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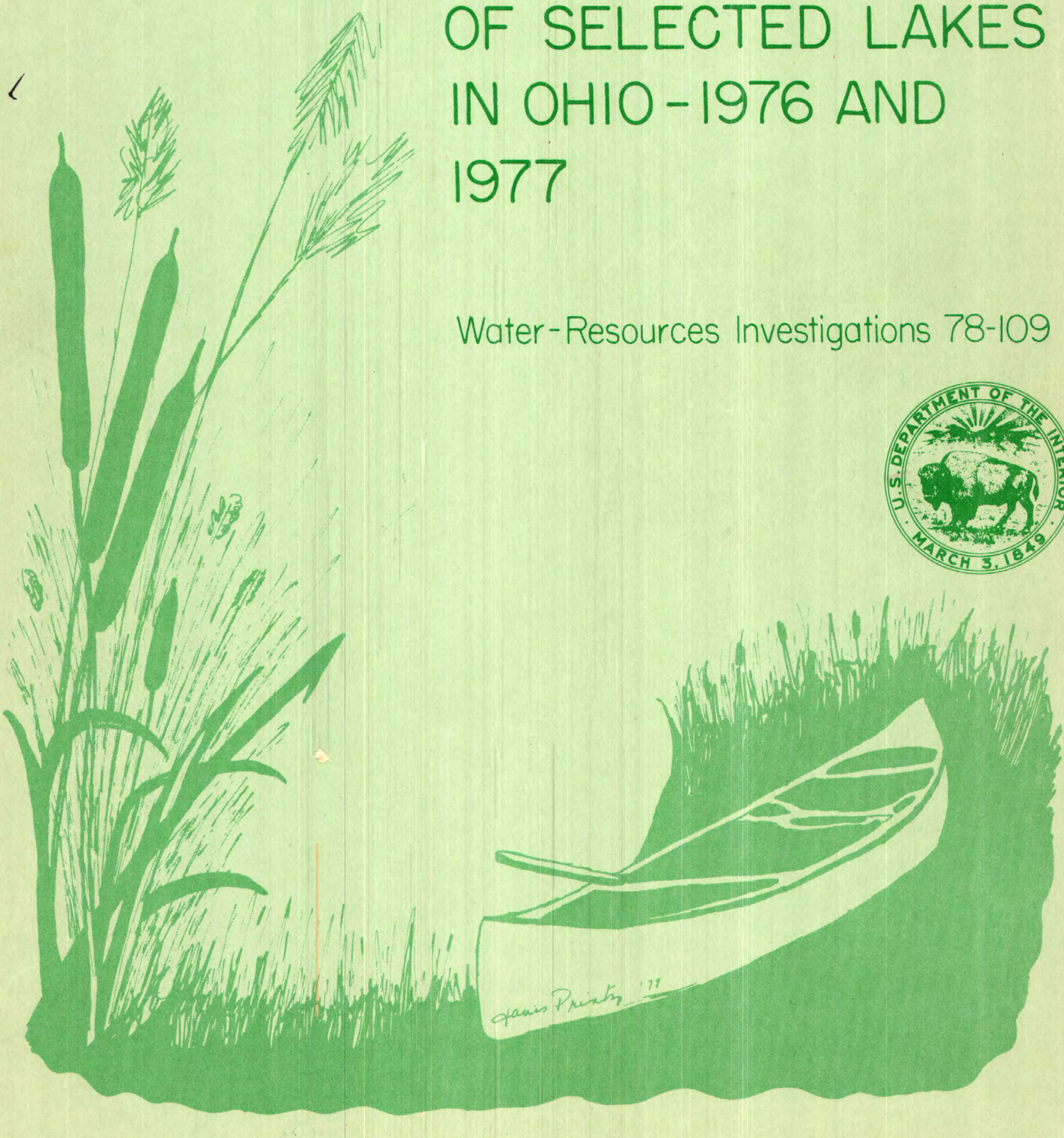
UNITED STATES DEPARTMENT OF THE INTERIOR

Prepared in cooperation with

GEOLOGICAL SURVEY and
OHIO ENVIRONMENTAL PROTECTION AGENCY

CHEMICAL AND BIOLOGICAL QUALITY OF SELECTED LAKES IN OHIO - 1976 AND 1977

Water-Resources Investigations 78-109



CHEMICAL AND BIOLOGICAL QUALITY OF SELECTED LAKES IN OHIO - 1976 AND 1977

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U.S. GEOLOGICAL SURVEY
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Prepared by
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UNITED STATE DEPARTMENT OF THE INTERIOR

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GEOLOGICAL SURVEY

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Open-File Report

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CONVERSION FACTORS FOR SI METRIC AND U.S. CUSTOMARY UNITS OF MEASUREMENT

To convert from	To	Multiply by
inch (in)	millimeter (mm)	25.40
foot (ft)	meter (m)	0.3048
mile (mi)	kilometer (km)	1.609
acre-foot (acre-ft)	hectometer^3 (hm^3)	0.001233
mile^2 (mi^2)	kilometer^2 (km^2)	2.590
foot^3 per second (ft^3/s)	meter^3 per second (m^3/s)	0.02832
ton (short)	metric ton (t)	0.9072
ton per mile^2 per year ((ton/mi^2)/yr)	metric ton per kilometer^2 per year ((t/km^2)/yr)	0.3502

CHEMICAL AND BIOLOGICAL QUALITY OF SELECTED LAKES IN OHIO - 1976 AND 1977

by Robert L. Tobin and John D. Youger

ABSTRACT

Twenty-eight Ohio lakes (14 per year) were sampled by the U.S. Geological Survey and Ohio Environmental Protection Agency for water-quality characteristics during the spring and summer of 1976 and 1977. Data items included: profiles of temperature, dissolved oxygen, pH, and specific conductance; physical, biological, nutrient, and organic characteristics; major and minor constituents; and physical and chemical data associated with major inflows.

Light penetration (secchi disk) was greatest (21 feet) in Mogadore Reservoir and least (0.8 foot) in Stonelick Lake. Seasonal thermal gradients developed in most lakes greater than 17 feet in depth.

Dissolved-oxygen saturation ranged from 220 percent in Summit Lake to zero percent in the bottom waters of all lakes having stable thermal gradients. Five-day BOD ranged from 0.3 milligrams per liter in Michael J. Kirwan Reservoir to more than 17 milligrams per liter in Nimisilia Reservoir. Anaerobic zones were frequently characterized by hydrogen sulfide and high concentrations of ammonia.

All lakes had moderately hard to very hard waters. Calcium, bicarbonate, and sulfate were the principal constituents. Specific conductance ranged from 130 micromhos (Lake Logan) to 1250 micromhos (Summit Lake). Because of nutrient uptake and recycling, significant chemical and physical differences developed in different thermal strata. Pesticide residues and trace elements were not above the limits recommended by the Ohio Environmental Protection Agency.

All counts of fecal coliform bacteria were within State standards. Blue-green algae (Cyanophyta) dominated the phytoplankton communities of 18 lakes in spring and 26 lakes in summer. Algal counts from euphotic-zone composite samples ranged from 180 cells per milliliter in Killdeer Reservoir to 3,400,000 cells per milliliter in Kiser Lake. Maximum algal counts were greater than 100,000 cells per milliliter in 19 lakes.

Streams are a major source of macronutrients in Ohio lakes. The estimated discharge-weighted mean concentration for nitrite plus nitrate and total phosphorus in 62 inflow samples was 1.22 milligrams per liter as N and 0.12 milligrams per liter as P.

INTRODUCTION

In 1975, the U.S. Geological Survey and the Ohio Environmental Protection Agency began a water-quality reconnaissance of inland lakes and reservoirs in Ohio. Different lakes were selected yearly; sampled in the spring and late summer; and analyzed for chemical, biological, and physical characteristics. The data are compiled and presented in yearly or bi-yearly reports.

Seventeen lakes were selected in 1975 (fig. 1) to establish a general statewide data baseline. These data, methods of collection and analysis, individual lake discussions, and general limnological concepts are presented in the first report of this series (Tobin and Youger, 1977).

This report is the second in the series and presents data for 14 lakes (reservoirs) sampled in 1976 (fig. 2) and 14 lakes sampled in 1977 (fig. 3). The lakes sampled in 1976 are in the eastern half of Ohio, an area of generally moderate to moderately low sediment yields (fig. 4). The lakes sampled in 1977 were selected statewide.

The schedule shown in table 1 was used and differs from 1975 schedule in that hydrogen sulfide (H_2S) was changed from a laboratory to a field determination, and the number of phytoplankton collections was increased to include both euphotic-zone composites and zones of maximum dissolved oxygen saturation. In addition, chlorophyll a and 20-day biochemical oxygen demand (BOD) were determined in 1977. A list of earlier investigations of some of the selected lakes is presented in table 2.

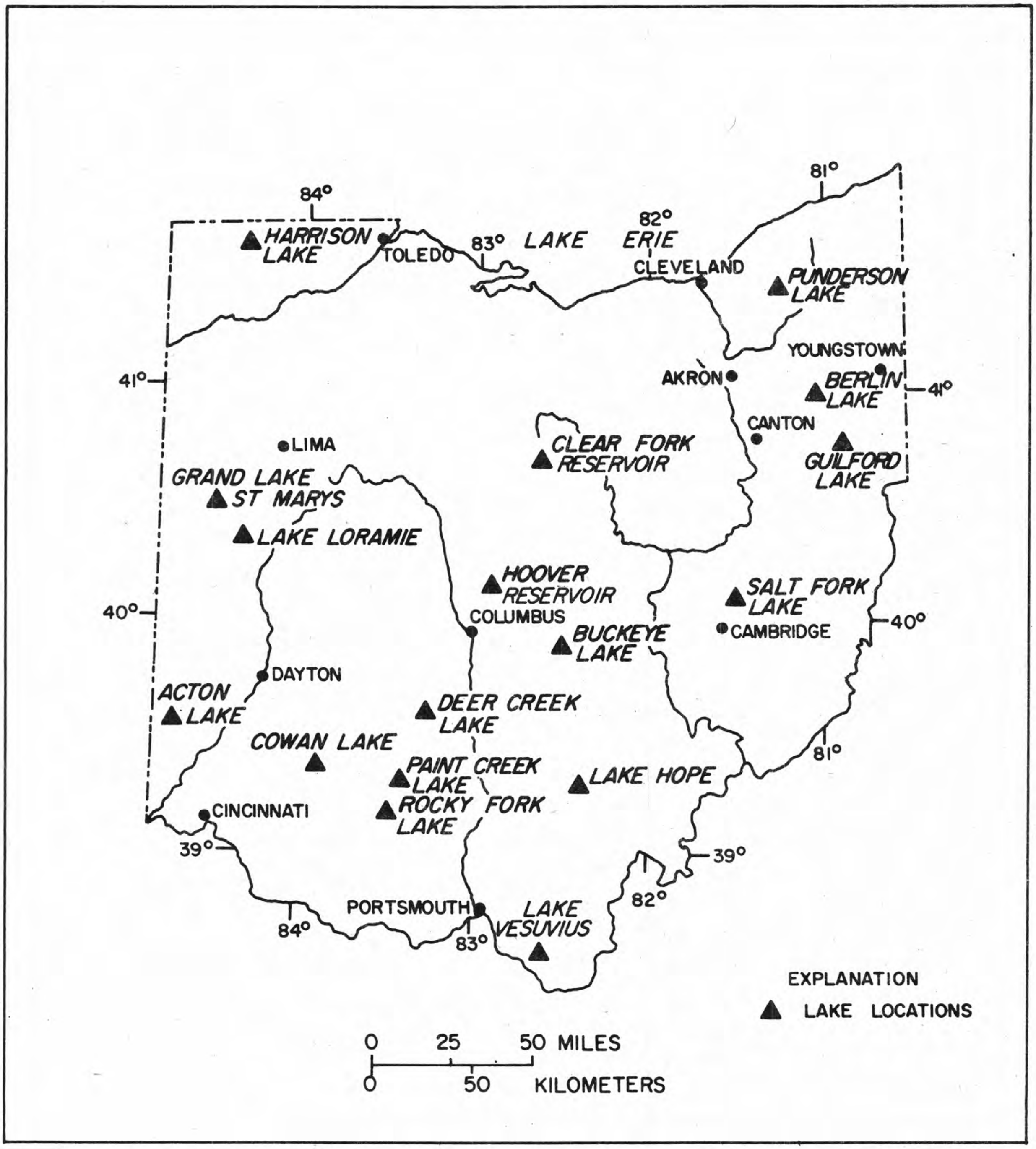


Figure 1.--Lakes sampled in Ohio during 1975 (from Tobin and Youger, 1977).

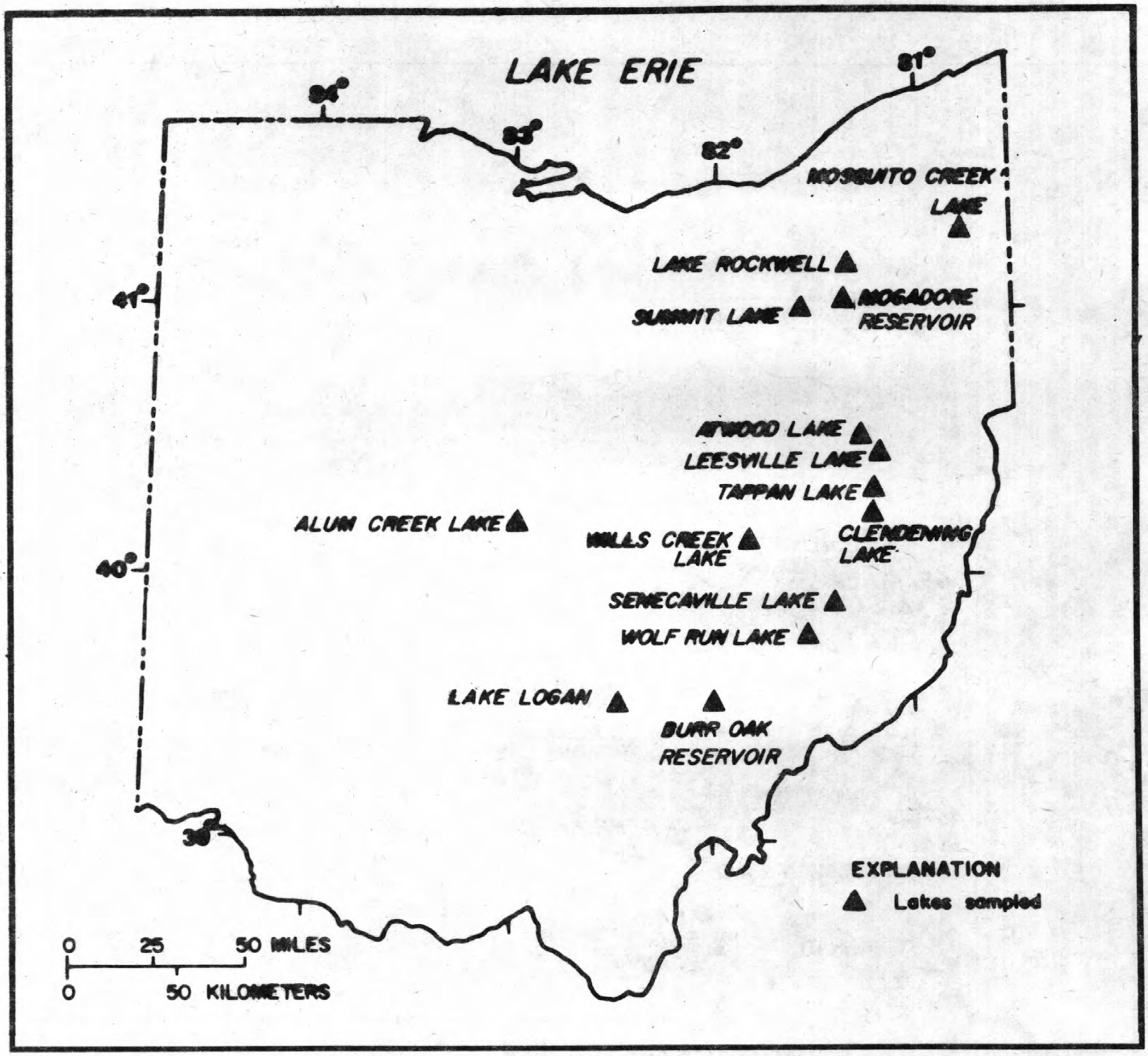


Figure 2.--Lakes sampled in Ohio during 1976.

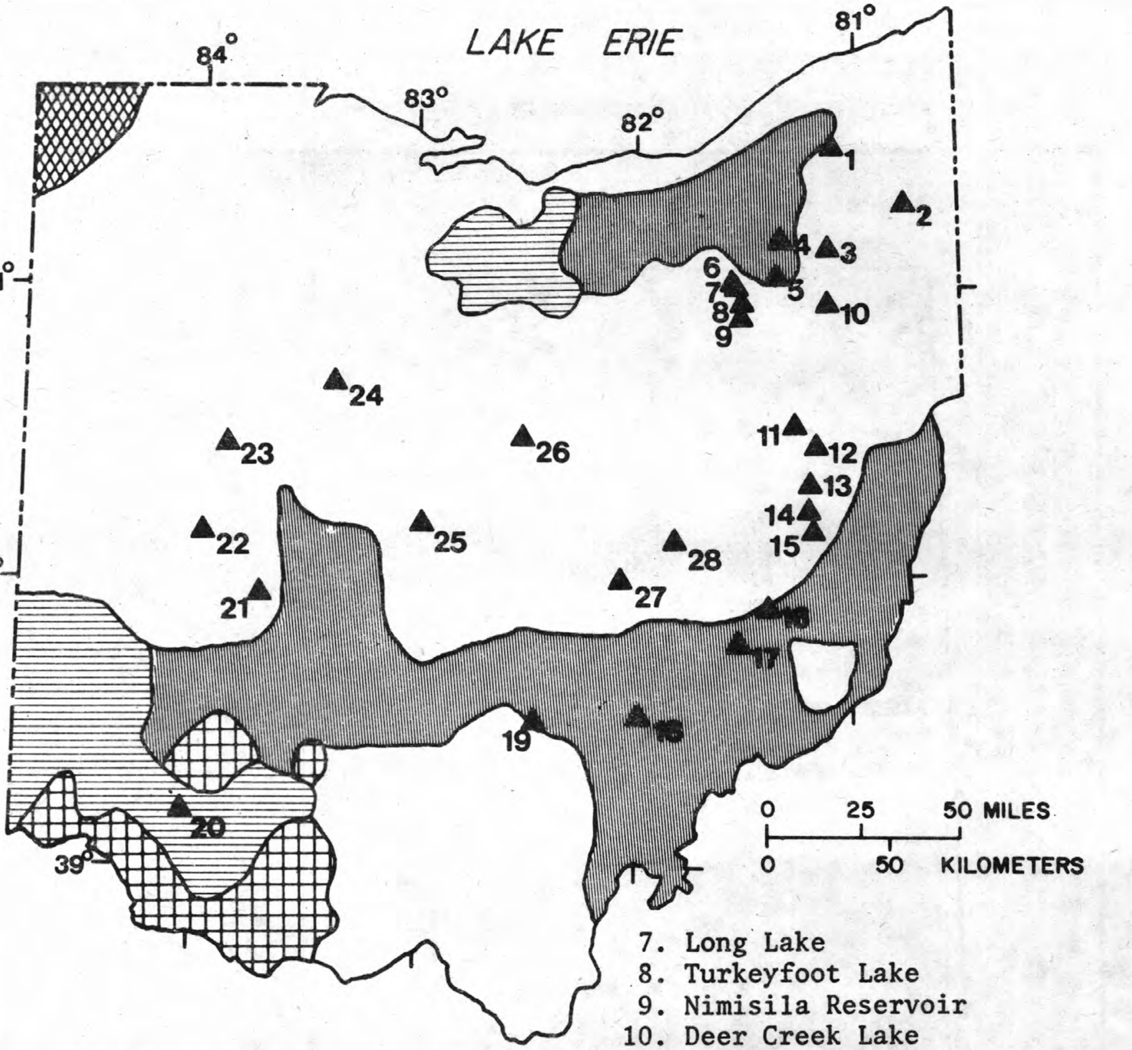
DATA SIGNIFICANCE

Three basic types of data were collected: physical, chemical, and biological. They are discussed in some detail in the first report (Tobin and Youger, 1977) and are summarized here for the convenience of the reader.

Figure 3.--Lakes sampled in Ohio during 1977.

Physical Measurements

Temperature.--An important physical parameter. Differences in water temperature, which determine water density, reduce vertical mixing and may lead to stratification (fig. 5).



EXPLANATION

SYMBOL	TONS/SQUARE MILES/YEAR	YIELD
	Less than 100	Low
	100-200	Moderately Low
	200-350	Moderate
	350-500	Moderately High
	Greater than 500	High
▲	Lake sampled	
4	Site identification	

1. East Branch Reservoir
2. Mosquito Creek Lake
3. Michael J. Kirwan Reservoir
4. Lake Rockwell
5. Mogadore Reservoir
6. Summit Lake
7. Long Lake
8. Turkeyfoot Lake
9. Nimisila Reservoir
10. Deer Creek Lake
11. Atwood Lake
12. Leesville Lake
13. Tappan Lake
14. Clendening Lake
15. Piedmont Lake
16. Senecaville Lake
17. Wolf Run Lake
18. Burr Oak Reservoir
19. Lake Logan
20. Stonelick Lake
21. Clarence J. Brown Reservoir
22. Kiser Lake
23. Indian Lake
24. Killdeer Reservoir
25. Alum Creek Lake
26. Knox Lake
27. Dillon Lake
28. Wills Creek Lake

Figure 4.--Estimated sediment yields for major drainage basins in Ohio (modified from Anttila and Tobin, 1976).

Table 1.--Sampling schedule, 1976 and 1977 Ohio lakes study.

Season	Location within water column	Temperature; dissolved oxygen; pH; specific conductance [1]	Nutrients: Major (HCO_3, TOC, N, P, SiO_2)	Nutrients: Trace (B, Co, Cu, Fe, Mn, Mo, Zn)	Oxygen demand: BOD	Oxygen demand: COD	Biological and physical characteristics: Fecal coliform and streptococci [1]	Phytoplankton identification and count [5]	Turbidity	Color	Suspended solids	Light penetration [1]	Major chemical constituents (Ca, Mg, K, Na, SO_4, Cl, F, DS)	Toxic and undesirable substances: As, Ba, Cd, Cr, Pb, Hg, Ni, Se, Ag, MBAS	H_2S [1]	Pesticides [2]
Spring	Profile (continuous with depth)	x										x				
	Near surface (2-ft depth)		x		x	x	x	[3] x	x	x					x	x
	Water column composite			x				x			x		x	x		
	Near bottom (1-3 ft from bed)		x		x	x	x		x	x					x	x
Late summer	Profile (continuous with depth)	x										x				
	Near surface (2-ft depth)		x		x	x	x	[3] x	x	x					x	x
	Water column composite							x								
	Near bottom (1-3 ft from bed)		x	[4] x	x	x	x		x	x				[4] x	x	x

1 Field determinations.
2 Pesticides listed on page 19
3 Taken from the depth of maximum DO saturation.
4 Selected constituents taken for additional information.
5 Chlorophyll a determined on 1977 lakes.

Table 2.--Publications on selected lakes in Ohio

1. Atwood Reservoir U.S. EPA, 1975a	7. Portage Lakes Cassidy and others, 1930 Kraatz, 1941 Mason, 1938
2. Burr Oak Lake Michalsby, 1971	8. Tappan Reservoir U.S. EPA, 1975e
3. Dillon Reservoir U.S. EPA, 1975b	9. General Dexter and others, 1942 Hahn, 1955 Hare, 1943 Kettelle and Uttormank, 1971 Roach, 1933 Sanderson, 1948 U.S. EPA, 1977 Wickliff, 1932 Wickliff, and Roach, 1936(a) Wickliff, and Roach, 1937(b)
4. Indian Lake U.S. EPA, 1975c	
5. Mogadore Reservoir Wickliff, 1945	
6. Mosquito Creek Reservoir U.S. EPA, 1975d	

Light.--Light penetration influences temperature, photosynthetic rates, photochemical reactions, and biological activities. Lake zones have been defined based on light penetration (fig. 6). Secchi disk extinction depths, when multiplied by a factor of 2.5 to 5.0, have been used to estimate the depth of the compensation level (Verduin, 1956).

Turbidity and suspended solids.--Turbidity is the qualitative measurement of the light-scattering ability of suspended matter in water. Suspended solids is the quantitative measurement of suspended matter. Turbidity and suspended solids are not directly related, although high values of either can affect the physiological functions of aquatic life (McKee and Wolf, 1971).

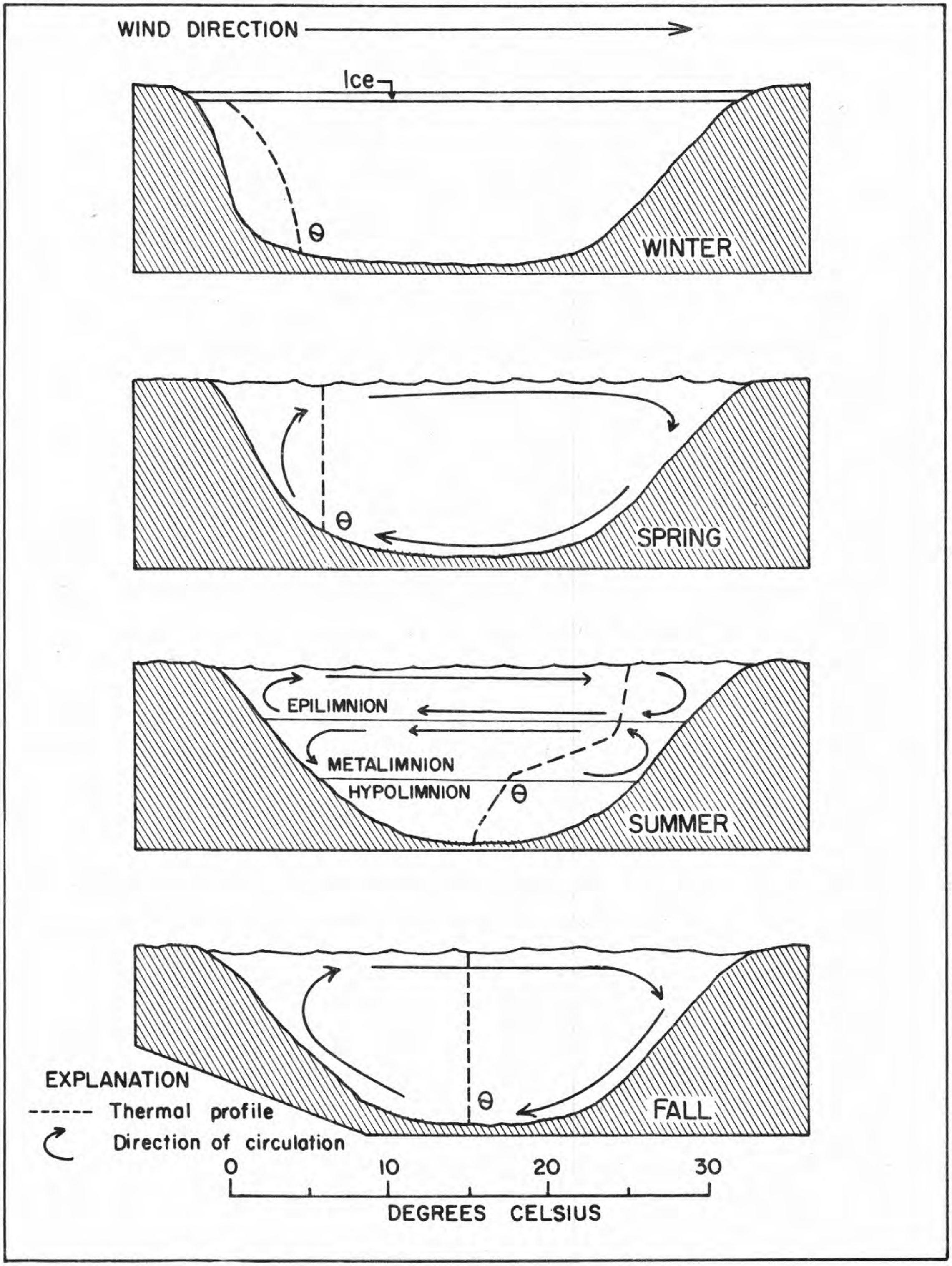
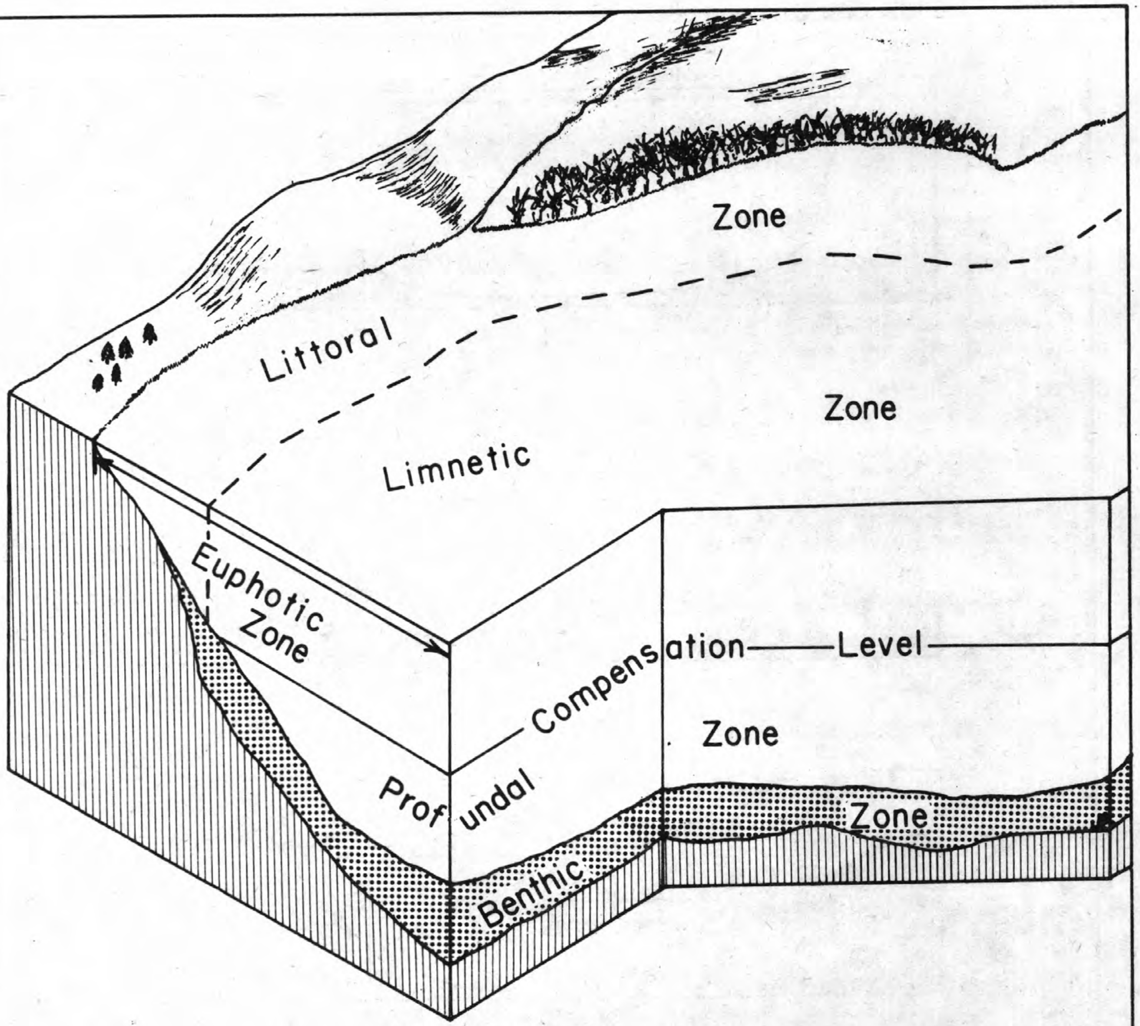


Figure 5.--Seasonal thermal profiles (Θ) and circulation patterns in a temperate-zone lake (modified from Britton and others, 1975, p. 4).



EXPLANATION

Littoral Zone - Shallow water area with sufficient light to support attached vegetation.

Limnetic Zone - Open water area whose base is defined by the 1-percent light-intensity level.

Euphotic Zone - The combined littoral and limnetic zones.

Profundal Zone - Zone of deep water where the light intensity is less than 1 percent of the surface light. Little or no photosynthesis occurs in this zone.

Benthic Zone - Lake bottom.

Compensation Level - Level at which oxygen production equals oxygen uptake.

Figure 6.--Major life zones in a lake (modified from Britton and others, 1975, p. 3).

Chemical Characteristics

Major constituents.--Major constituents in natural waters are derived mainly from the action of water containing atmospheric and (or) biologically recycled carbon dioxide (CO_2) on minerals and rocks (Hem, 1970). The most common major constituents are listed below:

Cations (positive charge)	Anions (negative charge)
Calcium (Ca)	Bicarbonate (HCO_3)
Magnesium (Mg)	Carbonate (CO_3)
Potassium (K)	Sulfate (SO_4)
Sodium (Na)	Chloride (Cl)
	Fluoride (F)

Data on the above provide a basis for the determination of hardness and geochemical typing used in this report (table 3).

Table 3.--Criteria used in the chemical classification of Ohio's lakes

Hardness (modified from Durfor and Becker, 1964, p. 27)		Major ions (modified from Piper and others, 1953, p. 26)	
Description	Bivalent cations (mg/L as $CaCO_3$)	Cations (in me/l)	Anions (in me/l)
soft	0- 60	Single cation used when it amounts to 50 percent or more of the total cations ....when the above does not exist then the highest two cations are used	Single anion used when it amounts to 50 percent or more of the total anions ....when the above does not exist then the highest two anions are used.
moderately hard	61-120		
hard	121-180		
very hard	>180		

An example might be ....a very hard calcium bicarbonate sulfate water

General organic indicators.--Organic substances are those compounds built around the carbon (C) atom. Although many such compounds may exist in natural waters, their concentrations are normally low and are reported in micrograms per liter (µg/L). Total organic carbon (TOC) is used as a broad-spectrum constituent to approximate the organic content in water.

Specific conductance.--Specific conductance is a measure of the property of water to conduct an electrical current and is reported in micromhos per centimeter at 25°C. It is sometimes used to estimate the dissolved-solids content of similar water types (Hem, 1970).

Hydrogen ion activity (pH).--The pH of water is a measure of the acid-base characteristics. Water free of dissolved matter has a pH of 7.0. Natural waters containing dissolved material normally range between 5.0 on the acid side to 9.0 on the basic side.

Nutrients.--Nutrients are those substances needed in relatively large quantities (macronutrients) and small quantities (micronutrients) for biological growth. A list of the more common nutrients is presented in table 4. Sawyer (1947) indicated that excessive algal growths may occur when inorganic nitrogen and phosphorus concentrations exceed 0.30 and 0.01 mg/L (milligrams per liter), respectively.

Toxic and undesirable substances.--These are substances in water which, when present at critical levels, can produce harmful or degrading effects on organisms that live in or use the water. The Ohio Environmental Protection Agency (1975), in its "Water Quality Standards for Ohio," has set forth the following criteria for selected constituents in water:

The following chemical pollutants shall not exceed the specified concentrations at any time:

Constituent*	Concentration mg/L	Concentration µg/L
Ammonia	1.5	-
Arsenic	-	50
Barium	-	800
Cadmium	-	5
Chloride	250	-
Chromium	-	300
Chromium (hexavalent)	-	50
Cyanide (free)	0.005	-
Cyanide	0.2	-
Fluoride	1.3	-
Foaming agents (MBAS)	0.5	-
Iron (dissolved)	-	1000
Lead	-	40
Manganese (dissolved)	-	1000
Mercury	-	.5
Oil and grease (hexane soluble)	5.	-
Phenols	-	10
Selenium	-	5
Silver	-	11

In addition, total copper and total zinc shall not exceed the following specified concentrations at any time:

	Hardness as mg/L of $CaCO_3$ 0-80	80-160	160-240	240-320	>320
Copper in µg/L	5	10	20	50	75
Zinc in µg/L	75	100	200	400	500

*Total unless otherwise indicated.

Table 4.--Common forms, minimum requirements, and some sources of elements essential for the growth of algae (from Britton and others, 1975, p. 7)

[The minimum nutrient requirements of algae in the aquatic environment are difficult to determine, and this uncertainty is shown by the wide range of concentrations in the table. "Trace" quantities generally refer to concentrations less than 1 mg/l, and more exact concentration requirements for these elements have not been determined. "Quantities always sufficient in surrounding medium" refers to those elements that are never below minimum concentrations so as to limit algal growth]

Element[1]	Symbol	Some common forms in water[1, 2]	Minimum requirements[3]	Examples of natural sources[1, 4]	Examples of manmade sources[5, 6, 7]
Aluminum....	Al	Al^{+3}, $AlSO_4$, AlO_2, (salts of aluminum)	Probably trace quantities	Clay minerals, silicate rock minerals	Domestic sewage, industrial wastes, mine drainage.
Boron	B	B, H_3BO_3	100 μg/l	Evaporite deposits, igneous rock minerals, springs, volcanic gases	Cleaning aids, detergents, industrial wastes, irrigation, sewage.
Calcium	Ca	Ca^{+2}, $CaCO_3$, $CaSO_4$	20 mg/l	Igneous rock minerals, rainwater, sedimentary rocks, soil	Industrial wastes (metallurgy, steelmaking), treatment plant wastes.
Carbon	C	CO_2, CO_3, HCO_3, H_2CO_3, $CaCO_3$	Quantities always sufficient in surrounding medium	Atmosphere, organic compounds and decay products, rainwater, soil	Industrial wastes (carbonation, metallurgy, pulp and paper, soda, and steelmaking), domestic sewage.
Chlorine	Cl	Cl^{-1}, (oxides of chlorine)	Trace quantities	Evaporite deposits, igneous rock minerals, ocean water, rainwater, sedimentary rocks, volcanic gases	Chlorinated hydrocarbon process, cleaning aids, industrial wastes (petroleum and refining), irrigation, salt mining.
Cobalt	Co	Co	500 μg/l	Coal ash, soil, ultramafic rocks	Manufacturing wastes (tools and instruments), metallurgy.
Copper	Cu	Cu^{+2}, Cu, $CuSO_4$	6.0 μg/l	Crustal rocks, ground water, marine animals	Industrial wastes (fabrication of pipes, refining, smelting), manufacturing wastes (electrical, foods), mill tailings, mine wastes, ore dumps, treatment plant wastes.
Hydrogen	H	H^+, H_2S, H_2O, HCO_3, H_2CO_3, OH	Quantities always sufficient in surrounding medium	Atmosphere, oxidation processes, rainwater, volcanic activity	Industrial wastes (hydrocarbon process), oils.
Iron.........	Fe	Fe^{+2}, Fe^{+3}, $FeSO_4$, $Fe(OH)_2$	0.65–6,000 μg/l	Ground water, igneous rock minerals, iron minerals, organic decomposition, soil	Acid drainage from mines, industrial wastes (steelmaking), iron ore mining, manufacturing wastes, oxides of iron metals (car bodies, refigerators).
Magnesium ...	Mg	Mg^{+2}, $MgSO_4$	Trace quantities	Igneous rock minerals, ground water, rainwater, sedimentary rocks	Irrigation, manufacturing wastes (transportation vehicles).
Manganese ...	Mn	Mn^{+2}, MnO_2	5.0 μg/l	Ground water, plants, rocks, soil, tree leaves	Acid drainage from coal mines, industrial wastes (steelmaking).

Table 4.--Common forms, minimum requirements, and some sources of elements essential for the growth of algae (from Britton and others, 1975, p. 7)--Continued

Element[1]	Symbol	Some common forms in water[1, 2]	Minimum requirements[3]	Examples of natural sources[1]	Examples of manmade sources[5, 6, 7]
Molybdenum . .	Mo	Mo, MoO_4	Trace quantities	Ground water, rocks, soil	Industrial wastes (electrical devices, metallurgy, steelmaking), manufacturing wastes (alloys).
Nitrogen	N	N, NO_2, NO_3, organic nitrogen, NH_3	Trace quantities to 5.3 mg/l	Atmosphere, bacterial and plant fixation, limestone, rainwater, soil	Agricultural wastes (feedlots, fertilizers), domestic sewage, industrial wastes, storm drainage.
Oxygen	O	O_2, H_2O, oxides	Quantities always sufficient in surrounding medium	Atmosphere, oxidation processes, photosynthesis, rainwater	Industry (metallurgy).
Phosphorus . . .	P	P^{+5}, PO_4, HPO_3, organic phosphorus	0.002–0.09 mg/l	Ground water, igneous and marine sediments, rainwater, soil, waterfowl	Agricultural wastes (feedlots, fertilizers), domestic sewage (detergents), industrial wastes.
Potassium	K	K^+ (salts of potassium)	Trace quantities	Evaporite deposits, igneous rock minerals, plant ash, sedimentary rocks	Agricultural wastes (feedlots, fertilizers), industrial wastes (preservatives, pulp ash).
Silicon	Si	Si^{+4}, SiO_2	0.5–0.8 mg/l	Diatom shells, igneous rock minerals, metamorphic rocks	Domestic sewage, industrial wastes.
Sodium	Na	Na^+, Na salts (NaCl, $NaCO_3$	5.0 mg/l	Ground water, igneous rock minerals, ocean water, soil	Industrial wastes (paper and pulp, rubber, soda, water softeners), manufacturing wastes (dyes and drugs).
Sulfur	S	SO_2, HS, H_2S, SO_4	5.0 mg/l	Animal and plant decomposition, igneous rocks, rainwater, sedimentary rocks, springs, volcanic activity	Agricultural wastes (fertilizers), industrial wastes (fuels, paper and pulp).
Vanadium	V	V^{+2}, V^{+3}, V^{+4}, V^{+5} (salts and oxides of vanadium)	Trace quantities	Ground water, plant ash	Industrial wastes.
Zinc.	Zn	Zn^{+2} (salts of zinc), ZnO_2	10–100 µg/l	Igneous and carbonate rock minerals	Industrial wastes (piping, refining), mine wastes.

1. Hem (1970).
2. McKee and Wolf (1971).
3. Greeson (1971).
4. Reid (1961).
5. Gurnham (1965).
6. Nebergall, Schmidt, and Holtzclaw (1963).
7. Sawyer and McCarty (1967).

Dissolved oxygen.--Dissolved oxygen is an important chemical constituent and symptomatic indicator of water quality. Oxygen concentrations in water are governed by water temperature, salinity, and barometric pressure (fig. 7). Oxygen is fundamental to all aerobic forms of life and a recommended "Floor level" minimum concentration of 4.0 mg/L is suggested for all waters supporting fish life (National Academy of Sciences, 1972). Oxygen concentrations may be significantly reduced in water through ambient biological and chemical processes. These processes are artificially measured by biochemical oxygen demand (BOD) and chemical oxygen demand (COD) determinations.

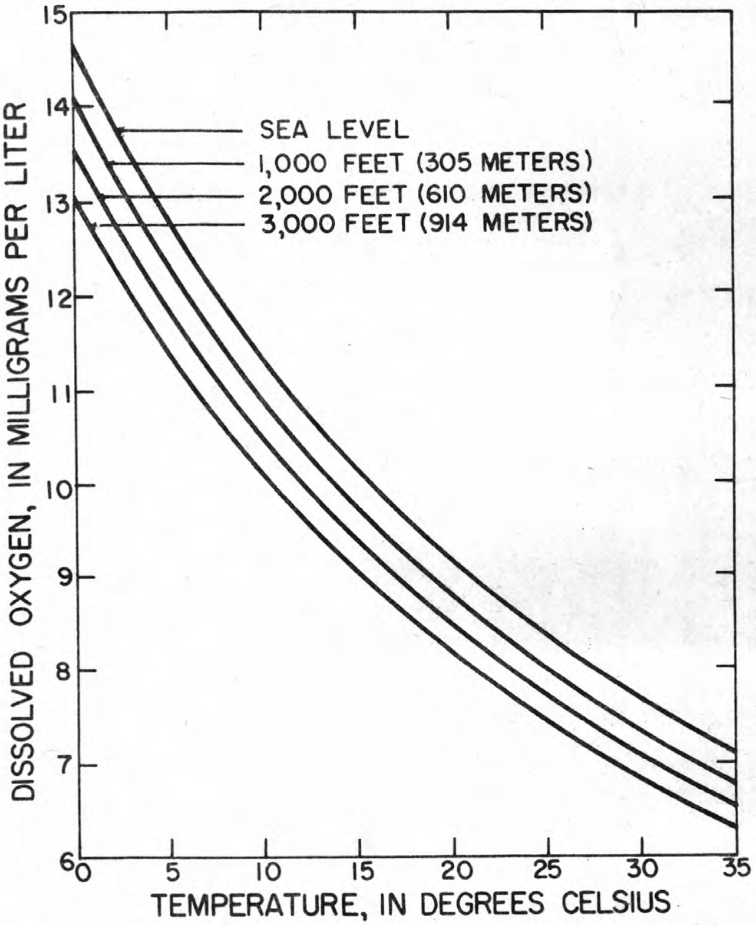


Figure 7.--Equilibrium values of dissolved-oxygen concentrations in low saline (less than 300 mg/L Cl^-) water at different elevations (pressures) and temperatures, based on values of Whipple and Whipple, (1911).

Other dissolved gases.--Those gases which originate largely from bio-geochemical recycling (Odum, 1971) such as carbon dioxide (CO_2), ammonia (NH_3), and hydrogen sulfide (H_2S).

Biological Determinations

Phytoplankton.--Phytoplankton (algae) are passive floating or weakly motile microscopic plants that inhabit the open waters of lakes and streams. Algae are primary producers, and their populations and cell densities may reflect and affect environmental conditions and nutrient availability (Hutchinson, 1967). The taxonomic classification used in this report follows Prescott (1970) and is listed below.

Chlorophyta ----------	green algae
Cyanophyta -----------	blue-green algae
Chrysophyta ----------	yellow-green or yellow-brown algae (includes diatoms)
Euglenophyta ---------	Euglenoids
Cryptophyta ----------	Cryptomonads (Cryptophyceae of some authors)
Pyrrhophyta ----------	Dinoflagellates
Rhodophyta -----------	red algae

A measure of the community diversity, as presented in Wilhm and Dorris (1968) and discussed in Slack and others (1973, p. 24), is used in this report. The diversity index, $\bar{d}$, is formulated as

$$\bar{d} = \sum_{i=1}^{s} \frac{n_i}{n} \log \frac{n_i}{n}$$

where n_i and n are individuals per taxon and total individuals in the sample, respectively, and s is the number of identifiable groups or taxa. Higher values of $\bar{d}$ indicate greater diversity within the sampled community.

Individual plankton cell size varies greatly among different phyla and within a given phylum. Consequently, the small cell size common in the phylum Cyanophyta may account, in part, for the very high algae densities observed in some lakes.

Bacteria.--The bacteria groups, fecal coliform and fecal streptococci, are used as indicators of sanitary conditions, and their ratio, FC/FS, may indicate their source (Federal Water Quality Administration, 1971).

The Ohio Environmental Protection Agency (1975) has set the following criteria for recreational waters designated for primary contact activities:

"Bacteria: The fecal coliform content (either MPN or MF count) not to exceed 200 per 100 ML as a monthly geometric mean based on not less than five samples per month; nor exceed 400 per 100 ML in more than 10 percent of all samples taken during a month."

DATA PRESENTATION

The 28 Ohio lakes (14 per year) surveyed for water-quality characteristics in 1976 and 1977 are listed in tables 5 and 6. The accompanying physical data were taken from various State and Federal reports, U.S. Geological Survey topographic maps, or available data. Primary lake and inflow sampling site identification numbers are generated from the latitude and longitude of their locations. For example, 410202080595100 is the identification number for a site, located at 41°02'02" latitude 080°59'51" longitude. For convenience, however, primary lake sites are identified as, L-1, and secondary sites as, L-2, L-3, etc. Inflow sites are labelled as I-1, I-2, etc.

The sampling in spring was scheduled in an attempt to gather data from well-mixed lakes subsequent to the basin runoffs of winter and early spring. Late summer sampling provided an opportunity to re-examine the same lakes for the effects of physical and biological stresses that occur during summer.

Data for the primary lake sites are presented in profile form and as tabulations for discrete water samples or water-column composites. Data from secondary lake-sampling sites are shown in profile form only. Computed saturation concentrations for dissolved oxygen (O_2)s are also included for comparison.

Table 5.--Morphometric data for lakes sampled in Ohio 1976

Type: Res - reservoir.
Use: FC - flood control; WS - water supply; Rec - recreation.
C/I: capacity divided by mean annual inflow - decreasing values indicate shorter hydraulic retention time.

Name and primary site identification number	Location (county)	Type (a)	Date of origin	Use (b)	Morphology: Surface area (acres)	Morphology: Depth: Maximum (feet)	Morphology: Depth: Mean (feet)	Morphology: Shore-line (miles)	Capacity (acre-feet)	Drainage area (miles)	Mean annual inflow (acre-feet)	Capacity inflow ratio C/I (c)
Alum Creek Lake 401121082575100	Delaware	Res	1974	FC	4852	78	28		134,800	123	80,400	1.68
				Rec								
				WS	3387	65	24		81,730			1.02
Atwood Lake 403141081165900	Tuscarawas Carroll	Res	1937	FC	2460	51	20		40,700	70	51,100	0.97
				Rec	1540	38	15	27.6	23,000			0.46
Burr Oak Res 393226082031900	Athens Morgan	Res	1952	FC	1192	57	23		26,900	33.1	23,900	1.13
				Rec								
				WS	664	38	14	20	9,300			0.39
Clendening Lake 401612081164000	Harrison	Res	1937	FC	2620	52	21		54,000	60.3	52,200	1.03
				Rec	1800	40	15	43.6	26,500			0.51
Lake Logan 393200082270200	Hocking	Res	1955	Rec	342	24	9	10	3,000	14.8	10,000	0.29
Lake Rockwell 411059081194900	Portage	Res	1914	WS	769	25	9.2	10.6	7,060	208	157,000	0.04
Leesville Lake 402814081113500	Carroll	Res	1937	FC	1470	58	25		37,400	48.3	37,900	0.99
				Rec	1000	43	20	27.6	19,500			0.51
Mogadore Res 410331081223900	Portage	Res	1939	WS Rec	1000	25	6.9	19	6,900	13.2	9,090	0.76
Mosquito Creek Lake 411806080452800	Trumbull	Res	1943	FC	8000	34	12		104,100	97.5	71,600	1.45
				Rec								
				WS	7850	31	10	39.9	82,400			1.15
Senecaville Lake 395530081255600	Guernsey Noble	Res	1937	FC	5170	39	17		88,500	118	94,800	0.93
				Rec	3550	29	12	47	43,500			0.46
Summit Lake 410323081324700	Summit	Res		WS	115	40	--	1.8	--	--	--	--
Tappan Lake 402129081133200	Harrison	Res	1936	FC	3100	44	20		61,600	71.1	54,200	1.14
				Rec	2350	34	15	41	35,100			0.65
Wills Creek Lake 400918081510200	Muskingum Coshocton	Res	1937	FC	11,450	59	17		196,000	842	657,000	0.30
				Rec	900	22	6.7	16.2	6,000			0.01
Wolf Run Lake 394727081324600	Noble	Res		WS Rec	220	55	33	8.5	7,200	5.7	4,290	1.68

Analytical data from the water column-composites were used for general chemical classification and background information. Unfiltered water samples were taken near the top and bottom of each lake during both visits and analyzed for the following pesticides:

Aldrin	Chlordane	Methoxychlor
DDD	Endrin	Malathion
DDE	Heptachlor	Parathion
DDT	Heptachlor-Epoxide	Methyl Parathion
Dieldrin	Lindane	BHC

Analyses from the lakes sampled during 1976 and 1977 showed no concentrations at or above detectable limits (0.005 µg/L).

Table 6.--Morphometric data for lakes sampled in Ohio, 1977

Type: Res - reservoir; Lk - lake.
Use: FC - flood control; WS - water supply; Rec - recreation.
C/I: capacity divided by mean annual inflow - decreasing values indicate shorter hydraulic retention time.

Name and primary site identification number	Location (county)	Type (a)	Date of origin	Use (b)	Morphology: Surface area (acres)	Morphology: Depth: Maximum (feet)	Morphology: Depth: Mean (feet)	Morphology: Shoreline (miles)	Capacity (acre-feet)	Drainage area (miles)	Mean annual inflow (acre-feet)	Capacity inflow ratio C/I (c)
C.J. Brown Res 395702083443000	Clark	Res	1974	FC	2,720	58	23		63,700	82	46,480	1.37
				Rec WS	2,120	47	17	11	36,900			0.79
Deer Creek Res 405815081071400	Stark	Res	1954	WS Rec	313	20	9.8	8	3,070	38	25,560	0.12
Dillon Lake 395930082050500	Muskingum	Res	1960	FC	10,280	69	27		274,000	742	567,600	0.48
				Rec	1,560	32	11	21.2	17,500			0.03
East Branch Res 413016081054200	Geauga	Res	1939	WS Rec	416	20	11	7.6	4,659	17.5	13,720	0.34
Indian Lake 402931083514700	Logan	Res	1853	WS Rec	6,130	12	7.6	29	46,300	99.8	61,540	0.75
Killdeer Res 404202083225800	Wyandot	Res	1972	WS Rec	253	38	26	2.4	6,670	--	--	--
Kiser Lake 401144083584700	Champaign	Res	1940	Rec	374	17	8.6	5.3	3,215	8.7	5,590	0.58
Knox Lake 402942082313100	Knox	Res	1954	Rec	474	25	6.9	12	3,280	31.4	23,900	0.14
Long Lake 410032081323000	Summit	Lk-Res	1830's	WS Rec	166	38	--	4.4	--	--	--	--
M.J. Kirwan Res 410921081045800	Portage	Res	1966	FC	3,240	57	24		78,700	80.5	77,460	1.02
				WS Rec	2,650	49	20	20	52,900			0.68
Nimisila Res 405544081313700	Summit	Res	1939	WS Rec	811	30	12	16	9,400	17.4	11,400	0.82
Piedmont Lake 401116081125500	Harrison Belmont Guernsey	Res	1937	FC	3,270	49	20		66,700	85.9	69,900	0.95
				Rec	2,270	38	15	36	34,500			0.49
Stonelick Lake 391258084045900	Clermont	Res	1948	Rec	171	21	10	9.5	1,750	23.3	18,900	0.09
Turkeyfoot Lake 405747081321700	Summit	Lk-Res	1830's	WS Rec	450	60	--	6.1	--	--	--	--

Data for phytoplankton identification (genus) and cell counts for each lake are included. The data are from water-column composites of the euphotic zone and point samples taken from zones of maximum dissolved oxygen concentration. Chlorophyll _a_ concentrations for samples taken in 1977 were determined by the Ohio Environmental Protection Agency Biomonitoring Laboratory.

SUMMARY AND CONCLUSIONS

A review of the data, and the summaries presented in tables 7-11, indicate the following:

1. Lake depth is a major controlling influence on water quality. Stable thermal gradients, which limit vertical mixing, did not develop in wind-exposed shallow lakes (depths less than 17 ft) during summer. These lakes (Indian and Kiser are examples) remained generally mixed. Lakes deeper than 17 ft developed seasonal thermal gradients, the stability and configuration of which were influenced by water-release patterns at the lake outlet.

2. Light transparency (secchi disk) ranged from 0.75 ft in Stonelick Lake to 21 ft in Mogadore Reservoir. Seventeen lakes had maximum transparency depths of 4 ft or less.

3. Dissolved oxygen supersaturation was common in the euphotic zones of many Ohio lakes. A maximum of 220 percent (17.4 mg/L) was recorded at Summit Lake on August 19, 1976. Dissolved oxygen depletion occurred in the bottom waters of all thermally stabilized lakes.

4. The 5-day BOD ranged from 0.3 mg/L in Michael J. Kirwan Reservoir to more than 17 mg/L in the bottom water of Nimisila Reservoir. Comparison of 20-day BOD curves for summer 1977 show that BOD was higher and rates more varied in the bottom samples than in surface samples of all thermally stabilized lakes.

5. Hydrogen sulfide was generated within all sustained anaerobic zones. Concentrations of H_2S increased with depth within these zones (see Logan, Leesville, Tappan, and Turkeyfoot Lakes) and was highest (11 mg/L) in Clendening Lake.

Table 7.--Summary of physical and chemical characteristics for the primary sites (L-1) of selected lakes in Ohio, 1976.

Lake name and site location	Maximum observed depth (feet)	Secchi disk transparency (feet)		Thermal stratification		Dissolved oxygen range [1] (mg/L)		pH range [1]		5-Day BOD range [1] (mg/L)	
		spring	summer	spring	summer	spring	summer	spring	summer	spring	summer
Alum Creek Lake above dam	60	8.5	11	no	yes	11.2-10.2	8.0-0.0	8.3-8.1	7.9-7.1	1.0-1.1	0.7-1.1
Atwood Lake above dam	30	4.1	3.0	slight	partial	10.2-4.3	8.1-0.0	8.0-6.6	8.0-6.7	1.6-2.4	2.5-1.9
Burr Oak Reservoir above dam	35	6.4	4.5	yes	partial	12.9-2.3	9.4-0.0	8.7-6.9	8.5-6.5	1.2	3.0-2.5
Clendening Lake above dam	35	3.3	3.3	slight	partial	11.7-1.5	8.0-0.0	8.6-7.2	8.5-7.1	2.7-1.7	2.5-6.8
Lake Logan above dam	24	3.7	2.0	yes	yes	10.9-8.0	9.2-0.0	8.0-7.0	8.2-6.8	1.9-1.5	4.9
Lake Rockwell above dam	23	4.1	3.3	slight	partial	10.4-7.2	12.3-0.0	8.1-7.4	8.7-6.9	2.0-1.6	3.0-2.2
Leesville Lake above dam	38	4.5	5.2	yes	partial	9.9-3.0	8.3-0.0	7.0-6.5	8.1-6.5	1.6-0.8	2.1-1.6
Mogadore Reservoir above dam	23	21	5.1	no	yes	8.8-8.6	12.4-0.0	7.8	9.0-7.1	0.8-0.6	2.0-0.8
Mosquito Creek Lake above dam	24	2.7	2.0	no	partial	10.3-10.0	9.1-0.0	7.9-7.8	8.4-6.6	1.0-1.0	4.0-1.8
Senecaville Lake above dam	22	3.2	2.6	yes	slight	14.6-5.7	10.2-6.0	8.7-7.7	8.4-7.1	2.2-1.9	2.7-1.8
Summit Lake near midpoint	38	2.8	2.1	yes	partial	10.5-0.0	17.8-0.0	8.4-7.3	8.8-7.1	3.8-4.2	6.2-0.1
Tappan Lake above dam	28	3.5	3.7	slight	partial	7.7-0.8	8.0-0.0	7.9-7.3	8.3-7.1	2.3-1.6	2.5-1.9
Wills Creek Lake above dam	15	1.5	1.5	partial	yes	13.6-11.0	12.5-2.4	8.6-7.9	8.5-7.1	4.0-4.6	4.0-2.2
Wolf Run Lake above dam	50	6.4	11	partial	yes	12.4-6.5	8.8-0.0	8.5-7.6	8.3-6.9	1.5-0.7	0.8-0.7

1 Water column data--near surface values shown first; single value used when near-surface and near-bottom values were equal.
2 Refer to table 3.
3 National Academy of Sciences, 1972.
4 Ohio EPA Regulation EP-1 Water Quality Standards.

6. The pH of vertically mixed lakes (most common in spring) ranged from 7.1 (East Branch Reservoir) to 8.5 (Kiser Lake). The pH in stratified lakes generally reflected the dominant type of biological activity in the stratum. High pH (maximum of 9.0 in Mogadore and Stonelick Lakes) occurred within the euphotic zones of many lakes during periods of high photosynthetic activity. Values of pH less than 7.0 (minimum of 6.4 in East Branch Reservoir) were common in many anaerobic zones. The maximum change in pH for a single profile (2.4 units) was observed in Stonelick Lake. Mean pH change and standard deviation within the water columns of primary sites in summer was 1.4 ± 0.4 units.

Table 7.—Continued.

TOC range [1] (mg/L)		Specific conductance range [1] (umhos)		Chemical typing (spring only) [2]		Substances at or above accepted limits		Total N (maximum concentration in mg/L)	Total P (maximum concentration in mg/L)	H_2S present
spring	summer	spring	summer	hardness	major ions	pesticides [3]	metals [4]			
6.8-7.1	5.8-8.1	435	460-492	hard	$CaHCO_3SO_4$	no	no	2.2	0.15	yes
6.2-5.1	6.1-10	222-220	255-285	mod. hard	$CaMgSO_4Cl$	no	no	1.6	0.28	yes
3.4-6.0	6.9-12	190-180	198-160	mod. hard	$CaSO_4HCO_3$	no	no	2.7	0.11	yes
6.9-10	6.1-12	605-655	718-810	very hard	$CaSO_4$	no	no	3.2	0.42	yes
5.4-2.5	7.9-11	130	162-287	mod. hard	$CaHCO_3SO_4$	no	no	5.8	0.23	yes
7.4-7.9	7.2-7.6	300-295	288-345	mod. hard	$CaHCO_3Cl$	no	yes (Cu)	1.4	0.16	yes
4.4-3.3	4.1-8.5	155-158	170-202	mod. hard	$CaHCO_3SO_4$	no	no	2.3	0.24	yes
3.8-4.1	7.3-8.1	318	265-320	hard	$CaHCO_3$	no	no	0.76	0.17	yes
7.3-7.0	7.8-8.0	220	240-283	mod. hard	$CaNaHCO_3SO_4$	no	no	0.98	0.08	no
4.6-7.0	4.7-6.8	325-350	340-365	hard	$CaHCO_3$	no	no	1.1	0.11	yes
6.8-6.0	---	915-1250	850-1150	very hard	NaCl	no	no	12	0.74	yes
2.4-3.7	6.5-9.9	620-635	625-668	very hard	CaSO4	no	no	1.7	0.26	yes
11	5.8-7.1	590-620	522-557	very hard	CaSO4	no	no	0.91	0.12	no
3.9-3.3	3.5-6.8	280-305	265-305	mod. hard	$CaHCO_3$	no	no	1.0	0.05	yes

7. All lakes had moderately hard to very hard waters. Calcium was the most common cation, and bicarbonate and sulfate were the most common anions. Summit Lake, which lies within the city limits of Akron, was the only NaCl type lake sampled during 1976-77. The copper concentration of 10 µg/L in Lake Rockwell (sampled while being treated for algae control) was the only concentration that exceeded State standards.

8. Specific conductance ranged from 130 µmhos per cm in Lake Logan to 1250 µmhos per cm in Summit Lake. Profile and other data (alkalinity, nutrient, etc.) show that specific conductance changed significantly with depth during periods of thermal stratification and that major chemical differences develop between thermally stabilized zones.

Table 8.--Summary of biological characteristics for the primary sites (L-1) of selected lakes in Ohio, 1976

Lake name and site location	Bacteria[1]				Phytoplankton											
					Dominant phylum and genus, and percent of total cell count											
					Spring						Summer					
	Fecal coliform (colonies per 100 ml)		Fecal streptococci (colonies per 100 ml)		Cells per ml	Composites from euphotic zone		Cells per ml	Samples from zone of maximum dissolved oxygen		Cells per ml	Composites from euphotic zone		Cells per ml	Samples from zone of maximum dissolved oxygen	
	spring	summer	spring	summer												
Alum Creek Lake above dam -----------	<2	<2-2	<2	54-2	590	Chrysophyta Cyclotella	80% 40%				2,100	Chlorophyta Sphaerocystic	65% 42%	3,400	Cyanophyta Aphanizomenon	72% 18%
Atwood Lake above dam ---------------	<2	<3	<2-4	<3-3	65,000	Cyanophyta Oscillatoria	77% 54%				190,000	Cyanophyta Oscillatoria	95% 52%	220,000	Cyanophyta Cylindrospermum	96% 40%
Burr Oak Reservoir above dam --------	<2-46	2-12	<2	<2-2	1,900	Cyanophyta Oscillatoria	46% 46%	1,600	Chrysophyta Melosira	47% 34%	130,000	Cyanophyta Lyngbya	> 99% 67%	120,000	Cyanophyta Aphanizomenon	100% 75%
Clendening Lake above dam -----------	<2	<2	<2	<2-2	210,000	Cyanophyta Oscillatoria	95% 95%				1,100,000	Cyanophyta Oscillatoria	> 99% 55%	340,000	Cyanophyta Cylindrospermum	98% 92%
Lake Logan above dam ----------------	<2	3-6	<2	3-<3	11,000	Cyanophyta Arthrospira	60% 56%				270,000	Cyanophyta Agmenellum	99% 71%	64,000	Cyanophyta Cylindrospermum	98% 64%
Lake Rockwell above dam -------------	<2-2	<2-2	<2	<2	20,000	Chrysophyta Cyclotella	48% 18%				96,000	Cyanophyta Raphidiopsis	65% 36%	70,000	Cyanophyta Oscillatoria	65% 40%
Leesville Lake above dam ------------	<2-18	<3-3	2-4	<3	42,000	Cyanophyta Oscillatoria	94% 94%				73,000	Cyanophyta Oscillatoria	98% 69%	49,000	Cyanophyta Aphanizomenon	96% 48%
Mogadore Reservoir above dam --------	<2	<2-12	<2	<2-50	1,000	Chlorophyta Schroederia	83% 83%				22,000	Cyanophyta Aphanizomenon	89% 33%	54,000	Cyanophyta Anabaena	87% 29%
Mosquito Creek Lake above dam -------	<2-2	<2-2	<2	2-8	51,000	Cyanophyta Anacystis	50% 46%				230,000	Cyanophyta Oscillatoria	89% 53%	650,000	Cyanophyta Oscillatoria	96% 76%
Senecaville Lake above dam ----------	<2	8-18	<2-2	<2-18	56,000	Cyanophyta Oscillatoria	53% 31%	62,000	Cyanophyta Oscillatoria	68% 68%	630,000	Cyanophyta Oscillatoria	98% 71%	260,000	Cyanophyta Oscillatoria	95% 64%
Summit Lake near midpoint -----------	48-4	240-77	72-12	<2-72	440,000	Cyanophyta Oscillatoria	95% 94%				300,000	Cyanophyta Oscillatoria	94% 75%	550,000	Cyanophyta Oscillatoria	94% 66%
Tappan Lake above dam ---------------	<2	2-<2	<2	2	110,000	Cyanophyta Oscillatoria	82% 81%				650,000	Cyanophyta Cylindrospermum	99% 70%	490,000	Cyanophyta Cylindrospermum	> 99% 56%
Wills Creek Lake above dam ----------	8	2-6	<2	2-12	72,000	Cyanophyta Oscillatoria	54% 43%				37,000	Cyanophyta Oscillatoria	92% 86%	95,000	Cyanophyta Oscillatoria	89% 66%
Wolf Run Lake above dam -------------	<2-2	2-12	<2	<2	2,500	Chrysophyta Dinobryon	100% 59%				8,700	Cyanophyta Aphanizomenon	83% 46%	4,100	Chrysophyta Fragilaria	59% 55%

[1] Water column data - near surface values shown first; single value used when near-surface and near-bottom values were equal.

9. The macronutrient concentrations in the lakes, especially nitrogen and phosphorus, were high. Biological conversions of inorganic nutrients into organic matter and reduced compounds (NH_3, H_2S, etc.) during spring and summer were common. Point-sample total nitrogen concentration was highest (12 mg/L as N) in Summit and Stonelick Lakes, and lowest (0.76 mg/L as N) in Mogadore Reservoir. Total phosphorus was highest (3.2 mg/L as P) in Stonelick Lake and lowest (0.02 mg/L as P) in Killdeer Reservoir.

10. The bacteria counts at the primary lake sites were low. Fecal coliform counts ranged from less than 2 to 240 per 100 ml, and streptococci counts ranged from less than 2 to 430 per 100 ml. All counts of fecal coliform were within State standards. Bacteria counts generally were highest in Summit Lake and East Branch Reservoir.

11. Phytoplankton densities were high in most lakes. Cell counts from euphotic-zone composite samples ranged from 180 cells per ml (58 percent Euglenophyta) in Killdeer Reservoir to 3,400,000 cells per ml (98 percent Cyanophyta) in Kiser Lake. Maximum counts were above 100,000 cells per ml in 19 lakes. Counts from depths of maximum dissolved oxygen saturation ranged from 910-4,200,000 cells per ml. Blue-green algae (Cyanophyta) dominated the phytoplankton communities of 18 lakes in spring and 26 lakes in summer. A comparison of algal dominance in 44 euphotic-zone composites versus samples from zones of maximum dissolved oxygen saturation showed phylum shifts in seven lakes and genus changes in 15 lakes.

Table 9.--Summary of physical and chemical characteristics for the primary sites (L-1) of selected lakes in Ohio, 1977.

