final report for CPG-5006-1

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Water Resources Division
6417 Normandy Lane
Madison, Wisconsin 53719-1133
608 274-3535 (Fax 608 276-3817)

July 13, 1995

Mr. Ted Ritter
Little St. Germain Protection and
Rehabilitation District
1624 Shields Road
St. Germain, Wisconsin 54558

Dear Mr. Ritter:

This letter describes the progress on the evaluation of the water quality of Little St. Germain Lake according to the data collected from October 1993 to September 1994 as stated in our agreement. Please read the "U.S. Geological Survey Lake Monitoring Program in Wisconsin", sent to you previously, before proceeding with this letter.

In a brief summary, based on the 1994 data:

- The water quality of Little St. Germain Lake varies considerably throughout the lake. The northeast bay is eutrophic with many nutrients and very poor to poor water quality, the south bay is meso-eutrophic with moderate to many nutrients and good to fair water quality, and the west bay is mesotrophic with moderate nutrients and very good to good water quality.

- The water-quality data in 1994 is very similar to data from 1991 through 1993. No trends are apparent.

- In the south and west bays, algal growth appears to be dependent upon the amount of available phosphorus rather than nitrogen.

- In the south bay during the February sampling, oxygen concentrations were near zero.

- In June, July, and August, during summer stratification, oxygen disappeared from the bottom portion of the lake in the west bay and, in June, in the south bay which was then unable to support a fish population.

- During the summer anoxic (devoid of oxygen) period, there are large amounts of phosphorus being released from the bottom sediments in the west bay and moderate amounts in the south bay.

- The data enclosed herein are provisional until published.

Little St. Germain Lake has a surface area of 980 acres (1.53 square miles) and a drainage area at the outlet of 19 square miles for a drainage area/lake size ratio of 12:1. Lakes with drainage area/lake size ratios of greater than 10:1 tend to develop water-quality problems. (Uttormark, Paul D., and Mark L. Hutchins, 1978, Input/output models as decision criteria for lake restoration. University of Wisconsin-Madison, Wisconsin, Water Resources Center technical report No. 78-03, 61 pp.).

Three sites were sampled in Little St. Germain Lake. The northeast bay site is located at a depth of about 12 feet, the south bay site is located at a depth of about 21 feet, and the west bay site is located approximately at the deepest spot in the lake at a depth of about 53 feet. All sites are shown in figure 1.

The data for this report are found in the following tables and figures:

Table 1. Lake stages for Little St. Germain Lake, 1994 water year

Table 2a. Lake-depth profiles for Little St. Germain Lake, south bay, near St. Germain, Wisconsin, 1994 water year

Table 2b. Lake-depth profiles for Little St. Germain Lake, west bay (deep hole), at St. Germain, Wisconsin, 1994 water year

Table 3a. Water clarity and water-quality analyses and their associated Trophic State Indices (TSI) for Little St. Germain Lake, northeast bay, near St. Germain, Wisconsin, 1994 water year

Table 3b. Water clarity and water-quality analyses and their associated Trophic State Indices (TSI) for Little St. Germain Lake, south bay, near St. Germain, Wisconsin, 1994 water year

Table 3c. Water clarity and water-quality analyses and their associated Trophic State Indices (TSI) for Little St. Germain Lake, west bay, at St. Germain, Wisconsin, 1994 water year

Table 4. Water-quality data for Little St. Germain Lake, northeast bay, near St. Germain, Wisconsin, 1994 water year

Figure 1. Location of sampling sites and staff gage

Figure 2a. Water-quality data for Little St. Germain Lake, south bay, near St. Germain, Wisconsin, 1994 water year

Figure 2b. Water-quality data for Little St. Germain Lake, west bay (deep hole) at St. Germain, Wisconsin, 1994 water year

Figure 3a. Trophic state indices for Little St. Germain Lake, northeast bay, near St. Germain, Wisconsin

Figure 3b. Trophic state indices for Little St. Germain Lake, south bay, near St. Germain, Wisconsin

Figure 3c. Trophic state indices for Little St. Germain Lake, west bay, at St. Germain, Wisconsin

Figure 4a. Surface total phosphorus and chlorophyll a concentrations and Secchi-disc depths for Little St. German Lake, northeast bay, near St. Germain, Wisconsin

Figure 4b. Surface total phosphorus and chlorophyll a concentrations and Secchi-disc depths for Little St. German Lake, south bay, near St. Germain, Wisconsin

Figure 4c. Surface total phosphorus and chlorophyll a concentrations and Secchi-disc depths for Little St. German Lake, west bay, at St. Germain, Wisconsin

All the water-quality samples collected were analyzed by the Wisconsin State Laboratory of Hygiene at Madison, Wisconsin. The water-quality data are published in our annual publications, "Water Resources Data for Wisconsin, 1994" and "Water-Quality and Lake-Stage Data for Wisconsin Lakes, Water Year 1994".

LAKE-STAGE FLUCTUATIONS

Lake stages were read from a staff gage mounted on the dam wall at the lake outlet and were provided by the Wisconsin Valley Improvement Company. Lake-stage data are listed in table 1. Lake stages fluctuated 1.76 feet and ranged from 12.08 feet on January 22 to 13.84 feet on September 15.

LAKE-DEPTH PROFILES

Profiles of water temperature, dissolved oxygen, pH, and specific conductance at the south bay and the west bay (deep hole) are listed in tables 2a and 2b and shown in figures 2a and 2b. In the south bay, the oxygen concentrations during the February sampling were less than 2.8 mg/L in the entire water column. No other abnormalities in the data are apparent. Among our sampling dates, complete water-column mixing was observed on May 3 in the south bay and almost complete mixing was observed on the same date in the west bay (deep hole). The remainder of the profile data show incomplete mixing. The lake thermally stratifies during summer. During June, July, and August, in the west bay (deep hole), depths greater than 40 feet became anoxic (devoid of oxygen) and were then unable to support a fish population. In June, in the south bay, the lake-bottom 2.5 feet also became anoxic. The levels of pH are within acceptable levels to support aquatic life. Because of the buffering capacity of the lake water, Little St. Germain Lake is not susceptible to the effects of acid rain.

SELECTED ANALYSES

Analyses of selected constituents for May 3 for samples collected at 1.5- and 19-foot depths in the south bay, and 1.5- and 52-foot depths for the west bay are listed in figures 2a and 2b. The water-quality values for both sites for color, chlorophyll a, chlorides, 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.

To compute the nitrogen-phosphorus ratio, only the sample collected from the 1.5-foot sampling depth for May was used. This depth was used because algae grow in the upper part of the lake rather than at the bottom. The ratio of total nitrogen to phosphorus was calculated as 16:1 for the south bay and 21:1 for the west bay, which suggests the lake is phosphorus-limited and is consistent with previous data. This means algal growth appears to be dependent on the amount of available phosphorus rather than nitrogen.

MAY, JUNE, JULY AND AUGUST WATER QUALITY

The data for total phosphorus, chlorophyll a, and Secchi-depth readings, are listed in tables 3a, 3b, 3c, and 4 and on figures 2a and 2b.

Little St. Germain Lake, northeast bay

Total phosphorus: Total phosphorus concentrations sampled at a 1.5-foot depth range from 0.032 mg/L in June to 0.058 mg/L in August. All values fall within the regional values previously referenced.

Chlorophyll a: Chlorophyll a concentrations, which indicate algal biomass, ranged from 10.6 µg/L in May to 59.3 µg/L in July. Three of the values are within the regional values, and the July value is greater than the regional values. The July value indicates a dense algal bloom on that date.

Secchi disc: Secchi-disc depths, which indicate water clarity, ranged from 2.6 feet in July to 5.2 feet in May. These data are within the regional values.

Little St. Germain Lake, south bay

Total phosphorus: Total phosphorus concentrations sampled at a 1.5-foot depth range from 0.018 mg/L in June to 0.027 mg/L in August. All values fall within the regional values previously referenced.

Concentration of total phosphorus 1.5 feet above the lake bottom ranged from 0.023 mg/L in June to 0.129 mg/L in July. These concentrations are indicate of moderate phosphorus release from the bottom sediments during anoxic periods.

Chlorophyll a: Chlorophyll a concentrations, which indicate algal biomass, ranged from 5.62 µg/L in August to 12.9 µg/L in July. These data are within the regional values.

Secchi disc: Secchi-disc depths, which indicate water clarity, ranged from 5.2 feet in May to 7.2 feet in June. These data are within the regional values.

Little St. Germain Lake, west bay

Total phosphorus: Total phosphorus concentrations sampled at a 1.5-foot depth range from 0.007 mg/L in June to 0.016 mg/L in May. All values fall within the regional values previously referenced.

Concentration of total phosphorus 1.5 feet above the lake bottom ranged from 0.015 mg/L in May to 0.556 mg/L in August. These concentrations are indicative of large phosphorus release from the bottom sediments during anoxic (absence of oxygen) periods.

Chlorophyll a: Chlorophyll a concentrations, which indicate algal biomass, ranged from 0.71 µg/L in August to 10.3 µg/L in May. Three of the values are within the regional values, and the August value is less than the regional values.

