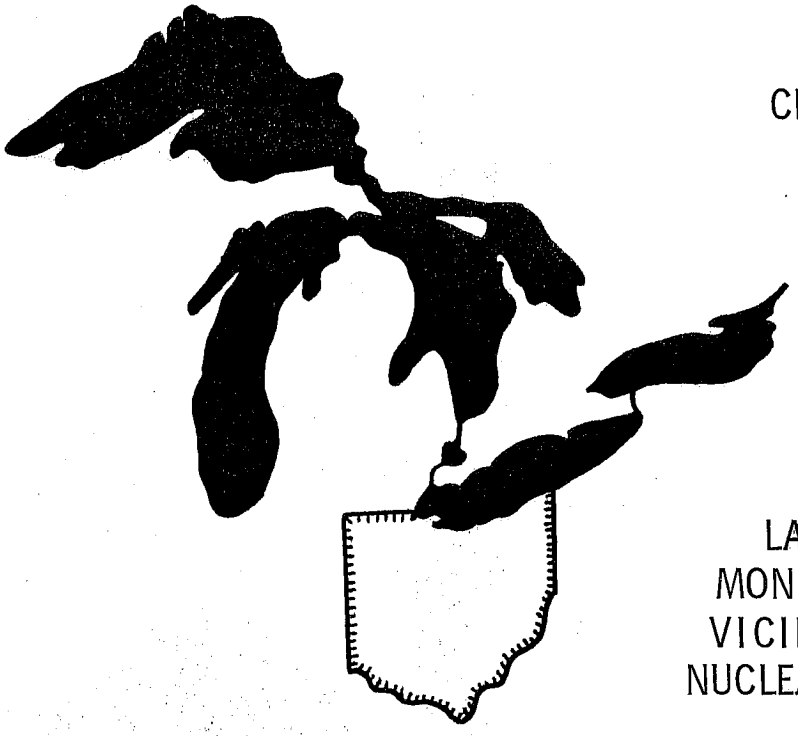

CLEAR TECHNICAL REPORT NO. 82

LAKE ERIE WATER QUALITY MONITORING PROGRAM IN THE VICINITY OF THE DAVIS-BESSE NUCLEAR POWER STATION FOR 1977

Environmental Technical Specifications Sec. 3.1.1.a.1 Water Quality Analysis

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3.1.1.a.1 Water Quality Analysis

Procedures

Water quality samples were collected and related sensor measurements were made at six stations (Fig. 1) in Lake Erie during the ice-free period of 1977 (April through November). The nineteen parameters measured and the analytical methods employed for these determinations are listed in Table 1.

Field Measurements. Water quality measurements were made monthly in the field at Stations 1, 8, and 13 (Fig. 1). Temperature, dissolved oxygen and conductivity were measured from a small survey boat with submerged sensors and shipboard readout meters. Dissolved oxygen was determined with a YSI model 51 meter and conductivity with a Beckman RB3-3341 solubridge temperature-compensated meter; each meter was equipped with a thermistor for temperature readings. Sensor readings were taken 10 cm below the surface and approximately 50 cm above the bottom. Transparency was determined with a 30 cm diameter Secchi disk lowered on a marked line until it was no longer visible. (Welch, 1948, Limnology, McGraw-Hill). Solar radiation was measured at five stations (3, 8, 13, 14, and 28) from May to October with a Kahl Scientific Instrument Corp. submarine photometer, model no. 15M2-02, at the surface and at one-half meter depth intervals. This meter measures the amount of sunlight, expressed as an electrical current, reaching various depths.

Laboratory Determinations. Surface and bottom (50 cm above) water samples were taken at Stations 1, 8, and 13 with a 3-liter Kemmerer sampler at the same time that field measurements were being made. These samples were placed in polyethylene containers and taken to the laboratory for analysis; in most cases, analyses were completed within 24 hours of the sampling time. Fifteen water quality parameters (Table 1) were determined in the Toledo Edison Company chemical laboratory using the procedures prescribed in Standard Methods for the Examination of Water and Wastewater, 14th Edition (American Public Health Association, 1975); "ASTM Standards, Part 23, Water" (American Society for Testing and Materials, 1973); and Water Analysis Procedures (U.S. Environmental Protection Agency, 1974).

Results

The results of the monthly 1977 water quality determinations at Stations 1, 8, and 13 are presented in Tables 3-9. The results of solar radiation measurements at Stations 3,8,13,14, and 28 are given in Table 10. Mean values and ranges for the monthly water quality determinations (April through November) are listed in Table 11 and a summary of solar radiation means and ranges are presented in Table 12.

Analysis

Seasonal Variations. The quality of the water in the vicinity of the Davis-Besse Nuclear Power Station during the period April through July 1977 was typical for the south shore of western Lake Erie and showed normal seasonal trends. Water Temperature rose nearly 13°C during the period from April to July while the dissolved oxygen level fell 5 ppm (Fig. 2). The turbulence of the early spring period and the corresponding high sediment load are reflected in the high turbidity and suspended solids values and low transparency observed for April (Fig. 3). A 5-fold improvement in the clarity of the water took place between April and May. The biochemical oxygen demand was rather low during the entire period even at the time of high turbidity indicating that the suspended material was largely of an inorganic nature. In a like manner most dissolved substances in the water were highest in the early spring and decreased later in the season (Fig. 4-6). Alkalinity and pH remained relatively constant while the major ions such as calcium and sulfate decreased significantly. Biological nutrients, such as nitrate and phosphorus, also showed notable decreases as spring algal populations utilized these materials.

The water quality in the vicinity of the Davis-Besse Nuclear Power Station during the period of July through November 1976 was typical for western Lake Erie and showed normal seasonal trends. Water temperature fell 19°C during the 5-month period while the dissolved oxygen (DO) level rose 5 ppm (Fig. 2). In July 1977 the DO at Station 1 (bottom) dropped to 3.0 ppm, the lowest value recorded during the pre-operational study:

Year	Dissolved Oxygen Range
1974	5.7 - 14.1 ppm
1975	7.2 - 13.6 ppm
1976	5.0 - 12.5 ppm
1977	3.0 - 12.2 ppm

The International Joint Commission recommends a minimum DO level of 6.0 ppm for Lake Erie water. The high turbulence and sediment load of the lake in early spring improved during the summer and remained relatively constant in water clarity in the fall. Biochemical

oxygen demand, which is related to the suspended organic material in the water, was low and nearly constant throughout the year. Dissolved substances in the water were highest in the spring and fall samples; conductivity showed a significant decrease between April and June but remained relatively stable in the summer (Fig. 6). Specific ions such as calcium, sulfate, and chloride were also highest in April and were fairly stable throughout the fall (Fig. 4). The important nutrients, such as nitrate and phosphate, for primary productivity by green and blue-green algae had a peak in the spring, decreased markedly during the summer and then increased in the fall (Fig. 5). A diatom bloom in April resulted in a low value for silica, wheras the green and blue-green algae utilized nitrogen in the summer and fall.

The alkalinity and pH of the water remained fairly constant throughout the year. Lake Erie is primarily a bicarbonate solution with a corresponding moderately alkaline pH of approximately 8.3 The bicarbonate in the water provides an abundant source of carbon for algae production. The pH showed a slight rise in summer (8.9 maximum) which corresponded with the bloom of the blue-green, Aphanizomenon sp.

Station Variations. Stations 1, 8, and 13 are located approximately 500, 3,000, and 1,500 feet offshore respectively. Generally a slight temperature decrease was noted in an offshore direction in the spring. Slight decreases were also found for such parameters as conductivity, most of the specific ions, alkalinity, B.O.D., suspended and dissolved solids, and turbidity throughout the year. Conversely, transparency increases away from the shore. Station 8 (the farthest offshore) had the best water quality; Station 1 (nearshore) had the poorest quality for most parameters. The differential in water quality values was greatest in spring and fall which may have been related to seasonal storms. During the summer no significant difference was found between the inshore and offshore stations.

Differences between the surface and bottom water quality were slight because of the shallowness of this portion of Lake Erie. Some depression in the level of dissolved oxygen and small increases in the concentrations of dissolved and suspended solids were noted near the bottom, particularly at Station 1. In November (Table 9) the dissolved oxygen level on the bottom (4.8 ppm) was only half of the surface value (10.2 ppm). This may have resulted from oxygen-poor discharge water at that time.

