WASTE LOAD EVALUATION

FOR

THE WICHITA RIVER

IN THE RED RIVER BASIN

Segment 0214

WLE 90-03

Texas Water Commission

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ABSTRACT

A waste load evaluation for the Wichita River (Segment 0214) has been prepared by the Texas Water Commission. It was adopted by the Texas Water Commission on September 27, 1988 and approved by the United States Environmental Protection Agency on December 22, 1989. The purpose of this evaluation is to recommend waste treatment levels and effluent limitations that will result in the receiving water meeting applicable dissolved oxygen criteria through the year 2005. Recommendations are based on growth projections, water quality data and other information that were available as of June 8, 1987. This report updates and amends any previous waste load evaluations and becomes part of the state water quality management plans.

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INTRODUCTION

This waste load evaluation for the Wichita River Below Diversion Dam (Segment 0214) was prepared by the Water Quality Division of the Texas Water Commission in accordance with 40 CFR §130.7 as promulgated under Federal Water Pollution Control Act §303(d). It was adopted by the Texas Water Commission on September 27, 1988 and approved by the United States Environmental Protection Agency on December 22, 1989. The purpose of this evaluation is to define wastewater treatment levels and effluent limitations that will result in the receiving water meeting applicable dissolved oxygen criteria through the year 2005. Recommendations are based on growth projections, water quality data, and other information that were available as of June 8, 1987. As authorized under Texas Water Code §26.036, this waste load evaluation becomes part of the state water quality management plan. Pursuant to Texas Water Code §26.037, the Texas Water Commission may use this waste load evaluation in reviewing and making determinations on applications for wastewater discharge permits. All references to the Wichita River in this report refer only to Segment 0214.

SEGMENT DESCRIPTION

GENERAL INFORMATION

Geography

Wichita River Below Diversion Lake (Segment 0214) is located in north central Texas in the Red River Basin (see Figure 1). Segment 0214 begins at Diversion Dam in Archer County and flows 177.6 kilometers (110.4 miles) to the confluence with the Red River in Clay County. The Wichita River watershed (see Figure 2) encompasses 3,440 square kilometers (1,328 square miles) of Clay, Wichita, Archer, Foard, Baylor and Wilbarger Counties, and includes the communities of Electra, Iowa Park, and Crowell, as well as the City of Wichita Falls. Due to the extreme western location of Crowell and the absence of any dischargers, Wilbarger and Baylor Counties were omitted from the watershed map for the purpose of clarity. Elevations range from 311 meters (1,020 feet) above mean sea level at Diversion Dam to 265 meters (870 feet) at the confluence of Red River. Principal tributaries to the Wichita River include Buffalo Creek south of Iowa Park, Beaver Creek north of Diversion Lake, Bear Creek north of Wichita Falls, and Holliday Creek south of Wichita Falls.

Climatology

The climate of the Wichita River watershed is classified as continental. It is characterized by rapid changes in temperature, large daily and annual temperature extremes, and by rather erratic rainfall. In January, the normal daily maximum temperature is 11°C (52°F), and the normal daily minimum temperature is -2°C (28°F). In July, the normal daily maximum temperature is 37°C (98°F), and the normal daily minimum temperature is 22°C (72°F). The normal rainfall is 68 centimeters (27 inches) per year, but the distribution is erratic to such an extent that prolonged dry periods are common. Mean annual relative humidity ranges from fifty to eighty percent. Wind speeds average over 18 km/hr (11 mi/hr), and southerly winds prevail. Climatology for the Wichita River watershed is based on data obtained from the National Climatic Data Center station in Wichita Falls, Texas.

Hydrology

The Wichita River headwaters originate at Diversion Dam, impounding Lake Diversion. Beginning in March or April, and continuing until September or October, water is released from Lake Diversion via the South Side Canal for agricultural purposes. Irrigation canals and laterals continue the distribution of flow before returning to the Wichita River. The river bottom is composed of fine, hard-pacted sand with little vegetation on the banks. Average slope is 0.0003 ft/ft. River width increases from 6 meters (20 feet) at the headwaters to 25 meters (82 feet) at the confluence with the Red River. River depth increases commensurately from 0.1 meters (0.3 feet) upstream to 0.8 meters (2.6 feet) downstream. The United States Geological Survey (USGS) currently maintains two continuous flow recording gages on the Wichita River. Upstream at Beverly Drive (SH Loop 11) in Wichita Falls (USGS 07312500) discharge records from 1975, corresponding to the completion of Lake Kemp, to 1985 indicate an average discharge of 5.2 m^3/s (184 ft^3/s), a maximum discharge of 183 m^3/s (6,450 ft^3/s), and a 7-day 2-year low-flow of 0.586 m^3/s (20.7 ft^3/s). Downstream at FM 810, near Charlie, Texas (USGS 07312700) discharge records from 1975 to 1985 indicate an average discharge of 6.7 m^3/s (236 ft^3/s), a maximum discharge of 161 m^3/s (5,670 ft^3/s), a minimum discharge of 0.42 m^3/s (15 ft^3/s), and a 7-day 2-year low-flow of 1.504 m^3/s (53.1 ft^3/s).

Land Use Patterns

Approximately sixty-one percent of the watershed is composed of rangeland, including improved pasture. Irrigated and dry cropland account for thirty-five percent of the land area, with the remaining four percent land use devoted to urbanized areas.

WATER QUALITY STANDARDS

Rules on water quality standards specifying desired water uses and numerical criteria have been developed pursuant to Texas Water Code §26.023 and Federal Water Pollution Control Act §303. These rules were adopted April 7, 1988 by the Texas Water Commission and written in accordance with the Texas Water Code to meet the goals of the Federal Water Pollution Control Act, as amended through 1987 (33 United States Code 1251 et seq.). Those goals require that, where attainable, water quality will support aquatic life and contact recreational uses. The rules concerning Texas Surface Water Quality Standards are contained in 31 TAC §§307.1-307.10.

Desired Water Uses

The water uses deemed desirable for the Wichita River (Segment 0214) are as follows:

Contact Recreation
High Quality Aquatic Habitat

Numerical Criteria

The following are the numerical criteria established for the Wichita River (Segment 0214) and are intended to insure that water quality will be sufficient to maintain the desired uses:

Segment 0214

Parameter	Criteria
Dissolved Oxygen	5.0 mg/L 24-hour average, 3.0 mg/L minimum
pH	Not less than 6.5 nor more than 9.0
Temperature	Not to exceed 90°F
Chloride	Annual average not to exceed 1,800 mg/L
Sulfate	Annual average not to exceed 800 mg/L
Total Dissolved Solids	Annual average not to exceed 5,000 mg/L
Fecal Coliform	Thirty-day geometric mean not to exceed 200/100 mL

The numerical criteria are applicable, except for conditions described in §307.4(j) of the Texas Surface Water Quality Standards whenever the flow equals or exceeds the low-flow criteria described in Appendix B of §307.10 which is defined as either the seven-day minimum average flow with a recurrence interval of two years (7-day 2-year low-flow) or 0.0028 m^3/s (0.1 ft^3/s), whichever value is higher. Determination of criteria attainment is dependent on depth collection procedures and varies depending on the water body being sampled. For the Wichita River, samples shall be collected one foot below the water surface if the stream exhibits a vertically mixed water column. A depth integrated sample shall be used to determine attainment if the stream is vertically stratified. Where depth is less than 1.5 feet, the collection depth shall be one-third of the water depth measured from the water surface. At least four measurements per year are required to determine compliance for chloride, sulfate, and total dissolved solids. Five or more samples collected over a period of not more than 30 days are required to determine the attainment of the fecal coliform criterion. Reference should be made to the Texas Surface Water Quality Standards for additional numerical criteria that may not have been included here. Specific dissolved oxygen criteria have not been assigned to each individual tributary within the segment based on observed uses. The criterion for these streams will be evaluated as a result of a Texas Water Commission Receiving Water Assessment, which is conducted in response to individual permit actions in unclassified waters.

WASTEWATER DISCHARGES

A list of the approved, pending, and projected permits for wastewater discharge to the Wichita River as of June 8, 1987 is shown in Table 1 giving the existing (year 1986), projected (year 2005), and permitted loadings. They are ordered numerically by segment number and then by permit number within each segment. Existing loadings are based on monthly self-reported data. Permitted loadings are based on the 30-day average (or when present, the annual average) value in the permit. Ammonia nitrogen loading is based on an assumed effluent concentration of 15 mg/L NH_3-N for those domestic discharges that do not have permitted NH_3-N limitations or that did not self-report NH_3-N. The totals for continuous discharges are summarized on the last page of Table 1 with the approximate locations of these outfalls shown on the map in Figure 3. The exact location of all outfalls can be obtained from the Texas Water Commission upon request.

In general, the current permit limitations required for domestic dischargers to the Wichita River are secondary with commensurate permit limitations for industrial dischargers. There are currently seven approved outfalls for continuous domestic discharge with final permit limitations totaling 1.042 m^3/s, 1,823 kg/day BOD_5 and 1,349 kg/day NH_3-N (23.8 MGD, 4,020 lb/day BOD_5, and 2,975 lb/day NH_3-N). In addition, one "no discharge" permit is approved for domestic wastewater. There are two approved outfalls for continuous industrial discharge with final permit limitations totaling 0.004 m^3/s, 0.3 kg/day BOD_5 and 0 kg/day NH_3-N (0.1 MGD, 0.7 lb/day BOD_5, and 0 lb/day NH_3-N). In addition, three intermittent outfalls, are approved for industrial wastewater.

The historical wastewater flows and BOD_5 loadings since 1970 are shown in Figures 4 through 5. Since 1970, total wastewater flow has increased erratically. Conversely, total BOD_5, loading has generally decreased. The Wichita Falls-River Road wastewater treatment plant contributes approximately 80 percent of the total loading into the Wichita River. The increased flow with the decreased BOD_5 loading is most likely the result of improved treatment at the River Road WWTP. Existing loadings, based on 1986 self-reporting data, indicate that seven continuous domestic outfalls are discharging an average flow of 0.625 m^3/s, 463 kg/day BOD_5 and 798 kg/day NH_3-N (14.3 MGD, 1,021 lb/day BOD_5, and 1,760 lb/day NH_3-N). The two continuous industrial outfalls are not yet in existence.

WATER QUALITY CONDITIONS

The Texas Water Commission currently maintains one active monitoring station within Segment 0214: Station 0214.0100 at FM 810, west of Byers. This data is stored in the Stream Monitoring Network (SMN) system. Other entities may also maintain active stations with data stored in the SMN system. All data in the SMN system are available upon request from the Texas Water Commission.

A summary of the last four years of data taken at all SMN stations during the period of October 1, 1983 through September 30, 1987 is shown in Table 2 for the parameters having specified numerical criteria. As shown in Table 2, the mean values for all the parameters are within the numerical criteria established for the Wichita River.

Station 0214.0100 at FM 810 is approximately 55.6 kilometers (34.5 miles) downstream of the Wichita Falls-River Road WWTP. As shown in Figure 6, five of the past thirteen years have recorded minimum dissolved oxygen measurements of less than 5.0 mg/L. Due to the fluctuation of the minimum dissolved oxygen values there appears to be no discernible trend at the present time.

CLASSIFICATION

Classification is taken from The State of Texas Water Quality Inventory (1988) prepared by the Texas Water Commission pursuant to Section 305(b) of the *Federal Water Pollution Control Act*. Segments are classified as "water quality limited" if applicable water quality criteria cannot be met following incorporation of best practicable treatment (BPT) for industries and/or secondary treatment for municipalities. Segments are classified as "effluent limited" if they are presently meeting or will meet applicable water quality criteria following incorporation of best practicable treatment (BPT) for industries and/or secondary treatment for municipalities. The Wichita River (Segment 0214) was classified as "Water Quality Limited".

DOCUMENTATION OF THE WATER QUALITY MODEL

MODEL FORMULATION

General

Water quality modeling is basically an attempt to account for the major sources and sinks of a water quality constituent in a system composed of a number of complex interacting subsystems, each with its own set of physical and biological characteristics. In the case of dissolved oxygen, the primary sources are atmospheric reaeration and photosynthesis. The primary sinks for oxygen are carbonaceous demands, nitrogenous demands, sediment oxygen demands, and biological respiration. In addition, dissolved oxygen may be added or removed from the system through inflows or outflows.

The steady-state model used for the Wichita River is QUAL-TX, an updated version of QUAL-II developed by the Texas Water Commission. The QUAL-TX model was chosen because of its ability to rapidly predict water quality profiles in an advective and dispersive system and because its precursor, QUAL-II, is well-known and widely used in the field of modeling.

QUAL-TX uses a set of interrelated differential mass transport equations to describe the effects of advection, dispersion, decay, sources, and sinks for all water quality constituents being modeled. The transport equations are then solved by numerical integration using an implicit-finite-difference technique under the assumption that transport occurs along the longitudinal axis of the stream channel. QUAL-TX is capable of simulating carbonaceous biochemical oxygen demand (BOD), nitrogenous oxygen demand through the nitrogen cycle, sediment oxygen demand, dissolved oxygen, the nutrient cycles, algae production, coliforms, and conservative and nonconservative materials. The following discussion briefly summarizes the general theory and use of the model QUAL-TX. Further documentation on the theory and detailed use of the model can be found in the QUAL-TX User's Manual.

Segmentation

The first step in setting up a QUAL-TX water quality model is to divide the stream into segments of uniform characteristics called reaches. Since new hydraulic and biological coefficients can be specified for each reach, the way in which a model is segmented can significantly affect the output. New segments or reaches may be established due to changes in velocity, depth, or dispersion. Additional flow from tributaries or wastewater discharges may require that a new reach be established. A spatial variation from sediment oxygen demand or photosynthesis/respiration parameters may also require additional segmentation. Stream distances associated with the reaches have been determined from USGS quadrangle maps and increase from downstream to upstream from some reference point, usually the mouth of the stream or a dam.

With the finite-difference numerical technique, reaches are subdivided into computational elements of equal length. Each element is considered to be completely mixed and therefore has uniform water quality characteristics. As element lengths become smaller, the model will more accurately depict the plug-flow regime with a commensurate increase in storage requirements and computational costs. These factors must be balanced to determine element length.

A schematic representation of the Wichita River segmentation is shown in Figure 7. Reach identification data including reach lengths and element lengths are shown in Table 3. The Wichita River model was segmented into 41 reaches with 12 headwaters consisting of the mainstem, 7 primary tributaries, and 4 secondary tributaries. The Wichita River was segmented into twenty-three reaches with 1.0 kilometer (0.6 mile) element lengths from Diversion Dam (Km 177.6) in Archer County to the confluence with the Red River (Km 0.0) in Clay County. Beaver Creek was segmented into two reaches with 1.0 kilometer (0.6 mile) element lengths for a distance of 17.0 kilometers (10.6 miles). Deer Creek was segmented into one reache with 0.5 kilometer (0.3 mile) element length for a distance of 0.5 kilometer (0.3 mile). Buffalo Creek was segmented into four reaches with 1.0 kilometer (0.6 mile) element lengths for a distance of 17.0 kilometers (10.6 miles). Upper Plum Creek was segmented into one reach with 0.5 kilometer (0.3 mile) element length for a distance of 0.5 kilometer (0.3 mile). Lower Plum Creek was segmented into three reaches with 0.5 kilometer (0.3 mile) element lengths for a distance of 4.0 kilometers (2.5 miles). Holliday Creek was segmented into one reach with 0.5 kilometer (0.3 mile) element lengths for a distance of 0.5 kilometers (0.3 miles). Bear Creek was segmented into two reaches with 1.0 kilometer (0.6 mile) element lengths for a discharge of 13.0 kilometers (8.1 miles). An unnamed creek to which the City of Iowa Parks WWTP discharges was segmented into one reach with 0.5 kilometer (0.3 mile) element lengths for a distance of 1.5 kilometers (0.9 miles). The South Fork of Buffalo Creek was segmented into one reach with 1.0 kilometer (0.6 mile) element lengths for a distance of 26.0 kilometers (16.2 miles). An unnamed creek to which Sheppard A.F.B. WWTP discharges was segmented into one reach with 1.0 kilometer (0.6 mile) element lengths for a distance of 4.0 kilometers (2.5 miles). An unnamed creek to which the City of Wichita Falls-Northside WWTP discharges was segmented into one reach with 0.5 kilometer (0.3 mile) element lengths for a distance of 3.0 kilometers (1.9 miles).

<u>Hydraulics</u>

After a stream has been segmented, it is necessary to specify the hydraulic and physical characteristics of each reach in the stream system. Hydrodynamic factors fix the transport of oxygen and oxygen-demanding materials in and out of each element in the reach through advective and dispersive components. In a river or stream, transport is accomplished primarily by advection. In an estuary or tidal system, dispersion becomes a dominating factor. These parameters are significantly affected by the geometry and shape of each reach in the system.

The advective hydraulic characteristics can be described by two exponential equations. These equations represent the relationship of discharge to velocity and depth as follows:

$$V = a\,Q^{b}$$

$$D = c\,Q^{d} + e$$

where:

V = mean velocity, m/s

Q = mean discharge, m^3/s

D = mean depth, m

a, b, c, d, e = constants

In free-flowing systems, the velocity and depth equations are best determined from dye study measurements that are typical for the entire reach. When two or more sets of dye study measurements are available for the same reach, the equations can be determined by graphical means or by regression. When only one set of dye study measurements have been taken, the appropriate procedure is to assume a typical exponent and calculate the coefficient that will reproduce the measured values. If no dye study is available, the equations must be estimated. In constant level lakes or pools and in tidal systems, the depth is assumed to be constant and the depth is entered as the coefficient "e" with "c" and "d" left blank. The velocity exponent "b" is set equal to 1.0 and the coefficient "a" is set equal to $1/W \times D$ where W is the width and D is the depth.

Two hydraulic surveys with dye study measurements have been conducted on the Wichita River to date. Advective hydraulic coefficients, as shown in Table 6, were estimated based on flows and cross-sections documented in Intensive Survey of the Wichita River Segment 0214 (Draft, 1987). The exponential equation exponents for all reaches were assumed as follows: velocity exponent "b" equal to 0.5 and depth exponent "d" equal to 0.4. The coefficients were then adjusted to predict the measured velocities and depths.

The dispersive hydraulic characteristics can be described by one of two equations depending on whether the system is tidally influenced. In a non-tidal stream, the dispersion is calculated by the following equation:

$$E = 18.53\ n\ V\ D^{0.833}$$

where:

E = longitudinal dispersion, m^2/s

n = Manning's roughness coefficient

V = mean velocity, m/s

D = mean depth, m

A Manning's roughness coefficient of 0.035 corresponding to natural channels in good condition was used for all reaches. The Wichita River is not tidally influenced and tidal dispersion was therefore excluded in the hydraulic considerations.

Carbonaceous Biochemical Oxygen Demand

One of the major sinks of oxygen in the receiving water is carbonaceous biochemical oxygen demand. Carbonaceous biochemical oxygen demand is a measure of organic material and is usually defined as the amount of oxygen required by bacteria while stabilizing the decomposable carbonaceous portion of organic matter under aerobic conditions. For purposes of discussion herein, biochemical oxygen demand (BOD) will refer to the carbonaceous portion only. Wastewater discharges usually contain significant quantities of BOD which decompose rapidly in the presence of aerobic bacteria. These bacteria are present in most waters and begin the process of decomposition quickly. When dissolved oxygen concentrations become very low, the decomposition process slows down as the bacteria convert to anaerobic pathways.

The BOD is typically determined through a laboratory procedure involving the measurement of oxygen consumed by bacteria over a specified period of time. In order to prevent possible interference from nitrogenous compounds which also consume oxygen, the BOD test should utilize a nitrification suppression technique to inhibit nitrifying bacteria. While biochemical oxidation theoretically takes an infinite time to go to completion, the oxidation is usually 95 to 99 percent complete within a twenty-day period. Hence, the ultimate BOD (BOD_μ) may be considered to be the same as the twenty-day BOD (BOD_{20}) unless the organic material degrades very slowly. Routine BOD testing typically uses the five-day period because of the shorter time involved in obtaining the results. Oxidation in the five-day BOD (BOD_5) test is usually from 60 to 70 percent complete. The BODµ has often been assumed to be equal to 1.5 times the BOD_5. However, statistical analysis of BOD data collected throughout the state indicates that the BODµ is equal to approximately 2.3 times the BOD_5. This factor is used in this waste load evaluation whenever the conversion of BOD_5 to BODµ is required. Documentation of the BOD values actually used in the model is presented in greater detail in the Calibration Section.

The rate at which BOD disappears from the system is a combination of two mechanisms: decay and settling. The BOD decay rate is the rate at which BOD is removed due to bacterial decomposition. When the dissolved oxygen concentrations are high, this process proceeds rapidly. At reduced dissolved oxygen concentrations, this process slows considerably. The QUAL-TX model adjusts the BOD decay rates accordingly. The BOD settling rate is based on standard settling kinetics and assumes that a portion of the BOD in the system is settleable. As the soluble fraction of BOD increases, the settling rate may need to be reduced in a commensurate manner.

The BOD rates can sometimes be determined from a semi-logarithmic plot of the stream BOD values downstream of a discharger versus the time-of-travel down the stream. The slope of the line is used to determine the rates. This method proves unacceptable when a large number of discharges prevents isolating one BOD profile or when a dispersive system is encountered. In these cases, the rates must be adjusted so that the predicted BOD profiles match the observed BOD profiles. Documentation of the technique used for selection of the BOD rates is presented in greater detail in the Calibration Section.

Nitrogenous Oxygen Demands

Various nitrogen compounds present in wastewater discharges also exert an oxygen demand in the receiving water as they change from one form to another. These changes in form require the presence of specific bacterial populations. Ammonia nitrogen (NH_3-N) is converted to nitrite nitrogen (NO_2-N) by the bacteria Nitrosomonas and theoretically consumes 3.43 mg oxygen/mg nitrogen. Nitrite nitrogen is converted to nitrate nitrogen (NO_3-N) by the bacteria Nitrobacter and theoretically consumes 1.14 mg oxygen/mg nitrogen. The conversion of organic nitrogen to ammonia nitrogen is accomplished by hydrolysis and therefore consumes no oxygen. Because the conversion of nitrite nitrogen to nitrate nitrogen takes place so rapidly in comparison to the conversion of ammonia nitrogen to nitrite nitrogen, the two processes are combined together as one in the model. This combined process is known as nitrification. The total theoretical oxygen demand for the conversion of ammonia nitrogen to nitrate nitrogen is 4.57 mg oxygen/mg nitrogen. However, a small portion of the oxygen can be obtained through inorganic compounds, slightly reducing the total oxygen demand required by the nitrification process. Based on experimental data, the conversion of ammonia nitrogen to nitrate nitrogen requires 4.33 mg oxygen/mg nitrogen. This is the factor utilized in the model.

Under certain circumstances, such as low dissolved oxygen concentrations, the nitrifying bacterial populations and/or their activity may be suppressed. Research indicates that dissolved oxygen levels below 2 mg/L significantly inhibit nitrification. Under anaerobic conditions, nitrate nitrogen may be converted to nitrogen gas in a process known as denitrification. These kinetics are accounted for in the QUAL-TX model.

Nitrification rates can be determined by the same graphical means as described previously for BOD decay rates unless interfering processes such as photosynthesis or denitrification are taking place. The graphical method also proves unacceptable when a large number of discharges are present or when a dispersive system is encountered. In these cases the rates must be adjusted so that the predicted nitrogen and dissolved oxygen profiles match the observed profiles. Documentation of the technique used for the selection of the nitrification rates is presented in greater detail in the Calibration Section.

Sediment Oxygen Demand

Another major sink of oxygen in the receiving water is sediment oxygen demand. Bottom deposits in the form of settled organics accumulate along the streambed when stream velocities are not sufficient to keep solid particles in suspension and can exert an oxygen demand. Background sediment oxygen demand resulting from nonpoint sources, decaying leaves, and detrital matter can range from 0.05 gm oxygen/m^2-day in mineral soils to 2.0 gm oxygen/m^2-day in estuarine muds at 20°C.

In addition to background sources, organics discharged from domestic or industrial wastewater treatment plants can settle out below wastewater outfalls creating sediment oxygen demands ranging from 0.05 gm oxygen/m^2-day to 10 gm oxygen/m^2-day. At higher treatment levels, the sediment oxygen demand will be reduced to background levels due to the reduction in discharged solids.

The model can convert settled BOD and organic nitrogen to sediment oxygen demand to account for this increase in sediment oxygen demand below wastewater outfalls. As with BOD decay rates and nitrification rates, low dissolved oxygen concentrations can inhibit the rate of sediment oxygen demand. The QUAL-TX model takes this factor into account.

Sediment oxygen demand can be determined based on in situ techniques, laboratory core analyses, or literature values. Documentation of the technique used for selection of the sediment oxygen demands is presented in greater detail in the Calibration Section.

Atmospheric Reaeration

The process by which dissolved oxygen in the stream is replenished from the overlying air is known as atmospheric reaeration and is the primary source of dissolved oxygen in the receiving water. The reaeration process is generally a function of stream geometry and hydraulics. Several techniques and equations have been developed to estimate reaeration coefficients based on stream geometry and stream characteristics. The equations are generally of the following form:

$$K_2 = \frac{a\ V^b}{D^c}$$

where:

K_2 = reaeration rate, per day

V = mean stream velocity, m/s

D = mean stream depth, m

a, b, c = constants

The selection of the constants can be determined from previous research done on streams with similar characteristics or from direct measurements. Direct measurements provide the most reliable results and are best determined from krypton-tritium radiotracer techniques. The reaeration equation selected for this model was determined by regression analysis of data obtained from krypton-tritium radiotracer studies on streams throughout Texas. The regressed equation follows the general form given previously using "a" equal to 1.923, "b" equal to 0.273, and "c" equal to 0.894.

Photosynthesis/Respiration

The presence of algae and aquatic plants can also have an effect on dissolved oxygen in surface waters. During periods of daylight, oxygen is produced as a by-product of photosynthesis and is consumed due to respiration. At night, oxygen production stops while respiration continues. This complex process, involving both a source and sink of oxygen can cause a surplus or deficit of oxygen frequently resulting in diurnal variations of dissolved oxygen concentrations. These variations depend on a number of conditions including light intensities, available nutrients, and turbidity.

Planktonic algae are represented in the model by chlorophyll *a*. Chlorophyll *a* is one of the chemical pigments which determines the photosynthetic activity of algae. Although present in all algae, it is predominant in green algae. Attached algae and/or rooted plants are presented in the model by macrophytes. Both planktonic algae and macrophytes require certain nutrients for growth. Although other nutrients are necessary, phosphorus and nitrogen are generally the limiting factors and are the ones of primary interest. The utilization of nitrogen in the growth of algae and macrophytes can be an important factor in the nitrogen balance and often complicates attempts to account for other processes such as nitrification. For this reason, photosynthesis/respiration must be considered in modeling analyses. Further discussion of the role of photosynthetic activity as related to this model is presented in the Calibration Section.

Temperature

Many of the reactions which determine water quality in natural systems are dependent on temperature. This dependence is usually considered by changing the various rate constants according to the following equation:

$$K_T = K_{20}\ \Theta^{(T-20)}$$

where K_T and K_{20} are rate constants at a temperature T and 20°C, respectively, and Θ is a temperature correction factor which depends on the reaction being considered. The default values for temperature correction factors as specified in the QUAL-TX User's Manual were used in this modeling effort. The default value temperature correction factors were obtained from Rates, Constants and Kinetics Formulations in Surface Water Quality Modeling published by the United States Environmental Protection Agency. Four of the more important factors are listed as follows:

Reaction	Θ, Temperature Correction Factor
Atmospheric Reaeration	1.017 - 1.024
Carbonaceous Decay	1.047
Nitrogenous Decay	1.083
Sediment Oxygen Demand	1.074

Boundary Conditions

Boundary conditions are used to fix water quality at a constant value at the upper and lower bounds of a system. The boundary conditions should be chosen at a point where the quality is unlikely to change regardless of the upstream conditions or downstream conditions. The upper boundary is represented by the headwaters and should always be an area of advective transport so that dispersion from downstream does not affect it. The lower boundary is required only in dispersive systems. In advective systems, it is unrestrained and does not affect upstream water quality. The lower boundary should be a large body of water that can act as a sink/source of water quality constituents without being affected by the upstream conditions. Because the Wichita River is an advective system, a lower boundary is not required for this model.

Waste Loads

Whenever possible, the tributaries into which waste loads enter should be modeled. However, sometimes this is not possible due to the complexity of the system. When a waste load must pass through an unmodeled series of streams or ditches before reaching the modeled stream or tributary, the waste load should be degraded to account for this travel time. For the purposes of this model, the waste load from any discharger over 0.5 kilometer (0.3 mile) from a modeled stream is degraded based on a velocity of 0.03 m/s (0.1 ft/s), a BOD decay rate of 0.1 per day, and a nitrification rate of 0.2 per day, which are typical values for small shallow Texas streams.

CALIBRATION

Survey Discussion

The intensive survey field data and water samples used to calibrate the Wichita River model were gathered by the Texas Water Commission during the period of July 21-25, 1986. Laboratory analyses of water samples were conducted by the Texas Department of Health in Austin, Texas. Summaries of flow, field, and laboratory data collected at stream stations are shown in Tables 7 through 9. Summaries of flow, field, laboratory, and self-reporting data collected from wastewater dischargers are shown in Tables 10 through 13. A more detailed presentation of the data is available from the Texas Water Commission in the report Intensive Survey of the Wichita River Segment 0214 (June, 1987). The water quality data were collected over a 12-hour period with composite water samples and field measurements being collected approximately every four hours. The locations of stream stations and wastewater dischargers listed in Tables 7 through 13 are shown in Figure 3.

Stream flows in the Wichita River during this survey were erratic and variable. Fluctuating irrigation return flows - high-flow occurs during the summer - and scattered thunderstorms combined to create non-steady state conditions. As shown in Table 7, mainstem stream flows ranged from 0.175 m^3/s (6.2 ft^3/s) to 4.984 m^3/s (176 ft^3/s). Flow velocities calculated from time-of-travel studies were moderately fast and ranged from 0.103 m^3/s (0.34 ft^3/s) to 0.357 m^3/s (1.17 ft^3/s). Diurnal dissolved oxygen averages remained above the 5.0 mg/L segment criterion throughout the river. The City of Wichita Falls-River Road WWTP discharge had minimal effect on the water quality of the river lowering the dissolved oxygen diurnal average approximately 1.7 mg/L between SH 240 and River Road.

Model Discussion

Using the July 21-25, 1986 data presented previously, the Wichita River model was calibrated under stream conditions of high-flows and high temperatures. The input data used for the calibration run are shown in Table 14. The calibration profiles for dissolved oxygen, biochemical oxygen demand, and ammonia nitrogen are shown in Figures 8 through 10.

The first step in the calibration process was to set up a flow balance for the Wichita River, stream flows were based on measured values from the survey and adjusted on a flow per unit area basis if the input locations were different from the location of the measured value. Incremental inflows were also determined on a flow per unit area basis. Wastewater discharge flow for the City of Wichita Falls-River Road WWTP was based on measured values from the survey. All other wastewater discharge flows were based on self-reporting data.

Biochemical oxygen demand concentrations used in the model were based on self-reporting BOD_5 data corrected to ultimate BOD except for the City of Wichita Falls-River Road WWTP discharge, where the ultimate BOD and ammonia nitrogen were measured directly during the intensive survey. If data were not available, the values were estimated. Water quality associated with incremental inflows was input using estimated background water quality levels.

Following determination of loadings from the tributaries, dischargers, and incremental flows as described above, the actual calibration was begun. Initial estimates of the coefficients were made and then adjusted within acceptable ranges until the predicted profiles provided a reasonable fit to the observed data.

Some of the major rate coefficients (base e) for the calibration run excluding those in the tributary reaches are summarized as follows:

Rate Coefficient	20°C Value	Corrected Value
Reaeration	----	9.02 per day
Sediment Oxygen Demand	0.30-0.30 g/m^2-day	0.58-0.82 g/m^2-day
BOD Decay	0.10-0.10 per day	0.15-0.16 per day
BOD Settling	0.05-0.05 m/day	0.08-0.47 per day
Ammonia Nitrogen Decay	0.30-0.30 per day	0.58-0.69 per day

As indicated in Figures 8 through 10, reasonable agreement is shown between the predicted and observed values for dissolved oxygen, ultimate biochemical oxygen demand, and ammonia nitrogen.

VERIFICATION

Survey Discussion

The intensive survey field data and water samples used to verify the Wichita River model were gathered by the Texas Department of Water Resources during the period of April 6-9, 1981. Laboratory analyses of water samples were conducted by the Texas Department of Health in Austin, Texas. Summaries of flow, field, and laboratory data collected at stream stations are shown in Tables 15 through 17. Summaries of flow, field, laboratory, and self-reporting data collected from wastewater dischargers are shown in Tables 18 through 21. A more detailed presentation of the data is available from the Texas Water Commission in the report Intensive Survey of the Wichita River, Segment 0214. The water quality data were collected over a 12-hour period with composite water samples and field measurements being collected approximately every four hours. The locations of stream stations and wastewater dischargers listed in Tables 15 through 21 are shown in Figure 3.

Stream flows in the Wichita River watershed during this survey were only half as large as the 1986 survey flows. Flows in the mainstem ranged from 0.077 m^3/s (2.7 ft^3/s) at FM 1180 to 2.280 m^3/s (81 ft^3/s) at FM 810. Flow velocities were slightly slower than the calibration survey and ranged from 0.136 m/s (0.45 ft/s) to 0.271 m/s (0.89 ft/s). Similar to the 1986 survey, diurnal dissolved oxygen averages were above the 5 mg/L dissolved oxygen criterion for all mainstem sampling locations.

Model Discussion

Using the April 6-9, 1981 data presented previously, the Wichita River model was verified under stream conditions of low-flows and average temperatures. The input data used for the verification run are shown in Table 22. The verification profiles for dissolved oxygen, biochemical oxygen demand, and ammonia nitrogen are shown in Figures 11 through 13.

The verification process follows many of the same procedures utilized during the calibration. The first step was to set up the flow balance. Stream flows were based on measured values from the survey and adjusted on a flow per unit area basis if the input locations were different from the location of the measured value. Incremental inflows were also determined on a flow per unit area basis. Wastewater discharge flows were based on self-reporting data, except for the City of Wichita Falls-River Road WWTP and the City of Iowa Park WWTP which were measured during the intensive survey.

Biochemical oxygen demand concentrations used in the model were based on self-reporting BOD_5 corrected to ultimate BOD except for the City of Wichita Falls-River Road WWTP discharge, where the ultimate BOD and ammonia nitrogen were measured directly during the intensive survey. If data were not available, the values were estimated. Water quality associated with incremental inflows was input using estimated background water quality levels.

None of the rates, coefficients, or assumptions in the Wichita River verification model changed from the calibration model.

Some of the major rate coefficients (base e) for the verification run excluding those in the tributary reaches are summarized as follows:

Rate Coefficient	20°C Value	Corrected Value
Reaeration	----	8.63 per day
Sediment Oxygen Demand	0.30-0.30 g/m^2-day	0.33-0.43 g/m^2-day
BOD Decay	0.10-0.10 per day	0.09-0.10 per day
BOD Settling	0.05-0.05 m/day	0.07-0.48 per day
Ammonia Nitrogen Decay	0.30-0.30 per day	0.26-0.28 per day

As indicated in Figures 11 through 13, reasonable agreement is shown between the predicted and observed values for dissolved oxygen, ultimate biochemical oxygen demand, and ammonia nitrogen.

WATER QUALITY PROJECTIONS

PREDICTIVE USE OF THE MODEL

The calibrated and verified QUAL-TX water quality model for the Wichita River described previously can be used to evaluate water quality impacts of various stream conditions and waste load projections. Temperature correction factors, hydraulic relationships, and biological coefficients remain unchanged from the calibration and verification runs and are considered acceptable for various waste load projections and various combinations of stream conditions including low-flow, high- flow, summer temperatures, and winter temperatures. Biochemical oxygen demand was input as BOD_5 in the alternative runs using a $BOD\mu:BOD_5$ ratio of 2.3. Table 23 shows the coefficients used in the alternative runs.

STREAM CONDITIONS

Waste load impacts in the Wichita River have been evaluated under a combination of stream conditions. These stream conditions have included high-flow with summer temperatures and low-flow with winter temperatures. Because the Wichita River is used extensively for irrigation during the summer months, the standard critical conditions of high temperature and low-flow do not occur simultaneously. Accordingly, alternatives were analyzed under both summer (high temperature and high-flow) and winter (low temperature and low-flow) critical conditions. Ninety percentile flows and temperatures were calculated for each month and then run individually with the calibrated/verified model. This examination concluded that July had the most critical base conditions.

A frequency analysis of USGS discharge records for the Wichita River at SH Loop 11 in Wichita Falls (USGS Station 07312500) from 1960 to 1985 determined the ninety percentile flow for July to be 2.048 m^3/s (72.3 ft^3/s). This flow was then adjusted for any wastewater return flows and allocated as the baseflow throughout the watershed on a flow per unit area basis. Table 23 shows how the baseflows were distributed. Water quality for the baseflows was assumed to be at background levels and is also shown in Table 23.

The summer temperature was based on the ninety percentile water temperature for the month of July. The data for this statistical analysis was obtained from the Texas Water Commission Stream Monitoring Network. The summer temperature as determined by this analysis is 32.6°C (90.7°F).

WASTE LOAD PROJECTIONS

Many waste load projections were examined using the water quality model. The "No Load" alternative represents the no discharge projection in which no wastewater discharges are occurring. Although, realistically, it is not a viable alternative, it represents a baseline from which to evaluate the other alternatives.

Various projections of wastewater discharge flows were developed for evaluating the effect of effluent limitations on water quality in the Wichita River watershed. These flows are shown in Table 1. Ultimate permitted flows were based on the final flows in existing permits plus the flows from pending permit applications. Projected flows for the year 2005 were developed based on population projections provided by the Texas Water Commission.

Several different sets of BOD_5 and NH_3-N effluent limitations were examined for the various projections. Ultimate permitted quality for dischargers is based on the BOD_5 and NH_3-N in existing and pending permits and is shown in Table 1. The "20 mg/L BOD_5, 15 mg/L NH_3-N, and 2 mg/L dissolved oxygen" effluent set represents secondary treatment, the "10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen" effluent set represents advanced treatment, the "10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L dissolved oxygen" effluent set represents advanced treatment with nitrification, and the "5 mg/L BOD_5, 2 mg/L NH_3-N, and 5 mg/L dissolved oxygen" effluent set represents advanced treatment with nitrification and filtration.

