FY 1993 104(b)(3)

ASSESSMENT OF BIOASSESSMENT TECHNIQUES IN SMALL RESERVOIRS

Kevin Wagner
Technical Writer
Oklahoma Conservation Commission
Water Quality Division

FINAL REPORT
November 1996

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

Page

LIST OF TABLES

I. Introduction

Assessment methods for lakes and reservoirs are needed to support various decision making processes used by state, local, and federal government agencies. With recent emphasis on the biotic health of waterbodies, the need for standardized, reproducible, and meaningful bioassessment methods has surfaced. The Clean Lakes Program described in §314 of the Clean

Water Act (CWA) provides guidance for assessing a lake or reservoir in detail; however, at least a year of sampling and a budget of $50,000 to $140,000 per reservoir is required. There is currently no federal guidance for assessing large numbers of lakes and reservoirs in a short period within the budget limits of most states. To satisfy the reporting requirements of several CWA sections [i.e. §305(b), 303(d), 314, and 319(h)], states have resorted to a variety of methods, most of which rely on physical/chemical data, trophic state indices (TSI), and remote sensing of chlorophyll a and turbidity. The Environmental Protection Agency (EPA) has recognized the need for reliable assessment methodologies that are inexpensive, rapid, and biological in nature. To this end, EPA funded this §104(b)(3) project. Note that this study is a continuation of a 1993 study (OCC 1995) and that the 1993 data was incorporated into this report. Finally, the project goals were to: 1) refine the benthic macroinvertebrate and fish metrics developed by the Tennessee Valley Authority (TVA) to assess the biotic integrity of large reservoirs, and 2) test the efficacy of these metrics in determining the integrity of the biological communities in small reservoirs.

II. **Description Of Reservoirs Studied**

Fifteen small to medium sized reservoirs (Table 1) ranging in size from 47 to 2,860 acres were sampled for fish and benthic macroinvertebrates.

Table 1. Locations and sizes (acres) of reservoirs studied.

LAKE	COUNTY	ECOREGION	SIZE
Eucha	Delaware	Ozark Highlands	2,860
Carl Albert	Latimer	Ouachita Mountains	183
McAlester	Pittsburg	Central OK-TX Plains	1,521
Pauls Valley	Garvin	Central OK-TX Plains	750
Cushing	Payne	Central OK-TX Plains	591
Big Hauani	Marshall	Central OK-TX Plains	270
Taylor	Grady	Central OK-TX Plains	227
Comanche	Stephens	Central OK-TX Plains	184
Bixhoma	Wagoner	Central OK-TX Plains	110
Pawhuska	Osage	Central OK-TX Plains	96
Claremore	Rogers	Central Irregular Plains	470
Chickasha	Caddo	Central Great Plains	1,358
Frederick	Tillman	Central Great Plains	925
Rocky	Washita	Central Great Plains	347
Skipout	Roger Mills	Central Great Plains	47

With the exception of Lake Eucha, the reservoirs are situated on intermittent or small perennial streams having less than 3 cfs base flow and are generally stagnant most of the summer. The reservoirs studied are spread across five ecoregions and fifteen counties in Oklahoma and were selected to represent the range of trophic conditions and problems in the state. Maps of the reservoirs are shown in Appendix A.

These reservoirs were sampled quarterly from 1987-92 for surface chlorophyll a, turbidity, and conductivity near the dam. Carlson's TSI-chlorophyll a (Carlson 1977) was calculated for each reservoir using the mean chlorophyll concentrations from 1987-92 (Table 2).

Table 2. Mean turbidities, conductivities, chlorophyll a concentrations, and TSI-chlorophyll a calculated from data collected from 1987-92 near the dam of each reservoir.

Lake	**Turbidity**	**Conductivity**	**Chlorophyll**	**TSI Chlorophyll**	**Trophic State**
Taylor	18.7	417	40.5	67	Hypereutrophic
Chickasha	12.8	1837	24.7	62	Hypereutrophic
Rocky	50.1	504	23.7	62	Hypereutrophic
Skipout	15.1	919	22.5	61	Hypereutrophic
Claremore	13.7	164	22.3	61	Hypereutrophic
Big Hauani	5.7	233	9.1	52	Eutrophic
Cushing	117.4	252	8.6	52	Eutrophic
Comanche	15.2	262	7.8	51	Eutrophic
Frederick	62.2	327	7.7	51	Eutrophic
Eucha	5.0	164	7.3	50	Eutrophic
McAlester	76.7	115	4.3	45	Mesotrophic
Pauls Valley	20.8	274	3.9	44	Mesotrophic
Carl Albert	14.1	52	3.9	44	Mesotrophic
Bixhoma	7.5		2.9	41	Mesotrophic
Pawhuska	4.2	279	2.3	39	Oligotrophic

In addition to the quarterly sampling from 1987-92, several of the lakes have been the subjects of Section 314 Clean Lakes Studies. This includes Lake Chickasha (1991-92), Pauls Valley Lake (1991-93), Lake Skipout (1992-93), Lake Eucha (1993-94), Lake Claremore (1993-94), and Taylor Lake (1994-95).

As Table 2 indicates, the entire range of trophic conditions was represented in this study. In addition to the general trophic classifications, several of the reservoirs studied represent the disharmonic lake type of argillotrophic as described by Carlson (1991). Lakes Cushing, Frederick, McAlester, Pauls Valley, and Rocky would be classified as argillotrophic, because their dynamics are controlled by suspended sediment. Many reservoirs in the Southern Plains are of this type and it is imperative that the methods recommended will work for this type of reservoir.

TSI-chlorophyll a was used to indicate the trophic state of the reservoirs instead of TSI-total phosphorous or TSI-Secchi depth for several reasons. First, more chlorophyll a data was available for the reservoirs studied (quarterly samples from 1987-92). With the exception of the reservoirs which were the subjects of Clean Lakes Studies, total phosphorous was analyzed in only 6 samples from each reservoir and Secchi depth was measured only once in each reservoir (on the date that the benthic macroinvertebrates were collected). Second, TSI-chlorophyll a was used to avoid misclassification which can occur with using TSI-total phosphorous or TSI-Secchi depth. Use of TSI-total phosphorous will cause misclassification of a reservoir if phosphorous is not the factor limiting productivity. For example, several of the reservoirs studied are argillotrophic; therefore, high total phosphorous concentrations will not result in high levels of productivity, because productivity is limited by light. In addition, total phosphorous will bind to suspended matter in high mineral turbidity waters and thus will not be available for biotic uptake. The high turbidity in the argillotrophic reservoirs also nullifies the applicability of TSI-Secchi depth, because the low Secchi depths found in the argillotrophic reservoirs will not necessarily correspond to reservoirs with high trophic states.

The range of thermal structure possibilities was also represented in this study. Lakes Bixhoma, Carl Albert, Eucha, and Pawhuska are monomictic or dimictic (depending on the severity of the winter) and remain strongly stratified throughout the summer. The remaining reservoirs are polymictic and stratify only during relatively calm, hot periods of the summer <u>or</u> express only weak stratification throughout the summer. This is discussed in Sections IV.A (2) and (3).

III. Methods

A. Assessment of Benthic Macroinvertebrate Community

I. Introduction

Many shallow reservoirs stratify for short periods and go anoxic at lower depths for periods lasting from a few days to a few weeks during the summer. Dissolved oxygen (D.O.) measurements taken once or twice a summer are an unreliable indicator of conditions at the sediment/water interface if the measurement is taken during one of the frequent periods of mixing, and the researcher has no way of knowing if this is the case.

In small to medium sized reservoirs, such as those used in this study, this relatively shallow water (<5 m) is often the major depth class of the reservoir and as such includes the major part of the sediments available to organisms. Since D.O. measurements taken once or twice during the summer are an unreliable indicator of whether or not there has been sufficient oxygen to sustain a healthy benthic macroinvertebrate community, the benthic macroinvertebrates must be examined. This is more time consuming than taking D.O. measurements and relying on them alone. However, this is not overly burdensome, as sample collection can be completed in a day, and it provides a good estimate of reservoir health at the sediment-water interface and in the upper layer of sediments.

2. Selection Of Transects For Benthic Macroinvertebrate Collection

Reservoirs typically have three zones: riverine, lacustrine, and transition. The riverine zone, which behaves much like a river, is located near the inlet of the reservoir. The lacustrine zone is located nearest to the dam and behaves most like a lake. The transition zone is located between the two previously mentioned zones. Excluding Lake Eucha, the reservoirs could not be divided into actual riverine, transition, and lacustrine zones due to the small size of the reservoirs sampled and the lack of inflow. Therefore, each reservoir was divided into three zones based on

Secchi depths taken along a longitudinal transect extending from the dam to the inlet. The Secchi depths were taken during a single sampling day for each reservoir under a variety of weather conditions. The range of Secchi depths were recorded, ranked, and divided into quartiles.

Sampling transect A, which represents the lacustrine zone, was located perpendicular to the longitudinal transect at the midpoint of the highest quartile. Sampling transect B, which represents the transition zone, was located perpendicular to the longitudinal transect at the median of the Secchi depth range. Sampling transect C, which represents the riverine zone, was located perpendicular to the longitudinal transect at the midpoint of the lowest quartile. The sampling transect locations for each reservoir can be observed on the maps in Appendix A.

3. **Benthic Macroinvertebrate Collection**

Benthic macroinvertebrate collections from Lakes Bixhoma, Claremore, Eucha, Pauls Valley, Pawhuska, and Taylor were made between June 28 and September 3, 1993. Benthic macroinvertebrate collections from Lakes Big Hauani, Carl Albert, Chickasha, Comanche, Cushing, Frederick, McAlester, Rocky, and Skipout were made between July 24 and August 16, 1995. Ten evenly spaced ponar grabs were taken from each of the three sampling transacts starting and ending 50 m from the shore. Samples 1 through 10 were collected from transect A. Samples 11 through 20 were collected from transect B. Samples 21 through 30 were collected from C. The samples were required to include a substantial amount of sediment and the dredge jaws must have closed completely. Dredge samples which failed to meet these requirements were discarded and additional hauls were made until an acceptable sample was collected. Once on board the boat, samples were washed in a #30 mesh sieve using lake water. Lake water was also used to clean off large substrate materials, which were discarded after cleaning. Each sample was preserved separately in the field using 70% ethanol. The preserved samples were returned to the laboratory for sorting and identification. The City-County Health Department Laboratory of Oklahoma City was contracted to identify and enumerate the benthic macroinvertebrates in each sample. Substrate conditions (habitat characteristics) were not evaluated in the field and not considered in the analysis of the benthic macroinvertebrate communities.

Several species were excluded from the analysis so that the metrics focused on the resident benthic macroinvertebrate life at the sample sites. The organisms excluded include the amphipod

Hyalella, the coleopteran Berosus, the dipteran Chaoborus, the hemipteran family corixidae, the odonate Enallagma, and the odonatan family libellulidae. As indicated in Appendix B, these species are not benthic.

Hyalella are generally associated with macrophytes. Chaoborus is planktonic. The hemipteran family corixidae is generally associated with the water surface. The odonate Enallagma and the odonatan family libellulidae are both climbers which live on vascular hydrophytes.

4. **Benthic Macroinvertebrate Metrics**

Seven benthic macroinvertebrate metrics (Table 3) were evaluated for use in determining the biotic integrity of fifteen small Oklahoma reservoirs. Two metrics *(percentage of samples with long-lived taxa present and average taxa richness/sample)* were developed by the TVA (Masters 1992) and the remainder were developed by Dan Butler of the OCC (OCC 1995).

Table 3. Rapid bioassessment metrics applied to small reservoir benthic samples.

METRIC	DESCRIPTION
Percentage of samples with long lived taxa present	Separates low quality reservoirs from high quality reservoirs by indicating the percent of the reservoir bottom with no toxicants & suitable D.O. to support benthic macroinvertebrates over long periods of time.
Average taxa richness/sample (family level)	Determines reservoir quality by indicating the diversity of the benthic macroinvertebrate community.
Percentage of samples with sensitive taxa present	Identifies high quality reservoirs by indicating the percent of the reservoir bottom having sediment & water capable of supporting sensitive taxa.
Percentage of samples with only tubificids and/or chironomids present	Identifies low quality reservoirs by indicating the percent of the reservoir bottom that is only capable of supporting very tolerant benthic macroinvertebrates.
Percentage of total organisms composed of tubificids & chironomini	Separates low and mid range reservoir quality by indicating the percent of total organisms made up of very tolerant organisms.
Percentage of total organisms sensitive	Identifies high quality reservoirs.
Percentage of samples with no benthic macroinvertebrates present	Identifies low quality reservoirs by indicating the percent of reservoir bottom unable to support benthic macroinvertebrates.

Metrics which compare the percent of samples possessing a particular quality to the total number of samples (i.e. *percentage of samples with long lived taxa present, percentage of samples with sensitive taxa present, percentage of samples with only tubificids and/or chironomids present, and percentage of samples with no benthic macroinvertebrates present)* give an indication of the percent of reservoir area which meets certain minimum or maximum criteria. These metrics can be affected severely by the presence of a very few organisms in each sample, but are independent

of the bias introduced by very large numbers of organisms present at one or a few sites. This type of metric is especially useful when surveying a reservoir that does not remain stratified throughout summer and the possibility of sampling it in a well-mixed state is present.

Conversely, metrics which examine the density of certain taxonomic groups (i.e. *percentage of total organisms composed of tubificids and chironomini and percentage of total organisms sensitive)* indicate the overall quality of the entire benthic community. These metrics are most appropriate when considering the food web and energy flow within a reservoir.

The *average taxa richness/sample* is used to indicate the diversity of the benthic species present. The family level is used as the taxonomic unit for the metric, because the genera in the Naidae and Tubificidae families often function in a similar manner ecologically but add to the taxa richness. Subfamily and tribe were used for the chironomids. Use of this metric at the family level also speeds up identification making the test more affordable.

5 . **Scoring Criteria For Benthic Macroinvertebrates**

For this study, a score of 1 represents the lowest quality and 3 represents the highest quality. The benthic metrics used with their corresponding scoring criteria can be found in Table 4.

Table 4. Benthic macroinvertebrate metrics and scoring criteria.

METRIC	**SCORE**		
	1	**2**	**3**
Percentage of samples with long lived taxa present	0-30	31-70	71-100
Average taxa richness/sample (family level)	<2	2-3	>3
Percentage of samples with sensitive taxa present	0-30	31-70	71-100
Percentage of samples with only tubificids &/or chironomids present	71-100	31-70	0-30
Percentage of total organisms composed of tubificids & chironomini	71-100	31-70	0-30
Percentage of total organisms sensitive	<5	5-25	>25
Percentage of samples with no benthic macroinvertebrates present	>5	1-5	<1

B. **Physical And Chemical Data Collection**

In addition to Secchi depths, which were measured in each reservoir to determine transect locations, Hydrolab profile readings of dissolved oxygen (DO), temperature, pH, conductivity, and depth were taken with each benthic sample.

C. **Assessment of Fish Community**

I. **Introduction**

Fish populations in small reservoirs typically receive much higher levels of management per acre than do larger ones and are often managed to optimize particular species. These reservoirs are almost entirely populated by introduced, and often non-native species.

The stream(s) which feed these small reservoirs are in many cases not perennial; therefore, fish spawning activities which require upstream migration may be limited or absent during much of the year. The combination of these factors makes small reservoirs very different from larger ones. This creates a scenario where the effectiveness of fish metrics developed for large reservoirs can be evaluated under conditions different from the ones for which they were developed.

2. Fish Collection

In 1993, fish were collected by the Oklahoma Department of Wildlife Conservation (ODWC) under contract to the OCC from the three zones of five reservoirs (Lakes Taylor, Skipout, Pauls Valley, Pawhuska, and Claremore) using electroshocking and gill nets. Ten experimental gill nets were set perpendicular to the shore in the sublittoral. Electroshocking efforts consisted of ten 10 minute sublittoral runs parallel to the shore. Habitat was sampled in proportion to its occurrence. All fish caught at each reservoir were compiled and identified.

In 1995, fish were again collected by ODWC under contract to the OCC from the three zones of ten reservoirs (Lakes Big Hauani, Bixhoma, Carl Albert, Chickasha, Comanche, Cushing, Eucha, Frederick, McAlester, and Rocky); however, only electroshocking was used. Gill netting was eliminated, because the small amount of additional data gathered didn't justify the expense. Electroshocking efforts consisted of ten 10 minute sublittoral runs parallel to the shore. Habitat was sampled in proportion to its occurrence. All fish caught at each reservoir were compiled and identified.

3. Fish Metrics And Scoring Criteria

Fish metrics, which were co-developed by Drs. James R. Karr, Michelle Dionne, and Martin Jennings under contract with the Tennessee Valley Authority (TVA) for use on the large TVA reservoirs, were evaluated for use on small reservoirs in Oklahoma. The metrics describe different facets of the fish community structure and function. The facets of the fish community described by the metrics include: 1) species richness and composition, 2) trophic composition, 3) reproductive composition, and 4) abundance and fish health. For more information on fish metrics, the reader is encouraged to review *Assessing Biological Integrity In Running Waters: A Method And Its Rationale* (Karr et al. 1986) and *Reservoir Vital Signs Monitoring, 1991 - Fish Community Results* (Scott 1992).

Eleven metrics were originally used by the TVA; however, the metric *fish health assessment index* was excluded from this study due to the high cost of fish pathology services. The 10 metrics and scoring criteria used (Table 5) are self explanatory and reflect relative fish community quality, with a score of 3 representing the highest quality, and a score of 1 the poorest quality.

All species collected were considered in the total species counts, except hybrids and species that were only present as young of year (YOY). For the metric *number of sunfish species,* only the species of the genus <u>Lepomis</u> were considered. For the metric *number of sucker species,* only the species white sucker, spotted sucker, river carpsucker, black buffalo, black redhorse, and golden redhorse were considered (Miller and Robison 1980). Oklahoma-based tolerance classifications were used (Jester et al., 1992). In the metrics *total number of individuals, percent of individuals tolerant, percent of individuals omnivores, and percent of individuals invertivores/insectivores,* gizzard shad, threadfin shad, and YOY counts were not included. In addition, trophic level was determined according to EPA classification (Plafkin et al. 1989). For the metric *number of migratory spawning species,* only the species white bass, spotted sucker, river carpsucker, black buffalo, black redhorse, and golden redhorse were considered. For the metric *number of lithophilic spawning species,* only the species white bass, spotted sucker, black redhorse, and golden redhorse were considered (Scott 1992).

Table 5. Fish metrics and scoring criteria.

METRIC	SCORE		
	1	2	3
Total number of species	<19	19-23	>23
Number of sunfish species	<3	3-4	>4
Number of sucker species	<2	2	>2
Number of intolerant species	<2	2-3	>3
Percentage of individuals tolerant	>15	7.5-15	<7.5
Percentage of individuals omnivorous	>10	5-10	<5
Percentage of individuals invertivorous or insectivorous	<70	70-80	>80
Number of migratory spawning species	0	1-2	>2
Number of lithophilic spawning species	<2	2-4	>4
Total number of individuals (excluding shad)	<300	300-600	>600

IV. **Results**

A. **Physical and Chemical Data**

1. **Secchi Depths**

The minimum and maximum Secchi depths measured at each reservoir are listed in Table 6. As Table 6 indicates, a wide range of water clarifies were present in the reservoirs studied from the

clear, spring fed Big Hauani to the extremely turbid Lakes Cushing and Rocky. As discussed in Section 11, water clarity in Lakes Cushing, Frederick, McAlester, Pauls Valley, and Rocky has been reduced by suspended sediment to the extent that productivity is limited; therefore, their trophic state is classified as argillotrophic.

Table 6. Secchi depths (inches).

LAKE	MIN. SECCHI	MAX. SECCHI
Big Hauani	102	130
Eucha	48	90
Comanche	21	81
Carl Albert	56	72
Pawhuska	18	72

Bixhoma	42	60
Skipout	22	39
Chickasha	12	38
Claremore	18	24
Taylor	6	16
Pauls Valley	9	12
Frederick	9	12
McAlester	8	11
Cushing	4	4
Rocky	4	4

2. **Reservoir Depths**

As Table 7 indicates, a wide range of reservoir depths were sampled, from the deep Lake Bixhoma to the extremely shallow Rocky Lake. Reservoir depth plays an important role in what conditions are present in the reservoirs. For example, the deep reservoirs strongly stratify during the summer, while the shallower reservoirs exhibit only weak thermal stratification during the summer, if they stratify at all. Strong thermal stratification generally results in hypolinmetic dissolved oxygen depletion in the deep reservoirs, which results in a poorer benthic community when compared to a shallower reservoir with similar water quality. Because of this, the reservoirs were divided into two groups based on depth and thermal structure when the benthic macroinvertebrate data was analyzed. The two groups will be discussed in the next section.

In addition, Table 7 allows the comparison of fetch, as indicated by reservoir size, with depth. For example, when comparing Lake Skipout to Rocky Lake, it can be assumed that Rocky Lake experiences more mixing than Lake Skipout, even though their depths are similar, due to the greater fetch in Rocky Lake.

Table 7. Minimum, maximum, and mean depths (m) measured during benthic macroinvertebrates sampling compared with reservoir size (acres).

Lake	Zone	Max Depth	Min Depth	Mean Depth	Overall Mean Depth	Reservoir Size
Bixhoma	Lacustrine	17.3	3.4	12.3		
	Transition	13.3	3.4	9.2		
	Riverine	9.4	2.5	6.9	9.5	110
Eucha	Lacustrine	23.7	1.5	11.8		
	Transition	7.5	6	6.8		
	Riverine	1.6	0.7	1	6.5	2860
Carl Albert	Lacustrine	11.6	2.9	8.8		
	Transition	7.5	1.4	6		
	Riverine	5	1.8	3.5	6.1	183
Pawhuska	Lacustrine	12.2	2.6	9		

	Transition	5.9	2.7	4.4		
	Riverine	4.2	2.2	3.3	6.6	96
Big Hauani	Lacustrine	1.1	3.5	8.1		
	Transition	9.4	2.5	4.7		
	Riverine	2.7	0.6	1.6	4.8	270
Pauls Valley	Lacustrine	7.7	1.8	5.8		
	Transition	6.9	1.3	5.2		
	Riverine	4	1.3	2.7	4.6	750
Comanche	Lacustrine	9.5	1	7		
	Transition	6	2	4.2		
	Riverine	3.6	1.6	2.7	4.6	184
Chickasha	Lacustrine	7.8	1.6	6.3		
	Transition	4.8	0.6	3.8		
	Riverine	2.7	1.2	2	4	1358
Frederick	Lacustrine	8	2.2	6		
	Transition	7	1.6	3.8		
	Riverine	2.1	0.7	1.4	3.7	925
McAlester	Lacustrine	9.3	1.2	6		
	Transition	4.5	1	3.2		
	Riverine	3.2	1	2	3.7	1521
Cushing	Lacustrine	5.8	1.2	4.6		
	Transition	3.1	1	2.6		
	Riverine	2.1	1.2	1.7	3	591
Claremore	Lacustrine	6.7	3.9	5		
	Transition	4.3	1.9	3.1		
	Riverine	1.2	0.8	1	3	470
Skipout	Lacustrine	5.3	2.5	4.7		
	Transition	2.4	0.8	1.6		
	Riverine	1.1	0.6	0.8	2.4	47
Taylor	Lacustrine	4.2	1.1	3.2		
	Transition	3.2	1	2.4		
	Riverine	2.4	1.1	1.6	2.4	227
Rocky	Lacustrine	3.2	0.9	2.6		
	Transition	2.8	1.2	2.4		
	Riverine	1.7	1	1.4	2.1	347

3. Temperature and Dissolved Oxygen

Physical and chemical data collected during benthic macroinvertebrate sampling are included in Appendix B. It should be noted that several of the hypereutrophic reservoirs exhibited strong oxygen gradients, even though thermal stratification was weak or absent.

In the following discussion, "strongly stratified" indicates that the difference between top and bottom temperatures is greater than 5°C. Observation of the data collected indicated that the breaking point between strong and weak stratification was between 4 and 5°C. Also, in the following discussion "sufficient levels of dissolved oxygen" indicates that D.O. concentrations were greater than 2 mg/l. While this departs from the Oklahoma Water Quality Standards D.O. criteria, the 2 mg/l level was chosen to indicate sufficient or insufficient levels of D.O. for three reasons: 1) fish can't survive in water containing less than 2 mg/l of D.O., 2) sensitive benthic macroinvertebrates need D.O. concentrations of 2 mg/l or greater, and 3) D.O. readings from the Hydrolab are not as accurate as concentrations approach zero.

Big Hauani Lake was strongly stratified (temperature difference between top and bottom > 5°C) at seven sites in transect (A) and at one site in transect (B). The bottom D.O. concentrations at the eight stratified sites were less than 2 mg/l. The remainder of the sites were unstratified and possessed sufficient levels of dissolved oxygen.

Overall mean depth makes Lake Bixhoma the deepest reservoir sampled (Table 7). Although it was strongly stratified throughout, bottom D.O. levels were less than 2 mg/l at only ten sites.

Carl Albert Lake was also strongly stratified throughout. Only four sites were not strongly stratified. Bottom D.O. concentrations were less than 2 mg/l at fifteen sites.

Although historical data show that Lake Chickasha experiences periods of thermal stratification, it was well mixed on the day of the investigation due to the very windy conditions present. Bottom D.O. concentrations were present at sufficient levels throughout the reservoir except for six sites in transect (A) which had D.O. levels less than 2 mg/l.

Lake Claremore was weakly stratified throughout transects (A) and (B). The bottom D.O. concentrations at all sites in transect (A) and two sites in transect (B) were less than 2 mg/l.

Comanche Lake was strongly stratified in transect (A); however, transects (B) and (C) were well mixed. The bottom D.O. concentrations at the seven strongly stratified sites in transect (A) were less than 2 mg/l, while the remainder of the sites in the reservoir possessed sufficient D.O. levels.

Cushing Lake was weakly stratified on the day of the investigation and the bottom D.O. concentrations were greater than 2 mg/l throughout with the exception of one site in transect (A).

Lake Eucha was strongly stratified at eight sites in transect (A) and at all sites in transect (B). The bottom D.O. concentrations at the eighteen strongly stratified sites were less than 2 mg/l. The remaining twelve sites were unstratified and well oxygenated.

Lake Frederick was only weakly stratified at the three deepest sites. The remainder of the lake was not thermally stratified. With the exception of one site in transect (B), bottom D.O. concentrations in the reservoir were greater than 2 mg/l.

Lake McAlester was strongly stratified at six sites in transect (A) where hypolinmetic D.O. concentrations were 2 mg/l or less. The remainder of the sites were well mixed or only weakly stratified and contained sufficient levels of dissolved oxygen.

Pauls Valley Lake was weakly stratified throughout transects (A) and (B), while transect (C) was unstratified. Bottom D.O. concentrations were less than 2 mg/l at one site in transect (A) and seven sites in transect (B). The remaining sites contained sufficient levels of dissolved oxygen.

Lake Pawhuska was strongly stratified at nine sites in transect (A) and three sites in transect (B). The bottom D.O. concentrations were less than 2 mg/l at the twelve strongly stratified sites. The remainder of the sites were unstratified and contained sufficient levels of dissolved oxygen.

Rocky Lake was weakly stratified at five sites in transect (A) where hypolirrmetic D.O. concentrations were less than 2 mg/l. The remainder of the sites were not stratified and contained sufficient levels of dissolved oxygen.

Lake Skipout was weakly stratified throughout transect (A); however, bottom D.O. levels were less than 2 mg/l at only two sites and approached 2 mg/l at three sites. Sites in transects (B) and (C) were unstratified and contained sufficient levels of dissolved oxygen.

Taylor Lake is very shallow; however, historical data show that it often experiences weak stratification on calm, warm summer days. However, on the day of investigation the reservoir was well mixed thermally and sufficient levels of D.O. were present throughout the profile.

Because of differences between depths, thermal structures, and oxygen regimes, the reservoirs are separated into two groups: 1) those reservoirs which are strongly stratified at 40% or more of the sites and 2) those reservoirs which are not. The metric scores (as discussed in Section B) seem to be significantly influenced when 40% or more of the sites are strongly stratified. Those reservoirs which are strongly stratified at 40% or more of the sites includes Lakes Bixhoma, Carl Albert, Eucha, and Pawhuska. The remainder of the reservoirs studied fall into the second category.

B. Benthic Macroinvertebrate Metrics

I . Analysis of Benthic Macroinvertebrate Data

a. General Findings

Appendix C lists the benthic macroinvertebrates collected, the results of the benthic macro-invertebrate metrics, and the benthic macroinvertebrate scores for each reservoir. A brief discussion of the findings in each reservoir follows.

Benthic macroinvertebrates were present at all sites in Big Hauani Lake. With the exception of the deep profundal zone of transect (A), diversity was high. Tolerant chironomids were the most abundant taxa in the reservoir. Numerous sensitive and long-lived species were also found.

