

## **Long (Kee Nong Go-Mong) Lake at Wind Lake, WI Water-Quality Data Summary 1988 through 1996**

This **summary** covers the period 1988 to 1996, which is the period of water-quality monitoring of Long Lake by the U.S. Geological Survey. Emphasis in this summary is on data collected during 1996. All data collected during 1996 is included. Data from previous years is included in graphs to illustrate changes or trends.

In reviewing the data, it may be helpful to refer to the methods and explanations of physical and chemical characteristics sections in the USGS annual lake data report "Water-Quality and Lake-Stage Data for Wisconsin Lakes, Water Year 1996" and to Shaw and others (1994) "Understanding Lake Data."

The data that have been collected for Long Lake from 1988-1996 are useful for understanding the lake's water quality, and for managing the lake. These data define the present water quality of the lake and provide a basis for assessing trends or changes in water quality in the future.

### **Lake description and sampling locations:**

Long Lake is classified as a drainage lake, with two intermittent inlets and an outlet to Waubeesee Lake. The average depth of Long Lake is 9 feet, the surface area is 88 acres (0.14 square miles), and the lake's watershed area is 4.29 square miles. The water-quality sampling site is located at the deepest point in the lake at a depth of about 27 feet. Lake stage was monitored near the outlet, which is located on the **southeast** side of the lake. The locations of the monitoring sites are shown in Figure 1.

### **Hydrologic conditions** during water year 1996:

Annual variability in lake condition often reflects variability in climatic and hydrologic conditions. Air temperature in southeastern Wisconsin was, on the average, 2.2 °F colder than normal for the period December 1995 through March 1996: April and May was 4.0 °F colder than normal; and the period June through August was 1.3 °F colder than normal (National Oceanic and Atmospheric Administration "Climatological Data--Wisconsin"). Precipitation during water year 1996 was 103 percent of normal precipitation for southeastern Wisconsin (Pamela Naber-Knox, UW-Extension, Geological and Natural History Survey, written commun., 1996). Watershed runoff in the region of Long Lake was between 100 and 120 percent of long-term average runoff (Holmstrom and others, 1997, Water Resources Data--

Wixonsin").

#### **Lake Data for 1996:**

The following summarizes some highlights of data given in the tables and shown in the figures

#### Lake-stage fluctuations:

Lake stages were read by about weekly during the ice-free period by Marilyn Starck, and by USGS personnel on lake sampling dates. Observed stages ranged between 5.32 feet on **August 29** and **6.20** feet on April 21. Actual range of stage experienced by the lake may have been somewhat greater than the observed range.

#### Lake-depth profiles:

Vertical profiles of water temperature, dissolved oxygen, pH, and specific conductance exhibit no abnormalities and are similar to those from the previous years. These profiles, which were measured over the deepest point in the lake, are listed in Table 2 and shown in Figure 2. During the February through August sampling period, complete water-column mixing was observed on April 10. The lake became thermally stratified through the summer. In June the lower 4 feet of water were anoxic (devoid of oxygen), and by August the lower 8-10 feet were anoxic. The anoxic zone is unable to support fish. The pH, which ranged between 7.0 and 8.5, is common for southeastern Wisconsin lakes and poses no problems for aquatic life.

#### Chemical constituents:

Analyses of water samples collected on April 10 for selected chemical constituents for chemical characterization of the lake are shown in Figure 2. Samples collected at 1.5 and 26-foot depths show similar constituent concentrations, as would be expected under mixed water column conditions. The constituent values for color, chlorophyll *a*, chloride, calcium, magnesium, pH, alkalinity, total-nitrogen, and total-phosphorus are within regional values for this area as described by Lillie and Mason in "Limnological Characteristics of Wisconsin Lakes," 1983, Technical Bulletin No. 138, Department of Natural Resources.

