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HYDROLOGIC DATA FOR POINT MACKENZIE AREA, SOUTHCENTRAL ALASKA

By R. L. Glass

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CONVERSION FACTORS

For use of readers who prefer to use metric units, conversion factors for terms used in this report are listed below:

Multiply	By	To obtain
inch (in)	25.40	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
gallons per minute (gal/min)	3.785	liters per minute (L/min)
micromho per centimeter at 25° Celsius (umhos/cm at 25°C)	1.000	microsiemens per centimeter at 25° Celsius (uS/cm at 25°C)

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as follows:

$$°F = 1.8°C + 32$$

National Geodetic Vertical Datum of 1929 (NGVD of 1929): The reference surface to which relief features and altitude data are related, and formally called mean sea level. NGVD of 1929 is referred to as sea level in this report.

INTRODUCTION

The Matanuska-Susitna Borough is planning for agricultural development on the west side of Cook Inlet between Point MacKenzie and Goose Bay. The state of Alaska recently sold the agricultural rights to approximately 13,940 acres of land in the vicinity of Point MacKenzie (fig. 1). The Point MacKenzie Agricultural Project is expected to provide a major stimulus to develop the area. Information on the area's water resources -- their distribution, quantity, quality and availability for use -- will be important to the planning and management of that development.

This report is a compilation of water-resources data collected by the U.S. Geological Survey as part of a cooperative program with the Matanuska-Susitna Borough. The Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, funded a part of the program. The data include: lithology of materials penetrated during the drilling of 8 wells, chemical analyses of water from 5 wells, levels of the water in wells, periodic measurements of water levels in 4 lakes, and water-quality analyses of 2 lakes. A previous report (Patrick, 1981) describes results of drilling 2 test wells (wells 21585 and 21586, fig. 1) near Point MacKenzie. Data for those wells are included in this report.

GROUND-WATER DATA

Eight wells have recently been drilled in the Point MacKenzie area. Two test holes (wells 21585 and 21586) were drilled for the Matanuska-Susitna Borough to provide information on the subsurface geology and aquifer conditions in the proposed industrial area near Point MacKenzie. Two additional test holes (wells 21614 and 21615) were drilled for the U.S.

Geological Survey within the Point MacKenzie Agricultural Project area. The remaining 4 wells were drilled by private individuals to provide water for domestic or agricultural uses.

Lithologic logs for the 8 wells (tables 1-8) were compiled from information provided by well drillers. The logs indicate a large variability in the vertical and areal extent of the deposits penetrated during the drilling of the wells. Geologic materials ranged in character from mixed coarse-grained (gravel-sand), through mixed coarse and fine-grained (gravel-sand-silt-clay), to very fine (clay) sediments.

The wells range in depth from 50 ft (well 21619) to 398 ft (well 21585). Most wells penetrate both a shallow, unconfined aquifer and a deeper, confined aquifer or a series of confined aquifers. Wells 21585 and 21618 yield approximately 300 and 200 gal/min, respectively, from the confined aquifer. However, wells 21614 (depth 200 ft) and 21617 (depth 380 ft) did not penetrate a confined aquifer and yield virtually no water.

Water levels in well 21585 are affected by tides, yet the maximum-daily water levels fluctuate little throughout the year (fig. 2).

The results of chemical analyses of water from wells are shown in table 9. The relative concentrations of chemical constituents are portrayed graphically in figure 3.

The "pie" diagrams represent both the total concentration of dissolved solids and the percentage of each major anion and cation. The area of the circle

represents the total dissolved solids; the larger the circle the more dissolved solids. The subdivisions of the circle represent the percentages of the different anions and cations in milliequivalents per liter, a unit which recognizes that different types of ions have different weights and electric charges.

In an analysis expressed in milliequivalents per liter, if the concentrations of all anions and cations have been correctly determined, the total milliequivalents per liter of anions (such as bicarbonate, HCO_3; sulfate, SO_4; and chloride, Cl) should exactly equal the total milliequivalents per liter of cations (such as calcium, Ca; magnesium, Mg; sodium, Na; and potassium, K).

LAKE DATA

Data were collected from 4 lakes in the Point MacKenzie area. All the lakes are bordered in part by marshy areas; none of the lakes have a distinct surface-outflow channel.

Horseshoe Lake is a U-shaped lake at the eastern edge of the Point MacKenzie Agricultural Project area. The surface area of the lake is approximately 0.2 mi^2. The maximum depths of its west and east arms are 25 and 19 ft, respectively. These two main arms are connected at their southern ends by a shallow-water (4 ft) arm.

Lost Lake, Twin Island Lake, and Lake Lorraine, east of the agricultural area, are on or adjacent to the Elmendorf Moraine (fig. 1). Each of these lakes has a surface area of approximately 0.2 mi^2. Lake Lorraine, near the center of the proposed industrial area, has a maximum depth of 28 ft.

Water levels were measured periodically at all 4 lakes. The water level at each lake is referenced to the elevation of a lag bolt in a nearby tree. The datum assigned to each reference mark was arbitrary and does not reflect its height above sea level. Water levels varied seasonally, responding to rainfall and evapotranspiration (fig. 4). Measurements of water level at Horseshoe Lake on August 1, 1978 and October 5, 1978 were 3.36 and 3.34, respectively; about a foot lower than when measurements were made between October 1980 and May 1982.

Water-quality data were collected at Horseshoe Lake and Lake Lorraine. Water samples for analysis of nutrients and vertical profiles of temperature, pH, specific conductance, and dissolved oxygen were obtained in June, July, August, and September 1981 and in March 1982. Samples for analysis of major anions and cations were collected in August 1981 and March 1982.

The results of analyses of water from Lakes Lorraine and Horseshoe are shown in table 10. The relative concentrations of chemical constituents are shown in fig. 3. Figures 5 (a-e), 6 (a-e), and 7 (a-e) illustrate changes in temperature, pH, specific conductance, and dissolved oxygen within a vertical section at Lake Lorraine, East Arm Horseshoe Lake, and West Arm Horseshoe Lake.

Dissolved oxygen is essential to the metabolism of all aerobic aquatic organisms. Even at low temperatures, most fish cannot survive when concentrations of dissolved oxygen are less than 2 mg/L. Vertical profiles of Horseshoe Lake show that concentrations of dissolved oxygen were sometimes less than 2 mg/L in the bottom-most strata of water.

The concentration of oxygen and pH may affect the solubility of other constituents including many inorganic nutrients. Concentrations of iron and manganese were sometimes high when concentrations of dissolved oxygen were low.

The concentrations of nutrients such as nitrogen (N) and phosphorous (P) affect the growth of many organisms such as algae and larger aquatic plants and commonly limit biological productivity. Nitrogen in lakes occurs mainly as ammonia (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-), and dissolved and particulate organic nitrogen. The concentrations of dissolved ammonia, as N, ranged from 0.067 to 1.3 mg/L and the concentration of dissolved nitrite and nitrate, as N, were generally less than 0.1 mg/L. Inorganic phosphorus in lakes is generally in the form of orthophosphate (PO_4^-). The total orthophosphate concentrations, as P, were generally less than 0.03 mg/L.

The concentrations of total organic nitrogen, as N, and total phosphorus, as P, in Lakes Lorraine and Horseshoe were generally less than 1.0 and 0.05 mg/L, respectively. The September 25, 1981, sample of the hypolimnion of the East Arm Horseshoe Lake may have sampled water containing sediments stirred up from the bottom of the lake; thus its values for total organic nitrogen and total phosphorus are suspect.

WATER-QUALITY CRITERIA

The chemical character of water governs its suitability for many uses. Domestic users are chiefly concerned with hardness, iron and maganese

content, pH, color, turbidity, odor, and the concentrations of dissolved solids, chloride, nitrogen, fluoride, and sulfate, and the bacteriological quality of the water. Recommended concentration limits for domestic uses (table 11) are set to provide acceptable esthetic and taste characteristics as well as for physiological reasons.

The suitability of water for irrigation is dependent on the effects of the mineral constituents of the water on both the plant and the soil. Agricultural users are interested in concentrations of dissolved solids, sodium, and boron.

The quality requirements of water for industrial processes range widely. In general, industrial users are concerned with the concentrations of dissolved solids and silica and the temperature and hardness of the water.

REFERENCES CITED

Patrick, Leslie, 1981, Results of exploratory drilling at Point MacKenzie, Alaska, 1981: U.S. Geological Survey Open-File Report 81-1072, 8 p.

National Academy of Sciences, National Academy of Engineering, Water quality criteria 1972: U.S. Government Printing Office, 594 p.

U.S. Environmental Protection Agency, 1976, Quality criteria for water: U.S. Government Printing Office, 256 p.

Table 1. -- Lithologic log of well 21585

Owner: Matanuska-Susitna Borough
Location: Section 23, T. 14 N., R. 4 W. (Seward Meridian)
Well completed: March 18, 1981
Driller: M-W Drilling, Inc.

Depth from land surface, in feet	Lithologic description
1 to 4	Silty sand and gravel
4 to 15	Silty sand and gravel (water)
15 to 26	Silty sand (water)
26 to 35	Clay
35 to 55	Silty, sandy clay (damp)
55 to 63	Clay
63 to 125	Hardpan
125 to 130	Silty sand and gravel (water)
130 to 170	Sand and gravel (water)
170 to 188	Clay
188 to 197	Gravelly clay
197 to 219	Clayey, silty sandy gravel
219 to 284	Sand and gravel (water)
284 to 294	Sand (water)
294 to 309	Sand and gravel (water)
309 to 312	Gravelly sand (water)
312 to 323	Silty sand (water)
323 to 338	Silty sand and gravel (water)
338 to 398	Sand and gravel (water)

Well cased to ---------- 398 ft below land surface
Depth of perforations ---------- 379 to 398 ft (100 slot, wire-wound screen) below land surface
Depth to water---------- 106 ft below land surface (March 18, 1981)
Yield ---------- 310 gal/min with 27.3 ft of drawdown after 24 hours (March 18, 1981)
Altitude of land surface ---------- 130 ft above sea level

Remarks: Water levels are influenced by tides. Tidal-fluctuation effects are in the order of 0.2 to 0.5 ft. Water analyses indicate calcium bicarbonate water in the upper aquifer; water types trend toward sodium bicarbonate in the deeper aquifers.

Modified from Patrick, 1981

Table 2. -- Lithologic log of well 21586

Owner: Matanuska-Susitna Borough
Location: Section 26, T. 14 N., R. 4 W. (Seward Meridian)
Well completed: March 3, 1981
Driller: M-W Drilling, Inc.

Depth from land surface, in ft	Lithologic description
1 to 8	Sand and gravel
8 to 18	Silty sand
18 to 23	Sand (water)
23 to 31	Clay, gray
31 to 106	Gravelly clay, grey
106 to 116	Clayey gravel
116 to 156	Silty gravel
156 to 166	Sand and gravel (water)
166 to 185	Hard dry silt
185 to 198	Sand and gravel (water)
198 to 203	Sand (water)
203 to 219	Silt, sand, and gravel
219 to 225	Sandy, sand and gravel (water)
225 to 238	Gravel (water)
238 to 328	Sand and gravel (water)
328 to 339	Sand, heaving (water)
339 to 349	Silty sand and gravel, heaving (water)
349 to 351	Silty gravel
351 to 352	Cemented sand and gravel
352 to 358	Clay, sticky

Well cased to ---------- 358 ft below land surface
Depth of perforations ---------- 318 to 323 ft below land surface
Depth to water ---------- 142 ft below land surface (March 3, 1981)
Yield ---------- Not reported
Altitude of land surface ---------- 152 ft above sea level

Remarks: Water levels are influenced by tides in the order of 2 ft. Water obtained from this well is moderately hard and sodium bicarbonate in type.

Modified from Patrick, 1981

Table 3. -- Lithologic log of well 21614

Owner: U.S. Geological Survey
Location: Section 23, T. 15 N., R. 5 W. (Seward Meridian)
Well completed: September 22, 1982
Driller: M-W Drilling, Inc.

Depth from land surface, in ft	Lithologic description
0 to 14	Sand and gravel
14 to 43	Sand and gravel (water)
43 to 78	Clay, gray
78 to 80	Silty sand and gravel, gray
80 to 104	Silty sand
104 to 111	Silty clay, gray
111 to 133	Sand, gray
133 to 145	Gravelly, silt, gray
145 to 158	Sandy silt, gray
158 to 178	Gravelly silt, gray
178 to 200	Sandy silt, gray

Well cased to ---------- 200 ft below land surface with 6-inch steel casing, open ended
Yield ---------- 0 gal/min
Altitude of land surface ---------- 120 ft above sea level

Modified from driller's log

Table 4. -- Lithologic log of well 21615

Owner: U.S. Geological Survey
Location: Section 20, T. 15 N., R. 4 W. (Seward Meridian)
Well completed: October 4, 1982
Driller: M-W Drilling, Inc.

