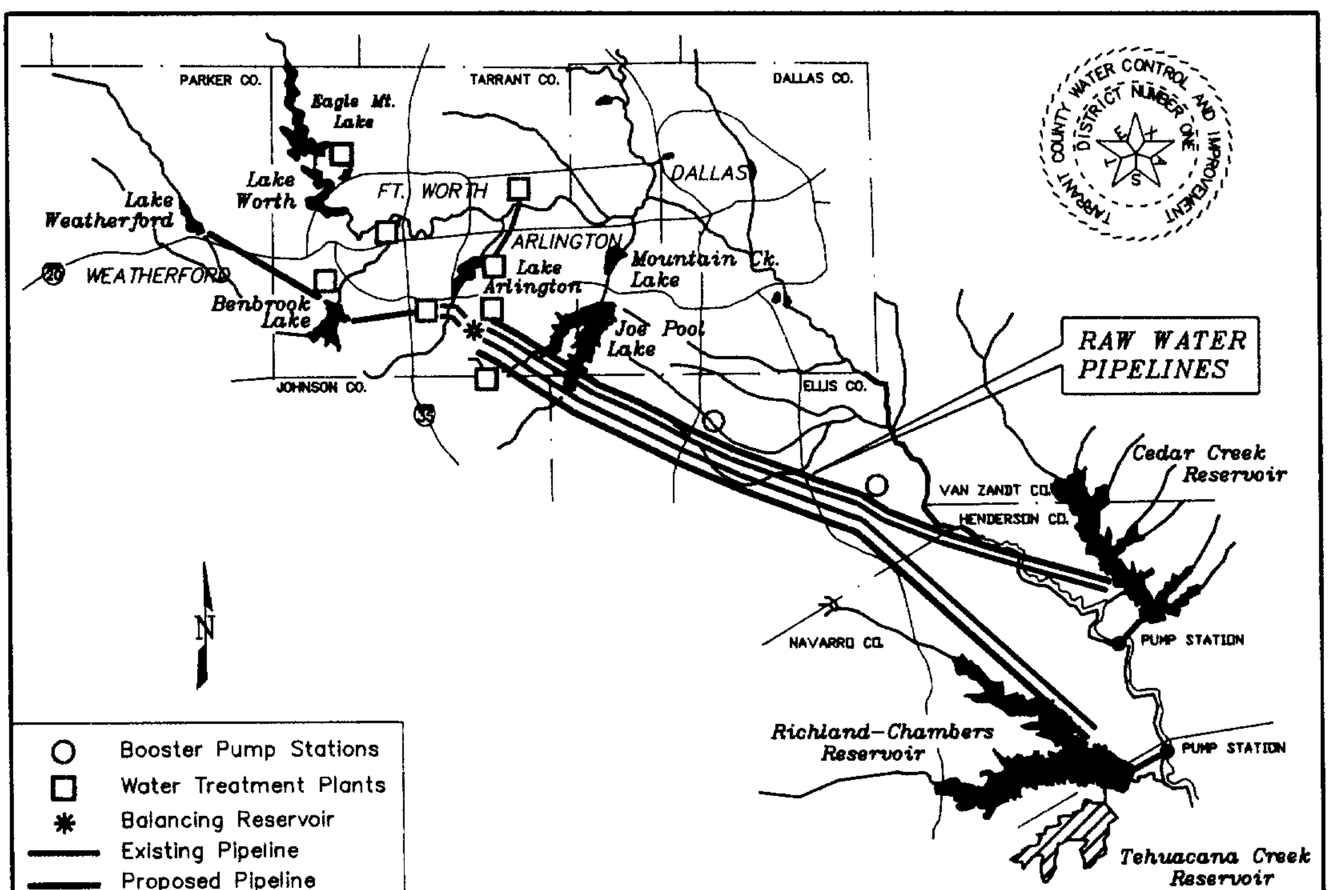
November 1991

Appendices for

Tarrant County
Water Control and Improvement
District Number One



Water Quality Assessments
and

November 1991

Appendices for

Tarrant County
Water Control and Improvement
District Number One

Water Quality Assessments
and
Recommended Pilot–Scale/Bench–Scale Studies
Associated with Water Supply Diversion
from
the Trinity River

11-6-91

STATE OF TEXAS
ROBERT S. GOOCH
16177
REGISTERED
PROFESSIONAL ENGINEER

11-6-91

Alan Plummer and Associates, Inc.

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APPENDIX B

HYDROLOGIC ANALYSIS

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HYDROLOGIC ANALYSIS

Basically, the proposed project involves diverting enough supplemental water from the Trinity River into Richland-Chambers Reservoir and Cedar Creek Reservoir to increase their yields by 30 percent. The hydrologic feasibility of this concept was studied by means of computer model simulations of reservoir performance. Reservoir operation studies were made with and without the proposed supplemental diversions. Data reflecting stream flows and evaporation losses were based on observed historical conditions during the 48-year period from 1941 through 1988, adjusted to reflect future conditions as of the years 2020 and 2050. The methodology and results are described in this appendix. Figure B-1 is a schematic representation of the upper Trinity River Basin, showing the relationship of major reservoirs, along with their drainage areas and dates of closure. Figure B-2 is a flow diagram of the analysis.

Hydrologic Data

All but the last two years of the necessary reservoir inflow and evaporation data were already available from previous studies (1). Data for 1987 and 1988 were derived as follows:

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(1) Numbers in parentheses match references listed at the end of Section B.

SCHEMATIC DIAGRAM OF STREAMS AND RESERVOIRS
IN THE UPPER TRINITY RIVER BASIN
-With Drainage Areas and Closure Dates-

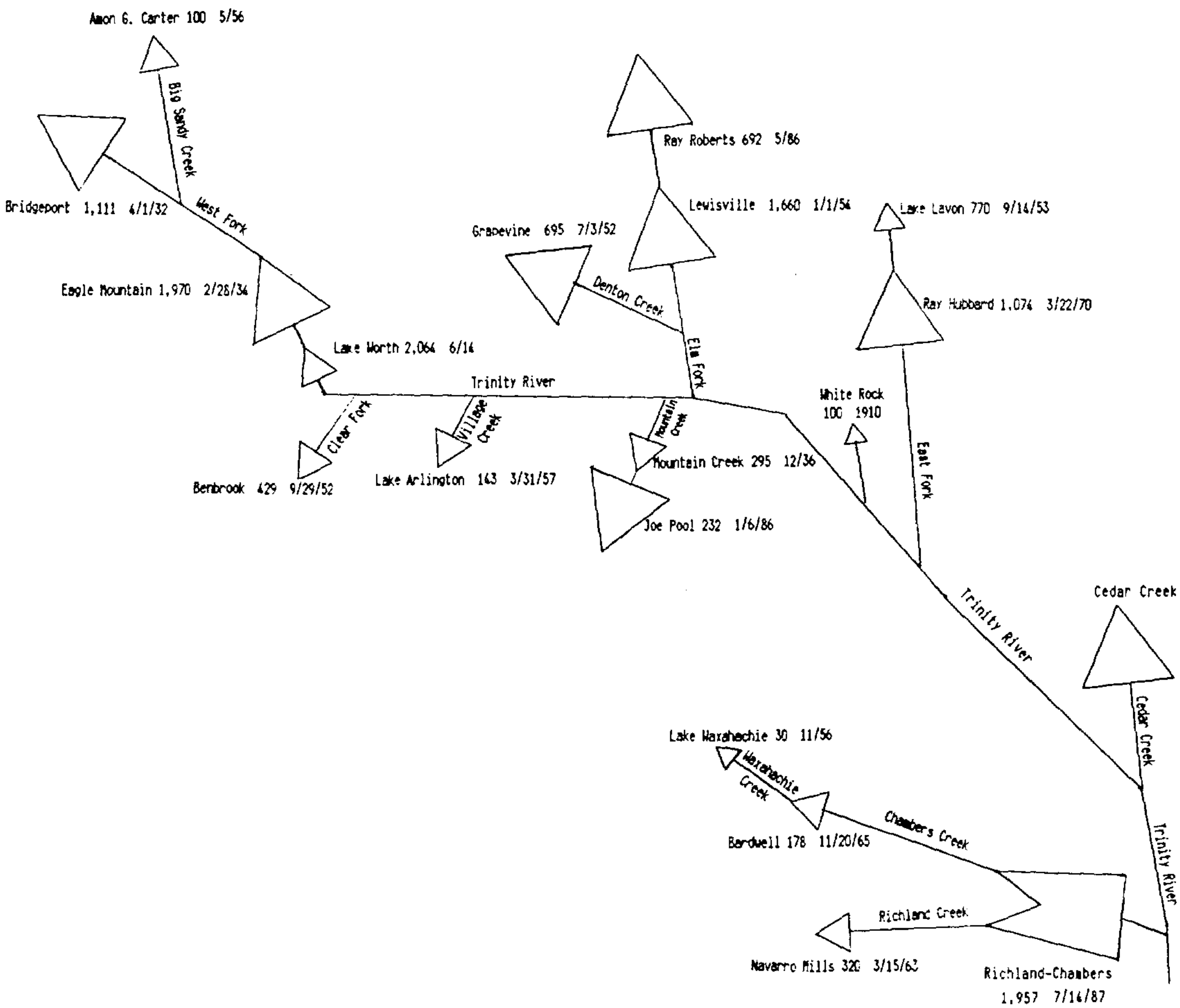


Figure B-1

RESERVOIR YIELD AND MAKEUP DETERMINATION

Historical Hydrology - 48 years
- >Evaporation
- >Inflow

Reservoir Operation Criteria
- >Maximum Rates
  - 110 cfs Cedar Cr. Res.
  - 125 cfs R-C Res.
- >Makeup pumping when reservoirs 5 feet down

Daily Trinity River Flow - 17,526 days
- >Historical return flows
  - NCTCOG
  - Fort Worth
  - Dallas
  - TRA
  - Texas Water Commission
- >Daily natural flow (without return flows)
- >2020 & 2050 return flows - Based on:
  - Ratio of historical return flow to Tarrant and Dallas water use and,
  - Texas Water Development Board projected water use.
- >2020 & 2050 daily Trinity flow
- >Daily percent wastewater in available makeup
- >Monthly percent wastewater in available makeup

Reservoir Operation

Yield

Makeup From Trinity
- Natural
- Wastewater

Figure B-2

a. The evaporation data for Cedar Creek Reservoir were extended for 1987 and 1988 using the Texas Water Commission evaporation data for quadrangles E-11 and E-12 (2). Table B-1 shows the results.

b. The evaporation data for Richland-Chambers Reservoir were determined by using quadrangles E-11, E-12, F-11 and F-12. Table B-2 shows the results.

c. The inflows to Cedar Creek Reservoir were determined by analysis of the recorded operation of the reservoir. This involved a basic reservoir operation study for the two years 1987 and 1988 years in which everything is known except the inflow, which is then determined. See Table B-3.

d. Local gages upstream and near Richland-Chambers Reservoir were used to determine its 1987 and 1988 inflow (3). The extension of the inflow data is shown in Table B-4.

Daily Trinity River Flow, 1965-1988

The daily Trinity River flow at the diversion point made use of the USGS Trinidad gage flow measurements (3). As an example, see Table B-5.

Daily Trinity River Flow, 1941-1965

Daily Trinity River flows from 1941 to 1965 made use of the flows measured by the USGS gage at Rosser (3). Table B-6 shows some of the Rosser daily flow data.

a. A double mass curve for the Trinidad gage and the Rosser gage was determined from records of flow observations during their common

Table B-1

Cedar Creek Reservoir - Net Evaporation

Units - Feet

1987			1988		
E11	E12	Evap.	E11	E12	Evap.
0.07	0.04	0.06	0.19	0.13	0.16
(0.03)	(0.08)	(0.05)	0.04	(0.01)	0.02
0.17	0.08	0.13	0.17	0.08	0.13
0.43	0.39	0.41	0.29	0.21	0.25
0.14	0.14	0.14	0.41	0.43	0.42
0.25	0.18	0.22	0.44	0.44	0.44
0.56	0.42	0.49	0.54	0.44	0.49
0.81	0.64	0.73	0.76	0.59	0.68
0.41	0.30	0.36	0.43	0.38	0.41
0.45	0.29	0.37	0.29	0.20	0.25
0.03	0.00	0.02	0.17	0.05	0.11
(0.01)	(0.13)	(0.07)	0.04	0.01	0.03
3.28	2.27	2.78	3.77	2.95	3.37

Net Evap = .5096 E11 + 0.4904 E12

Table B-2

Richland-Chambers Reservoir Net Reservoir Evaporation

1987	A E11 (Ft)	B E12 (Ft)	C F11 (Ft)	D F12 (Ft)	.28*(A+C)+.22*(B+D)
1	0.07	0.04	0.10	0.08	0.07
2	-0.03	-0.08	-0.03	-0.07	-0.05
3	0.17	0.08	0.16	0.14	0.14
4	0.43	0.39	0.41	0.35	0.40
5	0.14	0.14	0.14	0.11	0.13
6	0.25	0.18	0.20	0.19	0.21
7	0.56	0.42	0.52	0.33	0.47
8	0.81	0.64	0.76	0.47	0.68
9	0.41	0.30	0.36	0.18	0.32
10	0.45	0.29	0.48	0.40	0.41
11	0.03	0.00	0.05	0.03	0.03
12	-0.01	-0.13	-0.01	-0.05	-0.05
Total	3.28	2.27	3.14	2.16	2.76

1987	A E11 (Ft)	B E12 (Ft)	C F11 (Ft)	D F12 (Ft)	.28*(A+C)+.22*(B+D)
1	0.19	0.13	0.15	0.13	0.15
2	0.04	-0.01	0.06	0.04	0.03
3	0.17	0.08	0.14	0.09	0.12
4	0.29	0.21	0.29	0.19	0.25
5	0.41	0.43	0.36	0.41	0.40
6	0.44	0.44	0.41	0.38	0.42
7	0.54	0.44	0.56	0.45	0.50
8	0.76	0.59	0.71	0.48	0.65
9	0.43	0.38	0.54	0.41	0.45
10	0.29	0.20	0.39	0.25	0.29
11	0.17	0.05	0.21	0.08	0.14
12	0.04	0.01	0.03	-0.03	0.02
Total	3.77	2.95	3.85	2.88	3.42

Table B-3

Cedar Creek Reservoir Inflow Calculation

1987	Elevation	Contents (Ac-Ft)	Area (Acres)	Net Evap.* (Ft)	Evap. Loss (Ac-Ft)	Spills (Ac-Ft)	Pumpage (Mil. Gal.)	Reservoir Inflow** (Ac-Ft)
1	321.96	678,036	33,660	0.06	2,019	27,062	3,363.050	38,720
2	321.94	677,349	33,640	(0.05)	(1,687)	0	2,616.330	12,210
3	322.11	683,214	33,827	0.13	4,388	80,527	1,782.690	45,900
4	321.98	638,726	33,680	0.41	13,700	0	2,916.150	44,550
5	321.45	660,623	33,150	0.14	4,666	0	2,942.500	25,620
6	321.80	672,543	33,500	0.22	7,370	13,665	1,761.910	26,440
7	321.80	672,543	33,500	0.49	16,270	0	3,574.790	7,230
8	321.21	652,527	32,910	0.73	23,648	0	3,427.460	120
9	320.18	618,481	31,880	0.36	11,385	0	3,184.070	4,390
10	319.66	601,711	31,369	0.37	11,467	0	3,079.990	0
11	318.88	577,062	30,614	0.01	307	0	3,262.290	9,720
12	318.98	580,189	30,707	(0.07)	(2,149)	23,589	3,069.580	127,330
Total				2.80	91,383	144,843	34,980.810	342,230

1988	Elevation	Contents (Ac-Ft)	Area (Acres)	Net Evap.* (Ft)	Evap. Loss (Ac-Ft)	Spills (Ac-Ft)	Pumpage (Mil. Gal.)	Reservoir Inflow** (Ac-Ft)
1	321.92	676,660	33,620	0.16	5,374	6,168	3,389.880	19,540
2	321.85	674,256	33,550	0.02	673	28,751	2,650.680	43,060
3	322.01	679,760	33,711	0.13	4,375	34,550	3,633.000	45,940
4	321.89	675,630	33,590	0.25	8,333	0	3,938.150	2,710
5	321.37	657,917	33,070	0.42	13,778	0	4,174.070	8,840
6	320.84	640,168	32,540	0.44	14,168	0	4,048.890	4,260
7	320.16	617,831	31,860	0.49	15,386	0	4,292.310	0
8	319.22	587,732	30,940	0.68	20,708	0	4,305.670	110
9	318.18	555,461	29,967	0.41	12,172	0	4,395.250	7,830
10	317.59	537,633	29,410	0.25	7,311	0	4,003.030	9,190
11	317.24	527,223	29,078	0.11	3,225	0	2,438.265	25,920
12	317.75	542,434	29,563	0.03	889	0	1,895.210	10,620
			29,686					
Total				3.39	106,391	69,469	43,164.405	178,020

Table B-4

Extension of Inflow to Richland-Chambers Reservoir

1987	Richland Cr. nr. Richland (Ac-Ft)	Chambers Cr. nr. Rice (Ac-Ft)	Richland Cr. nr. Dawson (Ac-Ft)	Waxahachie Cr. nr. Bardwell (Ac-Ft)	Corsicana Diversion (Ac-Ft)	Reservoir Inflow (Ac-Ft)
1	40,810	29,380	21,630	6,500	291	59,220
2	25,550	51,500	1,800	5,610	6,130	92,410
3	40,890	49,170	19,570	18,170	7,229	66,800
4	2,470	5,510	1,180	450	0	8,990
5	40,810	33,140	21,910	1,650	0	71,300
6	78,320	83,640	37,280	22,490	0	144,600
7	19,260	4,290	14,580	712	0	11,690
8	57	141	10	0	0	270
9	239	138	44	0	0	470
10	8	20	170	0	0	0
11	251	4,050	32	3	0	5,840
12	33,160	26,140	1,340	174	0	81,770
Total	281,825	287,119	119,546	55,759	13,650	543,360

1988	Richland Cr. nr. Richland (Ac-Ft)	Chambers Cr. nr. Rice (Ac-Ft)	Richland Cr. nr. Dawson (Ac-Ft)	Waxahachie Cr. nr. Bardwell (Ac-Ft)	Corsicana Diversion (Ac-Ft)	Reservoir Inflow (Ac-Ft)
1	19,880	10,720	11,420	2,050	291	23,950
2	28,290	20,420	9,670	2,290	6,130	45,870
3	17,140	15,790	9,190	6,480	7,229	17,190
4	4,590	5,540	4,130	1,820	0	5,910
5	187	483	90	8	0	810
6	2,900	1,220	107	8	0	5,670
7	7	5	91	2	0	0
8	0	0	23	0	0	0
9	1,750	0	345	0	0	1,850
10	3,740	0	83	1	0	5,170
11	747	102	215	5	0	890
12	1,040	89	83	10	0	1,470
Total	80,271	54,369	35,447	12,674	13,650	108,780

Table B-5

Example of USGS Flow Records at the Trinidad Gage

STREAMFLOW (CFS), WATER YEAR OCT 1965 TO SEP 1966
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	457	415	436	520	937	1140	1780	42300	7340	7400	520	2570
2	405	468	457	562	646	1160	1160	54200	7220	7100	520	1980
3	426	499	468	510	562	1010	914	63100	7100	6860	488	1320
4	415	499	625	488	541	868	776	62800	7040	6740	530	1240
5	446	1890	914	583	510	914	688	66300	6740	6620	499	1040
6	562	3130	776	541	446	868	625	66200	5400	6300	488	709
7	562	2280	625	510	415	776	583	59400	4550	6000	488	625
8	625	1370	562	457	415	753	562	49100	5250	5850	436	541
9	562	960	520	405	1410	709	520	41800	5700	5950	426	530
10	510	753	520	365	2650	604	478	37000	5600	6000	405	625
11	426	667	499	345	6350	520	499	34500	5450	5850	405	730
12	395	625	520	325	6980	510	468	31300	5450	5600	457	1340
13	375	583	625	355	5060	510	541	26100	5450	5350	436	1210
14	365	562	625	355	3740	646	520	23400	5550	4550	499	914
15	375	530	583	335	3740	730	696	21900	6740	4320	1060	776
16	395	530	541	345	3740	709	1770	20800	7400	4550	1540	753
17	488	499	520	355	3920	1860	1340	19900	7580	3380	1320	845
18	510	488	562	335	4100	2380	1540	19000	7460	2140	985	1710
19	520	488	562	325	4140	1440	2110	18200	7700	2310	709	1540
20	936	488	604	345	4010	667	3560	17600	8180	2070	583	1180
21	1450	488	799	415	3200	499	2620	17200	8580	1770	520	1040
22	985	488	799	530	2450	478	1510	16800	9000	3040	499	822
23	625	468	667	520	2140	468	2910	16300	9350	3880	499	709
24	510	478	604	499	1320	446	8340	15900	9560	4190	499	646
25	478	468	562	488	822	446	11700	15200	9490	2280	604	604
26	446	488	604	446	776	436	14400	14300	9280	1290	1290	562
27	436	457	583	426	868	426	25100	13400	8720	1570	1400	530
28	415	530	541	415	985	698	36200	12200	8120	1320	937	530
29	436	583	520	468	---	3350	43100	10600	7820	960	667	1170
30	436	457	488	1060	---	4680	42300	8790	7580	868	985	1480
31	415	---	499	1320	---	3360	---	7700	---	667	1480	---
Total	16387	22629	18210	14948	66873	34061	209310	923290	216400	126775	22174	30271
Mean	529	754	587	482	2388	1099	6977	29784	7213	4090	715	1009
Max	1450	3130	914	1320	6980	4680	43100	66300	9560	7400	1540	2570
Min	365	415	436	325	415	426	468	7700	4550	667	405	530
Ac-Ft	32503	44884	36119	29649	132641	67559	415160	1831318	429223	251454	43981	60042

WTR YR 1966 TOTAL 1701328 MEAN 4661 MAX 66300 MIN 325 AC-FT 3374533

Table B-6

Example of USGS Flow Records at the Rosser Gage

STREAMFLOW (CFS), WATER YEAR OCT 1942 TO SEP 1943
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	425	2180	860	1980	2760	470	11000	816	4240	1200	218	204
2	407	2460	700	1920	2980	440	7630	768	4680	1010	204	190
3	354	2360	582	1860	2980	420	5590	720	5950	816	204	190
4	354	2110	538	1360	1200	410	4370	674	6300	651	197	226
5	345	2610	538	1030	1200	407	3530	605	5850	502	190	728
6	354	3050	628	898	1200	416	3250	605	8000	434	190	3270
7	328	3120	720	1060	1200	407	2460	960	15700	398	190	1960
8	320	3970	792	1180	1200	416	1860	1990	21400	354	190	674
9	320	3170	792	1100	1200	410	3760	2140	20800	336	190	462
10	311	3020	815	984	1200	415	6650	3780	19500	328	190	345
11	279	2910	768	912	1200	410	7700	6010	17200	416	183	287
12	150	2610	674	840	1200	405	6560	7070	14400	371	176	263
13	140	2320	628	752	1200	2900	3720	7630	10900	425	183	240
14	125	2280	555	744	1200	2900	3730	8210	8840	345	176	233
15	129	2180	548	720	1200	2900	4600	8280	6980	320	176	225
16	200	1890	513	720	490	2900	4190	5700	4700	320	263	218
17	1880	1460	513	697	490	2900	4350	4680	3090	295	279	218
18	6360	1250	480	674	490	2900	4330	4550	2720	271	226	271
19	8830	1200	462	605	490	2900	3810	3850	1600	256	204	398
20	9120	1150	720	582	490	2900	2910	3000	1200	256	197	303
21	10200	1200	1140	502	490	2900	2320	1950	984	240	190	256
22	10600	1200	2780	502	490	2900	2180	2980	888	226	183	233
23	7910	1200	2650	490	770	2900	2320	7660	792	226	176	226
24	5160	1200	2610	490	770	2900	2390	7770	697	218	183	218
25	3300	1200	2010	513	770	2900	2010	7210	628	211	183	218
26	2010	1200	2020	582	770	2900	1660	5920	582	204	170	226
27	1410	1200	3280	549	770	2900	1410	4300	559	322	170	225
28	1180	1200	5010	471	770	17700	1150	3360	697	248	256	256
29	1060	1200	4660	443	---	22900	984	4100	792	240	336	362
30	1130	1200	2740	434	---	21400	888	4960	1030	233	295	303
31	1630	---	2110	1030	---	16800	---	4330	---	233	248	---
Total	76361	61310	43837	26653	31170	127326	113462	126578	192599	11905	6416	13430
Mean	2463	2044	1414	860	1113	4107	3782	4083	6420	384	207	448
Max	10600	5120	5010	1980	2980	22900	11000	8280	21400	1200	336	3270
Min	125	1150	462	434	490	405	888	605	559	204	170	190
Ac-Ft	151460	121607	86949	52865	61825	252547	225048	251064	382014	23613	12726	26638

WTR YR 1943 TOTAL 831047 MEAN 2277 MAX 22900 MIN 125 AC-FT 1648357 period of record (1965-1989). The Cedar Creek Reservoir spills were removed from the Trinidad gage flows prior to summing the flows. Example double mass data are shown in Table B-7.

b. The double mass curve is plotted in Figure B-3, which shows a relatively constant slope of 1.097.

c. The estimated daily flows at the Trinidad gage from 1941 to 1965 were then determined by multiplying the daily Rosser gage flows by 1.097. An example is shown by Table B-8.

Historical Wastewater Return Flows, 1970-1988

a. The monthly return flows for this time period were determined by first obtaining NCTCOG data (4) in the form of a Lotus file. Table B-9 shows an example of the NCTCOG data.

b. The NCTCOG data were edited to remove flows that would be intercepted by reservoirs and to add other flows as determined by the Texas Water Commission (5). Table B-10 shows an example of data obtained from the TWC. This body of data began in 1970 when the self-reporting to the TWC started. The added sources are the City of Forney, the Dallas Water Treatment Plant (east side), the Dallas Water Treatment Plant (Elm Fork), the North Tarrant County Wastewater Treatment Plant, City of Hutchens, City of Wilmer, Dallas/Fort Worth Airport, Palmer, Crandall, and Red Oak. An example of the modified data is shown in Table B-11.

c. The many sources of return flow were grouped into Fort Worth, TRA,

Table B-7

Example of Double Mass Curve Computations

		Trin. River @ Trinidad (Ac-Ft.)	Spills from Cedar Cr. Reservoir (Ac-Ft.)	Flow @ Trinidad excluding Spills (Ac-Ft.)	Cumulative Trinidad Flows (Ac-Ft.)	Trin. River near Rosser (Af-Ft.)	Cumulative Rosser Flows (Af-Ft.)
1964	10	247,557	0	247,557	247,557	211,914	211,914
	11	301,646	0	301,646	549,203	328,244	540,158
	12	434,003	0	434,003	983,206	445,130	985,288
1965	1	159,523	0	159,523	1,142,729	167,540	1,152,828
	2	533,276	0	533,276	1,676,005	531,570	1,684,398
	3	243,987	0	243,987	1,919,992	233,058	1,917,456
	4	77,512	0	77,512	1,997,504	69,937	1,987,393
	5	556,262	0	556,262	2,553,766	515,101	2,502,494
	6	260,985	0	260,985	2,814,751	229,845	2,732,339
	7	36,787	0	36,787	2,851,538	35,334	2,767,673
	8	29,460	0	29,460	2,880,998	30,484	2,798,157
	9	46,588	0	46,588	2,927,586	45,527	2,843,684
	10	32,503	0	32,503	2,960,089	30,742	2,874,426
	11	44,884	0	44,884	3,004,973	41,431	2,915,857
	12	36,119	0	36,119	3,041,092	33,439	2,949,296
1966	1	29,649	0	29,649	3,070,741	26,957	2,976,253
	2	132,641	0	132,641	3,203,382	124,058	3,100,311
	3	67,559	0	67,559	3,270,941	56,809	3,157,120
	4	415,160	0	415,160	3,686,101	414,773	3,571,893
	5	1,831,318	195,372	1,635,946	5,322,047	1,200,634	4,772,527
	6	429,223	0	429,223	5,751,270	449,355	5,221,882
	7	251,454	0	251,454	6,002,724	249,120	5,471,002
	8	43,981	0	43,981	6,046,705	50,422	5,521,424
	9	60,042	0	60,042	6,106,747	54,165	5,575,589
	10	68,553	0	68,553	6,175,300	66,409	5,641,998
	11	23,998	0	23,998	6,199,298	23,066	5,665,064
	12	28,258	0	28,258	6,227,556	25,470	5,690,534
1967	1	25,535	0	25,535	6,253,091	23,901	5,714,435
	2	23,538	0	23,538	6,276,629	22,750	5,737,185
	3	33,356	0	33,356	6,309,985	31,551	5,768,736
	4	68,100	0	68,100	6,378,085	68,662	5,837,398
	5	77,994	0	77,994	6,456,079	79,363	5,916,761
	6	223,418	0	223,418	6,679,497	224,806	6,141,567
	7	80,475	0	80,475	6,759,972	75,433	6,217,000
	8	24,238	0	24,238	6,784,210	22,661	6,239,661
	9	59,016	0	59,016	6,843,226	57,564	6,297,225
	10	132,464	113	132,351	6,975,577	116,551	6,413,776
	11	172,945	19	172,926	7,148,503	101,772	6,515,548
	12	129,701	16,654	113,047	7,261,550	91,684	6,607,232
1968	1	331,101	143,004	188,097	7,449,647	159,828	6,767,060
	2	220,185	50,267	169,918	7,619,565	142,969	6,910,029
	3	674,499	133,805	540,694	8,160,259	498,089	7,408,118
	4	685,586	104,167	581,419	8,741,678	485,930	7,894,048
	5	786,347	151,831	634,516	9,376,194	533,791	8,427,839

Double Mass Curve Analysis

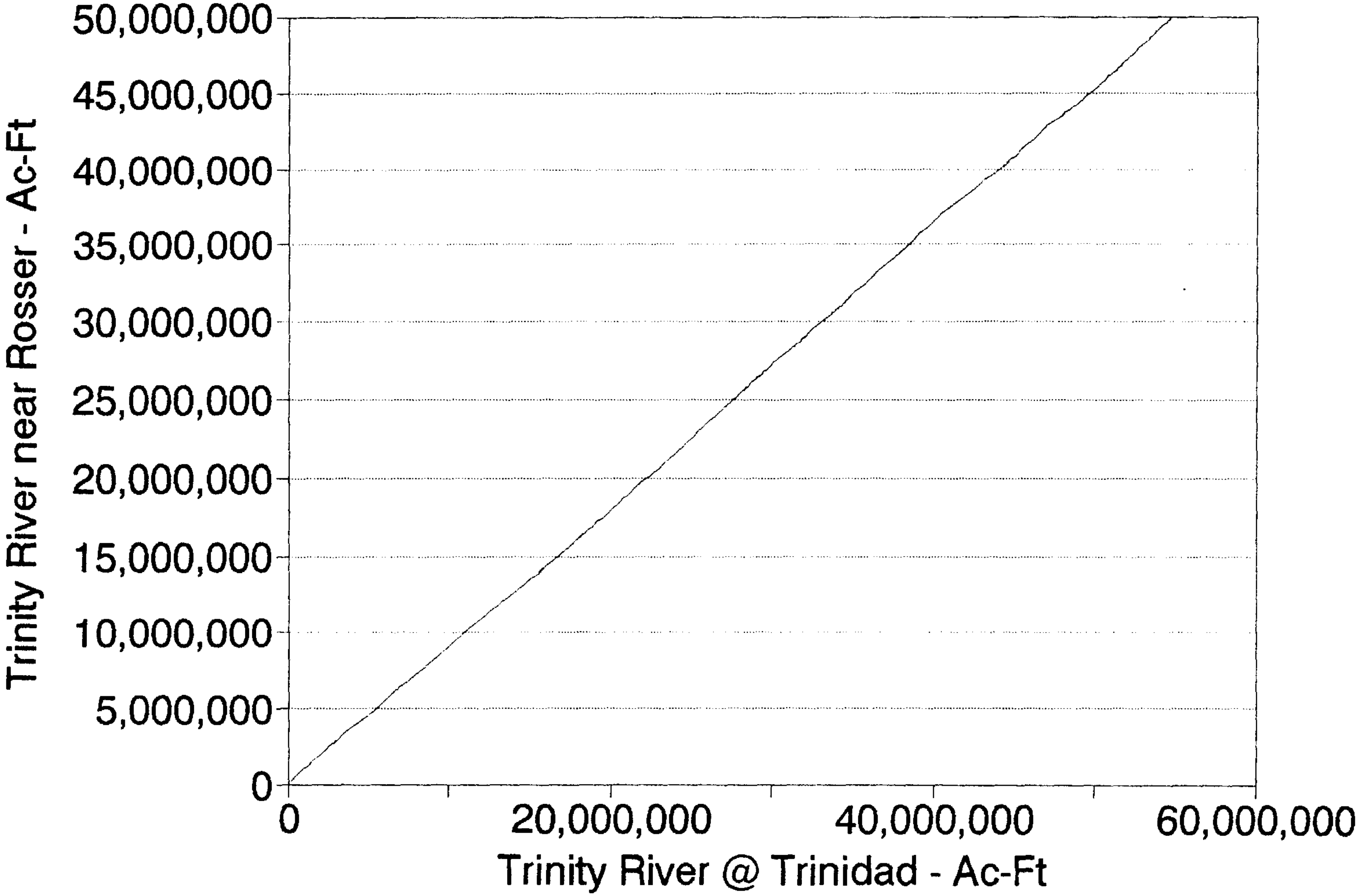


Figure B-3

Table B-8

Example of Estimation of Daily Trinity River Flows at Trinidad

Units - CFS

		ROSSER	TRINIDAD (1.097*Rosser)	Return Flow	Natural Flow	Adjusted Natural Flow	CC 2020 Total Flow	CC 2050 Total Flow	****MW fraction*** 2020	2050	Monthly Fraction 2020	2050
JAN-55 JAN-55	1	221	242	135	107	107	908	1037	0.882	0.897		
	2	179	196	135	61	61	862	991	0.929	0.938		
	3	147	161	135	26	26	827	956	0.969	0.973		
	4	137	150	135	15	15	816	945	0.982	0.984		
	5	142	156	135	21	21	822	951	0.974	0.978		
	6	147	161	135	26	26	827	956	0.969	0.973		
	7	152	167	135	32	32	833	962	0.962	0.967		
	8	147	161	135	26	26	827	956	0.969	0.973		
	9	147	161	135	26	26	827	956	0.969	0.973		
	10	161	177	135	42	42	843	972	0.950	0.957		
	11	419	460	135	325	325	1126	1255	0.711	0.741		
	12	312	342	135	207	207	1008	1137	0.795	0.818		
	13	327	359	135	224	224	1025	1154	0.781	0.806		
	14	256	281	135	146	146	947	1076	0.846	0.864		
	15	209	229	135	94	94	895	1024	0.895	0.908		
	16	185	203	135	68	68	869	998	0.922	0.932		
	17	173	190	135	55	55	856	985	0.936	0.944		
	18	167	183	135	48	48	849	978	0.943	0.951		
	19	240	263	135	128	128	929	1058	0.862	0.879		
	20	221	242	135	107	107	908	1037	0.882	0.897		
	21	197	216	135	81	81	882	1011	0.908	0.920		
	22	197	216	135	81	81	882	1011	0.908	0.920		
	23	179	196	135	61	61	862	991	0.929	0.938		
	24	167	183	135	48	48	849	978	0.943	0.951		
	25	157	172	135	37	37	838	967	0.956	0.962		
	26	157	172	135	37	37	838	967	0.956	0.962		
	27	157	172	135	37	37	838	967	0.956	0.962		
	28	162	178	135	43	43	844	973	0.949	0.956		
	29	152	167	135	32	32	833	962	0.962	0.967		
	30	157	172	135	37	37	838	967	0.956	0.962		
	31	152	167	135	32	32	833	962	0.962	0.967	0.920	0.930
FEB-55	1	147	161	134	27	27	828	957	0.967	0.972		
	2	152	167	134	33	33	834	963	0.960	0.966		
	3	152	167	134	33	33	834	963	0.960	0.966		
	4	270	296	134	162	162	963	1092	0.832	0.852		
	5	794	871	134	737	737	1538	1667	0.521	0.558		
	6	686	753	134	619	619	1420	1549	0.564	0.600		
	7	626	687	134	553	553	1354	1483	0.592	0.627		
	8	440	483	134	349	349	1150	1279	0.697	0.727		
	9	298	327	134	193	193	994	1123	0.806	0.828		
	10	246	270	134	136	136	937	1066	0.855	0.872		
	11	227	249	134	115	115	916	1045	0.874	0.890		
	12	203	223	134	89	89	890	1019	0.900	0.913		
	13	185	203	134	69	69	870	999	0.921	0.931		
	14	173	190	134	56	56	857	986	0.935	0.943		

Table B-9

Example of NCTCOG Data on Historical Flow

Units - MGD

MONTH	FWRV	FWVC	TRAC	DALC	DALS	TRAT	GRDC	NTMO	DENT	GRRT	NTRT	NTWC	AZLA	AZLW	DC#6	FMND	FRSC	FRCC	GRAP	HALT	KLEB	LAKC	LVIL	LELM	MCKS	MIDL	NTBC	NTFB	NTMU	NTSQ	SEGO	TCOL	TROF	WYLE
Jan-70	32.34	24.53		110.50			11.13								0.68	0.00																		
Feb-70	33.74	25.49		126.90			12.11			3.89					0.82	0.00																		
Mar-70	42.94	33.11		121.90			14.90			4.72					0.88	0.00												2.79						
Apr-70	35.79	25.40		116.60			12.03			3.27					0.73	0.00												2.04						
Mar-70	35.35	27.40		118.90			12.08			3.10					0.73	0.00												1.69						
Jun-70	30.52	23.78	18.10	117.70	1.60		10.47	3.73	2.73	3.68	2.25				0.73	0.00		0.08	0.45	0.50	0.20				1.18	0.07		1.78		0.38	0.30			0.15
Jul-70	27.36	21.76	17.20	101.10	1.50		10.85	4.30	3.59	2.29	1.75				0.70	0.00			0.40	0.65	0.21				1.35	0.13		1.49		0.14	0.30			
Aug-70	29.31	20.50	18.00	103.90	1.56		11.34	4.58	4.23	2.06	2.05				0.74	0.00		0.08	0.47	0.60	0.22				1.57	0.10		1.55		0.17	0.30			
Sep-70	32.45	25.84	20.60	117.70	4.30		11.76	4.92	4.89	1.90	2.60				0.78	0.00		0.08	0.39	0.65	0.24	0.04	1.22		1.43	0.10		1.96		0.28	0.30			0.14
Oct-70	27.31	22.82	20.80	116.80	2.60		12.26	5.14	4.69	2.07	2.90				0.76	0.00		0.08	0.40	0.65	0.23	0.07	0.97		1.32	0.05		1.78		0.29	0.30			0.13
Nov-70	21.83	23.75	20.00	105.10	2.00		11.49	4.32	4.85	2.22	1.70				0.56	0.00		0.08	0.38	0.65	0.25	0.14	0.95		1.35	0.10		1.50		0.17	0.30			0.12
Dec-70	19.15	24.09	20.10	103.50	2.50	3.00	11.27	4.50	4.81	2.01	1.70				0.58	0.00		0.08	0.41	0.60	0.24	0.16	0.91		1.30	0.06		1.20		0.16	0.30			0.17
Jan-71	21.36	24.22	20.00	105.50	2.50	3.00	10.66	6.46	4.79	2.22	2.00				0.50	0.00		0.08	0.41	0.65	0.28	0.07	0.88		1.40	0.17		1.35		0.16	0.30			0.15
Feb-71	28.99	19.85	20.20	107.30	2.60	3.50	12.23	7.06	4.84	2.27	1.50				0.68	0.00		0.08	0.46	0.40	0.35	0.07	0.90		1.30	0.06		1.34		0.17	0.30			0.15
Mar-71	30.87	18.88	20.60	108.50	2.60	3.50	13.52	3.99	6.17	2.35	1.50				0.67	0.00		0.09	0.46	0.59	0.28	0.06	0.92		1.20	0.06		1.10			0.30			0.16
Apr-71	30.47	22.39	21.00	116.10	2.70	3.80	12.28	4.47	6.74	2.37	1.40				0.68	0.00		0.09	0.50	0.60	0.30	0.07	0.88		1.01	0.04		1.47		0.15	0.33			0.18
May-71	27.41	23.58	22.20	117.40	2.70	3.90	11.73	4.81	6.11	1.96	1.70				0.73	0.00		0.09	0.48	0.55	0.28	0.07	0.89		0.99	0.08		1.39		0.15	0.35			0.19
Jun-71	26.22	23.43	23.00	118.60	2.90	3.80	14.12	4.92	5.79	2.10	1.60				0.86	0.00		0.08	0.48	0.43	0.24	0.09	0.93		0.61	0.06		1.39		0.12	0.35			0.15
Jul-71	27.48	22.91	22.60	118.10	2.90	4.00	14.27	4.30	6.00	2.47	1.50				0.61	0.00		0.09	0.45	0.70	0.25	0.10	0.91		0.61	0.05		1.44		0.16	0.30			0.18
Aug-71	28.91	24.52	24.76	130.50	2.60	4.40	16.04	5.29	5.90	2.69	1.80				0.75	0.00		0.08	0.48	0.80	0.28	0.08	0.95		0.47	0.06		1.51		0.19	0.30			0.14
Sep-71	24.00	24.46	20.84	119.60	3.20	3.30	15.84	4.85	6.82	2.59	1.80				0.72	0.00		0.08	0.38	0.67		0.08	0.97		0.55	[illegible]		1.44		0.15	0.28			0.13
Oct-71	30.15	25.91	25.65	121.70	3.80	6.70	17.61	5.40	6.69	3.29	4.20				0.82	0.00		0.08	0.52	0.77	0.44	0.17	1.07		1.19	0.12		1.71		0.41	0.33			0.20
Nov-71	27.83	26.34	21.70	115.70	2.90	3.90	16.01	4.67	6.07	1.94	2.80					0.00		0.08	0.40	0.75	0.35	0.13	1.00		0.79			1.50		0.19	0.30			0.17
Dec-71	38.52	36.56	31.11	116.20	4.00	8.90	18.53		6.70	3.27	5.40				0.88	0.00		0.09	0.37	0.95	0.45		1.22		1.90	0.24		2.62		0.62				0.16
Jan-72	32.31	27.34	27.20	135.30	3.90	5.60	17.57	5.11	6.14	2.36	2.90			0.03	0.93	0.00		0.08	0.43	0.75	0.36	0.16	1.03		1.26	0.24		1.86		0.33	0.30			0.23
Feb-72	28.46	25.49	22.40	125.00	3.10	3.60	15.59	5.03	5.89	2.11	1.90			0.03	0.44	0.00		0.08	0.40	0.50	0.34	0.11	1.06		0.92	0.15		1.70		0.23	0.32			0.22
Mar-72	26.64	22.76	22.43	116.80	3.30	3.50	15.37	5.03	5.67	2.00	1.80			0.03	0.40	0.00	0.01	0.09	0.38	0.50	0.28	0.11	1.07		0.90	0.15		1.52		0.19	0.33			0.29
Apr-72	26.38	26.20	22.60	115.80	3.70	4.10	16.29	5.18	5.81	2.18	1.80			0.03	0.42	0.00		0.09	0.39	0.65	0.22	0.10	1.12		0.92	0.23		1.52		0.18	0.30			0.30
May-72	29.15	26.62	22.43	118.00	1.59	5.20	17.91	5.08	5.75	2.26	2.00			0.03	0.50	0.00			0.44	0.60	0.27	0.12	1.11		0.82	0.23		1.44		0.19	0.31			0.34
Jun-72	19.38	30.72	22.25	114.40	2.42	4.80	17.59	5.24	5.38	2.14	1.90			0.03	0.76	0.00	0.01	0.09	0.37	0.45	0.22	0.14	1.21		0.67	0.31		1.43		0.20	0.32			0.41
Jul-72	15.78	31.27	21.45	109.60	1.75	3.20	16.19	5.28	5.72	1.98	1.60				0.78	0.00	0.01	0.09	0.37	0.50	0.24	0.13	1.18		0.80			1.55			0.31			0.45
Aug-72	17.81	31.51	21.78	110.90	1.83	3.70	17.33	5.17	6.01	1.95	1.80				0.80	0.00	0.01	0.09	0.37	0.50	0.23	0.13	1.19		0.91	0.20		2.03		0.18	0.33			0.44
Sep-72	17.67	31.19	23.52	110.90	3.00	3.60	17.29	5.07	6.01	1.93	1.80			0.03	0.60	0.00	0.01	0.09	0.38	0.50	0.22	0.12	1.15		0.89	0.21		1.71		0.19	0.31			0.37
Oct-72	25.11	36.34	25.14	113.20	3.20	4.40	17.59	5.03	5.81	2.24	2.42			0.03	0.65	0.00	0.01	0.09	0.43	0.70	0.24	0.13	1.27		0.62	0.22		1.34		0.25	0.35			0.32
Nov-72	26.23	34.99	25.89	108.00	3.10	5.20	18.86	5.26	6.15	2.44				0.03	0.64	0.00	0.01	0.09	0.40	0.60	0.31	0.11	1.34		0.67	0.20		1.63		0.29	0.30			0.30
Dec-72	25.12	28.84	26.56	102.10	3.30	4.20	17.40	5.26	5.75	2.61	3.34			0.03	0.63	0.00	0.01	0.09	0.36	0.50	0.44	0.11	1.35		0.11	0.12		1.45		0.24	0.29			0.32
Jan-73	30.24	39.63	32.50	114.40	3.30	7.40	18.80	6.57	6.85	3.62	4.18			0.03	0.72	0.00	0.01		0.48	0.50	0.58	0.13	1.36		0.93	0.23		1.85		0.37	0.31			
Feb-73	31.63	36.78	32.97	77.30	3.40		19.33		6.25	3.39					0.71	0.00		0.09	0.46				1.33					2.30						
Mar-73	29.05	43.74	32.64	117.00	4.54	6.40	19.70	6.11	6.22	3.31	5.35			0.04	0.70	0.00		0.09	0.47	0.60	0.37	0.16	1.50		0.96	0.22		2.19		0.39	0.31			
Apr-73	26.78	49.21	36.78	115.80	5.88	7.10	19.76	5.78	6.68	3.32	4.75			0.04	0.73	0.00	0.01	0.09	0.55	0.80		0.14	1.47		1.20	0.34		2.26		0.53	0.32			
May-73	26.73	37.21	34.35	100.60	2.86	5.20	19.53	6.05	6.18	2.91	5.49				0.68	0.00	0.01	0.09	0.54	0.60	0.67	0.18	1.41		1.40	0.28		2.34		0.61	0.32			0.15
Jun-73	32.56	50.96	38.95	130.30	6.78	7.40	17.49	6.13	6.54	3.93	5.66				0.76	0.00	0.01	0.09	0.56	0.70	0.81		1.53		1.50	0.28		2.77			0.30			0.15
Jul-73	30.43	45.60	34.05	136.40	6.30	5.70	19.19	6.21	6.30	2.81	4.55			0.04	0.72	0.00	0.01	0.09	0.47	0.80	0.68	0.14	1.42		1.44	0.19		2.32		0.57	0.32			0.18

JOINT SYSTEMS

FWRV = Fort Worth Riverside Plant
FWVC = Fort Worth Village Creek Plant
TRAC = Trinity River Authority Central Plant
DALC = Dallas Central Regional Wastewater Plant
DALS = Dallas Southside Regional Wastewater Plant
TRAT = Trinity River Authority Ten Mile Creek Plant
GRDC = Garland Duck Creek Plant
NTMO = North Texas Municipal Water District Mesquite Plant
DENT = Denton Pecan Creek Plant
GRRT = Garland Rowlett Plant
NTRT = North Texas Municipal Water District Plant
NTWC = North Texas Municipal Water District Wilson Creek Plant

COMMUNITY SYSTEMS

AZLA = Azle Ash Creek Plant
AZLW = Azle Walnut Creek Plant
DC#6 = Dallas County WCID #6 Plant
FMND = Flower Mound Plant
FRSC = Frisco Stewart Creek Plant
FRCC = Frisco Cottonwood Creek Plant
GRAP = Grapevine Peach Street Plant
HALT = Haltom City Plant
KLEB = Dallas Kleberg Plant
LAKC = Lake Cities MUA Plant
LVIL = Lewisville Plant
LELM = Little Elm Plant
MCKS = McKinney South Plant
MIDL = Midlothian Plant
NTBC = North Texas Municipal Water District Buffalo Creek Plant
NTFB = North Texas Municipal Water District Floyd Branch Plant
NTMU = North Texas Municipal Water District Murphy Plant
NTSQ = North Texas Municipal Water District Squabble Creek Plant
SEGO = Seagoville Plant
TCOL = The Colony Plant
TROF = Trophy Club MUD Plant
WYLI = North Texas Municipal Water District Wylie Plant

Table B-10

Example of TWC Data on Historical Flow

FORM 510813 *** TEXAS WATER QUALITY BOARD ***

WASTEWATER EFFLUENT REPORT

NUMERIC — NORMAL DOMESTIC — DATE OF RUN 01/29/81

WCO-NUMBER — NAME OF WCO HOLDER — PLANT OR OUTFALL NAME — DIST CTY BASIN SGMT — SPECIAL MESSAGE

10060-03 DALLAS CITY OF — EAST SIDE WTP-OUTFALL 001 — 04 057 08 0819

REPORT DATE	DAYS DISC	DAYS BYPASS	VOL-MAX BYPASSED	FLOW-MAX MG/DAY	FLOW-AVE MG/DAY	% VOL RELEASED	BOD MAX	BOD MOAVE	TSS MAX	TSS MOAVE	CHL-RES MIN	CHL-RES MOAVE	%STA MIN	%STA MOAVE	S-SOL MAX	S-SOL MOAVE	SPEC PROV
01-74	31	00	.000	2.551	1.544	100			25	14					0	0	YES
02-74	28	00	.000	3.318	1.889	100			21	11					1	0	YES
03-74	31	00	.000	3.144	2.224	100			41	20					1	0	YES
04-74	30	00	.000	5.805	5.081	100			23	19					0	0	YES
05-74	31	00	.000	2.578	2.170	100			46	21*					0	0	YES
06-74	30	00	.000	3.327	2.418	100			30	14					0	0	YES
07-74	31	00	.000	10.260	7.148*	100			35	28*	NC	NC			0	0	YES
08-74	31	00	.000	8.148	3.785	100			30	18					0	0	YES
09-74	30	00	.000	4.253	2.747	100			31	18					0	0	YES
10-74	28	00	.000	2.877	2.033	100			21	15					0	0	YES
11-74	14	00	.000	2.308	1.945	100			15	10					0	0	YES
12-74	01	00	.000	1.835	1.835	100			35	35*					0	0	YES
REQUIREMENTS				80.000	7.000				65	20			85	85	2	2	

10060-05 DALLAS CITY OF — ELM FORK WTP-OUTFALL NO 001 — 04 057 08 0822

REPORT DATE	DAYS DISC	DAYS BYPASS	VOL-MAX BYPASSED	FLOW-MAX MG/DAY	FLOW-AVE MG/DAY	% VOL RELEASED	BOD MAX	BOD MOAVE	TSS MAX	TSS MOAVE	CHL-RES MIN	CHL-RES MOAVE	%STA MIN	%STA MOAVE	S-SOL MAX	S-SOL MOAVE	SPEC PROV
01-74	22	00	.000	2.824	1.791	100			224*	89*					1	0	YES
02-74	28	00	.000	1.134	.721	100			80	48*					0	0	YES
03-74	31	00	.000	2.778	1.872	100			999*	999*					40	15	YES
04-74	30	00	.000	2.800	1.925	100			999*	899*					40	17	YES
05-74	31	00	.000	3.665	2.574	100			776*	507*					5	3	YES
06-74	30	00	.000	3.178	2.221	100			999*	999*					80	19	YES
07-74	31	00	.000	3.882	2.432	100			898*	486*	NC	NC			5	2	YES
08-74	31	00	.000	2.193	1.711	100			321*	164*					1	1	YES
09-74	30	00	.000	1.980	1.357	100			999*	341*					80	16	YES
10-74	30	00	.000	1.838	1.225	100			330*	183*					1	0	YES
11-74	30	00	.000	3.180	2.427	100			999*	999*					38	13	YES
12-74	31	00	.000	2.418	1.427	100			998*	899*					89	15	YES
REQUIREMENTS				50.000	5.000				65	20			85	95	2	2	

FORM 510813 *** TEXAS WATER QUALITY BOARD *** PAGE 0013

WASTEWATER EFFLUENT REPORT

NUMERIC — NORMAL DOMESTIC — DATE OF RUN 01/29/81

WCO-NUMBER — NAME OF WCO HOLDER — PLANT OR OUTFALL NAME — DIST CTY BASIN SGMT — SPECIAL MESSAGE

10060-06 DALLAS CITY OF — SOUTHSIDE SEWAGE TREAT PLANT — 04 057 08 0805

REPORT DATE	DAYS DISC	DAYS BYPASS	VOL-MAX BYPASSED	FLOW-MAX MG/DAY	FLOW-AVE MG/DAY	% VOL RELEASED	BOD MAX	BOD MOAVE	TSS MAX	TSS MOAVE	CHL-RES MIN	CHL-RES MOAVE	%STA MIN	%STA MOAVE	S-SOL MAX	S-SOL MOAVE	SPEC PROV
01-74	31	00	.000	8.840	6.320	100	55	42*	112*	76*	NC	NC					NO
02-74	28	00	.000	5.980	3.940	100	81	53*	144*	108*	NC	NC					NO
03-74	31	00	.000	7.400	5.900	100	160*	72*	188*	137*	NC	NC					NO
04-74	30	00	.000	6.470	5.270	100	170*	103*	188*	118*	NC	NC					NO
05-74	31	00	.000	10.400	5.760	100	99	31*	96	40*	NC	NC					NO
06-74	30	00	.000	12.500	8.600*	100	46	34*	130*	90*	NC	NC					NO
07-74	31	00	.000	5.820	3.600	100	88	41*	152*	107*	NC	NC					NO
08-74	31	00	.000	7.020	5.210	100	100	52*	96	82*	NC	NC					NO
09-74	30	00	.000	12.070	6.770	100	140*	78*	132*	81*	NC	NC					NO
10-74	31	00	.000	8.470	4.450	100	340*	200*	82	70*	NC	NC					NO
11-74	30	00	.000	9.700	6.200	100	240*	180*	80	48*	NC	NC					NO
12-74	31	00	.000	8.500	5.700	100	280*	135*	100	70*	NC	NC					NO
REQUIREMENTS				14.000	7.000		100	30	100	30			85	85	2	2	

10060-07 DALLAS CITY OF — BACHMAN STORMWATER CONTROL STA — 04 057 08 0822

REPORT DATE	DAYS DISC	DAYS BYPASS	VOL-MAX BYPASSED	FLOW-MAX MG/DAY	FLOW-AVE MG/DAY	% VOL RELEASED	BOD MAX	BOD MOAVE	TSS MAX	TSS MOAVE	CHL-RES MIN	CHL-RES MOAVE	%STA MIN	%STA MOAVE	S-SOL MAX	S-SOL MOAVE	SPEC PROV
01-74	00				.000												
02-74	00				.000												
03-74	00				.000												
04-74	00				.000												
05-74	00				.000												
06-74	00				.000												
07-74	00				.000												
08-74	00				.000												
09-74	00				.000												
10-74	01	00	.000	2.800	2.800	100	17	12	40	28	1.5	1.5			0	0	YES
11-74	00				.000												
12-74	00				.000												
REQUIREMENTS				27.000	3.000		80	30	80	30	1.0	1.0	85	85	2	2	

Table B-11

Example Data For Modified NCTCOG With Added Sources

Units - MGD

																	ADDED=>									
MONTH	FWRV	FWVC	TRAC	DALC	DALS	TRAT	GPDC	NTMQ	DC#6	HALT	KLEB	LVIL	MIDL	NTBC	NTFB	SEGO	FOR	DWTPE	DWTPF	NTCWW	HUCENS	WIMER	DFWA	PAL	CRAN	REDOK
Jan-74	26.36	35.28	32.48	128.70	6.32	7.10	18.55	5.66	0.59	0.55	1.03	1.55	0.30		1.84	0.31	0.13	1.54	1.79	0.12	0.17	0.06	0.33	0.02	0.06	0.04
Feb-74	24.88	35.28	31.17	118.40	3.94	5.20	17.89	5.67	0.63	0.48	0.99	1.58	0.29		1.75	0.29	0.13	1.89	0.72	0.12	0.15	0.08	0.32	0.02	0.06	0.04
Mar-74	20.03	40.50	33.44	109.70	5.90	4.80	18.73	5.69	0.67	0.51	1.05	1.59	0.30		1.66	0.29	0.13	2.22	1.97	0.12	0.14	0.10	0.25	0.02	0.06	0.04
Apr-74	22.78	35.94	35.20	115.70	5.27	4.20	18.83	5.70	0.61	0.45	1.02	1.66	0.36		1.86	0.21	0.10	5.08	1.93	0.12	0.14	0.10	0.18	0.02	0.05	0.04
May-74	24.43	41.59	38.02	123.50	5.76	5.40	17.36	5.74	0.58	0.46	0.91	1.69	0.40		2.03	0.23	0.10	2.17	2.57	0.13	0.12	0.11	0.18	0.03	0.05	0.04
Jun-74	24.66	40.85	37.85	122.20	8.60	4.60	14.76	5.80	0.58	0.47	0.63	1.69	0.38		1.92	0.24	0.10	2.42	2.22	0.13	0.12	0.11	0.18	0.04	0.05	0.05
Jul-74	23.30	33.80	33.61	109.90	3.60	4.21	18.04	5.78	0.66	0.44	0.85	1.60	0.34		1.68	0.41	0.08	7.15	2.43	0.13	0.24	0.11	0.18	0.06	0.05	0.04
Aug-74	25.74	39.57	36.97	120.10	5.21	4.20	19.79	5.80	0.77	0.48	0.61	1.62	0.31		1.76	0.18	0.08	3.80	1.71	0.2	0.23	0.11	0.18	0.04	0.05	0.05
Sep-74	28.20	46.29	35.52	135.80	6.77	6.70	19.52	5.90	0.69	0.48	0.59	1.68	0.27		2.11	0.53	0.08	2.75	1.36	0.2	0.24	0.10	0.04	0.05	0.06	0.05
Oct-74	27.12	48.00	36.29	127.50	4.45	6.60	19.50	5.54	0.47	0.55	0.64	1.78	0.24		1.79	0.58	0.13	2.03	1.23	0.12	0.23	0.10	0.04	0.05	0.05	0.04
Nov-74	27.20	51.06	36.20	160.10	6.20	9.00	19.62	5.60	0.69	0.68	0.82	1.77	0.38		2.46	0.65	0.13	1.99	2.43	0.15	0.02	0.10	0.06	0.05	0.06	0.06
Dec-74	23.79	41.27	36.15	123.30	5.70	6.00	15.55	5.60	0.55	0.48	0.74	1.68	0.21		1.94	0.62	0.13	1.64	1.43	0.18	0.23	0.10	0.04	0.04	0.06	0.05
Jan-75	27.47	43.49	32.54	129.50	5.80	6.10	16.69	5.60	0.59	0.50	0.80	1.94	0.28		1.95	0.95	0.13	1.75	1.37	0.25	0.22	0.10	0.09	0.04	0.05	0.05
Feb-75	32.43	63.57	42.55	122.10	7.00	8.50	14.96	5.60	0.69	0.67	0.69	1.87	0.53		2.25	0.71	0.14	1.14	1.48	0.3	0.19	0.10	0.07	0.04	0.06	0.05
Mar-75	28.72	46.87	36.92	130.00	6.87	6.20	16.02	5.62	0.84	0.52	0.75	1.86	0.27		2.02	0.60	0.12	2.04	1.20	0.18	0.18	0.09	0.06	0.04	0.06	0.05
Apr-75	33.27	56.91	43.20	137.60	5.77	7.70	16.43	5.21	0.86	0.65	0.85	2.01	0.27		2.30	0.55	0.19	3.24	1.61	0.15	0.17	0.10	0.06	0.04	0.06	0.08
May-75	31.96	51.54	45.07	130.90	5.27	8.00	16.48	5.93	0.76	0.81	0.80	2.67	0.40		2.27	0.55	0.21	2.67	1.57	0.14	0.21	0.1	0.10	0.05	0.06	0.05
Jun-75	32.96	54.11	44.87	127.50	5.00	6.20	17.52	5.98	0.71	0.61	0.49	2.59	0.40		1.98	0.48	0.13	3.64	1.45	0.12	0.18	0.09	0.08	0.05	0.06	0.05
Jul-75	29.20	46.59	40.35	125.30	8.10	5.70	17.80	5.54	0.77	0.59	0.41	2.12	0.17		1.47	0.48	0.08	3.93	1.51	0.09	0.11	0.12	0.05	0.05	0.06	0.04
Aug-75	28.31	42.64	43.59	114.10	3.90	4.60	18.09	5.49	0.75	0.50	0.37	2.16	0.14		1.29	0.44	0.13	4.45	1.65	0.09	0.13	0.12	0.04	0.04	0.06	0.04
Sep-75	27.60	38.06	42.15	112.30	4.68	4.50	15.91	5.29	0.72	0.46	0.65	2.44	0.18		1.10	0.41	0.09	4.98	1.58	0.08	0.10	0.11	0.04	0.04	0.07	0.03
Oct-75	27.56	35.53	39.91	110.10	3.42	5.10	17.42	4.93	0.70	0.42	0.35	3.11	0.21		1.00	0.41	0.12	4.81	1.83	0.08	0.10	0.11	0.03	0.04	0.06	0.04
Nov-75	23.48	35.34	37.17	111.00	4.86	5.10	17.35	4.49	0.78	0.43	0.33	2.74	0.18		1.07	0.42	0.17	2.32	1.74	0.09	0.10	0.11	0.02	0.04	0.07	0.04
Dec-75	26.69	33.50	36.53	108.30	5.49	9.30	16.75	4.31	0.82	0.43	0.32	2.85	0.15		1.11	0.44	0.17	0.34	1.74	0.09	0.16	0.10	0.02	0.04	0.10	0.04
Jan-76	24.09	36.40	36.31	114.00	5.23	3.70	16.76	4.70	0.83	0.40	0.32	3.81	0.14		1.45	0.53	0.13	0.80	1.52	0.1	0.20	0.11	0.02	0.05	0.08	0.04
Feb-76	26.12	34.14	37.09	111.00	5.25	3.60	15.86	4.67	0.77	0.41	0.34	2.95	0.16		1.40	0.47	0.18	4.84	1.24	0.1	0.16	0.10	0.03	0.05	0.10	0.04
Mar-76	29.75	36.81	54.70	120.00	5.24	4.80	16.29	4.97	1.02	0.48	0.36	3.27	0.21		1.49	0.38	0.20	4.07	1.02	0.09	0.33	0.10	0.03	0.05	0.10	0.04
Apr-76	34.80	47.32	46.93	130.80	6.36	7.70	15.78	5.50	1.01	0.55	0.43	2.80	0.43		1.75	0.47	0.18	5.56	2.38	0.1	0.33	0.10	0.03	0.06	0.10	0.04
May-76	33.61	46.48	46.53	140.00	5.97	7.60	17.31	5.42	1.16	0.51	0.50	2.80	0.31		2.01	0.59	0.18	2.99	1.76	0.14	0.33	0.10	0.04	0.07	0.11	0.04
Jun-76	34.55	41.68	67.12	134.80	5.72	6.20	16.97	5.13	1.18	0.48	0.40	2.40	0.16		1.89	0.59	0.17	2.90	3.14	0.11	0.27	0.11	0.04	0.06	0.11	0.04
Jul-76	29.01	41.21	54.88	129.50	5.14	6.10	16.37	5.69	1.15	0.48	0.51	2.46	0.24		1.91	0.56	0.16	2.91	3.81	0.09	0.33	0.12	0.03	0.06	0.11	0.04
Aug-76	28.18	37.25	46.81	130.70	4.75	5.20	16.13	4.94	0.99	0.46	0.63	2.82	0.13		1.60	0.61	0.13	4.61	5.19	0.11	0.21	0.11	0.03	0.06	0.11	0.05
Sep-76	30.28	37.35	48.86	126.90	5.39	6.40	16.22	3.36	1.13	0.46	0.68	3.49	0.19		1.69	0.63	0.15	3.91	4.52	0.1	0.21	0.11	0.02	0.05	0.11	0.04
Oct-76	33.74	36.19	48.88	133.40	5.37	6.90	9.71	3.32	1.14	0.47	0.47	3.15	0.22		1.60	0.82	0.15	3.15	3.95	0.11	0.33	0.09	0.02	0.04	0.10	0.05
Nov-76	29.53	36.32	46.07	124.80	5.49	6.50	11.02	3.17	1.01	0.44	0.43	3.05	0.24		1.43	0.62	0.13	3.53	3.27	0.12	0.21	0.10	0.02	0.04	0.10	0.05
Dec-76	35.53	38.71	49.42	136.30	6.06	8.40	12.65	3.19	1.71	0.48	0.52	2.45	0.33		1.50	0.36	0.12	4.58	3.99	0.11	0.33	0.10	0.02	0.03	0.11	0.05
Jan-77	34.50	39.55	48.50	135.70	5.70	6.80	13.02	1.19	2.18	0.57	0.59	3.22	0.33		1.78	0.79	0.19	4.01	4.50	0.12	0.21	0.11	0.02	0.04	0.11	0.05
Feb-77	38.55	55.07	50.76	135.90	6.66	9.00	11.20	4.06	1.41	0.63	0.64	3.09	0.39		2.29	0.06	0.19	4.59	3.95	0.12	0.22	0.11	0.05	0.04	0.11	0.06
Mar-77	17.84	44.27	53.21	145.70	7.17	10.10	17.16	4.96	1.28	0.57	0.66	2.99	0.45		2.51	0.72	0.19	4.28	4.36	0.12	0.23	0.11	0.06	0.04	0.11	0.07
Apr-77	34.52	60.84	52.41	102.20	8.03	10.60	19.37	5.04	1.19	1.02	0.67	2.99	0.07		2.73	0.39	0.19	5.09	2.71	0.12	0.21	0.11	0.06	0.05	0.11	0.07
May-77	33.76	43.65	49.48	132.10	5.15	5.80	20.56	4.86	1.05	0.60	0.66	2.43	0.17		1.66	0.29	0.15	5.70	3.38	0.11	0.22	0.11	0.06	0.05	0.11	0.07
Jun-77	28.36	41.14	48.73	133.20	4.38	4.80	19.90	4.76	1.10	0.54	0.54	2.56	0.17		1.46	0.27	0.11	8.25	3.24	0.11	0.21	0.11	0.06	0.05	0.10	0.07
Jul-77	28.13	39.29	48.38	138.60	4.60	4.60	16.68	4.60	0.94	0.50	0.38	2.56	0.14		1.44	0.22	0.11	8.22	4.56	0.11	0.21	0.11	0.06	0.05	0.10	0.07
Aug-77	27.58	37.22	48.38	131.00	5.50	5.10	18.16	4.34	1.01	0.54	0.51	2.41	0.17		1.46	0.23	0.11	7.95	3.29	0.11	0.21	0.11	0.06	0.05	0.10	0.07
Sep-77	33.20	31.88	48.38	133.00	5.58	4.80	11.70	4.48	1.01	0.51	0.41	2.46	0.19		1.41	0.25	0.11	7.58	3.39	0.11	0.21	0.11	0.06	0.05	0.10	0.07
Oct-77	30.74	31.36	54.76	132.00	5.60	5.02	10.70	4.32	1.27	0.48	0.36	3.15	0.16		1.31	0.25	0.11	6.66	2.91	0.11	0.21	0.11	0.06	0.05	0.10	0.07
Nov-77	28.32	32.02	56.53	136.60	5.28	5.26	13.50	4.25	1.01	0.46	0.33	2.55	0.18		1.31	0.24	0.11	6.15	2.44	0.11	0.21	0.11	0.06	0.05	0.10	0.07
Dec-77	26.29	29.20	55.37	130.00	6.02	5.09	12.40	4.61	0.98	0.46	0.32	2.26	0.22		1.29	0.43	0.11	6.07	3.68	0.11	0.12	0.11	0.06	0.05	0.11	0.07
Jan-78	27.12	35.92	48.87	134.80	6.93	4.91	12.00	4.98	1.01	0.48	0.45	2.36	0.25		1.38	0.40	0.11	4.75	4.75						0.10	
Feb-78	31.61	40.21	53.32	140.00	7.63	8.70	17.88	5.28	1.16	0.53	0.62	2.56	0.32		1.81	0.67	0.11	4.03	3.95						0.10	
Mar-78	29.71	40.64	49.18	141.90	7.33	6.91	16.32	5.22	1.03	0.48	0.64	2.48	0.16		1.93	0.41	0.11	4.85	3.20						0.10	
Apr-78	30.26	43.82	48.03	143.30	6.97	5.51	15.89	5.14	1.00	0.48	0.66	2.62	0.19		1.81	0.79	0.11	5.52	2.85						0.10	
May-78	29.90	39.94	50.94	140.50	7.72	7.92	18.71	5.80	1.10	0.58	0.35	2.84	0.21		2.20	0.46	0.11	7.41	2.52						0.10	
Jun-78	22.79	44.56	48.25	145.30	5.41	5.16	13.95	5.87	1.07	0.49	0.10	2.49	0.20		1.88	0.38	0.08	6.00	3.39						0.11	
Jul-78	18.95	49.92	45.76	141.00	6.07	4.62	11.29	5.74	1.02	0.44	1.08	2.33	0.20		1.60	0.23	0.08	7.39	5.81						0.11	
Aug-78	19.44	48.77	46.06	150.40	6.28	4.18	12.17	5.98	1.01	0.45	1.12	2.53	0.18		1.58	0.35	0.10	7.79	3.06						0.11	

Dallas, and "other". An example of the flow after grouping is shown in Table B-12. Figure B-4 is a plot of return flows from 1970 to 1990.