The "Projected Effluent Quality" is as follows: the City of Wichita Falls' River Road wastewater treatment plant and the United State's Sheppard A.F.B. wastewater treatment plant both at 10 mg/L biochemical oxygen demand, 3 mg/L ammonia nitrogen, and 4 mg/L dissolved oxygen; the City of Wichita Falls' Northside wastewater treatment plant at 10 mg/L biochemical oxygen demand, 15 mg/L ammonia nitrogen, and 4 mg/L dissolved oxygen; the City of Iowa Park's wastewater treatment plant at 20 mg/L biochemical oxygen demand, 15 mg/L ammonia nitrogen, and 4 mg/L dissolved oxygen; the Community of Crowell's wastewater treatment plant at 20 mg/L biochemical oxygen demand, 15 mg/L ammonia nitrogen, and 3 mg/L dissolved oxygen; and the remaining dischargers at current permitted effluent quality. The "Projected Effluent Quality" is shown in Table 1 under projected waste loads.

PREDICTED WATER QUALITY FOR IOWA PARK WWTP DITCH AND BUFFALO CREEK

Water quality profiles resulting from the waste load projections described previously were predicted for the stream conditions described previously using the calibrated/verified model and are shown in Figures 14 through 17. A brief summary of these results are tabulated as follows:

Figure	Alternative	Minimum Predicted Dissolved Oxygen (mg/L)	River Kilometers Below Criterion	River Miles Below Criterion
14	No Waste Loads	6.02	0.0	0.0
15	Ultimate Permitted Flows Ultimate Permitted Effluent Limitations	2.42	1.5	0.9

16	2005 Projected Flows 20 mg/L BOD_5 15 mg/L NH_3-N 2 mg/L DO	2.41	1.5	0.9
17	2005 Projected Flows Projected Effluent Quality	2.95	0.0	0.0

As shown in the preceding table and Figure 17, the "2005 Projected Flows and Projected Effluent Quality" effluent set will meet the dissolved oxygen criterion of 3 mg/L in the Iowa Park WWTP Ditch and Buffalo Creek.

PREDICTED WATER QUALITY FOR WICHITA FALLS-NORTHSIDE WWTP DITCH AND BEAR CREEK

Water quality profiles resulting from the waste load projections described previously were predicted for the stream conditions described previously using the calibrated/verified model and are shown in Figures 18 through 21. A brief summary of these results are tabulated as follows:

Figure	Alternative	Minimum Predicted Dissolved Oxygen (mg/L)	River Kilometers Below Criterion	River Miles Below Criterion
18	No Waste Loads	5.94	0.0	0.0
19	Ultimate Permitted Flows Ultimate Permitted Effluent Limitations	1.79	14.0	8.7
20	2005 Projected Flows 20 mg/L BOD_5 15 mg/L NH_3-N 2 mg/L DO	2.31	3.0	1.9
21	2005 Projected Flows 10 mg/L BOD_5 15 mg/L NH_3-N 4 mg/L DO	3.22	0.0	0.0

As shown in the preceding table and Figure 21, an effluent set of 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen will meet the dissolved oxygen criterion of 3 mg/L in the Wichita Falls-Northside WWTP Ditch and Bear Creek.

NONPOINT SOURCE ASSESSMENT

The Red River Basin 208 Planning Program included a discussion of nonpoint sources of pollution for the Wichita River (Segment 0214) watershed. The documentation and results of that discussion are contained in the following reports:

> Water Quality Management Plan for the Red River Basin. Plan Summary Report. August, 1978, Red River Authority of Texas.
>
> Wichita River Urban Runoff Program. Analysis of Sampling Data. May, 1985, Red River Authority of Texas, City of Wichita Falls, and Freese and Nichols, Inc.

Nonpoint Sources in the Red River Basin and particularly the Wichita River watershed were inventoried and identified in the above referenced publications. Although the Wichita River and especially Holliday Creek receive substantial pollution from nonpoint sources, this pollution cannot be directly associated to specific origins. In addition, nonpoint source impacts on water quality do not appear to have a significant adverse affect on the Wichita River.

ANALYSIS OF ALTERNATIVES

CHANGES IN STANDARDS

At the present time there are no recommended changes in the standards governing the Wichita River (Segment 0214).

SELECTED TREATMENT LEVEL

Based on the calibrated/verified model, model simulations indicate that the following domestic treatment levels will support a 5 mg/L dissolved oxygen criterion in the Wichita River: City of Wichita Falls-River Road (Permit No. 10509.001) at 10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L dissolved oxygen; the City of Wichita Falls-Northside (Permit No. 10509.005) at 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen; and the U.S. Department of the Air Force-Sheppard A.F.B. (Permit No. 12511.001) at 10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L dissolved oxygen. The following domestic treatment levels will support a 3 mg/L dissolved oxygen criterion in non-designated tributaries: City of Iowa Park (Permit No. 10691.002) at 20 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen; and the Community of Crowell (Permit No. 10638.001) at 20 mg/L BOD_5, 15 mg/L NH_3-N, and 3 mg/L dissolved oxygen; with all other existing dischargers at their existing effluent set.

SENSITIVITY ANALYSIS

The output of any water quality simulation depends upon the coefficients and stream conditions input in the model. Uncertainty concerning these factors may affect the reliability of the model. Therefore, it is useful to determine the sensitivity of the model to changes in input values. The results of a sensitivity analysis indicate which parameters are most affected by uncertainties and to what extent these uncertainties may affect the predictions. In the following sensitivity analysis, all but one parameter are held constant, and the remaining parameter value is varied by ± 50 percent (except temperature, ± 2°C). The selection of a 50 percent variation is purely arbitrary and provides a relative measure of comparison.

Sensitivity analyses were performed on the following parameters: temperature, stream baseflow, BOD decay rate, ammonia decay rate, background sediment oxygen demand , and reaeration rate. Figures 34 through 39 indicate the relative sensitivity of the dissolved oxygen concentrations using the "2005 Projected Flows at Projected Effluent Quality" alternative as the basis for comparison. As shown in Figure 39, the Wichita River is most sensitive to a change in the reaeration rate. A fifty-percent decrease in reaeration rate would lower the predicted dissolved oxygen profile by 1.5 mg/L. None of the other parameters analyzed were affected more than 0.5 mg/L.

PERMIT VARIANCES

Certain allowances can sometimes be made within the permitting process and still maintain the objectives of the allocation. These variances are subject to change if additional data or circumstances dictate such action.

A seasonal analysis indicates that a decrease in stream temperatures during the winter allows the treatment requirements of advanced treatment with nitrification to be less stringent from the months of September through March. Effluent limitations of 10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L dissolved oxygen may be relaxed to 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen. Effluent limitations of 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen may be relaxed to 20 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen. Effluent limitations of 20 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen may be relaxed to 20 mg/L BOD_5, 15 mg/L NH_3-N, and 2 mg/L dissolved oxygen. Effluent limitations of 20 mg/L BOD_5, 15 mg/L NH_3-N, and 3 mg/L dissolved oxygen may be relaxed to 20 mg/L BOD_5, 15 mg/L NH_3-N, and 2 mg/L dissolved oxygen. All other dischargers must remain at the projected water quality shown in Table 1.

CONCLUSIONS AND RECOMMENDATIONS

SUMMARY OF ANALYSIS

1. The Wichita River (Segment 0214) has been deemed desirable for contact recreation and high quality aquatic habitat.

2. Poor water quality in the Wichita River watershed has necessitated the development of a waste load evaluation for the Wichita River.

3. A water quality model (QUAL-TX) for the Wichita River was calibrated using data collected during the period of July 21-25, 1986.

4. The calibrated water quality model was verified using data collected during the period of April 6-9, 1981.

5. Using the calibrated/verified model, many treatment alternatives for the year 2005 were evaluated under critical (high-flow and high temperature) conditions.

6. All BOD_5 concentrations expressed in the Conclusions and Recommendations of this Waste Load Evaluation can be measured by the TCMP nitrogen-suppressed, 5-day biochemical oxygen demand procedure ($CBOD_5$).

7. An effluent set of 10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L dissolved oxygen during critical conditions is required for the City of Wichita Falls-River Road wastewater treatment plant to maintain the 5 mg/L dissolved oxygen criterion of the Wichita River (Segment 0214) using year 2005 projected wastewater flow.

8. An effluent set of 10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L dissolved oxygen during critical conditions is required for the U.S. Department of the Air Force-Sheppard A.F.B. wastewater treatment plant to maintain the 5 mg/L dissolved oxygen criterion of the Wichita River (Segment 0214) using year 2005 projected wastewater flow.

9. An effluent set of 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen during critical conditions is required for the City of Wichita Falls-Northside wastewater treatment plant to maintain the 5 mg/L dissolved oxygen criterion of the Wichita River (Segment 0214) using year 2005 projected wastewater flow.

10. An effluent set of 20 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen during critical conditions is required for the City of Iowa Park wastewater treatment plant to maintain the 3 mg/L dissolved oxygen criterion of non-designated tributaries using year 2005 projected wastewater flow.

11. An effluent set of 20 mg/L BOD_5, 15 mg/L NH_3-N, and 3 mg/L dissolved oxygen during critical conditions is required for the Community of Crowell wastewater treatment plant to maintain the 3 mg/L dissolved oxygen criterion of non-designated tributaries using year 2005 projected wastewater flow.

12. The effects of discharges with respect to the growth of algae and aquatic plants, possible impacts on groundwater or shallow wells, and operations resulting in permit non-compliance were not evaluated in the waste load evaluation process.

13. Seasonal analysis indicates that effluent treatment levels may be relaxed for the months of October through March, except for Sheppard A.F.B. which may relax treatment levels for the months of November through March.

RECOMMENDATIONS

1. The City of Wichita Falls-River Road wastewater treatment plant must achieve water quality concentrations of 10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L dissolved oxygen.

2. Sheppard A.F.B. wastewater treatment plant must achieve water quality concentrations of 10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L dissolved oxygen.

3. The City of Wichita Falls-Northside wastewater treatment plant must achieve water quality concentrations of 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen.

4. The City of Iowa Park wastewater treatment plant must achieve water quality concentrations of 20 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen.

5. The Community of Crowell wastewater treatment plant must achieve water quality concentrations of 20 mg/L BOD_5, 15 mg/L NH_3-N, and 3 mg/L dissolved oxygen.

6. All other domestic dischargers must achieve water quality concentrations consistent with their existing permitted effluent limitations.

7. Any changes to existing domestic permits or any new domestic permits must require a minimum of secondary treatment and will be considered on a case-by-case basis.

8. All industrial dischargers should be limited to their final permitted values. Any changes to existing industrial permits or any new industrial permits must be commensurate with those of domestic wastewater dischargers and will be considered on a case-by-case basis.

9. If the final effluent limitations in existing permits are more stringent than those recommended, then the final limitations shall remain in force.

10. New effluent limitations as recommended in this waste load evaluation shall be complied with no later than July 1, 1992 regardless of the availability of state and/or federal funds.

11. All existing permits should be amended to reflect the recommended effluent limitations and to include compliance schedules for meeting those limitations as soon as is determined practicable and feasible by the Texas Water Commission.

12. Possible effects of discharges related to growth of algae and aquatic plants, impacts on groundwater or shallow wells, or operations resulting in permit non-compliance shall be considered on a case-by-case basis.

13. Regionalization of facilities is strongly encouraged to take advantage of economies of scale and improved operation and maintenance opportunities at larger facilities.

14. Monitoring of both growth and water quality conditions in the Wichita River watershed must continue to ensure the protection of water quality in the Wichita River.

15. As appropriate, continued revision of this document should be anticipated as water quality or pollutant loadings so indicate. Existing uses, which have been identified and attained, must be maintained in accordance with existing statutes.

16. Effluent limitations of 10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L dissolved oxygen for the U.S. Department of the Air Force-Sheppard A.F.B. wastewater treatment plant may be relaxed to 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen for the months of November through March.

17. Effluent limitations of 10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L dissolved oxygen for the City of Wichita Falls-River Road wastewater treatment plant may be relaxed to 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen for the months of October through March.

18. Effluent limitations of 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen may be relaxed to 20 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen for the months of October through March.

19. Effluent limitations of 20 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L dissolved oxygen may be relaxed to 20 mg/L BOD_5, 15 mg/L NH_3-N, and 2 mg/L dissolved oxygen for the months of October through March.

20. Effluent limitations of 20 mg/L BOD_5, 15 mg/L NH_3-N, and 3 mg/L dissolved oxygen may be relaxed to 20 mg/L BOD_5, 15 mg/L NH_3-N, and 2 mg/L dissolved oxygen for the months of October through March.

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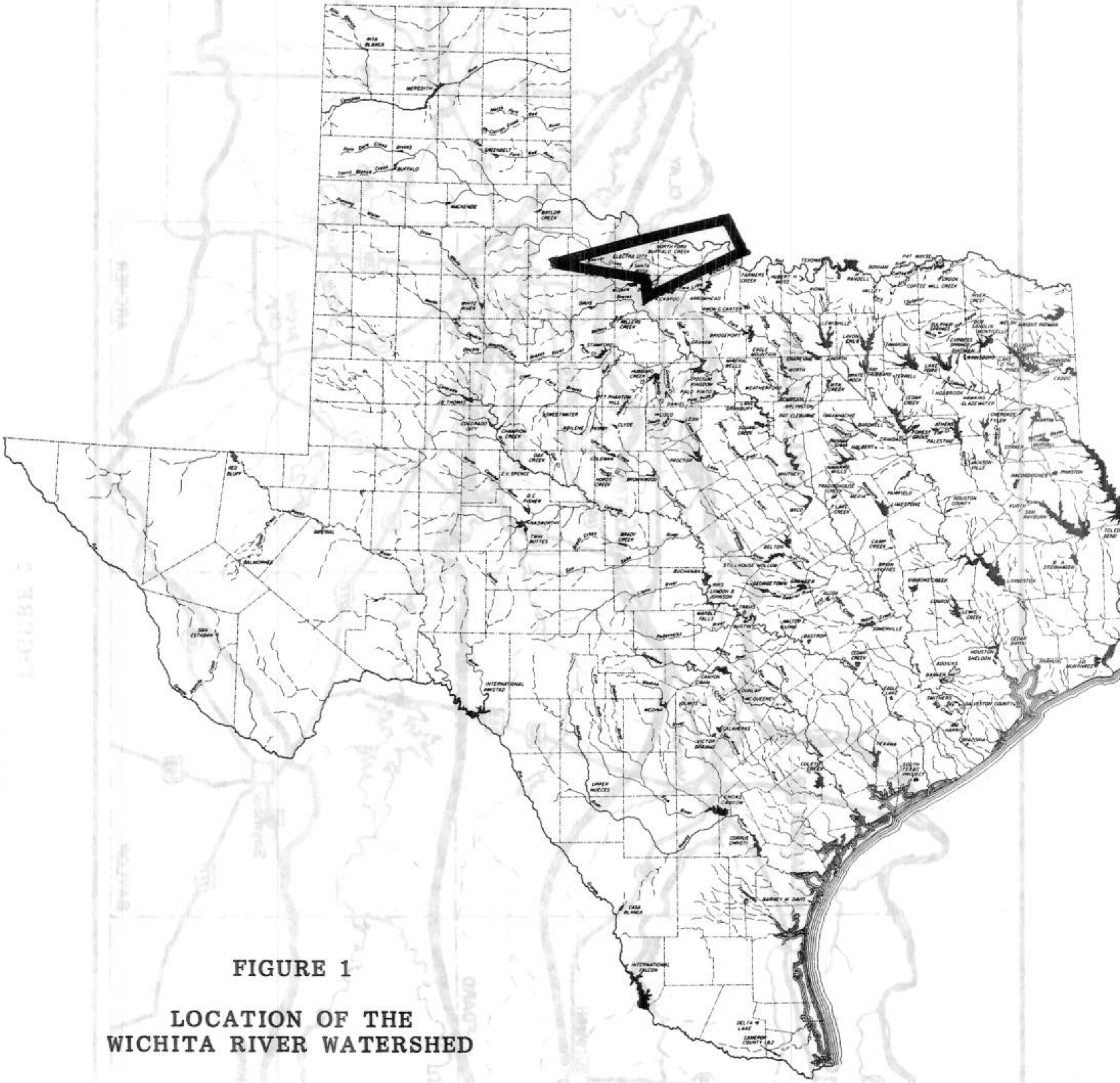

FIGURE 1

LOCATION OF THE WICHITA RIVER WATERSHED

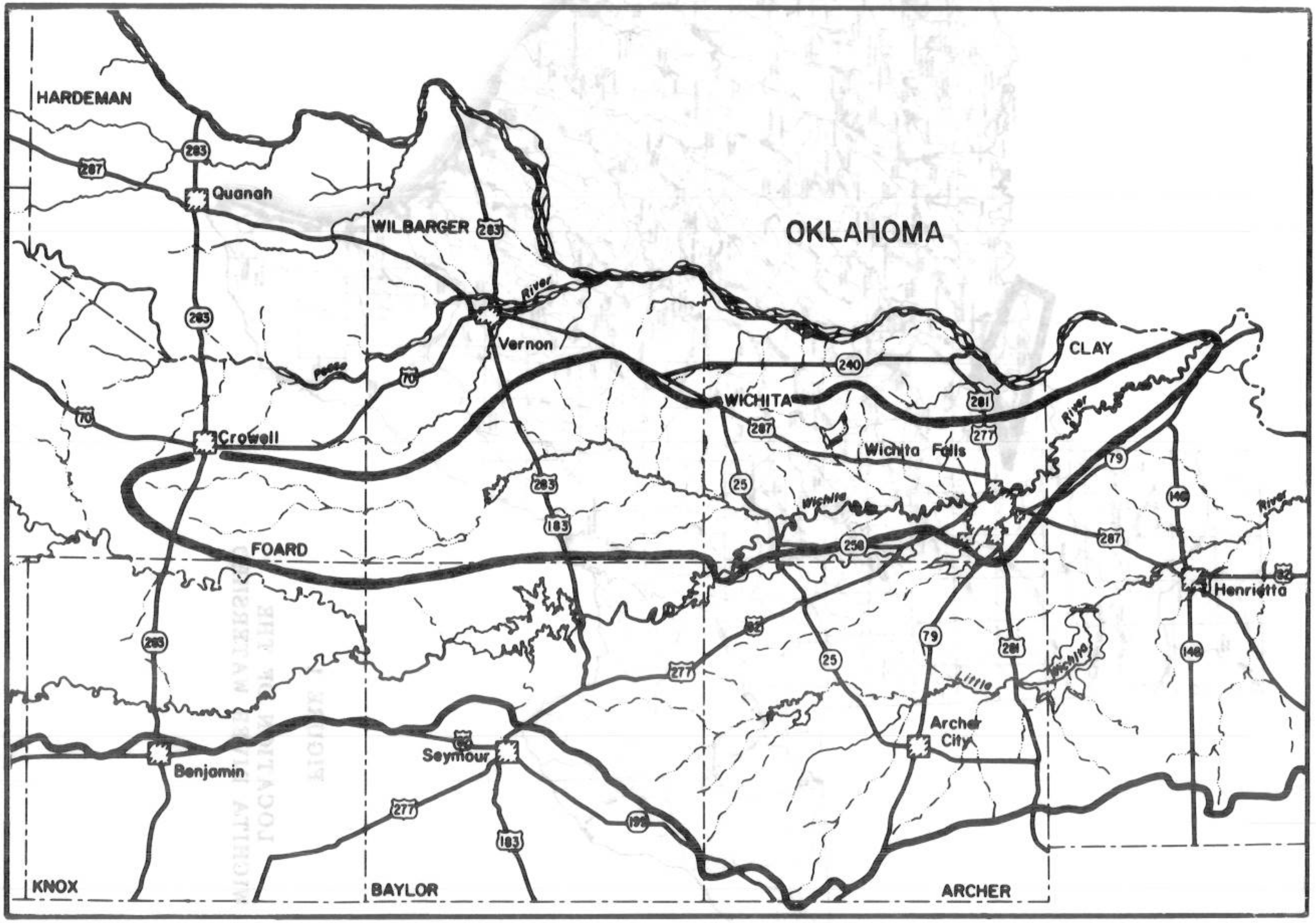

FIGURE 2

EXTENT OF THE WICHITA RIVER WATERSHED

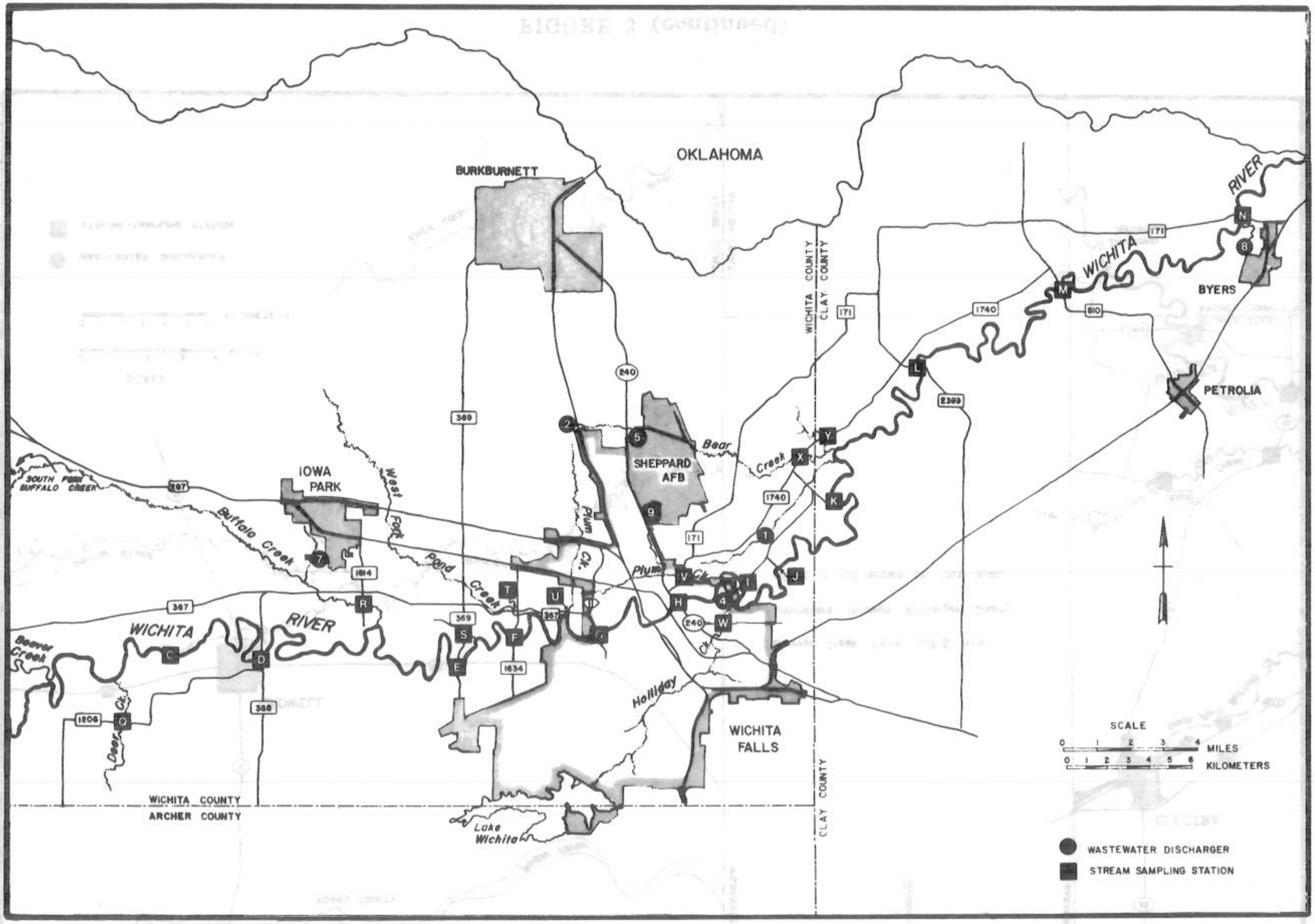

FIGURE 3

LOCATION OF STREAM STATIONS AND WASTEWATER DISCHARGERS TO THE WICHITA RIVER

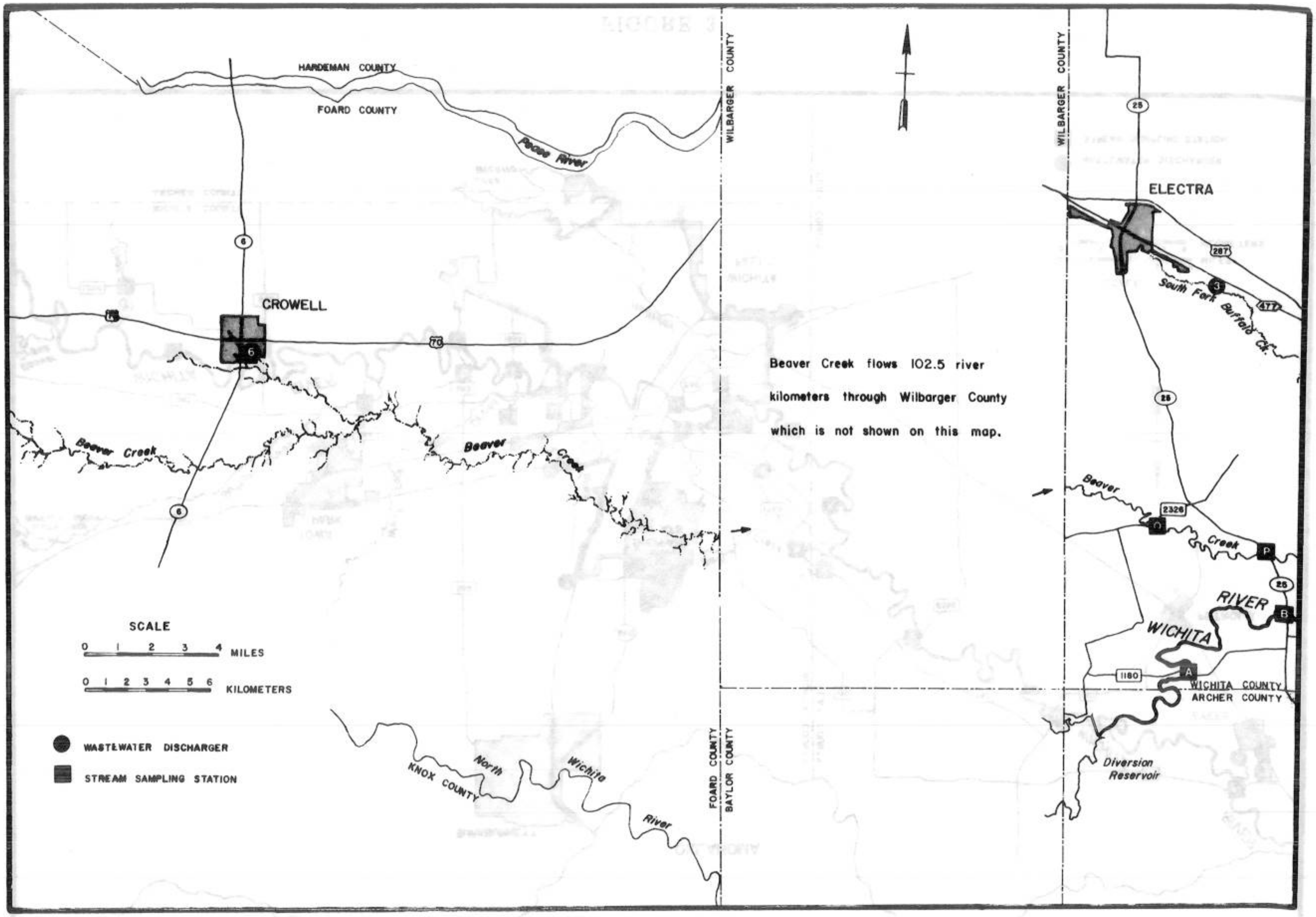

FIGURE 3 (continued)

MAP LEGEND

Stream Stations (Wichita River)

A Wichita River at FM 1180 (Km 176.3)

B Wichita River at SH 25 (Km 155.9)

C Wichita River at River Kilometer 139.0 (Km 139.0)

D Wichita River at FM 368 (Km 128.2)

E Wichita River at FM 369 (Km 106.1)

F Wichita River at FM 1634 (Km 100.1)

G Wichita River at SH Loop 11 (Km 92.1)

H Wichita River at SH 240 (Km 85.9)

I Wichita River at River Road (Km 79.8)

J Wichita River at Eastland Lane (Km 73.7)

K Wichita River at Krajca Lane (Km 63.2)

L Wichita River at FM 2393 (Km 48.6)

M Wichita River at FM 810 (Km 28.1)

N Wichita River at FM 171 (Km 6.5)

Stream Stations (Tributaries)

O Beaver Creek at FM 2326 (Km 16.5)

P Beaver Creek at SH 25 (Km 6.8)

Q Deer Creek at FM 1206 (Km 3.0)

R Buffalo Creek at FM 1814 (Km 1.8)

S Unnamed tributary at FM 369 (Km 0.7)

FIGURE 3 (continued)

T West Fork Pond Creek at FM 367 (Km 0.9)

U Plum Creek at FM 367 (Km 0.2)

V Plum Creek at FM 171 (Km 1.9)

W Holliday Creek at Harding Street (Km 1.3)

X Bear Creek at FM 1740 (Km 2.8)

Y Unnamed tributary at FM 1740 (Km 0.8)

Continuous Dischargers (Segment 0214)

1 Styles, Ray (01283.001)

2 PPG Industries (01863.001)

3 City of Electra (10020.001)

4 City of Wichita Falls-River Road (10509.001)

5 City of Wichita Falls-Northside (10509.005)

6 City of Crowell (10638.001)

7 City of Iowa Park (10691.002)

8 City of Byers (10890.001)

9 U.S. Department of Air Force-Sheppard A.F.B. (12511.001)

FIGURE 3 (continued)

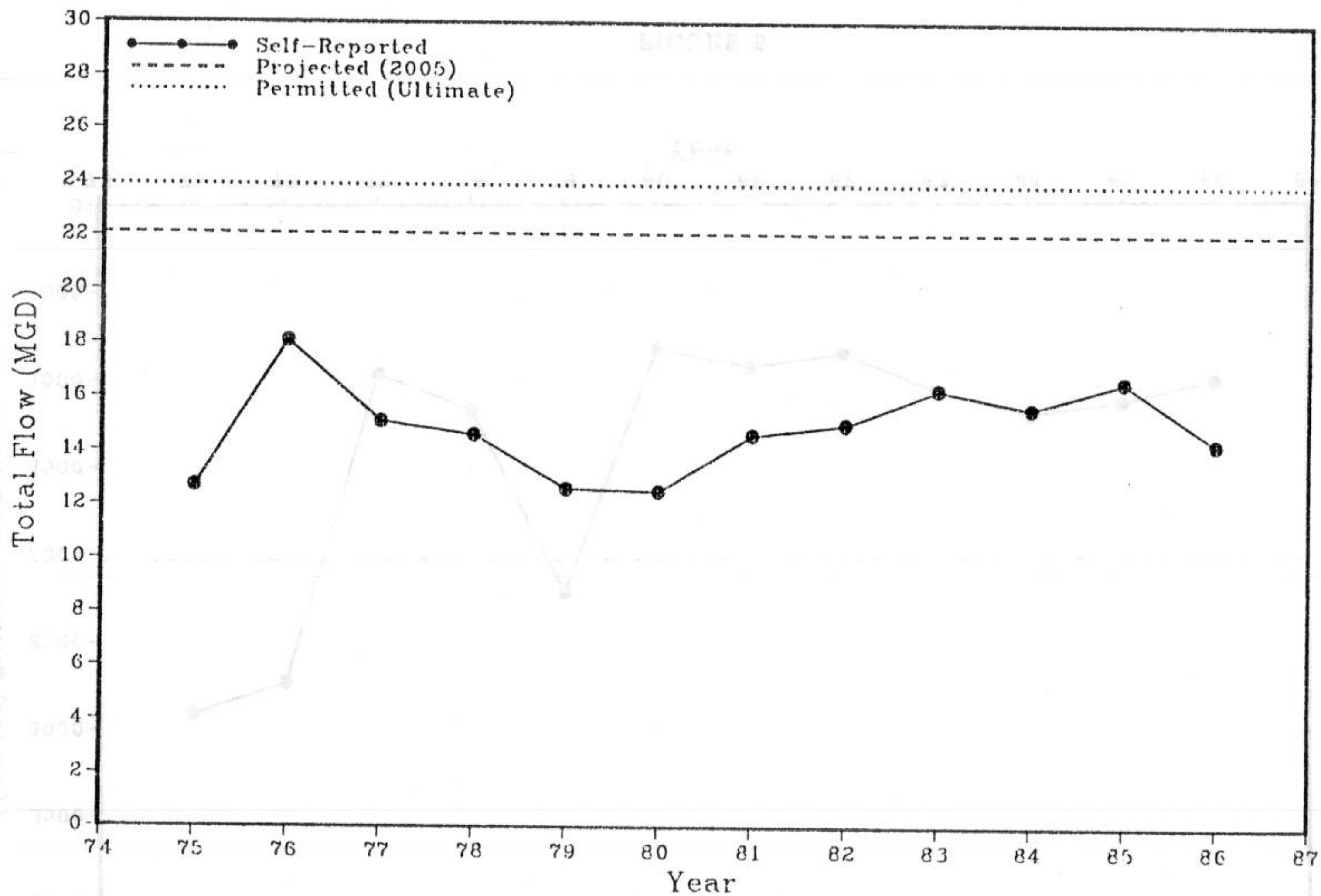

FIGURE 4

HISTORICAL TOTAL WASTEWATER FLOWS TO THE WICHITA RIVER

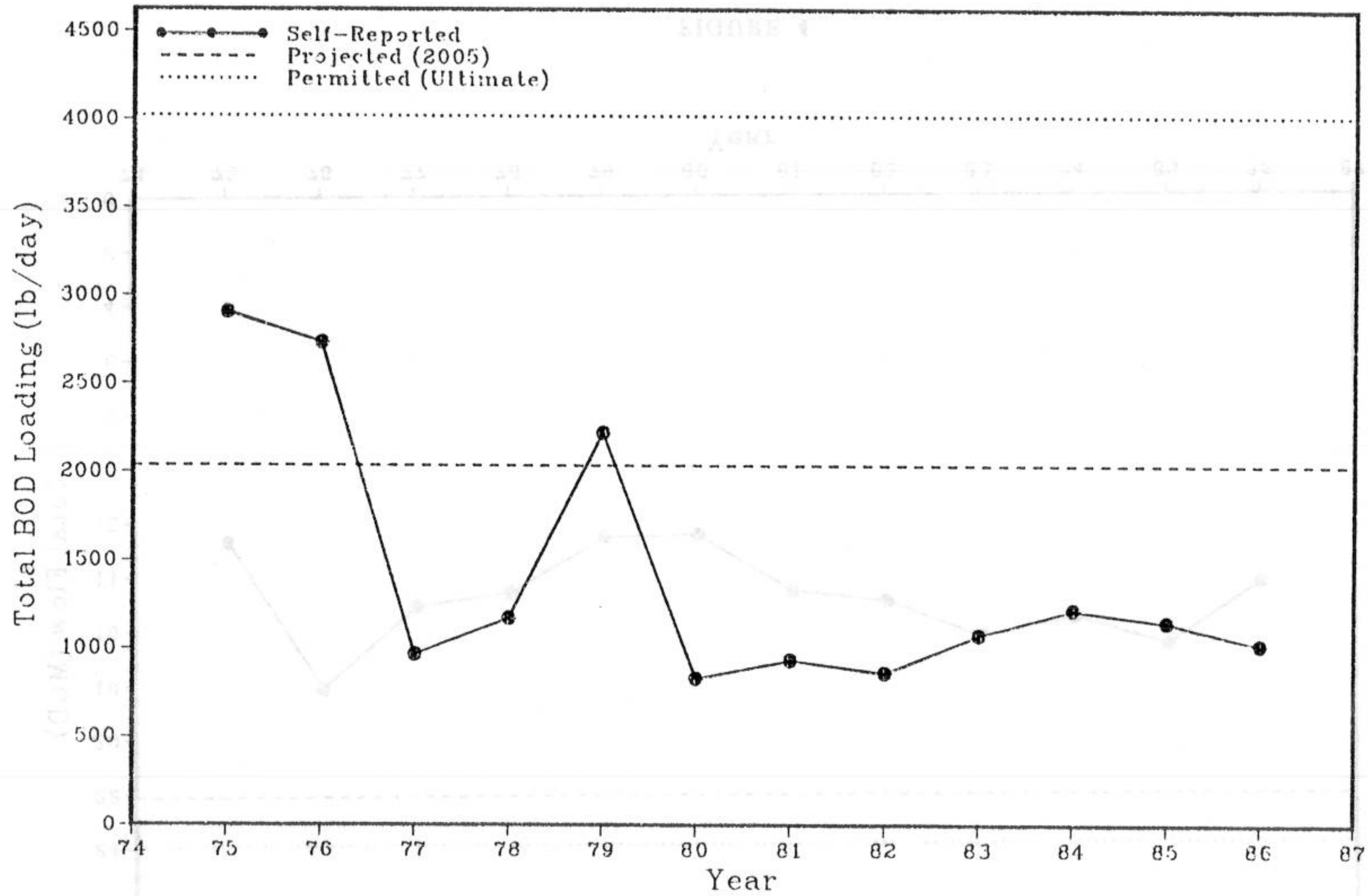

FIGURE 5

HISTORICAL TOTAL BOD_5 LOADING TO THE WICHITA RIVER

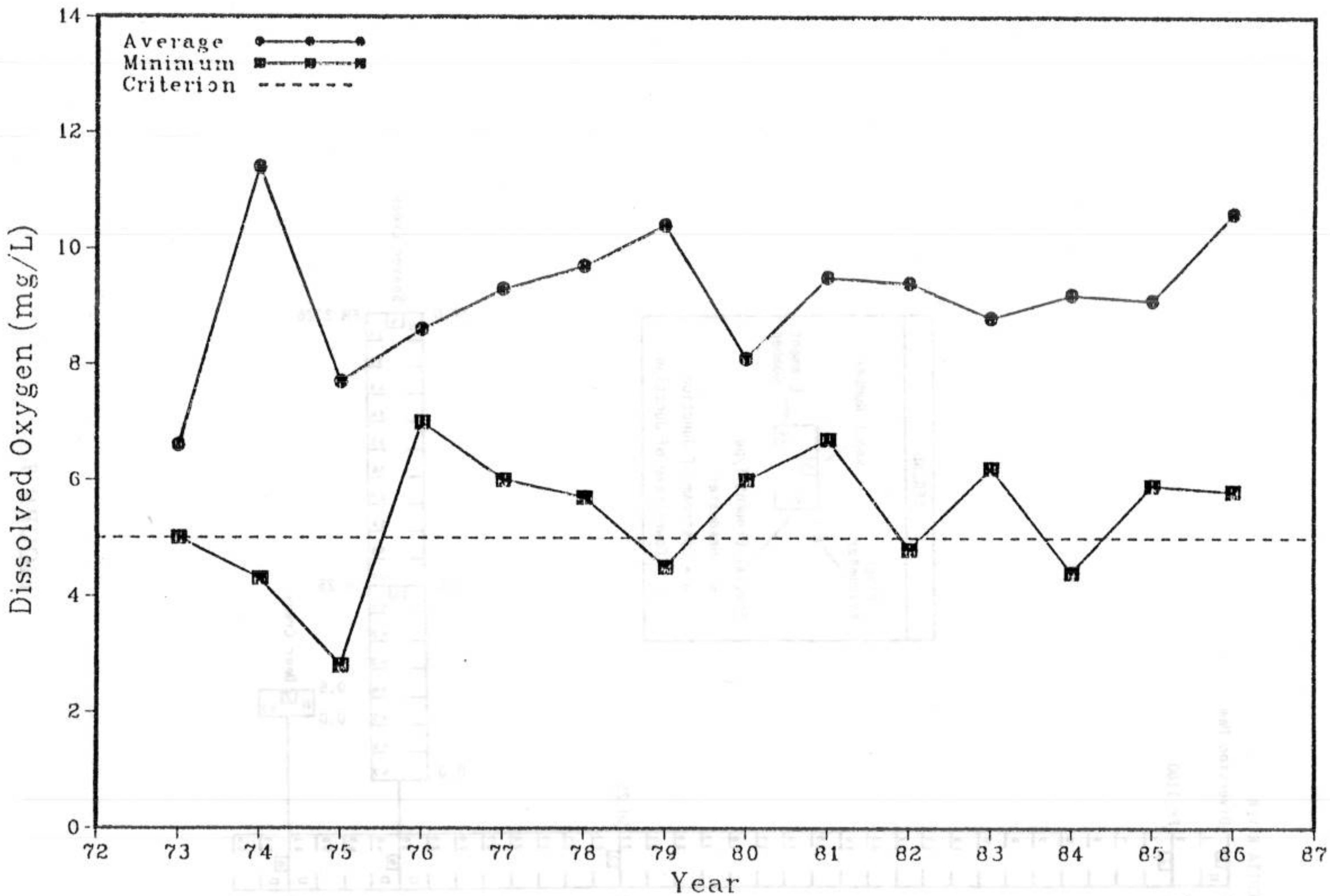

FIGURE 6

HISTORICAL DISSOLVED OXYGEN TREND IN THE WICHITA RIVER
SMN Station 0214.0100 at FM 810, West of Byers