Lake name and site location	Maximum observed depth (feet)	Secchi disk transparency (feet)		Thermal stratification		Dissolved oxygen range [1] (mg/L)		pH range [1]		5-Day BOD range [1] (mg/L)	
		spring	summer	spring	summer	spring	summer	spring	summer	spring	summer
C.J. Brown Reservoir above dam	40	4.0	5.0	no	yes	11.3-10.9	7.2-0.0	8.3	8.0-7.1	2.1-1.8	4.2-7.5
Deer Creek Reservoir above dam	20	3.0	2.4	yes	slight	11.5-0.2	7.7-0.0	8.5-6.8	7.9-7.0	3.4-1.6	1.9-2.3
Dillon Lake above dam	46	1.5	2.2	slight	slight	8.7-7.8	10.1-0.0	7.5-7.3	8.2-6.9	1.0-1.4	6.0-3.6
East Branch Reservoir above dam	20	2.8	3.0	no	partial	9.1-9.0	10.5-0.0	7.1	8.4-6.4	2.0-1.6	3.5-4.8
Indian Lake near Shawee Island	16	1.8	1.5	no	slight	9.5-9.1	9.3-5.4	8.3-8.2	8.3-7.7	7.6-7.5	6.1-5.5
Killdeer Reservoir at southwest corner	35	19	6.3	slight	yes	9.5-2.3	8.2-0.0	8.0-7.4	8.2-7.1	0.7-1.0	1.1-2.3
Kiser Lake above dam	12	2.1	1.2	no	slight	12.8-12.7	10.9-4.2	8.5	8.4-7.5	6.3	8.8-7.6
Knox Lake above dam	25	2.9	2.0	yes	partial	12.2-0.0	12.5-0.0	8.7-6.7	8.7-7.0	4.0-3.2	4.8-4.2
Long Lake at midpoint	38	2.8	2.4	yes	yes	18.6-0.8	10.9-0.0	8.8-7.3	8.4-6.8	6.4-1.9	3.7-4.2
M.J. Kirwan Reservoir above dam	50	3.5	4.5	slight	yes	11.9-9.6	8.6-0.0	7.9-7.4	7.9-6.7	1.0	0.3
Nimisila Reservoir above dam (L-1)	30	2.2	3.0	slight	yes	10.8-0.0	8.7-0.0	8.3-7.1	8.5-6.7	3.9-5.0	3.4->17
Piedmont Lake above dam	32	4.5	2.8	slight	yes	12.4-9.8	10.2-0.0	8.5-8.1	8.6-7.1	1.8-1.7	3.3-4.9
Stonelick Lake above dam	21	0.8	3.5	yes	yes	11.5-2.0	13.2-0.0	8.1-6.9	9.0-6.6	4.7-2.4	3.6-4.0
Turkeyfoot Lake at midpoint	60	2.1	3.7	yes	yes	18.4-0.4	8.5-0.0	8.9-7.4	8.2-6.9	7.5-5.3	2.8-4.8

1 Water column data--near surface values shown first; single value used when near-surface and near-bottom values were equal.
2 Refer to table 3.
3 National Academy of Sciences, 1972.
4 Ohio EPA Regulation EP-1 Water Quality Standards.

12. Comparison of inflow - lake data indicates that substantial quantities of nitrogen and phosphorus are transported into Ohio's lakes by their tributaries. The discharge-weighted mean concentration for nitrite plus nitrate and total phosphorus, based on an estimated mean discharge of 33 ft^3/s for 62 inflow samples, was 1.22 mg/L as N and 0.12 mg/L as P, respectively.

Table 9.--Continued.

TOC range[1] (mg/L)		Specific conductance range[1] (umhos)		Chemical typing (spring only)[2]		Substances at or above accepted limits		Total N (maximum concentration in mg/L)	Total P (maximum concentration in mg/L)	H_2S present
spring	summer	spring	summer	hardness	major ions	pesticides[3]	metals[4]			
6.0-4.1	4.2-7.7	565	470-620	very hard	$CaHCO_3$	no	no	5.7	0.55	yes
5.7-4.1	7.0-6.4	340-365	370-400	hard	$CaHCO_3SO_4$	no	no	3.3	0.06	yes
4.6-5.2	7.3-8.1	320-295	475-308	hard	$CaHCO_3$	no	no	3.3	0.23	yes
2.1-5.7	8.2-9.1	185	235-167	hard	$CaHCO_3SO_4$	no	no	2.3	0.11	yes
5.2-4.7	7.4-8.1	395	425-430	very hard	$CaMgHCO_3$	no	no	2.9	0.14	no
4.2-3.6	5.0-8.4	480-498	473-510	very hard	$CaHCO_3SO_4$	no	no	2.0	0.02	yes
4.2-4.4	7.9-10	370	360-380	very hard	$MgCaHCO_3$	no	no	4.3	0.12	no
6.3-8.2	6.0-8.1	240-222	275-350	mod. hard	$CaHCO_3$	no	no	11	0.85	yes
2.8-3.6	7.2-6.5	475-555	470-595	very hard	$CaHCO_3$	no	no	5.7	0.77	yes
3.8-3.0	4.9-6.0	358-365	380-385	hard	$CaMgHCO_3SO_4$	no	no	1.2	0.04	yes
5.9-9.1	6.9-7.4	390-420	355-480	hard	$CaHCO_3$	no	no	7.3	0.60	yes
6.0-4.9	7.5-6.2	990-1010	1000-1055	very hard	$CaSO_4$	no	no	1.7	0.29	yes
7.3-6.4	7.3-6.2	290-275	265-488	mod. hard	$CaHCO_3$	no	no	12	3.2	yes
7.1-6.9	7.6-9.1	410-475	420-515	hard	$CaHCO_3$	no	no	4.2	0.71	yes

The reconnaissance data were collected during two seasons only and may reflect representative spring and late summer conditions. The varying chemical distributions observed in many of the lakes demonstrate that care must be exercised when using data from a point source or within a given zone for water-quality assessment. More intensive studies are necessary before management decisions are made.

Table 10.--Summary of biological characteristics for the primary sites (L-1) of selected lakes in Ohio, 1977

Lake name and site location	Bacteria[1]				Phytoplankton															
					Dominant phylum and genus, and percent of total cell count															
	Fecal coliform (colonies per 100 ml)		Fecal streptococci (colonies per 100 ml)		Spring								Summer							
	spring	summer	spring	summer	Cells per ml	Chlorophyll a (ug/L)	Composites from euphotic zone		Cells per ml	Chlorophyll a (ug/L)	Samples from zone of maximum dissolved oxygen		Cells per ml	Chlorophyll a (ug/L)	Composites from euphotic zone		Cells per ml	Chlorophyll a (ug/L)	Samples from zone of maximum dissolved oxygen	
C.J. Brown Reservoir above dam -----	64-52	<2	20	<2	9,600	26	Chrysophyta Fragilaria	55% 35%	5,100	26	Euglenophyta Cryptomonas	55% 30%	130,000	--	Cyanophyta Aphanizomenon	100% 87%	290,000	32	Cyanophyta Aphanizomenon	100% 97%
Deer Creek Reservoir above dam -----	2	<2	<2	<2	8,200	28	Chrysophyta Cyclotella	47% 31%	15,000	38	Chrysophyta Cyclotella	34% 22%	460,000	22	Cyanophyta Anacystis	97% 43%	480,000	25	Cyanophyta Anacystis	98% 50%
Dillon Lake above dam --------------	10-54	<4-16	10-136	<4-120	1,900	2.7	Cyanophyta Oscillatoria	54% 42%	4,100	3.7	Cyanophyta Oscillatoria	50% 50%	160,000	41	Cyanophyta Oscillatoria	94% 93%	860,000	78	Cyanophyta Oscillatoria	99% 79%
East Branch Reservoir above dam ----	80-90	24-200	60-44	10-430	9,400	13	Chlorophyta Melosira (a Chrysophyte)	38% 19%	8,600	13	Chrysophyta Melosira	63% 27%	3,000,000	23	Cyanophyta Lyngbya	94% 48%	3,400,000	29	Cyanophyta Lyngbya	96% 70%
Indian Lake near Shawnee Island ----	<4	<3-3	2-<4	126-430	610,000	43	Cyanophyta Oscillatoria	92% 88%	730,000	72	Cyanophyta Oscillatoria	91% 87%	2,500,000	90	Cyanophyta Oscillatoria	97% 59%	1,500,000	93	Cyanophyta Oscillatoria	98% 60%
Killdeer Reservoir at SW corner ----	<2	<2-4	2	<2-6	180	3	Euglenophyta Cryptomonas	58% 48%	910	3	Chrysophyta Fragilaria	66% 44%	13,000	5.5	Cyanophyta Anacystis	78% 78%	12,000	5.4	Cyanophyta Anacystis	58% 58%
Kiser Lake above dam ---------------	<2	<2	2-<2	8	660,000	85	Cyanophyta Oscillatoria	90% 90%	560,000	39	Cyanophyta Oscillatoria	87% 73%	3,400,000	145	Cyanophyta Oscillatoria	97% 60%	4,200,000	149	Cyanophyta Oscillatoria	98% 84%
Knox Lake above dam ----------------	3-<9	<3-56	<3-3	<2-8	46,000	30	Chrysophyta Melosira	54% 44%	49,000	23	Cyanophyta Oscillatoria	37% 31%	320,000	46	Cyanophyta Oscillatoria	90% 31%	450,000	35	Cyanophyta Oscillatoria	91% 45%
Long Lake at midpoint --------------	2-<2	36-12	<2	26-12	270,000	87	Cyanophyta Oscillatoria	86% 84%	280,000	77	Cyanophyta Oscillatoria	83% 83%	860,000	46	Cyanophyta Cylindrospermum	98% 55%	470,000	35	Cyanophyta Oscillatoria	98% 64%
M.J. Kirwan Reservoir above dam ----	<2	2	<2-4	<2-2	3,200	5.6	Cyanophyta Oscillatoria	56% 56%	4,600	4.6	Cyanophyta Oscillatoria	93% 93%	1,800	4.3	Cyanophyta Anacystis	46% 40%	1,600	6.4	Cyanophyta Oscillatoria	58% 36%
Nimisila Reservoir above dam -------	2	72-12	2-<2	102-20	780,000	41	Cyanophyta Oscillatoria	100% 99%	390,000	31	Cyanophyta Oscillatoria	99% 97%	1,700,000	41	Cyanophyta Aphanizomenon	100% 69%	1,600,000	44	Cyanophyta Lyngbya	99% 69%
Piedmont Lake above dam ------------	<2-2	<2	2-<2	2-6	180,000	20	Cyanophyta Oscillatoria	90% 88%	210,000	16	Cyanophyta Oscillatoria	92% 91%	480,000	31	Cyanophyta Cylindrospermum	100% 82%	710,000	33	Cyanophyta Cylindrospermum	100% 57%
Stonelick Lake above dam -----------	3-24	4-8	6-9	12-14	6,000	38	Euglenophyta Cryptomonas	81% 52%	11,000	54	Euglenophyta Cryptomonas	77% 55%	59,000	24	Chlorophyta Sphaerocystis	93% 74%	91,000	21	Chlorophyta Sphaerocystis	83% 58%
Turkeyfoot Lake at midpoint --------	2-<2	12-<2	2	46-10	150,000	59	Cyanophyta Oscillatoria	64% 64%	590,000	62	Cyanophyta Oscillatoria	93% 93%	2,100,000	29	Cyanophyta Lyngbya	100% 71%	1,000,000	34	Cyanophyta Lyngbya	97% 55%

[1] Water column data - near surface values shown first; single value used when near-surface and near-bottom values were equal.

Table 11.--Partial chemical data summary of thirty-two inflows to twenty-two lakes, Ohio lakes study, 1976-77.

Constituent	Inflow samples: Mean and standard deviation N = 64	Inflow samples: Discharge weighted mean N = 62	Percent of inflow samples having values greater than related lake values at the 2-ft depth
NO_2+NO_3 as N in mg/L ---------------	0.60 ± 0.84	1.22	70
Total phosphorus as P in mg/L ------	0.07 ± 0.07	0.12	44
Total organic carbon in mg/L ------	6.0 ± 2.5	5.9	50
Specific conductance in umhos/cm ---	640 ± 474	493	88

N = number of samples.

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LAKES SAMPLED IN 1976

Alum Creek Lake

Location: Delaware County

Type : Reservoir; dam has multi-level release controls

Use: Flood control, water supply, and recreation

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1974	3387	81,730	1.02

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
123	agricultural, rural	moderately low

Lake data (figs. 8, 9; tables 12-15): Alum Creek Lake was sampled under clear skies on April 13 and overcast skies on August 27. The secchi-disk measurements at site L-1 of 8.5 ft in April and 12.5 ft in August, and low turbidity values indicate that the water transparency generally was high compared with that of other lakes in Ohio. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
April 13	no	no	hard Ca HCO_3 SO_4	no	no	no	Chrysophyta
August 27	yes	yes	--	no	--	no	Chlorophyta

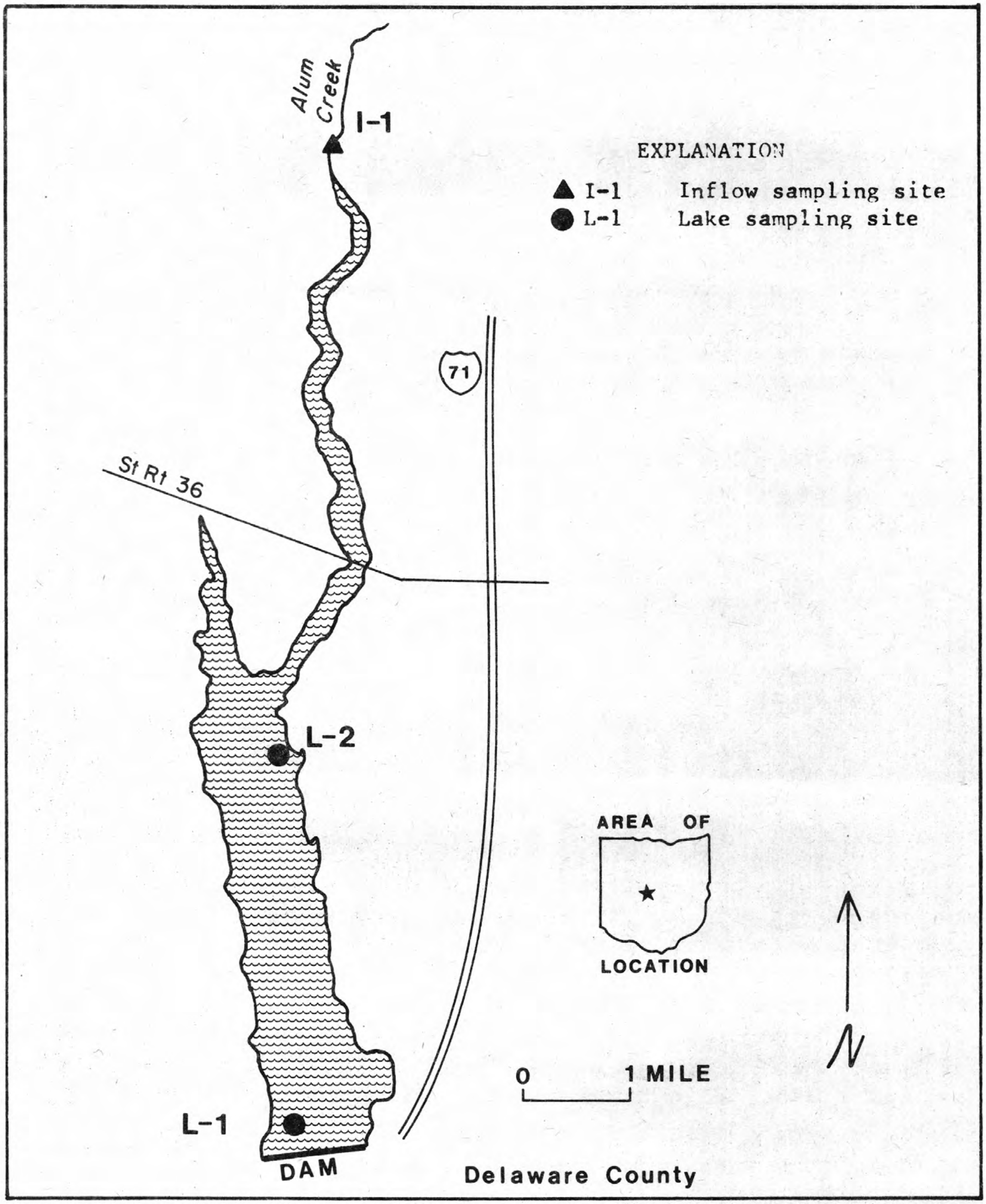

Figure 8.--Alum Creek Lake and inflow sampling site.

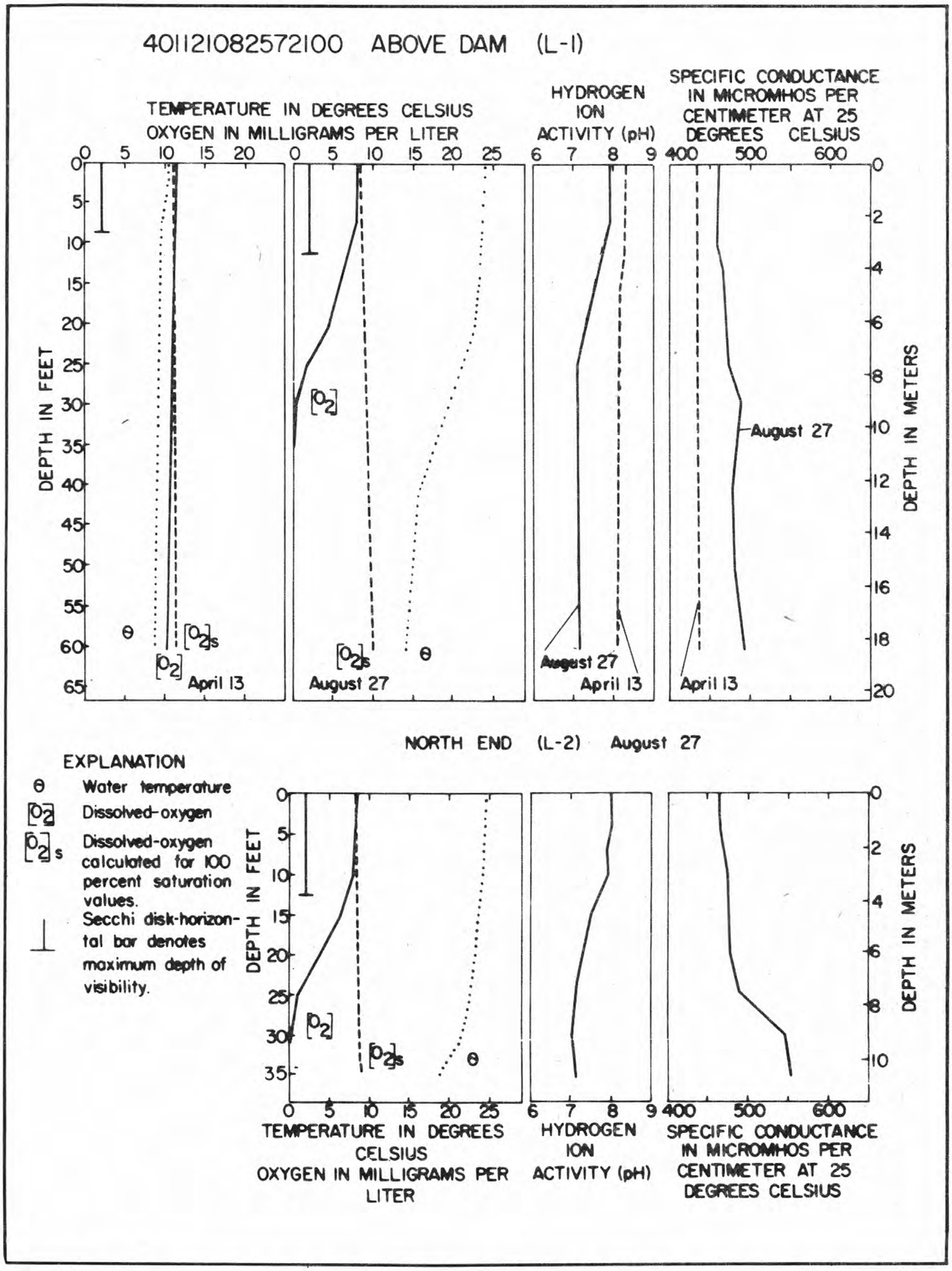

Figure 9.--Data profiles for Alum Creek Lake, Ohio on selected days in 1976.

Table 12.--Profile data for the primary lake site, Alum Creek Lake, Ohio

401121082575100 - ALUM CREEK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
13...	1330	.0	10.3	11.2	103	435	8.3	--	--	--	--	--
13...	1335	2.0	10.3	11.2	103	435	8.3	0	113	.9	.0	8.5
13...	1340	4.0	10.0	11.2	102	435	8.3	--	--	--	--	--
13...	1345	7.0	9.5	11.2	101	435	8.3	--	--	--	--	--
13...	1350	10	9.3	11.1	100	435	8.3	--	--	--	--	--
13...	1355	15	9.3	11.0	99	435	8.2	--	--	--	--	--
13...	1400	20	9.2	10.8	96	435	8.2	--	--	--	--	--
13...	1405	25	9.1	10.8	96	435	8.2	--	--	--	--	--
13...	1410	30	9.1	10.8	96	435	8.2	--	--	--	--	--
13...	1415	40	9.0	10.6	95	435	8.2	--	--	--	--	--
13...	1420	50	9.0	10.4	93	435	8.2	--	--	--	--	--
13...	1425	60	8.7	10.2	90	435	8.1	0	113	1.5	.0	--
AUG												
27...	1215	.0	23.8	7.9	96	462	7.9	--	--	--	--	--
27...	1220	2.0	23.8	7.9	96	462	7.9	0	132	2.6	.0	11
27...	1225	4.0	23.7	8.0	98	462	7.9	--	--	--	--	--
27...	1230	7.0	23.5	7.8	94	462	7.9	--	--	--	--	--
27...	1235	10	23.3	7.2	87	460	7.7	--	--	--	--	--
27...	1240	15	23.0	5.6	67	470	7.5	--	--	--	--	--
27...	1245	20	22.5	4.4	52	472	7.3	--	--	--	--	--
27...	1250	25	21.4	1.5	17	475	7.1	--	--	--	--	--
27...	1255	30	19.5	.2	2	488	7.1	--	--	--	--	--
27...	1300	40	15.5	.0	0	478	7.1	--	--	--	--	--
27...	1305	50	14.8	.0	0	480	7.1	--	--	--	--	--
27...	1310	60	14.0	.0	0	492	7.2	0	200	20	.8	--

Table 13.--Chemical analyses of water column composite samples, Alum Creek Lake, Ohio

401121082575100 - ALUM CREEK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 13...	1410	50	12	3.6	17	70	33	.2	170	275	25	300

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 13...	100	0	10	4	<.5	7	0	0	<10	.06

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 13...	40	1	10	140	50	11	10

Table 14.--Chemical, physical, and biological analyses of water samples from selected depths, Alum Creek Lake, Ohio

401121082575100 - ALUM CREEK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
13...	1335	2.0	.03	1.5	1.5	.04	.56	.60	.01
13...	1425	60	.03	1.5	1.5	.05	.63	.68	.01
AUG									
27...	1220	2.0	.04	.87	.91	.03	.40	.43	.01
27...	1310	60	.01	.00	.01	1.6	.60	2.2	.11

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
13...	.03	.4	2	10	7.1	1.0	13	<2	<2
13...	.02	.5	2	10	6.8	1.1	16	<2	<2
AUG									
27...	.04	.8	1	<5	5.8	.7	20	<2	54
27...	.15	5.3	8	25	8.1	1.1	28	2	2

Table 15.--Phytoplankton in Alum Creek Lake, Ohio

Sample description: Location	Date	Location in water column	Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Site L-1 above dam ----------	4-13-76	euphotic zone composite	590	2.8	Chrysophyta	80	Cyclotella (40); Asterionella (20); Ochromonas (8); Synedra (4); Nitzschia (4); Cymbella (4)
					Chlorophyta	8	Ankistrodesmus (4); Staurastrum (4)
					Euglenophyta	8	Cryptomonas (4); Trachelomonas (4)
					Pyrrhophyta	4	Glenodinium (4)
Site L-1 above dam ----------	8-27-76	euphotic zone composite	2100	2.1	Chlorophyta	65	Sphaerocystic (42); Dictyosphaerium (16) Ankistrodesmus (3); Oocystis (2); Chlamydomonas (2)
					Cyanophyta	30	Oscillatoria (30)
					Euglenophyta	4	Cryptomonas (3); Trachelomonas (1)
					Pyrrhophyta	1	Ceratium (1)
					Chrysophyta	<1	Cyclotella
Site L-1 above dam ----------	8-27-76	4-ft depth	3400	3.3	Cyanophyta	72	Aphanizomenon (18); Anabaena (15); Anacystis Incerta (14); Gomphosphaeria (12); Cylindrospermum (8); Lyngbya (5)
					Chlorophyta	22	Sphaerocystis (10); Oocystis (9); Crucigenia (2); Chlamydomonas (1)
					Euglenophyta	5	Chroomonas (3); Cryptomonas (1); Trachelomonas (1)
					Chrysophyta	4	Fragilaria (3); Ochromonas (1)

* Less than 1 percent not given.

The lake was well mixed in April, but thermally and chemically stratified in August. The August data at site L-1 show differences in bicarbonate and macronutrient concentrations between surface and bottom samples. A hydrogen sulfide odor was detected within the anaerobic zone below 30 ft, and ammonia generation from nutrient recycling occurred near the lake bottom. Lake BOD was low when compared with other Ohio lakes.

The August profiles at sites L-1 and L-2 show similar chemical conditions above 20 ft at both sites. The increase in specific conductance below 20 ft at site L-2 probably reflects the influence of water of higher specific conductance entering from Alum Creek.

Nitrogen and phosphorus concentrations were sufficient for nuisance algae growths, although no such growth was evident during either visit. The phytoplankton composite samples were dominated by diatoms (Chrysophyta) in April and green algae (Chlorophyta) in August. Blue-green (Cyanophyta) genera dominated the collection from 4 ft in August.

Inflow data (fig. 8; table 16): Alum Creek, the principal tributary to Alum Creek Lake, was sampled at site I-1. Drainage area at the site is 75 mi^2, which is 61 percent of the lake drainage basin. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1976)	Discharge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Alum Creek at site I-1	April 13	E 25	lake	lake	stream	stream
	August 27	< 5	stream	stream	stream	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Cladophora (green algae) and *Batrochiospermum* (red algae) were observed at site I-1 in April.

Table 16.--Physical and chemical data for selected inflows, Alum Creek Lake, Ohio

401949082572100 - ALUM C AB ALUM CREEK LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR												
13...	1125	E25	9.5	12.8	8.4	775	2	10	11	.10	.23	.02
AUG												
27...	0950	<5.0	20.0	6.5	7.6	900	30	35	8.8	.94	.85	.10

E - estimate.

Atwood Lake

Location: Tuscarawas and Carroll Counties

Type: Reservoir; dam has multi-level release controls

Use: Flood control and recreation

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1937	1540	23,600	0.46

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
70	agricultural, rural	moderately low

Lake data (figs. 10, 11; tables 17-20): Atwood Lake was sampled under overcast skies on May 17 and clear skies on August 30. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
May 17	slight	slight	moderately hard Ca Mg SO_4 Cl	no	no	no	Cyanophyta
August 30	partial	yes	--	no	--	no	Cyanophyta

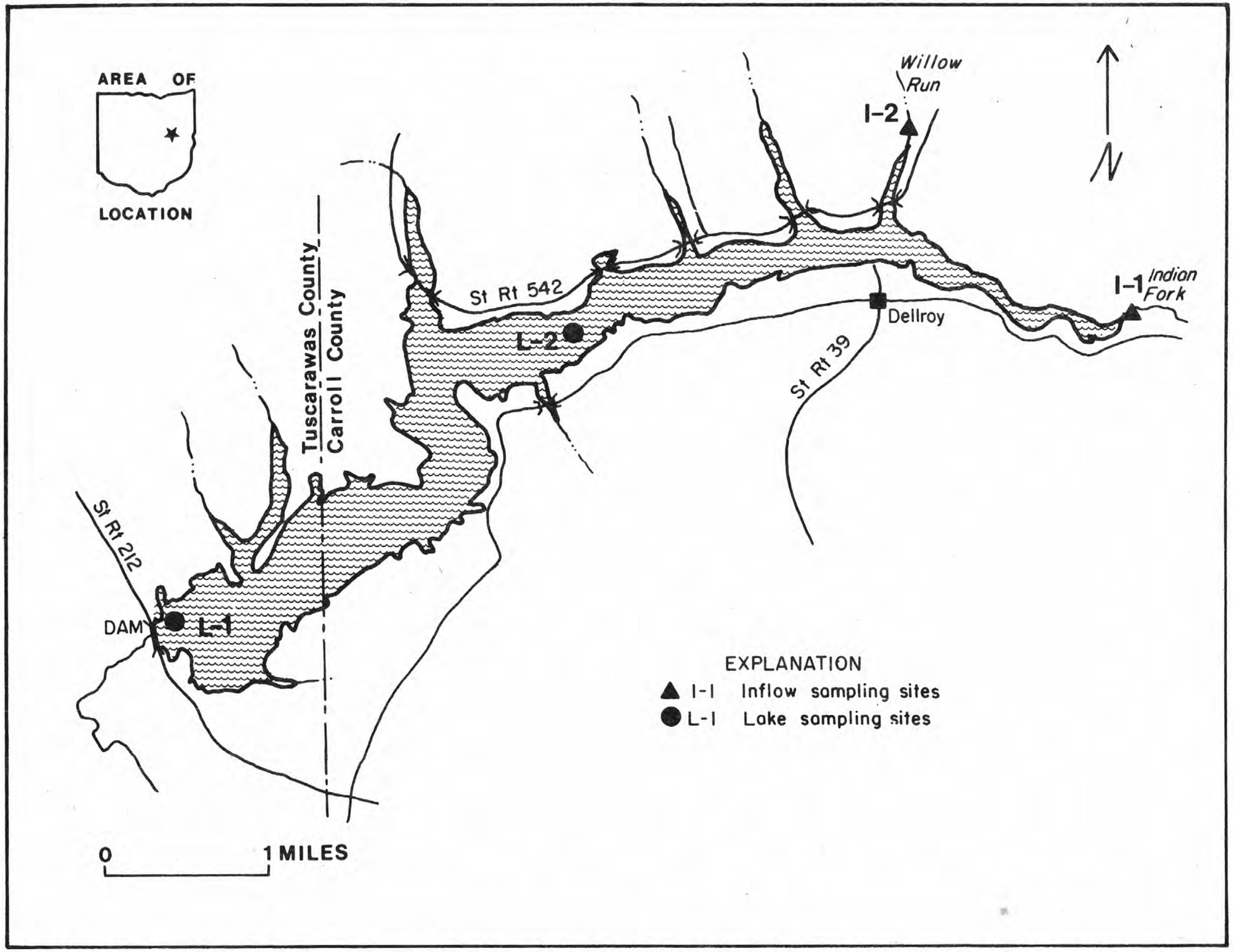

Figure 10.--Atwood Lake and inflow sampling sites.

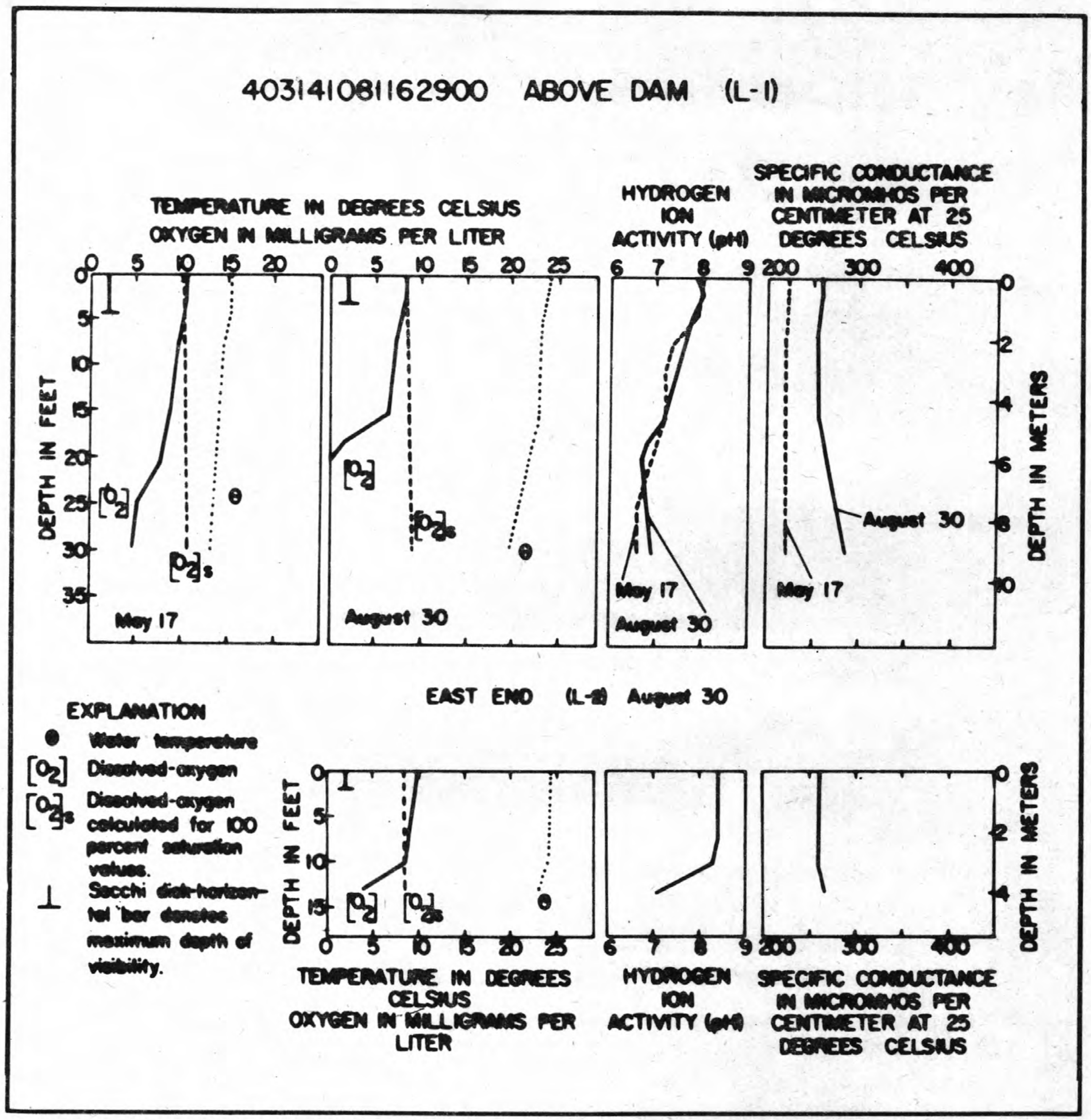

Figure 11.--Data profiles for Atwood Lake, Ohio, on selected days in 1976.

Table 17.--Profile data for the primary lake site, Atwood Lake, Ohio

403141081165900 - ATWOOD LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
MAY												
17...	1305	.0	15.0	10.2	104	222	8.0	--	--	--	--	--
17...	1310	2.0	15.0	10.2	104	222	8.0	0	36	.6	.0	4.1
17...	1315	4.0	15.0	10.0	102	222	7.9	--	--	--	--	--
17...	1320	7.0	14.3	9.3	93	220	7.4	--	--	--	--	--
17...	1325	10	14.1	8.9	89	220	7.2	--	--	--	--	--
17...	1330	15	14.0	8.8	88	220	7.2	--	--	--	--	--
17...	1335	20	13.5	7.4	73	220	6.9	--	--	--	--	--
17...	1340	25	13.0	4.8	47	220	6.6	--	--	--	--	--
17...	1345	30	13.0	4.3	42	222	6.6	0	37	15	.0	--
AUG												
30...	1510	.0	24.0	8.0	98	260	7.9	--	--	--	--	--
30...	1515	2.0	23.9	8.1	99	260	8.0	0	56	.9	.0	3.0
30...	1520	4.0	23.2	7.6	92	255	7.8	--	--	--	--	--
30...	1525	7.0	22.9	7.1	85	255	7.6	--	--	--	--	--
30...	1530	10	22.9	6.9	82	255	7.4	--	--	--	--	--
30...	1535	15	22.9	6.1	73	255	7.2	--	--	--	--	--
30...	1538	18	21.9	1.4	16	260	6.8	--	--	--	--	--
30...	1540	20	21.3	.0	0	265	6.7	--	--	--	--	--
30...	1545	25	20.5	.0	0	275	6.8	--	--	--	--	--
30...	1550	30	19.6	.0	0	285	6.9	0	88	18	1.4	--

Table 18.--Chemical analyses of water column composite samples, Atwood Lake, Ohio

403141081165900 - ATWOOD LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
MAY												
17...	1330	19	6.5	2.0	12	34	23	.1	74	139	22	161

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
MAY										
17...	0	0	<10	5	<.5	3	0	0	<10	.08

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
MAY							
17...	30	1	0	270	200	0	20

Table 19.--Chemical, physical, and biological analyses of water samples from selected depths, Atwood Lake, Ohio

403141081165900 - ATWOOD LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
MAY									
17...	1310	2.0	.01	.44	.45	.04	.41	.45	.00
17...	1345	30	.01	.48	.49	.13	.47	.60	.01
AUG									
30...	1515	2.0	.01	.00	.01	.08	.32	.40	.01
30...	1550	30	.01	.00	.01	1.0	.60	1.6	.10

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
MAY									
17...	.03	5.0	3	20	6.2	1.6	10	<2	<2
17...	.07	6.1	15	30	5.1	2.4	12	<2	4
AUG									
30...	.04	4.2	3	10	6.1	2.5	12	<3	<3
30...	.28	8.2	45	100	10	1.9	22	<3	3

Table 20.--Phytoplankton in Atwood Lake, Ohio

Sample description: Location	Date	Location in water column	Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Site L-1 above dam ----------	5-17-76	euphotic zone composite	65,000	2.2	Cyanophyta	77	Oscillatoria (54); Anacystis (17); Agmenellum (6)
					Chrysophyta	19	Nitzschia (8); Melosira (7); Cyclotella (4); Synedra; Ochromonas
					Chlorophyta	3	Scenedesmus (2); Tetrastrum (1); Ankistrodesmus; Chodatella; Tetraedron
					Euglenophyta	< 1	Cryptomonas; Trachelomonas
Site L-1 above dam ----------	8-30-76	euphotic zone composite	190,000	2.0	Cyanophyta	95	Oscillatoria (52); Agmenellum (20); Raphidiopsis (14); Anacystis (9); Anabaena
					Chlorophyta	3	Ankistrodesmus (2); Crucigenia (1); Carteria; Chlamydomonas
					Chrysophyta	< 1	Rhizosolenia; Achnanthes; Cymbella; Nitzschia; Mallomonas; Ochromonas
					Euglenophyta	< 1	Trachelomonas
					Pyrrhophyta	< 1	Peridinium
Site L-1 above dam ---------	8-30-76	2-ft depth	220,000	1.9	Cyanophyta	95	Cylindrospermum (40); Agmenellum (32); Oscillatoria (21); Anacystis (2)
					Chlorophyta	5	Scenedesmus (3); Ankistrodesmus (2)

* Less than 1 percent not given.

The thermal gradient in May had reduced vertical mixing, thus contributing to the decreases with depth in dissolved oxygen and pH. A thermally stabilized anaerobic condition below 16 ft existed at site L-1 in August. A hydrogen sulfide odor was detected at 20 ft and confirmed near the lake bed. A comparison of top and bottom data show ammonia production and an increased bicarbonate (HCO_3) concentration within the anaerobic zone. The small differences in profile data between site L-1 and L-2 suggest that lateral mixing occurred within the epilimnion.

Inorganic nitrogen levels in May exceeded the minimum concentration (0.30 mg/L as N) considered sufficient for nuisance algae growths. Inorganic phosphorus concentrations at 2 ft were low in May and August, but the higher phosphorus concentrations near the lake bottom suggests recycling within this zone. High cell counts of the blue-green genus, Oscillatoria, existed in the May and August composite samples; diatoms, which accounted for 19 percent of the cell count in May, accounted for less than 1 percent in August. The blue-green alga, Cylindrospermum, was not detected in the August composite, but they did account for 40 percent of the 220,000 cells from the 2-ft depth. Zooplankters were observed in all lake-water collections.

Inflow data (fig. 10; table 21): Two inflows were sampled; Indian Fork (site I-1), which drains 37 mi²; and Willow Run (site I-2), which drains 8.6 mi². The streams drain 53 and 12 percent, respectively, of the drainage area to Atwood Lake. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1976)	Dis-charge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Indian Fork at site I-1	May 17	< 10	stream	stream	stream	stream
	August 31	< 5	stream	stream	lake	stream
Willow Run at site I-2	May 17	< 5	lake	stream	lake	stream
	August 31	E 3	stream	stream	same	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Table 21.--Physical and chemical data for selected inflows, Atwood Lake, Ohio

403304081102800 - INDIAN F AB ATWOOD LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
MAY 17...	1235	<10	17.0	6.3	7.0	305	20	40	11	1.1	1.1	.20
AUG 31...	1000	<5.0	15.0	7.4	7.3	510	15	25	5.4	1.0	.75	.16

52

403414081114400 - WILLOW RN AB ATWOOD LK AT SITE (I-2)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
MAY 17...	1300	<5.0	17.0	8.2	7.1	270	20	40	3.1	.22	.53	.06
AUG 31...	0940	E3.0	14.5	7.9	7.0	475	20	25	6.1	.16	.35	.05

E - estimate.

Burr Oak Reservoir

Location: Athens and Morgan Counties

Type: Reservoir; dam has multi-level release controls

Use: Flood control, recreation, and water supply

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1952	664	9300	0.39

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
33.1	agricultural, rural	moderate

Lake data (figs. 12, 13; tables 22-25): Burr Oak Reservoir was sampled in partly cloudy weather on April 22 and under clear skies on September 8. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient) ther-mal	Stratification (gradient) chem-ical	Chemical type	Substances at or above State limits pesti-cides	toxi-cants	bac-teria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
April 22	yes	slight	moderately hard Ca SO_4 HCO_3	no	no	no	Cyanophyta Chrysophyta
September 8	partial	yes	--	no	--	no	Cyanophyta

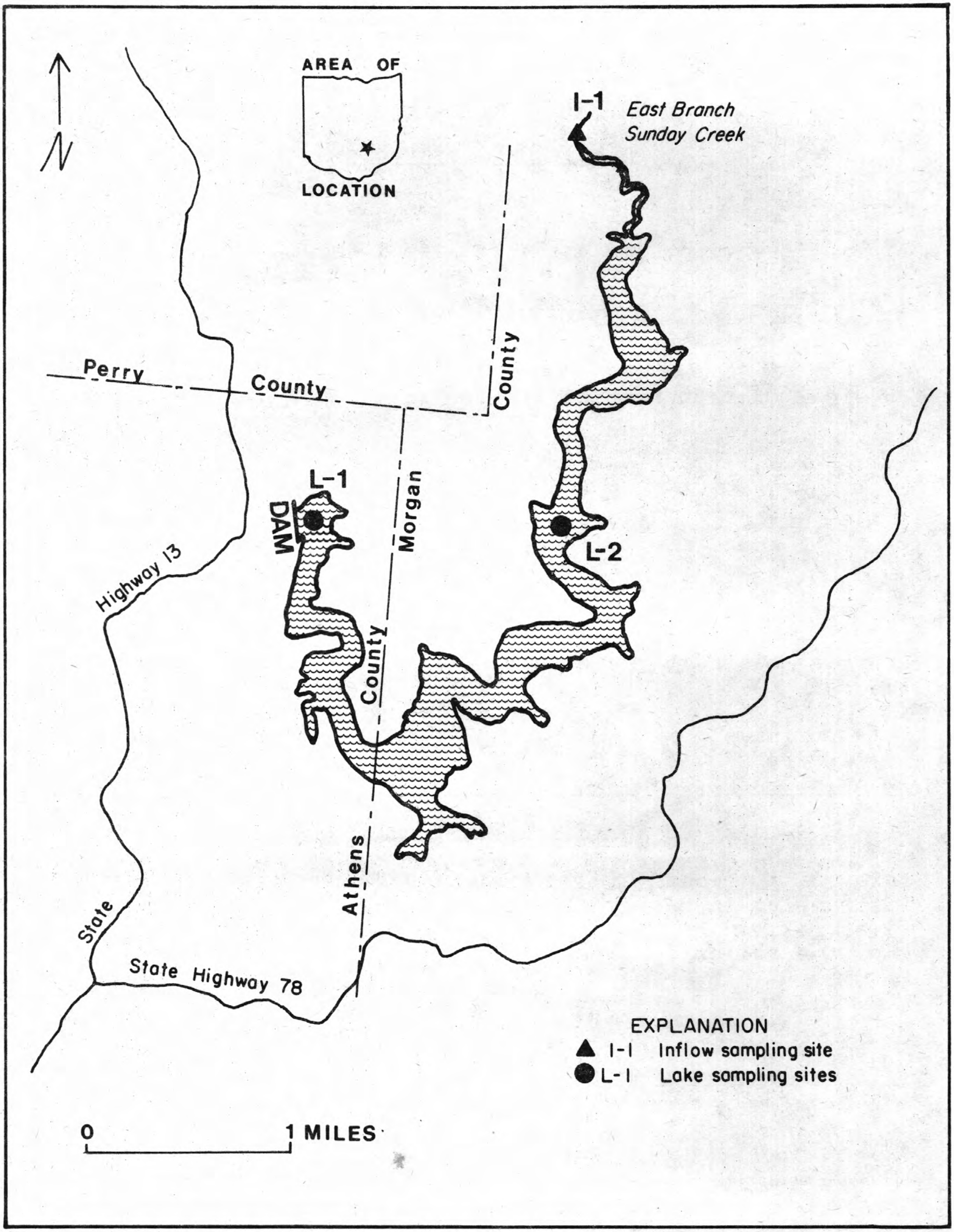

Figure 12.--Burr Oak Reservoir and inflow sampling sites.

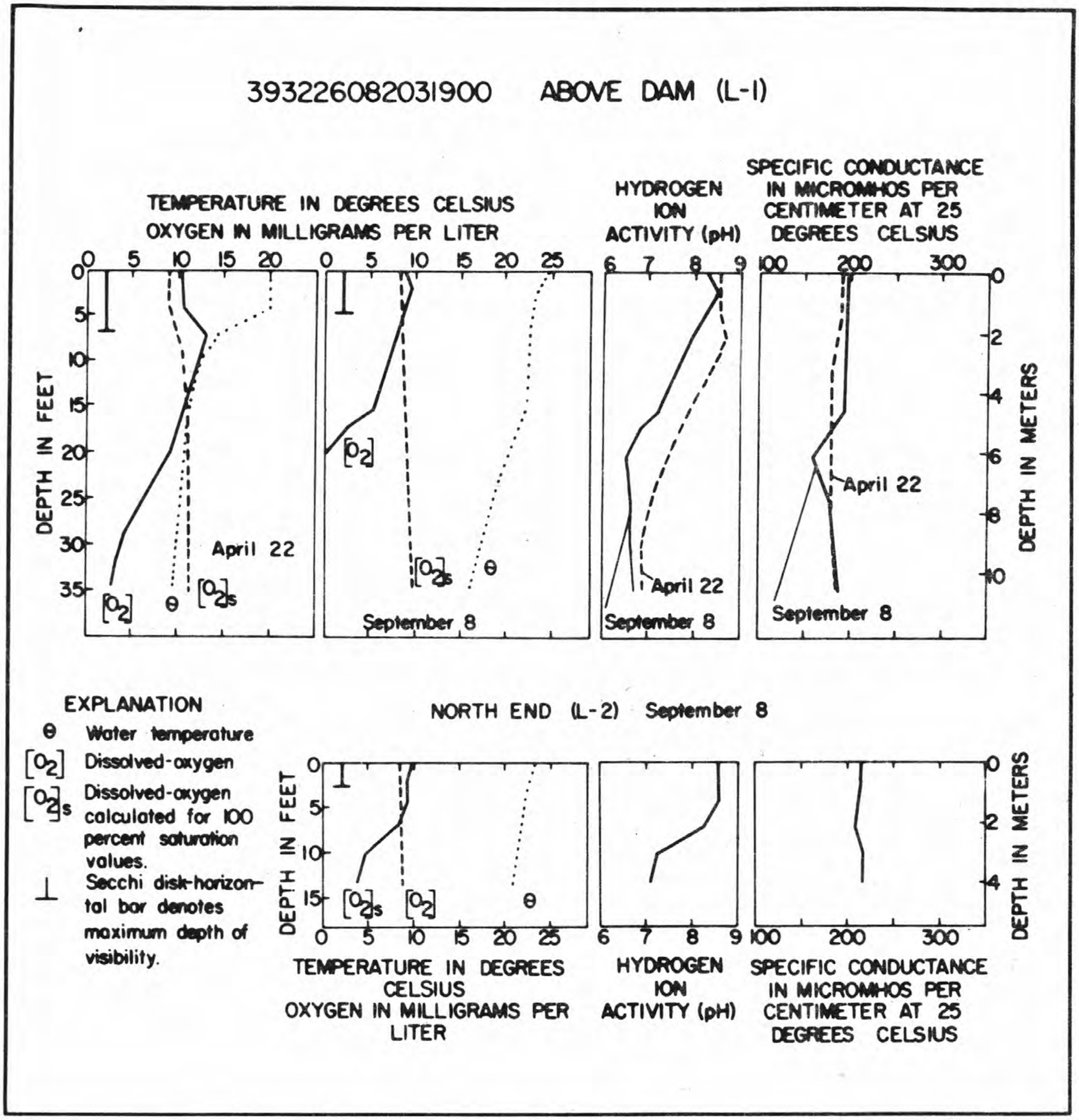

Figure 13.--Data profiles for Burr Oak Reservoir, Ohio, on selected days in 1976.

Table 22.--Profile data for the primary lake site, Burr Oak Reservoir, Ohio

393226082031900 - BURR OAK RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
22...	1440	.0	20.0	10.2	115	190	8.6	--	--	--	--	--
22...	1445	2.0	20.0	10.3	116	190	8.6	2	46	.2	.0	6.4
22...	1500	4.0	20.0	10.3	116	190	8.6	--	--	--	--	--
22...	1505	7.0	14.2	12.9	129	185	8.7	--	--	--	--	--
22...	1510	10	12.0	12.3	117	180	8.5	--	--	--	--	--
22...	1515	15	11.0	10.9	101	180	7.9	--	--	--	--	--
22...	1520	20	10.6	9.0	83	180	7.4	--	--	--	--	--
22...	1525	25	10.1	6.0	55	180	7.1	--	--	--	--	--
22...	1530	30	9.8	3.3	30	180	6.9	0	50	10	.0	--
22...	1535	35	9.5	2.3	21	185	6.9	--	--	--	--	--
SEP												
08...	1330	.0	24.6	8.8	107	198	8.3	--	--	--	--	--
08...	1335	2.0	23.4	9.4	113	195	8.5	1	60	.3	.0	4.5
08...	1340	4.0	23.0	8.7	104	195	8.3	--	--	--	--	--
08...	1345	7.0	22.7	7.7	91	195	7.9	--	--	--	--	--
08...	1350	10	22.5	6.7	79	195	7.6	--	--	--	--	--
08...	1355	15	22.2	5.6	66	192	7.2	--	--	--	--	--
08...	1357	17	21.8	2.6	30	180	6.8	--	--	--	--	--
08...	1400	20	20.2	.0	0	160	6.5	--	--	--	--	--
08...	1405	25	18.5	.0	0	177	6.6	--	--	--	--	--
08...	1410	30	17.2	.0	0	180	6.6	--	--	--	--	--
08...	1415	35	16.1	.0	0	185	6.7	0	110	35	3.2	--

Table 23.--Chemical analyses of water column composite samples, Burr Oak Reservoir, Ohio

393226082031900 - BURR OAK RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 22...	1515	22	5.8	1.4	6.7	42	5.6	.1	79	107	20	127

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 22...	0	0	10	2	<.5	23	0	0	<10	.05

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 22...	20	0	0	180	150	2	0

Table 24.--Chemical, physical, and biological analyses of water samples from selected depths, Burr Oak Reservoir, Ohio

393226082031900 - BURR OAK RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
22...	1445	2.0	.01	.15	.16	.04	.26	.30	.01
22...	1530	30	.01	.22	.23	.18	.25	.43	.01
SEP									
08...	1335	2.0	.01	.00	.01	.04	.36	.40	.00
08...	1415	35	.03	.00	.03	2.0	.70	2.7	.04

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
22...	.03	4.6	3	5	3.4	1.2	7	<2	<2
22...	.03	5.6	5	10	6.0	1.2	4	46	<2
SEP									
08...	.05	4.4	4	25	6.9	3.0	15	2	<2
08...	.11	10	55	180	12	2.5	33	12	2

Table 25.--Phytoplankton in Burr Oak Reservoir, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Location	Date	Location in water column					
Site L-1 above dam ----------	4-22-76	euphotic zone composite	1900	2.3	Cyanophyta	46	Oscillatoria (46)
					Chrysophyta	42	Nizschia (20); Melosira (15); Achnanthes (4); Cyclotella (2); Synedra (1)
					Chlorophyta	11	Selenastrum (6); Chlamydomonas (4); Ankistrodesmus (1)
					Euglenophyta	< 1	Trachelomonas
Site L-1 above	4-22-76	7-ft depth	1600	2.7	Chrysophyta	47	Melosira (34); Cyclotella (3); Nitzschia (3); Achnanthes (2); Asterionella (2); Synedra (2); Cymbella (1)
					Cyanophyta	40	Oscillatoria (32); Anacystis (8)
					Chlorophyta	8	Oocystis (4); Scenedesmus (2); Ankistrodesmus (1); Selenastrum (1)
					Euglenophyta	5	Cryptomonas (3); Trachelomonas (2)
Site L-1 above dam ----------	9-8-76	euphotic zone composite	130,000	1.1	Cyanophyta	99	Lyngbya (67); Aphanizomenon (28); Anabaena (6); Anacystis
					Euglenophyta	< 1	Trachelomonas
Site L-1 above dam ----------	9-8-76	2-ft depth	120,000	1.1	Cyanophyta	100	Aphanizomenon (75); Lyngbya (17); Anacystis (4); Anabaena (4)

* Less than 1 percent not given.

The three thermal layers (the epilimnion, metalimnion or thermocline, and hypolimnion) are displayed in the April profiles at site L-1. Profile data also show decreases in dissolved oxygen with depth. By September, only the epilimnion and thermocline remained. Data comparison suggest that the epilimnion at both sites L-1 and L-2 were chemically similar. The oxygen-deficient water below 20 ft had detectable amounts of hydrogen sulfide, a high concentration of ammonia (2.0 mg/L as N), and, although specific conductances were similar, much higher bicarbonate alkalinity than water near the surface.

The concentrations of inorganic nitrogen and phosphorus in the epilimnion were less than 0.3 mg/L as N and 0.015 mg/L as P during both sampling visits. The phytoplankton community in April consisted of a low-density assemblage of blue-green (Cyanophyta) and diatom (Chrysophyta) algae. The September community in the euphotic zone at site L-1 was dominated by high counts of the blue-green genera, Lyngbya and Aphanizomenon. A thin surface mat of decaying blue-green algae and extensive growths of water milfoil (Myriophylum sp.) were observed in the inlet areas of the lake.

Inflow data (fig 12; table 26): East Branch Sunday Creek was sampled at site I-1 where the stream drains 23 mi^2 or 69 percent of the drainage area to Burr Oak Reservoir. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1976)	Discharge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
East Branch Sunday Creek at site I-1	April 22	E 14	lake	stream	stream	stream
	September 8	< 3	stream	lake	lake	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Table 26.--Physical and chemical data for selected inflows, Burr Oak Reservoir, Ohio

393411082015700 - E B SUNDAY C AB BURR OAK RE AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR												
22...	1200	E14	17.5	8.5	7.5	275	25	25	4.3	.08	.45	.05
SEP												
08...	1020	<3.0	15.0	7.2	7.1	290	3	10	1.5	.03	.00	.03

E - estimated.

Clendening Lake

Location: Harrison County

Type: Reservoir; dam has multi-level release controls

Use: Flood control and recreation

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1937	1800	26,500	0.51

Drainage basin characteristics:

Drainage area (miles^2)	Type	Estimated sediment yield (from fig. 4)
69	agricultural, rural	moderately low

Lake data (fig 14, 15; tables 27-30): Clendening Lake was sampled during a cold, cloudy period on April 27 and in calm, clear weather on September 3. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient) thermal	Stratification (gradient) chemical	Chemical type	Substances at or above State limits: pesticides	toxicants	bacteria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
April 27	slight	yes	very hard Ca SO_4	no	no	no	Cyanophyta
September 3	partial	yes	--	no	--	no	Cyanophyta

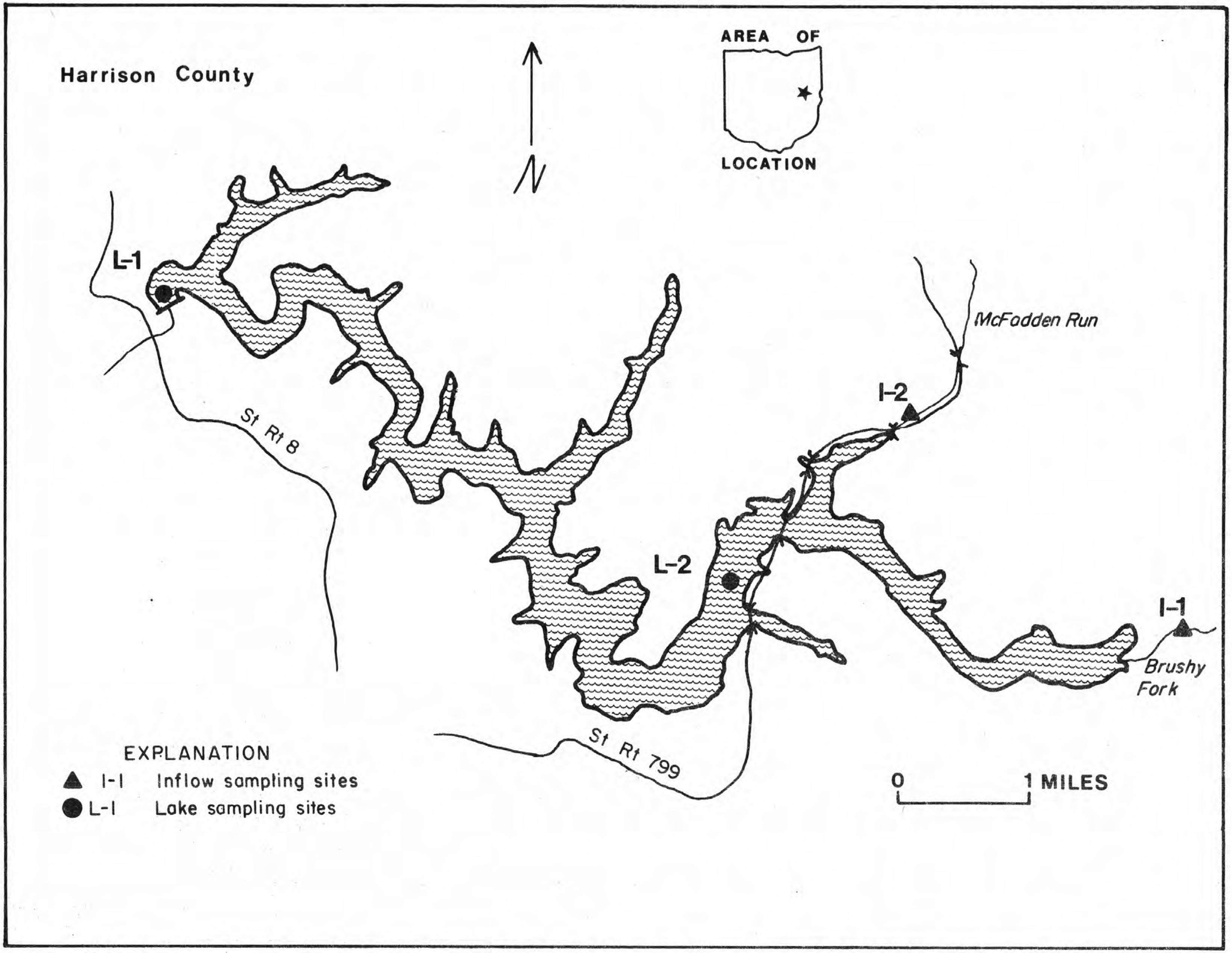

Figure 14.--Clendening Lake and inflow sampling sites.

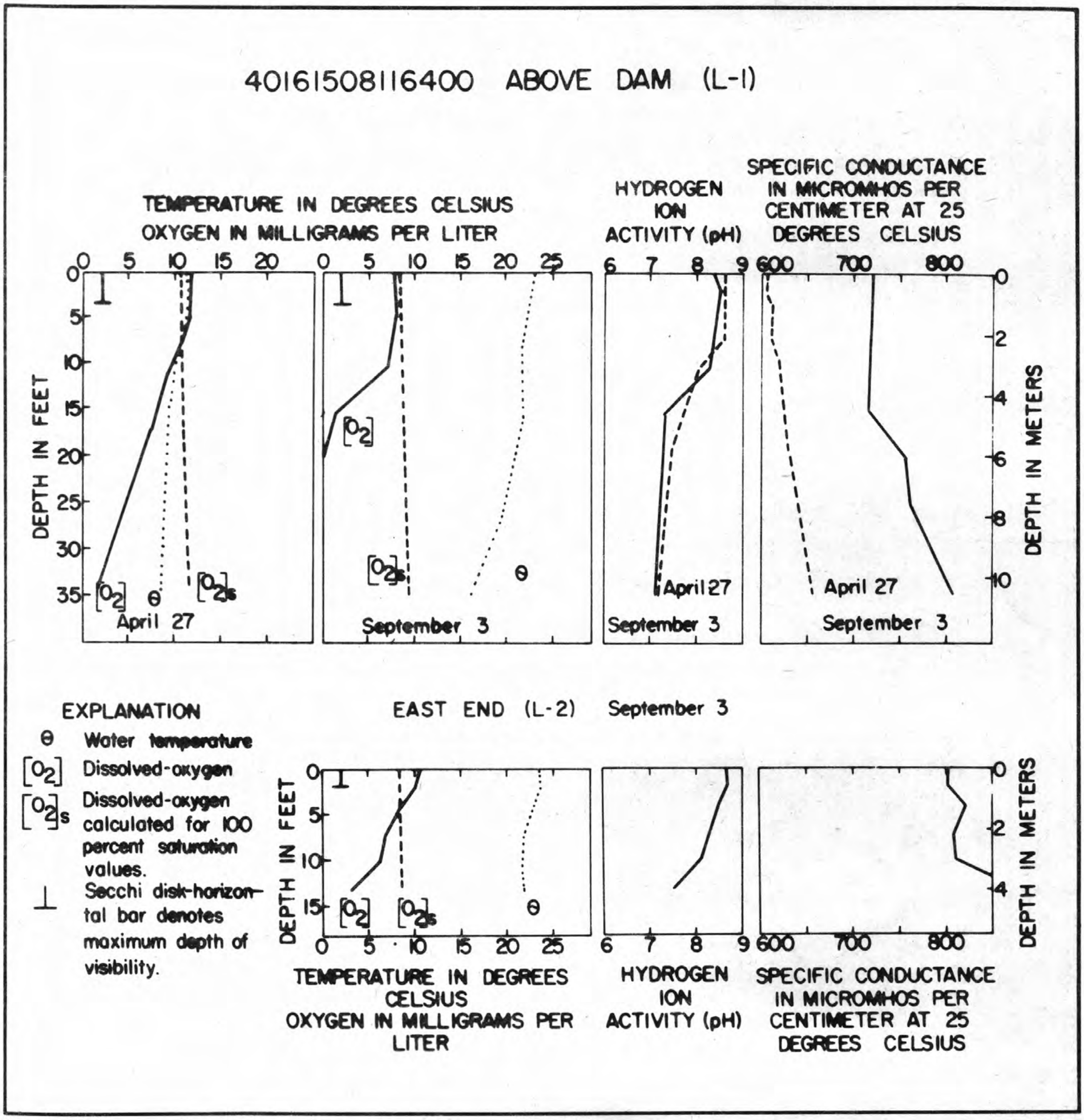

Figure 15.--Data profiles for Clendening Lake, Ohio, on selected days in 1976.

Table 27.--Profile data for the primary lake site, Clendening Lake, Ohio

401612081164000 - CLENDENING LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
27...	1240	.0	11.1	11.7	109	605	8.6	--	--	--	--	--
27...	1245	2.0	11.2	11.7	109	605	8.6	6	69	.3	.0	3.3
27...	1250	4.0	11.2	11.6	108	610	8.6	--	--	--	--	--
27...	1255	7.0	11.0	11.0	103	610	8.6	--	--	--	--	--
27...	1300	10	10.0	9.7	88	620	8.1	--	--	--	--	--
27...	1305	15	9.3	7.9	71	625	7.7	--	--	--	--	--
27...	1310	20	9.0	6.4	57	630	7.5	--	--	--	--	--
27...	1315	25	9.0	4.7	42	640	7.4	--	--	--	--	--
27...	1320	30	8.7	2.7	24	650	7.3	--	--	--	--	--
27...	1325	35	8.6	1.5	13	655	7.2	0	100	10	.0	--
SEP												
03...	1210	.0	23.0	7.7	92	720	8.4	--	--	--	--	--
03...	1215	2.0	22.8	7.8	93	720	8.5	2	81	.4	.0	3.3
03...	1220	4.0	22.5	8.0	94	720	8.5	--	--	--	--	--
03...	1225	7.0	22.0	7.5	88	720	8.4	--	--	--	--	--
03...	1230	10	22.0	7.1	84	718	8.3	--	--	--	--	--
03...	1235	15	21.8	1.3	15	718	7.3	--	--	--	--	--
03...	1240	20	21.0	.0	0	758	7.3	--	--	--	--	--
03...	1245	25	20.0	.0	0	763	7.2	--	--	--	--	--
03...	1250	30	18.0	.0	0	783	7.2	--	--	--	--	--
03...	1255	35	16.0	.0	0	810	7.1	0	220	28	11	--

Table 28.--Chemical analyses of water column composite samples, Clendening Lake, Ohio

401612081164000 - CLENDENING LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 27...	1310	76	28	1.9	7.7	240	4.6	.1	310	452	28	480

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 27...	100	0	10	1	<.5	2	0	0	<10	<.05

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 27...	30	1	0	110	670	0	10

Table 29.--Chemical, physical, and biological analyses of water samples from selected depths, Clendening Lake, Ohio

401612081164000 - CLENDENING LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
27...	1245	2.0	.01	.00	.01	.02	.53	.55	.01
27...	1325	35	.01	.08	.09	.42	.28	.70	.00
SEP									
03...	1215	2.0	.01	.00	.01	.05	.45	.50	.02
03...	1255	35	.01	.00	.01	2.8	.40	3.2	.30

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
27...	.04	4.4	2	10	6.9	2.7	11	<2	<2
27...	.05	5.8	3	10	10	1.7	8	<2	<2
SEP									
03...	.06	5.0	2	15	6.1	2.5	14	<2	<2
03...	.42	9.1	90	10	12	>8.8	18	<2	2

Table 30.--Phytoplankton in Clendening Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Location	Date	Location in water column					
Site L-1 above dam ---------	4-27-76	euphotic zone composite	210,000	0.3	Cyanophyta	95	Oscillatoria (95)
					Chrysophyta	4	Nitzschia (4); Achnanthes
					Chlorophyta	< 1	Ankistrodesmus
					Euglenophyta	< 1	Cryptomonas; Euglena
Site L-1 above dam ---------	9-3-76	euphotic zone composite	1,100,000	1.0	Cyanophyta	99	Oscillatoria (55); Cylindrospermum (45); Agmenellum
					Chlorophyta	< 1	Chlamydomonas; Pandorina
					Chrysophyta	< 1	Nitzschia; Chrysococcus
					Euglenophyta	< 1	Cryptomonas; Euglena; Trachelomonas
					Pyrrhophyta	< 1	Ceratium; Peridinium
Site L-1 above dam ----------	9-3-76	4-ft depth	340,000	0.5	Cyanophyta	98	Cylindrospermum (92); Raphidiopsis (5); Oscillatoria (1)
					Chlorophyta	2	Ankistrodesmus (2); Scenedesmus

* Less than 1 percent not given.

The profiles at site L-1 in April show general vertical mixing above 7 ft. In September, vertical mixing was limited to the top 10 ft at site L-1 and was irregular at site L-2. Major chemical differences in September between surface and bottom waters at site L-1 are indicated by the increase in specific conductance below 15 ft, detection of hydrogen sulfide and anaerobic conditions below 20 ft, and high bicarbonate and BOD values near the lake bottom. The irregular patterns in the temperature and specific conductance profiles at site L-2 probably reflect the influence of the inflow from Brushy Fork Creek.

Concentrations of inorganic nitrogen and phosphorus at the 2 ft depth were low in April. In September, the surface concentrations were low, but the bottom water had high amounts of recycled ammonia and phosphorus. The phytoplankton community at site L-1 was dominated by the blue-green genera *Oscillatoria* on April 27 and *Oscillatoria* and *Cylindrospermum* on September 3. The September composite sample had the highest cell count (1,100,000 cells per ml) of the lakes sampled during 1976.

Inflow data (fig. 14; table 31): Brushy Fork Creek, which drains 35 mi^2, and McFadden Run, which drains 6.4 mi^2, were sampled at sites I-1 and I-2, respectively. Their combined drainage areas represent 60 percent of the lake drainage basin. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1976)	Discharge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Brusky Fork at site I-1	April 27	E 15	stream	lake	lake	stream
	September 3	< 5	stream	lake	lake	stream
McFadden Run at site I-1	April 27	E 3	stream	lake	lake	lake
	September 3	< 3	stream	lake	lake	lake

* At 2-ft (0.6-m) depth.
E Estimated.

Table 31.--Physical and chemical data for selected inflows, Clendening Lake, Ohio

401457081085800 - BRUSHY F AB CLENDENING LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR 27...	1040	E15	8.0	10.2	7.8	1800	2	5	5.0	.21	.28	.02
SEP 03...	1000	<5.0	15.5	8.8	8.0	2100	8	10	4.6	.12	.25	.05

401602081110600 - MCFADDEN RN AB CLENDENING LK AT SITE (I-2)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR 27...	1010	E3.0	7.5	10.2	7.2	260	4	10	1.4	.12	.25	.02
SEP 03...	1025	<3.0	14.5	8.5	7.8	300	8	20	5.0	.05	.23	.03

E - estimate.