Secchi disc: Secchi-disc depths, which indicate water clarity, ranged from 7.2 feet in May to 11.5 feet in June. These data are within the regional values.

TROPHIC STATUS

Lillie and Mason (1983) classified Wisconsin lakes using a random data set (summer, July and August) according to total phosphorus and chlorophyll a concentrations, and Secchi-disc depth. This evaluation is shown below:

Water quality index	Approximate total phosphorus equivalent (mg/L)	Approximate chlorophyll a equivalent (µg/L)	Approximate water clarity equivalent (Secchi-disc depth in ft)
Excellent	<0.001	<1	<19.7
Very good	.001-.010	1-5	9.8-19.7
Good	.010-.030	5-10	6.6-9.8
Fair	.030-.050	10-15	4.9-6.6
Poor	.050-.150	15-30	3.3-4.9
Very poor	>.150	>30	<3.3

Using the above criteria to evaluate the mean summer (July-August) 1994 data shown in table 3a for the northeast bay, chlorophyll a concentrations and Secchi-disc depths indicate very poor water quality, while surface total phosphorus concentrations indicate poor water quality. For the south bay (shown in table 3b), surface total phosphorus and chlorophyll a concentrations indicate good water quality, while Secchi-disc depths indicate fair water quality. For the west bay (shown in table 3c), chlorophyll a concentrations and Secchi-disc depths indicate very good water quality, while surface total phosphorus concentrations indicate good water quality.

Using the data from "Limnological Characteristics of Wisconsin Lakes," 1983, by Lillie and Mason, a comparison of the 1994 mean summer data (July and August) for total phosphorus, chlorophyll a, and Secchi depths for all three sites of Little St. Germain Lake to other lakes in northeast Wisconsin are shown below:

Parameter		Percentage of distribution of lakes in northeast Wisconsin within these concentrations	
Total phosphorus (mg/L)			
	<.010	Best condition	22
	.010-.020	↓	41
	.020-.030		21
Little St. Germain Lake values →	.030-.050		12
	>.050	Worst condition	5
Chlorophyll a (µg/L)			
	0- 5	Best condition	34
	5-10	↓	38
	10-15		11
Little St. Germain Lake values →	15-30		11
	>30	Worst condition	5
Secchi depth (in feet)			
	>19.7	Best condition	4
	9.8-19.7	↓	32
Little St. Germain Lake values →	6.6- 9.8		22
	3.3- 6.6		26
	<3.3	Worst condition	16

Comparing other lakes in northeast Wisconsin to the 1994 data for Little St. Germain Lake, the above data show, during the period 1966 to 1979, 84 percent had lower total phosphorous concentrations, 83 percent had lower chlorophyll a concentrations, and 36 percent had better water clarity.

A second approach to assessing the "health" or trophic status of a lake is to use Carlson's Trophic State Index (TSI). Graphic illustrations of the Trophic State Index for Little St. Germain Lake are shown on figures 3a, 3b, and 3c. The data from 1994 show the northeast bay to be eutrophic or one with many nutrients; the south bay ranks as meso-eutrophic with moderate to many nutrients; and the west bay ranks as mesotrophic or one with moderate nutrients.

Surface total phosphorus and chlorophyll a concentrations and Secchi-disc depths for all three bays of Little St. Germain Lake since 1991 are shown in figures 4a, 4b, and 4c. The water quality in 1994 is very similar to the previous years. No trends are apparent.

The data that has been collected for Little St. Germain Lake from 1991-1994 is extremely important for understanding the lake's water quality and managing the lake. To continue with the monitoring as in the past will help to build on this very valuable data base.

If you have any questions regarding this evaluation, please contact me at 608/276-3842.

Sincerely,

Stephen J. Field
Biologist

Enclosures

cc: Bob Young, DNR, Rhinelander

Table 1. Lake stages for Little St. Germain Lake, 1994 water year

05390700 LITTLE ST. GERMAIN LAKE NEAR EAGLE RIVER, WI

LOCATION (REVISED).--Lat 45°53'55", long 89°27'10", in SW 1/4 SE 1/4 sec.35, T.40 N., R.8 E., Vilas County, Hydrologic Unit 07070001, 9.6 mi west of Eagle River.

DRAINAGE AREA.--19.0 mi^2.

PERIOD OF RECORD.--October 1990 to current year.

GAGE.--Staff gage mounted on the dam wall at lake outlet. Datum of gage is 1,600 ft, above sea level.

REMARKS.--Lake level controlled at the dam outlet.

COOPERATION.--Gage readings furnished by Wisconsin Valley Improvement Company.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height observed, 13.90 ft, Sept. 14, 1993; minimum observed, 12.00 ft, Jan. 3 and Feb. 3, 1992.

EXTREMES FOR CURRENT YEAR.--Maximum gage height observed, 13.84 ft, Sept. 15; minimum observed, 12.08 ft, Jan. 22.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 1993 TO SEPTEMBER 1994
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	13.72	13.38	13.08	12.58	12.42	12.28	12.60	13.14	13.32	13.48	13.70	13.60
2	13.74	13.32	---	---	---	---	12.62	13.16	13.36	13.46	13.68	13.58
3	13.72	---	---	---	12.42	---	12.62	13.14	13.36	13.46	13.66	13.58
4	13.76	---	13.04	12.50	12.40	12.26	12.62	13.14	13.34	13.44	13.66	13.56
5	13.76	13.24	---	---	---	---	12.64	13.20	13.34	13.48	13.66	13.56
6	13.72	---	---	---	---	---	12.64	13.22	13.36	13.60	13.64	13.58
7	13.72	---	13.00	12.40	---	---	12.66	13.20	13.38	13.60	13.64	13.58
8	13.74	---	---	---	12.38	12.22	12.66	13.20	13.38	13.60	13.68	13.56
9	13.80	13.36	---	---	---	12.26	12.70	13.22	13.38	13.72	13.68	13.54
10	13.76	---	12.92	---	---	12.28	12.70	13.20	13.36	13.72	13.66	13.52
11	13.74	---	---	12.32	12.40	12.28	12.70	13.20	13.38	13.72	13.64	13.52
12	13.72	13.32	---	---	---	12.30	12.72	13.22	13.40	13.74	13.62	13.52
13	13.70	---	---	---	---	12.30	12.78	13.22	13.48	13.74	13.60	13.58
14	13.70	---	12.86	12.28	---	12.32	12.76	13.22	13.50	13.74	13.60	13.70
15	13.70	---	---	---	12.36	12.34	12.82	13.28	13.50	13.72	13.60	13.84
16	13.78	13.40	---	---	---	12.36	12.90	13.28	13.48	13.72	13.58	13.82
17	13.76	---	12.80	---	---	12.36	12.92	13.28	13.48	13.76	13.58	13.78
18	13.76	---	---	12.20	12.30	12.38	12.92	13.26	13.56	13.74	13.60	13.74
19	13.76	13.32	---	---	---	12.38	12.90	13.26	13.54	13.76	13.60	13.74
20	13.72	---	---	---	---	12.38	12.92	13.26	13.54	13.82	13.62	13.74
21	13.72	---	12.74	12.10	---	12.40	12.92	13.26	13.54	13.76	13.60	13.76
22	13.70	---	---	12.08	12.32	12.40	12.94	13.26	13.52	13.74	13.60	13.80
23	13.68	13.26	---	---	12.34	12.42	12.96	13.26	13.52	13.72	13.58	13.80
24	13.62	---	12.68	---	---	12.48	12.96	13.26	13.52	13.70	13.58	13.78
25	13.60	---	---	12.30	12.30	12.48	13.00	13.26	13.52	13.70	13.58	13.74
26	13.56	13.20	---	---	---	12.48	13.02	13.18	13.52	13.70	13.58	13.76
27	13.54	---	---	---	---	12.50	13.10	13.26	13.50	13.70	13.58	13.70
28	13.48	---	12.62	12.40	---	12.50	13.12	13.26	13.48	13.70	13.58	13.72
29	13.46	---	---	---	---	12.58	13.14	13.24	13.52	13.68	13.58	13.72
30	13.40	13.10	---	---	---	12.58	13.14	13.30	13.50	13.68	13.60	13.72
31	13.38	---	12.58	---	---	12.60	---	13.34	---	13.68	13.62	---
MEAN	13.67	---	---	---	---	---	12.84	13.23	13.45	13.67	13.62	13.67
MAX	13.80	---	---	---	---	---	13.14	13.34	13.56	13.82	13.70	13.84
MIN	13.38	---	---	---	---	---	12.60	13.14	13.32	13.44	13.58	13.52

Table 2a. Lake-depth profiles for Little St. Germain Lake, south bay, near St. Germain, Wisconsin, 1994 water year