The ratio of dissolved-nitrogen to dissolved-phosphorus was 55:1, based on the surface concentrations on **April 10**. This ratio suggests the lake is phosphorus limited, which means algal growth is dependent on the amount of available phosphorus rather than nitrogen. During the 9 years of monitoring the lake has remained phosphorus limited.

Three common measures of water quality used as indices are concentrations of near-surface total-phosphorus and chlorophyll *a*, and Secchi depth. Total-phosphorus concentrations ranged from 0.023 mg/L on August 8 to 0.035 mg/L on April 10, chlorophyll *a* ranged from 10 µg/L on August 8 to 24 µg/L on July 17, and Secchi depths ranged from 1.2 m on July 17 to 2.1 m on June 11.

Surface total-phosphorus and chlorophyll *a* concentrations, and Secchi depths for the 1988-96 period are shown on Figure 3. There is little year-to-year variation in data. However, there is a seasonal pattern in 7 of the 8 years of monitoring of showing the highest total-phosphorus, chlorophyll *a* and Secchi values in spring.

Total-phosphorus concentration 1.5 feet above the lake bottom at the center site ranged from 0.040 mg/L on April 10 to 0.508 mg/L on August 8. The high total-phosphorus concentrations observed during anoxic periods are indicative of large phosphorus release from the bottom sediments. During fall turnover these high concentrations are mixed throughout the lake water column and may be reflected in the high spring surface values.

#### **Lake condition:**

##### Water-quality index

Lillie and Mason (1983) classified all Wisconsin lakes using a random data set collected in the summer (July and August). The index, shown on page 12 of "Water-Quality and Lake-Stage data for Wisconsin Lakes, Water Year 1996," is based on surface total-phosphorus and chlorophyll *a* concentrations, and Secchi depths. According to the index, surface total-phosphorus concentrations in Long Lake indicate "good" water quality, the surface chlorophyll *a* concentrations indicate "fair" water quality, and Secchi depths indicate "poor" water quality.

Lillie and Mason (1983) also provided a means of comparing the condition of Long Lake with other lakes in southeastern Wisconsin. The comparison on page 4 shows the percentage distribution of southeastern Wisconsin lakes within each condition group and the relative position of Long Lake.

**1996 Data**

	Parameter	Percentage distribution of lakes in southeast Wisconsin within parameter ranges	
	<u>Total-phosphorus (mg/L)</u>		
	<0.010	best condition	7
	0.010-0.020	↓	21
Long Lake values	0.020-0.030		15
	0.030-0.050		21
	0.050-0.100		21
	0.100-0.150		3
	>0.150	worst condition	12
	<u>Chlorophyll a (µg/L)</u>		
	0-5	best condition	22
	5-10	↓	31
Long Lake values	10-15		14
	15-30		<b>12</b>
	>30	worst condition	22
	<u>Secchi depth (feet)</u>		
	>19.7	best condition	1
	9.8-19.7	↓	9
	6.6-9.8		26
Long Lake values	3.3-6.6		31
	<3.3		worst condition

Trophic status:

Another means of assessing the nutrient, or trophic, status of a lake is to use Carlson's Trophic State **Index** (TSI). The 1996 TSI data is listed in Table 2. Figure 4 is a graphical illustration of the variation in Trophic State Indices for Long Lake during the 9 year study period. The data from 1996 show the lake to be lower eutrophic, or a lake with high nutrient levels.



