LAKE WATER QUALITY ASSESSMENT REPORT

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF WATER RESOURCES

JEFFERSON LAKE

PEMBERTON 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

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 $CaCO_3$ has been recommended, except where natural conditions are lower (Quality Critera 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 equilibruim 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 it's 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

Jefferson Lake is a 60 acre body of water located in Pemberton Township, Burlington County. The Lake has a maximum depth of four and one-half feet and is fed by one main source which is the outlet of Lebanon Lake. Much of the eastern and western shores of the lake are bordered by homes except for a large beach with swimming area at the lower eastern end. The upper and lower ends of the lake provide access for shoreline fishing.

LAKE NUM.AND NAME: #1672 PRESIDENTIAL LAKES-JEFFERSON

STUDY PERIOD: SPRING, SUMMER, FALL 1989

LOCATION: PEMBERTON TWP., BURLINGTON CO.

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

LAKE AREA: 60.3 ACRES

LAKE MAXIMUM DEPTH: 4.5 ft.

GEOLOGIC DESIGNATION: TKW KIRKWOOD

TRIBUTARIES: SPILLWAY OF LEBANON LAKE

POINT SOURCES: NONE

LAKE USE AND HISTORICAL NOTES: SWIMMING, BOATING AND FISHING. SAMPLED BY NJDEP FROM 1975-1978, AND 1981.

COMMENTS: MACROPHYTES COVERING 50% OF LAKE. POTENTIAL RUNOFF FROM SURROUNDING HOMES.

RESULTS

PHYSICAL/CHEMICAL PARAMETERS

Temperature and Dissolved Oxygen

Because of the shallow depth, temperatures and dissolved oxygen levels were uniform throughout the water column. Dissolved oxygen levels were somewhat depressed for the summer (5.9 mg/m^3) when compared to the spring (9.6 $mg/^3$) and fall (8.6 mg/m^3) samples.

Secchi Disk

The transparency of the water was nearly equal to the lake's depth during the spring and fall (the lake was lowered in the fall). Transparency was minimal during the summer algal bloom with a secchi disk reading of only one foot.

Alkalinity and pH

The alkalinity of the water was less than 1 mg/l for each sampling run and therefore, the lake had a poor buffering capacity. The pH of the water was acidic with readings for the spring, summer and fall 4.40, 3.32 and 3.98 respectively.

Nutrients

Total phosphorus levels in the water column were low to moderate ranging from 0.02 mg/l to 0.04 mg/l.

RESULTS

BIOLOGICAL DATA

Chlorophyll a/Algae

Chlorophyll a levels for the summer and fall were 38.36 mg/m^3 and 9.56 mg/m^3 respectively (analysis not performed on spring sample due to lab malfunction). Species diversity was minimal with the diatom (Actinella punctata) dominant during the summer bloom. Actinella is commonly found in acidic waters.

Macrophytes

Areal coverage of the lake by macrophytes was about 50%. The dominant species was water milfoil (Myriophyllum spp.).

Bacteria

Fecal coliform counts were less than 20 mpn/100ml for each sampling run, indicating safe swimming conditions on these dates.

CONCLUSION

Jefferson Lake is considered to be in a eutrophic state because of the proliferation of aquatic macrophytes within it's boundaries. The shallow depth of the entire lake is one reason for the extensive growth.

The recreational uses of Jefferson Lake were adversely affected by the heavy macrophyte growth. Fishing and boating were hampered in areas along the shoreline and in the upper region of the lake where the macrophyte growth was heaviest. Also, as parts of the aquatic plants were broken away from their stems or roots they floated to the lower end of the lake where the beach was located. They congregated here and formed floating and submerged mats that may have been a nuisance to swimmers.

The ecology of the lake was also impacted by the macrophyte growth. The accumulation of dying aquatic plants on the lake bottom may have contributed to the decreased overall depth of the lake. This, in turn, could have led to more macrophyte production.

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	DO	pH	ALK	ACIDITY	TOT P	ORTHO P	F COLI	F STREP	TOT COLI	FC/FS	SECCHI (ft.)
INLET	04/18/89	14.9	8.8	4.26		96	.02	.01	<20	<2	20	NA	
	08/15/89	24.0	5.4	3.46			.04	<.01	20	350	70	.29	
	11/02/89	13.7	8.2	4.14		24	.03	.02	<20	350	40		
LAKE	04/18/89	15.3	9.6	4.40		70	.02	<.01	<20	2	20	NA	4.0
	08/15/89	25.1	5.9	3.32			.04	<.01	<20	94	130	NA	1.0
	11/02/89	13.1	8.6	3.98		24	.04	.06	<20	350	20		2.0

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/04/18
Sample No. 54371
DWR/Lakes Management
Presidential Lake

Plankton Identification

CHLOROPHYCEAE (green)
Chlamydomonas sp.

CHRYSOPHYCEAE (golden or brown)
Dinobryon sp.