Macroinvertebrates were present at all sampling sites in Lake Bixhoma. The benthic macroinvertebrate community was dominated primarily by tolerant tubificids. Diversity was also low throughout the reservoir. Few sensitive taxa and no long-lived species were present.

In Carl Albert Lake, benthic macroinvertebrates were found at twenty-nine of the thirty sampling sites. Diversity was low throughout the lake. Tolerant tubificids were the most abundant taxa. In addition, very few sensitive or long-lived taxa were collected.

The benthic macroinvertebrate community in Lake Chickasha was in very poor condition. Benthic macroinvertebrates were absent from six sites. In addition, diversity was extremely low throughout the reservoir with only tolerant tubificids and chironomids being collected.

In Lake Claremore, benthic macroinvertebrates were present at all sample sites. Diversity was moderate to high. The benthic macroinvertebrate community was dominated by tolerant chironomids and tubificids; however, several sensitive and long-lived taxa were found.

Benthic macroinvertebrates were present throughout Comanche Lake. Diversity was moderate to high. The benthic community was dominated by tolerant chironomids; however, a large number of sensitive and long-lived megalopterans and mollusks were also found.

Benthic macroinvertebrates were absent from two sites in Cushing Lake. In addition, diversity was low to moderate. Although chironomids dominated the benthic conununity, a large number of sensitive ephemeropterans and long-lived mollusks were also collected [primarily in transects (B) and (C)].

In Lake Eucha, benthic macroinvertebrates were present at twenty-nine of the thirty sampling sites. Diversity was high throughout the reservoir. The benthic macroinvertebrate community was dominated by tolerant tubificids; however, numerous sensitive species were also present. In Lake Eucha, numerous long lived species were also found in the littoral zone of transect (A) and

throughout transects (B) and (C) indicating the presence of sufficient water quality for an extended period (> 1 yr.).

Benthic macroinvertebrates were present at all sites in Lake Frederick. However, diversity was consistently low. The benthic community was dominated by both tolerant chironomids and sensitive ephemeropterans.

In Lake McAlester, benthic macroinvertebrates were present throughout. Diversity was moderate throughout the reservoir. The sensitive ephemeropterans were the most abundant species. In addition, long-lived species were found in a large number of samples.

In Pauls Valley Lake, benthic macroinvertebrates were present at all sites. Diversity was high throughout the reservoir. The benthic community was not dominated by any one taxa. The most abundant and common taxa were the tolerant chironomids, the long-lived mollusks, and the sensitive ephemeropterans, respectively. The presence of the sensitive, long-lived mollusks indicates that water quality has been good for an extended period.

In Lake Pawhuska, macroinvertebrates were present at all sampling sites. Overall, diversity was high in the reservoir. The lowest numbers of taxa (9) were found in transect (A) where 90% of the sites experienced low dissolved oxygen due to their location in the hypolimnion. Most sites in transects (B) and (C) were located in the well-oxygenated epilimnion, and had much higher numbers of taxa [15 in transect (B) and 14 in transect (C)]. Tolerant tubificids and chironomids dominated the benthic community; however, a large number of sensitive and long-lived species were also collected.

Benthic macroinvertebrates were present throughout Rocky Lake. Diversity was moderate. Chironomids dominated the benthic community. However, a large number of mollusks and ephemeropterans were also collected.

In Lake Skipout, benthic macroinvertebrates were present at twenty-nine of the thirty sampling sites. Diversity was moderate. The benthic community was dominated by tolerant chironomids and tubificids. Very few sensitive species and no long-lived species were collected in the reservoir.

Benthic macroinvertebrates were generally poor throughout Taylor Lake. Three sampling sites in transect (A) lacked benthic macroinvertebrates completely. Diversity was low with tolerant chironomids and tubificids dominating the benthic commity. No long-lived species were collected and only one sensitive species was found.

b. Results of Benthic Metrics

The results of the benthic macroinvertebrate metrics for each reservoir can be found in Table 8. As Table 8 indicates, the metrics provide excellent differentiation between lakes. Percentages for the metric *percent of samples with long-lived taxa* ranged from 0-97 %. This

Table 8. Results of benthic macroinvertebrate metrics.

METRICS	Big Hanani	Bixhoma	Carl Albert	Chickasha	Claremore	Comanche	Cushing	Eucha	Frederick	McAlester	Pauls Valley	Pawhuska	Rocky	Skipout	Taylor
Percent samples with long lived taxa	10.0%	0.0%	10.0%	0.0%	30.0%	56.7%	36.7%	60.0%	3.6%	40.0%	96.7%	24.1%	43.3%	0.0%	0.0%
Ave. taxa richness per sample (family level)	2.9	2.0	1.7	1.1	2.9	2.9	2.1	3.3	1.8	2.7	3.3	3.2	2.5	2.4	1.9
Percent samples with sensitive taxa	43.3%	10.3%	16.7%	0.0%	30.0%	73.3%	66.7%	63.3%	67.9%	93.3%	96.7%	31.0%	56.7%	13.3%	13.3%
Percent samples with only tubificids and/or chironomids	46.7%	79.3%	73.3%	80.0%	36.7%	16.7%	26.7%	23.3%	28.6%	6.7%	3.3%	27.6%	43.3%	50.0%	73.3%
Percent total organisms tubificids and chironomini	44.9%	97.1%	92.5%	17.7%	18.1%	19.3%	7.5%	78.5%	3.0%	20.9%	22.6%	57.5%	27.5%	63.9%	89.9%
Percent total organisms sensitive	8.4%	0.1%	2.4%	0.0%	1.5%	35.1%	46.7%	9.1%	46.6%	53.9%	43.8%	20.4%	11.0%	2.4%	0.4%
Percent samples with no macroinvertebrates	0.0%	0.0%	3.3%	20.0%	0.0%	0.0%	6.7%	3.3%	0.0%	0.0%	0.0%	0.0%	0.0%	3.3%	10.0%

metric provided an excellent indicator of the long-term conditions at the sediment-water interface. This metric, for example, indicates that 97 % of Pauls Valley Lake's bottom and 0 %

of Taylor Lake's bottom had sufficient dissolved oxygen (and possibly no toxics) to support benthic macroinvertebrates over a long period of time (> 1 year).

Values for the metric *average taxa richness (family level)* ranged from 1. 1-3.3. This metric provides a superb indicator of the benthic macroinvertebrate community diversity in each reservoir. Using the family level eliminates overestimation of diversity, which results from using genus or species due to the presence of numerous genera or species (i.e. tubificids and chironomids) which occupy similar niches. This metric indicated that Pauls Valley Lake has the most diverse benthic community, while Lake Chickasha has the least diverse.

Percentages for the metric *percent of samples with sensitive taxa present* ranged from 0-97 This metric, as with the metric *percent of samples with long-lived taxa,* provides an excellent indicator of the conditions at the sediment-water interface. This metric indicates that the conditions of 97% of Pauls Valley Lake's sediment-water interface were favorable for the habitation of sensitive species, while conditions at the sediment-water interface throughout Lake Chickasha were unfavorable for habitation by sensitive species.

Percentages for the metric *percent of samples with only tubificids and/or chironomids present* ranged from 3-80%. This metric provides an excellent indicator of the area of the reservoir bottom, which will support only tolerant species. This metric indicated that 80% of the bottom of Lake Chickasha would support only the most tolerant organisms.

Percentages for the metric *percent of total organisms composed of tubificids and chironomini* ranged from 3-97 %. This metric separates the reservoirs by providing an excellent indicator of the percentage of the benthic population which is extremely tolerant. According to this metric, 3 % of Lake Frederick's benthic population is made up of very tolerant species, while 97 % of the species in Lake Bixhoma are very tolerant.

Percentages for the metric *percent of total organisms which are sensitive* ranged from 0-54 %. This metric differentiates reservoir quality by providing an indication of the portion of the benthic mass composed of sensitive taxa which cannot tolerate low D. O. levels or the presence of toxics. This metric indicated that 54% of the benthic population in Lake McAlester was sensitive, while 0% of the benthic population in Lake Chickasha is sensitive.

Although percentages for the metric *percent of samples with no macroinvertebrates present* ranged only from 0-20 %, it provides an excellent indicator of reservoir quality. This metric aids in the identification of low quality reservoirs by indicating the percent of the reservoir bottom where conditions are so bad that no benthic macroinvertebrates can live. According to this metric, Lakes Taylor and Chickasha are the worst reservoirs because 10 and 20% of their reservoir bottoms, respectively, will not support benthic organisms.

c . **Reservoir Scores for Benthic Metrics**

Table 9 lists the final benthic macroinvertebrate score for each reservoir. The entire range of scoring possibilities was represented by the reservoirs studied. Pauls Valley Lake consistently scored the highest on all metrics and had a perfect score (21), while Taylor Lake consistently scored the lowest on all metrics and had the lowest score possible (7).

The depth and thermal structure of the reservoirs significantly affected the benthic scores. Due to their greater depths and accompanying thermal structures and oxygen regimes, the mesotrophic Lakes Bixhoma and Carl Albert fall into the same category as shallow hypereutrophic reservoirs, while the deep, oligotrophic Lake Pawhuska falls into the same category as shallow eutrophic reservoirs. The deeper reservoirs that were strongly stratified (top and bottom temperature difference >5°C) at 40% or more of their sites obviously fall into a separate category than the shallower reservoirs which are not strongly stratified at 40% or more of their sites.

Once the four deep reservoirs (in gray) are removed from Table 10, the correlation between trophic state and benthic score in the shallow reservoirs can easily be seen. With the exception of Rocky Lake, benthic scores increased as trophic state decreased. The reason for Rocky Lake's scores divergence is unknown. Because the chlorophyll a data used to determine trophic state is several years old, it is possible that the trophic state has decreased. However, this has not been confirmed. In addition, Rocky Lake is the shallowest and also has a very long fetch. Due to its shallowness and long fetch, it may remain well mixed and maintain sufficient levels of D.O. which would compensate for its trophic state.

Hypereutrophy generally corresponded with benthic scores of thirteen or less. Eutrophy generally corresponded with benthic scores ranging from fourteen to nineteen. Mesotrophy generally corresponded with benthic scores of nineteen or greater. Because the mesotrophic Pauls Valley Lake achieved a perfect score, it is obvious that oligotrophic reservoirs will not be distinguishable from mesotrophic reservoirs with the current benthic metrics scoring criteria. However, because no shallow oligotrophic reservoirs were sampled, it is not known if the benthic metrics will separate oligotrophic from mesotrophic reservoirs. Future sampling of shallow, oligotrophic reservoirs may reveal that the metric scoring criteria should be adjusted. In addition, the most diverse benthic community may be present in the mesotrophic reservoir which has sufficient levels of productivity to sustain a large, healthy benthic flora, as well as sufficient bottom dissolved oxygen. This compares to streams, where fish and invertebrates often reach their highest diversity when conditions are mildly enriched and exhibit lower diversity when conditions are very pristine.

d. Correlation of Benthic Metric Scores to Trophic State

In order to determine the efficacy of the benthic macroinvertebrate metrics, the correlation between benthic scores and TSI-chlorophyll a was calculated. The reason for using TSI-chlorophyll a as an indicator of trophic state is discussed in Section II. The correlation between

Table 9. Benthic macroinvertebrate metric scores.

METRICS	Big Hauani	Bixhoma	Carl Albert	Chickasha	Claremore	Comanche	Cushing	Eucha	Frederick	McAlester	Pauls Valley	Pawhuska	Rocky	Skipout	Taylor
Percent samples with long lived taxa	1	1	1	1	1	2	2	2	1	2	3	1	2	1	1
Ave. taxa richness per sample (family level)	2	1	1	1	2	2	2	3	1	2	3	3	2	2	1
Percent samples with sensitive taxa	2	1	1	1	1	3	2	2	2	3	3	2	2	1	1
Percent samples with only tubificids and/or chironomids	2	1	1	1	2	3	3	3	3	3	3	3	2	2	1
Percent total organisms tubificids and chironomini	2	1	1	3	3	3	3	1	3	3	3	2	3	2	1
Percent total organisms sensitive	2	1	1	1	1	3	3	2	3	3	3	2	2	1	1
Percent samples with no macroinvertebrates	3	3	2	1	3	3	1	2	3	3	3	3	3	2	1
TOTAL	**14**	**9**	**8**	**9**	**13**	**19**	**16**	**15**	**16**	**19**	**21**	**16**	**16**	**11**	**7**

Table 10 ranks the reservoirs according to their benthic scores and compares the scores to the reservoir's trophic state.

Table 10. Benthic scores as compared to trophic state and TSI-chlorophyll *a*.

Lake	Benthic Score	TSI-Chlorophyll	Trophic State
Pauls Valley	21	44	Mesotrophic
McAlester	19	45	Mesotrophic
Comanche	19	51	Eutrophic
Pawhuska	16	39	Oligotrophic
Frederick	16	51	Eutrophic
Cushing	16	52	Eutrophic
Rocky	16	62	Hypereutrophic
Eucha	15	50	Eutrophic
Big Hauani	14	52	Eutrophic
Claremore	13	61	Hypereutrophic
Skipout	11	61	Hypereutrophic
Chickasha	9	62	Hypereutrophic
Bixhoma	9	41	Mesotrophic
Carl Albert	8	44	Mesotrophic
Taylor	7	67	Hypereutrophic

TSI-chlorophyll a and the benthic macroinvertebrate scores produced an r^2 value of 0.78 for the shallow reservoirs and an r^2 value of 0.01 for the deep reservoirs.

The metrics do not accurately reflect trophic state in monomictic and dimictic reservoirs. This is due to the hard thermal stratification and the development of an anoxic hypolinmion in the deeper reservoirs. Regardless of trophic state, all of the deeper reservoirs developed anoxic hypolinmions. This is due to the fact that, unlike natural lakes, significant loads of organic material enter reservoirs (especially during runoff events). Decomposition of this organic mater results in the anoxic conditions such as that observed in the deep, oligotrophic Lake Pawhuska.

The benthic macroinvertebrate scores and TSI-chlorophyll a are correlated in the shallow reservoirs indicating that the benthic macroinvertebrate metrics used reflect the trophic state of shallow reservoirs.

2. **Analysis of Various Sampling Methods**

In order to reduce the workload and cost of bioassessment using benthic macroinvertebrate metrics, several collection scenarios were tested to determine if fewer samples could be used without significantly reducing the accuracy of the results. Table 11 compares the r^2 values resulting from the correlation of the benthic scores for each collection scenario to the TSI-chlorophyll a value. Appendix D lists the benthic scores and their correlation to the TSI-chlorophyll a values for each of the sampling scenarios. Notice that Big Hauani Lake falls into the category of deep lake (temperature difference between top and bottom >5°C at 40% or more of its sites) when the three deepest sites from each transect are used. Also notice that Lakes Big Hauani, McAlester, and Comanche fall into the category of deep lake (temperature difference between top and bottom >5°C at 40% or more of its sites) when only the sites from the lacustrine zone are used.

Table 11. Comparison of various benthic macroinvertebrate sampling scenarios.

Collection Methods	Total # of samples	r^2 Shallow Lakes	r^2 Deep Lakes
10 samples from each of 3 transects (lacustrine, transition, riverine)	30	0.78	0.01
10 samples from each of 2 transects (lacustrine & riverine)	20	0.76	0.10
3 deepest samples from each of 3 transects (lacustrine, transition, riverine)	9	0.79	0.01
10 samples from lacustrine transect	10	0.66	0.04
5 samples from each of 3 transects (lacustrine, transition, riverine)	15	0.65	0.01

It is obvious from Table 11 that the number of samples can be reduced substantially without significantly reducing the r^2 value. However, these metrics are only applicable to the shallower reservoirs, as the r^2 values for the deep reservoirs indicate. Although the use of the lacustrine zone transect only is examined here as a possible collection method and produced a reasonable r^2

value, it is recommended that this method not be used. Use of only the lacustrine transect only biases the sample, because it does not give an accurate indication of lake wide conditions. It also reduces the number of reservoirs to which the metrics apply. As indicated in Appendix D, this method only applied to 8 reservoirs, as opposed to 10- 11 reservoirs when the other collection methods are used.

3. **Cost Analysis**

The 1995 costs for collection, picking, identification, and enumeration of samples ranged from $20-25 per sample. Collection of thirty samples took a three-man crew one day per reservoir. Picking of samples generally took 15-20 minutes per sample.

Identification and enumeration of the thirty samples cost an average of $360 per reservoir. Based on this, Table 12 was developed.

Table12. Costs for collection, picking, identification, and numeration of samples for various benthic macroinvertebrate collection methods.

Collection Methods	**Total # of samples**	**Cost per lake**
10 samples from each of 3 transects (lacustrine, transition, riverine)	30	$600-750
10 samples from each of 2 transects (lacustrine & riverine)	20	$400-500
3 deepest samples from each of 3 transects (lacustrine, transition, riverine)	9	$180-225
10 samples from lacustrine transect	10	$200-250
5 samples from each of 3 transects (lacustrine, transition, riverine)	15	$300-375

Table 12 does not include the cost of data entry, report writing, travel, supplies, or equipment. Data entry is relatively inexpensive and should not add more than $20 per reservoir. Because the metrics are so easily interpreted, report writing should be easy and take no longer than half a day per reservoir and add $50 to the cost per reservoir. Travel expenses vary with distance traveled and whether an overnight stay is necessary. The only supplies needed are alcohol and mason jars. Equipment can be quite expensive; however, this report assumes that the necessary equipment is already in hand.

As Table 12 indicates, an assessment can be performed for as little as $180 or as much as $750 per reservoir depending on the desired accuracy. Collection of 9 samples is the most cost effective method, followed by collection of 10, then 15, then 20, and the least cost effective method is the collection of 30 samples per reservoir.

However, as seen in the previous section, the collection method utilizing 20 samples (10 from the lacustrine zone and 10 from the riverine zone) produced an r^2 value similar to the r^2 value produced by the method utilizing 30 samples. However, because the use of 20 samples costs $200 less per reservoir, it seems to be the best method.

C. **Fish Metrics**

I. Results of Fish Metrics

Appendix E lists fish caught at each reservoir. The results of the fish metrics for each reservoir are listed in Table 13.

Table 13. Results of fish metrics.

METRIC	Big Hauani	Bixhoma	Carl Albert	Chickasha	Comanche	Cushing	Eucha	Frederick	McAlester	Rocky	Taylor	Skipout	Pauls Valley	Pawhuska	Claremore
Total species	8	11	14	10	13	17	17	17	21	16	16	13	15	15	18
# of sunfish sp.	3	5	5	3	5	5	5	5	4	5	3	4	6	6	5
# of sucker sp.	0	0	0	1	0	1	4	1	0	0	1	0	1	0	1
# of intolerant sp.	0	0	0	0	0	0	5	0	1	0	0	0	0	3	2
% of individuals tolerant	100	100	100	100	100	100	94.8	100	99.4	100	100	100	100	97	95.1
% of individuals omnivores	0	0	<1	47	12	13	3	25	2	23	6	3	5	1	5
% of individuals invertivores/ insectivores	63	64	84	28	70	71	80	66	72	65	77	79	81	91	65
# of migratory spawning sp.	0	0	0	2	0	2	3	2	0	0	1	0	1	0	2
# of lithophilic spawning sp.	0	0	0	1	0	1	3	1	0	0	0	0	0	0	2
Total individuals	607	559	891	193	305	442	1580	418	328	508	1460	576	526	1033	796

Values for the metric *total species* ranged from 8-21. This metric provided some differentiation between reservoirs by indicating the diversity of the fish community in each reservoir. However, because the fish communities in the reservoirs resulted mainly from stocking programs and incidental releases, this metric may not provide an accurate indication of the environmental quality in the reservoirs.

Values for the metric *number of sunfish species* ranged from 3-6. This metric provided little differentiation between reservoirs and the environmental quality within them.

Values for the metric *number of sucker species* ranged from 0-4. This metric provided little differentiation between reservoirs. With the exception of Lake Eucha, one or fewer sucker species were found in the reservoirs studied (median = 0, mean = 1). In Lake Eucha, four sucker species were found. As mentioned before, Lake Eucha is the only reservoir fed by a large perennial stream; and, as a result, it had a large number of stream fish species (including several sucker species).

Values for the metric *number of intolerant species* ranged from 0-5. This metric provided little differentiation between the reservoirs studied. Eleven of the fifteen reservoirs studied had no intolerant species. In Lake Eucha, five intolerant species were found. Again, this is likely due to it being fed by a large perennial stream, which resulted in the collection of several stream dwelling species. In Oklahoma, there are no true native lake fish communities, with the exception of the communities found in oxbow lakes. Therefore, the reservoirs in Oklahoma are stocked primarily with fish species, which, in nature, are stream pool dwelling species. These species are generally rather tolerant. Because of this, the metric provided little differentiation between reservoirs.

Percentages for the metric *percent of individuals tolerant* ranged from 94.8-1 00%. This metric did not provide any differentiation between reservoir quality. As discussed in the previous paragraph, the fish communities in the reservoirs studied resulted primarily from stocking of pool dwelling species which are generally rather tolerant.

Percentages for the metric *percent of individuals omnivores* ranged from 0-47%. This metric provided some differentiation between reservoirs. Omnivores are generally less sensitive to environmental stresses due to their ability to vary their diet. For example, this metric indicates that 47 percent of the fish population in Lake Chickasha is relatively tolerant of environmental stress compared to 0 percent in Lakes Bixhoma and Big Hauani. Thus, according to this metric, environmental conditions in Lakes Bixhoma and Big Hauani are of a higher quality than the environmental conditions in Lake Chickasha.

Percentages for the metric *percent of individuals invertivores or insectivores* ranged from 28 - 91%. This metric provided some differentiation between reservoirs. Invertivores/insectivores are less tolerant of environmental stresses because of their inability to vary their diet. For example, this metric indicates that 91 percent of the fish population in Lake Pawhuska is relatively intolerant to environmental stresses, while only 28 percent of the fish population in Lake Chickasha is relatively intolerant. Thus, according to this metric, environmental conditions in Lake Pawhuska are of a higher quality than the conditions in Lake Chickasha.

Values for the metric *number of migratory spawning species* ranged from 0-3. This metric provided little differentiation between reservoirs. This metric is not applicable to the reservoirs studied, because a majority of the reservoirs studied are located on small perennial streams where little migration is possible.

Values for the metric *number of lithophilic spawning species* ranged from 0-3. This metric provided little differentiation between reservoirs. Ten of the reservoirs had no lithophilic spawners. This metric is not applicable to the reservoirs studied, because many lithophilic spawners are migratory (which was discussed in the previous paragraph). In addition, numbers of lithophilic spawning species varies with ecoregion. For example, a greater number of lithophilic spawning species are found in the Ozark Highlands Ecoregion than in the Central Great Plains Ecoregion.

Values for the metric total number of individuals ranged from 193 - 1,580. Although the total number of species in each reservoir varied significantly, it did not provide an accurate reflection of the quality of the environment in the reservoirs studied. The metric assumes that high quality communities support large numbers of individuals. However, this might not always be the case. If an imbalance exists in the fish community between the number of predators and prey, large numbers of stunted prey may be present and the fish community may be of very poor quality. This is the case in Lake Skipout where most of the fish population is stunted.

2. **Reservoir Scores for Fish Metrics**

The fish metric scores are listed in Table 14.

Table 14. Fish metric scores.

METRIC	Big Hauani	Bixhoma	Carl Albert	Chickasha	Comanche	Cushing	Eucha	Frederick	McAlester	Rocky	Taylor	Skipout	Pauls Valley	Pawhuska	Claremore
Total species	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1
# of sunfish species	2	3	3	2	3	3	3	3	2	3	2	2	3	3	3
# of sucker species	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1
# of intolerant sp.	1	1	1	1	1	1	3	1	1	1	1	1	1	2	2
% of individuals tolerant	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
% of individuals omnivores	3	3	3	1	1	1	3	1	3	1	2	3	2	3	2
% of individuals invert/insectivores	1	1	3	1	2	2	3	1	2	1	2	2	3	3	1
# of migratory spawning species	1	1	1	2	1	2	3	2	1	1	2	1	2	1	2
# of lithophilic spawning species	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
Total individuals	3	2	3	1	2	2	3	2	2	2	3	2	2	3	3
TOTAL	**15**	**15**	**18**	**12**	**14**	**15**	**25**	**14**	**16**	**13**	**16**	**15**	**17**	**19**	**17**

Only two-thirds (12-25) of the entire range of possible scores (10-30) was represented by the reservoirs studied. Lake Eucha consistently scored the highest on the fish metrics, scoring a total of 25 points, while Lake Chickasha consistently scored the lowest on all metrics, scoring a total of 12 points. The metrics *total species, number of sucker species, percent of individuals tolerant,* and *number of lithophilic spawning species* provided no differentiation between reservoirs (with the exception of distinguishing Lake Eucha from the rest). In addition, the metrics *number of sunfish species and number of intolerant species* provided very little differentiation between the reservoirs. Only the metrics *percent if individuals omnivores, percent of individuals invertivores/insectivores, number of migratory species, and total individuals* provided adequate differentiation between reservoirs. However, the differentiation achieved between the reservoirs by these metrics may be due to factors other than trophic state or water quality [see IV.C (3)].

3. **Comparison of Fish Metric Scores to Various Environmental Parameters**

Table 15 ranks the reservoirs according to their fish scores and compares the scores to the reservoirs' trophic states and ecoregions.

Table 15. Comparison of fish score to TSI-chlorophyll a, trophic state, and ecoregion

Lake	Fish Score	TSI-Chlorophyll	Trophic State	Ecoregion
Eucha	21	50	Eutrophic	Ozark Highlands
Carl Albert	18	44	Mesotrophic	Ouachita Mountains.
Pawhuska	17	39	Oligotrophic	Central OK-TX Plains
Claremore	16	61	Hypereutrophic	Central Irregular Plains
Bixhoma	15	41	Mesotrophic	Central OK-TX Plains
Big Hauani	15	52	Eutrophic	Central OK-TX Plains
Pauls Valley	14	44	Mesotrophic	Central OK-TX Plains
Cushing	14	52	Eutrophic	Central OK-TX Plains
Taylor	14	67	Hypereutrophic	Central OK-TX Plains
Frederick	14	51	Eutrophic	Central Great Plains
McAlester	13	45	Mesotrophic	Central OK-TX Plains
Comanche	13	51	Eutrophic	Central OK-TX Plains
Rocky	13	62	Hypereutrophic	Central Great Plains
Chickasha	12	62	Hypereutrophic	Central Great Plains
Skipout	12	61	Hypereutrophic	Central Great Plains

In order to test the efficacy of the fish metrics, the correlation of fish scores to benthic scores, as well as fish scores to TSI-chlorophyll a were determined. The coefficient of determination (r^2) of 0.01 indicates that a linear relationship does not exist between the fish scores and benthic scores. The fish metrics also did not correlate with the trophic state of the reservoirs ($r^2 = 0.13$) as indicated by TSI-chlorophyll a. This is likely due to the fact that numerous factors influence the quality of the fish populations present in reservoirs besides trophic state and water quality. In addition, the highest quality fish communities may be found in mesotrophic reservoirs. Therefore, the relationship between the fish community and trophic state is likely not linear.

Habitat plays a very important role in the quality of fish communities. This is likely why the fish score was somewhat correlated with the maximum depth of the reservoirs studied ($r^2 = 0.51$), because reservoirs of greater depth generally have a greater diversity of habitat. Situation on large perennial streams also influences the fish community. Because most of the reservoirs are not fed by large perennial streams, few migratory spawning fish (or lithophilic spawners) were present. Ecoregion (Table 15) also affects the fish populations. For example, according to the *Oklahoma Biodiversity* report fish diversity in the Ozark Highlands is significantly greater than fish diversity in the Central Great Plains.

In small reservoirs, the fish populations are also greatly influenced by human interaction. The fish populations in the reservoirs studied resulted primarily from stocking and incidental releases of fish and therefore do not reflect natural fish communities. Fishing pressure on these reservoirs further modifies the fish populations due to the selective harvest of certain species. Sampling techniques can also bias samples. Collection gear biases the samples toward certain fish. The season of the sampling event can have a substantial impact on the findings of fish surveys. Due to these limitations, fish metrics did not accurately indicate the water quality or trophic state of the reservoirs studied.

V. **Conclusion**

The study demonstrated that benthic macroinvertebrate metrics accurately indicate the biotic health of the shallower reservoirs which were not strongly stratified at 40% or more of the sampling sites. The study also indicated that it was not necessary to collect 30 samples. Reasonable accuracy could be achieved with as few as 9 samples. However, collection of 20 samples per reservoir (10 from lacustrine and 10 from riverine zone) is recommended to achieve the best accuracy at the most reasonable price. Cost analysis of the use of the benthic macroinvertebrate metrics indicates that this method is very cost effective, costing only $20-25 per sample, or $180-750 per lake.

In contrast to the success achieved by the benthic metrics in the shallow reservoirs, the application of the benthic metrics to the deeper reservoirs, which were stratified at 40% or more of their sites, failed miserably. However, it is likely that with further research, the benthic metrics may be adapted, or more appropriate ones may be developed, for deeper reservoirs in the future.

