EVALUATION OF CERTAIN TOXIC SUBSTANCES IN SEGMENT 0804 OF THE TRINITY RIVER

Prepared for

TEXAS DEPARTMENT OF WATER RESOURCES

July 1986

Trinity River Authority of Texas

INTERIM REPORT

EVALUATION OF
CERTAIN TOXIC SUBSTANCES
IN SEGMENT 0804
OF THE TRINITY RIVER

Developed to satisfy the requirements of
Section 208 of the Federal Clean Water Act of 1977
and applicable regulations thereto.

Preparation of this report was financed through
a grant from the U.S. Environmental Protection Agency
and the State of Texas through the
Texas Department of Water Resources

Prepared for

TEXAS DEPARTMENT OF WATER RESOURCES

By

TRINITY RIVER AUTHORITY OF TEXAS

July 1986

This study has been funded by state and federal appropriations administered by the Texas Department of Water Resources and the U. S. Environmental Protection Agency under various planning requirements of the Clean Water Act and the Texas Water Quality Act.

TABLE OF CONTENTS

Introduction

1.1 Authorization - This report is submitted under Contract No. 14-00069 between the Texas Department of Water Resources (TDWR) and the Trinity River Authority of Texas (TRA). The Department is the official planning agency for water quality planning in the state. The Authority is the local planning agency designated by the Department to assist in water quality planning for the "non-designated" portion of the Trinity River Basin (all of the Trinity River Basin except for the Dallas-Fort Worth area).

The scope of the contract included wastewater facility planning and a study of toxic substances in Segment 0804. The facility planning was completed earlier. This report completes the toxics evaluation and is the final task to be performed under the contract.

The toxics evaluation included a review of available data (Task 0804.511 in the Contract) and a sampling design (Task 0804.512) which were completed earlier. This report combines Task 0804.513, the implementation of the sampling design and analysis of the resulting data, and Task 0804.514, a comparison of the data collected in this study with the prior data and recommendations.

1.2 Scope - The purpose of this task is to determine the occurrence, nature and significance of toxic substances, particularly regarding impacts on the biological community, in Segment 0804 of the Trinity River. Above and beyond this purpose is the monitoring and protection of the River and Lake Livingston as a water supply.

1.3 Study Area - The study area is the reach of the Trinity River from State Highway (SH) 34 downstream to just above the headwaters of Lake Livingston. SH 34 is just downstream from the Dallas-Fort Worth area, and the flow there includes all of the wastewater and runoff from the urban area. The reach is 201 river miles long. At the time the project began, this reach was defined as Segment 0804 in the Texas Surface Water Quality Standards, and that designation has been used throughout the study. After the study began the Water Quality Standards were amended and the upper boundary of Segment 0804 was changed from SH 34 to SH 31 near Trinidad, a shortening of 56 river miles. However, this latter change is of no consequence in this study and the older reference is used.

The main sources of flow in the study reach are threefold: Urban rainfall runoff (almost entirely from the Dallas-Fort Worth urban area); rural rainfall runoff (almost entirely from downstream from the Dallas-Fort Worth area); municipal wastewater treatment plant discharges (predominantly from the Dallas-Fort Worth area); and lake releases during times of flood. Industrial wastewater discharges, aside from those that pass through municipal systems, are few in number and quantity. They usually involve cooling and runoff water rather than process water. Springs and other sources are a very small portion of the flow.

During dry weather the flow is predominantly derived from the municipal wastewater plant discharges. Flow frequency analyses and other analyses of the large amount of flow data available indicate that such conditions exist approximately half of the time.

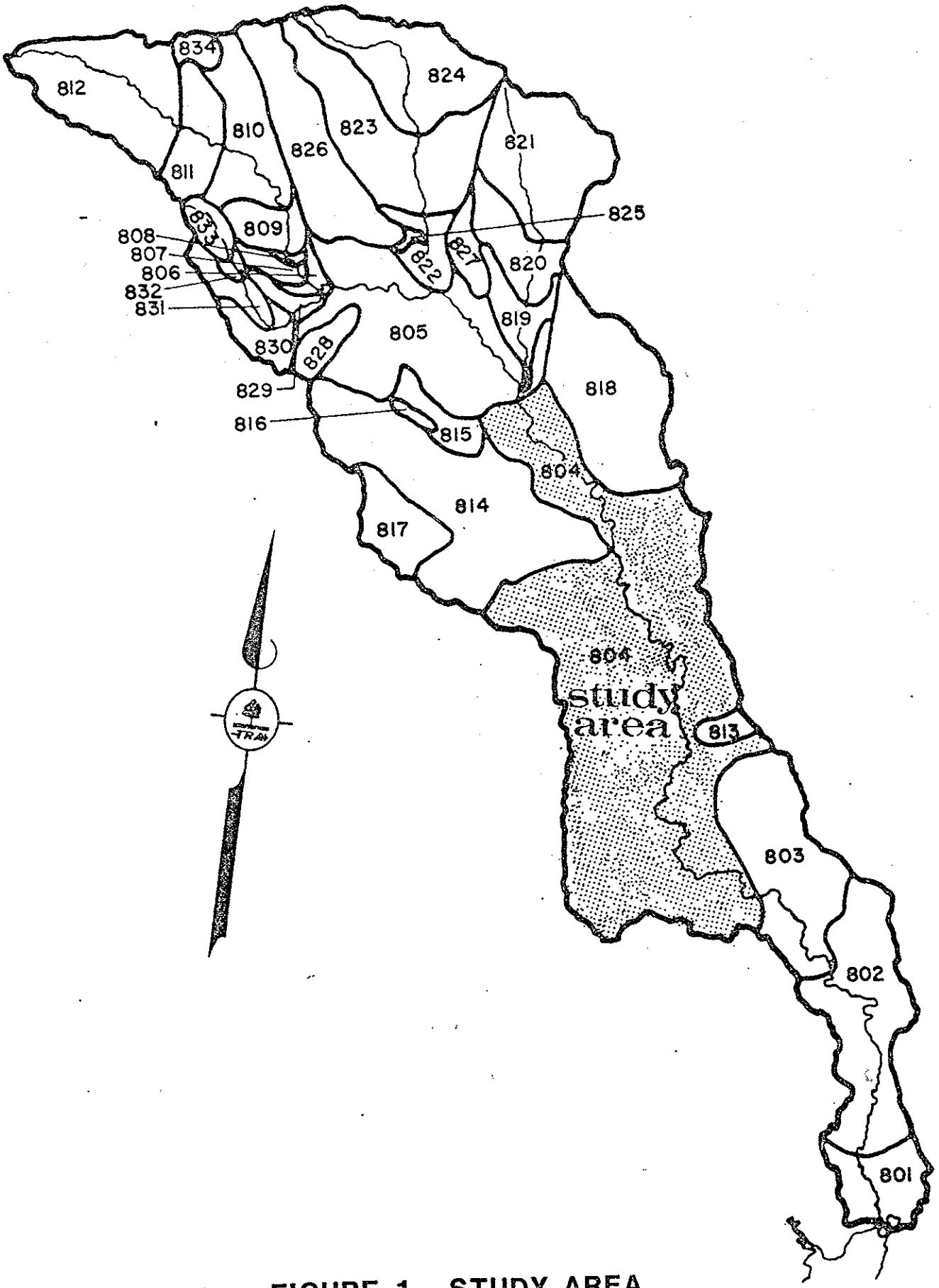

FIGURE 1 STUDY AREA

When it rains there is a typical hydrograph of rising and falling flow. In the study reach these events can take several days to pass and additional rainfall can impose a new rise upon an older one.

When extensive rainfall runoff fills the several water supply lakes upstream of the study reach, they release any excess flow. These situations are not frequent; in many years it does not occur at all. However, in some exceptional cases, all the lakes fill and spill. Six of the lakes have designated flood control storage space, in which large quantities of flood water are retained and released more slowly than from the other lakes. When this occurs, lake releases may constitute a major portion of the flow in the study reach for weeks or even months after the rain.

Water quality and biological conditions in the study reach during low flow are fairly well known. The water quality is characterized by the municipal wastewater effluents, resulting in depressed dissolved oxygen and elevated BOD, ammonia, volatile suspended solids, phosphorus, and nitrogen. These conditions are most pronounced at the upstream end of the reach and gradually improve through its course downstream to levels characteristic of good quality surface water at the downstream end. Fish and other aquatic life respond accordingly, being notably limited upstream, and much more diverse and prolific downstream. These conditions have been described in detail many times in previous planning and technical reports.

In the past few years, during the course of this study, there has been a major, steady improvement in the quality of treatment achieved by the major wastewater plants in the Dallas-Fort Worth area, as they completed the construction and start-up of major enlargements and design treatment levels. These improvements were planned starting in the late '60s and early '70s. They are still not completely on line, and further improvement can be anticipated in the next few years. The general effect of these improvements, in terms of the conventional parameters and aquatic life mentioned above, is to move the zone of better conditions further upstream so that they occupy more and more of the study reach.

When a rise occurs after a period of low flow, there is usually an initial decline in dissolved oxygen accompanied by increases in one or more of the other conventional parameters. Sometimes these suddenly changed conditions have extended throughout the reach, and sometimes there have been fish kills, particularly in the spring. The occurrences of suddenly poor quality in a rise have been known locally for years as "black rises," and the term remains a convenient one to distinguish them from other high flow events.

Other than "black rises," high flows resulting from runoff generally are associated with high turbidity and high suspended solids, but otherwise good quality in terms of conventional parameters, and no crises in biological life such as fish kills.

High flows resulting from lake releases have much lower turbidity and have very good water quality, as expected from their source.

In summary, there are several distinct conditions and sources which must be considered separately regarding water quality in this reach of the Trinity River. As stated above, these have been discussed in detail with respect to

conventional parameters elsewhere. That detail is not repeated here, but this general description provides the background for this report on toxic parameters.

Review of Existing Data

2.1 Prior Working Paper - In Task 0804.511 of this project a working paper entitled "Review of Existing Data" was prepared. It presented a description of the study area, as above, with somewhat more detail regarding hydrology and conventional water quality parameters, and it reviewed the then available data on toxic substances in the study reach. The main sources available were the U. S. Geological Survey (USGS) data at SH 34 and SH 7; the Texas Department of Water Resources at SH 34, SH 31, and SH 7; and the report by Qasim for the Corps of Engineers in 1977.