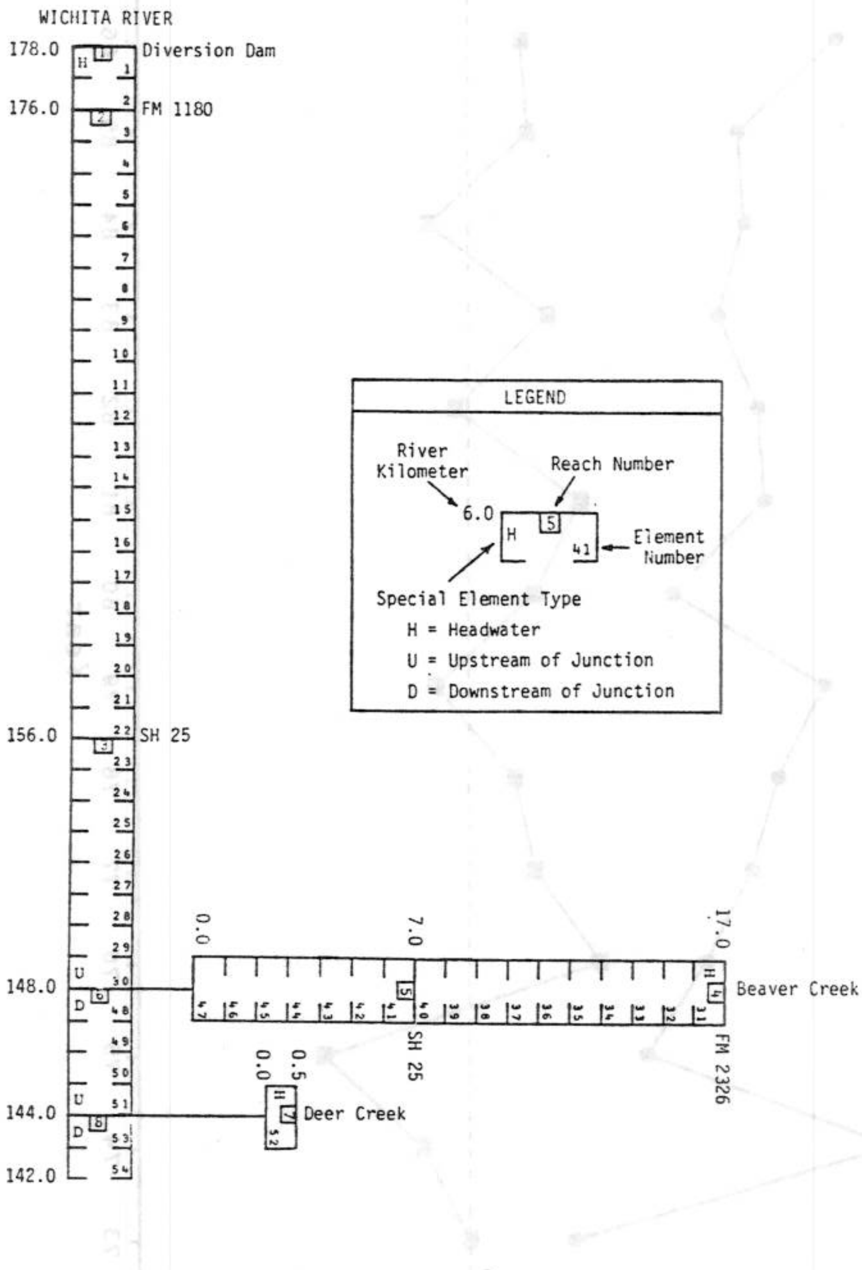

FIGURE 7

MODEL SCHEMATIC OF THE WICHITA RIVER

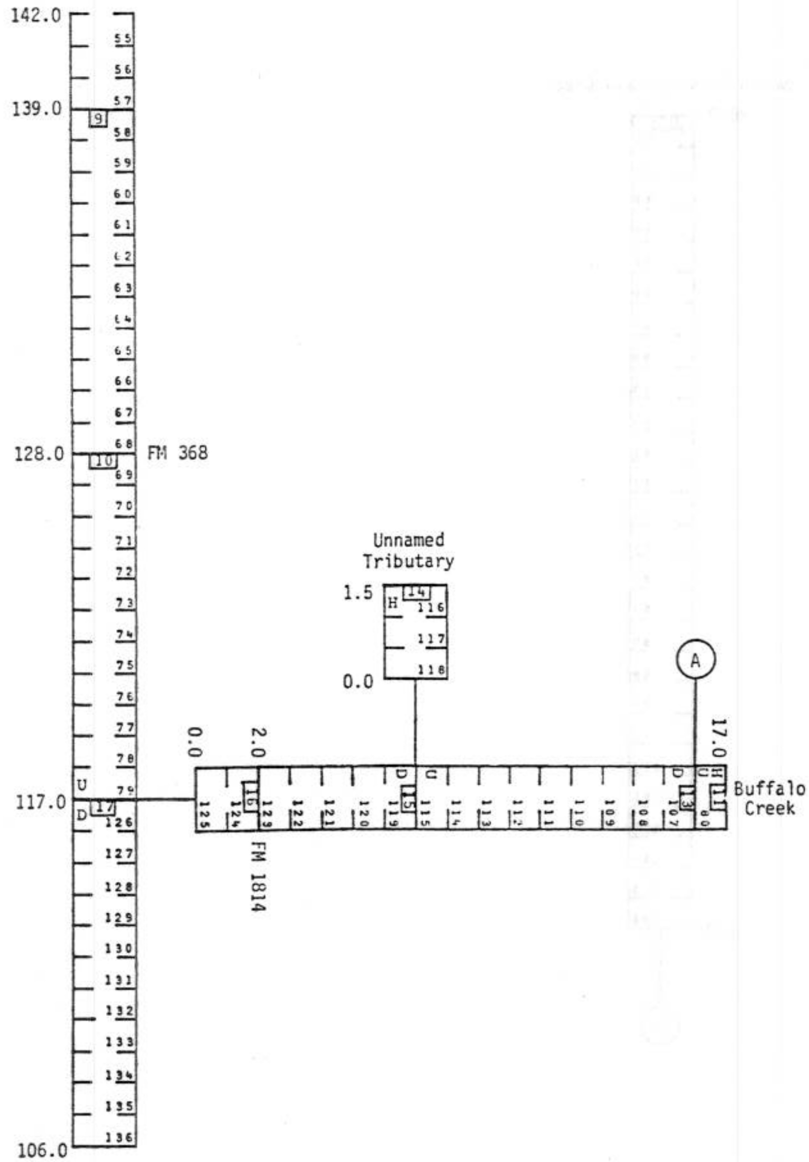

FIGURE 7 (continued)

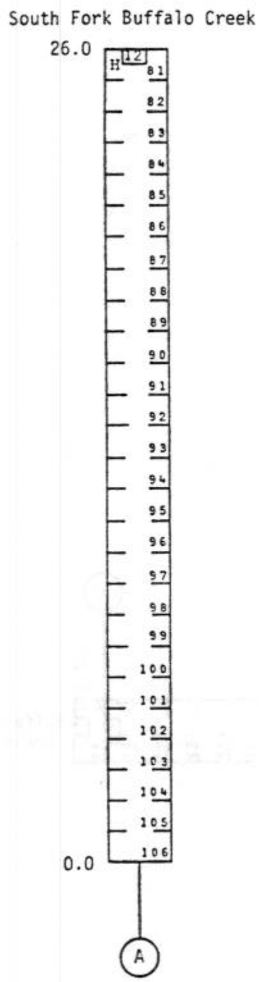

FIGURE 7 (continued)

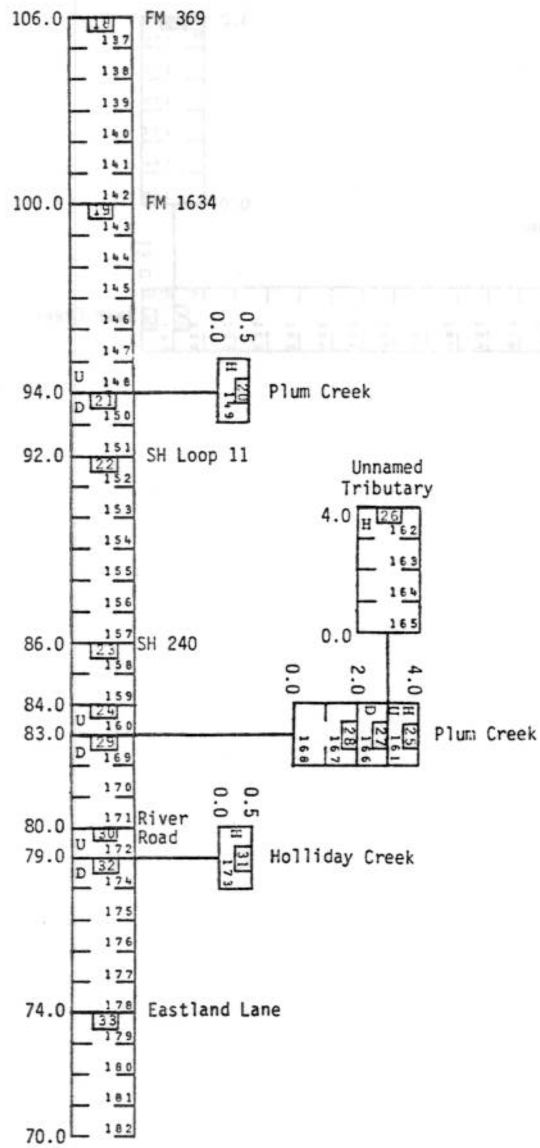

FIGURE 7 (continued)

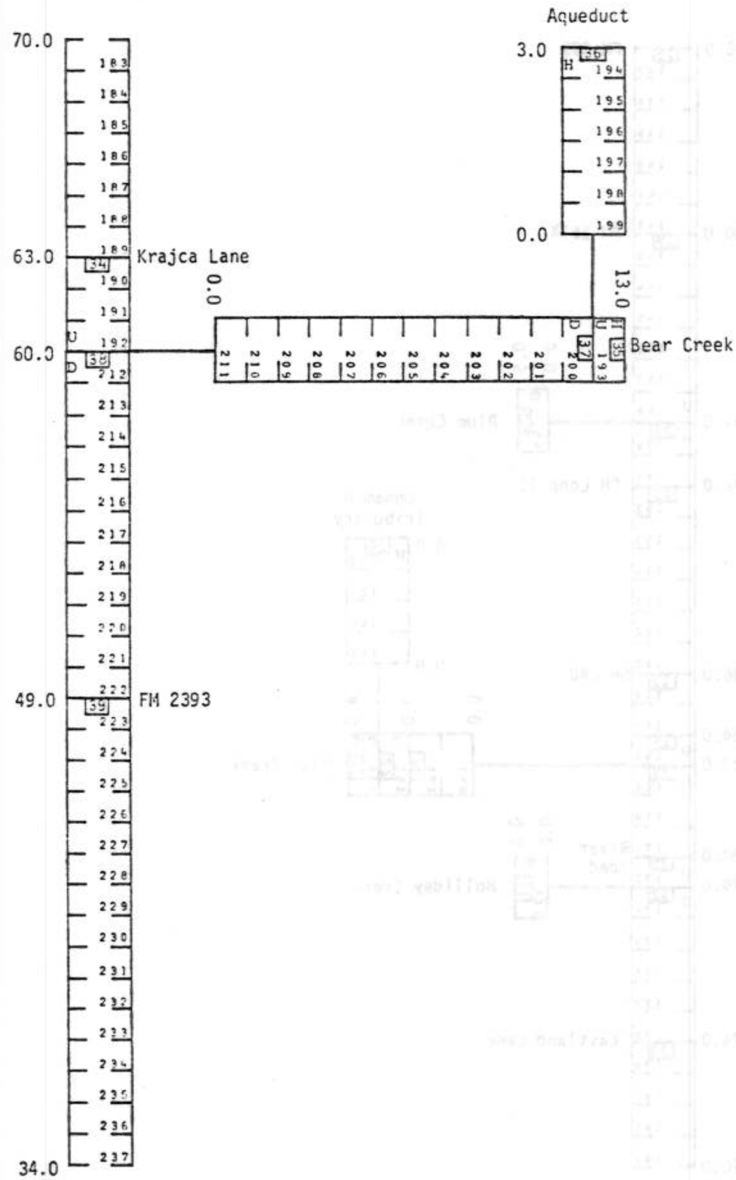

FIGURE 7 (continued)

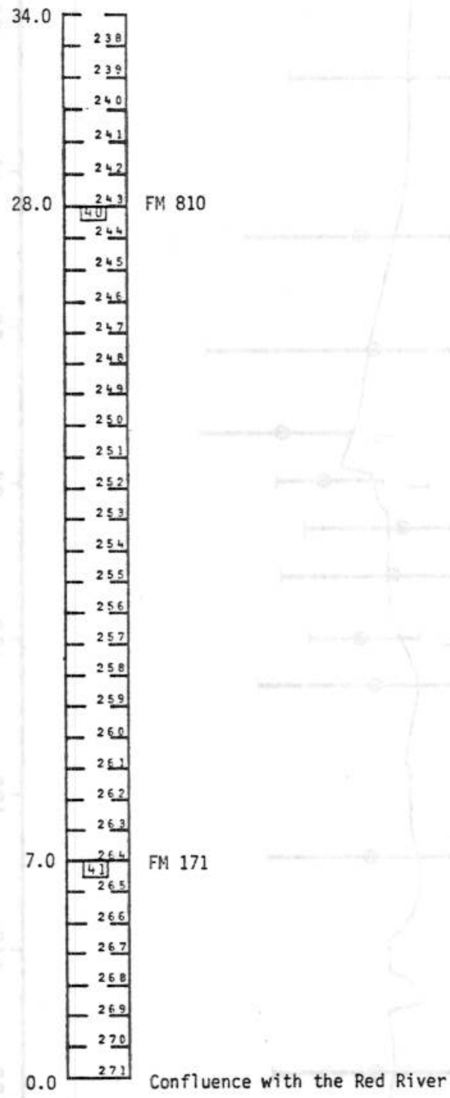

FIGURE 7 (continued)

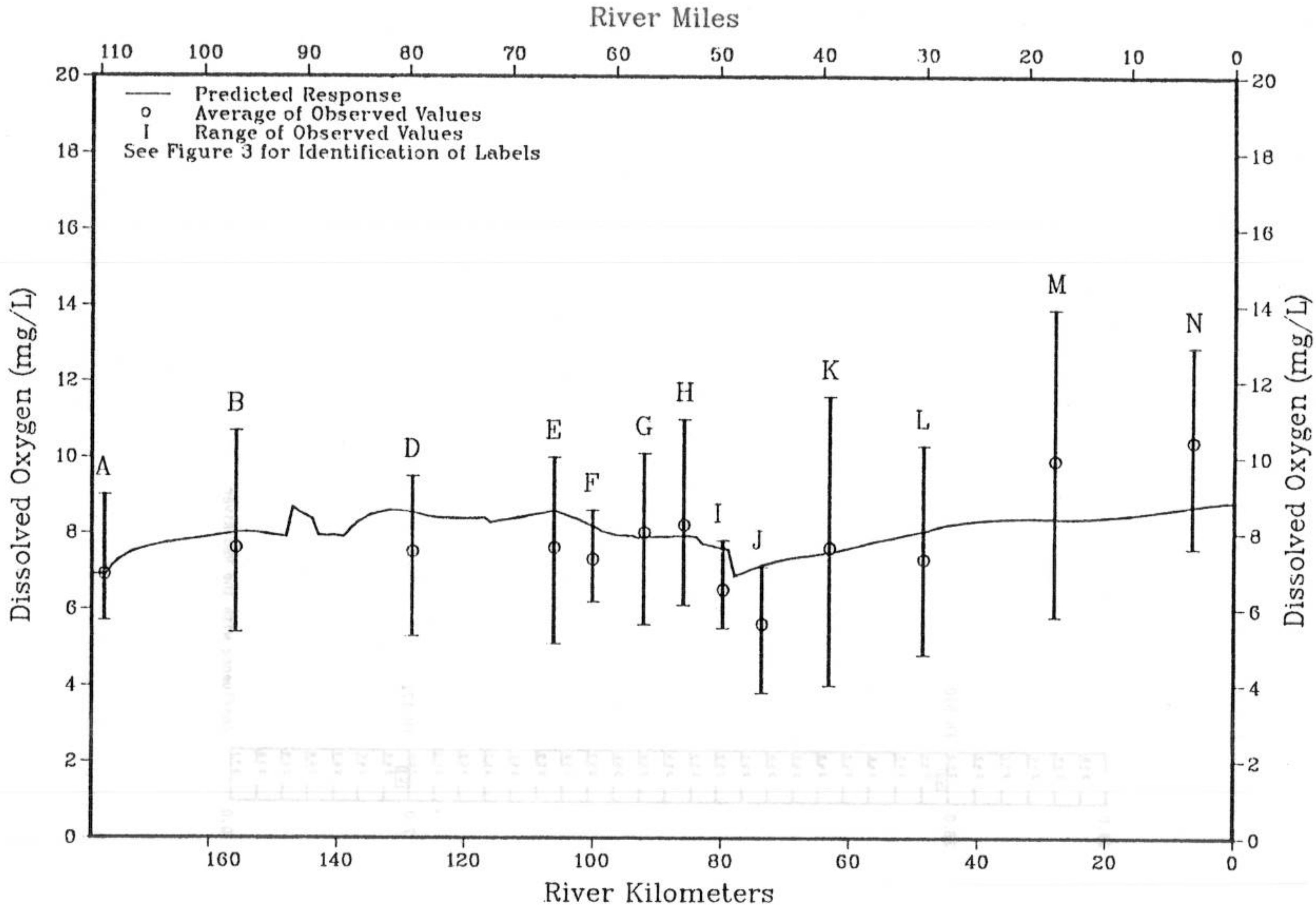

FIGURE 8

WICHITA RIVER CALIBRATION PLOT FOR DISSOLVED OXYGEN
July 21, 1986 Data

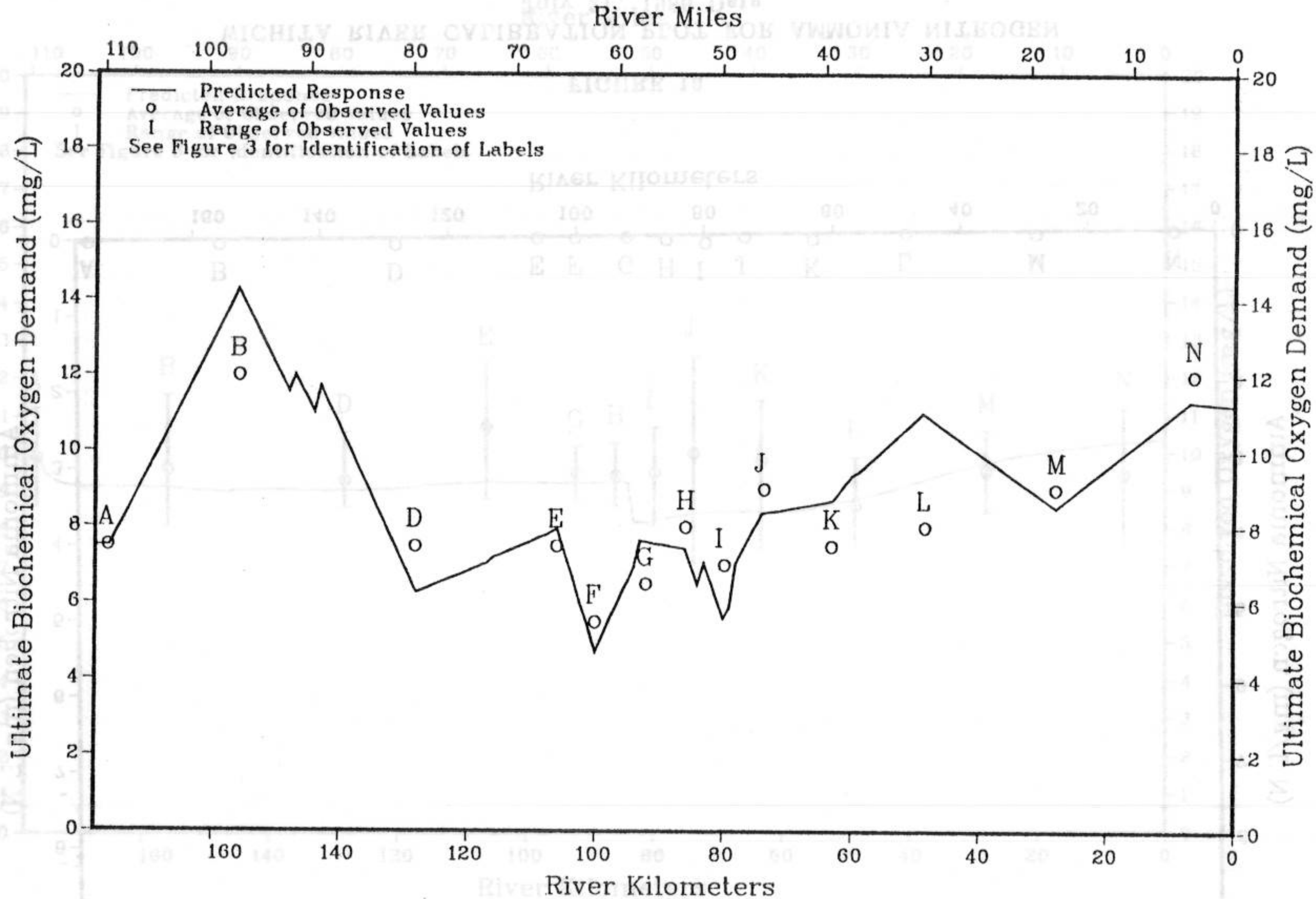

FIGURE 9

WICHITA RIVER CALIBRATION PLOT FOR ULTIMATE BOD
July 21, 1986 Data

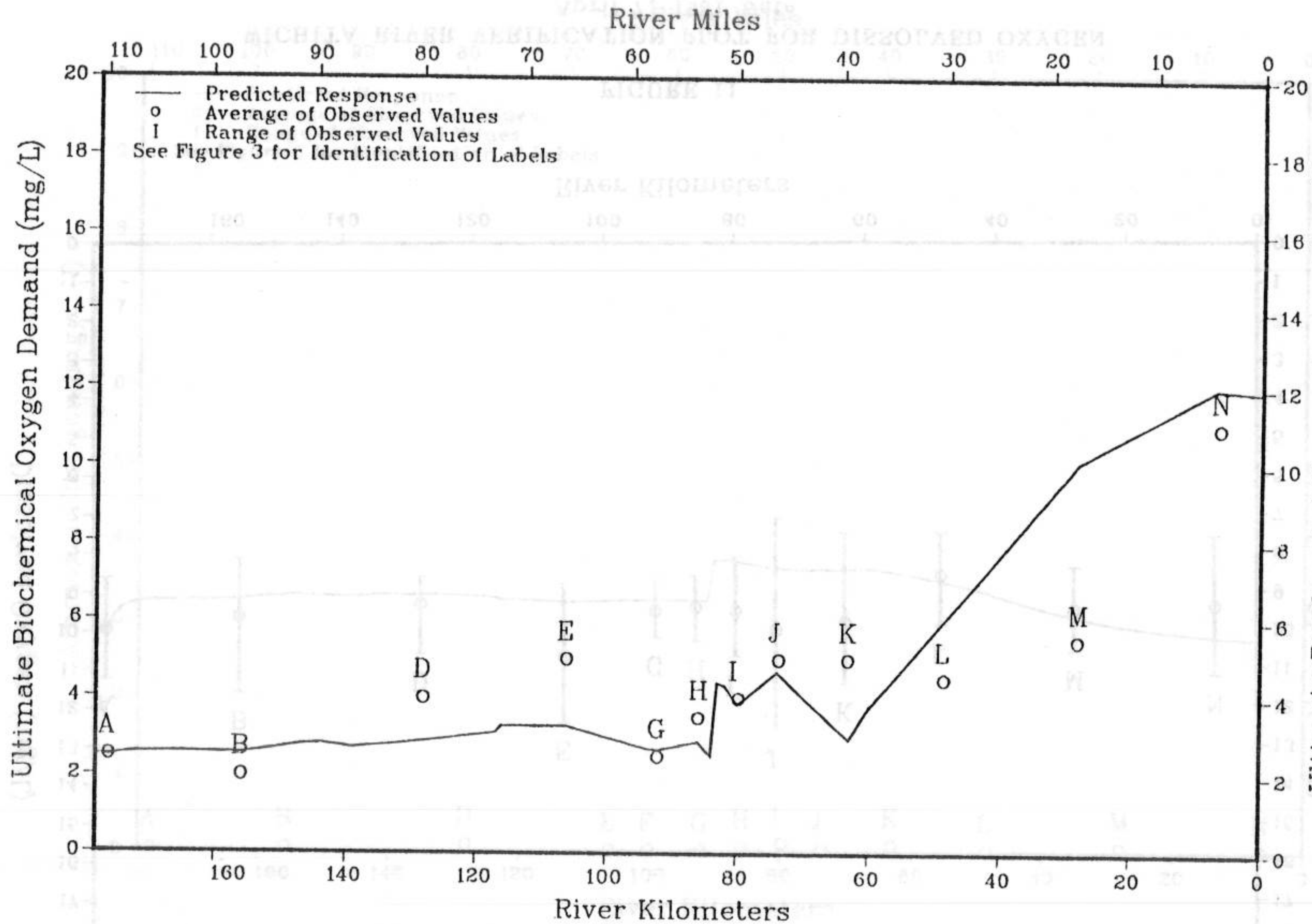

FIGURE 12

WICHITA RIVER VERIFICATION PLOT FOR ULTIMATE BOD
April 7, 1981 Data

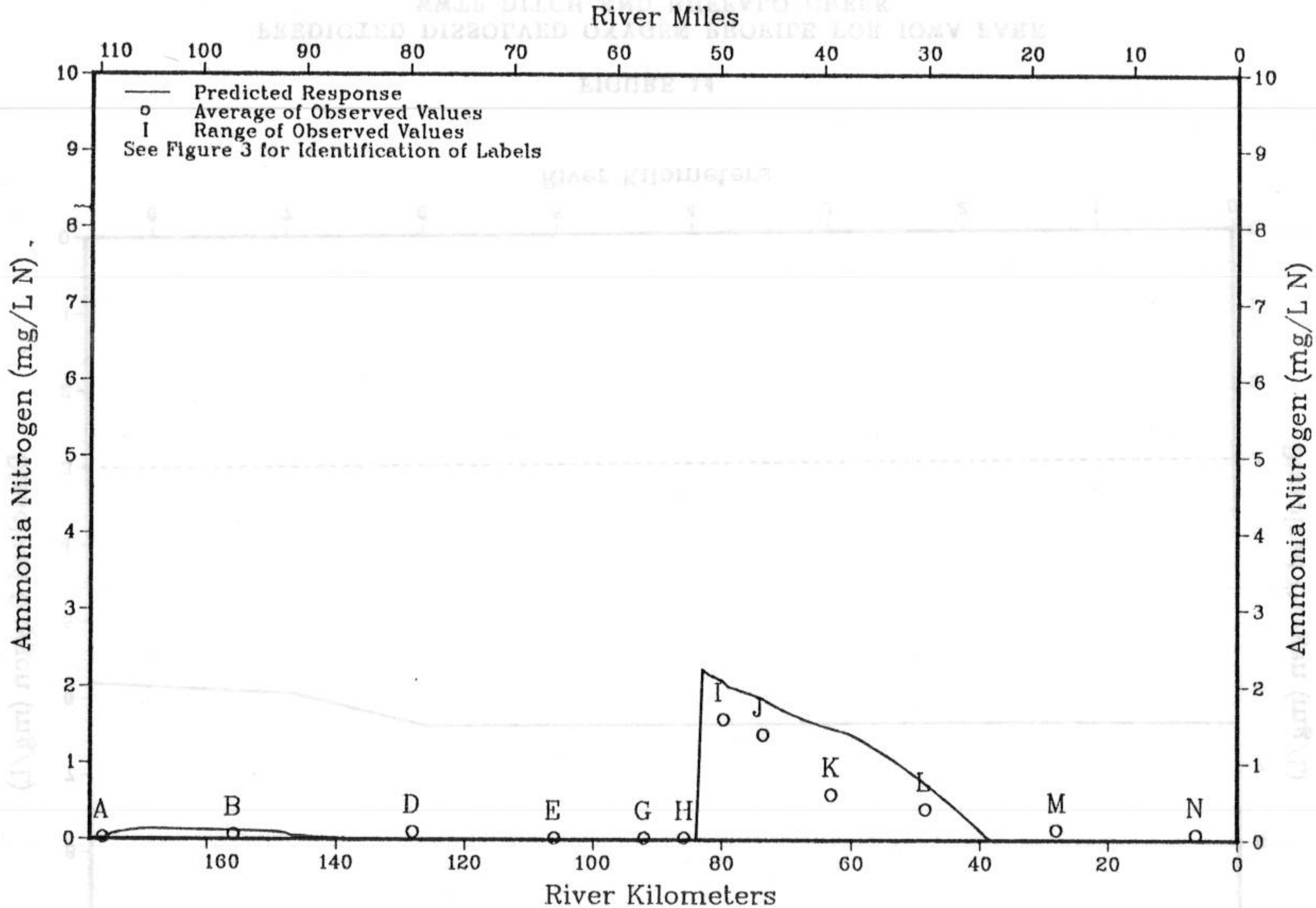

FIGURE 13

WICHITA RIVER VERIFICATION PLOT FOR AMMONIA NITROGEN
April 7, 1981 Data

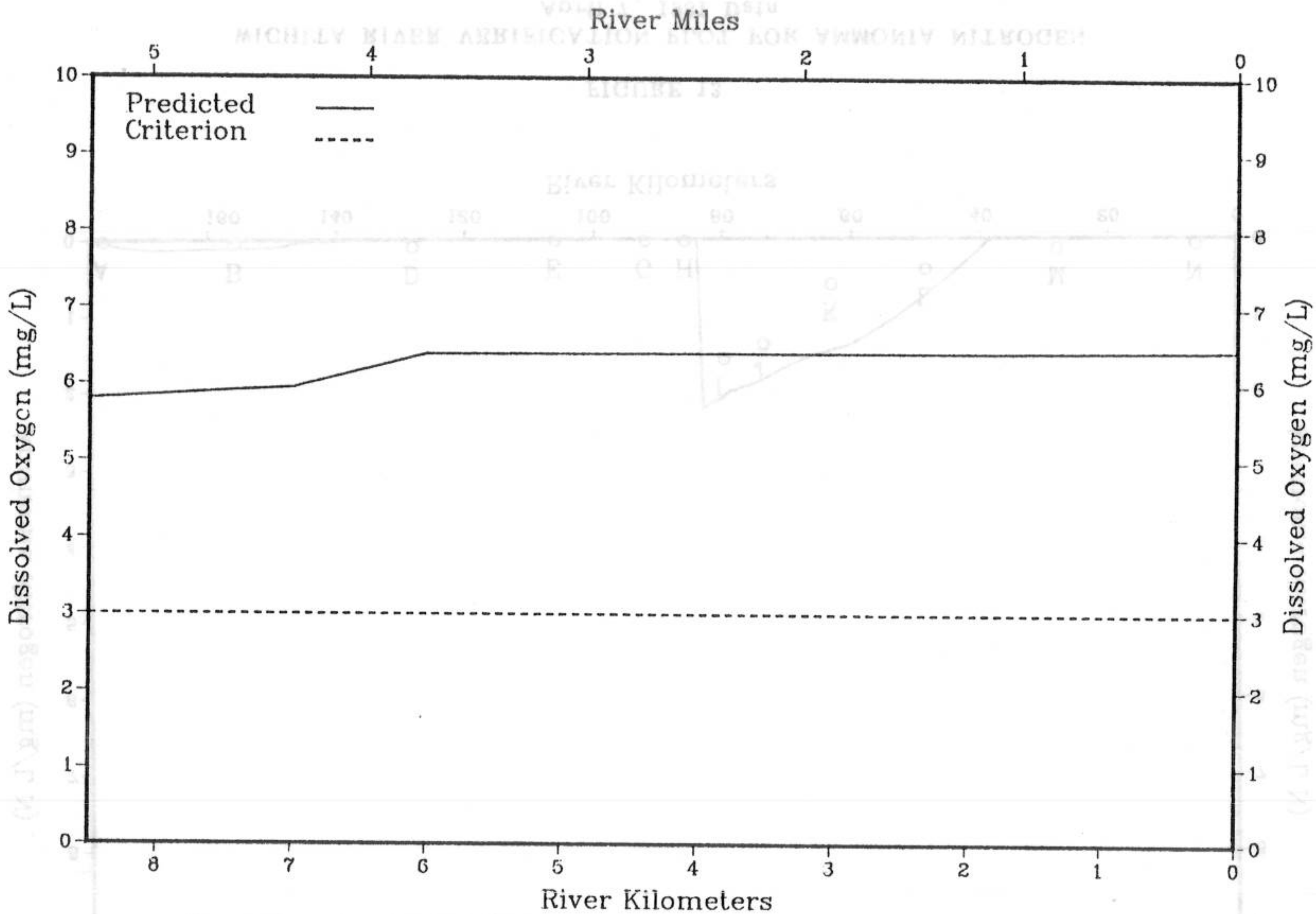

FIGURE 14

PREDICTED DISSOLVED OXYGEN PROFILE FOR IOWA PARK WWTP DITCH AND BUFFALO CREEK
No Waste Loads

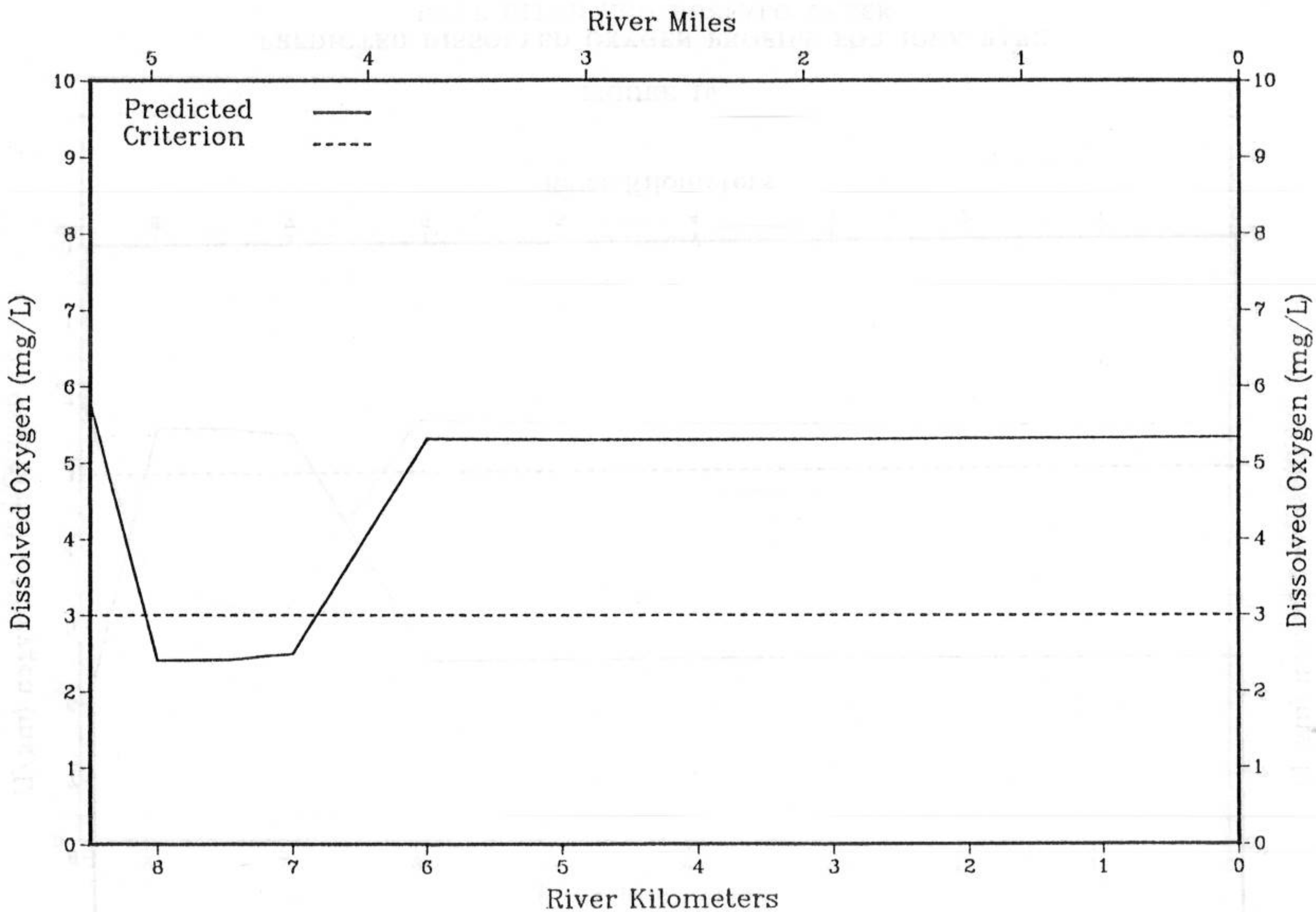

FIGURE 15

PREDICTED DISSOLVED OXYGEN PROFILE FOR IOWA PARK WWTP DITCH AND BUFFALO CREEK
Ultimate Permitted Flows with Ultimate Permitted Effluent Limitations