Historical Wastewater Return Flows, 1941-1970

a. Prior to 1970, the historical return flows were determined from data from Fort Worth (6), Dallas (7) and TRA (8). Examples are presented in Tables 13, 14 and 15.

b. For some of the years, only the yearly averages were available. In those years, the monthly values were estimated by using the historical pattern of monthly flows from years which had monthly records.

c. The "other" contributions were estimated from the historical data and were taken to be 10 percent of the total from 1969 back to through 1960. Before 1960, the other return flows were estimated at 15 percent of the total, to allow for the fact that the TRA operation was not present.

d. These data were used to estimate the monthly return flows prior to 1970. Where monthly flow records were available, they were used. Where only the yearly data were available, they were distributed in a typical pattern throughout the year. The estimated monthly historical wastewater return flows were assumed to be constant throughout the month.

Table B-12

Example of Grouping of Historical Return Flow

- Units-MGD -

Month	Fort Worth	TRA	Dallas	Other	Total MGD
Jan-70	56.9	21.0	111.2	21.0	210.0
Feb-70	59.2	21.0	127.7	23.1	231.0
Mar-70	76.1	21.0	122.8	24.4	244.2
Apr-70	64.2	21.0	117.3	22.5	225.0
May-70	62.8	21.0	119.6	22.6	226.0
Jun-70	54.3	18.1	120.2	21.4	214.0
Jul-70	49.1	17.2	103.5	18.9	188.7
Aug-70	49.8	18.0	106.4	19.3	193.6
Sep-70	58.3	20.6	123.0	22.4	224.3
Oct-70	50.1	20.8	120.4	21.2	212.6
Nov-70	45.6	20.0	107.9	19.3	192.7
Dec-70	43.2	23.1	106.8	19.2	192.4
Jan-71	45.6	23.0	108.8	20.5	197.8
Feb-71	48.8	23.7	110.9	22.3	205.8
Mar-71	49.7	24.1	112.0	20.5	206.4
Apr-71	52.9	24.8	119.8	20.1	217.5
May-71	51.0	26.1	121.1	19.8	218.0
Jun-71	49.7	26.8	122.6	22.2	221.2
Jul-71	50.4	26.6	121.9	20.0	220.8
Aug-71	53.4	29.2	134.1	24.9	241.7
Sep-71	48.5	24.1	123.8	24.1	220.5
Oct-71	56.1	32.4	126.8	27.0	242.2
Nov-71	54.2	25.6	119.8	24.4	224.0
Dec-71	75.1	40.0	121.5	28.4	265.0
Jan-72	59.7	32.8	140.5	26.9	259.8
Feb-72	53.9	26.0	128.9	24.3	233.2
Mar-72	49.4	25.9	120.8	24.0	220.1
Apr-72	52.6	26.7	120.1	25.3	224.7
May-72	55.8	27.6	120.4	26.7	230.4
Jun-72	50.1	27.1	117.8	26.5	221.5
Jul-72	47.0	24.7	112.4	25.2	209.3
Aug-72	49.3	25.5	113.8	26.8	215.3
Sep-72	48.9	27.1	114.7	26.2	216.9
Oct-72	61.5	29.5	117.3	26.5	234.8
Nov-72	61.2	31.1	112.1	28.2	232.5
Dec-72	54.0	30.8	106.5	26.4	217.6

TRINITY RIVER
Wastewater Return Flow

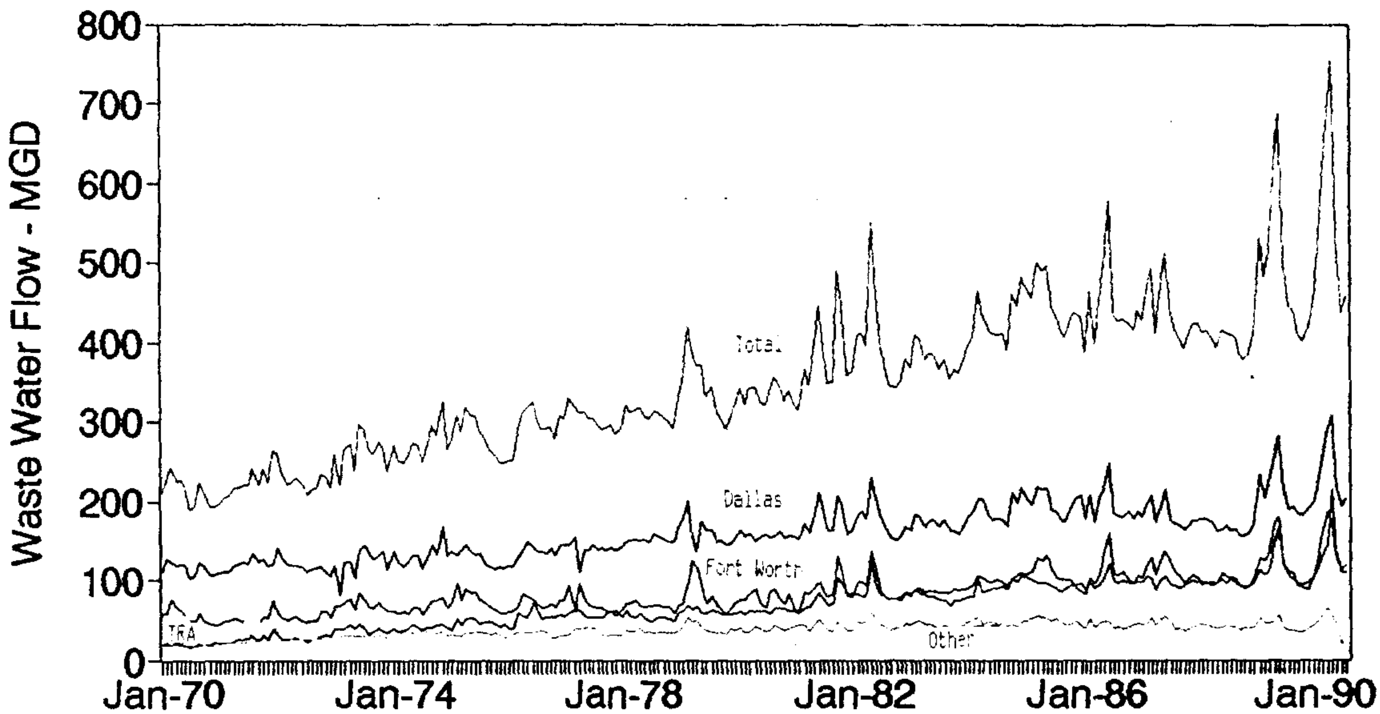


Figure B-4

Table B-13

Example of Data From Fort Worth

OPERATING RESULTS 1925 - 1973

RIVERSIDE PLANT

YEAR	DAYS PLANT OPER.	TREATED TOTAL M.G.	TREATED AVERAGE M.G.D.	BOD mg/L IN	BOD mg/L OUT	SUSPENDED SOLIDS mg/L IN	SUSPENDED SOLIDS mg/L OUT	LBS. BOD REMOVED PER DAY	COST PER 1000 LBS BOD REMVD	COST PER M.G.
1925	355	1,825.267	5.142	392	38	351	39	10,892	7.52	$ 15.92
1925*	149	979.710	6.571	461	52	351	55	22,430	4.26	14.54
1926	357	2,163.305	6.050	532	38	382	27	24,966	3.07	12.65
1927	352	2,370.670	6.735	445	37	357	54	22,918	3.26	11.11
1928	329	2,245.113	6.824	508	44	334	65	26,408	3.41	13.21
1929	52	232.391	4.469	342	33	321	63	11,517	**	**
1930	295	2,380.683	8.070	380	33	318	32	23,355	6.54	18.94
1931	355	3,776.080	10.637	418	30	341	33	34,421	4.22	13.66
1932	291	3,111.590	10.693	339	27	322	34	27,824	6.81	17.73
1933	354	3,762.970	10.630	377	25	328	36	22,341	7.47	15.71
1934	365	3,405.450	9.330	332	17	336	30	24,979	4.84	12.96
1935	350	3,648.330	10.424	372	31	333	42	29,646	3.60	10.25
1936	318	2,951.320	9.281	418	38	345	43	29,432	3.24	10.26
1937	358	4,062.570	11.348	438	27	354	43	38,899	2.72	9.34
1938	351	4,125.295	11.753	369	34	369	34	33.815	3.52	10.12
1939	349	3,560.580	10.202	438	20	367	30	35,567	3.24	11.30
1940	362	3,966.550	10.957	427	24	391	31	36,829	3.53	11.87
1941	288	3,661.920	12.715	357	43	311	34	33,299	5.07	13.27
1942	303	3,754.610	12.391	460	68	377	47	40,512	4.61	15.06
1943	333	4,503.250	13.523	460	50	360	42	46.243	3.39	11.58
1944	345	4,415.040	12.797	481	50	410	44	46,001	3.82	13.74
1945	288	4,320.780	14.982	402	53	375	48	43,670	4.45	12.98
1946	252	3,519.850	13.957	382	55	323	46	38.094	6.46	17.62
1947	96	887.793	9.296	338	20	330	27	24.527	***	***
1948	354	6,080.448	17.191	352	38	323	40	39.937	5.01	11.66
1949	333	5,952.478	17.886	354	33	325	41	44.451	5.17	12.84
1950	311	5,398.494	17.379	340	28	298	33	41.061	5.88	13.90
1951	354	6,898.958	19.483	343	31	314	40	49,771	4.99	12.76
1952	354	8,511.271	24.043	324	25	318	35	59,145	5.05	12.42
1953	359	8,954.190	24.956	338	26	314	35	64,384	5.34	13.77
1954	355	8,966.725	25.172	365	29	328	41	70.098	5.14	14.30
1955	365	9,948.616	27.286	354	39	323	45	71,311	5.51	14.40

* Fiscal year changed from May 1 to October 1.
** Plant in operation only 52 days
*** Plant in operation only 96 days

Table B-14

Example of Data from Dallas Central Wastewater Treatment Plant Flow (MGD)

Year*	Flow	Year	Flow
1943	20.0	1967	106.4
1944	20.6	1968	111.0
1945	17.9	1969	114.9
1946	25.3	1970	116.5
1947	29.6	1971	120.1
1948	30.0	1972	112.8
1949	36.7	1973	124.7
1950	32.7	1974	132.8
1951	34.1	1975	123.2
1952	34.7	1976	131.8
1953	31.0	1977	140.4
1954	53.1	1978	152.9
1955	50.0	1979	143.3
1956	58.8	1980	143.9
1957	74.9	1981	158.8
1958	69.1	1982	142.3
1959	76.9	1983	147.6
1960	81.5	1984	166.0
1961	80.0	1985	162.6
1962	79.5	1986	152.0
1963	79.0	1987	134.4
1964	88.4	1988	140.1
1965	84.7	1989	153.5
1966	88.1		

Table B-15

Example of Data from the TRA

- Units-MGD -

Trinity River Authority
CRWS Historical Metered Flow

- 1960-1970 -

Year	Flow
1960	6.6
1961	7.7
1962	8.3
1963	8.1
1964	8.7
1965	12.8
1966	14.5
1967	13.6
1968	15.8
1969	16.4
1970	20.0

Natural Flow

The natural flow is the historical flow without the wastewater included.

a. The daily return flows were subtracted from the daily measured historical flows to produce the natural flow. See Table B-8 for an example of the results.

b. The estimated natural flows were adjusted as required to eliminate occasional negative values.

Future Return Flows

Estimates were derived for the return flows expected at the Trinity River diversion point as of 2020 and 2050.

a. The historical yearly ratios of return flows reaching Trinidad to the total water use in Dallas and Tarrant Counties were determined. See Table B-16.

b. From 1974 through 1990 the ratios varied from 0.57 to 0.70 and averaged 0.64. To allow for some additional wastewater recycling and to be conservative, a value of 0.55 was chosen for use in this study.

c. The Dallas County projected water use as predicted by the TWDB was used in the projection (9). Comparisons were made to the Turner, Collie & Braden projections (10) for the Dallas Water Utilities and the results were found to be reasonable. See Figure B-5.

Table B-16

Historical and Extrapolated Return Flow
Units - MGD

Year	********Total Tarrant Co.	Water Use************ Dallas Co.	(1) Sum	(2) Return Flow(a)	(2)/(1)
1974	164.1	270.7	434.8	272.4	0.63
1977	189.6	344.4	534.1	303.6	0.57
1980	215.9	376.1	592.0	335.7	0.57
1984	214.6	410.4	625.0	427.4	0.68
1985	222.0	431.8	653.8	450.4	0.69
1986	225.8	418.3	644.1	445.4	0.69
1987	233.3	422.8	656.1	438.2	0.67
1988	248.2	459.2	707.5	403.7	0.57
1990	277.9 *	459.8	737.7	518	0.70
					0.64 Avg.
				(use 0.55 to be conservative)	
2020	374.2 *	566.7	940.9	517	801 CFS
2050	524.1 *	678.3 **	1,202.4	601 ***	930 CFS

References: * TCWCID#1 Rpt. 1990, F&N/Alan Plummer
** Linearly extraporated from TWDB projections.
***Reduced by 60 MGD to account for average pumpback from Dallas South WWTP. (TC&B '90 rpt.)
Others: Water Use - Texas Water Development Board
Return Flow - Texas Water Commission and NCTCOG

(a) This is the return flow that flows into the Trinity River and is not intercepted by reservoirs.

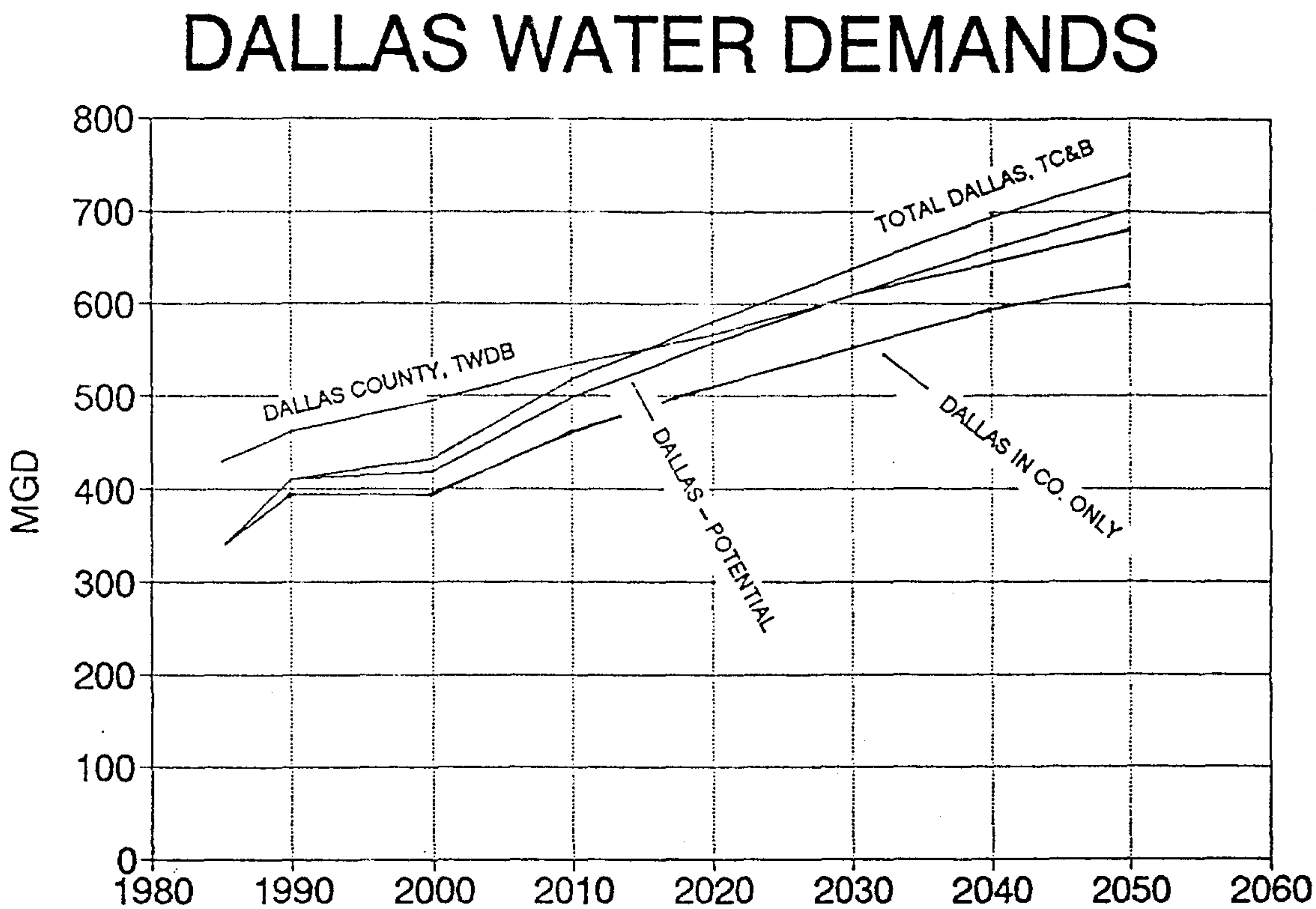

DALLAS WATER DEMANDS
MGD
800
700
600
500
400
300
200
100
0
1980
1990
2000
2010
2020
2030
2040
2050
2060
TOTAL DALLAS, TC&B
DALLAS COUNTY, TWDB
DALLAS - POTENTIAL
DALLAS IN CO. ONLY

Figure B-5

d. The Tarrant County projected water use was taken from the F&N/Alan Plummer 1990 report on the TCWCID#1 regional water supply (1).

e. The Dallas County projected water use and the Tarrant County projected water use were added together and multiplied by 0.55 to obtain the estimated 2020 and 2050 return flows.

f. The 2050 return flow projection was reduced by 60 mgd to reflect the alternative recommended by TC&B for pumping part of the output of the Dallas southside WWTP to Lake Ray Hubbard starting in 2035. Table B-8 shows the results of about 800 cfs for 2020 and 930 cfs for 2050. Figure B-6 shows the total return flow and its relationship to the maximum pumping that would be needed for makeup water. Figure B-7 shows the comparison between the estimated Tarrant County return flow and the peak pumping rate required for the makeup water.

2020 and 2050 Trinity River Daily Flow

To obtain the 2020 and 2050 Trinity River estimated daily flows, the projected 2020 and 2050 return flows were added to the daily natural flows to get the total Trinity River flows. Table B-8 presents an example of the total predicted daily flows at the proposed diversion points.

Wastewater Fractions

a. The wastewater fractions were calculated by dividing the wastewater (801 for 2020 and 930 for 2050) by the total flow for each day. An example is shown in Table B-8.

RETURN FLOW vs. PEAK PUMPING RATE FOR 30% INCREASE IN YIELD

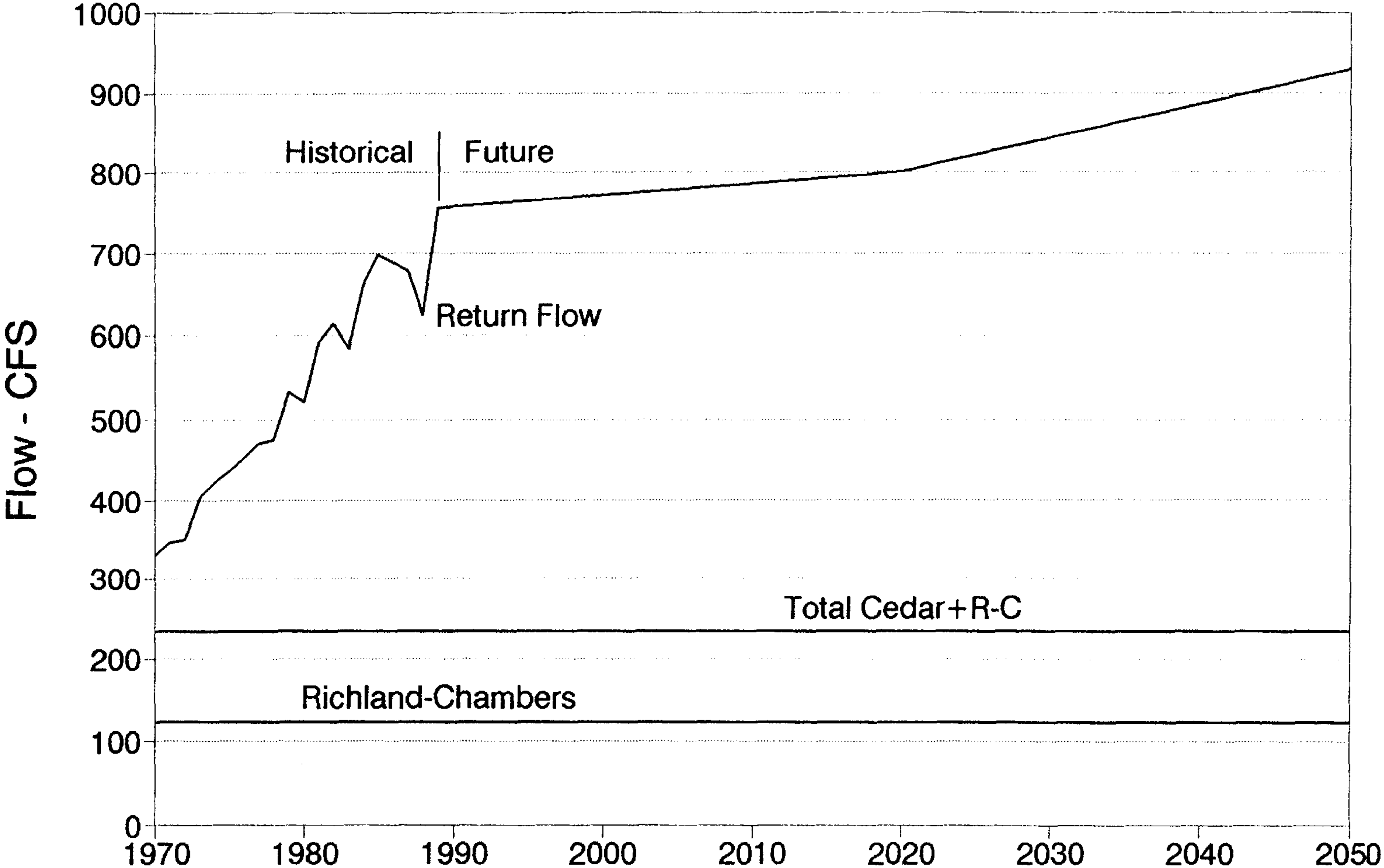


Figure B-6

TARRANT CO. CONTRIBUTION TO RETURN FLOW

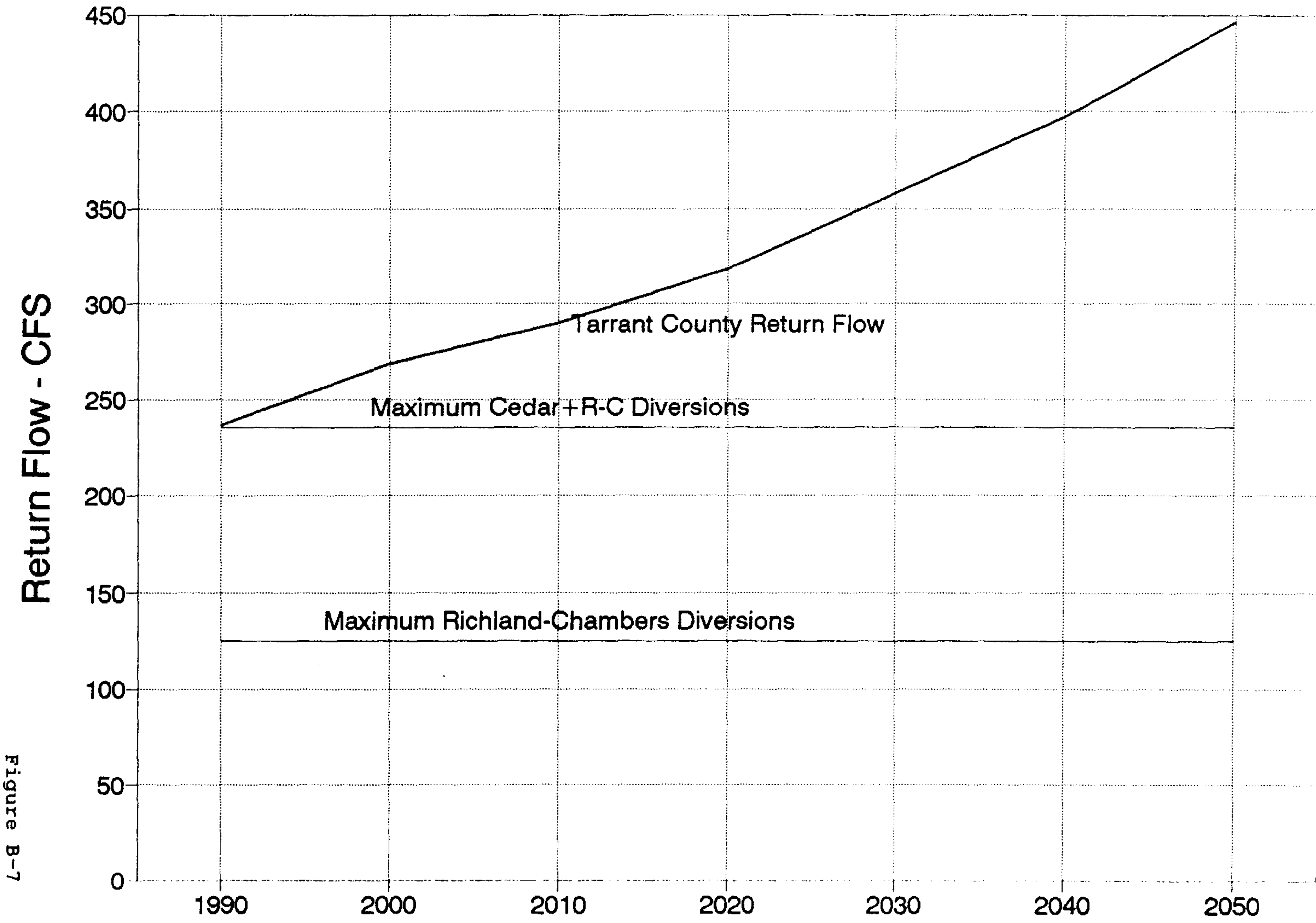


Figure B-7

WASTEWATER COMPONENT OF RIVER WATER

2020 Conditions

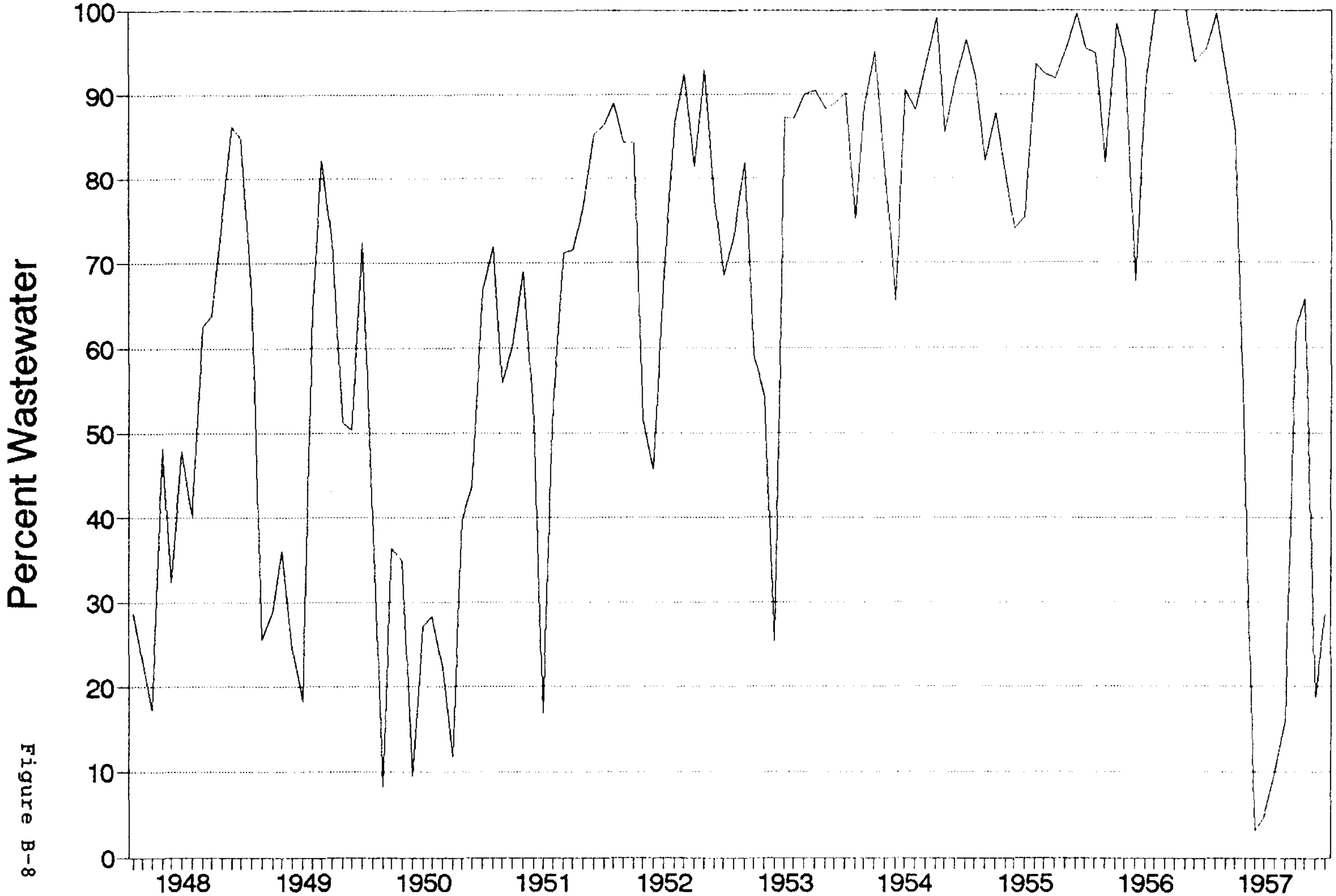


Figure B-8

b. The total Trinity River flows in 2020 and 2050 will be sufficiently large such that the desired diversion rates can be maintained throughout any month. Because of this, the monthly averages of the wastewater fractions were determined for each month by averaging the daily fractions during the month. These data are shown in the example in Table B-8. During the critical period of 1948-1957, the fraction of wastewater in the available makeup river water can be seen to increase in Figure B-8.

Monthly Reservoir Operation

a. The pumping criteria adopted for the study of reservoir performance call for pumping of supplemental diversions whenever the reservoir levels drop five feet below the top of the conservation pools. Pumping rates were limited to 110 cfs for Cedar Creek Reservoir and 125 cfs for Richland-Chambers Reservoir with allowance for 20% average downtime. An alternative operating criterion was also considered in which lesser pumping rates were used between five feet and 10 feet below the top of conservation storage in the reservoirs with higher rates when the lakes were more than 10 feet down. It was found that the long-term volume of water pumped would be less under that set of operating rules. It is anticipated that the final pumping criteria will be dependent upon tradeoffs between reservoir levels, months of the year, pumping costs and capital costs.

b. The desired 30% increase in yield was achieved, resulting in a 227,500 af/yr yield from Cedar Creek Reservoir and a 273,000 af/yr yield from Richland-Chambers Reservoir.

c. Calculations were made on a monthly basis. An example of the computer output is presented in Table B-17.

d. The monthly wastewater fractions were used in the monthly reservoir operation computer program to determine the amount of wastewater pumped in the makeup water to Cedar Creek Reservoir and Richland-Chambers Reservoir. The amount of return flow in the makeup water pumped for the 2020 conditions when 5,360 acre-feet per month is pumped to Cedar Creek Reservoir can be seen in Figure B-9. Table B-18 presents a summary of the results.

Impact of Diversions on River Flow

The maximum pumping considered above is 235 cfs while the 2020 return flow is estimated to be 800 cfs and the 2050 return flow is estimated to be 930 cfs. The estimated minimum flow remaining in the river after the maximum diversion would be 565 cfs in 2020 and 695 cfs in 2050. This compares to a historical minimum flow at the Trinity River Rosser gage during the drought of the 1950's of 96 cfs on October 3, 1953. The return flow estimates for that time period indicate that all of the 96 cfs was wastewater return flow. The estimated historical return flow during the critical period varied from around 100 cfs to 180 cfs. Without the historical return flow, the Trinity River would have had many days of zero flow during the 1950's. It has been estimated that at the proposed diversion point there would have been 55 zero-flow days

Table B-17

Example of Reservoir Operation Study Output

RICHLAND CREEK -MAKEUP - TRINITY RIVER DIVERSION RUP 10/09/89
DIVERSION = 6050 AC-FT/MONTH; TRIGGER POINT = 971,753 AC-FT

DATE	EVAP. LOSS *AC-FT*	DEMAND *AC-FT*	INFLOW *AC-FT*	SHORT-AGE *AC-FT*	D/S RELEASE *AC-FT*	SPILLS *AC-FT*	--END OF MONTH--- CONTENT *AC-FT*	ELEV. *FT*	MAKE-UP *AC-FT*	RETURN FLOW IN MAKE-UP *AC_FT*
1986										
1	7340.	23150.	9700.	0.	307.	0.	802534.	305.4	6050.	4495.
2	1442.	21349.	110500.	0.	280.	0.	896013.	308.0	6050.	1234.
3	11458.	20994.	0.	0.	307.	0.	869304.	307.3	6050.	3775.
4	3279.	21130.	5900.	0.	298.	0.	856547.	306.9	6050.	1742.
5	4873.	19492.	109800.	0.	307.	0.	947725.	309.4	6050.	865.
6	7940.	19410.	255600.	0.	298.	0.	1181727.	315.0	6050.	448.
7	29608.	23014.	7800.	0.	307.	0.	1136598.	314.0	0.	0.
8	22803.	25799.	600.	0.	307.	0.	1088289.	312.8	0.	0.
9	11781.	25061.	12000.	0.	298.	0.	1063149.	312.2	0.	0.
10	5051.	24543.	56500.	0.	307.	0.	1089748.	312.9	0.	0.
11	-1303.	24597.	100400.	0.	298.	0.	1166556.	314.7	0.	0.
12	-2228.	24461.	110600.	0.	308.	72729.	1181886.	315.0	0.	0.
	102044.	273000.	779400.	0	3622.	72729.			36300.	12560.
1987										
1	3133.	23150.	40810.	0.	307.	14220.	1181886.	315.0	0.	0.
2	-2238.	21349.	25550.	0.	280.	6159.	1181886.	315.0	0.	0.
3	6265.	20994.	40890.	0.	307.	13324.	1181886.	315.0	0.	0.
4	17720.	21130.	2470.	0.	298.	0.	1145208.	314.2	0.	0.
5	5725.	19492.	40810.	0.	307.	0.	1160494.	314.5	0.	0.
6	9343.	19410.	78320.	0.	298.	27877.	1181886.	315.0	0.	0.
7	20889.	23014.	19260.	0.	307.	0.	1156936.	314.4	0.	0.
8	29543.	25799.	57.	0.	307.	0.	1101344.	313.2	0.	0.
9	13518.	25061.	239.	0.	298	0.	1062706.	312.2	0.	0.
10	16886.	24543.	8.	0.	307.	0.	1020978.	311.2	0.	0.
11	1209.	24597.	251.	0.	298.	0.	995125.	310.6	0.	0.
12	-2005.	24461.	33160.	0.	308	0.	1005521.	310.8	0.	0.
	119988.	273000.	281825.	0.	3622.	61580.			0.	0.
1988										
1	6015.	23150.	19880.	0.	307.	0.	995929.	310.6	0.	0.
2	1201.	21349.	28290.	0.	280.	0.	1001389.	310.7	0.	0.
3	4800.	20994.	17140.	0.	307.	0.	992428.	310.5	0.	0.
4	9882.	21130.	4590.	0.	298.	0.	965708.	309.8	0.	0.
5	15515.	19492.	187.	0.	307.	0.	936631.	309.1	6050.	4743.
6	15979.	19410.	2900.	0.	298.	0.	909894.	308.4	6050.	4894.
7	18605.	23014.	7.	0.	307.	0.	874025.	307.4	6050.	4840.
8	23492.	25799.	0.	0.	307.	0.	830477.	306.2	6050.	6050.
9	15776.	25061.	1750.	0.	298.	0.	797142.	305.3	6050.	5427.
10	9927.	24543.	3740.	0.	307.	0.	772155.	304.5	6050.	4852.
11	4692.	24597.	747.	0.	298.	0.	749365.	303.8	6050.	4296.
12	658.	24461.	1040.	0.	308.	0.	731028.	303.3	6050.	4138.
	126542.	273000.	80271.	0.	3622.	0.			48400.	39240.

CRITICAL PERIOD IS FROM 6/1948 THROUGH 2/1957. MINIMUM CONTENT = 175875.

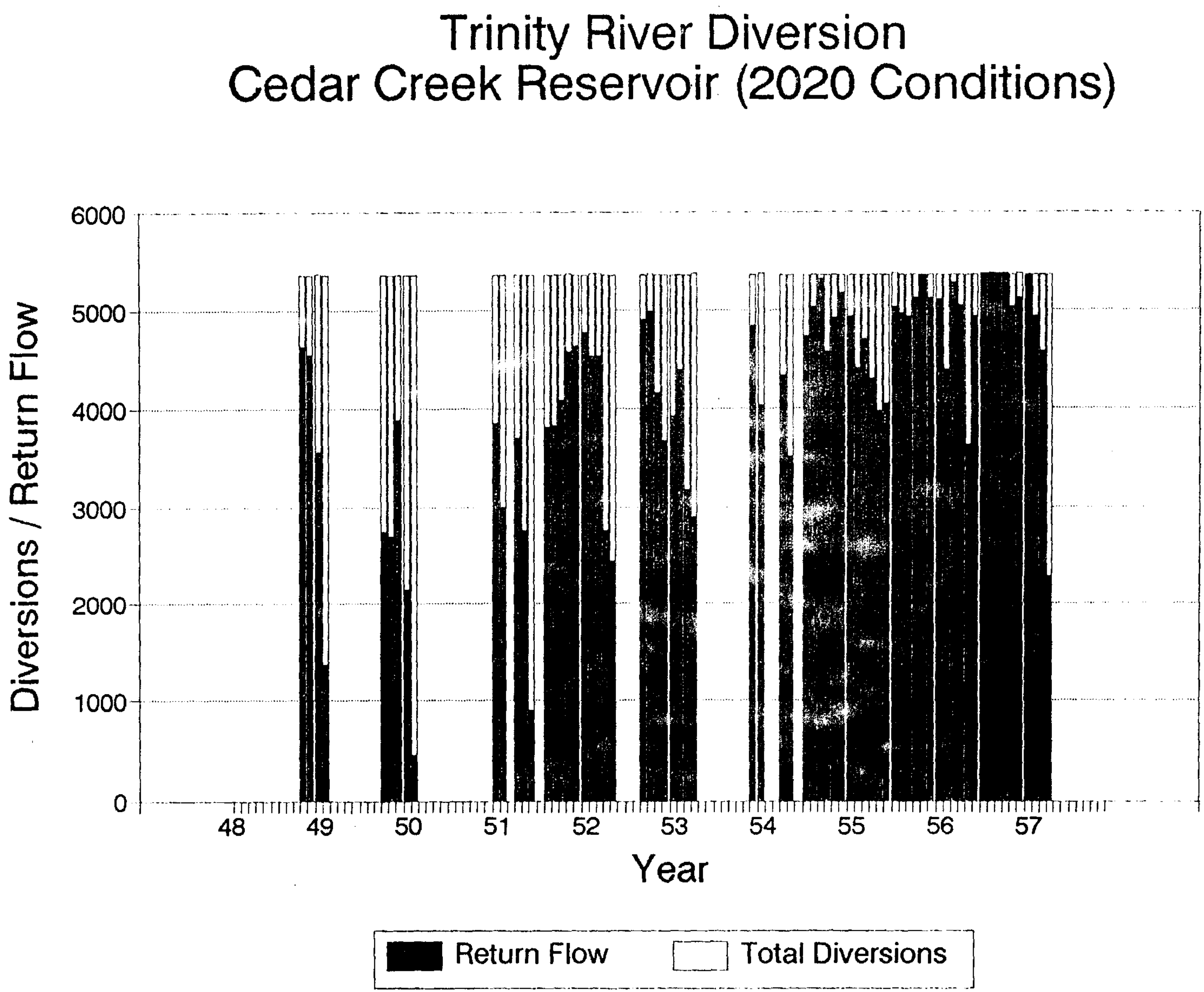

Trinity River Diversion
Cedar Creek Reservoir (2020 Conditions)
Diversions / Return Flow
6000
5000
4000
3000
2000
1000
0
48
49
50
51
52
53
54
55
56
57
Year
Return Flow
Total Diversions

Figure B-9

Table B-18

Summary of Results of Computer Simulations

Parameter	Cedar Creek Reservoir	Richland/Chambers Reservoir
Original Yield	175,000 af/yr	210,000 af/yr
New Yield	227,500 af/yr	273,000 af/yr
Percent increase in yield	30 %	30 %
Maximum diversion rate	110 cfs	125 cfs
Downtime allowance	20 %	20 %
Max. Monthly diversion	5,360 af/mo	6,050 af/mo
Max. Yearly diversion	64,320 af/yr	72,600 af/yr
Avg. 48 yr diversion	1,600 af/mo	2,700 af/mo
	19,200 af/yr	32,400 af/yr
Avg. Critical Period diversion	4,264 af/mo	5,070 af/mo
	51,168 af/yr	60,840 af/yr

Estimated Minimum River Flow at Trinidad

2020	800 cfs
2050	930 cfs

Estimated Tarrant County Contribution to the Trinity River flow

2020	318 cfs
2050	446 cfs

in 1954, 103 zero-flow days in 1955, 201 zero-flow days in 1956 and 32 zero-flow days in 1957. With the proposed diversions, the remaining 2020 flow of 565 cfs in the Trinity River greatly exceeds the historical minimum of around 100 cfs and the natural flow minimum of zero. The amount of water proposed for diversion can be visualized by comparison with the predicted 2020 total flow in Figure B-10.

The 7-day, 2-year recurrence low flow for this section of the Trinity River is increasing with time because of the increase in wastewater return flow. This is evidenced by the 1976 (11) Texas Water Quality Standards (TWQS) which have no 7Q2 flows defined at any location, while the 1981 (12) standards show 382 cfs, 1985 (13) shows 405 cfs and 1988 (14) shows 460 cfs. A calculation of the minimum 7-day flow for each year during the period of 1941-1988 is shown by Figure B-11. The data of the figure reflect the progressive increase in return flow. A frequency-of-recurrence analysis of this data suggests a 7Q2 value of 342 cfs for the entire period and a value of 443 cfs for 1965-1988 (based on Weibull plot position). If the natural flow (without return flows) is considered for the 7Q2 evaluation the Weibull positioning technique gives a 7Q2 value of 189 cfs. The data indicate that the growing volume of the return flows is increasing the base flow of the Trinity River and that even after the diversions proposed in 2020 the minimum flow and the 7Q2 flow will be higher than the historical flows prior to 1991.

Flow At Diversion Point
Acre-Feet Per Year

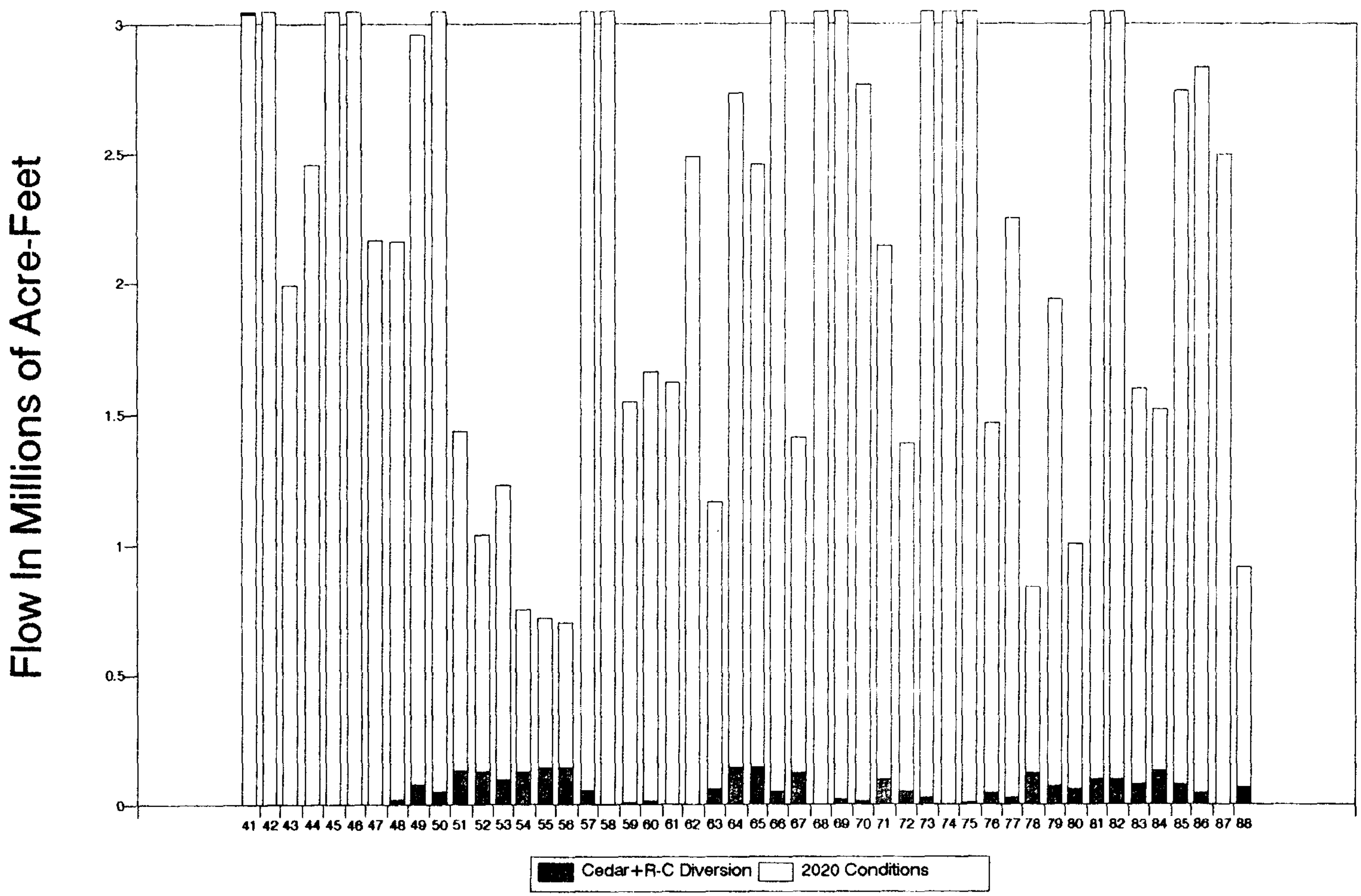


Figure B-10

7-DAY MINIMUM FLOW

Historical

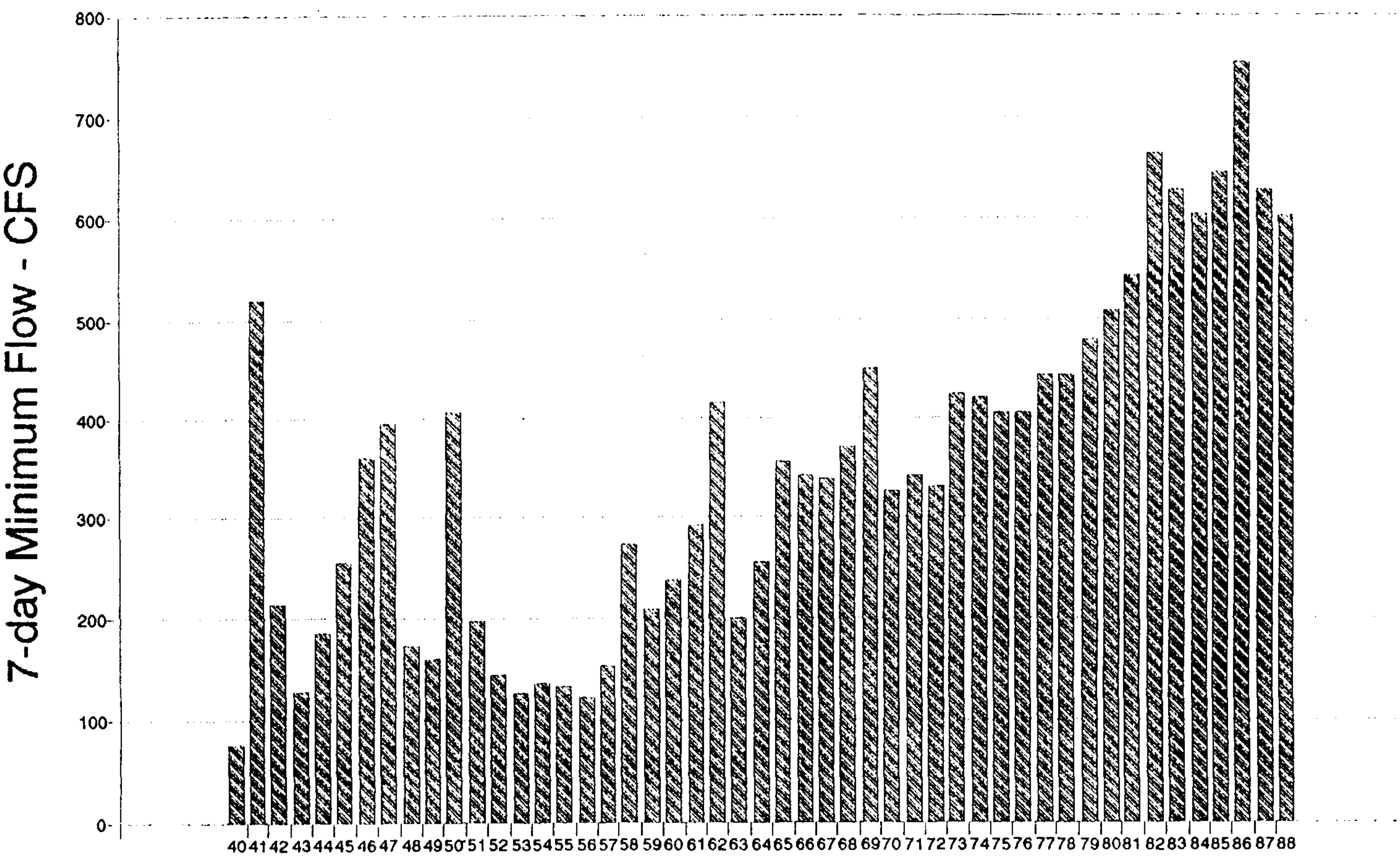


Figure B-11

LIST OF REFERENCES FOR APPENDIX B

(1) Freese and Nichols, Inc. and Alan Plummer and Associates, Inc. Regional Water Supply Plan. Prepared for the Tarrant County Water Control and Improvement District Number One, Fort Worth, Texas, in conjunction with the Texas Water Development Board, Austin, Texas. October 1990.

(2) Texas Water Development Board Report 64: "Monthly Reservoir Evaporation Rates for Texas, 1940 through 1965," as subsequently updated by the Texas Water Development Board, Austin, Texas, 1967.

(3) U.S. Geological Survey: "Water Resources Data for Texas," published annually in Austin, Texas. Formerly (prior to 1961) published annually in Washington, D.C., as USGS "Water Supply Papers."

(4) Brush, Samuel W., North Central Texas Council of Governments, letter to Tom C. Gooch, Freese and Nichols, Inc., February 5, 1991.

(5) Texas Water Commission, Data Processing Services Section, Austin, Texas, Computer printout, January 29, 1991.

(6) Fort Worth Water Department: "1988-1989 Statistical Report," published annually in Fort Worth, Texas.

(7) Peterson, Larry, City of Dallas, Fax Communication to Tom C. Gooch, February 14, 1991.

(8) Hunter, Wayne, Trinity River Authority of Texas, Arlington, Texas, Fax Communication to Tom C. Gooch, February 25, 1991.

(9) Texas Water Development Board: Summaries of population and water use in 1980 and 1985 and projections of future population and water requirements at 10-year intervals through 2040 for Dallas County, Austin, Texas, July 1990.

(10) Turner, Collie & Braden, Inc.: "Long-Range Water Supply Plan," prepared for the City of Dallas, Dallas, Texas, 1989.

(11) Texas Water Quality Board: "Texas Water Quality Standards, Austin, Texas, February 1976.

(12) Texas Department of Water Resources: "Texas Surface Water Quality Standards," Austin, Texas, April 1981.

(13) Texas Water Commission: "Texas Surface Water Quality Standards," Austin, Texas, April 1985.

(14) Texas Water Commission: "Texas Surface Water Quality Standards," Austin, Texas, April 1988.

APPENDIX C

TRINITY RIVER WATER QUALITY ANALYSIS

APPENDIX C

OUTLINE

I. PHOSPHOROUS

A. All Data

1. Summary of Analysis
2. Raw Data

B. Phosphorous Forms

1. Total Phosphorous
2. Dissolved Phosphorous
3. Dissolved Orhto Phosphorous
4. Dissolved Orhto Phosphate

II. NITROGEN

A. All Data

1. Summary of Analysis
2. Raw Data

B. Nitrogen Forms

1. Total NO_2+NO_3 Nitrogen
2. Dissolved NO_2+NO_3 Nitrogen
3. Total Ammonia Nitrogen
4. Dissolved Ammonia Nitrogen
5. Total Organic Nitrogen
6. Dissolved Organic Nitrogen

III. SOLIDS & BACTERIOLOGICAL DATA

A. Summary of Analysis
B. Total Suspended Solids
C. Fecal Coliform

IV. METALS

A. Summary of Analysis

B. Dissolved Metals

1. Arsenic
2. Cadmium
3. Copper
4. Lead
5. Mercury
6. Selenium
7. Zinc

C. Reference

APPENDIX C

ANALYSIS TECHNIQUES

The analyses of the individual parameters in sections I, II, and III of this appendix involved two basic parts. Part one entailed the analysis of the complete data set as a whole. Expected values and standard deviations were calculated for the whole data set based upon the assumption that the data were log-normally distributed. Plots of the parameter concentrations versus streamflow were made on rectilinear and log-log scales.

The second part of the analysis involved the breakdown of parameter data based upon different streamflow intervals. Four to five individual sub-data sets within each parameter data set were created based upon streamflow intervals. Separate analyses for each streamflow interval were performed to determine the expected values and standard deviations for each parameter by streamflow interval. The expected concentration values for each streamflow interval are plotted versus streamflow on log-log scale.

The analysis of the metals data presented in section IV did not involve streamflow intervals, but still included two different parts. The first part consisted of calculating the expected value and standard deviation for each metal based upon the assumption that the data were log-normally distributed. These calculations could utilize only those data which were greater than the detectable limits of the sampling equipment. The second part of the analysis considered the non-detectables as well as the detectable data. Probability plots were generated for each data set with plotting positions calculated for all non-detectables. Based upon the log-normal assumption, a best-fit line was drawn across the plot and the 50th, 90th, and 99th percentile values were recorded. A copy of a reference supporting this method of analysis is included in section IV-C of this appendix. The percentile values presented in the summary table that were determined based upon the part two analysis are considered to better represent the data than the expected value calculations which do not take into consideration the non-detectables.