Analyst/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/08/15
Sample No. 69321
Lakes Management
Jefferson Lake, NJ

Plankton Identification

EUGLENOPHYCEAE (motile green)
Trachelomonas volvocina

CHRYSOPHYCEAE (golden or brown)
Mallomonas acaroides
Synura sphagnicola

BACILLARIOPHYCEAE (diatom)
Actinella punctata **DOMINANT**

DINOPHYCEAE (dinoflagellate)
Gymnodinium sp.

CRYPTOPHYCEAE (colorless or brownish)
Cryptomonas ovata

==========

Chlorophyll Analysis

Chlorophyll "a" (mg/m^3) = 38.36

Analyst/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/11/02
Sample No. 76035
Lakes Management
Jefferson Lake, NJ

Plankton Identification

CHLOROPHYCEAE (green)
Chlamydomonas sp.
Nannochloris sp.

BACILLARIOPHYCEAE (diatom)
Actinella punctata
Asterionella formosa
Pinnularia sp.
Tabellaria fenestrata

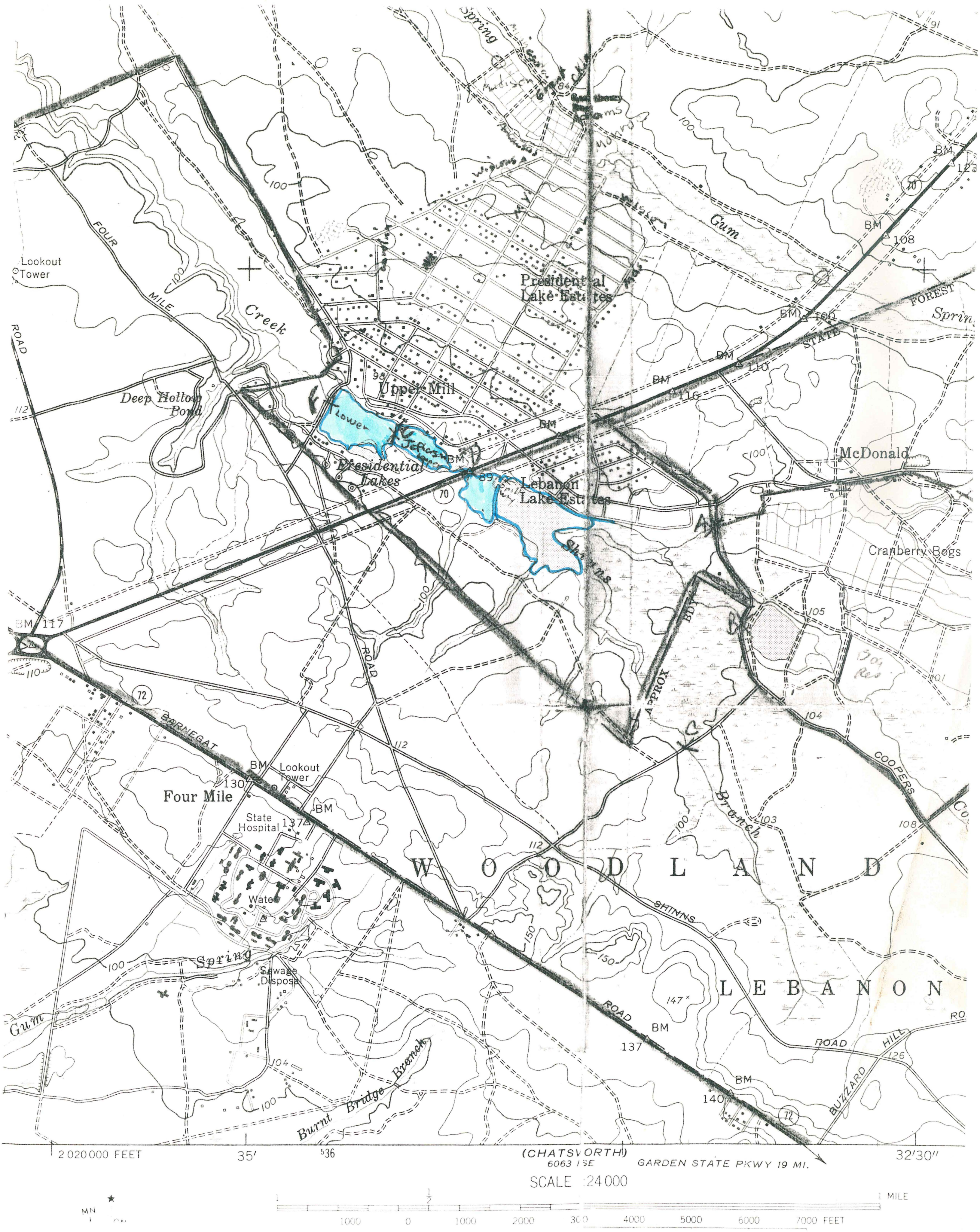
DINOPHYCEAE (dinoflagellate)
Gymnodinium sp.

