

Water-Quality and Lake-Stage Data for Wisconsin Lakes, Water Year 2003



U.S. GEOLOGICAL SURVEY
Open-File Report 2004-1087

*Prepared in cooperation with the
State of Wisconsin and local agencies*





Water-Quality and Lake-Stage Data for Wisconsin Lakes, Water Year 2003

A report by the Wisconsin District Lake-Studies Team—
W.J. Rose (team leader), H.S. Garn, G.L. Goddard, D.L. Olson, and D.M. Robertson

Open-File Report 2004–1087



**Prepared in cooperation with the
State of Wisconsin and with other agencies**

U.S. DEPARTMENT OF THE INTERIOR
GALE A. NORTON, Secretary

U.S. GEOLOGICAL SURVEY
Charles G. Groat, Director

For additional information write to:

District Chief
U.S. Geological Survey
8505 Research Way
Middleton, WI 53562

Copies of this report can be purchased from:

U.S. Geological Survey
Earth Science Information Center
Open-File Reports Section
Box 25286, MS 517
Denver Federal Center
Denver, CO 80225

CONTENTS

Introduction	1
Methods of data collection	4
Explanation of physical and chemical characteristics of lakes	9
Water temperature and thermal stratification	9
Specific conductance	11
Water clarity	12
pH	12
Dissolved oxygen	13
Phosphorus	14
Nitrogen	14
Chlorophyll <i>a</i>	15
Classification of lakes	15
References cited	17
Lake data	19
Big Cedar	
North Site, near West Bend, 432409088151600	21
South Site, near West Bend, 432224088154900	23
Booth near East Troy, 424800088254800	25
Butternut	
near Park Falls, 455854090310300	28
Deep Hole, near Park Falls, 455803090310800	29
North Site, near Butternut, 455904090303400	32
South Site, near Park Falls, 455731090311000	35
Far South Site, near Park Falls, 455651090312700	38
Delavan	
near Delavan, 423706088363400	41
at Center near Delavan Lake, 423556088365001	42
at North End near Lake Lawn, 423659088354401	48
at SW End near Delavan Lake, 423526088380101	48
Devils near Baraboo, 05404500	49
Fish near Sauk City, 05406050	50
Geneva	
at Lake Geneva, 423525088260400	51
West End, near Williams Bay, 423329088323300	52
Green at County Trunk Highway A near Green Lake, 434928088553601	58
Kawaguesaga	
Deep Hole, near Minocqua, 455208089435800	59
South Site, near Minocqua, 455145089442600	61
Koshkonong near Newville, 05427235	63
Lac La Belle at Oconomoc, 430733088305900	64

CONTENTS--Continued

Little Cedar	
North Site, near West Bend, 432255088134700	66
South Site, near West Bend, 432249088134500	68
Little Green, at Center, near Markesan, 43441208859070079	70
Little St. Germain	
near Eagle River, 05390700	73
Upper East Bay, at St. Germain, 4553208925390	74
Northeast Bay, near St. Germain, 455545089262500	77
South Bay, near St. Germain, 455437089270800	80
West Bay, at St. Germain, 455428089282400	83
Little Sand--Site Number 2--near Mole Lake, 452826088544101	86
Mendota at Madison, 05428000	87
Middle at Lauderdale, 424621088335500	88
Middle Genesee near Oconomowoc, 430309088284800	91
Minocqua	
Deep Hole, at Minocqua, 455214089412800	93
North Bay, at Minocqua, 455232089424100	94
South Bay, at Minocqua, 455206089425200	97
Monona at Madison, 05429000	99
Muskego (Big Muskego) near Wind Lake, 425109088075000	100
Nagawicka	
at Delafield, 430347088240800	101
at Deep Hole, at Delafield, 430417088230300	102
Oconomowoc	
No. 1 (Center) at Oconomowoc, 430551088273500	105
No. 2 (off Hewitt Point) at Oconomowoc, 430609088262200	107
Okauchee	
at Okauchee, 430723088252100	109
No. 1, near Okauchee, 430759088244200	111
No. 2, at Okauchee, 430645088264500	113
No. 3, at Okauchee, 430642088252400	115
No. 4, at Okauchee, 430757088261700	117
Potter near Mukwonago, 424905088204000	119
Powers at Powers Lake, 423246088175800	121
Spooner	
Deep Hole, near Spooner, 455034091493300	124
Southeast Site, near Spooner, 454945091483900	126
Tichigan near Waterford, 424854088123300	128
Twin	
East Twin, near Westfield, 435430089350700	130
West Twin, near Westfield, 435438089352300	132

CONTENTS--Continued

Waterford Waterway, Fox River Site, near Waterford, 424614088123600	134
Wazee	
Beach, near Black River Falls, 441710090425200	136
Deep Hole, near Black River Falls, 441730090432900	137
Wind, at Outlet at Wind Lake, 424848088083100	141
at Wind Lake, 424915088083900	142
Winnebago	
at Oshkosh, 04082500	145
near Stockbridge, 04084255	146
Wisconsin District publications pertaining to lakes	147
Appendix - Quality-Assurance/Quality-Control Plan	154

FIGURE

Figure 1. Map showing location of lake water-quality and lake-stage stations in Wisconsin	2
---	---

TABLES

Table 1. Discontinued lake stations	5
2. Parameter identification numbers and laboratory reporting levels (LRL) for chemical parameters commonly measured in lakes, and analyzed at the National Water-Quality Laboratory (NWQL) or the Wisconsin State Laboratory of Hygiene (WSLH)	10

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATED WATER-QUALITY UNITS

Multiply	By	To Obtain
mile (mi)	1.609	kilometer
pound (lb)	453.6	gram
acre	0.4048	hectare
foot (ft)	0.3048	meter
gallon (gal)	3.785	liter
square mile (mi ²)	2.590	square kilometer

Temperature, in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) by use of the following equation:

$$^{\circ}\text{F} = 1.8(^{\circ}\text{C}) + 32.$$

Sea level: In this report “sea level” refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Abbreviated water-quality units: Chemical concentrations and water temperature are given in metric units. Chemical concentration is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter. For water with dissolved-solids concentrations less than 7,000 mg/L, the numerical values for concentrations expressed as mg/L and µg/L are the same as for concentrations in parts per million and parts per billion, respectively.

Specific conductance of water is expressed in microsiemens per centimeter at 25 degrees Celsius (µS/cm). This unit is equivalent to micromhos per centimeter at 25 degrees Celsius (µmho/cm), formerly used by the U.S. Geological Survey.

WATER-QUALITY AND LAKE-STAGE DATA FOR WISCONSIN LAKES, WATER YEAR 2003

By Wisconsin District Lake-Studies Team

INTRODUCTION

The U.S. Geological Survey (USGS), in cooperation with local and other agencies, collects data at selected lakes throughout Wisconsin. These data, accumulated over many years, provide a data base for developing an improved understanding of the water quality of lakes. To make these data available to interested parties outside the USGS, the data are published annually in this report series. The locations of water-quality and lake-stage stations in Wisconsin for water year 2003 are shown in figure 1. A water year is the 12-month period from October 1 through September 30. It is designated by the calendar year in which it ends. Thus, the period October 1, 2002 through September 30, 2003 is called "water year 2003."

The purpose of this report is to provide information about the chemical and physical characteristics of Wisconsin lakes. Data that have been collected at specific lakes, and information to aid in the interpretation of those data, are included in this report. Data collected include measurements of in-lake water quality and lake stage. Time series of Secchi depths, surface total phosphorus and chlorophyll *a* concentrations collected during non-frozen periods are included for all lakes. Graphs of vertical profiles of temperature, dissolved oxygen, pH, and specific conductance are included for sites where these parameters were measured. Descriptive information for each lake includes: location of the lake, area of the lake's watershed, period for which data are available, revisions to previously published records, and pertinent remarks. Additional data, such as streamflow and water quality in tributary and outlet streams of some of the lakes, are published in another volume: "Water Resources Data-Wisconsin, 2003."

Water-resources data, including stage and discharge data at most streamflow-gaging stations, are available through the World Wide Web on the Internet. The Wisconsin District's home page is at <http://wi.water.usgs.gov/>. Information on the Wisconsin District's Lakes Program is found at wi.water.usgs.gov/lake/index.html and wi.water.usgs.gov/projects/index.html.

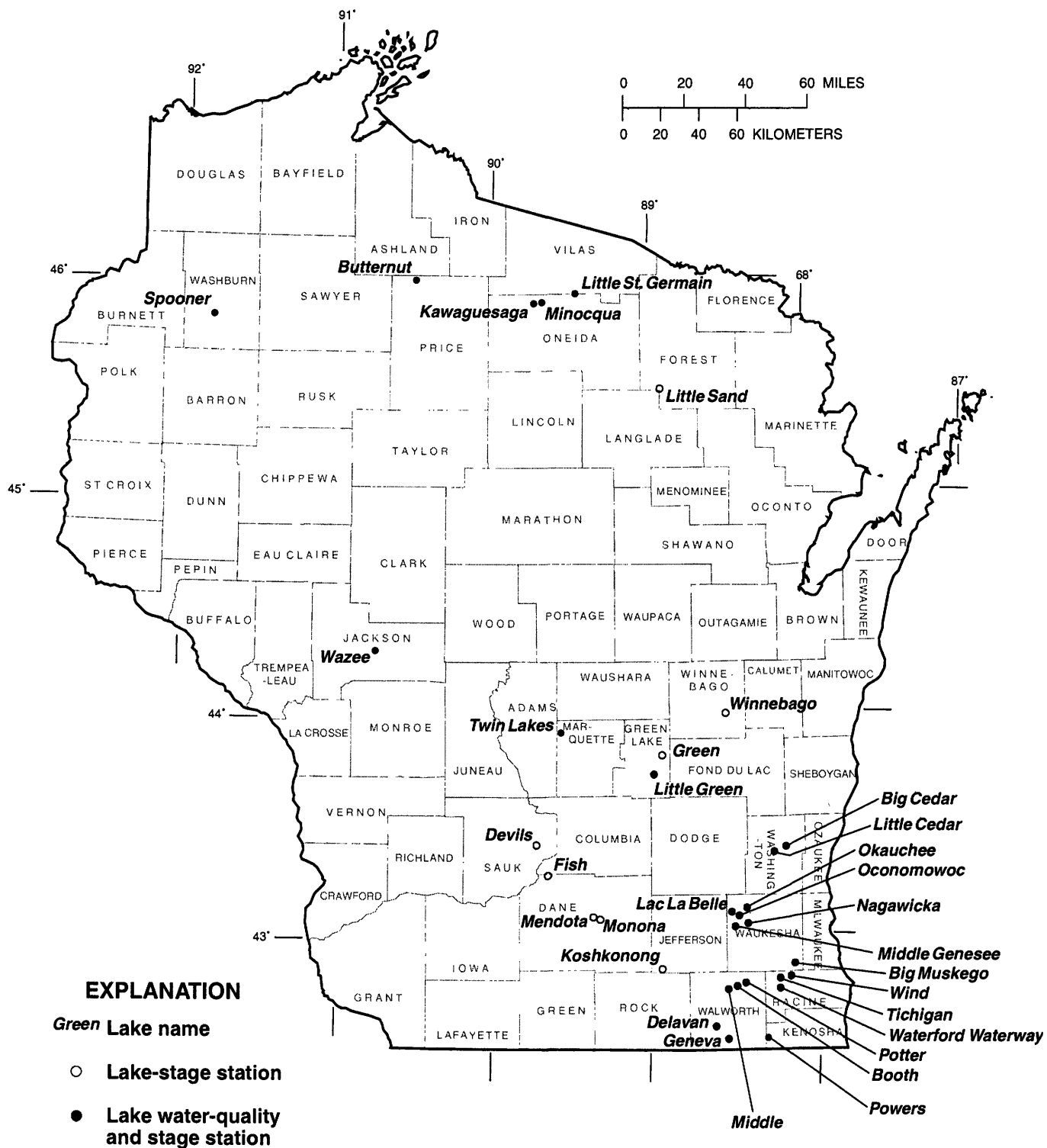


Figure 1. Location of lake water-quality and lake-stage stations in Wisconsin.

The USGS has done cooperative lake monitoring with local and other agencies since 1983. Cooperators in 2003 included:

Big Cedar Lake Protection and Rehabilitation District
Big Muskego Lake District
Booth Lake Management District
City of Delafield
City of Muskego
Dane County Department of Public Works
Delavan Lake Sanitary District
Geneva Lake Environmental Agency
Green Lake Sanitary District
Jackson County
Lac La Belle Management District
Lauderdale Lakes Lake District
Little Green Lake Protection and Rehabilitation District
Little Muskego Lake Protection and Rehabilitation District
Little St. Germain Lake Protection and Rehabilitation District
Middle Genesee Lake District
Okauchee Lake Management District
Potters Lake Protection and Rehabilitation District
Powers Lake District
Rock County Public Works Department
St. Croix Tribe
Spooner Lake District
Town of Cedar Lake (Red Cedar Lake Association)
Town of Springfield (Twin Lakes Conservancy)
U.S. Army Corps of Engineers
Village of Oconomowoc Lake
Whitewater Lake Management District
Wind Lake Management District
Wisconsin Department of Natural Resources

Lake data-collection sites are identified by a unique identification number. Lake water-quality sites are identified by a 15-digit number that is a concatenation of the site's latitude, longitude, and a two-digit sequence number. The sequence number is used to distinguish between sites located at the same latitude-longitude designation. The site identification number is permanently assigned to the site; actual latitude and longitude of the site are subject to update and are stored separately. For some lakes, which have historical records of lake stage, an eight-to-ten digit number is assigned according to downstream order. Gaps are left in the numerical series to allow for new stations; hence, the numbers are not consecutive. The first two digits of the complete eight-to-ten digit number, such as 04087000 or 054310157, designate the major river basin. For example, "04" designates the St. Lawrence River Basin and "05" designates the Upper Mississippi River Basin.

The water-quality lake stations that were discontinued prior to water year 2003 are listed in table 1. Discontinued lake-stage stations are not included in this table.

This report is the culmination of a concerted effort by a number of people who collected, compiled, analyzed, verified, and organized the data, and who typed, edited, and assembled the report. The authors had primary responsibility for assuring that the information contained herein is accurate, complete, and adheres to USGS policy and established guidelines. Technicians in charge of the field offices are: T.J. Popowski (Rice Lake), J.J. Hanig (Merrill), and J. Habale (Middleton). The data were collected and processed by S.M. Berg, C.J. Bloom, G.L. Goddard, J.J. Hanig, D.E. Housner, B.W. Olson, D.L. Olson, and J.G. Schuler. P.A. Stark assembled, edited, and formatted the report. Additional assistance in preparation of the report was provided by M.M. Greenwood.

METHODS OF DATA COLLECTION

Depth profiles of water temperature, dissolved oxygen, pH, and specific conductance were collected using multi-parameter meters. Prior to measurements, the meters were calibrated using standards for pH and conductance, and dissolved oxygen was calibrated using the air calibration method. Generally, field measurements in profiles were made at 0.5-m intervals if the maximum depth of the lake was 5 m or less and at 1.0-m intervals if the maximum depth was greater than 5 m.

Table 1. Discontinued lake stations

Station name	Site identification number	Period of record
Alma Lake near St. Germain	455426089254700	Oct. 1984–Sept. 1990, May 1992–Sept. 1996
Balsam Lake, off Cedar Island, at Balsam Lake	452755092264600	Feb. 1991–Aug. 1994
off Little Narrows, near Balsam Lake	452858092265300	May 1991–Aug. 1994
off Rock Island, near Balsam Lake	452754092234300	May 1991–Aug. 1994
Balsam Lake near Birchwood	453907091345800	Mar. 1993–Aug. 1994, Mar. 1996–Aug. 1997, Mar.–Sept. 2001
Bass Lake near Shawano	445215088300300	Feb. 1990–Aug. 1992
Bear Lake at Deep Hole near Haugen	453754091490900	Mar. 1992–Aug. 1993
Beaver Dam Lake, South end, at Beaver Dam	432814088515000	June–Oct. 1991
North end, near Beaver Dam	433122088545700	June–Oct. 1991
Benedict Lake near Powers Lake	423201088180800	May 1998–Aug. 2000
Big Blacksmith Lake near Keshena	445401088334500	Feb. 1990–Aug. 1992
Big Hills (Hills) Lake near Wild Rose	440912089092000	June 1983–Aug. 1984, Feb.–Aug. 1987, Feb.–Aug. 1990, Feb.–Aug. 1993, Feb.–Aug. 1996, Feb.–Aug. 1999
Big Muskego Lake, at North Site, near Muskego	425301088061300	Feb.–Aug. 1988
Research Base, near Muskego	425235088075300	May–June 1994
Big Round Lake near Milltown	453142092180100	Feb.–Sept. 2001
Big St. Germain Lake, near St. Germain	455557089311000	Feb. 1992–Aug. 1996
near Lake Tomahawk	05390750	1991–2001
Big Sand Lake, Deep Hole, near Hertel	454910092134000	Feb.–Sept. 2001
East Site, near Hertel	454921092124300	Feb.–Sept. 2001
Big Sissabagama Lake, near Stone Lake	454724091303600	Apr. 1986–Sept. 1996 Oct. 1997–Sept. 2002
North Site, near Stone Lake	454800091312900	Mar. 1998–Sept. 2001
Buffalo Lake, Center Site, at Packwaukee	434558089260600	May 1998–Sept. 2001
East End, at Montello	434720089201600	May 1998–Sept. 2001
West End, near Endeavor	434414089282400	May 1998–Sept. 2001
Denoon Lake at Wind Lake	425044088100300	Feb. 1991–Aug. 1996
Druid Lake near Hartford	431643088243300	Feb. 1991–Sept. 1996
Eagle Lake near Kansasville	05544500	1936–64, 1975–77, 1979, Feb. 1993–Sept. 1996
Eagle Lake, at Deep Hole, near Kansasville	424207088072400	Feb. 1993–Aug. 1996
Eagle Spring Lake at Eagleville	425103088261500	Apr. 1991–Sept. 2001
Elizabeth Lake near Twin Lakes	423051088155300	Feb. 1995–Sept. 1997
Forest Lake near Dundee	433632088100200	Mar. 1994–Aug. 1996
Fowler Lake, Center, at Oconomowoc	430653088294601	Jan.–Dec. 1984, Oct. 1986–Sept. 1996
Fox Lake Deep Hole at Fox Lake	433458088560600	June 1991–Mar. 1993

Table 1. Discontinued lake stations

Station name	Site identification number	Period of record
Geneva Lake		
Geneva Bay, at Lake Geneva	423455088263800	Apr. 1997–Feb. 1999
Williams Bay, at Williams Bay	423420088320500	Apr. 1997–Feb. 1999
Center, near Lake Geneva	423402088301400	Apr. 1997–Mar. 1999
East End, near Lake Geneva	423421088272300	Apr. 1997–May 2000
Hemlock Lake near Mikana	453421091333700	Mar. 1993–Aug. 1994, Mar. 1996–Aug. 1997, Mar.–Sept. 2001
Hooker Lake at Salem	423335088060300	Feb. 1992–Aug. 1993
Kirby Lake near Cumberland	453554092042101	Nov. 1995–Oct. 1996
(Site 1) near Cumberland	453608092035801	Nov. 1995–Nov. 1996
(Site 2) near Cumberland	453601092035301	Nov. 1995–Nov. 1996
(Site 3) near Cumberland	453612092034901	Nov. 1995–Nov. 1996
(Site 4) near Cumberland	453603092035701	Nov. 1995–Nov. 1996
(Site 5) near Cumberland	453608092041201	Nov. 1995–Nov. 1996
(Site 6) near Cumberland	453555092040901	Nov. 1995–Nov. 1996
Lac La Belle, NW, at Oconomowoc	430809088313900	Feb. 1984–Aug. 1985
SE at Oconomowoc	430707088301400	Feb. 1984–Aug. 1985
Lake Blass at Lake Delton	433545089482400	Mar. 1989–Aug. 1990
Lake Keesus, East Bay, near Merton	430957088183400	Apr. 1991–Aug. 1995
North Bay, near Merton	431006088191000	Apr. 1991–Aug. 1995
Lake Morris at Mount Morris	440654089120500	Jun. 1983–Sept. 1989
Lake Nebagamon, Northeast Bay, at Lake Nebagamon	463050091412300	May 1992–Aug. 1995
Southeast Bay, at Lake Nebagamon	462928091413500	Mar. 1992–Sept. 1995
West Bay, at Lake Nebagamon	463034091425300	May 1992–Aug. 1995
Lake Noquebay near Crivitz	451511087550900	Feb. 1987–Aug. 1988, Apr. 1991–Aug. 1994
East End, near Crivitz	451540087525700	Apr. 1991–Aug. 1994
Lamotte Lake near Shawano	445305088361200	Feb. 1990–Aug. 1992
Lauderdale Lakes		
at Lauderdale	424554088332700	Oct. 1993–Oct. 1994
Green, Auxiliary, Number 1, near Lauderdale	424640088341900	June 1999–Sept. 2000
Green, near Lauderdale	424652088341500	Nov. 1993–Nov. 1994 Aug. 2002
Mill, at Lauderdale	424555088335700	Nov. 1993–Nov. 1994 Aug. 2002
Legend Lake (site 1) near Shawano	445342088312700	Feb. 1990–Feb. 1992
Little Arbor Vitae near Woodruff	455446089370300	Feb. 1991–Sept. 2002
Little Cedar Lake		
North Site, near West Bend	432255088134700	Feb. 1997–Aug. 1999
South Site, near West Bend	432249088134500	Feb. 1997–Aug. 1999
Little Muskego Lake at Muskego	425425088083500	Oct. 1986–Aug. 2002
Little Rock Lake near Woodruff	455946089415702	Oct. 1983–Sept. 1996
Long (Kee Nong Go-Mong) Lake at Wind Lake	424937088103400	Feb. 1988–Aug. 1989, Feb. 1991–Aug. 1996

Table 1. Discontinued lake stations

Station name	Site identification number	Period of record
Loon Lake near Shawano	445009088303700	Feb. 1991–Aug. 1993
Lost Lake near Beaver Dam	432640088580500	June–Oct. 1991
McKenzie Lakes		
McKenzie (Big McKenzie)		
Deep Hole, near Spooner	455507092013500	Feb. 1987–Aug. 1998
Northern Site, near Spooner	455540092022000	June 1997–Aug. 1998
South Site, near Spooner	455437092022300	June 1997–Aug. 1998
Lower McKenzie, near Webb Lake	455902092011900	June 1997–Aug. 1998
Middle McKenzie, near Spooner	455635092021800	June 1997–Aug. 1998
Mary (Marie) Lake at Twin Lakes	423128088151200	Feb. 1995–Aug. 1997
Max Lake near Woodruff	460128089423501	Mar. 1988–Dec. 1996
Mead Lake, East Bay near Willard	444720090445000	Apr. 1991–Aug. 1995
West Bay near Willard	444733090460100	Feb. 1991–Sept. 1995
Montello Lake at Montello	434748089195800	Feb. 1995–Aug. 1998
Moon Lake near St. Germain	455504089260500	Feb. 1992–Aug. 1996
Morgan Lake near Fence	454622088324801	Oct. 1987–Sept. 1998.
Moshawquit Lake near Shawano	445352088295800	Feb. 1990–Aug. 1992
Muskego (Big Muskego)		
Auxiliary Number 1, near Muskego	425329088054000	June 1996–Aug. 2000
Bass Bay, near Muskego	425344008807010	Feb. 1988–Aug. 2002
near Wind Lake	425109088075000	Oct. 1987–Sept. 1989, Jan. 1991–Sept. 2002
South Site, near Muskego	425212088072800	Feb. 1988–Aug. 2002
Muskellunge Lake, near Lake Outlet near Eagle River	455706089232400	Nov. 2000–Oct. 2001
near Eagle River	455700089224900	June 2000–Aug. 2001
Namekagon Lakes		
Garden, near Cable	461224091033200	Mar. 1998–Aug. 1999
Jackson, near Cable	461457091065900	Mar. 1998–Aug. 1999
Namekagon		
Deep Hole, near Cable	461308091065100	Mar. 1998–Aug. 1999
East Basin, near Cable	461228091044300	Mar. 1998–Aug. 1999
Northeast Basin, near Cable	461410091050700	Mar. 1998–Aug. 1999
Park Lake (site 1) at Pardeeville	433239089175800	Feb. 1986–Aug. 1987, May–Nov. 1993
(site 2) at Pardeeville	433226089175500	May–Nov. 1993
(site 3) at Pardeeville	433245089173000	May–Nov. 1993
(site 4) at Pardeeville	433257089165100	May–Nov. 1993
Pike Lake near Hartford	431916088200501	Dec. 1998–Dec. 2000
Pike Lake-QW Site-near Hartford	431835088200600	Feb.–Aug. 2000
Pretty Lake, at Deep Hole, near Dousman	425722088295000	Feb. 1993–Aug. 1997
Red Cedar Lake, at Mikana	453522091360600	Mar. 1993–Aug. 1994, Mar. 1996–Aug. 1997, Oct. 2000–Sept. 2001
Deep Hole, near Mikana	453725091345100	Mar. 1993–Aug. 1994, Mar. 1996–Aug. 1997, Mar. –Sept. 2001

Table 1. Discontinued lake stations

Station name	Site identification number	Period of record
South End, at Mikana	453519091352500	Mar. 1993–Aug. 1994, Mar. 1996–Aug. 1997, Mar. –Sept. 2001
Rice Lake at Deep Hole near Whitewater	424629088415700	Apr.–Nov. 1991
Round Lake near Shawano	445328088335000	Feb. 1990–Aug. 1992
Sand Lake (Deep Hole) near Keshena	445321088323101	June–Aug. 1992
Shell Lake at Shell Lake	05334000	Aug. 1936–Sept. 1999
Silver Lake near Oconomowoc	430436088293300	Apr. 1992–Aug. 1996
Silver Lake near West Bend	432322088125000	Feb. 1996–Aug. 1997
Sinissippi Lake, off Anthony Is., at Hustisford	432113088361100	Feb. 1991–Aug. 1993
off Butternut Is., near Hustisford	432240088363900	Apr. 1991–Aug. 1993
off Sam Point, near Hustisford	432300088374200	Apr. 1991–Aug. 1993
Spirit Lake near Keshena	445400088320100	Apr.–Aug. 1992
Stewart Lake at Mt. Horeb	430117089442701	May 1992–Sept. 1993
Tombeau Lake near Powers Lake	423153088184800	May 1998–Aug. 2000
Upper Nemahbin Lake, Center, near Delafield	430400088254900	June 1993–Aug. 1995
South Site, near Delafield	430339088254800	June 1993–Aug. 1995
Outlet near Delafield	430334088255400	June 1993–Aug. 1995
Vandercook Lake near Woodruff	455909089405602	Nov. 1980–Aug. 1998
Watosah-skice Lake near Keshena	445330088361400	Feb. 1990–Aug. 1992
Waubeesee Lake at Wind Lake	424857088101500	Feb. 1988–Aug. 1989, Feb. 1991–Aug. 1996
Wazee Lake near Black River Falls	441721090431700	Nov. 1999–Aug. 2000
Whitefish Lake, North Basin, near Gordon	461321091520900	Mar. 1998–Sept. 2001
South Basin, near Gordon	461212091523200	Mar. 1998–Sept. 2001
Whitewater Lake, off Heart Prairie, near Whitewater	424533088420100	Apr.–Nov. 1991
near Whitewater	424608088414800	Nov. 1990–Sept. 2002
North Bay, near Whitewater	424625088405500	Apr.–Nov. 1991
South Bay, near Whitewater	424501088422300	Apr.–Nov. 1991
Wind Lake, Northeast Basin, at Wind Lake	424938088080800	Feb. 1997–Aug. 1998
Wolf Lake near Mt. Calvary	435152088123100	Nov. 1983–Sept. 1986, Nov. 1992–Sept. 1997

In most lakes, water samples were collected at two depths - near the surface and near the bottom. Chemical analyses of water samples were performed using standard analytical methods by either the USGS National Water Quality Laboratory (Wershaw and others, 1987; Fishman and Friedman, 1989; Fishman, 1993) or the Wisconsin State Laboratory of Hygiene (Wisconsin State Laboratory of Hygiene, 1993). Analyses for dissolved constituents were performed on samples that were filtered in the field through a 0.45- μm (micrometer) pore-size filter. Total or total recoverable constituents were determined by analyzing unfiltered water samples. Preservation and shipment of samples followed standard protocols established by the laboratories. Water-quality data were archived in the Water Quality Data Base (QWDATA) of the National Water Information System (NWIS). Additional descriptive information about water-quality data is available in the data report: "Water Resources Data – Wisconsin, 2003". NWIS parameter codes and minimum laboratory reporting levels for chemical constituents are given in table 2.

Records of lake stage are considered complete when one or more manual or automatic measurements were obtained per day. Partial records of lake stage result when measurements were less frequent than daily. A complete description of manual or automatic measurements of lake stage is described by Rantz and others (1982).

EXPLANATION OF PHYSICAL AND CHEMICAL CHARACTERISTICS OF LAKES

Following are brief, generalized explanations of some of the common measurements of water quality and some of the physical processes occurring in lakes that influence these measures of water quality. More detailed explanations of water-quality data and lake processes are given by Wetzel (1983), Hem (1985), and Shaw and others (1993).

Water Temperature and Thermal Stratification

Water temperature in lakes is important because of its role in stratification and because of the temperature dependence of many chemical reactions and life processes of aquatic organisms. The extent of thermal stratification in lakes depends on the interaction between the lake's shape, water clarity, solar heating, and wind-driven mixing. Complete mixing of the lake is usually inhibited by thermal stratification in summer and by ice cover in winter. Thermal stratification affects water quality and the distribution of organisms in the lake. Summer thermal stratification can occur in any lake, but in Wisconsin it commonly occurs in lakes deeper than about 6 m (Shaw and others, 1993).

Table 2. Parameter identification numbers and laboratory reporting levels (LRL) for chemical parameters commonly measured in lakes, and analyzed at the National Water Quality Laboratory (NWQL) or the Wisconsin State Laboratory of Hygiene (WSLH)

Parameter Name	Units	CAS Number (1)	Parameter Code (2)	(NWQL)				(WSLH)	
				Standard Analysis		Low-Level Analysis		LRL	Test Code
				LRL	Lab Code	LRL	Lab Code		
Calcium, diss. (Ca)	mg/L	7440-70-2	00915	0.020	659	0.002	1895	0.02	I230IUD
Magnesium, diss. (Mg)	mg/L	7439-95-4	00925	0.004	663	0.001	1897	0.02	I390IUD
Sodium, diss. (Na)	mg/L	7440-23-5	00930	0.09	675	0.025	1898	0.09	I80IUD
Potassium, diss. (K)	mg/L	7440-09-7	00935	0.24	54	0.01	833	0.3	I540IUD
Sulfate, diss. (SO ₄)	mg/L	14808-79-8	00945	0.31	1572	0.01	1263	1.0	I600DLD
Chloride, diss. (Cl)	mg/L	16887-00-6	00940	0.29	1571	0.01	1259	0.1	I240ELD
Fluoride, diss. (F)	mg/L	16984-48-8	00950	0.100	31	0.01	1260	0.03	I330FLD
Iron, diss. (Fe)	µg/L	7439-89-6	01046	10	645	3	1896	10	I370IUD
Manganese, diss. (Mn)	µg/L	7439-96-5	01056	2.2	648	1	1793	0.4	I400IUD
Silica, diss. (SiO ₂)	mg/L	7631-86-9	00955	0.1	56	0.02	1899	0.008	I560LLD
Nitrogen, NO ₂ +NO ₃ , diss.	mg/L		00631	0.05	1975	0.005	1979	0.01	I460MLD
Nitrogen, ammonia, diss.	mg/L	7664-41-7	00608	0.02	1976	0.002	1980	0.013	I440NLD
Nitrogen, organic, total (3)	mg/L								
Nitrogen, amm.+org., total (4)	mg/L	17778-88-0	00625	0.100	1985			0.2	I470BLT
Nitrogen, amm.+org.,diss.	mg/L		00623						I470DLD
Nitrogen, total (5)	mg/L								
Nitrogen, dissolved	mg/L		00602						
Phosphorus, total	mg/L	7723-14-0	00665	0.05	1984	0.004	837	0.005	I520PLT
Phosphorus, ortho, diss.	mg/L	14265-44-2	00671	0.01	1262	0.002	1978	0.002	I530CLD
Chlorophyll a, phytoplankton	µg/L	479-61-8	70953	0.1	586				
Chlorophyll a, phytoplankton	µg/L	479-61-8	32210					0.26	I250UNF

Footnotes:

- 1: CAS (Chemical Abstracting Services) number = unique identification for each constituent
- 2: Parameter Code - unique number for storage of data in database
- 3: Calculated as difference between total ammonia + organic nitrogen and ammonia nitrogen
- 4: Also known as Total Kjeldahl Nitrogen (TKN)
- 5: Calculated as sum of TKN + Nitrogen as (NO₂+NO₃)

The density of water increases with decreasing temperature down to a temperature of 4°C, then decreases with decreasing temperature between 4°C and the freezing point of water (0°C). For a brief period in the spring after the ice is out, water temperature is usually uniform through the entire water column and wind action causes the lake to mix completely. This process is known as “spring turnover.” As the lake absorbs the sun’s energy, the surface water becomes warmer and its density decreases, making it more resistant to complete mixing. The difference in density caused by different water temperatures can prevent warm and cold water from mixing. In most lakes, therefore, a density “barrier” forms between the warmer surface water (epilimnion) and the underlying colder water (hypolimnion). This barrier is often marked by a sharp temperature gradient known as the “thermocline (metalimnion).” During the stratified summer period, these three distinct layers of lake water are often present. As the temperature difference between surface and deep water increases, this “stratified” condition stabilizes and can persist until surface temperatures decrease in the fall, which decreases the stability of the stratification. The mixing of the lake water in the fall is known as “fall turnover.”

Thermal stratification may also occur under ice cover in the winter. In the winter, the coldest water (near 0°C) under the ice at the surface of the lake is less dense than water deeper in the lake with warmer temperatures.

Specific Conductance

Specific conductance is a measure of the ability of water to conduct an electrical current and is an indicator of the concentration of dissolved solids in the water. Because conductance is temperature related, reported values are normalized at 25°C and are termed specific conductance. As the concentration of dissolved minerals increases, specific conductance increases. During winter and summer thermal stratification, concentrations of dissolved constituents near the lake bottom increase due to the decomposition of materials settling from the epilimnion, or release of dissolved materials (such as iron, manganese, and phosphorus) from the bottom sediments during anoxic periods. Therefore, differences in specific conductance with depth indicate differences in concentrations of dissolved solids.

Water Clarity

Water clarity, or transparency, is commonly measured using a Secchi disc. The range of depths within which photosynthetic activity occurs depends largely on depth of light penetration, which is influenced by water clarity. A Secchi disc, most commonly an 20-cm.-diameter disc with alternating black-and-white quadrants, is lowered to a depth at which it is no longer visible. This depth is referred to as the Secchi depth. Clarity can be reduced by algae, zooplankton, water color, and suspended sediment. Algae are often the most dominant influence on clarity in lakes and, therefore, Secchi depth is usually correlated with the algal abundance. Secchi depths are generally the least during summer when algal populations are largest.

pH

The pH is a measure of the acidity of the water. It is defined as the negative logarithm of hydrogen-ion concentration and varies over a 14-unit log scale, with a pH of 7 being neutral. Values less than 7 indicate acidic conditions; the lower the value, the stronger the acidity. Values greater than 7 indicate alkaline conditions. The pH of water is influenced in part by photosynthesis and respiration of planktonic algae and aquatic plants. It is important because it affects the solubility of many chemical constituents, and because aquatic organisms have limited pH tolerances. Planktonic algae and aquatic plants produce oxygen and consume carbon dioxide as they photosynthesize during daytime; they consume oxygen and produce carbon dioxide when they respire at night. Carbon dioxide combines with the water molecule to form carbonic acid; therefore respiration causes a decrease in pH at night and photosynthesis during the day causes an increase in pH. The result is a daily cycle in pH. Because phytoplankton are usually concentrated in the near-surface water, changes in pH in the epilimnion are more extreme than in the hypolimnion, where less photosynthesis usually occurs.

Lakes having good fish populations and productivity generally have a pH between 6.7 and 8.2. Values of pH greater than 8.5 have been shown to cause the release of phosphorus from lake sediments (James and Barko, 1991).

Dissolved Oxygen

Dissolved oxygen is one of the most critical factors affecting a lake ecosystem because it is essential to most aquatic organisms, and it is involved in many chemical reactions. Very low dissolved oxygen concentrations can control some types of chemical reactions. The solubility of oxygen in water is inversely related to temperature—that is, oxygen solubility decreases as water temperature increases. This relation is important because at warmer temperatures the metabolic rate of organisms increases but less oxygen is available for respiration. The primary sources of dissolved oxygen are from the air and from photosynthesis. The minimum dissolved oxygen concentration specified in national water-quality criteria for early life stages of warmwater aquatic life is 5.0 mg/L (U.S. Environmental Protection Agency, 1986).

In early summer, if thermal stratification develops, the metalimnion restricts the surface supply of dissolved oxygen to the hypolimnion. The hypolimnion can become isolated from the atmosphere. Thus, as summer progresses, the dissolved oxygen concentration can decrease in response to decomposition of dead algae that settle from the epilimnion and in response to the biological and chemical oxygen demand of the sediments. The oxygen demand from these processes may completely deplete the oxygen (anoxia) in the water near the lake bottom. The oxygen depletion then progresses upward but usually is confined to the hypolimnion.

Anoxia in the hypolimnion is common in stratified eutrophic (nutrient-rich) lakes in Wisconsin. Complete anoxia, however, is often not detected because of meter constraints. During anoxic conditions, many aquatic organisms cannot survive, but many other species (primarily bacteria) actually function only in such conditions. Therefore, a shift from oxic to anoxic conditions produces a rapid and dramatic change in the biological community and chemical environment. Anoxia also can cause release of phosphorus from the bottom sediments. This phosphorus then mixes throughout the water column during spring and fall turnover.

Phosphorus

Phosphorus is one of the essential nutrients for plant growth. High phosphorus concentrations can cause dense algal populations (blooms) and can therefore be a major cause of eutrophication in lakes. When phosphorus concentrations exceed 0.025 mg/L at the time of spring overturn in lakes and reservoirs, these water bodies may occasionally experience excess or nuisance growth of algae or other aquatic plants (U.S. Environmental Protection Agency, 1986). In many regions of the country, including the upper Midwest, other nutrients, particularly nitrogen, tend to be in abundant supply. Phosphorus is often the nutrient in shortest supply, therefore limiting or controlling plant growth. About 90 percent of the lakes in Wisconsin are limited by phosphorus (Shaw and others, 1993). In water, dissolved orthophosphate is that part of total phosphorus that is most readily available for use by algae.

Internal phosphorus recycling occurs in many lakes. Phosphorus used by algae, aquatic plants, fish, and zooplankton is stored within these organisms. As these organisms die and decompose, this phosphorus is returned to the lake water and sediments. Anoxia in the hypolimnion makes phosphorus more soluble, adding further to the release of phosphorus from the falling particles and the lake sediments. During spring and fall turnover the phosphorus, which was released from the bottom sediments into the hypolimnion during anoxia, is mixed throughout the lake. The phosphorus is then available for algal growth. These phenomena are part of the internal-recycling processes of lakes.

Nitrogen

Nitrogen, like phosphorus, is an essential nutrient for plant and algal growth. Usually in Wisconsin lakes, nitrogen is in abundant supply from the atmosphere and other sources. If phosphorus is abundant relative to algal needs, nitrogen can become the limiting nutrient. In that case, algal blooms are more likely to be triggered by increases in nitrogen than by increases in phosphorus. Some bluegreen algal species can fix nitrogen from the atmosphere (Wetzel, 1983). Therefore, in situations where other types of algae are excluded because of a shortage of nitrogen, the nitrogen-fixing bluegreen algae have a competitive advantage and may be present in abundance.

Lakes with a nitrogen to phosphorus ratio larger than 15 to 1 near the surface may generally be considered phosphorus limited; a ratio from 10 to 1 to 15 to 1 indicates a transition situation; and a ratio smaller than 10 to 1 generally indicates nitrogen limitation. Total nitrogen is the sum of ammonia, organic nitrogen, and nitrate-plus-nitrite nitrogen. The near-surface concentration is commonly used to compute the total nitrogen to phosphorus ratio because most algal species grow near the lake surface.

Chlorophyll *a*

Chlorophyll *a* is a photosynthetic pigment found in algae (Wetzel, 1983) and other green plants. Its concentration, therefore, is commonly used as a measure of the density of the algal population in a lake. Chlorophyll *a* concentrations are generally highest during summer when algal populations are highest. Moderate populations of desirable algae are important in the food chain; however, excessive populations or algal blooms are undesirable. Algal blooms can cause taste and odor problems, and limit light penetration needed to support growth of submerged aquatic plants. Certain species of bluegreen algae can produce toxins (Rapavich and others, 1987).

CLASSIFICATION OF LAKES

Two methods are commonly used to classify and evaluate Wisconsin lakes according to their water quality or trophic state: Lillie and Mason's (1983) water-quality index and a modification of Carlson's (1977) Trophic State Index (TSI) by Lillie and others (1993). Three water-quality measures are used in these classification systems: near-surface concentrations of total phosphorus and chlorophyll *a*, and water clarity as indicated by the Secchi depth.

Lillie and Mason's (1983) water-quality indices for Wisconsin lakes were developed based on random summer measurements of total phosphorus and chlorophyll *a* concentrations, and Secchi depth to classify the lakes' water quality as shown below:

Water-quality index	Total phosphorus range (mg/L)	Chlorophyll <i>a</i> range (µg/L)	Water clarity range (Secchi depth, in meters)
"Excellent"	<0.001	<1.0	>6.0
"Very good"	.001–.009	1.0– 4.9	3.0–6.0
"Good"	.010–.029	5.0– 9.9	2.0–2.9
"Fair"	.030–.049	10.0–14.9	1.5–1.9
"Poor"	.050–.149	15.0–30.0	1.0–1.4
"Very poor"	>.150	>30.0	<1.0

The TSI approach to lake classification assigns numerical ranges to the three trophic conditions generally used to describe the wide range of lake water-quality conditions. Oligotrophic lakes are typically clear, algal populations and phosphorus concentrations are low, and the deepest water is likely to contain oxygen throughout the year. Mesotrophic lakes typically have a moderate supply of nutrients, experience moderate algal blooms, and have occasional oxygen depletions at depth. Eutrophic lakes are nutrient rich with relatively severe water-quality problems, such as frequent seasonal algal blooms, oxygen depletion in lower parts of the lakes, and poor clarity. When eutrophic conditions are very severe, the lake is considered hyper-eutrophic.

The WDNR modified the lakes classification scheme developed by Carlson (1977) to apply specifically to Wisconsin lakes. The WDNR system (Lillie and others, 1993) uses surface total phosphorus and chlorophyll *a* concentrations, and Secchi depth for ice-free periods to calculate values for TSI's. The WDNR has adopted the following TSI ranges to classify Wisconsin lakes: indices of less than 40 define oligotrophic conditions, 40 to 50 define mesotrophic conditions, greater than 50 to define eutrophic conditions, and greater than 70 define hypereutrophic conditions (Wisconsin Department of Natural Resources, 1992). These ranges are used to make relative comparisons in Wisconsin lake trophic-state evaluations by the WDNR and others.

The TSI for a lake can be calculated using the following equations (Lillie and others, 1993):

$$TSI_{\text{Secchi}} = 60.0 - 33.2 \times (\log_{10} \text{ Secchi depth})$$

$$TSI_{\text{chlorophyll } a} = 34.82 + (17.41 \times (\log_{10} \text{ chlorophyll } a \text{ concentration}))$$

$$TSI_{\text{total phosphorus}} = 28.24 + (17.81 \times (\log_{10} [\text{total phosphorus concentration} \times 1,000]))$$

where: Secchi depth is in meters,
chlorophyll *a* is in micrograms per liter, and
total phosphorus is in milligrams per liter.

The three trophic conditions are defined with the following boundaries for total phosphorus, Secchi disc, and chlorophyll *a*:

Trophic Level	Trophic State Index	Total phosphorus (mg/L)	Secchi depth (m)	Chlorophyll <i>a</i> (µg/L)
Eutrophic	50	0.017	2.0	7.4
Mesotrophic	40	0.005	4.0	2.0
Oligotrophic				

REFERENCES CITED

- Carlson, R.E., 1977, A trophic state index for lakes: *Limnology and Oceanography*, March, v. 22, no. 2, p. 361-369.
- Fishman, M.J., ed., 1993, *Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—Determination of inorganic and organic constituents in water and fluvial sediments*: U.S. Geological Survey Open-File Report 93-125, 217 p.
- Fishman, M.J., and Friedman, L.C., eds., 1989, *Methods for determination of inorganic substances in water and fluvial sediments* (3d ed.): U.S. Geological Survey *Techniques of Water-Resources Investigations*, book 5, chap. A1, 545 p.
- Hem, J.D., 1985, *Study and interpretation of the chemical characteristics of natural water* (3rd ed.): U.S. Geological Survey Water-Supply Paper 2254, 263 p.
- James, W.F., and Barko, J.W., 1991, Littoral-pelagic phosphorus dynamics during nighttime convective circulation: *Limnology and Oceanography*, v. 36, no. 5, p. 946-960.
- Lillie, R.A., Graham, S., and Rasmussen, P., 1993, Trophic-State Index equations and regional predictive equations for Wisconsin lakes: Wisconsin Department of Natural Resources Research Management Findings No. 35, 4 p.
- Lillie, R.A., and Mason, J.W., 1983, *Limnological characteristics of Wisconsin lakes*: Wisconsin Department of Natural Resources Technical Bulletin No. 138, 116 p.
- Rantz, S.E., and others, 1982, *Measurement and computation of streamflow*: U.S. Geological Survey Water-Supply Paper 2175, 631 p.
- Rapavich, W.M., Sonzogni, W.C., Standridge, J.H., Vennie J.G., and Wedepohl, R.E., 1987, Incidence of algal toxins in Wisconsin water experiencing blue-green algae blooms: Wisconsin State Laboratory of Hygiene and Wisconsin Department of Natural Resources, Informational Paper, 8 p.
- Shaw, B., Mechenich, C., and Klessig, L., 1993, *Understanding Lake Data: G3582*: University of Wisconsin Extension, Madison, Wis., 19 p.
- U.S. Environmental Protection Agency, 1986, *Quality Criteria for Water 1986*: U.S. Environmental Protection Agency publication, EPA 440/5-86-001 [variously paged].
- Wershaw, R.L., Fishman, M.J., Grabbe, R.R., and Lowe, L.E., eds., 1987, *Methods for the determination of organic substances in water and fluvial sediments*: U.S. Geological Survey *Techniques of Water-Resources Investigations*, book 5, chap. A3, 80 p.
- Wetzel, R.G., 1983, *Limnology* (2d ed.): New York, W.B. Saunders, 767 p.

Wisconsin Department of Natural Resources, 1992, Wisconsin water quality assessment—Report to Congress, 1992: Wisconsin Department of Natural Resources Publ-WR254-92-REV, 220 p.

Wisconsin State Laboratory of Hygiene, Environmental Sciences Section, 1993, Manual of analytical methods, inorganic chemistry unit: Wisconsin State Laboratory of Hygiene, revised November 1993 [variously paged].

LAKE DATA

432409088151600 BIG CEDAR LAKE, NORTH SITE, NEAR WEST BEND, WI

LOCATION.--Lat 43°24'09", long 88°15'16", in NE 1/4 sw 1/4 sec.20, T.11 N., R.19 E., Washington County, Hydrologic Unit 04040003, near West Bend.

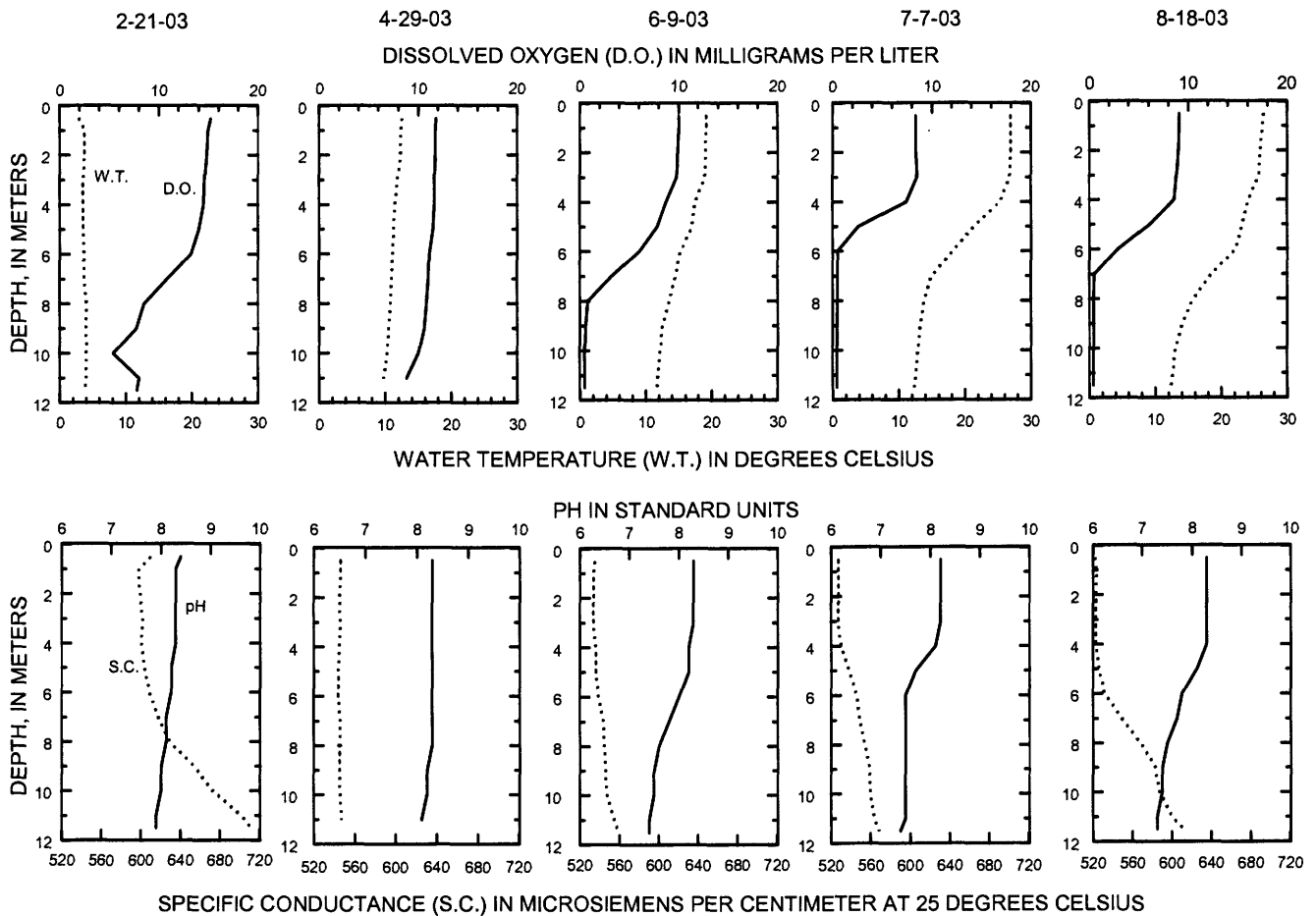
PERIOD OF RECORD.--February 2000 to to current year.

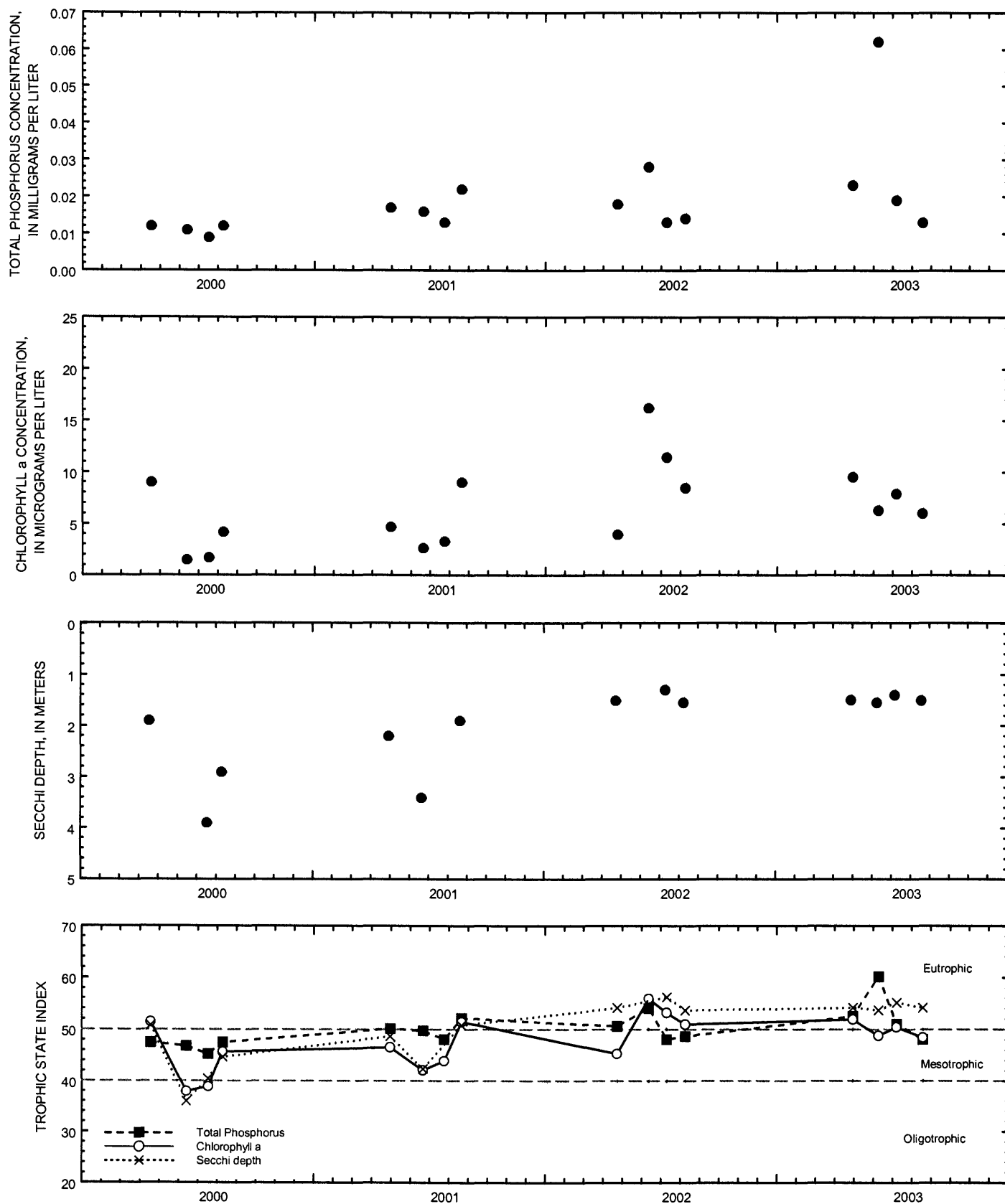
REMARKS.--Lake sampled on north side at a depth of 12 m. Lake ice-covered during February sampling. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 21 TO AUGUST 18, 2003

(Milligrams per liter unless otherwise indicated)

	<u>Feb-21</u>		<u>Apr-29</u>		<u>Jun-9</u>		<u>Jul-7</u>		<u>Aug-18</u>	
Secchi-depth (m)	--	11.5	0.5	11	0.5	11.5	0.5	11.5	0.5	11.5
Depth of sample (m)	--	--	0.5	--	6.3	--	7.88	--	6.03	--
Chlorophyll a, phytoplankton (µg/L)	--	--	9.53	--	19.2	11.7	26.9	12.4	26.4	12.4
Water temperature (°C)	2.9	3.9	12.6	9.8	535	559	527	569	522	612
Specific conductance (µS/cm)	610	711	546	547	8.3	7.4	8.2	7.4	8.3	7.3
pH	8.4	7.9	8.3	8.1	10	0.5	8.4	0.4	9.1	0.4
Dissolved oxygen (mg/L)	15.2	7.8	11.8	8.8	0.062	0.034	0.019	0.026	0.013	0.046
Phosphorus, total (as P)	0.01	0.01	0.023	0.044						





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Big Cedar Lake, North Site, near West Bend, Wisconsin.

432224088154900 BIG CEDAR LAKE, SOUTH SITE, NEAR WEST BEND, WI

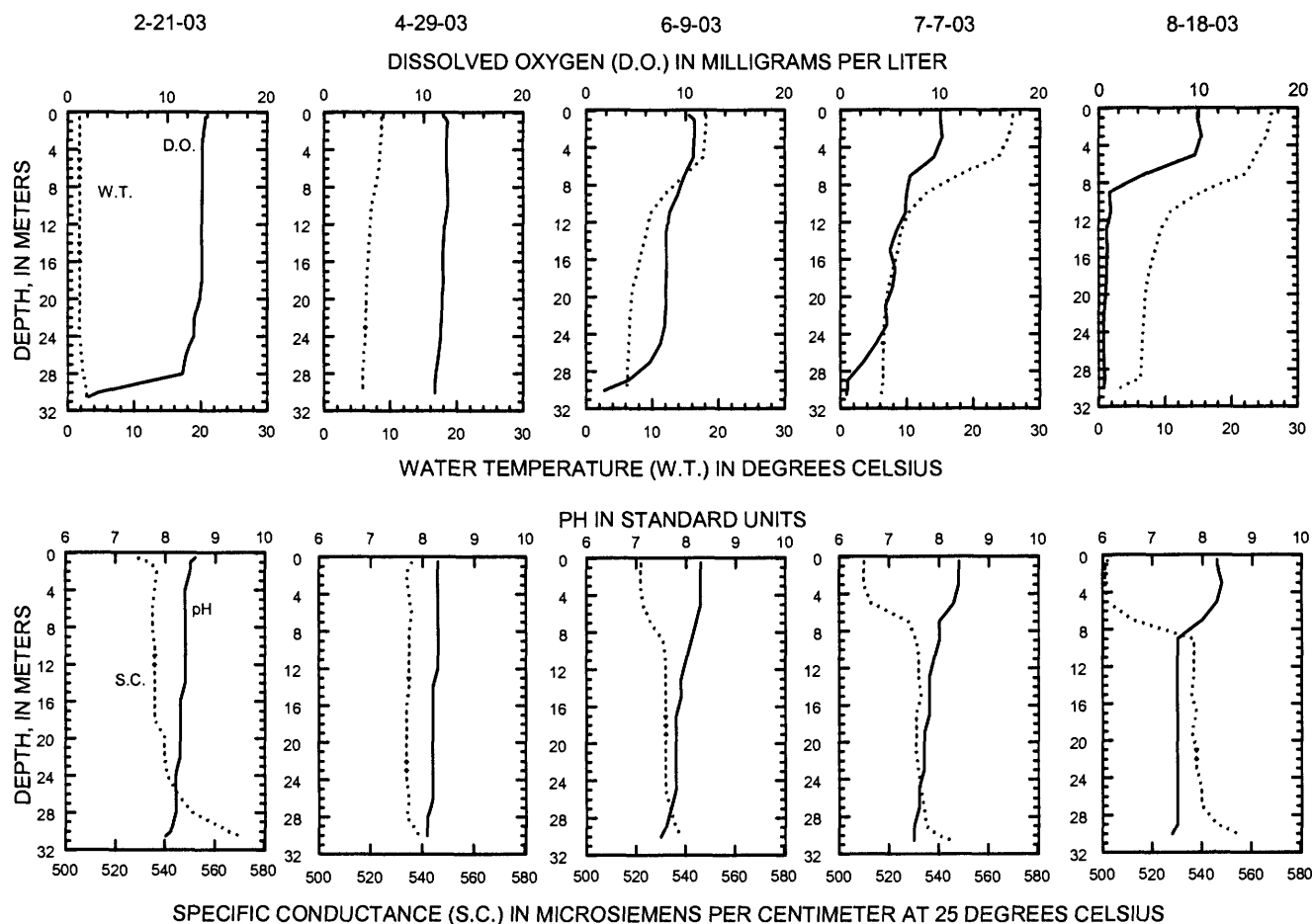
LOCATION.--Lat 43°22'24", long 88°15'49", in NE 1/4 SE 1/4 sec.31, T.11 N., R.19 E., Washington County, Hydrologic Unit 04040003, near West Bend.

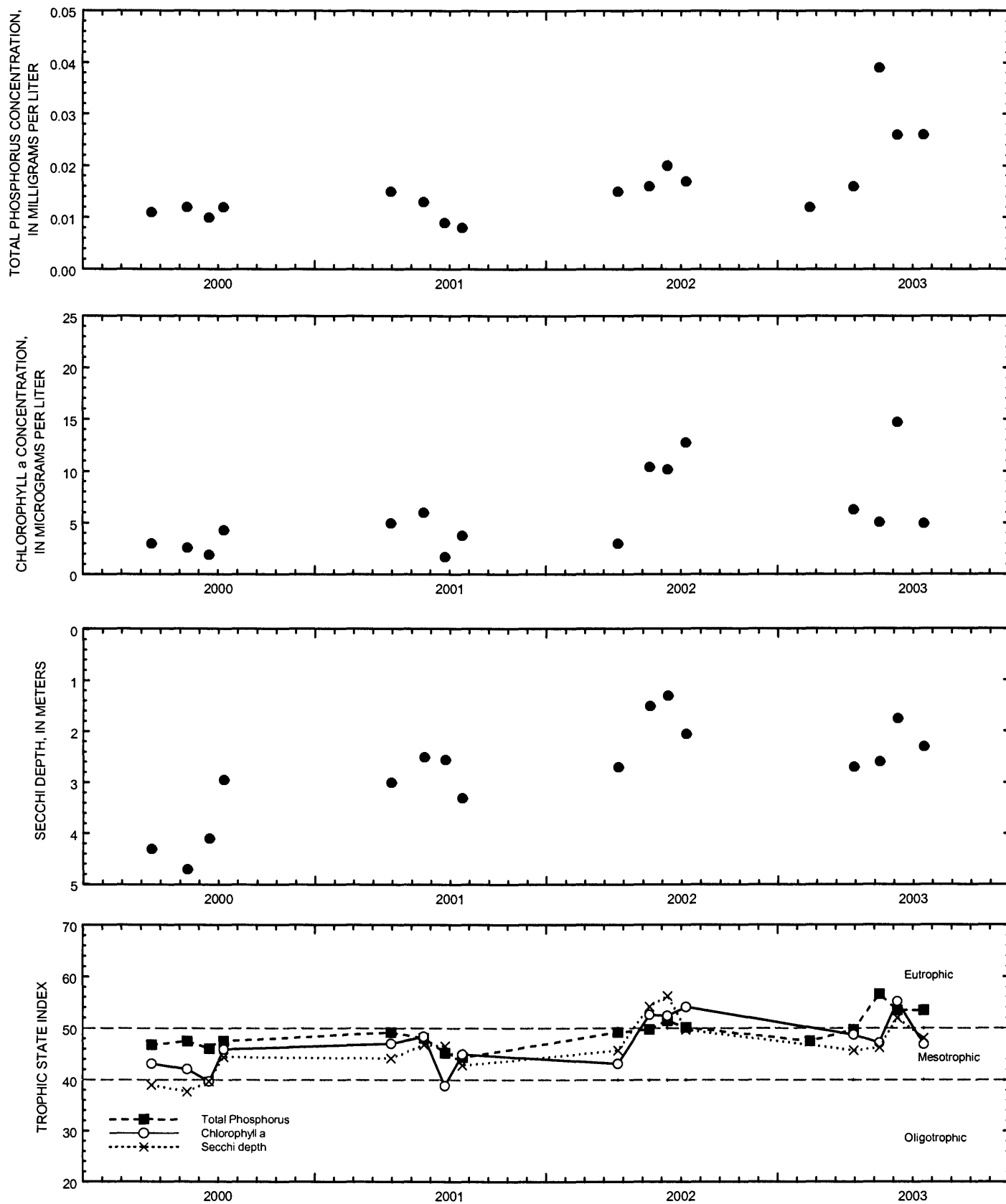
PERIOD OF RECORD.--February 2000 to current year.

REMARKS.--Lake sampled on south side at deep hole. Lake ice-covered during February sampling. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 21 TO AUGUST 18, 2003 (Milligrams per liter unless otherwise indicated)

	<u>Feb-21</u>		<u>Apr-29</u>		<u>Jun-9</u>		<u>Jul-7</u>		<u>Aug-18</u>	
	--		2.7		2.6		1.8		2.3	
Secchi-depth (m)	30.5		30		30		30.5		30	
Depth of sample (m)	--		--		--		--		--	
Chlorophyll a, phytoplankton (µg/L)	--		6.29		5.1		14.7		4.93	
Water temperature (°C)	1.8		8.7		18.1		25.9		26	
Specific conductance (µS/cm)	529		536		522		510		502	
pH	8.6		8.3		8.3		8.4		8.3	
Dissolved oxygen (mg/L)	13.8		12.4		10.9		10		9.9	
Phosphorus, total (as P)	0.012		0.016		0.039		0.026		0.026	
Phosphorus, ortho, dissolved (as P)	--		<0.002		--		0.003		--	
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--		0.19		--		0.041		--	
Nitrogen, ammonia, dissolved (as N)	--		0.018		--		0.015		--	
Nitrogen, amm. + org., total (as N)	--		0.53		--		0.62		--	
Nitrogen, total (as N)	--		0.72		--		--		--	
Color (Pt-Co. scale)	--		5		--		--		--	
Turbidity (NTU)	--		2.1		--		--		--	
Hardness, as CaCO ₃	--		230		--		--		--	
Calcium, dissolved (Ca)	--		37.7		--		--		--	
Magnesium, dissolved (Mg)	--		33.7		--		--		--	
Sodium, dissolved (Na)	--		20		--		--		--	
Potassium, dissolved (K)	--		2		--		--		--	
Alkalinity, as CaCO ₃	--		194		--		--		--	
Sulfate, dissolved (SO ₄)	--		20.4		--		--		--	
Chloride, dissolved (Cl)	--		44.4		--		--		--	
Silica, dissolved (SiO ₂)	--		1.26		--		--		--	
Solids, dissolved, at 180°C	--		296		--		--		--	
Iron, dissolved (Fe) (µg/L)	--		<100		--		--		--	
Manganese, dissolved, (Mn) (µg/L)	--		<1		--		--		--	





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Big Cedar Lake, South Site, near West Bend, Wisconsin.

424800088254800 BOOTH LAKE NEAR EAST TROY, WI

LOCATION.--Lat 42°48'00", long 88°25'48", in SW 1/4 SE 1/4 sec.13, T.4 N., R.17 E., Walworth County, Hydrologic Unit 07120006, 1.6 mi northwest of East Troy.

PERIOD OF RECORD.--February 1992 to August 1994, February 2001 to current year.

REMARKS.--Lake sampled near center of lake at the deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 19 TO JUNE 10, 2003 (Milligrams per liter unless otherwise indicated)

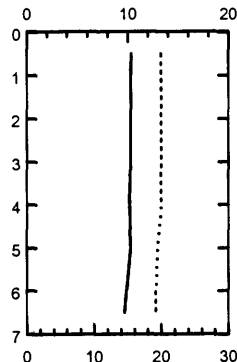
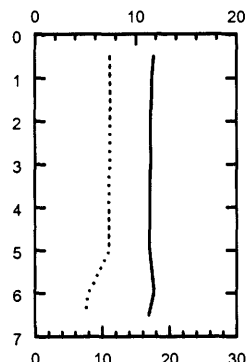
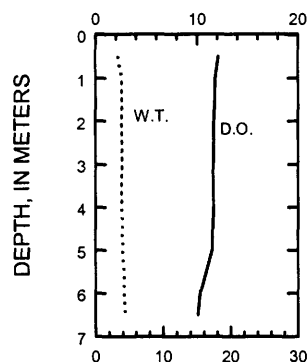
	Feb-19		Apr-15		Jun-10	
Lake stage (ft)	--	--	--	--	11.94	--
Secchi-depth (m)	--	--	5.7	--	2.6	--
Depth of sample (m)	0.5	6.5	0.5	6.5	0.5	6.5
Chlorophyll a, phytoplankton (µg/L)	--	--	0.83	--	3.63	--
Water temperature (°C)	3.3	4.4	11.2	7.5	20	19.2
Specific conductance (µS/cm)	363	373	330	329	328	332
pH	8.4	8.3	7.9	7.9	8.2	8.1
Dissolved oxygen (mg/L)	12.1	10.1	11.8	11.3	10.4	9.7
Phosphorus, total (as P)	0.008	0.005	0.016	0.013	0.013	0.019
Phosphorus, ortho, dissolved (as P)	--	--	<.002	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	0.134	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.163	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	1.6	--	--	--
Nitrogen, total (as N)	--	--	1.7	--	--	--
Color (Pt-Co. scale)	--	--	<5	--	--	--
Turbidity (NTU)	--	--	1.6	--	--	--
Hardness, as CaCO ₃	--	--	160	--	--	--
Calcium, dissolved (Ca)	--	--	33	--	--	--
Magnesium, dissolved (Mg)	--	--	18.8	--	--	--
Sodium, dissolved (Na)	--	--	6.9	--	--	--
Potassium, dissolved (K)	--	--	1	--	--	--
Alkalinity, as CaCO ₃	--	--	135	--	--	--
Sulfate, dissolved (SO ₄)	--	--	15.8	--	--	--
Chloride, dissolved (Cl)	--	--	14.2	--	--	--
Silica, dissolved (SiO ₂)	--	--	0.487	--	--	--
Solids, dissolved, at 180°C	--	--	188	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	<100	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	<1	--	--	--

2-19-03

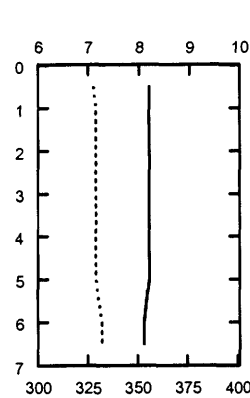
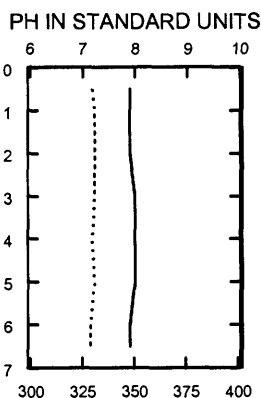
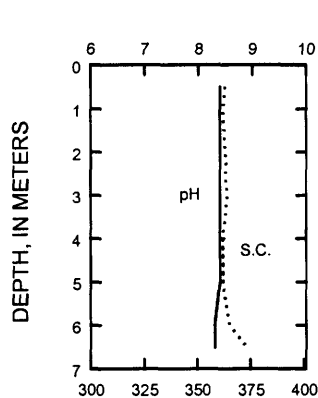
4-15-03

6-10-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

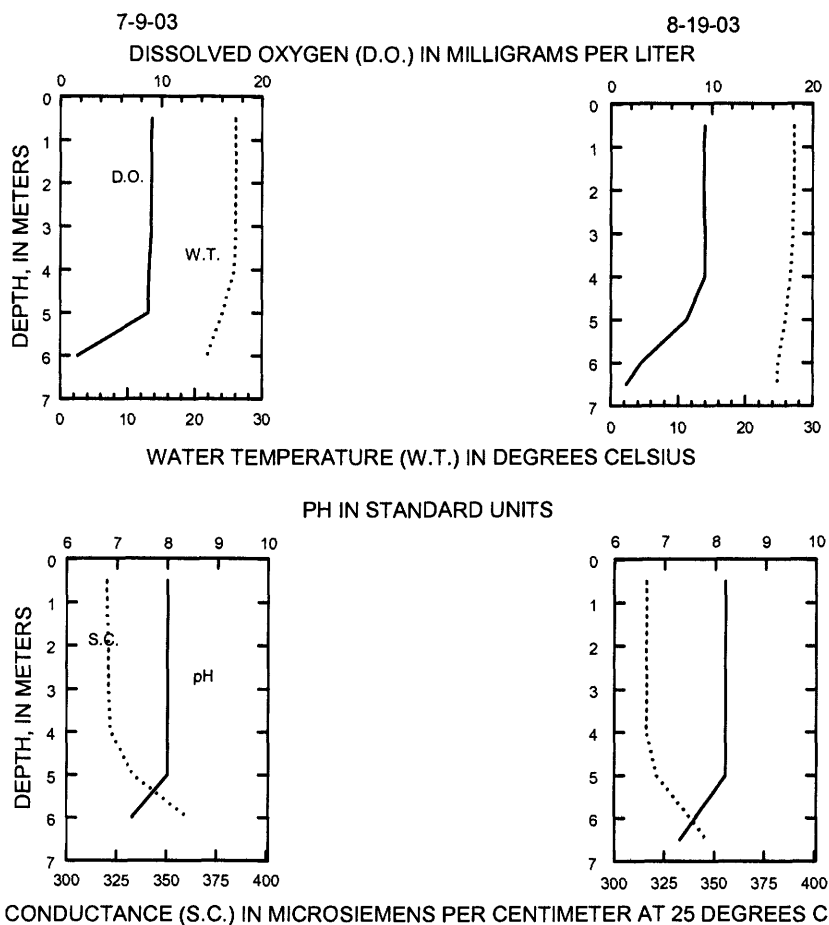


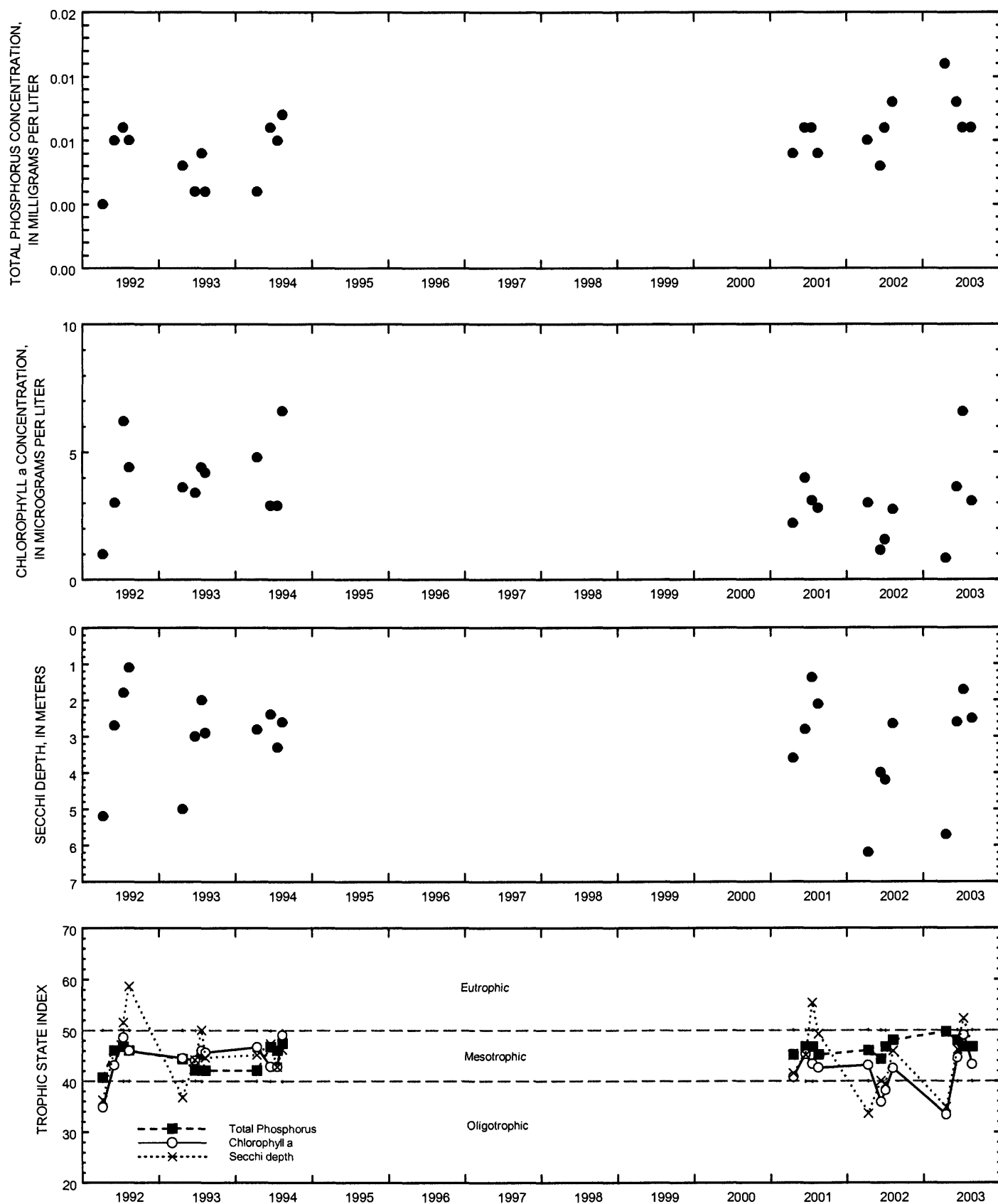
SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

424800088254800 BOOTH LAKE NEAR EAST TROY, WI--CONTINUED

WATER-QUALITY DATA, JULY 9 to AUGUST 19, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Jul-9</u>		<u>Aug-19</u>		
Lake stage (ft)	--	--	12.29	--	
Secchi-depth (m)	--	--	2.5	--	
Depth of sample (m)	0.5	6	0.5	6	6.5
Chlorophyll a, phytoplankton (µg/L)	6.59	--	3.07	--	--
Water temperature (°C)	26.1	21.8	27.2	24.9	24.7
Specific conductance (µS/cm)	320	361	316	338	346
pH	8	7.3	8.2	7.6	7.3
Dissolved oxygen (mg/L)	9.1	1.7	9.3	3	1.5
Phosphorus, total (as P)	0.011	0.019	0.011	0.019	0.026
Phosphorus, ortho, dissolved (as P)	0.003	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	0.027	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	0.015	--	--	--	--
Nitrogen, amm. + org., total (as N)	0.84	--	--	--	--





Surface total phosphorus, chlorophyll a concentrations, Secchi depths,
and TSI data for Booth Lake, near East Troy, Wisconsin.

