

LAKE WATER QUALITY ASSESSMENT REPORT
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

COOPER RIVER LAKE
PENNSAUKEN TOWNSHIP, CAMDEN COUNTY

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PREFACE

The 1986 revisions to the Clean Water Act requires states to provide the United States Environmental Protection Agency (USEPA) with water quality information on public lakes. This information is a prerequisite for eligibility in the USEPA Clean Lakes Program.

The New Jersey Department of Environmental Protection obtained a grant to assess the water quality of the State's lakes during 1989. The objectives of the FY 89 Project were to acquire limited limnological data for 21 lakes. The data was analyzed to determine the trophic status for each lake.

Lakes were selected based on several criteria which included; the amount of public access the lake provided, it's recreational usage (e.g. swimming, fishing, ...) and it's value as a local resource. The following lakes were surveyed during 1989:

COUNTY	LAKE
Burlington	Lake Absegami Crystal Lake Evans Pond Indian Mills Lake Jefferson Lake Smithville Lake
Camden	Cooper River Lake
Cape May	East Creek Pond Lake Nummy
Gloucester	Greenwich Lake Iona Lake Narriticon Lake
Mercer	Mercer County Park Lake Rosedale Lake
Middlesex	Brainerd Lake Farrington Lake
Monmouth	Mac's Pond
Morris	Lake Ames Mount Hope Pond
Ocean	Lake Carasaljo
Passaic	Shepherds Lake

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Appendix includes	
-Data	
-Algae identification	
-Map of lake and watershed	
-Map with sampling stations	

SCOPE OF SURVEY

The quality of a lake's water is determined by many factors. These factors may be found within the lake itself or they may come from the watershed surrounding it. The collection of data through sampling and measurements can help to determine what may be influencing the lake's water quality. Although the scope covered by this report is somewhat limited, the following data may be found:

1. Limited Historical Data
2. Geology
3. Morphology and Hydrology
4. Physical & Chemical Data Results
5. Biological Data

All lakes in the program were monitored three times during the year; once each during the spring, summer and fall. Samples were taken at the major inlets and at sites deemed representative of the entire lake. Samples were taken above the outlet when a boat was unavailable. The samples were analyzed for the following parameters:

In-situ analysis:

1. Temperature
2. Dissolved Oxygen
3. pH
4. Depth and Secchi readings
5. Visual check of Macrophytes

Laboratory Analysis (NJ Department of Health):

1. Bacterial Analysis
2. Alkalinity
3. Nutrients

Biological Analysis (Bio-Monitoring Unit of the NJDEP):

1. Chlorophyll a
2. Algal Scan (Microscopic)
3. Macrophyte Survey

EXPLANATION OF PARAMETERS SAMPLED

PHYSICAL AND CHEMICAL PARAMETERS

1. TEMPERATURE AND DISSOLVED OXYGEN (D.O.):

The temperature of a shallow lake generally follows climatic changes. As the temperature of the water increases the dissolved oxygen level of the water decreases. A deeper lake will usually stratify thermally, during the summer. A warmer, less dense layer of water (epilimnion) will float on a cooler, denser layer of water (hypolimnion). These two layers are separated by a zone of rapidly changing temperature and density called the metalimnion. The metalimnion, can form a barrier, which can keep the hypolimnion from being reoxygenated from the atmosphere. In a productive (eutrophic) lake this can cause anoxic conditions in the hypolimnion as oxygen is used up by animals and decomposers (bacteria).

2. ALKALINITY AND pH:

Alkalinity is a measurement that indicates the degree to which an aquatic system can buffer pH changes that can occur during photosynthesis and/or by the introduction of pollutants. The toxicity of certain pollutants can be reduced by this buffering action. A minimum of 20 mg/L CaCO₃ has been recommended, except where natural conditions are lower (Quality Criteria for Water, 1986, EPA 440/5-86-001). The Pine Barrens are an example of an area where natural conditions favor low alkalinity. PH is a measurement of hydrogen ion activity or the acid-base equilibrium in natural waters. The pH can be raised by the photosynthetic processes of algae and/or macrophytes.