455437089270800 - LITTLE ST. GERMAIN L S. BAY NEAR ST. GERMAIN, W

WATER-QUALITY DATA

DATE	SAMPLING DEPTH (FEET) (00003)	TEMPERATURE WATER (DEG C) (00010)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STANDARD UNITS) (00400)	OXYGEN, DISSOLVED (MG/L) (00300)
FEB 1994					
23...	3.00	1.5	100	7.6	2.8
23...	5.00	3.0	98	7.5	0.7
23...	7.00	3.0	98	7.4	0.7
23...	9.00	3.0	99	7.4	0.5
23...	11.0	3.5	98	7.3	0.4
23...	13.0	3.5	98	7.3	0.3
23...	15.0	3.5	98	7.2	0.3
23...	17.0	4.0	103	7.2	0.2
23...	19.0	4.0	111	7.2	0.2
23...	20.5	4.5	137	7.2	0.2
23...	20.5	--	--	--	--
MAY					
03...	1.50	8.5	75	7.7	11.7
03...	3.00	8.5	75	7.7	11.7
03...	5.00	8.5	74	7.7	11.7
03...	7.00	8.5	73	7.7	11.7
03...	9.00	8.5	73	7.7	11.7
03...	11.0	8.5	73	7.7	11.7
03...	13.0	8.5	72	7.7	11.7
03...	15.0	8.5	72	7.7	11.7
03...	17.0	8.5	71	7.7	11.7
03...	19.5	8.5	71	7.7	11.6
03...	21.0	--	--	--	--
JUN					
16...	1.50	23.5	67	8.2	8.3
16...	3.00	23.5	66	8.2	8.4
16...	5.00	23.0	65	8.2	8.4
16...	7.00	23.0	65	8.2	8.5
16...	9.00	23.0	65	8.2	8.6
16...	11.0	23.0	65	8.0	8.4
16...	13.0	21.0	65	7.6	7.7
16...	15.0	21.0	65	7.6	7.2
16...	17.0	16.5	69	7.0	5.3
16...	18.5	15.5	69	7.0	4.7
16...	21.0	--	--	--	--
JUL					
19...	1.50	22.5	72	8.0	9.3
19...	3.00	22.5	71	8.0	9.3
19...	5.00	22.5	71	8.0	9.3
19...	7.00	22.5	70	8.1	9.3
19...	9.00	22.5	71	8.0	9.3
19...	11.0	22.5	71	8.0	9.1
19...	13.0	21.5	71	7.6	8.2
19...	15.0	21.0	71	6.9	5.2
19...	17.0	20.5	72	6.7	4.2
19...	19.0	18.5	91	6.8	0.4
19...	20.0	16.5	122	6.9	0.2
19...	21.5	--	--	--	--
AUG					
17...	1.50	21.5	73	7.8	9.1
17...	3.00	21.0	73	7.8	9.1
17...	5.00	21.0	73	7.8	9.1
17...	7.00	20.5	73	7.8	9.1
17...	9.00	20.0	73	7.6	8.4
17...	11.0	19.5	73	7.4	8.2
17...	13.0	19.5	73	7.2	6.8
17...	15.0	19.0	73	7.0	6.2
17...	17.0	18.5	74	6.9	5.1
17...	19.5	18.5	74	6.8	3.3
17...	21.0	--	--	--	--

Table 2b. Lake-depth profiles for Little St. Germain Lake, west bay (deep hole), at St. Germain, Wisconsin, 1994 water year

455428089282400 - LITTLE ST. GERMAIN LK WEST BAY @ ST. GERMAIN, W

WATER-QUALITY DATA

DATE	SAMPLING DEPTH (FEET) (00003)	TEMPERATURE WATER (DEG C) (00010)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STANDARD UNITS) (00400)	OXYGEN, DISSOLVED (MG/L) (00300)
FEB 1994					
23...	3.00	1.0	85	7.1	12.0
23...	6.00	2.0	83	7.0	11.5
23...	10.0	2.0	80	7.0	10.9
23...	14.0	2.0	80	7.0	10.7
23...	18.0	2.5	78	7.0	9.2
23...	22.0	2.5	80	7.0	8.3
23...	26.0	2.5	80	7.0	6.9
23...	30.0	2.5	83	6.9	3.7
23...	34.0	2.5	84	6.9	1.5
23...	38.0	3.0	85	6.8	0.9
23...	42.0	3.0	88	6.8	0.8
23...	46.0	3.0	96	6.8	0.6
23...	47.0	--	--	--	--
MAY					
03...	1.50	7.0	68	6.8	11.2
03...	3.00	7.0	68	6.9	11.2
03...	8.00	7.0	67	7.0	11.1
03...	13.0	7.0	66	7.1	11.1
03...	18.0	7.0	66	7.1	10.9
03...	23.0	6.5	66	7.1	10.8
03...	28.0	6.5	65	7.2	10.8
03...	33.0	6.5	65	7.2	10.7
03...	38.0	6.5	64	7.2	10.5
03...	43.0	6.0	64	7.2	10.1
03...	48.0	6.0	64	7.1	9.9
03...	52.5	5.5	65	7.1	9.7
03...	54.0	--	--	--	--
JUN					
16...	1.50	22.5	68	7.8	8.7
16...	5.00	22.5	67	7.8	8.7
16...	10.0	21.0	66	7.9	8.9
16...	15.0	20.0	66	8.0	9.3
16...	20.0	14.5	66	8.4	12.0
16...	25.0	11.0	65	7.8	11.2
16...	30.0	9.0	64	7.2	4.4
16...	35.0	8.5	65	6.9	1.4
16...	40.0	8.0	66	6.8	0.3
16...	45.0	8.0	66	6.7	0.2
16...	50.0	8.0	70	6.8	0.2
16...	52.0	7.5	72	6.8	0.2
16...	53.5	--	--	--	--
JUL					
19...	1.50	22.0	76	7.5	8.8
19...	5.00	22.0	75	7.6	8.8
19...	10.0	22.0	73	7.6	8.8
19...	15.0	21.5	74	7.6	8.7
19...	20.0	17.5	75	7.4	10.2
19...	25.0	12.0	75	7.1	8.2
19...	30.0	10.0	75	6.8	2.0
19...	35.0	8.5	84	6.8	0.3
19...	40.0	8.0	89	6.9	0.2
19...	45.0	8.0	97	6.9	0.2
19...	50.0	8.0	98	7.0	0.2
19...	53.5	8.0	102	7.1	0.2
19...	55.0	--	--	--	--
AUG					
17...	1.50	21.0	78	7.6	9.1
17...	5.00	20.5	77	7.6	9.1
17...	10.0	20.0	77	7.6	9.1
17...	15.0	20.0	76	7.7	9.0
17...	20.0	19.0	76	7.4	8.6
17...	25.0	13.0	79	7.0	3.5
17...	30.0	11.0	78	6.8	1.0
17...	35.0	9.0	88	6.8	0.2
17...	40.0	8.0	104	6.9	0.2
17...	45.0	8.0	108	7.0	0.2
17...	50.0	8.0	113	7.0	0.2
17...	52.5	8.0	114	7.1	0.2
17...	54.0	--	--	--	--

Table 3a.--Water clarity and water-quality analyses and their associated Trophic State Indices (TSI) for Little St. Germain Lake, northeast bay, near St. Germain, Wisconsin, 1994 water year
[- indicates not applicable; -- indicates no data available]

Date	Secchi Disk			Sampling	Total Phosphorus			Chlorophyll a		Dissolved Ortho-phosphate Phosphorus
	Depth (meters)	Depth (feet)	T.S.I.	Depth (feet)	Conc. (mg/L)	Conc. (µg/L)	T.S.I	Conc. (µg/L)	T.S.I.	Conc. (mg/L)
05/03/94	1.6	5.2	53	1.5	0.033	33	55	10.6	53	--
	-	-	-				-	-	-	--
06/16/94	1.3	4.3	56	1.5	0.032	32	55	19.2	57	--
	-	-	-				-	-	-	--
07/19/94	0.8	2.6	63	1.5	0.056	56	59	59.3	66	--
	-	-	-				-	-	-	--
08/17/94	0.9	3.0	62	1.5	0.058	58	60	27.5	60	--
	-	-	-				-	-	-	--

Table 3b.--Water clarity and water-quality analyses and their associated Trophic State Indices (TSI) for Little St. Germain Lake, south bay, near St. Germain, Wisconsin, 1994 water year
[- indicates not applicable; -- indicates no data available]

Date	Secchi Disk			Sampling	Total Phosphorus			Chlorophyll a		Dissolved Ortho-phosphate Phosphorus
	Depth (meters)	Depth (feet)	T.S.I.	Depth (feet)	Conc. (mg/L)	Conc. (µg/L)	T.S.I	Conc. (µg/L)	T.S.I.	Conc. (mg/L)
05/03/94	1.6	5.2	53	1.5	0.025	25	53	9.59	52	0.002
	-	-	-	19	0.025	25	-	-	-	<0.002
06/16/94	2.2	7.2	49	1.5	0.018	18	51	9.51	52	--
	-	-	-	18	0.023	23	-	-	-	--
07/19/94	2.1	6.9	49	1.5	0.025	25	53	12.9	54	--
	-	-	-	20	0.129	129	-	-	-	--
08/17/94	1.8	5.9	52	1.5	0.027	27	54	5.62	48	--
	-	-	-	19	0.029	29	-	-	-	--