455854090310300 BUTTERNUT LAKE NEAR PARK FALLS, WI

LOCATION.--Lat 45°58'54", long 90°31'03", in NW 1/4 NW 1/4 NE 1/4 sec.5, T.40 N., R.1 W., Ashland County, Hydrologic Unit 07050002, about 150 ft south of Wisconsin Department of Natural Resources boat landing off County Highway B about 5 mi northwest of Park Falls.

DRAINAGE AREA.--47.6 mi², at lake outlet. Area of Butternut Lake is 1.57 mi².

PERIOD OF RECORD.--October 2002 to September 2003.

GAGE.--Water-stage recorder. Datum of gage is about 1,485 ft above sea level.

EXTREMES FOR CURRENT YEAR.--Maximum recorded gage height, 7.38 ft, May 13; minimum recorded, 4.79 ft, July 30.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	5.16	4.98	4.97	4.84	4.81	5.11	5.42	5.11	5.04	4.87	4.90
2	---	5.14	4.98	4.96	4.85	4.81	5.11	5.36	5.09	5.02	4.90	4.90
3	---	5.13	4.97	4.95	4.88	4.81	5.12	5.31	5.06	5.03	4.91	4.88
4	---	5.11	4.96	4.94	4.89	4.82	5.12	5.27	5.04	5.02	4.92	4.88
5	---	5.10	4.97	4.94	4.88	4.82	5.12	5.24	5.02	4.99	4.94	4.89
6	---	5.09	4.96	4.95	4.88	4.81	5.10	5.26	5.03	4.97	4.94	4.90
7	---	5.08	4.96	4.94	4.87	4.81	5.08	5.27	5.06	4.95	4.93	4.90
8	---	5.07	4.95	4.94	4.86	4.82	5.07	5.27	5.08	4.92	4.93	4.90
9	---	5.07	4.95	4.95	4.86	4.83	5.07	5.32	5.08	4.90	4.93	4.91
10	---	5.08	4.94	4.95	4.86	4.82	5.11	5.42	5.12	4.90	4.93	4.91
11	---	5.08	4.94	4.94	4.85	4.82	5.22	5.77	5.21	4.92	4.92	4.90
12	---	5.09	4.94	4.93	4.85	4.82	5.32	6.70	5.26	4.92	4.91	4.93
13	---	5.09	4.94	4.93	4.84	4.83	5.38	7.32	5.26	4.91	4.91	4.96
14	---	5.08	4.94	4.92	4.84	4.84	5.41	7.24	5.23	4.90	4.91	4.96
15	---	5.09	4.94	4.91	4.83	4.86	5.43	6.85	5.19	4.90	4.91	4.98
16	---	5.08	4.94	4.90	4.83	4.97	5.53	6.48	5.15	4.88	4.91	5.00
17	---	5.06	4.94	4.89	4.83	5.12	5.64	6.18	5.11	4.88	4.90	5.00
18	---	5.05	4.98	4.89	4.83	5.18	5.65	5.94	5.07	4.87	4.89	5.00
19	5.30	5.04	5.04	4.89	4.83	5.16	5.67	5.76	5.03	4.86	4.89	5.05
20	5.28	5.03	5.08	4.88	4.83	5.18	5.91	5.68	5.01	4.86	4.91	5.05
21	5.28	5.03	5.08	4.88	4.83	5.20	6.19	5.63	4.98	4.88	4.91	5.05
22	5.27	5.03	5.08	4.87	4.83	5.19	6.41	5.57	4.95	4.88	4.90	5.08
23	5.26	5.02	5.07	4.86	4.83	5.19	6.44	5.49	4.99	4.87	4.90	5.08
24	5.24	5.01	5.06	4.85	4.83	5.21	6.31	5.42	5.01	4.85	4.91	5.08
25	5.22	5.01	5.04	4.85	4.82	5.22	6.12	5.34	5.06	4.85	4.91	5.07
26	5.22	5.00	5.03	4.85	4.82	5.22	5.94	5.29	5.08	4.84	4.92	5.08
27	5.22	4.99	5.02	4.84	4.82	5.21	5.80	5.25	5.07	4.83	4.92	5.10
28	5.21	4.99	5.01	4.85	4.81	5.24	5.67	5.22	5.06	4.82	4.92	5.12
29	5.20	4.98	5.00	4.85	---	5.20	5.57	5.18	5.06	4.82	4.91	5.13
30	5.19	4.98	4.99	4.85	---	5.16	5.49	5.17	5.05	4.82	4.91	5.13
31	5.18	---	4.99	4.84	---	5.13	---	5.14	---	4.86	4.91	---
MEAN	---	5.06	4.99	4.90	4.84	5.00	5.54	5.67	5.08	4.90	4.91	4.99
MAX	---	5.16	5.08	4.97	4.89	5.24	6.44	7.32	5.26	5.04	4.94	5.13
MIN	---	4.98	4.94	4.84	4.81	4.81	5.07	5.14	4.95	4.82	4.87	4.88

455803090310800 BUTTERNUT LAKE, DEEP HOLE, NEAR PARK FALLS, WI

LOCATION.--Lat 45°58'03", long 90°31'08", in NW 1/4 NW 1/4 NE 1/4 sec.8, T.40 N., R.1 W., Ashland County, Hydrologic Unit 07050002, near Park Falls.

PERIOD OF RECORD.--March to September 2003.

REMARKS.--Lake sampled at deep hole at a lake depth of about 8 m. Lake ice-covered during March sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MARCH 10 TO JULY 16, 2003 (Milligrams per liter unless otherwise indicated)

	Mar-10		May-13		Jun-18		Jul-16	
Lake stage (ft)	--	--	7.29	--	5	--	4.87	--
Secchi-depth (m)	--	--	1.25	--	1.5	--	1.35	--
Depth of sample (m)	1	8	0.5	8	0.5	7.5	0.5	8.5
Chlorophyll a, phytoplankton (µg/L)	--	--	2.56	--	7.44	--	15.7	--
Water temperature (°C)	0.4	4.7	10.7	8.6	22.4	14.2	21.6	16.6
Specific conductance (µS/cm)	132	202	81	50	76	82	89	108
pH	7.3	6.9	7.6	7.2	7.6	6.8	7.6	7
Dissolved oxygen (mg/L)	10.1	1.1	9.8	9.3	9	2.2	8.1	0.1
Phosphorus, total (as P)	0.041	0.1	0.037	0.0	0.027	0.12	0.045	0.24
Phosphorus, ortho, dissolved (as P)	--	--	0.013	--	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	0.218	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.072	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.56	--	--	--	--	--
Nitrogen, total (as N)	--	--	0.78	--	--	--	--	--
Color (Pt-Co. scale)	--	--	70	--	--	--	--	--
Turbidity (NTU)	--	--	3	--	--	--	--	--
Hardness, as CaCO ₃	--	--	40	--	--	--	--	--
Calcium, dissolved (Ca)	--	--	10.3	--	--	--	--	--
Magnesium, dissolved (Mg)	--	--	3.4	--	--	--	--	--
Sodium, dissolved (Na)	--	--	2.4	--	--	--	--	--
Potassium, dissolved (K)	--	--	<1.00	--	--	--	--	--
Alkalinity, as CaCO ₃	--	--	33	--	--	--	--	--
Sulfate, dissolved (SO ₄)	--	--	4.7	--	--	--	--	--
Chloride, dissolved (Cl)	--	--	3.7	--	--	--	--	--
Silica, dissolved (SiO ₂)	--	--	8.43	--	--	--	--	--
Solids, dissolved, at 180°C	--	--	68	--	--	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	200	--	--	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	40	--	--	--	--	--

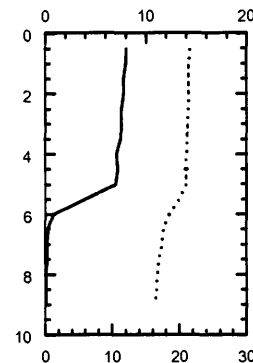
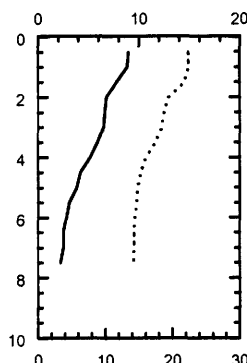
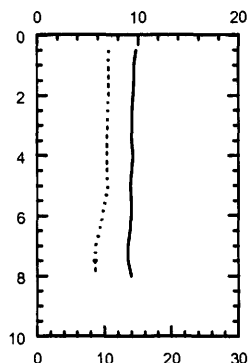
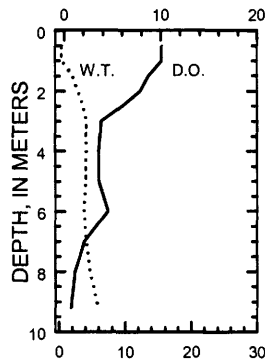
3-10-03

5-13-03

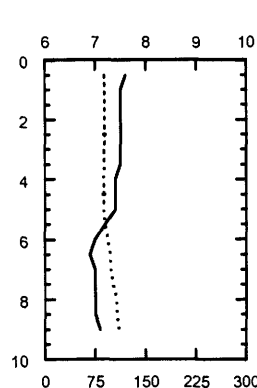
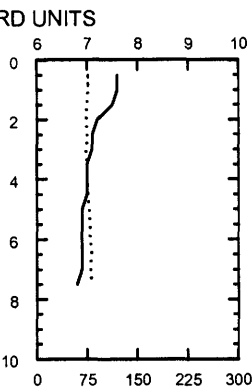
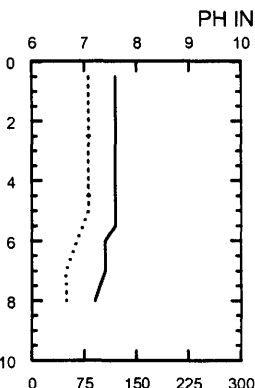
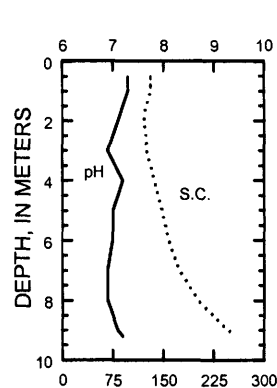
6-18-03

7-16-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

455803090310800 BUTTERNUT LAKE, DEEP HOLE, NEAR PARK FALLS, WI--CONTINUED

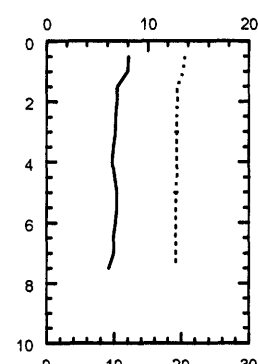
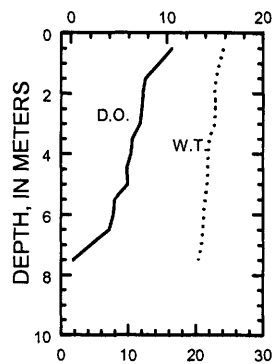
WATER-QUALITY DATA, AUGUST 13 TO SEPTEMBER 16, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Aug-13</u>					<u>Sep-16</u>	
Lake stage (ft)			4.91			4.99	
Secchi-depth (m)			1.25			0.85	
Depth of sample (m)	0.5	0.5	0.5	4	7	0.5	7
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	44	46.1	45.2	--	--	33.9	--
Water temperature ($^{\circ}\text{C}$)	24.1	24.1	24.1	21.9	20.8	20.5	--
Specific conductance ($\mu\text{S/cm}$)	96	96	96	100	107	106	--
pH	9.1	9.1	9.1	7.5	7.1	7.9	--
Dissolved oxygen (mg/L)	10.5	10.5	10.5	6.3	2	8.1	--
Phosphorus, total (as P)	0.04	0.042	0.008	0.036	0.036	0.046	0.051
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	--	--	<.034	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.013	--	--	--	--
Nitrogen, amm. + diss., total (as N)	--	--	0.46	--	--	--	--

8-13-03

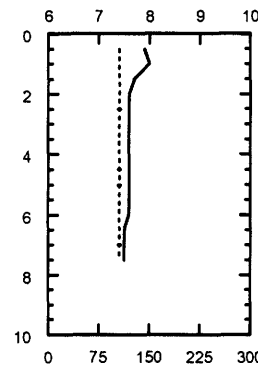
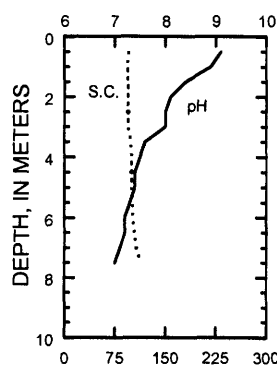
9-16-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

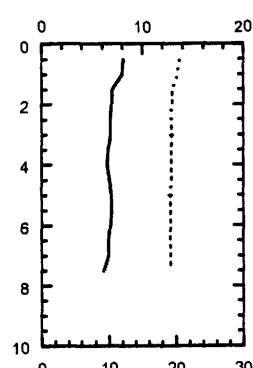
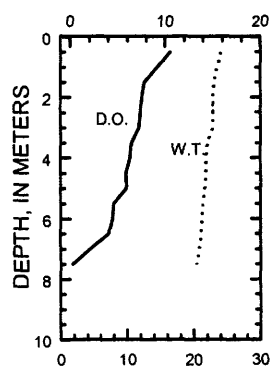
WATER-QUALITY DATA, AUGUST 13 TO SEPTEMBER 16, 2003
(Milligrams per liter unless otherwise indicated)

	Aug-13			Sep-16	
Lake stage (ft)		4.91		4.99	
Secchi-depth (m)		1.25		0.85	
Depth of sample (m)	0.5	4	7	0.5	7
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	44	--	--	33.9	--
Water temperature ($^{\circ}\text{C}$)	24.1	21.9	20.8	20.5	--
Specific conductance ($\mu\text{S/cm}$)	96	100	107	106	--
pH	9.1	7.5	7.1	7.9	--
Dissolved oxygen (mg/L)	10.5	6.3	2	8.1	--
Phosphorus, total (as P)	0.04	0.036	0.036	0.046	0.051
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	<0.034	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	0.013	--	--	--	--
Nitrogen, amm. + diss., total (as N)	0.46	--	--	--	--

8-13-03

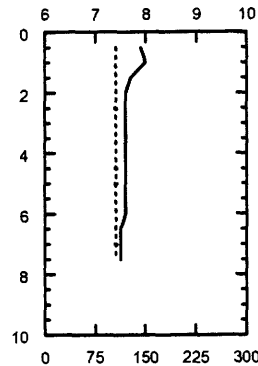
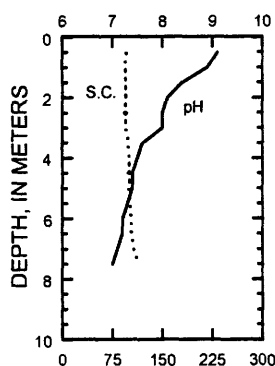
9-16-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER

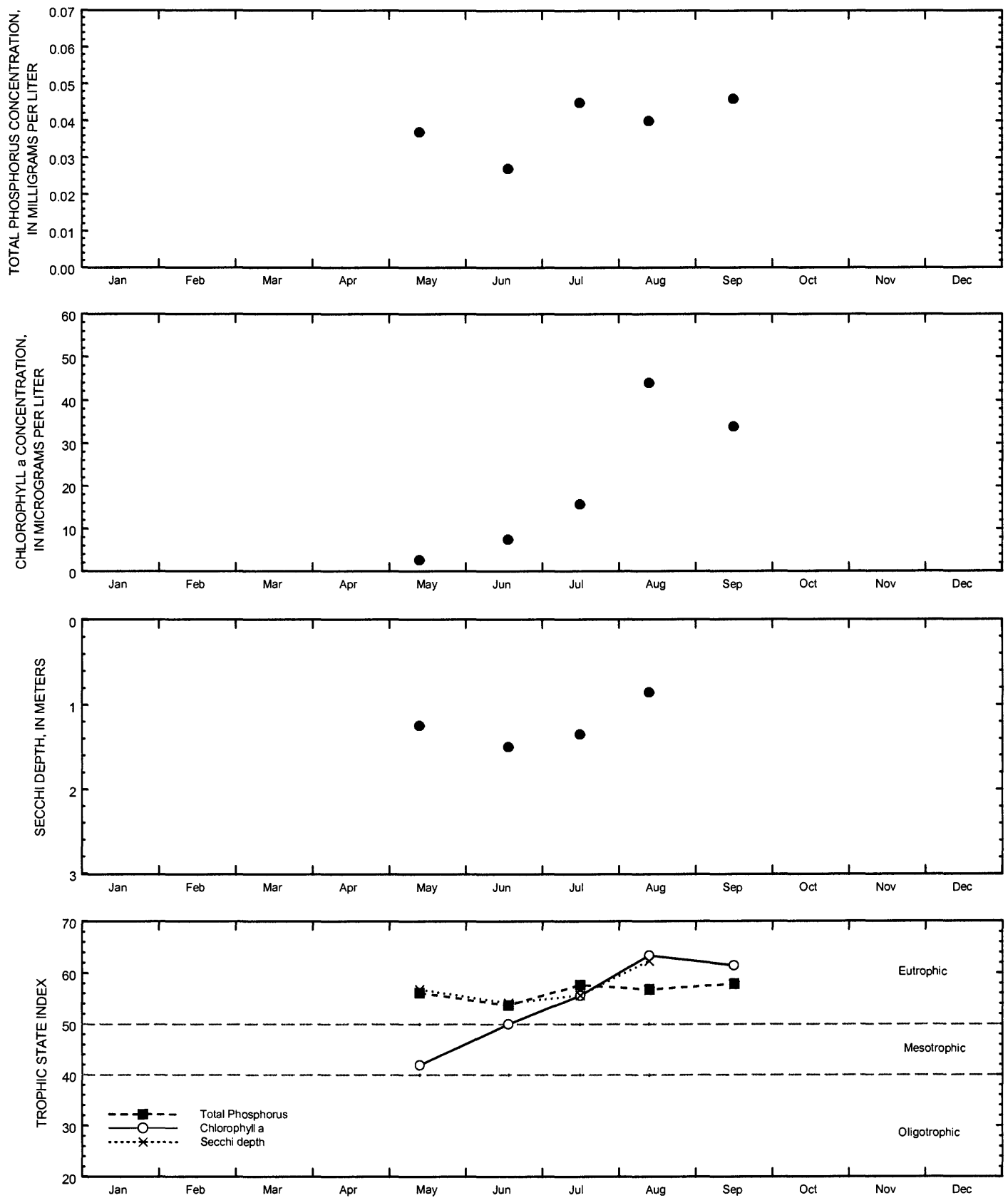


WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Butternut Lake, Deep Hole, near Park Falls, Wisconsin.

455904090303400 BUTTERNUT LAKE, NORTH SITE, NEAR BUTTERNUT, WI

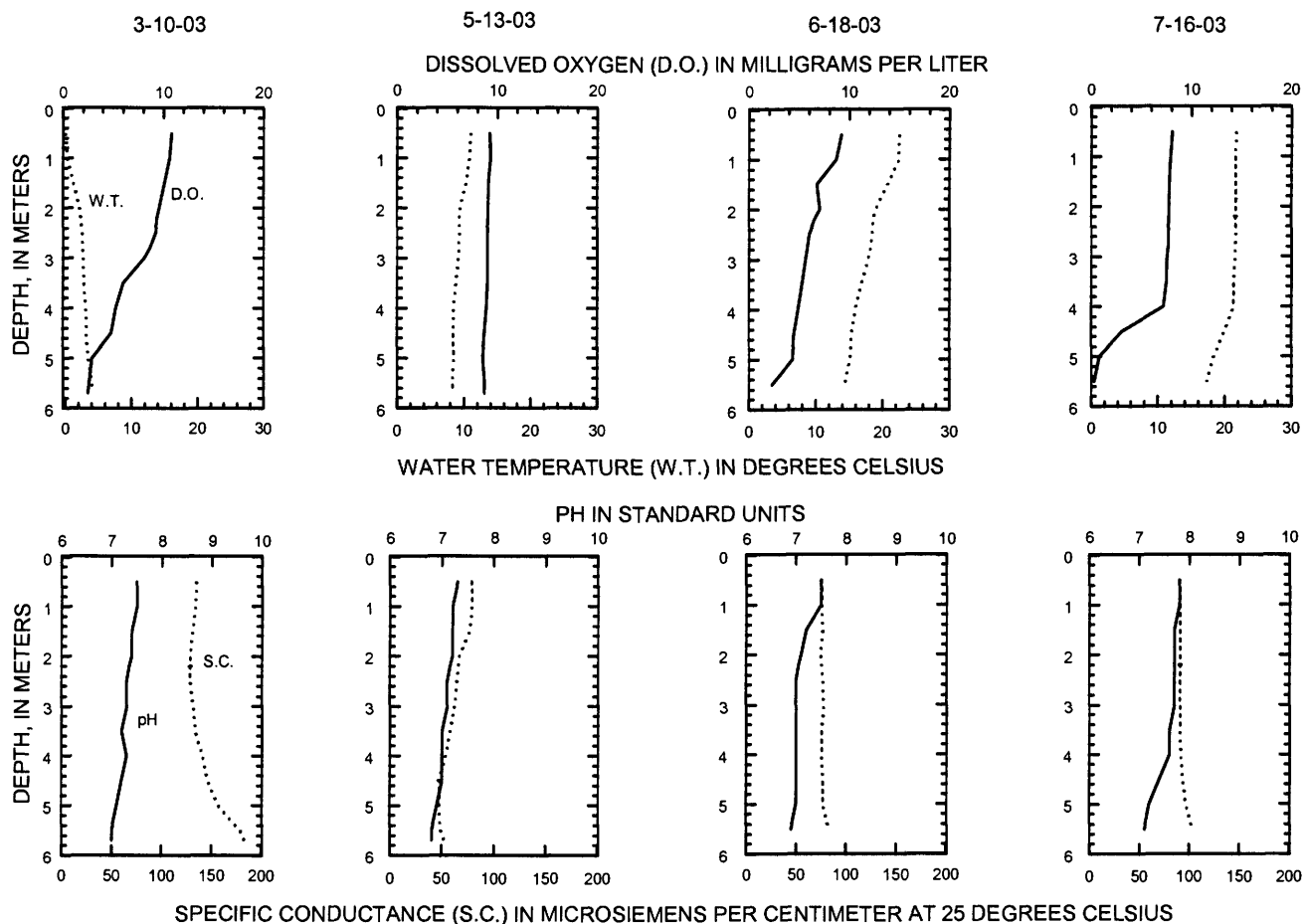
LOCATION.--Lat 45°59'04", long 90°30'34", in NE 1/4 SE 1/4 NE 1/4 sec.32, T.41 N., R.1 W., Ashland County, Hydrologic Unit 07050002, near Butternut.

PERIOD OF RECORD.--March to September 2003.

REMARKS.--Lake sampled at North Site at a lake depth of about 5.5 m. Lake ice-covered during March sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MARCH 10 TO JULY 16, 2003
(Milligrams per liter unless otherwise indicated)

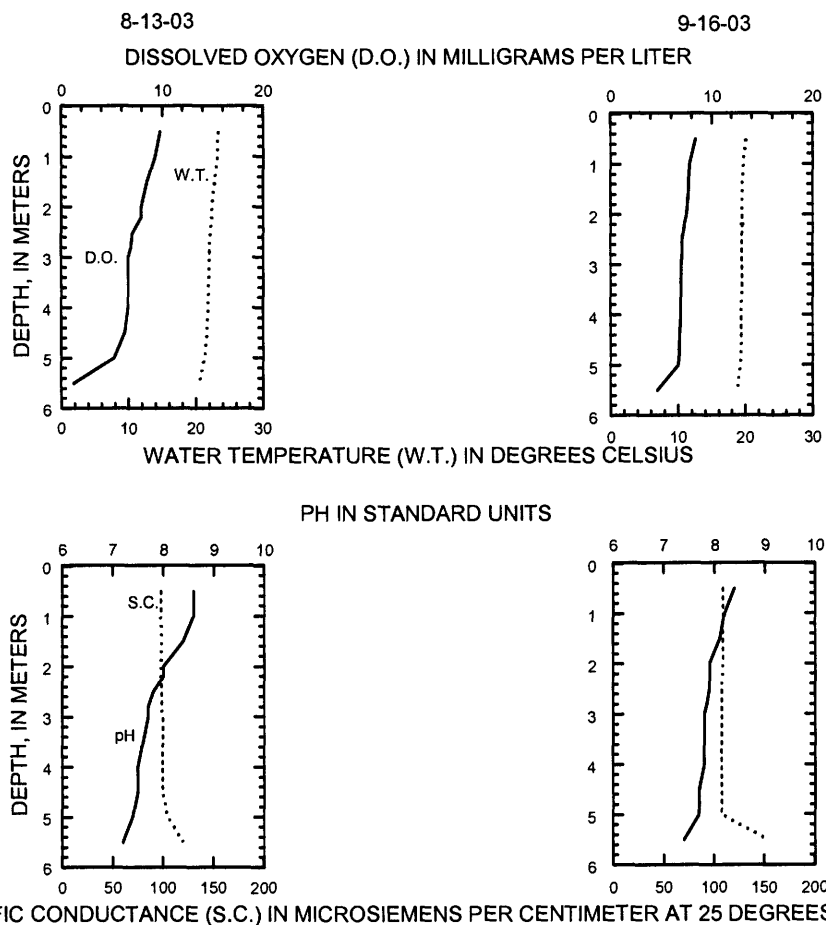
	<u>Mar-10</u>		<u>May-13</u>		<u>Jun-18</u>		<u>Jul-16</u>	
Lake stage (ft)	--		7.29		5		4.87	
Secchi-depth (m)	--		1.2		1.3		1.1	
Depth of sample (m)	5		6		5.5		5.5	
Chlorophyll a, phytoplankton (µg/L)	--		1.85		9.13		16.4	
Water temperature (°C)	0.3		11		22.5		21.7	
Specific conductance (µS/cm)	134		79		76		91	
pH	7.5		7.3		7.5		7.8	
Dissolved oxygen (mg/L)	10.6		9.2		9.2		8.1	
Phosphorus, total (as P)	0.031		0.035		0.032		0.045	

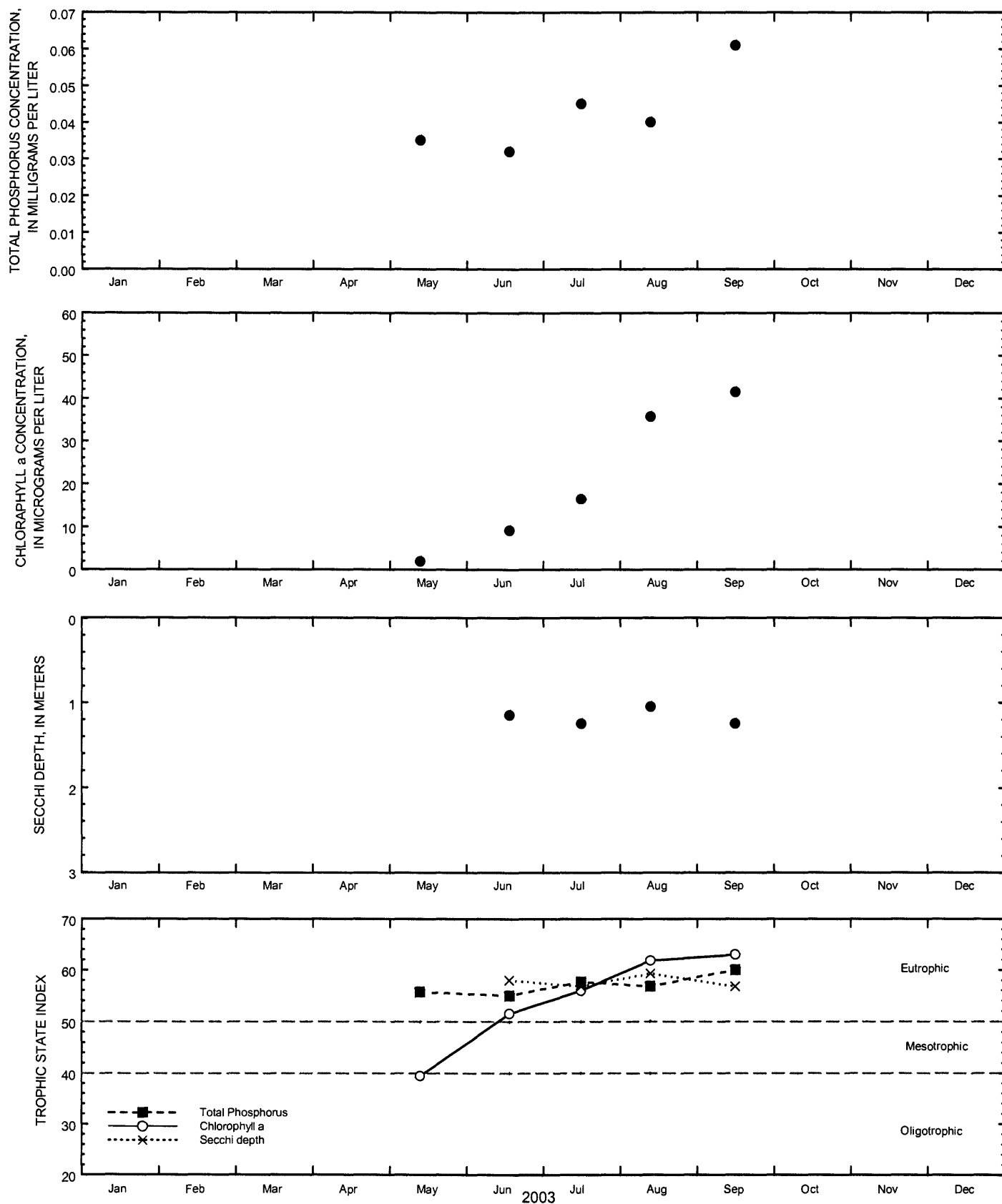


455904090303400 BUTTERNUT LAKE, NORTH SITE, NEAR BUTTERNUT, WI--CONTINUED

WATER-QUALITY DATA, AUGUST 13 TO SEPTEMBER 16, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Aug-13</u>		<u>Sep-16</u>	
Lake stage (ft)	4.91		4.99	
Secchi-depth (m)	1.05		1.25	
Depth of sample (m)	0.5	5	0.5	5.5
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	35.6	--	41.4	--
Water temperature ($^{\circ}\text{C}$)	23.3	21.3	20.1	18.8
Specific conductance ($\mu\text{S/cm}$)	98	105	109	153
pH	8.6	7.4	8.4	7.4
Dissolved oxygen (mg/L)	9.8	5.2	8.4	4.6
Phosphorus, total (as P)	0.04	0.037	0.061	0.053





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Butternut Lake, North Site, near Butternut, Wisconsin.

455731090311000 BUTTERNUT LAKE, SOUTH SITE, NEAR PARK FALLS, WI

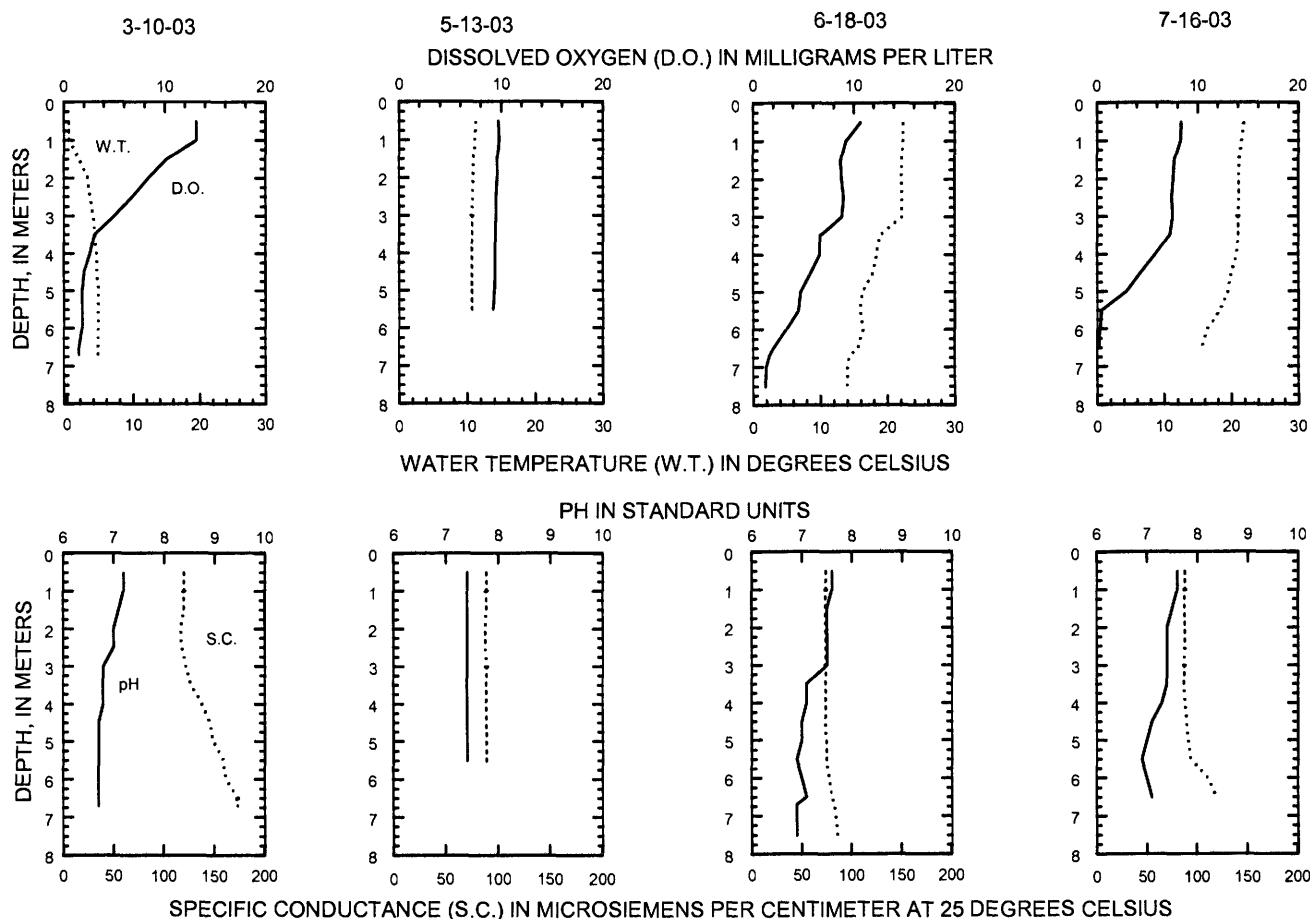
LOCATION.--Lat 45°57'31", long 90°31'10", in SW 1/4 NW 1/4 SE 1/4 sec.8, T.40 N., R.1 W., Ashland County, Hydrologic Unit 07050002, near Park Falls.

PERIOD OF RECORD.--March to September 2003.

REMARKS.--Lake sampled at South Site at a lake depth of about 6 m. Lake ice-covered during March sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MARCH 10 TO JULY 16, 2003 (Milligrams per liter unless otherwise indicated)

	<u>Mar-10</u>		<u>May-13</u>		<u>Jun-18</u>		<u>Jul-16</u>	
Lake stage (ft)	--		7.29		5		4.87	
Secchi-depth (m)	--		1.25		1.4		1.25	
Depth of sample (m)	1	6	0.5	5.5	0.5	7.5	0.5	6
Chlorophyll a, phytoplankton (µg/L)	--	--	2.5	--	9.81	--	19	--
Water temperature (°C)	0.3	4.8	11.3	10.7	22.4	14.1	21.9	16.4
Specific conductance (µS/cm)	120	162	89	89	74	85	88	111
pH	7.2	6.7	7.4	7.4	7.6	6.9	7.6	7
Dissolved oxygen (mg/L)	13.1	1.8	9.7	9.2	10.7	1.3	8.4	0.3
Phosphorus, total (as P)	0.036	0.07	0.037	0.037	0.031	0.193	0.045	0.109



455731090311000 BUTTERNUT LAKE, SOUTH SITE, NEAR PARK FALLS, WI--CONTINUED

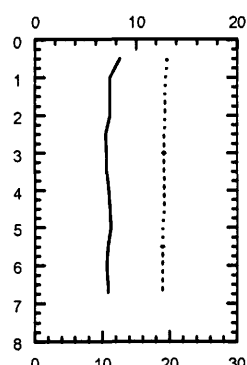
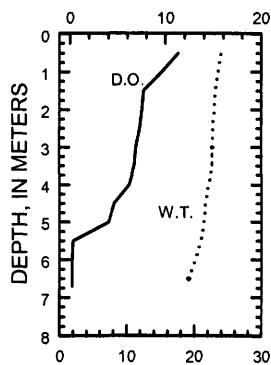
WATER-QUALITY DATA, AUGUST 13 TO SEPTEMBER 16, 2003
(Milligrams per liter unless otherwise indicated)

		<u>Aug-13</u>		<u>Sep-16</u>	
Lake stage (ft)		4.91		4.99	
Secchi-depth (m)		0.9		1.3	
Depth of sample (m)		5	6	0.5	6
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	0.5	--	--	31.9	--
Water temperature ($^{\circ}\text{C}$)	24	21.5	20.2	19.6	18.9
Specific conductance ($\mu\text{S/cm}$)	96	102	126	105	105
pH	9.3	7.2	7.1	7.9	7.6
Dissolved oxygen (mg/L)	11.3	4	0.2	8.4	7.1
Phosphorus, total (as P)	0.055	0.035	0.045	0.053	0.046

8-13-03

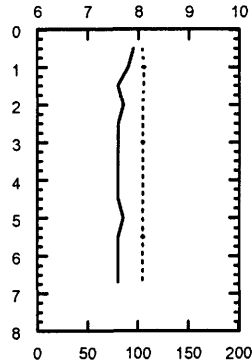
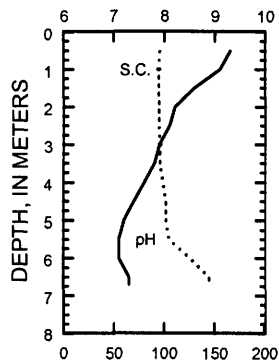
9-16-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER

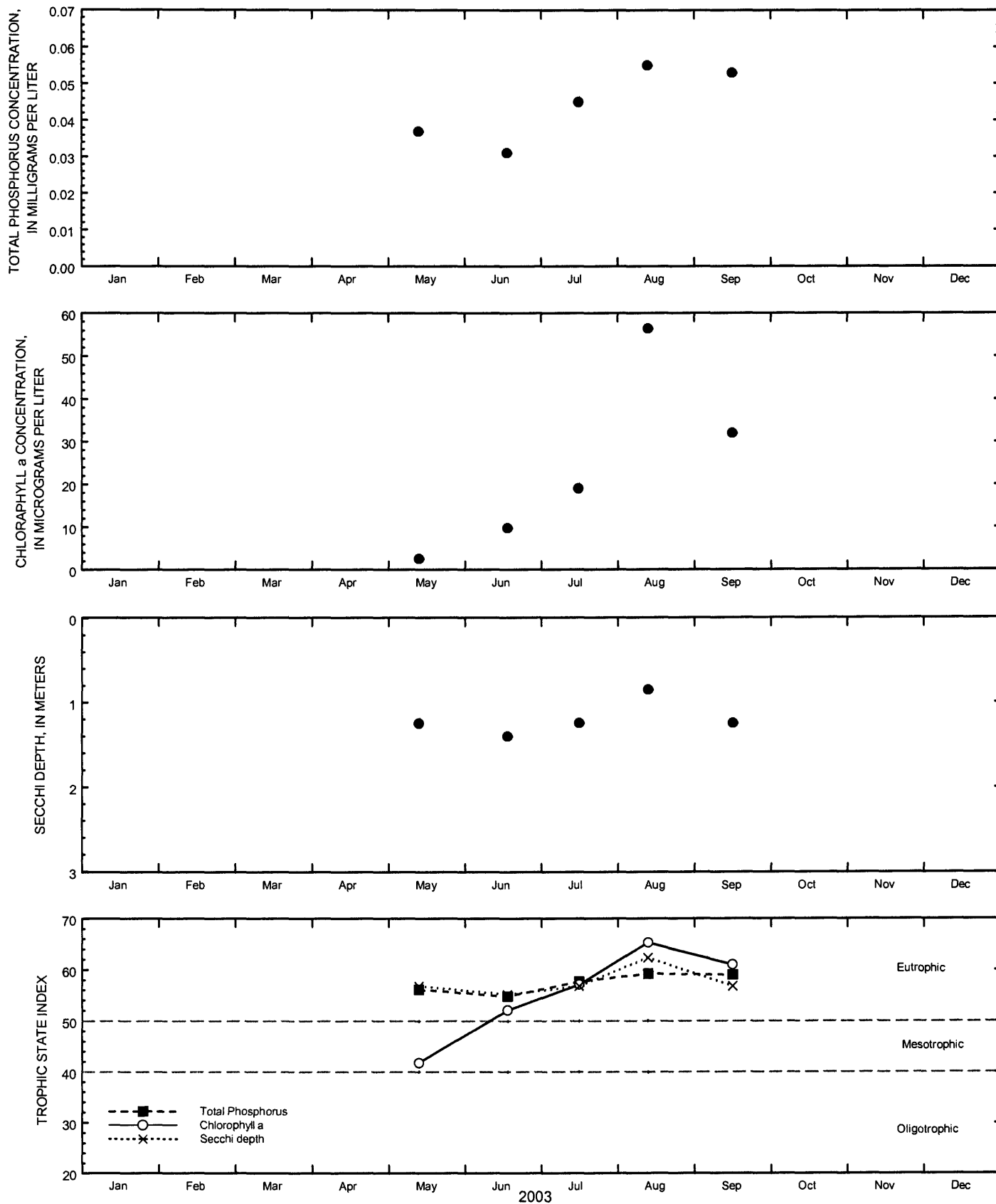


WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Butternut Lake, South Site, near Park Falls, Wisconsin.

455651090312700 BUTTERNUT LAKE, FAR SOUTH SITE, NEAR PARK FALLS, WI

LOCATION.--Lat 45°56'51", long 90°31'27", in SW 1/4 SE 1/4 NE 1/4 sec.17, T.40 N., R.1 W., Ashland County, Hydrologic Unit 07050002, near Park Falls.

PERIOD OF RECORD.--March to September 2003.

REMARKS.--Lake sampled at deep hole at Far South Site at a lake depth of about 4 m. Lake ice-covered during March sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MARCH 10 TO JULY 16, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Mar-10</u>		<u>May-13</u>		<u>Jun-18</u>		<u>Jul-16</u>	
Lake stage (ft)	--		7.29		5.0		4.87	
Secchi-depth (m)	--		1.55		1.55		1.25	
Depth of sample (m)	1	4.5	0.5	4	0.5	4.2	0.5	4
Water temperature (°C)	0.7	4.5	11.9	10.7	22.5	15.5	21.7	18.9
Specific conductance (µS/cm)	123	131	89	89	74	76	87	92
pH	7.1	7.2	7.3	7.4	7.8	6.9	7.5	6.9
Dissolved oxygen (mg/L)	11.1	3.9	10.3	9	9.5	3.1	8.4	0.7

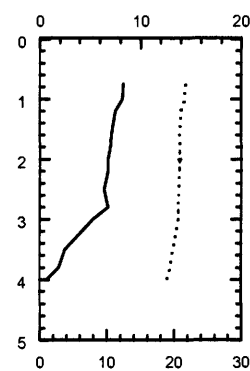
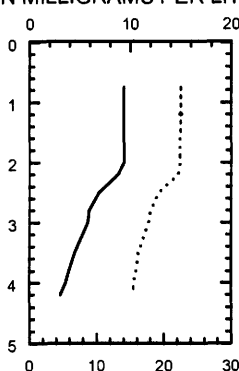
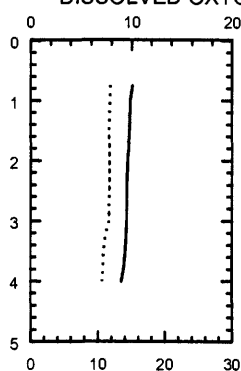
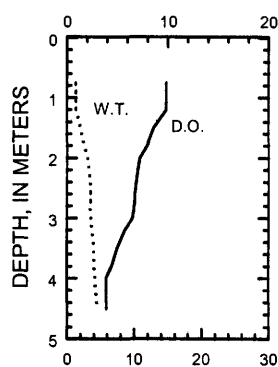
3-10-03

5-13-03

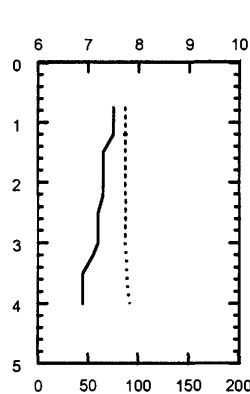
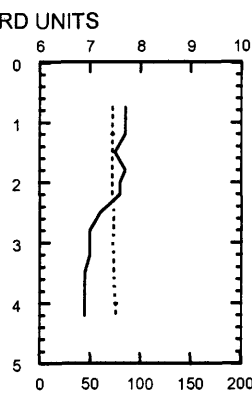
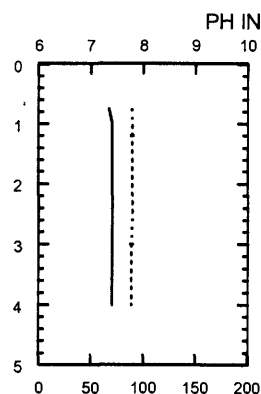
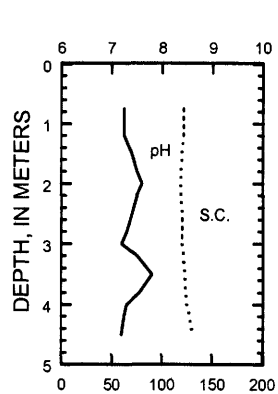
6-18-03

7-16-03

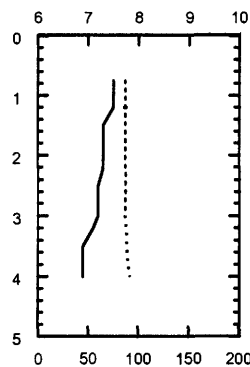
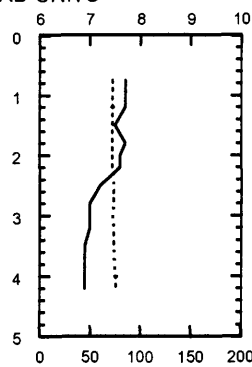
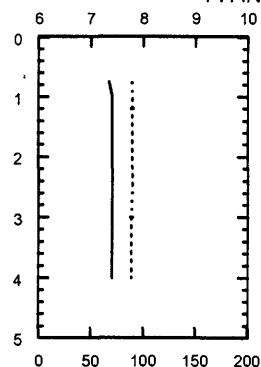
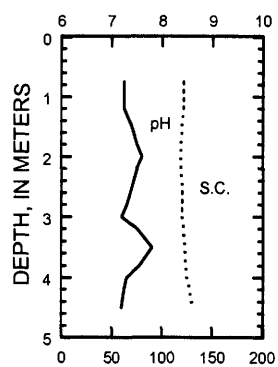
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

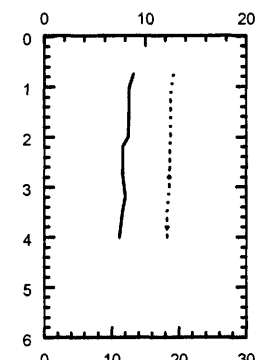
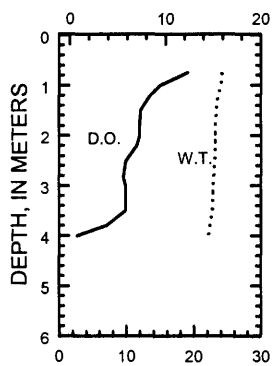
WATER-QUALITY DATA, AUGUST 13 TO SEPTEMBER 16, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Aug-13</u>		<u>Sep-16</u>	
Lake stage (ft)	4.91		4.99	
Secchi-depth (m)	0.65		--	
Depth of sample (m)	0.5	4	0.5	4
Water temperature (°C)	25.4	22.2	20.5	18.2
Specific conductance (μS/cm)	99	108	105	105
pH	9.4	7.2	8.5	7.6
Dissolved oxygen (mg/L)	13.1	0.7	9.8	7.4

8-13-03

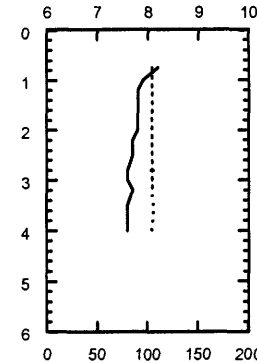
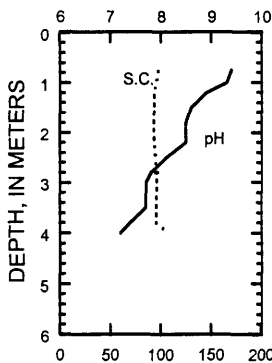
9-16-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER

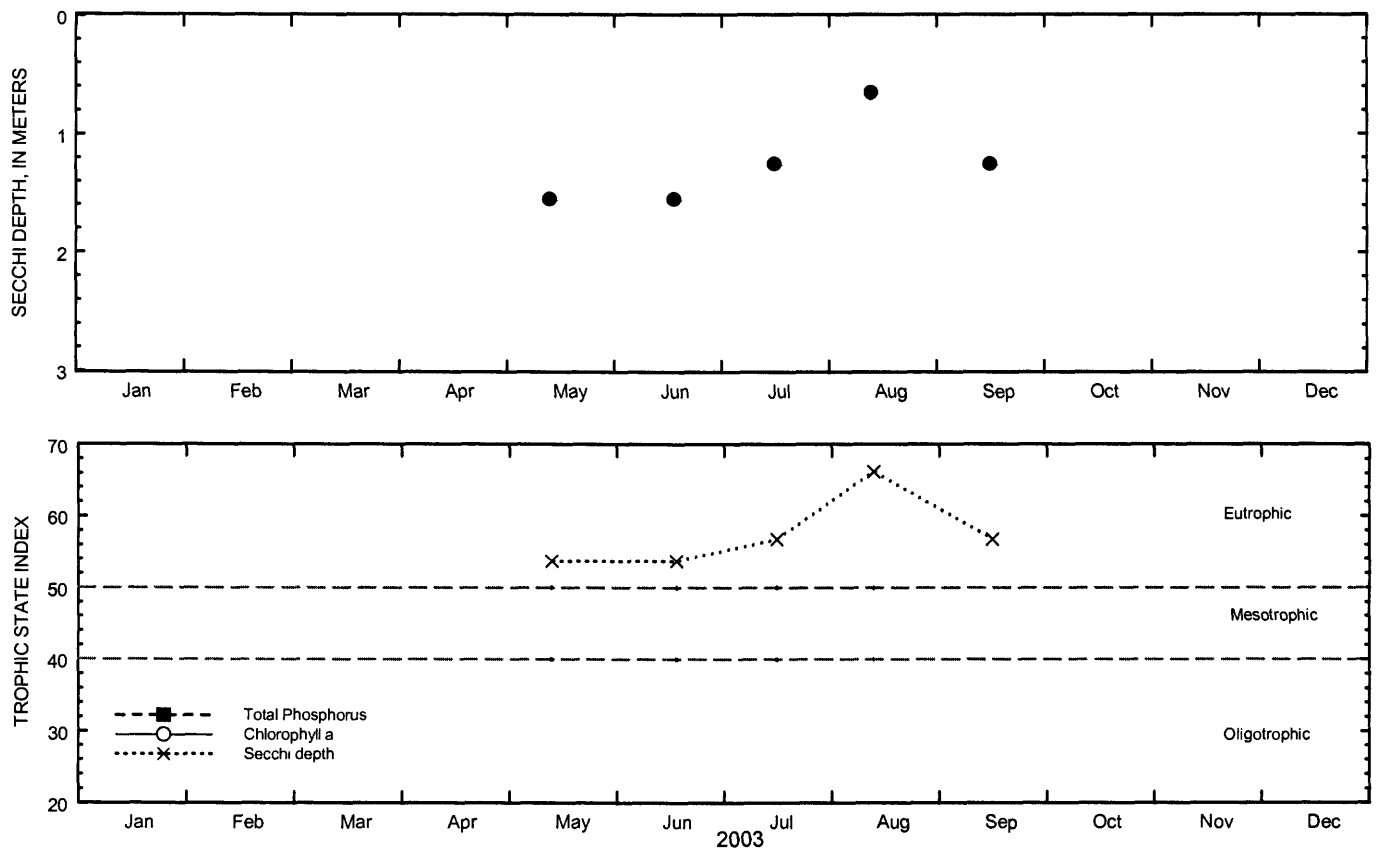


WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Butternut Lake, Far South Site, near Park Falls, Wisconsin.

423706088363400 DELAVAN LAKE NEAR DELAVAN, WI

LOCATION.--Lat 42°36'27", long 88°36'19", in SW 1/4 NE 1/4 sec.28, T.2 N., R.16 E., Walworth County, Hydrologic Unit 07090001, at Delavan Lake Sanitary District Lift Station No. 2 at Delavan Lake Yacht Club, 1.0 mi southeast of outlet, and 2.7 mi southeast of Delavan.

DRAINAGE AREA.--41.4 mi², of which 2.3 mi² is non-contributing. Area of Delavan Lake, 2,072 acres.

PERIOD OF RECORD.--October 1983 to current year. October 1983 to September 1985 data published in Water Resources Investigation series report "Water Quality and Hydrology of Delavan Lake in Southeastern Wisconsin" by S. J. Field and M. D. Duerk (1988).

GAGE.--Water-stage recorder. Datum of gage is 922.92 ft above sea level. Prior to Sept. 5, 1989, staff gage at bridge on North Shore Drive at same datum.

REMARKS.--Lake was ice covered from Dec. 4-19 and Jan. 14 to Mar. 28. Lake levels controlled by Delavan Lake Sanitary District. Gage-height telemeter at station.

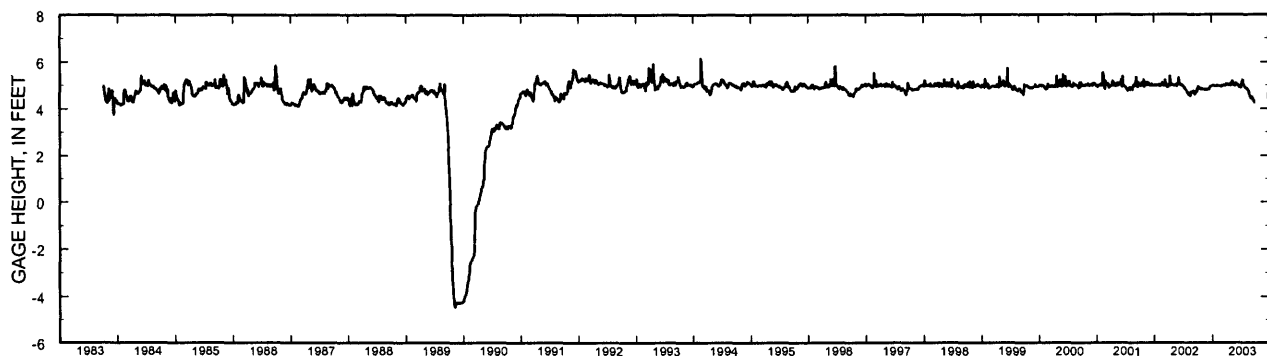
EXTREMES FOR PERIOD OF RECORD.--Maximum gage height observed, 6.19 ft, Feb. 21, 1994; minimum daily, -4.44 ft, Nov. 6, 1989 (lake drawn down for lake rehabilitation program).

EXTREMES FOR CURRENT YEAR.--Maximum gage height, 5.26 ft, July 15, 16; minimum, 4.26 ft, Sept. 30.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003 DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.77	4.84	4.82	e4.97	4.97	4.96	5.05	5.11	5.09	4.92	4.89	4.56
2	4.86	4.82	4.82	e4.97	4.97	4.96	5.06	5.09	5.08	4.91	4.88	4.55
3	4.88	4.82	4.83	4.97	e4.98	4.95	5.06	5.06	e5.07	4.89	4.88	4.53
4	4.92	4.82	4.83	4.97	e5.00	4.96	5.07	5.04	5.06	4.90	4.90	4.51
5	4.96	4.82	4.83	4.98	4.99	5.00	5.07	5.10	5.04	4.95	4.89	4.50
6	4.95	4.82	4.83	4.99	4.99	5.00	5.06	5.09	5.02	4.99	4.89	4.48
7	4.92	4.82	4.83	4.99	4.99	5.00	5.05	5.11	5.02	5.04	4.88	4.47
8	4.91	4.82	4.83	4.99	4.99	5.00	5.05	5.12	5.05	5.08	4.87	4.46
9	4.90	4.82	4.83	5.00	4.99	5.01	5.04	5.17	5.06	5.13	4.86	4.44
10	4.90	4.83	4.83	5.00	e4.99	5.01	5.04	5.17	5.04	5.08	4.85	4.43
11	4.90	4.84	4.83	4.99	e4.99	5.00	5.03	5.18	5.03	5.04	4.84	4.42
12	4.90	4.83	4.84	4.99	4.99	4.99	5.02	5.17	5.02	5.03	4.83	4.42
13	4.89	4.83	4.84	4.99	4.98	4.99	5.01	5.12	5.02	5.03	4.82	4.46
14	4.87	4.83	4.84	4.99	4.98	4.99	5.00	5.09	5.02	5.02	4.81	4.49
15	4.86	4.83	4.84	4.98	4.98	5.00	5.00	5.07	5.01	5.21	4.81	4.50
16	4.85	4.82	4.84	4.98	4.97	5.01	5.01	5.02	5.00	5.23	4.81	4.48
17	4.84	4.82	4.84	4.98	4.97	5.02	5.00	5.01	4.99	5.14	4.79	4.46
18	4.86	4.82	4.89	4.98	4.98	5.02	5.00	5.01	4.99	5.05	4.78	4.44
19	4.85	4.82	4.94	4.98	4.97	5.02	5.01	5.01	4.98	5.01	4.76	4.42
20	4.85	4.82	4.95	4.98	4.97	5.02	5.04	5.04	4.95	5.00	4.74	4.40
21	4.84	4.83	4.96	4.98	4.97	5.02	5.05	5.02	4.94	5.01	4.74	4.39
22	4.84	4.83	4.96	4.97	4.97	5.01	5.05	5.01	4.93	5.00	4.72	4.40
23	4.83	4.82	4.95	4.97	4.96	5.00	5.04	5.00	4.92	4.99	4.70	4.39
24	4.82	4.83	4.95	4.97	4.97	4.98	5.03	5.00	4.91	4.98	4.68	4.37
25	4.85	4.83	4.95	4.97	4.97	4.98	5.03	4.99	4.92	4.96	4.66	4.35
26	4.86	4.83	4.95	4.97	4.97	4.99	5.01	4.99	4.97	4.95	4.66	4.34
27	4.86	4.83	4.95	4.96	4.96	5.00	5.00	4.98	4.95	4.94	4.65	4.33
28	4.86	4.83	4.95	4.96	4.96	5.03	4.99	5.01	4.94	4.93	4.62	4.31
29	4.85	4.83	4.95	4.97	---	5.05	4.99	5.05	4.94	4.92	4.61	4.30
30	4.85	4.82	e4.96	4.97	---	5.05	5.02	5.06	4.93	4.91	4.60	4.28
31	4.84	---	e4.98	4.97	---	5.05	---	5.10	---	4.90	4.58	---
MEAN	4.87	4.83	4.89	4.98	4.98	5.00	5.03	5.06	5.00	5.00	4.77	4.43
MAX	4.96	4.84	4.98	5.00	5.00	5.05	5.07	5.18	5.09	5.23	4.90	4.56
MIN	4.77	4.82	4.82	4.96	4.96	4.95	4.99	4.98	4.91	4.89	4.58	4.28

e Estimated



423556088365001 DELAVAN LAKE AT CENTER NEAR DELAVAN LAKE, WI

LOCATION.--Lat 42°35'56", long 88°36'50", in SE 1/4 SW 1/4 sec.28, T.2 N., R.16 E., Walworth County, Hydrologic Unit 07090001, 2.6 mi southeast of Delavan.

DRAINAGE AREA.--41.4 mi², of which 2.3 mi² is non-contributing. Area of Delavan Lake, 2,072 acres.

PERIOD OF RECORD.--October 1983 to current year.

REMARKS.--Lake ice-covered during February measurements. Water-quality analyses done by the U.S. Geological Survey National Water Quality Laboratory. Samples for determination of chlorophyll-*a* concentration are collected from the top 1.5 ft of the lake.

WATER-QUALITY DATA, NOVEMBER 18, 2002 TO MAY 21, 2003
(Milligrams per liter unless otherwise indicated)

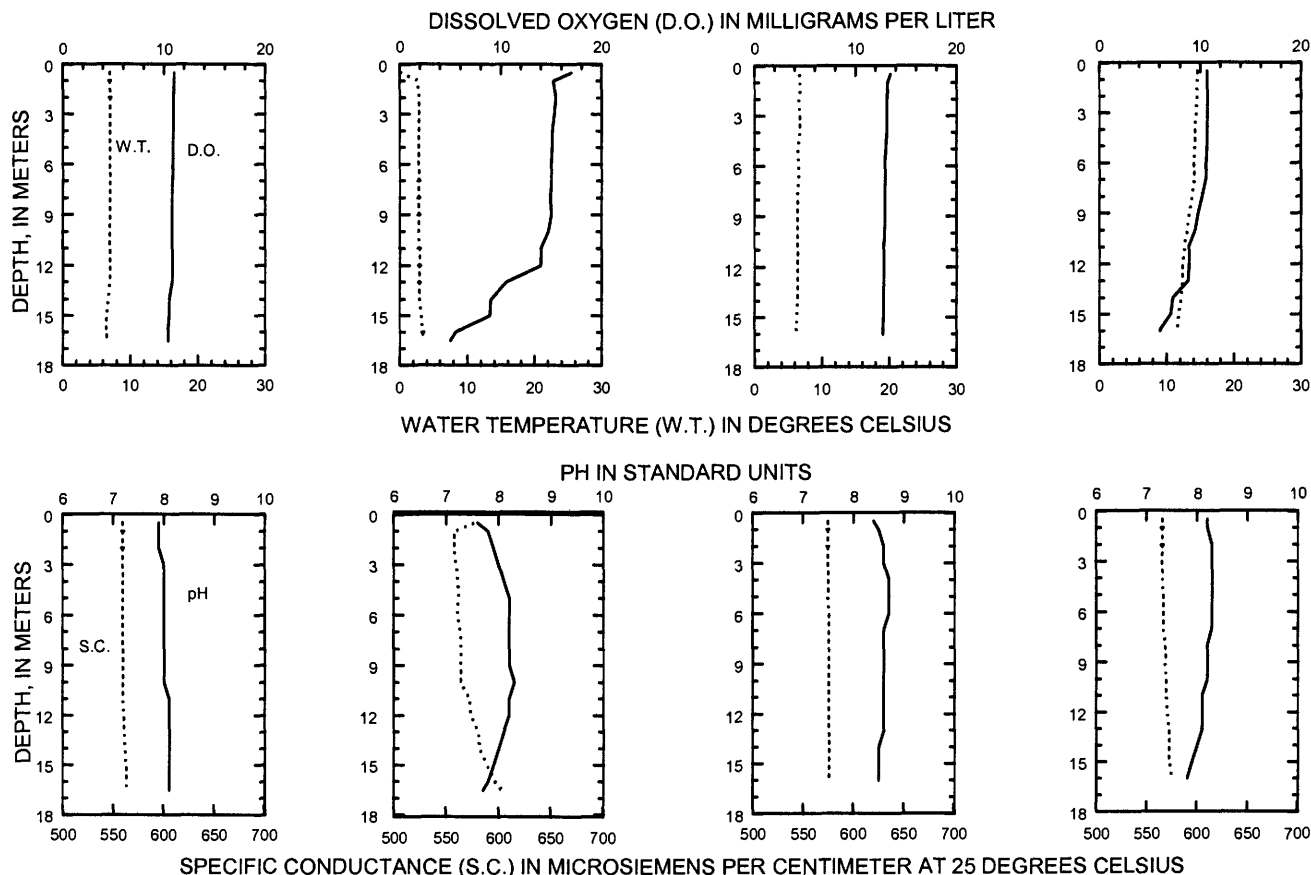
	Nov-18		Feb-20		Apr-14		May-21	
Lake stage (ft)	4.82		4.97		5.0		5.02	
Secchi-depth (m)	3.5		3.2		2.9		7	
Chlorophyll <i>a</i> , phytoplankton (µg/L)	11.5		9.02		5.8		3.84	
Depth of sample (m)	0.5	16.5	0.5	16	0.5	16	0.5	16
Water temperature (°C)	7	6.5	0	3.4	6.7	6.2	14.6	11.6
Specific conductance (µS/cm)	560	564	577	597	575	576	566	576
pH	7.9	8.1	7.6	7.8	8.4	8.5	8.2	7.8
Dissolved oxygen (mg/L)	11	10.4	17	5.5	13.5	12.7	10.7	6
Phosphorus, total (as P)	0.106	0.105	0.076	0.192	0.057	0.063	0.054	0.113
Phosphorus, ortho, dissolved (as P)	0.071	0.07	0.034	0.139	0.022	0.023	0.025	0.078
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	0.095	--	0.022	--	<.022	<.022	E.017	--
Nitrogen, ammonia, dissolved (as N)	0.073	--	<.015	--	<.015	<.015	E.008	--
Nitrogen, amm. + org., total (as N)	0.56	--	0.54	--	0.64	0.64	0.65	--
Nitrogen, total (as N)	0.65	--	0.56	--	0.65	0.65	--	--
Color (Pt-Co. scale)	--	--	--	--	12	12	--	--
Turbidity (NTU)	--	--	--	--	2.1	3.2	--	--
Hardness, as CaCO ₃	--	--	--	--	230	230	--	--
Calcium, dissolved (Ca)	--	--	--	--	38.4	38.5	--	--
Magnesium, dissolved (Mg)	--	--	--	--	33.3	33.3	--	--
Sodium, dissolved (Na)	--	--	--	--	26.2	26	--	--
Potassium, dissolved (K)	--	--	--	--	2.48	2.44	--	--
Alkalinity, as CaCO ₃	--	--	--	--	188	188	--	--
Sulfate, dissolved (SO ₄)	--	--	--	--	24.5	24.4	--	--
Chloride, dissolved (Cl)	--	--	--	--	57.9	57.3	--	--
Silica, dissolved (SiO ₂)	--	--	--	--	<.2	<.2	--	--
Solids, dissolved, at 180°C	--	--	--	--	323	322	--	--
Iron, dissolved (Fe) (µg/L)	--	--	--	--	<10	<10	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	--	--	E.9	<2.0	--	--

11-18-02

2-20-03

4-14-03

5-21-03

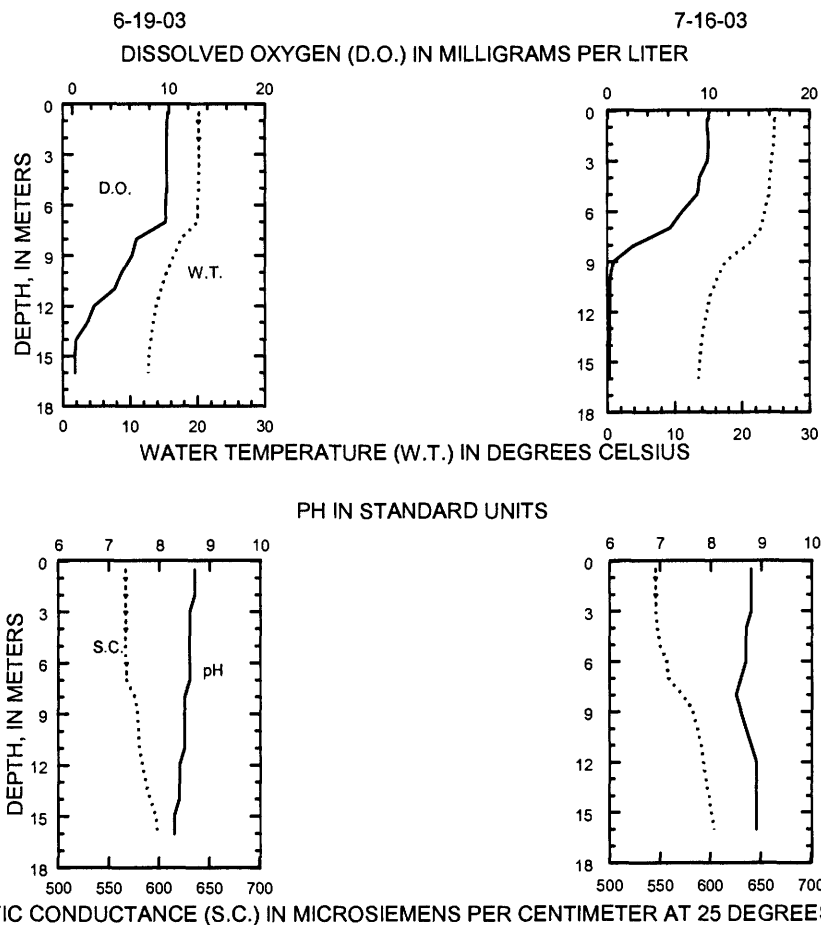


423556088365001 DELAVAN LAKE AT CENTER NEAR DELAVAN LAKE, WI--CONTINUED

WATER-QUALITY DATA, JUNE 19 TO JULY 16, 2003

(Milligrams per liter unless otherwise indicated)

		Jun-19				Jul-16			
Lake stage (ft)		4.98				5.23			
Secchi-depth (m)		3.7				2.9			
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)		5.9				21.8			
Depth of sample (m)	0.5	7	12	16	0.5	5	11	16	
Water temperature ($^{\circ}\text{C}$)	20.2	20	13.8	12.7	24.8	24	15.2	13.5	
Specific conductance ($\mu\text{S/cm}$)	567	568	584	599	546	550	591	604	
pH	8.7	8.6	8.4	8.3	8.8	8.7	8.8	8.9	
Dissolved oxygen (mg/L)	9.9	9.7	2.3	0.3	9.9	8.9	0.3	0.2	
Phosphorus, total (as P)	0.056	0.052	0.2	0.34	0.037	0.036	0.21	0.44	
Phosphorus, ortho, dissolved (as P)	E.004	0.007	0.163	0.297	E.004	<.007	0.177	0.379	
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	<.022	--	--	--	<.022	--	--	--	
Nitrogen, ammonia, dissolved (as N)	<.015	--	--	--	E.008	--	--	--	
Nitrogen, amm. + org., total (as N)	0.62	--	--	--	0.87	--	--	--	



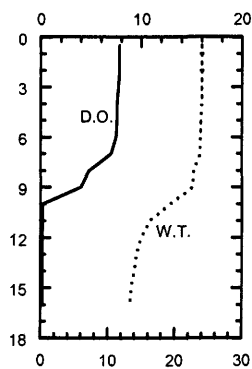
423556088365001 DELAVAN LAKE AT CENTER NEAR DELAVAN LAKE, WI--CONTINUED

WATER-QUALITY DATA, AUGUST 12, 2003
(Milligrams per liter unless otherwise indicated)

	Aug-12							
Lake stage (ft)	4.83							
Secchi-depth (m)	2.9							
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	8.87							
Depth of sample (m)	0.5	7	9	11	13	14	15	16
Water temperature ($^{\circ}\text{C}$)	24	23.8	22.7	16.3	14.3	14	13.6	13.4
Specific conductance ($\mu\text{S/cm}$)	550	552	562	590	600	604	610	618
pH	8.3	8.3	8.1	8	8.1	8.1	8.1	8.1
Dissolved oxygen (mg/L)	7.8	7	4	0.2	0.2	0.2	0.2	0.2
Phosphorus, total (as P)	0.044	0.046	0.093	0.32	0.43	0.47	0.51	0.59
Phosphorus, ortho, dissolved (as P)	<.007	0.009	--	--	0.336	--	--	0.482
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	<.022	--	--	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	<.015	--	--	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	0.69	--	--	--	--	--	--	--

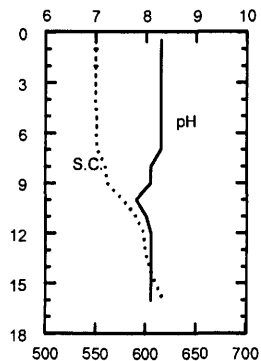
8-12-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

423556088365001 DELAVAN LAKE AT CENTER NEAR DELAVAN LAKE, WI--CONTINUED

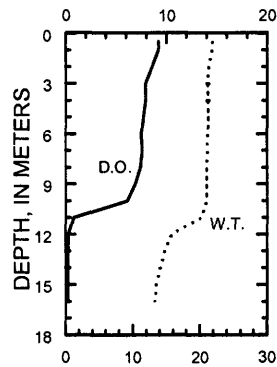
WATER-QUALITY DATA, SEPTEMBER 18, 2003

(Milligrams per liter unless otherwise indicated)

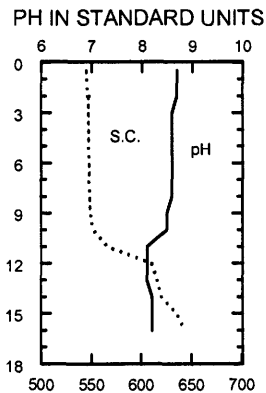
	Sep-18			
Lake stage (ft)			4.44	
Secchi-depth (m)			1.2	
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)			26	
Depth of sample (m)	0.5	11	14	16
Water temperature ($^{\circ}\text{C}$)	21.9	20.2	14.1	13.3
Specific conductance ($\mu\text{S/cm}$)	545	566	620	643
pH	8.7	8.1	8.2	8.2
Dissolved oxygen (mg/L)	9.2	0.8	0.2	0.2
Phosphorus, total (as P)	0.073	0.106	0.6	0.75
Phosphorus, ortho, dissolved (as P)	<.007	0.062	0.533	0.65
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	<.022	--	--	--
Nitrogen, ammonia, dissolved (as N)	<.015	--	--	--
Nitrogen, amm. + org., total (as N)	0.9	--	--	--

9-18-03

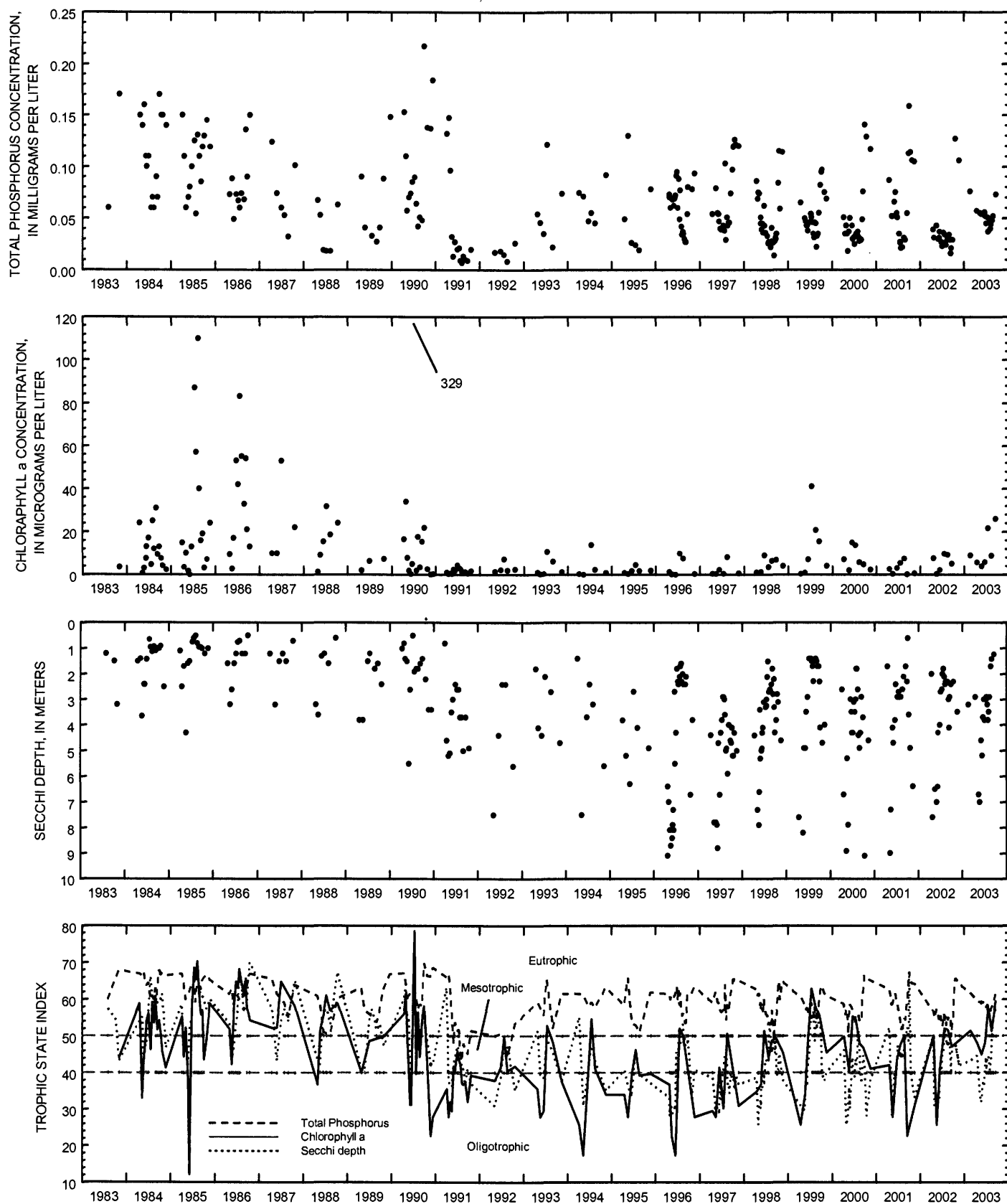
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Delavan Lake, at Center, near Delavan, Wisconsin.