2.2 Scope of Parameters - The above available sources provided data on a number of heavy metals and pesticides plus a few substances chemically related to pesticides. These substances are all measured by two analytical procedures, the metals by digestion and atomic absorption, the pesticides and related compounds by gas chromatography. There are many other toxic chemicals which have been of concern in the environment at various times and places. There is no intent in this study to ignore those contaminants. However, given the organization of the study and the time and resources available, it was decided to base the scope of parameters on the existing data and that consisted of the heavy metals and pesticides.

2.3 Prior Findings - The Task 0804.511 Working Paper findings are briefly summarized as follows:

2.31 Heavy Metals - USGS data for 1974-80 at SH 34 and SH 7 were reviewed. There were 4-5 measurements per year of 15 different metals. Compared to EPA recommended criteria for surface waters, there was no indication that these metals threatened the use of this study reach for water supply or aquatic life. Iron and manganese were occasionally above the EPA criteria, but usually below. Arsenic, copper, lead, nickel, cadmium and zinc were at detectable but low levels, and the concentration of strontium always ranged from 200-650 mg/l.

The Texas Department of Water Resources data at SH 34, SH 31, and SH 7 were very similar to the USGS data.

The study by Qasim found unfiltered river water high in concentrations of many metals. Cadmium, lead, and manganese were found frequently above EPA criteria. Also, most metals measured in bottom segments were in high concentrations.

2.32 Pesticides - The USGS data at SH 34 consistently showed pesticides such as DDD, DDE, dieldrin, chlordane and PCB in sediments, but few of these appeared at SH 7. A number of pesticides were observed in trace amounts in water, as opposed to sediment, samples. These were diazinon, malathion, 2,4-D, 2,4,5-T, and silvex.

TDWR data agreed well with the USGS data. All pesticides were below trace levels in water. Accumulation in sediments was similar to the USGS measurements. However, one set of data in 1976 had abnormally high levels. Methoxychlor, PCB, malathion, parathion, 2,4-D, 2,4,5-T, and silvex were recorded at 1.0, 1.0, 1.5, 1.5, 10.0, 10.0, and 10.0 mg/l, respectively.

Some data recorded by Qasim were quite high. The levels of DDT, dieldrin, endrin, heptachlor, and lindane were high in water as well as sediments. The maximum values of DDT, dieldrin, endrin, heptachlor, and lindane in the study reach water were 11.7, 9.4, 82, 92.4, and 17.1 mg/l respectively. In sediments, the maxima were 5400, 5000, 7800, 9300, and 700 mg/kg, respectively.

Sampling Design

3.1 Purpose - Task 0804.512 in this study called for the design of a sampling program which would produce data that could double-check important findings from the Review of Existing Data, above, and measure previously unsampled conditions in order to learn more about the actual contaminant levels and their effects on aquatic organisms. The sampling design is summarized as follows.

3.2 Sampling points - The points selected were:

1A - Trinity River @ SH 34 near Rosser
2A - Trinity River @ SH 31 near Trinidad
6A - Trinity River @ US 79/81 near Long Lake
8A - Trinity River @ SH 7 near Crockett
3A - Richland Creek @ FM 488 near Fairfield

At the time of sampling, there were USGS streamflow gages at all five points. Subsequently, the gage on Richland Creek was removed because of the construction of the dam for Richland-Chambers Reservoir about one-quarter mile upstream.

The four points on the main stem were selected because of their even distribution through the study reach and because of prior available data from those sites. SH 34 is the exact upper boundary of the study reach and SH 7 is just 22 river miles upstream from the lower boundary. The river mile locations are:

Site	River Miles	Interval
SH34	427	56
SH31	371	76
SH79	295	47
SH 7	248	22
lower boundary	226	

In addition to other data, there are automatic water quality monitors at SH 7 and SH 34 which record dissolved oxygen, temperature, pH, and conductivity hourly.

The Richland Creek site was selected because it is a large tributary capable of contributing significant flow to the River during high flow; it had a large area of unregulated runoff in its watershed, the quality of which would not be

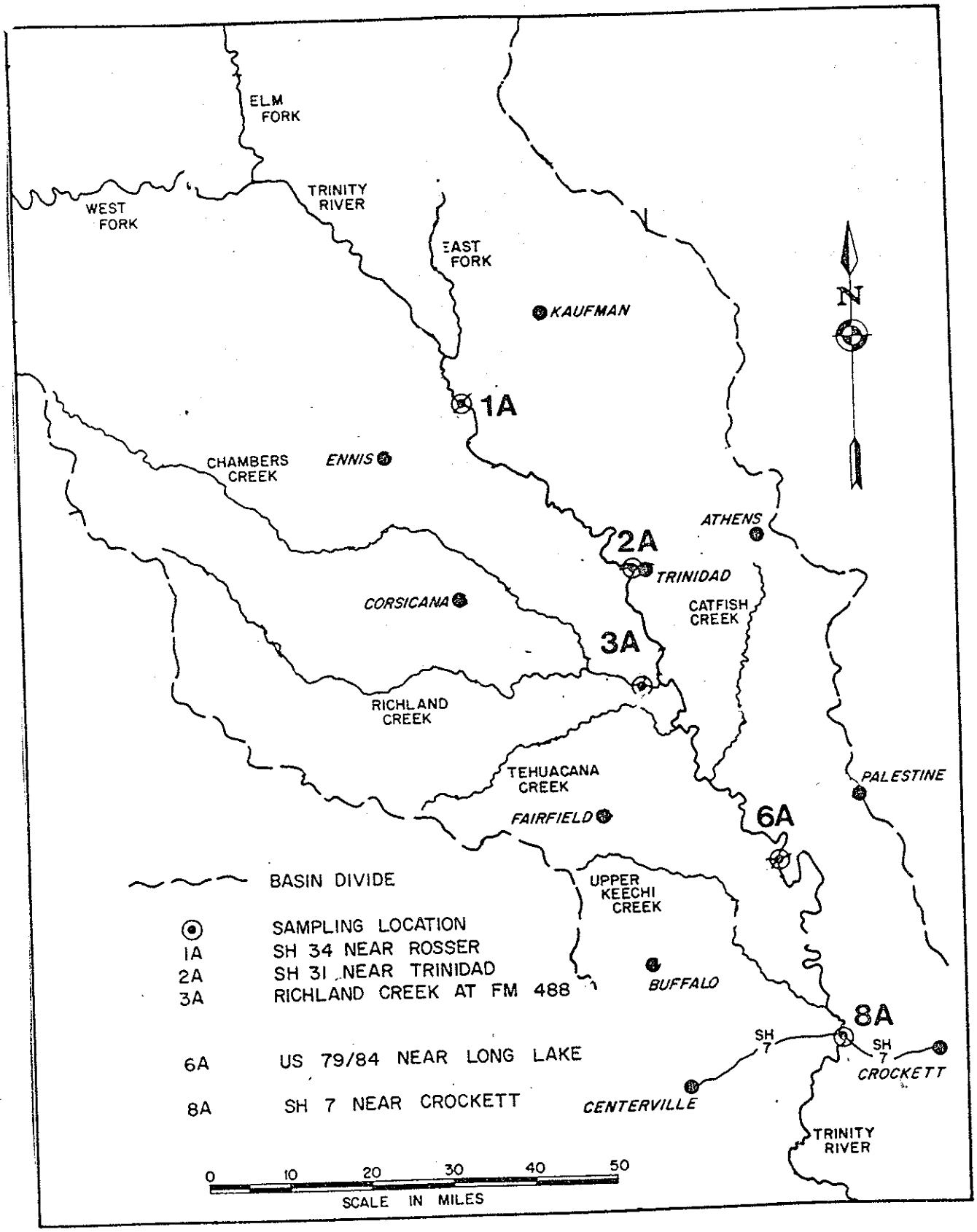

FIGURE 2. SAMPLING LOCATIONS

affected by passing through a reservoir; its watershed was extensively developed as cropland and pasture and would therefor yield whatever contaminants might result from those practices; there was a flow gage plus a small amount of prior water quality data at the site; and it was near the confleunce with the River, therefor closely representing what actually reached the River.

3.3 Parameters selected - The following were selected for analysis in this study:

Arsenic	Chlordane	Total Suspended Solids
Cadmium	DDD	
Copper	DDE	
Lead	DDT	
Mercury	Diazinon	
Selenium	Dieldrin	
Zinc	Endrin	
	Lindane	
	Malathion	
	Toxaphene	
	PCB	
Field Measurements:	Streamflow	
	Dissolved oxygen	
	pH	

These parameters were selected on the basis of the Review of Existing Data. They represent substances which had been reported in high concentrations before and those anticipated from the types of sources in the study area.

3.4 Types of sampling - There were three types of sampling designed.

3.41 Low flow sampling - Low flow conditions were sampled because they are common in the study reach and because they focus on one of the major sources, the municipal wastewater effluents. The sampling was designed to detect the occurrence and transport of substances through the reach and deposition of substances in the sediment. Only the main stem sites were to be sampled, as the Richland Creek site carried little flow, about 10-15 cfs, under these conditions. Grab samples of water and sediments were to be obtained every two weeks as long as the base flow condition lasted, making at least four collections in a given low flow event if possible. Two separate events were to be sampled.

3.42 High flow sampling - This was intended to indicate something about loadings in different types of runoff and resuspension of sediments. The Richland site would be used to represent agricultural runoff. One of the main stem sites would be dropped because of time limitation in sampling. Only water samples would be collected. In a given high flow event an attempt would be made to collect five samples at each site distributed over the hydrograph. Three events were proposed to be sampled.

3.42 Fish tissue sampling - Fish were to be collected at the five sites by electroshocking. As available, five individuals of one species within each of the feeding types, bottom feeders, planktivores, and carnivores, would be selected at each site. They would be dissected in the field, the tissues sealed in plastic, stored on ice, and frozen until analysis.

Results

4.1 General flow conditions - Shortly after the study began one of the unusual occurrences of extensive rainfall and reservoir releases began and prevented any of the design sampling conditions from occurring for an extended period. Repeated periods of wet weather extended this condition further. A certain amount of sampling was accomplished early, in summer, 1981. Even then, changing flows prevented the completion of most events exactly as designed. Then, after extensive delay, the final sampling was accomplished in 1984.

4.2 Tabulation of data - Tables containing the complete data are in the Appendix. All of the data except the fish tissue samples are gathered in the first set of tables (A-1 through A-5). There is one table for each site, and the high and low flow, water and sediment, data are all shown together. They are combined because in some cases low flow sampling led directly into high flow sampling. The fish tissues are shown in a separate set of tables (A-6 through A-10).

4.3 Low flow-water - These samples were collected by TRA personnel in 1981 and by North Texas State University personnel under contract with TRA in 1984. The sediment samples and high flow water samples were collected by the same parties in the two respective time periods.