Table 3c.--Water clarity and water-quality analyses and their associated Trophic State Indices (TSI) for Little St. Germain Lake, west bay, near St. Germain, Wisconsin, 1994 water year
[- indicates not applicable; -- indicates no data available]

Date	Secchi Disk			Sampling	Total Phosphorus			Chlorophyll a		Dissolved Ortho-phosphate Phosphorus
	Depth (meters)	Depth (feet)	T.S.I.	Depth (feet)	Conc. (mg/L)	Conc. (µg/L)	T.S.I	Conc. (µg/L)	T.S.I.	Conc. (mg/L)
05/03/94	2.2	7.2	49	1.5	0.016	16	50	10.3	52	<0.002
	-	-	-	52	0.015	15	-	-	-	<0.002
06/16/94	3.5	11.5	42	1.5	0.007	7	43	2.16	41	--
	-	-	-	52	0.030	30	-	-	-	--
07/19/94	3.4	11.2	42	1.5	0.010	10	46	3.37	44	--
	-	-	-	53	0.190	190	-	-	-	--
08/17/94	3.2	10.5	43	1.5	0.012	12	47	0.71	32	--
	-	-	-	52	0.556	556	-	-	-	--

Table 4. Water-quality data for Little St. Germain Lake, northeast bay, near St. Germain, Wisconsin, 1994 water year

455545089262500 LITTLE ST. GERMAIN LAKE, NORTHEAST BAY, NEAR ST. GERMAIN, WI

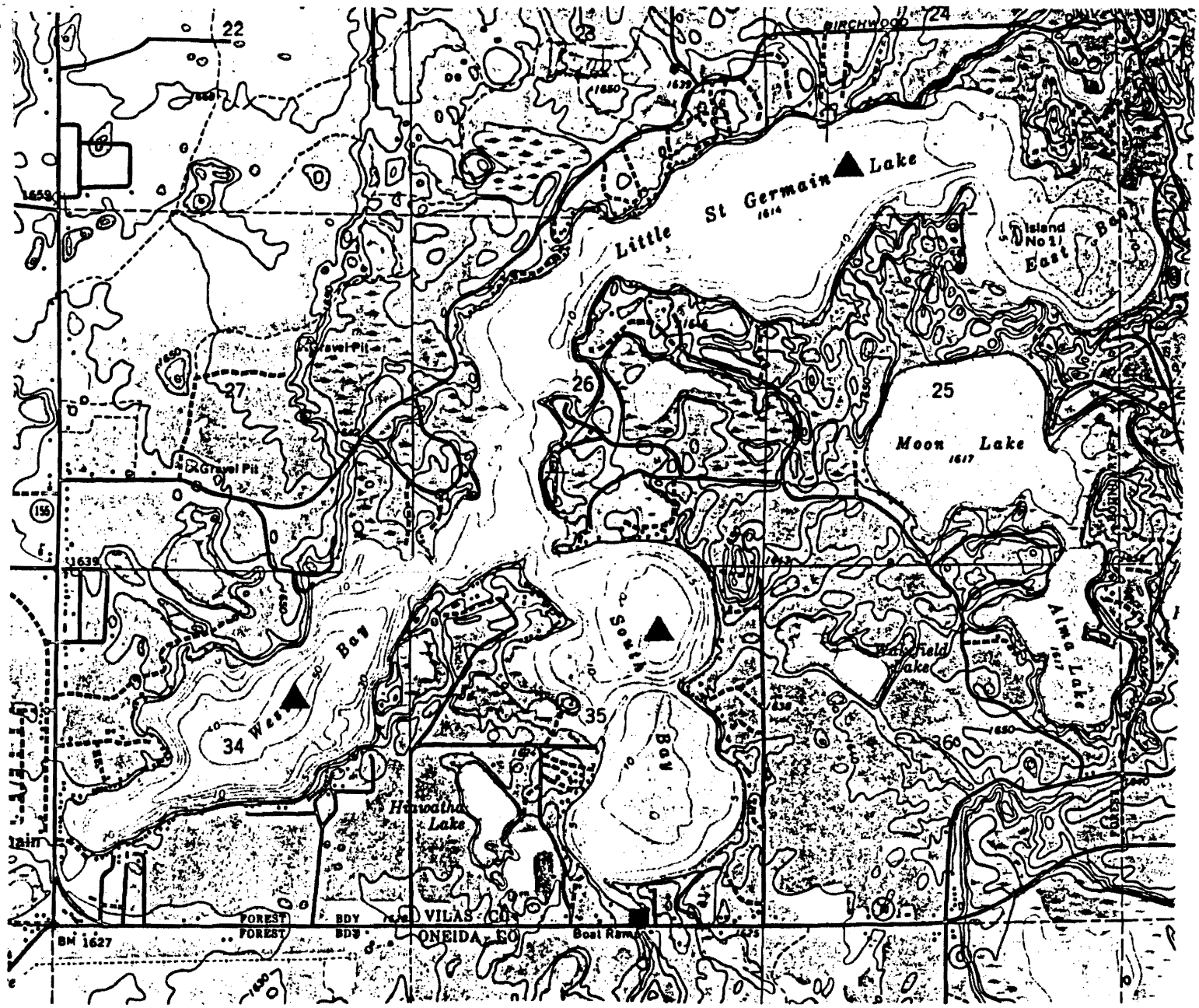
LOCATION.--Lat 45°55'45", long 89°26'25", in SW 1/4 SE 1/4 sec.24, T.40 N., R.8 E., Vilas County, Hydrologic Unit 07070001, near St. Germain.

PERIOD OF RECORD.--April 1991 to current year.

REMARKS.--Lake sampled in northeast bay at a lake depth of about 12 ft. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MAY 03 TO AUGUST 17, 1994
(Milligrams per leter unless otherwise indicated)

	May 03	June 16	July 19	Aug. 17
Depth of sample (ft)	1.5	1.5	1.5	1.5
Lake stage (ft)	13.12	13.48	13.77	13.58
Specific conductance (µS/cm)	70	69	77	80
pH (units)	8.1	8.1	8.7	8.7
Water temperature (°C)	9.0	23.5	22.5	21.5
Secchi-depth (meters)	1.6	1.3	0.8	0.9
Dissolved oxygen	12.2	8.6	10.5	11.0
Phosphorus, total (as P)	0.033	0.032	0.056	0.058
Chlorophyll a, phytoplankton (µg/L)	11	19	59	28



EXPLANATION

▲ Water-quality sampling site

■ Lake staff gage

Figure 1.--Location of sampling sites and staff gage

455428089282400 LITTLE ST. GERMAIN LAKE, WEST BAY, AT ST. GERMAIN, WI

LOCATION.--Lat 45°54'28", long 89°28'24", in SW 1/4 NE 1/4 sec.34, T.40 N., R.8 E., Vilas County, Hydrologic Unit 07070001, at St. Germain.

PERIOD OF RECORD.--April 1991 to current year.

REMARKS.--Lake sampled in west bay at a lake depth of about 53 ft. Lake ice-covered during February sampling. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 23 TO AUGUST 17, 1994
(Milligrams per liter unless otherwise indicated)

	Feb. 23		May 03		June 16		July 19		Aug. 17	
Depth of sample (ft)	3.0	46	1.5	52	1.5	52	1.5	53	1.5	52
Lake stage (ft)	12.34		13.12		13.48		13.77		13.58	
Specific conductance (µS/cm)	85	96	68	65	68	72	76	102	78	114
pH (units)	7.1	6.8	6.8	7.1	7.8	6.8	7.5	7.1	7.6	7.1
Water temperature (°C)	1.0	3.0	7.0	5.5	22.5	7.5	22.0	8.0	21.0	8.0
Color (Pt-Co. scale)	---	---	15	15	---	---	---	---	---	---
Turbidity (NTU)	---	---	1.00	0.90	---	---	---	---	---	---
Secchi-depth (meters)	---		2.2		3.5		3.4		3.2	
Dissolved oxygen	12.0	0.6	11.2	9.7	8.7	0.2	8.8	0.2	9.1	0.2
Hardness, as CaCO3	---	---	32	32	---	---	---	---	---	---
Calcium, dissolved (Ca)	---	---	8.3	8.3	---	---	---	---	---	---
Magnesium, dissolved (Mg)	---	---	2.8	2.8	---	---	---	---	---	---
Sodium, dissolved (Na)	---	---	2.2	2.2	---	---	---	---	---	---
Potassium, dissolved (K)	---	---	0.4	0.6	---	---	---	---	---	---
Alkalinity, as CaCO3	---	---	33	35	---	---	---	---	---	---
Sulfate, dissolved (SO4)	---	---	3.0	3.0	---	---	---	---	---	---
Chloride, dissolved (Cl)	---	---	2.0	2.0	---	---	---	---	---	---
Fluoride, dissolved (F)	---	---	0.1	0.0	---	---	---	---	---	---
Silica, dissolved (SiO2)	---	---	8.7	8.8	---	---	---	---	---	---
Solids, dissolved, at 180°C	---	---	54	60	---	---	---	---	---	---
Nitrogen, NO2 + NO3, diss. (as N)	---	---	0.04	0.04	---	---	---	---	---	---
Nitrogen, ammonia, dissolved (as N)	---	---	0.03	0.04	---	---	---	---	---	---
Nitrogen, amm. + org., total (as N)	---	---	0.30	0.30	---	---	---	---	---	---
Nitrogen, total (as N)	---	---	0.34	0.34	---	---	---	---	---	---
Phosphorus, total (as P)	---	---	0.016	0.015	0.007	0.030	0.010	0.190	0.012	0.556
Phosphorus, ortho, dissolved (as P)	---	---	<0.002	<0.002	---	---	---	---	---	---
Iron, dissolved (Fe) µg/L	---	---	<50	60	---	---	---	---	---	---
Manganese, dissolved (Mn) µg/L	---	---	<40	<40	---	---	---	---	---	---
Chlorophyll a, phytoplankton (µg/L)	---	---	10	---	2.2	---	3.4	---	0.7	---