423556088365001 DELAVAN LAKE AT CENTER NEAR DELAVAN LAKE, WI--CONTINUED

ADDITIONAL WATER-QUALITY DATA, OCTOBER 16, 2002 TO AUGUST 29, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Oct. 16</u>	<u>May 13</u>	<u>June 5</u>	<u>June 13</u>	<u>June 20</u>
Lake stage (ft)	4.85	5.12	5.04	5.02	4.95
Secchi-depth (meters)	2.3	6.7	4.6	5.2	3.7
Depth of sample (meters)	0.5	0.5	0.5	0.5	0.5
Water temperature (°C)	9.5	13.0	16.5	19.0	20.0
Phosphorus, total (as P)	0.127	0.055	0.054	0.055	0.053
	<u>June 27</u>	<u>July 2</u>	<u>July 14</u>	<u>July 23</u>	<u>July 30</u>
Lake stage (ft)	4.95	4.91	5.02	4.99	4.91
Secchi-depth (meters)	3.0	3.8	3.0	3.2	3.8
Depth of sample (meters)	0.5	0.5	0.5	0.5	0.5
Water temperature (°C)	21.5	24.5	24.5	24.0	24.0
Phosphorus, total (as P)	0.052	0.045	0.051	0.038	0.046
	<u>Aug. 6</u>	<u>Aug. 22</u>	<u>Aug. 29</u>		
Lake stage (ft)	4.89	4.72	4.61		
Secchi-depth (meters)	3.5	1.7	1.4		
Depth of sample (meters)	0.5	0.5	0.5		
Water temperature (°C)	25.0	26.0	25.0		
Phosphorus, total (as P)	0.040	0.048	0.052		

* Measurements and samples collected by the Delavan Lake Sanitary District.

423659088354401 DELAVAN LAKE, AT NORTH END, NEAR LAKE LAWN, WI

LOCATION.--Lat 42°36'59", long 88°35'44", in NW 1/4 SW 1/4, sec.22, T.2 N., R.16 E., Walworth County, Hydrologic Unit 07090001, 2.6 mi southeast of Delavan.

DRAINAGE AREA.--41.4 mi², of which 2.3 mi² is non-contributing.

PERIOD OF RECORD.--October 1983 to current year.

WATER-QUALITY DATA, MAY 21 TO AUGUST 12, 2003

	<u>May 21</u>	<u>June 19</u>	<u>July 16</u>	<u>Aug. 12</u>
Secchi-depth (meters)	6.7	3.7	2.8	3.4

423526088380101 DELAVAN LAKE, AT SW END, NEAR DELAVAN LAKE, WI

LOCATION.--Lat 42°35'26", long 88°38'01", in SE 1/4 NW 1/4, sec.32, T.2 N., R.16 E., Walworth County, Hydrologic Unit 07090001, 2.6 mi southeast of Delavan.

DRAINAGE AREA.--41.4 mi², of which 2.3 mi² is non-contributing.

PERIOD OF RECORD.--October 1983 to current year.

WATER-QUALITY DATA, MAY 21 TO AUGUST 12, 2003

	<u>May 21</u>	<u>June 19</u>	<u>July 16</u>	<u>Aug. 12</u>
Secchi-depth (meters)	6.2	3.0	3.4	2.1

05404500 DEVILS LAKE NEAR BARABOO, WI

LOCATION.--Lat 43°25'35", long 89°43'40", in SW 1/4 SE 1/4 sec.13, T.11 N., R.6 E., Sauk County, Hydrologic Unit 07070004, in Devils Lake State Park, 3.5 mi south of Baraboo.

DRAINAGE AREA.--4.79 mi². Area of Devils Lake, 361 acres.

PERIOD OF RECORD.--June 1922 to August 1930, June to August 1932, June 1934 to September 1981, October 1984 to June 1991 (fragmentary), July 1991 to current year. Unpublished daily stage records from October 1981 to September 1984 in District files.

REVISED RECORDS.--WDR WI-78-1: Drainage area.

GAGE.--Water-stage recorder installed July 17, 1991. Datum of gage is 955.00 ft, above sea level.

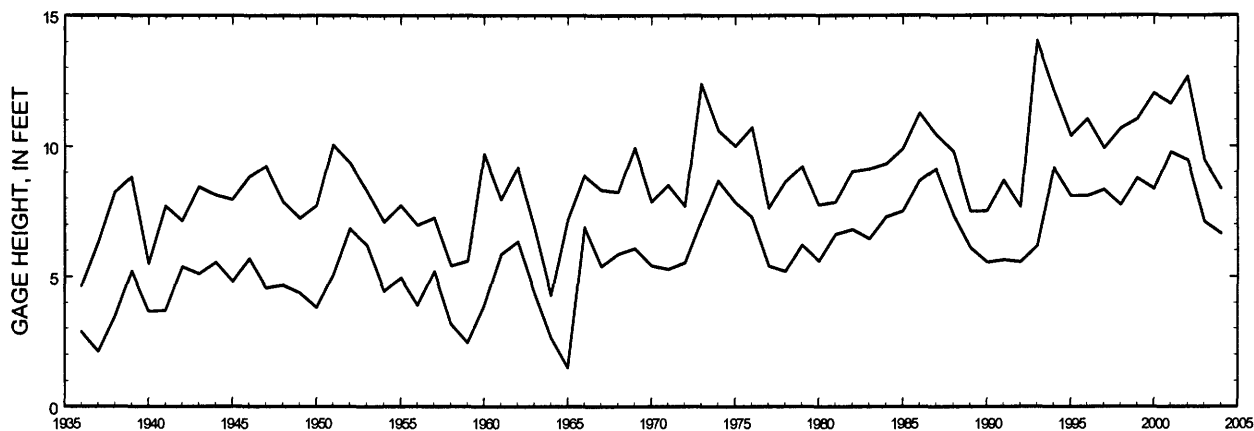
REMARKS.--Lake has no surface outlet. Water removed from lake by pumping or siphon Oct. 1-15 and Sept. 8-30.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height observed, 14.13 ft, July 18, 1993; minimum observed, 1.49 ft, Feb. 8, 1965.

EXTREMES FOR CURRENT YEAR.--Maximum recorded gage height, 9.50 ft, Oct. 4; minimum recorded, 7.08 ft, Sept. 30.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003 DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	9.42	8.78	8.50	8.34	8.21	8.13	8.26	8.19	8.54	8.39	8.10	7.72
2	9.41	8.77	8.49	8.33	8.21	8.13	8.25	8.18	8.52	8.37	8.09	7.70
3	9.39	8.76	8.48	8.32	8.22	8.12	8.24	8.17	8.50	8.36	8.07	7.67
4	9.43	8.74	8.47	8.32	8.22	8.13	8.25	8.16	8.48	8.36	8.06	7.64
5	9.43	8.74	8.46	8.32	8.22	8.14	8.26	8.19	8.47	8.38	8.04	7.62
6	9.38	8.73	8.46	8.32	8.22	8.14	8.25	8.21	8.46	8.38	8.03	7.60
7	9.33	8.73	8.45	8.32	8.22	8.13	8.26	8.22	8.47	8.37	8.01	7.58
8	9.29	8.71	8.44	8.31	8.21	8.14	8.27	8.22	8.48	8.35	7.99	7.57
9	9.24	8.71	8.43	8.31	8.21	8.14	8.26	8.32	8.47	8.33	7.97	7.53
10	9.20	8.70	8.43	8.30	8.21	8.14	8.25	8.36	8.48	8.39	7.95	7.49
11	9.16	8.71	8.42	8.29	8.20	8.13	8.25	8.46	8.47	8.39	7.93	7.45
12	9.12	8.70	8.41	8.28	8.20	8.13	8.25	8.55	8.45	8.37	7.91	7.42
13	9.07	8.69	8.41	8.27	8.19	8.13	8.24	8.56	8.44	8.35	7.89	7.50
14	9.02	8.68	8.41	8.27	8.19	8.13	8.23	8.61	8.43	8.33	7.88	7.64
15	8.96	8.66	8.40	8.26	8.19	8.14	8.22	8.65	8.41	8.41	7.86	7.63
16	8.94	8.65	8.39	8.26	8.18	8.17	8.22	8.66	8.40	8.40	7.85	7.60
17	8.93	8.64	8.39	8.25	8.18	8.20	8.21	8.66	8.38	8.38	7.83	7.57
18	8.93	8.63	8.42	8.24	8.17	8.20	8.20	8.67	8.37	8.36	7.80	7.52
19	8.91	8.63	8.42	8.24	8.17	8.21	8.20	8.67	8.48	8.33	7.78	7.47
20	8.90	8.62	8.42	8.23	8.17	8.23	8.23	8.68	8.45	8.31	7.75	7.44
21	8.89	8.61	8.41	8.23	8.16	8.24	8.22	8.68	8.43	8.31	7.73	7.40
22	8.87	8.60	8.40	8.22	8.16	8.24	8.21	8.66	8.40	8.28	7.71	7.39
23	8.86	8.59	8.39	8.21	8.15	8.24	8.20	8.65	8.38	8.26	7.69	7.37
24	8.85	8.57	8.38	8.21	8.15	8.24	8.19	8.64	8.37	8.24	7.66	7.33
25	8.87	8.56	8.37	8.20	8.15	8.24	8.17	8.62	8.39	8.22	7.64	7.28
26	8.86	8.55	8.37	8.20	8.14	8.24	8.16	8.60	8.43	8.19	7.62	7.24
27	8.85	8.54	8.36	8.19	8.14	8.25	8.15	8.59	8.40	8.17	7.60	7.20
28	8.85	8.53	8.36	8.19	8.14	8.27	8.13	8.57	8.43	8.15	7.60	7.17
29	8.83	8.52	8.35	8.19	---	8.27	8.12	8.55	8.42	8.13	7.79	7.14
30	8.82	8.50	8.35	8.19	---	8.27	8.14	8.54	8.41	8.11	7.77	7.12
31	8.80	---	8.34	8.21	---	8.26	---	8.55	---	8.11	7.74	---
MEAN	9.06	8.65	8.41	8.26	8.18	8.19	8.22	8.49	8.44	8.31	7.85	7.47
MAX	9.43	8.78	8.50	8.34	8.22	8.27	8.27	8.68	8.54	8.41	8.10	7.72
MIN	8.80	8.50	8.34	8.19	8.14	8.12	8.12	8.16	8.37	8.11	7.60	7.12



05406050 FISH LAKE NEAR SAUK CITY, WI

LOCATION.--Lat 43°17'27", long 89°39'09" in NE 1/4 SW 1/4 sec.3, T.9 N., R.7 E., Dane County, Hydrologic Unit 07070005, on north side of lake, 0.4 mi southwest of Crystal Lake, and 3.1 mi east of Sauk City.

DRAINAGE AREA.--2.23 mi². Area of Fish Lake, 252 acres.

PERIOD OF RECORD.--November 1966 to September 1981, April 1985 to May 1987, May 1988, April 1989 to October 1990 (fragmentary); continuous record from October 1990 to November 1996; nonrecording gage November 1996 to current year.

REVISED RECORDS.--WDR WI-92-1: Drainage area. WDR WI-87-1: All published values for the 1987 water year are invalid. Two valid values for water years 1987 and 1988 are available: May 7, 1987, water surface 10.52 ft, and May 16, 1988, water surface 10.83 ft.

GAGE.--Nonrecording gage. Datum of gage is 848.07 ft above sea level. Local observer, Richard Lillie, reads staff gage when lake is ice-free.

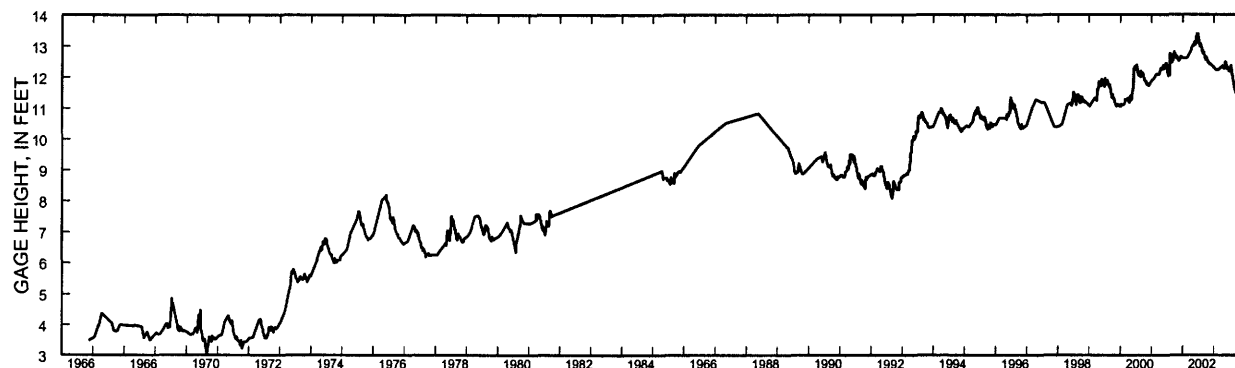
REMARKS.--Lake has no surface outlet.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height observed, 13.39 ft, June 14 and 26, 2002; minimum observed, 3.02 ft, Aug. 29, 1970.

EXTREMES FOR CURRENT YEAR.--Maximum gage height observed, 12.65 ft, Oct. 4; minimum observed, 11.50 ft, Sept. 11.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003 DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	---	12.33	12.34	12.20	12.08	11.67
2	---	---	---	---	---	---	---	---	12.33	12.19	12.06	11.65
3	---	---	---	---	---	---	---	12.32	12.32	---	12.05	---
4	12.65	12.45	---	---	---	---	---	12.30	12.30	12.23	12.04	11.61
5	---	---	---	---	---	---	---	12.34	---	12.25	12.04	11.59
6	---	---	---	---	---	---	---	12.33	12.28	12.31	12.02	11.57
7	12.62	---	---	---	---	---	---	12.35	12.30	12.31	12.01	11.56
8	12.60	---	---	---	---	---	---	---	12.33	12.30	12.00	11.55
9	12.58	---	---	---	---	---	---	12.38	12.32	12.29	11.98	11.54
10	12.58	12.42	---	---	---	---	12.37	---	12.33	12.29	11.96	---
11	---	---	---	---	---	---	---	12.50	12.31	12.26	---	11.50
12	12.57	---	---	---	---	---	12.36	12.50	---	12.24	---	11.52
13	---	12.45	---	---	---	---	---	---	12.30	12.23	---	11.66
14	12.54	---	---	---	---	---	---	---	12.29	12.20	11.90	11.79
15	---	---	---	---	---	---	---	12.50	12.28	12.38	11.88	11.78
16	12.52	---	---	---	---	---	---	---	12.26	12.35	11.87	---
17	---	---	---	---	---	---	---	---	---	12.33	11.85	11.73
18	12.54	---	---	12.25	---	---	---	---	12.24	12.31	11.83	11.70
19	---	12.43	---	---	---	---	12.30	---	12.30	12.29	11.81	---
20	12.52	12.42	---	---	---	---	---	---	---	12.28	---	11.68
21	12.50	---	---	---	---	---	12.35	---	12.24	12.27	11.78	11.67
22	---	---	---	---	---	---	12.34	---	---	12.25	11.77	11.67
23	12.48	---	---	---	---	---	---	---	12.20	---	11.75	11.64
24	---	---	---	---	---	---	12.31	---	12.21	12.20	11.73	---
25	---	---	---	---	---	---	---	12.42	12.25	---	---	11.60
26	12.51	---	---	---	---	---	12.28	---	12.23	12.17	---	11.59
27	12.49	---	12.32	---	12.24	---	---	---	12.19	12.16	11.66	---
28	---	---	---	---	---	---	12.27	12.39	12.25	12.14	---	11.57
29	12.48	---	---	---	---	---	---	12.38	12.23	12.12	11.74	---
30	---	---	---	---	---	---	12.29	12.36	12.22	12.10	11.70	11.53
31	---	---	---	---	---	---	---	---	---	12.10	11.68	---



423525088260400 GENEVA LAKE AT LAKE GENEVA, WI

LOCATION.--Lat 42°35'25", long 88°26'04" in SE 1/4 NW 1/4 sec.36, T.2 N., R.17 E., Walworth County, Hydrologic Unit 07120006, at Geneva Lake dam at Center Street at Lake Geneva.

DRAINAGE AREA.--28.7 mi². Area of Geneva Lake, 5,262 acres.

PERIOD OF RECORD.--October 1997 to August 2002, December 2002 to current year.

GAGE.--Water-stage recorder. Datum of gage is 862.08 ft above sea level. Intermittent staff-gage readings October to March.

REMARKS.--Gage-height telemeter at station.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height, 3.29 ft, June 13, 2000; minimum gage height, 1.66 ft, Apr. 9, 2001.

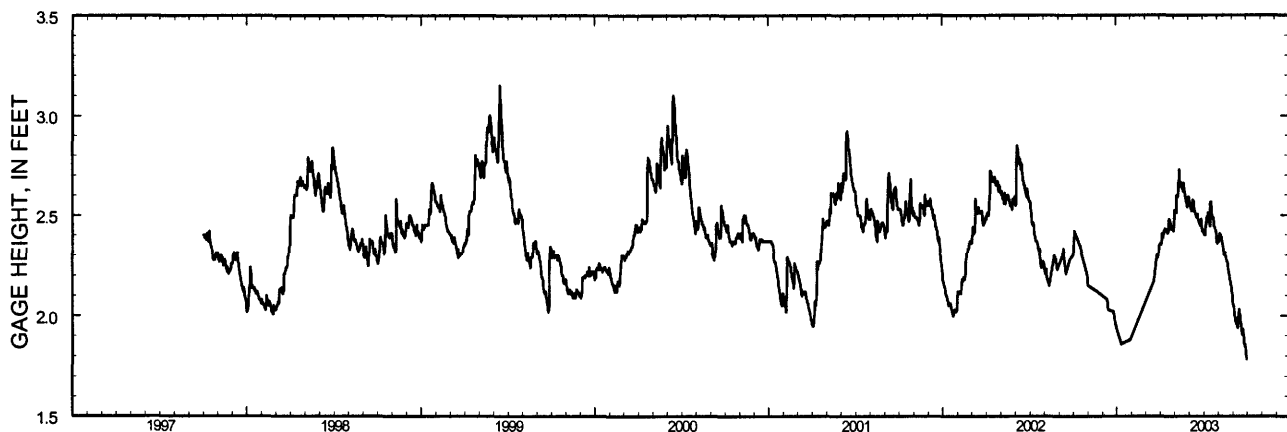
EXTREMES FOR CURRENT YEAR.--Maximum gage height, 3.11 ft, May 9 (affected by wind); minimum gage height, 1.72 ft, Sept. 30.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2.30	2.15	---	---	---	---	2.36	2.52	2.58	2.41	2.37	2.06
2	2.42	---	---	---	---	---	2.35	2.52	2.56	2.40	2.37	2.05
3	---	---	---	---	---	---	2.35	2.52	2.56	2.41	2.40	2.05
4	---	---	---	---	---	---	2.37	2.51	2.54	2.40	2.41	2.01
5	---	---	---	---	---	---	2.41	2.60	2.53	2.45	2.40	2.00
6	---	---	---	---	---	---	2.39	2.60	2.52	2.46	2.39	1.99
7	---	---	---	---	---	---	2.39	2.59	2.52	2.48	2.39	1.97
8	---	---	---	---	---	---	2.42	2.59	2.58	2.49	2.37	1.96
9	---	---	---	---	---	---	2.42	2.66	2.57	2.49	2.36	1.96
10	---	---	---	e1.86	---	---	2.42	2.66	2.57	2.51	2.35	1.95
11	---	---	2.08	---	---	---	e2.43	2.73	2.54	2.49	2.34	1.94
12	---	---	---	---	---	---	e2.43	2.67	2.53	2.47	2.32	1.96
13	---	---	2.03	---	---	---	e2.42	2.64	2.52	2.46	2.31	2.01
14	---	---	---	---	---	---	e2.42	2.65	2.51	2.45	2.30	2.03
15	2.34	---	---	---	---	---	e2.42	2.66	2.50	2.56	2.31	2.02
16	---	---	---	---	---	---	e2.41	2.65	2.49	2.57	2.31	2.00
17	---	---	---	---	---	---	e2.41	2.63	e2.49	2.55	2.29	1.98
18	2.31	---	---	---	---	e2.17	2.42	2.62	2.50	2.50	2.28	1.96
19	---	---	---	---	---	---	2.43	2.62	2.48	2.49	2.27	1.96
20	---	2.12	---	---	---	---	2.48	2.66	2.47	2.49	2.27	1.92
21	---	---	---	---	---	---	2.47	2.63	2.46	2.49	2.26	1.91
22	---	---	---	---	---	---	2.46	2.61	2.46	2.46	2.23	1.93
23	---	---	---	---	---	---	2.45	2.60	2.45	2.44	2.21	1.91
24	2.26	---	e2.02	---	---	---	2.44	2.59	2.45	2.43	2.22	1.88
25	---	---	2.01	---	---	e2.30	2.43	2.57	2.45	2.43	2.19	1.86
26	---	---	2.00	---	---	2.29	2.43	2.56	2.48	2.42	2.18	1.85
27	---	---	1.98	---	---	2.29	2.44	2.54	2.45	2.38	2.16	1.86
28	---	---	1.97	---	---	2.33	2.43	2.56	2.42	2.36	2.15	1.82
29	---	---	1.95	e1.88	---	2.35	2.42	2.59	2.43	2.36	2.13	1.81
30	2.20	---	1.95	---	---	2.35	2.44	2.59	2.41	2.37	2.10	1.79
31	---	---	1.94	---	---	2.35	---	2.59	---	2.37	2.09	---
MEAN	---	---	---	---	---	---	2.42	2.60	2.50	2.45	2.28	1.95
MAX	---	---	---	---	---	---	2.48	2.73	2.58	2.57	2.41	2.06
MIN	---	---	---	---	---	---	2.35	2.51	2.41	2.36	2.09	1.79

e Estimated



423329088323300 GENEVA LAKE AT WEST END NEAR WILLIAMS BAY, WI

LOCATION.--Lat 42°33'29", long 88°32'33", in NE 1/4 SE 1/4, sec.12, T.1 N., R.16 E., Walworth County, Hydrologic Unit 07120006, 1.3 mi south of Williams Bay.

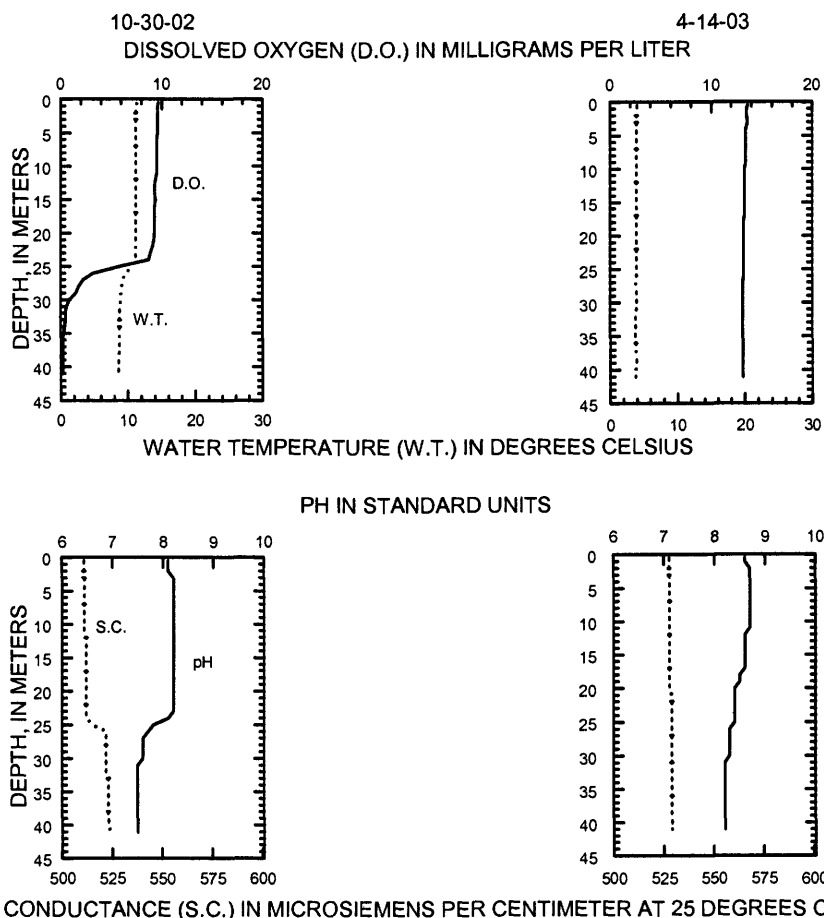
DRAINAGE AREA.--28.7 mi².

PERIOD OF RECORD.--April 1997 to current year.

REMARKS.--Lake sampled at deep hole at a depth of about 43 m. Water-quality analyses done by Wisconsin State Laboratory of Hygiene. Samples for determination of chlorophyll-*a* concentration are collected from the top 1.5 ft of the lake.

WATER-QUALITY DATA, OCTOBER 30, 2002 TO APRIL 14, 2003
(Milligrams per liter unless otherwise indicated)

		Oct-30				Apr-14	
Lake stage (ft)		2.2				2.42	
Secchi-depth (m)		4.3				5.2	
Chlorophyll <i>a</i> , phytoplankton (µg/L)		10.3				4.31	
Depth of sample (m)	0.5	24	31	41	0.5	42.5	
Water temperature (°C)	11.3	11.1	8.8	8.6	4	3.8	
Specific conductance (µS/cm)	511	512	522	524	528	529	
pH	8.1	8.1	7.5	7.5	8.6	8.1	
Dissolved oxygen (mg/L)	9.7	8.9	0.6	0.2	13.6	13	
Phosphorus, total (as P)	0.009	0.011	0.021	0.032	0.011	0.011	
Phosphorus, ortho, dissolved (as P)	<.002	--	--	--	<.002	<.002	
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	0.033	--	--	--	0.078	0.078	
Nitrogen, ammonia, dissolved (as N)	0.008	--	--	--	0.015	<.013	
Nitrogen, amm. + org., total (as N)	0.38	--	--	--	0.37	0.34	
Nitrogen, total (as N)	0.41	--	--	--	0.45	0.42	
Color (Pt-Co. scale)	--	--	--	--	<5	<5	
Turbidity (NTU)	--	--	--	--	<1.0	<1.0	
Hardness, as CaCO ₃	--	--	--	--	230	230	
Calcium, dissolved (Ca)	--	--	--	--	34	34.2	
Magnesium, dissolved (Mg)	--	--	--	--	34.4	34.5	
Sodium, dissolved (Na)	--	--	--	--	17.4	--	
Potassium, dissolved (K)	--	--	--	--	2	--	
Alkalinity, as CaCO ₃	--	--	--	--	182	--	
Sulfate, dissolved (SO ₄)	--	--	--	--	30	--	
Chloride, dissolved (Cl)	--	--	--	--	37.6	--	
Solids, dissolved, at 180°C	--	--	--	--	288	--	
Iron, dissolved (Fe) (µg/L)	--	--	--	--	<100	--	
Manganese, dissolved, (Mn) (µg/L)	--	--	--	--	<1	--	



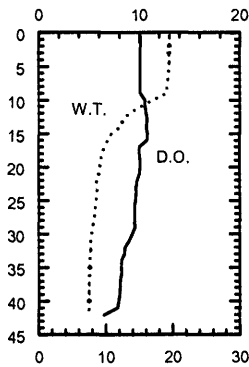
423329088323300 GENEVA LAKE AT WEST END NEAR WILLIAMS BAY, WI--CONTINUED

WATER-QUALITY DATA, JUNE 19, 2003
(Milligrams per liter unless otherwise indicated)

	Jun-19					
Lake stage (ft)	2.48					
Secchi-depth (m)	4.6					
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	1.63					
Depth of sample (m)	0.5	9	18	33	38	42
Water temperature ($^{\circ}\text{C}$)	19.5	19.1	9.4	7.7	7.5	7.4
Specific conductance ($\mu\text{S/cm}$)	513	514	522	524	526	528
pH	8.5	8.5	9	8.5	8.3	8.1
Dissolved oxygen (mg/L)	10.1	10.1	10	8.5	8.1	6.5
Phosphorus, total (as P)	0.011	0.011	0.012	0.012	0.012	0.017
Phosphorus, ortho, dissolved (as P)	<.002	--	--	--	--	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	<.022	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	0.025	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	0.28	--	--	--	--	--

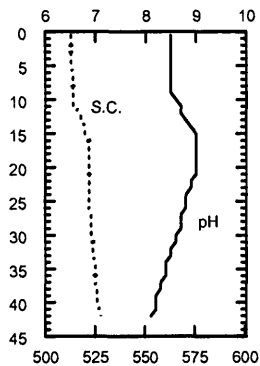
6-19-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

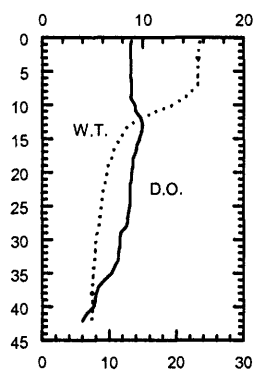
423329088323300 GENEVA LAKE AT WEST END NEAR WILLIAMS BAY, WI--CONTINUED

WATER-QUALITY DATA, JULY 16, 2003
(Milligrams per liter unless otherwise indicated)

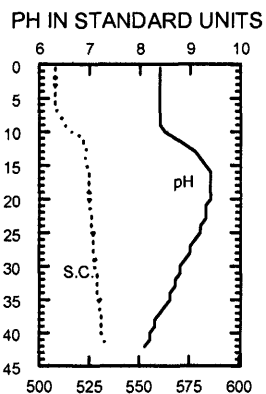
	Jul-16					
Lake stage (ft)	2.57					
Secchi-depth (m)	5.3					
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	2.4					
Depth of sample (m)	0.5	7	17	33	38	42
Water temperature ($^{\circ}\text{C}$)	23.5	23.1	10.5	7.8	7.5	7.4
Specific conductance ($\mu\text{S/cm}$)	508	509	525	529	531	534
pH	8.4	8.4	9.4	8.7	8.3	8.1
Dissolved oxygen (mg/L)	8.9	8.9	9.3	7.6	5.4	4
Phosphorus, total (as P)	0.009	0.01	0.009	0.009	0.011	0.015
Phosphorus, ortho, dissolved (as P)	<.002	--	--	--	--	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	<.022	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	<.013	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	0.37	--	--	--	--	--

7-16-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

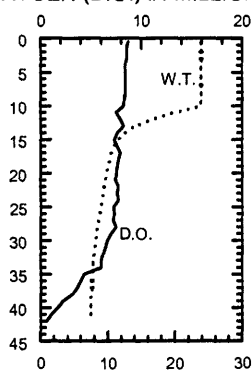
423329088323300 GENEVA LAKE AT WEST END NEAR WILLIAMS BAY, WI--CONTINUED

WATER-QUALITY DATA, AUGUST 12, 2003
(Milligrams per liter unless otherwise indicated)

	Aug-12					
Lake stage (ft)	2.32					
Secchi-depth (m)	5.3					
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	2.39					
Depth of sample (m)	0.5	10	17	33	38	42
Water temperature ($^{\circ}\text{C}$)	23.9	23.9	10.5	7.8	7.6	7.4
Specific conductance ($\mu\text{S/cm}$)	511	511	528	530	532	535
pH	8.2	8.2	9.2	8.5	8.1	7.8
Dissolved oxygen (mg/L)	8.7	8.2	7.9	6	3.2	0.6
Phosphorus, total (as P)	0.011	0.011	0.008	0.009	0.02	0.066
Phosphorus, ortho, dissolved (as P)	0.002	--	--	--	--	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	<.034	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	<.013	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	0.37	--	--	--	--	--

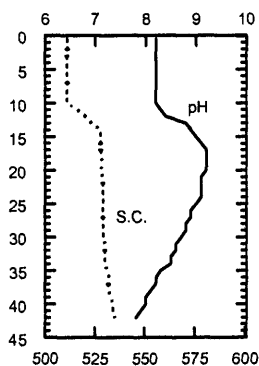
8-12-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

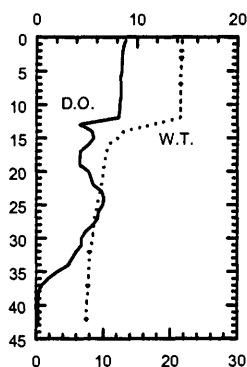
423329088323300 GENEVA LAKE AT WEST END NEAR WILLIAMS BAY, WI--CONTINUED

WATER-QUALITY DATA, SEPTEMBER 18, 2003
(Milligrams per liter unless otherwise indicated)

	Sep-18					
Lake stage (ft)	1.96					
Secchi-depth (m)	4.6					
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	3.11					
Depth of sample (m)	0.5	12	24	33	38	42
Water temperature ($^{\circ}\text{C}$)	21.7	21.5	9.3	8	7.7	7.5
Specific conductance ($\mu\text{S/cm}$)	518	519	532	533	535	540
pH	7.9	8.2	8.8	8.3	7.9	7.8
Dissolved oxygen (mg/L)	8.9	8.2	6.7	3.6	0.3	0.2
Phosphorus, total (as P)	0.012	0.012	0.009	0.014	0.061	0.087
Phosphorus, ortho, dissolved (as P)	0.005	0.003	0.004	0.009	0.049	0.074
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	<.022	<.022	0.078	0.26	0.275	<.022
Nitrogen, ammonia, dissolved (as N)	0.028	<.013	0.014	<.013	0.088	0.345
Nitrogen, amm. + org., total (as N)	0.22	0.26	0.25	<.14	0.29	0.56
Nitrogen, total (as N)	--	--	0.33	--	0.56	--

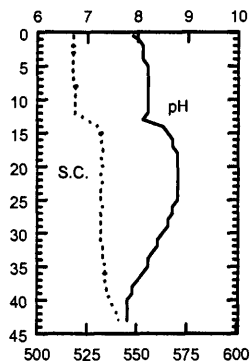
9-18-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER

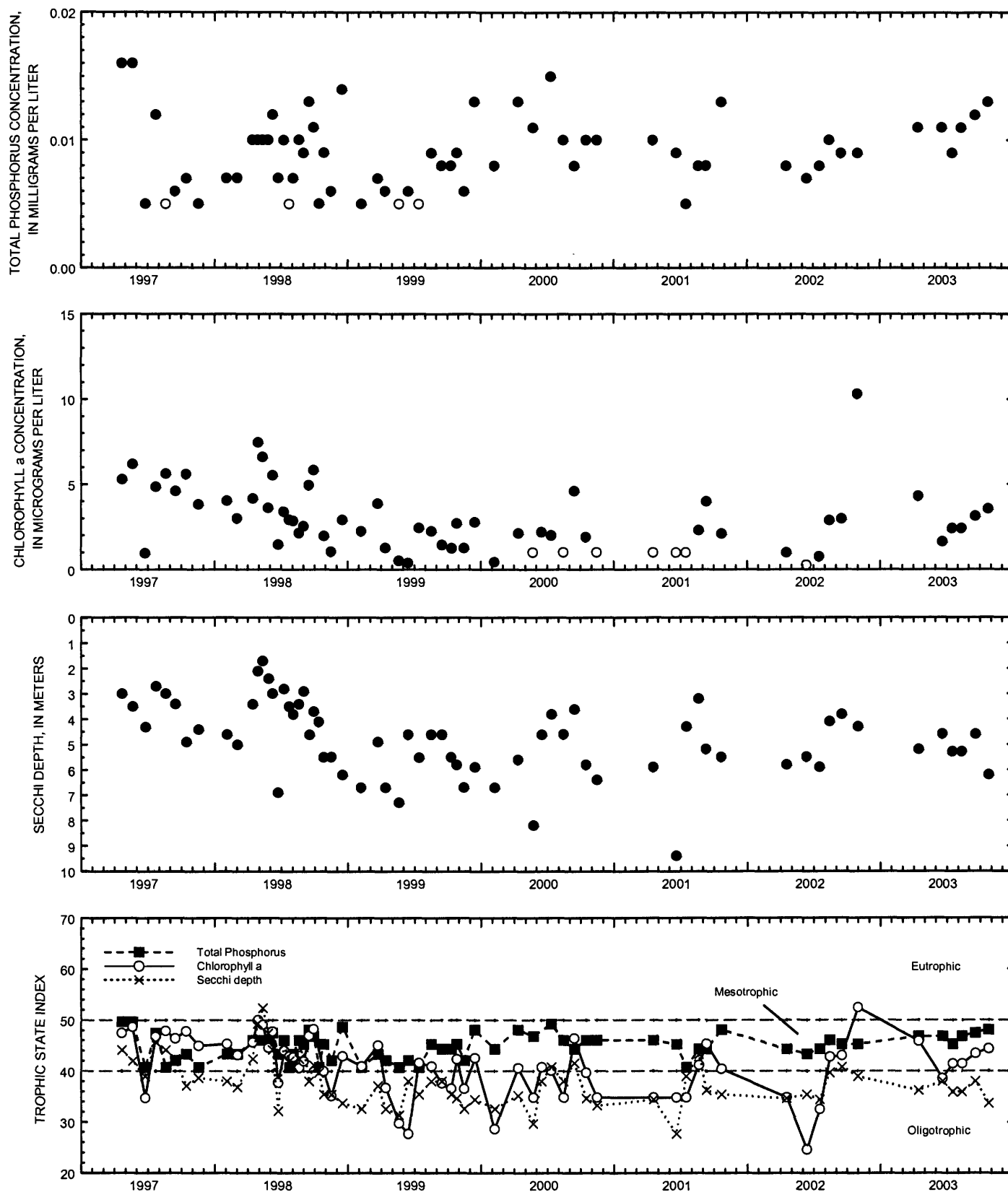


WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Lake Geneva, West End, near Williams Bay, Wisconsin.

(Circles on the first two plots indicate laboratory detection limit for selected analyses. Actual concentrations for these particular analyses are less than the plotted circles.)

434928088553601 GREEN LAKE AT COUNTY TRUNK HIGHWAY A NEAR GREEN LAKE, WI

LOCATION.--Lat 43°49'28", long 88°55'36" in NE 1/4 SE 1/4 SE 1/4 sec.27, T.16 N., R.13 E., Green Lake County, Hydrologic Unit 04030201, on left bank at downstream side of County Trunk Highway A, 2.3 mi southeast of Green Lake.

DRAINAGE AREA.--103 mi².

PERIOD OF RECORD.--October 1993 to current year.

GAGE.--Water-stage recorder. Datum of gage is 790.00 ft above sea level.

REMARKS.--Lake level regulated by dam at outlet at Green Lake. Gage-height telemeter at station.

EXTREMES FOR PERIOD OF RECORD.--Maximum recorded gage height, 7.05 ft, Apr. 12, 2001; minimum recorded, 5.41 ft, Jan. 17, 1995.

EXTREMES FOR CURRENT YEAR.--Maximum recorded gage height, 6.90 ft, May 11; minimum recorded, 5.87 ft, Sept. 12.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	6.09	6.21	6.09	6.04	5.98	6.02	6.29	6.51	6.51	6.45	6.26	6.02
2	6.11	6.18	6.06	6.04	5.99	6.01	6.30	6.51	6.51	6.45	6.26	6.02
3	6.11	6.17	6.06	6.04	6.00	6.01	6.30	6.50	6.51	6.45	6.26	6.00
4	6.22	6.16	6.06	6.04	6.02	6.01	6.30	6.49	6.49	6.45	6.26	5.97
5	6.24	6.16	6.07	6.05	6.02	6.01	6.34	6.54	6.50	6.45	6.28	5.96
6	6.26	6.17	6.05	6.05	6.03	6.01	6.33	6.57	6.49	6.47	6.29	5.95
7	6.22	6.17	6.05	6.06	6.03	6.01	6.33	6.59	6.50	6.53	6.30	5.94
8	6.22	6.16	6.03	6.06	6.03	6.02	6.34	6.60	6.53	6.53	6.29	5.94
9	6.22	6.17	6.03	6.06	6.03	6.03	6.35	6.64	6.55	6.51	6.28	5.93
10	6.23	6.17	6.02	6.06	6.03	6.04	6.36	6.65	6.58	6.53	6.28	5.92
11	6.24	6.18	6.01	6.04	6.03	6.03	6.36	6.82	6.59	6.54	6.26	5.91
12	6.25	6.18	6.01	6.03	6.04	6.03	6.36	6.82	6.58	6.52	6.24	5.88
13	6.26	6.17	6.01	6.01	6.04	6.04	6.36	6.78	6.59	6.51	6.23	5.97
14	6.22	6.16	6.01	6.00	6.03	6.03	6.38	6.76	6.59	6.49	6.22	6.16
15	6.21	6.15	6.01	6.00	6.04	6.04	6.39	6.73	6.57	6.51	6.21	6.19
16	6.19	6.14	5.99	5.99	6.04	6.06	6.38	6.70	6.57	6.50	6.23	6.17
17	6.18	6.14	5.99	5.98	6.04	6.07	6.41	6.68	6.56	6.47	6.21	6.16
18	6.20	6.14	6.02	5.98	6.03	6.09	6.41	6.65	6.55	6.45	6.20	6.14
19	6.21	6.16	6.06	5.97	6.03	6.10	6.43	6.63	6.57	6.44	6.18	6.14
20	6.19	6.15	6.09	5.97	6.03	6.12	6.49	6.64	6.56	6.42	6.16	6.09
21	6.19	6.15	6.10	5.96	6.03	6.14	6.51	6.59	6.54	6.39	6.17	6.06
22	6.20	6.14	6.10	5.96	6.03	6.15	6.50	6.57	6.52	6.36	6.13	6.08
23	6.19	6.15	6.08	5.96	6.02	6.15	6.49	6.53	6.49	6.34	6.11	6.07
24	6.19	6.14	6.04	5.95	6.03	6.16	6.49	6.50	6.49	6.34	6.10	6.04
25	6.21	6.13	6.04	5.95	6.02	6.17	6.48	6.48	6.49	6.32	6.10	6.00
26	6.23	6.12	6.05	5.95	6.02	6.17	6.47	6.45	6.54	6.30	6.12	5.99
27	6.22	6.12	6.05	5.94	6.02	6.20	6.48	6.43	6.48	6.29	6.10	6.00
28	6.22	6.11	6.04	5.95	6.02	6.25	6.47	6.44	6.47	6.26	6.09	5.97
29	6.20	6.13	6.04	5.95	---	6.27	6.46	6.46	6.48	6.26	6.08	5.97
30	6.21	6.10	6.06	5.96	---	6.27	6.46	6.48	6.46	6.25	6.06	5.95
31	6.21	---	6.06	5.97	---	6.28	---	6.49	---	6.24	6.04	---
MEAN	6.20	6.15	6.04	6.00	6.03	6.10	6.40	6.59	6.53	6.42	6.19	6.02
MAX	6.26	6.21	6.10	6.06	6.04	6.28	6.51	6.82	6.59	6.54	6.30	6.19
MIN	6.09	6.10	5.99	5.94	5.98	6.01	6.29	6.43	6.46	6.24	6.04	5.88

455208089435800 KAWAGUESAGA LAKE, DEEP HOLE, NEAR MIINOCQUA, WI

LOCATION.--Lat 45°52'08", long 89°43'58", in NE 1/4 NW 1/4 SW 1/4 sec.15, T.39 N., R.6 E., Oneida County, Hydrologic Unit 07070001, near Minocqua.

PERIOD OF RECORD.--May to September 2003.

REMARKS.--Lake sampled at deep hole. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MAY 8 TO SEPTEMBER 24, 2003

(Milligrams per liter unless otherwise indicated)

	May-8		Jun-18		Jul-15		Aug-12		Sep-24	
Lake stage (ft)	1584.16		1584.56		1584.54		1584.55		1584.38	
Secchi-depth (m)	2.9		3.6		2.9		3.1		1.8	
Depth of sample (m)	0.5	10.5	0.5	10	0.5	10	0.5	10	0.5	10
Chlorophyll a, phytoplankton (µg/L)	6.25	--	3.21	--	7.24	--	6.6	--	16.8	--
Water temperature (°C)	10.9	7.4	22.1	10.3	21.7	10.9	23.5	11.4	16.7	11.8
Specific conductance (µS/cm)	111	112	114	137	115	167	119	200	119	249
pH	7.5	6.8	7.7	6.6	7.9	6.9	7.6	6.7	7.5	7.5
Dissolved oxygen (mg/L)	11.3	4.8	9.4	0.1	7	0	7.9	0.1	8	0.7
Phosphorus, total (as P)	0.021	0.033	0.014	0.066	0.018	0.098	0.016	0.131	0.02	0.106
Phosphorus, ortho, dissolved (as P)	0.003	--	--	--	--	--	--	--	--	--
Nitrogen, NO ² + NO ³ , diss. (as N)	<.022	--	--	--	--	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	<.013	--	--	--	--	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	0.27	--	--	--	--	--	--	--	--	--
Nitrogen, total (as N)	0.281	--	--	--	--	--	--	--	--	--
Color (Pt-Co. scale)	5	--	--	--	--	--	--	--	--	--
Turbidity (NTU)	1.9	--	--	--	--	--	--	--	--	--
Hardness, as CaCO ₃	47	--	--	--	--	--	--	--	--	--
Calcium, dissolved (Ca)	13	--	--	--	--	--	--	--	--	--
Magnesium, dissolved (Mg)	3.6	--	--	--	--	--	--	--	--	--
Sodium, dissolved (Na)	3.6	--	--	--	--	--	--	--	--	--
Potassium, dissolved (K)	<1.00	--	--	--	--	--	--	--	--	--
Alkalinity, as CaCO ₃	44	--	--	--	--	--	--	--	--	--
Sulfate, dissolved (SO ₄)	<4.5	--	--	--	--	--	--	--	--	--
Chloride, dissolved (Cl)	6.2	--	--	--	--	--	--	--	--	--
Silica, dissolved (SiO ₂)	9.33	--	--	--	--	--	--	--	--	--
Solids, dissolved, at 180°C	74	--	--	--	--	--	--	--	--	--
Iron, dissolved (Fe) (µg/L)	<100	--	--	--	--	--	--	--	--	--
Manganese, dissolved, (Mn) (µg/L)	40	--	--	--	--	--	--	--	--	--

5-8-03

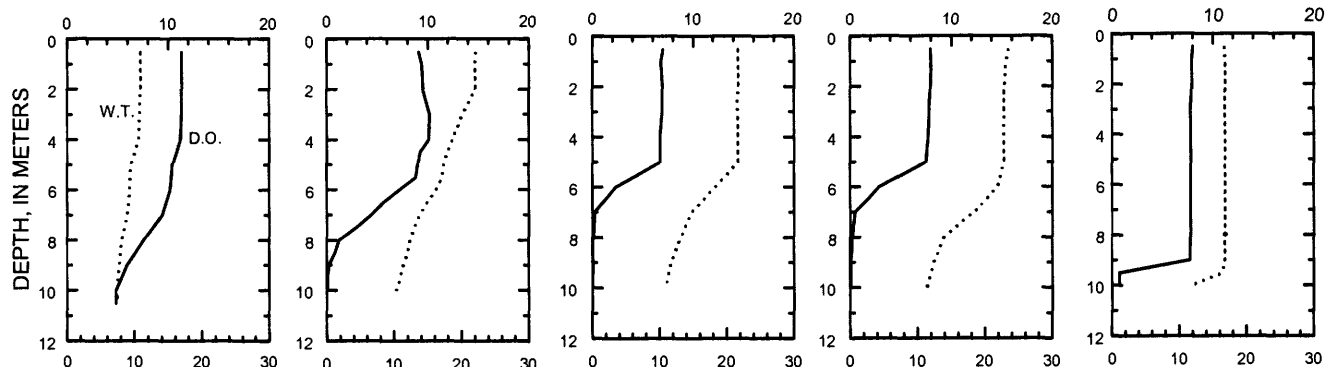
6-18-03

7-15-03

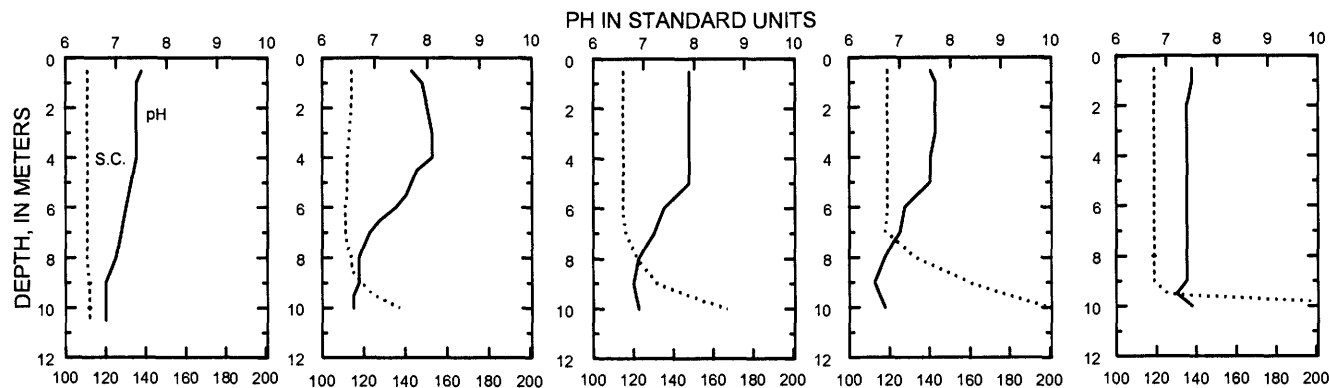
8-12-03

9-24-03

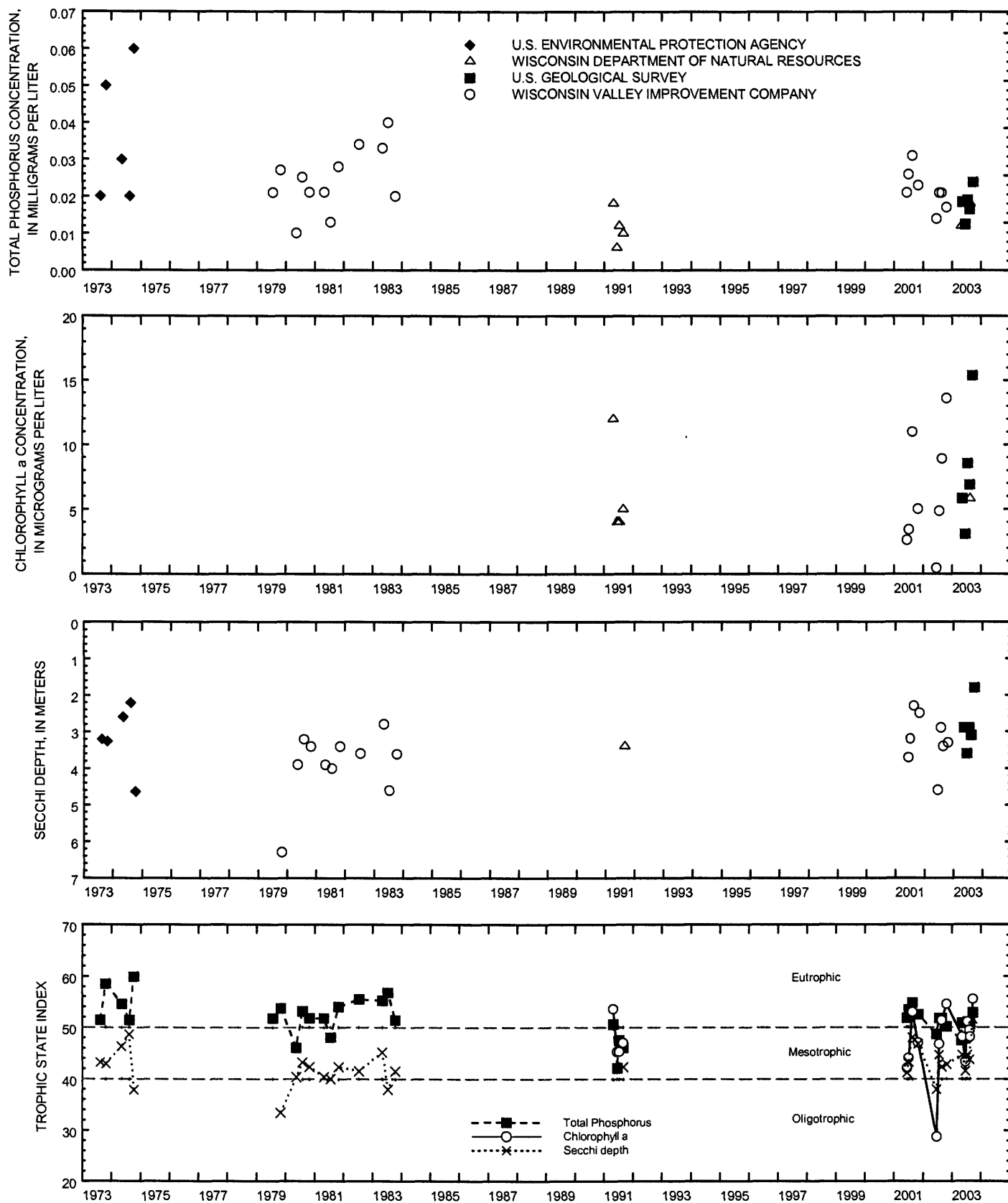
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Kawaguesaga Lake, Deep Hole, near Minocqua, Wisconsin.

455145089442600 KAWAGUESAGA LAKE, SOUTH SITE, NEAR MINOCQUA, WI

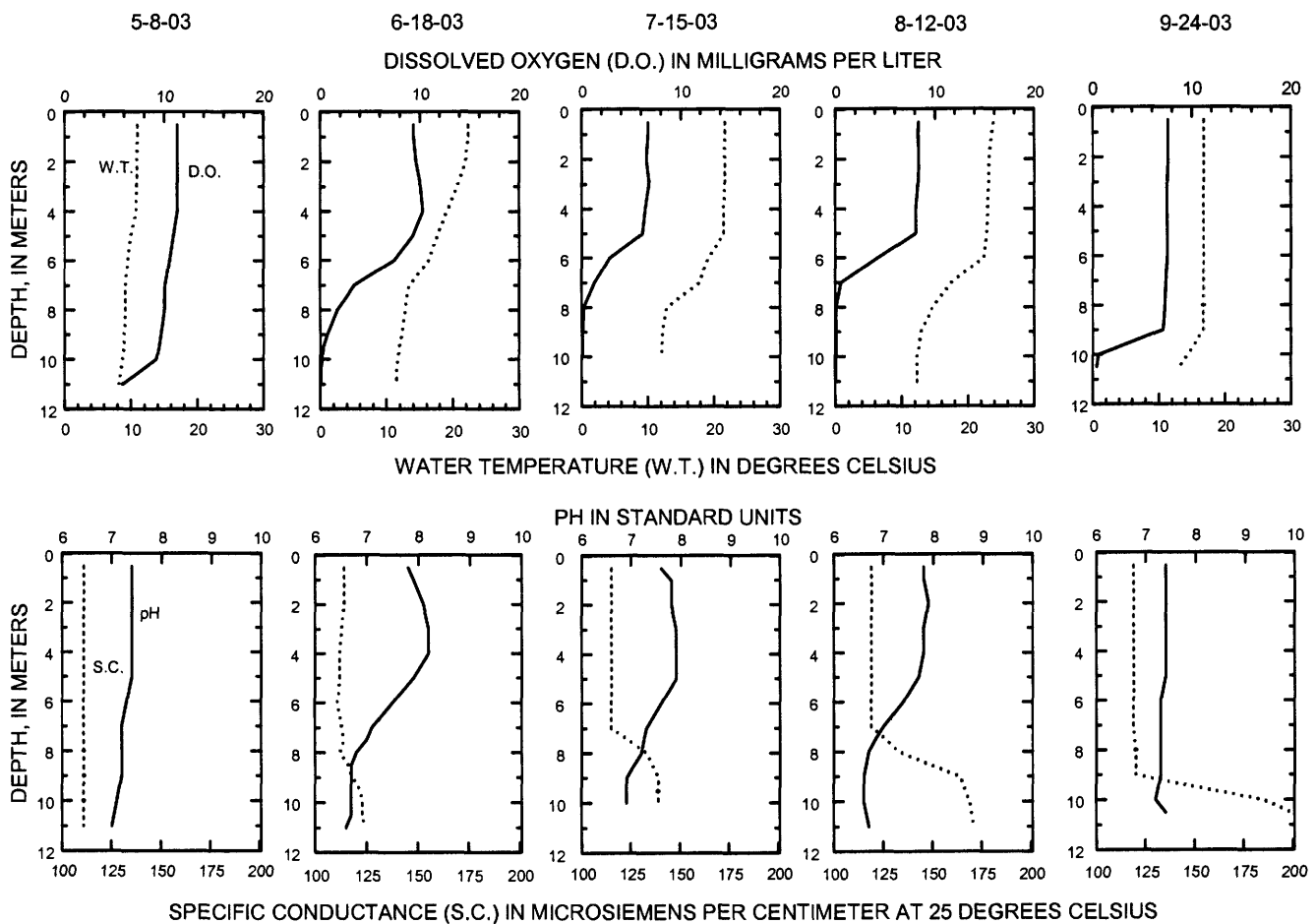
LOCATION.--Lat 45°51'45", long 89°44'26", in SW 1/4 SE 1/4 SE 1/4 sec.16, T.39 N., R.6 E., Oneida County, Hydrologic Unit 07070001, near Minocqua.

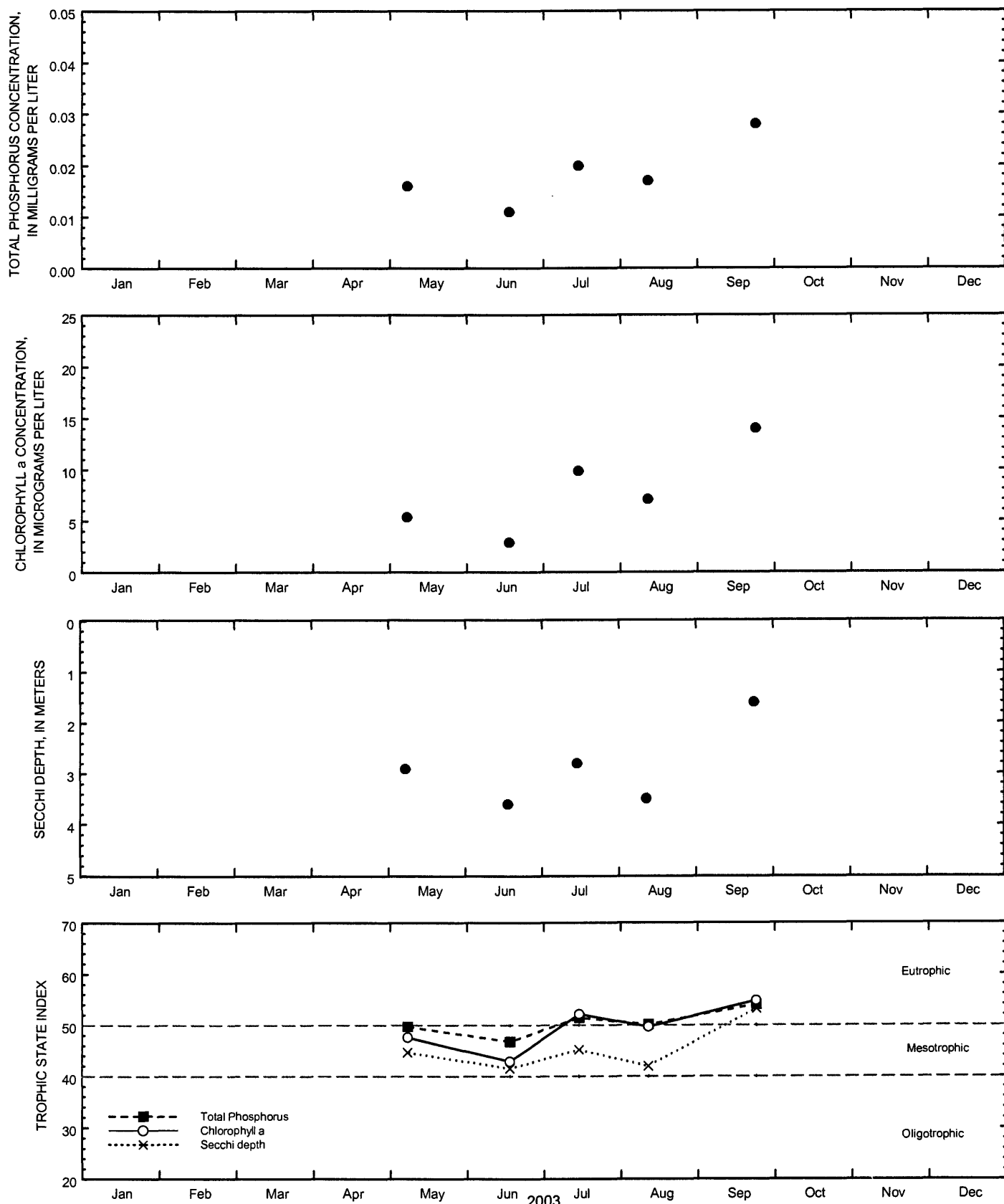
PERIOD OF RECORD.--May to September 2003.

REMARKS.--Lake sampled at South Site. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MAY 8 TO SEPTEMBER 24, 2003 (Milligrams per liter unless otherwise indicated)

	<u>May-8</u>		<u>Jun-18</u>		<u>Jul-15</u>		<u>Aug-12</u>		<u>Sep-24</u>	
Lake stage (ft)	1584.16		1584.56		1584.54		1584.55		1584.38	
Secchi-depth (m)	2.9		3.6		2.8		3.5		1.6	
Depth of sample (m)	0.5	11	0.5	11	0.5	10	0.5	11	0.5	10.5
Chlorophyll a, phytoplankton (µg/L)	5.39	--	2.9	--	9.85	--	7.14	--	14	--
Water temperature (°C)	0.5	8.2	22.3	11.5	21.7	12	23.9	12.3	16.8	13.1
Specific conductance (µS/cm)	111	111	114	124	115	139	119	171	119	199
pH	7.4	7	7.8	6.6	7.6	6.9	7.8	6.7	7.4	7.4
Dissolved oxygen (mg/L)	11.3	5.8	9.4	0.1	6.7	0.1	8.4	0.1	7.6	0.4
Phosphorus, total (as P)	0.016	0.023	0.011	0.064	0.02	0.077	0.017	0.135	0.028	0.11





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Kawaguesaga Lake, South Site, near Minocqua, Wisconsin.

05427235 LAKE KOSHKONONG NEAR NEWVILLE, WI

LOCATION.--Lat 42°51'27", long 88°56'27", in NW 1/4 NE 1/4 sec.34, T.5 N., R.13 E., Jefferson County, Hydrologic Unit 07090001, 80 ft east of Pottawatom Trail Bridge at Bingham Point Estates, and 4.5 mi northeast of Newville.

DRAINAGE AREA.--2,560 mi², at lake outlet. Area of Lake Koshkonong, 16.3 mi².

PERIOD OF RECORD.--July 1987 to current year.

GAGE.--Water-stage recorder. Datum of gage is 770.00 ft above sea level.

REMARKS.--Lake level regulated by dam at Indianford. Gage-height telemeter at station.

EXTREMES FOR PERIOD OF RECORD.--Maximum recorded gage height, 12.23 ft, Apr. 25, 1993; minimum recorded, 5.10 ft, Dec. 28, 29, 1999.

EXTREMES FOR CURRENT YEAR.--Maximum recorded gage height, 7.53 ft, May 20; minimum daily gage height, 5.31 ft, Jan. 28, 30 and 31.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	6.45	5.56	5.58	5.71	e5.32	e5.41	5.65	6.39	6.39	6.27	6.06	5.85
2	6.46	5.49	5.60	5.70	e5.33	e5.41	5.62	6.46	6.30	6.26	6.06	5.85
3	6.41	5.44	5.60	5.70	e5.35	e5.41	5.56	6.50	6.27	6.25	6.05	5.87
4	6.46	5.42	5.59	5.69	e5.37	e5.42	5.58	6.53	6.26	6.27	6.05	5.86
5	6.47	5.38	5.59	5.70	e5.36	e5.44	5.59	6.65	6.23	6.29	6.06	5.85
6	6.48	5.38	5.58	5.70	e5.36	e5.47	5.53	6.69	6.22	6.29	6.07	5.85
7	6.45	5.39	5.57	5.70	e5.36	e5.48	5.52	6.72	6.22	6.31	6.08	5.85
8	6.38	5.43	5.56	5.70	e5.35	e5.49	5.57	6.74	6.24	6.34	6.09	5.85
9	6.33	5.42	5.55	5.67	e5.35	e5.50	5.58	6.85	6.23	6.35	6.09	5.85
10	6.27	5.45	5.53	5.61	e5.35	e5.49	5.58	6.95	6.18	6.36	6.10	5.85
11	6.24	5.45	5.52	5.54	e5.36	e5.49	5.59	7.13	6.22	6.33	6.11	5.83
12	6.25	5.45	5.51	5.48	e5.37	e5.50	5.59	7.24	6.26	6.25	6.08	5.82
13	6.25	5.43	5.49	5.42	e5.36	e5.51	5.57	7.30	6.30	6.20	6.06	5.89
14	6.19	5.45	5.47	5.40	e5.35	e5.52	5.54	7.36	6.34	6.16	6.05	6.04
15	6.19	5.44	5.46	5.38	e5.34	e5.56	5.57	7.41	6.37	6.29	6.05	6.06
16	6.15	5.42	5.46	5.36	e5.34	e5.60	5.58	7.43	6.38	6.30	6.03	6.07
17	6.12	5.41	5.45	5.34	e5.35	5.64	5.62	7.44	6.36	6.32	6.01	6.06
18	6.09	5.40	5.48	5.34	e5.36	5.72	5.73	7.42	6.32	6.31	5.98	6.07
19	6.10	5.42	5.53	5.34	e5.36	5.78	5.82	7.40	6.29	6.30	5.95	6.13
20	6.04	5.43	5.57	5.34	e5.36	5.85	6.00	7.45	6.26	6.29	5.93	6.11
21	6.00	5.48	5.61	5.34	e5.38	5.90	6.15	7.38	6.22	6.35	5.94	6.10
22	5.99	5.47	5.64	5.34	e5.39	5.91	6.24	7.35	6.19	6.33	5.92	6.15
23	5.92	5.48	5.65	e5.33	e5.39	5.91	6.30	7.29	6.16	6.28	5.89	6.14
24	5.84	5.51	5.66	e5.33	e5.40	5.91	6.32	7.22	6.18	6.24	5.86	6.14
25	5.82	5.52	5.68	e5.33	e5.40	5.88	6.34	7.14	6.21	6.20	5.86	6.13
26	5.82	5.52	5.70	e5.33	e5.41	5.84	6.30	7.05	6.28	6.17	5.85	6.11
27	5.80	5.53	5.70	e5.32	e5.40	5.78	6.26	6.95	6.23	6.17	5.85	6.15
28	5.76	5.54	5.71	e5.31	e5.40	5.79	6.23	6.86	6.25	6.14	5.84	6.14
29	5.69	5.56	5.71	e5.32	---	5.77	6.23	6.80	6.28	6.11	5.87	6.12
30	5.64	5.59	5.72	e5.31	---	5.71	6.25	6.64	6.27	6.08	5.85	6.13
31	5.60	---	5.73	e5.31	---	5.67	---	6.54	---	6.06	5.85	---
MEAN	6.12	5.46	5.59	5.46	5.37	5.64	5.83	7.01	6.26	6.25	5.99	6.00
MAX	6.48	5.59	5.73	5.71	5.41	5.91	6.34	7.45	6.39	6.36	6.11	6.15
MIN	5.60	5.38	5.45	5.31	5.32	5.41	5.52	6.39	6.16	6.06	5.84	5.82

e Estimated

430733088305900 LAC LA BELLE AT OCONOMOWOC, WI

LOCATION.--Lat 43°07'33", long 88°30'59", in NW 1/4 SW 1/4 sec.29, T.8 N., R.17 E., Waukesha County, Hydrologic Unit 07090001, at Oconomowoc.

DRAINAGE AREA.--99.6 mi².

PERIOD OF RECORD.--February 1984 to August 1985, April to August 1991, and February 2001 to current year.

REMARKS.--Lake sampled near center of lake at a depth of 13 m. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 20 TO AUGUST 19, 2003 (Milligrams per liter unless otherwise indicated)

	Feb-20		Apr-24		Jun-10		Jul-8		Aug-19	
Secchi-depth (m)	--		2.6		1.4		1.5		2.2	
Depth of sample (m)	0.5	12.5	0.5	13	0.5	12.5	0.5	13.5	0.5	12
Chlorophyll a, phytoplankton (µg/L)	--	--	2.81	--	8.17	--	5.57	--	3.28	--
Water temperature (°C)	1.6	3.2	10.4	9.4	19.1	13.6	26.2	14	25.7	14.3
Specific conductance (µS/cm)	608	745	558	563	551	590	554	609	554	629
pH	8.3	8	8	8	8.2	7.4	8	7.5	8	7.2
Dissolved oxygen (mg/L)	15.4	10.2	11.1	9.7	10.5	0.6	8	0.3	8.6	0.4
Phosphorus, total (as P)	0.005	0.009	0.028	0.025	0.078	0.053	0.016	0.029	0.015	0.028
Phosphorus, ortho, dissolved (as P)	--	--	<.002	--	--	--	0.003	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	0.664	--	--	--	0.255	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.049	--	--	--	0.036	--	--	--
Nitrogen, amm. + diss., total (as N)	--	--	--	--	--	--	0.77	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.49	--	--	--	--	--	--	--
Nitrogen, total (as N)	--	--	1.2	--	--	--	--	--	--	--
Color (Pt-Co. scale)	--	--	5	--	--	--	--	--	--	--
Turbidity (NTU)	--	--	2.7	--	--	--	--	--	--	--
Hardness, as CaCO ₃	--	--	240	--	--	--	--	--	--	--
Calcium, dissolved (Ca)	--	--	43.3	--	--	--	--	--	--	--
Magnesium, dissolved (Mg)	--	--	33	--	--	--	--	--	--	--
Sodium, dissolved (Na)	--	--	20.8	--	--	--	--	--	--	--
Potassium, dissolved (K)	--	--	2	--	--	--	--	--	--	--
Alkalinity, as CaCO ₃	--	--	200	--	--	--	--	--	--	--
Sulfate, dissolved (SO ₄)	--	--	25	--	--	--	--	--	--	--
Chloride, dissolved (Cl)	--	--	48.4	--	--	--	--	--	--	--
Silica, dissolved (SiO ₂)	--	--	4.14	--	--	--	--	--	--	--
Solids, dissolved, at 180°C	--	--	284	--	--	--	--	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	<100	--	--	--	--	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	<1	--	--	--	--	--	--	--

2-20-03

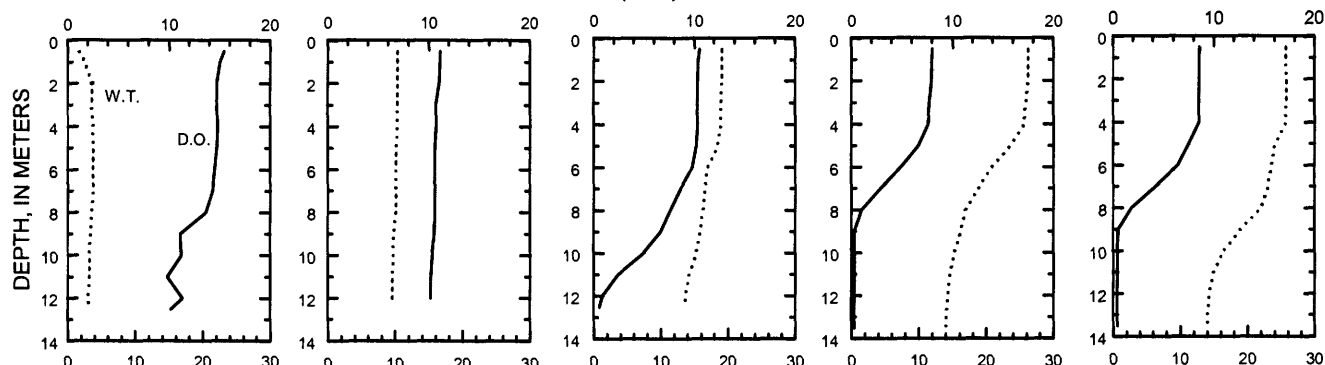
4-24-03

6-10-03

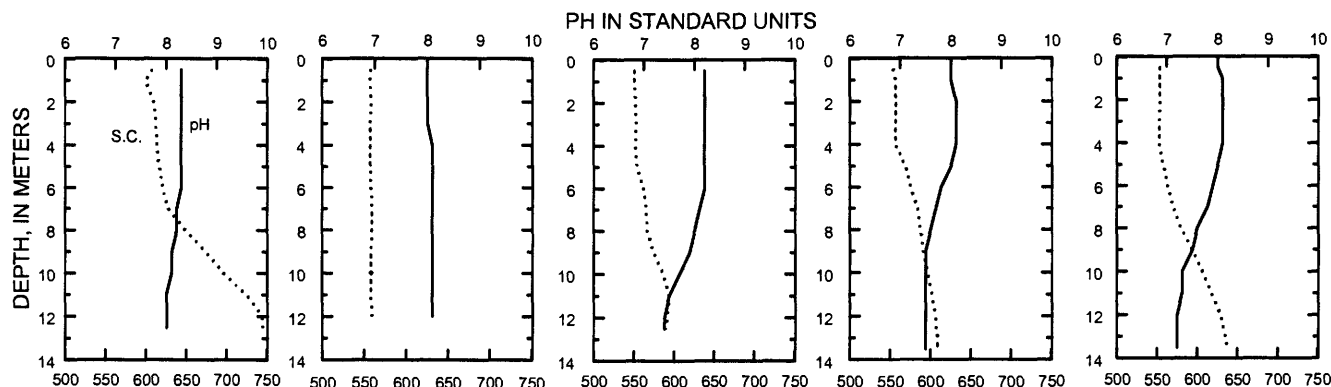
7-8-03

8-19-03

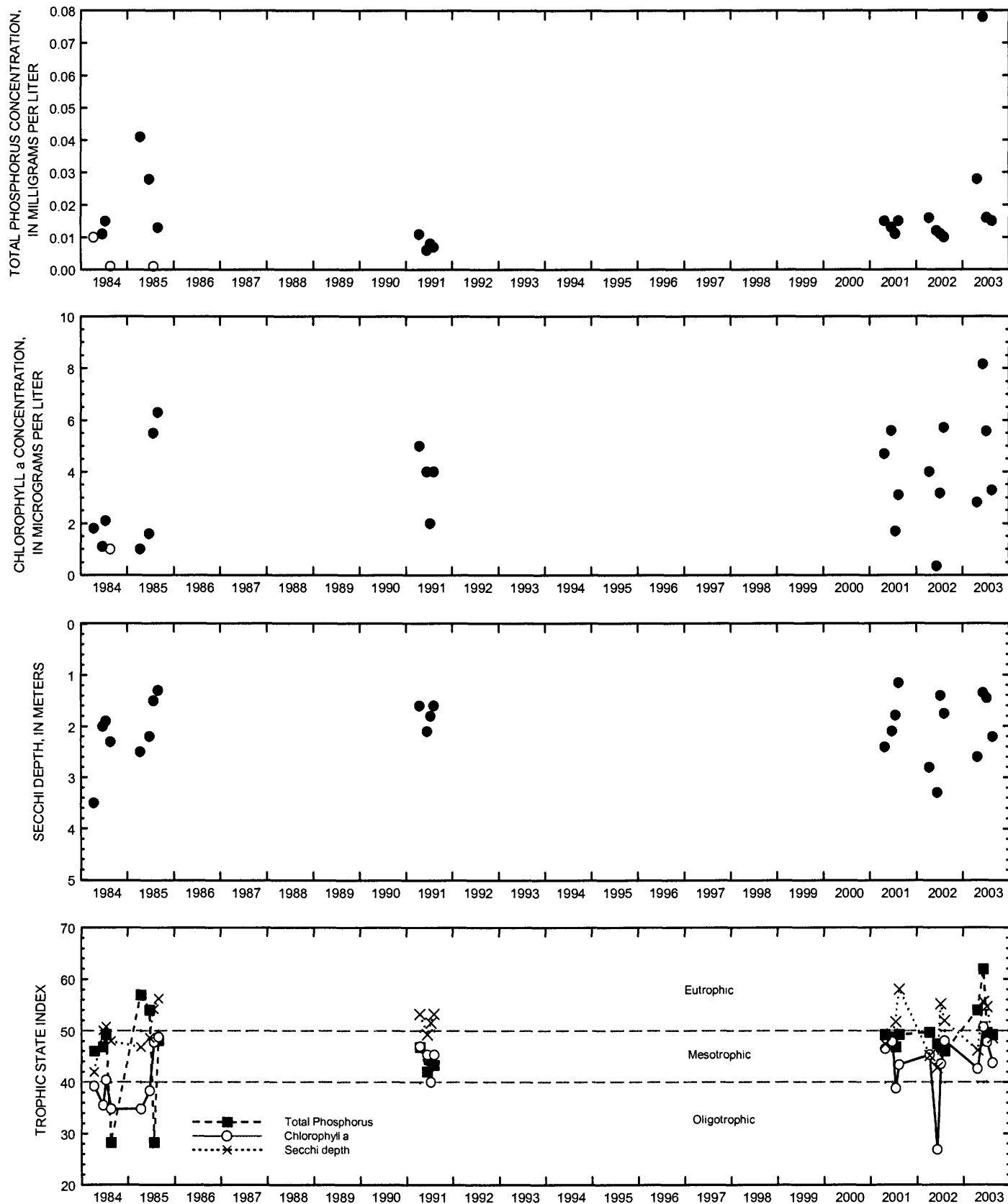
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths,
and TSI data for Lac La Belle, at Oconomowoc, Wisconsin.