The samples were all collected per the sampling design. Each sample was collected from the surface, to one foot below the surface, of the river in the main flowing current. Appropriate field measurements were made at the site. Samples were placed on ice and transmitted to the laboratory. All laboratory analyses were by the TRA Central Regional Wastewater System laboratory.

The low flow sampling was the most difficult to complete in the magnitude intended in the sampling design. The design indicated that each of four sites would be sampled four times, each sampling separated by two weeks, during a continuous period, or event, of low flow. And there were to be two such events.

As mentioned above, an extraordinary period of elevated flows occurred in 1981-1983. When there was low flow it was interrupted by high flow before four samples could be taken. The design recognized the unpredictability of the weather and allowed for such interruption. The samples obtained, for most of the sites, represent three different low flow periods, with one or two samples from each period.

The results are summarized in Table 1. For each metal and pesticide there is a Reference Level, to which the data obtained in this study is compared. The term, "Reference Level," is used instead of "standard" because there are no completely comparable, uniform sources for these numbers, and there is no one, complete, official set of standards for all the parameters covered in this study. As noted in the table, one of the main sources is EPA's Quality Criteria for Water, 1976. However, that document provides only ranges of concentrations for a number of parameters. In each case, certain choices have to be made. The levels shown here are very conservative, that is, they are many times lower than concentrations known to cause the adverse effects in aquatic organisms.

The sampling was not able to track any one low flow event long enough to give any indication whether there was any trend in the water concentrations with time. One would not expect much of a trend with time because the flow is coming predominantly

Table 1

Summary Results of Low Flow Water Samples

Parameter	Reference Level[a] ppb	NO. OF SAMPLES Total	Below Reference Level	Above Reference Level	Trends/Comments
Arsenic	50	30	30	0	Range 2-9. No trend downstream.
Cadmium	1-12	30	21	9	Range ND-74. No trend downstream.
Copper	20	30	30	0	Range 3-19. No trend downstream.
Lead	25	30	30	0	Range 8-23. No trend downstream.
Mercury	0.05	30	23	7	Range ND-1.4. No trend downstream.
Selenium	20	30	30	0	Range ND-4.6. Slight increase downstream.
Zinc	50	30	25	5	Range ND-91. Slight increase downstream.
Aldrin	0.003	9	7	2	Range ND-0.5. All ND except 2 above standard.
Chlordane	0.01	21	21	0	All ND.
DDD		21	21	0	All ND.
DDE		21	21	0	All ND.
DDT	0.001	21	20	1	All ND except one 0.2 at start of rise.
Diazinon	88	21	21	0	All ND.
Dieldrin	0.003	21	21	0	All ND.
Endrin	0.004	21	21	0	All ND.
Lindane	0.01	21	19	2	All ND except 0.5 and 0.02. No trend downstream.
Malathion	0.1	21	21	0	All ND.
Toxaphene	9	21	21	0	All ND.
PCB	0.001	21	21	0	All ND.

[a] These reference levels are based primarily upon Quality Criteria for Water, EPA, 1976. In a number of cases where there is no one criterion given for aquatic life, there is a criterion such as "0.01 times LC_{50}" in those cases, the listed LC_{50}'s were considered in selecting the number used. These are not official standards.

from a few continuous point sources. Also of interest was whether there was a trend going downstream. One might expect some trends if certain substances introduced with the point sources were to gradually precipitate or leave the flowing water in some other way. Or there might be gradual increases if there were other point or non-point sources along the way, besides the major known point sources. The number of samples is not sufficient to perform an exhaustive analysis, but those available do not indicate any clear trends going downstream.

The data for most of the substances indicate that they are at consistently low concentrations which do not cause concern for aquatic life, raw water supply uses or other purposes. This is consistent with the data obtained in routine monitoring by the TDWR and USGS.

Some of the contaminants, however, deserve attention based on the present study. Cadmium and mercury had enough samples above the reference level selected in the table to be of interest. Less so, but also of interest, are some of the higher readings for aldrin, zinc and lindane. Cadmium and mercury are both known to have toxic effects at certain concentrations in fish, humans, and other organisms. Therefore, the reference levels are quite low. The values found here in the low flow waters are not critical in themselves, but the frequency of values above the reference levels (9 for Cd and 7 for Hg) need further attention with respect to the sediment and fish tissue data below.

Aldrin had two readings in 1981 above its reference level and is of interest because of its persistence, bioaccumulation, and carcinogenicity in laboratory animals. Aldrin must be considered with dieldrin, to which it is readily converted by aquatic organisms, mostly within 30 to 90 days. The finding of all dieldrin measurements within its reference level in this study suggests that the two aldrin readings may have been an isolated event. Both of the aldrin readings were in late summer of 1981, 0.5 ppm at Rosser on August 4 and 0.039 at Crockett on September 4.

Zinc and lindane are less toxic than the above substances, but there were enough values above the reference level to merit continued attention.

One limitation in interpreting these data, particularly for the substances with the lowest reference levels, is that the limits of detection are about the same level as the reference level, sometimes higher. Moreover, the great majority of all these readings are below the detection limit. The latter fact makes averages and most statistical analyses inappropriate. The former fact causes many of the readings to have an all-or-nothing meaning, either above or below reference level. When the actual value is near the detection limit the analytical procedure is usually at its least precise. The actual concentration in a sample may be above the reference level but not be noted because it is below the detection limit. This problem, plus the possibility of a false reading or contamination in any given analysis, plus the great variation in natural materials and individual organisms, makes it necessary to not draw conclusions from single readings but to look to the trends in the larger body of data.

4.4 Low flow-sediment - These samples were collected at the same time as low flow water samples. They were obtained by driving a 3/4-inch inside diameter plastic tube into the bottom sediment at a point along the shore at which there

was an eddy and evidence of sediment accumulation. The coring obtained, with overlying water, was kept in the tube by placing stoppers in the top and bottom of the tube. The tube was then placed on ice for transport to the laboratory. At some of the later sampling by North Texas State University, some duplicate sediment samples were taken by Ekman dredge in addition to the core samples, and both were analysed for comparison.

The concentration of all substances in sediments is reported as parts per million (ppm) in contrast to parts per billion (ppb) for water samples.

The results are summarized in Table 2.

Standards for sediments are less defined than for water. The main fresh water aquatic organisms of interest live in the water and sediment concentrations do not affect them directly. Some standards are available for some metals, and they are generally estimates of concentrations that are compatible or to be expected with the respective water standards.

The pesticides were almost all below detection limits, except for two values for aldrin and one value each for chlordane, DDD, and DDE, all of which occurred in one sample at Crockett on 8/4/81. The most significant of these higher values are those for aldrin, which had also had some elevated values in low flow water.

Among the metals, cadmium and mercury are again the most notable, for their higher frequency of above standard values and their potential toxicity. Zinc had even more frequent high values, but its toxicity is not of great concern. Arsenic and lead also had some high values. Overall these data are consistent with the low flow water data.

The higher values for most of the metals are at Rosser and the lower values are generally all at Crockett, indicating an upstream source and gradual precipitation through the study reach.

The values reported in this study are 2-5 times higher at the upper extremes than previous monitoring by TDWR and USGS. This is probably because this study attempted to sample the most recent, relatively organic, rapidly accumulating sediments. Sampling midstream or at random, it is known from earlier studies, obtains gravel, clay, or sand sediments which are cleaner. The sediments in this study are not representative of the entire channel sediments or cross-section.

4.5 High flow-water - These samples were collected and analyzed by the same parties as the low flow samples.

The purpose of this part of the program was to learn about the concentration and total mass of contaminants moving in rise events, about rural runoff (Richland Cr.), and to draw inferences if possible about sediment resuspension and urban area conditions in these events, analysis and discussion of all of the substances is not attempted. As at low flow and in the sediments, the concentrations of pesticides are almost all below the detection limts, and they will not be discussed in detail. The metals concentrations are much more variable and several of those are discussed, as follows.

There were four events sampled, 18-23 August 1981, 1-10 September 1981,

2 May 1984 and 28 May-3 June 1984.

4.51 18-23 August 1981 - At Rosser, the most notable parameter is mercury, which appears in the first sample at the high level of 26 ppm and then falls off to 0.1, 0.06, and 0.9 ppb. These correspond to flux rates of 245, 0.9, 0.5 and 0.8 lbs/day, respectively. There are not enough points sampled on this hydrograph to define the total mass transport, but it is evident from flow records that the first sample was taken on the leading edge of the rise, as intended. It is not possible to identify the source of the mercury as resuspended sediment, urban runoff, or point sources. Also at Rosser there is one detectable value of chlordane. Though it was late August when cotton in the area was being harvested with the use of arsenical defoliants, arsenic was at low levels in this event.

At Long Lake mercury did not appear in an initial peak as it did at Rosser, though the mercury levels are steady, somewhat above the standard criterion. At Crockett, mercury was at the same level as at Long Lake. About the time the rise reached Crockett, it rained in that area, new runoff joined the old, and the sampling was stopped. Richland Creek did not rise at all in this event.

4.52 1-10 September 1981 - Cadmium rose sharply to 52 ppb in the first sample at Rosser, returned to a lower level, and then rose again. Mercury remained at moderate levels. There was one high reading for lead, 90 ppb, in the middle of the rise.

At Long Lake the initial peak for cadmium reappeared at 38 ppb and then returned to normal levels. Zinc rose over 100 ppb at the beginning and end of the rise, separated by lower values. At Crockett, there was no sign of the initial cadmium peak, though it may have been missed. Mercury and zinc were steady and slightly above standard criteria.

4.53 28 May-3 June 1984 - This rise was covered with six samples at Rosser. All parameters were within reference levels except for slightly elevated levels for lead (43 ppb) and zinc (86 ppb) in the middle of the rise. The same was true at Long Lake and Crockett, except that lead was within the reference level and mercury (ND-3 ppb) was elevated. Richland Creek did not rise.

4.54 2 May 1984 - A special effort was made to sample a rise from a local rain in Richland Creek because the kind of rise desired had not occurred with the other events. Five samples were taken within eight hours. Pesticides were below detection but the highest metals results in the study occurred. Copper was 8, 9, 286, 96, 109 and 33 ppb through the hydrograph. Lead was 19, 21, 316, 126, 119, and 45 ppb. Zinc was 21, 30, 1140, 130, 420, and 140 ppb. Very high suspended solids, over 6000 ppm, occurred. Mercury remained at moderate levels along with arsenic, cadmium, and selenium. At the time of this sampling, a very large dam and reservoir was under construction immediately upstream. Construction had been underway about two years and involved much heavy machinery, earth moving, concrete, and steel. The high metals readings may have been the residue of some of that activity.