The fish metrics also failed to accurately depict the biotic health of reservoirs. Because of direct human influence on the fisheries of small reservoirs, it is unlikely that fish metrics will be able to successfully indicate the biotic health of small reservoirs. Also, because there are no true native fish communities in Oklahoma reservoirs, we are looking at the pool species of streams which are, in general, relatively tolerant. The costs of collection, identification, and analysis of fish are also much higher than those associated with analysis of the benthic macroinvertebrate community. Costs for the collection of fish are $ 1000 per reservoir using only electroshocking and $1500 per reservoir using both electroshocking and gill netting. These costs are significantly greater than those for the analysis of the benthic macroinvertebrate community.

Further research is needed to adapt or develop new benthic metrics for use in deeper reservoirs. In addition, more sampling is needed to confirm the results found by this study.

Literature Cited

Carlson, R.E. 1977. A trophic state index for lakes. Journal of Limnology and Oceanography 22:361-369.

Carlson, R.E. 1991. Expanding the trophic state concept to identify non-nutrient limited lakes and reservoirs. Enhancing the States' Lake Management Programs, 1991: 59-71.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessment Protocols For Use In Streams And Rivers: Benthic Macroinvertebrates And Fish. EPA/444/4-89-001. U.S. Environmental Protection Agency, Assessment and Watershed Protection Division, Washington, D.C.

Karr, JR., K.D. Fausch, P.L. Angermeier, and P.R. Yant. 1986. Assessing biological integrity in running waters: a method and its rationale. Illinois Natural History Survey Special Publication 5.

Masters, A.E. 1992. TVA Reservoir Vital Signs Monitoring - 1991 Benthic Macroinvertebrate Community Results. TVA/WR-92/3. Tennessee Valley Authority, Resource Group, River Basin Operations, Water Resources. Chattanooga, Tennessee.

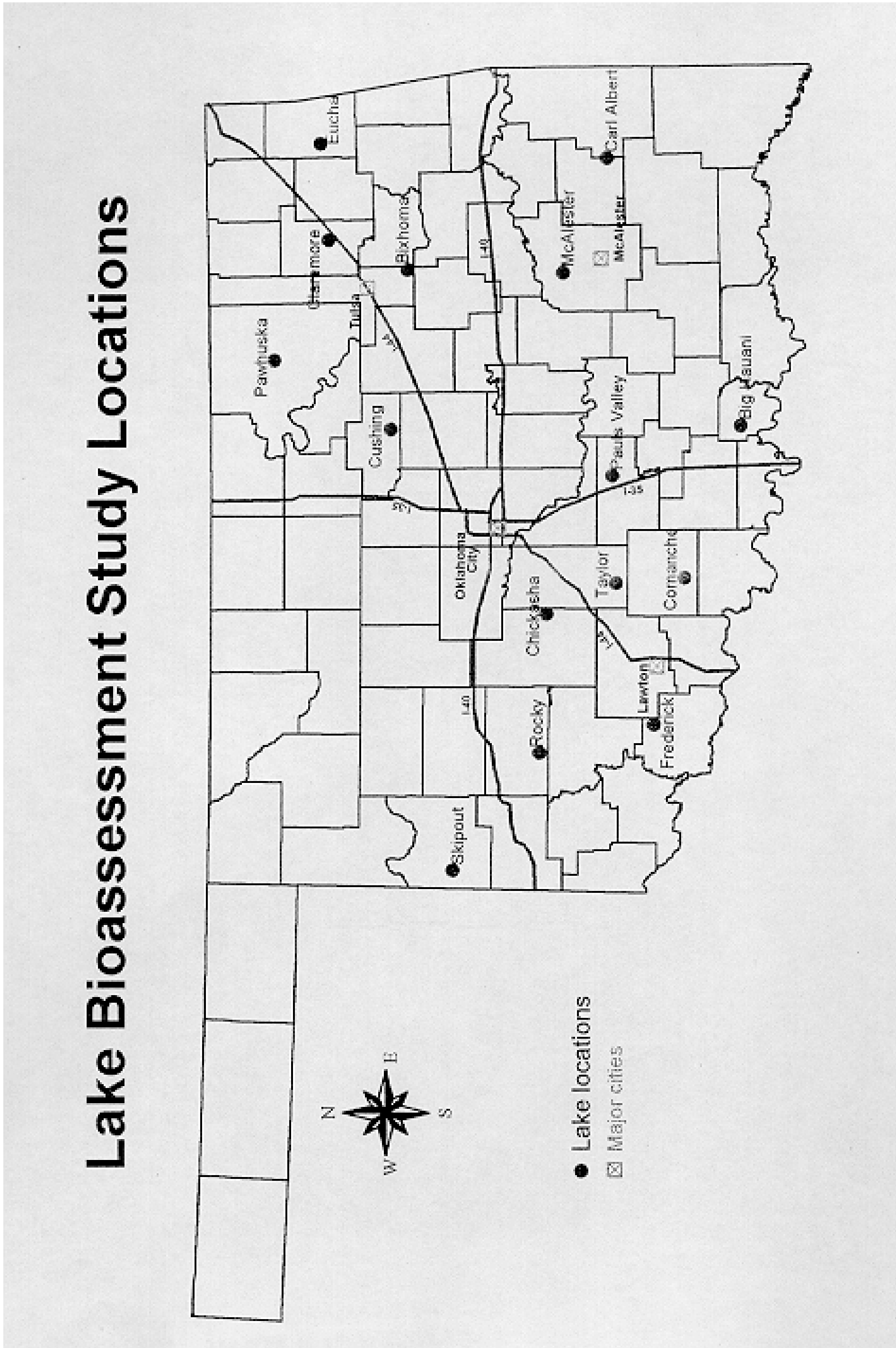
Miller, R.J. and H.W. Robison. 1980. The Fishes of Oklahoma. Oklahoma State University Press. Stillwater, Oklahoma.

OCC (Oklahoma Conservation Commission). 1995. Macroinvertebrate and Fish Bioassessment Methods for Small to Medium Sized Reservoirs. OCC - Water Quality Division. Oklahoma City, Oklahoma.

Scott, E.M. 1992. TVA Reservoir Vital Signs Monitoring - 1991 Fish Community Results. TVA/WR-92/5. Tennessee Valley Authority, Resource Group, River Basin Operations, Water Resources. Norris, Tennessee.

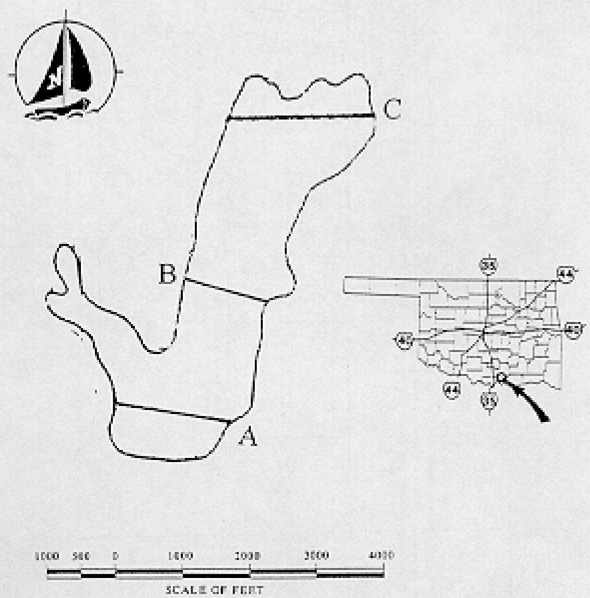
APPENDIX A

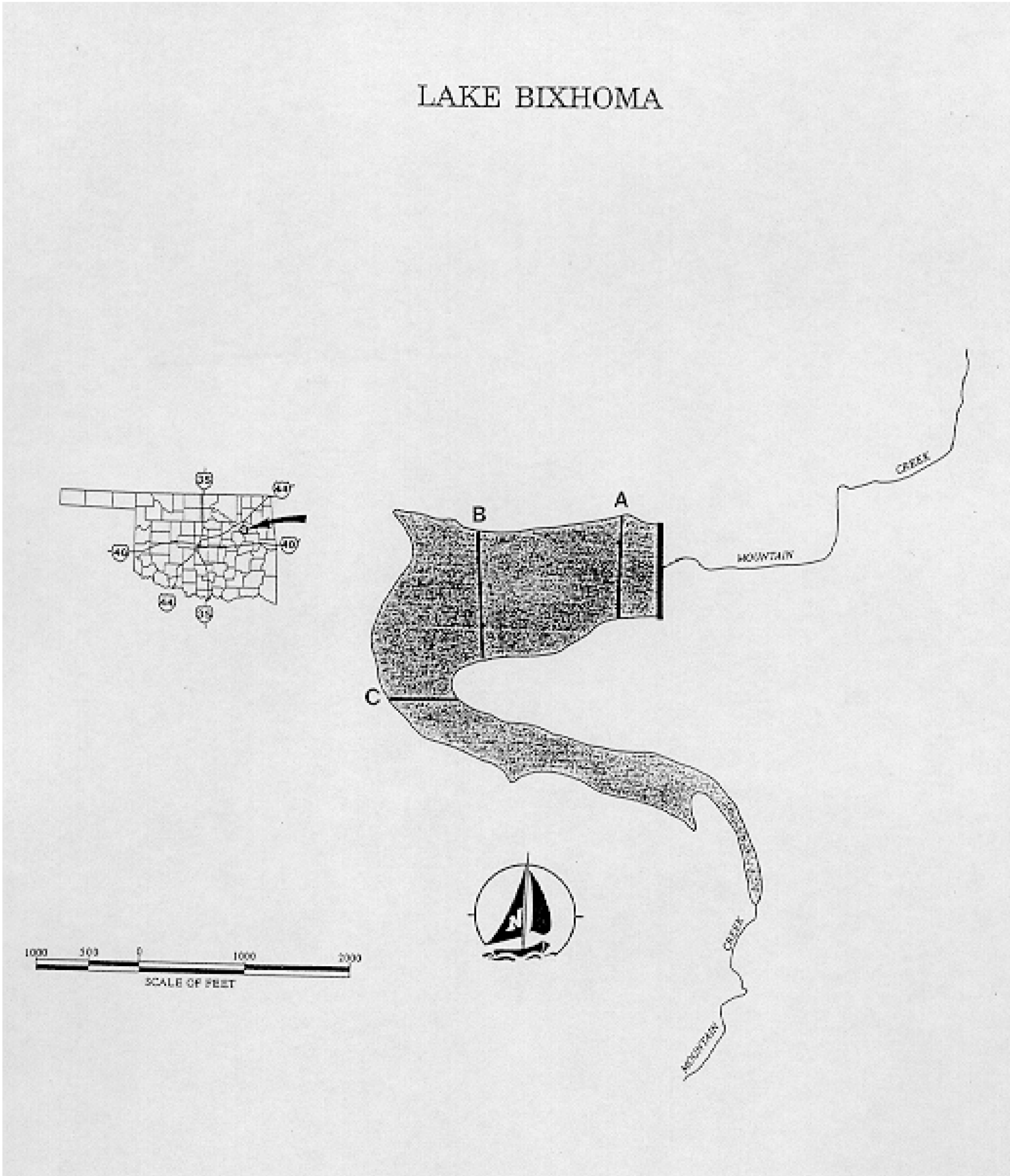
RESERVOIR MAPS



Lake Bioassessment Study Locations
Eucha
Carl Albert
Claremore
Bixhoma
McAlester
McAlester
Tulsa
Pawhuska
Cushing
Pauls Valley
Big Hauani
Oklahoma City
Taylor
Comanche
Chickasha
Lawton
Frederick
Rocky
Skipout
I-40
I-40
I-35
I-35
I-44
I-44
N
E
S
W
Lake locations
Major cities

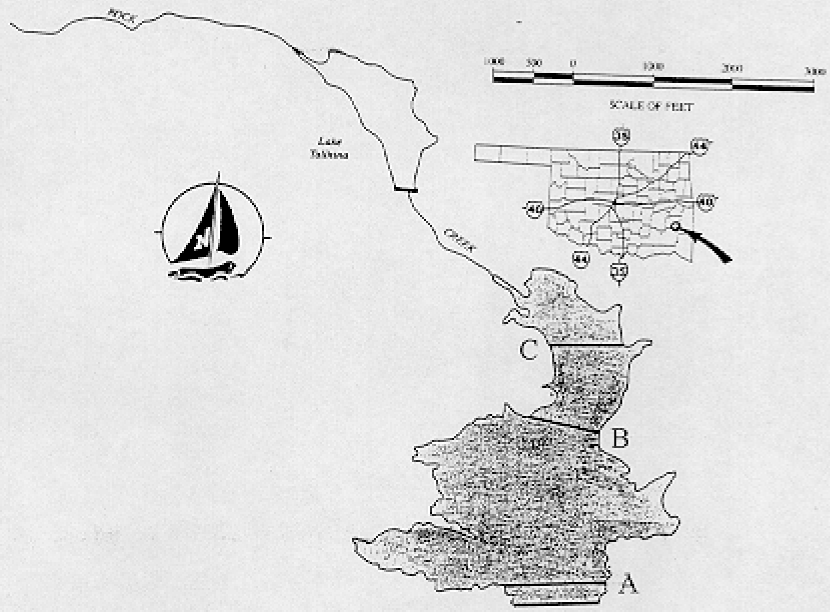
BIG HAUANI LAKE

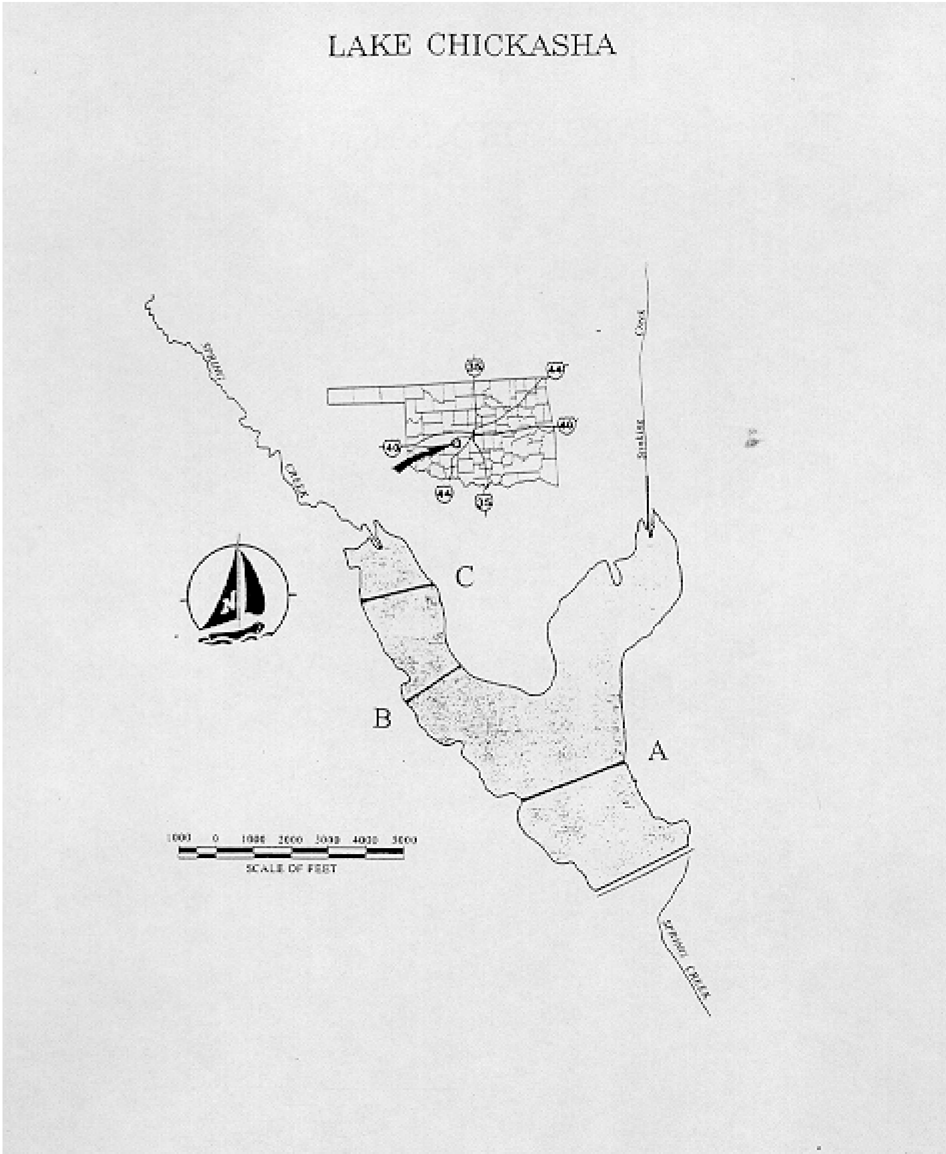




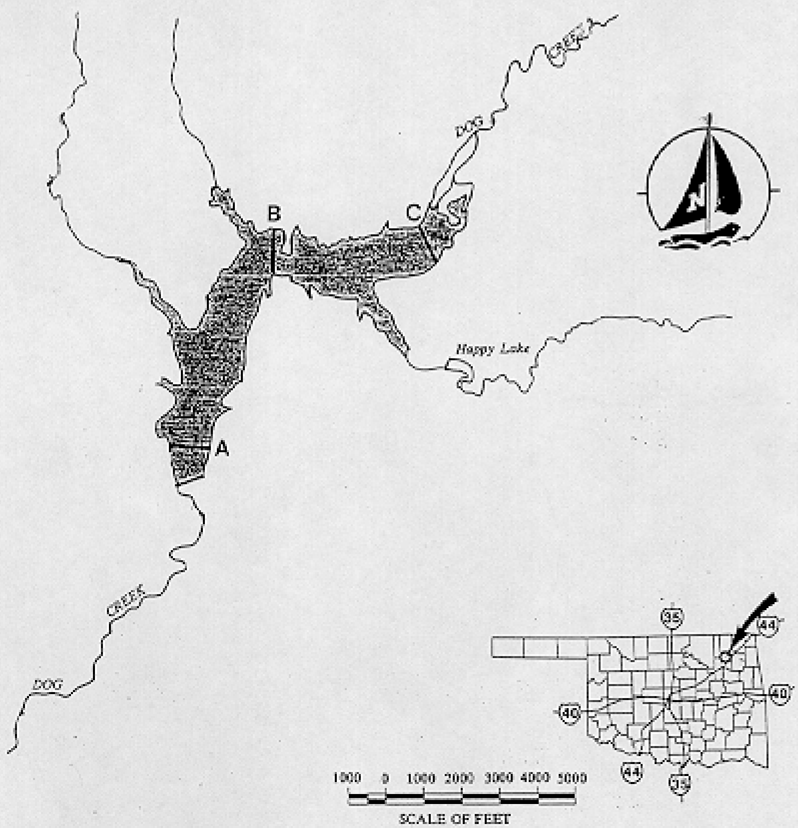
LAKE BIXHOMA
A
B
C
MOUNTAIN
CREEK
MOUNTAIN
CREEK
SCALE OF FEET

CARL ALBERT LAKE
ROCK CREEK SITE 2

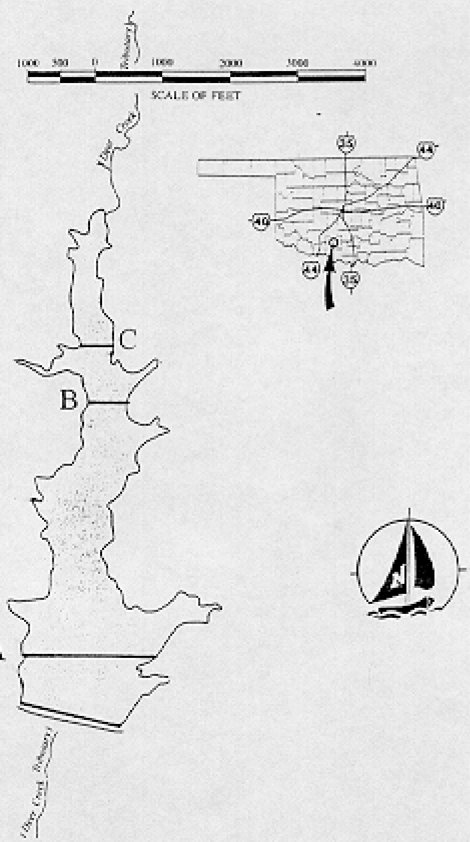



LAKE CHICKASHA
C
B
A
SCALE OF FEET
SPRING CREEK
Stinking Creek

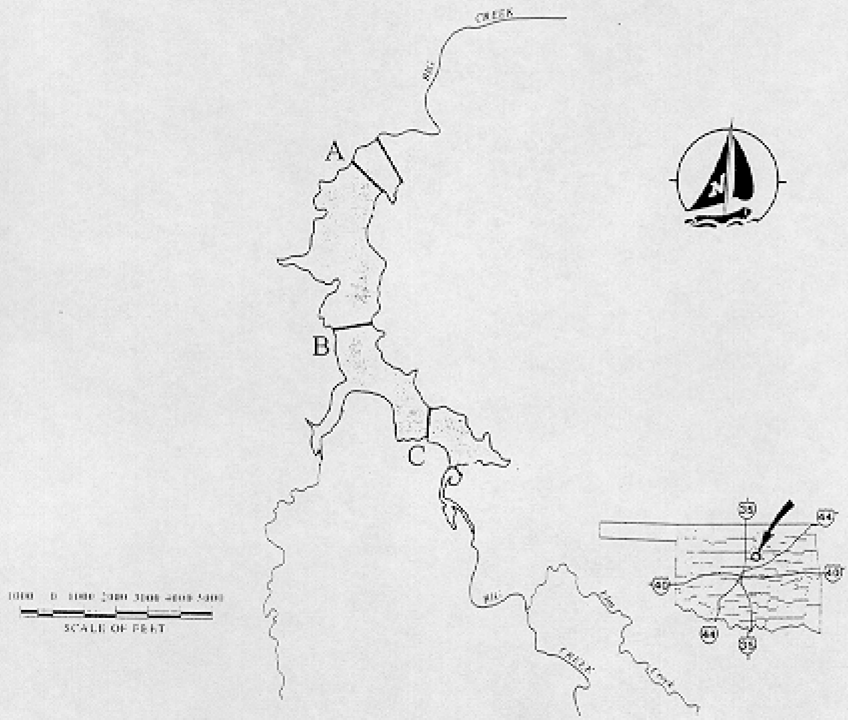
CLAREMORE LAKE



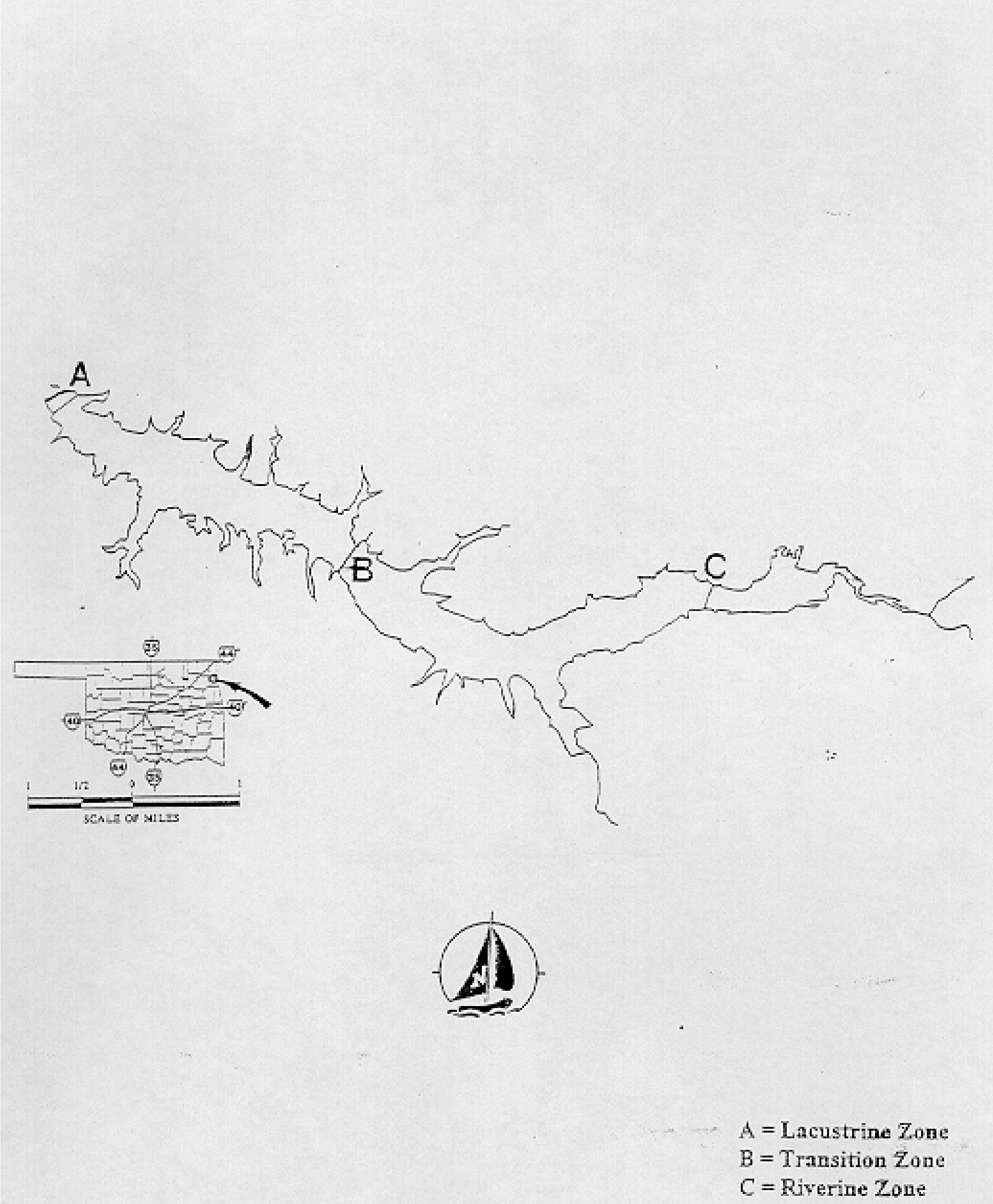
COMANCHE LAKE



CUSHING MUNICIPAL LAKE

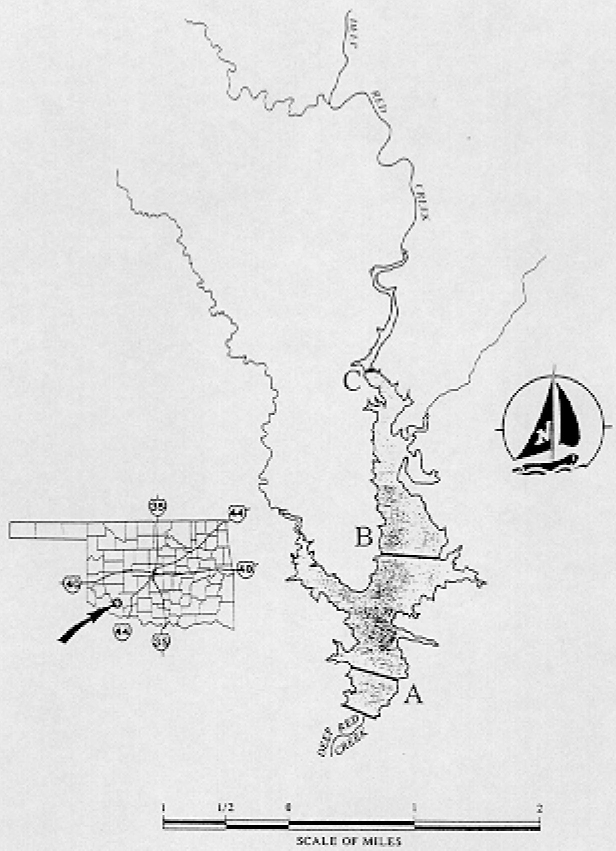


LAKE EUCHA

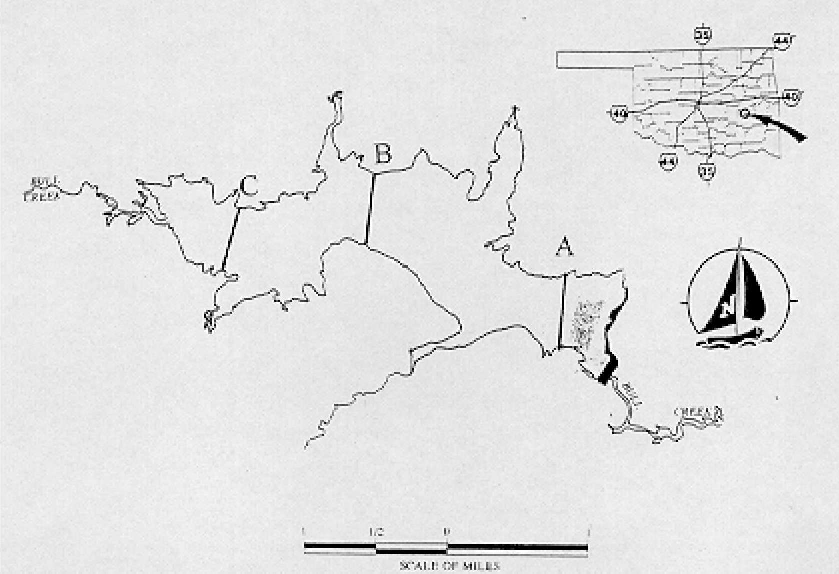


A
B
C
1/2
0
1
SCALE OF MILES
A = Lacustrine Zone
B = Transition Zone
C = Riverine Zone