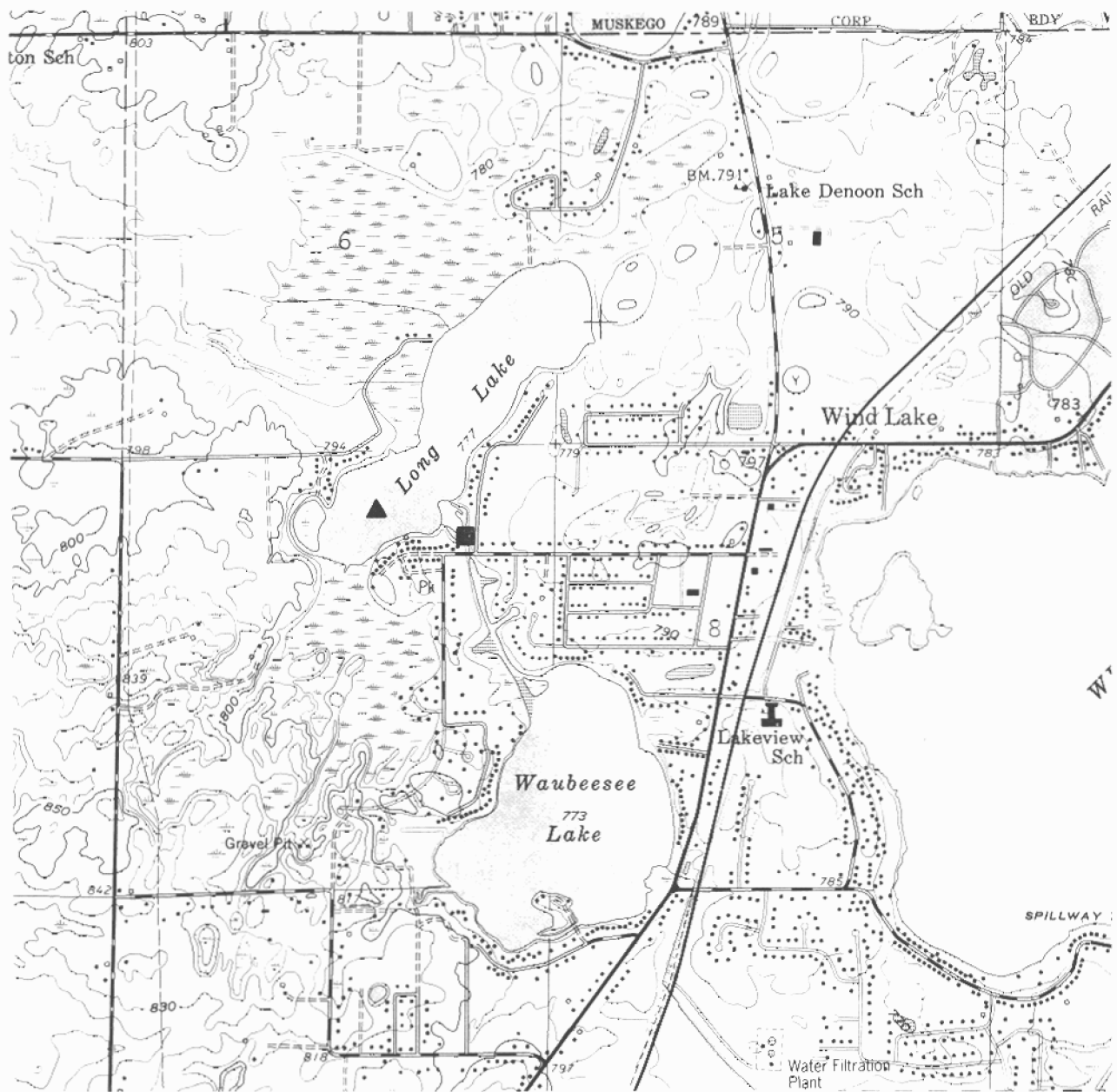
**Table 2. Lake-depth profiles for Long (Kee Nong Go-Mong) Lake at Wind Lake, Wisconsin, 1996 water year**

