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Effect of Phosphorus Control Options on Lake Water Quality

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EFFECT OF PHOSPHORUS CONTROL OPTIONS ON LAKE WATER QUALITY

FINAL REPORT
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by

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SUMMARY AND CONCLUSIONS

BACKGROUND

Data collected as part of the National Eutrophication Survey (NES) were compiled and used to assess the consequences of eight different possible phosphorus control policies (options). The purpose of this analysis was to identify options that would have the most significant impact on water quality of the nation's lakes. The original data base included measurements made at over 800 lakes distributed throughout the contiguous United States. Data used in the analysis included phosphorus loading from different sources (municipal, industrial, septic tank, tributary and nonpoint); phosphorus retention coefficients; in-lake concentration of total phosphorus and chlorophyll-a; and Secchi disc measurements. Physical characteristics of each lake including mean depth, area, and volume were also used in the analyses.

Prior to use of the data base for analysis of phosphorus control options, a number of checks were performed to assure completeness, reasonableness of values, and appropriateness for the analytical techniques used. Lakes without morphometric data, phosphorus concentration data, phosphorus loading data, or measurements of Secchi disc, chlorophyll-a or phosphorus retention were eliminated from the data base. After screening, 493 individual lakes were retained.

Table 1 provides a summary of the lakes' characteristics. Detailed data for each lake are contained in Appendix A. Curves showing the distribution of characteristic values among the lakes are given in Section II.

Table 1

SUMMARY OF LAKE CHARACTERISTICS (493 lakes)

Variable	Minimum	Mean	Maximum	Standard Deviation
Surface Area (km^2)	0.1	44	1,490	110
Mean Depth (m)	0.5	9.2	89	9.7
Volume ($10^6 m^3$)	0.1	639	35,000	2,510
Retention Time (yr)	0.001	1.7	58.5	5.9
Median Total Phosphorus (mg/ℓ)	0.004	0.084	1.525	0.15
Secchi Disc (m)	0.1	1.7	13.3	1.5
Mean Chlorophyll-a (μg/ℓ)	0.5	17.3	381	29.5
Phosphorus Loading				
kg/yr	204	159,513	6,697,765	486,648
g/m^2/yr	0.03	10.6	818	45
Phosphorus Retention Coefficient	0.002	0.458	0.996	0.260

OPTIONS

The purpose of the project was to assess the impact of various phosphorus control options on the trophic state of the nations lakes. The available options consisted of reducing the input of phosphorus from different sources by various amounts. The eight options which were analyzed are listed below.

Option 1	Detergent phosphorus control
Option 2	Tertiary sewage treatment
Option 3	20% reduction in nonpoint sources
Option 4	40% reduction in nonpoint sources
Option 5	60% reduction in nonpoint sources
Option 6	Tertiary sewage treatment plus 20% reduction in nonpoint sources
Option 7	Tertiary sewage treatment plus 40% reduction in nonpoint sources
Option 8	Tertiary sewage treatment plus 60% reduction in nonpoint sources.

METHODS

The method used to project the effects of each phosphorus control option on lake trophic status consisted of five steps as follows:

1. Compute new total phosphorus loading in accordance with option.
2. Compute new in-lake phosphorus concentration with a mass balance model and measured retention coefficient.

3. Compute new chlorophyll-*a* concentration from predicted phosphorus level.

4. Compute new Secchi Disc depth from new chlorophyll-*a* concentration and light attenuation coefficients.

5. Present results as figures and tables.

The detailed procedures used in each step are described in Section III.

Before analyzing specific phosphorus control options the NES data were reviewed to test the assumptions of common projection techniques. The results of this review showed that several common assumptions were not appropriate and projection techniques were modified accordingly.

Phosphorus Retention

Recent literature (Lee, *et al*., 1978; Larsen and Mercier, 1975) has indicated that phosphorus retention coefficients could be predicted from other variables (morphometry and flow rate). However, a comparison of measured and predicted retention coefficients was found to yield a very poor correlation as shown in Figure 1. As a result it was decided to use observed retention coefficients based on influent and effluent phosphorus concentrations for this study. It is realized that these retention coefficients are subject to measurement error and also may change as a result of changed loads. However, the measured value was judged to be the best available indicator of phosphorus retention for each lake.

Phosphorus-Chlorophyll Relationship

As discussed in Section III, considerable effort was devoted to establishing a usable relationship between total phosphorus and

$$R_c = \frac{1}{(Q/V)^{\frac{1}{2}} + 1}$$

Q = hydraulic outflow

V = lake volume

$$R_m = \frac{\text{mass in - mass out}}{\text{mass in}}$$

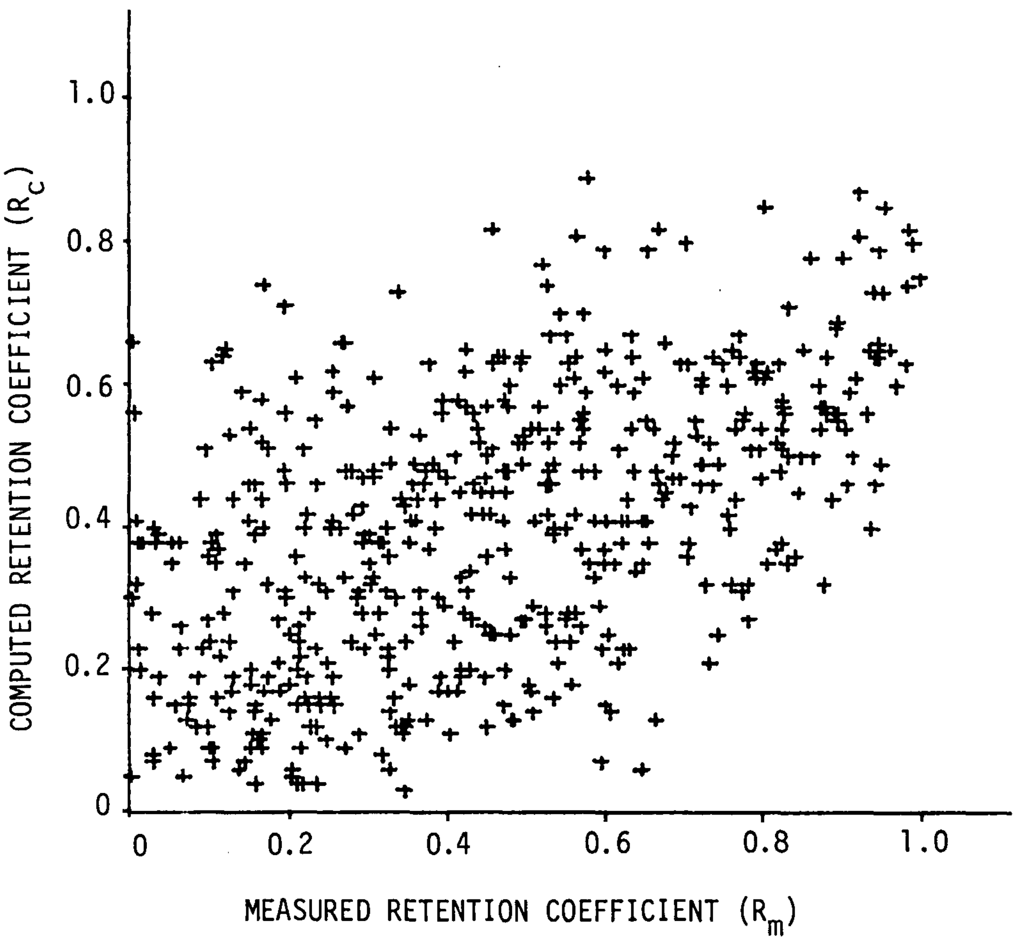


FIGURE 1. RELATIONSHIP BETWEEN THEORETICAL AND MEASURED PHOSPHORUS RETENTION COEFFICIENTS

chlorophyll-a levels. It was found that a simple regression equation was not supported by the NES data. An alternative method was developed that requires phosphorus to be reduced below a certain limiting level (1 μg P = 1 μg chl.-a) before available phosphorus would limit algal production.

Chlorophyll-a - Transparency

In order to predict the effects of chlorophyll-a on transparency, a relationship between chlorophyll-a and Secchi isc depth was needed. It was found that simple regressions were not adequate. Most of the lakes apparently had considerable non-chlorophyll related light attenuating characteristics. Consequently, a non-chlorophyll light attenuation coefficient was computed for each lake and later used in conjunction with predicted chlorophyll levels to compute Secchi disc depths for each option.

RESULTS

The predicted total phosphorus concentration, chlorophyll-a concentration, and Secchi disc depth for each lake for each option are tabulated in Appendices B-1 through B-8. The results are shown graphically and by tabular summary in Sections IV through XI. As part of the analysis the country was divided into seven areas as shown in Figure 2. Table 2 summarizes the mean predicted total phosphorus concentrations for all lakes within each region, for each option tested. Table 3 summarizes the percent of lakes with median total phosphorus concentrations less than 0.025 mg/ℓ for each region and each option.

The following discussion summarizes the results of each option analyzed. This summary is followed by a comparison of results and conclusions.

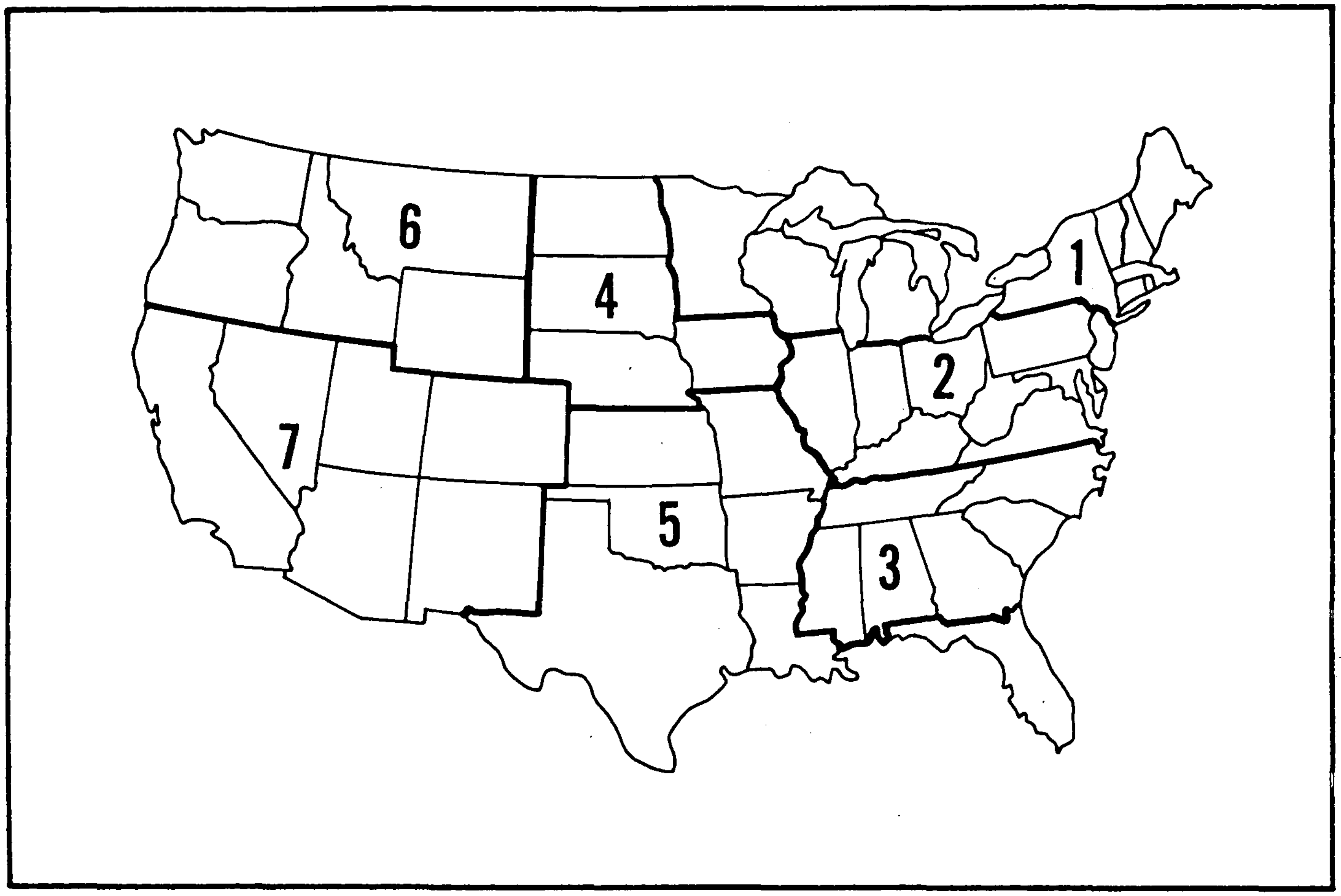


FIGURE 2. GEOGRAPHICAL AREAS USED TO GROUP LAKE DATA

Table 2

MEAN PREDICTED TOTAL PHOSPHORUS CONCENTRATION
FOR LAKES IN EACH AREA AND FOR EACH OPTION

Area	No. of Lakes	OPTION								
		No Action	1	2	3	4	5	6	7	8
1	120	0.141	0.101	0.070	0.132	0.124	0.115	0.060	0.052	0.044
2	108	0.086	0.060 (areas 2–3)	0.053 (areas 2–3)	0.073	0.064	0.054	0.052	0.040	0.030
3	56	0.041			0.035	0.029	0.023	0.026	0.020	0.014
4	32	0.121	0.073 (areas 4–5)	0.071 (areas 4–5)	0.099	0.076	0.054	0.095	0.072	0.050
5	83	0.058			0.048	0.038	0.028	0.043	0.033	0.023
6	41	0.034	0.043 (areas 6–7)	0.042 (areas 6–7)	0.028	0.022	0.016	0.026	0.020	0.014
7	53	0.054			0.045	0.036	0.027	0.040	0.031	0.022
All	493	0.084	0.070	0.059	0.074	0.064	0.055	0.049	0.039	0.029

Table 3

PERCENT OF LAKES IN EACH AREA WITH PREDICTED
TOTAL PHOSPHORUS CONCENTRATION LESS THAN 0.025 mg/ℓ FOR EACH OPTION

Area	No. of Lakes	PERCENT OF LAKES WITH TOTAL PHOSPHORUS LESS THAN 0.025 mg/ℓ								
		OPTION								
		No Action	1	2	3	4	5	6	7	8
1	120	30	32	42	36	40	48	48	54	64
2	108	27	(28)	(31)	31	37	45	36	44	59
			33	36						
3	56	41	(42)	(45)	45	52	68	54	68	88
4	32	9	(9)	(12)	12	16	28	13	16	31
			23.5	27						
5	83	29	(29)	(32)	35	46	59	43	57	73
6	41	49	(50)	(52)	59	68	80	59	68	83
			48	50						
7	53	45	(46)	(48)	51	57	72	53	62	77
All	493	32	33	38	37	44	55	44	53	68

Options

Section IV presents the results of a ban on detergent phosphorus. Two levels of control were considered. A complete ban was assumed to result in a 45% reduction in municipal treatment plant phosphorus discharges (Welch, 1979). A partial reduction was assumed to result in a 27% reduction in treatment plant phosphorus discharges. The results indicate that this option would have very little effect on lake water quality. Although 347 out of the total 493 lakes receive municipal treatment plant effluent, only a small fraction of the total phosphorus load is from municipal sources (∿29%) and a 45% reduction would not be expected to have a large effect on in-lake phosphorus concentrations. The average concentration of total phosphorus for all lakes was predicted to decrease from 0.084 mg/ℓ to 0.070 mg/ℓ. Only four lakes (0.8%) were projected to change from an average phosphorus concentration greater than 0.025 mg/ℓ to less than 0.025 mg/ℓ. Projected chlorophyll-a concentrations and Secchi disc depths were indistinguishable from old values.

Section V presents the results of imposing an 80% reduction on municipal treatment plant phosphorus discharges. This was assumed to approximate a nutrient removal requirement (tertiary treatment) and was found to result in effluent phosphorus concentrations very near 1.0 mg/ℓ. The results indicated that for all 493 lakes the average total phosphorus concentration would decrease from 0.084 mg/ℓ to 0.059 mg/ℓ. For the 347 lakes which receive municipal effluent the average phosphorus concentration was projected to decrease from 0.099 mg/ℓ to 0.062 mg/ℓ. The number of lakes with average total phosphorus concentrations less than 0.025 mg/ℓ was projected to increase from 160 to 187 (27 lakes, 5.5%). Again, projected chlorophyll-a concentrations and Secchi disc depths were indistinguishable from old values.

Sections VI, VII and VIII present the results of analysis for nonpoint source phosphorus control. The contribution of rivers and direct runoff was reduced by 20, 40, and 60%. The 20% reduction in nonpoint sources projected a decrease in average total phosphorus concentration from 0.084 mg/ℓ to 0.074 mg/ℓ, roughly comparable to a detergent ban. However, the number of lakes with average phosphorus concentrations less than 0.025 mg/ℓ was projected to increase from 160 to 183 (23 lakes, 4.6%) whereas the detergent ban resulted in the same change for only four lakes. An analysis by geographical area (see Figure 2) indicated some variation in the effectiveness of non-point source control. The Northwest showed the highest percent improvement.

The 40% reduction in nonpoint sources projected a decrease in average total phosphorus concentrations from 0.084 mg/ℓ to 0.064 mg/ℓ, roughly comparable to tertiary sewage treatment (0.059 mg/ℓ). However, the number of lakes with average phosphorus concentrations less than 0.025 mg/ℓ was projected to increase from 160 to 218 (58 lakes) whereas tertiary sewage treatment resulted in the same change for only 27 lakes. The effectiveness of a 40% reduction in nonpoint source phosphorus was geographically quite uniform. From seven to 12 percent of the lakes shifted below the 0.025 mg/ℓ guideline except in the Northwest (Area 6) where 20% of the lakes shifted below the 0.025 mg/ℓ criterion.

The 60% reduction in nonpoint sources projected a decrease in average total phosphorus concentrations from 0.084 mg/ℓ to 0.055 mg/ℓ, again comparable to the tertiary sewage treatment option (0.059 mg/ℓ). However, the number of lakes with average phosphorus concentrations less than 0.025 mg/ℓ was projected to increase from 160 to 273 (113 lakes) whereas tertiary sewage treatment resulted in the same change for only 27 lakes. The effectiveness of the 60% nonpoint source control was found to be greatest in the western two-thirds and southeastern part of the country. This reflects the fact that nonpoint sources represented a larger fraction of the total phosphorus load in the western and southeastern states.

Sections IX, X, and XI present the results of analysis for combinations of tertiary sewage treatment and nonpoint source control. The results reflect an incremental improvement over the three nonpoint source control cases. Tertiary sewage treatment plus 20% nonpoint source phosphorus control results in an average in-lake phosphorus decrease from 0.084 mg/ℓ to 0.049 mg/ℓ, somewhat better than 60% nonpoint source control. The number of lakes with an average total phosphorus concentration less than 0.025 mg/ℓ was projected to increase from 160 to 219 (59 lakes, 12%), considerably fewer than 60% nonpoint source control (113 lakes). Regional differences were more pronounced with East-Central and Southwest lakes being the least improved in terms of the fraction of lakes with less than 0.025 mg/ℓ total phosphorus.

Tertiary sewage treatment plus 40% nonpoint source control results in an average in-lake total phosphorus decrease from 0.084 mg/ℓ to 0.039 mg/ℓ. Although this represents a considerable improvement over the 60% nonpoint source control option (0.055 mg/ℓ) the number of lakes with average total phosphorus concentrations less than 0.025 mg/ℓ was projected to increase from 160 to 264 (104 lakes, 21%) compared to 113 lakes for the 60% nonpoint source control alone.

The most stringent control option tested was tertiary sewage treatment plus 60% nonpoint source control. It was considered unreasonable to expect that greater than 80% treatment plant removal or greater than 60% nonpoint source control could be achieved. The results project a decrease of average phosphorus concentration from 0.084 mg/ℓ to 0.029 mg/ℓ. The number of lakes with a total phosphorus concentration less the 0.025 mg/ℓ was projected to increase from 160 to 336 (176 lakes, 35.7%). This option would increase the fraction of lakes with less than 0.025 mg/ℓ total phosphorus from 32% to 68%.

Comparison and Conclusions

The results of the phosphorus control options analyses have shown that, on a national scale, average lake phosphorus concentrations could be reduced from 0.084 mg/ℓ to 0.029 mg/ℓ by a combination of municipal treatment plant and nonpoint source control. Intermediate levels of improvement could be achieved with nonpoint source control or municipal treatment plant control alone. It was found that control of point sources was generally more effective in reducing average phosphorus concentrations than it was in increasing the number of lakes with median phosphorus levels below 0.025 mg/ℓ. For example, Option 5 (60% nonpoint source control) resulted in approximately the same average phosphorus concentration for all lakes (0.055 mg/ℓ) as did 80% control of municipal treatment plant phosphorus (0.059 mg/ℓ). However, the 60% nonpoint source control resulted in 55% (273) lakes having an average phosphorus concentration less than 0.025 mg/ℓ whereas 80% municipal control only resulted in 38% (187) lakes having average phosphorus concentrations less than 0.025 mg/ℓ.

The results varied somewhat by geographical area depending primarily on the fraction of total loading from municipal versus nonpoint sources. However, even in the Northeast where municipal loads were the greatest fraction of the total, a 60% reduction in nonpoint sources resulted in an average concentration of 0.115 mg/ℓ and 48% (58 lakes) with less than 0.025 mg/ℓ average phosphorus concentration. The reduction of municipal phosphorus sources by 80% resulted in a lower average phosphorus concentration (0.070 mg/ℓ) but fewer lakes (42% or 50 lakes) with median phosphorus levels below 0.025 mg/ℓ.

The study findings lead to the following conclusions:

1. The degree of phosphorus enrichment of the nations lakes could be substantially reduced by point and nonpoint source control measures.

2. The relative value of point versus nonpoint control depends on the relative proportion of loads.

3. Nonpoint source control results in a larger number of lakes meeting an 0.025 mg/ℓ phosphorus criteria than does a similar reduction in point sources.

4. Although generalizations can be made about regional and national lake quality, the most effective control program must be designed for each lake individually.

5. In general, industrial and septic tank phosphorus sources are negligible.

6. The analysis indicates that chlorophyll-a levels and transparency (Secchi disc) would be very insensitive to phosphorus reductions.

LIMITATIONS AND ASSUMPTIONS

Because the results of this study provide some broad general findings which are based on a limited data set and may not be applicable to any individual lake, it is important to understand some of the limitations and assumptions of the study.

The objective of the study was to identify in broad terms the effectiveness of different phosphorus controls, alone and in combination, on a nationwide basis. The large scope of the project limited the study to the use of a large data base which required computer manipulations. The National Eutrophication Survey was used because it was the largest and most comprehensive system available, but it also limited the study to the use of very simple models. More complex models incorporating biological controls on dissolved oxygen and chlorophyll, or those using phosphorus released from the sediments, could not be used because of lack of available data for a large number of lakes.

The National Eutrophication Survey data were extensive in terms of the number of lakes sampled but limited in temporal and spatial detail. It was beyond the scope of this project to assess the adequacy of methods used to collect samples, conduct analyses or estimate nutrient loading rates. In addition, it is possible that mean and median values of the data collected may not be truly representative of conditions in any one lake as a result of the limited number of samples. However, the analysis assumed that reported values were truly representative as these were the best available data.

The analytical approach to data analysis was also simplified and in many cases conservative. Such factors as sediment phosphorus release, zooplankton grazing, temperature, and nutrients other than phorphorus were not considered. It was shown that phosphorus retention coefficients based on influent and effluent concentrations were in poor agreement with theoretical values (see pp. III-3, -4, and -5). The observed values were assumed to be correct and were used to predict the effects of changed loading rates.

The greatest uncertainty in the analysis is believed to be in the prediction of chlorophyll-a (see pp. III-5, -6). Previous researchers have found good correlations between total phosphorus and chlorophyll-a levels. In this study neither median phosphorus and mean chlorophyll-a nor spring phosphorus and maximum summer chlorophyll-a were correlated. This lack of good relationship resulted in selection of a phosphorus-chlorophyll relationship that is very conservative in terms of predicting reduced chlorophyll or increased transparency. It is possible that other relationships such as mean summer chlorophyll and mean summer phosphorus might give a better relationship. However, it should be kept in mind that there is great difference between examining many years of chlorophyll-phosphorus data for one lake as compared to examining one data point for each of many lakes.

The results of the study provide some general conclusions but strongly indicate that the proper design and evaluation of a lake restoration program must be on a case-by-case basis.

SECTION I

INTRODUCTION

BACKGROUND

Eutrophication of the nation's waters has been recognized as a problem of increasing magnitude. One of the primary causes of accelerated eutrophication is high loading rates of critical nutrients. Phosphorus has been recognized as frequently not only the most important nutrient but also the one most amenable to control. Recognizing the need to control phosphorus as a potential environmental hazard the U.S. Environmental Protection Agency has contracted with Tetra Tech, Inc., to perform an analysis of the possible environmental consequences of implementing various phosphorus control options.

The analysis is based on an evaluation of data collected as part of the National Eutrophication Survey conducted by the U.S. Environmental Protection Agency for over 800 lakes between 1972 and 1975. These data include phosphorus loadings and in-lake concentrations of phosphorus and chlorophyll-a as well as measurements of transparency. The basic analyses conducted were to modify the loading rates and compute the response of each lake.

SCOPE AND OBJECTIVES

This report documents the data base, the technical approach and the results of options analysis.

Section II describes the National Eutrophication Survey data with a general summary of the data to provide some guidance in understanding the lakes' status and in selecting control options. Criteria used and results of preliminary data base screening are described.

Section III describes the technical approach and rationale for procedures used in the evaluation of the effects of various control options.

Sections IV through XI present the results of the analysis of control options as listed below.

Option 1	Detergent phosphorus control
Option 2	Tertiary sewage treatment
Option 3	20% reduction in nonpoint sources
Option 4	40% reduction in nonpoint sources
Option 5	60% reduction in nonpoint sources
Option 6	Tertiary sewage treatment plus 20% reduction in nonpoint sources
Option 7	Tertiary sewage treatment plus 40% reduction in nonpoint sources
Option 8	Tertiary sewage treatment plus 60% reduction in nonpoint sources.

Appendix A provides listings of data for each lake.

Appendices B-1 through B-8 provide the results of each option for each lake.

Appendix C provides a review of phosphorus budget models.

SECTION II

NATIONAL EUTROPHICATION SURVEY DATA BASE

BACKGROUND

The National Eutrophication Survey (NES) was initiated in 1972 by the U.S. Environmental Protection Agency (EPA) to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs. In conjunction with state environmental agencies, the Survey developed information on nutrient sources, inputs, and impacts on selected freshwater lakes throughout the contiguous United States. In total, over 800 lakes and reservoirs, 4,200 tributaries and lake outlets, and 1,000 sewage treatment plants were included in the sampling programs. The number of lakes sampled in each state and the year surveyed are shown in Figure II-1. The joint field effort involved EPA personnel, the National Guard of each state, operators of municipal and industrial sewage treatment plants, and personnel of the respective state agencies responsible for water pollution control activities. For details of the procedures and methods used, refer to NES Working Paper No. 1, "National Eutrophication Survey Methods for Lakes Sampled in 1972" and Working Paper No. 175, "National Eutrophication Survey Methods for Lakes Sampled in 1973-1975".

One of the primary outputs of the NES program is a set of reports in which are summarized for each lake the trophic condition, nutrient sources, loads, controllability and the limiting nutrient. Each report also includes all the NES data pertaining to the water body, the drainage area, and the nutrient point sources. Data have been summarized and compiled for water bodies sampled during each year of the Survey (NES Working Papers Nos. 474, 475, 476, 477).

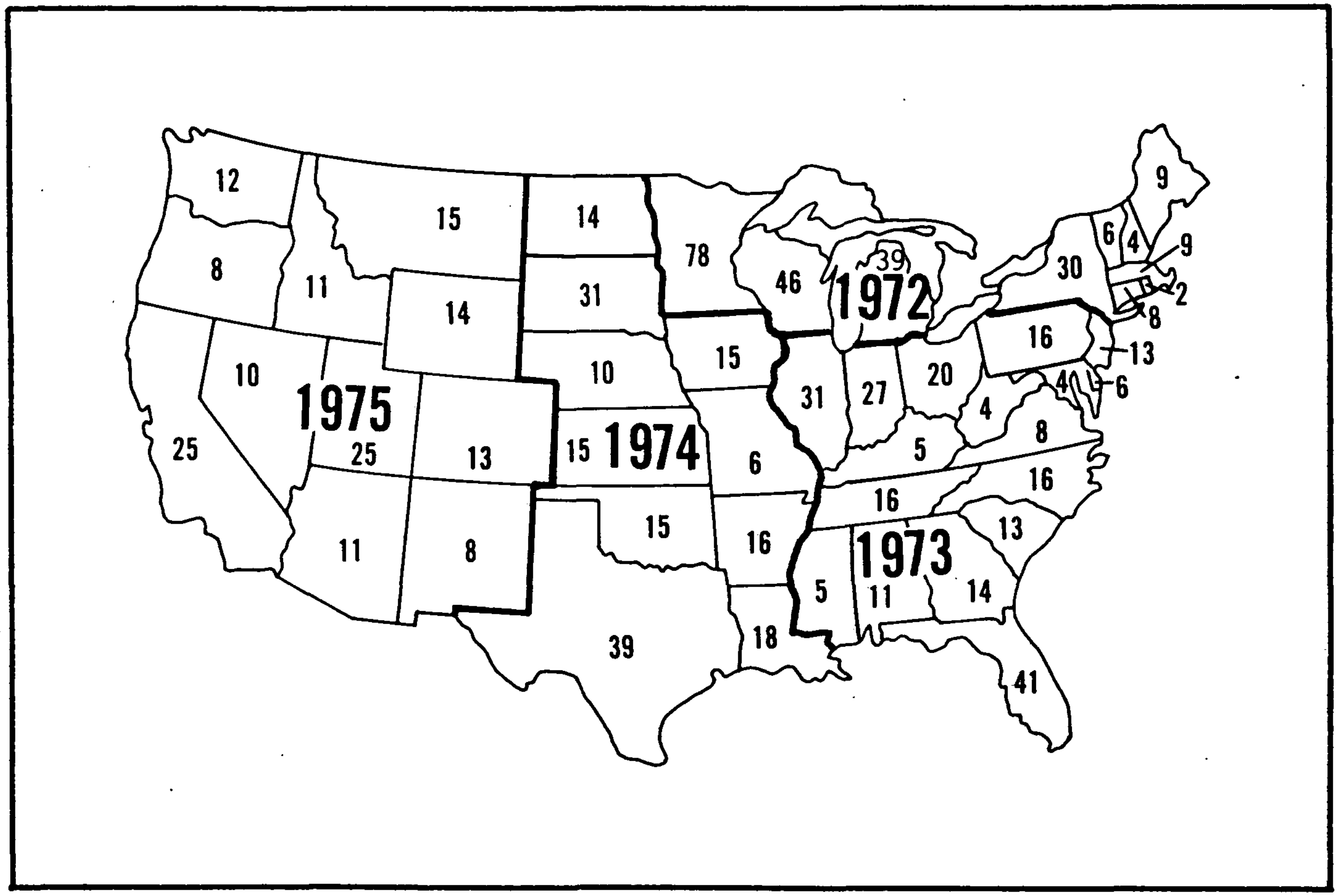


FIGURE II-1 NUMBER OF LAKES SAMPLED DURING NATIONAL EUTROPHICATION SURVEY

The compendium data base contains the following information as described by EPA (1975b).

Morphometry

The morphometric data were compiled from the literature and/or from information provided by state and Federal personnel, and include:

LAKE TYPE--either of NATURAL origin or resulting from stream IMPOUNDMENT.

DRAINAGE AREA (SQ KM)--the total drainage area, measured to the lake outlet.

SURFACE AREA (SQ KM)--the area of the water surface.

MEAN DEPTH (METERS)--the volume of the water body, in cubic meters, divided by the surface area in square meters.

TOTAL INFLOW (CMS)--the mean of the sums of the inflows of all tributaries and the immediate drainage.

RETENTION TIME (YEARS or DAYS)--a mean value determined by dividing the lake volume, in cubic meters, by the mean annual outflow in cubic meters per unit of time.

Physical and Chemical Characteristics

These data are based on three samplings of each lake during the ice-free period. For each lake, depending on its size, from one to many sites were sampled, and multiple depths were sampled at each site. For every parameter in this category, except Secchi disc depth, the median value is reported. The median represents the middle value of all sampling stations, times, and depths. The mean of the Secchi disc depths at all stations and all sampling times are given.

MEDIAN ALKALINITY (MG/L)--total alkalinity, as $CaCO_3$.

MEDIAN CONDUCTIVITY (UMHOS)--specific conductance at 25°C.

MEAN SECCHI DISC (METERS)--the mean limit of visability of a standard Secchi disc.

MEDIAN TOTAL PHOSPHORUS (MG/L)--as P.

As a separate task, the U.S. EPA also provided a listing of spring surface total phosphorus concentrations.

MEDIAN DISSOLVED PHOSPHORUS (MG/L)--as P.

MEDIAN INORGANIC NITROGEN (MG/L)--nitrate + nitrite + ammonia, as N.

MEDIAN TOTAL NITROGEN (MG/L)--Kjeldahl nitrogen + nitrate + nitrite, as N (not determined in 1972).

Biological Characteristics

MEAN CHLOROPHYLL-A (μG/L)--the mean concentration of all samples. Maximum chlorophyll-a values were also supplied as a separate listing.

ALGAL ASSAY CONTROL YIELD (MG/L-DRY WT)--for the majority of lakes is based on one value, in milligrams per liter dry weight, obtained from an assay sample collected during the last (fall) sampling. The test organism was *Selenastrum capyicornutum* Printz.

LIMITING NUTRIENT (no units)--may be determined by two procedures which are (1) the growth response of *Selenastrum capricornutum* to the addition of various amounts of phosphorus or nitrogen or (2) the ratio or inorganic nitrogen to dissolved phosphorus determined from the lake sampling data. When the weight ratio of inorganic nitrogen to dissolved phosphorus is 14 to 1 or greater, the lake is considered phosphorus limited, whereas ratios of less than 14 to 1 are considered indicative of nitrogen limitation. It should be noted that these methods may not result in an accurate estimate of what process or parameter actually limits algal production *in situ*. For example, available light may limit biomass when nutrients are present in excess.

SUMMARY OF PHYTOPLANKTON DATA--the COUNT of individuals, filaments, or colonies per milliliter of sample for each of the five most numerous genera are the data shown. The sum of the units of other genera present in the sample, but not specified, is also included.

Nutrient Loading Characteristics

Nutrient loads of significant tributaries and the lake outlet(s) were calculated using the results of analyses of from 12 to 14 samples collected from each stream by the state national guard monthly for a one-year period and stream flow estimates as provided by the U.S. Geological Survey through an interagency agreement. The nutrient loads of the unsampled portion of the lake drainage areas were estimated from the measured nutrient loads in the sampled streams in the area. Nutrient loads of all streams and the unsampled drainage area were estimated on the basis of a year of average or "normal" stream flow to minimize the influence of extreme hydrological events that may have occurred during the sampling year.

Sewage treatment plant nutrient loads were determined from results of analyses of 12 monthly effluent samples and corresponding flow data provided by plant operators or by state agency personnel. For sewage treatment plants which did not participate in the sampling program, nutrient discharges were estimated on the basis of the population served by the facility and estimated per capita nutrient production.

For details of sampling procedures and methods of calculation, refer to NES Working Paper No. 1 and NES Working Paper No. 175.

INPUT (KG/YR)--an estimate of all external inputs of nitrogen and phosphorus to the water body.

POINT SOURCE MUNICIPAL (KG/YR)--an estimate of annual nitrogen and phosphorus inputs from municipal sewage treatment plants.

POINT SOURCE INDUSTRIAL (KG/YR)--an estimate of annual nitrogen and phosphorus inputs from industrial waste treatment plants.

POINT SOURCE SEPTIC TANKS (KG/YR)--an estimate of annual nitrogen and phosphorus inputs from septic tanks within approximately 100 yards of the lake shoreline.

NONPOINT SOURCE (KG/YR)--an estimate of the annual nitrogen and phosphorus inputs from tributaries, immediate drainage, and precipitation.

TOTAL LOADING (KG/YR)--the sum of all external nitrogen and phosphorus inputs.

LAKE SURFACE AREA LOADING RATE (G/SQ M/YR)--the total loading for the sampling year divided by the lake surface area $(\frac{kg/yr}{km^2} \times 10^{-3})$.

OUTPUT (KG/YR)--an estimate of the annual nitrogen and phosphorus discharged through the lake OUTLET(S).

PERCENT RETENTION--the percentage of incoming nitrogen or phosphorus retained in the lake annually:

$$\left(\frac{\text{Input load-output load}}{\text{input load}} \times 100\%\right)$$

Nonpoint Source Nutrient Export (Note: "Export" was used by EPA to represent loading to the lake)

STREAM NAME--

MEAN FLOW (CMS)--the mean stream flow in a year of average hydrology.

DRAINAGE AREA (SQ KM)--the drainage basin area of the stream.

MEAN TOTAL P (MG/L)--the mean concentration of total phosphorus in the stream at the sampling site during the year of sampling.

MEAN TOTAL N (MG/L)--the mean concentration of total nitrogen in the stream at the sampling site during the year of sampling.

TOTAL P EXPORT (KG/SQ KM/YR)--the total phosphorus load of the stream (after subtracting known point-source loads) divided by the drainage area, in kilograms per square kilometer per year.

TOTAL N EXPORT (KG/SQ KM/YR)--the total nitrogen load of the stream (after subtracting known point-source loads) divided by the drainage area.

In addition to these data, average hydraulic flow rates for municipal treatment plants were compiled and keypunched from individual lake reports. These data were needed to compute treatment plant effluent phosphorus concentrations.

It is beyond the scope of this study to describe and evaluate the methods, analytical procedures and validity of the data base. The reader is referred to the three NES Working Papers (Nos. 1, 175, and Allum, *et al.*, 1977) for descriptions of methods, procedures and evaluation of data.

DATA COMPILATION

The first step in the preparation of the data base was to compile data relevant to this study into tables and plots. For each lake the following variables were tabulated:

Lake Characteristics
- Surface Area, km^2
- Drainage Area, km^2
- Mean Depth, m
- Volume, $10^6 m^3$
- Retention Time, years
- Median Total Phosphorus Concentration, mg/l
- Mean Secchi Disc, m
- Mean Chlorophyll-a, μg/l

Phosphorus Loading (kg/yr, % of total) from:
- Septic Tanks
- Municipal Treatment Plants
- Industrial Sources
- Rivers
- Direct Runoff
- Precipitation
- Total (kg/yr, g/m^2/year)

Measured Phosphorus Retention, $\frac{\text{INPUT-OUTPUT}}{\text{INPUT}}$ (decimal fraction)

DATA SCREENING

Prior to use of the data base for analysis of phosphorus control options, a number of checks were performed to assure completeness and reasonableness of values.

In order for a lake to be included in the data base, data had to be available for each of the following:

1. Mean depth
2. Volume
3. Hydraulic residence time
4. Median phosphorus concentration
5. Secchi disc depth
6. Mean chlorophyll-a
7. Total phosphorus loading
8. Measured phosphorus retention coefficient

In addition, lakes with a negative measured phosphorus retention coefficient were rejected as not being amenable to the analytical procedures used in this analysis (see Section III). Lake Tahoe was also rejected because of its very long retention time (400 years) which implies that the data are not representative of steady-state conditions.

Table II-1 shows the number of lakes not meeting each selection criterion and the total number of lakes rejected from each year's survey. Figure II-2 shows the location of lakes remaining in the screened data base.

Tables of all data subsequently used in analysis are provided in Appendix A to this report. The distributions of selected parameter values for all lakes used are illustrated in Figures II-3 through II-9. These figures show the cumulative distributions of parameter values by plotting the number of lakes with parameter values less than or equal to the plotted value. Plots of parameter values by year surveyed (geographical area) are contained in Appendix A.

Table II-1

Number of Lakes Not Meeting Each Criterion

	Survey Year				
	1972	1973	1974	1975	1972-75
Total Lakes Reported	200	206	177	153	736
CRITERIA					
1. Mean Depth[1]	26	3	1	4	34
2. Volume[1]	26	3	1	4	34
3. Retention Time[1]	49	12	39	32	132
4. Phosphorus Concentration[1]	0	0	0	0	0
5. Secchi Disc[1]	0	0	0	1	1
6. Chlorophyll-*a*[1]	2	0	0	1	3
7. Total P Loading[1]	32	6	41	31	110
8. Retention Coeff.[1]	31	11	44	35	121
9. Neg. Ret. Coeff.[2]	25	24	18	19	86
10. Municipal[3] Treatment Plant Phosphorus Concentration >20 or <1.0 mg/l	6	4	0	2	12
Total Lakes Rejected:	81	41	62	59	243
Total Lakes Remaining:	119	165	115	94	493

1. Lake omitted if data not available for this variable.

2. Lake omitted if measured phosphorus retention coefficient was negative.

3. Municipal treatment plant phosphorus concentrations <1.0 or >20 mg/l are thought to be outliers and these lakes were omitted.

FIGURE II-2 LOCATION OF LAKES REMAINING IN DATA BASE AFTER SCREENING (493 LAKES)

NES DATA 1972-1975

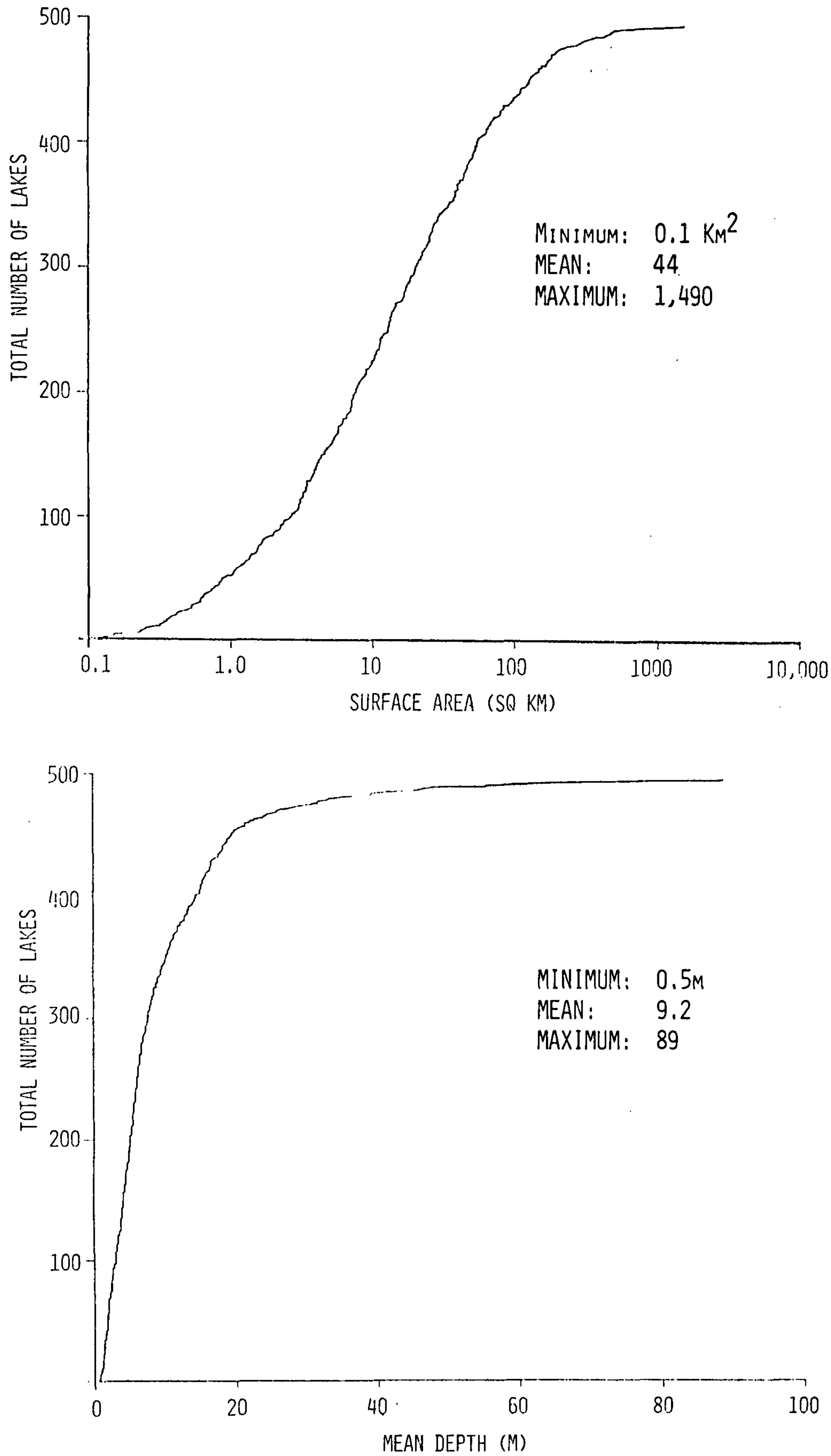


FIGURE II-3 DISTRIBUTION OF SURFACE AREA AND MEAN DEPTH

NES DATA 1972-1975

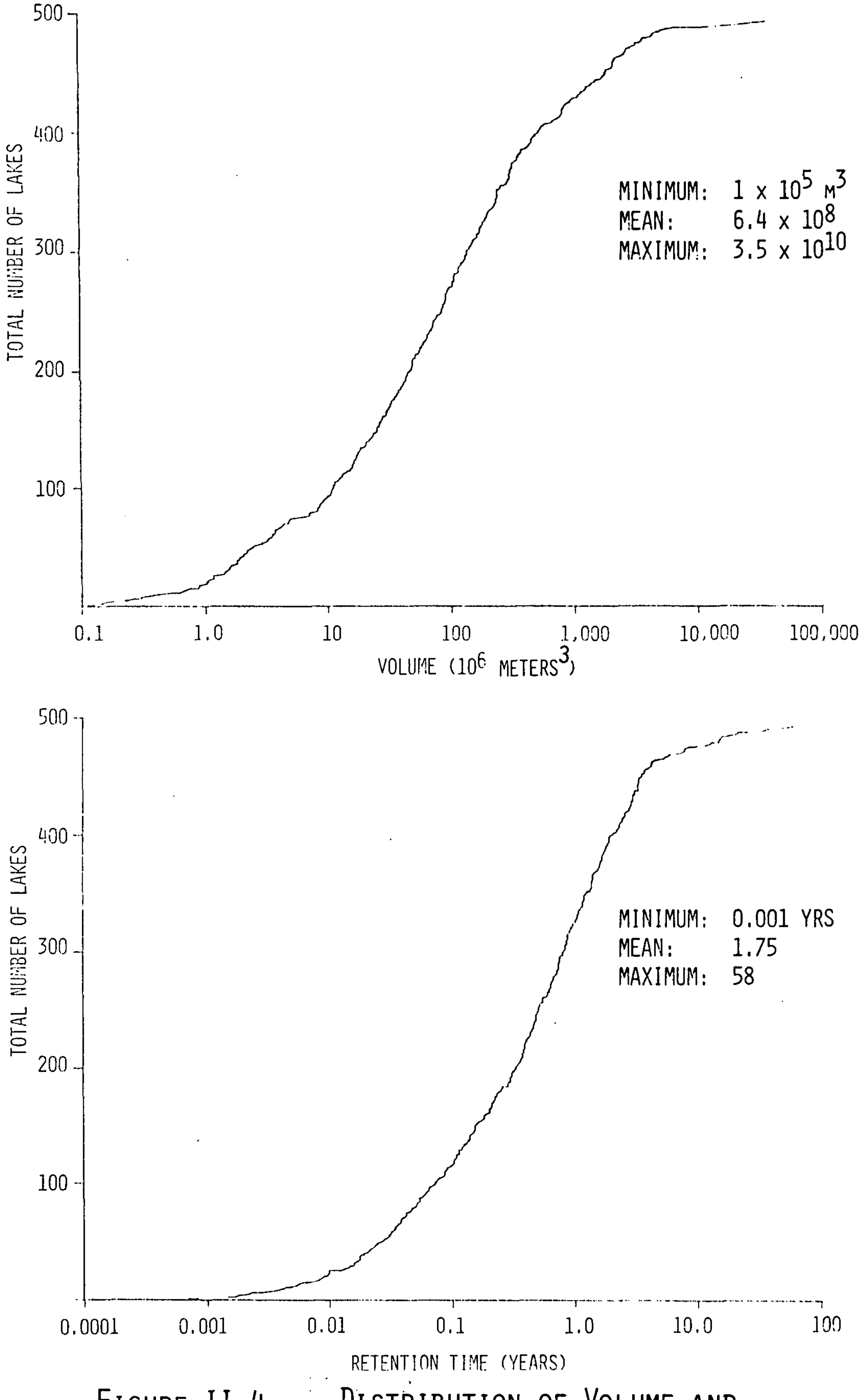


FIGURE II-4 DISTRIBUTION OF VOLUME AND RETENTION TIME

NES DATA 1972-1975

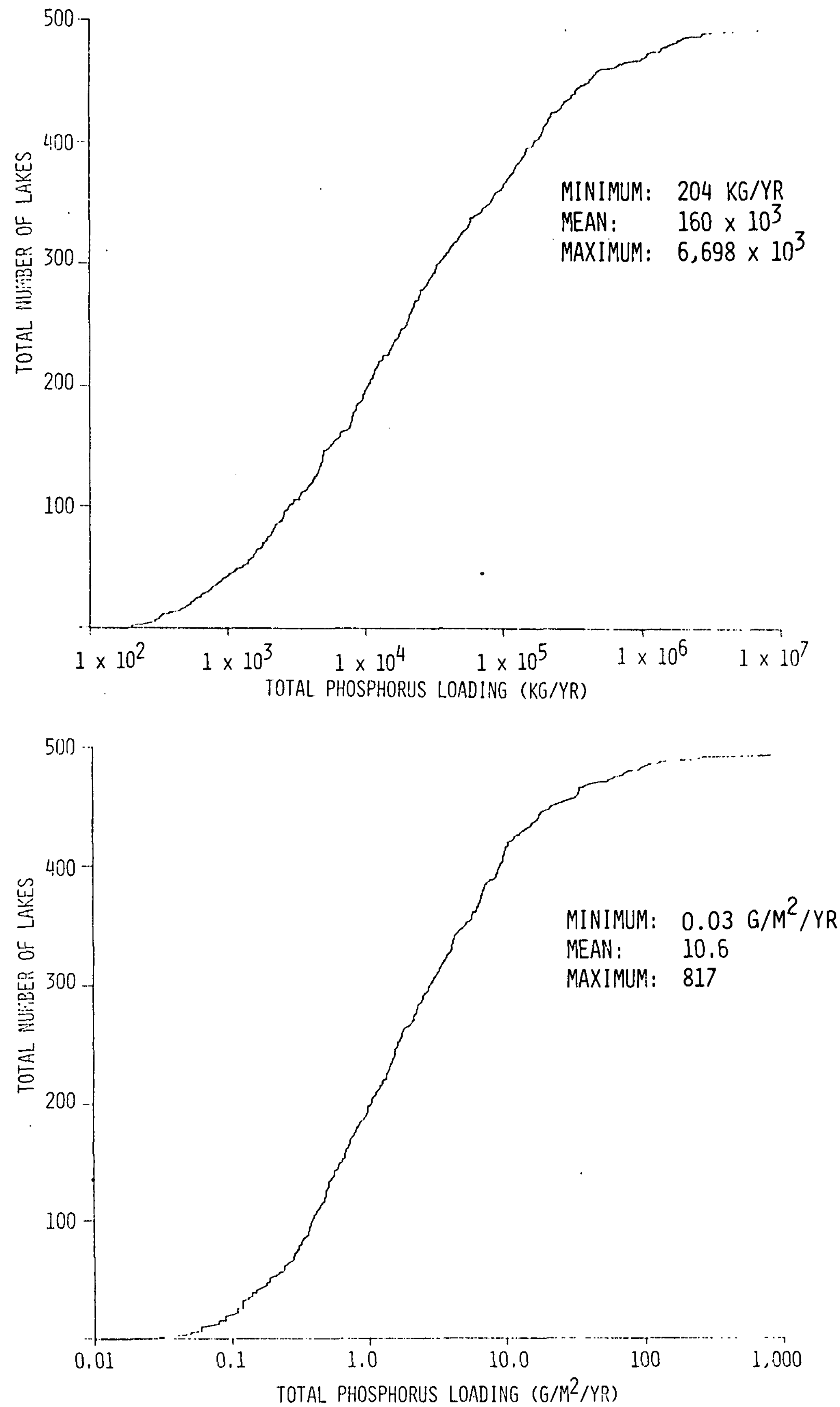


FIGURE II-5 DISTRIBUTION OF TOTAL PHOSPHORUS LOADING

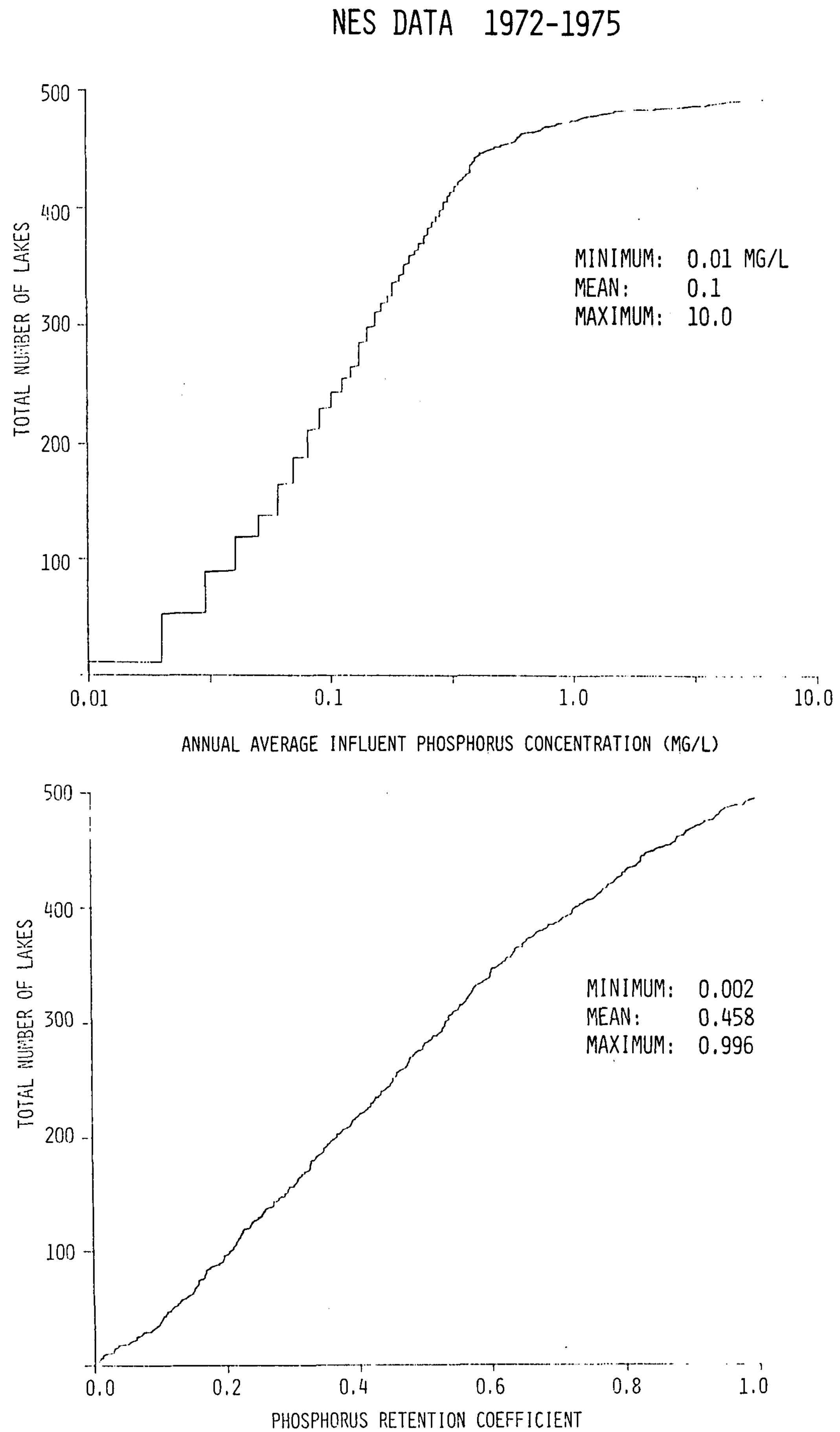
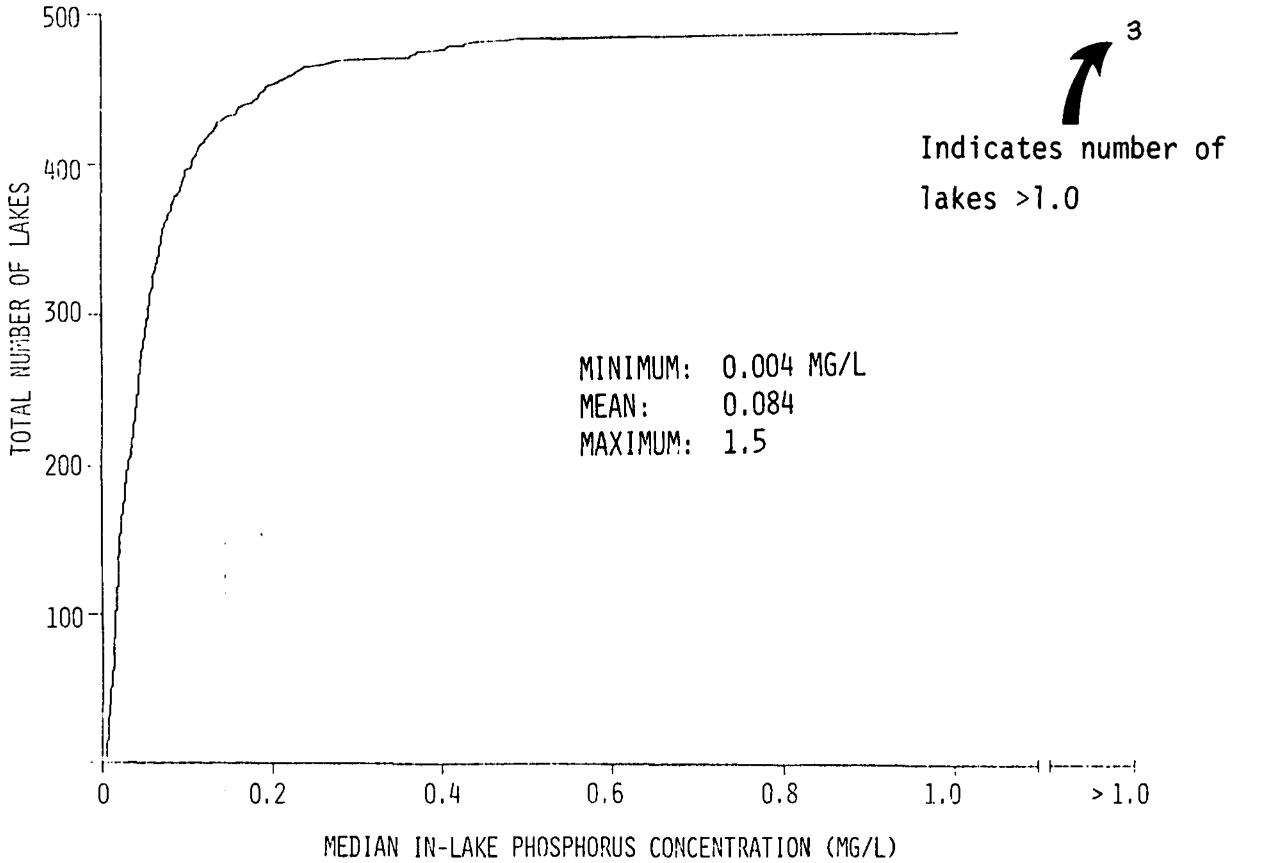


FIGURE II-6 DISTRIBUTION OF INFLUENT PHOSPHORUS CONCENTRATION AND PHOSPHORUS RETENTION COEFFICIENT

NES DATA 1972-1975



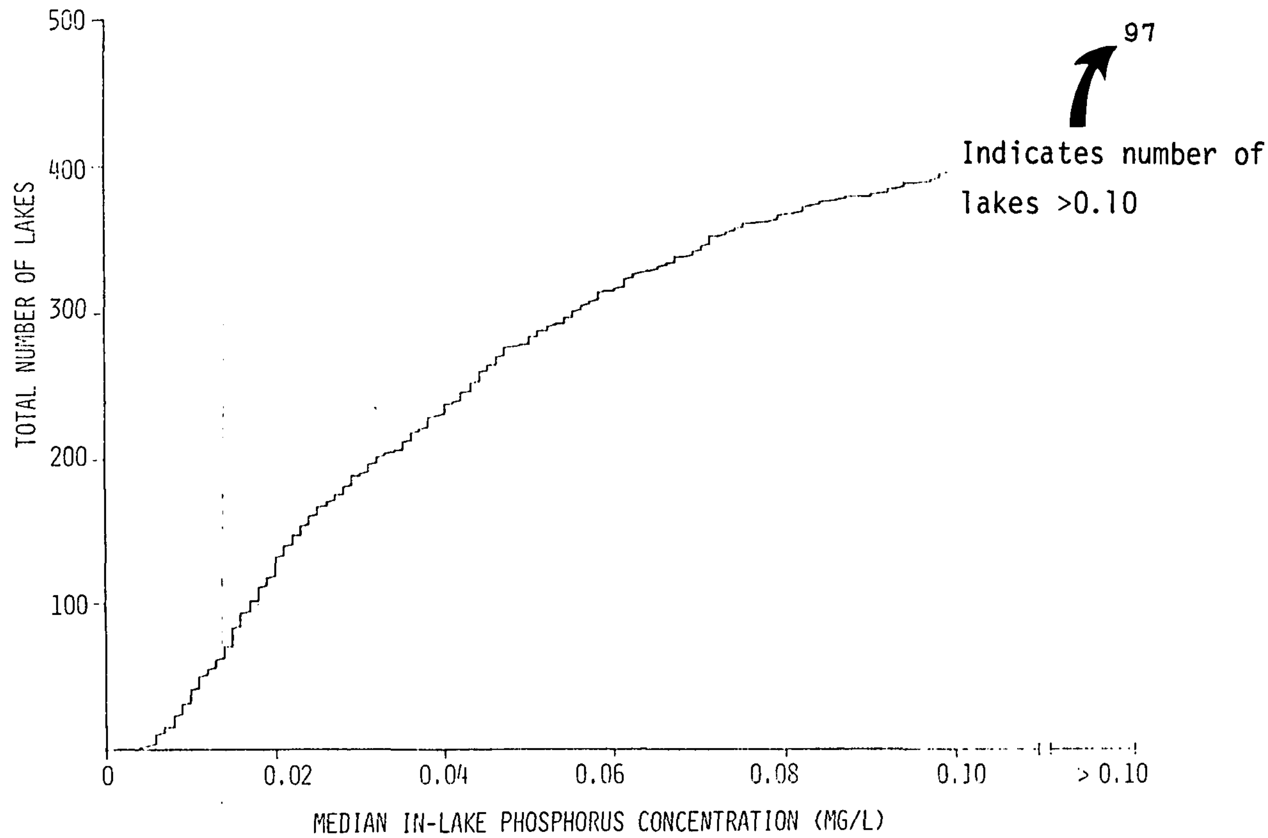
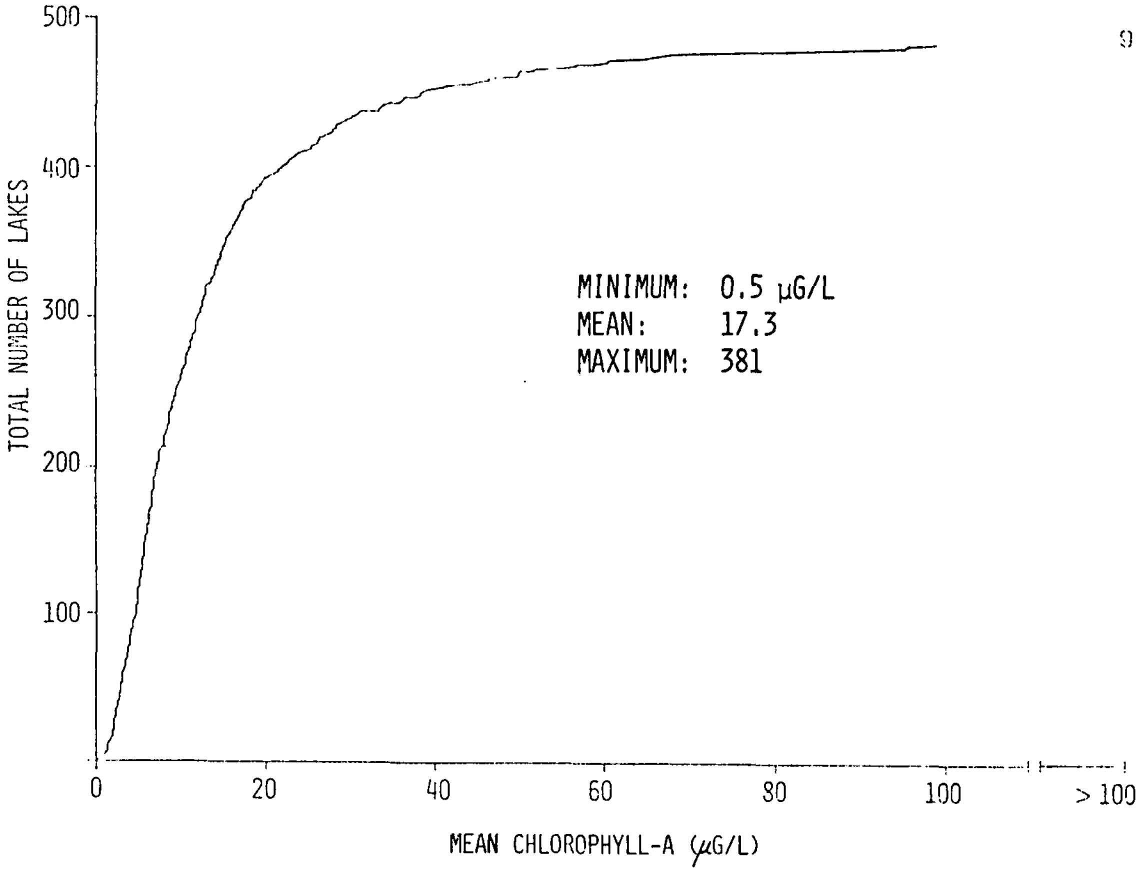


FIGURE II-7 DISTRIBUTION OF MEDIAN IN-LAKE PHOSPHORUS CONCENTRATION

NES DATA 1972-1975



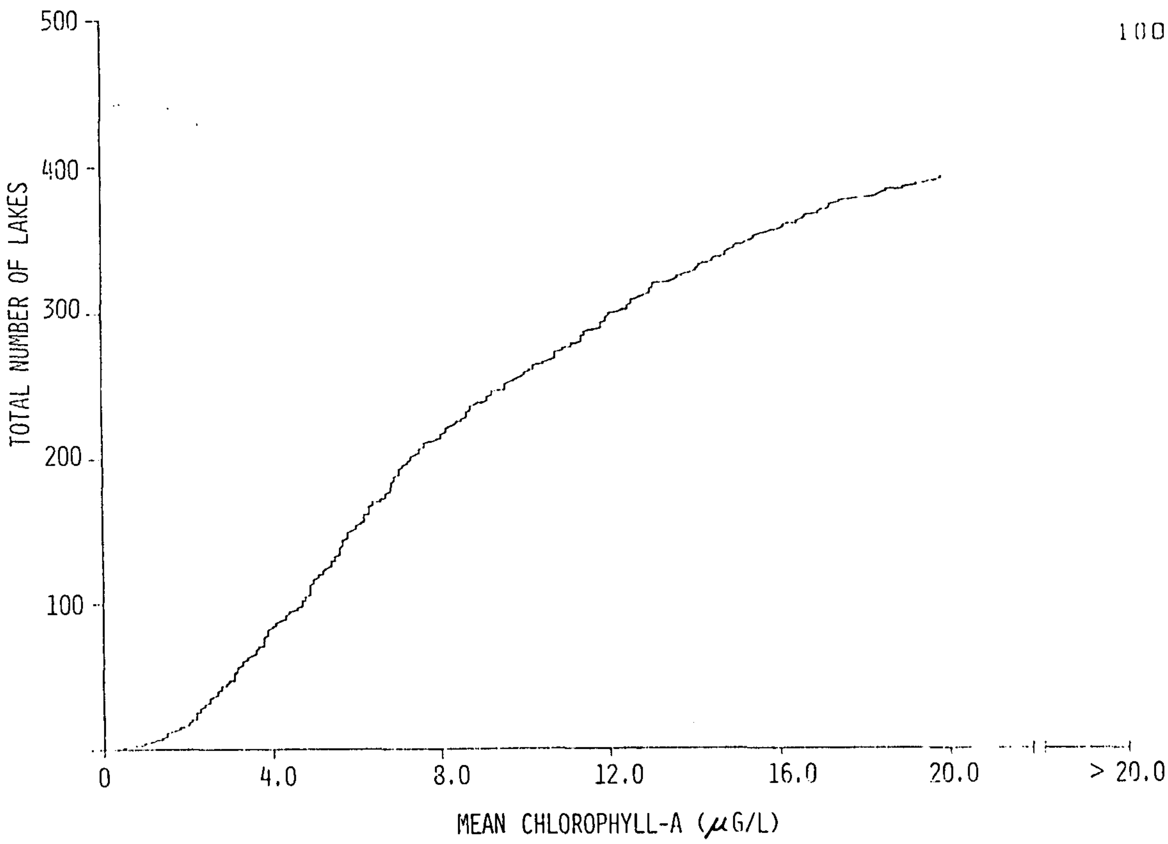


FIGURE II-8 DISTRIBUTION OF MEAN CHLOROPHYLL-A

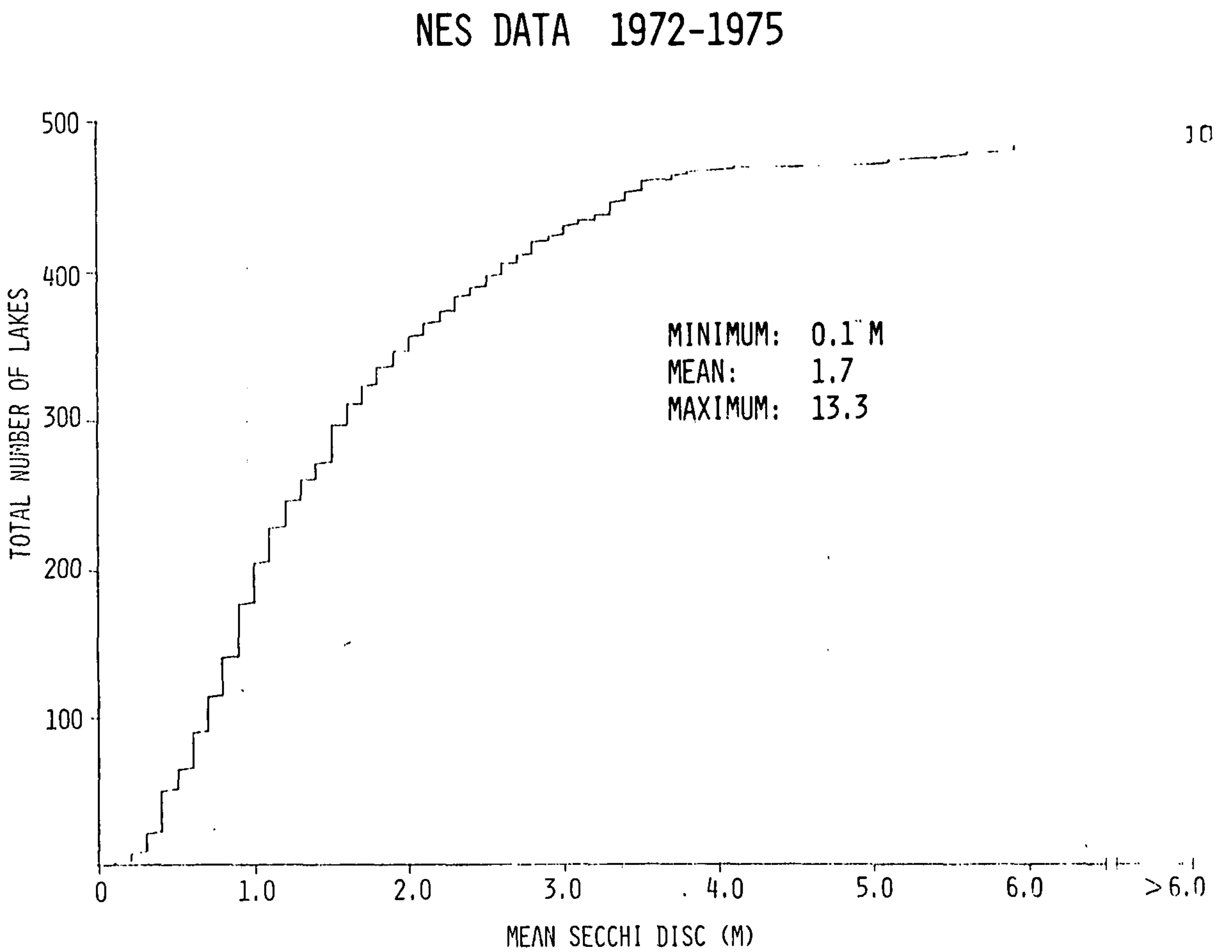


FIGURE II-9 DISTRIBUTION OF MEAN SECCHI DISC

LAKE CHARACTERISTICS

The characteristics of the lakes in the data base are briefly discussed below. Special attention was given to examination of Figures II-3 through II-9 to determine if there were any logical groupings of lake types that might emerge.

Surface Area

The mean surface area for all lakes contained in the final data base is 44 square kilometers. The minimum is 0.10 square kilometers, and the maximum is 1,490 square kilometers. Although the lakes do not fall into distinct size classes, approximately 70% of the lakes have a surface area between 5 and 100 square kilometers.

Mean Depth

The mean average depth for all lakes in the final data base is 9.2 meters. The minimum mean depth is 0.5 meters and the maximum is 89 meters. Over 90% of the lakes have a mean depth less than 20 meters.

Volume

Lake volumes ranged from 0.1×10^6 to $35,039 \times 10^6$ cubic meters with a mean value of 638×10^6 cubic meters. Approximately 70% of the lakes had volumes between 10×10^6 and $5,000 \times 10^6$ cubic meters.

Residence Time

The minimum hydraulic residence time was 0.001 year and the maximum 58 years. The mean for all lakes was 1.75 years. Approximately 70% of the lakes had a hydraulic residence time between 0.1 and 5.0 years.

Phosphorus Loading

The phosphorus loading rates are illustrated in terms of total loading (kg/yr), surface loading ($g/m^2/yr$) and average influent concentration (mg/l). The range and mean values are shown below.

	kg/yr	$g/m^2/yr$	mg/l
Minimum	204	0.03	0.01
Mean	159,513	10.64	0.1
Maximum	6,697,765	817	10.0

Approximately 80% of the lakes had a total phosphorus loading rate between 0.5 and 10.0 $g/m^2/year$.

The phosphorus loadings from different types of sources, including municipal, septic tank, industrial, tributary rivers, direct runoff, and precipitation are listed for each lake in Appendix A. Table II-2 lists the statistics related to percent contribution for all lakes in the screened data base. Table II-3 shows mean percent contributions of various sources by geographical area.* These values clearly show regional differences in phosphorus sources. However, it should be noted that the Northeast and North-Central Lakes are biased because the selection process used for this region favored lakes with municipal treatment plants. It is clear that so called "nonpoint" sources, rivers and direct runoff, account for the majority of phosphorus loading. Municipal treatment plants are significant, but represent a considerably smaller contribution. In general, industrial and septic tank sources are negligible.

*Note: Year surveyed corresponds to geographical area as follows (see Figure II-1):

1972	Northeast and North-Central
1973	East and Southeast
1974	Central
1975	West

Table II-2

Relative Contribution of Phosphorus from Different Sources (493 lakes)

Source	Number of Lakes	Percent of Total P Loading			
		Min.	Mean	Max.	Mean*
Municipal	347	1	29	99	20
Septic Tank	114	1	5	52	1
Industrial	24	1	12	56	0.6
Rivers	484	1	64	100	63
Direct Runoff	452	1	12	87	11
Precipitation	321	1	5	66	3

NOTE: Mean = mean value for lakes with loading $\geq$ 1% from indicated source.

Mean* = mean value for all lakes (includes lakes with < 1% loading).

Number of lakes is the number which have $\geq$ 1% loading from the indicated source.

Table II-3

Relative Contribution of Phosphorus from Different Sources
(mean percent, 493 lakes)

Source	1972 North Central & Northeast	1973 Southeast	1974 Central	1975 Western
Municipal	38	22	12	7.0
Septic Tank	2.4	1.3	0.3	0.5
Industrial	1.1	0.5	0	0.9
Rivers	45	64	69	76
Direct Runoff	8.6	10	15	12
Precipitation	5.1	1.9	3.6	3.6

Phosphorus Retention

The phosphorus retention coefficient ranged from 0.002 to 0.996 with an average value of 0.458. The minimum, mean, maximum and standard deviation of values observed in each geographical area are tabulated below:

Phosphorus Retention Coefficient

Year Surveyed	Min.	Mean	Max.	Standard Deviation
1972	0.002	0.386	0.958	0.245
1973	0.003	0.417	0.981	0.229
1974	0.004	0.576	0.996	0.260
1975	0.012	0.476	0.988	0.283

Median Phosphorus

The median *in situ* total phosphorus concentration ranged from 0.004 mg/l to 1.5 mg/l with a mean value of 0.084 mg/l. Only 160 of 493 lakes (32%) had a median total phosphorus concentration less than the 0.025 mg/l recommended by the U.S. EPA (1974b). The minimum, mean, maximum and standard deviation of values observed in each geographical area are tabulated below along with the percent of lakes which had median total phosphorus concentrations less than the recommended 0.025 mg/l.

Median Phosphorus Concentration

Year Surveyed	Min. mg/l	Mean mg/l	Max. mg/l	Standard Deviation mg/l	%<0.025
1972	0.004	0.141	1.525	0.258	32
1973	0.006	0.070	0.865	0.099	33
1974	0.010	0.075	0.489	0.084	24
1975	0.006	0.045	0.371	0.054	48

Chlorophyll-a

Mean chlorophyll-*a* concentrations for all lakes averaged 17.3 μg/l. The minimum was 0.5 μg/l and the maximum 381 μg/l. Nine lakes had mean chlorophyll-*a* values greater than 100 μg/l and 100 lakes had chlorophyll-*a* values greater than 20 μg/l. The distribution of values by geographical area (year surveyed) is shown below.

Mean Chlorophyll-*a* Concentrations

Year Surveyed	Min. μg/l	Mean μg/l	Max. μg/l	Standard Deviation μg/l
1972	1.0	24.1	381	44
1973	1.2	18.8	221	29
1974	1.5	15.3	100	15
1975	0.5	8.4	72	8.4

Secchi Disc

The mean Secchi disc depths ranged from 0.1 meter to 13.3 meters with a mean value of 1.7 meters. Only ten lakes had a mean Secchi disc depth greater than six meters. The distribution of values by geographic region is shown below.

Mean Secchi Disc

Year Surveyed	Min. m	Mean m	Max. m	Standard Deviation m
1972	0.2	1.8	5.9	1.2
1973	0.2	1.4	4.1	0.9
1974	0.1	1.3	6.4	1.0
1975	0.2	2.8	13.3	2.5

Chlorophyll-a vs. Phosphorus

Numerous attempts have been made to relate chlorophyll-*a* to phosphorus concentrations (Sakamoto, 1966; Lund, 1971; Dillon and Rigler, 1975; Dillon, 1974). These studies found reasonably good relationships of the form:

$$\text{chl-}\underline{a} = 0.08\ (P)^{1.5} \qquad \text{(II-1)}$$

where P = total phosphorus

The U.S. EPA (1974b) used data from the 1972 NES survey to obtain the following expression with an r^2 of 0.61:

$$\log_{10} P_{total} = 0.846 \log_{10} \text{Chl } \underline{a} - 2.354$$

This equation can be transformed to:

$$\text{chl-}\underline{a} = 0.172(P)^{1.18} \qquad \text{(II-2)}$$

Figure II-10 shows the relationship between mean chlorophyll-a and median total phosphorus for all lakes with data. Equation II-2 is also shown. The line bounding these data has an initial slope very nearly equal to 1,000 μg chl.-a per mg phosphorus (1 μg of phosphorus results in 1 μg of chlorophyll-a when nothing else limits production). Figures II-11 and II-12 illustrate subsets of the data by geographic region. The relationships are essentially the same.

Because a relationship between chlorophyll-a and phosphorus would be very helpful in evaluating the effects of phosphorus control on lake quality, additional effort was devoted to examining any potential relationships.

The first step was to examine the data on a regional basis. The 493 lakes were separated into seven geographical areas as shown in Figure II-13. These areas were somewhat arbitrarily selected to see if differences that might result from climate, geological or hydrological conditions might become apparent. The mean chlorophyll-a was then plotted against the median phosphorus concentration for each lake within each area. The results are shown in Figures II-14 through II-20. No distinct regional differences were found. Additional subclassification of lakes into five groups within each area was also examined. The five groups were: 1) mean depth ≤five meters, 2) mean depth >five meters, 3) hydraulic detention time <one month, 4) hydraulic detention time ≥one month but ≤one year, and 5) hydraulic detention time greater than one year. These data were plotted for the 35 sets (seven areas x five lake types) and are shown in Appendix A. Again no clear distinctions could be made between areas or lake characteristics.