Water Quality Trends. The Ohio State University, Center for Lake Erie Area Research initiated water quality studies at Locust Point in July 1972. Over the past six years most parameters have shown typical seasonal trends with only small variations from year to year. Trends for eight water quality parameters from June 1972 through

November 1977 are shown on Figures 7-9. Temperature and dissolved oxygen show typical seasonal trends for each year with only minor variations from one year to the next. Dissolved oxygen appears to have undergone more depletion in 1976 and 1977 than in previous years. Hydrogen-ion concentration and alkalinity remained fairly stable over the period. Transparency, turbidity, phosphorus and conductivity values have shown radical variations which are probably due to storms and dredging activities that have disturbed the bottom sediments. Phosphorus levels were low in 1977 compared to earlier years. In general, however, no significant deviations from the normal quality of the water in this part of western Lake Erie have been observed in the past six years.

T A B L E S

TABLE 1

ANALYTICAL METHODS FOR WATER QUALITY DETERMINATIONS

Parameter	Units	References for Analytical Methods
1. Temperature	^{o}C	APHA (1975): Sec. 212
2. Dissolved Oxygen	ppm	APHA (1975): Sec. 422B
3. Conductivity	μmhos/cm (25^{o}C)	ASTM (1975): D1125-64
4. Transparency	meters	Welch (1948): Secchi disk
5. Calcium (Ca)	mg/l	APHA (1975): Sec. 306C
6. Magnesium (Mg)	mg/l	APHA (1975): Sec. 313C
7. Sodium (Na)	mg/l	ASTM (1973): D1428-64
8. Chloride (Cl)	mg/l	APHA (1975): Sec. 408B
9. Nitrate (NO_3)	mg/l	ASTM (1973): D992-71
10. Sulfate (SO_4)	mg/l	ASTM (1973): D516-68C
11. Phosphorus (Total as P)	mg/l	APHA (1975): Sec. 425F
12. Silica (SiO_2)	mg/l	ASTM (1973): D859-68B
13. Alkalinity (Total as $CaCO_3$)	mg/l	APHA (1975): Sec. 403
14. Biochemical oxygen demand	mg/l	APHA (1975): Sec. 507
15. Suspended solids	mg/l	APHA (1975): Sec. 208D
16. Dissolved solids	mg/l	USEPA (1974)
17. Turbidity	F.T.U.	APHA (1975): Sec. 214A
18. Hydrogen-ion conc.	pH units	ASTM (1973): D1293-65
		Field Procedure
19. Solar radiation	μamps/ft candles	Kahl Scientific Instrument Corp. submarine photometer model 15M2-02

TABLE 2

LAKE ERIE WATER QUALITY ANALYSES FOR APRIL 1977

Dates:
Field 26 April 1977
Laboratory 27 April 1977

Parameters	Station No. 1		Station No. 8		Station No. 13		Range	Mean	Standard Deviation
	Surface	Bottom	Surface	Bottom	Surface	Bottom			
Field Measurements:									
Temperature (°C)	10.6	11.1	10.0	10.0	10.0	10.0	10.0–11.1	10.3	0.5
Dissolved Oxygen (ppm)	11.0	11.0	11.1	11.0	–	–	11.0–11.1	11.0	0.1
Conductivity (umhos/cm)	360	360	350	360	360	360	350–360	358	4
Transparency (m)	0.25		0.25		0.20		0.20–0.25	0.23	0.03
Depth (m)		2.0		4.3		3.0	2.0–4.3	3.1	1.2
Laboratory Determinations:									
Calcium (mg/l)	41.6	42.8	45.6	44.4	43.2	43.2	41.6–45.6	43.5	1.4
Magnesium (mg/l)	10.1	11.0	8.2	8.4	8.9	9.1	8.2–11.0	9.3	1.1
Sodium (mg/l)	12.4	12.2	12.7	12.7	12.4	12.4	12.2–12.7	12.5	0.2
Chloride (mg/l)	26.3	26.8	26.8	26.8	26.3	26.5	26.3–26.8	26.6	0.3
Nitrate (mg/l)	18.6	17.5	16.4	14.9	16.4	17.0	14.9–18.6	16.8	1.2
Sulfate (mg/l)	36.5	40.0	32.5	34.5	35.0	33.5	32.5–40.0	35.3	2.7
Phosphorus (mg/l)	0.10	0.09	0.08	0.12	0.12	0.09	0.08–0.12	0.10	0.02
Silica (mg/l)	0.05	0.13	0.08	0.10	0.10	0.12	0.05–0.13	0.10	0.03
Total Alkalinity (mg/l)	91	91	94	95	94	96	91–96	94	2
B.O.D. (mg/l)	3	3	3	3	4	4	3–4	3.3	0.5
Suspended Solids (mg/l)	118	108	63	80	98	101	63–118	95	20
Dissolved Solids (mg/l)	216	216	204	204	212	214	204–216	211	6
Turbidity (F.T.U.)	72	71	51	51	65	66	51–72	63	9
pH	8.3	8.3	8.6	8.2	8.6	8.3	8.2–8.6	8.4	0.2
Conductivity (umhos/cm)	340	340	335	340	340	340	335–340	339	2.0

TABLE 3

LAKE ERIE WATER QUALITY ANALYSES FOR MAY 1977

Dates:
Field 24 May 1977
Laboratory 26 May 1977

Parameters	Station No. 1		Station No. 8		Station No. 13		Range	Mean	Standard Deviation
	Surface	Bottom	Surface	Bottom	Surface	Bottom			
Field Measurements:									
Temperature (°C)	19.5	15.0	20.0	15.0	20.5	15.0	15.0–20.5	17.5	2.8
Dissolved Oxygen (ppm)	11.5	11.4	11.0	9.0	11.4	9.2	9.0–11.5	10.6	1.2
Conductivity (umhos/cm)	280	280	280	280	270	270	270–280	277	5
Transparency (m)	0.55		0.70		0.60		0.55–0.70	0.62	0.08
Depth (m)		2.0		4.1		3.0	2.0–4.1	3.0	1.1
Laboratory Determinations:									
Calcium (mg/l)	42.4	41.6	40.8	40.0	42.0	41.6	40.0–42.4	41.4	0.9
Magnesium (mg/l)	9.1	9.6	10.6	10.6	9.1	9.4	9.1–10.6	9.7	0.7
Sodium (mg/l)	10.7	10.7	11.0	10.7	10.7	10.4	10.4–11.0	10.7	0.2
Chloride (mg/l)	20.0	19.3	20.3	20.0	20.3	20.0	19.3–20.3	20.0	0.4
Nitrate (mg/l)	14.0	14.9	14.9	13.5	15.9	13.5	13.5–15.9	14.5	1.0
Sulfate (mg/l)	31.5	29.5	30.5	30.0	31.5	28.0	28.0–31.5	30.2	1.3
Phosphorus (mg/l)	0.03	0.04	0.01	0.02	0.00	0.02	0.00–0.04	0.02	0.01
Silica (mg/l)	0.30	0.16	0.16	0.06	0.19	0.10	0.06–0.19	0.16	0.08
Total Alkalinity (mg/l)	98	94	100	94	97	98	94–100	97	2
B.O.D. (mg/l)	4	4	3	3	2	4	2–4	3.3	0.8
Suspended Solids (mg/l)	15	17	11	12	12	20	11–20	15	4
Dissolved Solids (mg/l)	210	206	212	202	208	202	202–210	207	4
Turbidity (F.T.U.)	17	21	6	21	12	28	6–28	18	8
pH	7.7	8.1	8.0	8.1	7.7	8.2	7.7–8.2	8.0	0.2
Conductivity (umhos/cm)	370	365	375	365	370	365	365–375	368	4