(Circles on the first two plots indicate laboratory detection limit for selected analyses.
Actual concentrations for these particular analyses are less than the plotted circles.)

432255088134700 LITTLE CEDAR LAKE, NORTH SITE, NEAR WEST BEND, WI

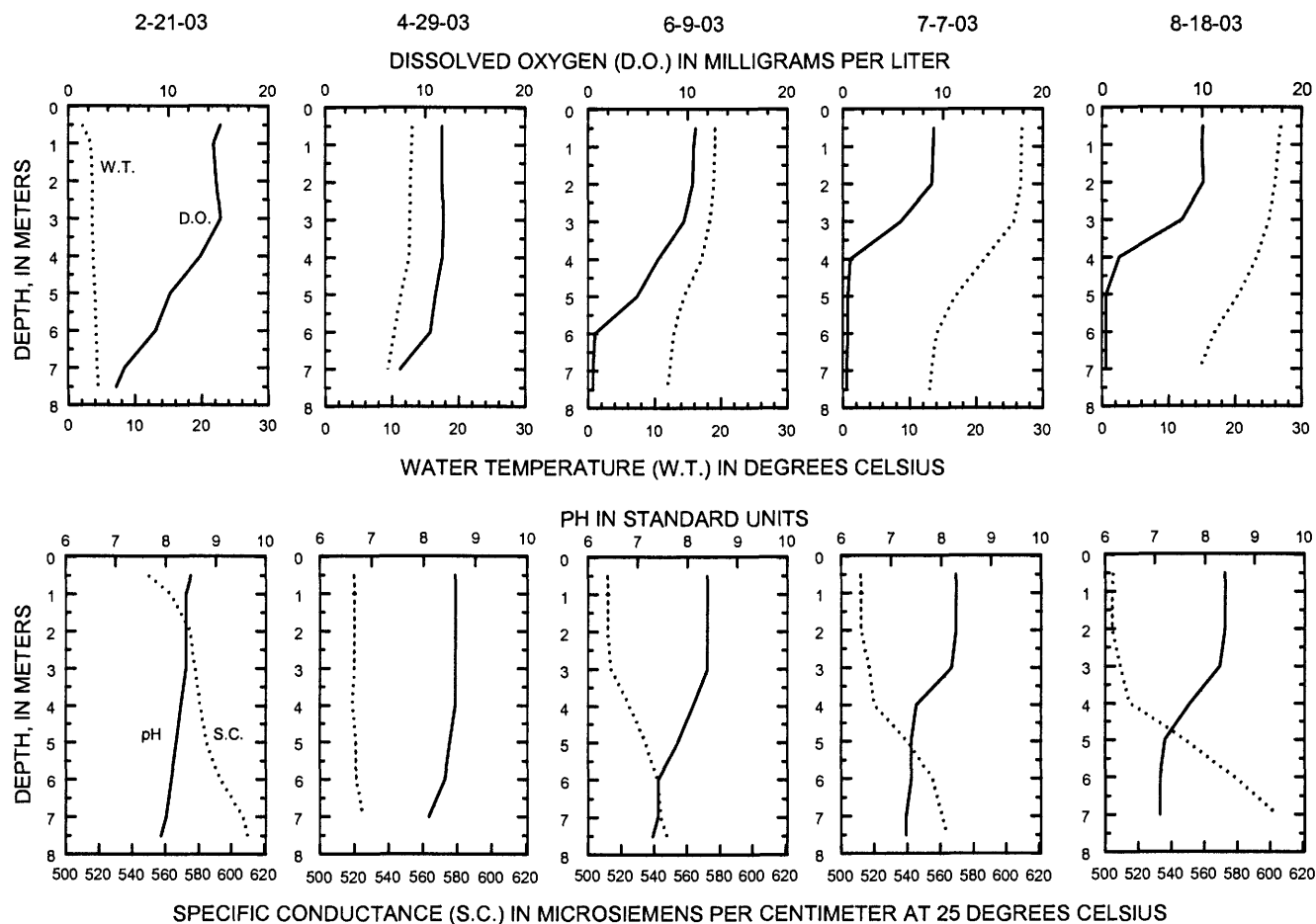
LOCATION.--Lat 43°22'55", long 88°13'47", in NW 1/4 NE 1/4 sec.33, T.11 N., R.19 E., Washington County, Hydrologic Unit 04040003, 2.6 mi southwest of West Bend.

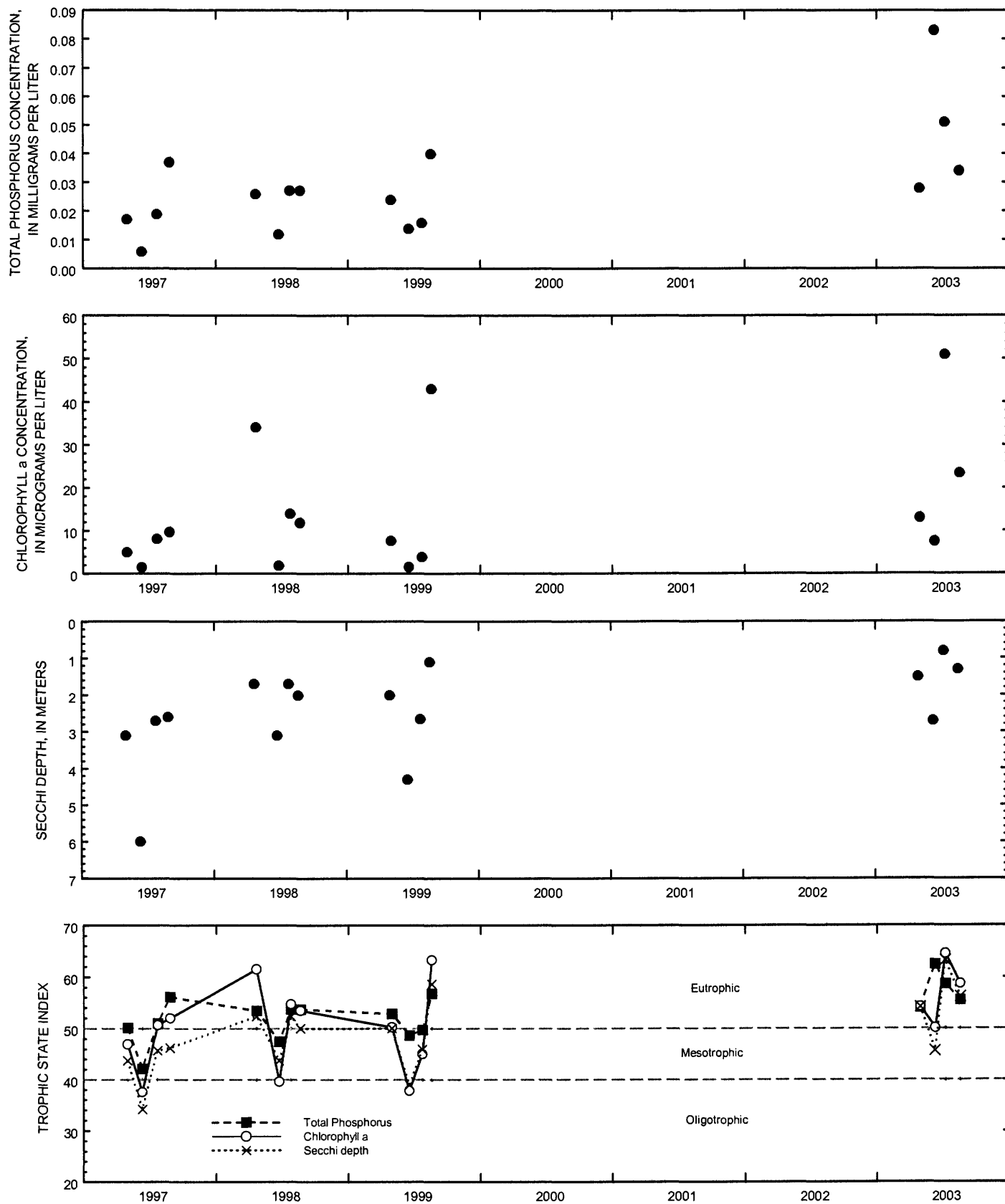
PERIOD OF RECORD.--February 1997 to August 1999, February to August 2003.

REMARKS.--Lake sampled at center of northern basin at deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 21 TO AUGUST 18, 2003 (Milligrams per liter unless otherwise indicated)

	Feb-21		Apr-29		Jun-9		Jul-7		Aug-18	
Lake stage (ft)	--		0.41		0.458		--		0.568	
Secchi-depth (m)	--		1.5		2.7		0.8		1.3	
Depth of sample (m)	0.5	7.5	0.5	8	0.5	7.5	0.5	7.5	0.5	7
Chlorophyll a, phytoplankton (µg/L)	--	--	13	--	7.53	--	51	--	23.4	--
Water temperature (°C)	2.1	4.5	13.1	9.1	19.1	11.9	26.9	13.1	26.9	14.7
Specific conductance (µS/cm)	550	610	520	527	512	548	512	564	505	604
pH	8.5	7.9	8.6	8	8.4	7.3	8.3	7.3	8.4	7.1
Dissolved oxygen (mg/L)	15.2	4.8	11.7	6.3	10.8	0.5	9.1	0.4	10.1	0.4
Phosphorus, total (as P)	0.013	0.02	0.028	0.05	0.083	0.093	0.051	0.053	0.034	0.074





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Little Cedar Lake, North Site, near West Bend, Wisconsin.

432249088134500 LITTLE CEDAR LAKE, SOUTH SITE, NEAR WEST BEND, WI

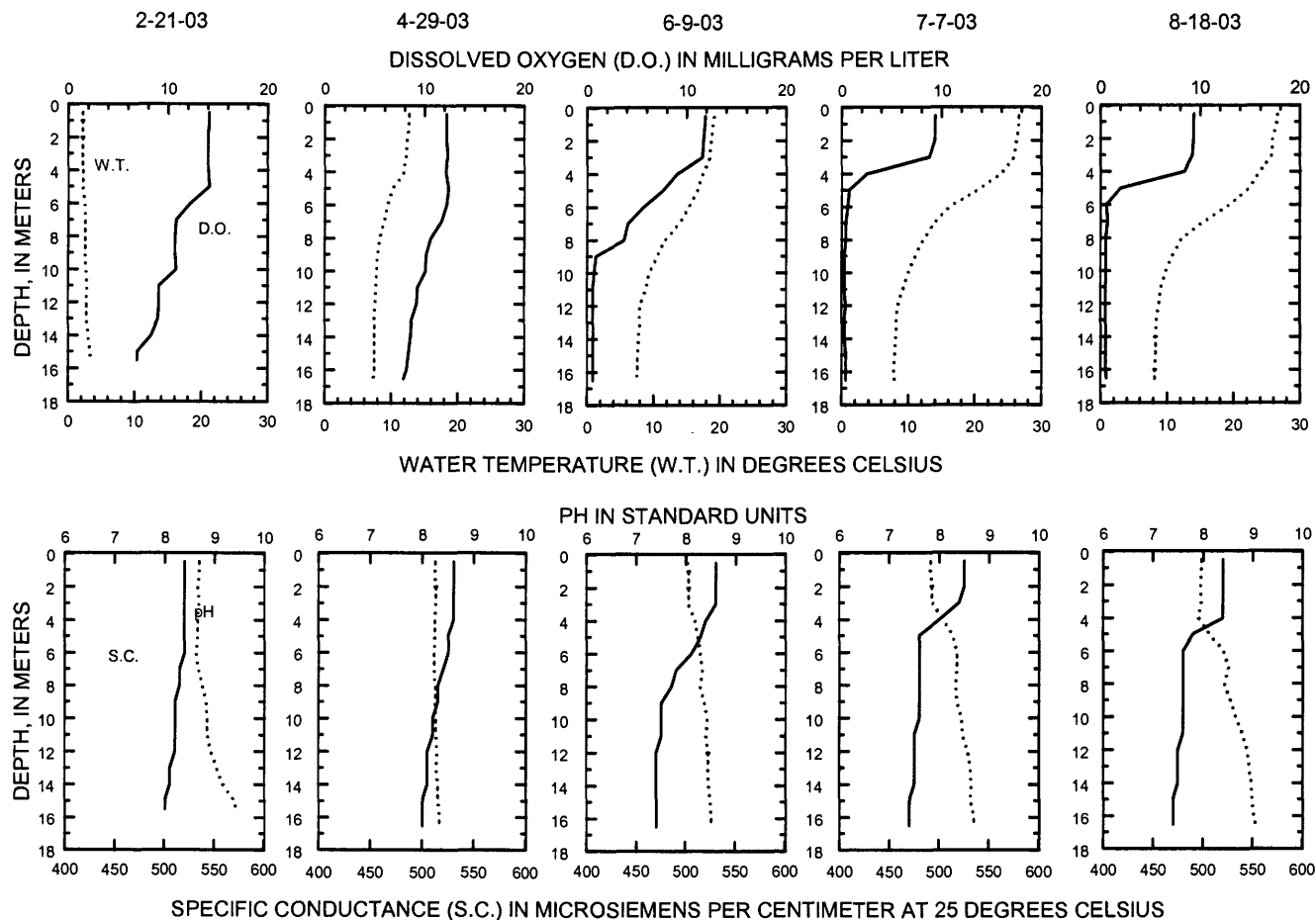
LOCATION.--Lat 43°22'49", long 88°13'45", in NW 1/4 SE 1/4 sec.33, T.11 N., R.19 E., Washington County, Hydrologic Unit 04040003, 2.8 mi southwest of West Bend.

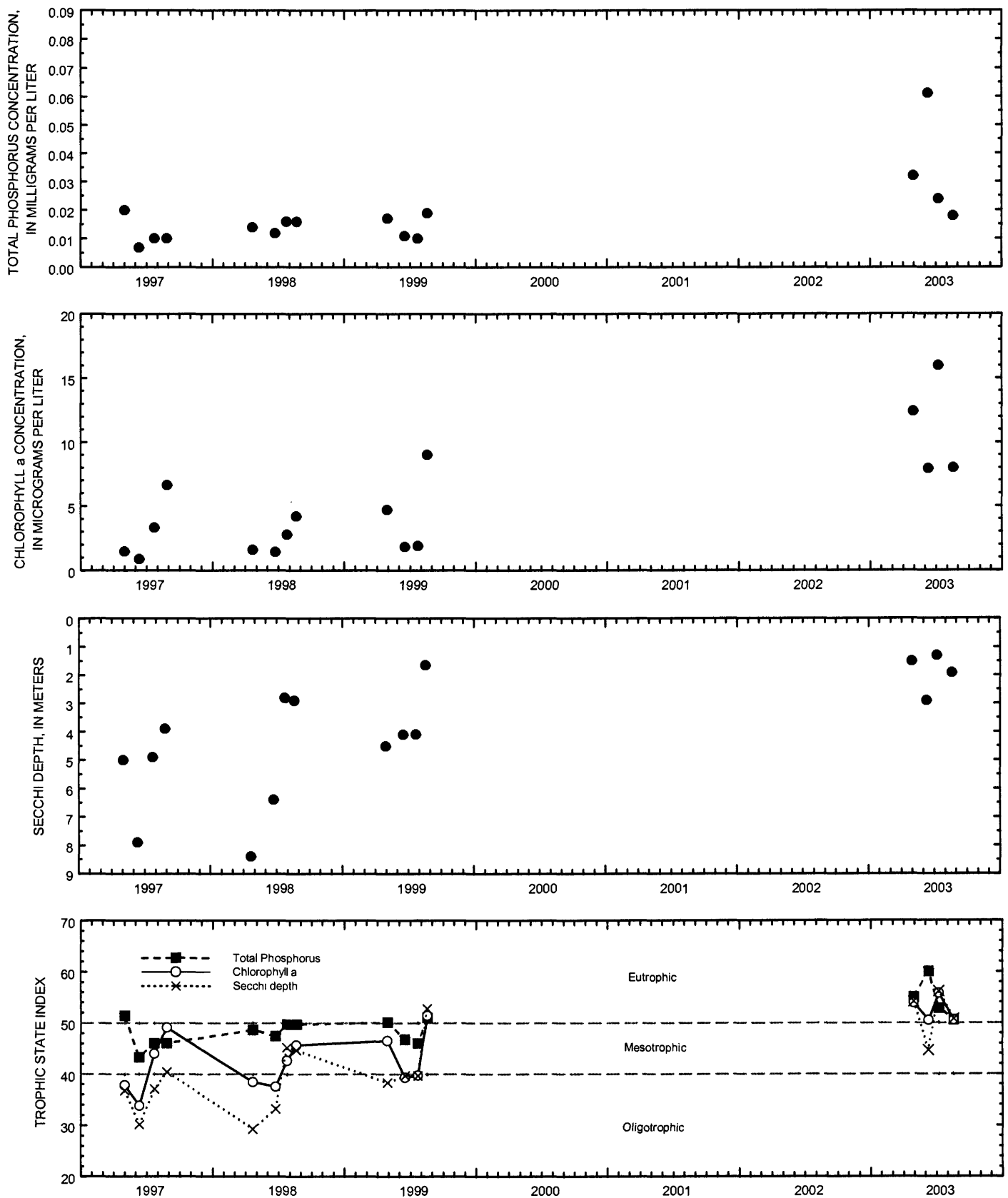
PERIOD OF RECORD.--February 1997 to current year.

REMARKS.--Lake sampled in southern basin at deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 21 TO AUGUST 18, 2003 (Milligrams per liter unless otherwise indicated)

	Feb-21		Apr-29		Jun-9		Jul-7		Aug-18		
Lake stage (ft)	--	--	0.41	--	0.458	--	--	--	0.568	--	--
Secchi-depth (m)	--	--	1.5	--	2.9	--	1.3	--	1.9	--	--
Depth of sample (m)	0.5	15.5	0.5	16.5	0.5	16.5	0.5	16.5	0.5	13	16.5
Chlorophyll a, phytoplankton (µg/L)	--	--	12.4	--	7.92	--	16	--	8	--	--
Water temperature (°C)	2.2	3.4	12.7	7.3	19.2	7.5	26.6	7.9	26.6	8.4	8.2
Specific conductance (µS/cm)	535	572	513	517	502	526	492	535	499	547	553
pH	8.4	8	8.6	8	8.6	7.4	8.5	7.4	8.4	7.5	7.4
Dissolved oxygen (mg/L)	14.1	6.9	12.2	7.9	11.9	0.6	9.4	0.4	9.4	0.5	0.6
Phosphorus, total (as P)	0.025	0.042	0.032	0.032	0.061	0.148	0.024	0.154	0.018	0.119	0.184
Phosphorus, ortho, dissolved (as P)	--	--	0.002	--	--	--	<.002	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	0.016	--	--	--	<.022	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	<.013	--	--	--	<.013	--	--	--	--
Nitrogen, amm. + diss., total (as N)	--	--	--	--	--	--	0.72	--	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.51	--	--	--	--	--	--	--	--
Nitrogen, total (as N)	--	--	0.53	--	--	--	--	--	--	--	--
Color (Pt-Co. scale)	--	--	<5	--	--	--	--	--	--	--	--
Turbidity (NTU)	--	--	3.3	--	--	--	--	--	--	--	--
Hardness, as CaCO ₃	--	--	220	--	--	--	--	--	--	--	--
Calcium, dissolved (Ca)	--	--	34.3	--	--	--	--	--	--	--	--
Magnesium, dissolved (Mg)	--	--	32.1	--	--	--	--	--	--	--	--
Sodium, dissolved (Na)	--	--	20.3	--	--	--	--	--	--	--	--
Potassium, dissolved (K)	--	--	2	--	--	--	--	--	--	--	--
Alkalinity, as CaCO ₃	--	--	183	--	--	--	--	--	--	--	--
Sulfate, dissolved (SO ₄)	--	--	17	--	--	--	--	--	--	--	--
Chloride, dissolved (Cl)	--	--	45.6	--	--	--	--	--	--	--	--
Silica, dissolved (SiO ₂)	--	--	0.309	--	--	--	--	--	--	--	--
Solids, dissolved, at 180°C	--	--	286	--	--	--	--	--	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	<100	--	--	--	--	--	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	<1	--	--	--	--	--	--	--	--





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Little Cedar Lake, South Site, near West Bend, Wisconsin.

434412088590700 LITTLE GREEN LAKE, AT CENTER, NEAR MARKESAN, WI

LOCATION--Lat 43°44'12", long 88°59'07", in SW 1/4 SW 1/4 sec.29, T.15 N., R.13 E., Green Lake County, Hydrologic Unit 04030201, 2 mi north of Markesan.

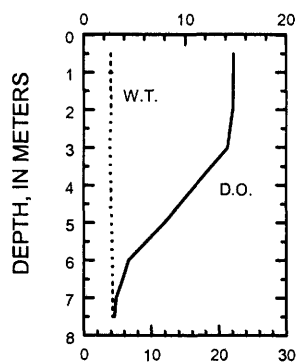
PERIOD OF RECORD--February 1991 to current year.

REMARKS--Lake sampled near center at the deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 27 TO JUNE 9, 2003 (Milligrams per liter unless otherwise indicated)

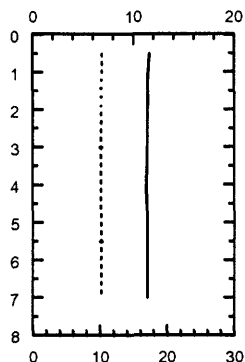
	Feb-27		Apr-16		Jun-9	
Lake stage (ft)	--	--	--	--	6.03	1.3
Secchi-depth (m)	--	--	0.7	--	0.5	7
Depth of sample (m)	0.5	7.5	0.5	7	0.5	7
Chlorophyll a, phytoplankton (µg/L)	--	--	15.9	--	17.8	--
Water temperature (°C)	4	4.3	10.3	10.2	17.9	17.16
Specific conductance (µS/cm)	445	447	377	377	333	349
pH	8.4	7.9	7.9	8	8.4	7.53
Dissolved oxygen (mg/L)	14.8	3	11.6	11.4	8.5	1.8
Phosphorus, total (as P)	0.026	0.036	0.048	0.062	0.066	0.13
Phosphorus, ortho, dissolved (as P)	--	--	0.003	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	<.022	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	<.013	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.72	--	--	--
Nitrogen, total (as N)	--	--	0.73	--	--	--
Color (Pt-Co. scale)	--	--	5	--	--	--
Turbidity (NTU)	--	--	12	--	--	--
Hardness, as CaCO ₃	--	--	180	--	--	--
Calcium, dissolved (Ca)	--	--	31.8	--	--	--
Magnesium, dissolved (Mg)	--	--	23.4	--	--	--
Sodium, dissolved (Na)	--	--	8.4	--	--	--
Potassium, dissolved (K)	--	--	3	--	--	--
Alkalinity, as CaCO ₃	--	--	159	--	--	--
Chloride, dissolved (Cl)	--	--	19.8	--	--	--
Silica, dissolved (SiO ₂)	--	--	0.07	--	--	--
Solids, dissolved, at 180°C	--	--	216	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	<100	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	<1	--	--	--

2-27-03

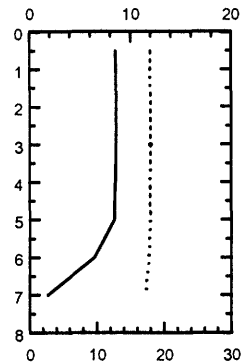


4-16-03

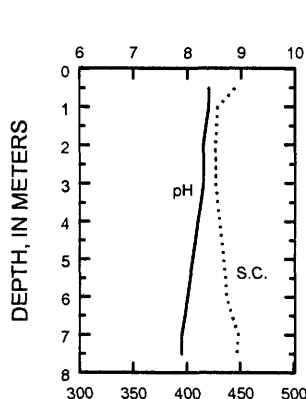
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



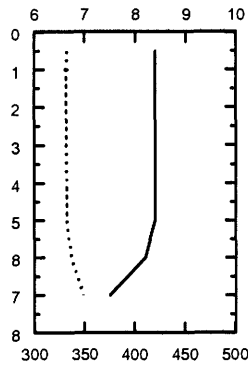
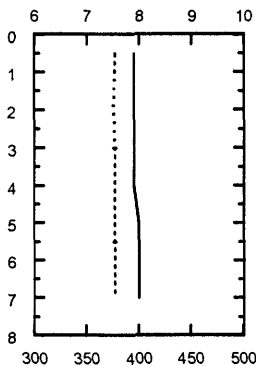
6-9-03



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

434412088590700 LITTLE GREEN LAKE, AT CENTER, NEAR MARKESAN, WI--CONTINUED

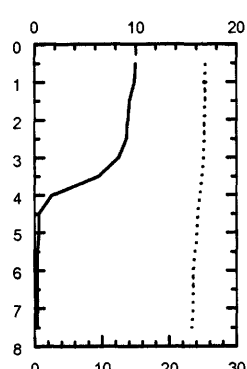
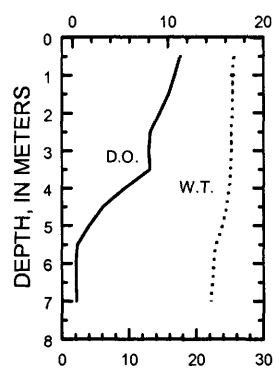
WATER-QUALITY DATA, JULY 7 TO AUGUST 18, 2003
(Milligrams per liter unless otherwise indicated)

		<u>Jul-7</u>			<u>Aug-18</u>	
Lake stage (ft)		6.11			5.92	
Secchi-depth (m)		0.75			0.35	
Depth of sample (m)	0.5	5.5	6.5	7	0.5	7.5
Chlorophyll a, phytoplankton (µg/L)	215	--	--	--	223	--
Water temperature (°C)	25.6	22.9	22.4	22.2	25.4	23.4
Specific conductance (µS/cm)	313	356	362	366	331	359
pH	8.7	7.7	7.8	7.8	8.6	7.7
Dissolved oxygen (mg/L)	11.3	0.5	0.4	0.4	10	0.3
Phosphorus, total (as P)	0.152	0.15	0.264	0.262	0.286	0.408
Phosphorus, ortho, dissolved (as P)	0.004	--	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	<.022	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	0.06	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	1.1	--	--	--	--	--

7-7-03

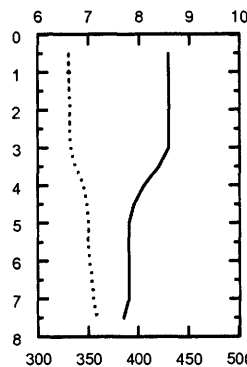
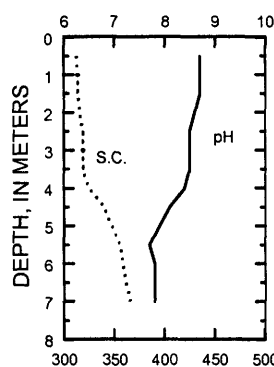
8-18-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER

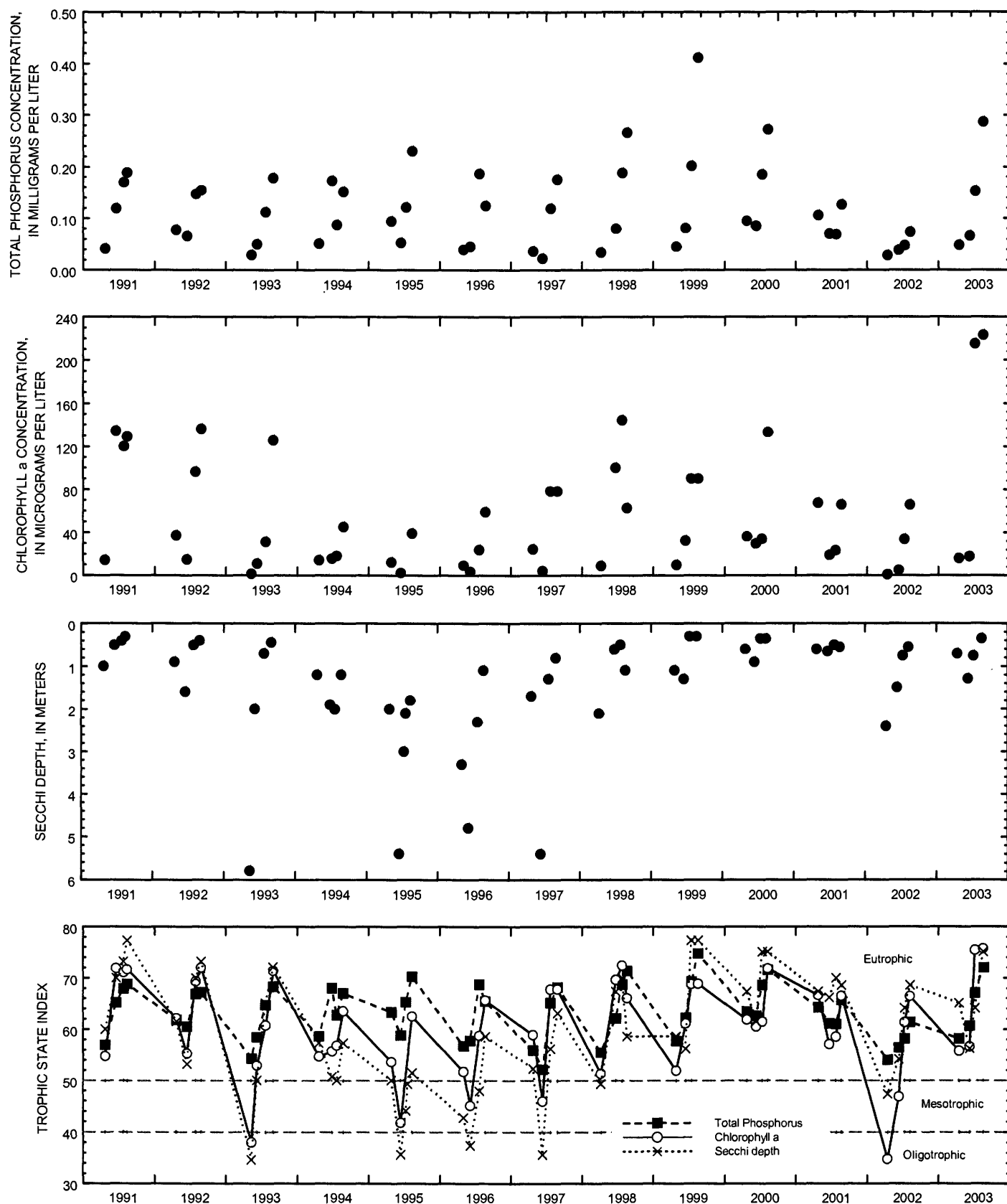


WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Little Green Lake, at Center, near Markesan, Wisconsin.

05390700 LITTLE ST. GERMAIN LAKE NEAR EAGLE RIVER, WI

LOCATION--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 mi².

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 regulated by dam at outlet.

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

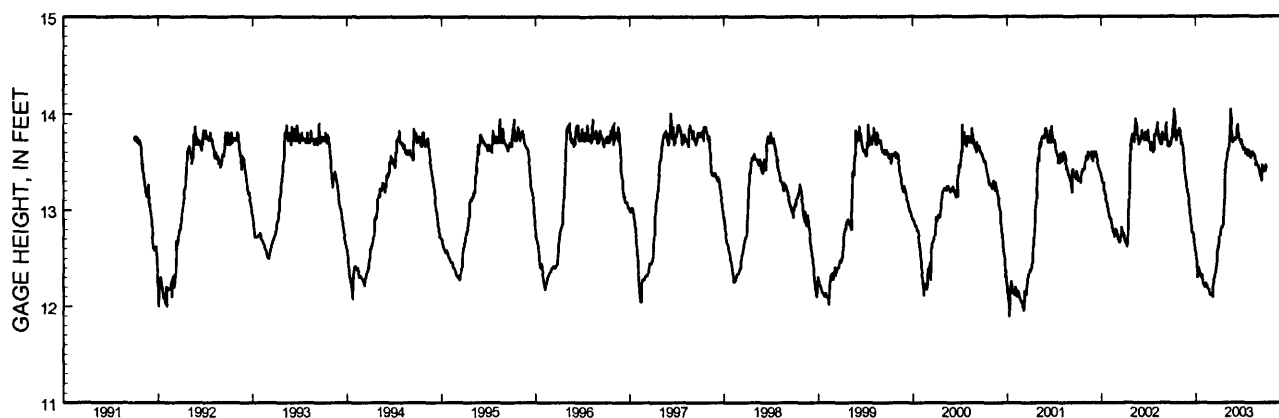
EXTREMES FOR PERIOD OF RECORD.--Maximum gage height observed, 14.04 ft, Oct. 6, 2002 and May 12, 2003; minimum observed, 12.00 ft, Jan. 3 and Feb. 3, 1992.

EXTREMES FOR CURRENT YEAR.--Maximum gage height observed, 14.04, Oct. 6 and May 12; minimum observed, 12.10 ft, Mar. 4.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003

DAILY MEAN VALUE

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	13.80	13.76	---	---	12.22	12.12	12.74	13.60	13.74	13.64	13.60	13.42
2	13.84	13.74	13.10	12.46	---	---	---	13.62	13.74	13.62	13.60	13.42
3	13.84	13.72	---	---	---	---	12.76	13.62	13.74	13.64	13.60	13.40
4	13.94	13.68	---	12.40	12.20	12.10	---	13.62	13.74	13.64	13.60	13.40
5	13.96	13.68	13.00	---	---	---	12.82	13.64	13.74	13.64	13.60	13.36
6	14.04	13.70	---	---	12.20	12.20	---	13.66	13.74	13.64	13.60	13.36
7	13.98	13.68	---	12.30	---	---	---	13.68	13.78	13.62	13.60	13.36
8	13.98	13.68	---	12.38	12.24	12.28	12.82	13.74	13.80	13.60	13.60	13.34
9	13.96	13.68	12.90	12.40	---	---	---	13.76	13.84	13.58	13.58	13.34
10	13.92	13.64	---	---	---	---	12.82	13.78	13.88	13.58	13.58	13.34
11	13.80	---	---	12.38	12.22	12.30	---	13.88	13.86	13.62	13.58	13.34
12	13.76	13.60	12.84	---	---	---	12.84	14.04	13.80	13.60	13.56	13.30
13	13.78	---	---	---	12.22	12.32	---	14.02	13.76	13.60	13.56	13.40
14	13.74	13.48	---	12.32	---	---	---	14.00	13.78	13.58	13.56	13.46
15	13.72	---	12.76	---	12.20	12.38	12.86	13.96	13.74	13.58	13.54	13.44
16	13.72	13.44	---	12.34	---	12.40	---	13.92	13.72	13.56	13.52	13.44
17	13.74	---	---	---	---	---	13.06	13.86	13.72	13.58	13.52	13.42
18	13.76	---	---	12.32	12.18	12.40	---	13.80	13.72	13.58	13.50	13.42
19	13.78	13.36	12.76	---	---	---	13.18	13.74	13.72	13.58	13.48	13.42
20	13.80	---	---	---	12.18	12.48	13.30	13.76	13.70	13.58	13.46	13.42
21	13.80	13.32	---	12.30	---	---	13.38	13.72	13.70	13.62	13.48	13.40
22	13.80	---	---	---	12.14	12.56	13.42	13.70	13.70	13.62	13.48	13.42
23	13.82	---	12.70	12.32	---	---	13.42	13.70	13.68	13.60	13.46	13.42
24	13.82	---	---	---	---	---	13.46	13.72	13.70	13.58	13.48	13.42
25	13.82	13.22	---	12.32	12.12	12.62	13.50	13.72	13.72	13.56	13.46	13.42
26	13.84	---	12.58	---	---	---	13.50	13.72	13.70	13.56	13.46	13.40
27	13.84	13.18	---	---	12.12	12.60	13.52	13.72	13.68	13.56	13.46	13.42
28	13.84	---	12.58	12.24	---	---	13.56	13.72	13.66	13.56	13.46	13.46
29	13.82	---	---	---	---	12.72	13.56	13.72	13.66	13.54	13.46	13.44
30	13.82	---	12.54	12.22	---	---	13.58	13.74	13.64	13.54	13.44	13.44
31	13.80	---	---	---	---	---	---	13.72	---	13.58	13.42	---
MEAN	13.83	---	---	---	---	---	---	13.76	13.74	13.59	13.53	13.40
MAX	14.04	---	---	---	---	---	---	14.04	13.88	13.64	13.60	13.46
MIN	13.72	---	---	---	---	---	---	13.60	13.64	13.54	13.42	13.30



455532089253900 LITTLE ST. GERMAIN LAKE, UPPER EAST BAY, AT ST. GERMAIN, WI

LOCATION.--Lat 45°55'32", long 89°25'39", in NE 1/4 NW 1/4 sec.25, T.40 N., R.8 E., Vilas County, Hydrologic Unit 07070001, near St. Germain.

PERIOD OF RECORD.--December 1996, January-March 1997, March 1999, and March 2000 to current year.

REMARKS.--Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, OCTOBER 29, 2002 TO MAY 7, 2003

(Milligrams per liter unless otherwise indicated)

	Oct-29	Jan-8	Mar-11	May-7
Lake stage (ft)	13.81	12.41	12.3	13.68
Secchi-depth (m)	1.4	--	--	1.1
Depth of sample (m)	0.5	0.5	1	0.5
Chlorophyll a, phytoplankton (µg/L)	29	--	--	15.6
Water temperature (°C)	3.8	1.9	0.4	12.1
Specific conductance (µS/cm)	70	95	105	76
pH	7.5	6.8	6.7	7.3
Dissolved oxygen (mg/L)	8.3	10.6	7	11.4
Phosphorus, total (as P)	0.052	0.058	0.071	0.046

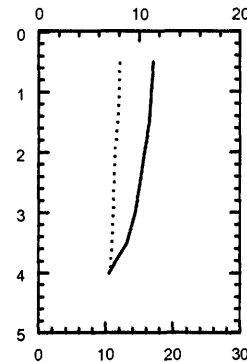
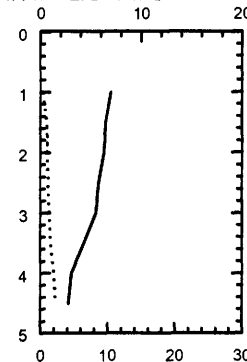
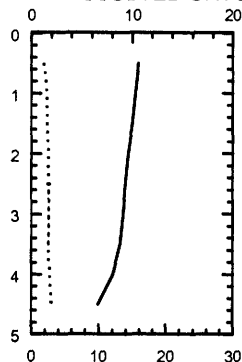
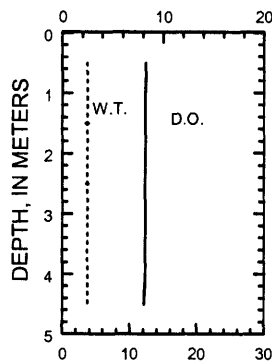
10-29-02

1-8-03

3-11-03

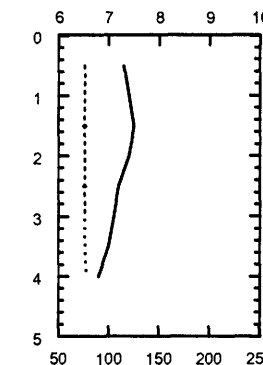
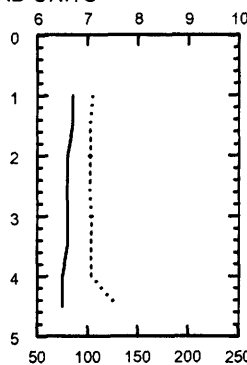
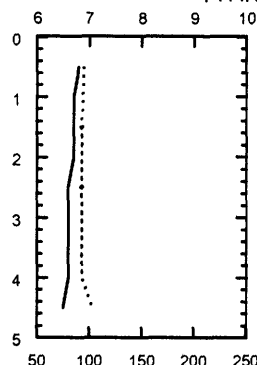
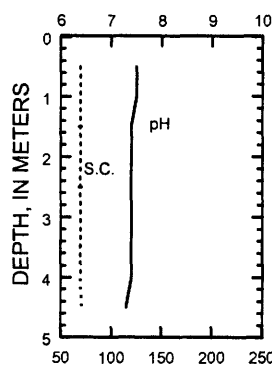
5-7-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

WATER-QUALITY DATA, JUNE 17 TO AUGUST 12, 2003
(Milligrams per liter unless otherwise indicated)

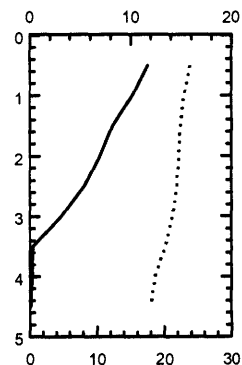
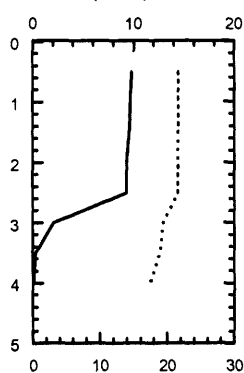
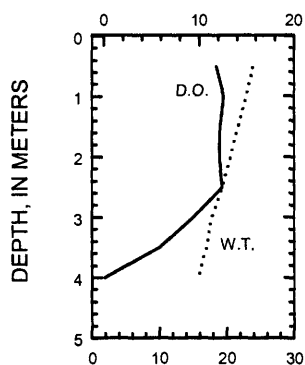
	<u>Jun-17</u>		<u>Jul-15</u>		<u>Aug-12</u>	
Lake stage (ft)	13.71		13.6		13.5	
Secchi-depth (m)	2.3		0.5		0.5	
Depth of sample (m)	0.5	4	0.5	4	0.5	4.5
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	5.18	--	120	--	120	--
Water temperature ($^{\circ}\text{C}$)	23.9	15.8	21.7	17.5	23.8	18
Specific conductance ($\mu\text{S/cm}$)	79	85	82	139	129	242
pH	7.9	6.8	9.2	7.2	8.7	6.7
Dissolved oxygen (mg/L)	11.8	0.1	9.8	0.1	11.7	0.1
Phosphorus, total (as P)	0.028	0.107	0.068	0.201	0.098	0.638
Phosphorus, ortho, dissolved (as P)	--	--	0.003	--	--	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	--	--	<0.022	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.015	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.72	--	--	--

6-17-03

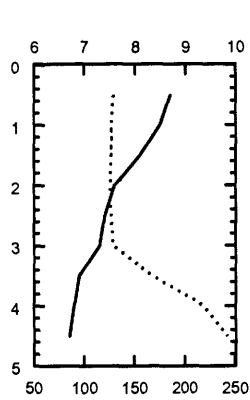
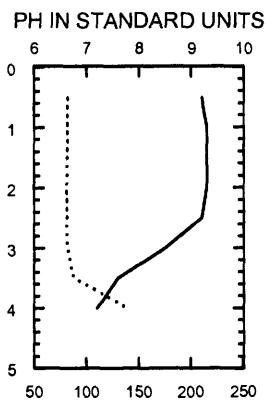
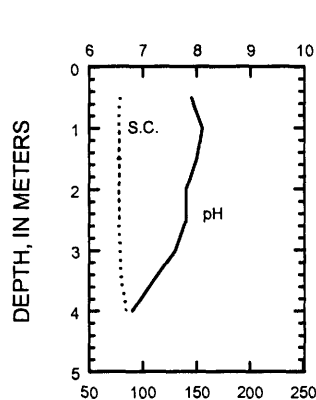
7-15-03

8-12-03

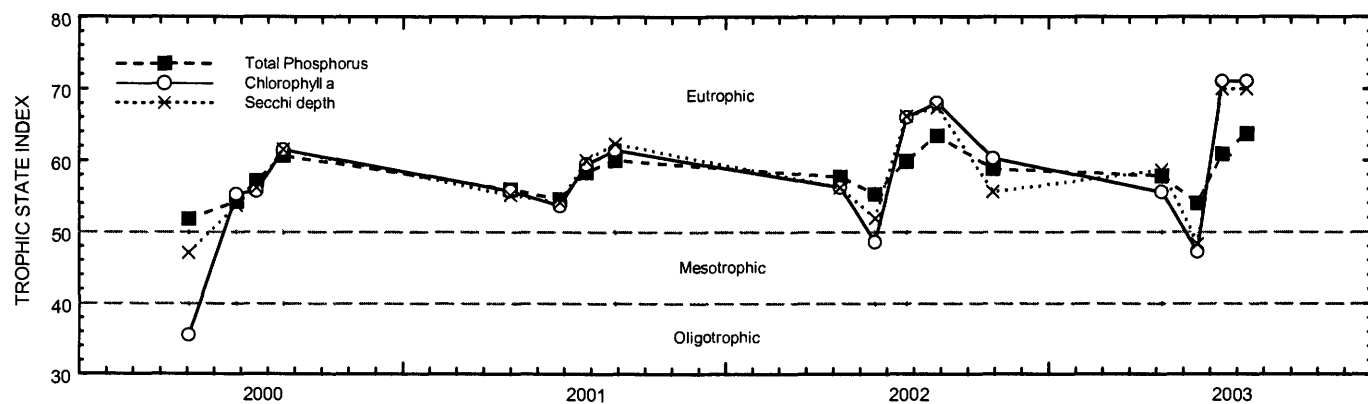
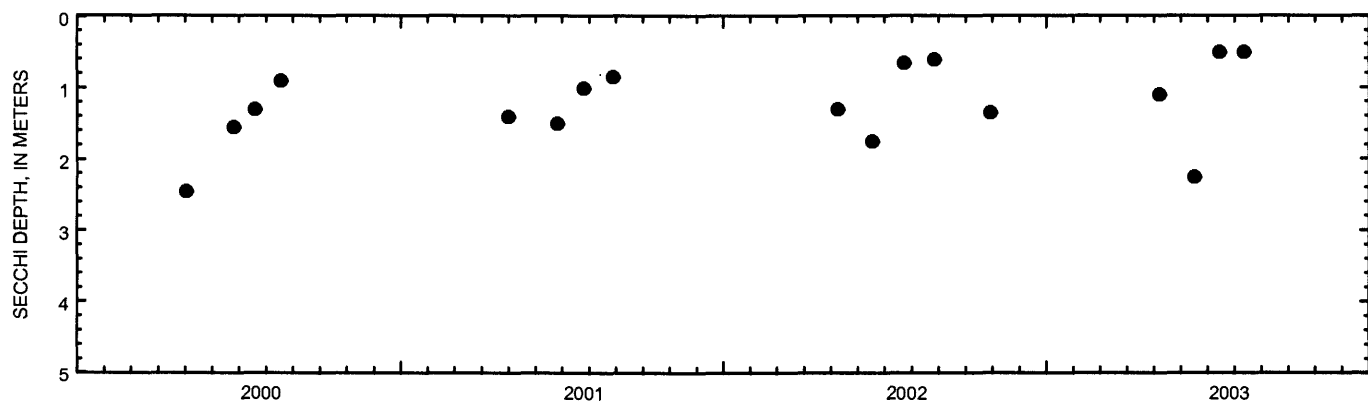
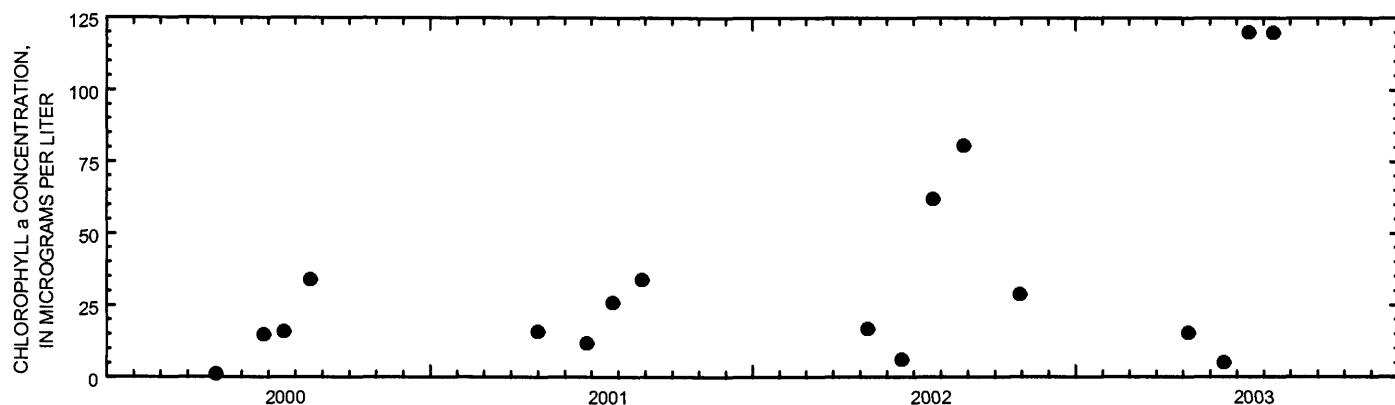
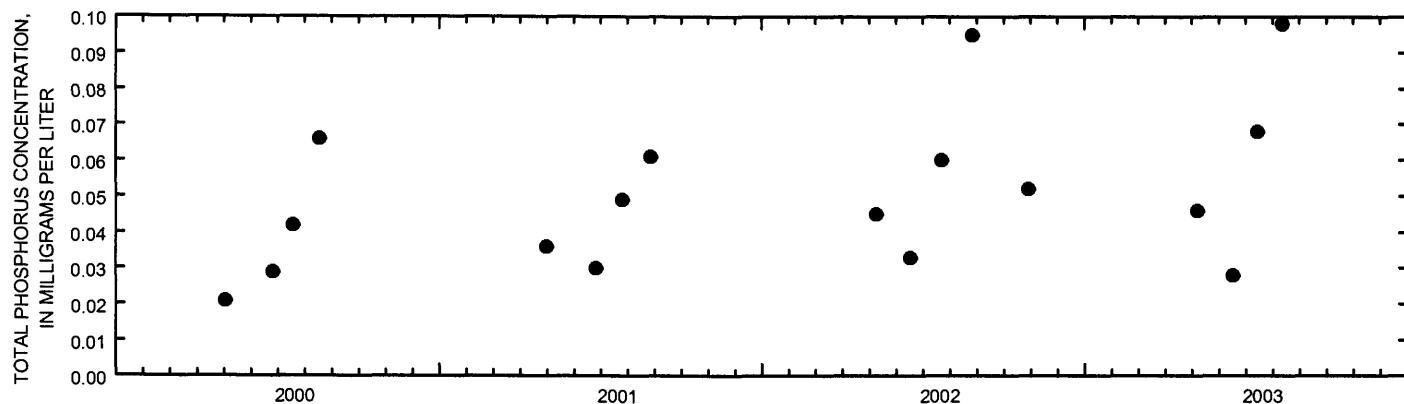
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Little St. Germain Lake, Upper East Bay, at St. Germain, Wisconsin.

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

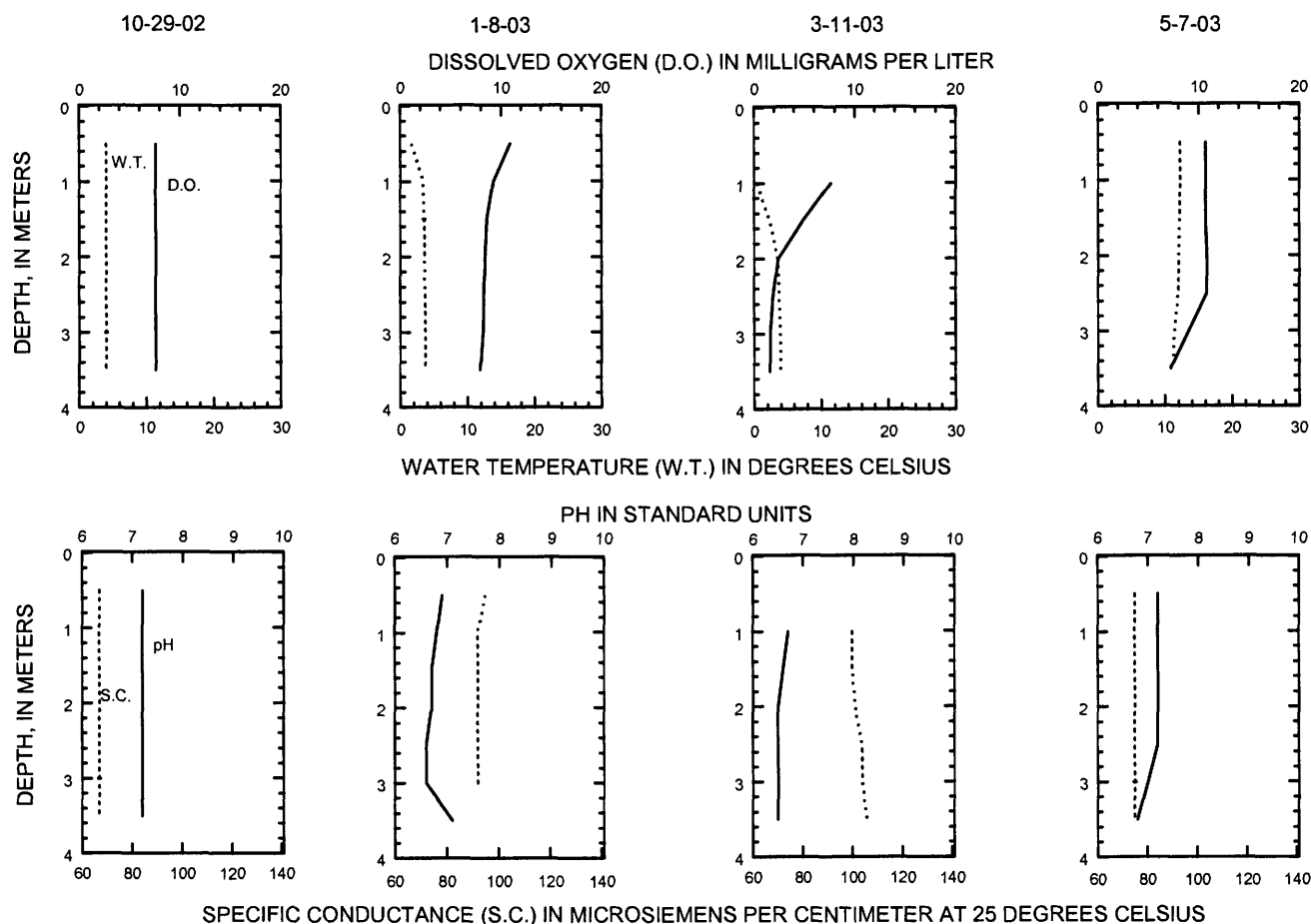
LOCATION.--Lat 45°55'45", long 89°26'25", in SW 1/4 SE 1/4 sec.24, T.40 N., R.8 E., Vilas County, Hydrologic Unit 07070001, near St. Germain.

PERIOD OF RECORD.--April 1991 to August 1994, August 1996 to August 1997, March 1999 to current year.

REMARKS.--Lake sampled in northeast bay at a lake depth of about 4 m. Lake ice-covered during January and March sampling. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, OCTOBER 29, 2002 TO MAY 7, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Oct-29</u>	<u>Jan-8</u>	<u>Mar-11</u>	<u>May-7</u>
Lake stage (ft)	13.81	12.41	12.3	13.68
Secchi-depth (m)	1.5	--	--	1.1
Depth of sample (m)	0.5	0.5	1	0.5
Chlorophyll a, phytoplankton (µg/L)	20	--	--	18
Water temperature (°C)	4	1.7	0.5	12.2
Specific conductance (µS/cm)	67	95	100	75
pH	7.2	6.9	6.7	7.2
Dissolved oxygen (mg/L)	7.6	10.9	7.6	10.7
Phosphorus, total (as P)	0.046	0.039	0.053	0.049



WATER-QUALITY DATA, JUNE 17 TO AUGUST 12, 2003
(Milligrams per liter unless otherwise indicated)

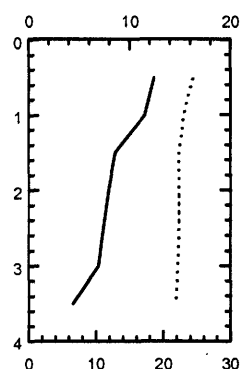
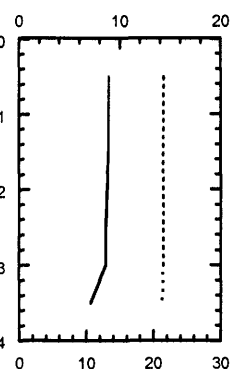
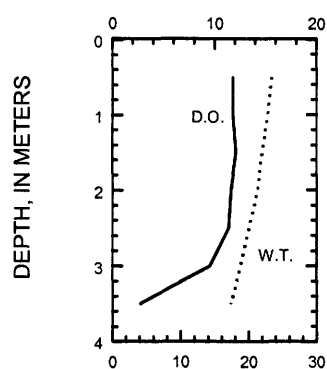
	<u>Jun-17</u>	<u>Jul-15</u>	<u>Aug-12</u>
Lake stage (ft)	13.71	13.6	13.5
Secchi-depth (m)	2.15	0.5	0.6
Depth of sample (m)	0.5	0.5	0.5
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	6.34	92.1	105
Water temperature ($^{\circ}\text{C}$)	23.4	21.5	24.4
Specific conductance ($\mu\text{S/cm}$)	79	81	128
pH	7.9	8.9	8.8
Dissolved oxygen (mg/L)	11.8	8.9	12.4
Phosphorus, total (as P)	0.023	0.069	0.115
Phosphorus, ortho, dissolved (as P)	--	0.003	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	--	<.022	--
Nitrogen, ammonia, dissolved (as N)	--	0.02	--
Nitrogen, amm. + org., total (as N)	--	0.64	--

6-17-03

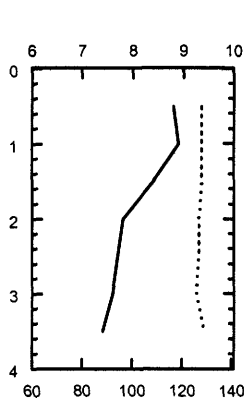
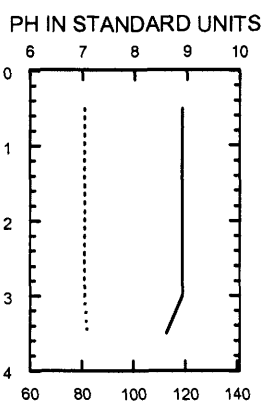
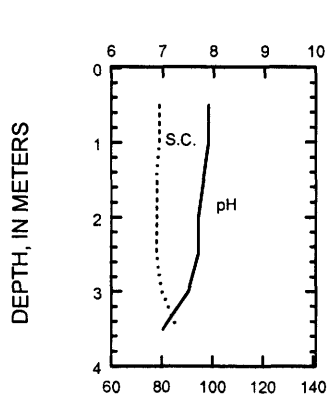
7-15-03

8-12-03

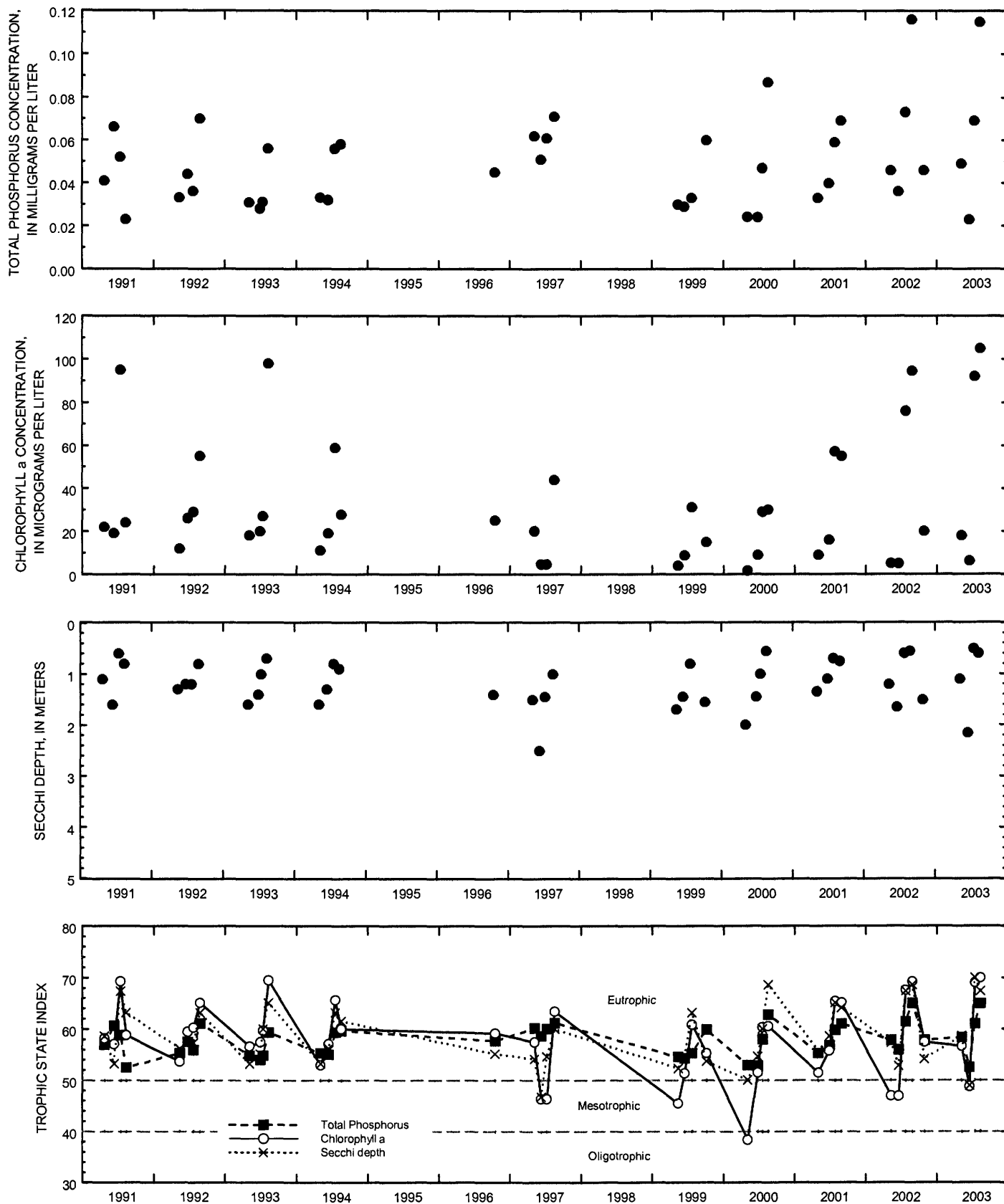
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Little St. Germain Lake, Northeast Bay, at St. Germain, Wisconsin.

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 August 1994, August 1996 to August 1997, March 1999 to current year.

REMARKS.--Lake sampled in south bay at a lake depth of about 7 m. Lake ice-covered during January and March sampling. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, OCTOBER 29 TO MAY 7, 2003 (Milligrams per liter unless otherwise indicated)

	Oct-29 13.81 1.6		Jan-8 12.41 --		Mar-11 12.3 --		May-7 13.68 1.8	
Lake stage (ft)								
Secchi-depth (m)	0.5		0.5		1		0.5	
Depth of sample (m)	--		6.8		6		5.5	
Chlorophyll a, phytoplankton (µg/L)	28.1		--		--		11.2	
Water temperature (°C)	4.4		2.3		0.8		12.2	
Specific conductance (µS/cm)	73		87		104		79	
pH	7.7		6.7		6.8		7.6	
Dissolved oxygen (mg/L)	9.2		9.5		7.4		11.7	
Phosphorus, total (as P)	0.042		0.035		0.052		0.027	
Phosphorus, ortho, dissolved (as P)	--		--		--		0.003	
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--		--		--		<0.022	
Nitrogen, ammonia, dissolved (as N)	--		--		--		0.017	
Nitrogen, amm. + org., total (as N)	--		--		--		0.35	
Nitrogen, total (as N)	--		--		--		0.36	
Color (Pt-Co. scale)	--		--		--		5	
Turbidity (NTU)	--		--		--		3.2	
Hardness, as CaCO ₃	--		--		--		36	
Calcium, dissolved (Ca)	--		--		--		9.7	
Magnesium, dissolved (Mg)	--		--		--		2.8	
Sodium, dissolved (Na)	--		--		--		1.9	
Potassium, dissolved (K)	--		--		--		<1.00	
Alkalinity, as CaCO ₃	--		--		--		35	
Sulfate, dissolved (SO ₄)	--		--		--		<4.5	
Chloride, dissolved (Cl)	--		--		--		2	
Silica, dissolved (SiO ₂)	--		--		--		11.4	
Solids, dissolved, at 180°C	--		--		--		60	
Iron, dissolved (Fe) (µg/L)	--		--		--		<100	

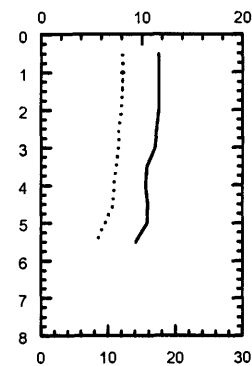
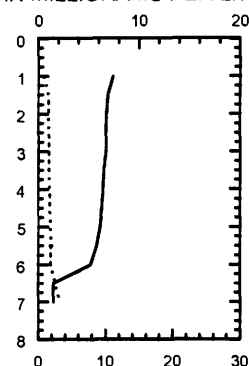
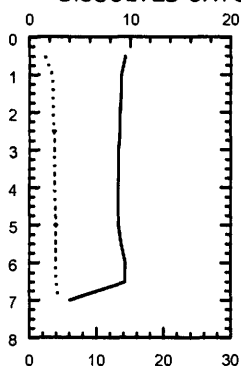
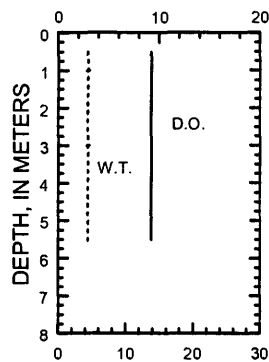
10-29-02

1-8-03

3-11-03

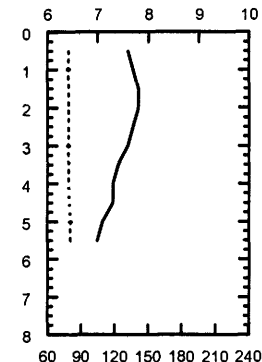
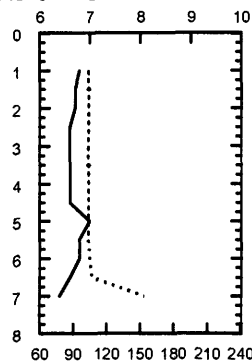
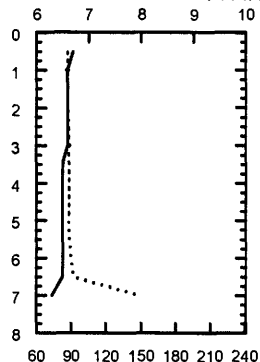
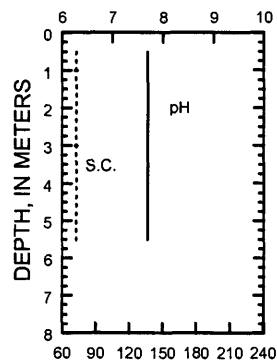
5-7-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

pH IN STANDARD UNITS

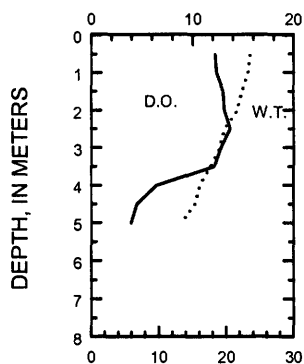


SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

WATER-QUALITY DATA, JUNE 17 TO AUGUST 12, 2003
(Milligrams per liter unless otherwise indicated)

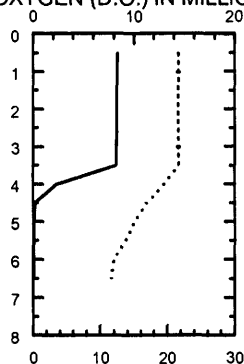
	<u>Jun-17</u>		<u>Jul-15</u>		<u>Aug-12</u>	
Lake stage (ft)	13.71		13.6		13.5	
Secchi-depth (m)	2.3		1.1		0.8	
Depth of sample (m)	0.5	5	0.5	6.5	0.5	7
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	5.46	--	29.7	--	45.4	--
Water temperature ($^{\circ}\text{C}$)	23.6	13.3	21.6	11.6	25.1	12.7
Specific conductance ($\mu\text{S/cm}$)	80	81	80	182	128	220
pH	8.2	6.8	8	6.9	8.1	6.6
Dissolved oxygen (mg/L)	12.2	3.9	8.4	0.1	9.1	0.1
Phosphorus, total (as P)	0.026	0.046	0.045	0.159	0.057	0.621
Phosphorus, ortho, dissolved (as P)	--	--	<.002	--	--	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	--	--	2.8	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.022	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.74	--	--	--

6-17-03

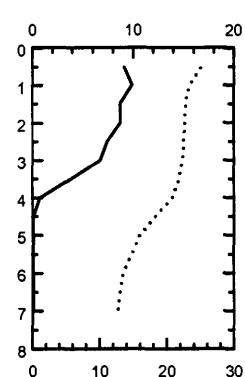


7-15-03

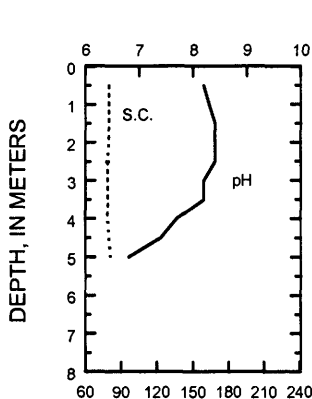
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



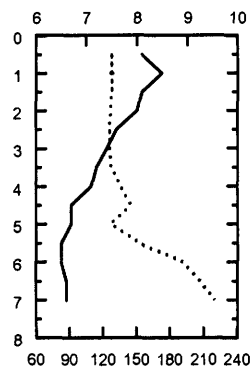
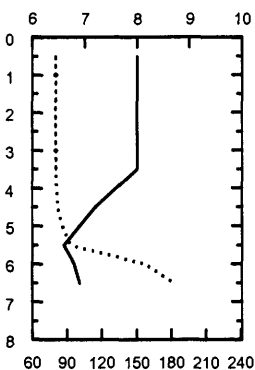
8-12-03



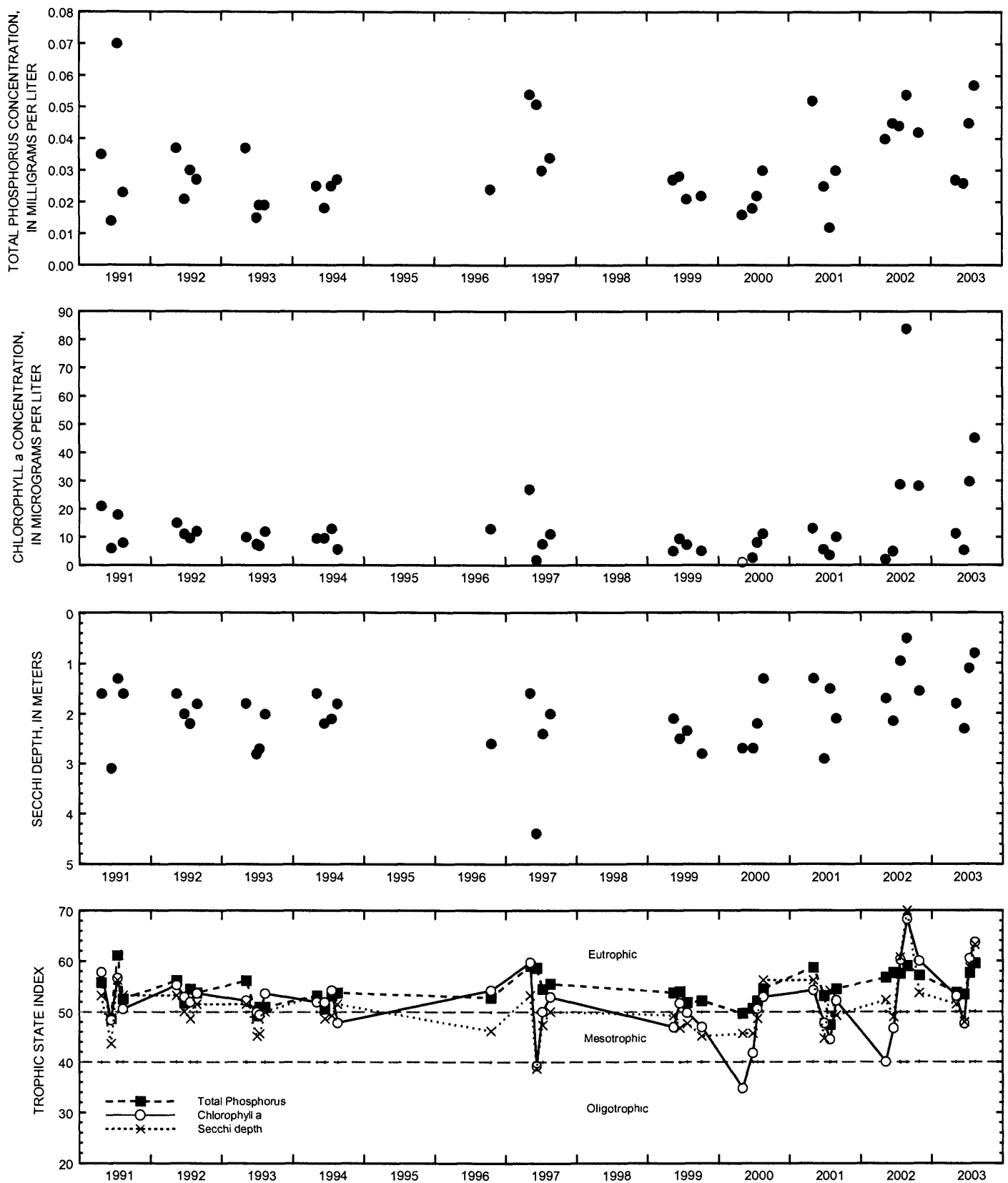
WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths,
and TSI data for Little St. Germain Lake, South Bay, near St. Germain, Wisconsin.

(Circles on the first two plots indicate laboratory detection limit for selected analyses.
Actual concentrations for these particular analyses are less than the plotted circles.)

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

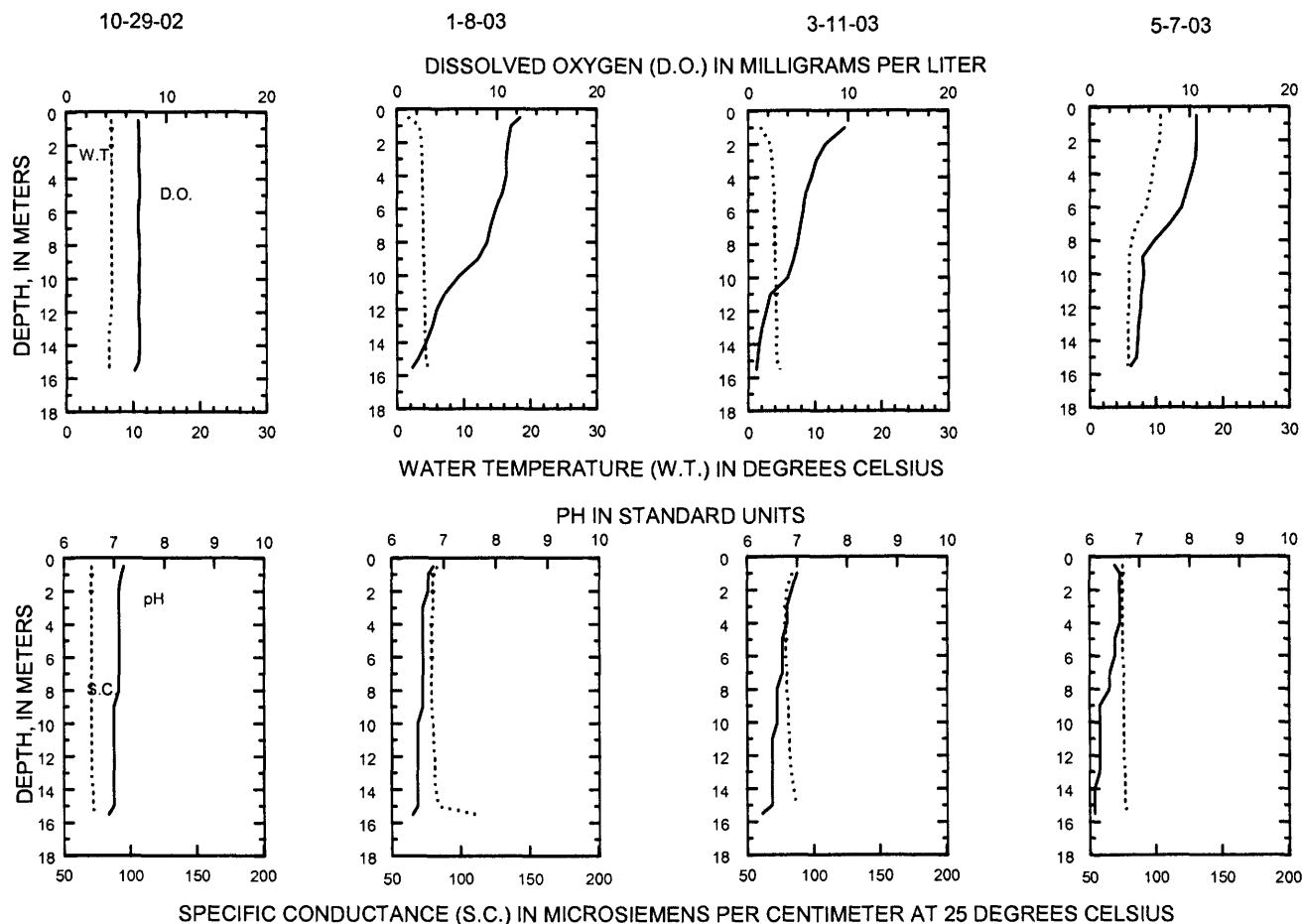
LOCATION.--Lat 45°54'28", long 89°28'24", in SW 1/4 NE 1/4 sec.34, T.40 N., R.8 E., Vilas County, Hydrologic Unit 07070001, at St. Germain.