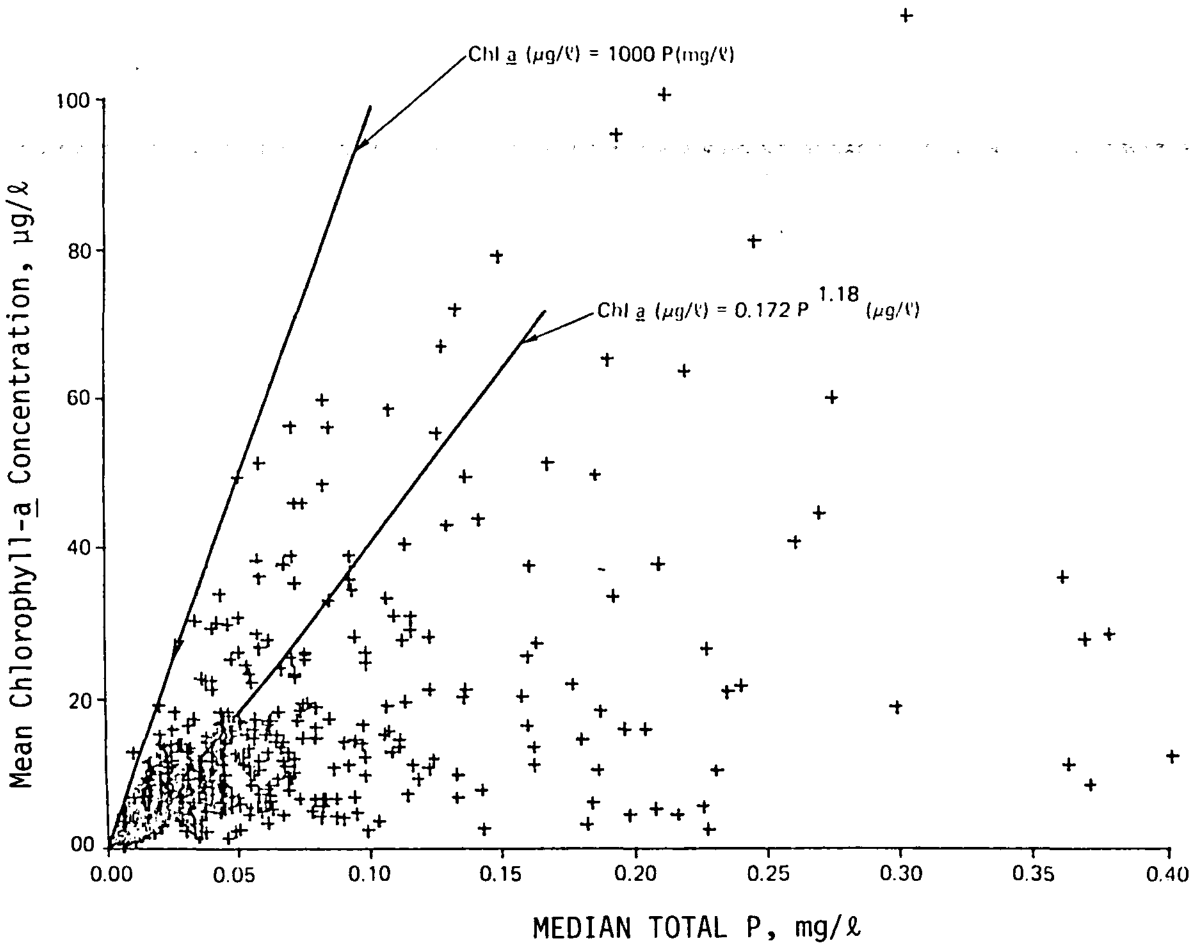
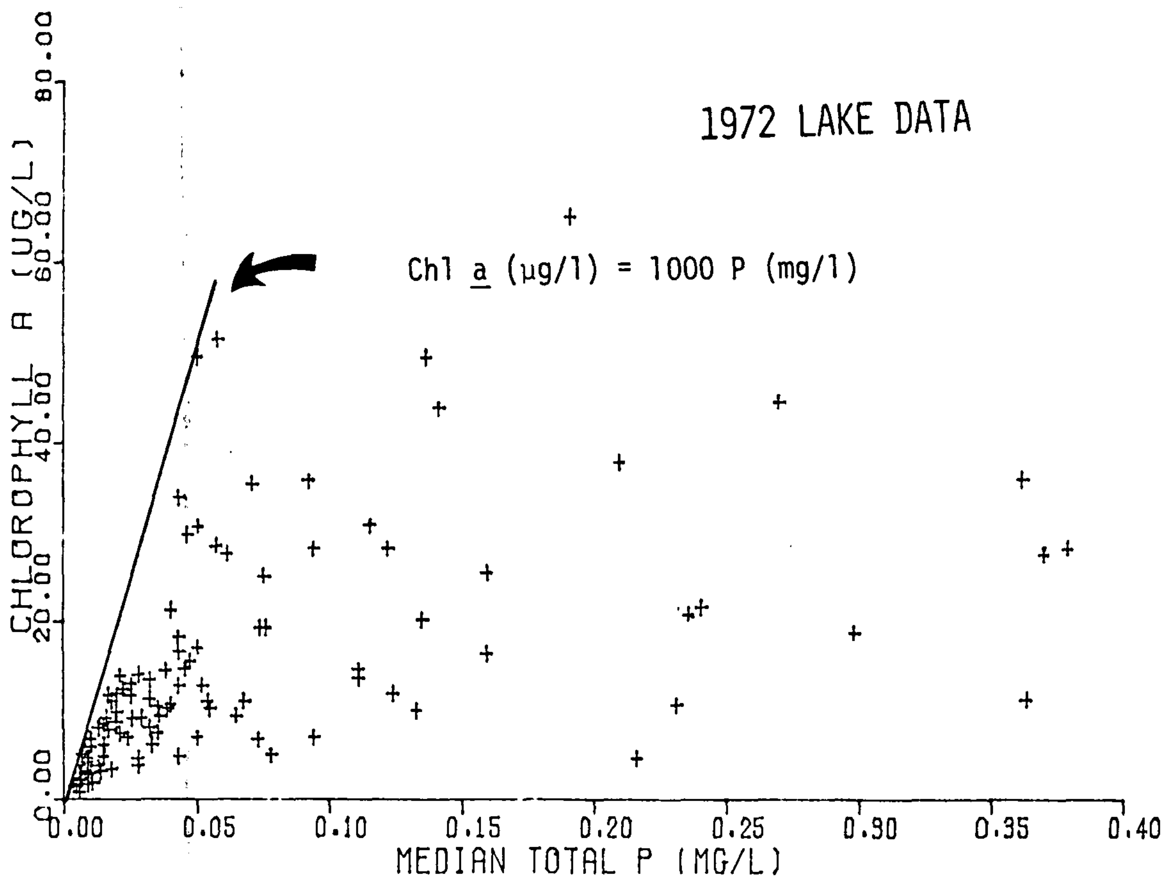


FIGURE II-10 MEAN CHLOROPHYLL-A VERSUS MEDIAN TOTAL PHOSPHORUS (493 LAKES)



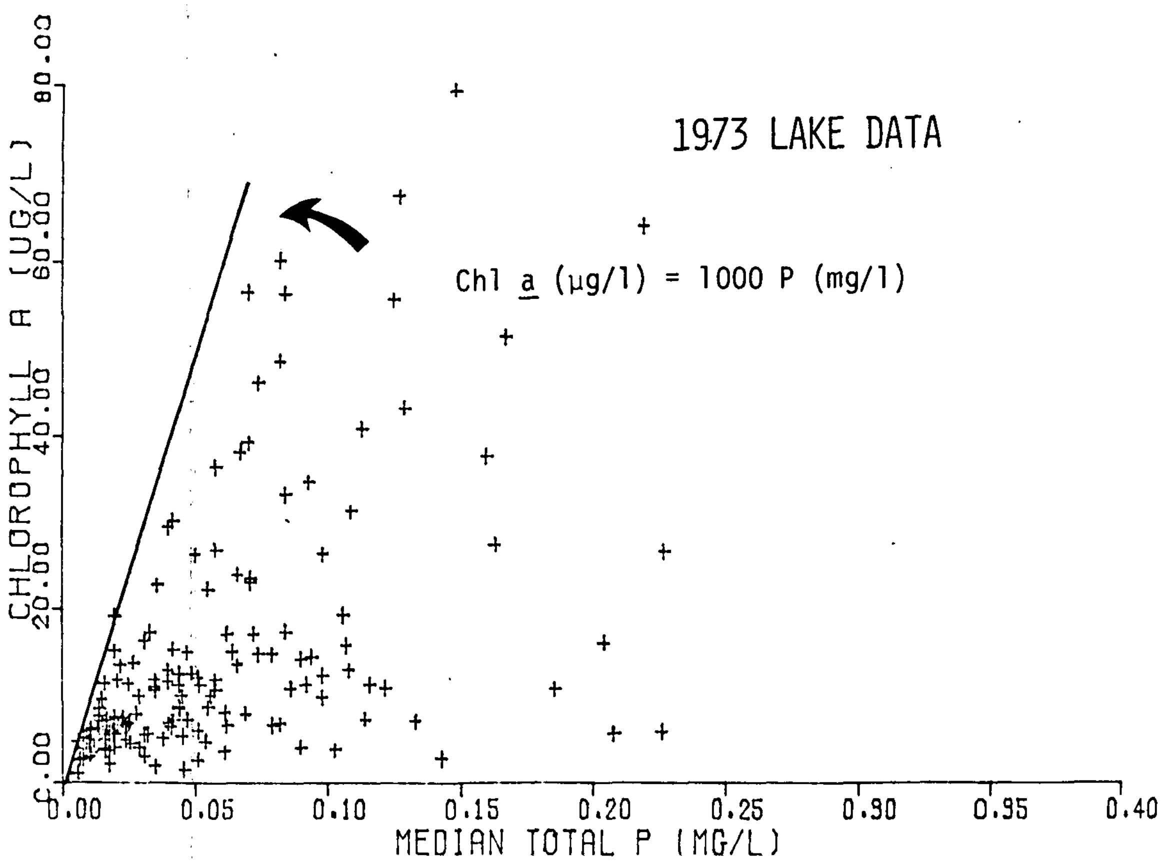


FIGURE II-11 MEAN CHLOROPHYLL-A VS MEDIAN TOTAL PHOSPHORUS FOR 1972 AND 1973 DATA

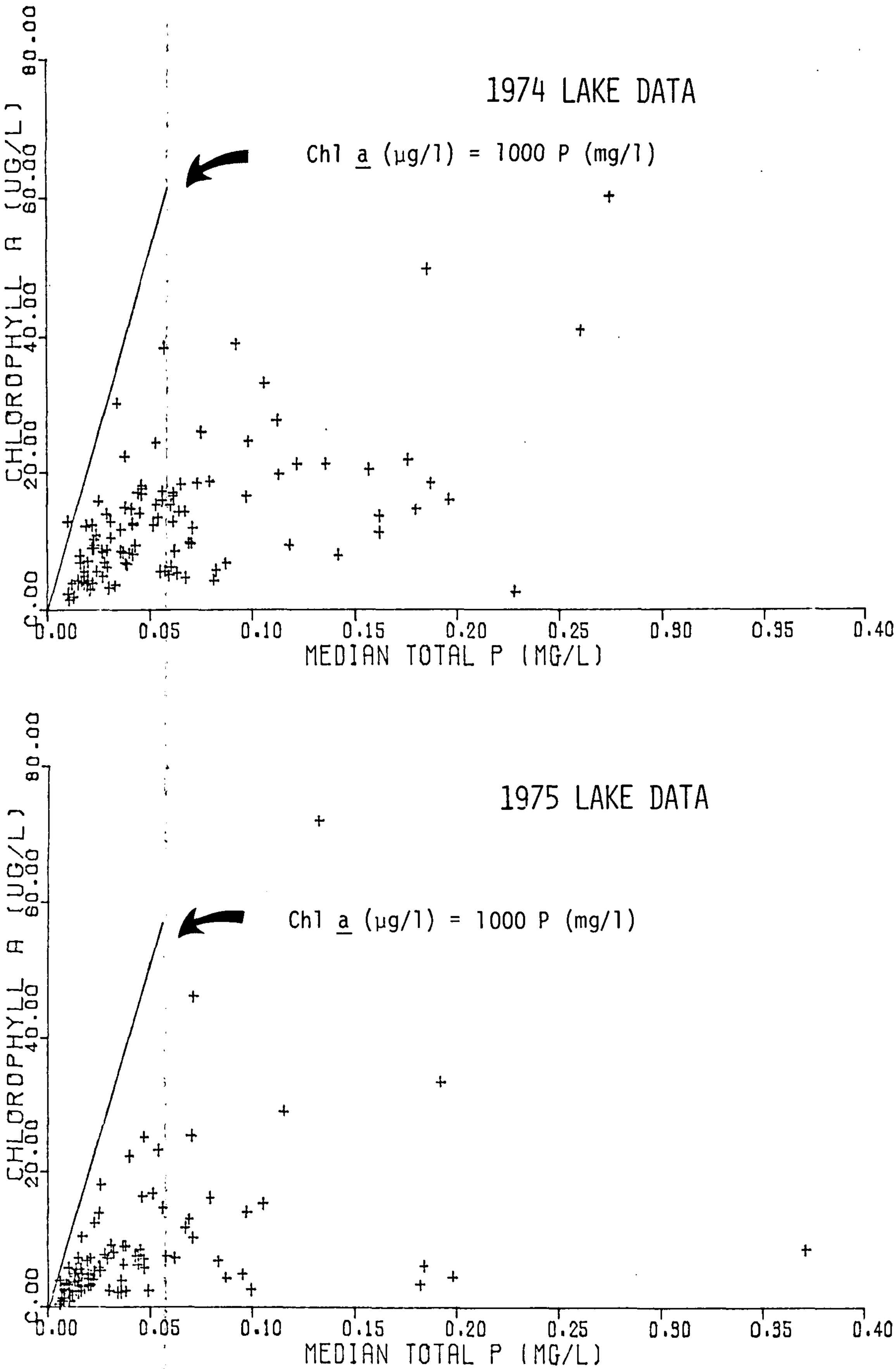


FIGURE II-12 MEAN CHLOROPHYLL-A VS MEDIAN TOTAL PHOSPHORUS FOR 1974 AND 1975 DATA

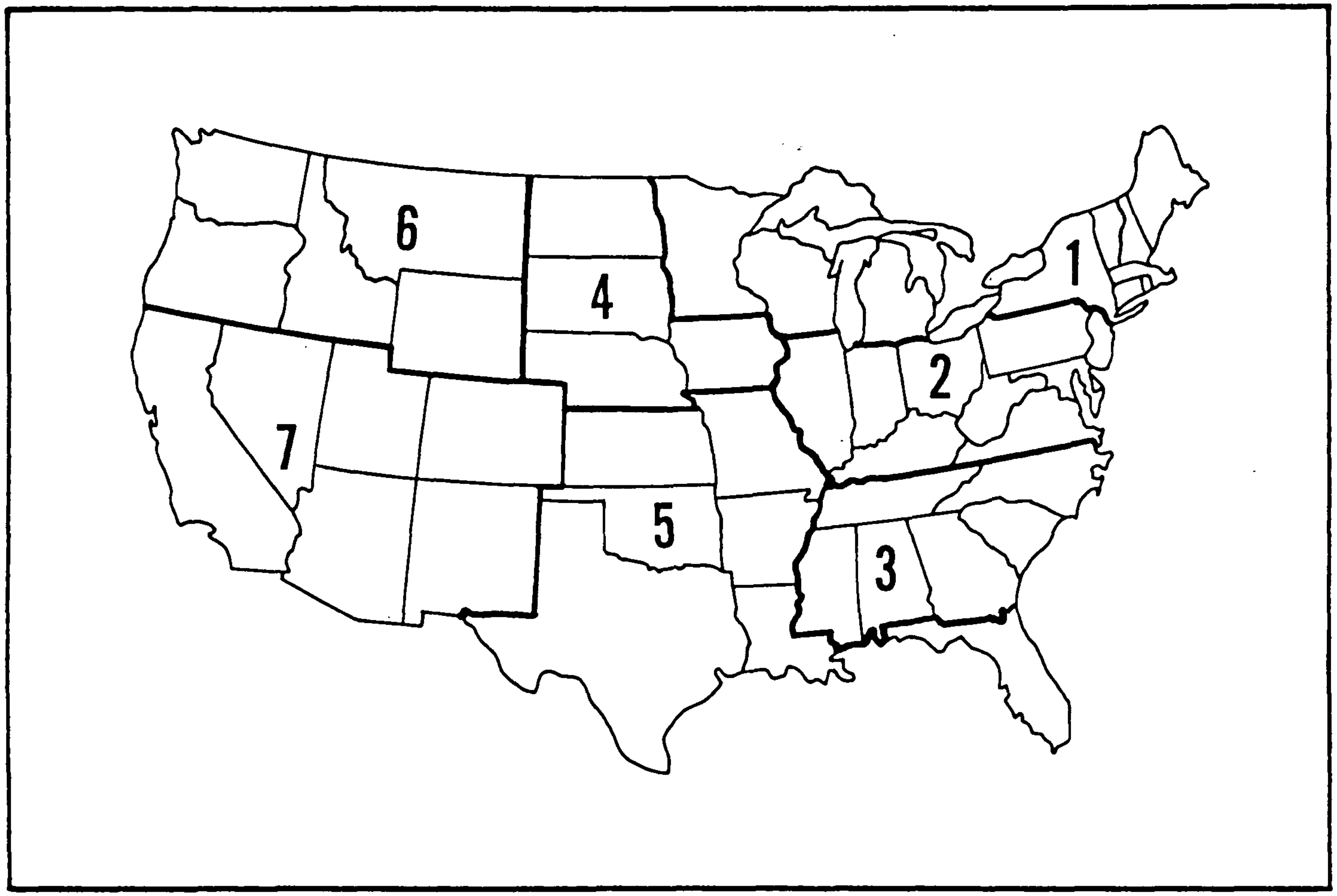


FIGURE II-13 GEOGRAPHICAL AREAS USED TO GROUP LAKE DATA

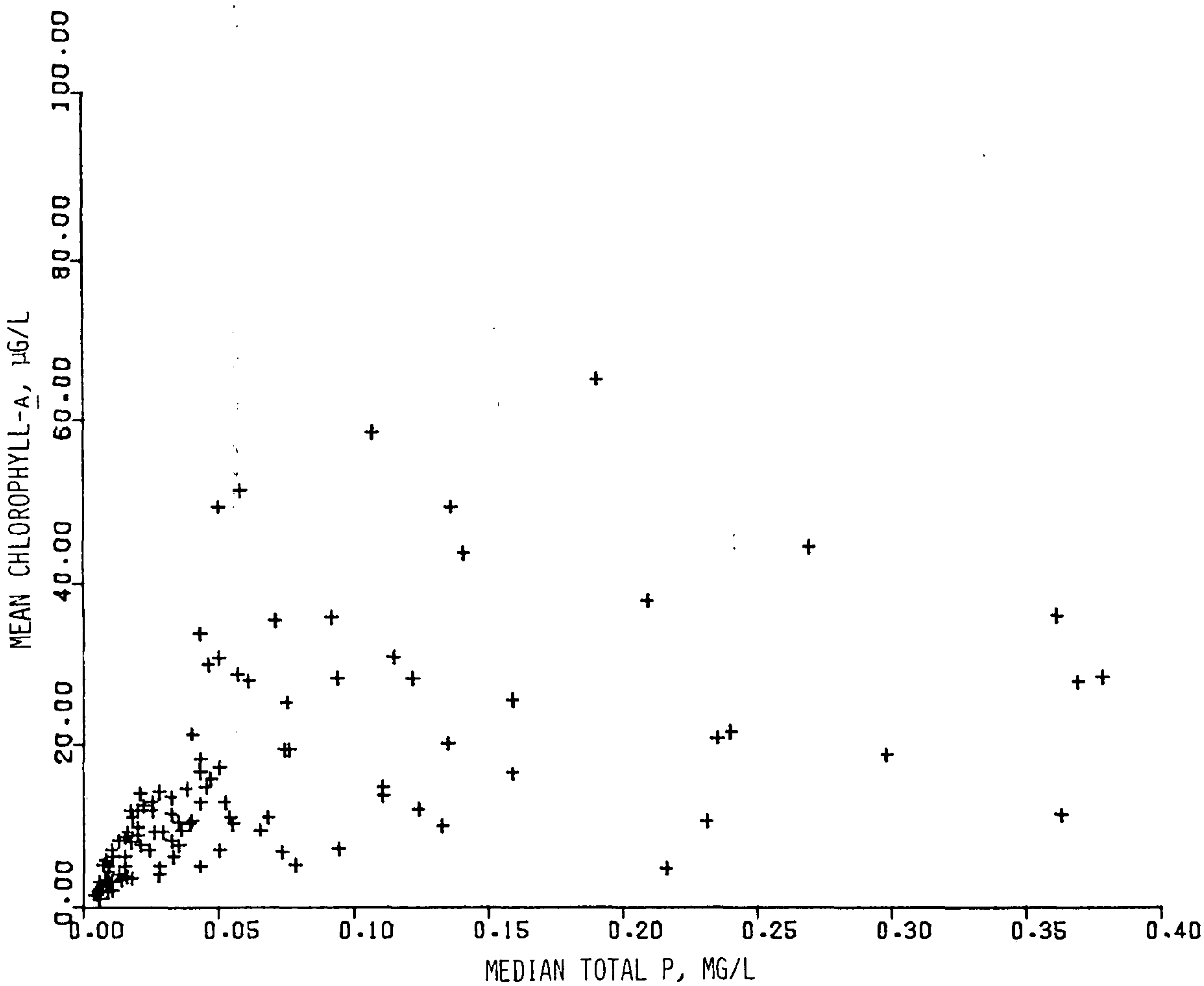


FIGURE II-14 MEAN CHLOROPHYLL-A VERSUS MEDIAN TOTAL PHOSPHORUS FOR LAKES IN AREA 1

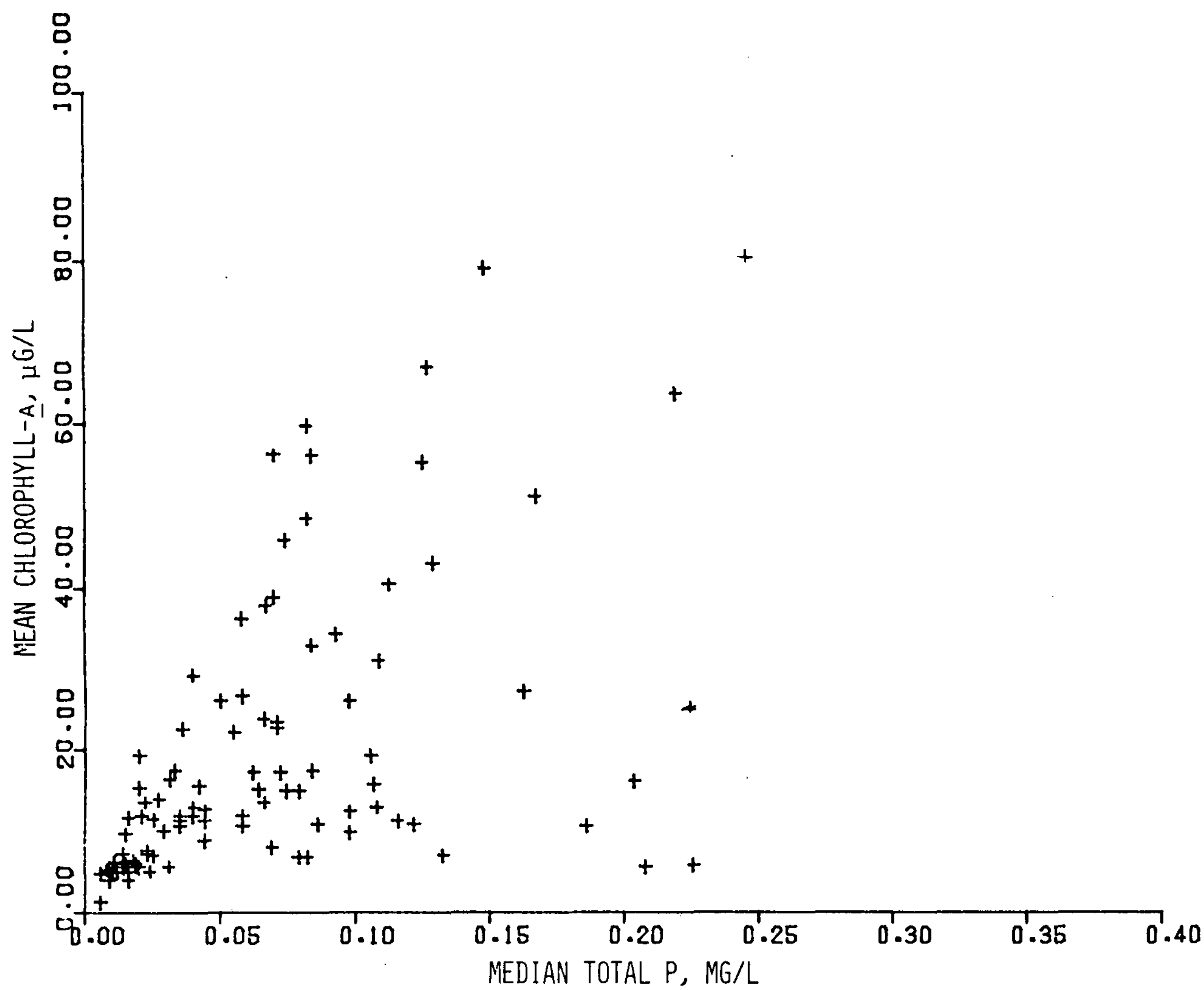


FIGURE II-15 MEAN CHLOROPHYLL-A VERSUS MEDIAN TOTAL PHOSPHORUS FOR LAKES IN AREA 2

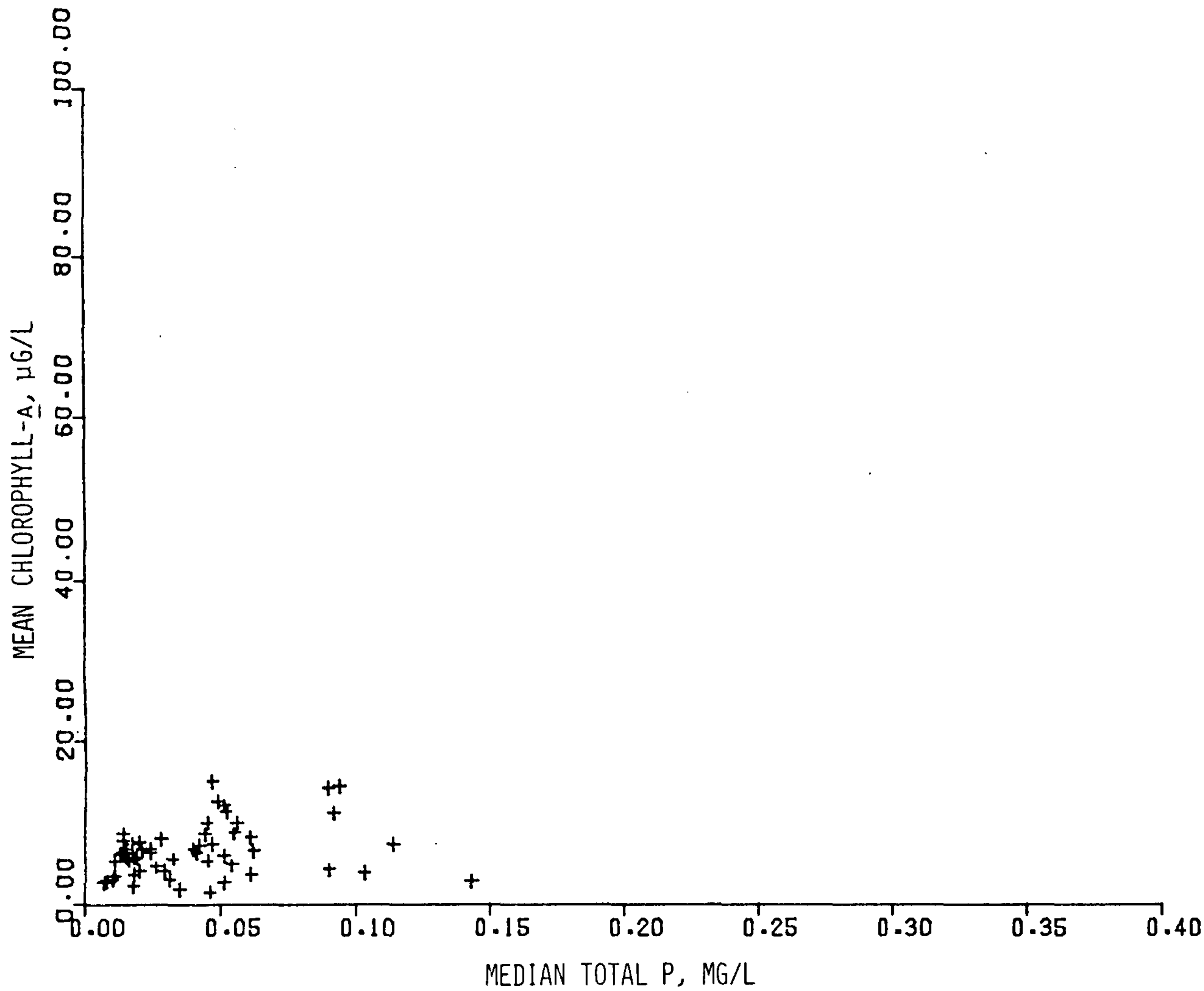


FIGURE II-16 MEAN CHLOROPHYLL-A VERSUS MEDIAN TOTAL PHOSPHORUS FOR LAKES IN AREA 3

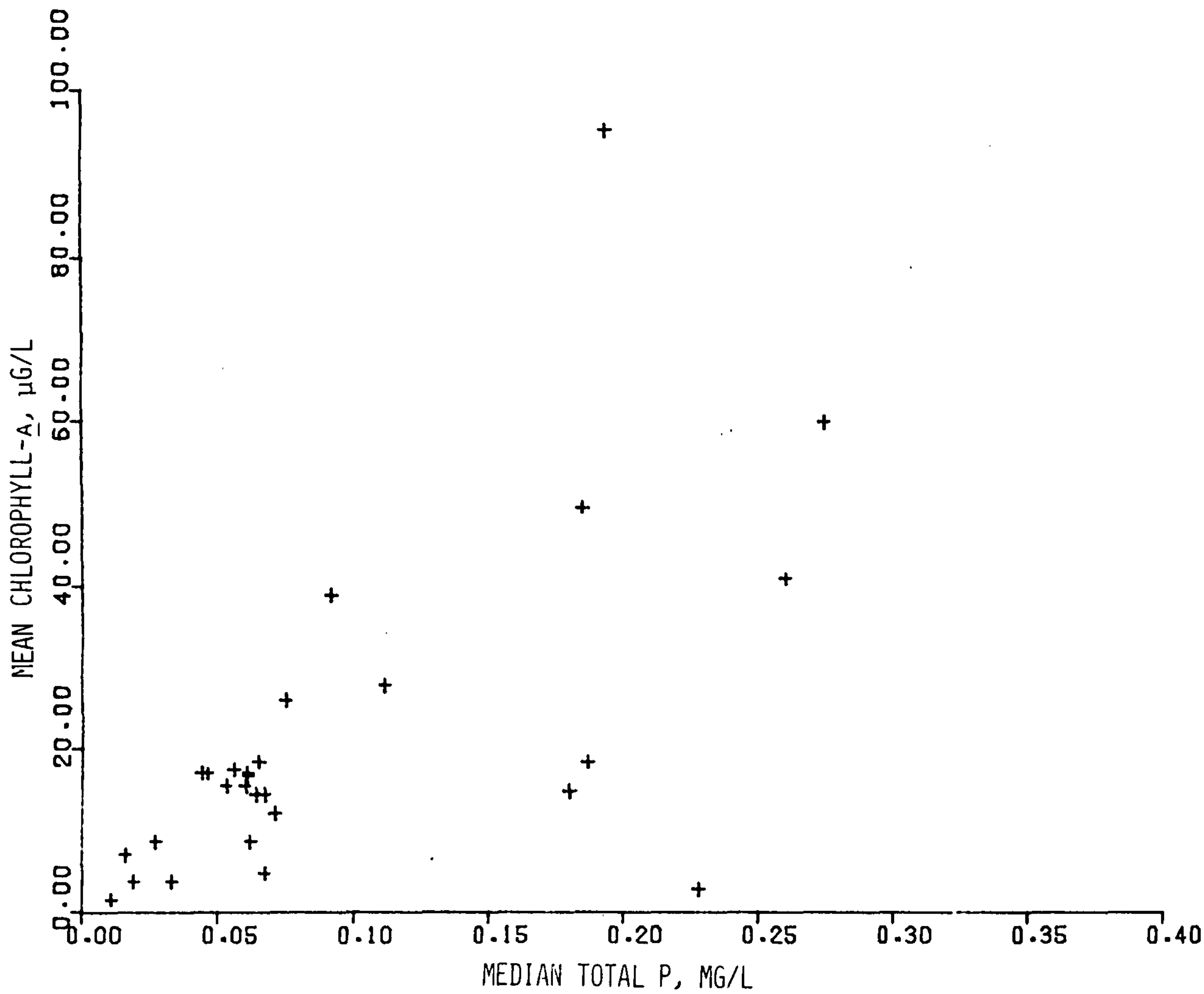


FIGURE II-17 MEAN CHLOROPHYLL-A VERSUS MEDIAN TOTAL PHOSPHORUS FOR LAKES IN AREA 4

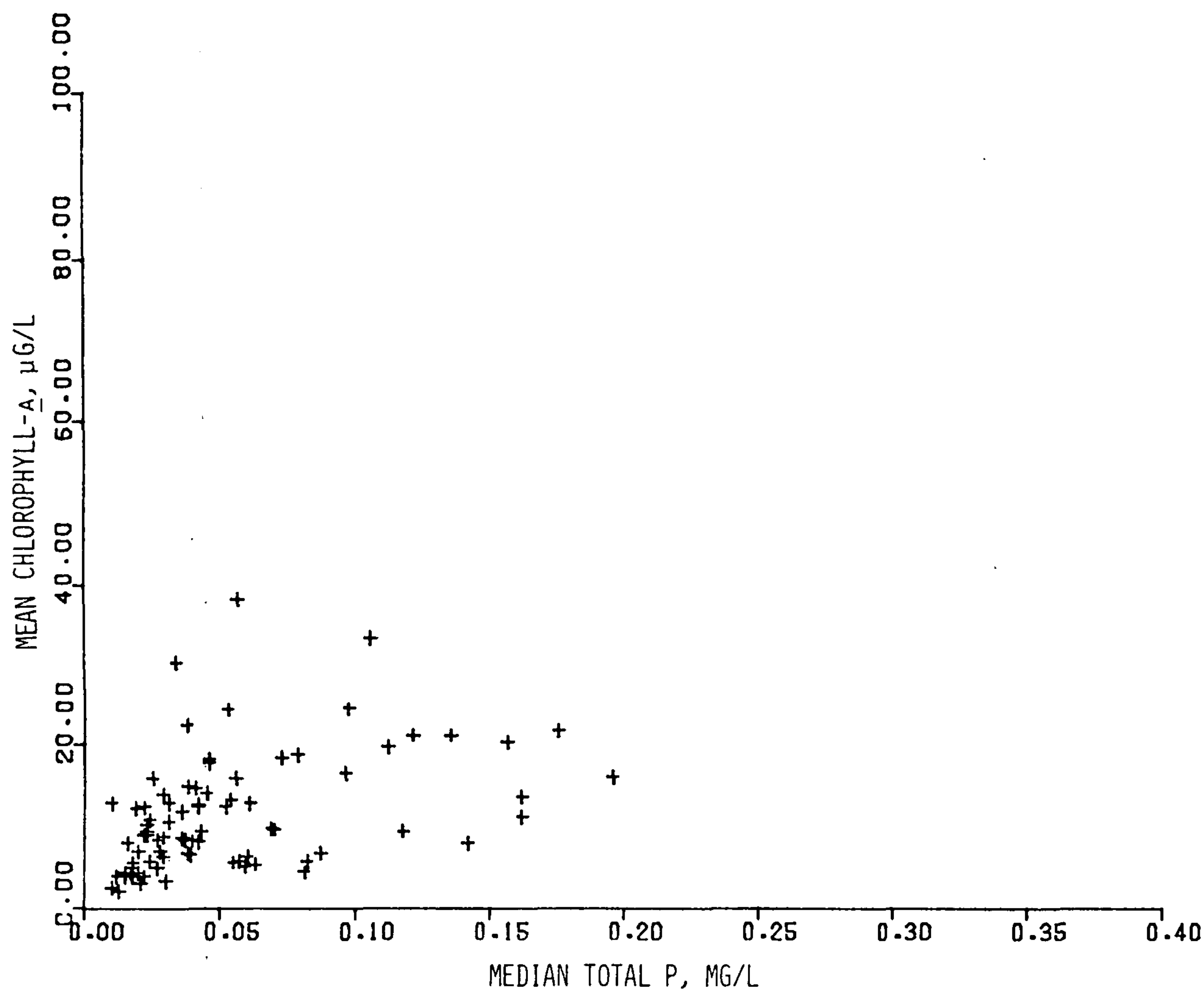


FIGURE II-18 MEAN CHLOROPHYLL-A VERSUS MEDIAN TOTAL PHOSPHORUS FOR LAKES IN AREA 5

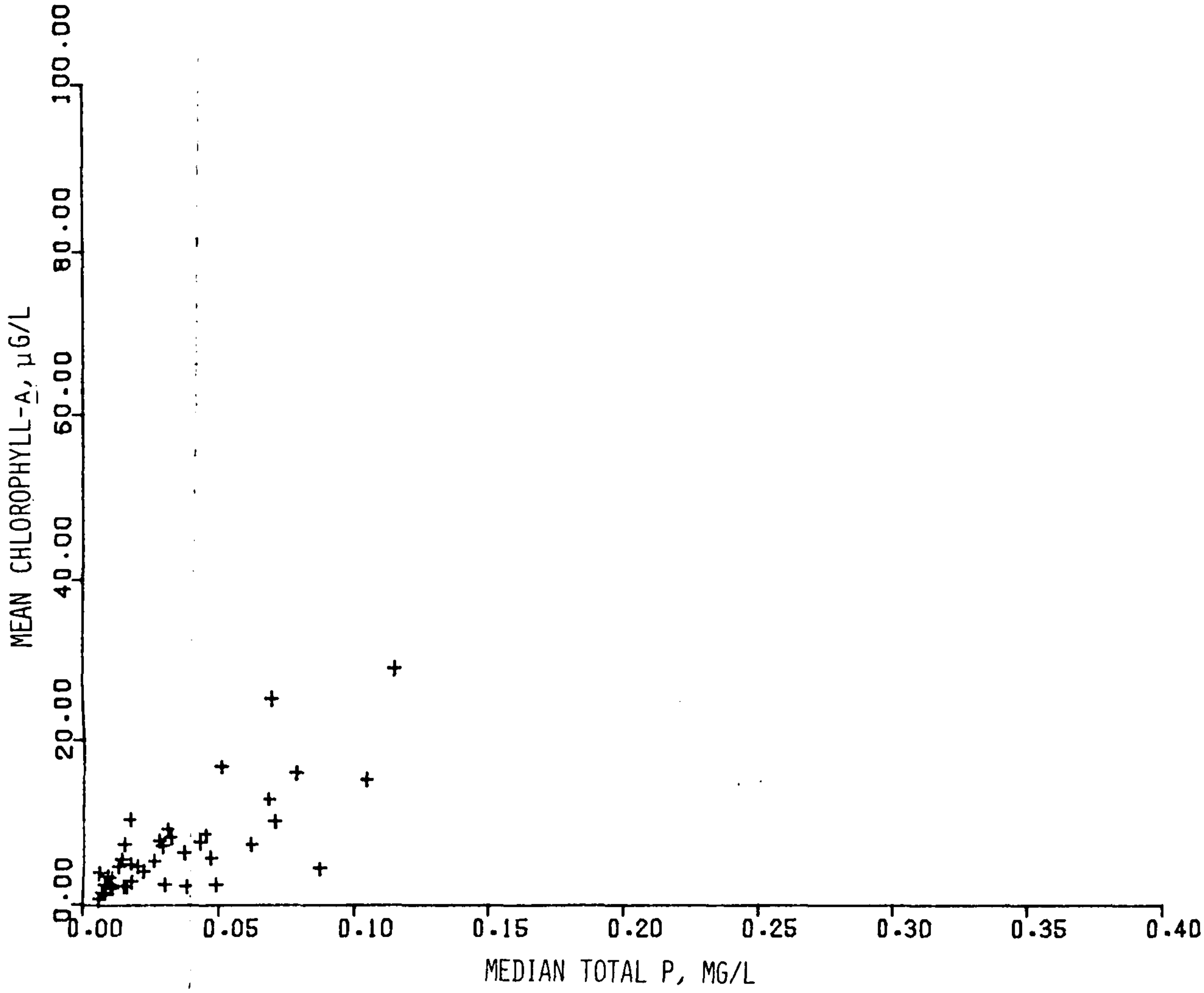


FIGURE II-19 MEAN CHLOROPHYLL-A VERSUS MEDIAN TOTAL PHOSPHORUS FOR LAKES IN AREA 6

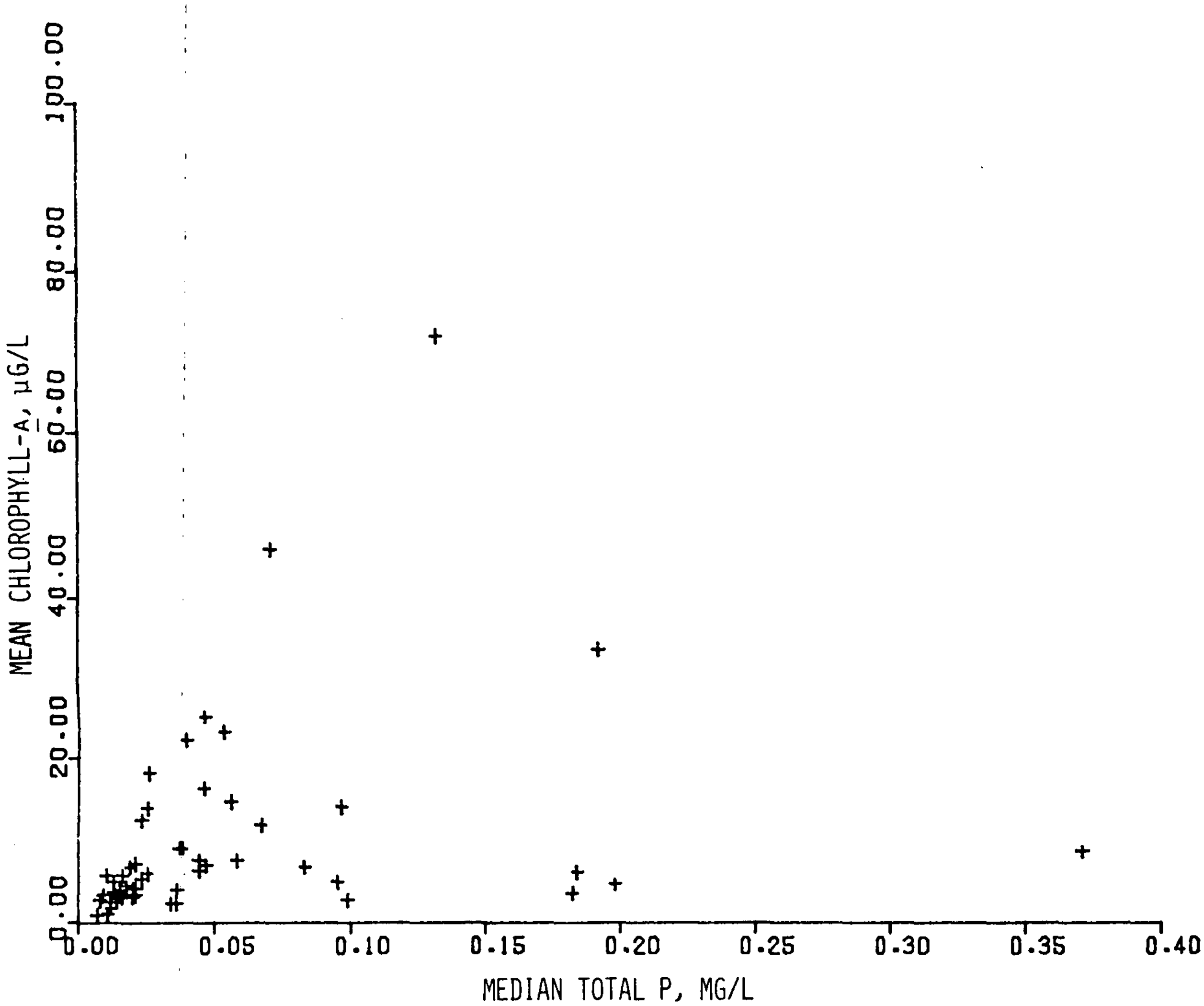


FIGURE II-20 MEAN CHLOROPHYLL-A VERSUS MEDIAN TOTAL PHOSPHORUS FOR LAKES IN AREA 7

It is understood that the variables plotted (median total phosphorus and mean chlorophyll-a) may not be the most appropriate to find the type of relationship desired. The U.S. EPA therefore suggested and provided a listing of maximum measured chlorophyll-a values and surface spring phosphorus concentrations. These data were plotted in the same manner as used for median values and are shown by area in Figures II-21 through II-27. The further breakdown by lake characteristics is shown in Appendix A. As expected, higher concentrations of chlorophyll-a as a function of total phosphorus were found. However, the general pattern of the data (wide scatter with many lakes having high phosphorus concentrations and low chlorophyll values) was similar to when median concentrations were used.

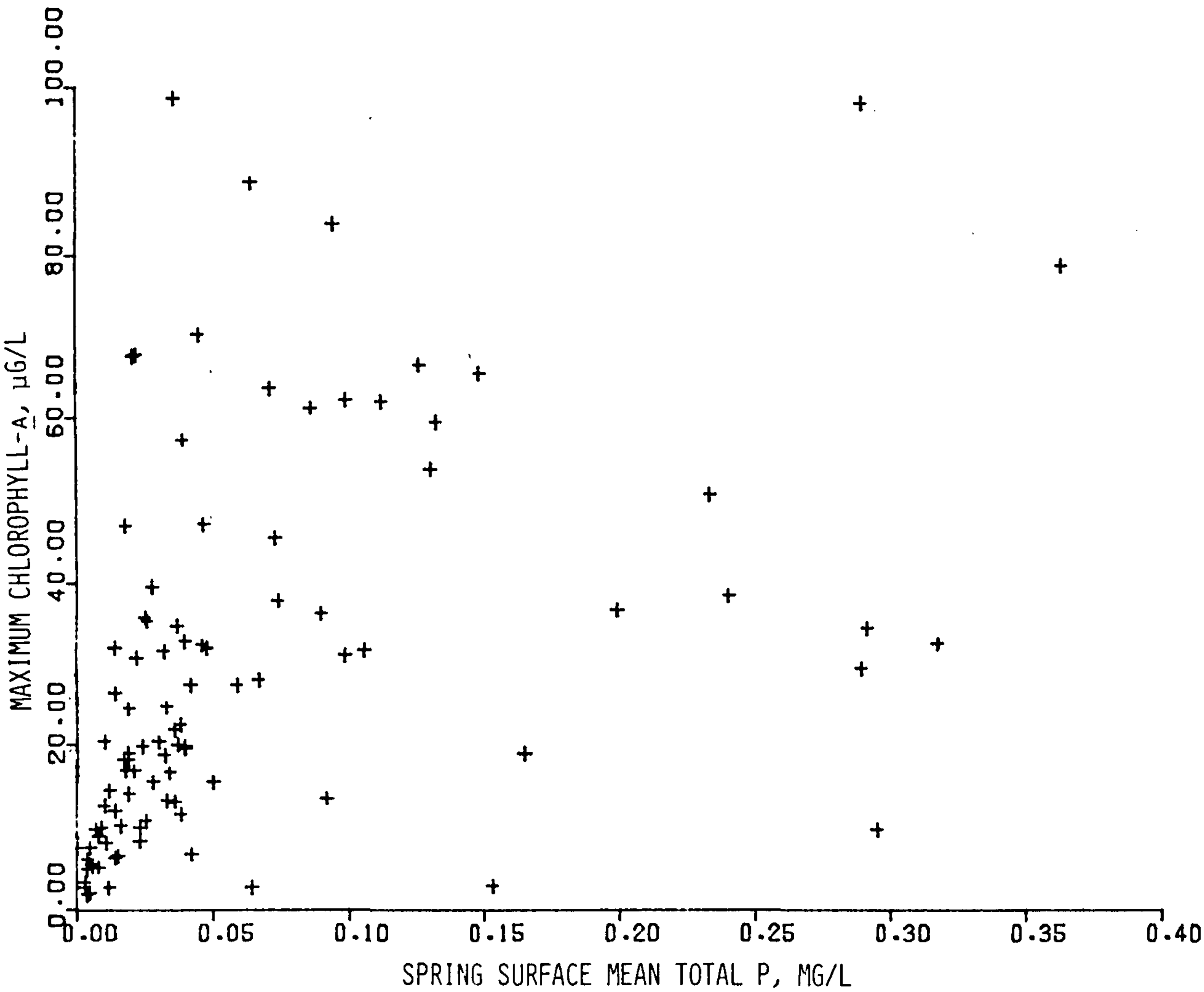


FIGURE II-21 MAXIMUM CHLOROPHYLL-A VERSUS SPRING SURFACE TOTAL PHOSPHORUS CONCENTRATION FOR LAKES IN AREA 1

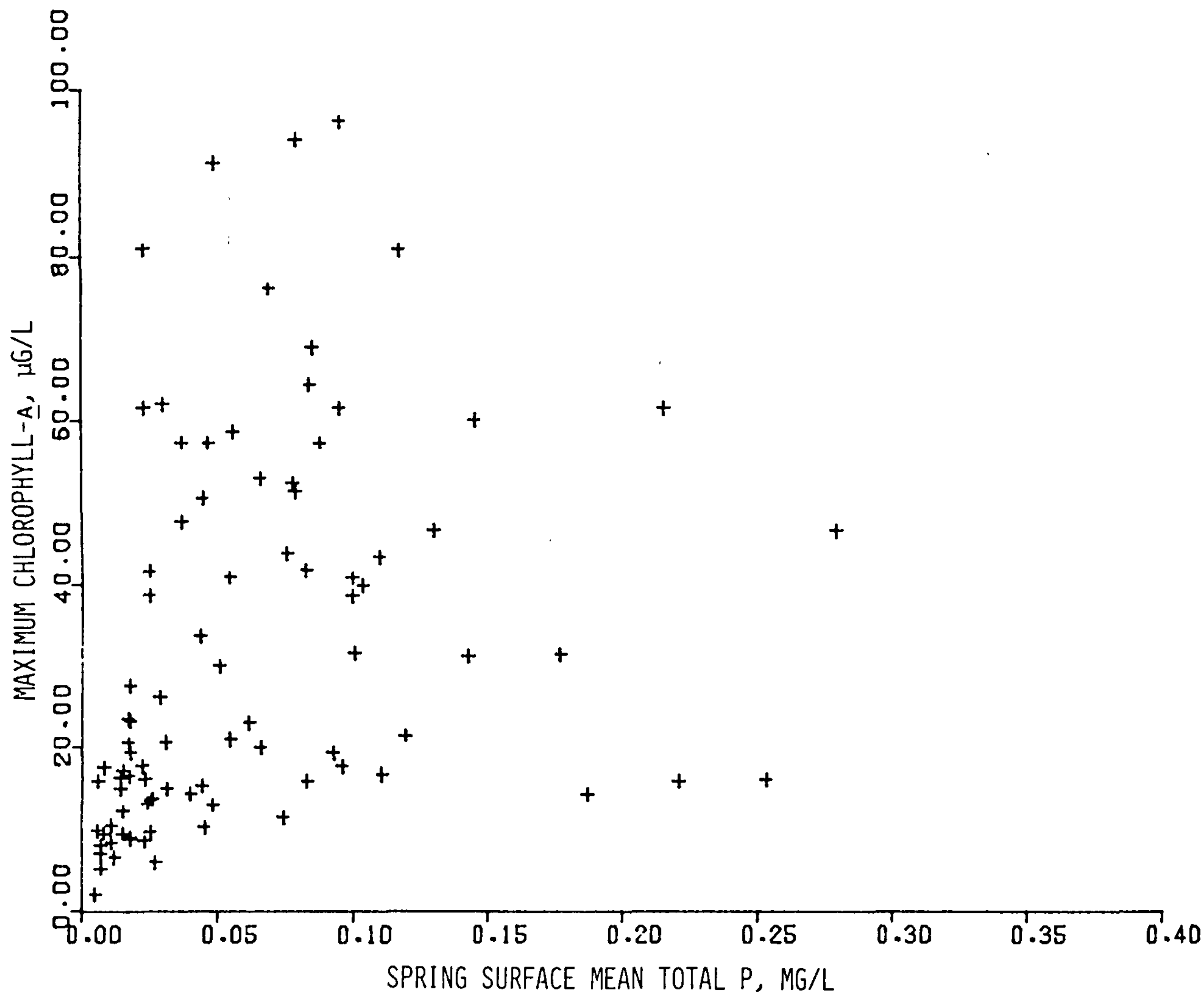


FIGURE II-22 MAXIMUM CHLOROPHYLL-A VERSUS SPRING SURFACE TOTAL PHOSPHORUS CONCENTRATION FOR LAKES IN AREA 2

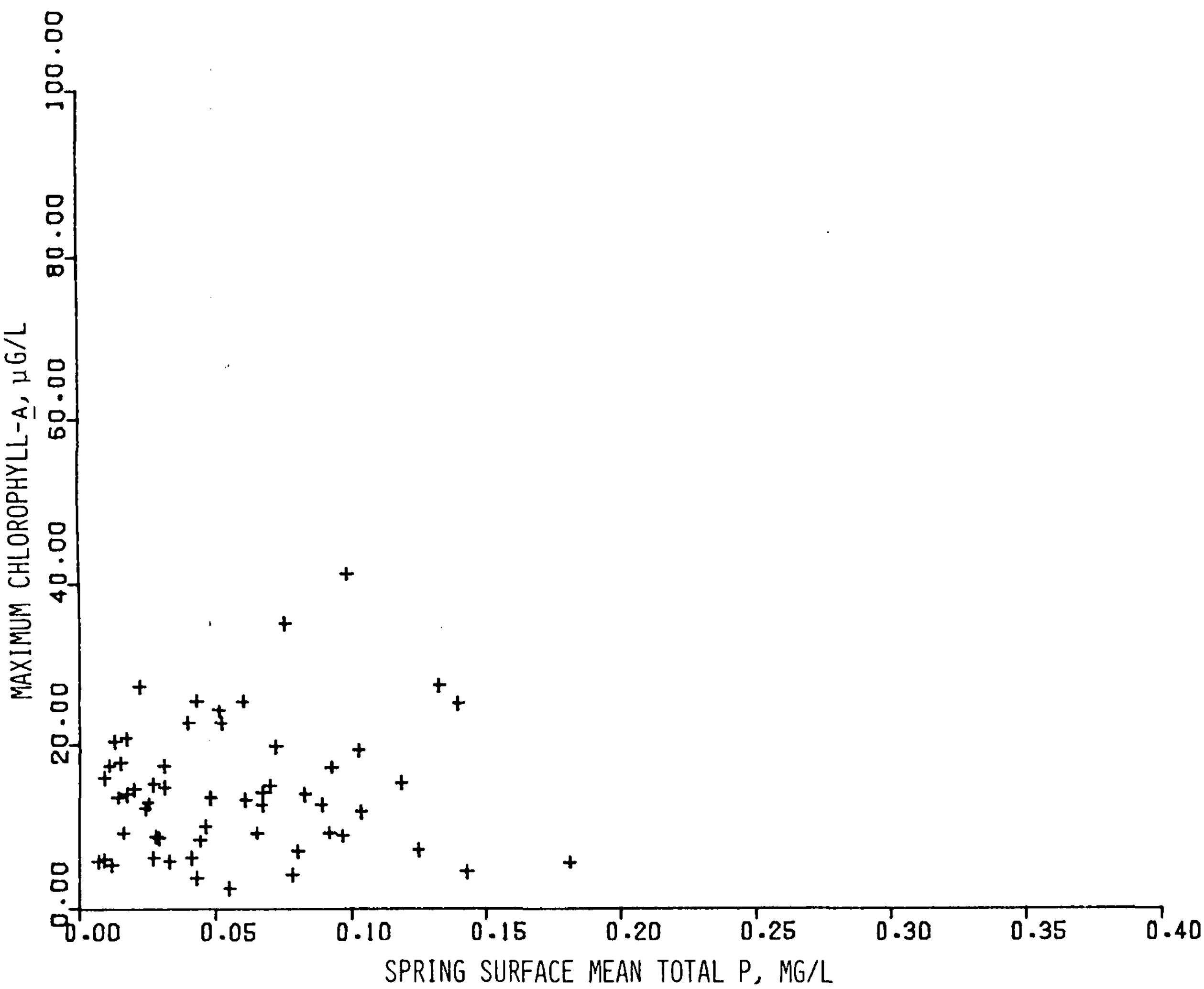


FIGURE II-23 MAXIMUM CHLOROPHYLL-A VERSUS SPRING SURFACE TOTAL PHOSPHORUS CONCENTRATION FOR LAKES IN AREA 3

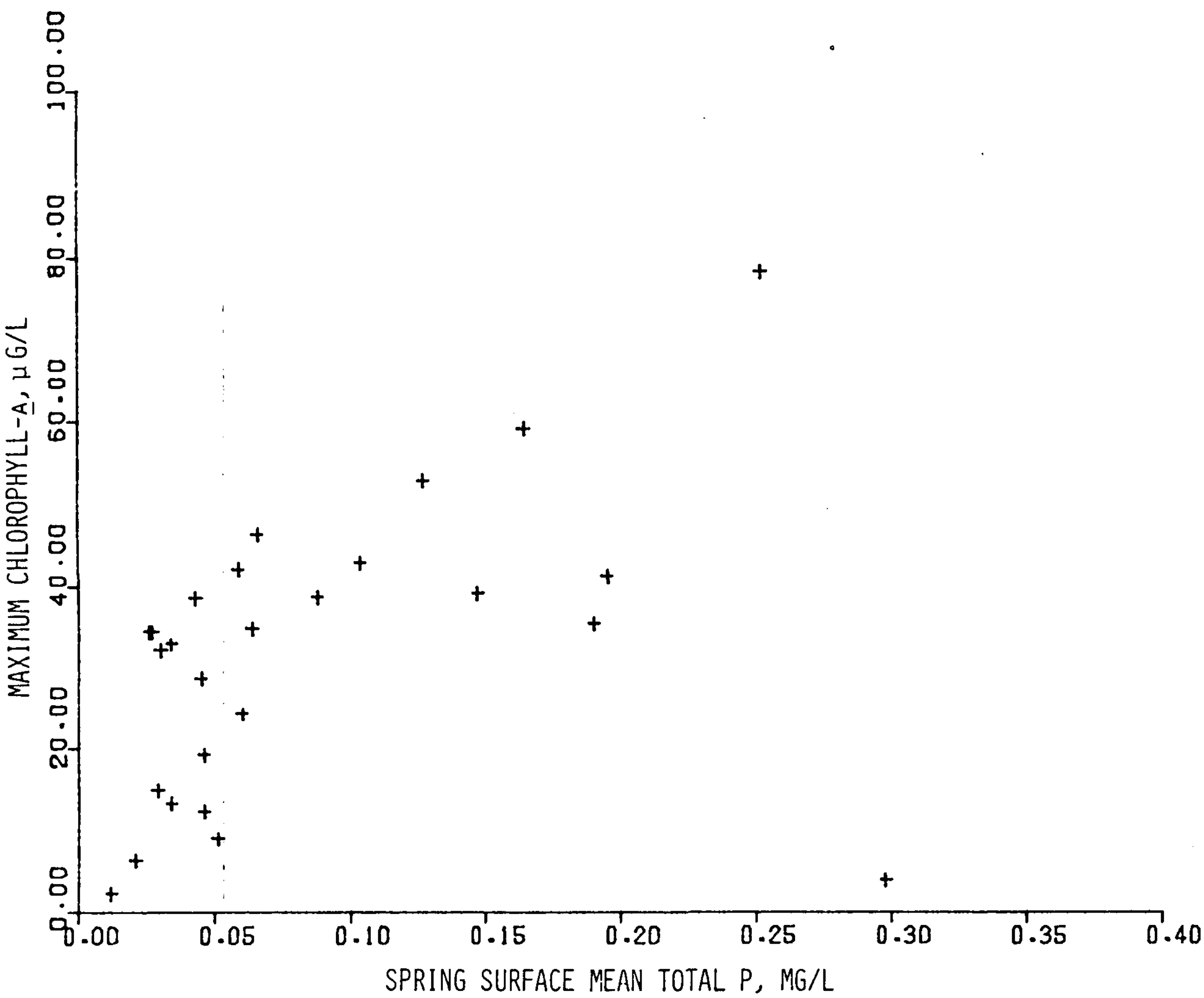


FIGURE II-24 MAXIMUM CHLOROPHYLL-A VERSUS SPRING SURFACE TOTAL PHOSPHORUS CONCENTRATION FOR LAKES IN AREA 4

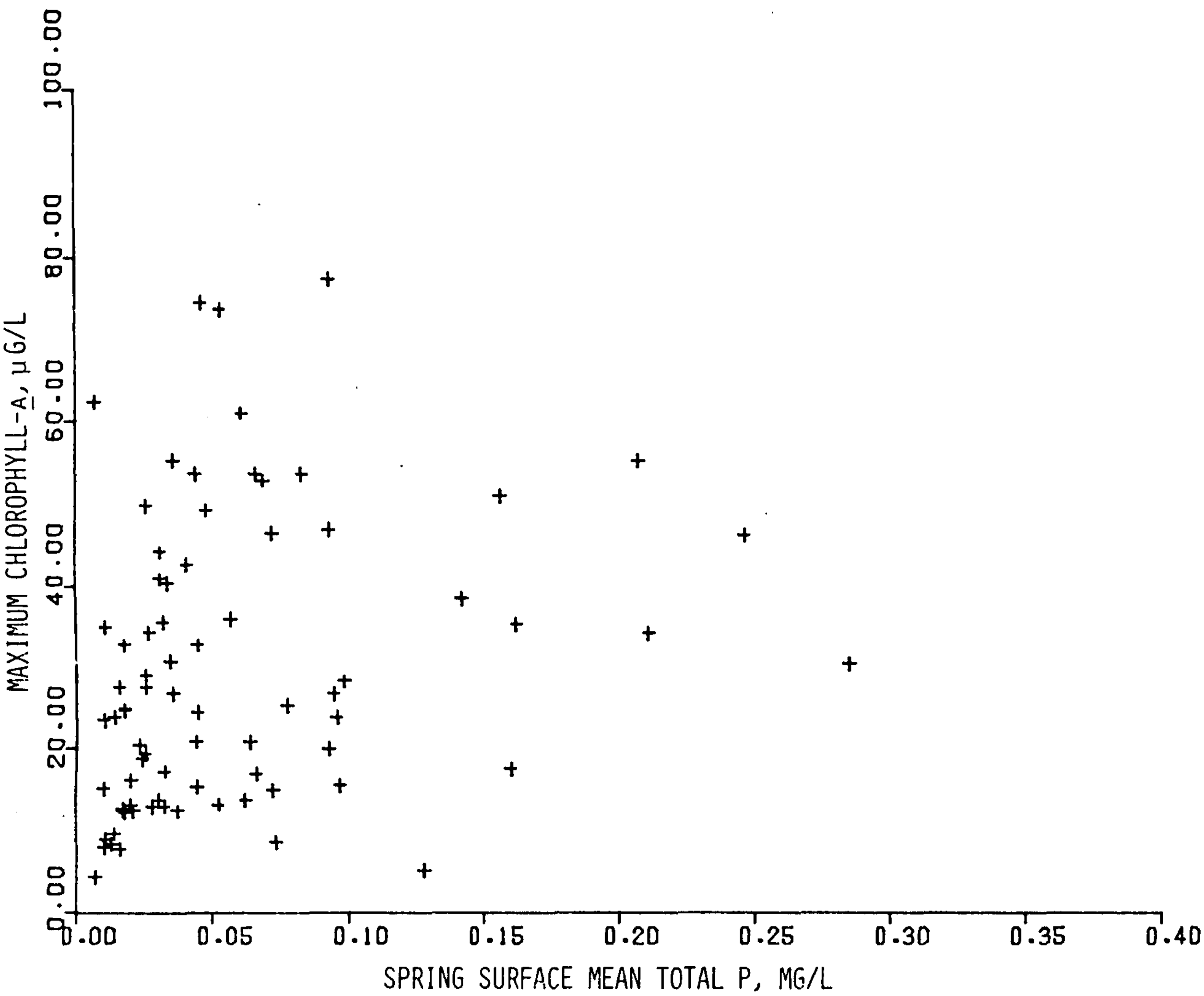


FIGURE II-25 MAXIMUM CHLOROPHYLL-A VERSUS SPRING SURFACE TOTAL PHOSPHORUS CONCENTRATION FOR LAKES IN AREA 5

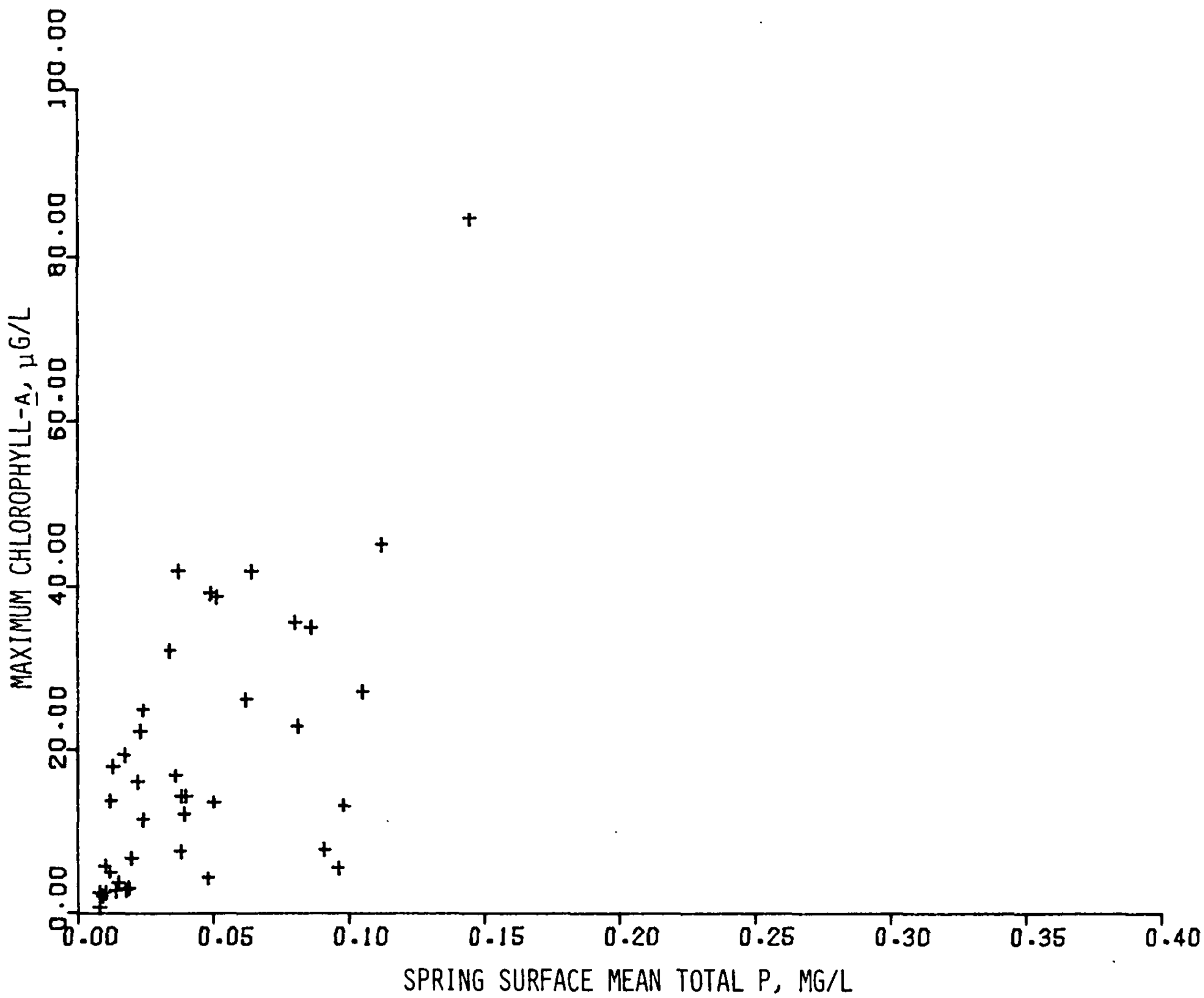


FIGURE II-26 MAXIMUM CHLOROPHYLL-A VERSUS SPRING SURFACE TOTAL PHOSPHORUS CONCENTRATION FOR LAKES IN AREA 6

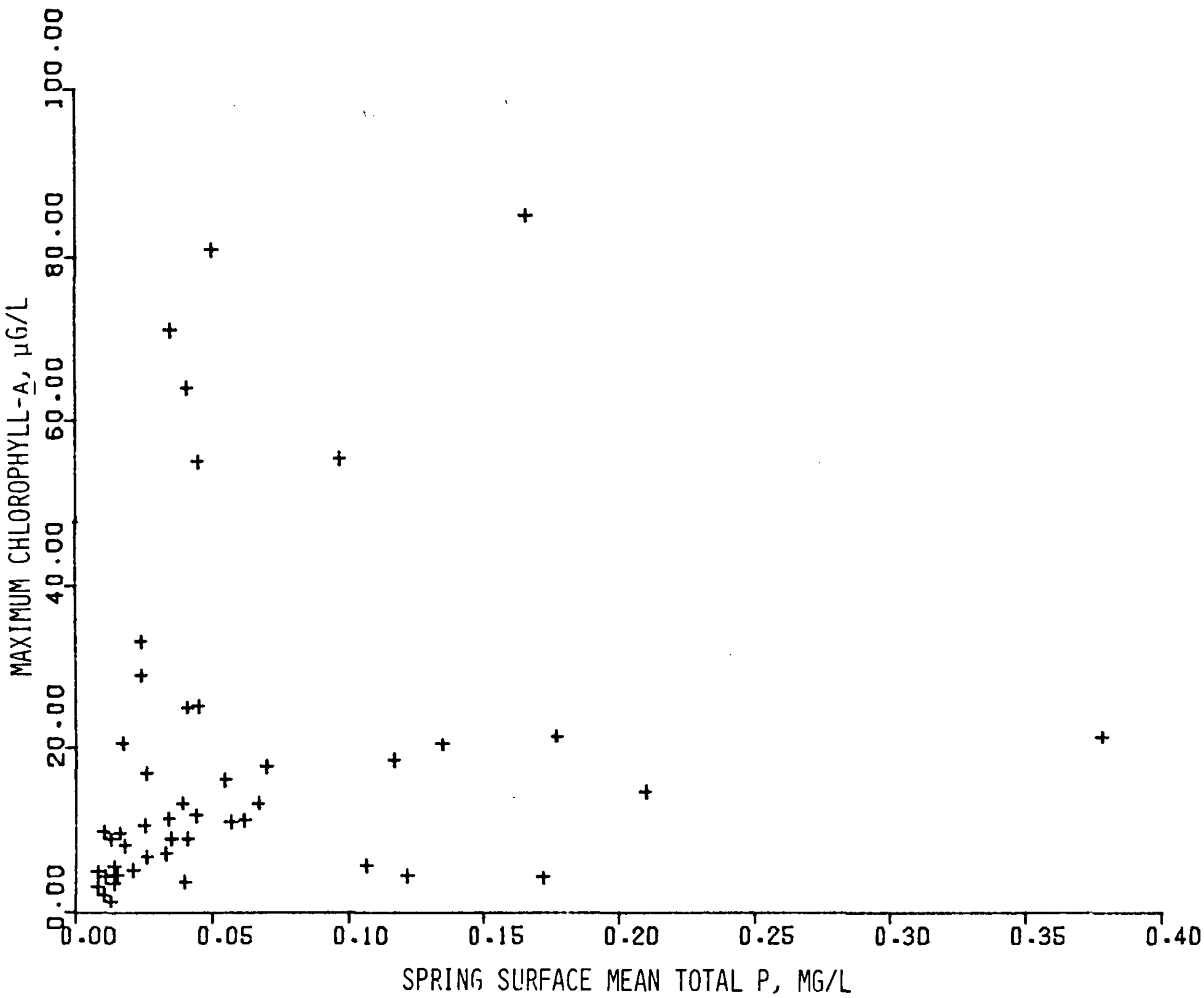


FIGURE II-27 MAXIMUM CHLOROPHYLL-A VERSUS SPRING SURFACE TOTAL PHOSPHORUS CONCENTRATION FOR LAKES IN AREA 7

Chlorophyll-a vs Secchi Disc

It has been shown experimentally and theoretically (Lorenzen & Mitchell, 1975) that light attenuation in a water column can be closely approximated by an expression such as:

$$\frac{I_d}{I_o} = e^{-(\alpha+\beta C)\, d} \qquad \text{(II-3)}$$

where

I_d = Illumination at depth, d
I_o = Surface illumination
α = Attenuation coefficient for color, turbidity, etc.
β = Incremental attenuation coefficient for algae
C = Algal concentration
d = Depth

It has also been shown that Secchi disc depth can be closely approximated by the depth to which 20% of surface visible light penetrates (Lorenzen, 1978).

The Secchi disc depth can therefore be approximated by

$$\text{Secchi disc} = \frac{-\ln\,(0.20)}{\alpha+\beta C} \qquad \text{(II-4)}$$

At high algal concentrations ($\beta C >> \alpha$) the attenuation of light and Secchi disc depth are controlled by the phytoplankton. However, at low algal concentrations, the penetration of light is largely due to light absorbing properties other than phytoplankton (α). Large variations in Secchi disc depth at low chlorophyll concentrations. are likely due to factors other than changes in chlorophyll concentration.

The extinction coefficient due to factors other than algae (α), varies widely ranging from 0.04 m^{-1} for distilled water (Clarke, 1954) to 0.7 m^{-1} or more. The incremental extinction coefficient, β, has been found to be fairly constant at approximately 0.2 m^{-1}/mg/l ash free dry weight (Lorenzen, 1975). Unfortunately, the chlorophyll content of algal cells is quite variable, so it is more difficult to relate the attenuation coefficient to chlorophyll. For illustrative purposes, Figure II-28 was constructed for various values of α (0.04 to 1.0 m^{-1}) and β = .030 m^{-1}/mg/l chl.-a. **Figure II-29 shows a similar** plot of NES data for all years surveyed. Data from each year are shown in Figures II-30 and II-31. A comparison of these plots with Figure II-28 shows that most lakes had non-chlorophyll attenuation coefficients greater than 0.5 m^{-1}.

The relationship between mean Secchi disc depth and mean chlorophyll-a (equation II-4) was used to compute a value for α for each lake. Values for α ranged from essentially zero to 15 m^{-1} with an average of 1.35 m^{-1} for all lakes.

Response Time

An important question related to any control option and its effect on lake status is: how long will it take to respond? The response time is related to both the hydraulic residence time (V/Q) and phosphorus retention coefficient. The response time for each lake was computed according to the equation

$$t_{1/2} = \frac{0.69\ (1 - R_m)}{Q/V} \qquad \text{(II-5)}$$

where:

$t_{1/2}$ = time required to change from original concentration halfway to the new steady-state concentration

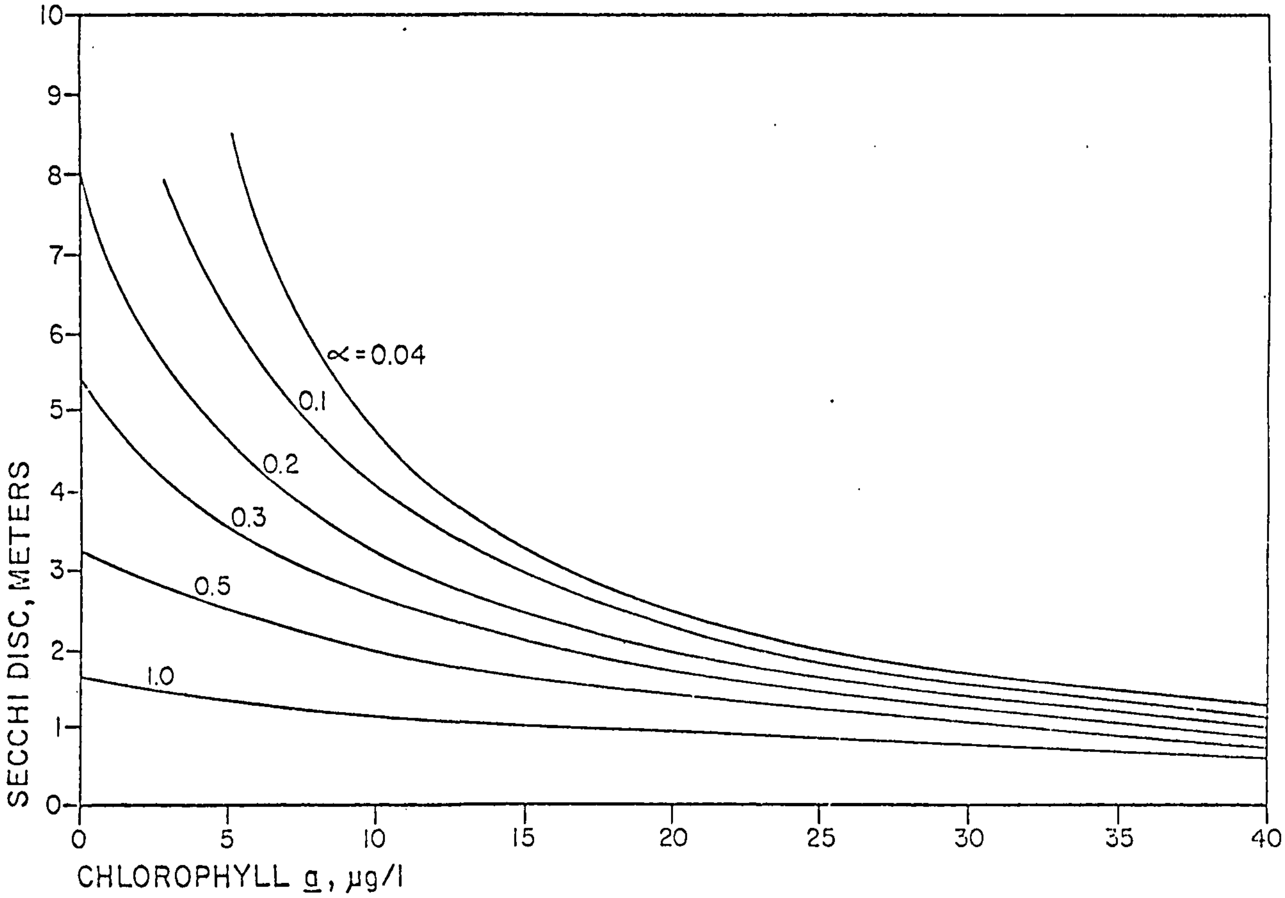


FIGURE II-28 THEORETICAL RELATIONSHIP BETWEEN SECCHI DISC AND CHLOROPHYLL FOR VARIOUS VALUES OF α

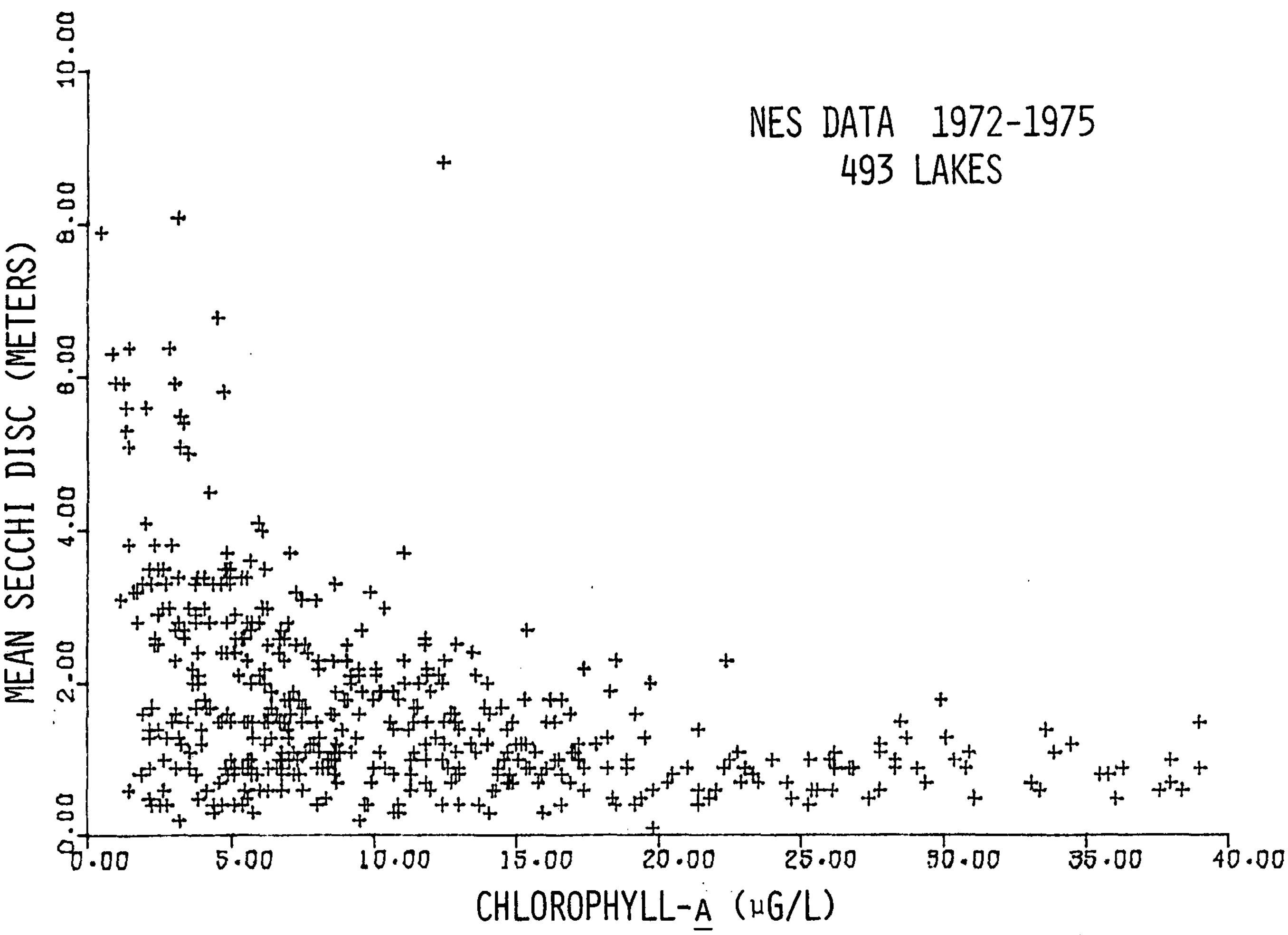


FIGURE II-29 MEAN SECCHI DISC VERSUS MEAN CHLOROPHYLL-A

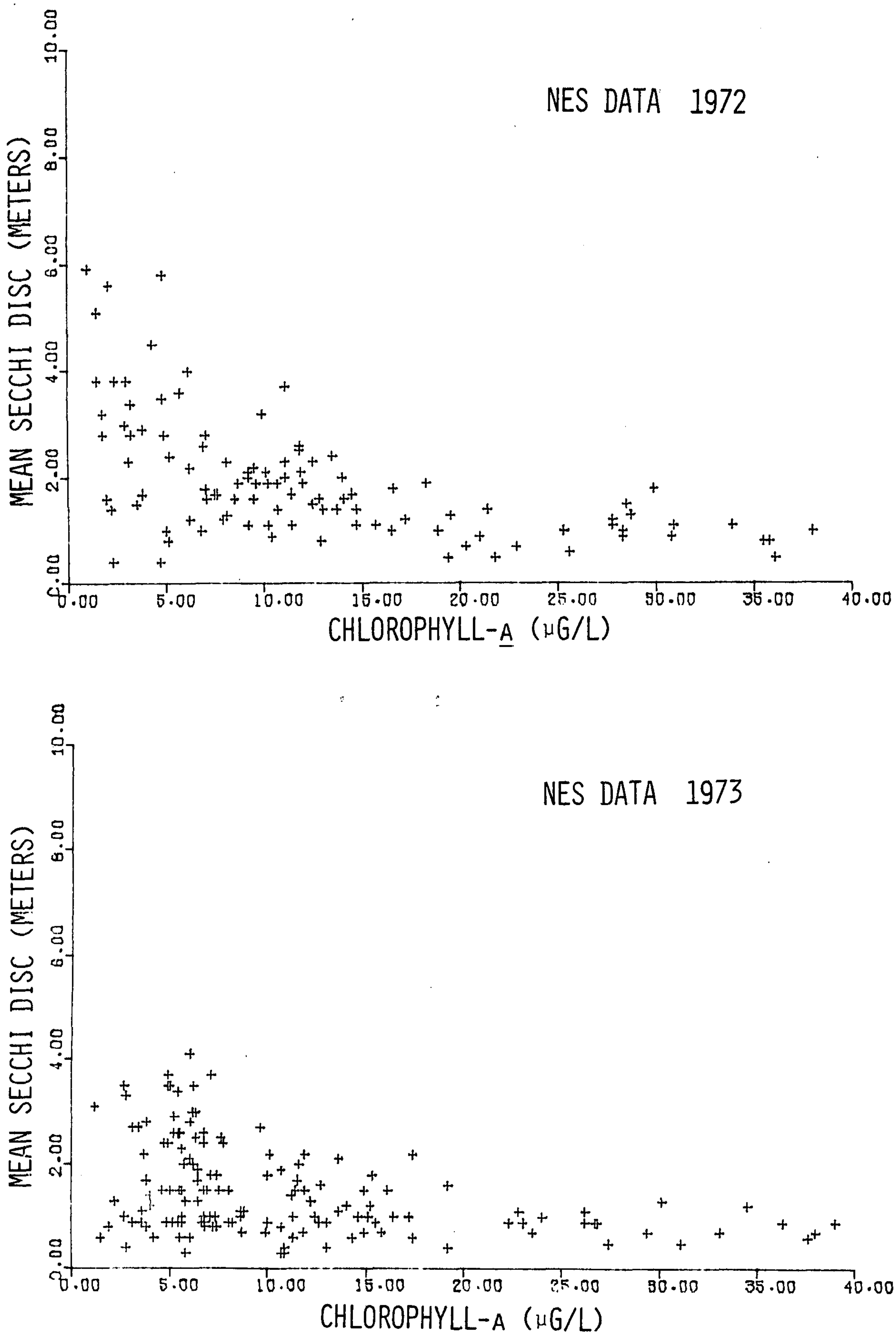


FIGURE II-30 MEAN SECCHI DISC VERSUS MEAN CHLOROPHYLL-A

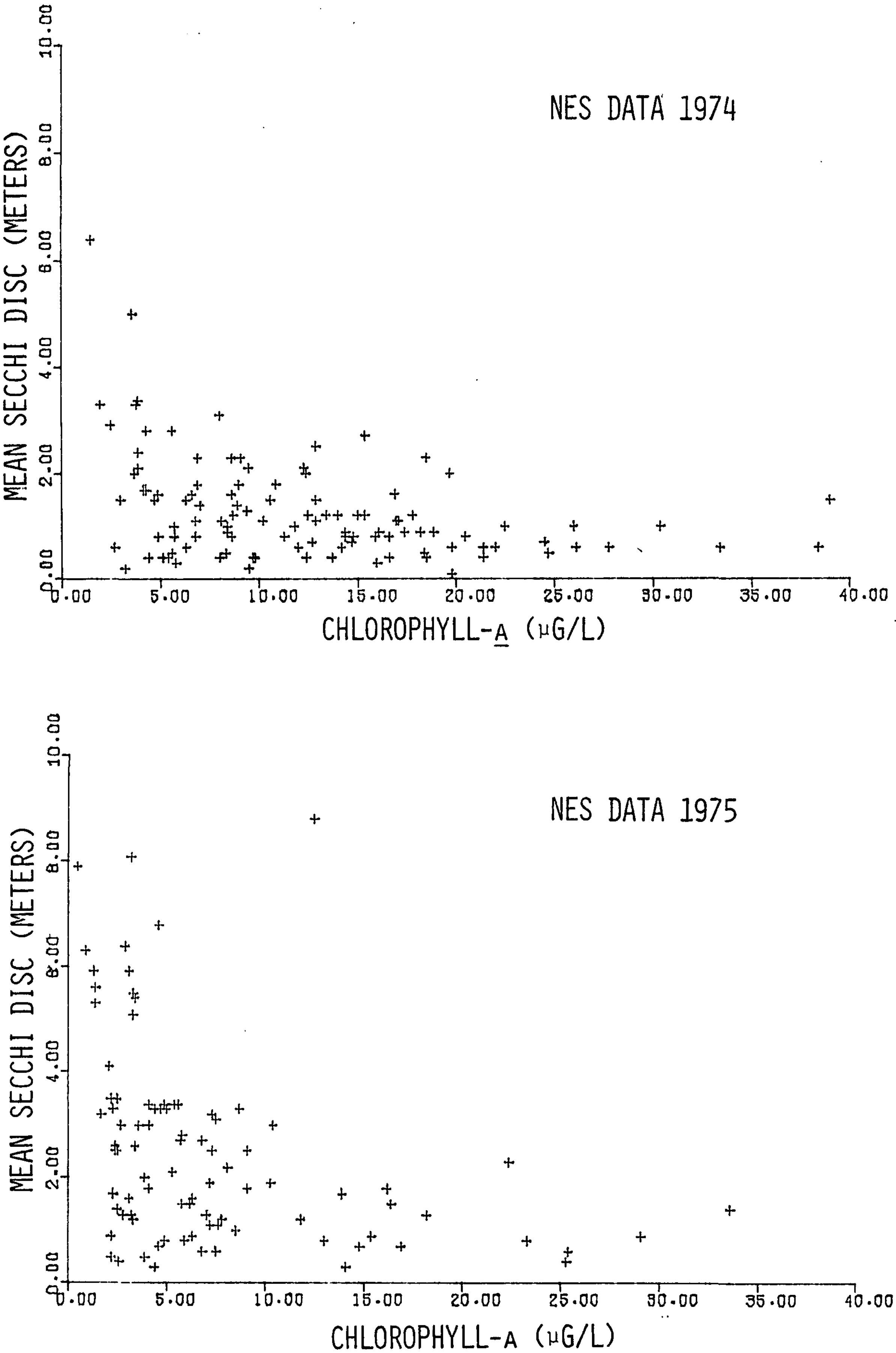


FIGURE II-31 MEAN SECCHI DISC VERSUS MEAN CHLOROPHYLL-A

R_m = measured phosphorus retention coefficient

Q = volumetric flow rate (outlet)

V = lake volume

Figure II-32 shows the cumulative distribution of response times for all lakes in the screened data base. Only 16 lakes have times greater than two years and over 80% of the lakes have a computed "response time" of six months or less. These data indicate that 80% of the lakes should be within 10% of a new steady-state condition within two years of a step change in phosphorus loading.

However, it should be noted that the available data base did not allow consideration of sediment phosphorus release. It is possible that lakes which have received high loadings for a long period of time may respond considerably more slowly while the sediments equilibrate with a new loading rate (Lorenzen, *et al.*, 1976).

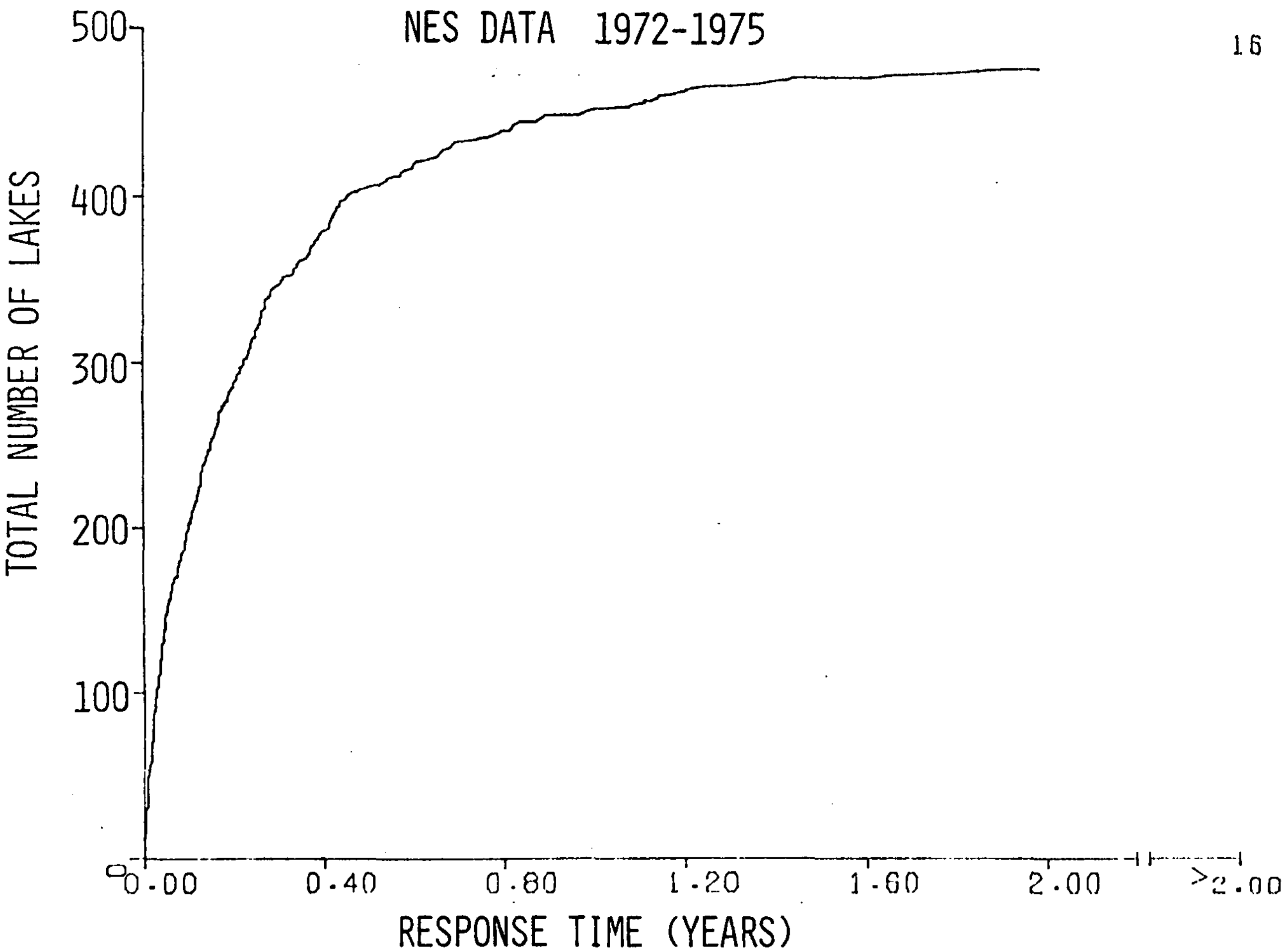


FIGURE II-32 CUMULATIVE DISTRIBUTION OF LAKE RESPONSE TIMES

SECTION III

TECHNICAL APPROACH

The approach used to analyze the consequences of various phosphorus control options was very straightforward and necessarily simplified as dictated by available data. The procedure consisted of four major steps.