I. PHOSPHOROUS

I.A.1. SUMMARY OF ANALYSIS

TABLE C-1

SUMMARY OF PHOSPHOROUS CONCENTRATIONS BY
STREAM FLOW INTERVAL CLASS
TRINITY RIVER AT TRINIDAD: 1980-1989

			Stream Flow Interval (cfs)				
Parameter Designation	Phosphorous Form		0-1,000	1,000-3,000	3,000-6,000	6,000-20,000	>20,000
P1	Total Phosphorous	Avg.+1 std. dev.	5.18	2.65	0.88	0.66	0.32
		Avg.	3.68	1.77	0.84	0.46	0.21
		Avg.-1 std. dev.	2.17	0.88	0.81	0.26	0.11
P2	Dissolved Phosphorous	Avg.+1 std. dev.	4.99	2.21	0.66	0.34	0.25
		Avg.	3.43	1.41	0.55	0.25	0.16
		Avg.-1 std. dev.	1.87	0.62	0.45	0.16	0.07
P3	Total Ortho Phosphorous	Avg.+1 std. dev.	4.68	2.00	0.69	0.33	-
		Avg.	2.99	1.26	0.52	0.23	0.07
		Avg.-1 std. dev.	1.31	0.53	0.34	0.12	-
P4	Total Ortho Phosphate	Avg.+1 std. dev.	12.94	6.64	2.10	0.97	-
		Avg.	9.83	4.16	1.90	0.71	0.21
		Avg.-1 std. dev.	6.71	1.68	1.70	0.45	-

I.A.2. RAW DATA

TABLE C-2

TRI-PHOS.WR1
03/27/91 kgl
307-1000

TWC STATEWIDE MONITORING NETWORK
AND USGS WQ PARAMETERS
(WITH USGS FLOWS)
PHOSPHOROUS
PERIOD OF RECORD: 1980 - 1989

	DATE	TIME	FLOW INSTAN-TANEOUS (cfs)	P-1 PHOSPHOROUS TOTAL (MG/L AS P)	P-2 PHOSPHOROUS DISSOLVED (MG/L AS P)	P-3 PHOSPHOROUS ORTHO, DISSOLVED (MG/L AS P)	P-4 PHOSPHATE, ORTHO, DISSOLVED (MG/L AS PO4)
*	01/09/80	11:40	560	4.4	3.9		
*	02/12/80	16:30	4380	0.81	0.47		
*	03/19/80	15:00	983	2.3	2		
*	04/23/80	16:50	815	2.6	2.1		
*	05/13/80	15:15	1040	2.3	1.9		
*	06/03/80	14:15	753	4.5	3.2		
*	07/15/80	13:20	490	5.3	3.7		
*	08/20/80	13:30	496	6	6		
*	09/11/80	11:45	667	6.1	5.1		
*	10/21/80	11:50	1000	1.6	0.88		
*	11/05/80	12:30	558	4	3.7		
*	12/08/80	12:00	626	4.8	4.7		
*	01/21/81	13:00	612	4.7	4.6		
*	02/18/81	11:30	562	2.5	3.5		
*	03/10/81	11:30	2700	2.9	1.5		
*	04/13/81	15:00	641	4.3	4		
*	05/07/81	09:30	909	2.4	2.3		
*	06/10/81	13:30	21100	0.39	0.31		
*	07/08/81	12:30	10500	0.25	0.18		
*	08/10/81	13:30	562	3.6	3.4		
*	09/08/81	16:10	727	1.3	1.2		
*	11/09/81	14:45	35000	0.17	0.17		
*	01/19/82	12:30	6320	0.32	0.28		
*	03/02/82	12:40	9030	0.3	0.24		
*	05/18/82	13:00	22000	0.19	0.09		
*	06/22/82	13:38	10400	0.29	0.13		
*	08/03/82	12:30	7400	0.46	0.24		
*	10/25/82	13:40	1100	2.4	2.6	2.4	
*	01/18/83	12:50	1320	1.8	1.6	1.3	
*	03/01/83	12:10	3870	0.9	0.47	0.31	
*	04/20/83	09:10	951	1.9	1.8	1.2	
*	06/07/83	12:15	2390	1.6	1.3	1	
*	09/07/83	10:45	1045	1.1	1	1.2	
*	11/29/83	11:45	2940	2.3	1.4	1.4	
*	01/10/84	12:00	813	3.6	3.5	3.8	
*	03/27/84	11:40	10400	0.57	0.17	0.1	
*	05/08/84	11:55	1060	0.92	0.9	0.87	
*	06/19/84	14:50	654	3.3	3	0.89	
*	09/17/84	13:00	566	4.5	4.4	4.2	
*	10/17/84	15:20	1560	1.2	0.65	0.62	
*	01/08/85	17:30	2270	1.7	1.4	1.2	
*	02/13/85	14:30	1160	2.1	2	1.9	
*	03/14/85	17:00	8860	0.8	0.4	0.3	
*	06/25/85	19:00	1380	0.93	0.62	0.67	
*	09/17/85	16:30	2890	2.7	0.43	0.35	

TABLE C-2

TRI-PHOS.WR1
03/27/91 kg1
307-1000

TWC STATEWIDE MONITORING NETWORK
AND USGS WQ PARAMETERS
(WITH USGS FLOWS)
PHOSPHOROUS
PERIOD OF RECORD: 1980 - 1989

			PARAMETER DESIGNATION P-1	P-2	P-3	P-4
DATE	TIME	FLOW INSTAN-TANEOUS (cfs)	PHOSPHOROUS TOTAL (MG/L AS P)	PHOSPHOROUS DISSOLVED (MG/L AS P)	PHOSPHOROUS ORTHO, DISSOLVED (MG/L AS P)	PHOSPHATE, ORTHO, DISSOLVED (MG/L AS PO4)
* 11/13/85	08:00	1400	2.6	2.7	2.2	6.7
* 01/29/86	08:30	1440	3.3	3.2	3.2	9.8
* 04/15/86	10:15	6800	0.49	0.29	0.25	0.77
* 06/17/86	09:45	14300	0.21	0.16	0.15	0.46
* 07/22/86	10:00	1260	0.81	0.64	0.64	2
* 09/09/86	09:45	2420	1.3	1.2	1.1	3.4
* 11/12/86	12:30	2030	3.1	2.4	2.2	6.7
* 01/21/87	08:10	6420	0.62	0.42	0.37	1.1
* 04/14/87	10:00	3580	0.82	0.53	0.56	1.7
* 06/09/87	10:10	8450	0.52	0.3	0.26	0.8
* 07/14/87	10:15	2300	0.84	0.83	0.64	2
* 09/01/87	09:50	790	2.4	2.5	2	6.1
* 11/03/87	11:00	635	4	4	3.9	12
* 01/05/88	10:00	1310	1.9	1.6	1.3	4
* 03/29/88	10:20	895	2.9	2.9	2.5	7.7
* 06/07/88	12:10	1210	0.79	0.74	0.68	2.1
* 07/12/88	12:30	946	2.8	2.5	2.3	7.1
* 09/07/88	10:50	1060	0.89	0.84	0.77	2.4
* 11/16/88	10:00	614	5	4.9	4.3	13
* 01/11/89	10:30	740	4.2	4.1	4.2	13
* 04/13/89	10:00	4210	0.85	0.74	0.67	2.1
* 06/14/89	10:30	35800	0.11	0.09	0.07	0.21
* 07/18/89	11:00	12200	0.7	0.17	0.14	0.43
* 08/29/89	11:00	1760	0.97	0.94	0.93	2.9

* WQ data obtained from USGS WRD Reports

I.B.1. TOTAL PHOSPHOROUS

P1_QINT.WR1 TABLE C-3
03/27/91 kgl
307-1000

STATISTICAL ANALYSIS OF
TOTAL PHOSPHORUS CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

DATE	STREAMFLOW (cfs)	x TOTAL PHOSPHORUS CONCENTRATION (mg/l)	y=ln(x) NATURAL LOG OF TOTAL PHOSPHORUS ln(mg/l)
--07/15/80	490	5.3	1.668
08/20/80	496	6	1.792
11/05/80	558	4	1.386
01/09/80	560	4.4	1.482
02/18/81	562	2.5	0.916
08/10/81	562	3.6	1.281
09/17/84	566	4.5	1.504
01/21/81	612	4.7	1.548
11/16/88	614	5	1.609
12/08/80	626	4.8	1.569
11/03/87	635	4	1.386
04/13/81	641	4.3	1.459
06/19/84	654	3.3	1.194
09/11/80	667	6.1	1.808
09/08/81	727	1.3	0.262
01/11/89	740	4.2	1.435
06/03/80	753	4.5	1.504
09/01/87	790	2.4	0.875
01/10/84	813	3.6	1.281
04/23/80	815	2.6	0.956
03/29/88	895	2.9	1.065
05/07/81	909	2.4	0.875
07/12/88	946	2.8	1.030
04/20/83	951	1.9	0.642
03/19/80	983	2.3	0.833
--10/21/80	1000	1.6	0.470
05/13/80	1040	2.3	0.833
09/07/83	1045	1.1	0.095
05/08/84	1060	0.92	-0.083
09/07/88	1060	0.89	-0.117
10/25/82	1100	2.4	0.875
02/13/85	1160	2.1	0.742
06/07/88	1210	0.79	-0.236
07/22/86	1260	0.81	-0.211
01/05/88	1310	1.9	0.642
01/18/83	1320	1.8	0.588
06/25/85	1380	0.93	-0.073
11/13/85	1400	2.6	0.956
01/29/86	1440	3.3	1.194
10/17/84	1560	1.2	0.182
08/29/89	1760	0.97	-0.030
11/12/86	2030	3.1	1.131
01/08/85	2270	1.7	0.531
07/14/87	2300	0.84	-0.174
06/07/83	2390	1.6	0.470
09/09/86	2420	1.3	0.262

P1_QINT.WR1 TABLE C-3
03/27/91 kgl
307-1000

STATISTICAL ANALYSIS OF TOTAL PHOSPHORUS CONCENTRATIONS IN TRINITY RIVER AT TRINIDAD

DATE	STREAMFLOW (cfs)	x TOTAL PHOSPHORUS CONCENTRATION (mg/l)	y=ln(x) NATURAL LOG OF TOTAL PHOSPHORUS ln(mg/l)
03/10/81	2700	2.9	1.065
09/17/85	2890	2.7	0.993
--11/29/83	2940	2.3	0.833
04/14/87	3580	0.82	-0.198
03/01/83	3870	0.9	-0.105
04/13/89	4210	0.85	-0.163
--02/12/80	4380	0.81	-0.211
01/19/82	6320	0.32	-1.139
01/21/87	6420	0.62	-0.478
04/15/86	6800	0.49	-0.713
08/03/82	7400	0.46	-0.777
06/09/87	8450	0.52	-0.654
03/14/85	8860	0.8	-0.223
03/02/82	9030	0.3	-1.204
03/27/84	10400	0.57	-0.562
06/22/82	10400	0.29	-1.238
07/08/81	10500	0.25	-1.386
07/18/89	12200	0.7	-0.357
--06/17/86	14300	0.21	-1.561
06/10/81	21100	0.39	-0.942
05/18/82	22000	0.19	-1.661
11/09/81	35000	0.17	-1.772
06/14/89	35800	0.11	-2.207

Xbar =	2.10 mg/l	0.36	= Ybar
Xmax =	6.10 mg/l	0.98	= Sy
Xmin =	0.11 mg/l	0.97	= Sy^2
std	1.599		

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(X)	= exp[Ybar + (Sy^2)/2] =	2.323
VAR(X)	= Xbar^2 * [exp(Sy^2) - 1] =	7.235
STD(X)	= SQRT[VAR(X)] =	2.690
CV(X)	= SQRT[exp(Sy^2) - 1] =	1.278

E(X) + STD(X) =	5.012 mg/l
E(X) =	2.32 mg/l
E(X) - STD(X) =	0.00 mg/l

Number of data points-> 69

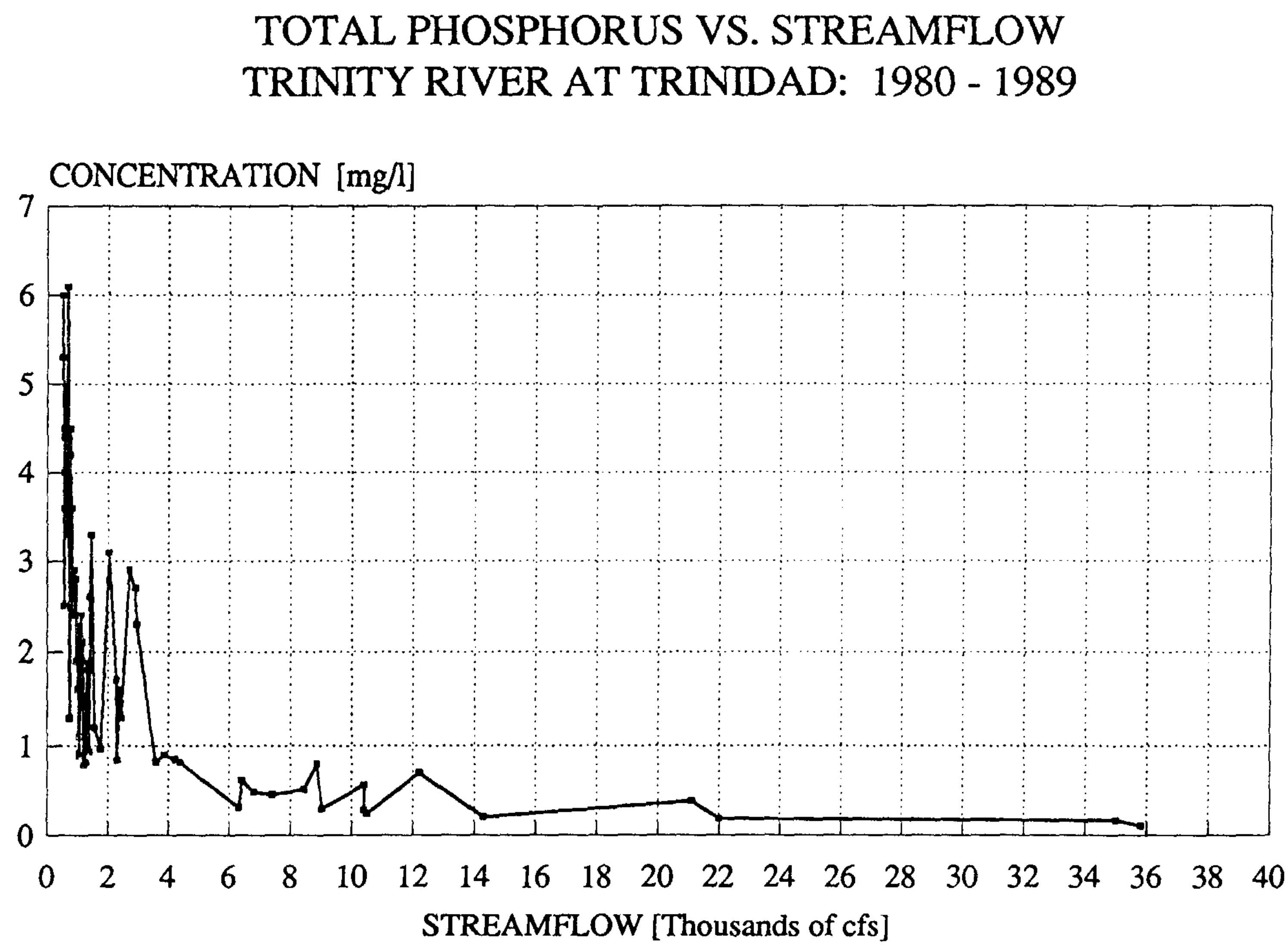

TOTAL PHOSPHORUS VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
7
6
5
4
3
2
1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
STREAMFLOW [Thousands of cfs]

FIGURE C-1

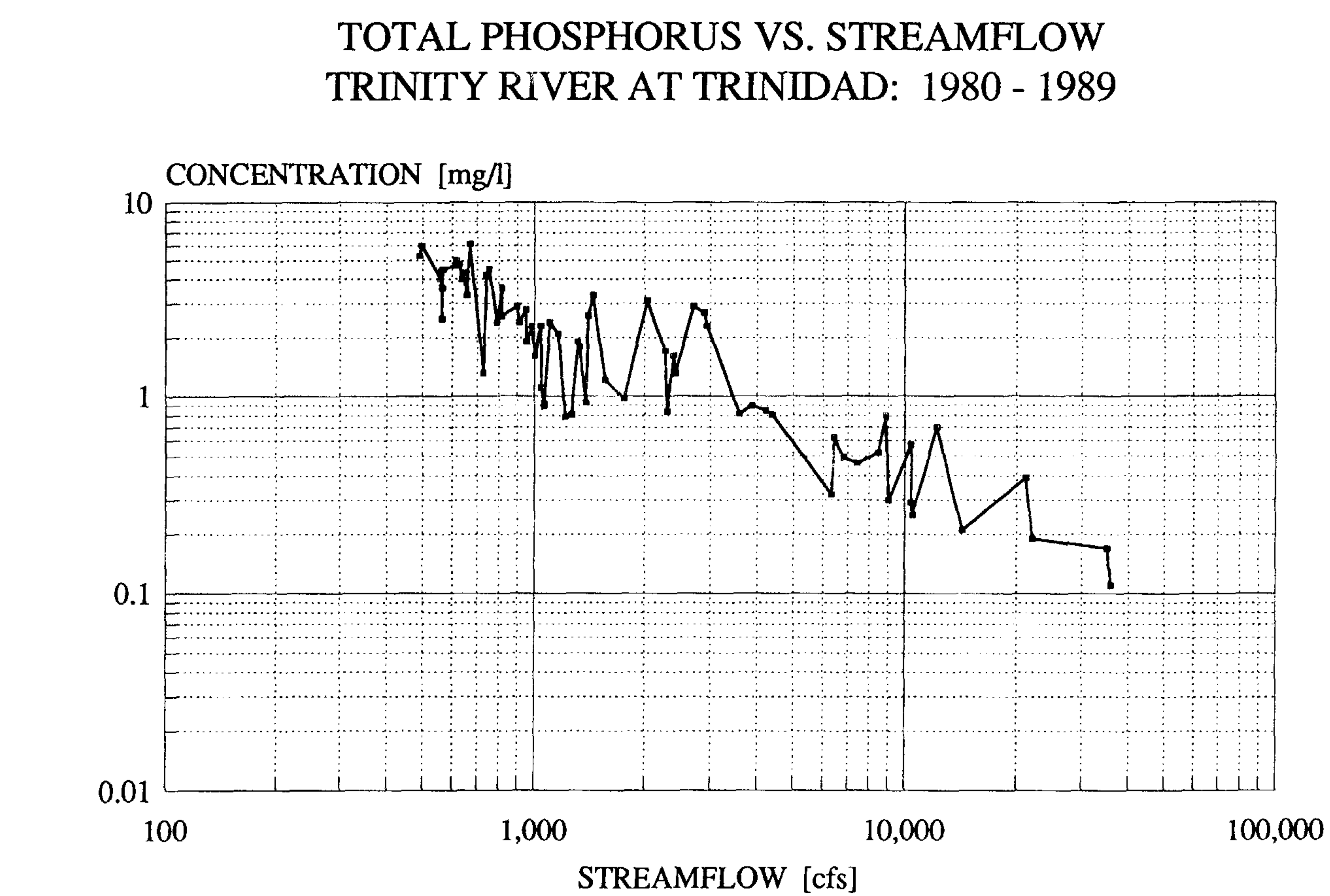

TOTAL PHOSPHORUS VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
10
1
0.1
0.01
100
1,000
10,000
100,000
STREAMFLOW [cfs]

FIGURE C-2

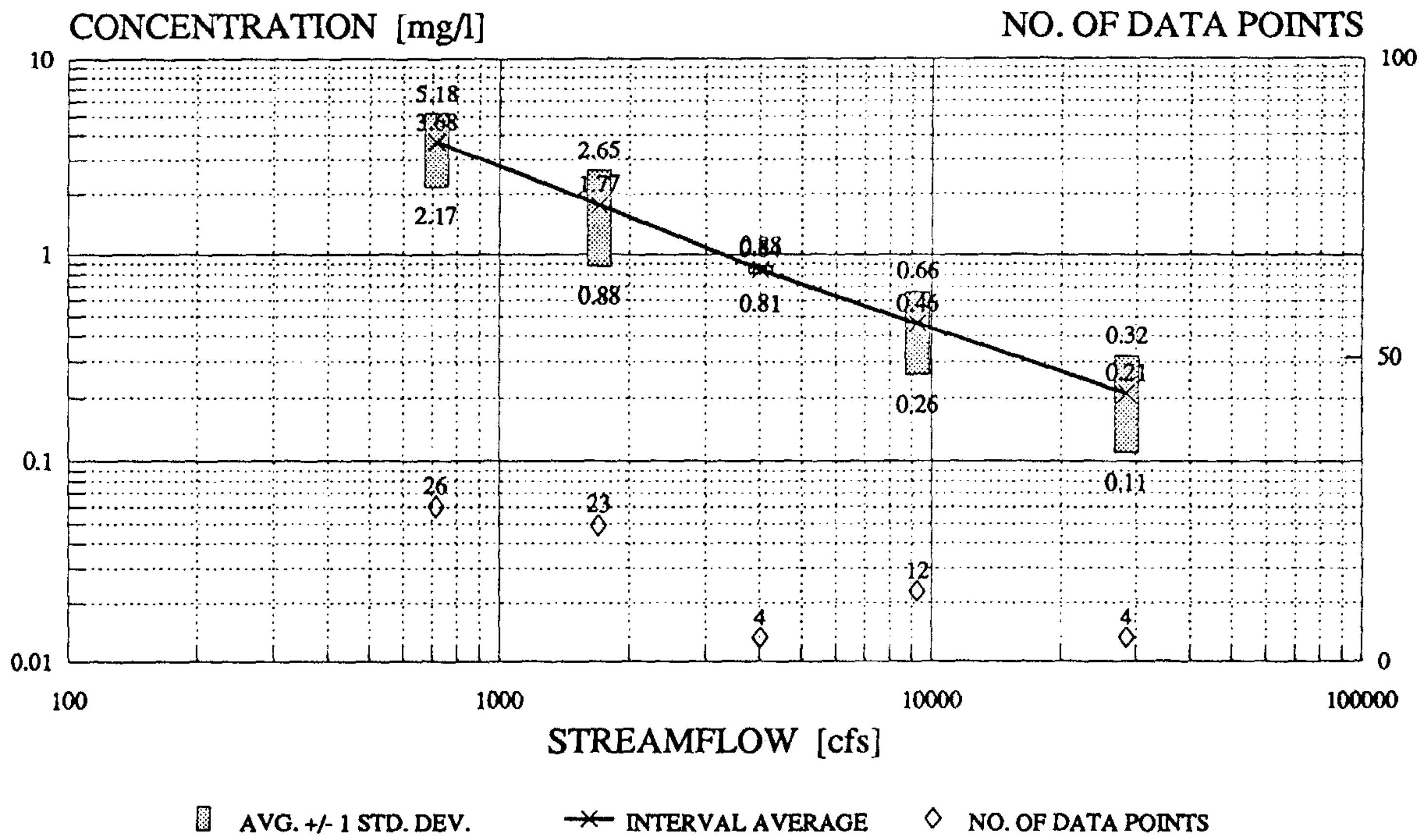
P1_QINT.WR1
03/27/91 kgl
307-1000

TABLE C-4

STATISTICAL ANALYSIS OF
TOTAL PHOSPHORUS CONCENTRATIONS IN
TRINITY RIVER BY STREAMFLOW INTERVAL

	STREAMFLOW INTERVAL (cfs)									
	0 - 1000		1000 - 3000		3000 - 6000		6000 - 20,000		> 20,000	
AVERAGE STREAMFLOW (cfs)	714		1698		4010		9257		28475	
	x1	y1	x2	y2	x3	y3	x4	y4	x5	y5
NO. OF DATA POINTS	26.00		23.00		4.00		12.00		4.00	
AVERAGE (mg/L)	3.65	1.22	1.76	0.46	0.85	-0.17	0.46	-0.86	0.22	-1.65
MAXIMUM (mg/L)	6.10		3.30		0.90		0.80		0.39	
MINIMUM (mg/L)	1.30		0.79		0.81		0.21		0.11	
STANDARD DEVIATION (mg/L)	1.29	0.40	0.80	0.48	0.03	0.04	0.18	0.42	0.11	0.45
COEFFICIENT OF VARIATION	0.35		0.45		0.04		0.39		0.49	
VARIANCE		0.16		0.23		0.00		0.17		0.21
E(X), mg/L = exp[Ybar + (Sy^2)/2] =		3.68		1.77		0.84		0.46		0.21
VAR(X), mg/L = Xbar^2 * [exp(Sy^2) - 1] =		2.26		0.79		0.00		0.04		0.01
STD(X), mg/L = SQRT[VAR(X)] =		1.50		0.89		0.03		0.20		0.10
CV(X), mg/L = SQRT[exp(Sy^2) - 1] =		0.412		0.504		0.041		0.434		0.479
E(X) + 1*STD(X), mg/L =		5.18		2.65		0.88		0.66		0.32
E(X), mg/L =		3.68		1.77		0.84		0.46		0.21
E(X) - 1*STD(X), mg/L =		2.17		0.88		0.81		0.26		0.11
AVERAGE DAILY LOAD, lbs =		14,158		16,153		18,263		23,070		32,838

TOTAL PHOSPHOROUS CONCENTRATION BY STREAMFLOW INTERVAL CLASS TRINITY RIVER AT TRINIDAD: 1980 - 1989



USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-3

I.B.2. DISSOLVED PHOSPHOROUS

P2_QINT.WR1 TABLE C-5
03/27/91 kgl
307-1000

STATISTICAL ANALYSIS OF
DISSOLVED PHOSPHOROUS CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

DATE	STREAMFLOW (cfs)	x DISSOLVED PHOSPHOROUS CONCENTRATION (mg/l)	y=ln(x) NATURAL LOG OF DISSOLVED PHOSPHOROUS ln(mg/l)
--07/15/80	490	3.7	1.308
08/20/80	496	6	1.792
11/05/80	558	3.7	1.308
01/09/80	560	3.9	1.361
02/18/81	562	3.5	1.253
08/10/81	562	3.4	1.224
09/17/84	566	4.4	1.482
01/21/81	612	4.6	1.526
11/16/88	614	4.9	1.589
12/08/80	626	4.7	1.548
11/03/87	635	4	1.386
04/13/81	641	4	1.386
06/19/84	654	3	1.099
09/11/80	667	5.1	1.629
09/08/81	727	1.2	0.182
01/11/89	740	4.1	1.411
06/03/80	753	3.2	1.163
09/01/87	790	2.5	0.916
01/10/84	813	3.5	1.253
04/23/80	815	2.1	0.742
03/29/88	895	2.9	1.065
05/07/81	909	2.3	0.833
07/12/88	946	2.5	0.916
04/20/83	951	1.8	0.588
03/19/80	983	2	0.693
--10/21/80	1000	0.88	-0.128
05/13/80	1040	1.9	0.642
09/07/83	1045	1	0.000
05/08/84	1060	0.9	-0.105
09/07/88	1060	0.84	-0.174
10/25/82	1100	2.6	0.956
02/13/85	1160	2	0.693
06/07/88	1210	0.74	-0.301
07/22/86	1260	0.64	-0.446
01/05/88	1310	1.6	0.470
01/18/83	1320	1.6	0.470
06/25/85	1380	0.62	-0.478
11/13/85	1400	2.7	0.993
01/29/86	1440	3.2	1.163
10/17/84	1560	0.65	-0.431
08/29/89	1760	0.94	-0.062
11/12/86	2030	2.4	0.875
01/08/85	2270	1.4	0.336
07/14/87	2300	0.83	-0.186
06/07/83	2390	1.3	0.262
09/09/86	2420	1.2	0.182

P2_QINT.WR1 TABLE C-5
03/27/91 kgl
307-1000

STATISTICAL ANALYSIS OF
DISSOLVED PHOSPHOROUS CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

		x	y=ln(x)
DATE	STREAMFLOW	DISSOLVED PHOSPHOROUS CONCENTRATION	NATURAL LOG OF DISSOLVED PHOSPHOROUS
	(cfs)	(mg/l)	ln(mg/l)
03/10/81	2700	1.5	0.405
09/17/85	2890	0.43	-0.844
--11/29/83	2940	1.4	0.336
04/14/87	3580	0.53	-0.635
03/01/83	3870	0.47	-0.755
04/13/89	4210	0.74	-0.301
--02/12/80	4380	0.47	-0.755
01/19/82	6320	0.28	-1.273
01/21/87	6420	0.42	-0.868
04/15/86	6800	0.29	-1.238
08/03/82	7400	0.24	-1.427
06/09/87	8450	0.3	-1.204
03/14/85	8860	0.4	-0.916
03/02/82	9030	0.24	-1.427
06/22/82	10400	0.13	-2.040
03/27/84	10400	0.17	-1.772
07/08/81	10500	0.18	-1.715
07/18/89	12200	0.17	-1.772
--06/17/86	14300	0.16	-1.833
06/10/81	21100	0.31	-1.171
05/18/82	22000	0.09	-2.408
11/09/81	35000	0.17	-1.772
06/14/89	35800	0.09	-2.408

Xbar =	1.83 mg/l	0.096 = Ybar
Xmax =	6.00 mg/l	1.142 = Sy
Xmin =	0.09 mg/l	1.305 = Sy^2
std	1.547	

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(X)	= exp[Ybar + (Sy^2)/2] =	2.112 mg/l
VAR(X)	= Xbar^2 * [exp(Sy^2) - 1] =	8.973
STD(X)	= SQRT[VAR(X)] =	2.996 mg/l
CV(X)	= SQRT[exp(Sy^2) - 1] =	1.639

E(X) + STD(X) =	5.107 mg/l
E(X) =	2.11 mg/l
E(X) - STD(X) =	0.00 mg/l

Number of data points-> 69

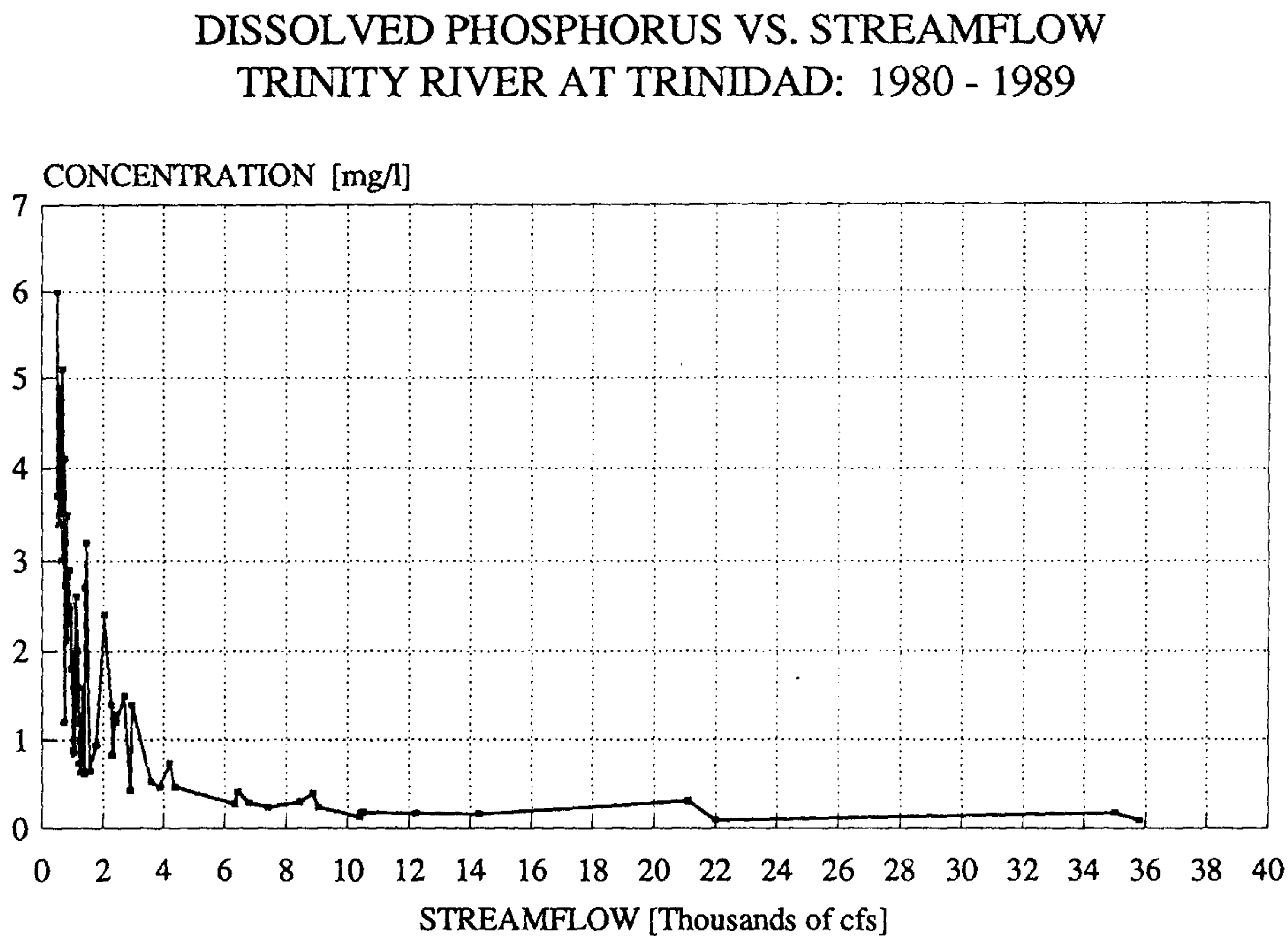

DISSOLVED PHOSPHORUS VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
0
1
2
3
4
5
6
7
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
STREAMFLOW [Thousands of cfs]

FIGURE C-4

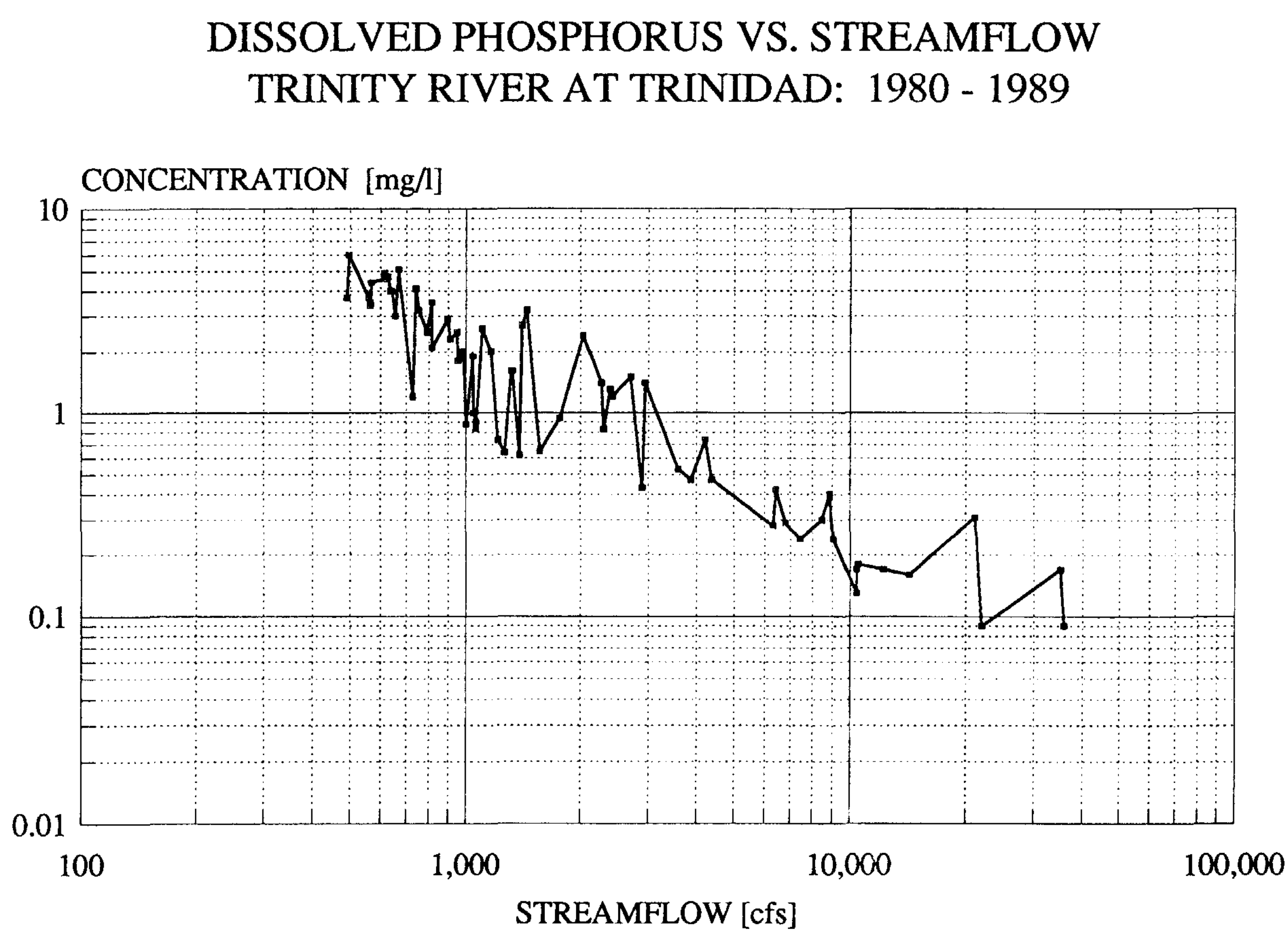

DISSOLVED PHOSPHORUS VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
10
1
0.1
0.01
100
1,000
10,000
100,000
STREAMFLOW [cfs]

FIGURE C-5

P2_QINT.WR1
03/27/91 kgl
307-1000

TABLE C-6

STATISTICAL ANALYSIS OF
DISSOLVED PHOSPHORUS CONCENTRATIONS IN
TRINITY RIVER BY STREAMFLOW INTERVAL

	STREAMFLOW INTERVAL (cfs)									
	0 - 1000		1000 - 3000		3000 - 6000		6000 - 20,000		> 20,000	
AVERAGE STREAMFLOW (cfs)	714		1698		4010		9257		28,475	
	x1	y1	x2	y2	x3	y3	x4	y4	x5	y5
NO. OF DATA POINTS	26		23		4		12		4	
AVERAGE (mg/L)	3.38	1.136	1.41	0.21	0.55	-0.61	0.25	-1.46	0.17	-1.94
MAXIMUM (mg/L)	6.00		3.20		0.74		0.42		0.31	
MINIMUM (mg/L)	0.88		0.43		0.47		0.13		0.09	
STANDARD DEVIATION (mg/L)	1.21	0.439	0.74	0.53	0.11	0.19	0.09	0.36	0.09	0.51
COEFFICIENT OF VARIATION	0.359		0.524		0.201		0.362		0.545	
VARIANCE		0.193		0.276		0.035		0.128		0.264
E(X), (mg/L) = exp[Ybar + (Sy^2)/2] =		3.43		1.41		0.55		0.25		0.16
VAR(X), (mg/L) = Xbar^2 * [exp(Sy^2) - 1] =		2.43		0.63		0.01		0.01		0.01
STD(X), (mg/L) = SQRT[VAR(X)] =		1.56		0.79		0.10		0.09		0.09
CV(X) = SQRT[exp(Sy^2) - 1] =		0.461		0.564		0.187		0.369		0.550
E(X) + 1*STD(X), (mg/L) =		4.99		2.21		0.66		0.34		0.25
E(X), (mg/L) =		3.43		1.41		0.55		0.25		0.16
E(X) - 1*STD(X), (mg/L) =		1.87		0.62		0.45		0.16		0.07
AVERAGE DAILY LOAD, lbs =		13,195		12,921		11,930		12,388		25,178

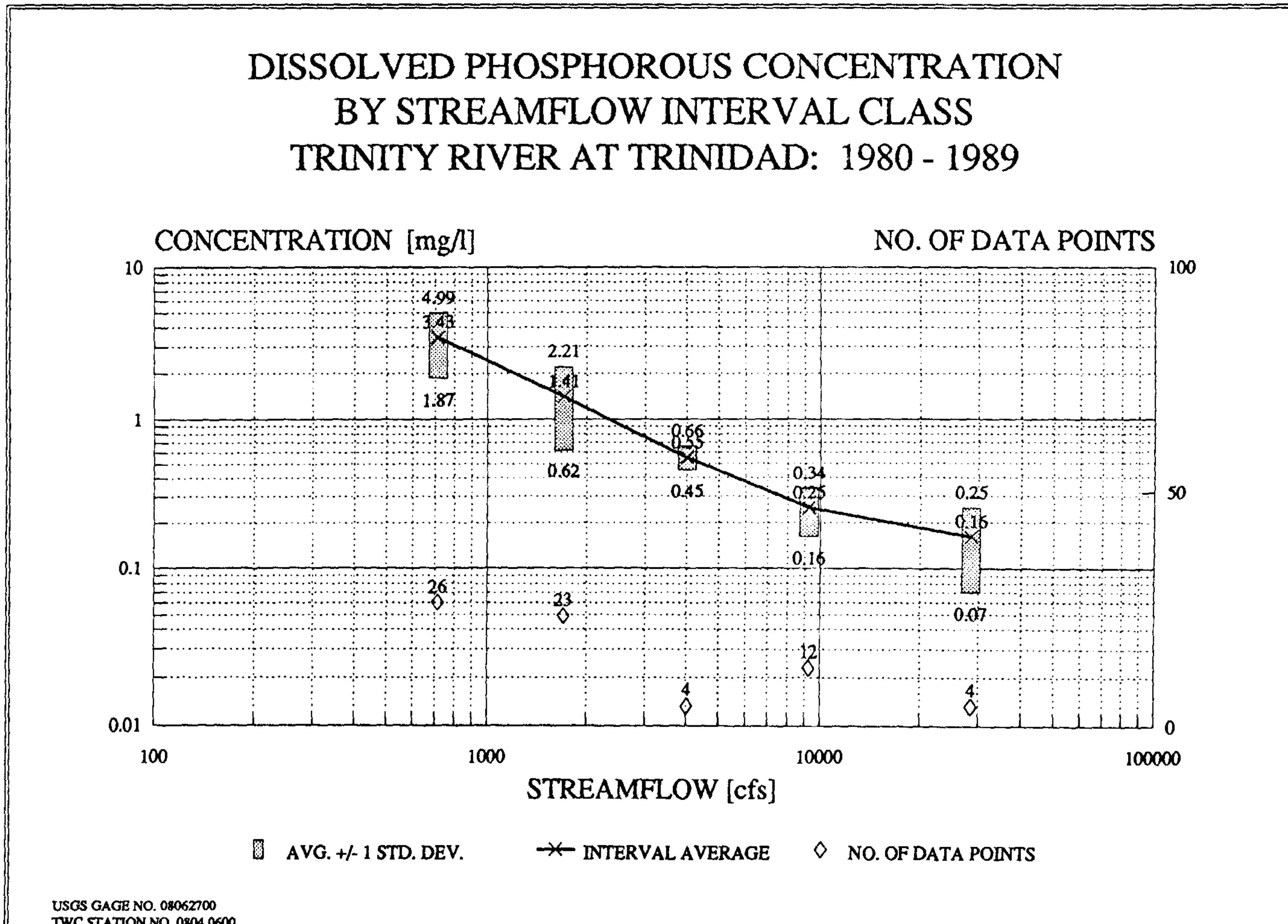

DISSOLVED PHOSPHOROUS CONCENTRATION
BY STREAMFLOW INTERVAL CLASS
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
NO. OF DATA POINTS
10
1
0.1
0.01
100
50
0
4.99
3.43
1.87
2.21
1.41
0.62
0.66
0.55
0.45
0.34
0.25
0.16
0.25
0.16
0.07
26
23
4
12
4
100
1000
10000
100000
STREAMFLOW [cfs]
AVG. +/- 1 STD. DEV.
INTERVAL AVERAGE
NO. OF DATA POINTS
USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-6

I.B.3. DISSOLVED ORTHO PHOSPHOROUS

P3_QINT.WR1 TABLE C-7
03/27/91 kgl
307-1000

STATISTICAL ANALYSIS OF
DISSOLVED ORTHOPHOSPHORUS CONC'NS
IN TRINITY RIVER AT TRINIDAD

		x	y=ln(x)
DATE	STREAMFLOW (cfs)	TOTAL ORTHO PHOSPHORUS CONCENTRATION (mg/l)	NATURAL LOG OF ORTHO PHOSPHORUS ln(mg/l)
--09/17/84	566	4.2	1.435
11/16/88	614	4.3	1.459
11/03/87	635	3.9	1.361
06/19/84	654	0.89	-0.117
01/11/89	740	4.2	1.435
09/01/87	790	2	0.693
01/10/84	813	3.8	1.335
03/29/88	895	2.5	0.916
07/12/88	946	2.3	0.833
--04/20/83	951	1.2	0.182
09/07/83	1045	1.2	0.182
05/08/84	1060	0.87	-0.139
09/07/88	1060	0.77	-0.261
10/25/82	1100	2.4	0.875
02/13/85	1160	1.9	0.642
06/07/88	1210	0.68	-0.386
07/22/86	1260	0.64	-0.446
01/05/88	1310	1.3	0.262
01/18/83	1320	1.3	0.262
06/25/85	1380	0.67	-0.400
11/13/85	1400	2.2	0.788
01/29/86	1440	3.2	1.163
10/17/84	1560	0.62	-0.478
08/29/89	1760	0.93	-0.073
11/12/86	2030	2.2	0.788
01/08/85	2270	1.2	0.182
07/14/87	2300	0.64	-0.446
06/07/83	2390	1	0.000
09/09/86	2420	1.1	0.095
09/17/85	2890	0.35	-1.050
--11/29/83	2940	1.4	0.336
04/14/87	3580	0.56	-0.580
03/01/83	3870	0.31	-1.171
--04/13/89	4210	0.67	-0.400
01/21/87	6420	0.37	-0.994
04/15/86	6800	0.25	-1.386
06/09/87	8450	0.26	-1.347
03/14/85	8860	0.3	-1.204
03/27/84	10400	0.1	-2.303
07/18/89	12200	0.14	-1.966
--06/17/86	14300	0.15	-1.897
06/14/89	35800	0.07	-2.659
Xbar =		1.41 mg/l	-0.107 = Ybar
Xmax =		4.30 mg/l	1.042 = Sy
Xmin =		0.07 mg/l	1.085 = Sy^2
std		1.231	

TABLE C-7

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(X)	= exp[Ybar + (Sy^2)/2]	=	1.547 mg/l
VAR(X)	= Xbar^2 * [exp(Sy^2) - 1]	=	3.873
STD(X)	= SQRT[VAR(X)]	=	1.968 mg/l
CV(X)	= SQRT[exp(Sy^2) - 1]	=	1.400

E(X) =	1.55 mg/l
E(X) + STD(X) =	3.51
E(X) - STD(X) =	0.00 mg/l

Number of data points-> 42

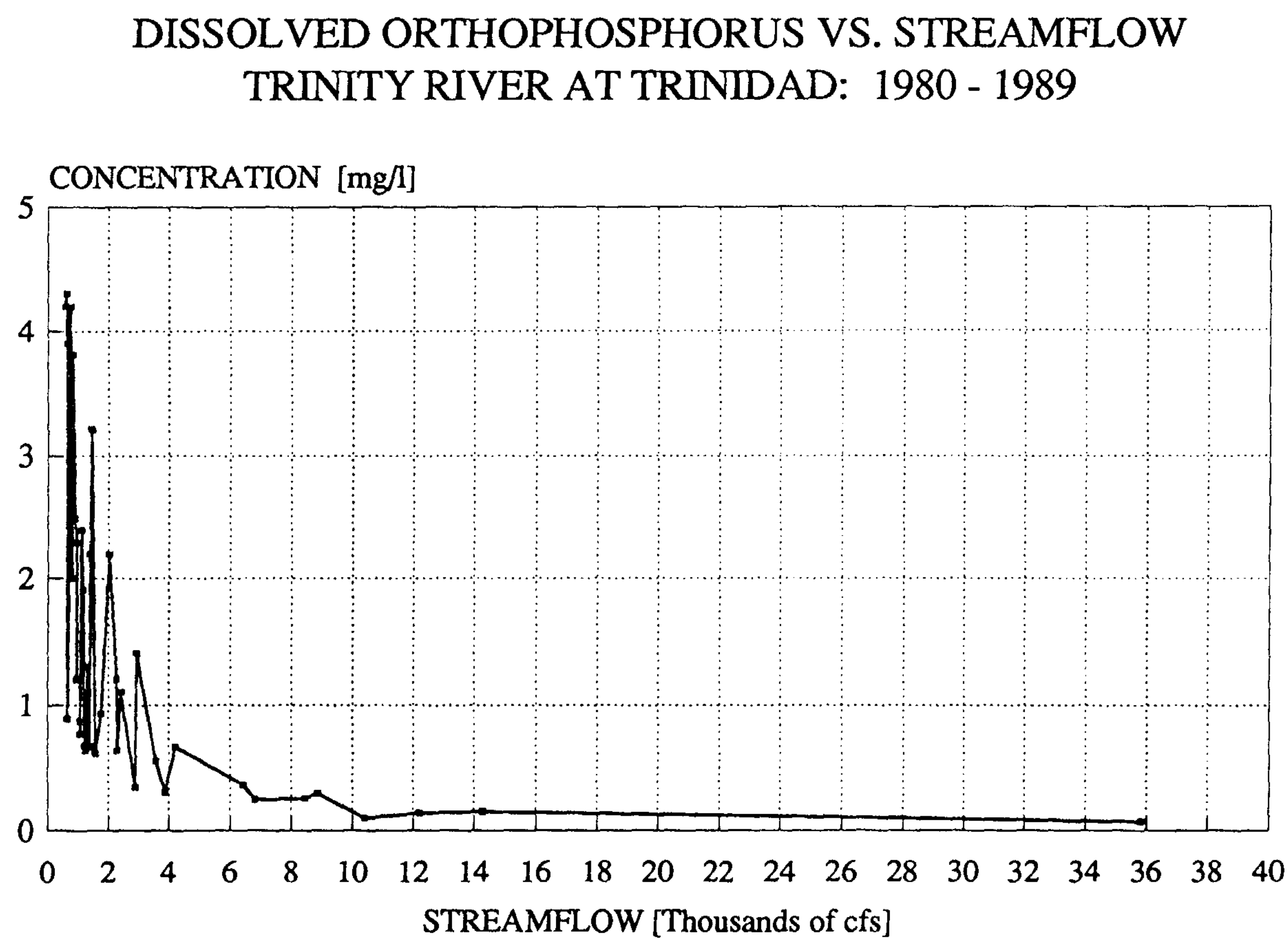

DISSOLVED ORTHOPHOSPHORUS VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
5
4
3
2
1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
STREAMFLOW [Thousands of cfs]

FIGURE C-7

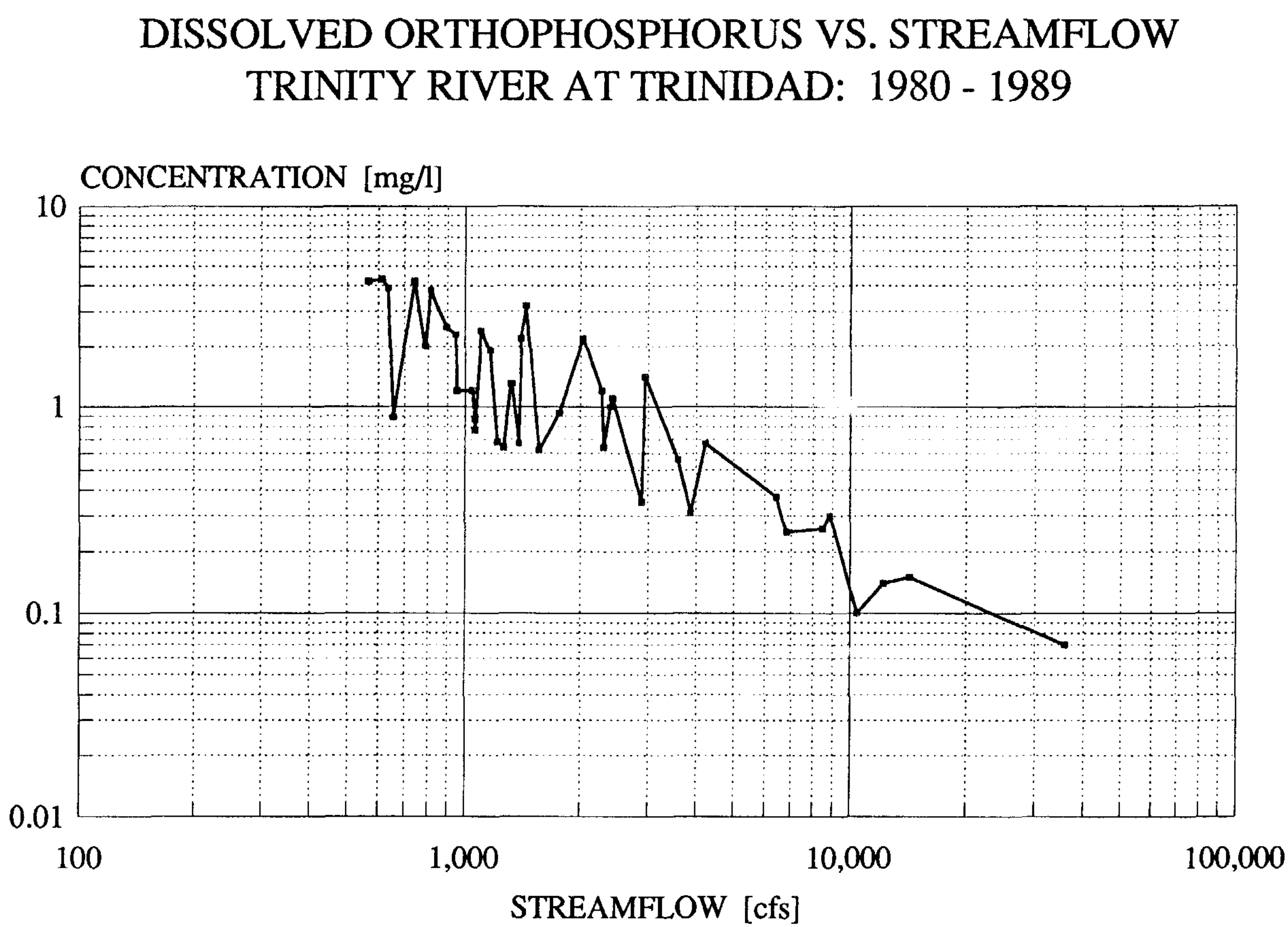

DISSOLVED ORTHOPHOSPHORUS VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
10
1
0.1
0.01
100
1,000
10,000
100,000
STREAMFLOW [cfs]

FIGURE C-8

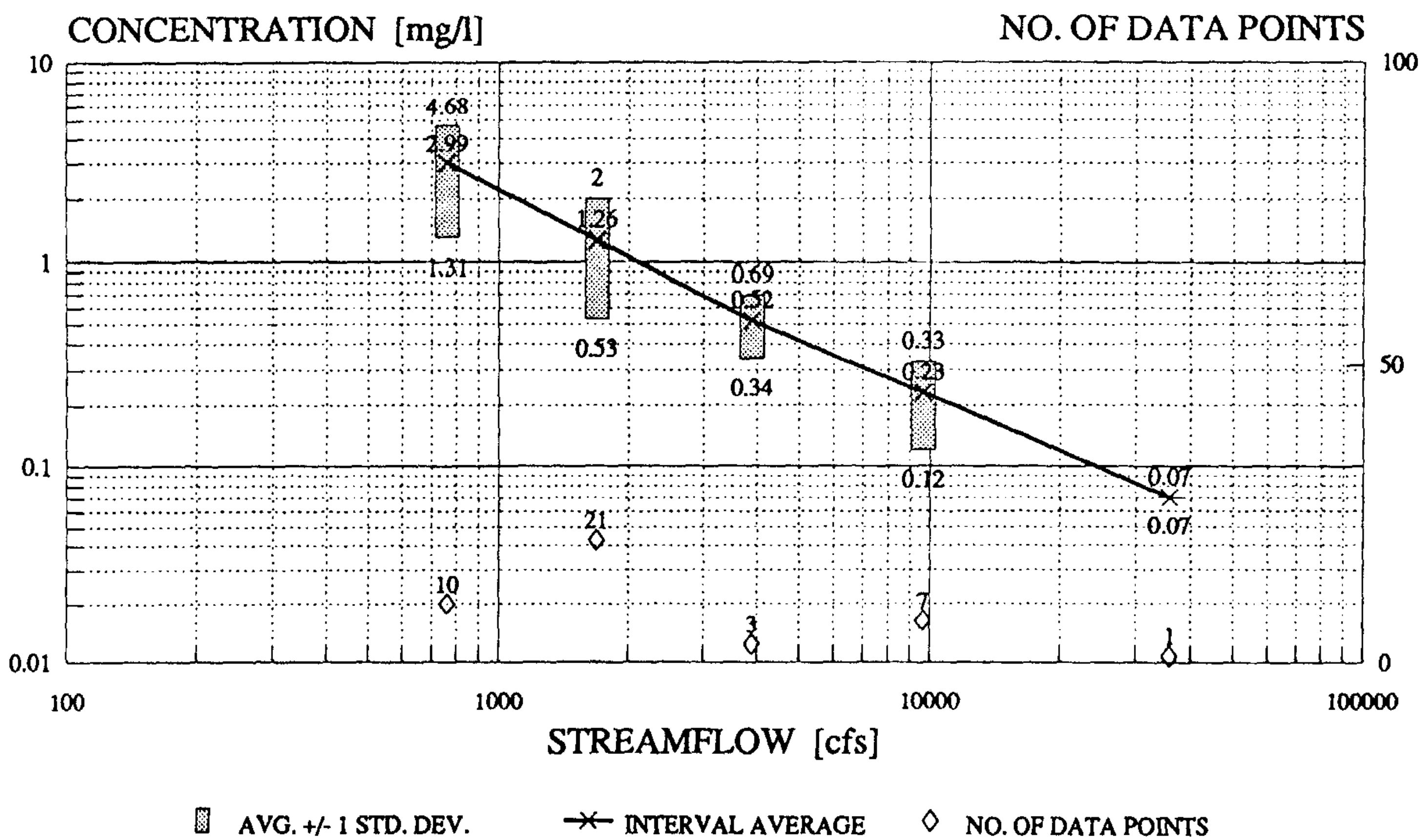
P3_QINT.WR1
03/27/91 kgl
307-1000

TABLE C-8

STATISTICAL ANALYSIS OF
DISSOLVED ORTHOPHOSPHORUS CONC'NS IN
TRINITY RIVER BY STREAMFLOW INTERVAL

	STREAMFLOW INTERVAL (cfs)									
	0 - 1000		1000 - 3000		3000 - 6000		6000 - 20,000		> 20,000	
AVERAGE STREAMFLOW (cfs)	760		1681		3887		9633		35800	
	x1	y1	x2	y2	x3	y3	x4	y4	x5	y5
NO. OF DATA POINTS	10		21		3		7		1	
AVERAGE (mg/L)	2.93	0.95	1.27	0.09	0.51	-0.72	0.22	-1.59	0.07	-2.66
MAXIMUM (mg/L)	4.30		3.20		0.67		0.37		0.07	
MINIMUM (mg/L)	0.89		0.35		0.31		0.10		0.07	
STANDARD DEVIATION (mg/L)	1.24	0.53	0.71	0.54	0.15	0.33	0.09	0.44	N/A	N/A
COEFFICIENT OF VARIATION	0.42		0.56		0.29		0.40		N/A	
VARIANCE		0.29		0.29		0.11		0.19		N/A
E(X), (mg/L) = exp[Ybar + (Sy^2)/2] =		2.99		1.26		0.52		0.23		N/A
VAR(X), (mg/L) = Xbar^2 * [exp(Sy^2) - 1] =		2.83		0.54		0.03		0.01		N/A
STD(X), (mg/L) = SQRT[VAR(X)] =		1.68		0.73		0.17		0.10		N/A
CV(X) = SQRT[exp(Sy^2) - 1] =		0.575		0.578		0.338		0.461		N/A
E(X) + 1*STD(X), (mg/L) =		4.68		2.00		0.69		0.33		N/A
E(X), (mg/L) =		2.99		1.26		0.52		0.23		0.07
E(X) - 1*STD(X), (mg/L) =		1.31		0.53		0.34		0.12		N/A
AVERAGE DAILY LOAD, lbs =		12,263		11,459		10,796		11,712		13,507

DISSOLVED ORTHOPHOSPHORUS CONC'N BY STREAMFLOW INTERVAL CLASS TRINITY RIVER AT TRINIDAD: 1980 - 1989



USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-9

I.B.4. DISSOLVED ORTHO PHOSPATE

P4_QINT.WR1
03/27/91 kgl
307-1000

TABLE C-9

STATISTICAL ANALYSIS OF
DISSOLVED ORTHOPHOSPHATE CONC'NS
IN TRINITY RIVER AT TRINIDAD

DATE	STREAMFLOW (cfs)	x: TOTAL ORTHO PHOSPHATE CONCENTRATION (mg/l)	y=ln(x): NATURAL LOG OF ORTHO PHOSPHATE ln(mg/l)
--11/16/88	614	13	2.565
11/03/87	635	12	2.485
01/11/89	740	13	2.565
09/01/87	790	6.1	1.808
03/29/88	895	7.7	2.041
--07/12/88	946	7.1	1.960
09/07/88	1060	2.4	0.875
06/07/88	1210	2.1	0.742
07/22/86	1260	2	0.693
01/05/88	1310	4	1.386
11/13/85	1400	6.7	1.902
01/29/86	1440	9.8	2.282
08/29/89	1760	2.9	1.065
11/12/86	2030	6.7	1.902
07/14/87	2300	2	0.693
--09/09/86	2420	3.4	1.224
04/14/87	3580	1.7	0.531
--04/13/89	4210	2.1	0.742
01/21/87	6420	1.1	0.095
04/15/86	6800	0.77	-0.261
06/09/87	8450	0.8	-0.223
07/18/89	12200	0.43	-0.844
--06/17/86	14300	0.46	-0.777
06/14/89	35800	0.21	-1.561

Xbar =	4.52 mg/l	0.995 = Ybar
Xmax =	13.00 mg/l	1.133 = Sy
Xmin =	0.21 mg/l	1.284 = Sy^2
std	4.025	

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(X) = exp[Ybar + (Sy^2)/2]	=	5.142 mg/l
VAR(X) = Xbar^2 * [exp(Sy^2) - 1]	=	53.328
STD(X) = SQRT[VAR(X)]	=	7.303 mg/l
CV(X) = SQRT[exp(Sy^2) - 1]	=	1.616

E(X) + STD(X) =	12.44 mg/l
E(X) =	5.14 mg/l
E(X) - STD(X) =	0.00 mg/l

Number of data points -> 24

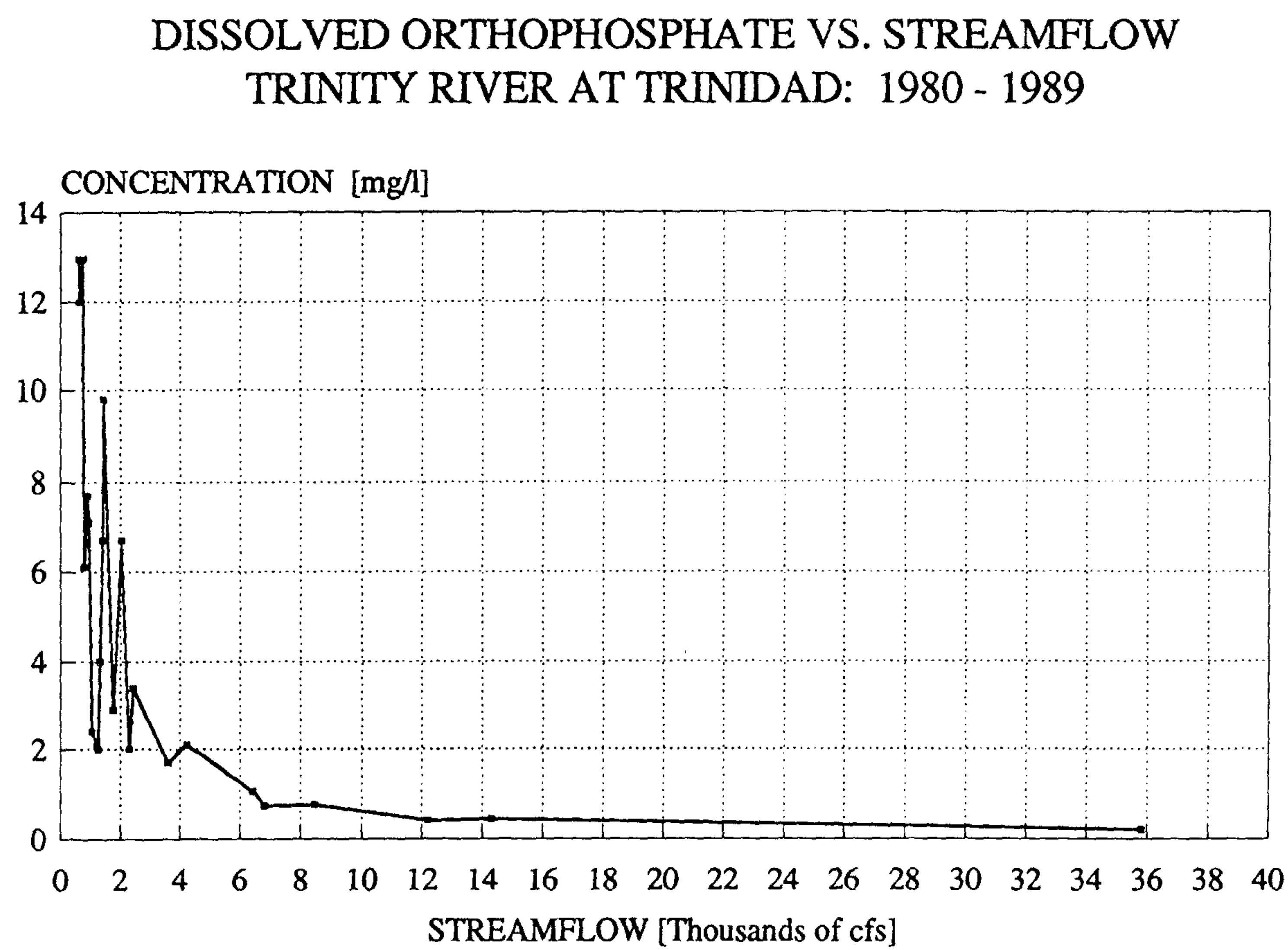

DISSOLVED ORTHOPHOSPHATE VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
14
12
10
8
6
4
2
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
STREAMFLOW [Thousands of cfs]

FIGURE C-10

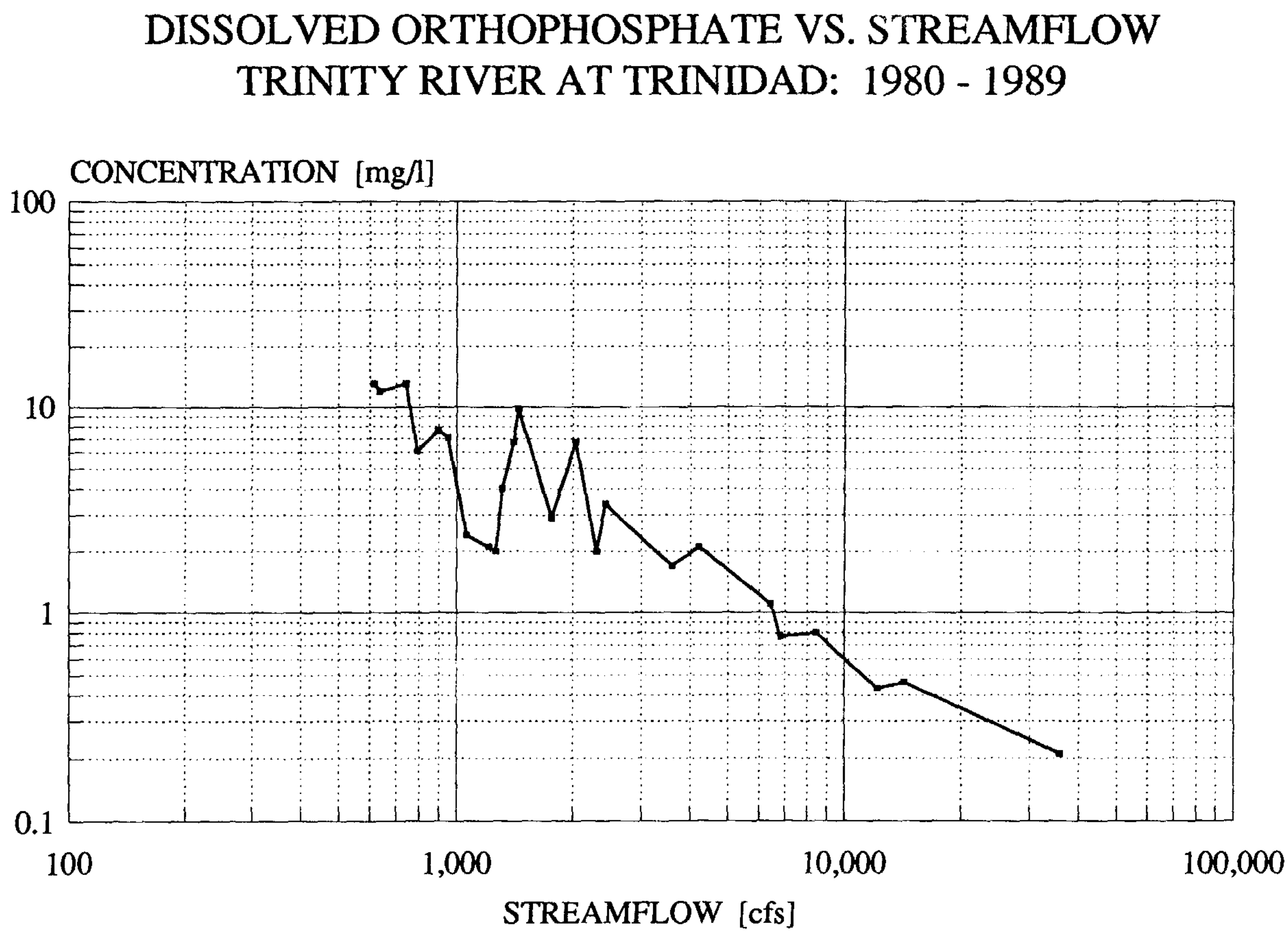

DISSOLVED ORTHOPHOSPHATE VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
100
10
1
0.1
100
1,000
10,000
100,000
STREAMFLOW [cfs]

FIGURE C-11

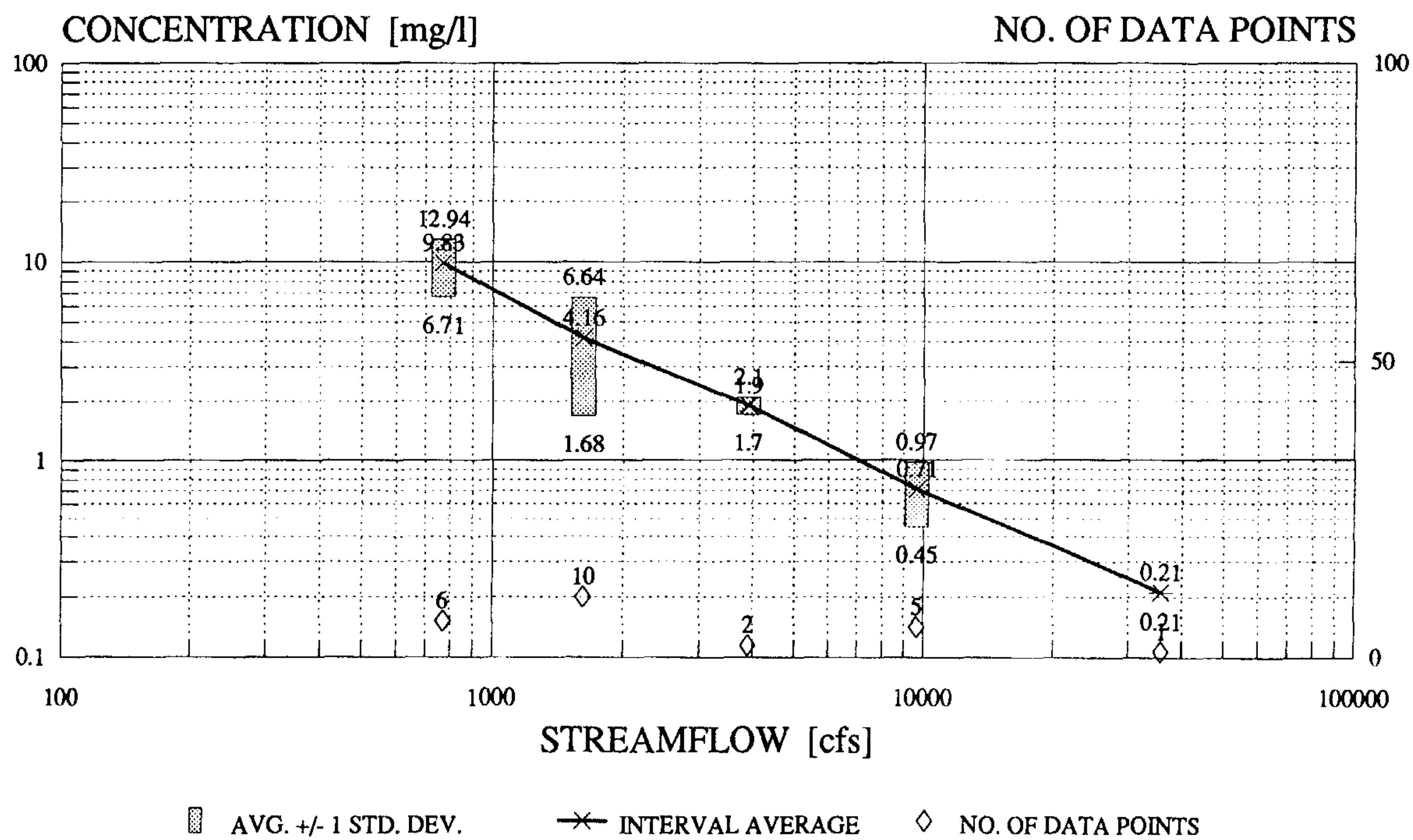
P4_QINT.WR1
03/27/91 kgl
307-1000

TABLE C-10

STATISTICAL ANALYSIS OF
ORTHO PHOSPHATE CONCENTRATIONS IN
TRINITY RIVER BY STREAMFLOW INTERVAL

	STREAMFLOW INTERVAL (cfs)									
	0 - 1000		1000 - 3000		3000 - 6000		6000 - 20,000		> 20,000	
AVERAGE STREAMFLOW (cfs)	770		1619		3895		9634		35800	
	x1	y1	x2	y2	x3	y3	x4	y4	x5	y5
NO. OF DATA POINTS	6		10		2		5		1	
AVERAGE (mg/L)	9.82	2.24	4.20	1.28	1.90	0.64	0.71	-0.40	0.21	-1.56
MAXIMUM (mg/L)	13.00		9.80		2.10		1.10		0.21	
MINIMUM (mg/L)	6.10		2.00		1.70		0.43		0.21	
STANDARD DEVIATION (mg/L)	2.91	0.31	2.52	0.55	0.20	0.11	0.25	0.36	N/A	N/A
COEFFICIENT OF VARIATION	0.30		0.60		0.11		0.35		N/A	
VARIANCE		0.10		0.30		0.01		0.13		N/A
E(X), (mg/L) = exp[Ybar + (Sy^2)/2] =		9.83		4.16		1.90		0.71		N/A
VAR(X), (mg/L) = Xbar^2 * [exp(Sy^2) - 1] =		9.70		6.13		0.04		0.07		N/A
STD(X), (mg/L) = SQRT[VAR(X)] =		3.11		2.48		0.20		0.26		N/A
CV(X), (mg/L) = SQRT[exp(Sy^2) - 1] =		0.317		0.589		0.106		0.368		N/A
E(X) + 1*STD(X), (mg/L) =		12.94		6.64		2.10		0.97		N/A
E(X), (mg/L) =		9.83		4.16		1.90		0.71		0.21
E(X) - 1*STD(X), (mg/L) =		6.71		1.68		1.70		0.45		N/A
AVERAGE DAILY LOAD, lbs =		40,793		36,304		39,888		37,016		40,521

DISSOLVED ORTHOPHOSPHATE CONC'N BY STREAMFLOW INTERVAL CLASS TRINITY RIVER AT TRINIDAD: 1980 - 1989



USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-12

II. NITROGEN

II.A.1. SUMMARY OF ANALYSIS

TABLE C-11

**SUMMARY OF NITROGEN CONCENTRATIONS
BY STREAM FLOW INTERVAL CLASS
TRINITY RIVER AT TRINIDAD: 1980-1989
(all concentrations in mg/L)**

<table>
<tr><th rowspan="2">Nitrogen Form</th><th rowspan="2"></th><th colspan="5">Stream Flow Interval (cfs)</th></tr>
<tr><th>0-1,000</th><th>1,000-
3,000</th><th>3,000-
6,000</th><th>6,000
20,000</th><th>>20,000</th></tr>
<tr><td>Total NO_2+NO_3 nitrogen</td><td>Avg.+1 std. dev.</td><td>7.78</td><td>3.50</td><td colspan="2">0.84</td><td>0.41</td></tr>
<tr><td></td><td>Avg.</td><td>5.36</td><td>3.45</td><td colspan="2">0.77</td><td>0.41</td></tr>
<tr><td></td><td>Avg.-1 std. dev.</td><td>2.95</td><td>3.40</td><td colspan="2">0.69</td><td>0.41</td></tr>
<tr><td>Dissolved NO_2+NO_3 nitrogen</td><td>Avg.+1 std. dev.</td><td>9.51</td><td>4.67</td><td>2.75</td><td>1.28</td><td>0.50</td></tr>
<tr><td></td><td>Avg.</td><td>5.71</td><td>3.50</td><td>1.71</td><td>0.97</td><td>0.43</td></tr>
<tr><td></td><td>Avg.-1 std. dev.</td><td>1.92</td><td>2.33</td><td>0.67</td><td>0.65</td><td>0.36</td></tr>
<tr><td>Total ammonia nitrogen</td><td>Avg.+1 std. dev.</td><td>6.79</td><td colspan="2">2.19</td><td>0.30</td><td>0.18</td></tr>
<tr><td></td><td>Avg.</td><td>2.41</td><td colspan="2">0.77</td><td>0.18</td><td>0.09</td></tr>
<tr><td></td><td>Avg.-1 std. dev.</td><td>0</td><td colspan="2">0</td><td>0.05</td><td>0.01</td></tr>
<tr><td>Dissolved ammonia nitrogen</td><td>Avg.+1 std. dev.</td><td>7.10</td><td>3.91</td><td>1.11</td><td>0.39</td><td>0.14</td></tr>
<tr><td></td><td>Avg.</td><td>2.33</td><td>1.23</td><td>0.51</td><td>0.23</td><td>0.08</td></tr>
<tr><td></td><td>Avg.-1 std. dev.</td><td>0</td><td>0</td><td>0</td><td>0.07</td><td>0.02</td></tr>
<tr><td>Total organic nitrogen</td><td>Avg.+1 std. dev.</td><td>3.44</td><td>2.26</td><td colspan="2">1.35</td><td>1.25</td></tr>
<tr><td></td><td>Avg.</td><td>2.34</td><td>1.34</td><td colspan="2">1.10</td><td>0.84</td></tr>
<tr><td></td><td>Avg.-1 std. dev.</td><td>1.25</td><td>0.42</td><td colspan="2">0.84</td><td>0.42</td></tr>
<tr><td>Dissolved organic nitrogen</td><td>Avg.+1 std. dev.</td><td>4.74</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td></td><td>Avg.</td><td>2.57</td><td>1.40</td><td>0.80</td><td>0.62</td><td>0.74</td></tr>
<tr><td></td><td>Avg.-1 std. dev.</td><td>0.40</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
</table>

Note: Expected values (i.e., averages) have beem calculated assuming the data to be lognormally distributed.