Lake Logan

Location: Hocking County

Type: Reservoir

Use: Recreation

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1955	342	3080	0.29

Drainage basin characteristics:

Drainage area (miles^2)	Type	Estimated sediment yield (from fig. 4)
14.8	agricultural, rural	moderate

Lake data (figs. 16, 17; tables 32-35): Lake Logan was sampled under hazy skies on April 15 and September 14. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
April 15	yes	no	moderately hard Ca HCO_3, SO_4	no	no	no	Cyanophyta
September 14	yes	yes	--	no	--	no	Cyanophyta

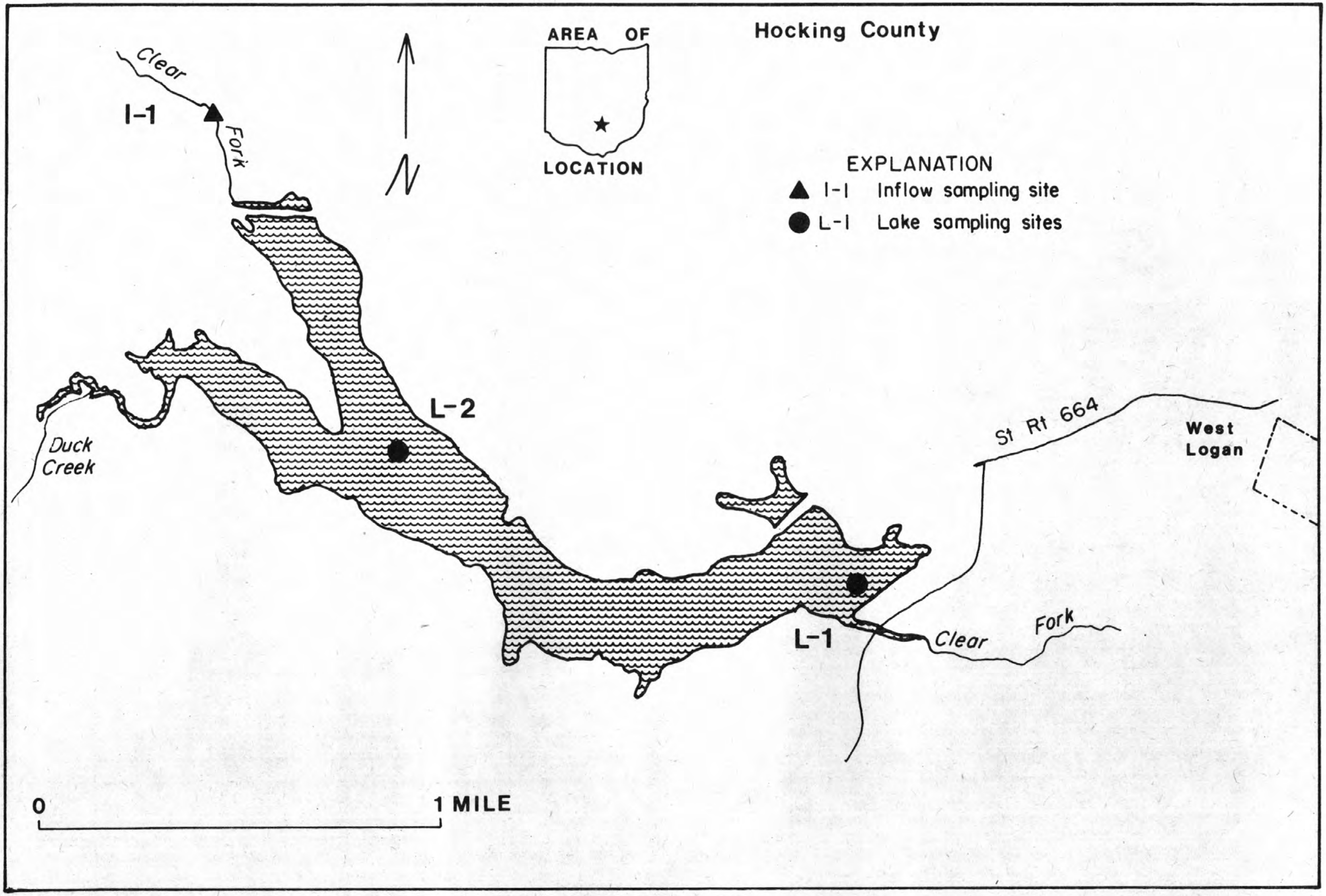

Figure 16.--Lake Logan and inflow sampling sites.

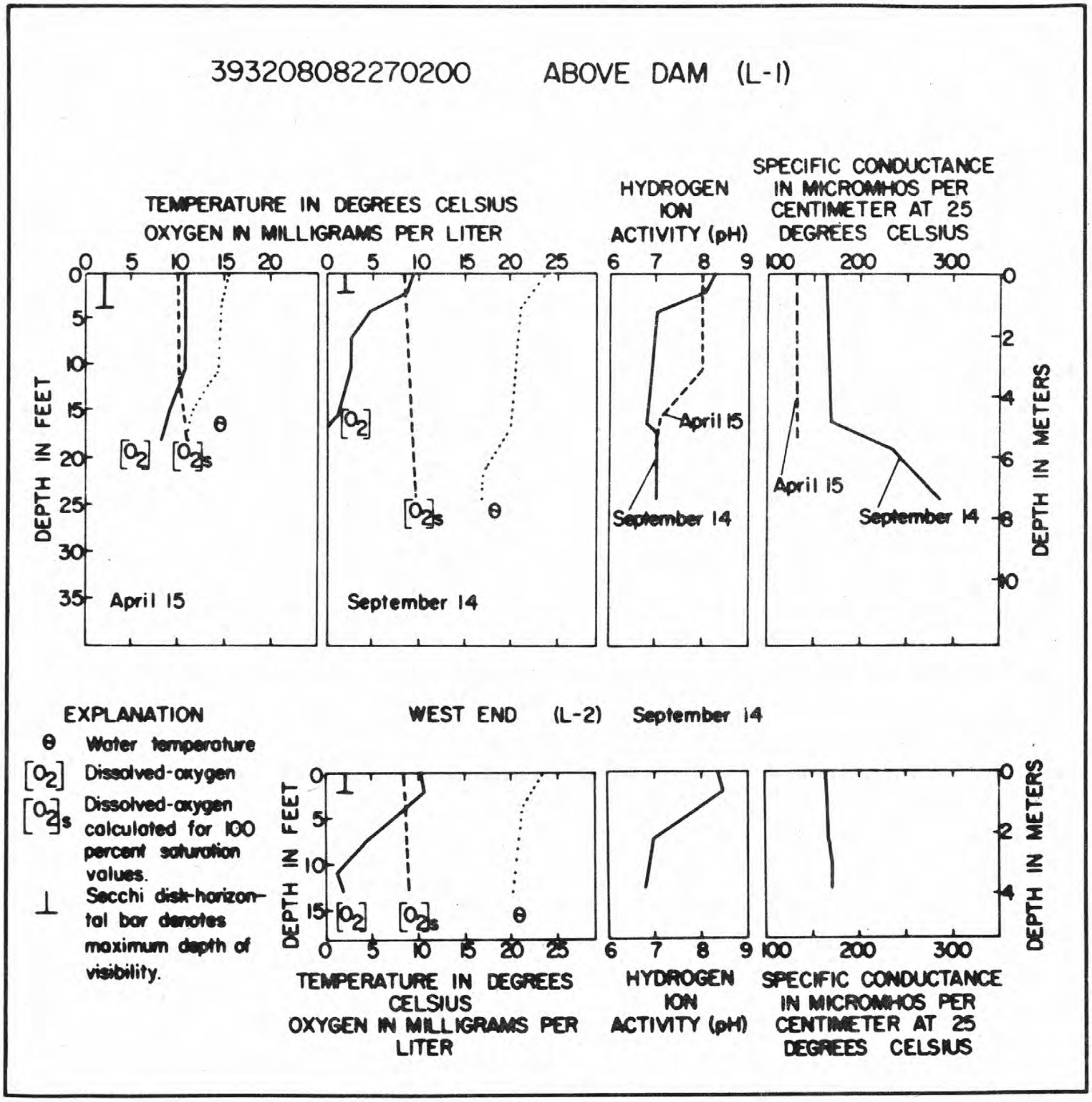

Figure 17.--Data profiles for Lake Logan, Ohio, on selected days in 1976.

Table 32.--Profile data for the primary lake site, Lake Logan, Ohio

393208082270200 - LAKE LOGAN AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
15...	1320	.0	15.5	10.7	109	130	8.0	--	--	--	--	--
15...	1325	2.0	15.0	10.8	109	130	8.0	0	36	.6	.0	3.7
15...	1330	4.0	14.5	10.9	109	130	8.0	--	--	--	--	--
15...	1335	7.0	14.5	10.8	108	130	8.0	--	--	--	--	--
15...	1340	10	14.5	10.8	108	130	8.0	--	--	--	--	--
15...	1345	15	11.3	8.7	81	130	7.1	--	--	--	--	--
15...	1350	18	10.8	8.0	74	130	7.0	0	36	5.7	.0	--
SEP												
14...	1220	.0	23.4	9.2	111	162	8.2	--	--	--	--	--
14...	1225	2.0	22.3	8.7	102	162	8.0	0	64	1.0	.0	2.0
14...	1230	4.0	21.0	4.6	53	163	7.0	--	--	--	--	--
14...	1235	7.0	20.5	2.8	32	163	6.9	--	--	--	--	--
14...	1240	10	20.3	2.3	26	165	6.9	--	--	--	--	--
14...	1245	15	20.0	1.0	11	167	6.8	--	--	--	--	--
14...	1247	17	19.5	.0	0	198	7.0	--	--	--	--	--
14...	1248	18	18.7	.0	0	220	7.0	--	--	--	1.4	--
14...	1250	20	17.5	.0	0	245	7.0	--	--	--	--	--
14...	1255	22	16.8	.0	0	262	7.0	0	150	24	2.8	--
14...	1300	24	16.5	.0	0	287	7.0	--	--	--	--	--

Table 33.--Chemical analyses of water column composite samples, Lake Logan, Ohio

393208082270200 - LAKE LOGAN AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 15...	1340	15	5.8	1.6	4.7	27	6.7	.1	61	81	26	107

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 15...	0	0	10	2	<.5	24	0	0	<10	.05

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 15...	20	0	0	290	140	3	10

Table 34.--Chemical, physical, and biological analyses of water samples from selected depths, Lake Logan, Ohio

393208082270200 - LAKE LOGAN AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
15...	1325	2.0	.01	.44	.45	.08	.40	.48	.01
15...	1350	18	.01	.45	.46	.09	.31	.40	.01
SEP									
14...	1225	2.0	.01	.00	.01	.24	.66	.90	.02
14...	1255	22	.01	.00	.01	4.2	1.6	5.8	.09

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
15...	.04	6.4	4	10	5.4	1.9	6	<2	<2
15...	.04	6.6	6	15	2.5	1.5	6	<2	<2
SEP									
14...	.11	7.0	5	30	7.9	4.9	20	3	3
14...	.23	12	20	180	11	4.9	48	6	<3

Table 35.--Phytoplankton in Lake Logan, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Location	Date	Location in water column					
Site L-1 above dam ----------	4-15-76	euphotic zone composite	11,000	2.5	Cyanophyta	60	Arthrospira (56); Anacystis (4)
					Chlorophyta	29	Scenedesmus (11); Ankistrodesmus (7); Dictyosphaerium (4); Micractinium(2); Oocystis (2); Tetraedron (2); Chodatella (1)
					Chrysophyta	12	Nitzschia (4); Cymbella (2); Asterionella (2); Synedra (1); Melosira (1); Achnanthes (1); Dinobryon (1); Cocconeis
					Euglenophyta	2	Euglena (1); Trachelomonas (1)
Site L-1 above dam ----------	9-14-76	euphotic zone composite	270,000	1.3	Cyanophyta	99	Agmenellum (71); Oscillatoria (16); Cylindrospermum (11); Aphanizomenon (2)
					Chlorophyta	1	Scenedesmus (1)
Site L-1 above dam ----------	9-14-76	surface	64,000	1.5	Cyanophyta	98	Cylindrospermum (64); Oscillatoria (19); Agmenellum (14); Aphanizomenon (1); Anacystis
					Euglenophyta	1	Trachelomonas (1); Euglena
					Chlorophyta	< 1	Scenedesmus
					Chrysophyta	< 1	Cyclotella; Nitzschia

* Less than 1 percent not given.

The lake was thermally stratified on April 15. Dissolved oxygen and pH below 10 ft decreased with depth at site L-1, but other chemical differentiation within the water column (specific conductance, alkalinity, etc.) was not evident. The September profiles at site L-1 show a vertically mixed zone between 4 and 16 ft. Below 16 ft the water was anaerobic and had high concentrations of ammonia (4.2 mg/L). Furthermore, specific conductance and hydrogen sulfide increased rapidly with depth. The oxygen demands (BOD, COD) in the water were considerably higher in September than in April. Data comparison between sites L-1 and L-2 show similar water types to a depth of 12 feet.

Inorganic macronutrient levels within the lake were sufficient for nuisance algal growths. Biological uptake of nitrogen within the euphotic zone and the reduction of nitrate (NO_3) and organic nitrogen to ammonia at the lake bottom are indicated. The lake phytoplankton in April and September were dominated by blue-green algae (Cyanophyta) although higher cell counts and a lower diversity index ($\bar{d}$) characterized the September samples. *Myriophylum* was seen growing in the lake.

Inflow data (fig. 16, table 36): Clear Fork Creek was sampled at site I-1 where the stream drains 4.6 mi² or 31 percent of the drainage area to Lake Logan. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1976)	Discharge (ft³/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Clear Fork Creek at site I-1	April 15	E 3	stream	lake	lake	stream
	September 14	E 2	stream	lake	lake	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Caddisfly (Trichoptera) and mayfly (Ephemeroptera) larvae, and darters were observed at the sampling site.

Table 36.--Physical and chemical data for selected inflows, Lake Logan, Ohio

393310082285000 - CLEAR F C AB LAKE LOGAN AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR												
15...	1030	E3.0	13.0	11.1	8.0	355	3	5	2.9	2.6	.20	.02
SEP												
14...	1120	E2.0	16.0	9.3	7.6	465	3	5	2.3	3.3	.20	.05

E - estimated.

Lake Rockwell

Location: Portage County

Type: Reservoir

Use: Water supply

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1914	769	7060	0.04

Drainage basin characteristics:

Drainage area (miles^2)	Type	Estimated sediment yield (from fig. 4)
208	agricultural, rural	moderate

Lake data (figs. 18, 19; tables 37-40): Lake Rockwell was sampled between showers on May 11 and during clear weather on August 20. A copper compound, used for algae control, had been applied to the lake during the morning of May 11. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
May 11	slight	slight	moderately hard Ca HCO_3 Cl	no	at(Cu)	no	Chrysophyta Chlorophyta
August 20	partial	yes	--	no	--	no	Cyanophyta

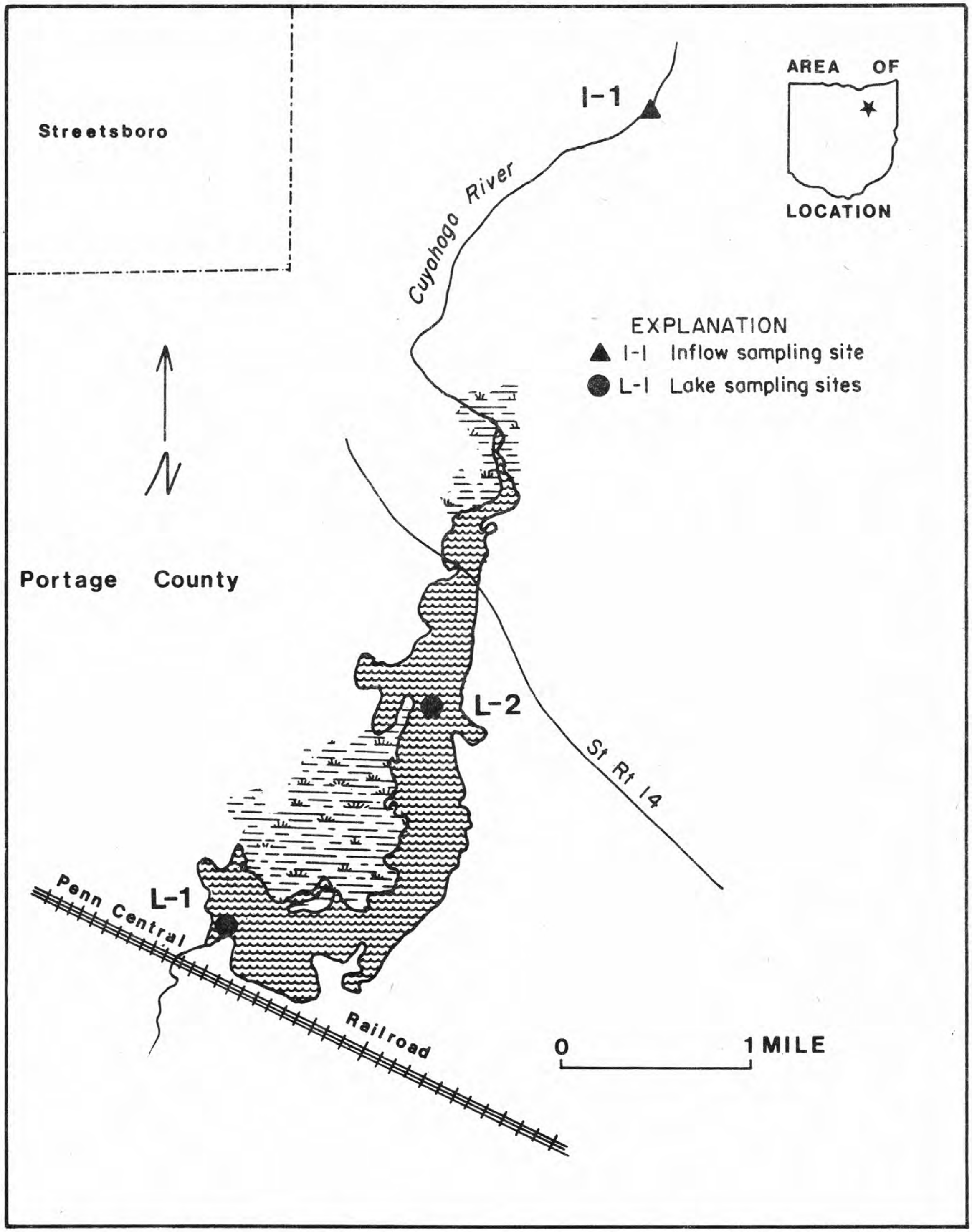

Figure 18.--Lake Rockwell and inflow sampling sites.

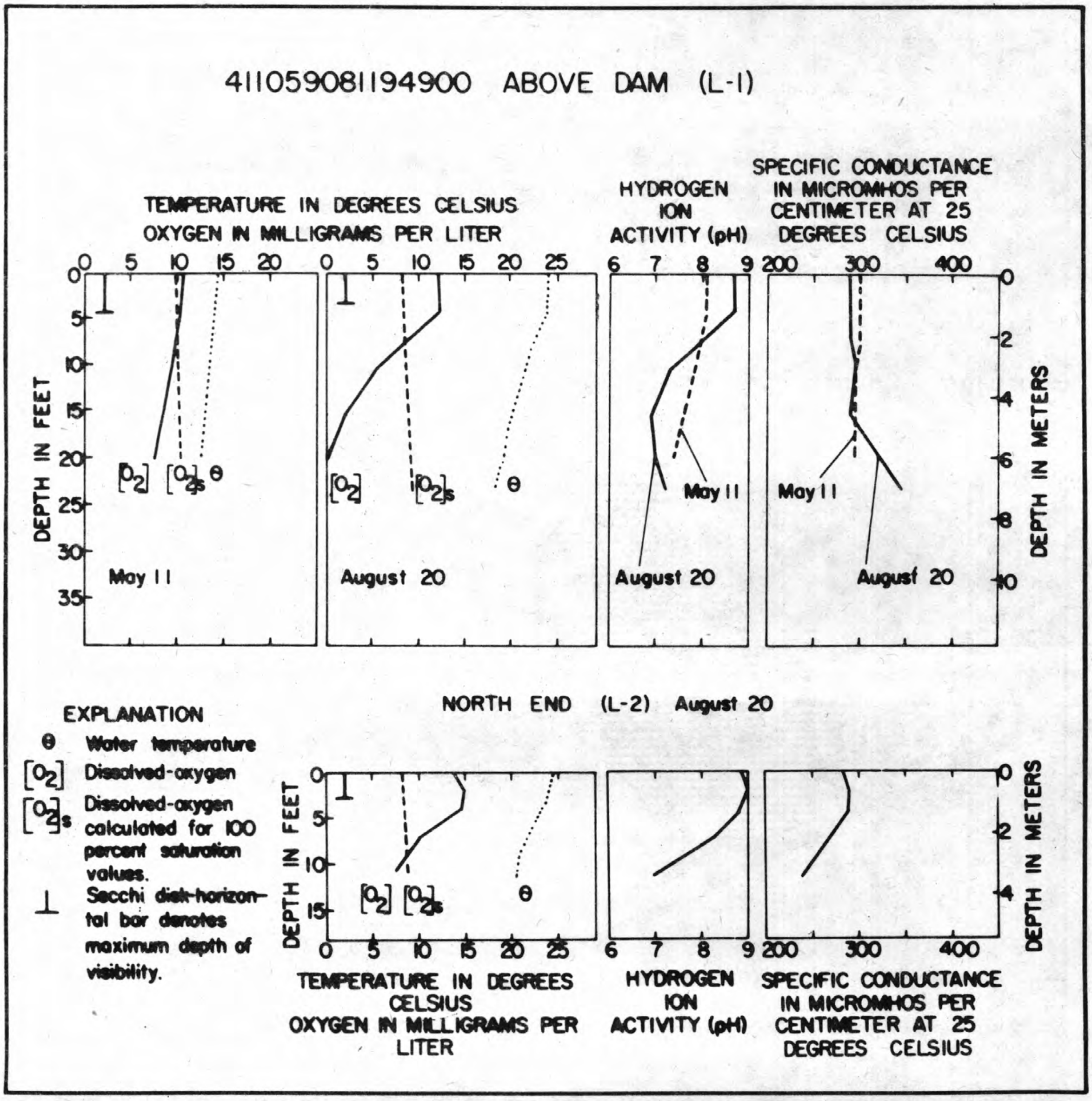

Figure 19.--Data profiles for Lake Rockwell, Ohio on selected days in 1976.

Table 37.--Profile data for the primary lake site, Lake Rockwell, Ohio

411059081194900 - LAKE ROCKWELL AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
MAY												
11...	1500	.0	14.2	10.4	105	300	8.1	--	--	--	--	--
11...	1505	2.0	14.2	10.3	104	300	8.1	0	83	1.1	.0	4.1
11...	1510	4.0	14.1	10.2	102	300	8.1	--	--	--	--	--
11...	1515	7.0	13.9	9.8	98	300	8.0	--	--	--	--	--
11...	1520	10	13.5	9.5	94	295	7.9	--	--	--	--	--
11...	1525	15	13.0	8.4	82	295	7.6	--	--	--	--	--
11...	1530	20	12.5	7.2	70	295	7.4	0	83	5.2	.0	--
AUG												
20...	1250	.0	24.0	12.0	146	288	8.7	--	--	--	--	--
20...	1255	2.0	24.0	12.3	150	288	8.7	6	92	.3	.0	3.3
20...	1300	4.0	23.9	12.1	148	288	8.7	--	--	--	--	--
20...	1305	7.0	22.5	9.5	113	290	8.1	--	--	--	--	--
20...	1310	10	21.5	5.5	64	295	7.3	--	--	--	--	--
20...	1315	15	20.0	2.0	23	290	6.9	--	--	--	--	--
20...	1320	20	19.0	.0	0	325	7.0	0	123	20	.4	--
20...	1325	23	18.0	.0	0	345	7.2	--	--	--	--	--

Table 38.--Chemical analyses of water column composite samples, Lake Rockwell, Ohio

411059081194900 - LAKE ROCKWELL AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
MAY												
11...	1520	32	8.0	2.0	13	29	28	.1	110	177	25	202
AUG												
20...	1320	--	--	--	--	--	--	--	--	--	--	--

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
MAY										
11...	100	0	<10	3	<.5	5	0	0	<10	.05
AUG										
20...	--	--	--	--	--	--	--	--	--	--

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
MAY							
11...	40	1	10	840	100	0	40
* AUG							
20...	--	--	10	590	2000	--	40

* Taken from a water sample 1-3 ft from the lake bottom.

Table 39.--Chemical, physical, and biological analyses of water samples from selected depths, Lake Rockwell, Ohio

411059081194900 - LAKE ROCKWELL AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
MAY									
11...	1505	2.0	.01	.00	.01	.01	.52	.53	.01
11...	1530	20	.01	.00	.01	.04	.44	.48	.01
AUG									
20...	1255	2.0	.02	.01	.03	.02	.73	.75	.01
20...	1320	20	.01	.00	.01	.71	.69	1.4	.07

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
MAY									
11...	.05	.6	3	20	7.4	2.0	18	<2	<2
11...	.05	1.2	3	30	7.9	1.6	18	2	<2
AUG									
20...	.06	1.1	2	20	7.2	3.0	22	<2	<2
20...	.16	6.8	6	30	7.6	2.2	20	2	<2

Table 40.--Phytoplankton in Lake Rockwell, Ohio

Sample description: Location	Date	Location in water column	Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(s) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Site L-1 above dam ----------	5-11-76	euphotic zone composite	20,000	3.8	Chrysophyta	48	Cyclotella (18); Fragilaria (10); Melosira (9); Asterionella (8); Nitzschia (3); Synedra; Navicula; Dinobryon
					Chlorophyta	34	Chlamydomonas (8); Dictyosphaerium (6); Ankistrodesmus (5); Oocystis (4); Micractinium (3); Actinostrum (3); Chodatella (1); Crucigenia (1); Scenedesmus (1); Elakatothrix (1); Chlorogonium (1)
					Cyanophyta	15	Oscillatoria (11); Anacystis (4)
					Euglenophyta	1	Trachelomonas (1); Phacus
Site L-1 above dam ----------	8-20-76	euphotic zone composite	96,000	2.8	Cyanophyta	65	Raphidiopsis (36); Oscillatoria (24); Anacystis (4); Anabaena
					Chlorophyta	28	Kirchneriella (14); Dictyosphaerium (7); Ankistrodesmus (2); Chlamydomonas (2); Micractinium (1); Phacotus (1); Scenedesmus (1); Chodatella; Tetraedron
					Chrysophyta	6	Cyclotella (3); Nitzschia (2); Synedra (1)
					Euglenophyta	1	Trachelomonas (1); Euglena; Phacus
Site L-1 above dam ----------	8-20-76	2-ft depth	70,000	2.8	Cyanophyta	65	Oscillatoria (48); Raphidiopsis (11) Anacystis (4); Anabaena (2)
					Chlorophyta	24	Kirchneriella (13); Scenedesmus (3); Treubaria (2); Ankistrodesmus (2); Tetrastrum (2); Tetraedron (1); Chlamydomonas (1); Golenkinia
					Chrysophyta	8	Cyclotella (5); Nitzschia (2); Synedra (1)
					Euglenophyta	4	Trachelomonas (2); Chroomonas (1); Euglena (1)

* Less than 1 percent not given.

The profile values at site L-1 decreased only slightly with depth in May, indicating that the lake was generally mixed. In August, a thermocline extended from 4 ft to the lake bottom. Dissolved-oxygen concentrations were well above saturation (up to 183 percent) within the upper 8 ft of the lake at sites L-1 and L-2, and surface pH was high (9.0 at site L-2). These extended values resulted from high photosynthetic rates of aquatic flora. The water near the lake bottom at site L-1 was anaerobic, contained hydrogen sulfide, and had higher specific conductance and bicarbonate values than the water near the surface.

The nutrient concentrations of inorganic nitrogen and phosphorus were low. The May-August increases in the bottom-water concentrations of N, P, SiO_2, CO_2 suggest nutrient recycling. The diversity indices for phytoplankton were the highest of the lakes sampled during 1976. Blue-green algae (Cyanophyta) dominated the counts in August, but no single genus accounted for more than 50 percent of the total cells. Water milfoil (Myriophyllum) was common in the littoral zone of the lake.

Inflow data (fig. 18; table 41): The Cuyahoga River is the major tributary to Lake Rockwell and was sampled above the lake at site I-1. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1976)	Discharge (ft^3/s)	Water body (stream or lake*) having higher concentration			
			NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Cuyahoga River at site I-1	May 11	E 160	stream	stream	lake	same
	August 20	E 300	stream	stream	stream	lake

* At 2-ft (0.6-m) depth.
E Estimated.

Various invertebrates (mayflies, caddisflies, and crayfish) and growths of Anacharis and Sagittaria were observed at site I-1.

Table 41.--Physical and chemical data for selected inflows, Lake Rockwell, Ohio

411443081171000 - CUYAHOGA R AB LAKE ROCKWELL AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTAN-TANEOUS DIS-CHARGE (CFS)	TEMPER-ATURE (DEG C)	DIS-SOLVED OXYGEN (MG/L)	PH (UNITS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)
MAY												
11...	1350	E160	15.0	8.8	7.5	300	3	30	5.4	.30	.40	.07
AUG												
20...	0950	E300	19.0	6.7	6.8	248	5	50	11	.25	.68	.16

88

E - estimated.

Leesville Lake

Location: Carroll County

Type: Reservoir; dam has multi-level release controls

Use: Flood control and recreation

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1937	1000	19,500	0.51

Drainage basin characteristics:

Drainage area (miles^2)	Type	Estimated sediment yield (from fig. 4)
48.3	agricultural, rural	moderately low

Lake data (figs. 20, 21; tables 42-45): Leesville Lake was sampled under cloudy skies on May 18 and under clear skies on August 31. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient) thermal	Stratification (gradient) chemical	Chemical type	Substances at or above State limits: pesticides	Substances at or above State limits: toxicants	Substances at or above State limits: bacteria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
May 18	yes	slight	moderately hard Ca HCO_3 SO_4	no	no	no	Cyanophyta
August 31	partial	yes	--	no	--	no	Cyanophyta

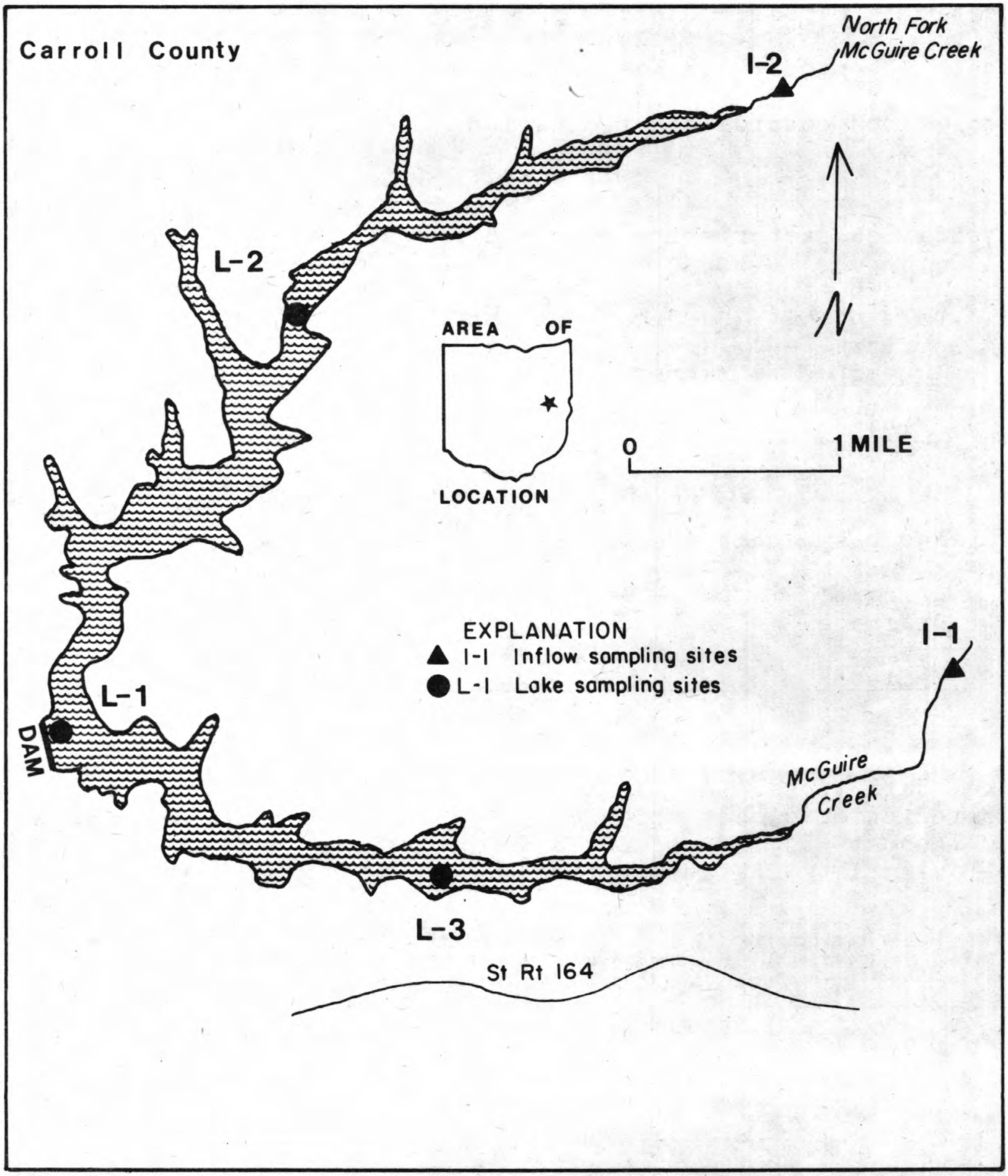

Figure 20.--Leesville Lake and inflow sampling sites.

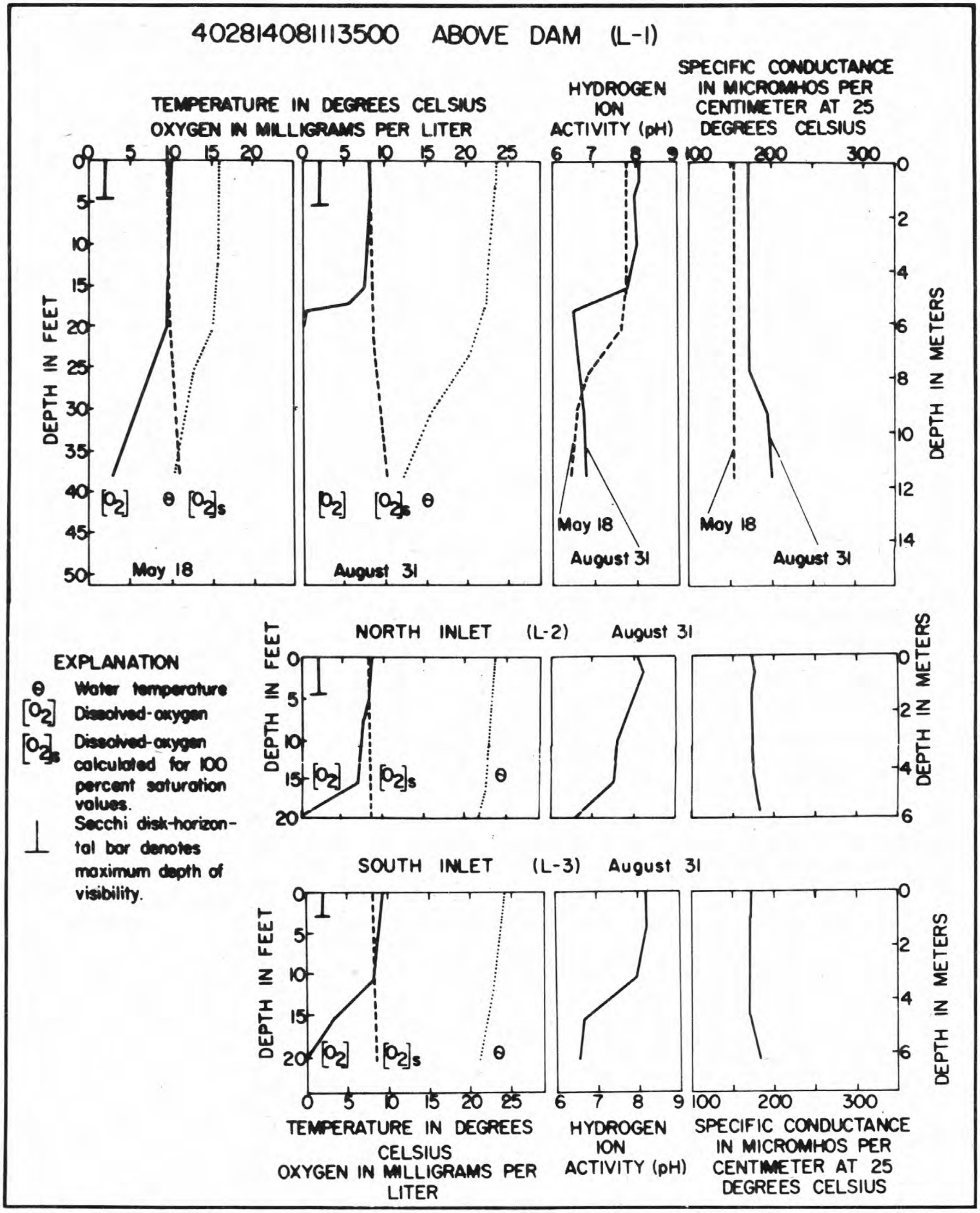

Figure 21.--Data profiles for Leesville Lake, Ohio, on selected days in 1976.

Table 42.--Profile data for the primary lake site, Leesville Lake, Ohio

402814081113500 - LEESVILLE LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
MAY												
18...	1230	.0	15.8	9.9	103	155	7.8	--	--	--	--	--
18...	1235	2.0	15.8	9.9	103	155	7.8	0	38	1.0	.0	4.5
18...	1240	4.0	15.8	9.9	103	155	7.8	--	--	--	--	--
18...	1245	7.0	15.8	9.8	102	155	7.8	--	--	--	--	--
18...	1250	10	15.7	9.7	100	158	7.8	--	--	--	--	--
18...	1255	15	15.5	9.7	100	158	7.8	--	--	--	--	--
18...	1300	20	15.0	9.4	96	158	7.7	--	--	--	--	--
18...	1305	25	12.8	7.4	72	155	6.9	--	--	--	--	--
18...	1310	30	11.9	5.5	52	155	6.6	--	--	--	--	--
18...	1315	38	10.3	3.0	28	155	6.5	0	38	19	.0	--
AUG												
31...	1340	.0	23.7	8.2	100	172	8.1	--	--	--	--	--
31...	1345	2.0	23.7	8.3	101	172	8.1	0	50	.6	.0	5.2
31...	1350	4.0	23.2	8.3	100	172	8.0	--	--	--	--	--
31...	1355	7.0	23.0	8.1	98	170	8.0	--	--	--	--	--
31...	1400	10	22.8	8.0	95	170	8.0	--	--	--	--	--
31...	1405	15	22.7	7.7	92	170	7.8	--	--	--	--	--
31...	1408	18	21.8	.3	4	170	6.5	--	--	--	--	--
31...	1410	20	21.5	.0	0	170	6.5	--	--	--	--	--
31...	1415	25	19.2	.0	0	175	6.6	--	--	--	.4	--
31...	1420	30	15.5	.0	0	195	6.7	--	--	--	--	--
31...	1425	38	12.4	.0	0	202	6.8	0	108	27	2.2	--

Table 43.--Chemical analyses of water column composite samples, Leesville Lake, Ohio

402814081113500 - LEESVILLE LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
MAY 18...	1300	18	4.4	1.6	3.8	29	6.3	.1	63	96	20	116

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
MAY 18...	0	0	10	3	<.5	2	0	0	<10	.06

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
MAY 18...	0	0	0	400	390	0	20

Table 44.--Chemical, physical, and biological analyses of water samples from selected depths, Leesville Lake, Ohio

402814081113500 - LEESVILLE LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
MAY									
18...	1235	2.0	.01	.39	.40	.04	.31	.35	.00
18...	1315	38	.02	.41	.43	.29	.31	.60	.01
AUG									
31...	1345	2.0	.01	.00	.01	.04	.34	.38	.01
31...	1425	38	.01	.00	.01	2.1	.20	2.3	.10

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
MAY									
18...	.03	4.7	4	15	4.4	1.6	8	<2	2
18...	.04	7.1	10	20	3.3	.8	7	18	4
AUG									
31...	.04	3.3	2	10	4.1	2.1	<10	<3	<3
31...	.24	10	15	70	8.5	1.6	15	3	<3

Table 45.--Phytoplankton in Leesville Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Location	Date	Location in water column					
Site L-1 above dam ----------	5-18-76	euphotic zone composite	42,000	0.5	Cyanophyta	94	Oscillatoria (94); Anacystis
					Chrysophyta	4	Cyclotella (3); Melosira (1); Cocconeis; Asterionella; Nitzschia; Mallomonas
					Chlorophyta	2	Ankistrodesmus (1); Scenedesmus (1)
					Euglenophyta	< 1	Trachelomonas
Site L-1 above dam ----------	8-31-76	euphotic zone composite	73,000	1.5	Cyanophyta	98	Oscillatoria (69); Aphanizomenon (18); Lyngbya (5); Cylindrospermum (3); Anacystis (2); Anabaena (1)
					Chrysophyta	1	Achnanthes (1); Nitzschia
					Chlorophyta	< 1	Ankistrodesmus; Kirchneriella
					Euglenophyta	< 1	Trachelomonas
Site L-1 above dam ---------	8-31-76	2-ft depth	49,000	2.0	Cyanophyta	96	Aphanizomenon (48); Lyngbya (29); Cylindrospermum (11); Anabaena (4); Anacystis (4)
					Chlorophyta	3	Scenedesmus (2); Kirchneriella (1)
					Chrysophyta	2	Melosira (1); Achnanthes (1)

* Less than 1 percent not given.

The May profiles at site L-1 show a well-mixed water column within the upper 20 ft. Below 20 ft, temperature, dissolved oxygen, and pH decreased with depth. The lake had generally warmed by August 31, although the temperature distribution was similar to that observed in May. Dissolved oxygen and pH decreased rapidly between 15 ft and the top of the anaerobic zone at 20 ft. This lower zone was further characterized by increases in hydrogen sulfide and specific conductance with depth (below 25 ft), and ammonia generation near the lake bottom. A comparison of profile data from sites L-1, L-2, and L-3 show similar conditions within the upper 20 ft at all three sites. A hydrogen sulfide odor was detected near the bottom at sites L-2 and L-3.

The orthophosphorus concentration in May was less than 0.005 mg/L at 2 ft. This low concentration may reflect an earlier uptake by the lake flora. Comparison of top and bottom water analyses in August suggests regeneration of inorganic nutrients within the anaerobic zone. Phytoplankton data show blue-green algae (Cyanophyta) as the principal algal group in the lake.

Inflow data (fig. 20; table 46): Two inflows were sampled; North Fork McGuire Creek (site I-1), which drains 12.8 mi²; and McQuire Creek (site I-2), draining 10.5 mi². Their combined drainage areas account for 48 percent of the drainage basin to Leesville Lake. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1976)	Discharge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
McGuire Creek at site I-1	May 18	< 10	stream	stream	stream	stream
	Augst 31	< 2	stream	same	stream	stream
N.F. McGuire Creek at site I-2	May 18	E 8	stream	stream	stream	stream
	August 31	E 2	stream	stream	stream	stream

* At 2-ft (0.6-m) depth.
E Estimated.

The data show that the creeks were contributing similar nutrient and chemical loads to the lake.

Table 46.--Physical and chemical data for selected inflows, Leesville Lake, Ohio

402828081063400 - MCGUIRE C AB LEESVILLE LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
MAY												
18...	1010	<10	13.0	9.0	7.4	235	25	50	5.5	.33	.48	.09
AUG												
31...	1145	<2.0	13.5	9.1	7.4	325	5	15	5.1	.23	.28	.04

403044081073400 - N F MCGUIRE C AB LEESVILLE LK AT SITE (I-2)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
MAY												
18...	1035	E8.0	13.0	9.7	7.5	250	20	50	8.0	.32	.65	.06
AUG												
31...	1030	E2.0	15.5	10.0	7.5	365	5	20	4.6	.16	.30	.06

E - estimated.

Mogadore Reservoir

Location: Portage County

Type: Reservoir

Use: Water supply and recreation

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1939	1000	6900	0.76

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
13.2	rural, agricultural	moderate

Lake data (figs. 22, 23; tables 47-50): Mogadore Reservoir was sampled under partly cloudy skies on May 4 and under clear skies on August 23. Numerous zooplankton, particularly Cladocerans (water fleas), were seen throughout the water column in May; their grazing effects on the lake phytoplankton may account for the high secchi-disk transparency of 21 ft, the maximum observed during 1976-77. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
May 4	no	no	hard Ca HCO_3	no	no	no	Chlorophyta
August 23	yes	yes	--	no	--	no	Cyanophyta

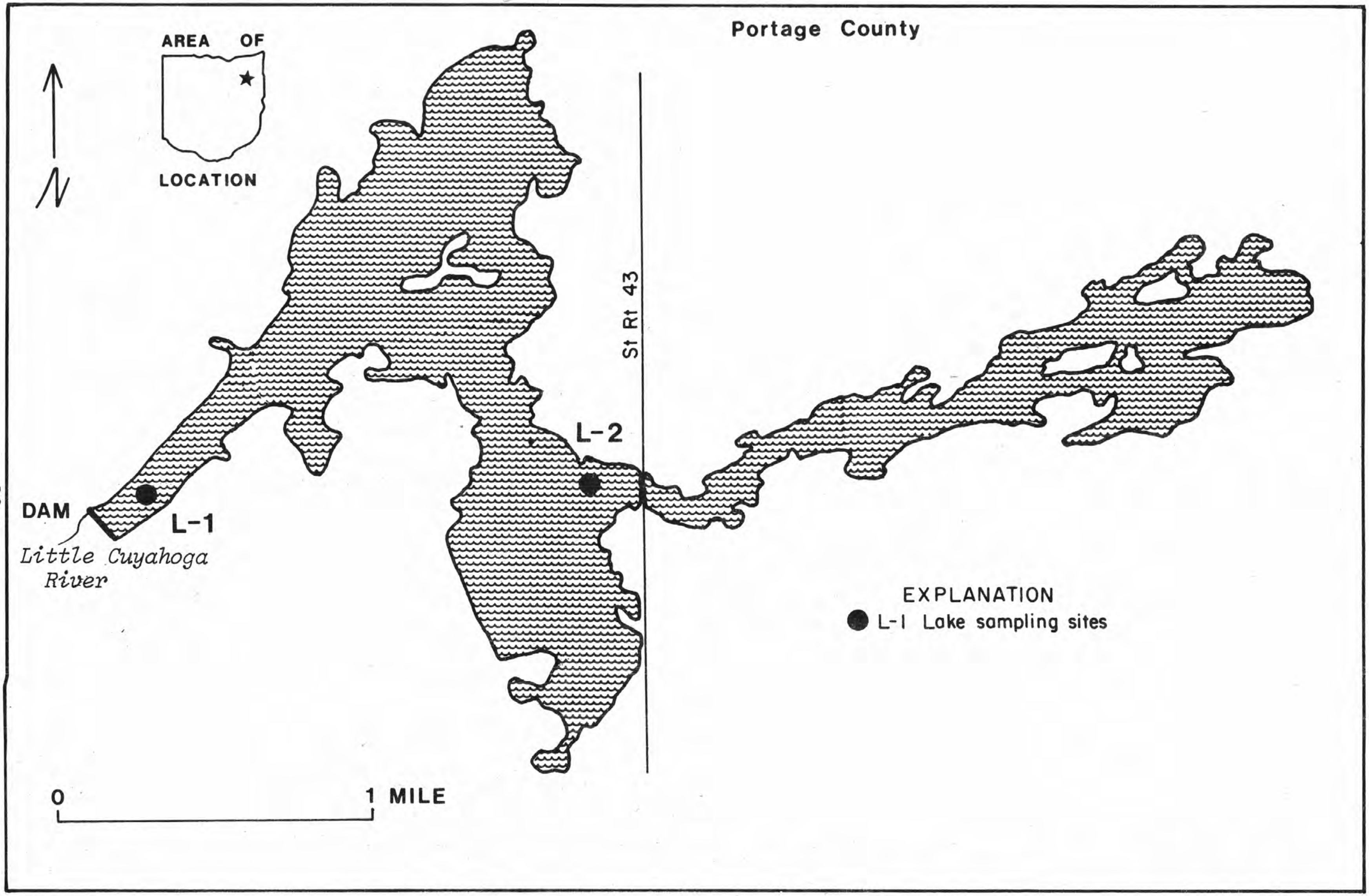

Figure 22.--Mogadore Reservoir sampling sites.

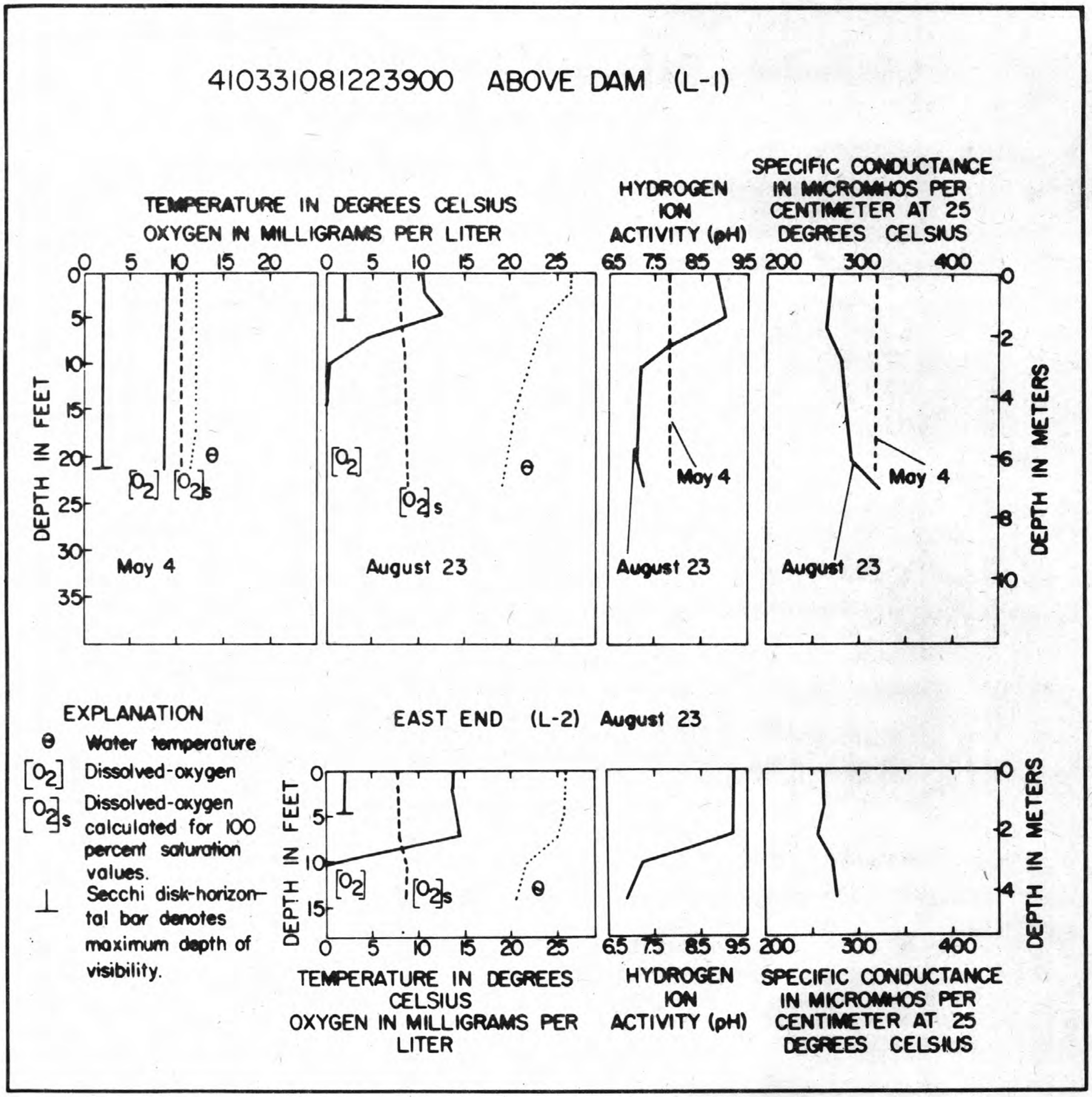

Figure 23.--Data profiles for Mogadore Reservoir, Ohio, on selected days in 1976.

Table 47.--Profile data for the primary lake site, Mogadore Reservoir, Ohio

410331081223900 - MOGADORE RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
MAY												
04...	1040	.0	12.0	8.8	85	318	7.8	--	--	--	--	--
04...	1045	2.0	12.0	8.8	85	318	7.8	0	92	2.3	.0	21
04...	1050	4.0	12.0	8.8	85	318	7.8	--	--	--	--	--
04...	1055	7.0	12.0	8.8	85	318	7.8	--	--	--	--	--
04...	1100	10	12.0	8.7	84	318	7.8	--	--	--	--	--
04...	1105	15	12.0	8.7	84	318	7.8	--	--	--	--	--
04...	1110	20	11.6	8.6	82	318	7.8	0	92	2.3	.0	--
AUG												
23...	1500	.0	26.6	10.3	132	268	8.8	--	--	--	--	--
23...	1505	2.0	26.4	10.4	132	268	8.9	8	52	.1	.0	5.1
23...	1510	4.0	24.7	12.1	151	265	9.0	--	--	--	--	--
23...	1512	4.5	24.0	12.4	153	265	9.0	--	--	--	--	--
23...	1515	7.0	23.0	4.4	53	268	8.0	--	--	--	--	--
23...	1520	10	22.0	.2	2	280	7.2	--	--	--	--	--
23...	1525	15	20.8	.0	0	285	7.1	--	--	--	--	--
23...	1530	20	19.8	.0	0	290	7.1	0	108	14	1.2	--
23...	1535	23	19.0	.0	0	320	7.2	--	--	--	--	--

Table 48.--Chemical analyses of water column composite samples, Mogadore Reservoir, Ohio

410331081223900 - MOGADORE RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
MAY 04...	1100	42	8.9	1.6	7.8	50	15	.1	140	218	5	223

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
MAY 04...	0	0	10	1	<.5	0	0	0	<10	.05

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
MAY 04...	40	0	0	70	70	1	10

Table 49.--Chemical, physical, and biological analyses of water samples from selected depths, Mogadore Reservoir, Ohio

410331081223900 - MOGADORE RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
MAY									
04...	1045	2.0	.01	.02	.03	.05	.55	.60	.01
04...	1110	20	.01	.02	.03	.06	.54	.60	.01
AUG									
23...	1505	2.0	.01	.00	.01	.03	.42	.45	.01
23...	1530	20	.01	.00	.01	.19	.56	.75	.10

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
MAY									
04...	.03	1.3	1	5	3.8	.8	12	<2	<2
04...	.03	1.3	1	5	4.1	.6	7	<2	<2
AUG									
23...	.03	4.5	2	5	7.3	2.0	23	<2	<2
23...	.17	6.2	3	90	8.1	.8	16	12	50

Table 50.--Phytoplanton in Mogadore Reservoir, Ohio

Sample description: Location	Date	Location in water column	Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Site L-1 above dam ----------	5-4-76	euphotic zone composite	1000	0.6	Chlorophyta	83	Schroederia (83)
					Chrysophyta	17	Ochromonas (17)
Site L-1 above dam ----------	8-23-76	euphotic zone composite	22,000	2.4	Cyanophyta	89	Aphanizomenon (33); Oscillatoria (29); Anabaena (16); Anacystis (11); Gomphosphaeria
					Pyrrhophyta	6	Ceratium (6)
					Chrysophyta	5	Cyclotella (3); Nitzschia (1); Melosira (1); Navicula
					Euglenophyta	1	Cryptomonas (1); Trachelomonas
					Chlorophyta	< 1	Ankistrodesmus; Chlamydomonas
Site L-1 above dam ---------	8-23-76	4.5-ft depth	54,000	2.3	Cyanophyta	87	Anabaena (29); Anacystic Incerta (28); Aphanizomenon (27); Oscillatoria (2); Anacystis (1)
					Chrysophyta	8	Cyclotella (6); Nitzschia (1); Cymbella (1)
					Chlorophyta	3	Pandorina (3); Phacotus
					Euglenophyta	1	Trachelomonas (1)
					Pyrrhophyta	1	Ceratium (1); Glenodinium

*Less than 1 percent not given.

Mogadore Reservoir was a well-mixed clear-water lake on May 4. The August profiles at site L-1 show a thermal gradient extending from the 2 ft (0.6 m) depth to the lake bottom. The lake was poorly mixed below 5 ft and anaerobic below 10 ft. Hydrogen sulfide was present near the lake bottom. The supersaturated zone of dissolved oxygen (153 percent) and high pH (9.0) at the 5 ft depth resulted from high photosynthetic activity within the poorly mixed waters. Similar activities are indicated by the data at site L-2.

Except for the surface sample in August, the BOD in the lake was low when compared with other Ohio lakes. The high BOD from the 2-ft depth on August 23 most likely reflected the respiration of the dense algal community.

Inorganic nitrogen concentrations were low during both sampling periods. Nutrient recycling near the lake bottom in August is indicated, but there was no accumulation of ammonia as seen in other lakes. Zooplankton grazing may have been responsible for both the low cell counts and low diversity index of the algal community on May 4. Blue-green algae dominated the August 23 collections.

Inflow data: Due to the diversity of inflow sources, no data were taken.

Mosquito Creek Lake

Location: Trumbull County

Type: Reservoir; dam has multi-level release controls

Use: Flood control, recreation, and water supply

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1943	7850	82,400	1.15

Drainage basin characteristics:

Drainage area (miles²)	Type	Estimated sediment yield (from fig. 4)
97.5	agricultural, rural	moderately low

Lake data (figs. 24, 25; tables 51-54): Mosquito Creek Lake was sampled under partly cloudy skies on both May 12 and August 24. The secchi disk visibility was less than 3 ft on both dates. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient) ther-mal	Stratification (gradient) chem-ical	Chemical type	Substances at or above State limits pesti-cides	toxi-cants	bac-teria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
May 12	no	no	moderately hard Ca Na HCO_3 SO_4	no	no	no	Cyanophyta Chlorophyta
August 24	partial	slight	--	no	--	no	Cyanophyta

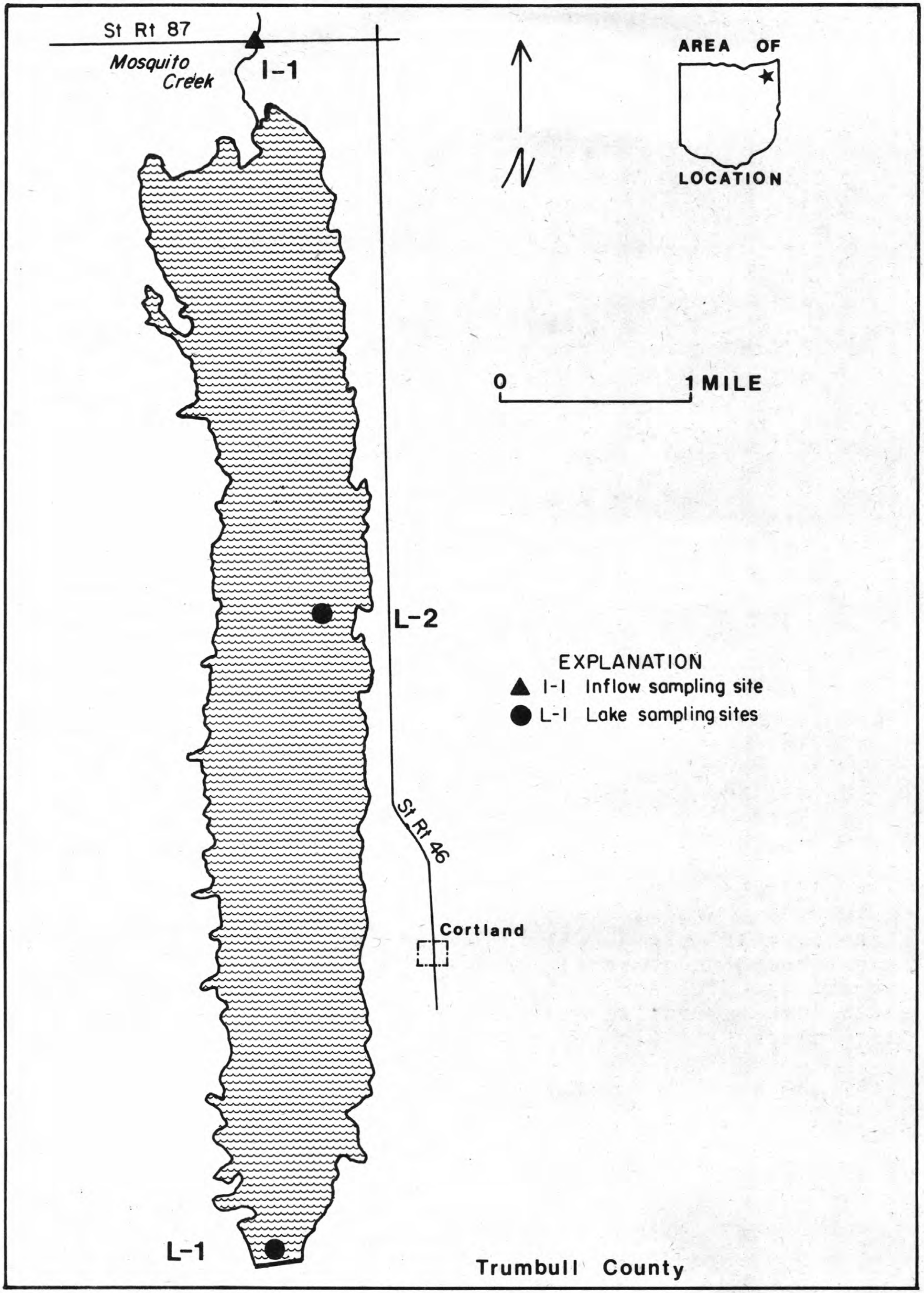

Figure 24.--Mosquito Creek Lake and inflow sampling sites.

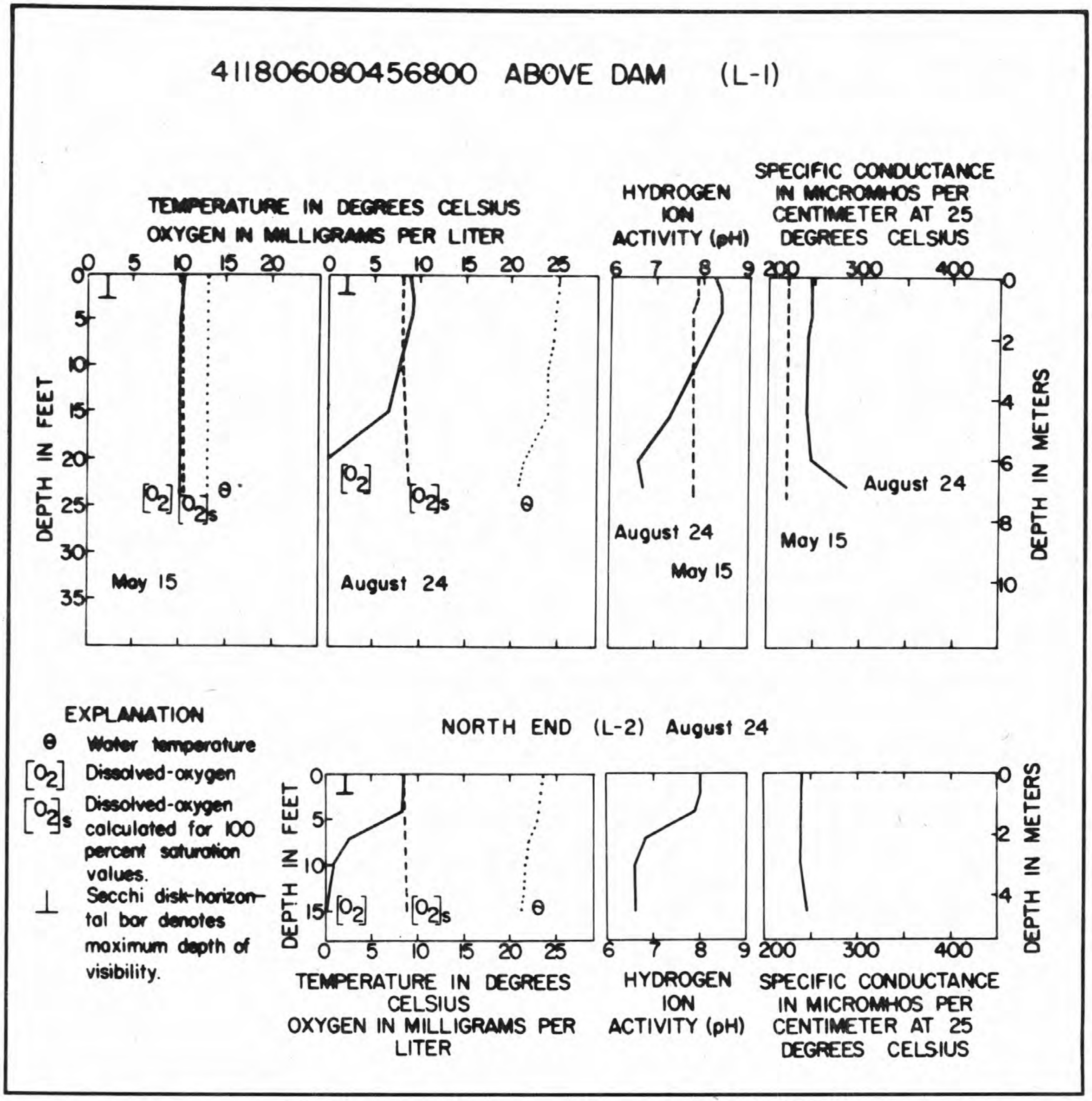

Figure 25.--Data profiles for Mosquito Lake, Ohio, on selected days in 1976.

Table 51.--Profile data for the primary lake site, Mosquito Creek Lake, Ohio

411806080452800 - MOSQUITO CREEK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
MAY												
12...	1300	.0	13.0	10.3	101	220	7.9	--	--	--	--	--
12...	1305	2.0	13.0	10.3	101	220	7.9	0	44	.9	.0	2.7
12...	1310	4.0	13.0	10.1	99	220	7.8	--	--	--	--	--
12...	1315	7.0	13.0	10.0	98	220	7.8	--	--	--	--	--
12...	1320	10	13.0	10.1	99	220	7.8	--	--	--	--	--
12...	1325	15	13.0	10.1	99	220	7.8	--	--	--	--	--
12...	1330	20	13.0	10.0	98	220	7.8	--	--	--	--	--
12...	1335	24	13.0	10.0	98	220	7.8	0	44	.9	.0	--
AUG												
24...	1200	.0	25.0	8.9	110	245	8.3	--	--	--	--	--
24...	1205	2.0	25.0	9.1	112	245	8.4	1	54	.3	.0	2.0
24...	1210	4.0	24.8	9.1	112	245	8.4	--	--	--	--	--
24...	1215	7.0	24.5	8.4	104	242	8.2	--	--	--	--	--
24...	1220	10	24.0	7.6	93	242	7.8	--	--	--	--	--
24...	1225	15	23.9	6.3	77	240	7.3	--	--	--	--	--
24...	1230	20	21.5	.0	0	247	6.6	0	60	19	<.1	--
24...	1235	23	20.7	.0	0	283	6.7	--	--	--	--	--

Table 52.--Chemical analyses of water column composite samples, Mosquito Creek Lake, Ohio

411806080452800 - MOSQUITO CREEK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
MAY												
12...	1320	21	5.8	2.8	12	31	20	.2	76	135	13	148

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
MAY										
12...	0	0	<10	2	<.5	4	0	0	<10	.06

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
MAY							
12...	30	0	0	420	60	0	10

Table 53.--Chemical, physical, and biological analyses of water samples from selected depths, Mosquito Creek Lake, Ohio

411806080452800 - MOSQUITO CREEK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
MAY									
12...	1305	2.0	.01	.11	.12	.01	.57	.58	.01
12...	1335	24	.01	.11	.12	.01	.64	.65	.01
AUG									
24...	1205	2.0	.01	.00	.01	.01	.72	.73	.01
24...	1230	20	.01	.02	.03	.18	.77	.95	.01

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
MAY									
12...	.06	.4	9	20	7.3	1.8	22	<2	<2
12...	.06	.5	9	20	7.0	1.0	22	2	<2
AUG									
24...	.07	.1	6	15	7.8	4.0	23	<2	2
24...	.08	--	9	35	8.0	1.8	23	2	8

Table 54.--Phytoplankton in Mosquito Creek Lake, Ohio

Sample description: Location	Date	Location in water column	Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Site L-1 above dam ---------	5-12-76	euphotic zone composite	51,000	2.5	Cyanophyta	50	Anacystis (25); Anacystis Incerta (21); Aphanizomenon (4)
					Chlorophyta	48	Oocystis (15); Scenedesmus (10); Crucigenia (9); Pediastrum (8); Tetrastrum (3); Kirchneriella (2); Ankistrodesmus (1); Chodatella
					Chrysophyta	2	Nitzschia (1); Melosira (1); Cyclotella
Site L-1 above dam ---------	8-24-76	euphotic zone composite	230,000	2.6	Cyanophyta	89	Oscillatoria (53); Agmenellum (11); Cylindrospermum (8); Raphidiopsis (8); Anacystis (4); Lyngbya (3); Aphanizomenon (2); Anabaena
					Chlorophyta	6	Tetrastrum (2); Dictyosphaerium (1); Ankistrodesmus (1); Scenedesmus (1); Kirchneriella (1); Golenkinia; Chodatella; Crucigenia; Euastrum; Staurastrum
					Chrysophyta	3	Cyclotella (2); Asterionella (2); Melosira; Nitzschia
					Euglenophyta	< 1	Trachelomonas
Site L-1 above dam ----------	8-24-76	2-ft depth	650,000	1.4	Cyanophyta	96	Oscillatoria (76); Lyngbya (7); Anacystis (6); Agmenellum (3); Cylindrospermum (3); Anabaenopsis (1); Anabaena; Aphanizomenon
					Chrysophyta	1	Cylotella (1); Stephanodiscus; Asterionella; Navicula; Nitzschia
					Chlorophyta	1	Crucigenia (1); Pediastrum; Golenkinia; Kirchneriella; Oocystis; Polydriopsis; Tetraedron; Treubaria; Westella; Scenedesmus; Tetrastrum; Cosmarium; Euastrum; Staurastrum
					Euglenophyta	< 1	Cryptomonas; Euglena; Phacus; Trachelomonas
					Pyrrhophyta	< 1	Ceratium

* Less than 1 percent not given.

The lake was vertically mixed on May 12. By August 24, the water at site L-1 was stabilized below 15 ft and anaerobic below 20 ft. Specific conductance increased near the lake bottom at site L-1, and trace amounts of hydrogen sulfide were detected in the bottom waters at sites L-1 and L-2. Biochemical oxygen demands (BOD) in May and August were higher in surface waters than at the lake bottom, possibly reflecting higher respiration rates of phytoplankton within the euphotic zone.