WATER-QUALITY DATA					
DATE	SAMPLING DEPTH (FEET) (00003)	TEMPERATURE WATER (DEG C) (00010)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH WATER HOLE FIELD (STANDARD WITS) (00400)	OXYGEN, DIS-SOLVED (MG/L) (00300)
<b>FEB 1W6</b>					
06...	3.00	1.5	536	7.5	9.5
06...	6.00	2.0	535	7.5	8.3
06...	9.00	2.0	537	7.5	6.6
06...	12.0	2.5	536	7.4	6.0
06...	15.0	3.0	540	7.3	4.7
06...	18.0	3.5	560	7.3	3.3
06...	21.0	3.5	582	7.2	0.9
06...	24.0	4.0	601	7.1	0.3
06...	26.0	4.0	616	7.0	0.2
06...	27.0	--	--	--	--
<b>APR</b>					
10.. .	1.50	6.5	487	8.1	12.2
10...	3.00	6.5	489	8.1	12.1
10...	6.00	6.5	490	8.1	12.1
10...	9.00	6.5	490	8.1	12.3
10.. .	12.0	6.5	487	8.1	12.7
10...	15.0	6.5	486	8.1	12.6
10...	18.0	6.5	488	8.1	12.0
10.. .	21.0	6.0	490	8.0	11.6
10...	24.0	6.0	488	8.0	11.4
10...	25.5	6.0	489	8.0	11.4
10...	27.0	--	--	--	--
<b>JUN</b>					
11...	1.50	17.0	486	8.4	10.0
11...	3.00	17.5	482	8.4	9.8
11...	6.00	17.5	481	8.4	9.6
11...	9.00	16.5	483	8.2	8.0
11...	12.0	15.5	490	8.0	7.9
11...	15.0	14.0	501	7.8	5.1
11...	18.0	13.5	503	7.7	3.2
11...	21.0	11.5	507	7.5	0.6
11...	24.0	10.5	507	7.4	0
11...	26.5	10.0	509	7.3	0
11...	28.0	--	--	--	--
<b>JUL</b>					
17.. .	1.50	24.5	447	8.5	9.2
17.. .	3.00	24.5	447	8.5	9.1
17...	6.00	24.0	458	8.2	6.7
17...	9.00	22.0	468	7.7	1.6
17...	12.0	17.0	505	7.4	1.2
17...	15.0	14.5	512	7.5	1.0
17...	18.0	13.0	515	7.5	0.5
17...	21.0	12.0	516	7.5	0.2
17.. .	24.0	10.5	524	7.3	0.1
17...	26.5	10.5	531	7.2	0.1
17...	28.0	--	--	--	--
<b>AUG</b>					
08...	1.50	26.5	450	8.1	7.5
08...	3.00	26.5	450	8.1	7.4
08...	6.00	26.5	451	8.1	6.9
08...	9.00	24.0	461	7.5	2.1
08...	12.0	20.0	482	7.3	0.9
08...	15.0	16.0	510	7.3	0.8
08...	18.0	13.5	515	7.4	0.3
08...	21.0	12.5	517	7.4	0
08...	24.0	11.0	527	7.3	0
08...	25.0	11.0	534	7.2	0
08...	26.5	--	--	--	--

Table 3.--Water clarity and water-quality analyses and their associated Trophic State Indices (TSI) for Long Lake,  
 1996 water year  
 [ - indicates not applicable; -- indicates no data available]

Date	Secchi Disk			Sampling Depth (feet)	Total Phosphorus			Chlorophyll a		Dissolved Ortho- phosphate Phosphorus Conc. (mg/L)
	Depth (meters)	Depth (feet)	T.S.I.		Conc. (mg/L)	Conc. (µg/L)	T.S.I	Conc. (µg/L)	T.S.I.	
04/11/96	1.5	4.9	54	1.5	0.035	35	56	16	56	0.002
				26	0.040	40	-			0.002
06/11/96	2.1	6.9	49	1.5	0.031	31	55	17	56	--
				27	0.119	119	--			--
07/17/96	1.2	3.9	57	1.5	0.030	30	55	24	59	--
				27	0.505	505	--			--
08/08/96	1.8	5.9	52	1.5	0.023	23	52	10	52	--
				25	0.508	508	--			--





### EXPLANATION

- ▲ Water-quality monitoring site
- Lake-stage monitoring site

**Figure 1.** Locations of water-quality and lake-stage monitoring sites on Long Lake at Wind Lake, Wisconsin.

LOCATION.--Lat 42°49'37", long 88°10'34" in NW 1/4 NE 1/4 sec. 7, T.4N., R.20 E., Racine County, Hydrologic Unit 07120006, at Wind Lake.  
 DRAINAGE AREA.--4.29 mi<sup>2</sup>.