Depth from ground surface, in feet	Lithologic description
2 to 20	Sand, gravel, and cobbles
20 to 45	Sand and gravel
45 to 50	Silt, brown
50 to 63	Sand (water)
63 to 72	Silty gravel
72 to 74	Silt, brown
74 to 76	Sand and gravel (water)
76 to 80	Silty sand and gravel
80 to 90	Sand and gravel (water)
90 to 95	Silt, gray
95 to 100	Clay, brownish gray
100 to 114	Clayey silt with thin sand lenses (water)
114 to 120	Gravelly silt
120 to 258	Clayey silt, gray
258 to 278	Sandy and clayey silt, gray
278 to 314	Silty gravelly clay, gray
314 to 318	Sand and gravel (water)

Well cased to ---------- 318 ft below land surface with 6-inch steel casing, open end
Depth to water level ---------- 91 ft (October 12, 1982)
Yield ---------- Not reported
Altitude of land surface ---------- 185 ft above sea level

Modified from driller's log

Table 5. -- Lithologic log of well 21616

Owner: John Faeo
Location: Section 23, T. 15 N., R. 4 W. (Seward Meridian)
Well completed: July 12, 1982
Driller: M-W Drilling, Inc.

Depth from ground surface, in feet	Lithologic Description
0 to 18	Top soil
18 to 19	Very hard cobble gravel
19 to 38	Sand
38 to 58	Layered sand and gravel
58 to 68	Sand
68 to 73	Sand and gravel (water)

Well cased to ---------- 73 ft below land surface with 6-inch steel casing, open end
Depth to water level ---------- 60 ft below land surface (July 12, 1982)
Yield ---------- 6 gal/min (estimated by driller)
Altitude of land surface ---------- 50 ft above sea level

Modified from driller's log

Table 6. -- Lithologic log of well 21617

Owner: Greg Bell
Location: Section 27, T. 15 N., R. 4 W. (Seward Meridian)
Well completed: July 19, 1982
Driller: M-W Drilling, Inc.

Depth from land surface, in ft	Lithologic description
0 to 2	Top soil
2 to 103	Sand, very fine
103 to 136	Silty clay
136 to 198	Clay
198 to 238	Silty clay
238 to 328	Clay
328 to 338	Clay - hard pan
338 to 373	Hard pan
373 to 380	Sand, very fine, heaving

Well cased to ---------- 380 ft below land surface with 6-inch steel casing, open ended.
Yield ---------- 0 gal/min
Altitude of land surface--------- 200 ft above sea level

Modified from driller's log

Table 7. -- Lithologic log of well 21618

Owner: Karen Lee (Dairy West)
Location: Section 35, T. 15 N., R. 5 W. (Seward Meridian)
Well completed: July 29, 1982
Driller: M-W Drilling, Inc.

Depth from land surface, in ft	Lithologic description
0 to 26	Sandy gravel
26 to 30	Gravel (damp)
30 to 58	Sandy clay
58 to 78	Silty sand
78 to 86	Sily sand and clay
86 to 98	Clayish hard pan
98 to 104	clay - hard pan
104 to 106	Hard pan and gravel (damp)
106 to 200	Clay
200 to 206	Sand, fine, gray
206 to 219	Silty sand and gravel
219 to 239	Gravel (water)

Well cased to ---------- 239 ft below land surface with 6-inch steel casing, open ended
Depth to water ---------- 2 ft below land surface (July 29, 1982)
Yield ---------- 200 gal/min
Altitude of land surface ---------- 120 ft above sea level

Modified from driller's log

Table 8. -- Lithologic log of well 21619

Owner: Karen Lee (Dairy West)
Location: Section 35, T. 15 N., R. 5 W. (Seward Meridian)
Well completed: July 29, 1982
Driller: M-W Drilling, Inc.

Depth from land surface, in ft	Lithologic description
2 to 34	Sand and gravel
34 to 38	Sand (damp)
38 to 50	Sand and gravel (water)

Well cased to ---------- 50 ft below land surface with 6-inch steel casing, open ended
Depth to water ---------- 28 ft below land surface (July 29, 1982)
Yield ---------- 5 gal/min
Altitude of land surface ------ 120 ft above sea level

Modified from driller's log

TABLE 9. -- PHYSICAL PROPERTIES AND CONCENTRATIONS OF DISSOLVED CONSTITUENTS FOR WELLS IN PT. MACKENZIE AREA, MATANUSKA-SUSITNA BOROUGH.

WELL NUMBER	SAMPLE DEPTH (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS) (00095)	PH (UNITS) (00400)	TEMPERATURE (DEG C) (00010)	HARDNESS (MG/L AS CACO3) (00900)	HARDNESS NONCARBONATE (MG/L AS CACO3) (95902)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	PERCENT SODIUM (00932)	SODIUM ADSORPTION RATIO (00931)
21585	137	81-02-19	250	8.3	3.0	110	.00	24	13	12	18	.5
	277	81-02-23	400	8.7	4.0	140	.00	31	15	45	41	1.7
	347	81-02-25	675	8.8	4.0	83	.00	22	6.8	120	75	5.7
21586	158	81-02-12	338	8.2	3.5	72	.00	15	8.5	54	61	2.8
	240	81-02-13	338	8.1	3.5	93	.00	22	9.2	43	49	1.9
21615	318	82-10-12	2100	8.3	3.5	330	--	54	48	400	72	9.6
21618	239	82-09-24	350	8.2	3.5	63	.00	13	7.5	58	64	3.5
21619	50	82-09-24	280	7.9	3.5	95	4.0	31	4.3	18	29	.8

WELL NUMBER	DATE OF SAMPLE	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	ALKALINITY LAB (MG/L AS CACO3) (90410)	SULFATE DISSOLVED (MG/L AS SO4) (00945)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	PHOSPHORUS, DISSOLVED (MG/L AS P) (00666)	ARSENIC DISSOLVED (UG/L AS AS) (01000)
21585	81-02-19	2.9	120	9.5	3.1	.1	13	150	.00	.060	13
	81-02-23	3.1	200	8.7	16	.2	12	252	.00	.070	22
	81-02-25	2.5	190	14	97	.2	11	388	.00	.060	6
21586	81-02-12	1.9	170	9.1	3.3	.5	9.1	204	.00	.040	8
	81-02-13	2.9	150	7.3	17	.2	12	204	.00	.040	9
21615	82-10-12	9.2	<1.0	130	700	.2	12	1430	<.10	.040	15
21618	82-09-24	5.1	181	<5.0	7.8	.3	15	--	<.10	.990	38
21619	82-09-24	1.3	91	8.0	23	<.1	10	151	.20	.020	1

TABLE 9. -- PHYSICAL PROPERTIES AND CONCENTRATIONS OF DISSOLVED CONSTITUENTS FOR WELLS IN PT. MACKENZIE AREA, MATANUSKA-SUSITNA BOROUGH.

WELL NUMBER	DATE OF SAMPLE	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)
21585	81-02-19	90	30	100
	81-02-23	170	40	90
	81-02-25	200	60	60
21586	81-02-12	410	20	40
	81-02-13	160	40	80
21615	82-10-12	130	560	170
21618	82-09-24	200	100	76
21619	82-09-24	30	14	6

TABLE 10. -- PHYSICAL PROPERTIES AND CONCENTRATIONS OF DISSOLVED CONSTITUENTS FOR LAKES IN THE PT. MACKENZIE AREA, MATANUSKA-SUSITNA BOROUGH.

STATION	DATE OF SAMPLE	SAMPLING DEPTH (FEET) (00003)	SPECIFIC CONDUCTANCE (UMHOS) (00095)	PH (UNITS) (00400)	TEMPERATURE (DEG C) (00010)	OXYGEN, DISSOLVED (MG/L) (00300)	OXYGEN, DISSOLVED (PERCENT SATURATION) (00301)	HARDNESS (MG/L AS CACO3) (00900)	HARDNESS NONCARBONATE (MG/L AS CACO3) (95902)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)
LAKE LORRAINE	81-06-15	3.00	66	8.0	17.3	10.3	106	--	--	--	--
	81-06-15	24.0	60	8.6	10.1	15.7	139	--	--	--	--
	81-07-22	3.00	61	7.4	17.9	9.3	97	--	--	--	--
	81-07-22	22.0	61	--	--	--	--	--	--	--	--
	81-08-19	3.00	65	7.1	15.1	9.2	93	28	.00	7.8	2.0
	81-08-19	24.0	66	6.6	14.8	8.2	83	31	7.0	9.0	2.1
	81-09-25	3.00	57	7.1	10.6	11.2	100	--	--	--	--
	81-09-25	24.0	63	6.9	11.0	3.2	29	--	--	--	--
	82-03-10	6.00	73	6.5	4.5	6.7	52	41	4.0	10	4.0
	82-03-10	24.0	73	6.5	4.6	5.7	45	43	4.0	12	3.1
WEST ARM HORSESHOE LAKE	81-06-16	3.00	148	7.9	17.7	10.2	106	--	--	--	--
	81-06-16	24.0	194	6.8	7.0	.0	0	--	--	--	--
	81-07-22	3.00	139	7.4	17.5	9.5	98	--	--	--	--
	81-07-22	24.0	206	6.3	9.3	.5	4	--	--	--	--
	81-08-18	3.00	142	7.1	14.5	9.1	89	62	3.0	21	2.4
	81-08-18	24.0	166	7.1	14.1	6.8	66	67	6.0	23	2.4
	81-09-25	3.00	138	6.9	10.1	10.5	93	--	--	--	--
	81-09-25	24.0	138	7.3	9.9	10.0	88	--	--	--	--
	82-03-10	6.00	149	6.9	2.9	10.3	77	76	4.0	26	2.6
	82-03-10	21.0	--	--	--	--	--	82	.00	28	3.0
EAST ARM HORSESHOE LAKE	81-06-16	3.00	159	8.2	17.0	12.3	127	--	--	--	--
	81-06-16	18.0	164	8.2	16.3	12.2	124	--	--	--	--
	81-07-22	3.00	148	7.7	17.3	9.8	100	--	--	--	--
	81-07-22	18.0	165	7.4	16.2	8.4	84	--	--	--	--
	81-08-18	3.00	177	7.6	13.8	10.0	97	80	6.0	28	2.5
	81-08-18	18.0	182	7.4	13.6	8.7	84	80	6.0	28	2.5
	81-09-25	3.00	180	7.5	9.0	11.3	97	--	--	--	--
	81-09-25	18.0	180	7.7	8.9	11.0	95	--	--	--	--
	82-03-10	5.00	--	--	--	--	--	110	3.0	40	3.1
	82-03-10	16.0	311	7.2	5.5	1.2	10	160	.00	57	4.3

TABLE 10. -- PHYSICAL PROPERTIES AND CONCENTRATIONS OF DISSOLVED CONSTITUENTS FOR LAKES IN THE PT. MACKENZIE AREA, MATANUSKA-SUSITNA BOROUGH.

STATION	DATE OF SAMPLE	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	PERCENT SODIUM (00932)	SODIUM AD-SORP-TION RATIO (00931)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS NH4) (71846)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N) (00605)	NITRO-GEN, ORGANIC DIS-SOLVED (MG/L AS N) (00607)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NH4 + ORG. SUSP. TOTAL (MG/L AS N) (00624)
LAKE LORRAINE	81-06-15	--	--	--	.00	--	--	.59	--	.64	--
	81-06-15	--	--	--	.01	--	--	.69	--	.71	--
	81-07-22	--	--	--	.02	--	--	.76	--	.82	--
	81-07-22	--	--	--	.02	--	--	.70	--	.75	--
	81-08-19	2.3	15	.2	.00	.084	.11	.71	.57	.76	.11
	81-08-19	2.4	14	.2	.00	.086	.11	.78	.62	.85	.14
	81-09-25	--	--	--	.01	.109	.14	.57	.89	.69	.00
	81-09-25	--	--	--	.01	.085	.11	.84	.76	.93	.09
	82-03-10	3.0	13	.2	.09	.333	.43	.45	.45	.80	.02
	82-03-10	3.9	16	.3	.07	.435	.56	.59	.56	1.00	.00
WEST ARM HORSESHOE LAKE	81-06-16	--	--	--	.02	--	--	.46	--	.53	--
	81-06-16	--	--	--	.02	--	--	1.2	--	1.30	--
	81-07-22	--	--	--	.02	--	--	.65	--	.71	--
	81-07-22	--	--	--	.02	--	--	.71	--	.74	--
	81-08-18	5.3	15	.3	.00	.067	.09	.59	.50	.64	.07
	81-08-18	5.9	16	.3	.00	.095	.12	.71	.47	.79	.23
	81-09-25	--	--	--	.00	.122	.16	.37	.70	.49	.00
	81-09-25	--	--	--	.01	.135	.17	.41	.59	.55	.00
	82-03-10	5.6	14	.3	.11	.089	.11	.61	.54	.71	.08
	82-03-10	6.3	14	.3	.06	.322	.41	.61	.52	.88	.04
EAST ARM HORSESHOE LAKE	81-06-16	--	--	--	.02	--	--	.33	--	.37	--
	81-06-16	--	--	--	.02	--	--	1.0	--	1.10	--
	81-07-22	--	--	--	.02	--	--	.53	--	.60	--
	81-07-22	--	--	--	.02	--	--	--	--	.00	--
	81-08-18	3.2	8	.2	.00	.075	.10	.48	.38	.53	.08
	81-08-18	3.2	8	.2	.00	.081	.10	.55	.39	.61	.14
	81-09-25	--	--	--	.01	.110	.14	.35	.60	.44	.00
	81-09-25	--	--	--	.01	.079	.10	6.6	.60	6.70	6.0
	82-03-10	4.8	8	.2	.03	.113	.15	.25	.32	.39	.00
	82-03-10	9.9	12	.3	<.01	1.30	1.7	.50	.40	2.00	.30

TABLE 10. -- PHYSICAL PROPERTIES AND CONCENTRATIONS OF DISSOLVED CONSTITUENTS FOR LAKES IN THE PT. MACKENZIE AREA, MATANUSKA-SUSITNA BOROUGH.