TABLE 4

LAKE ERIE WATER QUALITY ANALYSES FOR JUNE 1977

Dates:
Field 22 June 1977
Laboratory 23 June 1977

Parameters	Station No. 1		Station No. 8		Station No. 13		Range	Mean	Standard Deviation
	Surface	Bottom	Surface	Bottom	Surface	Bottom			
Field Measurements:									
Temperature (°C)	21.0	20.0	21.0	20.0	21.5	–	20.0–21.5	20.7	0.7
Dissolved Oxygen (ppm)	9.6	6.8	9.6	7.2	9.0	8.5	6.8–9.6	8.5	1.2
Conductivity (umhos/cm)	250	250	260	250	250	250	250–260	252	4
Transparency (m)	0.5		0.5		0.5		0.0	0.5	–
Depth (m)		1.8		4.4		3.0	1.8–4.4	3.1	1.3
Laboratory Determinations:									
Calcium (mg/l)	40.0	40.0	39.2	38.0	38.4	38.4	38.0–40.0	39.0	0.9
Magnesium (mg/l)	9.6	9.6	9.6	10.3	9.8	9.6	9.6–10.3	9.8	0.3
Sodium (mg/l)	11.7	11.2	11.0	10.7	11.0	11.0	10.7–11.7	11.1	0.3
Chloride (mg/l)	21.8	21.8	21.0	20.3	22.5	22.5	20.3–22.5	21.7	0.9
Nitrate (mg/l)	8.4	8.4	7.7	8.0	7.7	7.7	7.7–8.4	8.0	0.3
Sulfate (mg/l)	34.5	34.0	32.0	30.5	31.5	30.5	30.5–34.5	32.2	1.7
Phosphorus (mg/l)	0.05	0.06	0.02	0.02	0.02	0.04	0.02–0.06	0.04	0.02
Silica (mg/l)	0.59	0.51	0.30	0.66	0.23	0.40	0.23–0.66	0.45	0.17
Total Alkalinity (mg/l)	96	96	95	97	97	96	95–97	96	1
B.O.D. (mg/l)	2	3	3	<1	2	2	2–3	2	0.8
Suspended Solids (mg/l)	40	30	36	60	17	67	17–67	42	19
Dissolved Solids (mg/l)	103	98	90	96	96	98	90–103	97	4.2
Turbidity (F.T.U.)	32	29	23	53	13	23	13–53	30	13
pH	8.6	8.6	8.7	8.4	8.6	8.6	8.4–8.7	8.6	0.1
Conductivity (umhos/cm)	335	330	325	310	340	340	310–340	330	11

TABLE 5

LAKE ERIE WATER QUALITY ANALYSES FOR JULY 1977

Dates:
Field 13 July 1977
Laboratory 14 July 1977

Parameters	Station No. 1		Station No. 8		Station No. 13		Range	Mean	Standard Deviation
	Surface	Bottom	Surface	Bottom	Surface	Bottom			
Field Measurements:									
Temperature (°C)	24.0	24.0	22.0	22.0	23.0	23.0	22.0-24.0	23.0	0.9
Dissolved Oxygen (ppm)	7.3	3.0	7.3	4.8	7.3	4.5	3.0-7.3	5.7	1.9
Conductivity (umhos/cm)	230	230	220	220	230	230	220-230	227	5
Transparency (m)	0.25		0.40		0.30		0.25-0.40	0.32	0.08
Depth (m)		2.0		4.5		3.0	2.0-4.5	3.2	1.3
Laboratory Determinations:									
Calcium (mg/l)	36.0	35.2	33.2	33.6	34.4	34.8	33.2-36.0	34.5	1.0
Magnesium (mg/l)	8.2	8.9	9.4	9.1	9.1	9.1	8.2-9.4	9.0	0.4
Sodium (mg/l)	10.1	9.9	9.5	9.5	9.5	8.9	8.9-10.1	9.6	0.4
Chloride (mg/l)	19.3	19.3	19.8	19.5	20.0	20.0	19.3-20.0	19.7	0.3
Nitrate (mg/l)	6.9	8.0	6.9	7.7	8.8	8.4	6.9-8.8	7.8	0.8
Sulfate (mg/l)	27.0	25.0	23.5	25.0	23.0	24.5	23.0-27.0	24.7	1.4
Phosphorus (mg/l)	0.14	0.09	0.08	0.07	0.07	0.09	0.07-0.14	0.09	0.03
Silica (mg/l)	0.23	0.44	1.10	1.20	0.44	0.44	0.23-1.20	0.64	0.40
Total Alkalinity (mg/l)	90	93	90	89	92	91	89-93	91	2
B.O.D. (mg/l)	2	3	2	2	1	1	1-3	1.8	0.8
Suspended Solids (mg/l)	75	91	38	33	47	52	33-91	56	2.3
Dissolved Solids (mg/l)	174	176	194	180	186	184	174-194	182	7
Turbidity (F.T.U.)	64	65	47	53	31	45	31-65	51	13
pH	8.3	8.0	8.1	8.1	8.1	8.0	8.1-8.3	8.1	0.1
Conductivity (umhos/cm)	282	282	270	275	280	280	270-282	278	5

TABLE 6

LAKE ERIE WATER QUALITY ANALYSES FOR AUGUST 1977

Dates:
Field 30 August 1977
Laboratory 31 August 19

Parameters	Station No. 1		Station No. 8		Station No. 13		Range	Mean	Standard Deviation
	Surface	Bottom	Surface	Bottom	Surface	Bottom			
Field Measurements:									
Temperature (°C)	22.3	21.9	23.0	22.0	23.1	21.5	21.5-23.1	22.3	0.6
Dissolved Oxygen (ppm)	7.7	7.3	8.7	7.2	9.0	6.9	6.9-9.0	7.8	0.9
Conductivity (umhos/cm)	260	265	260	265	260	265	260-265	263	3
Transparency (m)	0.40		0.73		0.62		0.40-0.73	0.58	0.17
Depth (m)		1.5		4.0		3.0	1.5-4.0	2.8	1.3
Laboratory Determinations:									
Calcium (mg/l)	31.6	31.6	31.2	31.6	31.6	32.8	31.2-32.8	31.7	0.6
Magnesium (mg/l)	7.0	7.0	7.0	6.7	6.7	6.7	6.7-7.0	6.9	0.2
Sodium (mg/l)	8.4	8.2	8.4	8.5	8.4	8.5	8.2-8.5	8.4	0.1
Chloride (mg/l)	16.3	16.3	17.0	16.8	16.8	16.8	16.3-17.0	16.7	0.3
Nitrate (mg/l)	2.0	1.2	1.2	1.2	2.0	1.2	1.2-2.0	1.5	0.4
Sulfate (mg/l)	20.5	21.0	20.5	20.0	20.0	21.0	20.0-21.0	20.5	0.5
Phosphorus (mg/l)	0.06	0.06	0.03	0.05	0.04	0.06	0.03-0.06	0.05	0.01
Silica (mg/l)	0.17	0.17	0.10	0.11	0.11	0.12	0.10-0.17	0.13	0.03
Total Alkalinity (mg/l)	85	84	83	85	85	85	83-85	84.5	0.8
B.O.D. (mg/l)	3	3	3	3	3	4	3-4	3.2	0.4
Suspended Solids (mg/l)	18	24	11	19	7	24	7-24	17	7
Dissolved Solids (mg/l)	158	156	160	152	158	152	152-160	156	3
Turbidity (F.T.U.)	28	27	24	23	25	24	23-28	25	2
pH	8.8	8.6	8.6	8.8	8.9	8.6	8.6-8.9	8.8	0.1
Conductivity (umhos/cm)	247	249	243	247	245	251	243-251	247	3

TABLE 7

LAKE ERIE WATER QUALITY ANALYSES FOR SEPTEMBER 1977

Dates:
Field 12 September 1977
Laboratory 13 September 1977

Parameters	Station No. 1		Station No. 8		Station No. 13		Range	Mean	Standard Deviation
	Surface	Bottom	Surface	Bottom	Surface	Bottom			
Field Measurements:									
Temperature (°C)	19.3	19.3	19.8	19.8	19.4	19.2	19.2–19.8	19.5	0.3
Dissolved Oxygen (ppm)	9.6	9.6	9.2	9.2	9.3	9.2	9.2–9.6	9.4	0.2
Conductivity (umhos/cm)	270	275	275	275	265	280	265–280	273	5
Transparency (m)	0.50		0.60		0.50		0.5–0.6	0.53	0.06
Depth (m)		1.6		3.8		2.7	1.6–3.8	2.7	1.1
Laboratory Determinations:									
Calcium (mg/l)	30.4	30.4	30.8	30.4	30.8	31.2	30.4–31.2	30.7	0.3
Magnesium (mg/l)	8.2	8.4	7.7	8.2	8.2	7.7	7.7–8.4	8.1	0.3
Sodium (mg/l)	8.3	8.3	8.6	8.5	8.3	8.5	8.3–8.6	8.4	0.1
Chloride (mg/l)	16.3	16.3	16.0	16.3	16.3	16.5	16.0–16.5	16.3	0.2
Nitrate (mg/l)	0.3	0.6	0.8	0.6	0.8	0.3	0.3–0.8	0.6	0.2
Sulfate (mg/l)	20.5	20.0	20.0	20.5	20.0	20.0	20.0–20.5	20.2	0.3
Phosphorus (mg/l)	0.06	0.04	0.04	0.04	0.04	0.04	0.04–0.06	0.043	0.008
Silica (mg/l)	0.30	0.28	0.21	0.28	0.26	0.36	0.21–0.36	0.28	0.05
Total Alkalinity (mg/l)	88	84	86	86	86	88	84–88	86	2
B.O.D. (mg/l)	2	3	2	3	2	4	2–4	2.7	0.8
Suspended Solids (mg/l)	17	15	5	37	23	26	5–37	21	11
Dissolved Solids (mg/l)	146	154	144	146	152	158	144–158	150	6
Turbidity (F.T.U.)	23	23	13	27	25	28	13–28	23	5
pH	8.8	8.7	8.8	8.7	8.7	8.7	8.7–8.8	8.7	0.1
Conductivity (umhos/cm)	215	215	218	222	230	230	215–230	222	7

