

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

INDIAN MILLS LAKE
SHAMONG TOWNSHIP, BURLINGTON COUNTY

Patrick Goan
Senior Environmental
Specialist

Robert Runyon
Chief, Bureau of Monitoring
Management

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

CONTENTS

	Page
Preface.....	1
Contents.....	2
Scope of Survey.....	3
Explanation of Parameters Sampled.....	4-7
Lake Trophic States.....	8
Introduction	9
Physical/Chemical Results.....	10
Biological Results.....	11
Conclusion.....	12
References.....	13
Appendix.....	14
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

Indian Mills Lake is a 42 acre body of water located in Shamong Township, Burlington County. There is one main inlet, the Muskingum brook, which feeds the lake. It is a shallow lake with a maximum depth of about four feet and is bordered on the west by homes and on the east by sod farms. The lake is accessible to the public for fishing from the southern shoreline.

LAKE NUM. AND NAME: #1128 INDIAN MILLS LAKE

STUDY PERIOD: SPRING, SUMMER, FALL 1989

LOCATION: SHAMONG TWP., BURLINGTON CO.

U.S.G.S. QUAD: #27 INDIAN MILLS

LAKE AREA: 42 ACRES

MAXIMUM DEPTH: 4 ft.

GEOLOGIC DESIGNATION: TCH COHANSEY

TRIBUTARIES: MUSKINGUM BROOK

POINT SOURCES: NONE

LAKE USE AND HISTORICAL NOTES: BOATING AND FISHING. SAMPLED BY
NJDEP IN 1975, 1976, 1977 AND
1980

COMMENTS: TURF FARMS PART OF WATERSHED.

RESULTS

PHYSICAL/CHEMICAL PARAMETERS

Temperature and Dissolved Oxygen

Temperatures and dissolved oxygen levels were uniform throughout the water column for each sampling. Dissolved oxygen levels were always above 10.0 mg/l. High dissolved oxygen levels may have been due to the algae blooms.

Secchi Disk

The transparency of the lake's water ranged from 3.5 feet to 4.0 feet.

Alkalinity and pH

The alkalinity of the lake's water was low ranging from 9 mg/l to 19 mg/l and therefore, offered little buffering capacity. The pH of the water was around 7.00 for each sampling.

Nutrients

Total phosphorus levels in the Muskingum Brook's water column were high (0.05 mg/l to 0.14 mg/l). These numbers were reduced to 0.04 mg/l to 0.06 mg/l in the lake's water column.

RESULTS

BIOLOGICAL DATA

Chlorophyll a/Algae

Chlorophyll a levels for the summer and fall were 19.90 mg/m³ and 5.57 mg/m³ respectively (analysis not performed on spring sample due to lab malfunction). During the summer and fall, three filamentous algae (Hydrodictyon, Nitella and Pithophora) formed floating mats on the lake. These mats covered about 40% of the lake.

Macrophytes

Small areas of spatterdock (Nuphar spp.) were growing on the western side of the lake. Their areal coverage made up less than five percent of the lake.

Bacteria

Fecal coliform counts were near 20 mpn/100ml for each sampling, indicating swimmable waters on these dates.

CONCLUSION

Because of the high biological productivity occurring within its boundaries, Indian Mills Lake is considered to be eutrophic. High nutrient levels in the lake, possibly due to runoff from surrounding farms and homes, contributed to the proliferation of filamentous green algae. These algae formed floating mats that collected on the sides of the lake and made launching a boat and fishing from the shoreline nearly impossible.

Besides being a nuisance to recreational use, the productivity may also have had an impact on the ecology of the lake. The maximum depth of the lake has decreased from eight feet in 1975 to about four feet at the present time. Accumulated dead plant material was one possible source of the sedimentation problem.

REFERENCES

Aquatic Vegetation of New Jersey. 1965. Rutgers Extension Service Bulletin # 382.

Lake and Reservoir Restoration Guidance Manual. 1988. North American Lake Management Society. First Edition.

NJDEP. 1987. Water Resources Field Procedures Manual.

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 C	DO	pH	ALK	TOT. P	ORTHO P	F COLI	F STREP	TOT COLI	FC/FS	SECCHI (feet)
INLET	04/20/89	14.8	11.6	6.67	8	.05		<20	23	<20	NA	
	06/28/89	21.0	5.2	6.03	12	.14		790	350	16000	2.26	
	10/16/89	16.1	6.1	6.25	10	.07	.09	790	>2400	>24000	NA	
UPPER LAKE	04/20/89	15.6	10.4	7.00	14	.06						3.0
	06/28/89	27.2	10.2	7.06	18	.06						2.0
	10/16/89	16.5	10.3	6.41	9	.06	.05					
LOWER LAKE	04/20/89	16.7	10.9	7.19	13	.04		<20	<2	<20	NA	3.5
	06/28/89	26.9	11.2	7.01	19	.06		<20	5	50	NA	
	10/16/89	18.1	12.4	7.00	11	.04	.01	20	2	50	NA	3.5

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/04/20
Sample No. 76790
DWR/Lakes Management
Indian Mills Lake

Plankton Identification

CHLOROPHYCEAE (green)
Chlamydomonas sp.

EUGLENOPHYCEAE (motile green)
Phacus sp.