PERIOD OF RECORD.--February 1988 to August 1989, February 1991 to current year.

REMARKS.--Lake sampled at the deepest point in southwest end of lake. Lake ice-covered during February measurements. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 06 TO AUGUST 08, 1996

(Milligrams per liter unless otherwise indicated)

	Feb 06		Apr. 10		June 11		July 17		Aug. 08	
Depth of sample (ft)	3.0	26	1.5	26	1.5	27	1.5	27	1.5	25
Lake stage (ft)	5.40		5.42		6.17		5.78		5.81	
Specific conductance (µS/cm)	536	616	487	489	486	509	447	531	450	534
pH (units)	7.5	7.0	8.1	8.0	8.4	7.3	8.5	7.2	8.1	7.2
Water temperature (C)	1.5	4.0	6.5	6.3	17.0	10.0	24.5	10.5	26.5	11.0
Color (Pt-Co scale)	---	---	50	50	---	---	---	---	---	---
Turbidity (NTU)	---	---	1.4	1.4	---	---	---	---	---	---
Secchi-depth (meters)	---	---	1.5	---	2.1	---	1.2	---	1.8	---
Dissolved oxygen	9.5	0.2	12.2	11.4	10.0	0.0	9.2	0.1	7.5	0.0
Hardness, as CaCO <sub>3</sub>	---	---	230	230	---	---	---	---	---	---
Calcium, dissolved (Ca)	---	---	48	48	---	---	---	---	---	---
Magnesium, dissolved (Mg)	---	---	26	26	---	---	---	---	---	---
Sodium, dissolved (Na)	---	---	13	13	---	---	---	---	---	---
Potassium, dissolved (K)	---	---	3	3	---	---	---	---	---	---
Alkalinity, as CaCO <sub>3</sub>	---	---	200	200	---	---	---	---	---	---
sulfate, dissolved (SO <sub>4</sub> )	---	---	27	27	---	---	---	---	---	---
Chloride, dissolved (Cl)	---	---	28	28	---	---	---	---	---	---
Fluoride, dissolved (F)	---	---	0.1	0.1	---	---	---	---	---	---
silica, dissolved ~SiO <sub>2</sub>	---	---	1.3	1.3	---	---	---	---	---	---
Solids, dissolved, at 180°C	---	---	306	238	---	---	---	---	---	---
Nitrogen, NO <sub>2</sub> + NO <sub>3</sub> diss (as N)	---	---	0.04	0.07	---	---	---	---	---	---
Nitrogen, ammonia, dissolved (as N)	---	---	0.06	0.03	---	---	---	---	---	---
Nitrogen, organic, total (as N)	---	---	1.2	1.2	---	---	---	---	---	---
Nitrogen, am. + org. [bra] (as N)	---	---	1.3	1.3	---	---	---	---	---	---
Nitrogen, total (as N)	---	---	0.035	0.040	0.031	0.119	0.030	0.505	0.023	0.508
Phosphorus, total (as P)	---	---	0.002	0.002	---	---	---	---	---	---
Phosphorus, ortho, dissolved (as P)	---	---	---	---	---	---	---	---	---	---
Iron, dissolved (Fe) µg/L	---	---	20	20	---	---	---	---	---	---
Manganese, dissolved (Mn) µg/L	---	---	0.7	2	---	---	---	---	---	---
Chlorophyll a, phytoplankton (µg/L)	---	---	16	---	17	---	24	---	10	---