Table 2

Summary Results of Low Flow Sediment Samples

Parameter	Ref. Level ppm	NO. OF SAMPLES Total	Below Ref. Lev.	Above Ref. Lev.	Range ppm	Comments
Arsenic	5	24	19	5	<0.06-49	Decrease downstream. Max Rosser.
Cadmium	2	24	14	10	0.005-22	Decrease downstream. Max Trinidad.
Copper	50	24	23	1	0.04-164	Decrease downstream. Max Rosser.
Lead	50	24	19	5	0.08-88	Decrease downstream. Max Rosser.
Mercury	1	24	14	10	0.0021-61	Decrease downstream. Max Rosser.
Selenium	-	24			<0.002-10.2	Max Long Lake.
Zinc	75	24	11	13	27-267	Max Long Lake. Max Rosser.
Aldrin		5			ND-23.95	All ND but 23.95 Trinidad, 10.9 Long Lake.
Chlordane		15			<0.0003-28.06	All ND but 28.06 Crockett 8/4/81.
DDD		15			<0.0002-16.64	All ND but 16.64 Crockett 8/4/81.
DDE		15			<0.0007-3.59	All ND but 3.59 Crockett 8/4/81.
DDT		15			<0.0002-<20	All ND.
Diazinon		14			<0.0002-0.62	All ND but 0.62 Trinidad 5/16/84.
Dieldrin		14			<0.0002-<1.4	All ND.
Endrin		13			<0.002-<.27	All ND.
Lindane		13			<0.0001-0.659	All ND but 0.659 Crockett 9/18/81.
Malathion		15			<0.002-<112	All ND.
Toxaphene		14			<0.001-<39	All ND.
PCB		15			<0.001-<90	All ND.

4.55 Comparison - There has not been any comparable sampling of high flow events at these sites before for these parameters. However, the occurrence of peak concentrations at the leading edge of a rise, and sometimes again at the trailing edge, have been seen often elsewhere.

4.6 Fish tissue samples - These samples were collected 27-29 July 1981 by the Texas Parks and Wildlife Department, Inland Fisheries, Tyler, personnel. The Department's generous contribution to this study is appreciated. The sampling was done as planned in the sampling design. The fish were stunned with an electroshocker on a boat, netted, and dissected at the site. The tissues of a given type, species, and location were wrapped together and placed on ice. Within twelve hours they were deep frozen until analyzed in the laboratory. For example, all the liver tissue from all five gars from Rosser were wrapped together. Then in the laboratory part one or all of the pieces of liver in the package were composited for the rest of the analyses, so that all the individuals would be represented.

The first 14 samples, Table A-6 and A-7 through the buffalo liver sampled at Richland Creek and shown in the first column of Table A-8, were analyzed initially by the City of Houston Department of Health Laboratory under a services agreement with TRA. Then, due to a shortage of staff in the senior positions involved in these analyses, that laboratory was unable to do the rest of the samples. The rest of the samples, which were still frozen, and the remaining frozen tissues of the first fourteen were then taken on dry ice to Normandeau Associates, Inc., Dallas for analysis under contract with TRA. They analyzed the last 24 samples, and then reanalyzed the first 14 in order to produce a complete set from one laboratory and also to get the perspective of some duplicate samples. In the Tables, for each pair of duplicate samples, the one titled "dup." is the Normandeau-analyzed duplicate. The concentrations in Tables A-6 through A-10 are all in parts per million, ppm.

4.61 Standards - There are no well-established standards for concentrations of metals and pesticides in fish, at least with respect to the health of the fish itself.

The only specific guideline for concentration of these substances in fish is one promulgated by the Food and Drug Administration, and it is intended primarily for protection of people who would eat the fish. This listing includes only eleven substances, of which seven are in this study. They are as follows:

FDA "ACTION LEVELS" FOR CERTAIN SUBSTANCES IN EDIBLE FISH TISSUE

	ppm
aldrin plus dieldrin	0.3
DDT plus DDD plus DDE	5.0
endrin	0.3
mercury	1.0
PCB's	5.0 (but proposed to be 2.0 soon)
toxaphene	5.0
chlordane	0.3

4.62 Results - The fish sampled in this study were all healthy and none had noticeable symptoms or signs of disease. That was also true of their internal organs and appearance when dissected. Most of them were full-size mature individuals.

Compared to the "Action Levels" above, the results of this study are as follows:

Aldrin plus dieldrin - Aldrin was not measured, but in tissue it would all be expected to be converted to dieldrin. Of the 38 samples, one was above the action level for dieldrin. It was 0.486 in a drum liver at Trinidad.

DDT plus DDD plus DDE - None of 38 were above the action level.

Endrin - None of the 38 were above the action level.

Mercury - Six of 38, 5 in liver, one in shad muscle.

PCB's - One of 38 above either the 5 ppm or 2 ppm level, but the one was 37 ppm in a liver sample.

Toxaphene - None of 38.

Chlordane - Seven of 38, 6 in liver, 1 in buffalo muscle.

Considering the definition and purposes of the FDA list, none of the samples that were above action levels would ordinarily be eaten by humans, except buffalo muscle in some cases. Also only the shad muscle is in the usual food chain to game fish.

Aside from the purposes of the FDA list, the frequency of samples above action levels calls attention to mercury and chlordane.

Liver samples consistently had higher concentrations of all substances than muscle samples.

In the duplicate samples, the pesticides were consistently different from the two laboratories. The Houston results were almost all at detectable levels and the Normandeau results were almost all below detection. There were many differences in metals, too, but they were much more similar. It is not possible to say that one was right and the other wrong. Both sets of results must be considered. The differences illustrate: 1) the variability in natural, complex materials and 2) the intricacy and sensitivity of analytical procedures.

Cadmium, which was at high levels in some water and sediment samples, does not appear in extraordinarily high levels in these samples. Mercury and chlordane deserve continuing attention.

Conclusions

1. Seven metals and twelve pesticides were sampled in low flow water, low flow sediments, high flow water, and fish tissues. The water and sediment samples were taken during two periods, August-September 1981 and May-July 1984. The fish were sampled on one occasion in July 1981.

2. The results, taken from two sampling periods three years apart, are not sufficient to characterize the river, but they do enable certain parameters to be better targeted in future work.

3. Cadmium, mercury and chlordane were found often enough and at high enough levels to merit particular attention in future analyses, monitoring, and management.

4. Most of the other substances were at non-detectable or otherwise low levels, though there were values which require continued monitoring, especially lindane, zinc, arsenic, and lead.

5. Though the biological samples taken (fish) were healthy, adults without signs of disease, the overall biological community is quite limited in species diversity. Low dissolved oxygen is known to be one limiting parameter in the study reach. Some of the concentrations of substances analyzed in this study were high enough that some toxicity might be expected, though toxicity was not directly demonstrated.

6. All water supplies appear to be safe and within standards for the parameters studied, after diversion and treatment downstream of the study area.

TABLE A-1

Trinity River @ SH 34 near Rosser (Site 1A)

Date	8/4/81	8/4/81	8/18/81	8/19/81	8/20/81	8/21/81	9/1/81	9/2/81
Time	1035	1035	1000	1330	1300	1200	1500	1210
Type	Water	Sed.	Water	Water	Water	Water	Water	Water
Conc.	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb
Arsenic	<2	49	< 2	< 2	2	ND	7	2
Cadmium	15	3	2	ND	10	ND	52	6
Copper	11	13	10	9	8	8	15	22
Lead	20	36	12	16	9	15	12	33
Mercury	< 0.05	0.09	26	0.1	0.06	0.9	ND	ND
Selenium	< 2	< 2	< 2	< 2	< 2	2	2	2
Zinc	35	53	27	29	16	21	27	61
Aldrin	0.5		< 0.1	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Chlordane	ND		< 0.1	0.15	< 0.01	< 0.01	< 0.01	< 0.01
DDD	ND		< 0.3	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
DDE	ND		< 0.1	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
DDT	0.2		< 1.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Diazinon	ND		< 4.9	< 3.0	< 3	< 3	4	6
Dieldrin	ND		< 0.2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Endrin	ND							
Lindane	0.5		< 0.7					
Malathion	ND		< 5.9	< 3.0	< 3	< 3	< 3	< 3
Toxaphene	ND		< 2.2	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
PCB	ND		< 5.0	< 1	< 1	< 1	< 1	< 1
TSS mg/l			44	41	23	39	218	354
DO mg/l	5.5		2.5	3.4	2.7	3.8	2.9	2.0
T,°C	30		23	28	28	28	28	27
pH	7.4		6.8	7.2	7.4	7.4	7.4	7.3
Flow, cfs	616		1750	1600	774	750	774	2471

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-1 cont.

Trinity River @ SH 34 near Rosser (Site 1A)

Date	9/3/81	9/4/81	9/6/81	5/2/84	5/2/84	5/16/84	5/16/84	5/16/8
Time	1050	1200	0900	0820	0820	0800	0800	0800
Type	Water	Water	Water	Water	Sed.	Water	Sed. Core	Sed. Dredge
Conc.	ppb	ppb	ppb	ppb	ppm	ppb	ppm	ppm
Arsenic	23	4	4	4	5	3	2	
Cadmium	13	23	6	4	0.005	4	3	
Copper	35	16	12	7	0.04	18	15	
Lead	90	43	13	21	0.08	11	29	
Mercury	ND	ND	0.5	ND	0.1	ND	ND	
Selenium	2	ND	ND	5	<0.2	<2	<0.2	
Zinc	180	140	49	34	92	26	120	
Aldrin	<0.02	<0.02	<0.02					
Chlordane	0.05	<0.02	<0.02	<0.03	<0.0004	<0.07	<0.0003	<0.001
DDD	<0.03	<0.03	<0.03	<0.01	<0.0003	<0.05	<0.0002	<0.001
DDE	<0.02	<0.03	<0.03	<0.05	<0.002	<0.03	<0.001	<0.000
DDT	<0.1	<0.1	<0.1	<0.01	<0.0002	<0.02	<0.0002	<0.000
Diazinon	<3	2	3	<0.02	<0.002	<0.4	<0.0006	<0.007
Dieldrin	<0.01	<0.01	<0.01	<0.005	<0.0002	<0.02	<0.0002	<0.000
Endrin				<0.005	<0.0002	<0.03	<0.0001	<0.006
Lindane	<0.01		<0.06	<0.02	<0.001		<0.0001	<0.000
Malathion	<3	<3	<3	<0.07	<0.002	<0.2	<0.002	<0.004
Toxaphene	<0.6	<0.6	<0.6	<0.05	<0.002	<0.2	<0.002	<0.004
PCB	<1	<1	<1	<0.03	<0.001	<0.2	<0.001	<0.004
TSS mg/l	1052	310	126	48		36		
DO mg/l	1.3	3.3	2.7	6.0		5.0		
T,°C	25	27	28	22		23		
pH	7.4	7.4	7.3	7.2		7.4		
Flow, cfs	3743	2197	1042	804		658		

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-1 cont.