Inorganic nitrogen concentrations were generally low. Silica concentrations were also low and may have had a limiting effect on diatom (Chrysophyta) development. The phytoplankton data show higher cell counts and a higher percentage of blue-green algae on August 24 than on May 12.

Inflow data (fig 24, table 55): Mosquito Creek, which drains 26 mi^2, was sampled at site I-1, where it represents 27 percent of the drainage basin to Mosquito Creek Lake. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1976)	Discharge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Mosquito Creek at site I-1	May 12	E 6	lake	lake	stream	stream
	August 24	< 10	stream	lake	stream	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Mayfly (Ephemeroptera) and caddisfly (Trichoptera) larvae, and water pennies (Coleoptera) were observed at site I-1.

Table 55.--Physical and chemical data for selected inflows, Mosquito Creek Lake, Ohio

412744080451800 - MOSQUITO C AB MOSQUITO CREEK LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTAN-TANEOUS DIS-CHARGE (CFS)	TEMPER-ATURE (DEG C)	DIS-SOLVED OXYGEN (MG/L)	PH (UNITS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)
MAY												
12...	1000	E6.0	11.0	9.2	7.5	295	4	40	11	.02	.45	.04
AUG												
24...	0940	<10	20.0	7.6	7.4	515	3	30	10	.10	.50	.06

E - estimated.

Senecaville Lake

Location: Guernsey and Noble Counties

Type: Reservoir; dam has multi-level release controls

Use: Flood control and recreation

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1937	3550	43,500	0.46

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
118	agricultural, rural	moderate to moderately low

Lake data (figs. 26, 27; tables 56-59): Senecaville Lake was sampled under clear skies on April 20 and August 17. A warm dry period preceded the April visit. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient) thermal	Stratification (gradient) chemical	Chemical type	Substances at or above State limits: pesticides	toxicants	bacteria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
April 20	yes	yes	hard Ca HCO_3	no	no	no	Cyanophyta
August 17	slight	yes	--	no	--	no	Cyanophyta

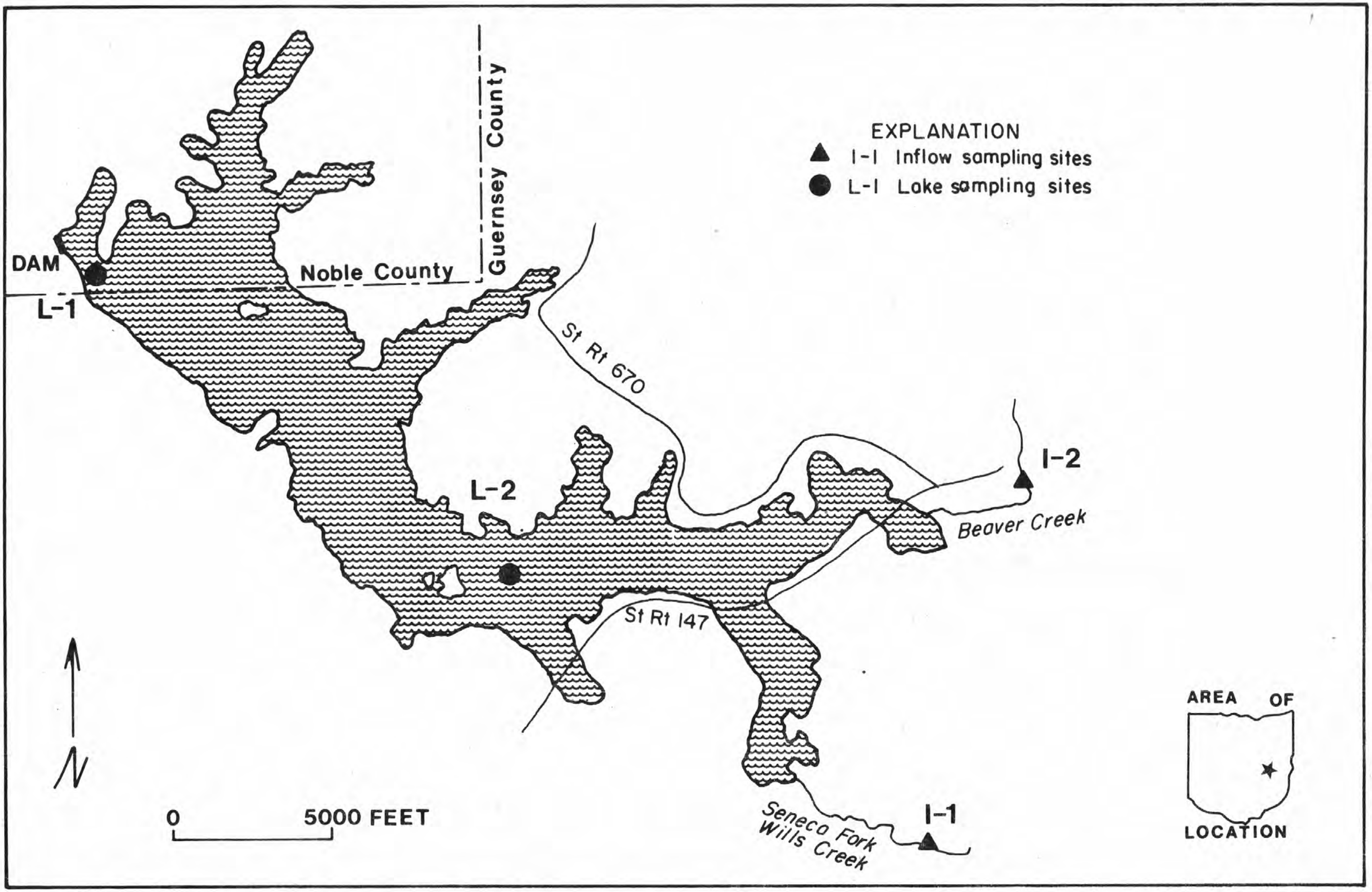

Figure 26.--Senecaville Lake and inflow sampling sites.

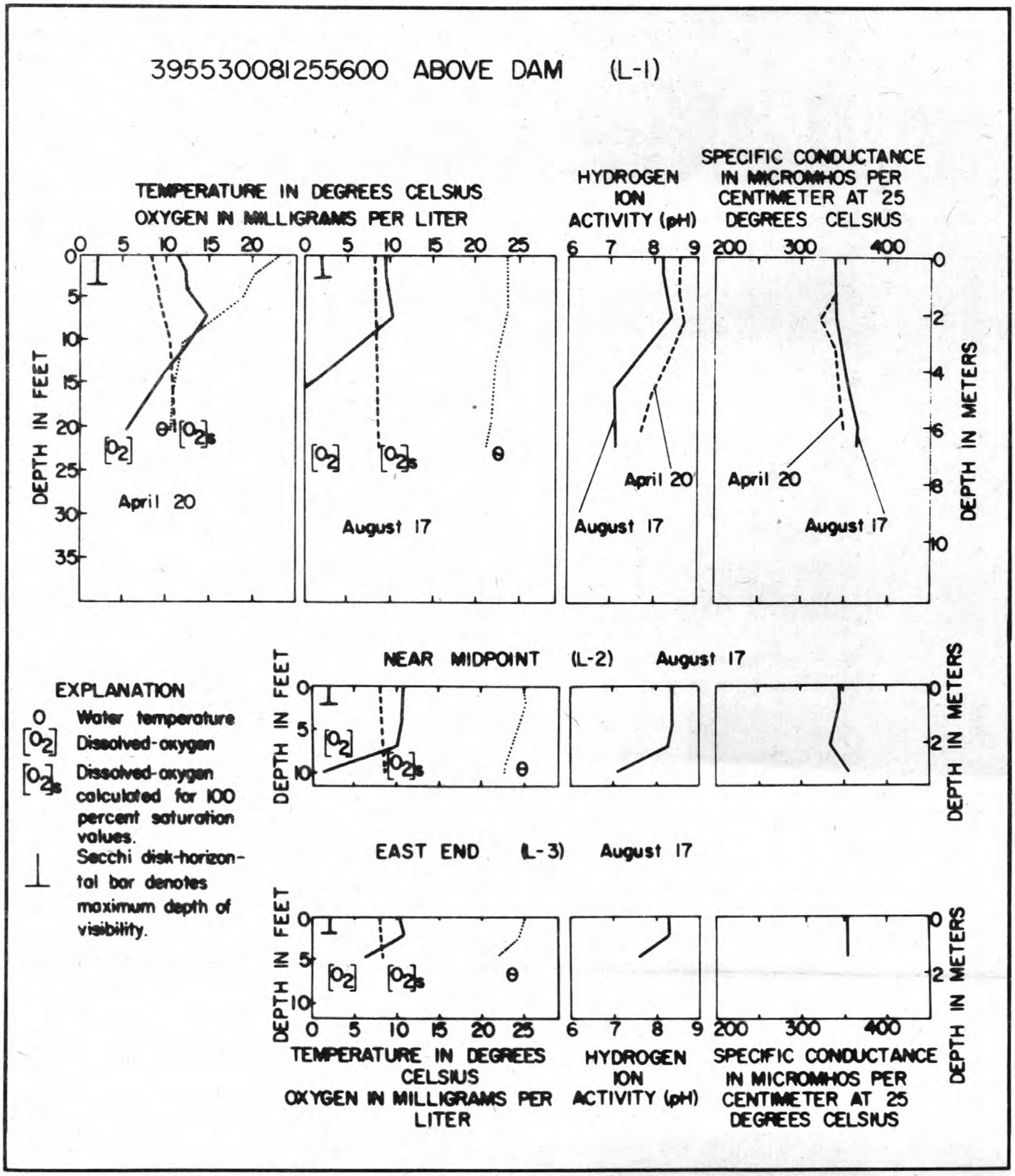

Figure 27.--Data profiles for Senecaville Lake, Ohio, on selected days in 1976.

Table 50.--Profile data for the primary lake site, Senecaville Lake, Ohio

395530081255600 - SENECAVILLE LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
20...	1240	.0	23.1	11.3	136	340	8.6	--	--	--	--	--
20...	1245	2.0	20.5	12.4	141	340	8.6	7	109	.4	.0	3.2
20...	1250	4.0	19.5	12.6	140	340	8.6	--	--	--	--	--
20...	1255	7.0	16.0	14.6	152	325	8.7	--	--	--	--	--
20...	1300	10	12.0	12.4	118	340	8.5	--	--	--	--	--
20...	1305	15	10.8	8.7	81	345	8.0	--	--	--	--	--
20...	1310	20	10.5	5.7	52	350	7.7	0	133	4.3	.0	--
AUG												
17...	1325	.0	23.8	9.4	115	340	8.2	--	--	--	--	--
17...	1330	2.0	23.8	9.4	115	340	8.2	0	127	1.3	.0	2.6
17...	1335	4.0	23.8	9.7	118	340	8.3	--	--	--	--	--
17...	1340	7.0	23.5	10.2	123	340	8.4	--	--	--	--	--
17...	1345	10	22.7	7.2	86	345	7.9	--	--	--	--	--
17...	1350	15	22.0	.0	0	355	7.1	--	--	--	--	--
17...	1355	20	21.5	.0	0	365	7.1	0	150	19	.4	--
17...	1400	22	21.1	.0	0	365	7.1	--	--	--	--	--

Table 57.--Chemical analyses of water column composite samples, Senecaville Lake, Ohio

395530081255600 - SENECAVILLE LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 20...	1300	49	11	1.7	4.9	62	4.7	.1	170	181	53	234

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 20...	100	0	<10	3	<.5	23	0	0	<10	<.05

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 20...	20	2	0	230	220	3	0

Table 58.--Chemical, physical, and biological analyses of water samples from selected depths, Senecaville Lake, Ohio

395530081255600 - SENECAVILLE LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
20...	1245	2.0	.01	.35	.36	.21	.17	.38	.01
20...	1310	20	.01	.05	.06	.08	.50	.58	.01
AUG									
17...	1330	2.0	.01	.00	.01	.01	.54	.55	.01
17...	1355	20	.01	.00	.01	.45	.65	1.1	.01

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
20...	.04	1.6	4	10	4.6	2.2	10	<2	<2
20...	.07	2.9	10	20	7.0	1.9	10	<2	2
AUG									
17...	.04	3.7	5	20	4.7	2.7	13	8	<2
17...	.11	5.3	25	25	6.8	1.8	20	18	18

Table 59.--Phytoplankton in Senecaville Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Location	Date	Location in water column					
Site L-1 above dam ----------	4-20-76	euphotic zone composite	56,000	3.2	Cyanophyta	53	Oscillatoria (31); Agmenellum (14); Anacystis (8)
					Chrysophyta	33	Cyclotella (11); Nitzschia (11); Melosira (8); Synedra (2); Achnanthes (1)
					Chlorophyta	12	Ankistrodesmus (3); Golenkinia (3); Dictyosphaerium (2); Chodatella (1); Scenedesmus (1); Crucigenia (1); Tetrastrum (1); Kirchneriella; Treubaris; Chlamydomonas
					Euglenophyta	1	Trachelomonas (1); Euglena; Phacus; Crytomonas
					Pyrrhophyta	< 1	Glenodinium
Site L-1 above dam ----------	4-20-76	7-ft depth	62,000	1.8	Cyanophyta	68	Oscillatoria (68)
					Chrysophyta	19	Nitzschia (14); Melosira (4); Chrysococcus (1); Cymbella; Navicula
					Chlorophyta	11	Micractinium (3); Dictyosphaerium (3); Ankistrodesmus (2); Oocystis (1); Scenedesmus (1); Kirchneriella (1); Chodatella; Tetraedron; Actinastrum; Tetrastrum; Chlamydomonas
					Euglenophyta	1	Euglena (1); Trachelomonas; Phacus; Crytomonas
					Pyrrhophyta	1	Peridinium (1)
Site L-1 above dam ----------	8-17-76	euphotic zone composite	630,000	1.1	Cyanophyta	98	Oscillatoria (71); Cylindrospermum (26); Agmenellum (1); Trichodesmium
					Chrysophyta	1	Melosira (1)
					Chlorophyta	< 1	Crucigenia; Chlamydomonas
					Euglenophyta	< 1	Euglena; Trachelomonas
Site L-1 above dam ----------	8-17-76	7-ft depth	260,000	1.7	Cyanophyta	95	Oscillatoria (64); Cylindrospermum (19); Agmenellum (6); Lyngbya (5); Anabaenopsis (1); Anacystis
					Chrysophyta	1	Nitzschia (1); Cyclotella; Melosira; Fragilaria; Chrysococcus; Ochromonas
					Chlorophyta	1	Chlamydomonas (1); Ankistrodesmus; Selenastrum; Tetraedron; Scenedesmus
					Euglenophyta	< 1	Crytomonas; Euglena; Trachelomonas

* Less than 1 percent not given.

The profiles at site L-1 in April show the warm weather effects on the lake. A thermocline, which extended from the lake surface to the 10-ft depth had reduced vertical mixing. Maximum dissolved oxygen and pH coincided with the minimum specific-conductance values at 7 ft and suggest a zone of optimum nutrient uptake and photosynthetic activity at that depth.

By August 17, the bottom half of the lake had warmed considerably, but vertical mixing at site L-1 below 7 ft was negligible. Hydrogen sulfide was detected within the anaerobic zone below 15 ft. Data at sites L-2 and L-3 show a slight increase in specific conductance and turbidity toward the east end of the lake. The rapid decreases in dissolved oxygen with depth at all three sites indicate that high oxygen demand existed at or near the lake bottom.

The near-surface inorganic nitrogen concentrations in April were adequate for nuisance algal growths. By August 17, however, biological uptake had greatly reduced inorganic nitrogen levels, except for the ammonia generated near the lake bottom. Dissolved silica concentrations were higher in August than in April and may reflect the recycling of the silica-rich diatom cells (frustules) which were present in April. Blue-green algae (Cyanophyta) dominated in all the phytoplankton collections, and extensive beds of American Lotus (Nelumbo lutea) were observed in several of the lake embayments.

Inflow data (fig. 26, table 60): Two inflows to Senecaville Lake were sampled; Seneca Fork Wills Creek (site I-1), which drains 70.6 mi², and Beaver Creek (site I-2), which drains 23.4 mi². Their combined drainage represents 80 percent of the total drainage area to the lake. A qualitative comparison of stream versus lake data is shown below.

			Water body (stream or lake*) having higher concentration			
Stream	Date (1976)	Discharge (ft^3/s)	NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Seneca Fork Wills Creek at site I-1	April 20	E 15	lake	stream	stream	stream
	August 17	E 10	stream	stream	stream	stream
Beaver Creek at site I-2	April 20	E 10	lake	lake	lake	stream
	August 17	E 15	stream	same	lake	stream

* At 2-ft (0.6-m) depth.
E Estimated.

The data suggest that Beaver Creek may contribute higher chemical (specific conductance) loads to Senecaville Lake than Seneca Fork Wills Creek, but that the latter may have higher nutrient inputs.

Table 60.--Physical and chemical data for selected inflows, Senecaville Lake, Ohio

395200081195300 - SENECA F WILLS C AB SENECAVILLE LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTAN-TANEOUS DIS-CHARGE (CFS)	TEMPER-ATURE (DEG C)	DIS-SOLVED OXYGEN (MG/L)	PH (UNITS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)
APR												
20...	1000	E15	19.0	6.5	7.9	475	35	40	6.2	.04	.50	.09
AUG												
17...	1100	E10	19.5	6.5	7.3	480	30	20	8.0	.19	.40	.08

395404081191100 - BEAVER C AB SENECAVILLE LK AT SITE (I-2)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTAN-TANEOUS DIS-CHARGE (CFS)	TEMPER-ATURE (DEG C)	DIS-SOLVED OXYGEN (MG/L)	PH (UNITS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)
APR												
20...	0930	E10	17.0	7.7	8.1	630	5	10	3.7	.01	.33	.03
AUG												
17...	1130	E15	19.0	9.0	7.5	710	8	10	3.5	.16	.18	.04

E - estimated.

Summit Lake

Location: Summit County

Type: Reservoir

Use: Water supply

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
--	115	--	--

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
--	urban	moderate to moderately low

Lake data (figs. 28,29; tables 61-64): Summit Lake is an industrial water supply and is part of a complex hydrologic system within the Akron, Ohio area. The lake was sampled during intermittent rains on May 3 and under clear skies on August 19. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
May 3	yes	yes	very hard Na Cl	no	no	no	Cyanophyta
August 19	partial	yes	--	no	--	no	Cyanophyta

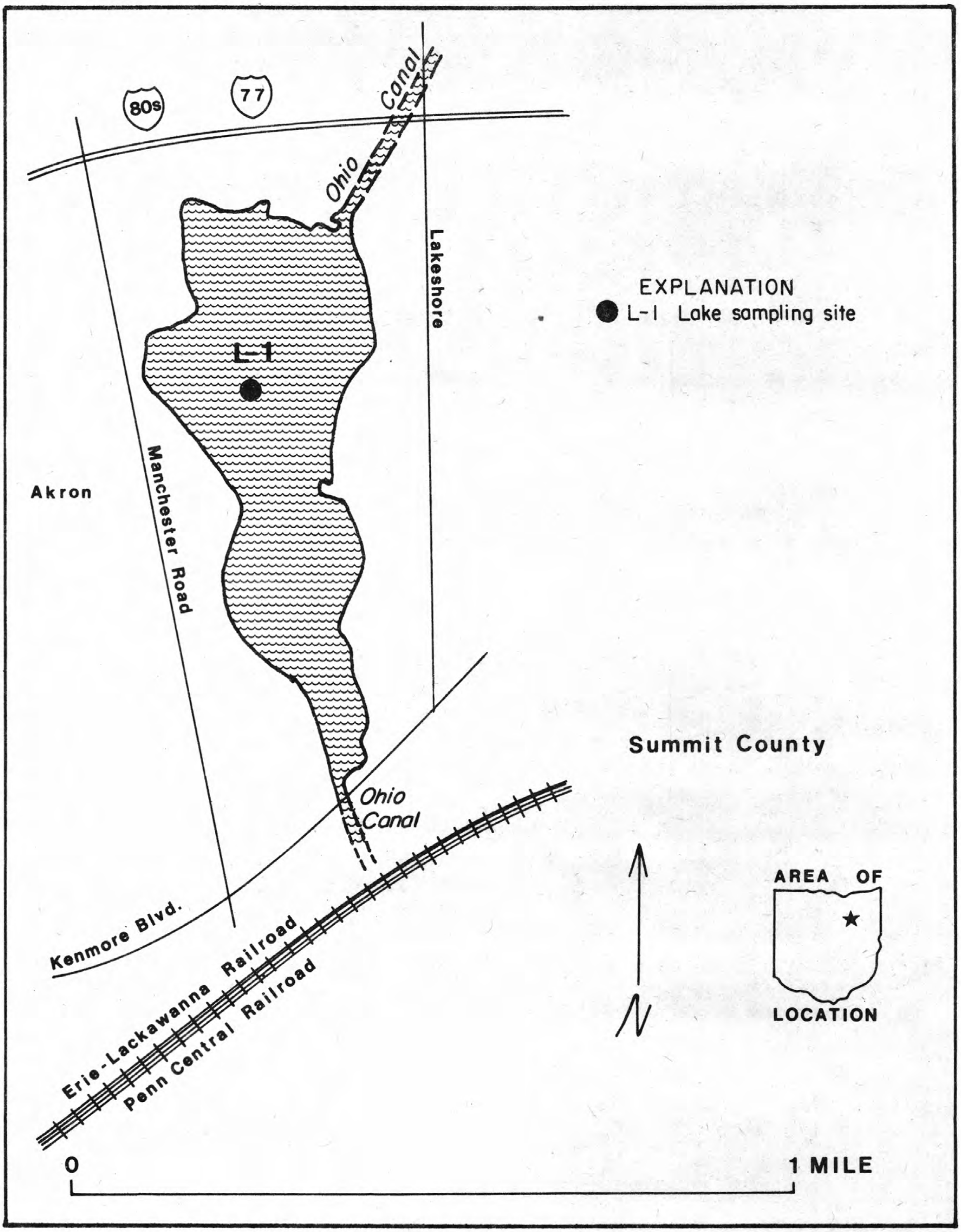

Figure 28.--Summit Lake sampling site.

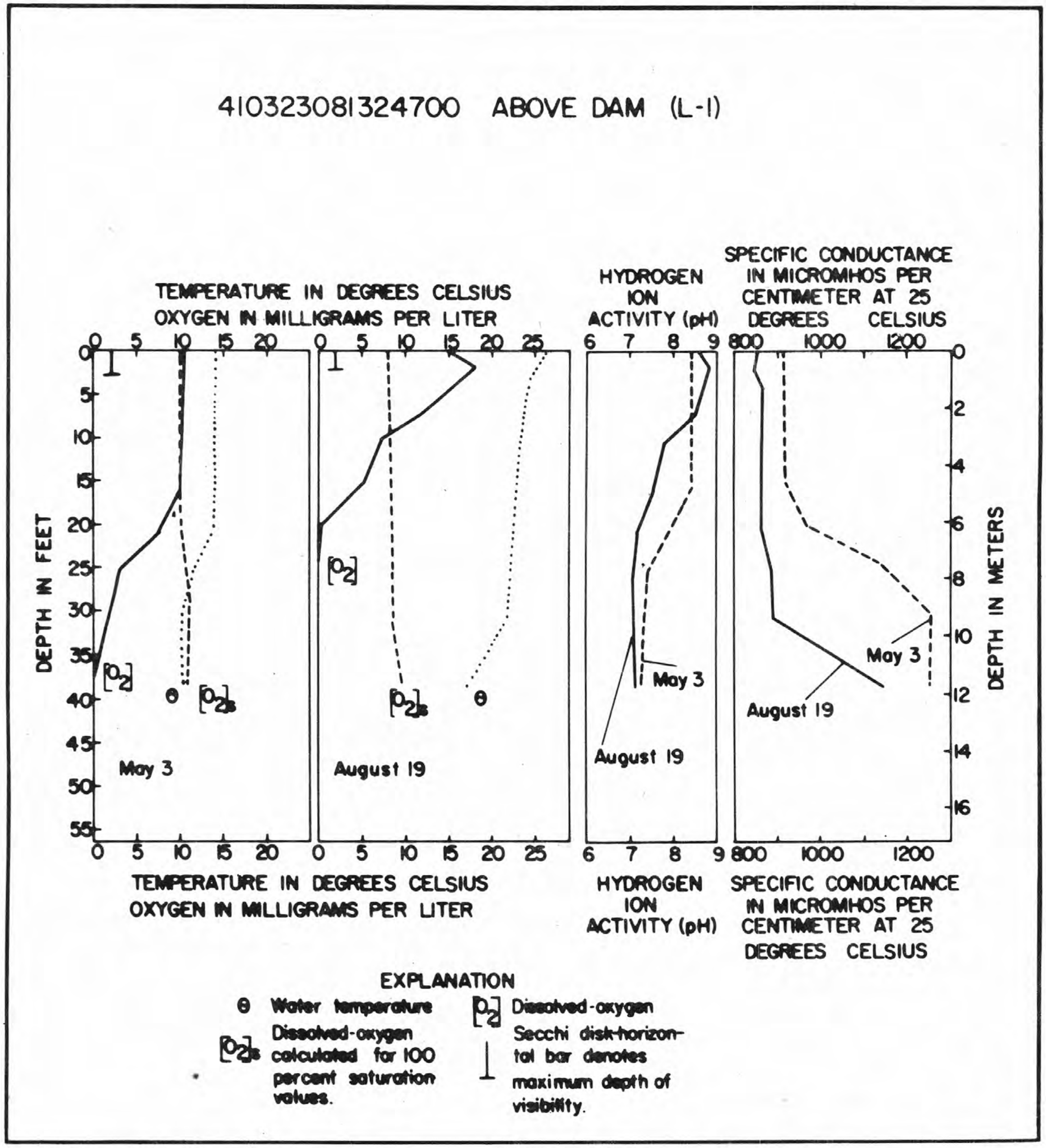

Figure 29.--Data profiles for Summit Lake, Ohio, on selected days in 1976.

Table G1.--Profile data for the primary lake site, Summit Lake, Ohio

410323081324700 - SUMMIT LK NR MIDPOINT AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
MAY												
03...	1410	.0	14.0	10.5	105	915	8.4	--	--	--	--	--
03...	1415	2.0	14.0	10.5	105	915	8.4	1	143	.9	.0	2.8
03...	1420	4.0	14.0	10.4	105	918	8.4	--	--	--	--	--
03...	1425	7.0	14.0	10.4	104	920	8.4	--	--	--	--	--
03...	1430	10	14.0	10.2	102	920	8.4	--	--	--	--	--
03...	1435	15	14.0	10.1	101	920	8.4	--	--	--	--	--
03...	1440	20	13.8	8.1	80	970	8.0	--	--	--	--	--
03...	1445	25	11.4	3.1	29	1150	7.4	--	--	--	--	--
03...	1450	30	10.1	2.0	18	1250	7.3	--	--	--	--	--
03...	1455	38	10.1	.0	0	1250	7.3	0	158	13	.0	--
AUG												
19...	1405	.0	26.0	14.6	185	855	8.6	--	--	--	--	--
19...	1410	2.0	24.5	17.8	220	850	8.8	12	115	.3	.0	2.1
19...	1415	4.0	24.0	15.0	183	865	8.7	--	--	--	--	--
19...	1420	7.0	23.5	12.0	145	865	8.5	--	--	--	--	--
19...	1425	10	23.0	7.2	86	865	7.8	--	--	--	--	--
19...	1430	15	22.8	5.2	62	865	7.6	--	--	--	--	--
19...	1435	20	22.3	.2	2	865	7.2	--	--	--	--	--
19...	1440	25	22.0	.0	0	885	7.1	--	--	--	--	--
19...	1445	30	21.8	.0	0	890	7.1	--	--	--	--	--
19...	1450	38	17.0	.0	0	1150	7.2	0	310	31	3.2	--

Table 62.--Chemical analyses of water column composite samples, Summit Lake, Ohio

410323081324700 - SUMMIT LK NR MIDPOINT AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
MAY 03...	1440	64	13	3.5	130	84	220	.2	210	670	18	668
AUG 19...	1450	--	--	--	--	--	--	--	--	--	--	--

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
MAY 03...	0	0	20	5	<.5	2	0	0	--	--
AUG 19...	--	--	10	23	<.5	--	--	--	--	--

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
MAY 03...	100	0	0	380	310	1	30
* AUG 19...	--	--	--	16000	3000	--	--

* Taken from a water sample 1-3 ft from the lake bottom.

Table 63.--Chemical, physical, and biological analyses of water samples from selected depths, Summit Lake, Ohio

410323081324700 - SUMMIT LK NR MIDPOINT AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMP-LING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITRO-GEN (N) (MG/L)	TOTAL ORGANIC NITRO-GEN (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL ORTHO PHOS-PHORUS (P) (MG/L)
MAY									
03...	1415	2.0	.01	.02	.03	.10	.88	.98	.01
03...	1455	38	.05	.28	.33	1.1	1.0	2.1	.02
AUG									
19...	1410	2.0	.01	.00	.01	.09	1.1	1.2	.01
19...	1450	38	.01	.00	.01	8.3	3.7	12	.04

DATE	TOTAL PHOS-PHORUS (P) (MG/L)	DIS-SOLVED SILICA (SIO2) (MG/L)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIO-CHEM-ICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEM-ICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLI-FORM (COL. PER 100 ML)	STREP-TOCOCCI (COL-ONIES PER 100 ML)
MAY									
03...	.07	.8	4	20	6.8	3.8	22	48	72
03...	.10	3.1	6	20	6.0	4.2	20	4	12
AUG									
19...	.09	3.0	5	25	6.3	6.2	26	240	<2
19...	.74	14	55	250	--	8.1	--	77	72

Table 64.--Phytoplankton in Summit Lake, Ohio

Sample description: Location	Date	Location in water column	Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Site L-1 at midpoint -----	5-3-76	euphotic zone composite	440,000	0.5	Cyanophyta	95	Oscillatoria (94); Anacystis (1)
					Chrysophyta	3	Nitzschia (1); Cyclotella (1); Asterionella (1); Synedra; Dinobryon
					Chlorophyta	2	Ankistrodesmus (1); Scenedesmus (1); Micractinium; Gonium; Chlamydomonas; Golenkinia
					Euglenophyta	< 1	Cryptomonas; Euglena; Trachelomonas
Site L-1 at midpoint -----	8-19-76	euphotic zone composite	300,000	1.6	Cyanophyta	94	Oscillatoria (75); Agmenellum (7); Lyngbya (6); Anabaena (3); Aphanizomenon (2); Anacystis (1)
					Chrysophyta	3	Cyclotella (2); Melosira (1); Synedra; Nitzschia; Ochromonas
					Chlorophyta	2	Gonium (1); Scenedesmus (1); Pediastrum; Ankistrodesmus; Carteria; Chlamydomonas
					Euglenophyta	< 1	Cryptomonas; Euglena; Trachelomonas
					Pyrrhophyta	< 1	Ceratium; Peridinium
Site L-1 at midpoint -----	8-19-76	2-ft depth	550,000	1.9	Cyanophyta	94	Oscillatoria (65); Raphidiopsis (16); Agmenellum (5); Anacystis (4); Anabaena (4)
					Chlorophyta	4	Crucigenia (1); Scenedesmus (1); Kirchneriella (1); Chlamydomonas (1); Micractinium; Treubaria; Ankistrodesmus; Dictyosphaerium
					Chrysophyta	2	Cyclotella (2); Melosira; Achnanthes; Synedra; Nitzschia; Synura
					Euglenophyta	< 1	Cryptomonas

* Less than 1 percent not given.

The May profiles for Summit Lake at site L-1 show thermal and chemical stratification. The increase in salinity (specific conductance) with depth, and the effect of temperature had increased water density and reduced vertical mixing. Summit Lake was the only sodium chloride (NaCl) type lake sampled during the 1976-77 reconnaissance.

The lake had generally warmed by August 19. The chemocline still existed below 30 ft, although chemical changes had occurred within this zone since May (salinity decreased and bicarbonate increased). High concentrations of dissolved oxygen, produced through photosynthesis, were detected near the 2 ft depth, and an anaerobic zone, characterized by a hydrogen sulfide odor, had developed below 25 ft. The August BOD was nearly double that of the May samples.

The concentrations of silica and inorganic nitrogen from the euphotic zone were generally low on May 3; much higher inorganic nitrogen existed in the bottom water. By August, the concentrations of oxidized nitrogen (NO_2, NO_3) within the lake were near zero. Almost all the lake nitrogen was bound up either as organic N or as recycled ammonia near the lake bottom. The bottom-water concentrations of total phosphorus (0.74 mg/L) and dissolved silica (14 mg/L), and the bacteria counts (240 colonies per 100 ml) of fecal coliforms at the surface in August were the highest of the lakes sampled in 1976. The blue-green (Cyanophyta) genus *Oscillatoria* accounted for a minimum of 65 percent of the total cell count of all phytoplankton samples. The macrophytes *Typha*, *Nymphaea*, and *Sagittaria* were observed growing in the lake.

Inflow data: No inflow data were taken.

Tappan Lake

Location: Harrison County

Type: Reservoir; dam has multi-level release controls

Use: Flood control and recreation

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1936	2350	35,100	0.65

Drainage basin characteristics:

Drainage area (miles²)	Type	Estimated sediment yield (from fig. 4)
71.1	agricultural, rural	moderately low

Lake data (figs. 30,31; tables 65-68): Tappan Lake was sampled under cloudy skies on April 26 and during clearing conditions on September 2. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient) thermal	Stratification (gradient) chemical	Chemical type	Substances at or above State limits: pesticides	toxicants	bacteria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
April 26	slight	slight	very hard Ca SO_4	no	no	no	Cyanophyta
September 2	partial	yes	--	no	--	no	Cyanophyta

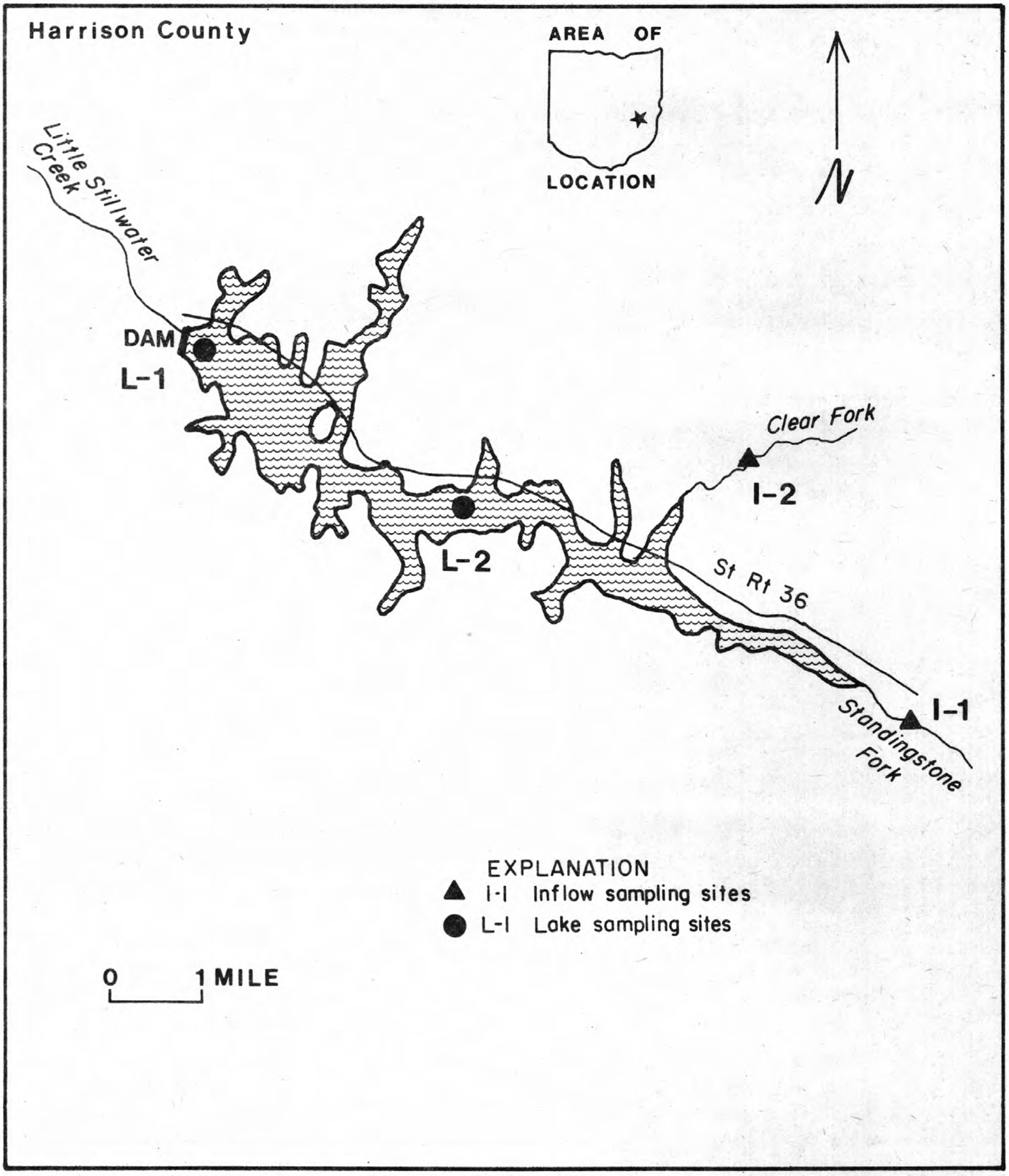

Figure 30.--Tappan Lake and inflow sampling sites.

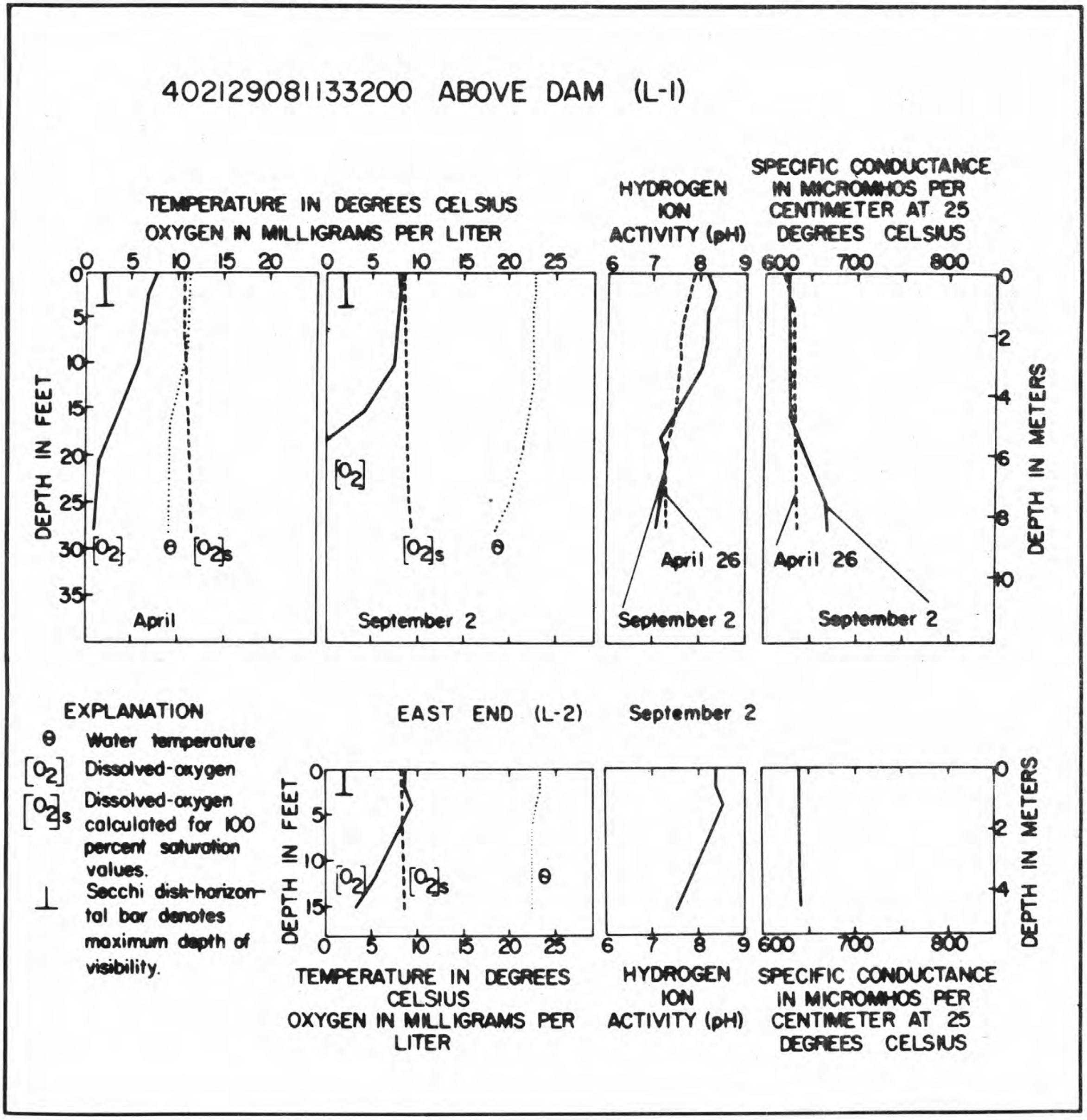

Figure 31.--Data profiles for Tappan Lake, Ohio, on selected days in 1976.

Table 65.--Profile data for the primary lake site, Tappan Lake, Ohio

402129081133200 - TAPPAN LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
26...	1530	.0	11.4	7.7	73	620	7.9	--	--	--	--	--
26...	1535	2.0	11.1	6.7	63	625	7.8	0	81	2.0	.0	3.5
26...	1540	4.0	11.0	6.5	61	630	7.7	--	--	--	--	--
26...	1545	7.0	11.0	6.1	57	630	7.6	--	--	--	--	--
26...	1550	10	10.5	5.4	50	630	7.6	--	--	--	--	--
26...	1555	15	9.2	3.8	34	635	7.5	--	--	--	--	--
26...	1600	20	9.0	1.4	12	635	7.3	--	--	--	--	--
26...	1605	28	9.0	.8	7	635	7.3	0	90	7.2	.0	--
SEP												
02...	1340	.0	22.8	7.8	93	625	8.2	--	--	--	--	--
02...	1345	2.0	22.8	8.0	95	625	8.3	0	84	.7	.0	3.7
02...	1350	4.0	22.5	7.6	90	625	8.2	--	--	--	--	--
02...	1355	7.0	22.5	7.4	88	625	8.2	--	--	--	--	--
02...	1400	10	22.5	7.2	86	625	8.1	--	--	--	--	--
02...	1405	15	22.2	4.0	47	628	7.5	--	--	--	--	--
02...	1408	18	21.5	.0	0	635	7.2	--	--	--	.8	--
02...	1410	20	21.3	.0	0	643	7.3	--	--	--	--	--
02...	1415	25	19.8	.0	0	665	7.2	0	132	13	1.2	--
02...	1420	28	18.2	.0	0	668	7.1	--	--	--	--	--

Table 66.--Chemical analyses of water column composite samples, Tappan Lake, Ohio

402129081133200 - TAPPAN LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 26...	1555	76	28	1.9	6.8	230	6.5	.1	310	472	11	483
SEP 02...	1415	--	--	--	--	--	--	--	--	--	--	--

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 26...	100	1	10	2	<.5	1	0	0	<10	<.05
SEP 02...	--	0	--	--	--	--	--	--	--	--

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 26...	40	1	0	740	700	0	20
*SEP 02...	--	--	--	1300	2200	--	--

*Taken from a water sample 1-3 ft from the lake bottom.

Table 67.--Chemical, physical, and biological analyses of water samples from selected depths, Tappan Lake, Ohio

402129081133200 - TAPPAN LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
26...	1535	2.0	.01	.05	.06	.08	.35	.43	.00
26...	1605	28	.01	.08	.09	.15	.25	.40	.01
SEP									
02...	1345	2.0	.01	.00	.01	.09	.36	.45	.01
02...	1415	25	.02	.00	.02	1.0	.70	1.7	.09

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
26...	.04	4.9	3	10	2.4	2.3	11	<2	<2
26...	.04	5.4	3	10	3.7	1.6	3	<2	<2
SEP									
02...	.05	4.7	2	25	6.5	2.5	31	2	2
02...	.26	7.1	8	20	9.9	1.9	20	<2	2

Table 68.--Phytoplankton in Tappan Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Location	Date	Location in water column					
Site L-1 above dam ---------	4-26-76	euphotic zone composite	110,000	1.2	Cyanophyta	82	Oscillatoria (81); Anacystis (1)
					Chrysophyta	13	Melosira (6); Nitzschia (5); Achnanthes (1); Ochromonas (1); Cyclotella; Cymbella; Navicula
					Chlorophyta	3	Ankistrodesmus (1); Micractinium (1); Scenedesmus (1); Selenastrum
					Euglenophyta	< 1	Cryptomonas; Trachelomonas
Site L-1 above dam ---------	9-2-76	euphotic zone composite	650,000	1.0	Cyanophyta	99	Cylindrospermum (70); Oscillatoria (27); Anacystis (2)
					Chlorophyta	< 1	Ankistrodesmus; Tetraedron
					Chrysophyta	< 1	Cyclotella; Nitzschia
					Euglenophyta	< 1	Euglena
Site L-1 above dam ----------	9-2-76	2-ft depth	490,000	1.4	Cyanophyta	99	Cylindrospermum (56); Lyngbya (36); Oscillatoria (7); Anacystis (1); Agmenellum; Anabaenopsis
					Chlorophyta	< 1	Scenedesmus; Chlamydomonas; Pandorina
					Chrysophyta	< 1	Nitzschia; Ochromonas
					Euglenophyta	< 1	Cryptomonas; Trachelomonas
					Pyrrhophyta	< 1	Peridinium

* Less than 1 percent not given.

Water temperature at site L-1 differed by 2.5° Celcius between the lake surface and bottom on April 26. The dissolved-oxygen concentrations were well below saturation levels throughout the water column and were less than 1.0 mg/L below 25 ft. The September profiles at site L-1 show decreasing temperature and increasing specific conductance with depth below 15 ft. Hydrogen sulfide analyses from 18 and 25 ft indicate increasing H_2S toward the lake bottom. (Also see lakes Logan and Leesville.) Profile data taken from the east end of the lake at site L-2 show slightly higher values compared with those at site L-1.

Concentrations of inorganic nitrogen and phosphorus were generally low. Nitrogen (ammonia)and phosphorus recycling near the lake bottom in September are indicated. Phytoplankton cell counts from the composite samples were six times higher in September than in April and consisted mostly of blue-green (Cyanphyta) algae.

Inflow data (fig. 30; table 69): Clear Fork, which drains 25.1 mi^2 and Standingstone Fork, draining 16.3 mi^2 were sampled at sites I-1 and I-2, respectively. Their combined areas represent 58 of the lake drainage basin. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1976)	Dis-charge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Clear Fork at site I-1	April 26	E 15	stream	lake	same	stream
	September 3	< 3	stream	lake	stream	stream
Standingstone Fork at site I-2	April 26	E 9	stream	lake	lake	stream
	September 3	E 5	stream	same	stream	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Chemical concentrations (indicated by specific conductance) were much higher in the inflows than in Tappan Lake.

Table 69.--Physical and chemical data for selected inflows, Tappan Lake, Ohio

402021081063100 - CLEAR F AB TAPPAN LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR 26...	1350	E15	11.0	9.8	7.9	1320	5	10	2.4	.07	.30	.03
SEP 03...	0855	<3.0	15.5	7.9	7.7	1270	9	15	6.7	.07	.23	.04

401816081054000 - SANDINGSTONE F AB TAPPAN LK AT SITE (I-2)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR 26...	1415	E9.0	9.5	10.7	8.2	2070	2	5	2.1	.09	.35	.02
SEP 03...	0920	E5.0	13.0	9.8	8.0	2400	7	5	9.9	.12	.18	.05

E - estimate.

Wills Creek Lake

Location: Muskingum and Coshocton Counties

Type: Reservoir; dam has multi-level release controls

Use: Flood control and recreation

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1937	900	6000	0.01

Drainage basin characteristics:

Drainage area (miles^2)	Type	Estimated sediment yield (from fig. 4)
842	agricultural, rural	moderate to moderately low

Lake data (figs. 32, 33; tables 70-73): Wills Creek Lake was sampled during partly cloudy weather on May 6 and in clear weather on September 7. The lake had the smallest capacity-inflow ratio (0.01) of the lakes sampled; a slightly perceptible flow was noted at site L-1 on both sampling days. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient) thermal	Stratification (gradient) chemical	Chemical type	Substances at or above State limits pesticides	Substances at or above State limits toxicants	Substances at or above State limits bacteria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
May 6	partial	yes	very hard Ca SO_4	no	no	no	Cyanophyta
September 7	yes	yes	--	no	--	no	Cyanophyta

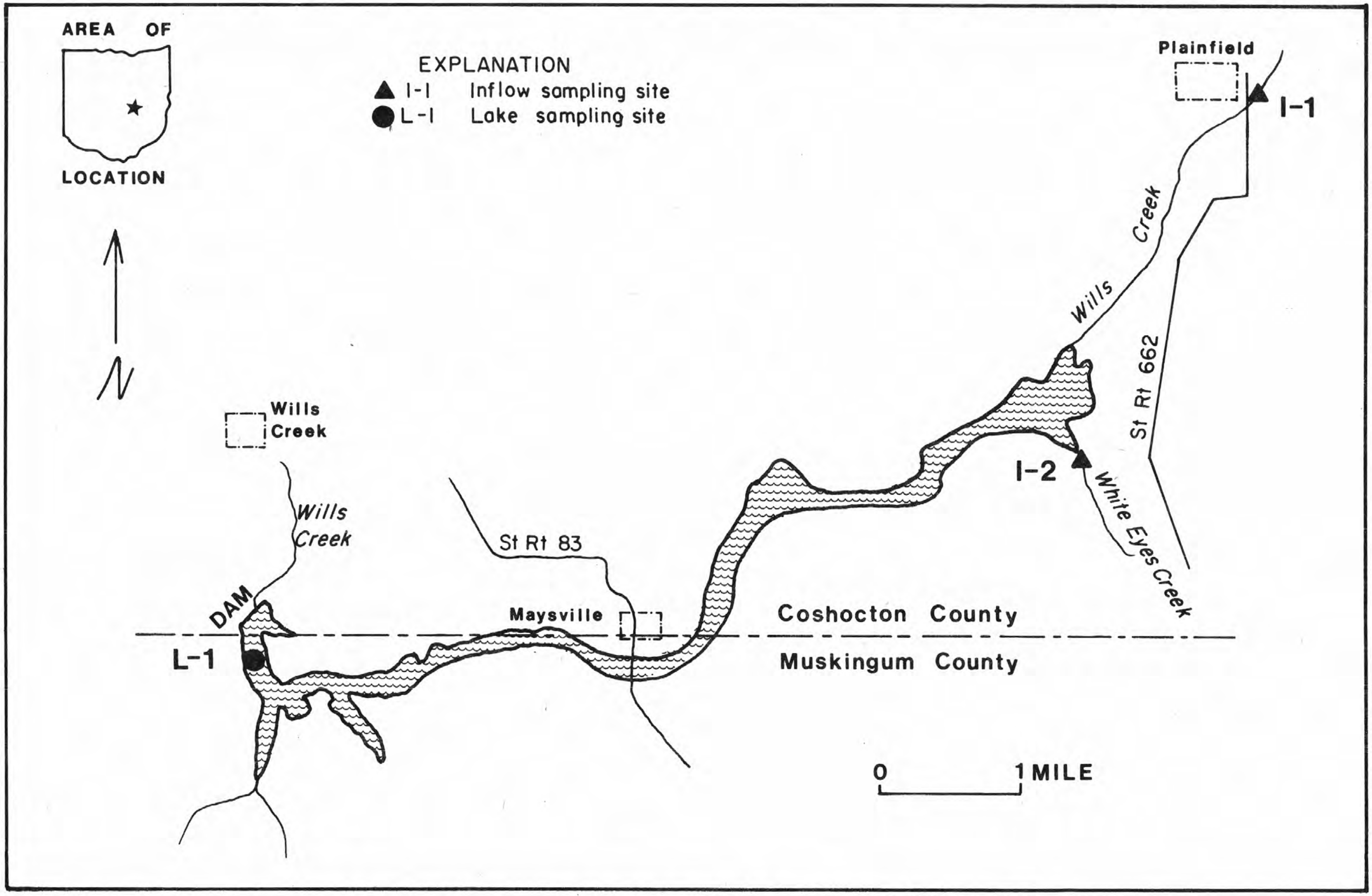

Figure 32.--Wills Creek Lake and inflow sampling sites.

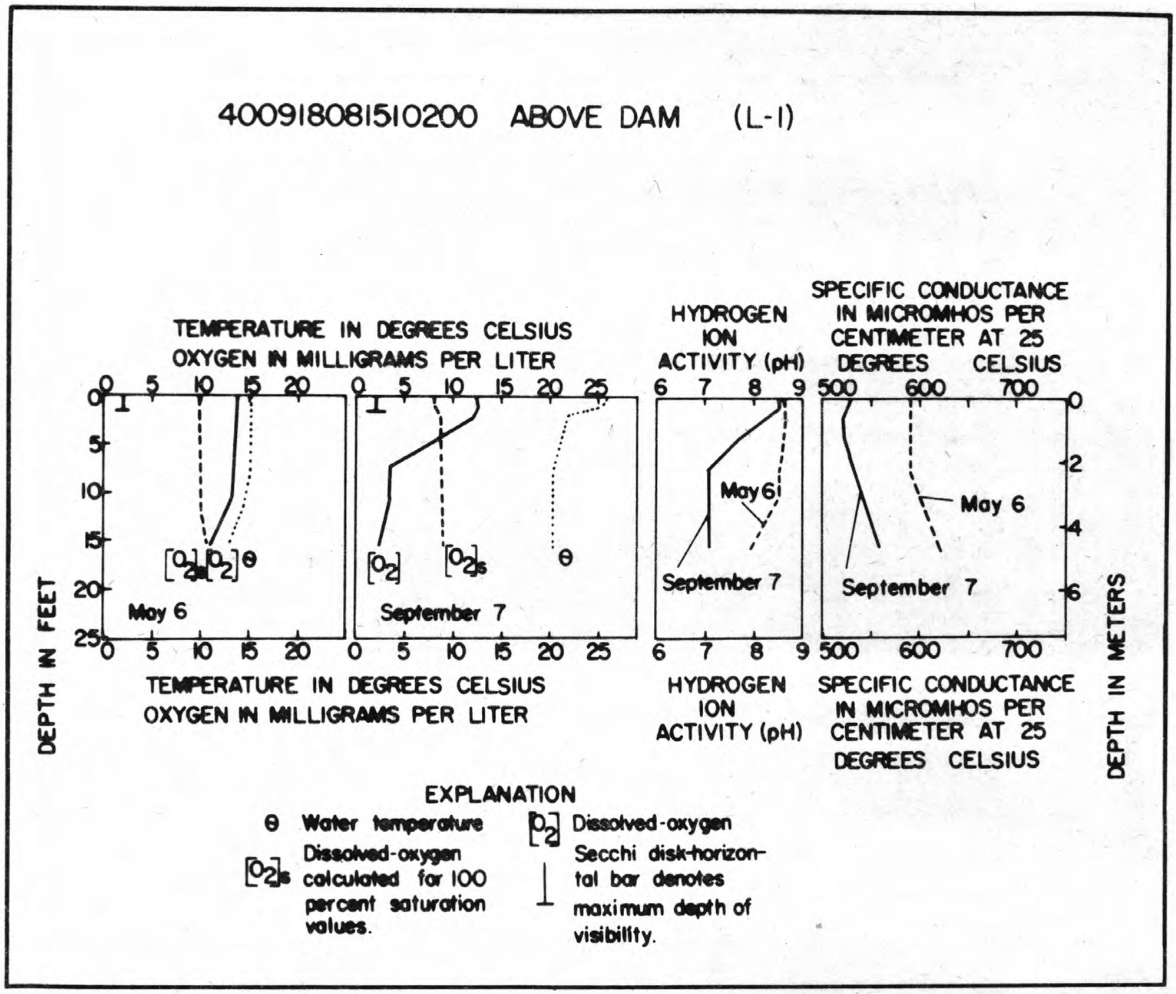

Figure 33.--Data profiles for Wills Creek Lake, Ohio, on selected days in 1976

Table 70.--Profile data for the primary lake site, Wills Creek Lake, Ohio

400918081510200 - WILLS CREEK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
MAY												
06...	1230	.0	15.0	13.6	139	590	8.6	--	--	--	--	--
06...	1235	2.0	15.0	13.5	138	590	8.6	4	96	.4	.0	1.5
06...	1240	4.0	15.0	13.4	137	590	8.6	--	--	--	--	--
06...	1245	7.0	14.8	13.2	133	590	8.5	--	--	--	--	--
06...	1250	10	14.5	13.1	132	600	8.5	--	--	--	--	--
06...	1255	15	13.0	11.0	107	620	7.9	0	108	2.2	.0	--
SEP												
07...	1510	.0	25.5	12.3	154	530	8.5	--	--	--	--	--
07...	1513	1.0	25.0	12.5	154	525	8.5	--	--	--	--	--
07...	1515	2.0	21.6	12.1	141	522	8.2	0	110	1.1	.0	1.5
07...	1520	4.0	21.0	9.0	103	522	7.7	--	--	--	--	--
07...	1525	7.0	20.4	3.6	41	530	7.1	--	--	--	--	--
07...	1530	10	20.2	3.6	40	543	7.1	--	--	--	--	--
07...	1535	15	20.0	2.4	27	557	7.1	0	126	16	.0	--

Table 71.--Chemical analyses of water column composite samples, Wills Creek Lake, Ohio

400918081510200 - WILLS CREEK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
MAY												
06...	1250	60	24	2.1	18	190	17	.2	250	392	57	449

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
MAY										
06...	0	0	10	3	<.5	5	1	0	<10	.05

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
MAY							
06...	60	2	0	1400	760	0	10

Table 72.--Chemical, physical, and biological analyses of water samples from selected depths, Wills Creek Lake, Ohio

400918081510200 - WILLS CREEK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
MAY									
06...	1235	2.0	.02	.02	.04	.06	.64	.70	.01
06...	1255	15	.01	.10	.11	.10	.70	.80	.01
SEP									
07...	1515	2.0	.01	.06	.07	.15	.55	.70	.02
07...	1535	15	.01	.11	.12	.29	.44	.73	.01

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
MAY									
06...	.08	3.0	20	20	11	4.0	15	8	<2
06...	.12	3.8	20	30	11	4.6	16	8	<2
SEP									
07...	.08	5.4	10	30	5.8	4.0	16	2	2
07...	.11	6.2	35	40	7.1	2.2	17	6	12

Table 73.--Phytoplankton in Wills Creek Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Location	Date	Location in water column					
Site L-1 above dam ---------	5-6-76	euphotic zone composite	72,000	2.8	Cyanophyta	54	Oscillatoria (43); Anacystis (9); Raphidiopsis (2)
					Chrysophyta	31	Melosira (14); Cyclotella (13); Nitzschia (4) Navicula
					Chlorophyta	11	Micractinium (4); Dictyosphaerium (2); Scenedesmus (2); Ankistrodesmus (1); Chodatella (1); Crucigenia (1); Golenkinia; Selenastrum
					Euglenophyta	2	Euglena (2); Phacus
Site L-1 above dam ---------	9-7-76	euphotic zone composite	37,000	0.8	Cyanophyta	92	Oscillatoria (86); Raphidiopsis (6)
					Euglenophyta	9	Trachelomonas (9); Euglena; Lepocinclis
Site L-1 above dam ----------	9-7-76	1-ft depth	95,000	2.0	Cyanophyta	89	Oscillatoria (65); Agmenellum (11); Anabaena (5); Lyngbya (3); Raphidiopsis (3); Anacystis (2)
					Chlorophyta	6	Dictyosphaerium (3); Tetraedron (2); Scenedesmus (1)
					Euglenophyta	4	Trachelomonas (4); Euglena
					Chrysophyta	1	Cyclotella (1); Gyrosigma
					Pyrrhophyta	< 1	Peridinium

* Less than 1 percent not given.

The May profiles at site L-1 show a thermal gradient below 10 ft and increasing specific conductance with depth below 7 ft. The entire water column was supersaturated with dissolved oxygen, although BOD was high. A warm layer of water covered a poorly mixed water column below 2 ft in September. The low dissolved oxygen and low pH below 7 ft suggest significant decomposition and (or) respiration.

Nitrogen concentrations, except for the organic form, were generally low. Total phosphorus concentrations were above 0.08 mg/L and were similar to the concentrations in Wills Creek (table 74). Although nitrogen recycling and oxygen-depleting activities are indicated at the lake bottom in September, the lake's high flushing rate (C/I=0.01) probably reduced the accumulation of re-cycled by-products.

Except for a May-September reduction in diatoms, the phytoplankton communities (dominated by blue-green algae) on both sampling dates were similar. Extensive growths of *Myriophyllum* sp. were common in the lake shallows.

Inflow data (fig. 32; table 74): Wills Creek is the major inflow to Wills Creek Lake. The creek was sampled at site I-1 where it drains 756 mi² or 90 percent of the lake drainage basin. A secondary inflow, White Eyes Creek, which drains 43.8 mi² or 5 percent of the basin, was sampled at site I-2. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1976)	Discharge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductanc
Wills Creek at site I-1	May 6	--	stream	stream	lake	lake
	September 7	--	stream	stream	stream	stream
White Eyes Creek at site I-2	May 6	< 10	stream	lake	lake	lake
	September 7	< 5	stream	lake	lake	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Table 74.--Physical and chemical data for selected inflows, Wills Creek Lake, Ohio

401011081442400 - WHITE EYES C AB WILLS CREEK LK AT (SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
MAY												
06...	1555	<10	16.0	9.5	7.2	460	6	10	2.1	.19	2.1	.03
SEP												
07...	1330	<5.0	16.0	8.2	6.9	535	20	15	2.5	.39	.23	.03

401222081424200 - WILLS C AB WILLS CREEK LK AT SITE (I-2)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
MAY												
06...	1515	--	15.0	12.3	8.2	540	20	20	4.7	.16	.73	.11
SEP												
07...	1350	--	16.0	8.7	7.5	605	30	40	6.8	.22	.93	.15

Wolf Run Lake

Location: Noble County

Type: Reservoir

Use: Water supply and recreation

Physical characteristics (table 5):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
--	220	7200	1.68

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
5.7	agricultural, rural	moderate

Lake data (figs. 34, 35; tables 75-78): Wolf Run Lake was sampled in clear, hot weather on April 19 and under partly cloudy skies on August 16. The secchi-disk transparencies were greater than 6 ft in April and 22 ft in August. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
April 19	partial	slight	moderately hard Ca HCO_3	no	no	no	Chrysophyta
August 16	yes	yes	--	no	--	no	Cyanophyta

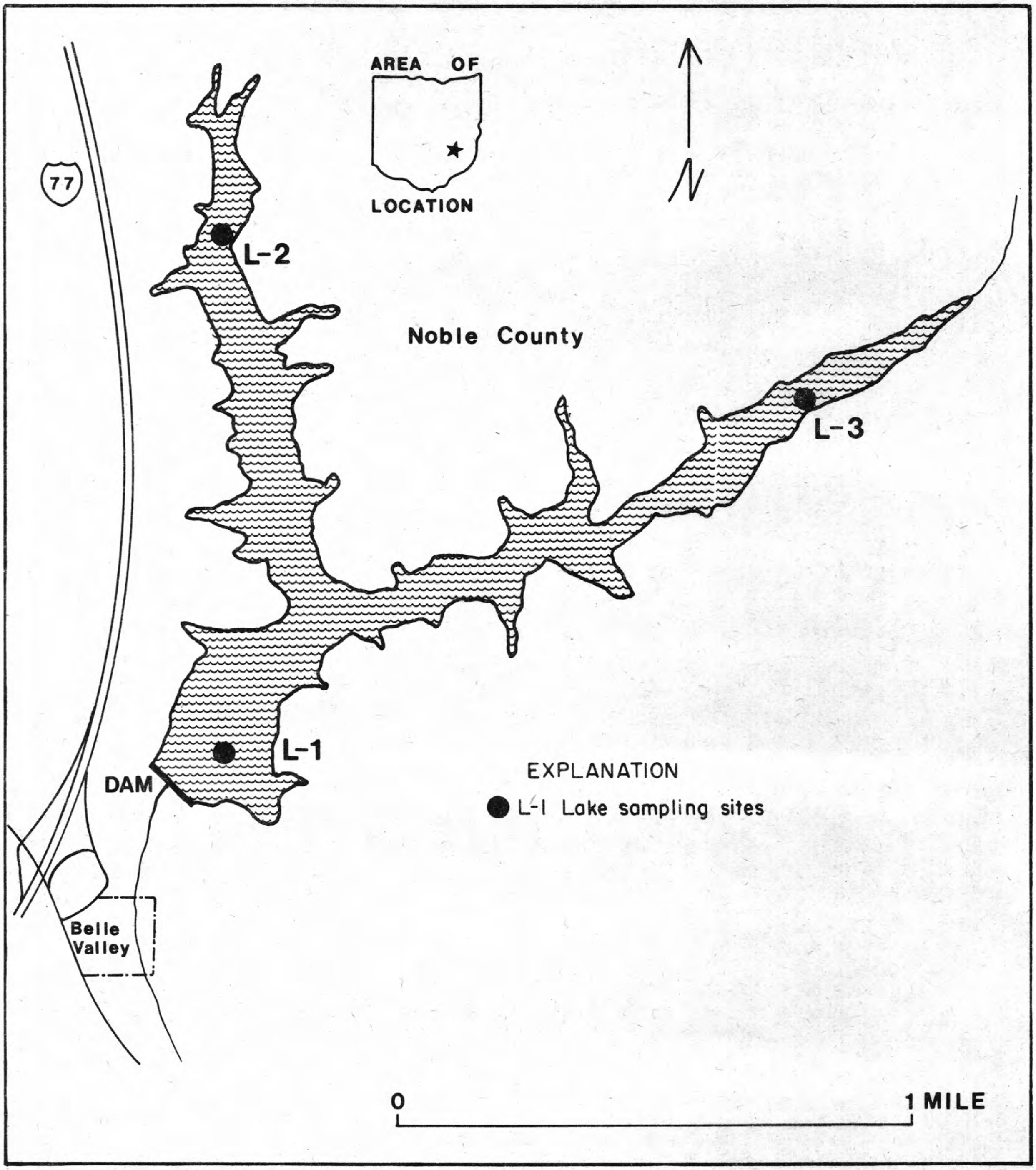

Figure 34.--Wolf Run Lake sampling sites.

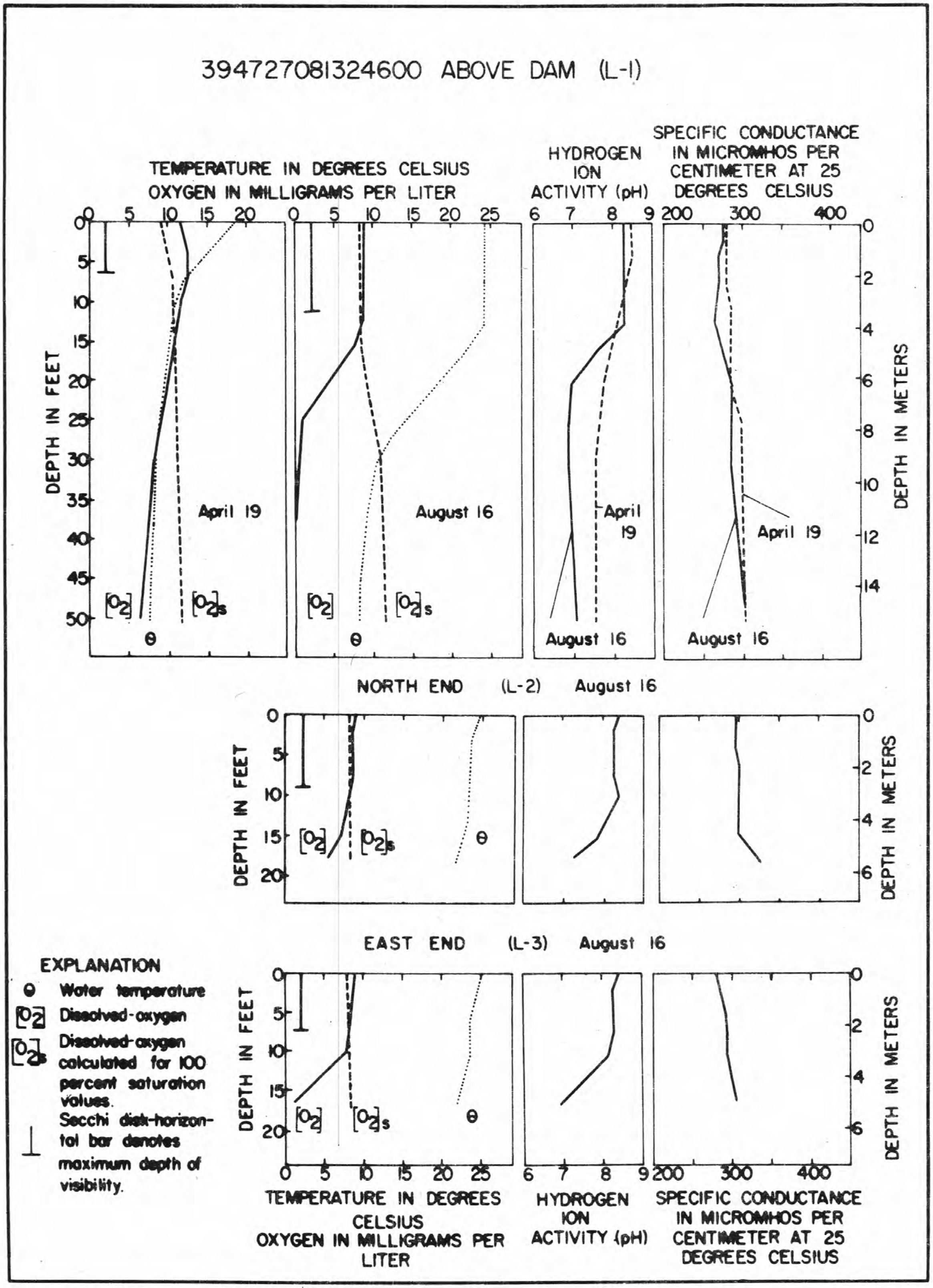

Figure 35.--Data profiles for Wolf Run Lake, Ohio, on selected days in 1976.