STATION	DATE OF SAMPLE	NITROGEN, AMMONIA + ORGANIC DIS. (MG/L AS N) (00623)	NITROGEN, TOTAL (MG/L AS N) (00600)	NITROGEN, TOTAL (MG/L AS NO3) (71887)	PHOSPHORUS, TOTAL (MG/L AS P) (00665)	PHOSPHORUS, DISSOLVED (MG/L AS P) (00666)	PHOSPHORUS, ORTHO, TOTAL (MG/L AS P) (70507)	PHOSPHORUS, ORTHO, DISSOLVED (MG/L AS P) (00671)	PHOSPHATE, ORTHO, DISSOLVED (MG/L AS PO4) (00660)
LAKE LORRAINE	81-06-15	--	.64	2.8	.010	--	.010	--	--
	81-06-15	--	.72	3.2	.010	--	.030	--	--
	81-07-22	--	.84	3.7	.016	--	.000	--	--
	81-07-22	--	.77	3.4	.013	--	.000	--	--
	81-08-19	.65	.76	3.4	.007	.008	.004	.004	.01
	81-08-19	.71	.85	3.8	.003	.006	.003	.005	.02
	81-09-25	1.0	.70	3.1	.001	<.001	.000	.004	.01
	81-09-25	.84	.94	4.2	.005	<.001	.004	.003	.01
	82-03-10	.78	.89	3.9	.013	.010	.000	.000	.00
	82-03-10	1.0	1.1	4.7	.011	.012	<.001	<.001	--
WEST ARM HORSESHOE LAKE	81-06-16	--	.55	2.4	.010	--	.010	--	--
	81-06-16	--	1.3	5.8	.050	--	.020	--	--
	81-07-22	--	.73	3.2	.013	--	.000	--	--
	81-07-22	--	.76	3.4	.020	--	.000	--	--
	81-08-18	.57	.64	2.8	.006	.009	.006	.003	.01
	81-08-18	.56	.79	3.5	.010	.004	.009	.003	.01
	81-09-25	.82	.49	2.2	<.001	.001	.000	.002	.01
	81-09-25	.73	.56	2.5	--	<.001	.000	.003	.01
	82-03-10	.63	.82	3.6	.008	.002	.009	<.001	--
	82-03-10	.84	.94	4.2	.002	<.001	.004	.000	.00
EAST ARM HORSESHOE LAKE	81-06-16	--	.39	1.7	.010	--	.000	--	--
	81-06-16	--	1.1	5.0	.020	--	.010	--	--
	81-07-22	--	.62	2.7	.011	--	.000	--	--
	81-07-22	--	.02	.10	.017	--	.023	--	--
	81-08-18	.45	.53	2.4	.007	.004	.003	.005	.02
	81-08-18	.47	.61	2.7	.008	.007	.002	.007	.02
	81-09-25	.71	.45	2.0	<.001	<.001	.002	.004	.01
	81-09-25	.68	6.7	30	.336	<.001	.136	.003	.01
	82-03-10	.43	.42	1.9	.012	.007	.002	.000	.00
	82-03-10	1.7	--	--	.008	.006	.007	<.001	--

TABLE 10. -- PHYSICAL PROPERTIES AND CONCENTRATIONS OF DISSOLVED CONSTITUENTS FOR LAKES IN THE PT. MACKENZIE AREA, MATANUSKA-SUSITNA BOROUGH.

STATION	DATE OF SAMPLE	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)
LAKE LORRAINE	81-06-15	--	--	--
	81-06-15	--	--	--
	81-07-22	--	--	--
	81-07-22	--	--	--
	81-08-19	0	14	3
	81-08-19	10	<10	2
	81-09-25	--	--	--
	81-09-25	--	--	--
	82-03-10	0	30	10
	82-03-10	0	30	30
WEST ARM HORSESHOE LAKE	81-06-16	--	--	--
	81-06-16	--	--	--
	81-07-22	--	--	--
	81-07-22	--	--	--
	81-08-18	0	82	29
	81-08-18	10	270	1100
	81-09-25	--	--	--
	81-09-25	--	--	--
	82-03-10	10	560	90
	82-03-10	10	2300	1400
EAST ARM HORSESHOE LAKE	81-06-16	--	--	--
	81-06-16	--	--	--
	81-07-22	--	--	--
	81-07-22	--	--	--
	81-08-18	0	12	3
	81-08-18	10	20	3
	81-09-25	--	--	--
	81-09-25	--	--	--
	82-03-10	0	20	10
	82-03-10	10	240	250

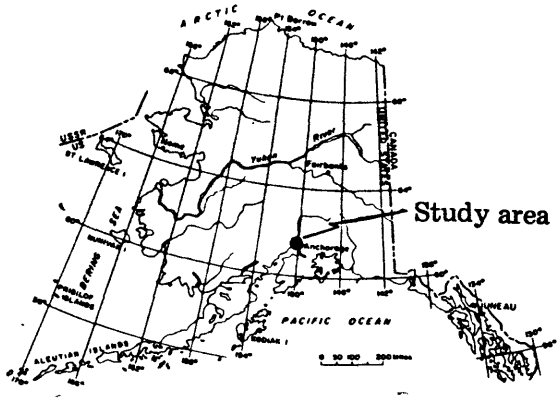
TABLE 11. -- Chemical constituents and their recommended maximum concentrations.

Constituent	Recommended concentration limits (mg/L)		
	Domestic uses 1./	Agricultural uses 2./	
		Livestock	Irrigated crops
Dissolved solids	500	3,000-7,000	700
Chloride (Cl)	250		
Sulfate (SO_4^{-2})	250		
Nitrogen (NO_3^-, as N)	10	100	
Iron (Fe)	0.3		
Manganese (Mn)	0.5		0.2
Boron (B)		5	0.75
Arsenic (As)	0.05	0.2	0.1

1 mg/L = 1,000 ug/L

1./ U.S. Environmental Protection Agency, 1976.

2./ National Academy of Sciences, National Academy of Engineering, 1972.



EXPLANATION

21616 ○ Water well and number

⌀ Dry well

⊘ Observation well

⊘ Observation well equipped with a water-level recorder

△ Stage-measurement station

▼ Water-quality and stage-measurement station

---- Road

—— Boundary of Pt. MacKenzie agricultural project

Location and explanation for figure 1.

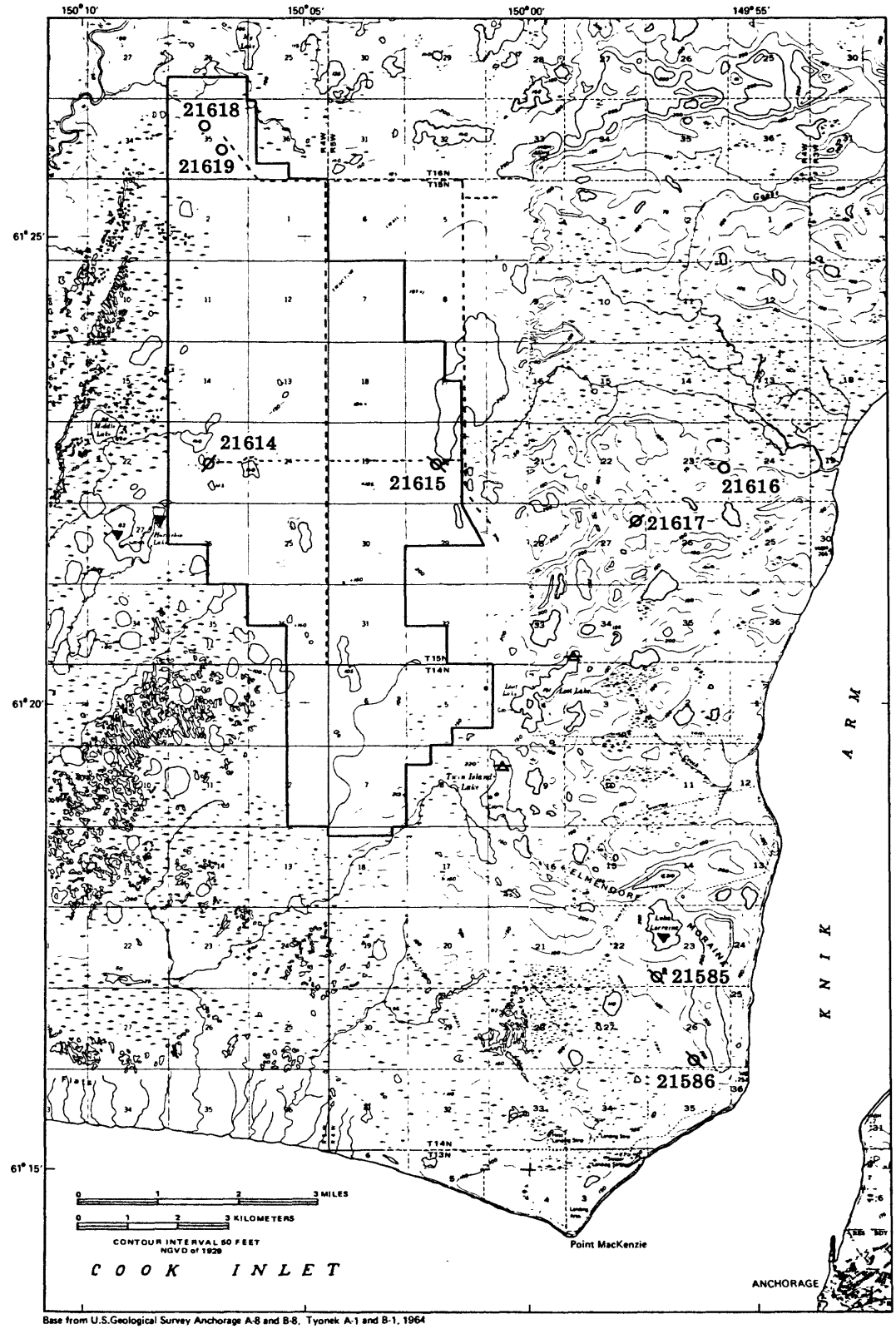


Figure 1.--Location of data-collection sites.

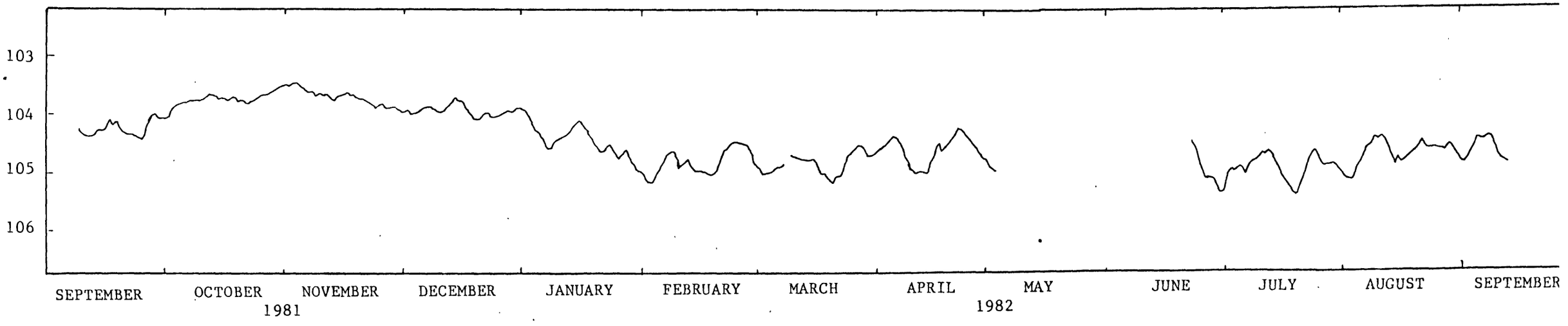
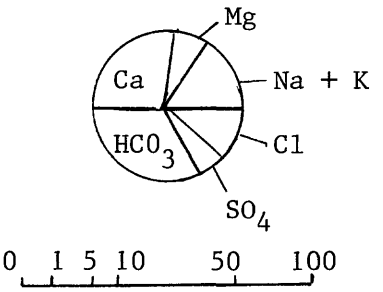


FIGURE 2. -- Water levels in well 21585.