Trinity River @ SH 34 near Rosser (Site 1A)

Date	5/28/84	5/28/84	5/28/84	5/29/84	5/29/84	5/29/84	5/29/84
Time	1030	1530	2000	0400	1340	1620	2042
Type	Water	Water	Water	Water	Water	Water	Water
Conc.	ppb	pbb	ppb	ppb	ppb	ppb	ppb
Arsenic	3	3	6	8		5	4
Cadmium	1	1	3	2		3	4
Copper	11	7	19	27		20	19
Lead	14	13	17	43		40	32
Mercury	ND	ND	ND	ND		ND	ND
Selenium	<2	<2	<2	<2		<2	<2
Zinc	53	50	86	83		67	65
Aldrin							
Chlordane	< 0.07	< 0.07	< 0.07	<0.03		<0.02	<0.03
DDD	< 0.05	< 0.05	< 0.05	<0.11		<0.07	<0.11
DDE	< 0.03	< 0.03	< 0.03	<1.02		<0.08	<0.12
DDT	< 0.02	< 0.02	< 0.02	<0.11		<0.07	<0.11
Diazinon	< 0.4	< 0.4	< 0.4	<0.5		<0.032	<0.05
Dieldrin	< 0.02	< 0.02	< 0.02	<0.05		<0.03	<0.05
Endrin	< 0.03	< 0.03	< 0.03	<0.07		<0.04	<0.07
Lindane		< 0.02	< 0.02	<0.05		<0.03	<0.05
Malathion	< 0.2	< 0.2	< 0.2	<0.2		<0.13	<0.2
Toxaphene	< 0.2	< 0.2	< 0.2	<1.76		<1.13	<1.76
PCB	< 0.2	< 0.2	< 0.2	<1.2		<0.78	<1.2
TSS mg/l	26	32	66	498		110	234
DO mg/l	6.5	6.2	5.2	5.0	3.0	2.8	4.0
T,°C	27	27	26	21	23	24	23
pH	7.4	6.5	6.0	6.5		6.7	6.8
Flow, cfs	617	824	1554	1957	1903	1821	1658

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-1 cont.

Trinity River @ SH 34 near Rosser (Site 1A)

Date	5/31/84	6/24/84	6/24/84	6/24/84	7/10/84	7/10/84	7/10/84
Time	1045	1020	1020	1020	0845	0845	0845
Type	Water	Water	Sed. Core	Sed. Dredge	Water	Sed. Core	Sed. Dredge
Conc.	ppb	ppb	ppm	ppm	ppb	ppm	ppm
Arsenic	5	3	2	2	4	7	4
Cadmium	1	64	4	4	4	1	4
Copper	11	12	24	164	12	25	24
Lead	19	23	88	84	8	38	43
Mercury	2	1	55	26	0.2	58	61
Selenium	<2	<2	<0.2	<0.2	<2	<0.2	<0.2
Zinc	31	30	92	267	28	95	170
Aldrin							
Chlordane	<0.02		<0.0007	<0.0007		<0.0007	<0.0006
DDD	<0.07		<0.0002	<0.0002		<0.0001	<0.0002
DDE	<0.08		<0.002	<0.002		<0.001	<0.002
DDT	<0.07		<0.0002	<0.0002		<0.0001	<0.0002
Diazinon	<0.32		<0.005	<0.005		<0.005	<0.005
Dieldrin	<0.03		<0.00009	<0.00008		<0.00009	<0.00008
Endrin	<0.04		<0.0001	<0.00009		<0.00009	<0.00009
Lindane	<0.03		<0.00009	<0.00008		<0.00009	<0.00008
Malathion	<0.13		<0.001	<0.001		<0.001	<0.001
Toxaphene	<1.13		<0.002	<0.002		<0.002	<0.002
PCB	<0.78		<0.002	<0.002		<0.002	<0.002
TSS mg/l	82	27			26		
DO mg/l	5.4	6.6			5.4		
T,°C	25	29			29		
pH	6.8	7.2			7.2		
Flow, cfs	791	576			570		

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-2

Trinity River @ SH 31 near Trinidad (Site 2A)

Date	8/4/81	8/4/81	8/19/81	8/20/81	8/21/81	9/2/81	9/3/81	9/4/81
Time	1215	1315	1530	1430		1400	1230	1340
Type	Water	Sed.	Water	Water	Water	Water	Water	Water
Conc.	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb
Arsenic	< 2.0	4.4	< 2.0	2.0	1.11	2.07	12.11	6.90
Cadmium	4.0	2.0	1.0	ND	2.0	9.0	6.0	1.0
Copper	9.0	11.0	10.0	8.0	7.0	5.0	15.0	22.0
Lead	19.0	32.0	16.0	12.0	12.0	8.0	20.0	24.0
Mercury	< 0.05	0.1	0.38	0.46	0.30	ND	ND	ND
Selenium	< 2.0	ND	ND	0.403	1.85	2.50	2.50	ND
Zinc	< 0.03	55.0	33.0	55.0	24.0	36.0	60.0	132.0
Aldrin		23.95	< 0.024	< 0.021	< 0.021	< 0.021	< 0.021	< 0.019
Chlordane	ND	ND	< 0.01	< 0.015	< 0.01	< 0.02	< 0.029	< 0.02
DDD	ND	ND	0.2	< 0.08	< 0.03	< 0.03	< 0.03	< 0.03
DDE	ND	ND	< 0.02	< 0.02	< 0.02	< 0.02	< 0.019	< 0.03
DDT	0.147	ND	< 0.2	< 0.1	< 0.1	< 0.13	< 0.13	< 0.13
Diazinon	ND	ND	7.57	7.39	< 3.0	< 3.0	3.77	< 3.0
Dieldrin	ND	ND	< 0.02	< 0.010	< 0.01	< 0.01	< 0.010	< 0.011
Endrin	ND	ND						
Lindane	ND	ND					< 0.056	
Malathion	ND	ND	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Toxaphene	ND	ND	< 0.48	< 0.6	< 0.6	< 0.64	< 0.64	< 0.65
PCB	ND	ND	< 1.100	< 1.127	< 1.127	< 1.13	< 1.13	< 0.78
TSS mg/l			139.6	66.0	61.5	42.0	410.0	518.0
DO mg/l	6.0		5.3	5.4	5.2	6.1	4.1	6.1
T,°C	31		30	28	28	28	27	28
pH	7.4		7.57	7.42	7.45	7.6	7.4	7.6
Flow, cfs	565		963	1232	903	1270	1947	1265

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-2 cont.

Trinity River @ SH 31 near Trinidad (Site 2A)

Date	9/6/81	5/2/84	5/2/84	5/16/84	5/16/84	5/16/84
Time	1030	1010		1000	1000	1000
Type	Water	Water	Sed.	Water	Sed. dredge	Sed. core
Conc.	ppb	ppb	ppm	ppb	ppm	ppm
Arsenic	9.45	<1.0	1.78			
Cadmium	27.0	5.0	22.0			
Copper	15.0	8.0	6.0			
Lead	21.0	17.0	30.0			
Mercury	0.960	ND	0.0021			
Selenium	ND	4.4	< 0.0002			
Zinc	66.0	29.0	54.0			
Aldrin	< 0.019					
Chlordane	< 0.02		< 1.32	< 0.07	< 0.001	< 0.001
DDD	< 0.03	< 0.01	< 0.39	< 0.05	< 0.001	< 0.001
DDE	< 0.031	< 0.07	< 2.74	< 0.03	< 0.0007	< 0.0007
DDT	< 0.13	< 0.01	< 0.34	< 0.02	< 0.0008	< 0.0008
Diazinon	< 3.0	< 0.03	< 1.13	< 0.4	0.062	< 0.007
Dieldrin	< 0.011	< 0.01	< 0.26	< 0.02	< 0.0005	< 0.0004
Endrin			< 0.27	< 0.03	< 0.0006	< 0.0006
Lindane	< 0.056	0.02	< 0.20	< 0.02	< 0.0004	< 0.0004
Malathion	< 3.0		< 3.54	< 0.2	< 0.004	< 0.004
Toxaphene	< 0.65	< 0.08	< 2.54	< 0.2	< 0.004	< 0.004
PCB	< 0.78		< 1.17	< 0.2	< 0.004	< 0.004
TSS mg/l	234					
DO mg/l	4.2	5.4				
T,°C	26.0	23.0				
pH	7.0	6.5				
Flow, cfs	2492	685.0				

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-2 cont.