1. Compute new phosphorus loading to each lake
2. Compute new *in situ* phosphorus concentration
3. Compute new chlorophyll-*a* and Secchi disc
4. Display results

The procedures used in each step are described below.

PHOSPHORUS LOADING

The method of computing phosphorus loading depends on the specific option to be tested and is described for each option in subsequent chapters. In general, loading rates from each type of source (municipal, streams, septic tanks, etc.) are reduced by some fraction which corresponds to the control option specified. A new total phosphorus loading is then computed by subtracting any reduction from the original mass loading rate.

NEW PHOSPHORUS CONCENTRATION

A number of methods and models were reviewed for computation of the lakes' response to changed loading. This review is documented in Appendix C, "Evaluation of Available Phosphorus Models". The method chosen was the simple mass balance model which considers loading, loss to the sediments, and discharge.

$$\frac{dC}{dt} = \frac{QC_{in}}{V} - \frac{Q}{V}C - K_L C \qquad \text{(III-1)}$$

where:

C = Annual average total phosphorus concentration, mg/l

t = time, years

Q = hydraulic flow, m^3/yr (outflow was assumed equal to the inflow)

C_{in} = average annual influent phosphorus concentration, mg/l

V = lake volume, m^3

K_L = sedimentation loss rate constant, yr^{-1}

The steady-state solution to this mass balance is:

$$C_{ss} = C_{in} \frac{1}{1 + K_L V/Q} \qquad \text{(III-2)}$$

There have been some theoretical attempts to relate K_L to other lake parameters (volume, area, mean depth). Here the value K_L will be shown to be related to the phosphorus retention coefficient, R_m, a parameter measured in the study and defined by the following equation:

$$R_m = \frac{\text{mass in - mass out}}{\text{mass in}} = \frac{C_{in} Q_{in} - C_{out} Q_{out}}{C_{in} Q_{in}} \qquad \text{(III-3)}$$

During steady state conditions C_{out} in the above expression equals C_{ss}, the concentration at steady state. Likewise at steady state the volumetric inflow and outflow rates are equal, hence $Q_{in} = Q_{out} = Q$. Rewriting Equation III-3 for steady state conditions,

$$R_m = \frac{C_{in} Q - C_{ss} Q}{C_{in} Q} = \frac{C_{in} - C_{ss}}{C_{in}} \qquad \text{(III-4)}$$

Substituting the expression for C_{ss} from equation III-2 into Equation III-4 yields upon rearrangement:

$$R_m = \frac{K_L}{Q/V + K_L} \qquad \text{(III-5)}$$

Finally, the above equation can be solved for K_L. This yields an explicit equation for K_L as a function of the phosphorus retention coefficient R_m, and the reciprocal detention time Q/V:

$$K_L = \frac{R_m Q/V}{(1 - R_m)} \qquad \text{(III-6)}$$

The expression used in this study to compute new steady-state mean annual phosphorus concentrations is the mass balance equation (Equation III-4), solved for C_{ss}.

$$C_{ss} = C_{in} (1 - R_m) \qquad \text{(III-7)}$$

The use of this equation assumes that the measured value of R_m is correct, is representative of steady-state conditions, and will not change when loading rates are changed. The data base screening procedures attempted to eliminate lakes which were not at steady-state by rejecting lakes with negative retention coefficients or very long residence times. There is no way to validate the other assumptions.

A brief analysis of theoretical phosphorus retention coefficients was conducted to determine if current theories could correctly predict the measured values. The best relationship previously published was that proposed by Larsen and Mercier (1975) in which the predicted retention coefficient, R_p, was given by

$$R_p = \frac{1}{1 + (Q/V)^{\frac{1}{2}}} \qquad r = 0.94$$

Figure III-1 shows a comparison of measured and predicted retention coefficients using this relationship. It was decided that, in spite of limitations, the observed phosphorus retention is the best available indication of probably future retention in each lake and was used in subsequest analyses.

Because of the steady-state assumption, the phosphorus retention coefficient was computed based on influent and effluent concentrations assuming that the outflow was equal to the inflow for each lake. The resulting equation for new phosphorus concentrations is simply:

$$C_{new} = C_{old} \left(\frac{\text{New P Load}}{\text{Old P Load}} \right)$$

where C_{new} = predicted phosphorus concentration

C_{old} = NES *in situ* median total phosphorus concentration

New P Load = computed load with option

Old P Load = NES reported total phosphorus load

It should also be noted that the analysis was based on the median observed phosphorus concentrations. Since mean values were not volume-weighted, the medians were judged to be a better measure of central tendency and therefore were used and treated as mean values for predictive purposes.

$$R_c = \frac{1}{(Q/V)^{\frac{1}{2}} + 1}$$

Q = hydraulic outflow

V = lake volume

$$R_m = \frac{\text{mass in} - \text{mass out}}{\text{mass in}}$$

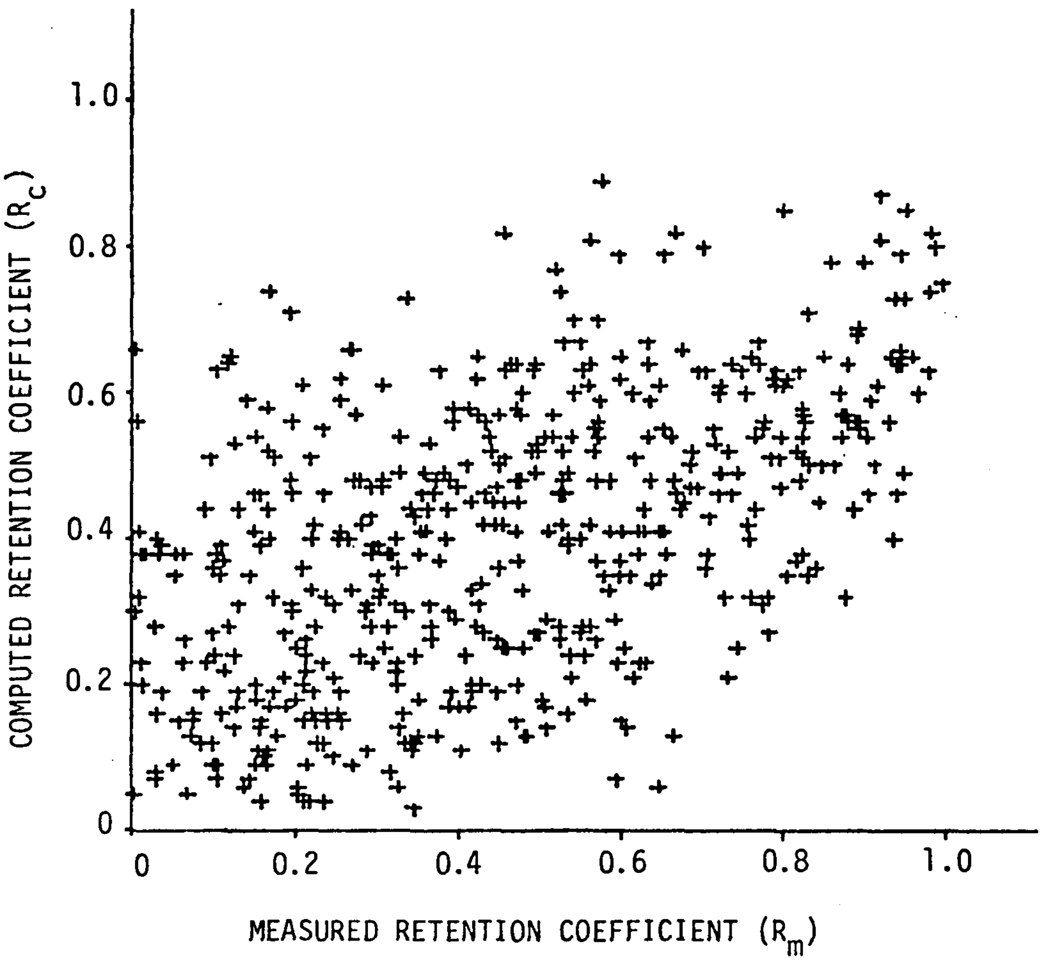


FIGURE III-1 RELATIONSHIP BETWEEN THEORETICAL AND MEASURED PHOSPHORUS RETENTION COEFFICIENTS

NEW CHLOROPHYLL CONCENTRATIONS

The prediction of new chlorophyll concentrations following a reduction in phosphorus loading is a very sensitive issue. Assuming that new phosphorus concentrations can be predicted, many researchers (Dillon and Rigler, 1974; Jones and Bachman, 1976), have proposed the use of regression equations which relate chlorophyll to total phosphorus. The problem with this type of relationship is that there is a very wide scatter (masked by log-log plots) that may be a result of the fact that in many lakes chlorophyll production may not be limited by available phosphorus. The mixed depth, light attenuation characteristics, residence time, or other factors may control the maximum algal yield.

The data which were presented in Figures II-10 through II-27 clearly illustrate that the use of a simple regression equation for chlorophyll-*a* as a function of total phosphorus would not be appropriate. If a line of best fit were used and new chlorophyll concentrations computed as a result of reduction in phosphorus concentration, approximately one-half of the lakes would show less chlorophyll with no change in loading (those lakes which fall above the regression line). Likewise, those lakes which fall below the regression line would show more chlorophyll with no change in phosphorus loading.

Because of these difficulties and consideration of theoretical yield concepts it was decided to compute a new chlorophyll concentration based on the assumption that chlorophyll yield would not be reduced unless total phosphorus were reduced to a low enough level to impose phosphorus limitation in accordance with the line bounding the data.

The new chlorophyll-*a* concentration was therefore computed to be equal to the old value or 1.0 times the new phosphorus concentration in μg/l, whichever is less. This procedure is illustrated in Figure

III-2 which shows chlorophyll-a versus total phosphorus for all lakes included in the data base. For the example shown, no decrease in chlorophyll-a would be predicted until median total phosphorus is reduced below 0.03 mg/l.

NEW SECCHI DISC

The new Secchi disc depth for each lake was computed according to the theoretical relationship:

$$\text{Secchi disc depth} = \frac{1.609}{\alpha + \beta C}$$

C = chlorophyll concentration

The value of β was assumed to be 0.03 $m^{-1}/\mu g/l$ chlorophyll-a (Lorenzen, 1972). The value of α was computed for each lake using Equation II-4 as described earlier.

The new Secchi disc depth was then computed for each new chlorophyll concentration.

PRESENTATION OF RESULTS

When such large quantities of data and computations are used, it is difficult to present results which are understandable and at the same time comprehensive. Tabulated results for new and old values of phosphorus loading, *in situ* phosphorus concentration, chlorophyll-a and Secchi disc for each lake are given in Appendix B for each option.

These data are displayed graphically in cumulative frequency plots for each parameter and by geographical area when differences were found. For each plot, the "base case" or condition measured during the NES is shown for comparison.

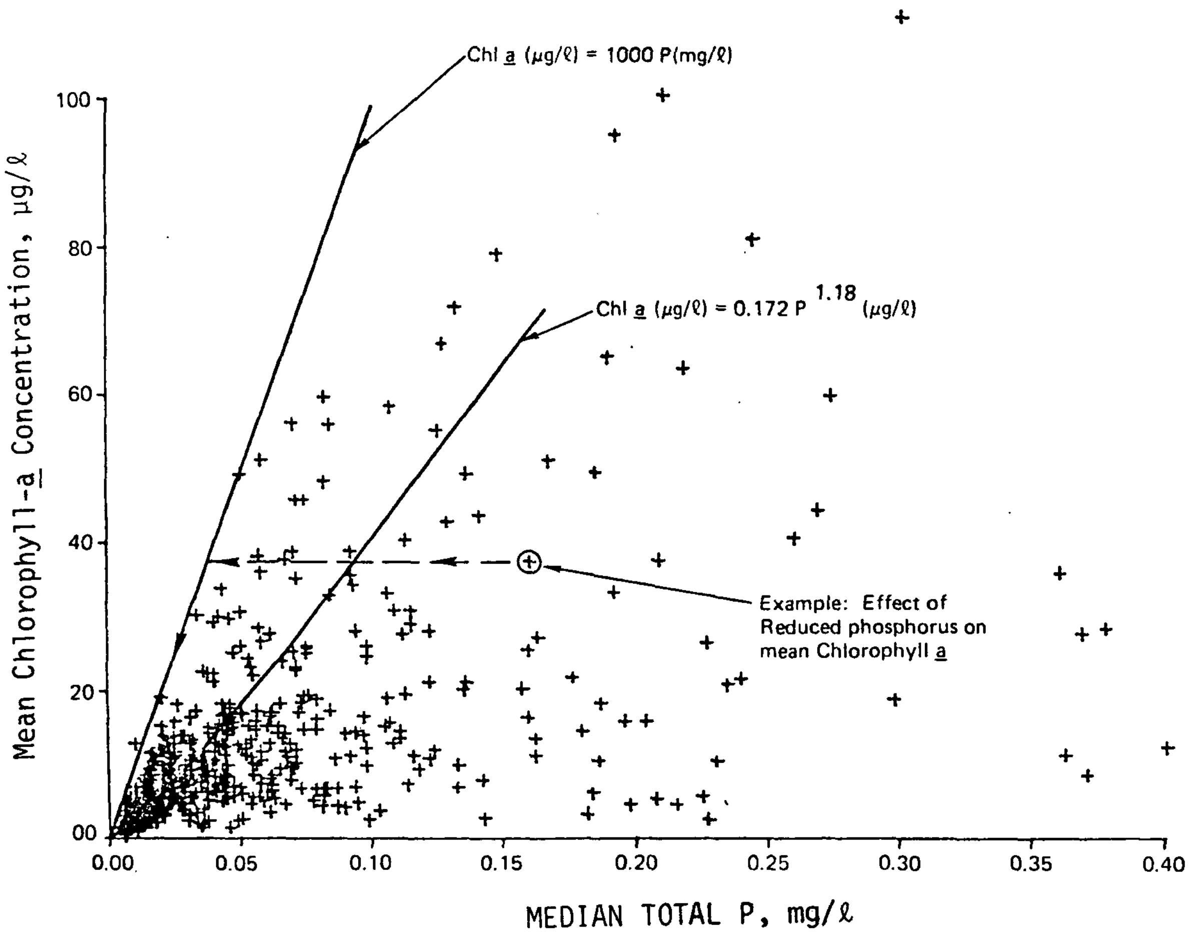


FIGURE III-2 MEAN CHLOROPHYLL-A VERSUS MEDIAN TOTAL PHOSPHORUS (493 LAKES) (HEAVY LINE SHOWS EFFECT OF REDUCING PHOSPHORUS ON CHLOROPHYLL-A)

SECTION IV

CONTROL OPTION I

DETERGENT PHOSPHORUS CONTROL

The purpose of this study is to analyze the effect of various phosphorus control options on lake water quality on a national scale. The analysis is based on 493 lakes distributed throughout the country for which data are available as a result of the National Eutrophication Survey. This section describes the results of analyzing the effects of controlling phosphorus in detergents.

> "During the period of the lake survey, the contribution to sewage phosphorus from detergents decreased in response to a nationwide reduction in the phosphorus content of detergent formulations. EPA believed that in the early 1970s (the beginning of the lake survey), about 50-60% of the phosphorus in sewage was thought to be derived from detergents, as evidenced by data from municipalities where phosphate detergents were banned (Region V Phosphorus Committee, 1977). At the end of the survey, this figure was thought to be closer to 30-35% (Booman, 1978). EPA chose the midpoint of this range (45%) to reflect the average contribution to sewage phosphorus from detergents throughout the nation during the survey. Areas that differed from this figure (e.g. New York and Indiana) received special treatment when they were identified.
>
> "Two levels of control were evaluated: (1) complete phosphate detergent ban, corresponding to a 45% reduction in municipal treatment plant effluent concentration, and (2) limitation of detergent phosphorus to 3% which would imply a 27% reduction in municipal loading. The latter analysis was included to reflect interest of detergent formulators in a 3% P:18% zeolite formulation. The 3% P formulation was considered a 60% reduction in current detergent phosphorus levels and correspond to a 27% reduction (average) in phosphorus concentration in NES effluents." (Welch, 1979)

METHODS

The procedures followed were as described in Section III. For all states except Indiana and New York, which had detergent phosphorus bans during part of all of the Survey (phosphorus loads to lakes in Indiana and New York were not changed), the total phosphorus load from municipal sources was reduced by 45 and 27 percent. A new total load to each lake was then computed assuming loads from other sources (runoff, streams, industrial, precipitation) remained the same.

After computing a new total load for each lake, the predicted in situ steady state concentration of phosphorus was computed according to the procedure described in Section III. Chlorophyll-a and Secchi disc depths were subsequently computed for each lake as described previously. All computed values represent annual averages for each lake at steady-state.

The response time of each lake was computed as described in Chapter III. Since only 3% (16 lakes) of the lakes had a response time of greater than two years, it was felt that most lakes would not be too far from equilibrium and only the steady-state results are shown.

RESULTS (all lakes)

Values of old and new total phosphorus loading, average in situ phosphorus concentration, chlorophyll-a concentration and Secchi disc depth for each lake and each control level (45% and 27%) are tabulated in Appendix B-1, both by geographical area (year surveyed) and for all lakes combined.

Figures IV-1 through IV-4 show the distribution of parameter values for the base case (NES data) and each control level for all lakes. Plots for subsets of lakes by geographical area (year surveyed) are contained in Appendix B-1.

It is readily apparent that the results indicate that even a complete ban of detergent phosphorus would have a very little effect on the trophic condition of the NES lakes as a whole. For all 493 lakes the median total phosphorus would decrease from 0.084 mg/l to 0.070 mg/l. Computed changes in chlorophyll-a and Secchi disc are negligible. Of the 493 lakes, the number with a median total phosphorus concentration less than the recommended 0.025 mg/l would increase from 160 to 164.

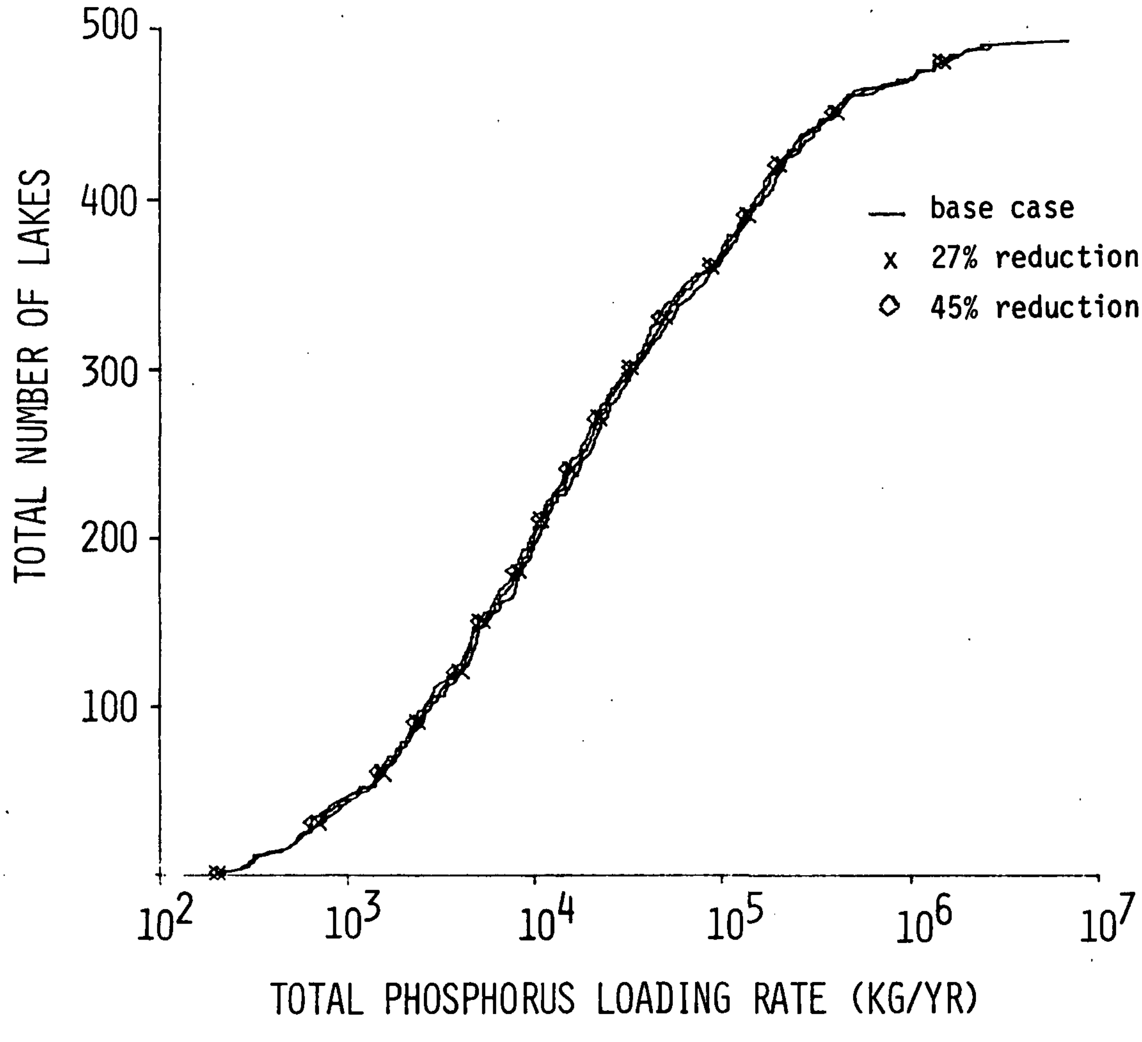


FIGURE IV-1 DISTRIBUTION OF NEW AND OLD PHOSPHORUS LOADING RATES, OPTION 1

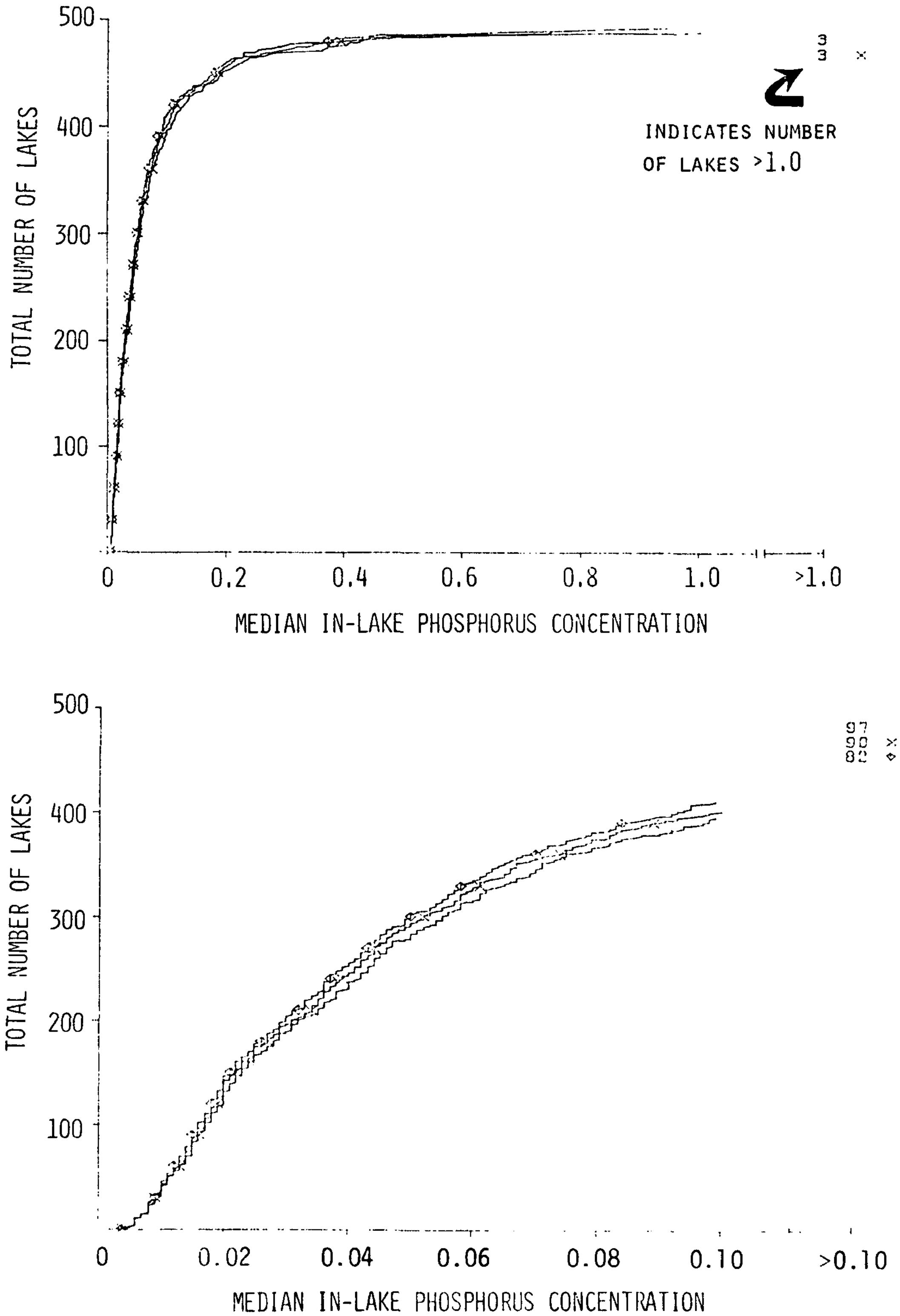


FIGURE IV-2 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS, OPTION 1

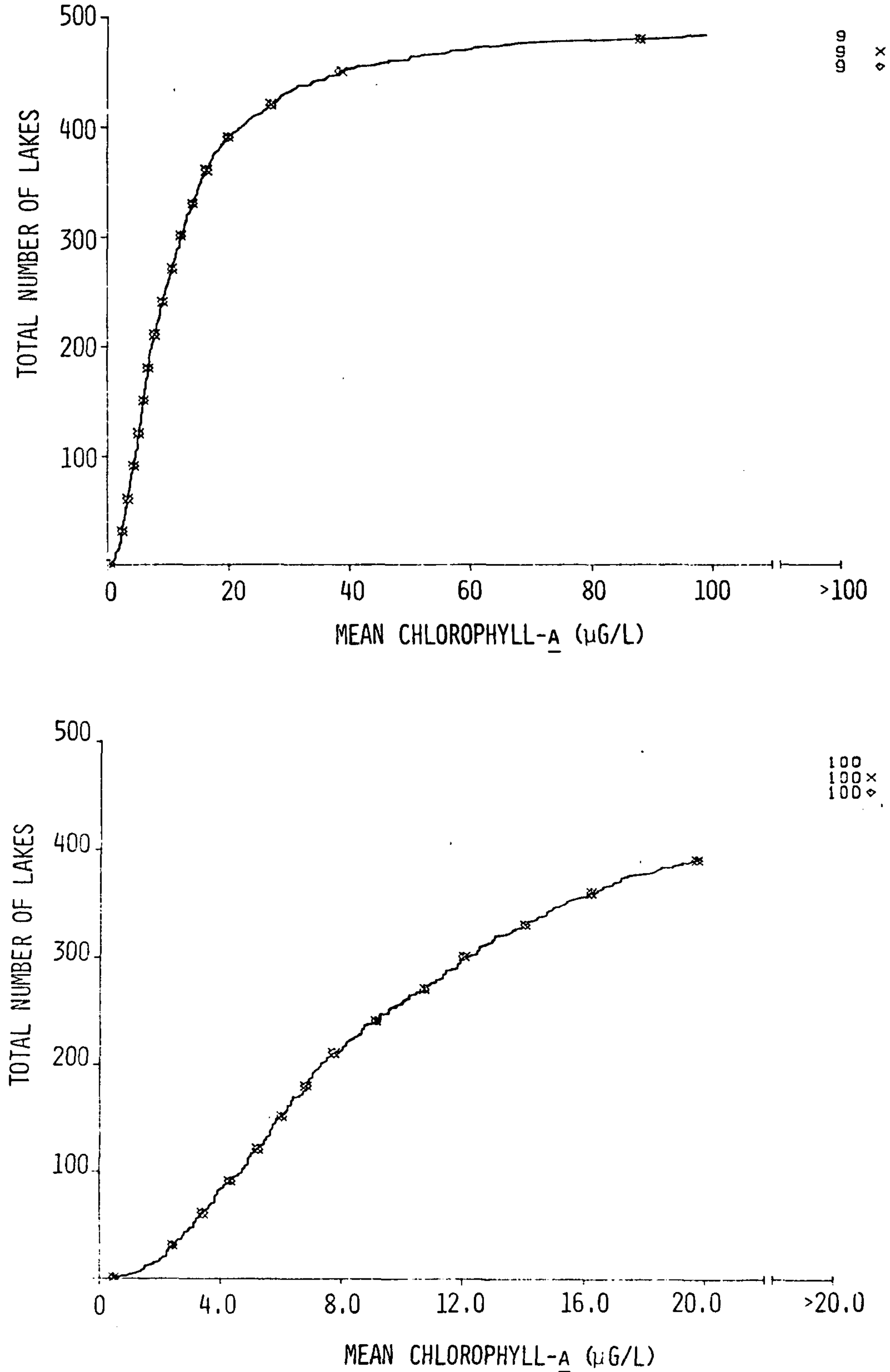


FIGURE IV-3 DISTRIBUTION OF NEW AND OLD CHLOROPHYLL-A CONCENTRATIONS, OPTION 1

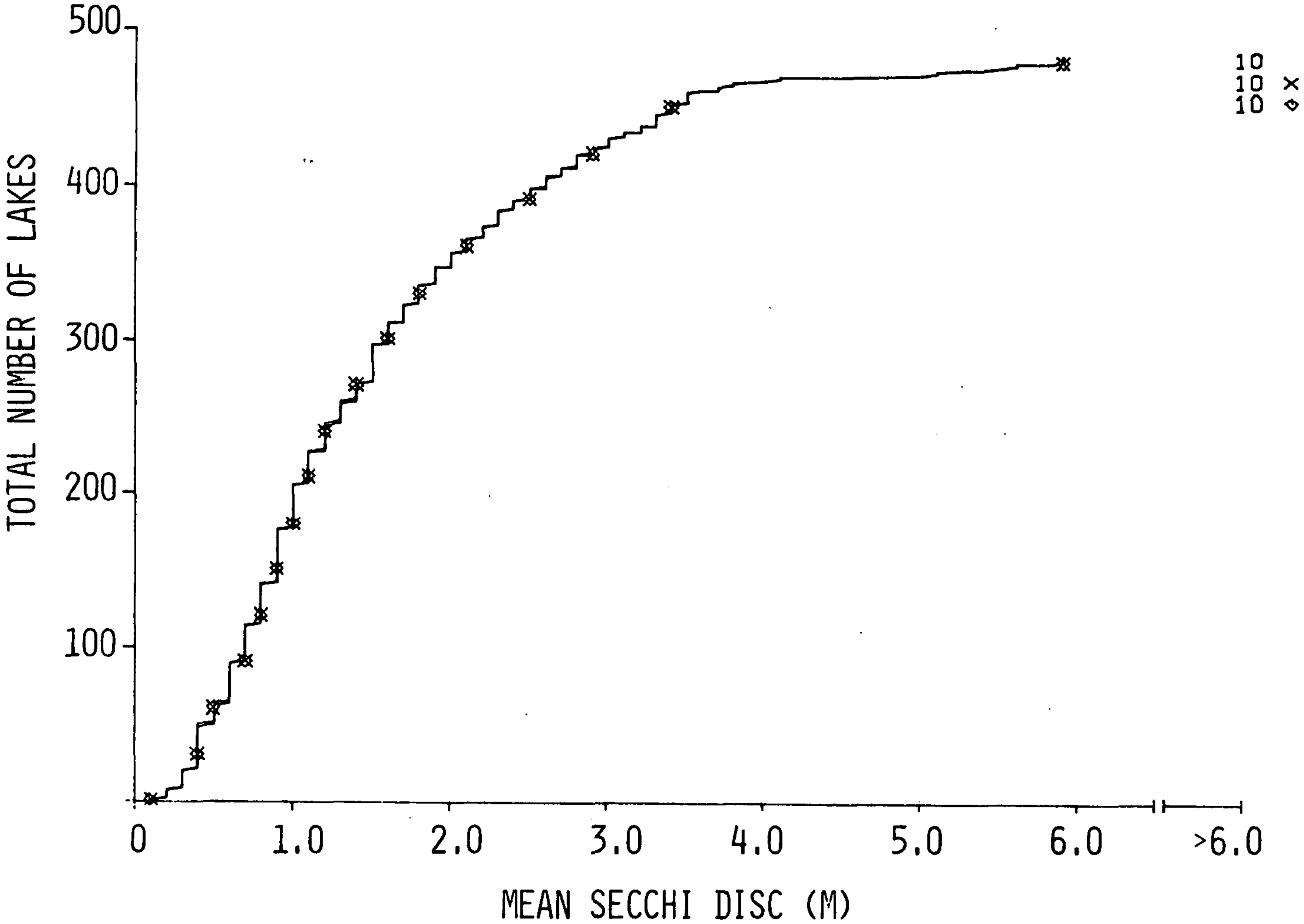


FIGURE IV-4 DISTRIBUTION OF NEW AND OLD SECCHI DISC DEPTHS, OPTION 1

Table IV-1 summarizes the phosphorus concentration data with the original loading and the new reduced phosphorus loading. Table IV-2 summarizes the number and percent of the total lakes that would have a total phosphorus concentration less than 0.025 mg/l, both with and without a 45% reduction in municipal treatment plant phosphorus discharges.

Table IV-1

Effect of Control Option 1 on *In Situ* Total Phosphorus Concentrations

Year Surveyed	Original Loading			New Loading (45% Reduction in Municipal)		
	Concentration, mg/l			Concentration, mg/l		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
1972	0.004	0.141	1.525	0.004	0.101	0.944
1973	0.006	0.070	0.865	0.004	0.060	0.660
1974	0.010	0.075	0.489	0.008	0.073	0.458
1975	0.006	0.045	0.371	0.006	0.043	0.371
1972-75	0.004	0.084	1.525	0.004	0.070	0.944

Table IV-2

Number and Fraction of Lakes with Median Phosphorus Concentrations Less Than 0.025 mg/l

Year Surveyed	Number of Lakes Surveyed	Lakes with Total P <0.025 mg/l				Difference (New - Old)	
		Old		New			
		#	%	#	%	#	%
1972	119	36	30.3	38	31.9	2	1.6
1973	165	53	32.1	54	32.7	1	0.6
1974	115	27	23.5	27	23.5	0	0.0
1975	94	44	46.8	45	47.9	1	1.1
1972-75	493	160	32.5	164	33.3	4	0.8

RESULTS (lakes with municipal treatment plants)

Because the results of these options were barely distinguishable from the present condition, a separate analysis of only lakes with treatment plants was conducted. The results were not noticeably different from the results shown. Essentially, the only difference was that the four additional lakes with median phosphorus concentrations less than 0.025 mg/l would represent 1.2% of the number of lakes with treatment plants rather than 0.8% of the total number of lakes.

SECTION V

CONTROL OPTION 2

TERTIARY SEWAGE TREATMENT
(80% P REMOVAL)

This section describes the results of analyzing the effects of 80 percent phosphorus removal from municipal sewage treatment plants. Figure V-1 illustrates the distribution of old and new treatment plant effluent phosphorus concentrations for all lakes. The 80% reduction resulted in a narrower range of values, the mean being 1.0 mg/l.

Figures V-2 and V-3 show the new and old effluent concentrations for treatment plant effluent in the different geographical regions represented by each year's survey.

METHODS

The procedures followed were as described in Section III. The total phosphorus load from municipal sources was reduced by 80 percent. A new total load to each lake was then computed assuming loads from other sources (runoff, streams, industrial, precipitation) remained the same.

After computing a new total load for each lake, the predicted *in situ* steady-state concentration of phosphorus was computed according to the procedure described in Section III. Chlorophyll-*a* concentrations and Secchi disc depths were subsequently computed for each lake as described previously. All computed values represent annual averages for each lake at steady-state.

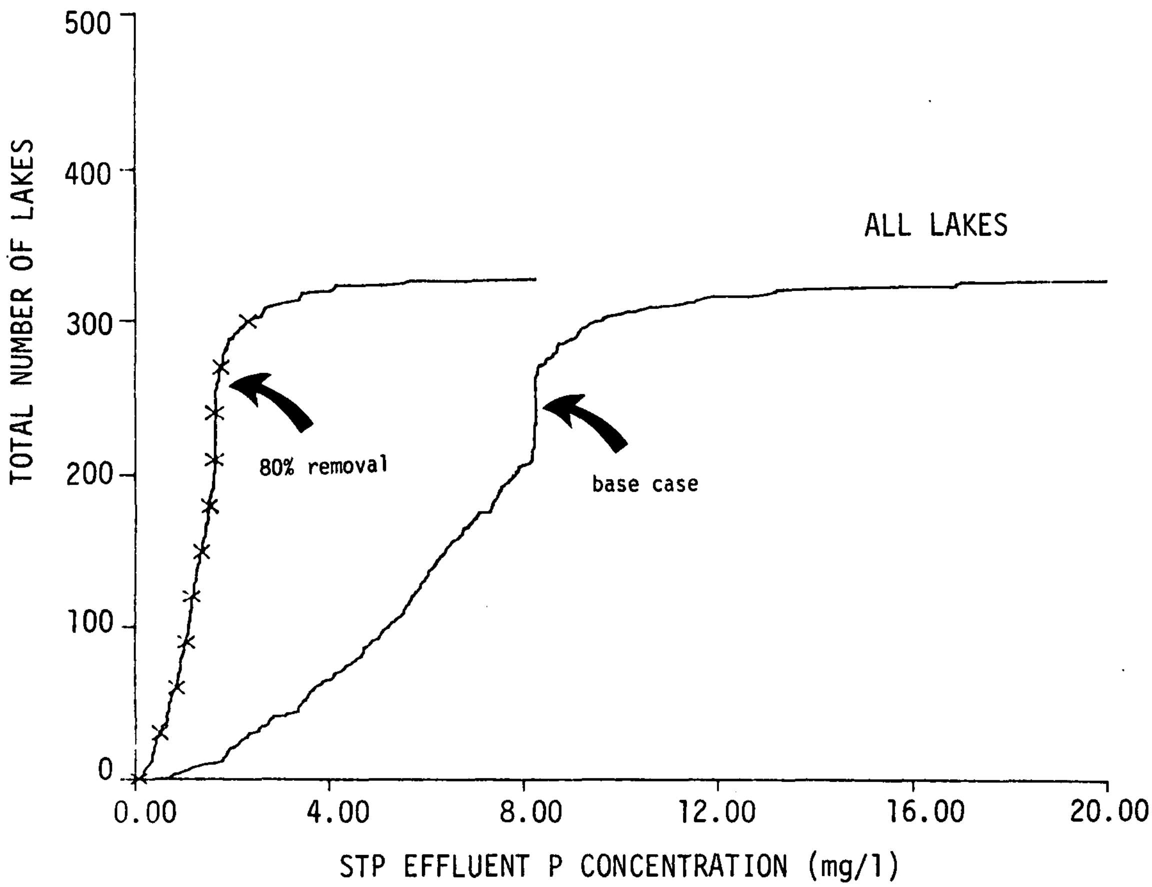


FIGURE V-1 DISTRIBUTION OF SEWAGE TREATMENT PLANT EFFLUENT PHOSPHORUS CONCENTRATIONS, OPTION 2

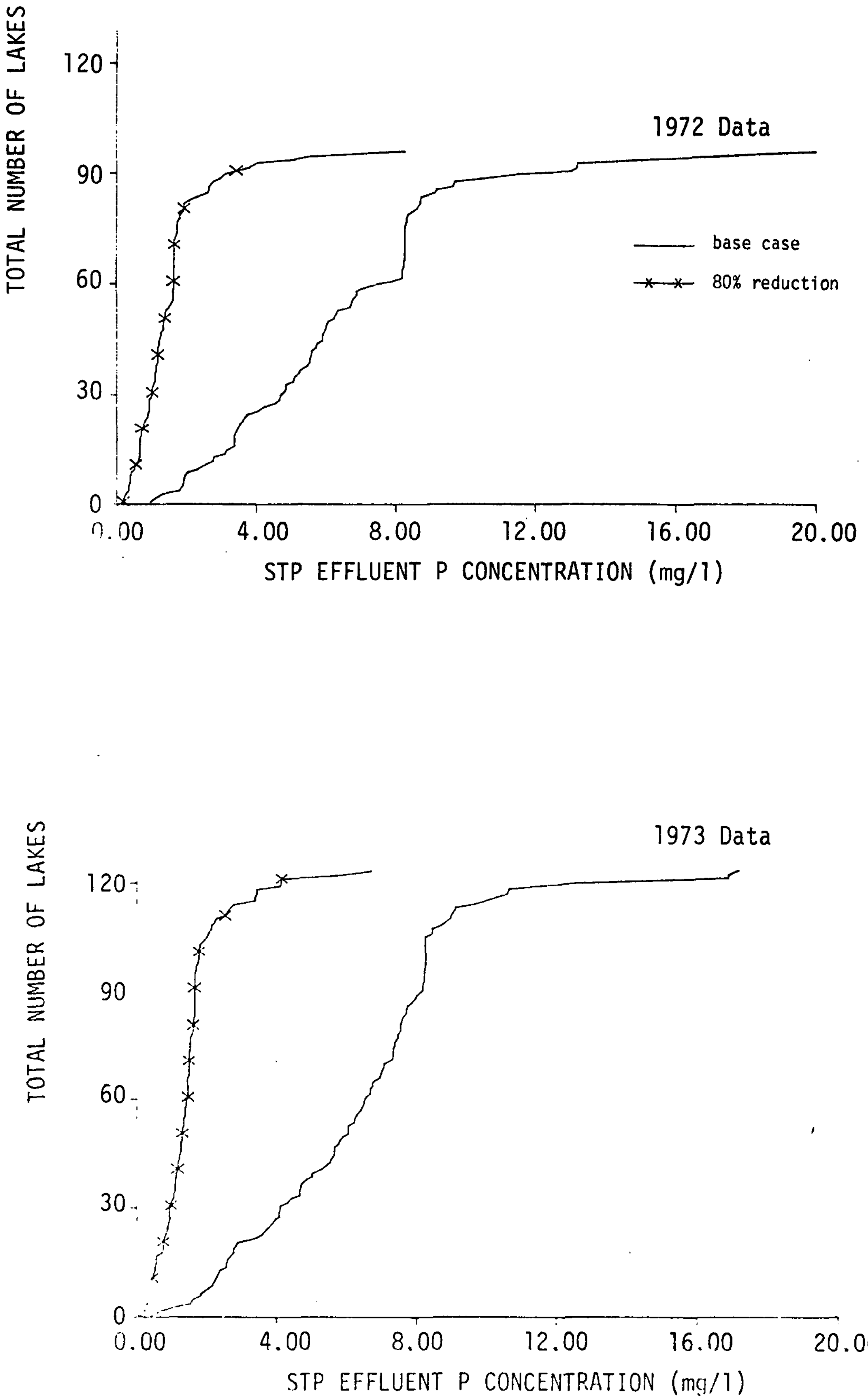
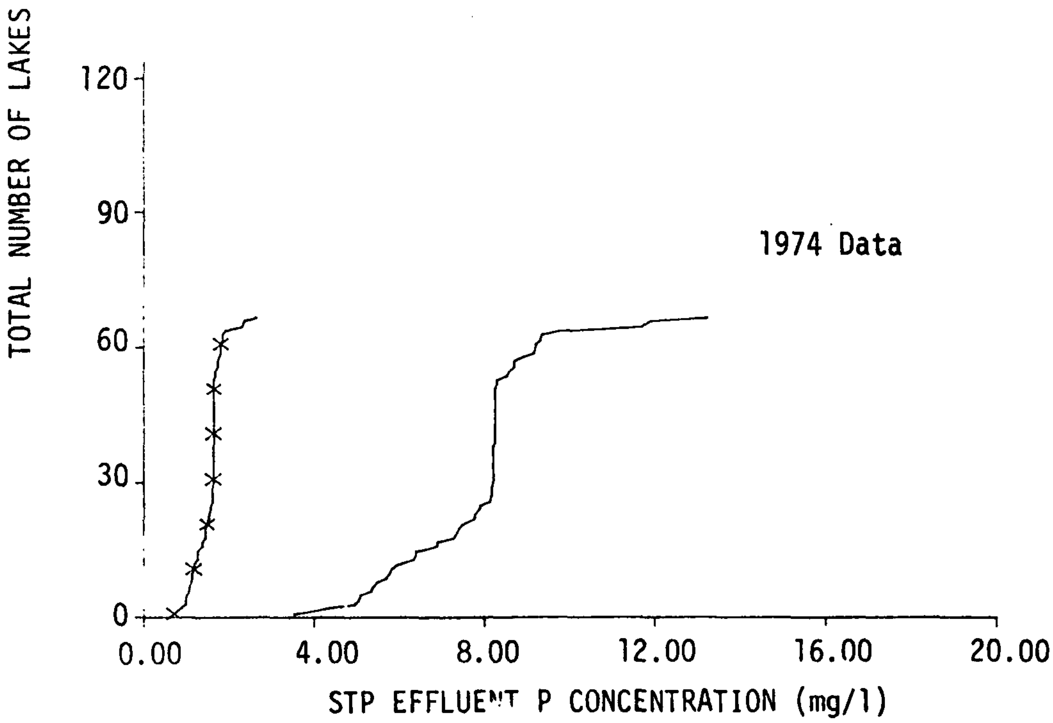


FIGURE V-2 DISTRIBUTION OF SEWAGE TREATMENT PLANT EFFLUENT PHOSPHORUS CONCENTRATIONS, OPTION 2



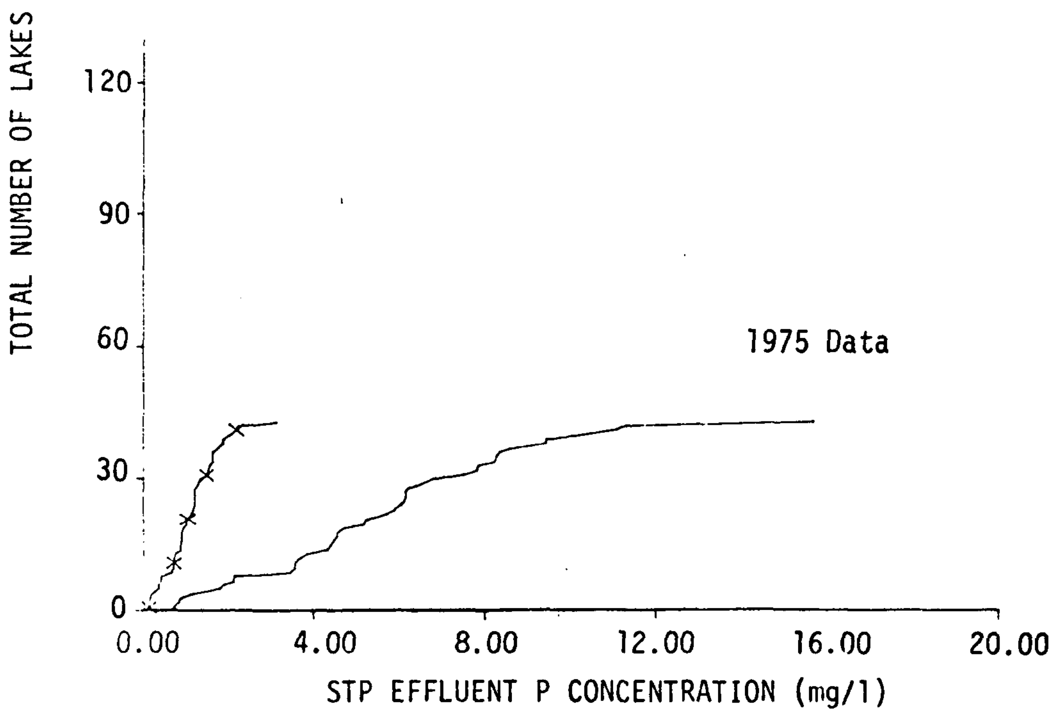


FIGURE V-3 DISTRIBUTION OF SEWAGE TREATMENT PLANT EFFLUENT PHOSPHORUS CONCENTRATIONS, OPTION 2

RESULTS (all lakes)

Values of old and new total phosphorus loading, average *in situ* phosphorus concentration, chlorophyll-*a* concentration and Secchi disc depth for each lake are tabulated in Appendix B-2, both by geographical area (year surveyed) and for all lakes combined.

Figures V-4 through V-7 show the distribution of parameter values for the base case (NES data) and the control option for all lakes. Plots for subsets of lakes by geographical region are contained in Appendix B-2.

It is apparent from the results presented that tertiary treatment (80% reduction in effluent phosphorus concentration) of municipal sewage should have a small but detectable effect on lake phosphorus concentrations. For example, as shown in Table V-1, the median total phosphorus concentration for all 493 lakes should decrease from 0.084 mg/l a to 0.059 mg/l. Table V-2 shows that the percent of lakes which have total phosphorus concentrations less than 0.025 mg/l should increase from 32.5% to 37.9% (27 lakes). The effects would be most pronounced in the Northeast and North-Central lakes where larger fractions of total phosphorus loads are from sewage treatment plants.

In spite of predicted decreases in phosphorus concentrations, the analysis indicates little or no improvement in terms of chlorophyll-*a* or Secchi disc depth. This lack of biological response is because most lakes in the sample would require a substantial reduction in total phosphorus loading before phosphorus could be made to limit chlorophyll-*a* to low levels.

RESULTS (lakes with municipal treatment plants)

Because not all of the lakes included in the data base received municipal sewage treatment plant effluent, a separate analysis was conducted

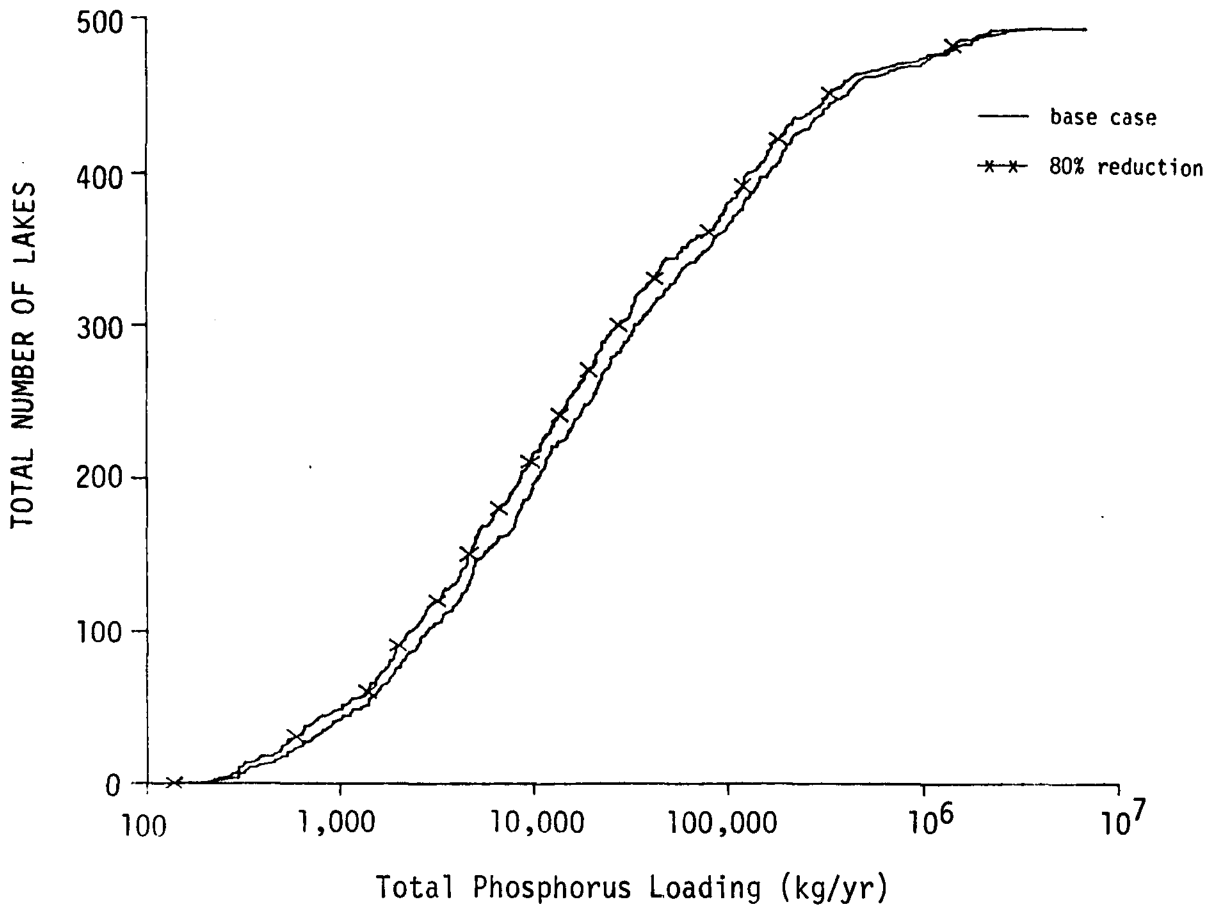


FIGURE V-4 DISTRIBUTION OF NEW AND OLD PHOSPHORUS LOADING RATES, OPTION 2

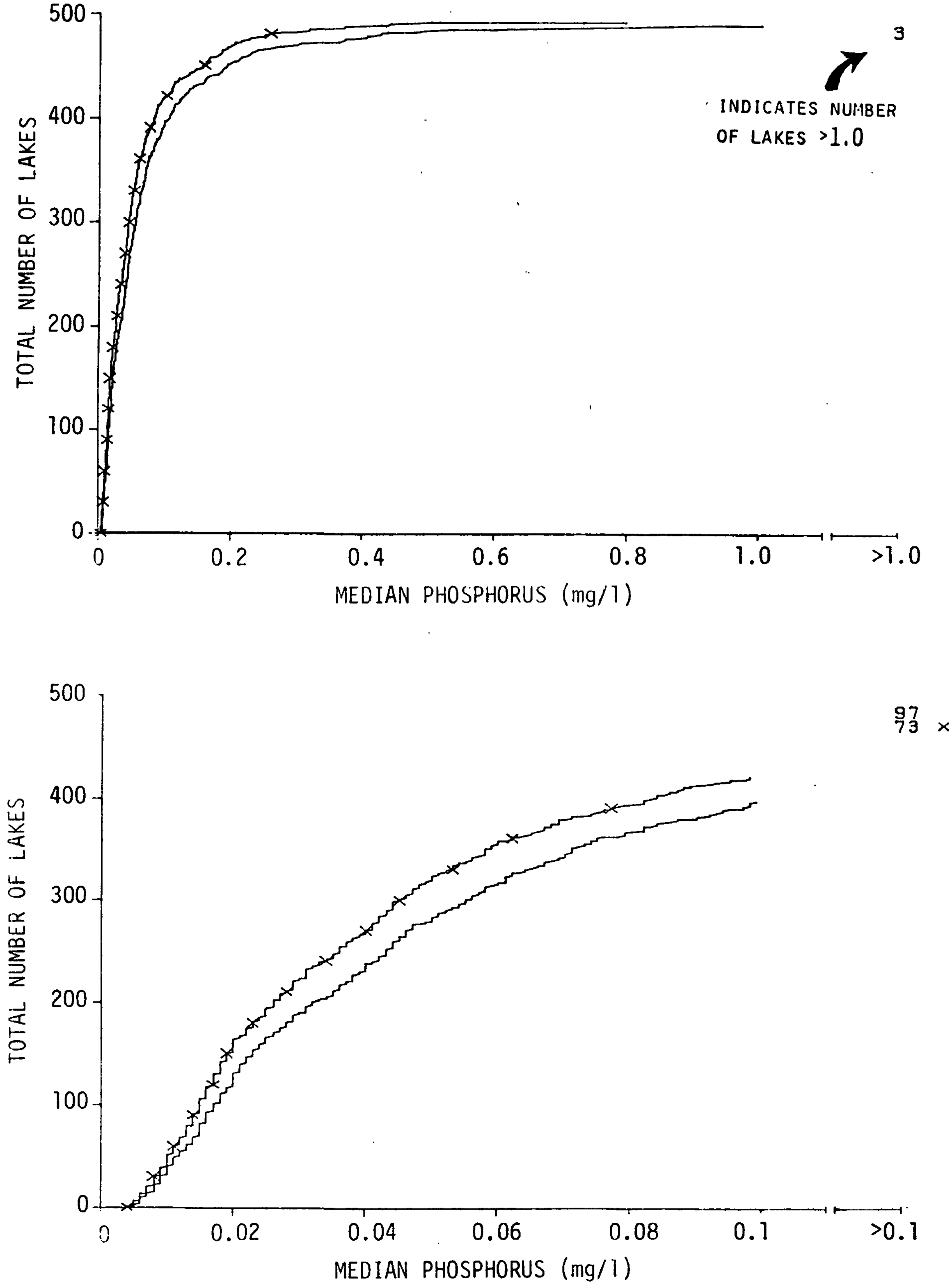


FIGURE V-5 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS, OPTION 2

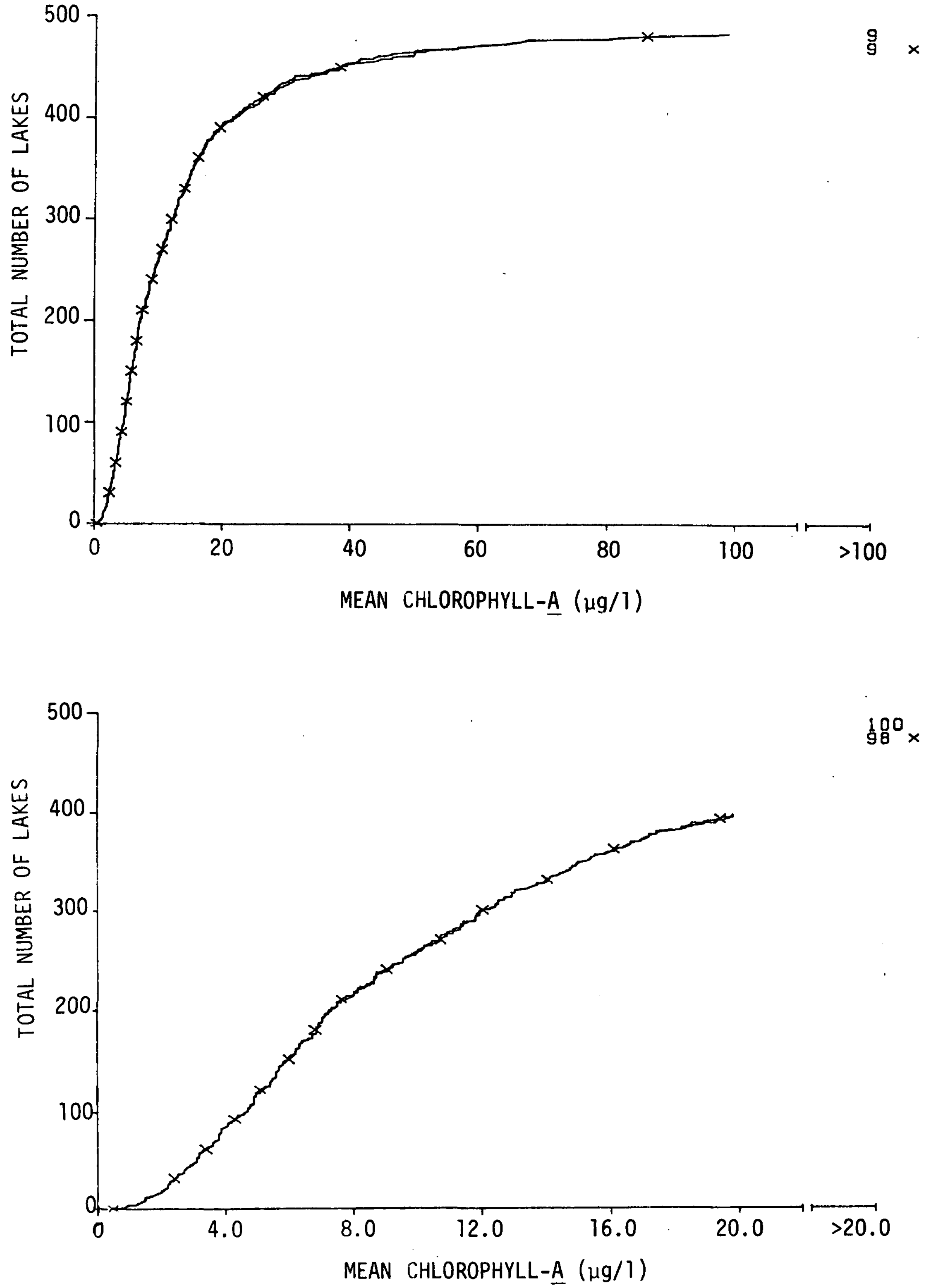


FIGURE V-6 DISTRIBUTION OF NEW AND OLD CHLOROPHYLL-A CONCENTRATIONS, OPTION 2

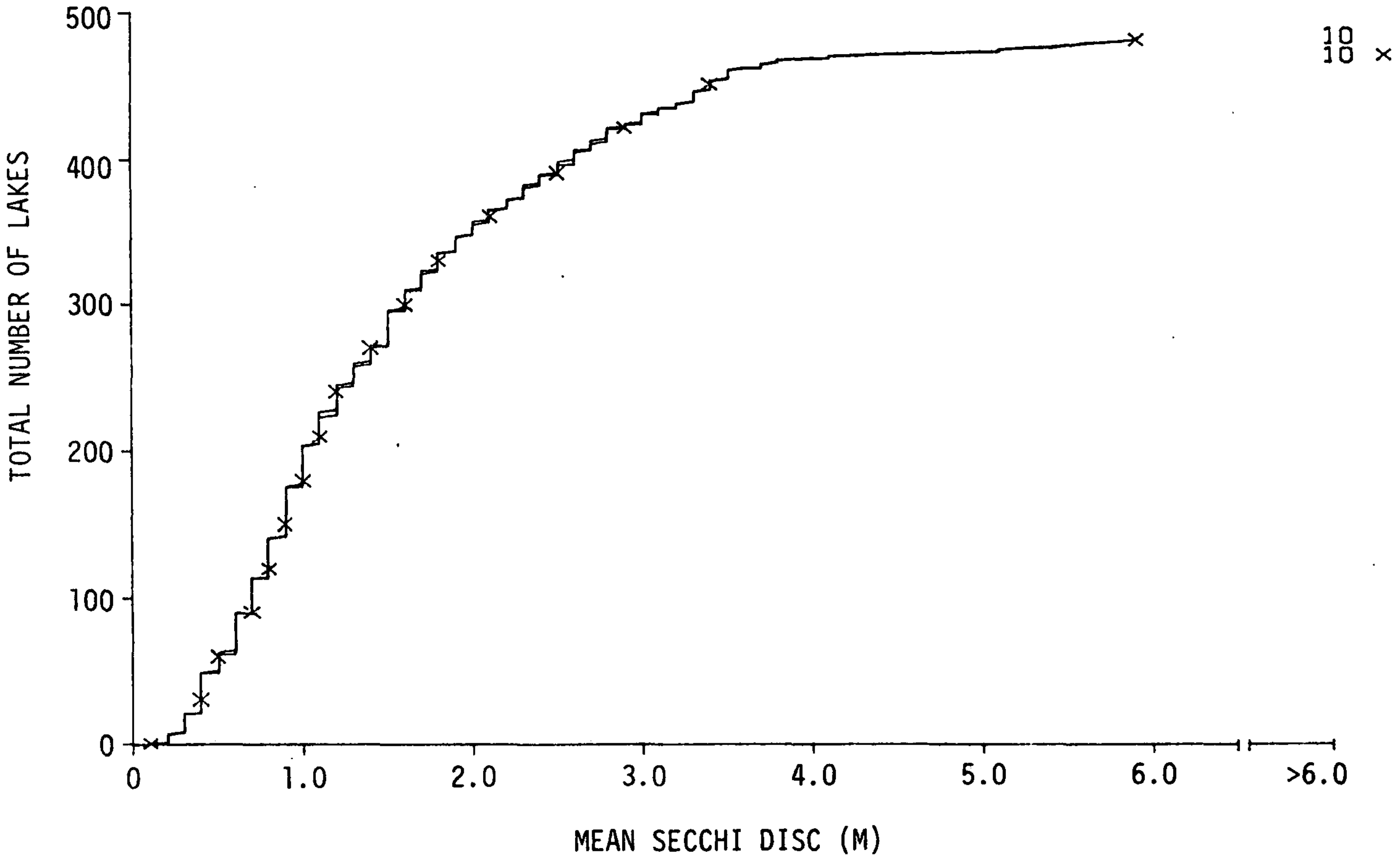


FIGURE V-7 DISTRIBUTION OF NEW AND OLD SECCHI DISC DEPTHS, OPTION 2

Table V-1

Effect of Control Option 2 on *In Situ* Total Phosphorus Concentrations

Year Surveyed	Original Loading Concentration, mg/l Minimum	Original Loading Concentration, mg/l Mean	Original Loading Concentration, mg/l Maximum	New Loading (80% Reduction in Municipal) Concentration, mg/l Minimum	New Loading (80% Reduction in Municipal) Concentration, mg/l Mean	New Loading (80% Reduction in Municipal) Concentration, mg/l Maximum
1972	0.004	0.141	1.525	0.004	0.070	0.795
1973	0.006	0.070	0.865	0.005	0.053	0.500
1974	0.010	0.075	0.489	0.007	0.071	0.438
1975	0.006	0.045	0.371	0.006	0.042	0.371
1972-75	0.004	0.084	1.525	0.004	0.059	0.795

Table V-2

Number and Fraction of Lakes with Median Phosphorus Concentrations Less Than 0.025 mg/l

Year Surveyed	Number of Lakes	Lakes with Total P <0.025 mg/l Old #	Old %	New #	New %	Change (New - Old) #	Change (New - Old) %
1972	119	36	30.3	50	42.0	14	11.7
1973	165	53	32.1	59	35.8	6	3.7
1974	115	27	23.5	31	27.0	4	3.5
1975	94	44	46.8	47	50.0	3	3.2
1972-75	493	160	32.5	187	37.9	27	5.4

for the set of lakes which do receive municipal effluent. It should be noted that in the NES survey a treatment plant located within 40 km (25 miles) of a lake was considered a municipal source. Plants located at more distant points on tributaries were not identified.

Table V-3 lists the total number of lakes in each years survey and the number of lakes which receive municipal effluent.

Figure V-8 shows the cumulative distribution of median phosphorus concentrations for the set of lakes (347 lakes) that have municipal sources. These data can be compared with Figure V-5, which is for all lakes surveyed. By considering only lakes with municipal sources the regional bias is removed and results are shown for the country as a whole. For this set of lakes the average total phosphorus concentration was predicted to decrease from 0.099 mg/l to 0.062 mg/l. The number of lakes with a total phosphorus concentration less than 0.025 mg/l would increase from 90 to 117 (27 lakes) or 8.6 percent.

Predicted new chlorophyll-a and Secchi disc values were indistinguishable from the old values.

Table V-3

Number of Lakes Surveyed and Number With Municipal Sources

Year Surveyed	Number of Lakes Surveyed	Number of Lakes With Municipal Sources	Percent With Municipal Sources
1972	119	100	84
1973	165	135	82
1974	115	69	60
1975	94	43	46
1972-75	493	347	70

Note: Loads from lakes in New York and Indiana were not changed. The resulting number of lakes with a computed decrease in load from municipal treatment was 335.

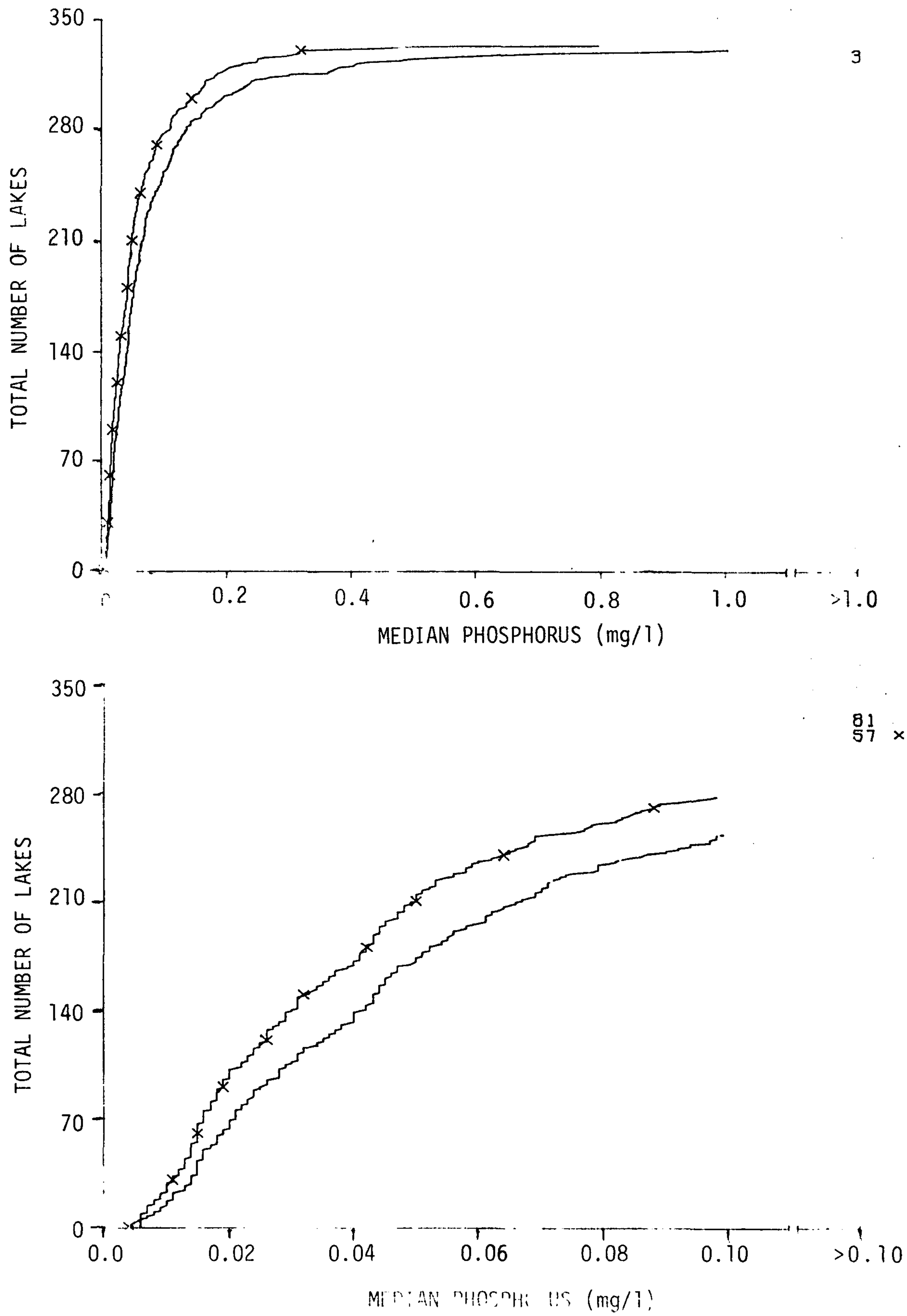


FIGURE V-8 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS (LAKES WITH MUNICIPAL TREATMENT PLANTS), OPTION 2

SECTION VI

CONTROL OPTION 3

20% NONPOINT SOURCE CONTROL

This section describes the results of analyzing the effects of a 20% reduction in nonpoint source phosphorus loading. The mass loadings of phosphorus from "rivers" and "direct runoff" were reduced by 20%. Figure VI-1 illustrates the distribution of old and new total phosphorus loading rates. It is evident that a 20% reduction in nonpoint source loads does not have a marked effect on loading.

METHODS

The procedures followed were as described in Section III. After computing a new total phosphorus load to each lake, the predicted *in situ* steady-state concentration of phosphorus was computed according to the procedures described in Section III. Chlorophyll-*a* concentrations and Secchi isc depths were subsequently computed for each lake. All computed values represent annual averages for each lake at steady-state.

RESULTS

Values of old and new total phosphorus loading, average *in situ* phosphorus concentration, chlorophyll-*a* concentration and Secchi disc depth for each lake are tabulated in Appendix B-3, both by geographical area (Figure II-13, page II-30) and for all lakes combined.

Figures VI-2 through VI-4 show the distribution of parameter values for the base case (NES data) and the control option for all lakes. New

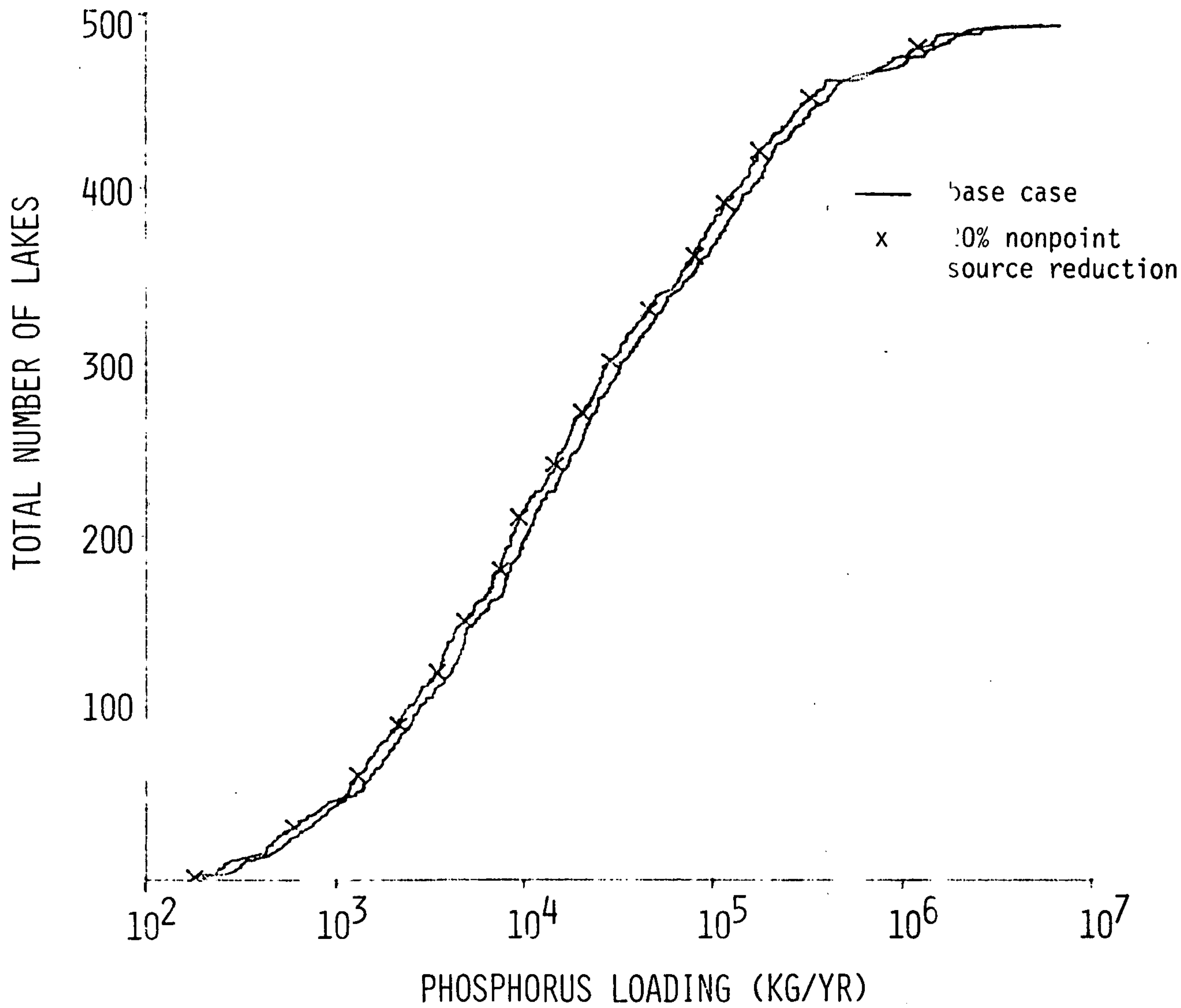


FIGURE VI-1 DISTRIBUTION OF NEW AND OLD PHOSPHORUS LOADING RATES, OPTION 3

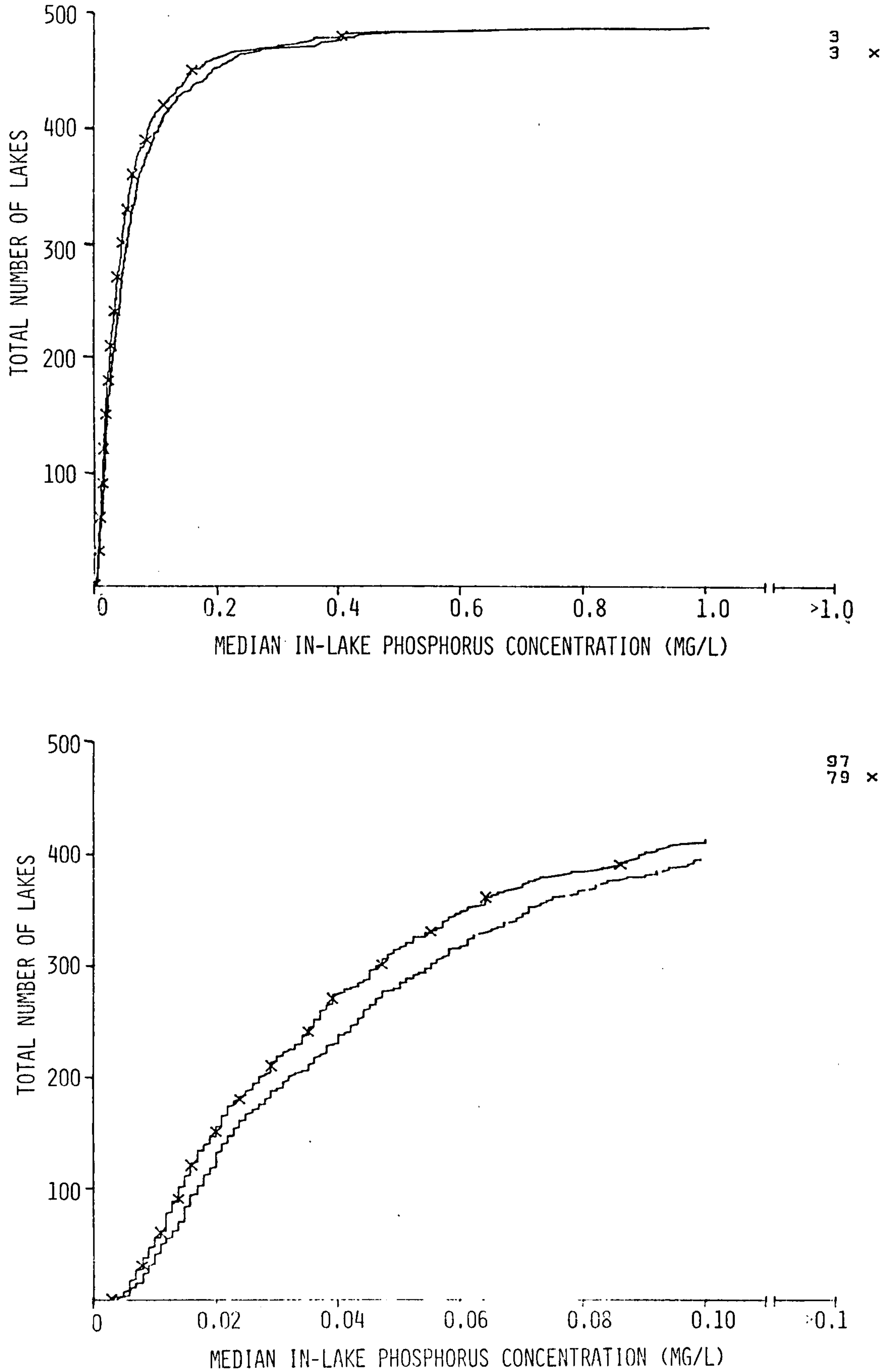
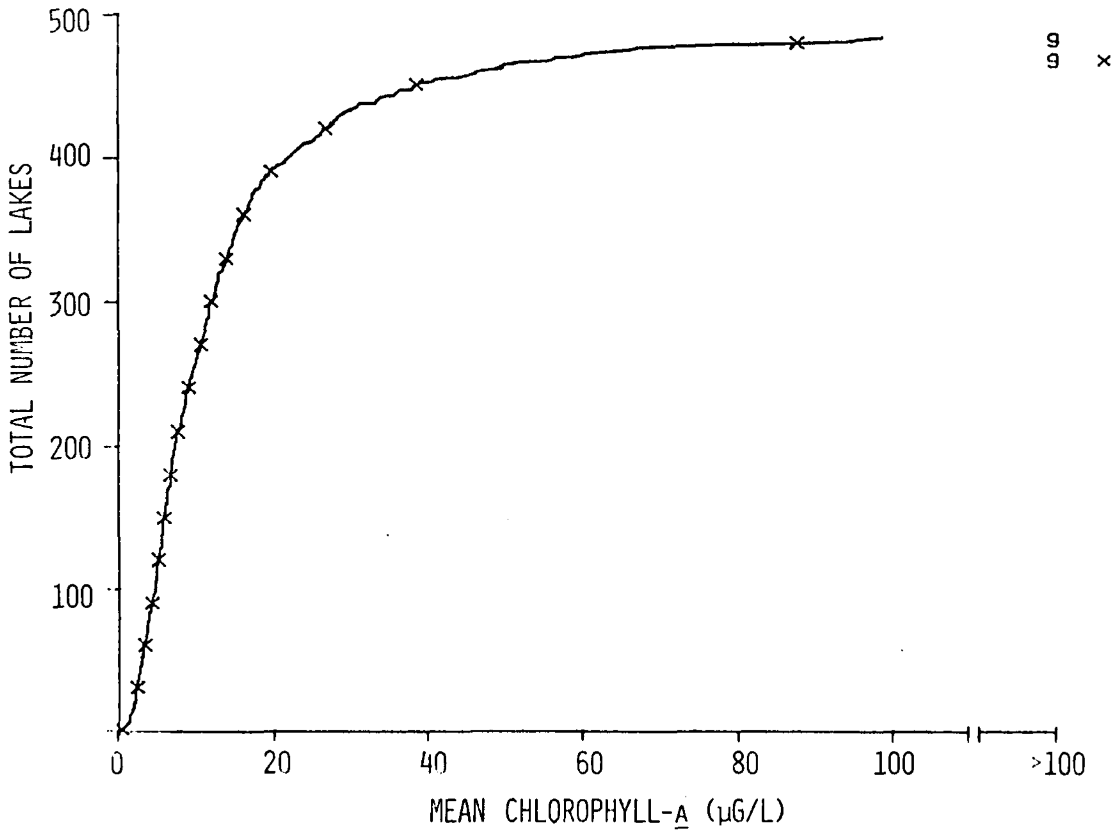


FIGURE VI-2 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS, OPTION 3



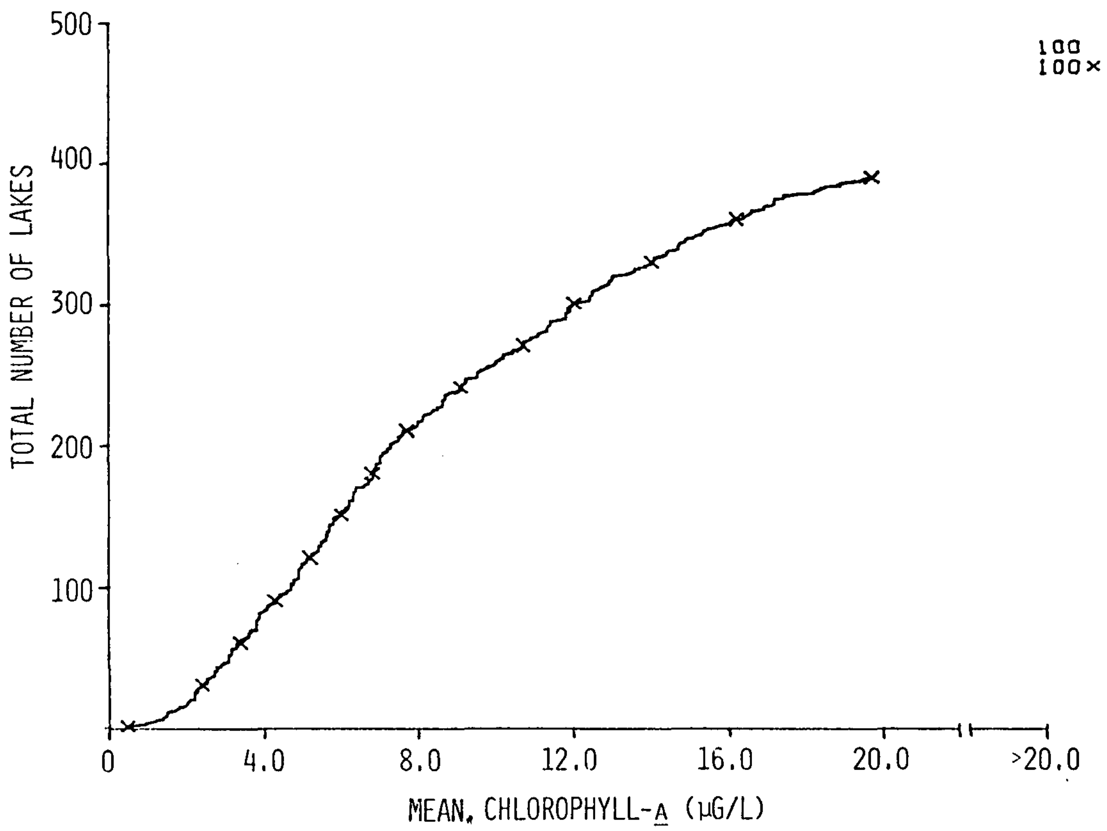


FIGURE VI-3 DISTRIBUTION OF NEW AND OLD MEAN CHLOROPHYLL-A CONCENTRATIONS, OPTION 3

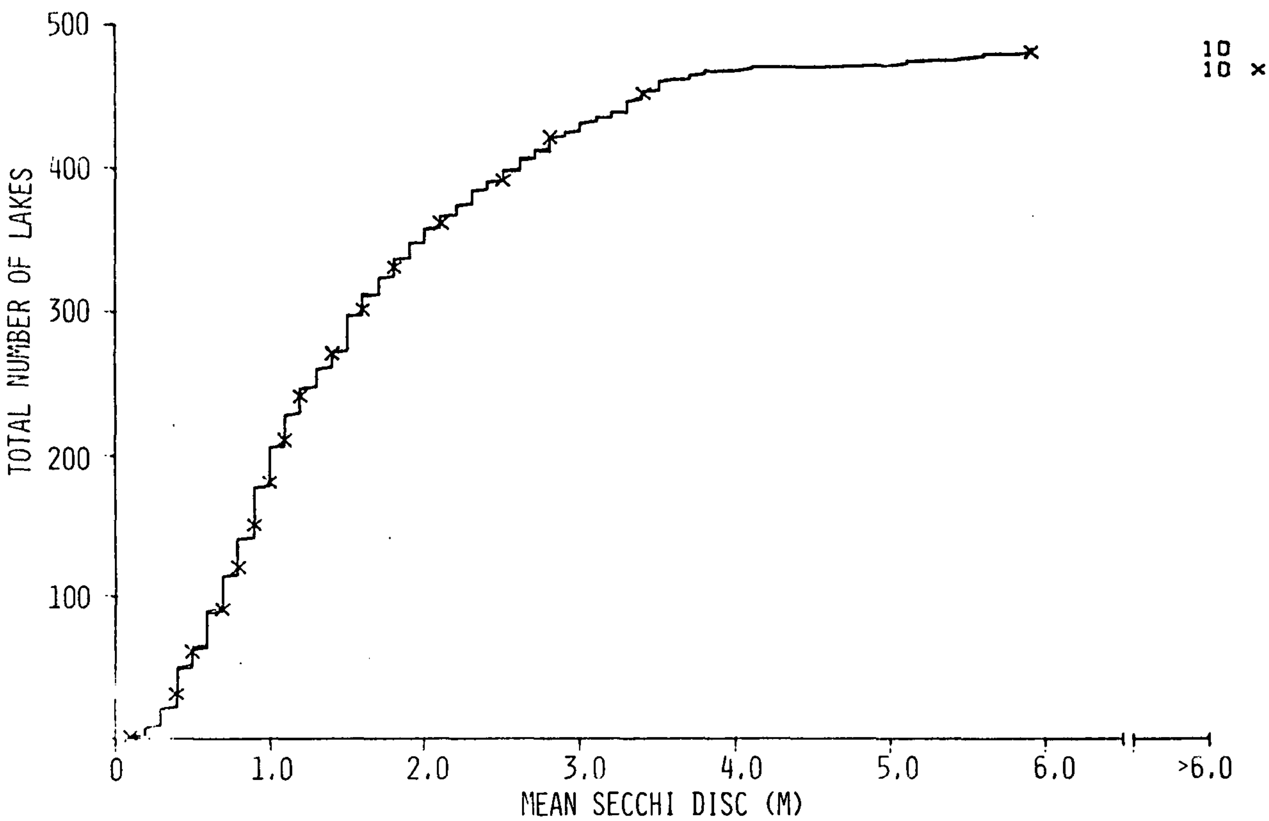


FIGURE VI-4 DISTRIBUTION OF NEW AND OLD MEAN SECCHI DISC DEPTHS, OPTION 3 and old median phosphorus concentrations for the lakes within each of the seven geographical areas are shown in Figures VI-5 through VI-11.