II.A.2. RAW DATA

TABLE C-12

TRI-NITR.WR1
11/15/91
326-1300

USGS NITROGEN CONCENTRATIONS AND STREAMFLOWS

TRINITY RIVER AT TRINIDAD
PERIOD OF RECORD: 1980 - 1989

				PARAMETER DESIGNATION									
				N-1	N-2	N-3	N-4	N-5	N-6	N-7	N-8	N-9	N-10
	DATE	TIME	FLOW INSTAN-TANEOUS (cfs)	NITROGEN, NITRATE DISSOLVED (MG/L AS N)	NITROGEN, NITRITE DISSOLVED (MG/L AS N)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N)	NITROGEN, AMMONIA TOTAL (MG/L AS N)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N)	NITROGEN ORGANIC TOTAL (MG/L AS N)	NITROGEN ORGANIC DISSOLVED (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC DISSOLVED (MG/L AS N)
*	01/09/80	11:40	560			4.4	3.9	6	5.8	6	4.2	12	10
*	02/12/80	16:30	4380			0.84	0.56	1.2	1	1.6	0.8	2.8	1.8
*	03/19/80	15:00	983			2	0.47	5.7	1.9	5.3	10	11	12
*	04/23/80	16:50	815			4.3	1.4	5.5	2.2	3.5	7.8	9	10
*	05/13/80	15:15	1040			3.5	3.2	1.5	1.6	1.3	1.4	2.8	3
*	06/03/80	14:15	753			3.6	3.5	1.7	1.7	1.7	0.8	3.4	2.5
*	07/15/80	13:20	490			5	4.3	1.2	1.1	1.2	1.5	2.4	2.6
*	08/20/80	13:30	496			9.3	8.4		1.9				
*	09/11/80	11:45	667			5.6	5.2	2.9	2.7	2.7	1.2	5.6	3.9
*	10/21/80	11:50	1000			3.3	3.3	0.32	0.39	3.7	1.1	4	1.5
*	11/05/80	12:30	558			8.9	9.1	1.4	1.3	1.5	1.4	2.9	2.7
*	12/08/80	12:00	626			10	11	2.9	2.6	1.5	0	4.4	0.04
*	01/21/81	13:00	612			5.9	4.3	4.1	4.1	2.2	2.7	6.3	6.8
*	02/18/81	11:30	562			4.4	4.4	3.4	3.7	0	0	2.1	0.38
*	03/10/81	11:30	2700			3.4	3.4	2.1	2.1	2.9	1.4	5	3.5
*	04/13/81	15:00	641			6.2	6	2.3	2.3	2.5	1.5	4.8	3.8
*	05/07/81	09:30	909			4	4.1	1.4	1.4	1.8	1	3.2	2.4
*	06/10/81	13:30	21100			0.41	0.46	0.15	0.12	1.2	0.74	1.3	0.86
*	07/08/81	12:30	10500			0.69	0.54	0.22	0.19	1.2	0.62	1.4	0.81
*	08/10/81	13:30	562			6.1	5.1	0.32	0.23	2.3	1.4	2.6	1.6
*	09/08/81	16:10	727			2.6	2.7	0.24	0.19	1.5	1	1.7	1.2
*	11/09/81	14:45	35000				0.41		0.08			0.75	
*	01/19/82	12:30	6320				0.77		0.47			1.2	
*	03/02/82	12:40	9030				1.4		0.45			1.5	
*	05/18/82	13:00	22000				0.52		0.08			1.1	
*	06/22/82	13:38	10400				0.84		0.41			1.2	
*	08/03/82	12:30	7400				0.96		0.08			1	
*	10/25/82	13:40	1100				5.1		3.1			9.5	
*	01/18/83	12:50	1320				4.5		1.6			3.4	
*	03/01/83	12:10	3870				1.7		0.54			2.5	

TABLE C-12

TRI-NITR.WR1
11/15/91
326-1300

USGS NITROGEN CONCENTRATIONS
AND STREAMFLOWS

TRINITY RIVER AT TRINIDAD
PERIOD OF RECORD: 1980 - 1989

			PARAMETER DESIGNATION									
			N-1	N-2	N-3	N-4	N-5	N-6	N-7	N-8	N-9	N-10
DATE	TIME	FLOW INSTAN-TANEOUS (cfs)	NITROGEN, NITRATE DISSOLVED (MG/L AS N)	NITROGEN, NITRITE DISSOLVED (MG/L AS N)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N)	NITROGEN, AMMONIA TOTAL (MG/L AS N)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N)	NITROGEN ORGANIC TOTAL (MG/L AS N)	NITROGEN ORGANIC DISSOLVED (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC DISSOLVED (MG/L AS N)
* 04/20/83	09:10	951				5.5		0.62			2.5	
* 06/07/83	12:15	2390				4		0.87			2.3	
* 09/07/83	10:45	672				3.7		0.18			2	
* 11/29/83	11:45	2940				4.4		1.1			8.5	
* 01/10/84	12:00	813				3.4		7			7.5	
* 03/27/84	11:40	10400				1.2		0.24			2.5	
* 05/08/84	11:55	1060				3.9		0.09			1.4	
* 06/19/84	14:50	654				6.3		0.01			2.6	
* 09/17/84	13:00	566				6.2		0.67			2.7	
* 10/17/84	15:20	1560				2.6		0.19			2.1	
* 01/08/85	17:30	2270				2.2		1.9			3.9	
* 02/13/85	14:30	1160				3.2		4.8			9	
* 05/14/85	17:00	8860				1.4		0.15			0.6	
* 06/25/85	19:00	1380				3		0.09			1.3	
* 09/17/85	16:30	2890				2.5		0.14			2	
* 11/13/85	08:00	1400	3.92	0.68		4.6	1.2	1.2	0.9		2.1	
* 01/29/86	08:30	1440	6.28	0.62		6.9	2.3	2.3	1.3		3.6	
* 04/15/86	10:15	6800	1.15	0.15		1.3	0.19	0.16	1.3		1.5	
* 06/17/86	09:45	14300	0.62	0.03		0.65	0.09	0.1	0.81		0.9	
* 07/22/86	10:00	1260	2.34	0.16		2.5	0.19	0.15	1.1		1.3	
* 09/09/86	09:45	2420	2.64	0.36		3	0.07	0.06	1.3		1.4	
* 11/12/86	12:30	2030	4.7	0.3		5	0.22	0.18	4.3		4.5	
* 01/21/87	08:10	6420	1.02	0.08		1.1	0.36	0.3	1		1.4	
* 04/14/87	10:00	3580	1.58	0.22		1.8	0.32	0.24	0.98		1.3	
* 06/09/87	10:10	8450	0.74	0.07		0.81	0.13	0.13	1.3		1.4	
* 07/14/87	10:15	2300	1.66	0.14		1.8	0.13	0.11	0.77		0.9	
* 09/01/87	09:50	790	4.22	0.28		4.5	0.15	0.14	1.4		1.6	
* 11/03/87	11:00	635	7.96	0.24		8.2	0.3	0.31	1.8		2.1	
* 01/05/88	10:00	1310	3.31	0.19		3.5	1	1.1	0.6		1.6	
* 03/29/88	10:20	895	5.73	0.47		6.2	0.3	0.33	1.3		1.6	

TABLE C-12

TRI-NITR.WR1
11/15/91
326-1300

USGS NITROGEN CONCENTRATIONS
AND STREAMFLOWS

TRINITY RIVER AT TRINIDAD
PERIOD OF RECORD: 1980 - 1989

			PARAMETER DESIGNATION N-1	N-2	N-3	N-4	N-5	N-6	N-7	N-8	N-9	N-10
DATE	TIME	FLOW INSTAN-TANEOUS (cfs)	NITROGEN, NITRATE DISSOLVED (MG/L AS N)	NITROGEN, NITRITE DISSOLVED (MG/L AS N)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N)	NITROGEN, AMMONIA TOTAL (MG/L AS N)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N)	NITROGEN ORGANIC TOTAL (MG/L AS N)	NITROGEN ORGANIC DISSOLVED (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC DISSOLVED (MG/L AS N)
* 06/07/88	12:10	1170	2.26	0.14		2.4	0.14	0.15	0.46		0.6	
* 07/12/88	12:30	946	6.12	0.08		6.2	0.07	0.06	2.1		2.2	
* 09/07/88	10:50	1060	2.01	0.09		2.1	0.09	0.1	0.71		0.8	
* 11/16/88	10:00	614	8.89	0.21		9.1	0.93	0.93	1.6		2.5	
* 01/11/89	10:30	740	9.92	0.08		10	0.17	0.15	1.9		2.1	
* 04/13/89	10:00	4210	2.56	0.04		2.6	0.08	0.07	0.92		1	
* 06/14/89	10:30	35800	0.31	0.02		0.33	0.03	0.02	0.47		0.5	
* 07/18/89	11:00	12200	0.6	0.01		0.61	0.05	0.07	0.75		0.8	
* 08/29/89	11:00	1760	3.26	0.04		3.3	0.08	0.08	0.92		1	

II.B.1. TOTAL NO_2 + NO_3 NITROGEN

N3.WR1
11/15/91 kgl
307-1000

TABLE C-13

STATISTICAL ANALYSIS OF NO2 + NO3 NITROGEN (TOTAL) CONCENTRATION IN TRINITY RIVER AT TRINIDAD

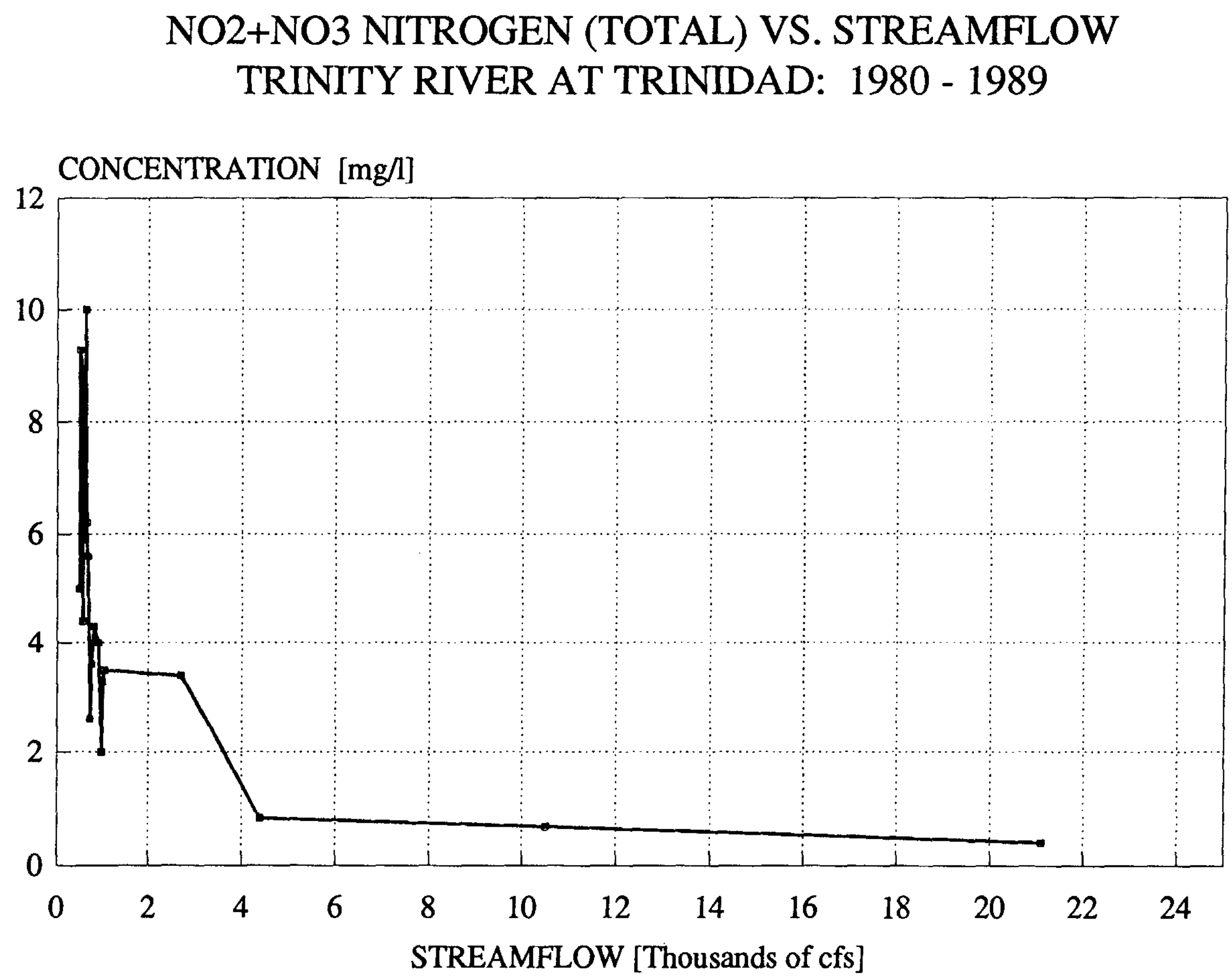
DATE	STREAMFLOW (cfs)	x TOTAL NO2 + NO3 NITROGEN (mg/l)	y=ln(x) NATURAL LOG NO2 + NO3 NITROGEN ln(mg/l)	NO. OF DATA POINTS
--07/15/80	490	5	1.61	21
08/20/80	496	9.3	2.23	
11/05/80	558	8.9	2.19	
01/09/80	560	4.4	1.48	
02/18/81	562	4.4	1.48	
08/10/81	562	6.1	1.81	
01/21/81	612	5.9	1.77	
12/08/80	626	10	2.30	
04/13/81	641	6.2	1.82	
09/11/80	667	5.6	1.72	
09/08/81	727	2.6	0.96	
06/03/80	753	3.6	1.28	
04/23/80	815	4.3	1.46	
05/07/81	909	4	1.39	
03/19/80	983	2	0.69	
--10/21/80	1000	3.3	1.19	
05/13/80	1040	3.5	1.25	
--03/10/81	2700	3.4	1.22	
02/12/80	4380	0.84	-0.17	
--07/08/81	10500	0.69	-0.37	
06/10/81	21100	0.41	-0.89	
Xbar =		4.50 mg/l	1.26 = Ybar	
Xmax =		10.00 mg/l	0.82 = Sy	
Xmin =		0.41 mg/l	0.67 = Sy^2	
std		2.59		

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(X)	= exp[Ybar + (Sy^2)/2] =	4.92 mg/l
VAR(X)	= Xbar^2 * [exp(Sy^2) - 1] =	19.22
STD(X)	= SQRT[VAR(X)] =	4.38 mg/l
CV(X)	= SQRT[exp(Sy^2) - 1] =	0.97

E(X) + STD(X) =	9.300 mg/l
E(X) =	4.92 mg/l
E(X) - STD(X) =	0.53 mg/l

NO. OF DATA POINTS = 21



NO2+NO3 NITROGEN (TOTAL) VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
12
10
8
6
4
2
0
0
2
4
6
8
10
12
14
16
18
20
22
24
STREAMFLOW [Thousands of cfs]

FIGURE C-13

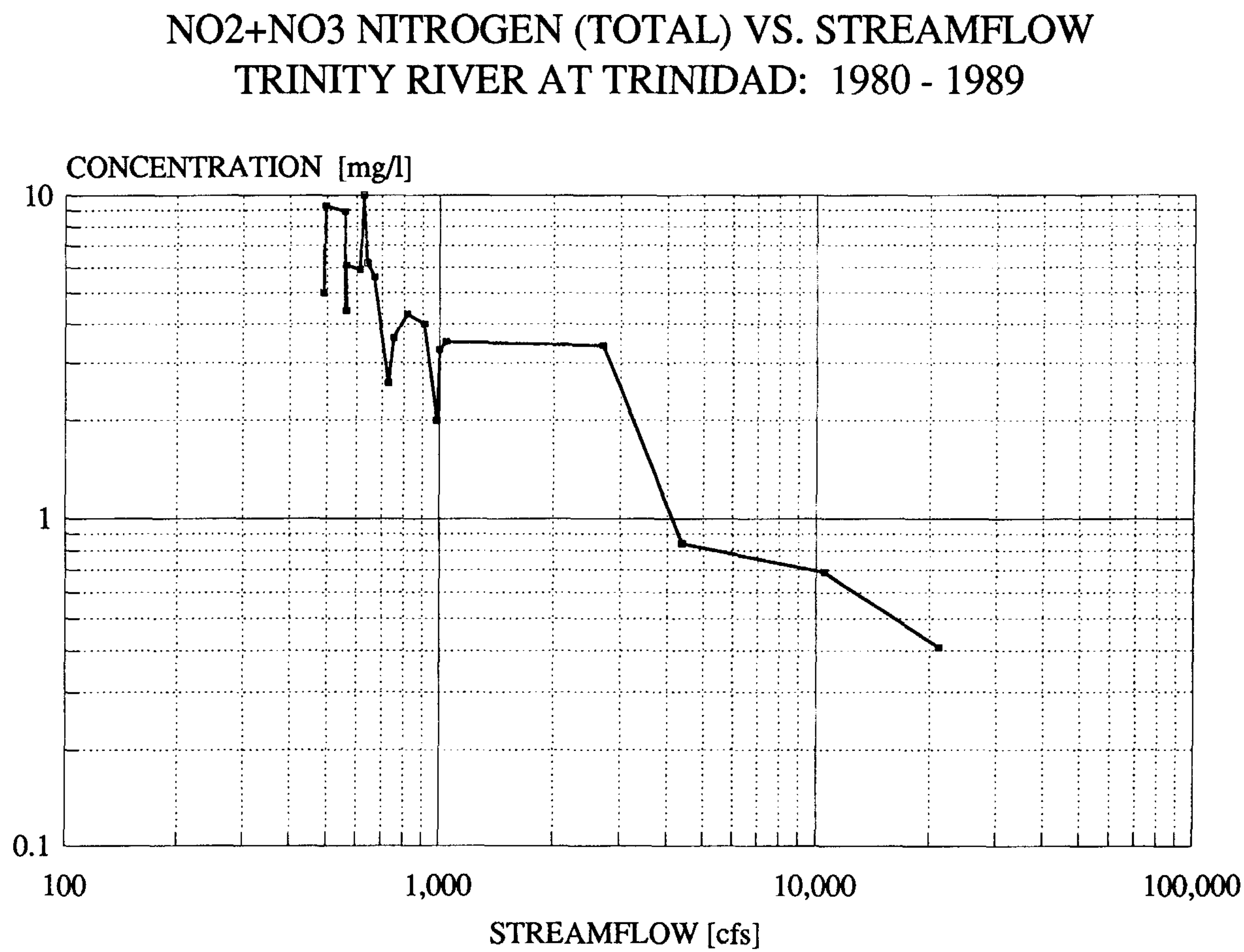

NO2+NO3 NITROGEN (TOTAL) VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
10
1
0.1
100
1,000
10,000
100,000
STREAMFLOW [cfs]

FIGURE C-14

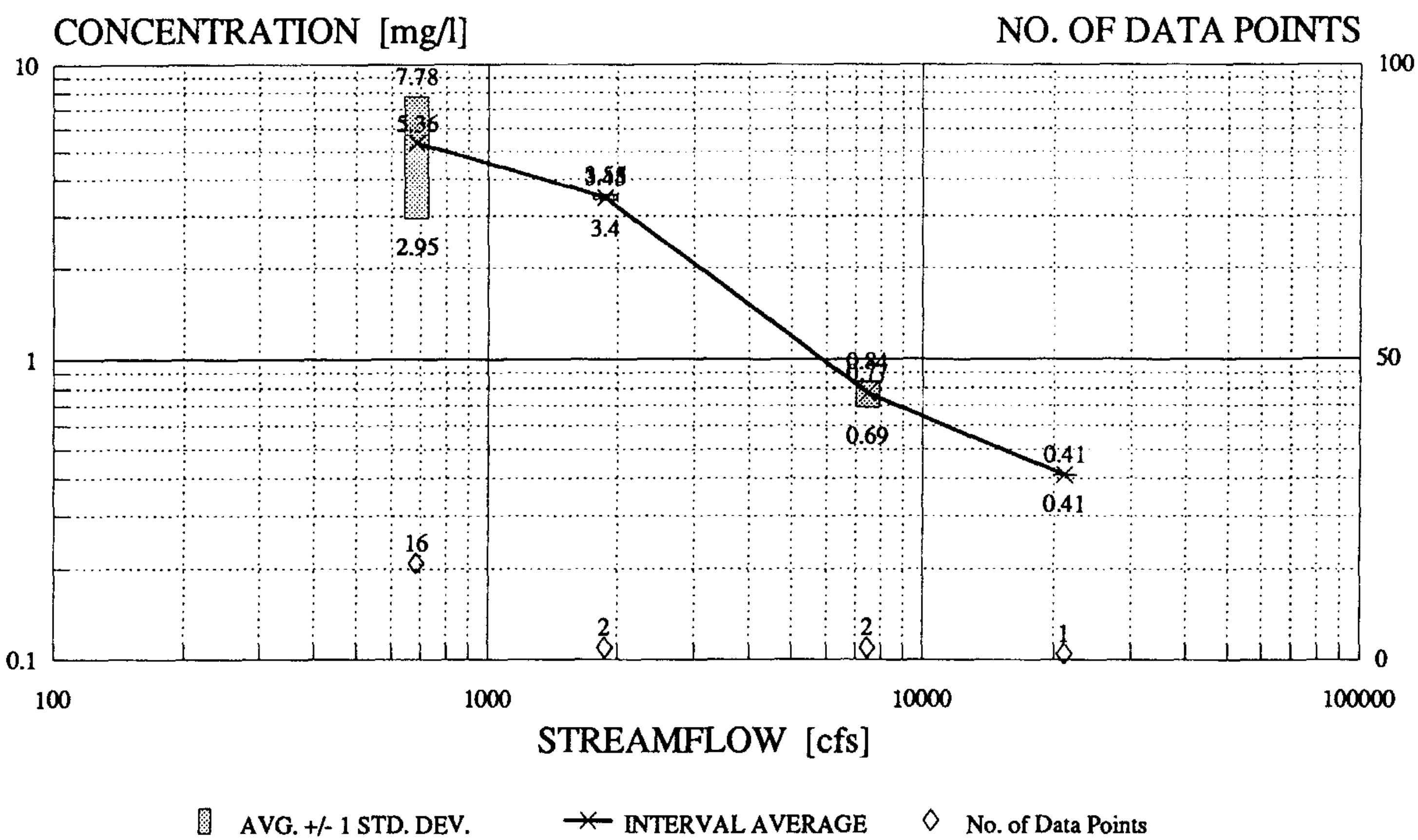
N3.WR1
11/15/91 kgl
307-1000

TABLE C-14

STATISTICAL ANALYSIS OF
NO2 + NO3 NITROGEN (TOTAL) CONCENTRATIONS
IN THE TRINITY RIVER, BY STREAMFLOW INTERVAL

		STREAMFLOW INTERVAL (cfs)							
		0 - 1000		1000 - 3000		3000 - 20,000		> 20,000	
AVERAGE STREAMFLOW (cfs)		685		1,870		7,440		21,100	
		x1	y1	x2	y2	x3	y3	x4	y4
NO. OF DATA POINTS		16		2		2		1	
AVERAGE		5.35	1.587	3.45	1.24	0.77	-0.27	0.41	-0.89
MAXIMUM		10.00		3.50		0.84		0.41	
MINIMUM		2.00		3.40		0.69		0.41	
STANDARD DEVIATION		2.27	0.431	0.05	0.01	0.07	0.10	--	0.00
COEFFICIENT OF VARIATION		0.424		0.014		0.098		--	
VARIANCE			0.186		0.0002		0.010		0.000
E(X) = exp[Ybar + (Sy^2)/2]	=		5.36		3.45		0.77		0.41
VAR(X) = Xbar^2 * [exp(Sy^2) - 1]	=		5.84		0.00		0.01		0.00
STD(X) = SQRT[VAR(X)]	=		2.42		0.05		0.08		0.00
CV(X) = SQRT[exp(Sy^2) - 1]	=		0.452		0.014		0.099		0.000
E(X) + 1*STD(X)	=		7.78		3.50		0.84		0.41
E(X)	=		5.36		3.45		0.77		0.41
E(X) - 1*STD(X)	=		2.95		3.40		0.69		0.41

NO2 + NO3 NITROGEN (TOTAL) CONCENTRTIONS BY STREAMFLOW INTERVAL CLASS TRINITY RIVER AT TRINIDAD: 1980 - 1989



USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-15

II.B.2. DISSOLVED NO_2 + NO_3 NITROGEN

N4.WR1
11/15/91
307-1000

TABLE C-15

STATISTICAL ANALYSIS OF NO2+NO3 NITROGEN (DISSOLVED) CONCENTRATIONS IN TRINITY RIVER AT TRINIDAD

		x	y=ln(x)
DATE	STREAMFLOW	TOTAL DISSOLVED NO2 & NO3 NITROGEN	NATURAL LOG DISSOLVED NO2 & NO3 NITROGEN
	(cfs)	(mg/l)	ln(mg/l)
--07/15/80	490	4.3	1.46
08/20/80	496	8.4	2.13
11/05/80	558	9.1	2.21
01/09/80	560	3.9	1.36
02/18/81	562	4.4	1.48
08/10/81	562	5.1	1.63
09/17/84	566	6.2	1.82
01/21/81	612	4.3	1.46
11/16/88	614	9.1	2.21
12/08/80	626	11	2.40
11/03/87	635	8.2	2.10
04/13/81	641	6	1.79
06/19/84	654	6.3	1.84
09/11/80	667	5.2	1.65
09/07/83	672	3.7	1.31
09/08/81	727	2.7	0.99
01/11/89	740	10	2.30
06/03/80	753	3.5	1.25
09/01/87	790	4.5	1.50
01/10/84	813	3.4	1.22
04/23/80	815	1.4	0.34
03/29/88	895	6.2	1.82
05/07/81	909	4.1	1.41
07/12/88	946	6.2	1.82
04/20/83	951	5.5	1.70
03/19/80	983	0.47	-0.76
10/21/80	1000	3.3	1.19
--05/13/80	1040	3.2	1.16
09/07/88	1060	2.1	0.74
05/08/84	1060	3.9	1.36
10/25/82	1100	5.1	1.63
02/13/85	1160	3.2	1.16
06/07/88	1170	2.4	0.88
07/22/86	1260	2.5	0.92
01/05/88	1310	3.5	1.25
01/18/83	1320	4.5	1.50
06/25/85	1380	3	1.10
11/13/85	1400	4.6	1.53
01/29/86	1440	6.9	1.93
10/17/84	1560	2.6	0.96
08/29/89	1760	3.3	1.19
11/12/86	2030	5	1.61
01/08/85	2270	2.2	0.79
07/14/87	2300	1.8	0.59
06/07/83	2390	4	1.39
09/09/86	2420	3	1.10

N4.WR1
11/15/91
307-1000

TABLE C-15

STATISTICAL ANALYSIS OF
NO2+NO3 NITROGEN (DISSOLVED) CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

		x	y=ln(x)
DATE	STREAMFLOW	TOTAL DISSOLVED NO2 & NO3 NITROGEN	NATURAL LOG DISSOLVED NO2 & NO3 NITROGEN
	(cfs)	(mg/l)	ln(mg/l)
03/10/81	2700	3.4	1.22
09/17/85	2890	2.5	0.92
11/29/83	2940	4.4	1.48
--04/14/87	3580	1.8	0.59
03/01/83	3870	1.7	0.53
04/13/89	4210	2.6	0.96
02/12/80	4380	0.56	-0.58
--01/19/82	6320	0.77	-0.26
01/21/87	6420	1.1	0.10
04/15/86	6800	1.3	0.26
08/03/82	7400	0.96	-0.04
06/09/87	8450	0.81	-0.21
05/14/85	8860	1.4	0.34
03/02/82	9030	1.4	0.34
03/27/84	10400	1.2	0.18
06/22/82	10400	0.84	-0.17
07/08/81	10500	0.54	-0.62
07/18/89	12200	0.61	-0.49
06/17/86	14300	0.65	-0.43
--06/10/81	21100	0.46	-0.78
05/18/82	22000	0.52	-0.65
11/09/81	35000	0.41	-0.89
06/14/89	35800	0.33	-1.11

Xbar =	3.53 mg/l	0.94	= Ybar
Xmax =	11.00 mg/l	0.88	= Sy
Xmin =	0.33 mg/l	0.78	= Sy^2
std	2.51		

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(X)	= exp[Ybar + (Sy^2)/2]	=	3.80 mg/l
VAR(X)	= Xbar^2 * [exp(Sy^2) - 1]	=	14.73
STD(X)	= SQRT[VAR(X)]	=	3.84 mg/l
CV(X)	= SQRT[exp(Sy^2) - 1]	=	1.09

E(X) + STD(X) =	7.633 mg/l
E(X) =	3.80 mg/l
E(X) - STD(X) =	-0.04 mg/l

No. OF DATA POINTS 69

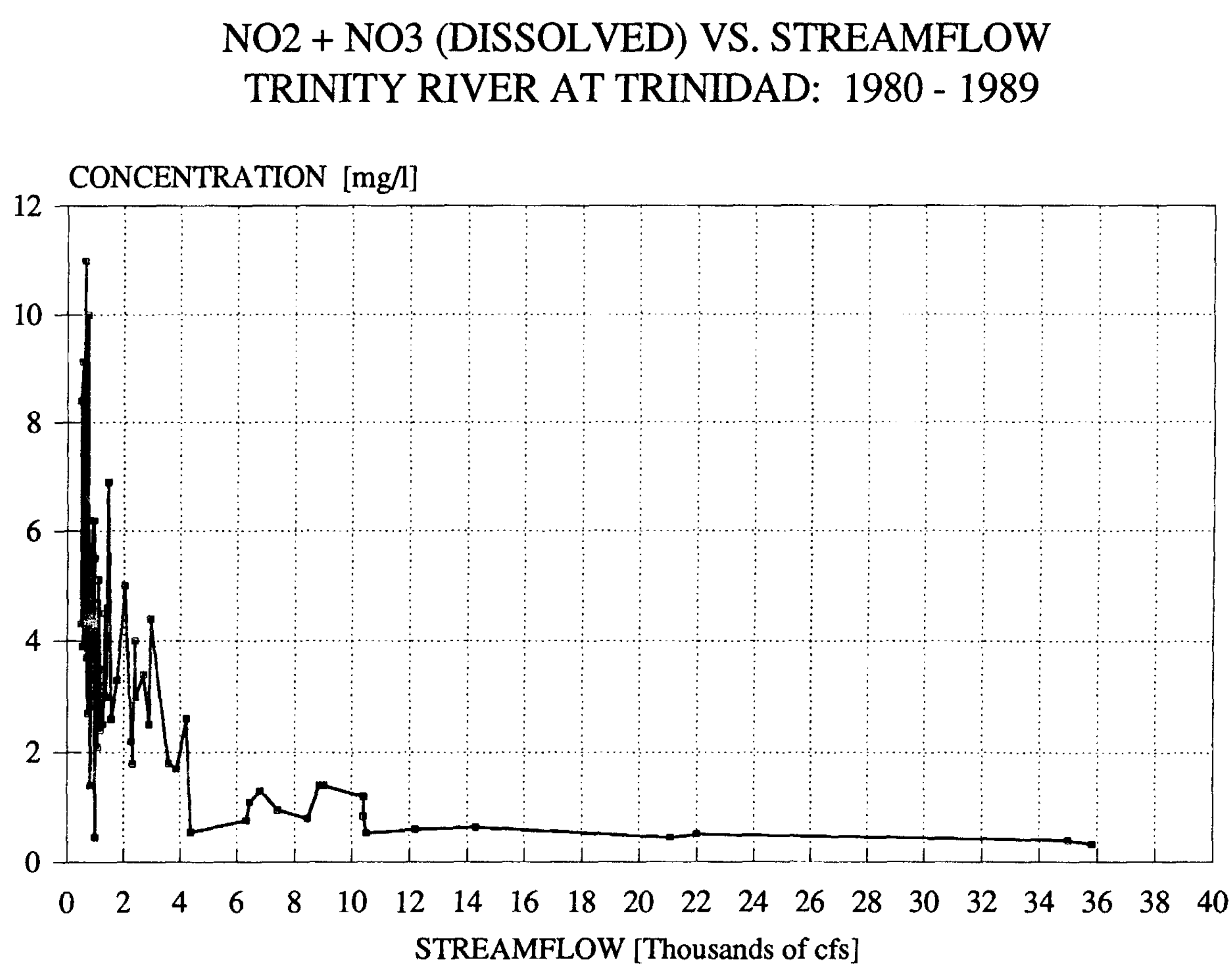

NO2 + NO3 (DISSOLVED) VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
12
10
8
6
4
2
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
STREAMFLOW [Thousands of cfs]

FIGURE C-16

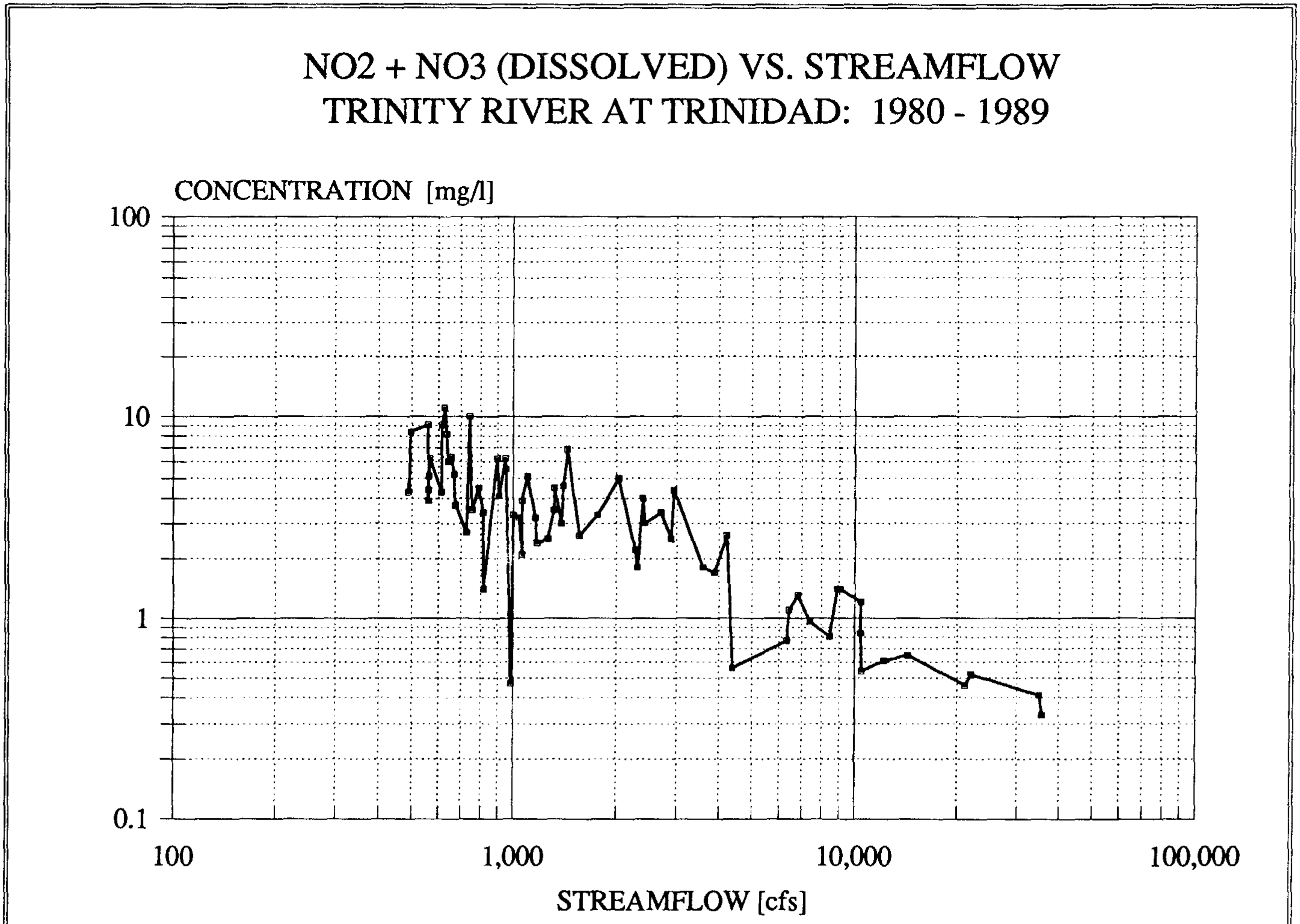

NO2 + NO3 (DISSOLVED) VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
100
10
1
0.1
100
1,000
10,000
100,000
STREAMFLOW [cfs]

FIGURE C-17

N4.WR1
11/15/91
307-1000

TABLE C-16

STATISTICAL ANALYSIS OF
NO2+NO3 NITROGEN (DISSOLVED) CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

	STREAMFLOW INTERVAL (cfs)										
		0 - 1000		1000 - 3000		3000 - 6000		6000 - 20,000		> 20,000	
AVERAGE STREAMFLOW (cfs)		712		1,725		4,010		9,257		28,475	
		x1	y1	x2	y2	x3	y3	x4	y4	x5	y5
NO. OF DATA POINTS		27		22		4		12		4	
AVERAGE		5.42	1.543	3.50	1.20	1.67	0.37	0.97	-0.08	0.43	-0.86
MAXIMUM		11.00		6.90		2.60		1.40		0.52	
MINIMUM		0.47		1.80		0.56		0.54		0.33	
STANDARD DEVIATION		2.51	0.631	1.19	0.33	0.73	0.57	0.30	0.32	0.07	0.17
COEFFICIENT OF VARIATION		0.463		0.339		0.437		0.306		0.162	
VARIANCE			0.398		0.106		0.330		0.101		0.028
E(X) = exp[Ybar + (Sy^2)/2]	=		5.71		3.50		1.71		0.97		0.43
VAR(X) = Xbar^2 * [exp(Sy^2) - 1]	=		14.40		1.37		1.08		0.10		0.01
STD(X) = SQRT[VAR(X)]	=		3.79		1.17		1.04		0.31		0.07
CV(X) = SQRT[exp(Sy^2) - 1]	=		0.700		0.334		0.625		0.325		0.169
E(X) + 1*STD(X)	=		9.51		4.67		2.75		1.28		0.50
E(X)	=		5.71		3.50		1.71		0.97		0.43
E(X) - 1*STD(X)	=		1.92		2.33		0.67		0.65		0.36

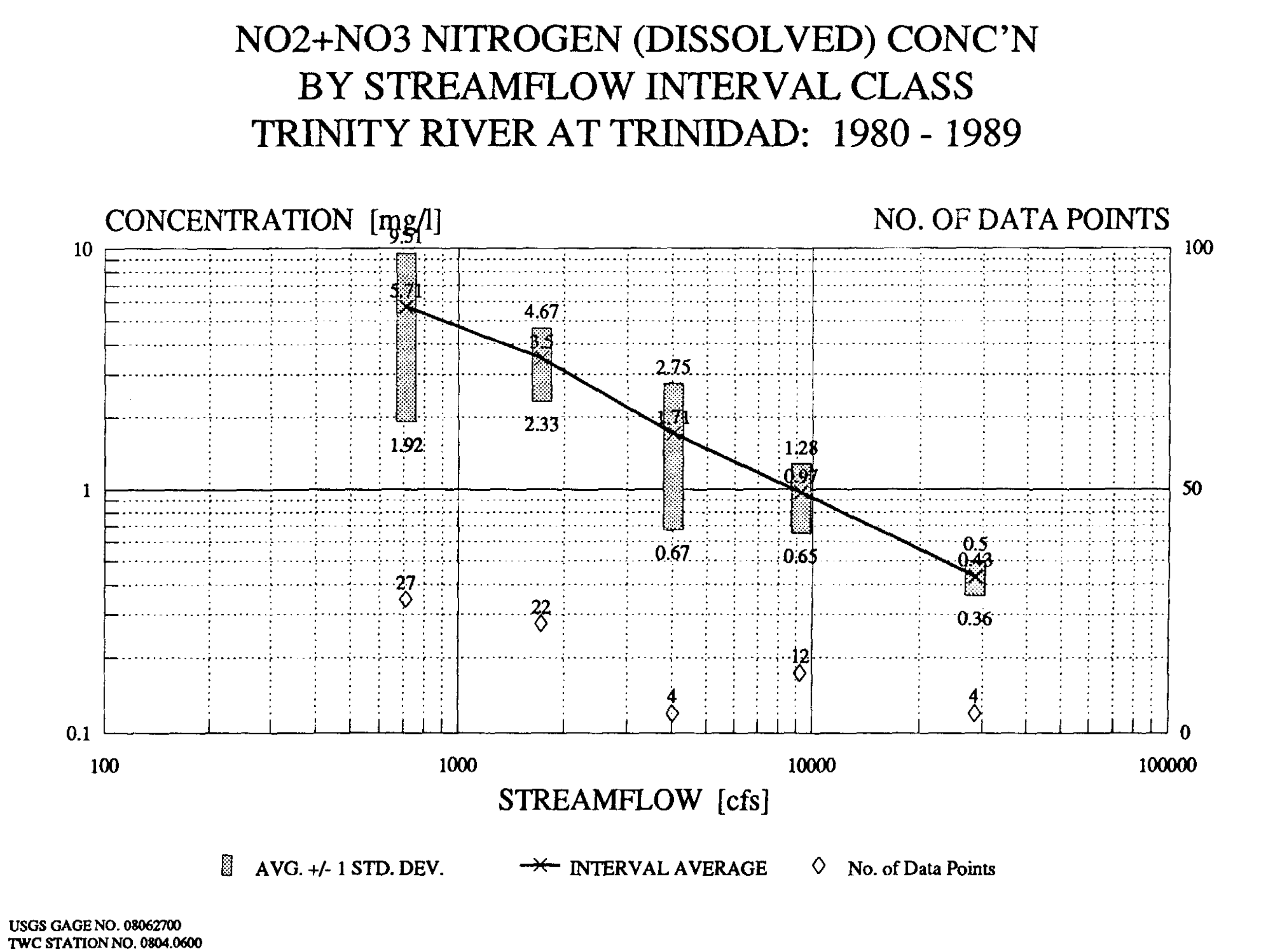

NO2+NO3 NITROGEN (DISSOLVED) CONC'N
BY STREAMFLOW INTERVAL CLASS
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
NO. OF DATA POINTS
10
1
0.1
100
50
0
100
1000
10000
100000
STREAMFLOW [cfs]
9.51
5.71
1.92
27
4.67
3.5
2.33
22
2.75
1.71
0.67
4
1.28
0.97
0.65
12
0.5
0.43
0.36
4
AVG. +/- 1 STD. DEV.
INTERVAL AVERAGE
No. of Data Points
USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-18

II.B.3. TOTAL AMMONIA NITROGEN

TNH4.WR1
03/27/91 kgl
307-1000

TABLE C-17

STATISTICAL ANALYSIS OF
TOTAL AMMONIA NITROGEN CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

		x	y=ln(x)
DATE	STREAMFLOW	TOTAL AMMONIA NITROGEN	NATURAL LOG TOTAL AMMONIA NITROGEN
	(cfs)	(mg/l)	ln(mg/l)
-----07/15/80	490	1.2	0.18
11/05/80	558	1.4	0.34
01/09/80	560	6	1.79
02/18/81	562	3.4	1.22
08/10/81	562	0.32	-1.14
01/21/81	612	4.1	1.41
11/16/88	614	0.93	-0.07
12/08/80	626	2.9	1.06
11/03/87	635	0.3	-1.20
04/13/81	641	2.3	0.83
09/11/80	667	2.9	1.06
09/08/81	727	0.24	-1.43
01/11/89	740	0.17	-1.77
06/03/80	753	1.7	0.53
09/01/87	790	0.15	-1.90
04/23/80	815	5.5	1.70
03/29/88	895	0.3	-1.20
05/07/81	909	1.4	0.34
07/12/88	946	0.07	-2.66
03/19/80	983	5.7	1.74
10/21/80	1000	0.32	-1.14
-----05/13/80	1040	1.5	0.41
09/07/88	1060	0.09	-2.41
06/07/88	1170	0.14	-1.97
07/22/86	1260	0.19	-1.66
01/05/88	1310	1	0.00
11/13/85	1400	1.2	0.18
01/29/86	1440	2.3	0.83
08/29/89	1760	0.08	-2.53
11/12/86	2030	0.22	-1.51
07/14/87	2300	0.13	-2.04
09/09/86	2420	0.07	-2.66
03/10/81	2700	2.1	0.74
04/14/87	3580	0.32	-1.14
04/13/89	4210	0.08	-2.53
02/12/80	4380	1.2	0.18

TNH4.WR1
03/27/91 kgl
307-1000

TABLE C-17

STATISTICAL ANALYSIS OF
TOTAL AMMONIA NITROGEN CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

DATE	STREAMFLOW (cfs)	x TOTAL AMMONIA NITROGEN (mg/l)	y=ln(x) NATURAL LOG TOTAL AMMONIA NITROGEN ln(mg/l)
-----01/21/87	6420	0.36	-1.02
04/15/86	6800	0.19	-1.66
06/09/87	8450	0.13	-2.04
07/08/81	10500	0.22	-1.51
07/18/89	12200	0.05	-3.00
06/17/86	14300	0.09	-2.41
-----06/10/81	21100	0.15	-1.90
06/14/89	35800	0.03	-3.51

Xbar =	1.21 mg/l	-0.76	= Ybar
Xmax =	6.00 mg/l	1.47	= Sy
Xmin =	0.03 mg/l	2.15	= Sy^2
std	1.59		

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(X)	= exp[Ybar + (Sy^2)/2] =	1.37 mg/l
VAR(X)	= Xbar^2 * [exp(Sy^2) - 1] =	11.03
STD(X)	= SQRT[VAR(X)] =	3.32 mg/l
CV(X)	= SQRT[exp(Sy^2) - 1] =	2.75

E(X) + STD(X) = 4.689 mg/l
E(X) = 1.37 mg/l
E(X) - STD(X) = 0.00 mg/l

NO. OF DATA POINTS = 44

TOTAL AMMONIA NITROGEN VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989

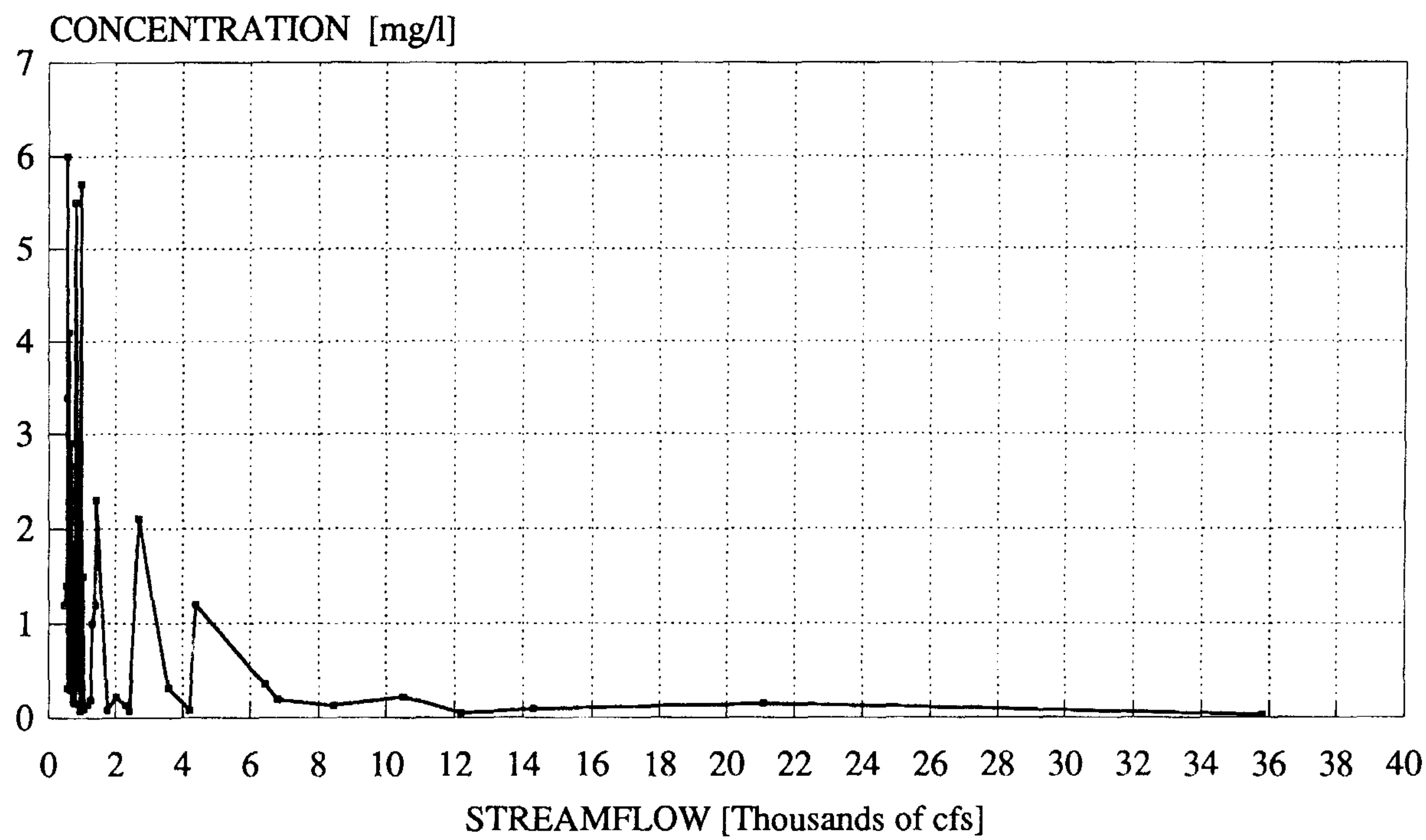


FIGURE C-19

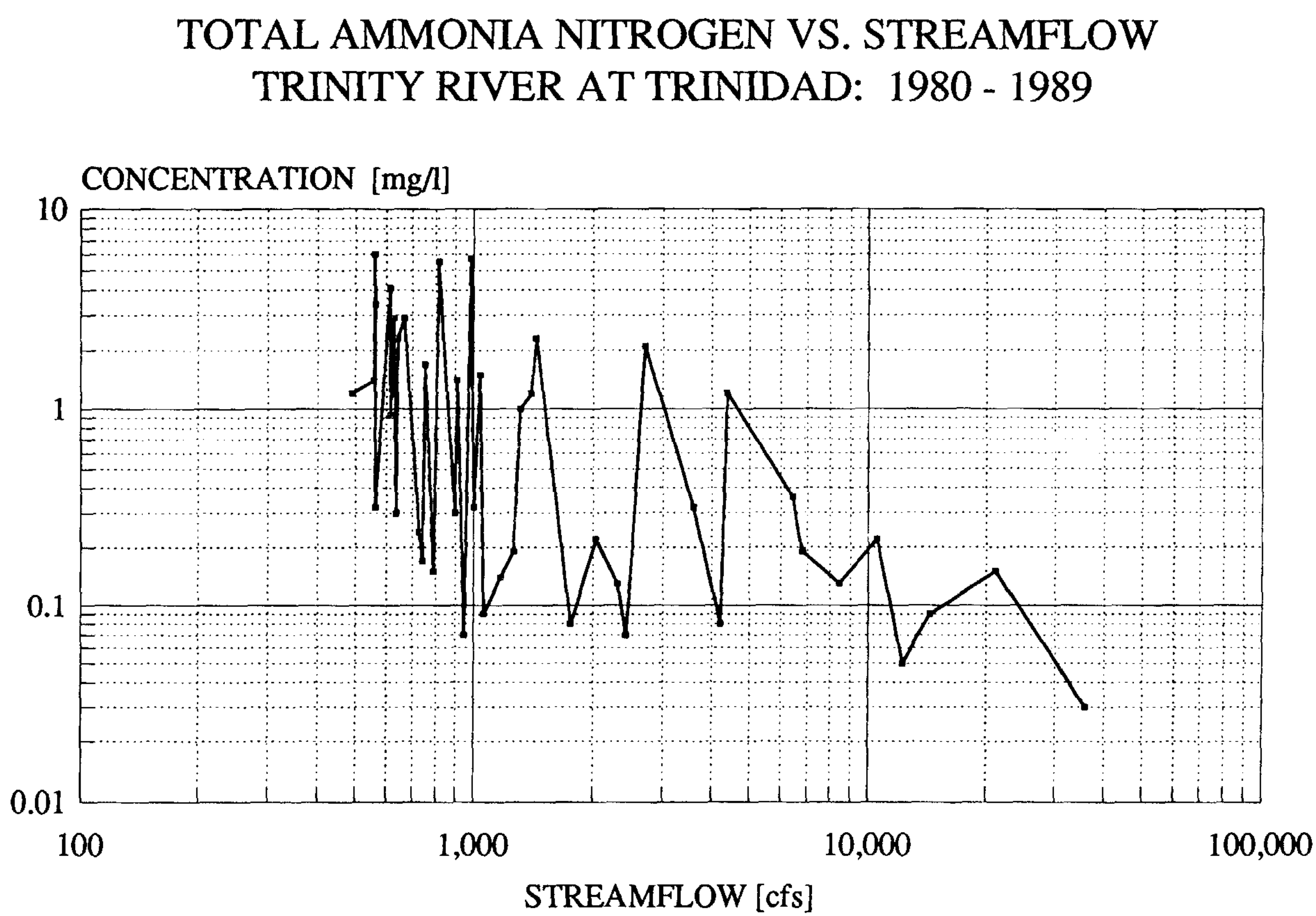

TOTAL AMMONIA NITROGEN VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
10
1
0.1
0.01
100
1,000
10,000
100,000
STREAMFLOW [cfs]

FIGURE C-20

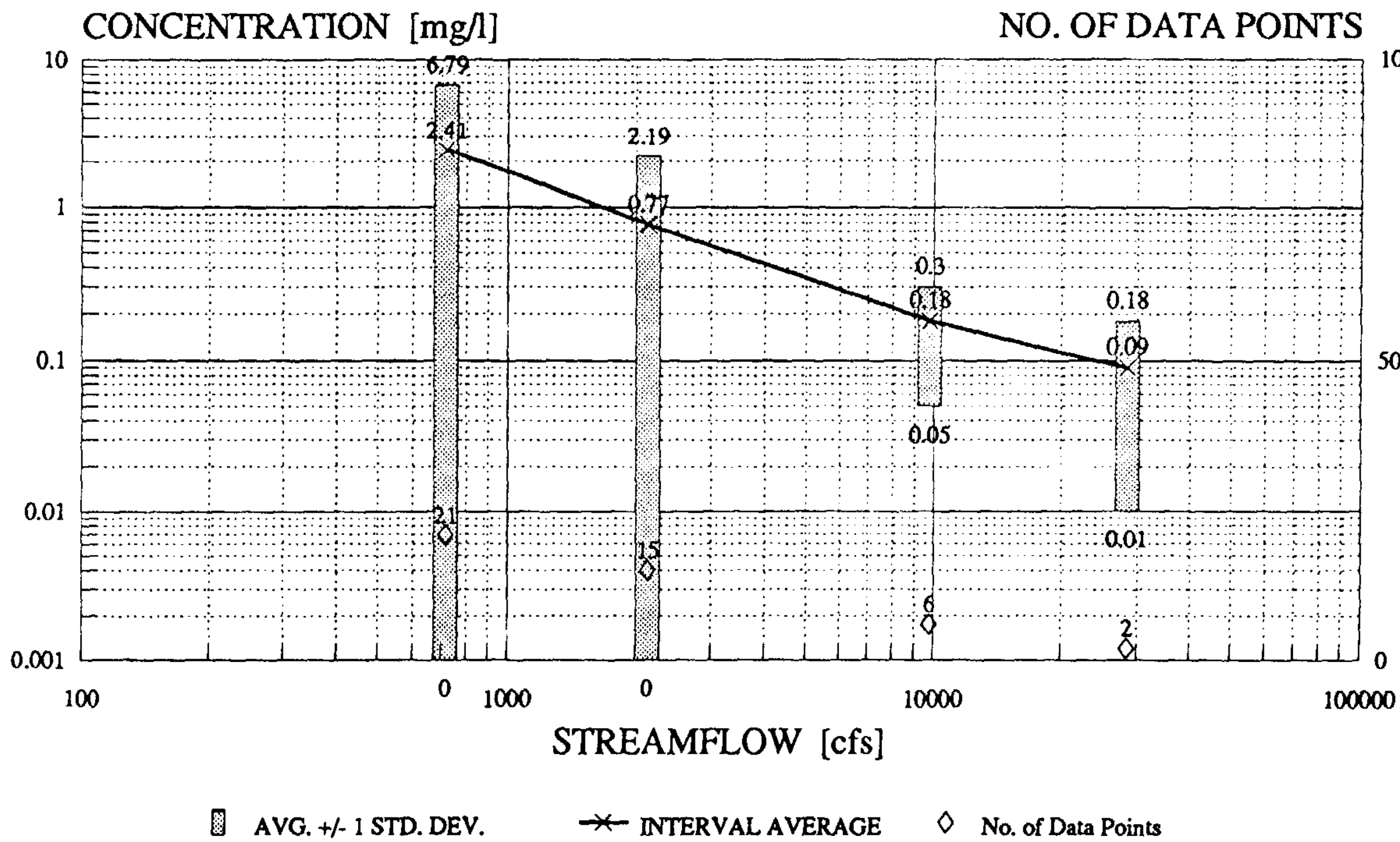
TNH4.WR1
03/27/91 kgl
307-1000

TABLE C-18

STATISTICAL ANALYSIS OF
TOTAL AMMONIA NITROGEN CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

	STREAMFLOW INTERVAL (cfs							
	0 - 1000		1000 - 6000		6000 - 20,000		> 20,000	
AVERAGE STREAMFLOW (cfs)	718		2137		9778		28,450	
	x1	y1	x2	y2	x4	y4	x5	y5
NO. OF DATA POINTS	21		15		6		2	
AVERAGE (mg/l)	1.97	-0.014	0.71	-1.07	0.17	-1.94	0.09	-2.70
MAXIMUM (mg/l)	6.00		2.30		0.36		0.15	
MINIMUM (mg/l)	0.07		0.07		0.05		0.03	
STANDARD DEVIATION (mg/l)	1.92	1.336	0.76	1.27	0.10	0.64	0.06	0.80
COEFFICIENT OF VARIATION	0.978		1.067		0.583		0.667	
VARIANCE		1.785		1.614		0.408		0.648
E(X), mg/l = exp[Ybar + (Sy^2)/2]	=	2.41		0.77		0.18		0.09
VAR(X) = Xbar^2 * [exp(Sy^2) - 1]	=	19.18		2.02		0.02		0.01
STD(X), mg/l = SQRT[VAR(X)]	=	4.38		1.42		0.12		0.09
CV(X) = SQRT[exp(Sy^2) - 1]	=	2.227		2.006		0.709		0.954
E(X) + 1*STD(X), mg/l	=	6.79		2.19		0.30		0.18
E(X), mg/l	=	2.41		0.77		0.18		0.09
E(X) - 1*STD(X), mg/l	=	0.00		0.00		0.05		0.01
AVERAGE LOAD (lb/d)		9,319		8,830		9,286		14,220