EXPLANATION OF PARAMETERS SAMPLED

3. NUTRIENT ANALYSIS:

Phosphorus and nitrogen are the major nutrients required by algae for growth. In New Jersey's lakes, phosphorus is the nutrient most often responsible for limiting algal growth. Dissolved orthophosphorus is believed to approximate the solid reactive phosphorus used by all photosynthetic organisms (aquatic plants/algae). However, all forms of total phosphorus can become reactive through biological decomposition and can be used as nutrients to enhance weed growth and/or algae blooms.

Nutrients can enter a lake or its watershed via point (i.e. sewerage treatment plant) or nonpoint sources (i.e. fertilizer runoff from lawns). Nutrients may also be recycled from the sediments in the lake.

4. SECCHI DISC TRANSPARENCY:

A greater depth of light transmission generally indicates good water quality (low algal growth). However, heavy macrophyte growth can also keep the water clear. The macrophytes may outcompete the algae for nutrients and therefore, restrict most algal growth. Erosion from the watershed or upwelling of the lake's sediments, from adverse weather conditions, could also decrease the water's transparency. To determine the transparency of a lake's water a secchi disk is used. The secchi disk is an 8 inch black and white disk. Measurements are taken by lowering the disk until it is no longer visible.

EXPLANATION OF PARAMETERS SAMPLED

BIOLOGICAL DATA

1. BACTERIAL ANALYSIS:

Bacterial samples for Total coliform, Fecal coliform (FC) and Fecal streptococcus (FS) were taken at the inlets and in-lake. While sources are difficult to determine with 3 sampling runs, the ratio of FC/FS can imply whether the source is from human or animal waste.

FC/FS Possible Bacterial source (Millipore Corp. 1972)

>4	-Human wastes
2-4	-Mainly human wastes and other sources
1-2	-Inconclusive
0.7-1	-Mainly animal wastes and other sources
<.7	-Animal wastes

A lake's water is considered unsafe for swimming when Fecal coliform levels exceed 200 mpn/100ml.

2. CHLOROPHYLL a/ALGAE

Chlorophyll a is a pigment that is present in all types of algae. The chlorophyll a content of the water can indicate the amount of planktonic algae present in the lake. Algae are an important part of a lake ecosystem because they are a vital part of the food chain. However, an excessive amount of algae can negatively impact a lake. Excessive algae growth can inhibit the growth of other plants, cause aesthetic problems and curtail recreational uses. Through the processes of photosynthesis, increased algal growth can raise the dissolved oxygen level in a lake during the daytime (sunlight) and decrease the dissolved oxygen level during the night (dark). Depressed dissolved oxygen levels, if extreme, could cause fishkills.

EXPLANATION OF PARAMETERS SAMPLED

3. ALGAL SURVEY:

As the growing season proceeds, a succession of algal communities typically occurs in a lake. During the spring and fall, diatoms are usually dominant. In the early summer, chlorophytes (green algae) become dominant. As available nutrients change during the summer, filamentous green or blue-green algae may become dominant. These may float to the surface forming mats that can cause aesthetic and recreational problems.

High chlorophyll a levels with little algal species diversity are indicative of nutrient rich water.

4. MACROPHYTE SURVEY:

Macrophytes are also a vital part of a lake. They provide cover for fish and food for wildlife. However, excessive macrophyte growth can limit the recreational uses of a lake including swimming, fishing and boating. A visual survey was done to identify and determine areal coverage of macrophytes.

LAKE TROPHIC STATES

Lake eutrophication (aging) is a natural process resulting from the gradual accumulation of nutrients, increased productivity, and filling in from sediments, silt and organic matter.

Lakes usually follow a progression through a series of trophic states, which are the following:

1. Oligotrophic
-nutrient poor and low biological productivity.
2. Mesotrophic
-intermediate levels of nutrients and biological productivity.
3. Eutrophic
-nutrient rich and highly productive.

Accelerated or cultural eutrophication occurs to a lake when nutrients, silt and organic matter inputs are increased by activity in the watershed. Several examples of increased inputs include; a sewage treatment plant discharging into a lake, runoff of fertilizers from farms or lawns, and erosion from new construction sites. Because of New Jersey's large population, all lakes in the State are considered to be threatened by accelerated eutrophication.