Because the chlorophyll-a levels and Secchi disc depths were relatively insensitive to changed phosphorus loading the following discussion is limited to effects of the control option on phosphorus concentrations.

For all 493 lakes used in the data base the effect of a 20% nonpoint source phosphorus reduction is shown in Figure VI-2 The mean value of predicted phosphorus concentrations is 0.074 mg/ℓ compared to 0.084 with no control. The number of lakes with a median phosphorus concentration less than 0.025 mg/ℓ increased from 160 to 183.

Table VI-1 summarizes the results for all lakes and for subsets of lakes grouped by geographical area. Table VI-2 summarizes the number and fraction of lakes with median phosphorus concentrations less than 0.025 mg/ℓ.

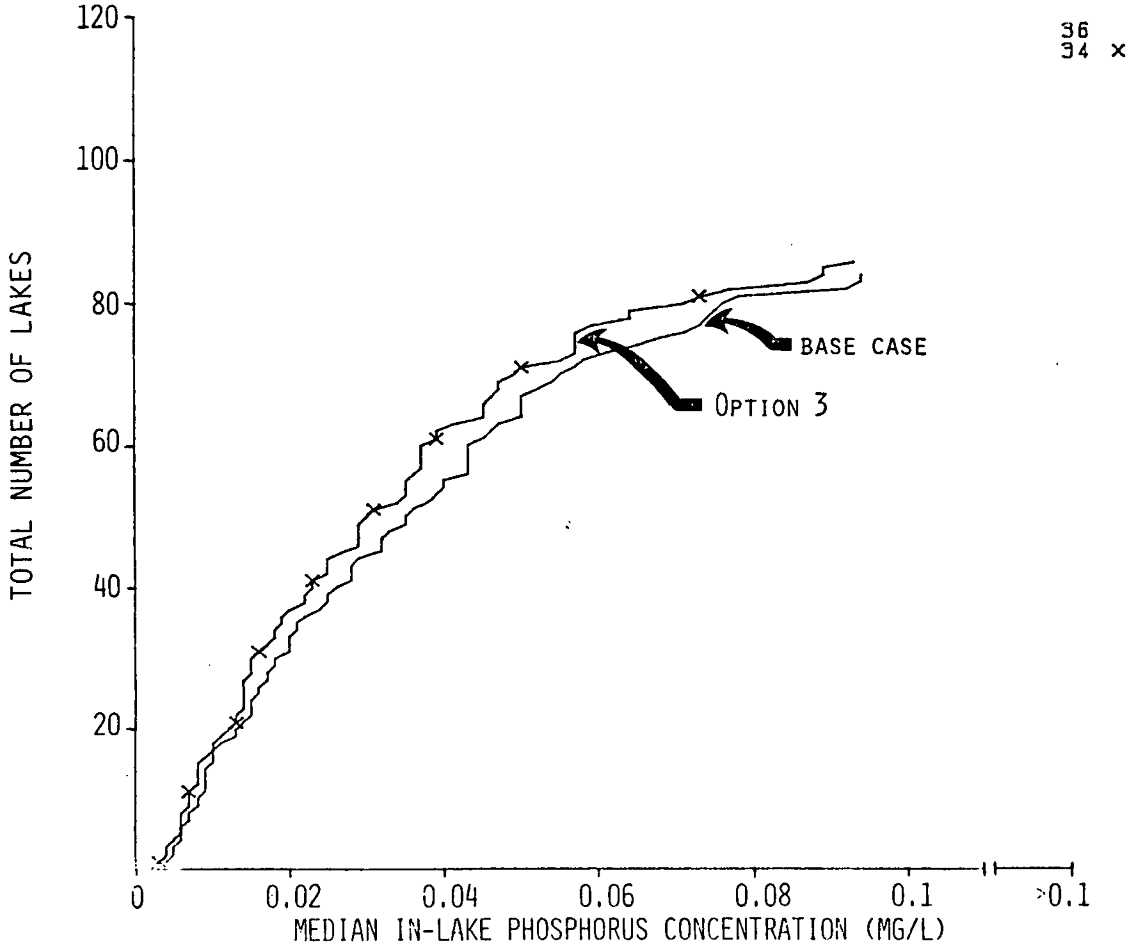


FIGURE VI-5 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 1, OPTION 3

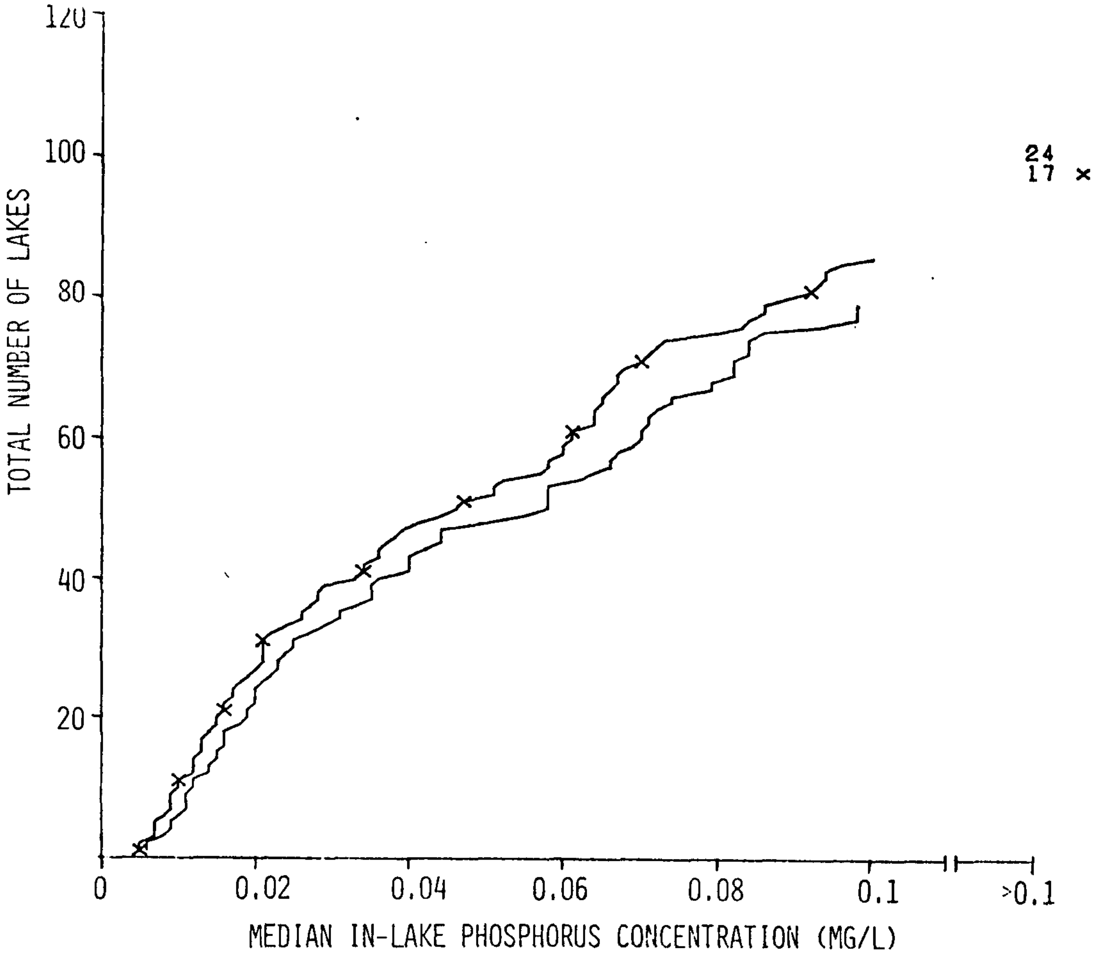


FIGURE VI-6 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 2, OPTION 3

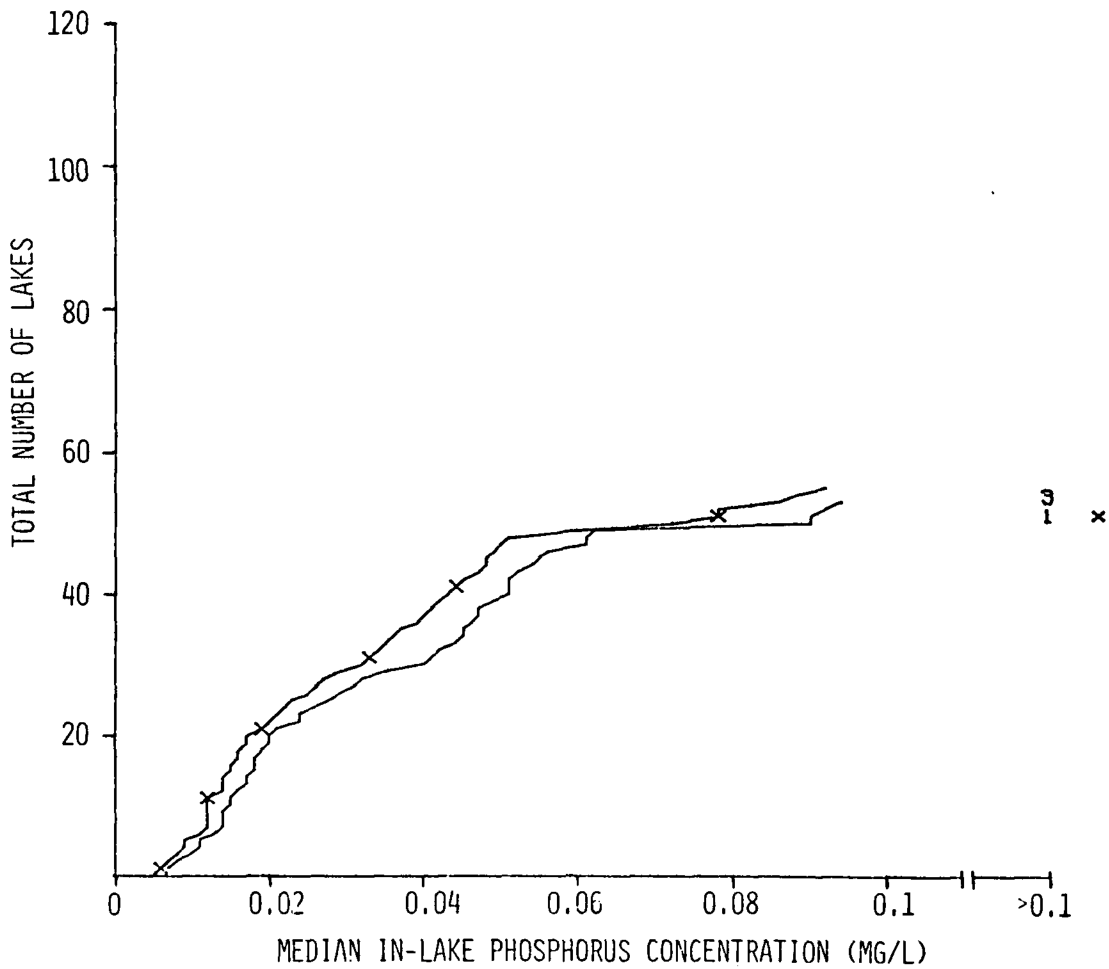


FIGURE VI-7 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 3, OPTION 3

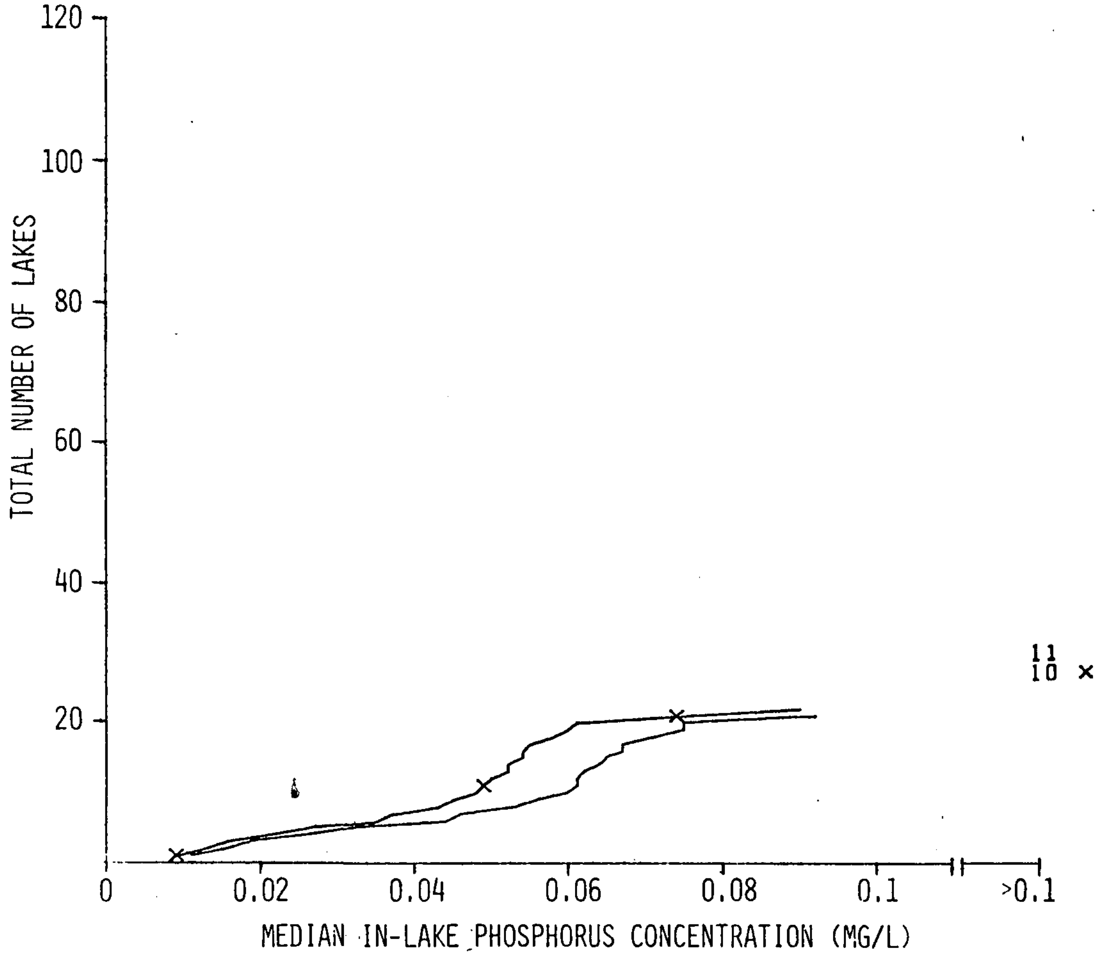


FIGURE VI-8 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 4, OPTION 3

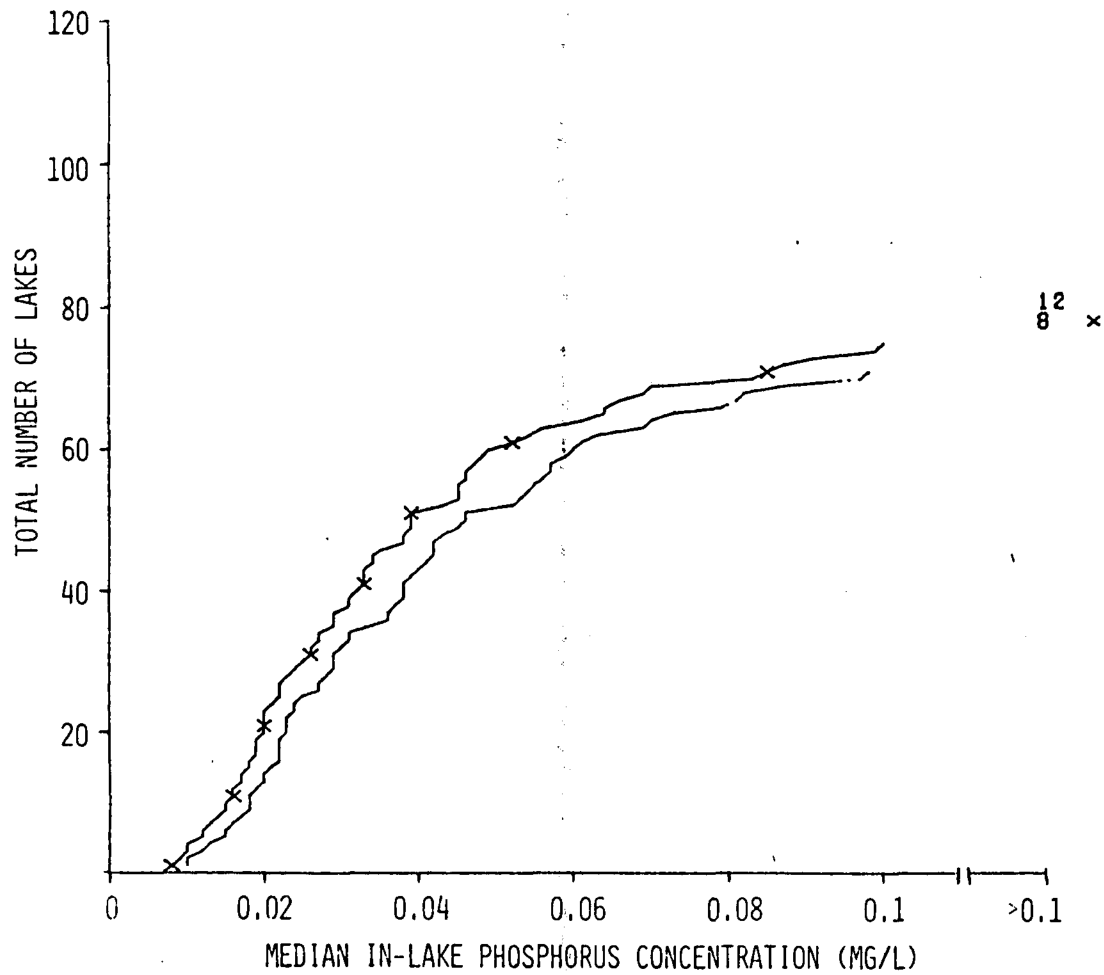


FIGURE VI-9 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 5, OPTION 3

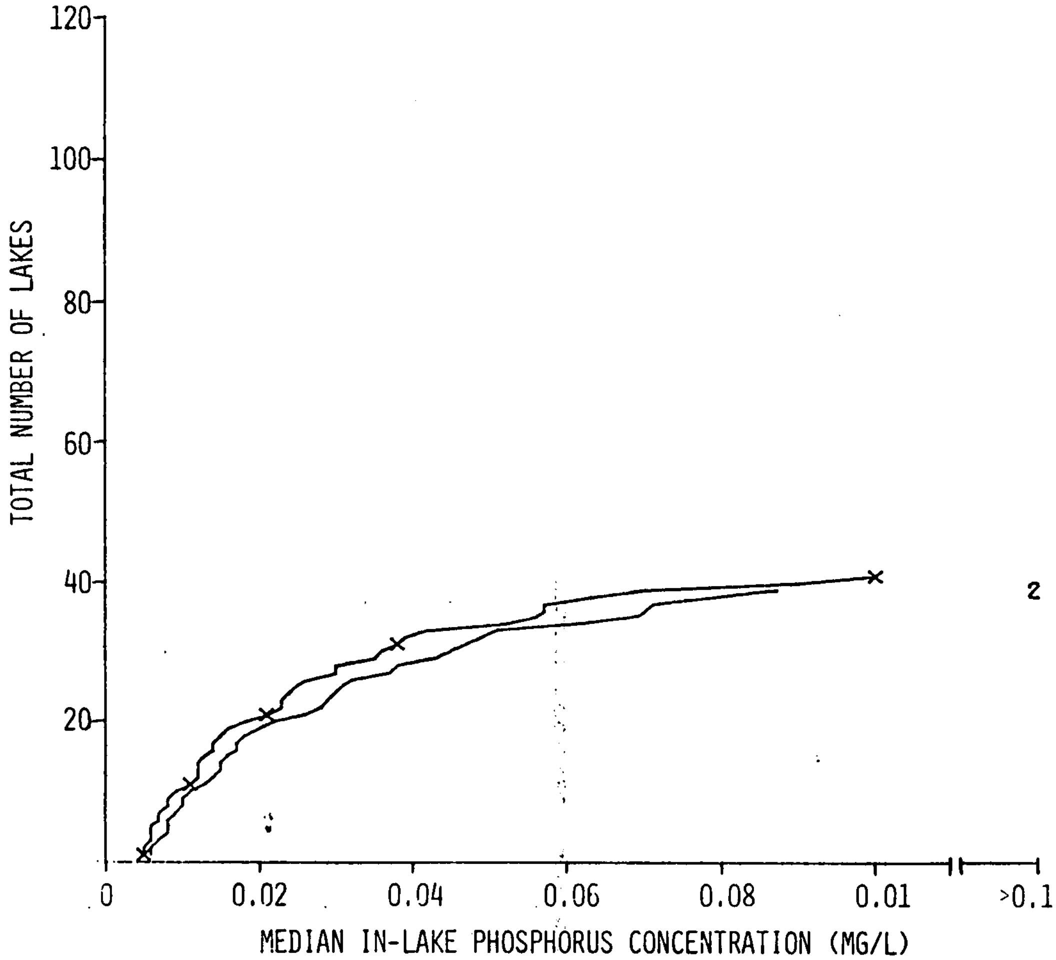


FIGURE VI-10 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 6, OPTION 3

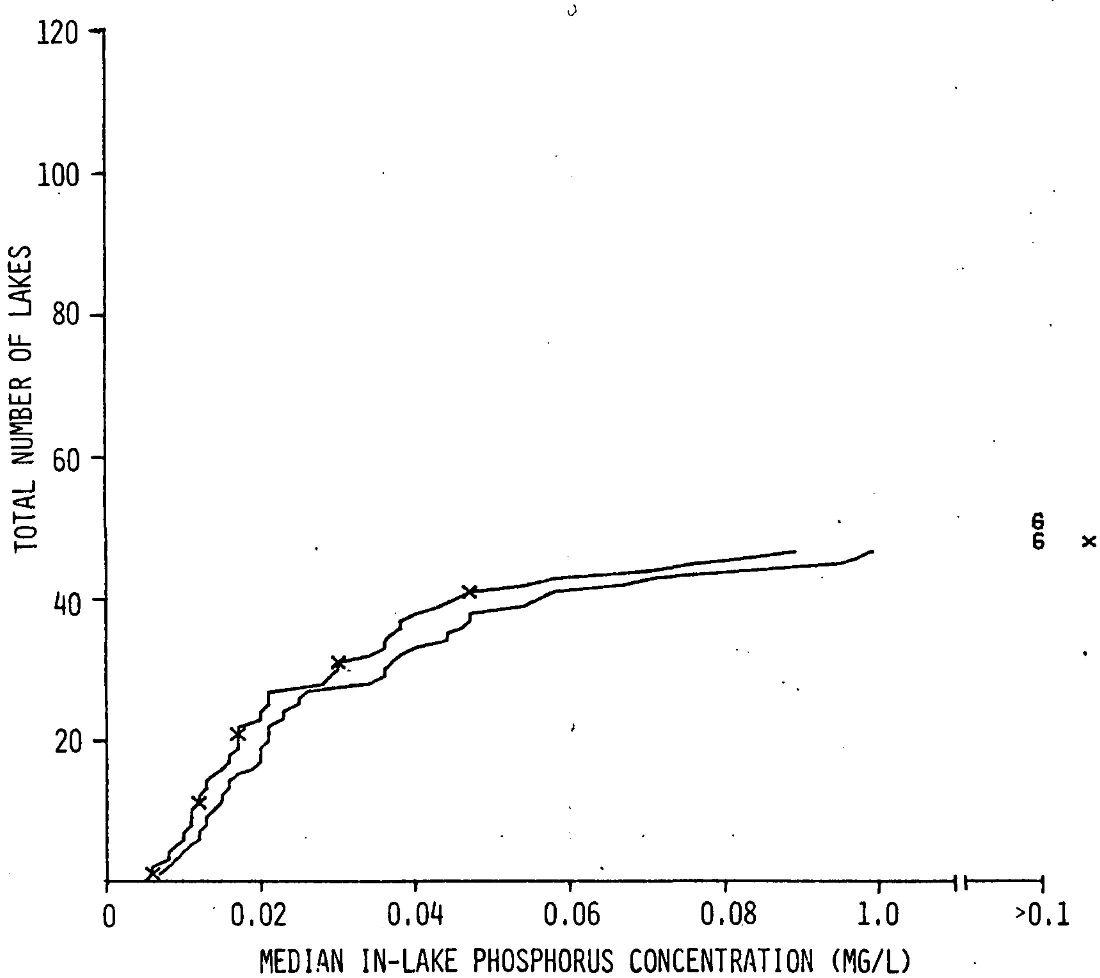


FIGURE VI-11 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 7, OPTION 3

Table VI-1

Effect of Control Option 3 on In Situ Total Phosphorus Concentrations

Region	Number of Lakes	Original Loading Concentration, mg/ℓ			New Loading (20% Nonpoint Reduction) Concentration, mg/ℓ		
		Minimum	Mean	Maximum	Minimum	Mean	Maximum
1	120	0.004	0.141	1.525	0.003	0.132	1.522
2	108	0.006	0.086	0.865	0.005	0.073	0.784
3	56	0.007	0.041	0.143	0.006	0.035	0.136
4	32	0.011	0.121	0.489	0.009	0.099	0.405
5	83	0.010	0.058	0.424	0.008	0.048	0.339
6	41	0.006	0.034	0.115	0.005	0.028	0.100
7	53	0.007	0.054	0.371	0.006	0.045	0.298
All	493	0.004	0.084	1.525	0.003	0.074	1.522

Table VI-2

Number and Fraction of Lakes with Median Phosphorus Concentrations Less Than 0.025 mg/ℓ

Region	Number of Lakes	Lakes with Total P <0.025 mg/ℓ Old		New		Change (New - Old)	
		#	%	#	%	#	%
1	120	37	31	41	34	4	3
2	108	29	27	33	31	4	4
3	56	23	41	25	45	2	4
4	32	3	9	4	13	1	4
5	83	24	29	29	35	5	6
6	41	20	49	24	59	4	10
7	53	24	45	27	51	3	6
All	493	160	32	183	37	23	5

SECTION VII

CONTROL OPTION 4

40% NONPOINT SOURCE CONTROL

This section describes the results of analyzing the effects of a 40% reduction in nonpoint source phosphorus loading. The mass loadings of phosphorus from "rivers" and "direct runoff" were reduced by 40%. Figure VII-1 illustrates the distribution of old and new total phosphorus loading rates. It is evident that a 40% reduction in nonpoint source loads has a marginal effect on loading rates.

METHODS

The procedures followed were as described in Section III. After computing a new total phosphorus load to each lake, the predicted *in situ* steady-state concentration of phosphorus was computed according to the procedures described in Section III. Chlorophyll-*a* concentrations and Secchi disc depths were subsequently computed for each lake. All computed values represent annual averages for each lake at steady-state.

RESULTS

Values of old and new total phosphorus loading, average *in situ* phosphorus concentration, chlorophyll-*a* concentration and Secchi disc depth for each lake are tabulated in Appendix B-4, both by geographical area (Figure II-13, page II-30) and for all lakes combined.

Figures VII-2 through VII-4 show the distribution of parameter values for the base case (NES data) and the control option for all

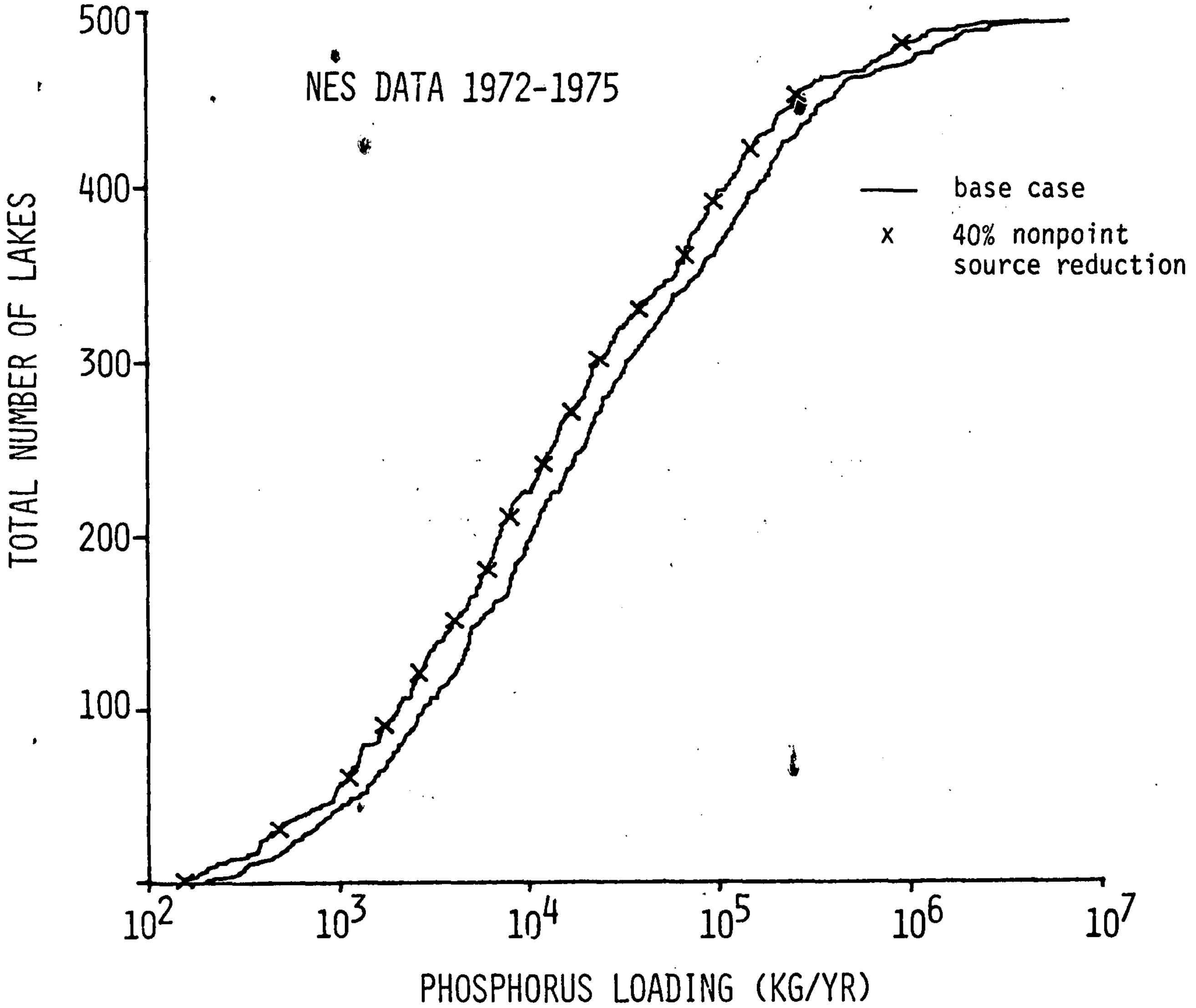
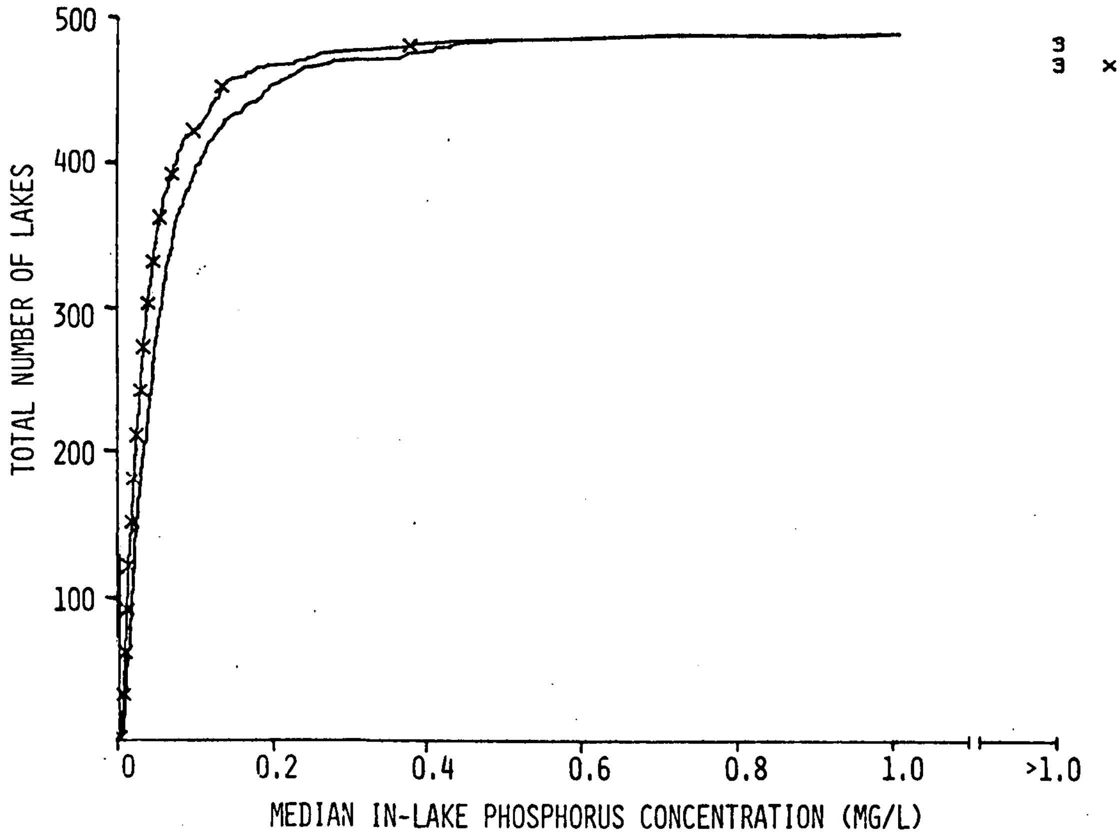


FIGURE VII-1 DISTRIBUTION OF NEW AND OLD PHOSPHORUS LOADING RATES, OPTION 4



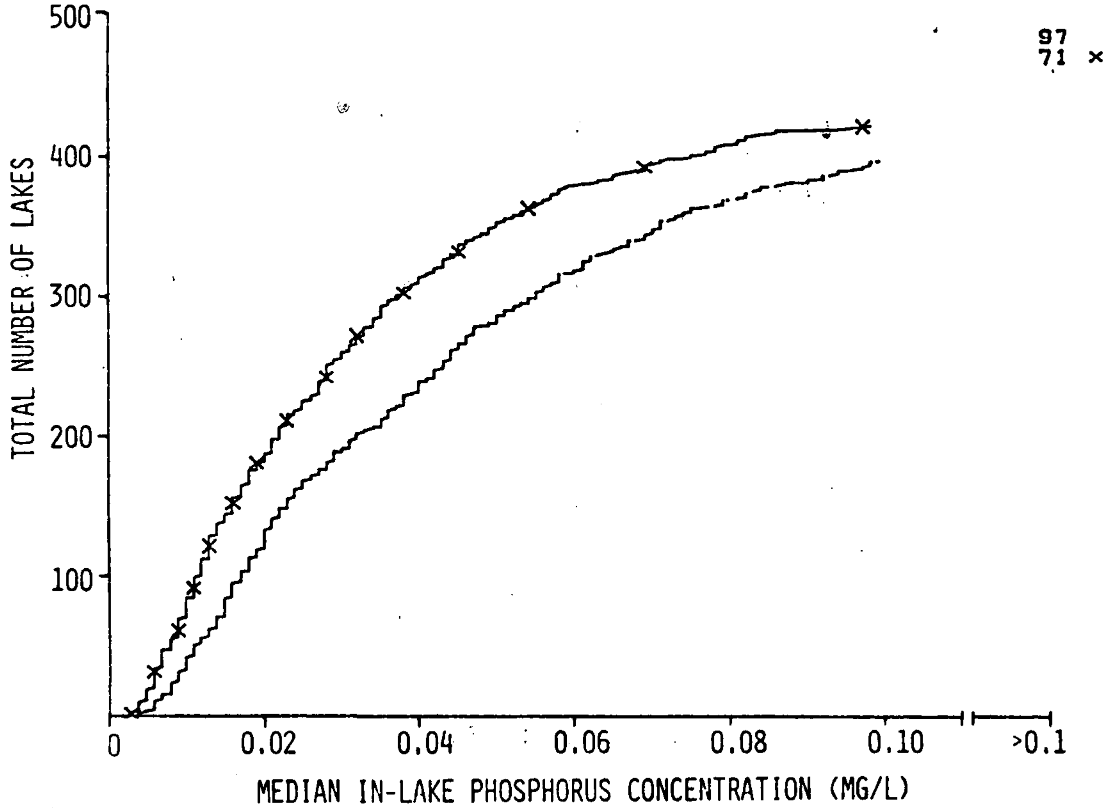
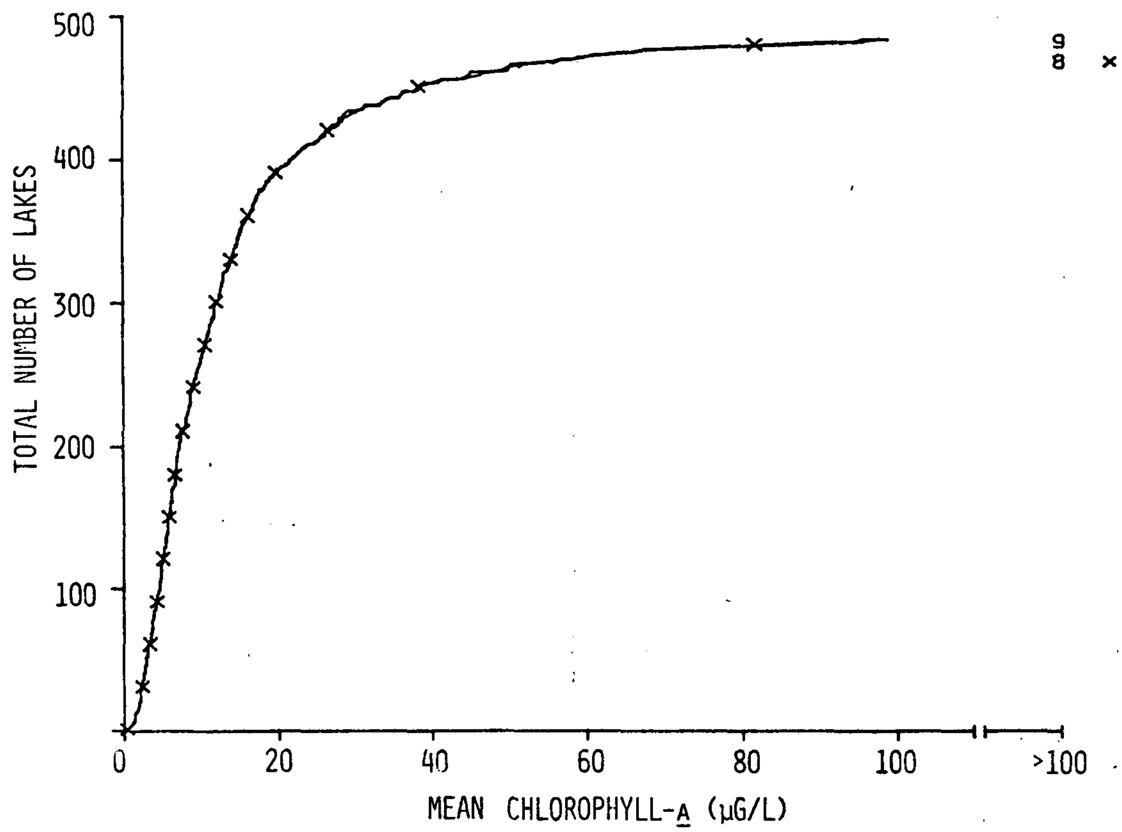


FIGURE VII-2 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS, OPTION 4



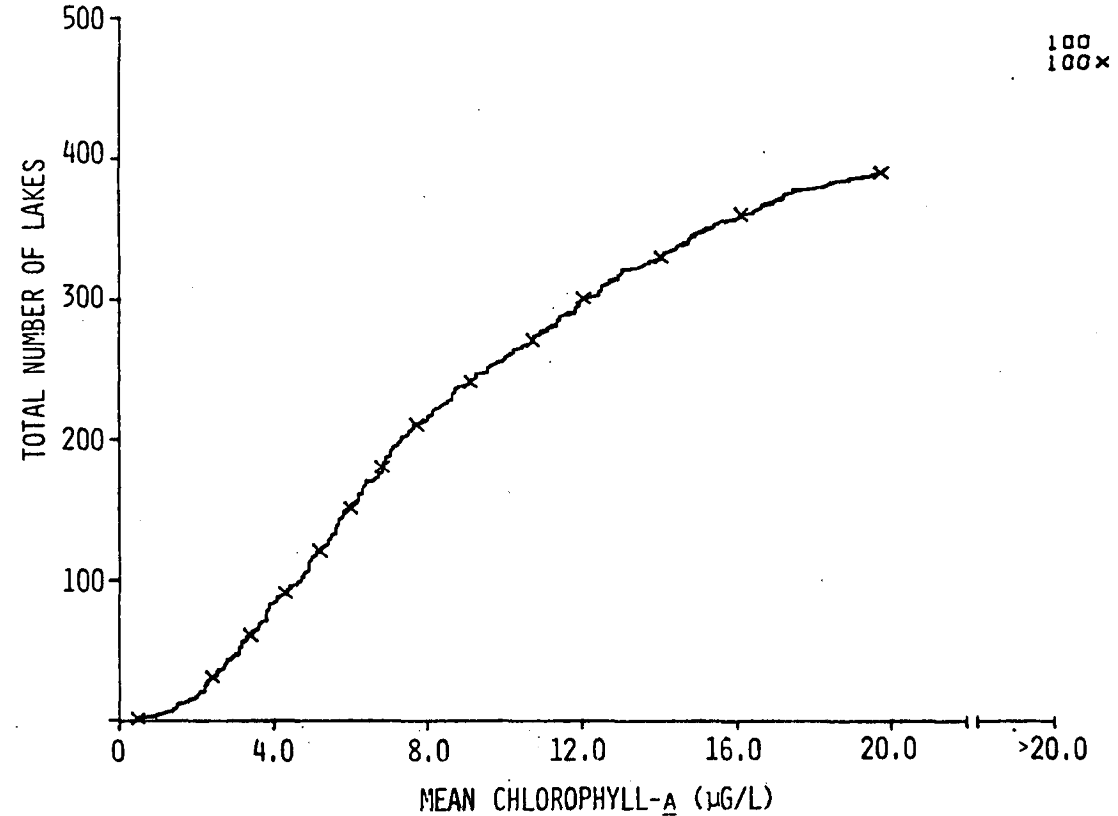


FIGURE VII-3 DISTRIBUTION OF NEW AND OLD MEAN CHLOROPHYLL-A CONCENTRATIONS, OPTION 4

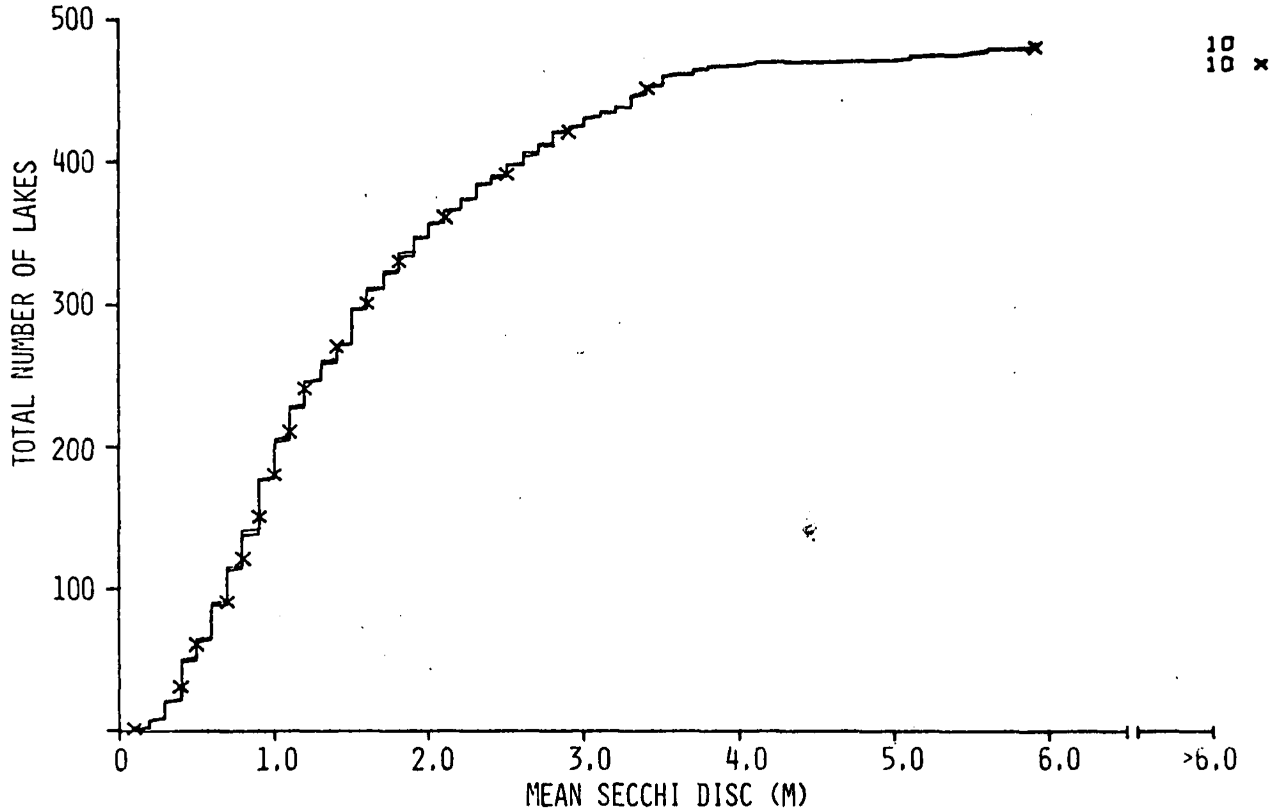


FIGURE VII-4 DISTRIBUTION OF NEW AND OLD MEAN SECCHI DISC DEPTHS, OPTION 4 lakes. New and old median phosphorus concentrations for the lakes within each of the seven geographical areas are shown in Figures VII-5 through VII-11.

Because the chlorophyll-a levels and Secchi disc depths were relatively insensitive to changed phosphorus loading the following discussion is limited to effects of the control option on phosphorus concentrations.

For all 493 lakes used in the data base the effect of a 40% nonpoint source phosphorus reduction is shown in Figure VII-2. The mean value of predicted phosphorus concentration is 0.064 mg/ℓ compared to 0.084 with no control. The number of lakes with median phosphorus concentrations less than 0.025 mg/ℓ increased from 160 to 218.

Table VII-1 summarizes the results for all lakes and for subsets of lakes grouped by geographical area. Table VII-2 summarizes the number and fraction of lakes with median phosphorus concentrations less than 0.025 mg/ℓ.

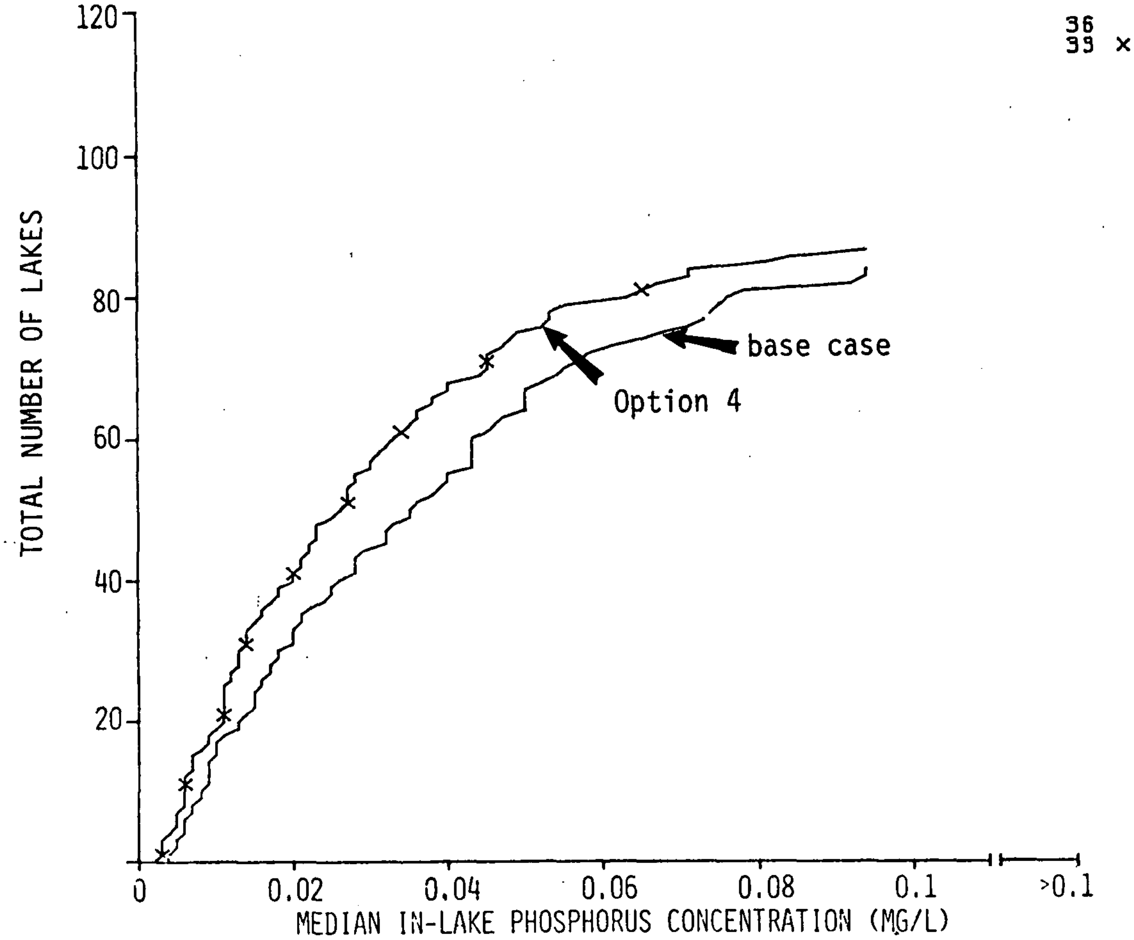


FIGURE VII-5 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 1, OPTION 4

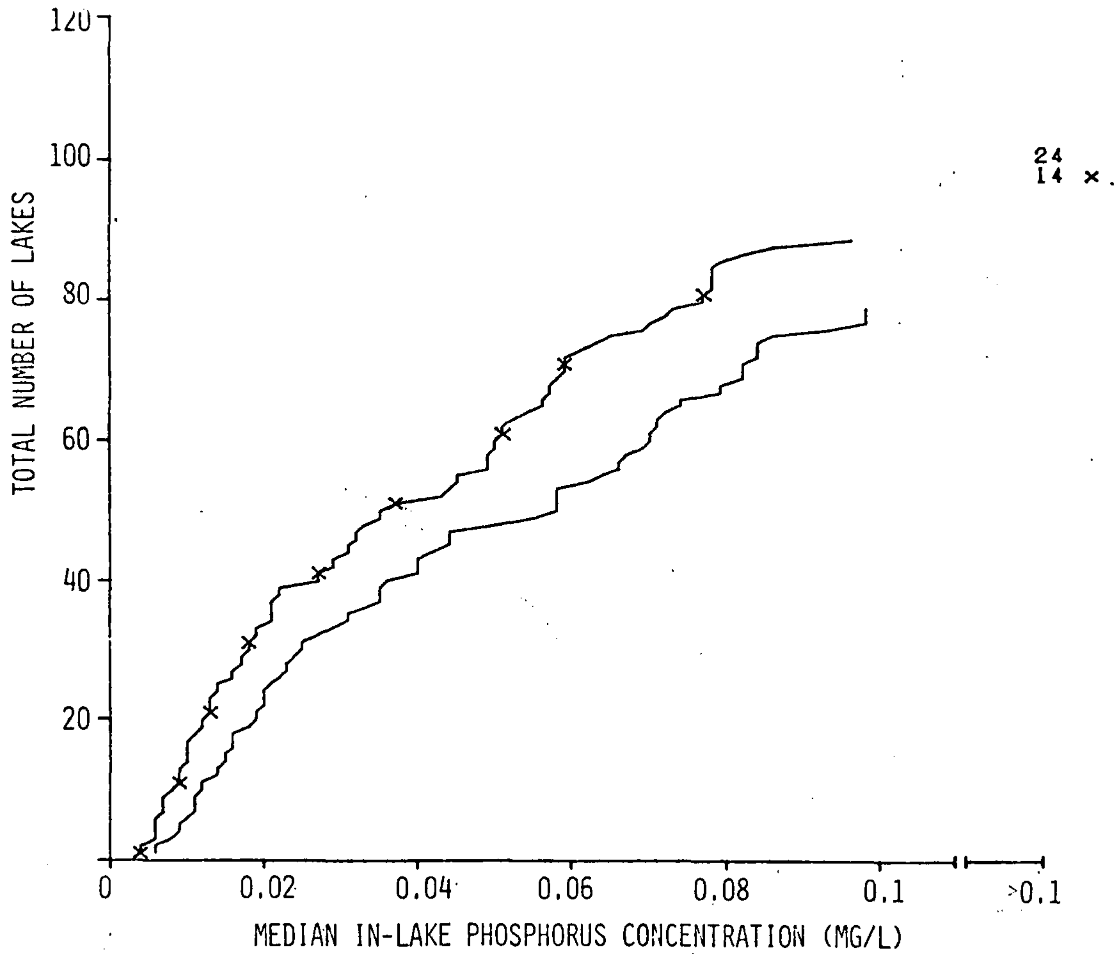


FIGURE VII-6 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 2, OPTION 4

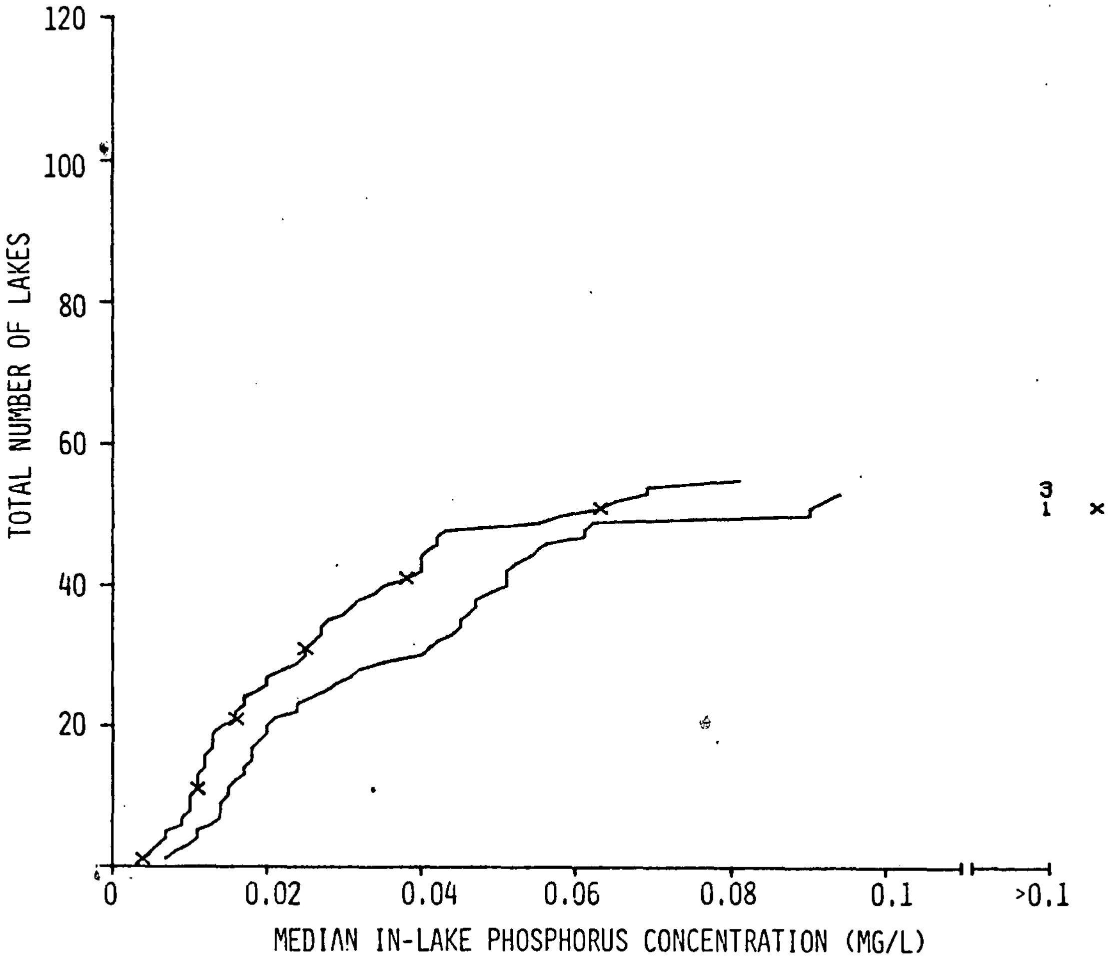


FIGURE VII-7 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 3, OPTION 4

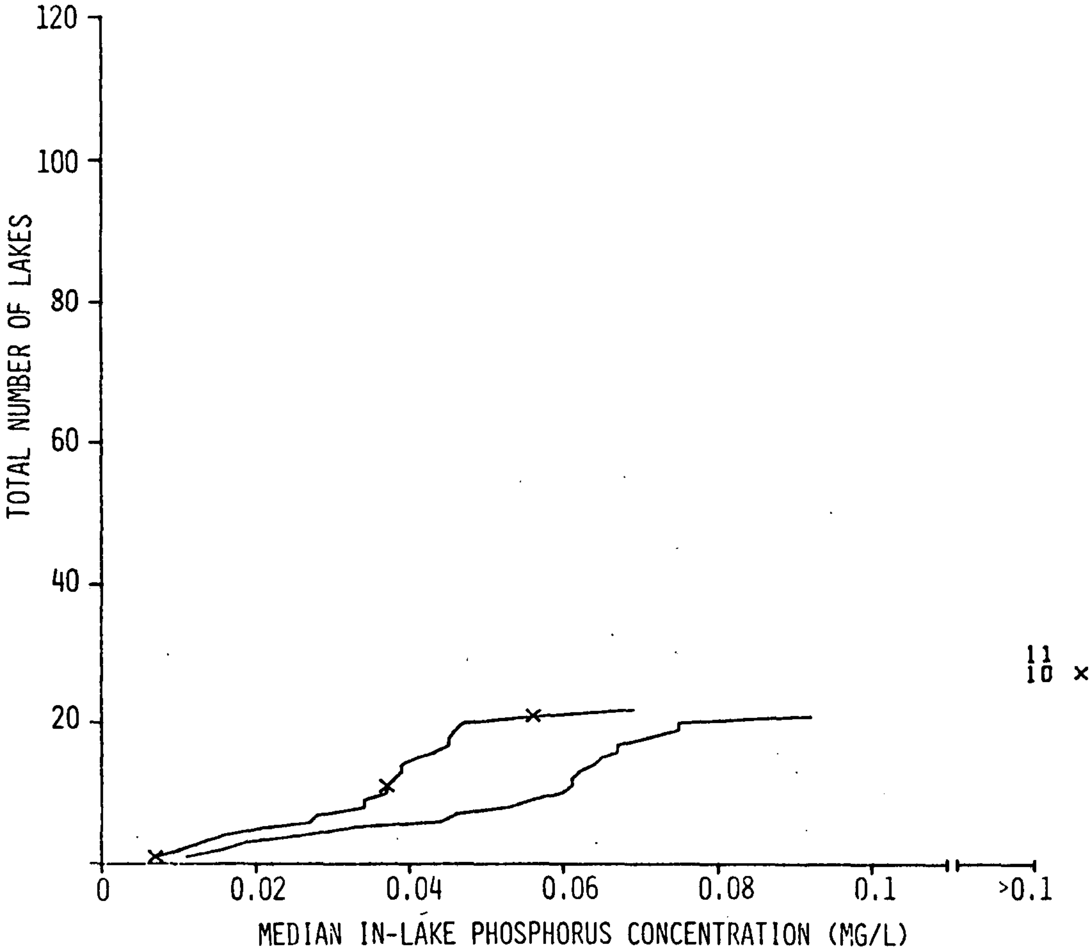


FIGURE VII-8 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 4, OPTION 4

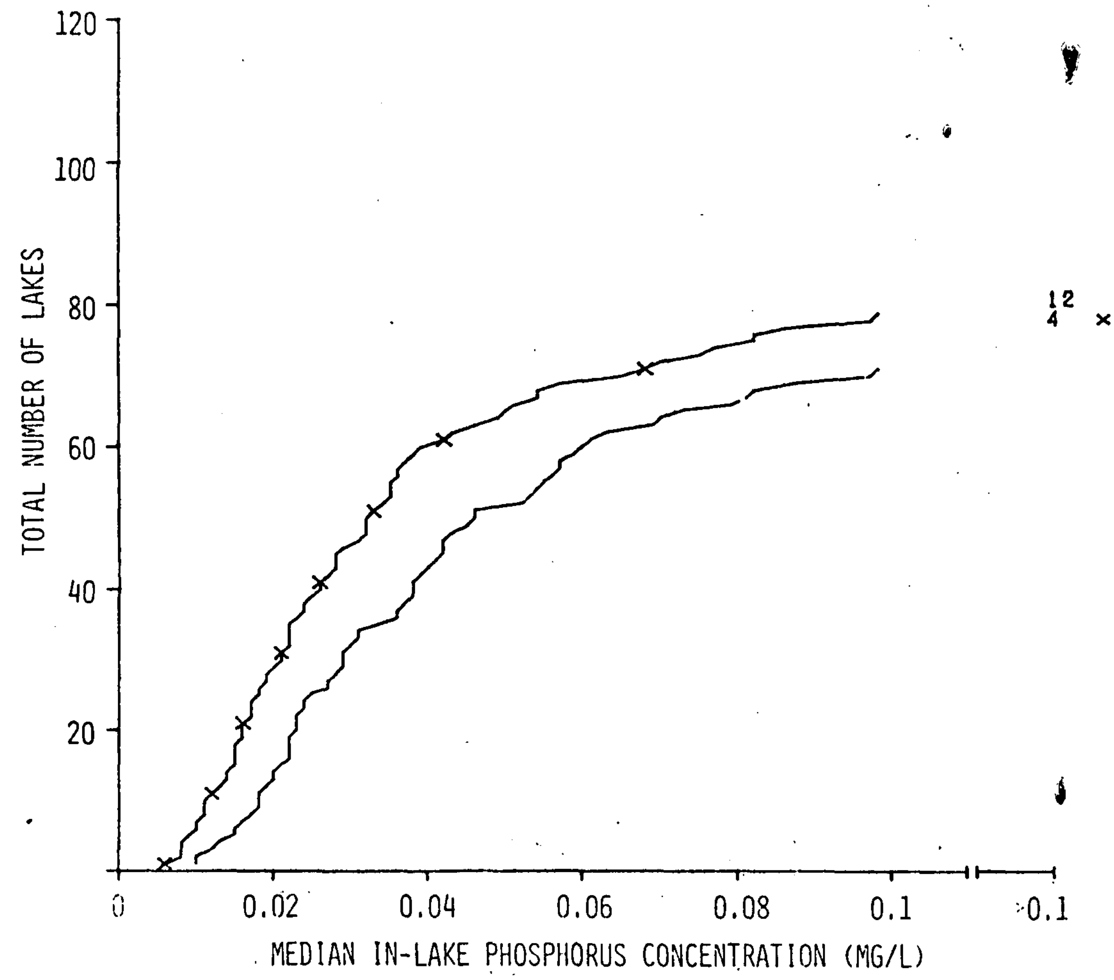


FIGURE VII-9 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 5, OPTION 4

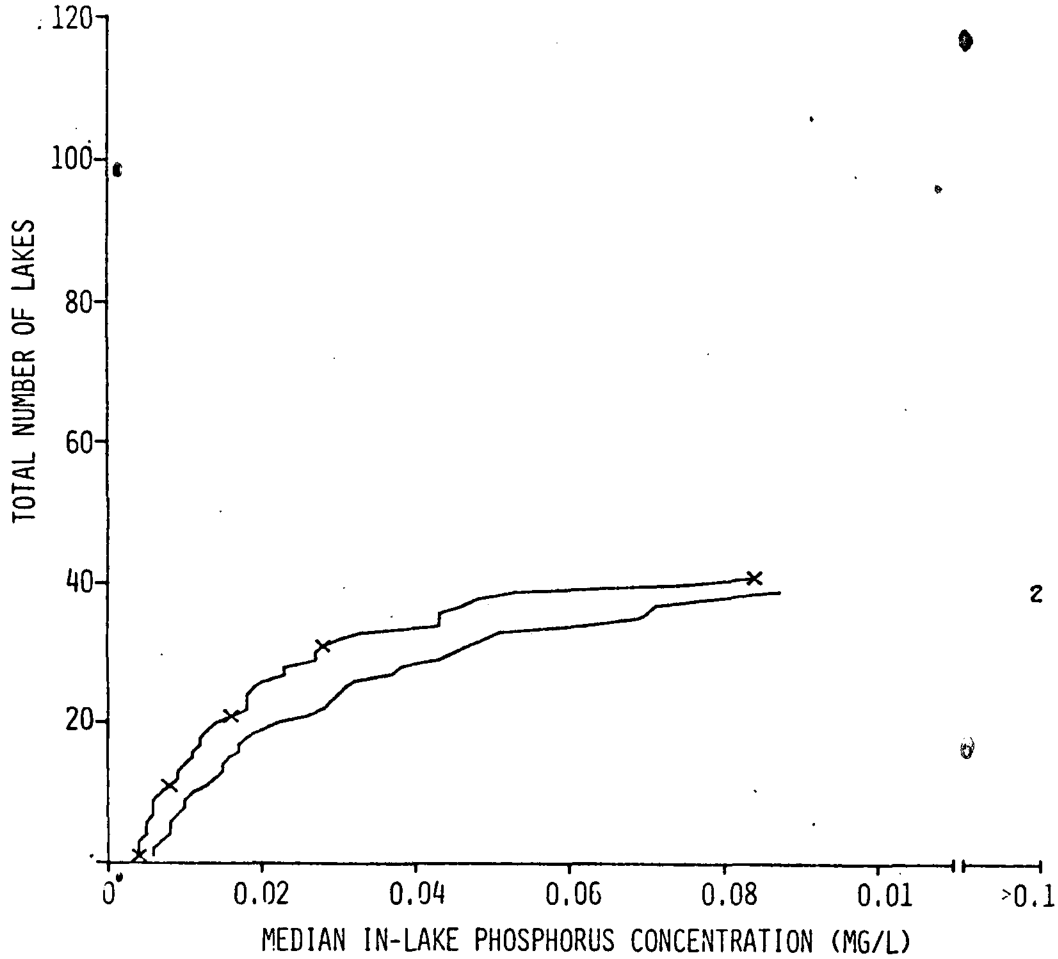


FIGURE VII-10 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 6, OPTION 4

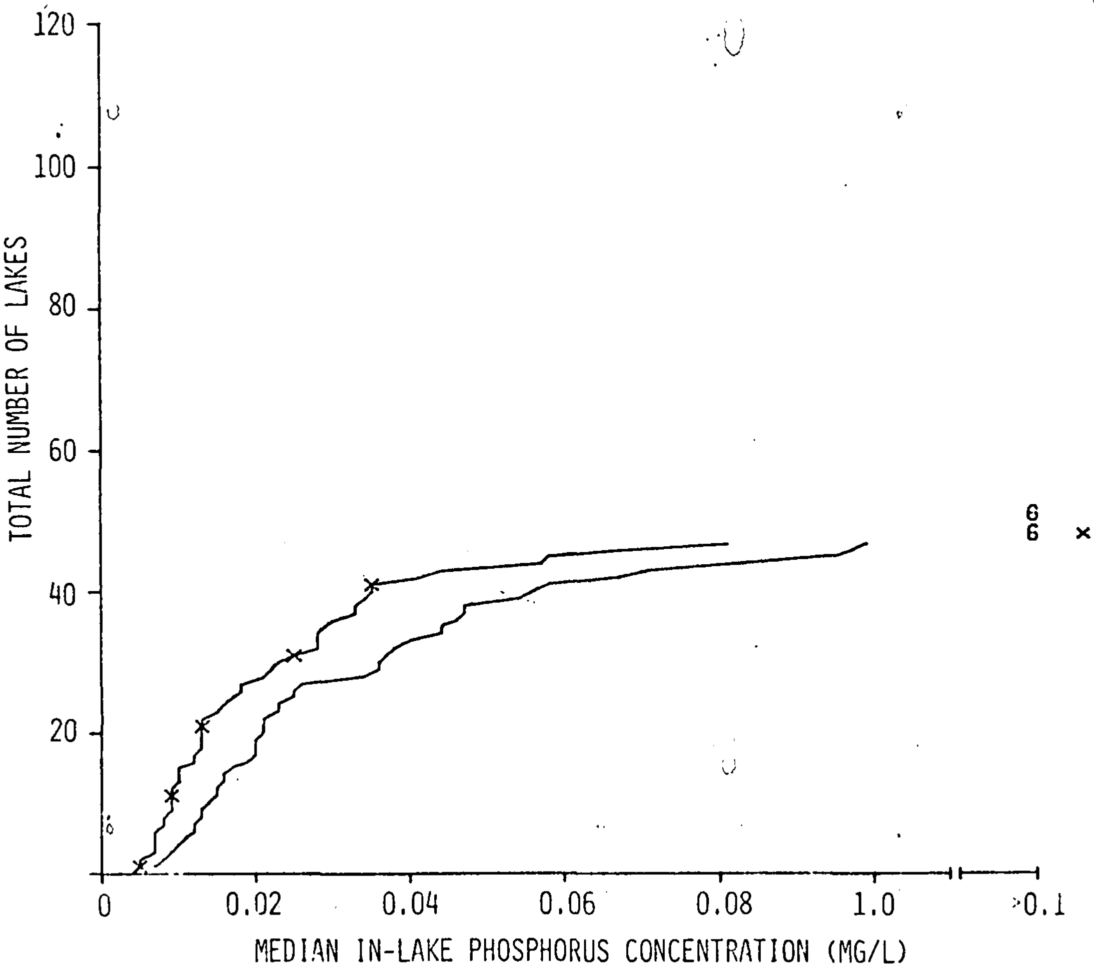


FIGURE VII-11 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 7, OPTION 4

Table VII-1

Effect of Control Option 4 on *In Situ* Total Phosphorus Concentrations

Region	Number of Lakes	Original Loading			New Loading (40% Nonpoint Source Reduction)		
		Concentration, mg/ℓ			Concentration, mg/ℓ		
		Minimum	Mean	Maximum	Minimum	Mean	Maximum
1	120	0.004	0.141	1.525	0.003	0.124	1.520
2	108	0.006	0.086	0.865	0.004	0.064	0.703
3	56	0.007	0.041	0.143	0.004	0.029	0.128
4	32	0.011	0.121	0.489	0.007	0.076	0.321
5	83	0.010	0.058	0.424	0.006	0.038	0.254
6	41	0.006	0.034	0.115	0.004	0.022	0.084
7	53	0.007	0.054	0.371	0.005	0.036	0.225
All	493	0.004	0.084	1.525	0.003	0.064	1.520

Table VII-2

Number and Fraction of Lakes with Median Phosphorus Concentrations Less Than 0.025 mg/ℓ

Region	Number of Lakes	Lakes with Total P <0.025 mg/ℓ				Change (New - Old)	
		Old		New			
		#	%	#	%	#	%
1	120	37	31	48	40	11	9
2	108	29	27	40	37	11	10
3	56	23	41	29	52	6	11
4	32	3	9	5	16	2	7
5	83	24	29	38	46	14	17
6	41	20	49	28	68	8	19
7	53	24	45	30	57	6	12
All	493	160	32	218	44	58	12

SECTION VIII

CONTROL OPTION 5

60% NONPOINT SOURCE CONTROL

This section describes the results of analyzing the effects of a 60% reduction in nonpoint source phosphorus loading. The mass loadings of phosphorus from "rivers" and direct runoff" were reduced by 60%. Figure VIII-1 illustrates the distribution of old and new total phosphorus loading rates. It is evident that a 60% reduction in nonpoint source loads has an effect on total loading rates.

METHODS

The procedures followed were as described in Section III. After computing a new total phosphorus load to each lake, the predicted *in situ* steady-state concentration of phosphorus was computed according to the procedures described in Section III. Chlorophyll-*a* concentrations and Secchi disc depths were subsequently computed for each lake. All computed values represent annual averages for each lake at steady-state.

RESULTS

Values of old and new total phosphorus loading, average *in situ* phosphorus concentrations, chlorophyll-*a* concentration and Secchi disc depth for each lake are tabulated in Appendix B-5, both by geographical area (Figure II-13, page II-30) and for all lakes combined.

Figures VIII-2 through VIII-4 show the distribution of parameter values for the base case (NES data) and the control option for all

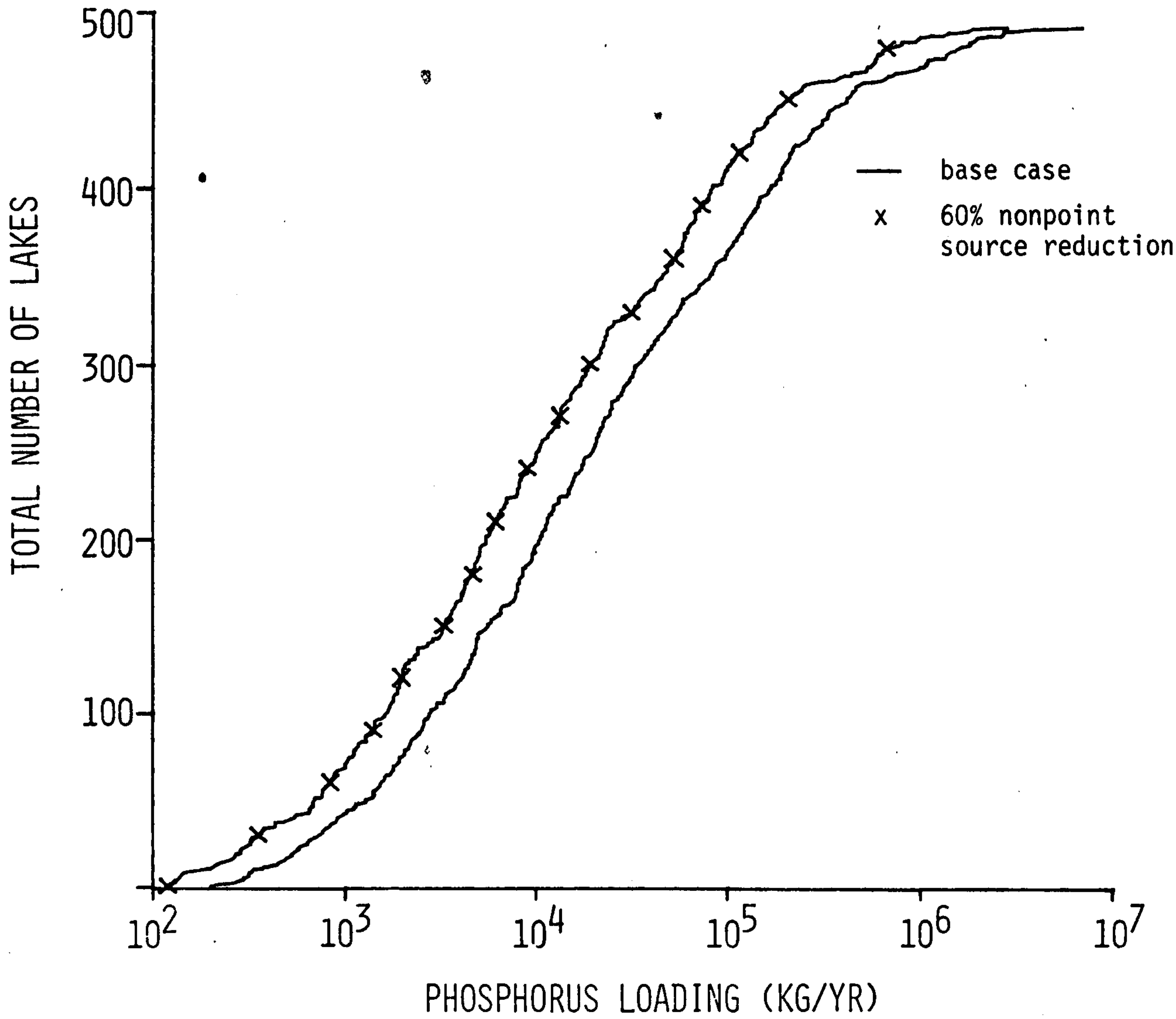
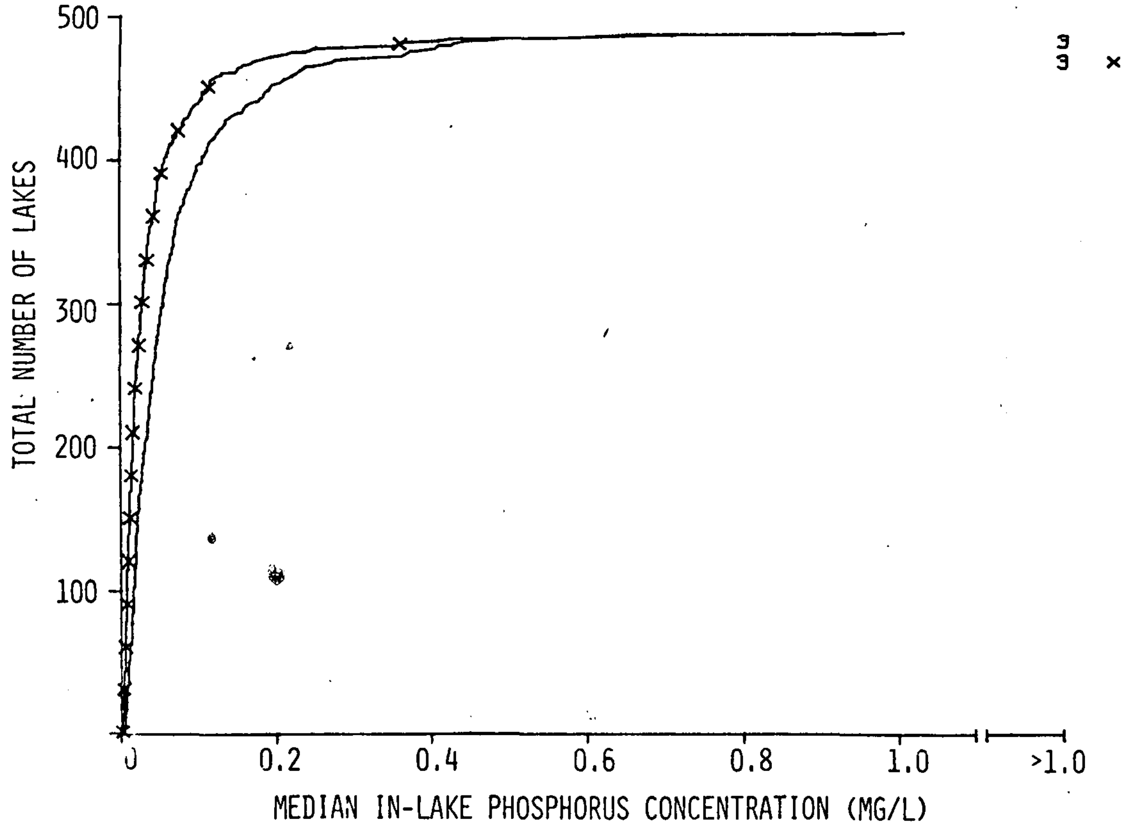


FIGURE VIII-1 DISTRIBUTION OF NEW AND OLD PHOSPHORUS LOADING RATES, OPTION 5



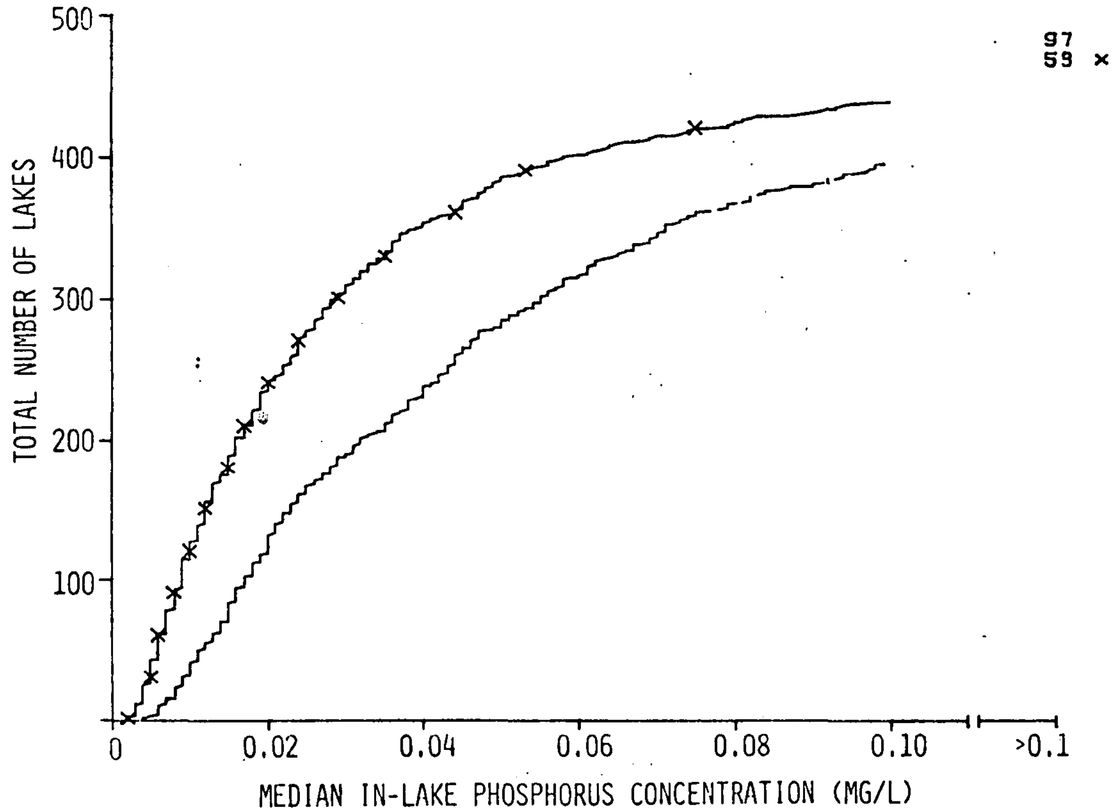


FIGURE VIII-2 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS, OPTION 5

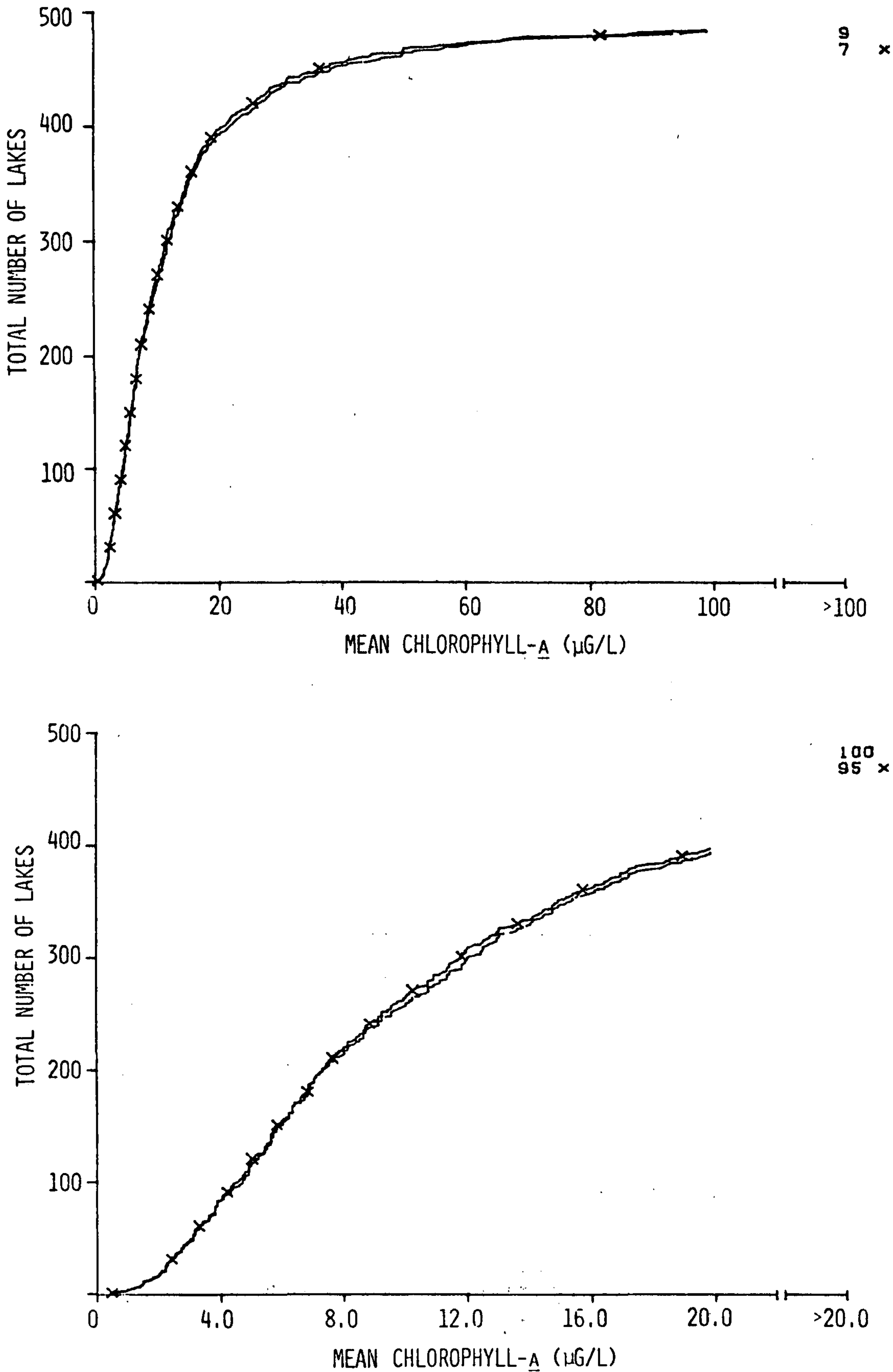


FIGURE VIII-3 DISTRIBUTION OF NEW AND OLD MEAN CHLOROPHYLL-A CONCENTRATIONS, OPTION 5

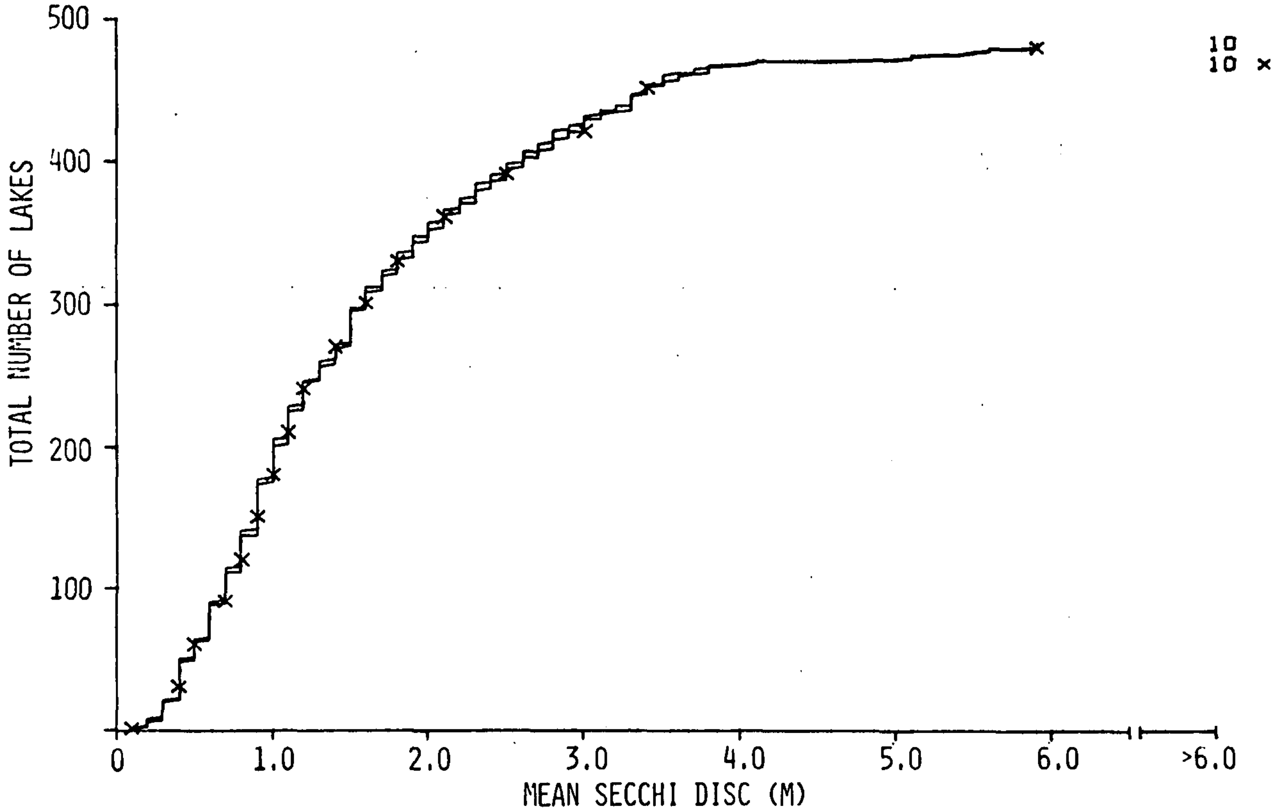


FIGURE VIII-4 DISTRIBUTION OF NEW AND OLD MEAN SECCHI DISC DEPTHS, OPTION 5 lakes. New and old median phosphorus concentrations for the lakes within each of the seven geographical areas are shown in Figures VIII-5 through VIII-11.