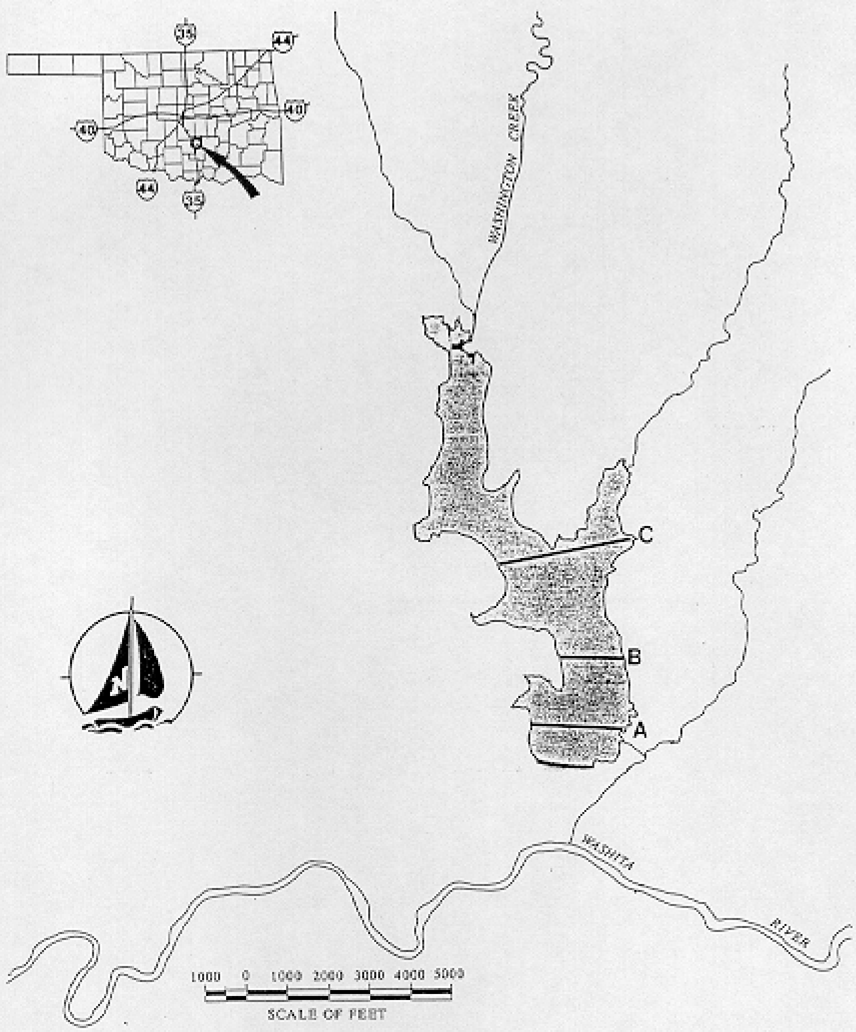
LAKE FREDERICK
DEEP RED RUN—COFFIN CREEK SITE 1



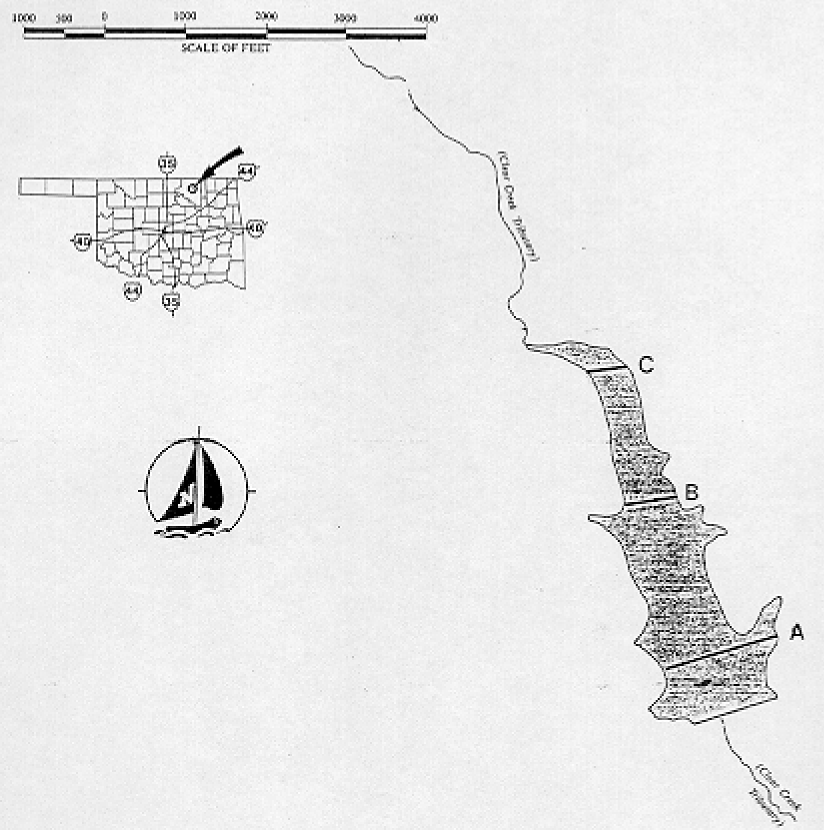
LAKE McALESTER



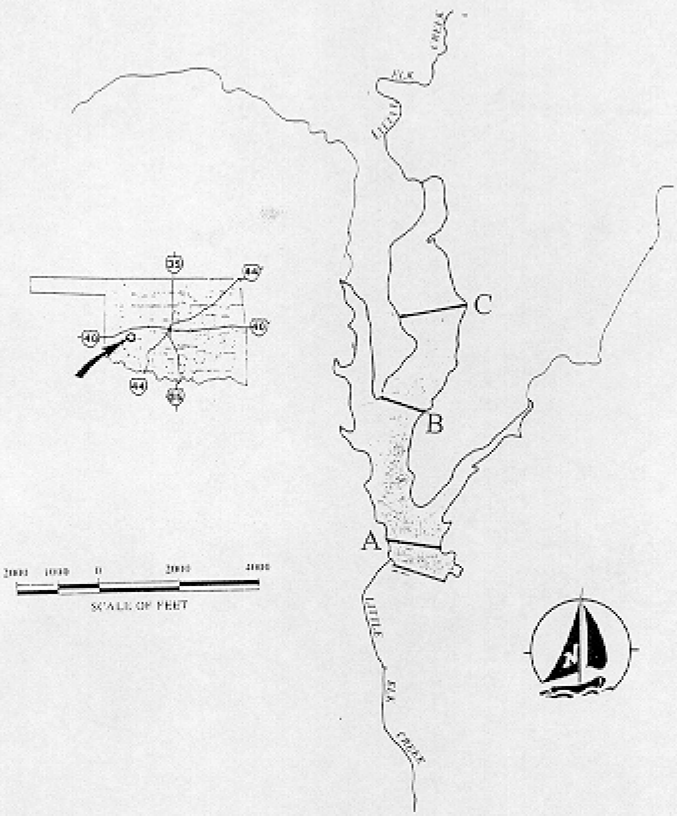
PAULS VALLEY CITY LAKE



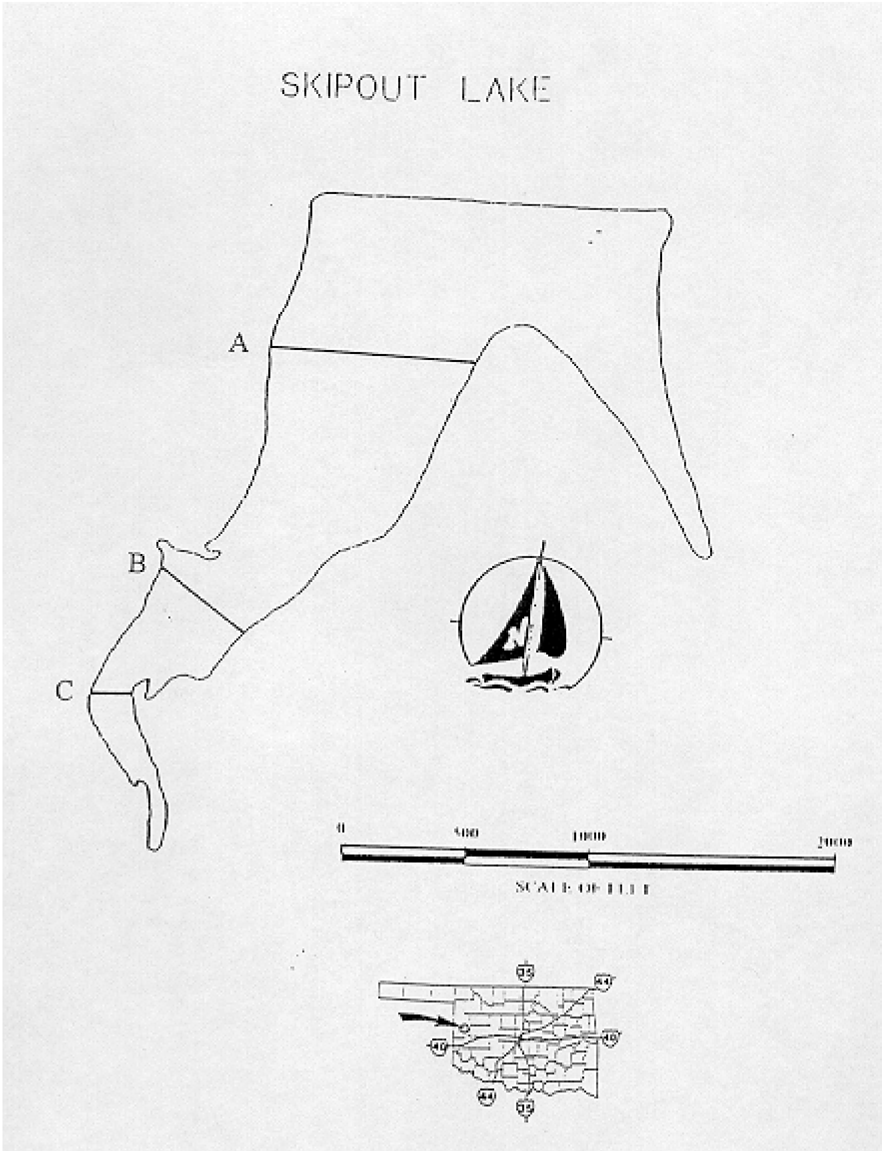
LAKE PAWHUSKA



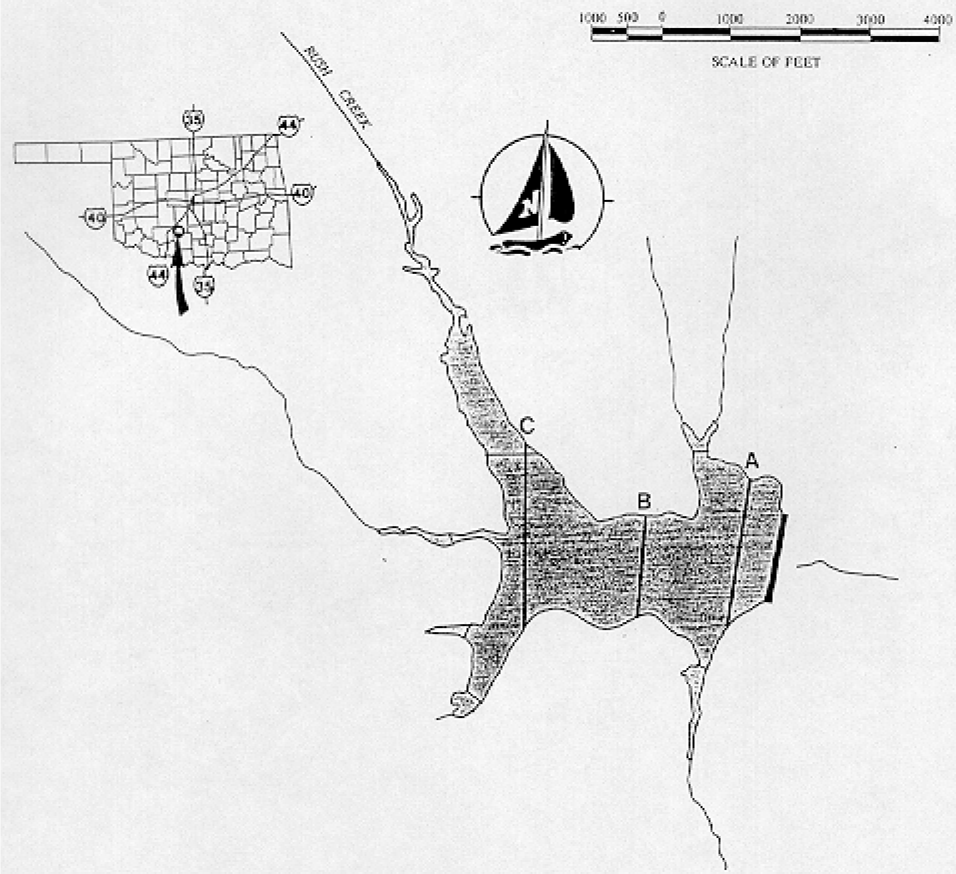
ROCKY LAKE



ELK CREEK
LITTLE ELK CREEK
C
B
A
35
44
40
40
44
35
2000 1000 0 2000 4000
SCALE OF FEET


SKIPOUT LAKE
A
B
C
0
500
1000
2000
SCALE OF FEET

TAYLOR LAKE


1000 500 0 1000 2000 3000 4000
SCALE OF FEET
RUSH CREEK
C
B
A
35
44
40
40
44
35

APPENDIX B

FIELD DATA

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/l)
Chickasha	08/12/95	1	0.5		8.2	1451	28.7		7.9
Chickasha	08/12/95		1.1	1.6	8.2	1456	28.5	0.1	7.6
Chickasha	08/12/95	2	0.5		8.2	1409	28.4		7.4
Chickasha	08/12/95		6.1	6.6	8.0	1468	28.2	0.2	3.9
Chickasha	08/12/95	3	0.5		8.1	1448	28.3		7.3

Chickasha	08/12/95		7.3	7.8	8.1	1467	28.0	0.3	<2.0
Chickasha	08/12/95	4	0.5		8.2	1456	28.3		7.2
Chickasha	08/12/95		7.1	7.6	8.1	1467	27.9	0.4	<2.0
Chickasha	08/12/95	5	0.5		8.2	1447	28.3		7.2
Chickasha	08/12/95		7.1	7.6	7.9	1473	27.8	0.5	<2.0
Chickasha	08/12/95	6	0.5		8.1	1472	28.3		7.1
Chickasha	08/12/95		7.2	7.7	7.5	1470	27.5	0.8	<2.0
Chickasha	08/12/95	7	0.5		8.1	1451	28.3		7.3
Chickasha	08/12/95		7.2	7.7	7.3	1474	27.4	0.9	<2.0
Chickasha	08/12/95	8	0.5		8.1	1445	28.2		7.0
Chickasha	08/12/95		7.2	7.7	7.3	1466	27.1	1.2	<2.0
Chickasha	08/12/95	9	0.5		8.0	1430	28.3		6.7
Chickasha	08/12/95		5.9	6.4	7.5	1456	27.5	0.8	3.9
Chickasha	08/12/95	10	0.5		8.0	1458	28.6		6.1
Chickasha	08/12/95		2.2	2.7	7.7	1468	27.7	0.9	6.6
Chickasha	08/12/95	11	0.5		8.2	1453	28.8		6.9
Chickasha	08/12/95		1.1	1.6	8.1	1465	28.7	0.1	7.0
Chickasha	08/12/95	12	0.5		8.1	1451	28.7		6.9
Chickasha	08/12/95		3.8	4.3	8.1	1456	28.5	0.1	5.3
Chickasha	08/12/95	13	0.5		8.1	1457	28.7		7.0
Chickasha	08/12/95		4.3	4.8	8.0	1467	28.5	0.2	6.2
Chickasha	08/12/95	14	0.5		8.1	1458	28.7		6.6
Chickasha	08/12/95		4.3	4.8	8.0	1464	28.4	0.3	5.6
Chickasha	08/12/95	15	0.5		8.1	1456	28.8		6.5
Chickasha	08/12/95		4.3	4.8	7.8	1467	28.2	0.5	5.0
Chickasha	08/12/95	16	0.5		8.1	1455	28.8		6.6
Chickasha	08/12/95		4.2	4.7	7.9	1464	28.2	0.6	4.3
Chickasha	08/12/95	17	0.5		8.1	1443	28.7		6.8
Chickasha	08/12/95		4.0	4.5	7.9	1456	28.2	0.6	5.0
Chickasha	08/12/95	18	0.5		8.1	1415	28.7		6.6
Chickasha	08/12/95		3.8	4.3	8.0	1466	28.2	0.5	5.3
Chickasha	08/12/95	19	0.5		8.2	1446	28.8		6.9
Chickasha	08/12/95		3.6	4.1	7.9	1468	28.2	0.6	5.3
Chickasha	08/12/95	20	0.5		8.2	1441	29.1		6.9
Chickasha	08/12/95		0.5	0.6	8.2	1441	29.1	0.0	6.9
Chickasha	08/12/95	21	0.5		8.1	1500	28.5		7.4
Chickasha	08/12/95		0.7	1.2	8.1	1500	28.5	0.0	7.3
Chickasha	08/12/95	22	0.5		8.1	1464	28.7		6.9
Chickasha	08/12/95		1.7	2.2	8.1	1475	28.6	0.1	6.8
Chickasha	08/12/95	23	0.5		8.1	1463	28.6		6.6
Chickasha	08/12/95		2.2	2.7	8.1	1477	28.5	0.1	6.6
Chickasha	08/12/95	24	0.5		8.1	1463	28.6		6.4
Chickasha	08/12/95		2.1	2.6	8.0	1471	28.5	0.1	6.6
Chickasha	08/12/95	25	0.5		8.1	1474	28.7		6.7
Chickasha	08/12/95		1.9	2.4	8.1	1481	28.5	0.2	6.5
Chickasha	08/12/9526	0.5		8.1	1406	28.8		6.5	
Chickasha	08/12/95	1.9	2.4	8.1	1467	28.6	0.1	6.5	
Chickasha	08/12/9527	0.5		8.1	1473	28.8		6.7	
Chickasha	08/12/95	1.6	2.1	8.1	1478	28.8	0.0	6.8	
Chickasha	08/12/9528	0.5		8.1	1464	28.9		6.8	
Chickasha	08/12/95	1.3	1.8	8.1	1472	28.8	0.0	6.8	
Chickasha	08/12/9529	0.5		8.1	1453	28.9		6.7	
Chickasha	08/12/95	1.2	1.7	8.1	1462	28.9	0.0	6.5	
Chickasha	08/12/9530	0.5		8.1	1477	29.0		6.4	
Chickasha	08/12/95	0.7	1.2	8.1	1470	29.0	0.0	6.4	

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Cushing	07/24/95	1	0.5		7.2	181	28.4		5.0
Cushing	07/24/95		1.2	1.7	7.2	181	28.4	0.1	4.9
Cushing	07/24/95	2	0.5		7.3	181	28.6		5.0
Cushing	07/24/95		3.0	3.5	7.3	181	28.1	0.4	4.7
Cushing	07/24/95	3	0.5		7.4	177	28.4		5.7
Cushing	07/24/95		4.7	5.2	7.0	185	26.3	2.1	3.5

Cushing	07/24/95	4	0.5		7.5	176	28.5		5.5
Cushing	07/24/95		4.8	5.3	7.1	180	26.9	1.6	3.7
Cushing	07/24/95	5	0.5		7.6	167	29.4		5.4
Cushing	07/24/95		5.1	5.6	7.1	182	25.6	3.9	<2.0
Cushing	07/24/95	6	0.5		7.5	173	28.7		5.9
Cushing	07/24/95		5.5	6.0	7.1	182	25.5	3.1	3.9
Cushing	07/24/95	7	0.5		7.6	174	28.8		5.5
Cushing	07/24/95		5.8	6.3	7.1	180	25.2	3.6	3.1
Cushing	07/24/95	8	0.5		7.5	172	28.7		5.9
Cushing	07/24/95		5.5	6.0	7.1	180	25.5	3.2	4.7
Cushing	07/24/95	9	0.5		7.6	173	28.9		5.3
Cushing	07/24/95		5.0	5.5	7.1	181	26.6	2.3	3.3
Cushing	07/24/95	10	0.5		7.6	176	29.4		5.3
Cushing	07/24/95		4.3	4.8	7.2	175	27.6	1.8	3.8
Cushing	07/24/95	11	0.5		7.4	181	28.3		5.9
Cushing	07/24/95		1.0	1.5	7.3	181	28.2	0.1	6.2
Cushing	07/24/95	12	0.5		7.5	178	28.4		6.4
Cushing	07/24/95		2.5	3.0	7.3	184	27.7	0.7	6.6
Cushing	07/24/95	13	0.5		7.5	180	28.4		5.4
Cushing	07/24/95		2.9	3.4	7.3	190	27.5	0.9	3.8
Cushing	07/24/95	14	0.5		7.5	178	28.4		5.8
Cushing	07/24/95		3.1	3.6	7.3	192	27.2	1.2	4.1
Cushing	07/24/95	15	0.5		7.5	177	28.5		5.2
Cushing	07/24/95		3.1	3.6	7.3	189	27.2	1.3	3.0
Cushing	07/24/95	16	0.5		7.5	176	28.4		6.2
Cushing	07/24/95		2.9	3.4	7.4	180	27.7	0.7	6.1
Cushing	07/24/95	17	0.5		7.1	179	28.6		6.0
Cushing	07/24/95		2.3	2.8	7.1	183	27.8	0.8	5.3
Cushing	07/24/95	18	0.5		7.4	178	28.5		5.4
Cushing	07/24/95		2.1	2.6	7.3	183	27.7	0.8	4.4
Cushing	07/24/95	19	0.5		7.5	177	28.7		5.9
Cushing	07/24/95		2.1	2.6	7.3	179	27.7	1.1	5.7
Cushing	07/24/95	20	0.5		7.5	175	28.9		5.4
Cushing	07/24/95		2.0	2.5	7.3	181	27.8	1.1	4.2
Cushing	07/24/95	21	0.5		7.5	193	29.9		6.0
Cushing	07/24/95		0.9	1.4	7.5	200	28.8	1.1	4.6
Cushing	07/24/95	22	0.5		7.5	191	29.6		5.7
Cushing	07/24/95		1.3	1.8	7.2	204	27.8	1.8	3.5
Cushing	07/24/95	23	0.5		7.5	190	29.2		6.4
Cushing	07/24/95		1.3	1.8	7.3	201	28.1	1.1	5.8
Cushing	07/24/95	24	0.5		7.5	186	29.8		5.1
Cushing	07/24/95		0.7	1.2	7.4	195	28.9	0.8	5.2
Cushing	07/24/95	25	0.5		7.5	195	29.2		4.9
Cushing	07/24/95		1.0	1.5	7.3	198	28.0	1.2	3.9
Cushing	07/24/95	26	0.5		7.5	195	28.5		5.0
Cushing	07/24/95		1.2	1.7	7.2	195	27.7	0.9	3.6
Cushing	07/24/95	27	0.5		7.5	191	29.0		5.6
Cushing	07/24/95		1.3	1.8	7.1	202	27.8	1.2	3.8
Cushing	07/24/95	28	0.5		7.5	192	29.3		5.1
Cushing	07/24/95		0.9	1.4	7.3	188	27.9	1.3	4.0
Cushing	07/24/95	29	0.5		7.5	180	28.9		5.8
Cushing	07/24/95		1.6	2.1	7.2	188	26.9	1.9	4.6
Cushing	07/24/95	30	0.5		7.5	184	28.6		5.2
Cushing	07/24/95		1.5	2.0	7.2	190	27.0	1.6	3.1

Lake	Date	Site	Sampling Depth(m)	Total Depth(m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Big Hauani	08/16/95	1	0.5		7.5	222	30.2		7.0
Big Hauani	08/16/95		7.3	7.8	7.7	222	30.0	0.2	9.5
Big Hauani	08/16/95	2	0.5		7.7	217	30.1		6.5
Big Hauani	08/16/95		4.7	5.2	7.4	235	29.3	0.8	3.4
Big Hauani	08/16/95	3	0.5		7.8	218	30.1		6.8
Big Hauani	08/16/95		8.7	9.2	6.9	302	19.2	10.9	<2.0
Big Hauani	08/16/95	4	0.5		7.9	219	30.1		7.4

Big Hauani	08/16/95		9.2	9.7	6.9	307	18.7	11.4	<2.0
Big Hauani	08/16/95	5	0.5		7.3	214	30.1		7.2
Big Hauani	08/16/95		10.5	11.0	6.7	327	17.7	12.4	<2.0
Big Hauani	08/16/95	6	0.5		7.9	220	30.1		6.8
Big Hauani	08/16/95		7.8	8.3	7.8	297	20.9	9.2	<2.0
Big Hauani	08/16/95	7	0.5		7.9	210	30.0		7.1
Big Hauani	08/16/95		8.2	8.7	6.9	301	19.5	10.6	<2.0
Big Hauani	08/16/95	8	0.5		7.9	222	30.0		6.6
Big Hauani	08/16/95		7.5	8.0	7.1	293	20.5	9.5	<2.0
Big Hauani	08/16/95	9	0.5		7.9	221	30.1		7.0
Big Hauani	08/16/95		8.6	9.1	7.0	301	19.3	10.8	<2.0
Big Hauani	08/16/95	10	0.5		8.0	216	30.3		7.6
Big Hauani	08/16/95		3.0	3.5	8.0	223	29.9	0.4	7.6
Big Hauani	08/16/95	11	0.5		8.0	216	30.3		6.6
Big Hauani	08/16/95		2.4	2.9	7.9	217	30.2	0.1	6.9
Big Hauani	08/16/95	12	0.5		8.0	213	30.2		6.5
Big Hauani	08/16/95		3.7	4.2	7.8	216	30.0	0.2	6.3
Big Hauani	08/16/95	13	0.5		8.0	219	30.2		6.8
Big Hauani	08/16/95		4.3	4.8	7.9	215	30.1	0.2	7.2
Big Hauani	08/16/95	14	0.5		8.0	222	30.2		6.6
Big Hauani	08/16/95		8.9	9.4	7.0	318	18.9	11.4	<2.0
Big Hauani	08/16/95	15	0.5		7.9	221	30.1		6.9
Big Hauani	08/16/95		4.4	4.9	8.0	219	30.1	0.0	7.0
Big Hauani	08/16/95	16	0.5		8.0	219	30.2		7.3
Big Hauani	08/16/95		4.6	5.1	7.9	221	29.9	0.3	5.9
Big Hauani	08/16/95	17	0.5		8.0	218	30.2		6.6
Big Hauani	08/16/95		4.4	4.9	7.9	220	29.9	0.3	5.8
Big Hauani	08/16/95	18	0.5		8.0	217	30.3		7.1
Big Hauani	08/16/95		4.3	4.8	8.0	219	30.0	0.3	6.4
Big Hauani	08/16/95	19	0.5		8.1	214	30.4		7.8
Big Hauani	08/16/95		3.4	3.9	8.0	219	30.0	0.4	6.9
Big Hauani	08/16/95	20	0.5		8.1	209	30.4		7.4
Big Hauani	08/16/95		2.0	2.5	8.0	210	30.1	0.3	7.2
Big Hauani	08/16/95	21	0.5		8.0	204	31.2		6.8
Big Hauani	08/16/95		2.1	2.6	7.7	214	30.2	1.0	6.2
Big Hauani	08/16/95	22	0.5		8.2	204	30.9		7.9
Big Hauani	08/16/95		0.9	1.4	8.3	199	30.8	0.1	8.1
Big Hauani	08/16/95	23	0.5		8.2	203	30.9		8.0
Big Hauani	08/16/95		0.8	1.3	8.3	202	30.9	0.0	7.9
Big Hauani	08/16/95	24	0.5		8.1	205	30.8		7.7
Big Hauani	08/16/95		1.6	2.1	8.0	214	29.8	1.0	4.2
Big Hauani	08/16/95	25	0.5		8.3	196	30.9		8.8
Big Hauani	08/16/95		1.0	1.5	8.5	190	30.5	0.3	9.5
Big Hauani	08/16/95	26	0.5		8.3	196	30.9		8.4
Big Hauani	08/16/95		0.9	1.4	8.5	188	30.9	0.0	9.1
Big Hauani	08/16/95	27	0.5		8.3	207	30.8		8.7
Big Hauani	08/16/95		2.2	2.7	8.3	193	30.4	0.4	9.0
Big Hauani	08/16/95	28	0.5		8.3	207	30.8		8.5
Big Hauani	08/16/95		0.9	1.4	8.4	206	30.9	0.0	8.9
Big Hauani	08/16/95	29	0.5		8.5	193	31.1		9.3
Big Hauani	08/16/95		0.7	1.2	8.8	185	31.1	0.0	10.5
Big Hauani	08/16/95	30	0.5		8.7	173	31.6		11.3
Big Hauani	08/16/95		0.5	0.6	8.7	173	31.6	0.0	11.3