2-6-96

4-10-96

6-11-96

7-17-96

8-8-96

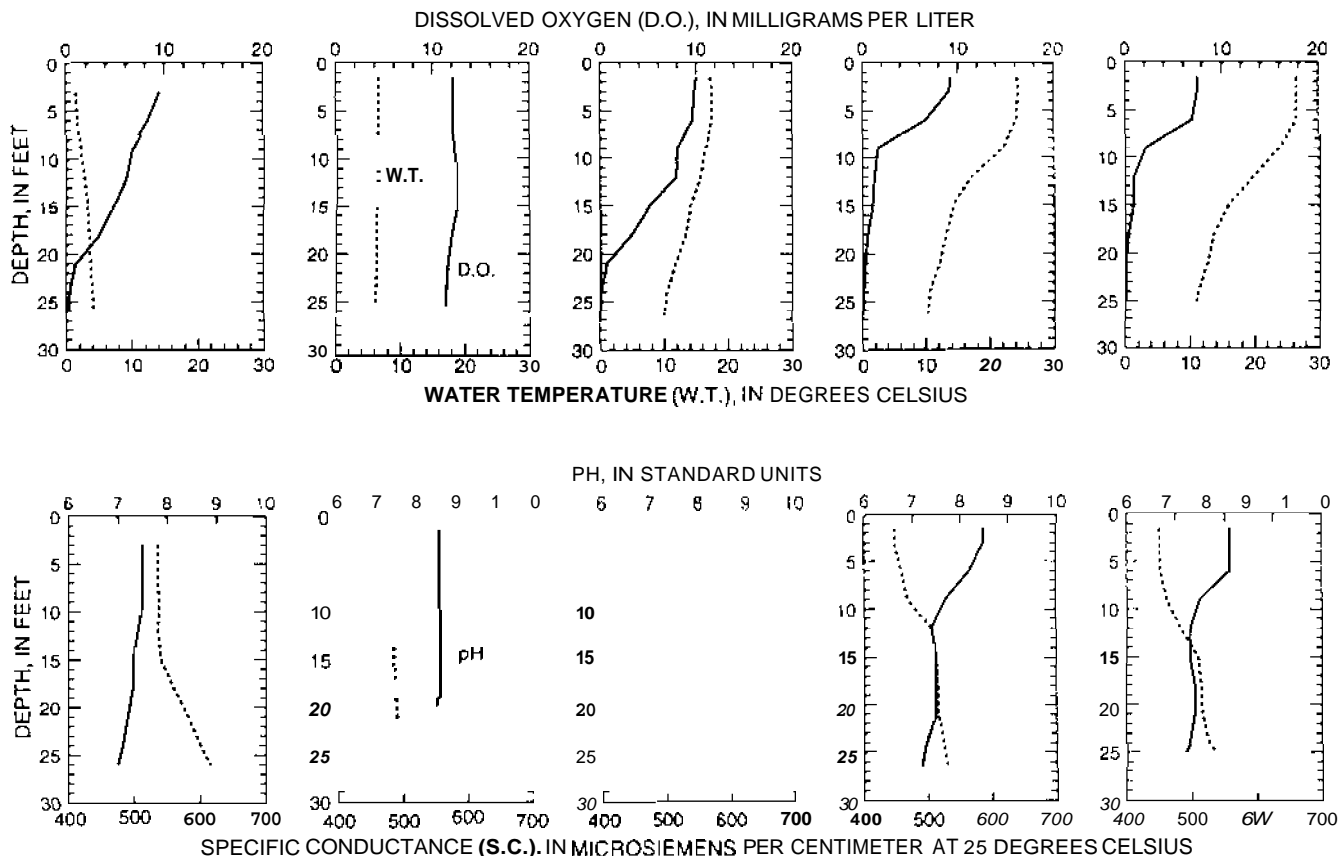


Figure 2. Water-quality data and depth profiles for Long (Kee Nong Go-Mong) Lake at Wind Lake, Wisconsin, 1996 water year