Because the chlorophyll-a levels and Secchi disc depths were relatively insensitive to changed phosphorus loading the following discussion is limited to effects of the control option on phosphorus concentrations.

For all 493 lakes used in the data base the effect of a 60% nonpoint source phosphorus reduction is shown in Figure VIII-2. The mean value of predicted phosphorus concentration is 0.055 mg/ℓ compared to 0.084 with no control. The number of lakes with median phosphorus concentrations less than 0.025 mg/ℓ increased from 160 to 273.

Table VIII-1 summarizes the results for all lakes and for subsets of lakes grouped by geographical area. Table VIII-2 summarizes the number and fraction of lakes with median phosphorus concentrations less than 0.025 mg/ℓ.

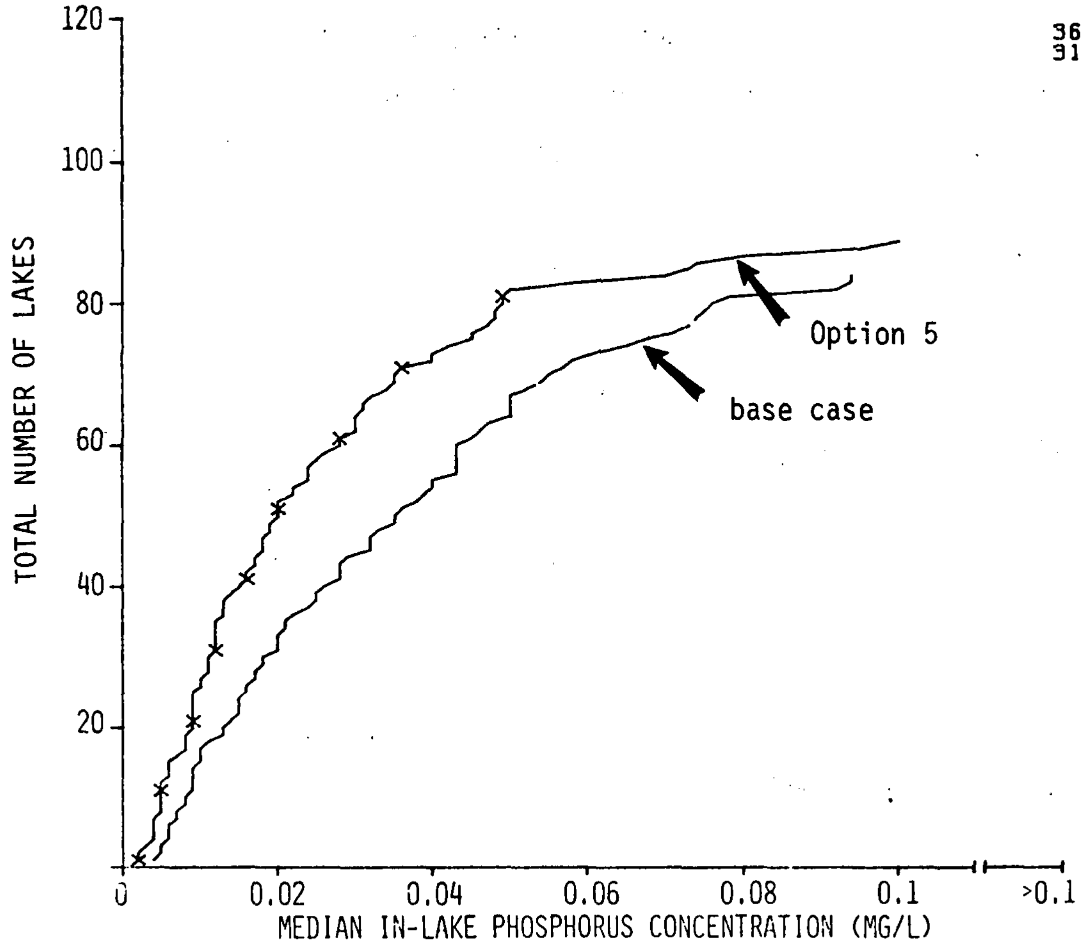


FIGURE VIII-5 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 1, OPTION 5

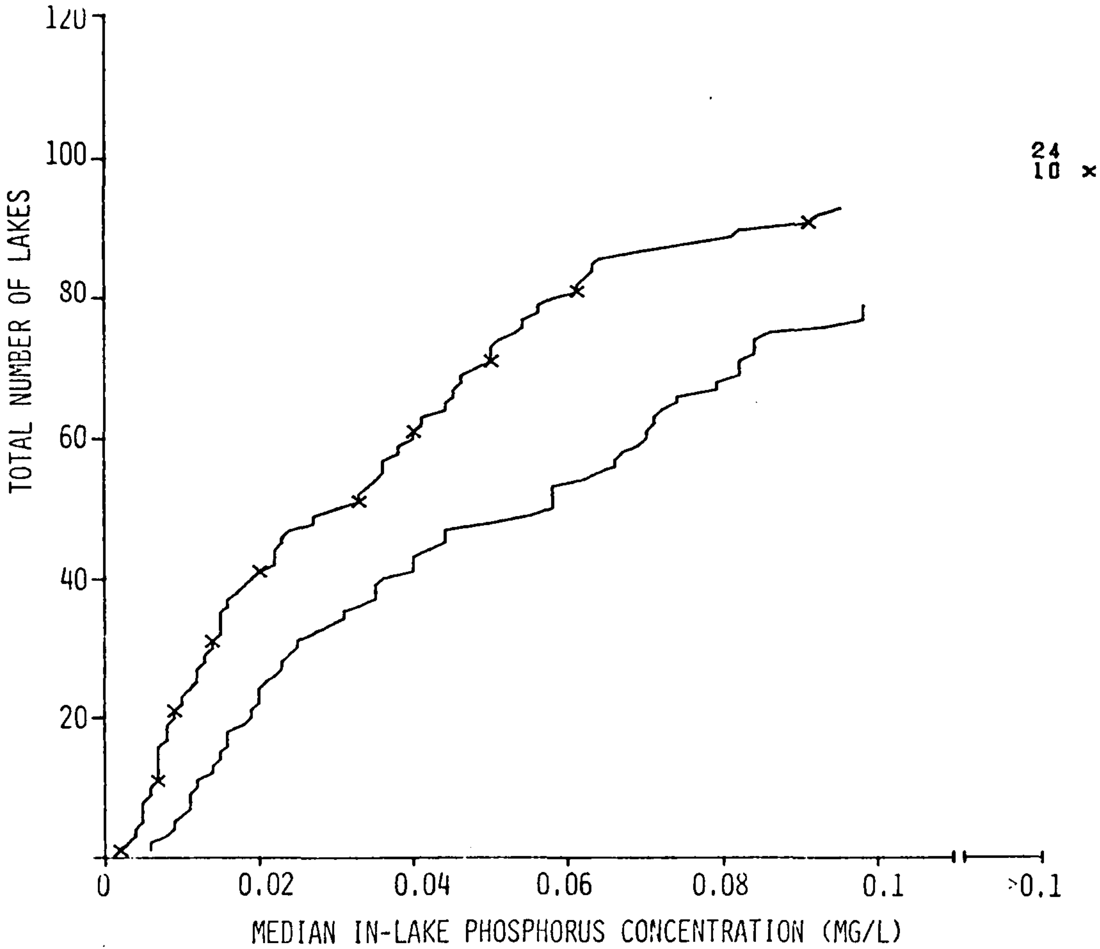


FIGURE VIII-6 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 2, OPTION 5

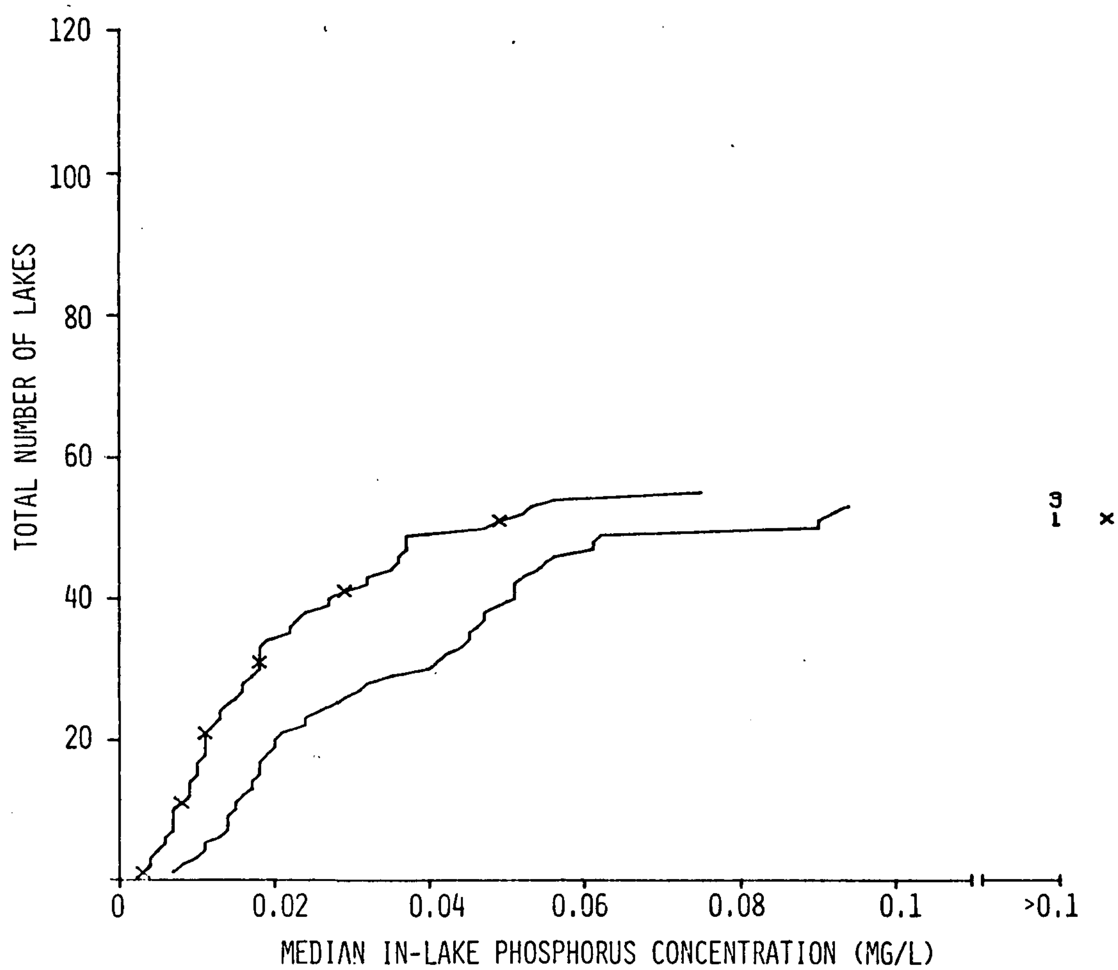


FIGURE VIII-7 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 3, OPTION 5

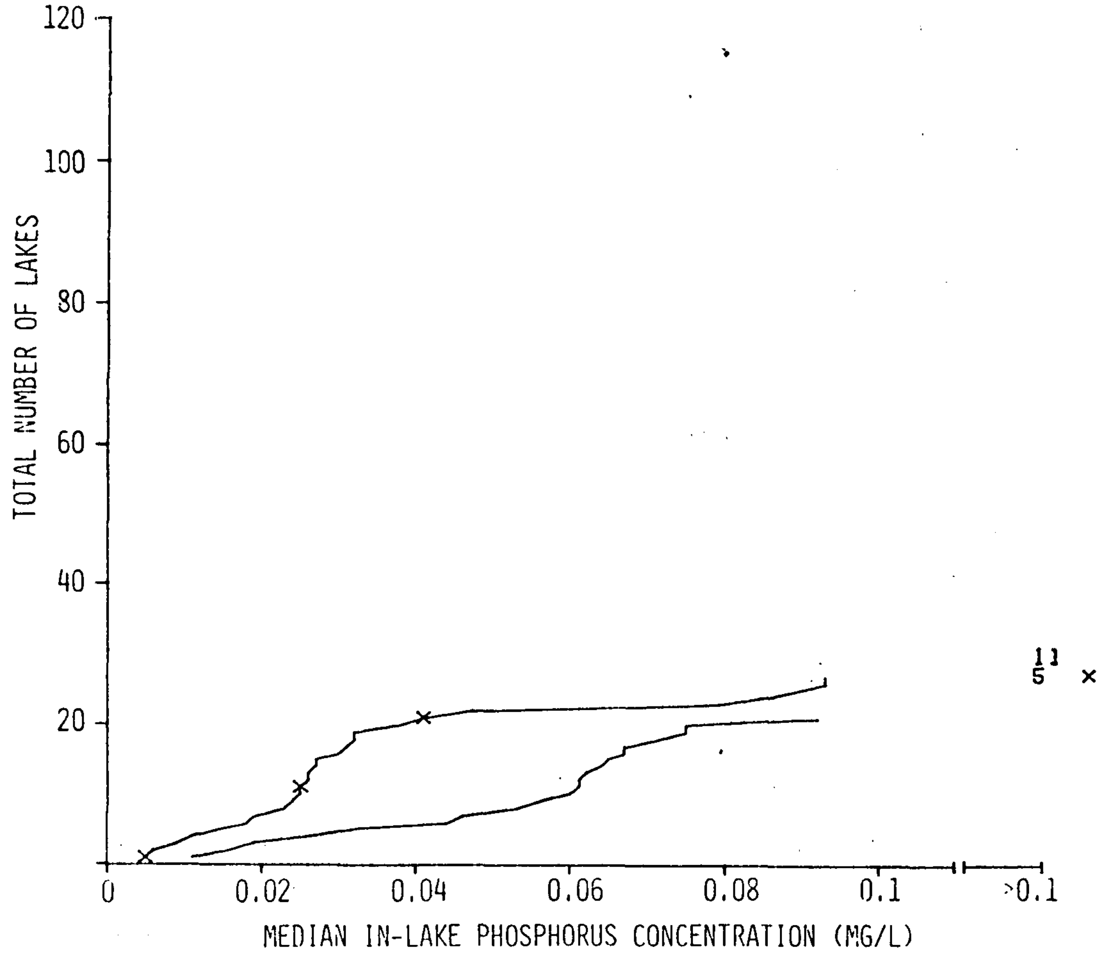


FIGURE VIII-8 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 4, OPTION 5

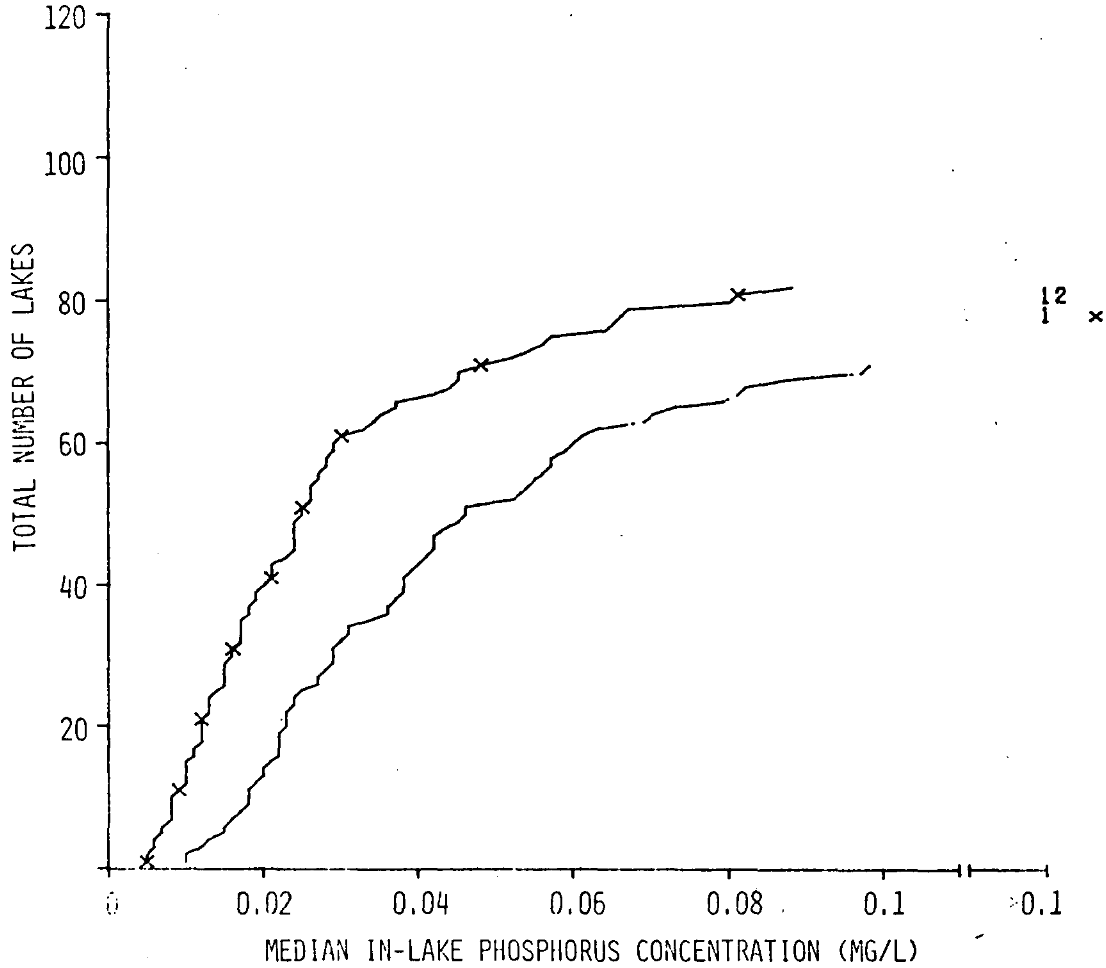


FIGURE VIII-9 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 5, OPTION 5

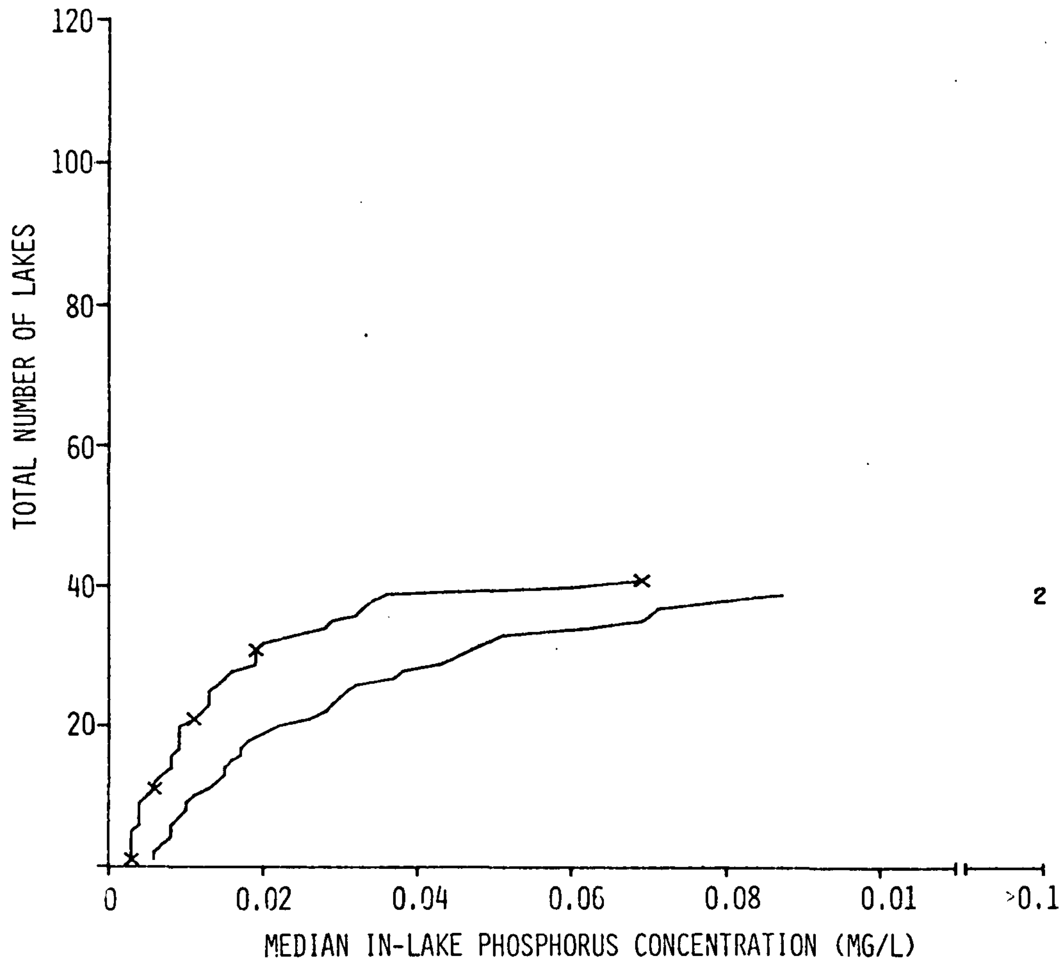


FIGURE VIII-10 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 6, OPTION 5

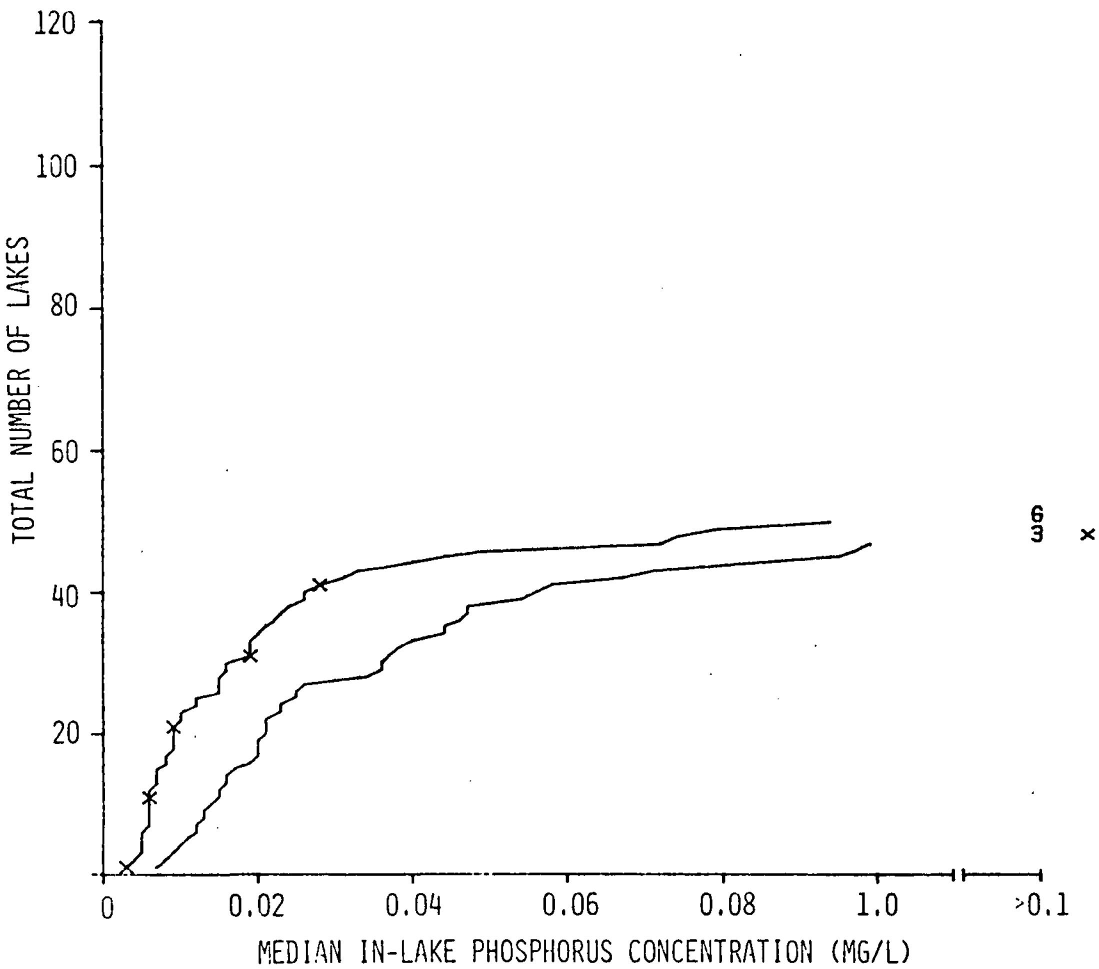


FIGURE VIII-11 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 7, OPTION 5

Table VIII-1

Effect of Control Option 5 on In Situ Total Phosphorus Concentrations

Region	Number of Lakes	Original Loading			New Loading (60% Nonpoint Source Reduction)		
		Concentration, mg/ℓ			Concentration, mg/ℓ		
		Minimum	Mean	Maximum	Minimum	Mean	Maximum
1	120	0.004	0.141	1.525	0.002	0.115	1.517
2	108	0.006	0.086	0.865	0.002	0.054	0.651
3	56	0.007	0.041	0.143	0.003	0.023	0.121
4	32	0.011	0.121	0.489	0.005	0.054	0.237
5	83	0.010	0.058	0.424	0.005	0.028	0.170
6	41	0.006	0.034	0.115	0.003	0.016	0.069
7	53	0.007	0.054	0.371	0.003	0.027	0.152
All	493	0.004	0.084	1.525	0.002	0.055	1.517

Table VIII-2

Number and Fraction of Lakes with Median Phosphorus Concentrations Less Than 0.025 mg/ℓ

Region	Number of Lakes	Lakes with Total P <0.025 mg/ℓ				Change (New - Old)	
		Old		New			
		#	%	#	%	#	%
1	120	37	31	57	48	20	17
2	108	29	27	49	45	20	18
3	56	23	41	38	68	15	27
4	32	3	9	9	28	6	19
5	83	24	29	49	59	25	30
6	41	20	49	33	80	13	31
7	53	24	45	38	72	14	27
All	493	160	32	273	55	113	23

SECTION IX

CONTROL OPTION 6

20% NONPOINT SOURCE AND 80% MUNICIPAL CONTROL

This section describes the results of analyzing the effects of a 20% reduction in nonpoint source plus an 80% reduction in municipal treatment plant phosphorus loading. The mass loadings of phosphorus from "rivers" and "direct runoff" were reduced by 20%. The mass loadings from municipal treatment plants were reduced by 80%. Figure IX-1 illustrates the distribution of old and new total phosphorus loading rates. It is evident that this reduction in phosphorus loads has an effect on total loading rates.

METHODS

The procedures followed were as described in Section III. After computing a new total phosphorus load to each lake, the predicted *in situ* steady-state concentration of phosphorus was computed according to the procedures described in Section III. Chlorophyll-*a* concentrations and Secchi disc depths were subsequently computed for each lake. All computed values represent annual averages for each lake at steady-state.

RESULTS

Values of old and new total phosphorus loading, average *in situ* phosphorus concentration, chlorophyll-*a* concentration and Secchi disc depth for each lake are tabulated in Appendix B-6, both by geographical area (Figure II-13, page II-30) and for all lakes combined.

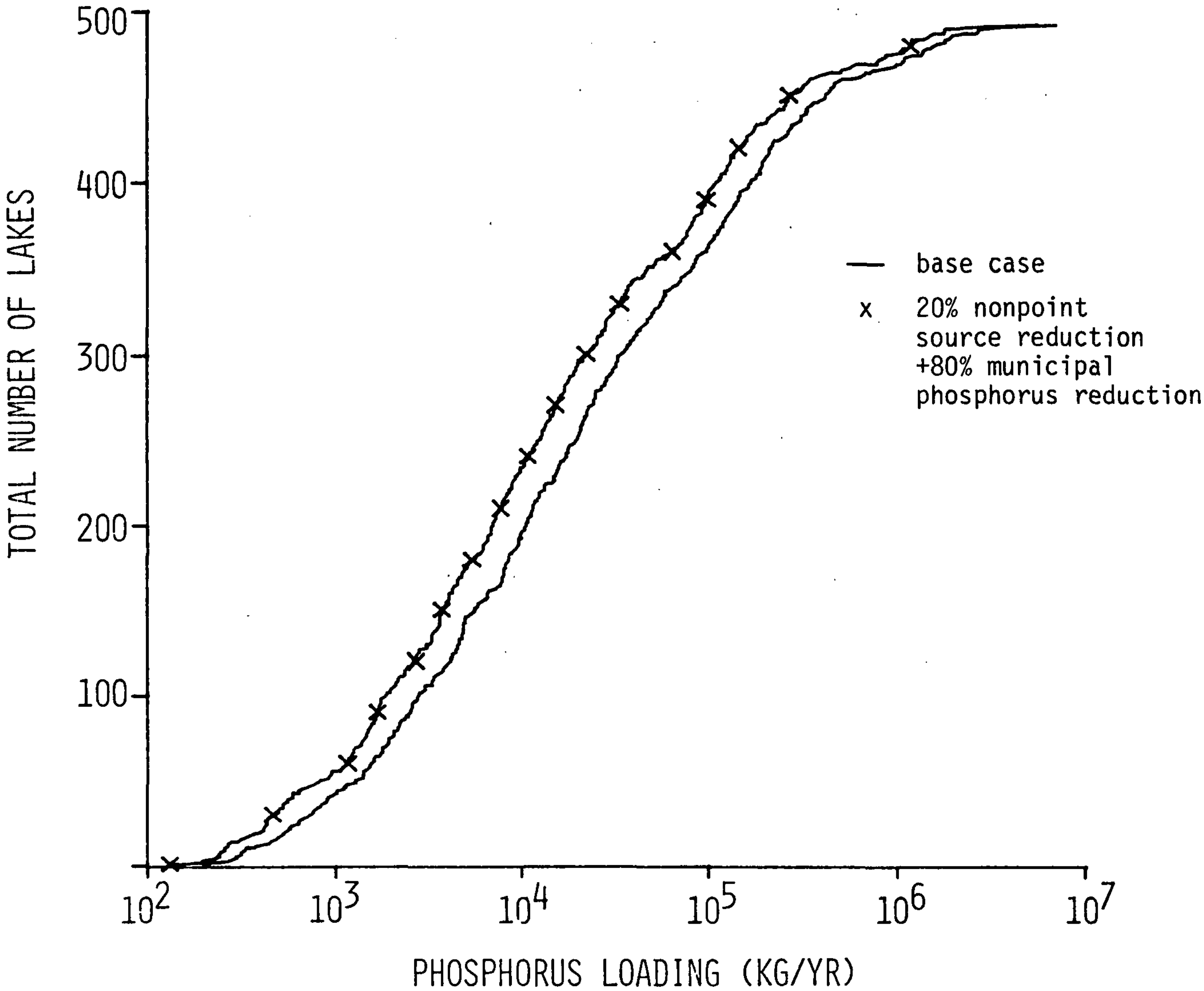


FIGURE IX-1 DISTRIBUTION OF NEW AND OLD PHOSPHORUS LOADING RATES, OPTION 6

Figures IX-2 through IX-4 show the distribution of parameter values for the base case (NES data) and the control option for all lakes. New and old median phosphorus concentrations for the lakes within each of the seven geographical areas are shown in Figures IX-5 through IX-11.

Because the chlorophyll-a levels and Secchi disc depths were relatively insensitive to changed phosphorus loading the following discussion is limited to effects of the control option on phosphorus concentrations.

For all 493 lakes used in the data base the effect of a 20% nonpoint source plus 80% municipal phosphorus reduction is shown in Figure IX-2. The mean value of predicted phosphorus concentration is 0.049 mg/ℓ compared to 0.084 with no control. The number of lakes with a median phosphorus concentration less than 0.025 mg/ℓ increased from 160 to 219.

Table IX-1 summarizes the results for all lakes and for subsets of lakes grouped by geographical area. Table IX-2 summarizes the number and fraction of lakes with median phosphorus concentrations less than 0.025 mg/ℓ.

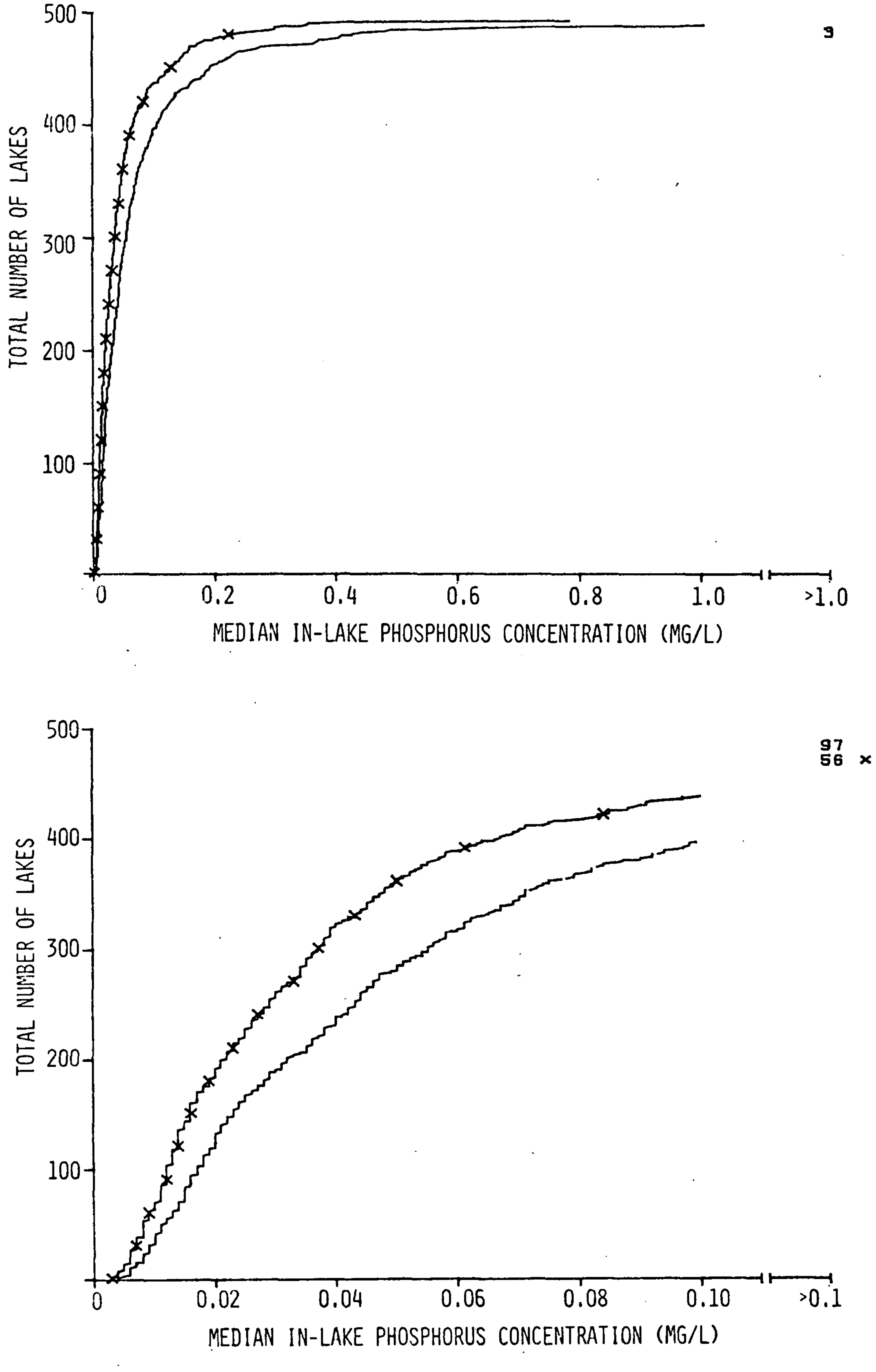


FIGURE IX-2 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS, OPTION 6

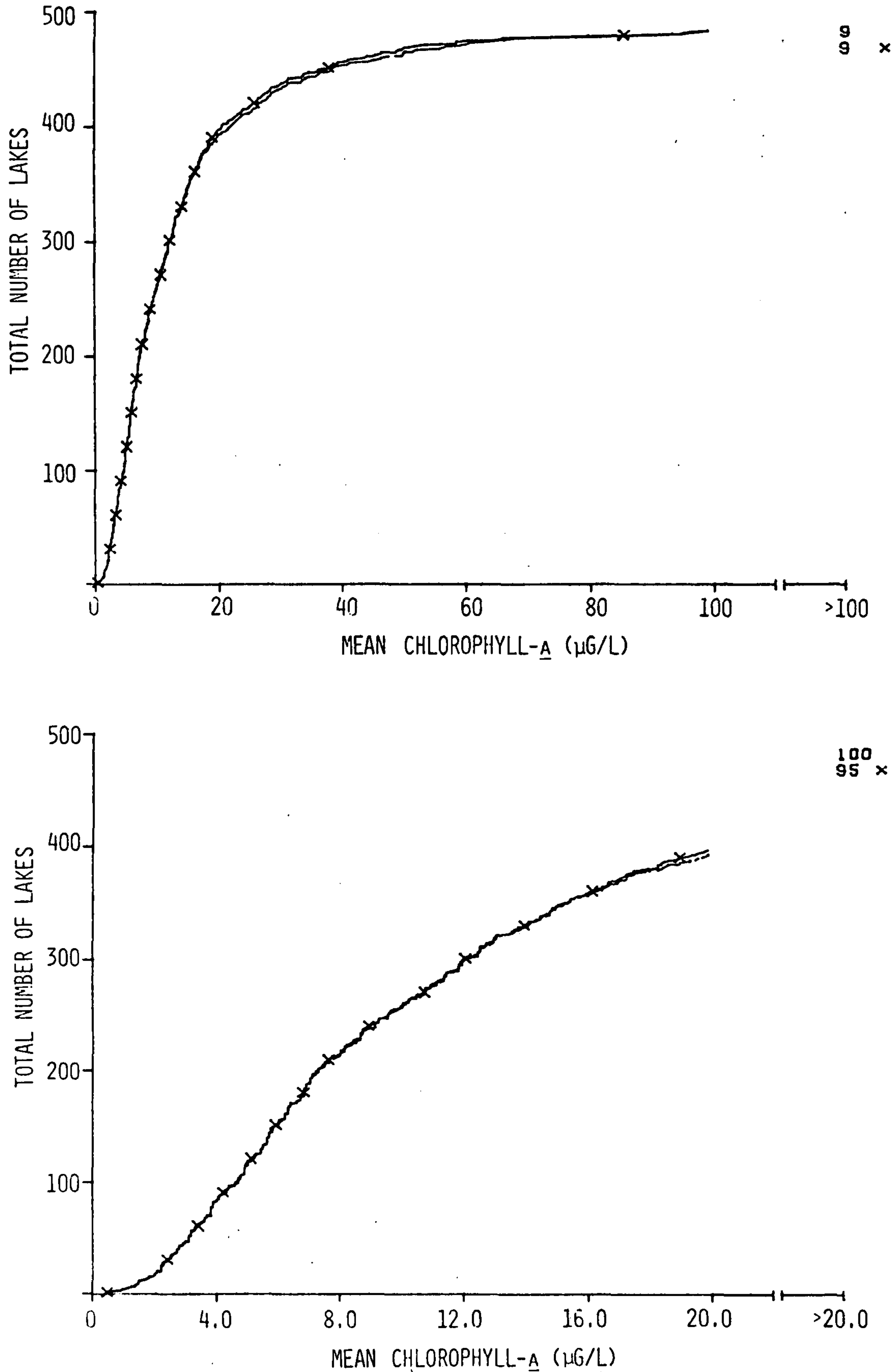


FIGURE IX-3 DISTRIBUTION OF NEW AND OLD MEAN CHLOROPHYLL-A CONCENTRATIONS, OPTION 6

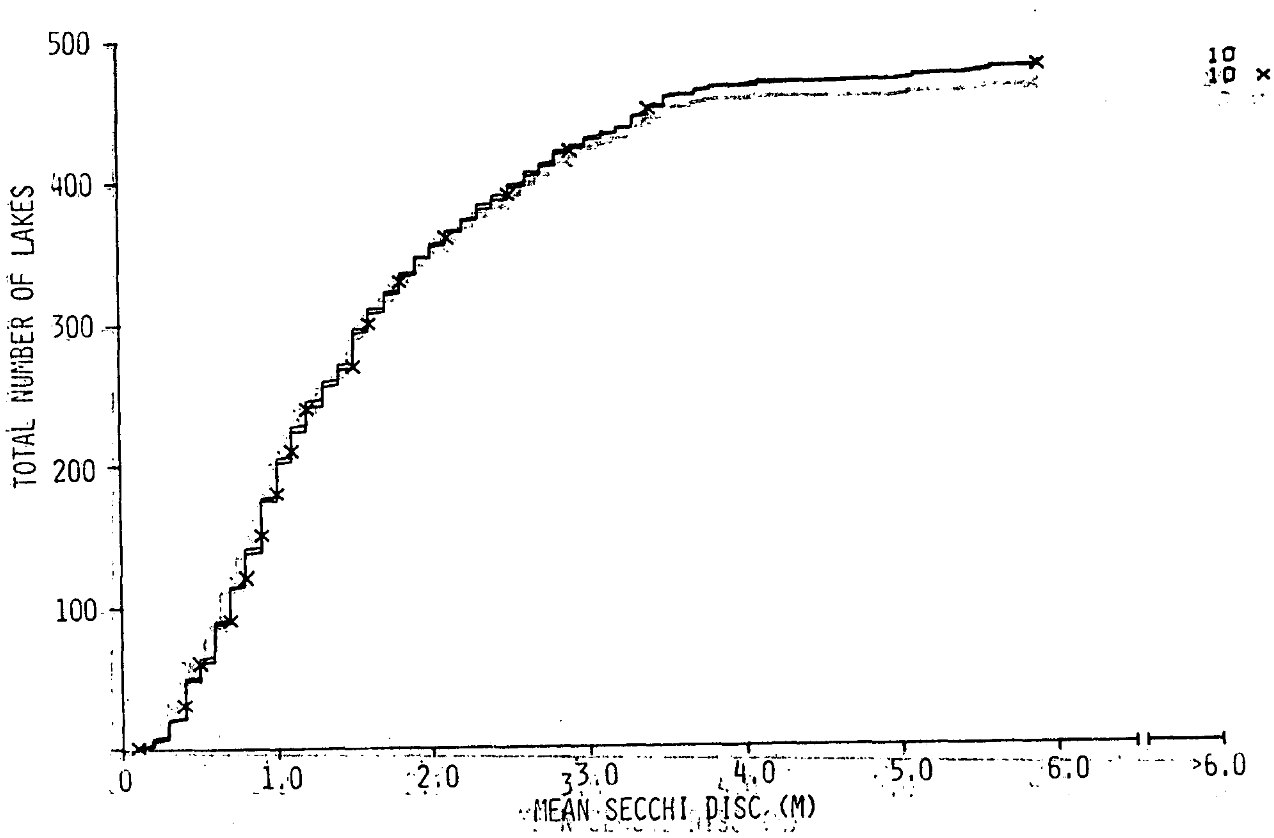


FIGURE IX-4 DISTRIBUTION OF NEW AND OLD MEAN SECCHI DISC DEPTHS, OPTION 6

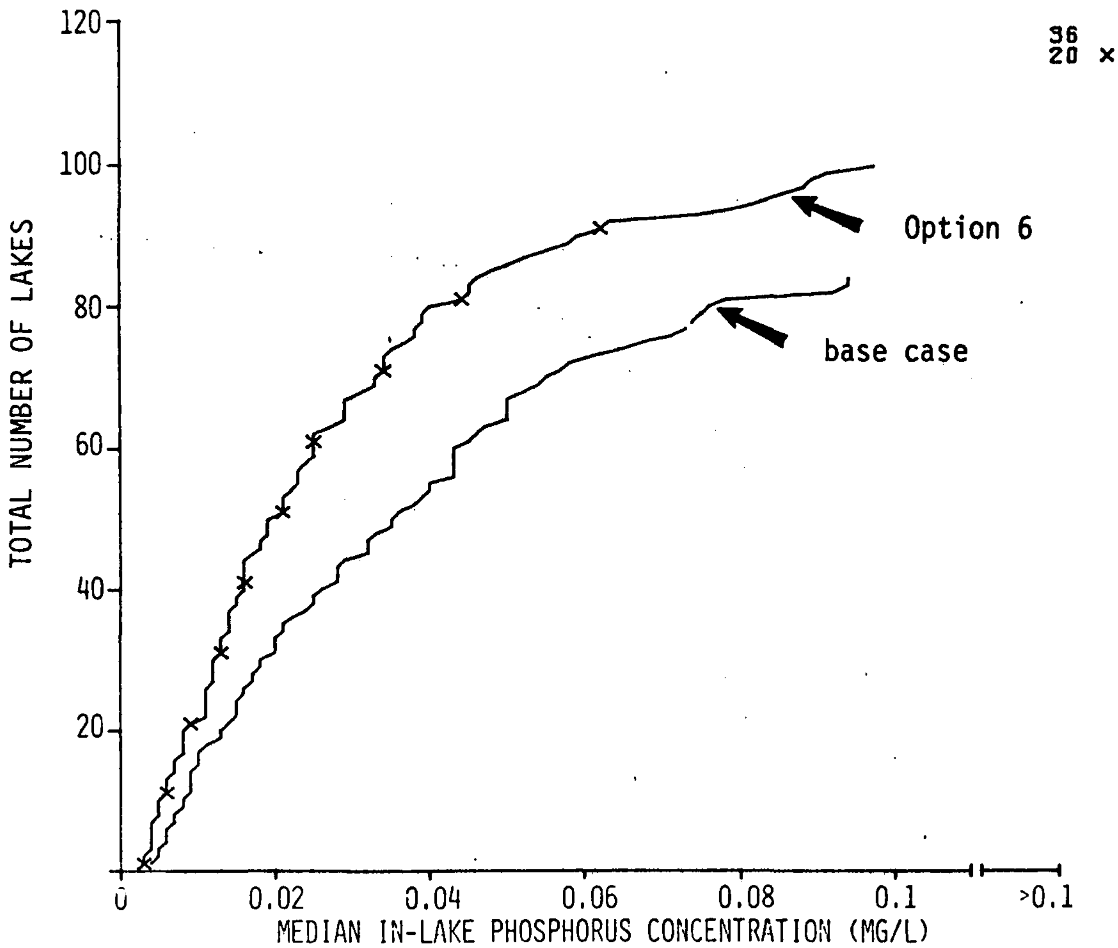


FIGURE IX-5. DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 1, OPTION 6

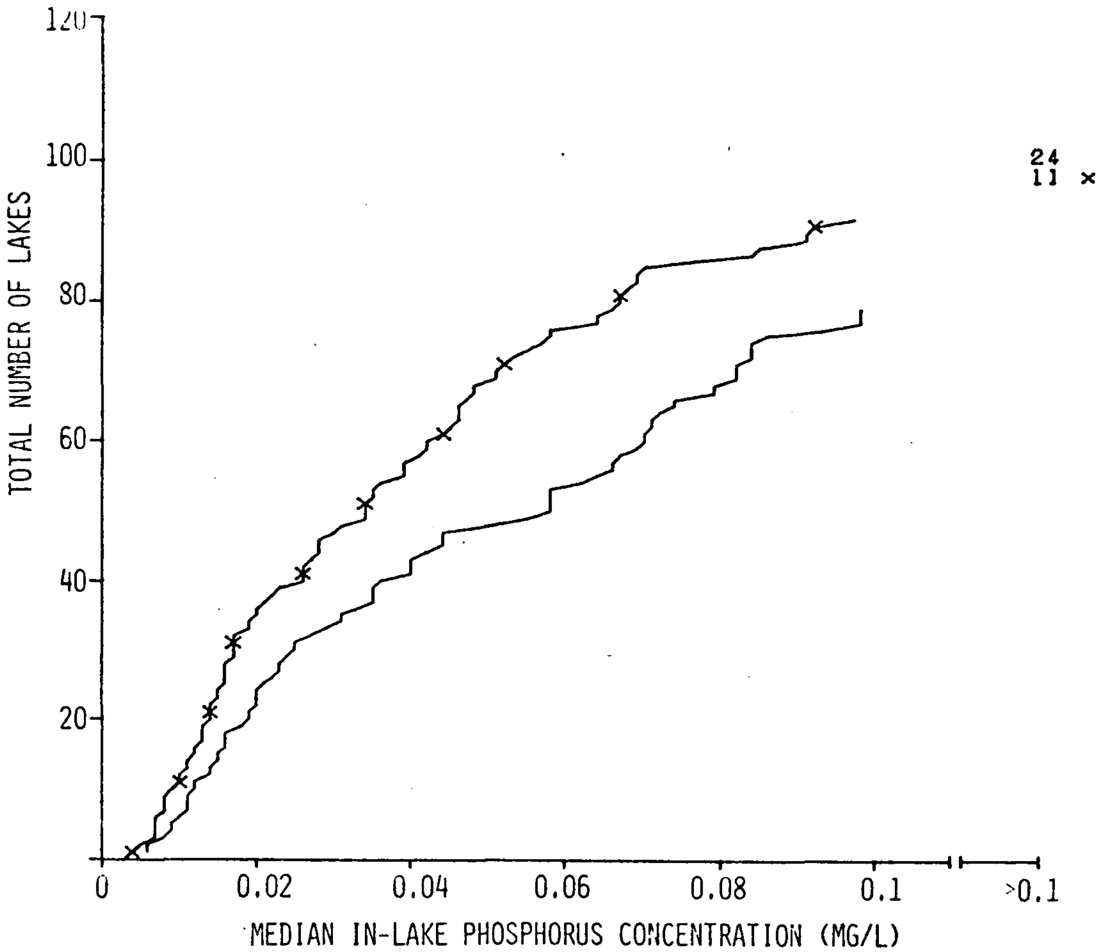


FIGURE IX-6 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 2, OPTION 6

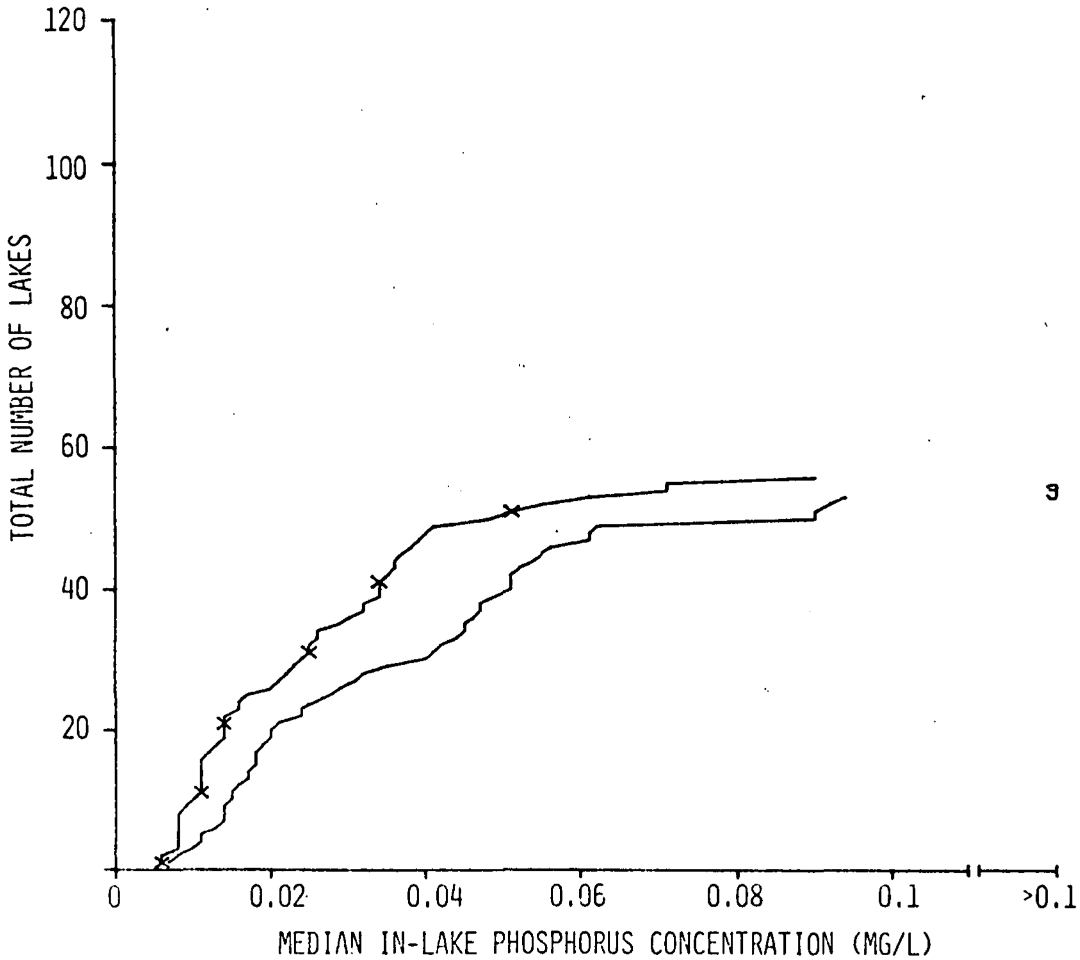


FIGURE IX-7 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 3, OPTION 6

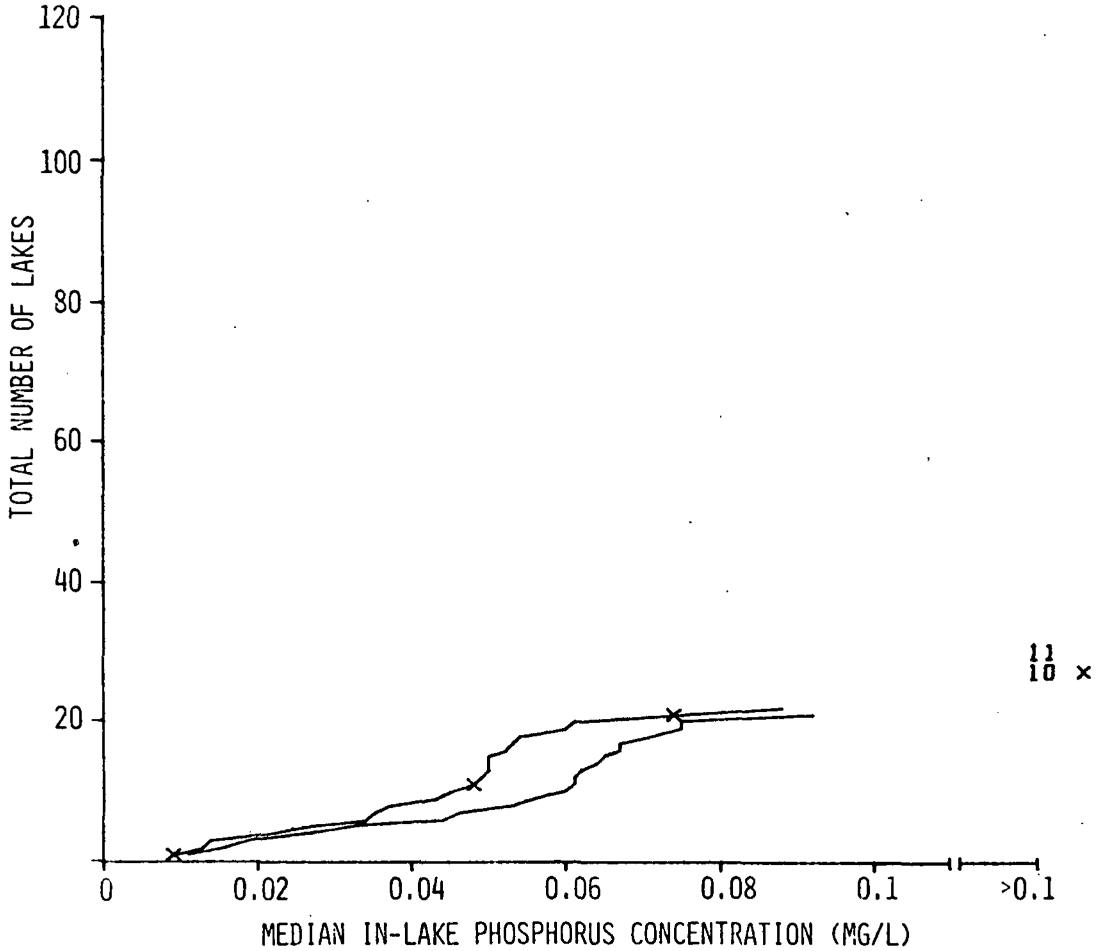


FIGURE IX-8 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 4, OPTION 6

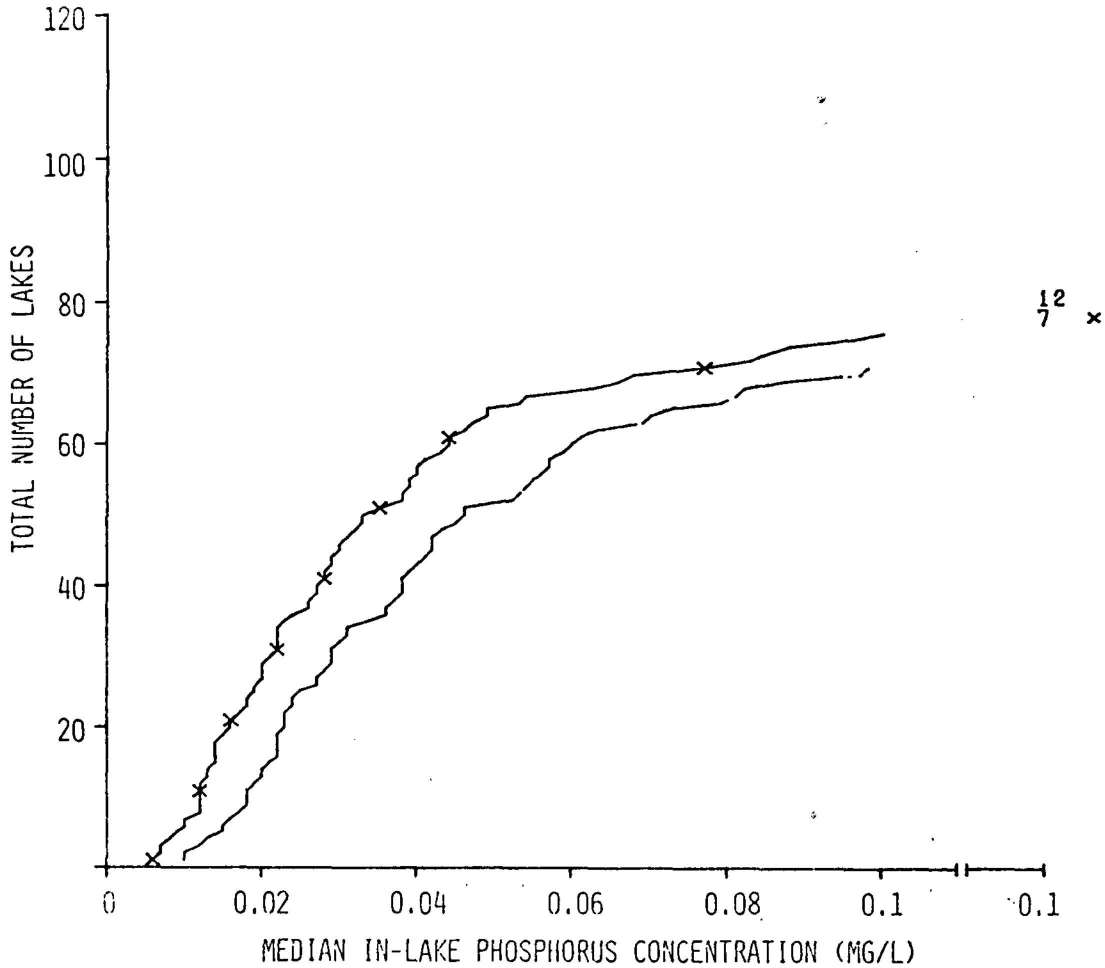


FIGURE IX-9 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 5, OPTION 6

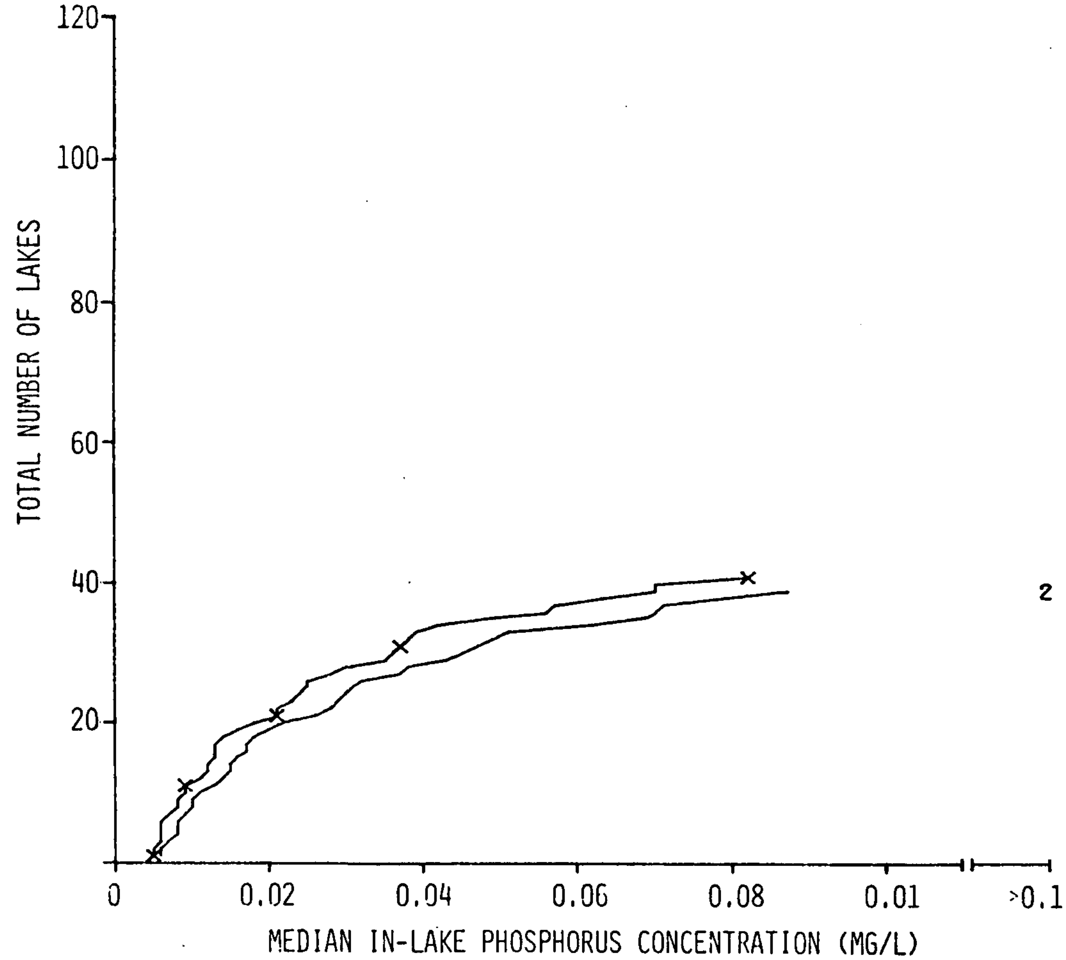


FIGURE IX-10 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 6, OPTION 6

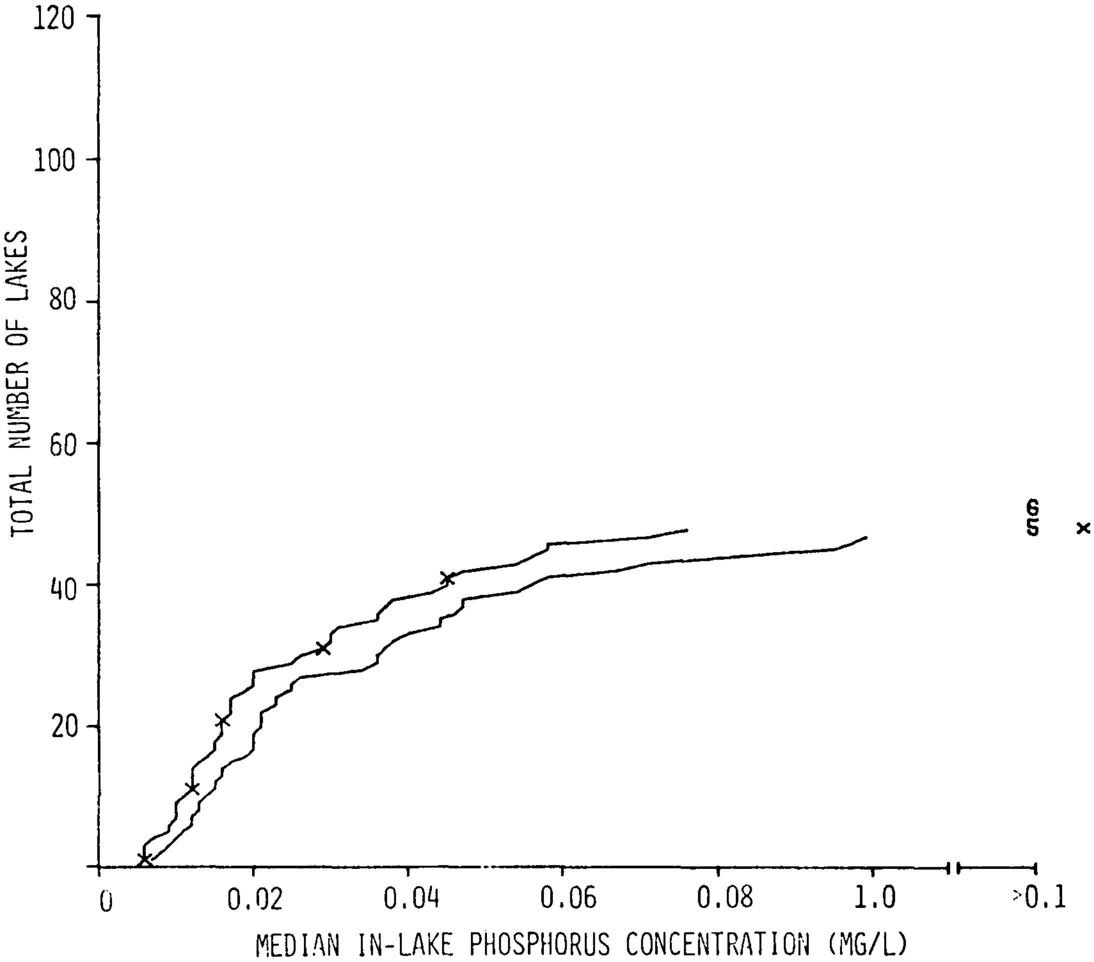


FIGURE IX-11 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 7, OPTION 6

Table IX-1

Effect of Control Option 6 on *In Situ* Total Phosphorus Concentrations

Region	Number of Lakes	Original Loading			New Loading (20% Nonpoint & 80% Municipal Reduction)		
		Concentration, mg/ℓ			Concentration, mg/ℓ		
		Minimum	Mean	Maximum	Minimum	Mean	Maximum
1	120	0.004	0.141	1.525	0.003	0.060	0.781
2	108	0.006	0.086	0.865	0.004	0.052	0.419
3	56	0.007	0.041	0.143	0.006	0.026	0.090
4	32	0.011	0.121	0.489	0.009	0.095	0.352
5	83	0.010	0.058	0.424	0.006	0.043	0.339
6	41	0.006	0.034	0.115	0.005	0.026	0.082
7	53	0.007	0.054	0.371	0.006	0.040	0.298
All	493	0.004	0.084	1.525	0.003	0.049	0.781

Table IX-2

Number and Fraction of Lakes with Median Phosphorus Concentrations Less Than 0.025 mg/ℓ

Region	Number of Lakes	Lakes with Total P <0.025 mg/ℓ				Change (New - Old)	
		Old		New			
		#	%	#	%	#	%
1	120	37	31	58	48	21	17
2	108	29	27	39	36	10	9
3	56	23	41	30	54	7	13
4	32	3	9	4	13	1	4
5	83	24	29	36	43	12	14
6	41	20	49	24	59	4	10
7	53	24	45	28	53	4	8
All	493	160	32	219	44	59	12

SECTION X

CONTROL OPTION 7

40% NONPOINT SOURCE AND 80% MUNICIPAL CONTROL

This section describes the results of analyzing the effects of a 40% reduction in nonpoint source plus an 80% reduction in municipal treatment plant phosphorus loading. The mass loadings of phosphorus from "rivers" and "direct runoff" were reduced by 40%. The mass loadings from municipal treatment plants were reduced by 80%. Figure X-1 illustrates the distribution of old and new total phosphorus loading rates. It is evident that this reduction in phosphorus loads has an effect on total loading rates.

METHODS

The procedures followed were as described in Section III. After computing a new total phosphorus load to each lake, the predicted *in situ* steady-state concentration of phosphorus was computed according to the procedures described in Section III. Chlorophyll-*a* concentrations and Secchi disc depths were subsequently computed for each lake. All computed values represent annual averages for each lake at steady-state.

RESULTS

Values of old and new total phosphorus loading, average *in situ* phosphorus concentration, chlorophyll-*a* concentration and Secchi disc depth for each lake are tabulated in Appendix B-7, both by geographical areas (Figure II-13, page II-30) and for all lakes combined.

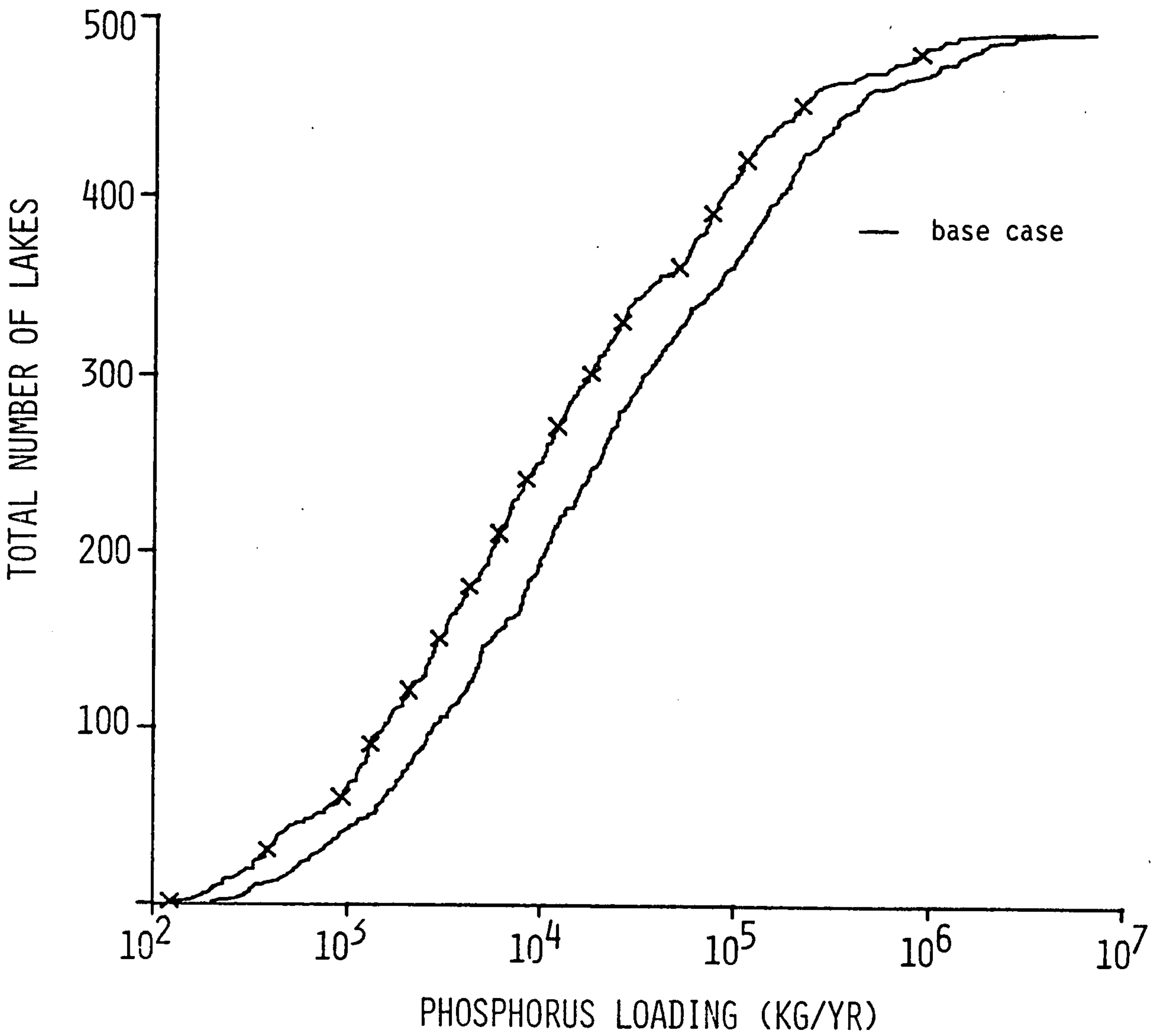


FIGURE X-1 DISTRIBUTION OF NEW AND OLD PHOSPHORUS LOADING RATES, OPTION 7

Figures X-2 through X-4 show the distribution of parameter values for the base case (NES data) and the control option for all lakes. New and old median phosphorus concentrations for the lakes within each of the seven geographical areas are shown in Figures X-5 through X-11.

Because the chlorophyll-a levels and Secchi disc depths were relatively insensitive to changed phosphorus loading the following discussion is limited to effects of the control option on phosphorus concentrations.

For all 493 lakes used in the data base the effect of a 40% nonpoint source plus 80% municipal phosphorus reduction is shown in Figure X-2. The mean value of predicted phosphorus concentration is 0.039 mg/ℓ compared to 0.084 with no control. The number of lakes with median phosphorus concentrations less than 0.025 mg/ℓ increased from 160 to 264.

Table X-1 summarizes the results for all lakes and for subsets of lakes grouped by geographical area. Table X-2 summarizes the number and fraction of lakes with median phosphorus concentrations less than 0.025 mg/ℓ.