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Carl Albert	08/10/96	1	0.5		6.4	394	30.8		5.7
Carl Albert	08/10/96		2.4	2.9	6.1	394	30.1	0.7	5.8
Carl Albert	08/10/96	2	0.5		6.5	381	30.9		6.0
Carl Albert	08/10/96		5.2	5.7	5.8	481	18.2	12.7	3.4
Carl Albert	08/10/96	3	0.5		6.4	381	30.8		5.2
Carl Albert	08/10/96		6.8	7.3	6.0	480	15.1	15.6	<2.0
Carl Albert	08/10/96	4	0.5		6.6	384	31.2		5.3
Carl Albert	08/10/96		9.7	10.2	6.1	602	13.3	17.9	<2.0

Carl Albert	08/10/96	5	0.5		6.5	381	30.7		6.0
Carl Albert	08/10/96		10.7	11.2	6.2	614	12.9	17.7	<2.0
Carl Albert	08/10/96	6	0.5		6.6	384	31.0		5.6
Carl Albert	08/10/96		10.4	10.9	6.1	621	13.0	18.1	<2.0
Carl Albert	08/10/96	7	0.5		6.6	380	30.8		5.9
Carl Albert	08/10/96		11.1	11.6	6.2	639	12.8	18.0	<2.0
Carl Albert	08/10/96	8	0.5		6.4	380	30.6		5.4
Carl Albert	08/10/96		11.0	11.5	6.2	634	12.8	17.8	<2.0
Carl Albert	08/10/96	9	0.5		6.5	382	30.5		5.6
Carl Albert	08/10/96		10.7	11.2	6.3	637	12.9	17.6	<2.0
Carl Albert	08/10/96	10	0.5		6.4	382	30.5		6.2
Carl Albert	08/10/96		4.7	5.2	6.1	466	19.4	11.1	6.1
Carl Albert	08/10/96	11	0.5		6.9	369	31.3		6.4
Carl Albert	08/10/96		7.0	7.5	6.3	542	14.7	16.6	<2.0
Carl Albert	08/10/96	12	0.5		6.4	373	32.3		5.9
Carl Albert	08/10/96		6.2	6.7	6.2	494	16.2	16.1	<2.0
Carl Albert	08/10/96	13	0.5		6.5	376	31.1		5.4
Carl Albert	08/10/96		6.1	6.6	6.2	499	16.3	14.7	<2.0
Carl Albert	08/10/96	14	0.5		6.5	379	32.4		5.8
Carl Albert	08/10/96		5.7	6.2	6.2	488	17.3	15.1	<2.0
Cad Albert	08/10/96	15	0.5		6.6	379	32.3		6.1
Carl Albert	08/10/96		6.1	6.6	6.2	499	16.5	15.8	<2.0
Carl Albert	08/10/96	16	0.5		6.5	378	32.0		6.0
Carl Albert	08/10/96		6.6	7.1	6.2	529	15.1	16.9	<2.0
Carl Albert	08/10/96	17	0.5		6.6	381	32.6		5.5
Carl Albert	08/10/96		5.8	6.3	6.0	493	16.6	16.0	<2.0
Carl Albert	08/10/96	18	0.5		6.4	373	32.3		5.8
Carl Albert	08/10/96		6.2	6.7	6.2	498	15.9	16.4	<2.0
Carl Albert	08/10/96	19	0.5		6.6	376	32.6		5.6
Carl Albert	08/10/96		4.0	4.5	6.3	410	24.4	8.3	3.3
Cad Albert	08/10/96	20	0.5		6.6	379	32.5		5.9
Carl Albert	08/10/96		0.9	1.4	6.7	375	31.0	1.5	6.2
Carl Albert	08/10/96	21	0.5		6.8	383	32.7		5.9
Carl Albert	08/10/96		1.3	1-8	6.8	373	30.5	2.2	6.1
Carl Albert	08/10/96	22	0.5		6.9	371	32.6		5.5
Carl Albert	08/10/96		3.0	3.5	6.3	382	28.2	4.4	3.9
Carl Albert	08/10/96	23	0.5		6.8	381	32.7		6.0
Carl Albert	08/10/96		1.0	3.15	15.2	382	27.1	5.7	3.9
Carl Albert	08/10/96	24	0.5		6.7	380	32.7		5.6
Carl Albert	08/10/96		3.4	3.9	6.2	392	26.2	6.5	3.6
Carl Albert	08/10/96	25	0.5		6.7	367	32.5		5.9
Carl Albert	08/10/96		3.0	3.5	6.2	381	27.0	5.5	3.6
Carl Albert	08/10/96	26	0.5		6.6	376	32.6		5.6
Carl Albert	08/10/96		3.1	3.6	6.2	382	27.2	5.4	3.6
Carl Albert	08/10/96	27	0.5		6.6	377	37.5		5.9
Carl Albert	08/10/96		2.7	3.2	6.3	381	28.4	9.2	4.5
Carl Albert	08/10/96	28	0.5		6.6	375	36.6		5.8
Carl Albert	08/10/96		2.7	3.2	6.3	384	30.0	6.7	4.5
Carl Albert	08/10/96	29	0.5		6.8	381	33.1		5.9
Carl Albert	08/10/96		4.5	5.0	6.1	502	19.4	13.6	4.0
Carl Albert	08/10/96	30	0.5		6.4	378	33.0		6.0
Carl Albert	08/10/96			4.0	6.2	488	21.7	11.3	5.2

Lake	Date	Site	Sampling Depth(m)	Total Depth(m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Comanche	08/15/95	1	0.5		7.7	237	29.0		6.5
Comanche	08/15/95		2.1	2.6	7.9	232	28.9	0.1	7.5
Comanche	08/15/95	2	0.5		8.0	221	29.1		7.5
Comanche	08/15/95		5.5	6.0	7.2	228	26.4	2.7	5.8
Comanche	08/15/95	3	0.5		8.0	229	29.0		7.4
Comanche	08/15/95		7.5	8.0	7.0	250	19.7	9.3	<2.0
Comanche	08/15/95	4	0.5		8.0	228	29.0		7.0
Comanche	08/15/95		8.0	8.5	7.0	253	19.4	9.5	<2.0
Comanche	08/15/95	5	0.5		7.9	230	28.9		7.2

Comanche	08/15/95		8.4	8.9	7.0	253	19.3	9.6	<2.0
Comanche	08/15/95	6	0.5		7.9	231	28.9		7.0
Comanche	08/15/95		8.9	9.4	7.0	256	19.5	9.4	4.3
Comanche	08/15/95	7	0.5		7.9	236	29.0		6.5
Comanche	08/15/95		9.0	9.5	7.1	257	19.1	9.9	<2.0
Comanche	08/15/95	8	0.5		7.9	230	28.9		6.7
Comanche	08/15/95		8.0	8.5	7.0	250	19.9	9.0	<2.0
Comanche	08/15/95	9	0.5		7.9	230	29.1		6.4
Comanche	08/15/95		7.2	7.7	7.1	241	21.8	7.3	<2.0
Comanche	08/15/95	10	0.5		8.1	230	29.4		6.9
Comanche	08/15/95		0.5	1.0	8.1	230	29.4	0.0	6.9
Comanche	08/15/95	11	0.5		8.0	228	30.0		6.5
Comanche	08/15/95		1.5	2.0	8.0	231	29.7	0.3	6.9
Comanche	08/15/95	12	0.5		8.0	227	29.8		6.9
Comanche	08/15/95		2.8	3.3	8.0	229	29.6	0.2	7.3
Comanche	08/15/95	13	0.5		8.0	228	29.7		6.3
Comanche	08/15/95		3.7	4.2	8.0	230	29.6	0.1	6.2
Comanche	08/15/95	14	0.5		8.0	229	29.8		7.0
Comanche	08/15/95		4.3	4.8	8.0	230	29.6	0.2	7.0
Comanche	08/15/95	15	0.5		8.0	230	29.8		7.0
Comanche	08/15/95		4.3	4.8	8.0	230	29.6	0.2	7.7
Comanche	08/15/95	16	0.5		8.0	229	29.8		6.8
Comanche	08/15/95		5.5	6.0	8.0	230	29.4	0.4	5.8
Comanche	08/15/95	17	0.5		8.0	227	29.9		7.2
Comanche	08/15/95		4.6	5.1	8.1	229	29.7	0.2	8.0
Comanche	08/15/95	18	0.5		8.0	229	29.9		7.4
Comanche	08/15/95		4.2	4.7	8.1	228	29.7	0.2	6.5
Comanche	08/15/95	19	0.5		8.1	227	30.0		6.8
Comanche	08/15/95		2.5	3.0	8.1	229	29.8	0.3	6.7
Comanche	08/15/9520	0.5		8.1	223	29.9		7.3	
Comanche	08/15/95	3.2	3.7	8.1	229	29.8	0.1	7.6	
Comanche	08/15/9521	0.5		8.0	226	30.2		7.0	
Comanche	08/15/95	1.1	1.6	8.0	227	30.2	0.0	7.1	
Comanche	08/15/9522	0.5		8.0	228	30.2		6.5	
Comanche	08/15/95	1.9	2.4	8.0	229	30.2	0.0	6.5	
Comanche	08/15/9523	0.5		8.0	225	30.2		7.0	
Comanche	08/15/95	2.5	3.0	8.0	229	30.2	0.0	6.6	
Comanche	08/15/9524	0.5		8.0	232	30.2		6.3	
Comanche	08/15/95	2.7	3.2	8.0	231	30.2	0.0	6.1	
Comanche	08/15/9525	0.5		8.0	225	30.2		6.7	
Comanche	08/15/95	2.6	3.1	7.9	232	30.0	0.2	6.5	
Comanche	08/15/9526	0.5		8.0	225	30.2		6.5	
Comanche	08/15/95	3.1	3.6	7.8	232	29.9	0.3	5.6	
Comanche	08/15/9527	0.5		7.9	231	30.3		6.5	
Comanche	08/15/95	2.6	3.1	7.8	232	30.0	0.3	5.8	
Comanche	08/15/9528	0.5		7.9	229	30.4		7.3	
Comanche	08/15/95	2.7	3.2	7.9	231	30.2	0.2	7.7	
Comanche	08/15/9529	0.5		8.0	229	30.5		6.2	
Comanche	08/15/95	2.1	2.6	7.9	231	30.1	0.4	5.5	
Comanche	08/15/9530	0.5		8.0	230	30.6		6.8	
Comanche	08/15/95	1.1	1.6	8.0	231	30.3	0.4	6.7	

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Frederick	07/31/95	1	0.5		7.9	342	27.9		5.6
Frederick	07/31/95		1.7	2.2	7.9	342	27.9	0.0	5.3
Frederick	07/31/95	2	0.5		8.0	335	27.9		6.0
Frederick	07/31/95		4.0	4.5	8.0	342	27.9	0.1	5.6
Frederick	07/31/95	3	0.5		8.1	333	28.0		6.6
Frederick	07/31/95		6.3	6.8	8.0	341	27.7	0.2	7.4
Frederick	07/31/95	4	0.5		8.1	330	28.0		6.1
Frederick	07/31/95		6.1	6.6	7.9	336	27.6	0.4	5.8
Frederick	07/31/95	5	0.5		8.1	336	28.0		5.9
Frederick	07/31/95		5.8	6.3	8.1	337	27.8	0.2	5.2

Frederick	07/31/95	6	0.5		8.1	331	28.0		5.9
Frederick	07/31/95		5.8	6.3	8.1	337	28.0	0.0	5.5
Frederick	07/31/95	7	0.5		8.2	333	28.1		6.2
Frederick	07/31/95		5.6	6.1	8.2	338	28.0	0.1	7.0
Frederick	07/31/95	8	0.5		8.2	337	28.1		6.6
Frederick	07/31/95		5.8	6.3	8.1	337	28.0	0.1	7.6
Frederick	07/31/95	9	0.5		8.2	336	28.2		6.3
Frederick	07/31/95		7.5	8.0	7.5	332	25.9	2.3	2.2
Frederick	07/31/95	10	0.5		8.2	337	28.2		5.9
Frederick	07/31/95		6.3	6.8	7.7	335	26.8	1.4	4.2
Frederick	07/31/95	11	0.5		8.1	335	27.8		5.4
Frederick	07/31/95		1.1	1.6	8.0	338	27.7	0.1	5.1
Frederick	07/31/95	12	0.5		8.1	338	27.8		7.8
Frederick	07/31/95		2.5	3.0	8.0	331	27.7	0.2	5.7
Frederick	07/31/95	13	0.5		8.1	336	27.9		5.8
Frederick	07/31/95		3.4	3.9	8.1	336	27.6	0.3	5.9
Frederick	07/31/95	14	0.5		8.1	334	27.8		6.1
Frederick	07/31/95		2.6	3.1	8.1	338	27.7	0.1	6.2
Frederick	07/31/95	15	0.5		8.1	335	27.9		5.9
Frederick	07/31/95		4.7	5.2	8.2	336	27.6	0.3	6.0
Frederick	07/31/95	16	0.5		8.1	337	27.9		5.8
Frederick	07/31/95		6.1	6.5	7.7	335	26.7	1.2	2.9
Frederick	07/31/95	17	0.5		8.1	334	27.9		6.3
Frederick	07/31/95		6.5	7.0	7.5	337	26.2	1.6	<2.0
Frederick	07/31/95	18	0.5		8.1	336	27.9		6.8
Frederick	07/31/95		2.4	2.9	8.1	337	27.8	0.0	5.5
Frederick	07/31/95	19	0.5		8.1	328	27.8		6.5
Frederick	07/31/95		2.1	2.6	8.1	336	27.8	0.0	6.4
Frederick	07/31/95	20	0.5		8.1	336	27.9		6.3
Frederick	07/31/95		1.6	2.1	8.2	336	27.9	0.0	6.4
Frederick	07/31/95	21	0.5		7.9	354	28.6		4.7
Frederick	07/31/95		1.0	1.5	7.9	351	28.4	0.2	4.3
Frederick	07/31/95	22	0.5		8.0	354	28.5		4.7
Frederick	07/31/95		1.3	1.8	7.9	352	28.4	0.1	4.7
Frederick	07/31/95	23	0.5		8.0	356	28.5		5.7
Frederick	07/31/95		1.6	2.1	7.8	354	28.3	0.3	4.8
Frederick	07/31/95	24	0.5		8.0	339	28.6		5.8
Frederick	07/31/95		1.5	2.0	7.8	352	28.3	0.3	4.9
Frederick	07/31/95	25	0.5		8.0	348	28.6		6.1
Frederick	07/31/95		1.5	2.0	7.9	352	28.4	0.3	5.8
Frederick	07/31/95	26	0.5		8.0	354	28.6		5.8
Frederick	07/31/95		0.9	1.4	7.9	353	28.6	0.0	5.3
Frederick	07/31/95	27	0.5		7.9	346	28.5		5.4
Frederick	07/31/95		0.8	1.0	7.9	347	28.5	0.0	5.2
Frederick	07/31/95	28	0.5		8.0	354	28.5		5.4
Frederick	07/31/95		0.7	0.8	8.0	354	28.6	0.0	5.3
Frederick	07/31/95	29	0.5		8.0	360	28.6		5.6
Frederick	07/31/95		0.5	0.7	8.0	360	28.6	0.0	5.6
Frederick	07/31/95	30	0.5		8.0	356	28.6		5.8
Frederick	07/31/95		0.7	0.9	8.0	360	28.6	0.0	5.5

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
McAlester	08/11/95	1	0.5		7.4	821	30.0		6.6
McAlester	08/11/95		0.7	1.2	7.3	914	30.0	0.0	6.4
McAlester	08/11/95	2	0.5		7.4	797	30.0		6.9
McAlester	08/11/95		2.7	3.2	7.1	799	29.3	0.8	6.7
McAlester	08/11/95	3	0.5		7.4	797	30.0		7.1
McAlester	08/11/95		4.6	5.1	6.9	805	27.1	3.0	6.3
McAlester	08/11/95	4	0.5		7.4	801	30.1		6.7
McAlester	08/11/95		6.2	6.7	6.9	903	24.0	6.1	2.0
McAlester	08/11/95	5	0.5		7.4	802	30.1		6.4
McAlester	08/11/95		7.3	7.8	6.8	947	23.0	7.2	<2.0
McAlester	08/11/95	6	0.5		7.3	792	30.1		6.3

McAlester	08/11/95		6.6	7.1	6.8	906	23.7	6.4	<2.0
McAlester	08/11/95	7	0.5		7.3	801	30.1		6.6
McAlester	08/11/95		8.7	9.2	6.8	959	22.6	7.4	<2.0
McAlester	08/11/95	8	0.5		7.3	790	30.1		6.9
McAlester	08/11/95		6.5	7.0	6.8	877	24.1	6.0	<2.0
McAlester	08/11/95	9	0.5		7.2	800	29.9		6.1
McAlester	08/11/95		8.8	9.3	6.7	980	27.4	2.5	<2.0
McAlester	08/11/95	10	0.5		7.2	787	29.7		6.6
McAlester	08/11/95		2.9	3.4	7.1	801	29.0	0.7	6.6
McAlester	08/11/95	11	0.5		7.3	767	30.4		6.4
McAlester	08/11/95		0.5	1.0	7.3	767	30.4	0.0	6.4
McAlester	08/11/95	12	0.5		7.4	803	30.2		6.0
McAlester	08/11/95		1.4	1.9	7.3	804	30.0	0.2	5.7
McAlester	08/11/95	13	0.5		7.4	793	30.3		6.5
McAlester	08/11/95		2.5	3.0	7.2	803	29.8	0.5	6.2
McAlester	08/11/95	14	0.5		7.4	799	30.3		6.4
McAlester	08/11/95		2.8	3.3	7.2	805	29.8	0.5	6.3
McAlester	08/11/95	15	0.5		7.5	805	30.5		6.5
McAlester	08/11/95		3.2	3.7	7.3	806	29.7	0.8	6.0
McAlester	08/11/95	16	0.5		7.5	777	30.3		6.5
McAlester	08/11/95		4.0	4.5	7.0	818	28.3	2.1	4.1
McAlester	08/11/95	17	0.5		7.4	800	30.3		6.3
McAlester	08/11/95		4.0	4.5	6.9	800	29.0	1.3	4.2
McAlester	08/11/95	18	0.5		7.3	802	30.3		6.6
McAlester	08/11/95		3.8	4.3	7.0	801	28.8	1.6	5.4
McAlester	08/11/95	19	0.5		7.4	787	30.4		6.7
McAlester	08/11/95		3.9	4.4	7.0	811	28.7	1.7	4.8
McAlester	08/11/95	20	0.5		7.3	789	30.1		6.1
McAlester	08/11/95		1.1	1.6	7.2	801	29.8	0.3	5.8
McAlester	08/11/95	21	0.5		7.4	778	31.5		6.5
McAlester	08/11/95		0.5	1.0	7.4	778	31.5	0.0	6.5
McAlester	08/11/95	22	0.5		7.4	778	31.1		6.8
McAlester	08/11/95		1.6	2.1	7.3	803	29.5	1.6	5.6
McAlester	08/11/95	23	0.5		7.4	798	30.3		6.4
McAlester	08/11/95		1.8	2.3	7.2	803	29.3	1.0	6.4
McAlester	08/11/95	24	0.5		7.3	802	30.5		6.3
McAlester	08/11/95		1.4	1.9	7.2	803	29.4	1.1	6.1
McAlester	08/11/95	25	0.5		7.3	798	29.6		5.8
McAlester	08/11/95		1.3	1.8	7.2	799	29.4	0.2	5.6
McAlester	08/11/95	26	0.5		7.3	793	29.8		6.5
McAlester	08/11/95	1.4	1.9	7.1	807	29.2	0.7	6.7	
McAlester	08/11/9527	0.5		7.3	799	29.5		5.8	
McAlester	08/11/95	2.7	3.2	7.0	803	28.7	0.8	5.1	
McAlester	08/11/9528	0.5		7.2	774	29.7		6.6	
McAlester	08/11/95	1.8	2.3	7.0	797	28.7	1.1	6.0	
McAlester	08/11/9529	0.5		7.4	803	31.4		6.2	
McAlester	08/11/95	2.3	2.8	7.1	801	28.8	2.6	5.3	
McAlester	08/11/9530	0.5		7.2	794	29.4		6.4	
McAlester	08/11/95	0.7	1.2	7.1	795	29.3	0.1	6.3	

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Rocky	08/08/95	1	0.5		7.3	201	26.4		4.1
Rocky	08/08/95		0.5	1.0	7.3	201	26.4	0.0	4.1
Rocky	08/08/95	2	0.5		7.5	197	26.5		5.0
Rocky	08/08/95		2.0	2.5	7.4	197	26.1	0.4	3.7
Rocky	08/08/95	3	0.5		7.5	195	26.6		5.2
Rocky	08/08/95		2.5	3.0	7.4	190	25.8	0.8	3.6
Rocky	08/08/95	4	0.5		7.5	188	26.6		5.9
Rocky	08/08/95		2.6	3.1	7.4	181	26.5	0.1	4.0
Rocky	08/08/95	5	0.5		7.6	194	26.7		5.8
Rocky	08/08/95		2.7	3.2	7.4	182	24.3	2.4	<2.0
Rocky	08/08/95	6	0.5		7.5	194	26.6		4.5
Rocky	08/08/95		2.6	3.1	7.4	185	23.8	2.8	<2.0

Rocky	08/08/95	7	0.5		7.5	197	26.5		5.7
Rocky	08/08/95		2.7	3.2	7.4	174	24.4	2.0	<2.0
Rocky	08/08/95	8	0.5		7.6	191	26.7		4.5
Rocky	08/08/95		2.6	3.1	7.5	176	25.1	1.5	<2.0
Rocky	08/08/95	9	0.5		7.6	196	26.6		5.8
Rocky	08/08/95		2.2	2.7	7.5	189	25.7	0.9	<2.0
Rocky	08/08/95	10	0.5		7.5	199	27.0		3.8
Rocky	08/08/95		0.5	0.9	7.5	199	27.0	0.0	3.8
Rocky	08/08/95	11	0.5		7.7	267	27.5		5.2
Rocky	08/08/95		1.0	1.5	7.7	249	27.4	0.1	4.7
Rocky	08/08/95	12	0.5		7.7	216	27.4		4.8
Rocky	08/08/95		1.8	2.3	7.6	216	27.4	0.0	4.7
Rocky	08/08/95	13	0.5		7.6	225	27.4		6.0
Rocky	08/08/95		2.1	2.6	7.6	221	27.6	-0.2	5.1
Rocky	08/08/95	14	0.5		7.7	222	27.6		6.2
Rocky	08/08/95		2.2	2.7	7.6	217	27.4	0.2	6.0
Rocky	08/08/95	15	0.5		7.7	242	27.6		6.4
Rocky	08/08/95		2.2	2.7	7.6	223	27.4	0.2	4.8
Rocky	08/08/95	16	0.5		7.7	234	27.6		5.9
Rocky	08/08/95		2.3	2.8	7.6	239	27.4	0.1	4.8
Rocky	08/08/95	17	0.5		7.7	236	27.7		5.1
Rocky	08/08/95		2.2	2.7	7.7	236	27.5	0.2	6.0
Rocky	08/08/95	18	0.5		7.7	244	27.8		6.6
Rocky	08/08/95		2.2	2.7	7.7	253	27.5	0.3	4.9
Rocky	08/08/95	19	0.5		7.7	261	27.7		5.5
Rocky	08/08/95		1.8	2.3	7.7	259	27.7	0.0	5.2
Rocky	08/08/95	20	0.5		7.7	253	27.9		5.7
Rocky	08/08/95		0.7	1.2	7.7	255	27.8	0.1	5.6
Rocky	08/08/95	21	0.5		7.7	260	28.4		5.5
Rocky	08/08/95		0.5	1.0	7.7	260	28.4	0.0	5.5
Rocky	08/08/95	22	0.5		7.7	267	28.3		6.1
Rocky	08/08/95		0.8	1.3	7.7	270	28.3	0.0	6.1
Rocky	08/08/95	23	0.5		7.8	291	28.3		5.5
Rocky	08/08/95		1.0	1.5	7.7	285	28.2	0.1	5.2
Rocky	08/08/95	24	0.5		7.8	289	28.3		5.9
Rocky	08/08/95		1.1	1.6	7.7	291	28.3	0.0	5.7
Rocky	08/08/95	25	0.5		7.8	301	28.3		5.3
Rocky	08/08/95		1.2	1.7	7.7	302	28.2	0.1	5.3
Rocky	08/08/95	26	0.5		7.8	322	28.4		6.1
Rocky	08/08/95		1.2	1.7	7.8	336	28.2	0.2	5.5
Rocky	08/08/95	27	0.5		7.8	334	28.4		5.5
Rocky	08/08/95		1.1	1.6	7.8	336	28.4	0.0	5.5
Rocky	08/08/95	28	0.5		7.8	361	28.6		6.3
Rocky	08/08/95	1.0	1.5	7.8	363	28.6	0.1	6.2	
Rocky	08/08/9529	0.5		7.8	354	28.5		5.5	
Rocky	08/08/95		0.5	7.8	360	28.3	0.2	5.4	
Rocky	08/08/9530	0.5		7.7	410	27.9		4.9	
Rocky	08/08/95		0.5	7.7	393	28.2	-0.3	4.9	

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Skipout	08/06/95	1	0.5		8.3	828	27.1		9.1
Skipout	08/06/95		4.1	4.6	8.0	839	25.4	1.7	2.9
Skipout	08/06/95	2	0.5		8.4	831	27.0		9.1
Skipout	08/06/95		4.5	5.0	8.0	834	25.2	1.9	<2.0
Skipout	08/06/95	3	0.5		8.5	825	27.0		9.3
Skipout	08/06/95		4.4	4.9	8.1	829	25.2	1.8	<2.0
Skipout	08/06/95	4	0.5		8.5	807	27.0		9.6
Skipout	08/06/95		4.2	4.7	8.0	827	24.9	2.1	5.0
Skipout	08/06/95	5	0.5		8.5	819	26.9		9.1
Skipout	08/06/95		4.1	4.6	8.2	829	25.5	1.4	5.2
Skipout	08/06/95	6	0.5		8.5	806	26.8		9.0
Skipout	08/06/95		4.3	4.8	8.1	822	25.2	1.5	4.4
Skipout	08/06/95	7	0.5		8.5	783	26.9		9.5