Trinity River @ SH 31 near Trinidad (Site 2A)

Date	6/24/84	6/24/84	6/24/84	7/10/84	7/10/84	7/10/84
Time	1210	1210	1210	1030	1030	1030
Type	Water	Sed. Core	Sed. Dredge	Water	Sed. Core	Sed. Dredge
Conc.	ppb	ppm	ppm	ppb	ppm	ppm
Arsenic	4	4	3	6	23	21
Cadmium	74	2	1	4	3	1
Copper	9	27	24	9	25	27
Lead	23	56	38	10	37	55
Mercury	<0.25	44	<2	<0.2	35	15
Selenium	<2	<0.2	<0.2	<2	<0.2	<0.2
Zinc	30	114	91	35	91	99
Aldrin						
Chlordane		<0.0007	<0.001		<0.002	<0.0006
DDD		<0.0002	<0.0005		<0.0004	<0.0002
DDE		<0.002	<0.0005		<0.004	<0.002
DDT		<0.0002	<0.0004		<0.0004	<0.0002
Diazinon		<0.005	<0.006		<0.01	<0.005
Dieldrin		<0.00008	<0.0004		<0.0002	<0.00008
Endrin		<0.00009	<0.0004		<0.0002	<0.00009
Lindane		<0.00008			<0.0002	<0.00008
Malathion		<0.001	<0.003		<0.002	<0.001
Toxaphene		<0.002	<0.003		<0.005	<0.002
PCB		<0.002	<0.003		<0.004	<0.002
TSS mg/l	35			49		
DO mg/l	5.6			5.6		
T, °C	29			29		
pH	7.6			7.6		
Flow, cfs	482			482		

ND or - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-3

Trinity River @ US 79 near Long Lake (Site 6A)

Date	8/4/81	8/4/81	8/18/81	8/20/81	8/21/81	8/23/81	9/3/81	9/4/81
Time	1450	1450	1335	1600	1500	1620	1400	1500
Type	Water	Sed.	Water	Water	Water	Water	Water	Water
Conc.	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb
Arsenic	< 2	4.5	< 2	<2	3.6	2.6	3.8	6.5
Cadmium	1	1	3	ND	2	5	38	1
Copper	8	2	13	15	8	9	11	10
Lead	18	20	15	14	11	20	16	6
Mercury	ND	0.098	0.26	0.3	0.38	0.34	0.1	0.5
Selenium	ND	ND	ND	0.14	2.28	ND	2.5	ND
Zinc	19	27	38	74	33	29	19	107
Aldrin	< 0.1	10.9	< 0.1		< 0.02	< 0.02	< 0.02	< 0.02
Chlordane	< 0.1	< 2	< 0.1	< 0.05	< 0.01	< 0.01	< 0.01	< 0.01
DDD	< 0.3	< 6	< 0.4	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03
DDE	< 0.1	< 1.8	< 0.1	< 0.02	< 0.02	< 0.02	< 0.03	< 0.03
DDT	< 1	< 20	< 1	< 0.2	< 0.1	< 0.1	< 0.1	< 0.1
Diazinon	< 5	< 93	< 5	< 3	< 3.5	< 3	< 3	2.9
Dieldrin	< 0.2	< 1.4	< 0.2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Endrin								< 0.6
Lindane	< 0.6	< 1.7	< 0.1					< 3
Malathion	< 6	< 112	< 6	< 3	< 3	< 3	< 3	< 0.6
Toxaphene	< 2.2	< 39	< 2.2	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
PCB	< 5	< 90	< 5	< 1.1	< 1.1	< 1.1	< 0.8	< 0.8
TSS mg/l			98		115		63	
DO mg/l	9.4		5.6	5.4	6.1	5.3	6.0	
T, °C	32		29	29	29	30	28	
pH	8.1		7.1	7.5	7.3	7.1	7.3	
Flow, cfs	801		690	787	1270	960	710	

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-3 cont.

Trinity River @ US 79 near Long Lake (Site 6A)

Date	9/6/81	9/7/81	9/10/81	5/2/84	5/16/84	5/16/84	5/28/84
Time	1200	1630	1127		1230	1232	1730
Type	Water	Water	Water	Sed.	Sed.	Water	Water
Conc.	ppb	ppb	ppb	ppm	ppm	ppb	ppb
Arsenic	9.7	14.4	3.5	0.84	1.25	4.44	4
Cadmium	3.0	5.0	2.0	64.0	2.0	5.0	1
Copper	12.0	19.0	6.0	8.0	7.0	10.0	11
Lead	24.0	32.0	13.0	32.0	20.0	21.0	10
Mercury	0.6	0.8	0.5	0.03	ND	ND	ND
Selenium	ND	ND	ND	0.002	0.2	2.0	2.0
Zinc	79.0	106.0	39.0	76.0	84.0	46.0	59.0
Aldrin	<0.02	<0.02	<0.02				
Chlordane	<0.02	<0.02	<0.02	<0.001	<0.02	<0.03	<0.07
DDD	<0.03	<0.03	<0.03	<0.004	<0.01	<0.02	<0.05
DDE	<0.03	<0.02	<0.02	<0.003	<0.07	<0.01	<0.03
DDT	<0.1	<0.1	<0.1	<0.001	<0.01	<0.02	<0.02
Diazinon	2.7	<3.0	<3.0	<0.0002		<0.06	<0.40
Dieldrin	<0.01	<0.01	<0.01		<0.01	<0.02	<0.02
Endrin					<0.01	<0.01	<0.03
Lindane	<0.06	<0.01	<0.01	<0.0002			<0.02
Malathion	<3.0	<3.0	<3.0	<0.003	<0.09	<0.02	<0.2
Toxaphene	<0.6	<0.6	<0.6		<0.004	<0.02	<0.2
PCB	<0.8	<0.8	<0.8	<0.001	<0.04	<0.07	<0.2
TSS mg/l	221	418	82		52		116
DO mg/l	2.4	3.7	6.4			6.9	6.5
T,°C	27	28	27			25	28
pH	7.2	6.8	7.4			7.5	6.5
Flow, cfs	3182	1636	880			715	800

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-3 cont.

Trinity River @ US 79 near Long Lake (Site 6A)

Date	5/29/84	5/31/84	5/31/84	5/31/84	6/1/84	6/1/84	6/2/84
Time	1800	1230	1615	2330	1100	1500	1330
Type	Water	Water	Water	Water	Water	Water	Water
Conc.	ppb	ppb	ppb	ppb	ppb	ppb	ppb
Arsenic	5	5	7	8	7	10	7
Cadmium	4	2	3	3	2	2	25
Copper	14	13	23	14	11	12	14
Lead	22	24	28	22	18	22	20
Mercury	ND	0.49	ND	ND	ND		
Selenium	<2	<2	<2	<2	<2	<2	<2
Zinc	30	42	68	56	50	37	37
Aldrin							
Chlordane	<0.01	<0.01	<0.02		<0.02		
DDD	<0.07	<0.04	<0.07		<0.07		
DDE	<0.04	<0.04	<0.08		<0.08		
DDT	<0.04	<0.04	<0.07		<0.07		
Diazinon	<0.2	<0.2	<0.32		<0.3		
Dieldrin	<0.02	<0.02	<0.03		<0.03		
Endrin	<0.02	<0.02	<0.04		<0.04		
Lindane	<0.02	<0.02	<0.03		<0.03		
Malathion	<0.07	<0.07	<0.1		<0.13		
Toxaphene	<0.6	<0.6	<1		<1		
PCB	<0.4	<0.42	<0.8		<0.7		
TSS mg/l	104	158	178	208	88	138	78
DO mg/l	6.6	5.5	6.1	6.4	3.9	6.1	6.2
T,°C	27	26	26	22	25	26	26
pH	6.9	6.3	6.4	6.8	6.5	6.7	6.5
Flow, cfs	747	1444	1566	1727	1695	1625	1132

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-3 cont.

Trinity River @ US 79 near Long Lake (Site 6A)

Date	6/24/84	6/24/84	6/24/84	7/10/84	7/10/84	7/10/85
Time	1330	1330	1330	1201	1201	1201
Type	Water	Sed. Core	Sed. Dredge	Water	Sed. Core.	Sed. Dredge
Conc.	ppb	ppm	ppm	ppb	ppm	ppm
Arsenic	8	0.98	1	8	2	2
Cadmium	11	0.84	7	10	2	2
Copper	12	17.9	15	6	15	23
Lead	18	25.5	65	13	18	27
Mercury	1.4	26	32	<0.2	<0.02	<0.02
Selenium	<2	10.2	<0.2	<2	<0.2	<0.2
Zinc	45	132	57	24	55	84
Aldrin					<0.0006	
Chlordane	<0.0006		<0.0006		<0.0002	<0.005
DDD	<0.0002		<0.0002		<0.002	<0.0004
DDE	<0.002		<0.002		<0.0002	<0.0004
DDT	<0.0002		<0.0002		<0.005	<0.006
Diazinon	<0.006		<0.005		<0.00008	<0.0004
Dieldrin	<0.00009		<0.00008		<0.00009	<0.0004
Endrin	<0.0001		<0.00009		<0.00008	<0.0002
Lindane	<0.0001		<0.00008		<0.001	<0.003
Malathion	<0.002		<0.001		<0.002	<0.003
Toxaphene	<0.002		<0.002		<0.002	<0.003
PCB	<0.002		<0.002			
TSS mg/l	66			51		
DO mg/l	7.4			6.0		
T,°C	25			30		
pH	7.6			7.7		
Flow, cfs	602			600		

ND or - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-4

Trinity River @ SH 7 near Crockett (Site 8A)

Date	8/4/81	8/4/81	8/18/81	9/18/81	8/23/81	9/4/81	9/6/81	9/7/81
Time	1115	1345	1315		1820	1615	1320	1520
Type	Water	Sed.	Water	Sed.	Water	Water	Water	Water
Conc.	ppb	ppm	ppb	ppm	ppb	ppb	ppb	ppb
Arsenic	<2.0	4.55	<2.0	<0.060	ND	4.77	8.58	12.15
Cadmium	9.0	2.0	2.0	< 0.2	1.0	ND	12.0	27.0
Copper	8.0	10.0	6.0	3.0	9.0	7.0	11.0	16.0
Lead	16.0	29.0	8.0	10.0	10.0	14.0	12.0	17.0
Mercury	ND	0.158	0.26	<0.5	0.26	0.719	0.479	0.65
Selenium	ND	ND	ND	< 0.2	1.85	ND	ND	ND
Zinc	17.0	59.0	17.0	30.0	17.0	67	77	85
Aldrin	<0.123	ND	<0.024	ND	<0.021	0.039	< 0.019	0.16
Chlordane	< 0.111	28.06	<0.015	ND	< 0.013	< 0.017	< 0.021	< 0.01
DDD	< 0.335	16.64	<0.074	ND	< 0.031	<0.032	< 0.032	< 0.03
DDE	< 0.101	3.59	<0.022	ND	< 0.019	< 0.031	< 0.031	< 0.01
DDT	< 1.178	ND	<0.240	ND	<0.128	< 0.130	< 0.130	< 0.10
Diazinon	< 4.88	ND	< 3.0	ND	< 3.0	< 3.0	< 3.03	3.76
Dieldrin	< 0.130	ND	< 0.017	ND	< 0.010	< 0.011	< 0.011	< 0.01
Endrin		ND		ND				
Lindane	< 0.093	ND	< 0.148	0.0659		< 0.056	< 0.056	< 0.05
Malathion	< 5.9	ND	< 3.0	ND	< 3.0	< 3.0	< 3.0	< 3.0
Toxaphene	< 2.150	ND	< 0.478	ND	< 0.636	< 0.653	< 0.653	< 0.58
PCB	< 4.951	ND	< 1.100	ND	< 1.127	< 0.784	< 0.784	< 0.76
TSS mg/l			38.8			74	223	
DO mg/l	9.6		8.5		6.3	6.6		4.5
T,°C	31.0		32.0		30.0	27.0		29.0
pH	8.2		7.8		7.1	7.2		7.1
Flow, cfs			703		1259	858		3110

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-4 cont.