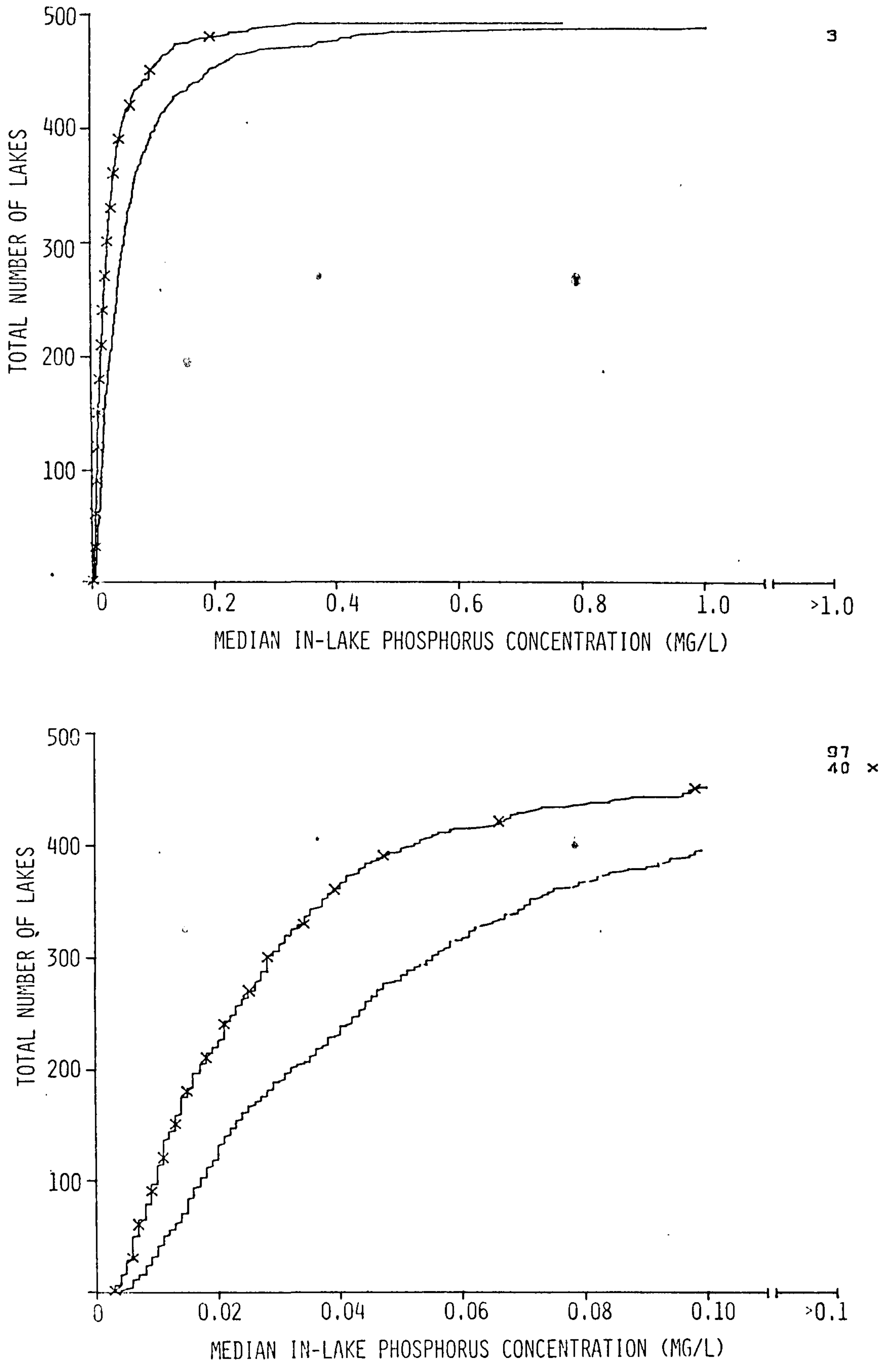


FIGURE X-2 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS, OPTION 7

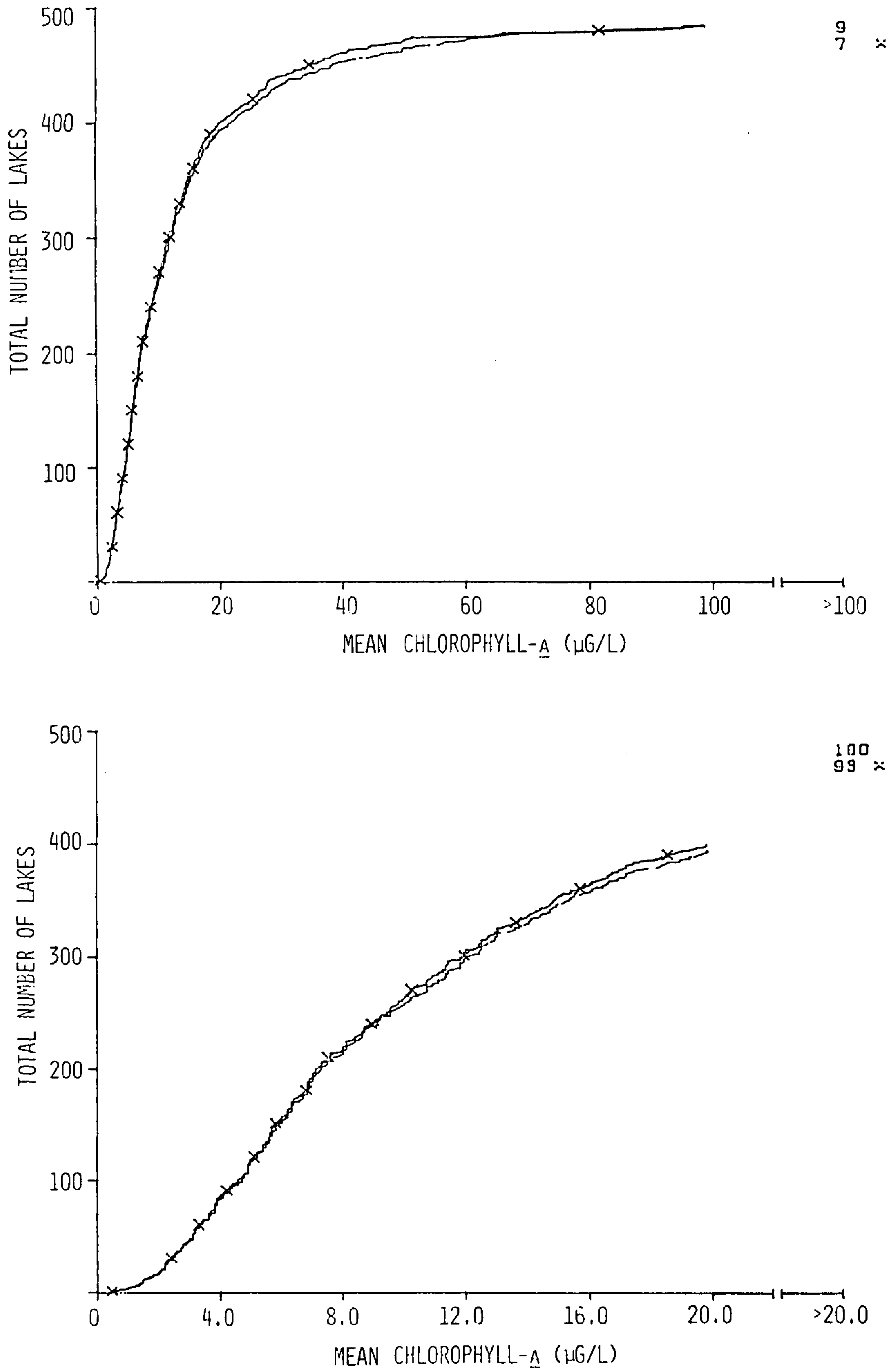


FIGURE X-3 DISTRIBUTION OF NEW AND OLD MEAN CHLOROPHYLL-A CONCENTRATIONS, OPTION 7

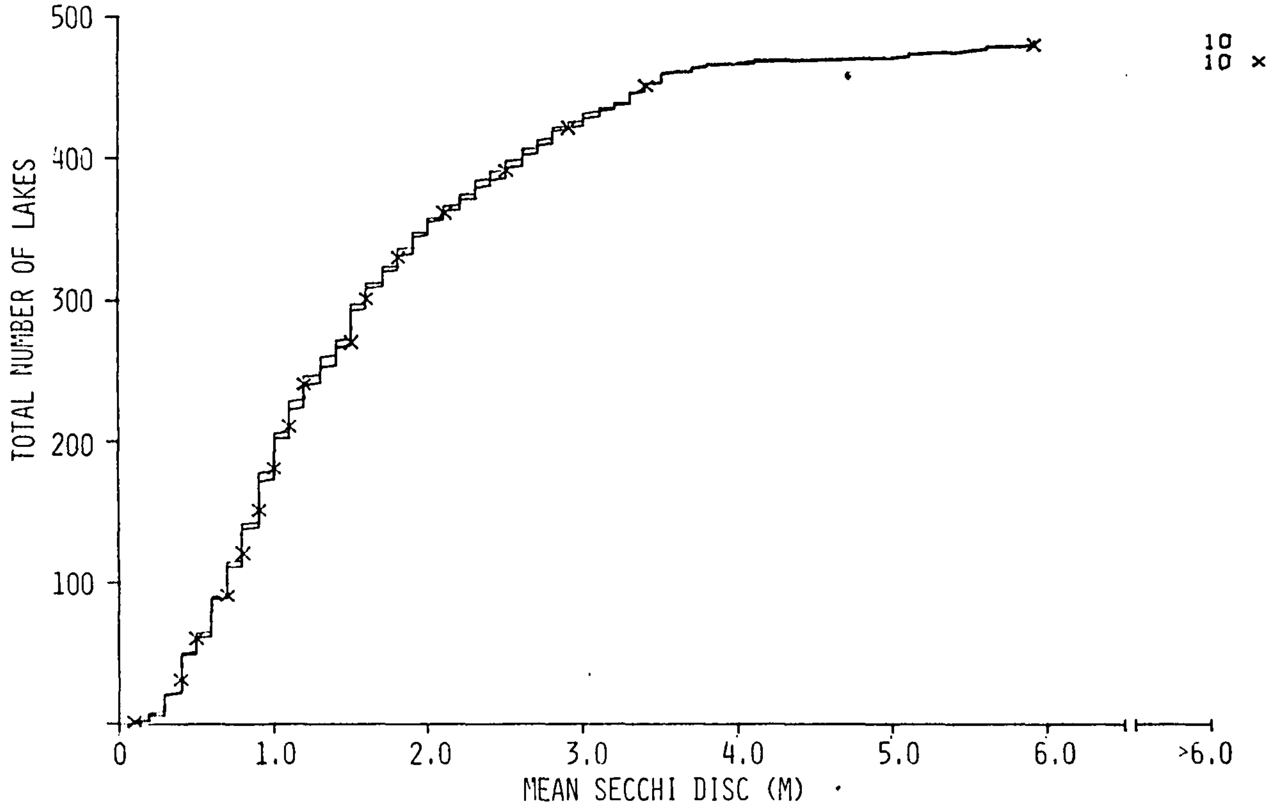


FIGURE X-4 DISTRIBUTION OF NEW AND OLD MEAN SECCHI DISC DEPTHS, OPTION 7

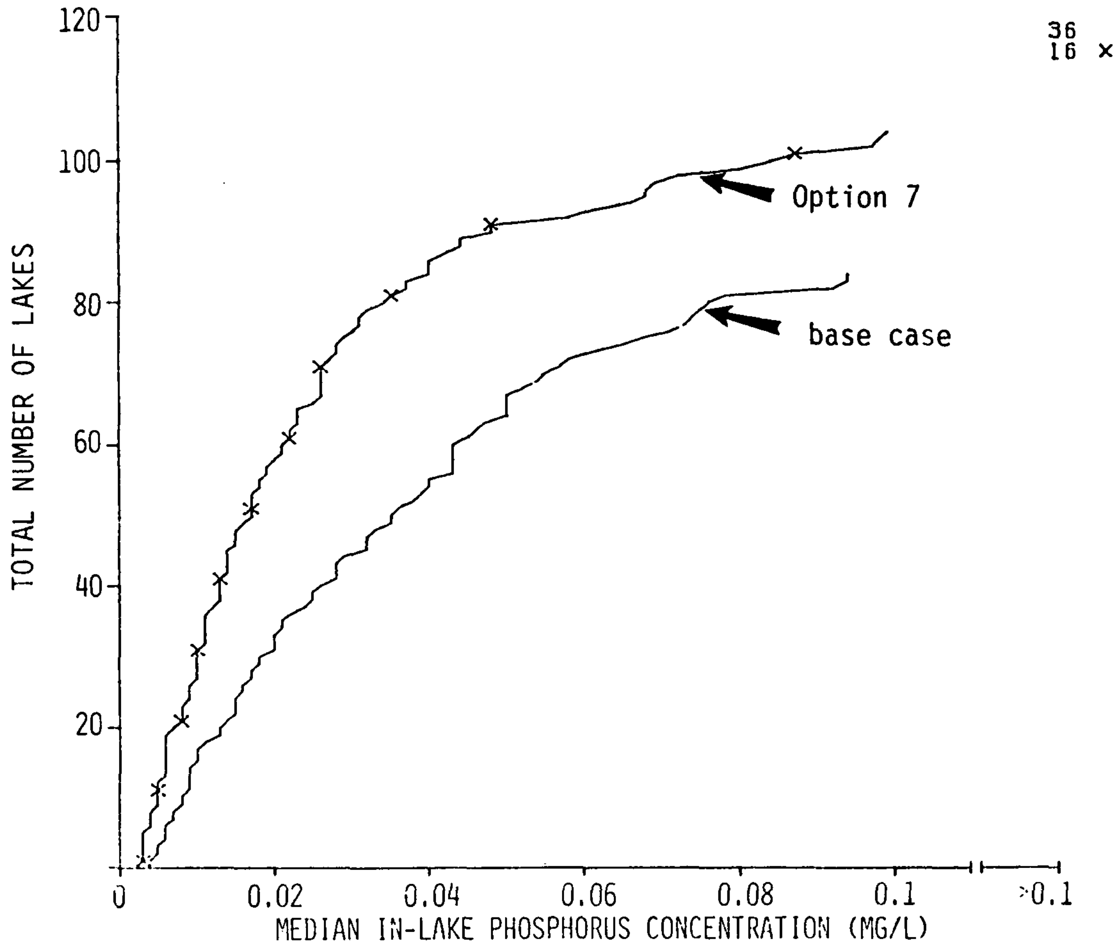


FIGURE X-5 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 1, OPTION 7

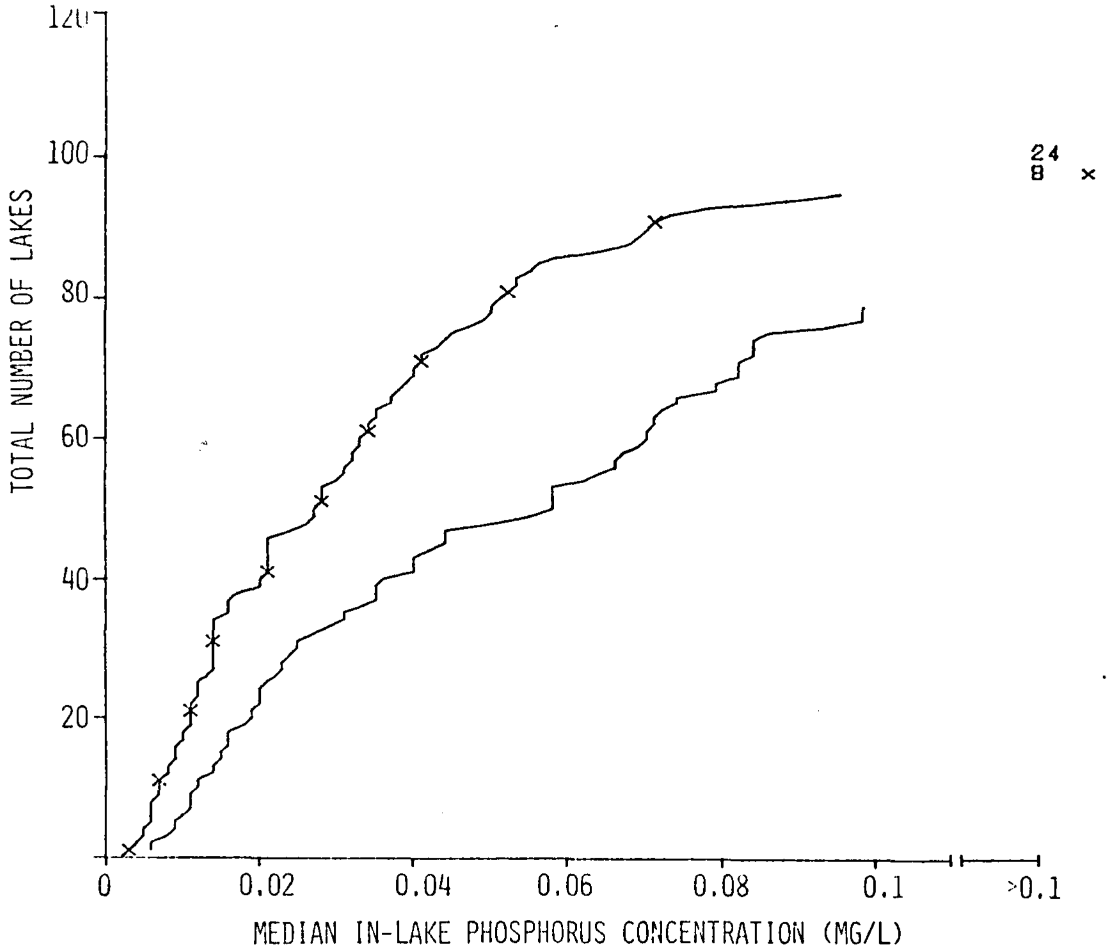


FIGURE X-6 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 2, OPTION 7

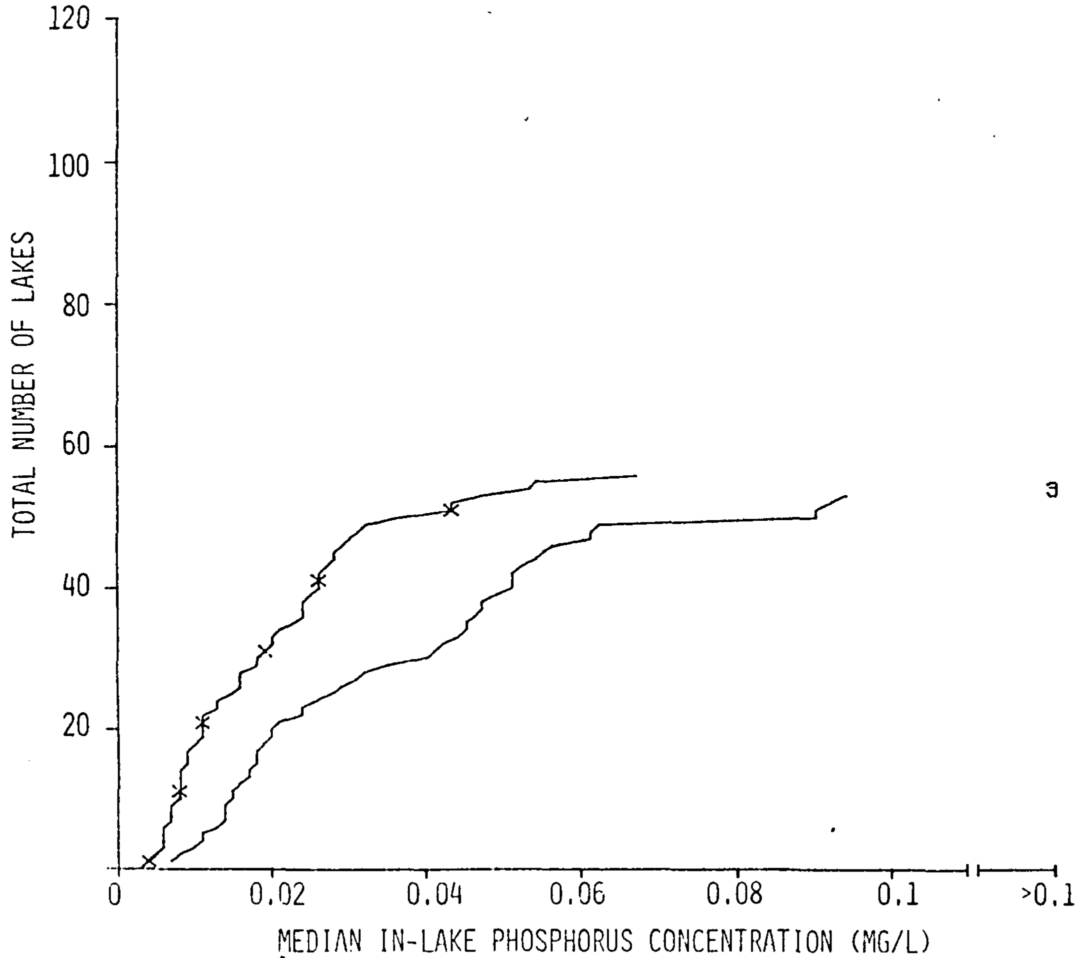


FIGURE X-7 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 3, OPTION 7

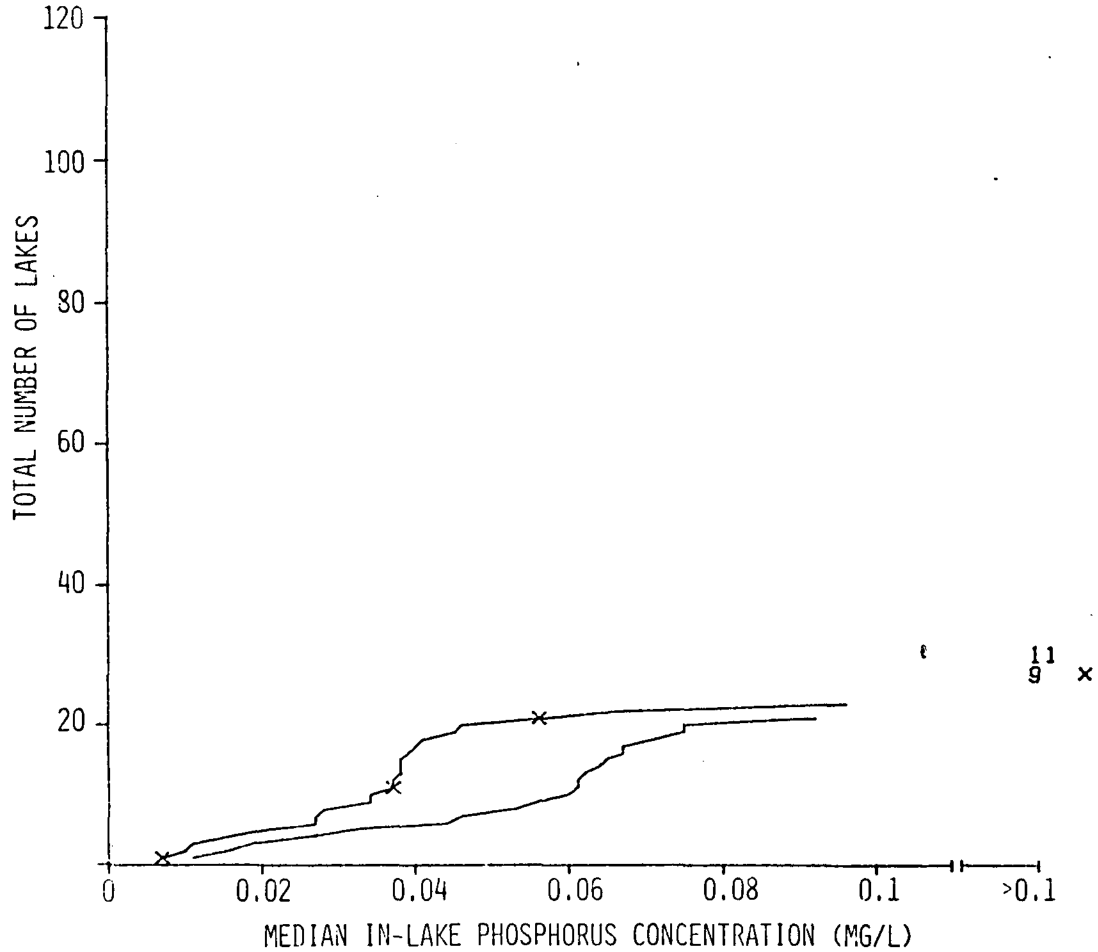


FIGURE X-8 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 4, OPTION 7

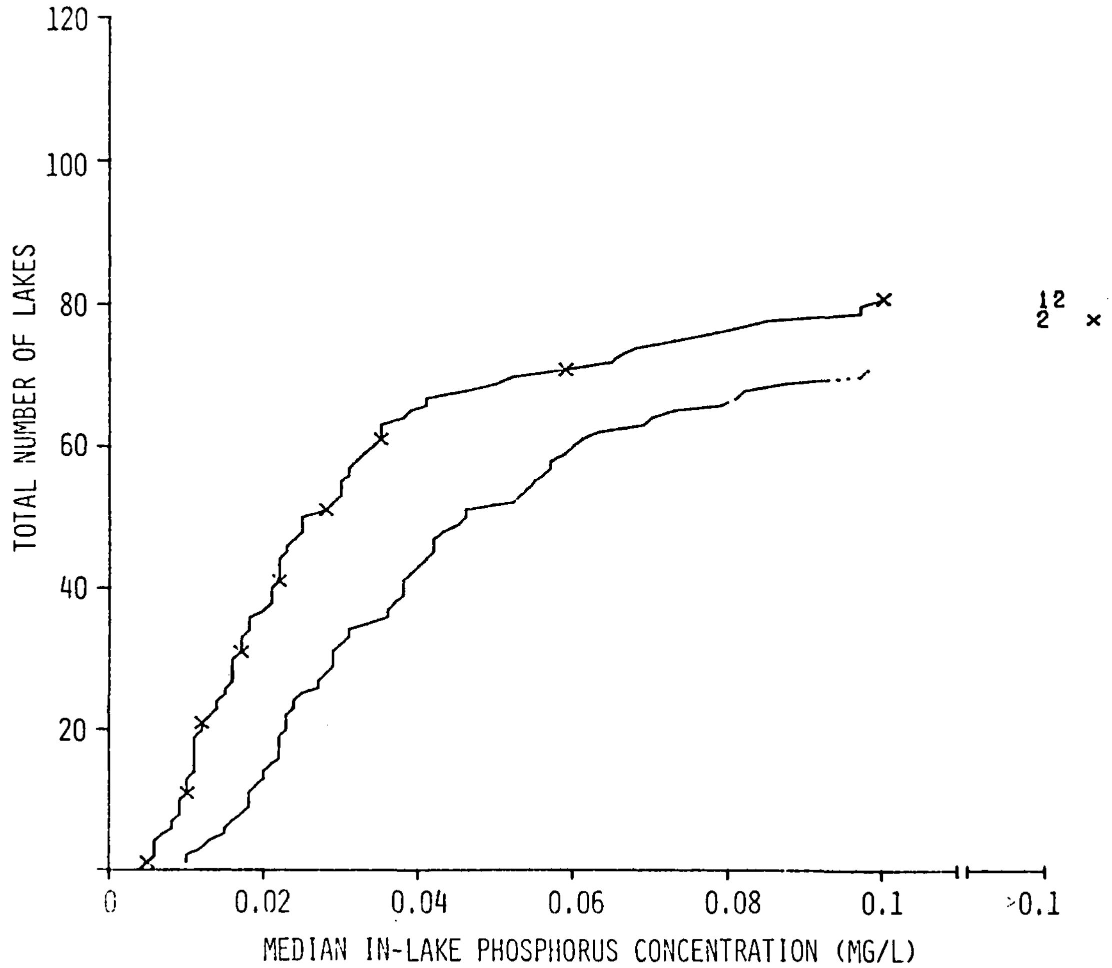


FIGURE X-9 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 5, OPTION 7

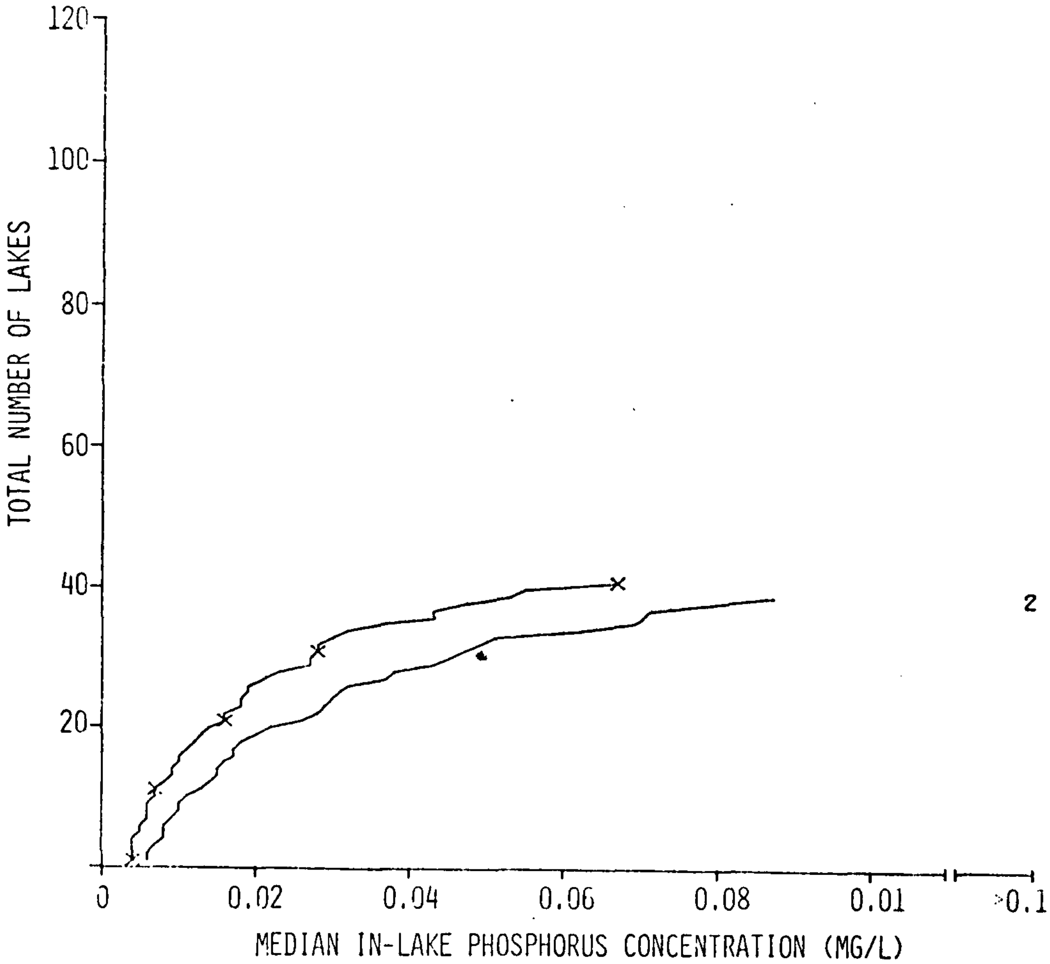


FIGURE X-10 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 6, OPTION 7

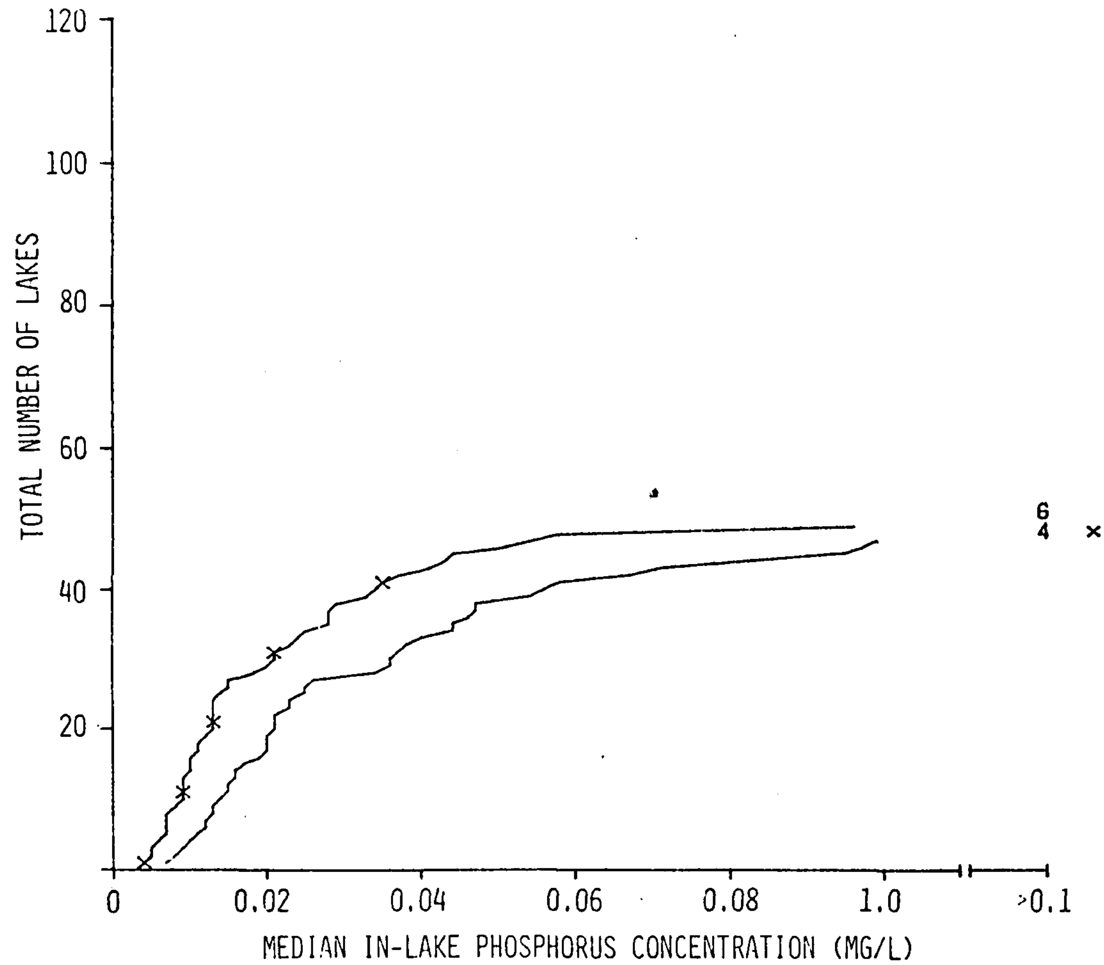


FIGURE X-11 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 7, OPTION 7

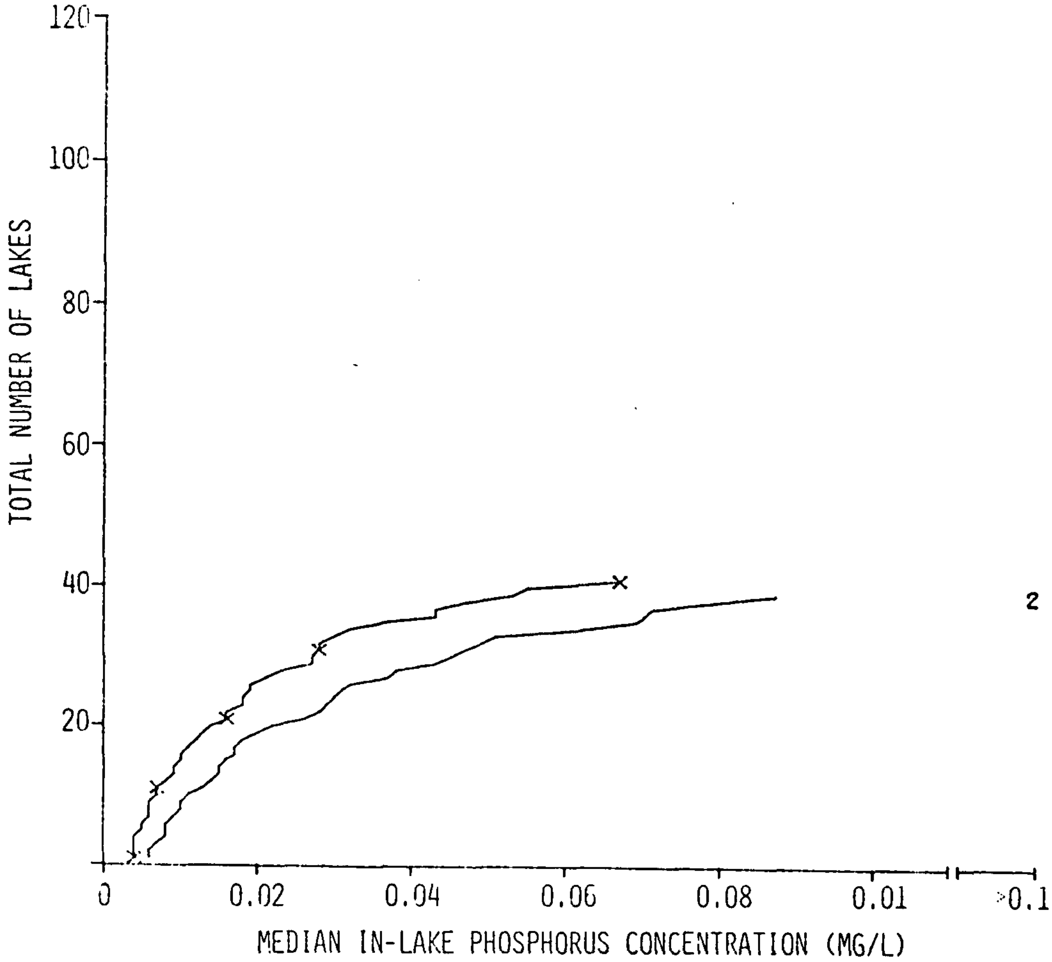


FIGURE X-10 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 6, OPTION 7

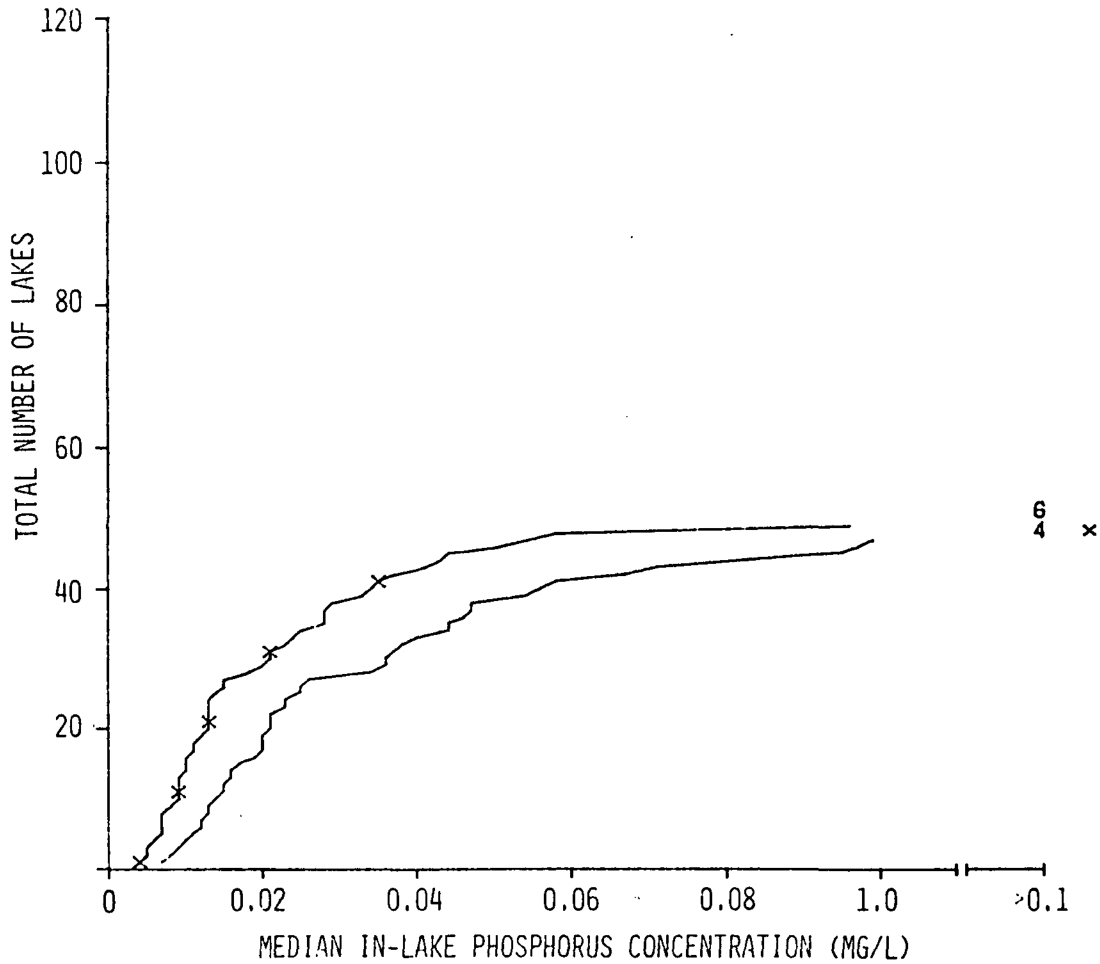


FIGURE X-11 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 7, OPTION 7

Table X-1

Effect of Control Option 7 on <u>In Situ</u> Total Phosphorus Concentrations

Region	Number of Lakes	Original Loading			New Loading (40% Nonpoint & 80% Municipal Reduction)		
		Concentration, mg/ℓ			Concentration, mg/ℓ		
		Minimum	Mean	Maximum	Minimum	Mean	Maximum
1	120	0.004	0.141	1.525	0.003	0.052	0.767
2	108	0.006	0.086	0.865	0.003	0.040	0.337
3	56	0.007	0.041	0.143	0.004	0.020	0.067
4	32	0.011	0.121	0.489	0.007	0.072	0.267
5	83	0.010	0.058	0.424	0.005	0.033	0.254
6	41	0.006	0.034	0.115	0.004	0.020	0.067
7	53	0.007	0.054	0.371	0.004	0.031	0.225
All	493	0.004	0.084	1.525	0.003	0.039	0.767

Table X-2

Number and Fraction of Lakes with Median Phosphorus Concentrations Less Than 0.025 mg/ℓ

Region	Number of Lakes	Lakes with Total P <0.025 mg/ℓ				Change (New - Old)	
		Old		New			
		#	%	#	%	#	%
1	120	37	31	65	54	28	23
2	108	29	27	48	44	19	17
3	56	23	41	38	68	15	27
4	32	3	9	5	16	2	7
5	83	24	29	47	57	23	28
6	41	20	49	28	68	8	19
7	53	24	45	33	62	9	17
All	493	160	32	264	53	104	21

SECTION XI

CONTROL OPTION 8

60% NONPOINT SOURCE AND 80% MUNICIPAL CONTROL

This section describes the results of analyzing the effects of a 60% reduction in nonpoint source plus an 80% reduction in municipal treatment plant phosphorus loading. The mass loadings of phosphorus from "rivers" and "direct runoff" were reduced by 60%. The mass loadings from municipal treatment plants were reduced by 80%. Figure XI-1 illustrates the distribution of old and new total phosphorus loading rates. It is evident that this reduction in phosphorus loads has a marked effect on total loading rates.

METHODS

The procedures followed were as described in Section III. After computing a new total phosphorus load to each lake, the predicted *in situ* steady-state concentration of phosphorus was computed according to the procedure described in Section III. Chlorophyll-*a* concentrations and Secchi disc depths were subsequently computed for each lake. All computed values represent annual averages for each lake at steady-state.

RESULTS

Values of old and new total phosphorus loading, average *in situ* phosphorus concentration, chlorophyll-*a* concentration and Secchi disc depth for each lake are tabulated in Appendix B-8, both by geographical area (Figure II-13, page II-30) and for all lakes combined.

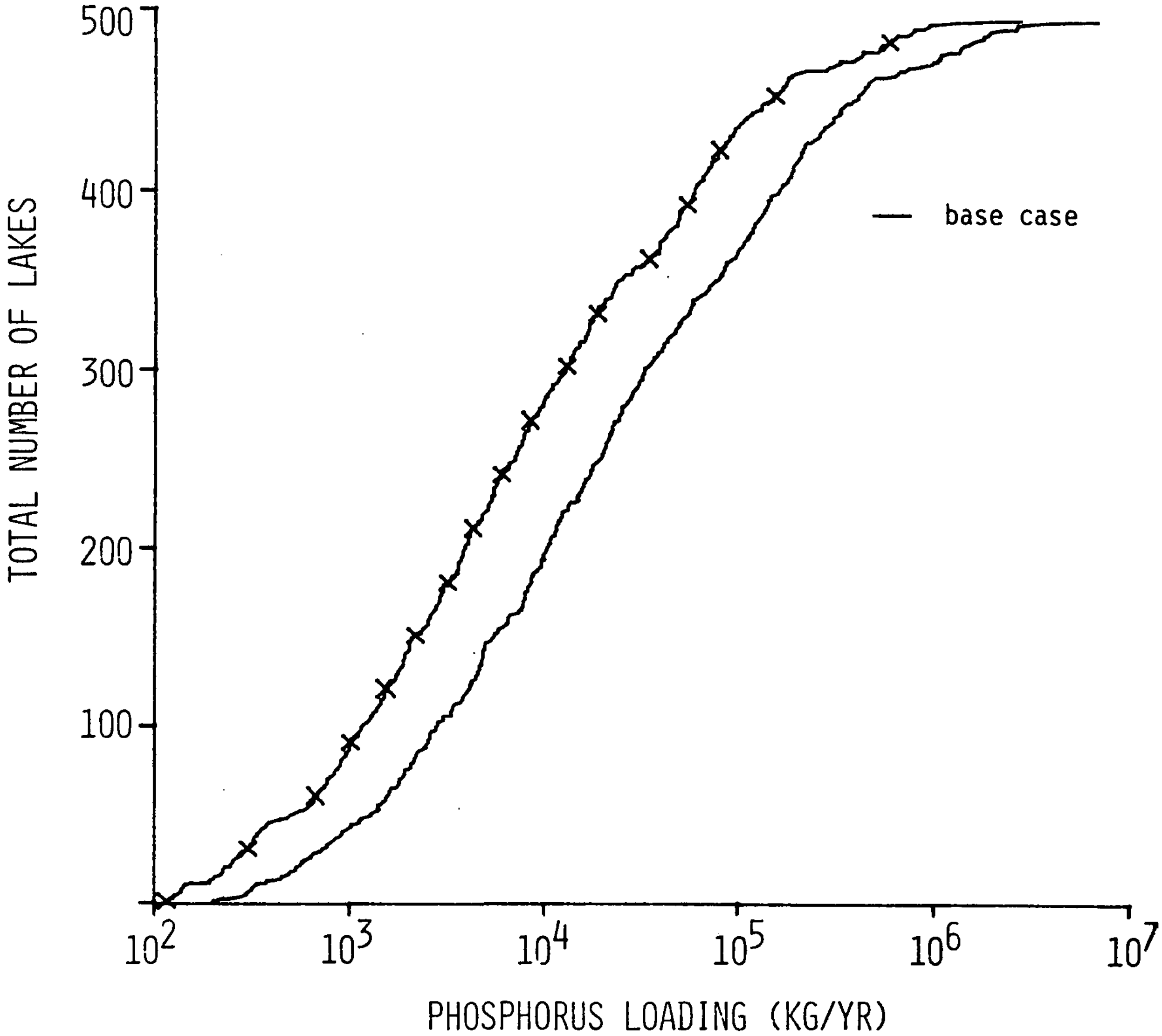


FIGURE XI-1 DISTRIBUTION OF NEW AND OLD PHOSPHORUS LOADING RATES, OPTION 8

Figures XI-2 through XI-4 show the distribution of parameter values for the base case (NES data) and the control option for all lakes. New and old median phosphorus concentrations for the lakes within each of the seven geographical areas are shown in Figures XI-5 through XI-11.

Because the chlorophyll-a levels and Secchi disc depths were relatively insensitive to changed phosphorus loading, the following discussion is limited to effects of the control option on phosphorus concentrations.

For all 493 lakes used in the data base the effect of a 60% nonpoint source and 80% municipal phosphorus reduction is shown in Figure XI-2. The mean value of predicted phosphorus concentration is 0.029 mg/ℓ compared to 0.084 with no control. The number of lakes with median phosphorus concentrations less than 0.025 mg/ℓ increased from 160 to 336.

Table XI-1 summarizes the results for all lakes and for subsets of lakes grouped by geographical area. Table XI-2 summarizes the number and fraction of lakes with median phosphorus concentrations less than 0.025 mg/ℓ.

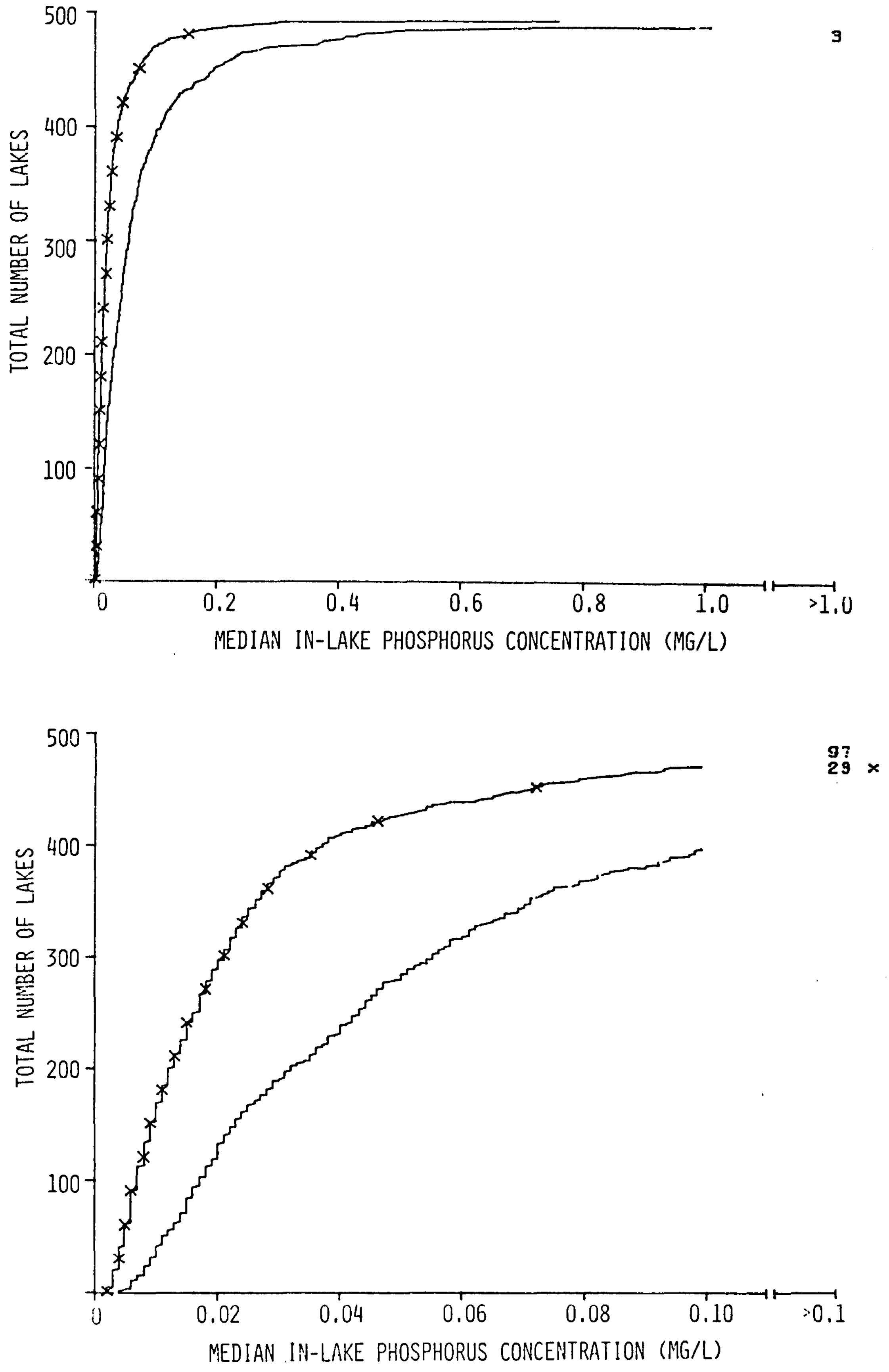


FIGURE XI-2 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS, OPTION 8

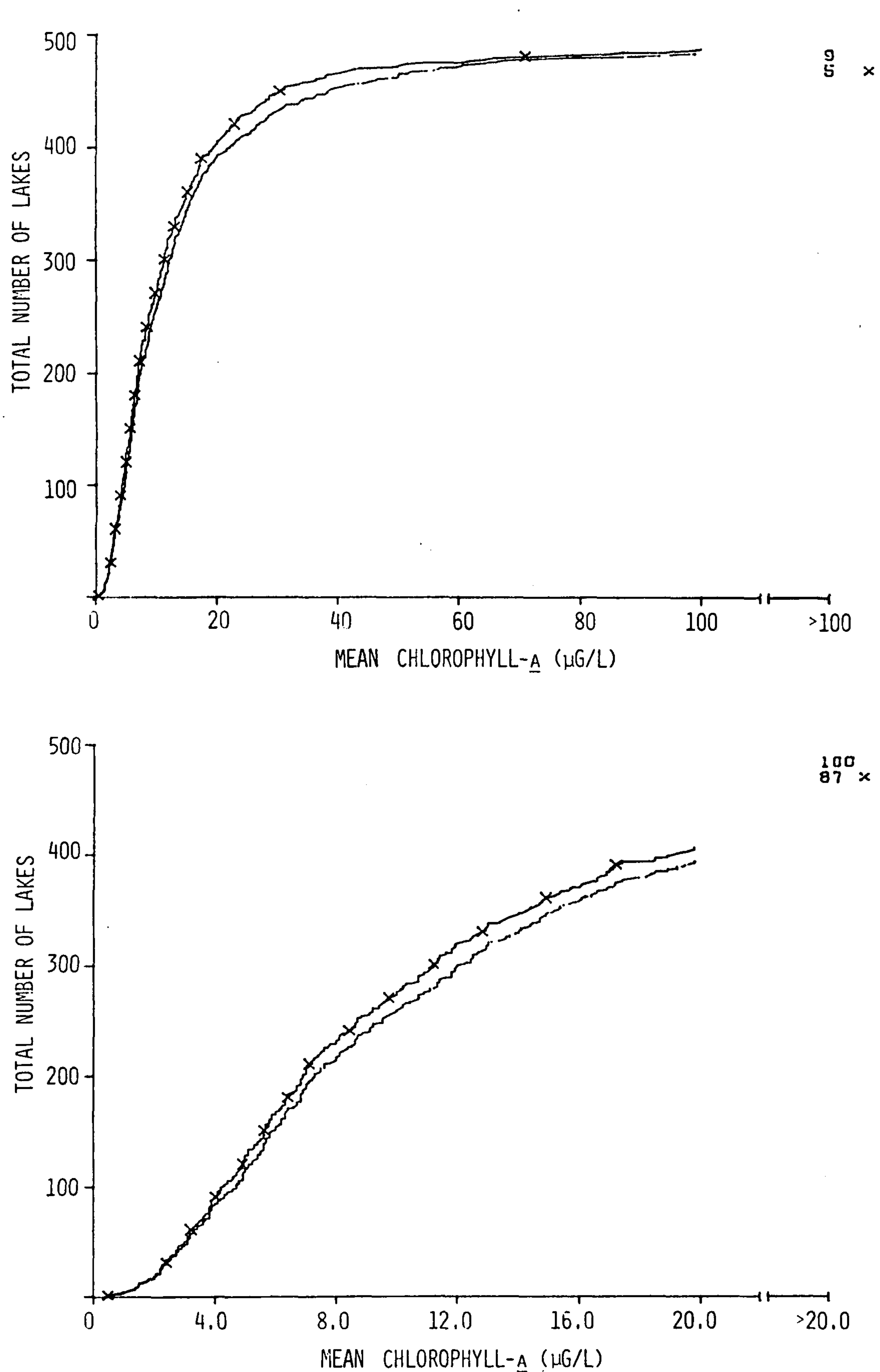


FIGURE XI-3 DISTRIBUTION OF NEW AND OLD MEAN CHLOROPHYLL-A CONCENTRATIONS, OPTION 8

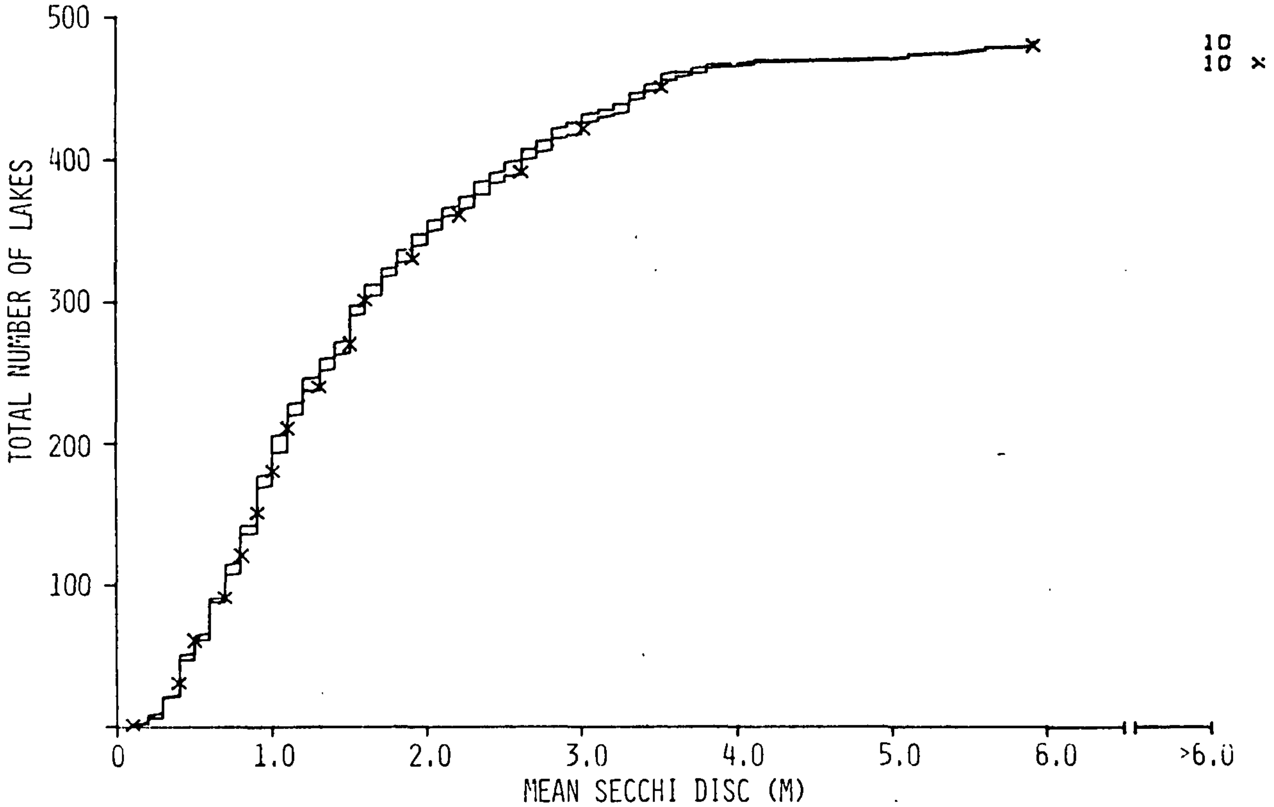


FIGURE XI-4 DISTRIBUTION OF NEW AND OLD MEAN SECCHI DISC DEPTHS, OPTION 8

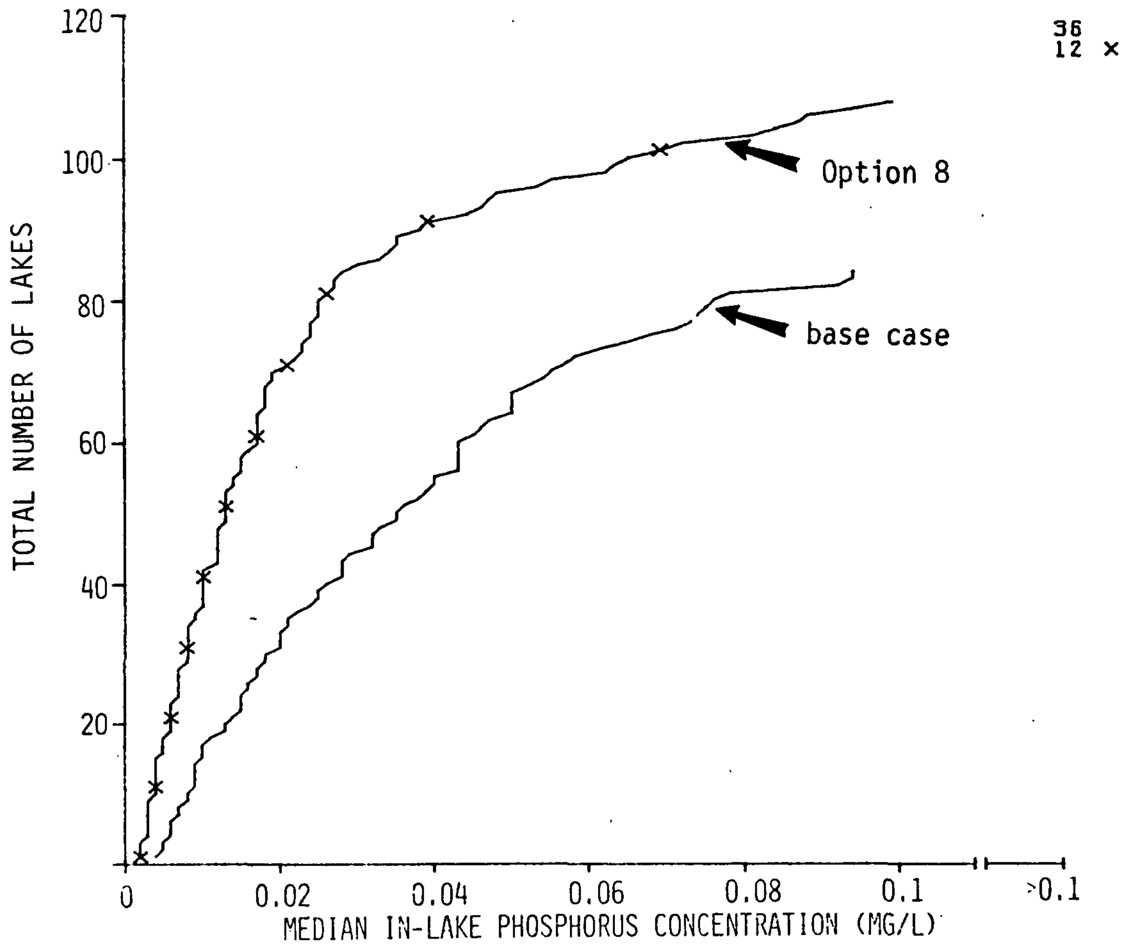


FIGURE XI-5 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 1, OPTION 8

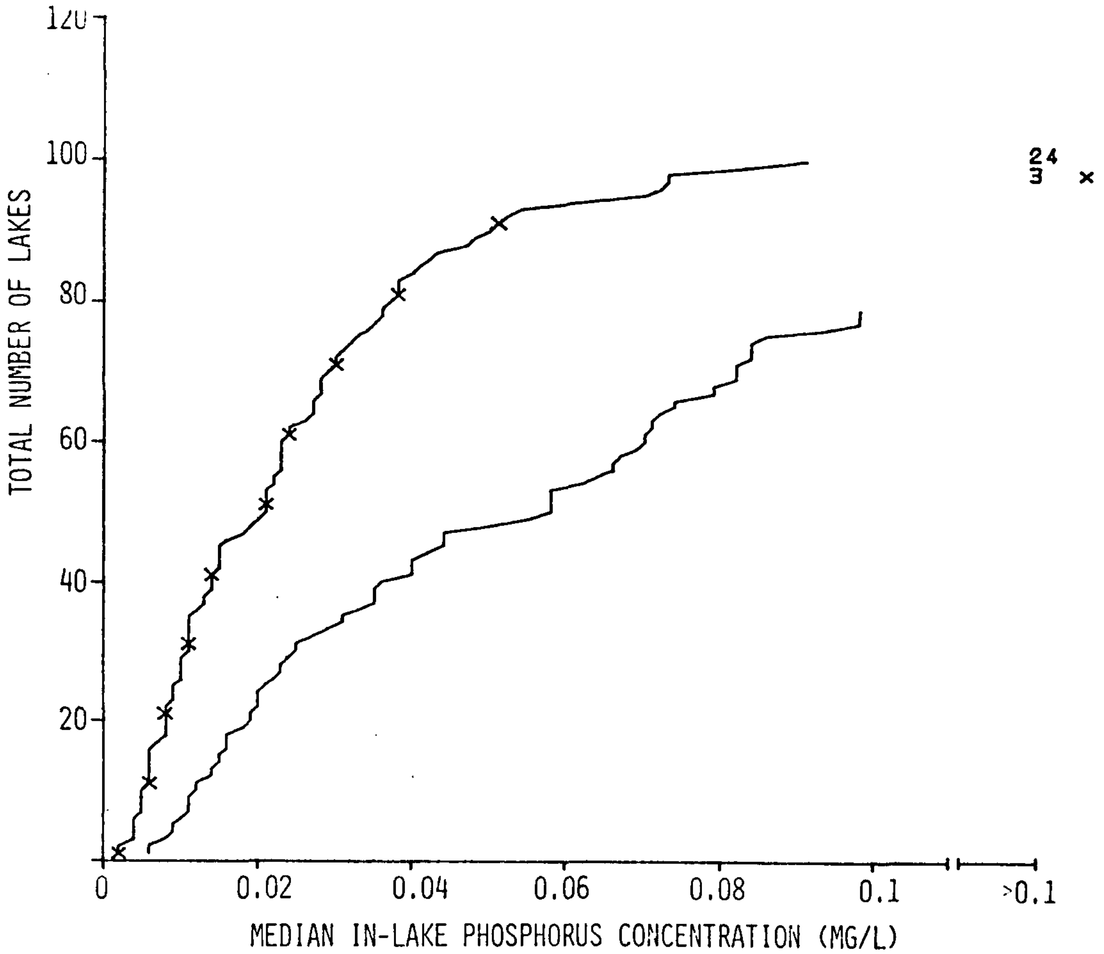


FIGURE XI-6 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 2, OPTION 8

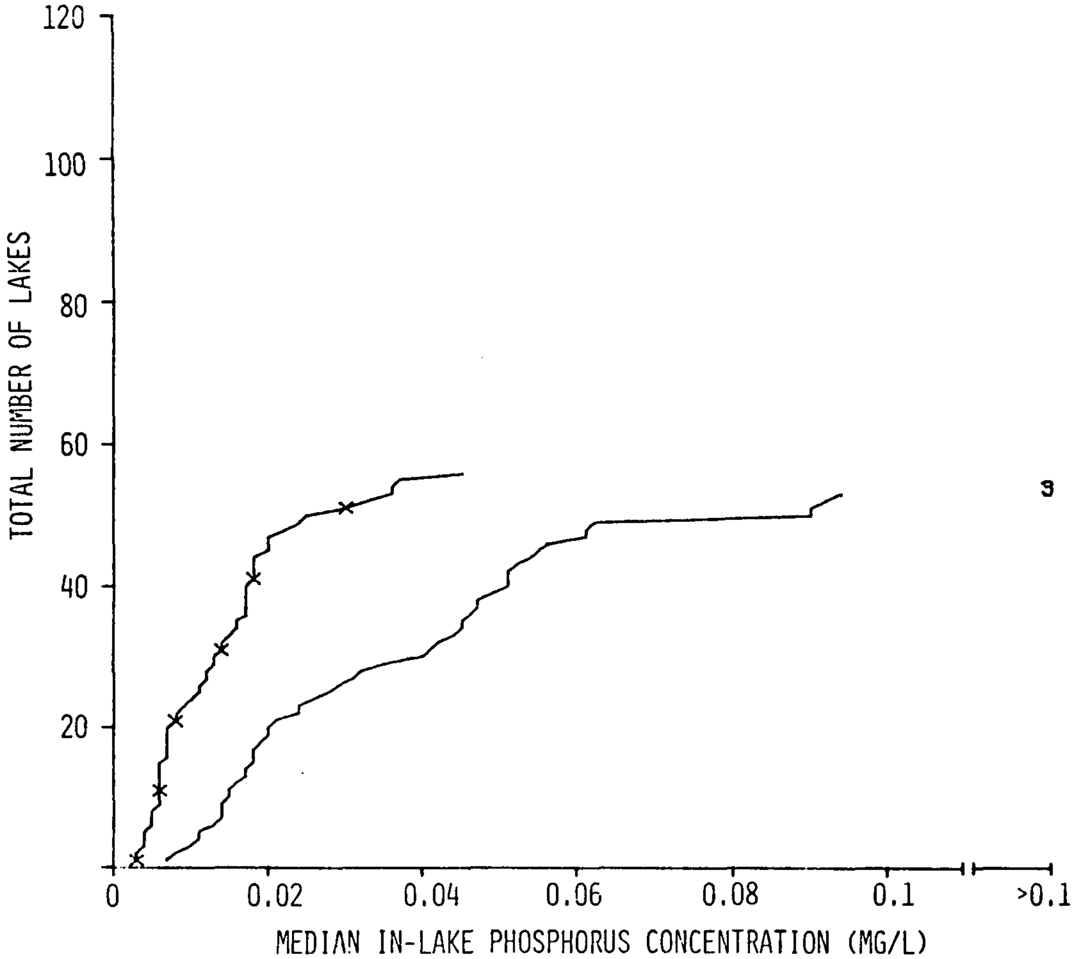


FIGURE XI-7 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 3, OPTION 8

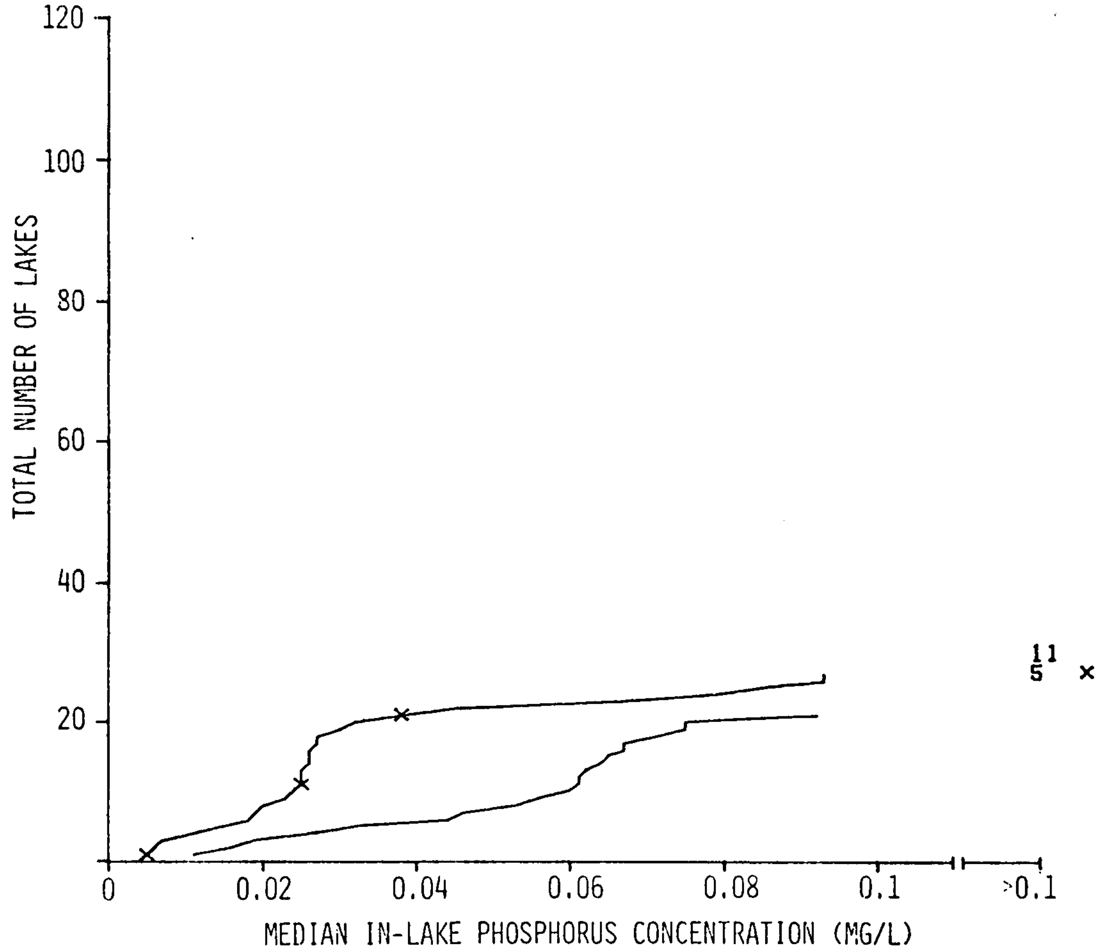


FIGURE XI-8 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 4, OPTION 8

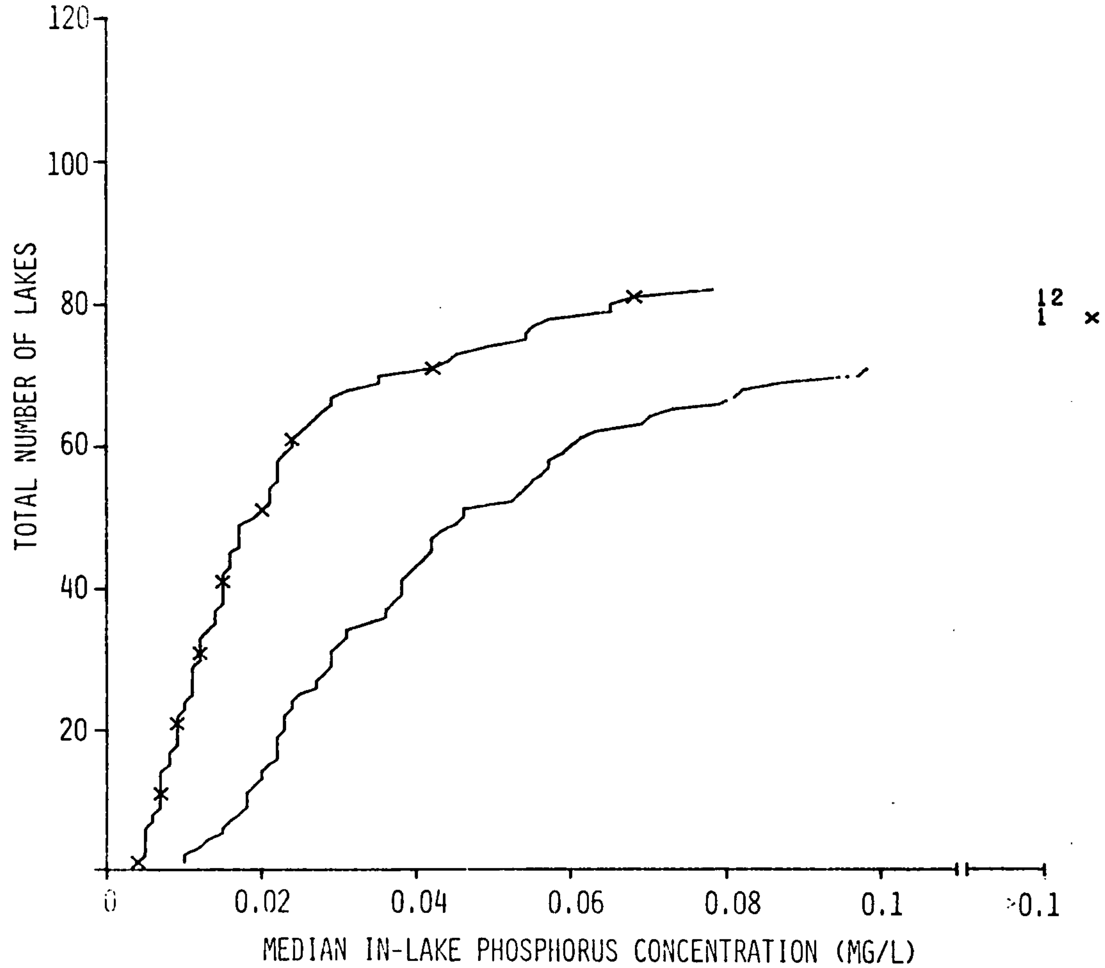


FIGURE XI-9 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 5, OPTION 8

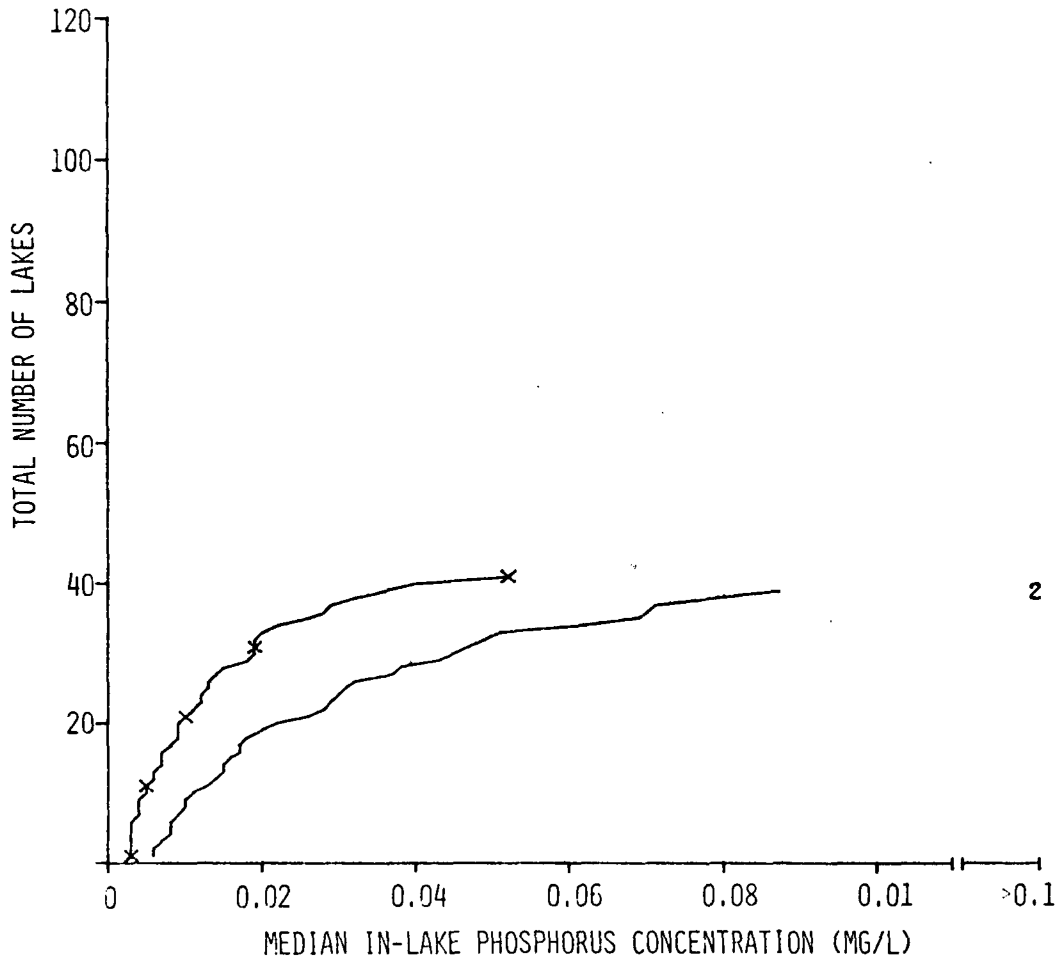


FIGURE XI-10 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 6, OPTION 8

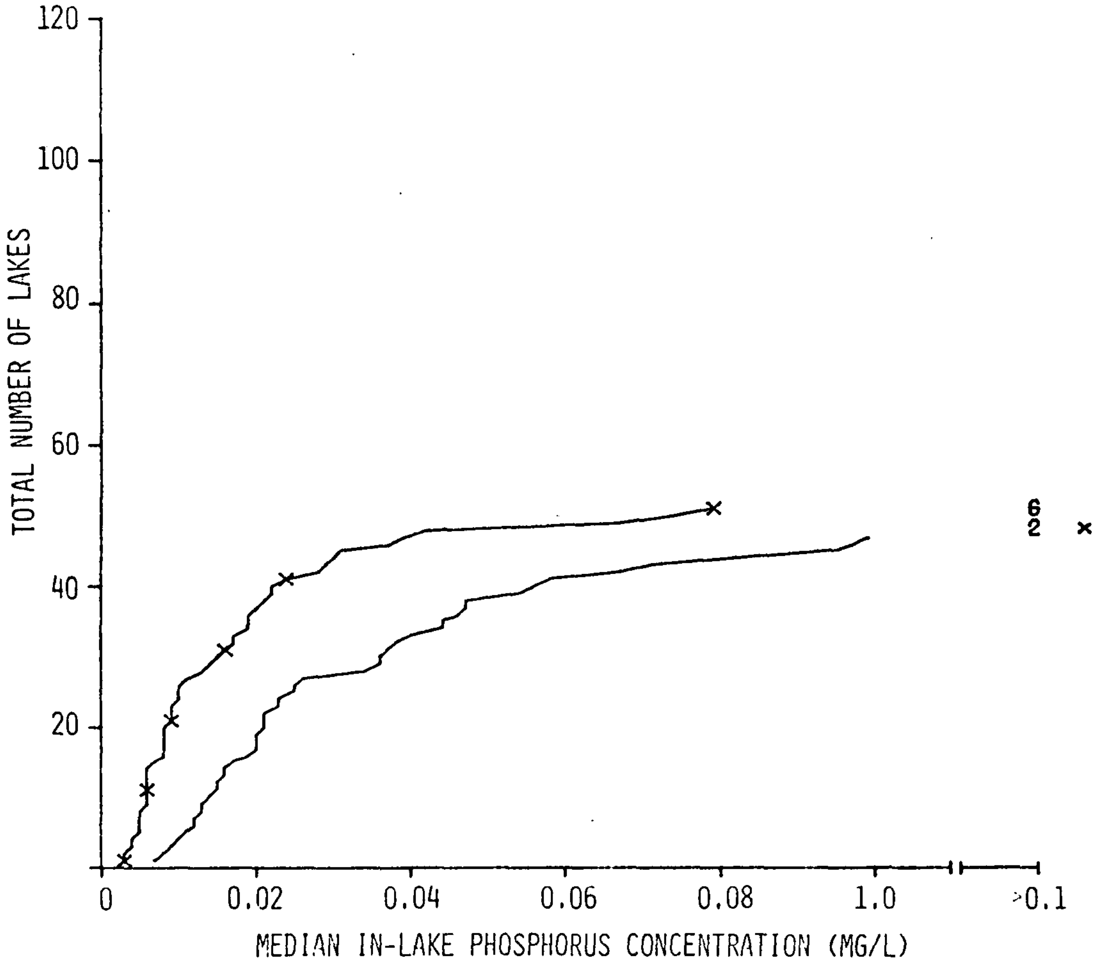


FIGURE XI-11 DISTRIBUTION OF NEW AND OLD MEDIAN PHOSPHORUS CONCENTRATIONS FOR LAKES IN AREA 7, OPTION 8

Table XI-1

Effect of Control Option 8 on *In Situ* Total Phosphorus Concentrations

Region	Number of Lakes	Original Loading			New Loading (60% Nonpoint & 80% Municipal Reduction)		
		Concentration, mg/ℓ			Concentration, mg/ℓ		
		Minimum	Mean	Maximum	Minimum	Mean	Maximum
1	120	0.004	0.141	1.525	0.002	0.044	0.753
2	108	0.006	0.086	0.865	0.002	0.030	0.256
3	56	0.007	0.041	0.143	0.003	0.014	0.045
4	32	0.011	0.121	0.489	0.005	0.050	0.183
5	83	0.010	0.058	0.424	0.004	0.023	0.170
6	41	0.006	0.034	0.115	0.003	0.014	0.052
7	53	0.007	0.054	0.371	0.003	0.022	0.152
All	493	0.004	0.084	1.525	0.002	0.029	0.753

Table XI-2

Number and Fraction of Lakes with Median Phosphorus Concentrations Less Than 0.025 mg/ℓ

Region	Number of Lakes	Lakes with Total P <0.025 mg/ℓ				Change (New - Old)	
		Old		New			
		#	%	#	%	#	%
1	120	37	31	77	64	40	33
2	108	29	27	64	59	35	32
3	56	23	41	49	88	26	47
4	32	3	9	10	31	7	22
5	83	24	29	61	73	37	44
6	41	20	49	34	83	14	34
7	53	24	45	41	77	17	32
All	493	160	32	336	68	176	36

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APPENDIX

APPENDIX A

NATIONAL EUTROPHICATION SURVEY DATA

USED IN EVALUATION OF PHOSPHORUS CONTROL OPTIONS

1972 THROUGH 1975

Prepared by Tetra Tech, Inc.

September 15, 1978

Note: A portion of Appendix A which lists the data used is included here for easy reference. The complete Appendix is included in the microfich attached to the back cover of the report.

TABLE OF CONTENTS

STATE CODES

STATE CODES

01	ALABAMA	32	NEVADA
02	ALASKA	33	NEW HAMPSHIRE
04	ARIZONA	34	NEW JERSEY
05	ARKANSAS	35	NEW MEXICO
06	CALIFORNIA	36	NEW YORK
08	COLORADO	37	NORTH CAROLINA
09	CONNECTICUT	38	NORTH DAKOTA
10	DELAWARE	39	OHIO
12	FLORIDA	40	OKLAHOMA
13	GEORGIA	41	OREGON
15	HAWAII	42	PENNSYLVANIA
16	IDAHO	44	RHODE ISLAND
17	ILLINOIS	45	SOUTH CAROLINA
18	INDIANA	46	SOUTH DAKOTA
19	IOWA	47	TENNESSEE
20	KANSAS	48	TEXAS
21	KENTUCKY	49	UTAH
22	LOUISIANA	50	VERMONT
23	MAINE	51	VIRGINIA
24	MARYLAND	53	WASHINGTON
25	MASSACHUSETTS	54	WEST VIRGINIA
26	MICHIGAN	55	WISCONSIN
27	MINNESOTA	56	WYOMING
28	MISSISSIPPI	11	DISTRICT OF COLUMBIA
29	MISSOURI	14	GUAM
30	MONTANA	43	PUERTO RICO
31	NEBRASKA	52	VIRGIN ISLANDS

MISCELLANEOUS CODES

Retention Time Codes

1 - RT ≤ 3 months
2 - 3 months < RT ≤ 12 months
3 - 12 months < RT ≤ 36 months
4 - RT > 36 months

Depth Codes

1 - Depth < 5 meters
2 - 5 < Depth ≤ 20 meters
3 - Depth > 20 meters

Type Codes

I - Impound
N - Natural

Trophic State Codes

O - Oligotrophic
M - Mesotrophic
E - Eutrophic
HE - Hypereutrophic
OM - Oligotrophic -- Mesotrophic
OE - Oligotrophic -- Eutrophic
OH - Oligotrophic -- Hypereutrophic
ME - Mesotrophic -- Eutrophic
MH - Mesotrophic -- Hypereutrophic
EH - Eutrophic -- Hypereutrophic
LM - Oligo - Mesotrophic
MU - Meso - Eutrophic
OU - Oligo - Eutrophic

LAKE NAMES AND CODES

STORET NUMBER (1st 2 digits are state code)	TYPE	TROPHIC STATE	YEAR SURVEYED	WORKING PAPER NUMBER
X X X X	X	X X	X X	X X X

LAKE NAMES AND CODES

					Lake Name	County
0901	I	E	72	176	ASPINOOK POND	NEW LONDON, WINDOM
0904	I	E	72	179	EAGLEVILLE LAKE	TOLLAND
0905	I	HE	72	180	HANOVER POND	NEW HAVEN
0910	I	E	72	181	LAKE ZOAR	LITCHFIELD, NEW HAVEN
0911	I	E	72	181	LAKE LILLINONAH	FAIRFIELD
0912	I	E	72	181	LAKE HOUSATONIC	NEWHAVEN, FAIRFIELD
2304	I	E	72	3	ESTES LAKE	YORK
2306	N	M	72	4	LONG LAKE	CUMBERLAND
2308	N	M	72	8	MATTAWAMKEAG LAKE	AROOSTOOK
2309	N	O	72	2	MOOSEHEAD LAKE	PISCATAQUIS, SOMERSET
2310	N	O	72	6	RANGELEY LAKE	FRANKLIN
2311	N	O	72	5	SEBAGO LAKE	CUMBERLAND
2312	N	E	72	9	SEBASTICOOK LAKE	PENOBSCOT
2313	N	M	72	7	LONG LAKE	AROOSTOOK
2314	N	O	72	5	BAY OF NAPLES	CUMBERLAND
2502	N	HE	72	220	HAGER POND	MIDDLESEX
2503	I	E	72	27	HARRIS POND	PROVIDENCE, (RI); WORCHESTER, (MA)
2507	I	HE	72	223	WOODS POND	BERKSHIRE
2508	I	E	72	221	MATFIELD IMPOUNDMENT	PLYMOUTH
2513	I	E	72	219	HUDSON IMPOUNDMENT	MIDDLESEX, WORCHESTER
2603	I	E	72	182	LAKE ALLEGAN	ALLEGAN
2606	N	E	72	183	BARTON LAKE	KALAMAZOO
2609	I	E	72	184	BELLEVILLE LAKE	WAYNE
2617	N	O	72	188	LAKE CHARLEVOIX	CHARLEVOIX
2618	N	E	72	189	LAKE CHEMUNG	LIVINGSTON
2629	I	E	72	193	FORD LAKE	WASHTENAW
2631	N	HE	72	194	FREMONT LAKE	NEWAYGO
2643	N	E	72	199	KENT LAKE	OAKLAND, LIVINGSTON
2648	N	HE	72	200	MACATAWA LAKE	OTTAWA
2659	N	E	72	203	MUSKEGON LAKE	MUSKEGON
2673	I	E	72	209	ROSS RESERVOIR	GLADWIN
2683	N	E	72	215	THORNAPPLE LAKE	BARRY
2685	N	E	72	216	UNION LAKE	BRANCH
2688	N	E	72	217	WHITE LAKE	MUSKEGON

LAKE NAMES AND CODES

					Lake Name	County
2691	N	E	72	202	MONA LAKE	MUSKEGON
2692	N	E	72	211	LONG LAKE	ST JOSEPH
2694	N	O	72	191	CRYSTAL LAKE	MONTCALM
2695	N	O	72	195	HIGGINS LAKE	ROSCOMMON
2696	N	E	72	196	HOUGHTON LAKE	ROSCOMMON
2699	N	E	72	213	STRAWBERRY LAKE	LIVINGSTONE
27A1	N	E	72	135	LAKE WINONA	DOUGLAS
27A2	N	E	72	136	WOLF LAKE	BELTRAMI, HUBBARD
27A5	I	E	72	137	ZUMBRO LAKE	OLMSTED, WABASHA
27A6	I	E	72	127	SPRING LAKE	DAKOTA, WASHINGTON
27A7	I	E	72	122	LAKE ST. CROIX	WASHINGTON, (MN); ST. CROIX, PIERCE, (WI)
27B1	N	E	72	133	WAGONGA LAKE	KANDIYOHI
27B2	N	M	72	101	GREEN LAKE	KANDIYOHI
27B3	N	E	72	117	NEST LAKE	KANDIYOHI
27B4	N	ME	72	96	LAKE DARLING	DOUGLAS
27C0	N	E	72	81	LAKE ANDRUSIA	BELTRAMI
27C1	N	E	72	84	LAKE BEMIDJI	BELTRAMI
27C2	N	E	72	115	MUD LAKE	ITASCA
2702	N	E	72	80	ALBERT LEA LAKE	FREEBORN
2705	N	E	72	83	BARTLETT LAKE	KOOCHICHING
2709	N	E	72	85	BIG STONE	BIG STONE, (MN); ROBERTS, GRANT, (SD)
2711	N	E	72	86	BLACKDUCK LAKE	BELTRAMI
2712	N	E	72	87	BLACKHOOF LAKE	CROW WING
2713	N	E	72	88	BUFFALO LAKE	WRIGHT
2715	N	M	72	92	CASS LAKE	BELTRAMI, CASS
2716	N	E	72	93	CLEARWATER LAKE	WRIGHT, STEARNS
2719	N	E	72	94	COKATO LAKE	WRIGHT
2725	N	E	72	97	ELBOW LAKE	ST. LOUIS
2737	N	E	72	102	GULL LAKE (SOUTH BASIN)	CASS, CROW WING
2739	N	E	72	103	HERON LAKE	JACKSON
2746	N	M	72	105	LEECH LAKE	CASS
2750	N	E	72	108	MADISON LAKE	BLUE EARTH
2756	N	E	72	111	MASHKENODE LAKE	ST. LOUIS
2757	N	E	72	112	MCQUADE LAKE	ST. LOUIS

LAKE NAMES AND CODES

					Lake Name	County
2761	N	E	72	114	LAKE MINNEWASKA	POPE
2765	N	M	72	118	PELICAN LAKE	ST. LOUIS
2776	N	E	72	123	ST. LOUIS BAY	ST. LOUIS, (MN); DOUGLAS, (WI)
2782	N	E	72	125	SILVER LAKE	MCLEOD
2783	N	E	72	126	SIX MILE LAKE	ST. LOUIS
2788	N	M	72	129	SWAN LAKE	ITASCA
2793	N	E	72	131	TROUT LAKE	ITASCA
3302	I	E	72	14	POWDER MILL POND	HILLSBOROUGH
3303	N	O	72	11	LAKE WINNIPESAUKEE	BELKNAP, CARROLL
3305	I	E	72	13	KELLYS FALLS POND	HILLSBOROUGH
3306	I	E	72	12	GLEN LAKE	HILLSBOROUGH
3604	N	O	72	149	CANADIAGUA	ONTARIO, YATES
3605	I	E	72	150	CANNONSVILLE RESERVOIR	DELAWARE
3606	N	M	72	151	CARRY FALLS RESERVOIR	ST. LAWRENCE
3608	N	M	72	153	CAYUGA LAKE	CAYUGA, SENECA, TOMPKINS
3611	N	E	72	157	CROSS LAKE	CAYUGA, ONONDAGA
3617	N	O	72	160	KEUKA LAKE	YATES, STEUBEN
3632	N	M	72	167	SACANDAGA RESERVOIR	FULTON, SARATOGA
3633	N	E	72	168	SARATOGA LAKE	SARATOGA
3635	N	M	72	170	SENECA LAKE	SCHUYLER
3637	I	E	72	172	SWINGING BRIDGE RES.	SULLIVAN
3639	N	E	72	156	CONESUS LAKE	LIVINGSTON
3640	N	E	72	162	LOWER ST. REGIS	FRANKLIN
4402	I	E	72	28	SLATERSVILLE RESERVOIR	PROVIDENCE
4403	I	E	72	29	TURNER RESV.-CENTRAL PND	PROVIDENCE, (RI); BRISTOL, (MA)
5001	N	M	72	154	LAKE CHAMPLAIN	VT, AND NY AREA
5002	I	E	72	15	CLYDE POND	ORLEANS
5005	I	M	72	20	HARRIMAN RESERVOIR	WINDHAM
5007	I	E	72	16	LAKE LAMOILLE	LOMOILLE
5008	N	E	72	19	LAKE MEMPHREMAGOG	ORLEANS
5010	I	E	72	17	ARROWHEAD MOUNTAIN LAKE	CHITTENDEN, FRANKLIN
5011	I	M	72	18	WATERBURY RESERVOIR	WASHINGTON, LAMOILLE
5509	N	E	72	34	BUTTERNUT LAKE	PRICE, ASHLAND
5513	N	E	72	36	DELAVAN LAKE	WALWORTH

LAKE NAMES AND CODES

					Lake Name	County
5519	N	M	72	39	GREEN LAKE	GREEN LAKE
5520	N	E	72	40	KEGONSA LAKE	DANE
5522	I	E	72	41	KOSHKONONG LAKE	JEFFERSON
5531	N	E	72	43	NAGAWICKA LAKE	WAUKESHA
5538	N	E	72	45	LAKE POYGAN	WINNEBAGO, WAUSHARA
5539	N	E	72	48	SHAWANO LAKE	SHAWANO
5541	I	E	72	49	SINISSIPPI LAKE	DODGE
5546	N	E	72	51	TAINTER LAKE	DUNN
5548	N	E	72	53	TOWNLINE LAKE	ONEIDA
5550	N	E	72	54	WAPOGASSET LAKE	POLK
5555	I	E	72	58	WISCONSON LAKE	COLUMBIA, SAUK
5556	I	E	72	59	LAKE WISSOTA	CHIPPEWA
5559	N	HE	72	52	TICHIGAN LK-WATERF. IMPD	RACINE
5564	N	M	72	46	ROCK LAKE	JEFFERSON
5565	I	E	72	33	BIG EAU PLEINE RES	MARATHON
5570	N	E	72	38	GRAND LAKE	GREEN LAKE
5574	I	M	72	56	WILLOW RESERVOIR	ONEIDA
0101	I	E	73	226	BANKHEAD LAKE	JEFFERSON, TUSCALOOSA, WALKER
0104	I	E	73	228	GUNTERSVILLE RESERVOIR	MARSHALL, JACKSON
0105	I	E	73	226	HOLT LOCK AND DAM	TUSCALOOSA
0107	I	M	73	231	MARTIN LAKE	COOSA, ELMORE, TALLAPOOSA
0112	I	E	73	235	WEISS RESERVOIR	CHEROKEE, AL; FLOYD, GA
0115	I	E	73	234	LAKE PURDY	JEFFERSON, SHELBY
1005	I	E	73	238	MOORES LAKE	KENT
1007	I	E	73	239	NOXONTOWN POND	NEW CASTLE
1008	I	E	73	240	SILVER LAKE	NEW CASTLE
1009	I	E	73	242	WILLIAMS POND	SUSSEX
1010	I	E	73	241	TRUSSUM POND	SUSSEX
1301	I	E	73	281	ALLATOONA RES.	BARTOW, CHEROKEE, COBB
1302	I	E	73	283	LAKE BLACKSHEAR	CRISP, DOOLY, LEE, SUMTER, WORTH
1303	I	M	73	286	CHATUGE LAKE	TOWNS, GA; CLAY, NC
1304	I	ME	73	287	CLARK HILL RESERVOIR	COLUMBIA, ELBERT, LINCOLN, MCDUFFIE, WILKS, GA; ABBEVILLE, MCCO
1309	I	E	73	290	JACKSON LAKE	BUTTS, JASPER, NEWTON
1310	I	M	73	293	SIDNEY LANIER LAKE	DAWSON, FORSYTH, GWINNETT, HALL, LUMPKIN