Skipout	08/06/95		4.6	5.1	7.9	820	24.3	2.6	2.0
Skipout	08/06/95	8	0.5		8.5	801	27.1		9.7
Skipout	08/06/95		4.8	5.3	7.9	814	24.3	2.8	2.2
Skipout	08/06/95	9	0.5		8.6	814	27.2		9.8
Skipout	08/06/95		4.7	5.2	7.9	812	24.2	3.0	2.4
Skipout	08/06/95	10	0.5		8.6	813	27.2		10.2
Skipout	08/06/95		2.0	2.5	8.6	817	26.9	0.3	9.9
Skipout	08/06/95	11	0.5		8.4	812	26.8		7.3
Skipout	08/06/95		1.1	1.6	8.4	815	26.5	0.3	6.7
Skipout	08/06/95	12	0.5		8.4	805	26.7		8.9
Skipout	08/06/95		1.2	1.7	8.3	817	26.0	0.6	6.2
Skipout	08/06/95	13	0.5		8.4	804	26.5		6.5
Skipout	08/06/95		1.9	2.4	8.3	813	25.8	0.6	5.3
Skipout	08/06/95	14	0.5		8.3	805	26.5		6.6
Skipout	08/06/95		1.5	2.0	8.3	801	25.8	0.6	5.0
Skipout	08/06/95	15	0.5		8.3	812	26.4		7.1
Skipout	08/06/95		1.1	1.6	8.3	815	26.4	0.0	6.6
Skipout	08/06/95	16	0.5		8.4	809	26.4		7.9
Skipout	08/06/95		1.1	1.6	8.4	815	26.4	0.0	6.8
Skipout	08/06/95	17	0.5		8.4	810	26.4		7.0
Skipout	08/06/95		1.1	1.6	8.4	815	26.4	0.0	6.6
Skipout	08/06/95	18	0.5		8.4	799	26.5		7.1
Skipout	08/06/95		0.9	1.4	8.4	799	26.5	0.0	7.1
Skipout	08/06/95	19	0.5		8.3	811	26.6		6.9
Skipout	08/06/95		0.8	1.3	8.3	816	26.6	0.0	6.8
Skipout	08/06/95	20	0.5		8.3	814	26.9		7.0
Skipout	08/06/95		0.5	6.8	8.3	814	26.9	0.0	7.0
Skipout	08/06/95	21	0.5		8.4	803	26.7		8.4
Skipout	08/06/95		0.6	1.1	8.3	808	26.6	0.1	6.8
Skipout	08/06/95	22	0.5		8.3	804	26.5		7.4
Skipout	08/06/95		0.5	1.0	8.3	804	26.5	0.0	7.4
Skipout	08/06/95	23	0.5		8.3	802	26.5		7.6
Skipout	08/06/95		0.5	1.0	8.3	802	26.5	0.0	7.6
Skipout	08/06/95	24	0.5		8.3	789	26.8		7.5
Skipout	08/06/95		0.5	0.8	8.3	789	26.8	0.0	7.5
Skipout	08/06/95	25	0.5		8.3	788	26.7		8.1
Skipout	08/06/95		0.5	0.8	8.3	788	26.7	0.0	8.1
Skipout	08/06/95	26	0.5		8.4	804	26.8		8.0
Skipout	08/06/95		0.5	0.7	8.4	804	26.8	0.0	8.0
Skipout	08/06/95	27	0.5		8.3	807	26.8		7.6
Skipout	08/06/95		0.5	0.8	8.3	807	26.8	0.0	7.6
Skipout	08/06/95	28	0.5		8.4	809	26.9		7.3
Skipout	08/06/95		0.5	0.8	8.4	809	26.9	0.0	7.3
Skipout	08/06/95	29	0.5		8.4	793	26.7		8.1
Skipout	08/06/95		0.5	0.8	8.4	793	26.7	0.0	8.1
Skipout	08/06/95	30	0.5		8.4	807	26.8		7.5
Skipout	08/06/95		0.5	0.8	8.4	807	26.8	0.0	7.5

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Eucha	09/03/93	1	0.5		8.1	172	26.7		7.4
Eucha	09/03/93		1.5	1.5	8.3	170	26.8	-0.1	7.3
Eucha	09/03/93	2	0.5		8.3	170	26.8		7.6
Eucha	09/03/93		3.5	3.5	8.3	171	26.8	0.0	7.0
Eucha	09/03/93	3	0.5		8.3	172	26.8		7.3
Eucha	09/03/93		6.7	6.7	7.2	235	21.4	5.4	<2.0
Eucha	09/03/93	4	0.5		8.3	174	26.8		7.1
Eucha	09/03/93		9.6	9.6	7.3	226	15.5	11.3	<2.0
Eucha	09/03/93	5	0.5		8.3	170	26.7		7.3
Eucha	09/03/93		12.2	12.2	7.1	219	13.1	13.6	<2.0
Eucha	09/03/93	6	0.5		8.3	170	26.7		7.1
Eucha	09/03/93		9.9	9.9	7.3	218	15.0	11.7	<2.0
Eucha	09/03/93	7	0.5		8.4	172	26.7		7.5
Eucha	09/03/93		14.9	14.9	7.3	222	13.1	13.6	<2.0

Eucha	09/03/93	8	0.5		8.3	176	26.7		7.4
Eucha	09/03/93		17.0	17.0	7.2	220	12.9	13.8	<2.0
Eucha	09/03/93	9	0.5		8.2	174	26.7		7.2
Eucha	09/03/93		19.0	19.0	7.1	227	12.7	14.0	<2.0
Eucha	09/03/93	10	0.5		8.2	175	26.6		7.0
Eucha	09/03/93		23.7	23.7	7.0	237	12.1	14.5	<2.0
Eucha	09/03/93	11	0.5		8.3	190	26.8		8.1
Eucha	09/03/93		6.7	6.7	7.0	290	17.2	9.6	<2.0
Eucha	09/03/93	12	0.5		8.3	184	26.8		8.3
Eucha	09/03/93		6.7	6.7	7.1	251	16.8	10.0	<2.0
Eucha	09/03/93	13	0.5		8.4	184	26.9		7.9
Eucha	09/03/93		6.4	6.4	7.0	251	17.9	9.0	<2.0
Eucha	09/03/93	14	0.5		8.4	185	26.8		8.2
Eucha	09/03/93		6.0	6.0	7.1	239	23.1	3.7	<2.0
Eucha	09/03/93	15	0.5		8.4	187	26.8		8.3
Eucha	09/03/93		6.5	6.5	7.0	239	17.7	9.1	<2.0
Eucha	09/03/93	16	0.5		8.4	187	26.9		8.2
Eucha	09/03/93		6.5	6.5	7.1	251	17.9	9.0	<2.0
Eucha	09/03/93	17	0.5		8.4	188	26.9		8.3
Eucha	09/03/93		7.1	7.1	7.1	254	16.0	10.9	<2.0
Eucha	09/03/93	18	0.5		8.4	188	26.9		8.3
Eucha	09/03/93		7.2	7.2	7.1	252	16.1	10.8	<2.0
Eucha	09/03/93	19	0.5		8.4	188	26.9		8.5
Eucha	09/03/93		7.5	7.5	7.1	255	15.4	11.5	<2.0
Eucha	09/03/93	20	0.5		8.4	185	27.1		8.6
Eucha	09/03/93		7.4	7.4	7.1	239	15.2	11.9	<2.0
Eucha	09/03/93	21	0.5		8.3	200	26.9		9.0
Eucha	09/03/93		1.6	1.6	7.3	228	25.4	1.5	5.0
Eucha	09/03/93	22	0.5		8.3	200	26.8		9.3
Eucha	09/03/93		1.2	1.2	7.6	219	26.7	0.1	8.5
Eucha	09/03/93	23	0.5		8.4	195	27.1		9.1
Eucha	09/03/93		1.6	1.6	7.5	242	24.6	2.5	5.9
Eucha	09/03/93	24	0.5		8.4	195	27.0		9.0
Eucha	09/03/93		1.0	1.0	8.1	204	26.5	0.5	8.2
Eucha	09/03/93	25	0.5		8.4	194	27.1		9.2
Eucha	09/03/93		0.8	0.8	8.4	196	26.9	0.2	9.0
Eucha	09/03/93	26	0.5		8.4	195	27.0		8.8
Eucha	09/03/93		0.7	0.7	8.4	195	26.9	0.1	8.8
Eucha	09/03/93	27	0.5		8.3	197	26.9		9.1
Eucha	09/03/93		0.7	0.7	8.3	200	26.9	0.0	9.0
Eucha	09/03/93	28	0.5		8.3	199	26.9		9.2
Eucha	09/03/93		0.9	0.9	8.3	200	26.9	0.0	9.0
Eucha	09/03/93	29	0.5		8.4	195	27.1		9.4
Eucha	09/03/93		0.8	0.8	8.2	265	23.5	3.6	8.9
Eucha	09/03/93	30	0.5		8.5	196	27.2		9.4
Eucha	09/03/93		0.8	0.8	8.5	196	27.2	0.0	9.3

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Bixhoma	07/21/93	1	0.5		7.2	68	31.8		7.3
Bixhoma	07/21/93		5.9	5.9	6.0	68	11.8	20.0	3.9
Bixhoma	07/21/93	2	0.5		7.2	68	31.2		7.4
Bixhoma	07/21/93		14.0	14.0	5.9	77	7.3	23.9	<2.0
Bixhoma	07/21/93	3	0.5		7.2	70	31.1		7.4
Bixhoma	07/21/93		17.3	17.3	6.4	107	7.2	23.9	<2.0
Bixhoma	07/21/93	4	0.5		7.2	70	31.1		7.3
Bixhoma	07/21/93		16.8	16.8	6.3	100	7.2	23.9	<2.0
Bixhoma	07/21/93	5	0.5		7.2	69	31.1		7.4
Bixhoma	07/21/93		16.6	16.6	6.2	95	7.1	24.0	<2.0
Bixhoma	07/21/93	6	0.5		7.2	69	31.1		7.4
Bixhoma	07/21/93		14.9	14.9	6.0	87	7.1	24.0	<2.0
Bixhoma	07/21/93	7	0.5		7.3	69	31.3		7.3
Bixhoma	07/21/93		14.2	14.2	6.0	81	7.1	24.2	<2.0
Bixhoma	07/21/93	8	0.5		7.3	69	31.3		7.5

Bixhoma	07/21/93		10.1	10.1	5.9	72	7.5	23.8	5.2
Bixhoma	07/21/93	9	0.5		7.3	69	31.2		7.5
Bixhoma	07/21/93		10.2	10.2	6.0	72	7.5	23.7	5.4
Bixhoma	07/21/93	10	0.5		7.3	69	31.8		7.5
Bixhoma	07/21/93		3.4	3.4	5.7	59	20.5	11.3	<2.0
Bixhoma	07/21/93	11	0.5		7.4	69	31.2		7.6
Bixhoma	07/21/93		4.8	4.8	5.9	64	13.2	18.0	3.2
Bixhoma	07/21/93	12	0.5		7.2	69	31.2		7.5
Bixhoma	07/21/93		13.2	13.2	6.0	78	7.2	24.0	<2.0
Bixhoma	07/21/93	13	0.5		7.3	69	31.2		7.5
Bixhoma	07/21/93		13.3	13.3	5.9	78	7.3	23.9	<2.0
Bixhoma	07/21/93	14	0.5		7.3	69	31.2		7.5
Bixhoma	07/21/93		12.1	12.1	5.9	76	7.4	23.8	4.2
Bixhoma	07/21/93	15	0.5		7.4	69	31.1		7.3
Bixhoma	07/21/93		11.5	11.5	5.9	73	7.4	23.7	4.5
Bixhoma	07/21/93	16	0.5		7.2	69	31.1		7.4
Bixhoma	07/21/93		10.5	10.5	6.0	72	7.8	23.3	4.9
Bixhoma	07/21/93	17	0.5		7.3	69	31.5		7.3
Bixhoma	07/21/93		9.5	9.5	6.0	71	8.1	23.4	5.3
Bixhoma	07/21/93	18	0.5		7.2	69	31.5		7.4
Bixhoma	07/21/93		7.8	7.8	6.0	71	8.9	22.6	5.3
Bixhoma	07/21/93	19	0.5		7.2	69	31.8		7.5
Bixhoma	07/21/93		5.7	5.7	5.9	70	11.4	20.4	4.4
Bixhoma	07/21/93	20	0.5		7.2	69	31.8		7.5
Bixhoma	07/21/93		3.4	3.4	5.8	61	21.5	10.3	<2.0
Bixhoma	07/21/93	21	0.5		7.1	68	30.2		6.8
Bixhoma	07/21/93		5.5	5.5	6.0	66	12.0	18.2	3.4
Bixhoma	07/21/93	22	0.5		7.1	68	29.9		7.0
Bixhoma	07/21/93		6.3	6.3	6.0	71	10.9	19.0	2.4
Bixhoma	07/21/93	23	0.5		7.0	68	29.9		7.1
Bixhoma	07/21/93		6.7	6.7	6.1	72	10.2	19.7	3.2
Bixhoma	07/21/93	24	0.5		7.0	69	29.9		7.0
Bixhoma	07/21/93		6.6	6.6	6.0	71	10.4	19.5	2.9
Bixhoma	07/21/93	25	0.5		7.0	69	29.9		7.0
Bixhoma	07/21/93		6.7	6.7	6.0	72	10.2	19.7	2.8
Bixhoma	07/21/93	26	0.5		7.0	69	29.9		7.0
Bixhoma	07/21/93		8.0	8.0	6.0	73	9.2	20.7	3.0
Bixhoma	07/21/93	27	0.5		7.0	69	29.9		7.1
Bixhoma	07/21/93		9.4	9.4	6.0	75	8.6	21.3	3.5
Bixhoma	07/21/93	28	0.5		7.0	70	29.9		7.0
Bixhoma	07/21/93		9.3	9.3	6.0	73	8.4	21.5	3.5
Bixhoma	07/21/93	29	0.5		7.0	70	30.0		7.0
Bixhoma	07/21/93		8.0	8.0	6.0	72	9.0	21.0	3.5
Bixhoma	07/21/93	30	0.5		7.0	69	30.1		7.2
Bixhoma	07/21/93		2.5	2.5	6.8	68	29.4	0.7	4.3

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Pauls Valley	07/14/93	1	0.5		8.1	355	27.2		6.6
Pauls Valley	07/14/93		1.8	1.8	8.1	355	27.2	0.0	6.6
Pauls Valley	07/14/93	2	0.5		8.1	355	27.3		6.8
Pauls Valley	07/14/93		6.0	6.0	7.9	355	26.1	1.2	4.7
Pauls Valley	07/14/93	3	0.5		8.1	355	27.3		6.7
Pauls Valley	07/14/93		7.7	7.7	7.7	359	24.1	3.2	<2.0
Pauls Valley	07/14/93	4	0.5		8.0	355	27.2		6.7
Pauls Valley	07/14/93		6.7	6.7	7.9	354	25.5	1.7	3.7
Pauls Valley	07/14/93	5	0.5		8.1	355	27.3		6.5
Pauls Valley	07/14/93		7.0	7.0	7.9	357	25.2	2.1	2.8
Pauls Valley	07/14/93	6	0.5		8.1	355	27.2		6.7
Pauls Valley	07/14/93		6.3	6.3	7.8	358	25.4	1.8	3.5
Pauls Valley	07/14/93	7	0.5		8.0	354	27.2		6.7
Pauls Valley	07/14/93		6.0	6.0	7.9	353	25.7	1.5	4.2
Pauls Valley	07/14/93	8	0.5		8.1	350	27.1		6.7
Pauls Valley	07/14/93		5.1	5.1	7.9	347	25.9	1.2	4.4

Pauls Valley	07/14/93	9	0.5		8.1	350	27.1		6.8
Pauls Valley	07/14/93		5.5	5.5	7.9	348	25.8	1.3	4.3
Pauls Valley	07/14/93	10	0.5		8.1	352	27.1		7.0
Pauls Valley	07/14/93		5.6	5.6	7.8	353	25.8	1.3	3.8
Pauls Valley	07/14/93	11	0.5		8.1	359	28.6		6.1
Pauls Valley	07/14/93		6.9	6.9	7.4	363	24.6	4.0	<2.0
Pauls Valley	07/14/93	12	0.5		8.1	361	28.6		6.1
Pauls Valley	07/14/93		5.6	5.6	7.5	358	26.2	2.4	<2.0
Pauls Valley	07/14/93	13	0.5		8.1	360	28.6		6.3
Pauls Valley	07/14/93		5.6	5.6	7.4	361	26.2	2.4	<2.0
Pauls Valley	07/14/93	14	0.5		8.1	359	28.6		6.5
Pauls Valley	07/14/93		5.9	5.9	7.4	360	26.0	2.6	<2.0
Pauls Valley	07/14/93	15	0.5		8.1	359	28.6		6.4
Pauls Valley	07/14/93		6.1	6.1	7.4	363	25.6	3.0	<2.0
Pauls Valley	07/14/93	16	0.5		8.1	361	28.6		6.4
Pauls Valley	07/14/93		6.1	6.1	7.4	360	25.9	2.7	<2.0
Pauls Valley	07/14/93	17	0.5		8.1	361	28.6		6.6
Pauls Valley	07/14/93		5.6	5.6	7.4	353	26.4	2.2	<2.0
Pauls Valley	07/14/93	18	0.5		8.2	360	28.6		6.5
Pauls Valley	07/14/93		5.0	5.0	7.8	358	27.0	1.6	2.8
Pauls Valley	07/14/93	19	0.5		8.2	368	28.6		6.6
Pauls Valley	07/14/93		4.3	4.3	8.1	361	28.3	0.3	5.7
Pauls Valley	07/14/93	20	0.5		8.2	360	28.6		6.6
Pauls Valley	07/14/93		1.3	1.3	8.2	360	28.6	0.0	6.6
Pauls Valley	07/14/93	21	0.5		8.2	364	29.2		6.3
Pauls Valley	07/14/93		3.0	3.0	8.2	359	28.6	0.6	6.5
Pauls Valley	07/14/93	22	0.5		8.2	362	29.2		6.3
Pauls Valley	07/14/93		3.5	3.5	8.2	360	28.7	0.5	6.2
Pauls Valley	07/14/93	23	0.5		8.2	361	29.2		6.7
Pauls Valley	07/14/93		4-0	4.0	8.2	360	28.5	0.7	6.1
Pauls Valley	07/14/93	24	0.5		8.2	360	29.2		6.9
Pauls Valley	07/14/93		2.6	2.6	8.3	360	29.1	0.1	6.6
Pauls Valley	07/14/93	25	0.5		8.3	359	29.1		7.0
Pauls Valley	07/14/93		2.1	2.1	8.2	359	29.1	0.0	6.7
Pauls Valley	07/14/93	26	0.5		8.2	359	29.0		7.1
Pauls Valley	07/14/93		2.8	2.8	8.2	359	29.0	0.0	6.8
Pauls Valley	07/14/93	27	0.5		8.3	360	29.0		6.9
Pauls Valley	07/14/93		2.6	2.6	8.3	359	28.9	0.1	6.7
Pauls Valley	07/14/93	28	0.5		8.2	360	28.9		6.9
Pauls Valley	07/14/93		2.7	2.7	8.3	361	28.9	0.0	6.6
Pauls Valley	07/14/93	29	0.5		8.2	360	29.1		6.8
Pauls Valley	07/14/93		2.7	2.7	8.2	360	28.9	0.2	6.5
Pauls Valley	07/14/93	30	0.5		8.2	360	29.1		7.1
Pauls Valley	07/14/93		1.3	1.3	8.3	360	29.1	0.0	6.6

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Pawhuska	06/28/93	1	0.5		8.1	315	27.9		7.5
Pawhuska	06/28/93		2.6	2.6	8.1	318	26.6	1.3	6.7
Pawhuska	06/28/93	2	0.5		8.2	316	27.7		7.8
Pawhuska	06/28/93		6.2	6.2	7.9	316	21.2	6.5	<2.0
Pawhuska	06/28/93	3	0.5		8.2	315	27.4		7.9
Pawhuska	06/28/93		8.3	8.3	7.7	316	16.2	11.2	2.0
Pawhuska	06/28/93	4	0.5		8.2	314	27.3		7.8
Pawhuska	06/28/93		8.3	8.3	8.0	330	16.1	11.2	<2.0
Pawhuska	06/28/93	5	0.5		8.2	315	27.1		7.9
Pawhuska	06/28/93		10.3	10.3	7.9	330	14.8	12.3	<2.0
Pawhuska	06/28/93	6	0.5		8.2	315	27.1		7.8
Pawhuska	06/28/93		11.2	11.2	7.9	340	14.5	12.6	<2.0
Pawhuska	06/28/93	7	0.5		8.3	316	27.0		7.8
Pawhuska	06/28/93		12.2	12.2	7.9	348	14.1	12.9	<2.0
Pawhuska	06/28/93	8	0.5		8.3	318	27.0		7.7
Pawhuska	06/28/93		12.0	12.0	7.9	350	14.2	12.8	<2.0
Pawhuska	06/28/93	9	0.5		8.3	317	27.0		7.7

Pawhuska	06/28/93		11.5	11.5	8.0	346	14.2	12.8	<2.0
Pawhuska	06/28/93	10	0.5		8.3	321	26.9		7.5
Pawhuska	06/28/93		7.8	7.8	8.0	325	17.4	9.5	<2.0
Pawhuska	06/28/93	11	0.5		8.2	317	26.8		7.4
Pawhuska	06/28/93		2.7	2.7	8.2	317	26.8	0.0	7.2
Pawhuska	06/28/93	12	0.5		8.2	319	26.9		7.2
Pawhuska	06/28/93		3.5	3.5	8.2	314	26.9	0.0	7.2
Pawhuska	06/28/93	13	0.5		8.2	317	26.9		7.4
Pawhuska	06/28/93		3.5	3.5	8.2	314	26.9	0.0	7.3
Pawhuska	06/28/93	14	0.5		8.3	317	26.9		7.3
Pawhuska	06/28/93		3.6	3.6	8.3	317	26.9	0.0	7.2
Pawhuska	06/28/93	15	0.5		8.3	317	27.0		7.3
Pawhuska	06/28/93		4.5	4.5	8.3	317	26.9	0.1	7.1
Pawhuska	06/28/93	16	0.5		8.3	314	27.0		7.4
Pawhuska	06/28/93		4.8	4.8	8.1	313	25.6	1.4	2.0
Pawhuska	06/28/93	17	0.5		8.3	317	27.1		7.2
Pawhuska	06/28/93		5.9	5.9	7.9	321	20.5	6.6	<2.0
Pawhuska	06/28/93	18	0.5		8.2	317	27.0		7.4
Pawhuska	06/28/93		5.5	5.5	8.0	319	21.7	5.3	<2.0
Pawhuska	06/28/93	19	0.5		8.2	317	27.0		7.3
Pawhuska	06/28/93		5.6	5.6	8.0	318	21.1	5.9	<2.0
Pawhuska	06/28/93	20	0.5		8.2	316	21.0		7.4
Pawhuska	06/28/93		4.0	4.0	8.2	317	26.9	-5.9	7.0
Pawhuska	06/28/93	21	0.5		8.2	317	27.1		7.1
Pawhuska	06/28/93		4.0	4.0	8.2	313	27.1	0.0	7.1
Pawhuska	06/28/93	22	0.5		8.3	319	27.2		7.1
Pawhuska	06/28/93		4.2	4.2	8.3	318	27.0	0.2	7.1
Pawhuska	06/28/93	23	0.5		8.2	317	27.2		7.1
Pawhuska	06/28/93		3.1	3.1	8.3	315	27.1	0.1	6.9
Pawhuska	06/28/93	24	0.5		8.2	315	27.2		6.9
Pawhuska	06/28/93		3.0	3.0	8.2	320	27.2	0.0	6.7
Pawhuska	06/28/93	25	0.5		8.2	317	27.2		6.9
Pawhuska	06/28/93		2.9	2.9	8.2	321	27.2	0.0	6.7
Pawhuska	06/28/93	26	0.5		8.2	313	27.3		6.9
Pawhuska	06/28/93		2.5	2.5	8.2	317	27.3	0.0	6.8
Pawhuska	06/28/93	27	0.5		8.2	317	27.3		6.9
Pawhuska	06/28/93		2.2	2.2	8.2	319	27.3	0.0	6.8
Pawhuska	06/28/93	28	0.5		8.2	317	27.3		6.9
Pawhuska	06/28/93		3.2	3.2	8.3	320	27.2	0.1	7.1
Pawhuska	06/28/93	29	0.5		8.2	317	27.2		7.4
Pawhuska	06/28/93		4.1	4.1	8.3	314	27.2	0.0	7.3
Pawhuska	06/28/93	30	0.5		8.2	317	27.2		7.2
Pawhuska	06/28/93		4.0	4.0	8.2	318	27.2	0.0	7.2

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Taylor	07/01/93	1	0.5		8.3	401	27.0		7.4
Taylor	07/01/93		2.1	2.1	8.3	401	27.0	0.0	7.4
Taylor	07/01/93	2	0.5		8.4	402	27.1		7.3
Taylor	07/01/93		2.5	2.5	8.4	403	27.0	0.1	7.3
Taylor	07/01/93	3	0.5		8.4	404	27.1		7.6
Taylor	07/01/93		3.6	3.6	8.4	402	27.0	0.1	7.2
Taylor	07/01/93	4	0.5		8.4	403	27.1		7.6
Taylor	07/01/93		3.9	3.9	8.5	404	26.9	0.2	7.0
Taylor	07/01/93	5	0.5		8.4	402	27.1		7.6
Taylor	07/01/93		4.1	4.1	8.4	402	27.0	0.1	7.0
Taylor	07/01/93	6	0.5		8.5	401	27.1		7.7
Taylor	07/01/93		4.2	4.2	8.5	404	27.0	0.1	7.2
Taylor	07/01/93	7	0.5		8.5	402	27.1		7.7
Taylor	07/01/93		4.1	4.1	8.5	404	27.0	0.1	7.2
Taylor	07/01/93	8	0.5		8.5	399	27.2		7.8
Taylor	07/01/93		3.7	3.7	8.4	405	26.9	0.3	6.8
Taylor	07/01/93	9	0.5		8.5	401	27.4		7.9
Taylor	07/01/93		2.8	2.8	8.4	403	26.8	0.6	5.9

Taylor	07/01/93	10	0.5		8.5	400	27.5		7.9
Taylor	07/01/93		1.1	1.1	8.5	404	26.0	1.5	6.8
Taylor	07/01/93	11	0.5		8.2	402	27.0		6.9
Taylor	07/01/93		1.4	1.4	8.2	406	26.8	0.2	6.3
Taylor	07/01/93	12	0.5		8.3	405	27.0		7.0
Taylor	07/01/93		2.4	2.4	8.3	405	26.8	0.2	6.6
Taylor	07/01/93	13	0.5		8.3	404	26.9		7.3
Taylor	07/01/93		2.9	2.9	8.3	404	26.8	0.1	7.1
Taylor	07/01/93	14	0.5		8.4	404	26.9		7.5
Taylor	07/01/93		2.8	2.8	8.4	406	26.8	0.1	7.4
Taylor	07/01/93	15	0.5		8.4	404	26.9		7.3
Taylor	07/01/93		3.2	3.2	8.4	404	26.7	0.2	7.1
Taylor	07/01/93	16	0.5		8.4	404	26.9		7.5
Taylor	07/01/93		2.8	2.8	8.4	405	26.7	0.2	7.3
Taylor	07/01/93	17	0.5		8.4	404	26.9		7.7
Taylor	07/01/93		2.7	2.7	8.4	404	26.9	0.0	7.5
Taylor	07/01/93	18	0.5		8.4	405	26.9		7.7
Taylor	07/01/93		2.7	2.7	8.4	408	26.8	0.1	7.5
Taylor	07/01/93	19	0.5		8.4	406	27.0		7.7
Taylor	07/01/93		1.6	1.6	8.4	407	27.0	0.0	7.7
Taylor	07/01/93	20	0.5		8.4	404	27.0		8.0
Taylor	07/01/93		1.0	1.0	8.4	406	27.0	0.0	8.0
Taylor	07/01/93	21	0.5		8.4	416	26.0		7.5
Taylor	07/01/93		1.1	1.1	8.4	416	26.0	0.0	7.4
Taylor	07/01/93	22	0.5		8.5	418	26.0		7.5
Taylor	07/01/93		1.6	1.6	8.5	418	26.0	0.0	7.3
Taylor	07/01/93	23	0.5		8.5	417	26.0		7.4
Taylor	07/01/93		1.7	1.7	8.5	418	26.0	0.0	7.2
Taylor	07/01/93	24	0.5		8.5	419	26.0		7.5
Taylor	07/01/93		1.9	1.9	8.5	419	26.0	0.0	7.3
Taylor	07/01/93	25	0.5		8.5	417	26.0		7.6
Taylor	07/01/93		1.2	1.2	8.6	416	26.0	0.0	7.5
Taylor	07/01/93	26	0.5		8.5	418	26.0		7.6
‘ftylor	07/01/93		1.2	1.2	8.6	418	26.0	0.0	7.6
Taylor	07/01/93	27	0.5		8.6	417	26.1		7.8
Taylor	07/01/93		1.2	1.2	8.6	418	26.0	0.1	7.8
Taylor	07/01/93	28	0.5		8.5	418	26.1		7.7
Taylor	07/01/93		2.0	2.0	8.5	419	26.1	0.0	7.6
Taylor	07/01/93	29	0.5		8.6	417	26.3		8.1
Taylor	07/01/93		2.4	2.4	8.6	419	26.0	0.3	7.9
Taylor	07/01/93	30	0.5		8.6	417	26.1		8.3
Taylor	07/01/93		1.4	1.4	8.6	417	26.2	-0.1	8.1

Lake	Date	Site	Sampling Depth (m)	Total Depth (m)	Ph (S.U.)	Cond. (Us/cm)	Temp. (°C)	Dt (°C)	D.O. (mg/1)
Claremore	08/11/93	1	0.5		7.7	205	27.1		6.9
Claremore	08/11/93		3.9	3.9	7.0	208	25.7	1.4	<2.0
Claremore	08/11/93	2	0.5		7.5	206	26.9		6.6
Claremore	08/11/93		5.4	5.4	6.9	211	25.5	1.4	<2.0
Claremore	08/11/93	3	0.5		7.4	206	26.9		6.2
Claremore	08/11/93		5.4	5.4	7.0	211	25.5	1.4	<2.0
Claremore	08/11/93	4	0.5		7.5	205	27.0		6.9
Claremore	08/11/93		6.7	6.7	7.0	222	25.0	2.0	<2.0
Claremore	08/11/93	5	0.5		7.6	204	27.0		7.1
Claremore	08/11/93		5.2	5.2	6.9	216	25.4	1.6	<2.0
Claremore	08/11/93	6	0.5		7.7	205	27.1		7.4
Claremore	08/11/93		5.1	5.1	7.0	216	25.3	1.8	<2.0
Claremore	08/11/93	7	0.5		7.7	208	27.2		7.7
Claremore	08/11/93		5.0	5.0	6.9	212	25.3	1.9	<2.0
Claremore	08/11/93	8	0.5		7.8	206	27.2		7.8
Claremore	08/11/93		4.8	4.8	6.9	210	25.3	1.9	<2.0
Claremore	08/11/93	9	0.5		7.8	204	27.2		7.7
Claremore	08/11/93		4.6	4.6	7.0	218	25.3	1.9	<2.0
Claremore	08/11/93	10	0.5		7.8	205	27.5		7.9

Claremore	08/11/93		3.9	3.9	7.0	211	25.7	1.8	<2.0
Claremore	08/11/93	11	0.5		9.0	205	29.6		10.4
Claremore	08/11/93		4.2	4.2	7.0	210	26.5	3.1	<2.0
Claremore	08/11/93	12	0.5		9.0	206	29.3		10.5
Claremore	08/11/93		3.3	3.3	7.4	206	27.1	2.2	4.4
Claremore	08/11/93	13	0.5		9.0	204	29.4		10.4
Claremore	08/11/93		4.3	4.3	7.0	210	25.6	3.8	<2.0
Claremore	08/11/93	14	0.5		9.0	205	29.5		10.6
Claremore	08/11/93		3.9	3.9	7.3	205	26.9	2.6	3.7
Claremore	08/11/93	15	0.5		9.0	205	29.5		10.6
Claremore	08/11/93		3.0	3.0	7.6	205	27.4	2.1	5.5
Claremore	08/11/93	16	0.5		9.1	205	29.5		10.7
Claremore	08/11/93		2.6	2.6	7.9	205	27.7	1.8	7.0
Claremore	08/11/93	17	0.5		9.1	204	29.6		10.8
Claremore	08/11/93		2.7	2.7	7.7	206	27.4	2.2	6.3
Claremore	08/11/93	18	0.5		9.1	206	29.7		10.8
Claremore	08/11/93		2.5	2.5	7.4	205	27.3	2.4	4.5
Claremore	08/11/93	19	0.5		9.2	206	29.9		11.2
Claremore	08/11/93		2.2	2.2	7.7	207	27.5	2.4	5.6
Claremore	08/11/93	20	0.5		9.1	203	30.0		11.0
Claremore	08/11/93		1.9	1.9	8.7	206	29.9	0.1	8.0
Claremore	08/11/93	21	0.5		7.7	210	28.7		6.2
Claremore	08/11/93		1.0	1.0	7.7	210	28.7	0.0	5.6
Claremore	08/11/93	22	0.5		8.0	208	28.7		6.7
Claremore	08/11/93		0.9	0.9	7.9	208	28.7	0.0	6.6
Claremore	08/11/93	23	0.5		8.0	208	28.8		7.0
Claremore	08/11/93		1.0	1.0	7.9	208	28.7	0.1	6.7
Claremore	08/11/93	24	0.5		8.1	208	28.8		7.2
Claremore	08/11/93		1.2	1.2	8.0	208	28.7	0.1	6.9
Claremore	08/11/93	25	0.5		8.2	208	28.8		7.4
Claremore	08/11/93		1.0	1.0	8.0	208	28.7	0.1	6.9
Claremore	08/11/93	26	0.5		8.3	206	28.8		7.5
Claremore	08/11/93		1.1	1.1	8.1	208	28.7	0.1	7.1
Claremore	08/11/93	27	0.5		8.4	208	28.8		7.8
Claremore	08/11/93		1.1	1.1	8.3	208	28.7	0.1	7.5
Claremore	08/11/93	28	0.5		8.4	206	28.7		7.6
Claremore	08/11/93		1.1	1.1	8.3	206	28.6	0.1	7.4
Claremore	08/11/93	29	0.5		8.3	208	28.7		7.8
Claremore	08/11/93		0.8	0.8	8.2	208	28.7	0.0	7.3
Claremore	08/11/93	30	0.5		8.3	207	28.7		7.8
Claremore	08/11/93		0.9	0.9	8.2	207	28.7	0.0	7.2

APPENDIX C

BENTHIC MACROINVERTEBRATE COLLECTION RESULTS, METRICS, AND SCORES

SUMMARY OF ALL BENTHICS FOUND DURING STUDY.