Table 75.--Profile data for the primary lake site, Wolf Run Lake, Ohio

394727081324600 - WOLF RUN LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
19...	1410	.0	18.3	11.5	125	280	8.5	--	--	--	--	--
19...	1415	2.0	16.5	12.0	125	280	8.5	3	90	.4	.0	6.4
19...	1420	4.0	14.5	12.4	124	280	8.5	--	--	--	--	--
19...	1425	7.0	12.2	12.3	117	280	8.4	--	--	--	--	--
19...	1430	10	11.0	11.7	109	285	8.3	--	--	--	--	--
19...	1435	15	10.2	10.8	99	285	8.0	--	--	--	--	--
19...	1440	20	9.6	9.8	89	285	7.8	--	--	--	--	--
19...	1445	25	9.2	9.2	82	300	7.7	--	--	--	--	--
19...	1450	30	8.7	8.4	74	300	7.6	--	--	--	--	--
19...	1455	40	8.0	7.5	65	300	7.6	--	--	--	--	--
19...	1500	50	7.5	6.5	56	305	7.6	0	98	3.9	.0	--
AUG												
16...	1400	.0	24.1	8.8	107	275	8.3	--	--	--	--	--
16...	1405	2.0	24.1	8.8	107	275	8.3	0	68	.5	.0	11
16...	1410	4.0	24.1	8.8	107	270	8.3	--	--	--	--	--
16...	1415	7.0	24.0	8.8	107	270	8.3	--	--	--	--	--
16...	1420	10	23.9	8.7	105	265	8.3	--	--	--	--	--
16...	1425	15	22.8	7.8	93	270	7.8	--	--	--	--	--
16...	1430	20	18.5	4.1	45	285	7.0	--	--	--	--	--
16...	1435	25	13.5	1.0	9	285	6.9	--	--	--	--	--
16...	1440	30	10.3	.5	4	285	6.9	--	--	--	--	--
16...	1445	40	8.8	.0	0	295	7.0	--	--	--	--	--
16...	1450	50	8.2	.0	0	305	7.1	0	130	16	.4	--

Table 76.--Chemical analyses of water column composite samples, Wolf Run Lake, Ohio

394727081324600 - WOLF RUN LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 19...	1445	36	9.1	1.9	12	53	11	.1	130	210	<1	210

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 19...	100	0	10	3	<.5	38	0	0	<10	<.05

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 19...	20	3	0	110	150	2	0

Table 77.--Chemical, physical, and biological analyses of water samples from selected depths, Wolf Run Lake, Ohio

394727081324600 - WOLF RUN LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
19...	1415	2.0	.01	.14	.15	.04	.39	.43	.01
19...	1500	50	.01	.26	.27	.09	.21	.30	.01
AUG									
16...	1405	2.0	.01	.00	.01	.01	.27	.28	.01
16...	1450	50	.02	.00	.02	.62	.38	1.0	.01

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
19...	.02	3.9	3	10	3.9	1.5	12	<2	<2
19...	.02	4.6	3	10	3.3	.7	8	2	<2
AUG									
16...	.01	1.0	1	5	3.5	.8	<10	2	<2
16...	.05	6.2	6	10	6.8	.7	17	12	<2

Table 78.--Phytoplankton in Wolf Run Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Phylum(a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Location	Date	Location in water column					
Site L-1 above dam ----------	4-19-76	euphotic zone composite	2500	1.4	Chrysophyta	100	Dinobryon (59); Asterionella (27); Ochromonas (15)
Site L-1 above dam ----------	8-16-76	euphotic zone composite	8700	2.4	Cyanophyta	83	Aphanizomenon (46); Oscillatoria (18); Anacystis (10); Lyngbya (9)
					Chrysophyta	12	Fragilaria (8); Cyclotella (2); Asterionella (1); Nitzschia (1); Achnanthes; Cocconeis
					Chlorophyta	4	Scenedesmus (3); Gloeocystis (1); Chlamydomonas
Site L-1 above dam ---------	8-16-76	4-ft depth	4100	2.0	Chrysophyta	59	Fragilaria (55); Cyclotella (3); Nitzschia (1); Stephanodiscus
					Cyanophyta	26	Oscillatoria (15); Aphanizomenon (11);
					Chlorophyta	15	Dictyosphaerium (13); Scenedesmus (1); Chlamydomonas (1)
					Euglenophyta	< 1	Trachelomonas
					Pyrrhophyta	< 1	Ceratium

* Less than 1 percent not given.

The hot weather in mid-April had warmed the surface waters and reduced vertical mixing within the water column. The dissolved oxygen concentrations near the lake bottom at site L-1 were less than 60 percent saturation, despite a relatively low BOD of 0.7 mg/L. The specific conductance profile shows that a slight chemical enrichment occurred with depth.

By August, thermal stratification was established. Reductions in dissolved oxygen corresponded closely with decreases in temperature. The lake was anaerobic below 40 ft, and hydrogen sulfide was detected in the bottom waters at site L-1. A comparison of top and bottom bicarbonate (HCO_3) values in April and August indicates that some change developed in general chemistry between these layers. The rapid decrease in dissolved oxygen below 10 ft at site L-3 may have resulted from reduced photosynthesis with depth (due to reduced light transparency), and (or) a higher BOD than at sites L-1 and L-2.

Nitrogen and phosphorus concentrations in the lake were low compared with those of other lakes in Ohio. Nitrogen recycling to ammonia is shown in the bottom data for August. The phytoplankton cell counts were low when compared with most Ohio lakes. Diatoms (Chrysophyta) were the only algae identified in the April sample. Blue-green algae (Cyanophyta) dominated in the August euphotic-zone composite, but diatoms were most common at 4 ft.

Inflow data: No inflow samples were taken.

LAKES SAMPLED IN 1977

Clarence J. Brown Reservoir

Location: Clark County

Type: Reservoir; dam has multi-level release controls

Use: Flood control, recreation, and water supply

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1974	2120	36,900	0.79

Drainage basin characteristics:

Drainage area (miles²)	Type	Estimated sediment yield (from fig. 4)
82	agricultural	moderately low

Lake data (figs. 36-38; tables 79-82): Clarence J. Brown Reservoir was sampled in cool windy partly cloudy weather on April 7 and in pleasant, sunny weather on August 2. The secchi disk transparency depths were similar on both sampling days at site 1, although the August data for site L-2 suggest increasing water turbidity at the north end of the lake. Other profile and analytical data show the following lake characteristics:

Date (1977)	Stratification (gradient) thermal	Stratification (gradient) chemical	Chemical type	Substances at or above State limits pesticides	Substances at or above State limits toxicants	Substances at or above State limits bacteria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
April 7	no	no	very hard Ca HCO_3	no	no	no	Chrysophyta
August 2	yes	yes	--	no	--	no	Cyanophyta

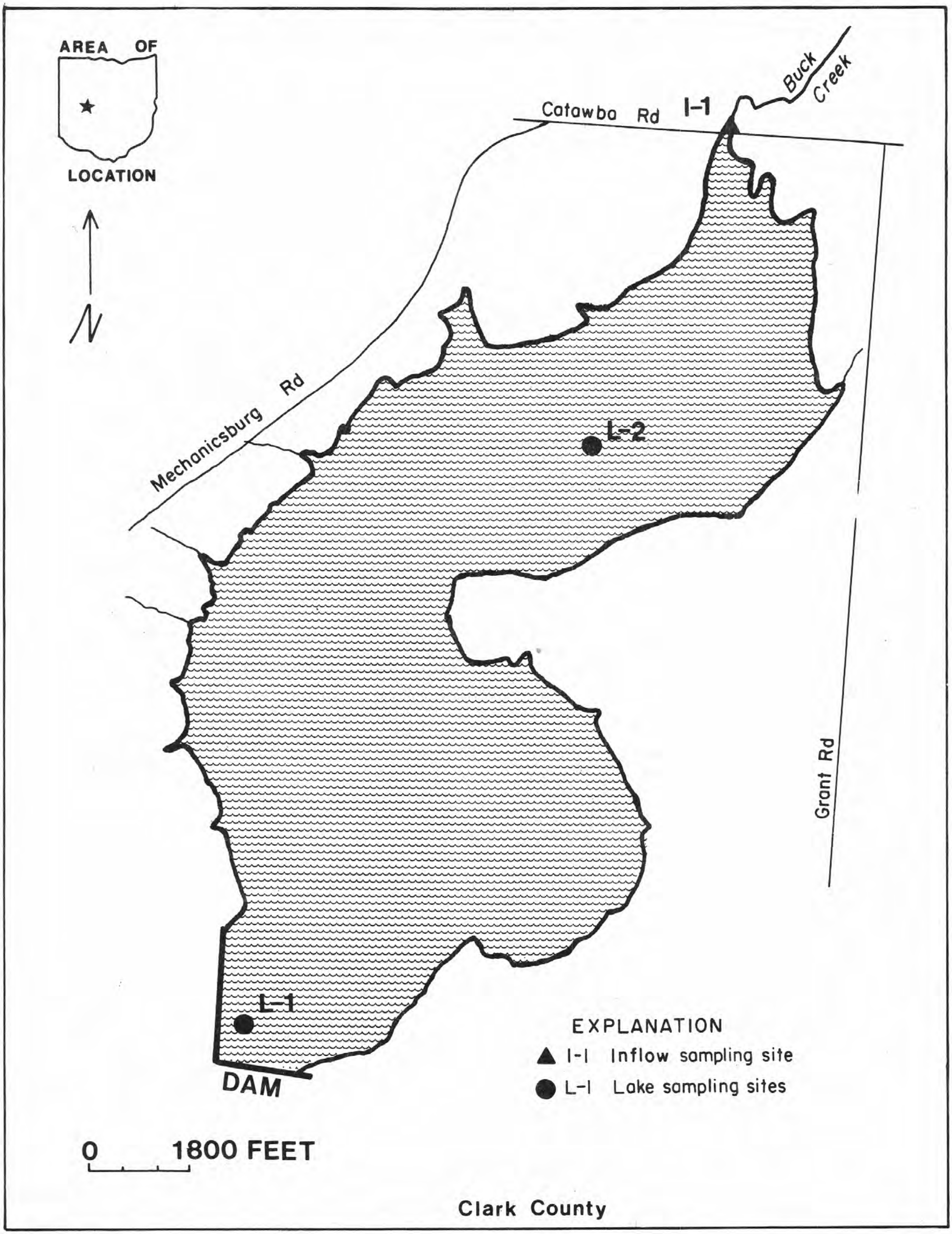

Figure 36.--Clarence J. Brown Reservoir and inflow sampling sites.

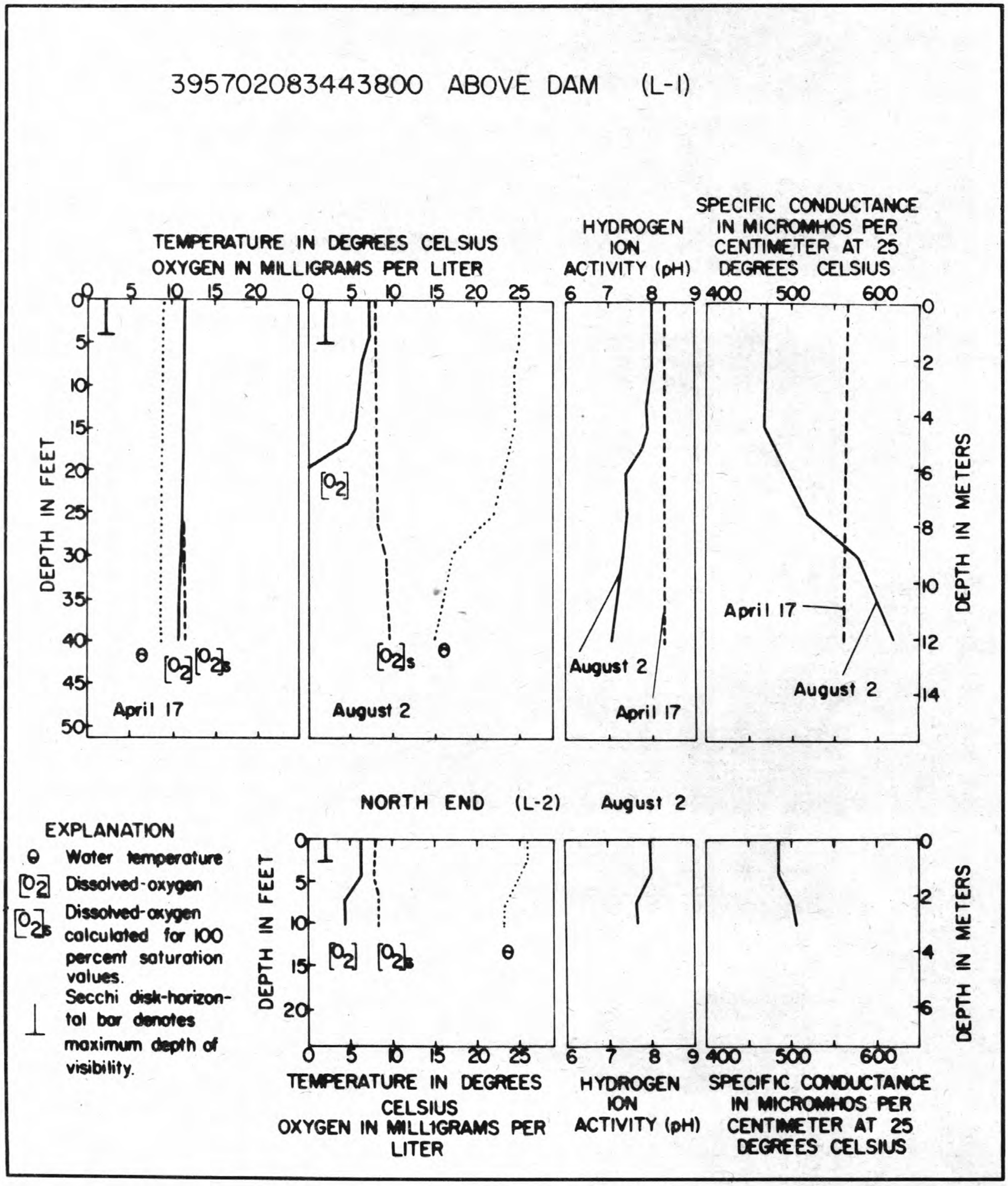

Figure 37.--Data profiles for Clarence J. Brown Reservoir, Ohio, on selected days in 1977.

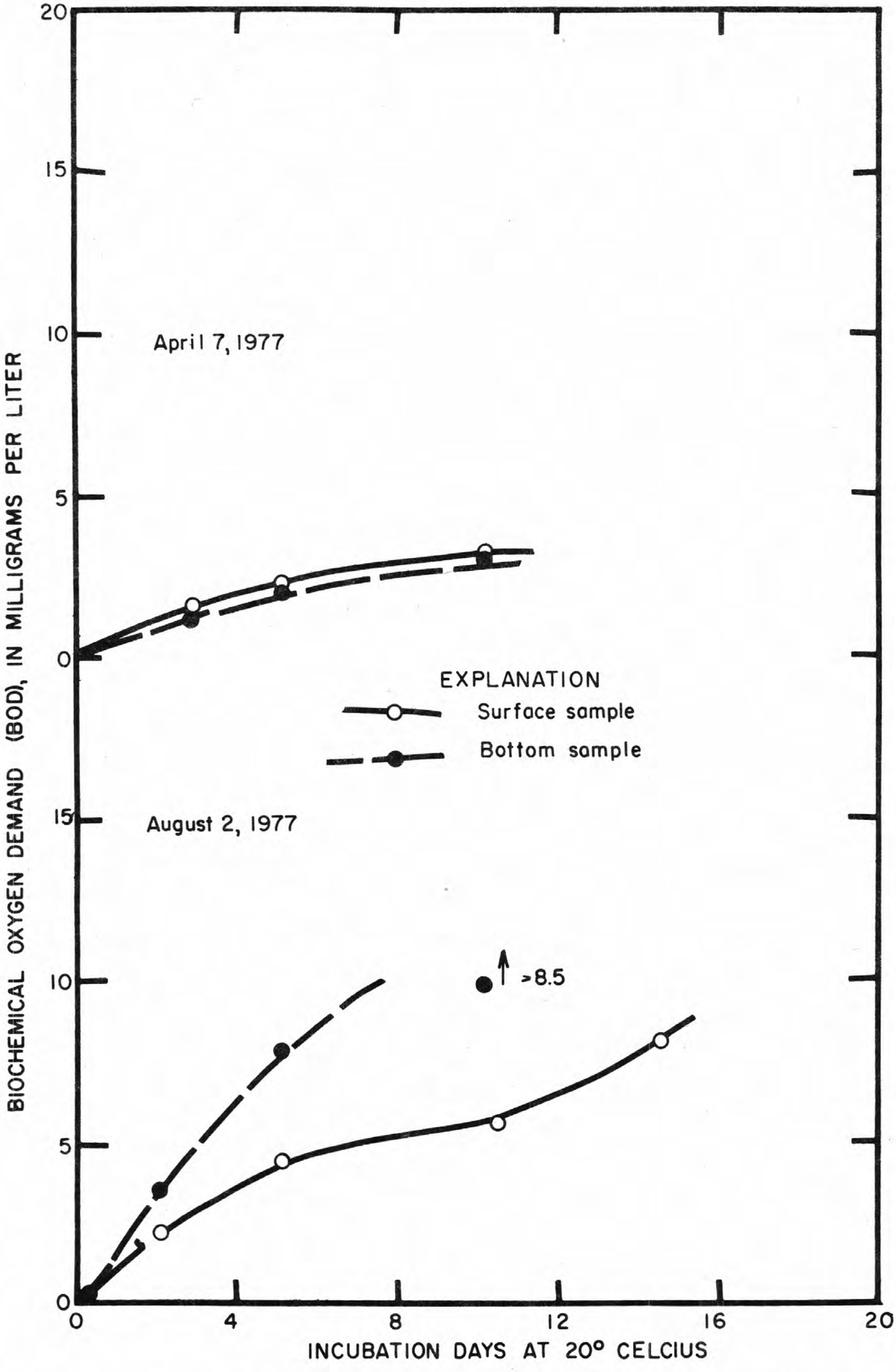

Figure 38.--BOD of water samples from C.J. Brown Reservoir on selected days in 1977.

Table 79.--Profile data for the primary lake site, Clarence J. Brown Reservoir, Ohio

395702083443800 - CLARENCE J BROWN RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
07...	1340	.0	9.0	11.3	101	565	8.3	--	--	--	--	--
07...	1345	2.0	9.0	11.2	100	565	8.3	0	284	2.3	.0	4.0
07...	1350	4.0	9.0	11.2	100	565	8.3	--	--	--	--	--
07...	1355	7.0	9.0	11.2	100	565	8.3	--	--	--	--	--
07...	1400	10	9.0	11.2	100	565	8.3	--	--	--	--	--
07...	1405	15	9.0	11.2	100	565	8.3	--	--	--	--	--
07...	1410	20	8.7	11.2	100	565	8.3	--	--	--	--	--
07...	1415	25	8.7	11.2	100	565	8.3	--	--	--	--	--
07...	1420	30	8.7	10.9	97	565	8.3	--	--	--	--	--
07...	1425	40	8.7	10.9	97	565	8.3	0	284	2.3	.0	--
AUG												
02...	1310	.0	25.5	7.1	89	470	8.0	--	--	--	--	--
02...	1315	2.0	25.0	7.2	90	470	8.0	0	212	3.4	.0	5.0
02...	1320	4.0	25.0	7.2	90	470	8.0	--	--	--	--	--
02...	1325	7.0	24.6	6.4	79	470	8.0	--	--	--	--	--
02...	1330	10	24.5	6.1	75	470	7.9	--	--	--	--	--
02...	1335	15	24.4	5.7	70	470	7.9	--	--	--	--	--
02...	1337	17	24.1	4.3	53	480	7.8	--	--	--	--	--
02...	1340	20	23.2	.0	0	495	7.4	--	--	--	--	--
02...	1345	25	22.0	.0	0	520	7.4	--	--	--	--	--
02...	1350	30	17.5	.0	0	580	7.3	--	--	--	--	--
02...	1355	40	15.0	.0	0	620	7.1	0	372	47	5.5	--

Table 80.--Chemical analyses of water column composite samples, Clarence J. Brown Reservoir, Ohio

395702083443800 - CLARENCE J BROWN RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 07...	1410	69	32	2.5	5.5	64	15	.2	300	359	34	393

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 07...	200	0	10	6	.0	2	0	0	<10	.07

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 07...	10	0	3	170	160	2	0

Table 81.--Chemical, physical and biological analyses of water samples from selected depths, Clarence J. Brown Reservoir, Ohio

395702083443800 - CLARENCE J BROWN RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMP-LING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITRO-GEN (N) (MG/L)	TOTAL ORGANIC NITRO-GEN (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL ORTHO PHOS-PHORUS (P) (MG/L)
APR									
07...	1345	2.0	.02	1.1	1.1	.12	.85	.97	.01
07...	1425	40	.02	1.1	1.1	.11	.80	.91	.01
AUG									
02...	1315	2.0	.01	.00	.01	.25	.85	1.1	.01
02...	1355	40	.00	.00	.00	4.9	.80	5.7	.50

DATE	TOTAL PHOS-PHORUS (P) (MG/L)	DIS-SOLVED SILICA (SIO2) (MG/L)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIO-CHEM-ICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEM-ICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLI-FORM (COL. PER 100 ML)	STREP-TOCOCCI (COL-ONIES PER 100 ML)
APR									
07...	.04	1.2	4	10	6.0	2.1	13	64	20
07...	.04	1.2	5	15	4.1	1.8	12	52	20
AUG									
02...	.04	2.8	7	15	4.2	4.2	15	<2	<2
02...	.55	6.4	50	40	7.7	7.5	20	<2	<2

Table 82.--Phytoplankton in Clarence J. Brown Reservoir, Ohio

Sample description: Location	Date	Location in water column	Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chloro-phyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Site L-1 above dam ---------	4-7-77	euphotic zone composite	9600	2.6	26	Chrysophyta	55	Fragilaria (35); Asterionella (15); Cyclotella (3); Navicula (1); Nitzschia (1); Melosira; Synedra
						Euglenophyta	41	Cryptomonas (19); Chroomonas (15); Trachelomonas (7)
						Chlorophyta	5	Ankistrodesmus (2); Scenedesmus (2); Chlamydomonas (1); Coelastrum; Pediastrum
						Pyrrhophyta	1	Glenodinium (1)
Site L-1 above dam ---------	4-7-77	4-ft depth	5100	2.6	26	Euglenophyta	55	Cryptomonas (30); Trachelomonas (17); Chroomonas (8)
						Chrysophyta	42	Asterionella (26); Fragilaria (10); Cyclotella (3); Nitzschia (3)
						Chlorophyta	2	Ankistrodesmus (1); Chlamydomonas (1)
						Pyrrhophyta	1	Glenodinium (1)
Site L-1 above dam ---------	8-2-77	euphotic zone composite	130,000	0.7	--	Cyanophyta	100	Aphanizomenon (87); Anacystis (11); Anabaena (2)
						Chrysophyta	< 1	Melosira
Site L-1 above dam ---------	8-2-77	2-ft depth	290,000	0.2	32	Cyanophyta	100	Aphanizomenon (97); Anacystis (2); Anabaena (1)
						Chlorophyta	< 1	Schroederia; Closterium
						Chrysophyta	< 1	Ochromonas

* Less than 1 percent not given.

The reservoir was vertically mixed at site L-1 on April 14. By August 2, reduced vertical mixing and the biological and chemical processes had greatly altered the water quality. Specific conductance and bicarbonate increased with depth, and the lake was anaerobic below 20 ft. Hydrogen sulfide odor was first detected at 25 ft and confirmed at a 5.5 mg/L concentration near the lake bottom. A similar concentration is seen for ammonia. A comparison of the April and August BOD curves shows an increased oxygen demand in August, especially in the bottom water. The shallow water profiles at site L-2 are similar to those at site L-1, but show a slightly higher specific conductance.

Nitrogen was most abundant as nitrate (NO_3) in April and as ammonia (NH_3) in August. Phosphorus and silica concentrations were highest in the bottom sample in August. These data indicate nutrient uptake and recycling within the stratified layers. Diatoms (Chrysophyta) and euglenoids (Euglenophyta) were most common in April. The blue-green genus *Aphanizomenon* dominated the low-diversity algal community on August 2.

Inflow data (fig. 36, table 83): Buck Creek is the principal tributary to Clarence J. Brown Reservoir. The creek was sampled at site I-1, where it drains 65.3 mi² or 80 percent of the lake drainage basin. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1977)	Dis-charge (ft³/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Buck Creek at site I-1	April 17	E 100	stream	stream	lake	stream
	August 2	< 10	stream	lake	stream	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Table 83.--Physical and chemical data for selected inflows, Clarence J. Brown Reservoir, Ohio

395931083425400 - BUCK C AB C J BROWN RE AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR												
07...	1600	E100	12.5	9.9	8.0	735	7	5	3.6	3.4	.56	.05
AUG												
02...	1200	<10	18.0	8.9	7.9	655	3	10	6.8	1.9	.31	.01

E - estimate.

Deer Creek Reservoir

Location: Stark County

Type: Reservoir; dam has multi-level release controls

Use: Water supply and recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1954	313	3070	0.12

Drainage basin characteristics:

Drainage area (miles²)	Type	Estimated sediment yield (from fig. 4)
38	rural, agricultural	moderately low

Lake data (figs. 39-41; tables 84-87): Deer Creek Reservoir was sampled on April 27 and August 16 under hazy skies. Prior to the August visit, the lake had been lowered approximately 5 ft and then refilled. The secchi disk transparencies were 3 ft or less at all sampling sites. Profile and analytical data show the following lake characteristics:

Date (1977)	Stratification (gradient) thermal	Stratification (gradient) chemical	Chemical type	Substances at or above State limits: pesticides	toxicants	bacteria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
April 27	yes	yes	hard Ca HCO_3 SO_4	no	no	no	Chrysophyta Cyanophyta
August 16	slight	partial	--	no	--	no	Cyanophyta

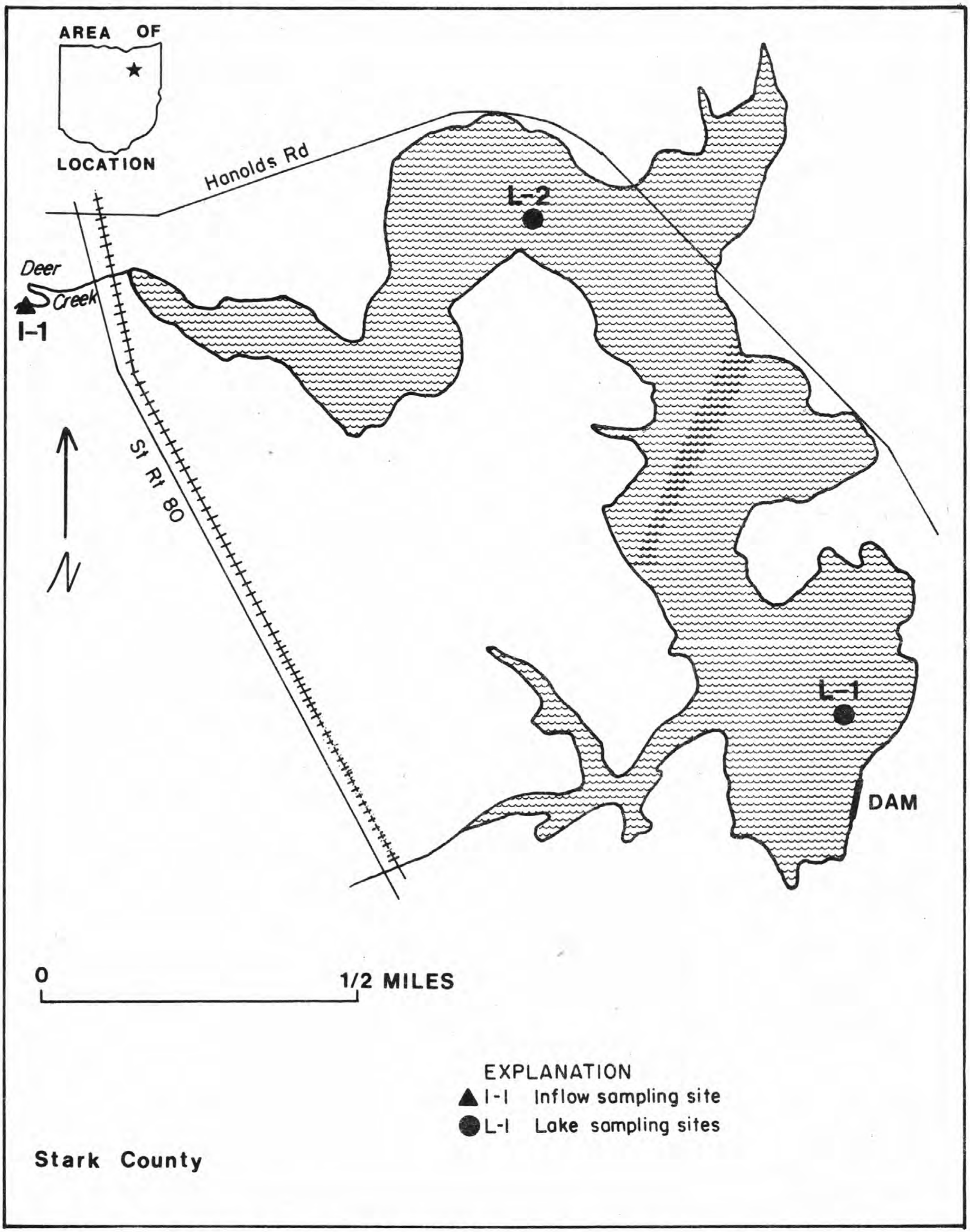

Figure 39.--Deer Creek Reservoir and inflow sampling sites.

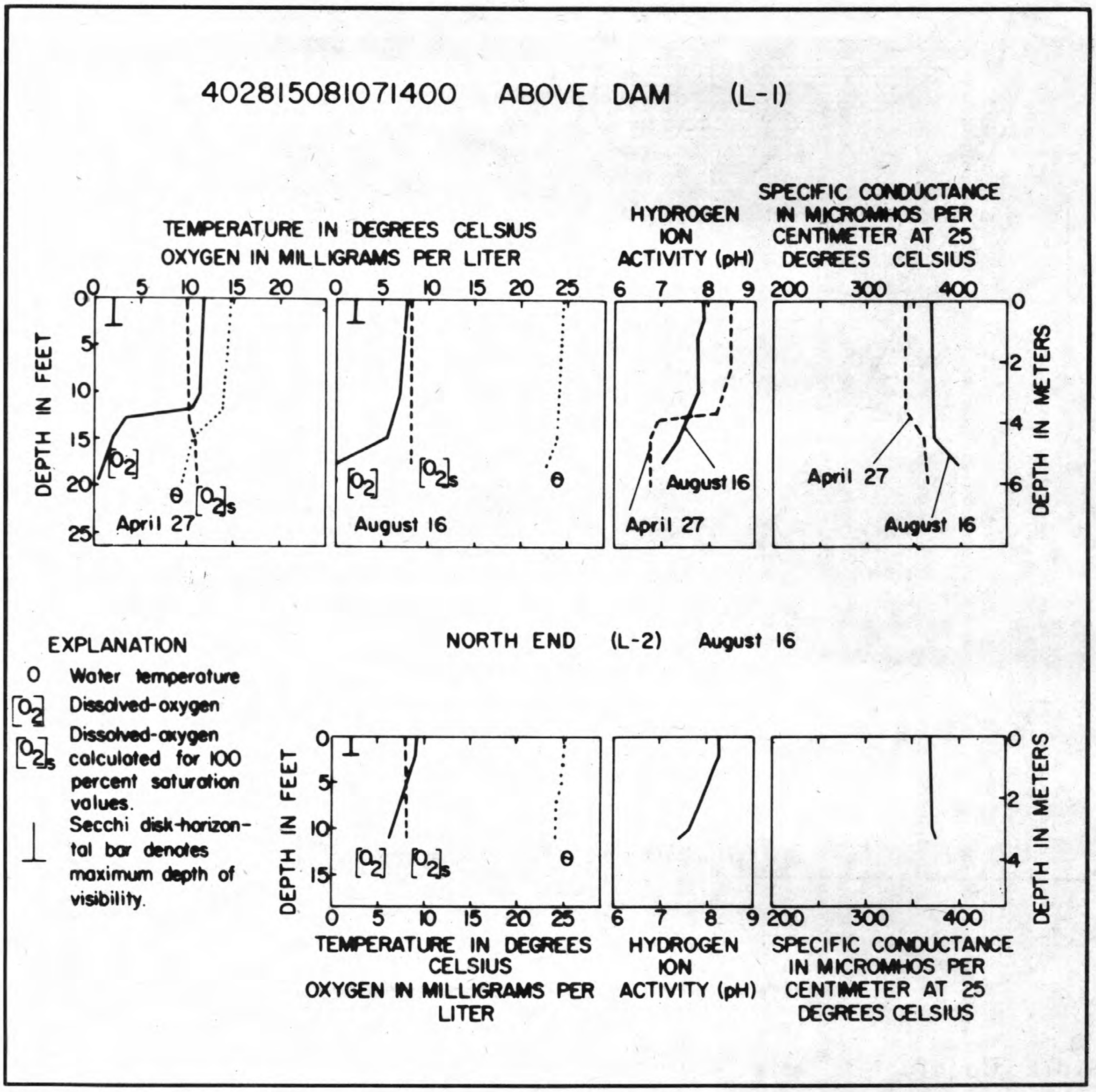

Figure 40.--Data profiles for Deer Creek Reservoir, Ohio, on selected days in 1977.

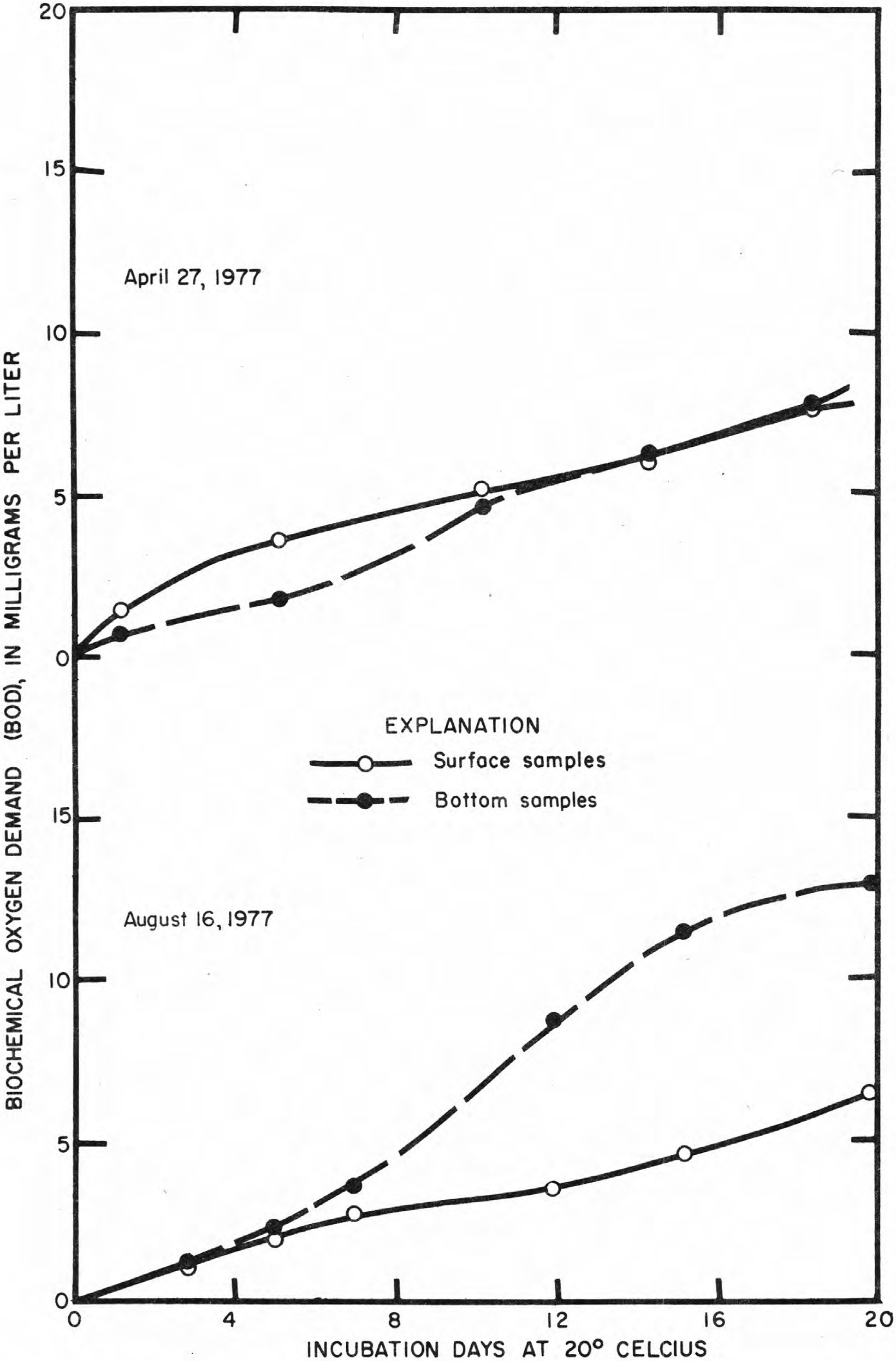

Figure 41.--BOD of water samples from Deer Creek Reservoir on selected days in 1977.

Table 84.--Profile data for the primary lake site, Deer Creek Reservoir, Ohio

405815081071400 - DEER CREEK RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
27...	1440	.0	14.5	11.5	117	340	8.5	--	--	--	--	--
27...	1445	2.0	14.5	11.5	117	340	8.5	2	72	.4	.0	3.0
27...	1450	4.0	14.3	11.4	115	340	8.5	--	--	--	--	--
27...	1455	7.0	14.2	11.3	114	340	8.5	--	--	--	--	--
27...	1500	10	14.0	11.1	111	340	8.4	--	--	--	--	--
27...	1502	12	13.8	10.3	103	342	8.2	--	--	--	--	--
27...	1503	13	11.8	3.2	30	350	6.9	--	--	--	--	--
27...	1505	15	10.8	1.9	18	360	6.8	--	--	--	--	--
27...	1510	20	9.5	.2	2	365	6.8	0	93	23	.0	--
AUG												
16...	1150	.0	24.8	7.7	96	370	7.9	--	--	--	--	--
16...	1155	2.0	24.8	7.6	95	370	7.9	0	93	1.9	.0	2.4
16...	1200	4.0	24.6	7.6	94	370	7.8	--	--	--	--	--
16...	1205	7.0	24.5	7.2	89	370	7.8	--	--	--	--	--
16...	1210	10	24.5	6.8	84	370	7.8	--	--	--	--	--
16...	1215	15	24.0	5.6	69	373	7.4	--	--	--	--	--
16...	1220	18	23.0	.0	0	400	7.0	0	127	20	.7	--

Table 85.--Chemical analyses of water column composite samples, Deer Creek Reservoir, Ohio

405815081071400 - DEER CREEK RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 27...	1500	38	9.5	3.4	15	53	29	.1	130	225	35	260

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 27...	100	0	<10	6	.0	5	0	0	<10	.10

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 27...	20	0	2	1000	1300	3	10

Table 86.--Chemical, physical, and biological analyses of water samples from selected depths, Deer Creek Reservoir, Ohio

405815081071400 - DEER CREEK RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
27...	1445	2.0	.02	.98	1.0	.10	.68	.78	.00
27...	1510	20	.02	.62	.64	.49	.71	1.2	.01
AUG									
16...	1155	2.0	.00	.01	.01	.05	.74	.79	.00
16...	1220	18	.01	.00	.01	.79	2.5	3.3	.00

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
27...	.04	.9	6	30	5.7	3.4	22	2	<2
27...	.06	3.0	25	30	4.1	1.6	20	2	<2
AUG									
16...	.03	1.5	6	25	7.0	1.9	20	<2	<2
16...	.06	2.8	20	35	6.4	2.3	30	<2	<2

Table 87.--Phytoplankton in Deer Creek Reservoir, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)*of total cell count
Location	Date	Location in water column						
Site L-1 above dam ----------	4-27-77	euphotic zone composite	8200	2.9	28	Chrysophyta	47	Cyclotella (31); Nitzschia (5); Melosira (5); Fragilaria (4); Achnanthes (1); Dinobryon (1)
						Cyanophyta	32	Oscillatoria (29); Lyngbya (3)
						Chlorophyta	14	Scenedesmus (9); Ankistrodesmus (3); Kirchneriella (1); Treubaria (1)
						Euglenophyta	8	Trachelomonas (3); Euglena (3); Chroomonas (1); Cryptomonas (1)
Site L-1 above dam ----------	4-27-77	4-ft depth	15,000	3.1	38	Chrysophyta	34	Cyclotella (22); Fragilaria (10); Dinobryon (2); Melosira; Nitzschia
						Cyanophyta	29	Oscillatoria (22); Anacystis (7)
						Euglenophyta	22	Chroomonas (18); Trachelomonas (3); Cryptomonas (1); Euglena
Site L-1 above dam ---------	8-16-77	euphotic zone composite	460,000	2.0	22	Cyanophyta	97	Anacystis (43); Lyngbya (37); Raphidiopsis (8); Gomphosphaeria (5); Aphanizomenon (2); Anabaena (1); Agmenellum (1)
						Chlorophyta	2	Sphaerocystis (1); Pediastrum (1); Gloeocystis; Micractinium; Ankistrodesmus; Crucigenia; Tetraedron; Schroederia; Chlamydomonas
						Chrysophyta	1	Cyclotella; Synedra; Melosira; Dinobryon; Nitzschia
						Euglenophyta	< 1	Trachelomonas
Site L-1 above dam ---------	8-16-77	2-ft depth	420,000	1.8	25	Cyanophyta	98	Anacystis (50); Lyngbya (37); Raphidiopsis (6); Cylindrospermum; Anabaena (3); Aphanizomenon; Agmenellum
						Chlorophyta	2	Dictyosphaerium; Pediastrum; Scenedesmus; Gloeocystis; Golenkinia; Schroederia; Cosmarium; Tetraedron
						Chrysophyta	1	Synedra; Cyclotella; Nitzschia
						Euglenophyta	< 1	Trachelomonas; Euglena
						Pyrrhophyta	< 1	Ceratium

* Less than 1 percent not given.

The spring data for site L-1 disclose an early thermal and chemical stratification. Dissolved oxygen and pH values decreased rapidly below 12 ft, and dissolved oxygen concentrations approached zero at the lake bottom. Hydrogen sulfide was not detected within the hypolimnion in April, although concentrations of ammonia, silica, bicarbonate, and carbon dioxide were higher within this zone than at the surface. Algal respiration may have accounted for an initially higher BOD in the surface sample than in the bottom sample.

The summer profiles show a slight temperature decrease with depth. The lake drawdown and refilling prior to the August 16 sampling evidently had increased the general mixing depth or removed the hypolimnion observed in April. Some chemical change with depth did exist in August, however, in that the bottom water was anaerobic and contained low concentrations of hydrogen sulfide. Other changes were observed in pH, BOD, nutrients, and specific conductance. The similarity of profile data at sites L-1 and L-2 indicates that lateral mixing had occurred.

The nitrogen concentration in the lake was adequate for the development of high algae concentrations (see page 14), but orthophosphorus was low. A diverse community of diatoms (Chrysophyta) and blue-green (Cyanophyta) algae characterized the euphotic zone at site L-1 on April 27. High counts of blue-green algae dominated the August 16 samples.

Inflow data (fig. 39; table 88): Deer Creek contributes most of the inflow to Deer Creek Reservoir. The creek was sampled at site I-1, where it represents drainage from 33.2 mi² or 87 percent of the lake drainage basin. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1977)	Discharge (ft³/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Deer Creek at site E-1	April 27	E 25	stream	stream	lake	stream
	August 16	E 10	stream	stream	stream	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Mayflies (Ephemeroptera), caddisflies (Trichoptera), crayfish, and growths of <u>Alisma</u>, <u>Sagittaria</u>, and <u>Myosatis</u> were observed at site I-1.

Table 88.--Physical and chemical data for selected inflows, Deer Creek Lake, Ohio

405847081085300 - DEER C AB DEER CREEK RE AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR 27...	1330	E25	15.5	10.3	7.3	375	5	25	5.3	1.1	.68	.05
AUG 16...	1030	E10	22.5	7.8	7.7	380	8	30	8.6	.11	1.2	.07

E - estimated.

Dillon Lake

Location: Muskingum County

Type: Reservoir; dam has multi-level release controls

Use: Flood control and recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1960	1560	17,500	0.03

Drainage basin characteristics:

Drainage area (miles^2)	Type	Estimated sediment yield (from fig. 4)
742	agricultural, rural	moderately low

Lake data (figs. 42-44; tables 89-92): Dillon Lake was sampled under sunny skies on April 11 and under overcast skies on August 12. The water was turbid on April 11, and data showed only slight improvement in secchi-disk transparency on August 12. Profile and analytical data show the following lake characteristics:

Date (1977)	Stratification (gradient) thermal	Stratification (gradient) chemical	Chemical type	Substances at or above State limits: pesticides	toxicants	bacteria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
April 11	slight	slight	hard Ca HCO_3	no	no	no	Cyanophyta
August 12	slight	yes	--	no	--	no	Cyanophyta

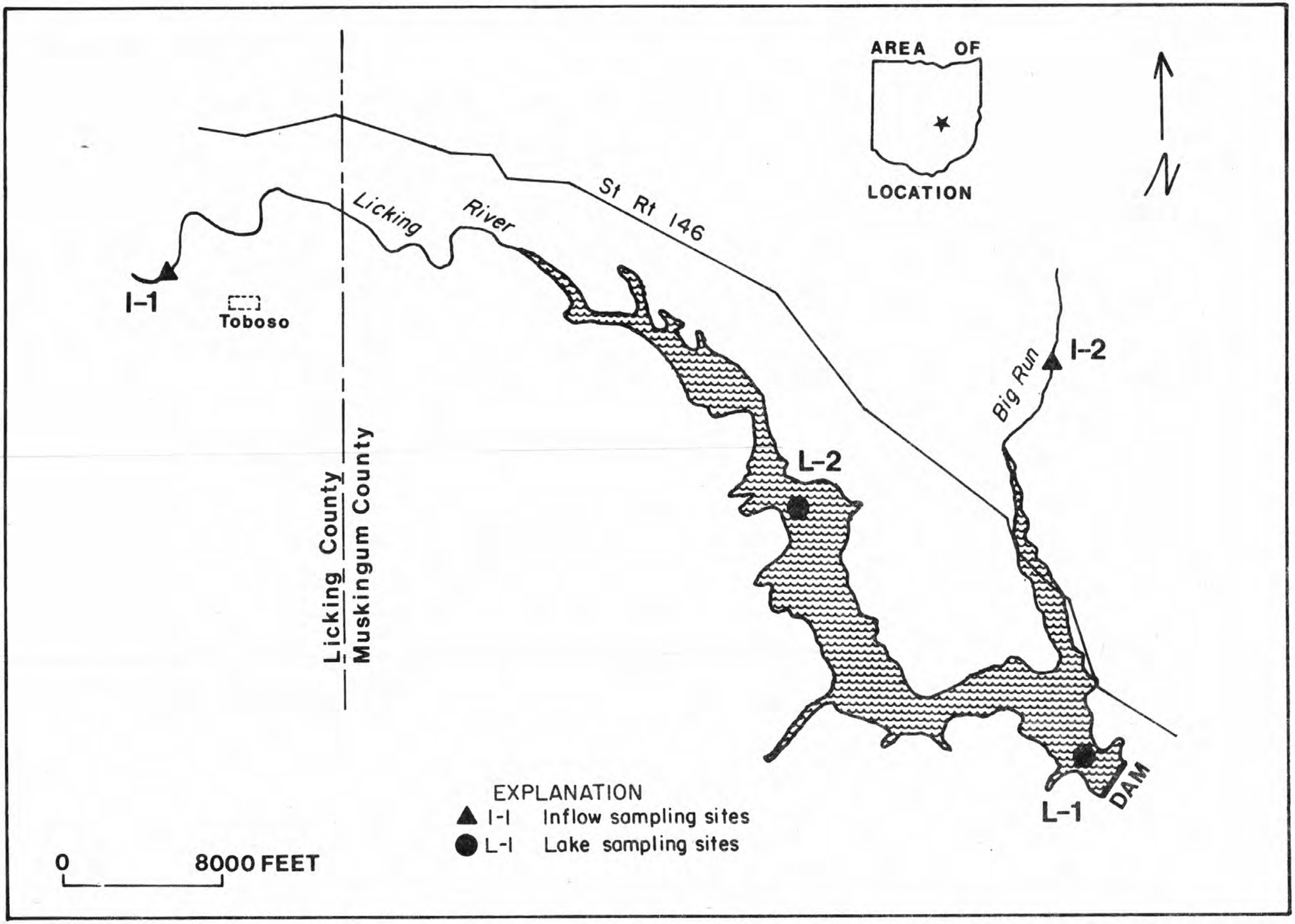

Figure 42.--Dillon Lake and inflow sampling sites.

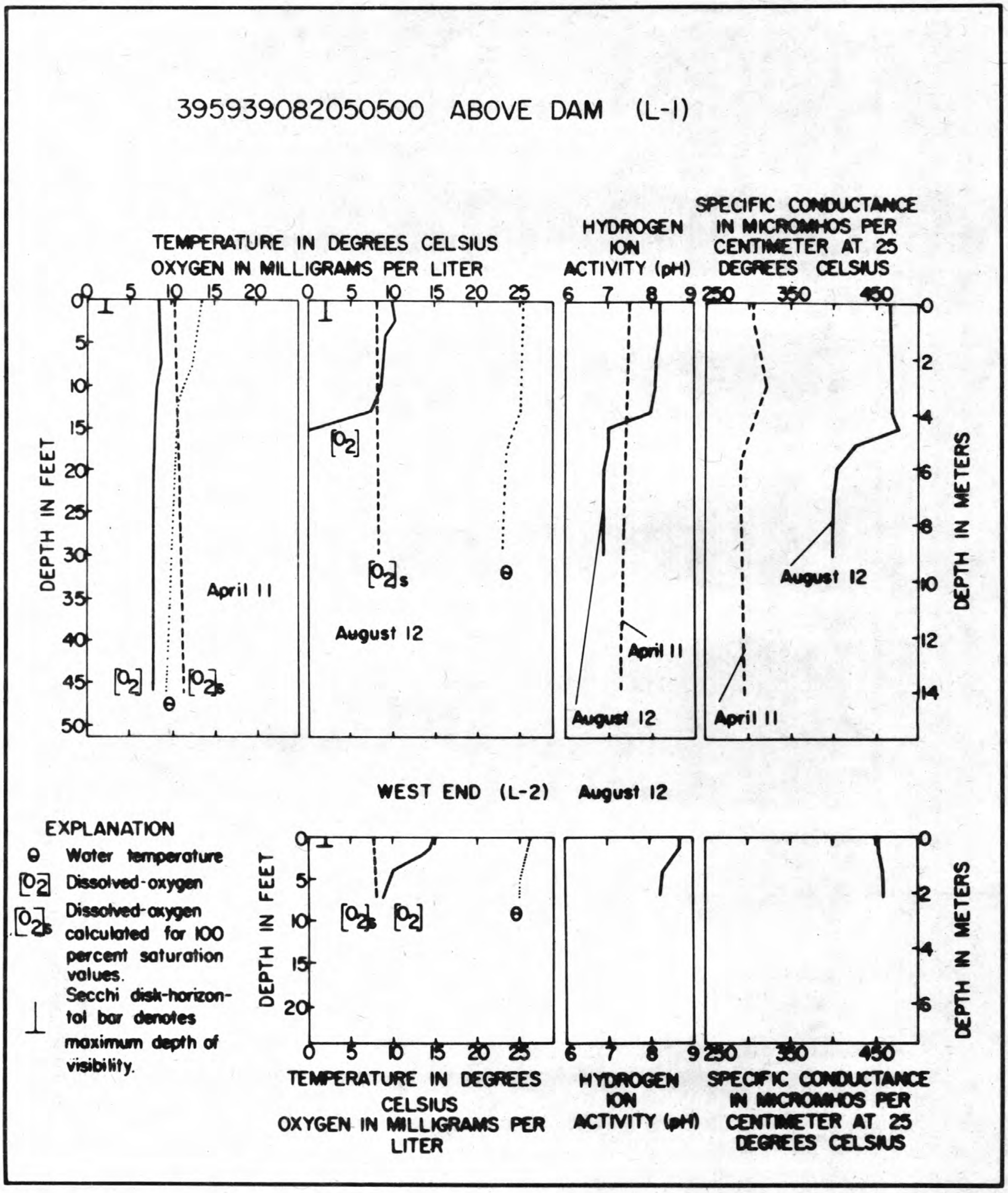

Figure 43.--Data profiles for Dillon Lake, Ohio, on selected days in 1977.

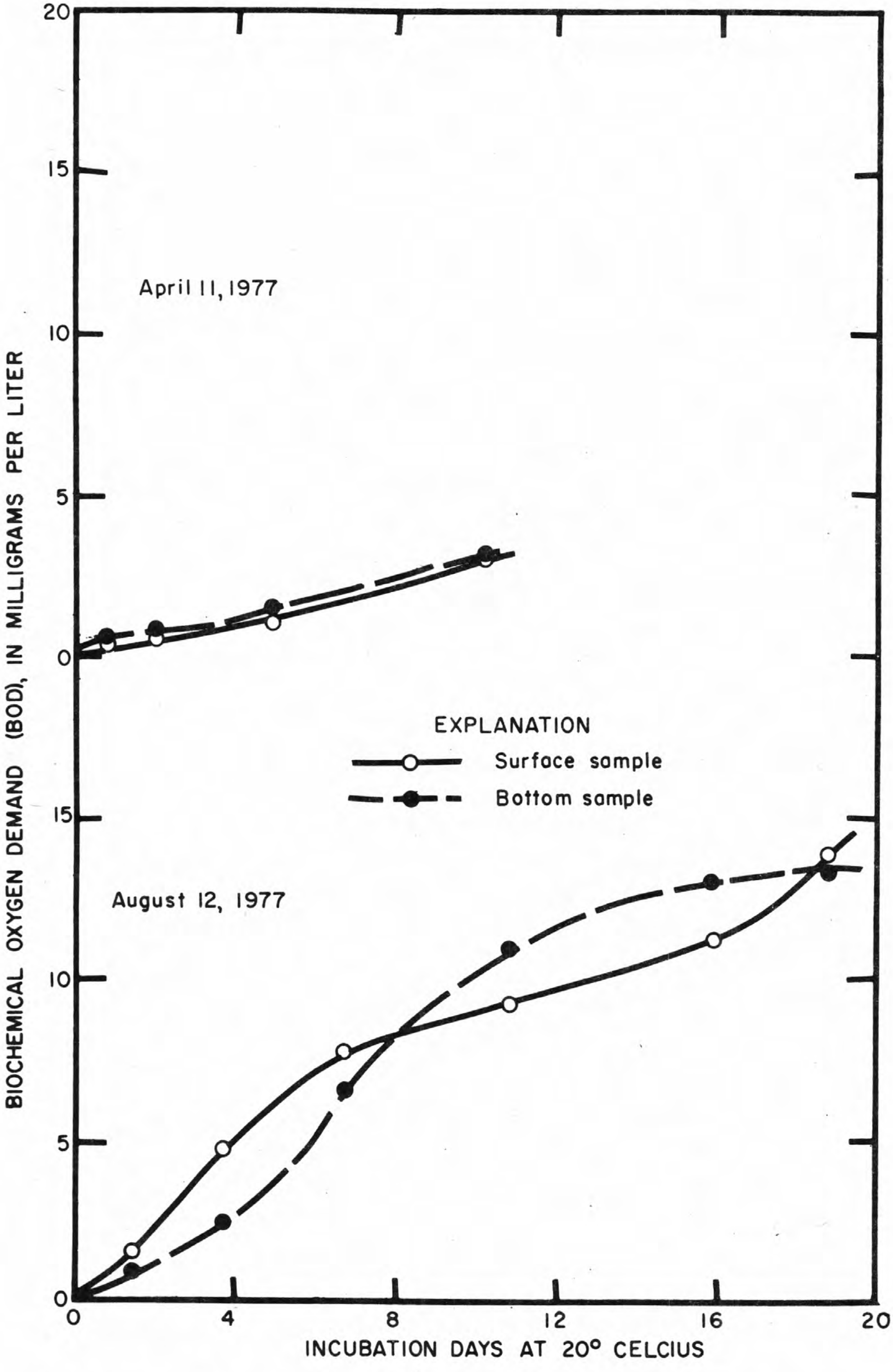

Figure 44.--BOD of water samples from Dillon Lake on selected days in 1977.

Table 89.--Profile data for the primary lake site, Dillon Lake, Ohio

395939082050500 - DILLON LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMP- LING DEPTH (FT)	TEMPER- ATURE (DEG C)	DIS- SOLVED OXYGEN (MG/L)	PER- CENT SATUR- ATION	SPE- CIFIC CON- DUCT- ANCE (MICRO- MHOS)	PH (UNITS)	CAR- BONATE (CO3) (MG/L)	BICAR- BONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDRO- GEN SULFIDE (MG/L)	TRANS- PAR- ENCY (SECCHI DISK) (FT)
APR												
11...	1400	.0	13.3	8.5	83	305	7.5	--	--	--	--	--
11...	1405	2.0	13.0	8.5	82	305	7.5	0	105	5.2	.0	1.5
11...	1410	4.0	12.8	8.5	82	310	7.5	--	--	--	--	--
11...	1415	7.0	12.5	8.7	83	315	7.5	--	--	--	--	--
11...	1420	10	11.2	8.1	75	320	7.5	--	--	--	--	--
11...	1425	15	10.5	7.9	72	300	7.4	--	--	--	--	--
11...	1430	20	10.2	7.8	71	290	7.4	--	--	--	--	--
11...	1435	25	10.1	7.8	71	295	7.4	--	--	--	--	--
11...	1440	30	10.0	7.9	72	295	7.4	--	--	--	--	--
11...	1445	40	9.5	7.8	70	295	7.3	--	--	--	--	--
11...	1450	46	9.5	7.8	70	295	7.3	0	100	8.0	.0	--
AUG												
12...	1300	.0	25.4	9.9	123	468	8.2	--	--	--	--	--
12...	1305	2.0	25.4	10.1	126	468	8.2	0	150	1.5	.0	2.2
12...	1310	4.0	25.3	9.0	112	470	8.2	--	--	--	--	--
12...	1315	7.0	25.2	8.8	109	470	8.1	--	--	--	--	--
12...	1320	10	25.2	8.6	107	470	8.1	--	--	--	--	--
12...	1323	13	25.0	7.3	90	470	8.0	--	--	--	--	--
12...	1325	15	24.2	.0	0	475	7.0	--	--	--	--	--
12...	1330	20	23.4	.0	0	405	6.9	--	--	--	--	--
12...	1335	25	23.2	.0	0	398	6.9	--	--	--	--	--
12...	1340	30	23.1	.0	0	400	6.9	0	138	28	.3	--

Table 90.--Chemical analyses of water column composite samples, Dillon Lake, Ohio

395939082050500 - DILLON LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 11...	1430	34	10	3.6	7.8	33	16	.1	130	199	61	260

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 11...	100	0	10	10	.0	1	0	0	<10	.07

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 11...	90	0	4	1300	40	1	10

Table 91.--Chemical, physical, and biological analyses of water samples from selected depths, Dillon Lake, Ohio

395939082050500 - DILLON LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
11...	1405	2.0	.04	1.8	1.8	.24	.76	1.0	.06
11...	1450	46	.05	2.3	2.3	.19	.78	.97	.06
AUG									
12...	1305	2.0	.04	.42	.46	.13	1.1	1.2	.01
12...	1340	30	.03	.63	.66	.82	1.6	2.4	.05

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
11...	.09	5.9	35	80	4.6	1.0	17	10	10
11...	.11	6.6	40	80	5.2	1.4	21	54	136
AUG									
12...	.07	4.4	5	25	7.3	6.0	20	<4	<4
12...	.23	6.0	60	75	8.1	3.6	25	16	120

Table 92.--Phytoplankton in Dillon Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)*of total cell count
Location	Date	Location in water column						
Site L-1 above dam ---------	8-12-77	euphotic zone composite	160,000	0.5	41	Cyanophyta	94	Oscillatoria (93); Anacystis (1)
						Chlorophyta	6	Ankistrodesmus (4); Scenedesmus (1); Kirchneriella (1)
						Chrysophyta	< 1	Navicula
Site L-1 above dam ---------	8-12-77	2-ft depth	860,000	1.2	78	Cyanophyta	99	Oscillatoria (79); Raphidiopsis (9); Agmenellum (5); Lyngbya (3); Anacystis (2)
						Chrysophyta	< 1	Cyclotella; Synedra; Nitzschia
						Chlorophyta	< 1	Scenedesmus; Golenkinia; Kirchneriella; Closterium
						Euglenophyta	< 1	Trachelomonas
Site L-1 above dam ---------	4-11-77	euphotic zone composite	1900	2.8	2.7	Cyanophyta	54	Oscillatoria (42); Anacystis (9); Agmenellum (3)
						Chrysophyta	25	Cyclotella (15); Melosira (7); Nitzschia (2); Navicula (1)
						Chlorophyta	19	Ankistrodesmus (7); Scenedesmus (7); Actinastrum (4); Chodatella (1); Tetraedron; Treubaria
						Euglenophyta	1	Peridinium (1); Trachelomonas
Site L-1 above dam ---------	4-11-77	2-ft depth	4100	2.4	3.7	Cyanophyta	50	Oscillatoria (50)
						Euglenophyta	22	Chroomonas (13); Cryptomonas (9); Euglena
						Chrysophyta	21	Melosira (12); Cyclotella (7); Nitzschia (2); Navicula
						Chlorophyta	7	Scenedesmus (3); Actinastrum (2); Ankistrodesmus (2); Carteria
Site L-2 at west end -----	8-12-77	1-ft depth	450,000	1.2	225	Cyanophyta	96	Oscillatoria (79); Agmenellum (9); Anacystis (7); Raphidiopsis (1)
						Chlorophyta	2	Spermatozoopsis (1); Scenedesmus (1)
						Euglenophyta	2	Chroomonas (1); Phacus; Euglena
						Chrysophyta	< 1	Navicula

* Less than 1 percent not given.

Except for a decrease in temperature and an increase in specific conductance near the 9-ft level at site L-1 in April, the lake chemistry changed little with depth. The August data show a decrease in temperature and similar decreases in dissolved oxygen, pH, and specific conductance, below 13 ft. The lake water was anaerobic below 15 ft, but nitrate (0.82 mg/L as N) still existed at 30 ft. In addition, hydrogen sulfide and ammonia concentrations within the hypolimnion were low compared with concentrations in many Ohio lakes. These relationships indicate a less severe reducing environment than elsewhere in Ohio, a condition that may have been influenced by the high flushing rate (C/I=0.03) of Dillon Lake.

The BOD curves show a much higher rate of oxygen consumption in August than in April. The higher dissolved oxygen and pH values at site L-2 compared with those at site L-1 suggest that photosynthetic rates were higher near the inflow end of the lake than at the dam.

Nitrogen concentrations in April and August were well above minimum requirements (see page 14) needed for nuisance algal growths. The uptake of orthophosphorus from the near-surface water during summer is indicated by its low concentration in August. The blue-green (Cyanophyta) genus, *Oscillatoria*, was most common. The total cell counts in August greatly exceeded those of April, and the sample from the 1-ft depth at site L-2 had the highest chlorophyll *a* concentration (225 µg/L) of the lakes sampled in 1977. The somewhat higher than average bacteria counts from the bottom samples at site L-1 may relate to the short residence time of inflowing waters.

Inflow data (fig. 42; table 93): Licking River is the major source of inflow to Dillon Lake. The river was sampled at site I-1, where it represents drainage from 672 mi², or 91 percent of the total drainage area to Dillon Lake. Big Run, which drains 25 mi², was sampled at site I-2. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1977)	Dis-charge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Licking River at site I-1	April 11	E 760	stream	lake	lake	stream
	August 12	E 250	stream	stream	lake	stream
Big Run at site I-2	April 11	< 15	lake	lake	stream	stream
	August 12	E 20	stream	stream	stream	lake

* At 2-ft (0.6-m) depth.
E Estimated.

Table 93.--Physical and chemical data for selected inflows, Dillon Lake, Ohio

400325082131200 - LICKING R AB DILLON LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTAN- TANEOUS DIS- CHARGE (CFS)	TEMPER- ATURE (DEG C)	DIS- SOLVED OXYGEN (MG/L)	PH (UNITS)	SPE- CIFIC CON- DUCT- ANCE (MICRO- MHOS)	TUR- BID- ITY (JTU)	COLOR (PLAT- INUM- COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJEL- DAHL NITRO- GEN (N) (MG/L)	TOTAL PHOS- PHORUS (P) (MG/L)
APR												
11...	1230	E760	12.0	9.4	7.5	485	7	10	3.6	1.9	.81	.08
AUG												
12...	1030	E250	22.0	6.7	6.8	475	80	50	6.9	1.5	3.3	.38

400222082050800 - BIG RN AB DILLON LK AT SITE (I-2)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTAN- TANEOUS DIS- CHARGE (CFS)	TEMPER- ATURE (DEG C)	DIS- SOLVED OXYGEN (MG/L)	PH (UNITS)	SPE- CIFIC CON- DUCT- ANCE (MICRO- MHOS)	TUR- BID- ITY (JTU)	COLOR (PLAT- INUM- COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJEL- DAHL NITRO- GEN (N) (MG/L)	TOTAL PHOS- PHORUS (P) (MG/L)
APR												
11...	1300	<15	13.0	9.5	7.4	320	8	15	4.8	.57	.33	.03
AUG												
12...	1100	E20	21.5	7.5	6.8	325	140	--	7.5	.76	1.5	.27

E - estimated.

East Branch Reservoir

Location: Geauga County

Type: Reservoir

Use: Water supply and recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1939	416	4659	0.34

Drainage basin characteristics:

Drainage area (miles²)	Type	Estimated sediment yield (from fig. 4)
17.5	agricultural, rural	moderate

Lake data (figs. 45-47; tables 94-97): East Branch Reservoir was sampled in cold rainy weather on April 28 and under partly cloudy skies on August 15. Profile and analytical data show the following lake characteristics:

Date (1976)	Stratification (gradient) ther-mal	Stratification (gradient) chem-ical	Chemical type	Substances at or above State limits pesti-cides	Substances at or above State limits toxi-cants	Substances at or above State limits bac-teria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
April 28	no	no	hard Ca HCO_3 SO_4	no	no	no	Chlorophyta Chrysophyta
August 15	partial	yes	--	no	--	no	Cyanophyta

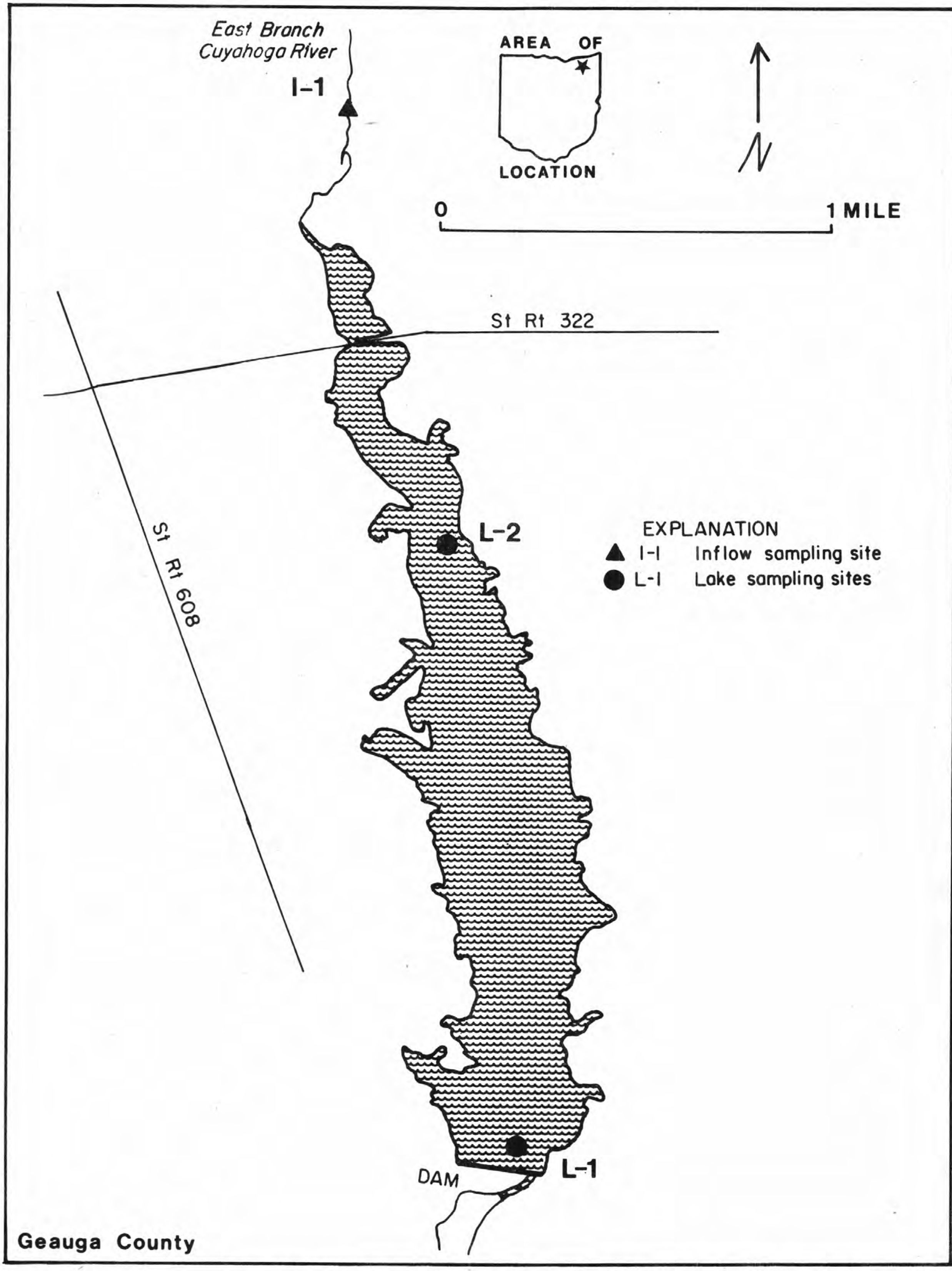

Figure 45.--East Branch Reservoir and inflow sampling sites.