LAKE NAMES AND CODES

					Lake Name	County
1311	I	M	73	291	NOTTELY RES.	UNION
1313	I	E	73	294	SINCLAIR LAKE	BALDWIN, HANCOCK, PUTNAM
1316	I	LM	73	284	BLUE RIDGE LAKE	FANNIN
1317	I	E	73	282	LAKE HARDING	HARRIS, GA; CHAMBERS, LEE, AL
1318	I	LM	73	285	BURTON LAKE	RABUN
1319	I	E	73	289	HIGH FALLS POND	BUTTS, LAMAR, MONROE
1703	I	E	73	296	BLOOMINGTON LAKE	MCLEAN
1706	I	E	73	297	CARLYLE RESERVOIR	BOND, CLINTON, FAYETTE
1712	I	E	73	301	CRAB ORCHARD LAKE	JACKSON, WILLIAMSON
1714	I	E	73	302	LAKE DECATUR	MACON
1725	N	E	73	309	LONG LAKE	LAKE
1726	I	E	73	310	LAKE LOU YAEGER	MONTGOMERY
1735	I	E	73	313	REND LAKE	FRANKLIN, JEFFERSON
1739	I	E	73	315	SHELBYVILLE RESERVOIR	SHELBY, MOULTRIE
1740	I	E	73	306	HIGHLAND SILVER LAKE	MADISON
1742	I	E	73	317	LAKE SPRINGFIELD	SANGAMON
1748	I	E	73	320	LAKE VERMILION	VERMILION
1750	I	E	73	322	WONDER LAKE	MCHENRY
1751	I	E	73	318	LAKE STOREY	KNOX
1754	I	E	73	307	HOLIDAY LAKE	LASALLE
1755	N	E	73	305	FOX LAKE	LAKE
1758	N	E	73	316	SLOCUM LAKE	LAKE
1761	I	E	73	321	LAKE WEE-MA-TUK	FULTON
1762	I	E	73	312	RACCOON LAKE	MARION
1763	I	E	73	295	BALDWIN LAKE	RANDOLPH
1764	I	E	73	319	LAKE VANDALIA	FAYETTE
1766	N	E	73	308	HORSESHOE LAKE	MADISON
1805	I	E	73	324	CATARACT LAKE	OWEN, PUTNAM
1811	I	E	73	327	GEIST RESERVOIR	HAMILTON, MARION
1827	I	E	73	334	MISSISSINEWA RESERVOIR	GRANT, MIAMI, WABASH
1828	I	E	73	336	MONROE RESERVOIR	BROWN, MONROE
1829	I	E	73	337	MORSE RESERVOIR	HAMILTON
1836	N	M	73	344	WAWASEE LAKE	KOSCIUSKO
1837	N	E	73	345	WEBSTER LAKE	KOSCIUSKO

LAKE NAMES AND CODES

					Lake Name	County
1839	I	E	73	347	WHITEWATER LAKE	UNION
1840	N	E	73	348	WINONA LAKE	KOSCIUSKO
1841	N	E	73	346	WESTLER LAKE	LAGRANGE
1842	N	E	73	349	WITMER LAKE	LAGRANGE
1843	N	M	73	335	LAKE MAXINKUCKEE	MARSHALL
1844	N	M	73	342	LAKE TIPPECANOE	KOSCIUSKO
1845	N	E	73	326	DALLAS LAKE	LAGRANGE
1846	N	M	73	338	OLIN LAKE	LAGRANGE
1847	N	M	73	339	OLIVER LAKE	LAGRANGE
1851	N	E	73	323	BASS LAKE	STARKE
1852	I	MU	73	325	CROOKED LAKE	STEUBEN
1853	N	M	73	331	JAMES LAKE	STEUBEN
1854	N	E	73	332	LONG LAKE	STEUBEN
1855	N	E	73	340	PIGEON LAKE	STEUBEN
1856	N	E	73	333	MARSH LAKE	STEUBEN
1857	N	E	73	328	HAMILTON LAKE	STEUBEN
2101	I	M	73	351	CUMBERLAND LAKE	CLINTON, PULASKI, RUSSELL, WAYNE
2103	I	E	73	353	HERRINGTON LAKE	BOYLE, GARRARD, MERCER
2402	I	M	73	355	DEEP CREEK LAKE	GARRETT
2403	I	M	73	357	LIBERTY RESERVOIR	CARROLL, BALTIMORE
2408	I	E	73	358	LOCH RAVEN RESERVOIR	BALTIMORE
2409	I	E	73	356	JOHNSON POND	WICOMICO
2802	I	E	73	360	ENID LAKE	YALOBUSHA
2804	I	E	73	362	ROSS BARNETT RESERVOIR	JACKSON, MADISON, RANKIN
2805	I	E	73	363	SARDIS LAKE	LAFAYETTE, PANOLA
2806	I	E	73	361	GRENADA LAKE	CALHOUN, GRENADA, YALOBUSHA
3402	N	E	73	364	BUDD LAKE	MORRIS
3403	I	E	73	367	GREENWOOD LAKE	PASSAIC, NJ; ORANGE, NY
3406	I	E	73	370	ORADELL RESERVOIR	BERGEN
3409	I	E	73	372	PINECLIFF LAKE	PASSAIC
3410	I	E	73	373	POMPTON LAKES	PASSAIC
3412	I	E	73	365	DUHERNAL LAKE	MIDDLESEX
3415	I	E	73	368	LAKE HOPATCONG	MORRIS, SUSSEX
3419	I	E	73	371	PAULINSKILL LAKE	SUSSEX

LAKE NAMES AND CODES

					Lake Name	County
3420	I	E	73	374	SPRUCE RUN RESERVOIR	HUNTERDON
3423	I	M	73	376	WANAQUE RESERVOIR	PASSAIC
3641	I	ME	73	147	ALLEGHENY	MCKEAN, WARREN, PA; CATTARAUGUS, NY
3701	I	E	73	377	BADIN LAKE	MONTGOMERY, STANLY
3702	I	E	73	378	BLEWETT FALLS LAKE	ANSON, RICHMOND
3704	I	M	73	379	FONTANA LAKE	SWAIN, GRAHAM
3705	I	E	73	380	HICKORY LAKE	ALEXANDER, CALDWELL, CATAWBA
3706	I	E	73	381	HIGH ROCK LAKE	DAVIDSON, ROWAN
3707	I	M	73	382	HIWASSEE LAKE	CHEROKEE
3711	I	M	73	386	MOUNTAIN ISLAND LAKE	GASTON, MECKLENBURG
3713	I	E	73	387	LAKE NORMAN	CATAWBA, IRADELL, LINCOLN, MECKLENBURG
3715	I	E	73	388	RHODHISS LAKE	BURKE, CALDWELL
3716	I	M	73	389	SANTEETLAH LAKE	GRAHAM
3717	I	E	73	390	LAKE TILLERY	MONTGOMERY, STANLY
3718	I	E	73	392	WATERVILLE LAKE	HAYWOOD
3719	N	M	73	391	WACCAMAW LAKE	COLUMBUS
3901	I	E	73	394	BEACH CITY RESERVOIR	STARK, TUSCARAWAS
3902	N	E	73	396	BUCKEYE LAKE	FAIRFIELD, LICKING, PERRY
3905	I	E	73	397	CHARLES MILL RESERVOIR	ASHLAND, RICHLAND
3906	I	E	73	398	DEER CREEK RESERVOIR	FAYETTE, PICKAWAY
3907	I	E	73	399	DELAWARE RESERVOIR	DELAWARE
3908	I	E	73	400	DILLON RESERVOIR	MUSKINGUM
3912	I	E	73	401	LAKE GRANT	BROWN
3914	I	E	73	403	HOOVER RESERVOIR	DELAWARE, FRANKLIN
3921	I	E	73	406	MOSQUITO CREEK RESERVOIR	TRUMBULL
3924	I	E	73	408	PLEASANT HILL RESERVOIR	ASHLAND, RICHLAND
3927	N	E	73	411	GRAND LAKE OF ST. MARYS	AUGLAIZE, MERCER
3928	I	E	73	393	ATWOOD RESERVOIR	CARROL, TUSCARAWAS
3929	I	E	73	395	BERLIN RESERVOIR	MAHONING, PORTAGE, STARK
3930	I	E	73	402	HOLIDAY LAKE	HURON
3931	I	E	73	407	O'SHAUGHNESSY RESERVOIR	DELAWARE
3932	I	E	73	409	ROCKY FORK RESERVOIR	HIGHLAND
4201	I	E	73	415	BLANCHARD RESERVOIR	CENTRE
4204	N	E	73	417	CONNEAUT LAKE	CRAWFORD

LAKE NAMES AND CODES

					Lake Name	County
4207	I	E	73	418	GREENLANE RESERVOIR	MONTGOMERY
4213	I	E	73	425	PYMATUNING RESERVOIR	CRAWFORD, PA; ASHTABULA, OH
4216	I	E	73	426	SHENANGO RIVER RESERVOIR	MERCER
4219	I	M	73	413	BEAVER RUN RESERVOIR	WESTMORELAND
4220	I	M	73	414	BELTZVILLE LAKE	CARBON
4221	N	E	73	416	LAKE CANADOHTA	CRAWFORD
4222	N	M	73	419	HARVEYS LAKE	LUZERNE
4223	I	M	73	420	INDIAN LAKE	SOMERSET
4224	I	M	73	421	LAKE NAOMI	MONROE
4225	I	E	73	422	LAKE ONTELAUNEE	BERKS
4226	I	E	73	423	CONEWAGO LAKE (PINCHOT)	YORK
4227	I	M	73	424	POCONO LAKE	MONROE
4229	I	M	73	428	LAKE WALLENPAUPACK	PIKE, WAYNE
4503	I	E	73	430	FISHING CREEK RES	CHESTER, LANCASTER
4504	I	E	73	431	LAKE GREENWOOD	GREENWOOD, LAURENS, NEWBERRY
4505	I	MU	73	432	LAKE HARTWELL	ANDERSON, OCONEE, PICKENS, SC; FRANKLIN, HART, STEPHENS, GA
4506	I	E	73	434	LAKE MARION	BERKELEY, CALHOUN, CLARENDON, ORANGEBURG, SUMTER
4507	I	ME	73	436	LAKE MURRAY	FAIRFIELD, LEXINGTON, NEWBERRY, SALUDA, RICHLAND
4508	I	MU	73	437	LAKE ROBINSON	CHESTERFIELD, DARLINGTON
4511	I	E	73	441	LAKE WYLIE	YORK, SC; GASTON, MECKLENBURG, NC
4513	I	LM	73	433	LAKE KEOWEE	OCONEE, PICKENS
4515	I	MU	73	438	SALUDA LAKE	GREENVILLE, PICKENS
4704	I	E	73	443	BOONE RESERVOIR	WASHINGTON, SULLIVAN, CARTER
4707	I	E	73	445	CHEROKEE LAKE	JEFFERSON, HAMBLEN, GRAINGER, HAWKINS
4708	I	E	73	446	CHICKAMAUGA RESERVOIR	HAMILTON, RHEA, MEIGS, MCMINN
4711	I	E	73	447	DOUGLAS LAKE	SEVIER, JEFFERSON, COCKE
4712	I	E	73	446	FT. LOUDOUN RESERVOIR	LOUDON, KNOX, BLOUNT
4713	I	M	73	449	GREAT FALLS LAKE	WHITE, VAN BUREN
4717	I	E	73	446	NICKAJACK RESERVOIR	MARION, HAMILTON
4722	I	E	73	446	WATTS BAR RESERVOIR	CUMBERLAND, LOUDON, MEIGS, RHEA, ROANE
4723	I	E	73	444	J. PERCY PRIEST RES.	DAVIDSON, RUTHERFORD
4724	I	E	73	455	TIMS FORD RESERVOIR	FRANKLIN, MOORE
4725	I	MU	73	443	SOUTH HOLSTON RESERVOIR	SULLIVAN, TN; WASHINGTON, VA
4728	I	E	73	455	WOODS RESERVOIR	FRANKLIN, COFFEE

LAKE NAMES AND CODES

					Lake Name	County
5103	I	E	73	460	CLAYTOR LAKE	PULASKI
5105	I	M	73	463	JOHN W FLANNAGAN RES.	DICKENSON
5106	I	E	73	462	JOHN H KERR RES	HALIFAX, MECKLENBURG, VA; GRANVILLE, VANCE, WARREN, NC
5108	I	E	73	464	OCCOQUAN RESERVOIR	FAIRFAX
5110	I	ME	73	465	SMITH MOUNTAIN RESERVOIR	BEDFORD, FRANKLIN, PITTSYLVANIA
5111	I	E	73	458	LAKE CHESDIN	AMELIA, CHESTERFIELD, DINWIDDIE
5112	I	E	73	459	CHICKAHOMINY LAKE	NEW KENT, CHARLES
5113	I	E	73	466	RIVANNA RESERVOIR	ALBERMARLE
5401	I	E	73	467	BLUESTONE RESERVOIR	GILES, VA; MERCER, MONROE, SUMMERS, WV
5402	I	M	73	468	LAKE LYNN	MONONGALIA
5403	I	M	73	469	SUMMERSVILLE RESERVOIR	NICHOLAS
5404	I	M	73	470	TYGART RESERVOIR	BARBOUR, TAYLOR
0501	I	M	74	480	BEAVER RESERVOIR	BENTON, CARROLL, WASHINGTON
0502	N	HE	74	481	BLACKFISH LAKE	CRITTENDEN, ST. FRANCIS
0504	I	M	74	480	BULL SHOALS RESERVOIR	BAXTER, BOONE, MARION, AR; TANEY, OZARK, MO
0505	I	E	74	483	LAKE CATHERINE	GARLAND, HOT SPRING
0506	I	E	74	484	CHICOT LAKE	CHICOT
0507	I	M	74	485	DEGRAY RESERVOIR	CLARK, HOT SPRING
0508	I	E	74	486	LAKE ERLING	LAFAYETTE
0510	I	E	74	483	HAMILTON LAKE	GARLAND
0514	I	M	74	483	OUACHITA LAKE	GARLAND, MONTGOMERY
0515	I	M	74	480	TABLE ROCK RESERVOIR	BOONE, CARROLL, AR; BARRY, TANEY, MO
0516	I	M	74	487	GREER'S FERRY RESERVOIR	VAN BUREN, CLEBURNE
1901	I	E	74	494	LAKE AHQUABI	WARREN
1902	I	E	74	495	BIG CREEK RESERVOIR	POLK
1903	N	E	74	496	BLACK HAWK LAKE	SAC
1907	N	E	74	500	LAKE MACBRIDE	JOHNSON
1908	I	E	74	501	PRAIRIE ROSE LAKE	SHELBY
1909	I	E	74	502	RATHBUN RESERVOIR	APPANOOSE, LUCAS, MONROE, WAYNE
1910	I	E	74	503	RED ROCK RESERVOIR	MARION
1911	I	E	74	504	ROCK CREEK LAKE	JASPER
1912	N	E	74	505	SILVER LAKE	WORTH
1914	I	E	74	507	VIKING LAKE	MONTGOMERY
2001	I	M	74	511	CEDAR BLUFF RESERVOIR	TREGO

LAKE NAMES AND CODES

					Lake Name	County
2002	I	E	74	512	COUNCIL GROVE RESERVOIR	MORRIS
2003	I	E	74	513	ELK CITY RESERVOIR	MONTGOMERY
2005	I	E	74	515	JOHN REDMOND RESERVOIR	COFFEY, LYON
2006	I	E	74	516	KANOPOLIS RESERVOIR	ELLSWORTH
2007	I	E	74	517	MARION RESERVOIR	MARION
2008	I	E	74	518	MELVERN RESERVOIR	OSAGE
2009	I	E	74	519	MILFORD RESERVOIR	CLAY, GEARY
2010	I	E	74	520	NORTON RESERVOIR	NORTON
2011	I	E	74	521	PERRY RESERVOIR	JEFFERSON
2012	I	E	74	522	POMONA RESERVOIR	OSAGE
2014	I	E	74	524	TUTTLE CREEK RESERVOIR	MARSHALL, POTTAWATOMIE, RILEY
2015	I	M	74	525	WILSON RESERVOIR	RUSSELL
2203	I	E	74	529	LAKE BISTINEAU	BIENVILLE, BOSSIER, WEBSTER
2204	I	E	74	530	BLACK BAYOU RESERVOIR	CADDO
2205	I	E	74	533	BUNDICK LAKE	BEAUREGARD
2210	I	E	74	538	CROSS LAKE	CADDO
2211	I	MU	74	539	BAYOU D'ARBONNE LAKE	UNION, LINCOLN
2215	I	E	74	543	TURKEY CREEK LAKE	FRANKLIN
2217	I	M	74	528	LAKE VERNON	VERNON
2220	N	E	74	535	COCODRIE LAKE	RAPIDES
2902	I	E	74	548	POMME DE TERRE RESERVOIR	POLK, HICKORY
2903	I	E	74	549	STOCKTON RESERVOIR	DADE, POLK, CEDAR
2905	I	E	74	550	THOMAS HILL RESERVOIR	MACON, RANDOLPH
3101	I	E	74	553	BRANCHED OAK RESERVOIR	LANCASTER
3102	I	HE	74	555	HARLAN COUNTY RESERVOIR	HARLAN
3103	I	E	74	556	HARRY D. STRUNK RES.	FRONTIER
3104	I	E	74	557	HUGH BUTLER RESERVOIR	FRONTIER, RED WILLOW
3105	I	E	74	558	JOHNSON RESERVOIR	DAWSON, GOSPER
3106	I	MU	74	559	C.W. MCCONAUGHY RES.	KEITH
3107	I	E	74	560	PAWNEE RESERVOIR	LANCASTER
3110	I	E	74	562	SWANSON RESERVOIR	HITCHCOCK
3801	I	E	74	565	LAKE ASHTABULA	BARNES, GRIGGS
3804	I	E	74	568	LAKE DARLING	RENVILLE, WARD
3807	I	E	74	571	LAKE LAMOURE	LAMOURE

LAKE NAMES AND CODES

					Lake Name	County
3808	I	E	74	572	MATEJCEK LAKE	WALSH
3812	I	OU	74	575	LAKE SAKAKAWEA	DUNN, MCKENZIE, MCLEAN, MERCER, MOUNTRAIL, WILLIAMS
3814	I	E	74	577	SWEET BRIAR LAKE	MORTON
4001	I	E	74	581	ALTUS RESERVOIR	GREER, KIOWA
4002	I	M	74	582	ARBUCKLE LAKE	MURRAY
4003	I	E	74	583	LAKE ELSWORTH	CADDO, COMANCHE
4004	I	E	74	584	LAKE EUFAULA	HASKELL, MCINTOSH, OKMULGEE, PITTSBURG
4005	I	E	74	585	FORT COBB RESERVOIR	CADDO
4006	I	E	74	586	FORT SUPPLY RESERVOIR	WOODWARD
4008	I	E	74	588	LAKE FRANCES	ADAIR
4009	I	E	74	589	GRND LK O' THE CHEROKEES	MAYES, DELAWARE, CRAIG, OTTOWA
4010	I	E	74	590	LAKE HEFNER	OKLAHOMA
4011	I	E	74	591	KEYSTONE RESERVOIR	TULSA, OSAGE, CREEK, PAWNEE
4012	I	E	74	592	OOLOGAH RESERVOIR	NOWATA, ROGERS
4013	I	E	74	593	TENKILLER FERRY RES.	CHEROKEE, SEQUOYAH
4014	I	E	74	594	LAKE THUNDERBIRD	CLEVELAND
4602	I	E	74	599	LAKE ALVIN	LINCOLN
4603	I	M	74	600	ANGOSTURA RESERVOIR	FALL RIVER
4610	I	M	74	607	DEERFIELD LAKE	PENNINGTON
4620	I	O	74	617	PACTOLA RESERVOIR	PENNINGTON
4624	I	E	74	621	RICHMOND LAKE	BROWN
4626	I	E	74	623	SAND LAKE	BROWN
4627	I	E	74	624	SHERIDAN LAKE	PENNINGTON
4629	I	E	74	626	EAST VERMILLION LAKE	MCCOOK
4801	I	M	74	631	AMISTAD RESERVOIR	VAL VERDE
4802	I	MU	74	632	LAKE BASTROP	BASTROP
4803	I	MU	74	633	BELTON RESERVOIR	BELL, CORYELL
4805	I	E	74	635	LAKE BROWNWOOD	BROWN
4806	I	E	74	636	LAKE BUCHANAN	BURNET, LLANO
4808	I	E	74	638	CALAVERAS LAKE	BEXAR
4809	I	M	74	639	CANYON RESERVOIR	COMAL
4810	I	E	74	640	LAKE COLORADO CITY	MITCHELL
4811	I	E	74	641	LAKE CORPUS CHRISTI	JIM WELLS, LIVE OAK, SAN PATRICIO
4812	I	E	74	642	LAKE DIVERSION	ARCHER, BAYLOR

LAKE NAMES AND CODES

					Lake Name	County
4813	I	MU	74	643	EAGLE MOUNTAIN LAKE	TARRANT, WISE
4814	I	E	74	644	LAKE FORT PHANTOM HILL	JONES
4815	I	E	74	650	LAKE LEWISVILLE	DENTON
4816	I	E	74	646	LAKE KEMP	BAYLOR
4817	I	E	74	647	LAKE HOUSTON	HARRIS
4818	I	E	74	648	LAKE O' THE PINES	CAMP, MARION, MORRIS, UPSHUR
4819	I	E	74	649	LAKE LAVON	COLLIN
4820	I	E	74	651	LIVINGSTON RESERVOIR	POLK, SAN JACINTO, TRINITY, WALKER
4821	I	E	74	645	LAKE LYNDON B. JOHNSON	BURNET, LLANO
4822	I	MU	74	652	MEDINA LAKE	BANDERA, MEDINA
4823	I	M	74	653	LAKE MEREDITH	HUTCHINSON, MOORE, POTTER
4824	I	E	74	654	PALESTINE RESERVOIR	ANDERSON, CHEROKEE, HENDERSON, SMITH
4825	I	MU	74	655	POSSUM KINGDOM RESERVOIR	PALO PINTO, STEPHENS, YOUNG
4826	I	E	74	656	O. C. FISHER	TOM GREEN
4827	I	E	74	657	SAM RAYBURN RESERVOIR	ANGELINA, JASPER, NACOGDOCHES, SABINE, SAN AUGUSTINE
4828	I	E	74	658	E. V. SPENCE RESERVOIR	COKE
4829	I	E	74	659	SUMMERVILLE LAKE	BURLESON, LEE, WASHINGTON
4830	I	E	74	660	LAKE STAMFORD	HASKELL
4831	I	M	74	661	STILLHOUSE HOLLOW RESERV.	BELL
4832	I	E	74	662	LAKE TAWAKONI	HUNT, RAINS, VAN ZANDT
4834	I	E	74	663	LAKE TEXOMA	COOKE, GRAYSON, TX; BRYAN, JOHNSON, LOVE, MARSHALL, OK
4835	I	M	74	664	LAKE TRAVIS	BURNET, TRAVIS
4837	I	E	74	666	TWIN BUTTES RESERVOIR	TOM GREEN
4838	I	MU	74	667	WHITE RIVER RESERVOIR	CROSBY
4839	I	E	74	668	WHITNEY RESERVOIR	BOSQUE, HILL
0403	I	M	75	728	LAKE HAVASU	MOHAVE, AZ; SAN BERNARDINO, CA
0404	I	E	75	729	LUNA LAKE	APACHE
0405	I	E	75	730	LYMAN LAKE	APACHE
0406	I	M	75	731	LAKE MOHAVE	MOHAVE, AZ; CLARK, NV
0409	N	E	75	734	RAINBOW LAKE	NAVAJO
0410	I	M	75	735	THEODORE ROOSEVELT LAKE	GILA
0411	I	E	75	736	SAN CARLOS RESERVOIR	GILA, GRAHAM, PINAL
0601	I	E	75	739	LAKE AMADOR	AMADOR
0602	I	O	75	740	BOCA RESERVOIR	NEVADA

LAKE NAMES AND CODES

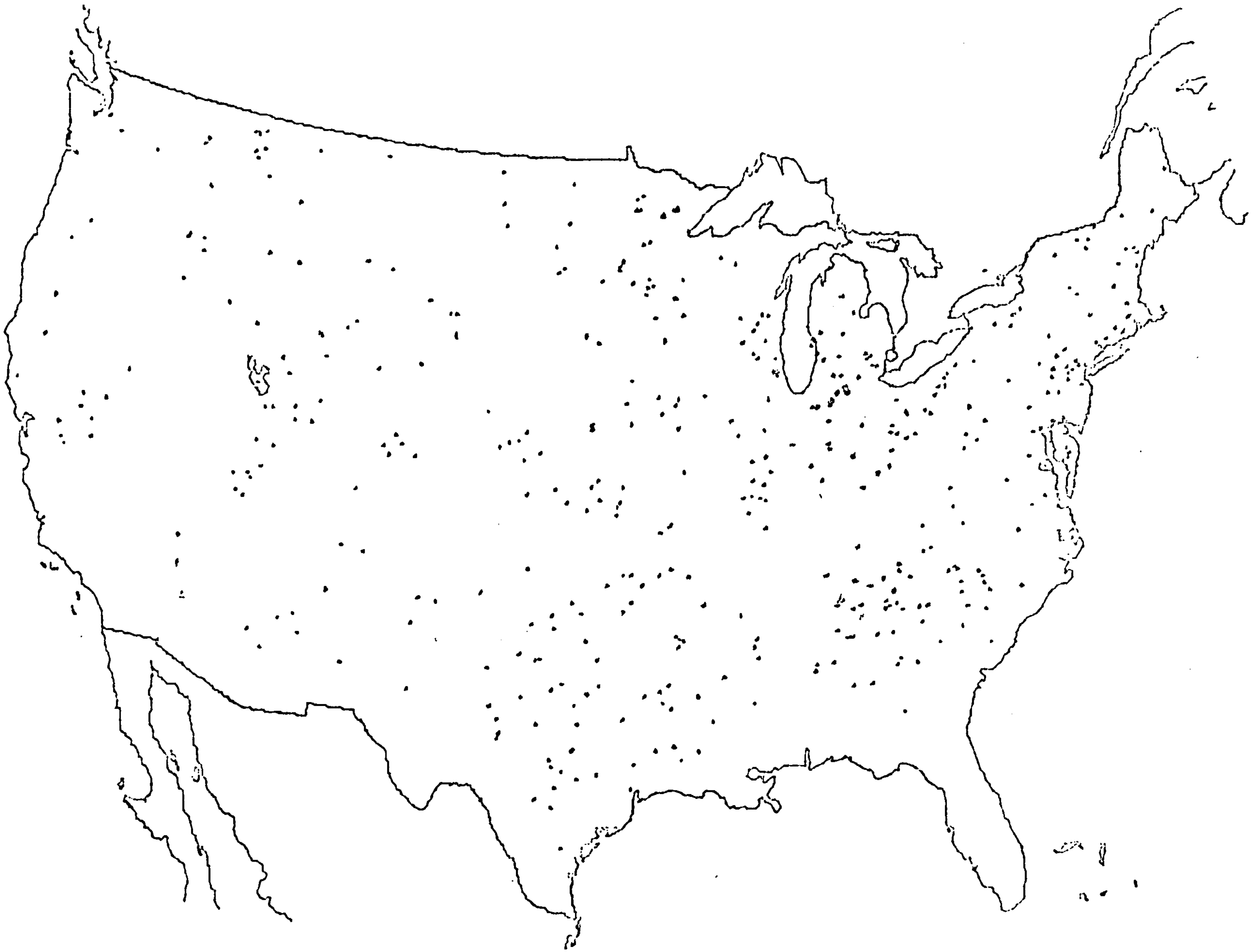
					Lake Name	County
0606	I	M	75	744	DON PEDRO RESERVOIR	TUOLUMNE
0608	N	O	75	746	FALLEN LEAF LAKE	EL DORADO
0611	I	E	75	749	IRON GATE RESERVOIR	SISKIYOU
0614	I	E	75	750	LOPEZ RESERVOIR	SAN LUIS OBISPO
0616	I	MU	75	752	LAKE MENDOCINO	MENDOCINO
0620	I	E	75	756	SANTA MARGARITA LAKE	SAN LUIS OBISPO
0621	I	M	75	757	SHASTA LAKE	SHASTA
0624	I	E	75	760	TULLOCK RESERVOIR	CALAVERAS, TUOLUMNE
0625	N	M	75	762	UPPER TWIN LAKE	MONO
0626	N	M	75	761	LOWER TWIN LAKE	MONO
0801	I	M	75	765	BARKER RESERVOIR	BOULDER
0803	I	M	75	767	BLUE MESA RESERVOIR	GUNNISON
0804	I	E	75	768	CHERRY CREEK LAKE	ARAPAHOE
0806	I	O	75	769	DILLON RESERVOIR	SUMMIT
0807	N	M	75	770	GRAND LAKE	GRAND *** INCLUDES TRIBS AND LOADS FOR SHADOW MTN LAKE (0813)
0808	I	O	75	771	GREEN MOUNTAIN RESERVOIR	SUMMIT
0812	I	MU	75	775	NAVAJO RESERVOIR	ARCHULETA, CO; SAN JUAN, RIO ARRIBA, NM
1601	I	E	75	776	AMERICAN FALLS RESERVOIR	BANNOCK, BINGHAM, POWER
1602	I	E	75	777	CASCADE RESERVOIR	VALLEY
1603	N	M	75	778	COEUR D'ALENE LAKE	BENEWAH, KOOTENAI
1604	I	O	75	779	DWORSHAK RESERVOIR	CLEARWATER
1608	I	E	75	783	LAKE LOWELL	CANYON
1609	I	E	75	785	MAGIC RESERVOIR	CAMAS, BLAINE
1611	N	M	75	784	PAYETTE LAKE	VALLEY
1612	I	E	75	787	LOWER TWIN LAKES	KOOTENAI
1613	I	E	75	787	UPPER TWIN LAKES	KOOTENAI
3001	I	E	75	790	CANYON FERRY RESERVOIR	BROADWATER, LEWIS & CLARK
3002	I	E	75	791	CLARK CANYON RESERVOIR	BEAVERHEAD
3003	N	O	75	792	FLATHEAD LAKE	FLATHEAD, LAKE
3005	I	MU	75	794	HEBGEN LAKE	GALLATIN
3007	N	MU	75	796	MARY RONAN LAKE	LAKE
3008	N	O	75	797	LAKE MCDONALD	FLATHEAD
3009	I	E	75	798	NELSON RESERVOIR	PHILLIPS
3010	N	MU	75	799	SEELEY LAKE	MISSOULA

LAKE NAMES AND CODES

					Lake Name	County
3011	N	M	75	800	SWAN LAKE	LAKE
3012	N	OM	75	801	TALLY LAKE	FLATHEAD
3013	I	MU	75	802	TIBER RESERVOIR	LIBERTY, TOOLE
3014	I	E	75	803	TONGUE RIVER RESERVOIR	BIG HORN
3016	N	O	75	804	WHITEFISH LAKE	FLATHEAD
3201	I	LM	75	808	LAKE MEAD	CLARK, NV; MOHAVE, AZ
3202	I	E	75	807	LAHONTAN RESERVOIR	CHURCHILL, LYON
3204	I	E	75	809	RYE PATCH RESERVOIR	PERSHING
3206	N	E	75	811	TOPAZ LAKE	DOUGLAS, NV; MONO, CA
3501	I	E	75	817	ALAMOGORDO RESERVOIR	DE BACA, GUADALUPE
3502	I	MU	75	818	BLUEWATER LAKE	MCKINLEY, VALENCIA
3503	I	M	75	819	CONCHAS RESERVOIR	SAN MIGUEL
3505	I	E	75	821	ELEPHANT BUTTE RESERVOIR	SIERRA, SOCORRO
3506	I	MU	75	822	EL VADO RESERVOIR	RIO ARRIBA
3507	I	E	75	823	LAKE MCMILLAN	EDDY
3509	I	M	75	824	UTE RESERVOIR	QUAY
4101	I	E	75	827	BROWNLEE RESERVOIR	BAKER, OR; WASHINGTON, ID
4104		E	75	830	HILLS CREEK RESERVOIR	LANE
4106	I	E	75	832	OXBOW RESERVOIR	BAKER, OR; ADAMS, ID
4107	N	MU	75	833	SUTTLE LAKE	JEFFERSON
4901	N	O	75	836	BEAR LAKE	RICH, UT; BEAR LAKE, ID
4903	I	E	75	837	DEER CREEK RESERVOIR	WASATCH
4904	I	E	75	838	ECHO RESERVOIR	SUMMIT
4906	N	ME	75	839	FISH LAKE	SEVIER
4908	I	M	75	841	JOES VALLEY RESERVOIR	EMERY
4909	I	E	75	846	MINERSVILLE RESERVOIR	BEAVER
4910	N	O	75	847	MOON LAKE	DUCHESNE
4913	I	E	75	850	OTTER CREEK RESERVOIR	PIUTE
4914	N	E	75	851	PANGUITCH LAKE	GARFIELD
4915	N	E	75	852	PELICAN LAKE	UINTAH
4917	I	E	75	854	PIUTE RESERVOIR	PIUTE
4920	I	E	75	857	SEVIER BRIDGE RESERVOIR	JUAB, SANPETE
4921	I	M	75	858	STARVATION RESERVOIR	DUCHESNE
4923	I	M	75	860	TROPIC RESERVOIR	GARFIELD

LAKE NAMES AND CODES

					Lake Name	County
4924	N	HE	75	861	UTAH LAKE	UTAH
4925	I	E	75	862	WILLARD RESERVOIR	BOX ELDER
5306	I	O	75	869	KEECHELUS LAKE	KITTITAS
5309	I	E	75	872	MOSES LAKE	GRANT
5311	N	MU	75	874	SAMMAMISH LAKE	KING
5312	N	M	75	875	LAKE WHATCOM	WHATCOM
5601	I	E	75	881	BIG SANDY RESERVOIR	SUBLETTE, SWEETWATER
5602	N	O	75	882	BOULDER LAKE	SUBLETTE
5603	I	E	75	883	BOYSEN RESERVOIR	FREMONT
5605	I	ME	75	885	FLAMING GORGE RESERVOIR	SWEETWATER, WY; DAGGETT, UT
5606	N	O	75	886	FREMONT LAKE	SUBLETTE
5607	I	E	75	887	GLENDO RESERVOIR	CONVERSE, PLATTE
5608	I	E	75	888	KEYHOLE RESERVOIR	CROOK
5609	N	E	75	889	OCEAN LAKE	FREMONT
5610	I	ME	75	890	SEMINOE RESERVOIR	CARBON
5613	I	E	75	893	WOODRUFF NARROWS RES.	UINTA
5614	I	ME	75	894	YELLOWTAIL RESERVOIR	BIGHORN, WY; BIGHORN, CARBON, MT



LOCATIONS OF LAKES IN 1972-1975 SURVEYS

LAKE DATA 1972-1975

TETRA TECH., INC.
3700 MT. DIABLO BLVD.
LAF., CA. 94549

LAKE DATA

YEAR : 1972 TO 1975
TOTAL NUMBER OF LAKES : 493

STORET NUMBER	SURFACE AREA (KM^2)	DRAINAGE AREA (KM^2)	MEAN DEPTH (M)	VOLUME (10^6 M^3)	RETENTION TIME (YEARS)	MEDIAN PHOSPHORUS (MG/L)	SECCHI DISK (M)	MEAN CHL-A (UG/L)	RESPONSE TIME (YEARS)
0101	37.23	10334.10	3.10	115.413	.020	.029	1.2	4.0	.0047
0104	274.99	63325.50	4.60	1264.954	.035	.044	1.0	8.6	.0222
0105	13.36	10960.90	7.90	105.544	.017	.018	1.3	2.2	.0080
0107	157.83	7674.20	12.90	2036.007	.482	.017	1.7	6.4	.1264
0112	122.22	13649.40	2.80	342.216	.043	.092	.6	11.3	.0181
0115	4.30	106.40	5.10	21.930	.298	.049	1.6	12.7	.0828
0403	77.30	463091.80	9.20	711.160	.087	.015	2.0	3.9	.0403
0404	.30	93.50	2.50	.750	.297	.182	2.6	3.4	.1943
0405	5.67	2046.10	6.70	37.989	2.362	.099	.4	2.6	.5769
0406	105.63	438486.80	18.90	1996.407	.199	.017	3.3	4.4	.1106
0409	.32	26.20	4.60	1.472	.467	.046	1.5	16.4	.1575
0410	60.70	15084.20	28.00	1699.600	1.896	.020	1.8	4.1	.2316
0411	52.61	33374.70	15.30	804.933	2.941	.056	.7	14.8	.0426
0501	114.20	3087.30	17.80	2032.760	1.522	.022	2.1	3.9	.2384
0502	1.62	288.80	1.80	2.916	.022	.424	.1	19.8	.0123
0504	183.89	15672.10	20.40	3751.356	.708	.015	3.4	3.9	.3073
0505	7.85	3926.40	5.50	43.175	.021	.029	1.2	14.0	.0090
0506	21.45	1046.40	2.70	57.915	.133	.162	.4	13.7	.0745
0507	54.23	1173.30	14.90	808.027	1.309	.019	2.1	12.3	.7892
0508	28.33	1023.00	2.10	59.493	.179	.054	1.2	13.4	.0822
0510	24.28	3732.20	9.70	235.516	.119	.024	1.8	10.9	.0391
0514	162.28	2861.90	16.30	2645.164	1.857	.015	2.8	4.3	1.0701
0515	174.42	10411.80	19.10	3331.422	.903	.022	2.3	9.1	.1601
0516	163.90	2986.30	21.40	3507.460	2.246	.012	3.3	3.8	.8074
0601	1.56	151.30	17.40	27.144	.715	.040	2.3	22.4	.2336
0602	3.97	445.50	12.80	50.816	.308	.012	3.2	1.7	.1682
0606	52.45	3957.90	47.70	2501.865	1.693	.013	3.0	3.6	.5654
0608	5.71	43.30	1.50	8.565	.180	.007	12.1	.8	.0997
0611	3.39	11838.90	21.40	72.546	.031	.184	1.5	6.2	.0197
0614	3.80	175.30	16.60	63.080	7.300	.371	3.3	8.7	3.3891
0616	7.92	271.90	19.10	151.272	.461	.020	1.6	3.1	.1957
0620	3.18	290.10	10.10	32.118	1.577	.037	2.5	9.1	.6562
0621	119.40	16630.40	46.50	5552.100	.596	.021	3.0	4.1	.3574
0624	5.10	2533.30	16.50	84.150	.052	.025	1.7	13.9	.0310

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0625	1.07	76.40	14.30	15.301	.372	.015	5.1	3.3	.1769
0626	1.52	101.30	15.20	23.104	.431	.014	6.4	2.9	.2474
0801	1.70	99.20	8.30	14.110	.283	.023	2.1	5.3	.1673
0803	36.62	8873.30	31.10	1138.882	.758	.019	2.7	6.8	.1647
0804	3.24	997.10	5.20	16.848	3.634	.054	.8	23.3	.3711
0806	12.76	867.60	24.60	313.896	1.305	.009	8.1	3.2	.2574
0807	2.05	479.10	41.30	84.665	.202	.013	3.4	4.9	.0801
0808	8.60	1551.40	22.20	190.920	.450	.010	2.8	5.8	.3010
0812	63.25	8443.40	33.30	2106.225	1.350	.036	.5	2.2	.1649
0901	1.35	1851.80	2.65	3.574	.003	.092	.8	35.8	.0021
0904	.32	287.50	.91	.296	.002	.094	1.6	7.1	.0010
0905	.26	246.30	1.37	.355	.002	.298	1.0	18.9	.0016
0910	3.95	3991.10	7.50	29.585	.013	.043	1.9	18.3	.0069
0911	7.69	3605.20	11.86	91.166	.046	.054	3.7	11.1	.0158
0912	1.33	4076.60	2.87	3.803	.002	.039	1.9	10.2	.0010
1005	.10	35.20	1.10	.110	.004	.245	.7	81.3	.0024
1007	.64	24.40	1.10	.704	.053	.160	.6	37.6	.0202
1008	.15	19.50	1.50	.225	.022	.227	.9	26.7	.0077
1009	.34	59.80	1.20	.408	.008	.042	1.3	30.1	.0057
1010	.22	38.60	1.20	.264	.016	.038	.9	5.1	.0071
1301	48.00	2845.00	9.40	451.200	.283	.020	1.5	7.5	.0691
1302	34.46	9712.50	5.30	182.638	.043	.035	.8	1.9	.0176
1303	28.94	489.50	10.60	306.764	.811	.014	3.0	6.3	.3954
1304	283.29	15893.20	10.90	3087.861	.370	.024	1.5	6.7	.0971
1309	19.22	3627.10	6.90	132.618	.085	.094	1.0	14.6	.0216
1310	161.47	2663.30	19.50	3148.665	1.650	.016	2.6	5.4	.1207
1311	17.36	557.00	13.10	227.416	.633	.015	2.4	6.7	.2676
1313	62.17	7510.90	6.60	410.322	.146	.028	1.5	8.0	.0690
1316	13.44	600.80	18.40	247.296	.481	.010	2.7	3.1	.2124
1317	23.67	10982.00	9.40	222.498	.038	.114	.8	7.4	.0122
1318	11.23	297.90	11.90	133.637	.441	.007	3.5	2.7	.1371
1319	2.43	533.30	3.70	8.991	.038	.047	1.0	15.1	.0200
1601	277.03	35224.00	9.20	2548.676	.364	.105	.9	15.4	.2373
1602	107.24	1621.30	8.10	868.644	.929	.032	2.2	8.1	.4110

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1603	129.50	9945.60	2.30	297.850	.054	.017	3.0	10.4	.0225
1604	76.89	6319.60	55.50	4267.395	.837	.010	2.5	2.4	.4209
1608	39.80		5.90	234.820	.720	.070	.6	25.4	.2817
1609	15.80	4144.00	15.00	237.000	.480	.062	2.5	7.3	.1368
1611	21.60	373.00	5.70	123.120	.383	.013	6.8	4.6	.2601
1612	16.35	133.40	2.30	37.605	1.807	.016	3.3	2.3	.1533
1613	16.35	133.40	2.30	37.605	1.807	.017	3.3	5.0	.1533
1703	1.97	180.00	5.00	9.850	.390	.050	.9	26.2	.1851
1706	105.22	7042.20	2.70	284.094	.176	.084	.6	17.4	.0743
1712	28.19	520.60	3.00	84.570	.789	.082	.4	59.9	.1110
1714	11.35	2429.40	1.40	15.890	.029	.129	.5	43.0	.0148
1725	1.03	99.70	1.60	1.648	.087	.704	.4	49.3	.0227
1726	5.72	279.70	3.30	18.876	.333	.186	.3	10.7	.2040
1735	76.49	1300.20	4.70	359.503	1.239	.071	.7	23.5	.4309
1739	44.52	2729.90	5.00	222.600	.360	.062	1.0	17.2	.0857
1740	2.99	122.00	4.20	12.558	.517	.226	.3	5.8	.2773
1742	17.13	681.20	4.00	68.520	.483	.108	.4	13.0	.2482
1748	2.83	774.40	1.40	3.962	.025	.109	.5	31.1	.0114
1750	2.95	252.00	2.50	7.375	.146	.426	.4	98.5	.0441
1751	.53	18.20	4.60	2.438	.773	.072	1.0	17.2	.1638
1754	1.21	168.10	2.70	3.267	.104	.167	.4	51.2	.0467
1755	6.76	3120.90	2.40	16.224	.023	.219	.4	63.8	.0147
1758	.87	22.60	1.20	1.044	.331	.865	.3	221.1	.0918
1761	2.38	49.50	1.80	4.284	.453	.069	.9	8.0	.1453
1762	3.93	125.90	1.20	4.716	.187	.106	.4	19.2	.0921
1763	8.00	12.60	3.10	24.800	7.864	.044	1.0	11.3	.1031
1764	2.67	62.90	16.20	43.254	3.429	.116	.6	11.3	2.0797
1766	8.78	83.10	2.10	18.438	1.169	.127	.4	182.2	.6729
1805	5.66	762.00	6.10	34.526	.137	.058	.8	10.7	.0538
1811	7.28	559.20	3.60	26.208	.159	.074	.7	46.0	.0662
1827	12.75	2091.20	7.20	91.800	.139	.107	.7	15.8	.0482
1828	43.50	1119.70	5.30	230.550	.667	.025	1.5	6.9	.2568
1829	5.57	555.30	4.70	26.179	.154	.084	.7	56.2	.0505
1836	12.38	94.20	6.70	82.946	3.461	.012	3.5	5.0	.9576

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1837	2.37	126.70	2.10	4.977	.132	.025	1.7	11.5	.0458
1839	.81	49.80	4.60	3.726	.257	.084	.7	33.1	.0642
1840	2.27	83.10	9.10	20.657	.819	.035	1.4	11.2	.2960
1841	.36	97.90	6.10	2.196	.077	.035	1.9	10.7	.0473
1842	.83	93.50	10.40	8.632	.304	.035	1.5	11.9	.1414
1843	7.54	35.50	7.30	55.042	5.818	.020	2.6	5.5	.6784
1844	3.11	292.70	11.30	35.143	.407	.019	2.8	6.0	.1981
1845	1.14	103.10	10.80	12.312	.390	.029	2.2	10.1	.2524
1846	.42	15.00	11.70	4.914	1.113	.012	2.4	4.9	.1582
1847	1.50	28.70	12.20	18.300	2.321	.009	2.8	3.8	.7335
1851	5.69	13.40	1.80	10.242	3.248	.040	.7	29.4	1.1317
1852	3.25	30.80	6.10	19.825	2.619	.019	2.3	5.6	.3868
1853	4.18	123.80	7.30	30.514	.856	.016	3.7	4.9	.2452
1854	.37	176.10	5.10	1.887	.035	.204	1.5	16.1	.0162
1855	.25	82.90	4.60	1.150	.048	.058	1.5	11.9	.0264
1856	.23	38.60	6.10	1.403	.124	.093	1.2	34.5	.0798
1857	3.25	42.80	6.30	20.475	1.803	.033	2.2	17.4	.6521
1901	.53	12.80	3.00	1.590	.720	.062	.8	8.6	.1655
1902	3.44	203.60	6.70	23.048	.738	.046	1.6	16.9	.1340
1903	3.72	60.30	1.70	6.324	.743	.185	.3	49.7	.4115
1907	3.84	69.90	7.30	28.032	2.168	.061	1.1	17.1	.4189
1908	.88	20.40	3.30	2.904	1.151	.056	.9	17.4	.2129
1909	44.52	1421.90	6.70	298.284	1.046	.071	.6	12.0	.1278
1910	36.22	31916.60	3.00	108.660	.028	.180	.7	14.7	.0077
1911	2.60	107.20	2.70	7.020	.391	.065	.5	18.4	.0480
1912	1.29	8.20	1.20	1.548	1.227	.193	.4	95.3	.5377
1914	.61	10.30	5.80	3.538	1.603	.075	1.0	26.0	.6270
2001	26.84	14322.70	8.50	228.140	4.255	.017	1.7	4.2	1.3830
2002	13.27	647.50	3.90	51.753	.597	.069	.4	9.8	.1351
2003	17.81	1642.10	2.40	42.744	.125	.030	.2	3.2	.0476
2005	38.04	7808.80	2.00	76.080	.062	.118	.2	9.5	.0245
2006	14.37	20349.60	4.50	64.665	.212	.056	.3	16.0	.0322
2007	24.93	518.00	4.10	102.213	2.437	.052	.4	12.4	.4691
2008	28.05	909.10	6.00	168.300	1.061	.034	1.0	30.4	.2804

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2009	65.51	64465.10	7.80	510.978	.619	.079	.9	18.9	.0483
2010	8.86	1771.60	5.00	44.300	2.255	.122	.6	21.4	.3861
2011	49.37	2893.00	3.70	182.669	.456	.055	.5	5.6	.0764
2012	16.19	834.00	6.40	103.616	.705	.040	.5	8.3	.4101
2014	63.94	24967.60	8.20	524.308	.315	.162	.8	11.3	.0349
2015	36.42	4965.00	8.40	305.928	2.780	.023	1.4	8.9	.5677
2101	203.36	14993.50	24.20	4921.312	.617	.016	1.7	3.8	.2611
2103	11.90	1137.00	23.90	284.410	.537	.079	1.5	14.9	.1754
2203	69.67	3752.90	2.10	146.307	.114	.061	1.1	12.9	.0428
2204	16.06	608.60	1.40	22.484	.103	.046	1.2	17.8	.0329
2205	7.07	546.50	1.60	11.312	.040	.157	.8	20.5	.0162
2210	35.77	655.30	2.70	96.579	.498	.057	.6	38.4	.3405
2211	61.64	4162.10	2.60	160.264	.098	.038	1.1	6.8	.0401
2215	12.54	461.00	2.00	25.080	.154	.176	.6	22.0	.0672
2217	17.09	295.30	4.10	70.069	.537	.018	1.6	4.9	.2659
2220	24.68	621.40	.50	12.340	.035	.106	.6	33.4	.0214
2304	1.57	271.90	3.05	4.774	.030	.094	1.0	28.3	.0196
2306	19.70	295.30	10.36	204.114	1.176	.008	3.4	3.2	.4084
2308	13.48	813.20	3.66	49.290	.114	.011	1.6	2.0	.0543
2309	303.07	3279.90	16.46	4988.265	2.990	.005	3.8	1.5	1.1182
2310	24.28	256.40	14.33	347.841	2.837	.007	3.8	2.4	.9939
2311	116.43	1142.20	30.78	3584.333	5.433	.004	5.1	1.5	1.6045
2312	17.35	326.30	6.00	104.100	.548	.050	1.1	49.5	.2679
2313	24.28	234.10	13.41	325.639	3.230	.010	2.6	6.9	.9752
2314	3.08	308.20	4.27	13.159	.072	.005	3.2	1.8	.0404
2402	15.78	167.60	8.10	127.818	1.142	.011	3.0	6.1	.2474
2403	12.59	424.80	13.00	163.670	1.128	.018	2.5	6.3	.3674
2408	7.67	791.60	15.20	116.584	.401	.023	1.8	7.1	.1936
2409	.42	96.10	2.10	.882	.015	.098	1.1	26.2	.0086
2502	.10	4.40	1.52	.154	.066	1.525	.4	198.5	.0129
2503	.36	85.70	2.44	.868	.017	.052	.8	12.9	.0076
2507	.49	445.50	1.22	.602	.002	.363	1.1	11.4	.0011
2508	.15	356.90	.91	.141	.001	.535	.4	2.3	.0003
2513	.12	188.30	1.20	.144	.001	.476	1.4	2.2	.0008

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2603	6.42	3991.10	3.35	21.519	.019	.135	.7	20.3	.0101
2606	1.40	129.20	6.10	8.560	.221	.061	1.1	27.8	.1509
2609	5.14	2157.40	6.10	31.330	.069	.122	.9	28.3	.0357
2617	69.85	854.70	16.76	1170.942	3.240	.006	3.8	3.0	.8182
2618	1.25	14.00	8.53	10.707	4.134	.032	2.4	13.5	1.0776
2629	4.25	2108.20	4.36	18.521	.042	.111	1.1	14.7	.0233
2631	3.20	52.60	10.06	32.157	1.866	.378	1.5	28.5	.6767
2643	4.05	383.30	2.01	8.141	.091	.043	1.1	33.9	.0483
2648	7.20	463.60	3.66	26.347	.212	.159	.6	25.6	.0399
2659	16.79	6821.90	7.01	117.736	.062	.065	1.6	9.5	.0419
2673	1.19	1261.30	1.52	1.813	.006	.035	.9	10.4	.0033
2683	1.66	932.40	4.27	7.063	.030	.045	1.4	14.7	.0165
2685	2.12	1383.00	.85	1.813	.005	.047	1.1	15.7	.0033
2688	10.40	1318.30	6.86	71.354	.153	.026	2.1	9.2	.0819
2691	2.81	212.60	3.96	11.144	.203	.369	1.2	27.8	.1054
2692	.85	194.00	5.18	4.424	.086	.133	2.1	10.1	.0536
2694	2.93	14.50	4.24	12.413	3.310	.009	3.0	2.9	.5998
2695	38.85	127.40	14.94	580.229	15.582	.006	5.9	1.0	3.2169
2696	81.12	575.00	2.32	187.901	1.343	.016	2.0	9.2	.4482
2699	1.04	914.30	6.74	7.006	.036	.068	2.0	11.1	.0194
27A1	.78	7.50	1.34	1.042	2.917	.107	.5	58.6	.0958
27A2	4.25	1771.50	8.53	36.299	.100	.050	1.2	17.2	.0607
27A5	2.47	2206.60	5.50	13.585	.050	.401	1.5	12.5	.0153
27A6	23.92	96346.20	2.44	58.319	.006	.240	.5	21.8	.0043
27A7	33.22	19942.60	8.78	291.618	.064	.055	1.1	10.2	.0298
27B1	6.54	66.00	1.28	8.377	1.380	1.000	.3	94.5	.4129
27B2	21.88	357.40	6.40	140.032	3.698	.015	2.8	4.9	.8298
27B3	3.82	318.60	4.57	17.485	.521	.040	1.4	21.4	.1581
27B4	3.86	453.20	6.19	23.888	.871	.017	2.6	11.8	.4331
27C0	6.11	1895.80	7.92	48.426	.129	.025	1.4	13.0	.0562
27C1	25.98	1631.70	9.75	253.406	.736	.036	2.2	9.5	.3270
27C2	.23	3.10	1.31	.297	.665	.408	.2	87.4	.0338
2702	9.93	381.80	1.07	10.590	.200	.958	.2	381.2	.0982
2705	1.23	8.80	2.59	3.177	1.872	.136	.5	49.5	.5922

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2709	51.03	3004.30	3.35	171.096	1.652	.159	1.0	16.5	1.1345
2711	11.10	75.10	4.51	50.057	4.215	.038	1.7	14.5	1.2970
2712	.74	20.70	4.42	3.273	.705	.043	1.6	12.8	.0745
2713	6.11	114.00	4.42	27.007	1.368	.209	1.0	38.0	.4324
2715	63.11	2926.60	7.62	480.934	.859	.020	1.9	8.7	.2163
2716	12.88	450.70	5.18	66.724	1.366	.028	1.6	14.1	.2223
2719	2.20	116.50	7.62	16.775	1.132	.231	1.9	10.7	.4373
2725	.69	16.30	3.14	2.173	.811	1.380	1.9	9.6	.1997
2737	38.61	766.60	9.14	353.022	2.930	.022	2.3	12.5	1.2617
2739	33.39	1222.50	.91	30.532	.371	.302	.3	111.1	.1659
2746	453.25	2693.60	4.72	2141.320	5.197	.015	2.2	6.2	1.6418
2750	4.50	61.60	3.96	17.847	3.276	.050	.9	30.8	.5536
2756	.41	45.60	2.13	.872	.109	.075	1.0	25.3	.0197
2757	.66	64.20	2.74	1.821	.156	.040	1.4	10.7	.0762
2761	28.77	227.90	5.97	171.893	12.748	.035	1.7	7.6	.8834
2765	44.29	179.50	2.41	106.653	3.263	.032	1.7	11.4	1.2004
2776	9.79	9563.90	3.38	33.120	.015	.216	.4	4.7	.0076
2782	1.71	5.70	2.10	3.591	4.067	.600	.3	126.1	1.9119
2783	.34	38.30	1.92	.653	.097	.235	.9	21.0	.0302
2788	10.58	293.40	12.13	128.377	2.380	.013	2.9	3.8	.3466
2793	7.65	42.00	15.24	116.564	17.404	.050	2.8	7.0	.9716
2802	52.49	1450.40	15.50	813.595	1.122	.062	.9	6.6	.1672
2804	121.41	7770.00	3.70	449.217	.134	.045	.9	10.0	.0417
2805	125.46	4001.50	16.50	2070.090	1.066	.041	1.3	6.4	.6073
2806	98.38	3418.80	16.50	1623.270	1.095	.051	.6	6.0	.6839
2902	31.65	1592.80	9.50	300.675	.861	.043	1.3	9.4	.3625
2903	100.77	3004.40	7.30	735.621	1.062	.022	1.8	9.0	.1597
2905	17.81	388.50	4.10	73.021	1.169	.082	.3	5.8	.3502
3001	142.45	41191.30	17.40	2478.630	.511	.047	1.5	5.8	.1960
3002	19.97	6011.40	15.80	315.526	1.022	.049	2.6	2.4	.4168
3003	475.60	18854.20	13.50	6420.600	.618	.008	5.9	1.3	.2808
3005	51.27	2408.70	8.20	420.414	.471	.022	3.4	4.1	.2760
3007	6.15	76.80	8.50	52.275	17.449	.020	3.3	4.7	5.5536
3008	32.63	443.90	45.70	1491.191	3.201	.006	7.9	.5	1.1708

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3009	18.45		5.70	105.165	1.758	.029	1.1	7.2	.2131
3010	3.49	378.40	18.30	63.867	.348	.015	3.5	2.2	.1496
3011	10.85	1737.90	21.90	237.615	.233	.010	5.5	3.3	.0936
3012	5.37	527.10	68.90	369.993	2.761	.011	4.1	2.1	1.4191
3013	50.59	12760.90	15.30	774.027	.871	.018	1.3	2.8	.2591
3014	14.15	4584.30	6.10	86.315	.213	.051	.7	16.9	.0181
3016	13.56	325.80	32.90	446.124	2.540	.008	5.3	1.4	.7728
3101	7.28	214.70	5.50	40.040	2.760	.044	1.1	17.0	.3752
3102	54.50	35042.70	7.80	425.100	1.357	.112	.6	27.8	.1911
3103	7.49	1657.60	5.80	43.442	.703	.064	.8	14.4	.0286
3104	6.59	828.80	5.90	38.881	1.163	.061	.8	16.6	.1469
3105	11.53		6.10	70.333	.075	.075	.6	26.1	.0350
3106	141.64	66821.90	19.80	2804.472	2.387	.027	2.3	8.6	.3294
3107	2.99	85.20	3.70	11.063	2.923	.060	1.2	15.4	.5103
3110	20.13	10204.60	7.30	146.949	1.362	.067	.9	14.4	.3187
3201	592.88	434601.80	59.10	35039.208	3.530	.016	5.9	3.1	.1632
3202	19.69	9375.80	6.70	131.923	.252	.198	.7	4.6	.0903
3204	46.14	41699.00	4.60	212.244	1.160	.095	.8	4.9	.4083
3206	9.71	1080.00	15.80	153.418	.719	.058	3.1	7.5	.2330
3302	1.51	373.00	2.47	3.717	.018	.033	1.2	6.2	.0110
3303	180.43	940.20	13.11	2364.825	4.110	.006	5.6	2.1	.6578
3305	.52	564.60	2.26	1.177	.004	.024	1.8	7.0	.0019
3306	.61	523.20	3.35	2.049	.008	.028	1.7	3.8	.0037
3402	1.52	12.10	1.80	2.736	.394	.082	.7	48.5	.2294
3403	7.77	70.20	5.20	40.404	.949	.021	2.2	11.9	.3307
3406	2.64	292.70	4.10	10.824	.207	.055	.9	22.3	.0964
3409	.57	18.80	1.80	1.026	.088	.070	.9	39.0	.0245
3410	.83	414.40	1.80	1.494	.006	.071	.9	23.0	.0017
3412	.38	245.00	1.40	.532	.005	.082	.9	6.8	.0012
3415	10.87	66.30	5.50	59.785	1.708	.022	2.1	13.6	.6481
3419	.64	188.80	1.80	1.152	.012	.133	1.0	7.0	.0070
3420	5.22	107.00	7.90	41.238	.812	.020	1.8	15.3	.3368
3423	9.35	234.10	11.30	105.655	2.864	.014	3.7	7.1	1.7723
3501	18.49	11370.10	8.10	149.769	1.714	.025	.8	5.9	.1514

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3502	7.07	520.60	6.70	47.369	5.777	.036	.5	3.9	3.2089
3503	38.83	19189.30	11.80	458.194	3.040	.020	1.2	3.3	.1258
3505	148.05	76275.40	18.30	2709.315	2.243	.083	.6	6.8	.0511
3506	13.07	2012.40	18.30	239.181	.889	.034	.9	2.2	.2859
3507	23.05	44004.10	2.10	48.405	.221	.097	.3	14.1	.1062
3509	16.79	28852.60	8.00	134.320	1.356	.021	1.3	3.2	.0917
3604	42.99	476.60	39.01	1677.374	14.663	.009	4.5	4.3	3.5184
3605	19.42	1175.80	19.20	373.004	.575	.046	1.8	29.9	.1163
3606	26.13	2261.00	5.39	140.995	.104	.010	2.3	3.1	.0520
3608	171.97	2033.10	54.56	9382.813	11.258	.014	2.8	3.2	3.7284
3611	8.81	8031.40	5.49	48.313	.018	.076	1.3	19.5	.0096
3617	47.40	471.40	22.56	1069.133	7.840	.008	3.6	5.7	2.5721
3632	122.00	2703.90	7.59	925.893	.454	.009	3.5	4.8	.2300
3633	16.32	631.90	7.92	129.308	.411	.025	2.5	11.8	.1322
3635	175.34	1823.30	88.70	15552.263	33.745	.010	4.0	6.1	4.6582
3637	3.47	382.50	13.41	46.566	.252	.057	1.3	28.7	.0720
3639	12.89	180.50	8.90	114.716	1.673	.020	3.2	9.9	.4951
3640	1.87	54.90	5.12	9.553	.303	.017	1.2	7.9	.1864
3641	48.77	5646.20	14.40	702.288	.211	.016	2.2	3.7	.0923
3701	24.17	10818.40	14.20	343.214	.077	.042	.8	7.2	.0417
3702	10.36	17793.30	11.60	120.176	.018	.090	.6	4.2	.0068
3704	43.18	4068.90	41.30	1783.334	.490	.011	2.7	3.4	.1790
3705	16.63	3392.90	9.50	157.985	.090	.047	1.0	7.3	.0437
3706	64.29	10360.00	4.90	315.021	.073	.090	.6	14.3	.0232
3707	25.41	2507.10	21.30	541.233	.318	.015	2.0	5.7	.1208
3711	13.09	4822.60	5.40	70.686	.033	.018	1.0	5.6	.0175
3713	131.57	4636.10	10.20	1342.014	.653	.019	1.3	5.8	.1455
3715	14.22	2823.10	6.34	90.155	.059	.061	.9	3.6	.0215
3716	11.59	455.80	16.80	194.712	.441	.011	3.4	5.4	.2057
3717	21.29	12090.10	9.70	206.513	.042	.040	.8	6.8	.0243
3718	1.38	1178.40	22.70	31.326	.041	.103	.8	3.8	.0140
3719	36.17	251.20	1.50	54.255	.662	.018	1.1	3.6	.2666
3801	21.98	4946.90	4.00	87.920	.832	.260	.7	40.9	.4628
3804	40.06	8417.50	3.40	136.204	1.371	.274	.8	60.1	.5317

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3807	2.00	357.40	5.00	10.000	1.865	.438	2.0	19.7	.7555
3808	.53	227.90	4.20	2.226	.642	.228	.6	2.7	.2825
3812	1490.21	469825.80	18.90	28164.969	1.576	.016	2.3	6.9	.0750
3814	1.10	393.70	2.90	3.190	.506	.092	1.5	39.0	.1905
3901	1.70	777.00	1.20	2.040	.009	.122	.3	10.9	.0052
3902	12.71	114.50	1.90	24.149	.638	.179	.2	186.6	.4011
3905	5.46	562.00	1.70	9.282	.055	.127	.4	67.1	.0311
3906	5.17	717.40	5.00	25.850	.114	.098	.7	9.9	.0627
3907	5.26	999.70	3.30	17.358	.063	.086	.4	10.9	.0254
3908	5.36	1921.80	3.00	16.080	.025	.163	.5	27.4	.0083
3912	.76	68.10	1.90	1.444	.065	.113	.3	40.5	.0383
3914	11.43	492.10	6.50	74.295	.481	.040	.9	13.0	.1168
3921	31.57	252.50	2.70	85.239	1.126	.058	.9	36.3	.4220
3924	3.44	510.20	4.80	16.512	.103	.036	1.1	22.8	.0558
3927	44.52	290.40	3.00	133.560	.784	.148	.4	79.2	.3750
3928	6.23	181.00	4.70	29.281	.464	.031	1.0	16.4	.1118
3929	8.90	642.30	4.90	43.610	.223	.042	.9	15.5	.0371
3930	.91	35.70	3.90	3.549	.281	.125	.9	55.4	.0379
3931	3.35	2535.60	4.80	16.080	.024	.208	.6	5.5	.0106
3932	8.17	295.30	5.10	41.667	.389	.067	.7	38.0	.0791
4001	25.41	5480.40	6.40	162.624	2.079	.041	.8	14.8	.5237
4002	9.51	326.30	9.40	89.394	3.221	.020	1.4	7.0	.5157
4003	22.66	642.30	5.10	115.566	1.393	.037	1.0	8.4	.8163
4004	414.81	97958.90	10.10	4189.581	.846	.081	.4	4.4	.3668
4005	16.47	787.40	6.40	105.408	7.597	.038	1.2	15.0	.3302
4006	7.61	3869.50	11.90	90.559	1.595	.070	.4	9.7	.8850
4008	2.31	1644.60	1.80	4.158	.009	.142	.4	8.0	.0048
4009	188.18	26671.50	10.90	2051.162	.354	.087	.8	6.8	.1286
4010	10.12	25.10	9.10	92.092	2.950	.057	1.0	5.7	.4254
4011	106.43	162673.40	7.70	819.511	.150	.136	.4	21.4	.0462
4012	119.22	11237.70	5.70	679.554	.298	.059	.4	5.1	.0801
4013	51.19	4169.90	15.50	793.445	.657	.039	1.6	6.6	.2465
4014	24.56	662.30	6.00	147.360	14.602	.027	.9	8.4	.5642
4101	56.66	188033.90	31.60	1790.456	.108	.079	1.8	16.2	.0402

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4104	11.07	1007.50	39.20	433.944	.416	.038	1.7	2.3	.2560
4106	5.66	188810.90	11.40	64.524	.004	.071	1.9	10.3	.0023
4107	1.09	57.50	9.90	10.791	.238	.031	10.3	9.2	.1197
4201	7.00	878.00	1.60	11.200	.030	.064	1.2	15.2	.0108
4204	3.78	69.70	7.30	27.594	.292	.023	2.5	7.6	.1407
4207	3.29	182.20	5.00	16.450	.137	.066	1.0	24.0	.0207
4213	66.45	398.90	3.70	245.865	1.392	.070	.8	56.3	.4755
4216	14.41	1512.60	2.50	36.025	.057	.058	.9	26.8	.0293
4219	4.55	110.60	7.30	33.215	.301	.009	2.9	5.2	.0355
4220	3.83	249.70	12.80	49.024	.379	.010	3.5	4.9	.1852
4221	.69	20.40	8.80	6.072	.241	.020	1.6	19.2	.1153
4222	2.67	17.30	11.00	29.370	1.552	.015	4.1	6.0	.3074
4223	3.04	36.10	4.30	13.072	.829	.008	2.6	5.2	.3032
4224	2.02	49.50	.90	1.818	.058	.014	1.5	5.5	.0383
4225	4.38	559.40	3.40	14.892	.039	.040	.7	11.8	.0237
4226	1.38	45.60	2.70	3.726	.197	.027	1.2	14.0	.1181
4227	3.04	193.70	3.70	11.248	.102	.024	1.5	5.0	.0632
4229	23.31	590.50	8.50	198.135	.628	.015	2.7	9.6	.3611
4402	.84	232.30	2.44	2.043	.015	.032	1.3	8.1	.0084
4403	1.04	138.60	1.52	1.575	.019	1.135	.7	22.9	.0087
4503	13.64	9867.90	5.40	73.656	.018	.143	.4	2.8	.0111
4504	46.14	2978.40	6.80	313.752	.201	.061	.9	8.2	.0315
4505	226.43	5407.90	13.90	3147.377	.833	.013	2.0	6.2	.1035
4506	447.59	38073.00	4.00	1790.360	.121	.055	.7	8.7	.0359
4507	205.58	6268.00	12.70	2610.866	.955	.024	1.9	6.4	.1846
4508	8.68	448.10	4.30	37.324	.181	.014	1.1	8.6	.1247
4511	53.10	7821.80	7.00	371.700	.107	.045	.9	5.4	.0292
4513	69.41	1137.00	15.20	1055.032	1.061	.008	3.3	2.8	.5727
4515	2.25	753.70	4.00	9.000	.016	.046	.6	1.5	.0066
4602	.44	114.00	3.70	1.628	.890	.067	1.5	4.7	.2802
4603	19.55	23569.00	9.10	177.905	1.454	.019	2.0	3.7	.1073
4610	1.68	248.60	10.50	17.640	1.998	.033	5.0	3.6	1.1841
4620	3.48	828.80	16.40	57.072	1.645	.011	6.4	1.5	.1260
4624	3.35	450.70	4.60	15.410	48.865	.187	2.3	18.5	2.6973

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4626	3.10	10308.20	.80	2.480	.033	.489	.7	65.8	.0178
4627	1.56	230.50	10.20	15.912	3.604	.053	2.7	15.4	1.4324
4629	2.23	1036.00	3.70	8.251	2.907	.211	.7	100.8	.3651
4704	17.80	4765.60	13.30	236.740	.114	.052	1.5	11.4	.0408
4707	122.62	8878.50	14.90	1827.038	.500	.051	1.3	12.2	.1282
4708	143.25	53846.10	5.40	773.550	.026	.031	.9	3.1	.0154
4711	123.03	11766.40	14.10	1734.723	.302	.026	1.5	4.6	.0875
4712	59.09	24734.50	7.60	449.084	.038	.054	.9	4.8	.0198
4713	12.38	4346.00	5.00	61.900	.023	.020	1.4	4.0	.0083
4717	41.97	56643.30	7.10	297.987	.010	.051	1.0	2.7	.0061
4722	157.82	44832.90	7.90	1246.778	.053	.032	.9	5.6	.0286
4723	57.47	2310.30	8.50	488.495	.382	.056	1.8	10.0	.2365
4724	42.90	1370.10	15.20	652.080	.903	.021	2.6	6.7	.3852
4725	30.68	1820.80	26.40	809.952	1.014	.014	2.4	7.7	.1078
4728	16.11	681.20	5.70	91.827	.233	.017	1.8	7.4	.1256
4801	262.48	318828.90	16.50	4330.920	3.796	.013	3.3	2.0	.1467
4802	3.67	24.60	5.60	20.552	5.172	.022	2.0	12.4	.3701
4803	50.27	9230.80	10.80	542.916	1.006	.016	3.1	8.0	.0611
4805	29.54	3975.60	6.00	177.240	1.544	.027	.8	4.9	.3718
4806	93.32	80937.40	13.10	1222.492	1.680	.036	1.6	8.6	.2017
4808	13.96	174.60	5.50	76.780	20.289	.038	1.0	22.5	.2380
4809	33.35	3719.20	14.00	466.900	1.872	.010	2.9	2.5	.7826
4810	6.52	834.00	6.00	39.120	3.877	.042	.7	12.7	2.6641
4811	88.63	43149.40	4.20	372.246	.480	.113	.6	19.8	.1323
4812	13.84	5710.90	3.70	51.208	.428	.025	.8	15.9	.2309
4813	36.42	5102.30	6.40	233.088	.992	.024	.8	5.7	.1164
4814	10.93	1238.00	5.60	61.208	2.231	.060	.6	6.3	.5926
4815	93.93	4299.40	6.00	563.580	1.021	.045	.6	14.2	.2225
4816	62.17	5402.70	5.30	329.501	2.816	.023	1.1	10.2	.5946
4817	49.53	7324.50	3.70	183.261	.153	.097	.4	16.6	.0610
4818	75.27	2201.50	4.10	308.607	.606	.031	1.5	12.9	.0983
4819	86.43	1994.30	6.50	561.795	1.643	.063	.4	5.4	.2551
4820	334.28	42950.00	6.50	2172.820	.360	.196	.9	16.1	.1067
4821	25.80	93991.10	6.70	172.860	.153	.042	1.1	8.1	.1026

TETRA TECH.,INC.
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LAKE DATA

YEAR : 1972 TO 1975
TOTAL NUMBER OF LAKES : 493

STORET NUMBER	SURFACE AREA (KM^2)	DRAINAGE AREA (KM^2)	MEAN DEPTH (M)	VOLUME (10^6 M^3)	RETENTION TIME (YEARS)	MEDIAN PHOSPHORUS (MG/L)	SECCHI DISK (M)	MEAN CHL-A (UG/L)	RESPONSE TIME (YEARS)
4822	22.56	1642.10	13.90	313.584	2.709	.010	2.5	12.9	.7515
4823	66.77	41564.30	16.00	1068.320	8.576	.021	1.5	3.0	.0237
4824	103.44	2201.50	4.90	506.856	1.330	.031	1.5	10.6	.1184
4825	80.13	58404.50	11.20	897.456	1.008	.023	2.1	9.5	.0960
4826	21.85	3853.90	6.50	142.025	8.340	.098	.5	24.7	4.7878
4827	463.48	8932.90	7.70	3568.796	2.670	.029	1.5	6.3	1.0650
4828	25.62	40766.60	6.70	171.654	7.162	.036	1.0	11.8	.2520
4829	46.38	2610.70	4.30	199.434	.960	.053	.7	24.5	.4456
4830	19.00	932.40	3.50	66.500	2.478	.073	.4	18.5	.1438
4831	26.02	3413.60	11.30	294.026	1.338	.018	2.4	3.9	.3387
4832	148.52	1957.90	7.70	1143.604	3.221	.046	.9	18.2	.2689
4834	360.18	87500.50	5.70	2053.026	.475	.042	1.2	12.5	.1312
4835	76.61	98756.60	18.90	1447.929	1.020	.018	2.8	5.6	.3870
4837	36.50	6594.10	6.30	229.950	14.881	.029	1.2	8.7	4.1379
4838	7.32	2007.20	6.50	47.580	12.573	.020	1.7	4.3	1.2232
4839	95.35	67780.20	8.10	772.335	.534	.028	1.8	6.9	.0899
4901	171.59	1030.80	10.20	1750.218	21.936	.011	6.3	.9	5.0555
4903	9.66	1450.40	19.90	192.234	.578	.038	1.8	9.1	.2610
4904	5.95	1895.90	15.30	91.035	.367	.047	1.3	7.0	.1728
4906	10.12	57.00	25.90	262.108	58.531	.023	8.8	12.5	17.3684
4908	4.74	378.10	16.30	77.262	.869	.012	2.5	2.5	.4154
4909	4.01	1320.90	5.60	22.456	.727	.192	1.4	33.6	.3835
4910	3.12	290.10	14.10	43.992	.382	.008	3.0	2.7	.2605
4913	10.20	984.20	6.30	64.260	1.418	.067	1.2	11.8	.6552
4914	4.99	121.70	6.40	31.936	2.173	.071	1.9	46.0	1.1061
4915	6.88	25.90	3.00	20.640	36.361	.044	1.6	6.3	1.1064
4917	10.15	6319.60	10.10	102.515	.661	.047	.4	25.3	.2398
4920	44.52	13260.80	6.50	289.380	1.636	.026	1.3	18.2	.1366
4921	11.17	2745.40	19.90	222.283	2.031	.016	2.7	5.7	.1289
4923	.73	217.60	3.00	2.190	.156	.021	1.9	7.2	.0938
4924	396.60	6876.40	2.10	832.860	2.487	.132	.2	72.0	1.1891
4925	40.47	62.20	5.90	238.773	3.236	.044	1.1	7.6	1.9714
5001	1130.27	21185.80	19.39	21910.654	2.220	.018	2.3	11.1	.4289
5002	.57	362.60	3.35	1.900	.010	.021	1.7	7.5	.0058

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LAKE DATA

YEAR : 1972 TO 1975
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STORET NUMBER	SURFACE AREA (KM^2)	DRAINAGE AREA (KM^2)	MEAN DEPTH (M)	VOLUME (10^6 M^3)	RETENTION TIME (YEARS)	MEDIAN PHOSPHORUS (MG/L)	SECCHI DISK (M)	MEAN CHL-A (UG/L)	RESPONSE TIME (YEARS)
5005	8.84	486.40	10.36	91.593	.213	.009	2.8	1.8	.1216
5007	.62	694.10	1.68	1.038	.003	.018	1.5	3.5	.0015
5008	94.57	1779.30	15.54	1470.084	1.709	.021	2.0	14.0	.6806
5010	3.34	1815.60	3.14	10.494	.010	.015	1.6	8.5	.0049
5011	3.60	290.10	12.68	45.668	.227	.007	2.4	5.2	.1193
5103	18.19	6138.30	29.00	527.510	.172	.031	1.5	5.6	.0581
5105	4.63	572.40	18.00	83.340	.322	.011	2.1	6.0	.0660
5106	198.25	20150.20	10.70	2121.275	.340	.044	1.1	8.8	.0434
5108	6.88	1533.30	4.90	33.712	.074	.098	1.0	12.4	.0195
5110	80.94	2652.90	35.10	2840.994	3.183	.016	2.0	11.6	.1208
5111	12.95	3457.60	7.00	90.650	.084	.044	.9	12.6	.0545
5112	6.07	774.40	4.90	29.743	.119	.066	1.1	13.6	.0648
5113	1.82	673.40	6.10	11.102	.045	.079	1.0	6.7	.0202
5306	10.36	141.70	18.70	193.732	.603	.007	5.6	1.4	.1549
5309	27.58	7990.10	5.90	162.722	.796	.115	.9	29.1	.3038
5311	19.82	253.00	17.70	350.814	1.746	.015	3.2	7.3	.8748
5312	20.25	145.30	1.80	36.450	.257	.009	5.4	3.4	.1012
5401	8.25	11924.40	5.80	47.850	.009	.074	.7	14.9	.0059
5402	7.00	3654.50	12.80	89.600	.032	.006	2.4	4.7	.0089
5403	11.02	2082.40	21.00	231.420	.137	.011	3.5	6.2	.0854
5404	7.08	3537.90	17.40	123.192	.054	.006	3.1	1.2	.0339
5509	4.07	118.60	4.27	17.372	.401	.073	1.0	6.8	.2677
5513	7.18	105.20	7.62	54.705	2.810	.141	1.3	43.9	.8649
5519	29.73	303.00	31.70	942.359	20.980	.028	5.8	4.8	7.8990
5520	10.99	994.50	5.18	56.952	.372	.115	1.1	30.9	.2484
5522	42.41	6474.90	1.62	68.512	.064	.361	.5	36.1	.0350
5531	4.15	115.50	9.91	41.130	1.535	.124	1.9	12.0	.4574
5538	44.48	10100.80	2.13	94.909	.036	.074	.5	19.4	.0239
5539	24.91	194.00	3.23	80.489	1.533	.020	2.1	11.9	.8088
5541	9.31	986.80	1.40	13.050	.089	.404	.2	169.3	.0608
5546	6.85	4351.10	4.05	27.758	.028	.111	1.4	13.7	.0166
5548	.61	12.20	3.78	2.294	.694	.078	.8	5.1	.2389
5550	4.80	256.70	5.27	25.308	.532	.043	1.8	16.6	.2083
5555	36.02	23180.10	1.83	65.868	.010	.058	.8	51.4	.0066

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LAKE DATA

YEAR : 1972 TO 1975
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5556	21.97	14374.20	8.81	193.531	.046	.043	1.0	5.0	.0270
5559	4.59	922.00	1.92	8.804	.052	.269	.6	44.7	.0208
5564	4.70	36.50	5.61	26.350	3.598	.013	2.3	8.1	1.8399
5565	27.64	945.30	4.75	131.444	.432	.071	.8	35.5	.2224
5570	.95	253.30	1.22	1.155	.031	.190	.6	65.3	.0183
5574	20.78	846.90	4.57	94.990	.327	.029	1.1	9.2	.2033
5601	8.34	1139.60	5.80	48.372	.749	.087	.3	4.4	.4388
5602	7.03	336.70	12.20	85.766	.497	.008	3.5	2.5	.2216
5603	89.84	19945.60	10.40	934.336	.741	.037	.9	6.3	.0486
5605	137.67	39109.00	33.90	4667.013	2.342	.014	3.4	5.6	.2117
5606	20.23	295.30	24.40	493.612	2.484	.006	13.3	3.8	1.3577
5607	53.97	50523.10	18.30	987.651	.723	.045	1.0	8.5	.1401
5608	38.02	5180.00	6.50	247.130	15.246	.028	1.2	7.8	.1272
5609	24.68		4.20	103.656	4.383	.043	.6	7.5	.3296
5610	48.77	28979.50	25.60	1248.512	.936	.030	1.4	2.5	.1790
5613	7.08	2030.60	4.90	34.692	.160	.069	.8	13.0	.0451
5614	51.34	50937.50	26.80	1375.912	.433	.026	3.4	5.4	.0191
N	493	489	493	493	493	493	493	493	493
MEAN	44.09	11608.21	9.20	638.685	1.745	.084	1.7	17.304	.4047
S.D.	109.90	46951.98	9.68	2510.579	4.869	.150	1.5	29.512	1.0772
MAX.	1490.21	469825.80	88.70	35039.208	58.531	1.525	13.3	381.200	17.3684
STR. NO.	3812	3812	3635	3201	4906	2502	5606	2702	4906
MIN.	.10	3.10	.50	.110	.001	.004	.1	.500	.0003
STR. NO.	1005	27C2	2220	1005	2508	2311	0502	3008	2508

N = NUMBER OF LAKES WITH NON-ZERO DATA

PHOSPHORUS LOADING 1972-1975

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PHOSPHORUS LOADING

YEAR : 1972 TO 1975
TOTAL NUMBER OF LAKES : 493

STORET NUMBER	MUNICIPAL (KG/YR)	MUNICIPAL (%)	SEPTIC TANK (KG/YR)	SEPTIC TANK (%)	INDUSTRIAL (KG/YR)	INDUSTRIAL (%)	RIVERS (KG/YR)	RIVERS (%)	DIRECT RUNOFF (KG/YR)	DIRECT RUNOFF (%)	PRECIPITATION (KG/YR)	PRECIPITATION (%)	TOTAL (KG/YR)	TOTAL ($G/M^2/YR$)	FLOW (CMS)	FLOW (M/YR)
0101	458830	70	20				187660	29	4140	1	650		651300	17.49	178.63	151.310
0104	53115	3	75		660		1751480	95	37935	2	4810		1848075	6.72	1153.16	132.245
0105			10				223845	99	2280	1	235		226370	16.94	191.39	451.772
0107	61930	29	30				140105	66	8520	4	2760	1	213345	1.35	133.88	26.751
0112	254590	22	130				888335	77	10080	1	2140		1155275	9.45	252.56	65.167
0115	7940	55	5				5420	37	1050	7	75	1	14490	3.37	2.33	17.088
0403	7490	3	25				272195	97	660		1350		281720	3.64	260.69	106.353
0404	105	18					370	65	90	16	5	1	570	1.90	.08	8.410
0405	1425	15					7775	80	425	4	100	1	9725	1.72	.51	2.837
0406			5				247325	98	3780	1	1850	1	252960	2.39	317.53	94.799
0409	10	1	10	1			565	81	105	15	5	1	695	2.17	.10	9.855
0410	15050	12					104680	83	5700	5	1060	1	126490	2.08	28.42	14.765
0411	1565						475170	97	14325	3	920		491980	9.35	8.68	5.203
0501	45860	56	10				26910	33	7230	9	2000	2	82010	.72	42.35	11.695
0502			5				110960	99	1140	1	30		112135	69.22	4.25	82.733
0504	1475	1	35				93455	91	4995	5	3220	3	103180	.56	168.02	28.814
0505	42410	54	15				35975	46	300		135		78835	10.04	65.82	264.420
0506			5				129285	91	12870	9	375		142535	6.64	13.82	20.318
0507	1375	12	30				7615	65	1780	15	950	8	11750	.22	19.58	11.386
0508	2615	11					20330	84	805	3	495	2	24245	.86	10.51	11.699
0510	36190	50	75				30485	43	4530	6	425	1	71705	2.95	62.53	81.217
0514	590	2	10				18865	67	5765	21	2840	10	28070	.17	45.16	8.776
0515	214095	83	35				37730	15	4510	2	3050	1	259420	1.49	116.98	21.151
0516	4020	10	25				20555	52	11930	30	2870	7	39400	.24	49.52	9.528
0601	2610	68					860	23	320	8	25	1	3815	2.45	1.20	24.258
0602							2960	88	350	10	70	2	3380	.85	5.23	41.545
0606	10625	19	5				19305	35	24080	44	920	2	54935	1.05	46.86	28.175
0608			50	8			360	57	125	20	100	16	635	.11	1.51	8.340
0611							367785	99	4955	1	60		372800	109.97	74.48	692.862
0614			5				2000	47	2205	52	65	2	4275	1.12	.27	2.241
0616							28240	90	2980	10	140		31360	3.96	10.40	41.411
0620			5				745	48	735	48	55	4	1540	.48	.65	6.446
0621	4760	1					330295	91	27470	8	2090	1	364615	3.05	295.38	78.016
0624			10				34750	93	2570	7	90		37420	7.34	51.59	319.008
0625	5	1	5	1			590	66	275	31	20	2	895	.84	1.30	38.315

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PHOSPHORUS LOADING

YEAR : 1972 TO 1975
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STORET NUMBER	MUNICIPAL (KG/YR)	(%)	SEPTIC TANK (KG/YR)	(%)	INDUSTRIAL (KG/YR)	(%)	RIVERS (KG/YR)	(%)	DIRECT RUNOFF (KG/YR)	(%)	PRECIPITATION (KG/YR)	(%)	TOTAL (KG/YR)	TOTAL ($G/M^2/YR$)	FLOW (CMS)	FLOW (M/YR)
0626			10	1			615	74	185	22	25	3	835	.55	1.70	35.271
0801	455	45					500	50	20	2	30	3	1005	.59	1.58	29.310
0803	3160	3	10				85485	88	8265	8	640	1	97560	2.66	47.65	41.035
0804			5				4880	99	5		55	1	4945	1.53	.15	1.460
0806	2365	30	10				3720	48	1450	19	225	3	7770	.61	7.63	18.857
0807	920	9	45				9190	88	135	1	130	1	10420	5.08	13.27	204.138
0808	895	14	10				4735	72	795	12	150	2	6585	.77	13.46	49.358
0812	2510	2	10				123165	78	31300	20	1105	1	158090	2.50	49.46	24.660
0901	28263	21	14				104082	77	2731	2	23		135113	100.26	35.49	829.046
0904	11376	65	14				5837	33	286	2	5		17518	54.11	5.31	523.300
0905	29678	52					26799	47	77		5		56559	218.37	4.83	585.842
0910	10156	7					139346	90	5230	3	68		154800	39.23	70.15	560.063
0911	75033	28					188529	70	5271	2	136		268969	34.98	62.66	256.963
0912							116584	99	1651	1	23		118258	89.09	71.79	1702.233
1005	2995	41	10				4015	55	290	4	5		7315	73.15	.79	249.134
1007	475	19	5				1210	49	755	31	10		2455	3.84	.42	20.695
1008	2155	44	5				2585	53	120	2	5		4870	32.47	.33	69.379
1009			5				2125	96	85	4	5		2220	6.53	1.53	141.912
1010			1				345	91	30	8	5	1	381	1.73	.53	75.973
1301	26595	27	60				67845	68	4070	4	840	1	99410	2.07	50.60	33.244
1302	34065	10	140				300300	89	1970	1	605		337080	9.78	136.20	124.643
1303	460	4	70	1			8415	74	1870	17	505	4	11320	.39	12.00	13.076
1304	90520	20	75				343500	76	11545	3	4960	1	450600	1.59	264.42	29.435
1309	426005	66	415				212645	33	2065		340		641470	33.38	49.60	81.383
1310	78100	49	410				60605	38	16695	11	2825	2	158635	.98	60.50	11.816
1311	555	4	35				8550	65	3615	28	305	2	13060	.75	11.40	20.709
1313	13285	5	360				231970	91	9365	4	1090		256070	4.12	89.30	45.298
1316							11230	92	735	6	235	2	12200	.91	16.30	38.247
1317	31190	2	325				1354980	97	3480		415		1390390	58.74	185.80	247.545
1318			215	5			3525	79	520	12	195	4	4455	.40	9.60	26.959
1319	12495	64	5				6545	33	515	3	45		19605	8.07	7.50	97.333
1601	58095	10			108130	18	431560	71	7380	1	4850	1	610015	2.20	222.29	25.305
1602	1520	4					27085	67	10065	25	1875	5	40545	.38	29.64	8.716
1603	13580	8	250				157535	88	6185	3	2265	1	179815	1.39	176.52	42.986
1604	570						91195	79	22205	19	1345	1	115315	1.50	161.71	66.324