Trinity River @ SH 7 near Crockett (Site 8A)

Date	9/10/81	5/2/84	5/2/84	5/16/84	5/16/84	5/16/84
Time	1000	1315		1440	1440	1440
Type	Water	Water	Sed.	Water	Sed. core	Sed. dredge
Conc.	ppb	ppb	ppm	ppb	ppm	ppm
Arsenic	2.68	1.0	1.1	2.67	0.943	
Cadmium	8.0	4.0	8.0	2.0	2.0	
Copper	8.0	2.0	3.0	9.0	4.0	
Lead	11.0	12.0	14.0	11.0	13.0	
Mercury	0.539	ND	0.03		ND	
Selenium	ND	4.6	< 0.02	< 2.0	< 0.2	
Zinc	54.0	17.0	40.0	91.0	72.0	
Aldrin	< 0.023					
Chlordane	< 0.022	< 0.03	< 0.001	< 0.02	< 0.001	< 0.001
DDD	< 0.030	< 0.05	< 0.001	< 0.01	< 0.001	< 0.001
DDE	< 0.019	< 0.01	< 0.010	< 0.07	< 0.0007	< 0.0007
DDT	< 0.104		< 0.002	< 0.01	< 0.0008	< 0.0008
Diazinon	< 3.0	< 0.02	< 0.040	< 0.03	< 0.007	< 0.007
Dieldrin	< 0.011	< 0.005	< 0.001	< 0.01	< 0.0005	< 0.0005
Endrin		< 0.005	< 0.002	< 0.01	< 0.0006	< 0.0006
Lindane	< 0.013	< 0.02		< 0.04	< 0.0005	< 0.0005
Malathion	< 3.0	< 0.07	< 0.002	< 0.09	< 0.004	< 0.004
Toxaphene	< 0.587	< 0.05	< 0.001	< 0.08	< 0.004	< 0.004
PCB	< 0.768	< 0.025	< 0.001	< 0.04	< 0.004	< 0.004
TSS mg/l	69	34				
DO mg/l	6.6	7.2		7.5		
T,°C	27.0	23.0		27.0		
pH	7.3	6.4		7.5		
Flow, cfs	1300	1035		893		

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-4 cont.

Trinity River @ SH 7 near Crockett (Site 8A)

Date	5/31/84	6/1/84	6/1/84	6/1/84	6/2/84	6/2/84	6/3/84
Time	1400	0945	1400	1730	1215	1645	1400
Type	Water	Water	Water	Water	Water	Water	Water
Conc.	ppb	ppb	ppb	ppb	ppb	ppb	ppb
Arsenic	4	4	7	5	6	7	6
Cadmium	1	2	1	2	1	2	2
Copper	4	6	9	8	7	11	11
Lead	10	16	15	13	19	18	22
Mercury	ND	1.2	3	0.9	0.7	ND	0.4
Selenium	<2	<2	<2	<2	<2	<2	<2
Zinc	11	16	29	20	28	48	38
Aldrin							
Chlordane	<0.01	<0.01		<0.01	<0.01		
DDD	<0.04	<0.03	<0.04	<0.03	<0.04		
DDE	<0.04	<0.03	<0.04	<0.03	<0.04		
DDT	<0.04	<0.03	<0.04	<0.03	<0.04		
Diazinon	<0.2	<0.1	<0.2	<0.1	<0.2		
Dieldrin	<0.02	<0.01	<0.02	<0.02	<0.02		
Endrin	<0.02	<0.02	<0.02	<0.02	<0.02		
Lindane	<0.02	<0.01	<0.02	<0.01	<0.02		
Malathion	<0.07	<0.05	<0.07	<0.06	<0.07		
Toxaphene	<0.6	<0.46	<0.6	<0.5	<0.6		
PCB	<0.4	<0.31	<0.4	<0.35	<0.4		
TSS mg/l	24	33	52	42	84	75	36
DO mg/l		6.8	6.7	6.6	5.7	7.5	7.2
T,°C		25	26	26	27	27	27
pH		6.5	6.6	6.6	6.5	6.7	6.6
Flow, cfs		1255	1334	1359	1342	1300	1133

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-4 cont.

Trinity River @ SH 7 near Crockett (Site 8A)

Date	6/24/84	6/24/84	6/24/84	7/10/84	7/10/84	7/10/84
Time	1430	1430	1430	1300	1300	1300
Type	Water	Sed. Core	Sed. Dredge	Water	Sed. Core	Sed. Dredge
Conc.	ppb	ppm	ppm	ppb	ppm	ppm
Arsenic	9	0.07	0.8	6	3	0.3
Cadmium	71	1.0	3	3	1	2
Copper	11	12.0	5	6	18	5
Lead	22	16.0	42	10	21	25
Mercury	0.4	32		<0.2	< 0.02	< 0.02
Selenium	<2	<0.2	<0.2	<2	<0.2	<0.2
Zinc	57	48	51	17	62	47
Aldrin						
Chlordane	<0.6		<0.001	<0.6		<0.001
DDD	<0.2		<0.0005	<0.2		<0.0005
DDE	<2		<0.0004	<2		<0.0003
DDT	<0.2		<0.0004	<0.2		<0.0004
Diazinon	<5		<0.006	<5		<0.006
Dieldrin	<0.08		<0.0004	<0.08		<0.0004
Endrin	<0.09		<0.0004	<0.09		<0.0004
Lindane	<0.08		<0.0002	<0.08		<0.0002
Malathion	<1		<0.003	<1		<0.004
Toxaphene	<2		<0.003	<2		<0.003
PCB	<2		<0.003	<2		<0.003
TSS mg/l	22			27		
DO mg/l	8.2			7.2		
T, °C	27			30		
pH	8.2			7.8		
Flow, cfs	751			800		

ND or / - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-5

Richland Creek @ FM 488 (Site 3A)

Date	8/8/81	5/2/84	5/2/84	5/2/84	5/2/84	5/2/84
Time	1125	1120	1605	1700	1745	1850
Type	Water	Water	Water	Water	Water	Water
Conc.	ppb	ppb	ppb	ppb	ppb	ppb
Arsenic	< 2.0	<1.0	34.35	26.87	30	8
Cadmium	ND	1.0	11.0	6.0	5	3
Copper	8.0	9.0	286.0	96.0	109	33
Lead	19.0	21.0	316.0	126.0	119	45
Mercury	0.18	ND	0.79	ND	ND	ND
Selenium	ND	<2.0	< 2.0	< 2.0	2	2
Zinc	21.0	30.0	1140.0	130.0	420	140
Aldrin	< 0.183					
Chlordane	< 0.179	< 0.02	< 0.03	< 0.03	0.03	0.03
DDD	< 0.335	< 0.01	< 0.01	< 0.01	0.01	0.01
DDE	< 0.101	< 0.07	< 0.05	< 0.05	0.05	0.05
DDT	< 1.078	< 0.01	< 0.01	< 0.01	0.01	0.01
Diazinon	< 4.88	< 0.03	< 0.02	< 0.02	0.02	0.02
Dieldrin	< 0.130	< 0.01	< 0.005	< 0.005	0.005	0.005
Endrin		< 0.01	< 0.005	< 0.005	0.005	0.005
Lindane	< 0.093	< 0.04	< 0.02	< 0.02	0.02	0.02
Malathion	< 5.9	< 0.09	< 0.07	< 0.07	0.07	0.07
Toxaphene	< 2.150	< 0.08	< 0.05	< 0.05	0.05	0.05
PCB	< 4.951	< 0.04	< 0.025	< 0.025	0.025	0.025
TSS mg/l	122.9	191.0			6196	1244
DO mg/l	6.4	9.5	8.9	8.0	7.8	8.1
T,°C	29.0	24.0	22.0	22.0	22	23
pH	7.1	6.5	6.4	6.3	6.5	7.4
Flow, cfs		65	64			

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-6

Tissue Samples
Trinity River @ SH 34 near Rosser (Site 1A)

Date	7/27/81	7/27/81	7/27/81	7/27/81	7/27/81	7/27/81	7/27/81	7/27/81
Time	1325	1325	1325	1325	1325	1325	1325	1325
Type	gar liver	gar liver dup.[a]	gar muscle	gar muscle dup.[a]	drum liver	drum muscle	drum muscle dup.[a]	buffalo liver
Conc.	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Arsenic	0.12		0.12	0.011	0.10	0.14	0.011	< 0.1
Cadmium	1.29		< 0.48	0.018	0.72	< 0.39	ND	0.35
Copper	23.22		< 0.48	0.412	3.96	< 0.39	0.291	9.52
Lead	< 0.43		< 0.48	0.027	< 0.36	< 0.39	0.054	< 0.35
Mercury	2.69		0.43	ND	0.11	0.12	ND	0.14
Selenium	0.52		0.18	0.023	0.21	0.23	0.132	0.20
Zinc	21.50		10.13	7.40	16.21	3.53	7.53	13.04
Aldrin								
Chlordane	0.655	< 0.01	0.257	< 0.01	0.564	0.197	0.201	0.814
DDD	0.330	< 0.01	0.146	< 0.01	0.258	0.060	< 0.01	0.270
DDE	< 0.001	< 0.01	0.704	< 0.01	0.764	0.288	< 0.01	0.409
DDT	< 0.001	< 0.01	0.070	< 0.01	0.234	0.073	< 0.01	0.280
Diazinon	0.144	< 0.01	0.324	< 0.01	1.15	0.602	< 0.01	3.003
Dieldrin	0.188	< 0.01	0.065	< 0.01	0.330	0.120	< 0.01	0.458
Endrin	< 0.001	< 0.01	< 0.001	< 0.01	< 0.001	0.001	< 0.01	< 0.001
Lindane	0.034	< 0.01	0.016	< 0.01	0.100	0.050	< 0.01	0.097
Malathion		< 0.01		< 0.01				
Toxaphene	< 0.001	< 0.1	< 0.001	< 0.1	< 0.001	< 0.001	< 0.1	< 0.001
PCB	ND	< 0.01	ND	< 0.01	ND	ND	< 0.01	ND

TSS mg/l	
DO mg/l	4.8
T,°C	30
pH	7.5
Flow, cfs	680

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-6 cont.