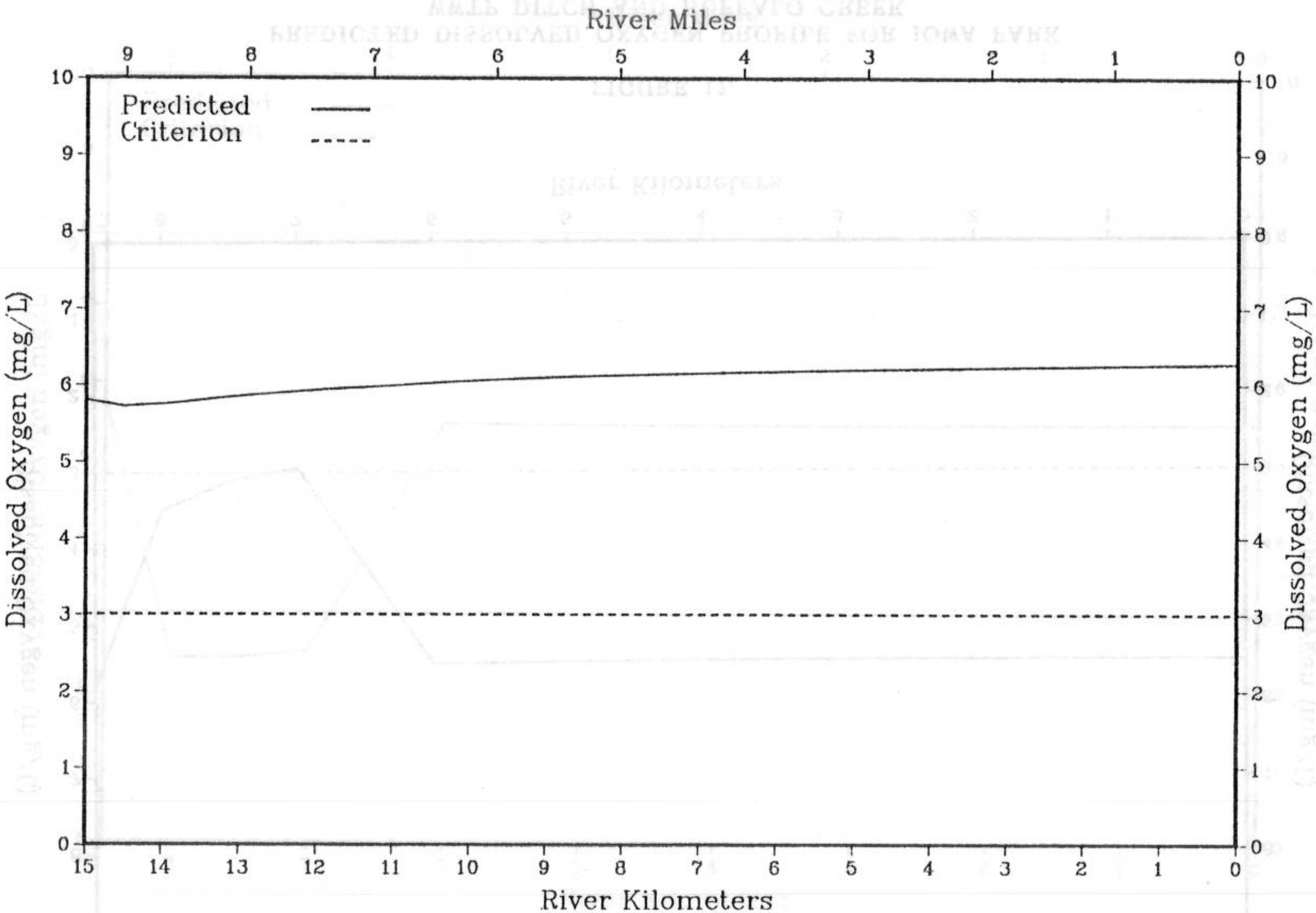

FIGURE 18

PREDICTED DISSOLVED OXYGEN PROFILE FOR
WICHITA FALLS-NORTHSIDE WWTP DITCH AND BEAR CREEK
No Waste Loads

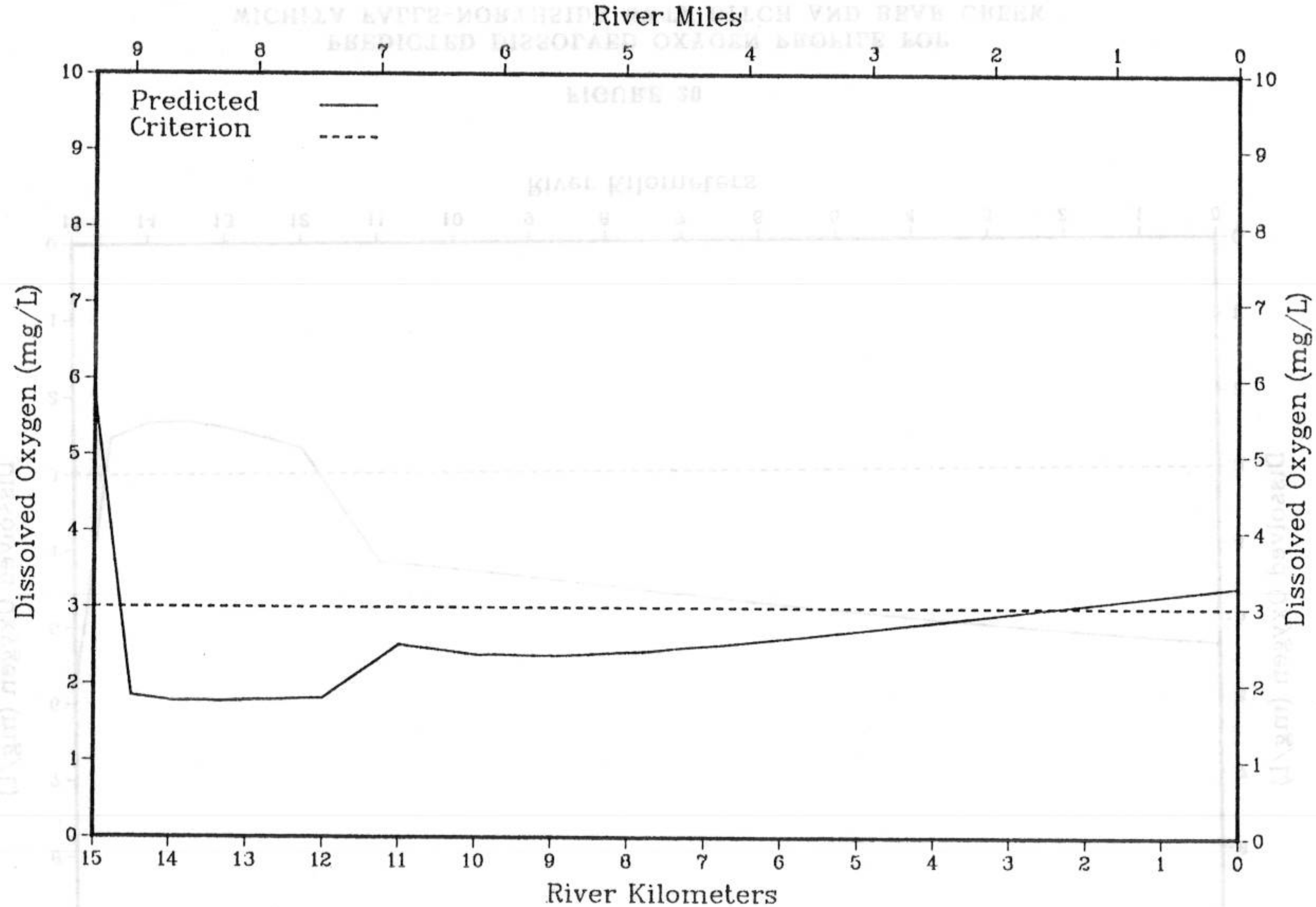

FIGURE 19

PREDICTED DISSOLVED OXYGEN PROFILE FOR
WICHITA FALLS-NORTHSIDE WWTP DITCH AND BEAR CREEK
Ultimate Permitted Flows with Ultimate Permitted Effluent Limitations

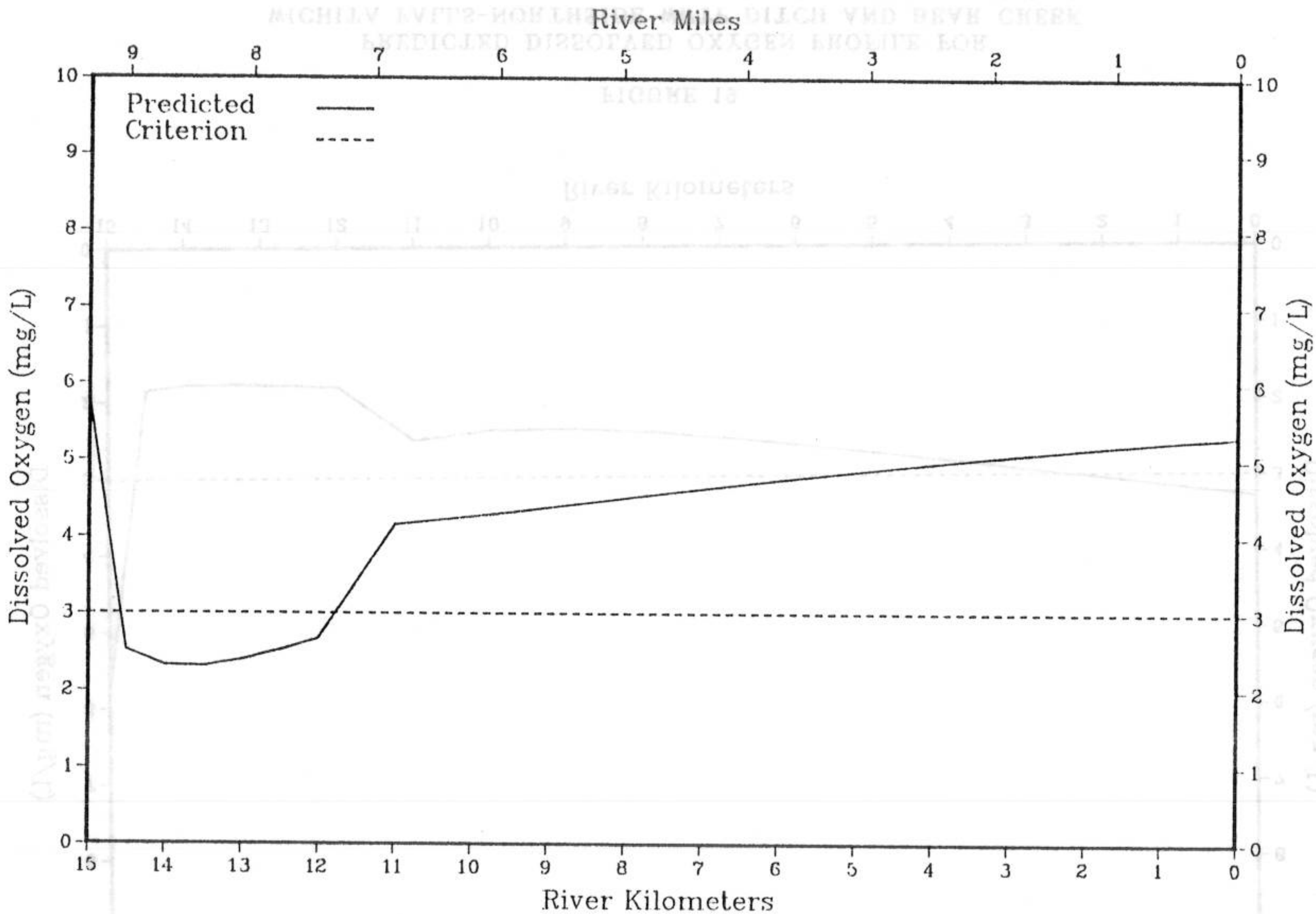

FIGURE 20

PREDICTED DISSOLVED OXYGEN PROFILE FOR
WICHITA FALLS-NORTHSIDE WWTP DITCH AND BEAR CREEK
2005 Projected Flows with 20 mg/L BOD_5, 15 mg/L NH_3-N, and 2 mg/L DO

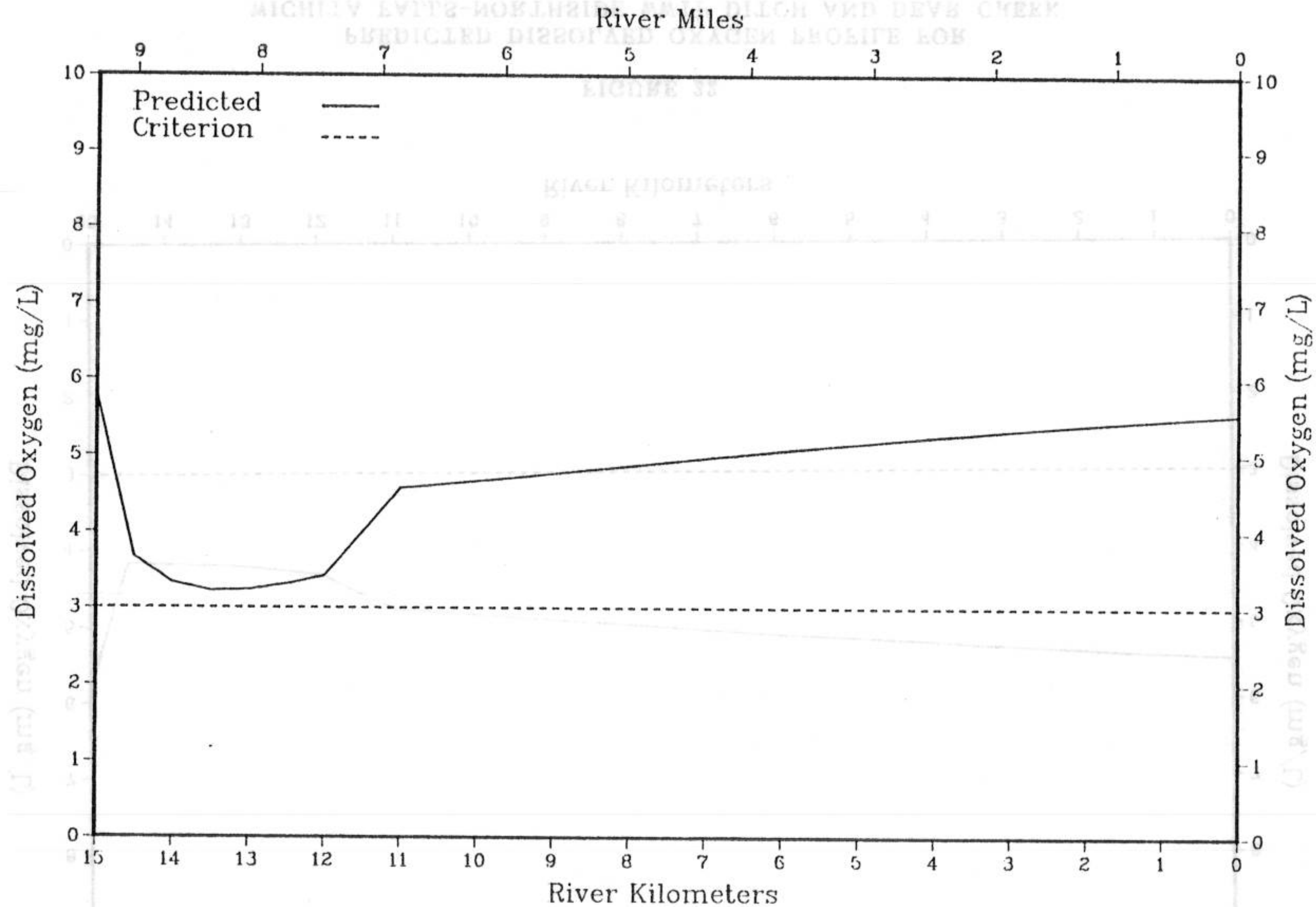

FIGURE 21

PREDICTED DISSOLVED OXYGEN PROFILE FOR
WICHITA FALLS-NORTHSIDE WWTP DITCH AND BEAR CREEK
2005 Projected Flows with 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L DO

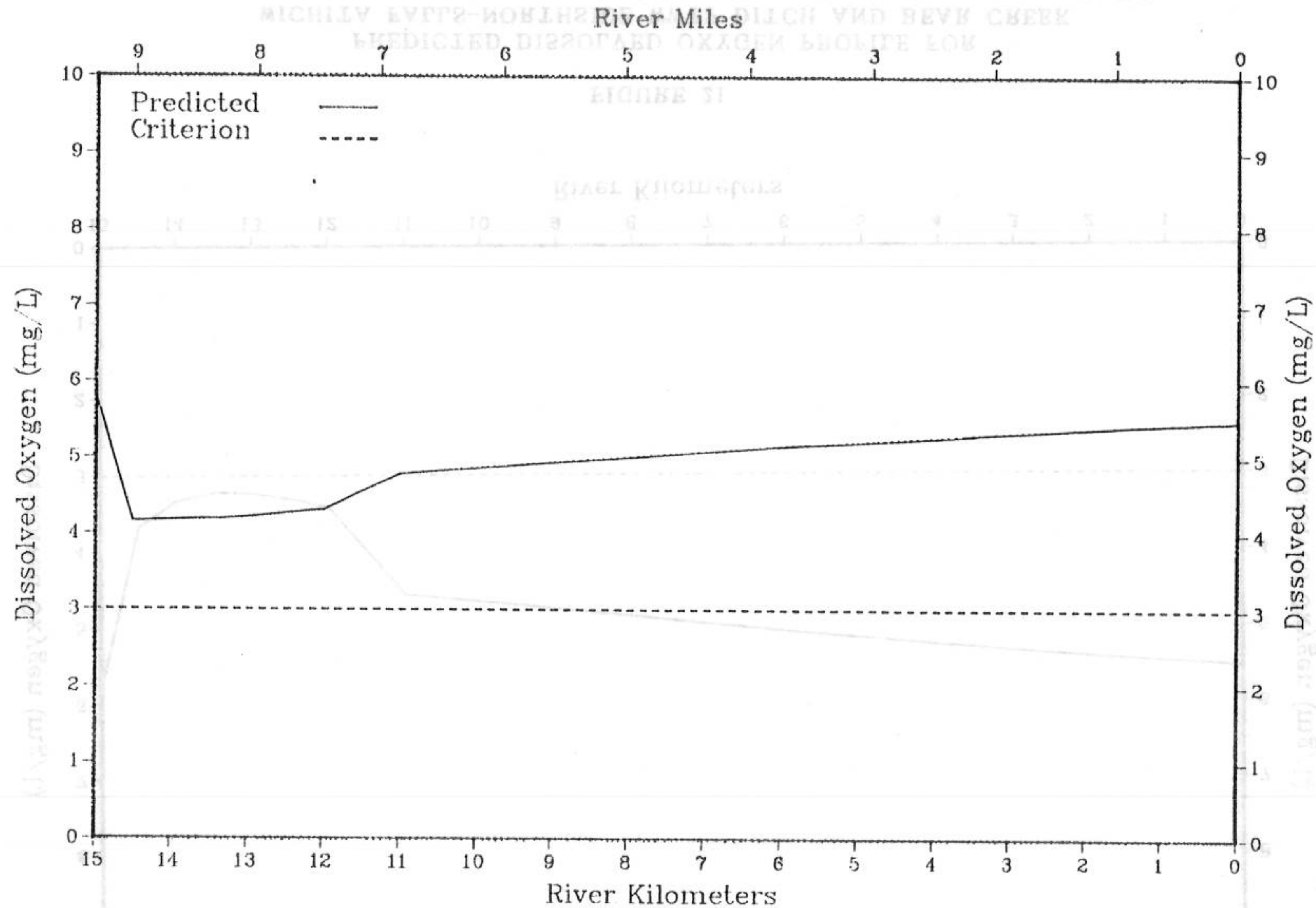

FIGURE 22

PREDICTED DISSOLVED OXYGEN PROFILE FOR
WICHITA FALLS-NORTHSIDE WWTP DITCH AND BEAR CREEK
2005 Projected Flows with 10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L DO

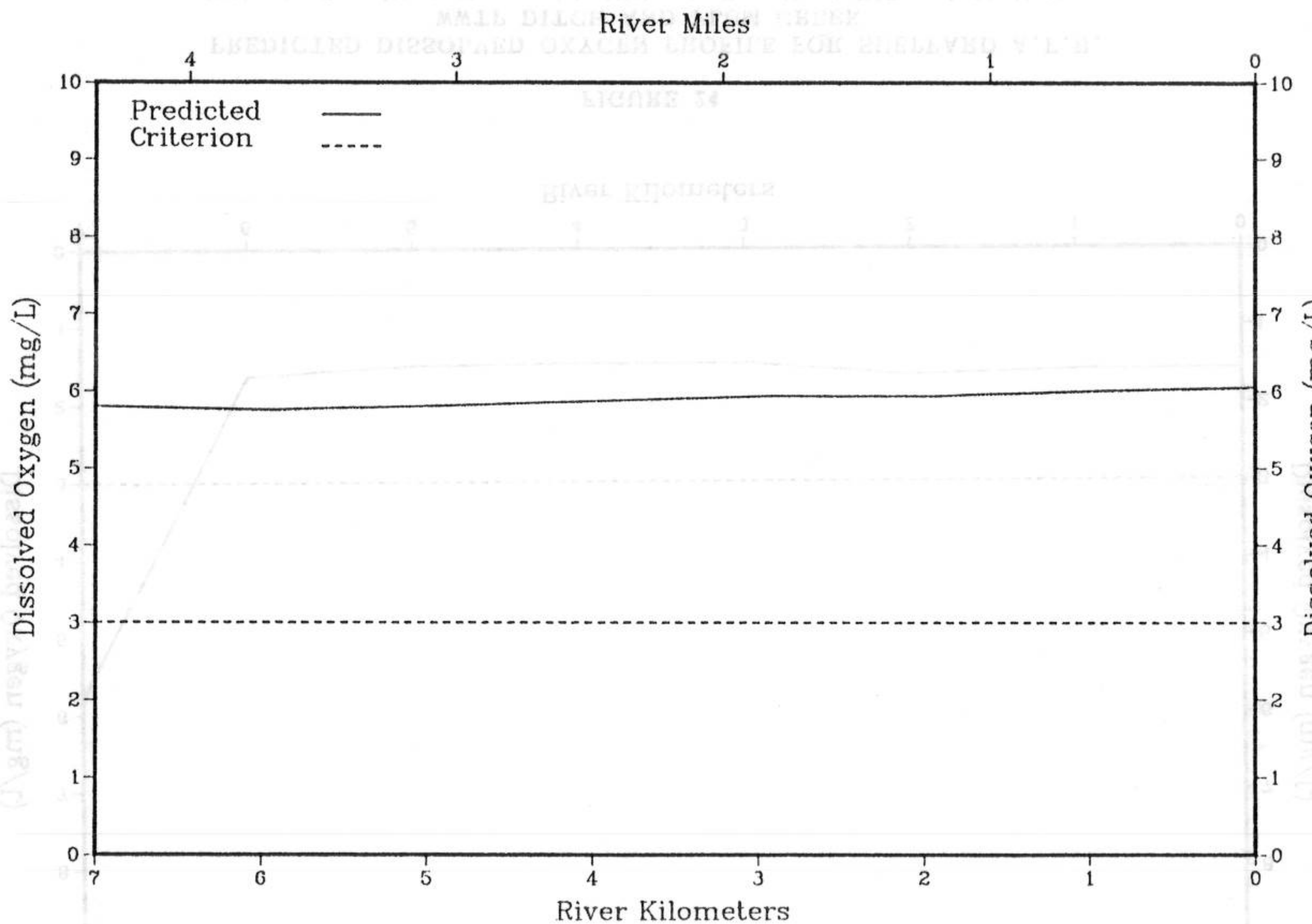

FIGURE 23

PREDICTED DISSOLVED OXYGEN PROFILE FOR SHEPPARD A.F.B.
WWTP DITCH AND PLUM CREEK
No Waste Loads

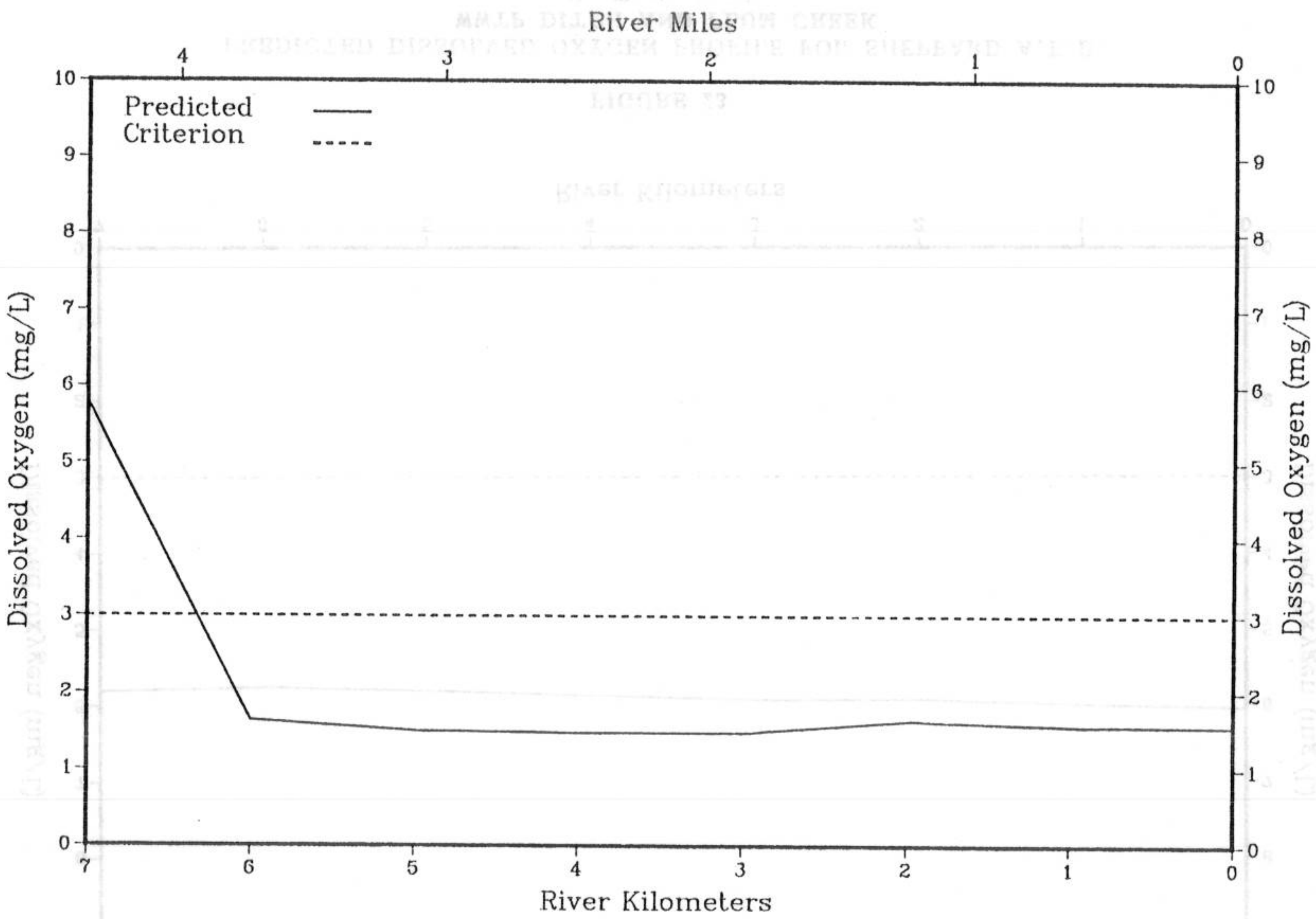

FIGURE 24

PREDICTED DISSOLVED OXYGEN PROFILE FOR SHEPPARD A.F.B.
WWTP DITCH AND PLUM CREEK
Ultimate Permitted Flows with Ultimate Permitted Effluent Limitations

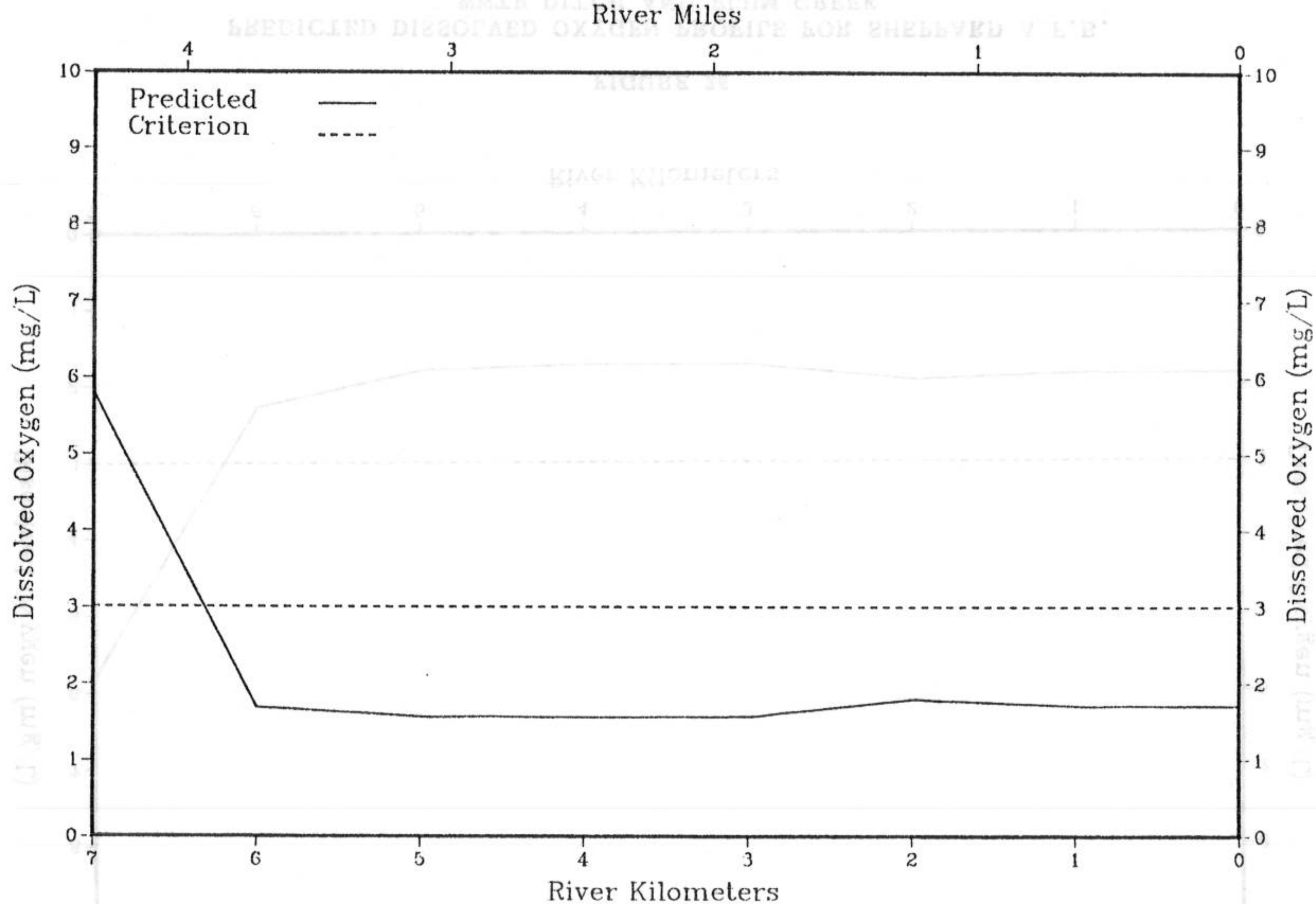

FIGURE 25

PREDICTED DISSOLVED OXYGEN PROFILE FOR SHEPPARD A.F.B.
WWTP DITCH AND PLUM CREEK
2005 Projected Flows with 20 mg/L BOD_5, 15 mg/L NH_3-N, and 2 mg/L DO

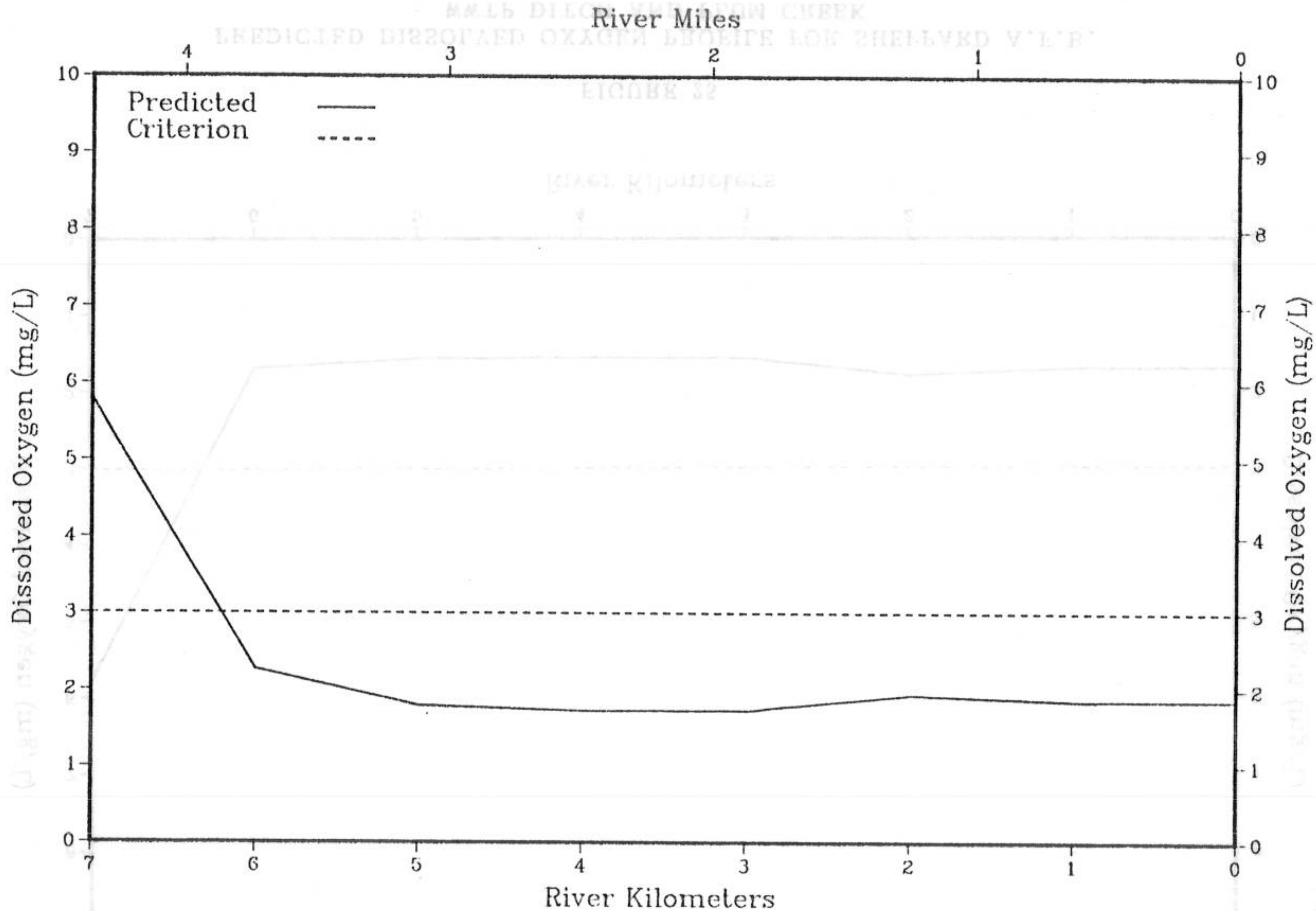

FIGURE 26

PREDICTED DISSOLVED OXYGEN PROFILE FOR SHEPPARD A.F.B.
WWTP DITCH AND PLUM CREEK
2005 Projected Flows with 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L DO

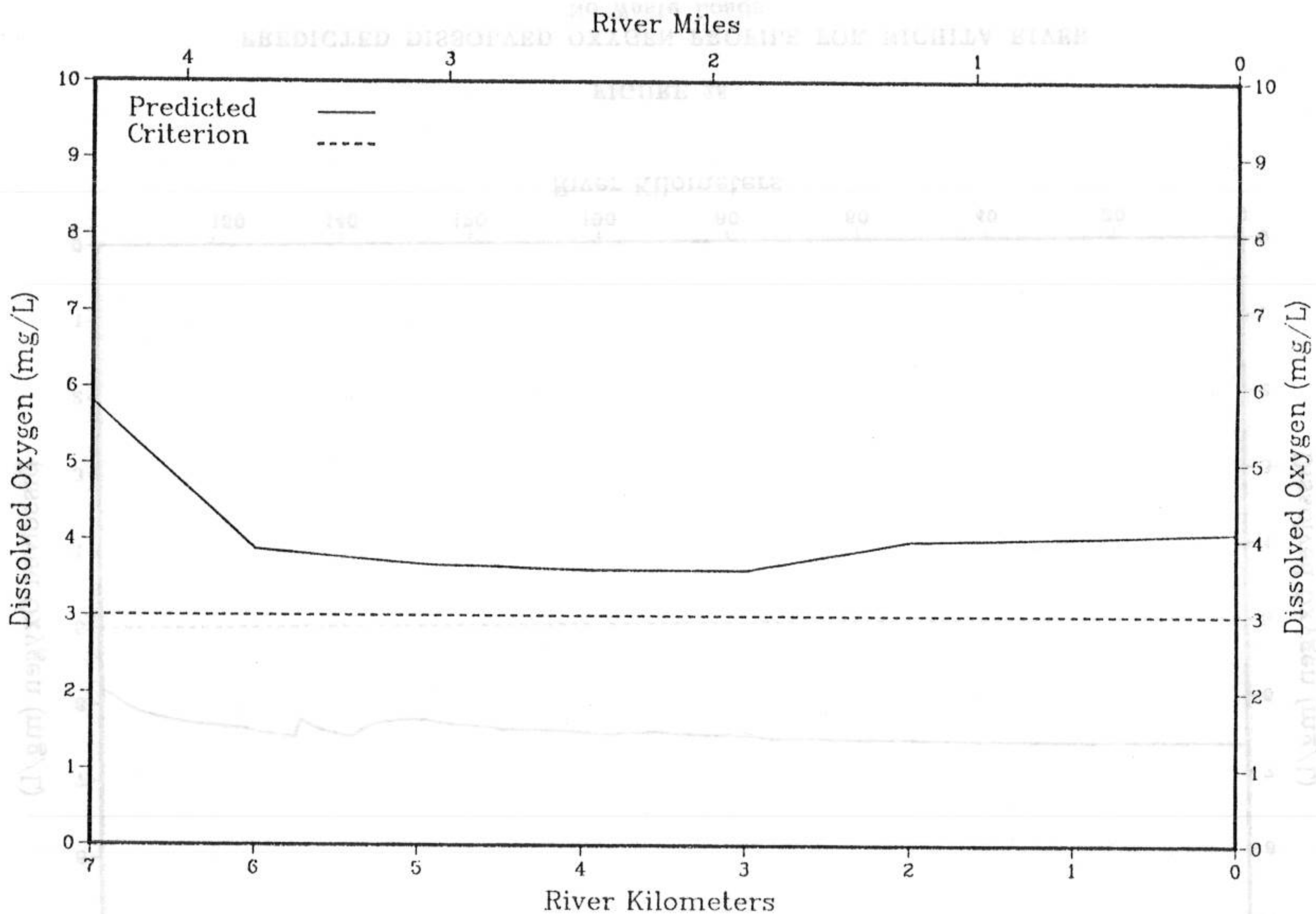

FIGURE 27

PREDICTED DISSOLVED OXYGEN PROFILE FOR SHEPPARD A.F.B.
WWTP DITCH AND PLUM CREEK
2005 Projected Flows with 10 mg/L BOD_5, 3 mg/L NH_3-N, and 4 mg/L DO