EXPLANATION

21618

239 ft

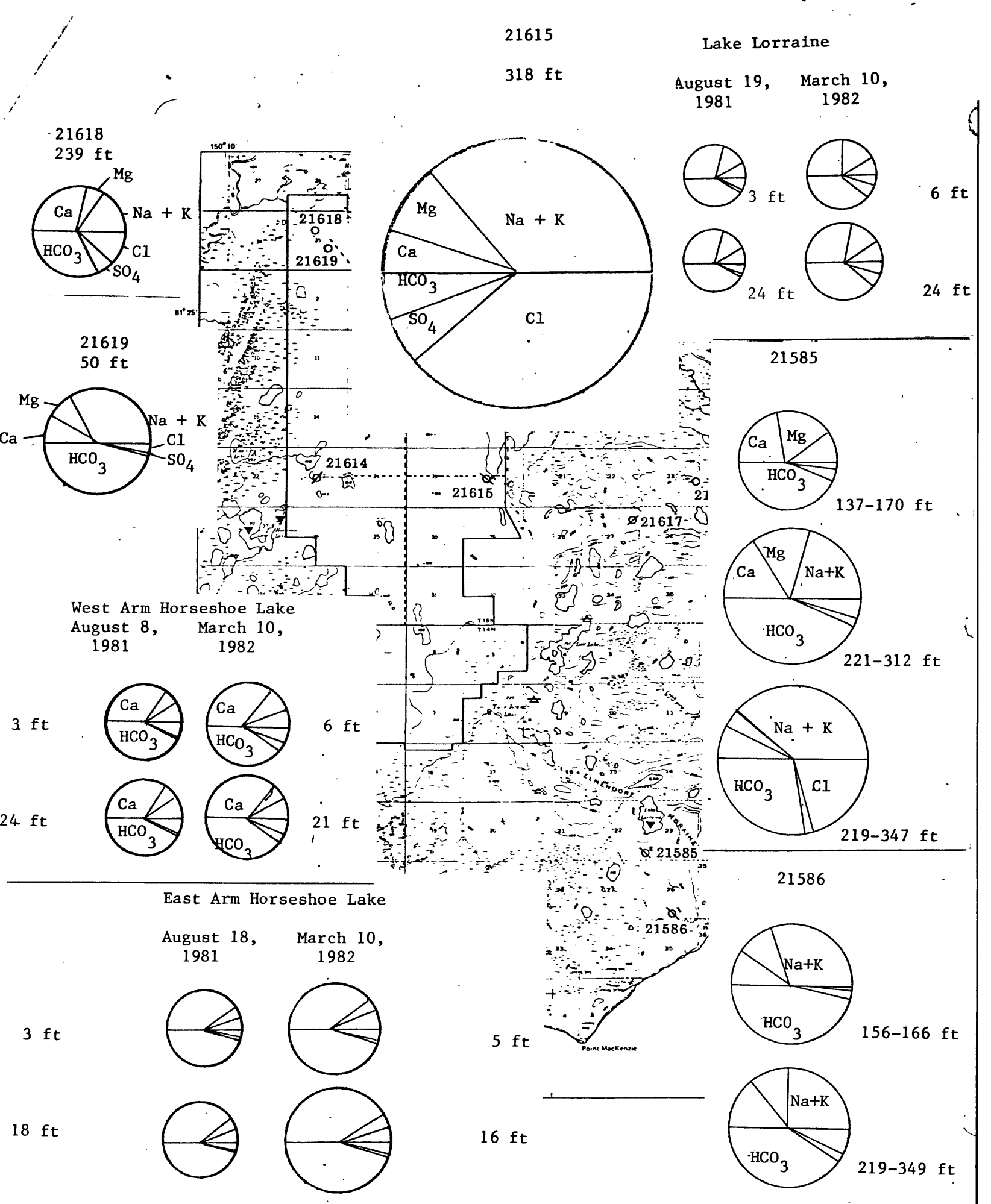


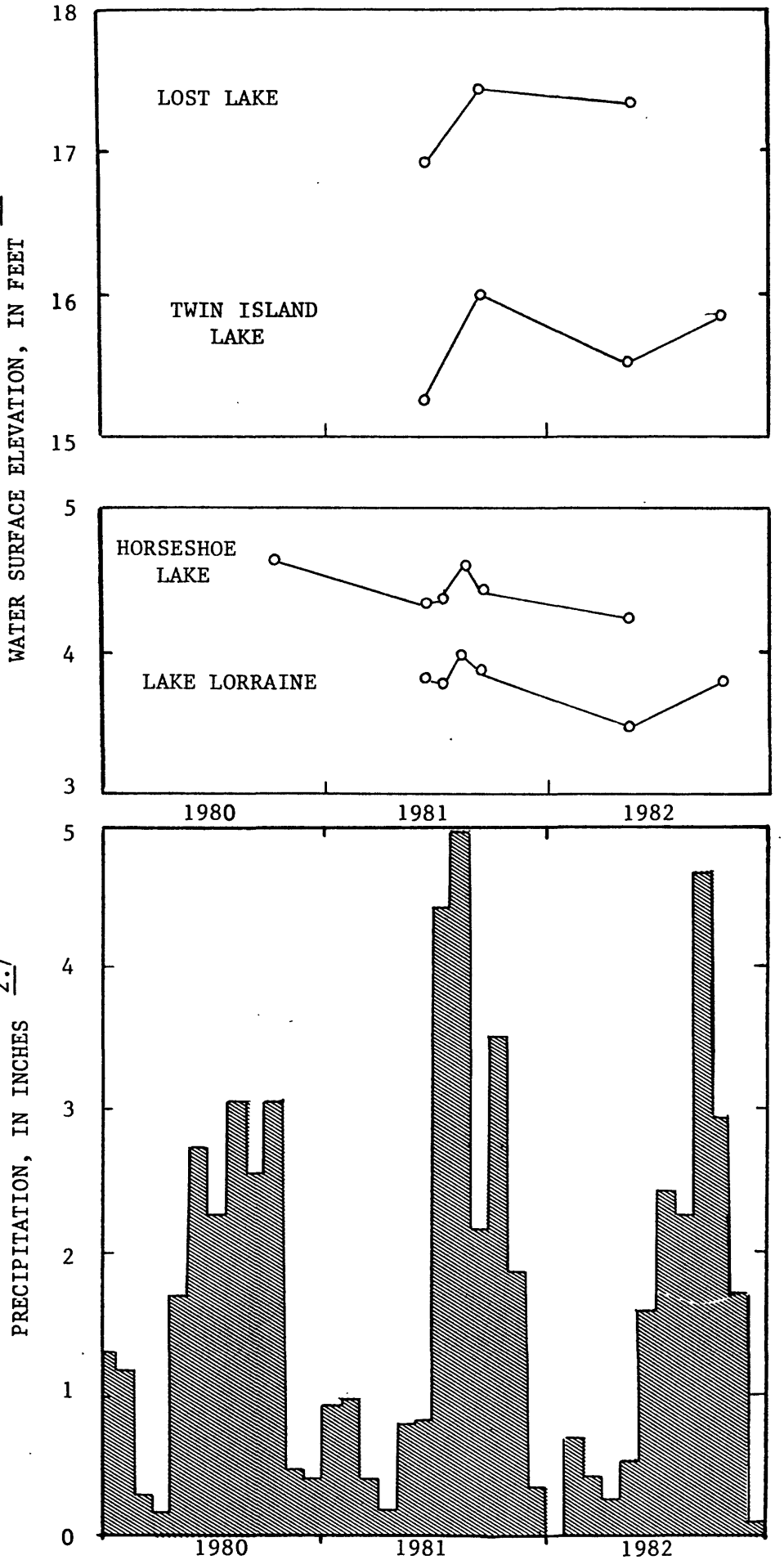
SCALE OF RADII
(TOTAL OF MILLIEQUIVALENTS PER LITER)

Analyses represented by circular diagrams subdivided on the basis of percent of total milliequivalents per liter

Numbers are site identification and sampling depth

FIGURE 3. -- Concentrations of chemical constituents in surface and ground water.


21615
318 ft
Lake Lorraine
August 19, 1981
March 10, 1982
21618
239 ft
Mg
Ca
Na + K
HCO3
Cl
SO4
21618
21619
3 ft
6 ft
24 ft
24 ft
21619
50 ft
Mg
Ca
Na + K
Cl
HCO3
SO4
21614
21615
21617
21585
Ca
Mg
HCO3
137-170 ft
Mg
Ca
Na+K
HCO3
221-312 ft
West Arm Horseshoe Lake
August 8, 1981
March 10, 1982
3 ft
6 ft
24 ft
21 ft
Ca
HCO3
Na + K
HCO3
Cl
219-347 ft
21585
21586
East Arm Horseshoe Lake
August 18, 1981
March 10, 1982
3 ft
5 ft
18 ft
16 ft
21586
Na+K
HCO3
156-166 ft
Na+K
HCO3
219-349 ft
Point MacKenzie



1./ Water surface elevations are referenced to an arbitrary datum at each site.
2./ Precipitation data provided by the National Oceanic and Atmospheric Administration.

FIGURE 4. -- Water levels of lakes and precipitation at Anchorage International Airport.

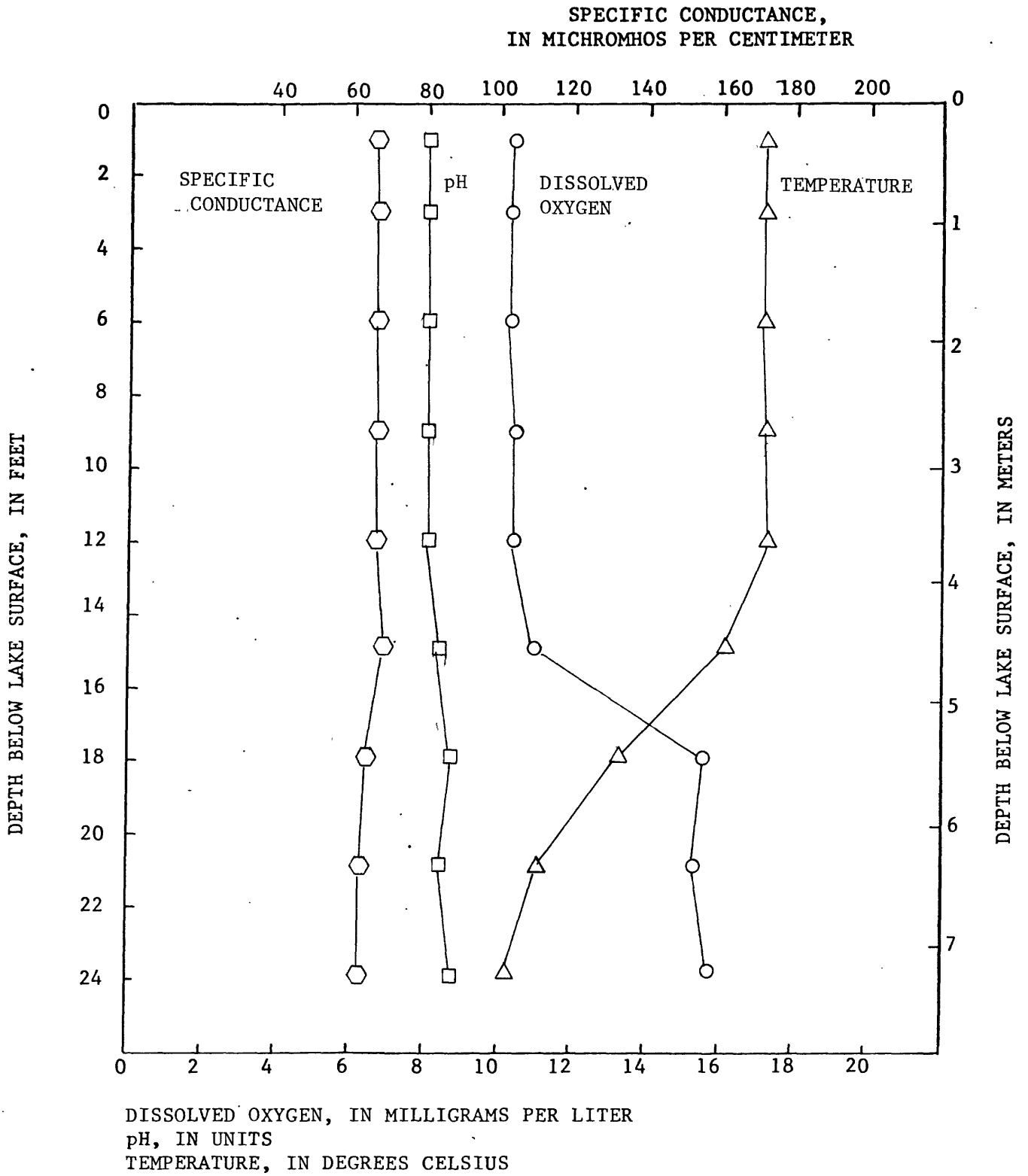


FIGURE 5A -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at Lake Lorraine, June 15, 1981.