TOTAL AMMONIA-NITROGEN CONCENTRATIONS BY STREAMFLOW INTERVAL CLASS TRINITY RIVER AT TRINIDAD: 1980 - 1989



USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-21

II.B.4. DISSOLVED AMMONIA NITROGEN

N6.WR1
11/15/91
307-1000

TABLE C-19

STATISTICAL ANALYSIS OF
DISSOLVED AMMONIA NITROGEN CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

DATE	STREAMFLOW (cfs)	x TOTAL DISSOLVED NH4-NITROGEN (mg/l)	y=ln(x) NATURAL LOG DISSOLVED NH4-NITROGEN ln(mg/l)
--07/15/80	490	1.1	0.10
08/20/80	496	1.9	0.64
11/05/80	558	1.3	0.26
01/09/80	560	5.8	1.76
08/10/81	562	0.23	-1.47
02/18/81	562	3.7	1.31
09/17/84	566	0.67	-0.40
01/21/81	612	4.1	1.41
11/16/88	614	0.93	-0.07
12/08/80	626	2.6	0.96
11/03/87	635	0.31	-1.17
04/13/81	641	2.3	0.83
06/19/84	654	0.01	-4.61
09/11/80	667	2.7	0.99
09/07/83	672	0.18	-1.71
09/08/81	727	0.19	-1.66
01/11/89	740	0.15	-1.90
06/03/80	753	1.7	0.53
09/01/87	790	0.14	-1.97
01/10/84	813	7	1.95
04/23/80	815	2.2	0.79
03/29/88	895	0.33	-1.11
05/07/81	909	1.4	0.34
07/12/88	946	0.06	-2.81
04/20/83	951	0.62	-0.48
03/19/80	983	1.9	0.64
10/21/80	1000	0.39	-0.94
--05/13/80	1040	1.6	0.47
05/08/84	1060	0.09	-2.41
09/07/88	1060	0.1	-2.30
10/25/82	1100	3.1	1.13
02/13/85	1160	4.8	1.57
06/07/88	1170	0.15	-1.90
07/22/86	1260	0.15	-1.90
01/05/88	1310	1.1	0.10
01/18/83	1320	1.6	0.47
06/25/85	1380	0.09	-2.41
11/13/85	1400	1.2	0.18
01/29/86	1440	2.3	0.83
10/17/84	1560	0.19	-1.66
08/29/89	1760	0.08	-2.53
11/12/86	2030	0.18	-1.71
01/08/85	2270	1.9	0.64
07/14/87	2300	0.11	-2.21
06/07/83	2390	0.87	-0.14
09/09/86	2420	0.06	-2.81

N6.WR1
11/15/91
307-1000

TABLE C-19

STATISTICAL ANALYSIS OF DISSOLVED AMMONIA NITROGEN CONCENTRATIONS IN TRINITY RIVER AT TRINIDAD

DATE	STREAMFLOW (cfs)	x TOTAL DISSOLVED NH4-NITROGEN (mg/l)	y=ln(x) NATURAL LOG DISSOLVED NH4-NITROGEN ln(mg/l)
03/10/81	2700	2.1	0.74
09/17/85	2890	0.14	-1.97
11/29/83	2940	1.1	0.10
--04/14/87	3580	0.24	-1.43
03/01/83	3870	0.54	-0.62
04/13/89	4210	0.07	-2.66
02/12/80	4380	1	0.00
--01/19/82	6320	0.47	-0.76
01/21/87	6420	0.3	-1.20
04/15/86	6800	0.16	-1.83
08/03/82	7400	0.08	-2.53
06/09/87	8450	0.13	-2.04
05/14/85	8860	0.15	-1.90
03/02/82	9030	0.45	-0.80
06/22/82	10400	0.41	-0.89
03/27/84	10400	0.24	-1.43
07/08/81	10500	0.19	-1.66
07/18/89	12200	0.07	-2.66
06/17/86	14300	0.1	-2.30
--06/10/81	21100	0.12	-2.12
05/18/82	22000	0.08	-2.53
11/09/81	35000	0.08	-2.53
06/14/89	35800	0.02	-3.91

Xbar =	1.04 mg/l	-0.89 = Ybar
Xmax =	7.00 mg/l	1.46 = Sy
Xmin =	0.01 mg/l	2.14 = Sy^2
std	1.41	

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(X)	= exp[Ybar + (Sy^2)/2] =	1.20 mg/l
VAR(X)	= Xbar^2 * [exp(Sy^2) - 1] =	8.15
STD(X)	= SQRT[VAR(X)] =	2.86 mg/l
CV(X)	= SQRT[exp(Sy^2) - 1] =	2.74

E(X) + STD(X) =	4.056 mg/l
E(X) =	1.20 mg/l
E(X) - STD(X) =	-1.65 mg/l

No. OF DATA POINTS = 69

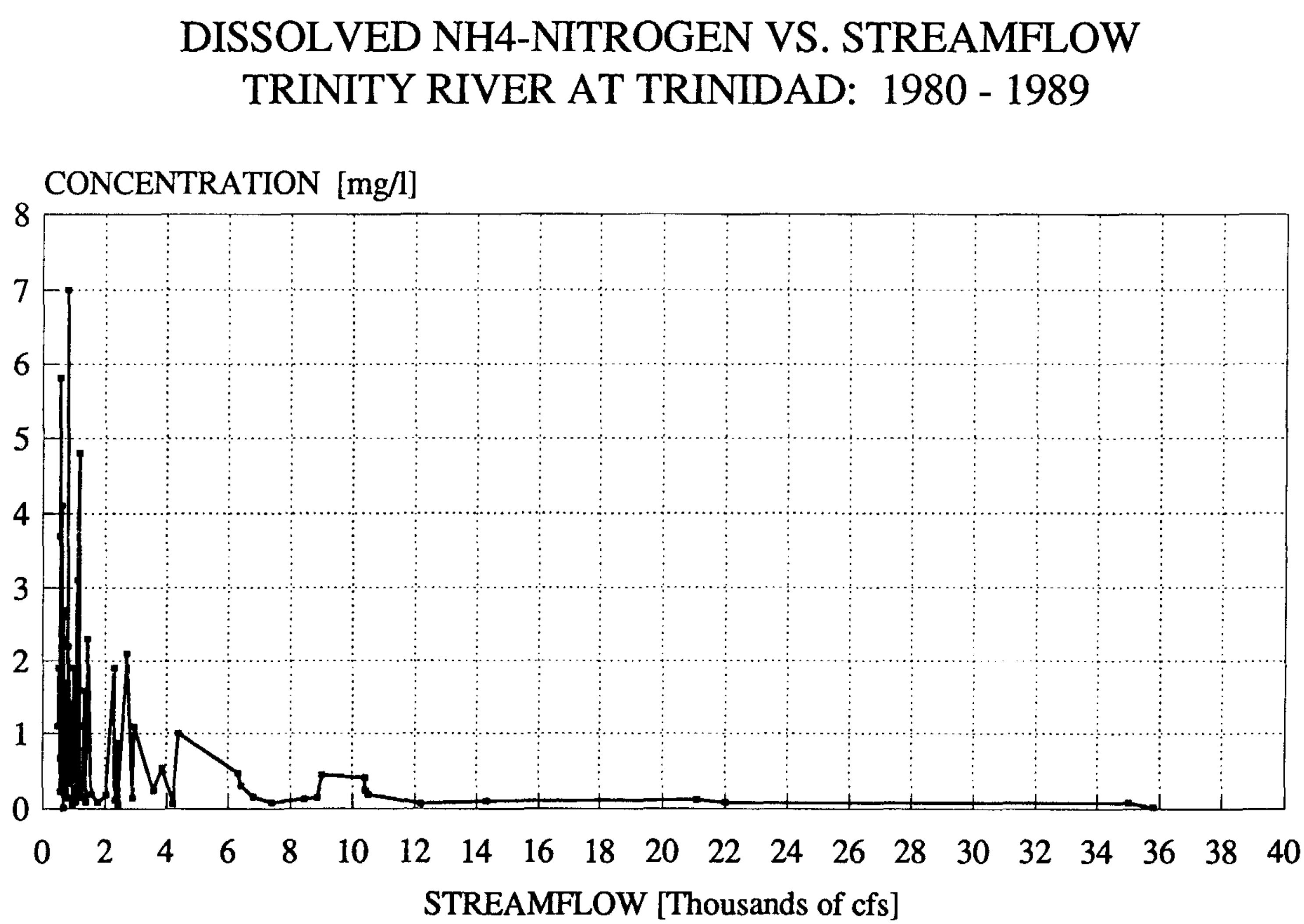

DISSOLVED NH4-NITROGEN VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
8
7
6
5
4
3
2
1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
STREAMFLOW [Thousands of cfs]

FIGURE C-22

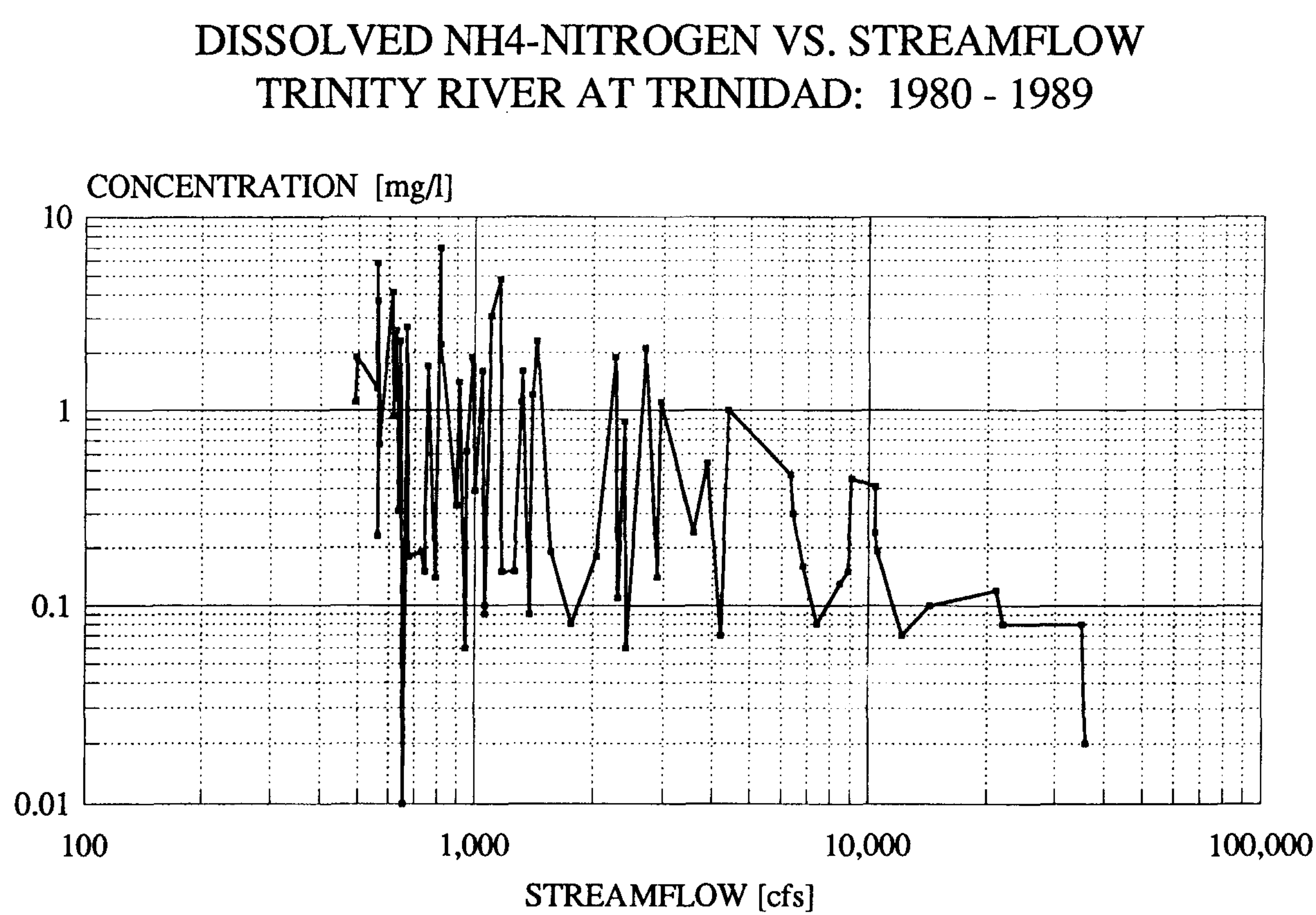

DISSOLVED NH4-NITROGEN VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
10
1
0.1
0.01
100
1,000
10,000
100,000
STREAMFLOW [cfs]

FIGURE C-23

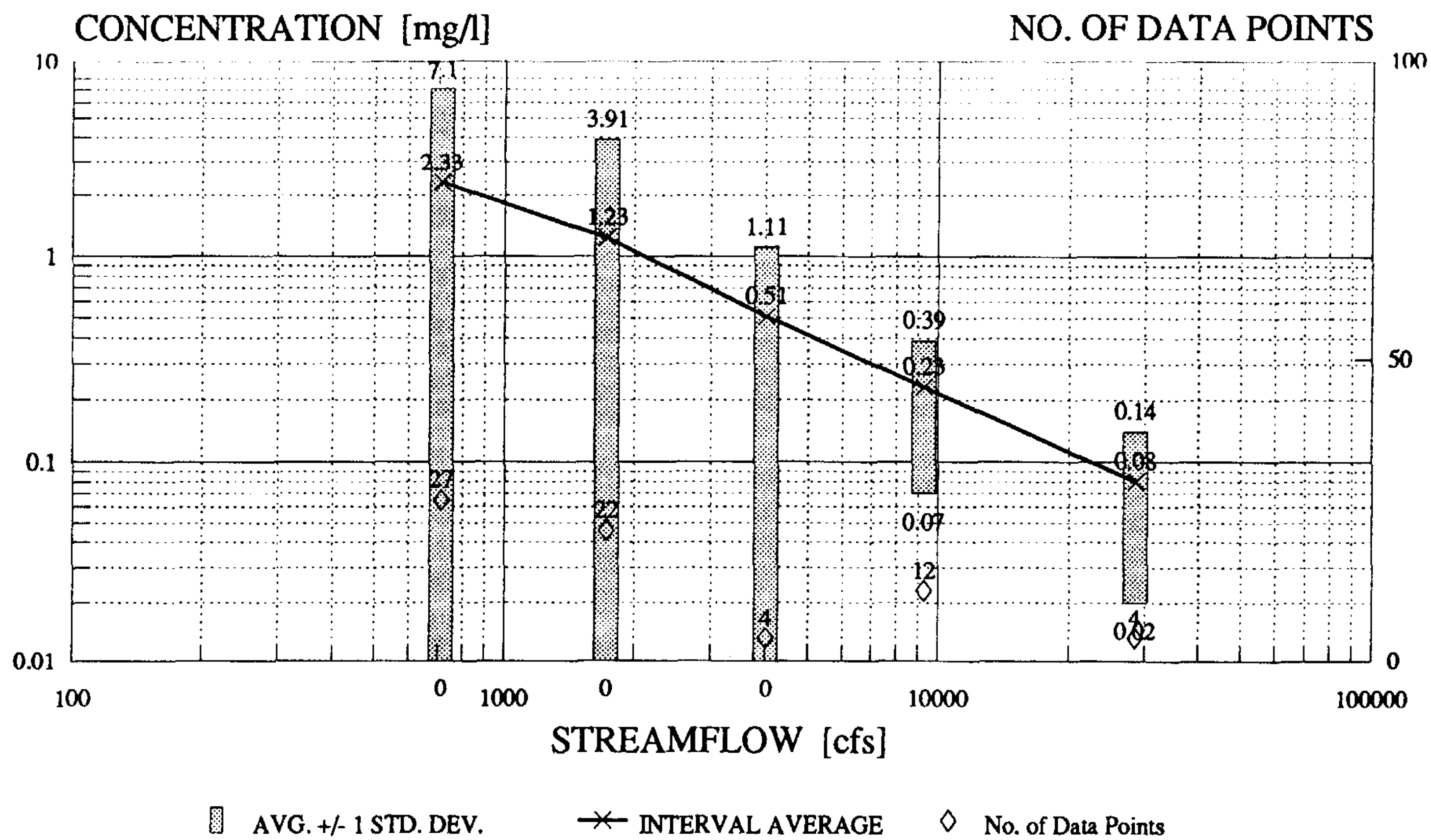
N6.WR1
11/15/91
307-1000

TABLE C-20

STATISTICAL ANALYSIS OF
DISSOLVED AMMONIA NITROGEN CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

	STREAMFLOW INTERVAL (cfs)									
	0 - 1000		1000 - 3000		3000 - 6000		6000 - 20,000		> 20,000	
AVERAGE STREAMFLOW (cfs)	712		1,725		4,010		9,257		28,475	
	x1	y1	x2	y2	x3	y3	x4	y4	x5	y5
NO. OF DATA POINTS	27		22		4		12		4	
AVERAGE	1.63	-0.289	1.05	-0.81	0.46	-1.18	0.23	-1.67	0.08	-2.77
MAXIMUM	7.00		4.80		1.00		0.47		0.12	
MINIMUM	0.01		0.06		0.07		0.07		0.02	
STANDARD DEVIATION	1.75	1.505	1.20	1.42	0.35	0.99	0.14	0.63	0.04	0.68
COEFFICIENT OF VARIATION	1.079		1.150		0.763		0.606		0.476	
VARIANCE		2.265		2.022		0.990		0.400		0.461
E(X) = exp[Ybar + (Sy^2)/2] =		2.33		1.23		0.51		0.23		0.08
VAR(X) = Xbar^2 * [exp(Sy^2) - 1] =		22.84		7.17		0.36		0.03		0.00
STD(X) = SQRT[VAR(X)] =		4.78		2.68		0.60		0.16		0.06
CV(X) = SQRT[exp(Sy^2) - 1] =		2.939		2.560		1.300		0.702		0.766
E(X) + 1*STD(X) =		7.10		3.91		1.11		0.39		0.14
E(X) =		2.33		1.23		0.51		0.23		0.08
E(X) - 1*STD(X) =		0.00		0.00		0.00		0.07		0.02

DISSOLVED AMMONIA-NITROGEN CONCENTRATION BY STREAMFLOW INTERVAL CLASS TRINITY RIVER AT TRINIDAD: 1980 - 1989



USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-24

II.B.5. TOTAL ORGANIC NITROGEN

N7.WR1
11/15/91
307-1000

TABLE C-21

STATISTICAL ANALYSIS OF
TOTAL ORGANIC NITROGEN CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

		x	y=ln(x)	
DATE	STREAMFLOW	TOTAL ORGANIC NITROGEN	NATURAL LOG ORGANIC NITROGEN	NO. OF DATA POINTS
	(cfs)	(mg/l)	ln(mg/l)	
--07/15/80	490	1.2	0.18	43
11/05/80	558	1.5	0.41	
01/09/80	560	6	1.79	
08/10/81	562	2.3	0.83	
01/21/81	612	2.2	0.79	
11/16/88	614	1.6	0.47	
12/08/80	626	1.5	0.41	
11/03/87	635	1.8	0.59	
04/13/81	641	2.5	0.92	
09/11/80	667	2.7	0.99	
09/08/81	727	1.5	0.41	
01/11/89	740	1.9	0.64	
06/03/80	753	1.7	0.53	
09/01/87	790	1.4	0.34	
04/23/80	815	3.5	1.25	
03/29/88	895	1.3	0.26	
05/07/81	909	1.8	0.59	
07/12/88	946	2.1	0.74	
03/19/80	983	5.3	1.67	
10/21/80	1000	3.7	1.31	
--05/13/80	1040	1.3	0.26	
09/07/88	1060	0.71	-0.34	
06/07/88	1170	0.46	-0.78	
07/22/86	1260	1.1	0.10	
01/05/88	1310	0.6	-0.51	
11/13/85	1400	0.9	-0.11	
01/29/86	1440	1.3	0.26	
08/29/89	1760	0.92	-0.08	
11/12/86	2030	4.3	1.46	
07/14/87	2300	0.77	-0.26	
09/09/86	2420	1.3	0.26	
03/10/81	2700	2.9	1.06	
--04/14/87	3580	0.98	-0.02	
04/13/89	4210	0.92	-0.08	
02/12/80	4380	1.6	0.47	
01/21/87	6420	1	0.00	
04/15/86	6800	1.3	0.26	
06/09/87	8450	1.3	0.26	
07/08/81	10500	1.2	0.18	
07/18/89	12200	0.75	-0.29	
06/17/86	14300	0.81	-0.21	
--06/10/81	21100	1.2	0.18	
06/14/89	35800	0.47	-0.76	

N7.WR1
11/15/91
307-1000

TABLE C-21

STATISTICAL ANALYSIS OF
TOTAL ORGANIC NITROGEN CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

DATE	STREAMFLOW	TOTAL ORGANIC NITROGEN (x)	NATURAL LOG ORGANIC NITROGEN (y=ln(x))	NO. OF DATA POINTS
	(cfs)	(mg/l)	ln(mg/l)	

Xbar =	1.76 mg/l	0.38 = Ybar
Xmax =	6.00 mg/l	0.58 = Sy
Xmin =	0.46 mg/l	0.34 = Sy^2
std	1.20	

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(X)	= exp[Ybar + (Sy^2)/2] =	1.74 mg/l
VAR(X)	= Xbar^2 * [exp(Sy^2) - 1] =	1.26
STD(X)	= SQRT[VAR(X)] =	1.12 mg/l
CV(X)	= SQRT[exp(Sy^2) - 1] =	0.64

E(X) + STD(X) =	2.859 mg/l
E(X) =	1.74 mg/l
E(X) - STD(X) =	0.62 mg/l

NO. OF DATA POINTS = 43

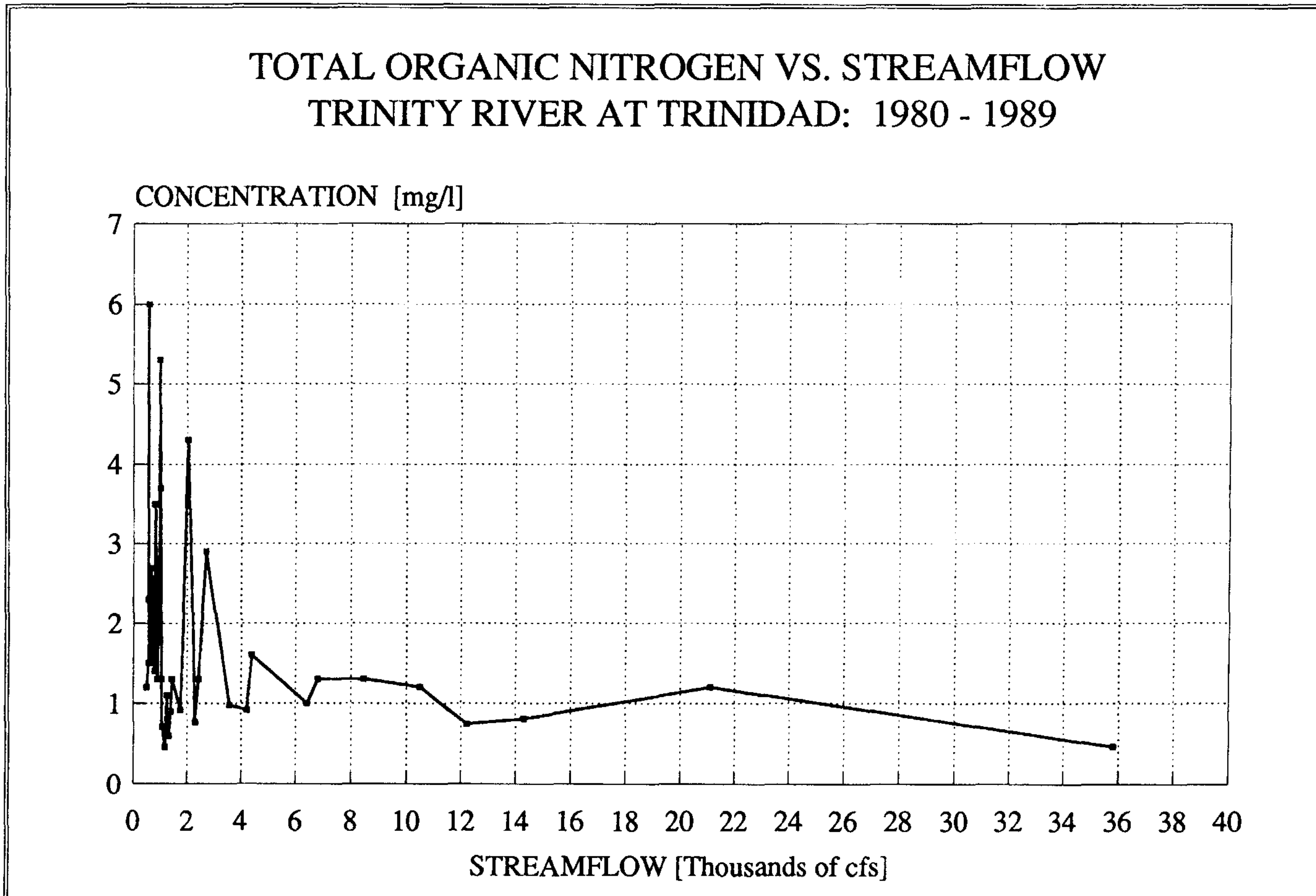

TOTAL ORGANIC NITROGEN VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
CONCENTRATION [mg/l]
7
6
5
4
3
2
1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
STREAMFLOW [Thousands of cfs]

FIGURE C-25

TOTAL ORGANIC NITROGEN VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989

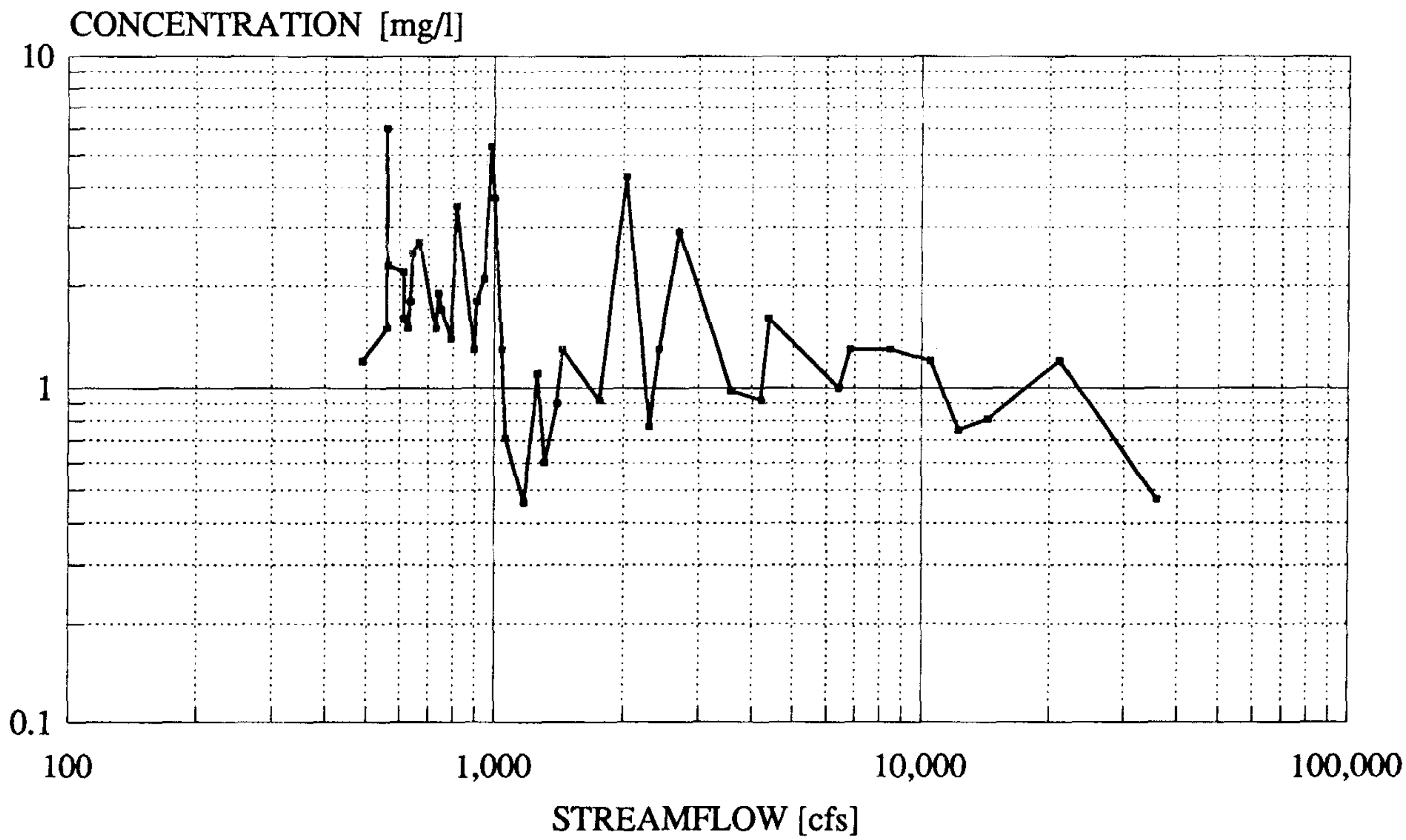


FIGURE C-26

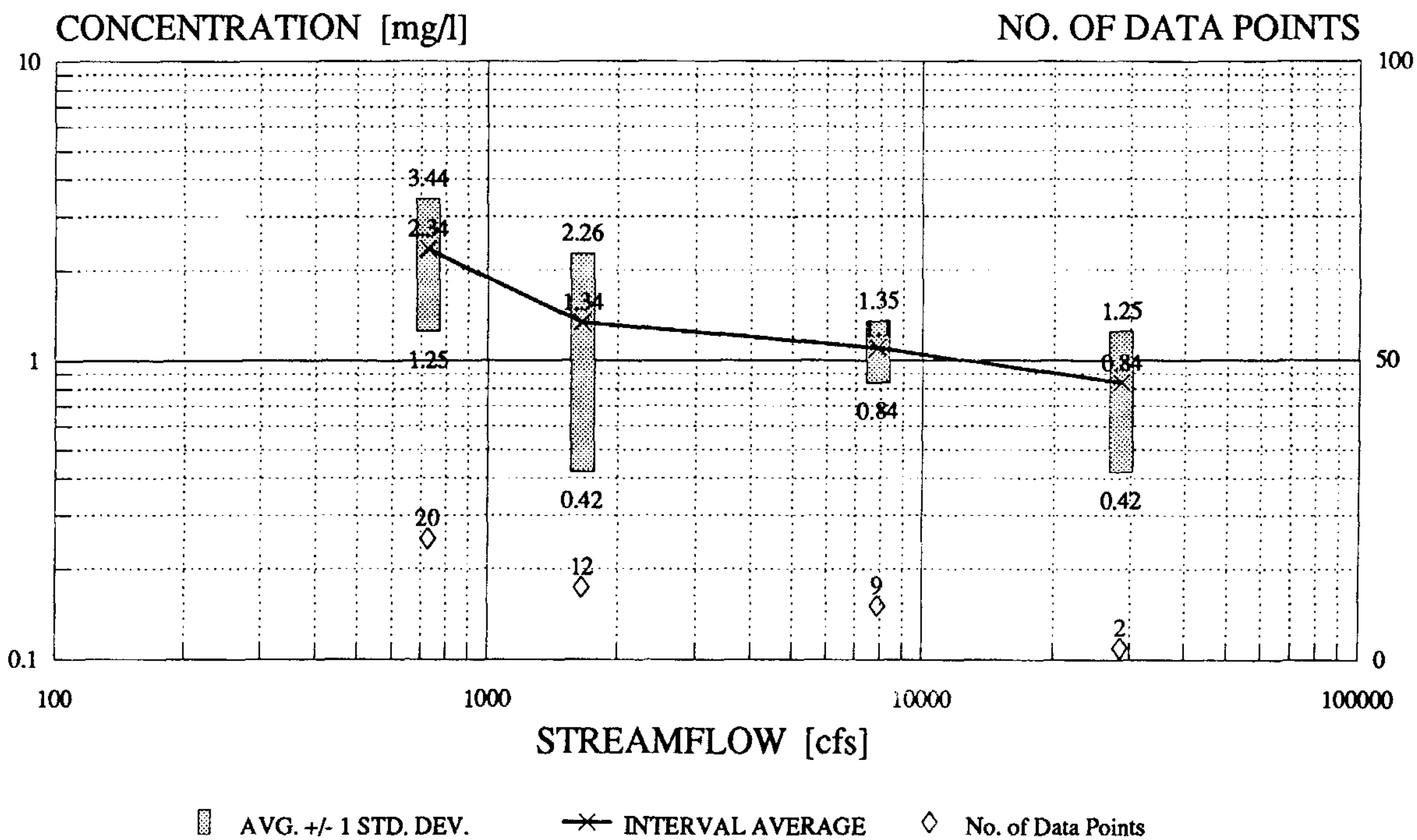
N7.WR1
11/15/91
307-1000

TABLE C-22

STATISTICAL ANALYSIS OF TOTAL ORGANIC NITROGEN CONCENTRATIONS IN TRINITY RIVER AT TRINIDAD

	STREAMFLOW INTERVAL (cfs)							
	0 - 1000		1000 - 3000		3000 - 20,000		> 20,000	
AVERAGE STREAMFLOW (cfs)	726		1,658		7,871		28,450	
	x1	y1	x2	y2	x3	y3	x4	y4
NO. OF DATA POINTS	20		12		9		2	
AVERAGE	2.38	0.76	1.38	0.11	1.10	0.06	0.84	-0.29
MAXIMUM	6.00		4.30		1.60		1.20	
MINIMUM	1.20		0.46		0.75		0.47	
STANDARD DEVIATION	1.28	0.44	1.07	0.61	0.26	0.23	0.36	0.47
COEFFICIENT OF VARIATION	0.538		0.773		0.236		0.437	
VARIANCE		0.193		0.366		0.054		0.220
E(X) = exp[Ybar + (Sy^2)/2] =		2.34		1.34		1.10		0.84
VAR(X) = Xbar^2 * [exp(Sy^2) - 1] =		1.20		0.84		0.07		0.17
STD(X) = SQRT[VAR(X)] =		1.10		0.92		0.26		0.41
CV(X) = SQRT[exp(Sy^2) - 1] =		0.462		0.665		0.236		0.496
E(X) + 1*STD(X) =		3.44		2.26		1.35		1.25
E(X) =		2.34		1.34		1.10		0.84
E(X) - 1*STD(X) =		1.25		0.42		0.84		0.42

TOTAL ORGANIC NITROGEN CONCENTRATION BY STREAMFLOW INTERVAL CLASS TRINITY RIVER AT TRINIDAD: 1980 - 1989



USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-27

II.B.6. DISSOLVED ORGANIC NITROGEN

DISSORG.WR1
03/27/91 kgl
307-1000

TABLE C-23

STATISTICAL ANALYSIS OF
DISSOLVED ORGANIC NITROGEN CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

DATE	STREAMFLOW (cfs)	x: DISSOLVED ORGANIC NITROGEN (mg/l)	y=ln(x): NATURAL LOG DISSOLVED ORGANIC NITROGEN ln(mg/l)
--07/15/80	490	1.5	0.41
11/05/80	558	1.4	0.34
01/09/80	560	4.2	1.44
08/10/81	562	1.4	0.34
02/18/81	562	ZERO (ND?)	
01/21/81	612	2.7	0.99
12/08/80	626	ZERO (ND?)	
04/13/81	641	1.5	0.41
09/11/80	667	1.2	0.18
09/08/81	727	1	0.00
06/03/80	753	0.8	-0.22
04/23/80	815	7.8	2.05
05/07/81	909	1	0.00
03/19/80	983	10	2.30
10/21/80	1000	1.1	0.10
--05/13/80	1040	1.4	0.34
03/10/81	2700	1.4	0.34
--02/12/80	4380	0.8	-0.22
--07/08/81	10500	0.62	-0.48
--06/10/81	21100	0.74	-0.30

Xbar =	2.03 mg/l	0.44	= Ybar
Xmax =	10.00 mg/l	0.75	= Sy
Xmin =	0.00 mg/l	0.57	= Sy^2
std	2.48		

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(X)	= exp[Ybar + (Sy^2)/2] =	2.07 mg/l
VAR(X)	= Xbar^2 * [exp(Sy^2) - 1] =	3.16
STD(X)	= SQRT[VAR(X)] =	1.78 mg/l
CV(X)	= SQRT[exp(Sy^2) - 1] =	0.88

E(X) + STD(X) =	3.850 mg/l
E(X) =	2.07 mg/l
E(X) - STD(X) =	0.30 mg/l

No. OF DATA POINTS 18

DISSOLVED ORG. NITROGEN VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989

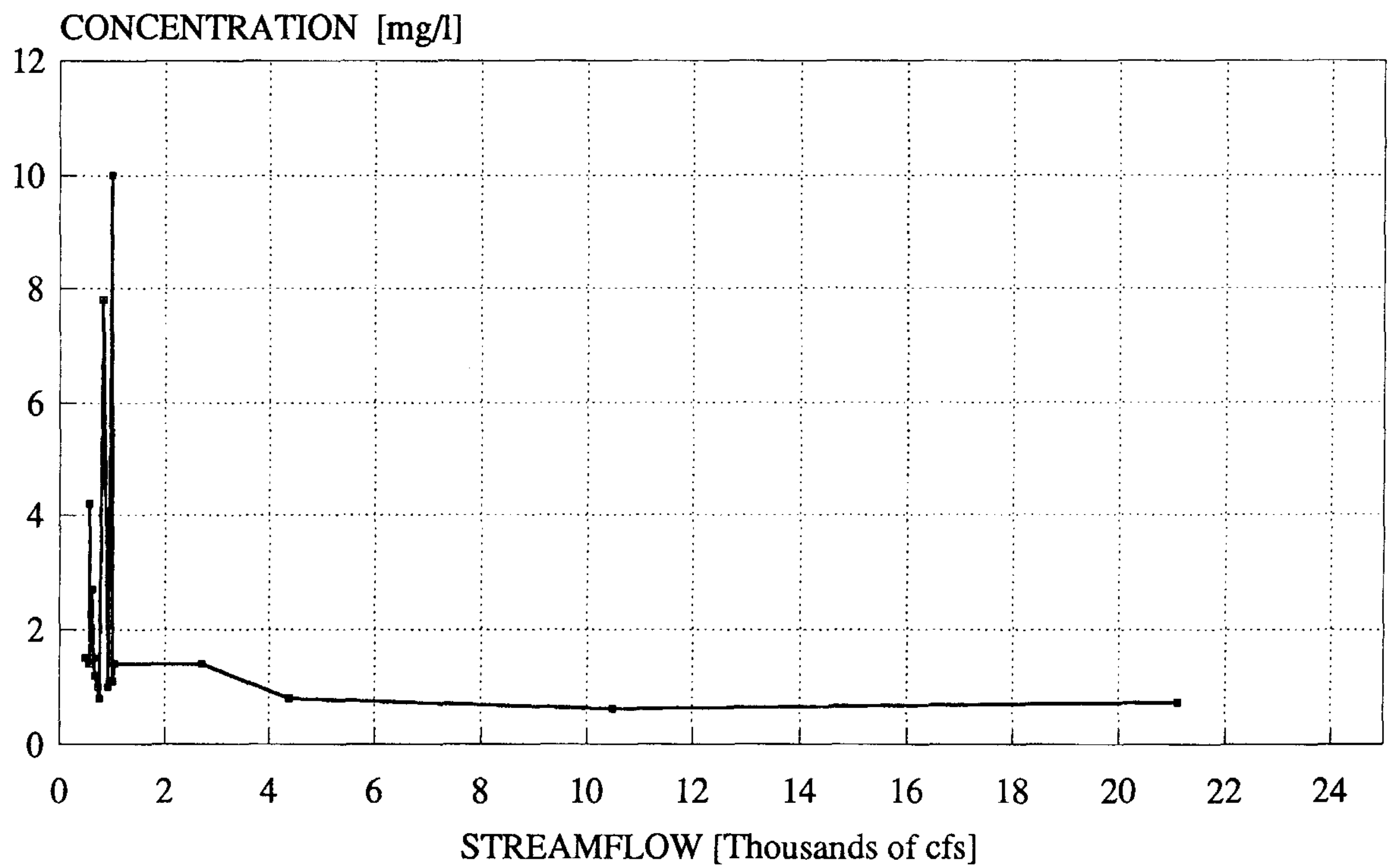


FIGURE C-28

DISSOLVED ORG. NITROGEN VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989

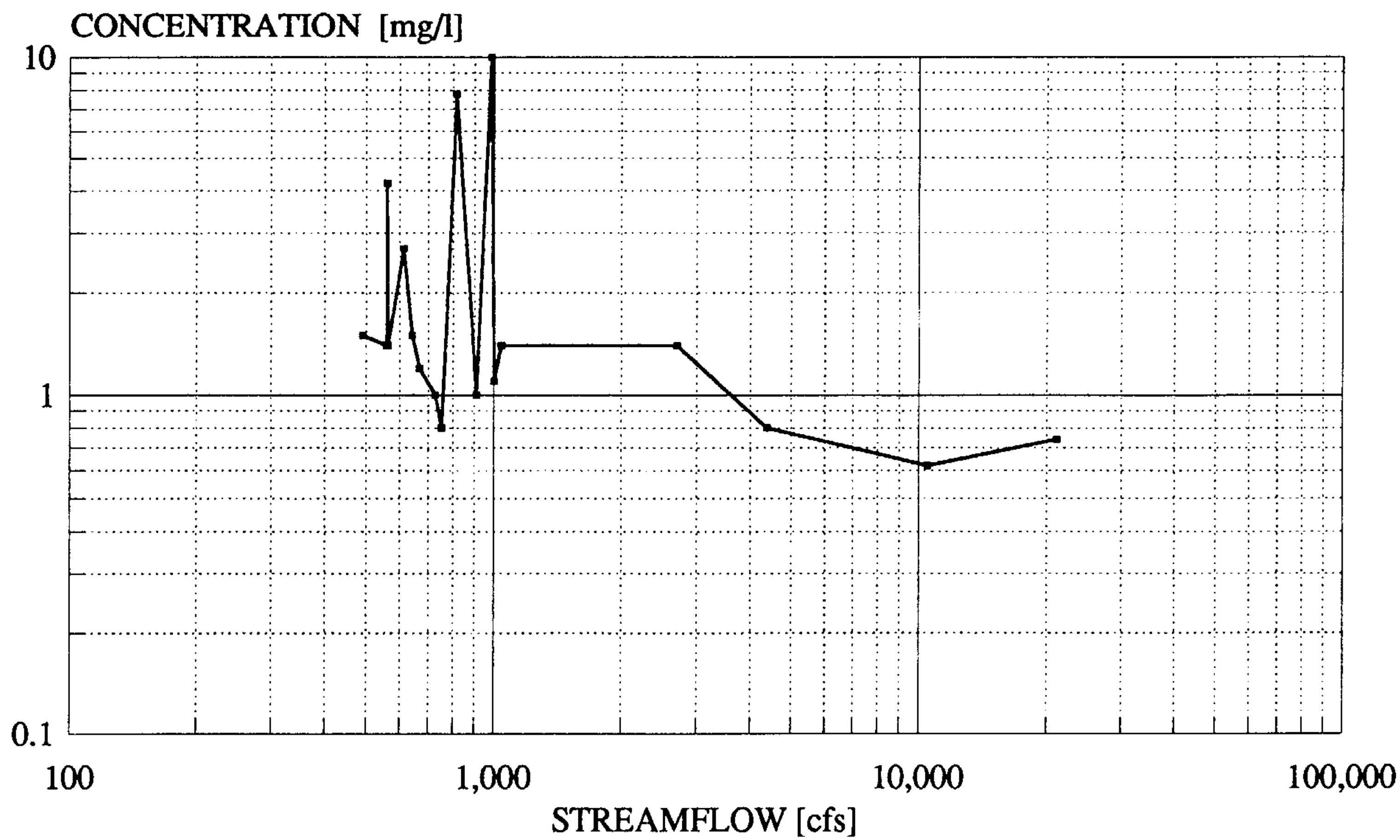


FIGURE C-29

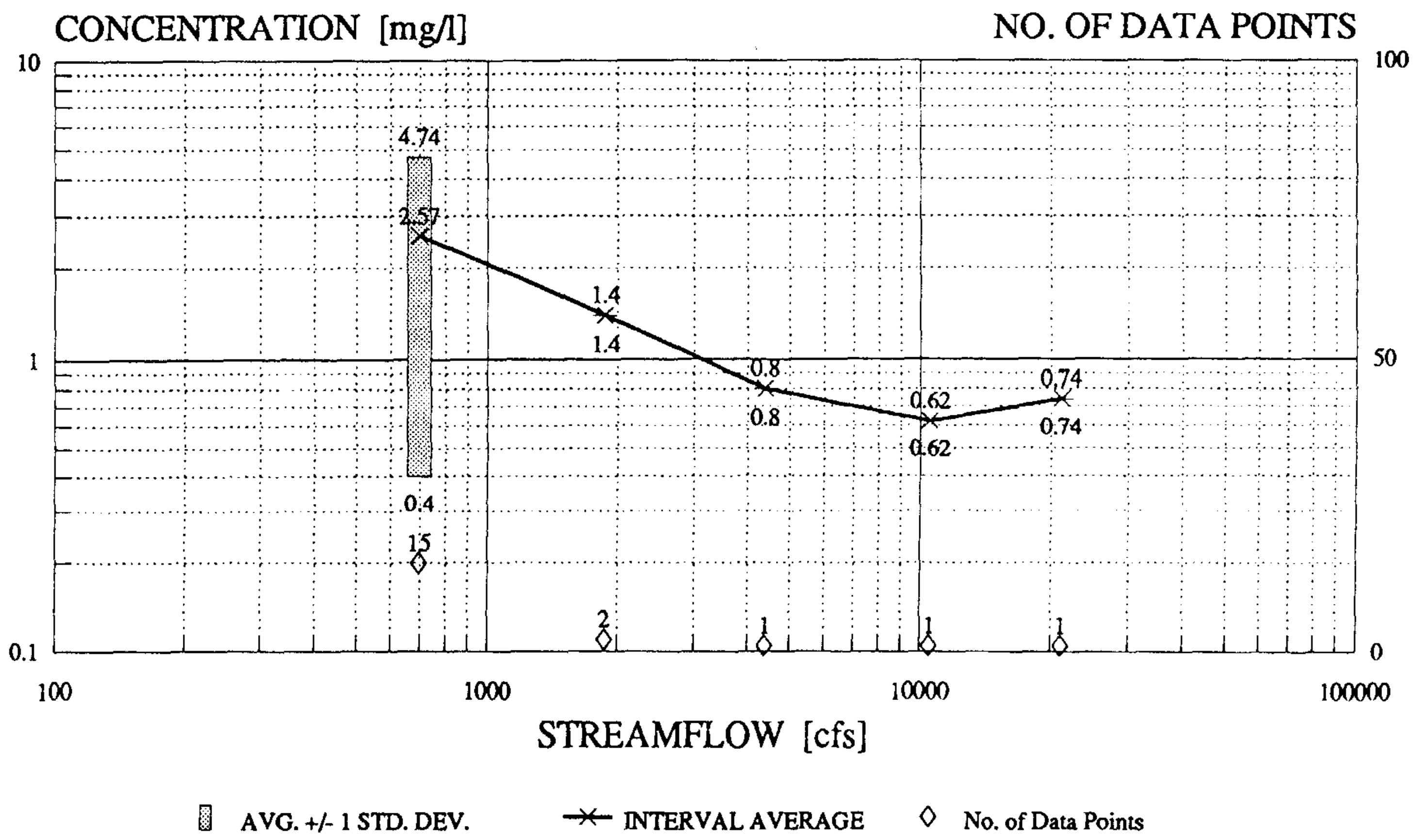
DISSORG.WR1
03/27/91 kgl
307-1000

TABLE C-24

STATISTICAL ANALYSIS OF
DISSOLVED ORGANIC NITROGEN CONCENTRATIONS
IN TRINITY RIVER AT TRINIDAD

	STREAMFLOW INTERVAL (cfs)										
	0 - 1000		1000 - 3000		3000 - 6000		6000 - 20,000		> 20,000		
AVERAGE STREAMFLOW (cfs)	698		1870		4380		10500		21,100		
	x1	y1	x2	y2	x3	y3	x4	y4	x5	y5	
NO. OF DATA POINTS	15		2		1		1		1		
AVERAGE (mg/l)	2.37	0.640	1.40	0.34	0.80	-0.22	0.62	-0.48	-0.30	-0.30	
MAXIMUM (mg/l)	10.00		1.40		0.80		0.62		-0.30		
MINIMUM (mg/l)	0.00		1.40		0.80		0.62		-0.30		
STANDARD DEVIATION (mg/l)	2.77	0.779	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COEFFICIENT OF VARIATION	1.167		0.00		0.000		0.000		0.000		
VARIANCE		0.607		0.00		0.000		0.000		0.000	
E(X), mg/l = exp[Ybar + (Sy^2)/2]	=	2.57		1.40		0.80		0.62		0.74	
VAR(X) = Xbar^2 * [exp(Sy^2) - 1]	=	4.70		0.00		0.00		0.00		0.00	
STD(X), mg/l = SQRT[VAR(X)]	=	2.17		0.00		0.00		0.00		0.00	
CV(X) = SQRT[exp(Sy^2) - 1]	=	0.913		0.000		0.000		0.000		0.000	
E(X) + 1*STD(X), mg/l	=	4.74		1.40		0.80		0.62		0.74	
E(X), mg/l	=	2.57		1.40		0.80		0.62		0.74	
E(X) - 1*STD(X), mg/l	=	0.40		1.40		0.80		0.62		0.74	
AVERAGE LOAD (lb/d)		9,661		14,111		18,886		35,088		84,158	

DISSOLVED ORGANIC NITROGEN CONCENTRATION BY STREAMFLOW INTERVAL CLASS TRINITY RIVER AT TRINIDAD: 1980 - 1989



USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-30

III. SOLIDS & BACTERIOLOGICAL DATA

III.A. SUMMARY OF ANALYSIS

TABLE C-25

EXPECTED VALUES FOR TSS AND FECAL COLIFORM BY STREAM FLOW INTERVALS TRINITY RIVER AT TRINIDAD: 1980-1989

Parameter designation	Parameter name	Stream Flow Interval (cfs)			
		0-1,000	1,000-3,000	3,000-10,000	>10,000
TSS[1]	Total suspended solids, (mg/L)	57.5	275.5	341.6	241.0
FC[2]	Fecal coliform, (col/100 ml)	89	305	291	406

[1]Expected values calculated assuming the data to be lognormally distributed.

[2]Values shown are the geometric mean for the given flow interval.

III.B. TOTAL SUSPENDED SOLIDS

TSS_QINT.WR TABLE C-26
04/15/91 kgl
307-1000

STATISTICAL ANALYSIS OF
TOTAL SUSPENDED SOLIDS
IN TRINITY RIVER AT TRINIDAD

		x	y=ln(x)
DATE	STREAMFLOW	TSS	NATURAL LOG OF TSS
	(cfs)	(mg/l)	ln(mg/l)
07/15/80	490	71	4.263
08/20/80	496	65	4.174
11/05/80	558	18	2.890
01/09/80	560	25	3.219
02/18/81	562	16	2.773
08/10/81	562	43	3.761
09/17/84	566	76	4.331
01/21/81	612	14	2.639
11/16/88	614	56	4.025
12/08/80	626	54	3.989
11/03/87	635	44	3.784
04/13/81	641	56	4.025
09/11/80	667	47	3.850
09/08/81	727	81	4.394
01/11/89	740	31	3.434
06/03/80	753	54	3.989
09/01/87	790	57	4.043
01/10/84	813	11	2.398
04/23/80	815	89	4.489
03/29/88	895	31	3.434
05/07/81	909	152	5.024
07/12/88	946	28	3.332
03/19/80	983	191	5.252
--10/21/80	1000	546	6.303
05/13/80	1040	183	5.209
05/08/84	1060	115	4.745
09/07/88	1060	267	5.587
10/25/82	1100	131	4.875
02/13/85	1160	41	3.714
06/07/88	1170	259	5.557
07/22/86	1260	274	5.613
01/05/88	1310	84	4.431
01/18/83	1320	108	4.682
06/25/85	1380	599	6.395
11/13/85	1400	206	5.328
01/29/86	1440	13	2.565
10/17/84	1560	341	5.832
08/29/89	1760	233	5.451
11/12/86	2030	155	5.043
01/08/85	2270	268	5.591
07/14/87	2300	134	4.898
06/07/83	2390	520	6.254
09/09/86	2420	300	5.704
03/10/81	2700	435	6.075

TSS_QINT.WR TABLE C-26
04/15/91 kgl
307-1000 STATISTICAL ANALYSIS OF
TOTAL SUSPENDED SOLIDS
IN TRINITY RIVER AT TRINIDAD

DATE	STREAMFLOW (cfs)	x TSS (mg/l)	y=ln(x) NATURAL LOG OF TSS ln(mg/l)	
04/14/87	3580	167	5.118	
03/01/83	3870	379	5.938	
04/13/89	4210	233	5.451	
02/12/80	4380	198	5.288	
01/21/87	6420	244	5.497	
04/15/86	6800	415	6.028	
06/09/87	8450	222	5.403	
05/14/85	8860	945	6.851	
--03/27/84	10400	402	5.996	
07/08/81	10500	380	5.940	
07/18/89	12200	217	5.380	
06/17/86	14300	101	4.615	
06/10/81	21100	238	5.472	
06/14/89	35800	64	4.159	
Xbar =		185 mg/l	4.73	= Ybar
Xmax =		945 mg/l	1.07	= Sy
Xmin =		11 mg/l	1.15	= Sy^2
std		177		

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(X) = exp[Ybar + (Sy^2)/2]	=	202 mg/l
VAR(X) = Xbar^2 * [exp(Sy^2) - 1]	=	73,645
STD(X) = SQRT[VAR(X)]	=	271 mg/l
CV(X) = SQRT[exp(Sy^2) - 1]	=	1.467

E(X) + STD(X) =	473 mg/l
E(X) =	202 mg/l
E(X) - STD(X) =	0 mg/l

Number of data points-> 58

TOTAL SUSPENDED SOLIDS VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989

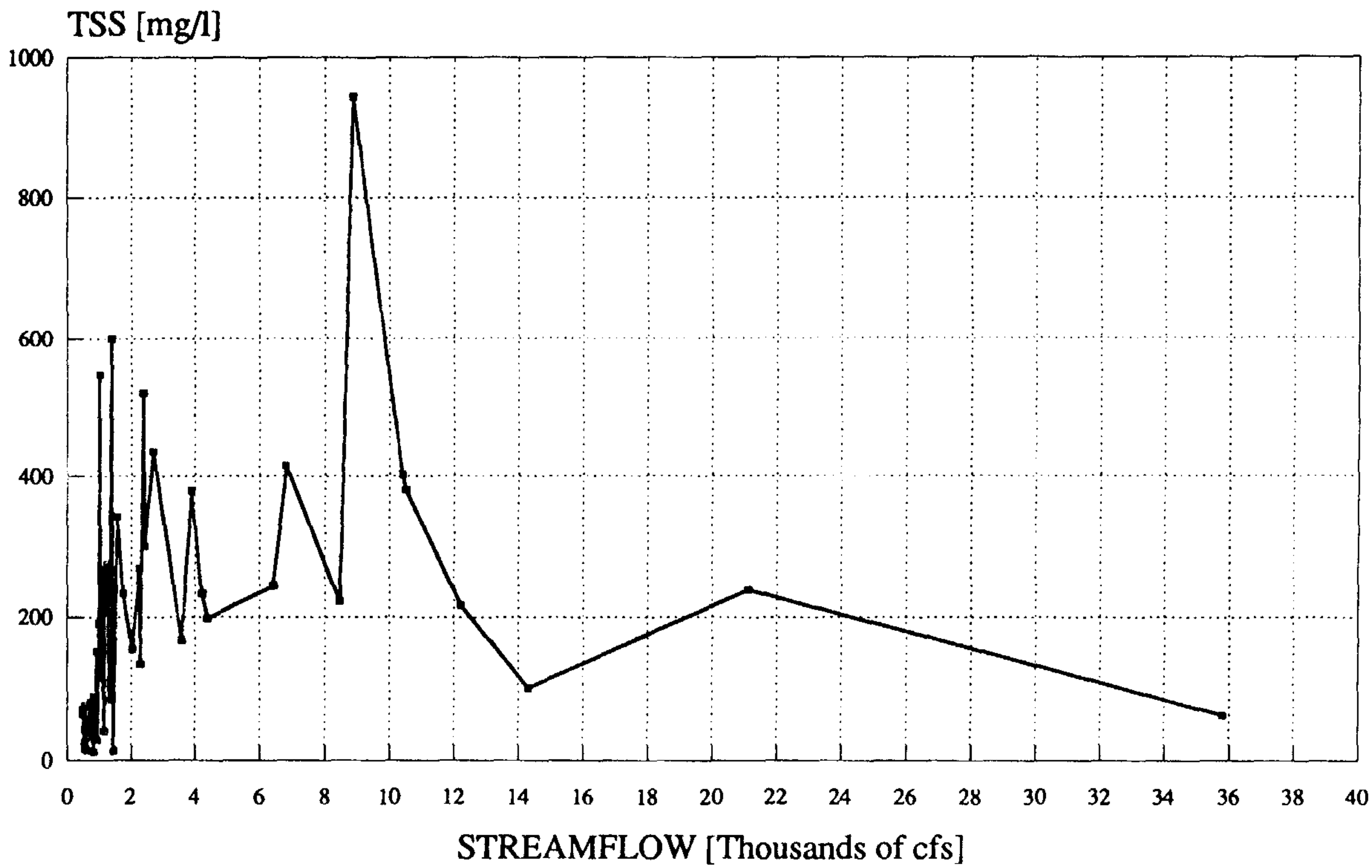


FIGURE C-31

TOTAL SUSPENDED SOLIDS VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989

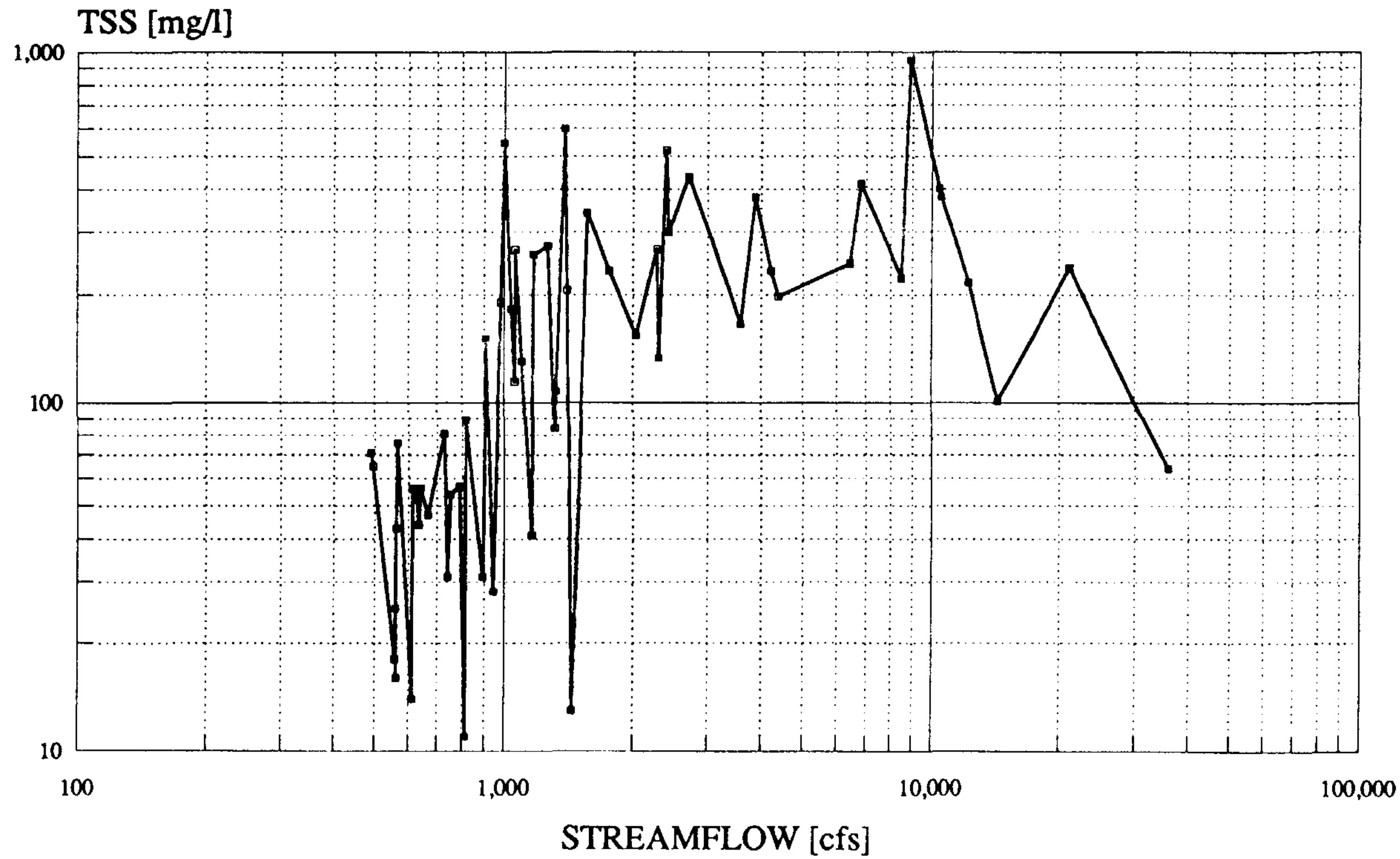


FIGURE C-32

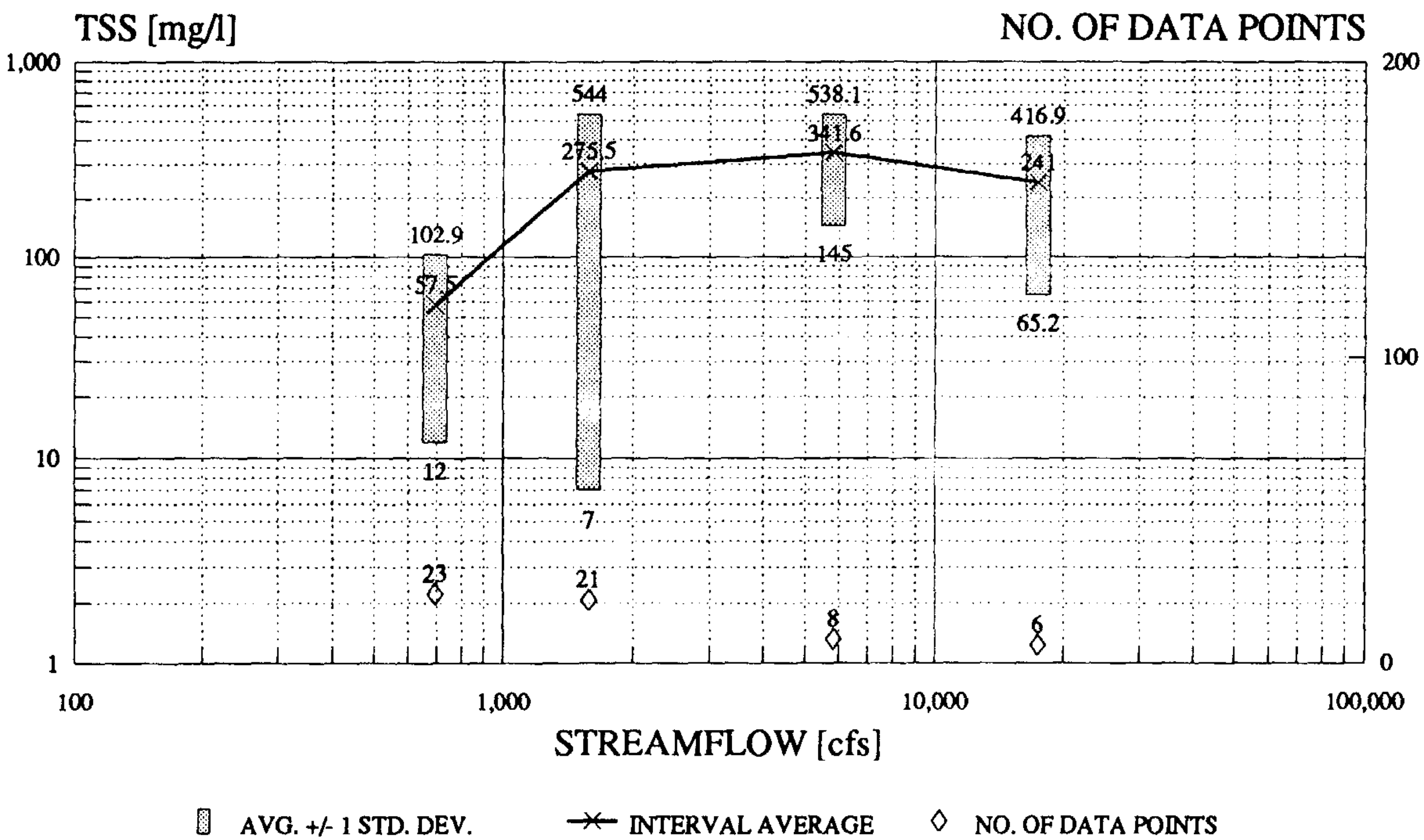
TSS_QINT.WR1
04/15/91 kgl
307-1000

TABLE C-27

STATISTICAL ANALYSIS OF
TOTAL SUSPENDED SOLIDS IN
TRINITY RIVER BY STREAMFLOW INTERVAL

		STREAMFLOW INTERVAL (cfs)							
		0 - 1,000		1,000 - 3,000		3,000 - 10,000		> 10,000	
AVERAGE STREAMFLOW (cfs)		694		1,578		5,821		17,383	
		x1	y1	x2	y2	x3	y3	x4	y4
NO. OF DATA POINTS		23		21		8		6	
AVERAGE (mg/l)		57.0	3.80	248	5.23	350	5.70	234	5.26
MAXIMUM (mg/l)		191		599		945		402	
MINIMUM (mg/l)		11		13		167		64	
STANDARD DEVIATION (mg/l)		41.7	0.70	160	0.88	239	0.52	127	0.67
COEFFICIENT OF VARIATION		0.73		0.64		0.68		0.54	
VARIANCE			0.49		0.78		0.27		0.45
E(X), mg/l = exp[Ybar + (Sy^2)/2]	=		57.5		275		342		241
VAR(X) = Xbar^2 * [exp(Sy^2) - 1]	=		2,064		72,110		38,638		30,927
STD(X), mg/l = SQRT[VAR(X)]	=		45.4		269		197		176
CV(X) = SQRT[exp(Sy^2) - 1]	=		0.798		1.082		0.561		0.753
E(X) + 1*STD(X), mg/l	=		102.9		544.0		538.1		416.9
E(X), mg/l	=		57.5		275.5		341.6		241.0
E(X) - 1*STD(X), mg/l	=		12.0		7.0		145.0		65.2