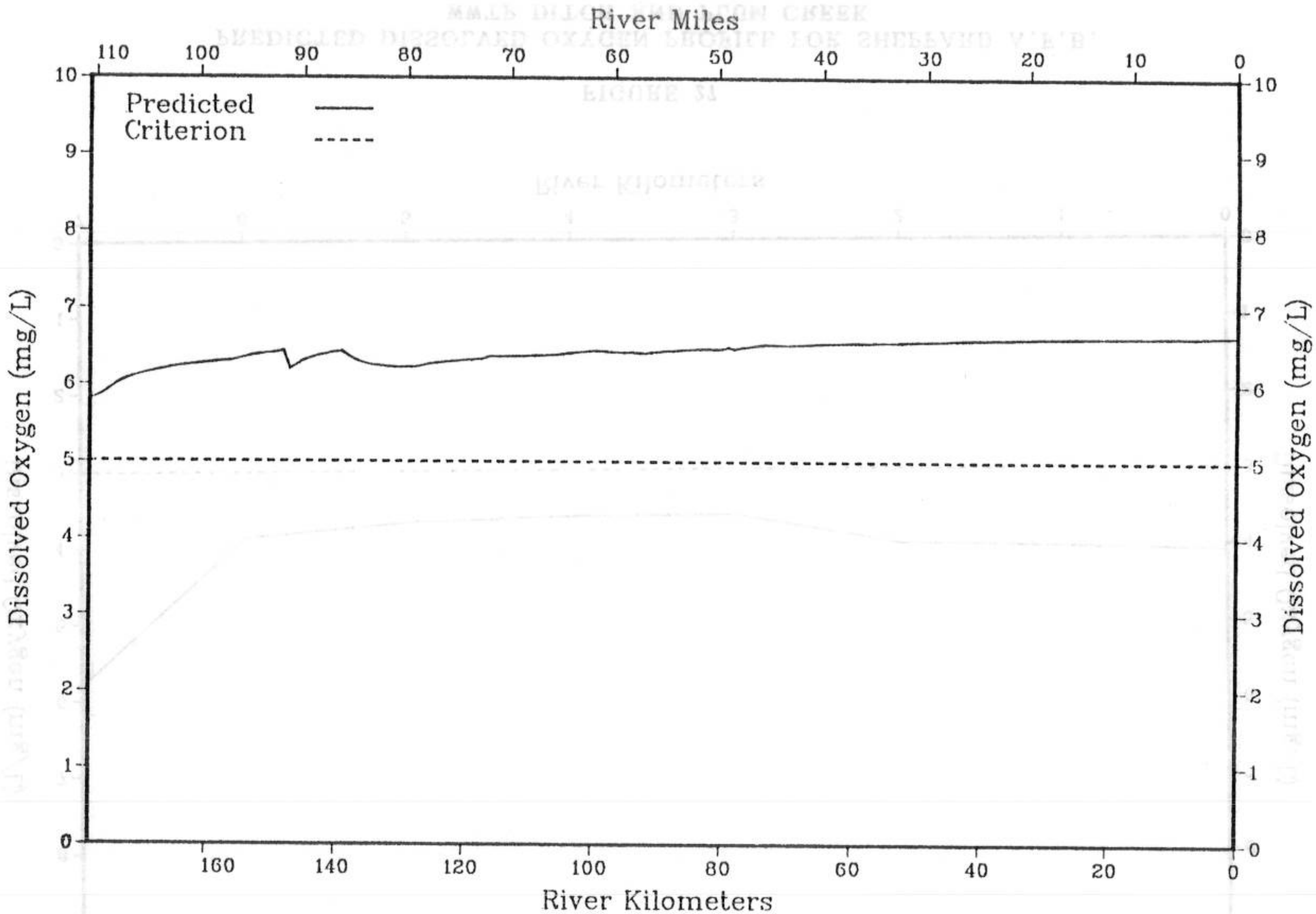

FIGURE 28

PREDICTED DISSOLVED OXYGEN PROFILE FOR WICHITA RIVER
No Waste Loads

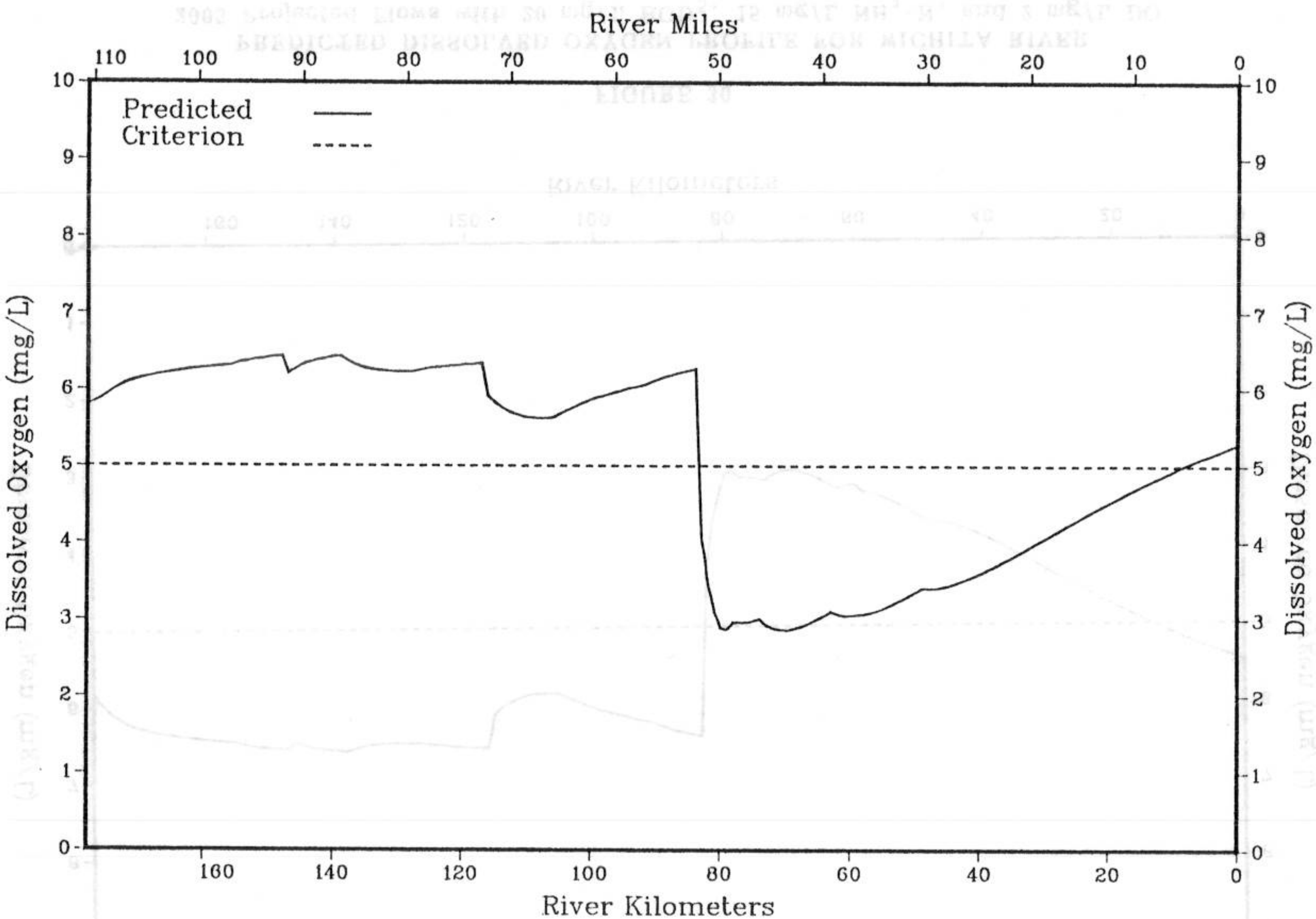

FIGURE 29

PREDICTED DISSOLVED OXYGEN PROFILE FOR WICHITA RIVER
Ultimate Permitted Flows with Ultimate Permitted Effluent Limitations

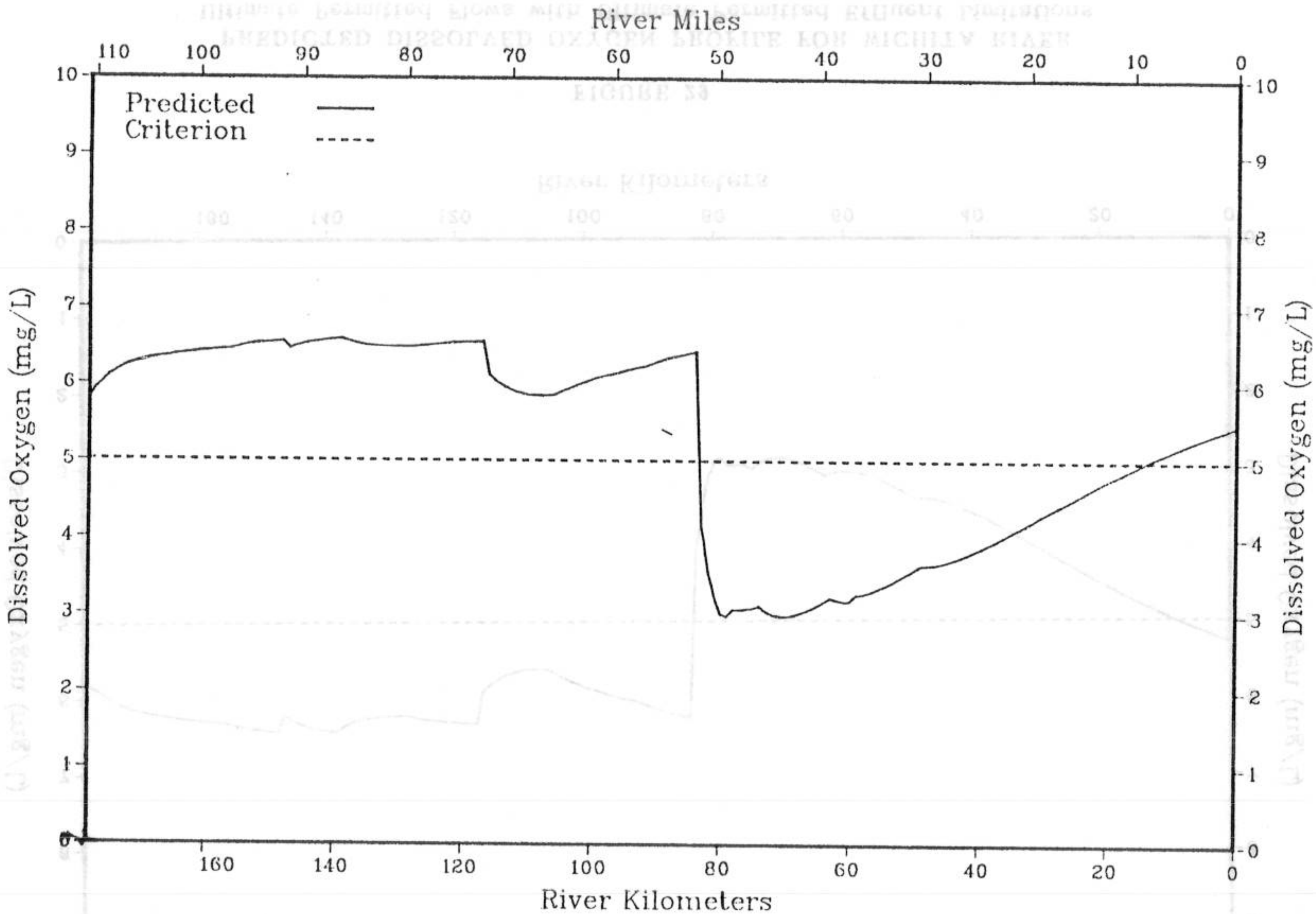

FIGURE 30

PREDICTED DISSOLVED OXYGEN PROFILE FOR WICHITA RIVER
2005 Projected Flows with 20 mg/L BOD_5, 15 mg/L NH_3-N, and 2 mg/L DO

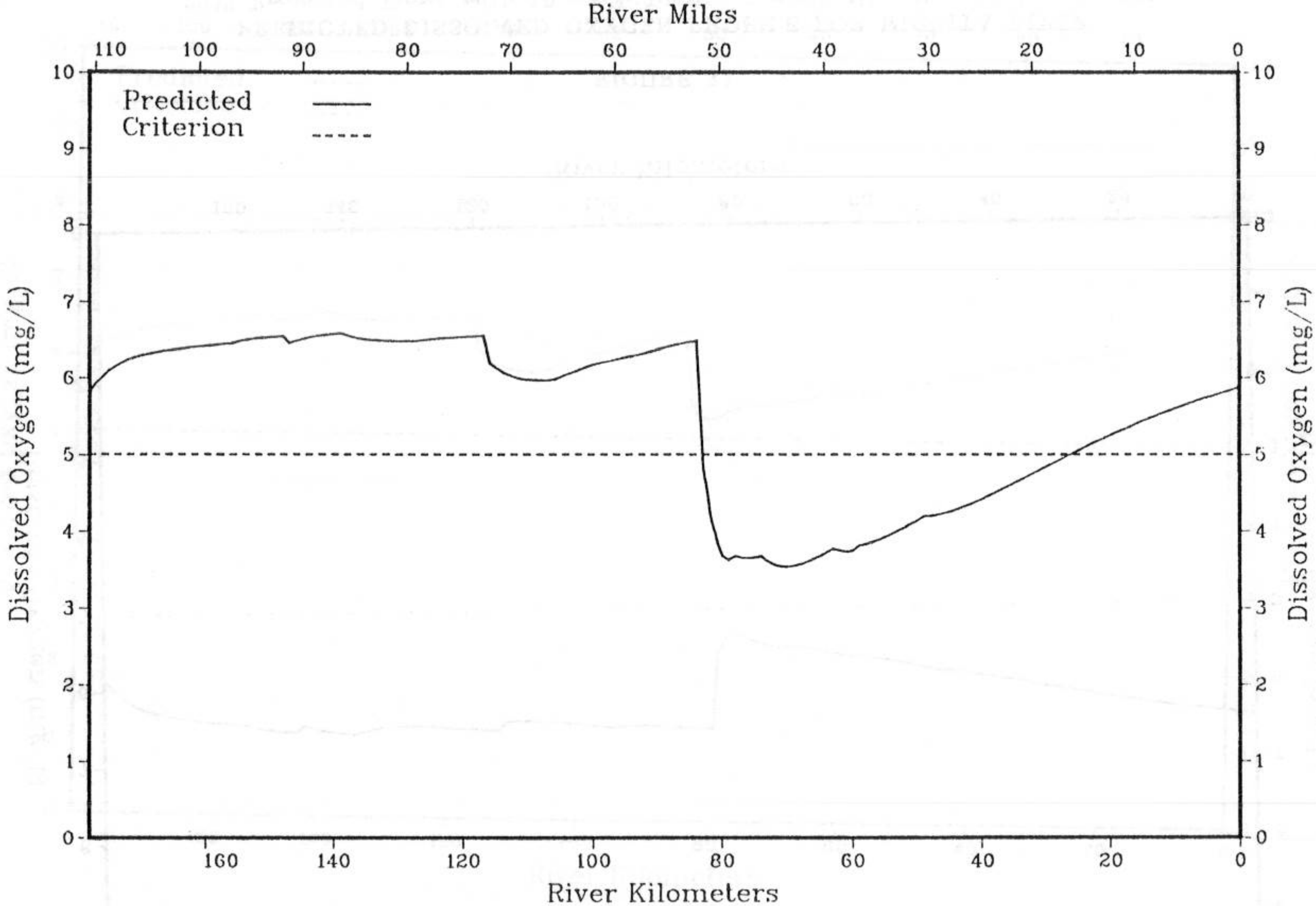

FIGURE 31

PREDICTED DISSOLVED OXYGEN PROFILE FOR WICHITA RIVER
2005 Projected Flows with 10 mg/L BOD_5, 15 mg/L NH_3-N, and 4 mg/L DO

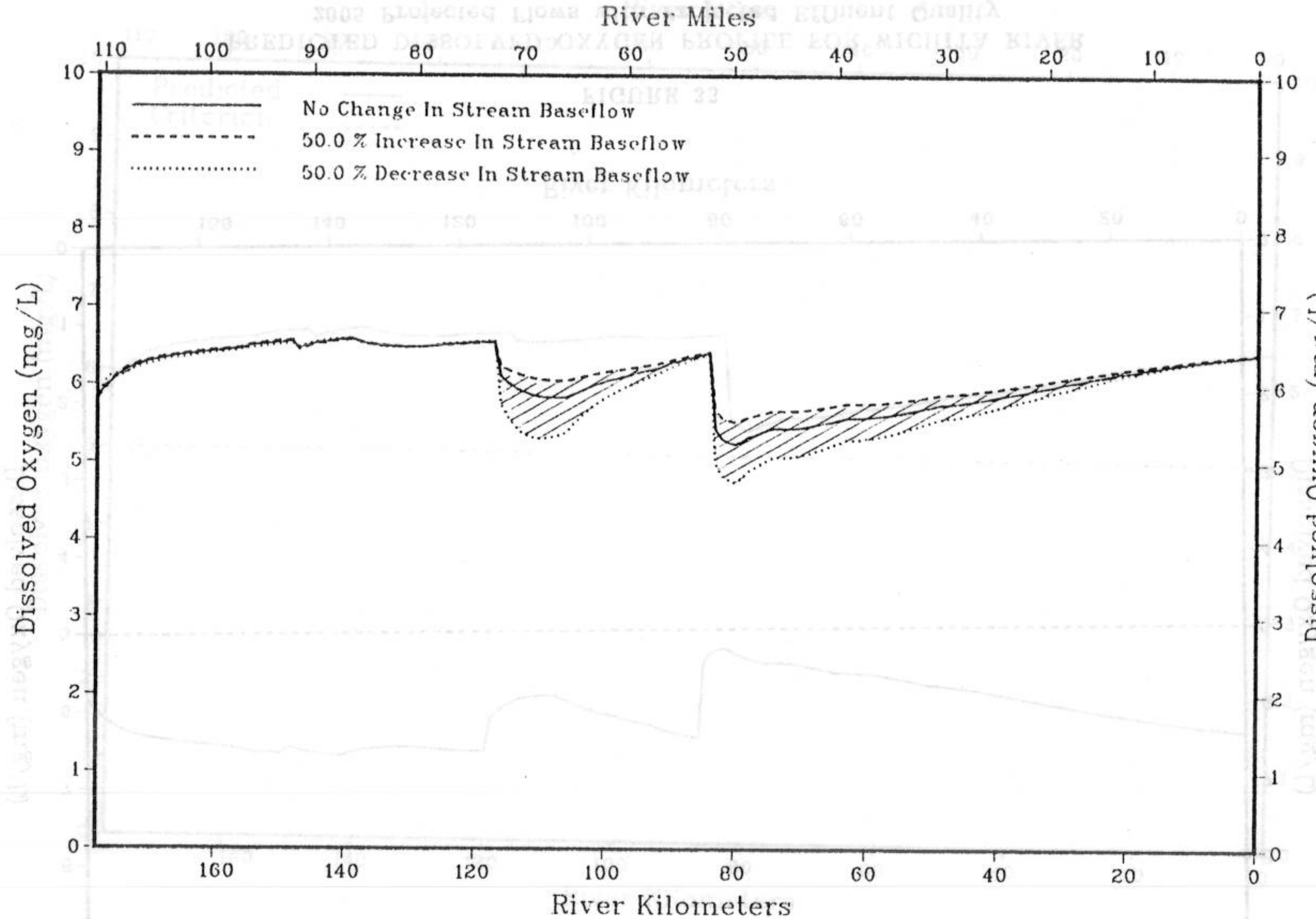

FIGURE 34

WICHITA RIVER DISSOLVED OXYGEN SENSITIVITY TO STREAM BASEFLOW
2005 Projected Flows with Projected Effluent Quality

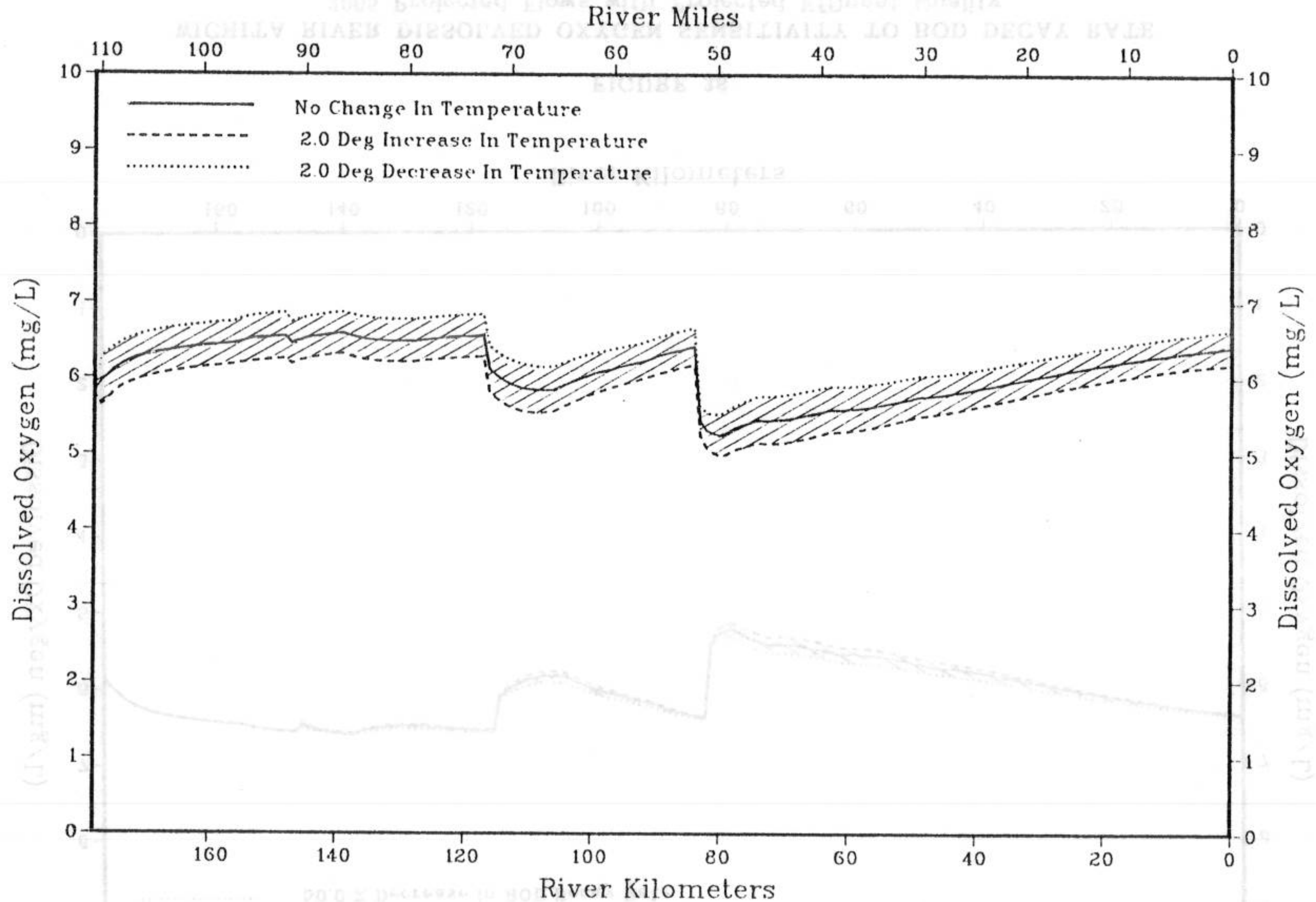

FIGURE 35

WICHITA RIVER DISSOLVED OXYGEN SENSITIVITY TO TEMPERATURE
2005 Projected Flows with Projected Effluent Quality

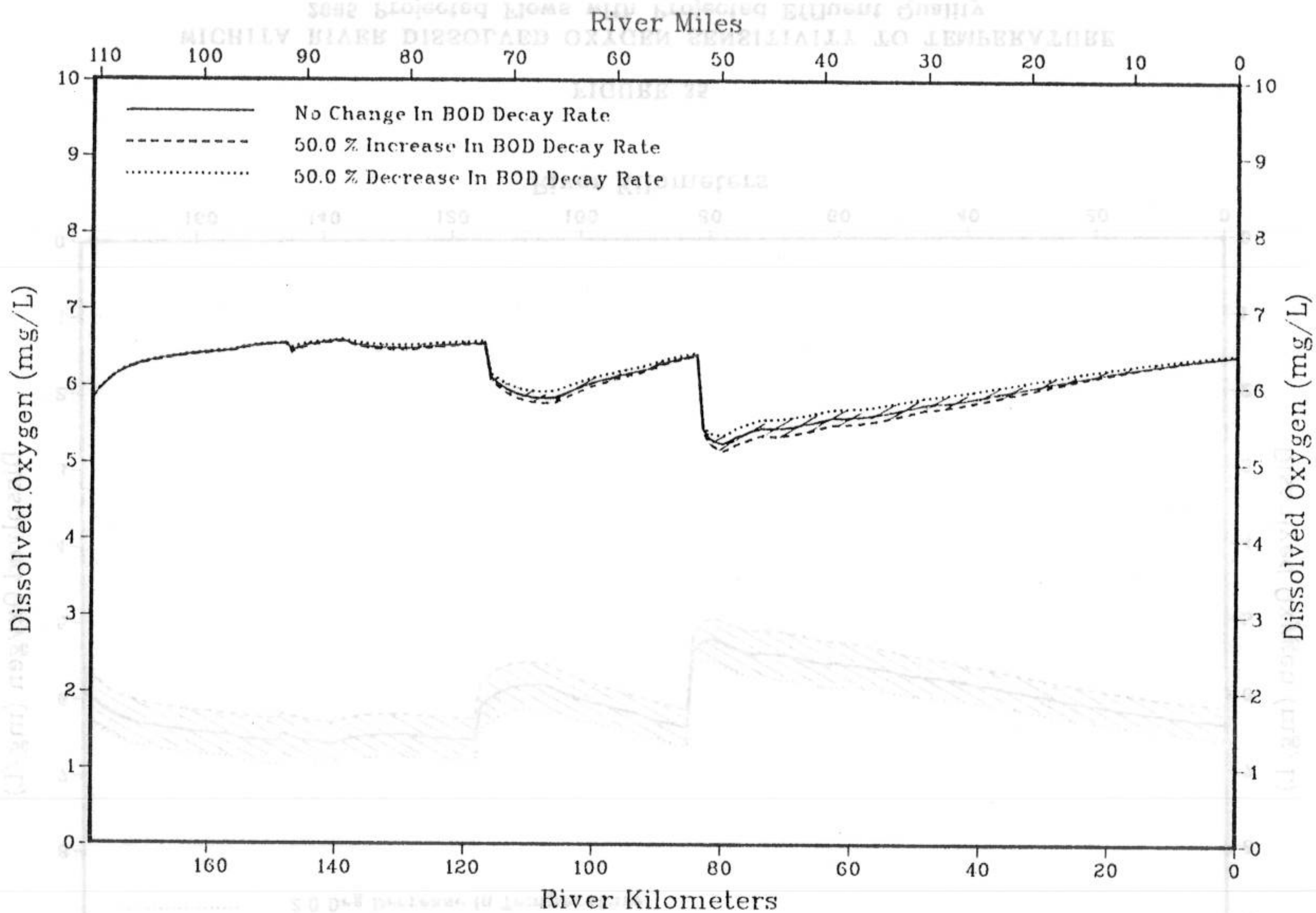

FIGURE 36

WICHITA RIVER DISSOLVED OXYGEN SENSITIVITY TO BOD DECAY RATE
2005 Projected Flows with Projected Effluent Quality

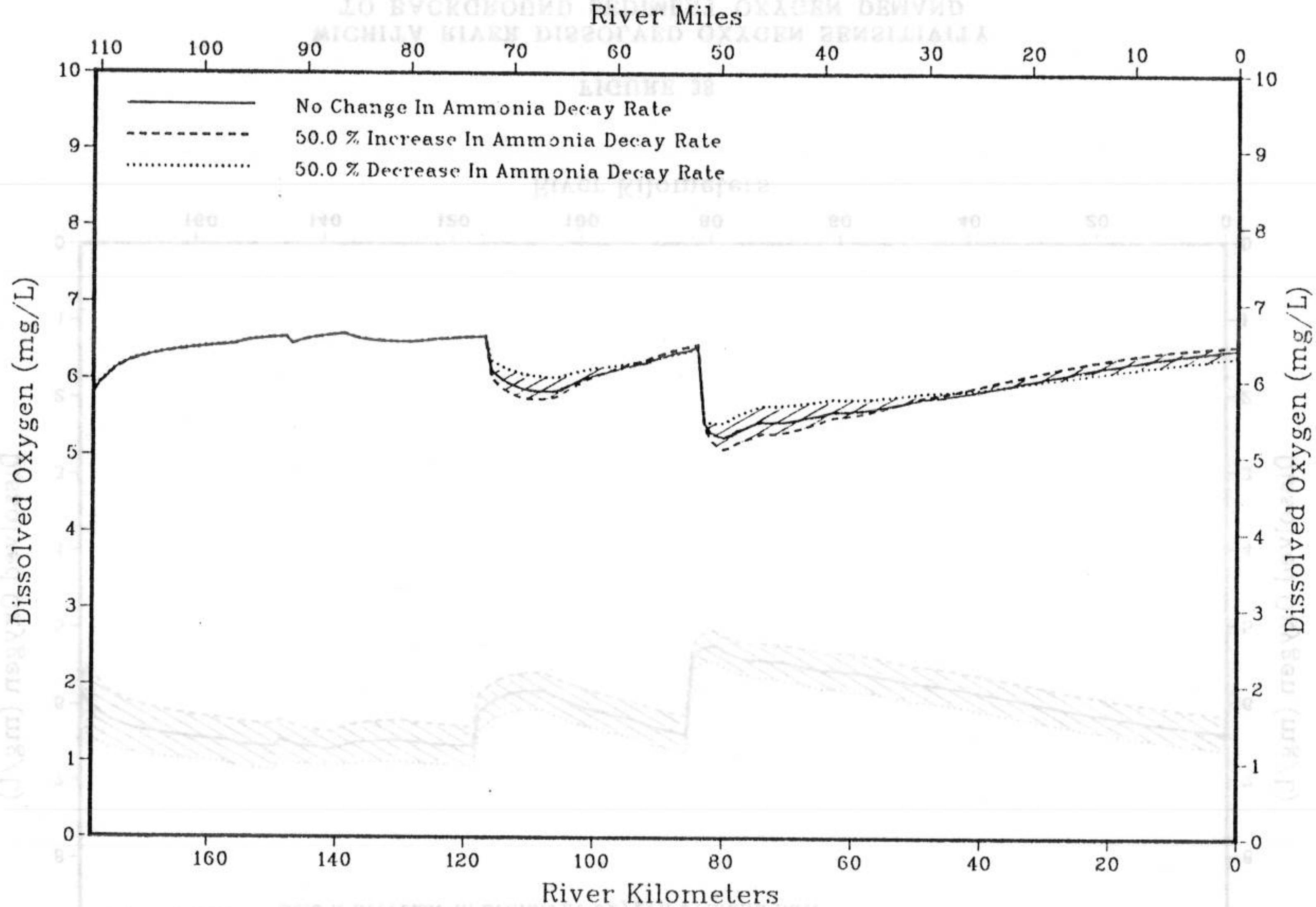

FIGURE 37

WICHITA RIVER DISSOLVED OXYGEN SENSITIVITY TO AMMONIA DECAY RATE
2005 Projected Flows with Projected Effluent Quality

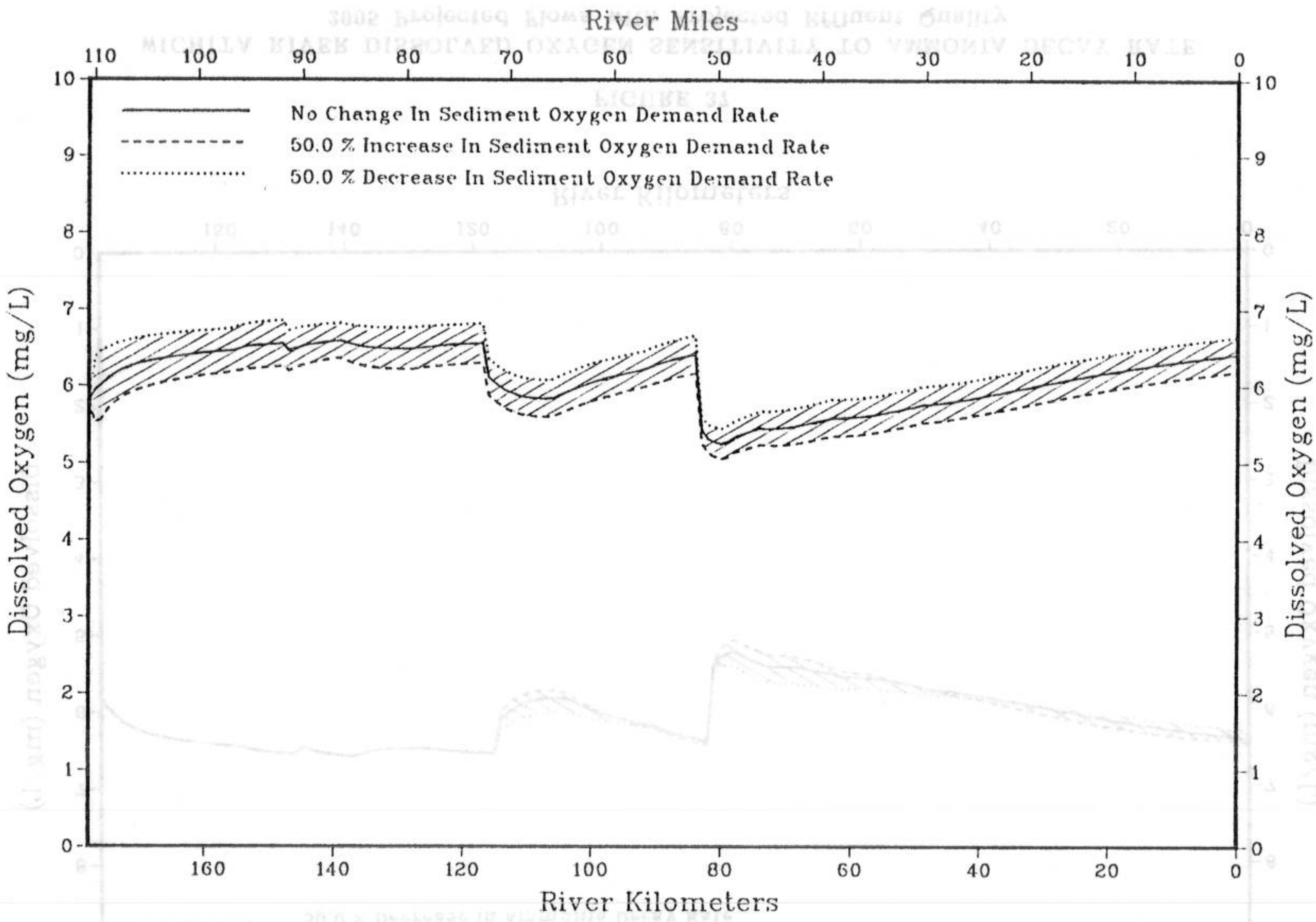

FIGURE 38

WICHITA RIVER DISSOLVED OXYGEN SENSITIVITY TO BACKGROUND SEDIMENT OXYGEN DEMAND
2005 Projected Flows with Projected Effluent Quality