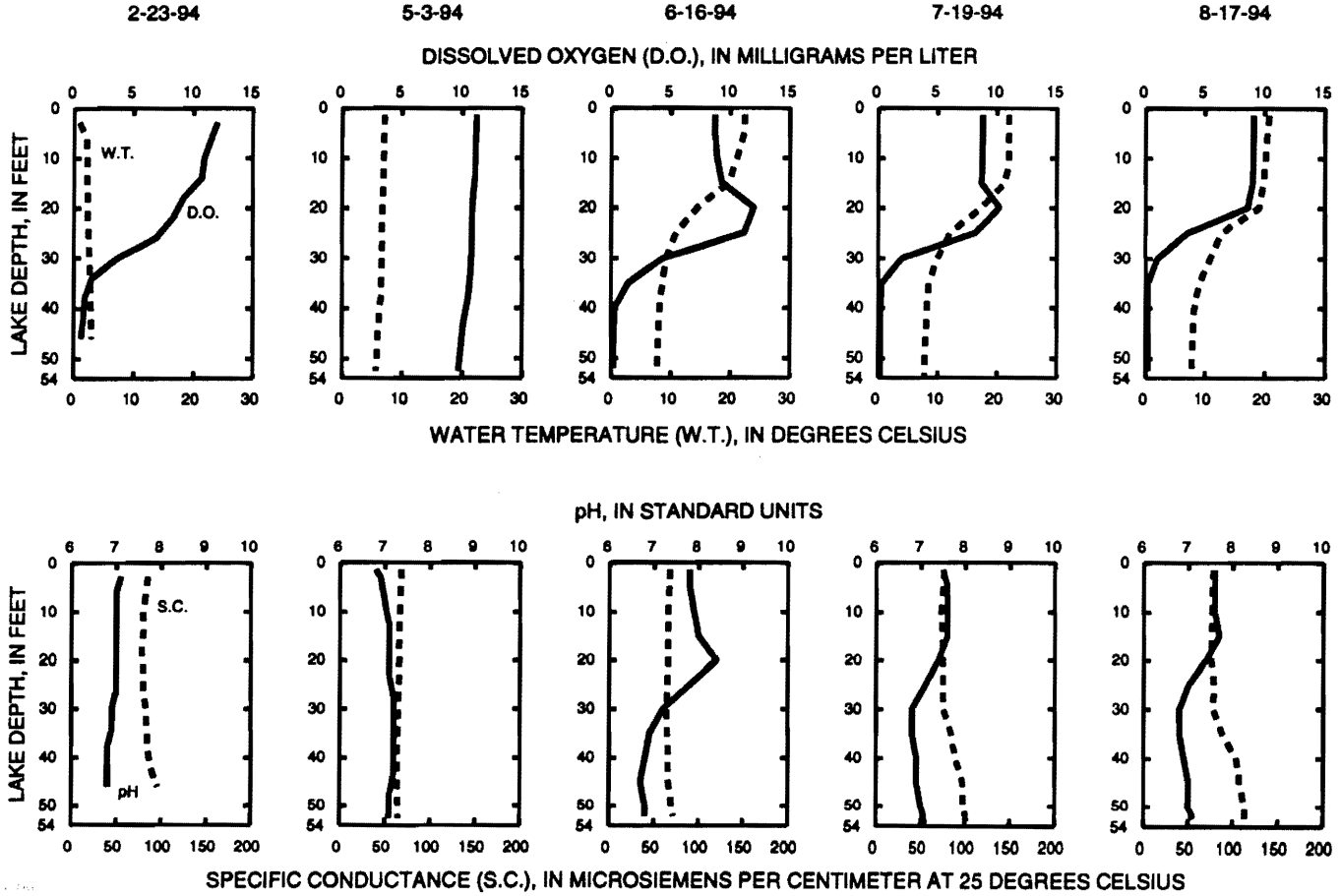


Figure 2a. Water-quality data for Little St. Germain Lake, south bay, near St. Germain, Wisconsin, 1994 water year

455437089270800 LITTLE ST. GERMAIN LAKE, SOUTH BAY, NEAR ST. GERMAIN, WI

LOCATION.--Lat 45°54'37", long 89°27'08", in NW 1/4 NE 1/4 sec.35, T.40 N., R.8 E., Vilas County, Hydrologic Unit 07070001, 1.7 mi east of St. Germain.

PERIOD OF RECORD.--April 1991 to current year.

REMARKS.--Lake sampled in south bay at a lake depth of about 22 ft. Lake ice-covered during February sampling. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 23 TO AUGUST 17, 1994
(Milligrams per liter unless otherwise indicated)

	Feb. 23		May 03		June 16		July 19		Aug. 17	
Depth of sample (ft)	3.0	21	1.5	19	1.5	18	1.5	20	1.5	19
Lake stage (ft)	12.34		13.12		13.48		13.77		13.58	
Specific conductance (µS/cm)	100	137	75	71	67	69	72	122	73	74
pH (units)	7.6	7.2	7.7	7.7	8.2	7.0	8.0	6.9	7.8	6.8
Water temperature (°C)	1.5	4.5	8.5	8.5	23.5	15.5	22.5	16.5	21.5	18.5
Color (Pt-Co. scale)	---	---	20	20	---	---	---	---	---	---
Turbidity (NTU)	---	---	2.1	2.0	---	---	---	---	---	---
Secchi-depth (meters)	---		1.6		2.2		2.1		1.8	
Dissolved oxygen	2.8	0.2	11.7	11.6	8.3	4.7	9.3	0.2	9.1	3.3
Hardness, as CaCO3	---	---	37	36	---	---	---	---	---	---
Calcium, dissolved (Ca)	---	---	9.6	9.5	---	---	---	---	---	---
Magnesium, dissolved (Mg)	---	---	3.1	3.0	---	---	---	---	---	---
Sodium, dissolved (Na)	---	---	2.0	2.0	---	---	---	---	---	---
Potassium, dissolved (K)	---	---	0.6	0.6	---	---	---	---	---	---
Alkalinity, as CaCO3	---	---	37	37	---	---	---	---	---	---
Sulfate, dissolved (SO4)	---	---	3.0	3.0	---	---	---	---	---	---
Chloride, dissolved (Cl)	---	---	1.5	1.6	---	---	---	---	---	---
Fluoride, dissolved (F)	---	---	0.0	0.0	---	---	---	---	---	---
Silica, dissolved (SiO2)	---	---	9.2	9.2	---	---	---	---	---	---
Solids, dissolved, at 180°C	---	---	54	56	---	---	---	---	---	---
Nitrogen, NO2 + NO3, diss. (as N)	---	---	<0.01	<0.01	---	---	---	---	---	---
Nitrogen, ammonia, dissolved (as N)	---	---	0.01	0.01	---	---	---	---	---	---
Nitrogen, amm. + org., total (as N)	---	---	0.40	0.40	---	---	---	---	---	---
Nitrogen, total (as N)	---	---	0.40	0.40	---	---	---	---	---	---
Phosphorus, total (as P)	---	---	0.025	0.025	0.018	0.023	0.025	0.129	0.027	0.029
Phosphorus, ortho, dissolved (as P)	---	---	0.002	<0.002	---	---	---	---	---	---
Iron, dissolved (Fe) µg/L	---	---	200	190	---	---	---	---	---	---
Manganese, dissolved (Mn) µg/L	---	---	<40	<40	---	---	---	---	---	---
Chlorophyll a, phytoplankton (µg/L)	---	---	9.6	---	9.5	---	13	---	5.6	---