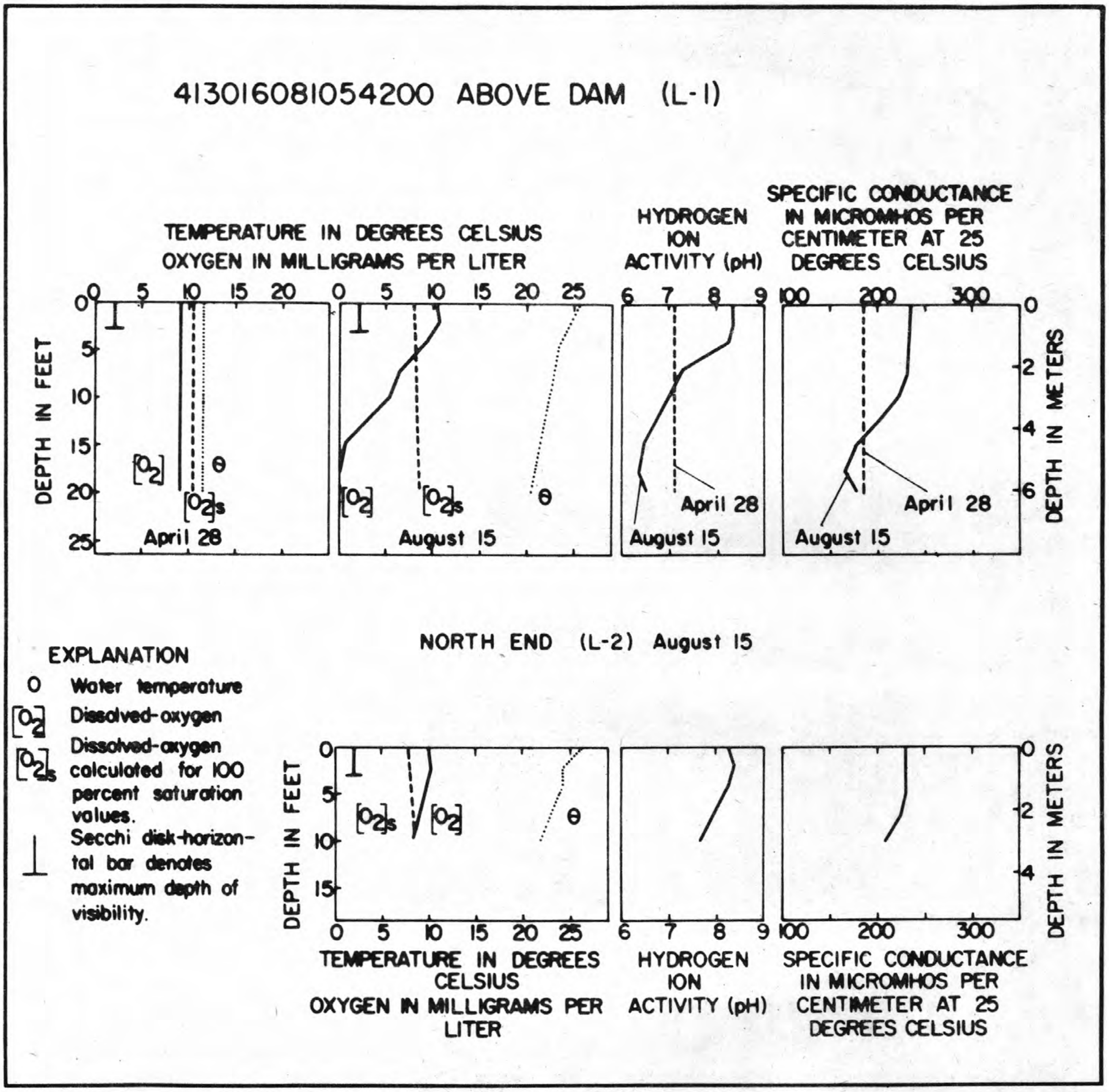

Figure 46.--Data profiles for East Branch Reservoir, Ohio on selected days in 1977.

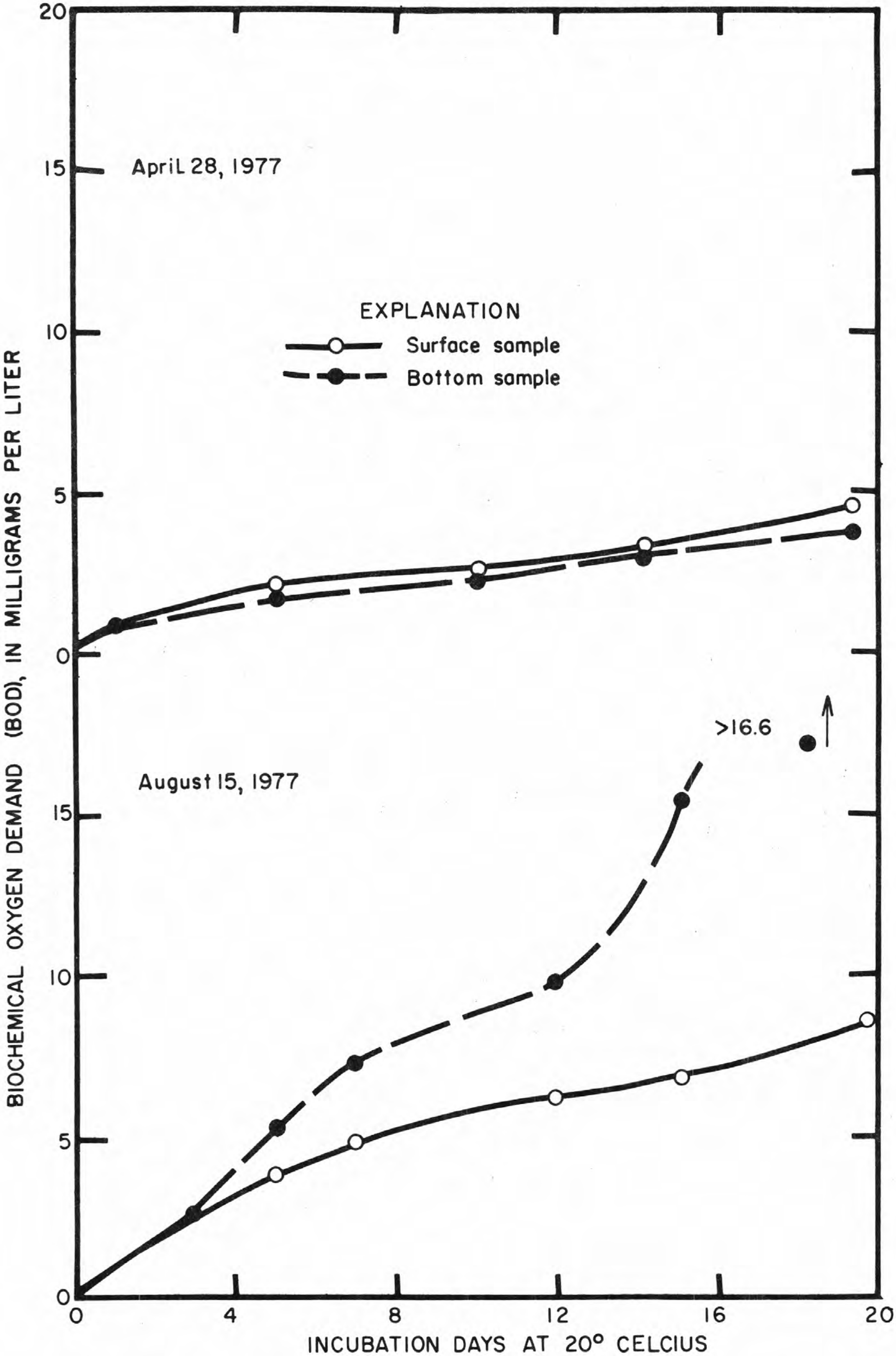

Figure 47.--BOD of water samples from East Branch Reservoir on selected days in 1977.

Table 94.--Profile data for the primary lake site, East Branch Reservoir, Ohio

413016081054200 - EAST BRANCH RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
28...	1100	.0	11.5	9.1	87	185	7.1	--	--	--	--	--
28...	1105	2.0	11.5	9.0	86	185	7.1	0	52	6.6	.0	2.8
28...	1110	4.0	11.5	9.0	86	185	7.1	--	--	--	--	--
28...	1115	7.0	11.5	9.0	86	185	7.1	--	--	--	--	--
28...	1120	10	11.5	9.0	86	185	7.1	--	--	--	--	--
28...	1125	15	11.5	9.0	86	185	7.1	--	--	--	--	--
28...	1130	20	11.5	9.0	86	185	7.1	0	52	6.6	.0	--
AUG												
15...	1540	.0	25.8	10.3	131	235	8.4	--	--	--	--	--
15...	1545	2.0	24.8	10.5	131	233	8.4	1	76	.5	.0	3.0
15...	1550	4.0	23.8	9.4	115	233	8.3	--	--	--	--	--
15...	1555	7.0	23.2	6.6	80	233	7.3	--	--	--	--	--
15...	1600	10	22.5	5.4	65	223	7.0	--	--	--	--	--
15...	1605	15	21.5	.6	7	178	6.5	--	--	--	--	--
15...	1608	18	21.0	.0	0	167	6.4	--	--	--	--	--
15...	1610	20	20.6	.0	0	177	6.5	0	54	27	.7	--

Table 95.--Chemical analyses of water column composite samples, East Branch Reservoir, Ohio

413016081054200 - EAST BRANCH RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 28...	1120	22	5.7	1.6	8.0	24	14	.1	78	120	22	142

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 28...	0	0	<10	6	.0	5	0	0	<10	.07

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 28...	10	0	2	650	110	5	20

Table 96.--Chemical, physical, and biological analyses of water samples from selected depths, East Branch Reservoir, Ohio

413016081054200 - EAST BRANCH RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
28...	1105	2.0	.01	.27	.28	.09	.36	.45	.00
28...	1130	20	.01	.24	.25	.08	.44	.52	.00
AUG									
15...	1545	2.0	.00	.00	.00	.01	.81	.82	.00
15...	1610	20	.05	.06	.11	.62	1.6	2.2	.01

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
28...	.04	3.0	8	25	2.1	2.0	12	80	60
28...	.04	3.0	9	25	5.7	1.6	15	90	44
AUG									
15...	.05	2.8	4	25	8.2	3.5	20	24	10
15...	.11	5.8	7	70	9.1	4.8	35	200	430

Table 97.--Phytoplankton in East Branch Reservoir, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chloro-phyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)*of total cell count
Location	Date	Location in water column						
Site L-1 above dam ----------	4-28-77	euphotic zone composite	9400	3.6	13	Chlorophyta	38	Scenedesmus (14); Ankistrodesmus (11); Selenastrum (4); Kirchneriella (3); Micractinium (2); Chodatella (2); Golenkinia (1); Chlamydomonas (1); Pediastrum; Dictyosphaerium; Tetrastrum
						Chrysophyta	30	Melosira (19); Nitzschia (5); Synedra (3); Cyclotella (2); Cymbella (1); Diatoma (1); Achnanthes; Navicula; Tabellaria
						Cyanophyta	26	Anacystis (16); Oscillatoria (10)
						Euglenophyta	6	Cryptomonas (3); Chroomonas (2); Trachelomonas (1); Phacus; Euglena; Lepocinclis
Site L-1 above dam ----------	4-28-77	2-ft depth	8600	3.4	13	Chrysophyta	63	Melosira (27); Cyclotella (13); Fragilaria (10); Nitzschia (6); Achnanthes (3); Dinobryon (3); Gomphonema (1)
						Chlorophyta	29	Scenedesmus (14); Ankistrodesmus (6); Chodatella (4); Pediastrum (3); Treubaria (1); Microactinium (1)
						Euglenophyta	10	Chroomonas (7); Cryptomonas (1); Euglena (1); Phacus (1); Trachelomonas (1)
Site L-1 above dam ----------	8-15-77	euphotic zone composite	3,000,000	2.2	23	Cyanophyta	94	Lyngbya (48); Anacystis (28); Gomphosphaeria (5); Raphidiopsis (4); Aphanizomenon (3); Cylindrospermum (3); Oscillatoria (3)
						Chlorophyta	5	Dictyosphaerium (4); Kirchneriella (1); Golenkinia; Scenedesmus; Tetrastrum; Micractinium; Ankistrodesmus; Schroederia; Elakatothrix; Carteria; Chodatella
						Chrysophyta	1	Cyclotella; Synedra; Nitzschia
						Euglenophyta	< 1	Trachelomonas; Phacus
						Pyrrhophyta	< 1	Ceratium
Site L-1 above dam ----------	8-15-77	2-ft depth	3,400,000	1.5	29	Cyanophyta	96	Lyngbya (70); Anacystis (17); Aphanizomenon (5); Raphidiopsis (3); Gomphosphaeria (1); Oscillatoria (1)
						Chlorophyta	3	Dictyosphaerium (2); Kirchneriella; Scenedesmus; Chlamydomonas; Golenkinia; Chodatella; Elakatothrix
						Chrysophyta	1	Melosira; Achnanthes; Cyclotella; Synedra; Navicula; Nitzschia
						Euglenophyta	< 1	Trachelomonas

* Less than 1 percent not given.

The reservoir at site L-1 was vertically mixed on April 28. The August 15 profiles show a general temperature decrease with depth, poor vertical mixing below 4 ft, and lower chemical concentrations (specific conductance and bicarbonate) below 10 ft. The zone below 18 ft was anaerobic and characterized by hydrogen sulfide; increases in specific conductance and pH with depth; and higher ammonia, BOD, carbon dioxide, and color values than those at the surface. Data from the north end of the lake at site L-2 indicate that similar conditions existed for the upper 10 ft, although dissolved oxygen and pH did not decrease as rapidly with depth as at site L-1.

Near-surface concentrations of inorganic nitrogen were less than 0.40 mg/L on April 28 and 0.01 mg/L or less on August 15. Orthophosphorus was low during both visits, although nutrient recycling and possible nitrogen fixation by blue-green algae are indicated by the apparent accumulation of organic nitrogen in the lake between April and August. The phytoplankton community structure at site L-1 in April consisted of a diverse assemblage of the major algal types. Blue-green (Cyanophyta) algae were identified in the euphotic-zone composite but were not detected in the sample from 2 ft. The August cell counts (3,000,000 and 3,400,000 cells/ml) were among the highest of the lakes sampled during the 1976-77 reconnaissance. The algal counts consisted mostly of members of the blue-green genera Lyngbya and Anacystis. The macrophyte, Myriophyllum, also was seen growing in the shallow areas of the lake.

Inflow data (fig 45, table 98): The East Branch of the Cuyahoga River is the principal inflow to East Branch Reservoir. The river was sampled at site I-1, where it represents 10.0 mi² or 57 percent of the drainage area of the reservoir. A relative comparison of stream versus lake data is shown below.

Stream	Date (1977)	Dis-charge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
East Branch Cuyahoga River at site I-1	April 28	E 25	lake	same	stream	stream
	August 15	E 15	stream	same	lake	lake

* At 2-ft (0.6-m) depth.
E Estimated.

The sampling site had the most diverse benthic community of the inflows sampled during 1977. Caddisflies (Trichoptera), three species of mayflies (Ephemeroptera), stoneflies (Plecoptera), sponges (Porifera), water pennies, (Coleoptera), bryzoans, and leeches were observed.

Table 98.--Physical and chemical data for selected inflows, East Branch Reservoir, Ohio

413235081061300 - E B CUYAHOGA R AB EAST BRANCH RE AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR 28...	1000	E25	11.0	10.6	7.3	220	7	30	6.2	.11	.31	.04
AUG 15...	1445	E15	21.5	8.2	7.2	192	6	40	8.1	.14	.95	.05

E - eastimated.

Indian Lake

Location: Logan County

Type: Reservoir

Use: Water supply and recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1853	6130	46,300	0.75

Drainage basin characteristics:

Drainage area (miles²)	Type	Estimated sediment yield (from fig. 4)
99.8	agricultural	moderately low

Lake data (figs. 48-50; tables 99-102): Indian Lake was sampled in windy cloudy weather on April 21 and under cool, clear skies on August 18. The secchi-disk transparency at site L-1 was less than 2 ft on both dates. Profile and analytical data show the following lake characteristics:

Date (1977)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
April 21	no	no	very hard Ca Mg HCO_3	no	no	no	Cyanophyta
August 18	slight	slight	--	no	--	no	Cyanophyta

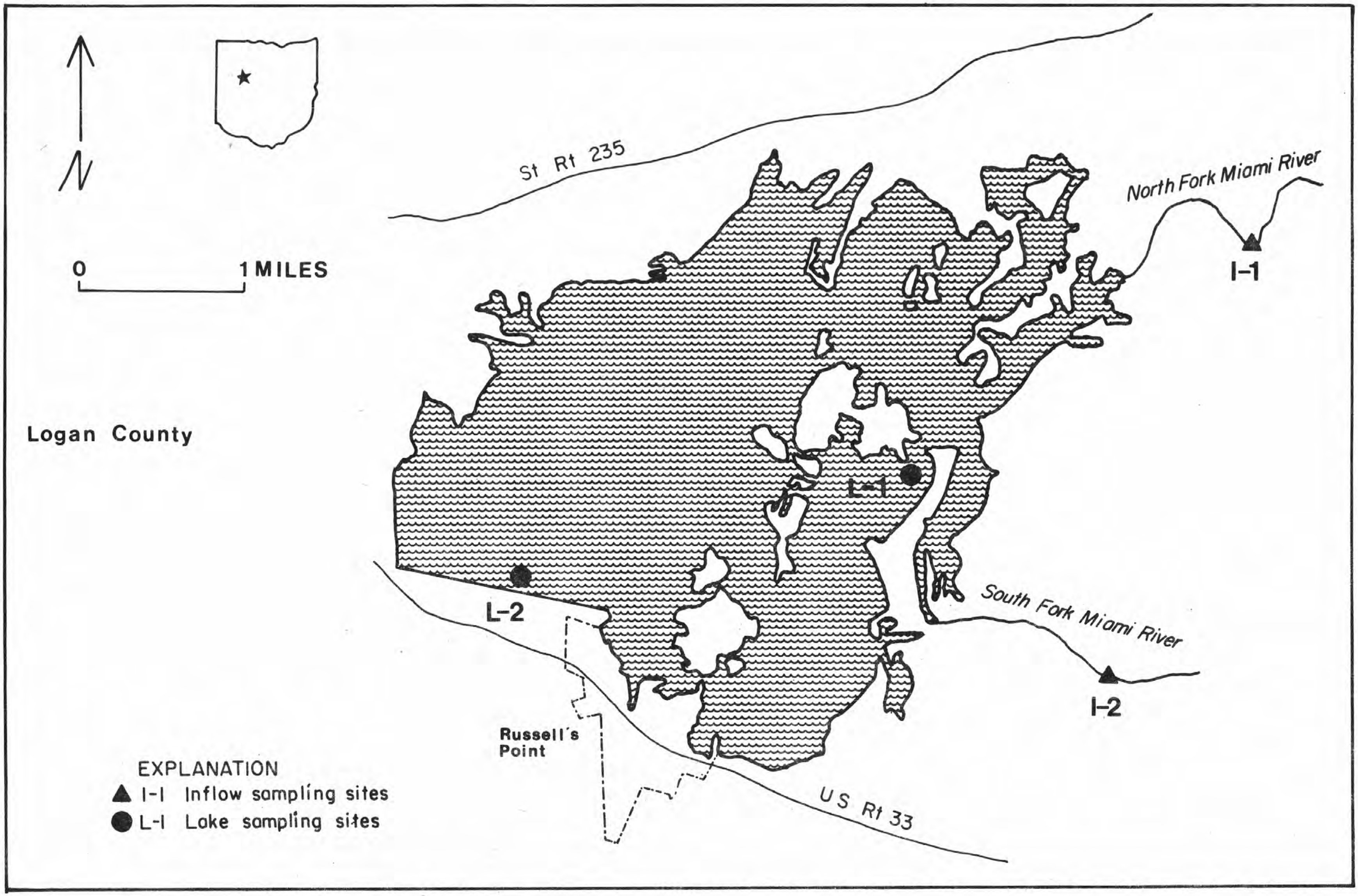

Figure 48.--Indian Lake and inflow sampling sites.

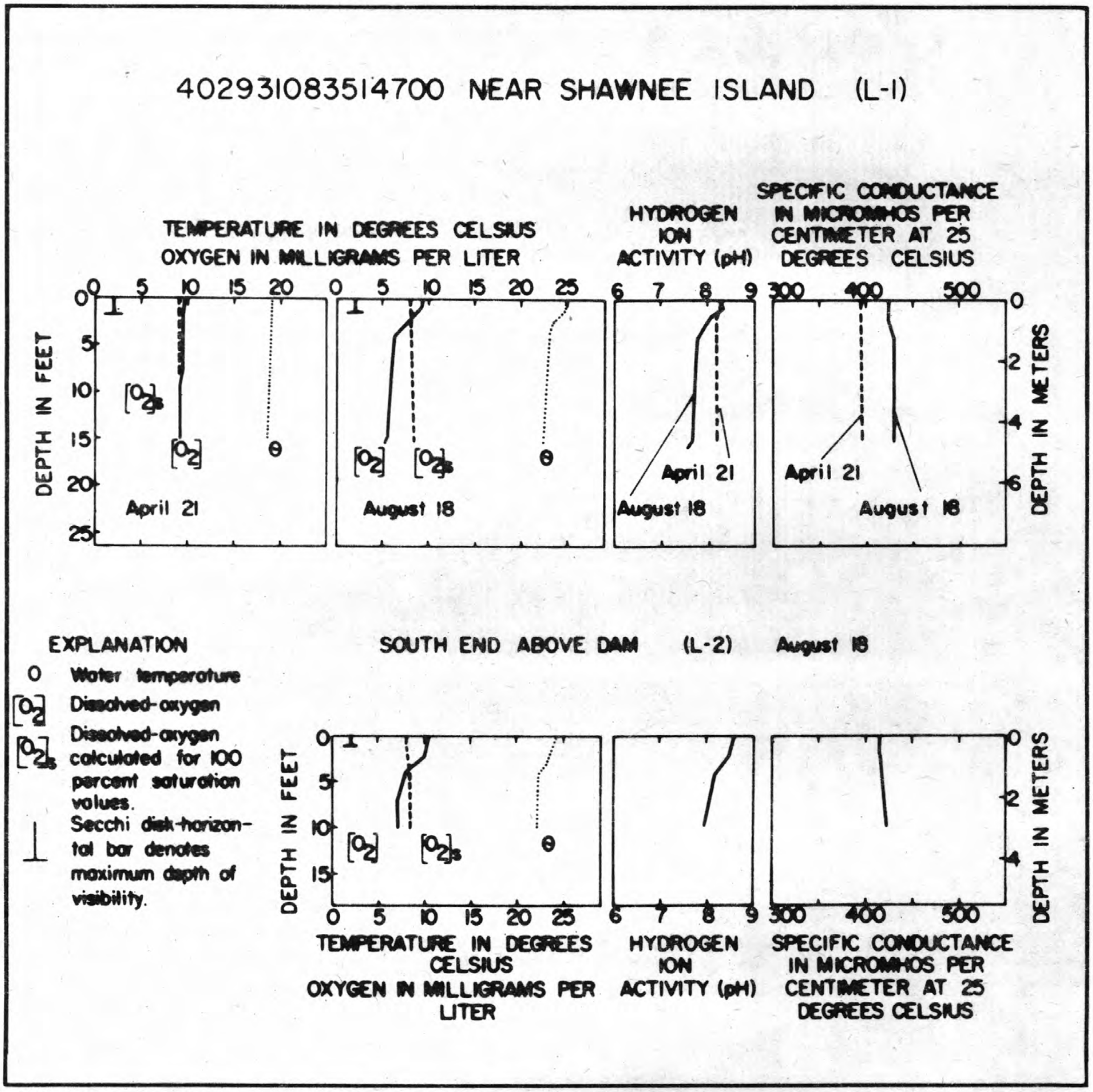

Figure 49.--Data profiles for Indian Lake, Ohio, on selected days in 1977.

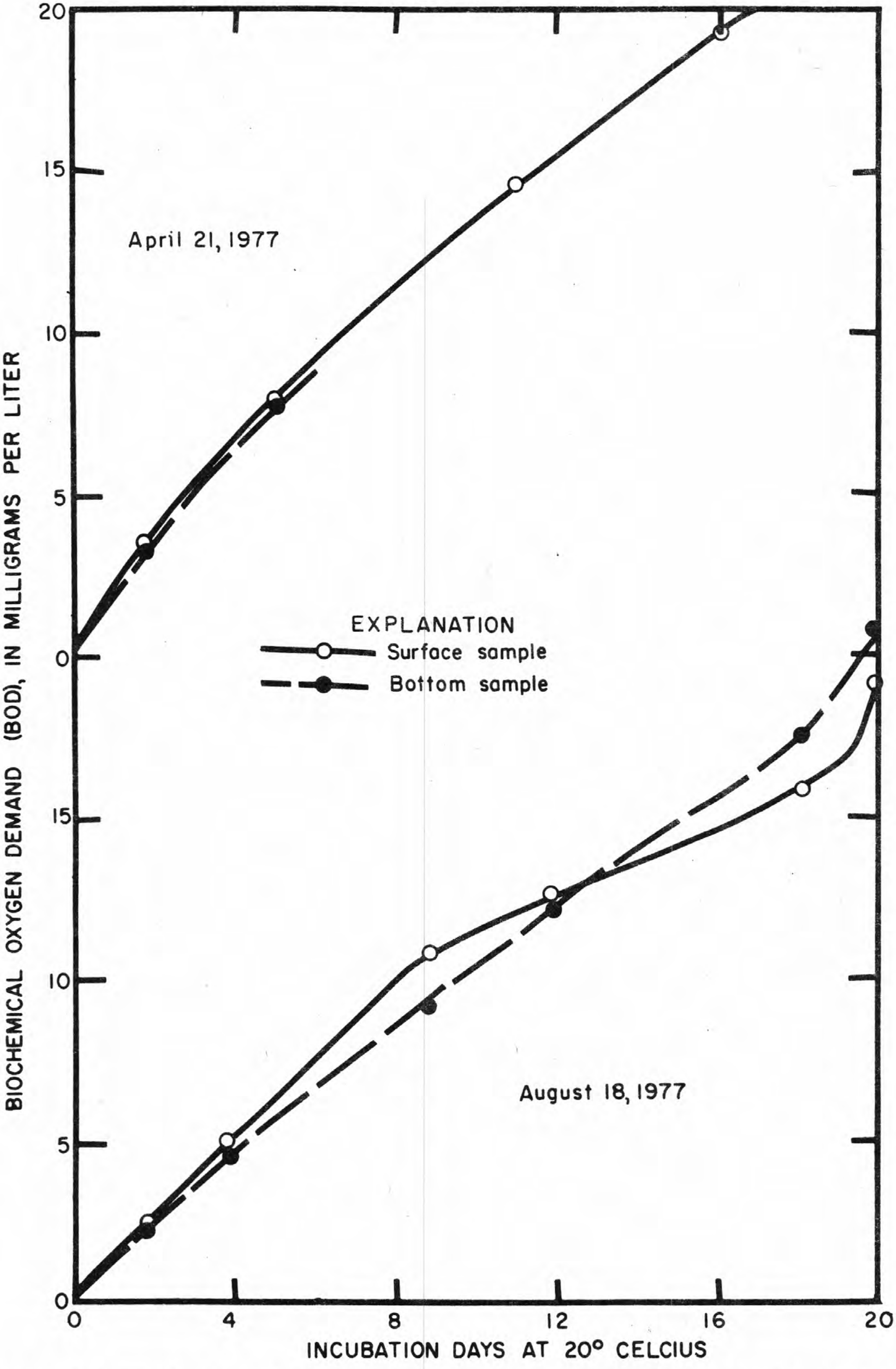

Figure 50.--BOD of water samples from Indian Lake on selected days in 1977

Table 99.--Profile data for the primary lake site, Indian Lake, Ohio

402931083514700 - INDIAN LK NR SHAWNEE ISLAND AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
21...	1250	.0	19.0	9.5	106	395	8.3	--	--	--	--	--
21...	1255	2.0	19.0	9.3	103	395	8.2	0	134	1.3	.0	1.8
21...	1300	4.0	19.0	9.3	103	395	8.2	--	--	--	--	--
21...	1305	7.0	19.0	9.3	103	395	8.2	--	--	--	--	--
21...	1310	10	18.8	9.1	101	395	8.2	--	--	--	--	--
21...	1315	15	18.5	9.1	100	395	8.2	0	136	1.4	.0	--
AUG												
18...	1330	.0	25.1	9.3	116	425	8.3	--	--	--	--	--
18...	1335	2.0	24.1	8.2	101	426	8.1	0	152	2.0	.0	1.5
18...	1340	4.0	23.3	6.2	75	430	7.8	--	--	--	--	--
18...	1345	7.0	23.1	5.8	70	430	7.7	--	--	--	--	--
18...	1350	10	23.0	5.7	68	430	7.7	--	--	--	--	--
18...	1355	15	22.5	5.4	64	430	7.7	0	150	4.8	.0	--

Table 100.--Chemical analyses of water column composite samples, Indian Lake, Ohio

402931083514700 - INDIAN LK NR SHAWNEE ISLAND AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 21...	1305	42	21	2.7	7.0	63	17	.2	190	271	31	302

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 21...	100	1	<10	7	.0	0	0	0	<10	.09

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 21...	80	0	3	650	80	4	20

Table 101.--Chemical, physical, and biological analyses of water samples from selected depths, Indian Lake, Ohio

402931083514700 - INDIAN LK NR SHAWNEE ISLAND AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
21...	1255	2.0	.02	.45	.47	.20	1.7	1.9	.01
21...	1315	15	.02	.55	.57	.24	2.1	2.3	.01
AUG									
18...	1335	2.0	.00	.00	.00	.04	2.3	2.3	.01
18...	1355	15	.00	.00	.00	.05	2.7	2.7	.01

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
21...	.10	.1	20	35	5.2	7.6	41	<4	2
21...	.14	.1	20	35	4.7	7.5	42	<4	<4
AUG									
18...	.12	.3	15	50	7.4	6.1	40	<3	126
18...	.14	.3	15	50	8.1	5.5	45	3	430

Table 102.--Phytoplankton in Indian Lake, Ohio

Sample description: Location	Date	Location in water column	Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Site L-1 near Shawnee Island	4-21-77	euphotic zone composite	610,000	0.9	43	Cyanophyta	92	Oscillatoria (88); Lyngbya (3); Anacystis (1)
						Chlorophyta	6	Ankistrodesmus (3); Scenedesmus (1); Dictyosphaerium (1); Chlamydomonas (1); Kirchneriella; Tetraedron; Chodatella
						Chrysophyta	2	Nitzschia (1); Fragilaria (1); Achnanthes; Cyclotella; Dinobryon
						Euglenophyta	< 1	Chroomonas; Cryptomonas
Site L-1 near Shawnee Island	4-21-77	2-ft depth	730,000	1.0	72	Cyanophyta	91	Oscillatoria (87); Lyngbya (4)
						Chlorophyta	6	Ankistrodesmus (3); Scenedesmus (1); Pediastrum; Dictyosphaerium; Oocystis; Chodatella; Tetraedron; Elakatothrix; Chlamydomonas
						Chrysophyta	2	Fragilaria (1); Nitzschia (1); Cyclotella; Achnanthes
						Euglenophyta	1	Cryptomonas; Euglena; Chroomonas
Site L-1 near Shawnee Island	8-18-77	euphotic zone composite	2,500,000	2.0	90	Cyanophyta	97	Oscillatoria (59); Lyngbya (16); Anacystis (10); Cylindrospermum (5); Agmenellum (4); Anabaenopsis (1); Aphanizomenon (1)
						Chlorophyta	2	Crucigenia (1); Scenedesmus; Tetrastrum; Dictyosphaerium; Kirchneriella; Cosmarium; Schroederia; Nephrocytium
						Chrysophyta	1	Nitzschia (1); Gyrosigma; Plagiotropis
Site L-1 near Shawnee Island	8-18-77	1-ft depth	1,500,000	1.6	93	Cyanophyta	98	Oscillatoria (60); Lyngbya (29); Agmenellum (4); Anacystis (3); Cylindrospermum (1); Anabaenopsis (1)
						Chlorophyta	2	Dictyosphaerium; Tetrastrum; Scenedesmus; Kirchneriella; Ankistrodesmus; Coelastrum; Crucigenia; Schroederia; Tetraedron; Cosmarium; Chodatella; Franceia; Chlamydomonas; Tetradesmus
						Chrysophyta	1	Nitzschia (1); Cyclotella; Achnanthes
						Euglenophyta	< 1	Euglena; Trachelomonas; Phacus
						Pyrrhophyta	< 1	Peridinium

* Less than 1 percent not given.

The lake at site L-1 was vertically mixed on April 21. By August 18, the water had warmed 4°-6° Celcius, but no signs of prolonged thermal stratification or of related major changes in water chemistry were evident. The BOD curves indicate that the water had a high oxygen demand, which could account for the undersaturated dissolved oxygen profile below 2 ft. Similar profile configurations existed near the dam at site L-2.

Nutrient concentrations (nitrogen and phosphorus) in the lake were high, and by August the biological uptake and conversion of inorganic nitrogen (observed in April) into organic nitrogen was evident. The low silica concentrations (less than 0.4 mg/L) may have limited diatom growth. Algal cell counts were as high as 2,500,000 cells per milliliter in August, and chlorophyll a concentrations were among the highest of the lakes sampled in 1977. The blue-green (Cyanophyta) genus Oscillatoria was most common in all collections for phytoplankton.

Inflow data (fig. 48; table 103): The North Fork Great Miami River, draining 21.3 mi^2, and the South Fork Great Miami River, draining 51.8 mi^2 were sampled at sites I-1 and I-2, respectively. Their combined drainage areas represent 73 percent of the total drainage to the lake. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1977)	Discharge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
North Fork Great Miami River at site I-1	April 21	< 5	stream	lake	lake	stream
	August 18	< 3	stream	stream	stream	stream
South Fork Great Miami River at site I-2	April 21	E 8	same	lake	stream	stream
	August 18	E 7	stream	lake	stream	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Mayflies (Ephemeroptera), water pennies (Coleoptera), crayfish, darters, and growths of Anacharis and Draparnaldia were observed at the South Fork sampling site (I-2).

Table 103.--Physical and chemical data for selected inflows, Indian Lake, Ohio

403041083492500 - N F GREAT MIAMI R AB INDIAN LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTAN-TANEOUS DIS-CHARGE (CFS)	TEMPER-ATURE (DEG C)	DIS-SOLVED OXYGEN (MG/L)	PH (UNITS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)
APR 21...	1600	<5.0	19.0	7.6	7.9	600	6	20	4.7	2.1	.75	.05
AUG 18...	1220	<3.0	19.0	7.3	7.7	500	50	50	8.5	2.6	2.0	.16

402827083502600 - S F GREAT MIAMI R AB INDIAN LK AT SITE (I-2)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTAN-TANEOUS DIS-CHARGE (CFS)	TEMPER-ATURE (DEG C)	DIS-SOLVED OXYGEN (MG/L)	PH (UNITS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)
APR 21...	1530	E8.0	19.0	12.6	8.2	780	4	15	5.3	.47	.43	.03
AUG 18...	1200	E7.0	19.0	9.1	7.9	705	30	20	9.1	.65	.64	.10

E - estimated.

Killdeer Reservoir

Location: Wyandot County

Type: Reservoir-upland

Use: Water supply and recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1972	253	6670	--

Drainage basin characteristics:

Drainage area (miles²)	Type	Estimated sediment yield (from fig. 4)
--	--	--

Lake data (figs. 51-53; tables 104-107): Killdeer Reservoir was the only upland reservoir sampled during 1976-77. Data were collected on windy hazy days on May 5 and August 4. The near-surface turbidity was 2 JTU during both visits, but the secchi-disk transparency was greater in May (19 ft) than in August (8 ft). Profile and analytical data show the following lake characteristics:

Date (1977)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
May 5	slight	slight	very hard Ca HCO_3 SO_4	no	no	no	Euglenophyta
August 4	yes	yes	--	no	--	no	Cyanophyta

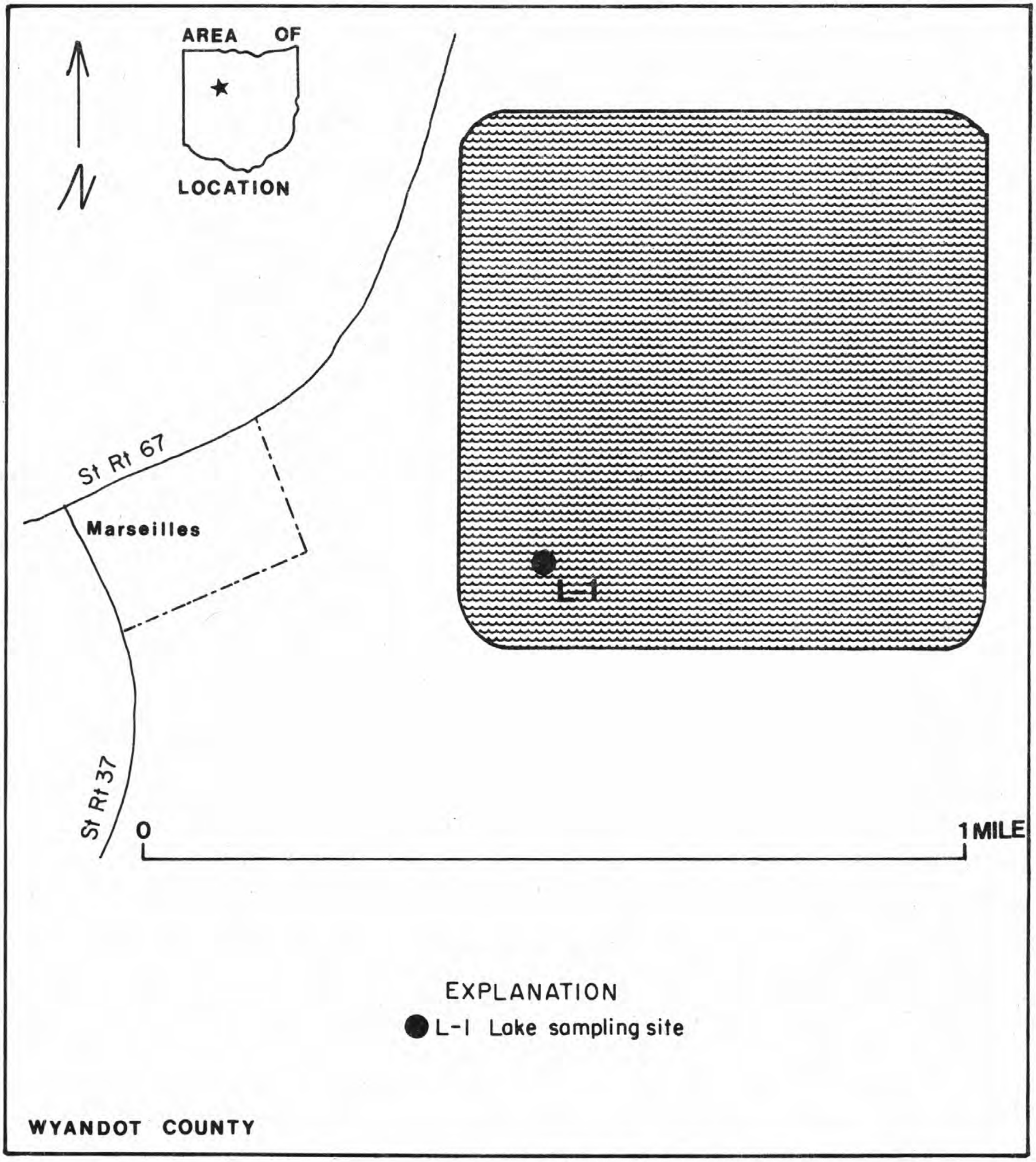

Figure 51.--Killdeer Reservoir sampling site.

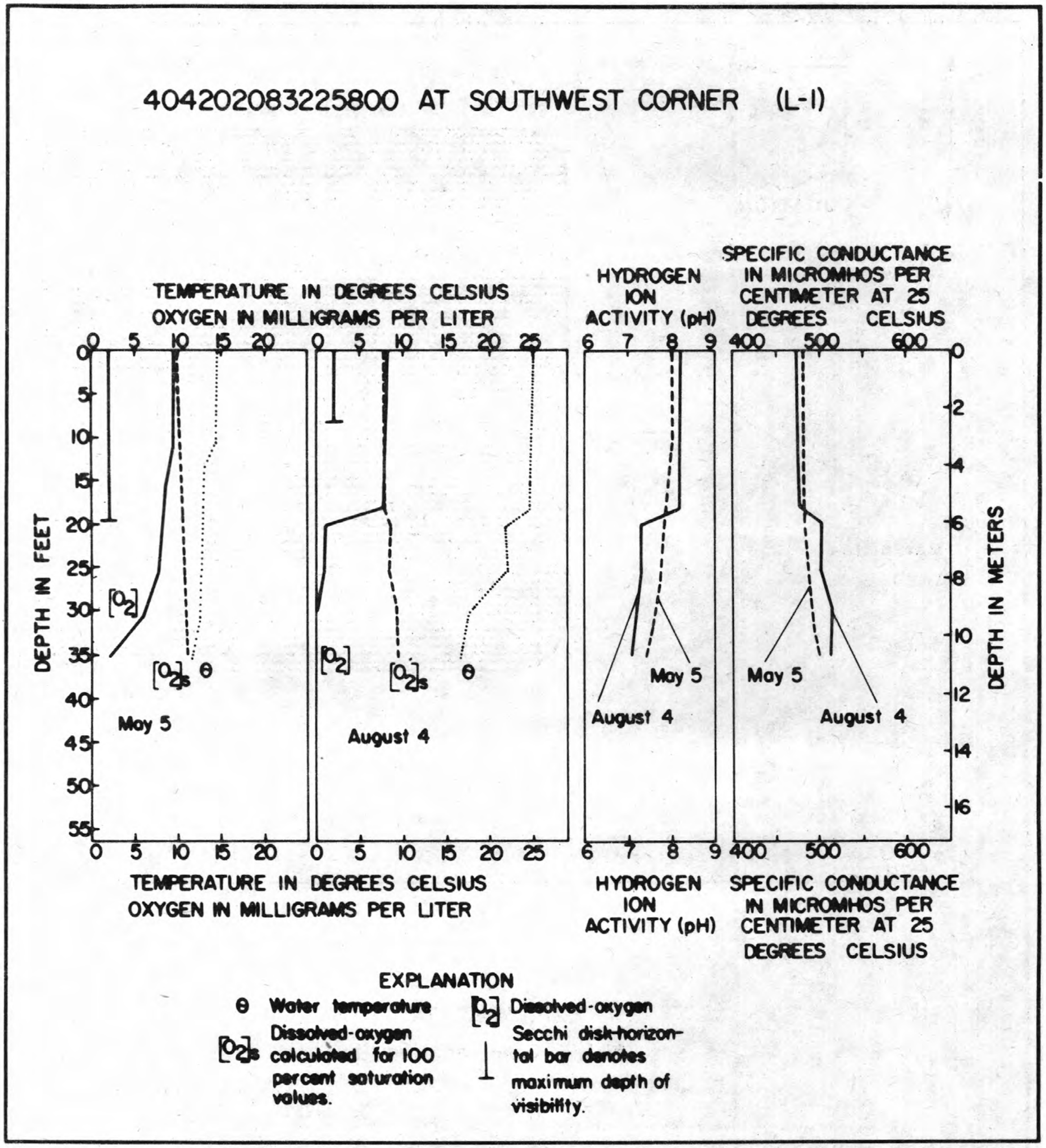

Figure 52.--Data profiles for Killdeer Reservoir, Ohio, on selected days in 1977.

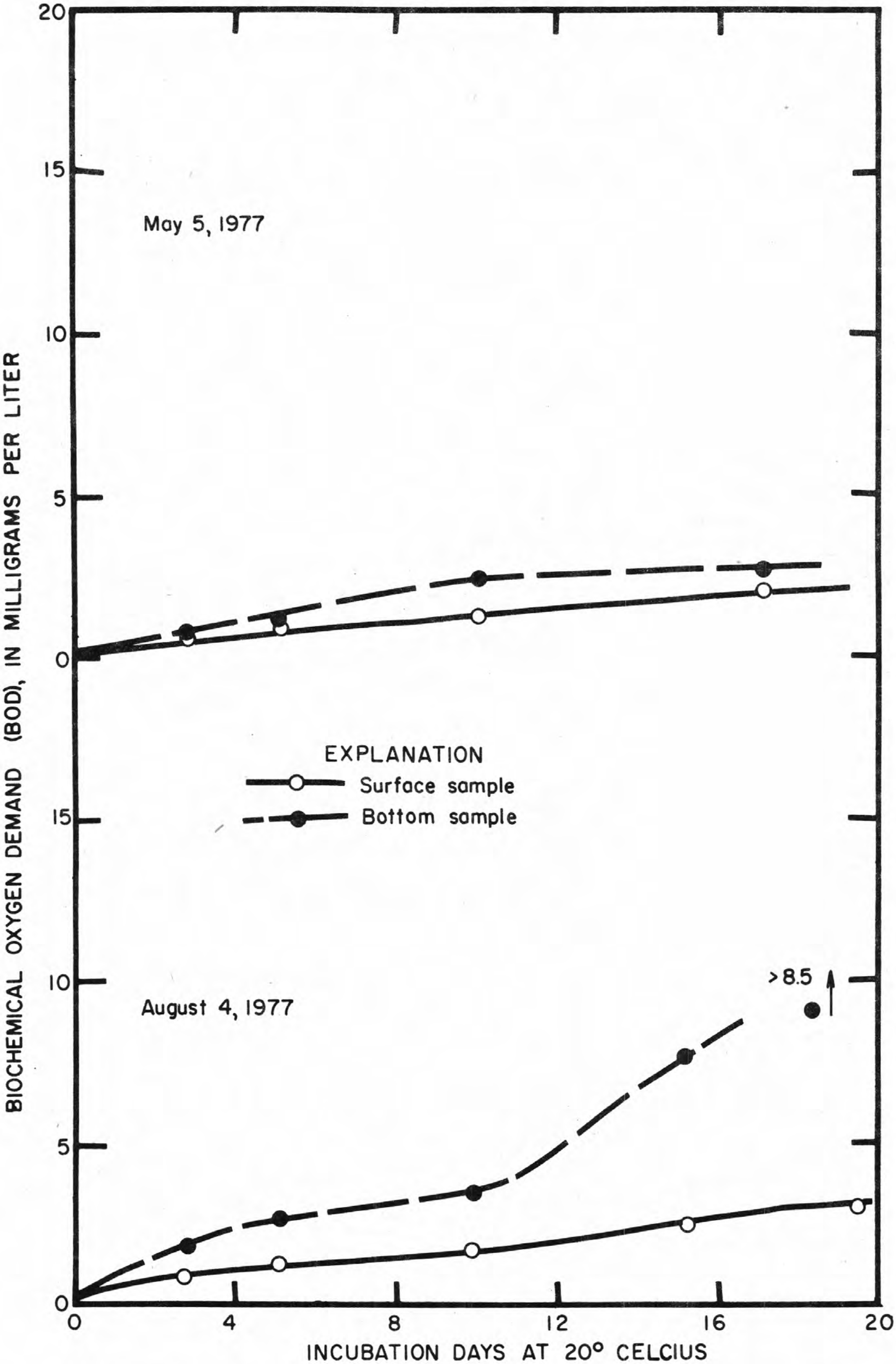

Figure 53.--BOD of water samples from Killdeer Reservoir on selected days in 1977.

Table 104.--Profile data for the primary lake site, Killdeer Reservoir, Ohio

404202083225800 - KILLDEER RE AT SOUTHWEST CORNER AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
MAY												
05...	1310	.0	14.5	9.5	96	480	8.0	--	--	--	--	--
05...	1315	2.0	14.5	9.5	96	480	8.0	0	134	2.1	.0	19
05...	1320	4.0	14.5	9.5	96	480	8.0	--	--	--	--	--
05...	1325	7.0	14.3	9.5	95	480	8.0	--	--	--	--	--
05...	1330	10	14.1	9.4	94	480	8.0	--	--	--	--	--
05...	1335	15	13.0	8.6	84	480	7.9	--	--	--	--	--
05...	1340	20	12.8	8.1	79	483	7.8	--	--	--	--	--
05...	1345	25	12.5	7.6	73	485	7.7	--	--	--	--	--
05...	1350	30	12.2	5.9	57	490	7.6	--	--	--	--	--
05...	1355	35	11.5	2.3	22	498	7.4	0	150	9.4	.0	--
AUG												
04...	1350	.0	25.0	8.2	102	473	8.2	--	--	--	--	--
04...	1355	2.0	25.0	8.2	102	473	8.2	0	132	1.3	.0	6.3
04...	1400	4.0	25.0	8.2	102	473	8.2	--	--	--	--	--
04...	1405	7.0	25.0	8.2	102	473	8.2	--	--	--	--	--
04...	1410	10	24.8	8.2	102	475	8.2	--	--	--	--	--
04...	1415	15	24.7	8.2	102	475	8.2	--	--	--	--	--
04...	1418	18	24.5	7.9	97	478	8.2	--	--	--	--	--
04...	1420	20	22.0	1.2	14	500	7.3	--	--	--	--	--
04...	1425	25	22.0	1.2	14	500	7.3	--	--	--	--	--
04...	1430	30	17.8	.0	0	510	7.2	--	--	--	--	--
04...	1435	35	16.8	.0	0	510	7.1	0	205	26	2.0	--

Table 105.--Chemical analyses of water column composite samples, Killdeer Reservoir, Ohio

404202083225800 - KILLDEER RE AT SOUTHWEST CORNER AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
MAY 05...	1340	58	20	2.5	9.0	96	21	.2	230	298	49	347

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
MAY 05...	0	0	10	6	.0	3	0	0	<10	.07

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
MAY 05...	20	0	2	370	20	10	0

Table 106.--Chemical, physical, and biological analyses of water samples from selected depths, Killdeer Reservoir, Ohio

404202083225800 - KILLDEER RE AT SOUTHWEST CORNER AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMP-LING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITRO-GEN (N) (MG/L)	TOTAL ORGANIC NITRO-GEN (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL ORTHO PHOS-PHORUS (P) (MG/L)
MAY									
05...	1315	2.0	.02	1.3	1.3	.09	.63	.72	.00
05...	1355	35	.02	.77	.79	.19	.67	.86	.01
AUG									
04...	1355	2.0	.01	.70	.71	.01	.64	.65	.01
04...	1435	35	.00	.00	.00	.85	1.2	2.0	.00

DATE	TOTAL PHOS-PHORUS (P) (MG/L)	DIS-SOLVED SILICA (SIO2) (MG/L)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIO-CHEM-ICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEM-ICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLI-FORM (COL. PER 100 ML)	STREP-TOCOCCI (COL-ONIES PER 100 ML)
MAY									
05...	.01	.3	2	5	4.2	.7	9	<2	2
05...	.01	2.0	15	20	3.6	1.0	9	<2	2
AUG									
04...	.01	.9	2	5	5.0	1.1	15	<2	<2
04...	.02	6.2	20	20	8.4	2.3	15	4	6

Table 107.--Phytoplankton in Killdeer Reservoir, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)*of total cell count
Location	Date	Location in water column						
Site L-1 at southwest corner ------	5-5-77	euphotic zone composite	180	2.3	3	Euglenophyta	58	Cryptomonas (48); Chroomonas (7); Trachelomonas (3)
						Chrysophyta	21	Cyclotelia (14); Fragilaria (7)
						Chlorophyta	20	Scenedesmus (14); Schroederia (3); Ankistrodesmus (3)
Site L-1 at southwest corner ------	5-5-77	10-ft depth	910	2.2	3	Chrysophyta	66	Fragilaria (44); Dinobryon (20); Ochromonas (2)
						Euglenophyta	32	Cryptomonas (20); Colacium (6); Chroomonas (4); Trachelomonas (2)
Site L-1 at southwest corner ------	8-4-77	euphotic zone composite	13,000	1.2	5.5	Cyanophyta	78	Anacystis (78)
						Euglenophyta	19	Chroomonas (13); Cryptomonas (3); Trachelomonas (3)
						Chlorophyta	3	Crucigenia (1); Scenedesmus (1); Kirchneriella
						Chrysophyta	< 1	Nitzschia
Site L-1 at southwest corner ------	8-4-77	2-ft depth	12,000	2.0	5.4	Cyanophyta	58	Anacystis (58)
						Chlorophyta	30	Dictyosphaerium (16); Pandorina (11); Scenedesmus (2); Elakatothrix (1); Kirchneriella (1)
						Euglenophyta	9	Cryptomonas (5); Chroomonas (4)
						Chrysophyta	3	Ochromonas (2); Dinobryon (1)

* Less than 1 percent not given.

The profiles at site L-1 indicate that, in May, the water was vertically mixed in the upper 10 ft. Below this level, temperature, dissolved oxygen, and pH decreased, and specific conductance increased slightly with depth. Bicarbonate and silica concentrations were higher near the bottom than at the lake surface.

The August data indicate vertical mixing to a depth of 18 ft. A second vertically mixed zone existed between 20 and 25 ft. The water below 30 ft was anaerobic and contained hydrogen sulfide and higher values of BOD, bicarbonate, ammonia and silica than at the 2-ft depth.

Except for the reduction of nitrate in the hypolimnion in August, nitrate concentrations were sufficient for nuisance algal growths. (See page 12.) Phosphorus concentrations, however, were low and may have limited phytoplankton growth; chlorophyll a concentrations (table 107) were among the lowest of the lakes sampled in 1977. Low cell counts of euglenoids (Euglenophyta), diatoms (Chrysophyta), and green algae (Chlorophyta) were identified in the May samples. Blue-greens (Cyanophyta) accounted for the majority of cell counts on August 4.

Inflow data: Diversions from high flows in Tymochtee Creek supply the water for Killdeer Reservoir. No inflow data were taken.

Kiser Lake

Location: Champaign County

Type: Reservoir

Use: Recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1940	374	3215	0.58

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
8.7	rural, agricultural	moderately low

Lake data (figs. 54-56; tables 108-111): Kiser Lake was sampled during a period of light rain on April 22 and under a hazy sky on August 19. Water turbidity at site L-1 was greater in August (15 JTU) than in April (6 JTU). Profile and analytical data show the following lake characteristics:

Date (1977)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
April 22	no	no	very hard Mg Ca HCO_3	no	no	no	Cyanophyta
August 19	slight	yes	--	no	--	no	Cyanophyta

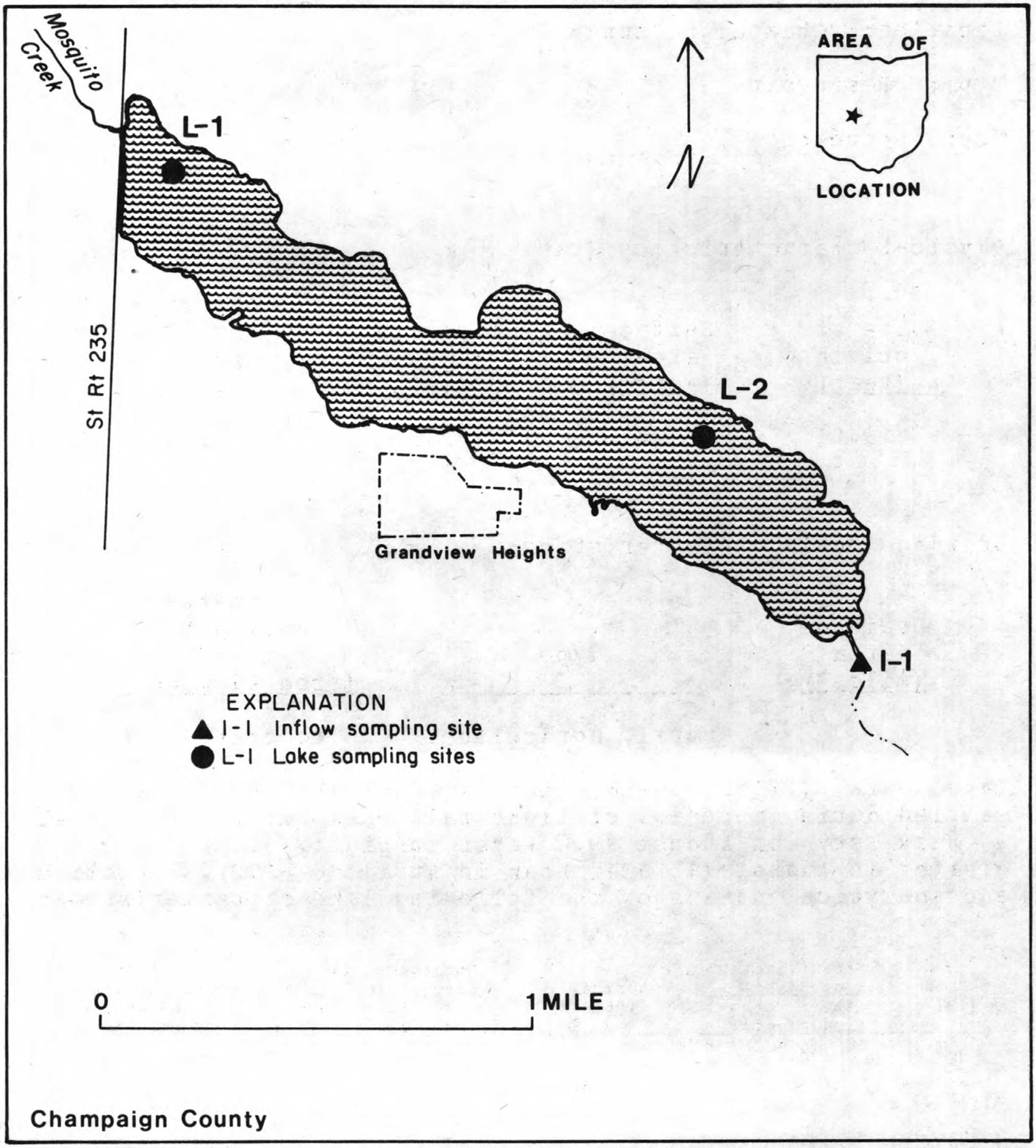

Figure 54.--Kiser Lake and inflow sampling sites.

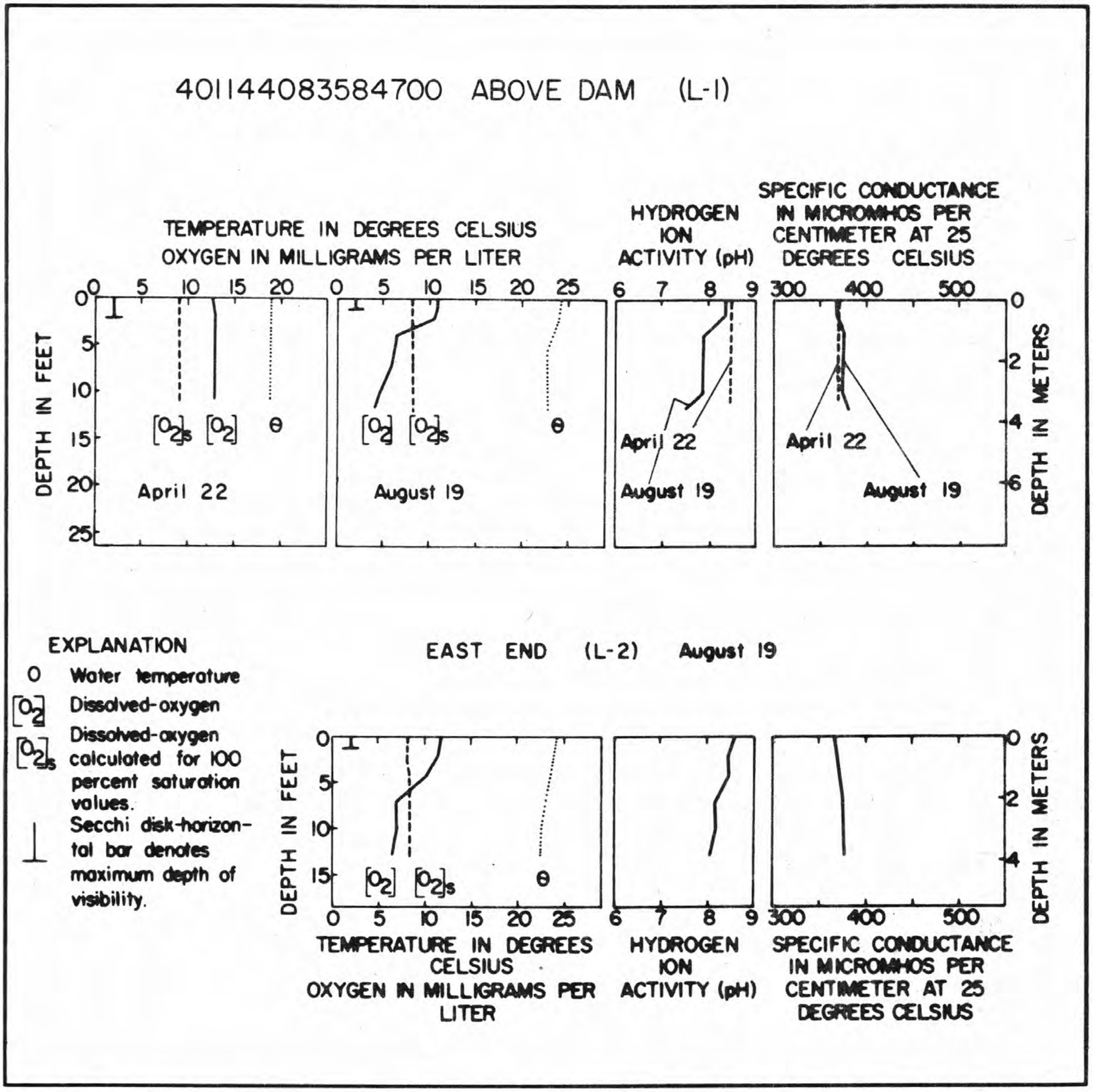

Figure 55.--Data profiles for Kiser Lake, Ohio, on selected days in 1977.

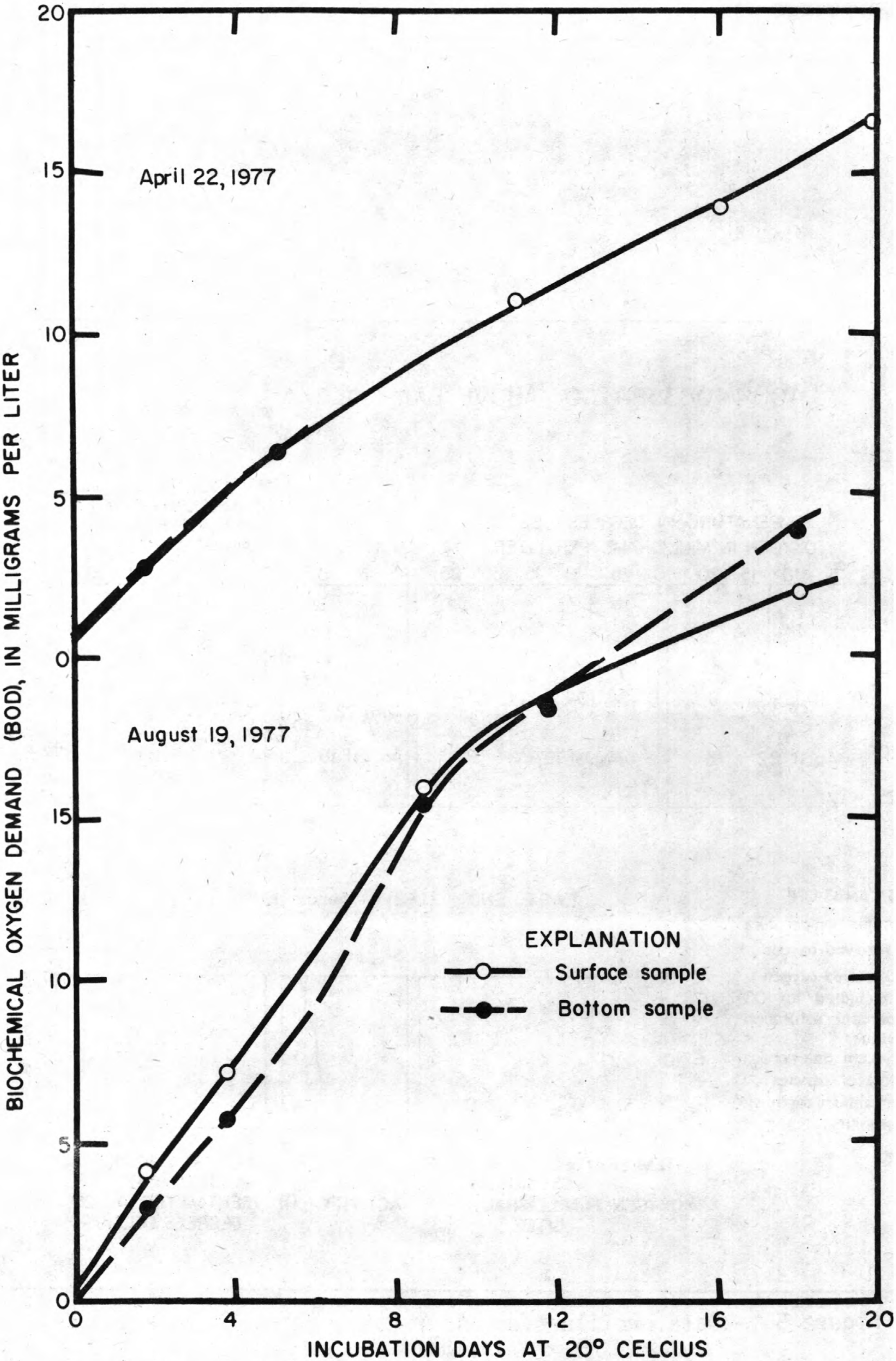

Figure 56.--BOD of water samples from Kiser Lake on selected days in 1977.

Table 108.--Profile data for the primary lake site, Kiser Lake, Ohio

401144083584700 - KISER LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMP-LING DEPTH (FT)	TEMPER-ATURE (DEG C)	DIS-SOLVED OXYGEN (MG/L)	PER-CENT SATUR-ATION	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH (UNITS)	CAR-BONATE (CO3) (MG/L)	BICAR-BONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDRO-GEN SULFIDE (MG/L)	TRANS-PAR-ENCY (SECCHI DISK) (FT)
APR												
22...	1430	.0	18.8	12.7	141	370	8.5	--	--	--	--	--
22...	1435	2.0	18.8	12.8	142	370	8.5	6	185	.9	.0	2.1
22...	1440	4.0	18.8	12.7	141	370	8.5	--	--	--	--	--
22...	1445	7.0	18.8	12.7	141	370	8.5	--	--	--	--	--
22...	1450	10	18.8	12.7	141	370	8.5	6	185	.9	.0	--
AUG												
19...	1305	.0	24.3	10.9	135	368	8.4	--	--	--	--	--
19...	1310	2.0	24.2	10.7	132	370	8.3	0	202	1.6	.0	1.2
19...	1315	4.0	23.5	6.4	78	375	7.9	--	--	--	--	--
19...	1320	7.0	23.0	6.0	72	375	7.9	--	--	--	--	--
19...	1325	10	23.0	4.7	57	375	7.9	0	202	4.0	.0	--
19...	1330	12	23.0	4.2	51	380	7.5	--	--	--	--	--

Table 109.--Chemical analyses of water column composite samples, Kiser Lake, Ohio

401144083584700 - KISER LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 22...	1445	38	25	1.9	5.3	29	8.1	.3	200	244	39	283

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 22...	100	1	<10	8	.0	0	0	0	<10	.06

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 22...	30	0	3	310	60	9	20

Table 110.--Chemical, physical, and biological analyses of water samples from selected depths, Kiser Lake, Ohio

401144083584700 - KISER LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
22...	1435	2.0	.02	.10	.12	.09	1.2	1.3	.01
22...	1450	10	.02	.09	.11	.07	1.2	1.3	.01
AUG									
19...	1310	2.0	.00	.00	.00	.03	2.4	2.4	.01
19...	1325	10	.00	.00	.00	.10	4.2	4.3	.01

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
22...	.07	.1	6	25	4.2	6.3	27	<2	2
22...	.07	.2	6	30	4.4	6.3	32	<2	<2
AUG									
19...	.12	7.0	15	60	7.9	8.8	45	<2	8
19...	.12	7.2	15	60	10	7.6	40	<2	8

Table 111.--Phytoplankton in Kiser Lake, Ohio

Sample description: Location	Date	Location in water column	Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Site L-1 above dam ---------	4-22-77	euphotic zone composite	660,000	0.8	85	Cyanophyta	90	Oscillatoria (90)
						Chlorophyta	7	Ankistrodesmus (4); Chlamydomonas (1); Scenedesmus (1); Tetrastrum (1); Chodatella; tetraedron
						Chrysophyta	3	Fragilaria (2); Nitzschia (1); Cyclotella; Achnanthes; Navicula
						Euglenophyta	< 1	Euglena; Trachelomonas
Site L-1 above dam ---------	4-22-77	2-ft depth	560,000	1.7	39	Cyanophyta	87	Oscillatoria (73); Anacystis (8); Lyngbya (4); Agmenellum (2)
						Chlorophyta	10	Ankistrodesmus (6); Dictyosphaerium (1); Scenedesmus (1); Coelastrum; Golenkinia; Micractinium; Kirchneriella; Gonium; Chlamydomonas; Tetraedron; Franceia; Carteria; Schroederia; Pediastrum, Polydriopsis, Tetrastrum; Spondylosium
						Chrysophyta	2	Synedra (1); Dinobryon (1); Melosira; Cyclotella; Nitzschia; Achnanthes
						Euglenophyta	1	Chroomonas (1); Euglena; Trachelomonas; Phacus
						Pyrrhophyta	< 1	Peridinium
Site L-1 above dam ---------	8-19-77	euphotic zone composite	3,400,000	1.8	145	Cyanophyta	97	Oscillatoria (60); Lyngbya (19); Agmenellum (9); Anacystis (8); Cylindrospermum (1); Anabaenopsis
						Chlorophyta	2	Scenedesmus (1); Pediastrum; Schroederia; Dictyosphaerium; Crucigenia; Tetrastrum; Cosmarium; Chodatella
						Chrysophyta	< 1	Nitzschia; Cyclotella; Melosira; Achnanthes
						Euglenophyta	< 1	Trachelomonas; Cryptomonas; Euglena; Phacus
Site L-1 above dam ---------	8-19-77	1-ft depth	4,200,000	0.9	149	Cyanophyta	98	Oscillatoria (84); Lyngbya (11); Cylindrospermum (1); Agmenellum (1); Anacystis; Anabaenopsis
						Chlorophyta	2	Tetrastrum (1); Dictyosphaerium (1); Scenedesmus; Crucigenia; Chlamydomonas; Tetraedron; Chodatella; Golenkinia; Chlorogonium
						Chrysophyta	< 1	Nitzschia; Melosira
						Euglenophyta	< 1	Trachelomonas

* Less than 1 percent not given.