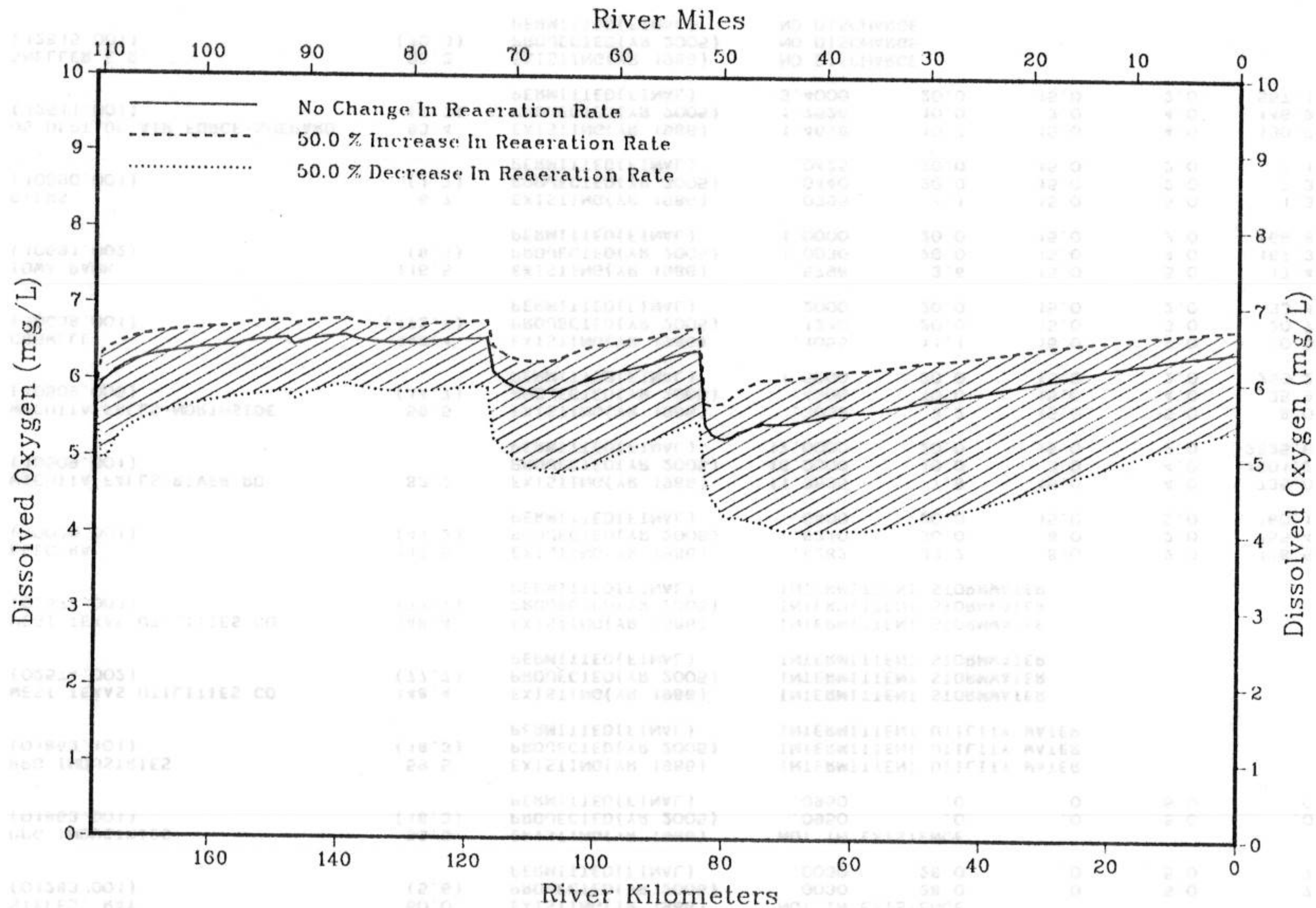

FIGURE 39

WICHITA RIVER DISSOLVED OXYGEN SENSITIVITY TO REAERATION RATE
2005 Projected Flows with Projected Effluent Quality

TABLE 1

EXISTING, PROJECTED, AND PERMITTED WASTEWATER LOADING TO THE WICHITA RIVER

SEG NUM	DISCHARGER NAME (PERMIT NUMBER)	RIVER KM		FLOW (MGD)	BOD5 (MG/L)	NH3-N (MG/L)	DO (MG/L)	BOD5 (LB/D)	NH3-N (LB/D)
0214	STYLES, RAY	60.0	EXISTING(YR 1986)	NOT IN EXISTENCE					
	(01283.001)	(5.6)	PROJECTED(YR 2005)	.0030	28.0	.0	5.0	.7	.0
			PERMITTED(FINAL)	.0030	28.0	.0	5.0	.7	.0
0214	PPG INDUSTRIES	59.5	EXISTING(YR 1986)	NOT IN EXISTENCE					
	(01863.001)	(18.3)	PROJECTED(YR 2005)	.0950	.0	.0	5.0	.0	.0
			PERMITTED(FINAL)	.0950	.0	.0	5.0	.0	.0
0214	PPG INDUSTRIES	59.5	EXISTING(YR 1986)	INTERMITTENT UTILITY WATER					
	(01863.101)	(18.3)	PROJECTED(YR 2005)	INTERMITTENT UTILITY WATER					
			PERMITTED(FINAL)	INTERMITTENT UTILITY WATER					
0214	WEST TEXAS UTILITIES CO	148.4	EXISTING(YR 1986)	INTERMITTENT STORMWATER					
	(02574.002)	(77.7)	PROJECTED(YR 2005)	INTERMITTENT STORMWATER					
			PERMITTED(FINAL)	INTERMITTENT STORMWATER					
0214	WEST TEXAS UTILITIES CO	148.4	EXISTING(YR 1986)	INTERMITTENT STORMWATER					
	(02574.003)	(77.7)	PROJECTED(YR 2005)	INTERMITTENT STORMWATER					
			PERMITTED(FINAL)	INTERMITTENT STORMWATER					
0214	ELECTRA	116.5	EXISTING(YR 1986)	.4282	33.2	8.0	2.0	118.6	28.6
	(10020.001)	(41.2)	PROJECTED(YR 2005)	.6210	30.0	8.0	2.0	155.4	41.4
			PERMITTED(FINAL)	.6400	30.0	15.0	2.0	160.1	80.1
0214	WICHITA FALLS-RIVER RD	83.7	EXISTING(YR 1986)	11.3535	7.8	15.0	4.0	735.0	1420.3
	(10509.001)		PROJECTED(YR 2005)	18.0000	10.0	3.0	4.0	1501.2	450.4
			PERMITTED(FINAL)	17.0000	20.0	15.0	2.0	2835.6	2126.7
0214	WICHITA FALLS-NORTHSIDE	59.5	EXISTING(YR 1986)	.3036	3.2	15.0	5.0	8.0	38.0
	(10509.005)	(14.7)	PROJECTED(YR 2005)	.4300	10.0	15.0	4.0	35.9	53.8
			PERMITTED(FINAL)	1.5000	20.0	15.0	2.0	250.2	187.6
0214	CROWELL	148.4	EXISTING(YR 1986)	.1055	11.4	15.0	2.0	10.0	13.2
	(10638.001)	(172.4)	PROJECTED(YR 2005)	.1240	20.0	15.0	3.0	20.7	15.5
			PERMITTED(FINAL)	.2000	20.0	15.0	2.0	33.4	25.0
0214	IOWA PARK	116.5	EXISTING(YR 1986)	.5798	3.6	15.0	5.0	17.4	72.5
	(10691.002)	(8.1)	PROJECTED(YR 2005)	1.0030	20.0	15.0	4.0	167.3	125.5
			PERMITTED(FINAL)	1.0000	20.0	15.0	2.0	166.8	125.1
0214	BYERS	6.7	EXISTING(YR 1986)	.0395	4.1	15.0	5.0	1.3	4.9
	(10890.001)	(1.7)	PROJECTED(YR 2005)	.0440	20.0	15.0	2.0	7.3	5.5
			PERMITTED(FINAL)	.0425	20.0	15.0	2.0	7.1	5.3
0214	US DEPT OF AIR FORCE-SHEPARD	83.4	EXISTING(YR 1986)	1.4618	10.7	15.0	4.0	130.7	182.9
	(12511.001)	(6.7)	PROJECTED(YR 2005)	1.7526	10.0	3.0	4.0	146.2	43.9
			PERMITTED(FINAL)	3.4000	20.0	15.0	2.0	567.1	425.3
0214	SNELLER E.R.	98.3	EXISTING(YR 1986)	NO DISCHARGE					
	(12815.001)	(10.3)	PROJECTED(YR 2005)	NO DISCHARGE					
			PERMITTED(FINAL)	NO DISCHARGE					

TABLE 1 (continued)

TOTALS FOR CONTINUOUS DISCHARGERS (ENGLISH UNITS)

		NUMBER	FLOW (MGD)	BOD5 (LB/D)	NH3-N (LB/D)	UOD (LB/D)
DOMESTIC	EXISTING(YR 1986)	7	14.2719	1021.0	1760.4	9971.0
	CAPACITY(YR 1986)		23.7825	4020.3	2975.2	22129.3
	PROJECTED(YR 2005)	7	21.9746	2033.9	735.9	7864.6
	PERMITTED(FINAL)	7	23.7825	4020.3	2975.2	22129.3
	PENDING PERMITS(NEW)	0	.0000	.0	.0	.0
	PENDING PERMITS(EXPANSION)	0	.0000	.0	.0	.0
	PERMITTED(ULTIMATE)	7	23.7825	4020.3	2975.2	22129.3
INDUSTRIAL	EXISTING(YR 1986)	0	.0000	.0	.0	.0
	CAPACITY(YR 1986)		.0000	.0	.0	.0
	PROJECTED(YR 2005)	2	.0980	.7	.0	1.6
	PERMITTED(FINAL)	2	.0980	.7	.0	1.6
	PENDING PERMITS(NEW)	0	.0000	.0	.0	.0
	PENDING PERMITS(EXPANSION)	0	.0000	.0	.0	.0
	PERMITTED(ULTIMATE)	2	.0980	.7	.0	1.6
DOMESTIC AND INDUSTRIAL	EXISTING(YR 1986)	7	14.2719	1021.0	1760.4	9971.0
	CAPACITY(YR 1986)		23.7825	4020.3	2975.2	22129.3
	PROJECTED(YR 2005)	9	22.0726	2034.6	735.9	7866.2
	PERMITTED(FINAL)	9	23.8805	4021.0	2975.2	22130.9
	PENDING PERMITS(NEW)	0	.0000	.0	.0	.0
	PENDING PERMITS(EXPANSION)	0	.0000	.0	.0	.0
	PERMITTED(ULTIMATE)	9	23.8805	4021.0	2975.2	22130.9

TABLE 1 (continued)

TOTALS FOR CONTINUOUS DISCHARGERS (METRIC UNITS)

		NUMBER	FLOW (CMS)	BOD5 (KG/D)	NH3-N (KG/D)	UOD (KG/D)
DOMESTIC	EXISTING(YR 1986)	7	.6254	463.0	798.3	4521.9
	CAPACITY(YR 1986)		1.0421	1823.2	1349.2	10035.6
	PROJECTED(YR 2005)	7	.9629	922.4	333.7	3566.6
	PERMITTED(FINAL)	7	1.0421	1823.2	1349.2	10035.6
	PENDING PERMITS(NEW)	0	.0000	.0	.0	.0
	PENDING PERMITS(EXPANSION)	0	.0000	.0	.0	.0
	PERMITTED(ULTIMATE)	7	1.0421	1823.2	1349.2	10035.6
INDUSTRIAL	EXISTING(YR 1986)	0	.0000	.0	.0	.0
	CAPACITY(YR 1986)		.0000	.0	.0	.0
	PROJECTED(YR 2005)	2	.0043	.3	.0	.7
	PERMITTED(FINAL)	2	.0043	.3	.0	.7
	PENDING PERMITS(NEW)	0	.0000	.0	.0	.0
	PENDING PERMITS(EXPANSION)	0	.0000	.0	.0	.0
	PERMITTED(ULTIMATE)	2	.0043	.3	.0	.7
DOMESTIC AND INDUSTRIAL	EXISTING(YR 1986)	7	.6254	463.0	798.3	4521.9
	CAPACITY(YR 1986)		1.0421	1823.2	1349.2	10035.6
	PROJECTED(YR 2005)	9	.9672	922.7	333.7	3567.3
	PERMITTED(FINAL)	9	1.0464	1823.5	1349.2	10036.3
	PENDING PERMITS(NEW)	0	.0000	.0	.0	.0
	PENDING PERMITS(EXPANSION)	0	.0000	.0	.0	.0
	PERMITTED(ULTIMATE)	9	1.0464	1823.5	1349.2	10036.3

TABLE 2

STREAM MONITORING NETWORK DATA SUMMARY
FOR THE WICHITA RIVER
(October 1, 1983 - September 30, 1987)

Parameter	Range	Mean	Number of Samples
Dissolved Oxygen (mg/L)	3.8 - 15.9	8.4	79
Temperature (°F)	36.0 - 91.8	77.8	79
pH	6.3 - 8.9	7.8	79
Chlorides (mg/L)	48 - 1,835	1,122	41
Sulfates (mg/L)	15 - 880	487	41
Total Dissolved Solids (mg/L)	278 - 4,450	2,563	92
Fecal Coliform (#/100 mL)	2 - 26,000	180	27

TABLE 3

REACH IDENTIFICATION DATA FOR THE WICHITA RIVER MODEL

$$$ DATA TYPE 8 (REACH IDENTIFICATION DATA) $$$

CARD TYPE	REACH	ID	NAME	BEGIN REACH KM		END REACH KM	ELEM LENGTH KM	REACH LENGTH KM	ELEMS PER RCH	BEGIN ELEM NUM	END ELEM NUM
REACH ID	1	WR	DIVERSION DAM - FM1180	178.00	TO	176.00	1.0000	2.00	2	1	2
REACH ID	2	WR	FM1180 - SH25	176.00	TO	156.00	1.0000	20.00	20	3	22
REACH ID	3	WR	SH25 - BEAVER CREEK	156.00	TO	148.00	1.0000	8.00	8	23	30
REACH ID	4	BV	FM2326 - SH25	17.00	TO	7.00	1.0000	10.00	10	31	40
REACH ID	5	BV	SH25 - WICHITA RIVER	7.00	TO	.00	1.0000	7.00	7	41	47
REACH ID	6	WR	BEAVER CREEK - DEER CREEK	148.00	TO	144.00	1.0000	4.00	4	48	51
REACH ID	7	DC	RKM 0.5 - WICHITA RIVER	.50	TO	.00	.5000	.50	1	52	52
REACH ID	8	WR	DEER CREEK - RKM 139	144.00	TO	139.00	1.0000	5.00	5	53	57
REACH ID	9	WR	RKM 139 - FM368	139.00	TO	128.00	1.0000	11.00	11	58	68
REACH ID	10	WR	FM368 - BUFFALO CREEK	128.00	TO	117.00	1.0000	11.00	11	69	79
REACH ID	11	BF	RKM 17 - SOUTH FORK BF	17.00	TO	16.00	1.0000	1.00	1	80	80
REACH ID	12	SF	RKM 26 - BUFFALO CREEK	26.00	TO	.00	1.0000	26.00	26	81	106
REACH ID	13	BF	SOUTH FORK BF - IOWA PARK DITCH	16.00	TO	7.00	1.0000	9.00	9	107	115
REACH ID	14	IP	RKM 1.5 - BUFFALO CREEK	1.50	TO	.00	.5000	1.50	3	116	118
REACH ID	15	BF	IOWA PARK DITCH - FM1814	7.00	TO	2.00	1.0000	5.00	5	119	123
REACH ID	16	BF	FM1814 - WICHITA RIVER	2.00	TO	.00	1.0000	2.00	2	124	125
REACH ID	17	WR	BUFFALO CK - FM369	117.00	TO	106.00	1.0000	11.00	11	126	136
REACH ID	18	WR	FM369 - FM1634	136.00	TO	130.00	1.0000	6.00	6	137	142
REACH ID	19	WR	FM1634 - PLUM CK (UPPER)	130.00	TO	94.00	1.0000	6.00	6	143	148
REACH ID	20	PU	RKM 0.5 - WICHITA RIVER	.50	TO	.00	.5000	.50	1	149	149
REACH ID	21	WR	PLUM CK (UPPER) - LOOP 11	94.00	TO	92.00	1.0000	2.00	2	150	151
REACH ID	22	WR	LOOP 11 - SH240	92.00	TO	86.00	1.0000	6.00	6	152	157
REACH ID	23	WR	SH240 - WICHITA FALLS WWTP	86.00	TO	84.00	1.0000	2.00	2	158	159
REACH ID	24	WR	WICHITA FALLS WWTP - PLUM CREEK	84.00	TO	83.00	1.0000	1.00	1	160	160
REACH ID	25	PL	RKM 4.0 - SHEPPARD DITCH	4.00	TO	3.00	1.0000	1.00	1	161	161
REACH ID	26	SH	RKM 4.0 - PLUM CK (LOWER)	4.00	TO	.00	1.0000	4.00	4	162	165
REACH ID	27	PL	SHEPPARD DITCH - FM171	3.00	TO	2.00	1.0000	1.00	1	166	166
REACH ID	28	PL	FM171 - WICHITA RIVER	2.00	TO	.00	1.0000	2.00	2	167	168
REACH ID	29	WR	PLUM CK - RIVER ROAD	93.00	TO	90.00	1.0000	3.00	3	169	171
REACH ID	30	WR	RIVER ROAD - HOLIDAY CREEK	80.00	TO	79.00	1.0000	1.00	1	172	172
REACH ID	31	HC	HOLIDAY CK HDWTR - WICHITA RIVER	.50	TO	.00	.5000	.50	1	173	173
REACH ID	32	WR	HOLIDAY CREEK - EASTLAND LANE	79.00	TO	74.00	1.0000	5.00	5	174	178
REACH ID	33	WR	EASTLAND LANE - KRAJCA ROAD	74.00	TO	63.00	1.0000	11.00	11	179	189
REACH ID	34	WR	KRAJCA RD - BEAR CREEK	63.00	TO	60.00	1.0000	3.00	3	190	192
REACH ID	35	BR	RKM 13 - AQUEDUCT	13.00	TO	12.00	1.0000	1.00	1	193	193
REACH ID	36	AQ	RKM 3.0 - BEAR CREEK	3.00	TO	.00	.5000	3.00	6	194	199
REACH ID	37	BR	BEAR CK HDWTR - WICHITA RIVER	12.00	TO	.00	1.0000	12.00	12	200	211
REACH ID	38	WR	BEAR CREEK - FM2393	60.00	TO	49.00	1.0000	11.00	11	212	222
REACH ID	39	WR	FM2393 - FM810	49.00	TO	28.00	1.0000	21.00	21	223	243
REACH ID	40	WR	FM810 - FM171	28.00	TO	7.00	1.0000	21.00	21	244	264
REACH ID	41	WR	FM171 TO CONFLUENCE W/ RED RIVER	7.00	TO	.00	1.0000	7.00	7	265	271
ENDATA08											

TABLE 4

SUMMARY OF HYDRAULIC DATA
Wichita River Survey (July 21, 1986)

Description of Reach	Distance (km)	Travel Time (hrs)	Avg. Flow (m^3/s)	Avg. Velocity (m/s)	Avg. Width (m)	Avg. Depth (m)
Wichita River from SH 25 (Km 155.9) to the Wichita River between SH 25 and FM 368 (Km 139.0)	16.9	19.08	0.244	0.246	6.6	(0.15)
Wichita River from between SH 25 and FM 368 (Km 139.0) to the Wichita River at FM 368 (Km 128.2)	10.8	29.00	0.638	0.103	9.0	(0.69)
Wichita River from FM 369 (Km 106.1) to Wichita River at FM 1634 (Km 100.1)	6.0	7.08	(1.054)	0.235	(6.7)	(0.67)
Wichita River from FM 1634 (Km 100.1) to Wichita River at SH Loop 11 (Km 92.1)	8.0	10.42	(1.054)	0.213	(6.7)	(0.74)
Wichita River from City of Wichita Falls-River Road WWTP outfall (Km 83.7) to Wichita River at River Road (Km 79.8)	3.9	4.00	1.297	0.271	24.7	(0.19)
Wichita River from River Road (Km 79.8) to Wichita River at Krajca Lane (Km 63.2)	16.6	4.83	1.181	0.954	22.6	(0.06)
Wichita River from FM 2393 (Km 48.6) to Wichita River at FM 810 (Km 28.1)	20.5	16.00	2.137	0.356	18.1	(0.33)

The data were gathered between July 21, 1986 and July 23, 1986 in five separate dye releases.
Values in parentheses are estimated.

TABLE 5

SUMMARY OF HYDRAULIC DATA
Wichita River Survey (April 7, 1981)

Description of Reach	Distance (km)	Travel Time (hrs)	Avg. Flow (m^3/s)	Avg. Velocity (m/s)	Avg. Width (m)	Avg. Depth (m)
Wichita River from FM 369 (Km 106.1) to Wichita River at FM 1634 (Km 100.1)	6.0	11.83	(0.829)	(0.141)	(18.3)	(0.32)
Wichita River from FM 1634 (Km 100.1) to Wichita River at Loop 11 (Beverly Drive) (Km 92.1)	8.0	16.33	(0.822)	(0.136)	(21.2)	(0.29)
Wichita River from Wichita Falls WWTP (10508.001) outfall (Km 83.7) to Wichita River at River Road (Km 79.8)	3.9	5.07	(1.617)	(0.214)	(21.0)	(0.36)
Wichita River from River Road (Km 79.8) to Wichita River at Eastland Lane (Km 73.7)	6.1	6.25	(1.617)	(0.271)	(22.9)	(0.26)
Wichita River from Eastland Lane (Km 73.7) to Wichita River at Krajca Lane (Km 63.2)	10.5	12.67	(1.778)	(0.230)	(24.0)	(0.32)

The data were gathered between April 7, 1981 and April 9, 1981 in two separate dye releases.
Values in parentheses are estimated.

TABLE 6

ADVECTIVE HYDRAULIC COEFFICIENTS FOR THE WICHITA RIVER MODEL

$$$ DATA TYPE 9 (ADVECTIVE HYDRAULIC COEFFICIENTS) $$$

CARD TYPE	REACH	ID	VELOCITY "A"	VELOCITY "B"	DEPTH "C"	DEPTH "D"	DEPTH "E"	MANNINGS "N"
HYDR-1	1	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	2	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	3	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	4	BV	.19100000	.500	.956	.400	.000	.035
HYDR-1	5	BV	.19100000	.500	.956	.400	.000	.035
HYDR-1	6	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	7	DC	.61500000	.500	.430	.400	.000	.035
HYDR-1	8	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	9	WR	.12900000	.500	.826	.400	.000	.035
HYDR-1	10	WR	.17900000	.500	.741	.400	.000	.035
HYDR-1	11	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	12	SF	.84400000	.500	.293	.400	.000	.035
HYDR-1	13	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	14	IP	.84400000	.500	.293	.400	.000	.035
HYDR-1	15	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	16	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	17	WR	.17900000	.500	.741	.400	.000	.035
HYDR-1	18	WR	.19200000	.500	.501	.400	.000	.035
HYDR-1	19	WR	.17900000	.500	.520	.400	.000	.035
HYDR-1	20	PU	.62500000	.500	.492	.400	.000	.035
HYDR-1	21	WR	.17900000	.500	.520	.400	.000	.035
HYDR-1	22	WR	.17400000	.500	.431	.400	.000	.035
HYDR-1	23	WR	.17400000	.500	.431	.400	.000	.035
HYDR-1	24	WR	.16800000	.500	.282	.400	.000	.035
HYDR-1	25	PL	.40500000	.500	.598	.400	.000	.035
HYDR-1	26	SH	.40500000	.500	.698	.400	.000	.035
HYDR-1	27	PL	.40500000	.500	.698	.400	.000	.035
HYDR-1	28	PL	.40500000	.500	.598	.400	.000	.035
HYDR-1	29	WR	.16800000	.500	.282	.400	.000	.035
HYDR-1	30	WR	.21300000	.500	.215	.400	.000	.035
HYDR-1	31	HC	.54200000	.500	.419	.400	.000	.035
HYDR-1	32	WR	.21300000	.500	.215	.400	.000	.035
HYDR-1	33	WR	.17100000	.500	.254	.400	.000	.035
HYDR-1	34	WR	.17100000	.500	.320	.400	.000	.035
HYDR-1	35	BR	.54200000	.500	.419	.400	.000	.035
HYDR-1	36	AQ	.54200000	.500	.419	.400	.000	.035
HYDR-1	37	BR	.54200000	.500	.419	.400	.000	.035
HYDR-1	38	WR	.17100000	.500	.320	.400	.000	.035
HYDR-1	39	WR	.17200000	.500	.396	.400	.000	.035
HYDR-1	40	WR	.17200000	.500	.396	.400	.000	.035
HYDR-1	41	WR	.17200000	.500	.396	.400	.000	.035
ENDATA09								

TABLE 7

SUMMARY OF FLOW MEASUREMENTS FOR STREAM STATIONS
Wichita River Water Quality Survey (July 21, 1986)

Stream Station	Date	Time	Flow (m^3/s)	Method*
Wichita River at SH 25 (Km 155.9)	07/21/86	1710	0.175	FM
Wichita River at River Kilometer 139 (Km 139.0)	07/22/86	1030	0.312	FM
Wichita River at FM 368 (Km 128.2)	07/22/86	---	0.963	FM
Wichita River at FM 369 (Km 106.1)	07/21/86	1950	1.054	FM
Wichita River at SH 11 (Km 92.1)	07/22/86	Dly Avg	2.039	USGS
	07/23/86	Dly Avg	1.897	USGS
Wichita River at River Road (Km 79.8)	07/23/86	1400	1.297	FM
Wichita River at Krajca Lane (Km 63.2)	07/23/86	1915	1.065	FM
Wichita River at FM 2393 (Km 48.6)	07/22/86	1725	2.264	FM
Wichita River at FM 810 (Km 28.1)	07/22/86	1158	2.974	USGS
	07/22/86	1948	3.483	USGS
	07/23/86	0702	4.984	USGS
	07/23/86	1100	4.531	USGS
	07/23/86	1200	4.446	USGS
	07/23/86	2400	3.540	USGS
	07/23/86	Dly Avg	4.361	USGS
	07/23/86	1125	4.015	FM
Beaver Creek at FM 2326 (Km 16.5)	07/21/86	Dly Avg	0.110	USGS
	07/22/86	Dly Avg	0.110	USGS
	07/23/86	Dly Avg	0.263	USGS
Deer Creek at FM 1206 (Km 3.0)	07/23/86	1000	0.187	FM
Buffalo Creek at FM 1814 (Km 1.8)	07/22/86	1745	0.124	FM

* FM: Flow Meter
USGS: USGS Gaging Station
--- No data available

TABLE 7 (continued)

Stream Station	Date	Time	Flow (m^3/s)	Method*
Plum Creek (WR Km 94.4) at FM 367 (Km 0.2)	07/22/86	---	0.360	FM

* FM: Flow Meter
USGS: USGS Gaging Station
--- No data available

TABLE 8

SUMMARY OF FIELD MEASUREMENTS FOR STREAM STATIONS
Wichita River Water Quality Survey (July 21, 1986)

Stream Station	Dissolved Oxygen (mg/l.)		Temperature (°C)		Conductivity (µmhos/cm)		pH	
	Average	Range	Average	Range	Average	Range	Average	Range
Wichita River at FM 1180 (Km 176.3)	6.9	5.7- 9.0	28.6	26.0-30.8	5,784	5,700-5,910	7.7	7.5-8.0
Wichita River at SH 25 (Km 155.9)	7.6	5.4-10.7	28.2	26.3-30.6	6,451	6,320-6,570	7.6	7.4-7.8
Wichita River at FM 368 (Km 128.2)	7.5	5.3- 9.5	29.8	27.6-32.5	5,820	5,710-5,900	7.7	7.5-7.9
Wichita River at FM 369 (Km 106.1)	7.6	5.1-10.0	30.2	27.8-33.2	5,874	5,710-5,960	7.8	7.6-8.1
Wichita River at FM 1634 (Km 100.1)	7.3	6.2- 8.6	29.3	26.6-31.9	5,361	4,560-5,920	7.7	7.4-8.1
Wichita River at SH Loop 11 (Km 92.1)	8.0	5.6-10.1	30.0	28.2-32.0	5,790	5,310-6,230	7.6	7.2-8.0
Wichita River at SH 240 (Km 85.9)	8.2	6.1-11.0	29.7	27.4-32.4	6,089	5,590-6,580	8.0	7.8-8.3
Wichita River at River Road (Km 79.8)	6.5	5.5- 7.8	29.7	27.7-31.2	5,226	4,980-5,390	7.8	7.2-8.2
Wichita River at Eastland Lane (Km 73.7)	5.6	3.8- 7.1	29.5	27.0-31.9	4,563	3,670-5,270	7.6	7.3-7.9
Wichita River at Krajca Lane (Km 63.2)	7.6	4.0-11.6	30.2	28.3-32.5	4,528	3,660-5,390	7.8	7.5-8.4
Wichita River at FM 2393 (Km 48.6)	7.3	4.8-10.3	30.2	28.2-31.8	4,815	3,900-5,340	7.9	7.7-8.2
Wichita River at FM 810 (Km 28.1)	9.9	5.8-13.9	30.3	29.0-31.7	5,631	5,380-5,930	8.3	8.0-8.6
Wichita River at FM 171 (Km 6.5)	10.4	7.6-12.9	30.5	29.0-32.4	5,381	4,760-5,730	8.8	8.7-8.9
Beaver Creek at SH 25 (Km 6.8)*	6.0	---	27.4	---	4,470	---	7.7	---
Buffalo Creek at FM 1814 (Km 1.8)	7.0	4.9- 9.4	28.9	27.1-31.1	4,746	4,700-4,770	7.5	7.3-7.8

Measurements were taken at the surface approximately every four hours between July 21, 1986 at 0600 and July 21, 1986 at 1800, unless otherwise noted.

--- No data available * Grab sample

TABLE 8 (continued)

Stream Station	Dissolved Oxygen (mg/L)		Temperature (°C)		Conductivity (μmhos/cm)		pH	
	Average	Range	Average	Range	Average	Range	Average	Range
Unnamed tributary (WR Km 104.1) at FM 369 (Km 0.7)*	4.6	---	30.4	---	5,500	---	7.2	---
West Fork Pond Creek at FM 367 (Km 0.9)*	7.7	---	31.1	---	5,200	---	7.8	---
Plum Creek (WR Km 94.4) at FM 367 (Km 0.2)*	7.4	---	31.7	---	5,430	---	8.0	---
Holliday Creek at Harding Street (Km 1.3)	3.7	1.6- 9.0	29.2	26.7-30.7	717	563- 802	8.2	7.7-9.6
Unnamed tributary (BR Km 0.7) at FM 1740 (Km 0.8)*	7.9	---	28.9	---	5,530	---	7.5	---
Bear Creek at FM 1740 (Km 2.8)*	8.0	---	30.1	---	3,770	---	7.7	---
Plum Creek (WR Km 83.4) at FM 171 (Km 1.9)	7.6	4.7-10.9	29.7	26.5-32.8	4,779	3,820-6,290	7.7	7.1-8.2

Measurements were taken at the surface approximately every four hours between July 21, 1986 at 0600 and July 21, 1986 at 1800, unless otherwise noted.

--- No data available * Grab sample

TABLE 9

SUMMARY OF LABORATORY ANALYSES FOR STREAM STATIONS
Wichita River Water Quality Survey (July 21, 1986)

Stream Station	Unfil. BOD_5 N-Supp (mg/L)	Filt. BOD_5 N-Supp (mg/L)	Unfil. BOD_{20} N-Supp (mg/L)	Filt. BOD_{20} N-Supp (mg/L)	TSS (mg/L)	VSS (mg/L)	Filt. TOC (mg/L)	Org-N (mg/L)	NH_3-N (mg/L)	NO_2-N + NO_3-N (mg/L)	Total N (mg/L)	Ortho P (mg/L)	Total P (mg/L)	Chlor a (μg/L)	Cl^- (mg/L)	$SO_4^=$ (mg/L)	TDS (mg/L)
Wichita River at FM 1180 (Km 176.3)	3.5	1.0	7.5	2.0	130	22	5	1.57	0.03	<0.02	<1.62	0.01	0.17	42	1,614	839	---
Wichita River at SH 25 (Km 155.9)	5.5	1.0	12.0	2.0	61	10	5	1.84	0.06	<0.02	<1.92	0.01	0.21	91	1,835	880	---
Wichita River at FM 368 (Km 128.2)	3.5	1.0	7.5	2.5	56	9	5	1.21	0.09	<0.02	<1.32	0.03	0.13	30	1,724	667	---
Wichita River at FM 369 (Km 106.1)	3.5	0.5	7.5	1.5	215	16	4	1.68	0.02	<0.02	<1.72	0.03	0.29	44	1,609	717	---
Wichita River at FM 1634 (Km 100.1)	2.5	1.0	5.5	2.0	69	8	5	1.28	<0.02	0.04	<1.34	0.03	0.16	23	1,469	733	---
Wichita River at SH Loop 11 (Km 92.1)	3.0	1.0	6.5	2.0	72	16	4	1.28	0.02	<0.02	<1.32	0.02	0.15	35	1,476	705	---
Wichita River at SH 240 (Km 85.9)	4.0	1.0	8.0	2.5	45	10	5	1.24	0.06	<0.02	<1.32	0.03	0.16	35	1,505	700	---
Wichita River at River Road (Km 79.8)	3.5	1.5	7.0	3.0	23	5	6	1.59	0.11	1.12	2.82	1.20	1.36	19	1,303	604	---
Wichita River at Eastland (Km 73.7)	4.5	1.5	9.0	3.0	42	12	7	2.66	0.04	0.67	3.37	0.90	1.07	33	998	458	---
Wichita River at Krajca Lane (Km 63.2)	3.5	1.0	7.5	2.5	68	10	6	1.62	0.08	0.78	2.48	1.02	1.25	38	1,066	492	---
Wichita River at FM 2393 (Km 48.6)	3.5	1.0	8.0	2.0	76	10	5	1.82	<0.02	0.68	<2.58	0.91	1.11	56	1,182	562	---

Samples were composited approximately every four hours between July 21, 1986 at 0600 and July 21, 1986 at 1800, unless otherwise noted.

--- No data available

TABLE 9 (continued)

Stream Station	Unfil. BOD_5 N-Supp (mg/L)	Filt. BOD_5 N-Supp (mg/L)	Unfil. BOD_{20} N-Supp (mg/L)	Filt. BOD_{20} N-Supp (mg/L)	TSS (mg/L)	VSS (mg/L)	Filt. TOC (mg/L)	Org-N (mg/L)	NH_3-N (mg/L)	NO_2-N + NO_3-N (mg/L)	Total N (mg/L)	Ortho P (mg/L)	Total P (mg/L)	Chlor a (µg/L)	Cl^- (mg/L)	$SO_4^=$ (mg/L)	TDS (mg/L)
Wichita River at FM 810 (Km 28.1)	5.0	1.0	9.0	3.5	46	12	10	1.95	0.05	0.26	2.26	0.75	0.96	42	835	379	---
Wichita River at FM 171 (Km 6.5)	4.5	1.0	12.0	2.0	65	14	5	1.58	0.02	< 0.02	< 1.62	0.44	0.73	63	1,384	620	---
Beaver Creek at SH 25 (Km 6.8)	2.0	0.5	6.5	2.0	60	5	5	1.58	< 0.02	< 0.02	< 1.62	0.01	0.11	36	1,535	55	---
Buffalo Creek at FM 1814 (Km 1.8)	2.5	1.0	5.0	2.5	49	14	7	1.36	0.24	3.02	4.62	1.45	1.59	18	1,287	630	---
Unnamed tributary (WR Km 104.1) at FM 369 (Km 0.7)	4.5	1.5	9.5	4.0	429	33	8	2.12	0.02	< 0.02	< 2.16	0.05	0.51	18	1,585	817	---
West Fork Pond Creek at FM 367 (Km 0.9)	3.0	1.5	7.0	3.5	50	4	7	1.48	0.02	0.07	1.57	0.14	0.29	22	1,444	757	---
Plum Creek (WR Km 94.4) at FM 367 (Km 0.2)	2.5	1.0	6.0	2.0	47	12	5	1.27	0.03	< 0.02	< 1.32	0.01	0.13	28	1,508	791	---
Holliday Creek at Harding Street (Km 1.3)	6.5	2.5	12.0	5.0	115	11	9	1.82	< 0.02	0.25	< 2.09	< 0.01	0.25	33	123	61	---
Unnamed tributary (BR Km 0.7) at FM 1740 (Km 0.8)	1.0	0.5	2.0	1.5	10	3	4	0.66	0.04	0.66	1.36	0.02	0.05	< 2	1,291	680	---
Bear Creek at FM 1740 (Km 2.8)	5.0	1.0	9.0	3.5	46	12	10	1.95	0.05	0.26	2.26	0.75	0.96	42	835	379	---
Plum Creek (WR Km 83.4) at FM 171 (Km 1.9)	3.0	1.5	7.0	4.0	50	13	7	1.28	< 0.02	0.89	2.19	0.73	0.93	25	1,182	560	---

Samples were composited approximately every four hours between July 21, 1986 at 0600 and July 21, 1986 at 1800, unless otherwise noted.

--- No data available

TABLE 10

SUMMARY OF FLOW MEASUREMENTS FOR WASTEWATER DISCHARGERS
Wichita River Water Quality Survey (July 21, 1986)

Wastewater Discharger	Date	Time	Flow (m^3/s)	Method*
City of Wichita Falls (10509.001)	07/22/86	1025	0.383	IM
	07/22/86	1441	0.460	IM
	07/22/86	1932	0.478	IM
	07/23/86	0555	0.274	IM

* IM: Instantaneous Measurements

TABLE 11

SUMMARY OF FIELD MEASUREMENTS FOR WASTEWATER DISCHARGERS
Wichita River Water Quality Survey (July 21, 1986)

Wastewater Discharger	Dissolved Oxygen (mg/L)		Temperature (°C)		Conductivity (μmhos/cm)		pH		Chlorine Residual (ppt)	
	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
City of Wichita Falls (10509.001)	7.0	6.9-7.5	27.3	26.9-27.7	1,532	1,220-2,157	7.5	7.3-7.7	1.5	0.4-2.5

Measurements were taken approximately every four hours between July 21, 1986 at 0600 and July 21, 1986 at 1800, unless otherwise noted.

TABLE 12

SUMMARY OF LABORATORY ANALYSES FOR WASTEWATER DISCHARGERS
Wichita River Water Quality Survey (July 21, 1986)

Wastewater Discharger	Unfil. BOD_5 N-Supp (mg/L)	Filt. BOD_5 N-Supp (mg/L)	Unfil. BOD_{20} N-Supp (mg/L)	Filt. BOD_{20} N-Supp (mg/L)	TSS (mg/L)	VSS (mg/L)	Filt. TOC (mg/L)	Org-N (mg/L)	NH_3-N (mg/L)	NO_2-N + NO_3-N (mg/L)	Total N (mg/L)	Ortho P (mg/L)	Total P (mg/L)	Chlor a (μg/L)	Cl^- (mg/L)	$SO_4^=$ (mg/L)	TDS (mg/L)
City of Wichita Falls (10509.001)	3.0	2.0	6.5	4.5	6	4	13	4.39	0.91	6.66	11.96	7.04	7.22	<2	217	99	---

Samples were composited approximately every four hours between July 21, 1986 at 0600 and July 21, 1986 at 1800, unless otherwise noted.