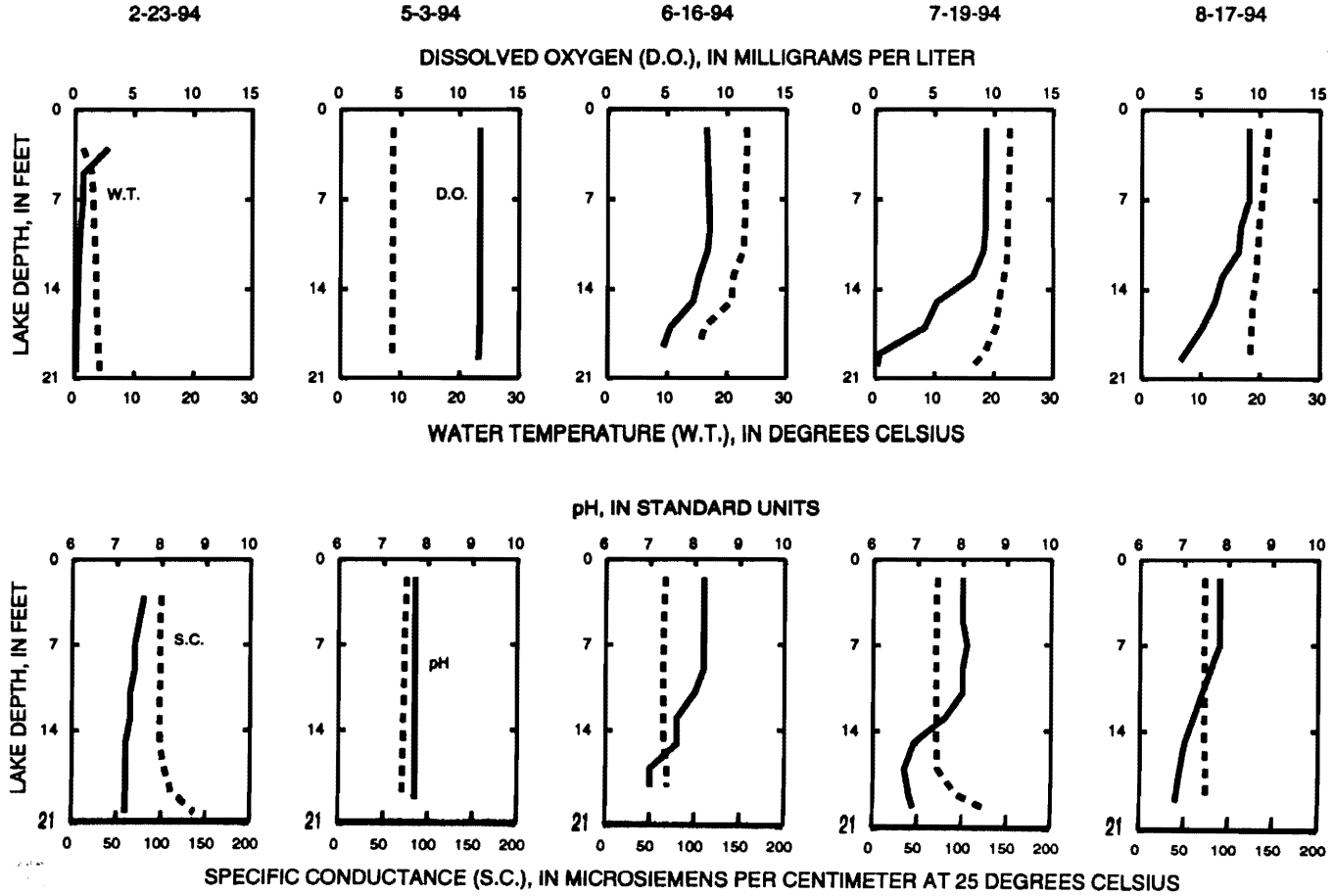


Figure 2b. Water-quality data for Little St. Germain Lake, west bay (deep hole) at St. Germain, Wisconsin, 1994 water year

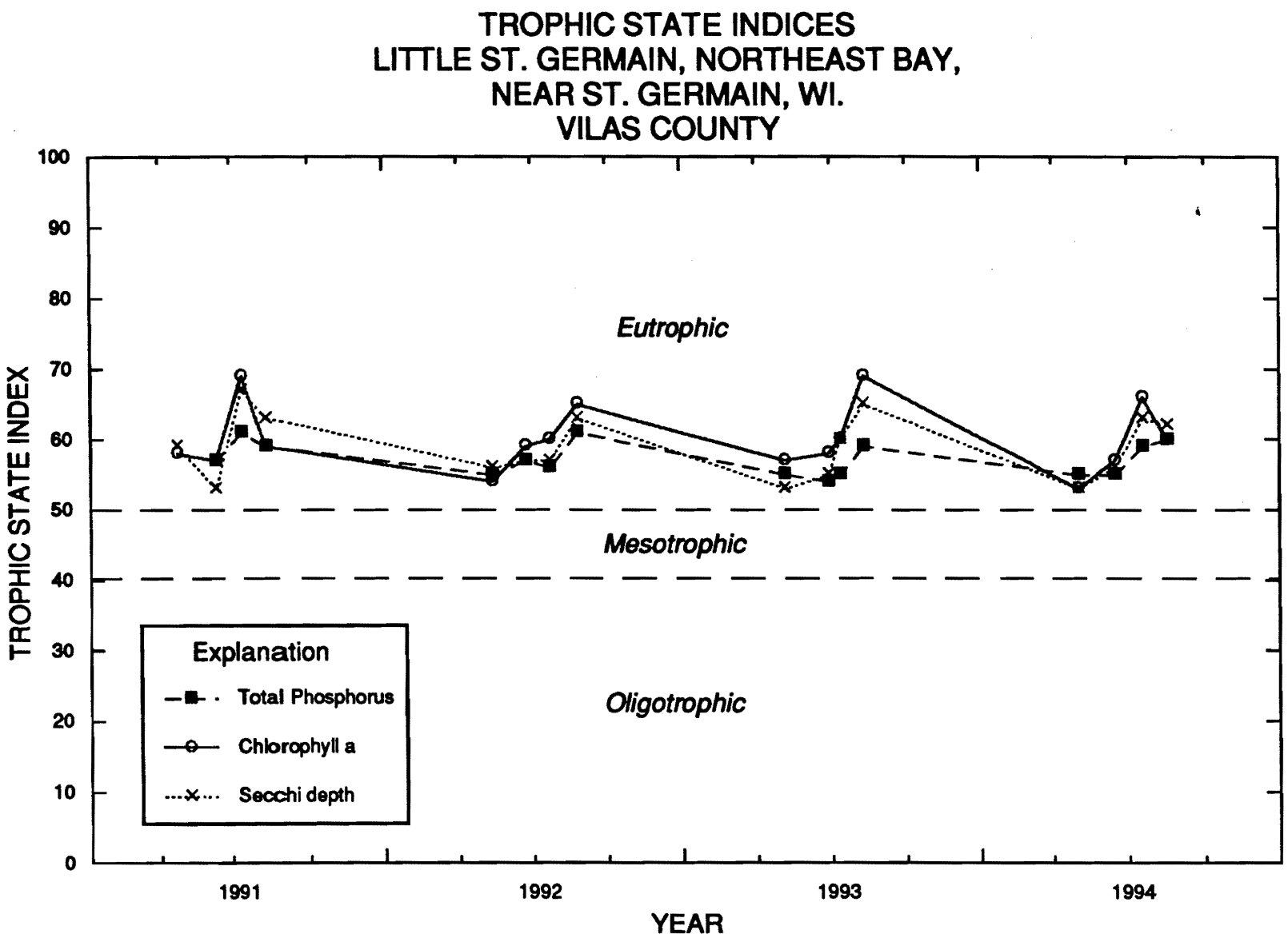


Figure 3a. Trophic state indices for Little St. Germain Lake, northeast bay, near St. Germain, Wisconsin