PHYLUM	CLASS	ORDER	FAMILY	GENUS	LONG LIVED	TOLERANCE	COMMENTS ON WHY NOT USED IN METRICS
ANNELIDA	Hirudinea					Tolerant	
ANNELIDA	Hirudinea		Glossiphoniidae	Helobdella		Tolerant	
ANNELIDA	Hirudinea		Glossiphoniidae	Helobdellax		Tolerant	
ANNELIDA	Oligochaeta		Naididae	Daro		Tolerant	
ANNELIDA	Oligochaeta		Naididae	Nais		Tolerant	
ANNELIDA	Oligochaeta		Naididae	Pristina		Tolerant	
ANNELIDA	Oligochaeta		Tubificidae	Aulodrilus		Tolerant	
ANNELIDA	Oligochaeta		Tubificidae	Branchiura		Tolerant	
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus		Tolerant	
ANNELIDA	Oligochaeta		Tubificidae	Tubifex		Tolerant	
ARTHROPODA	Acari					Sensitive	
ARTHROPODA	Acari	Arcarina				Sensitive	
ARTHROPODA	Crustacea	Amphipoda	Talitridae	Hyalella			Not benthic; assoc. with macrophytes
ARTHROPODA	Crustacea	Decapoda			X	Sensitive	
ARTHROPODA	Insecta	Coleoptera	Elmidae	Dubiraphia		Sensitive	
ARTHROPODA	Insecta	Coleoptera	Hydrophilidae	Berosus		Sensitive	Not benthic
ARTHROPODA	Insecta	Diptera	Ceratopogonidae			Tolerant	
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus			Planktonic insects
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini		Tolerant	
ARTHROPODA	Insecta	Diptera	Chironomidae	Orthocladiinae		Tolerant	
ARTHROPODA	Insecta	Diptera	Chironomidae	Pseudochironomi		Tolerant	
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae		Tolerant	
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanytarsini		Tolerant	
ARTHROPODA	Insecta	Ephemeroptera	Baetidae			Sensitive	
ARTHROPODA	Insecta	Ephemeroptera	Baetidae	Cloeon		Sensitive	
ARTHROPODA	Insecta	Ephemeroptera	Caenidae			Sensitive	
ARTHROPODA	Insecta	Ephemeroptera	Caenidae	Caenis		Sensitive	
ARTHROPODA	Insecta	Ephemeroptera	Ephemeridae	Hexagenia		Sensitive	
ARTHROPODA	Insecta	Ephemeroptera	Leptophlebiidae	Choroterpes		Sensitive	
ARTHROPODA	Insecta	Hemiptera	Corixidae				Not benthic; assoc. with water surface
ARTHROPODA	Insecta	Megaloptera	Sialidae	Sialis	X	Sensitive	
ARTHROPODA	Insecta	Odonata	Coenagrionidae	Enallagma			Climbers; live on vascular hydrophytes
ARTHROPODA	Insecta	Odonata	Gomphidae	Gomphus		Sensitive	
ARTHROPODA	Insecta	Odonata	Libellulidae				Climbers; live on vascular hydrophytes
ARTHROPODA	Insecta	Tricoptera				Sensitive	
ARTHROPODA	Insecta	Tricoptera	Hydroptilidae	Orthotrichia		Sensitive	
ARTHROPODA	Insecta	Tricoptera	Leptoceridae	Nectopsyche		Sensitive	
ARTHROPODA	Insecta	Tricoptera	Leptoceridae	Oecetis		Sensitive	
ARTHROPODA	Insecta	Tricoptera	Polycentropodidae			Sensitive	
ARTHROPODA	Insecta	Tricoptera	Polycentropodidae	Polycentropus		Sensitive	
ENTOPROCTA				Urnatella	X	Sensitive	
MOLLUSCA	Gastropoda		Physidae			Tolerant	
MOLLUSCA	Gastropoda		Physidae	Physa		Tolerant	
MOLLUSCA	Gastropoda		Planorbidae			Tolerant	
MOLLUSCA	Gastropoda		Planorbidae	Gyraulus		Tolerant	
MOLLUSCA	Gastropoda		Planorbidae	Helisoma		Tolerant	
MOLLUSCA	Pelecypoda		Corbiculidae	Corbicula	X	Sensitive	
MOLLUSCA	Pelecypoda		Sphaeriidae	Pisidium	X	Sensitive	
MOLLUSCA	Pelecypoda		Sphaeriidae	Sphaerium	X	Sensitive	
MOLLUSCA	Pelecypoda		Unionidae		X	Sensitive	
MOLLUSCA	Pelecypoda		Unionidae	Anodonta	X	Sensitive	
NEMATODA						Tolerant	
PORIFERA			Spongillidae	Trochospongilla	X	Sensitive	

BIG HAUANI LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: August 16, 1995

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs. 2562
ANNELIDA	Oligochaeta		Tubificidae	Aulodrilus	4	0	4	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	14
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	64	0	0	0	0	0	0	0	0	8	4	12	4	0	4	12	4	2	0	2	55	55	0	0	0	1	12	0	0	2	240
ARTHROPODA	*Acari*				*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*2*	*1*	5
ARTHROPODA	Crustacea	Amphipoda	Talitridae	Hyalella	24	0	0	0	0	0	0	0	0	4	8	0	0	0	0	0	0	0	0	0	0	20	28	0	20	8	0	66	32	10	
ARTHROPODA	Insecta	Coleoptera	Hydrophilidae	Berosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		16	0	0	0	0	0	0	0	0	10	8	8	4	0	0	0	0	0	0	0	173	36	0	0	4	2	0	11	2	2	276
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	4	104	144	414	172	171	59	23	356	6	60	0	40	409	128	132	34	24	14	4	45	38	4	44	12	19	24	[illegible]	1	3	
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	40	4	64	57	44	25	33	10	76	74	24	24	12	91	40	16	34	22	26	2	27	0	4	0	24	6	15	38	23	33	897
ARTHROPODA	Insecta	Diptera	Chironomidae	Orthocladinae	8	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	13
ARTHROPODA	Insecta	Diptera	Chironomidae	Pseudochironomi	4	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	9	4	0	4	5	0	62	0	77	177
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	108	4	0	0	0	0	0	0	4	44	60	36	10	9	8	12	16	4	42	0	45	91	28	8	32	5	0	35	12	18	639
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanytarsini	60	0	0	0	0	0	0	0	0	6	8	0	0	0	0	0	0	2	0	0	9	0	0	0	0	0	0	1	0	0	86
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Baetidae*		*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	4
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Baetidae*	*Cloeon*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*17*	*6*	*0*	27
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Caenidae*	*Caenis*	*24*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*10*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*2*	*0*	48
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Ephemeridae*	*Hexagenia*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	4
ARTHROPODA	Insecta	Odonata	Coenagrionidae	Enallagma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	2	0	1	
ARTHROPODA	Insecta	Odonata	Libellulidae		12	0	0	0	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ARTHROPODA	*Insecta*	*Tricoptera*	*Hydroptilidae*	*Orthotrichia*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*0*	*0*	6
ARTHROPODA	*Insecta*	*Tricoptera*	*Leptoceridae*	*Nectopsyche*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	4
ARTHROPODA	*Insecta*	*Tricoptera*	*Leptoceridae*	*Oecetis*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*0*	*3*	*0*	*26*	36
MOLLUSCA	Gastropoda		Physidae	Physa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
MOLLUSCA	Gastropoda		Planorbidae	Gyraulus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2
MOLLUSCA	*Pelecypoda*		*Sphaeriidae*	*Sphaerium*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*	*73*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*5*	*0*	*0*	*0*	82
			Taxa Richness (Family Level)		8	2	2	1	1	1	1	1	1	4	4	4	3	2	2	2	2	2	2	2	3	3	2	1	3	5	3	8	7	5	

% samples with long lived taxa	10.0%	1
Mean taxa richness/sample (family level)	2.9	2
% of samples with sensitive taxa present	43.3%	2
% of samples with only tubificids & chironomids	46.7%	2
% of total orgs. composed of tubificids & chironomini	44.9%	2
% of total orgs. sensitive	8.4%	2
% of samples with no macroinvertebrates present	0.0%	3
		14

C-3

BIXHOMA LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs/sq. ft.)
COLLECTED: July 21-22, 1993

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs. 5706
ANNELIDA	Oligochaeta		Naididae	Nais	0	0	0	0	0	0	0	0	0	1	0	0	0	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
ANNELIDA	Oligochaeta		Tubificidae	Aulodrilus	2	0	0	0	0	0	0	0	0	0	2	0	0	O	0	0	0	0	0	0	5	0	0	0	0	5	0	0	0	0	14
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus	65	67	342	140	335	420	150	260	150	4	2	105	260		310	155	235	155	22	7	105	32	150	130	44	250	320	465	94	9	4783
ANNELIDA	Oligochaeta		Tubificidae	Tubifex	20	1	8	4	25	0	0	20	5	2	1	45	40	S	0	20	65	15	6	1	20	12	5	55	2	115	75	30	60	0	660
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	0	0	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0	0	1	0	0	5	0	0	0	0	0	0	0	6
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	0	3	0	0	0	0	0	5	0	1	4	0	0	M	0	0	0	10	1	10	20	0	15	0	6	25	10	0	10	16	
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	2	0	0	0	0	0	0	0	0	2	4	0	0	P	0	0	0	0	2	1	30	4	5	0	2	0	10	0	2	18	82
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	0	0	0	0	0	0	0	5	5	0	2	5	0	L	0	5	5	5	2	3	5	10	15	0	10	25	5	20	4	15	146
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
ARTHROPODA	Insecta	Ephemeroptera	Ephemeridae	Hexagenia	1	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	1	7
NEMATODA					0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1	6
			Taxa Richness (Family Level)		3	1	1	1	1	1	1	2	2	3	2	2	1		1	2	2	3	2	4	2	2	3	1	2	2	2	2	2	4	

% samples with long lived taxa	0.0%	1
Mean taxa richness/sample (family level)	2.0	1
% of samples with sensitive taxa present	10.3%	1
% of samples with only tubificids & chironomids	79.3%	1
% of total orgs. composed of tubificids & chironomini	97.1%	1
% of total orgs. sensitive	0.1%	1
% of samples with no macroinvertebrates present	0.0%	3
		9

CARL ALBERT LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: August 10, 1995

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs. 2933
ANNELIDA	Oligochaeta		Tubificidae	Aulodrilus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8	4	0	0	4	1	0	0	0	25
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus	0	68	116	180	170	60	416	160	480	6	136	120	52	291	80	156	60	68	8	0	0	0	0	0	0	0	0	0	2	2	2631
ARTHROPODA	Acari				0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	0	0	0	0	0	0	0	0	0	8	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	0	124	74	72	30	28	40	16	80	18	128	32	20	45	40	28	40	26	44	0	0	84	28	8	36	18	2	10	34	8	
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	2	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	6	32	4	4	0	0	0	0	0	0	0	56
ARTHROPODA	Insecta	Diptera	Chironomidae	Orthocladiinae	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	22	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	4	0	0	7	32	16	0	0	8	4	4	10	0	8	123
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	8	0	0	0	0	0	0	0	0	0	11
ARTHROPODA	Insecta	Ephemeroptera	Ephemeridae	Hexagenia	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	16	0	0	0	0	0	0	0	0	0	36
ARTHROPODA	Insecta	Megaloptera	Sialidae	Sialis	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0	24
MOLLUSCA	Pelecypoda		Corbiculidae	Corbicula	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
MOLLUSCA	Pelecypoda		Unionidae	Anodonta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4
			Taxa Richness (Family Level)		4	1	1	2	1	2	1	1	1	1	2	3	3	1	1	1	2	1	1	3	5	2	2	0	1	2	3	1	1	2	

% samples with long lived taxa	10.0%	1
Mean taxa richness/sample (family level)	1.7	1
% of samples with sensitive taxa present	16.7%	1
% of samples with only tubificids & chironomids	73.3%	1
% of total orgs. composed of tubificids & chironomini	92.5%	1
% of total orgs. sensitive	2.4%	1
% of samples with no macroinvertebrates present	3.3%	2
		8

CHICKASHA LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: August 12, 1995

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total	
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs.	812
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus	0	0	0	0	0	0	0	0	0	5	41	0	0	0	0	0	0	0	0	0	5	6	0	4	0	2	4	0	2	2	71	
ANNELIDA	Oligochaeta		Tubificidae	Tubifex	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	0	3	8	0	1	9	2	3	3	0	0	5	11	9	5	12	21	3	1	0	0	2	0	0	0	0	0	0	0	0		
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	2	0	0	0	0	0	0	0	0	4	9	2	0	1	0	2	0	1	2	5	7	4	8	10	0	6	0	2	3	4	72	
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	0	2	0	0	0	0	0	2	0	0	1	46	23	38	1	9	34	32	48	0	0	44	56	36	64	84	76	21	38	8	663	
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanytarsini	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
			Taxa Richness (Family Level)		1	1	0	0	0	0	0	1	0	2	2	1	1	1	1	1	1	1	1	1	2	2	1	2	1	2	2	1	2	2		

% samples with long lived taxa	0.0%	1
Mean taxa richness/sample (family level)	1.1	1
% of samples with sensitive taxa present	0.0%	1
% of samples with only tubificids & chironomids	80.0%	1
% of total orgs. composed of tubificids & chironomini	17.7%	3
% of total orgs. sensitive	0.0%	1
% of samples with no macroinvertebrates present	20.0%	1
		9

CLAREMORE LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: August 11-12, 1993

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs. 2746
ANNELIDA	Hirudinea		Glossiphoniidae	Helobdella	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	7
ANNELIDA	Oligochaeta		Naididae	Pristina	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
ANNELIDA	Oligochaeta		Tubificidae	Aulodrilus	4	0	0	0	0	5	2	0	0	0	1	0	0	0	0	0	0	1	6	10	0	0	5	0	0	3	2	0	3	0	42
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	4	1	4	0	0	3	6	2	0	1	3	1	1	2	4	0	0	1	0	0	2	0	0	0	5	0	4	0	10	5	59
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus	64	29	46	30	4	46	13	54	16	2	0	11	3	0	0	0	0	0	1	5	0	0	5	0	0	0	0	0	0	0	329
ANNELIDA	Oligochaeta		Tubificidae	Tubifex	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	8
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	1	4	9	0	2	0	0	10	0	4	7	5	0	0	46
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	2	83	95	107	43	130	187	141	64	84	62	41	34	77	100	70	85	41	18	150	22	40	15	24	0	9	21	30	18	6	
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	8	5	2	1	0	5	6	9	1	0	1	0	0	4	1	0	2	0	2	5	2	3	0	0	0	1	1	0	0	0	59
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	30	8	1	1	0	4	8	14	77	40	4	11	20	8	25	29	119	98	71	130	72	97	160	220	170	149	158	200	97	130	2151
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Ephemeridae*	*Hexagenia*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
ARTHROPODA	*Insecta*	*Megaloptera*	*Sialidae*	*Sialis*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	3	5	2	3	0	0	0	0	0	0	7	10	33
MOLLUSCA	*Pelecypoda*		*Sphaeriidae*	*Pisidium*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7
NEMATODA					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
			Taxa Richness (Family Level)		2	2	2	2	2	2	2	3	5	3	2	2	2	4	3	3	3	4	4	3	5	2	2	3	2	3	4	2	4	4	

% samples with long lived taxa	30.0%	1
Mean taxa richness/sample (family level)	2.9	2
% of samples with sensitive taxa present	30.0%	1
% of samples with only tubificids & chironomids	36.7%	2
% of total orgs. composed of tubificids & chironomini	18.1%	3
% of total orgs. sensitive	1.5%	1
% of samples with no macroinvertebrates present	0.0%	3
		13

COMANCHE LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: August 15, 1995

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total	
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs.	891
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	8	
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus	0	0	0	0	0	12	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	
ARTHROPODA	*Acari*				0	0	0	0	0	0	0	1	0	0	0	0	0	10	2	14	2	6	0	0	2	0	0	2	0	0	0	0	2	4	45	
ARTHROPODA	Crustacea	Amphipoda	Talitridae	Hyalella	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	11	16	1	0	0	0	0	0	0	2	0	2	0	6	2	2	2	0	0	2	0	0	0	0	0	0	0	0	0	46	
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	0	12	308	36	112	172	215	108	55	12	8	8	2	38	30	172	48	44	2	0	6	10	4	8	44	2	18	6	4	0		
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	2	0	0	2	3	1	2	2	1	1	6	4	0	0	0	0	0	0	6	4	38	20	4	2	16	0	0	4	0	24	150	
ARTHROPODA	Insecta	Diptera	Chironomidae	Pseudochironomi	0	0	0	0	0	0	0	0	0	10	8	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	22	
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	4	2	4	0	0	1	1	0	0	1	8	18	30	4	2	0	4	12	6	8	12	22	12	16	24	18	44	26	12	10	309	
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanytarsini	0	0	0	0	0	0	0	0	0	5	6	0	0	0	0	0	0	0	0	0	4	6	0	0	0	0	0	0	0	8	29	
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Caenidae*		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Ephemeridae*	*Hexagenia*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	12	0	0	2	16	4	54	
ARTHROPODA	*Insecta*	*Megaloptera*	*Sialidae*	*Sialis*	3	0	0	0	0	0	0	0	0	0	0	8	4	0	2	0	0	0	10	4	0	0	12	2	4	0	12	4	2	16	83	
ARTHROPODA	*Insecta*	*Tricoptera*	*Leptoceridae*	*Oecetis*	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6	
ARTHROPODA	*Insecta*	*Tricoptera*	*Polycentropodidae*	*Polycentropus*	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
MOLLUSCA	*Pelecypoda*		*Corbiculidae*	*Corbicula*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	
MOLLUSCA	*Pelecypoda*		*Sphaeriidae*	*Pisidium*	7	0	0	0	0	0	0	0	0	0	80	0	0	2	0	0	0	0	0	0	12	2	0	2	0	0	0	0	0	0	105	
MOLLUSCA	*Pelecypoda*		*Sphaeriidae*	*Sphaerium*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	8	
			Taxa Richness (Family Level)		4	2	2	2	1	2	2	2	1	3	6	2	3	3	4	2	3	3	2	2	4	3	3	5	4	1	2	3	4	7		

% samples with long lived taxa	56.7%	2
Mean taxa richness/sample (family level)	2.9	2
% of samples with sensitive taxa present	73.3%	3
% of samples with only tubificids & chironomids	16.7%	3
% of total orgs. composed of tubificids & chironomini	19.3%	3
% of total orgs. sensitive	35.1%	3
% of samples with no macroinvertebrates present	0.0%	3
		19

CUSHING LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: July 24-26, 1995

PHYLUM	CLASS	ORDER	FAMILY	GENUS	LACUSTRINE ZONE 1	2	3	4	5	6	7	8	9	10	TRANSITION ZONE 11	12	13	14	15	16	17	18	19	20	RIVERINE ZONE 21	22	23	24	25	26	27	28	29	30	Total Orgs. 240
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
ANNELIDA	Oligochaeta		Tubificidae	Tubifex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
ARTHROPODA	*Acari*				0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
ARTHROPODA	*Insecta*	*Coleoptera*	*Elmidae*	*Dubiraphia*	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	0	11	4	16	22	39	18	25	46	2	14	9	3	10	7	12	9	15	17	4	34	6	[illegible]	[illegible]	7	22	18	[illegible]	15	26	
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	0	1	0	0	1	2	0	1	0	0	4	0	0	0	0	0	1	1	0	1	0	0	0	0	0	2	1	0	0	1	16
ARTHROPODA	Insecta	Diptera	Chironomidae	Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	3	0	0	0	0	0	0	4	0	1	11
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	1	2	0	6	2	4	4	2	5	0	6	4	3	0	6	0	9	10	6	2	6	2	3	1	1	1	0	5	5	2	98
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Ephemeridae*	*Hexagenia*	0	8	0	0	0	0	0	0	0	0	4	10	2	0	3	0	2	10	3	19	2	0	0	0	0	0	0	7	2	1	73
ARTHROPODA	***Insecta***	***Megaloptera***	***Sialidae***	***Sialis***	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	4
ARTHROPODA	*Insecta*	*Tricoptera*	*Leptoceridae*	*Oecetis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
MOLLUSCA	***Pelecypoda***		***Sphaeriidae***	***Sphaerium***	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	9	0	0	1	4	4	1	2	1	28
PORIFERA			*Spongillidae*	*Trochospongilli*	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
			Taxa Richness (Family Level)		1	2	0	2	1	1	1	1	1	0	7	2	3	1	2	1	4	2	2	3	2	4	2	1	2	2	2	3	3	4	

% samples with long lived taxa	36.7%	2
Mean taxa richness/sample (family level)	2.1	2
% of samples with sensitive taxa present	66.7%	2
% of samples with only tubificids & chironomids	26.7%	3
% of total orgs. composed of tubificids & chironomini	7.5%	3
% of total orgs. sensitive	46.7%	3
% of samples with no macroinvertebrates present	6.7%	1
		16

C-9

EUCHA LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: September 2-3, 1993

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total	
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs.	2700
ANNELIDA	Hirudinea		Glossiphoniidae	Helobdellax	5	0	0	0	2	4	2	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	15	
ANNELIDA	Oligochaeta		Naididae	Dero	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
ANNELIDA	Oligochaeta		Tubificidae	Aulodrilus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	4	
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	0	0	0	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	1	0	0	0	2	0	1	1	0	3	0	13	
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus	0	0	0	15	7	14	211	580	395	214	7	0	0	0	0	0	5	12	35	43	0	0	8	25	15	5	1	0	19	4	1615	
ANNELIDA	Oligochaeta		Tubificidae	Tubifex	0	0	0	0	0	1	0	0	0	0	2	0	1	0	15	3	11	33	17	37	0	0	0	1	0	4	0	0	1	1	127	
ARTHROPODA	Insecta	Coleoptera	Elmidae	Dubiraphia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	3	
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	2	0	6	
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	20	0	35	89	182	260	190	310	120	24	307	61	8	21	400	445	310	548	205	236	10	78	12	10	26	13	4	28	15	21		
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	20	6	0	1	4	4	20	10	5	0	1	0	0	1	0	18	24	3	29	25	8	34	0	21	13	11	53	19	10	20	380	
ARTHROPODA	Insecta	Diptera	Chironomidae	Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	6	
ARTHROPODA	Insecta	Diptera	Chironomidae	Pseudochironomi	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	42	12	25	37	18	18	41	17	41	294	
ARTHROPODA	Insecta	Ephemeroptera	Caenidae	Caenis	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	
ARTHROPODA	Insecta	Ephemeroptera	Ephemeridae	Hexagenia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	3	0	0	0	0	2	2	0	0	19	
ARTHROPODA	Insecta	Ephemeroptera	Leptophlebiidae	Choroterpes	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
ARTHROPODA	Insecta	Hemiptera	Corixidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0		
ARTHROPODA	Insecta	Megaloptera	Sialidae	Sialis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	4	0	0	0	0	4	0	2	17	
ARTHROPODA	Insecta	Tricoptera			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	
ARTHROPODA	Insecta	Tricoptera	Leptoceridae	Oecetis	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	
ARTHROPODA	Insecta	Tricoptera	Polycentropodidae		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
MOLLUSCA	Gastropoda		Planorbidae		2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
MOLLUSCA	Pelecypoda		Corbiculidae	Corbicula	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	14	
MOLLUSCA	Pelecypoda		Sphaeriidae	Pisidium	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	4	0	3	7	3	22	
MOLLUSCA	Pelecypoda		Sphaeriidae	Sphaerium	0	0	0	0	0	0	0	0	0	0	8	3	0	0	0	11	8	3	8	4	6	31	4	11	10	1	0	10	27	5	148	
MOLLUSCA	Pelecypoda		Unionidae		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
			Taxa Richness (Family Level)		9	4	0	2	3	3	3	2	2	1	3	1	1	2	1	4	3	4	3	3	4	6	4	5	5	4	4	6	4	4		

% samples with long lived taxa	60.0%	2
Mean taxa richness/sample (family level)	3.3	3
% of samples with sensitive taxa present	63.3%	2
% of samples with only tubificids & chironomids	23.3%	3
% of total orgs. composed of tubificids & chironomini	78.5%	1
% of total orgs. sensitive	9.1%	2
% of samples with no macroinvertebrates present	3.3%	2
		15