--- No data available

TABLE 13

SUMMARY OF SELF-REPORTING DATA FOR WASTEWATER DISCHARGERS
Wichita River (July, 1986)

Wastewater Discharger	Flow (m^3/s)	BOD_5 (mg/L)	TSS (mg/L)	NH_3-N (mg/L)	Permit Flow (m^3/s)	Capacity (percent)
City of Electra (10020.001)	0.019	38.0	110.0	---	0.056	33.9
City of Wichita Falls-River Road (10509.001)	0.461	3.0	5.0	---	0.745	61.9
City of Wichita Falls-Northside (10509.005)	0.014	3.0	7.0	---	0.066	21.2
City of Crowell (10638.001)	0.002	6.0	7.0	---	0.009	22.2
City of Iowa Park (10691.002)	0.031	14.6	5.0	---	0.044	70.5
City of Byers (10890.001)	0.0018	4.2	10.0	---	0.0019	94.7

The data are 30-day average values for July, 1986 as reported to TWC by the discharger.
--- No data available

TABLE 14

MODEL INPUT FOR THE WICHITA RIVER CALIBRATION RUN
July 21, 1986 Data

```
TEXAS WATER COMMISSION WATER QUALITY STREAM MODEL
QUAL-TX      VERSION 3.2      UPDATED JANUARY 17, 1986


$$$ DATA TYPE 1 (TITLES AND CONTROL CARDS) $$$

CARD TYPE          CONTROL TITLES

CNTROL01           WICHITA RIVER WASTELOAD EVALUATION- SEGMENT 0214
CNTROL02           CALIBRATION--JULY 21,1986 INTENSIVE WATER QUALITY SURVEY
CNTROL03   YES     ECHO DATA INPUT
CNTROL04    NO     INTERMEDIATE SUMMARY
CNTROL05    NO     FINAL REPORT
CNTROL06    NO     LINE PRINTER PLOT
CNTROL07    NO     GRAPHICS CAPABILITY
CNTROL08   YES     METRIC UNITS
CNTROL09   YES     OXYGEN DEPENDENT RATES
CNTROL11    NO     SENSITIVITY ANALYSIS
CNTROL12    NO     FLOW AUGMENTATION
ENDATA01


$$$ DATA TYPE 2 (MODEL OPTIONS) $$$

CARD TYPE          MODEL OPTION

MODOPT01    NO     TEMPERATURE
MODOPT02    NO     SALINITY
MODOPT03   YES     CONSERVATIVE MATERIAL  I = CHLORIDES MG/L
MODOPT04   YES     CONSERVATIVE MATERIAL II = CONDUCTIVITY MG/L
MODOPT05   YES     DISSOLVED OXYGEN
MODOPT06   YES     BIOCHEMICAL OXYGEN DEMAND
MODOPT07   YES     NITROGEN
MODOPT08    NO     PHOSPHORUS
MODOPT09    NO     CHLOROPHYLL A
MODOPT10    NO     MACROPHYTES
MODOPT11    NO     COLIFORM
MODOPT12    NO     NONCONSERVATIVE MATERIAL =
ENDATA02


$$$ DATA TYPE 3 (PROGRAM CONSTANTS) $$$

CARD TYPE          DESCRIPTION OF CONSTANT                        VALUE

PROGRAM            PLOT CONTROL VALUE                     =        3.00000
PROGRAM            MAXIMUM ITERATION LIMIT                =      500.00000
PROGRAM            N ALGAL UPTAKE (MG O/UG CHLA/D)        =         .05000
PROGRAM            EFFECTIVE BOD DUE TO ALGAE             =         .15000
PROGRAM            N PREFERENCE                           =         .00000
ENDATA03
```

TABLE 14 (continued)

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$$$ DATA TYPE 4 (TEMPERATURE CORRECTION CONSTANTS FOR RATE COEFFICIENTS) $$$

CARD TYPE        RATE CODE      THETA VALUE

ENDATA04

$$$ CONSTANTS TYPE 5 (TEMPERATURE DATA) $$$

CARD TYPE          DESCRIPTION OF CONSTANT                    VALUE

ENDATA05

$$$ DATA TYPE 6 (ALGAE CONSTANTS) $$$

CARD TYPE          DESCRIPTION OF CONSTANT                    VALUE

ENDATA06

$$$ DATA TYPE 7 (MACROPHYTE CONSTANTS) $$$

CARD TYPE          DESCRIPTION OF CONSTANT                    VALUE

ENDATA07

$$$ DATA TYPE 8 (REACH IDENTIFICATION DATA) $$$
```

CARD TYPE	REACH	ID	NAME	BEGIN REACH KM		END REACH KM	ELEM LENGTH KM	REACH LENGTH KM	ELEMS PER RCH	BEGIN ELEM NUM	END ELEM NUM
REACH ID	1	WR	DIVERSION DAM - FM1180	178.00	TO	176.00	1.0000	2.00	2	1	2
REACH ID	2	WR	FM1180 - SH25	176.00	TO	156.00	1.0000	20.00	20	3	22
REACH ID	3	WR	SH25 - BEAVER CREEK	156.00	TO	148.00	1.0000	8.00	8	23	30
REACH ID	4	BV	FM2326 - SH25	17.00	TO	7.00	1.0000	10.00	10	31	40
REACH ID	5	BV	SH25 - WICHITA RIVER	7.00	TO	.00	1.0000	7.00	7	41	47
REACH ID	6	WR	BEAVER CREEK - DEER CREEK	148.00	TO	144.00	1.0000	4.00	4	48	51
REACH ID	7	DC	RKM 0.5 - WICHITA RIVER	.50	TO	.00	.5000	.50	1	52	52
REACH ID	8	WR	DEER CREEK - RKM 139	144.00	TO	139.00	1.0000	5.00	5	53	57
REACH ID	9	WR	RKM 139.0 - FM 368	139.00	TO	128.00	1.0000	11.00	11	58	68
REACH ID	10	WR	FM368 - BUFFALO CREEK	128.00	TO	117.00	1.0000	11.00	11	69	79
REACH ID	11	BF	RKM 17 - SOUTH FORK BF	17.00	TO	16.00	1.0000	1.00	1	80	80
REACH ID	12	SF	RKM 26 - BUFFALO CREEK	26.00	TO	.00	1.0000	26.00	26	81	106
REACH ID	13	BF	SOUTH FORK BF - IOWA PARK DITCH	16.00	TO	7.00	1.0000	9.00	9	107	115
REACH ID	14	IP	RKM 1.5 - BUFFALO CREEK	1.50	TO	.00	.5000	1.50	3	116	118
RECAH ID	15	BF	IOWA PARK DITCH - FM1814	7.00	TO	2.00	1.0000	5.00	5	119	123
REACH ID	16	BF	FM1814 - WICHITA RIVER	2.00	TO	.00	1.0000	2.00	2	124	125
REACH ID	17	WR	BUFFALO CK - FM369	117.00	TO	106.00	1.0000	11.00	11	126	136
REACH ID	18	WR	FM369 - FM1634	106.00	TO	100.00	1.0000	6.00	6	137	142
REACH ID	19	WR	FM1634 - PLUM CK (UPPER)	100.00	TO	94.00	1.0000	6.00	6	143	148

TABLE 14 (continued)

REACH ID	20	PU	RKM 0.5 - WICHITA RIVER	.50	TO	.00	.5000	.50	1	149	149
REACH ID	21	WR	PLUM CK (UPPER) - LOOP 11	94.00	TO	92.00	1.0000	2.00	2	150	151
REACH ID	22	WR	LOOP 11 - SH240	92.00	TO	86.00	1.0000	6.00	6	152	157
REACH ID	23	WR	SH240 - WICHITA FALLS WWTP	86.00	TO	84.00	1.0000	2.00	2	158	159
REACH ID	24	WR	WICHITA FALLS WWTP - PLUM CREEK	84.00	TO	83.00	1.0000	1.00	1	160	160
REACH ID	25	PL	RKM 4.0 - SHEPPARD WWTP DITCH	4.00	TO	3.00	1.0000	1.00	1	161	161
REACH ID	26	SH	RKM 4.0 - PLUM CK (LOWER)	4.00	TO	.00	1.0000	4.00	4	162	165
REACH ID	27	PL	SHEPPARD WWTP DITCH - FM171	3.00	TO	2.00	1.0000	1.00	1	166	166
REACH ID	28	PL	FM171 - WICHITA RIVER	2.00	TO	.00	1.0000	2.00	2	167	168
REACH ID	29	WR	PLUM CK - RIVER ROAD	83.00	TO	80.00	1.0000	3.00	3	169	171
REACH ID	30	WR	RIVER ROAD - HOLIDAY CREEK	80.00	TO	79.00	1.0000	1.00	1	172	172
REACH ID	31	HC	HOLIDAY CK HDWTR - WICHITA RIVER	.50	TO	.00	.5000	.50	1	173	173
REACH ID	32	WR	HOLIDAY CREEK - EASTLAND LANE	79.00	TO	74.00	1.0000	5.00	5	174	178
REACH ID	33	WR	EASTLAND LANE - KRAJCA ROAD	74.00	TO	63.00	1.0000	11.00	11	179	189
REACH ID	34	WR	KRAJCA RD - BEAR CREEK	63.00	TO	60.00	1.0000	3.00	3	190	192
REACH ID	35	BR	RKM 13 - AQUEDUCT	13.00	TO	12.00	1.0000	1.00	1	193	193
REACH ID	36	AQ	RKM 3.0 - BEAR CREEK	3.00	TO	.00	.5000	3.00	6	194	199
REACH ID	37	BR	BEAR CK HDWTR - WICHITA RIVER	12.00	TO	.00	1.0000	12.00	12	200	211
REACH ID	38	WR	BEAR CREEK - FM2393	60.00	TO	49.00	1.0000	11.00	11	212	222
REACH ID	39	WR	FM2393 - FM810	49.00	TO	28.00	1.0000	21.00	21	223	243
REACH ID	40	WR	FM810 - FM171	28.00	TO	7.00	1.0000	21.00	21	244	264
REACH ID	41	WR	FM171 TO CONFLUENCE W/ RED RIVER	7.00	TO	.00	1.0000	7.00	7	265	271
ENDATA08											

$$$ DATA TYPE 9 (ADVECTIVE HYDRAULIC COEFFICIENTS) $$$

CARD TYPE	REACH	ID	VELOCITY "A"	VELOCITY "B"	DEPTH "C"	DEPTH "D"	DEPTH "E"	MANNINGS "N"
HYDR-1	1	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	2	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	3	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	4	BV	.19100000	.500	.956	.400	.000	.035
HYDR-1	5	BV	.19100000	.500	.956	.400	.000	.035
HYDR-1	6	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	7	DC	.61500000	.500	.430	.400	.000	.035
HYDR-1	8	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	9	WR	.12900000	.500	.826	.400	.000	.035
HYDR-1	10	WR	.17900000	.500	.741	.400	.000	.035
HYDR-1	11	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	12	SF	.84400000	.500	.293	.400	.000	.035
HYDR-1	13	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	14	IP	.84400000	.500	.293	.400	.000	.035
HYDR-1	15	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	16	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	17	WR	.17900000	.500	.741	.400	.000	.035
HYDR-1	18	WR	.19200000	.500	.501	.400	.000	.035
HYDR-1	19	WR	.17900000	.500	.520	.400	.000	.035
HYDR-1	20	PU	.62500000	.500	.482	.400	.000	.035
HYDR-1	21	WR	.17900000	.500	.520	.400	.000	.035
HYDR-1	22	WR	.17400000	.500	.431	.400	.000	.035
HYDR-1	23	WR	.17400000	.500	.431	.400	.000	.035
HYDR-1	24	WR	.16800000	.500	.282	.400	.000	.035
HYDR-1	25	PL	.40500000	.500	.598	.400	.000	.035
HYDR-1	26	SH	.40500000	.500	.598	.400	.000	.035

TABLE 14 (continued)

HYDR-1	27	PL	.40500000	.500	.598	.400	.000	.035
HYDR-1	28	PL	.40500000	.500	.599	.400	.000	.035
HYDR-1	29	WR	.16800000	.500	.282	.400	.000	.035
HYDR-1	30	WR	.21300000	.500	.215	.400	.000	.035
HYDR-1	31	HC	.54200000	.500	.419	.400	.000	.035
HYDR-1	32	WR	.21300000	.500	.215	.400	.000	.035
HYDR-1	33	WR	.17100000	.500	.254	.400	.000	.035
HYDR-1	34	WR	.17100000	.500	.320	.400	.000	.035
HYDR-1	35	BR	.54200000	.500	.419	.400	.000	.035
HYDR-1	36	AQ	.54200000	.500	.419	.400	.000	.035
HYDR-1	37	BR	.54200000	.500	.419	.400	.000	.035
HYDR-1	38	WR	.17100000	.500	.320	.400	.000	.035
HYDR-1	39	WR	.17200000	.500	.385	.400	.000	.035
HYDR-1	40	WR	.17200000	.500	.386	.400	.000	.035
HYDR-1	41	WR	.17200000	.500	.386	.400	.000	.035

ENDATA09

$$$ DATA TYPE 10 (DISPERSIVE HYDRAULIC COEFFICIENTS) $$$

CARD TYPE	REACH	ID	TIDAL RANGE	DISPERSION "A"	DISPERSION "B"	DISPERSION "C"	DISPERSION "D"

ENDATA10

$$$ DATA TYPE 11 (INITIAL CONDITIONS) $$$

CARD TYPE	REACH	ID	TEMP	SALIN	DO	NH3	NO3+2	PHOS	CHL A	MACRO
INITIAL	1	WR	.00	.00	6.90	1.00	1.00	1.00	42.00	.00
INITIAL	2	WR	28.60	.00	6.90	1.00	1.00	1.00	42.00	.00
INITIAL	3	WR	28.20	.00	7.60	1.00	1.00	1.00	91.00	.00
INITIAL	4	BV	27.40	.00	6.00	1.00	1.00	1.00	36.00	.00
INITIAL	5	BV	27.40	.00	6.00	1.00	1.00	1.00	36.00	.00
INITIAL	6	WR	28.60	.00	7.60	1.00	1.00	1.00	74.00	.00
INITIAL	7	DC	28.60	.00	7.60	1.00	1.00	1.00	2.00	.00
INITIAL	8	WR	28.60	.00	7.60	1.00	1.00	1.00	65.00	.00
INITIAL	9	WR	29.20	.00	7.50	1.00	1.00	1.00	54.00	.00
INITIAL	10	WR	29.80	.00	7.50	1.00	1.00	1.00	30.00	.00
INITIAL	11	BF	.00	.00	7.00	1.00	1.00	1.00	2.00	.00
INITIAL	12	SF	.00	.00	7.00	1.00	1.00	1.00	2.00	.00
INITIAL	13	BF	.00	.00	7.00	1.00	1.00	1.00	3.00	.00
INITIAL	14	IP	.00	.00	7.00	1.00	1.00	1.00	2.00	.00
INITIAL	15	BF	.00	.00	7.00	1.00	1.00	1.00	13.00	.00
INITIAL	16	BF	28.90	.00	7.00	1.00	1.00	1.00	18.00	.00
INITIAL	17	WR	30.00	.00	7.60	1.00	1.00	1.00	37.00	.00
INITIAL	18	WR	29.70	.00	7.60	1.00	1.00	1.00	44.00	.00
INITIAL	19	WR	29.70	.00	7.30	1.00	1.00	1.00	23.00	.00
INITIAL	20	PU	29.70	.00	8.00	1.00	1.00	1.00	2.00	.00
INITIAL	21	WR	29.70	.00	8.00	1.00	1.00	1.00	35.00	.00
INITIAL	22	WR	29.70	.00	8.00	1.00	1.00	1.00	35.00	.00
INITIAL	23	WR	29.70	.00	8.20	1.00	1.00	1.00	35.00	.00
INITIAL	24	WR	29.70	.00	7.60	1.00	1.00	1.00	29.00	.00
INITIAL	25	PL	.00	.00	7.60	1.00	1.00	1.00	2.00	.00

TABLE 14 (continued)

COEF-2	40	WR	.05	.05	1.00	.30	.00	.00	.00	
COEF-2	41	WR	.05	.05	1.00	.30	.00	.00	.00	
ENDATA13										

$$$ DATA TYPE 14 (ALGAE AND MACROPHYTE COEFFICIENTS) $$$

CARD TYPE	REACH	ID	SECCHI DEPTH	ALGAE: CHL A	ALGAE SETT	ALG CONV TO SOD	ALGAE GROW	ALGAE RESP	MACRO GROW	MACRO RESP
ENDATA14										

$$$ DATA TYPE 15 (COLIFORM AND NONCONSERVATIVE COEFFICIENTS) $$$

CARD TYPE	REACH	ID	COLIFORM DIE-OFF	NCM DECAY	NCM SETT	NCM CONV TO SOD
ENDATA15						

$$$ DATA TYPE 16 (INCREMENTAL DATA FOR FLOW, TEMPERATURE, SALINITY, AND CONSERVATIVES) $$$

CARD TYPE	REACH	ID	OUTFLOW	INFLOW	TEMP	SALIN	CM-I	CM-II	INFLOW/DIST
INCR-1	3	WR	.00000	.00100	28.20	.00	1835.00	6451.00	.00013
INCR-1	4	BV	.00000	.21000	27.40	.00	1535.00	4470.00	.02100
INCR-1	5	BV	.00000	.00800	27.40	.00	1535.00	4470.00	.00114
INCR-1	6	WR	.00000	.05600	28.60	.00	1805.00	6278.00	.01400
INCR-1	9	WR	.00000	.05700	29.20	.00	1767.00	6065.00	.00519
INCR-1	10	WR	-.02100	.00000	29.80	.00	1724.00	5820.00	.00000
INCR-1	17	WR	-.01200	.00000	30.00	.00	1663.00	5849.00	.00000
INCR-1	18	WR	.00000	.04300	30.20	.00	1609.00	5874.00	.00717
INCR-1	19	WR	.00000	.44000	29.30	.00	1469.00	5361.00	.07333
INCR-1	22	WR	.00000	.02600	30.00	.00	1476.00	5790.00	.00433
INCR-1	23	WR	.00000	.02500	29.70	.00	1505.00	6089.00	.01250
INCR-1	29	WR	.00000	.03800	29.70	.00	1422.00	5735.00	.01267
INCR-1	33	WR	.00000	.26000	29.50	.00	998.00	4563.00	.02364
INCR-1	34	WR	.00000	.04400	30.20	.00	1066.00	4528.00	.01467
INCR-1	38	WR	.00000	.52300	30.20	.00	1096.00	4602.00	.04755
INCR-1	39	WR	.00000	.00300	30.20	.00	1182.00	4815.00	.00014
ENDATA16									

$$$ DATA TYPE 17 (INCREMENTAL DATA FOR DO, BOD, AND NITROGEN) $$$

CARD TYPE	REACH	ID	DO	BOD	ORG-N	NH3	NO3+2
INCR-2	3	WR	6.90	3.00	.50	.05	.20
INCR-2	4	BV	7.60	3.00	.50	.05	.20
INCR-2	5	BV	6.00	3.00	.50	.05	.20
INCR-2	6	WR	7.60	3.00	.50	.05	.20
INCR-2	9	WR	7.50	3.00	.50	.05	.20

TABLE 14 (continued)

INCR-2	10	WR	7.50	3.00	.50	.05	.20
INCR-2	17	WR	7.60	3.00	.50	.05	.20
INCR-2	18	WR	7.60	3.00	.50	.05	.20
INCR-2	19	WR	7.30	3.00	.50	.05	.20
INCR-2	22	WR	8.00	3.00	.50	.05	.20
INCR-2	23	WR	8.20	3.00	.50	.05	.20
INCR-2	29	WR	7.50	3.00	.50	.05	.20
INCR-2	33	WR	5.60	3.00	.50	.05	.20
INCR-2	34	WR	7.60	3.00	.50	.05	.20
INCR-2	38	WR	7.50	3.00	.50	.05	.20
INCR-2	39	WR	7.30	3.00	.50	.05	.20
ENDATA17							

$$$ DATA TYPE 18 (INCREMENTAL DATA FOR PHOSPHORUS, CHLOROPHYLL, COLIFORM, AND NONCONSERVATIVES) $$$

CARD TYPE	REACH	ID	PHOS	CHL A	COLI	NCM
ENDATA18						

$$$ DATA TYPE 19 (NONPOINT SOURCE DATA) $$$

CARD TYPE	REACH	ID	BOD	ORG-N	COLI	NCM	DO
ENDATA19							

$$$ DATA TYPE 20 (HEADWATER FOR FLOW, TEMPERATURE, SALINITY AND CONSERVATIVES) $$$

CARD TYPE	ELEMENT	NAME	UNIT	FLOW	TEMP	SALIN	CM-I	CM-II
HDWTR-1	1	WICHITA RIVER	0	.17500	29.600	.000	1614.000	5784.000
HDWTR-1	31	BEAVER CREEK	0	.26300	27.400	.000	1535.000	4470.000
HDWTR-1	52	DEER CREEK	0	.18700	27.400	.000	1535.000	4470.000
HDWTR-1	80	BUFFALO CREEK	0	.12400	28.900	.000	1287.000	4745.000
HDWTR-1	81	SOUTH FORK BUFFALO C	0	.00000	29.900	.000	1287.000	4746.000
HDWTR-1	116	IOWA PARK WWTP DITCH	0	.00000	29.900	.000	1287.000	4746.000
HDWTR-1	149	PLUM CK. (UPPER)	0	.36000	31.700	.000	1508.000	5430.000
HDWTR-1	161	PLUM CK. (LOWER)	0	.21500	29.700	.000	1182.000	4779.000
HDWTR-1	162	SHEPPARD WWTP DITCH	0	.00000	29.700	.000	1182.000	4779.000
HDWTR-1	173	HOILDAY CREEK	0	.66700	29.200	.000	123.000	717.000
HDWTR-1	193	BEAR CREEK	0	.42900	30.100	.000	835.000	3770.000
HDWTR-1	194	AQUEDUCT	0	.00000	30.100	.000	835.000	3770.000
ENDATA20								

$$$ DATA TYPE 21 (HEADWATER DATA FOR DO, BOD, AND NITROGEN) $$$

CARD TYPE	ELEMENT	NAME	DO	BOD	ORG-N	NH3	NO3+2
HDWTR-2	1	WICHITA RIVER	6.90	7.50	1.57	.03	.02

TABLE 14 (continued)

HDWTR-2	31	BEAVER CREEK	6.00	6.50	1.58	.02	.02
HDWTR-2	52	DEER CREEK	6.00	6.50	1.58	.02	.02
HDWTR-2	80	BUFFALO CREEK	7.00	5.00	1.36	.24	3.02
HDWTR-2	81	SOUTH FORK BUFFALO C	7.00	5.00	1.36	.24	3.02
HDWTR-2	116	IOWA PARK WWTP DITCH	7.00	5.00	1.36	.24	3.02
HDWTR-2	149	PLUM CK. (UPPER)	7.40	6.00	1.27	.03	.02
HDWTR-2	161	PLUM CK. (LOWER)	7.60	7.00	1.28	.02	.89
HDWTR-2	162	SHEPPARD WWTP DITCH	7.60	7.00	1.28	.02	.89
HDWTR-2	173	HOILDAY CREEK	3.70	12.00	1.82	.02	.25
HDWTR-2	193	BEAR CREEK	8.00	9.00	1.95	.05	.26
HDWTR-2	194	AQUEDUCT	8.00	9.00	1.95	.05	.26
ENDATA21							

$$$ DATA TYPE 22 (HEADWATER DATA FOR PHOSPHORUS, CHLOROPHYLL, COLIFORM, AND NONCONSERVATIVES) $$$

CARD TYPE	ELEMENT	NAME	PHOS	CHL A	COLI	NCM
ENDATA22						

$$$ DATA TYPE 23 (JUNCTION DATA) $$$

CARD TYPE	JUNCTION ELEMENT	UPSTRM ELEMENT	NAME
JUNCTION	48	30	BEAVER CREEK CONFLUENCE
JUNCTION	53	51	DEER CREEK CONFLUENCE
JUNCTION	107	80	SOUTH FORK BUFFALO CK. CONF.
JUNCTION	119	115	IOWA PARK WWTP DITCH CONF.
JUNCTION	126	79	BUFFALO CREEK CONFLUENCE
JUNCTION	150	148	PLUM CK. (UPPER) CONF.
JUNCTION	166	161	SHEPPARD WWTP DITCH CONF.
JUNCTION	169	160	PLUM CK. (LOWER) CONF.
JUNCTION	174	172	HOLIDAY CREEK CONFLUENCE
JUNCTION	200	193	AQUEDUCT CONFLUENCE
JUNCTION	212	192	BEAR CREEK CONFLUENCE
ENDATA23			

$$$ DATA TYPE 24 (WASTELOAD DATA FOR FLOW, TEMPERATURE, SALINITY, AND CONSERVATIVES) $$$

CARD TYPE	ELEMENT	NAME	FLOW	TEMP	SAL	CM-I	CM-II
WSTLD-1	160	WICHTA FLS-RIVER RD	.39400	27.300	.000	217.000	1532.000
ENDATA24							

$$$ DATA TYPE 25 (WASTELOAD DATA FOR DO, BOD, AND NITROGEN) $$$

CARD TYPE	ELEMENT	NAME	DO	BOD	% BOD RMVL	ORG-N	NH3	% NITRIF	NO3+2

TABLE 14 (continued)

```
WSTLD-2      160    WICHTA FLS-RIVER RD       7.00     6.50      .00     4.39      .91      .00     6.66
ENDATA25


$$$ DATA TYPE 26 (WASTELOAD DATA FOR PHOSPHORUS, CHLOROPHYLL, COLIFORM, AND NONCONSERVATIVES) $$$

CARD TYPE     ELEMENT   NAME                         PHOS     CHL A      COLI       NCM

ENDATA26


$$$ DATA TYPE 27 (LOWER BOUNDARY CONDITIONS) $$$

CARD TYPE          CONSTITUENT                     CONCENTRATION

ENDATA27


$$$ DATA TYPE 28 (FLOW AUGMENTATION DATA) $$$

CARD TYPE         REACH       AVAIL HDWS       TARGET              ORDER OF AVAIL SOURCES

ENDATA28


$$$ DATA TYPE 29 (SENSITIVITY ANALYSIS DATA) $$$

CARD TYPE         PARAMETER     COL 1      COL 2      COL 3      COL 4      COL 5      COL 6      COL 7      COL 8

ENDATA29


$$$ DATA TYPE 30 (PLOT CONTROL CARDS) $$$

NUMBER OF PLOTS =  1
NUMBER OF REACHES IN PLOT 1 =  23      INCREMENT =  1.00
PLOT RCH    1   2   3   6   8   9  10  17  18  19  21  22  23  24  29  30  32  33  34  38  39  40  41
ENDATA30
```

TABLE 15

SUMMARY OF FLOW MEASUREMENTS FOR STREAM STATIONS
Wichita River Water Quality Survey (April 7, 1981)

Stream Station	Date	Time	Flow (m^3/s)	Method*
Wichita River at FM 1180 (Km 176.3)	04/07/81	1720	0.077	FM
Wichita River at FM 369 (Km 106.1)	04/09/81	1300	0.829	FM
Wichita River at SH Loop 11 (Km 92.1)	04/09/81	0730	0.822	USGS
Wichita River at River Road (Km 79.8)	04/09/81	0915	1.617	FM
Wichita River at Krajca Lane (Km 63.2)	04/08/81	1215	1.778	FM
Wichita River at FM 810 (Km 28.1)	04/07/81	0705	1.990	USGS
	04/07/81	1115	2.040	USGS
	04/07/81	1555	2.280	USGS
	04/07/81	1915	2.266	USGS
Beaver Creek at SH 25 (Km 6.8)	04/08/81	1500	0.020	FM
Buffalo Creek at FM 1814 (Km 1.8)	04/09/81	1230	0.046	FM
Plum Creek at FM 171 (Km 1.9)	04/09/81	0820	0.044	FM

* FM: Flow Meter
USGS: USGS Gaging Station

TABLE 16

SUMMARY OF FIELD MEASUREMENTS FOR STREAM STATIONS
Wichita River Water Quality Survey (April 7, 1981)

Stream Station	Dissolved Oxygen (mg/L)		Temperature (°C)		Conductivity (µmhos/cm)		pH	
	Average	Range	Average	Range	Average	Range	Average	Range
Wichita River at FM 1180 (Km 176.3)	9.9	8.6-11.2	18.2	14.6-21.1	6,368	6,330-6,410	---	---
Wichita River at SH 25 (Km 155.9)	9.6	8.1-11.6	18.3	13.7-22.2	7,855	7,780-7,960	---	---
Wichita River at FM 368 (Km 128.2)	9.3	8.6-10.6	19.0	14.5-23.1	7,599	7,530-7,710	---	---
Wichita River at FM 369 (Km 106.1)	10.7	8.8-12.4	18.2	13.7-21.8	7,597	7,340-7,810	7.7	7.4-8.0
Wichita River at SH Loop 11 (Km 92.1)	9.5	8.7-10.2	18.1	14.3-21.5	7,662	7,620-7,700	7.7	7.4-7.9
Wichita River at SH 240 (Km 85.9)	9.4	8.6-10.3	18.0	15.0-20.5	7,391	7,330-7,480	7.8	7.6-7.9
Wichita River at River Road (Km 79.8)	9.5	8.1-10.7	18.7	15.1-21.7	5,087	4,910-5,180	7.7	7.6-7.8
Wichita River at Eastland Lane (Km 73.7)	10.0	7.1-12.6	18.5	14.6-21.6	4,831	4,700-5,000	7.8	7.7-7.9
Wichita River at Krajca Lane (Km 63.2)	9.8	7.5-11.4	18.8	15.2-22.4	5,090	4,870-5,370	7.6	7.4-7.9
Wichita River at FM 2393 (Km 48.6)	8.6	7.5- 9.9	18.6	15.6-21.3	4,704	4,520-4,960	7.6	7.4-7.8
Wichita River at FM 810 (Km 28.1)	9.5	8.4-10.6	18.1	15.5-20.1	4,479	4,390-4,560	7.8	7.6-8.0
Wichita River at FM 171 (Km 6.5)	9.4	7.6-11.2	18.5	15.4-21.2	3,335	2,850-4,010	7.8	7.5-8.1
Beaver Creek at SH 25 (Km 6.8)	8.9	8.1- 9.6	18.5	15.6-20.8	3,409	3,360-3,450	---	---
Buffalo Creek at FM 1814 (Km 1.8)	12.3	8.9-16.4	18.5	14.2-23.0	6,036	5,810-6,260	---	---
Holliday Creek at Harding Street (Km 1.3)	9.5	7.0-12.3	17.0	14.6-19.4	1,599	1,574-1,634	8.0	7.9-8.2

Measurements were taken at the surface approximately every four hours between April 7, 1981 at 0630 and April 7, 1981 at 1830, unless otherwise noted.

--- No data available

TABLE 21

SUMMARY OF SELF-REPORTING DATA FOR WASTEWATER DISCHARGERS
Wichita River (April, 1981)

Wastewater Discharger	Flow (m^3/s)	BOD_5 (mg/L)	TSS (mg/L)	NH_3-N (mg/L)	Permit Flow (m^3/s)	Capacity (percent)
City of Electra (10020.001)	0.008	31.0	110.0	---	0.028	29.7
City of Wichita Falls (10509.001)	0.620	6.8	12.5	---	0.745	83.2
City of Crowell (10638.001)	0.006	5.0	13.0	---	0.009	70.0
City of Iowa Park (10691.002)	0.022	5.4	16.0	---	0.044	49.5
City of Byers (10890.001)	0.001	2.0	2.0	---	0.002	70.7

The data are 30-day average values for April, 1981 as reported to TWC by the discharger.
--- No data available

TABLE 22

MODEL INPUT FOR THE WICHITA RIVER VERIFICATION RUN
April 7, 1981 Data

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TEXAS WATER COMMISSION WATER QUALITY STREAM MODEL
QUAL-TX      VERSION 3.2     UPDATED JANUARY 17, 1986


$$$ DATA TYPE 1 (TITLES AND CONTROL CARDS) $$$

CARD TYPE           CONTROL TITLES

CNTROL01            WICHITA RIVER WASTELOAD EVALUATION- SEGMENT 0214
CNTROL02            VERIFICATION-APRIL 7,1981 INTENSIVE WATER QUALITY SURVEY
CNTROL03    YES     ECHO DATA INPUT
CNTROL04    NO      INTERMEDIATE SUMMARY
CNTROL05    NO      FINAL REPORT
CNTROL06    NO      LINE PRINTER PLOT
CNTROL07    NO      GRAPHICS CAPABILITY
CNTROL08    YES     METRIC UNITS
CNTROL09    YES     OXYGEN DEPENDENT RATES
CNTROL11    NO      SENSITIVITY ANALYSIS
CNTROL12    NO      FLOW AUGMENTATION
ENDATA01


$$$ DATA TYPE 2 (MODEL OPTIONS) $$$

CARD TYPE           MODEL OPTION

MODOPT01    NO      TEMPERATURE
MODOPT02    NO      SALINITY
MODOPT03    YES     CONSERVATIVE MATERIAL  I = CHLORIDES MG/L
MODOPT04    YES     CONSERVATIVE MATERIAL II = CONDUCTIVITY MG/L
MODOPT05    YES     DISSOLVED OXYGEN
MODOPT06    YES     BIOCHEMICAL OXYGEN DEMAND
MODOPT07    YES     NITROGEN
MODOPT08    NO      PHOSPHORUS
MODOPT09    NO      CHLOROPHYLL A
MODOPT10    NO      MACROPHYTES
MODOPT11    NO      COLIFORM
MODOPT12    NO      NONCONSERVATIVE MATERIAL =
ENDATA02


$$$ DATA TYPE 3 (PROGRAM CONSTANTS) $$$

CARD TYPE           DESCRIPTION OF CONSTANT                       VALUE

PROGRAM             PLOT CONTROL VALUE                  =       3.00000
PROGRAM             MAXIMUM ITERATION LIMIT             =     500.00000
PROGRAM             N ALGAL UPTAKE (MG O/UG CHLA/D)     =        .05000
PROGRAM             EFFECTIVE BOD DUE TO ALGAE          =        .15000
PROGRAM             N PREFERENCE                        =        .00000
ENDATA03
```

TABLE 22 (continued)

$$$ DATA TYPE 4 (TEMPERATURE CORRECTION CONSTANTS FOR RATE COEFFICIENTS) $$$

CARD TYPE RATE CODE THETA VALUE

ENDATA04

$$$ CONSTANTS TYPE 5 (TEMPERATURE DATA) $$$

CARD TYPE DESCRIPTION OF CONSTANT VALUE

ENDATA05

$$$ DATA TYPE 6 (ALGAE CONSTANTS) $$$

CARD TYPE DESCRIPTION OF CONSTANT VALUE

ENDATA06

$$$ DATA TYPE 7 (MACROPHYTE CONSTANTS) $$$

CARD TYPE DESCRIPTION OF CONSTANT VALUE

ENDATA07

$$$ DATA TYPE 8 (REACH IDENTIFICATION DATA) $$$

CARD TYPE	REACH	ID	NAME	BEGIN REACH KM		END REACH KM	ELEM LENGTH KM	REACH LENGTH KM	ELEMS PER RCH	BEGIN ELEM NUM	END ELEM NUM
REACH ID	1	WR	DIVERSION DAM - FM1180	178.00	TO	176.00	1.0000	2.00	2	1	2
REACH ID	2	WR	FM1180 - SH25	176.00	TO	156.00	1.0000	20.00	20	3	22
REACH ID	3	WR	SH25 - BEAVER CREEK	156.00	TO	148.00	1.0000	8.00	8	23	30
REACH ID	4	BV	FM2326 - SH25	17.00	TO	7.00	1.0000	10.00	10	31	40
REACH ID	5	BV	SH25 - WICHITA RIVER	7.00	TO	.00	1.0000	7.00	7	41	47
REACH ID	6	WR	BEAVER CREEK - DEER CK	148.00	TO	144.00	1.0000	4.00	4	48	51
REACH ID	7	DC	RKM 0.5 - WICHITA RIVER	.50	TO	.00	.5000	.50	1	52	52
REACH ID	8	WR	DEER CREEK - RKM 139	144.00	TO	139.00	1.0000	5.00	5	53	57
REACH ID	9	WR	RKM 139.0 - FM 368	139.00	TO	128.00	1.0000	11.00	11	58	68
REACH ID	10	WR	FM368 - BUFFALO CREEK	128.00	TO	117.00	1.0000	11.00	11	69	79
REACH ID	11	BF	RKM 17 - SOUTH FORK BF CK	17.00	TO	16.00	1.0000	1.00	1	80	80
REACH ID	12	SF	RKM 26 - BUFFALO CREEK	26.00	TO	.00	1.0000	26.00	26	81	106
REACH ID	13	BF	SOUTH FORK BF - IOWA PARK DITCH	16.00	TO	7.00	1.0000	9.00	9	107	115
REACH ID	14	IP	RKM 1.5 - BUFFALO CREEK	1.50	TO	.00	.5000	1.50	3	116	118
REACH ID	15	BF	IOWA PARK DITCH - FM1814	7.00	TO	2.00	1.0000	5.00	5	119	123
REACH ID	16	BF	FM1814 - WICHITA RIVER	2.00	TO	.00	1.0000	2.00	2	124	125
REACH ID	17	WR	BUFFALO CK - FM369	117.00	TO	106.00	1.0000	11.00	11	126	136
REACH ID	18	WR	FM369 - FM1634	106.00	TO	100.00	1.0000	6.00	6	137	142
REACH ID	19	WR	FM1634 - PLUM CREEK (UPPER)	100.00	TO	94.00	1.0000	6.00	6	143	148

TABLE 22 (continued)