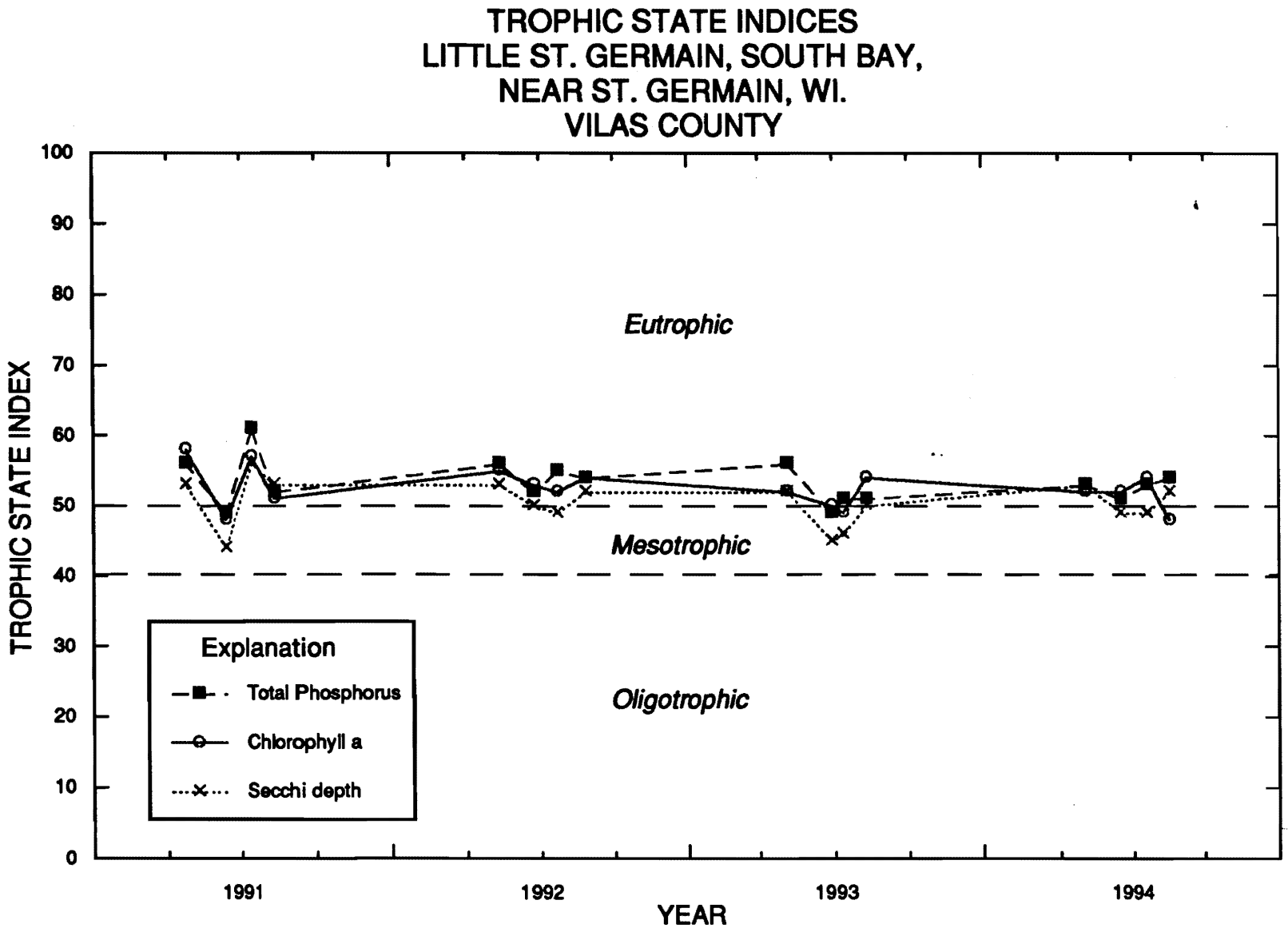


Figure 3b. Trophic state indices for Little St. Germain Lake, south bay, near St. Germain, Wisconsin

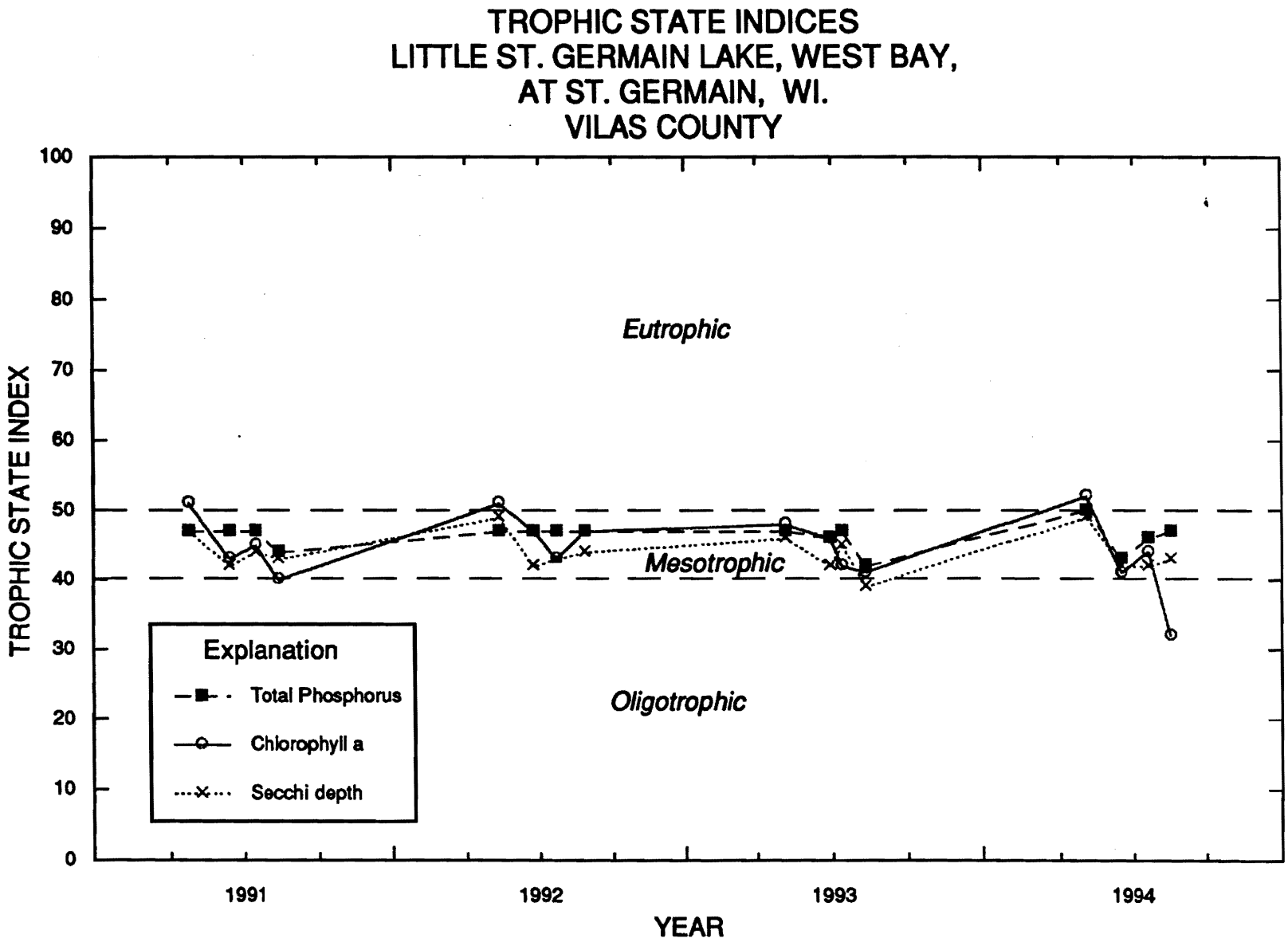


Figure 3c. Trophic state indices for Little St. Germain Lake, west bay, at St. Germain, Wisconsin

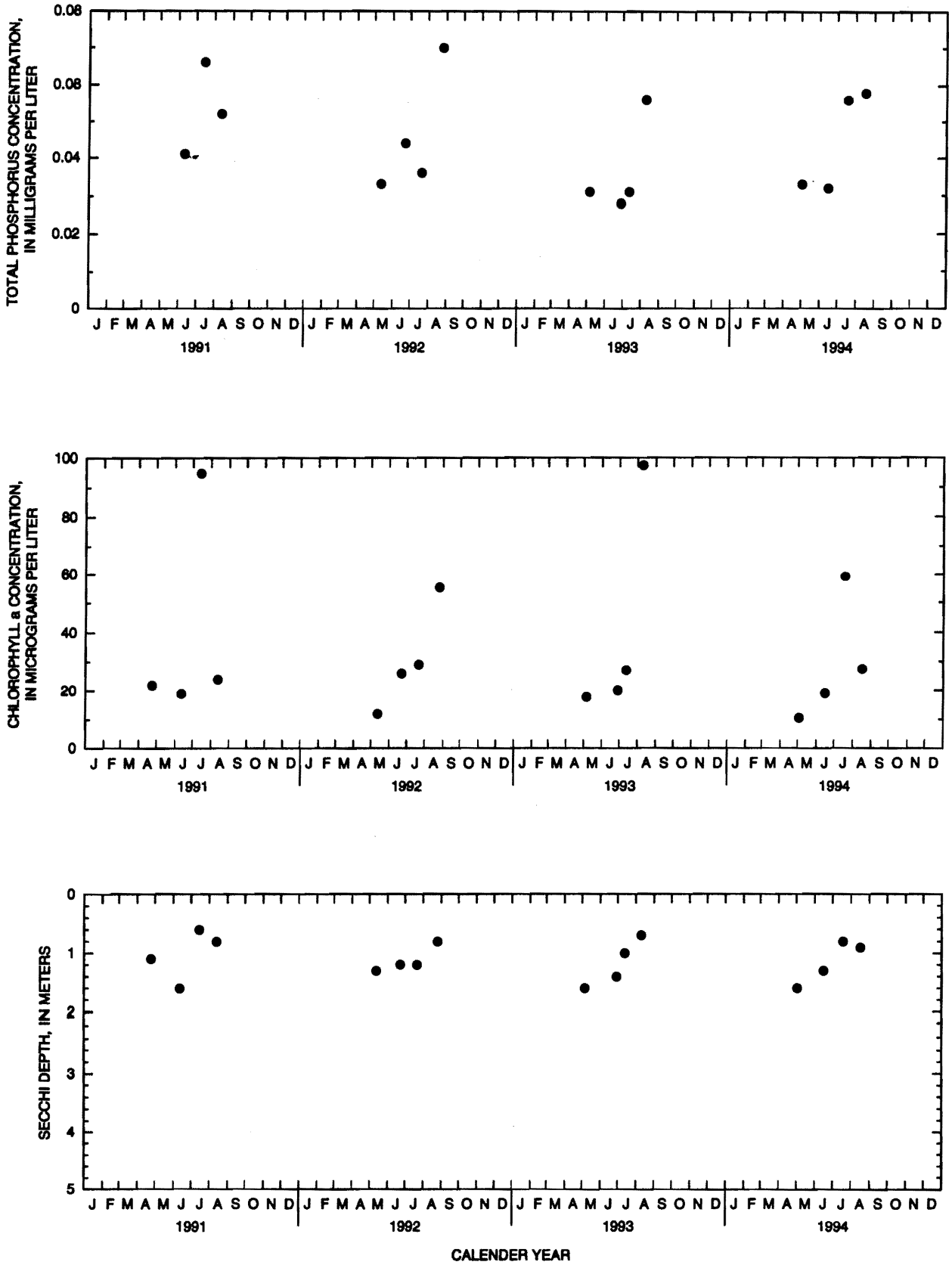


Figure 4a.-- Surface total phosphorus and chlorophyll a concentrations, and Secchi depths for Little St. Germain Lake, northeast bay, near St. Germain, Wisconsin.