INTRODUCTION

Cooper River Lake is a 150 acre body of water that is part of the Cooper River Camden County Park. The lake is situated between the Amtrak train trestle and Route 130. The lake has a maximum depth of about eight feet and is part of the Cooper River. Three separate sewage treatment plants discharge into the Cooper River, upstream of the lake. Until the creation of the Camden Regional Sewage Treatment Plant in the mid 1980's, 14 sewage treatment plants discharged into the river. There are also numerous storm sewer pipes that drain stormwater runoff into the lake. Cooper River Lake and the surrounding park are utilized heavily for recreational purposes. The lake is a popular place for boaters and is used for sailboat and scull races. Other uses include fishing and ice skating on an adjacent pond that is filled via the lake.

LAKE NUM. AND NAME: #1952 COOPER RIVER LAKE

STUDY PERIOD: SPRING, SUMMER, FALL 1989

LOCATION: CHERRY HILL TWP., CAMDEN COUNTY

U.S.G.S. QUAD: #25 CAMDEN

LAKE AREA: 150 ACRES

LAKE MAXIMUM DEPTH: 8 ft.

GEOLOGIC DESIGNATION: BRIDGETON SAND ON KMV MERCHANTVILLE
CLAY.

TRIBUTARIES: COOPER RIVER

POINT SOURCES: BARCLAY FARMS STP
OLD ORCHARD STP
N.J. TURNPIKE STP

LAKE USE AND HISTORICAL NOTES: BOATING, FISHING AND PARK AREA.
SAMPLED 1976, 1977 AND 1981.

COMMENTS: LARGE GOOSE POPULATION.

RESULTS

PHYSICAL/CHEMICAL PARAMETERS

Temperature and Dissolved Oxygen

Temperatures and dissolved oxygen levels were uniform throughout the water column except during the summer. Although the lake was not thermally stratified, dissolved oxygen levels near the lake bottom were only 2.6 mg/l while they were 13.4 mg/l at the surface.

Secchi Disk

Transparency of Cooper River Lake's water was poor. Secchi disk readings ranged from 0.5 to 1.0 foot.

Alkalinity and pH

The alkalinity of the water ranged from 19 mg/l to 31 mg/l and therefore, offered limited buffering capacity. The pH fluctuated from 7.70 during the spring and summer to 6.60 during the fall.

Nutrients

Total phosphorus levels in the water column were very high, ranging from 0.25 mg/l to 0.36 mg/l. These numbers are 12 to 18 times higher than the levels used to distinguish non-eutrophic from eutrophic waters.

RESULTS

BIOLOGICAL DATA

Chlorophyll a/Algae

Chlorophyll a levels for the summer and fall were 82.31 mg/m³ and 8.58 mg/m³ respectively (analysis was not performed on spring sample due to lab malfunction). There was a large diversity of algal species during the summer. Most were from the class Chlorophyceae.

Macrophytes

Yellow water lily (*Nuphar* spp.) and Arrow (*Peltandra virginica*) were growing along small portions of the shoreline. Their areal coverage was less than one percent of the lake.

Bacteria

Fecal coliform counts for the spring and fall were 460 mpn/100ml and 3500 mpn/100ml respectively. These levels are above the limits set for safe swimming conditions. The Fecal coliform level during the summer sampling run was less than 20 mpn/100ml which is safe for swimming. However, this body of water does not appear to be safe for swimming.

CONCLUSION

Cooper River Lake is in a eutrophic state because of several related factors. The high chlorophyll a level observed during the summer, which is indicative of a large algal population, was enhanced by high nutrient levels. Total phosphorus levels were well above the levels used to distinguish eutrophic from non-eutrophic waters.

The proliferation of algae was adversely affecting the appearance of the lake. The heavy algal bloom imparted a turbid quality to the water and the lake had an unpleasant odor in several areas, including isolated coves. These characteristics helped to detract from the aesthetic appeal of the park which surrounded the lake.