TABLE 8

LAKE ERIE WATER QUALITY ANALYSES FOR OCTOBER 1977

Dates:
Field 25 October 1977
Laboratory 26 October 1977

Parameters	Station No. 1		Station No. 8		Station No. 13		Range	Mean	Standard Deviation
	Surface	Bottom	Surface	Bottom	Surface	Bottom			
Field Measurements:									
Temperature (°C)	10.0	10.0	10.0	9.2	10.1	9.8	9.2-10.1	9.9	0.3
Dissolved Oxygen (ppm)	10.1	11.2	10.2	11.4	10.2	11.5	10.1-11.5	10.8	0.7
Conductivity (umhos/cm)	310	310	280	280	300	300	280-310	297	14
Transparency (m)	0.5		0.6		0.5		0.5-0.6	0.53	0.06
Depth (m)		1.5		4.0		3.0	1.5-4.0	2.8	1.3
Laboratory Determinations:									
Calcium (mg/l)	35.6	35.6	32.0	32.4	33.6	33.6	32.0-35.6	33.8	1.5
Magnesium (mg/l)	8.2	8.4	8.2	7.9	8.6	8.4	7.9-8.6	8.3	0.2
Sodium (mg/l)	9.2	9.2	8.0	7.6	8.9	8.9	7.6-9.2	8.6	0.7
Chloride (mg/l)	17.3	17.3	14.3	14.3	15.8	15.8	14.3-17.3	15.8	1.3
Nitrate (mg/l)	5.4	5.1	1.7	1.2	1.2	2.0	1.2-5.4	2.8	2.0
Sulfate (mg/l)	24.0	24.0	21.5	22.0	23.0	15.8	15.8-24.0	21.7	3.1
Phosphorus (mg/l)	0.09	0.09	0.04	0.05	0.05	0.03	0.03-0.09	0.06	0.03
Silica (mg/l)	0.05	0.05	0.05	0.13	0.07	0.10	0.05-0.13	0.08	0.03
Total Alkalinity (mg/l)	94	94	92	92	94	92	92-94	93	1
B.O.D. (mg/l)	4	5	3	3	3	4	3-5	4	1
Suspended Solids (mg/l)	26	51	14	18	14	13	13-51	23	15
Dissolved Solids (mg/l)	158	166	144	146	160	160	144-166	156	9
Turbidity (F.T.U.)	18	21	15	17	10	7	7-21	15	5
pH	8.2	8.1	8.1	8.3	8.2	8.1	8.1-8.3	8.2	0.1
Conductivity (umhos/cm)	341	351	336	335	358	332	332-358	342	10

TABLE 9

LAKE ERIE WATER QUALITY ANALYSES FOR NOVEMBER 1977

Dates:
Field 22 November 197
Laboratory 23 November 1977

Parameters	Station No. 1		Station No. 8		Station No. 13		Range	Mean	Standard Deviation
	Surface	Bottom	Surface	Bottom	Surface	Bottom			
Field Measurements:									
Temperature (°C)	4.0	4.0	4.0	4.0	4.0	4.0	0.0	4.0	–
Dissolved Oxygen (ppm)	10.6	10.6	12.2	10.2	10.2	4.8	4.8–12.2	9.8	2.5
Conductivity (umhos/cm)	–	–	–	–	–	–	–	–	–
Transparency (m)	0.5		0.8		0.8		0.5–0.8	0.7	0.2
Depth (m)		1.2		3.9		3.0	1.2–3.9	2.7	1.4
Laboratory Determinations:									
Calcium (mg/l)	38.8	38.8	36.8	36.8	38.4	38.8	36.8–38.8	38.1	1.0
Magnesium (mg/l)	10.1	10.1	9.8	9.8	9.8	9.6	9.6–10.1	9.9	0.2
Sodium (mg/l)	11.2	11.2	11.2	11.2	11.2	11.2	–	11.2	0.0
Chloride (mg/l)	21.5	21.5	20.0	20.0	21.5	21.5	20.0–21.5	21.0	0.8
Nitrate (mg/l)	7.2	8.3	9.4	7.9	7.6	6.8	6.8– 9.4	7.9	0.9
Sulfate (mg/l)	23.0	22.0	21.0	21.5	22.5	23.0	21.0–23.0	22.2	0.8
Phosphorus (mg/l)	0.05	0.04	0.03	0.03	0.04	0.04	0.03–0.05	0.04	0.01
Silica (mg/l)	0.46	0.52	0.61	0.59	0.64	0.64	0.46–0.64	0.58	0.07
Total Alkalinity (mg/l)	102	104	100	100	102	101	100–104	102	2
B.O.D. (mg/l)	3	4	2	2	3	2	2–4	3	1
Suspended Solids (mg/l)	21	10	13	32	14	27	10–32	20	9
Dissolved Solids (mg/l)	198	196	186	184	178	192	178–198	189	8
Turbidity (F.T.U.)	24	27	7	8	8	8	7–27	14	9
pH	7.9	7.8	8.1	8.0	8.0	8.1	7.8–8.1	8.0	0.1
Conductivity (umhos/cm)	335	340	320	320	330	330	320–340	329	8

TABLE 10

SOLAR RADIATION MEASUREMENTS AT LOCUST POINT

Station \ Time	Deck	Surface	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
12 May 1977										
3[a] 1128	2440	2250	205	19.5	2.5	0.5				
8[a] 1202	3880	3360	550	64	8.5	2.2				
13[a] 1244	5000	2000	350	65	10	2.5				
14[a] 1315	4200	3360	800	115	19.5	3.5	0.7			
18 July 1977										
3[b] 1100	5400	3500	1300	530	230	100	37	9		
8[b] 1145	5400	4000	1600	860	420	200	100	50	29	12
13[b] 1330	5500	4500	2000	870	410	180	54			
14[b] 1235	6200	4500	1700	950	440	210	120	66	25	6
28 July 1977										
3[b] 1110	5200	3500	1500	650	250	50	53	23	11	
14[b] 1220	5900	3700	1800	900	330	140	50	19	5.5	
19 August 1977										
3[b] 1056	3600	3400	550	130	27	7.9	2.9	0.8		
14[b] 1252	3100	2900	510	160	52	16	5	1.3	0.5	
28[b] 1153	6000	5700	1600	750	270	120	43	15	6.5	2.2
11 October 1977										
8[b] 1135		140	22	17	7.5	4.5	2.8	2.8		
13[b] 1106		280	45	16	5.3	1.8	0.75	0.3		

[a] Photometer readings in microamps

[b] Photometer readings in foot candles

TABLE 11

MEAN VALUES AND RANGES FOR WATER QUALITY

PARAMETERS TESTED IN 1977

Parameter	April – November 1977		Units
	Mean	Range	
1. Temperature	15.8	4.0–24.0	°C
2. Dissolved Oxygen	9.1	3.0–12.2	ppm
3. Conductivity (field)	278	220 – 360	µmhos/cm
4. Transparency	0.5	0.2–0.8	m
5. Calcium	36.8	30.4 – 45.6	mg/l
6. Magnesium	8.9	6.7–11.0	mg/l
7. Sodium	10.1	7.6–12.7	mg/l
8. Chloride	19.7	14.3–26.8	mg/l
9. Nitrate	7.5	0.3–18.6	mg/l
10. Sulfate	25.9	15.8–40.0	mg/l
11. Phosphorus	0.05	0.00–0.14	mg/l
12. Silica	0.30	0.05–1.20	mg/l
13. Total Alkalinity	93	83 – 104	mg/l
14. BOD	3.6	1 – 5	mg/l
15. Suspended Solids	36	5 – 118	mg/l
16. Dissolved Solids	168	90 – 216	mg/l
17. Turbidity	30	6 – 72	F.T.U.
18. Hydrogen-ions	8.3	7.7–8.9	pH
19. Conductivity (lab)	307	215–375	µmhos/cm