TOTAL SUSPENDED SOLIDS
BY STREAMFLOW INTERVAL CLASS
TRINITY RIVER AT TRINIDAD: 1980 - 1989



USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-33

III.C. FECAL COLIFORM

FC_QINT.WR1
04/18/91 kgl
307-1000

TABLE C-28

STATISTICAL ANALYSIS OF
FECAL COLIFORM COUNTS
IN TRINITY RIVER AT TRINIDAD

		x		y=ln(x)
DATE	STREAMFLOW (cfs)	FECAL COLIFORM (col/100 ml)		NATURAL LOG OF FECAL COLIFORM ln(col/100 ml)
07/15/80	490	21		3.045
08/20/80	496	280		5.635
11/05/80	558	53		3.970
01/09/80	560	48		3.871
02/18/81	562	13	K	2.565
08/10/81	562	62		4.127
09/17/84	566	48		3.871
01/21/81	612	50		3.912
11/16/88	614	93	K	4.533
12/08/80	626	60	K	4.094
11/03/87	635	30	K	3.401
04/13/81	641	200		5.298
06/19/84	654	80		4.382
09/11/80	667	4000		8.294
09/07/83	672	2400		7.783
09/08/81	727	120		4.787
01/11/89	740	14	K	2.639
06/03/80	753	32		3.466
09/01/87	790	110		4.700
01/10/84	813	94	K	4.543
04/23/80	815	61		4.111
03/29/88	895	44		3.784
05/07/81	909	320		5.768
07/12/88	946	150		5.011
04/20/83	951	23		3.135
03/19/80	983	400		5.991
-- 10/21/80	1000	960		6.867
05/13/80	1040	140		4.942
05/08/84	1060	560		6.328
09/07/88	1060	1000		6.908
10/25/82	1100	96		4.564
06/07/88	1170	220		5.394
07/22/86	1260	180	K	5.193
01/05/88	1310	65		4.174
01/18/83	1320	260		5.561
11/13/85	1400	1000		6.908
01/29/86	1440	200		5.298
10/17/84	1560	200		5.298
08/29/89	1760	27	K	3.296
11/12/86	2030	530		6.273
01/08/85	2270	1000		6.908
07/14/87	2300	40		3.689
06/07/83	2390	280		5.635
09/09/86	2420	250		5.521

FC_QINT.WR1
04/18/91 kgl
307-1000

TABLE C-28

STATISTICAL ANALYSIS OF
FECAL COLIFORM COUNTS
IN TRINITY RIVER AT TRINIDAD

	DATE	STREAMFLOW (cfs)	x FECAL COLIFORM (col/100 ml)		y=ln(x) NATURAL LOG OF FECAL COLIFORM ln(col/100 ml)
	03/10/81	2700	270		5.598
	09/17/85	2890	4350		8.378
	11/29/83	2940	1600		7.378
--	04/14/87	3580	58		4.060
	03/01/83	3870	360		5.886
	04/13/89	4210	68	K	4.220
	02/12/80	4380	1300		7.170
	01/19/82	6320	420		6.040
	01/21/87	6420	430		6.064
	04/15/86	6800	440		6.087
	08/03/82	7400	150	K	5.011
	06/09/87	8450	180		5.193
	03/02/82	9030	1100		7.003
--	03/27/84	10400	700		6.551
	07/08/81	10500	700		6.551
	07/18/89	12200	170		5.136
	06/17/86	14300	380		5.940
	06/10/81	21100	150		5.011
	03/18/82	22000	1000		6.908
	11/09/81	35000	350		5.858
	06/14/89	35800	440		6.087

Xbar, col/100 ml =	468.15	5.26	= Ybar
Xmax, col/100 ml =	4350.00	1.34	= Sy
Xmin, col/100 ml =	13.00	1.81	= Sy^2
std	790		

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

GEOMETRIC MEAN = exp[Ybar]	=	192 col/100 ml
VAR(X) = Xbar^2 * [exp(Sy^2) - 1]	=	1,116,778
STD(X) = SQRT[VAR(X)]	=	1,057 col/100 ml
CV(X) = SQRT[exp(Sy^2) - 1]	=	2.257
90th PERCENTILE VALUE	=	1073 col/100 ml
GEOMETRIC MEAN	=	192 col/100 ml
10th PERCENTILE VALUE	=	34 col/100 ml

Number of data points-> 65

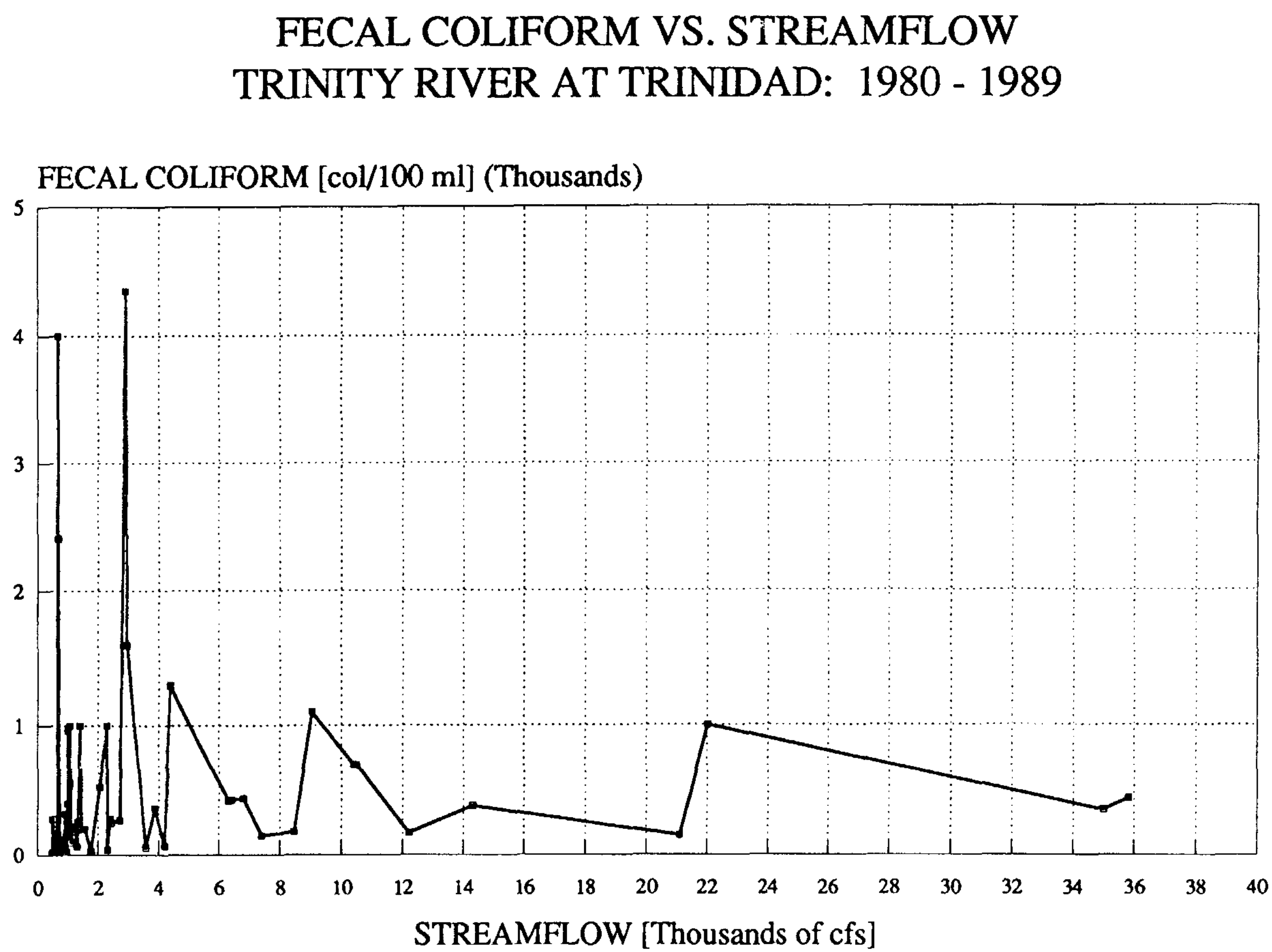

FECAL COLIFORM VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
FECAL COLIFORM [col/100 ml] (Thousands)
5
4
3
2
1
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
STREAMFLOW [Thousands of cfs]

FIGURE C-34

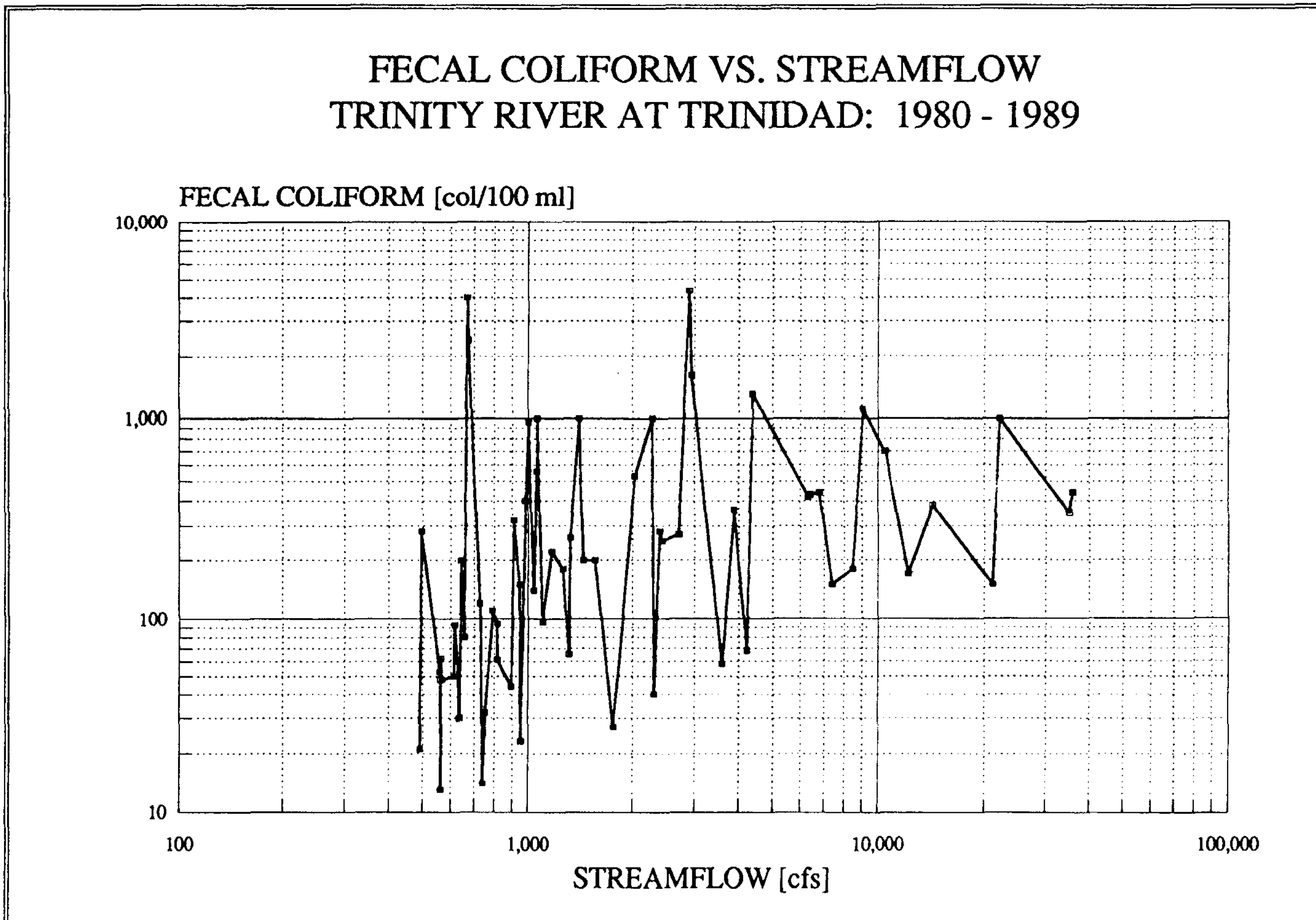

FECAL COLIFORM VS. STREAMFLOW
TRINITY RIVER AT TRINIDAD: 1980 - 1989
FECAL COLIFORM [col/100 ml]
10,000
1,000
100
10
100
1,000
10,000
100,000
STREAMFLOW [cfs]

FIGURE C-35

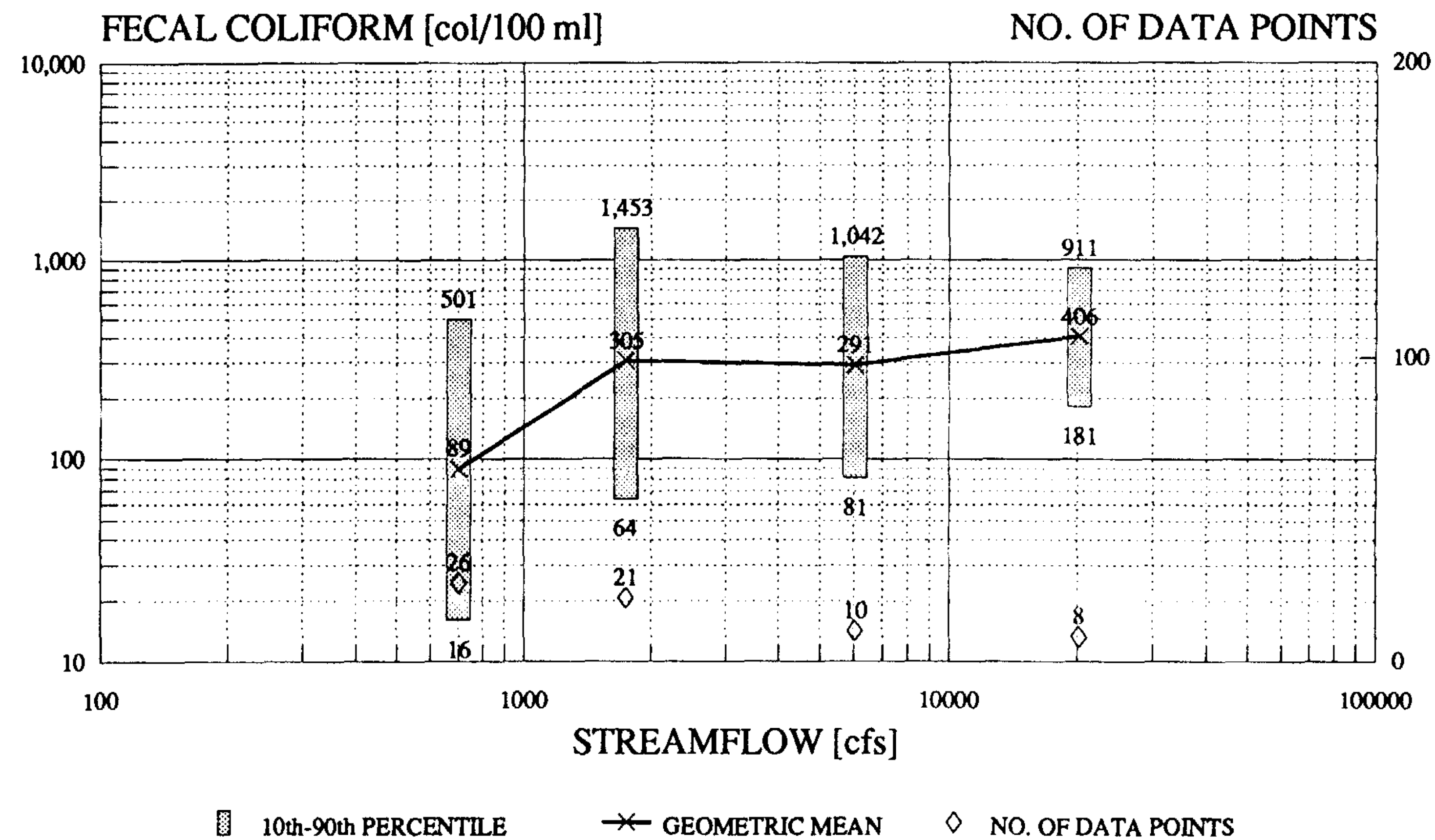
FC_QINT.WR1
04/18/91 kgl
307-1000

TABLE C-29

STATISTICAL ANALYSIS OF
FECAL COLIFORM COUNTS IN
TRINITY RIVER BY STREAMFLOW INTERVAL

	STREAMFLOW INTERVAL (cfs)							
	0 - 1,000		1,000 - 3,000		3,000 - 10,000		> 10,000	
AVERAGE STREAMFLOW (cfs)	701		1,734		6,046		20,163	
	x1	y1	x2	y2	x3	y3	x4	y4
NO. OF DATA POINTS	26		21		10		8	
AVERAGE (col/100 ml)	339	4.49	630	5.72	451	5.67	486	6.01
MAXIMUM (col/100 ml)	4,000		4,350		1,300		1,000	
MINIMUM (col/100 ml)	13		27		58		150	
STANDARD DEVIATION (col/100 ml)	861	1.35	930	1.22	402	0.99	274	0.63
COEFFICIENT OF VARIATION	2.54		1.48		0.89		0.56	
VARIANCE		1.81		1.49		0.99		0.40
GEOMETRIC MEAN, col/100 ml = exp[Ybar] =		89		305		291		406
VAR(X) = Xbar^2 * [exp(Sy^2) - 1] =		589,456		1,355,811		343,214		115,765
STD(X), col/100 ml = SQRT[VAR(X)] =		768		1,164		586		340
CV(X) = SQRT[exp(Sy^2) - 1] =		2.267		1.849		1.300		0.700
90th PERCENTILE VALUE, col/100 ml =		501		1,453		1,042		911
GEOMETRIC MEAN, col/100 ml =		89		305		291		406
10th PERCENTILE VALUE, col/100 ml =		16		64		81		181

FECAL COLIFORM COUNT
BY STREAMFLOW INTERVAL CLASS
TRINITY RIVER AT TRINIDAD: 1980 - 1989



USGS GAGE NO. 08062700
TWC STATION NO. 0804.0600

FIGURE C-36

IV. METALS

IV.A. SUMMARY OF ANALYSIS

TABLE C-30

SUMMARY OF METALS CONCENTRATIONS
TRINITY RIVER AT TRINIDAD: 1980-1989

Dissolved Metal	Total Number of Samples	Pct. Samples Below Detect. Limits	E(x)-1 Std(x)[1]	E(x)[1] (ug/l)	E(x)+1 Std.(x)[1]	Percentile[2] (ug/l) 50th	90th	99th	Stream Standards (ug/l) Acute	Chronic
Arsenic	87	37.9%	1.8	4.0	6.2	2.1	6.5	16	360	190
Cadmium	85	78.8%	0	5.9	23.0	0.015	1.5	55	37.5[3]	1.22[3]
Copper	89	50.6%	2.1	5.8	9.5	2.7	7.8	19	21.0[3]	13.9[3]
Lead	89	67.4%	0	8.6	21.3	0.14	7.0	110	92.2[3]	1.28[3]
Mercury	89	80.9%	0.08	0.28	0.48	0.016	0.19	1.4	2.4	1.3
Selenium	89	86.5%	1.1	2.2	3.2	0.16	1.1	5	20	5
Zinc	96	11.5%	3.0	25.9	48.8	19	30	125	126.9[3]	114.9[3]

[1]E(x) = expected (or average) concentration based upon only the sample concentrations above the detection limits.

Std(x) = standard deviation of the data based upon only the sample concentrations above the detection limits. These values were calculated assuming the data were log-normally distributed.

[2]Percentile values were determined considering all the data, including concentrations that were below detection limits. The data was assumed to be log-normally distributed.

[3]Standard calculated based on a hardness of 110 mg/L.

IV.B.1. ARSENIC

ASSTAT.WR1
03/28/91
307-1000

TABLE C-31

STATISTICAL ANALYSIS OF
DISSOLVED ARSENIC CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

Date	x Dissolved arsenic conc. (ug/L)	y=ln(x) Natural log of dissolved arsenic conc. ln(ug/L)
USGS 01/21/87	3	1.099
USGS 11/03/87	3	1.099
USGS 10/25/82	3	1.099
USGS 01/05/88	3	1.099
USGS 04/20/83	3	1.099
USGS 09/17/85	3	1.099
USGS 08/03/82	3	1.099
USGS 11/16/88	3	1.099
USGS 11/13/85	3	1.099
USGS 06/20/88	3	1.099
USGS 12/12/88	3.3	1.194
USGS 02/15/88	3.7	1.308
USGS 07/14/87	4	1.386
USGS 11/12/86	4	1.386
USGS 06/24/84	4	1.386
USGS 08/29/89	4	1.386
USGS 09/17/84	4	1.386
USGS 05/05/87	5.6	1.723
USGS 05/05/87	5.7	1.740
USGS 05/05/87	5.91	1.777
USGS 05/05/87	6	1.792
USGS 09/07/83	6	1.792
USGS 08/10/87	6	1.792
USGS 05/05/87	6	1.792
USGS 07/10/84	6	1.792
USGS 05/05/87	6.3	1.841
USGS 05/04/87	6.48	1.869
05/04/87	6.53	1.876
05/05/87	6.9	1.932
09/04/81	6.9	1.932
04/13/87	7	1.946
05/05/87	7.7	2.041
09/06/81	9.45	2.246
09/03/81	12.11	2.494
Xbar=	3.996	1.247 = Ybar
Xmax=	12.11	0.519 = Sy
Xmin=	1.11	0.269 = Sy^2

ASSTAT.WR1
03/28/91
307-1000

TABLE C-31

STATISTICAL ANALYSIS OF
DISSOLVED ARSENIC CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

==

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

==

E(x) = exp[Ybar + (Sy^2)/2] =	3.980 ug/l
VAR(x) = xbar^2 * [exp(Sy^2) - 1] =	4.935
STD(x) = SQRT[VAR(x)] =	2.221 ug/l
CV(x) = SQRT[exp(Sy^2) - 1] =	0.556

==

E(x) =	3.980 ug/l
E(x) + STD(x) =	6.202 ug/l
E(x) - STD(x) =	1.759 ug/l

Percent of samples below detectable limits -> 37.9
Total number of samples -> 87

ND = Non-Detectable concentration

PROBABILITY PLOT FOR DISSOLVED ARSENIC
TRINITY RIVER AT TRINIDAD
1980 - 1989

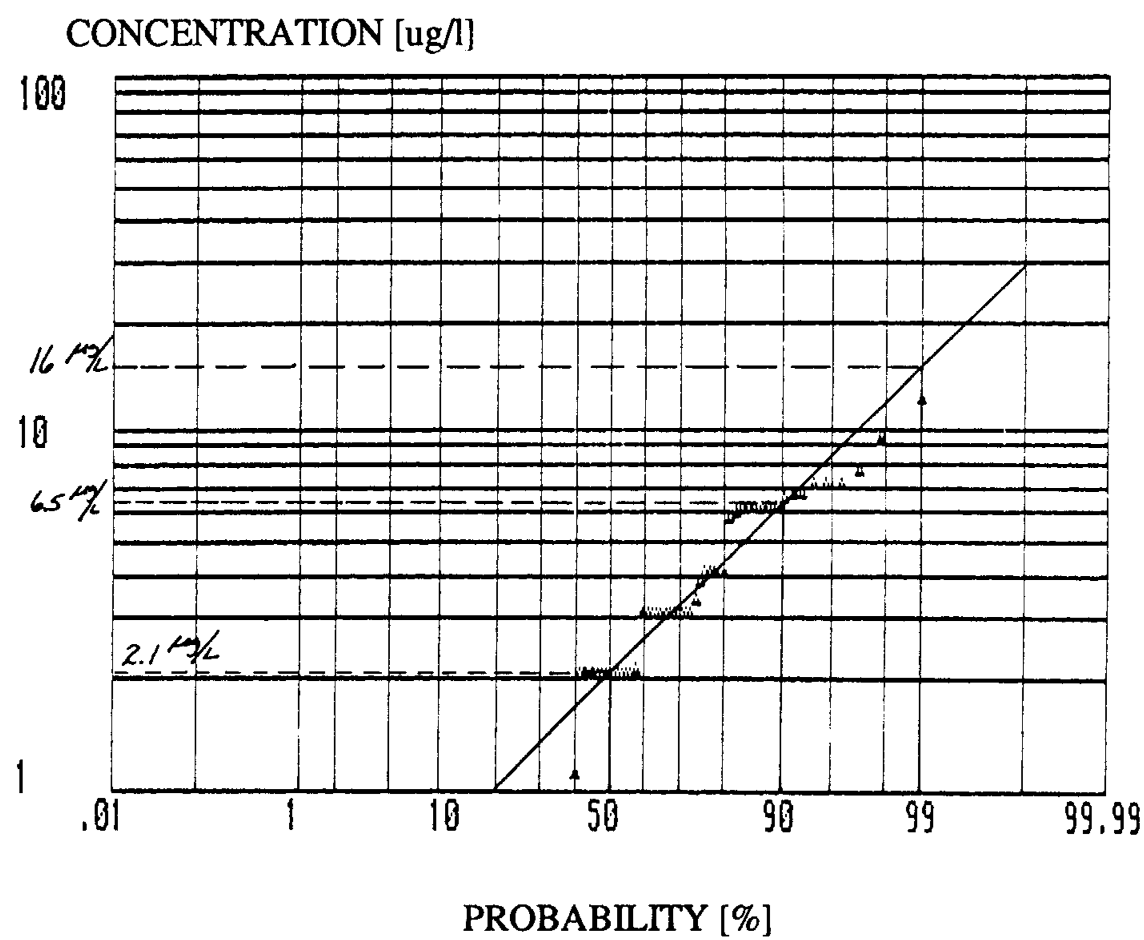


FIGURE C-37

ASSTAT.WR1 TABLE C-31
03/28/91
307-1000

STATISTICAL ANALYSIS OF
DISSOLVED ARSENIC CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

	x	y=ln(x)
Date	Dissolved arsenic conc. (ug/L)	Natural log of dissolved arsenic conc. ln(ug/L)
05/05/87	ND	
05/05/87	ND	
05/06/87	ND	
05/06/87	ND	
05/05/87	ND	
08/04/81	ND	
05/06/87	ND	
05/07/87	ND	
05/06/87	ND	
05/05/87	ND	
08/19/81	ND	
05/05/87	ND	
05/07/87	ND	
05/05/87	ND	
11/05/87	ND	
09/08/88	ND	
05/06/87	ND	
05/05/87	ND	
05/06/87	ND	
05/06/87	ND	
05/05/87	ND	
05/05/87	ND	
05/07/87	ND	
05/06/87	ND	
08/10/87	ND	
05/02/84	ND	
05/05/87	ND	
05/07/87	ND	
05/07/87	ND	
05/06/87	ND	
05/05/87	ND	
05/06/87	ND	
05/06/87	ND	
08/21/81	1.11	0.104
05/14/85	2	0.693
08/20/81	2	0.693
11/09/81	2	0.693
01/18/83	2	0.693
03/08/84	2	0.693
06/14/89	2	0.693
04/14/87	2	0.693
01/11/89	2	0.693
04/15/86	2	0.693
05/18/82	2	0.693
10/17/84	2	0.693
01/19/82	2	0.693
01/21/87	2	0.693
USGS 01/10/84	2	0.693
USGS 01/29/86	2	0.693
USGS 09/02/81	2.07	0.728
USGS 09/07/88	3	1.099
USGS 06/07/88	3	1.099
USGS 11/29/83	3	1.099

IV.B.2. CADMIUM

CDSTAT.WR1
03/28/91
307-1000

TABLE C-32

STATISTICAL ANALYSIS OF
DISSOLVED CADMIUM CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

		x	y=ln(x)	
	Date	Dissolved cadmium conc.	Natural log of dissolved cadmium	
		ug/L	ln(ug/L)	
	05/07/87	ND		
USGS	8/3/82	ND		
	05/05/87	ND		
USGS	10/25/82	ND		
	05/05/87	ND		
USGS	1/18/83	ND		
	05/06/87	ND		
USGS	4/20/83	ND		
	05/05/87	ND		
USGS	9/17/82	ND		
	05/05/87	ND		
	05/05/87	ND		
	08/20/81	ND		
USGS	11/29/83	ND		
	12/12/88	0.32	-1.139	
USGS	4/15/86	1	0.000	
	09/04/81	1	0.000	
USGS	4/13/81	1	0.000	
USGS	9/7/88	1	0.000	
	08/19/81	1	0.000	
USGS	6/7/88	1	0.000	
USGS	1/10/84	1	0.000	
USGS	11/16/88	1	0.000	
	08/21/81	2	0.693	
USGS	10/21/80	2	0.693	
	07/10/84	4	1.386	
	08/04/81	4	1.386	
	05/02/84	5	1.609	
	09/03/81	6	1.792	
	09/02/81	9	2.197	
	09/06/81	27	3.296	
	06/24/84	74	4.304	
	Xbar=	7.851	0.901	= Ybar
	Xmax=	74	1.323	= Sy
	Xmin=	0.32	1.750	= Sy^2

PROBABILITY PLOT FOR DISSOLVED CADMIUM
TRINITY RIVER AT TRINIDAD
1980 - 1989

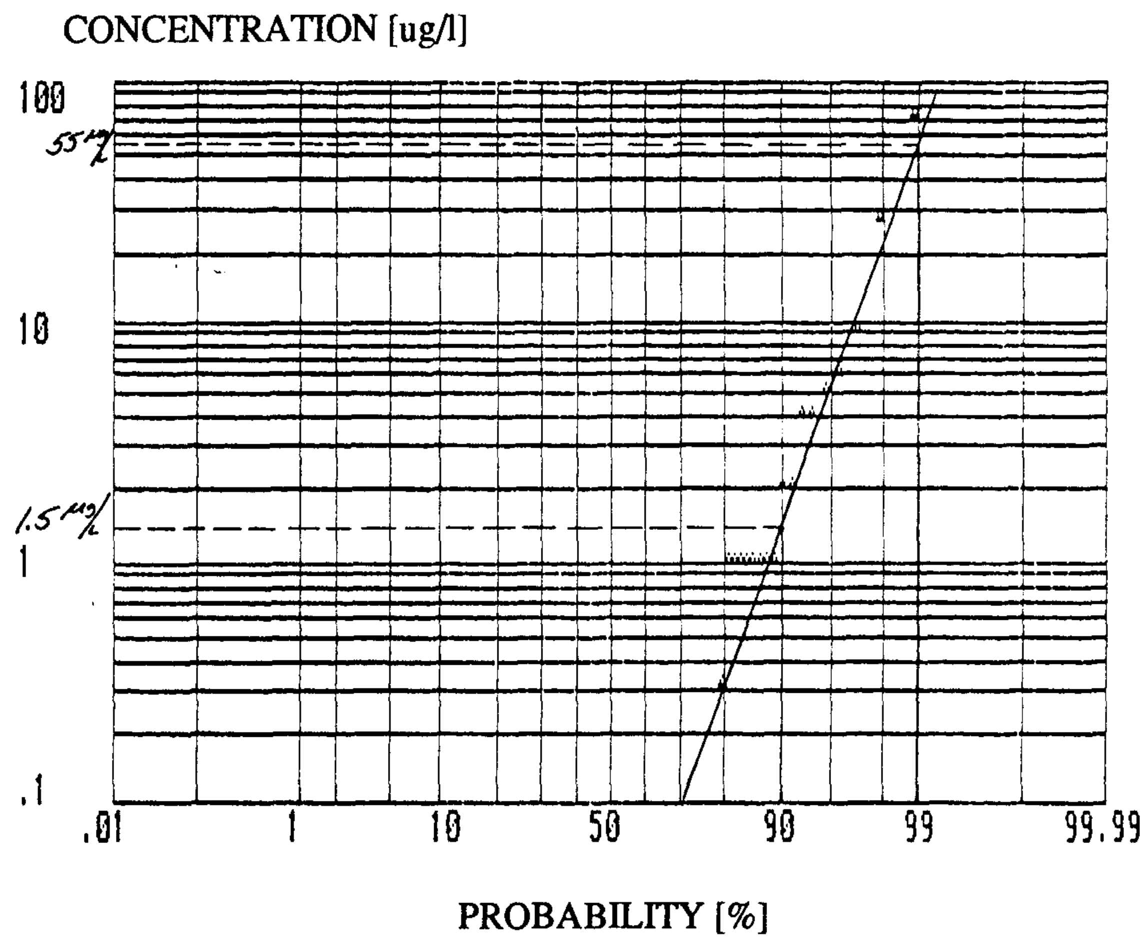


FIGURE C-38

IV.B.3. COPPER

CUSTAT.WR1
03/28/91
307-1000

TABLE C-33

STATISTICAL ANALYSIS OF
DISSOLVED COPPER CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

	x	y=ln(x)
Date	Dissolved copper conc. (ug/L)	Natural log of dissolved copper conc. ln(ug/L)
05/05/87	ND	
05/05/87	ND	
8/3/82	ND	
02/15/88	ND	
05/06/87	ND	
05/05/87	ND	
05/06/87	ND	
05/04/87	ND	
05/07/87	ND	
05/06/87	ND	
05/06/87	ND	
05/05/87	ND	
05/07/87	ND	
05/06/87	ND	
11/05/87	ND	
05/07/87	ND	
06/20/88	ND	
05/06/87	ND	
12/12/88	ND	
09/08/88	ND	
05/04/87	ND	
05/06/87	ND	
05/05/87	ND	
05/05/87	ND	
05/05/87	ND	
05/05/87	ND	
05/06/87	ND	
08/10/87	ND	
05/07/87	ND	
05/06/87	ND	
05/06/87	ND	
05/05/87	ND	
05/05/87	ND	
05/06/87	ND	
05/05/87	ND	
05/05/87	ND	
05/05/87	ND	
05/05/87	ND	
05/07/87	ND	
2/13/85	ND	
05/05/87	ND	
05/05/87	ND	
05/05/87	ND	
05/05/87	ND	
05/05/87	ND	
1/29/86	1	0.000
11/3/87	2	0.693
1/18/83	2	0.693
7/14/87	2	0.693
5/14/87	2	0.693
6/14/89	2	0.693
4/20/83	3	1.099

CUSTAT.WR1
03/28/91
307-1000

TABLE C-33

STATISTICAL ANALYSIS OF
DISSOLVED COPPER CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

	x	y=ln(x)	
Date	Dissolved copper conc. (ug/L)	Natural log of dissolved copper conc. ln(ug/L)	
9/7/83	3	1.099	
10/17/84	3	1.099	
USGS 1/21/87	4	1.386	
USGS 5/18/82	4	1.386	
USGS 9/7/88	4	1.386	
USGS 8/29/89	4	1.386	
USGS 8/10/81	4	1.386	
USGS 10/25/82	4	1.386	
USGS 1/19/82	4	1.386	
USGS 9/17/85	4	1.386	
USGS 5/15/86	4	1.386	
USGS 5/8/84	4	1.386	
USGS 11/29/83	5	1.609	
USGS 1/11/89	5	1.609	
USGS 10/21/80	5	1.609	
USGS 6/7/88	5	1.609	
USGS 11/13/85	5	1.609	
USGS 09/02/81	5	1.609	
USGS 4/13/81	5	1.609	
USGS 1/5/88	5	1.609	
USGS 11/16/88	5	1.609	
USGS 11/9/81	5	1.609	
USGS 1/21/81	6	1.792	
USGS 1/10/84	6	1.792	
USGS 9/17/84	6	1.792	
USGS 08/21/81	7	1.946	
USGS 11/12/86	7	1.946	
USGS 08/20/81	8	2.079	
USGS 5/14/85	8	2.079	
USGS 05/02/84	8	2.079	
USGS 08/04/81	9	2.197	
USGS 06/24/84	9	2.197	
USGS 07/10/84	9	2.197	
USGS 08/19/81	10	2.303	
USGS 09/06/81	15	2.708	
USGS 09/03/81	15	2.708	
USGS 09/04/81	22	3.091	
Xbar=	5.795	1.582	= Ybar
Xmax=	22	0.587	= Sy
Xmin=	1	0.344	= Sy^2

TABLE C-33

STATISTICAL ANALYSIS OF
DISSOLVED COPPER CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

===

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

===

```
E(x)   = exp[Ybar + (Sy^2)/2]       =      5.781 ug/l
VAR(x) = xbar^2 * [exp(Sy^2) - 1]   =     13.807
STD(x) = SQRT[VAR(x)]               =      3.716 ug/l
CV(x)  = SQRT[exp(Sy^2) - 1]        =      0.641
```

===

```
E(x) =                   5.781 ug/l
E(x) + STD(x) =          9.497 ug/l
E(x) - STD(x) =          2.065 ug/l
Percent of samples below detectable limits ->      50.6
Total number of samples ->                           89
```

ND = Non-Detectable concentration

PROBABILITY PLOT FOR DISSOLVED COPPER
TRINITY RIVER AT TRINIDAD
1980 - 1989

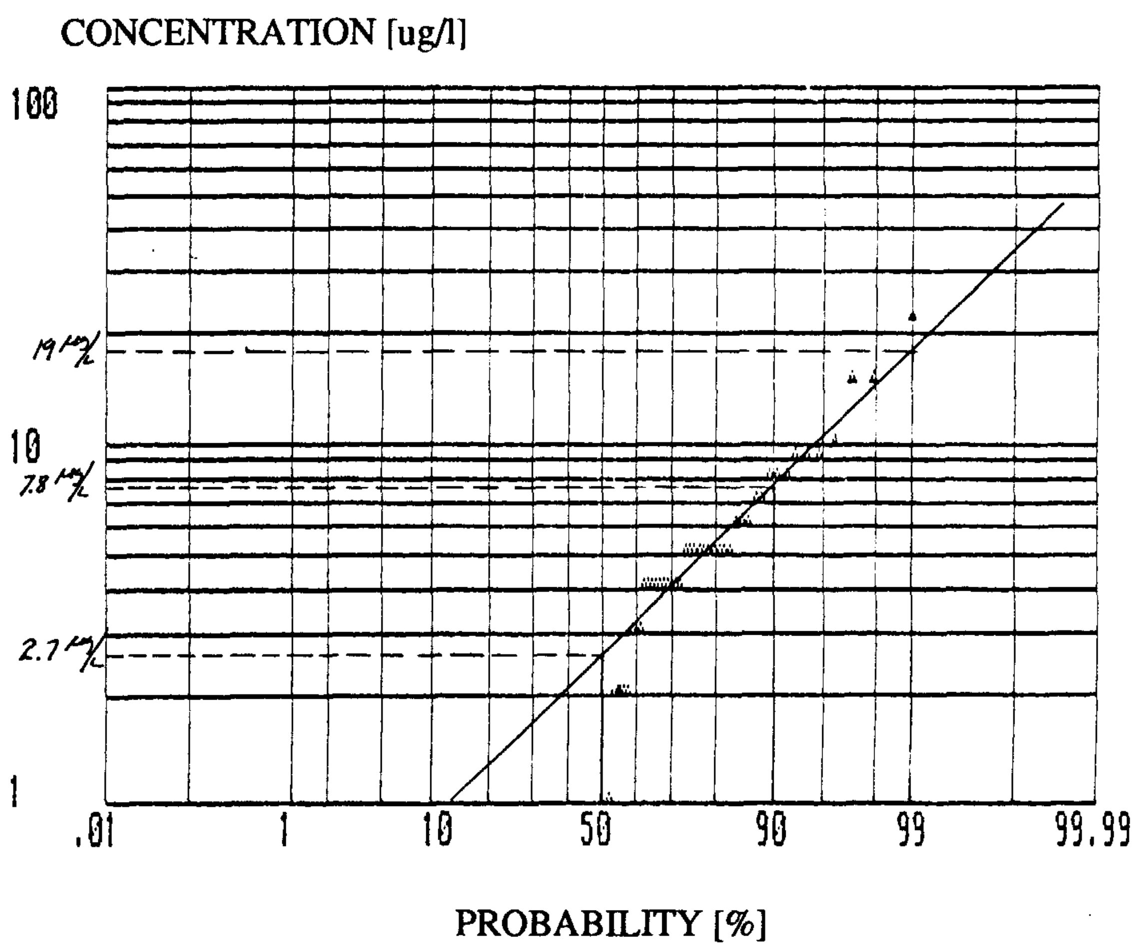


FIGURE C-39

IV.B.4. LEAD

PBSTAT.WR1
03/28/91
307-1000

TABLE C-34

STATISTICAL ANALYSIS OF
DISSOLVED LEAD CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

Date	x Dissolved lead conc. (ug/L)	y=ln(x) Natural log of dissolved lead conc. ln(ug/L)
05/06/87	ND	
05/06/87	ND	
05/05/87	ND	
USGS 11/12/86	ND	
USGS 7/14/87	ND	
02/15/88	ND	
05/06/87	ND	
05/05/87	ND	
USGS 8/3/82	ND	
05/05/87	ND	
USGS 11/3/87	ND	
05/05/87	ND	
USGS 2/13/85	ND	
05/05/87	ND	
05/05/87	ND	
05/07/87	ND	
USGS 1/18/83	ND	
05/06/87	ND	
USGS 1/11/89	ND	
05/07/87	ND	
USGS 4/20/83	ND	
USGS 1/21/87	ND	
USGS 9/7/88	ND	
05/07/87	ND	
05/05/87	ND	
05/06/87	ND	
05/06/87	ND	
USGS 11/16/88	ND	
05/07/87	ND	
05/05/87	ND	
05/05/87	ND	
05/06/87	ND	
05/04/87	ND	
05/05/87	ND	
USGS 8/29/89	ND	
11/05/87	ND	
08/10/87	ND	
05/05/87	ND	
05/05/87	ND	
06/20/88	ND	
USGS 4/14/87	ND	
05/05/87	ND	
USGS 1/5/88	ND	
12/12/88	ND	
USGS 6/14/89	ND	
05/05/87	ND	
05/06/87	ND	
05/04/87	ND	
USGS 6/7/88	ND	
05/05/87	ND	
05/06/87	ND	
05/05/87	ND	
09/08/88	ND	

PBSTAT.WR1
03/28/91
307-1000

TABLE C-34

STATISTICAL ANALYSIS OF
DISSOLVED LEAD CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

	x	y=ln(x)	
Date	Dissolved lead conc. (ug/L)	Natural log of dissolved lead conc. ln(ug/L)	
05/05/87	ND		
05/07/87	ND		
05/05/87	ND		
05/06/87	ND		
USGS 11/29/83	ND		
05/06/87	ND		
05/05/87	ND		
USGS 8/10/81	0		
USGS 10/21/80	0		
USGS 5/18/82	1	0.000	
USGS 9/7/83	1	0.000	
USGS 1/21/81	1	0.000	
USGS 1/10/84	1	0.000	
USGS 4/15/86	1	0.000	
USGS 10/25/82	1	0.000	
USGS 4/13/81	2	0.693	
USGS 9/17/85	2	0.693	
USGS 11/9/81	2	0.693	
USGS 11/13/85	2	0.693	
USGS 9/17/84	2	0.693	
USGS 5/14/85	2	0.693	
USGS 1/29/86	3	1.099	
USGS 1/19/82	3	1.099	
USGS 5/8/84	4	1.386	
USGS 10/17/84	7	1.946	
09/02/81	8	2.079	
07/10/84	10	2.303	
08/20/81	12	2.485	
08/21/81	12	2.485	
08/19/81	16	2.773	
05/02/84	17	2.833	
08/04/81	19	2.944	
09/03/81	20	2.996	
09/06/81	21	3.045	
06/24/84	23	3.135	
09/04/81	24	3.178	
Xbar=	7.483	1.479	= Ybar
Xmax=	24	1.162	= Sy
Xmin=	0	1.350	= Sy^2

PBSTAT.WR1
03/28/91
307-1000

TABLE C-34

STATISTICAL ANALYSIS OF
DISSOLVED LEAD CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

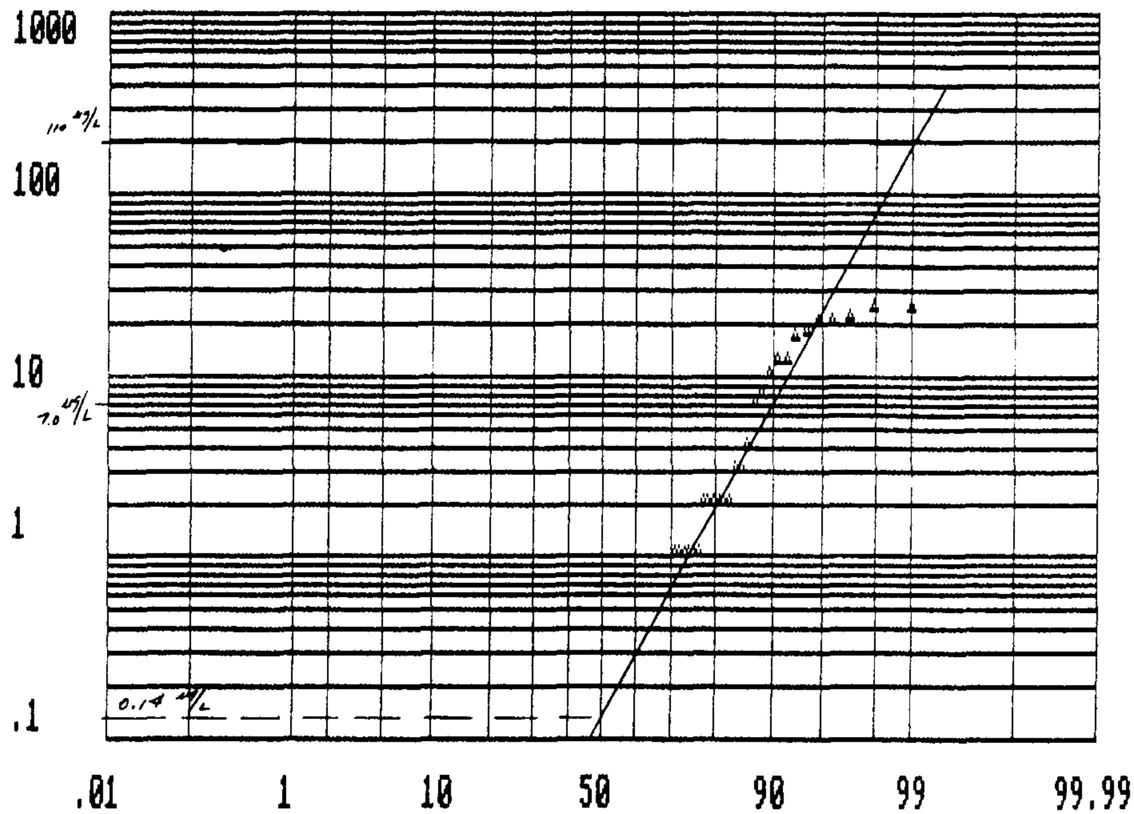
E(x) = exp[Ybar + (Sy^2)/2]	=	8.622 ug/l
VAR(x) = xbar^2 * [exp(Sy^2) - 1]	=	159.955
STD(x) = SQRT[VAR(x)]	=	12.647 ug/l
CV(x) = SQRT[exp(Sy^2) - 1]	=	1.690

E(x) =	8.622 ug/l
E(x) + STD(x) =	21.269 ug/l
E(x) - STD(x) =	0.000 ug/l
Percent of samples below detectable limits ->	67.4
Total number of samples ->	89

ND = Non-Detectable concentrations

PROBABILITY PLOT FOR DISSOLVED LEAD
TRINITY RIVER AT TRINIDAD
1980 - 1989

CONCENTRATION [ug/l]



PROBABILITY [%]

FIGURE C-40

IV.B.5. MERCURY

HGSTAT.WR1
03/28/91
307-1000

TABLE C-35

STATISTICAL ANALYSIS OF
DISSOLVED MERCURY CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

	x	y=ln(x)
Date	Dissolved mercury conc. (ug/L)	Natural log of dissolved mercury conc. ln(ug/L)
05/05/87	ND	
05/06/87	ND	
08/04/81	ND	
07/10/84	ND	
05/07/87	ND	
05/05/87	ND	
05/07/87	ND	
05/04/87	ND	
05/05/87	ND	
05/07/87	ND	
05/05/87	ND	
09/03/81	ND	
USGS 1/5/88	ND	
05/07/87	ND	
05/05/87	ND	
06/24/84	ND	
05/05/87	ND	
05/05/87	ND	
05/05/87	ND	
USGS 8/29/89	ND	
05/05/87	ND	
USGS 1/11/89	ND	
05/05/87	ND	
USGS 11/16/88	ND	
05/05/87	ND	
09/08/88	ND	
05/04/87	ND	
05/05/87	ND	
05/05/87	ND	
09/02/81	ND	
05/05/87	ND	
05/02/84	ND	
05/05/87	ND	
11/05/87	ND	
05/06/87	ND	
12/12/88	ND	
USGS 1/21/81	ND	
05/05/87	ND	
USGS 11/3/87	ND	
05/05/87	ND	
05/06/87	ND	
09/04/81	ND	
05/06/87	ND	
USGS 11/9/81	ND	
05/06/87	ND	
USGS 1/19/82	ND	
05/05/87	ND	
USGS 5/18/82	ND	
08/10/87	ND	
USGS 8/3/82	ND	
USGS 9/17/85	ND	
USGS 7/14/87	ND	
05/06/87	ND	

HGSTAT.WR1
03/28/91
307-1000

TABLE C-35

STATISTICAL ANALYSIS OF
DISSOLVED MERCURY CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

	x	y=ln(x)	
Date	Dissolved mercury conc. (ug/L)	Natural log of dissolved mercury conc. ln(ug/L)	
USGS 1/18/83	ND		
05/06/87	ND		
USGS 1/21/87	ND		
05/06/87	ND		
USGS 11/12/86	ND		
06/20/88	ND		
USGS 11/29/83	ND		
05/07/87	ND		
USGS 6/7/88	ND		
05/06/87	ND		
USGS 11/13/85	ND		
05/06/87	ND		
USGS 9/7/88	ND		
05/05/87	ND		
USGS 10/17/84	ND		
05/06/87	ND		
02/15/88	ND		
USGS 5/14/85	ND		
USGS 2/13/85	ND		
USGS 8/10/81	0		
USGS 10/21/80	0.1	-2.303	
USGS 4/13/81	0.1	-2.303	
USGS 1/29/86	0.1	-2.303	
USGS 4/14/87	0.1	-2.303	
USGS 10/25/82	0.1	-2.303	
USGS 4/20/83	0.2	-1.609	
USGS 5/8/84	0.2	-1.609	
USGS 9/7/83	0.2	-1.609	
USGS 1/10/84	0.2	-1.609	
08/21/81	0.3	-1.204	
USGS 6/14/89	0.3	-1.204	
08/19/81	0.38	-0.968	
USGS 9/17/84	0.4	-0.916	
USGS 4/15/86	0.4	-0.916	
08/20/81	0.46	-0.777	
09/06/81	0.96	-0.041	
Xbar=	0.265	-1.499	= Ybar
Xmax=	0.96	0.664	= Sy
Xmin=	0	0.441	= Sy^2

HGSTAT.WR1
03/28/91
307-1000

TABLE C-35

STATISTICAL ANALYSIS OF
DISSOLVED MERCURY CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(x)	= exp[Ybar + (Sy^2)/2]	=	0.279 ug/l
VAR(x)	= xbar^2 * [exp(Sy^2) - 1]	=	0.039
STD(x)	= SQRT[VAR(x)]	=	0.197 ug/l
CV(x)	= SQRT[exp(Sy^2) - 1]	=	0.745

E(x) =	0.279 ug/l
E(x) + STD(x) =	0.476 ug/l
E(x) - STD(x) =	0.081 ug/l
Percent of samples below detectable limits ->	80.9
Total number of samples ->	89

ND = Non-Detectable concentrations

PROBABILITY PLOT FOR DISSOLVED MERCURY
TRINITY RIVER AT TRINIDAD
1980 - 1989

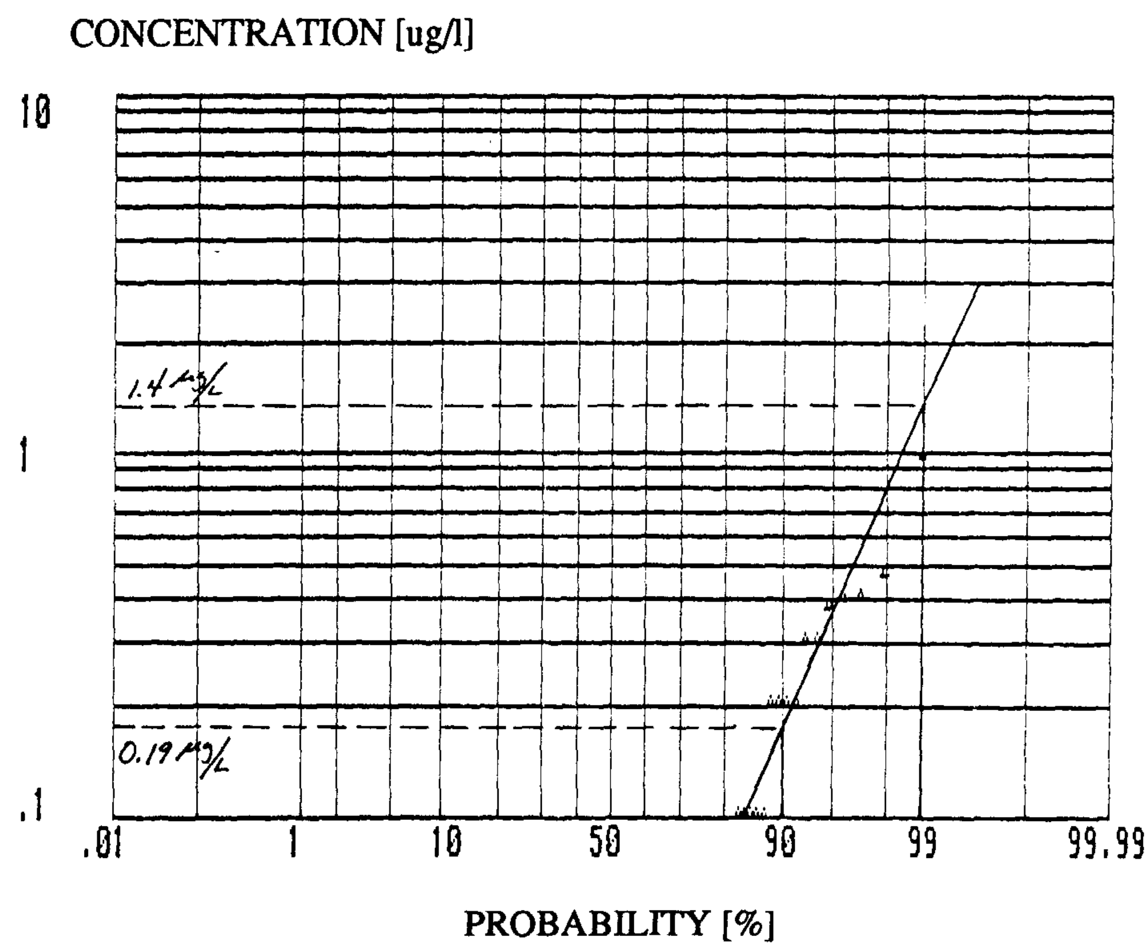


FIGURE C-41

IV.B.6. SELENIUM

SESTAT.WR1
03/28/91
307-1000

TABLE C-36

STATISTICAL ANALYSIS OF
DISSOLVED SELENIUM CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

	x	y=ln(x)
Date	Dissolved selenium conc. (ug/L)	Natural log of dissolved selenium ln(ug/L)
05/06/87	ND	
05/06/87	ND	
08/19/81	ND	
05/06/87	ND	
08/21/81	ND	
05/06/87	ND	
09/03/81	ND	
05/06/87	ND	
09/06/81	ND	
08/20/81	ND	
09/02/81	ND	
07/10/84	ND	
09/04/81	ND	
11/05/87	ND	
05/02/84	ND	
06/20/88	ND	
06/24/84	ND	
12/12/88	ND	
USGS 8/29/89	ND	
05/04/87	ND	
USGS 6/14/89	ND	
05/05/87	ND	
USGS 1/11/89	ND	
05/05/87	ND	
USGS 11/16/88	ND	
05/05/87	ND	
05/05/87	ND	
USGS 11/12/86	ND	
05/05/87	ND	
05/05/87	ND	
05/05/87	ND	
05/05/87	ND	
USGS 7/14/87	ND	
05/05/87	ND	
USGS 4/14/87	ND	
05/05/87	ND	
USGS 1/21/87	ND	
05/05/87	ND	
USGS 11/9/81	ND	
05/06/87	ND	
USGS 1/19/82	ND	
05/06/87	ND	
USGS 5/18/82	ND	
05/06/87	ND	
USGS 9/7/88	ND	
08/04/81	ND	
USGS 10/25/82	ND	
08/10/87	ND	
USGS 1/18/83	ND	
09/08/88	ND	
USGS 4/20/83	ND	
05/05/87	ND	
USGS 9/7/83	ND	

SESTAT.WR1
03/28/91
307-1000

TABLE C-36

STATISTICAL ANALYSIS OF
DISSOLVED SELENIUM CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(x) = exp[Ybar + (Sy^2)/2]	=	2.175 ug/l
VAR(x) = xbar^2 * [exp(Sy^2) - 1]	=	1.107
STD(x) = SQRT[VAR(x)]	=	1.052 ug/l
CV(x) = SQRT[exp(Sy^2) - 1]	=	0.758

E(x) =	2.175 ug/l	
E(x) + STD(x) =	3.227 ug/l	
E(x) - STD(x) =	1.123 ug/l	
Percent of samples below detectable limits->		86.5
Total number of samples->		89

ND = Non-Detectable concentration

PROBABILITY PLOT FOR DISSOLVED SELENIUM
TRINITY RIVER AT TRINIDAD
1980 - 1989

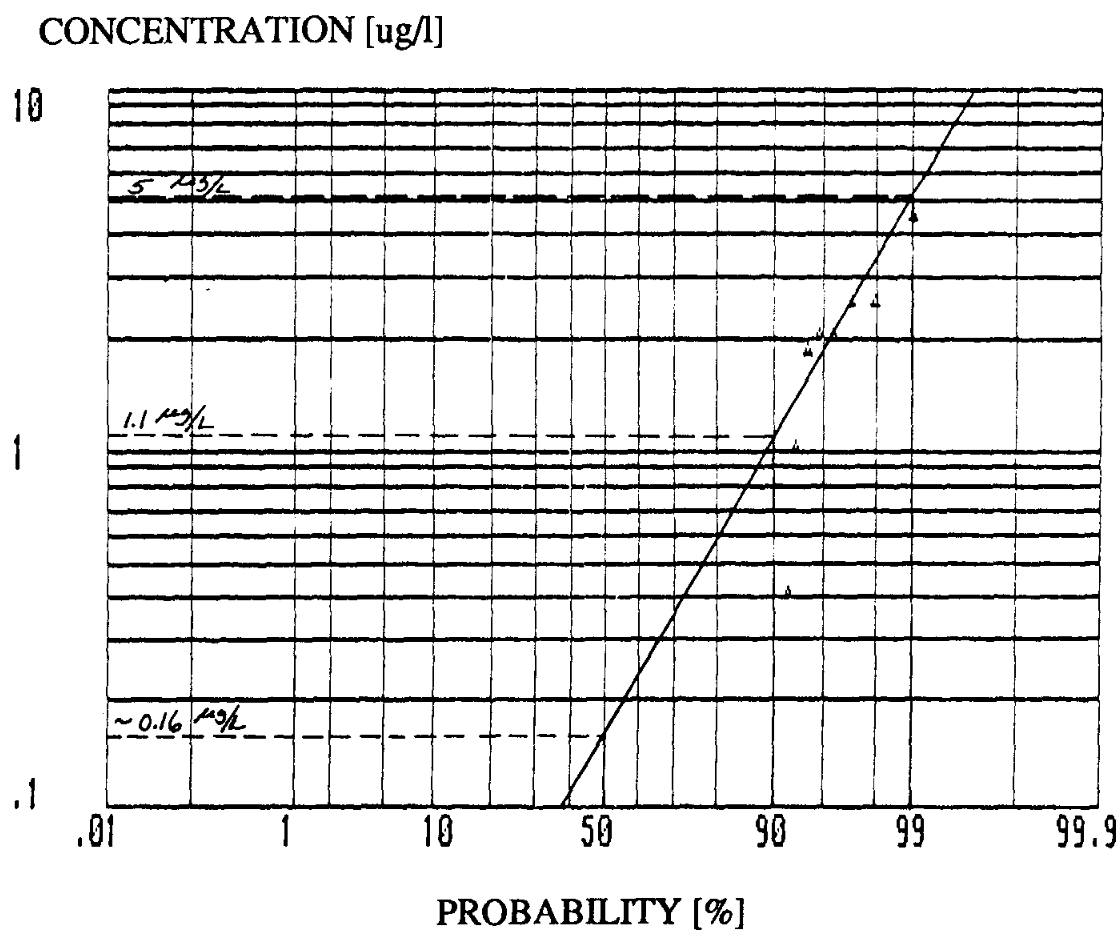


FIGURE C-42

IV.B.7. ZINC

ZNSTAT.WR1
03/28/91
307-1000

TABLE C-37

STATISTICAL ANALYSIS OF
DISSOLVED ZINC CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

	x		y=ln(x)
Date	Dissolved Zinc Conc. (ug/L)		Natural log of dissolved zinc conc. ln(ug/L)
USGS 05/18/82	ND	<12	
USGS 08/03/82	ND	< 3	
USGS 04/13/89	--		
USGS 07/22/86	--		
USGS 06/09/87	--		
USGS 03/29/88	--		
USGS 07/18/89	--		
USGS 09/01/87	--		
USGS 07/12/88	--		
USGS 09/09/86	--		
USGS 06/17/86	--		
USGS 01/19/82	4		1.386
USGS 04/14/87	5		1.609
USGS 06/14/89	5		1.609
05/07/87	5		1.609
05/05/87	5		1.609
05/07/87	5		1.609
05/07/87	6		1.792
USGS 11/09/81	7		1.946
05/06/87	7		1.946
05/05/87	7		1.946
05/07/87	7		1.946
USGS 07/14/87	8		2.079
USGS 01/21/87	9		2.197
05/06/87	9		2.197
USGS 08/29/89	9		2.197
USGS 09/07/83	10		2.303
USGS 06/07/88	10		2.303
05/05/87	10		2.303
USGS 04/13/81	10		2.303
09/08/88	10		2.303
05/06/87	11		2.398
05/05/87	12		2.485
USGS 10/17/84	12		2.485
USGS 01/05/83	12		2.485
USGS 11/12/86	13		2.565
USGS 02/13/85	13		2.565
USGS 04/20/83	14		2.639
USGS 11/29/83	14		2.639
05/06/87	15		2.708
USGS 05/08/84	15		2.708
05/06/87	16		2.773
USGS 04/15/86	16		2.773
05/05/87	17		2.833
USGS 10/25/82	17		2.833
05/05/87	17		2.833
05/06/87	18		2.890
USGS 08/10/81	18		2.890
05/06/87	18		2.890
05/05/87	19		2.944
02/15/88	20		2.996
USGS 09/17/85	20		2.996
11/05/87	20		2.996

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TABLE C-37

STATISTICAL ANALYSIS OF
DISSOLVED ZINC CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

Date	x Dissolved Zinc Conc. (ug/L)	y=ln(x) Natural log of dissolved zinc conc. ln(ug/L)	
06/20/88	20	2.996	
USGS 01/18/83	20	2.996	
USGS 09/07/88	21	3.045	
USGS 05/14/85	21	3.045	
05/05/87	21	3.045	
USGS 01/29/86	21	3.045	
05/06/87	21	3.045	
USGS 09/17/84	21	3.045	
USGS 11/16/88	22	3.091	
USGS 01/11/89	22	3.091	
05/05/87	23	3.135	
08/20/81	24	3.178	
05/06/87	25	3.219	
05/07/87	25	3.219	
05/05/87	27	3.296	
USGS 01/10/84	28	3.332	
05/05/87	29	3.367	
09/06/81	29	3.367	
USGS 01/21/81	30	3.401	
12/12/88	30	3.401	
05/06/87	30	3.401	
05/02/84	30	3.401	
USGS 11/13/85	30	3.401	
USGS 11/03/87	32	3.466	
05/05/87	33	3.497	
05/06/87	33	3.497	
08/04/81	33	3.497	
06/24/84	35	3.555	
08/21/81	36	3.584	
05/05/87	36	3.584	
05/05/87	38	3.638	
05/05/87	50	3.912	
05/05/87	50	3.912	
08/19/81	55	4.007	
05/04/87	57	4.043	
05/04/87	58	4.060	
05/05/87	59	4.078	
09/02/81	60	4.094	
05/05/87	64	4.159	
09/04/81	66	4.190	
08/10/87	110	4.700	
05/05/87	112	4.718	
09/03/81	132	4.883	
Xbar=	26.047	2.966	= Ybar
Xmax=	132	0.757	= Sy
Xmin=	0	0.573	= Sy^2

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TABLE C-37

STATISTICAL ANALYSIS OF
DISSOLVED ZINC CONCENTRATIONS
IN THE TRINITY RIVER AT TRINIDAD

ESTIMATES OF LOGNORMAL DISTRIBUTION PARAMETERS

E(x) = exp[Ybar + (Sy^2)/2]	=	25.864 ug/l
VAR(x) = xbar^2 * [exp(Sy^2) - 1]	=	524.548
STD(x) = SQRT[VAR(x)]	=	22.903 ug/l
CV(x) = SQRT[exp(Sy^2) - 1]	=	0.879

E(x) =	25.864 ug/l
E(x) + STD(x) =	48.767 ug/l
E(x) - STD(x) =	2.961 ug/l
Percent of samples below detectable limits ->	11.5
Total number of samples ->	96

ND = Non-Detectable concentration

PROBABILITY PLOT FOR DISSOLVED ZINC
TRINITY RIVER AT TRINIDAD
1980 - 1989

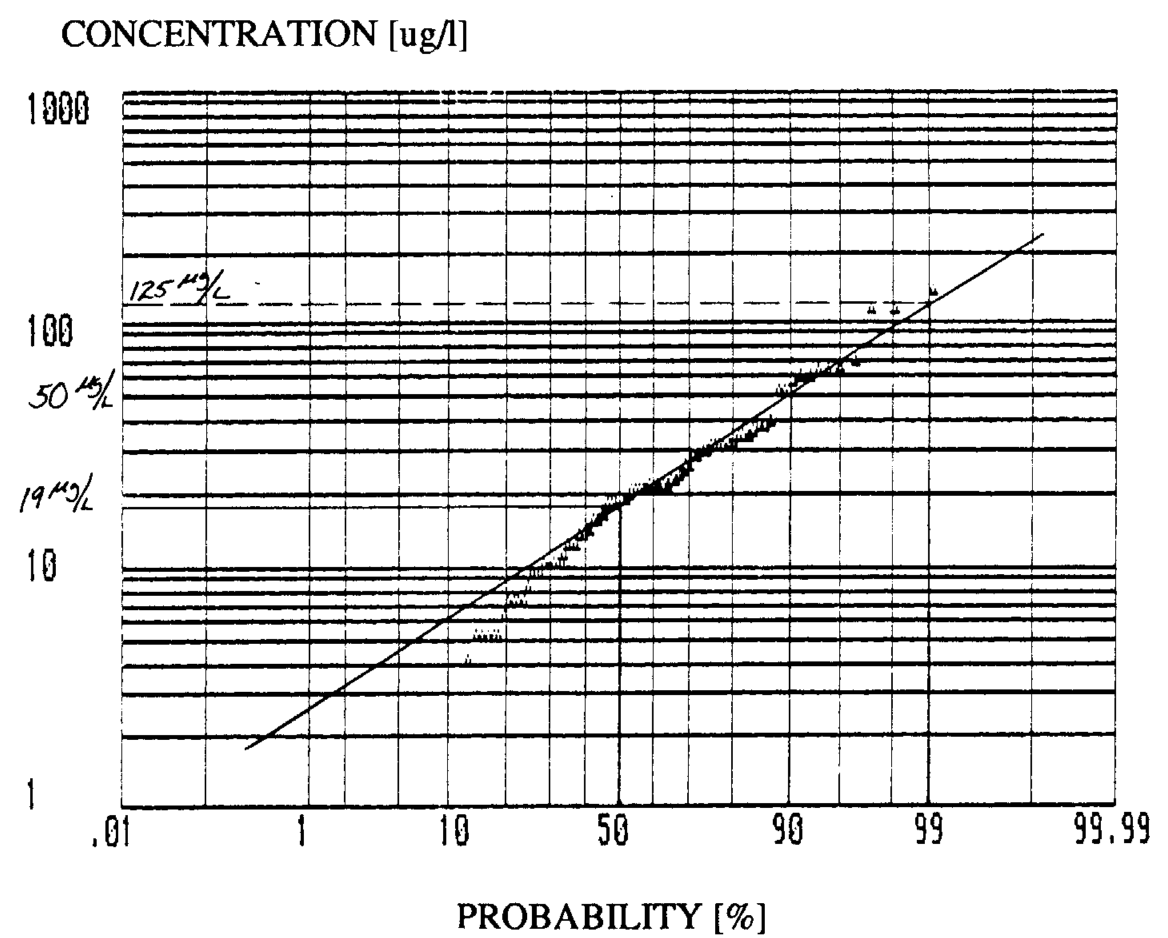

FIGURE C-43

IV.C. REFERENCE

5019

Estimating the mean of data sets with nondetectable values

By Curtis C. Travis
and Miriam L. Land

Interest in the determination of trace levels of contaminants in environmental media has increased with the recognition that even trace levels of pollutants can pose risks to human health and the environment. The analysis of trace level environmental data is frequently hampered, however, by chemical concentrations that are below detection limits established by analytical laboratories *(1, 2)*. Such concentrations are generally reported as "less than detection limit" rather than as actual numerical values. In determining the mean of such data, three approaches are commonly used: assume all nondetectable points are equal to zero, assume nondetectable points are equal to half the detection limit, or assume nondetectable points are equal to the detection limit. All these methods introduce a bias and result in erroneous estimates of the mean and standard deviation *(1)*.