PERIOD OF RECORD.--April 1991 to August 1994, August 1996 to August 1997, March 1999 to current year.

REMARKS.--Lake sampled in west bay at a lake depth of about 18 m. Lake ice-covered during January and March sampling. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, OCTOBER 29, 2002 TO MAY 7, 2003 (Milligrams per liter unless otherwise indicated)

	Oct-29 13.81 2		Jan-8 12.41 --		Mar-11 12.3 --		May-7 13.68 3.05	
Lake stage (ft)								
Secchi-depth (m)	0.5 15.5		0.5 15		1 15		0.5 16	
Depth of sample (m)	5.75 --		5.75 --		5.75 --		5.75 --	
Chlorophyll a, phytoplankton (µg/L)	6.8 6.4		1.7 4.5		1.8 4.3		10.7 5.7	
Water temperature (°C)	71 73		83 112		82 87		75 79	
Specific conductance (µS/cm)	7.2 6.9		6.8 6.4		7 6.5		6.5 6.1	
pH	7.2 6.8		12.3 1.5		9.7 0.9		10.7 4.1	
Dissolved oxygen (mg/L)	0.025 0.029		0.021 0.037		0.026 0.025		0.021 0.022	
Phosphorus, total (as P)	-- --		-- --		-- --		0.003 --	
Phosphorus, ortho, dissolved (as P)	-- --		-- --		-- --		0.17 --	
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	-- --		-- --		-- --		0.016 --	
Nitrogen, ammonia, dissolved (as N)	-- --		-- --		-- --		0.43 --	
Nitrogen, amm. + org., total (as N)	-- --		-- --		-- --		0.6 --	
Nitrogen, total (as N)	-- --		-- --		-- --		5 --	
Color (Pt-Co. scale)	-- --		-- --		-- --		3.3 --	
Turbidity (NTU)	-- --		-- --		-- --		33 --	
Hardness, as CaCO ₃	-- --		-- --		-- --		8.8 --	
Calcium, dissolved (Ca)	-- --		-- --		-- --		2.7 --	
Magnesium, dissolved (Mg)	-- --		-- --		-- --		2.1 --	
Sodium, dissolved (Na)	-- --		-- --		-- --		<1.00 --	
Potassium, dissolved (K)	-- --		-- --		-- --		32 --	
Alkalinity, as CaCO ₃	-- --		-- --		-- --		<4.5 --	
Sulfate, dissolved (SO ₄)	-- --		-- --		-- --		2 --	
Chloride, dissolved (Cl)	-- --		-- --		-- --		8.29 --	
Silica, dissolved (SiO ₂)	-- --		-- --		-- --		52 --	
Solids, dissolved, at 180°C	-- --		-- --		-- --		<100 --	
Iron, dissolved (Fe) (µg/L)	-- --		-- --		-- --		20 --	
Manganese, dissolved, (Mn) (µg/L)	-- --		-- --		-- --		--	



WATER-QUALITY DATA, JUNE 17 TO AUGUST 12, 2003

(Milligrams per liter unless otherwise indicated)

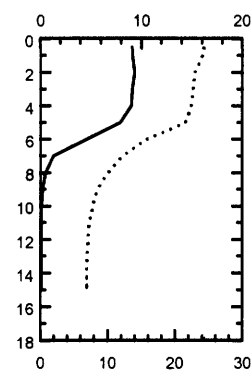
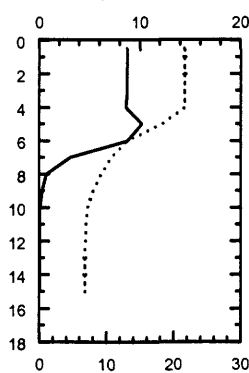
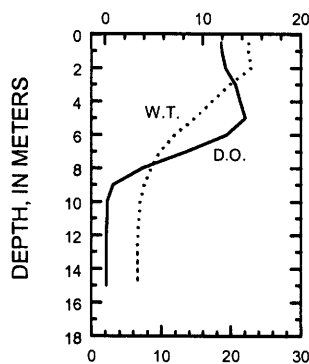
	<u>Jun-17</u>		<u>Jul-15</u>		<u>Aug-12</u>	
Lake stage (ft)	13.71		13.6		13.5	
Secchi-depth (m)	2.9		2.5		2.5	
Depth of sample (m)	0.5	15	0.5	15	0.5	15.5
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	4.55	--	5.05	--	8.33	--
Water temperature ($^{\circ}\text{C}$)	6.6	6.6	21.7	6.8	24.3	6.9
Specific conductance ($\mu\text{S/cm}$)	85	85	75	99	122	111
pH	6.7	6.7	7.8	6.6	8	6.3
Dissolved oxygen (mg/L)	0.1	0.1	8.7	0.1	9.1	0.1
Phosphorus, total (as P)	0.017	0.035	0.014	0.16	0.014	0.275
Phosphorus, ortho, dissolved (as P)	--	--	<.002	--	--	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	--	--	<.022	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.034	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.67	--	--	--

6-17-03

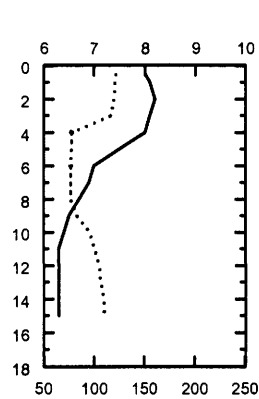
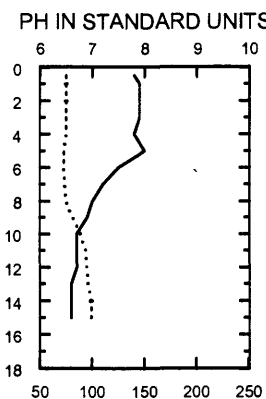
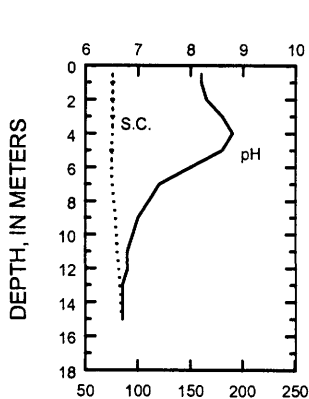
7-15-03

8-12-03

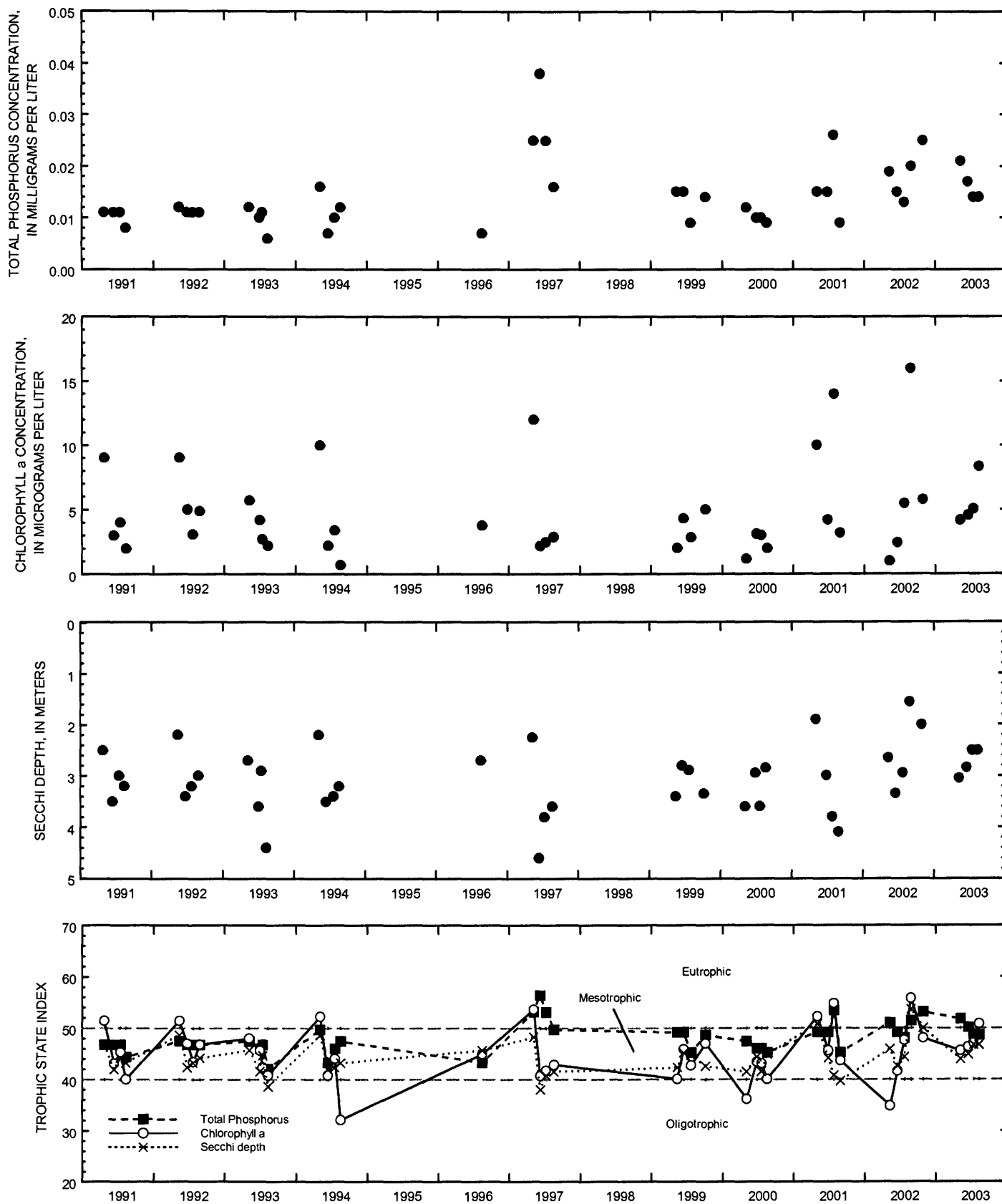
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Little St. Germain Lake, West Bay, at St. Germain, Wisconsin.

452826088544101 LITTLE SAND LAKE--SITE NUMBER 2--NEAR MOLE LAKE, WI

LOCATION.--Lat 45°28'26" long 88°54'41", in SW 1/4 NE 1/4 sec.31, T.35 N., R.13 E., Forest County, Hydrologic Unit 04030202, on left bank 1 mi upstream of outlet, 3 mi southeast of Mole Lake.

PERIOD OF RECORD.--May 1996 to September 2003 (discontinued). Prior to October 2000 published as "Little Sand Lake near Mole Lake, WI" under station number 04074651.

GAGE.--Water-stage recorder. Datum of gage is 1,587.32 ft above sea level.

REMARKS.--Recorder removed during winter period, Nov. 15, 2002 to Apr. 28, 2003.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height observed, 5.97 ft, May 25, 1997; minimum observed, 3.78 ft, Nov. 7-9, 1999.

EXTREMES FOR CURRENT YEAR.-- Maximum gage height observed, 5.41 ft, May 13 and 14; minimum observed, 4.33 ft, Oct. 3.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.34	4.58	---	---	---	---	---	5.25	5.20	4.77	4.87	4.61
2	4.34	4.58	---	---	---	---	---	5.22	5.20	4.76	4.87	4.58
3	4.33	4.60	---	---	---	---	---	5.20	5.18	4.75	4.88	4.56
4	4.43	4.62	---	---	---	---	---	5.18	5.15	4.75	4.88	4.54
5	4.46	4.62	---	---	---	---	---	5.18	5.11	4.74	4.87	4.53
6	4.51	4.63	---	---	---	---	---	5.22	5.09	4.73	4.85	4.52
7	4.52	4.64	---	---	---	---	---	5.21	5.09	4.72	4.85	4.52
8	4.52	4.64	---	---	---	---	---	5.22	5.09	4.70	4.85	4.51
9	4.52	4.64	---	---	---	---	---	5.23	5.09	4.69	4.84	4.50
10	4.53	4.67	---	---	---	---	---	5.24	5.10	4.68	4.81	4.48
11	4.53	4.68	---	---	---	---	---	5.32	5.10	4.68	4.81	4.47
12	4.54	4.68	---	---	---	---	---	5.40	5.09	4.67	4.80	4.48
13	4.55	4.68	---	---	---	---	---	5.41	5.08	4.65	4.80	4.53
14	4.54	4.68	---	---	---	---	---	5.41	5.07	4.63	4.78	4.57
15	4.53	---	---	---	---	---	---	5.40	5.05	4.62	4.76	4.58
16	4.52	---	---	---	---	---	---	5.39	5.04	4.61	4.74	4.58
17	4.52	---	---	---	---	---	---	5.39	5.02	4.60	4.73	4.56
18	4.53	---	---	---	---	---	---	5.37	5.00	4.59	4.73	4.53
19	4.55	---	---	---	---	---	---	5.36	4.96	4.56	4.71	4.53
20	4.54	---	---	---	---	---	---	5.37	4.94	4.54	4.72	4.52
21	4.55	---	---	---	---	---	---	5.34	4.92	4.54	4.72	4.51
22	4.58	---	---	---	---	---	---	5.32	4.90	4.53	4.70	4.55
23	4.59	---	---	---	---	---	---	5.30	4.89	4.51	4.69	4.55
24	4.59	---	---	---	---	---	---	5.28	4.88	4.50	4.70	4.57
25	4.58	---	---	---	---	---	---	5.26	4.88	4.48	4.69	4.57
26	4.59	---	---	---	---	---	---	5.24	4.85	4.77	4.69	4.57
27	4.60	---	---	---	---	---	---	5.23	4.82	4.87	4.68	4.57
28	4.60	---	---	---	---	---	---	5.23	4.80	4.87	4.67	4.57
29	4.60	---	---	---	---	---	5.28	5.22	4.80	4.86	4.65	4.58
30	4.59	---	---	---	---	---	5.27	5.29	4.79	4.85	4.63	4.57
31	4.59	---	---	---	---	---	---	5.22	---	4.86	4.62	---
MEAN	4.53	---	---	---	---	---	---	5.29	5.01	4.68	4.76	4.54
MAX	4.60	---	---	---	---	---	---	5.41	5.20	4.87	4.88	4.61
MIN	4.33	---	---	---	---	---	---	5.18	4.79	4.48	4.62	4.47

05428000 LAKE MENDOTA AT MADISON, WI

LOCATION.--Lat 43°05'42", long 89°22'12", in SE 1/4 sec.12, T.7 N., R.9 E., Dane County, Hydrologic Unit 07090001, in county boat house at dam at outlet, in Madison.

DRAINAGE AREA.--233 mi². Area of Lake Mendota, 15.2 mi².

PERIOD OF RECORD.--January 1916 to current year (incomplete).

REVISED RECORDS.--WDR WI-73-1: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is 840.00 ft above sea level, or 5.60 ft below City of Madison datum. Prior to Oct. 1, 1979, at datum 7.82 ft higher; prior to Nov. 15, 1971, nonrecording gage at same site.

REMARKS.--Lake level regulated by concrete dam with two 12-foot gates and 20-foot lock at outlet. Gage-height telemeter at station.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height observed, 12.75 ft, June 5, 2000; minimum observed, 8.02 ft, Feb. 24 to Mar. 10, 1920, current datum.

EXTREMES FOR CURRENT YEAR.--Maximum recorded gage height, 10.58 ft, May 10; minimum recorded, 8.35 ft, Jan. 7 and 17

**GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003
DAILY MEAN VALUES**

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	9.90	9.56	8.84	8.44	8.45	8.67	9.34	10.14	9.82	9.83	9.99	9.68
2	9.92	9.51	8.83	8.43	8.47	8.68	9.37	10.19	9.81	9.83	10.00	9.68
3	9.93	9.46	8.81	8.41	8.48	8.69	9.37	10.17	9.80	9.83	9.99	9.64
4	10.03	9.42	8.79	8.40	8.48	8.71	9.41	10.13	9.79	9.85	9.98	9.64
5	10.07	9.40	8.78	8.40	8.49	8.74	9.44	10.18	9.77	9.87	9.98	9.61
6	10.08	9.37	8.74	8.38	8.50	8.75	9.44	10.19	9.75	9.93	9.99	9.63
7	10.05	9.33	8.73	8.37	8.50	8.76	9.48	10.21	9.76	9.98	9.97	9.60
8	10.02	9.29	8.70	8.38	8.50	8.78	9.51	10.21	9.77	9.99	9.95	9.59
9	10.02	9.26	8.68	8.39	8.51	8.79	9.52	10.24	9.77	9.98	9.94	9.64
10	10.00	9.23	8.66	8.39	8.51	8.80	9.54	10.24	9.76	10.00	9.94	9.62
11	9.99	9.24	8.64	8.39	8.52	8.81	9.57	10.33	9.74	9.99	9.93	9.62
12	9.99	9.21	8.63	8.39	8.53	8.82	9.59	10.33	9.73	9.97	9.91	9.64
13	9.96	9.17	8.62	8.39	8.54	8.83	9.60	10.30	9.72	9.96	9.91	9.75
14	9.90	9.15	8.61	8.39	8.55	8.84	9.62	10.28	9.73	9.95	9.90	10.02
15	9.89	9.12	8.60	8.39	8.55	8.86	9.64	10.28	9.73	10.08	9.90	10.05
16	9.85	9.09	8.57	8.39	8.56	8.90	9.66	10.25	9.73	10.11	9.90	10.04
17	9.84	9.06	8.54	8.40	8.56	8.93	9.66	10.22	9.73	10.11	9.88	10.04
18	9.83	9.03	8.58	8.40	8.57	8.96	9.67	10.18	9.74	10.09	9.88	10.03
19	9.82	9.04	8.63	8.40	8.57	8.99	9.70	10.16	9.73	10.08	9.86	10.03
20	9.79	9.02	8.64	8.40	8.58	9.03	9.77	10.17	9.72	10.07	9.85	9.98
21	9.77	9.05	8.63	8.40	8.60	9.06	9.81	10.11	9.71	10.10	9.85	9.95
22	9.75	9.02	8.62	8.40	8.61	9.08	9.81	10.07	9.70	10.08	9.83	9.96
23	9.73	8.99	8.61	8.40	8.62	9.10	9.82	10.03	9.70	10.06	9.81	9.92
24	9.72	8.98	8.56	8.41	8.63	9.12	9.82	9.99	9.70	10.05	9.79	9.90
25	9.73	8.95	8.55	8.41	8.63	9.14	9.84	9.95	9.73	10.03	9.79	9.87
26	9.73	8.93	8.52	8.41	8.64	9.16	9.84	9.90	9.77	e10.02	9.78	9.84
27	9.70	8.91	8.51	8.41	8.65	9.19	9.85	9.87	9.72	e10.01	9.77	9.84
28	9.68	8.89	8.50	8.42	8.66	9.25	9.87	9.87	9.78	10.00	9.73	9.80
29	9.65	8.89	8.49	8.42	---	9.28	9.87	9.86	9.83	10.00	9.74	9.77
30	9.62	8.91	8.48	8.43	---	9.30	9.94	9.84	9.83	9.99	9.71	9.75
31	9.60	---	8.47	8.44	---	9.31	---	9.85	---	9.99	9.69	---
MEAN	9.86	9.15	8.63	8.40	8.55	8.95	9.65	10.12	9.75	9.99	9.88	9.80
MAX	10.08	9.56	8.84	8.44	8.66	9.31	9.94	10.33	9.83	10.11	10.00	10.05
MIN	9.60	8.89	8.47	8.37	8.45	8.67	9.34	9.84	9.70	9.83	9.69	9.59

e Estimated

424621088335500 MIDDLE LAKE AT LAUDERDALE, WI

LOCATION.--Lat 42°46'21", long 88°33'55", in SE 1/4 SE 1/4 sec.26, T.4 N., R.16 E., Walworth County, Hydrologic Unit 07120006, at Lauderdale.

PERIOD OF RECORD.--November 1993 to November 1994, February 1999 to current year.

REMARKS.--Lake sampled near east end of lake at a depth of about 52 ft. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

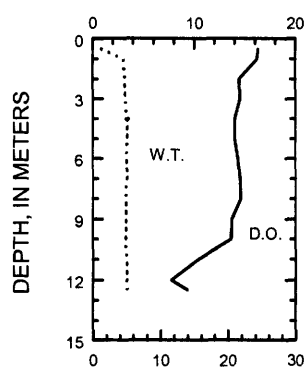
WATER-QUALITY DATA, FEBRUARY 19 TO JUNE 11, 2003 (Milligrams per liter unless otherwise indicated)

	Feb-19		Apr-22		Jun-11	
Secchi-depth (m)	--	--	--	--	--	--
Depth of sample (m)	0.5	12.5	0.5	14.5	0.5	14
Chlorophyll a, phytoplankton (µg/L)	--	--	1.79	--	3.95	--
Water temperature (°C)	1.1	5.1	9.7	5.3	19.5	7.5
Specific conductance (µS/cm)	520	685	554	568	529	578
pH	8.2	7.9	7.9	7.8	8.1	7.5
Dissolved oxygen (mg/L)	16.3	9.3	11.1	10.9	9.9	5.4
Phosphorus, total (as P)	0.006	0.012	0.017	0.011	0.012	0.014
Phosphorus, ortho, dissolved (as P)	--	--	<.002	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	1.46	--	--	--
Nitrogen, amm. + diss., total (as N)	--	--	0.234	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.75	--	--	--
Nitrogen, total (as N)	--	--	2.2	--	--	--
Color (Pt-Co. scale)	--	--	10	--	--	--
Turbidity (NTU)	--	--	1.3	--	--	--
Hardness, as CaCO ₃	--	--	270	--	--	--
Calcium, dissolved (Ca)	--	--	50.5	--	--	--
Magnesium, dissolved (Mg)	--	--	35.6	--	--	--
Sodium, dissolved (Na)	--	--	8.10	--	--	--
Potassium, dissolved (K)	--	--	2	--	--	--
Alkalinity, as CaCO ₃	--	--	219	--	--	--
Sulfate, dissolved (SO ₄)	--	--	35.4	--	--	--
Chloride, dissolved (Cl)	--	--	24.7	--	--	--
Silica, dissolved (SiO ₂)	--	--	3.69	--	--	--
Solids, dissolved, at 180°C	--	--	318	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	<100	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	<1	--	--	--

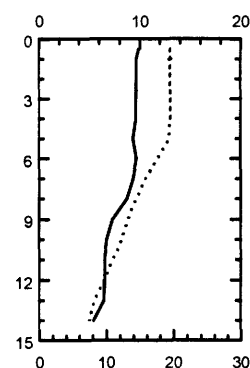
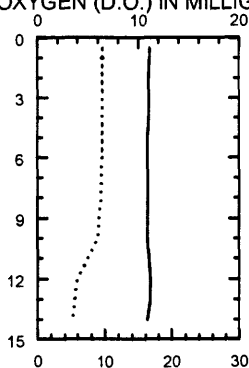
2-19-03

4-22-03

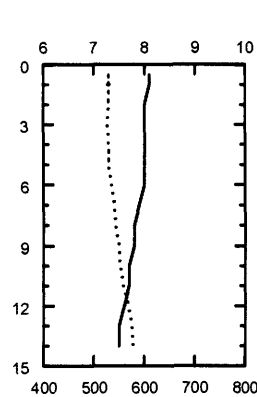
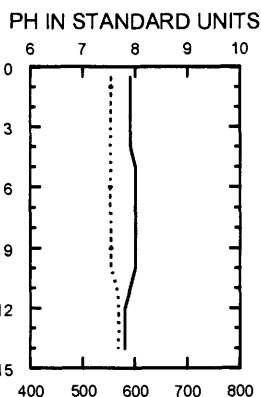
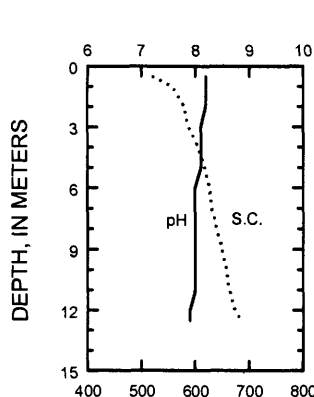
6-11-03



DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

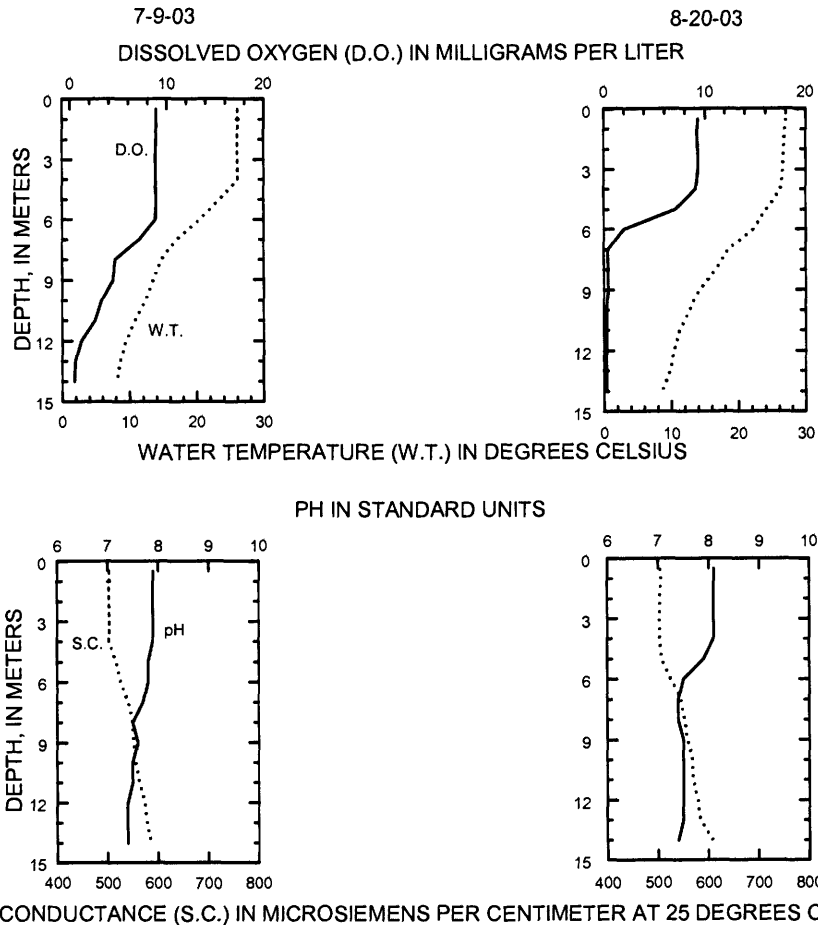


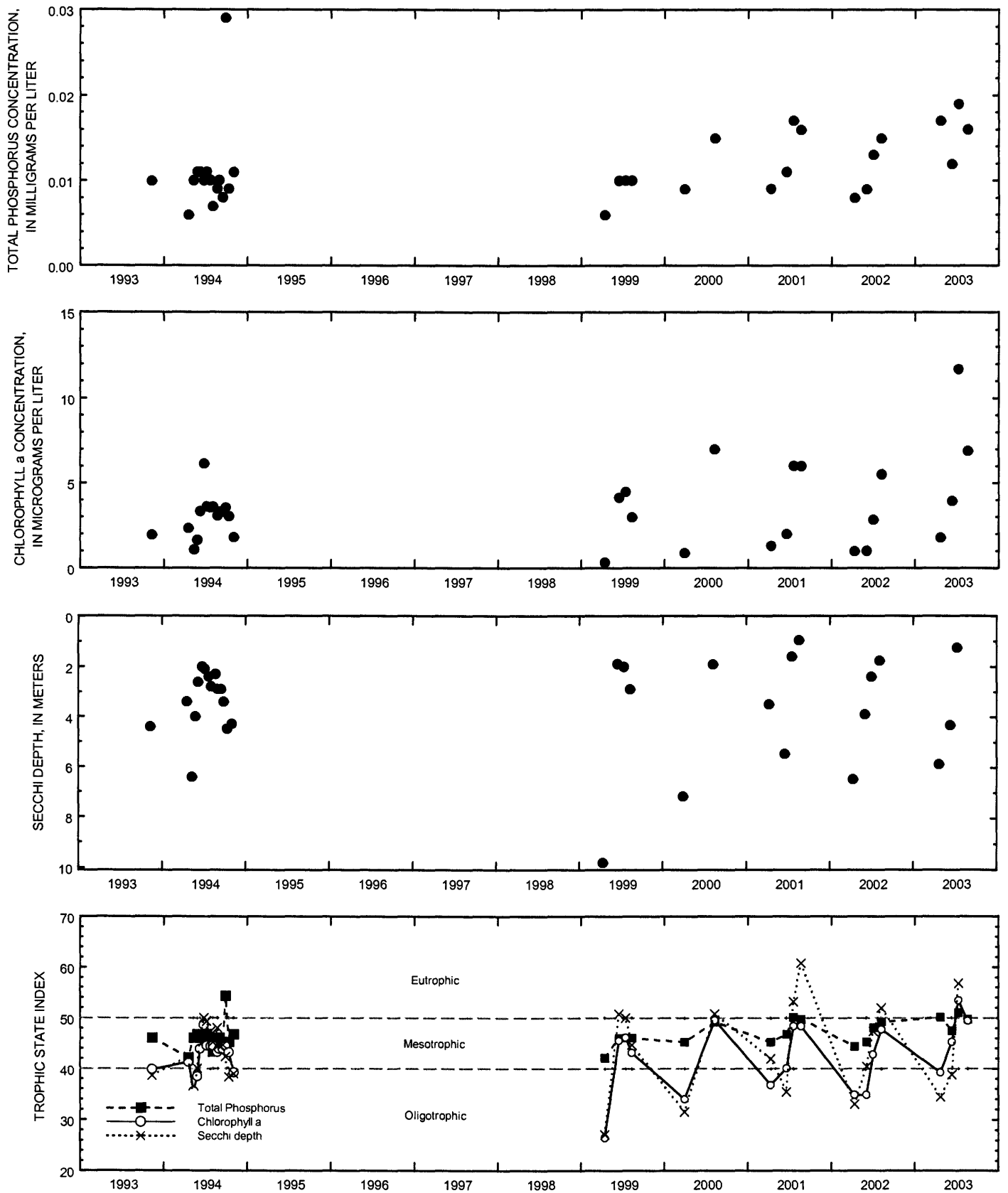
SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

424621088335500 MIDDLE LAKE AT LAUDERDALE, WI--CONTINUED

WATER-QUALITY DATA, JULY 9 TO AUGUST 20, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Jul-9</u>		<u>Aug-20</u>	
Secchi-depth (m)	0.5	1.3	4	1.8
Depth of sample (m)	11.7	14	6.9	12
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	26.1	--	27	--
Water temperature ($^{\circ}\text{C}$)	503	586	505	504
Specific conductance ($\mu\text{S/cm}$)	7.9	7.4	8.1	8.1
pH	8.9	0.4	9.3	9.1
Dissolved oxygen (mg/L)	0.019	0.043	0.016	0.015
Phosphorus, total (as P)	0.003	--	--	--
Phosphorus, ortho, dissolved (as P)	0.344	--	--	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	0.198	--	--	--
Nitrogen, ammonia, dissolved (as N)	0.99	--	--	--
Nitrogen, amm. + diss., total (as N)	--	--	--	--





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Middle Lake, near Lauderdale, Wisconsin.

430309088284800 MIDDLE GENESEE LAKE NEAR OCONOMOWOC, WI

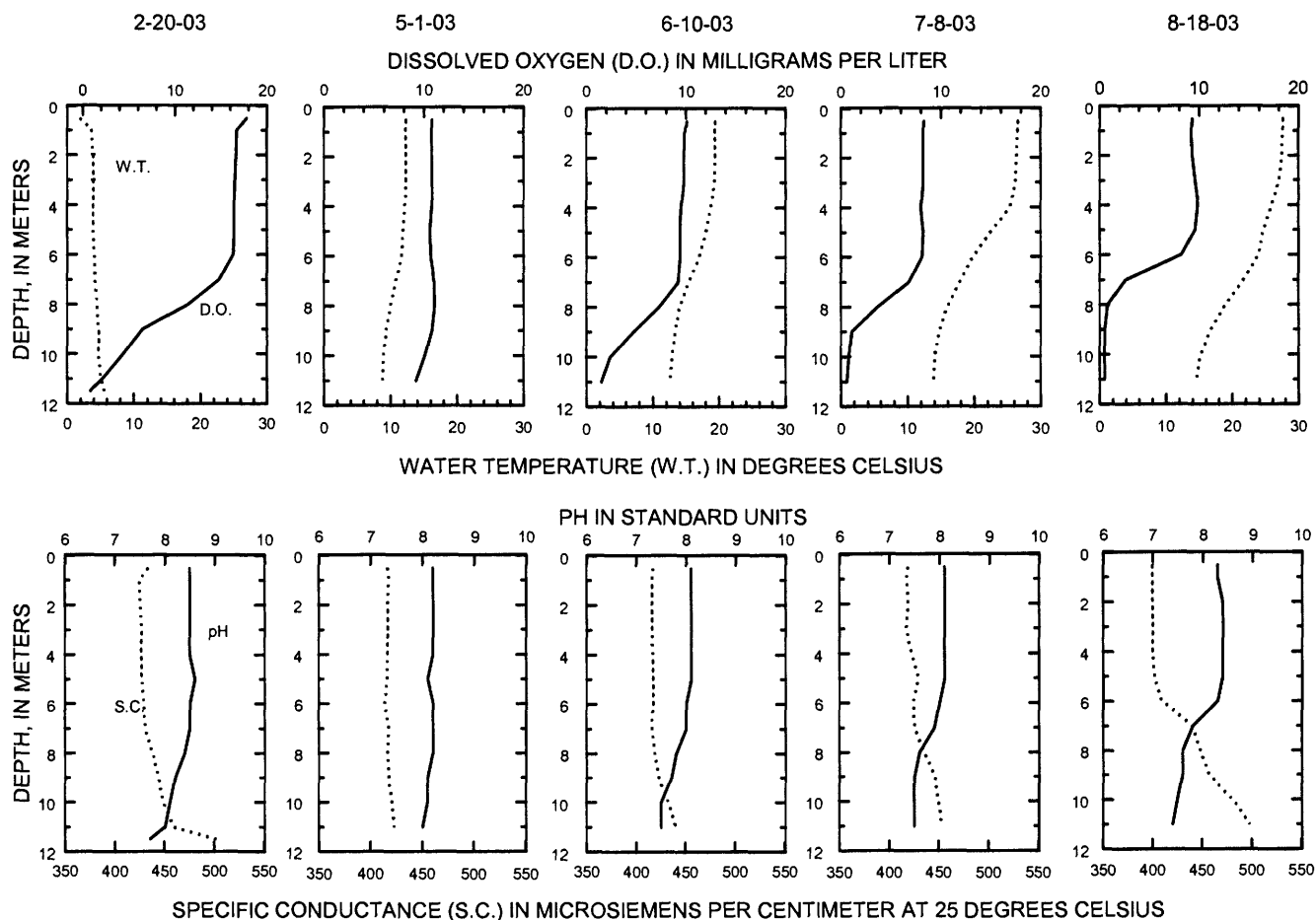
LOCATION.--Lat 43°03'09", long 88°28'48", in NW 1/4 SW 1/4 sec.22, T.7 N., R.17 E., Waukesha County, Hydrologic Unit 07090001, 1.8 mi south of Oconomowoc.

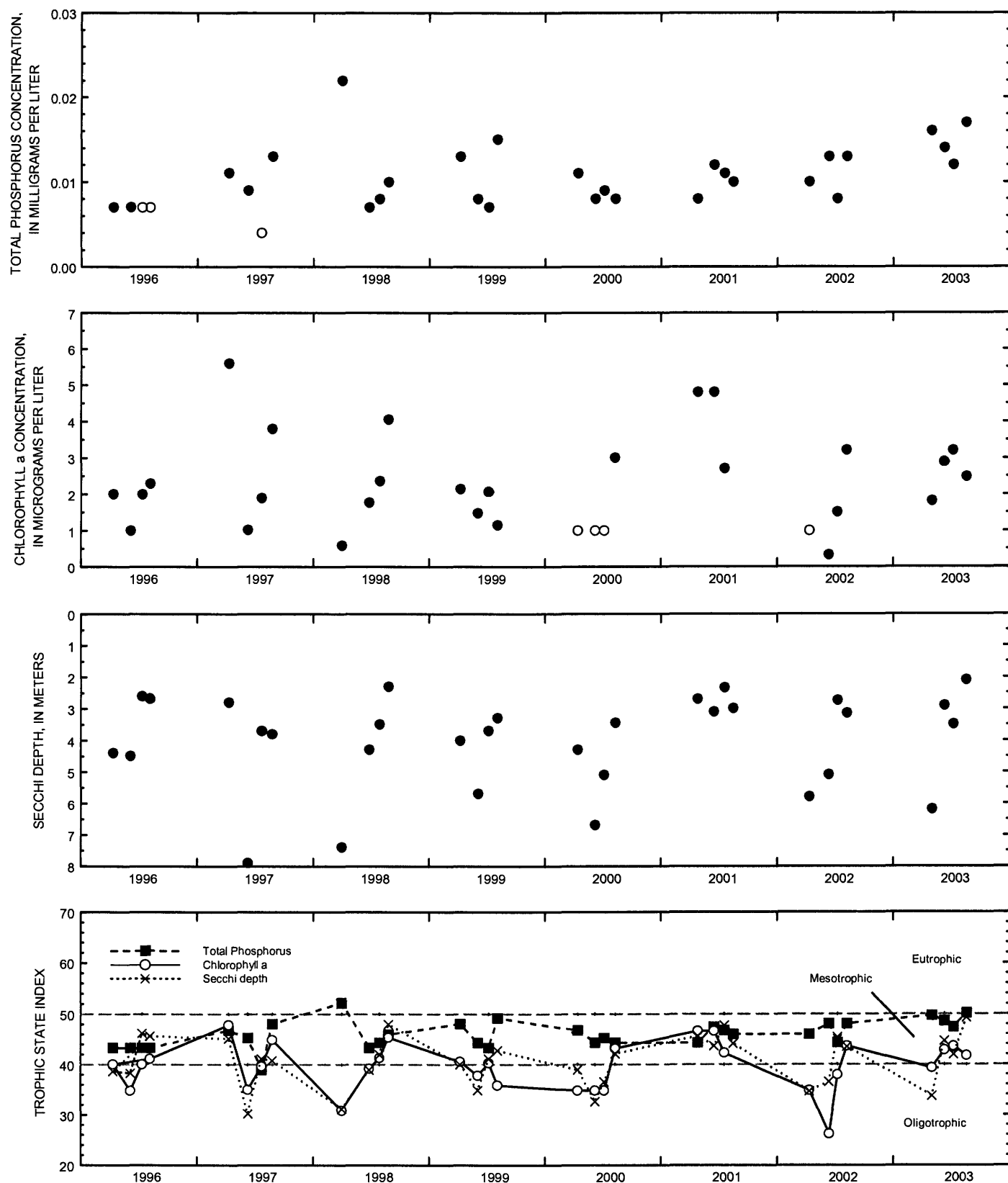
PERIOD OF RECORD.--February 1996 to current year.

REMARKS.--Lake sampled near center at the deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 20 TO AUGUST 18, 2003 (Milligrams per liter unless otherwise indicated)

	Feb-20		May-1		Jun-10		Jul-8		Aug-18	
Lake stage (ft)	--		--		--		--		--	
Secchi-depth (m)	--		6.2		2.9		3.5		2.1	
Depth of sample (m)	0.5	11.5	0.5	11	0.5	11	0.5	11	0.5	11
Chlorophyll a, phytoplankton (µg/L)	--	--	1.81	--	2.89	--	3.2	--	2.49	--
Water temperature (°C)	1.9	5.5	12.3	8.8	19.4	12.5	26.5	13.9	27.6	14.6
Specific conductance (µS/cm)	434	502	417	423	417	440	419	453	400	498
pH	8.5	7.7	8.2	8	8.1	7.5	8.1	7.5	8.3	7.4
Dissolved oxygen (mg/L)	17.8	0.8	10.8	9.2	10.1	1.5	8.3	0.6	9.3	0.5
Phosphorus, total (as P)	0.007	0.037	0.016	0.033	0.014	0.044	0.012	0.027	0.017	0.073
Phosphorus, ortho, dissolved (as P)	--	--	<.002	--	--	--	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	0.054	--	--	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.178	--	--	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.87	--	--	--	--	--	--	--
Nitrogen, total (as N)	--	--	0.92	--	--	--	--	--	--	--
Color (Pt-Co. scale)	--	--	5	--	--	--	--	--	--	--
Turbidity (NTU)	--	--	1.3	--	--	--	--	--	--	--
Hardness, as CaCO ₃	--	--	180	--	--	--	--	--	--	--
Calcium, dissolved (Ca)	--	--	30.4	--	--	--	--	--	--	--
Magnesium, dissolved (Mg)	--	--	26.1	--	--	--	--	--	--	--
Sodium, dissolved (Na)	--	--	11.6	--	--	--	--	--	--	--
Potassium, dissolved (K)	--	--	2	--	--	--	--	--	--	--
Alkalinity, as CaCO ₃	--	--	158	--	--	--	--	--	--	--
Sulfate, dissolved (SO ₄)	--	--	14.7	--	--	--	--	--	--	--
Chloride, dissolved (Cl)	--	--	28.5	--	--	--	--	--	--	--
Silica, dissolved (SiO ₂)	--	--	1.07	--	--	--	--	--	--	--
Solids, dissolved, at 180°C	--	--	244	--	--	--	--	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	<100	--	--	--	--	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	<1	--	--	--	--	--	--	--





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Middle Genesee Lake, near Oconomowoc, Wisconsin.

(Circles on the first two plots indicate laboratory detection limit for selected analyses. Actual concentrations for these particular analyses are less than the plotted circles.)

455214089412800 MINOCQUA LAKE, DEEP HOLE, AT MINOCQUA, WI

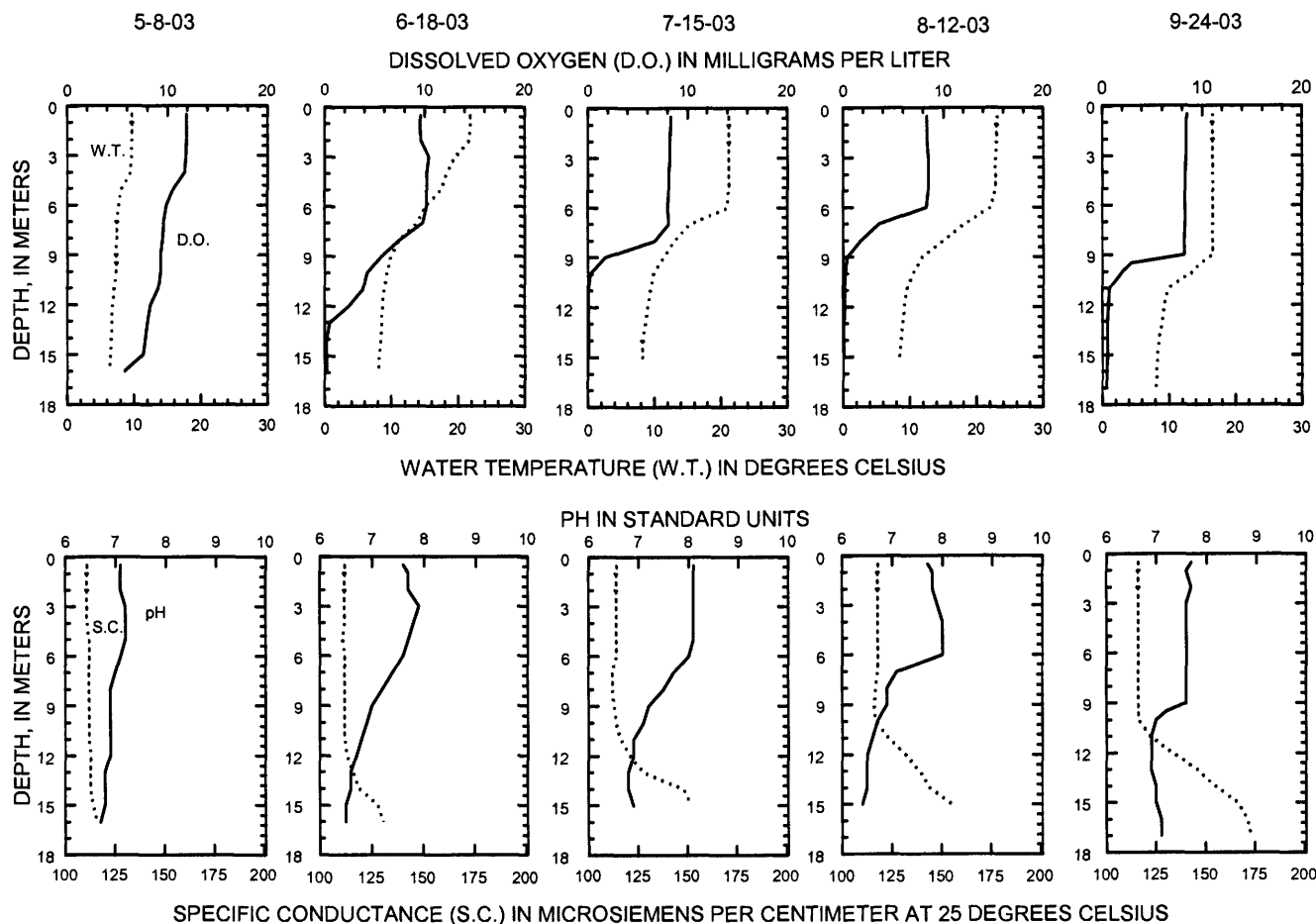
LOCATION.--Lat 45°52'14", long 89°41'28", in SE 1/4 SW 1/4 nw 1/4 sec.13, T.39 N., R.6 E., Oneida County, Hydrologic Unit 07070001, at Minocqua.

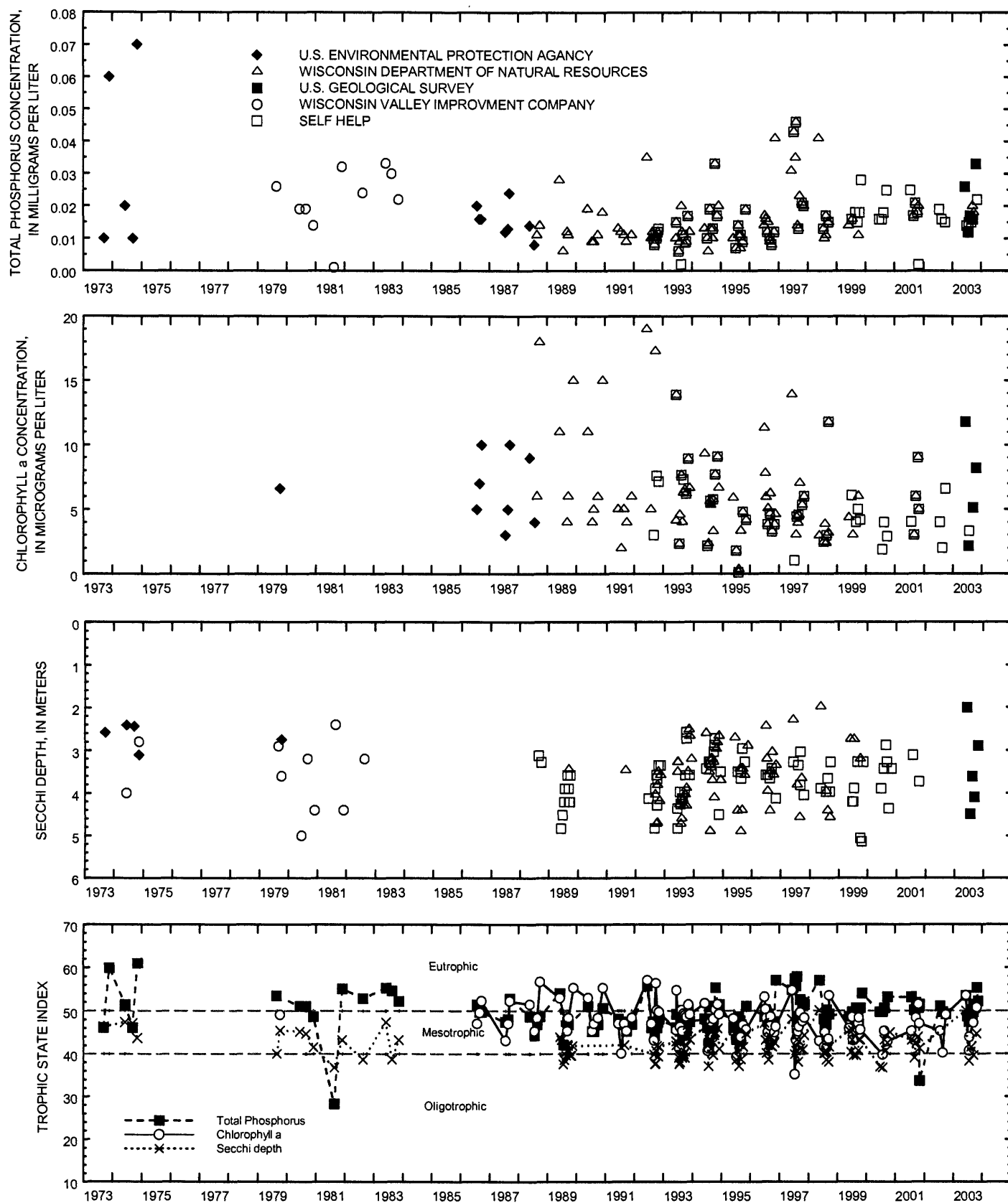
PERIOD OF RECORD.--May to September 2003.

REMARKS.--Lake sampled at deep hole. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MAY 8 TO September 24, 2003 (Milligrams per liter unless otherwise indicated)

	<u>May-8</u>		<u>Jun-18</u>		<u>Jul-15</u>		<u>Aug-12</u>		<u>Sep-24</u>		
Lake stage (ft)	1584.16		1584.56		1584.54		1584.55		1584.38		
Secchi-depth (m)	2.0		4.5		3.6		4.1		2.9		
Depth of sample (m)	0.5	16	0.5	16	0.5	15	0.5	15	0.5	9.5	19
Chlorophyll a, phytoplankton (µg/L)	11.8	--	2.18	--	--	--	5.14	--	8.21	--	--
Water temperature (°C)	9.7	6.4	21.9	8.1	21.2	8.2	23.1	8.4	16.6	14.7	8.1
Specific conductance (µS/cm)	111	116	112	131	114	152	118	155	116	116	173
pH	7.1	6.7	7.6	6.5	8.1	6.9	7.7	6.4	7.7	7.2	7.1
Dissolved oxygen (mg/L)	11.9	5.7	9.6	0.2	8.3	0.1	8.4	0.1	8.5	2.9	0.4
Phosphorus, total (as P)	0.026	0.02	0.012	0.079	0.017	0.237	0.016	0.273	0.033	0.019	0.027
Phosphorus, ortho, dissolved (as P)	0.003	--	--	--	--	--	--	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	<.022	--	--	--	--	--	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	<.013	--	--	--	--	--	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	0.37	--	--	--	--	--	--	--	--	--	--
Nitrogen, total (as N)	0.381	--	--	--	--	--	--	--	--	--	--
Color (Pt-Co. scale)	10	--	--	--	--	--	--	--	--	--	--
Turbidity (NTU)	2.9	--	--	--	--	--	--	--	--	--	--
Hardness, as CaCO ₃	48	--	--	--	--	--	--	--	--	--	--
Calcium, dissolved (Ca)	13.1	--	--	--	--	--	--	--	--	--	--
Magnesium, dissolved (Mg)	3.7	--	--	--	--	--	--	--	--	--	--
Sodium, dissolved (Na)	3.6	--	--	--	--	--	--	--	--	--	--
Potassium, dissolved (K)	<1.00	--	--	--	--	--	--	--	--	--	--
Alkalinity, as CaCO ₃	45	--	--	--	--	--	--	--	--	--	--
Sulfate, dissolved (SO ₄)	<4.5	--	--	--	--	--	--	--	--	--	--
Chloride, dissolved (Cl)	6.1	--	--	--	--	--	--	--	--	--	--
Silica, dissolved (SiO ₂)	10.3	--	--	--	--	--	--	--	--	--	--
Solids, dissolved, at 180°C	74	--	--	--	--	--	--	--	--	--	--
Iron, dissolved (Fe) (µg/L)	<100	--	--	--	--	--	--	--	--	--	--





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Minocqua Lake, Deep Hole, at Minocqua, Wisconsin.

455232089424100 MINOCQUA LAKE, NORTH BAY, AT MINOCQUA, WI

LOCATION.--Lat 45°52'32", long 89°42'41", in NE 1/4 NW 1/4 NW 1/4 sec.14, T.39 N., R.6 E., Oneida County Hydrologic Unit 07070001, at Minocqua.

PERIOD OF RECORD.--May to September 2003.

REMARKS.--Lake sampled at North Bay. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MAY 8 TO September 24, 2003 (Milligrams per liter unless otherwise indicated)

	May-8		Jun-18		Jul-15		Aug-12		Sep-24	
Lake stage (ft)	1584.16		1584.56		1584.54		1584.55		1584.38	
Secchi-depth (m)	2.1		4.2		3.7		2.1		1.6	
Depth of sample (m)	0.5	9	0.5	9.5	0.5	7.5	0.5	9	0.5	9
Chlorophyll a, phytoplankton (µg/L)	11.4	--	2.89	--	4.5	--	13.1	--	21	--
Water temperature (°C)	10.6	7.3	22	11.1	21.6	13.1	23.2	12.3	16.7	14.6
Specific conductance (µS/cm)	132	134	128	142	128	147	131	216	133	257
pH	7.8	7	8.1	6.7	8.1	6.9	8.3	6.7	7.5	7.2
Dissolved oxygen (mg/L)	12.1	5.1	9.9	0.1	7.5	0.1	8.9	0.1	7.6	0.5
Phosphorus, total (as P)	0.028	0.03	0.016	0.108	0.017	0.043	0.019	0.208	0.037	0.349

5-8-03

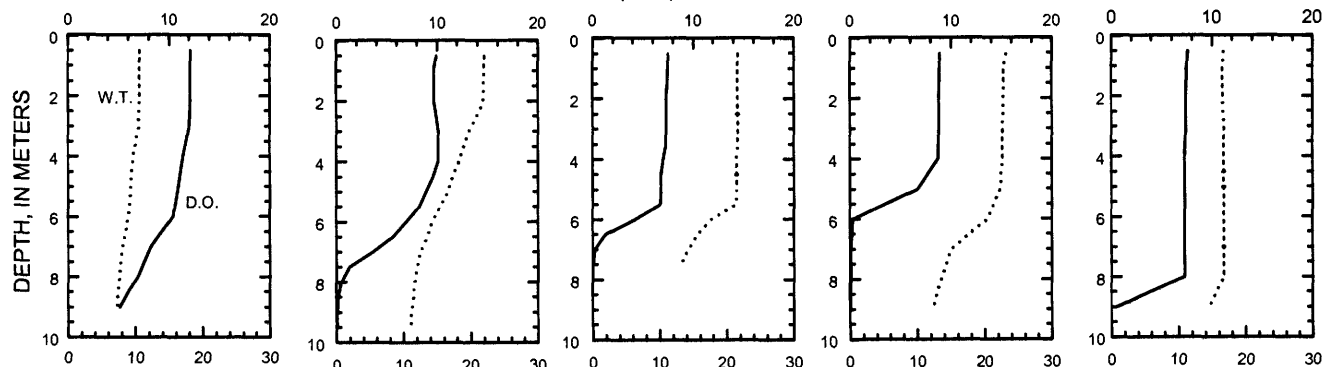
6-18-03

7-15-03

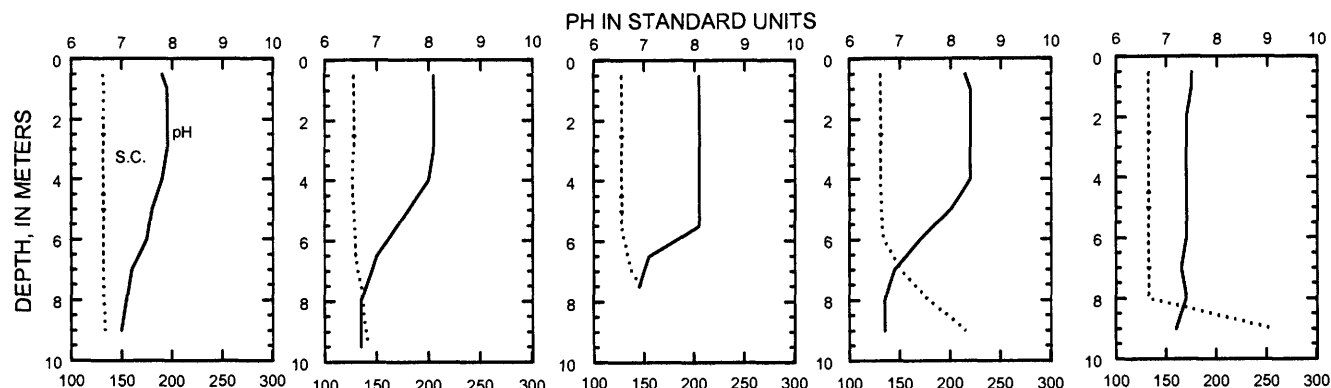
8-12-03

9-24-03

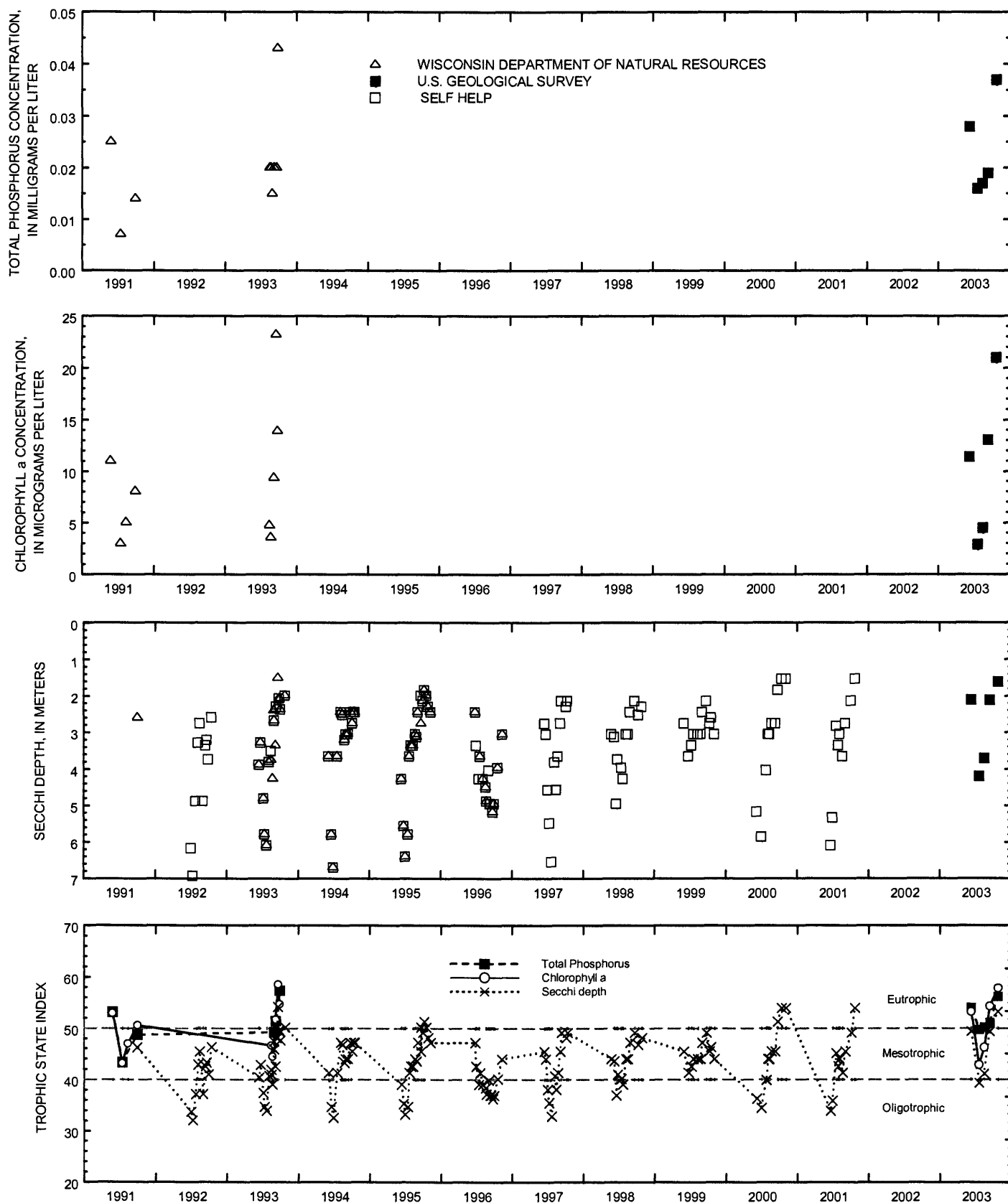
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Minocqua Lake, North Bay, at Minocqua, Wisconsin.

455206089425200 MINOCQUA LAKE, SOUTH BAY, AT MINOCQUA, WI

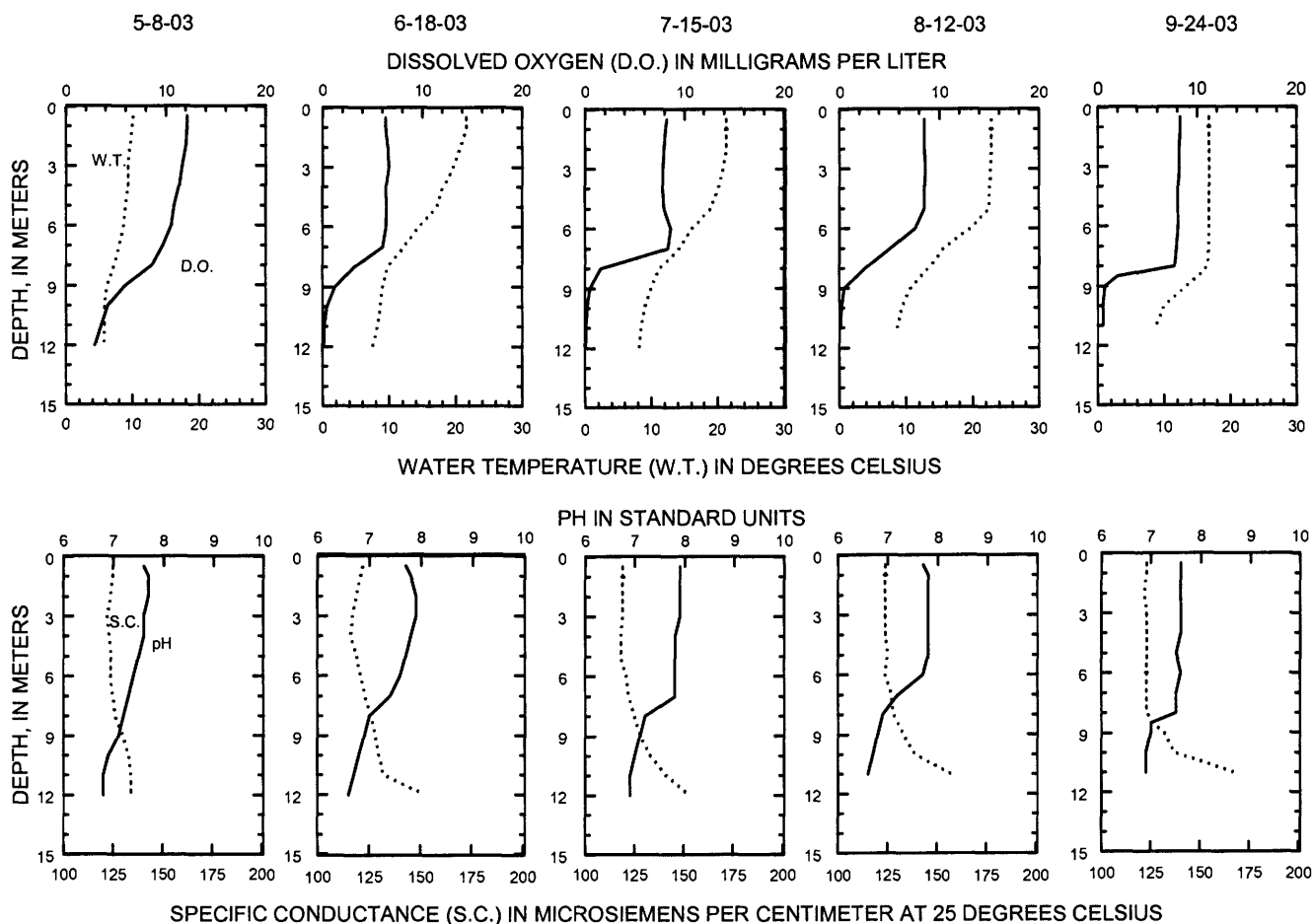
LOCATION.--Lat 45°52'06", long 89°42'52", in NW 1/4 NW 1/4 SW 1/4 sec.14, T.39 N., R.6 E., Oneida County, Hydrologic Unit 07070001, at Minocqua.

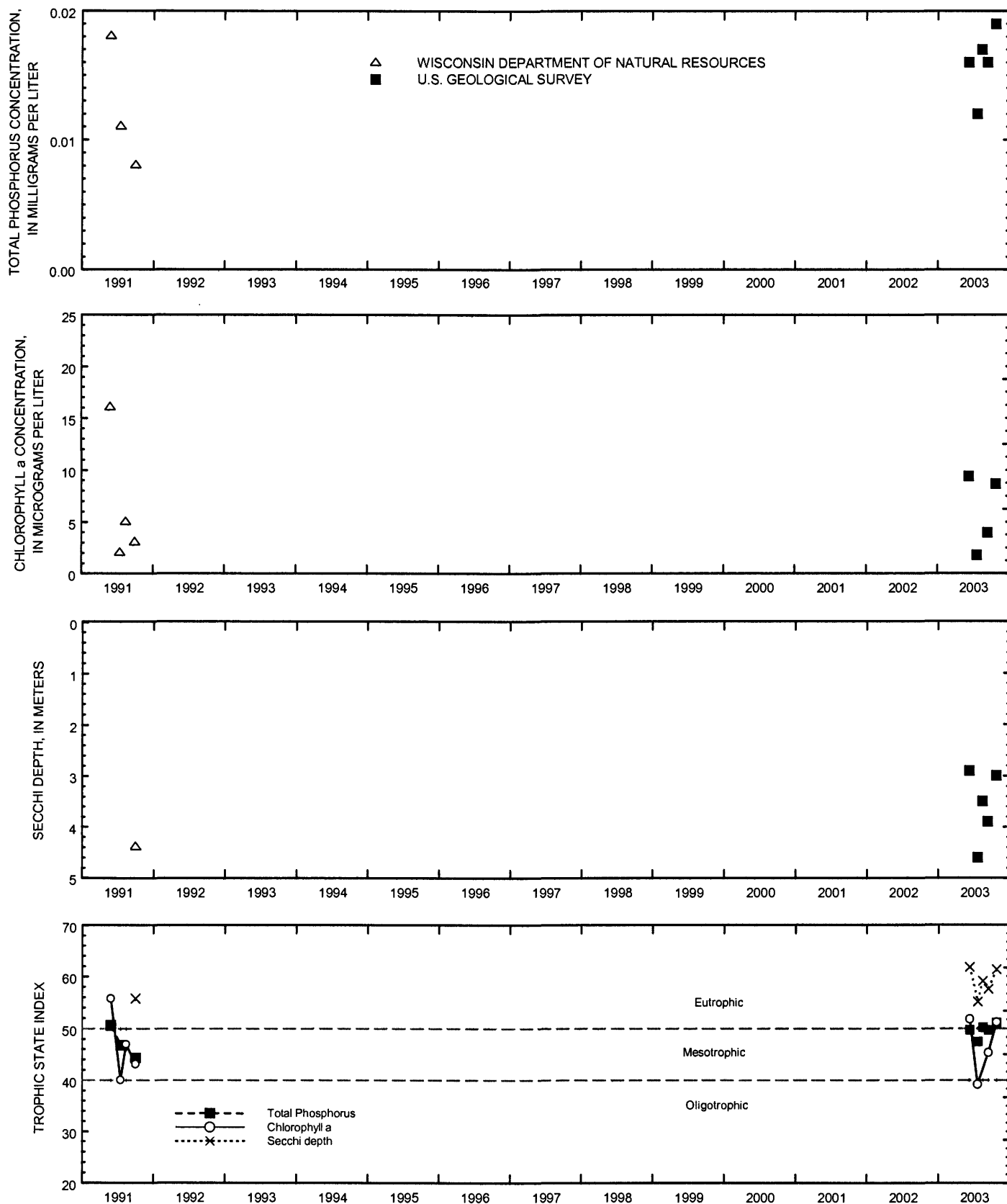
PERIOD OF RECORD.--May to September 2003.

REMARKS.--Lake sampled at South Bay. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MAY 8 TO September 24, 2003 (Milligrams per liter unless otherwise indicated)

	May-8		Jun-18		Jul-15		Aug-12		Sep-24		
Lake stage (ft)	1584.16		1584.56		1584.54		1584.55		1584.38		
Secchi-depth (m)	2.9		4.6		3.5		3.9		3.0		
Depth of sample (m)	0.5	12	0.5	12	0.5	12	0.5	11	0.5	8.5	11
Chlorophyll a, phytoplankton (µg/L)	9.39	--	1.78	--	--	--	4	--	8.68	--	--
Water temperature (°C)	10.1	5.7	21.6	7.5	8.2	8.2	22.9	8.7	16.8	15.2	8.8
Specific conductance (µS/cm)	125	134	122	152	153	153	124	157	123	126	167
pH	7.6	6.8	7.7	6.6	6.9	6.9	7.7	6.6	7.6	7	6.9
Dissolved oxygen (mg/L)	12.1	2.9	9.4	0.2	0.1	0.1	8.5	0.1	8.3	2	0.5
Phosphorus, total (as P)	0.016	0.019	0.012	0.072	0.017	0.135	0.016	0.056	0.019	0.05	0.359





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Minocqua Lake, South Bay, at Minocqua, Wisconsin.

05429000 LAKE MONONA AT MADISON, WI

LOCATION.--Lat 43°03'48", long 89°23'49', in SE 1/4 SW 1/4 sec.23, T.7 N., R.9 E., Dane County, Hydrologic Unit 07090001, in Brittingham Park, in Madison.

DRAINAGE AREA.--279 mi². Area of Lake Monona, 5.3 mi².

PERIOD OF RECORD.--September 1915 to current year (fragmentary) in reports of the Geological Survey. For 1856 to March 1917 in reports of Wisconsin Railroad Commission, volume 19.

REVISED RECORDS.--WSP 1338: Lake area. WDR WI-73-1: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is 840.00 ft above sea level, or 5.60 ft below City of Madison datum. Prior to Oct. 1, 1979, datum 3.61 ft higher; prior to Nov. 15, 1971, nonrecording gage at same site at the higher datum.

REMARKS.--Lake level regulated by concrete dam with four 12-foot stop-log sections and 12-foot lock at outlet of Lake Waubesa. Gage-height telemeter at station.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height observed, 7.48 ft, June 14, 15, 2000; minimum observed, 3.22 ft, Jan. 20, 1965, current datum.

EXTREMES FOR CURRENT YEAR.--Maximum recorded gage height, 5.61 ft, May 15; minimum recorded, 3.44, Mar. 2 and 3.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5.02	4.90	4.42	4.27	3.70	3.45	3.87	4.51	5.19	4.84	5.02	4.71
2	5.03	4.90	4.43	4.26	3.69	3.44	3.88	4.59	5.16	4.84	5.01	4.70
3	5.05	4.91	4.41	4.26	3.69	3.45	3.90	4.69	5.13	4.84	5.02	4.67
4	5.10	4.92	4.41	4.26	3.68	3.46	3.91	4.81	5.09	4.87	5.01	4.64
5	5.14	4.92	4.40	4.26	3.68	3.47	3.90	4.95	5.06	4.91	5.00	4.64
6	5.13	4.92	4.39	4.26	3.66	3.48	3.95	5.03	5.05	4.98	4.99	4.63
7	5.11	4.92	4.38	4.25	3.65	3.48	3.98	5.15	5.04	5.03	4.99	4.62
8	5.11	4.93	4.37	4.20	3.64	3.49	3.98	5.25	5.04	5.04	4.98	4.62
9	5.12	4.95	4.36	4.15	3.63	3.49	3.99	5.41	5.04	5.07	4.97	4.62
10	5.13	4.96	4.36	4.10	3.62	3.50	4.00	5.46	5.03	5.06	4.96	4.61
11	5.14	5.02	4.36	4.07	3.62	3.51	4.01	5.52	5.02	5.03	4.95	4.60
12	5.12	5.01	4.35	4.04	3.62	3.51	4.03	5.54	5.00	5.04	4.93	4.61
13	5.06	5.01	4.35	4.01	3.62	3.51	4.04	5.54	4.98	5.05	4.92	4.74
14	5.03	4.98	4.34	3.98	3.61	3.52	4.05	5.58	4.94	5.06	4.92	5.05
15	5.00	4.94	4.34	3.95	3.59	3.54	4.06	5.60	4.89	5.27	4.91	5.09
16	4.98	4.91	4.34	3.93	3.58	3.57	4.10	5.60	4.84	5.29	4.91	5.11
17	4.97	4.88	4.34	3.90	3.57	3.58	4.09	5.59	4.80	5.29	4.92	5.13
18	4.97	4.87	4.39	3.88	3.56	3.59	4.08	5.58	4.77	5.27	4.91	5.14
19	4.94	4.84	4.43	3.86	3.55	3.61	4.10	5.57	4.76	5.24	4.90	5.11
20	4.93	4.80	4.42	3.84	3.54	3.65	4.12	5.55	4.73	5.21	4.88	5.11
21	4.93	4.76	4.39	3.82	3.53	3.66	4.12	5.53	4.72	5.20	4.85	5.11
22	4.90	4.71	4.37	3.80	3.52	3.67	4.12	5.50	4.71	5.18	4.84	5.09
23	e4.88	4.68	4.31	3.78	3.50	3.69	4.15	5.47	4.70	5.15	4.83	5.07
24	e4.89	4.64	4.30	3.77	3.49	3.70	4.16	5.44	4.72	5.13	4.81	5.05
25	4.91	4.60	4.30	3.76	3.48	3.70	4.16	5.42	4.73	5.10	4.80	5.02
26	4.93	4.58	4.30	3.75	3.47	3.71	4.15	5.39	4.72	5.08	4.78	5.00
27	4.93	4.54	4.30	3.74	3.46	3.74	4.15	5.36	4.71	5.07	4.78	4.96
28	4.94	4.51	4.29	3.73	3.45	3.79	4.15	5.30	4.79	5.05	4.76	4.92
29	4.95	4.48	4.30	3.72	---	3.81	4.16	5.26	4.84	5.04	4.75	4.90
30	4.93	4.44	4.29	3.71	---	3.84	4.24	5.24	4.84	5.02	4.74	4.87
31	4.91	---	4.28	3.71	---	3.85	---	5.23	---	5.02	4.72	---
MEAN	5.01	4.81	4.36	3.97	3.59	3.60	4.05	5.31	4.90	5.07	4.90	4.87
MAX	5.14	5.02	4.43	4.27	3.70	3.85	4.24	5.60	5.19	5.29	5.02	5.14
MIN	4.88	4.44	4.28	3.71	3.45	3.44	3.87	4.51	4.70	4.84	4.72	4.60

e Estimated

425109088075000 MUSKEGO (BIG MUSKEGO) LAKE NEAR WIND LAKE, WI

LOCATION.--Lat 42°51'09", long 88°07'50", in SE 1/4 NE 1/4 sec.33, T.5 N., R.20 E., Waukesha County, Hydrologic Unit 07120006, on left bank 8 ft upstream of dam outlet of Muskego Lake, 700 ft north of Muskego Dam Drive, 2 mi northeast of Wind Lake.

DRAINAGE AREA.--33.9 mi² (revised).

PERIOD OF RECORD.--October 1987 to September 1989, January 1991 to current year. Prior to October 1993, published as Muskego Lake Outlet near Wind Lake, WI. October 1993 to September 2000, published as "Big Muskego Lake".

GAGE.--Water-stage recorder. Datum of gage is 760.00 ft above sea level. October to December 1987 and January 1991 to September 1995, nonrecording gage at the same datum. December 1987 through September 1989, data collected using water-stage recorder at the same datum.