TABLE 12

SUMMARY OF JULY TO OCTOBER 1977
SOLAR RADIATION MEASUREMENTS AT LOCUST POINT

Station	Range[a]	Mean	Standard Deviation
Station 3			
Deck	5400–3600	4733	987
Surface	3500–3400	3467	58
0.5m	1500–550	1117	501
1.0	650–130	437	272
1.5	250–27	169	123
2.0	100–7.9	53	46
2.5	53–2.9	31	26
3.0	23–0.8	11	11
Station 8			
Surface	4000–140	847	1764
0.5	1600–22	811	1116
1.0	860–17	439	596
1.5	420–7.5	214	292
2.0	200–4.5	102	138
2.5	100–2.8	51	69
3.0	50–2.8	26	33
Station 13			
Surface	4500–280	2390	2984
0.5	2000–45	1023	1382
1.0	870–16	443	604
1.5	410–5.3	208	286
2.0	180–1.8	91	126
2.5	54–0.75	27	38
Station 14			
Deck	6200–3200	4700	2121
Surface	4500–2900	3700	1131
0.5	1700–510	1105	841
1.0	950–160	555	559
1.5	440–52	246	274
2.0	210–16	113	137
2.5	120–5	63	81
3.0	66–1.3	34	46
3.5	25–0.5	13	17

[a] Photometer readings in foot candles

F I G U R E S

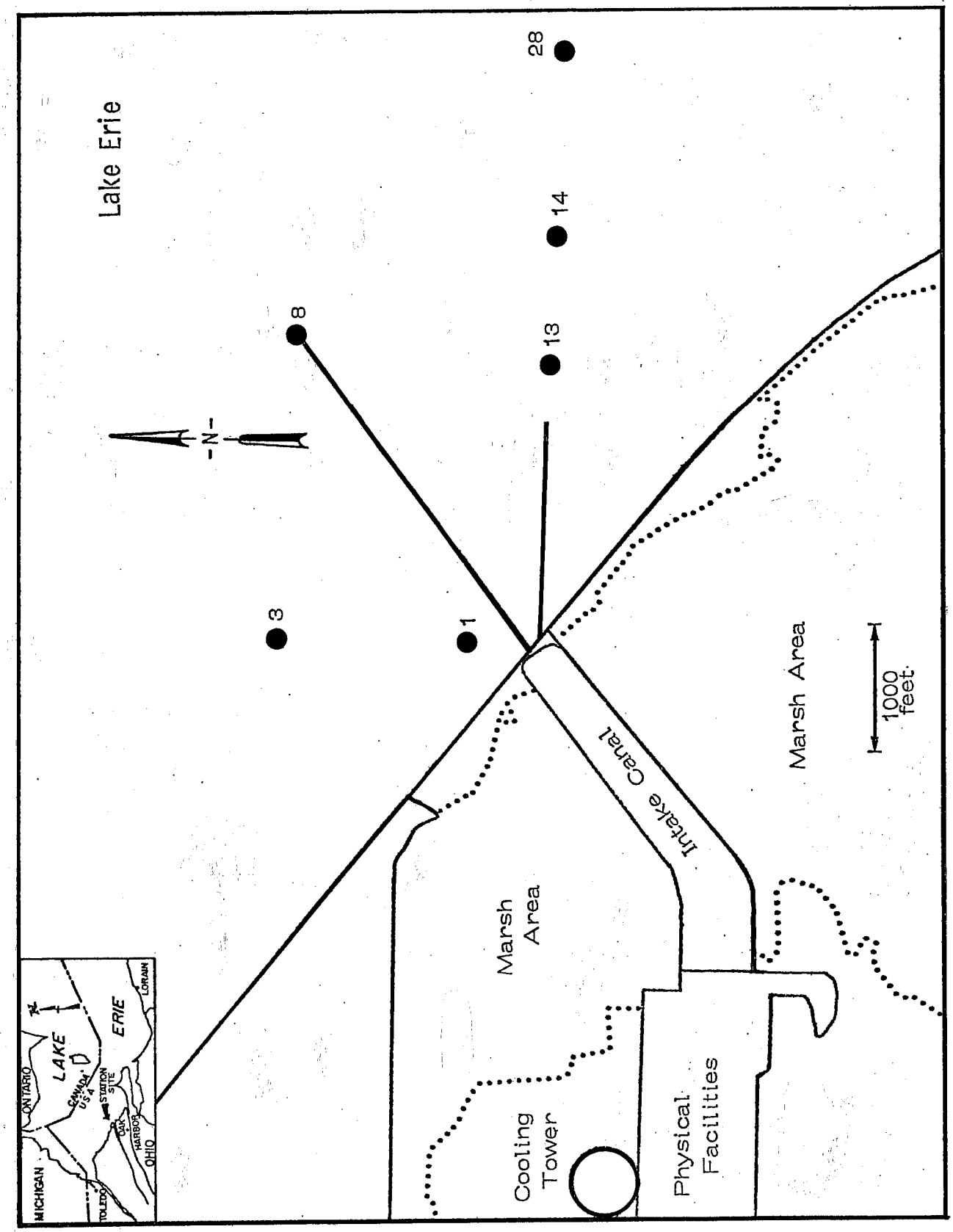
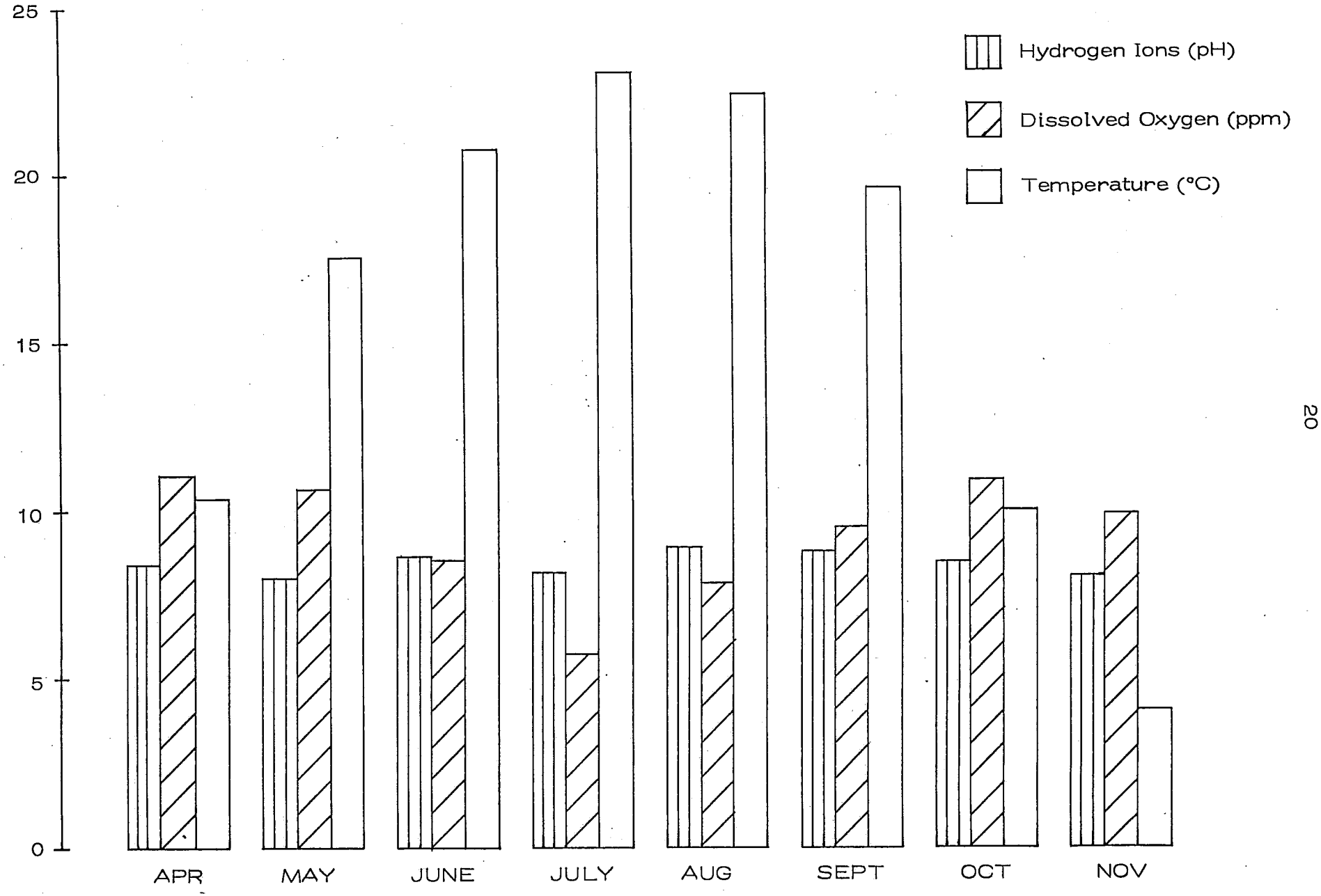


FIGURE 1. SAMPLING STATIONS AT THE DAVIS-BESSE NUCLEAR POWER STATION

FIGURE 2. MEAN MONTHLY HYDROGEN ION, TEMPERATURE AND DISSOLVED OXYGEN MEASUREMENTS FOR LAKE ERIE AT LOCUST POINT DURING 1977.