Fish Tissue Samples
Trinity River @ SH 34 near Rosser (Site 1A)

Date	7/27/81	7/27/81	7/27/81	7/27/81
Time	1325	1325	1325	1325
Type	buffalo liver dup.[a]	buffalo muscle	buffalo muscle dup.[a]	shad whole
Conc.	ppm	ppm	ppm	ppm
Arsenic		< 0.1	0.029	0.20
Cadmium		< 0.48	ND	< 0.53
Copper		1.92	0.174	< 0.53
Lead		< 0.48	0.082	< 0.53
Mercury		0.10	ND	0.05
Selenium			0.013	0.14
Zinc		5.28	8.71	12.78
Aldrin				
Chlordane	< 0.01	0.323	0.458	0.128
DDD	< 0.01	0.075	< 0.01	0.020
DDE	< 0.01	0.302	< 0.01	0.049
DDT	< 0.01	< 0.001	< 0.01	0.012
Diazinon	< 0.01	1.255	< 0.01	0.733
Dieldrin	< 0.01	0.167	< 0.01	0.047
Endrin	< 0.01	< 0.001	< 0.01	< 0.001
Lindane	< 0.01	0.059	< 0.01	0.008
Malathion	< 0.01		< 0.01	
Toxaphene	< 0.1	< 0.001	< 0.1	< 0.001
PCB	< 0.01	ND	0.077	ND
TSS mg/l				
DO mg/l				
T,°C				
pH				
Flow, cfs				

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-7

Fish Tissue Samples
Trinity River @ SH 31 near Trinidad (Site 2A)

Date	7/27/81	7/27/81	7/27/81	7/27/81	7/27/81	7/27/81	7/27/81	7/27/81
Time	1600	1600	1600	1600	1600	1600	1600	1600
Type	carp liver	carp liver dup.[a]	carp muscle	carp muscle dup.[a]	shad whole	shad whole dup.[a]	drum liver	drum muscle
Conc.	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Arsenic	0.12		0.32		0.10		0.21	<0.1
Cadmium	1.25		<0.38		<0.51	0.206	<0.56	<0.48
Copper	20.29		<0.38		<0.51	6.34	<0.56	<0.48
Lead	<0.42		<0.38		<0.51	0.25	<0.56	<0.48
Mercury	0.17		0.19		0.15	ND	0.11	0.10
Selenium			0.49		0.25		0.42	0.49
Zinc	104.31		8.44		20.24	26.1	9.53	3.97
Aldrin								
Chlordane	0.219	0.882	0.104	0.154	0.127	<0.01	0.938	0.072
DDD	0.340	<0.01	0.063	<0.01	<0.001	<0.01	0.149	<0.001
DDE	0.457	<0.01	0.105	<0.01	0.074	<0.01	0.759	<0.001
DDT	0.166	<0.01	0.019	<0.01	<0.001	<0.01	0.006	<0.001
Diazinon	0.228	<0.01	0.116	<0.01	0.290	<0.01	2.23	<0.001
Dieldrin	0.168	<0.01	0.050	<0.01	0.064	<0.01	0.486	0.027
Endrin	<0.001	<0.01	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001
Lindane	0.026	<0.01	0.010	<0.01	0.021	<0.01	0.115	<0.001
Malathion		<0.01		<0.01		<0.01		
Toxaphene	<0.001	<0.1	<0.001	<0.1	<0.001	<0.1	<0.001	<0.001
PCB	ND	1.364	ND	<0.01	ND	<0.01	ND	ND
TSS mg/l								
DO mg/l								
T,°C								
pH								
Flow, cfs	723							

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

[a] - Analysis by a separate laboratory of the tissue sample represented in the next column to the left.

TABLE A-7 cont.

Fish Tissue Samples
Trinity River @ SH 31 near Trinidad

Date	7/27/81	7/27/81	7/27/81
Time	1600	1600	1600
Type	drum muscle dup.[a]	buffalo liv. & musc.	buffalo liv. & musc. dup.[a]
Conc.	ppm	ppm	ppm
Arsenic	0.007	<0.1	ND
Cadmium	0.125	<0.43	0.14
Copper	0.098	<0.43	0.904
Lead	0.125	<0.43	0.14
Mercury	ND	0.17	ND
Selenium	0.020	0.34	0.022
Zinc	11.5	6.02	14.3
Aldrin			
Chlordane	<0.01	0.170	<0.01
DDD	<0.01	0.061	<0.01
DDE	<0.01	0.599	<0.01
DDT	<0.01	0.024	<0.01
Diazinon	<0.01	0.297	<0.01
Dieldrin	<0.01	0.087	<0.01
Endrin	<0.01	< 0.001	< 0.01
Lindane	< 0.01	0.014	< 0.01
Malathion	<0.01		<0.01
Toxaphene	< 0.1	<0.001	<0.1
PCB	<0.01	ND	<0.01
TSS mg/l			
DO mg/l			
T,°C			
pH			
Flow, cfs			

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

[a] - Analysis by a separate laboratory of the tissue sample represented in the next column to the left.

TABLE A-8

Fish Tissue Samples
Richland Creek @ F.M. 488 near Fairfield (Site 3A)

Date	7/28/81	7/28/81	7/28/81	7/28/81	7/28/81	7/28/81	7/28/81	7/28/81
Time	1000	1000	1000	1000	1000	1000	1000	1000
Type	buffalo liver	buffalo liver dup.[a]	buffalo muscle	drum liver	drum muscle & whole	shad whole	gar liver	gar muscle
Conc.	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Arsenic	<0.1	0.026	0.024	0.075	0.058	0.118	0.029	0.030
Cadmium	<0.38	0.009	0.142	0.309	0.081	0.065	0.194	0.023
Copper	16.99	1.799	24.845	1.767	7.071	3.166	24.210	2.662
Lead	<0.38	0.144	0.131	0.088	0.193	0.304	ND	0.102
Mercury	0.11	0.655	0.205	0.341	0.365	0.230	1.102	0.260
Selenium	0.34	0.132	0.037	ND	0.032	ND	0.192	0.076
Zinc	23.79	16.19	35.52	11.51	15.97	15.13	51.045	9.713
Aldrin								
Chlordane	0.833	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDD	0.273	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDE	2.62	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDT	0.038	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Diazinon	2.28	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	0.325	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lindane	0.102	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Malathion		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toxaphene	<0.001	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB	ND	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TSS mg/l								
DO mg/l								
T,°C								
pH								
Flow, cfs	24							

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

[a] - Analysis by a separate laboratory of the tissue sample represented in the next column to the left.

TABLE A-9

Fish Tissue Samples
Trinity River @ U. S. 79 near Long Lake (Site 6A)

Date	7/28/81	7/28/81	7/28/81	7/28/81	7/28/81	7/28/81	7/28/81	7/28/81
Time	1245	1245	1245	1245	1245	1245	1245	1245
Type	shad liver	shad muscle	drum liver	drum muscle	gar liver	gar muscle	carp liver	carp muscle
Conc.	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Arsenic	0.686	0.229	ND	0.019	0.026	0.017	0.024	0.009
Cadmium	0.139	0.010	0.400	0.010	1.130	0.009	1.428	0.029
Copper	60.402	0.793	16.533	1.833	22.796	3.681	14.481	1.606
Lead	1.595	0.059	0.267	0.058	0.121	0.114	0.159	0.172
Mercury	0.330	0.184	0.270	0.170	1.309	0.302	0.189	0.670
Selenium	ND	0.041	ND	0.052	0.875	0.081	0.035	0.139
Zinc	17.961	11.987	2.400	6.463	40.750	4.876	119.024	24.477
Aldrin								
Chlordane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	trace
DDD	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDT	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Diazinon	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lindane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Malathion	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toxaphene	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB	<0.01	<0.01	<0.01	<0.01	trace	trace	trace	0.620

TSS mg/l

DO mg/l
T,°C
pH
Flow, cfs 890

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-10

Fish Tissue Samples
Trinity River @ SH 7 near Crockett (Site 8A)

Date Time	7/29/81	7/29/81	7/29/81	7/29/81	7/29/81	7/29/81	7/29/81	7/29/81
Type	drum liver	drum muscle	shad liver	shad muscle	carp liver	carp muscle	gar liver	gar muscle
Conc.	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Arsenic	0.028	0.007	0.187	0.034	ND	ND	0.042	ND
Cadmium	0.763	0.014	0.195	0.029	ND	ND	1.653	0.029
Copper	7.544	1.431	42.479	1.432	71.309	2.495	21.687	0.853
Lead	0.180	0.140	1.481	0.137	1.671	0.086	0.171	0.074
Mercury	0.807	0.253	0.473	2.318	1.700	0.822	1.956	0.256
Selenium	ND	0.129	0.593	0.061	ND	ND	0.704	0.014
Zinc	13.875	8.110	27.202	8.936	1.114	7.183	42.177	6.209
Aldrin								
Chlordane	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	trace	<0.01
DDD	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01	<0.01
DDE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01	<0.01
DDT	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01	<0.01	<0.01
Diazinon	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01	<0.01
Dieldrin	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01	<0.01	<0.01
Endrin	<0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01	<0.01	<0.01
Lindane	< 0.01	<0.01	< 0.01	< 0.01	< 0.01	<0.01	<0.01	<0.01
Malathion	< 0.01	< 0.01	< 0.01	< 0.01	<0.01	<0.01	<0.01	<0.01
Toxaphene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	<0.1	<0.1	< 0.1
PCB	< 0.01	< 0.01	<0.01	< 0.01	< 0.01	<0.01	37.07	trace

TSS mg/l	
DO mg/l	7.1
T,°C	33
pH	7.4
Flow, cfs	1120

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.

TABLE A-10 cont.

Fish Tissue Samples
Trinity River @ SH 7 near Crockett (Site 8A)

Date	7/29/81	7/29/81
Time		
Type	bass liver	bass muscle
Conc.	ppm	ppm
Arsenic	ND	0.025
Cadmium	ND	ND
Copper	22.768	ND
Lead	0.893	ND
Mercury	0.273	0.074
Selenium	ND	0.058
Zinc	10.491	20.738
Aldrin		
Chlordane	<0.01	<0.01
DDD	<0.01	<0.01
DDE	<0.01	<0.01
DDT	<0.01	<0.01
Diazinon	<0.01	<0.01
Dieldrin	<0.01	<0.01
Endrin	<0.01	<0.01
Lindane	<0.01	<0.01
Malathion	<0.01	<0.01
Toxaphene	<0.1	<0.1
PCB	<0.01	<0.01
TSS mg/l		
DO mg/l		
T,°C		
pH		
Flow, cfs		

ND or < - Below detection limit. In some analyses these were reported simply as "ND". In all other cases the actual detection limit is shown. The detection limits vary in some cases because of different dilutions made in the analyses.