REMARKS.--Lake levels regulated by concrete dam with one 5-ft lift gate.

EXTREMES FOR PERIOD OF RECORD.--Maximum observed gage height, 12.60 ft, Oct. 7, 1991 and Aug. 8, 1994; minimum instantaneous, less than 8.72 ft, July 12, 1996 to Feb. 18, 1997, due to drawdown of lake.

EXTREMES FOR CURRENT YEAR.--Maximum observed gage-height, 12.22 ft, Oct. 31; minimum observed, 10.65 ft, Sept. 26.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2001 TO SEPTEMBER 2002 DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	11.21	e12.02	e11.58	11.62	e11.58	e11.58	11.70	11.73	11.40	11.21	11.11	10.94
2	11.35	e11.93	e11.58	11.62	e11.58	e11.58	11.77	11.78	11.40	11.19	11.10	10.91
3	11.36	e11.85	e11.58	11.61	e11.58	e11.58	11.76	11.68	11.42	11.14	11.13	10.87
4	11.25	e11.76	e11.58	11.61	e11.58	11.59	11.78	11.66	11.42	11.15	11.18	10.89
5	11.31	e11.68	e11.58	11.62	e11.58	11.62	11.70	11.73	11.37	11.16	11.16	10.84
6	11.24	11.59	e11.58	11.62	e11.58	11.62	11.73	11.75	11.35	11.18	11.20	10.81
7	11.32	11.53	e11.58	11.62	e11.58	11.62	11.82	11.81	11.35	11.23	11.30	10.83
8	11.27	11.54	e11.58	11.62	e11.58	11.62	11.74	11.80	11.39	11.28	11.32	10.82
9	11.32	11.55	e11.58	11.61	e11.58	11.63	11.68	11.80	11.42	11.35	11.29	10.81
10	11.32	11.60	e11.58	11.61	e11.58	11.63	11.68	11.86	11.39	11.30	11.26	10.79
11	11.32	11.63	11.58	11.59	e11.58	11.63	11.72	11.58	11.49	11.30	11.30	10.76
12	11.31	11.58	11.58	11.59	e11.58	11.62	11.75	11.88	11.46	11.30	11.29	10.75
13	11.30	11.58	11.58	11.59	e11.58	11.63	11.68	11.84	11.43	11.27	11.23	10.80
14	11.28	11.62	11.58	11.58	e11.58	11.63	11.60	11.82	11.45	11.25	11.21	10.84
15	11.32	11.65	11.59	11.58	e11.58	11.63	11.57	11.82	11.46	11.33	11.20	10.84
16	11.33	11.62	11.58	e11.58	e11.58	11.64	11.83	11.78	11.42	11.33	11.20	10.82
17	11.29	11.59	11.58	e11.58	e11.58	11.64	11.72	11.76	11.40	11.35	11.18	10.80
18	11.27	11.71	11.62	e11.58	e11.58	11.65	11.67	11.71	11.38	11.40	11.15	10.80
19	11.30	11.56	11.64	e11.58	e11.58	11.66	11.64	11.64	11.48	11.29	11.13	10.78
20	11.31	11.59	11.65	e11.58	e11.58	11.68	11.57	11.66	11.39	11.25	e11.10	10.78
21	11.30	11.65	11.63	e11.58	e11.59	11.68	11.65	11.61	11.32	11.30	e11.10	10.75
22	11.35	11.61	11.62	e11.58	e11.59	11.69	11.67	11.56	11.28	11.34	e11.10	10.75
23	11.41	11.55	11.62	e11.58	e11.58	11.69	11.65	11.52	11.25	11.31	e11.08	10.74
24	11.41	11.58	11.62	e11.58	e11.58	11.67	11.64	11.50	11.23	11.23	e11.07	10.72
25	11.45	e11.58	11.62	e11.58	e11.58	11.69	11.72	11.43	11.20	11.16	e11.05	10.73
26	11.48	e11.58	11.61	e11.58	e11.58	11.69	11.63	11.42	11.20	11.09	e11.04	10.71
27	11.50	e11.58	11.61	e11.58	e11.58	11.70	11.53	11.34	11.17	11.21	e11.03	10.70
28	11.71	e11.58	11.61	e11.58	e11.58	11.68	11.57	11.35	11.26	11.19	10.94	10.74
29	12.08	e11.58	11.61	e11.58	---	11.71	11.59	11.40	11.23	11.15	10.97	10.71
30	12.11	e11.58	11.61	e11.58	---	11.69	11.63	11.33	11.22	11.11	10.96	10.69
31	e12.10	---	11.61	e11.58	---	11.68	---	11.50	---	11.11	10.93	---
MEAN	11.42	11.63	11.60	11.59	11.58	11.65	11.68	11.65	11.35	11.24	11.14	10.79
MAX	12.11	12.02	11.65	11.62	11.59	11.71	11.83	11.88	11.49	11.40	11.32	10.94
MIN	11.21	11.53	11.58	11.58	11.58	11.58	11.53	11.33	11.17	11.09	10.93	10.69

e Estimated

430347088240800 NAGAWICKA LAKE AT DELAFIELD, WI

LOCATION.--Lat 43°03'47", long 88°24'08", in SW 1/4 SW 1/4 sec.17, T.7 N., R.18 E., Waukesha County, Hydrologic Unit 07090001, on dike of Nagawicka Lake dam about 120 ft west of gates in Delafield.

DRAINAGE AREA.--44.9 mi². Area of Nagawicka Lake, 917 acres.

PERIOD OF RECORD.--October 2002 to September 2003.

GAGE.--Water-stage recorder.

REMARKS.--Gage established Oct. 29, 2002. Lake levels controlled by City of Delafield.

EXTREMES FOR CURRENT YEAR.--Maximum gage height, 8.48 ft, May 11, affected by wind; minimum gage height, 7.57 ft, Feb. 18, 19.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	7.90	7.88	7.66	7.81	8.13	8.38	8.37	8.30	8.30	8.23
2	---	---	7.91	7.87	7.66	7.83	8.14	8.39	8.36	8.29	8.25	8.22
3	---	---	7.90	7.87	7.67	7.85	8.15	8.37	8.34	8.28	8.26	8.21
4	---	---	7.90	7.86	7.67	7.88	8.17	8.36	8.32	8.29	8.31	8.21
5	---	---	7.90	7.87	7.66	7.92	8.14	8.40	8.30	8.31	8.29	8.19
6	---	---	7.89	7.87	7.65	7.95	8.15	8.38	8.30	8.35	8.28	8.18
7	---	---	7.89	7.86	7.65	7.98	8.19	8.36	8.30	8.41	8.31	8.20
8	---	---	7.89	7.86	7.63	8.01	8.16	8.34	8.36	8.40	8.31	8.21
9	---	---	7.89	7.86	7.63	8.03	8.13	8.38	8.37	8.37	8.30	8.21
10	---	---	7.88	7.85	7.62	8.05	8.13	8.38	8.34	8.31	8.29	8.21
11	---	---	7.88	7.84	7.62	8.07	8.15	8.37	8.35	8.29	8.29	8.21
12	---	---	7.88	7.83	7.62	8.09	8.16	8.42	8.32	8.29	8.29	8.21
13	---	---	7.88	7.82	7.61	8.12	8.16	8.36	8.31	8.27	8.27	8.26
14	---	---	7.88	7.81	7.61	8.13	8.14	8.36	8.31	8.26	8.27	8.35
15	---	---	7.88	7.80	7.59	8.10	8.15	8.37	8.30	8.30	8.28	8.37
16	---	---	7.89	7.79	7.58	8.02	8.24	8.35	8.29	8.31	8.28	8.34
17	---	---	7.89	7.78	7.58	7.97	8.20	8.34	8.26	8.30	8.28	8.33
18	---	e8.40	7.93	7.77	7.58	7.98	8.18	8.31	8.26	8.28	8.27	8.31
19	---	8.39	7.94	7.76	7.58	8.00	8.17	8.28	8.30	8.24	8.26	8.30
20	---	8.32	7.88	7.75	7.61	8.00	8.19	8.32	8.26	8.23	8.25	8.30
21	---	8.27	7.88	7.74	7.63	8.02	8.21	8.34	8.24	8.23	8.25	8.30
22	---	8.20	7.88	7.73	7.66	8.05	8.22	8.34	8.23	8.23	8.26	8.31
23	---	8.12	7.87	7.71	7.67	8.06	8.23	8.34	8.22	8.22	8.25	8.31
24	---	8.06	7.88	7.71	7.70	8.07	8.23	8.34	8.22	8.21	8.21	8.31
25	---	8.00	7.88	7.71	7.72	8.09	8.23	8.33	8.23	8.19	8.22	8.29
26	---	7.94	7.88	7.69	7.75	8.11	8.21	8.32	8.25	8.17	8.23	8.29
27	---	7.91	7.87	7.68	7.77	8.14	8.19	8.30	8.24	8.20	8.24	8.29
28	---	7.91	7.87	7.68	7.79	8.16	8.19	8.30	8.29	8.19	8.21	8.29
29	e8.32	7.90	7.87	7.67	---	8.16	8.20	8.32	8.30	8.19	8.24	8.29
30	8.31	7.91	7.87	7.66	---	8.14	8.23	8.31	8.30	8.22	8.24	8.28
31	e8.30	---	7.88	7.66	---	8.13	---	8.39	---	8.32	8.23	---
MEAN	---	---	7.89	7.78	7.65	8.03	8.18	8.35	8.29	8.27	8.27	8.27
MAX	---	---	7.94	7.88	7.79	8.16	8.24	8.42	8.37	8.41	8.31	8.37
MIN	---	---	7.87	7.66	7.58	7.81	8.13	8.28	8.22	8.17	8.21	8.18

e Estimated

430417088230300 NAGAWICKA LAKE, AT DEEP HOLE, AT DELAFIELD, WI

LOCATION.--Lat 43°04'17", long 88°23'03", in SE 1/4 NE 1/4 sec.17, T.7 N., R.18 E., Waukesha County, Hydrologic Unit 07090001, at Delafield.

PERIOD OF RECORD.--February to September 2003.

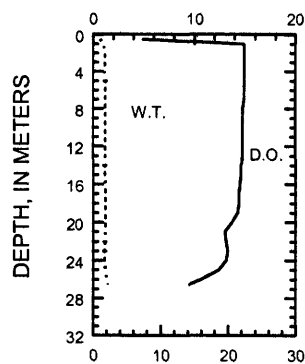
REMARKS.--Lake sampled near center at the deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 20 TO JUNE 9, 2003

(Milligrams per liter unless otherwise indicated)

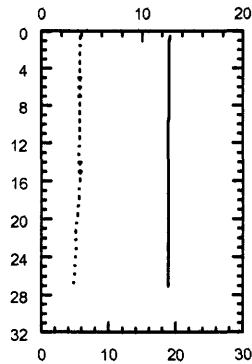
	Feb-20		Apr-15		Jun-9	
Lake stage (ft)	7.61		8.15		8.37	
Secchi-depth (m)	7.2		5.6		1.9	
Depth of sample (m)	0.5	26.5	0.5	27	0.5	31.5
Chlorophyll a, phytoplankton (µg/L)	--	--	1.85	--	6.9	--
Water temperature (°C)	1	2.2	5.8	4.8	19.6	7
Specific conductance (µS/cm)	707	787	745	746	691	729
pH	8.1	7.8	8.8	7.9	8.2	7.8
Dissolved oxygen (mg/L)	14.9	9.5	12.8	12.6	10.9	5.1
Phosphorus, total (as P)	0.007	0.012	0.013	0.014	0.016	0.023
Phosphorus, ortho, dissolved (as P)	--	--	<0.002	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	1.06	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.102	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.54	--	--	--
Nitrogen, total (as N)	--	--	1.6	--	--	--
Color (Pt-Co. scale)	--	--	<5	--	--	--
Turbidity (NTU)	--	--	<1.0	--	--	--
Hardness, as CaCO ₃	--	--	300	--	--	--
Calcium, dissolved (Ca)	--	--	58	--	--	--
Magnesium, dissolved (Mg)	--	--	37.8	--	--	--
Sodium, dissolved (Na)	--	--	30.9	--	--	--
Potassium, dissolved (K)	--	--	2	--	--	--
Alkalinity, as CaCO ₃	--	--	241	--	--	--
Sulfate, dissolved (SO ₄)	--	--	27.2	--	--	--
Chloride, dissolved (Cl)	--	--	72.5	--	--	--
Silica, dissolved (SiO ₂)	--	--	5.8	--	--	--
Solids, dissolved, at 180°C	--	--	410	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	<100	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	<1	--	--	--

2-20-03

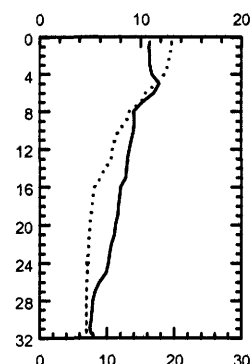


4-15-03

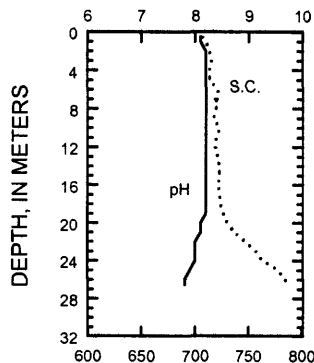
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



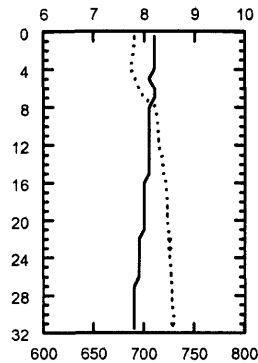
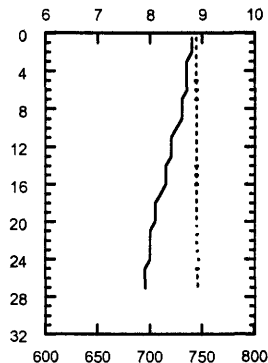
6-9-03



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



PH IN STANDARD UNITS



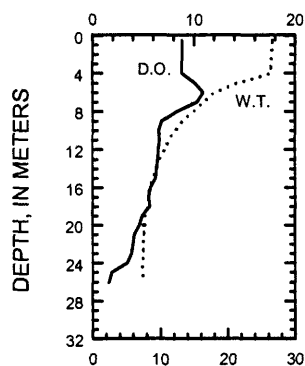
SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

430417088230300 NAGAWICKA LAKE, AT DEEP HOLE, AT DELAFIELD, WI-CONTINUED

WATER-QUALITY DATA, JULY 7 TO SEPTEMBER 16, 2003
(Milligrams per liter unless otherwise indicated)

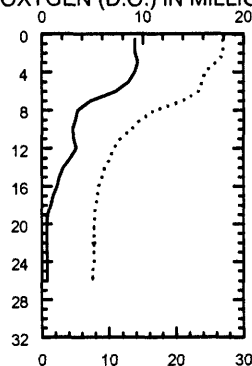
	Jul-7		Aug-18				Sep-16				
Lake stage (ft)	8.41		8.27				8.34				
Secchi-depth (m)	2.1		2.6				3.2				
Depth of sample (m)	0.5	26	0.5	26	0.5	8	13	17	20	23	26
Chlorophyll a, phytoplankton (µg/L)	2.7	--	3.04	--	4.24	--	--	--	--	--	--
Water temperature (°C)	26.6	7.2	26.9	7.5	20.8	20.5	10	8.3	7.9	7.7	7.5
Specific conductance (µS/cm)	670	729	658	729	661	665	742	749	751	756	759
pH	8.1	7.7	8.1	7.6	8	8.1	8.1	8.2	8.2	8.2	8.1
Dissolved oxygen (mg/L)	8.8	1.6	9.2	0.5	8.3	7.5	0.3	0.2	0.2	0.2	0.2
Phosphorus, total (as P)	0.016	0.04	0.014	0.02	0.009	0.01	0.007	0.011	0.011	0.015	0.028
Phosphorus, ortho, dissolved (as P)	0.002	--	--	--	--	--	--	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	0.644	--	--	--	--	--	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	0.032	--	--	--	--	--	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	0.45	--	--	--	--	--	--	--	--	--	--
Nitrogen, total (as N)	1.1	--	--	--	--	--	--	--	--	--	--

7-7-03

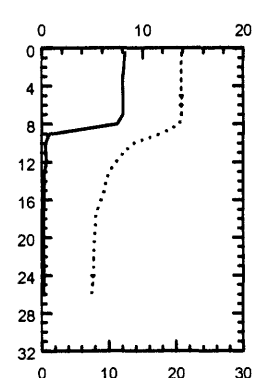


8-18-03

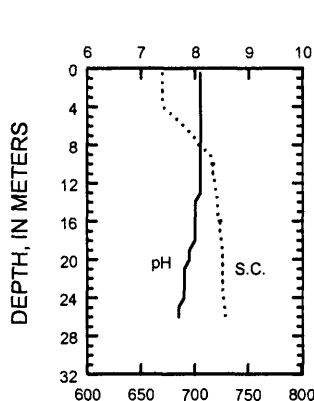
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



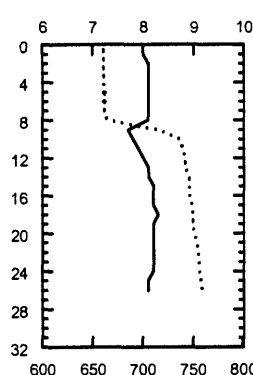
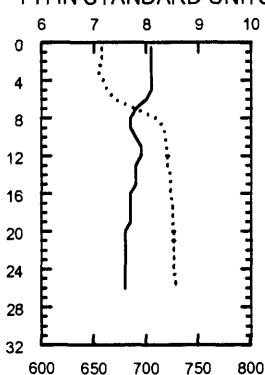
9-16-03



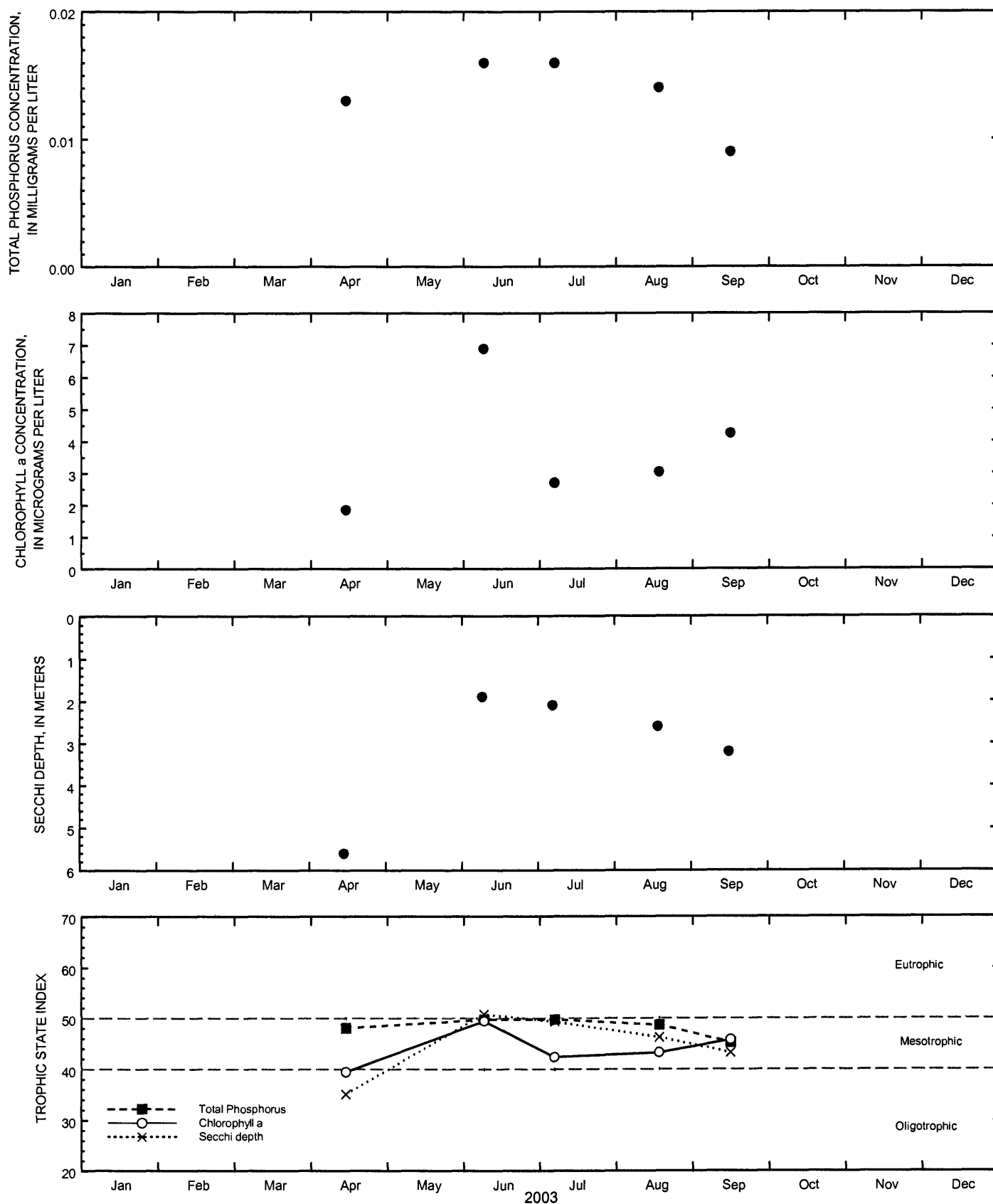
WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Nagawicka Lake, at Delafield, Wisconsin.

430551088273500 OCONOMOWOC LAKE NO. 1 (CENTER) AT OCONOMOWOC, WI

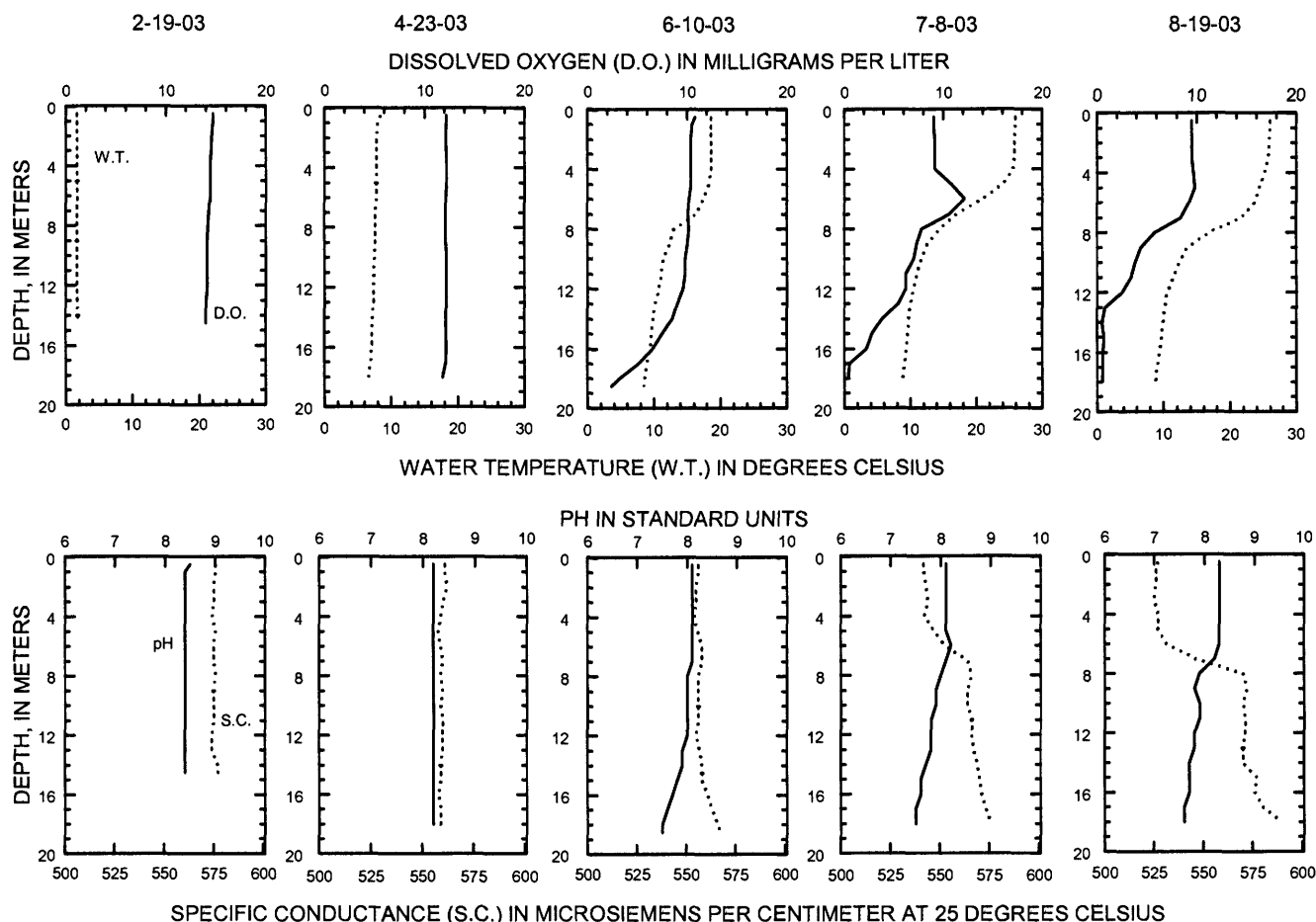
LOCATION.--Lat 43°05'51", long 88°27'35", in NW 1/4 SE 1/4 sec.2, T.7 N., R.17 E., Waukesha County, Hydrologic Unit 07090001, at Oconomowoc.

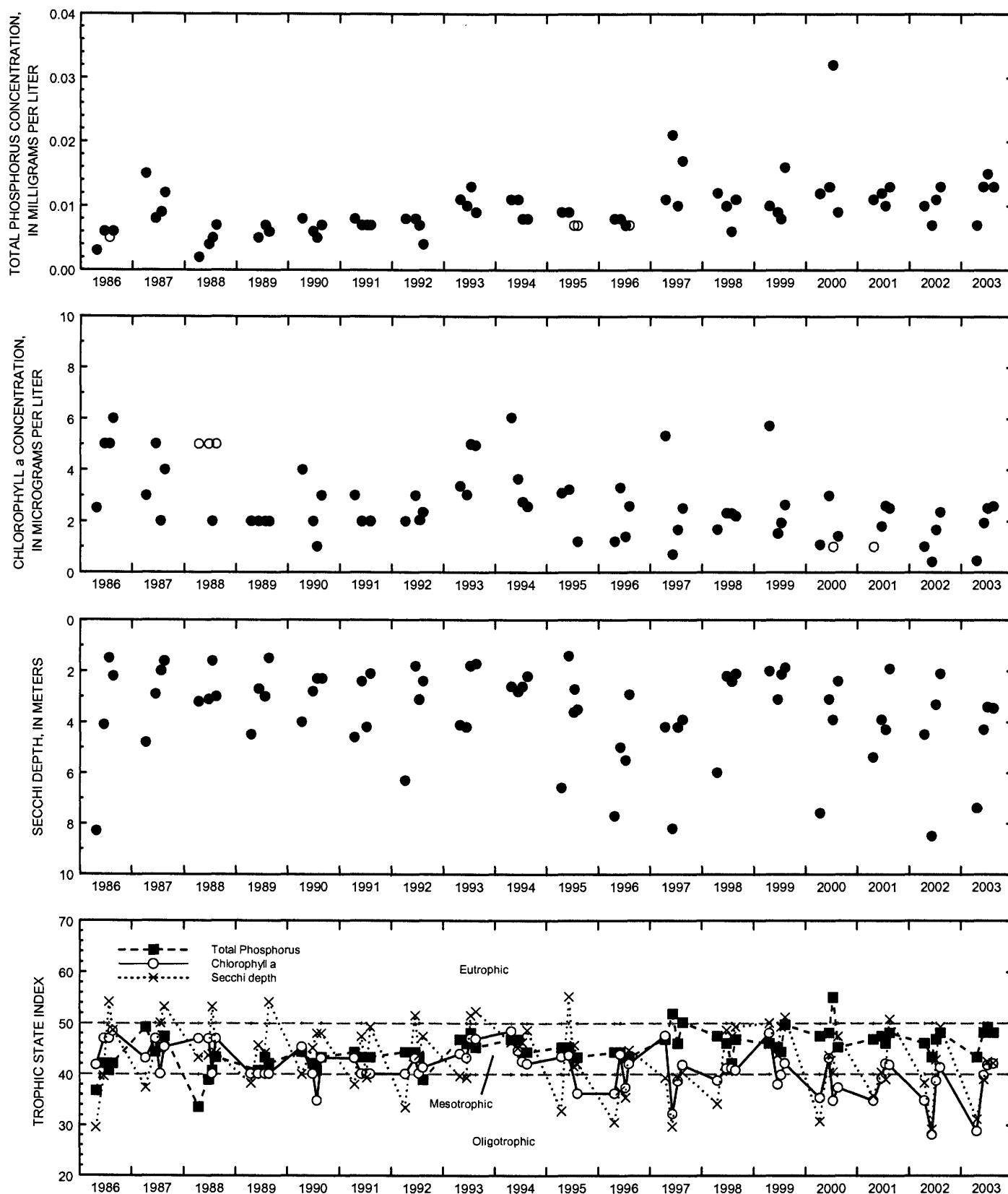
PERIOD OF RECORD.--March 1986 to current year.

REMARKS.--Lake sampled near center at the deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 19 TO AUGUST 19, 2003 (Milligrams per liter unless otherwise indicated)

	Feb-19		Apr-23		Jun-10		Jul-8		Aug-19	
Lake stage (ft)	--	--	--	--	--	--	--	--	--	--
Secchi-depth (m)	--	--	11.73	7.4	12.26	4.3	11.48	3.4	11.61	3.45
Depth of sample (m)	0.5	14.5	0.5	18.5	0.5	18.5	0.5	18	0.5	18.5
Chlorophyll a, phytoplankton (µg/L)	--	--	0.45	--	1.93	--	2.48	--	2.58	--
Water temperature (°C)	1.7	1.8	8.4	6.6	18.6	8.5	25.9	8.8	26	8.7
Specific conductance (µS/cm)	576	577	561	559	556	567	542	576	527	593
pH	8.5	8.4	8.2	8.2	8.1	7.5	8.1	7.5	8.3	7.5
Dissolved oxygen (mg/L)	14.7	14	12.2	11.8	10.8	2.4	9	0.4	9.5	0.5
Phosphorus, total (as P)	0.007	0.006	0.007	0.007	0.013	0.051	0.015	0.015	0.013	0.032
Phosphorus, ortho, dissolved (as P)	--	--	<.002	--	--	--	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	0.188	--	--	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.039	--	--	--	--	--	--	--
Nitrogen, amm. + diss., total (as N)	--	--	0.3	--	--	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.49	--	--	--	--	--	--	--
Nitrogen, total (as N)	--	--	0.448	--	--	--	--	--	--	--
Color (Pt-Co. scale)	--	--	5	--	--	--	--	--	--	--
Turbidity (NTU)	--	--	<1.0	--	--	--	--	--	--	--
Hardness, as CaCO ₃	--	--	250	--	--	--	--	--	--	--
Calcium, dissolved (Ca)	--	--	45	--	--	--	--	--	--	--
Magnesium, dissolved (Mg)	--	--	34.2	--	--	--	--	--	--	--
Sodium, dissolved (Na)	--	--	18.4	--	--	--	--	--	--	--
Potassium, dissolved (K)	--	--	2	--	--	--	--	--	--	--
Alkalinity, as CaCO ₃	--	--	208	--	--	--	--	--	--	--
Sulfate, dissolved (SO ₄)	--	--	24.7	--	--	--	--	--	--	--
Chloride, dissolved (Cl)	--	--	43.1	--	--	--	--	--	--	--
Silica, dissolved (SiO ₂)	--	--	5.52	--	--	--	--	--	--	--
Solids, dissolved, at 180°C	--	--	316	--	--	--	--	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	<100	--	--	--	--	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	<1	--	--	--	--	--	--	--





Surface total phosphorus, chlorophyll a concentrations, Secchi depths,
and TSI data for Oconomowoc Lake, Center Site, at Oconomowoc, Wisconsin.

(Circles on the first two plots indicate laboratory detection limit for selected analyses.
Actual concentrations for these particular analyses are less than the plotted circles.)

430609088262200 OCONOMOWOC LAKE NO. 2 (OFF HEWITT POINT) AT OCONOMOWOC, WI

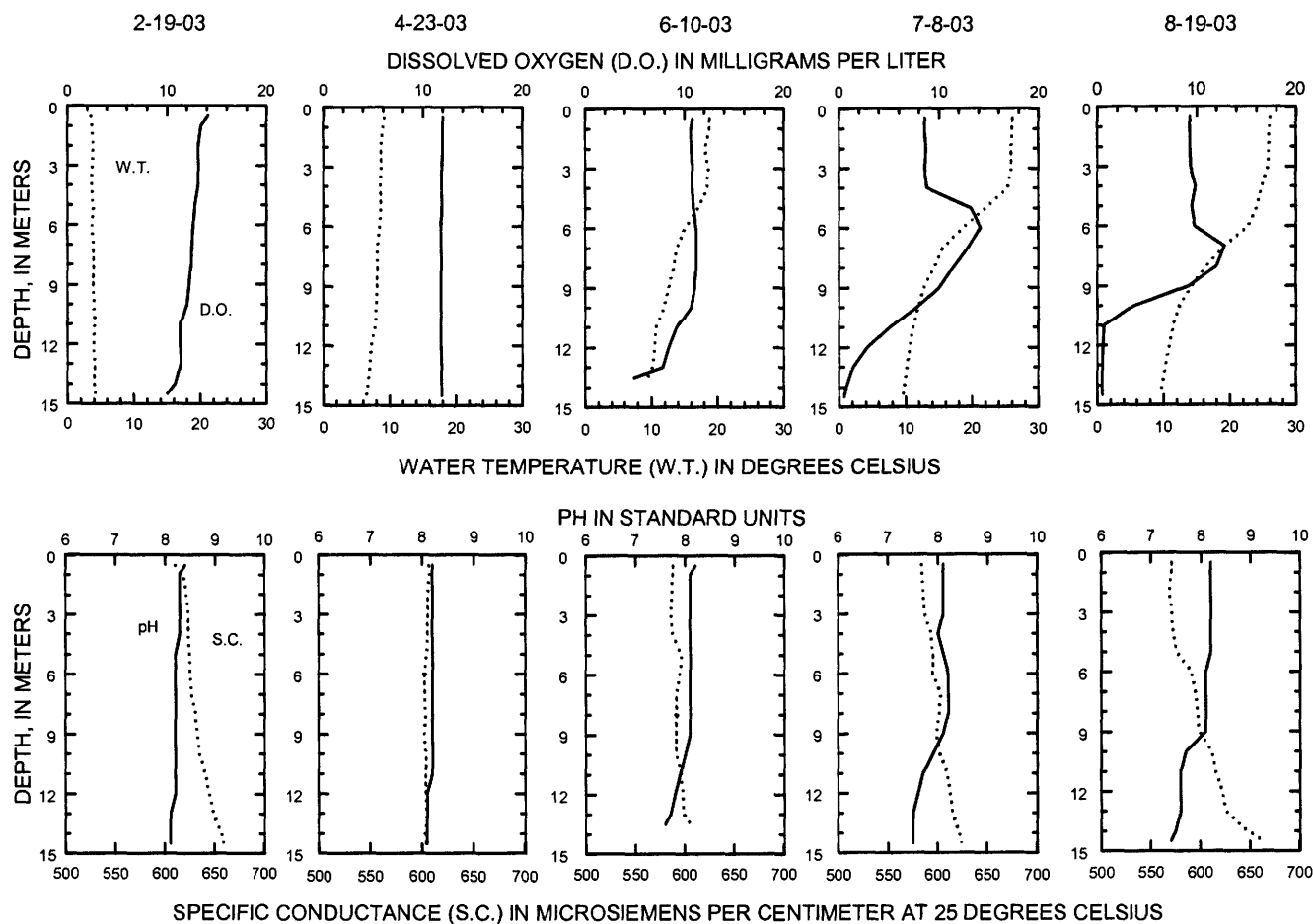
LOCATION.--Lat 43°06'09", long 88°26'22", in NW 1/4 NW 1/4 sec.1, T.7 N., R.17 E., Waukesha County, Hydrologic Unit 07090001, at Oconomowoc.

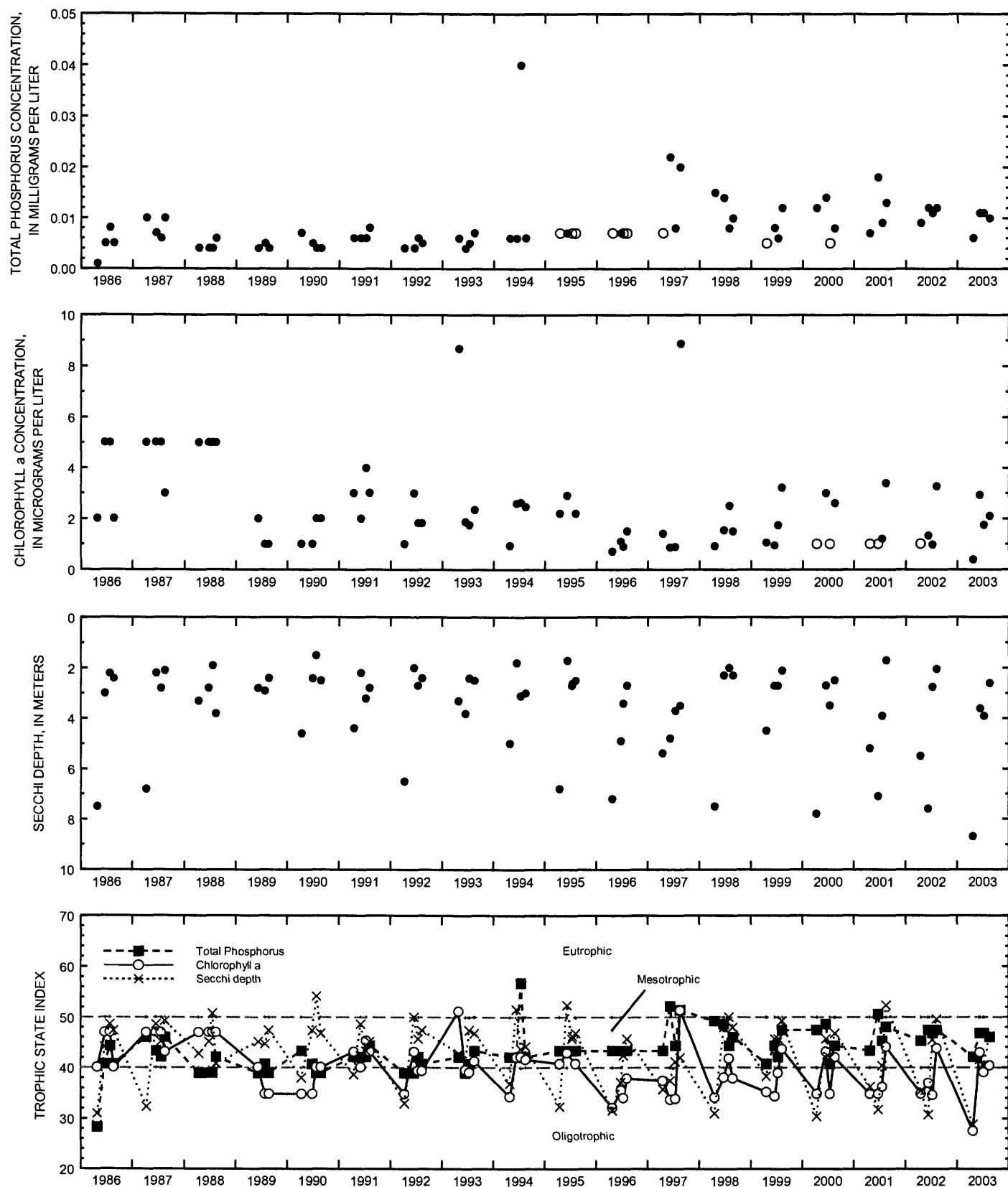
PERIOD OF RECORD.--March 1986 to current year.

REMARKS.--Lake sampled at the deepest point in northeast bay near Hewitt Point. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 19 TO AUGUST 19, 2003 (Milligrams per liter unless otherwise indicated)

	<u>Feb-19</u>		<u>Apr-23</u>		<u>Jun-10</u>		<u>Jul-8</u>		<u>Aug-19</u>	
Lake stage (ft)	--		11.73		12.26		11.48		11.61	
Secchi-depth (m)	--		8.7		3.6		3.9		2.6	
Depth of sample (m)	0.5	14.5	0.5	14.5	0.5	13.5	0.5	14.5	0.5	14.5
Chlorophyll a, phytoplankton (µg/L)	--	--	0.38	--	2.93	--	1.75	--	2.1	--
Water temperature (°C)	3.5	4.2	9.2	6.5	18.8	5.4	26.1	9.6	26.1	9.6
Specific conductance (µS/cm)	610	659	607	604	588	607	584	624	571	663
pH	8.4	8.1	8.2	8.1	8.2	7.6	8.1	7.5	8.2	7.4
Dissolved oxygen (mg/L)	14.1	10	12	11.9	10.8	4.9	8.6	0.5	9.3	0.5
Phosphorus, total (as P)	0.005	0.007	0.006	0.007	0.011	0.019	0.011	0.031	0.01	0.024





Surface total phosphorus, chlorophyll a concentrations, Secchi depths,
 and TSI data for Oconomowoc Lake, Hewitt Point, at Oconomowoc, Wisconsin.

(Circles on the first two plots indicate laboratory detection limit for selected analyses.
 Actual concentrations for these particular analyses are less than the plotted circles.)

430723088252100 OKAUCHEE LAKE AT OKAUCHEE, WI

LOCATION.--Lat 43°07'23", long 88°25'21", in SE 1/4 SE 1/4, sec.25, T.8 N., R.17 E., Waukesha County, Hydrologic Unit 07090001, at Okauchee.

DRAINAGE AREA.--80.7 mi².

PERIOD OF RECORD.--February 1984 to current year.

LAKE-STAGE GAGE.--Datum of gage is 869.00 ft above sea level.

REMARKS.--Lake sampled near center at the deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 20 TO AUGUST 19, 2003

(Milligrams per liter unless otherwise indicated)

	Feb-20		Apr-23		Jun-11		Jul-8		Aug-19		
Lake stage (ft)	3.98		4.67		4.74		4.77		4.64		
Secchi-depth (m)	--		2.5		2.3		1.0		2.0		
Depth of sample (m)	0.5	27.5	0.5	27.5	0.5	28	0.5	28	0.5	23	28
Chlorophyll a, phytoplankton (µg/L)	--	--	9.46	--	5.5	--	7.06	--	4.26	--	--
Water temperature (°C)	1.2	2	7.7	5.5	18.6	6	25.7	6.2	25.4	6.7	6.2
Specific conductance (µS/cm)	598	598	548	554	553	565	530	569	509	564	584
pH	8.3	8.2	8	8	8.2	7.4	8.1	7.5	8.2	7.6	7.4
Dissolved oxygen (mg/L)	14.5	12.3	13.1	11.9	9.8	0.7	8.9	0.4	9.5	0.6	0.5
Phosphorus, total (as P)	0.009	0.016	0.021	0.014	0.025	0.046	0.019	0.037	0.014	0.016	0.047
Phosphorus, ortho, dissolved (as P)	--	--	0.002	--	--	--	0.003	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	0.3	--	--	--	0.076	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	<0.13	--	--	--	0.02	--	--	--	--
Nitrogen, amm. + diss., total (as N)	--	--	--	--	--	--	0.82	--	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.41	--	--	--	--	--	--	--	--
Nitrogen, total (as N)	--	--	0.71	--	--	--	--	--	--	--	--
Color (Pt-Co. scale)	--	--	15	--	--	--	--	--	--	--	--
Turbidity (NTU)	--	--	3.2	--	--	--	--	--	--	--	--
Hardness, as CaCO ₃	--	--	260	--	--	--	--	--	--	--	--
Calcium, dissolved (Ca)	--	--	49.4	--	--	--	--	--	--	--	--
Magnesium, dissolved (Mg)	--	--	33.2	--	--	--	--	--	--	--	--
Sodium, dissolved (Na)	--	--	14.2	--	--	--	--	--	--	--	--
Potassium, dissolved (K)	--	--	2	--	--	--	--	--	--	--	--
Alkalinity, as CaCO ₃	--	--	219	--	--	--	--	--	--	--	--
Sulfate, dissolved (SO ₄)	--	--	24.5	--	--	--	--	--	--	--	--
Chloride, dissolved (Cl)	--	--	35.6	--	--	--	--	--	--	--	--
Silica, dissolved (SiO ₂)	--	--	3.36	--	--	--	--	--	--	--	--
Solids, dissolved, at 180°C	--	--	322	--	--	--	--	--	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	<100	--	--	--	--	--	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	<1	--	--	--	--	--	--	--	--

2-20-03

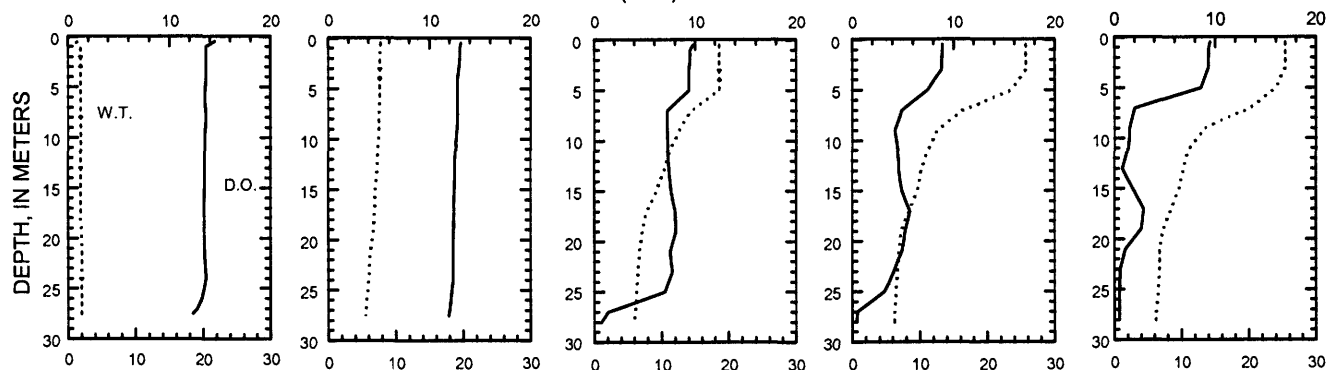
4-23-03

6-11-03

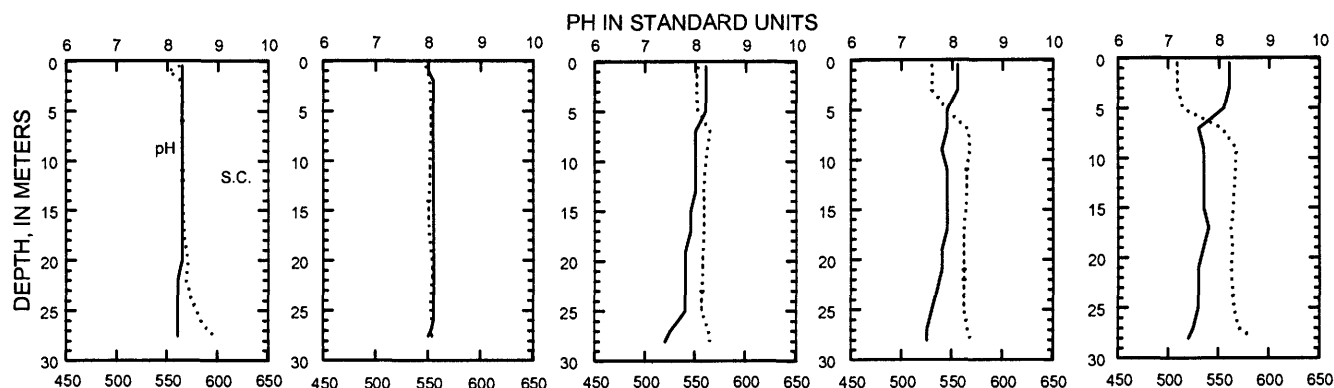
7-8-03

8-19-03

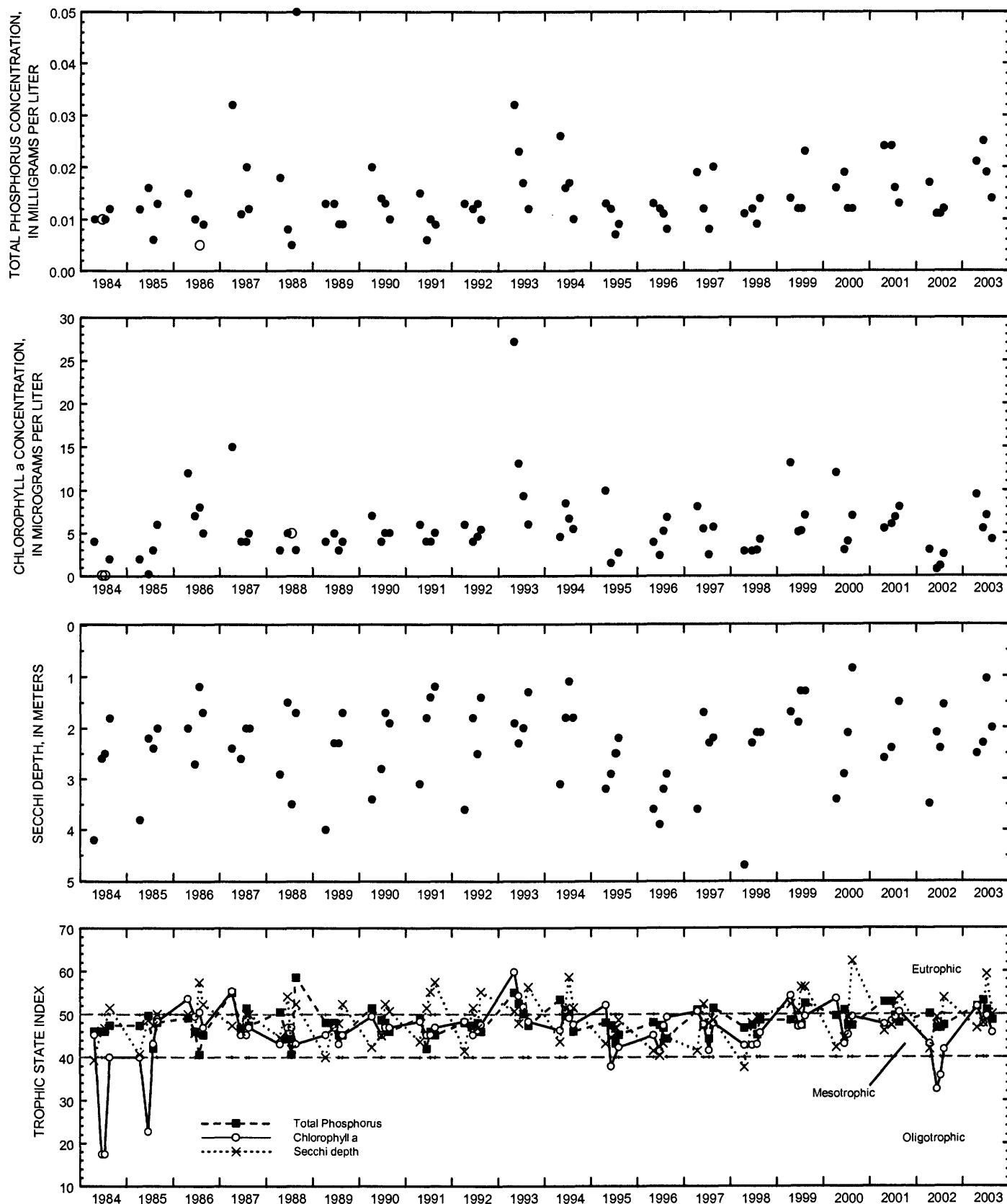
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths,
and TSI data for Okauchee Lake, near Okauchee, Wisconsin.

(Circles on the first two plots indicate laboratory detection limit for selected analyses.
Actual concentrations for these particular analyses are less than the plotted circles.)

430759088244200 OKAUCHEE LAKE, NO. 1, NEAR OKAUCHEE, WI

LOCATION.--Lat 43°07'59", long 88°24'42", in NE 1/4 NW 1/4 sec.30, T.8 N., R.18 E., Waukesha County, Hydrologic Unit 07090001, near Okauchee.

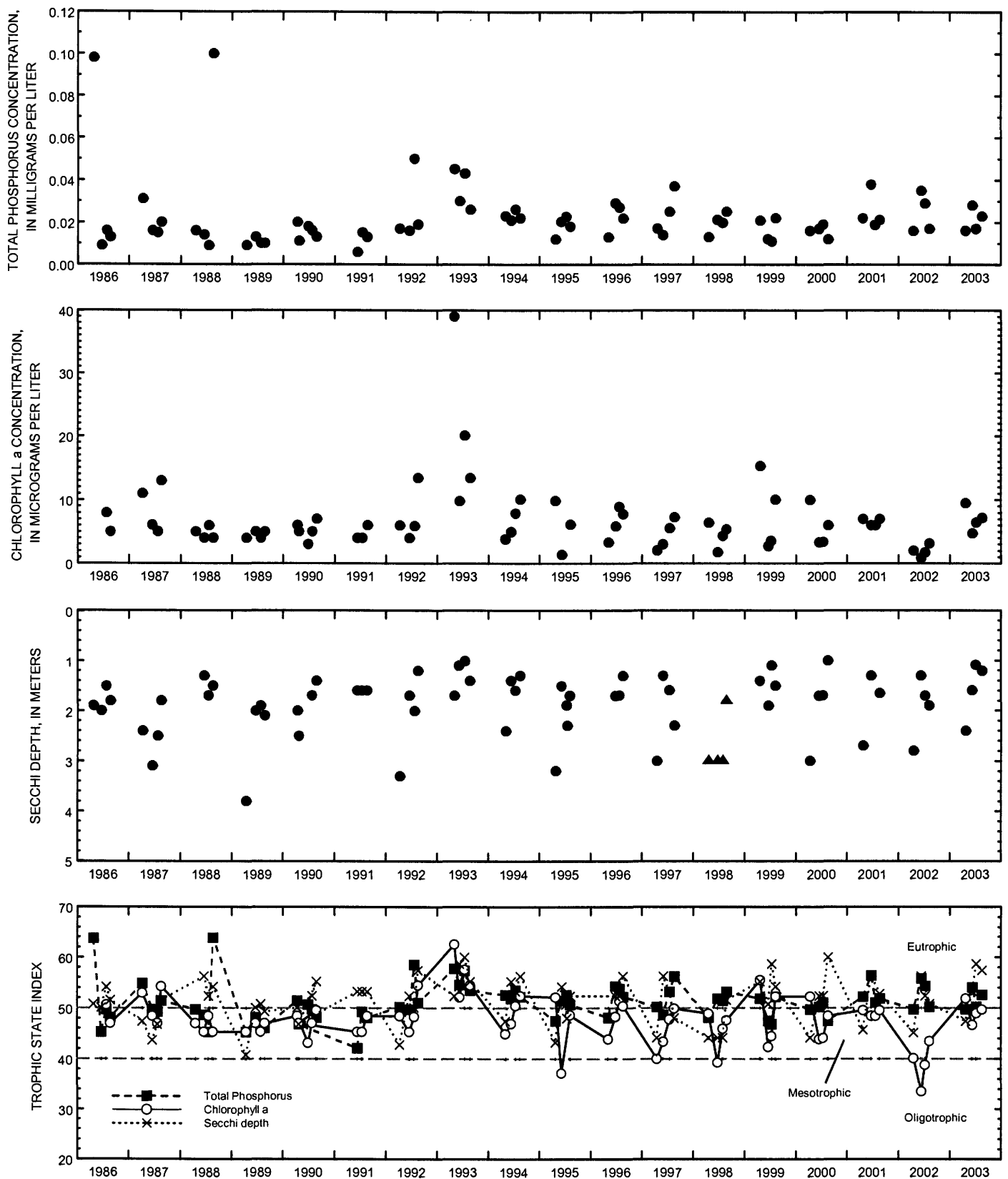
PERIOD OF RECORD.--April 1986 to current year.

LAKE-STAGE GAGE.--Datum of gage is 869.00 ft above sea level.

REMARKS.--Lake sampled in Crane's Nest Bay, in the northeast part of the lake, at an approximate depth of 2 m. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, APRIL 23 TO AUGUST 19, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Apr-23</u>	<u>Jun-11</u>	<u>Jul-8</u>	<u>Aug-19</u>
Lake stage (ft)	4.67	4.74	4.77	4.64
Secchi-depth (m)	2.4	1.6	1.1	1.2
Chlorophyll a, phytoplankton (mg/L)	9.49	4.74	6.45	7.1
Depth of sample (m)	0.5	0.5	0.5	0.5
Water temperature (°C)	7.6	19	26.1	25.9
Specific conductance (µS/cm)	553	590	543	549
pH (units)	8.4	8.2	8.1	8.2
Dissolved oxygen (mg/L)	12.7	10.5	8.4	9.8
Phosphorus, total (as P)	0.016	0.028	0.017	0.023



Surface total phosphorus, chlorophyll a concentrations, Secchi depths,
and TSI data for Okauchee Lake, No. 1, near Okauchee, Wisconsin.

(Triangles in Secchi plot indicate maximum depth at sampling site.
Actual Secchi depth on these days was greater than the plotted triangles.)

430645088264500 OKAUCHEE LAKE, NO. 2, AT OKAUCHEE, WI

LOCATION.--Lat 43°06'45", long 88°26'45", in SE 1/4 NE 1/4 sec.35, T.8 N., R.17 E., Waukesha County, Hydrologic Unit 07090001, at Okauchee.

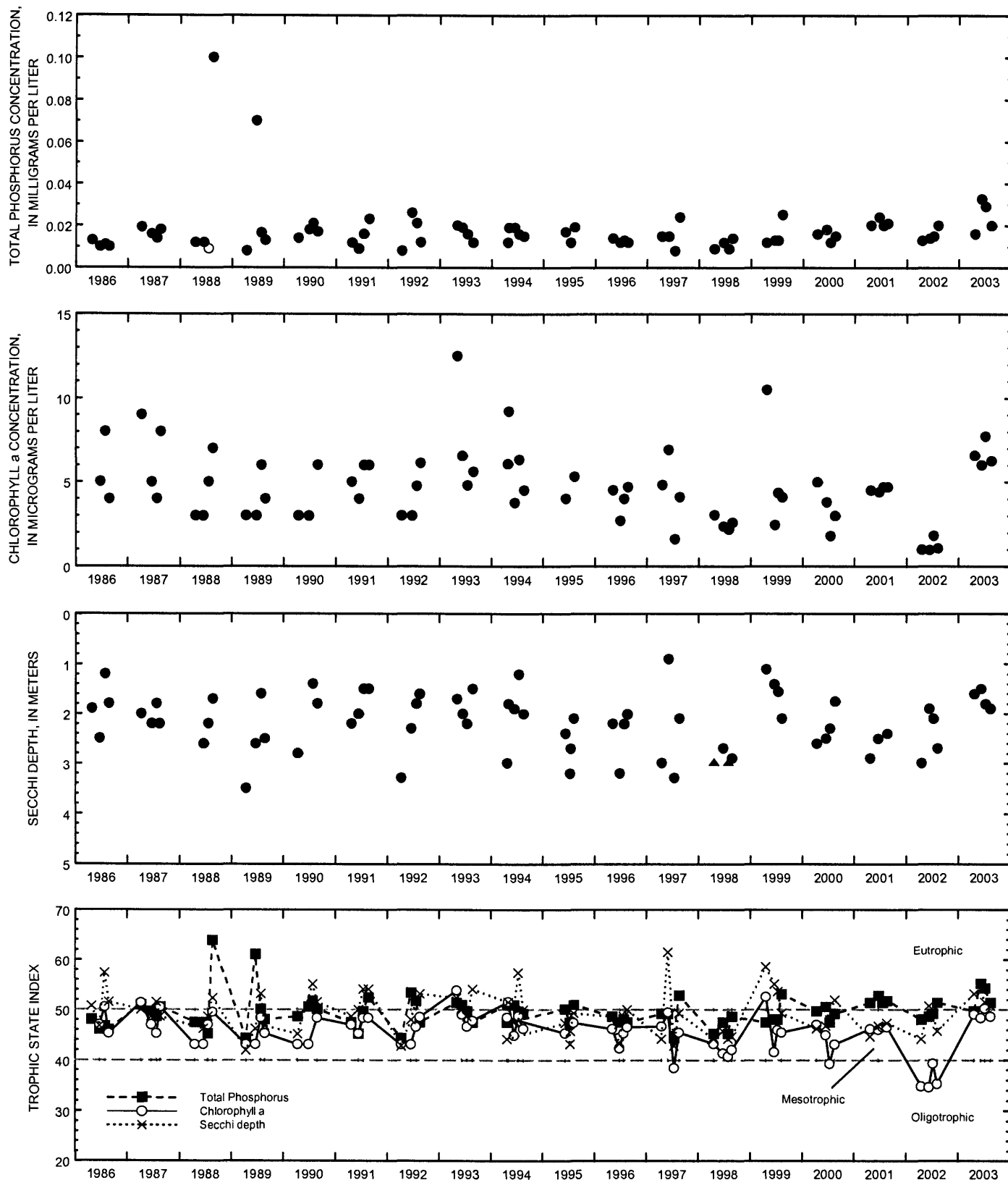
PERIOD OF RECORD.--April 1986 to current year.

LAKE-STAGE GAGE.--Datum of gage is 869.00 ft above sea level.

REMARKS.--Lake sampled in Lower Okauchee Lake, at an approximate depth of 5 m. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, APRIL 23 TO AUGUST 19, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Apr-23</u>	<u>Jun-11</u>	<u>Jul-8</u>	<u>Aug-19</u>
Lake stage (ft)	4.67	4.74	4.77	4.64
Secchi-depth (m)	1.6	1.5	1.8	1.9
Chlorophyll a, phytoplankton (mg/L)	6.58	6.01	7.71	6.25
Depth of sample (m)	0.5	0.5	0.5	0.5
Water temperature (°C)	10.4	19.5	26.9	26.5
Specific conductance (µS/cm)	543	544	516	499
pH (units)	8.5	8	7.9	8.2
Dissolved oxygen (mg/L)	11.8	9.2	7.6	9
Phosphorus, total (as P)	0.016	0.033	0.029	0.020



Surface total phosphorus, chlorophyll a concentrations, Secchi depths,
and TSI data for Okauchee Lake, No. 2, near Okauchee, Wisconsin.

(Circles on the first two plots indicate laboratory detection limit for selected analyses.

Actual concentrations for these particular analyses are less than the plotted circles.)

(Triangles in Secchi plot indicate maximum depth at sampling site.

Actual Secchi depth on these days was greater than the plotted triangles.)

430642088252400 OKAUCHEE LAKE, NO. 3, AT OKAUCHEE, WI

LOCATION.--Lat 43°06'42", long 88°25'24", in NE 1/4 SE 1/4 sec.36, T.8 N., R.17 E., Waukesha County, Hydrologic Unit 07090001, at Okauchee.

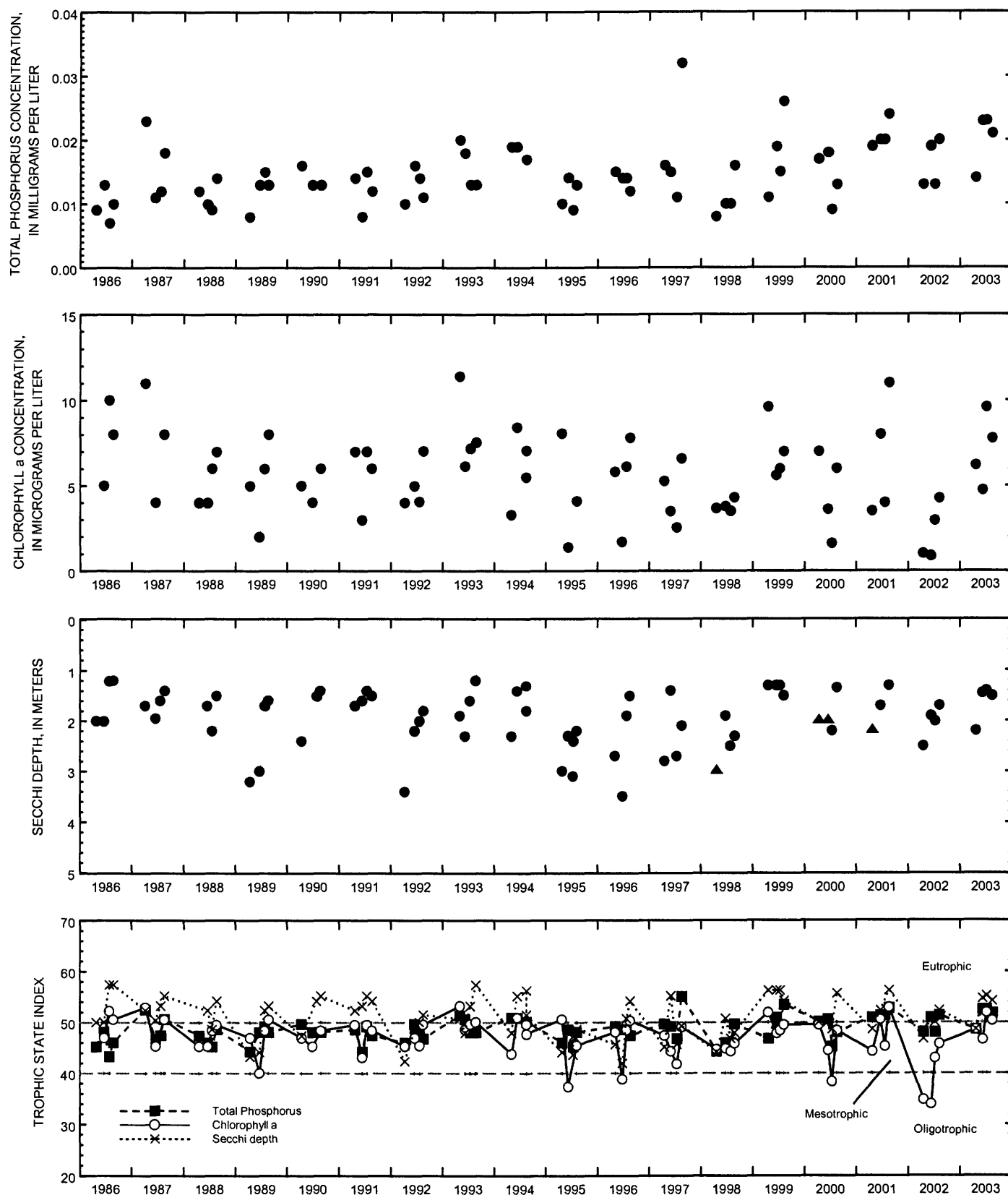
PERIOD OF RECORD.--April 1986 to current year.

LAKE-STAGE GAGE.--Datum of gage is 869.00 ft above sea level.

REMARKS.--Lake sampled in Ice House Bay, in the southern part of the lake, at an approximate depth of 4 m. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, APRIL 23 TO AUGUST 19, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Apr-23</u>	<u>Jun-11</u>	<u>Jul-8</u>	<u>Aug-19</u>
Lake stage (ft)	4.67	4.74	4.77	4.64
Secchi-depth (m)	2.2	1.45	1.4	1.5
Chlorophyll a, phytoplankton (mg/L)	6.19	4.74	9.57	7.76
Depth of sample (m)	0.5	0.5	0.5	0.5
Water temperature (°C)	8.8	18.9	26.6	26.4
Specific conductance (µS/cm)	549	538	517	505
pH (units)	8.5	8.2	8.1	8.3
Dissolved oxygen (mg/L)	12.7	9.6	8.3	9.2
Phosphorus, total (as P)	0.014	0.023	0.023	0.021



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Okauchee Lake, No. 3, near Okauchee, Wisconsin.

(Triangles in Secchi plot indicate maximum depth at sampling site.
Actual Secchi depth on these days was greater than the plotted triangles.)

430757088261700 OKAUCHEE LAKE, NO. 4, AT OKAUCHEE, WI

LOCATION.--Lat 43°07'57", long 88°26'17", in NW 1/4 NW 1/4 sec.25, T.8 N., R.17 E., Waukesha County, Hydrologic Unit 07090001, at Okauchee.

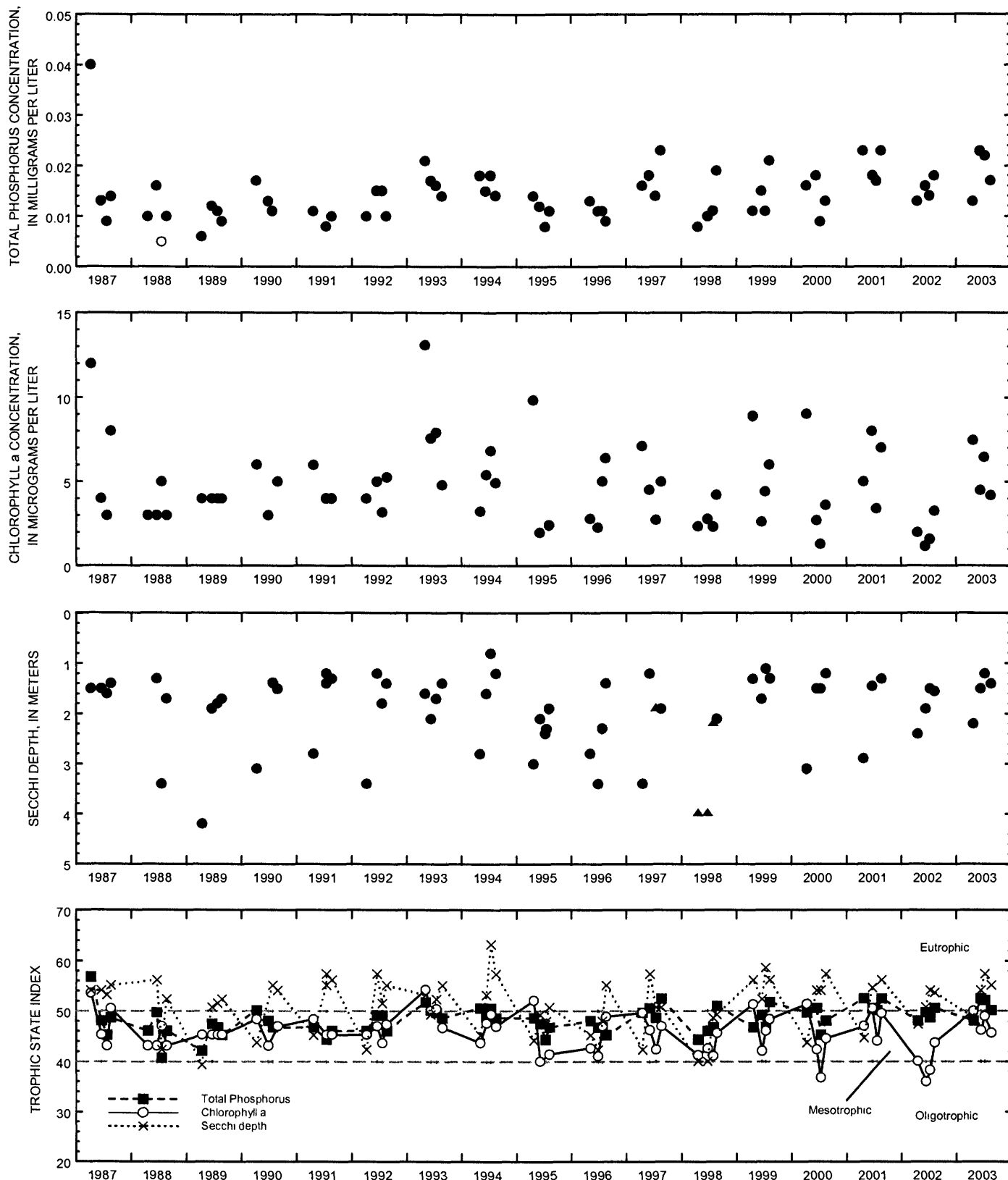
PERIOD OF RECORD.--June 1986 to current year.

LAKE-STAGE GAGE.--Datum of gage is 869.00 ft above sea level.

REMARKS.--Lake sampled near McDowell (Crazyman's) Island, in the northwest bay of the lake, at an approximate depth of 2 m. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, APRIL 23 TO AUGUST 19, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Apr-23</u>	<u>Jun-11</u>	<u>Jul-8</u>	<u>Aug-19</u>
Lake stage (ft)	4.67	4.74	4.77	4.64
Secchi-depth (m)	2.2	1.5	1.2	1.4
Chlorophyll a, phytoplankton (mg/L)	7.45	4.48	6.46	4.19
Depth of sample (m)	0.5	0.5	0.5	0.5
Water temperature (°C)	7.8	18.5	25.6	25.9
Specific conductance (µS/cm)	551	548	522	490
pH (units)	8.4	8.2	8.1	8.4
Dissolved oxygen (mg/L)	12.9	9.2	8.6	9.8
Phosphorus, total (as P)	0.013	0.023	0.022	0.017



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Okauchee Lake, No. 4, near Okauchee, Wisconsin.

(Circles on the first two plots indicate laboratory detection limit for selected analyses. Actual concentrations for these particular analyses are less than the plotted circles.)

(Triangles in Secchi plot indicate maximum depth at sampling site. Actual Secchi depth on these days was greater than the plotted triangles.)

424905088204000 POTTER LAKE NEAR MUKWONAGO, WI

LOCATION.--Lat 42°49'05", long 88°20'40", in NW 1/4 SW 1/4 sec.11, T.4 N., R.18 E., Walworth County, Hydrologic Unit 07120006, 3.3 mi south of Mukwonago.

PERIOD OF RECORD.--February 1993 to current year.