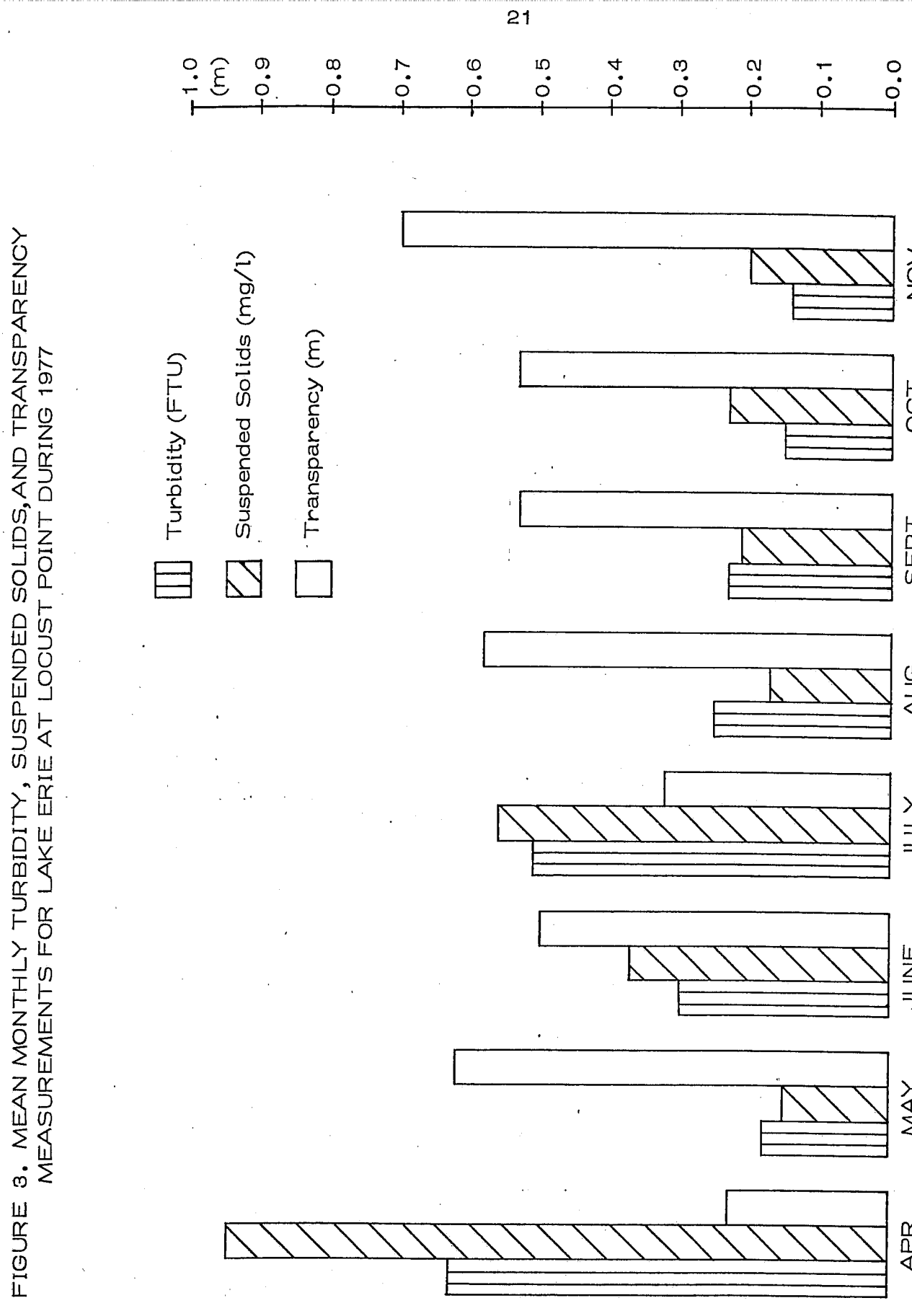


FIGURE 8. MEAN MONTHLY TURBIDITY, SUSPENDED SOLIDS, AND TRANSPARENCY MEASUREMENTS FOR LAKE ERIE AT LOCUST POINT DURING 1977