A method has been known for some time that circumvents these problems *(3, 4)*. It assumes that measured environmental data represent repeated samples from a lognormal probability distribution where only sample values above the detection limit are known. However, these values are often enough to define the right hand tail of the lognormal distribution, from which it is then theoretically possible to reconstruct the entire distribution (and thus obtain knowledge of the mean and standard deviation). To aid in this analysis, engineers have introduced a graphical approach called log-probit analysis *(3, 4)*.

In a log-probit analysis, all measurements (both detectable and nondetectable) are assumed to be samples taken from the same lognormal probability distribution. The assumption of lognormality for environmental data is fairly universal. A probit scale is designed so that when samples from a lognormal distribution are plotted on a probit scale, they will lie on a straight line


Curtis Travis


Miriam Land

(Figure 1). In a probit analysis involving both detectable and nondetectable values, the nondetectable values are treated as unknowns, but their percentile values are accounted for. Thus, if there were 100 samples, 30 of which are nondetectable, the first detectable data point would be plotted at the 31st percentile. If sufficient data exist, they can be used, through linear regression, to define the straight line characterizing the entire data set. The geometric mean concentration for the data set (both detectable and nondetectable values) is then determined from the 50th percentile value. Thus, a probit analysis allows the geometric mean to be extrapolated from detectable values even if it is below detection limits (provided there are sufficient detected values to define the probability distribution).

Available probit tables *(4)* and computerized programs *(5–7)* facilitate the process of calculating probit values. The geometric mean of the environmental concentrations can be estimated from the point on the regression line corresponding to the 50th percentile, and the standard deviation can be estimated from the antilog of the slope of the regression line. We briefly present a probit analysis of a heavily censored data set.

Because of the extreme toxicity of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), much concern and debate have arisen about human exposure to it. Levels measured in fish taken from lakes and rivers in the United States confirm that TCDD is bioaccumulating in fish and that low-level contamination of fish is widespread. Roughly 65% of the TCDD concentrations in whole fish were below detection limits. The probit plot, however, provides an estimated geometric mean of 0.45 pg/g. This example illustrates one of the primary benefits of probit analysis: its ability to estimate geometric means that are near or below the detection limit.

Log-probit analysis provides a robust method of evaluating environmental data sets with a large percentage of values lying below the detection limit. Limitations of the method have been pointed out *(1, 8, 9)*; however, it is easy to use and it is less biased and more accurate than other frequently used methods *(2)*. We therefore suggest that it become the method of choice for analyzing trace level environmental data.

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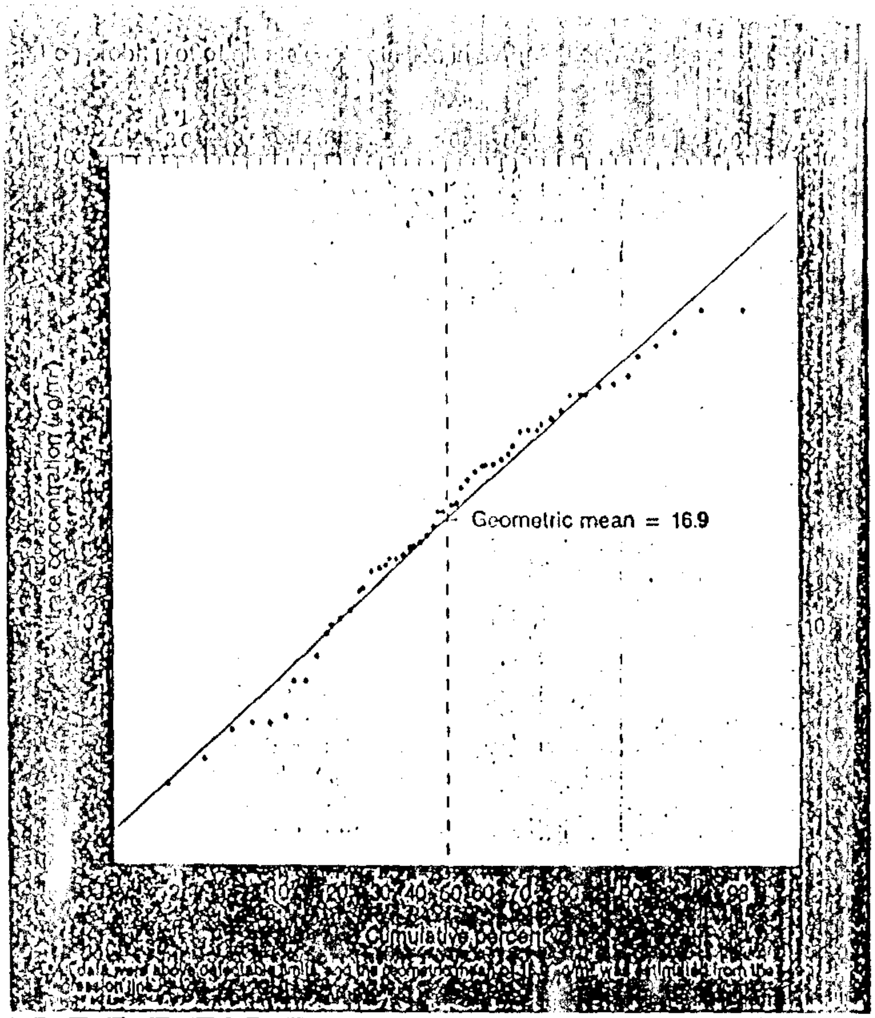

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APPENDIX D

FEASIBILITY STUDY OF PERIPHYTON-TILAPIA SYSTEM FOR REMOVAL OF PHOSPHORUS AND NITROGEN FROM TRINITY RIVER WATER

FEASIBILITY STUDY OF A PERIPHYTON-TILAPIA SYSTEM FOR REMOVAL OF PHOSPHORUS AND NITROGEN FROM TRINITY RIVER WATER

A Research Proposal to the Tarrant County Water Control and Improvement District Number One

Investigators: Dr. Ray W. Drenner and Dr. J. D. Smith
Biology Department
Texas Christian University
Fort Worth, Texas 76129

INTRODUCTION

Several recent papers have suggested that periphyton (attached algae) may have potential as a tool to remove nutrients from sewage waste or polluted rivers (Sladeckova et al. 1983, Vymazal 1988, Davis et al. 1990). Periphyton have several characteristics that give it potential for use as a nutrient removal system: (1) Periphyton have a phosphorus and nitrogen content ranging from 0.4-2.4 and 4.4-15.1% dry weight, respectively (Davis et al. 1990). By incorporating both phosphorus and nitrogen, periphyton remove the two nutrients which cause excessive phytoplankton blooms in lakes (Smith 1983, Elser et al. 1990). (2) Because periphyton growth rates increase with the availability of phosphorus and nitrogen (Stockner and Shortreed 1978, Elwood et al. 1981, Horner and Welch 1981, Peterson et al. 1983, Grimm and Fisher 1986, Pringle et al. 1986, Perrin et al. 1987, Hill and Knight 1988, Bothwell 1989, Mulholland et al. 1991), periphyton "naturally" adjust their growth and nutrient uptake rates with changes in nutrient loading. (3) Maximum removal rates of nutrients by periphyton can be very high (up to 160 mg $P/m^2/d$ and 1900 mg $N/m^2/d$) (Davis et al. 1990). (4) Because periphyton growth increases with current velocity (Whitford and Schumacher 1964, McIntire 1966, Rogers and Harvey 1976, Horner and Welch 1981, Horner et al. 1983) periphyton can be used to remove nutrients from constant flows of large volumes of water.

Although nutrients accumulate in periphyton, some of the nutrients may eventually be released from the periphyton if the periphyton layer becomes thick enough for formation of an anaerobic interior film (Davis et al. 1990, Mulholland et al. 1991). Several studies have shown that the thickness of the periphyton and nutrient release from the periphyton can be reduced by grazers that feed on periphyton (Gregory 1983, Colletti et al. 1987, Lamberti et al. 1987, Steinman et al. 1987, Power et al. 1988, Mulholland et al. 1991). An additional benefit of grazing is that it also reduces sloughing or detachment and movement of periphyton downstream (Mulholland et al. 1991). Therefore, maximal nutrient removal by periphyton is dependent on maintenance of periphyton in an exponential growth condition, the product of an optimum balance of grazing, current velocity and effluent retention time (Sladeckova et al. 1983).

PROPOSED NUTRIENT REMOVAL SYSTEM USING PERIPHYTON AND TILAPIA

We propose that phosphorus and nitrogen can be removed from Trinity River water using a periphyton-tilapia system in which fish, blue tilapia (Tilapia aurea), are used to graze the periphyton and convert the nutrients in periphyton to fish feces which can be removed from the system. Blue tilapia are omnivores which consume zooplankton, phytoplankton, periphyton and detritus (Spataru and Zorn 1976, 1978). During our previous investigations of the selective planktivory of blue tilapia (Drenner et al. 1984, Vinyard et al. 1987), I observed them to graze on periphyton on the sides of holding tanks. We did not quantify changes in periphyton biomass with tilapia density but it was apparent that periphyton biomass was dramatically reduced in the presence of blue tilapia.

Although blue tilapia graze algae, they do not efficiently digest and assimilate the nutrients in the algae. Consequently, much of the nutrients contained in the consumed algae are passed through the digestive tract of the fish and are released as mucus-bound algae in the feces. Preliminary tests have shown that the feces are relatively heavy and rapidly sink out of the water column. Based on these observations we propose that blue tilapia grazing and feces production can be used as a nutrient sink.

Others are investigating whether blue tilapia can be used in nutrient removal systems. After informing scientists at the University of Florida about our concept of a periphyton-tilapia system, they told me that they have begun to investigate use of blue tilapia to remove nutrients from ponds containing dairy waste. Although their system is not the same as we propose, they did report that they are successfully removing nutrients via collection of tilapia feces. They plan on marketing the phosphorus and nitrogen as a commercial product, an alternative that might be explored for nutrients removed from Trinity River water.

PROPOSED STUDY

Although the published literature and our preliminary observations suggest that the periphyton-tilapia system has potential as a nutrient removal strategy, we are unable at this time to conduct a thorough evaluation of the feasibility of a periphyton-tilapia system. We do not know the effects of various densities of tilapia on periphyton growth rates and how grazing by tilapia will affect the periphyton's ability to uptake phosphorus and nitrogen. In the proposed study we will investigate the interrelationships between tilapia grazing and periphyton biomass and its effect on the efficiency of nutrient removal by periphyton. Two experimental systems will be utilized in the study. One system will be the mesocosm facility at Texas Christian University which consists of thirty 1500 gallon white fiberglass tanks (Fig. 1A). Although useful for conducting studies of tilapia effects on periphyton, these tanks cannot be used to assess nutrient removal through fecal production because the tanks are flat bottomed and feces cannot be easily removed. Consequently, we will use funds from this project to construct a second tank system consisting of twelve 130 gallon cone-bottomed fish tanks (Fig. 1B), 36 in. diam. and 48 in. tall. These tanks will be located adjacent to the mesocosm facility at T.C.U.

Study Objectives

The primary objective of the study is to collect information and experimental data which can be used to evaluate the feasibility of using a periphyton-tilapia system to remove phosphorus and nitrogen from Trinity River water. The study will consist of three phases.

Phase 1 - Experimental Design Phase. During Phase 1 we will complete the literature search, interact with Alan Plummer and Associates to finalize designs for experiments in Phase 2,and set up the second tank facility.

Phase 2 - Experimental Phase. During Phase 2 we will conduct a series of three experiments focusing on three questions. The following narrative briefly outlines the experiments.

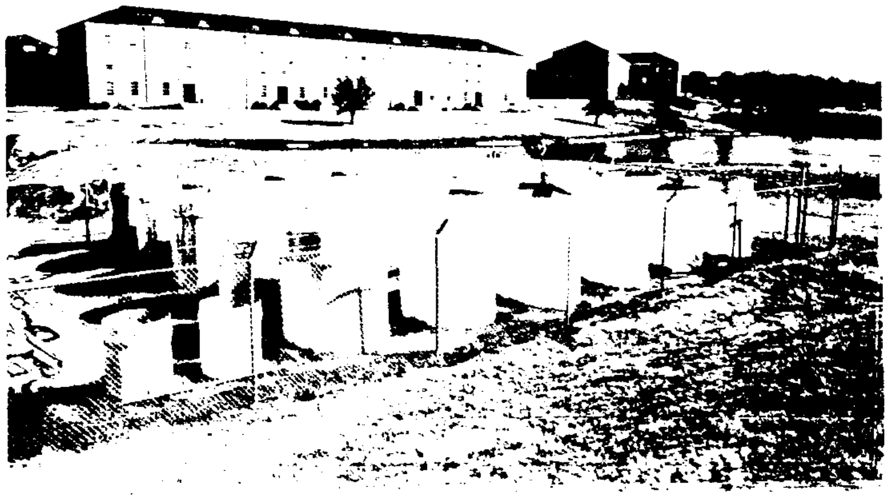

Fig. 1A. Experimental mesocosm facility at T.C.U.

Fig. 1B. Cone-bottomed tank.

Expt. 1. The first experiment will focus on the question: How do different densities of blue tilapia affect periphyton biomass at eutrophic nutrient concentrations? This experiment will be conducted in the mesocosm facility at T.C.U. and involve 12 of the tanks. Tentatively, the experiment will consist of 6 treatments (0, 5, 10, 20, 30 and 40 tilapia/tank), each with duplicate replication. The experiment would begin in June and last for 2 weeks. Tanks will be drained at the end of the experiment to evaluate tilapia effects on periphyton attached to the walls of the tanks.

Expt. 2. The second experiment will focus on the question: What effect does blue tilapia and water velocity have on nutrient uptake by a periphyton system? This experiment will be conducted in the new facility of cone-bottomed tanks. A factorial design will be used in which 2 levels of tilapia (presence and absence) are cross-classified with 2 levels of mixing (low and high) using airlifts. The density of tilapia will be based on the results of Experiment 1. Nutrients in the water, periphyton and feces collected during the experiment will be analyzed to assess the use of tilapia to remove nutrients, and how tilapia and water velocity interact to affect periphyton.

Expt. 3. The third experiment will focus on the question: How efficiently does the periphyton-tilapia system remove nutrients from Trinity River water. Water will be hauled by truck by the Western Transport Company from the Trinity River near Richland Chambers Reservoir and held in the mesocosm facility at T.C.U.. We have successfully transported water to T.C.U. from as far away as Lake Wichita at Wichita Falls and Stillhouse Hollow Reservoir south of Waco. Following a settling period, river water will be pumped through the cone-bottomed tank system to examine nutrient removal efficiency for phosphorus and nitrogen. For this experiment, the 12 tanks will be divided into 4 sets of 3 tanks. Water flow between the 3 tanks in a set will be achieved by linking the tanks via siphon tubes. Tentatively, we plan to use two treatments: (1) periphyton only and (2) periphyton grazed by tilapia. The density of tilapia will be based on the results of Experiment 1. Analysis of nutrients in the input and output of river water from the tanks as well as tilapia feces collected during the experiment will allow assessment of the nutrient removal efficiency of the periphyton-tilapia system.

Methods. We will use standard limnological methods to evaluate nutrients and chlorophyll biomass during Experiments 1, 2 and 3. Samples for total phosphorus will be digested with potassium persulfate (Menzel and Corwin 1965) and analyzed by the malachite green method (Van Veldhoven and Mannaerts 1987). Samples for total nitrogen will be digested with alkaline potassium persulfate (D'Elia et al. 1977) and analyzed by UV estimation at 220 nm (APHA 1985). To determine chlorophyll, samples will be filtered through 0.45-um HAWP Millipore filters. The filters will be extracted in 2:1 chloroform-methanol in the dark for a minimum of 4 h and read at 665 nm (Wood 1985).

Phase 3 - Feasibility Evaluation Phase In this phase we will use information from the literature search and our experiments to evaluate the feasibility of using the periphyton-tilapia system to remove nutrients from Trinity River water.

BUDGET[1]

SALARIES	
Principal Investigator (Drenner - 1 month)	$5,578
Co-Principal Investigator (Smith - 0.5 month)	$2,500
Research Assistant (320 hrs x $7.00/hr)	$2,240
Total Salaries	$10,318
FRINGE BENEFITS	
Principal Investigators (14% x $8,078)	$1,131
EQUIPMENT	
Cone-Bottomed Tanks	$6,000
SUPPLIES	
Nalgene Bottles, Chemicals	$1,500
PVC Tubing for Tanks	$1,000
Total Supplies	$2,500
INDIRECT	
57% of Salaries ($5,881 Cost Shared by TCU)	$0000
TOTAL	$19,949

[1] Cost of Experiment 3 is not included.

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EDUCATION

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Dissertation: The feeding mechanics of the gizzard shad (Dorosoma cepedianum)

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1972-1974 Curatorial Assistant, Ichthyology Division of the Museum of Natural History, University of Kansas

1974-1975 Research Assistant, Study of the impact of an electrical power plant on a Kansas reservoir, University of Kansas

1977-1983 Assistant Professor, Texas Christian University

1978-1984 Visiting Investigator (summers), University of Oklahoma Biological Station on Lake Texoma

1981-1986 Visiting Investigator (summers), Kinneret Limnological Laboratory, Lake Kinneret, Israel

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1990-1991 Professor, Texas Christian University, teaching courses in: Ecology of Lakes and Streams, Ichthyology, Environmental Biology, Environmental Impact Statements and General Biology

PROFESSIONAL SOCIETIES

American Association for the Advancement of Science
American Fisheries Society
American Society of Ichthyologists and Herpetologists
American Society of Limnology and Oceanography
Ecological Society of America
International Association of Theoretical and Applied Limnology
North American Lake Management Society
Sigma Xi
Society of Environmental Toxicology and Chemistry

Texas Academy of Sciences

PROFESSIONAL SERVICE

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Associate Editor, Transactions of American Fisheries Society, 1989-1990.

Reviewer for Scientific Journals including: American Midland Naturalist, American Naturalist, Aquaculture, Canadian Journal of Fisheries and Aquatic Sciences, Copeia, Ecology, Hydrobiologia, Journal of Freshwater Ecology, Limnology and Oceanography, Marine Biology, National Science Foundation, Progressive Fish-Culturist, Science, Southeastern Association of Fish and Wildlife Agencies, Southwestern Naturalist, Texas Academy of Science, Transactions of the American Fisheries Society, U.S. Fish and Wildlife Service.

RESEARCH SUPPORT

Extramural

Drenner, R.W., Agency for International Development, United States State Department, 1980-1983, Lake Manzalah, Egypt and Lake Kinneret, Israel: Scientific Basis for Lake Management, $149,000.

Drenner, R.W., S. Threlkeld and M. McCracken, National Science Foundation, 1982-1984, Experimental Analysis of Direct and Indirect Grazing Impacts of Filter-Feeding Fish on Phytoplankton Community Structure, $82,000.

Drenner, R.W., G.L. Vinyard, M. Gophen and U. Pollingher, National Science Foundation, 1985-1987, Selective Planktivory of the Galilee Saint Peter's Fish and Its Impact on the Plankton Community of Lake Kinneret, Israel, $150,000.

Drenner, R.W., K.D. Hoagland, J.D. Smith and W.J. Barcellona, FMC Corporation, 1987-1988, Experimental Microcosm Study of the Effects of a Sediment-Bound Pyrethroid Insecticide on Gizzard Shad and Plankton $51,469.

Hoagland, K.D. and R.W. Drenner, Texas Water Resources Institute, 1989-1990. Freshwater Community Response to Mixtures of Agricultural Pesticides: Synergistic Effects of Atrazine and Bifenthrin, $24,200.

Drenner, R.W. and J.D. Smith, National Science Foundation, 1989-1991, Responses of Plankton Biomass across Gradients of Fish Density and Lake Trophic State: Experimental Test of the Fish x Lake Trophic State Interaction Hypothesis, $149,000.

Intramural

Drenner, R.W., Texas Christian University Research Foundation, 1977-1990, 13 grants supporting experimental investigations of the feeding behavior and impacts of planktivorous fish, $31,000.

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Drenner, R.W., J.R. Strickler and W.J. O'Brien. 1978. Capture probability: the role of zooplankter escape in the selective feeding of planktivorous fish. Journal of Fisheries Research Board of Canada 35: 1370-1373.

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APPENDIX E

LAKE WATER QUALITY MODELING
CEDAR CREEK RESERVOIR MODEL CALIBRATION
CEDAR CREEK RESERVOIR MODEL VERIFICATION
RICHLAND-CHAMBERS RESERVOIR MODEL CALIBRATION

CEDAR CREEK RESERVOIR
MODEL CALIBRATION

CASE: CEDAR CREEK

INPUT GROUP 14 - CASE NOTES
CASE NOTES:

MARCH 27, 1991

DATABASE FIELD-1989;TRIB, WWTP

RAIN TODATE.

CALIBRATION DATASET.

GROSS WATER BALANCE:

ID T LOCATION	DRAINAGE AREA KM2	---- FLOW (HM3/YR) ---- MEAN	VARIANCE	CV	RUNOFF M/YR
PRECIPITATION	139.520	138.125	.763E+03	.200	.990
EXTERNAL INFLOW	2268.000	509.635	.000E+00	.000	.225
***TOTAL INFLOW	2407.520	647.760	.763E+03	.043	.269
GAUGED OUTFLOW	.000	412.050	.000E+00	.000	.000
UNGAUGED OUTFLOW	2407.520	.340	.481E+04	9.990	.000
***TOTAL OUTFLOW	2407.520	412.390	.481E+04	.168	.171
***EVAPORATION	.000	212.070	.405E+04	.300	.000
***STORAGE INCREASE	.000	23.300	.000E+00	.000	.000

(H)

CASE: CEDAR CREEK

INPUT GROUP 3 - MODEL OPTIONS

1	CONSERVATIVE SUBSTANCE	0 NOT COMPUTED
2	PHOSPHORUS BALANCE	2 2ND ORDER, DECAY
3	NITROGEN BALANCE	7 SETTLING VELOCITY
4	CHLOROPHYLL-A	2 P, LIGHT, T
5	SECCHI DEPTH	1 VS. CHLA & TURBIDITY
6	DISPERSION	1 FISCHER-NUMERIC
7	PHOSPHORUS CALIBRATION	1 DECAY RATES
8	NITROGEN CALIBRATION	2 CONCENTRATIONS
9	ERROR ANALYSIS	2 DATA ONLY

CASE: CEDAR CREEK

INPUT GROUP 4 - VARIABLES

<H>VARIABLE	ATMOSPHERIC LOADINGS KG/KM2-YR	CV	AVAILABILITY FACTOR
1 CONSERV	.00	.00	.00
2 TOTAL P	60.20	.25	1.00
3 TOTAL N	933.10	.45	1.00
4 ORTHO P	30.10	.00	.00
5 INORG N	541.80	.50	.00

CASE: CEDAR CREEK

INPUT GROUP 5 - GLOBAL PARAMETERS

PARAMETER		MEAN	CV
1 PERIOD LENGTH	YRS	1.000	.000
2 PRECIPITATION	M	.990	.200
3 EVAPORATION	M	1.520	.300
4 INCREASE IN STORAGE	M	.167	.000
5 FLOW FACTOR		1.000	.000
<6>DISPERSION FACTOR		.250	.700
7 TOTAL AREA	KM2	.000	.000
8 TOTAL VOLUME	HM3	.000	.000

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CASE: CEDAR CREEK

INPUT GROUP 6 - TRIBUTARY DRAINAGE AREAS AND FLOWS

ID	TYPE	SEG	NAME	DRAINAGE AREA KM2	MEAN FLOW HM3/YR	CV OF MEAN FLOW
1	3	3	MABANK	.000	.262	.000
2	3	1	KEMP	.000	.153	.000
3	3	4	EUSTACE	.000	.053	.000
4	3	3	ECCMUD	.000	.467	.000
5	3	1	KAUFMAN	.000	.676	.000
6	3	5	CHEROKEE	.000	.024	.000
7	2	1	KINGS	819.000	184.000	.000
8	2	1	CEDAR	737.000	167.000	.000
9	2	2	LACY	241.000	54.000	.000
10	2	3	NORTH TWIN	110.000	24.000	.000
11	2	3	SOUTH TWIN	82.000	18.000	.000
12	2	4	CANEY	87.000	19.000	.000
13	2	3	PRAIRIE	73.000	16.000	.000
14	2	4	CLEAR	91.000	20.000	.000
15	2	5	LYNN	28.000	6.000	.000
16	4	5	DAM OUTFLOW	.000	300.600	.000
17	4	5	PIPELINE	.000	111.450	.000

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CASE: CEDAR CREEK

INPUT GROUP 7 - TRIBUTARY CONCENTRATIONS (PPB): MEAN/CV

ID	CONSERV	TOTAL P	TOTAL N	ORTHO P	INORG N
1	.0/ .00	4730.0/ .26	10650.0/ .45	4010.0/ .26	6750.0/ .58
2	.0/ .00	6960.0/ .55	4040.0/ .69	5540.0/ .52	3330.0/ .73
3	.0/ .00	4320.0/ .52	2850.0/ .98	2970.0/ .57	2040.0/1.21
4	.0/ .00	7140.0/ .37	6010.0/ .64	5660.0/ .28	5340.0/ .67
5	.0/ .00	3820.0/ .40	15980.0/ .37	3360.0/ .47	15550.0/ .41
6	.0/ .00	7280.0/ .60	10980.0/ .72	7120.0/ .62	9320.0/ .79
7	.0/ .00	650.0/ .13	1630.0/ .43	200.0/ .25	1160.0/ .63
8	.0/ .00	495.0/ .17	1217.0/ .55	120.0/ .43	485.0/ .33
9	.0/ .00	320.0/ .30	1010.0/ .57	110.0/ .37	525.0/ .40
10	.0/ .00	330.0/ .19	1050.0/ .38	90.0/ .51	600.0/ .50
11	.0/ .00	190.0/ .30	700.0/ .21	80.0/ .00	345.0/ .31
12	.0/ .00	330.0/ .12	1110.0/ .13	50.0/ .98	830.0/ .18
13	.0/ .00	360.0/ .17	820.0/ .54	150.0/ .34	430.0/ .40
14	.0/ .00	165.0/ .21	1195.0/ .89	75.0/ .47	240.0/ .21
15	.0/ .00	320.0/ .38	970.0/ .34	70.0/ .96	490.0/ .64
16	.0/ .00	50.0/ .48	257.0/ .61	10.0/ .54	70.0/ .83
17	.0/ .00	50.0/ .48	257.0/ .61	10.0/ .54	70.0/ .83

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CASE: CEDAR CREEK

INPUT GROUP 10 - OBSERVED WATER QUALITY

SEG		TURBID	CONSER	TOTALP	TOTALN	CHL-A	SECCHI	ORG-N	TP-OP	HODV	MODV
		1/M	?	MG/M3	MG/M3	MG/M3	M	MG/M3	MG/M3	MG/M3-D	MG/M3-D
1	MN:	2.16	218.5	145.0	255.0	24.8	.4	175.0	90.0	.0	.0
	CV:	.00	.15	.33	.37	.45	.40	.34	.37	.00	.00
2	MN:	1.29	224.0	110.0	245.0	26.7	.5	160.0	70.0	.0	.0
	CV:	.00	.09	.30	.42	.35	.28	.52	.33	.00	.00
3	MN:	1.08	224.0	90.0	260.0	22.2	.6	180.0	60.0	.0	.0
	CV:	.00	.08	.47	.51	.41	.35	.63	.50	.00	.00
4	MN:	.54	226.5	40.0	270.0	15.9	1.1	150.0	30.0	.0	.0
	CV:	.00	.06	.33	.57	.34	.24	.54	.45	.00	.00
5	MN:	.70	227.0	50.0	257.0	16.0	.9	170.0	40.0	.0	.0
	CV:	.00	.04	.48	.61	.35	.23	.83	.67	.00	.00

CASE: CEDAR CREEK

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INPUT GROUP 13 - MODEL COEFFICIENTS

IC	COEFFICIENT	MEAN	CV
1	P DECAY RATE	1.000	.45
2	N DECAY RATE	1.000	.55
3	CHL-A MODEL	1.000	.26
4	SECCHI MODEL	1.000	.10
5	ORGANIC N MODEL	.300	.12
6	TP-OP MODEL	1.000	.15
7	HODV MODEL	1.000	.15
8	MODV MODEL	1.000	.22
9	BETA M2/MG	.025	.00
10	MINIMUM QS	.100	.00
11	FLUSHING EFFECT	1.000	.00
12	CHLOROPHYLL-A CV	.620	.00

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GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL P

ID	T	LOCATION	LOADING KG/YR	LOADING %(I)	VARIANCE KG/YR**2	VARIANCE %(I)	CV	CONC MG/M3	EXPORT KG/KM2
1	3	MABANK	1239.3	.5	.104E+06	.0	.260	4730.0	.0
2	3	KEMP	1064.9	.4	.343E+06	.1	.550	6960.0	.0
3	3	EUSTACE	229.0	.1	.142E+05	.0	.520	4320.0	.0
4	3	ECCMUD	3334.4	1.3	.152E+07	.3	.370	7140.0	.0
5	3	KAUFMAN	2582.3	1.0	.107E+07	.2	.400	3820.0	.0
6	3	CHEROKEE	174.7	.1	.110E+05	.0	.600	7280.0	.0
7	2	KINGS	119600.0	45.1	.242E+09	50.4	.130	650.0	146.0
8	2	CEDAR	82665.0	31.2	.197E+09	41.2	.170	495.0	112.2
9	2	LACY	17280.0	6.5	.269E+08	5.6	.300	320.0	71.7
10	2	NORTH TWIN	7920.0	3.0	.226E+07	.5	.190	330.0	72.0
11	2	SOUTH TWIN	3420.0	1.3	.105E+07	.2	.300	190.0	41.7
12	2	CANEY	6270.0	2.4	.566E+06	.1	.120	330.0	72.1
13	2	PRAIRIE	5760.0	2.2	.959E+06	.2	.170	360.0	78.9
14	2	CLEAR	3300.0	1.2	.480E+06	.1	.210	165.0	36.3
15	2	LYNN	1920.0	.7	.532E+06	.1	.380	320.0	68.6
16	4	DAM OUTFLOW	15030.0	5.7	.520E+08	10.9	.480	50.0	.0
17	4	PIPELINE	5572.5	2.1	.715E+07	1.5	.480	50.0	.0

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GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL P

ID T LOCATION	LOADING KG/YR	LOADING %(I)	VARIANCE KG/YR**2	VARIANCE %(I)	CV	CONC MG/M3	EXPORT KG/KM2
PRECIPITATION	8399.1	3.2	.441E+07	.9	.250	60.8	60.2
EXTERNAL INFLOW	256759.5	96.8	.475E+09	99.1	.085	503.8	113.2
***TOTAL INFLOW	265158.6	100.0	.479E+09	100.0	.083	409.3	110.1
GAUGED OUTFLOW	20602.5	7.8	.592E+08	12.3	.373	50.0	.0
UNGAUGED OUTFLOW	17.0	.0	.120E+08	2.5	9.999	50.0	.0
***TOTAL OUTFLOW	20619.5	7.8	.712E+08	14.9	.409	50.0	8.6
***STORAGE INCREASE	2010.8	.8	.128E+06	.0	.178	86.3	.0
***NET RETENTION	242528.3	91.5	.551E+09	114.9	.097	.0	.0

OVERFLOW RATE M/YR	HYDRAULIC RESIDENCE TIME YRS	TOTAL P POOL CONC MG/M3	TOTAL P RESIDENCE TIME YRS	TOTAL P TURNOVER RATIO -	TOTAL P RETENTION COEF -
3.12	1.9238	86.3	.2728	3.6655	.8582

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GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL N

ID	T	LOCATION	LOADING KG/YR	LOADING %(I)	VARIANCE KG/YR**2	VARIANCE %(I)	CV	CONC MG/M3	EXPORT KG/KM2
1	3	MABANK	2790.3	.3	.158E+07	.0	.450	10650.0	.0
2	3	KEMP	618.1	.1	.182E+06	.0	.690	4040.0	.0
3	3	EUSTACE	151.1	.0	.219E+05	.0	.980	2850.0	.0
4	3	ECCMUD	2806.7	.3	.323E+07	.0	.640	6010.0	.0
5	3	KAUFMAN	10802.5	1.3	.160E+08	.0	.370	15980.0	.0
6	3	CHEROKEE	263.5	.0	.360E+05	.0	.720	10980.0	.0
7	2	KINGS	299920.0	37.2	.166E+11	48.7	.430	1630.0	366.2
8	2	CEDAR	203239.0	25.2	.125E+11	36.6	.550	1217.0	275.8
9	2	LACY	54540.0	6.8	.966E+09	2.8	.570	1010.0	226.3
10	2	NORTH TWIN	25200.0	3.1	.917E+08	.3	.380	1050.0	229.1
11	2	SOUTH TWIN	12600.0	1.6	.700E+07	.0	.210	700.0	153.7
12	2	CANEY	21090.0	2.6	.752E+07	.0	.130	1110.0	242.4
13	2	PRAIRIE	13120.0	1.6	.502E+08	.1	.540	820.0	179.7
14	2	CLEAR	23900.0	3.0	.452E+09	1.3	.890	1195.0	262.6
15	2	LYNN	5820.0	.7	.392E+07	.0	.340	970.0	207.9
16	4	DAM OUTFLOW	77254.2	9.6	.222E+10	6.5	.610	257.0	.0
17	4	PIPELINE	28642.6	3.5	.305E+09	.9	.610	257.0	.0

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GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL N

ID T LOCATION	LOADING KG/YR	LOADING %(I)	VARIANCE KG/YR**2	VARIANCE %(I)	CV	CONC MG/M3	EXPORT KG/KM2
PRECIPITATION	130186.1	16.1	.343E+10	10.0	.450	942.5	933.1
EXTERNAL INFLOW	676861.1	83.9	.307E+11	90.0	.259	1328.1	298.4
***TOTAL INFLOW	807047.3	100.0	.342E+11	100.0	.229	1245.9	335.2
GAUGED OUTFLOW	105896.9	13.1	.253E+10	7.4	.475	257.0	.0
UNGAUGED OUTFLOW	87.3	.0	.318E+09	.9	9.999	257.0	.0
***TOTAL OUTFLOW	105984.1	13.1	.284E+10	8.3	.503	257.0	44.0
***STORAGE INCREASE	5996.2	.7	.187E+07	.0	.228	257.4	.0
***NET RETENTION	695066.9	86.1	.370E+11	108.3	.277	.0	.0

OVERFLOW RATE M/YR	HYDRAULIC RESIDENCE TIME YRS	TOTAL N POOL CONC MG/M3	TOTAL N RESIDENCE TIME YRS	TOTAL N TURNOVER RATIO -	TOTAL N RETENTION COEF -
3.12	1.9238	257.4	.2673	3.7413	.8611

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SEGMENT: 1 UPPER LAKE

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		218.5	.15	218.5	.15	1.00	.00	.00	.00
TOTAL P	MG/M3	145.0	.33	124.4	.16	1.17	.46	.57	.42
TOTAL N	MG/M3	255.0	.37	281.3	.26	.91	-.27	-.45	-.22
C.NUTRIENT	MG/M3	8.7	.37	10.9	.56	.80	-.60	-1.10	-.33
CHL-A	MG/M3	24.8	.45	30.5	.09	.81	-.46	-.59	-.45
SECCHI	M	.4	.40	.3	.02	1.05	.13	.18	.13
ORGANIC N	MG/M3	175.0	.34	304.3	.06	.58	-1.63	-2.21	-1.60
TP-ORTHO-P	MG/M3	90.0	.37	101.3	.05	.89	-.32	-.32	-.32

SEGMENT: 2 HWY85
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VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		224.0	.09	224.0	.09	1.00	.00	.00	.00
TOTAL P	MG/M3	110.0	.30	113.5	.14	.97	-.10	-.12	-.09
TOTAL N	MG/M3	245.0	.42	280.9	.26	.87	-.33	-.62	-.28
C.NUTRIENT	MG/M3	7.9	.41	10.9	.56	.73	-.77	-1.58	-.46
CHL-A	MG/M3	26.7	.35	21.7	.05	1.23	.59	.60	.58
SECCHI	M	.5	.28	.5	.01	.93	-.24	-.24	-.24
ORGANIC N	MG/M3	160.0	.52	224.8	.03	.71	-.65	-1.36	-.65
TP-ORTHO-P	MG/M3	70.0	.33	65.1	.03	1.07	.22	.20	.22

SEGMENT: 3 MIDLAKD
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VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		224.0	.08	224.0	.08	1.00	.00	.00	.00
TOTAL P	MG/M3	90.0	.47	98.0	.13	.92	-.18	-.32	-.18
TOTAL N	MG/M3	260.0	.51	280.3	.26	.93	-.15	-.34	-.13
C.NUTRIENT	MG/M3	9.1	.51	10.8	.55	.84	-.33	-.84	-.23
CHL-A	MG/M3	22.2	.41	16.0	.04	1.39	.80	.95	.80
SECCHI	M	.6	.35	.7	.01	.90	-.29	-.37	-.29
ORGANIC N	MG/M3	180.0	.63	180.9	.02	1.00	-.01	-.02	-.01
TP-ORTHO-P	MG/M3	60.0	.50	50.0	.02	1.20	.37	.50	.37

SEGMENT: 4 DAM SITE

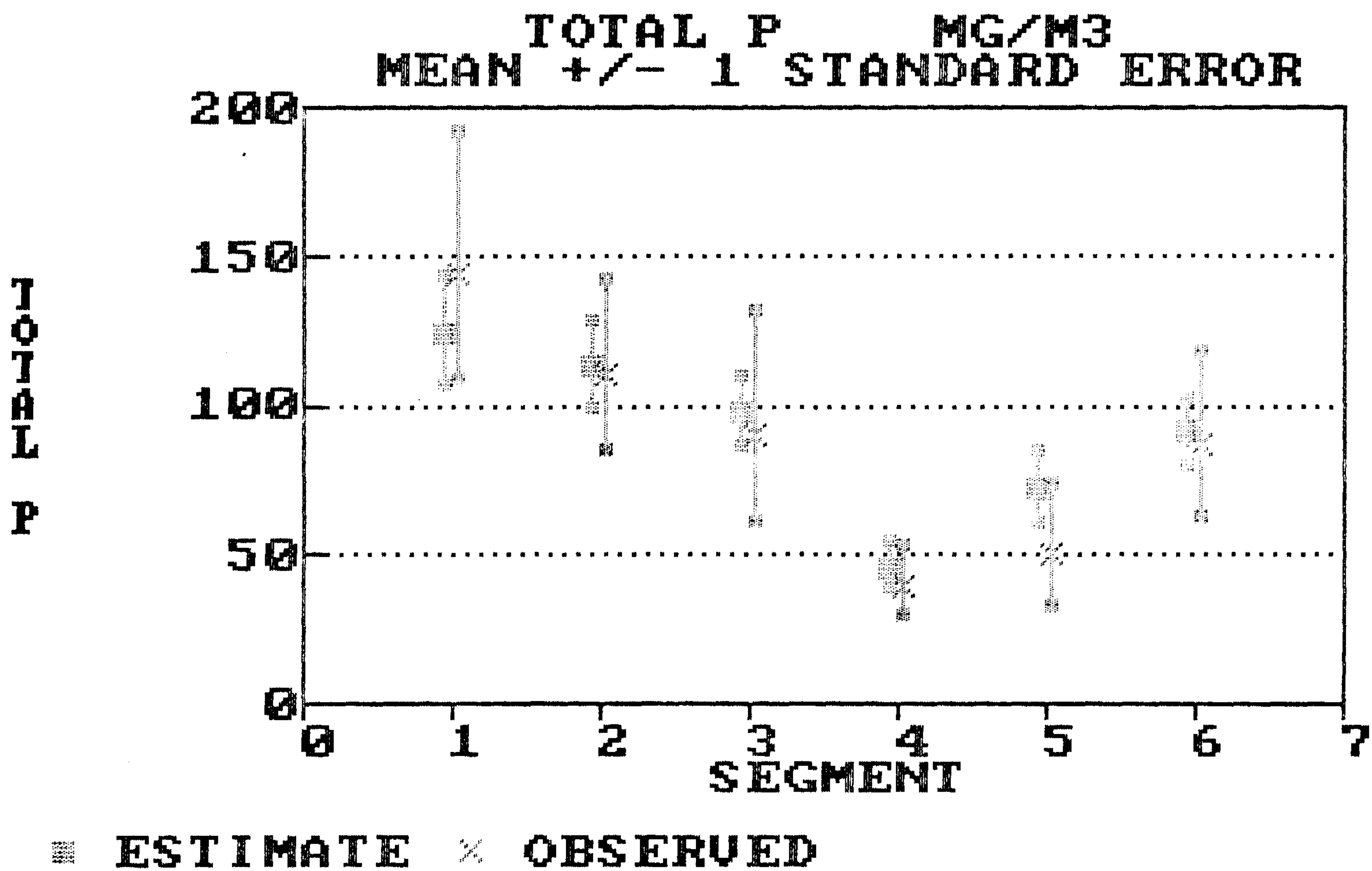
VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		226.5	.06	226.5	.06	1.00	.00	.00	.00
TOTAL P	MG/M3	40.0	.33	46.7	.19	.86	-.47	-.57	-.41
TOTAL N	MG/M3	270.0	.57	279.4	.26	.97	-.06	-.16	-.05
C.NUTRIENT	MG/M3	9.7	.52	10.5	.53	.92	-.15	-.40	-.11
CHL-A	MG/M3	15.9	.34	16.5	.12	.96	-.11	-.11	-.10
SECCHI	M	1.1	.24	1.1	.05	1.02	.08	.07	.08
ORGANIC N	MG/M3	150.0	.54	172.1	.08	.87	-.25	-.55	-.25
TP-ORTHO-P	MG/M3	30.0	.45	38.1	.09	.79	-.53	-.65	-.52

SEGMENT: 5 PUMPSTATION

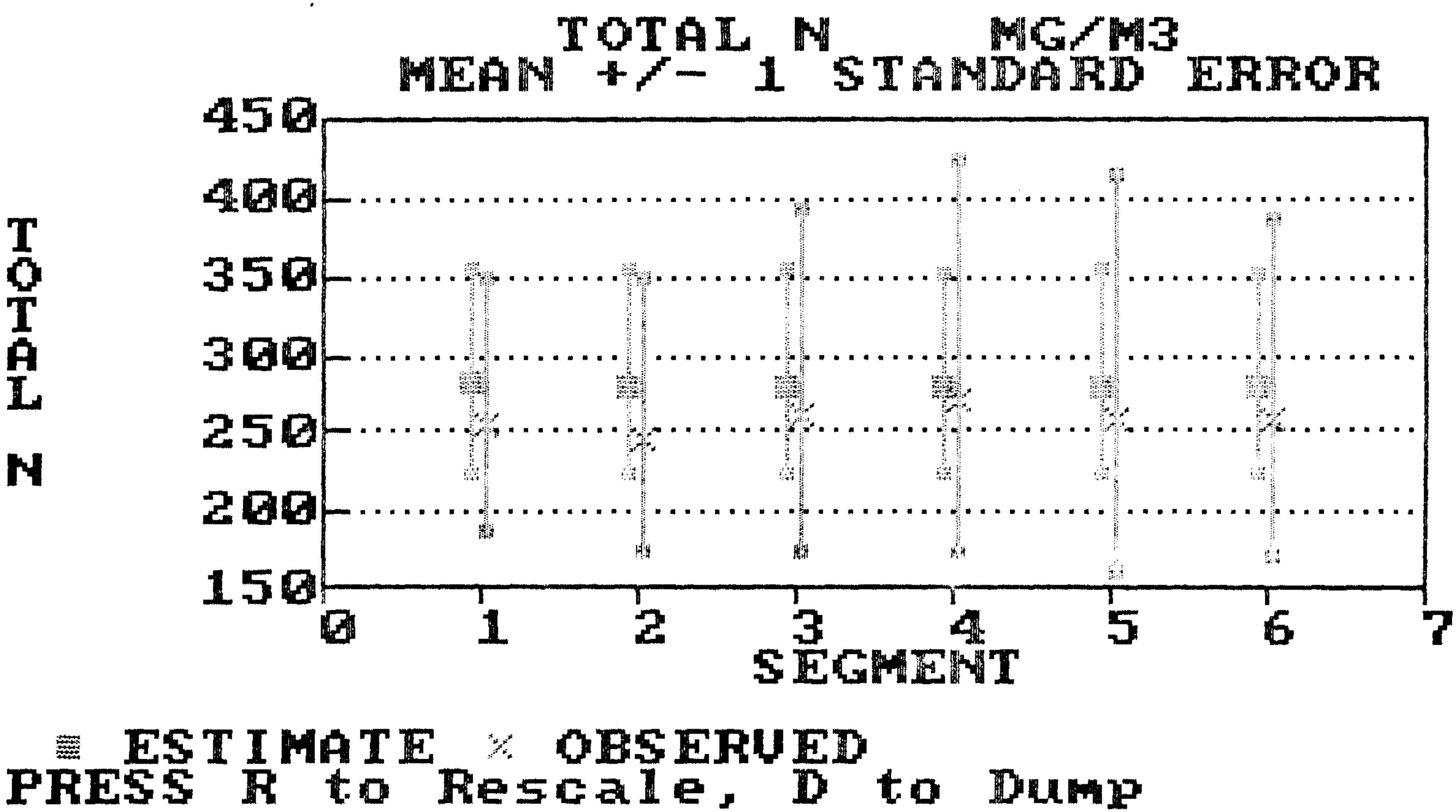
VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		227.0	.04	227.0	.04	1.00	.00	.00	.00
TOTAL P	MG/M3	50.0	.48	72.3	.18	.69	-.77	-1.37	-.72
TOTAL N	MG/M3	257.0	.61	280.7	.26	.92	-.14	-.40	-.13
C.NUTRIENT	MG/M3	8.8	.59	10.8	.55	.82	-.35	-1.02	-.25
CHL-A	MG/M3	16.0	.35	15.0	.07	1.07	.19	.19	.19
SECCHI	M	.9	.23	.9	.02	.98	-.10	-.08	-.10
ORGANIC N	MG/M3	170.0	.83	165.3	.04	1.03	.03	.11	.03
TP-ORTHO-P	MG/M3	40.0	.67	39.1	.05	1.02	.03	.06	.03
HOD-V	MG/M3-DAY	.0	.00	759.5	.03	.00	.00	.00	.00
MOD-V	MG/M3-DAY	.0	.00	345.2	.03	.00	.00	.00	.00

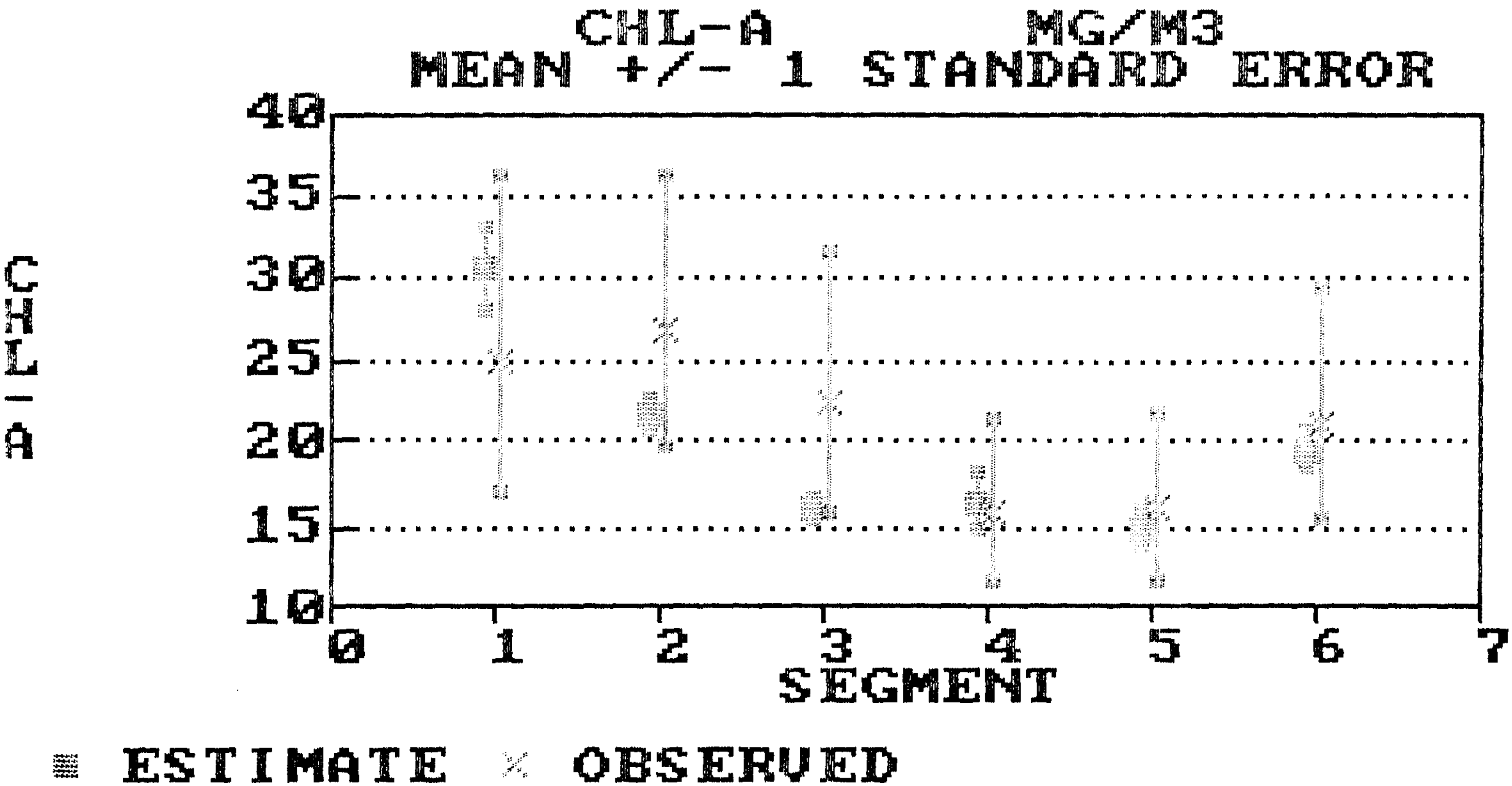
SEGMENT: 6 AREA-WTD MEAN
(H)

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		224.1	.08	224.1	.04	1.00	.00	.00	.00
TOTAL P	MG/M3	86.3	.37	90.8	.12	.95	-.14	-.19	-.13
TOTAL N	MG/M3	257.4	.50	280.5	.26	.92	-.17	-.39	-.15
C.NUTRIENT	MG/M3	8.8	.48	10.8	.54	.82	-.41	-.98	-.27
CHL-A	MG/M3	21.2	.38	19.6	.05	1.08	.20	.23	.20
SECCHI	M	.7	.28	.7	.02	.97	-.10	-.10	-.10
ORGANIC N	MG/M3	166.8	.58	206.9	.03	.81	-.37	-.86	-.37
TP-ORTHO-P	MG/M3	57.6	.44	57.6	.03	1.00	.00	.00	.00
HOD-V	MG/M3-DAY	.0	.00	759.5	.03	.00	.00	.00	.00
MOD-V	MG/M3-DAY	.0	.00	345.2	.03	.00	.00	.00	.00

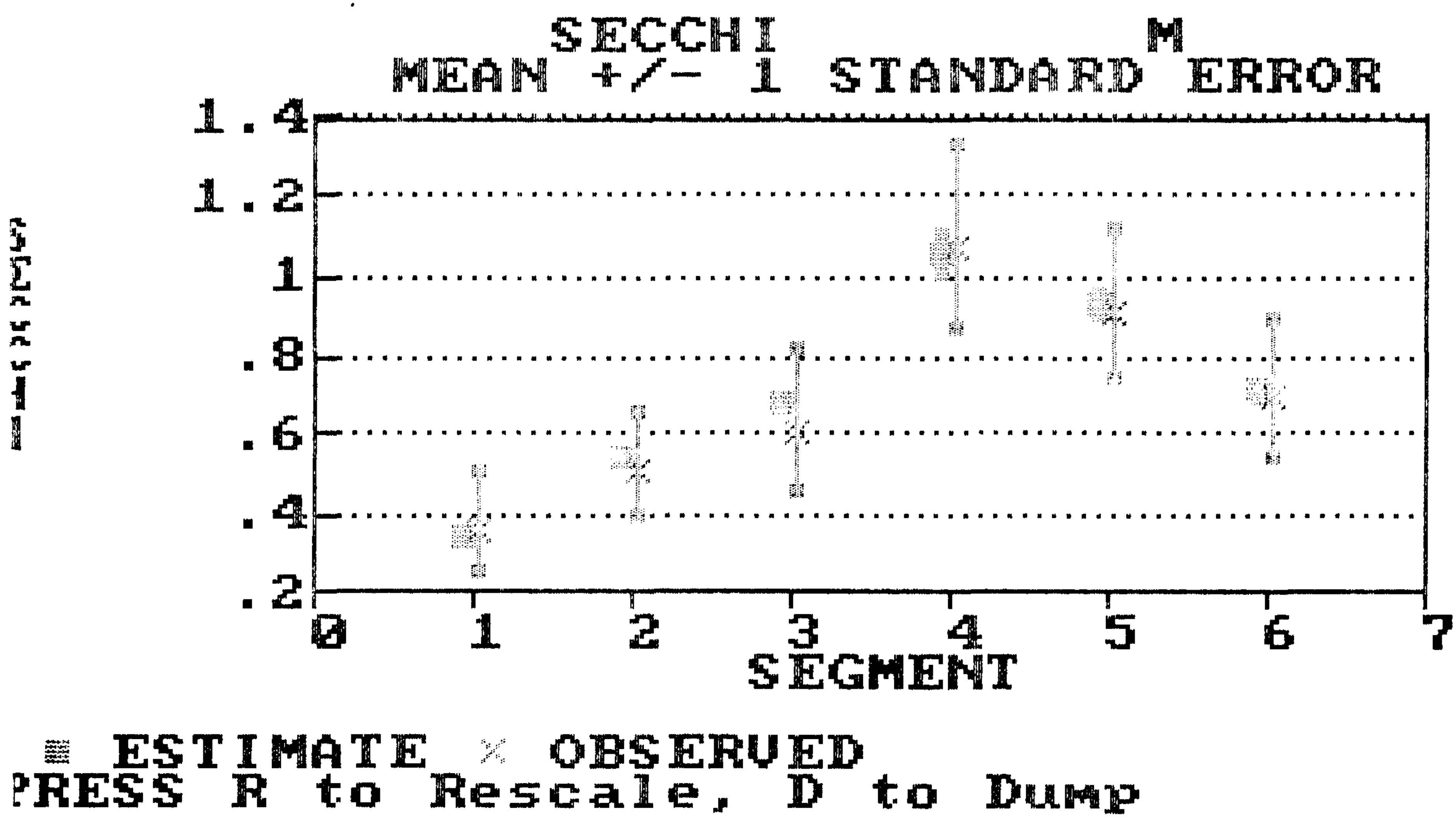


PRESS R to Rescale, D to Dump


TOTAL N MG/M3
MEAN +/- 1 STANDARD ERROR
450
400
350
300
250
200
150
TOTAL N
0
1
2
3
4
5
6
7
SEGMENT
ESTIMATE
OBSERVED
PRESS R to Rescale, D to Dump



PRESS R to Rescale, D to Dump


SECCHI M
MEAN +/- 1 STANDARD ERROR
1.4
1.2
1
.8
.6
.4
.2
0
1
2
3
4
5
6
7
SEGMENT
ESTIMATE
OBSERVED
PRESS R to Rescale, D to Dump

CEDAR CREEK RESERVOIR
MODEL VERIFICATION

CASE: CEDAR CREEK

INPUT GROUP 13 - MODEL COEFFICIENTS

IC	COEFFICIENT	MEAN	CV
1	P DECAY RATE	1.000	.45
2	N DECAY RATE	1.000	.55
3	CHL-A MODEL	1.000	.26
4	SECCHI MODEL	1.000	.10
5	ORGANIC N MODEL	.300	.12
6	TP-OP MODEL	1.000	.15
7	HODV MODEL	1.000	.15
8	MODV MODEL	1.000	.22
9	BETA M2/MG	.025	.00
10	MINIMUM QS	.100	.00
11	FLUSHING EFFECT	1.000	.00
12	CHLOROPHYLL-A CV	.620	.00

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CASE: CEDAR CREEK

INPUT GROUP 14 - CASE NOTES
VALIDATION RUN.

MAY 16, 1991. MRE MODEL/COEFF.

DATABASE 1990 WATER BAL AND

QUARTERLY SAMPLING OF RESERVOIR.

TRIB, RAINFALL AND WWTP DATA

SAME AS 1989 CALIBRATRION.