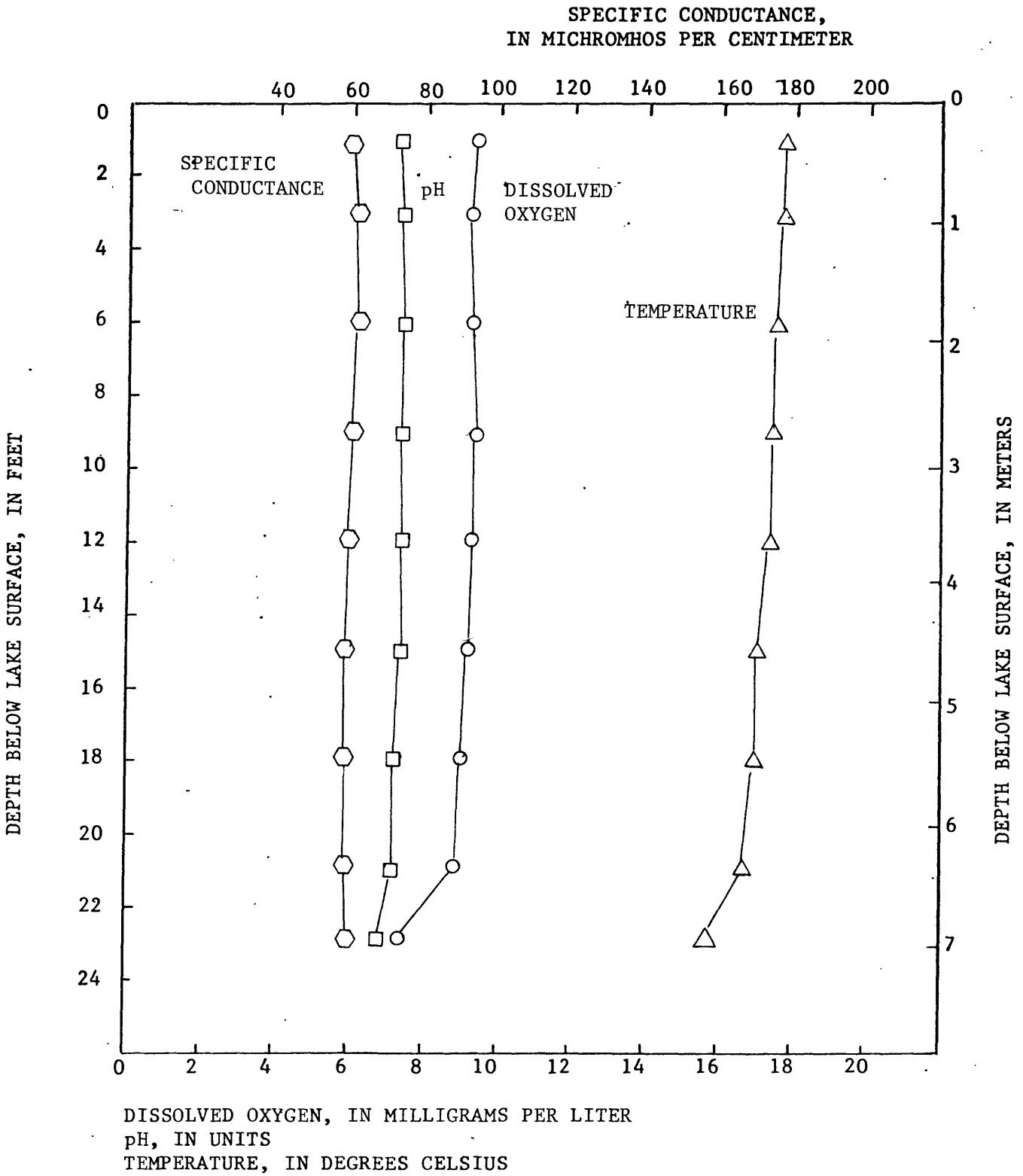


FIGURE 5B.-- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at Lake Lorraine, July 22, 1981.

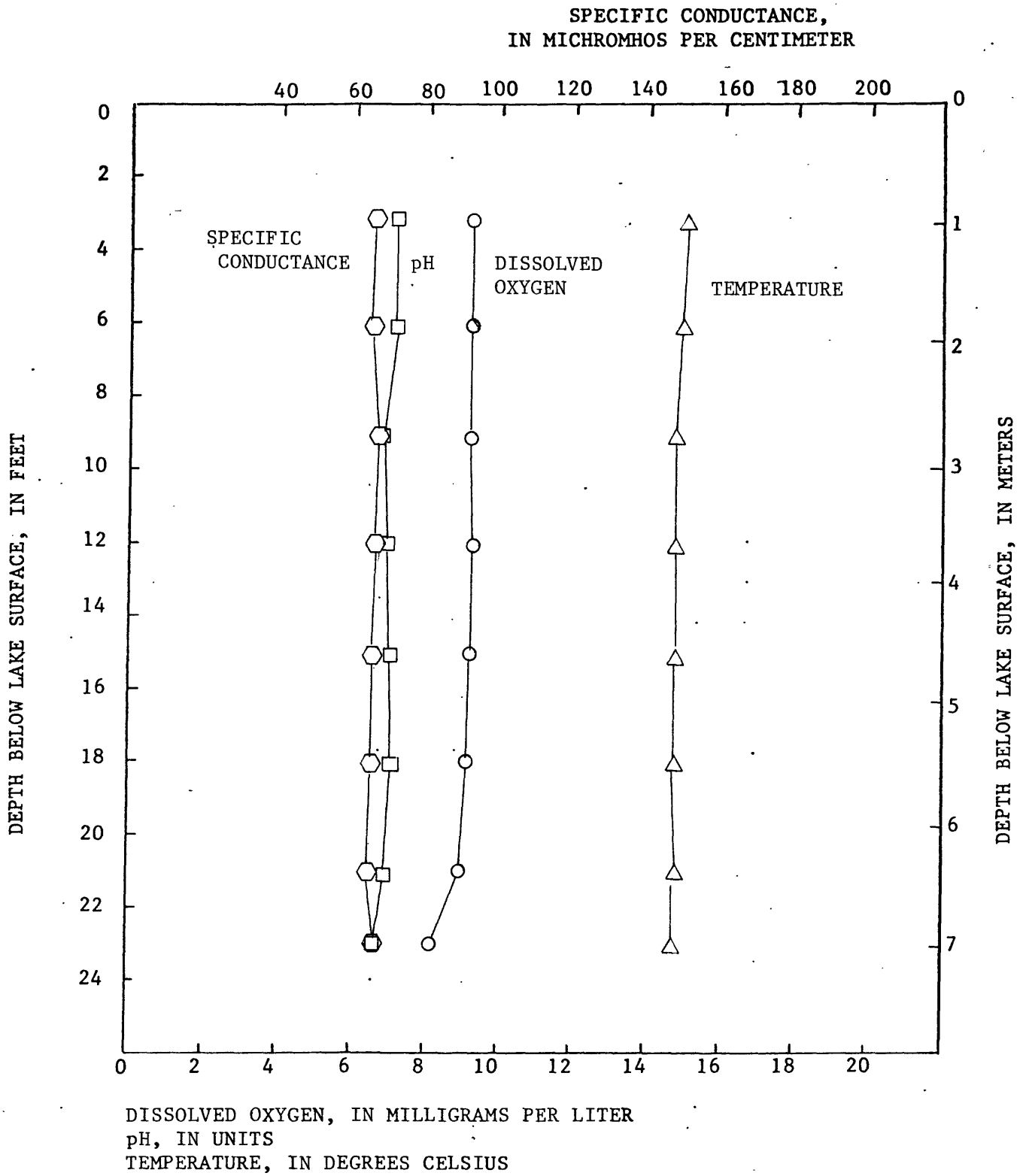


FIGURE 5G -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at Lake Lorraine, August 19, 1981.

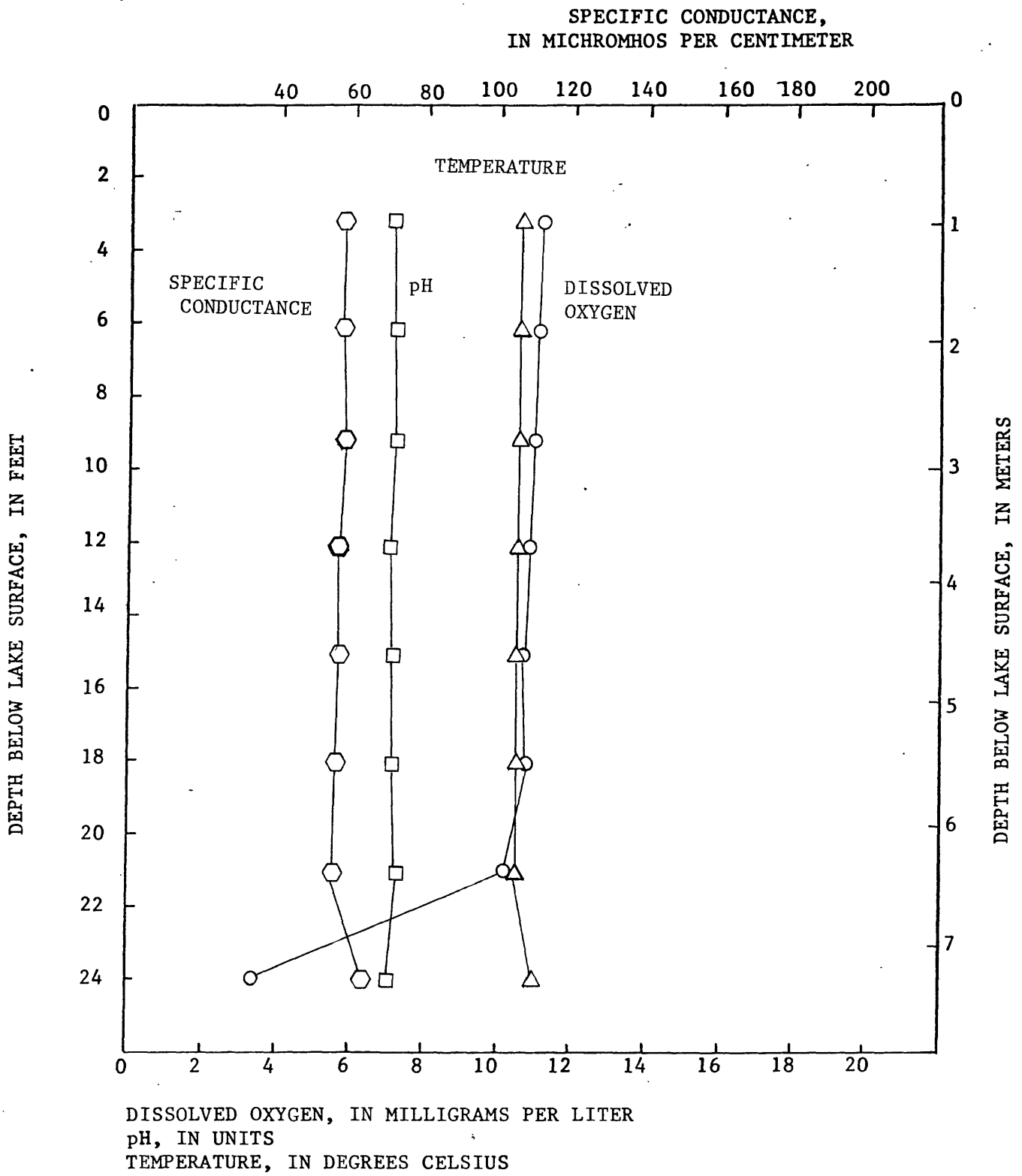


FIGURE 5D -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at Lake Lorraine, September 15, 1981.

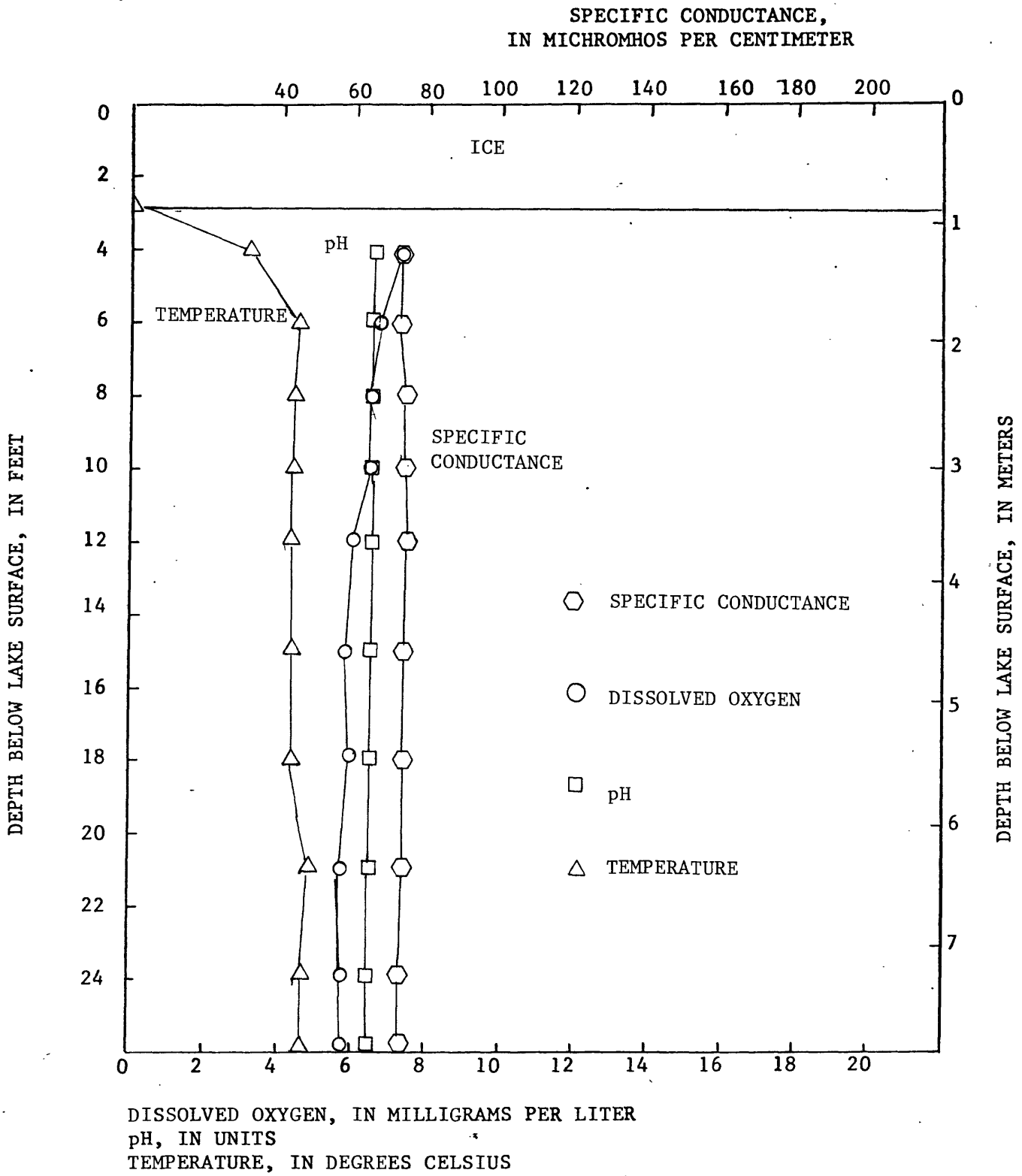


FIGURE 5E -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at Lake Lorraine, March 10, 1982.