C-10

FREDERICK LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: July 31, 1995

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total	
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs.	234
ANNELIDA	Oligochaeta		Naididae	Nais	0	0	0	0	0	0	0	0	0	N	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	0	0	0	0	0	0	0	0	0	O	O	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	0	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2	
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	0	0	7	10	13	22	9	7	12	S	S	2	12	5	5	34	34	[illegible]	1	0	9	21	41	7	21	4	5	0	3	5		
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	0	0	0	0	0	0	0	0	0	A	A	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	1	0	1	0	6	
ARTHROPODA	Insecta	Diptera	Chironomidae	Orthocladinae	0	0	0	0	0	0	0	0	0	M	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	1	3	2	3	2	3	1	5	1	P	P	2	2	0	4	2	1	0	0	3	16	6	4	6	3	18	2	4	14	5	113	
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Ephemeridae*	*Hexagenia*	*0*	*2*	*5*	*9*	*8*	*2*	*3*	*8*	*4*	*L*	L	*5*	*13*	*3*	*11*	*16*	*0*	*6*	*4*	*0*	*2*	*0*	*0*	*0*	*0*	*2*	*0*	*1*	*4*	*0*	108	
MOLLUSCA	*Pelecypoda*		*Sphaeriidae*	*Sphaerium*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	E	E	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	1	
			Taxa Richness (Family Level)		1	2	2	2	2	2	2	3	2			2	2	1	2	2	1	1	1	1	2	2	2	1	1	4	1	2	2	1		

% samples with long lived taxa	3.6%	1
Mean taxa richness/sample (family level)	1.8	1
% of samples with sensitive taxa present	67.9%	2
% of samples with only tubificids & chironomids	28.6%	3
% of total orgs. composed of tubificids & chironomini	3.0%	3
% of total orgs. sensitive	46.6%	3
% of samples with no macroinvertebrates present	0.0%	3
		16

MCALESTER LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: August 11, 1995

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs. 512
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	3	0	2	0	0	0	0	1	0	0	9
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus	0	0	0	1	2	16	12	14	19	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	71
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	0	9	1	8	8	8	9	15	13	17	0	4	10	1	11	2	9	5	2	6	3	7	10	0	1	6	20	0	7	6	
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	0	0	0	1	1	1	1	2	1	0	6	3	0	2	1	0	0	0	1	0	0	0	0	3	1	0	0	3	0	0	27
ARTHROPODA	Insecta	Diptera	Chironomidae	Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	3	0	0	0	0	1	0	0	6
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	5	1	1	0	3	3	0	0	0	10	5	0	2	5	9	8	7	7	7	3	2	7	8	0	0	6	6	6	5	6	122
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Ephemeridae*	*Hexagenia*	1	2	1	0	0	0	0	0	0	2	2	19	10	10	20	7	10	4	8	2	0	6	17	9	7	19	19	22	20	24	241
ARTHROPODA	***Insecta***	***Megaloptera***	***Sialidae***	***Sialis***	0	0	0	0	0	0	0	0	0	2	0	0	1	0	1	0	0	0	0	1	0	4	0	0	0	0	0	0	1	0	10
ARTHROPODA	*Insecta*	*Odonata*	*Gomphidae*	*Gomphus*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
ENTOPROCTA				*Urnatella*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
MOLLUSCA	***Pelecypoda***		*Corbiculidae*	*Corbicula*	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	8
MOLLUSCA	***Pelecypoda***		*Sphaeriidae*	*Sphaerium*	0	0	0	0	6	3	2	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
			Taxa Richness (Family Level)		3	2	2	2	3	3	3	3	2	6	2	2	4	3	3	2	2	2	3	4	3	3	3	2	2	2	2	3	3	2	

% samples with long lived taxa	40.0%	2
Mean taxa richness/sample (family level)	2.7	2
% of samples with sensitive taxa present	93.3%	3
% of samples with only tubificids & chironomids	6.7%	3
% of total orgs. composed of tubificids & chironomini	20.9%	3
% of total orgs. sensitive	53.9%	3
% of samples with no macroinvertebrates present	0.0%	3
		19

C-12

PAULS VALLEY LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: July 14 & 23, 1993

PHYLUM	CLASS	ORDER	FAMILY	GENUS	LACUSTRINE ZONE 1	2	3	4	5	6	7	8	9	10
ANNELIDA	Oligochaeta		Tubificidae	Aulodrilus	0	1	1	0	6	1	0	0	0	0
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	5	0	0	3	0	1	1	0	0	0
ANNELIDA	Oligochaeta		Tubificidae	Tubifex	0	0	0	1	0	0	0	2	0	0
ARTHROPODA	*Acari*	*Arcanna*			0	0	0	0	0	0	0	0	0	0
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	0	0	0	0	0	0	0	2	0
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	10	6	22	200	40	200	40	100	50	100
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	0	3	7	6	4	8	8	4	2	2
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	7	0	1	11	0	13	5	6	2	8
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Ephemeridae*	*Hexagenia*	10	0	0	0	0	0	0	1	0	2
ARTHROPODA	*Insecta*	*Megaloptera*	*Sialidae*	*Sialis*	1	0	0	0	0	0	0	0	0	0
MOLLUSCA	*Pelecypoda*		*Corbiculidae*	*Corbicula*	0	0	0	0	0	0	0	0	0	0
MOLLUSCA	*Pelecypoda*		*Sphaeriidae*	*Pisidium*	17	0	0	0	0	0	0	0	0	0
MOLLUSCA	*Pelecypoda*		*Sphaeriidae*	*Sphaerium*	0	1	1	5	0	2	1	2	2	8
NEMATODA					0	0	0	1	0	0	0	0	0	0
			Taxa Richness (Family Level)		5	3	3	4	2	3	3	4	3	3

GENUS	TRANSITION ZONE 11	12	13	14	15	16	17	18	19	30	RIVERINE ZONE 21	22	23	24	25	26	27	28	29	30	Total Orgs. 584
Aulodrilus	0	0	0	0	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Branchiura	0	0	0	1	1	0	0	0	1	4	0	0	0	0	4	0	0	0	0	4	25
Tubifex	0	0	4	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	11
(Acari)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
(Ceratopogonidae)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Chaoborus	90	0	15	20	70	50	45	00	9	0	4	0	3	[illegible]	1	5	0	1	2	0	
Chironomini	2	5	3	5	6	4	0	1	0	2	0	0	0	0	5	0	0	1	1	1	80
Tanypodinae	1	2	6	4	12	5	13	7	5	3	12	13	10	6	5	5	9	10	2	8	191
Hexagenia	0	0	0	0	0	0	0	2	0	12	0	7	2	15	11	2	1	0	10	42	117
Sialis	0	2	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	4	0	11
Corbicula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Pisidium	0	0	0	0	0	0	0	0	2	2	1	0	0	1	0	0	0	0	0	0	23
Sphaerium	10	0	1	1	1	3	8	0	0	1	23	8	2	9	1	2	3	1	4	2	103
(NEMATODA)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Taxa Richness (Family Level)	2	2	3	3	3	4	2	3	3	4	3	5	4	3	5	4	3	2	4	4	

% samples with long lived taxa	96.7%	3
Mean taxa richness/sample (family level)	3.3	3
% of samples with sensitive taxa present	96.7%	3
% of samples with only tubificids & chironomids	3.3%	3
% of total orgs. composed of tubificids & chironomini	22.6%	3
% of total orgs. sensitive	43.8%	3
% of samples with no macroinvertebrates present	0.0%	3
		21

PAWHUSKA LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: June 29, 1993

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs. 835
ANNELIDA	Hirudinea				0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	1
ANNELIDA	Oligochaeta		Tubificidae	Aulodrilus	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	2	0	N	1	0	0	0	0	0	0	0	0	0	0	6
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	20	9	16	10	0	0	0	0	0	0	3	13	7	4	6	0	7	1	O	0	5	10	4	25	7	23	0	5	12	0	167
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus	0	0	0	1	8	61	25	41	20	8	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	164
ANNELIDA	Oligochaeta		Tubificidae	Tubifex	0	0	0	1	0	15	0	0	2	2	0	0	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	20
ARTHROPODA	***Crustacea***	***Decapoda***			0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	A	1	0	0	0	0	0	0	0	0	0	0	2
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	1	0	2	0	2	0	1	1	3	1	0	0	2	0	0	1	1	M	11	13	9	0	0	0	0	0	0	1	0	49
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	0	14	8	34	2	22	14	16	20	15	0	3	1	1	3	2	2	9	P	1	0	0	0	1	0	12	1	0	0	0	
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	12	0	2	0	4	21	20	17	13	4	0	2	0	0	0	0	0	2	L	0	2	2	0	2	0	0	0	0	0	0	103
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	1	6	5	6	0	0	0	0	2	13	2	8	0	6	0	7	16	10	E	12	12	9	0	0	1	2	2	0	8	0	128
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Caenidae*	*Caenis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	1	0	0	0	0	4
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Ephemeridae*	*Hexagenia*	0	0	0	0	0	0	0	0	0	0	13	2	0	8	0	0	0	0		23	47	40	0	0	0	0	0	0	9	3	143
ARTHROPODA	***Insecta***	***Megaloptera***	***Sialidae***	***Sialis***	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0		2	4	5	0	0	0	0	0	0	0	0	13
MOLLUSCA	Gastropoda		Physidae		2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0		0	0	0	0	0	1	0	0	0	0	0	4
MOLLUSCA	Gastropoda		Planorbidae	Helisoma	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0		0	0	0	0	0	0	1	1	0	0	0	3
MOLLUSCA	***Pelecypoda***		***Corbiculidae***	***Corbicula***	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1	1	0	0	0	0	0	0	0	1	0	3
MOLLUSCA	***Pelecypoda***		***Sphaeriidae***	***Pisidium***	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0		0	0	1	0	0	0	0	0	0	0	0	2
MOLLUSCA	***Pelecypoda***		***Sphaeriidae***	***Sphaerium***	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0		0	2	0	0	0	0	0	0	0	0	0	3
			Taxa Richness (Family Level)		3	3	2	3	2	4	2	3	3	3	5	5	1	5	2	1	3	3		7	7	6	1	2	3	4	2	1	5	1	

% samples with long lived taxa	24.1%	1
Mean taxa richness/sample (family level)	3.2	3
% of samples with sensitive taxa present	31.0%	2
% of samples with only tubificids & chironomids	27.6%	3
% of total orgs. composed of tubificids & chironomini	57.5%	2
% of total orgs. sensitive	20.4%	2
% of samples with no macroinvertebrates present	0.0%	3
		16

C-14

ROCKY LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: August 8, 1995

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total	
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs.	1319
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	1	3	0	1	3	0	2	14	
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus	14	1	0	0	0	0	0	1	0	8	6	1	0	0	0	0	0	0	22	1	0	12	0	1	0	0	0	0	0	0	69	
ANNELIDA	Oligochaeta		Tubificidae	Tubifex	0	0	0	0	0	1	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	4	0	0	1	0	0	1	0	0	14	
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	0	1	8	7	17	7	3	20	2	0	4	2	20	13	6	10	6	1	1	0	2	0	4	3	0	0	0	1	4	0		
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	14	4	1	0	0	0	2	2	3	8	68	4	4	2	2	4	2	4	17	1	24	52	4	2	2	0	0	3	32	10	271	
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	31	21	4	2	6	9	7	3	8	144	60	18	11	18	12	24	16	15	8	1	19	72	56	42	35	3	24	29	48	54	798	
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Ephemeridae*	*Hexagenia*	*10*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*8*	*20*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*4*	*4*	*1*	*1*	*0*	*0*	*0*	*2*	*2*	56	
ARTHROPODA	Insecta	Hemiptera	Corixidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0		
MOLLUSCA	*Pelecypoda*		*Corbiculidae*	*Corbicula*	*3*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*8*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	11	
MOLLUSCA	*Pelecypoda*		*Sphaeriidae*	*Sphaerium*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*7*	*0*	*2*	*2*	*4*	*3*	*0*	*0*	*0*	*1*	*0*	*4*	*0*	*3*	*0*	*0*	*15*	*32*	*0*	*77*	
			Taxa Richness (Family Level)		4	3	1	1	1	2	2	2	1	5	4	3	1	2	2	2	3	1	2	2	4	4	3	3	5	1	2	4	3	3		

% samples with long lived taxa	43.3%	2
Mean taxa richness/sample (family level)	2.5	2
% of samples with sensitive taxa present	56.7%	2
% of samples with only tubificids & chironomids	43.3%	2
% of total orgs. composed of tubificids & chironomini	27.5%	3
% of total orgs. sensitive	11.0%	2
% of samples with no macroinvertebrates present	0.0%	3
		16

SKIPOUT LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: August 7, 1995

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs. 3324
ANNELIDA	Oligochaeta		Naididae	Nais	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	8	0	0	0	0	0	12
ANNELIDA	Oligochaeta		Tubificidae	Aulodrilus	0	0	0	0	0	0	0	0	0	0	0	12	0	4	16	24	16	28	4	83	16	100	27	0	20	43	8	44	56	129	630
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus	5	0	0	0	0	1	1	0	24	2	20	20	1	28	52	16	40	44	4	125	12	200	45	32	40	29	24	68	17	143	993
ANNELIDA	Oligochaeta		Tubificidae	Tubifex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4
ARTHROPODA	*Acari*				*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	4
ARTHROPODA	*Insecta*	*Coleoptera*	*Elmidae*	*Dubiraphia*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*42*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	42
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	0	0	0	0	0	0	0	1	0	0	8	0	4	4	0	12	4	4	0	4	0	0	8	0	0	0	8	6	29	91
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	1	37	22	7	2	26	9	33	49	[illegible]	1	4	7	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	14	0	1	0	0	0	0	0	0	40	14	36	6	44	12	8	24	28	12	56	16	50	9	12	20	7	16	24	6	43	497
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	0	1	0	0	1	2	0	1	1	0	13	156	6	12	20	36	24	56	4	111	16	175	109	24	12	36	8	28	11	129	992
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	14	0	0	0	0	4	0	0	4	0	0	26
ARTHROPODA	*Insecta*	*Ephemeroptera*	*Ephemeridae*	*Hexagenia*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*0*	*0*	*22*	*0*	30
ARTHROPODA	*Insecta*	*Tricoptera*	*Leptoceridae*	*Oecetis*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	4
			Taxa Richness (Family Level)		2	1	1	0	1	2	1	1	3	2	2	5	2	3	3	2	3	3	3	3	3	2	2	6	3	2	2	3	4	3	

% samples with long lived taxa	0.0%	1
Mean taxa richness/sample (family level)	2.4	2
% of samples with sensitive taxa present	13.3%	1
% of samples with only tubificids & chironomids	50.0%	2
% of total orgs. composed of tubificids & chironomini	63.9%	2
% of total orgs. sensitive	2.4%	1
% of samples with no macroinvertebrates present	3.3%	2
		11

C-16

TAYLOR LAKE BENTHIC MACROINVERTEBRATE DENSITIES (orgs./sq. ft.)
COLLECTED: July 1 & 8, 1993

					LACUSTRINE ZONE										TRANSITION ZONE										RIVERINE ZONE										Total	
PHYLUM	CLASS	ORDER	FAMILY	GENUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Orgs.	1073
ANNELIDA	Oligochaeta		Tubificidae	Aulodrilus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	
ANNELIDA	Oligochaeta		Tubificidae	Branchiura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	3	
ANNELIDA	Oligochaeta		Tubificidae	Limnodrilus	29	43	46	0	0	6	0	2	1	12	27	5	1	13	3	3	36	46	2	21	1	0	13	0	27	13	47	61	17	121	596	
ANNELIDA	Oligochaeta		Tubificidae	Tubifex	0	0	2	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	7	
ARTHROPODA	*Acari*	Arcarina			*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	4	
ARTHROPODA	Insecta	Diptera	Ceratopogonidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	
ARTHROPODA	Insecta	Diptera	Chaoboridae	Chaoborus	5	7	0	3	0	27	30	6	17	2	5	11	7	20	3	11	5	2	1	0	0	3	0	2	3	1	1	2	0	3		
ARTHROPODA	Insecta	Diptera	Chironomidae	Chironomini	6	0	0	0	0	0	0	0	1	6	8	0	0	2	0	2	2	10	5	30	0	0	4	0	13	10	26	25	74	126	358	
ARTHROPODA	Insecta	Diptera	Chironomidae	Tanypodinae	0	0	3	0	0	0	0	1	4	1	1	5	1	4	2	8	0	2	0	0	3	2	15	3	1	0	4	19	5	19	103	
ARTHROPODA	Insecta	Hemiptera	Corixidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		
			Taxa Richness (Family Level)		2	1	2	0	0	1	0	2	2	2	2	2	2	2	3	2	2	2	2	3	3	2	2	1	3	2	2	3	2	2		

% samples with long lived taxa	0.0%	1
Mean taxa richness/sample (family level)	1.9	1
% of samples with sensitive taxa present	13.3%	1
% of samples with only tubificids & chironomids	73.3%	1
% of total orgs. composed of tubificids & chironomini	89.0%	1
% of total orgs. sensitive	0.4%	1
% of samples with no macroinvertebrates present	10.0%	1
		7

APPENDIX D

CORRELATION OF BENTHIC MACROINVERTEBRATE
SCORES TO TSI-CHLOROPHYLL
FOR VARIOUS COLLECTION
SCENARIOS

Benthic Scores using all 30 sites.

Shallow Lakes (<40% of sites have dT>5°C) Regression Output:

Lake	Benthic Score	TSI-Chl.	Chl. a	Turb.	Cond.
P. Valley	21	44	3.9	20.8	274.5
McAlester	19	45	4.3	76.7	114.7
Frederick	16	51	7.7	62.2	326.9
Comanche	19	51	7.8	15.2	261.9
Cushing	16	52	8.6	117.4	252.4
B. Hauani	14	52	9.1	5.7	232.6
Claremore	13	61	22.3	13.7	163.6
Skipout	11	61	22.5	15.1	919.1
Rocky	16	62	23.7	50.1	503.8
Chickasha	9	62	24.7	12.8	1837.4
Taylor	7	67	40.5	18.7	417.2

Constant	42.38131
Std Err of Y Est.	2.175393
R Squared	0.776478
No. of Observations	1.1
Degrees of Freedom	9
X Coefficient(s)	-0.50263
Std Err of Coef.	0.089891

Deep Lakes (>40% of sites have dT>5°C)

Lake	Benthic Score	TSI-Chl.	Chl. a	Turb.	Cond.
Pawhuska	16	39	2.3	4.2	279.1
Bixhoma	9	41	2.9	7.5	
C.Albert	8	44	3.9	14.1	52.5
Eucha	15	50	7.3	5.0	164.3

Regression Output:

Constant	7.921108
Std Err of Y Est.	4.969256
R Squared	0.01226
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.093698
Std Err of Coef.	0.594699

Benthic scores using 10 sites (lacustrine transect only)

Shallow Lakes (<40% of sites have dT>5°C)

Lake	Benthic Score	TSI-Chl.	Chl. a	Turb.	Cond.

Regression Output:

Constant	39.62081

P. Valley	20	44	3.9	20.8	274.5
Frederick	17	51	7.7	62.2	326.9
Cushing	11	52	8.6	117.4	252.4
Claremore	12	61	22.3	13.7	163.6
Skipout	7	61	22.5	15.1	919.1
Rocky	14	62	23.7	50.1	503.8
Chickasha	9	62	24.7	12.8	1837.4
Taylor	8	67	40.5	18.7	417.2

Std Err of Y Est.	2.872043
R Squared	0.655109
No. of Observations	8
Degrees of Freedom	6
X Coefficient(s)	-0.47681
Std Err of Coef.	0.141239

Deep Lakes (>40% of sites have dT>5°C)

Lake	Benthic Score	TSI-Chl.	Chl. a	Turb.	Cond.
Pawhuska	12	39	2.3	4.2	279.1
Bixhoma	9	41	2.9	7.5	
C.Albert	9	44	3.9	14.1	52.5
McAlester	17	45	4.3	76.7	114.7
Eucha	9	50	7.3	5.0	164.3
Comanche	14	51	7.8	15.2	261.9
B. Hauani	13	52	9.1	5.7	232.6

Regression Output:

Constant	6.275349
Std Err of Y Est.	3.302938
R Squared	0.040631
No. of Observations	7
Degrees of Freedom	5
X Coefficient(s)	0.121307
Std Err of Coef.	0.263612

D-3

Benthic scores using 20 sites (lacustrine & riverine transacts)

Shallow Lakes (<40% of sites have dT>5°C)

Lake	Benthic Score	TSI-Chl.	Chl. a	Turb.	Cond.
P. Valley	21	44	3.9	20.8	274.5

Regression Output:

Constant	39.32371
Std Err of Y Est.	2.019954

McAlester	19	45	4.3	76.7	114.7	R Squared	0.762667
Frederick	15	51	7.7	62.2	326.9	No. of Observations	1.1
Comanche	18	51	7.8	15.2	261.9	Degrees of Freedom	9
Cushing	14	52	8.6	117.4	252.4		
B. Hauani	15	52	9.1	5.7	232.6	X Coefficient(s)	-0.44888
Claremore	13	61	22.3	13.7	163.6	Std Err of Coef.	0.083468
Skipout	11	61	22.5	15.1	919.1		
Rocky	16	62	23.7	50.1	503.8		
Chickasha	10	62	24.7	12.8	1837.4		
Taylor	8	67	40.5	18.7	417.2		

Deep Lakes (>40% of sites have dT>5°C)

Lake	**Benthic Score**	**TSI-Chl.**	**Chl. a**	**Turb.**	**Cond.**
Pawhusk	14	39	2.3	4.2	279.1
Bixhoma	9	41	2.9	7.5	
C.Albert	8	44	3.9	14.1	52.5
Eucha	15	50	7.3	5.0	164.3

Regression Output:

Constant	1.703646
Std Err of Y Est.	4.090484
R Squared	0.095564
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	0.225037
Std Err of Coef.	0.489531

Benthic scores using 9 sites (3 deepest sites from each transect)

Shallow Lakes (<40% of sites have dT>5°C)

Lake	**Benthic Score**	**TSI-Chl.**	**Chl. a**	**Turb.**	**Cond.**
P. Valley	21	44	3.9	20.8	274.5
McAlester	19	45	4.3	76.7	114.7

Regression Output:

Constant	40.15606
Std Err of Y Est.	2.009394
R Squared	0.790795

Frederick	15	51	7.7	62.2	326.9
Comanche	17	51	7.8	15.2	261.9
Cushing	16	52	8.6	117.4	252.4
Claremore	13	61	22.3	13.7	163.6
Skipout	12	61	22.5	15.1	919.1
Rocky	16	62	23.7	50.1	503.8
Chickasha	9	62	24.7	12.8	1837.4
Taylor	8	67	40.5	18.7	417.2

No. of Observations	10
Degrees of Freedom	8
X Coefficient(s)	-0.46048
Std Err of Coef.	0.083737

Deep Lakes (>40% of sites have dT>5°C)

Lake	Benthic Score	TSI-Chl.	Chl. a	Turb.	Cond.
Pawhuska	18	39	2.3	4.2	279.1
Bixhoma	9	41	2.9	7.5	
C.Albert	7	44	3.9	14.1	52.5
Eucha	14	50	7.3	5.0	164.3
B. Hauani	12	52	9.1	5.7	232.6

Regression Output:

Constant	15.36094
Std Err of Y Est.	4.942432
R Squared	0.00969
No. of Observations	5
Degrees of Freedom	3
X Coefficient(s)	-0.07425
Std Err of Coef.	0.433336

Benthic scores using 15 sites (deepest, 2 shallowest & 2 median)

Shallow Lakes (<40% of sites have dT>5°C)

Lake	Benthic Score	TSI-Chl.	Chl. a	Turb.	Cond.
P. Valley	21	44	3.9	20.8	274.5
McAlester	19	45	4.3	76.7	114.7
Frederick	15	51	7.7	62.2	326.9
Comanche	20	51	7.8	15.2	261.9

Regression Output:

Constant	38.99051
Std Err of Y Est.	2.500179
R Squared	0.65428
No. of Observations	1.1
Degrees of Freedom	9

Cushing	17	52	8.6	117.4	252.4
B. Hauani	16	52	9.1	5.7	232.6
Claremore	13	61	22.3	13.7	163.6
Skipout	12	61	22.5	15.1	919.1
Rocky	18	62	23.7	50.1	503.8
Chickasha	9	62	24.7	12.8	1837.4
Taylor	10	67	40.5	18.7	417.2

X Coefficient(s)	-0.42638
Std Err of Coef.	0.103312

Deep Lakes (>40% of sites have dT>5°C)

Lake	**Benthic Score**	**TSI-Chl.**	**Chl. a**	**Turb.**	**Cond.**
Pawhuska	17	39	2.3	4.2	279.1
Bixhoma	10	41	2.9	7.5	
C.Albert	10	44	3.9	14.1	52.5
Eucha	14	50	7.3	5.0	164.3

Regression Output:

Constant	16.49072
Std Err of Y Est.	4.137296
R Squared	0.014836
No. of Observations	4
Degrees of Freedom	2
X Coefficient(s)	-0.08593
Std Err of Coef.	0.495134

APPENDIX E

FISH COLLECTED AT EACH RESERVOIR

Fish Collected for Biological Assessment of Small Reservoirs

	Tolerance*	Trophic Level**	Big Hauani	Bixhoma	Carl Albert	Chickasha	Comanche	Cushing	Eucha	Frederick	McAlester	Rocky	Taylor	Skipout	Pauls Valley	Pawhuska	Claremore
White Bass	MT	Pisc.				7		1		3							57
Hybrid Bass	MT	Pisc.								6							
Black Bass	[illegible]	Pisc.									1						
Largemouth Bass	MT	Pisc.	226	192	136	27	49	37	269	10	34	39	74	31	22	53	93
Spotted Bass	MI	Pisc.							2		2					25	33
Smallmouth Bass	I	Pisc.														2	
White Crappie	T	Inv.	1	6	3		7	163		134	50	24	64	244	35	1	22
Black Crappie	MT	Inv.		7	12			1	5			1	16			6	6
Bluegill	MT	Ins.	294	243	408	21	154	102	808	28	74	183	227	103	311	270	336
Longear Sf.	MT	Ins.		32	106	4	1	29	99	71		40		41	6	2	35
Orangespotted Sf.	T	Ins.						3		20	9	7	42		1	34	
Redear Sf.	MT	Ins.	10	30	71		6	6	78	1	19	2		1	48	15	34
Green Sf.	T	Inv.	61	12	40	6	19	9	94	3		9	58	50	2	86	10
Warmouth Sf.	MT	Inv.		25	80		4		28		16				11	12	44
Hybrid Sf.	[illegible]	Ins./Inv.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	[illegible]
Sunfish spp.	[illegible]	Ins./Inv.	[illegible]	[illegible]	459	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	84	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Gizzard Shad	MT	Omn.		8	17	470	241	213	772	202	368	36	5690	4383	131		1745
Channel Catfish	MT	General.		6	1	13	5	30	1	17	10	22	99	67	53		56
Blue Catfish	T	Pisc.									5						
Black Bullhead	T	Ins.	2									34	16	3	1		
Yellow Bullhead	T	Ins.			3						4			13			
Flathead Catfish	MT	Pisc.						2		2	1				2	2	1
Saugeye	MT	Pisc.											75	3			
Carp	T	Omn.				82	35	23	37	76	1	114	57	13	13		35
White Sucker	MI	Omn.							3								
Spotted Sucker	MI	Ins.							70								6
Freshwater Drum	MT	Inv.					3	2		6	7				9		28
River Carpsucker	T	Omn.				8		19		29					12		
Black Buffalo	MT	Ins.											100				
Longnose Gar	T	Pisc.									4						
Shortnose Gar	T	Pisc.									9						
Spotted Gar	T	Pisc.									13						
Gar spp.	T	Pisc.									6						
White Amur	MT	Herb.					3						1				
Black Redhorse	MI	Ins.							4								
Golden Redhorse	MI	Ins.							3								
Inland Silverside	T	Ins.	6		24	24	16			5	6	22	606			500	
Brook Silverside	MT	Ins.		6					76								
Blackspotted Topminnow	MT	Ins.															1
Blackstripe Topminnow	MT	Ins.	5														
Mosquitofish	T	Ins.						1				3					
Golden Shiner	T	Omn.			1				3			1	1	7			1
Red Shiner	T	Omn.			6			14									
Bullhead Minnow	T	Omn.									7		24				
Fathead Minnow	T	Omn.														13	
Notropis spp.	MT	Ins.								7	50	7					
Logperch	MI	Ins.														4	

Fish (in gray) not included in total species count.

CLASSIFICATIONS OF FISH

*Tolerance classifications (Jester et al. 1992)
T = Tolerant
MT = Moderately tolerant
MI = Moderately intolerant
I = Intolerant

**Trophic Level (Plafkin et al. 1989)
Pisc. = Piscivore
Inv. = lnvertivore
Ins. = Insectivore
Omn. = Omnivore
Herb. = Herbivore
General. = Generalist

Sucker species (Miller & Robison 1980):
White sucker
Spotted sucker
River carpsucker
Black buffalo
Black redhorse
Golden redhorse

Migratory Spawners (Scott 1992)-.
White bass
Spotted Sucker
River carpsucker
Black Buffalo
Black redhorse
Golden redhorse

Lithophilic Spawners (Scott 1992):
White bass
Spotted sucker
Black redhorse
Golden redhorse