REMARKS.--Lake sampled at the deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 19 TO AUGUST 20, 2003 (Milligrams per liter unless otherwise indicated)

	Feb-19		Apr-15		Jun-10		Jul-9		Aug-20		
Lake stage (ft)	--		--		7.08		7.03		--		
Secchi-depth (m)	--		1.3		1.8		0.9		1.2		
Depth of sample (m)	0.5	6.5	0.5	7	0.5	6.5	0.5	6.5	0.5	5.5	6.5
Chlorophyll a, phytoplankton (µg/L)	--	--	7.07	--	6.92	--	14	--	7.48	--	--
Water temperature (°C)	3.4	4	11.9	11	20	13.8	26.1	15.8	26.5	20.4	17.5
Specific conductance (µS/cm)	526	551	449	448	420	460	426	486	421	510	573
pH	8.5	8.2	8.1	8.2	8.5	7.2	8.2	7	8.3	6.8	6.7
Dissolved oxygen (mg/L)	14.6	6.6	12.3	11.7	10.4	0.4	9.1	0.4	9.2	0.3	0.3
Phosphorus, total (as P)	0.017	0.024	0.04	0.031	0.039	0.049	0.037	0.096	0.03	0.063	0.092
Phosphorus, ortho, dissolved (as P)	--	--	0.008	--	--	--	0.024	--	--	--	--
Nitrogen, NO ₃ + NO ₂ , diss. (as N)	--	--	0.108	--	--	--	<.022	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.023	--	--	--	0.089	--	--	--	--
Nitrogen, amm. + diss., total (as N)	--	--	--	--	--	--	1.3	--	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	1.1	--	--	--	--	--	--	--	--
Nitrogen, total (as N)	--	--	1.2	--	--	--	--	--	--	--	--
Color (Pt-Co. scale)	--	--	5	--	--	--	--	--	--	--	--
Turbidity (NTU)	--	--	3.8	--	--	--	--	--	--	--	--
Hardness, as CaCO ₃	--	--	180	--	--	--	--	--	--	--	--
Calcium, dissolved (Ca)	--	--	33	--	--	--	--	--	--	--	--
Magnesium, dissolved (Mg)	--	--	22.6	--	--	--	--	--	--	--	--
Sodium, dissolved (Na)	--	--	23	--	--	--	--	--	--	--	--
Potassium, dissolved (K)	--	--	2	--	--	--	--	--	--	--	--
Alkalinity, as CaCO ₃	--	--	144	--	--	--	--	--	--	--	--
Sulfate, dissolved (SO ₄)	--	--	4.5	--	--	--	--	--	--	--	--
Chloride, dissolved (Cl)	--	--	52.4	--	--	--	--	--	--	--	--
Silica, dissolved (SiO ₂)	--	--	<.020	--	--	--	--	--	--	--	--
Solids, dissolved, at 180°C	--	--	262	--	--	--	--	--	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	<100	--	--	--	--	--	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	<1	--	--	--	--	--	--	--	--

2-19-03

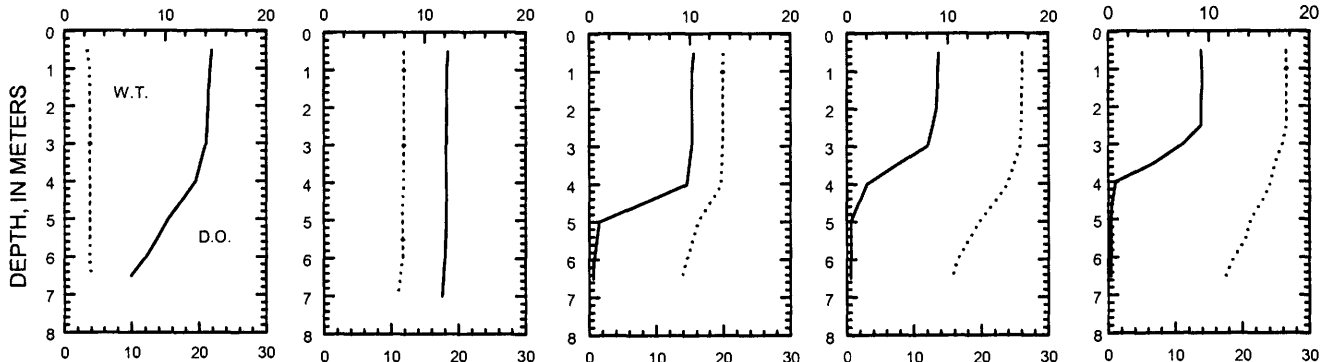
4-15-03

6-10-03

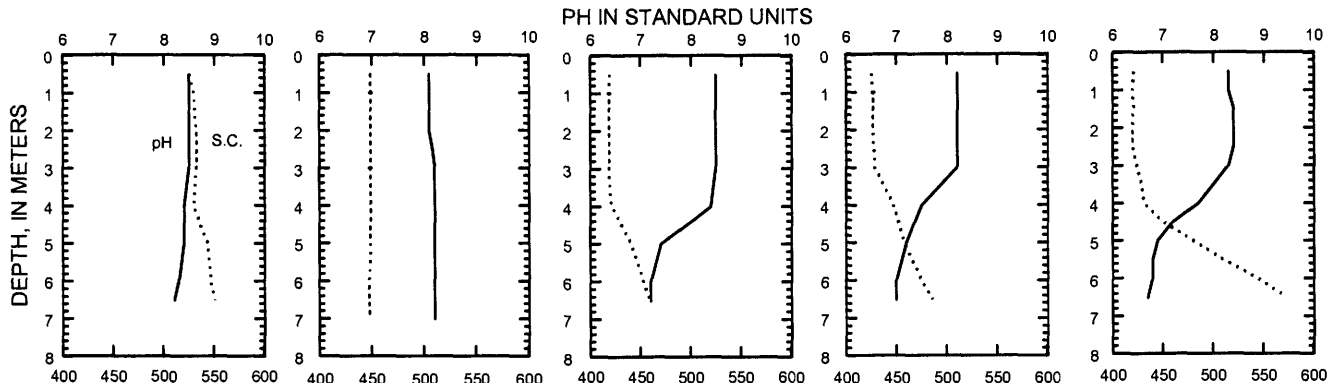
7-9-03

8-20-03

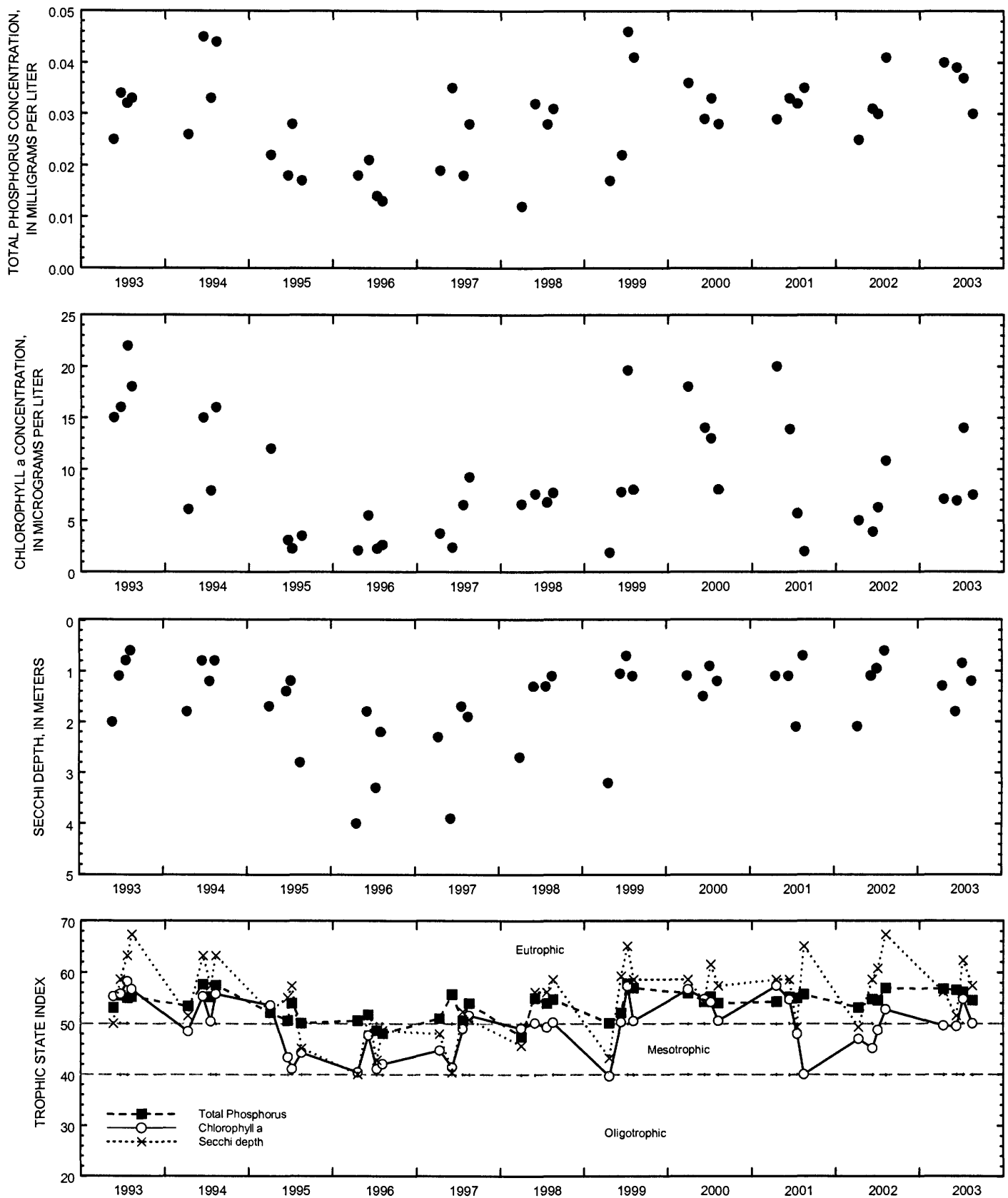
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Potter Lake, near Mukwonago, Wisconsin.

423246088175800 POWERS LAKE AT POWERS LAKE, WI

LOCATION.--Lat 42°32'46", long 88°17'58", in NW 1/4 SE 1/4 sec.13, T.1 N., R.18 E., Walworth County, Hydrologic Unit 07120006, at Powers Lake.

DRAINAGE AREA.--3.42 mi².

PERIOD OF RECORD.--March 1986 to August 1996, and April 1998 to current year.

REMARKS.--Lake sampled near center at the deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 20 TO JUNE 11, 2003 (Milligrams per liter unless otherwise indicated)

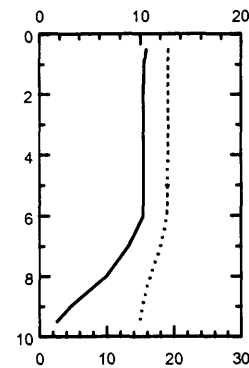
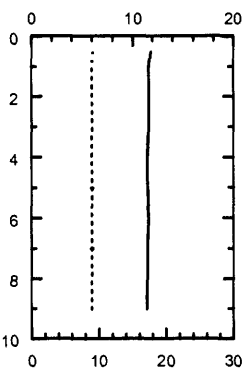
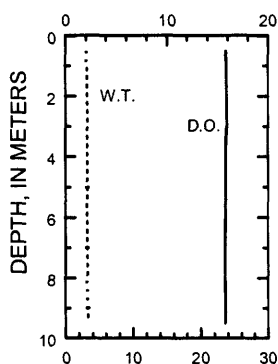
	Feb-20		Apr-18		Jun-11	
	8.3		9.86		9.92	
Lake stage (ft)	--		3.3		2.7	
Secchi-depth (m)						
Depth of sample (m)	0.5	9.5	0.5	9	0.5	9.5
Chlorophyll a, phytoplankton (µg/L)	--	--	2.38	--	6.37	--
Water temperature (°C)	3.1	3.3	9.1	9	19.1	14.9
Specific conductance (µS/cm)	513	510	488	490	490	506
pH (units)	8	8.3	8.1	8.2	8.3	7.4
Dissolved oxygen (mg/L)	15.8	15.7	11.8	11.4	10.6	1.7
Phosphorus, total (as P)	0.005	0.006	0.010	0.014	0.017	0.033
Phosphorus, ortho, dissolved (as P)	--	--	0.002	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	0.022	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.013	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.31	--	--	--
Nitrogen, total (as N)	--	--	0.33	--	--	--
Color (Pt-Co. scale)	--	--	5	--	--	--
Turbidity (NTU)	--	--	<1.0	--	--	--
Hardness, as CaCO ₃	--	--	213	--	--	--
Calcium, dissolved (Ca)	--	--	33	--	--	--
Magnesium, dissolved (Mg)	--	--	31.7	--	--	--
Sodium, dissolved (Na)	--	--	16.9	--	--	--
Potassium, dissolved (K)	--	--	2.00	--	--	--
Alkalinity, as CaCO ₃	--	--	169	--	--	--
Sulfate, dissolved (SO ₄)	--	--	28.7	--	--	--
Chloride, dissolved (Cl)	--	--	40.1	--	--	--
Silica, dissolved (SiO ₂)	--	--	4.74	--	--	--
Solids, dissolved, at 180°C	--	--	290	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	100	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	1	--	--	--

2-20-03

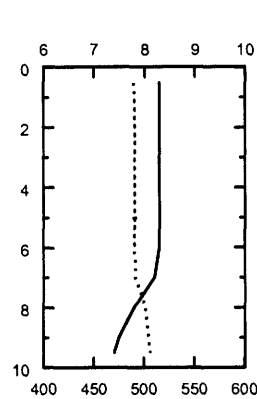
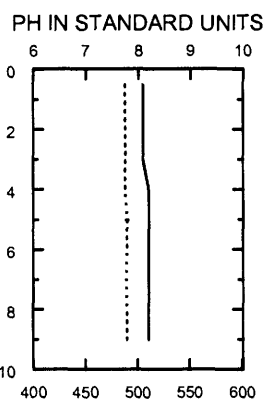
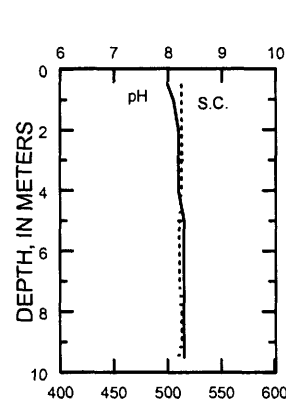
4-18-03

6-11-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

423246088175800 POWERS LAKE AT POWERS LAKE, WI--CONTINUED

WATER-QUALITY DATA, JULY 9 TO SEPTEMBER 25, 2003
(Milligrams per liter unless otherwise indicated)

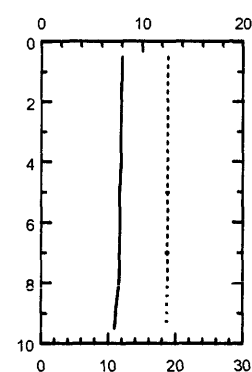
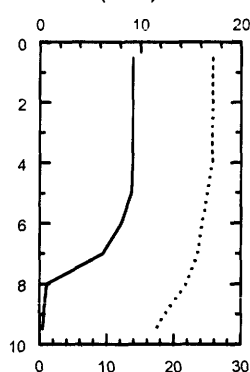
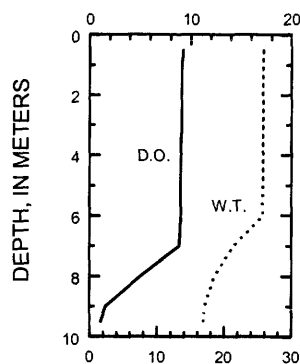
	Jul-9		Aug-20		Sep-25
Lake stage (ft)	9.86		9.64		9.28
Secchi-depth (m)	2.7		3.1		2.2
Depth of sample (m)	0.5	9.5	0.5	9.5	0.5
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	4.04	--	2.88	2.97	9.44
Water temperature ($^{\circ}\text{C}$)	25.8	16.9	25.8	25.8	18.8
Specific conductance ($\mu\text{S/cm}$)	477	508	478	478	496
pH (units)	8.1	7.3	8.2	8.2	8.1
Dissolved oxygen (mg/L)	9.2	1.1	9.2	9.2	8
Phosphorus, total (as P)	0.007	0.028	0.013	0.013	0.018
Phosphorus, ortho, dissolved (as P)	0.002	--	--	--	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	0.022	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	0.026	--	--	--	--
Nitrogen, amm. + org., total (as N)	0.67	--	--	--	--
Nitrogen, total (as N)	0.69	--	--	--	--

7-9-03

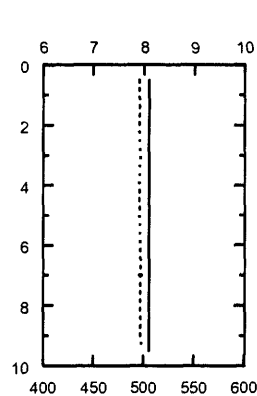
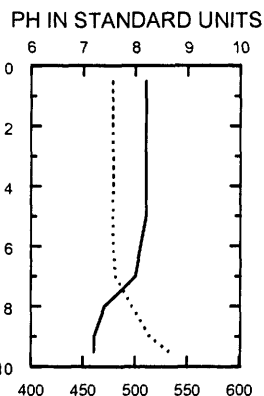
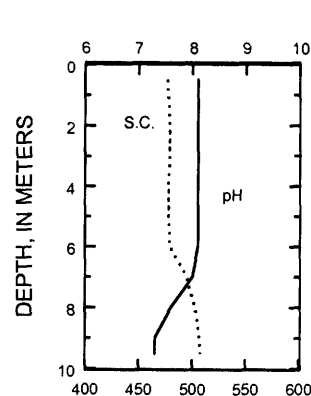
8-20-03

9-25-03

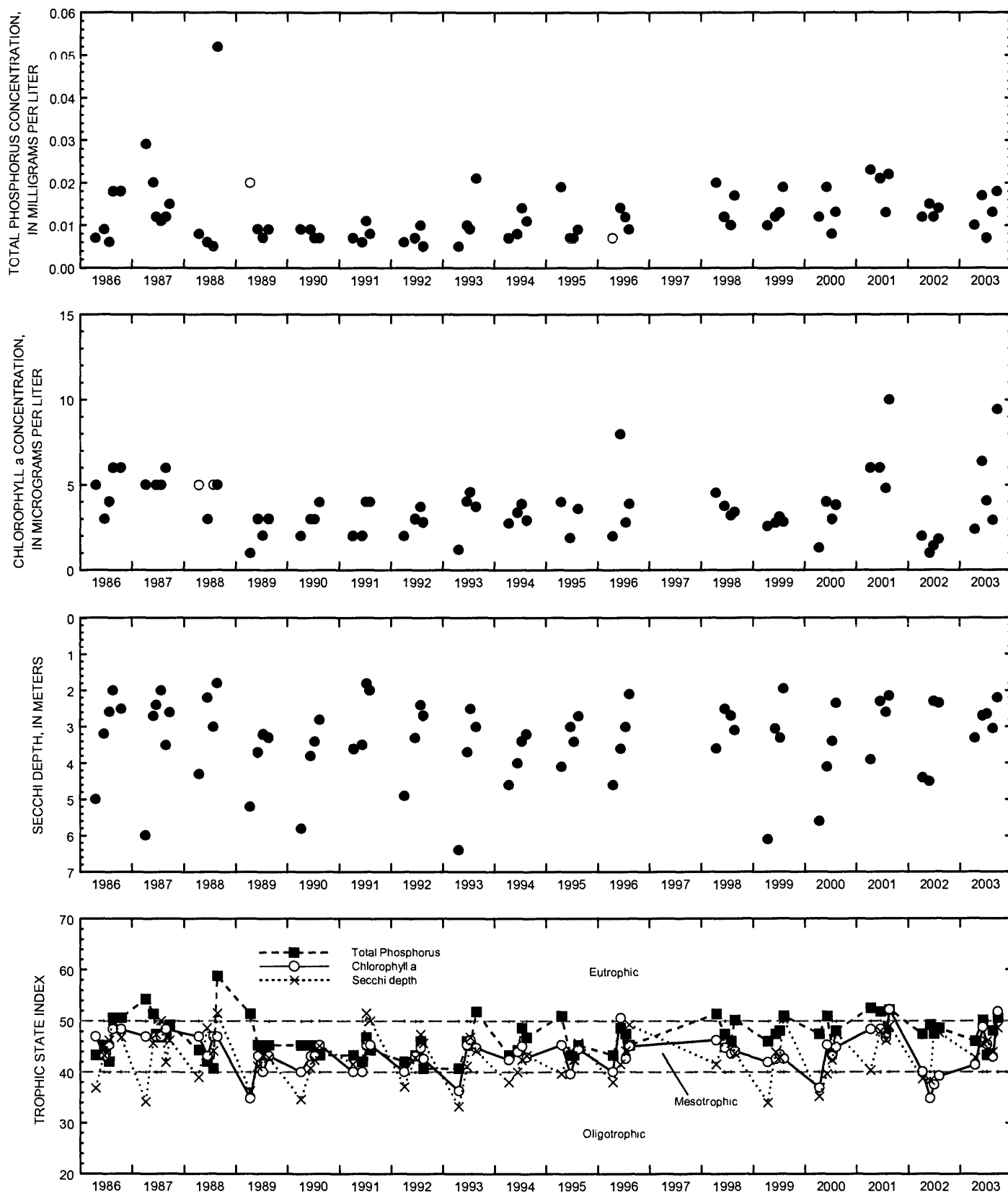
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths,
and TSI data for Powers Lake, at Powers Lake, Wisconsin.

(Circles on the first two plots indicate laboratory detection limit for selected analyses.
Actual concentrations for these particular analyses are less than the plotted circles.)

455034091493300 SPOONER LAKE, AT DEEP HOLE, NEAR SPOONER, WI

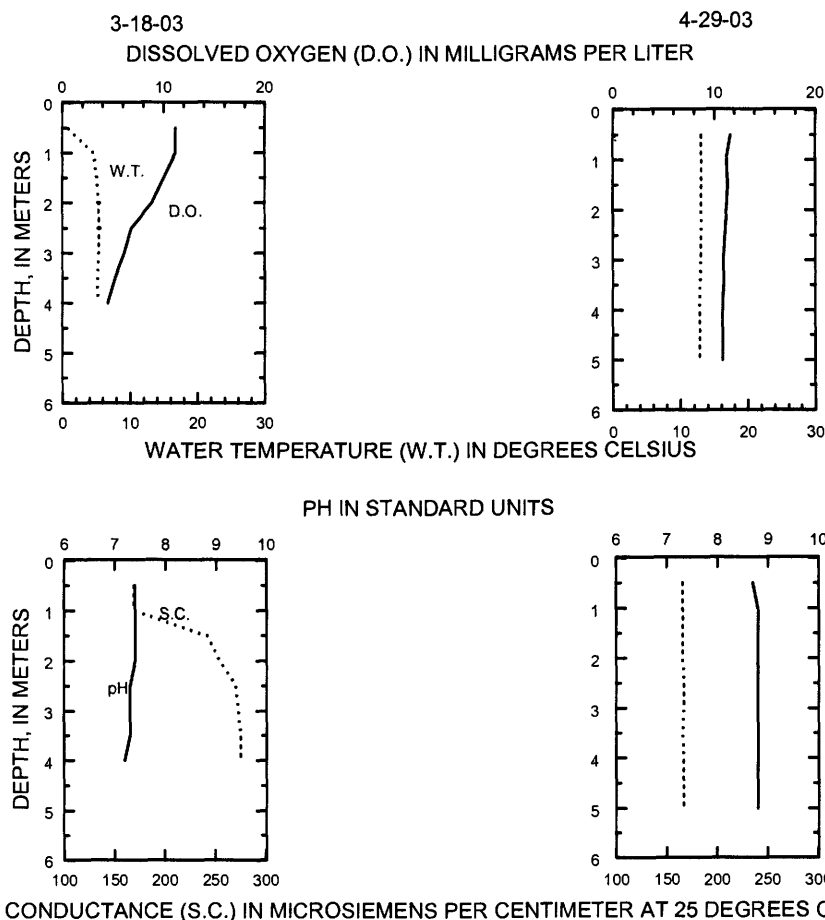
LOCATION.--Lat 45°50'34", long 91°49'33", in NE 1/4 NE 1/4 sec.27, T.39 N., R.12 W., Washburn County, Hydrologic Unit 07030001, near Spooner.

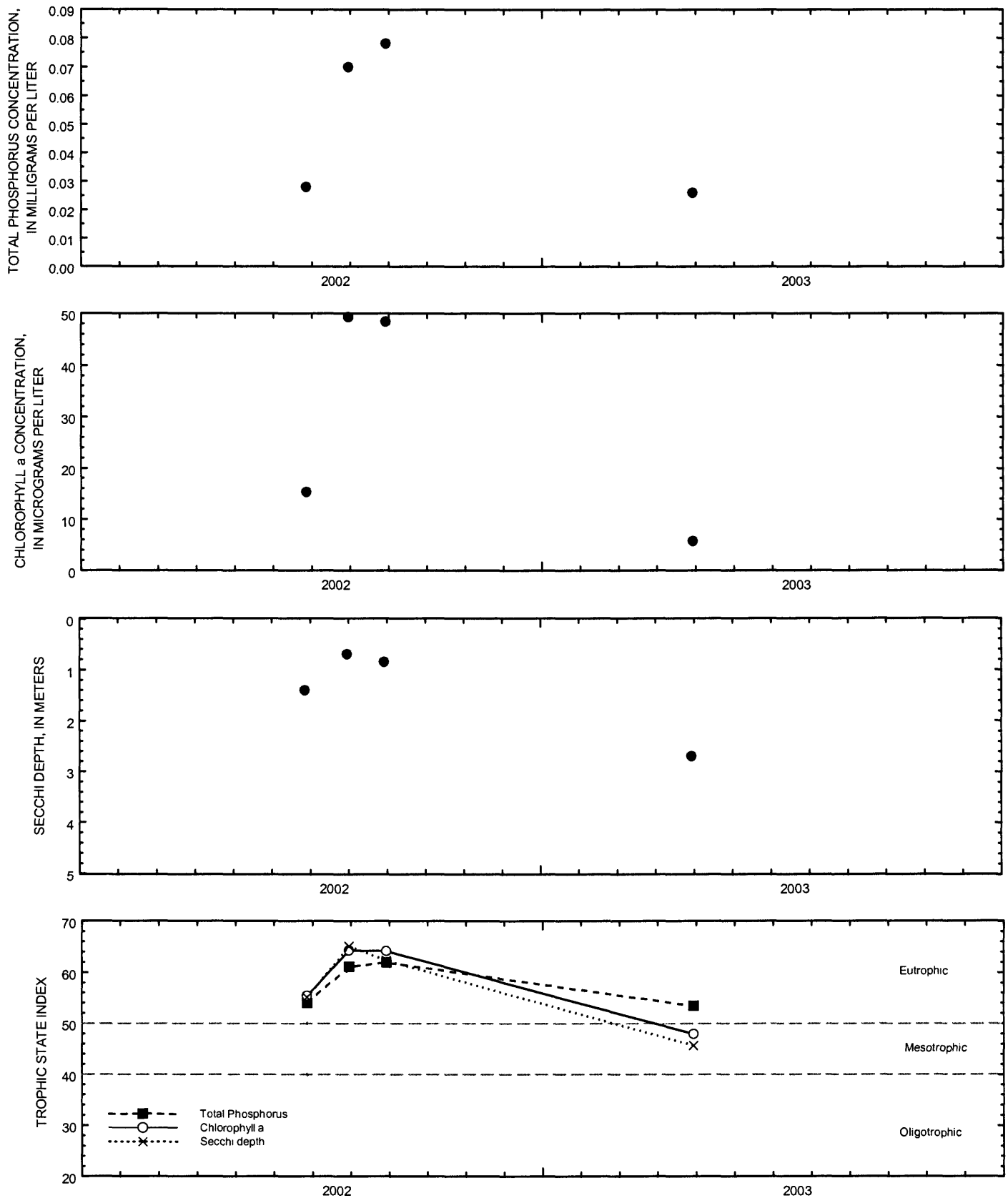
PERIOD OF RECORD.--June 2002 to current year.

REMARKS.--Lake sampled at deepest hole. Lake ice-covered during March sampling. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MARCH 18 TO APRIL 29, 2003 (Milligrams per liter unless otherwise indicated)

	Mar-18		Apr-29	
	6.75		6.88	
	--		2.7	
Lake stage (ft)				
Secchi-depth (m)				
Depth of sample (m)	0.5	4	0.5	4.5
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	--	--	5.68	--
Water temperature ($^{\circ}\text{C}$)	0.8	5.3	13.1	12.8
Specific conductance ($\mu\text{S/cm}$)	169	275	166	167
pH	7.4	7.2	8.7	8.8
Dissolved oxygen (mg/L)	11.2	4.5	11.6	10.8
Phosphorus, total (as P)	0.042	0.037	0.026	0.021
Phosphorus, ortho, dissolved (as P)	--	--	0.003	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	--	--	0.02	--
Nitrogen, ammonia, dissolved (as N)	--	--	<.013	--
Nitrogen, amm. + diss., total (as N)	--	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.39	--
Nitrogen, total (as N)	--	--	0.41	--
Color (Pt-Co. scale)	--	--	5	--
Turbidity (NTU)	--	--	4.2	--
Hardness, as CaCO_3	--	--	84	--
Calcium, dissolved (Ca)	--	--	23.6	--
Magnesium, dissolved (Mg)	--	--	6.2	--
Sodium, dissolved (Na)	--	--	2.4	--
Potassium, dissolved (K)	--	--	<1.00	--
Alkalinity, as CaCO_3	--	--	82	--
Sulfate, dissolved (SO_4)	--	--	<4.5	--
Chloride, dissolved (Cl)	--	--	2.4	--
Silica, dissolved (SiO_2)	--	--	8.76	--
Solids, dissolved, at 180°C	--	--	102	--
Iron, dissolved (Fe) ($\mu\text{g/L}$)	--	--	<100	--
Manganese, dissolved, (Mn) ($\mu\text{g/L}$)	--	--	<1	--





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Spooner Lake, Deep Hole, near Spooner, Wisconsin.

454945091483900 SPOONER LAKE, SOUTHEAST SITE, NEAR SPOONER, WI

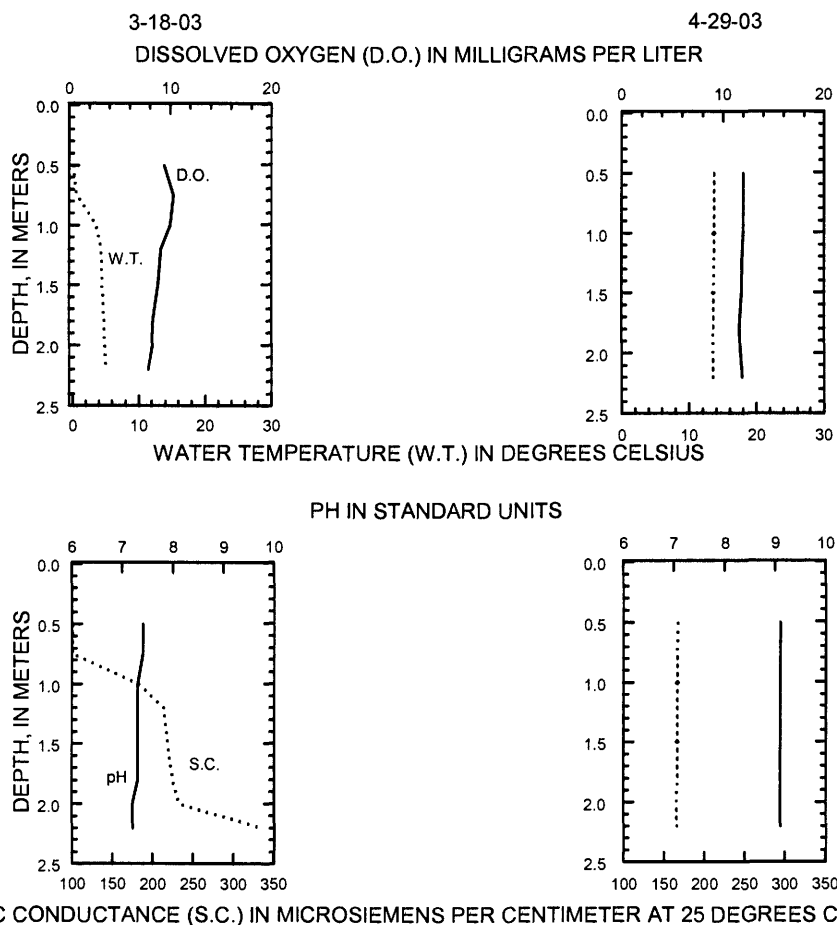
LOCATION.--Lat 45°49'45", long 91°48'39", in SW 1/4 SE 1/4 sec.26, T.39 N., R.12 W., Washburn County, Hydrologic Unit 07030001, near Spooner.

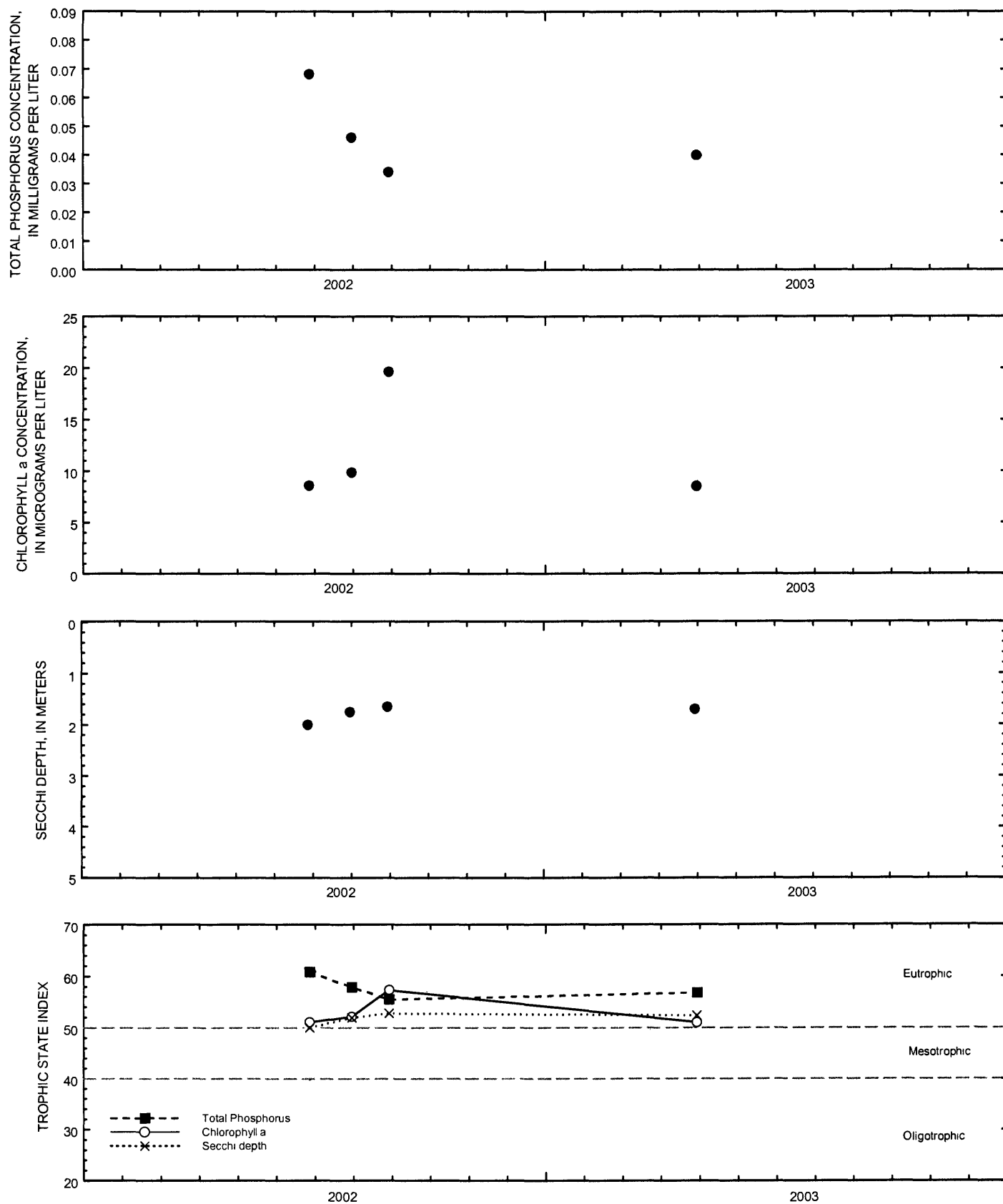
PERIOD OF RECORD.--June 2002 to current year.

REMARKS.--Lake sampled at deepest hole. Lake ice-covered during March sampling. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, MARCH 18 TO APRIL 29, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Mar-18</u>	<u>Apr-29</u>
Lake stage (ft)	6.75	6.88
Secchi-depth (m)	--	1.7
Depth of sample (m)	0.5	0.75
Chlorophyll a, phytoplankton (µg/L)	--	8.52
Water temperature (°C)	0.2	13.7
Specific conductance (µS/cm)	101	167
pH	7.4	9.1
Dissolved oxygen (mg/L)	9.4	12
Phosphorus, total (as P)	0.056	0.04





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Spooner Lake, Southeast Site, near Spooner, Wisconsin.

424854088123300 TICHIGAN LAKE NEAR WATERFORD, WI

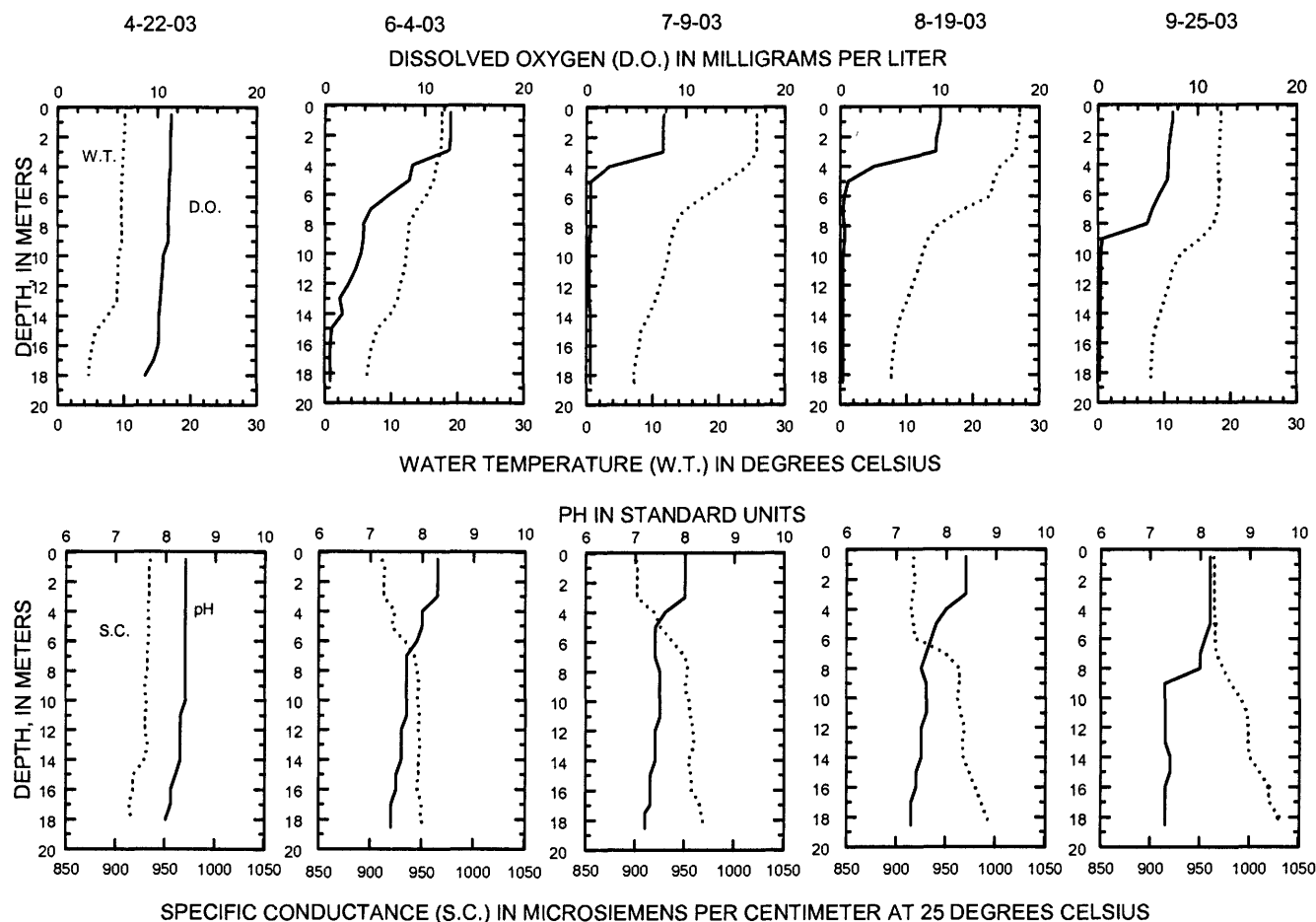
LOCATION.--Lat 42°48'54", long 88°12'33", in se 1/4 SE 1/4 sec.11, T.4 N., R.19 E., Racine County, Hydrologic Unit 07120006, 3.5 mi north of Waterford.

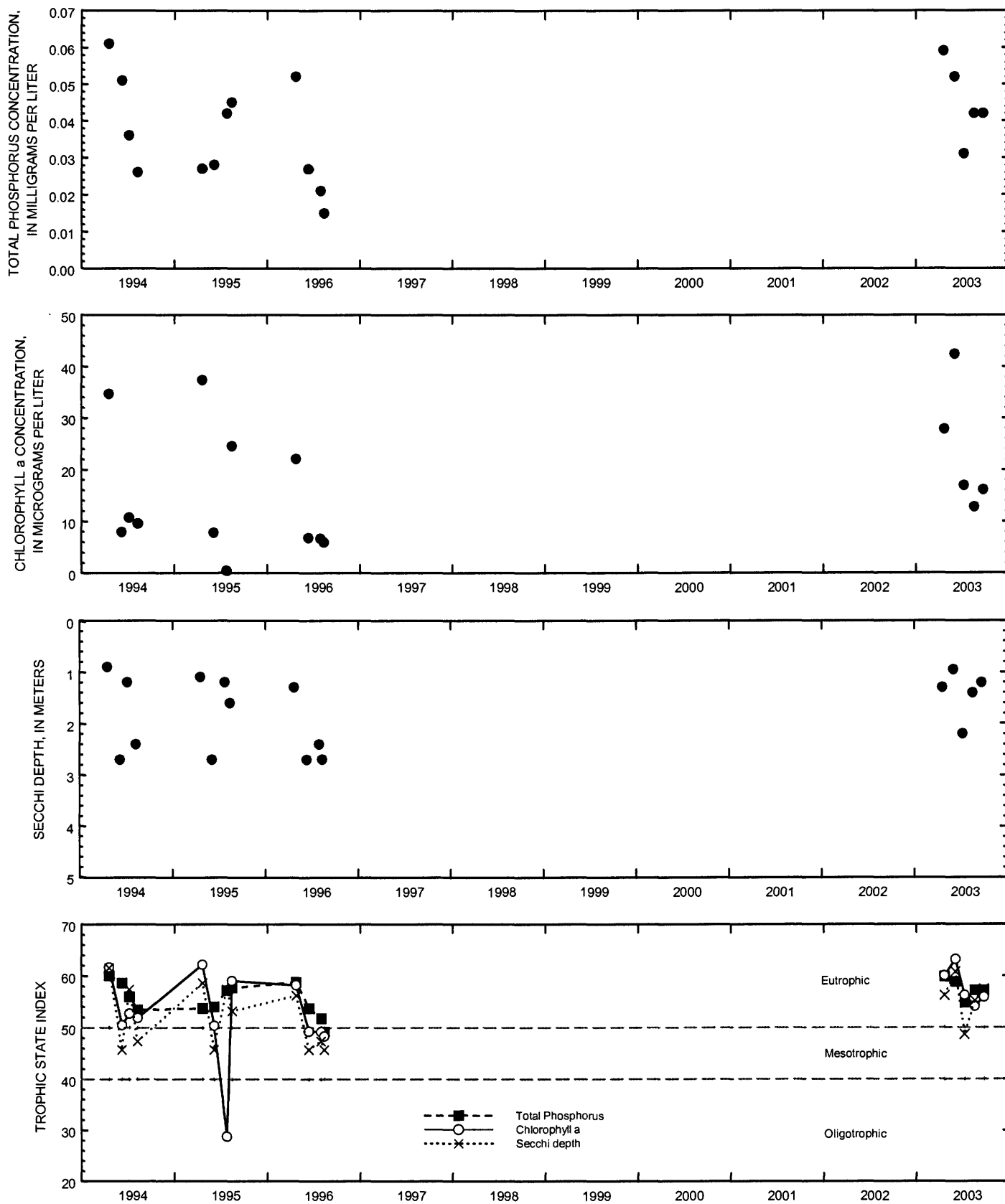
PERIOD OF RECORD.--March 1994 to August 1996, April to September 2003.

REMARKS.--Lake sampled near center at the deep hole. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, APRIL 22 TO SEPTEMBER 25, 2003 (Milligrams per liter unless otherwise indicated)

	Apr-22		Jun-4		Jul-9		Aug-19		Sep-25	
Lake stage (ft)	1.58		1.62		1.62		1.24		1.2	
Secchi-depth (m)	1.3		0.95		2.2		1.4		1.2	
Depth of sample (m)	0.5	18	0.5	18.5	0.5	18.5	0.5	18.5	0.5	18.5
Chlorophyll a, phytoplankton (µg/L)	27.8	--	42.4	--	16.9	--	12.8	--	16.1	--
Water temperature (°C)	10.1	4.8	17.6	6.3	25.7	7.2	27	7.7	18.5	8
Specific conductance (µS/cm)	935	916	911	953	901	968	918	995	964	1030
pH	8.4	8	8.3	7.4	8	7.2	8.4	7.3	8.2	7.3
Dissolved oxygen (mg/L)	11.4	8.8	12.6	0.6	7.8	0.4	10	0.3	7.5	0.2
Phosphorus, total (as P)	0.059	0.049	0.052	0.401	0.031	0.544	0.042	0.757	0.042	0.842





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Tichigan Lake, near Waterford, Wisconsin.

435430089350700 TWIN LAKES, EAST TWIN LAKE, NEAR WESTFIELD, WI

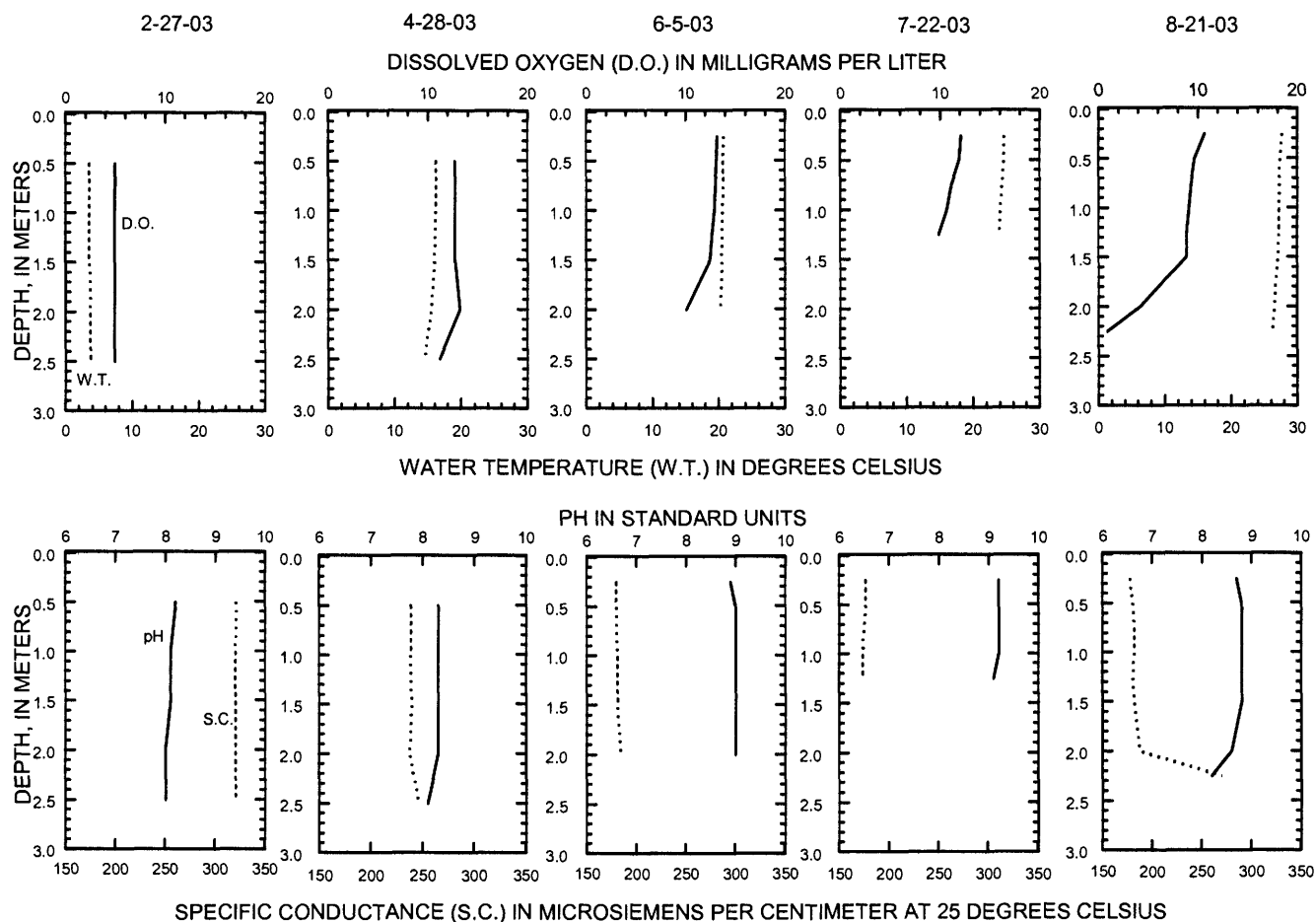
LOCATION.--Lat 43°54'30", long 89°35'07", in NE 1/4 NE 1/4 sec.3, T.17 N., R.8 E., Marquette County, Hydrologic Unit 04030201, near Westfield.

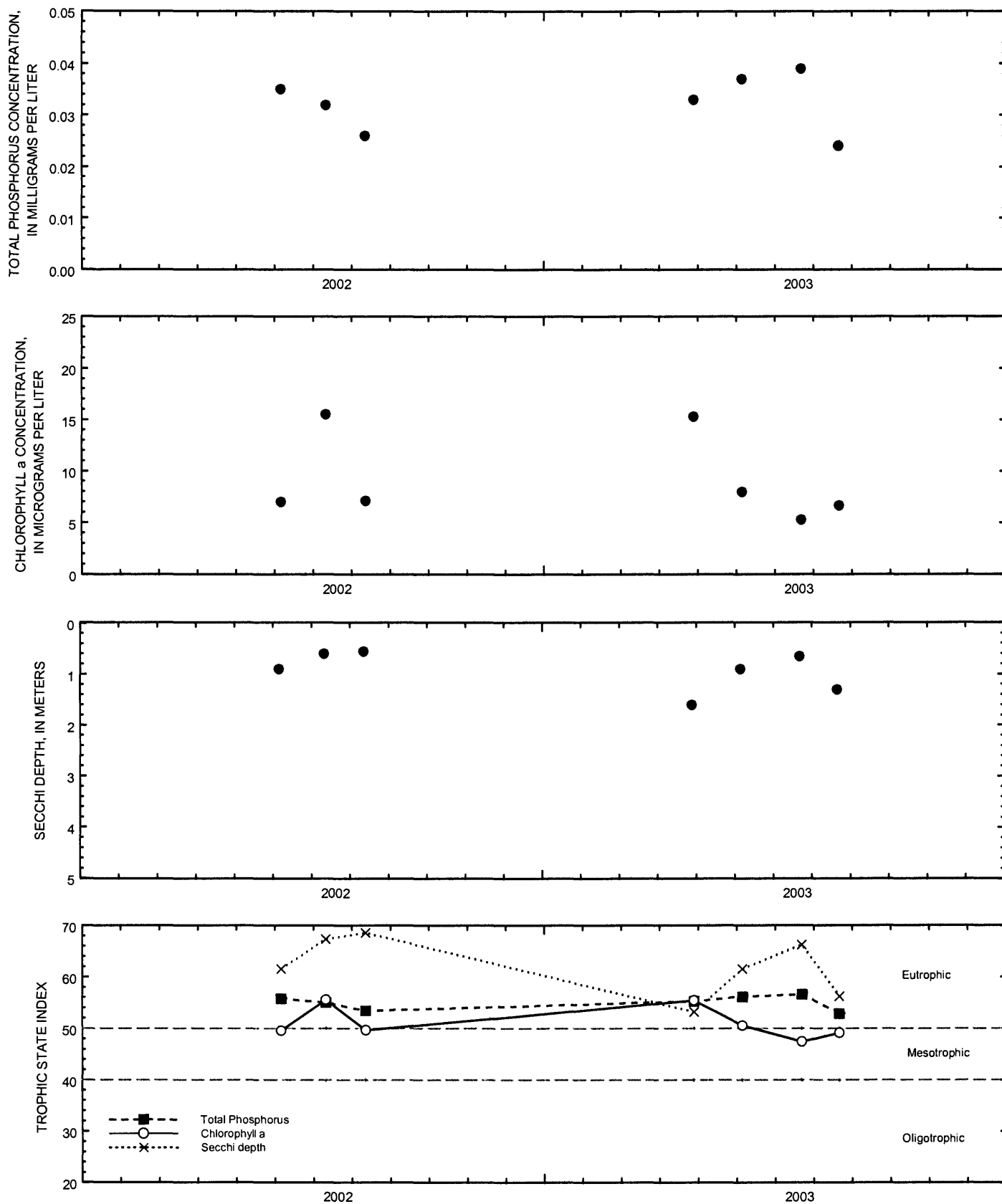
PERIOD OF RECORD.--June 2002 current year.

REMARKS.--Lake sampled at deepest hole. Lake ice-covered during February sampling. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 27 TO AUGUST 21, 2003
(Milligrams per liter unless otherwise indicated)

	<u>Feb-27</u>		<u>Apr-28</u>		<u>Jun-5</u>		<u>Jul-22</u>		<u>Aug-21</u>
Lake stage (ft)	--		10.03		9.88		9.57		9.18
Secchi-depth (m)	--		1.6		0.9		0.65		1.3
Depth of sample (m)	0.5	2.5	0.5	2.5	0.5	0.5	0.5	0.5	0.5
Chlorophyll a, phytoplankton (µg/L)	--	--	15.3	--	7.99		5.31		6.65
Water temperature (°C)	3.6	3.8	16.2	14.5	20.8		24.7		27.7
Specific conductance (µS/cm)	322	321	239	247	180		177		178
pH	8.2	8	8.3	8.1	8.9		9.2		8.7
Dissolved oxygen (mg/L)	5	4.9	12.7	11.2	13.2		12.1		10.7
Phosphorus, total (as P)	0.013	0.013	0.033	0.031	0.037		0.039		0.024





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Twin Lakes, East Twin Lake, near Westfield, Wisconsin.

435438089352300 TWIN LAKES, WEST TWIN LAKE, NEAR WESTFIELD, WI

LOCATION.--Lat 43°54'38", long 89°35'23", in SW 1/4 SE 1/4 sec.30, T.17 N., R.8 E., Marquette County, Hydrologic Unit 04030201, near Westfield.

PERIOD OF RECORD.--June 2002 to current year.

REMARKS.--Lake sampled at deepest hole. Lake ice-covered during February sampling. Water-quality analyses by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 27 TO AUGUST 21, 2003 (Milligrams per liter unless otherwise indicated)

	Feb-27		Apr-28		Jun-5		Jul-22		Aug-21	
Lake stage (ft)	--	--	10.031	1.4	9.881	0.8	9.57	1.35	9.18	2.1
Secchi-depth (m)	--	--	--	--	--	--	--	--	--	--
Depth of sample (m)	0.5	8.5	0.5	8.5	0.5	8	0.5	3.5	8	0.5
Chlorophyll a, phytoplankton (µg/L)	--	--	9.53	--	--	--	4.67	--	--	3.59
Water temperature (°C)	3.5	5.3	15.4	5.6	19.9	5.9	24.6	18.2	6.4	27.1
Specific conductance (µS/cm)	342	436	309	471	234	490	233	261	585	245
pH	8.1	7.5	8.3	6.9	8.6	7.1	8.6	8.5	7.1	8.5
Dissolved oxygen (mg/L)	8.9	0.8	12.1	0.7	12.6	0.6	11.4	>20.0	0.5	9.8
Phosphorus, total (as P)	0.023	0.062	0.029	0.275	0.032	0.089	0.022	0.033	0.122	0.016
Phosphorus, ortho, dissolved (as P)	--	--	<0.002	--	--	--	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	--	--	0.34	--	--	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.271	--	--	--	--	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.86	--	--	--	--	--	--	--
Nitrogen, total (as N)	--	--	1.2	--	--	--	--	--	--	--
Color (Pt-Co. scale)	--	--	10	--	--	--	--	--	--	--
Turbidity (NTU)	--	--	2.6	--	--	--	--	--	--	--
Hardness, as CaCO ₃	--	--	160	--	--	--	--	--	--	--
Calcium, dissolved (Ca)	--	--	33.7	--	--	--	--	--	--	--
Magnesium, dissolved (Mg)	--	--	19.1	--	--	--	--	--	--	--
Sodium, dissolved (Na)	--	--	1.3	--	--	--	--	--	--	--
Potassium, dissolved (K)	--	--	<1.00	--	--	--	--	--	--	--
Alkalinity, as CaCO ₃	--	--	150	--	--	--	--	--	--	--
Sulfate, dissolved (SO ₄)	--	--	5.4	--	--	--	--	--	--	--
Chloride, dissolved (Cl)	--	--	3.8	--	--	--	--	--	--	--
Silica, dissolved (SiO ₂)	--	--	1.96	--	--	--	--	--	--	--
Solids, dissolved, at 180°C	--	--	168	--	--	--	--	--	--	--
Iron, dissolved (Fe) (µg/L)	--	--	<100	--	--	--	--	--	--	--
Manganese, dissolved, (Mn) (µg/L)	--	--	<1	--	--	--	--	--	--	--

2-27-03

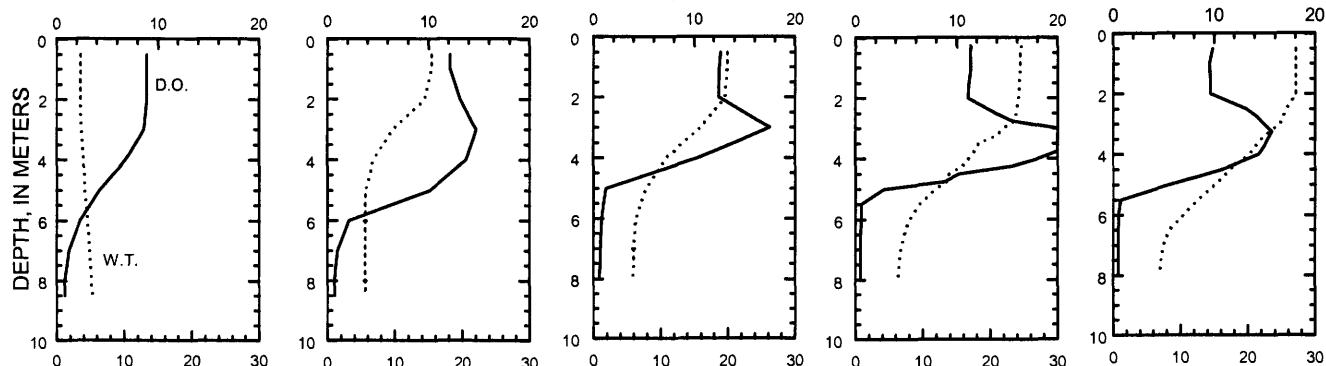
4-28-03

6-5-03

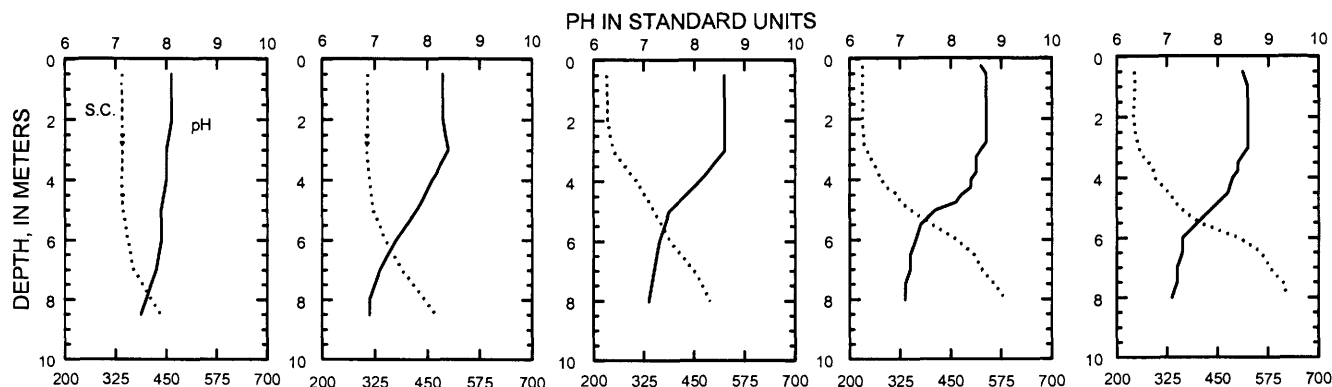
7-22-03

8-21-03

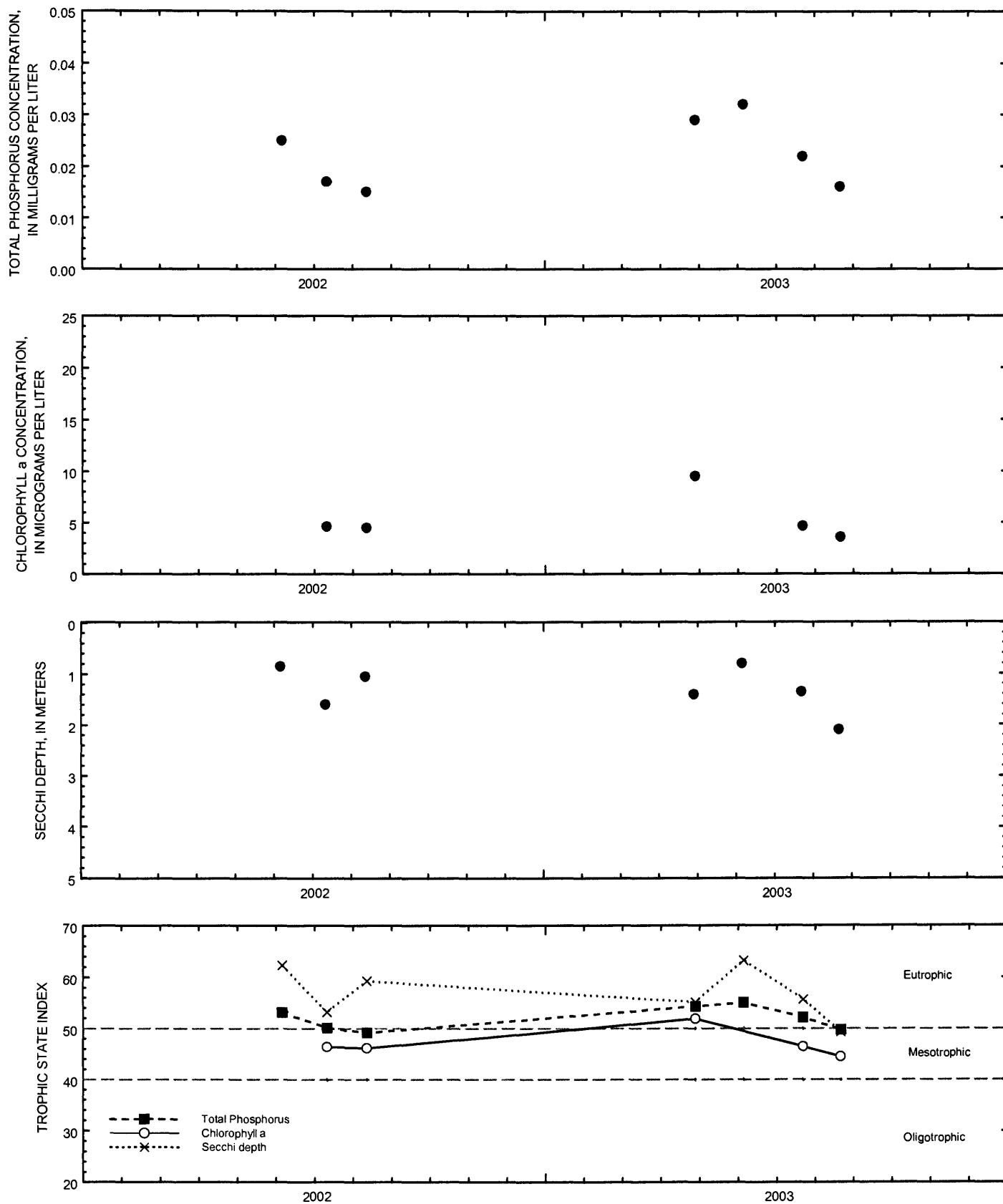
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Twin Lakes, West Twin Lake, near Westfield, Wisconsin.

424614088123600 WATERFORD WATERWAY, FOX RIVER SITE, NEAR WATERFORD, WI

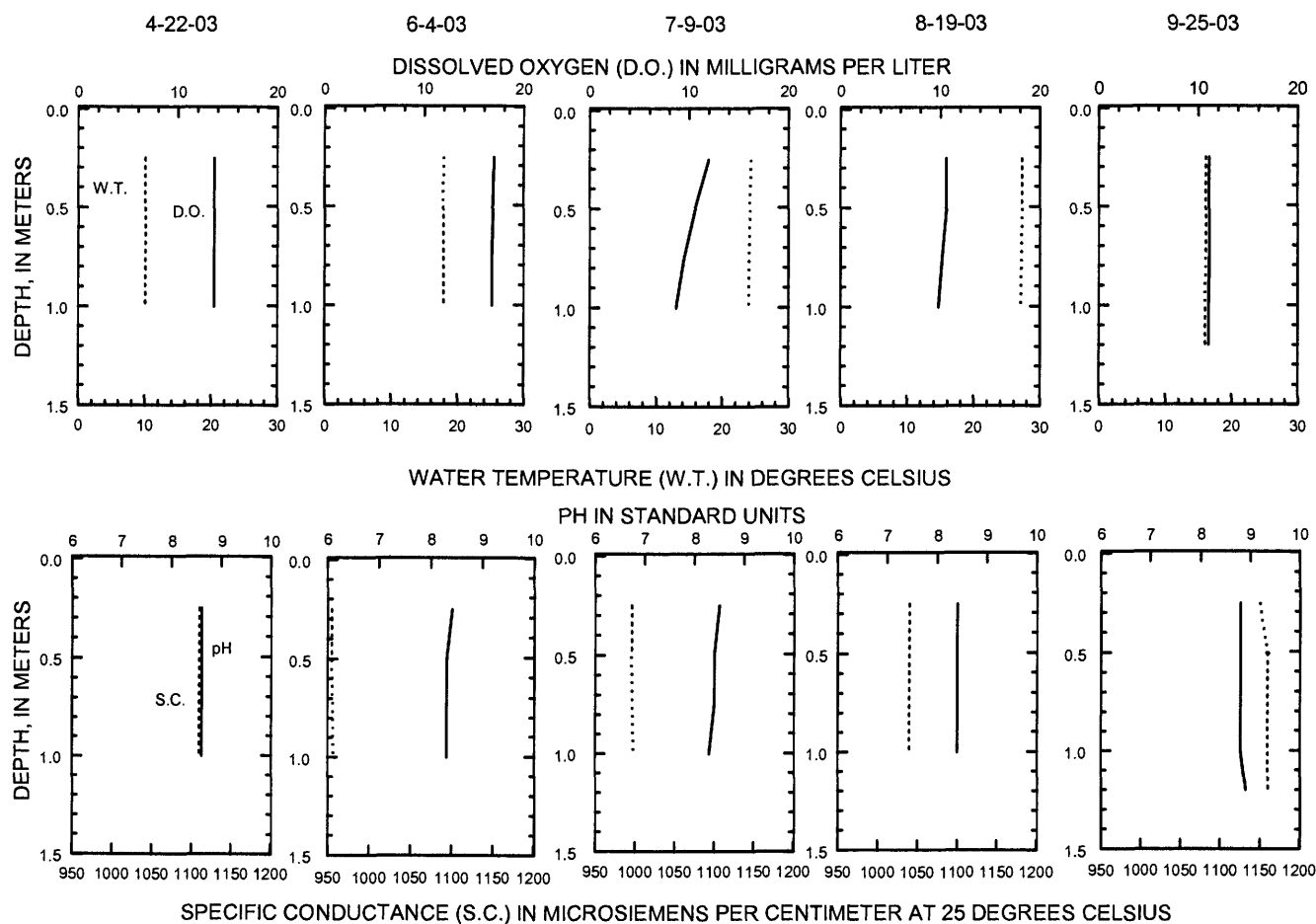
LOCATION.--Lat 42°46'14", long 88°12'36", in NE 1/4 NE 1/4 NE 1/4 sec.35, T.4 N., R.19 E., Racine County, Hydrologic Unit 07120006, near Waterford.

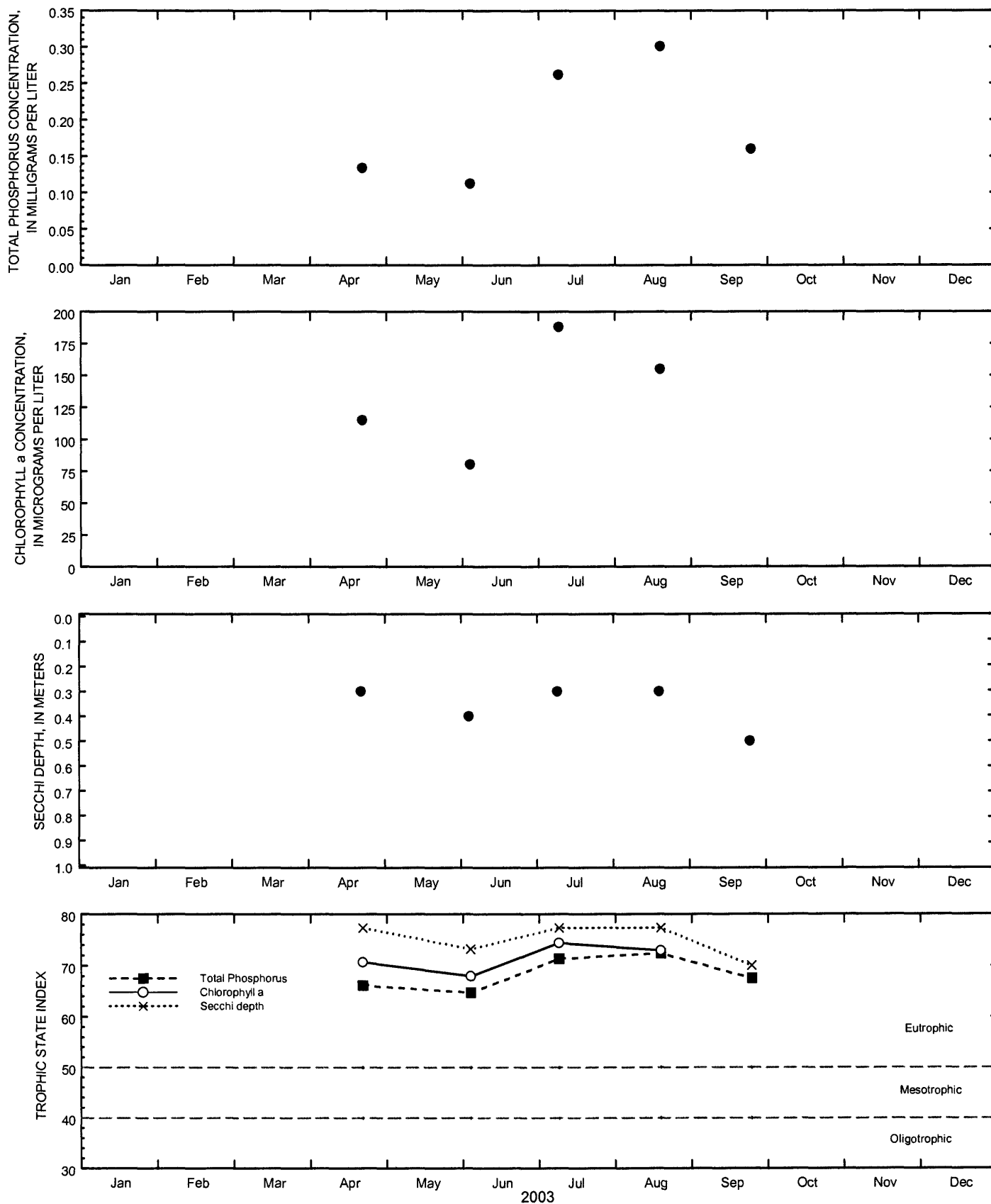
PERIOD OF RECORD.--April to September 2003.

REMARKS.--Lake sampled at Fox River site. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, APRIL 22 TO SEPTEMBER 25, 2003 (Milligrams per liter unless otherwise indicated)

	Apr-22		Jun-4		Jul-9		Aug-19		Sep-25
Lake stage (ft)	1.58		1.62		1.62		1.24		1.2
Secchi-depth (m)	0.3		0.4		0.3		0.3		0.2
Depth of sample (m)	0.5	1	0.5	1	0.5	1	0.5	1	0.5
Chlorophyll a, phytoplankton (µg/L)	115	--	80.4	--	188	--	155	--	--
Water temperature (°C)	10.1	10.1	18	17.9	24.4	24	27.3	27.1	16.1
Specific conductance (µS/cm)	1110	1110	955	957	996	998	1040	1040	1150
pH	8.6	8.6	8.4	8.3	8.5	8.3	8.4	8.4	8.8
Dissolved oxygen (mg/L)	13.6	13.6	17	16.6	12	8.7	10.6	9.8	11.1
Phosphorus, total (as P)	0.134	0.132	0.112	0.116	0.262	0.21	0.301	0.299	0.16





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Waterford Waterway, Fox River Site, near Waterford, Wisconsin.

441710090425200 WAZEE LAKE BEACH NEAR BLACK RIVER FALLS, WI

LOCATION.--Lat 44°17'10", long 90°42'52", in SE 1/4 NW 1/4 sec.23, T.21 N., R.3 W., Jackson County, Hydrologic Unit 07040007.

PERIOD OF RECORD.--June to September 2003.

REMARKS.--Total phosphorus analyses done by the USGS National Water Quality Laboratory. All other analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, JUNE 1 TO SEPTEMBER 23, 2003

(Milligrams per liter unless otherwise indicated)

	<u>Jun-1</u>	<u>Jul-9</u>	<u>Aug-19</u>	<u>Sep-23</u>
Lake stage (ft)	--	--	4.22	4.01
Secchi-depth (m)	--	--	--	--
Depth of sample (m)	0.5	0.5	0.5	0.5
Phosphorus, total (as P)	0.002	0.006	0.005	E.003
Phosphorus, ortho, dissolved (as P)	<.002	<.002	<.002	<.002
Nitrogen, NO ₂ + NO ₃ , diss. (as N)	0.209	--	--	--
Nitrogen, ammonia, dissolved (as N)	0.017	0.037	<.013	<.013
Nitrogen, amm. + org., total (as N)	<.14	--	--	--

441730090432900 WAZEE LAKE AT DEEP HOLE NEAR BLACK RIVER FALLS, WI

LOCATION.--Lat 44°17'30", long 90°43'29", in SE 1/4 SE 1/4 sec.15, T.21 N., R.3 W., Jackson County, Hydrologic Unit 07040007, 7.0 mi east of Black River Falls.

PERIOD OF RECORD.--November 1999 to current year.