<H>

CASE: CEDAR CREEK

INPUT GROUP 3 - MODEL OPTIONS

1	CONSERVATIVE SUBSTANCE	0	NOT COMPUTED
2	PHOSPHORUS BALANCE	2	2ND ORDER, DECAY
3	NITROGEN BALANCE	7	SETTLING VELOCITY
4	CHLOROPHYLL-A	2	P, LIGHT, T
5	SECCHI DEPTH	1	VS. CHLA & TURBIDITY
6	DISPERSION	1	FISCHER-NUMERIC
7	PHOSPHORUS CALIBRATION	1	DECAY RATES
8	NITROGEN CALIBRATION	2	CONCENTRATIONS
9	ERROR ANALYSIS	2	DATA ONLY

CASE: CEDAR CREEK

INPUT GROUP 4 - VARIABLES

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VARIABLE	ATMOSPHERIC LOADINGS KG/KM2-YR	CV	AVAILABILITY FACTOR
1 CONSERV	.00	.00	.00
2 TOTAL P	60.20	.25	1.00
3 TOTAL N	933.10	.45	1.00
4 ORTHO P	30.10	.00	.00
5 INORG N	541.80	.50	.00

CASE: CEDAR CREEK

INPUT GROUP 5 - GLOBAL PARAMETERS

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PARAMETER		MEAN	CV
1 PERIOD LENGTH	YRS	1.000	.000
2 PRECIPITATION	M	1.350	.200
3 EVAPORATION	M	1.630	.300
4 INCREASE IN STORAGE	M	.540	.000
5 FLOW FACTOR		1.000	.000
6 DISPERSION FACTOR		.250	.700
7 TOTAL AREA	KM2	.000	.000
8 TOTAL VOLUME	HM3	.000	.000

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CASE: CEDAR CREEK

INPUT GROUP 6 - TRIBUTARY DRAINAGE AREAS AND FLOWS

ID	TYPE	SEG	NAME	DRAINAGE AREA KM2	MEAN FLOW HM3/YR	CV OF MEAN FLOW
1	3	3	MABANK	.000	.262	.000
2	3	1	KEMP	.000	.153	.000
3	3	4	EUSTACE	.000	.053	.000
4	3	3	ECCMUD	.000	.467	.000
5	3	1	KAUFMAN	.000	.676	.000
6	3	5	CHEROKEE	.000	.024	.000
7	2	1	KINGS	819.000	440.000	.000
8	2	1	CEDAR	737.000	391.000	.000
9	2	2	LACY	241.000	135.000	.000
10	2	3	NORTH TWIN	110.000	61.000	.000
11	2	3	SOUTH TWIN	82.000	49.000	.000
12	2	4	CANEY	87.000	49.000	.000
13	2	3	PRAIRIE	73.000	37.000	.000
14	2	4	CLEAR	91.000	49.000	.000
15	2	5	LYNN	28.000	12.000	.000
16	4	5	DAM OUTFLOW	.000	1028.600	.000
17	4	5	PIPELINE	.000	83.300	.000

(H)

CASE: CEDAR CREEK

INPUT GROUP 7 - TRIBUTARY CONCENTRATIONS (PPB): MEAN/CV

ID	CONSERV	TOTAL P	TOTAL N	ORTHO P	INORG N
1	.0/ .00	4730.0/ .26	10650.0/ .45	4010.0/ .26	6750.0/ .58
2	.0/ .00	6960.0/ .55	4040.0/ .69	5540.0/ .52	3330.0/ .73
3	.0/ .00	4320.0/ .52	2850.0/ .98	2970.0/ .57	2040.0/1.21
4	.0/ .00	7140.0/ .37	6010.0/ .64	5660.0/ .28	5340.0/ .67
5	.0/ .00	3820.0/ .40	15980.0/ .37	3360.0/ .47	15550.0/ .41
6	.0/ .00	7280.0/ .60	10980.0/ .72	7120.0/ .62	9320.0/ .79
7	.0/ .00	650.0/ .13	1630.0/ .43	200.0/ .25	1160.0/ .63
8	.0/ .00	495.0/ .17	1217.0/ .55	120.0/ .43	485.0/ .33
9	.0/ .00	320.0/ .30	1010.0/ .57	110.0/ .37	525.0/ .40
10	.0/ .00	330.0/ .19	1050.0/ .38	90.0/ .51	600.0/ .50
11	.0/ .00	190.0/ .30	700.0/ .21	80.0/ .00	345.0/ .31
12	.0/ .00	330.0/ .12	1110.0/ .13	50.0/ .98	830.0/ .18
13	.0/ .00	360.0/ .17	820.0/ .54	150.0/ .34	430.0/ .40
14	.0/ .00	165.0/ .21	1195.0/ .89	75.0/ .47	240.0/ .21
15	.0/ .00	320.0/ .38	970.0/ .34	70.0/ .96	490.0/ .64
16	.0/ .00	50.0/ .48	257.0/ .61	10.0/ .54	70.0/ .83
17	.0/ .00	50.0/ .48	257.0/ .61	10.0/ .54	70.0/ .83

(H)

CASE: CEDAR CREEK

INPUT GROUP 10 - OBSERVED WATER QUALITY

SEG		TURBID 1/M	CONSER ?	TOTALP MG/M3	TOTALN MG/M3	CHL-A MG/M3	SECCHI M	ORG-N MG/M3	TP-OP MG/M3	HODV MG/M3-D	MODV MG/M3-D
1	MN:	4.16	134.0	120.0	510.0	15.6	.2	320.0	70.0	.0	.0
	CV:	.00	.27	.25	.37	.81	.54	.63	.43	.00	.00
2	MN:	2.46	140.0	150.0	480.0	12.9	.4	270.0	100.0	.0	.0
	CV:	.00	.26	.40	.46	.80	.43	.85	.30	.00	.00
3	MN:	1.67	162.0	110.0	510.0	14.6	.5	240.0	70.0	.0	.0
	CV:	.00	.15	.64	.39	.67	.47	.83	.57	.00	.00
4	MN:	.63	189.0	50.0	320.0	19.4	.9	210.0	40.0	.0	.0
	CV:	.00	.11	.40	.50	.12	.24	.66	.50	.00	.00
5	MN:	.93	180.0	70.0	440.0	14.8	.8	230.0	40.0	.0	.0
	CV:	.00	.10	.43	.41	.50	.38	.70	.50	.00	.00

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GROSS WATER BALANCE:

ID T LOCATION	DRAINAGE AREA KM2	---- FLOW (HM3/YR) ---- MEAN	VARIANCE	CV	RUNOFF M/YR
PRECIPITATION	139.520	188.352	.142E+04	.200	1.350
EXTERNAL INFLOW	2268.000	1224.635	.000E+00	.000	.540
***TOTAL INFLOW	2407.520	1412.987	.142E+04	.027	.587
GAUGED OUTFLOW	.000	1111.900	.000E+00	.000	.000
UNGAUGED OUTFLOW	2407.520	-1.671	.607E+04	9.990	-.001
***TOTAL OUTFLOW	2407.520	1110.229	.607E+04	.070	.461
***EVAPORATION	.000	227.418	.465E+04	.300	.000
***STORAGE INCREASE	.000	75.341	.000E+00	.000	.000

GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL P

ID T LOCATION	----- LOADING ---- KG/YR	%(I)	--- VARIANCE --- KG/YR**2	%(I)	CV	CONC MG/M3	EXPORT KG/KM2
1 3 MABANK	1239.3	.2	.104E+06	.0	.260	4730.0	.0
2 3 KEMP	1064.9	.2	.343E+06	.0	.550	6960.0	.0
3 3 EUSTACE	229.0	.0	.142E+05	.0	.520	4320.0	.0
4 3 ECCMUD	3334.4	.5	.152E+07	.1	.370	7140.0	.0
5 3 KAUFMAN	2582.3	.4	.107E+07	.0	.400	3820.0	.0
6 3 CHEROKEE	174.7	.0	.110E+05	.0	.600	7280.0	.0
7 2 KINGS	286000.0	46.8	.138E+10	51.6	.130	650.0	349.2
8 2 CEDAR	193545.0	31.7	.108E+10	40.4	.170	495.0	262.6
9 2 LACY	43200.0	7.1	.168E+09	6.3	.300	320.0	179.3
10 2 NORTH TWIN	20130.0	3.3	.146E+08	.5	.190	330.0	183.0
11 2 SOUTH TWIN	9310.0	1.5	.780E+07	.3	.300	190.0	113.5
12 2 CANEY	16170.0	2.6	.377E+07	.1	.120	330.0	185.9
13 2 PRAIRIE	13320.0	2.2	.513E+07	.2	.170	360.0	182.5
14 2 CLEAR	8085.0	1.3	.288E+07	.1	.210	165.0	88.8
15 2 LYNN	3840.0	.6	.213E+07	.1	.380	320.0	137.1
16 4 DAM OUTFLOW	51430.0	8.4	.609E+09	22.8	.480	50.0	.0
17 4 PIPELINE	4165.0	.7	.400E+07	.1	.480	50.0	.0

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GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL P

ID T LOCATION	----- LOADING ---- KG/YR	%(I)	--- VARIANCE --- KG/YR**2	%(I)	CV	CONC MG/M3	EXPORT KG/KM2
PRECIPITATION	8399.1	1.4	.441E+07	.2	.250	44.6	60.2
EXTERNAL INFLOW	602224.5	98.6	.267E+10	99.8	.086	491.8	265.5
***TOTAL INFLOW	610623.6	100.0	.268E+10	100.0	.085	432.2	253.6
GAUGED OUTFLOW	55595.0	9.1	.613E+09	22.9	.445	50.0	.0
UNGAUGED OUTFLOW	-117.0	.0	.298E+08	1.1	9.999	70.0	.0
***TOTAL OUTFLOW	55478.0	9.1	.643E+09	24.0	.457	50.0	23.0
***STORAGE INCREASE	7611.0	1.2	.283E+07	.1	.221	101.0	.0
***NET RETENTION	547534.6	89.7	.332E+10	124.1	.105	.0	.0

OVERFLOW RATE M/YR	HYDRAULIC RESIDENCE TIME YRS	TOTAL P: POOL CONC MG/M3	RESIDENCE TIME YRS	TURNOVER RATIO -	RETENTION COEF -
8.50	.7070	101.0	.1387	7.2113	.8039

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GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL N

ID	T	LOCATION	LOADING KG/YR	LOADING %(I)	VARIANCE KG/YR**2	VARIANCE %(I)	CV	CONC MG/M3	EXPORT KG/KM2
1	3	MABANK	2790.3	.2	.158E+07	.0	.450	10650.0	.0
2	3	KEMP	618.1	.0	.182E+06	.0	.690	4040.0	.0
3	3	EUSTACE	151.1	.0	.219E+05	.0	.980	2850.0	.0
4	3	ECCMUD	2806.7	.2	.323E+07	.0	.640	6010.0	.0
5	3	KAUFMAN	10802.5	.6	.160E+08	.0	.370	15980.0	.0
6	3	CHEROKEE	263.5	.0	.360E+05	.0	.720	10980.0	.0
7	2	KINGS	717200.0	41.4	.951E+11	53.8	.430	1630.0	875.7
8	2	CEDAR	475847.0	27.5	.685E+11	38.7	.550	1217.0	645.7
9	2	LACY	136350.0	7.9	.604E+10	3.4	.570	1010.0	565.8
10	2	NORTH TWIN	64050.0	3.7	.592E+09	.3	.380	1050.0	582.3
11	2	SOUTH TWIN	34300.0	2.0	.519E+08	.0	.210	700.0	418.3
12	2	CANEY	54390.0	3.1	.500E+08	.0	.130	1110.0	625.2
13	2	PRAIRIE	30340.0	1.8	.268E+09	.2	.540	820.0	415.6
14	2	CLEAR	58555.0	3.4	.272E+10	1.5	.890	1195.0	543.5
15	2	LYNN	11640.0	.7	.157E+08	.0	.340	970.0	415.7
16	4	DAM OUTFLOW	264350.2	15.3	.260E+11	14.7	.610	257.0	.0
17	4	PIPELINE	21408.1	1.2	.171E+09	.1	.610	257.0	.0

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GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL N

ID T LOCATION	LOADING KG/YR	LOADING %(I)	VARIANCE KG/YR**2	VARIANCE %(I)	CV	CONC MG/M3	EXPORT KG/KM2
PRECIPITATION	130186.1	7.5	.343E+10	1.9	.450	691.2	933.1
EXTERNAL INFLOW	1600104.0	92.5	.173E+12	98.1	.260	1306.6	705.5
***TOTAL INFLOW	1730290.0	100.0	.177E+12	100.0	.243	1224.6	718.7
GAUGED OUTFLOW	285758.3	16.5	.262E+11	14.8	.566	257.0	.0
UNGAUGED OUTFLOW	-735.5	.0	.118E+10	.7	9.999	440.0	-.3
***TOTAL OUTFLOW	285022.8	16.5	.273E+11	15.5	.580	256.7	118.4
***STORAGE INCREASE	34049.6	2.0	.427E+08	.0	.192	451.9	.0
***NET RETENTION	1411218.0	81.6	.204E+12	115.5	.320	.0	.0

OVERFLOW RATE M/YR	HYDRAULIC RESIDENCE TIME YRS	TOTAL N POOL CONC MG/M3	TOTAL N RESIDENCE TIME YRS	TOTAL N TURNOVER RATIO -	TOTAL N RETENTION COEF -
8.50	.7070	451.9	.2189	4.5676	.6903

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SEGMENT: 1 UPPER LAKE

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		134.0	.27	134.0	.27	1.00	.00	.00	.00
TOTAL P	MG/M3	120.0	.25	127.1	.15	.94	-.23	-.21	-.20
TOTAL N	MG/M3	510.0	.37	263.6	.26	1.93	1.78	3.00	1.46
C.NUTRIENT	MG/M3	29.1	.35	9.4	.60	3.08	3.25	5.60	1.63
CHL-A	MG/M3	15.6	.81	20.9	.08	.75	-.36	-.84	-.36
SECCHI	M	.2	.54	.2	.01	.94	-.12	-.24	-.12
ORGANIC N	MG/M3	320.0	.63	283.7	.04	1.13	.19	.48	.19
TP-ORTHO-P	MG/M3	70.0	.43	131.6	.02	.53	-1.47	-1.72	-1.47

SEGMENT: 2 HWY85

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		140.0	.26	140.0	.26	1.00	.00	.00	.00
TOTAL P	MG/M3	150.0	.40	116.6	.12	1.29	.63	.94	.60
TOTAL N	MG/M3	480.0	.46	262.9	.26	1.83	1.31	2.74	1.14
C.NUTRIENT	MG/M3	27.0	.45	9.4	.59	2.88	2.35	5.27	1.42
CHL-A	MG/M3	12.9	.80	14.2	.04	.91	-.12	-.28	-.12
SECCHI	M	.4	.43	.4	.00	1.13	.28	.42	.28
ORGANIC N	MG/M3	270.0	.85	199.9	.02	1.35	.35	1.20	.35
TP-ORTHO-P	MG/M3	100.0	.30	79.5	.01	1.26	.76	.63	.76

SEGMENT: 3 MIDLAKD

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		162.0	.15	162.0	.15	1.00	.00	.00	.00
TOTAL P	MG/M3	110.0	.64	101.7	.10	1.08	.12	.29	.12
TOTAL N	MG/M3	510.0	.39	261.9	.25	1.95	1.71	3.03	1.43
C.NUTRIENT	MG/M3	28.9	.44	9.3	.59	3.12	2.56	5.66	1.54
CHL-A	MG/M3	14.6	.67	12.0	.03	1.22	.30	.57	.30
SECCHI	M	.5	.47	.5	.00	.98	-.03	-.06	-.03
ORGANIC N	MG/M3	240.0	.83	166.7	.02	1.44	.44	1.46	.44
TP-ORTHO-P	MG/M3	70.0	.57	56.8	.01	1.23	.37	.57	.37

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VARIABLE		OBSERVED MEAN	CV	ESTIMATED MEAN	CV	RATIO	T STATISTICS 1	2	3
CONSERVATIVE SUB		189.0	.11	189.0	.11	1.00	.00	.00	.00
TOTAL P	MG/M3	50.0	.40	52.6	.20	.95	-.13	-.19	-.11
TOTAL N	MG/M3	320.0	.50	258.2	.24	1.24	.43	.98	.39
C.NUTRIENT	MG/M3	13.6	.48	8.9	.55	1.53	.89	2.13	.59
CHL-A	MG/M3	19.4	.12	16.3	.11	1.19	1.45	.50	1.06
SECCHI	M	.9	.24	1.0	.04	.93	-.29	-.24	-.28
ORGANIC N	MG/M3	210.0	.66	172.8	.07	1.22	.30	.78	.29
TP-ORTHO-P	MG/M3	40.0	.50	39.8	.08	1.00	.01	.01	.01

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SEGMENT: 5 PUMPSTATION

VARIABLE		OBSERVED MEAN	CV	ESTIMATED MEAN	CV	RATIO	T STATISTICS 1	2	3
CONSERVATIVE SUB		180.0	.10	180.0	.10	1.00	.00	.00	.00
TOTAL P	MG/M3	70.0	.43	76.3	.15	.92	-.20	-.32	-.19
TOTAL N	MG/M3	440.0	.41	261.1	.25	1.69	1.27	2.37	1.09
C.NUTRIENT	MG/M3	22.8	.42	9.2	.58	2.49	2.19	4.53	1.28
CHL-A	MG/M3	14.8	.50	12.8	.05	1.16	.29	.42	.29
SECCHI	M	.8	.38	.8	.01	1.00	.00	.00	.00
ORGANIC N	MG/M3	230.0	.70	155.5	.03	1.48	.56	1.57	.56
TP-ORTHO-P	MG/M3	40.0	.50	40.7	.03	.98	-.03	-.05	-.03
HOD-V	MG/M3-DAY	.0	.00	664.0	.02	.00	.00	.00	.00
MOD-V	MG/M3-DAY	.0	.00	301.8	.02	.00	.00	.00	.00

SEGMENT: 6 AREA-WTD MEAN
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VARIABLE		OBSERVED MEAN	CV	ESTIMATED MEAN	CV	RATIO	T STATISTICS 1	2	3
CONSERVATIVE SUB		161.2	.17	161.2	.08	1.00	.00	.00	.00
TOTAL P	MG/M3	101.0	.43	94.7	.10	1.07	.15	.24	.15
TOTAL N	MG/M3	451.9	.42	261.5	.25	1.73	1.30	2.49	1.11
C.NUTRIENT	MG/M3	24.3	.42	9.2	.58	2.63	2.28	4.82	1.35
CHL-A	MG/M3	15.4	.55	15.0	.04	1.03	.05	.08	.05
SECCHI	M	.6	.37	.6	.02	.99	-.03	-.05	-.03
ORGANIC N	MG/M3	252.3	.74	193.1	.02	1.31	.36	1.07	.36
TP-ORTHO-P	MG/M3	65.1	.44	68.1	.02	.95	-.11	-.13	-.11
HOD-V	MG/M3-DAY	.0	.00	664.0	.02	.00	.00	.00	.00
MOD-V	MG/M3-DAY	.0	.00	301.8	.02	.00	.00	.00	.00

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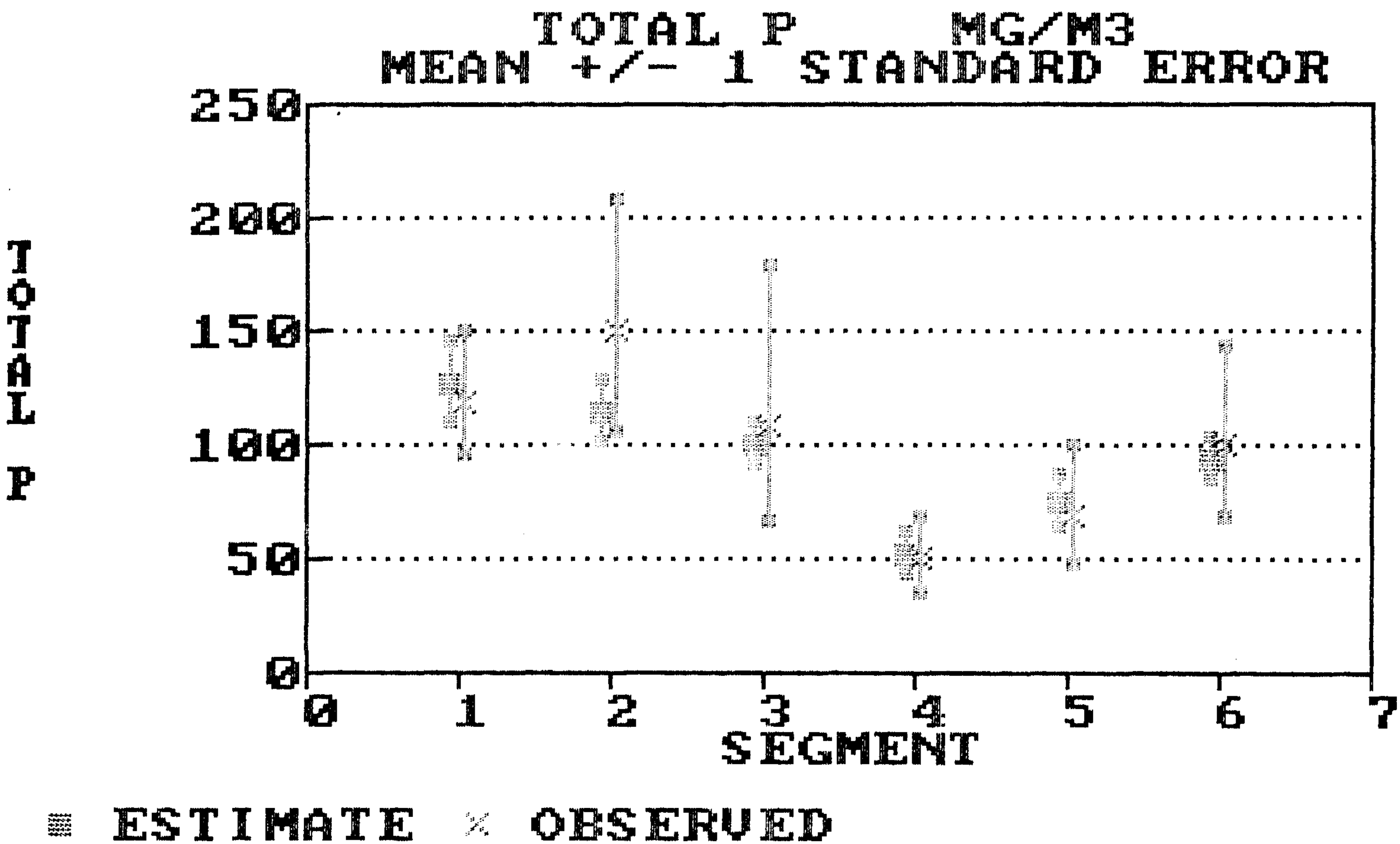
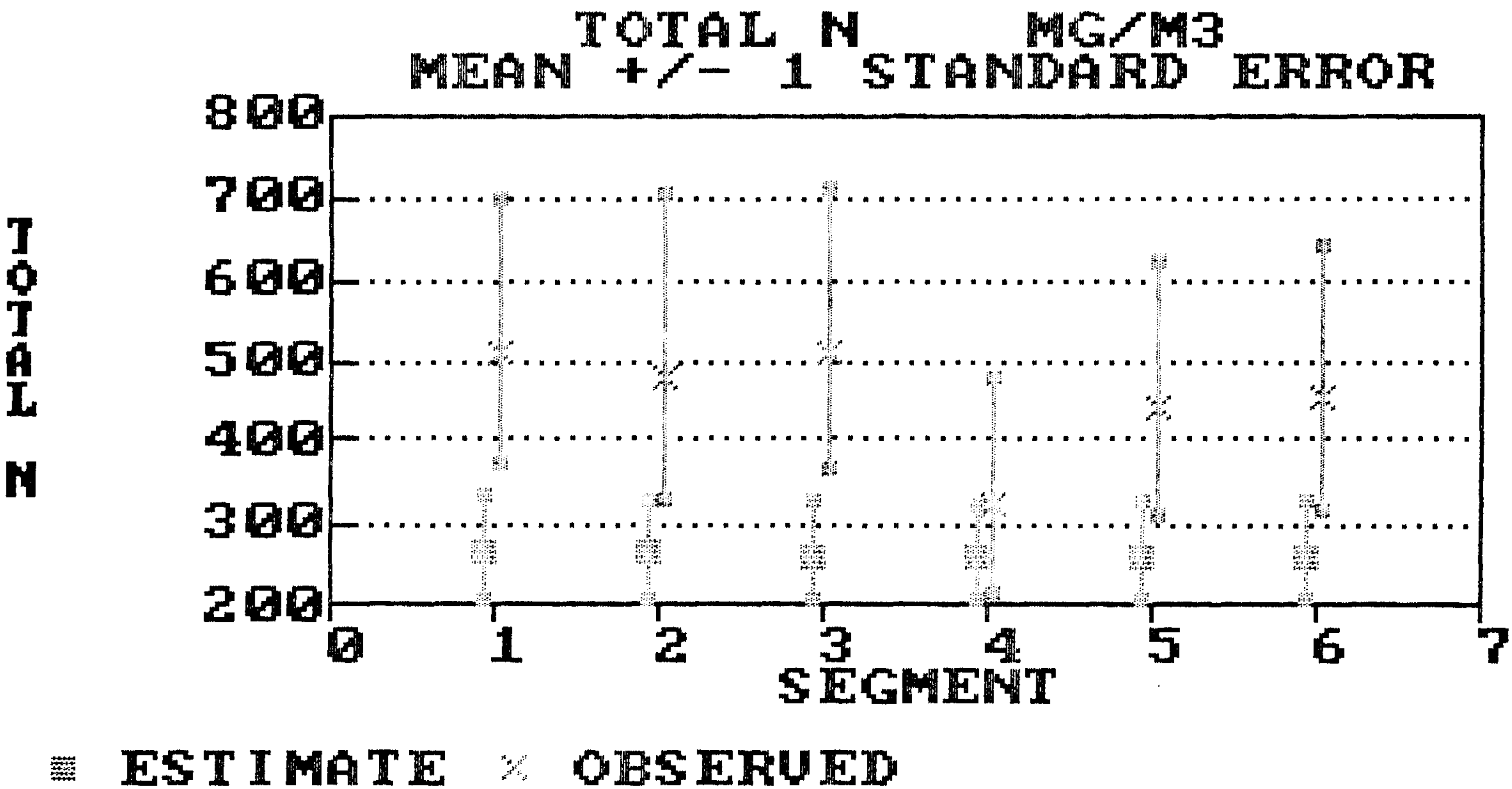


PRESS R to Rescale, D to Dump



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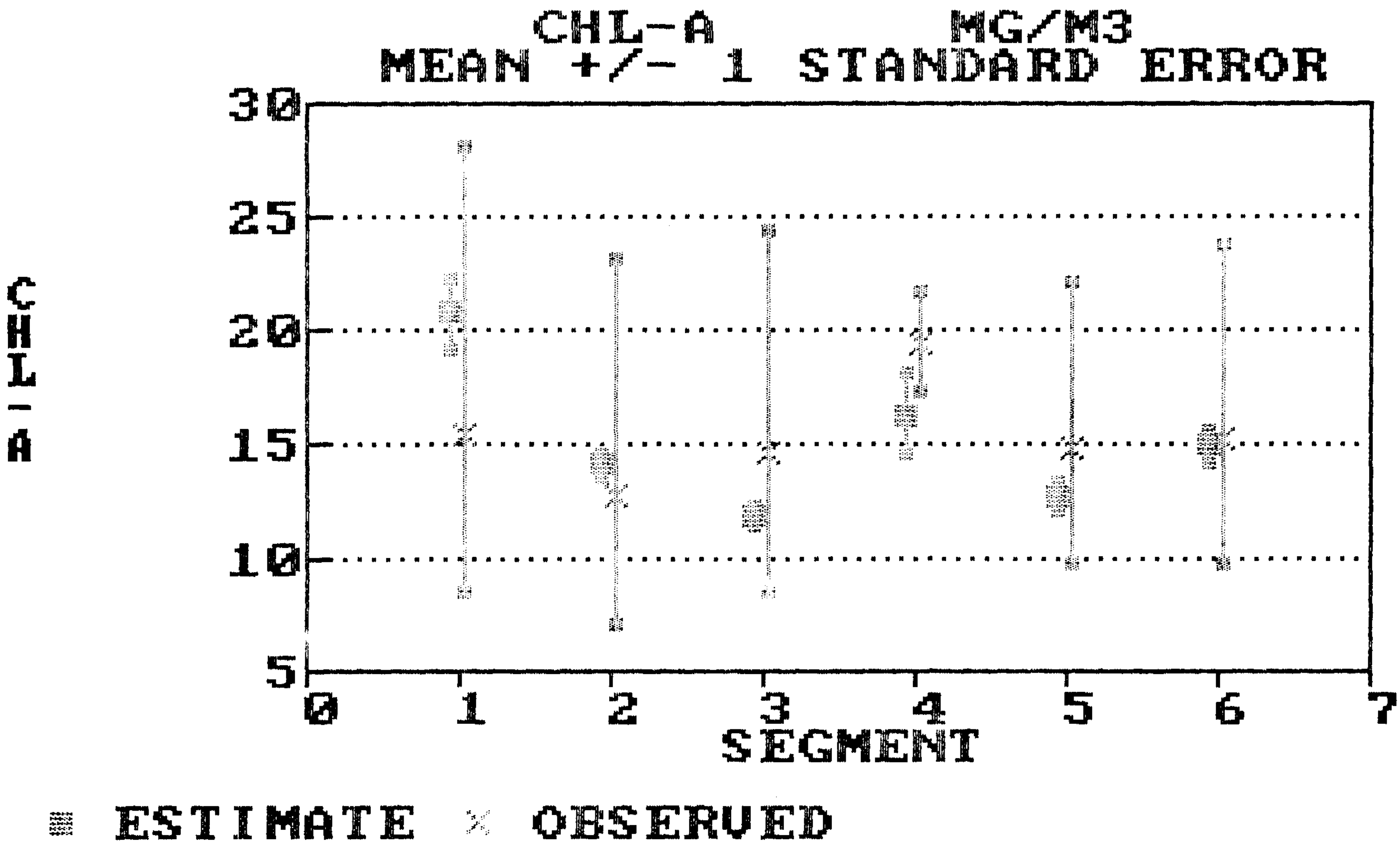
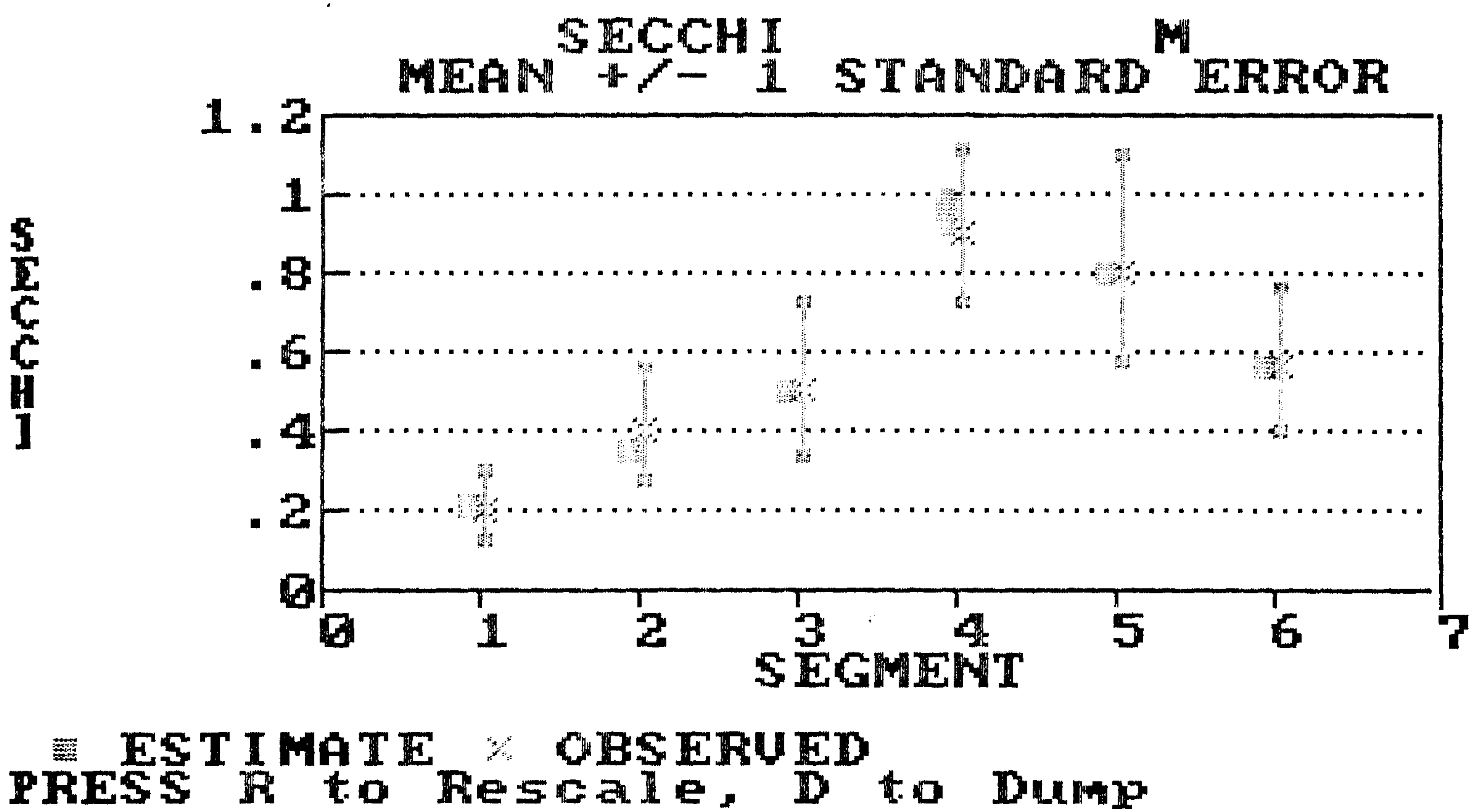


PRESS R to Rescale, D to Dump


SECCHI M
MEAN +/- 1 STANDARD ERROR
1.2
1
.8
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SEGMENT
ESTIMATE
OBSERVED
PRESS R to Rescale, D to Dump

RICHLAND-CHAMBERS RESERVOIR
MODEL CALIBRATION

CASE: RICHLAND-CHAMBERS

INPUT GROUP 14 - CASE NOTES
MAY 2, 1991

RC 1990 LAKE DATA.

TRIB, WWTP AND RAIN DATA TODATE

RICHLAND TRIB DATA USED FOR

GRAPE, CRAB & CEDAR.

WATER RELEASED FROM BARDWELL

AND NAVARRO MILLS ASSUMED TO

HAVE 25% OF TRIB NUTRIENTS.

CALIBRATION BY JLM

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CASE: RICHLAND-CHAMBERS

INPUT GROUP 3 - MODEL OPTIONS

1	CONSERVATIVE SUBSTANCE	0 NOT COMPUTED
2	PHOSPHORUS BALANCE	7 SETTLING VELOCITY
3	NITROGEN BALANCE	7 SETTLING VELOCITY
4	CHLOROPHYLL-A	1 P, N, LIGHT, T
5	SECCHI DEPTH	1 VS. CHLA & TURBIDITY
6	DISPERSION	1 FISCHER-NUMERIC
7	PHOSPHORUS CALIBRATION	1 DECAY RATES
8	NITROGEN CALIBRATION	1 DECAY RATES
9	ERROR ANALYSIS	2 DATA ONLY

CASE: RICHLAND-CHAMBERS

INPUT GROUP 4 - VARIABLES

VARIABLE	ATMOSPHERIC LOADINGS KG/KM2-YR	CV	AVAILABILITY FACTOR
1 CONSERV	.00	.00	.00
2 TOTAL P	60.20	.25	1.00
3 TOTAL N	933.10	.45	1.00
4 ORTHO P	30.10	.00	.00
5 INORG N	541.80	.50	.00

CASE: RICHLAND-CHAMBERS

INPUT GROUP 5 - GLOBAL PARAMETERS

PARAMETER		MEAN	CV
1 PERIOD LENGTH	YRS	1.000	.000
2 PRECIPITATION	M	1.505	.200
3 EVAPORATION	M	1.637	.300
4 INCREASE IN STORAGE	M	.478	.000
5 FLOW FACTOR		1.000	.000
6 DISPERSION FACTOR		.250	.700
7 TOTAL AREA	KM2	.000	.000
8 TOTAL VOLUME	HM3	.000	.000

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CASE: RICHLAND-CHAMBERS

INPUT GROUP 6 - TRIBUTARY DRAINAGE AREAS AND FLOWS

ID	TYPE	SEG	NAME	DRAINAGE AREA KM2	MEAN FLOW HM3/YR	CV OF MEAN FLOW
1	2	3	RICHLAND	1141.000	594.000	.000
2	2	1	CHAMBERS	360.800	188.000	.000
3	2	1	POSTOAK	104.840	54.200	.000
4	2	3	GRAPE	47.000	24.400	.000
5	2	4	CRAB	42.100	21.700	.000
6	2	2	CEDAR	40.700	20.800	.000
7	1	3	NAVARRO RELEASE	.000	217.900	.000
8	1	1	BARDWELL RELEASE	.000	127.900	.000
9	1	3	RICH GAGED	.000	13.200	.000
10	1	1	CHAM GAGED	.000	444.400	.000
11	4	6	DAM OUTFLOW	.000	1518.600	.000
12	4	2	PIPELINE	.000	82.000	.000
13	3	1	CORS-ASWWTP	.000	3.600	.000
14	3	1	CORS-OFWWTP	.000	.770	.000

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CASE: RICHLAND-CHAMBERS

INPUT GROUP 7 - TRIBUTARY CONCENTRATIONS (PPB): MEAN/CV

ID	CONSERV	TOTAL P	TOTAL N	ORTHO P	INORG N
1	.0/ .00	580.0/ .44	1450.0/ .80	160.0/ .51	690.0/ .96
2	.0/ .00	820.0/ .84	1780.0/ .61	180.0/1.54	1020.0/ .69
3	.0/ .00	610.0/ .35	2750.0/ .83	300.0/ .73	1510.0/ .97
4	.0/ .00	580.0/ .00	1450.0/ .00	160.0/ .00	690.0/ .00
5	.0/ .00	580.0/ .00	1450.0/ .00	160.0/ .00	690.0/ .00
6	.0/ .00	580.0/ .00	1450.0/ .00	160.0/ .00	690.0/ .00
7	.0/ .00	145.0/ .00	362.0/ .00	40.0/ .00	172.0/ .00
8	.0/ .00	205.0/ .00	445.0/ .00	45.0/ .00	255.0/ .00
9	.0/ .00	580.0/ .00	1450.0/ .00	160.0/ .00	690.0/ .00
10	.0/ .00	820.0/ .00	1780.0/ .00	180.0/ .00	1020.0/ .00
11	.0/ .00	40.0/ .17	390.0/ .39	10.0/ .60	240.0/ .52
12	.0/ .00	60.0/ .45	510.0/ .43	10.0/ .85	220.0/ .78
13	.0/ .00	1900.0/ .55	3200.0/ .91	1040.0/ .33	2570.0/ .96
14	.0/ .00	1160.0/ .33	1920.0/1.08	1040.0/ .45	1440.0/1.24

CASE: RICHLAND-CHAMBERS

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INPUT GROUP 9 - SEGMENT MORPHOMETRY: MEAN/CV

	PERIOD			STORAGE					
	LENGTH	PRECIP	EVAP	INCREA	LENGTH	AREA	ZMEAN	ZMIX	ZHYP
ID	YEARS	METERS	METERS	METERS	KM	KM2	M	M	M
1	1.00	1.00	1.00	1.00	9.50	29.2500	5.00	5.00/ .00	.00/ .00
2	1.00	1.00	1.00	1.00	5.50	25.0000	7.99	7.00/ .00	.00/ .00
3	1.00	1.00	1.00	1.00	9.50	35.5000	4.70	4.70/ .00	.00/ .00
4	1.00	1.00	1.00	1.00	9.50	33.6000	8.44	7.30/ .00	.00/ .00
5	1.00	1.00	1.00	1.00	5.50	27.4000	11.15	10.10/ .00	.00/ .00
6	1.00	1.00	1.00	1.00	4.80	30.0000	11.70	7.60/ .00	10.16/ .00

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CASE: RICHLAND-CHAMBERS

INPUT GROUP 10 - OBSERVED WATER QUALITY

SEG		TURBID 1/M	CONSER ?	TOTALP MG/M3	TOTALN MG/M3	CHL-A MG/M3	SECCHI M	ORG-N MG/M3	TP-OP MG/M3	HODV MG/M3-D	MODV MG/M3-D
1	MN:	3.16	340.0	80.0	860.0	16.5	.3	370.0	30.0	.0	.0
	CV:	.00	.19	.39	.65	.55	.39	.39	.93	.00	.00
2	MN:	.81	301.0	60.0	510.0	11.3	.9	340.0	47.0	.0	.0
	CV:	.00	.27	.45	.43	.54	.32	.49	.55	.00	.00
3	MN:	1.27	313.5	70.0	570.0	14.8	.6	540.0	30.0	.0	.0
	CV:	.00	.19	.97	.38	.16	.40	.27	.87	.00	.00
4	MN:	.52	290.0	35.0	440.0	11.9	1.2	370.0	27.0	.0	.0
	CV:	.00	.10	.50	.34	.49	.20	.33	.50	.00	.00
5	MN:	.57	314.0	40.0	370.0	9.9	1.2	340.0	20.0	.0	.0
	CV:	.00	.08	.02	.45	.34	.15	.44	.33	.00	.00
6	MN:	.72	309.0	40.0	390.0	12.6	1.4	250.0	30.0	.0	.0
	CV:	.00	.09	.17	.39	.24	.18	.52	.17	.00	.00

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CASE: RICHLAND-CHAMBERS

INPUT GROUP 13 - MODEL COEFFICIENTS

IC	COEFFICIENT	MEAN	CV
1	P DECAY RATE	1.000	.45
2	N DECAY RATE	1.000	.55
3	CHL-A MODEL	2.000	.26
4	SECCHI MODEL	1.000	.10
5	ORGANIC N MODEL	.750	.12
6	TP-OP MODEL	1.000	.15
7	HODV MODEL	1.000	.15
8	MODV MODEL	1.000	.22
9	BEW< 0	.025	.00
10	MINIMUM QS	.100	.00
11	FLUSHING EFFECT	1.000	.00
12	CHLOROPHYLL-A CV	.620	.00

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GROSS WATER BALANCE:

ID T LOCATION	DRAINAGE AREA KM2	---- FLOW (HM3/YR) ---- MEAN	VARIANCE	CV	RUNOFF M/YR
PRECIPITATION	180.750	272.029	.296E+04	.200	1.505
EXTERNAL INFLOW	1736.440	1710.870	.000E+00	.000	.985
***TOTAL INFLOW	1917.190	1982.899	.296E+04	.027	1.034
GAUGED OUTFLOW	.000	1600.600	.000E+00	.000	.000
UNGAUGED OUTFLOW	1917.190	.012	.108E+05	9.990	.000
***TOTAL OUTFLOW	1917.190	1600.612	.108E+05	.065	.835
***EVAPORATION	.000	295.888	.788E+04	.300	.000
***STORAGE INCREASE	.000	86.398	.000E+00	.000	.000

GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL P

ID	T	LOCATION	----- LOADING ---- KG/YR	%(I)	--- VARIANCE --- KG/YR**2	%(I)	CV	CONC MG/M3	EXPORT KG/KM2
1	2	RICHLAND	344520.0	33.8	.230E+11	57.6	.440	580.0	301.9
2	2	CHAMBERS	154160.0	15.1	.168E+11	42.0	.840	820.0	427.3
3	2	POSTOAK	33062.0	3.2	.134E+09	.3	.350	610.0	315.4
4	2	GRAPE	14152.0	1.4	.000E+00	.0	.000	580.0	301.1
5	2	CRAB	12586.0	1.2	.000E+00	.0	.000	580.0	299.0
6	2	CEDAR	12064.0	1.2	.000E+00	.0	.000	580.0	296.4
7	1	NAVARRO RELEASE	31595.5	3.1	.000E+00	.0	.000	145.0	.0
8	1	BARDWELL RELEASE	26219.5	2.6	.000E+00	.0	.000	205.0	.0
9	1	RICH GAGED	7656.0	.8	.000E+00	.0	.000	580.0	.0
10	1	CHAM GAGED	364408.0	35.8	.000E+00	.0	.000	820.0	.0
11	4	DAM OUTFLOW	60744.0	6.0	.107E+09	.3	.170	40.0	.0
12	4	PIPELINE	4920.0	.5	.490E+07	.0	.450	60.0	.0
13	3	CORS-ASWWTP	6840.0	.7	.142E+08	.0	.550	1900.0	.0
14	3	CORS-OFWWTP	893.2	.1	.869E+05	.0	.330	1160.0	.0

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GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL P

ID T LOCATION	----- LOADING ---- KG/YR	%(I)	--- VARIANCE --- KG/YR**2	%(I)	CV	CONC MG/M3	EXPORT KG/KM2
PRECIPITATION	10881.2	1.1	.740E+07	.0	.250	40.0	60.2
EXTERNAL INFLOW	1008156.0	98.9	.399E+11	100.0	.198	589.3	580.6
***TOTAL INFLOW	1019037.0	100.0	.399E+11	100.0	.196	513.9	531.5
GAUGED OUTFLOW	65664.0	6.4	.112E+09	.3	.161	41.0	.0
UNGAUGED OUTFLOW	.5	.0	.173E+08	.0	9.999	40.0	.0
***TOTAL OUTFLOW	65664.5	6.4	.129E+09	.3	.173	41.0	34.3
***STORAGE INCREASE	4683.0	.5	.171E+07	.0	.279	54.2	.0
***NET RETENTION	948689.9	93.1	.400E+11	100.3	.211	.0	.0

OVERFLOW RATE M/YR	HYDRAULIC RESIDENCE TIME YRS	TOTAL P: POOL CONC MG/M3	RESIDENCE TIME YRS	TURNOVER RATIO -	RETENTION COEF -
9.33	.8613	54.2	.0773	12.9398	.9103

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GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL N

ID	T	LOCATION	LOADING KG/YR	LOADING %(I)	VARIANCE KG/YR**2	VARIANCE %(I)	CV	CONC MG/M3	EXPORT KG/KM2
1	2	RICHLAND	861300.0	33.5	.475E+12	88.3	.800	1450.0	754.9
2	2	CHAMBERS	334640.0	13.0	.417E+11	7.8	.610	1780.0	927.5
3	2	POSTOAK	149050.0	5.8	.153E+11	2.8	.830	2750.0	1421.7
4	2	GRAPE	35380.0	1.4	.000E+00	.0	.000	1450.0	752.8
5	2	CRAB	31465.0	1.2	.000E+00	.0	.000	1450.0	747.4
6	2	CEDAR	30160.0	1.2	.000E+00	.0	.000	1450.0	741.0
7	1	NAVARRO RELEASE	78879.8	3.1	.000E+00	.0	.000	362.0	.0
8	1	BARDWELL RELEASE	56915.5	2.2	.000E+00	.0	.000	445.0	.0
9	1	RICH GAGED	19140.0	.7	.000E+00	.0	.000	1450.0	.0
10	1	CHAM GAGED	791032.0	30.8	.000E+00	.0	.000	1780.0	.0
11	4	DAM OUTFLOW	592254.0	23.0	.534E+11	9.9	.390	390.0	.0
12	4	PIPELINE	41820.0	1.6	.323E+09	.1	.430	510.0	.0
13	3	CORS-ASWWTP	11520.0	.4	.110E+09	.0	.910	3200.0	.0
14	3	CORS-OFWWTP	1478.4	.1	.255E+07	.0	1.080	1920.0	.0

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GROSS MASS BALANCE BASED UPON OBSERVED CONCENTRATIONS
COMPONENT: TOTAL N

ID T LOCATION	LOADING KG/YR	LOADING %(I)	VARIANCE KG/YR**2	VARIANCE %(I)	CV	CONC MG/M3	EXPORT KG/KM2
PRECIPITATION	168657.8	6.6	.576E+10	1.1	.450	620.0	933.1
EXTERNAL INFLOW	2400961.0	93.4	.532E+12	98.9	.304	1403.4	1382.7
***TOTAL INFLOW	2569619.0	100.0	.538E+12	100.0	.285	1295.9	1340.3
GAUGED OUTFLOW	634074.0	24.7	.537E+11	10.0	.365	396.1	.0
UNGAUGED OUTFLOW	4.9	.0	.165E+10	.3	9.999	390.0	.0
***TOTAL OUTFLOW	634078.9	24.7	.553E+11	10.3	.371	396.1	330.7
***STORAGE INCREASE	45296.2	1.8	.967E+08	.0	.217	524.3	.0
***NET RETENTION	1890243.0	73.6	.593E+12	110.3	.407	.0	.0

OVERFLOW RATE M/YR	HYDRAULIC RESIDENCE TIME YRS	TOTAL N POOL CONC MG/M3	TOTAL N RESIDENCE TIME YRS	TOTAL N TURNOVER RATIO -	TOTAL N RETENTION COEF -
9.33	.8613	524.3	.2964	3.3734	.6558

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SEGMENT: 1 CHAMBERS

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		340.0	.19	340.0	.19	1.00	.00	.00	.00
TOTAL P	MG/M3	80.0	.39	115.5	.28	.69	-.94	-1.37	-.76
TOTAL N	MG/M3	860.0	.65	649.4	.22	1.32	.43	1.28	.41
C.NUTRIENT	MG/M3	47.6	.54	39.2	.27	1.21	.36	.97	.32
CHL-A	MG/M3	16.5	.55	12.0	.23	1.38	.58	.93	.54
SECCHI	M	.3	.39	.3	.02	.97	-.08	-.11	-.08
ORGANIC N	MG/M3	370.0	.39	500.9	.09	.74	-.78	-1.21	-.76
TP-ORTHO-P	MG/M3	30.0	.93	92.1	.05	.33	-1.21	-3.06	-1.20

SEGMENT: 2 PUMPSTATION

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		301.0	.27	301.0	.27	1.00	.00	.00	.00
TOTAL P	MG/M3	60.0	.45	52.7	.19	1.14	.29	.48	.27
TOTAL N	MG/M3	510.0	.43	495.8	.23	1.03	.07	.13	.06
C.NUTRIENT	MG/M3	26.8	.44	25.3	.26	1.06	.14	.30	.12
CHL-A	MG/M3	11.3	.54	13.1	.24	.86	-.27	-.42	-.25
SECCHI	M	.9	.32	.9	.07	1.03	.11	.12	.10
ORGANIC N	MG/M3	340.0	.49	387.3	.14	.88	-.27	-.52	-.26
TP-ORTHO-P	MG/M3	47.0	.55	38.4	.14	1.22	.37	.55	.36

SEGMENT: 3 RICHLAND

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		313.5	.19	313.5	.19	1.00	.00	.00	.00
TOTAL P	MG/M3	70.0	.97	63.9	.35	1.10	.09	.34	.09
TOTAL N	MG/M3	570.0	.38	495.0	.45	1.15	.37	.64	.24
C.NUTRIENT	MG/M3	31.3	.58	26.2	.54	1.19	.31	.88	.22
CHL-A	MG/M3	14.8	.16	14.7	.55	1.01	.03	.01	.01
SECCHI	M	.6	.40	.6	.12	1.00	.00	.00	.00
ORGANIC N	MG/M3	540.0	.27	441.3	.31	1.22	.75	.81	.49
TP-ORTHO-P	MG/M3	30.0	.87	52.2	.27	.57	-.64	-1.51	-.61

SEGMENT: 4 RCMIDDLE

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		290.0	.10	290.0	.10	1.00	.00	.00	.00
TOTAL P	MG/M3	35.0	.50	46.2	.30	.76	-.55	-1.03	-.48
TOTAL N	MG/M3	440.0	.34	462.9	.39	.95	-.15	-.23	-.10
C.NUTRIENT	MG/M3	19.9	.41	22.7	.44	.88	-.33	-.66	-.22
CHL-A	MG/M3	11.9	.49	13.7	.42	.87	-.29	-.41	-.22
SECCHI	M	1.2	.20	1.2	.17	1.05	.26	.18	.20
ORGANIC N	MG/M3	370.0	.33	381.8	.26	.97	-.10	-.13	-.07
TP-ORTHO-P	MG/M3	27.0	.50	32.7	.32	.83	-.38	-.52	-.32

SEGMENT: 5 CONFLUENCE

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB		314.0	.08	314.0	.08	1.00	.00	.00	.00
TOTAL P	MG/M3	40.0	.02	38.9	.27	1.03	1.45	.11	.11
TOTAL N	MG/M3	370.0	.45	456.2	.28	.81	-.47	-.95	-.40
C.NUTRIENT	MG/M3	16.7	.31	21.3	.31	.78	-.78	-1.23	-.56
CHL-A	MG/M3	9.9	.34	9.9	.27	1.00	.00	.00	.00
SECCHI	M	1.2	.15	1.2	.08	1.00	-.01	-.01	-.01
ORGANIC N	MG/M3	340.0	.44	319.5	.14	1.06	.14	.25	.13
TP-ORTHO-P	MG/M3	20.0	.33	27.1	.18	.74	-.92	-.83	-.81

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SEGMENT: 6 DAMSITE

VARIABLE	OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB	309.0	.09	309.0	.09	1.00	.00	.00	.00
TOTAL P MG/M3	40.0	.17	35.0	.33	1.14	.79	.50	.37
TOTAL N MG/M3	390.0	.39	446.2	.28	.87	-.35	-.61	-.28
C.NUTRIENT MG/M3	17.9	.32	20.2	.31	.89	-.38	-.60	-.27
CHL-A MG/M3	12.6	.24	10.5	.31	1.20	.78	.54	.48
SECCHI M	1.4	.18	1.0	.08	1.34	1.65	1.06	1.50
ORGANIC N MG/M3	250.0	.52	337.3	.16	.74	-.58	-1.20	-.55
TP-ORTHO-P MG/M3	30.0	.17	31.6	.18	.95	-.30	-.14	-.21
HOD-V MG/M3-DAY	.0	.00	83.3	.17	.00	.00	.00	.00
MOD-V MG/M3-DAY	.0	.00	80.4	.17	.00	.00	.00	.00

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SEGMENT: 7 AREA-WTD MEAN

VARIABLE	OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
CONSERVATIVE SUB	311.0	.15	311.0	.07	1.00	.00	.00	.00
TOTAL P MG/M3	54.2	.49	58.8	.20	.92	-.17	-.30	-.15
TOTAL N MG/M3	524.3	.46	500.2	.29	1.05	.10	.21	.09
C.NUTRIENT MG/M3	26.8	.47	25.8	.32	1.04	.08	.18	.06
CHL-A MG/M3	12.9	.38	12.4	.33	1.04	.11	.12	.08
SECCHI M	.9	.24	.9	.10	1.08	.34	.29	.31
ORGANIC N MG/M3	374.8	.38	396.7	.18	.94	-.15	-.23	-.14
TP-ORTHO-P MG/M3	30.3	.58	45.9	.16	.66	-.72	-1.14	-.69
HOD-V MG/M3-DAY	.0	.00	83.3	.17	.00	.00	.00	.00
MOD-V MG/M3-DAY	.0	.00	80.4	.17	.00	.00	.00	.00

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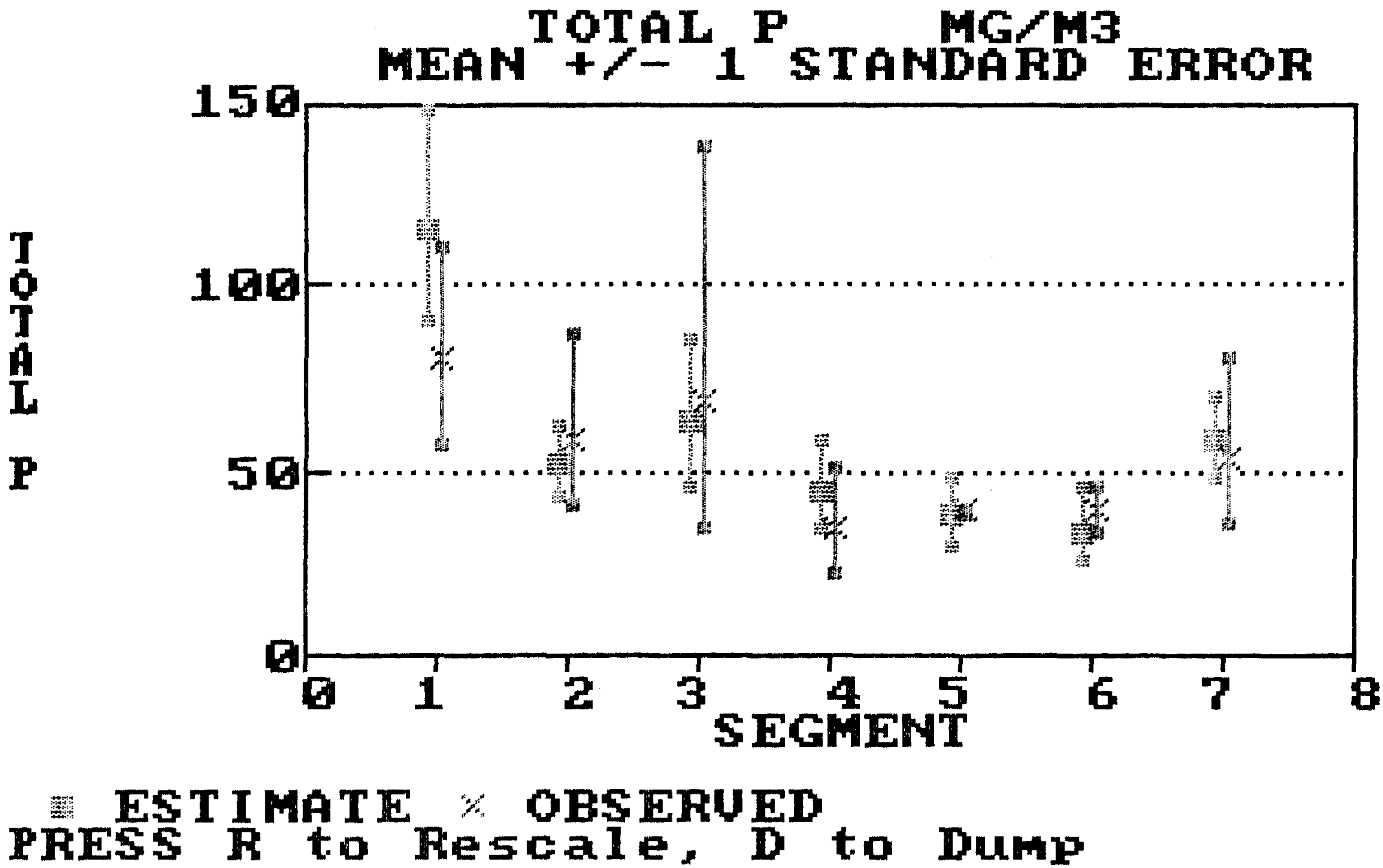
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50
0
TOTAL P
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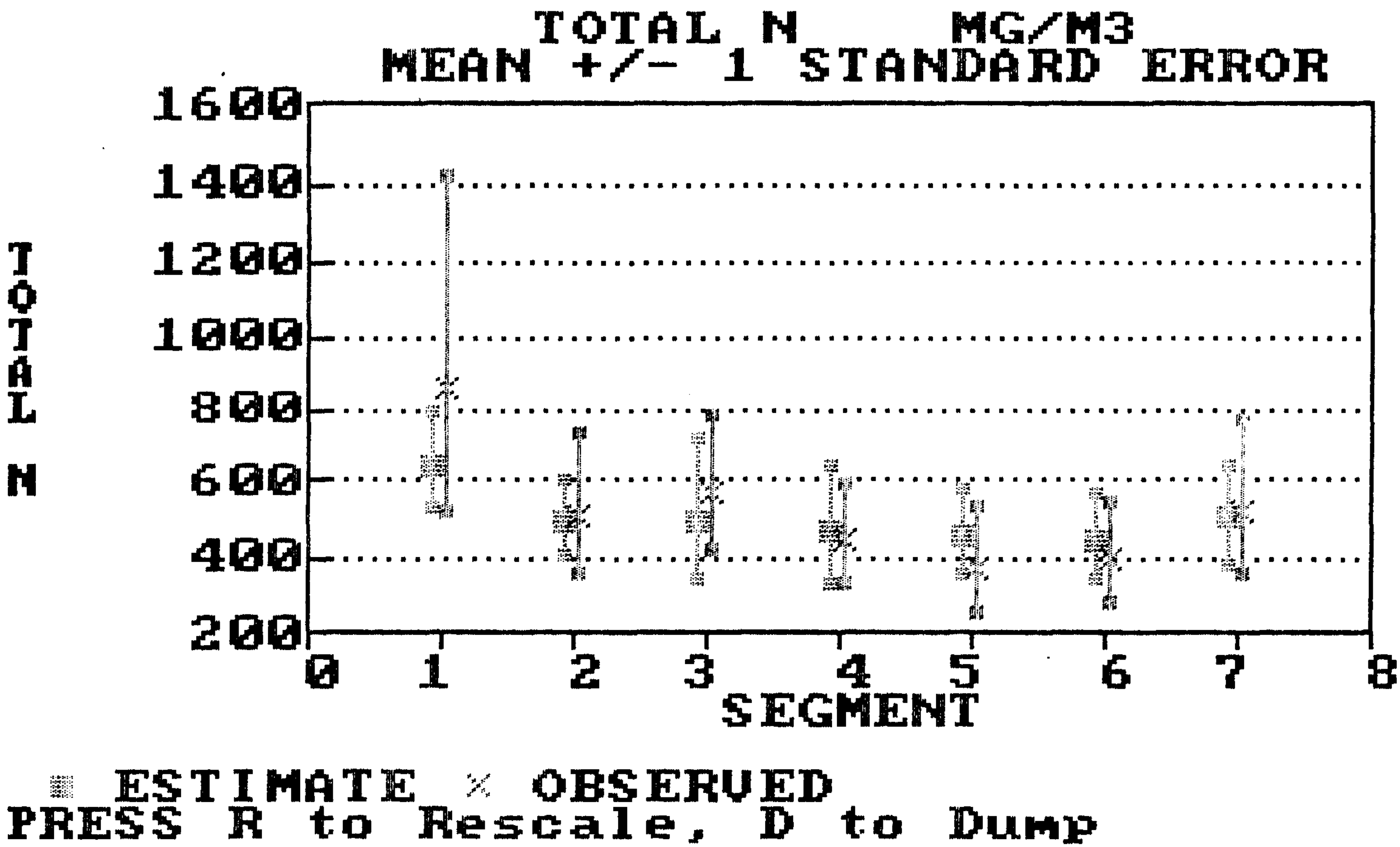
7
8
SEGMENT
ESTIMATE
% OBSERVED
PRESS R to Rescale, D to Dump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MEAN +/- 1 STANDARD ERROR
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TOTAL N
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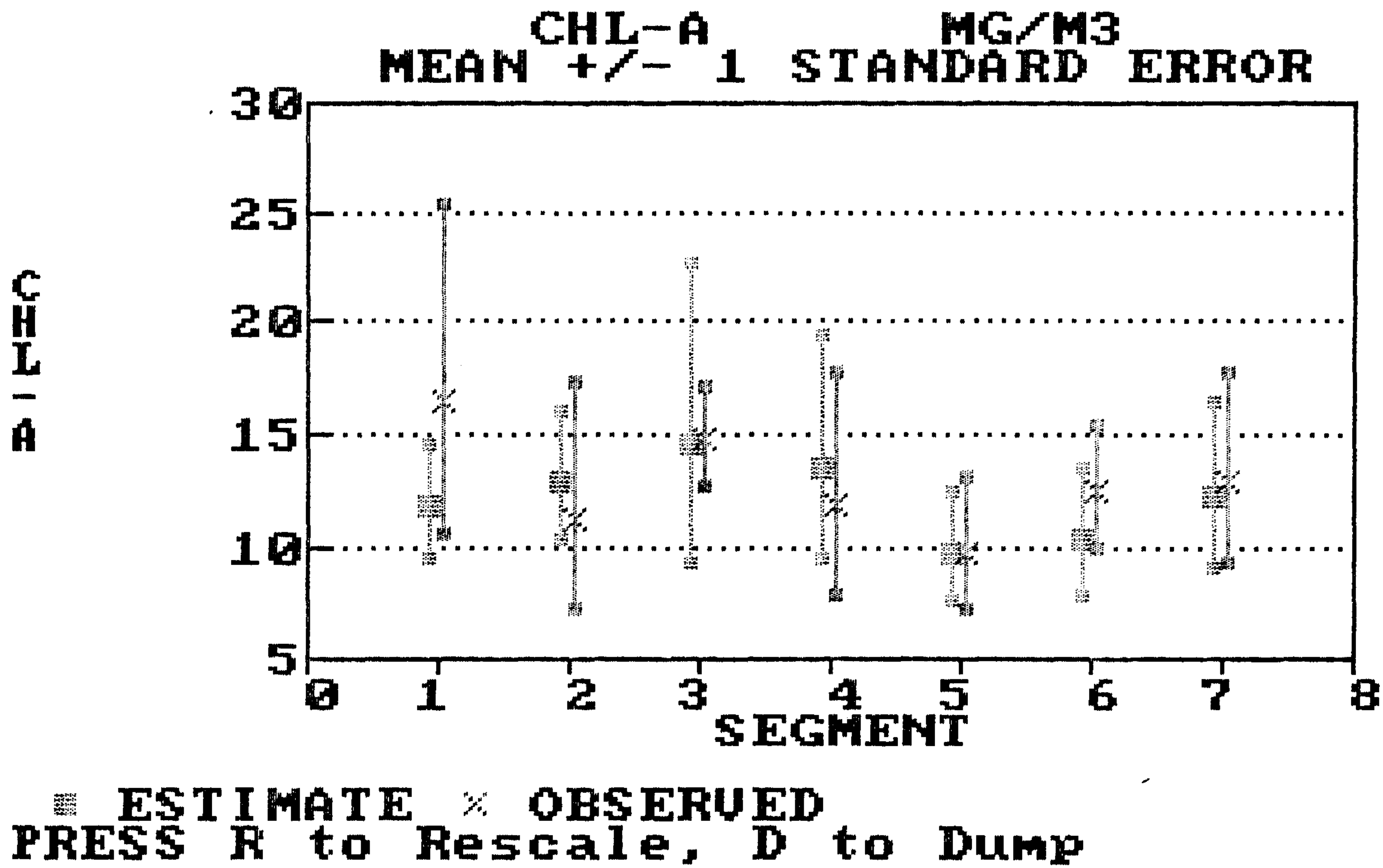
SEGMENT
ESTIMATE
OBSERVED
PRESS R to Rescale, D to Dump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MEAN +/- 1 STANDARD ERROR
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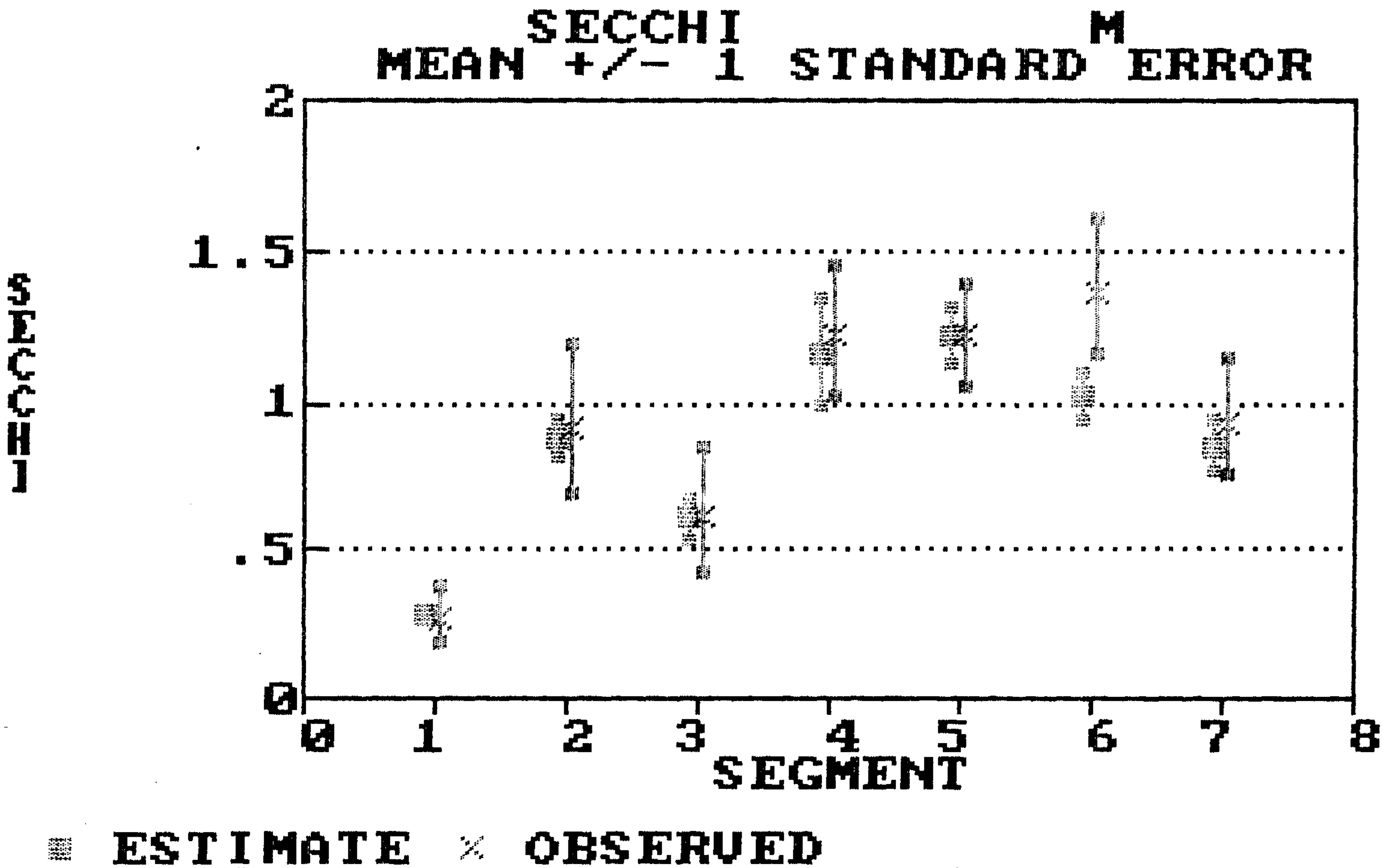
SEGMENT
ESTIMATE
OBSERVED
PRESS R to Rescale, D to Dump



PRESS R to Rescale, D to Dump