The lake was well mixed at site L-1 during the spring visit. The thermal gradient shown for August 19 had reduced vertical mixing sufficiently to allow for changes, with depth, in dissolved oxygen, pH, and specific conductance. The BOD curves indicate that rapid oxygen depletion will occur in poorly illuminated waters that are not frequently mixed or aerated. Profile data are similar for site L-2 near the east end of the lake. Long-term summer stratification seems unlikely because the lake is shallow.

The concentrations of inorganic nitrogen and orthophosphorus were low on both sampling dates; data show a large net accumulation of silica and organic nitrogen from April to August. Causes for this increase might be benthic recycling, surface-and ground-water inputs, and (or) nitrogen fixation by blue-green algae.

The phytoplankton samples consisted mostly of the blue-green (Cyanophyta) genus Oscillatoria. The 4,200,000 cells per ML and the chlorophyll a concentration of 149 µg/L from the 1-ft depth in August were among the highest observed during the 1976-77 reconnaissance.

Inflow data (fig. 54, table 112): Mosquito Creek was sampled at site I-1, where it drains 2.4 mi² or 28 percent of the drainage basin for Kiser Lake. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1977)	Dis-charge (ft^3/s)	Water body (stream or lake*) having higher concentration			
			NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Mosquito Creek at site I-1	April 22	E 4	stream	lake	lake	stream
	August 19	E 1.5	stream	lake	lake	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Table 112.--Physical and chemical data for selected inflows, Kiser Lake, Ohio

401044083570000 - MOSQUITO C AB KISER LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR 22...	1150	E4.0	14.0	9.1	7.8	615	4	20	4.1	1.8	.30	.01
AUG 19...	1145	E1.5	13.5	9.5	7.8	625	5	15	5.9	2.3	.23	.01

E - estimated.

Knox Lake

Location: Knox County

Type: Reservoir

Use: Recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1954	474	3280	0.14

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
31.4	agricultural, rural	moderately low

Lake data (figs. 57-59; table 113-116): Knox Lake was sampled after a rain and in cloudy weather on May 3. The sampling on August 30 was done under partly cloudy skies. All secchi-disk transparency measurements were less than 3 ft. Profile and analytical data show the following lake characteristics:

Date (1977)	Stratification (gradient) ther-mal	Stratification (gradient) chem-ical	Chemical type	Substances at or above State limits pesti-cides	Substances at or above State limits toxi-cants	Substances at or above State limits bac-teria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
May 3	yes	yes	moderately hard Ca HCO_3	no	no	no	Chrysophyta
August 30	partial	yes	--	no	--	no	Cyanophyta

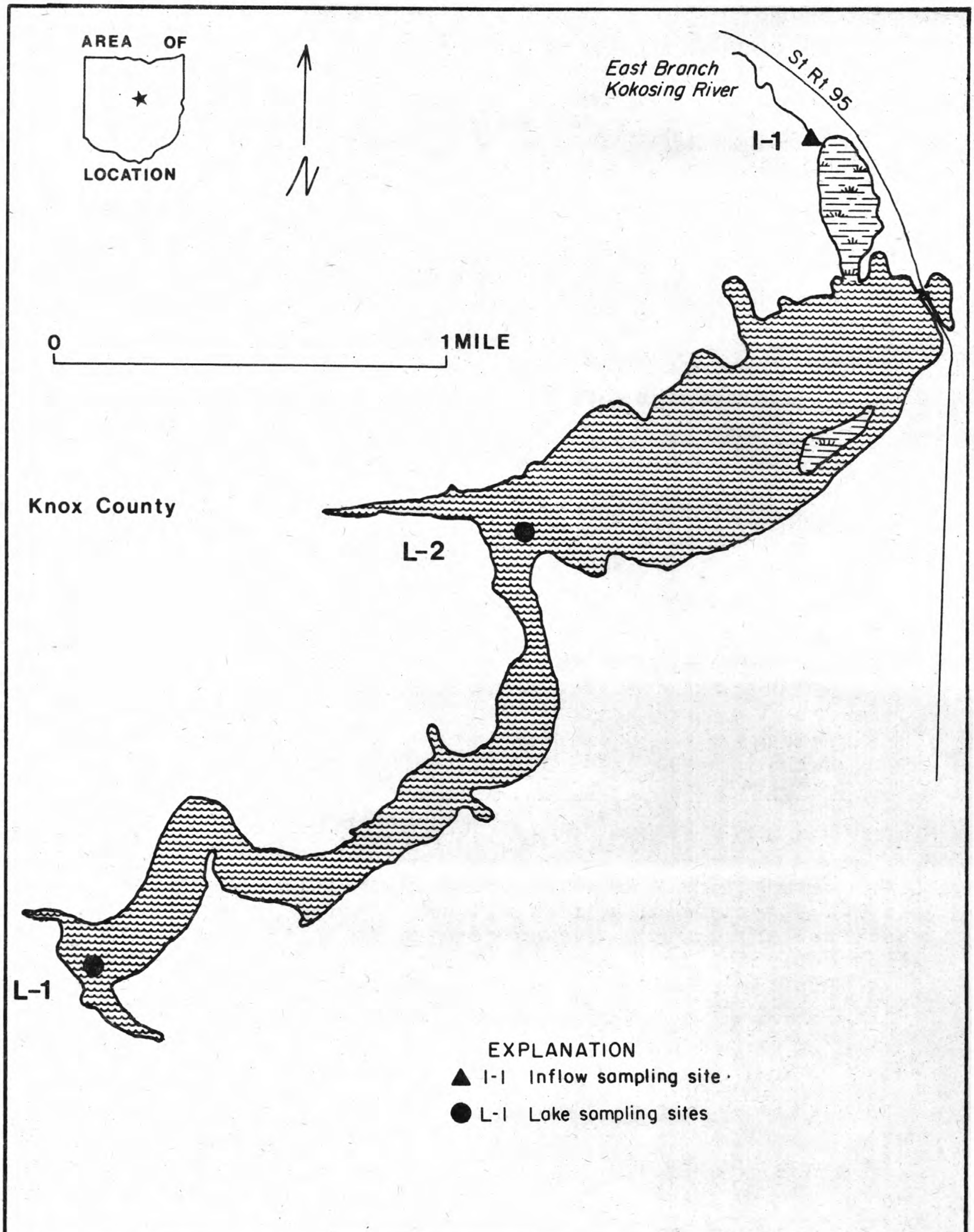

Figure 57.--Knox Lake and inflow sampling sites.

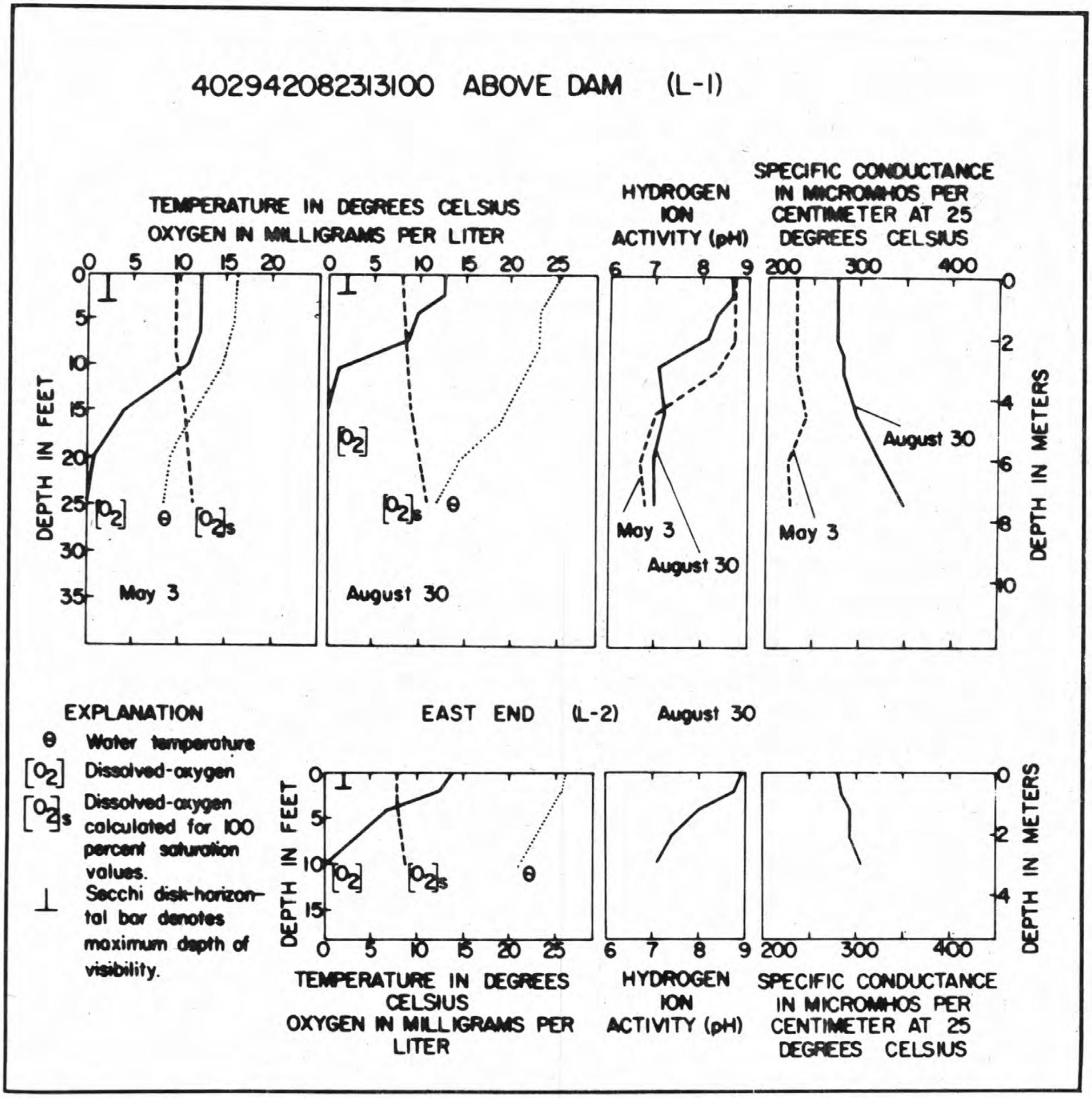

Figure 58.--Data profiles for Knox Lake, Ohio, on selected days in 1977.

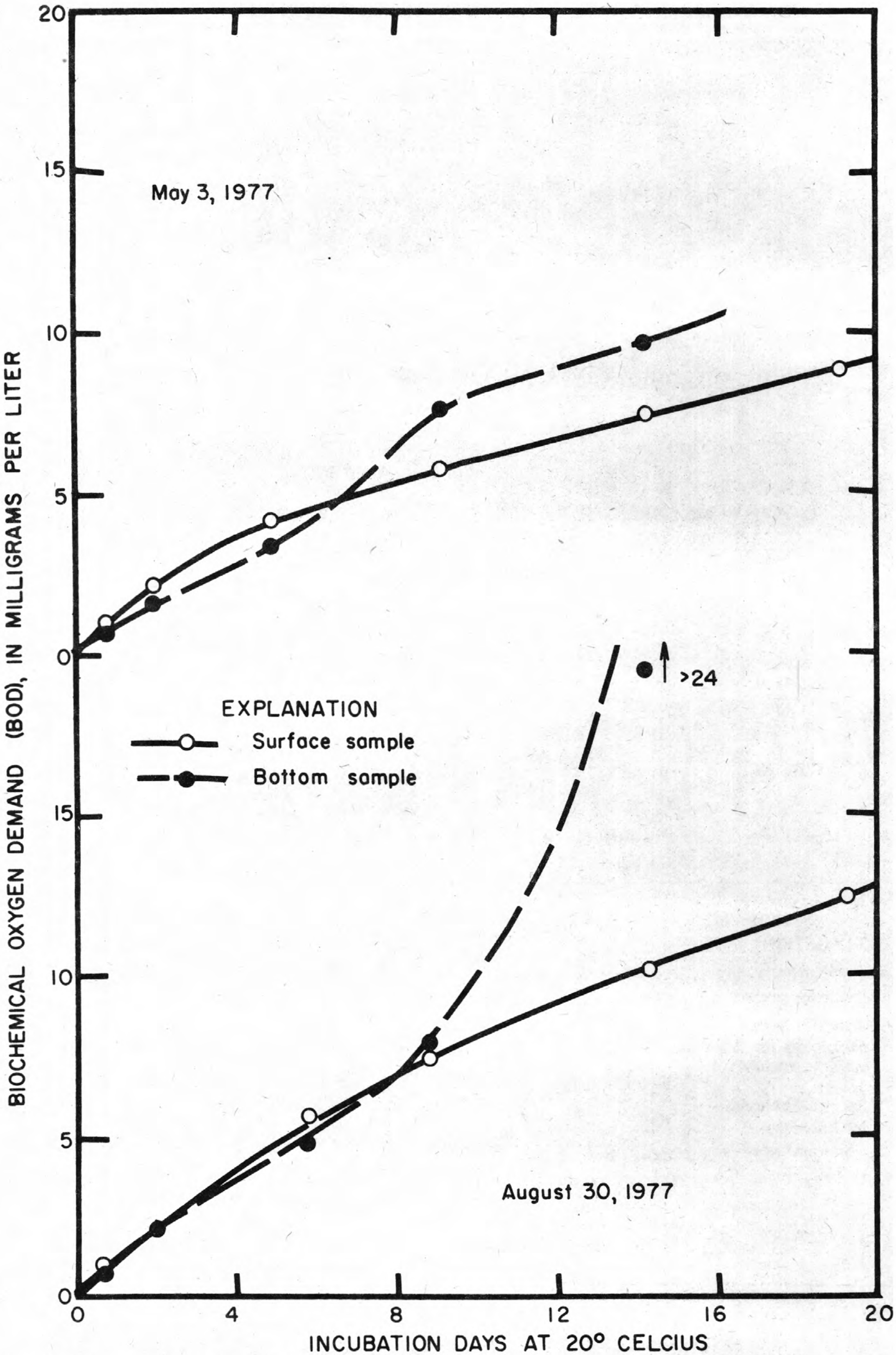

Figure 59.--BOD of water samples from Knox Lake on selected days in 1977.

Table 113.--Profile data for the primary lake site, Knox Lake, Ohio

402942082313100 - KNOX LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMP-LING DEPTH (FT)	TEMPER-ATURE (DEG C)	DIS-SOLVED OXYGEN (MG/L)	PER-CENT SATUR-ATION	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH (UNITS)	CAR-BONATE (CO3) (MG/L)	BICAR-BONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDRO-GEN SULFIDE (MG/L)	TRANS-PAR-ENCY (SECCHI DISK) (FT)
MAY												
03...	1320	.0	16.2	12.2	128	230	8.7	--	--	--	--	--
03...	1325	2.0	16.1	12.2	128	230	8.7	4	76	.2	.0	2.9
03...	1330	4.0	16.1	12.2	128	230	8.7	--	--	--	--	--
03...	1335	7.0	15.5	12.1	126	230	8.7	--	--	--	--	--
03...	1340	10	14.8	10.9	111	230	8.4	--	--	--	--	--
03...	1345	15	11.5	3.9	37	240	7.0	--	--	--	--	--
03...	1350	20	9.0	.6	5	222	6.7	--	--	--	--	--
03...	1355	25	8.3	.0	0	225	6.8	0	83	21	.0	--
AUG												
30...	1700	.0	25.3	12.5	158	275	8.7	--	--	--	--	--
30...	1705	2.0	24.5	12.5	155	275	8.7	8	114	.4	.0	?.0
30...	1710	4.0	23.3	9.8	119	275	8.4	--	--	--	--	--
30...	1715	7.0	23.0	8.7	105	275	8.2	--	--	--	--	--
30...	1720	10	21.8	1.0	12	280	7.1	--	--	--	--	--
30...	1725	15	19.6	.0	0	295	7.2	--	--	--	--	--
30...	1730	20	14.4	.0	0	320	7.0	--	--	--	--	--
30...	1735	25	12.0	.0	0	350	7.0	0	211	34	2.7	--

Table 114.--Chemical analyses of water column composite samples, Knox Lake, Ohio

402942082313100 - KNOX LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
MAY												
03...	1340	28	6.9	3.3	4.2	22	8.7	.1	98	156	18	174

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
MAY										
03...	0	0	<10	4	.0	3	0	0	<10	.06

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
MAY							
03...	0	0	2	750	520	0	10

Table 115.--Chemical, physical, and biological analyses of water samples from selected depths, Knox Lake, Ohio

402942082313100 - KNOX LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
MAY									
03...	1325	2.0	.03	1.3	1.3	.08	.73	.81	.00
03...	1355	25	.05	1.2	1.2	.87	.83	1.7	.00
AUG									
30...	1705	2.0	.00	.00	.00	.01	.85	.86	.00
30...	1735	25	.00	.00	.00	5.3	5.7	11	.30

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
MAY									
03...	.03	1.0	5	25	6.3	4.0	10	3	<3
03...	.07	6.4	20	60	8.2	3.2	12	9	3
AUG									
30...	.08	1.1	5	35	6.0	4.8	30	<3	<2
30...	.85	10	75	200	8.1	4.2	60	56	8

Table 116.--Phytoplankton in Knox Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)*of total cell count
Location	Date	Location in water column						
Site L-1 above dam ---------	5-3-77	euphotic zone composite	46,000	2.7	30	Chrysophyta	54	Melosira (4); Fragilaria (4); Nitzschia (3); Cyclotella (3)
						Cyanophyta	21	Oscillatoria (17); Agmenellum (3); Anacystis (1)
						Chlorophyta	17	Scenedesmus (12); Tetrastrum (3); Ankistrodesmus (2); Chodatella; Kirchneriella; Chlorogonium; Treubaria
						Euglenophyta	7	Chroomonas (6); Crytomonas (1); Trachelomonas
Site L-1 above dam ---------	5-3-77	4-ft depth	49,000	3.1	23	Cyanophyta	37	Oscillatoria (31); Anacystis (6)
						Chrysophyta	33	Melosira (20); Fragilaria (6); Cyclotella (5); Nitzschia (2); Epithemia
						Chlorophyta	23	Scenedesmus (12); Micractinium (3); Chlamydomonas (2); Kirchneriella (2); Ankistrodesmus (2); Chodatella (1); Tetrastrum (1); Treubaria
						Euglenophyta	6	Chroomonas (6); Cryptomonas; Trachelomonas
Site L-1 above dam ---------	8-30-77	euphotic zone composite	320,000	2.8	46	Cyanophyta	90	Oscillatoria (31); Lyngbya (23); Anacystis (14); Agmenellum (13); Raphidiopsis (9)
						Chlorophyta	5	Scenedesmus (2); Actinastrum (1); Ankistrodesmus (1); Kirchneriella; Tetrastrum; Chlorogonium; Schroederia; Tetraedron; Cosmarium; Crucigenia; Selenastrum; Dictyosphaerium; Coelastrum
						Chrysophyta	5	Melosira (4); Cyclotella (1); Nitzschia; Synedra
						Euglenophyta	< 1	Phacus; Trachelomonas; Euglena
						Pyrrhophyta	< 1	Glenodinium
Site L-1 above dam ---------	8-30-77	2-ft depth	450,000	2.6	35	Cyanophyta	91	Oscillatoria (45); Raphidiopsis (13); Agmenellum (13); Anacystis (11); Lyngbya (8)
						Chlorophyta	6	Scenedesmus (2); Kirchneriella (1); Crucigenia; Cosmarium; Tetraedron; Micractinium; Schroederia; Coelastrum; Ankistrodesmus; Selenastrum; Chodatella; Chlorogonium; Actinastrum; Treubaria; Dictyosphaerium; Pediastrum; Franceia; Sphaerocystis
						Chrysophyta	3	Melosira (2); Cyclotella (1); Nitzschia; Synedra
						Euglenophyta	< 1	Trachelomonas; Euglena; Cryptomonas

* Less than 1 percent not given.

Knox Lake was thermally stratified at site L-1 on May 3. High dissolved oxygen and pH (from photosyntheses) within the top 10 ft and low dissolved oxygen and pH below 15 ft are shown. The low surface-to-bottom silica ratio was likely caused by silica uptake by diatoms near the lake surface.

The irregular thermal gradient, shown in the August profiles had reduced vertical mixing. Photosynthetic rates were high (high dissolved oxygen and pH) near the surface. Dissolved oxygen concentrations were zero below 15 ft at site L-1 and near the lake bottom at site L-2. A hydrogen sulfide odor also was detected at these depths. Further chemical differentiation between top and bottom water strata is indicated by HCO_3, nutrients, specific conductance, BOD curves, etc.

Nutrient data reveal a high concentration of nitrate in the water column in May and subsequent high amounts of organic nitrogen and recycled ammonia, phosphorus, and silica at the lake bottom in August. The phytoplankton community at site L-1 was a diverse assemblage of major algal types on May 3. Blue-green algae dominated the August 30 collections.

Inflow data (fig. 57, table 117): The East Branch Kokosing River, the principal inflow to Knox Lake, was sampled at site L-1. The drainage area at the site is 17.1 mi² or 54 percent of the lake drainage basin. A qualitative comparison of stream versus lake data is shown below:

Stream	Date (1977)	Dis-charge (ft³/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
East Branch Kokosing River at site I-1	May 3	E 15	lake	lake	stream	stream
	August 30	E 3	stream	lake	stream	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Table 117.--Physical and chemical data for selected inflows, Knox Lake, Ohio

403132082292500 - E B KOKOSING R AB KNOX LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
MAY												
03...	1115	E15	13.0	9.7	7.4	415	4	15	7.8	.92	.35	.02
AUG												
30...	1545	E3.0	20.0	8.8	7.7	410	6	10	7.6	1.0	.26	.05

E - estimated.

Long Lake

Location: Summit County

Type: Lake-reservoir; natural pond dammed to increase capacity

Use: Water supply and recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1830's	166	--	--

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
--	rural	moderately low

Lake data (figs. 60-62; tables 118-121): Long Lake was sampled under hazy skies on April 19 and August 9. The August sampling followed intermittent rains the day before. Water turbidity at site L-1 was similar on both occasions. Profile and analytical data show the following lake characteristics:

Date (1977)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
April 19	yes	yes	very hard Ca HCO_3	no	no	no	Cyanophyta
August 9	yes	yes	--	no	--	no	Cyanophyta

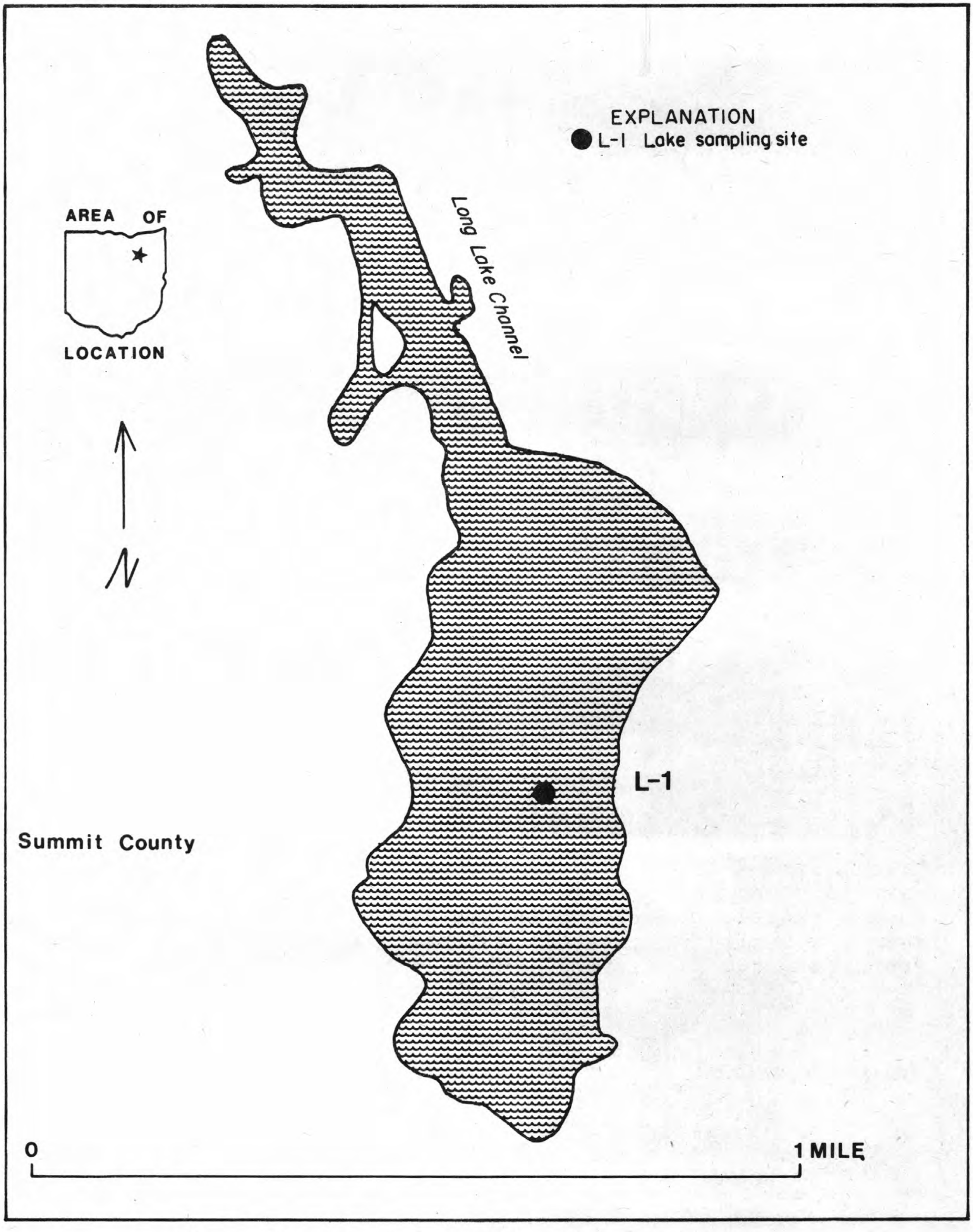

Figure 60.--Long Lake sampling site.

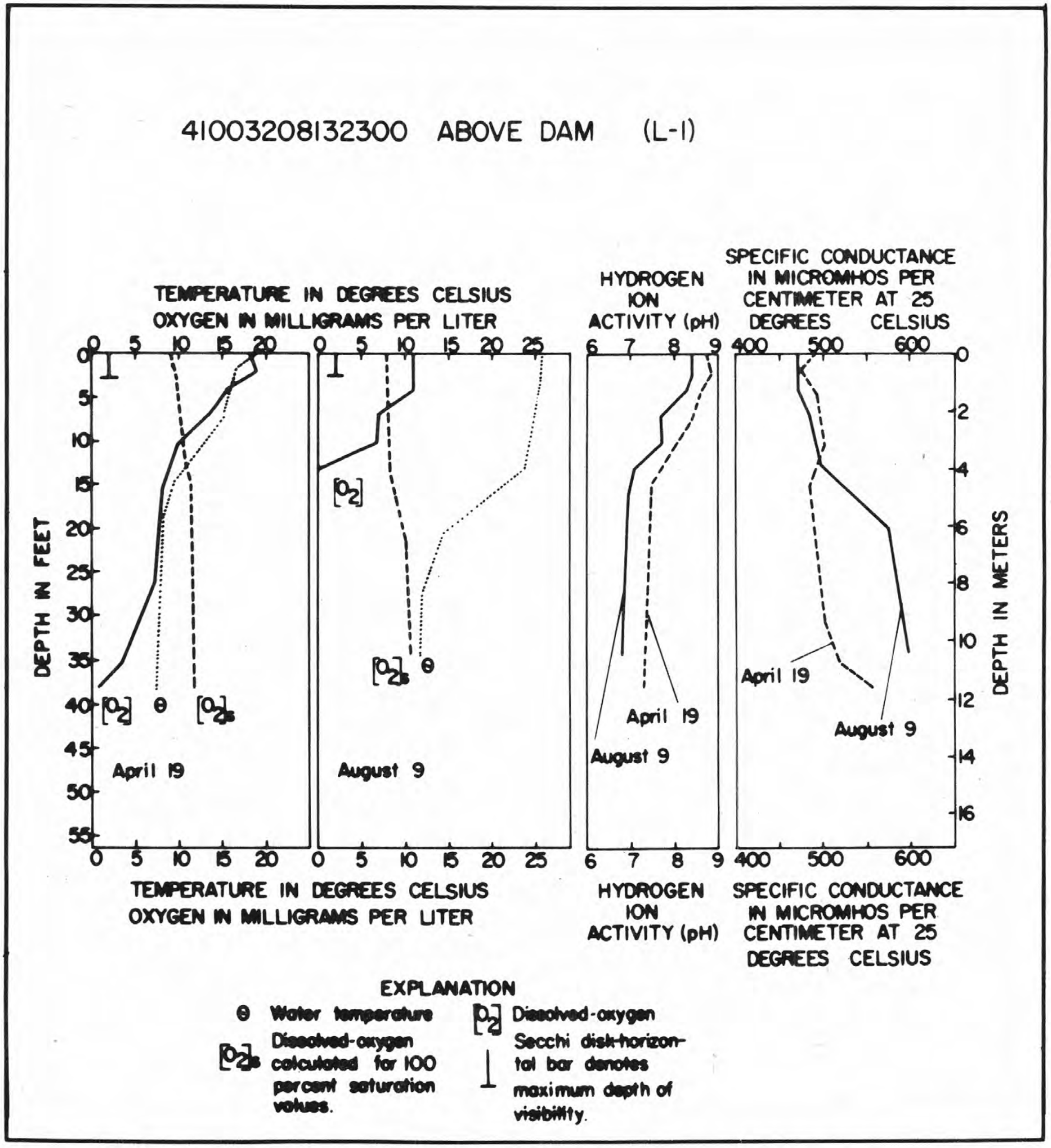

Figure 61.--Data profiles for Long Lake, Ohio, on selected days in 1977.

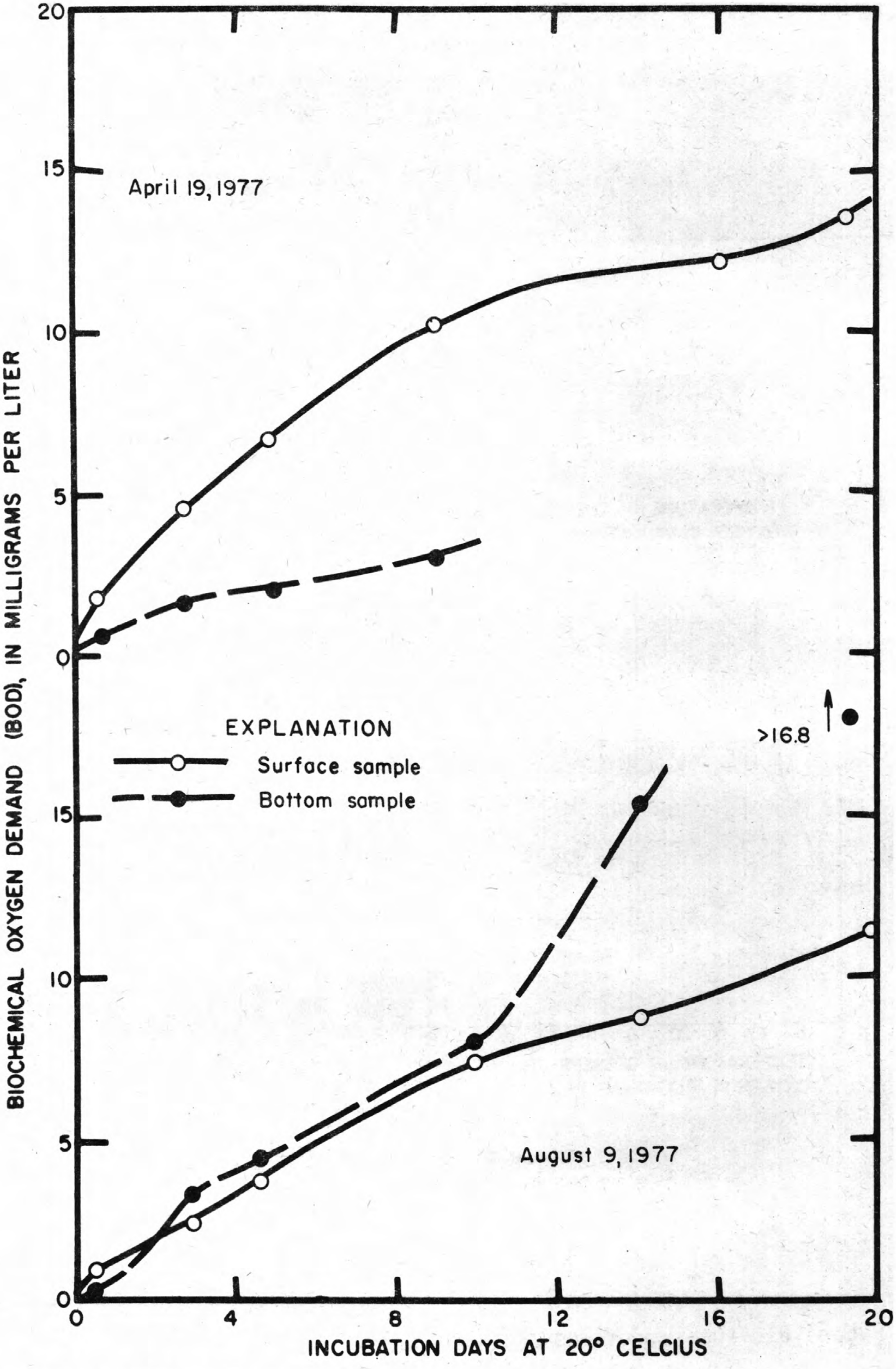

Figure 62.--BOD of water samples from Long Lake on selected days in 1977.

Table 118.--Profile data for the primary lake site, Long Lake, Ohio

410032081323000 - LONG LK AT MIDPOINT AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
19...	1200	.0	18.5	18.0	198	490	8.7	--	--	--	--	--
19...	1205	2.0	16.3	18.6	195	475	8.8	12	116	.3	.0	2.8
19...	1210	4.0	15.8	15.4	160	490	8.6	--	--	--	--	--
19...	1215	7.0	15.0	13.2	135	495	8.4	--	--	--	--	--
19...	1220	10	13.3	9.9	98	500	8.0	--	--	--	--	--
19...	1225	15	8.8	7.9	70	483	7.5	--	--	--	--	--
19...	1230	20	8.0	7.6	66	490	7.5	--	--	--	--	--
19...	1235	25	7.8	7.3	63	495	7.4	--	--	--	--	--
19...	1240	30	7.6	5.7	49	500	7.4	--	--	--	--	--
19...	1245	35	7.5	3.4	29	515	7.3	0	153	12	.0	--
19...	1250	38	7.3	.8	7	555	7.3	--	--	--	--	--
AUG												
09...	1400	.0	25.7	10.9	138	470	8.4	--	--	--	--	--
09...	1405	2.0	25.5	10.9	137	470	8.4	1	146	.9	.0	2.4
09...	1410	4.0	25.0	10.9	136	470	8.3	--	--	--	--	--
09...	1415	7.0	24.5	6.9	85	485	7.7	--	--	--	--	--
09...	1420	10	24.1	6.7	82	490	7.7	--	--	--	--	--
09...	1422	12	23.9	2.9	35	495	7.3	--	--	--	--	--
09...	1423	13	23.5	.0	0	500	7.1	--	--	--	--	--
09...	1425	15	22.0	.0	0	520	7.0	--	--	--	--	--
09...	1430	20	14.8	.0	0	575	6.9	--	--	--	--	--
09...	1435	25	12.5	.0	0	585	6.9	--	--	--	--	--
09...	1440	30	11.8	.0	0	592	6.8	--	--	--	--	--
09...	1445	34	11.6	.0	0	595	6.8	0	252	63	3.9	--

Table 119.--Chemical analyses of water column composite samples, Long Lake, Ohio

410032081323000 - LONG LK AT MIDPOINT AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 19...	1230	54	13	2.7	24	58	44	.1	190	294	30	324
AUG 09...	1445	--	--	--	--	--	--	--	--	--	--	--

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 19...	100	0	<10	6	.0	2	0	0	<10	.08
AUG 09...	--	--	--	--	.0	--	--	--	--	--

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 19...	40	0	2	190	310	2	20
* AUG 09...	--	--	--	540	3300	--	0

* Taken from a water sample 1 to 3 ft from the lake bottom.

Table 120.--Chemical, physical, and biological analyses of water samples from selected depths, Long Lake, Ohio

410032081323000 - LONG LK AT MIDPOINT AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMP-LING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITRO-GEN (N) (MG/L)	TOTAL ORGANIC NITRO-GEN (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL ORTHO PHOS-PHORUS (P) (MG/L)
APR									
19...	1205	2.0	.00	.01	.01	.11	1.1	1.2	.00
19...	1245	35	.02	.41	.43	.70	.70	1.4	.01
AUG									
09...	1405	2.0	.00	.00	.00	.00	.83	.83	.01
09...	1445	34	.00	.00	.00	4.3	1.4	5.7	.67

DATE	TOTAL PHOS-PHORUS (P) (MG/L)	DIS-SOLVED SILICA (SIO2) (MG/L)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIO-CHEM-ICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEM-ICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLI-FORM (COL. PER 100 ML)	STREP-TOCOCCI (COL-ONIES PER 100 ML)
APR									
19...	.07	1.5	5	25	2.8	6.4	29	2	<2
19...	.05	5.6	3	25	3.6	1.9	33	<2	<2
AUG									
09...	.06	5.9	5	30	7.2	3.7	15	36	26
09...	.77	9.5	50	30	6.5	4.2	25	12	12

Table 121.--Phytoplankton in Long Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Location	Date	Location in water column						
Site L-1 at midpoint ----	4-19-78	euphotic zone composite	270,000	1.1	87	Cyanophyta	85	Oscillatoria (84); Anabaena (1)
						Chrysophyta	8	Fragilaria (4); Cyclotella (3); Melosira (1); Asterionella; Navicula; Nitzschia; Dinobryon
						Euglenophyta	5	Chroomonas (5); Cryptomonas; Euglena; Trachelomonas
						Chlorophyta	1	Ankistrodesmus (1); Golenkinia; Actinastrum; Scenedesmus; Tetrastrum
Site L-1 at midpoint ----	4-19-77	2-ft depth	280,000	1.1	77	Cyanophyta	83	Oscillatoria (83); Agmenellum
						Euglenophyta	7	Chroomonas (6); Euglena (1); Trachelomonas
						Chrysophyta	7	Fragilaria (3); Cyclotella (2); Melosira (1); Nitzschia (1)
						Chlorophyta	2	Ankistrodesmus (1); Scenedesmus (1); Micractinium; Dictyosphaerium; Actinastrum; Crucigenia; Chodatella
Site L-1 at midpoint ----	8-9-77	euphotic zone composite	860,000	1.8	46	Cyanophyta	98	Cylindrospermum (55); Oscillatoria (23); Anacystis (12); Raphidiopsis (6); Anabaenopsis (2); Anabaena
						Chlorophyta	2	Dictyosphaerium (2); Chlamydomonas; Crucigenia; Scenedesmus; Carteria
						Euglenophyta	< 1	Trachelomonas
Site L-1 at midepoint ----	8-9-77	4-ft depth	470,000	2.0	35	Cyanophyta	98	Oscillatoria (64); Lyngbya (9); Aphanizomenon (6); Cylindrospermum (6); Anacystis (5); Anabaena (4); Anabaenopsis (3); Agmenellum (1)
						Chlorophyta	1	Pandorina (1); Dictyosphaerium; Carteria; Ankistrodesmus; Chodatella
						Chrysophyta	1	Cyclotella (1); Nitzschia
						Euglenophyta	< 1	Trachelomonas; Euglena

* Less tahn 1 percent not given.

The lake was thermally stratified on both sampling dates. The high concentrations of dissolved oxygen (greater than 18 mg/L) and high pH (8.8) in the near-surface water on April 19 resulted from high photosynthetic rates. The higher BOD at the lake surface in April, when compared with the bottom BOD, probably reflects the respiration of the algae population.

The effects of summer stratification are shown in the August data. The lake was anaerobic below 13 ft, developed a hydrogen sulfide odor below 15 ft, and showed a chemical change (pH, specific conductance and bicarbonate) with depth. The rapid decline in dissolved oxygen within the epilmnion and the high BOD rate indicate a high oxygen demand within the lake water.

The concentrations of inorganic nutrients in April at the 2-ft depth were low when compared with bottom data. This difference likely was caused by a rapid biological uptake within the euphotic zone. Biological recycling or chemical reduction is indicated by the high concentrations of ammonia, phosphorus, silica, and carbon dioxide near the lake bottom. Blue-green (Cyanophyta) genera, particularly *Oscillatoria*, accounted for most of the phytoplankton counts on April 19 and August 9. Zooplankters were noted in the surface and bottom water collections, and growths of *Ceratophyllum demersum*, *Myricphyllum* sp., *Lemna trisulca*, *Lemna minor*, and *Wolffia columbiana* were observed in the lake. *Nelumbo lutea* was common in the lake channels.

Inflow data: No inflow data were taken.

Michael J. Kirwan Reservoir (West Branch Reservoir)

Location: Portage County

Type: Reservoir; dam has multi-level release controls

Use: Flood control, water supply, and recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1966	2650	52,900	0.68

Drainage basin characteristics:

Drainage area (miles²)	Type	Estimated sediment yield (from fig. 4)
80.5	agricultural, rural	moderately low

Lake data (figs. 63-65; tables 122-125): Lake data were collected in warm hazy weather on April 18 and under cloudy skies on August 29. Profile and analytical data at site L-1 show the following lake characteristics:

Date (1977)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
April 18	slight	slight	hard Ca Mg HCO_3 SO_4	no	no	no	Cyanophyta
August 29	yes	yes	--	no	--	no	Cyanophyta, Chlorophyta

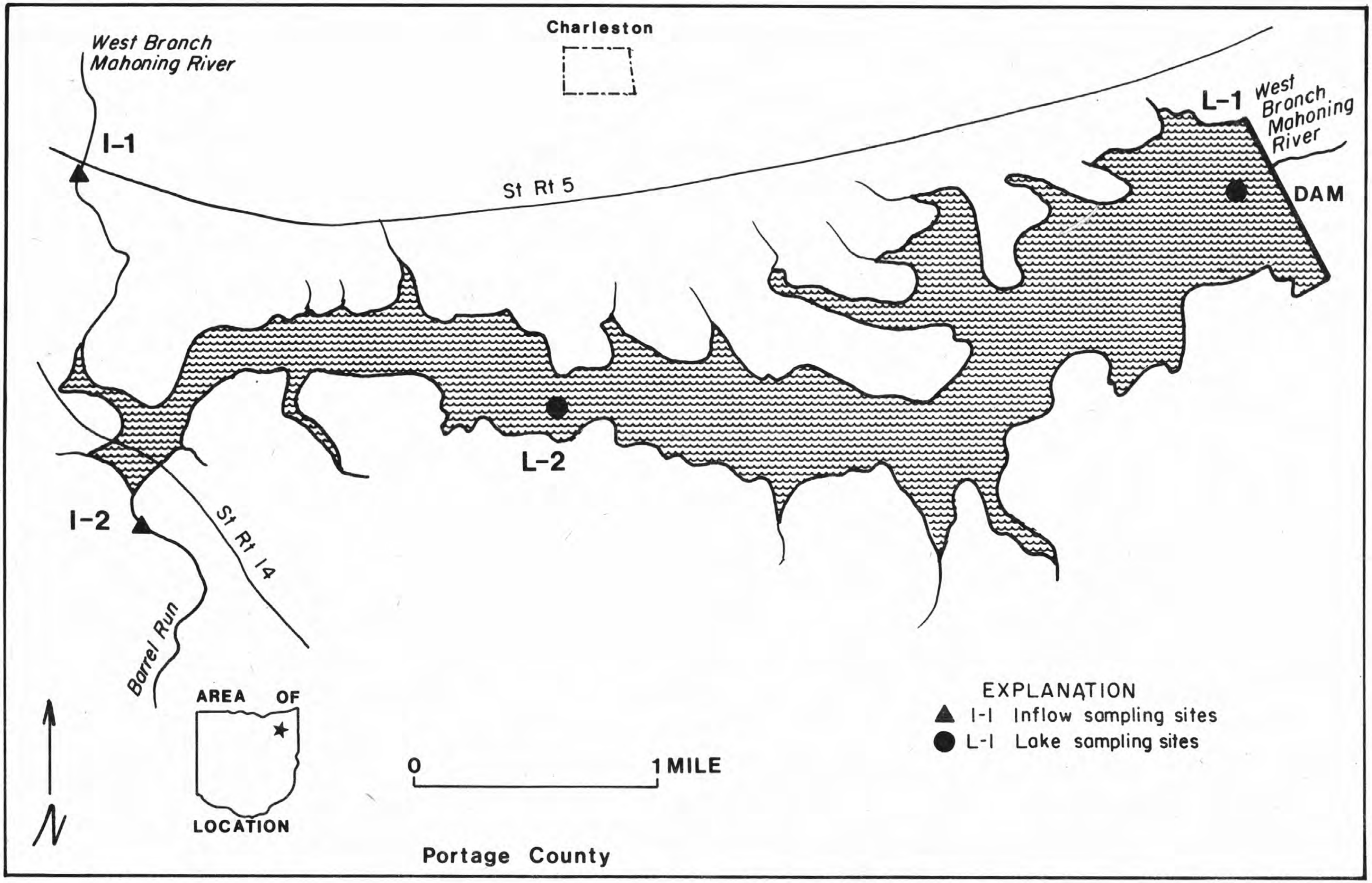

Figure 63.--Michael J. Kirwan Reservoir and inflow sampling sites.

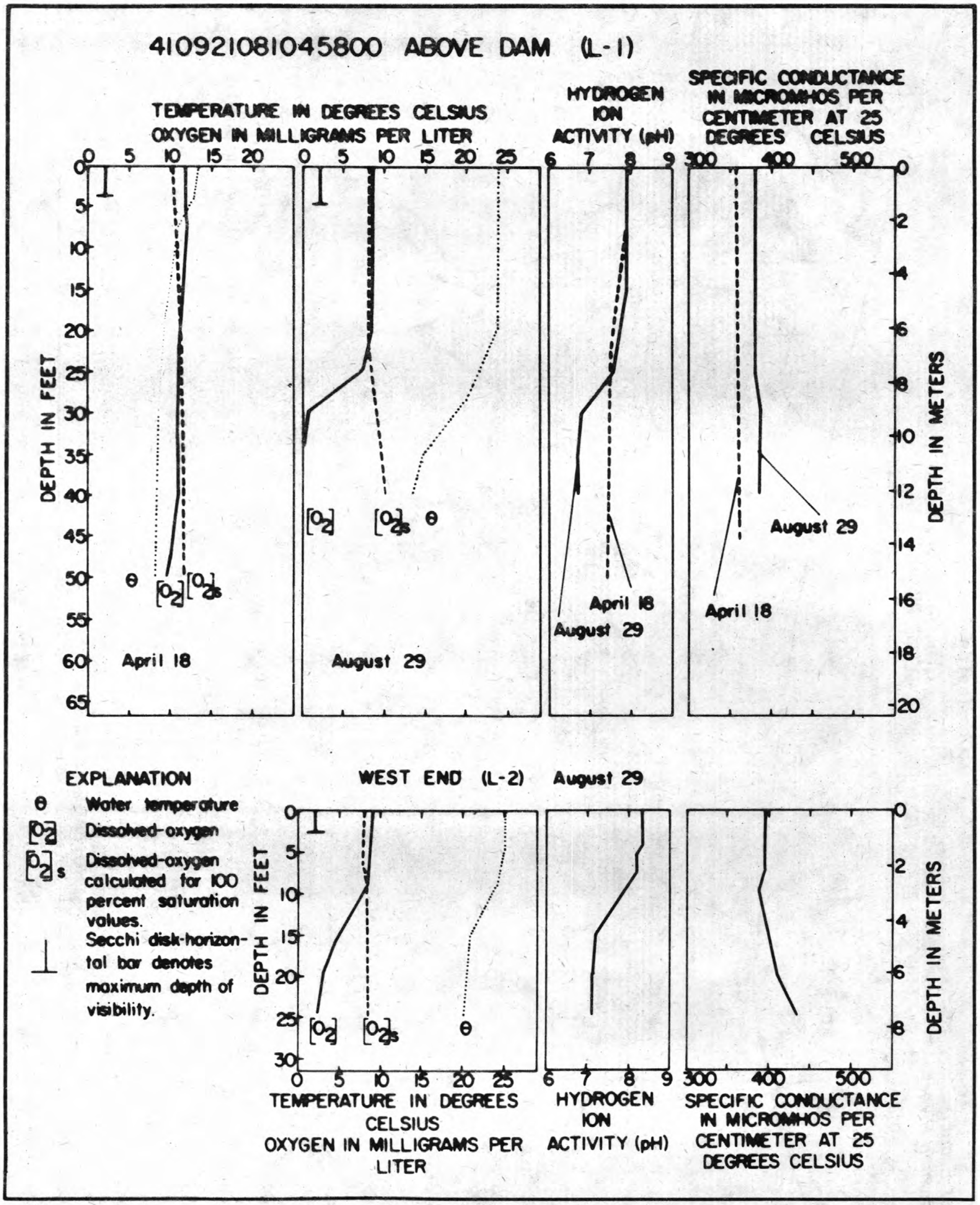

Figure 64.--Data profiles for Michael J. Kirwan Reservoir, Ohio on selected days in 1977.

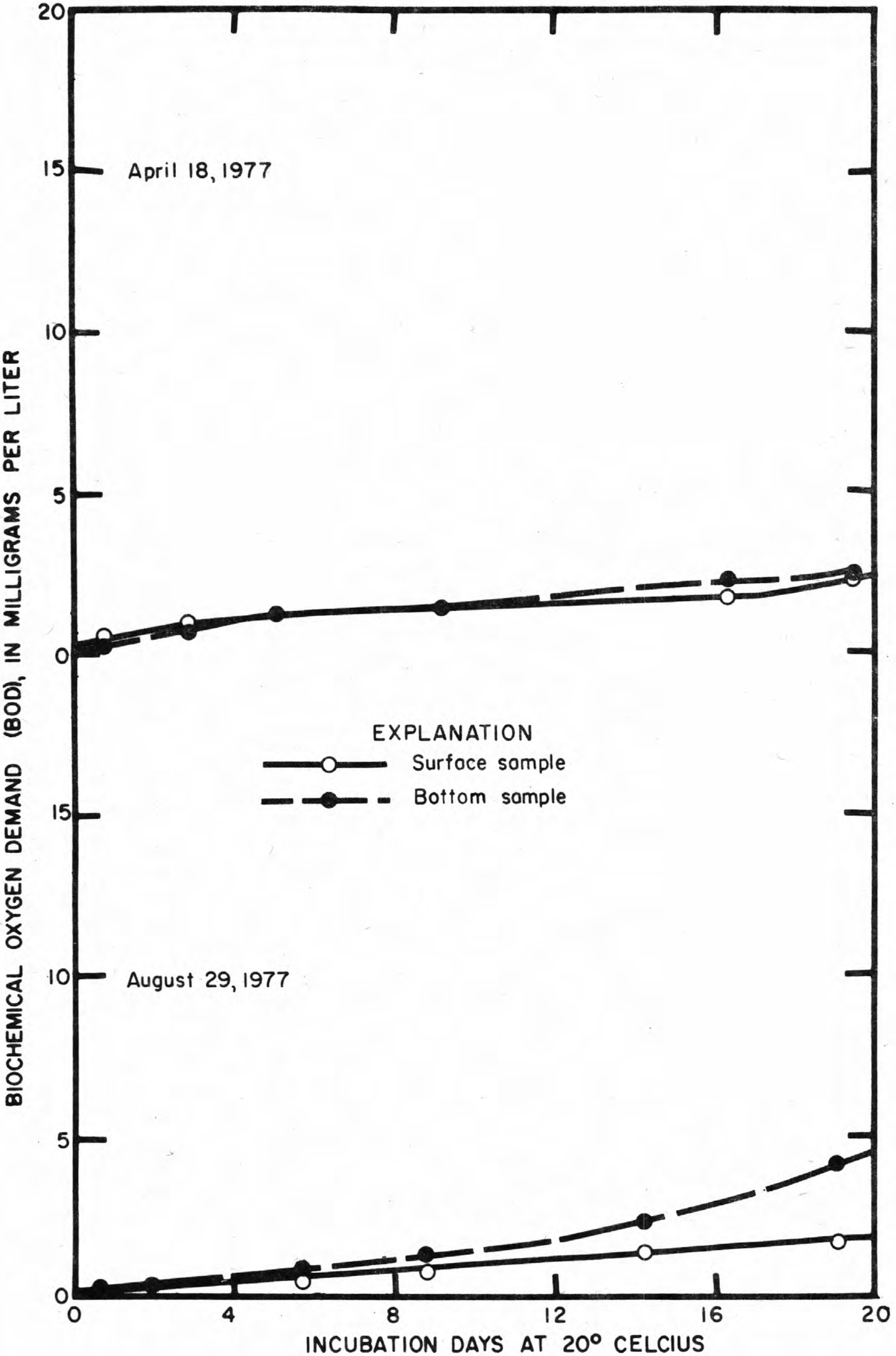

Figure 65.--BOD of water samples from Michael J. Kirwan Reservoir on selected days in 1977.

Table 122.--Profile data for the primary lake site, Michael J. Kirwan Reservoir, Ohio

410921081045800 - MICHAEL J KIRWAN RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
18...	1530	.0	13.2	11.8	116	358	7.9	--	--	--	--	--
18...	1535	2.0	13.0	11.7	115	358	7.9	0	78	1.6	.0	3.5
18...	1540	4.0	12.5	11.7	113	358	7.9	--	--	--	--	--
18...	1545	7.0	11.0	11.9	111	358	7.9	--	--	--	--	--
18...	1550	10	10.5	11.8	109	358	7.8	--	--	--	--	--
18...	1555	15	10.0	11.3	103	358	7.7	--	--	--	--	--
18...	1600	20	9.2	11.0	99	358	7.6	--	--	--	--	--
18...	1605	25	9.0	11.0	98	358	7.5	--	--	--	--	--
18...	1610	30	8.5	10.8	95	360	7.5	--	--	--	--	--
18...	1615	40	8.3	10.8	95	360	7.5	--	--	--	--	--
18...	1620	50	8.0	9.6	84	365	7.4	0	82	5.2	.0	--
AUG												
29...	1415	.0	24.0	8.6	105	380	7.9	--	--	--	--	--
29...	1420	2.0	24.0	8.6	105	380	7.9	0	90	1.8	.0	4.5
29...	1425	4.0	24.0	8.6	105	380	7.9	--	--	--	--	--
29...	1430	7.0	24.0	8.6	105	380	7.9	--	--	--	--	--
29...	1435	10	24.0	8.6	105	380	7.9	--	--	--	--	--
29...	1440	15	23.9	8.5	104	380	7.9	--	--	--	--	--
29...	1445	20	23.8	8.5	104	380	7.8	--	--	--	--	--
29...	1450	25	21.8	7.3	86	380	7.6	--	--	--	--	--
29...	1455	30	19.0	.8	9	385	6.8	--	--	--	--	--
29...	1457	35	15.0	.0	0	385	6.7	--	--	--	--	--
29...	1500	40	13.4	.0	0	385	6.7	0	106	34	.3	--

Table 123.--Chemical analyses of water column composite samples, Michael J. Kirwan Reservoir, Ohio

410921081045800 - MICHAEL J KIRWAN RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 18...	1600	34	11	3.0	19	53	32	.1	130	232	6	238

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 18...	0	0	<10	2	.0	3	0	0	<10	.07

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 18...	50	0	6	430	20	0	20

Table 124.--Chemical, physical, and biological analyses of water samples from selected depths, Michael J. Kirwan Reservoir, Ohio

410921081045800 - MICHAEL J KIRWAN RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
18...	1535	2.0	.01	.63	.64	.07	.42	.49	.00
18...	1620	50	.01	.62	.63	.11	.47	.58	.00
AUG									
29...	1420	2.0	.01	.30	.31	.01	.24	.25	.00
29...	1500	40	.00	.00	.00	.24	.40	.64	.00

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
18...	.01	3.5	7	15	3.8	1.0	15	<2	<2
18...	.01	3.6	9	15	3.0	1.0	23	<2	4
AUG									
29...	.01	1.8	4	5	4.9	.3	15	2	<2
29...	.04	--	10	20	6.0	.3	30	2	2

Table 125.--Phytoplankton in Michael J. Kirwan Reservoir, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)*of total cell count
Location	Date	Location in water column						
Site L-1 above dam ---------	4-18-77	euphotic zone composite	3200	2.0	5.6	Cyanophyta	56	Oscillatoria (56)
						Chrysophyta	36	Ochromonas (25); Cyclotella (3); Melosira (3); Asterionella (2); Surirella (1); Nitzschia; Cymbella; Dinobryon
						Euglenophyta	5	Cryptomonas (4); Trachelomonas (1)
						Chlorophyta	2	Ankistrodesmus (2)
						Pyrrhophyta	1	Gymnodinium (1)
Site L-1 above dam ---------	4-18-77	4-ft depth	4600	0.5	4.6	Cyanophyta	93	Oscillatoria (93)
						Chrysophyta	5	Asterionella (3); Nitzschia (1); Melosira (1); Tabellaria; Cyclotella; Dinobryon
						Euglenophyta	1	Cryptomonas; Euglena; Trachelomonas
						Chlorophyta	1	Oocystis; Chlamydomonas; Ankistrodesmus
Site L-1 above dam ----------	8-29-77	euphotic zone composite	1800	2.4	4.3	Cyanophyta	46	Anacystis (40); Anabaena (6)
						Chlorophyta	30	Oocystis (20); Crucigenia (8); Gloeocystis (1); Chodatella (1)
						Chrysophyta	23	Cyclotella (20); Melosira (1); Navicula (1); Nitzschia (1)
						Euglenophyta	1	Trachelomonas (1)
Site L-1 above dam ----------	8-29-77	4-ft depth	1600	2.2	6.4	Cyanophyta	58	Oscillatoria (36); Anacystis (12); Anabaena (10)
						Chlorophyta	23	Selenastrum (22); Crucigenia (1)
						Chrysophyta	19	Cyclotella (19)

* Less than 1 percent not given.

The lake was generally well mixed on April 18; only slight differences existed between top and bottom conditions. Dissolved oxygen was at or near saturation throughout the water column. By August 29, vertical mixing at site L-1 was limited to the top 20 ft. Below 20 ft, temperature, dissolved oxygen, and pH decreased with depth. The lake was anaerobic below 35 ft, and a hydrogen sulfide concentration (0.3 mg/L) was detected near the lake bottom. The data at site L-2 show increased water turbidity and a more restricted vertical mixing compared with the data at site L-1. The biochemical oxygen demand rate (BOD curves) was the lowest of the lakes sampled in 1977.

Nitrogen and phosphorus concentrations were low compared with those of most of the lakes surveyed during the reconnaissance (1976-77). Despite the anaerobic conditions in August, high concentrations of organic nitrogen, recycled nitrogen (ammonia), and phorphorus did not accumulate near the lake bottom. The failure of these substances to accumulate may have been caused by the release of water from selected depths at the dam. The phytoplankton cell counts on April 18 were higher than those on August 29. All counts were low (less than 5000 cells per ml) when compared with those of lakes sampled.

Inflow data (fig. 63, table 126): West Branch Mahoning River and Barrel Run were sampled at sites I-1 and I-2, respectively. The West Branch Mahoning River drains 31.2 mi² or 39 percent of the lake basin, and Barrel Run represents drainage from 12.6 mi² or 16 percent of the lake basin. A qualitative comparison of stream versus lake data is shown below:

Stream	Date (1977)	Discharge (ft^3/s)	Water body (stream or lake*) having higher concentration			
			NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
West Branch Mahoning River at site I-1	April 18	E 7	lake	stream	stream	stream
	August 29	E 4	lake	stream	stream	stream
Barrel Run at site I-2	April 18	E 3	lake	stream	stream	stream
	August 29	E 4	lake	lake	stream	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Mayflies (Ephemeroptera) and caddisflies (Trichoptera) were observed at both sites.

Table 126.--Physical and chemical data for selected inflows, Michael J. Kirwan Reservoir, Ohio

410915081115400 - W B MAHONING R AB M J KIRWAN RE AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR												
18...	1425	E7.0	15.5	13.8	8.5	395	3	15	7.0	.14	.32	.02
AUG												
29...	1710	E4.0	23.0	9.3	8.1	420	4	20	6.5	.11	.45	.05

410744081112900 - BARREL RN AB M J KIRWAN RE AT SITE (I-2)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR												
18...	1350	E3.0	18.0	9.8	7.8	515	5	15	6.8	.05	.40	.32
AUG												
29...	1740	E4.0	22.0	8.9	8.0	700	5	10	6.2	.00	.20	.00

E - estimated.

Nimisila Reservoir

Location: Summit County

Type: Reservoir

Use: Water supply and recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1939	811	9400	0.82

Drainage basin characteristics:

Drainage area (miles^2)	Type	Estimated sediment yield (from fig. 4)
17.4	rural	moderately low

Lake data (figs. 66-68; tables 127-130): Nimisila Reservoir was sampled during periods of intermittant rains on May 2 and August 8. Profile and analytical data at site L-1 show the following lake characteristics:

Date (1977)	Stratification (gradient) thermal	Stratification (gradient) chemical	Chemical type	Substances at or above State limits pesticides	toxicants	bacteria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
May 5	slight	yes	hard Ca HCO_3	no	no	no	Cyanophyta
August 8	yes	yes	--	no	--	no	Cyanophyta

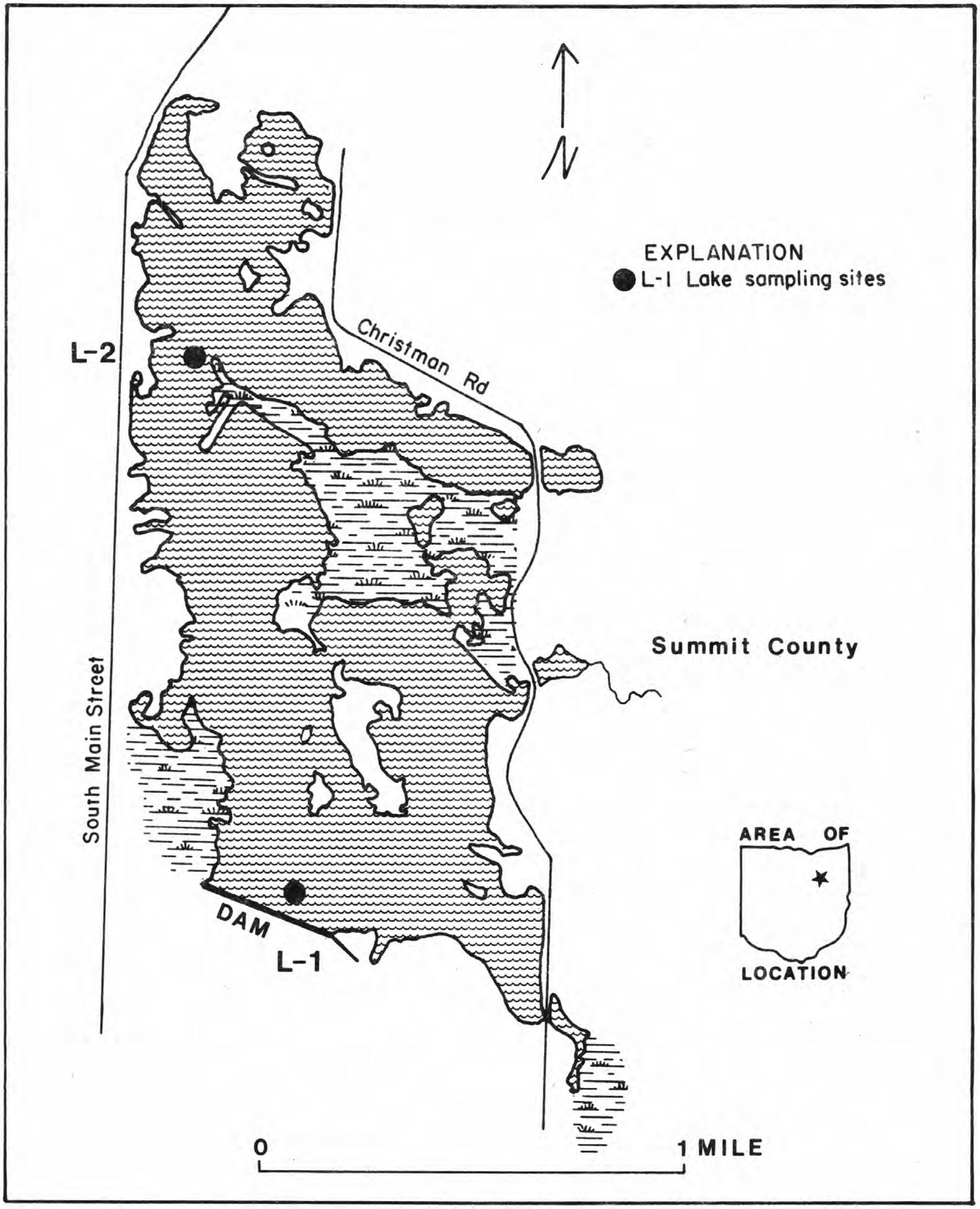

Figure 66.--Nimisila Reservoir sampling sites.

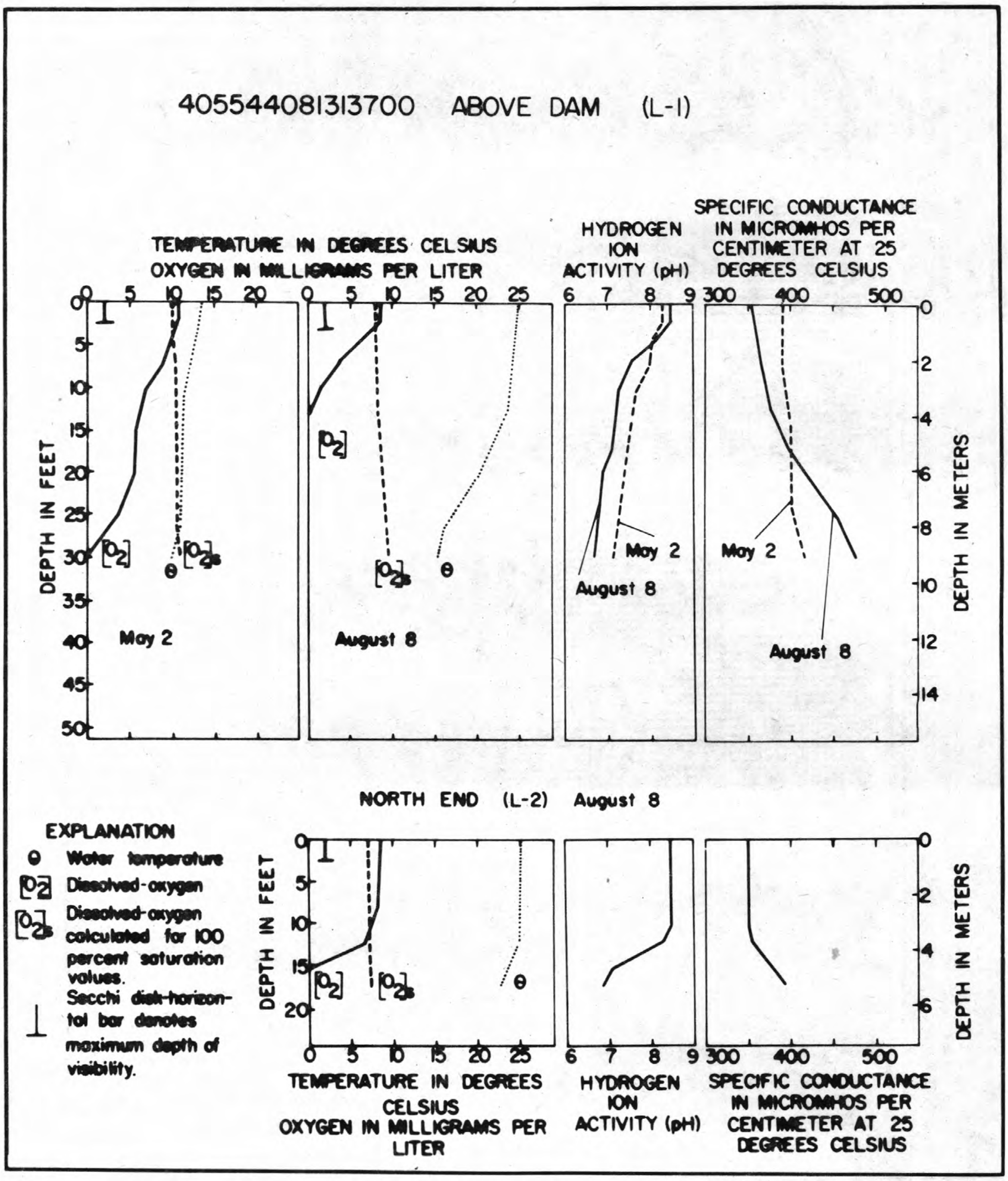

Figure 67.--Data profiles for Nimisila Reservoir, Ohio, on selected days in 1977.