REMARKS.--Date published under station number 441721090431700 in water year 2000. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, DECEMBER 5, 2002 TO MARCH 7, 2003

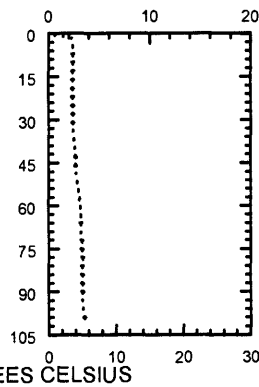
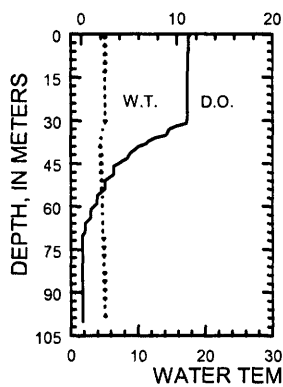
(Milligrams per liter unless otherwise indicated)

	<u>Dec-5</u>		<u>Mar-7</u>		
Lake stage (ft)	4.82		--		
Secchi-depth (m)	12.8		11.4		
Chlorophyll a, phytoplankton (µg/L)	0.67		--		
Depth of sample (m)	0.5	38	0.5	45	85
Water temperature (°C)	5.1	4.4	0.8	4	5
Specific conductance (µS/cm)	231	244	271	262	304
pH	--	--	7.6	7.2	7.1
Dissolved oxygen (mg/L)	11.3	6.8	--	--	--
Phosphorus, total (as P)	<.004	<.004	E.002	<.004	0.018

12-5-02

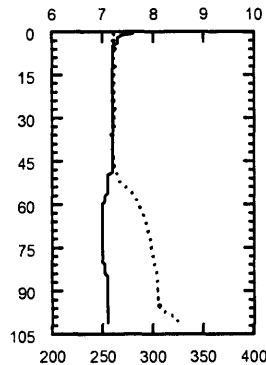
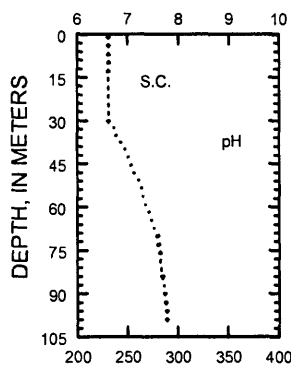
3-7-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

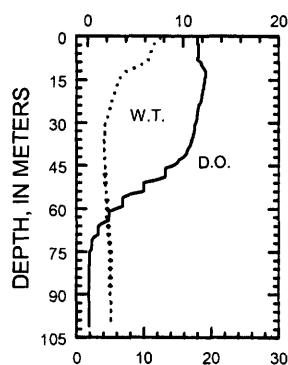
441730090432900 WAZEE LAKE AT DEEP HOLE NEAR BLACK RIVER FALLS, WI--CONTINUED

WATER-QUALITY DATA, MAY 16 TO JUNE 23, 2003

(Milligrams per liter unless otherwise indicated)

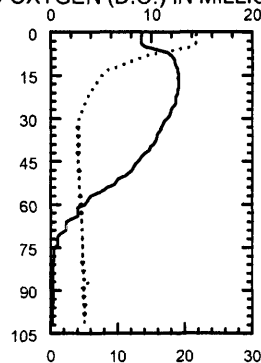
	May-16	Jun-23	Jul-1	Jul-9	Jul-23
Lake stage (ft)	4.92	4.85	--	--	4.72
Secchi-depth (m)	14.3	11.9	--	--	10.4
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	<.260	0.32	--	--	0.54
Depth of sample (m)	0.5	85	0.5	0.5	0.5
Water temperature ($^{\circ}\text{C}$)	12.6	4.1	5	21.7	4.9
Specific conductance ($\mu\text{S/cm}$)	241	247	299	242	303
pH	8	7.6	7.5	7.2	6.9
Dissolved oxygen (mg/L)	11.5	10.4	0.1	9.1	0.3
Phosphorus, total (as P)	E.003	E.003	0.018	E.003	0.013
Phosphorus, ortho, dissolved (as P)	<.002	--	--	0.002	0.008
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	0.249	--	--	<.002	<.002
Nitrogen, ammonia, dissolved (as N)	<.013	--	--	0.234	--
Nitrogen, amm. + org., total (as N)	0.54	--	--	0.014	0.021
Nitrogen, total (as N)	0.79	--	--	<.14	--
Color (Pt-Co. scale)	5	--	--	--	--
Turbidity (NTU)	<1.0	--	--	--	--
Hardness, as CaCO_3	110	--	--	--	--
Calcium, dissolved (Ca)	27.7	--	--	--	--
Magnesium, dissolved (Mg)	9.4	--	--	--	--
Sodium, dissolved (Na)	2.1	--	--	--	--
Potassium, dissolved (K)	5	--	--	--	--
Alkalinity, as CaCO_3	63	--	--	--	--
Sulfate, dissolved (SO_4)	56.7	--	--	--	--
Chloride, dissolved (Cl)	1.8	--	--	--	--
Silica, dissolved (SiO_2)	1.14	--	--	--	--
Solids, dissolved, at 180°C	140	--	--	--	--
Iron, dissolved (Fe) ($\mu\text{g/L}$)	<100	--	--	--	--
Manganese, dissolved, (Mn) ($\mu\text{g/L}$)	<1	--	--	--	--

5-16-03

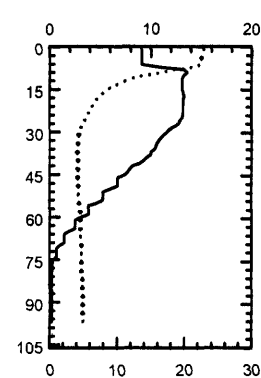


6-23-03

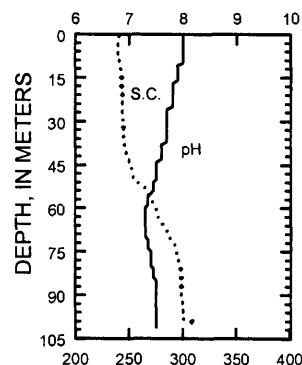
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



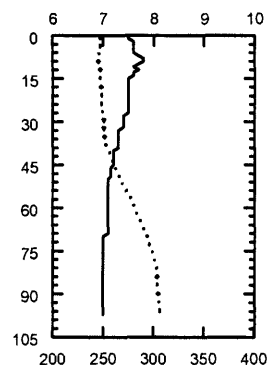
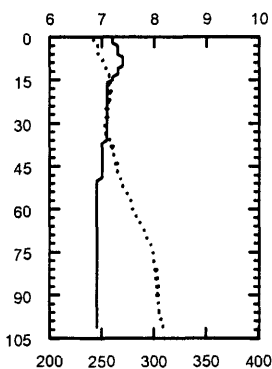
7-23-03



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



PH IN STANDARD UNITS

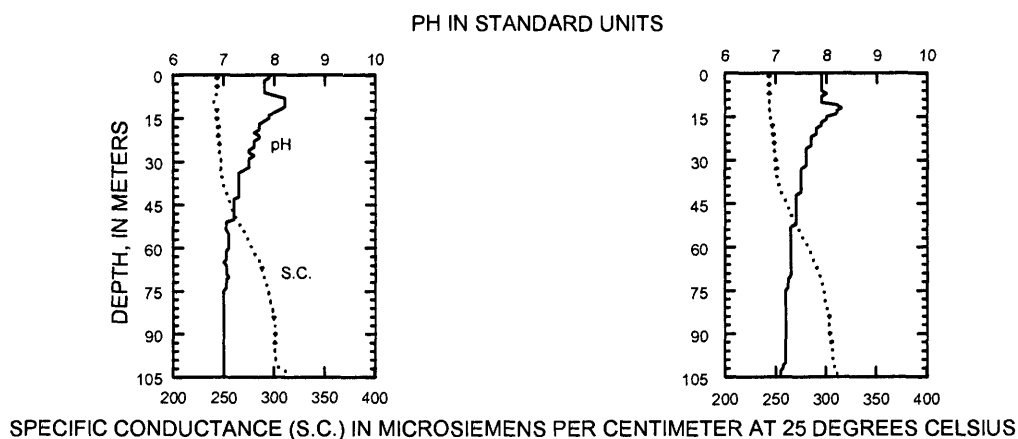
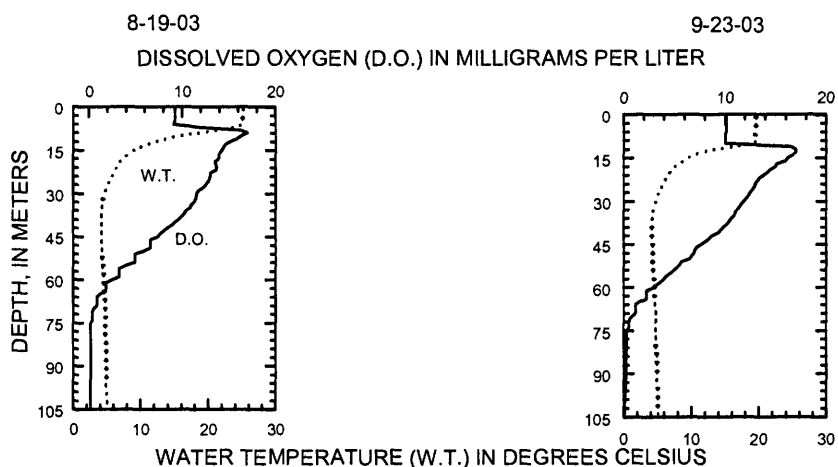


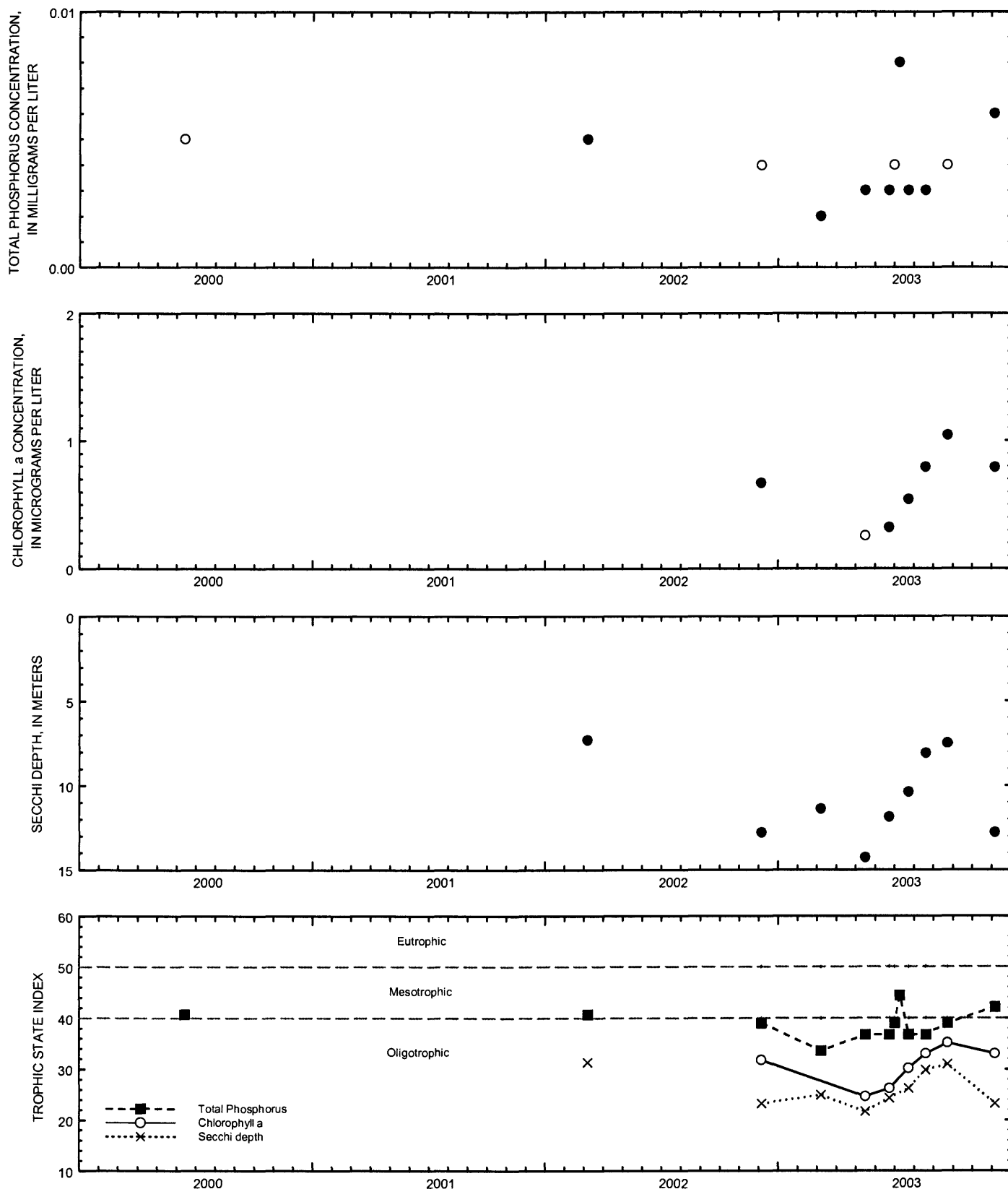
SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

441730090432900 WAZEE LAKE AT DEEP HOLE NEAR BLACK RIVER FALLS, WI--CONTINUED

WATER-QUALITY DATA, AUGUST 19 TO SEPTEMBER 23, 2003
(Milligrams per liter unless otherwise indicated)

		Aug-19				Sep-23		
Lake stage (ft)		4.22				4.01		
Secchi-depth (m)		8.1				7.5		
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	0.79	1.73	--	--		1.04		
Depth of sample (m)	0.5	9	38	85	0.5	11	40	85
Water temperature ($^{\circ}\text{C}$)	25.2	18.6	4.2	4.9	19.6	16.4	4.2	4.9
Specific conductance ($\mu\text{S/cm}$)	244	240	250	300	244	244	255	303
pH	7.9	8.2	7.3	7	7.9	8.2	7.5	7.2
Dissolved oxygen (mg/L)	9.2	17	9.9	0.2	10.1	16.5	9.6	0.2
Phosphorus, total (as P)	E.003	0.004	E.003	0.015	<.004	E.003	<.004	0.013
Phosphorus, ortho, dissolved (as P)	<.002	--	--	--	<.002	--	--	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	0.151	--	--	--	--	--	--	--
Nitrogen, ammonia, dissolved (as N)	<.013	--	--	--	<.013	--	--	--
Nitrogen, amm. + diss., total (as N)	0.22	--	--	--	--	--	--	--





Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Wazee Lake, Deep Hole, near Black River Falls, Wisconsin.

(Circles on the first two plots indicate laboratory detection limit for selected analyses. Actual concentrations for these particular analyses are less than the plotted circles.)

424848088083100 WIND LAKE AT OUTLET AT WIND LAKE, WI

LOCATION.--Lat 42°48'48" long 88°08'31", in NE 1/4 NW 1/4 sec.16, T.4 N., R.20 E., Racine County, Hydrologic Unit 07120006, at Wind Lake.

DRAINAGE AREA.--39.6 mi².

PERIOD OF RECORD.--March 1985 to current year. Prior to October 2000, published as "Wind Lake Outlet".

REVISED RECORDS.--WDR WI-91-1: 1988(m).

GAGE.--Water-stage recorder and concrete dam. Datum of gage is 760.30 ft above sea level. Prior to Oct. 2, 1987, nonrecording gage at same site and datum.

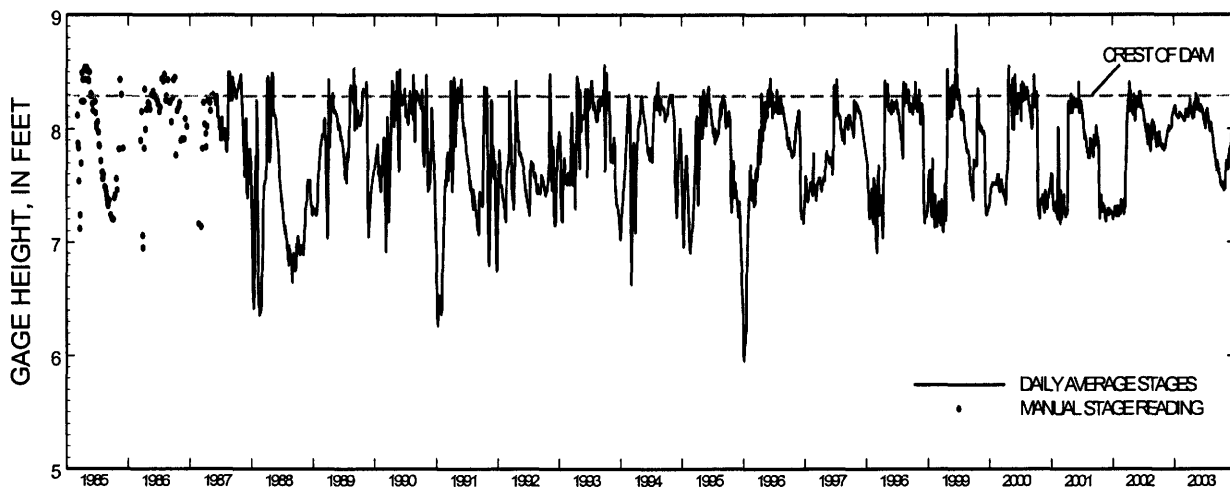
REMARKS.--Lake level regulated by dam with two 10-foot gates at outlet. Lake ice-covered Dec. 5-19 and Jan. 27 to Mar. 26. Prior to October 1987, published as Wind Lake at Wind Lake, Wis. Gage-height telemeter at station.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height, 8.93 ft, June 15, 1999; minimum recorded, 5.95 ft, Jan. 2, 1996.

EXTREMES FOR CURRENT YEAR.--Maximum recorded gage height, 8.35 ft, May 9; minimum recorded, 7.54 ft, Sept. 30.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003 DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	7.91	7.83	7.98	8.18	8.11	8.07	8.16	8.23	8.18	8.04	7.99	7.76
2	7.96	7.82	8.00	8.19	8.11	8.07	8.17	8.21	8.17	8.02	7.98	7.74
3	7.96	7.81	8.00	8.19	8.13	8.07	8.19	8.17	8.17	8.00	7.99	7.73
4	7.97	7.82	8.00	8.19	8.14	8.09	8.23	8.17	8.17	8.01	8.02	7.72
5	7.97	7.82	8.00	8.19	8.14	8.12	8.26	8.24	8.16	8.02	8.01	7.70
6	7.95	7.83	8.00	8.20	8.14	8.13	8.25	8.23	8.15	8.05	8.02	7.68
7	7.94	7.83	8.00	8.20	8.13	8.14	8.25	8.24	8.15	8.10	8.05	7.67
8	7.91	7.83	8.00	8.20	8.13	8.15	8.19	8.26	8.21	8.13	8.04	7.67
9	7.91	7.84	8.00	8.20	8.13	8.17	8.13	8.30	8.20	8.16	8.03	7.66
10	7.90	7.86	8.00	8.19	8.12	8.17	8.14	8.26	8.19	8.15	8.02	7.65
11	7.90	7.89	8.00	8.17	8.12	8.16	8.16	8.17	8.20	8.13	8.01	7.63
12	7.90	7.89	8.00	8.15	8.13	8.16	8.18	8.17	8.19	8.11	7.99	7.64
13	7.89	7.89	8.01	8.13	8.13	8.15	8.19	8.17	8.19	8.09	7.98	7.68
14	7.87	7.90	8.01	8.12	8.12	8.13	8.18	8.20	8.19	8.08	7.97	7.71
15	7.86	7.91	8.01	8.12	8.11	8.11	8.14	8.20	8.18	8.17	7.97	7.71
16	7.85	7.92	8.01	8.12	8.11	8.11	8.14	8.19	8.16	8.17	7.96	7.70
17	7.84	7.92	8.01	8.11	8.11	8.12	8.13	8.20	8.15	8.16	7.95	7.68
18	7.85	7.92	8.06	8.11	8.11	8.13	8.10	8.21	8.15	8.14	7.93	7.67
19	7.86	7.94	8.09	8.11	8.10	8.15	8.10	8.19	8.17	8.12	7.91	7.66
20	7.85	7.94	8.11	8.11	8.10	8.17	8.09	8.20	8.13	8.10	7.90	7.64
21	7.84	7.97	8.12	8.11	8.10	8.15	8.09	8.17	8.12	8.11	7.89	7.63
22	7.84	7.98	8.13	8.11	8.10	8.13	8.10	8.19	8.11	8.10	7.87	7.64
23	7.83	7.97	8.13	8.10	8.09	8.11	8.10	8.22	8.09	8.09	7.85	7.64
24	7.82	7.98	8.13	8.09	8.09	8.11	8.10	8.25	8.08	8.07	7.83	7.62
25	7.85	7.99	8.14	8.09	8.08	8.12	8.12	8.26	8.07	8.05	7.82	7.61
26	7.86	7.98	8.14	8.09	8.08	8.14	8.12	8.25	8.08	8.03	7.82	7.60
27	7.86	7.98	8.14	8.09	8.08	8.17	8.10	8.21	8.05	8.03	7.81	7.60
28	7.85	7.98	8.15	8.10	8.07	8.19	8.10	8.18	8.06	8.01	7.78	7.60
29	7.85	7.99	8.16	8.10	---	8.19	8.10	8.17	8.06	8.00	7.80	7.58
30	7.85	8.02	8.17	8.10	---	8.17	8.13	8.16	8.05	7.98	7.78	7.57
31	7.84	---	8.17	8.11	---	8.16	---	8.20	---	7.98	7.77	---
MEAN	7.88	7.91	8.06	8.14	8.11	8.14	8.15	8.21	8.14	8.08	7.93	7.66
MAX	7.97	8.02	8.17	8.20	8.14	8.19	8.26	8.30	8.21	8.17	8.05	7.76
MIN	7.82	7.81	7.98	8.09	8.07	8.07	8.09	8.16	8.05	7.98	7.77	7.57



424915088083900 WIND LAKE AT WIND LAKE, WI

LOCATION.--Lat 42°49'15", long 88°08'39", in NW 1/4 SW 1/4 sec.9, T.4 N., R.20 E., Racine County, Hydrologic Unit 07120006, at Wind Lake.

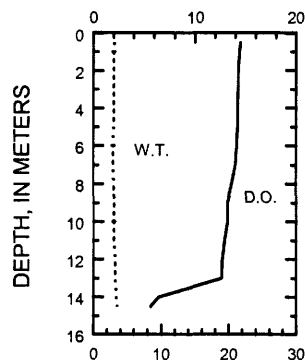
PERIOD OF RECORD.--February 1985 to current year.

REMARKS.--Lake sampled near center at the deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 19 TO JUNE 4, 2003 (Milligrams per liter unless otherwise indicated)

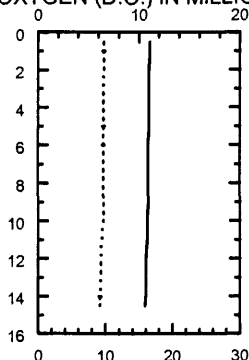
	Feb 19		Apr 22		Jun 4	
	8.1		8.1		8.17	
	--		2.0		2.0	
Lake stage (ft)	--		--		--	
Secchi-depth (m)	--		--		--	
Depth of sample (m)	0.5	14.5	0.5	14.5	0.5	14.5
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	--	--	5.6	--	8.43	--
Water temperature ($^{\circ}\text{C}$)	3.1	3.5	9.8	9.2	17.3	12.7
Specific conductance ($\mu\text{S/cm}$)	700	748	651	652	683	687
pH	8.5	8.2	8.3	8.3	8.5	7.4
Dissolved oxygen (mg/L)	14.5	5.6	11.1	10.6	11.8	0.5
Phosphorus, total (as P)	0.01	0.022	0.009	0.017	0.027	0.065
Phosphorus, ortho, dissolved (as P)	--	--	<.002	--	--	--
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	--	--	0.146	--	--	--
Nitrogen, ammonia, dissolved (as N)	--	--	0.116	--	--	--
Nitrogen, amm. + org., total (as N)	--	--	0.97	--	--	--
Nitrogen, total (as N)	--	--	1.1	--	--	--
Color (Pt-Co. scale)	--	--	15	--	--	--
Turbidity (NTU)	--	--	2.6	--	--	--
Hardness, as CaCO_3	--	--	220	--	--	--
Calcium, dissolved (Ca)	--	--	41.4	--	--	--
Magnesium, dissolved (Mg)	--	--	29	--	--	--
Sodium, dissolved (Na)	--	--	42	--	--	--
Potassium, dissolved (K)	--	--	3	--	--	--
Alkalinity, as CaCO_3	--	--	165	--	--	--
Sulfate, dissolved (SO_4)	--	--	35.3	--	--	--
Chloride, dissolved (Cl)	--	--	88.2	--	--	--
Silica, dissolved (SiO_2)	--	--	0.032	--	--	--
Solids, dissolved, at 180°C	--	--	378	--	--	--
Iron, dissolved (Fe) ($\mu\text{g/L}$)	--	--	<100	--	--	--
Manganese, dissolved, (Mn) ($\mu\text{g/L}$)	--	--	<1	--	--	--

2-19-03

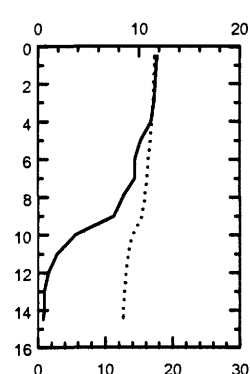


4-22-03

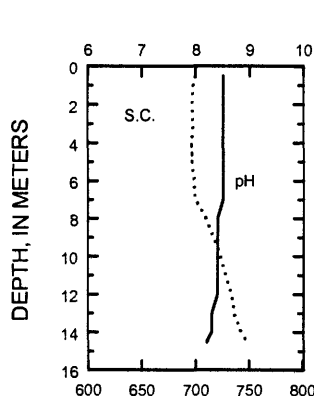
DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER



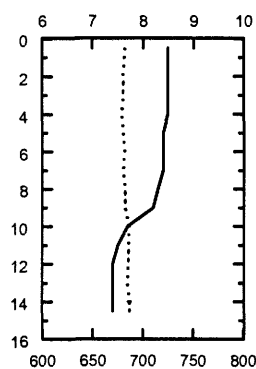
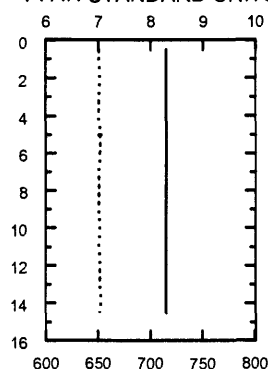
6-4-03



WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS



PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS

424915088083900 WIND LAKE AT WIND LAKE, WI--CONTINUED

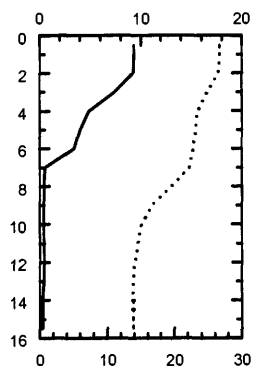
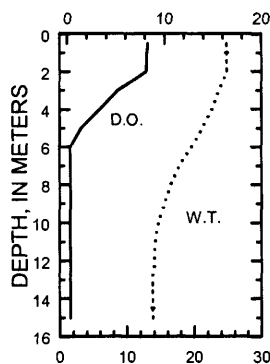
WATER-QUALITY DATA, JULY 9 TO AUGUST 19, 2003 (Milligrams per liter unless otherwise indicated)

	Jul 9		Aug 19		Aug 19		Aug 19	
Lake stage (ft)	8.16		7.91		7.91		7.91	
Secchi-depth (m)	1.7		2.3		2.3		2.3	
Depth of sample (m)	0.5	15	0.5	2.0	12.0	14.0	15.5	
Chlorophyll a, phytoplankton ($\mu\text{g/L}$)	6.4	--	5.11	--	--	--	--	--
Water temperature ($^{\circ}\text{C}$)	24.8	13.8	26.7	26.5	14.1	13.8	13.8	
Specific conductance ($\mu\text{S/cm}$)	649	705	668	669	728	734	737	
pH	8.3	7.2	8.4	8.4	7.2	7.1	7.1	
Dissolved oxygen (mg/L)	8.3	0.3	9.3	9.3	0.4	0.3	0.3	
Phosphorus, total (as P)	0.025	0.094	0.022	0.019	0.098	0.148	0.194	
Phosphorus, ortho, dissolved (as P)	0.003	--	--	--	--	--	--	
Nitrogen, $\text{NO}_2 + \text{NO}_3$, diss. (as N)	0.022	--	--	--	--	--	--	
Nitrogen, ammonia, dissolved (as N)	0.037	--	--	--	--	--	--	
Nitrogen, amm. + diss., total (as N)	1.2	--	--	--	--	--	--	

7-9-03

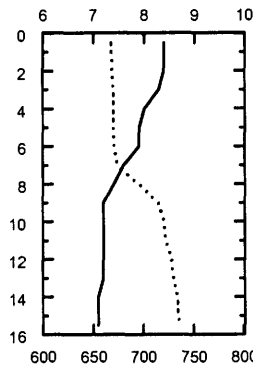
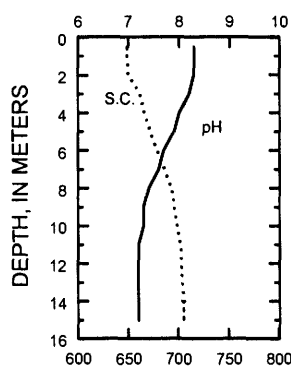
8-19-03

DISSOLVED OXYGEN (D.O.) IN MILLIGRAMS PER LITER

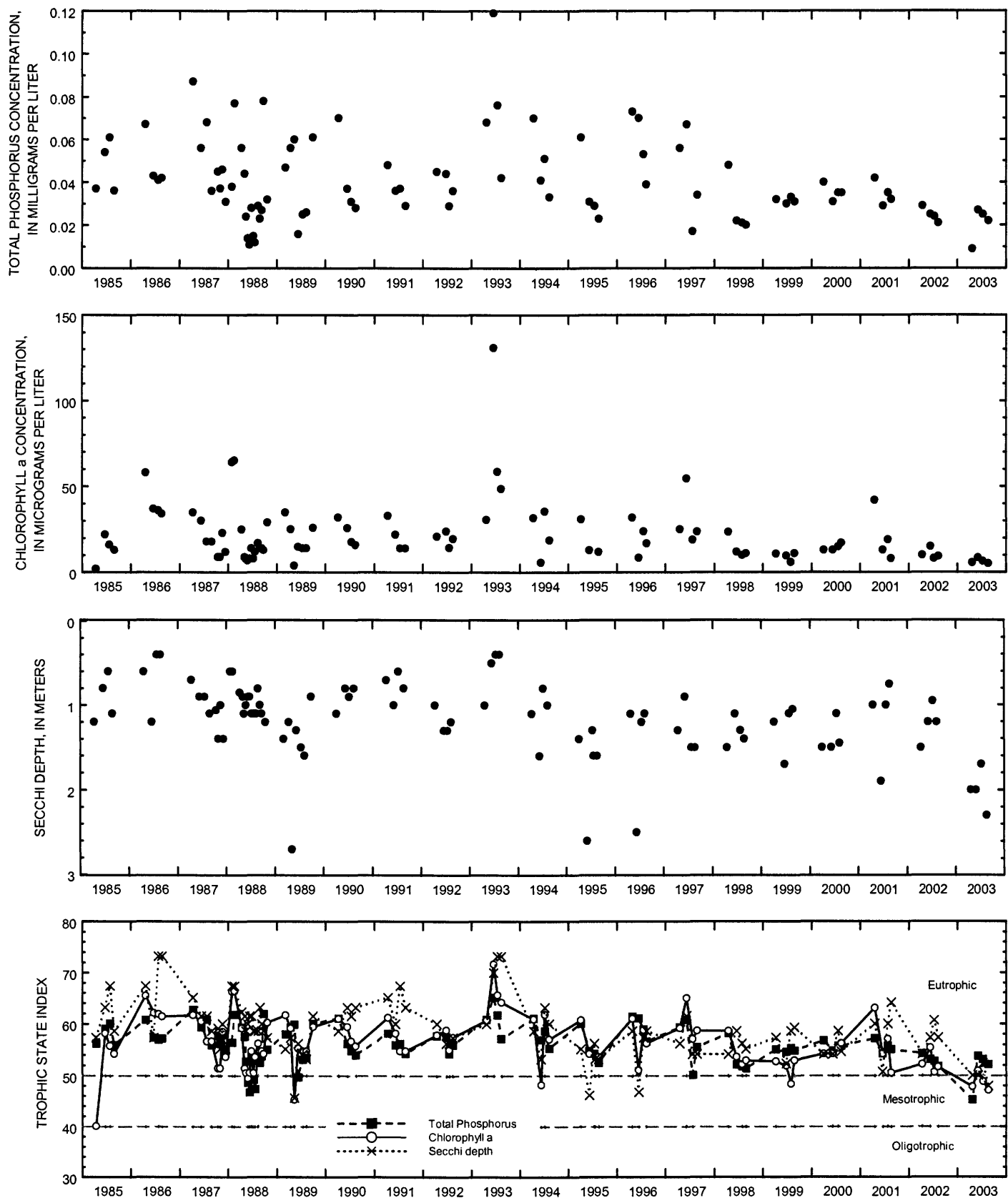


WATER TEMPERATURE (W.T.) IN DEGREES CELSIUS

PH IN STANDARD UNITS



SPECIFIC CONDUCTANCE (S.C.) IN MICROSIEMENS PER CENTIMETER AT 25 DEGREES CELSIUS



Surface total phosphorus, chlorophyll a concentrations, Secchi depths, and TSI data for Wind Lake, Deep Hole, at Wind Lake, Wisconsin.

04082500 LAKE WINNEBAGO AT OSHKOSH, WI

LOCATION.--Lat 44°00'35", long 88°31'38", in NE 1/4 NE 1/4 sec.25, T.18 N., R.16 E., Winnebago County, Hydrologic Unit 04030203, at 905 Bay Shore Drive, 800 ft east of mouth of the upper Fox River.

DRAINAGE AREA.--5,880 mi², at lake outlet at Menasha Dam. Area of Lake Winnebago, 215 mi².

PERIOD OF RECORD.--October 1938 to current year in reports of Geological Survey. Records from July 1882 to September 1938 in files of Geological Survey and U.S. Army Corps of Engineers. A report on Fox River by U.S. Army Corps of Engineers, published as House Document No. 146, 67th Congress, 2nd session, contains semi-monthly records of inflow of Lake Winnebago for the period 1896-1917.

REVISED RECORD.--WDR WI-83-1: Drainage area.

GAGE.--Water-stage recorder. Nonrecording gage read once daily October 1938 to October 1978. Datum of gage is 745.05 ft above mean tide at New York City (levels by U.S. Army Corps of Engineers). Datum of Deuchman gage is 745.00 ft above mean tide at New York City.

REMARKS.--Lake elevations controlled by dams at Menasha and Neenah, which are operated in the interest of navigation. Crests of both dams are at elevation 746.73 ft. Present limits of regulation are from 21 1/4 in. above the crest of Menasha dam to crest during navigation season, plus additional 18 in. below crest during winter. Oshkosh staff gage gives true level of lake, while Deuchman gage readings are affected by loss of head in the channel between lake and dam. Data-collection platform and gage-height telemeter at station.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height observed, 5.33 ft (Deuchman gage) Nov. 8, 1881; minimum observed, -2.00 ft (Deuchman gage) Nov. 28, 1891.

EXTREMES FOR CURRENT YEAR.--Maximum daily mean gage height, 3.09 ft, May 13; minimum recorded, 1.54 ft, Feb. 22.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2.95	2.86	2.39	2.05	1.65	1.62	2.03	2.65	2.77	2.76	2.86	2.74
2	3.01	2.88	2.40	2.02	1.66	1.62	2.10	2.67	2.75	2.74	2.90	2.72
3	2.99	2.83	2.37	1.99	1.67	1.62	2.14	2.66	2.76	2.74	2.92	2.66
4	2.95	2.82	2.36	1.97	1.67	1.63	2.17	2.67	2.75	2.74	2.94	2.68
5	3.08	2.78	2.36	1.95	1.65	1.64	2.12	2.70	2.72	2.78	2.95	2.64
6	2.97	2.75	2.36	1.94	1.63	1.63	2.23	2.73	2.73	2.79	2.97	2.62
7	3.05	2.71	2.35	1.92	1.62	1.62	2.30	2.80	2.73	2.87	3.02	2.63
8	3.02	2.69	2.35	1.90	1.61	1.62	2.20	2.85	2.76	2.88	3.03	2.62
9	3.04	2.66	2.35	1.90	1.60	1.62	2.20	2.84	2.78	2.89	3.02	2.61
10	3.03	2.63	2.35	1.89	1.59	1.61	2.22	2.85	2.84	2.90	3.03	2.60
11	3.02	2.62	2.34	1.88	1.59	1.60	2.23	2.83	2.88	2.91	3.05	2.58
12	2.99	2.56	2.33	1.85	1.60	1.59	2.24	3.05	2.86	2.92	3.04	2.55
13	2.97	2.54	2.31	1.83	1.60	1.60	2.23	3.09	2.84	2.90	3.03	2.66
14	2.97	2.51	2.30	1.82	1.59	1.60	2.21	3.07	2.85	2.87	3.02	2.82
15	2.94	2.52	2.29	1.80	1.60	1.61	2.22	3.07	2.83	2.84	3.02	2.83
16	2.96	2.50	2.28	1.79	1.60	1.63	2.35	3.08	2.81	2.88	3.02	2.82
17	2.94	2.48	2.25	1.78	1.60	1.64	2.20	3.07	2.80	2.89	3.01	2.80
18	2.92	2.47	2.25	1.76	1.60	1.65	2.23	3.06	2.81	2.86	2.98	2.77
19	2.91	2.50	2.27	1.75	1.60	1.66	2.24	3.05	2.86	2.84	2.95	2.69
20	2.94	2.50	2.26	1.74	1.60	1.69	2.25	3.01	2.81	2.83	2.93	2.76
21	2.95	2.50	2.25	1.72	1.60	1.73	2.31	3.05	2.82	2.86	2.91	2.75
22	2.95	2.49	2.22	1.70	1.60	1.74	2.39	3.00	2.81	2.86	2.93	2.70
23	2.97	2.45	2.21	1.68	1.60	1.73	2.38	2.97	2.82	2.83	2.92	2.71
24	2.96	2.47	2.19	1.66	1.61	1.73	2.38	2.95	2.81	2.80	2.82	2.66
25	2.96	2.46	2.16	1.64	1.61	1.74	2.45	2.91	2.79	2.77	2.84	2.68
26	2.93	2.47	2.13	1.63	1.61	1.77	2.46	2.88	2.75	2.75	2.85	2.61
27	2.95	2.43	2.11	1.61	1.61	1.80	2.45	2.85	2.78	2.79	2.85	2.59
28	2.96	2.40	2.10	1.61	1.62	1.86	2.50	2.79	2.79	2.76	2.78	2.64
29	2.95	2.36	2.10	1.63	---	1.94	2.58	2.78	2.77	2.75	2.78	2.61
30	2.93	2.33	2.06	1.62	---	1.98	2.60	2.76	2.77	2.74	2.78	2.59
31	2.89	---	2.05	1.65	---	2.01	---	2.83	---	2.80	2.75	---
MEAN	2.97	2.57	2.26	1.80	1.61	1.69	2.29	2.89	2.79	2.82	2.93	2.68
MAX	3.08	2.88	2.40	2.05	1.67	2.01	2.60	3.09	2.88	2.92	3.05	2.83
MIN	2.89	2.33	2.05	1.61	1.59	1.59	2.03	2.65	2.72	2.74	2.75	2.55

04084255 LAKE WINNEBAGO NEAR STOCKBRIDGE, WI

LOCATION.--Lat 44°04'17", long 88°19'52", Stockbridge Indian Reservation, Calumet County, Hydrologic Unit 04030203, on east shore of Lake Winnebago, 300 ft south of County Highway E and 1.6 mi west of Stockbridge.

DRAINAGE AREA.--5,880 mi², at lake outlet at Menasha Dam. Area of Lake Winnebago, 215 mi².

PERIOD OF RECORD.--November 1982 to current year.

GAGE.--Water-stage recorder. Datum of gage is 745.05 ft above mean tide of New York City (levels by U. S. Army Corps of Engineers).

REMARKS.--Lake elevations controlled by dams at Menasha and Neenah, which are operated in the interest of navigation. Crests of both dams are at elevation 746.73 ft. Present limits of regulation are from 21 1/4 in. above the crest of Menasha dam to crest during navigation season, plus additional 18 in. below crest during winter. Data-collection platform and gage-height telemeter at station.

EXTREMES FOR PERIOD OF RECORD.--Maximum daily mean gage height, 3.85 ft, July 9, 11, 1993; minimum observed, 0.30 ft, Mar. 1, 1986.

EXTREMES FOR CURRENT YEAR.--Maximum daily mean gage height, 3.10 ft, May 12; minimum recorded, 1.49 ft, Feb. 21.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 2002 TO SEPTEMBER 2003 DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2.91	2.95	2.38	1.95	1.61	1.56	1.95	2.55	2.71	2.71	2.81	2.69
2	2.88	2.88	2.31	1.95	1.61	1.57	1.90	2.54	2.70	2.71	2.86	2.68
3	2.88	2.81	2.31	1.94	1.62	1.57	1.88	2.58	2.68	2.74	2.86	2.69
4	3.03	2.77	2.30	1.91	1.64	1.58	1.89	2.55	2.66	2.76	2.88	2.62
5	3.08	2.72	2.30	1.90	1.60	1.58	2.05	2.53	2.68	2.76	2.91	2.61
6	3.08	2.74	2.29	1.89	1.58	1.58	2.07	2.67	2.66	2.76	2.93	2.60
7	3.05	2.70	2.30	1.86	1.57	1.57	1.96	2.72	2.64	2.85	2.94	2.57
8	3.01	2.64	2.30	1.85	1.56	1.57	2.07	2.76	2.68	2.85	2.93	2.55
9	2.99	2.60	2.28	1.86	1.55	1.58	2.15	2.73	2.75	2.79	2.96	2.54
10	2.96	2.57	2.28	1.86	1.54	1.56	2.16	2.78	2.76	2.86	2.99	2.52
11	2.96	2.53	2.28	1.83	1.55	1.54	2.16	3.08	2.78	2.96	2.94	2.51
12	2.97	2.55	2.27	1.79	1.55	1.54	2.15	3.10	2.77	2.89	2.95	2.51
13	3.08	2.49	2.26	1.78	1.55	1.55	2.15	3.05	2.79	2.86	2.97	2.64
14	2.96	2.43	2.25	1.77	1.54	1.55	2.17	3.03	2.77	2.86	2.97	2.78
15	2.91	2.39	2.23	1.75	1.55	1.56	2.14	3.02	2.75	2.88	3.00	2.83
16	2.88	2.39	2.22	1.73	1.55	1.57	1.97	3.01	2.75	2.86	2.98	2.79
17	2.89	2.41	2.18	1.72	1.55	1.59	2.03	3.00	2.74	2.82	2.94	2.76
18	2.91	2.43	2.18	1.71	1.55	1.60	2.11	2.99	2.74	2.79	2.94	2.71
19	2.96	2.46	2.22	1.70	1.55	1.61	2.15	2.99	2.72	2.83	2.93	2.78
20	2.92	2.44	2.23	1.68	1.54	1.63	2.26	3.01	2.75	2.83	2.91	2.72
21	2.87	2.41	2.23	1.66	1.54	1.67	2.30	2.96	2.77	2.78	2.92	2.66
22	2.88	2.44	2.22	1.65	1.55	1.69	2.31	2.93	2.78	2.75	2.88	2.73
23	2.86	2.47	2.20	1.64	1.56	1.67	2.29	2.91	2.79	2.74	2.82	2.77
24	2.87	2.48	2.13	1.61	1.56	1.66	2.30	2.88	2.80	2.77	2.83	2.73
25	2.85	2.46	2.11	1.60	1.56	1.69	2.31	2.84	2.81	2.79	2.83	2.69
26	2.92	2.38	2.09	1.59	1.56	1.72	2.37	2.81	2.89	2.77	2.81	2.62
27	2.92	2.40	2.06	1.55	1.56	1.74	2.44	2.79	2.80	2.71	2.76	2.70
28	2.87	2.43	2.04	1.56	1.56	1.82	2.48	2.75	2.69	2.70	2.74	2.62
29	2.82	2.42	2.02	1.58	---	1.90	2.50	2.72	2.76	2.71	2.75	2.60
30	2.85	2.40	2.01	1.57	---	1.92	2.50	2.72	2.73	2.72	2.72	2.63
31	2.90	---	2.01	1.60	---	1.94	---	2.64	---	2.77	2.71	---
MEAN	2.93	2.54	2.21	1.74	1.56	1.64	2.17	2.83	2.74	2.79	2.88	2.66
MAX	3.08	2.95	2.38	1.95	1.64	1.94	2.50	3.10	2.89	2.96	3.00	2.83
MIN	2.82	2.38	2.01	1.55	1.54	1.54	1.88	2.53	2.64	2.70	2.71	2.51

WISCONSIN DISTRICT PUBLICATIONS PERTAINING TO LAKES

The reports published in a U.S. Geological Survey series are for sale by the U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. Prepayment is required. Remittance should be sent by check or money order payable to the U.S. Geological Survey. Prices can be obtained by writing to the above address or by calling (303) 236-7476. Reprints of journal articles may be obtained by writing directly to the author at U.S. Geological Survey, 8505 Research Way, Middleton, WI 53562.

2003

- Dunning, C.P., Thomas, J.C., and Lin, Y-F., 2003, Simulation of the Shallow Aquifer in the Vicinity of Silver Lake, Washington County, Wisconsin, Using Analytic Elements: U.S. Geological Survey Water-Resources Investigations Report 02-4204, 29 p.
- Fitzpatrick, F.A., Garrison, P.J., Fitzgerald, S.A., and Elder, J.F., 2003, Nutrient, Trace-Element, and ecological history of Musky Bay, Lac Courte Oreilles, Wisconsin, as inferred from sediment cores: U.S. Geological Survey Water-Resources Investigations Report 02-4225, 141 p.
- Fitzpatrick, F.A., and Peppler, M.C., 2003, Sedimentation and sediment chemistry, Neopit Mill Pond, Menominee Indian Reservation, Wisconsin, 2001: U.S. Geological Survey Open-File Report 03-23, 58 p.
- Garn, H.S., Elder, J.F., and Robertson, D.M., 2003, Why study lakes? An overview of U.S. Geological Survey lake studies in Wisconsin: U.S. Geological Survey Fact Sheet FS-063-03, 8 p.
- Graczyk, D.G., Hunt, R.J., Greb, S.R., Buchwald, C.A., and Krohelski, J.T., 2003, Hydrology, water quality, and yields, from near-shore flows to four lakes in northern Wisconsin, 1999-2001, U.S. Geological Survey Water-Resources Investigations Report 03-4144, 64 p.
- Hunt, R.J., 2003, Ground water-lake interaction modeling using the LAK3 Package for MODFLOW2000: Ground Water, vol. 41, no. 2, p. 114-118.
- Hunt, R.J., Haitjema, H.M., Krohelski, J.T., and Feinstein, D.T., 2003, Simulating ground water-lake interactions: approaches and insights: Ground Water, vol. 41, no. 22, p. 227-237.
- Hunt, R.J., Pint, C.D., and Anderson, M.P., 2003, Using Diverse Data Types to Calibrate a Watershed Model of the Trout Lake Basin, Northern Wisconsin, p.600-604, In: MODFLOW and More 2003: Understanding through Modeling: Proceedings of the 5th International Conference of the International Ground Water Modeling Center. Golden, CO: Colorado School of Mines.
- Hunt, R.J., Saad, D.A., and Chapel, D.M., 2003, Numerical Simulation of Ground-Water Flow in La Crosse County, Wisconsin and into Nearby Pools of the Mississippi River. U.S. Geological Survey Water-Resources Investigations Report 03-4154, 36 p.
- John, R., Pint, C.D., Anderson, M.P., and Hunt, R.J., 2003, The Effects of Potential Climate Change on Lake Levels and Lake Capture Zones, p. 212-216, In MODFLOW and More 2003: Understanding through Modeling: Proceedings of the 5th International Conference of the International Ground Water Modeling Center. Golden, CO: Colorado School of Mines.
- Magnuson, J.J., Krohelski, J.T., Kunkel, K.E., and Robertson, D.M., 2003, Wisconsin's waters and climate: historical changes and possible futures: In Wisconsin's waters: a confluence of perspectives. Transactions of the Wisconsin Academy, p. 23-36.
- Pint, C.D., Hunt, R.J., and Anderson, M.P., 2003, Flow path delineation and ground water age, Allequash Basin, Wisconsin: Ground Water, vol. 41, no. 7, p. 895-902.
- Robertson, D.M., Rose, W.J., and Garn, H.S., 2003, Water quality and the effects of changes in phosphorus loading, Red Cedar Lakes, Barron and Washburn Counties, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 03-4238, 42 p.

Robertson, D.M., Rose, W.J., and Saad, D.A., 2003, Water quality and the effects of changes in phosphorus loading to Muskegon Lake, Vilas County, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 03-4011, 18 p.

2002

Anderson, M.P., Hunt, R.J., Krohelski, J.T., and Chung, K., 2002, Using high hydraulic conductivity nodes to simulate seepage lakes: *Ground Water* 40(2), p. 119-124.

Garn, H. S., 2002, Effects of lawn fertilizer on nutrient concentration in runoff from lakeshore lawns, Lauderdale Lakes, Wisconsin: USGS Water-Resources Investigations Report 02-4130, 6 p.

Kelson, V.A., Hunt, R.J., and Haitjema, H.M., 2002, Improving a regional model using reduced complexity and parameter estimation: *Ground Water* 40(2), p. 138-149.

Krohelski, J.T., Lin, Y., Rose, W.J., and Hunt, R.J., 2002, Simulation of Fish, Mud and Crystal Lakes and the shallow ground-water system, Dane County, Wisconsin: USGS Water-Resources Investigations Report 02-4014.

Krohelski, J.T., Rose, W.J., and Hunt, R.J., 2002, Hydrologic investigation of Powell Marsh and its relationship to Dead Pike Lake Vilas County, Wisconsin: USGS Water-Resources Investigations Report 02-4034.

Madenjian, C.P., Fahnenstiel, G.L., Johengen, T.H., Nalepa, T.F., Venderploeg, H.A., Fleischer, G.W., Schneeberger, P.J., Benjamin, D.M., Smith, E.B., Bence, J.R., Rutherford, E.S., Lavis, D.S., Robertson, D.M., Jude, D.J., and Ebener, M.P., 2002, Dynamics of the Lake Michigan food web, 1970-2000: *Canadian Journal of Fisheries and Aquatic Sciences*, Vol. 59, p. 736-753.

Robertson, D.M., Goddard, G.L., Mergerer, E.A., Rose, W.J., and Garrison, P.J., 2002, Hydrology and water quality of Geneva Lake, Walworth County, Wisconsin: U.S. Geological Survey Water Resources Investigations Report 02-4039, 73 p.

Robertson, D.M., and Lenz, B.N., 2002, Response of the St. Croix River Pools, Wisconsin and Minnesota, to various phosphorus-loading scenarios: U.S. Geological Survey Water-Resources Investigations Report 02-4181, 36 p.

2001

Hunt, R.J., Bradbury, K.R., and Krohelski, J.T., 2001, The effects of large-scale pumping and diversion on the water resources in Dane County, Wisconsin: USGS Fact Sheet FS-127-01, 4 p.

Hunt, R.J., Haitjema, H.M., Krohelski, J.T., and Feinstein, D.T., 2001, Simulating groundwater-lake interactions with models: MODFLOW and analytic element approaches. p. 328-334 in MODFLOW 2001 and Other Modeling Odysseys: Proceedings of the 4th International Conference of the International Ground Water Modeling Center. Golden, CO: Colorado School of Mines.

Lin, Y., Krohelski, J.T., and Hunt, R.J., 2001, Simulation of lake stage in two seepage lakes in southcentral Wisconsin using the LAK3 package for MODFLOW. p. 411-417 in MODFLOW 2001 and Other Modeling Odysseys: Proceedings of the 4th International Conference of the International Ground Water Modeling Center. Golden, CO: Colorado School of Mines.

2000

Elder, J.F., Robertson, D.M., and Garrison, P.J., 2000, Chemical composition of surficial deposits in Geneva Lake, Wisconsin: U.S. Geological Survey Fact Sheet FS-121-00.

Elder J.F., Rybicki, N.B., Carter, V.P., and Weintraub, V., 2000, Sources and yields of dissolved carbon in northern Wisconsin stream catchments with differing amounts of peatland: *Wetlands*, Vol. 20, No. 1, p.113-125.

- Hunt, R.J., Graczyk, D.J., and Rose, W.J., 2000, Water flows in the Necedah National Wildlife Refuge: U.S. Geological Survey Fact Sheet FS-068-00, 4 p.
- Hunt, R.J., Lin, J., Krohelski, J.T., and Juckem, P.F., 2000, Simulation of the shallow hydrologic system in the vicinity of Middle Genesee Lake, Wisconsin, using analytic elements and parameter estimation: U.S. Geological Survey Water Resources Investigations Report 00-4136, 16 p.
- Lathrop, R.C., Carpenter, S.R., and Robertson, D.M., 2000, Interacting factors causing exceptional water clarity in Lakes Mendota and Monona, Wisconsin, Proc. of the International Limnological Society, SIL, Dublin, Ireland, August, 1998.
- Magnuson, J.J., Robertson, D.M., Wynne, R.H., Benson, B.J., Livigstone, D.M., Arai, T., Assel, R.A., Barry, R.G., Card, V., Kuusisto, E., Granin, N.G., Prowse, T.D., Stewart, K.M., and Vuglinski, V.S., 2000, Historical Trends in Lake and River Ice Cover in the Northern Hemisphere: Science, Vol. 289, No. 5485, p. 1743-1746.
- Magnuson, J.J., Wynne, R.H., Benson, B.J., and Robertson, D.M., 2000, Lake and river ice as a powerful indicator of past and present climates, Proc. of the International Limnological Society, SIL, Dublin, Ireland, August, 1998.
- Robertson, D.M., 2000, One-dimensional simulation of stratification and dissolved oxygen in McCook Reservoir, Illinois: U.S. Geological Survey Water Resources Investigations Report 00-4258, 17 p.
- Robertson, D.M., Goddard, G.L., Helsel, D.R., and MacKinnon, K.L., 2000, Rehabilitation of Delavan Lake, Wisconsin: Lake and Reservoir Management, Vol. 20, No. 3, p. 155-176.
- Robertson, D.M., and Rose, W.J., 2000, Hydrology, water quality, and phosphorus loading of Little St. Germain Lake, Vilas County, Wisconsin: U.S. Geological Survey Water Resources Investigations Report 00-4209, 8 p.
- Robertson, D.M., Wynne, R.H., and Chang, W.Y.B., 2000, Variability in ice cover across the northern hemisphere during the 1900's associated with El Nino events, Proceedings of the International Limnological Society, SIL, Dublin, Ireland, August, 1998.
- Saad, D.A., and Robertson, D.M., 2000, Water-resources-related information for the St. Croix Reservation and vicinity, Wisconsin: U.S. Geological Survey Water Resources Investigations Report 00-4133, 65 p.
- Johnson, G.P., Hornewer, N.J., Robertson, D.M., and Olson, D.T., 2000, Methodology, data collection, and data analysis for determination of water-mixing patterns induced by aerators and mixers, U.S. Geological Survey Water Resources Investigations Report 00-4101, 72 p.
- Grannemann, N.G., Hunt, R.J., Nicholas, J.R., Reilly, T.E., and Winter, T.C., 2000, The importance of ground water to the Great Lakes Region: U.S. Geological Survey Water Resources Investigations Report 00-4008, 12 p.

1999

- Lathrop, R.C., Carpenter, S.R., and Robertson, D.M., 1999, Summer water clarity responses to phosphorus, Daphnia grazing, and internal mixing in Lake Mendota, Limnology and Oceanography, Vol. 44 (1), p. 137-146.
- Krohelski, J.T., Feinstein, D.T., and Lenz, B.N., 1999, Simulation of stage and hydrologic budget for Shell Lake, Washburn County, Wisconsin, U.S. Geological Survey Water-Resources Investigations Report 99-4209, 23 p.
- Panuska, J.C., and Robertson, D.M., 1999, Estimating phosphorus concentrations following alum treatment using apparent settling velocities, Lakes and Reservoir Management, Vol. 15 (1), p. 28-38.

1998

- Hunt, R.J., Anderson, M.P., and Kelson, V.A., 1998, Improving a complex finite-difference ground water flow model through the use of an analytic element screening model, Ground Water, Vol. 36, No. 6, p. 1011-1017.

- Hunt, R.J., Anderson, M.P., and Kelson, V.A., 1998, Linking an analytic element flow code to MODFLOW - Implementation and benefits. p. 477-504 in MODFLOW'98: Proceedings of the 3rd International Conference of the International Ground Water Center. Golden, CO: Colorado School of Mines.
- Krabbenhoft, D.P., Gilmour, C.C., Benoit, J.M., Babiarz, C.L., Andren, A.W., and Hurley, J.P., 1998, Methyl mercury dynamics in littoral sediments of a temperate lake, *Canadian Journal of Fisheries and Aquatic Sciences*, Vol. 55, p. 835-844.
- Robertson, D.M., Elder, J.F., Goddard, G.L., and James, W.F., 1998, Dynamics in phosphorus retention in wetlands upstream of Delavan Lake, Wisconsin, *Lakes and Reservoir Management*, Vol. 14, No. 4, p. 466-477.
- Rose, W.J., and Robertson, D.M., 1998, Hydrology, water quality, and phosphorus loading of Kirby Lake, Barron County, Wisconsin, U.S. Geological Survey Fact Sheet FS-066-98, 4 p.
- Walker, J.F. and Krabbenhoft, D.P., 1998, Groundwater and surface-water interactions in riparian and lake-dominated systems, in Kendall, C. and McDonnell, J.J. eds., *Isotope tracers in catchment hydrology*, Elsevier Publishing, New York, 839 P.

1997

- Elder, J.F., Manion, B.J., and Goddard, G.L., 1997, Mesocosm experiments to assess factors affecting phosphorus retention and release in an extended Wisconsin wetland: U.S. Geological Survey Water-Resources Investigations Report 97-4272, 14 p.
- Goddard, G.L., and Elder, J.F., 1997, Retention of sediments and nutrients in Jackson Creek Wetland near Delavan Lake, Wisconsin, 1993-95, U.S. Geological Survey Water-Resources Investigations Report 97-4014, 22 p.
- Hornewer, N.J., Johnson, G.P., Robertson, D.M. and Hondzo, M., 1997, Field-scale tests for determining mixing patterns associated with coarse-bubble air diffuser configurations, Egan Quarry, Illinois, In: *Environmental and Coastal Hydraulics: Protecting the Aquatic Habitat*, Proceedings of the International Association of Hydraulic Research, San Francisco, CA, USA, p. 57-63.
- Robertson, D.M., 1997, Regionalized loads of sediment and phosphorus to Lakes Michigan and Superior - High flow and long-term average, *Journal of Great Lakes Research*, Vol. 23, p. 416-439.

1996

- Anderson, W.L., Robertson, D.M., and Magnuson, J.J., 1996, Evidence of recent warming and El Nino-related variation in ice breakup of Wisconsin lakes, *Limnology and Oceanography*, Vol. 41, p. 815-821.
- Elder, J.F. and Goddard, G.L., 1996, Sediment and nutrient trapping efficiency of a constructed wetland near Delavan Lake, Wisconsin, 1993-1995: U.S. Geological Survey Fact Sheet FS-232-96.
- Garn, H.S., Olson, D.L., Seidel, T.L., and Rose, W.J., 1996, Hydrology and water quality of Lauderdale Lakes, Walworth County, Wisconsin, 1993-94: U.S. Geological Survey Water-Resources Investigations Report 96-4235, 29 p.
- Hunt, R.J. and Krohelski, J.T., 1996, The application of an analytical element model to investigate groundwater-lake interactions at Pretty Lake, Wisconsin, *Lake and Reservoir Management*, Vol. 12, p. 487-495.
- Imberger, J., Robertson, D.M., and Boland, K., 1996, Lake Number: A quantitative indicator of mixing to be used in water quality management. *Scientific Impeller*, Solna, Sweden, No. 4, p. 9-15.
- Kammerer, P.A., Jr., 1996, Hydrology and water quality of Park Lake, South-central Wisconsin: U.S. Geological Survey Fact Sheet FS-197-96.
- Robertson, D.M., Field, S.J., Elder, J.F., Goddard, G.L., and James, W.F., 1996, Phosphorus dynamics of Delavan Lake Inlet in southeastern Wisconsin. U.S. Geological Survey Water-Resources Investigations Report 96-4160, 18 p.

1995

- Assel, R.A. and Robertson, D.M. 1995, Changes in winter air temperatures near Lake Michigan during 1851 - 1993, as determined from regional lake-ice records, *Limnology and Oceanography*, v. 40, p 165-176.
- Assel, R.A., Robertson, D.M., Hoff, M.H., and Selgeby, J.H., 1995, Climatic-change implications from long-term (1823-1994) ice records near the Laurentian Great Lakes: *Annals of Glaciology*, v. 21, p. 383-386.
- Krabbenhoft, D.P., and Webster, K.E., 1995, Transient hydrogeological controls on the chemistry of a seepage lake: *Water Resources Research*, v. 31, no. 9, p. 2295-2305.
- Krohelski, J.T. and Batten, W.G., 1995, Simulation of stage and the hydrologic budget of Devils Lake, Sauk County, Wisconsin: U.S. Geological Survey Open-File Report 94-348, 22 p.
- Wentz, D.A., Rose, W.J., and Webster, K.E., 1995, Long-term hydrologic and biogeochemical responses of a soft water seepage lake in north central Wisconsin: *Water Resources Research*, v. 31, no. 1, p 199-212.

1994

- Elder, J.F., 1994, Distribution and grain-size partitioning of metals in bottom sediments of an experimentally acidified lake: *Water Resources Bulletin*, v. 30, no. 2, p. 251-259.
- Goddard, G.L., and Field, S.J., 1994, Hydrology and water quality of Whitewater and Rice Lakes in southeastern Wisconsin, 1990-91: U.S. Geological Survey Water-Resources Investigations Report 94-4101, 36 p.
- Greb, S.R., and Wentz, D.A., 1994, Chemical budgets, in Klepinger, K.E., ed., RILWAS 1983-86: Wisconsin Regional Integrated Lake Watershed Acidification Study, Volume 1: Madison, Wisconsin Department of Natural Resources, PUBL-RS-909-94, Chapter 7, 20 p.
- Hurley, J.P., Krabbenhoft, D.P., Babiarz, C.L., and Andren, A.W., 1994, Cycling processes of mercury across sediment/water interfaces in seepage lakes, in Baker, L.A. ed., *Environmental Chemistry of Lakes and Reservoirs: Advances in Chemistry Series*, American Chemical Society, Washington, D.C., p. 426-449.
- Krabbenhoft, D.P., Bowser, C.J., Kendall, C., and Gat, J.R., 1994, Use of oxygen-19 and deuterium to assess the hydrology of ground-water/lake systems, in Baker, L.A. ed., *Environmental Chemistry of Lakes and Reservoirs: Advances in Chemistry Series*, American Chemical Society, Washington, D.C., p. 67-90.
- Robertson, D.M., Anderson, W., and Magnuson, J.J., 1994, Relations between El Nino/Southern Oscillation events and the climate and ice cover of lakes in Wisconsin. P 48-57, in Greenland, D. ed., *El Nino and Long-Term Ecological Research (LTER) Sites: Publication No. 18*. LTER Network Office: University of Washington, Seattle, WA, USA., 57 p.
- Robertson, D.M. and Imberger, J. 1994, Lake Number, a quantitative indicator of mixing used to estimate changes in dissolved oxygen, *Internationale Revue der gesamten Hydrobiologie*, v. 79, p. 159-176.
- Watras, C.J., Bloom, N.S., Hurley, J.P., Fitzgerald, W.F., Andren, A.W., Krabbenhoft, D.P., and Porcella, D.B., 1994, Sources and fates of mercury and methylmercury in Wisconsin lakes, in Watras and Huckabee eds., *Mercury as a Global Pollutant: Intergration and Synthesis*, Lewis Pub., Chelsea, MI., p 153-177.
- Wentz, D.A., 1994, Chemistry of snowpack and ground water, in Klepinger, K.E., ed., RILWAS 1983-86: Wisconsin Regional Integrated Lake Watershed Acidification Study, Volume 1: Madison, Wisconsin Department of Natural Resources, PUBL-RS-909-94, Chapter 6, 45 p.
- Wentz, D.A., Krohelski, J.T., and Rose, W.J., 1994, Hydrology, in Klepinger, K.E., ed., RILWAS 1983-86: Wisconsin Regional Integrated Lake Watershed Acidification Study, Volume 1: Madison, Wisconsin Department of Natural Resources, PUBL-RS-909-94, Chapter 7, 74 p.

1993

- Field, S.J., 1993, Hydrology and water quality of Powers Lake, southeastern Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 90-4126, 36 p.

- Field, S.J., 1993, Hydrology and water quality of Wind Lake in southeastern Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 91-4107, 61 p.
- House, L.B., 1993, Simulation of the effects of hypothetical residential development on water levels in Graber Pond, Middleton, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 92-4029, 10 p.
- House, L.B., Waschbusch, R.J., and Hughes, P.E., 1993, Water quality of an urban wet detention pond in Madison, Wisconsin, 1987-88: U.S. Geological Survey Open-File Report 93-172, 57 p.
- Hughes, P.E., 1993, Hydrology, water quality, trophic status, and aquatic plants of Fowler Lake, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 91-4076, 44 p.
- Rose, W.J., 1993, Hydrology of Little Rock Lake in Vilas County, north-central Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 93-4139, 22 p.
- Rose, W.J., 1993, Water and phosphorus budgets and trophic state, Balsam Lake, northwestern Wisconsin, 1987-1989: U.S. Geological Survey Water-Resources Investigations Report 91-4125, 28 p.

1992

- Elder, J.F., Krabbenhoft, D.P., and Walker, J.F., 1992, Water, energy, and biogeochemical budgets (WEBB) program: Data availability and research at the northern temperate lakes site, Wisconsin: U.S. Geological Survey Open-File Report 92-48, 15 p.
- Krabbenhoft, D.P., and Babiarz, C.L., 1992, Role of groundwater transport in aquatic mercury cycling: Water Resources Research, vol. 28, no. 12, p. 3119-3128.
- Krabbenhoft, D.P., and Krohelski, J.T., 1992, Data on water quality, lake sediment, and lake-level fluctuation, St. Croix Indian Reservation, Wisconsin, 1981-87: U.S. Geological Survey Open-File Report 92-26, 53 p.
- Robertson, D.M., Ragotzkie, R.A., and Magnuson, J.J. 1992, Lake ice records used to detect historical and future climatic changes: Climatic Change, v. 21, p. 407-427.

1991

- Wentz, D.A., and Rose, W.J., 1991, Hydrology of Lakes Clara and Vandercook in North-Central Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 89-4204, 24 p.
- Watras, C.J., Andre, A.W., Bloom, N.S., Fitzgerald, W.F., Hurley, J.P., Krabbenhoft, D.P., Rada, R.G., Wiener, J.G., 1991, Mercury in temperate lakes: a mechanistic field study: Verhandlungen Internat. Verein. Limnologie, 24, p. 2199-2202.

Pre-1990

- Walker, J.F., Pickard, S.A., and Sonzogni, W.C., 1989 Spreadsheet watershed modeling for non-point-source pollution management in a Wisconsin basin: Water Resources Bulletin, v. 25, no. 1, p. 139-147.
- Wentz, D.A., Garrison, P.J., and Bockheim, J.G., 1989, Section 7—Chemical input-output budgets, in Knauer, D., and Brouwer, S.A., eds., The Wisconsin Regional Integrated Lake-Watershed Acidification Study (RILWAS): 1981-1983: Palo Alto, California, Electric Power Research Institute Report EA-6214, p. 7-1 to 7-30.
- Wentz, D.A., and Rose, W.J., 1989, Interrelationships among hydrologic-budget components of a northern Wisconsin seepage lake and implications for acid-deposition modeling: Archives of Environmental Contamination and Toxicology, v. 18, p. 147-155.
- Wentz, D.A., Rose, W.J., and Krohelski, J.T., 1989, Section 5—Hydrologic component, in Knauer, D., and Brouwer, S.A., eds., The Wisconsin Regional Integrated Lake-Watershed Acidification Study (RILWAS): 1981-1983: Palo Alto, California, Electric Power Research Institute Report EA-6214, p. 5-1 to 5-77.
- Field, S.J., and Duerk, M.D., 1988, Hydrology and water quality of Delavan Lake in southeastern Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 87-4168, 61 p.

- Krug, W.R., Ostenso, N.A., and Krohelski, J.T., 1988, Prediction of the effects of mine dewatering on four lakes near Crandon, Wisconsin, by use of a water-budget model: U.S. Geological Survey Open-File Report 87-471, 63 p.
- Wentz, D.A., Krohelski, J.T., Rose, W.J., Bockheim, J.G., Garrison, P.J., Knauer, D.R., and Goldstein, R.A., 1987, Hydrologic and chemical budgets of Wisconsin lakes, in Perry, R., Harrison, R.M., Bel, J.N.B., and Lester, J.N., eds., *Acid Rain: Scientific and Technical Advances*, Selper Ltd., London, p. 309-316.
- House, L.B., 1986, Stage fluctuations of Wisconsin Lakes: Wisconsin Geological and Natural History Survey Information Circular No. 49, 84 p.
- House, L.B., 1984, Effects of urbanization on three ponds in Middleton, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 84-4051, 17 p.
- Krug, W.R., and House, L.B., 1984, Evaluation of alternative reservoir-management practices in the Rock River basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 83-4186, 21 p.
- House, L.B., 1981, An assessment of streamflow, water quality, and the effects of construction on impoundment on Bridge Creek at Augusta, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Report 81-1192, 25 p.
- Krug, W.R., 1981, Hydrologic effects of proposed changes in management practices, Winnebago Pool, Wisconsin: U.S. Geological Survey Water-Resources Investigations 80-107, 19 p.
- Batten, W.G., and Hindall, S.M., 1980, Sediment deposition in the White River Reservoir, northwestern Wisconsin: U.S. Geological Survey Water-Supply Paper 2069, 30 p.
- Novitzki, R.P., and Holmstrom, B.K., 1979, Monthly and annual water budgets of Lake Wingra, Madison, Wisconsin, 1971-77: U.S. Geological Survey Water-Resources Investigations 79-100, 31 p.
- Rose, W.J., 1977, Hydrologic considerations associated with dredging spring ponds in Wisconsin: U.S. Geological Survey Water-Resources Investigations 77-18, 35 p.
- Oakes, E.L., Hendrickson, G.E., and Zuehls, E.E., 1975, Hydrology of the Lake Wingra basin, Dane County, Wisconsin: U.S. Geological Survey Water-Resources Investigations 17-75, 31 p.
- Novitzki, R.P., 1971, Hydrologic investigations of Heart Lake, Green Lake County, Wisconsin: U.S. Geological Survey Administrative Report, 9 p.

APPENDIX

Wisconsin Lakes Team Quality-Assurance Plan

Most lake studies and monitoring programs that are conducted by the USGS Wisconsin District entail water sampling and analysis to determine water quality and biological productivity. Because all sampling and analysis is subject to error and random variability, a certain proportion of the sampling effort should include quality-assurance samples. These samples are collected and/or prepared solely for the purpose of assessing the magnitude of error and random variability so that the accuracy and precision of all data can be evaluated. The plan for this quality-assurance sampling is described below.

Three types of QA/QC samples are collected:

blanks

provide information about accuracy and errors due to treatment or reagents

replicates

provide information about precision (variability)

standard additions (spikes)

provide information about accuracy and matrix interferences

Blank Sampling

B1. A **preservation blank** is prepared for each month of lake sampling. This consists of deionized water or inorganic blank water, to which is added any reagents or preservatives that are normally added to natural water samples. The blank is not taken to the field, but is shipped to the laboratory for analysis along with the natural water samples.

This blank sample is analyzed for the Nutrient Group¹ and chlorophyll-a.

B2. At one randomly-chosen lake each month, a **field blank** is prepared. This consists of deionized water or inorganic blank water treated exactly the same as regular samples. During winter, the field blank is analyzed for total phosphorus (TP) only; during summer, it is analyzed for TP and chlorophyll-a, and in the spring, it is analyzed for the Nutrient Group and chlorophyll-a.

¹ Nutrient Group = all phosphorus and nitrogen species that are commonly determined in lakes (total phosphorus, nitrate + nitrite, ammonia, total Kjeldahl nitrogen, total nitrogen)

Replicate Sampling

R1. At all lakes in program, **triplicate samples** are taken near water surface in summer for analysis of total phosphorus and chlorophyll-a. At two of these lakes, a set of triplicate samples is also taken from near-bottom water, for analysis of total phosphorus.

R2. At three selected lakes in the spring (different lakes each year), **triplicate samples** are taken near water surface for analysis of Nutrient Group.

R3. At one lake each year, **5 replicate samples** are taken near water surface for analysis of total phosphorus and chlorophyll-a.

Standard Addition Testing

S1. At Delavan Lake and one other lake (to be determined each year), **5 replicate samples** are taken in August for a **standard addition (spike) test**. The spike consists of addition of a prepared phosphorus solution (standard) of known volume and concentration, such that the expected result of analysis is the natural water TP concentration plus the known addition. One sample from each set will receive a low-concentration spike, one will receive a high-concentration spike, and three will receive no spike (the mean of these gives the natural water TP concentration).

Data and results of replicate sampling and field blank testing in water year 2000 are shown in Table A1.

Table A1. Analyses of replicate samples from Wisconsin lakes in water years 2001-2003. See text for procedures used. All data except chlorophyll in milligrams per liter. Symbol "<" indicates less than given detection limit (DL); mean and standard deviation not calculated for datasets containing values less than DL. All samples collected near surface (approximately 0.5 m depth) unless otherwise indicated.

Parameter	Lake	Date	Replicate Data				Standard Deviation		Percent Standard Deviation
							Mean	Deviation	Deviation
Total Phosphorus	Buffalo	7/23/01	0.276	0.275	0.277		0.276	0.001	0.4
	Delavan	7/15/01	0.027	0.027	0.031		0.028	0.002	8.2
	Delavan	8/19/01	0.031	0.027	0.035		0.031	0.004	12.9
	Geneva	7/15/01	0.005	<0.005	<0.005				
	Little Green	7/23/01	0.069	0.074	0.072		0.072	0.003	3.5
	Middle	6/17/01	0.012	0.012	0.017	0.016	0.014	0.003	18.5
	Muskego	4/18/01	0.039	0.044	0.047		0.043	0.004	9.3
	Muskego	7/25/01	0.030	0.031	0.031		0.031	0.001	1.9
	Oconomowoc	7/17/01	0.010	0.011	0.010		0.010	0.001	5.6
	Oconomowoc	8/23/01	0.011	0.010	0.009		0.010	0.001	10.0
	Okauchee	8/20/01	0.013	0.015	0.015		0.014	0.001	8.1
	Red Cedar	7/9/01	0.021	0.022			0.022	0.001	3.3
	Delavan	7/15/02	0.026	0.026	0.027	0.031	0.028	0.002	8.7
	Geneva	7/16/02	0.008	0.008	0.008		0.008	0.000	0.0
	Little Muskego	7/1/02	0.016	0.016	0.017		0.016	0.001	3.5
	Potter	8/5/02	0.041	0.036	0.042	0.043 0.041	0.041	0.003	6.7
	Little St. Germain	7/22/02	0.061	0.060	0.059		0.060	0.001	1.7
	Delavan	4/14/03	0.057	0.057	0.057		0.057	0.000	0.0
	Delavan	8/12/03	0.044	0.043	0.041		0.043	0.002	3.6
	Lac La Belle	8/19/03	0.015	0.012	0.012		0.013	0.002	13.3
	Butternut	8/13/03	0.040	0.042			0.041	0.001	3.5
Total Phosphorus, near bottom	Geneva	7/15/01	0.017	0.020	0.021		0.019	0.002	10.8
	Red Cedar	7/9/01	0.187	0.228	0.262		0.226	0.038	16.6
	Wind	7/8/02	0.084	0.089	0.092		0.088	0.004	4.6
Dissolved Phosphorus	Wind	8/19/03	0.194	0.192	0.165		0.184	0.016	8.8
	Delavan	7/15/01	0.010	<0.002	<0.007				
	Geneva	4/17/01	<0.002	<0.002					
	Oconomowoc	8/23/01	0.002	<0.002	<0.002				
	Delavan	4/14/03	0.022	0.023	0.023		0.023	0.001	2.5
Dissolved Ammonia	Delavan	7/15/01	0.026	0.013	0.021		0.020	0.007	32.8
	Geneva	4/17/01	0.014	0.022			0.018	0.006	31.4
	Muskego	4/18/01	0.086	0.083	0.084		0.084	0.002	1.8
	Oconomowoc	8/23/01	0.027	0.028	0.022		0.026	0.003	12.5
	Delavan	4/14/03	<0.015	<0.015	<0.015				
Total Kjeldahl Nitrogen	Delavan	7/15/01	0.560	0.580	0.560		0.567	0.012	2.0
	Geneva	4/17/01	0.390	0.390			0.390	0.000	0.0
	Muskego	4/18/01	1.200	1.100	1.200		1.167	0.058	4.9
	Oconomowoc	8/23/01	0.490	0.500	0.520		0.503	0.015	3.0
	Delavan	4/14/03	0.640	0.640	0.620		0.633	0.012	1.8

Parameter	Lake	Date	Replicate Data				Percent		
							Standard Mean	Standard Deviation	
Dissolved Nitrate plus Nitrite	Delavan	7/15/01	0.014	0.008	0.007		0.010	0.004	39.2
	Geneva	4/17/01	0.113	0.115			0.114	0.001	1.2
	Muskego	4/18/01	0.102	0.103	0.104		0.103	0.001	1.0
	Oconomowoc	8/23/01	0.370	0.371	0.369		0.370	0.001	0.3
	Delavan	4/13/03	<0.022	<0.022	<0.022				
Chlorophyll-a (micrograms per liter)	Buffalo	7/23/01	14.0	16.0	17.0		15.7	1.5	9.8
	Delavan	7/15/01	4.9	4.0	4.8		4.6	0.5	10.8
	Geneva	7/15/01	<1.0	<1.0	1.1				
	Little Green	7/23/01	23.0	24.0	24.0		23.7	0.6	2.4
	Middle	6/17/01	1.6	4.7			3.2	2.2	69.6
	Muskego	7/25/01	6.6	3.2	3.2		4.3	2.0	45.3
	Oconomowoc	7/17/01	2.6	2.8	2.3		2.6	0.3	9.8
	Okauchee	8/20/01	8.0	8.0	8.0		8.0	0.0	0.0
	Powers	7/25/01	4.8	5.0	5.5		5.1	0.4	7.1
	Red Cedar	7/9/01	5.2	3.7			4.5	1.1	23.8
	Delavan	7/15/02	9.7	6.9	8.0	8.1	8.2	1.2	14.1
	Geneva	7/16/02	0.74	1.00	0.96		0.9	0.1	15.6
	Little Muskego	7/1/02	1.74	1.50	1.34		1.5	0.2	13.2
	Potter	8/5/02	10.8	10.3	11.9	9.77 11.0	10.8	0.8	7.4
	Little St. Germain	7/22/02	63.8	62.2	69.7		65.2	4.0	6.1
	Lac La Belle	8/19/03	3.3	3.7	3.5		3.5	0.2	5.3
	Butternut	8/13/03	44.00	46.10	45.20		45.1	1.1	2.3

Table A2. Data from standard addition tests using stock solution containing 5.00 mg/L phosphorus. See text for detail of procedures. All concentration data in milligrams per liter.

Lake, Date	Original Sample Concentration	Stock Solution Volume Added (milliliters)	Final Expected Concentration	Actual Detected Concentration	Percent Recovery
Delavan 08/12/03	0.043	0.310	0.056	0.058	116%
	0.043	1.250	0.094	0.099	108%

Table A3. Data from tests of blanks, 2001-2003. All data in milligrams per liter, unless otherwise indicated. < = less than given detection limit;
E = estimated value.

Delavan Lake. Analyses at USGS National Water Quality Laboratory, Lakewood, CO.

Parameter	2/19/01	4/17/01	7/15/01	2/21/02	4/17/02	7/14/02	2/20/03	4/16/03	
Total P	E 0.003	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.006	E 0.002	< 0.004
Dissolved orthophosphate			< 0.007			< 0.007	< 0.007		< 0.007
Chlorophyll a	< 0.1	< 0.1		< 0.1		< 0.1	< 0.1		< 0.260
Chlorophyll b	< 0.1			< 0.1		< 0.1	< 0.1		
Total Kjeldahl Nitrogen (as N)			< 0.08		< 0.10	E 0.05	E 0.05		< 0.10
Ammonia (as N)			< 0.02			0.037	0.034		< 0.015
Nitrate + Nitrite (as N)			< 0.05			E 0.011	0.008		< 0.022

Big Cedar Lake, south site, near West Bend, WI. Analyses at Wisconsin State Laboratory of Hygiene, Madison, WI

Parameter	4/22/02	8/8/02
Total P	< 0.005	< 0.005
Dissolved orthophosphate	< 0.002	
Chlorophyll a	< 1.00	< 0.26
Total Kjeldahl Nitrogen (as N)	< 0.14	
Ammonia (as N)	< 0.013	
Nitrate + Nitrite (as N)	< 0.010	
Calcium, dissolved	< 0.20	
Magnesium, dissolved	< 0.20	
Potassium, dissolved	< 1.0	
Sodium, dissolved	< 0.10	
Iron, dissolved (micrograms per liter)	< 100	
Manganese, dissolved (micrograms per liter)	< 1	

Little Cedar Lake, south site, near West Bend, WI. Analyses at Wisconsin State Laboratory of Hygiene, Madison, WI

Parameter	4/29/03
Total P	< 0.005
Dissolved orthophosphate	< 0.002
Total Kjeldahl Nitrogen (as N)	< 0.14
Ammonia (as N)	< 0.013
Nitrate + Nitrite (as N)	0.016

Little Cedar Lake, North site, near West Bend, WI. Analyses at Wisconsin State Laboratory of Hygiene, Madison, WI

Parameter	2/21/03
Total P	< 0.005

U.S. DEPARTMENT OF THE INTERIOR
U.S. Geological Survey
8505 Research Way
Middleton, WI 53562