The algal bloom may also have had a negative effect on the ecology of the lake. As the algae die, they sink and organically enrich the lake's sediments. The decomposition of the dead algae on the lake bottom by bacteria increases the oxygen consumption in the hypolimnion. Low dissolved oxygen can stress some organisms such as favorable fish species and allow less favorable species to proliferate. Carp and bullhead catfish both of which are tolerant of low dissolved oxygen are dominant species in Cooper River Lake. Low dissolved oxygen levels also favor the release of nutrients from the sediments, which can lead to more algal growth.

REFERENCES

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Trudeau, Philip N. 1982. Nuisance Aquatic Plants and Aquatic Plant Management Programs in The United States.

USEPA 1980. Clean Lakes Program Guidance Manual. EPA 440/5-81-003.

Wetzel, Robert G. 1983. Limnology. Saunders College Publishing, New York.

APPENDIX

STATION	DATE	TEMP	D O	pH	ALK	TOT P	ORTHO P	F COLI	F STREP	TOT COLI	FC/FS	SECCHI (feet)
INLET	04/11/89	6.9	7.8	8.91	38	.27	.15	1300	49	5400	26.53	
	07/24/89	24.5	4.6	6.74	37	.32	.19	790	>2400	9200	NA	
	10/23/89	11.4	8.9	6.82	22	.41	.22	1400	540	16000		
UPPER LAKE	4/11/89	9.5	7.6	7.92	37	.24	.20	310	110	3500	2.81	
	07/24/89	29.6	4.8	6.64	37	.49	.24	1700	540	9200	3.15	
LAKE	04/11/89	9.0	8.2	7.68	31	.36	.19	460	49	2200	9.39	.5
	07/24/89	31.8	13.4	7.65	27	.25	.11	<20	5	490	NA	1.0
	10/23/89	14.6	7.7	6.63	19	.34	.19	3500	1600	9200	2.19	.75

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/07/24
Sample No. 76842
Lakes Management
Cooper River (lower lake), NJ

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Plankton Identification

CHLOROPHYCEAE (green)

Actinastrum hantschii
Ankistrodesmus falcatus
Chlorella vulgaris
Closteriopsis longissima
Coelastrum cambricum
Crucigenia sp.
Gloeocystis gigas
Golenkinia radiata
Micractinium pusillum longisetum
Nannochloris bacillaris
Pandorina morum
Pediastrum duplex
Scenedesmus quadricauda
Schroederia setigera
Selenastrum bibraianum
Sphaerocystis schroeteri
Staurastrum subcruciatum
Tetraedron limneticum

EUGLENOPHYCEAE (motile green)

Lepocinclis ovum
Trachelomonas gibberosa
T. robusta
T. volvocina

XANTHOPHYCEAE (yellowish green)

Centritractus belonophorus

CHRYSOPHYCEAE (golden or brown)

Dinobryon sertularia
Mallomonas acaroides

BACILLARIOPHYCEAE (diatom)

Melosira italica
Nitzschia acicularis
Rhizosolenia longiseta

Analyst(s)/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/07/24
Sample No. 76842
Lakes Management
Cooper River (lower lake), NJ

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Plankton Identification

MYXOPHYCEAE (blue-green or other color)

Anabaena circinalis
Merismopedia minima
Oscillatoria chlorina

=====
Chlorophyll Analysis

Chlorophyll "a" (mg/m³) = 82.31

Analyst(s)/Unit _____

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GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/10/23
Sample No. 79061
Lakes Management
Cooper Lake, NJ

Plankton Identification

CHLOROPHYCEAE (green)

Chlamydomonas sp.
Nannochloris sp.

BACILLARIOPHYCEAE (diatom)

Melosira sp.
Nitzschia sp.