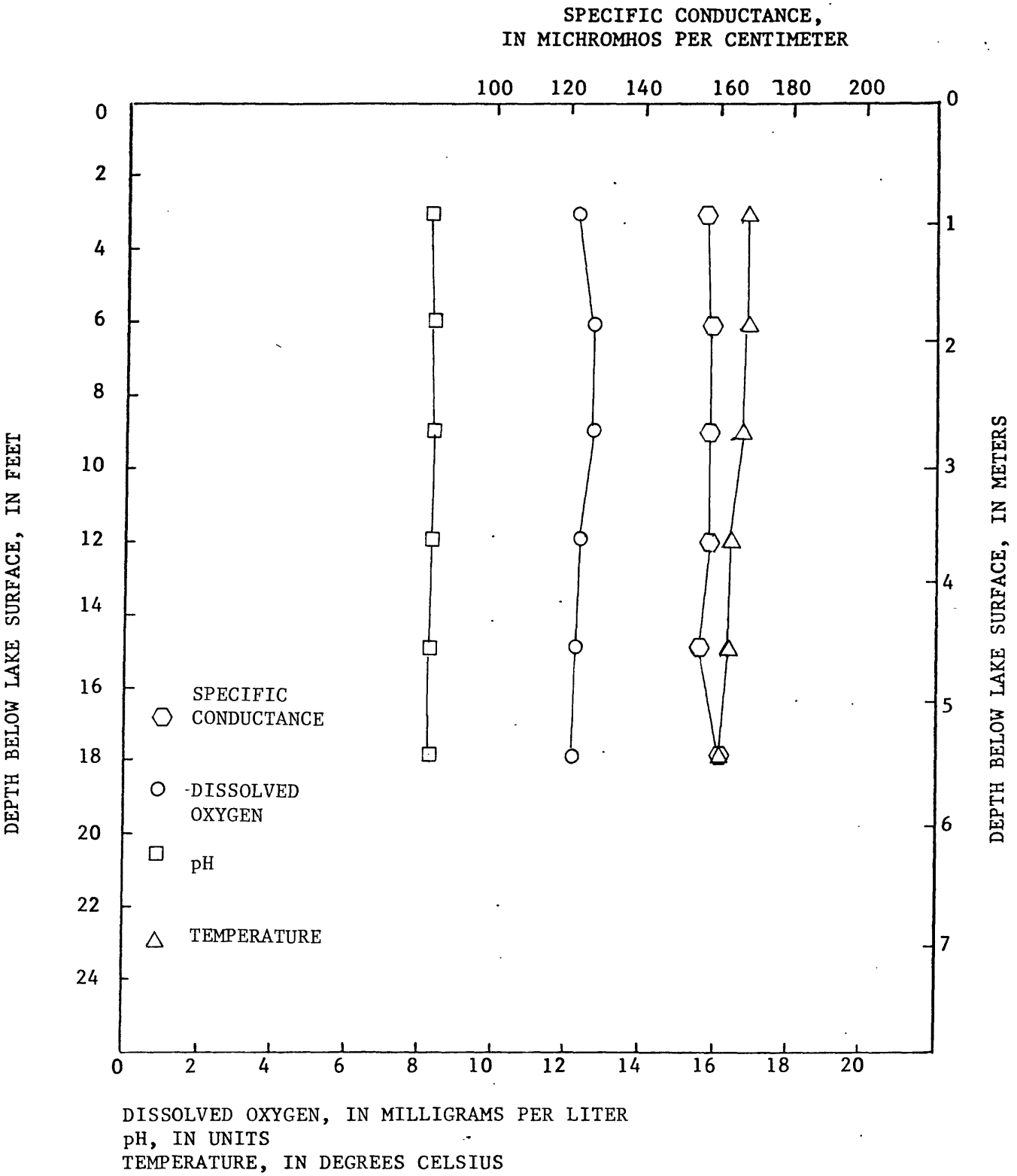


FIGURE 6 A. -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at East Arm Horseshoe Lake, June 16, 1981.

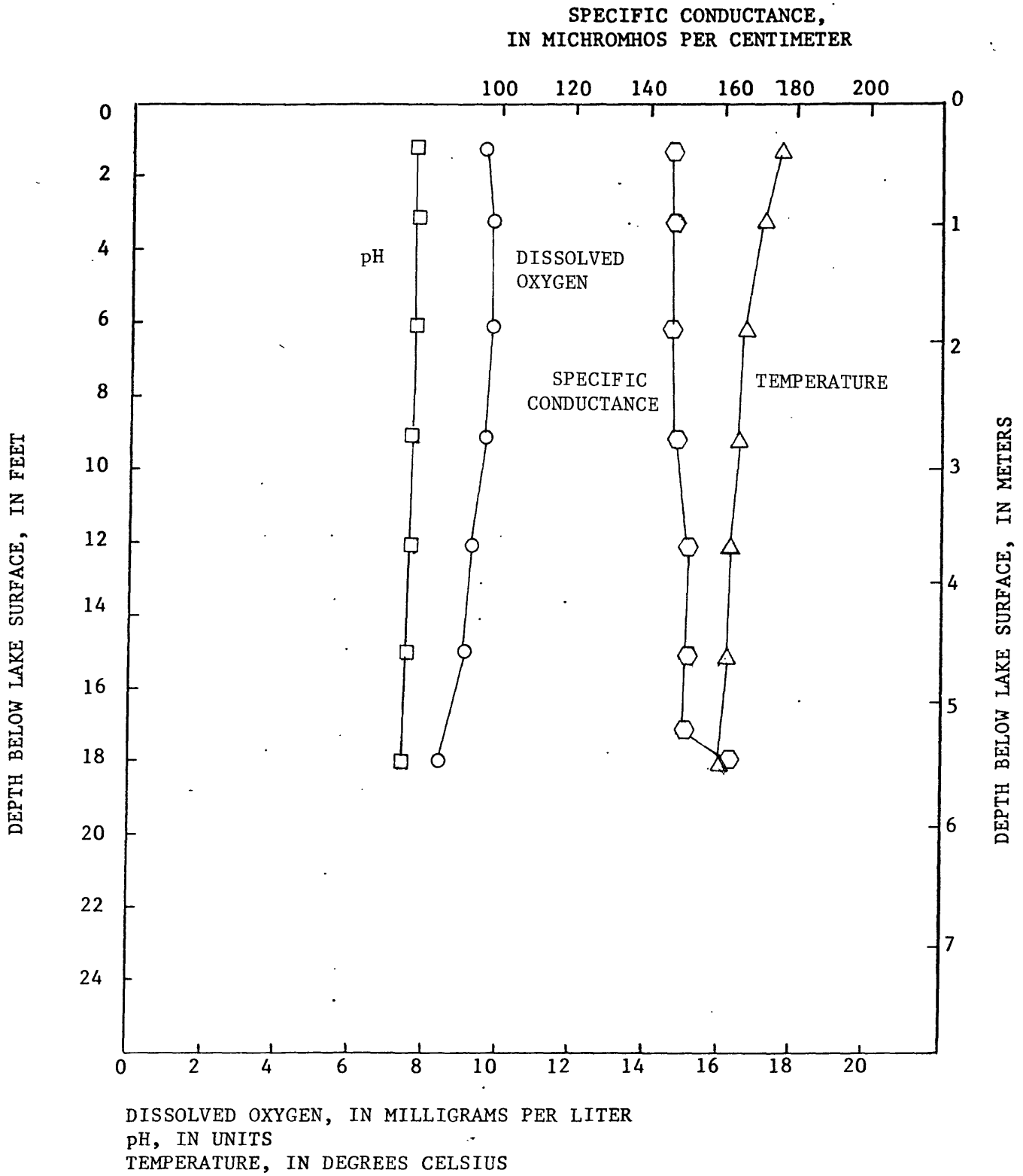


FIGURE 6 B. -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at East Arm Horseshoe Lake, July 22, 1981.

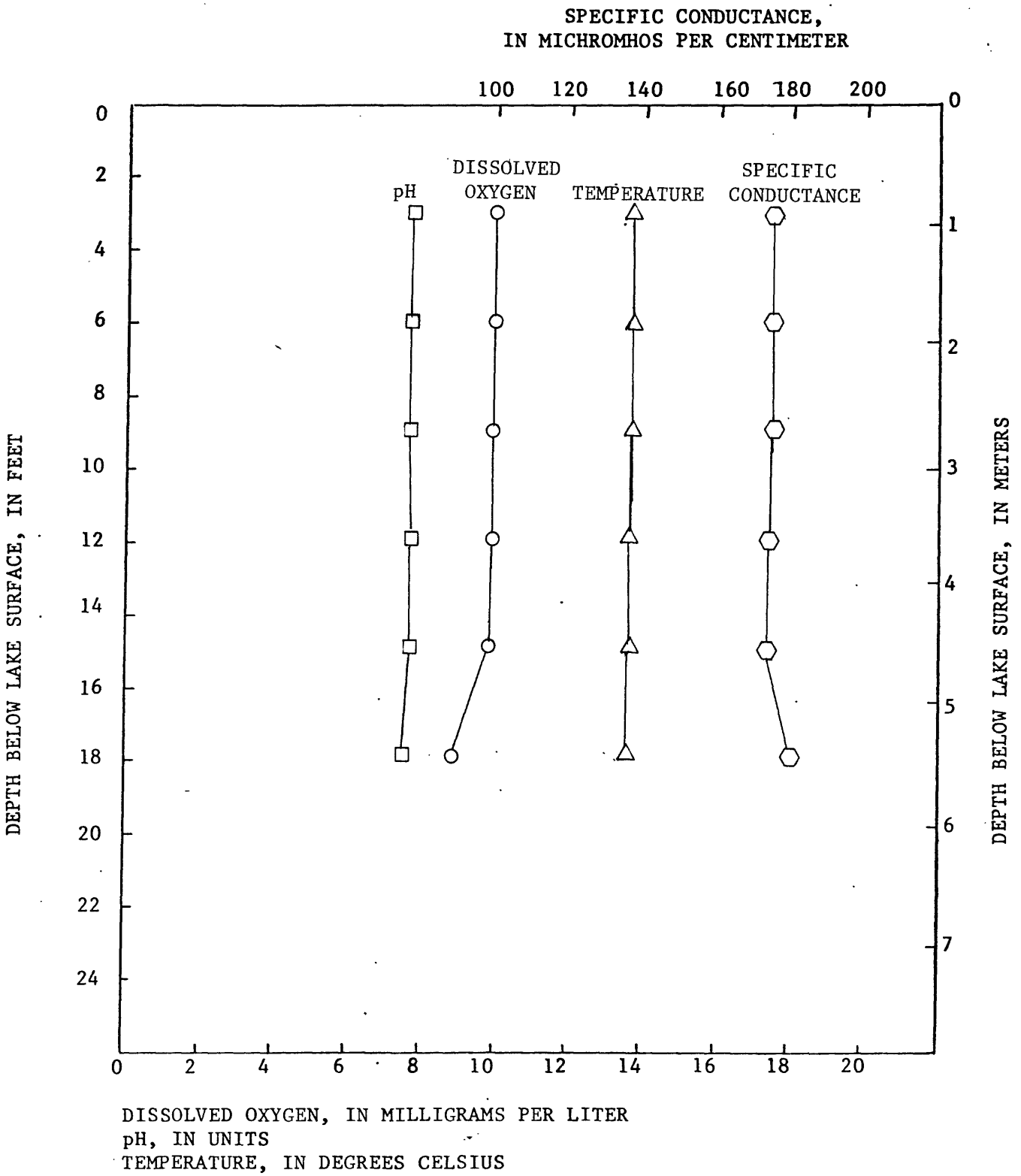


FIGURE 6C. -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at East Arm Horseshoe Lake, August 18, 1981.