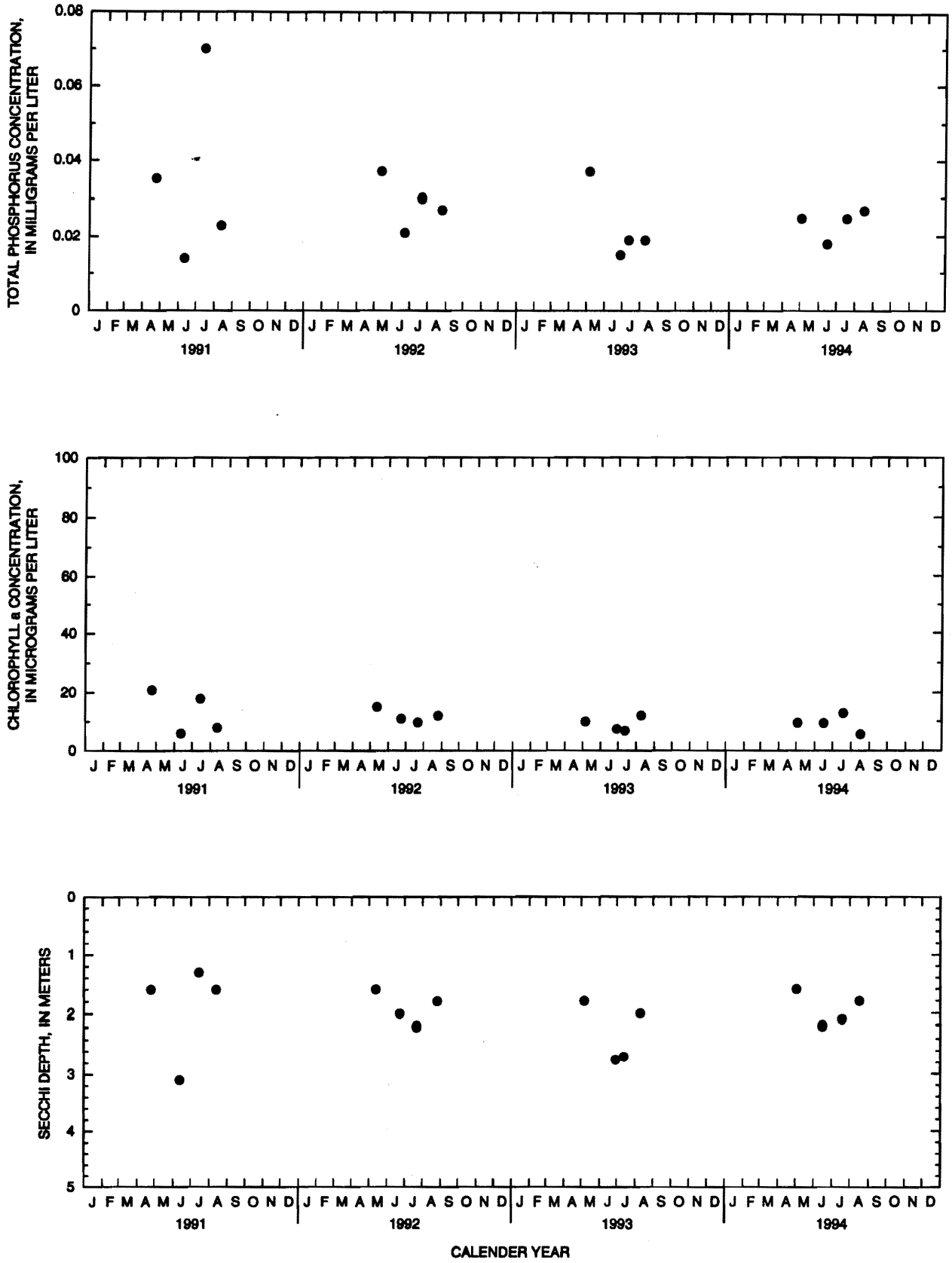


Figure 4b.-- Surface total phosphorus and chlorophyll a concentrations, and Secchi depths for Little St. Germain Lake, south bay, near St. Germain, Wisconsin.

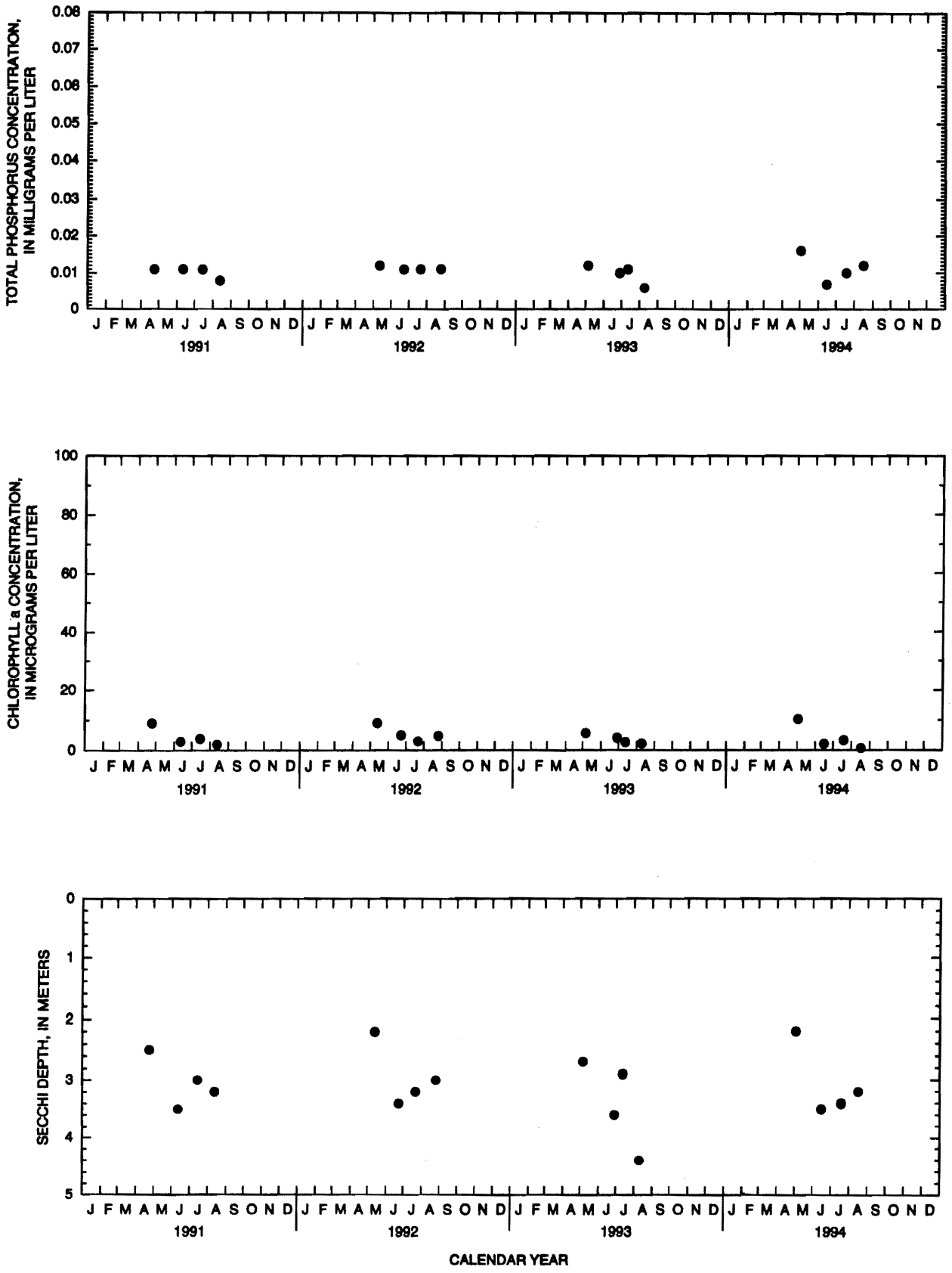


Figure 4c.-- Surface total phosphorus and chlorophyll a concentrations, and Secchi depths for Little St. Germain Lake, west bay, at St. Germain, Wisconsin.