CRYPTOPHYCEAE (colorless or brownish)

Cryptomonas erosa

MYXOPHYCEAE (blue-green or other color)

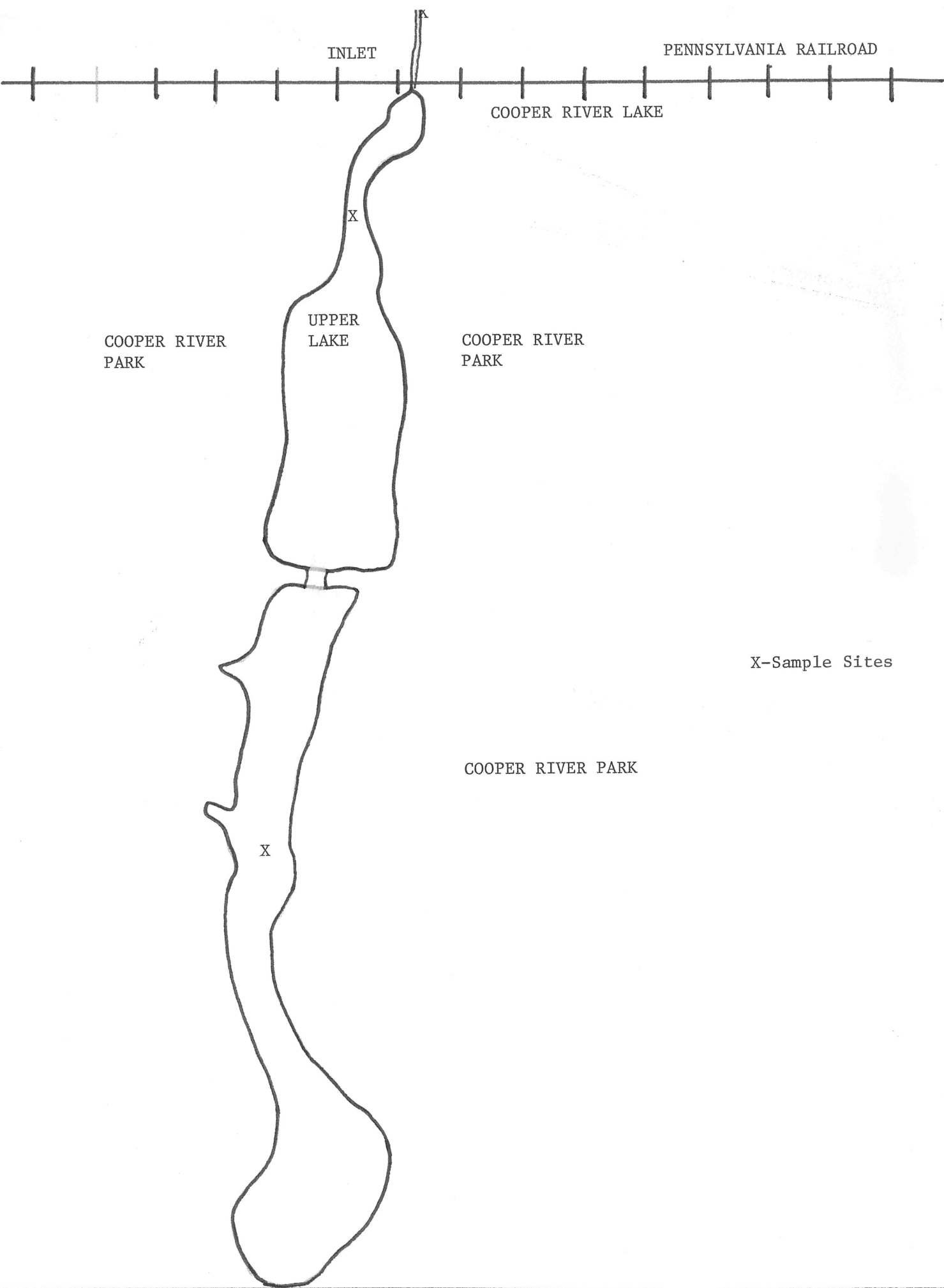
Lynxbya limnetica
Oscillatoria subtilissima

=====
Chlorophyll Analysis

Chlorophyll "a" (mg/m³) = 8.58

Analyst/Unit _____





INLET

PENNSYLVANIA RAILROAD

COOPER RIVER LAKE

X

COOPER RIVER
PARK

UPPER
LAKE

COOPER RIVER
PARK

X-Sample Sites

COOPER RIVER PARK

X

ROUTE 130