FIGURE 4. MEAN MONTHLY CALCIUM, CHLORIDE AND SULFATE CONCENTRATIONS IN LAKE ERIE AT LOCUST POINT DURING 1977

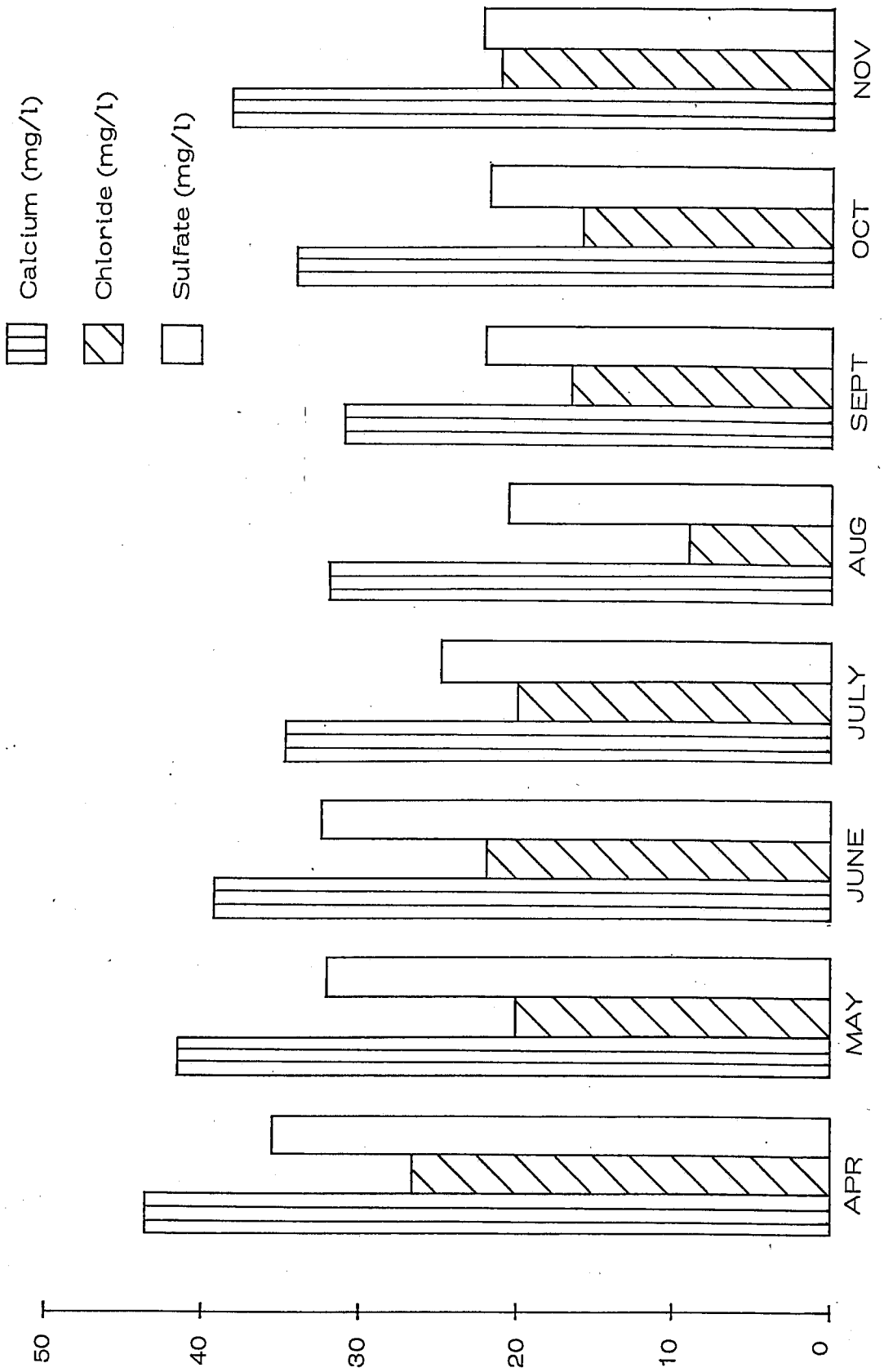


FIGURE 5. MEAN MONTHLY NITRATE, PHOSPHORUS, AND SILICA CONCENTRATIONS IN LAKE ERIE AT LOCUST POINT DURING 1977

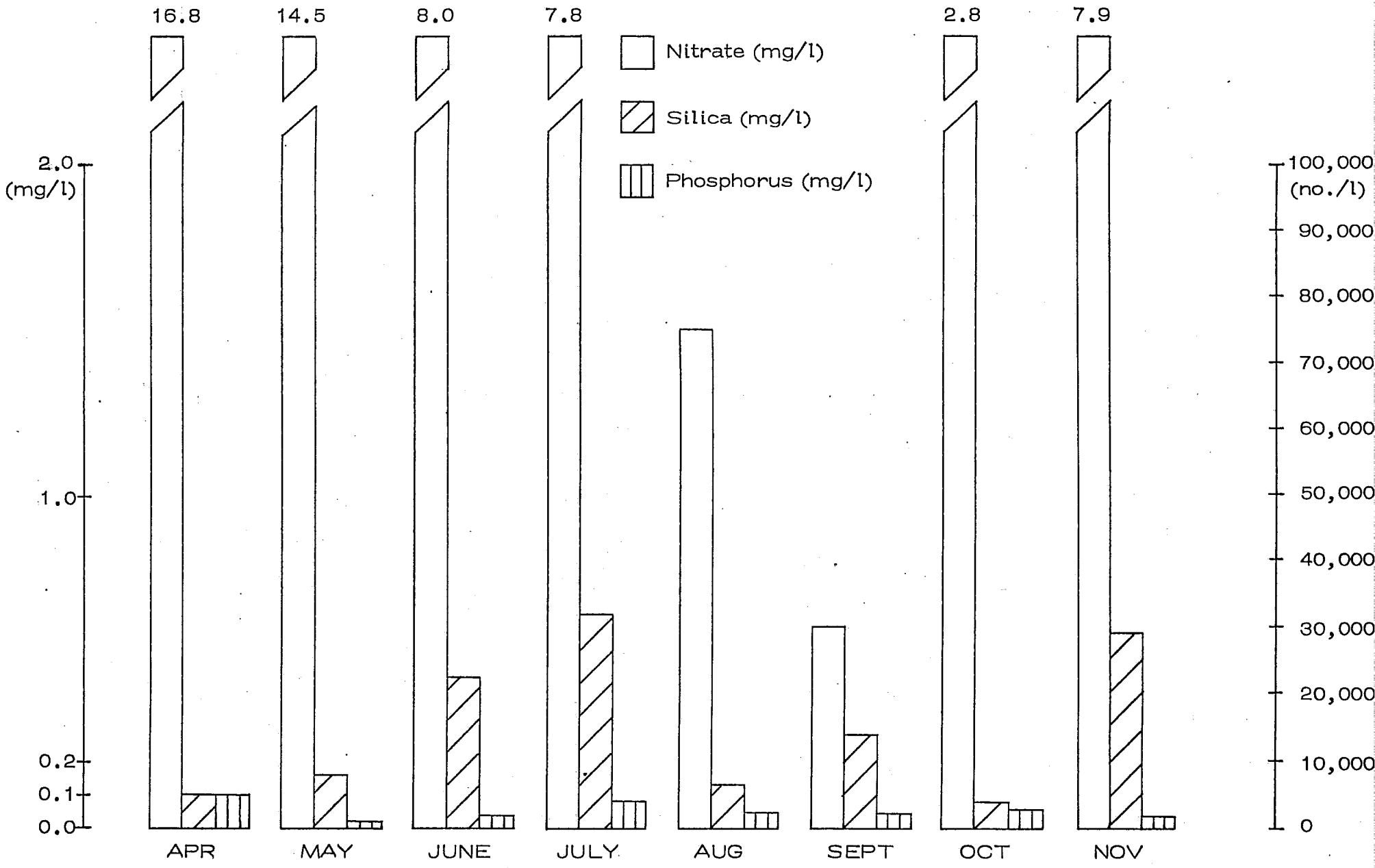


FIGURE 6. MEAN MONTHLY ALKALINITY, DISSOLVED SOLIDS AND CONDUCTIVITY MEASUREMENTS FOR LAKE ERIE AT LOCUST POINT DURING 1977.

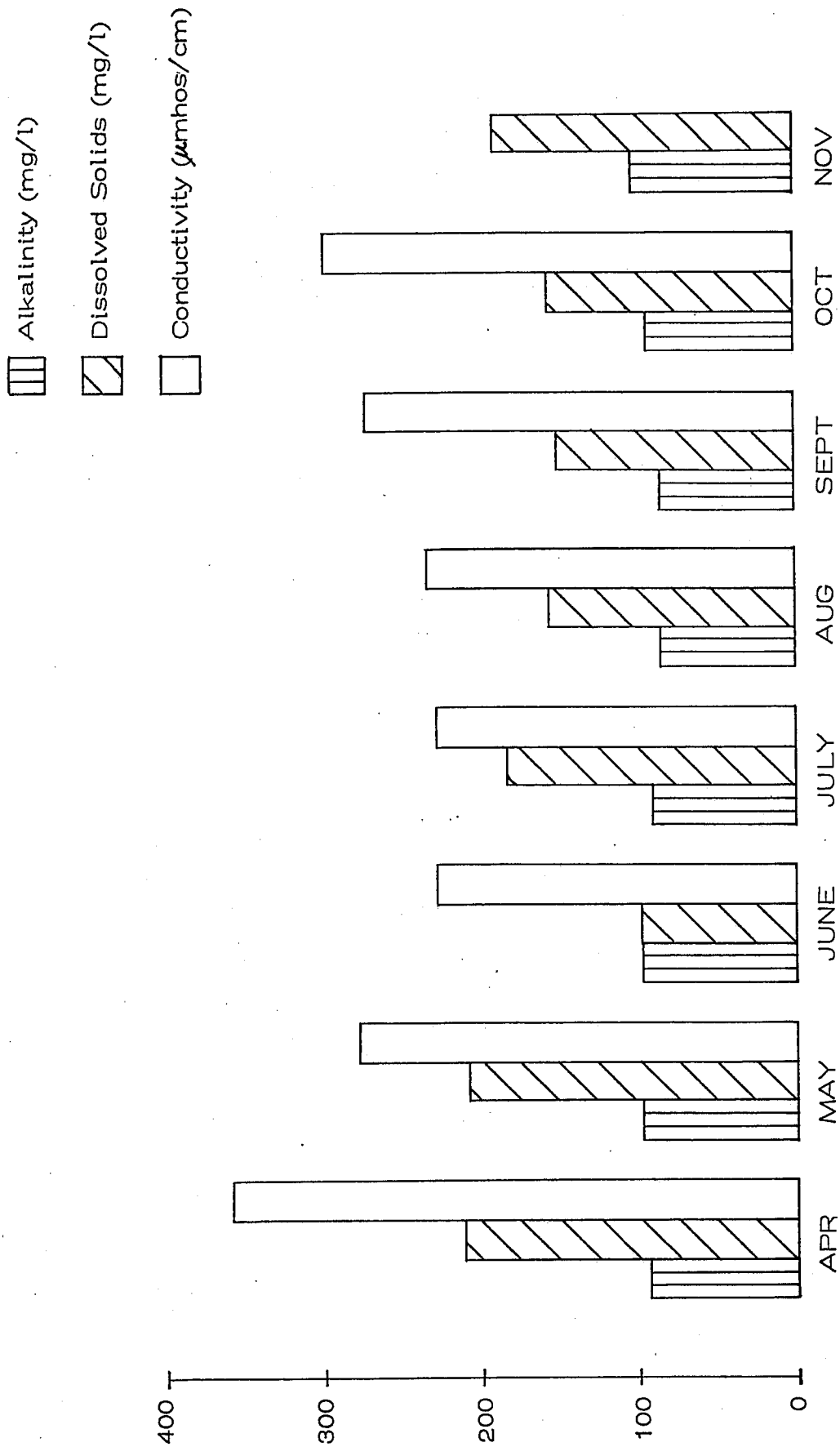


FIGURE 7. TRENDS IN MEAN MONTHLY TEMPERATURE, DISSOLVED OXYGEN, AND HYDROGEN ION MEASUREMENTS FOR LAKE ERIE AT LOCUST POINT FOR THE PERIOD 1972-1977