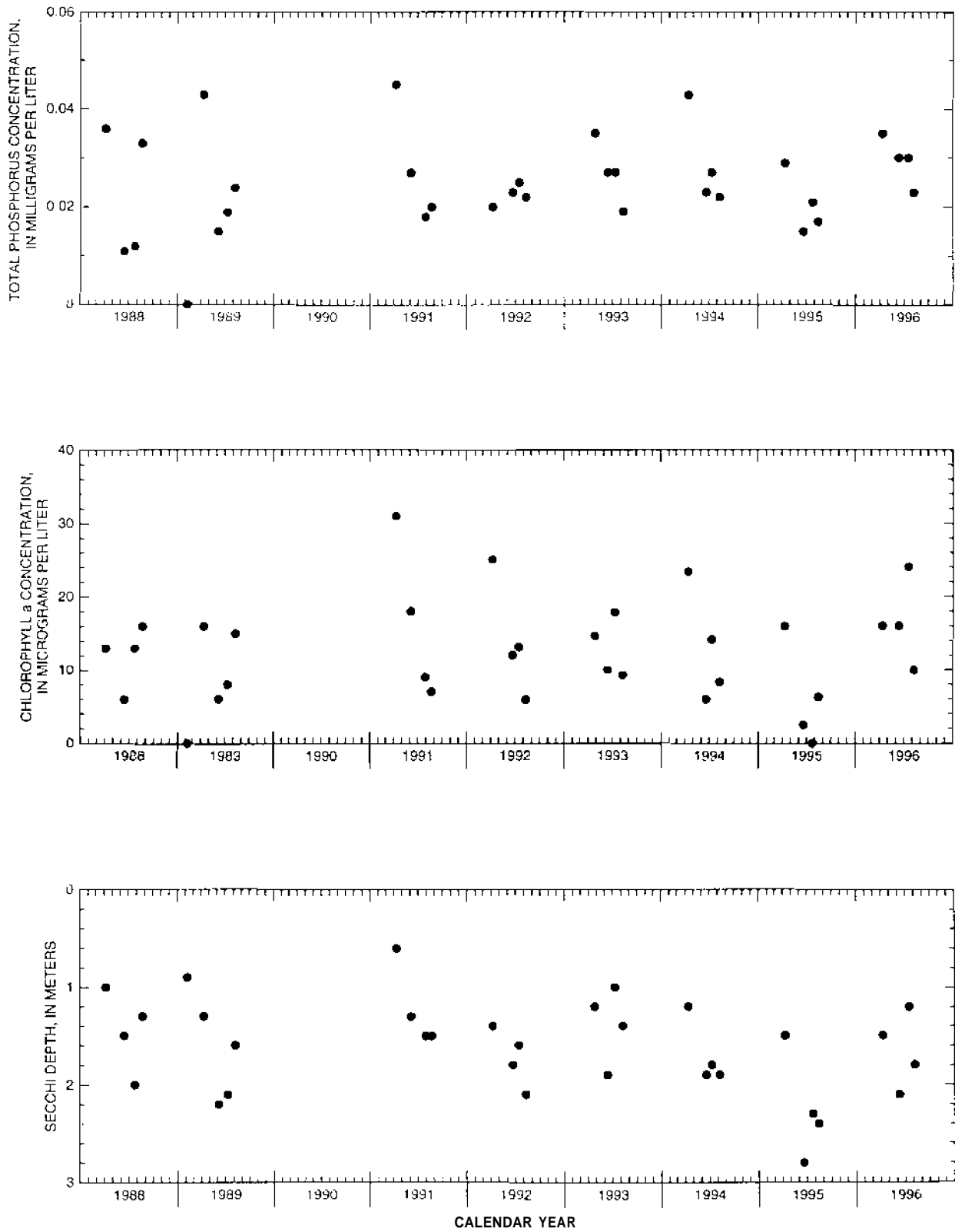


Figure 3. **Surface** total phosphorus and chlorophyll a concentrations, and Secchi depths for Long (Kee Nong Go-Mong) Lake at Wind Lake, Wisconsin.