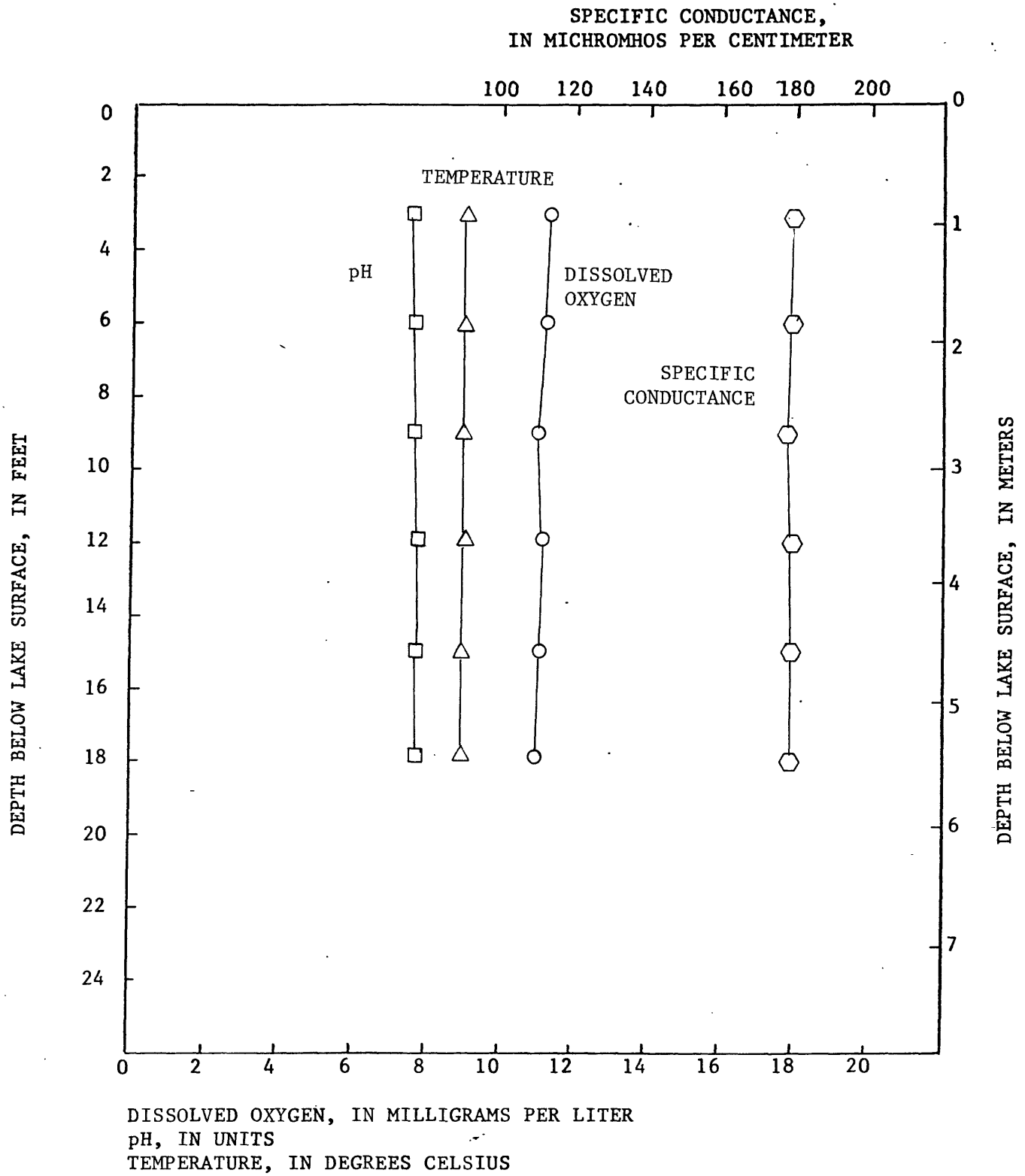


FIGURE 6 D. -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at East Arm Horseshoe Lake, September 25, 1981.

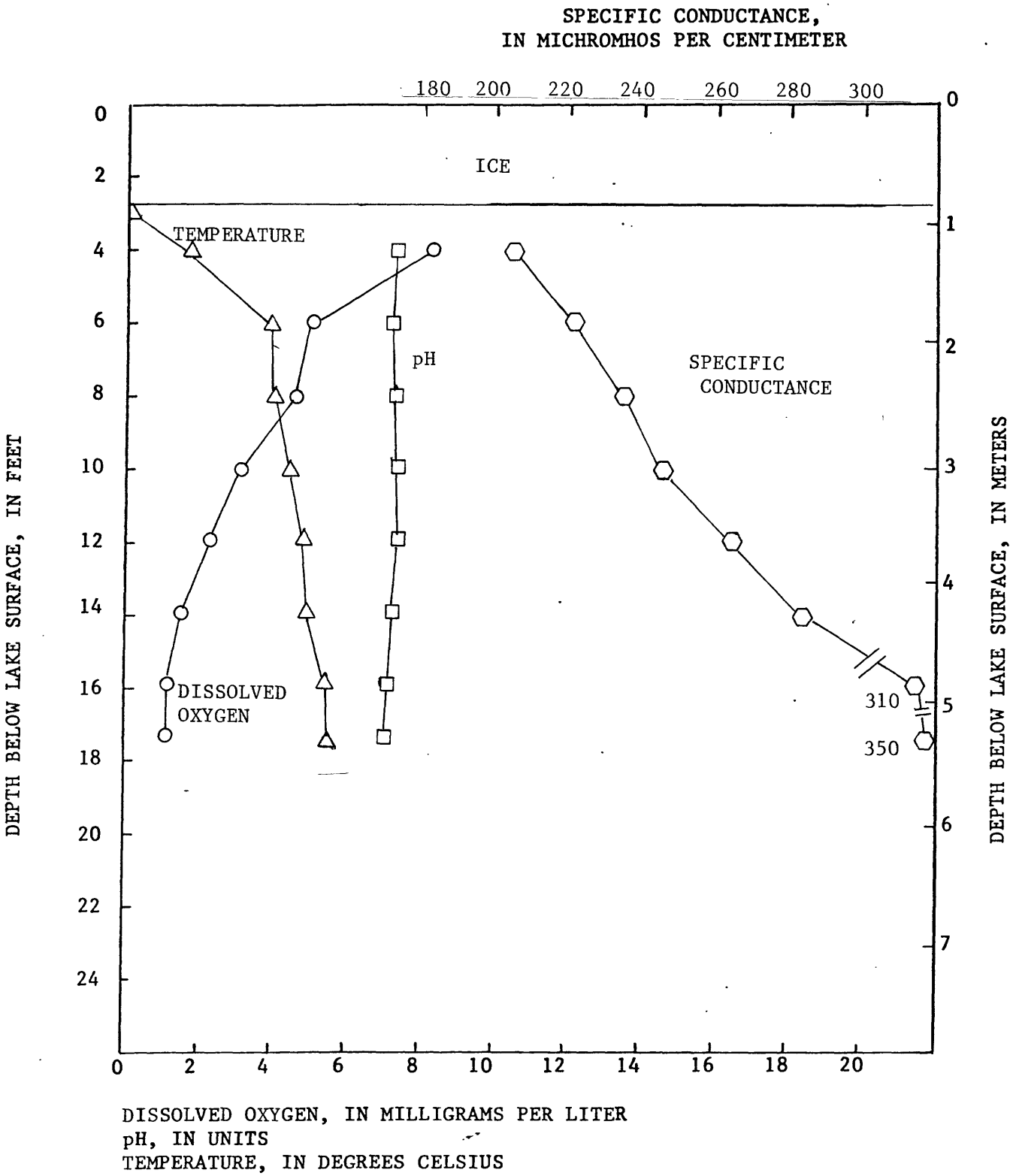


FIGURE 6E. -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at East Arm Horseshoe Lake, March 10, 1982.

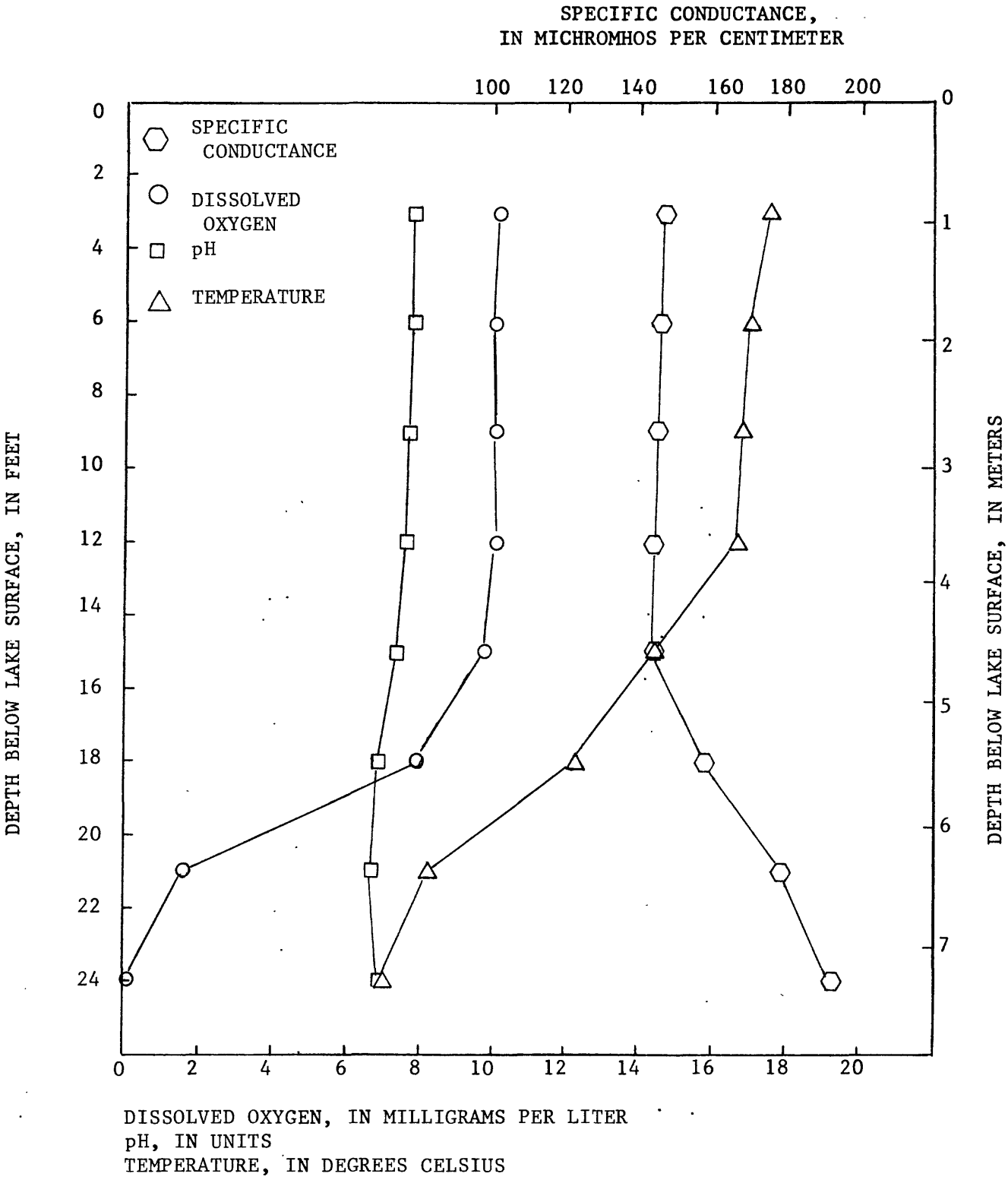


FIGURE 7A . -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at West Arm Horseshoe Lake, June 16, 1981.

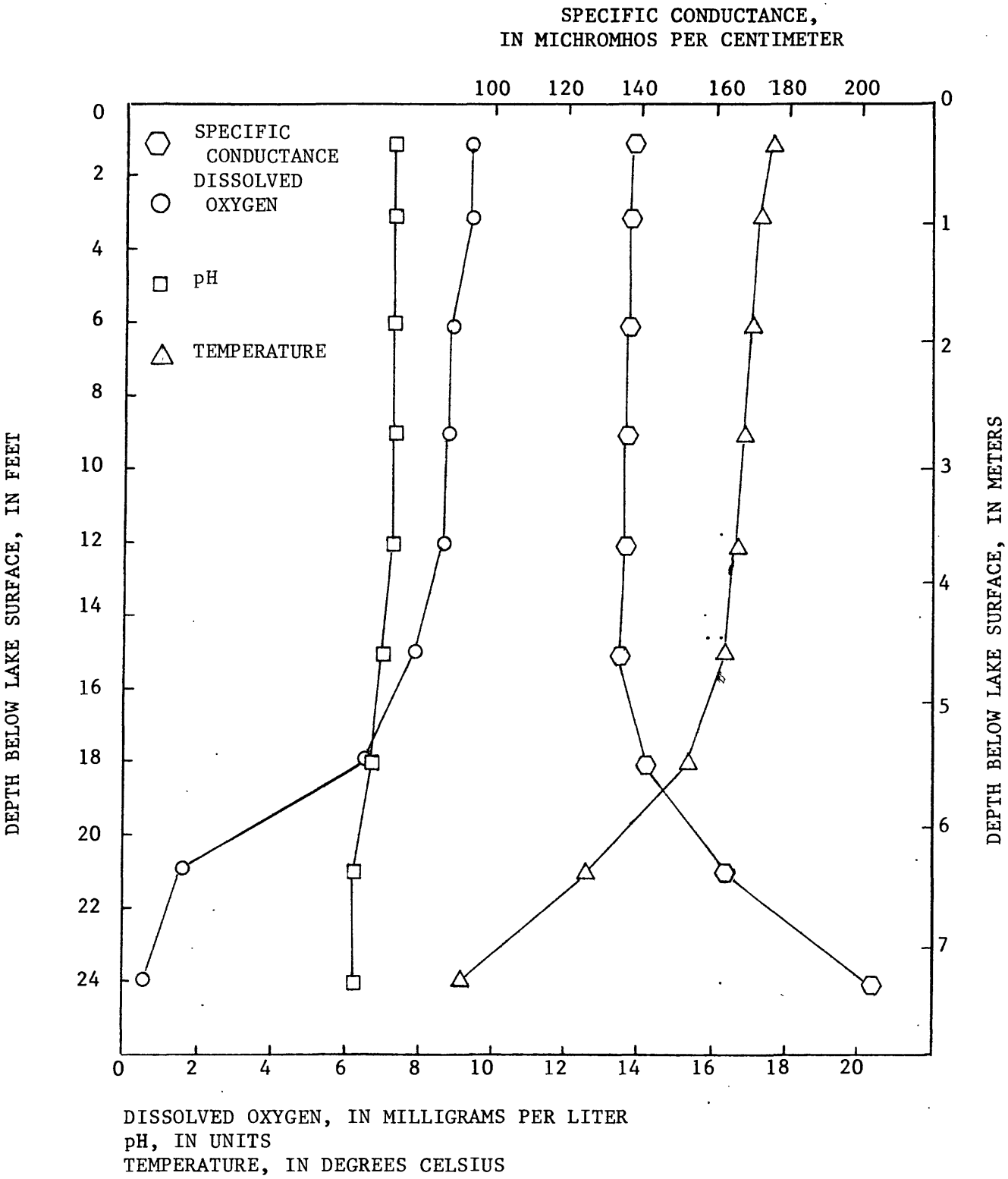


FIGURE 7B. -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at West Arm Horseshoe Lake, July 22, 1981