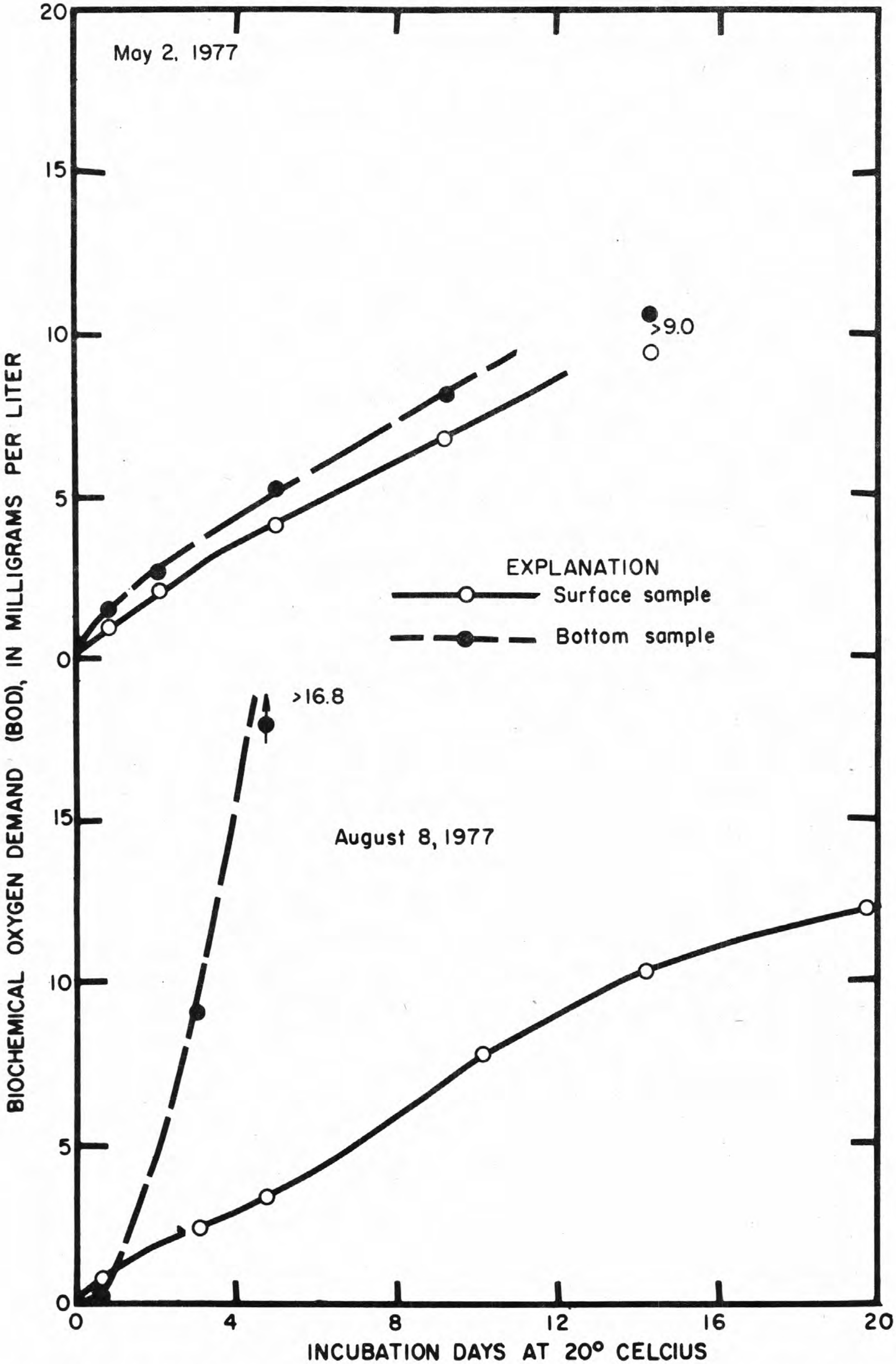

Figure 68.--BOD of water samples from Nimisila Reservoir on selected days in 1977.

Table 127.--Profile data for the primary lake site, Nimisila Reservoir, Ohio

405544081313700 - NIMISILA RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
MAY												
02...	1440	.0	13.3	10.8	107	390	8.3	--	--	--	--	--
02...	1445	2.0	13.3	10.8	107	390	8.3	0	154	1.2	.0	2.2
02...	1450	4.0	12.5	9.9	96	390	8.1	--	--	--	--	--
02...	1455	7.0	12.3	9.0	87	390	8.0	--	--	--	--	--
02...	1500	10	11.6	6.9	66	395	7.7	--	--	--	--	--
02...	1505	15	11.3	5.7	54	400	7.5	--	--	--	--	--
02...	1510	20	11.3	5.4	51	400	7.4	--	--	--	--	--
02...	1515	25	11.1	3.6	34	405	7.3	--	--	--	--	--
02...	1520	30	10.0	.0	0	420	7.1	0	135	17	.2	--
AUG												
08...	1500	.0	25.0	8.7	109	355	8.5	--	--	--	--	--
08...	1505	2.0	24.8	8.4	104	358	8.5	1	68	.3	.0	3.0
08...	1510	4.0	24.5	6.4	79	363	8.2	--	--	--	--	--
08...	1515	7.0	24.2	3.8	47	365	7.6	--	--	--	--	--
08...	1520	10	24.0	1.6	20	373	7.3	--	--	--	--	--
08...	1522	13	23.5	.1	1	380	7.2	--	--	--	--	--
08...	1525	15	22.8	.0	0	390	7.2	--	--	--	--	--
08...	1530	20	20.5	.0	0	420	6.9	--	--	--	--	--
08...	1535	25	16.9	.0	0	455	6.8	--	--	--	--	--
08...	1540	30	15.6	.0	0	480	6.7	0	240	76	9.5	--

Table 128.--Chemical analyses of water column composites samples, Nimisila Reservoir, Ohio

405544081313700 - NIMISILA RE AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
MAY												
02...	1510	54	12	2.4	15	41	27	.1	180	262	33	295

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
MAY										
02...	100	0	10	3	.0	0	0	0	<10	.06

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
MAY							
02...	10	0	0	230	470	0	0

Table 129.--Chemical, physical, and biological analyses of water samples from selected depths, Nimisila Reservoir, Ohio

405544081313700 - NIMISILA RE AB DAM AT SITE (L-J)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
MAY									
02...	1445	2.0	.00	.01	.01	.00	1.2	1.2	.00
02...	1520	30	.00	.00	.00	.83	1.1	1.9	.00
AUG									
08...	1505	2.0	.00	.00	.00	.01	1.1	1.1	.01
08...	1540	30	.00	.00	.00	6.7	.60	7.3	.53

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
MAY									
02...	.05	3.7	8	15	5.9	3.9	18	2	2
02...	.09	5.0	8	25	9.1	5.0	9	2	<2
AUG									
08...	.05	4.7	4	20	6.9	3.4	25	72	102
08...	.60	6.9	10	10	7.4	>17	35	12	20

Table 130.--Phytoplankton in Nimisila Reservoir, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Location	Date	Location in water column						
Site L-1 above dam ---------	5-2-77	euphotic zone composite	780,000	0.2	41	Cyanophyta	100	Oscillatoria (99); Aphanizomenon (1)
						Euglenophyta	< 1	Chroomonas; Cryptomonas; Trachelomonas
						Chrysophyta	< 1	Melosira; Nitzschia; Cyclotella; Asterionella; Fragilaria
						Chlorophyta	< 1	Scenedesmus; Kirchneriella; Chodatella
Site L-1 above dam ---------	5-2-77	2-ft depth	390,000	0.3	31	Cyanophyta	99	Oscillatoria (97); Aphanizomenon (2)
						Euglenophyta	< 1	Cryptomonas; Trachelomonas; Chroomonas
						Chrysophyta	< 1	Melosira; Nitzschia; Asterionella; Mallomonas
						Chlorophyta	< 1	Scenedesmus; Chlamydomonas; Ankistrodesmus; Chodatella; Oocystis; Dictyosphaerium; Actinastrum
Site L-1 above dam ---------	8-8-77	euphotic zone composite	1,700,000	1.2	41	Cyanophyta	100	Aphanizomenon (69); Oscillatoria (24); Lyngbya (2); Raphidiopsis (2); Cylindrospermum (2)
						Chlorophyta	< 1	Dictyosphaerium; Polydriopsis; Selenastrum; Scenedesmus
						Chrysophyta	< 1	Synedra
						Pyrrhophyta	< 1	Glenodinium; Peridinium
Site L-1 above dam ---------	8-8-77	2-ft depth	1,600,000	1.4	44	Cyanophyta	99	Lyngbya (69); Oscillatoria (18); Cylindrospermum (7); Raphidiopsis (4); Aphanizomenon (1)
						Chlorophyta	1	Scenedesmus; Kirchneriella
						Euglenophyta	< 1	Trachelomonas

* Less than 1 percent not given.

The temperature difference between the surface and bottom waters at site L-1 was only 3.3°C on May 2, but chemical differences (HCO_3 NH_3, pH, specific conductance, etc.) with depth had already developed. The data from the stabilized lake on August 8 indicate high oxygen demand. Dissolved oxygen decreased rapidly below 2 ft. The lake was anaerobic below 13 ft and had high concentrations of hydrogen sulfide, carbon dioxide, nitrogen, and phosphorus near the lake bottom. The BOD rate in the sample from 30 ft was the highest observed during the 1977 reconnaissance. Similar profile data existed near the north end at site L-2.

A comparison of the nitrogen and phosphorus data from the lake bottom in August with similar data in May suggests that major inputs or recycling (from the bottom muds) of these nutrients occurred during this period. Phytoplankton data show high cell counts and complete domination by blue-green (Cyanophyta) algae in all samples.

Inflow data: No inflow data were taken.

Piedmont Lake

Location: Harrison, Belmont, and Guernsey Counties

Type: Reservoir; dam has multi-level release controls

Use: Flood control and recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratic (C/I)
1937	2270	34,500	0.49

Drainage basin characteristics:

Drainage area (miles²)	Type	Estimated sediment yield (from fig. 4)
85.9	agricultural, rural	moderately low

Lake data (figs. 69-71; tables 131-134): Piedmont Lake was sampled on a clear warm day on April 12 and during intermittent rains on August 11. The secchi-disk visibility at site L-1 was 1.7 ft less in August than in April. Profile and analytical data show the following lake characteristics:

Date (1977)	Stratification (gradient)		Chemical type	Substances at or above State limits			Phytoplankton dominant phylum(a) (composite from euphotic zone)
	thermal	chemical		pesticides	toxicants	bacteria	
April 12	slight	slight	very hard Ca SO_4	no	no	no	Cyanophyta
August 11	yes	yes	--	no	--	no	Cyanophyta

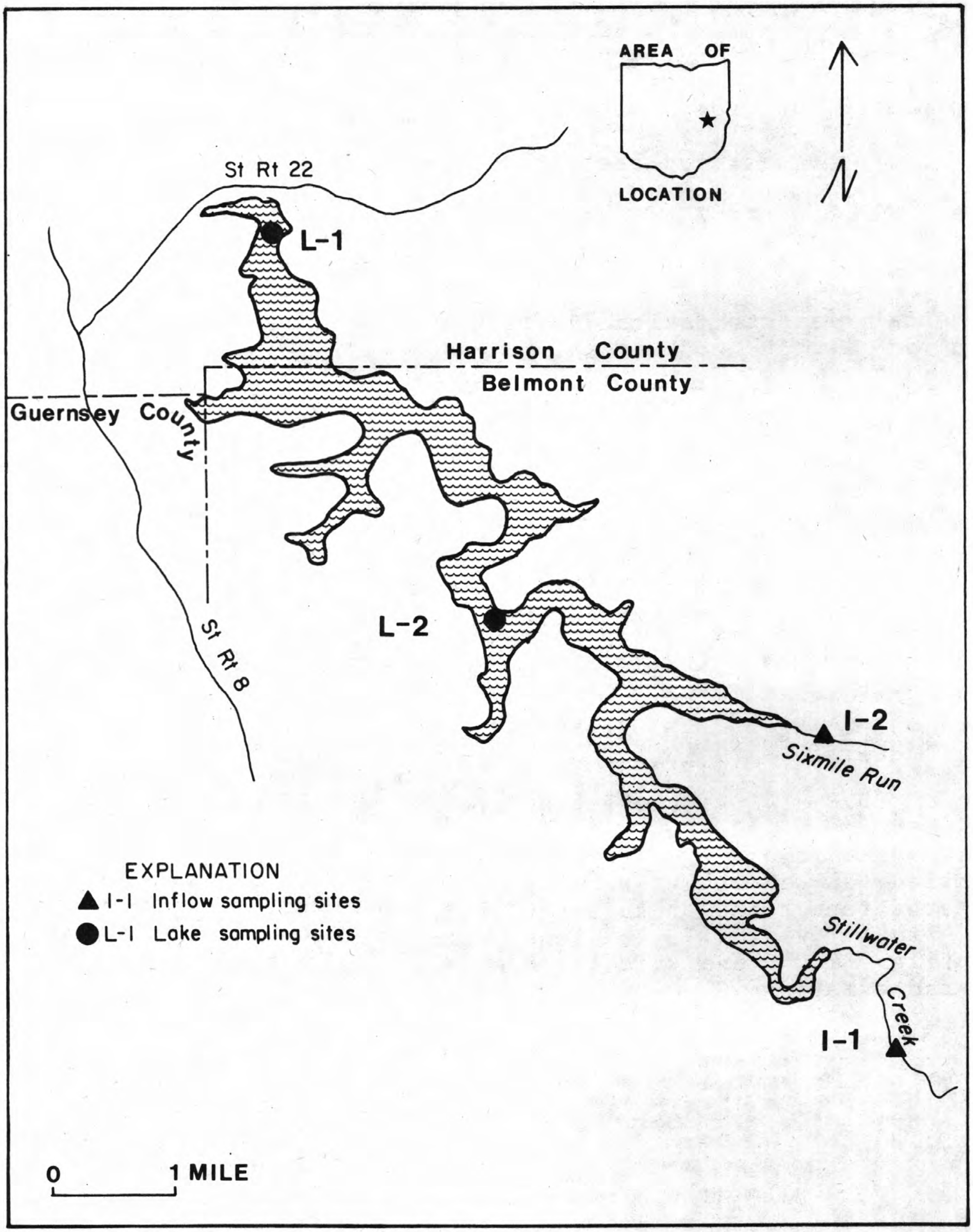

Figure 69.--Piedmont Lake and inflow sampling sites.

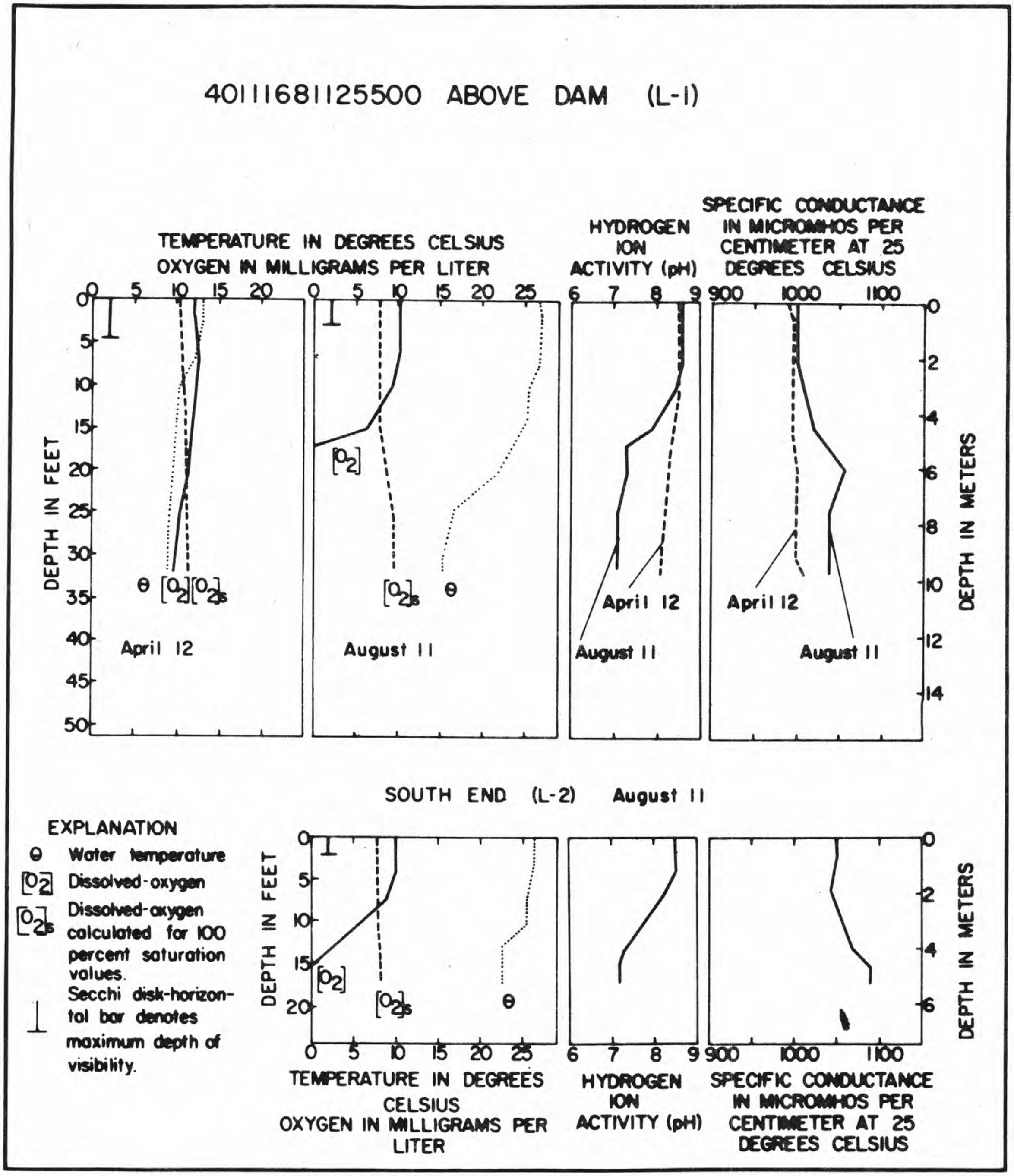

Figure 70.--Data profiles for Piedmont Lake, Ohio, on selected days in 1977.

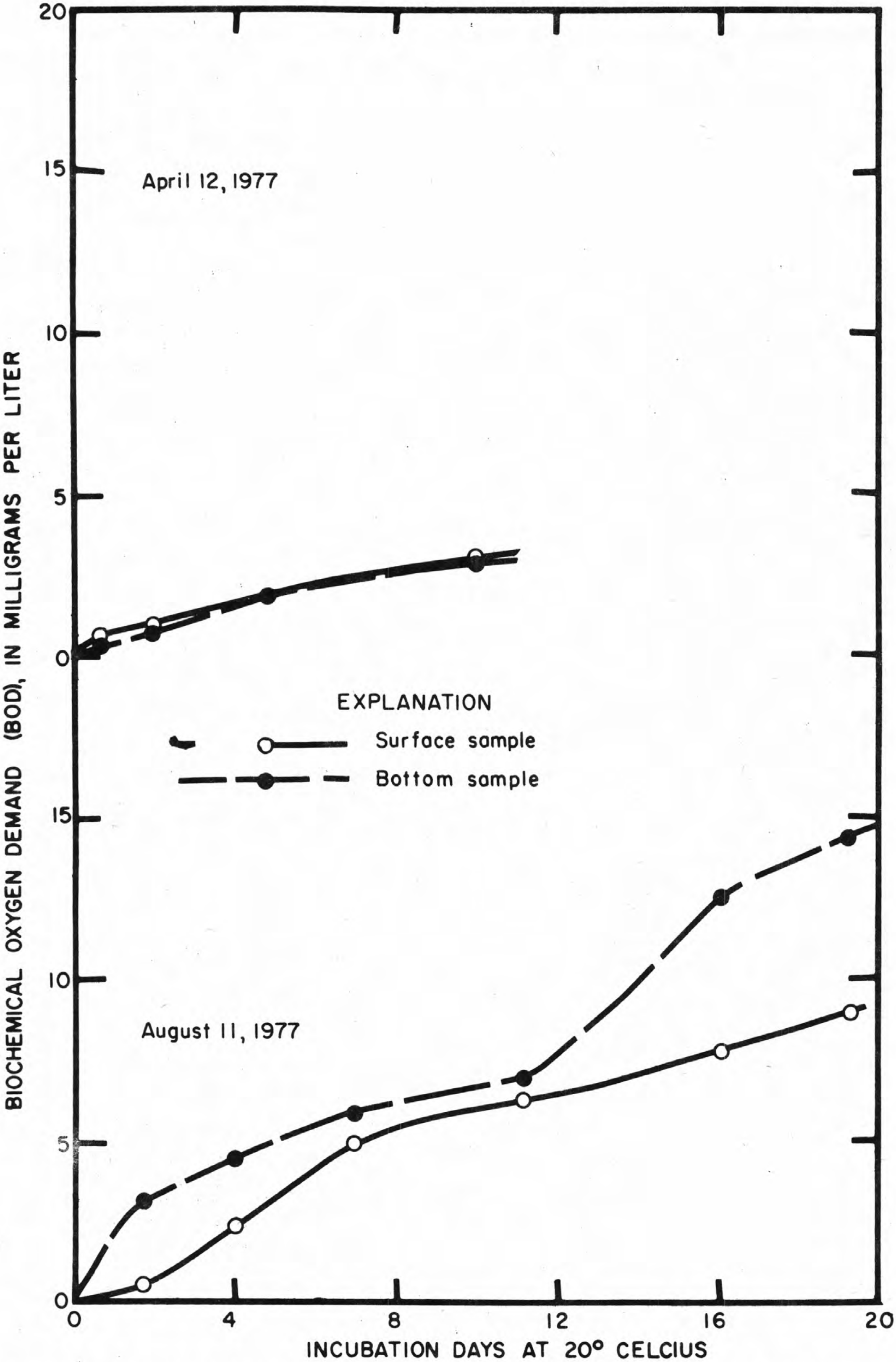

Figure 71.--BOD of water samples from Piedmont Lake on selected days in 1977.

Table 131.--Profile data for the primary lake site, Piedmont Lake, Ohio

401116081125500 - PIEDMONT LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
12...	1320	.0	13.0	12.0	117	990	8.5	--	--	--	--	--
12...	1325	2.0	13.0	12.0	117	995	8.5	1	124	.6	.0	4.5
12...	1330	4.0	12.5	12.3	119	995	8.5	--	--	--	--	--
12...	1335	7.0	12.1	12.4	119	995	8.5	--	--	--	--	--
12...	1340	10	10.5	12.3	114	995	8.5	--	--	--	--	--
12...	1345	15	10.0	12.0	110	995	8.4	--	--	--	--	--
12...	1350	20	9.6	11.4	103	1000	8.3	--	--	--	--	--
12...	1355	25	9.2	10.4	93	1000	8.2	--	--	--	--	--
12...	1405	30	9.2	10.2	91	1000	8.1	.0	128	1.7	.0	--
12...	1410	32	9.0	9.8	87	1010	8.1	--	--	--	--	--
AUG												
11...	1535	.0	26.8	10.2	131	1000	8.6	--	--	--	--	--
11...	1540	2.0	27.0	10.2	132	1000	8.6	4	76	.3	.0	2.8
11...	1545	4.0	26.8	10.2	131	1000	8.6	--	--	--	--	--
11...	1550	7.0	26.8	10.1	130	1000	8.6	--	--	--	--	--
11...	1555	10	25.6	9.3	117	1010	8.5	--	--	--	--	--
11...	1600	15	25.0	6.2	77	1020	7.9	--	--	--	--	--
11...	1602	17	23.7	.0	0	1040	7.3	--	--	--	--	--
11...	1605	20	22.0	.0	0	1055	7.3	--	--	--	--	--
11...	1610	25	16.6	.0	0	1040	7.1	--	--	--	--	--
11...	1615	30	15.5	.0	0	1040	7.1	0	196	25	4.1	--

Table 132.--Chemical analyses of water column composite samples, Piedmont Lake, Ohio

401116081125500 - PIEDMONT LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 12...	1350	130	47	3.0	18	410	14	.1	520	777	34	811

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 12...	100	0	10	7	.0	3	0	0	<10	<.05

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 12...	40	0	0	90	190	0	0

Table 133.--Chemical, physical, and biological analyses of water samples from selected depths, Piedmont Lake, Ohio

401116081125500 - PIEDMONT LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
12...	1325	2.0	.01	.10	.11	.01	.76	.77	.01
12...	1405	30	.01	.13	.14	.03	.59	.62	.00
AUG									
11...	1540	2.0	.00	.01	.01	.05	.66	.71	.00
11...	1615	30	.00	.02	.02	1.1	.60	1.7	.21

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
12...	.02	3.3	2	10	6.0	1.8	13	<2	2
12...	.02	3.6	3	10	4.9	1.7	12	2	<2
AUG									
11...	.02	3.4	4	20	7.5	3.3	25	<2	2
11...	.29	7.1	50	10	6.2	4.9	20	<2	6

Table 134.--Phytoplankton in Piedmont Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (s) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)*of total cell count
Location	Date	Location in water column						
Site L-1 above dam ---------	4-12-77	euphotic zone composite	180,000	0.8	20	Cyanophyta	90	Oscillatoria (88); Anacystis (2)
						Chrysophyta	6	Nitzschia (5); Fragilaria (1); Achnanthes
						Chlorophyta	2	Ankistrodesmus (2); Scenedesmus; Chlamydomonas
						Euglenophyta	2	Cryptomonas (1); Trachelomonas (1)
Site L-1 above dam ---------	4-12-77	4-ft depth	210,000	0.6	16	Cyanophyta	92	Oscillatoria (91); Anacystis (1)
						Chrysophyta	5	Nitzschia (5); Achnanthes; Cyclotella; Navicula
						Chlorophyta	2	Ankistrodesmus (1); Scenedesmus; Dictyosphaerium; Chlamydomonas; Selenastrum
						Euglenophyta	1	Chroomonas (1); Cryptomonas; Trachelomonas
						Pyrrhophyta	< 1	Glenodinium
Site L-1 above dam ---------	8-11-77	euphotic zone composite	480,000	0.9	31	Cyanophyta	100	Cylindrospermum (82); Raphidiopsis (14); Lyngbya (3); Oscillatoria (2)
Site L-1 above dam ----------	8-11-77	4-ft depth	710,000	1.5	33	Cyanophyta	100	Cylindrospermum (57); Oscillatoria (26); Raphidiopsis (14); Anacystis (3); Lyngbya

* Less than 1 percnet not given.

The April 12 data at site L-1 show slight chemical variation with depth; the data on August 11 show that the lake was thermally and chemically stratified at sites L-1 and L-2. The water below 17 ft at site L-1 and below 15 ft at site L-2 had no dissolved oxygen and contained detectable amounts of hydrogen sulfide. The much higher bicarbonate concentration in the bottom sample, compared with the 2 ft sample, indicates that a major change in water chemistry had occurred between these strata. The oxygen demand in the lake was higher in August than in April. Further comparison shows that the bottom sample in August had a high BOD, a relationship frequently seen in other Ohio lakes.

Inorganic nitrogen and phosphorus concentrations, except for the bottom sample in August, were low. The higher nitrogen and phorphorus concentrations in the bottom sample would suggest that nutrient recycling is an important source of inorganic nutrients. The phytoplankton cell counts from the spring samples were 90 percent or greater blue-green genera. Low-density populations of *Najas flexilas*, *Ceratophyllum demersum*, and *Sagittaria* sp. were seen growing in the lake.

Inflow data (fig 69, table 135): Stillwater Creek is the major inflow to Piedmont Lake. The creek was sampled at site I-1, where it represents runoff from 48.2 mi², which is 56 percent of the Piedmont Lake drainge basin. A minor inflow, Sixmile Run, was sampled at site I-1, where it represents drainage from 4.8 mi² or 5.6 percent of the drainage to Piedmont Lake. A qualitative comparison of stream versus lake data is shown below.

Stream	Date (1977)	Discharge (ft^3/s)	Water body (stream or lake*) having higher concentration			
			NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Stillwater Creek at site I-1	April 12	E 30	stream	stream	stream	stream
	August 11	E 25	stream	same	lake	stream
Sixmile Run at site I-2	April 12	E 4.5	lake	stream	lake	stream
	August 11	E 4	same	stream	lake	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Table 135.--Physical and chemical data for selected inflows, Piedmont Lake, Ohio

400543081075600 - STILLWATER C AB PIEDMONT LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTAN-TANEOUS DIS-CHARGE (CFS)	TEMPER-ATURE (DEG C)	DIS-SOLVED OXYGEN (MG/L)	PH (UNITS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)
APR												
12...	1000	E30	13.0	9.8	7.8	1180	30	15	7.8	.71	.34	.05
AUG												
11...	1300	E25	24.0	7.5	7.6	1090	70	25	7.4	.26	1.1	.02

400744081083100 - SIXMILE RN AB PIEDMONT LK AT SITE (I-2)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTAN-TANEOUS DIS-CHARGE (CFS)	TEMPER-ATURE (DEG C)	DIS-SOLVED OXYGEN (MG/L)	PH (UNITS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	TUR-BID-ITY (JTU)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)
APR												
12...	1050	E4.5	15.5	10.9	8.2	1410	35	15	4.7	.03	.30	.09
AUG												
11...	1400	E4.0	25.0	8.6	8.0	1325	20	15	7.0	.01	.26	.04

E - estimated.

Stonelick Lake

Location: Clermont County

Type: Reservoir

Use: Recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1948	171	1750	0.09

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
23.3	agricultural, rural	moderately high

Lake data (figs. 72-74; tables 136-139): Storelick Lake was sampled under partly cloudy skies on April 14 and September 1. The secchi-disk transparency was less than 1 ft at site L-1 on April 14. Profile and analytical data show the following lake characteristics:

Date (1977)	Stratification (gradient) thermal	Stratification (gradient) chemical	Chemical type	Substances at or above State limits: pesticides	toxicants	bacteria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
April 14	yes	yes	moderately hard Ca HCO_3	no	no	no	Euglenophyta
September 1	yes	yes	--	no	--	no	Chlorophyta

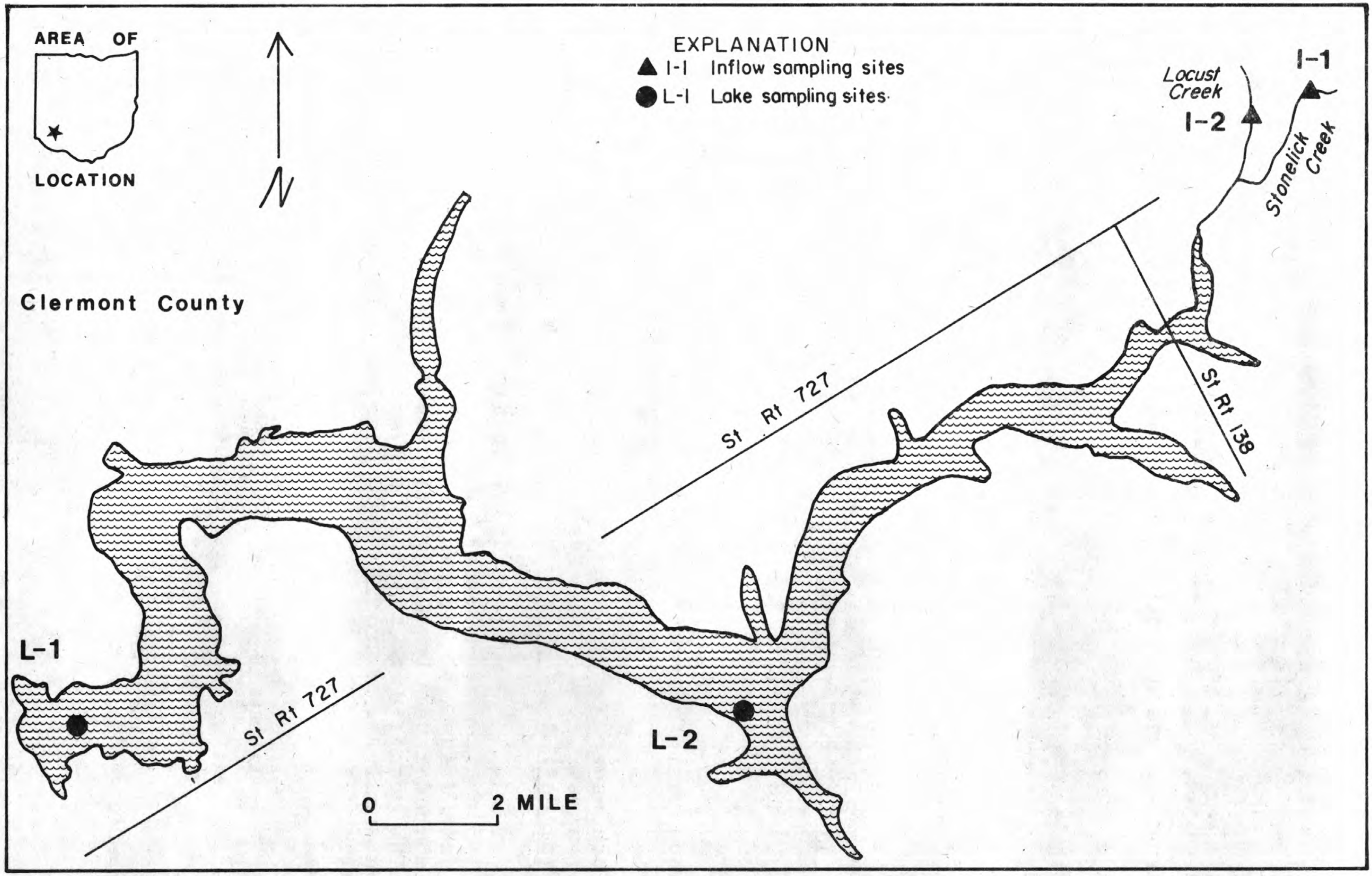

Figure 72.--Stonelick Lake and inflow sampling sites.

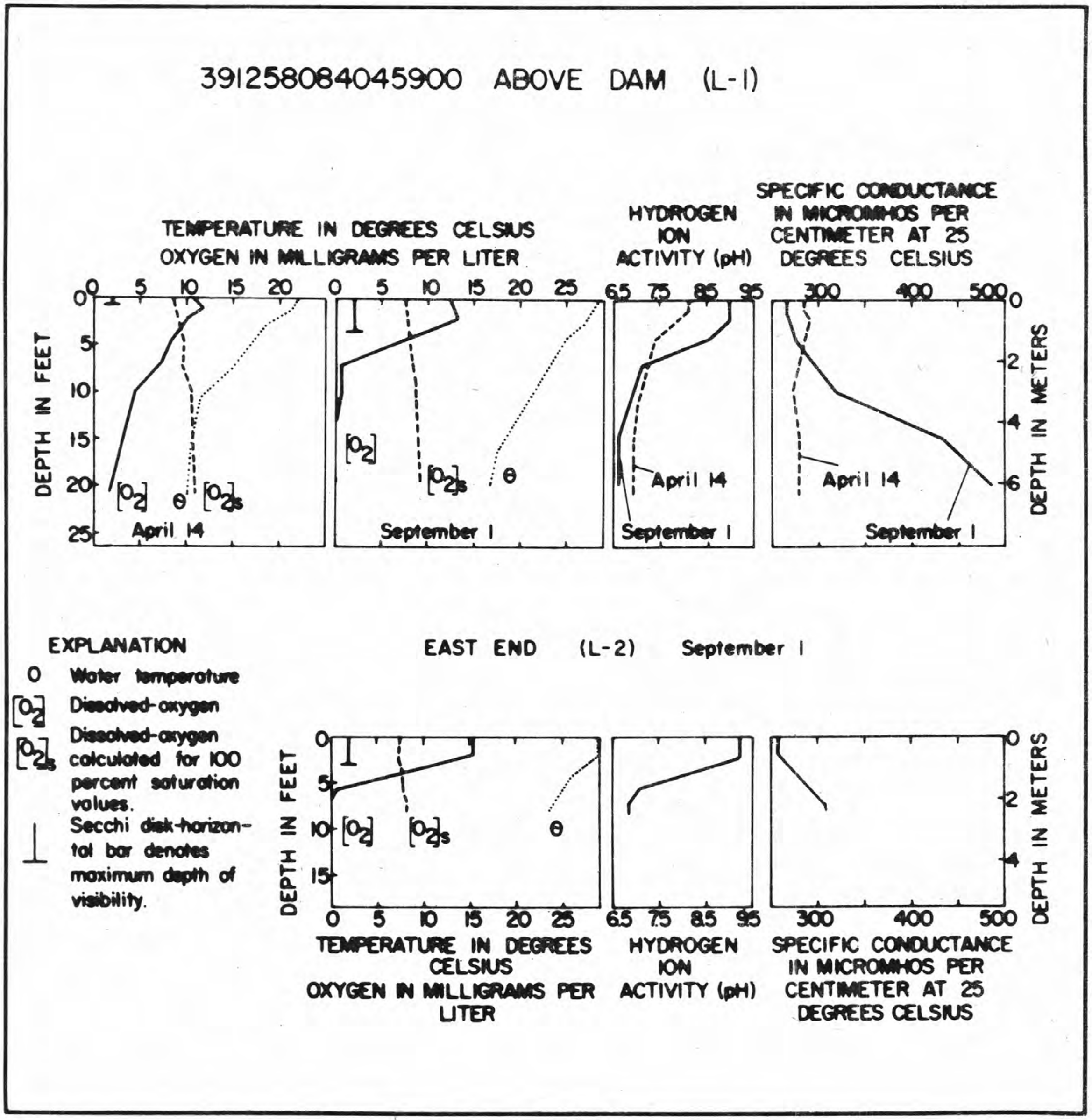

Figure 73.--Data profiles for Stonelick Lake, Ohio, on selected days in 1977.

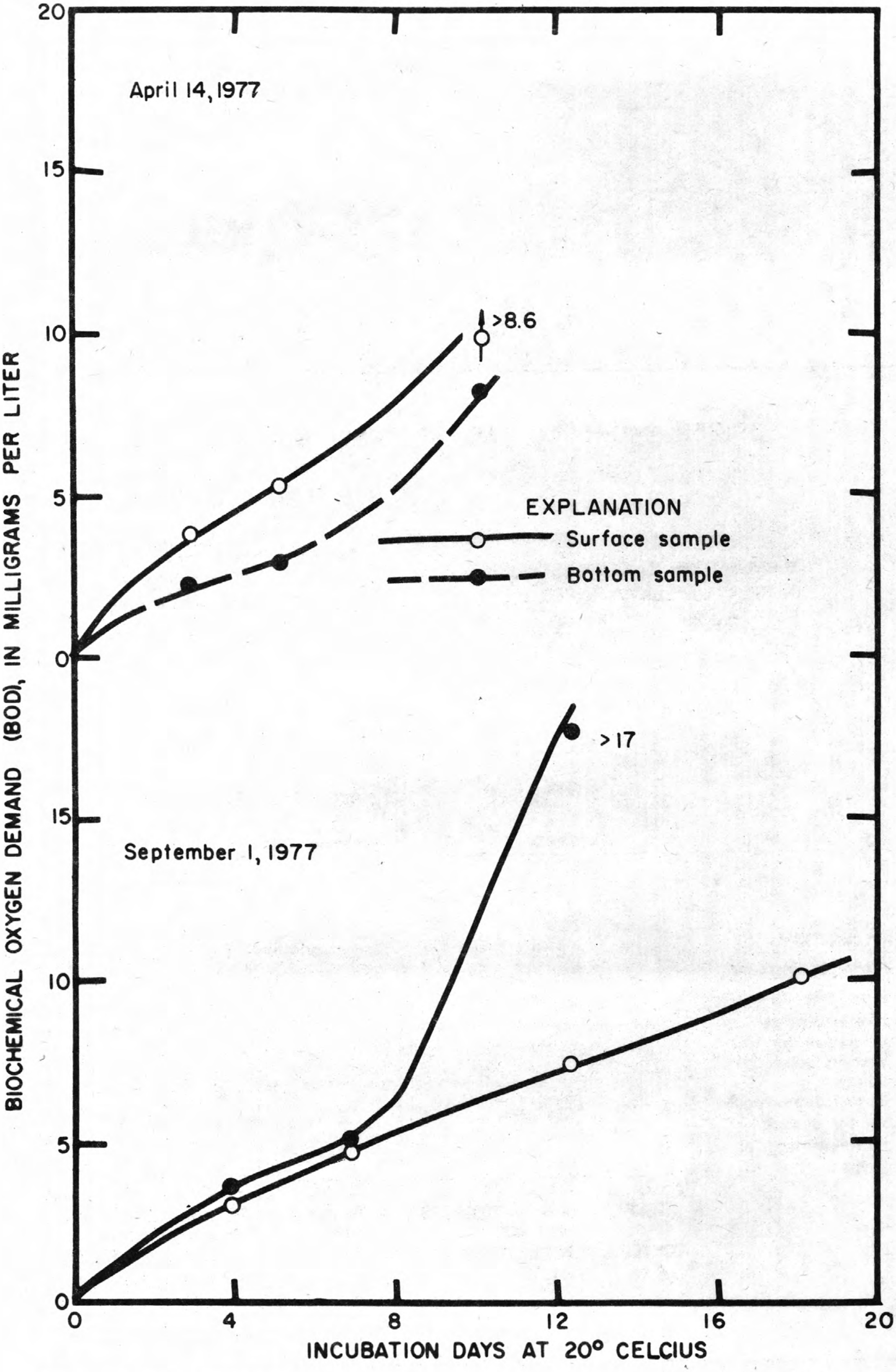

Figure 74.--BOD of water samples from Stonelick Lake on selected days in 1977.

Table 136.--Profile data for the primary lake site, Stonelick Lake, Ohio

391258084045900 - STONELICK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
14...	1455	.0	22.0	10.8	127	285	8.1	--	--	--	--	--
14...	1457	1.0	21.4	11.5	133	285	8.1	--	--	--	--	--
14...	1500	2.0	19.5	10.1	113	290	7.8	0	94	2.4	.0	0.8
14...	1505	4.0	17.2	8.5	91	285	7.4	--	--	--	--	--
14...	1510	7.0	15.5	7.1	73	280	7.2	--	--	--	--	--
14...	1515	10	12.0	4.2	40	275	7.0	--	--	--	--	--
14...	1520	15	10.8	3.0	28	280	6.9	--	--	--	--	--
14...	1525	20	10.4	2.0	18	280	6.9	0	94	19	.0	--
SEP												
01...	1415	.0	28.5	12.3	163	265	9.0	--	--	--	--	--
01...	1420	2.0	27.5	13.2	172	265	9.0	12	78	.2	.0	3.5
01...	1425	4.0	25.2	9.3	116	275	8.6	--	--	--	--	--
01...	1430	7.0	23.3	.6	7	295	7.1	--	--	--	--	--
01...	1435	10	21.5	.6	7	320	6.9	--	--	--	--	--
01...	1438	13	20.0	.0	0	395	6.7	--	--	--	--	--
01...	1440	15	18.5	.0	0	438	6.6	--	--	--	--	--
01...	1445	20	16.9	.0	0	488	6.6	0	270	108	3.4	--

Table 137.--Chemical analyses of water column composite samples, Stonelick Lake, Ohio

391258084045900 - STONELICK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 14...	1515	32	9.1	4.5	7.8	35	15	.1	120	228	65	293

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 14...	0	0	10	13	.0	3	0	0	<10	.12

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 14...	60	0	4	2200	450	0	30

Table 138.--Chemical, physical, and biological analyses of water samples from selected depths, Stonelick Lake, Ohio

391258084045900 - STONELICK LK AB DAM AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
14...	1500	2.0	.04	.58	.62	.25	1.6	1.8	.04
14...	1525	20	.05	.38	.43	.79	1.1	1.9	.08
SEP									
01...	1420	2.0	.00	.01	.01	.00	.60	.60	.01
01...	1445	20	.00	.00	.00	9.2	2.8	12	.78

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
14...	.13	5.5	55	120	7.3	4.7	36	3	6
14...	.15	6.3	65	150	6.4	2.4	34	24	9
SEP									
01...	.06	1.5	4	30	7.3	3.6	35	4	12
01...	3.2	13	50	220	6.2	4.0	45	8	14

Table 139.--Phytoplankton in Stonelick Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)*of total cell count
Location	Date	Location in water column						
Site L-1 above dam ----------	4-14-77	euphotic zone composite	6000	2.0	38	Euglenophyta	81	Cryptomonas (52); Chroomonas (27); Trachelomonas (2)
						Chrysophyta	13	Melosira (7); Cyclotella (5); Navicula (1)
						Chlorophyta	6	Ankistrodesmus (3); Kirchneriella (2); Chodatella
Site L-1 above dam ----------	4-14-77	1-ft depth	11,000	2.2	54	Euglenophyta	77	Cryptomonas (55); Chroomonas (18); Trachelomonas (3); Euglena (1)
						Chlorophyta	9	Ankistrodesmus (8); Chodatella (1)
						Chrysophyta	8	Cyclotella (3); Fragilaria (3); Synedra (1); Melosira (1)
						Cyanophyta	6	Anacystis (6)
Site L-1 above dam ----------	9-1-77	euphotic zone composite	59,000	1.4	24	Chlorophyta	93	Sphaerocystis (74); Oocystis (11); Dictyosphaerium (2); Scenedesmus (2); Tetrastrum (1); Crucigenia (1); Schroederia (1); Ankistrodesmus; Coelastrum; Kirchneriella; Cosmarium; Pediastrum
						Cyanophyta	7	Apanizomenon (3); Oscillatoriaceae (3); Anabaena
						Euglenophyta	< 1	Trachelomonas; Euglena
						Chrysophyta	< 1	Synedra
						Pyrrhophyta	< 1	Gonyaulax
Site L-1 above dam ----------	9-1-77	2-ft depth	91,000	2.0	21	Chlorophyta	83	Sphaerocystis (58); Oocystis (14); Dictyosphaerium (5); Kirchneriella (2); Scenedesmus (2); Phacotus (1); Cosmocladium (1); Schroederia; Coelastrum; Crucigenia; Tetrastrum; Gloeocystis; Chlamydomonas; Cosmarium; Staurastrum
						Cyanophyta	16	Aphanizomenon (14); Anabaena (2)
						Pyrrhophyta	< 1	Gonyaulax
						Chrysophyla	< 1	Synedra
						Euglenophyta	< 1	Euglena; Trachelomonas

* Less than 1 percent not given.

The high turbidity in the lake, which can absorb and scatter solar radiation, evidently reduced the warming rate in the deeper waters in mid-April. The reduction of dissolved oxygen with depth and the BOD rates at site L-1 indicate that oxygen depletion rates were high.

The September data show large chemical and physical differences between the near surface and near bottom waters. Dissolved oxygen at sites L-1 and L-2 was above saturation (from high photosynthetic rates) above 4 ft but decreased to less than 1 mg/L at 7 ft. The pH range (2.4 pH units) within the water column (site L-1) was the largest recorded during the 1976-77 reconnaissance. The specific conductance and bicarbonate values were much higher at the lake bottom than at the surface.

The inorganic nutrient concentrations on April 14 were sufficient for nuisance algal growths. (See page 12.) In early September, the inorganic nutrient concentrations were low in the surface water, but nutrient recycling at the lake bottom had produced high concentrations of ammonia (9.2 mg/L), orthophosphorus (0.78 mg/L), carbon dioxide (108 mg/L), and silica (13 mg/L). In addition, a hydrogen sulfide odor was detected at 13 ft and confirmed (3.5 mg/L) at 20 ft.

The algal community differed from that of most Ohio lakes in that euglenoids (Euglenophyta) dominated the spring samples and green algae (Chlorophyta) dominated the September samples. Blue-green algae were detected on both sampling dates and may have dominated at some other time.

Inflow data (fig. 72, table 140): Stonelick Creek, which drains 11.6 mi², or 50 percent of the lake drainage basin, and Locust Creek, draining 3.2 mi² or 14 percent of the basin, were sampled at sites I-1 and I-2, respectively. A qualitative comparison of stream versus lake data is shown below:

Stream	Date (1977)	Discharge (ft^3/s)	Water body (stream or lake*) having higher concentration: NO_2+NO_3	Total P	TOC	General chemistry (specific conductance)
Stonelick Creek at site I-1	April 14	E 2	lake	lake	lake	stream
	September 1	< 0.1	stream	stream	stream	stream
Locust Creek at site I-2	April 14	E 2	lake	lake	lake	stream
	September 1	< 0.1	same	lake	lake	stream

* At 2-ft (0.6-m) depth.
E Estimated.

Mayflies (Ephemeroptera) were observed at sites I-1 and I-2.

Table 140.--Physical and chemical data for selected inflows, Stonelick Lake, Ohio

391404084023000 - STONELICK C AB STONELICK LK AT SITE (I-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR												
14...	1300	E2.0	19.5	9.8	7.8	535	6	20	4.7	.02	.67	.04
SEP												
01...	1300	<.10	25.0	2.5	7.2	430	4	30	8.1	.05	.78	.10

391348084030400 - LOCUST C AB STONELICK LK AT SITE (I-2)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PH (UNITS)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL PHOSPHORUS (P) (MG/L)
APR												
14...	1315	E2.0	17.0	10.2	7.5	515	5	20	3.2	.06	.41	.03
SEP												
01...	1240	<.10	26.5	12.2	7.7	550	3	30	7.1	.01	.42	.02

E - estimated.

Turkeyfoot Lake

Location: Summit County

Type: Lake-reservoir; natural pond(s) dammed to increase capacity

Use: Water supply and recreation

Physical characteristics (table 6):

Date of origin (year)	Surface area (acres)	Capacity (acre-feet)	Capacity-inflow ratio (C/I)
1830's	450	--	--

Drainage basin characteristics:

Drainage area ($miles^2$)	Type	Estimated sediment yield (from fig. 4)
--	rural	moderately low

Lake data (figs. 75-77; tables 141-144): Turkeyfoot Lake was sampled under hazy skies on April 19 and August 9. The April 19 visit was preceded by rainy weather the day before. Light transparency (secchi disk) on August 9 was nearly twice the 2-ft value measured on April 19. Profile and analytical data show the following lake characteristics:

Date (1977)	Stratification (gradient) ther-mal	Stratification (gradient) chem-ical	Chemical type	Substances at or above State limits pesti-cides	Substances at or above State limits toxi-cants	Substances at or above State limits bac-teria	Phytoplankton dominant phylum(a) (composite from euphotic zone)
April 19	yes	yes	hard Ca HCO_3	no	no	no	Cyanophyta
August 9	yes	yes	--	no	--	no	Cyanophyta

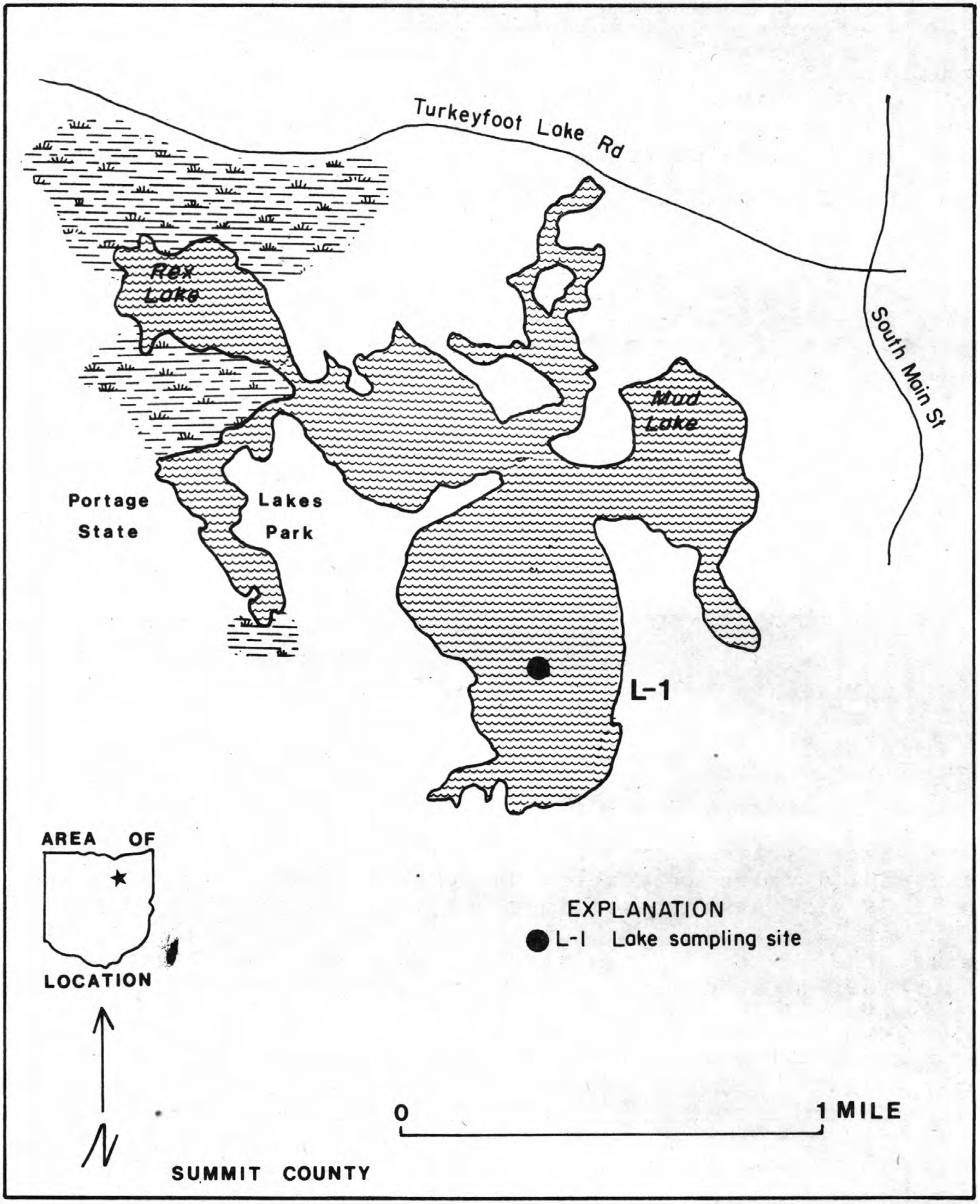

Figure 75.--Turkeyfoot Lake sampling site.

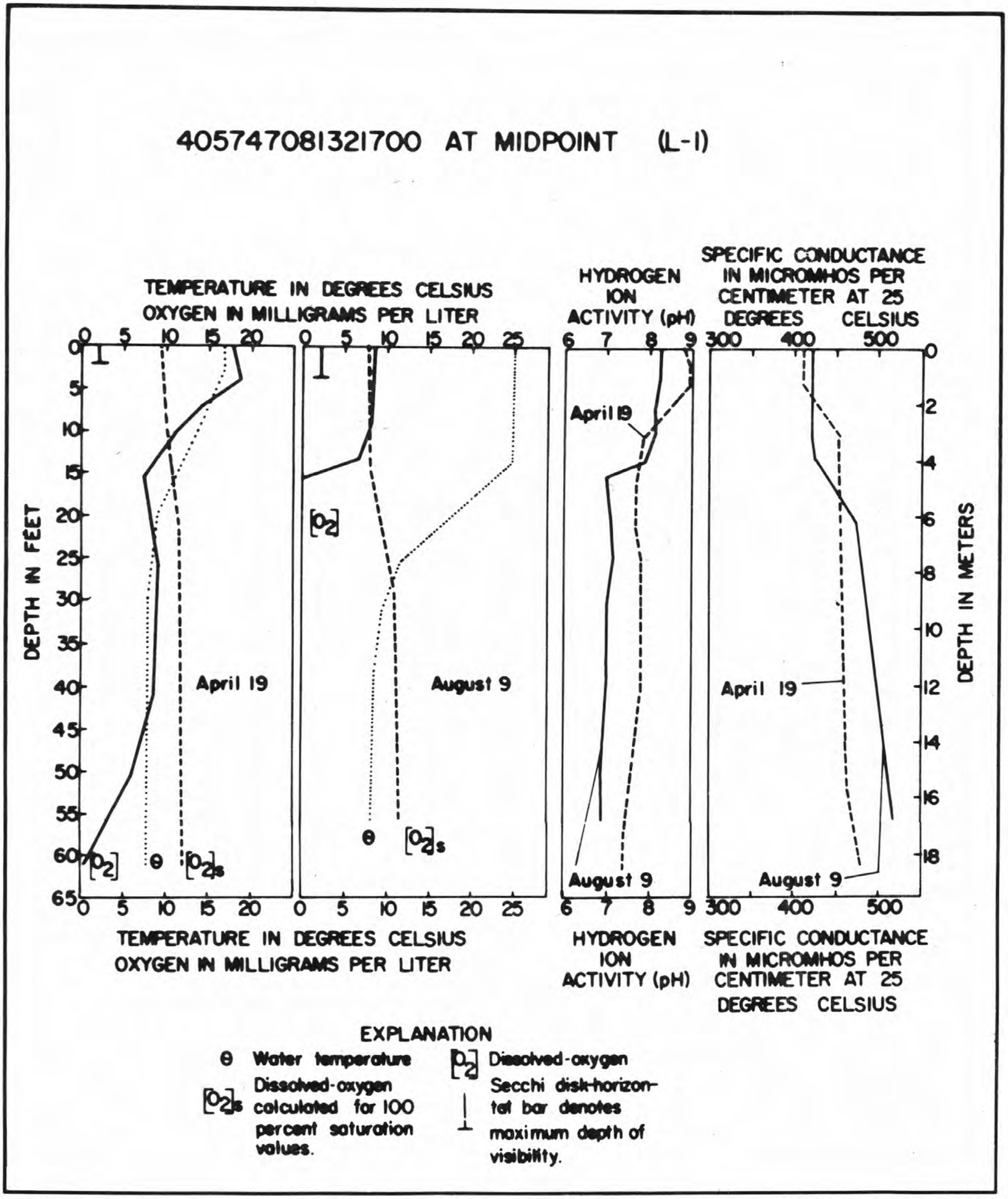

Figure 76.--Data profiles for Turkeyfoot Lake, Ohio, on selected days in 1977

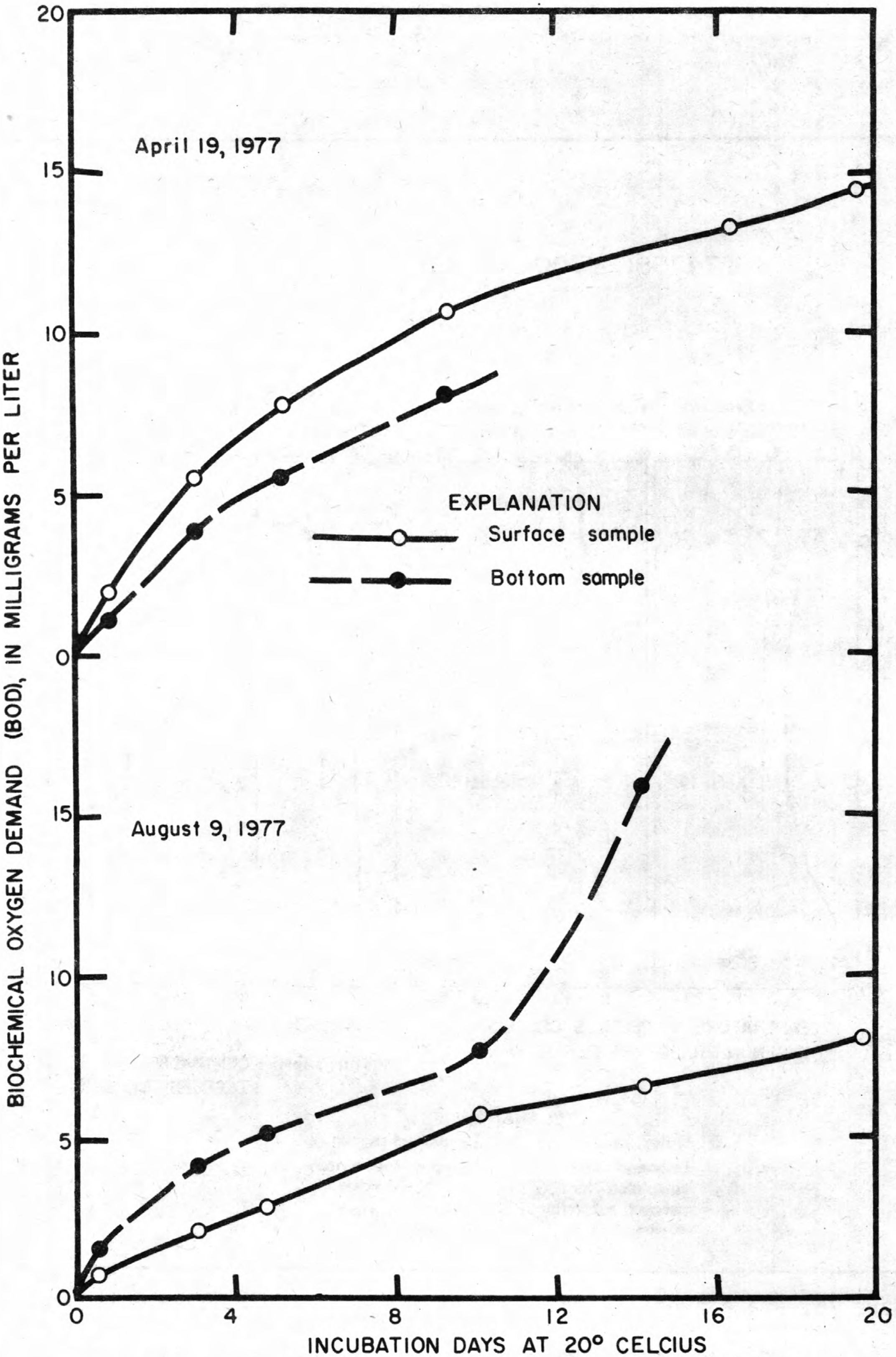

Figure 77.--BOD of water samples from Turkeyfoot Lake on selected days in 1977.

Table 141.--Profile data for the primary lake site, Turkeyfoot Lake, Ohio

405747081321700 - TURKEYFOOT LK AT MIDPOINT AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	CARBONATE (CO3) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBON DIOXIDE (CO2) (MG/L)	HYDROGEN SULFIDE (MG/L)	TRANSPARENCY (SECCHI DISK) (FT)
APR												
19...	1350	.0	16.8	17.8	189	410	8.8	--	--	--	--	--
19...	1355	2.0	16.8	18.0	191	410	8.9	10	104	.2	.0	2.1
19...	1400	4.0	16.1	18.4	192	410	8.9	--	--	--	--	--
19...	1405	7.0	14.8	14.0	143	428	8.4	--	--	--	--	--
19...	1410	10	13.8	10.9	109	450	7.9	--	--	--	--	--
19...	1415	15	11.0	7.6	71	453	7.7	--	--	--	--	--
19...	1420	20	8.8	8.0	71	453	7.7	--	--	--	--	--
19...	1425	25	8.1	8.9	78	453	7.8	--	--	--	--	--
19...	1430	30	7.8	8.6	75	455	7.8	--	--	--	--	--
19...	1435	40	7.7	8.3	72	455	7.8	--	--	--	--	--
19...	1440	50	7.7	5.6	49	460	7.6	--	--	--	--	--
19...	1445	57	7.5	1.6	14	470	7.4	0	168	11	.0	--
19...	1450	60	7.5	.4	3	475	7.4	--	--	--	--	--
AUG												
09...	1100	.0	24.9	8.5	106	420	8.2	--	--	--	--	--
09...	1105	2.0	24.9	8.5	106	420	8.2	0	127	1.3	.0	3.7
09...	1110	4.0	24.9	8.5	106	420	8.2	--	--	--	--	--
09...	1115	7.0	24.8	8.2	102	420	8.1	--	--	--	--	--
09...	1120	10	24.8	8.0	100	420	8.1	--	--	--	--	--
09...	1123	13	24.5	6.4	79	425	7.9	--	--	--	--	--
09...	1125	15	23.2	.0	0	438	7.0	--	--	--	--	--
09...	1130	20	17.0	.0	0	470	7.1	--	--	--	1.7	--
09...	1135	25	12.0	.0	0	480	7.1	--	--	--	--	--
09...	1140	30	10.0	.0	0	485	7.0	--	--	--	--	--
09...	1145	40	8.5	.0	0	500	7.0	--	--	--	3.7	--
09...	1150	50	8.3	.0	0	510	6.9	--	--	--	--	--
09...	1155	55	8.2	.0	0	515	6.9	0	204	41	4.1	--

Table 142.--Chemical analyses of water column composite samples, Turkeyfoot Lake, Ohio

405747081321700 - TURKEYFOOT LK AT MIDPOINT AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	HARD-NESS (CA,MG) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	TOTAL RESI-DUE (MG/L)
APR 19...	1430	50	12	2.4	25	45	40	.1	170	281	9	290

DATE	TOTAL BARIUM (BA) (UG/L)	TOTAL CAD-MIUM (CD) (UG/L)	TOTAL CHRO-MIUM (CR) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MERCURY (HG) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)
APR 19...	0	0	<10	4	.0	0	0	0	<10	.07

DATE	TOTAL BORON (B) (UG/L)	TOTAL COBALT (CO) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	TOTAL MAN-GANESE (MN) (UG/L)	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL ZINC (ZN) (UG/L)
APR 19...	40	0	0	40	600	1	20

Table 143.--Chemical, physical, and biological analyses of water samples from selected depths, Turkeyfoot, Ohio

405747081321700 - TURKEYFOOT LK AT MIDPOINT AT SITE (L-1)

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	SAMPLING DEPTH (FT)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL NITRITE PLUS NITRATE (N) (MG/L)	TOTAL AMMONIA NITROGEN (N) (MG/L)	TOTAL ORGANIC NITROGEN (N) (MG/L)	TOTAL KJELDAHL NITROGEN (N) (MG/L)	TOTAL ORTHO PHOSPHORUS (P) (MG/L)
APR									
19...	1355	2.0	.00	.04	.04	.04	1.4	1.4	.01
19...	1445	57	.00	.06	.06	1.2	1.1	2.3	.30
AUG									
09...	1105	2.0	.00	.00	.00	.04	.81	.85	.01
09...	1155	55	.00	.00	.00	3.5	.70	4.2	.66

DATE	TOTAL PHOSPHORUS (P) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	TURBIDITY (JTU)	COLOR (PLATINUM-COBALT UNITS)	TOTAL ORGANIC CARBON (C) (MG/L)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L)	CHEMICAL OXYGEN DEMAND (HIGH LEVEL) (MG/L)	FECAL COLIFORM (COL. PER 100 ML)	STREPTOCOCCI (COLONIES PER 100 ML)
APR									
19...	.09	.6	5	25	7.1	7.5	30	2	2
19...	.45	3.4	6	25	6.9	5.3	25	<2	2
AUG									
09...	.05	5.2	3	20	7.6	2.8	20	12	46
09...	.71	5.7	40	20	9.1	4.8	30	<2	10

Table 144.--Phytoplankton in Turkeyfoot Lake, Ohio

Sample description			Total cells (per ml)	Diversity index (genus) $\bar{d}$	Chlorophyll a ug/L	Phylum (a) (order of dominance)	Percent of total cell count	Dominant genera within phylum and percent (%)* of total cell count
Location	Date	Location in water column						
Site L-1 at midpoint ----	4-19-77	euphotic zone composite	150,000	2.1	59	Cyanophyta	64	Oscillatoria (64); Aphanizomenon
						Chlorophyta	22	Actinastrum (8); Ankistrodesmus (8); Dictyosphaerium (2); Chodatella (1); Tetrastrum (1); Crucigenia; Selenastrum; Chlamydomonas; Scenedesmus; Golenkinia
						Chrysophyta	7	Synedra (4); Ochromonas (3); Melosira; Asterionella
						Euglenophyta	7	Cryptomonas (3); Chroomonas (3); Trachelomonas (1); Lepocinclis; Phacus
						Pyrrhophyta	< 1	Peridinium
Site L-1 at midpoint ----	4-19-77	2-ft depth	590,000	0.6	62	Cyanophyta	93	Oscillatoria (93); Agmenellum
						Euglenophyta	4	Chroomonas (4); Trachelomonas; Euglena
						Chlorophyta	2	Actinastrum (1); Ankistrodesmus (1); Scenedesmus; Chodatella; Gloeocystis
						Chrysophyta	1	Fragilaria (1); Melosira; Cyclotella; Dinobryon; Mallomonas; Nitzschia
Site L-1 at midpoint ----	8-9-77	euphotic zone composite	2,100,000	1.4	29	Cyanophyta	100	Lyngbya (71); Raphidiopsis (14); Oscillatoria (9); Cylindrospermum (3); Aphanizomenon (2)
						Euglenophyla	< 1	Trachelomonas
Site L-1 at midepoint ----	8-9-77	2-ft depth	1,000,000	1.8	34	Cyanophyta	97	Lyngbya (55); Raphidiopsis (26); Aphanizomenon (7); Oscillatoria (5); Cylindrospermum (3); Anacystis
						Chlorophyta	2	Dictyosphaerium (1); Pandorina (1); Kirchneriella; Schroederia; Actinastrum; Scenedesmus
						Euglenophyta	< 1	Trachelomonas

* Less than 1 percent not given.

Thermal stratification, high photosynthetic rates within the epilimnion, and changes in water chemistry with depth are shown in the April data. By August 9, the epilimnion was 8°-9° C warmer than in April, but the hypolimnion below 30 ft had warmed only 1° C. Dissolved-oxygen concentrations within the epilimnion in August were near staturation. The metalimnion (thermocline) and hypolimnion were anaerobic, showed increases in specific conductance and hydrogen sulfide with depth, and had a pH of near 7.0. The bicarbonate concentration and BOD values were higher in the bottom water than near the surface. A significant increase in color occurred in the bottom BOD sample 3-5 days into the incubation period.

Nitrogen and orthophosphorus concentrations in the near-surface samples at site L-1 were low in April and August. Silica concentrations were lower in April than in August; the difference probably reflects silica uptake by diatoms in spring.

Nutrient recycling to ammonia and orthophorphorus at the lake bottom is indicated in both the April and August data. Zooplankters were common in the surface and bottom collections, and small amounts of *Myriophyllum* were observed in the lake. Composite collections for phytoplankton show a diverse community dominated by the blue-green (Cyanophyta) algae, *Oscillatoria*, in April and *Lyngbya* in August.

Inflow data: No inflows were sampled.

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