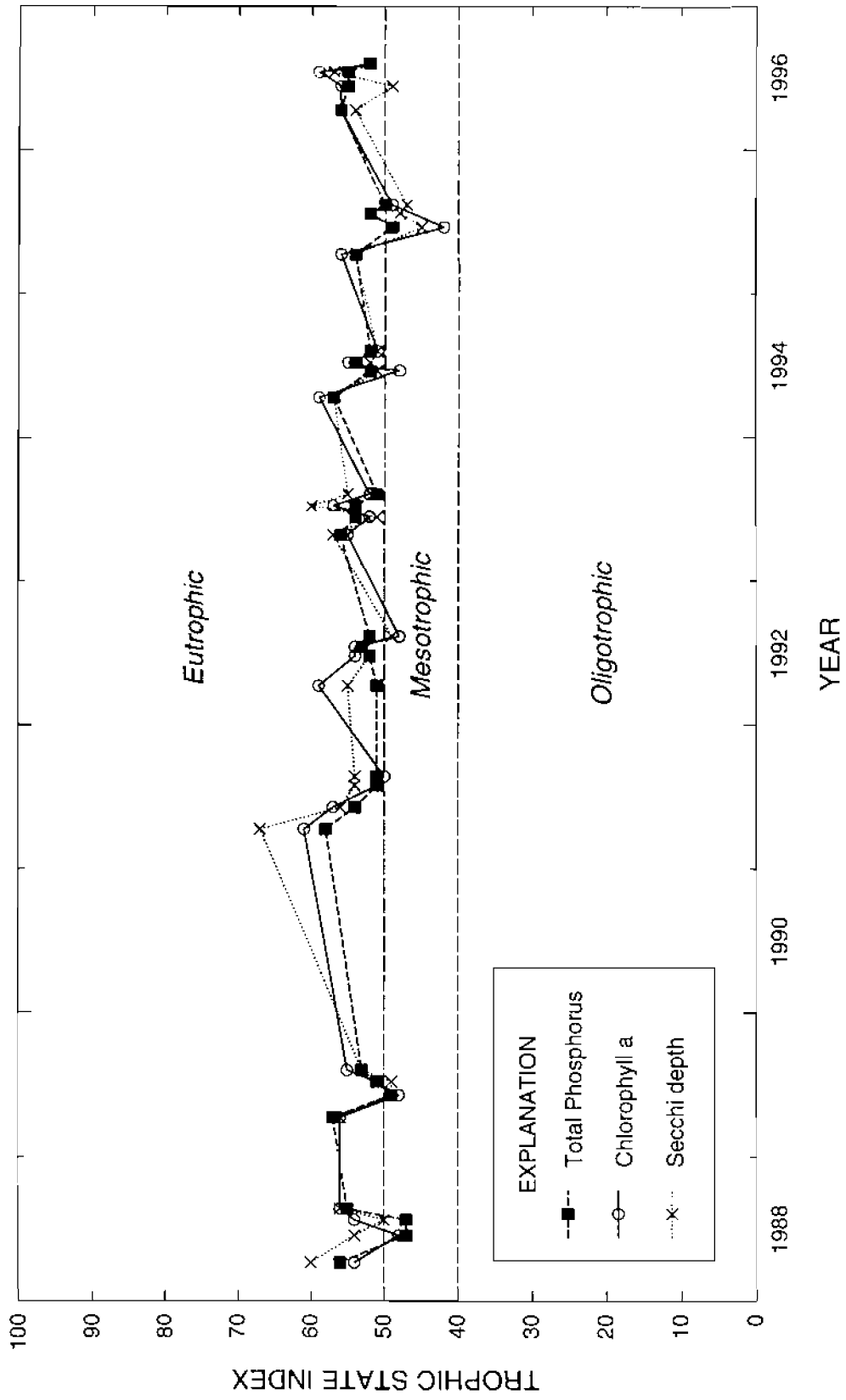


Figure 4. Trophic state indices for Long Lake at Wind Lake, Wisconsin