Analyst/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/06/28
Sample No. 76821
Lakes Management
Indian Mills Lake (lower lake), NJ

Plankton Identification

CHLOROPHYCEAE (green)
Ankistrodesmus nannoselene
Chlamydomonas sp.
Chlorella vulgaris
Closterium sp.
Staurostrum dejectum

BACILLARIOPHYCEAE (diatom)
Nitzschia closterium

=====

Macrophyte Identification

Hydrodictyon reticulatum
Nitella sp.
Pithophora kewensis

=====

Chlorophyll Analysis

Chlorophyll "a" (mg/m³) = 19.90

Analyst(s)/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/10/16
Sample No. 79057
Lakes Management
Indian Mills Lake (lower lake), NJ

Plankton Identification

CHLOROPHYCEAE (green)

Coelastrum cambricum
Nannochloris sp.
Scenedesmus quadricauda
Staurastrum subcruciatum

EUGLENOPHYCEAE (motile green)

Euglena caudata
Trachelomonas robusta

CHRYSOPHYCEAE (golden or brown)

Mallomonas caudata
Synura uvella **DOMINANT**

BACILLARIOPHYCEAE (diatom)

Fragilaria crotonensis
Melosira sp.
Nitzschia acicularis

DINOPHYCEAE (dinoflagellate)

Peridinium sp.

CRYPTOPHYCEAE (colorless or brownish)

Cryptomonas erosa
C. ovata

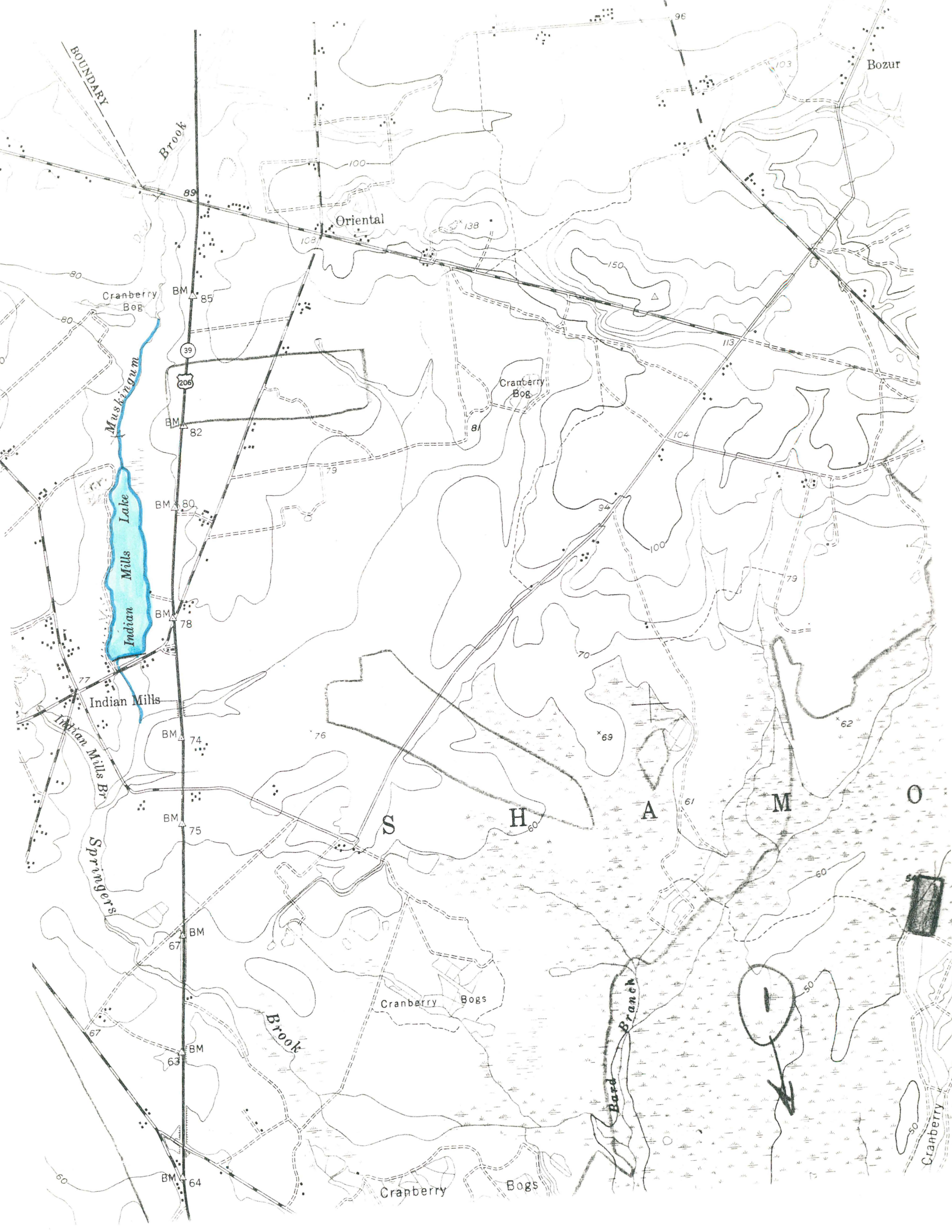
MYXOPHYCEAE (blue-green or other color)

Oscillatoria subtilissima

=====
Chlorophyll Analysis

Chlorophyll "a" (mg/m³) = 5.57

Analyst/Unit _____



TUCKERTON ROAD

X

INLET

HOMES

SOD FIELDS

WETLANDS

X

SOD FIELDS

UPPER LAKE

HOMES

X

OUTLET

SOD FIELDS

ROUTE
206