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PHOSPHORUS LOADING

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1608			10				31395	98			695	2	32100	.81	10.34	8.193
1609	8770	22	5				29740	73	1960	5	275	1	40750	2.58	15.66	31.257
1611			15				2875	70	825	20	380	9	4095	.19	10.19	14.877
1612			120	6			635	33	870	46	285	15	1910	.12	.66	1.273
1613			120	6			635	33	870	46	285	15	1910	.12	.66	1.273
1703	170	4	30	1			2500	59	1535	36	35	1	4270	2.17	.80	12.806
1706	9480	3	20				280350	89	24940	8	1840	1	316630	3.01	51.10	15.315
1712	20880	26	15				48030	61	9935	13	495	1	79355	2.82	3.40	3.804
1714	8390	8					89775	86	5480	5	200		103845	9.15	17.40	48.346
1725	21185	87	60		20		2790	11	295	1	20		24370	23.66	.60	18.370
1726	985	5					14100	78	2850	16	100	1	18035	3.15	1.80	9.924
1735	15130	20					49575	67	8445	11	1340	2	74490	.97	9.20	3.793
1739	37115	20	15		1380	1	135130	74	9100	5	780		183520	4.12	19.60	13.884
1740	85	1	5				7595	83	1365	15	50	1	9100	3.04	.77	8.121
1742	8070	28					18945	65	1835	6	300	1	29150	1.70	4.50	8.284
1748	8805	30	195	1			18010	62	1820	6	50		28880	10.20	5.10	56.832
1750	25985	71	545	1			8755	24	1205	3	50		36540	12.39	1.60	17.104
1751	630	55					360	31	155	13	10	1	1155	2.18	.10	5.950
1754	2360	48					2185	45	310	6	20		4875	4.03	1.00	26.063
1755	21380	13	640		415		135510	82	6690	4	355		164990	24.41	22.50	104.964
1758	5135	53	15				3850	40	715	7	15		9730	11.18	.10	3.625
1761	135	9					485	34	780	54	40	3	1440	.61	.30	3.975
1762	85	2	30	1			3245	71	1150	25	70	2	4580	1.17	.80	6.420
1763	60	1					4410	95	15		140	3	4625	.58	.10	.394
1764	90	4	5				1155	45	1275	50	45	2	2570	.96	.40	4.724
1766			25	1			2320	52	1985	44	155	3	4485	.51	.50	1.796
1805	635	2	10				30865	96	395	1	100		32005	5.65	7.97	44.407
1811	6195	30	55		620	3	12795	61	1155	6	125	1	20945	2.88	5.22	22.612
1827	46785	29	20		4155	3	106900	66	4380	3	225		162465	12.74	20.91	51.719
1828	2470	21	20				7755	65	985	8	760	6	11990	.28	10.96	7.946
1829	11600	32	5				23665	65	930	3	95		36295	6.52	5.40	30.574
1836	125	9	135	10			645	47	250	18	215	16	1370	.11	.76	1.936
1837	240	10	40	2			1990	80	165	7	40	2	2475	1.04	1.20	15.968
1839	625	24	5				1870	70	140	5	15	1	2655	3.28	.46	17.909
1840			15	1			1680	93	70	4	40	2	1805	.80	.80	11.114

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1841			20	1			1530	97	25	2	5		1580	4.39	.90	78.840
1842	190	8	15	1			2005	88	45	2	15	1	2270	2.73	.90	34.196
1843			40	3			650	56	335	29	130	11	1155	.15	.30	1.255
1844			50	1			3185	93	125	4	55	2	3415	1.10	2.74	27.784
1845	285	16	10	1			1400	80	25	1	20	1	1740	1.53	1.00	27.663
1846							290	85	45	13	5	1	340	.81	.14	10.512
1847			15	6			130	54	70	29	25	10	240	.16	.25	5.256
1851			115	24					270	56	100	21	485	.09	.10	.554
1852			50	6			545	71	120	16	55	7	770	.24	.24	2.329
1853			85	6			1175	83	85	6	75	5	1420	.34	1.13	8.525
1854	2560	23	10				8060	74	295	3	5		10930	29.54	1.70	144.895
1855							1610	77	465	22	5		2080	8.32	.76	95.869
1856	1120	80					190	14	85	6	5		1400	6.09	.36	49.361
1857			55	5			735	71	185	18	55	5	1030	.32	.36	3.493
1901			10	2			245	45	275	51	10	2	540	1.02	.07	4.165
1902							6365	82	1375	18	60	1	7800	2.27	.99	9.076
1903			25	1			1620	80	325	16	65	3	2035	.55	.27	2.289
1907	1075	42					465	18	980	38	65	3	2585	.67	.41	3.367
1908							180	28	440	69	15	2	635	.72	.08	2.867
1909	9535	9	10				65175	60	33355	31	780	1	108855	2.45	9.04	6.404
1910	427160	17					2038205	82	31730	1	635		2497730	68.96	121.04	105.387
1911							5255	65	2825	35	45	1	8125	3.13	.57	6.914
1912							100	32	190	60	25	8	315	.24	.04	.978
1914							30	10	260	87	10	3	300	.49	.07	3.619
2001			5				2850	64	1095	25	485	11	4435	.17	1.70	1.997
2002	585	2					12895	47	13760	50	230	1	27470	2.07	2.75	6.535
2003	2410	6					25740	65	11230	28	310	1	39690	2.23	10.87	19.247
2005	84550	24					246985	71	17655	5	665		349855	9.20	38.73	32.108
2006	4865	5	15				87765	92	2725	3	250		95620	6.65	9.66	21.200
2007	970	9					4715	46	4100	40	435	4	10220	.41	1.33	1.682
2008	310	1					11610	53	9675	44	490	2	22085	.79	5.03	5.655
2009	14030	3					396505	93	16925	4	1105		428565	6.54	26.17	12.598
2010	285	3					8000	72	2685	24	155	1	11125	1.26	.62	2.207
2011	18455	18					75255	74	7775	8	865	1	102350	2.07	12.71	8.119
2012	3245	20					8925	56	3420	22	285	2	15875	.98	4.66	9.077

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	(KG/YR)	(%)	(KG/YR)	(%)	(KG/YR)	(%)	(KG/YR)	(%)	(KG/YR)	(%)	(KG/YR)	(%)	(KG/YR)	(G/M^2/YR)	(CMS)	(M/YR)
2014	12870	1					1380420	97	29895	2	1120		1424305	22.28	52.86	26.071
2015	3795	22					10920	64	1785	10	635	4	17135	.47	3.49	3.022
2101	19230	5	20				354125	89	20835	5	3560	1	397770	1.96	252.84	39.209
2103	29310	27	155				74625	68	5635	5	210		109935	9.24	16.78	44.468
2203	28100	24	460				79750	69	6545	6	1220	1	116075	1.67	40.81	18.473
2204	3175	18	30				10750	62	2980	17	280	2	17215	1.07	6.94	13.628
2205	14275	27	5				32625	62	5995	11	125		53025	7.50	8.98	40.056
2210	1770	15	105	1			6295	52	3280	27	625	5	12075	.34	6.15	5.422
2211	25140	31	70				43700	53	12070	15	1080	1	82060	1.33	51.82	26.512
2215	3915	8	5				34660	73	8425	18	220		47225	3.77	5.17	13.002
2217			20				2530	61	1320	32	300	7	4170	.24	4.14	7.639
2220			30				9100	62	5125	35	430	3	14685	.60	11.24	14.362
2304	11235	74	14				3530	23	308	2	27		15114	9.65	5.02	100.835
2306			299	11			1561	57	553	20	345	13	2758	.14	5.50	8.804
2308	4459	55					3161	39	286	4	236	3	8142	.60	13.71	32.074
2309			136	1			12184	49	6990	28	5307	22	24617	.08	52.90	5.505
2310	331	15	145	7			939	43	327	15	426	20	2168	.09	3.89	5.053
2311			517	6			5325	57	1383	15	2037	22	9262	.08	20.92	5.666
2312	8264	70	86	1			2614	22	544	5	304	3	11812	.68	6.02	10.942
2313	290	10	209	7			822	27	1247	42	426	14	2994	.12	3.20	4.156
2314			41	3			1388	88	91	6	54	3	1574	.51	5.80	59.386
2402			255	9			680	24	1625	57	275	10	2835	.18	3.55	7.095
2403	145	3	5		35	1	3425	73	864	18	221	5	4695	.37	4.60	11.522
2408	3155	28			30		7085	64	715	6	135	1	11120	1.45	9.21	37.868
2409	1630	19	5		915	10	5760	66	425	5	5		8740	20.81	1.90	142.663
2502	12982	99					63		50		5		13100	129.48	.07	22.075
2503	2445	63			503	13	853	22	54	1	5		3860	10.84	1.63	142.788
2507	62196	47			61235	46	7151	5	1220	1	9		131811	266.98	8.85	569.579
2508	81356	65					44294	35	113		5		125768	817.84	6.79	1427.530
2513	25138	83					4558	15	476	2	5		30177	248.52	3.10	814.680
2603	46996	23					154152	76	286		113		201547	31.40	35.73	175.511
2606	1987	66	36	1			766	25	200	7	23	1	3012	2.14	1.23	27.707
2609	75858	94	100				4400	5	490	1	91		80939	15.75	14.42	88.473
2617	1211	14	231	3			4187	49	1733	20	1220	14	8582	.12	11.46	5.174
2618			141	52			35	13	73	27	23	8	272	.22	.08	2.018

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2629	63484	92					4962	7	177		73		68696	16.17	14.09	104.551
2631	4023	42	27				4768	50	626	7	54	1	9498	2.97	.55	5.420
2643	3461	54					2739	43	150	2	73	1	6423	1.59	2.83	22.036
2648	25102	55	86				19155	42	1243	3	127		45713	6.35	3.94	17.257
2659	40569	35	45				73543	64	721	1	295		115173	6.86	60.69	113.992
2673	3180	16					12972	64	4078	20	23		20253	17.02	10.14	268.719
2683	998	7	27				14007	92	227	1	27		15286	9.24	7.39	140.392
2685	1973	10	18				17610	89	54		36		19691	9.27	10.70	159.168
2688	2853	14	104	1	662	3	16566	80	218	1	181	1	20584	1.98	14.79	44.848
2691	13082	84	41				1991	13	395	3	50		15559	5.53	1.74	19.528
2692	2985	76	27	1			807	20	109	3	14		3942	4.62	1.64	60.846
2694			32	16			104	51	18	9	50	25	204	.07	.12	1.292
2695			290	28			19	2	41	4	680	66	1030	.03	1.18	.958
2696	1034	21	508	11			1415	29	440	9	1420	29	4817	.06	4.44	1.726
2699	1524	16	59	1			7117	74	839	9	18		9557	9.19	6.16	186.790
27A1	1247	97	9	1					14	1	14	1	1284	1.65	.01	.404
27A2	13485	49	36				13703	50	59		73		27356	6.43	11.45	84.962
27A5	170055	83	64				34854	17	708		27		205708	130.00	8.56	109.291
27A6	1265725	49					1266919	49	30000	1	417		2563061	107.17	287.08	378.485
27A7	34232	12	263				249788	85	10537	4	581		295401	8.89	144.22	136.909
27B1	24503	94					503	2	1030	4	113		26149	4.00	.19	.916
27B2	844	41	195	10			558	27	59	3	381	19	2037	.09	1.20	1.730
27B3	1751	58					1161	38	59	2	64	2	3035	.79	1.06	8.751
27B4							653	89	9	1	68	9	730	.19	.87	7.108
27C0	11866	48	36				12351	50	191	1	109		24553	4.02	11.93	61.575
27C1			86	1			10487	91	449	4	454	4	11476	.44	10.92	13.255
27C2	1111	99					4		5		5		1125	4.96	.01	1.371
2702	52263	83	14		395	1	7928	13	1828	3	172		62600	6.31	1.68	5.335
2705	399	87							36	8	23	5	458	.37	.05	1.282
2709	7697	48	213	1	23		6187	39	934	6	894	6	15948	.31	3.28	2.027
2711	676	42					349	22	372	23	195	12	1592	.14	.38	1.080
2712	640	71	9	1			163	18	77	9	14	2	903	1.22	.15	6.392
2713	4822	56	23				2884	34	739	9	109	1	8577	1.40	.63	3.252
2715	8967	40					11731	53	431	2	1102	5	22231	.35	17.76	8.875
2716	3139	36	59	1			4803	56	404	5	227	3	8632	.67	1.55	3.795

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2719	1551	27	9				3761	66	363	6	36	1	5720	2.60	.47	6.737
2725	5352	98					63	1	18		14		5447	7.87	.08	3.656
2737			150	4			2672	73	172	5	676	18	3670	.10	3.82	3.120
2739	14084	41					19011	55	943	3	585	2	34623	1.04	2.61	2.465
2746	1751	10	5				6863	38	1424	8	7924	44	17967	.04	13.07	.909
2750			667	42	45	3			812	51	77	5	1601	.36	.17	1.191
2756	1932	88					250	11	9		9		2200	5.38	.25	19.229
2757	367	46					381	48	32	4	14	2	794	1.20	.37	17.679
2761	2930	69	177	4			400	9	227	5	503	12	4237	.15	.43	.471
2765	358	14	73	3			185	7	1125	45	776	31	2517	.06	1.04	.741
2776	156375	49					160266	50	1715	1	172		318528	32.54	67.86	218.594
2782	789	87							86	9	32	4	907	.53	.03	.553
2783	1533	89					176	10	14	1	5		1728	5.08	.21	19.478
2788	3193	64	95	2			1321	27	181	4	186	4	4976	.47	1.71	5.097
2793	2204	88	9				9		150	6	132	5	2504	.33	.21	.866
2802	9635	5	15				195735	94	2490	1	920		208795	3.98	23.00	13.818
2804	7000	2	15				421375	97	1700		2125		432215	3.56	106.00	27.533
2805	4535	3					129020	92	4325	3	2195	2	140075	1.12	61.60	15.484
2806	4830	3	10				145105	94	2525	2	1720	1	154190	1.57	47.00	15.066
2902	7120	34	25				12140	58	940	5	555	3	20780	.66	11.07	11.030
2903	20700	42	5				11435	23	15390	31	1765	4	49295	.49	21.97	6.876
2905			5				3770	44	4450	52	310	4	8535	.48	1.98	3.506
3001	1305		105				323220	98	2185	1	2495	1	329310	2.31	153.84	34.058
3002			5				16930	85	2655	13	350	2	19940	1.00	9.79	15.460
3003	26290	15	465				137720	79	655		8325	5	173455	.36	329.69	21.861
3005			55				18410	76	4815	20	895	4	24175	.47	28.33	17.426
3007			15	1			645	58	350	31	110	10	1120	.18	.09	.462
3008	135	1	70	1			8265	87	460	5	570	6	9500	.29	14.77	14.275
3009			15				7295	96			325	4	7635	.41	1.90	3.248
3010			40	1			2945	87	335	10	60	2	3380	.97	5.82	52.590
3011			55				14865	88	1855	11	190	1	16965	1.56	32.39	94.143
3012							2210	81	425	16	95	3	2730	.51	4.25	24.959
3013	4390	14					25115	78	1735	5	885	3	32125	.64	28.17	17.560
3014	14775	11					100690	75	17815	13	250		133530	9.44	12.83	28.594
3016			55	1			4505	77	1060	18	235	4	5855	.43	5.57	12.954

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3101							3335	64	1790	34	125	2	5250	.72	.46	1.993
3102	3190	3	45				113150	93	3785	3	955	1	121125	2.22	9.93	5.746
3103	1320	3	5				36935	81	7490	16	130		45880	6.13	1.96	8.252
3104			10				6515	61	3955	37	115	1	10595	1.61	1.06	5.073
3105			165				77095	100			200		77460	6.72	29.65	81.096
3106	1475	1	45				174085	90	14325	7	2480	1	192410	1.36	37.26	8.296
3107							1575	72	565	26	50	2	2190	.73	.12	1.266
3110	1560	9	10				15105	86	470	3	350	2	17495	.87	3.42	5.358
3201	322055	9	10				3166635	86	193760	5	10375		3692835	6.23	314.74	16.741
3202			5				162435	87	24840	13	345		187625	9.53	16.62	26.619
3204							52995	97	695	1	805	1	54495	1.18	5.80	3.964
3206							12825	97	185	1	170	1	13180	1.36	6.77	21.988
3302	2540	52	5				2010	41	307	6	27	1	4889	3.24	6.69	139.719
3303	10006	45	1710	8			5198	23	2250	10	3157	14	22321	.12	18.25	3.190
3305	3230	21	64				11662	78	77	1	9		15042	28.92	8.92	540.964
3306	4032	50	36				3878	48	73	1	5		8024	13.13	8.26	427.028
3402			5	1			85	19	330	74	25	6	445	.29	.22	4.564
3403	325	13	475	20			990	41	510	21	135	6	2435	.31	1.35	5.479
3406							11930	89	1445	11	45		13420	5.08	1.66	19.829
3409	1065	54	20	1			850	43	35	2	10	1	1980	3.47	.37	20.471
3410	11315	28	5				28275	71	135		15		39745	47.89	7.83	297.502
3412	19590	86	1				3205	14	70		5		22871	60.19	3.50	290.463
3415	345	27	320	25			140	11	295	23	190	15	1290	.12	1.11	3.220
3419	5495	47	10				5865	50	250	2	10		11630	18.17	3.03	149.303
3420	40	3	1				1135	78	190	13	90	6	1456	.28	1.61	9.727
3423	365	10					2450	65	765	20	165	4	3745	.40	1.17	3.946
3501	2625	9	20				24605	88	485	2	325	1	28060	1.52	2.77	4.724
3502							330	56	135	23	125	21	590	.08	.26	1.160
3503			40				9340	82	1390	12	680	6	11450	.29	4.78	3.882
3505	540360	21	5				2025840	79	475		2590		2569270	17.35	38.31	8.160
3506	1375	4	5				32230	92	1080	3	230	1	34920	2.67	8.53	20.582
3507	13610	56					10040	41	180	1	405	2	24235	1.05	6.94	9.495
3509							10010	89	920	8	295	3	11225	.67	3.14	5.898
3604	2481	41	299	5			1402	23	1107	18	753	12	6042	.14	3.63	2.663
3605							81494	98	962	1	340		82796	4.26	20.56	33.387

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3606			5				15862	85	2318	12	458	2	18643	.71	42.86	51.727
3608	37081	44	336				37508	45	6169	7	3007	4	84101	.49	26.43	4.847
3611	59057	20	45				234653	79	1365		154		295274	33.53	85.36	305.552
3617			744	15			1642	33	1724	35	830	17	4940	.10	4.32	2.874
3632	567	3	150	1			16130	74	2898	13	2132	10	21877	.18	64.73	16.732
3633	13209	51	86				11975	46	535	2	286	1	26091	1.60	9.97	19.266
3635	45450	68	3035	5			10927	16	4536	7	3066	5	67014	.38	14.61	2.628
3637	19713	80	27				3929	16	816	3	59		24544	7.07	5.87	53.348
3639			336	7			3347	68	1016	21	227	5	4926	.38	2.17	5.309
3640	95	12	9	1			145	19	481	63	32	4	762	.41	1.00	16.864
3641	39690	25	10		2750	2	114820	71	3540	2	855	1	161665	3.31	105.60	68.284
3701	1155		55				399785	99	1245		425		402665	16.66	141.40	184.493
3702	22020	2					920660	98	675		180		943535	91.07	213.60	650.202
3704	6245	5	25				103830	84	13320	11	755	1	124175	2.88	115.50	84.354
3705	11015	11					86710	86	3050	3	290		101065	6.08	55.90	106.005
3706	298345	31					643250	68	7355	1	1125		950075	14.78	136.60	67.006
3707	4415	10	25				37455	83	3030	7	445	1	45370	1.79	54.00	67.019
3711							55400	98	765	1	230		56395	4.31	67.20	161.896
3713	8765	9	200				81130	85	3595	4	2300	2	95990	.73	65.20	15.628
3715	41140	20					158595	78	2450	1	250		202435	14.24	48.44	107.426
3716	1235	16					6150	78	275	3	205	3	7865	.68	14.00	38.094
3717	1555		65				312910	99	2700	1	375		317605	14.92	154.60	229.003
3718	23470	18					100025	78	5230	4	25		128750	93.30	24.10	550.737
3719			125	6			1270	58	145	7	635	29	2175	.06	2.60	2.267
3801	1975	6	35				28340	88	1300	4	385	1	32035	1.46	3.35	4.806
3804							17380	91	1010	5	700	4	19090	.48	3.15	2.480
3807							2505	93	150	6	35	1	2690	1.35	.17	2.681
3808							600	75	190	24	10	1	800	1.51	.11	6.545
3812	17655		10				6480650	97	173370	3	26080		6697765	4.49	566.84	11.996
3814			10	1			1275	68	580	31	20	1	1885	1.71	.20	5.734
3901	3990	9	560	1			38210	83	3365	7	30		46155	27.15	7.20	133.564
3902	1580	24	235	4			3990	61	465	7	220	3	6490	.51	1.20	2.977
3905	17380	57	50				11915	39	910	3	95		30350	5.56	5.40	31.189
3906	10515	37					16835	59	1195	4	90		28635	5.54	7.20	43.919
3907	13850	21	120				44865	68	6750	10	90		65675	12.49	8.70	52.160

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3908	71770	41	30		75		102105	58	2345	1	95		176420	32.91	20.70	121.790
3912	1480	23					4285	66	685	11	15		6465	8.51	.70	29.046
3914	5425	27	50				12210	61	1985	10	200	1	19870	1.74	4.90	13.519
3921	3625	36					2210	22	3600	36	550	6	9985	.32	2.40	2.397
3924	8580	71					2935	24	490	4	60		12065	3.51	5.10	46.754
3927	1445	7	275	1			16085	74	3085	14	780	4	21670	.49	5.40	3.825
3928	2525	24	55	1			6875	66	815	8	110	1	10380	1.67	2.00	10.124
3929	34990	67	180				12090	23	4850	9	155		52265	5.87	6.20	21.969
3930	6250	82	35				1035	14	315	4	15		7650	8.41	.40	13.862
3931	57755	24	195				178050	75	880		60		236940	70.73	21.50	202.395
3932	5305	32					8985	54	2345	14	145	1	16780	2.05	3.40	13.124
4001			5				9810	92	445	4	445	4	10705	.42	2.48	3.078
4002							2135	56	1510	40	165	4	3810	.40	.88	2.918
4003	1980	36	5				1570	29	1545	28	395	7	5495	.24	2.63	3.660
4004	429755	25	10				1175940	68	113940	7	7260		1726905	4.16	156.96	11.933
4005	260	3	5				5965	64	2850	30	290	3	9370	.57	.44	.842
4006	980	30	5				2050	62	150	5	135	4	3320	.44	1.80	7.459
4008	595	1					75645	89	8500	10	40		84780	36.70	14.88	203.141
4009	34600	3	60		12585	1	1231685	95	15625	1	3295		1297850	6.90	183.86	30.812
4010							4250	94	110	2	175	4	4535	.45	.99	3.085
4011	22765	1	10				1705265	97	23945	1	1860		1753845	16.48	173.80	51.498
4012	8330	2	15				390670	95	10360	3	2085	1	411460	3.45	72.21	19.101
4013	16970	16	20				77480	71	13685	13	895	1	109050	2.13	38.32	23.607
4014			5				5750	73	1695	22	430	5	7880	.32	.32	.411
4101	5315						1885410	99	4550		990		1896265	33.47	526.27	292.913
4104							33155	82	7190	18	195		40540	3.66	33.04	94.124
4106							1032285	99	6260	1	100		1038645	183.51	532.66	2967.838
4107			10	1			1520	82	305	16	20	1	1855	1.70	1.44	41.662
4201	64840	96	60				2355	3	255		125		67635	9.66	12.00	54.062
4204							755	39	1105	57	65	3	1925	.51	3.00	25.029
4207	11885	28	5		13610	32	14365	34	2290	5	60		42215	12.83	3.80	36.425
4213	3215	21	15				5250	34	5870	38	1165	8	15515	.23	5.60	2.658
4216	19295	34	5		1975	3	34605	61	420	1	250		56550	3.92	20.00	43.770
4219	610	8	5				6350	82	710	9	80	1	7755	1.70	3.50	24.258
4220							1630	77	410	19	65	3	2105	.55	4.10	33.759

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4221	15	3	140	26			340	63	35	6	10	2	540	.78	.80	36.563
4222			115	16			260	36	295	41	45	6	715	.27	.60	7.087
4223	25	8	60	18			40	12	150	45	55	17	330	.11	.50	5.187
4224	30	5	15	3			355	63	125	22	35	6	560	.28	1.00	15.612
4225	3620	17	30				15870	76	1360	6	75		20955	4.78	12.00	86.400
4226							295	55	215	40	25	5	535	.39	.60	13.711
4227	1055	37	15	1			1255	45	440	16	55	2	2820	.93	3.50	36.308
4229	620	7	245	3			6055	73	1000	12	410	5	8330	.36	10.00	13.529
4402	757	16	18				3833	82	77	2	14		4699	5.61	4.43	166.315
4403	30137	37			45358	56	4435	6	553	1	18		80501	77.40	2.64	80.053
4503	538500	74					182500	25	2070		240		723310	53.03	133.07	307.661
4504	345640	86					47555	12	6750	2	805		400750	8.69	49.50	33.833
4505	57950	31	1540	1	25860	14	80370	43	17645	9	4350	2	187715	.83	119.76	16.680
4506	711285	45	1900				845040	53	16750	1	7835		1582810	3.54	469.85	33.104
4507	178375	60	1425				102740	35	10965	4	3600	1	297105	1.45	86.66	13.294
4508	925	28	25	1			1805	55	400	12	150	5	3305	.38	6.53	23.725
4511	175855	40	30				264025	59	4115	1	930		444955	8.38	110.19	65.442
4513	1475	7					17540	81	1395	6	1215	6	21625	.31	31.52	14.321
4515							34150	100	85		40		34275	15.23	17.68	247.803
4602							615	98			10	2	625	1.42	.06	4.300
4603	1330	13	5				8560	83	45		340	3	10280	.53	3.88	6.259
4610							260	81	30	9	30	9	320	.19	.28	5.256
4620			25	1			3655	89	345	8	60	1	4085	1.17	1.10	9.968
4624			30	8			160	43	125	33	60	16	375	.11	.01	.094
4626	3060	14					15985	73	2815	13	55		21915	7.07	2.36	24.008
4627			5	2			220	75	45	15	25	8	295	.19	.14	2.830
4629			5	1			525	80	90	14	40	6	660	.30	.09	1.273
4704	95130	50	120				94925	50	475		310		190960	10.73	65.85	116.665
4707	34705	7	30				423635	90	9285	2	2145		469800	3.83	115.98	29.828
4708	60155	5	45				1232255	94	11395	1	2505		1306355	9.12	927.75	204.241
4711	12870	2	75				663500	97	3770	1	2155		682370	5.55	182.27	46.721
4712	402170	40	170				587475	59	10775	1	1035		1001625	16.95	371.59	198.315
4713	20310	14	20				118755	84	1285	1	215		140585	11.36	84.45	215.122
4717	378470	22	60				1355075	78	1445		735		1735785	41.36	957.05	719.121
4722	74930	6	75				1218245	93	14220	1	2760		1310230	8.30	741.05	148.079

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4723	72720	27	30		825		190490	70	7745	3	1005		272815	4.75	40.58	22.268
4724	29730	54	20				23125	42	1025	2	750	1	54650	1.27	22.89	16.827
4725	22030	41	10				29755	55	1660	3	535	1	53990	1.76	25.32	26.026
4728	4965	30	5				7550	46	3560	22	280	2	16360	1.02	12.48	24.430
4801							244895	95	7805	3	4595	2	257295	.98	36.18	4.347
4802							885	90	35	4	65	7	985	.27	.13	1.117
4803	24210	12	50				162935	82	10595	5	870		198660	3.95	17.11	10.734
4805			170	2			6455	76	1375	16	515	6	8515	.29	3.64	3.886
4806	35		325				89045	97	830	1	1635	2	91870	.98	23.07	7.796
4808							9980	95	325	3	245	2	10550	.76	.12	.271
4809			20				4010	78	505	10	585	11	5120	.15	7.91	7.480
4810			115	8			1020	73	140	10	115	8	1390	.21	.32	1.548
4811	8500	4	200				195250	92	7455	4	1550	1	212955	2.40	24.57	8.742
4812			40	1			3865	84	435	9	240	5	4580	.33	3.79	8.636
4813	1755	3	165				48560	88	4005	7	635	1	55120	1.51	7.45	6.451
4814			125	3			1980	49	1730	43	190	5	4025	.37	.87	2.510
4815	34060	29					64670	55	16725	14	1650	1	117105	1.25	17.51	5.879
4816			215	2			10190	83	745	6	1090	9	12240	.20	3.71	1.882
4817	145255	49					146680	49	3815	1	865		296615	5.99	38.02	24.208
4818	18930	26	95				39505	55	11835	17	1315	2	71680	.95	16.14	6.762
4819	27260	31	80				57815	65	2765	3	785	1	88705	1.03	10.84	3.955
4820	42240	2	30				2092505	97	7935		5850		2148560	6.43	191.55	18.071
4821	16445	46	465	1			18260	51	365	1	450	1	35985	1.39	35.82	43.784
4822	1135	39	125	4			955	33	275	10	395	14	2885	.13	3.67	5.130
4823	123605	29					303040	71	140		1170		427955	6.41	3.95	1.866
4824	45830	66					13595	20	8420	12	1810	3	69655	.67	12.08	3.683
4825	8930	4	255				201250	93	4830	2	1400	1	216665	2.70	28.24	11.114
4826							880	63	175	13	340	24	1395	.06	.54	.779
4827	28525	20	35				93390	67	10100	7	8005	6	140055	.30	42.38	2.884
4828							13330	94	340	2	450	3	14120	.55	.76	.935
4829	3760	15	5				14555	58	4965	20	1730	7	25015	.54	6.59	4.481
4830	9225	34	50				16145	59	1670	6	335	1	27425	1.44	.85	1.411
4831	6350	66					2380	25	400	4	455	5	9585	.37	6.97	8.448
4832	32175	24					82655	61	17275	13	2600	2	134705	.91	11.26	2.391
4834	38495	3	225				1414575	96	18815	1	6305		1478415	4.10	137.00	11.995

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4835	2325	5	15				44305	90	1415	3	1340	3	49400	.64	45.02	18.532
4837							705	45	205	13	640	41	1550	.04	.49	.423
4838			15	3			305	66	10	2	130	28	460	.06	.12	.517
4839	11170	9	250				103570	88	1220	1	1670	1	117880	1.24	45.89	15.178
4901			95	1			11000	75	640	4	3005	20	14740	.09	2.53	.465
4903	7360	31			4195	18	11715	49	410	2	170	1	23850	2.47	10.54	34.409
4904	3785	25					10085	68	925	6	105	1	14900	2.50	7.86	41.659
4906			40	8			180	36	100	20	175	35	495	.05	.14	.436
4908							3135	94	115	3	85	3	3335	.70	2.82	18.762
4909	1020	18			2435	42	1940	33	350	6	70	1	5815	1.45	.98	7.707
4910							1530	94	45	3	55	3	1630	.52	3.65	36.893
4913							6115	95	120	2	180	3	6415	.63	1.44	4.452
4914			20	1			1635	90	75	4	85	5	1815	.36	.47	2.970
4915							775	85	20	2	120	13	915	.13	.02	.092
4917							19895	96	580	3	180	1	20655	2.03	4.92	15.286
4920	2885	9					28810	86	945	3	780	2	33420	.75	5.61	3.974
4921							26465	88	3515	12	195	1	30175	2.70	3.47	9.797
4923							275	93	5	2	15	5	295	.40	.45	19.440
4924	125700	62			7645	4	52290	26	9320	5	6940	3	201895	.51	10.62	.844
4925	110	1					7540	90			710	8	8360	.21	2.34	1.823
5001	152098	14					484817	46	419657	40			1056572	.93	312.96	8.732
5002	875	19	14				3665	78	150	3	9		4713	8.32	6.04	334.171
5005	2041	26	259	3			4205	54	1134	15	154	2	7793	.88	13.63	48.624
5007	4554	29					10891	70	154	1	9		15608	25.21	12.37	629.194
5008	19999	42	172				20974	44	4926	10	1656	3	47727	.50	27.27	9.094
5010	7416	20	5		3801	10	26100	69	254	1	59		37635	11.26	34.43	325.085
5011	1905	39					2022	42	835	17	64	1	4826	1.34	6.38	55.889
5103	34730	19	145				146415	80	1450	1	320		183060	10.06	97.50	169.036
5105	3075	27					6840	60	1455	13	80	1	11450	2.47	8.20	55.852
5106	275270	33	135				521375	63	21600	3	3470		821850	4.15	197.80	31.464
5108	23665	25	5				68795	73	1125	1	120		93710	13.62	14.50	66.464
5110	87105	48	75		5475	3	74565	41	11725	7	1415	1	180360	2.23	28.30	11.026
5111	7480	15	5				40095	80	2585	5	225		50390	3.89	34.10	83.041
5112	6825	35	20				11595	60	925	5	105	1	19470	3.21	7.90	41.044
5113	230	1			1725	8	19060	89	480	2	30		21525	11.83	7.80	135.154

TETRA TECH.,INC.
3700 MT. DIABLO BLVD.
LAF., CA. 94549

PHOSPHORUS LOADING

YEAR : 1972 TO 1975
TOTAL NUMBER OF LAKES : 493

STORET NUMBER	MUNICIPAL (KG/YR)	(%)	SEPTIC TANK (KG/YR)	(%)	INDUSTRIAL (KG/YR)	(%)	RIVERS (KG/YR)	(%)	DIRECT RUNOFF (KG/YR)	(%)	PRECIPITATION (KG/YR)	(%)	TOTAL (KG/YR)	TOTAL ($G/M^2/YR$)	FLOW (CMS)	FLOW (M/YR)
5306							1810	40	2535	56	180	4	4525	.44	10.18	30.988
5309	9905	32	20				19680	63	1055	3	485	2	31145	1.13	6.48	7.409
5311			110	2			4780	78	895	15	345	6	6130	.31	6.37	10.135
5312			75	3			540	21	1620	63	355	14	2590	.13	4.50	7.008
5401	105310	40	20		2825	1	153615	58	2470	1	145		264385	32.05	159.90	611.225
5402	85		35				59795	99	535	1	125		60575	8.65	88.40	398.255
5403	4440	14					24860	80	1530	5	195	1	31025	2.82	53.50	153.101
5404	5330	11	15				32135	67	10490	22	125		48095	6.79	72.70	323.823
5509	894	34	73	3			1178	45	386	15	73	3	2604	.64	1.37	10.615
5513	6064	76	172	2			667	8	980	12	127	2	8010	1.12	.62	2.723
5519	3352	45	209	3			1410	19	1932	26	522	7	7425	.25	1.42	1.506
5520	544	3	122	1			18013	88	1510	7	191	1	20380	1.85	4.85	13.917
5522	66954	16	113				348016	83	2740	1	739		418562	9.87	33.82	25.148
5531	3134	57	168	3			1769	32	372	7	73	1	5516	1.33	.85	6.459
5538	1973	1	77				238684	97	5416	2	776		246926	5.55	84.15	59.662
5539			113	6			727	40	535	30	435	24	1810	.07	1.67	2.114
5541	6495	11	59				49788	84	2640	4	163		59145	6.35	4.64	15.717
5546	1102	1	59				135246	97	2499	2	122		139028	20.30	31.98	147.229
5548	454	54	27	3			317	37	41	5	9	1	848	1.40	.10	5.170
5550	735	22	77	2			1969	58	553	16	82	2	3416	.71	1.51	9.921
5555	20625	4	191				521926	95	4599	1	630		547971	15.21	207.09	181.310
5556	3461	2	204				187009	96	3688	2	445		194807	8.87	133.06	190.996
5559	78648	84	159				14401	15	762	1	82		94052	20.51	5.39	37.032
5564									141	64	82	37	222	.05	.23	1.543
5565	1452	3	27				38207	91	1769	4	485	1	41940	1.52	9.66	11.022
5570	1651	20	14				6078	75	358	4	18		8119	8.57	1.16	38.507
5574			23				7530	78	1755	18	363	4	9671	.47	9.21	13.977
5601							7160	72	2675	27	145	1	9980	1.20	2.05	7.752
5602			5				3595	75	1080	22	125	3	4805	.68	5.47	24.538
5603	18750	6					287630	90	12070	4	1570		320020	3.56	40.00	14.041
5605	40405	22					130890	70	12535	7	2410	1	186240	1.35	63.18	14.473
5606			15	1			1440	61	550	23	355	15	2360	.12	6.30	9.821
5607	2680	2	5				171200	98	125		945	1	174955	3.24	43.34	25.325
5608	1270	7					13920	79	1745	10	665	4	17600	.46	.51	.423
5609	70	1					5905	90	130	2	430	7	6535	.26	.75	.958

TETRA TECH., INC.
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PHOSPHORUS LOADING

YEAR : 1972 TO 1975
TOTAL NUMBER OF LAKES : 493

STORET NUMBER	MUNICIPAL (KG/YR)	MUNICIPAL (%)	SEPTIC TANK (KG/YR)	SEPTIC TANK (%)	INDUSTRIAL (KG/YR)	INDUSTRIAL (%)	RIVERS (KG/YR)	RIVERS (%)	DIRECT RUNOFF (KG/YR)	DIRECT RUNOFF (%)	PRECIPITATION (KG/YR)	PRECIPITATION (%)	TOTAL (KG/YR)	TOTAL ($G/M^2/YR$)	FLOW (CMS)	FLOW (M/YR)
5610	4205	3					122185	86	14455	10	855	1	141700	2.91	42.28	27.339
5613	6685	16					34480	81	1365	3	125		42655	6.02	6.87	30.601
5614	6055	1			2125		1018325	97	20820	2	900		1048225	20.42	100.78	61.905
N	356		332		32		487		488		492		493	493	493	493
MEAN	36779.45		110.22		9765.22		127903.98		5218.55		734.47		159513.	10.64	41.21	71.213
S.D.	108261.07		263.99		22458.48		435151.00		23327.48		1723.81		486648.	44.91	110.49	201.678
MAX.	1265725		3035		108130		6480650		419657		26080		6697765	817.84	1153.16	2967.838
STR.NO	27A6		3635		1601		3812		5001		3812		3812	2508	0104	4106
MIN.	5		1		20		4		5		5		204	.03	.01	.092
STR.NO	0625		1010		1725		27C2		0804		0404		2694	2695	27A1	4915

N = NUMBER OF LAKES WITH NON-ZERO DATA

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PHOSPHORUS LOADING

YEAR : 1972 TO 1975
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STATISTIC FOR % CALCULATION

STORET NUMBER	MUNICIPAL (KG/YR) (%)	SEPTIC TANK (KG/YR) (%)	INDUSTRIAL (KG/YR) (%)	RIVERS (KG/YR) (%)	DIRECT RUNOFF (KG/YR) (%)	PRECIPITATION (KG/YR) (%)	TOTAL (KG/YR)	TOTAL ($G/M^2/YR$)	FLOW (CMS)	FLOW (M/YR)
N	347	114	24	484	452	321				
MEAN	29.12	5.08	12.31	64.16	12.21	5.22				
S.D.	25.54	7.98	15.92	25.56	14.30	7.60				
MAX.	99	52	56	100	87	66				
STR.NO	2502	2618	4403	3105	1914	2695				
MIN.	1	1	1	1	1	1				
STR.NO	0409	0409	1739	2725	0101	0107				

COMPUTED PARAMETERS 1972-1975

$K_1 = (Q/V)^{1/2}$

$K_2 = \frac{R(m)\ Q/V}{1-R(m)}$

Z = mean depth, m

α = extinction coef. = $\frac{1.609}{\text{secchi disk}} - 0.02(\text{chl. } \underline{a})$

R(m) = measured phosphorus retention

R(c) = computed phosphorus retention

$$R(c) = \frac{1}{(Q/V)^{1/2} + 1}$$

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STORET CODE	TIME-DEPTH	TROPHIC STATE	WPN	K1	K2	K1*Z	K2*Z	ALPHA	R(M)	R(C)
0101	1 1	I E	226	6.99	96.44	21.66	298.95	1.260	.664	.130
0104	1 1	I E	228	5.36	2.34	24.66	10.74	1.440	.075	.160
0105	1 2	I E	226	7.56	29.63	59.74	234.10	1.190	.341	.120
0107	1 2	I M	231	1.44	3.38	18.58	43.61	.820	.620	.410
0112	1 1	I E	235	4.82	14.77	13.51	41.35	2.460	.388	.170
0115	1 2	I E	234	1.83	4.98	9.34	25.42	.750	.598	.350
0403	1 2	I M	728	3.40	5.56	31.28	51.11	.730	.325	.230
0404	1 1	I E	729	1.83	.19	4.59	.47	.550	.053	.350
0405	3 2	I E	730	.65	.77	4.36	5.17	3.970	.646	.610
0406	1 2	I M	731	2.24	1.22	42.33	23.10	.400	.196	.310
0409	1 1	N E	734	1.46	2.24	6.73	10.29	.740	.511	.410
0410	3 3	I M	735	.73	2.45	20.33	68.69	.810	.823	.580
0411	3 2	I E	736	.58	16.12	8.92	246.62	2.000	.979	.630
0501	3 2	I M	480	.81	2.24	14.43	39.92	.690	.773	.550
0502	1 1	N HE	481	6.78	9.98	12.20	17.96	15.690	.178	.130
0504	1 3	I M	480	1.19	.83	24.24	16.99	.400	.371	.460
0505	1 2	I E	483	6.93	28.74	38.14	158.07	1.060	.374	.130
0506	1 1	I E	484	2.74	1.74	7.41	4.70	3.750	.188	.270
0507	1 2	I M	485	.87	.11	13.03	1.64	.520	.126	.530
0508	1 1	I E	486	2.36	2.82	4.96	5.92	1.070	.336	.300
0510	1 2	I E	483	2.89	9.27	28.07	89.89	.680	.525	.260
0514	3 2	I M	483	.73	.11	11.96	1.73	.490	.165	.580
0515	1 2	I M	480	1.05	3.21	20.10	61.29	.520	.743	.490
0516	1 3	I M	487	.67	.41	14.28	8.76	.410	.479	.600
0601	1 2	I E	739	1.18	1.56	20.55	27.16	.250	.528	.460
0602	1 2	I O	740	1.80	.86	23.06	10.95	.470	.209	.360
0606	3 3	I M	744	.77	.63	36.66	30.01	.460	.516	.570
0608	1 1	N O	746	2.36	1.36	3.54	2.04	.120	.197	.300
0611	1 3	I E	749	5.69	2.58	121.77	55.20	.950	.074	.150
0614	4 2	I E	750	.37	.07	6.10	1.14	.310	.337	.730
0616	1 2	I MU	752	1.47	1.36	28.12	25.93	.940	.385	.400
0620	3 2	I E	756	.80	.41	8.07	4.17	.460	.393	.560
0621	1 3	I M	757	1.30	.25	60.23	11.80	.450	.131	.440
0624	1 2	I E	760	4.40	2.90	72.55	47.84	.670	.130	.190
0625	1 2	N M	762	1.64	1.22	23.41	17.44	.250	.313	.380
0626	1 2	N M	761	1.52	.47	23.15	7.10	.190	.168	.400
0801	1 2	I M	765	1.88	.60	15.60	4.94	.660	.144	.350
0803	1 3	I M	767	1.15	2.87	35.72	89.24	.460	.685	.470

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STORET CODE	TIME-DEPTH	TROPHIC STATE	WPN	K1	K2	K1*Z	K2*Z	ALPHA	R(M)	R(C)
0804	4 2	I E	768	.53	1.58	2.76	8.23	1.550	.849	.650
0806	3 3	I O	769	.88	1.91	21.54	47.00	.130	.714	.530
0807	1 3	N M	770	2.22	3.67	91.82	151.57	.380	.426	.310
0808	1 3	I O	771	1.49	.07	33.10	1.51	.460	.030	.400
0812	3 3	I MU	775	.86	3.45	28.66	114.72	3.170	.823	.540
0901	1 1	I E	176	17.70	22.78	46.89	60.37	1.300	.068	.050
0904	1 1	I E	179	23.79	151.33	21.64	137.71	.860	.211	.040
0905	1 1	I HE	180	20.71	.82	28.38	1.12	1.230	.002	.050
0910	1 2	I E	181	8.65	24.51	64.85	183.84	.480	.247	.100
0911	1 2	I E	181	4.66	22.02	55.22	261.13	.210	.504	.180
0912	1 1	I E	181	24.40	112.06	70.03	321.61	.640	.158	.040
1005	1 1	I E	238	15.05	57.93	16.55	63.73	.670	.204	.060
1007	1 1	I E	239	4.34	15.27	4.77	16.80	1.930	.448	.190
1008	1 1	I E	240	6.80	43.13	10.20	64.70	1.250	.483	.130
1009	1 1	I E	242	10.87	3.57	13.05	4.28	.640	.029	.080
1010	1 1	I E	241	7.96	33.17	9.55	39.81	1.690	.344	.110
1301	1 2	I E	281	1.88	6.46	17.68	60.70	.920	.646	.350
1302	1 2	I E	283	4.85	15.72	25.70	83.30	1.970	.401	.170
1303	1 2	I M	286	1.11	.51	11.77	5.43	.410	.293	.470
1304	1 2	I ME	287	1.64	4.40	17.91	48.01	.940	.620	.380
1309	1 2	I E	290	3.43	20.06	23.70	138.41	1.320	.630	.230
1310	3 2	I M	293	.78	5.09	15.18	99.23	.510	.894	.560
1311	1 2	I M	291	1.26	1.00	16.47	13.10	.540	.387	.440
1313	1 2	I E	294	2.62	3.15	17.29	20.77	.910	.314	.280
1316	1 2	I LM	284	1.44	1.17	26.53	21.50	.530	.360	.410
1317	1 2	I E	282	5.13	30.12	48.24	283.13	1.860	.534	.160
1318	1 2	I LM	285	1.51	2.77	17.91	32.94	.410	.550	.400
1319	1 1	I E	289	5.13	8.27	18.98	30.61	1.310	.239	.160
1601	1 2	I E	776	1.66	.16	15.26	1.43	1.480	.054	.380
1602	1 2	I E	777	1.04	.60	8.40	4.88	.570	.359	.490
1603	4 1	N M	778	4.32	11.99	9.94	27.59	.330	.391	.190
1604	1 3	I O	779	1.09	.45	60.67	24.70	.600	.271	.480
1608	1 2	I E	783	1.18	1.06	6.95	6.26	2.170	.433	.460
1609	1 2	I E	785	1.44	2.96	21.65	44.36	.500	.587	.410
1611	1 2	N M	784	1.62	.04	9.21	.24	.140	.016	.380
1612	3 1	I E	787	.74	3.95	1.71	9.07	.440	.877	.570
1613	3 1	I E	787	.74	3.95	1.71	9.07	.390	.877	.570
1703	1 1	I E	296	1.60	1.17	8.00	5.83	1.260	.313	.380

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1706	1 1	I E	297	2.38	3.60	6.43	9.73	2.330	.389	.300
1712	1 1	I E	301	1.13	4.96	3.38	14.87	2.820	.796	.470
1714	1 1	I E	302	5.88	12.03	8.23	16.84	2.360	.258	.150
1725	1 1	N E	309	3.39	18.95	5.42	30.32	3.040	.623	.230
1726	1 1	I E	310	1.73	.38	5.72	1.24	5.150	.111	.370
1735	3 1	I E	313	.90	.79	4.22	3.73	1.830	.496	.530
1739	1 1	I E	315	1.67	5.28	8.33	26.40	1.270	.655	.380
1740	1 1	I E	306	1.39	.55	5.84	2.32	5.250	.223	.420
1742	1 1	I E	317	1.44	.71	5.76	2.83	3.760	.255	.410
1748	1 1	I E	320	6.37	19.74	8.92	27.64	2.600	.327	.140
1750	1 1	I E	322	2.62	8.80	6.54	22.01	2.050	.563	.280
1751	1 1	I E	318	1.14	2.91	5.23	13.41	1.270	.693	.470
1754	1 1	I E	307	3.11	5.12	8.39	13.83	3.000	.347	.240
1755	1 1	N E	305	6.61	3.34	15.87	8.02	2.750	.071	.130
1758	1 1	N E	316	1.74	4.49	2.09	5.38	.940	.598	.370
1761	1 1	I E	321	1.49	2.54	2.67	4.57	1.630	.535	.400
1762	1 1	I E	312	2.31	2.14	2.78	2.57	3.640	.286	.300
1763	4 1	I E	295	.36	6.41	1.11	19.86	1.380	.981	.740
1764	4 2	I E	319	.54	.04	8.75	.65	2.460	.121	.650
1766	1 1	N E	308	.92	.17	1.94	.36	.380	.166	.520
1805	1 2	I E	324	2.70	5.53	16.46	33.73	1.800	.432	.270
1811	1 1	I E	327	2.51	4.14	9.02	14.90	1.380	.397	.290
1827	1 2	I E	334	2.68	7.12	19.30	51.29	1.980	.498	.270
1828	1 2	I E	336	1.22	1.19	6.49	6.28	.930	.442	.450
1829	1 1	I E	337	2.55	7.17	11.99	33.72	1.170	.524	.280
1836	4 2	N M	344	.54	.43	3.60	2.89	.360	.599	.650
1837	1 1	N E	345	2.76	7.45	5.79	15.65	.720	.495	.270
1839	1 1	I E	347	1.97	6.87	9.08	31.62	1.640	.638	.340
1840	1 2	N E	348	1.11	1.11	10.06	10.11	.930	.476	.480
1841	1 2	N E	346	3.60	1.66	21.93	10.14	.630	.114	.220
1842	1 2	N E	349	1.81	1.59	18.86	16.54	.830	.326	.360
1843	4 2	N M	335	.41	.85	3.03	6.18	.510	.831	.710
1844	1 2	N M	342	1.57	1.03	17.72	11.59	.450	.294	.390
1845	1 2	N E	326	1.60	.17	17.28	1.87	.530	.063	.380
1846	3 2	N M	338	.95	3.47	11.09	40.55	.570	.794	.510
1847	3 2	N M	339	.66	.51	8.01	6.21	.500	.542	.600
1851	4 1	N E	323	.55	.30	1.00	.54	1.710	.495	.640
1852	3 2	I MU	325	.62	1.40	3.77	8.54	.590	.786	.620

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1853	1 2	N M	331	1.08	1.64	7.89	11.99	.340	.585	.480
1854	1 2	N E	332	5.33	14.19	27.18	72.35	.750	.333	.160
1855	1 1	N E	340	4.57	5.27	21.00	24.26	.830	.202	.180
1856	1 2	N E	333	2.84	.56	17.35	3.39	.650	.064	.260
1857	3 2	N E	328	.74	.50	4.69	3.17	.380	.476	.570
1901	1 1	I E	494	1.18	2.78	3.53	8.33	1.840	.667	.460
1902	1 2	I E	495	1.16	3.79	7.80	25.37	.670	.737	.460
1903	1 1	N E	496	1.16	.33	1.97	.56	4.370	.197	.460
1907	3 2	N E	500	.68	1.18	4.96	8.64	1.120	.720	.600
1908	3 1	I E	501	.93	2.38	3.08	7.84	1.440	.732	.520
1909	2 2	I E	502	.98	4.44	6.55	29.73	2.440	.823	.510
1910	1 1	I E	503	5.93	54.54	17.78	163.62	2.000	.608	.140
1911	1 1	I E	504	1.60	11.79	4.32	31.83	2.850	.822	.380
1912	3 1	N E	505	.90	.47	1.08	.56	2.120	.365	.530
1914	3 2	I E-	507	.79	.48	4.58	2.77	1.090	.433	.560
2001	4 2	I M	511	.48	.26	4.12	2.24	.860	.529	.670
2002	1 1	I E	512	1.29	3.43	5.05	13.39	3.830	.672	.440
2003	1 1	I E	513	2.83	6.49	6.80	15.57	7.980	.447	.260
2005	1 1	I E	515	4.01	12.05	8.01	24.09	7.860	.429	.200
2006	1 1	I E	516	2.17	16.72	9.77	75.24	5.040	.780	.320
2007	3 1	I E	517	.64	1.06	2.63	4.35	3.770	.721	.610
2008	3 2	I E	518	.97	1.52	5.83	9.10	1.000	.617	.510
2009	1 2	I E	519	1.27	12.73	9.91	99.28	1.410	.887	.440
2010	3 1	I E	520	.66	1.34	3.32	6.72	2.250	.753	.600
2011	1 1	I E	521	1.48	6.84	5.48	25.32	3.110	.757	.400
2012	1 2	I E	522	1.19	.26	7.62	1.69	3.050	.157	.460
2014	1 2	I E	524	1.78	16.58	14.62	135.99	1.790	.839	.360
2015	3 2	I M	525	.60	.86	5.04	7.20	.970	.704	.630
2101	1 3	I M	351	1.27	1.02	30.80	24.78	.870	.387	.440
2103	1 3	I E	353	1.36	2.08	32.60	49.63	.770	.527	.420
2203	1 1	I E	529	2.97	7.31	6.23	15.36	1.200	.454	.250
2204	1 1	I E	530	3.12	11.25	4.37	15.75	.980	.536	.240
2205	1 1	I E	533	5.00	17.61	8.01	28.17	1.600	.413	.170
2210	1 1	I E	538	1.42	.02	3.83	.05	1.910	.009	.410
2211	1 1	I MU	539	3.19	7.02	8.30	18.24	1.330	.408	.240
2215	1 1	I E	543	2.55	3.77	5.10	7.54	2.240	.367	.280
2217	1 1	I M	528	1.37	.73	5.60	3.00	.910	.282	.420
2220	1 1	N E	535	5.36	3.54	2.68	1.77	2.010	.110	.160

TETRA TECH., INC.
3700 MT. DIABLO BLVD.
LAF., CAL. 94549

YEAR : 1972 TO 1975
TOTAL NUMBER OF LAKES : 493

STORET CODE	TIME-DEPTH	TROPHIC STATE	WPN	K1	K2	K1*Z	K2*Z	ALPHA	R(M)	R(C)
2304	1 1	I E	3	5.76	1.99	17.56	6.08	1.040	.057	.150
2306	3 2	N M	4	.92	.84	9.55	8.69	.410	.497	.520
2308	1 1	N M	8	2.96	3.94	10.84	14.41	.970	.310	.250
2309	3 2	N O	2	.58	.28	9.52	4.65	.390	.458	.630
2310	3 2	N O	6	.59	.34	8.51	4.89	.380	.492	.630
2311	4 3	N O	5	.43	.25	13.21	7.59	.290	.572	.700
2312	1 2	N E	9	1.35	.75	8.10	4.52	.470	.292	.430
2313	4 2	N M	7	.56	.40	7.47	5.33	.480	.562	.640
2314	1 1	N O	5	3.73	3.21	15.92	13.69	.470	.187	.210
2402	3 2	I M	355	.94	1.91	7.58	15.50	.410	.686	.520
2403	1 2	I M	357	.94	.99	12.24	12.90	.520	.528	.520
2408	1 2	I E	358	1.58	1.07	23.99	16.29	.750	.301	.390
2409	1 1	I E	356	8.24	12.46	17.31	26.18	.940	.155	.110
2502	1 1	I HE	220	3.79	39.15	5.75	59.51	.050	.732	.210
2503	1 1	I E	27	7.70	31.42	18.78	76.66	1.750	.347	.120
2507	1 1	I HE	223	21.53	143.89	26.27	175.55	1.230	.237	.040
2508	1 1	I E	221	38.97	802.83	35.46	730.58	3.980	.346	.030
2513	1 1	I E	219	26.06	189.68	31.27	227.61	1.110	.218	.040
2603	1 1	I E	182	7.24	16.08	24.24	53.85	1.890	.235	.120
2606	1 2	N E	183	2.13	.04	12.99	.25	.910	.009	.320
2609	1 2	I E	184	3.81	4.80	23.24	29.29	1.220	.249	.210
2617	4 2	N O	188	.56	.54	9.31	8.97	.360	.634	.640
2618	4 2	N E	189	.49	.41	4.14	3.46	.400	.632	.670
2629	1 1	I E	193	4.90	5.60	21.36	24.42	1.170	.189	.170
2631	3 2	N HE	194	.73	.48	7.39	4.84	.500	.471	.580
2643	1 1	N E	199	3.31	3.33	6.66	6.70	.780	.233	.230
2648	1 1	N HE	200	2.17	12.57	7.95	45.99	2.170	.727	.320
2659	1 2	N E	203	4.03	.21	28.26	1.46	.820	.013	.200
2673	1 1	I E	209	13.28	29.67	20.19	45.09	1.580	.144	.070
2683	1 1	N E	215	5.74	8.79	24.53	37.54	.860	.210	.150
2685	1 1	N E	216	13.64	21.58	11.60	18.34	1.150	.104	.070
2688	1 2	N E	217	2.56	1.88	17.54	12.92	.580	.224	.280
2691	1 1	N E	202	2.22	1.62	8.79	6.42	.780	.248	.310
2692	1 2	N E	211	3.42	1.19	17.71	6.14	.560	.092	.230
2694	4 1	N O	191	.55	.85	2.34	3.59	.480	.735	.640
2695	4 2	N O	195	.25	.15	3.78	2.25	.250	.701	.800
2696	3 1	N E	196	.86	.79	2.00	1.84	.620	.516	.540
2699	1 2	N E	213	5.27	7.85	35.49	52.92	.580	.221	.160

TETRA TECH., INC.
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YEAR : 1972 TO 1975
TOTAL NUMBER OF LAKES : 493

STORET CODE	TIME-DEPTH		TROPHIC STATE		WPN	K1	K2	K1*Z	K2*Z	ALPHA	R(M)	R(C)
27A1	3	1	N	E	135	.55	6.89	.74	9.24	2.050	.958	.650
27A2	1	2	N	E	136	3.15	1.42	26.90	12.08	1.000	.125	.240
27A5	1	2	I	E	137	4.46	25.08	24.52	137.92	.820	.558	.180
27A6	1	1	I	E	127	12.46	4.58	30.40	11.17	2.780	.029	.070
27A7	1	2	I	E	122	3.95	7.53	34.67	66.14	1.260	.326	.200
27B1	3	1	N	E	133	.85	.95	1.08	1.22	3.470	.572	.540
27B2	4	2	N	MU	101	.52	.56	3.33	3.59	.480	.675	.660
27B3	1	1	N	E	117	1.38	2.45	6.32	11.22	.720	.562	.420
27B4	1	2	N	MU	96	1.07	.45	6.63	2.76	.380	.279	.480
27C0	1	2	N	E	81	2.79	4.50	22.08	35.63	.890	.367	.260
27C1	1	2	N	E	84	1.17	.75	11.37	7.33	.540	.356	.460
27C2	1	1	N	E	115	1.03	19.18	1.35	25.13	6.300	.948	.490
2702	1	1	N	E	80	2.24	2.02	2.39	2.17	.420	.288	.310
2705	3	1	N	E	83	.70	.67	1.82	1.73	2.230	.574	.590
2709	3	1	N	E	85	.78		2.60	.01	1.280	.006	.560
2711	4	1	N	E	86	.49	.29	2.21	1.32	.660	.550	.670
2712	1	1	N	E	87	1.20	7.81	5.31	34.52	.750	.844	.450
2713	3	1	N	E	88	.86	.86	3.79	3.81	.850	.539	.540
2715	1	2	N	M	92	1.08	2.02	8.22	15.42	.670	.635	.480
2716	3	2	N	E	93	.86	2.37	4.43	12.29	.720	.764	.540
2719	1	2	N	E	94	.94	.69	7.16	5.29	.630	.440	.520
2725	1	1	N	E	97	1.08	2.30	3.38	7.22	.650	.664	.480
2737	3	2	N	E	102	.58	.21	5.34	1.88	.450	.376	.630
2739	1	1	N	E	103	1.64	1.47	1.49	1.33	3.140	.352	.380
2746	4	1	N	M	105	.44	.23	2.07	1.08	.610	.542	.700
2750	4	1	N	E	108	.55	.95	2.17	3.74	1.170	.759	.650
2756	1	1	N	E	111	3.01	26.04	6.40	55.46	1.100	.742	.250
2757	1	1	N	E	112	2.53	2.65	6.94	7.25	.940	.292	.280
2761	4	2	N	E	114	.28	.71	1.68	4.21	.790	.899	.780
2765	4	1	N	M	118	.55	.27	1.34	.64	.720	.465	.640
2776	1	1	N	E	123	8.04	26.21	27.17	88.61	3.930	.289	.110
2782	3	1	N	E	125	.51	.10	1.08	.20	2.840	.270	.660
2783	1	1	N	E	126	3.18	12.71	6.11	24.40	1.370	.556	.240
2788	3	2	N	M	129	.65	1.57	7.86	19.01	.480	.789	.610
2793	4	2	N	E	131	.24	.65	3.63	9.97	.430	.920	.810
2802	3	2	I	E	360	.94	3.24	14.64	50.16	1.660	.784	.510
2804	1	1	I	E	362	2.73	9.11	10.09	33.71	1.590	.550	.270
2805	3	2	I	E	363	.97	.20	15.98	3.25	1.110	.174	.510

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STORET CODE	TIME-DEPTH	TROPHIC STATE	WPN	K1	K2	K1*Z	K2*Z	ALPHA	R(M)	R(C)
2806	3 2	I E	361	.96	.10	15.77	1.58	2.560	.095	.510
2902	1 2	I E	548	1.08	.74	10.24	7.05	1.050	.390	.480
2903	3 2	I E	549	.97	3.38	7.08	24.68	.710	.782	.510
2905	3 1	I E	550	.92	1.12	3.79	4.58	5.250	.566	.520
3001	1 2	I E	790	1.40	1.56	24.34	27.22	.960	.444	.420
3002	2 2	I E	791	.99	.68	15.63	10.72	.570	.409	.500
3003	1 2	N O	792	1.27	.84	17.18	11.29	.250	.341	.440
3005	1 2	I MU	794	1.46	.37	11.95	3.07	.390	.150	.410
3007	4 2	N MU	796	.23	.07	1.98	.59	.390	.563	.810
3008	4 3	N O	797	.56	.28	25.54	12.66	.190	.470	.640
3009	3 2	I E	798	.75	2.68	4.30	15.26	1.320	.824	.570
3010	1 2	N MU	799	1.70	1.74	31.02	31.85	.420	.377	.370
3011	1 3	N M	800	2.07	3.08	45.41	67.43	.230	.417	.330
3012	3 3	N OM	801	.60	.12	41.47	8.52	.350	.255	.620
3013	1 2	I MU	802	1.07	1.51	16.39	23.16	1.180	.569	.480
3014	1 2	I E	803	2.17	33.27	13.21	202.95	1.960	.877	.320
3016	3 3	N O	804	.63	.50	20.64	16.44	.280	.559	.610
3101	3 2	I E	554	.60	1.48	3.31	8.12	1.120	.803	.620
3102	3 2	I HE	555	.86	2.87	6.69	22.39	2.130	.796	.540
3103	1 2	I E	556	1.19	22.53	6.92	130.69	1.720	.941	.460
3104	3 2	I E	557	.93	3.84	5.47	22.63	1.680	.817	.520
3105	1 2	I E	558	3.65	6.40	22.24	39.02	2.160	.325	.220
3106	3 2	I MU	559	.65	1.67	12.82	33.08	.530	.800	.610
3107	3 1	I E	560	.58	1.01	2.16	3.73	1.030	.747	.630
3110	3 2	I E	562	.86	1.43	6.25	10.45	1.500	.661	.540
3201	4 3	I LM	808	.53	3.95	31.45	233.23	.210	.933	.650
3202	1 2	I E	807	1.99	3.67	13.35	24.61	2.210	.480	.330
3204	3 1	I E	809	.93	.83	4.27	3.82	1.910	.490	.520
3206	1 2	N E	811	1.18	1.57	18.64	24.79	.370	.530	.460
3302	1 1	I E	14	7.53	6.11	18.61	15.09	1.220	.097	.120
3303	4 2	N O	11	.49	.81	6.47	10.56	.250	.768	.670
3305	1 1	I E	13	15.46	116.10	34.94	262.39	.750	.327	.060
3306	1 1	I E	12	11.28	59.36	37.77	198.85	.870	.318	.080
3402	1 1	N E	364	1.59	.47	2.87	.85	1.330	.157	.390
3403	1 2	I E	367	1.03	1.03	5.34	5.37	.490	.495	.490
3406	1 1	I E	370	2.20	2.32	9.02	9.49	1.340	.324	.310
3409	1 1	I E	372	3.37	16.77	6.07	30.19	1.010	.596	.230
3410	1 1	I E	373	12.86	242.73	23.14	436.92	1.330	.595	.070

TETRA TECH., INC.
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STORET CODE	TIME-DEPTH		TROPHIC STATE		WPN	K1	K2	K1*Z	K2*Z	ALPHA	R(M)	R(C)
3412	1	1	I	E	365	14.40	378.34	20.17	529.68	1.650	.646	.060
3415	1	2	I	E	368	.77	.48	4.21	2.63	.490	.450	.570
3419	1	1	I	E	371	9.11	15.99	16.39	28.79	1.470	.162	.100
3420	1	2	I	E	374	1.11	.82	8.77	6.46	.590	.399	.470
3423	1	2	I	M	376	.59	.04	6.68	.45	.290	.103	.630
3501	3	2	I	E	817	.76	3.99	6.19	32.31	1.890	.872	.570
3502	4	2	I	MU	818	.42	.04	2.79	.28	3.140	.195	.710
3503	3	2	I	M	819	.57	5.13	6.77	60.54	1.270	.940	.640
3505	3	2	I	E	821	.67	13.26	12.22	242.65	2.550	.967	.600
3506	1	2	I	MU	822	1.06	1.29	19.41	23.55	1.740	.534	.490
3507	1	1	I	E	823	2.13	1.98	4.47	4.15	5.080	.304	.320
3509	3	2	I	M	824	.86	6.82	6.87	54.56	1.170	.902	.540
3604	4	3	N	O	149	.26	.13	10.19	5.00	.270	.652	.790
3605	1	2	I	E	150	1.32	4.20	25.31	80.71	.300	.707	.430
3606	1	2	N	M	151	3.10	3.69	16.69	19.91	.640	.278	.240
3608	4	3	N	M	153	.30	.10	16.26	5.24	.510	.520	.770
3611	1	2	N	E	157	7.46	16.31	40.98	89.53	.850	.226	.120
3617	4	3	N	O	160	.36	.14	8.05	3.18	.330	.525	.740
3632	1	2	N	M	167	1.48	.79	11.27	6.03	.360	.265	.400
3633	1	2	N	E	168	1.56	2.78	12.35	22.03	.410	.534	.390
3635	4	3	N	M	170	.17	.12	15.27	10.49	.280	.800	.850
3637	1	2	I	E	172	1.99	5.61	26.74	75.18	.660	.585	.330
3639	3	2	N	E	156	.77	.80	6.87	7.09	.300	.572	.560
3640	1	2	N	E	162	1.82	.40	9.30	2.04	1.180	.108	.350
3641	1	2	I	ME	147	2.18	2.73	31.36	39.38	.660	.366	.310
3701	1	2	I	E	377	3.60	3.54	51.18	50.22	1.870	.214	.220
3702	1	2	I	E	378	7.49	46.11	86.85	534.86	2.600	.451	.120
3704	1	3	I	M	379	1.43	1.81	59.02	74.76	.530	.470	.410
3705	1	2	I	E	380	3.34	4.65	31.73	44.14	1.460	.294	.230
3706	1	1	I	E	381	3.70	16.05	18.12	78.67	2.400	.540	.210
3707	1	3	I	M	382	1.77	2.56	37.78	54.61	.690	.449	.360
3711	1	2	I	M	386	5.48	9.51	29.57	51.35	1.500	.241	.150
3713	1	2	I	E	387	1.24	3.22	12.63	32.82	1.120	.677	.450
3715	1	2	I	E	388	4.12	15.21	26.10	96.46	1.720	.473	.200
3716	1	2	I	M	389	1.51	1.09	25.30	18.28	.370	.324	.400
3717	1	2	I	E	390	4.86	4.79	47.13	46.48	1.880	.169	.170
3718	1	3	I	E	392	4.93	24.98	111.81	566.97	1.940	.507	.170
3719	1	1	N	M	391	1.23	1.08	1.84	1.62	1.390	.416	.450

TETRA TECH., INC.
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STORET CODE	TIME-DEPTH		TROPHIC STATE		WPN	K1	K2	K1*Z	K2*Z	ALPHA	R(M)	R(C)
3801	1	1	I	E	565	1.10	.29	4.38	1.16	1.480	.194	.480
3804	3	1	I	E	568	.85	.57	2.90	1.94	.810	.438	.540
3807	3	1	I	E	571	.73	.38	3.66	1.88	.410	.413	.580
3808	1	1	I	E	572	1.25	.89	5.24	3.72	2.630	.362	.440
3812	3	2	I	OU	575	.80	8.56	15.06	161.81	.560	.931	.560
3814	1	1	I	E	577	1.41	1.64	4.08	4.76	.290	.454	.420
3901	1	1	I	E	394	10.55	22.20	12.66	26.64	5.150	.166	.090
3902	1	1	N	E	396	1.25	.15	2.38	.29	4.310	.089	.440
3905	1	1	I	E	397	4.28	3.87	7.28	6.58	2.680	.174	.190
3906	1	1	I	E	398	2.96	2.22	14.82	11.12	2.100	.202	.250
3907	1	1	I	E	399	3.98	11.34	13.12	37.41	3.800	.418	.200
3908	1	1	I	E	400	6.37	42.03	19.11	126.10	2.670	.509	.140
3912	1	1	I	E	401	3.91	2.75	7.43	5.22	4.550	.152	.200
3914	1	2	I	E	403	1.44	3.84	9.37	24.94	1.530	.648	.410
3921	1	1	I	E	406	.94	.75	2.54	2.02	1.060	.457	.510
3924	1	1	I	E	408	3.12	2.64	14.98	12.65	1.010	.213	.240
3927	3	1	N	E	411	1.13	.56	3.39	1.69	2.440	.307	.470
3928	1	1	I	E	393	1.47	4.01	6.90	18.87	1.280	.651	.410
3929	1	1	I	E	395	2.12	14.12	10.38	69.19	1.480	.759	.320
3930	1	1	I	E	402	1.89	14.63	7.35	57.07	.680	.805	.350
3931	1	1	I	E	407	6.49	22.85	31.17	109.67	2.570	.351	.130
3932	1	2	I	E	409	1.60	6.16	8.18	31.41	1.540	.705	.380
4001	3	2	I	E	581	.69	.84	4.44	5.35	1.720	.635	.590
4002	4	2	I	M	582	.56	1.03	5.24	9.64	1.010	.768	.640
4003	3	2	I	E	583	.85	.13	4.32	.65	1.440	.151	.540
4004	1	2	I	E	584	1.09	.70	10.98	7.07	3.930	.372	.480
4005	4	2	I	E	585	.36	1.96	2.32	12.54	1.040	.937	.730
4006	3	2	I	E	586	.79	.15	9.42	1.82	3.830	.196	.560
4008	1	1	I	E	588	10.62	30.94	19.12	55.69	3.860	.215	.090
4009	1	2	I	E	589	1.68	2.53	18.33	27.61	1.880	.473	.370
4010	3	2	I	E	590	.58	1.28	5.30	11.64	1.500	.791	.630
4011	1	2	I	E	591	2.59	8.24	19.91	63.45	3.590	.552	.280
4012	1	2	I	E	592	1.83	5.27	10.43	30.05	3.920	.611	.350
4013	1	2	I	E	593	1.23	1.28	19.13	19.80	.870	.456	.450
4014	4	2	I	E	594	.26	1.16	1.57	6.95	1.620	.944	.790
4101	1	3	I	E	827	3.04	7.91	96.21	249.93	.570	.460	.250
4104	1	3		E	830	1.55	.29	60.74	11.49	.900	.109	.390
4106	1	2	I	E	832	16.13	41.76	183.94	476.10	.640	.138	.060

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STORET CODE	TIME-DEPTH		TROPHIC STATE		WPN	K1	K2	K1*Z	K2*Z	ALPHA	R(M)	R(C)
4107	1	2	N	MU	833	2.05	1.55	20.31	15.37	-.030	.270	.330
4201	1	1	I	E	415	5.81	30.14	9.30	48.23	1.040	.472	.150
4204	1	2	N	E	417	1.85	1.48	13.52	10.79	.490	.301	.350
4207	1	1	I	E	418	2.70	26.05	13.50	130.26	1.130	.781	.270
4213	3	1	I	E	425	.85	.73	3.14	2.71	.890	.505	.540
4216	1	1	I	E	426	4.18	6.03	10.46	15.08	1.250	.256	.190
4219	1	2	I	M	413	1.82	16.13	13.31	117.72	.450	.829	.350
4220	1	2	I	M	414	1.62	1.09	20.79	13.93	.360	.292	.380
4221	1	2	N	E	416	2.04	1.83	17.94	16.09	.620	.306	.330
4222	3	2	N	M	419	.80	1.60	8.83	17.63	.270	.713	.550
4223	1	1	I	M	420	1.10	1.07	4.72	4.59	.510	.470	.480
4224	1	1	I	M	421	4.16	.64	3.75	.58	.960	.036	.190
4225	1	1	I	E	422	5.04	3.76	17.14	12.78	2.060	.129	.170
4226	1	1	I	E	423	2.25	.76	6.08	2.06	1.060	.131	.310
4227	1	1	I	M	424	3.13	1.10	11.59	4.08	.970	.101	.240
4229	1	2	I	M	428	1.26	.32	10.72	2.71	.400	.167	.440
4402	1	1	I	E	28	8.27	13.69	20.18	33.41	1.080	.167	.110
4403	1	1	I	E	29	7.27	26.74	11.05	40.64	1.840	.336	.120
4503	1	2	I	E	430	7.55	5.27	40.76	28.47	3.970	.085	.120
4504	1	2	I	E	431	2.23	16.98	15.17	115.46	1.620	.773	.310
4505	1	2	I	MU	432	1.10	5.45	15.23	75.82	.680	.820	.480
4506	1	1	I	E	434	2.88	10.91	11.51	43.66	2.120	.569	.260
4507	1	2	I	ME	436	1.02	2.69	12.99	34.13	.720	.720	.490
4508	1	1	I	MU	437	2.35	.02	10.10	.07	1.290	.003	.300
4511	1	2	I	E	441	3.06	14.23	21.40	99.64	1.680	.604	.250
4513	3	2	I	LM	433	.97	.26	14.75	4.00	.430	.218	.510
4515	1	1	I	MU	438	7.87	41.93	31.48	167.73	2.650	.404	.110
4602	1	1	I	E	599	1.08	1.30	3.99	4.81	.980	.528	.480
4603	3	2	I	M	600	.83	5.74	7.55	52.23	.730	.893	.550
4610	3	2	I	M	607	.71	.08	7.43	.86	.250	.141	.590
4620	3	2	I	O	617	.78	4.85	12.79	79.53	.220	.889	.560
4624	4	1	I	E	621	.14	.24	.66	1.08	.330	.920	.870
4626	1	1	I	E	623	5.48	8.65	4.38	6.92	.980	.224	.150
4627	4	2	I	E	624	.53	.20	5.37	2.08	.290	.424	.650
4629	3	1	I	E	626	.59	1.55	2.17	5.73	.280	.818	.630
4704	1	2	I	E	443	2.96	8.14	39.39	108.32	.840	.481	.250
4707	1	2	I	E	445	1.41	3.38	21.08	50.37	.990	.628	.410
4708	1	2	I	E	446	6.15	7.04	33.21	38.01	1.730	.157	.140

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4711	1	2	I	E	447	1.82	4.57	25.67	64.48	.980	.580	.350
4712	1	2	I	E	446	5.11	8.83	38.82	67.08	1.690	.253	.160
4713	1	1	I	M	449	6.56	40.45	32.80	202.25	1.070	.485	.130
4717	1	2	I	E	446	10.06	11.81	71.45	83.88	1.560	.104	.090
4722	1	2	I	E	446	4.33	5.36	34.20	42.33	1.680	.222	.190
4723	1	2	I	E	444	1.62	.30	13.76	2.53	.690	.102	.380
4724	1	2	I	E	455	1.05	.68	15.99	10.39	.480	.382	.490
4725	1	3	I	MU	443	.99	5.43	26.21	143.27	.520	.846	.500
4728	1	2	I	E	455	2.07	1.21	11.80	6.88	.750	.220	.330
4801	4	2	I	M	631	.51	4.47	8.47	73.76	.450	.944	.660
4802	4	2	I	MU	632	.45	1.67	2.50	9.36	.560	.893	.690
4803	3	2	I	MU	633	1.00	10.32	10.77	111.43	.360	.912	.500
4805	3	2	I	E	635	.80	1.21	4.83	7.24	1.910	.651	.550
4806	3	2	I	E	636	.77	2.82	10.11	36.98	.830	.826	.560
4808	4	2	I	E	638	.22	2.92	1.22	16.07	1.160	.983	.820
4809	2	2	I	M	639	.73	.35	10.23	4.85	.500	.394	.580
4810	4	2	I	E	640	.51		3.05	.01	2.040	.004	.660
4811	1	1	I	E	641	1.44	3.13	6.06	13.16	2.290	.601	.410
4812	1	1	I	E	642	1.53	.66	5.65	2.43	1.690	.219	.400
4813	1	2	I	MU	643	1.00	4.91	6.43	31.42	1.900	.830	.500
4814	3	2	I	E	644	.67	.72	3.75	4.01	2.560	.615	.600
4815	2	2	I	E	650	.99	2.12	5.94	12.74	2.400	.684	.500
4816	3	2	I	E	646	.60	.81	3.16	4.27	1.260	.694	.630
4817	1	1	I	E	647	2.56	4.78	9.46	17.67	3.690	.422	.280
4818	1	1	I	E	648	1.28	5.38	5.27	22.07	.810	.765	.440
4819	3	2	I	E	649	.78	2.09	5.07	13.59	3.910	.775	.560
4820	1	2	I	E	651	1.67	3.69	10.84	23.99	1.470	.570	.370
4821	1	2	I	E	645	2.56	.19	17.13	1.26	1.300	.028	.280
4822	3	2	I	MU	652	.61	.55	8.44	7.63	.390	.598	.620
4823	4	2	I	M	653	.34	26.43	5.46	422.81	1.010	.996	.750
4824	3	1	I	E	654	.87	5.07	4.25	24.84	.860	.871	.540
4825	2	2	I	MU	655	1.00	6.21	11.16	69.60	.580	.862	.500
4826	4	2	I	E	656	.35	.02	2.25	.16	2.720	.168	.740
4827	3	2	I	E	657	.61	.27	4.71	2.11	.950	.422	.620
4828	4	2	I	E	658	.37	2.60	2.50	17.41	1.370	.949	.730
4829	2	1	I	E	659	1.02	.51	4.39	2.18	1.810	.327	.490
4830	3	1	I	E	660	.63	4.38	2.22	15.34	3.650	.916	.610
4831	2	2	I	M	661	.86	1.29	9.77	14.56	.590	.633	.540

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4832	4	2	I	E	662	.56	2.25	4.29	17.31	1.420	.879	.640
4834	1	2	I	E	663	1.45	3.15	8.27	17.97	1.090	.600	.410
4835	2	2	I	M	664	.99	.80	18.72	15.17	.460	.450	.500
4837	4	2	I	E	666	.26	.10	1.63	.63	1.170	.597	.790
4838	4	2	I	MU	667	.28	.48	1.83	3.14	.860	.859	.780
4839	2	2	I	E	668	1.37	5.79	11.09	46.91	.760	.756	.420
4901	4	2	N	O	836	.21	.09	2.18	.93	.240	.666	.820
4903	1	2	I	E	837	1.31	.91	26.17	18.18	.710	.346	.430
4904	1	2	I	E	838	1.65	1.27	25.25	19.41	1.100	.318	.380
4906	4	3	N	ME	839	.13	.02	3.36	.59	-.070	.576	.890
4908	1	2	I	M	841	1.07	.51	17.49	8.33	.590	.307	.480
4909	1	2	I	E	846	1.17	.42	6.57	2.36	.480	.235	.460
4910	1	2	N	O	847	1.62	.03	22.81	.46	.480	.012	.380
4913	3	2	I	E	850	.84	.35	5.30	2.18	1.100	.329	.540
4914	3	2	N	E	851	.68	.16	4.36	1.02	-.070	.256	.590
4915	4	1	N	E	852	.17	.59	.52	1.77	.880	.951	.850
4917	1	2	I	E	854	1.23	1.37	12.43	13.80	3.520	.474	.450
4920	3	2	I	E	857	.78	4.45	5.08	28.94	.870	.879	.560
4921	3	2	I	M	858	.70	4.87	13.96	96.92	.480	.908	.590
4923	1	1	I	M	860	2.55	.87	7.64	2.62	.700	.119	.280
4924	3	1	N	HE	861	.63	.18	1.33	.37	6.610	.307	.610
4925	4	2	I	E	862	.56	.04	3.28	.24	1.310	.117	.640
5001	3	2	N	M	154	.67	1.16	13.01	22.43	.480	.720	.600
5002	1	1	I	E	15	10.01	17.99	33.54	60.26	.800	.152	.090
5005	1	2	I	M	20	2.17	.98	22.44	10.16	.540	.173	.320
5007	1	1	I	E	16	19.39	96.31	32.57	161.81	1.000	.204	.050
5008	3	2	N	E	19	.76	.43	11.89	6.68	.520	.423	.570
5010	1	1	I	E	17	10.17	38.45	31.94	120.74	.840	.271	.090
5011	1	2	I	M	18	2.10	1.37	26.62	17.42	.570	.238	.320
5103	1	3	I	E	460	2.41	6.03	70.01	174.94	.960	.509	.290
5105	1	2	I	M	463	1.76	7.35	31.71	132.24	.650	.703	.360
5106	1	2	I	E	462	1.71	12.91	18.35	138.18	1.290	.815	.370
5108	1	1	I	E	464	3.68	21.74	18.05	106.52	1.360	.616	.210
5110	4	3	I	ME	465	.56	5.35	19.67	187.94	.570	.945	.640
5111	1	2	I	E	458	3.44	.79	24.11	5.54	1.540	.063	.230
5112	1	1	I	E	459	2.89	2.27	14.18	11.10	1.190	.213	.260
5113	1	2	I	E	466	4.71	12.04	28.71	73.47	1.480	.352	.180
5306	1	2	I	O	869	1.29	2.79	24.07	52.23	.260	.628	.440

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5309	1 2	I E	872	1.12	1.01	6.61	5.98	1.210	.447	.470
5311	3 2	N MU	874	.76	.22	13.39	3.83	.360	.274	.570
5312	1 1	N M	875	1.97	2.92	3.55	5.26	.230	.429	.340
5401	1 2	I E	467	10.27	11.73	59.54	68.02	2.000	.100	.090
5402	1 2	I M	468	5.58	46.61	71.40	596.56	.580	.600	.150
5403	1 3	I M	469	2.70	.79	56.70	16.69	.340	.098	.270
5404	1 2	I M	470	4.31	1.76	75.06	30.66	.500	.086	.190
5509	1 1	N E	34	1.58	.09	6.73	.38	1.470	.035	.390
5513	3 2	N E	36	.60	.44	4.56	3.36	.360	.552	.630
5519	4 3	N M	39	.22	.04	6.91	1.26	.180	.456	.820
5520	1 2	N E	40	1.64	.09	8.49	.47	.840	.033	.380
5522	1 1	I E	41	3.95	4.14	6.39	6.71	2.500	.210	.200
5531	3 2	N E	43	.81	.86	8.00	8.50	.610	.568	.550
5538	1 1	N E	45	5.29	.90	11.26	1.92	2.830	.031	.160
5539	3 1	N E	48	.81	.20	2.61	.64	.530	.233	.550
5541	1 1	I E	49	3.35	.13	4.69	.18	4.660	.012	.230
5546	1 1	N E	51	6.03	5.18	24.41	20.98	.880	.125	.140
5548	1 1	N E	53	1.17	1.51	4.43	5.71	1.910	.524	.460
5550	1 2	N E	54	1.37	1.43	7.23	7.54	.560	.432	.420
5555	1 1	I E	58	9.96	5.37	18.22	9.82	.980	.051	.090
5556	1 2	I E	59	4.66	3.92	41.02	34.57	1.510	.153	.180
5559	1 1	B HE	52	4.39	13.86	8.44	26.62	1.790	.418	.190
5564	4 2	N M	46	.52	.10	2.94	.56	.540	.266	.660
5565	1 1	I E	33	1.52	.78	7.23	3.73	1.300	.253	.400
5570	1 1	N E	38	5.63	5.92	6.87	7.23	1.380	.158	.150
5574	1 1	I M	56	1.75	.33	7.99	1.53	1.280	.099	.360
5601	1 2	I E	881	1.16	.24	6.71	1.37	5.280	.150	.460
5602	1 2	N O	882	1.42	1.10	17.30	13.43	.410	.354	.410
5603	1 2	I E	883	1.16	12.88	12.08	133.96	1.660	.905	.460
5605	3 3	I ME	885	.65	2.84	22.15	96.15	.360	.869	.600
5606	3 3	N O	886	.63	.11	15.48	2.57	.040	.208	.610
5607	1 2	I E	887	1.18	3.54	21.53	64.72	1.440	.719	.460
5608	4 2	I E	888	.26	5.39	1.66	35.03	1.180	.988	.800
5609	4 1	N E	889	.48	1.87	2.01	7.86	2.530	.891	.680
5610	1 3	I ME	890	1.03	2.78	26.46	71.27	1.100	.723	.490
5613	1 1	I E	893	2.50	9.05	12.25	44.33	1.750	.592	.290
5614	1 3	I ME	894	1.52	33.85	40.73	907.11	.370	.936	.400

N = NUMBER OF LAKES WITH NON-ZERO DATA

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N	493	491	493	493	493	493	493
MEAN	2.75	10.43	15.81	44.20	1.347	.458	.405
STD. DEV.	3.86	44.62	17.77	91.44	1.324	.260	.192
MAXIMUM	38.97	802.83	183.94	907.11	15.690	.996	.890
RELATED STORET NO.	2508	2508	4106	5614	0502	4823	4906
MINIMUM	.13	.02	.52	.01	-.070	.002	.030
RELATED STORET NO.	4906	2210	4915	2709	4906	0905	2508

N = NUMBER OF LAKES WITH NON-ZERO DATA

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-560/11-79-011	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Effect of Phosphorus Control Options on Lake Water Quality		5. REPORT DATE September, 1979 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Marc W. Lorenzen		8. PERFORMING ORGANIZATION REPORT NO. TC-3930
9. PERFORMING ORGANIZATION NAME AND ADDRESS Tetra Tech, Incorporated 3700 Mt. Diablo Boulevard Lafayette, CA 94549		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO. 68-01-3961
12. SPONSORING AGENCY NAME AND ADDRESS Environmental Protection Agency Office ofToxic Substances Washington, D.C. 20460		13. TYPE OF REPORT AND PERIOD COVERED Final Report 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

Justine Welch, Project Officer

16. ABSTRACT

Data collected as part of the National Eutrophication Survey (NES) were used to test the consequences of eight different phosphorus control options. The control options included detergent limitations, municipal treatment plant control, nonpoint source control and combinations of tertiary sewage treatment and nonpoint source control. The results indicated that although site specific studies should be conducted for any given lake, as a general rule detergent phosphorus control would be of marginal value. Eighty percent reductions in municipal treatment plant discharges would reduce average lake phosphorus control would be of marginal value. Eighty percent reductions in municipal treatment plant discharges would reduce average lake phosphorus concentration from 0.084 mg/ℓ to 0.059 mg/ℓ. A combination of municipal control and a sixty percent reduction in nonpoint sources would reduce average lake phosphorus concentration from 0.084 mg/ℓ to 0.029 mg/ℓ. It was found that nonpoint source control was more effective in increasing the number of lakes with less than 0.025 mg/ℓ of total phosphorus than was an equivalent level of point source control.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Phosphorus National Eutrophication Survey Eutrophication Chlorophyll-a		

18. DISTRIBUTION STATEMENT Unlimited Distribution	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 147 + Appendices
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE