TABLE 1 (Continued)

WASHTENAW COUNTY TOTAL: 18 Lakes, 20 Sites

Lake #	Lake Name	Township	Range	Number Sampling Sites
70	Baseline	1 S	5 E	1
71	Bruin	1 S	3 E	1
72	Cavanaugh	2 S	3 E	1
73	Crooked	2 S	3 E	1
74	Four Mile	1 S	4 E	1
75	Half Moon	1 S	3 E	1
76	Independence	1 S	5 E	1
77	Island	1 S	3 E	1
78	Joslin	1 S	2 E	1
79	Mill	2 S	3 E	1
80	North	1 S	3 E	1
81	Pleasant	3 S	4 E	2
82	Portage (Little)	1 S	4 E	1
83	Silver	1 S	4 E	1
84	South	1 S	3 E	1
85	Sugarloaf	1 S	3 E	1
86	West	1 S	4 E	1
87	Whitmore	1 S	5 E	2

FIGURE 1

AVERAGE DISSOLVED ORTHO PHOSPHORUS (mg-P/l)
FOR SPRING 1977 SURVEY

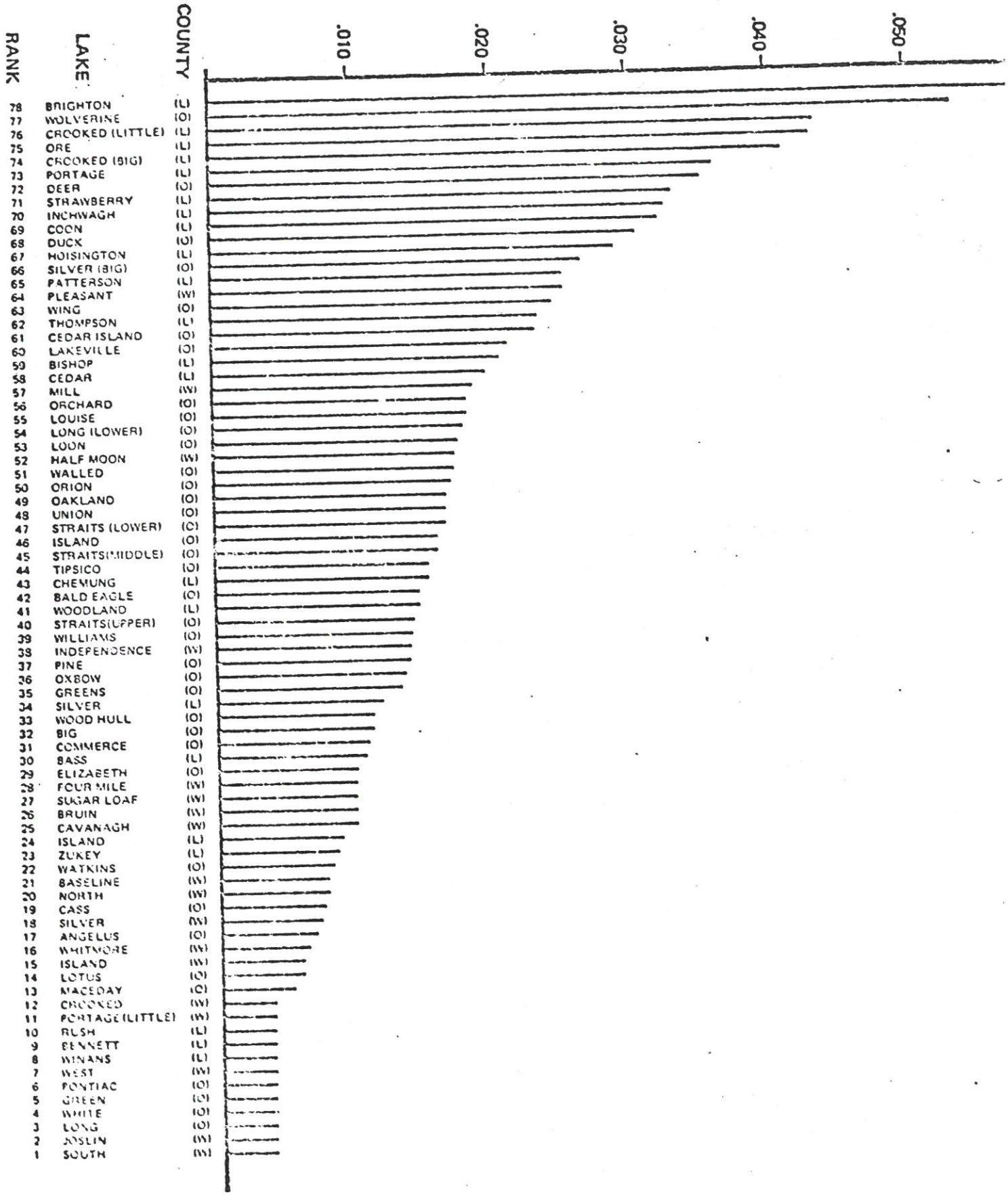


FIGURE 2

AVERAGE TOTAL PHOSPHORUS (mg-P/l)
FOR SPRING 1977 SURVEY

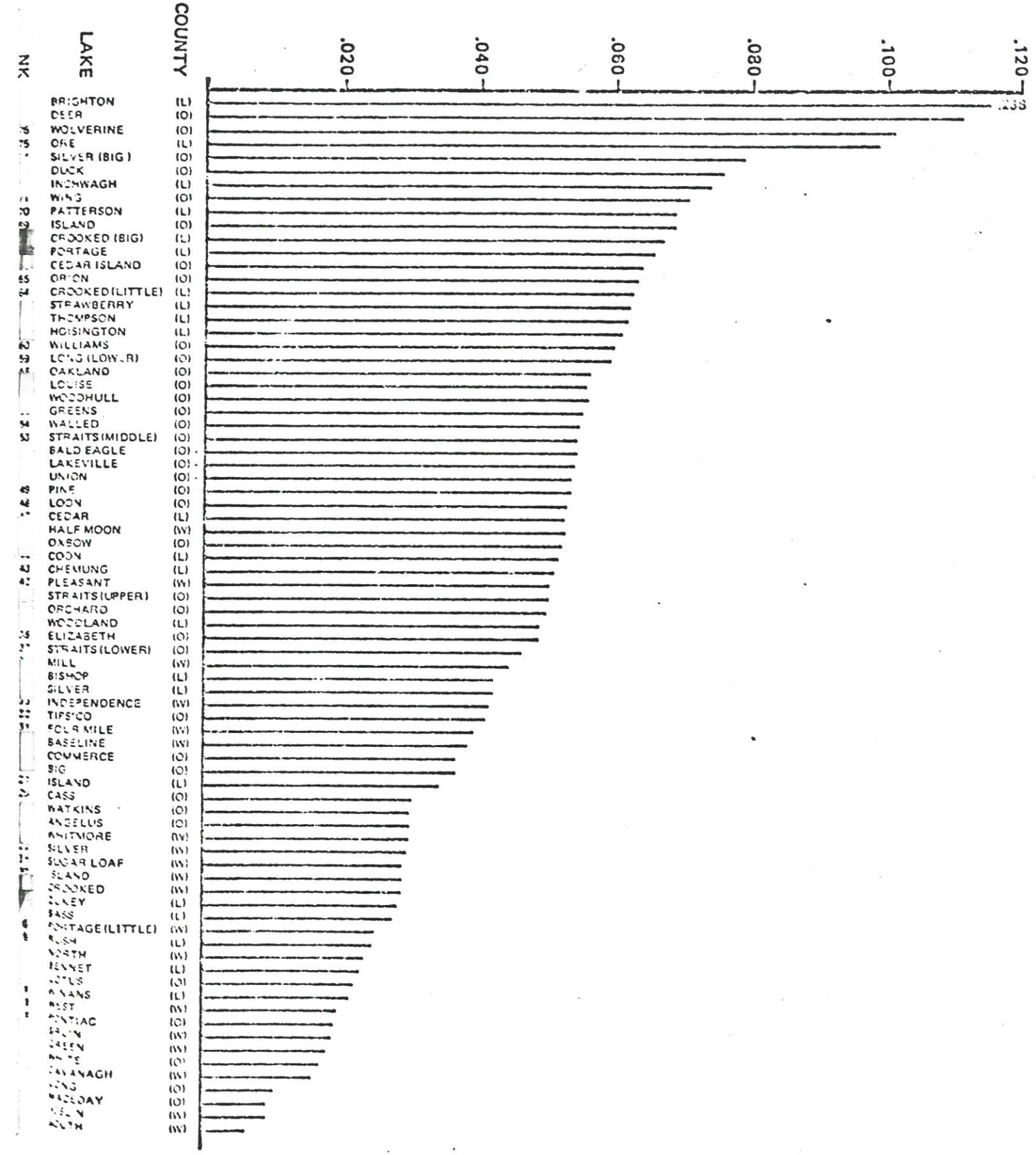
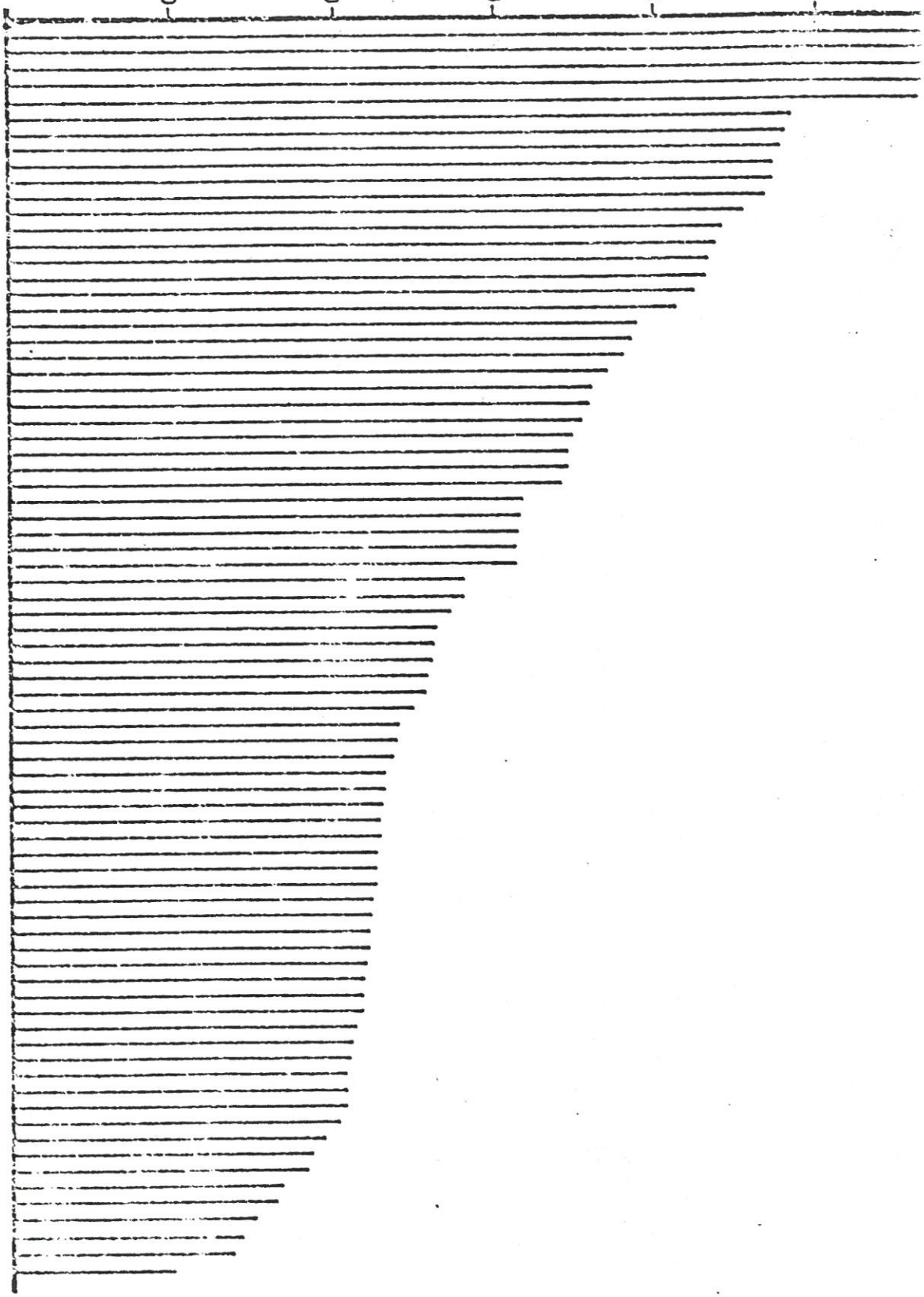


FIGURE 3
AVERAGE AMMONIA (mg-N/l)
FOR SPRING 1977 SURVEY



RANK	LAKE	COUNTY
78	BRIGHTON	(L)
77	INCHWAGH	(L)
76	PLEASANT	(W)
75	LOUISE	(O)
74	OAKLAND	(O)
73	PATTERSON	(L)
72	SILVER (BIG)	(O)
71	LAKEVILLE	(O)
70	STRAITS (LOWER)	(O)
69	LONG (LOWER)	(O)
68	ELIZABETH	(O)
67	THOMPSON	(L)
66	STRAITS(MIDDLE)	(O)
65	WOLVERINE	(O)
64	CROOKED(LITTLE)	(L)
63	WOODLAND	(L)
62	GREEN	(O)
61	MILL	(W)
60	ORCHARD	(O)
59	BASELINE	(W)
58	WALLED	(O)
57	HALF MOON	(W)
56	COON	(L)
55	DUCK	(O)
54	LOON	(O)
53	PORTAGE(LITTLE)	(W)
52	OXBOW	(O)
51	FOUR MILE	(W)
50	LOTUS	(O)
49	STRAITS(UPPER)	(O)
48	ORE	(L)
47	CEDAR ISLAND	(O)
46	GREENS	(O)
45	WINANS	(L)
44	HOISINGTON	(L)
43	STRAWBERRY	(L)
42	INDEPENDENCE	(W)
41	ZUKEY	(L)
40	TIPSICO	(O)
39	JOSLIN	(W)
38	BISHOP	(L)
37	CHEMING	(L)
36	BRUIN	(W)
35	WHITE	(O)
34	BALD EAGLE	(O)
33	COMMERCE	(O)
32	NORTH	(W)
31	PONTIAC	(O)
30	UNION	(O)
29	WING	(O)
28	BIG	(O)
27	BENNETT	(L)
26	CROOKED	(W)
25	ISLAND	(W)
24	PORTAGE	(L)
23	DEER	(O)
22	PINE	(O)
21	WATKINS	(O)
20	LONG	(O)
19	SILVER	(W)
18	WHITMORE	(W)
17	WILLIAMS	(O)
16	ISLAND	(O)
15	ORION	(O)
14	SILVER	(L)
13	SOUTH	(W)
12	CROOKED (BIG)	(L)
11	CEDAR	(L)
10	WEST	(W)
9	ISLAND	(L)
8	MACEDAY	(O)
7	CAVANAGH	(W)
6	WOODHULL	(O)
5	CASS	(O)
4	SUGARLOAF	(W)
3	ANGELUS	(O)
2	BASS	(L)
1	RUSH	(L)

FIGURE 4

AVERAGE DISSOLVED ORTHO PHOSPHORUS (mg-P/l) AT ONE METER DEPTH
FOR SUMMER 1977 SURVEY

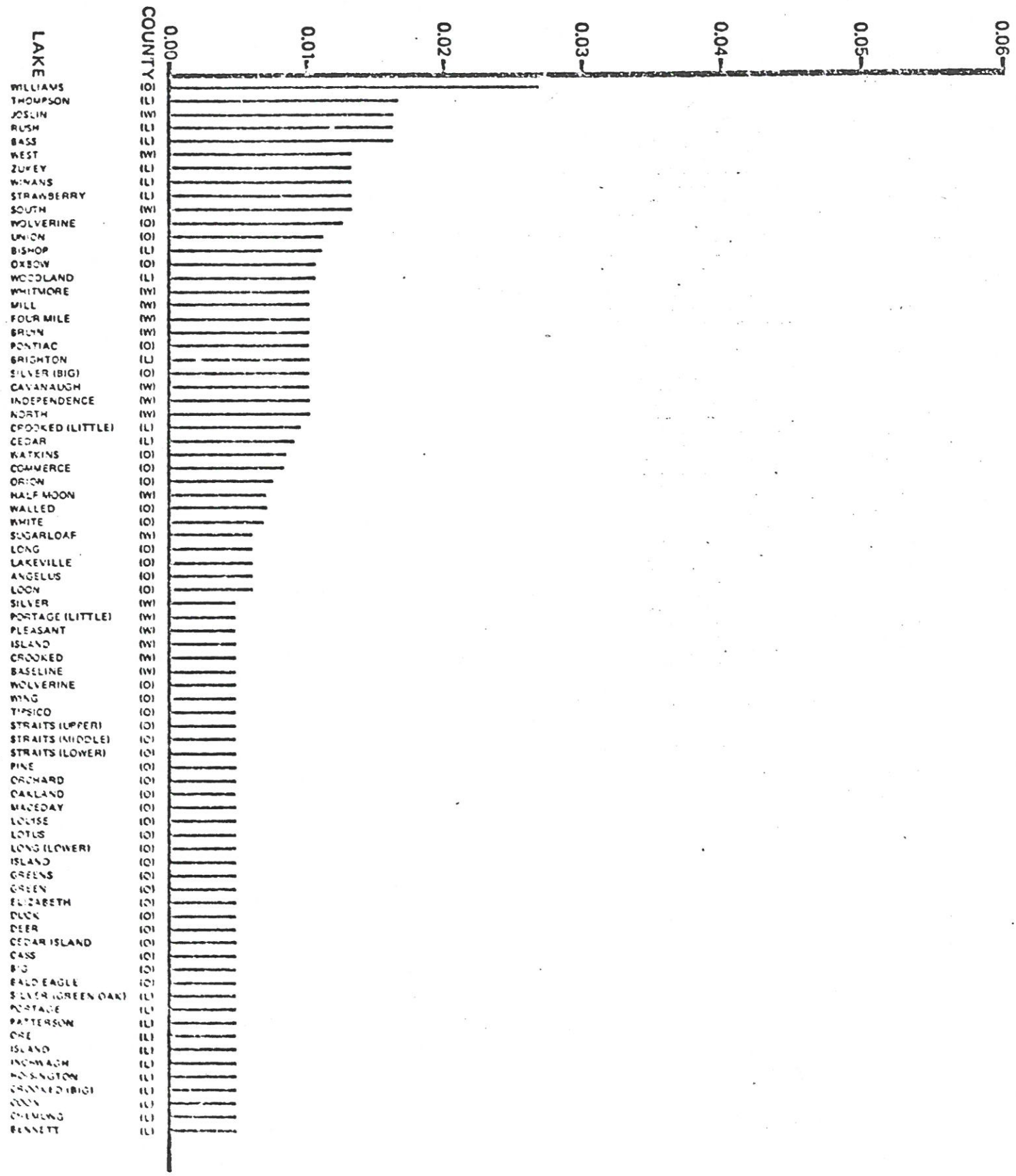


FIGURE 5

AVERAGE TOTAL PHOSPHORUS (mg-P/l) AT ONE METER DEPTH
FOR SUMMER 1977 SURVEY

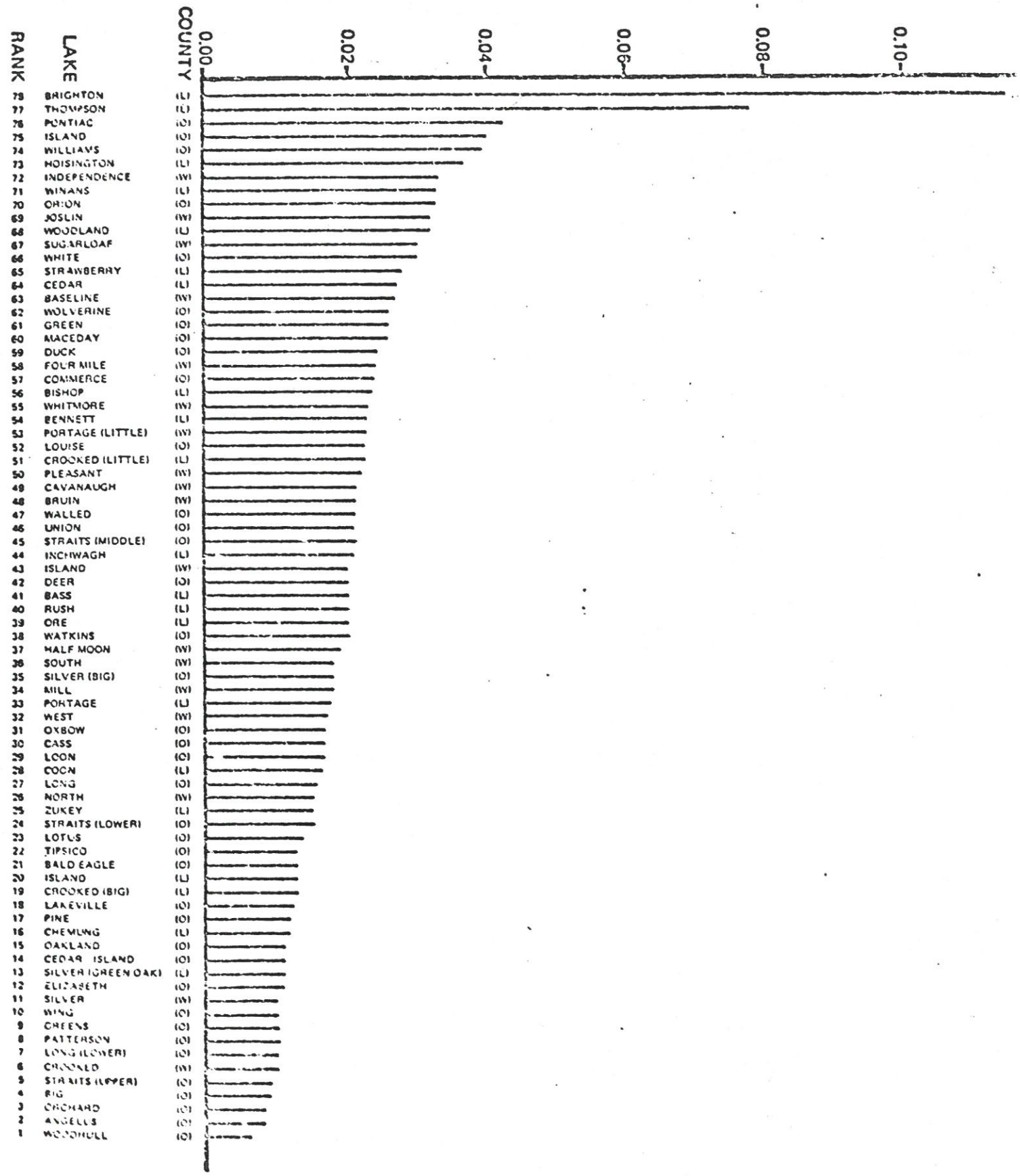


FIGURE 6

AVERAGE AMMONIA (mg-N/l) AT ONE METER DEPTH
FOR SUMMER 1977 SURVEY

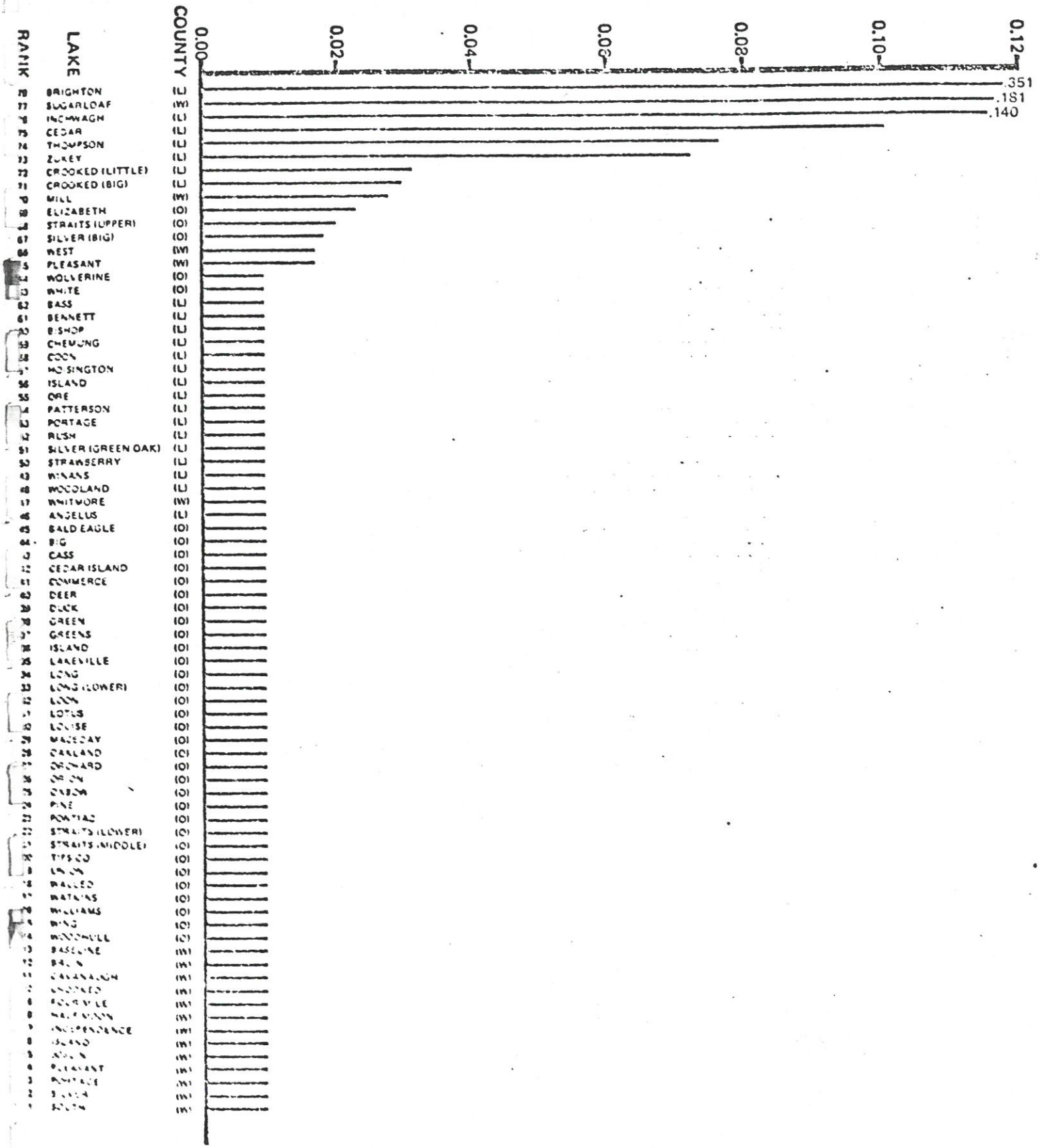


FIGURE 10
AVERAGE CHLORIDE (mg-Cl/l)
FOR SPRING 1977 SURVEY

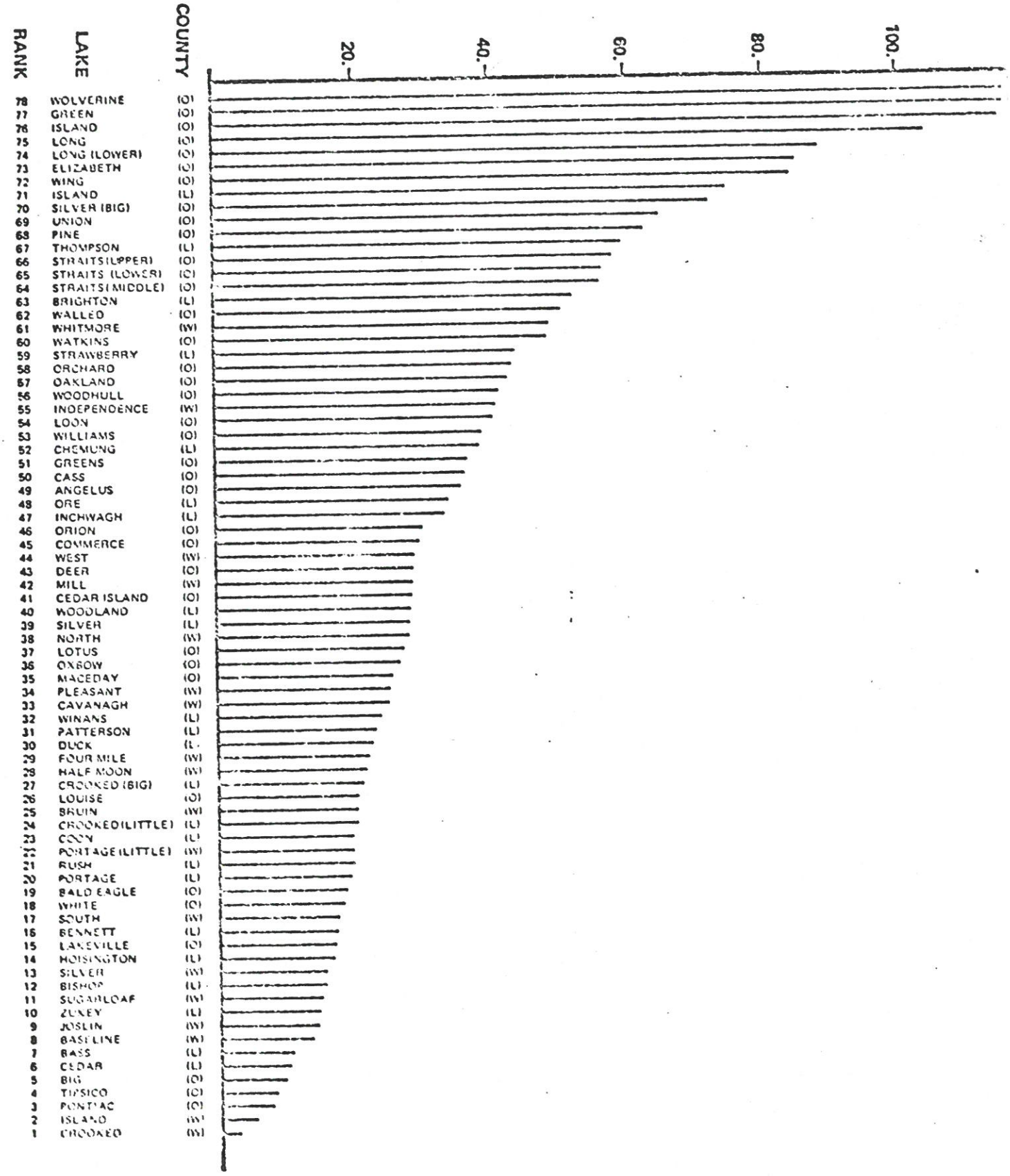
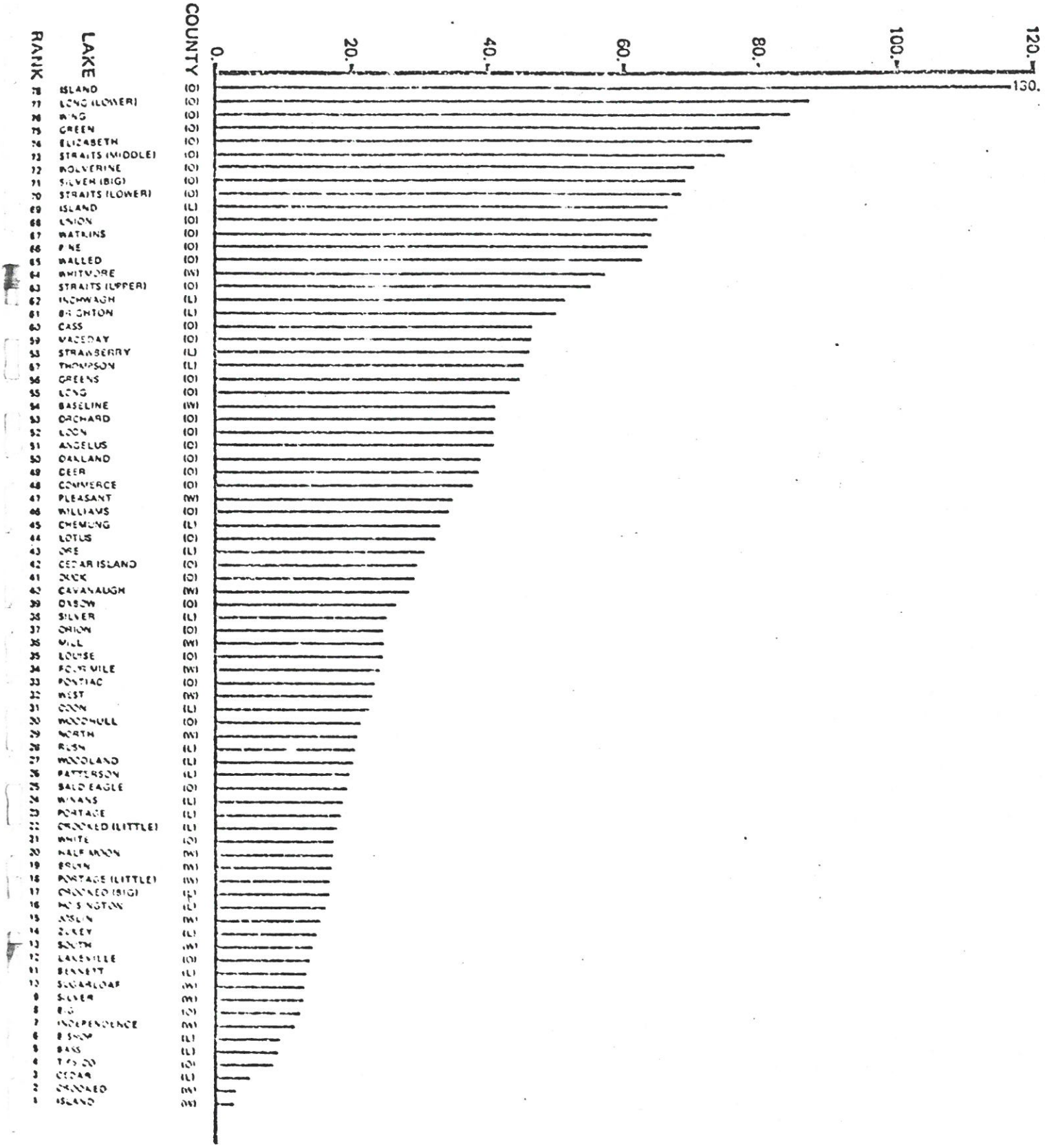


FIGURE 11
AVERAGE CHLORIDE (mg-Cl/l)
FOR SUMMER 1977 SURVEY



Perm No. MI 0037192

MICHIGAN WATER RESOURCES COMMISSION

AUTHORIZATION TO DISCHARGE UNDER THE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

(Superseding Order No. 1569 dated November 18, 1971)

In compliance with the provisions of the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251 et seq; the "Act"), and the Michigan Water Resources Commission Act, as amended, (Act 245, Public Acts of 1929, as amended, the "Michigan Act"),

PAUL SAPIANO

is authorized to discharge from a facility located at

10519 Denton Hill Road
Tyrone Township, Livingston County
Fenton, Michigan

to receiving waters named Denton Creek

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I and II hereof.

This permit shall become effective on the date of issuance.

This permit and the authorization to discharge shall expire at midnight, June 30, 1980. In order to receive authorization to discharge beyond the date of expiration, the permittee shall submit such information and forms as are required by the Michigan Water Resources Commission no later than 180 days prior to the date of expiration.

This permit is based on the company's application numbered MI 0037192, dated May 25, 1975, and shall supersede any and all Orders of Determination, Stipulation, or Final Orders of Determination previously adopted by the Michigan Water Resources Commission.

Issued this 31st day of July, 1975, for the Michigan Water Resources Commission.

W. G. Turney
Assistant Executive Secretary

APPENDIX 9 Page 2 of 10

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. Effluent Limitations

During the period beginning on the effective date of this permit and lasting until the expiration of this permit, the permittee is authorized to discharge from outfall(s) 001. Such discharge shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations kg/day (lbs/day) Daily Average	Daily Maximum	Other Limitations Daily Average	Daily Maximum	Monitoring Requirements Measurement Frequency	Sample Type
Flow, M^3/Day (MGD)					Daily*	
BOD_5				10 mg/l	Daily*	Grab
Total Suspended Solids				15 mg/l	Daily*	Grab
Fecal Coliform			200/100 ml	400/100 ml	Daily*	Grab
Total Phosphorus (as P)	"see below"				Daily*	Grab

* During discharge

Total Phosphorus (as P) - shall contain not more than twenty percent (20%) of the total phosphorus contained in the untreated sanitary waste.

Discharge Period: Discharge is to be during the high flow periods in the spring of each year with no discharge after April 15 and no discharge during periods of significant ice cover on the receiving stream.

a. The pH shall not be less than 6.5 nor greater than 9.5. The pH shall be monitored as follows: once daily during discharge - grab.

b. The discharge shall not cause excessive foam in the receiving waters. The discharge shall be essentially free of floating and settleable solids.

c. The discharge shall not contain oil or other substances in amounts sufficient to create a visible film or sheen on the receiving waters.

d. Samples taken in compliance with the monitoring requirements above shall be taken at the outfall 001, prior to discharge to Denton Creek.

e. At least 10 days prior to discharge to surface waters of the state the Commission's Basin engineer shall be notified of the intended discharge and the permittee shall obtain the approval of the discharge period and rate.

PART I

B. MONITORING AND REPORTING

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Reporting

The permittee shall submit monitoring reports containing results obtained during the previous month and shall be postmarked no later than the 10th day of the month following each completed report period. The first report shall be submitted within 90 days of the date of issuance of this permit.

3. Definitions

a. The daily average discharge is defined as the total discharge by weight, or concentration if specified, during a calendar month divided by the number of days in the month that the production or commercial facility was operating.

b. The daily maximum discharge means the total discharge by weight, or concentration if specified, during any calendar day.

c. The Regional Administrator is defined as the Region V Administrator, U.S. EPA, located at 230 South Dearborn, 13th Floor, Chicago, Illinois 60604.

d. The Michigan Water Resources Commission is located in the Stevens T. Mason Building, Lansing, Michigan.

4. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304(g) of the Act, under which such procedures may be required.

5. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

a. The exact place, date, and time of sampling;

b. The dates the analyses were performed;

c. The person(s) who performed the analyses;

d. The analytical techniques or methods used; and

e. The results of all required analyses.

6. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Monthly Operating Report. Such increased frequency shall also be indicated.

7. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator or the Michigan Water Resources Commission.

C. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the effluent limitations specified for outfall(s) 001 in accordance with the following schedule:

a. Submit progress report to the Chief Engineer of the Michigan Water Resources Commission on or before N/A.

b. Submit a preliminary engineering report and basis of design for said facilities to the Chief Engineer of the Michigan Water Resources Commission and obtain his approval thereof on or before N/A.

c. Submit progress report to the Chief Engineer of the Michigan Water Resources Commission on or before N/A.

d. Submit final plans and specifications for said facilities to the Chief Engineer of the Michigan Water Resources Commission and obtain his approval thereof on or before N/A.

e. Commence construction of said facilities on or before N/A.

f. Submit progress report to the Chief Engineer of the Michigan Water Resources Commission on or before N/A.

g. Complete construction of said facilities on or before N/A.

H. Attain operational level necessary to meet the limitations specified herein on or before date of issuance.

i. All wastewaters from this facility shall be connected to any sanitary sewer system which may be provided by any governmental unit, within sixty (60) days from the date when said sewer becomes available. At that time, any restrictions and conditions imposed by said governmental unit shall supersede the restrictions and conditions of this Permit and this Permit shall then be terminated.

APPENDIX 9 Page 5 of 10

2. The permittee shall comply with the requirements of Section 9, Part II in accordance with the following:

a. Submit plans for approval to the Chief Engineer of the Michigan Water Resources Commission necessary to comply with the primary power provision of Section 9 in Part II on or before N/A.

b. The permittee shall comply with the requirements of items 9a or 9b contained in Part II on or before N/A. Not withstanding the preceding sentence the permittee shall at all times halt, reduce, or otherwise control production in order to protect the waters of the State of Michigan upon the reduction or loss of the primary source of power.

3. No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

A. MANAGEMENT REQUIREMENTS

1. Change in Discharge

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit. Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants must be reported by submission of a new NPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the permit issuing authority of such changes. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

2. Containment Facilities

The permittee shall provide approved facilities for containment of any accidental losses of concentrated solutions, acids, alkalies, salts, oils, or other polluting materials in accordance with the requirements of the Michigan Water Resources Commission Rules, Part 5.

3. Operator Certification

The permittee shall have the waste treatment facilities under the direct supervision of an operator certified by the Michigan Water Resources Commission, as required by Section 6a of the Michigan Act.

4. Noncompliance Notification

If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum effluent limitation specified in this permit, the permittee shall provide the Regional Administrator and the State with the following information, in writing, within five (5) days of becoming aware of such condition:

a. A description of the discharge and cause of noncompliance; and

b. The period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

5. Facilities Operation

The permittee shall at all times maintain in good working order and operate as efficiently as possible, all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

6. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to navigable waters resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

7. By-passing

Any diversion from or by-pass of facilities necessary to maintain compliance with the terms and conditions of this permit is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage or runoff would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this permit. The permittee shall promptly notify the Michigan Water Resources Commission and the Regional Administrator, in writing, of such diversion or by-pass.

8. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed from or resulting from treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

9. Power Failures

In order to maintain compliance with the effluent limitations and prohibitions of this permit, the permittee shall either:

a. Provide an alternative power source sufficient to operate facilities utilized by permittee to maintain compliance with the effluent limitations and conditions of this permit which provision shall be indicated in this permit by inclusion of a specific compliance date in each appropriate "Schedule of Compliance for Effluent Limitations", or

b. Upon the reduction, loss, or failure of one or more of the primary sources of power to facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit, the permittee shall halt, reduce or otherwise control production and/or all discharge in order to maintain compliance with the effluent limitations and conditions of this permit.

B. RESPONSIBILITIES

1. Right of Entry

The permittee shall allow the Executive Secretary of the Michigan Water Resources Commission, the Regional Administrator and/or their authorized representatives, upon the presentation of the credentials:

a. To enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and

b. At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect any monitoring equipment or monitoring method required in this permit; and to sample any discharge of pollutants.

2. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Michigan Water Resources Commission and the Regional Administrator.

3. Availability of Reports.

Except for data determined to be confidential under Section 308 of the Act and Rule 2128 of the Water Resources Commission Rules, Part 21, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the State Water Pollution Control Agency and the Regional Administrator. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Act and Sections 7 and 10 of the Michigan Act.

4. Permit Modification

After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully, all relevant facts; or

c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

5. Toxic Pollutants

Notwithstanding Part II, B-4 above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

6. Civil and Criminal Liability

Except as provided in permit conditions on "By-passing" (Part II, A-7) and "Power Failures" (Part II, A-9), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance, whether or not such noncompliance is due to factors beyond his control, such as accidents, equipment breakdowns, or labor disputes.

7. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

8. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor infringement of Federal, State or local laws or regulations, nor does it obviate the necessary of obtaining such permits or approvals from other units of government as may be required by law.

10. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstances, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

It is further made a condition of this permit that the applicant give notice to public utilities in accordance with Act No. 53 of the Public Acts of 1974, being sections 460.701 to 460.718 of the Michigan Compiled Laws, and comply with each of the requirements of that Act.

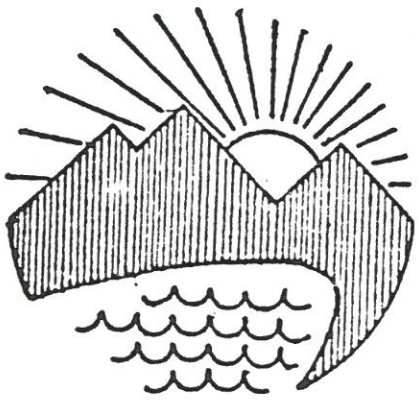
PAUL SAPIANO
Fenton, Michigan
MI 0037192

The mixing zone for the purpose of evaluating compliance with water quality standard is defined as the area enclosed within the left 1/4 of Denton Creek starting from the point of discharge and extending 100 feet downstream from the discharge.

PRM 78-9 STAGE 1 STUDY
GREEN OAK, BRIGHTON, GENOA, HARTLAND AND TYRONE TOWNSHIPS

C262789

JULY, 1978



McNamee, Porter and Seeley
Consulting Engineers
Ann Arbor, Michigan

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LIST OF APPENDICES

SUMMARY

Thirty-Four (34) areas in Brighton, Genoa, Green Oak, Hartland and Tyrone Township were evaluated to determine the existence of a water pollution problem or a public health hazard. The areas included 26 lakes, one unincorporated community and seven subdivisions. Sources of information invluded a review of existing water quality data, the Livingston County Soil Survey, Livingston County Health Department files and discussions with the Livingston County Sanitarian.

Some of the results of this study are summarized in Table 1. The U.S. Environmental Protection Agency has indicated that conventional collector sewers are generally not cost-effective when population densities are less than 1.7 persons/acre. In such areas, on-site disposal systems would generally be expected to be more cost-effective. Population densities of less than 1.7 persons/acre are found in some areas around Lake Shannon and the Pleasant View Estates Subdivision. However most of the areas contain population densities greater than 1.7 persons/acre. The U.S. Environmental Protection Agency has also indicated that collector sewers are generally cost-effective in areas with a population density greater than 10 persons/acre. Areas around Fonda Lake, Island Lake, Woodland Lake, Clark Lake, West Crooked Lake, East Crooked Lake, Clifford Lake, Lake Chemung, Handy Lake and Runyan Lake as well as the Saxony-Willmore Subdivision and the Country Club Annex Subdivision have population densities in excess of 10 persons/acre.

Column 2 of Table 1 indicates the approximate size of a typical lot in each of the areas. It is generally thought that a lot size

of 2 acres for the long term use of a septic tank disposal field in terms of providing isolation and replacement space. The lack of suitable soils may increase the space requirements. Very few of the areas have lots larger than ½ acre.

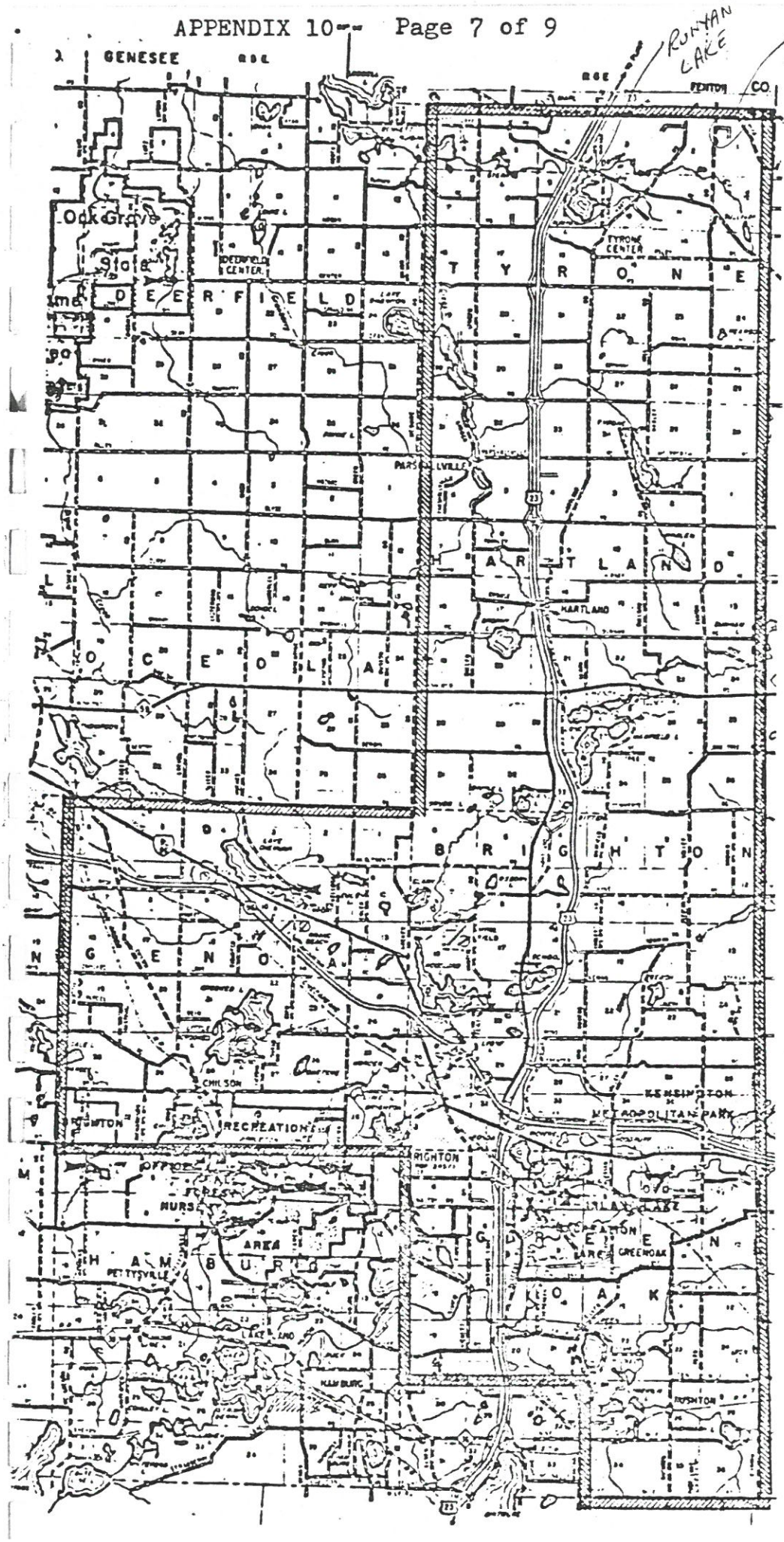
Column 3 is a preliminary estimate of the grant eligibility of each area for conventional collector sewers based on two-thirds of the flow in the sewer originating from houses in existence as of October 18, 1972. For example, it is estimate that about 95% of the conventional collector sewers that would be proposed to serve the Saxony-Willmore Subdivision would be eligible for a 75% grant from EPA and a 5% grant from DNR. The remaining 5% of the sewers would be totally ineligible. It should be noted that this is only a very preliminary estimate. Specific eligibility information for conventional collector sewers will be submitted for those areas in which conventional collector sewers are recommended as the cost-effective, environmentally and socially acceptable alternative.

As shown in column 4, it is estimated that most of the areas would be entirely eligible for an 80 to 90% grant from EPA and DNR if small community or onsite alternative is determined to be cost-effective. The reason for this apparent inconsistency is because conventional collector sewers must meet the requirements of two-thirds of the lots being served having been developed as of October 18, 1972 while onsite alternatives are eligible if the house being served existed as of December 27, 1977. Other factors enter into the question of grant eligibility, such as whether the house is a primary residence, and are discussed further in this report.

The purpose of this report is to present the existing informa-

tion available to document a pollution problem in the 34 areas evaluated. A map of each of the areas is included in the report which delineates areas in which we have been able to obtain sufficient information to document a pollution problem and areas in which we have not been able to obtain sufficient information to document a problem. It should be recognized that the lack of information does not indicate that a pollution problem does not exist.

This report is being submitted to the Michigan Department of Natural Resources, the Livingston County Health Department, the Southeast Livingston County Joint Utility Board and the Township Boards of Brighton, Genoa, Green Oak, Hartland and Tyrone Townships and will be incoroporated into the draft facilities plan for Southeast Livingston County.



NORTH

FIGURE 1
Study Area
Brighton Township
Genoa Township
Green Oak Township
Hartland Township
Tyrone Township

McNAMEE, PORTER & SEELEY
ANN ARBOR, MICHIGAN

Table 1

Summary of Areas Evaluated in Stage 1 Study

(see text for explanation)

Township	Area	Population Density (persons/acre)	Typical Lot Size (acres)	Estimated Eligibility of Conventional Collector Sewers	Estimated Eligibility for Onsite Alternatives
Green Oak Township	Green Oak Lake	3.5 to 7.7	0.14	10%	100%
	Crooked Lake	3.0 to 9.0	0.5 to 2.0	0%	100%
	Fish Lake	3.0 to 9.0	0.5 to 2.0	0%	100%
	Sandy Bottom Lake	3.0 to 9.0	0.5 to 2.0	30%	100%
	Limekiln Lake	3.0 to 9.0	0.5 to 2.0	30%	100%
	Fonda Lake	7.0 to 28.0	0.18	10%	100%
	Island Lake	22.0	0.10 to 0.22	40%	100%
	Briggs Lake	6.5	0.11	30%	100%
	Saxony-Willmore Sub'd	11.0	0.22 to 0.25	95%	100%
	Mapleview Sub'd	7.0	0.5	45%	100%
	Horizon Hills Sub'd	3.5	0.5	35%	100%
	Pleasant View Estates Sub'd	1.3 to 4.9	0.5	40%	100%
	Lake Oak Farms Sub'd	7.0	0.5	100%	100%
Brighton Township	Woodland Lake	2.8 to 20.0	0.11 to 0.7	80%	100%
	Lake of the Pines	5.6	0.57	5%	100%
	Clark Lake	3.5 to 12.3	0.09	50%	100%
	Moraine Lake	2.8 to 5.6	0.34	0%	100%
	Beach Lake	4.2	0.22	0%	100%
	Country Club Annex Sub'd	14.4 to 17.8	0.24	30%	100%
	School Lake	3.5 to 6.3	0.13 to 0.36	15%	100%
Genoa Township	West Crooked Lake	6.0 to 18.2	0.13	50%	100%
	East Crooked Lake	6.0 to 18.2	0.13	30%	100%
	Clifford Lake	6.0 to 18.2	0.13	30%	100%
	Lake Chemung	5.0 to 11.2	0.08 to 0.17	30 to 70%	100%
Hartland Township	Hartland	4.9 to 7.0	0.27	60%	100%
	Round Lake	7.0	0.18	50%	100%
	Handy Lake	4.2 to 11.2	0.23	5%	100%
	Maxfield Lake	8.4	0.25	5%	100%
	Long Lake	4.2 to 8.4	0.17 to 0.80	0%	100%
	Bitten Lake	4.9	0.7	0%	100%
Tyrone Township	Lake Tyrone	2.8 to 4.9	0.40 to 1.37	0%	40%
	Lake Shannon	1.4 to 6.3	0.39	5%	100%
	Runyan Lake	2.1 to 12.6	0.28	40%	100%
	Jayne Hill Farms Sub'd	7.0	0.34 to 0.45	100%	100%

Table 2

Summary of Areas Evaluated in Stage 1 Study as Reviewed by EPA

Township	Area	Estimated Eligibility of Conventional Collector Sewers	EPA Decision	Stage 2 Studies Recommended by EPA	Alternatives Recommended by EPA	Comments
Green Oak Township	Green Oak Lake	10%	Stage 2	Well Water	On-site & cluster	
	Crooked Lake	0%	No Action	--	No Action	
	Fish Lake	0%	No Action	--	No Action	
	Sandy Bottom Lake	30%	Stage 2	Not specified	On-site	
	Limekiln Lake	30%	Stage 2	Not specified	On-site	
	Fonda Lake	10%	Stage 2	Depth to ground water and well sampling.	On-site, cluster, alternative and conventional sewers.	
	Island Lake	40%	Stage 2	Depth to ground water and well sampling.	On-site, cluster, alternative and conventional sewers.	
	Briggs Lake	30%	Stage 2	Depth to ground water and well sampling	On-site, cluster, alternative and conventional sewers.	
	Saxony-Willmore Sub'd	95%	No Action	--	No Action	
	Mapleview Sub'd	45%	Stage 2	Not specified	Alternative or on-site	
	Horizon Hills Sub'd	35%	Stage 2	Not specified	Alternative or on-site	
	Pleasant View Estages Sub'd.	40%	No Action	--	No Action	
	Lake Oak Farms Sub'd.	100%	No Action	--	No Action	
Brighton Township	Woodland Lake	80%	Stage 2	Well testing	Alternative or cluster.	
	Lake of the Pines	5%	No Action	--	No Action.	
	Clark Lake	50%	Stage 2	Ground water studies.	Alternative or cluster.	
	Moraine Lake	0%	Stage 2	Well sampling and ground water studies	On-site or cluster.	
	Beach Lake	0%	Stage 2	Well sampling and ground water studies	On-site or cluster.	
	Country Club Annex Sub'd	30%	Stage 2	Not Specified.	Alternative & collector sewers.	
	School Lake	15%	No Action	---	No Action	
Genoa Township	West Crooked Lake	50%	Stage 2	Well sampling.	On-site, altern. or sewers.	
	East Crooked Lake	30%	Stage 2	Well sampling.	On-site, altern. or sewers.	
	Clifford Lake	30%	Stage 2	Well sampling.	On-site, altern. or sewers	
	Lake Chemung	30 to 70%	Fac. Plan	No. Stage 2	Altern. to conventional on-site	
Hartland Township	Hartland	60%	?	?	No conv. sewers	
	Round Lake	50%	Stage 2	Well water & percolation tests	?	
	Handy Lake	5%	Stage 2	Well water & percolation tests	?	
	Maxfield Lake	5%	Stage 2	Well water & percolation tests.	?	
	Long Lake	0%	No Action	--	No Action	
	Bitten Lake	0%	Stage 2	Well water & percolation tests	?	
Tyrone Township	Lake Tyrone	0%	Stage 2	Water quality analysis Well and percolation tests.	On-site & alternative	
	Lake Shannon	5%	No Action	--	No Action	
	Runyan Lake	40%	Fac. Plan	No Stage 2	Alternatives ?	
	Jayne Hill Farms Sub'd.	100%	Stage 2	Well sampling.	?	

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APPENDIX 10

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32° A.T. -

Plant 102% to 87% 3-0-T

Pertinent Information from:

A LIMNOLOGICAL AND FISHERIES SURVEY OF RUNYAN LAKE

WITH RECOMMENDATIONS AND A MANAGEMENT (to be submitted in late November 79

By: Freshwater Physicians, Inc.
David J. Jude, Ph.D; Joseph Ervin, M.S.
5256 Curtice, Mason, Michigan (517-428-2010)
Study Performed: 3 March, 11 August 1979
Report to be submitted to: Al Luchenbill

INTRODUCTION

Because of concerns about present conditions and future problems in Runyan Lake we were asked to conduct a physical, chemical and biological survey of Runyan Lake and summarize any problems observed, identify causes and suggest solutions. Runyan Lake is about a 200 acre lake located in Livingston county near Fenton Michigan. It is a deep lake with three basins, some as deep as 55 ft. The present recreational uses on the lake include: water skiing, fishing, sailing, Scuba and snowmobiling in the winter. Many just enjoy the aesthetics of the lake. We studied the lake during the winter and summer of 1979. We collected water chemistry samples and biological samples and are presently compiling these data into a final report. We set up 12 stations in the creeks and major basins of the lake from which our collections were made. To follow is a brief summary of the salient features of the data collected along with some comments on significant findings and our preliminary recommendations.

RESULTS - SOME SELECTED COMMENTS

There is a lagoon associated with an apartment complex on Denton Creek which can discharge effluent into the creek. To date information from the Michigan Dept. Of Natural Resources states that no discharges have been made from this lagoon.

Benthos - These are the animals that live in the bottom and we found them scarce in the deep areas of the lake because of the anoxic condition (no dissolved oxygen) which exists there. They were abundant in the weedy embayment(station L) on the south end of the lake.

Aquatic Plants - There are very few aquatic plants in Runyan Lake except for the station L area.

Sediments - Sediments were as expected in most areas. However in the weedy embayment (L) sediments are very thick and a problem. Dredging may have to be attempted sometime in the future. Much of this buildup is probably due to the chemical treatment of plants which we understand has gone on their regularly. This small bay is good for the whole lake in that it is acting as a treatment basin for the nutrients that enter it both from the houses around it and from the creek(station D) that enteres there. However it is unacceptable to the people who reside there. There are only two options: continue the chemical treatments as required to maintain boat movement and consider dredging in the future. This area should be a good bass and pike spawning ground, however the thick sediments and anoxic conditions that exist may kill some or all of the eggs of these species.

Water chemistry

We identified 6 creeks that enter Runyan lakeand they were sampled twice during 1979. Secchi disc reading were not as good as we expected. Algae was not the reason, however there could have been a bloom at the 17 to 25 ft depth as indicated by dissolved oxygen data.

Water temperature - Temperatures were as expected. Stratification

Dissolved oxygen - There was no lack of dissolved oxygen in the lower parts of the lake in winter as expected. During the summer however there was no oxygen present in the lower parts of the lake making a large part of the lake off limits to fish during the summer. In addition very toxic conditions existed there. There was high levels of ammonia, hydrogen sulfide and low pH, all potentially toxic to fish.

Total alkalinity - Alkalinity was low in the 100-150 ppm range. This means the lake will also be low in productivity.

Hardness - Hardness was also low in the 130-200 ppm range.

Chlorides - They were very low in the well sample collected (4 ppm) while in the lake they were somewhat higher in the 20 ppm range. However these values are still very low compared to other lakes in the county. The increase in chlorides however does indicate that nutrients and possible septic tank effluent is entering Runyan Lake causing a buildup of this indicator ion.

Ammonia - High in tw creek samples and on the bottom of the lake,

Nitrates - plant nutrient-is low in the lake.

Soluble Phosphorus - low in the lake

Total Phosphorus - Some high values in creek samples in winter; low the rest of the year in the creeks and in the lake. Some high values at station A in the winter.

Hydrogen sulfide -- High values on the bottom in the deep basins- this compound is toxic to fish.

Zooplankton - Good species diversity, there are many Daphnia in the main part of the lake indicating low predation by fish; in the lagoon (L) no Daphnia were found indicating high fish predation on this group.

Fish - We collected 16 species of fish in our nets; this is a high number of species of fish. Included were pike, perch, many different sunfish, lake herring (a coldwater species), darters, banded killifish and reports of gar and bowfin also in the lake. The problem with the fish is that the low productivity in the lake causes few fish to be able to survive. There is a small littoral zone(shallow weedy area) in the lake and most of the lake is deep where there is little food and toxic conditions for fish. A hypolimnetic aerator (aerates the bottom half of the lake only) may increase the production of fish. Most fish examined were eating well; food supply is diverse.

Algae - Very , very few present. Low nutrient conditions may be keeping the algae in control. It is thus important to maintain conditions as they now are and curtail any further inputs of nutrients into the lake to prevent significant algae blooms from occurring with regularity.

PROBLEMS, CAUSES AND SOLUTIONS

Nutrient input - Reduce all phosphorus entering the lake from residents (lawn fertilication, pipes, geese, etc.), support the proposed sewer, discourage any new developments alon the lake, fight any more major developments in the watershed creeks which feed Runyan Lake that wish to dump effluents (industrial or domestic) into these creeks. Preserve and support the maintenance of all wetlands in the watersheds of Runyan Lake.

Few fish - Inherent to this low productivity lake. There is a small littoral zone, few plants, low amounts of food for fish. One could aerate the hypolimnion in the summer to open up more of the lake - costly alternative however.

Abundant macrophytes and thick sediments in the small embayment - Result of having a creek enter there which contains sustained levels of nutrients and the shallow nature of this lagoon. Chemical treatment will probably have to be continued, even though such practice has caused high sediment buildup. Some dredging (constly) may have to be done eventually This area is now acting as a treatment basin for the whole lake - removes

PRELIMINARY RECOMMENDATIONS

1. Recognize that you have a beautiful , unique lake here, with relatively few plants, deep, usually clear water and appreciate its esthetic appeal. Understand that because of the character of the lake, productivity (amount of animals and plants) will be low and as a result there are few fish in the lake.

2. Regarding maintaining the long-term good water quality of the lake you must :

a. Curtail use of nutrients - reduce lawn fertilization, discourage geese, don't run evaes or other effluent pipes into the lake, plant a greenbelt, etc.

b. Support sewers; All septic tank nutrients gradually leach into the lake and because the lake has low levels now, it won't take much to make the lake worse and curtailment will improve water quality immensely.

c. Discourage any more development on the lake

d. Fight any source of pollution in any stream in the watershed that enters Runyan Lake

e. Support the preservation of all wetlands

3. Fish

Populations are low, they could be increased by aerating the lake in the summer(hypolimnetic aeration only). This is costly and is not a strong recommendation. Northern pike spawning is not understood. No young of the year were collected indicating poor reproduction. Some recommendations to imporve habitat or perhaps stock some pike may be made. More data or information on this point are required.

4. The shallow, plant-choked embayment

Chemical treatment of plants will probably have to continue to maintain open channels. No wholesale treatment of the whole bay should be performed. Some dredging may have to be done.

YOUR INTEREST, CONCERN AND SUPPORT ARE REQUIRED TO PURSUE THESE RECOMMENDATIONS AND PUT INTO EFFECT THOSE WHICH YOU FEEL ARE THE MOST FEASIBLE. THERE ARE NO PANACEAS: ALL SOLUTIONS WILL REQUIRE VOLUNTEER TIME, COMMITMENT, LEADERSHIP AND MONEY TO MAINTAIN RUNYAN LAKE AS A HEALTHY AQUATIC RESOURCE.

VITAE

Resumé

Personal Information

Name: Joseph L. Ervin
Marital Status: Married
Address: 2180 Auburn
Holt, Michigan 48842

Height 5'11"
Weight 195 lbs.

Academic Experience

B.S. Michigan State University 1965
Major: Fisheries and Wildlife

M.S. Michigan State University 1969
Major: Limnology
Thesis: Electronic Devices for the Capture of Aquatic Invertebrates.
Advisor: Dr. R.C. Ball

Work Experience:

Chief Biologist
Freshwater Physicians Inc.
October, 1975 to Present

Supervisor of Research
Michigan State University Institute of Water Research
September, 1973 to Present
Supervision of the Water Quality Management Project, Institute of Water Research. Project involves wastewater aquaculture in four research lakes and spray irrigation of wastewater.

Aquatic Biologist
Fisheries and Wildlife Department
Michigan State University
June, 1967 to September, 1973

Laboratory Aide, Microbiology
Michigan Department of Health
Summer 1963, 1964

Publications:

Ervin, Joseph L., and Terry Haines. 1972.
Using Light to Collect and Separate Zooplankton.
Progressive Fish Culturist, Vol. 34, No. 3, July 1972

DAVID J. JUDE
Birth date: July 30, 1944, St. Cloud, Minnesota
Address: Great Lakes Research Division
University of Michigan
Institute of Science and Technology Bldg.
Ann Arbor, MI 48109 (313) 764-2420

Education:

Undergraduate: University of Minnesota, B.S. Fisheries and Wildlife Management in the special graduate option curricula. Thesis: The Effects of Winterkill on the Bottom Fauna of Island Lake. Advisor: Dr. T. F. Waters.

Graduate: Iowa State University, M.S. Fishery Biology. Thesis: Food Habits and Distribution of 10 Species of Fish in Pool 19, Mississippi River. Advisor: Dr. R. J. Muncy.

Michigan State University, March 1973, Ph.D. in Limnology. Thesis: Sublethal Effects of Ammonia and Cadmium on Growth of Green Sunfish. Advisor: Dr. N. R. Kevern.

Employment:

Summer 1963	Lab technician for Dept. of Fisheries and Wildlife, University of Minnesota.
Summer 1964	Summer session at Itasca State Park, University of Minnesota.
Summer 1965	Fishery Aid for U.S. Bureau of Sport Fisheries and Wildlife, Bismarck, North Dakota under William Daugherty.
1966-1968	Iowa State University - Graduate Assistant
1968-1972	Michigan State University - NDEA Fellow
1973-present	Research Investigator concerned with fish population monitoring at the D. C. Cook Nuclear Plant on southeastern Lake Michigan.
1975-present	Chief Limnologist, Freshwater Physicians Inc.

Thesis Research Summaries:

A. Master's research was part of an established program on the Mississippi River initiated to determine future effects of proposed dredging of a 9-foot channel. As part of a four-man ecological team, regular sampling of fish for diurnal and seasonal distribution and food habits was conducted. These data were compiled and food habit information was correlated with concurrent benthic data collected at similar stations.

B. Doctoral research was concerned with devising an exact method of determining safe levels of toxicants for establishment of water quality criteria as well as evaluation of RNA-DNA ratios as an indication of stress in fish. To accomplish this, sunfish were placed in aquaria with *Gambusia* as food and subjected, via a flow-through system to different levels of the toxicants, ammonia and cadmium, at different temperatures for periods of up to 40 days. Growth of sunfish and efficiency of food conversion were determined as well as concentrations of cadmium in gills, liver and whole body after digestion and measurement on an atomic adsorption spectrophotometer.

Professional Affiliations:

American Society of Limnology and Oceanography
American Fisheries Society
North American Benthological Society
American Institute of Fishery Research Biologists
International Association of Great Lakes Research
Certified Fisheries Scientist
Sigma Xi
Sigma Delta Sigma

Publications and Presentations:

Jude, D. J. 1971. Mooneye activity, distribution and bottom fauna utilization in Pool 19, Mississippi River. Paper given at Midwest Benthological Society Meeting, Notre Dame, Indiana.

Jude, D. J. 1973. Food habits of Gizzard Shad in Pool 19, Mississippi River. Trans. Amer. Fish. Soc. 102(2): 378-383.

Jude, D. J., T. W. Bottrell, J. A. Dorr, III, and T. J. Miller. 1973. Studies of the fish populations near the Donald C. Cook Nuclear Power Plant, 1972. In: Benton Harbor power plant limnological studies, Pt. XII, Spec. Rep. No. 44, Great Lakes Res. Div., Univ. Michigan, 115 p.

Jude, D. J., J. A. Dorr, III, T. J. Miller, and F. J. Tesar. 1974. Vertical, diel and seasonal distribution of fish larvae during 1973 in the inshore waters of southeastern Lake Michigan. Oral presentation to 36th Midwest Fish and Wildlife Conference at Indianapolis, Indiana on Dec. 16-19, 1974.

Stewart, D. J., P. J. Rago, and D. J. Jude. 1974. Use of trawl catchs to monitor impact of heated effluents upon fish in Lake Michigan. Oral presentation to 36th Midwest Fish and Wildlife Conference at Indianapolis, Indiana on Dec. 16-19, 1974.

Jude, D. J., F. J. Tesar, J. A. Dorr III, T. J. Miller, P. J. Rago and D. J. Stewart. 1975. Inshore Lake Michigan fish populations near the Donald C. Cook Nuclear Power Plant, 1973. Great Lakes Res. Div., Spec. Rep. No. 52, 267 p.

Jude, D. J. and J. A. Dorr, III. 1975. Summary of impingement and entrainment data. In: Jude, et al., 1975. Inshore Lake Michigan fish populations near the Donald C. Cook Power Plant, 1973. Great Lakes Res. Div., Spec. Rep. No. 52.

Jude, D. J. and J. A. Dorr, III. 1975. Vertical, diel and seasonal distributions of fish eggs and larvae in the inshore waters of southeastern Lake Michigan. In: Jude, et al. 1975. Inshore Lake Michigan fish populations near the Donald C. Cook Power Plant, 1973. Great Lakes Res. Div., Spec. Rep. No. 52.

Tesar, F. J., D. J. Jude, T. J. Miller, J. A. Dorr, III, and P. J. Rago. 1975. Spatial and temporal distributions, gonad conditions and temperature preference of adult and juvenile fishes. In: Jude, et al., 1975. Inshore Lake Michigan fish populations near the Donald C. Cook Plant, 1973. Great Lakes Res. Div., Spec. Rep. No. 52.

Jude, D. J. (Accepted). Food habits, bottom fauna utilization and distribution of mooneye in Pool 19, Mississippi River. Trans. Amer. Fish. Soc.

Jude, D. J., J. A. Dorr III, F. J. Tesar and T. J. Miller. 1975. Larval fish distribution in southeastern Lake Michigan determined from sled tow and surface tow sampling. Paper presented at the 37th Midwest Fish and Wildlife Conference, Toronto, Canada on Dec. 8-10, 1975.

Rago, P. J. and D. J. Jude. 1975. An example of a comprehensive data analysis system for fisheries data. Paper presented at the 37th Midwest Fish and Wildlife Conference, Toronto, Canada on Dec. 8-10, 1975.

Dorr, J. A. III, D. J. Jude and N. J. Thurber. 1975. Identification of fish larvae taken from the inshore waters of southeastern Lake Michigan between 1973 and 1975. Paper presented at the 37th Midwest Fish and Wildlife Conference, Toronto, Canada on Dec. 8-10, 1975.

Jude, D. J. 1976. Entrainment studies on the Great Lakes with special reference to the D. C. Cook Nuclear Plant. Paper presented (and to be published in a symposium book)at the third national workshop on entrainment and impingement held on Feb. 2-4, 1976 in New York, NY. Sponsered by Ecological Analysts, Inc., New York Power Pool and the Electric Power Research Institute.

Dorr, J. A. III, D. J. Jude and N. J. Thurber. 1976. Identification of fish larvae taken from the inshore waters of southeastern Lake Michigan between 1973 and 1975. Paper presented at a national workshop on fish larvae on April 19-21, 1976 in Ann Arbor, Michigan. Sponsered by the National Power Plant Siting Team, U.S. Bureau Sport Fisheries and Wildlife, Ann Arbor, Michigan.