REACH ID	20	PU	RKM 0.5 - WICHITA RIVER	.50	TO	.00	.5000	.50	1	149	149
REACH ID	21	WR	PLUM CREEK (UPPER) - LOOP 11	94.00	TO	92.00	1.0000	2.00	2	150	151
REACH ID	22	WR	LOOP 11 - SH240	92.00	TO	86.00	1.0000	6.00	6	152	157
REACH ID	23	WR	SH240 - WICHITA FALLS WWTP	86.00	TO	84.00	1.0000	2.00	2	158	159
REACH ID	24	WR	WICHITA FALLS WWTP - PLUM CREEK	94.00	TO	93.00	1.0000	1.00	1	160	160
REACH ID	25	PL	RKM 4.0 - SHEPPARD AFB DITCH	4.00	TO	3.00	1.0000	1.00	1	161	161
REACH ID	26	SH	RKM 4.0 - PLUM CREEK	4.00	TO	.00	1.0000	4.00	4	162	165
REACH ID	27	PL	SHEPPARD AFB DITCH - FM171	3.00	TO	2.00	1.0000	1.00	1	166	166
REACH ID	28	PL	FM171 - WICHITA RIVER	2.00	TO	.00	1.0000	2.00	2	167	168
REACH ID	29	WR	PLUM CK - RIVER ROAD	83.00	TO	80.00	1.0000	3.00	3	169	171
REACH ID	30	WR	RIVER ROAD - HOLIDAY CREEK	80.00	TO	79.00	1.0000	1.00	1	172	172
REACH ID	31	HC	HOLIDAY CK HDWTR - WICHITA RIVER	.50	TO	.00	.5000	.50	1	173	173
REACH ID	32	WR	HOLIDAY CREEK - EASTLAND LANE	79.00	TO	74.00	1.0000	5.00	5	174	178
REACH ID	33	WR	EASTLAND LANE - KRAJCA ROAD	74.00	TO	63.00	1.0000	11.00	11	179	189
REACH ID	34	WR	KRAJCA RD - BEAR CREEK	63.00	TO	60.00	1.0000	3.00	3	190	192
REACH ID	35	BR	RKM 13 - AQUEDUCT	13.00	TO	12.00	1.0000	1.00	1	193	193
REACH ID	36	AQ	RKM 3.0 - BEAR CREEK	3.00	TO	.00	.5000	3.00	6	194	199
REACH ID	37	BR	BEAR CK HDWTR - WICHITA RIVER	12.00	TO	.00	1.0000	12.00	12	200	211
REACH ID	38	WR	BEAR CREEK - FM2393	60.00	TO	49.00	1.0000	11.00	11	212	222
REACH ID	39	WR	FM2393 - FM810	49.00	TO	28.00	1.0000	21.00	21	223	243
REACH ID	40	WR	FM810 - FM171	28.00	TO	7.00	1.0000	21.00	21	244	264
REACH ID	41	WR	FM171 TO CONFLUENCE W/ RED RIVER	7.00	TO	.00	1.0000	7.00	7	265	271
ENDATA08											

$$$ DATA TYPE 9 (ADVECTIVE HYDRAULIC COEFFICIENTS) $$$

CARD TYPE	REACH	ID	VELOCITY "A"	VELOCITY "B"	DEPTH "C"	DEPTH "D"	DEPTH "E"	MANNINGS "N"
HYDR-1	1	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	2	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	3	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	4	BV	.19100000	.500	.956	.400	.000	.035
HYDR-1	5	BV	.19100000	.500	.956	.400	.000	.035
HYDR-1	6	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	7	DC	.61500000	.500	.430	.400	.000	.035
HYDR-1	8	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	9	WR	.12900000	.500	.926	.400	.000	.035
HYDR-1	10	WR	.17900000	.500	.741	.400	.000	.035
HYDR-1	11	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	12	SF	.84400000	.500	.293	.400	.000	.035
HYDR-1	13	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	14	IP	.84400000	.500	.293	.400	.000	.035
HYDR-1	15	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	16	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	17	WR	.17900000	.500	.741	.400	.000	.035
HYDR-1	18	WR	.19200000	.500	.501	.400	.000	.035
HYDR-1	19	WR	.17900000	.500	.520	.400	.000	.035
HYDR-1	20	PU	.62500000	.500	.492	.400	.000	.035
HYDR-1	21	WR	.17900000	.500	.520	.400	.000	.035
HYDR-1	22	WR	.17400000	.500	.401	.400	.000	.035
HYDR-1	23	WR	.17400000	.500	.401	.400	.000	.035
HYDR-1	24	WR	.16800000	.500	.292	.400	.000	.035
HYDR-1	25	PL	.40500000	.500	.598	.400	.000	.035
HYDR-1	26	SH	.40500000	.500	.598	.400	.000	.035

TABLE 22 (continued)

COEF-1	33	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	34	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	35	BR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	36	AQ	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	37	BR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	38	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	39	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	40	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	41	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000

ENDATA12

$$$ DATA TYPE 13 (NITROGEN AND PHOSPHORUS COEFFICIENTS) $$$

CARD TYPE	REACH	ID	ORG-N DECA	ORG-N SETT	ORGN CONV TO NH3 SRCE	NH3 DECA	NH3 SRCE	PHOS SRCE	DENIT RATE
COEF-2	1	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	2	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	3	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	4	BV	.05	.05	1.00	.30	.00	.00	.00
COEF-2	5	BV	.05	.05	1.00	.30	.00	.00	.00
COEF-2	6	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	7	DC	.05	.05	1.00	.30	.00	.00	.00
COEF-2	8	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	9	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	10	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	11	BF	.05	.05	1.00	.30	.00	.00	.00
COEF-2	12	SF	.05	.05	1.00	.30	.00	.00	.00
COEF-2	13	BF	.05	.05	1.00	.30	.00	.00	.00
COEF-2	14	IP	.05	.05	1.00	.30	.00	.00	.00
COEF-2	15	BF	.05	.05	1.00	.30	.00	.00	.00
COEF-2	16	BF	.05	.05	1.00	.30	.00	.00	.00
COEF-2	17	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	18	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	19	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	20	PU	.05	.05	1.00	.30	.00	.00	.00
COEF-2	21	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	22	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	23	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	24	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	25	PL	.05	.05	1.00	.30	.00	.00	.00
COEF-2	26	SH	.05	.05	1.00	.30	.00	.00	.00
COEF-2	27	PL	.05	.05	1.00	.30	.00	.00	.00
COEF-2	28	PL	.05	.05	1.00	.30	.00	.00	.00
COEF-2	29	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	30	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	31	HC	.05	.05	1.00	.30	.00	.00	.00
COEF-2	32	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	33	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	34	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	35	BR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	36	AQ	.05	.05	1.00	.30	.00	.00	.00
COEF-2	37	BR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	38	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	39	WR	.05	.05	1.00	.30	.00	.00	.00

TABLE 22 (continued)

COEF-2	40	WR	.05	.05	1.00	.30	.00	.00	.00	
COEF-2	41	WR	.05	.05	1.00	.30	.00	.00	.00	
ENDATA13										

$$$ DATA TYPE 14 (ALGAE AND MACROPHYTE COEFFICIENTS) $$$

CARD TYPE	REACH	ID	SECCHI DEPTH	ALGAE: CHL A	ALGAE SETT	ALG CONV TO SOD	ALGAE GROW	ALGAE RESP	MACRO GROW	MACRO RESP
ENDATA14										

$$$ DATA TYPE 15 (COLIFORM AND NONCONSERVATIVE COEFFICIENTS) $$$

CARD TYPE	REACH	ID	COLIFORM DIE-OFF	NCM DECAY	NCM SETT	NCM CONV TO SOD
ENDATA15						

$$$ DATA TYPE 16 (INCREMENTAL DATA FOR FLOW, TEMPERATURE, SALINITY, AND CONSERVATIVES) $$$

CARD TYPE	REACH	ID	OUTFLOW	INFLOW	TEMP	SALIN	CM-I	CM-II	INFLOW/DIST
INCR-1	2	WR	.00000	.22300	18.20	.00	1450.00	6368.00	.01115
INCR-1	3	WR	.00000	.00100	18.50	.00	2070.00	7855.00	.00013
INCR-1	5	BV	.00000	.01900	18.50	.00	900.00	3409.00	.00271
INCR-1	6	WR	.00000	.05400	18.50	.00	2040.00	7785.00	.01350
INCR-1	8	WR	.00000	.06800	18.60	.00	2025.00	7742.00	.01360
INCR-1	9	WR	.00000	.15000	18.70	.00	2009.00	7698.00	.01364
INCR-1	10	WR	.00000	.10900	19.00	.00	1970.00	7599.00	.00991
INCR-1	16	BF	.00000	.00200	18.50	.00	1640.00	6036.00	.00100
INCR-1	17	WR	.00000	.05800	18.60	.00	2010.00	7598.00	.00527
INCR-1	19	WR	-.00700	.00000	.00	.00	.00	.00	.00000
INCR-1	22	WR	.00000	.02300	18.10	.00	2020.00	7622.00	.00383
INCR-1	28	PL	.00000	.00100	18.60	.00	341.00	1555.00	.00050
INCR-1	29	WR	.00000	.01700	18.30	.00	1740.00	6447.00	.00567
INCR-1	30	WR	.00000	.05100	18.70	.00	1400.00	5087.00	.05100
INCR-1	33	WR	.00000	.10700	18.50	.00	1320.00	4831.00	.00973
INCR-1	34	WR	.00000	.01400	18.80	.00	1170.00	5090.00	.00467
INCR-1	38	WR	.00000	.17200	18.70	.00	1170.00	4990.00	.01564
INCR-1	39	WR	.00000	.18000	18.60	.00	1170.00	4704.00	.00857
ENDATA16									

$$$ DATA TYPE 17 (INCREMENTAL DATA FOR DO, BOD, AND NITROGEN) $$$

CARD TYPE	REACH	ID	DO	BOD	ORG-N	NH3	NO3+2
INCR-2	2	WR	9.90	3.00	.50	.05	.20
INCR-2	3	WR	9.60	3.00	.50	.05	.20
INCR-2	5	BV	8.90	3.00	.50	.05	.20

TABLE 22 (continued)

```
CARD TYPE     ELEMENT  NAME                  DO     BOD   % BOD  ORG-N    NH3   %      NO3+2
                                                          RMVL                  NITRIF
WSTLD-2         160    WICHTA FLS-RIVER RD   6.90   5.50   .00   2.05    5.85   .00    3.65
ENDATA25

$$$ DATA TYPE 26 (WASTELOAD DATA FOR PHOSPHORUS, CHLOROPHYLL, COLIFORM, AND NONCONSERVATIVES) $$$

CARD TYPE     ELEMENT  NAME                PHOS   CHL A   COLI     NCM

ENDATA26

$$$ DATA TYPE 27 (LOWER BOUNDARY CONDITIONS) $$$

CARD TYPE        CONSTITUENT                       CONCENTRATION

ENDATA27

$$$ DATA TYPE 28 (FLOW AUGMENTATION DATA) $$$

CARD TYPE        REACH      AVAIL HDWS      TARGET              ORDER OF AVAIL SOURCES

ENDATA28

$$$ DATA TYPE 29 (SENSITIVITY ANALYSIS DATA) $$$

CARD TYPE       PARAMETER   COL 1    COL 2    COL 3    COL 4    COL 5    COL 6    COL 7    COL 8

ENDATA29

$$$ DATA TYPE 30 (PLOT CONTROL CARDS) $$$

NUMBER OF PLOTS = 1
NUMBER OF REACHES IN PLOT 1 = 23     INCREMENT =  1.00
PLOT RCH   1   2   3   6   8   9  10  17  18  19  21  22  23  24  29  30  32  33  34  38  39  40  41
ENDATA30
```

TABLE 23

MODEL INPUT FOR THE WICHITA RIVER "NO WASTE LOADS" ALTERNATIVE

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TEXAS WATER COMMISSION WATER QUALITY STREAM MODEL
QUAL-TX      VERSION 3.2    UPDATED JANUARY 17, 1986


$$$ DATA TYPE 1 (TITLES AND CONTROL CARDS) $$$

CARD TYPE           CONTROL TITLES

CNTROL01            WICHITA RIVER WLE-SEGMENT 0214     QM0214.ALT-SQH-JUL/NOLOAD
CNTROL02            ALTERNATIVE W/  JULY  TEMPERATURES &   JULY   STREAM CONDITIONS
CNTROL03   YES      ECHO DATA INPUT
CNTROL04   NO       INTERMEDIATE SUMMARY
CNTROL05   NO       FINAL REPORT
CNTROL06   NO       LINE PRINTER PLOT
CNTROL07   NO       GRAPHICS CAPABILITY
CNTROL08   YES      METRIC UNITS
CNTROL09   YES      OXYGEN DEPENDENT RATES
CNTROL10   NO       SENSITIVITY ANALYSIS
CNTROL11   NO       FLOW AUGMENTATION
ENDATA01


$$$ DATA TYPE 2 (MODEL OPTIONS) $$$

CARD TYPE           MODEL OPTION

MODOPT01   NO       TEMPERATURE
MODOPT02   NO       SALINITY
MODOPT03   YES      CONSERVATIVE MATERIAL  I = CHLORIDES MG/L
MODOPT04   NO       CONSERVATIVE MATERIAL II =
MODOPT05   YES      DISSOLVED OXYGEN
MODOPT06   YES      BIOCHEMICAL OXYGEN DEMAND
MODOPT07   YES      NITROGEN
MODOPT08   NO       PHOSPHORUS
MODOPT09   NO       CHLOROPHYLL A
MODOPT10   NO       MACROPHYTES
MODOPT11   NO       COLIFORM
MODOPT12   NO       NONCONSERVATIVE MATERIAL =
ENDATA02


$$$ DATA TYPE 3 (PROGRAM CONSTANTS) $$$

CARD TYPE           DESCRIPTION OF CONSTANT                          VALUE

PROGRAM             PLOT CONTROL VALUE                        =      8.00000
PROGRAM             MAXIMUM ITERATION LIMIT                   =    500.00000
PROGRAM             N ALGAL UPTAKE (MG O/UG CHLA/D)           =       .05000
PROGRAM             EFFECTIVE BOD DUE TO ALGAE                =       .15000
PROGRAM             N PREFERENCE                              =       .00000
PROGRAM             BOD OXYGEN UPTAKE RATE (MG O/MG)          =      2.30000
ENDATA03
```

TABLE 23 (continued)

$$$ DATA TYPE 4 (TEMPERATURE CORRECTION CONSTANTS FOR RATE COEFFICIENTS) $$$

CARD TYPE   RATE CODE   THETA VALUE

ENDATA04

$$$ CONSTANTS TYPE 5 (TEMPERATURE DATA) $$$

CARD TYPE   DESCRIPTION OF CONSTANT   VALUE

ENDATA05

$$$ DATA TYPE 6 (ALGAE CONSTANTS) $$$

CARD TYPE   DESCRIPTION OF CONSTANT   VALUE

ENDATA06

$$$ DATA TYPE 7 (MACROPHYTE CONSTANTS) $$$

CARD TYPE   DESCRIPTION OF CONSTANT   VALUE

ENDATA07

$$$ DATA TYPE 8 (REACH IDENTIFICATION DATA) $$$

CARD TYPE	REACH	ID	NAME	BEGIN REACH KM		END REACH KM	ELEM LENGTH KM	REACH LENGTH KM	ELEMS PER RCH	BEGIN ELEM NUM	END ELEM NUM
REACH ID	1	WR	DIVERSION DAM - FM1180	178.00	TO	176.00	1.0000	2.00	2	1	2
REACH ID	2	WR	FM1180 - SH25	176.00	TO	156.00	1.0000	20.00	20	3	22
REACH ID	3	WR	SH25 - BEAVER CREEK	156.00	TO	148.00	1.0000	8.00	8	23	30
REACH ID	4	BV	FM2326 - SH25	17.00	TO	7.00	1.0000	10.00	10	31	40
REACH ID	5	BV	SH25 - WICHITA RIVER	7.00	TO	.00	1.0000	7.00	7	41	47
REACH ID	6	WR	BEAVER CREEK - DEER CREEK	148.00	TO	144.00	1.0000	4.00	4	48	51
REACH ID	7	DC	RKM 0.5 - WICHITA RIVER	.50	TO	.00	.5000	.50	1	52	52
REACH ID	8	WR	DEER CREEK - RKM 139	144.00	TO	139.00	1.0000	5.00	5	53	57
REACH ID	9	WR	RKM 139 - FM368	139.00	TO	128.00	1.0000	11.00	11	58	68
REACH ID	10	WR	FM368 - BUFFALO CREEK	128.00	TO	117.00	1.0000	11.00	11	69	79
REACH ID	11	BF	RKM 17 - SOUTH FORK BF	17.00	TO	16.00	1.0000	1.00	1	80	80
REACH ID	12	SF	RKM 26 - BUFFALO CREEK	26.00	TO	.00	1.0000	26.00	26	81	106
REACH ID	13	BF	SOUTH FORK BF - IOWA PARK DITCH	16.00	TO	7.00	1.0000	9.00	9	107	115
REACH ID	14	IP	RKM 1.5 - BUFFALO CREEK	1.50	TO	.00	.5000	1.50	3	116	118
REACH ID	15	BF	IOWA PARK DITCH - FM1814	7.00	TO	2.00	1.0000	5.00	5	119	123
REACH ID	16	BF	FM1814 - WICHITA RIVER	2.00	TO	.00	1.0000	2.00	2	124	125
REACH ID	17	WR	BUFFALO CK - FM369	117.00	TO	106.00	1.0000	11.00	11	126	136
REACH ID	18	WR	FM369 - FM1634	106.00	TO	100.00	1.0000	6.00	6	137	142

TABLE 23 (continued)

REACH ID	19	WR	FM1634 - PLUM CK (UPPER)	100.00	TO	94.00	1.0000	6.00	6	143	148
REACH ID	20	PU	RKM 0.5 - WICHITA RIVER	.50	TO	.00	.5000	.50	1	149	149
REACH ID	21	WR	PLUM CK (UPPER) - LOOP 11	94.00	TO	92.00	1.0000	2.00	2	150	151
REACH ID	22	WR	LOOP 11 - SH240	92.00	TO	86.00	1.0000	6.00	6	152	157
REACH ID	23	WR	SH240 - WICHITA FALLS WWTP	86.00	TO	84.00	1.0000	2.00	2	158	159
REACH ID	24	WR	WICHITA FALLS WWTP - PLUM CREEK	84.00	TO	83.00	1.0000	1.00	1	160	160
REACH ID	25	PL	RKM 4.0 - SHEPPARD DITCH	4.00	TO	3.00	1.0000	1.00	1	161	161
REACH ID	26	SH	RKM 4.0 - PLUM CK (LOWER)	4.00	TO	.00	1.0000	4.00	4	162	165
REACH ID	27	PL	SHEPPARD DITCH - FM171	3.00	TO	2.00	1.0000	1.00	1	166	166
REACH ID	28	PL	FM171 - WICHITA RIVER	2.00	TO	.00	1.0000	2.00	2	167	168
REACH ID	29	WR	PLUM CK - RIVER ROAD	83.00	TO	80.00	1.0000	3.00	3	169	171
REACH ID	30	WR	RIVER ROAD - HOLIDAY CREEK	80.00	TO	79.00	1.0000	1.00	1	172	172
REACH ID	31	HC	HOLIDAY CK HDWTR - WICHITA RIVER	.50	TO	.00	.5000	.50	1	173	173
REACH ID	32	WR	HOLIDAY CREEK - EASTLAND LANE	79.00	TO	74.00	1.0000	5.00	5	174	178
REACH ID	33	WR	EASTLAND LANE - KRAJCA ROAD	74.00	TO	63.00	1.0000	11.00	11	179	189
REACH ID	34	WR	KRAJCA RD - BEAR CREEK	63.00	TO	60.00	1.0000	3.00	3	190	192
REACH ID	35	BR	RKM 13 - AQUEDUCT	13.00	TO	12.00	1.0000	1.00	1	193	193
REACH ID	36	AQ	RKM 3.0 - BEAR CREEK	3.00	TO	.00	.5000	3.00	6	194	199
REACH ID	37	BR	BEAR CK HDWTR - WICHITA RIVER	12.00	TO	.00	1.0000	12.00	12	200	211
REACH ID	38	WR	BEAR CREEK - FM2393	60.00	TO	49.00	1.0000	11.00	11	212	222
REACH ID	39	WR	FM2393 - FM810	49.00	TO	28.00	1.0000	21.00	21	223	243
REACH ID	40	WR	FM810 - FM171	28.00	TO	7.00	1.0000	21.00	21	244	264
REACH ID	41	WR	FM171 TO CONFLUENCE W/ RED RIVER	7.00	TO	.00	1.0000	7.00	7	265	271
ENDATA08											

$$$ DATA TYPE 9 (ADVECTIVE HYDRAULIC COEFFICIENTS) $$$

CARD TYPE	REACH	ID	VELOCITY "A"	VELOCITY "B"	DEPTH "C"	DEPTH "D"	DEPTH "E"	MANNINGS "N"
HYDR-1	1	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	2	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	3	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	4	BV	.19100000	.500	.956	.400	.000	.035
HYDR-1	5	BV	.19100000	.500	.956	.400	.000	.035
HYDR-1	6	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	7	DC	.61500000	.500	.430	.400	.000	.035
HYDR-1	8	WR	.49800000	.500	.264	.400	.000	.035
HYDR-1	9	WR	.12900000	.500	.926	.400	.000	.035
HYDR-1	10	WR	.17900000	.500	.741	.400	.000	.035
HYDR-1	11	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	12	SF	.84400000	.500	.293	.400	.000	.035
HYDR-1	13	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	14	IP	.84400000	.500	.293	.400	.000	.035
HYDR-1	15	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	16	BF	.84400000	.500	.293	.400	.000	.035
HYDR-1	17	WR	.17900000	.500	.741	.400	.000	.035
HYDR-1	18	WR	.19200000	.500	.501	.400	.000	.035
HYDR-1	19	WR	.17900000	.500	.520	.400	.000	.035
HYDR-1	20	PU	.62500000	.500	.482	.400	.000	.035
HYDR-1	21	WR	.17900000	.500	.520	.400	.000	.035
HYDR-1	22	WR	.17400000	.500	.431	.400	.000	.035
HYDR-1	23	WR	.17400000	.500	.431	.400	.000	.035
HYDR-1	24	WR	.16800000	.500	.282	.400	.000	.035
HYDR-1	25	PL	.40500000	.500	.698	.400	.000	.035

TABLE 23 (continued)

HYDR-1	26	SH	.40500000	.500	.698	.400	.000	.035
HYDR-1	27	PL	.40500000	.500	.698	.400	.000	.035
HYDR-1	28	PL	.40500000	.500	.698	.400	.000	.035
HYDR-1	29	WR	.16800000	.500	.282	.400	.000	.035
HYDR-1	30	WR	.21300000	.500	.215	.400	.000	.035
HYDR-1	31	HC	.54200000	.500	.419	.400	.000	.035
HYDR-1	32	WR	.21300000	.500	.215	.400	.000	.035
HYDR-1	33	WR	.17100000	.500	.254	.400	.000	.035
HYDR-1	34	WR	.17100000	.500	.320	.400	.000	.035
HYDR-1	35	BR	.54200000	.500	.419	.400	.000	.035
HYDR-1	36	AQ	.54200000	.500	.419	.400	.000	.035
HYDR-1	37	BR	.54200000	.500	.419	.400	.000	.035
HYDR-1	38	WR	.17100000	.500	.320	.400	.000	.035
HYDR-1	39	WR	.17200000	.500	.386	.400	.000	.035
HYDR-1	40	WR	.17200000	.500	.386	.400	.000	.035
HYDR-1	41	WR	.17200000	.500	.386	.400	.000	.035
ENDATA09								

$$$ DATA TYPE 10 (DISPERSIVE HYDRAULIC COEFFICIENTS) $$$

CARD TYPE	REACH	ID	TIDAL RANGE	DISPERSION "A"	DISPERSION "B"	DISPERSION "C"	DISPERSION "D"
ENDATA10							

$$$ DATA TYPE 11 (INITIAL CONDITIONS) $$$

CARD TYPE	REACH	ID	TEMP	SALIN	DO	NH3	NO3+2	PHOS	CHL A	MACRO
INITIAL	1	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	2	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	3	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	4	BV	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	5	BV	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	6	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	7	DC	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	8	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	9	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	10	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	11	BF	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	12	SF	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	13	BF	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	14	IP	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	15	BF	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	16	BF	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	17	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	18	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	19	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	20	PU	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	21	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	22	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	23	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	24	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00

TABLE 23 (continued)

INITIAL	25	PL	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	26	SH	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	27	PL	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	28	PL	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	29	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	30	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	31	HC	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	32	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	33	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	34	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	35	BR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	36	AQ	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	37	BR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	38	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	39	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	40	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
INITIAL	41	WR	32.60	.00	5.80	1.00	1.00	1.00	2.00	.00
ENDATA11										

$$$ DATA TYPE 12 (REAERATION, SEDIMENT OXYGEN DEMAND, BOD COEFFICIENTS) $$$

CARD TYPE	REACH	ID	K2 OPT	K2 "A"	K2 "B"	K2 "C"	BKGRND SOD	AEROB BOD DECAY	BOD SETT	BOD CONV TO SOD	ANAER BOD DECAY
COEF-1	1	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	2	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	3	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	4	BV	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	5	BV	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	6	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	7	DC	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	8	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	9	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	10	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	11	BF	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	12	SF	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	13	BF	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	14	IP	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	15	BF	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	16	BF	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	17	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	18	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	19	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	20	PU	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	21	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	22	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	23	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	24	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	25	PL	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	26	SH	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	27	PL	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	28	PL	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	29	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	30	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	31	HC	11.	.000	.000	.000	.300	.100	.050	1.000	.000

TABLE 23 (continued)

COEF-1	32	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	33	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	34	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	35	BR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	36	AQ	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	37	BR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	38	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	39	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	40	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
COEF-1	41	WR	11.	.000	.000	.000	.300	.100	.050	1.000	.000
ENDATA12											

$$$ DATA TYPE 13 (NITROGEN AND PHOSPHORUS COEFFICIENTS) $$$

CARD TYPE	REACH	ID	ORG-N DECA	ORG-N SETT	ORGN CONV TO NH3	SRCE	NH3 DECA	NH3 SRCE	PHOS SRCE	DENIT RATE
COEF-2	1	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	2	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	3	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	4	BV	.05	.05	1.00		.30	.00	.00	.00
COEF-2	5	BV	.05	.05	1.00		.30	.00	.00	.00
COEF-2	6	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	7	DC	.05	.05	1.00		.30	.00	.00	.00
COEF-2	8	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	9	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	10	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	11	BF	.05	.05	1.00		.30	.00	.00	.00
COEF-2	12	SF	.05	.05	1.00		.30	.00	.00	.00
COEF-2	13	BF	.05	.05	1.00		.30	.00	.00	.00
COEF-2	14	IP	.05	.05	1.00		.30	.00	.00	.00
COEF-2	15	BF	.05	.05	1.00		.30	.00	.00	.00
COEF-2	16	BF	.05	.05	1.00		.30	.00	.00	.00
COEF-2	17	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	18	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	19	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	20	PU	.05	.05	1.00		.30	.00	.00	.00
COEF-2	21	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	22	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	23	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	24	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	25	PL	.05	.05	1.00		.30	.00	.00	.00
COEF-2	26	SH	.05	.05	1.00		.30	.00	.00	.00
COEF-2	27	PL	.05	.05	1.00		.30	.00	.00	.00
COEF-2	28	PL	.05	.05	1.00		.30	.00	.00	.00
COEF-2	29	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	30	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	31	HC	.05	.05	1.00		.30	.00	.00	.00
COEF-2	32	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	33	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	34	WR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	35	BR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	36	AQ	.05	.05	1.00		.30	.00	.00	.00
COEF-2	37	BR	.05	.05	1.00		.30	.00	.00	.00
COEF-2	38	WR	.05	.05	1.00		.30	.00	.00	.00

TABLE 23 (continued)

COEF-2	39	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	40	WR	.05	.05	1.00	.30	.00	.00	.00
COEF-2	41	WR	.05	.05	1.00	.30	.00	.00	.00
ENDATA13									

$$$ DATA TYPE 14 (ALGAE AND MACROPHYTE COEFFICIENTS) $$$

CARD TYPE	REACH	ID	SECCHI DEPTH	ALGAE: CHL A	ALGAE SETT	ALG CONV TO SOD	ALGAE GROW	ALGAE RESP	MACRO GROW	MACRO RESP
ENDATA14										

$$$ DATA TYPE 15 (COLIFORM AND NONCONSERVATIVE COEFFICIENTS) $$$

CARD TYPE	REACH	ID	COLIFORM DIE-OFF	NCM DECAY	NCM SETT	NCM CONV TO SOD
ENDATA15						

$$$ DATA TYPE 16 (INCREMENTAL DATA FOR FLOW, TEMPERATURE, SALINITY, AND CONSERVATIVES) $$$

CARD TYPE	REACH	ID	OUTFLOW	INFLOW	TEMP	SALIN	CM-I	CM-II	INFLOW/DIST
INCR-1	1	WR	.00000	.00600	32.60	.00	1000.00	.00	.00300
INCR-1	2	WR	.00000	.13500	32.60	.00	1000.00	.00	.00675
INCR-1	4	BV	.00000	.32100	32.60	.00	1000.00	.00	.03210
INCR-1	5	BV	.00000	.01200	32.60	.00	1000.00	.00	.00171
INCR-1	6	WR	.00000	.03500	32.60	.00	1000.00	.00	.00875
INCR-1	8	WR	.00000	.04300	32.60	.00	1000.00	.00	.00860
INCR-1	9	WR	.00000	.09500	32.60	.00	1000.00	.00	.00864
INCR-1	10	WR	.00000	.06900	32.60	.00	1000.00	.00	.00627
INCR-1	12	SF	.00000	.16000	32.60	.00	1000.00	.00	.00615
INCR-1	13	BF	.00000	.05500	32.60	.00	1000.00	.00	.00611
INCR-1	14	IP	.00000	.00900	32.60	.00	1000.00	.00	.00600
INCR-1	15	BF	.00000	.03100	32.60	.00	1000.00	.00	.00620
INCR-1	16	BF	.00000	.00100	32.60	.00	1000.00	.00	.00050
INCR-1	17	WR	.00000	.03700	32.60	.00	1000.00	.00	.00336
INCR-1	18	WR	.00000	.01500	32.60	.00	1000.00	.00	.00250
INCR-1	19	WR	.00000	.11400	32.60	.00	1000.00	.00	.01900
INCR-1	21	WR	.00000	.03800	32.60	.00	1000.00	.00	.01900
INCR-1	22	WR	.00000	.03300	32.60	.00	1000.00	.00	.00550
INCR-1	23	WR	.00000	.01100	32.60	.00	1000.00	.00	.00550
INCR-1	26	SH	.00000	.00300	32.60	.00	1000.00	.00	.00075
INCR-1	28	PL	.00000	.00100	32.60	.00	1000.00	.00	.00050
INCR-1	29	WR	.00000	.03200	32.60	.00	1000.00	.00	.01067
INCR-1	33	WR	.00000	.03600	32.60	.00	1000.00	.00	.00327
INCR-1	34	WR	.00000	.00600	32.60	.00	1000.00	.00	.00200
INCR-1	35	BR	.00000	.00200	32.60	.00	1000.00	.00	.00200
INCR-1	36	AQ	.00000	.00600	32.60	.00	1000.00	.00	.00200
INCR-1	37	BR	.00000	.02300	32.60	.00	1000.00	.00	.00192
INCR-1	38	WR	.00000	.07200	32.60	.00	1000.00	.00	.00655

TABLE 23 (continued)

INCR-1	39	WR	.00000	.07600	32.60	.00	1000.00	.00	.00362
INCR-1	40	WR	.00000	.11700	32.60	.00	1000.00	.00	.00557
INCR-1	41	WR	.00000	.01900	32.60	.00	1000.00	.00	.00271

ENDATA16

$$$ DATA TYPE 17 (INCREMENTAL DATA FOR DO, BOD, AND NITROGEN) $$$

CARD TYPE	REACH	ID	DO	BOD	ORG-N	NH3	NO3+2
INCR-2	1	WR	5.80	1.30	.50	.05	.20
INCR-2	2	WR	5.80	1.30	.50	.05	.20
INCR-2	4	BV	5.80	1.30	.50	.05	.20
INCR-2	5	BV	5.80	1.30	.50	.05	.20
INCR-2	6	WR	5.80	1.30	.50	.05	.20
INCR-2	8	WR	5.80	1.30	.50	.05	.20
INCR-2	9	WR	5.80	1.30	.50	.05	.20
INCR-2	10	WR	5.80	1.30	.50	.05	.20
INCR-2	12	SF	5.80	1.30	.50	.05	.20
INCR-2	13	BF	5.80	1.30	.50	.05	.20
INCR-2	14	IP	5.80	1.30	.50	.05	.20
INCR-2	15	BF	5.80	1.30	.50	.05	.20
INCR-2	16	BF	5.80	1.30	.50	.05	.20
INCR-2	17	WR	5.80	1.30	.50	.05	.20
INCR-2	18	WR	5.80	1.30	.50	.05	.20
INCR-2	19	WR	5.80	1.30	.50	.05	.20
INCR-2	21	WR	5.80	1.30	.50	.05	.20
INCR-2	22	WR	5.80	1.30	.50	.05	.20
INCR-2	23	WR	5.80	1.30	.50	.05	.20
INCR-2	26	SH	5.80	1.30	.50	.05	.20
INCR-2	28	PL	5.80	1.30	.50	.05	.20
INCR-2	29	WR	5.80	1.30	.50	.05	.20
INCR-2	33	WR	5.80	1.30	.50	.05	.20
INCR-2	34	WR	5.80	1.30	.50	.05	.20
INCR-2	35	BR	5.80	1.30	.50	.05	.20
INCR-2	36	AQ	5.80	1.30	.50	.05	.20
INCR-2	37	BR	5.80	1.30	.50	.05	.20
INCR-2	38	WR	5.80	1.30	.50	.05	.20
INCR-2	39	WR	5.80	1.30	.50	.05	.20
INCR-2	40	WR	5.80	1.30	.50	.05	.20
INCR-2	41	WR	5.80	1.30	.50	.05	.20

ENDATA17

$$$ DATA TYPE 18 (INCREMENTAL DATA FOR PHOSPHORUS, CHLOROPHYLL, COLIFORM, AND NONCONSERVATIVES) $$$

CARD TYPE	REACH	ID	PHOS	CHL A	COLI	NCM

ENDATA18

$$$ DATA TYPE 19 (NONPOINT SOURCE DATA) $$$

CARD TYPE	REACH	ID	BOD	ORG-N	COLI	NCM	DO

TABLE 23 (continued)

ENDATA19

$$$ DATA TYPE 20 (HEADWATER FOR FLOW, TEMPERATURE, SALINITY AND CONSERVATIVES) $$$

CARD TYPE	ELEMENT	NAME	UNIT	FLOW	TEMP	SALIN	CM-I	CM-II
HDWTR-1	1	WICHITA RIVER	0	.00300	32.600	.000	80.000	.000
HDWTR-1	31	BEAVER CREEK	0	.00500	32.600	.000	80.000	.000
HDWTR-1	52	DEER CREEK	0	.00300	32.600	.000	80.000	.000
HDWTR-1	80	BUFFALO CREEK	0	.00600	32.600	.000	80.000	.000
HDWTR-1	81	SOUTH FORK BUFFALO C	0	.01800	32.600	.000	80.000	.000
HDWTR-1	116	IOWA PARK WWTP DITCH	0	.00700	32.600	.000	80.000	.000
HDWTR-1	149	PLUM CREEK (UPPER)	0	.00300	32.600	.000	80.000	.000
HDWTR-1	161	PLUM CREEK (LOWER)	0	.01800	32.600	.000	80.000	.000
HDWTR-1	162	SHEPPARD WWTP DITCH	0	.01100	32.600	.000	80.000	.000
HDWTR-1	173	HOLIDAY CREEK	0	.09200	32.600	.000	80.000	.000
HDWTR-1	193	BEAR CREEK	0	.02500	32.600	.000	80.000	.000
HDWTR-1	194	AQUEDUCT	0	.00500	32.600	.000	80.000	.000
ENDATA20								

$$$ DATA TYPE 21 (HEADWATER DATA FOR DO, BOD, AND NITROGEN) $$$

CARD TYPE	ELEMENT	NAME	DO	BOD	ORG-N	NH3	NO3+2
HDWTR-2	1	WICHITA RIVER	5.80	3.00	.50	.05	.20
HDWTR-2	31	BEAVER CREEK	5.80	3.00	.50	.05	.20
HDWTR-2	52	DEER CREEK	5.80	3.00	.50	.05	.20
HDWTR-2	80	BUFFALO CREEK	5.80	3.00	.50	.05	.20
HDWTR-2	81	SOUTH FORK BUFFALO C	5.80	3.00	.50	.05	.20
HDWTR-2	116	IOWA PARK WWTP DITCH	5.80	3.00	.50	.05	.20
HDWTR-2	149	PLUM CREEK (UPPER)	5.80	3.00	.50	.05	.20
HDWTR-2	161	PLUM CREEK (LOWER)	5.80	3.00	.50	.05	.20
HDWTR-2	162	SHEPPARD WWTP DITCH	5.80	3.00	.50	.05	.20
HDWTR-2	173	HOLIDAY CREEK	5.80	3.00	.50	.05	.20
HDWTR-2	193	BEAR CREEK	5.80	3.00	.50	.05	.20
HDWTR-2	194	AQUEDUCT	5.80	3.00	.50	.05	.20
ENDATA21							

$$$ DATA TYPE 22 (HEADWATER DATA FOR PHOSPHORUS, CHLOROPHYLL, COLIFORM, AND NONCONSERVATIVES) $$$

CARD TYPE	ELEMENT	NAME	PHOS	CHL A	COLI	NCM
ENDATA22						

$$$ DATA TYPE 23 (JUNCTION DATA) $$$

CARD TYPE	JUNCTION	UPSTRM	NAME

TABLE 23 (continued)

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                 ELEMENT  ELEMENT

JUNCTION            48       30      BEAVER CREEK CONFLUENCE
JUNCTION            53       51      DEER CREEK CONFLUENCE
JUNCTION           107       80      SOUTH FORK BUFFALO CK. CONF.
JUNCTION           119      115      IOWA PARK WWTP DITCH CONF.
JUNCTION           126       79      BUFFALO CREEK CONFLUENCE
JUNCTION           150      148      PLUM CK. (UPPER) CONF.
JUNCTION           166      161      SHEPPARD WWTP DITCH CONF.
JUNCTION           169      160      PLUM CK. (LOWER) CONF.
JUNCTION           174      172      HOLIDAY CREEK CONFLUENCE
JUNCTION           200      193      AQUEDUCT CONFLUENCE
JUNCTION           212      192      BEAR CREEK CONFLUENCE
ENDATA23

$$$ DATA TYPE 24 (WASTELOAD DATA FOR FLOW, TEMPERATURE, SALINITY, AND CONSERVATIVES) $$$

CARD TYPE  ELEMENT  NAME                          FLOW    TEMP     SAL     CM-I    CM-II

ENDATA24

$$$ DATA TYPE 25 (WASTELOAD DATA FOR DO, BOD, AND NITROGEN) $$$

                                                                % BOD                          %
CARD TYPE      ELEMENT   NAME                       DO    BOD    RMVL    ORG-N    NH3    NITRIF      NO3+2

ENDATA25

$$$ DATA TYPE 26 (WASTELOAD DATA FOR PHOSPHORUS, CHLOROPHYLL, COLIFORM, AND NONCONSERVATIVES) $$$

CARD TYPE      ELEMENT   NAME                      PHOS    CHL A    COLI    NCM

ENDATA26

$$$ DATA TYPE 27 (LOWER BOUNDARY CONDITIONS) $$$

CARD TYPE         CONSTITUENT                    CONCENTRATION

ENDATA27

$$$ DATA TYPE 28 (FLOW AUGMENTATION DATA) $$$

CARD TYPE       REACH      AVAIL HDWS      TARGET      ORDER OF AVAIL SOURCES

ENDATA28
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TABLE 23 (continued)

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$$$ DATA TYPE 29 (SENSITIVITY ANALYSIS DATA) $$$

CARD TYPE        PARAMETER     COL 1      COL 2      COL 3      COL 4      COL 5      COL 6      COL 7      COL 8

ENDATA29


$$$ DATA TYPE 30 (PLOT CONTROL CARDS) $$$


NUMBER OF PLOTS =  4
NUMBER OF REACHES IN PLOT 1 =  23      INCREMENT =  1.00
PLOT RCH   1   2   3   6   8   9  10  17  18  19  21  22  23  24  29  30  32  33  34  38  39  40  41
NUMBER OF REACHES IN PLOT 2 =   3      INCREMENT =   .50
PLOT RCH  26  27  28
NUMBER OF REACHES IN PLOT 3 =   3      INCREMENT =   .50
PLOT RCH  14  15  16
NUMBER OF REACHES IN PLOT 4 =   2      INCREMENT =   .50
PLOT RCH  36  37
ENDATA30
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