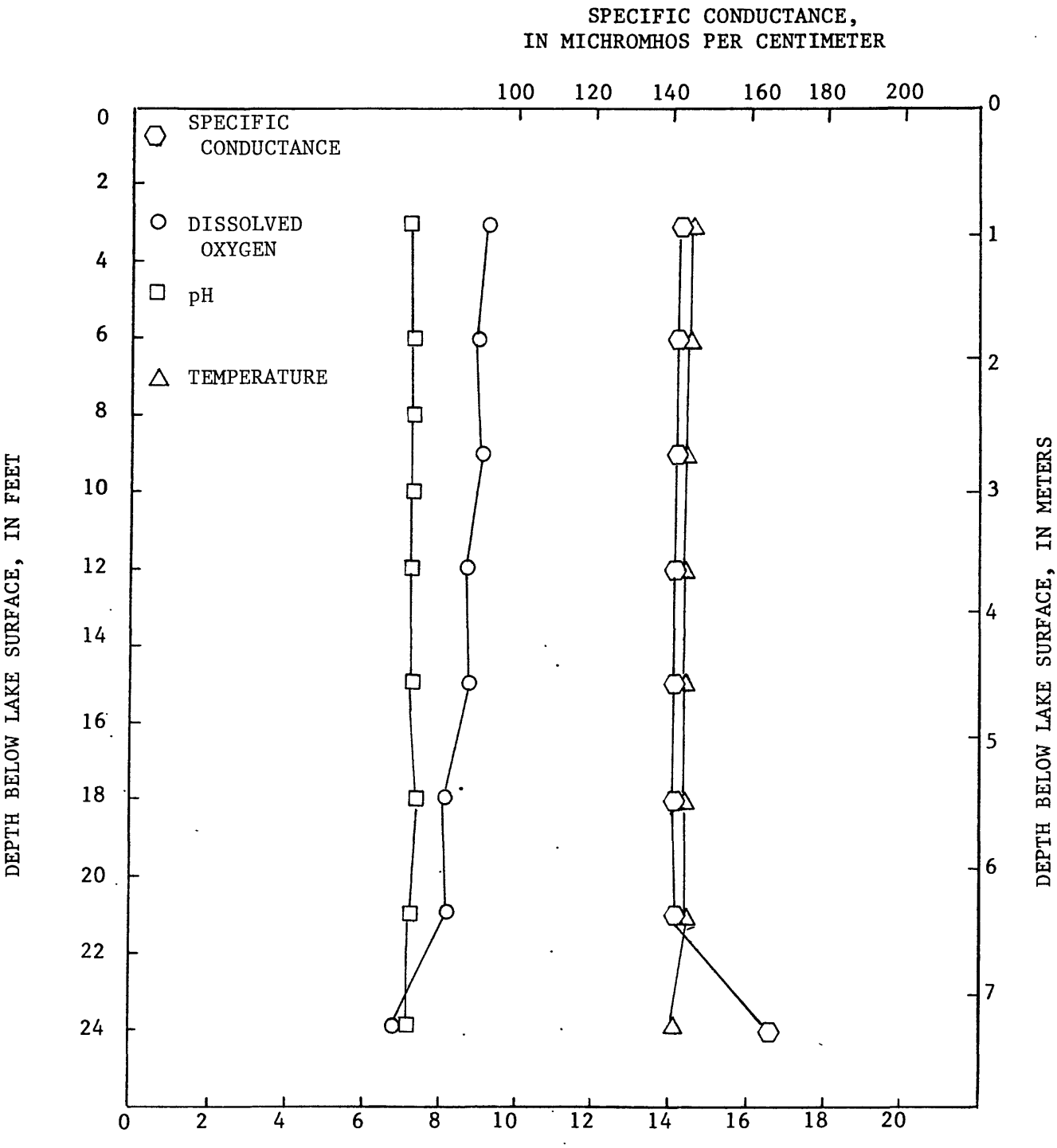


FIGURE 7C -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at West Arm Horseshoe Lake, August 18, 1981.

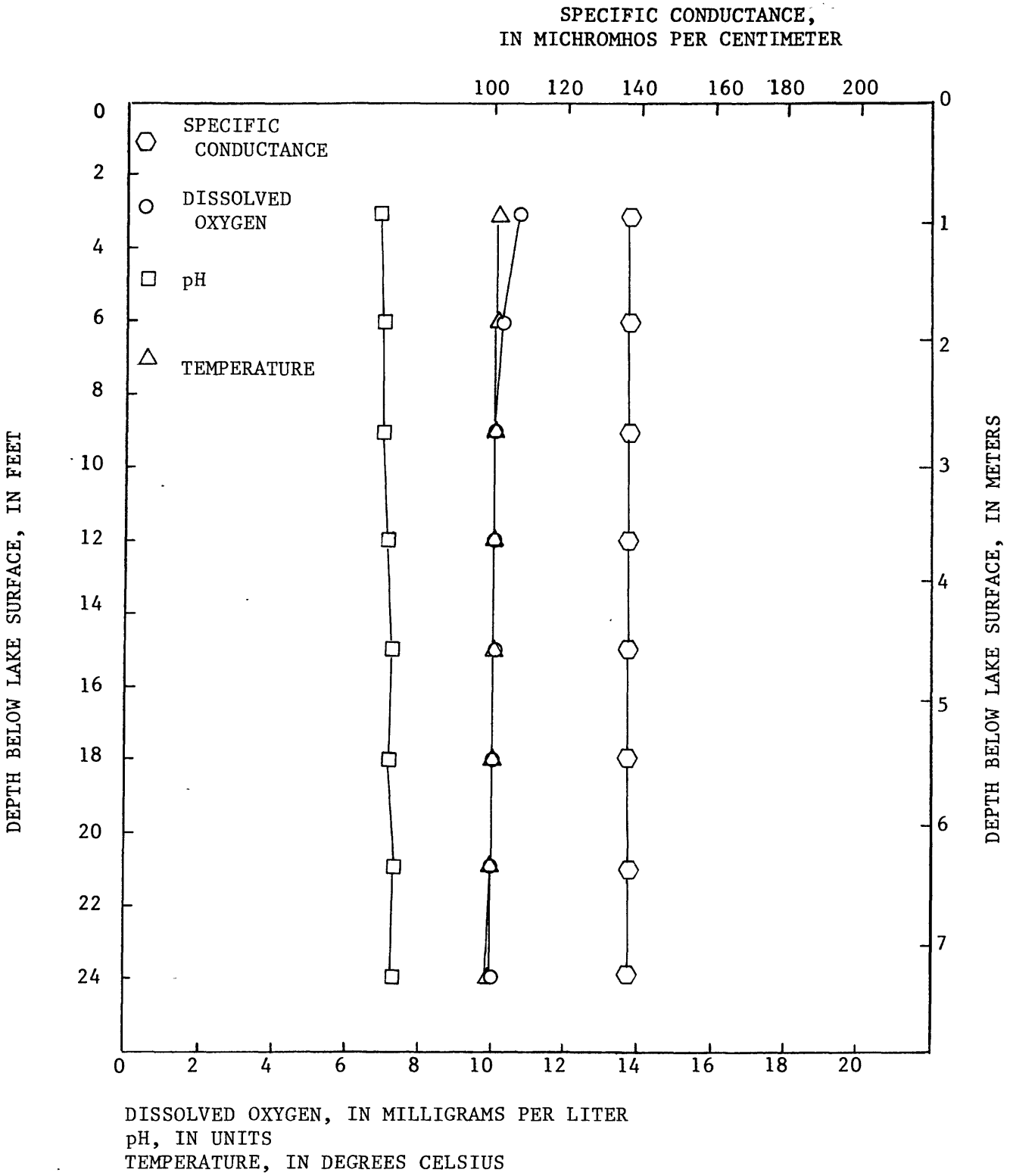


FIGURE 7D. -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at West Arm Horseshoe Lake, September 25, 1981.

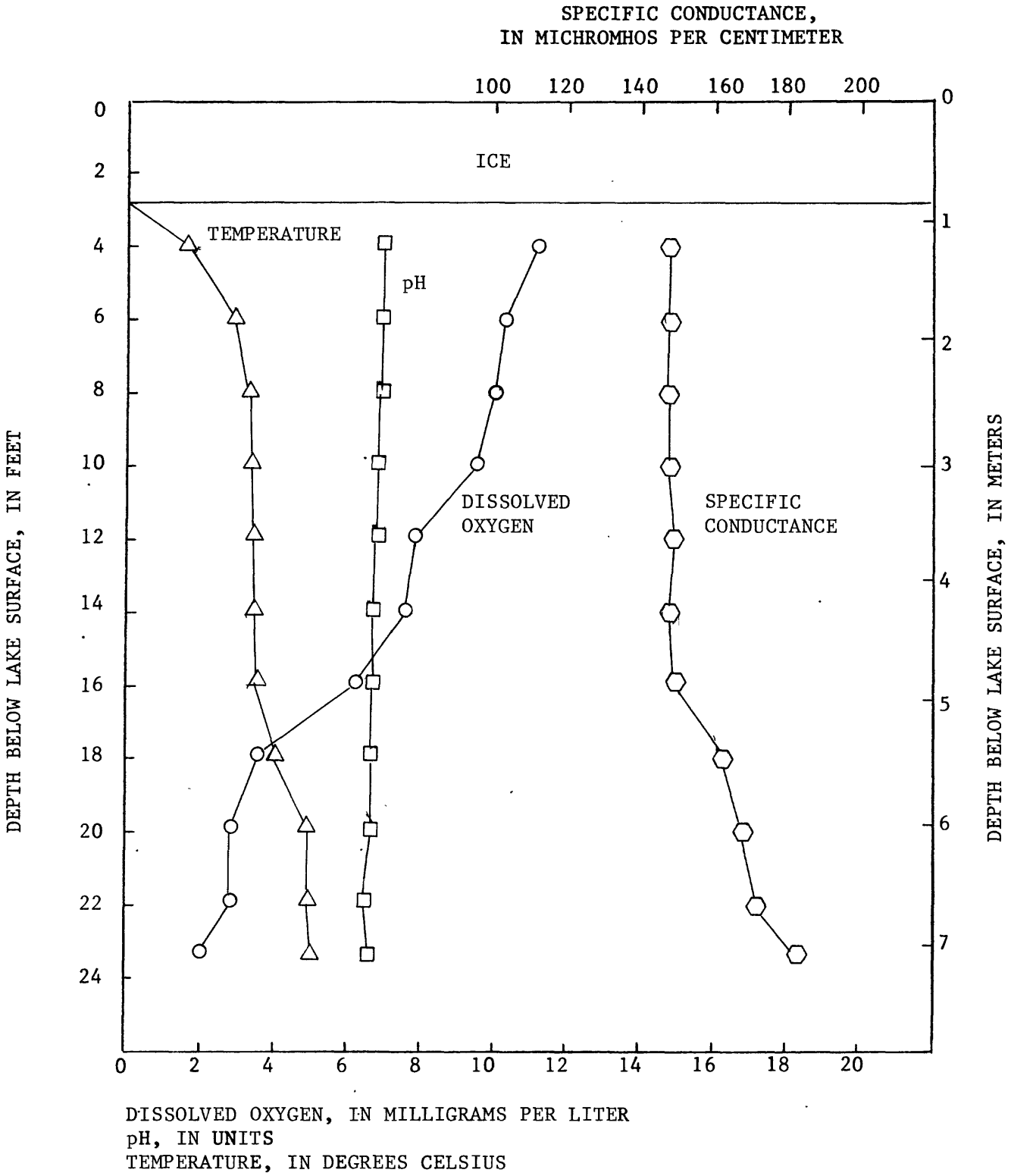


FIGURE 7E. -- Vertical distribution of specific conductance, dissolved oxygen, pH, and temperature at West Arm Horseshoe Lake, March 10, 1982.