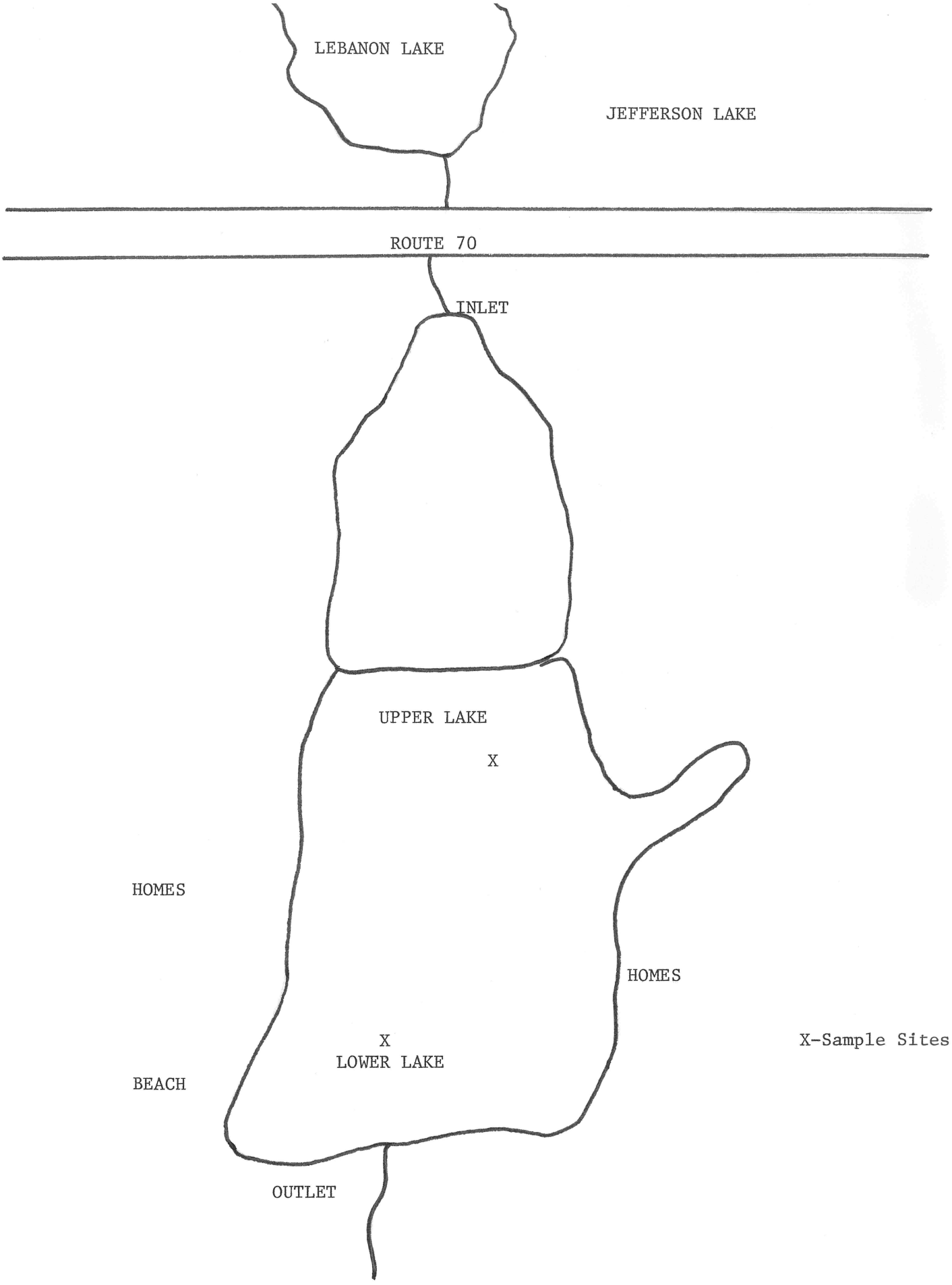
==========

Chlorophyll Analysis

Chlorophyll "a" (mg/m^3) = 9.56

Analyst/Unit _____


Lookout Tower
FOUR MILE ROAD
Creek
Deep Hollow Pond
Upper Mill
Presidential Lake Estates
Presidential Lakes
Lebanon Lake Estates
Gum
Spring
McDonald
Cranberry Bogs
FOREST STATE
BM 123
BM 108
BM 100
BM 110
BM 116
BM 117
70
72
BARNEGAT ROAD
BM 130
Lookout Tower
Four Mile
State Hospital
BM 137
Water
Sewage Disposal
Spring
Gum
Burnt Bridge Branch
W O O D L A N D
L E B A N O N
SHINNS ROAD
Shinns
Branch
APPROX BDY
COOPERS
BUZZARD HILL ROAD
BM 137
BM 140
2 020 000 FEET
35′
536
(CHATSWORTH)
6063 I SE
GARDEN STATE PKWY 19 MI.
32′30″
SCALE 1:24 000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
MN


LEBANON LAKE
JEFFERSON LAKE
ROUTE 70
INLET
UPPER LAKE
X
HOMES
HOMES
X
LOWER LAKE
BEACH
OUTLET
X-Sample Sites