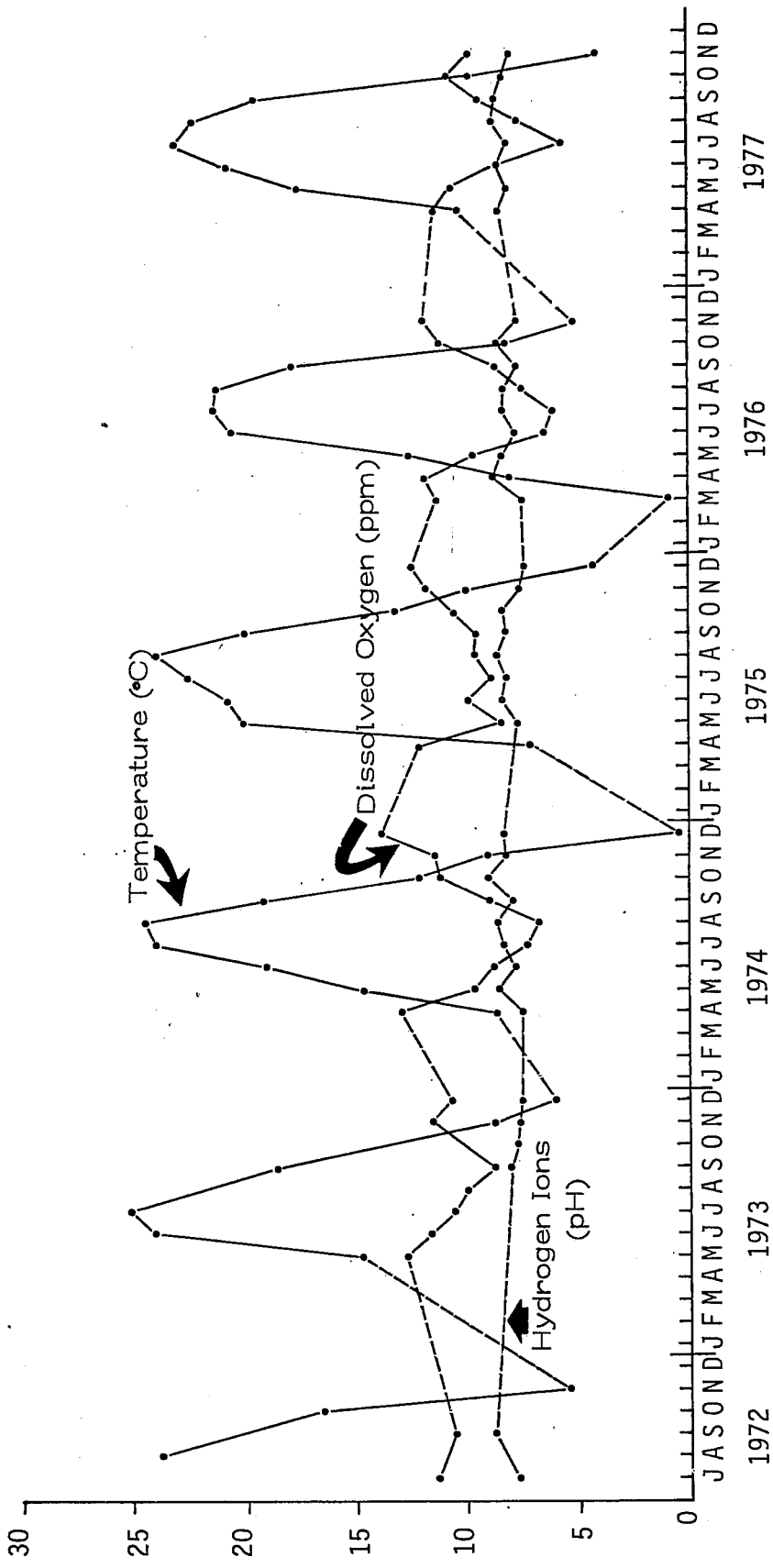


FIGURE 8. TRENDS IN MEAN MONTHLY CONDUCTIVITY, ALKALINITY AND TURBIDITY MEASUREMENTS FOR LAKE ERIE AT LOCUST POINT FOR THE PERIOD 1972-1977

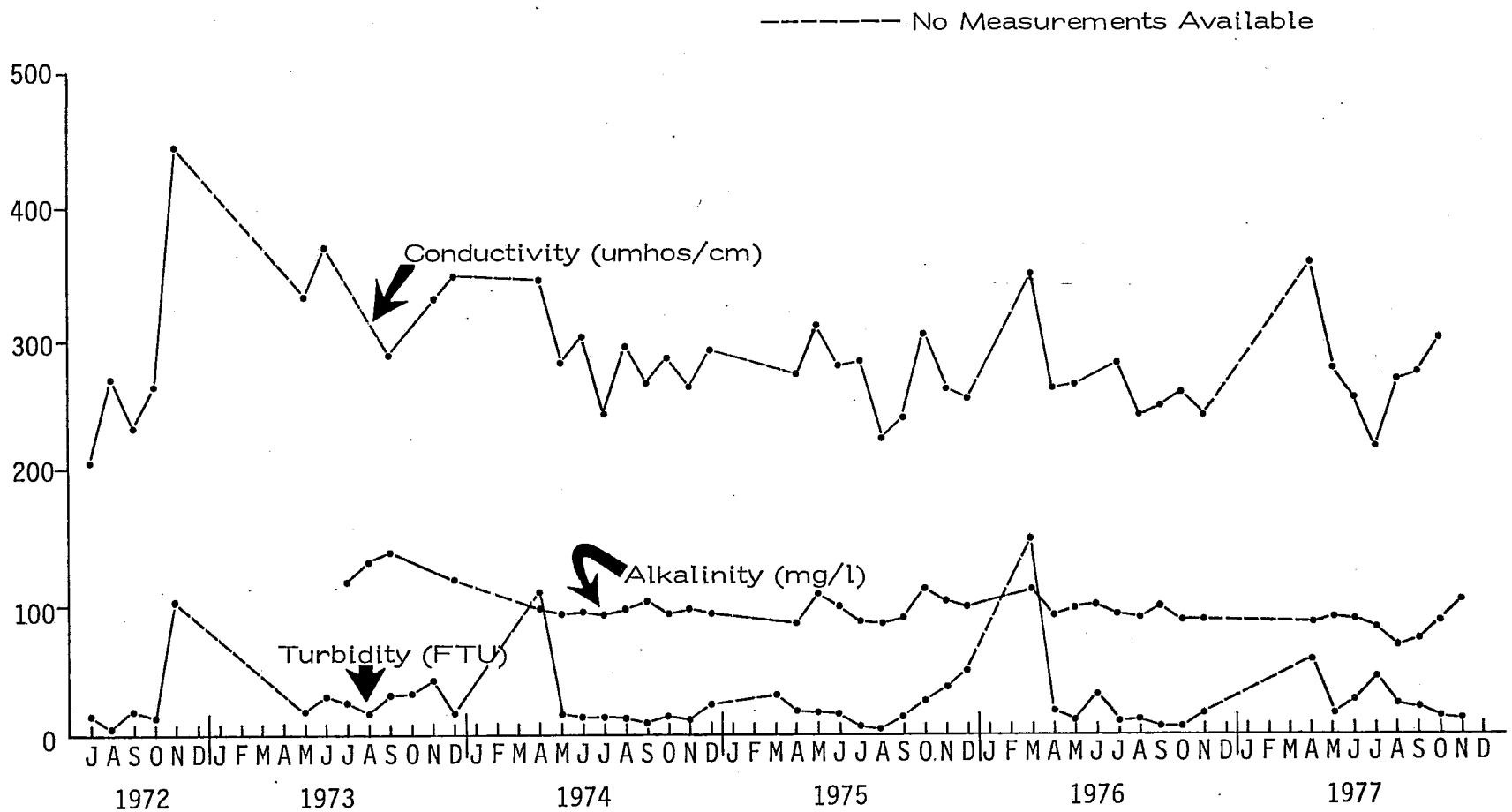


FIGURE 9. TRENDS IN MEAN MONTHLY TRANSPARENCY AND PHOSPHORUS MEASUREMENTS FOR LAKE ERIE AT LOCUST POINT FOR THE PERIOD 1972-1977