LAKE WATER QUALITY ASSESSMENT REPORT

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF WATER RESOURCES

NARRITICON LAKE

SWEDESBORO TOWNSHIP, GLOUCESTER 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

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

Lake Narriticon is a 37 acre body of water located in Swedesboro, Gloucester County. The lake has a maximum depth of about ten feet and is fed by two main sources. One inlet is an unnamed stream which enters at the upper end of the lake. It flows through areas of agriculture, woodlands and near some homes before entering the lake. The second inlet is the outlet of an adjacent unnamed pond located just west of the lake. Lake Narriticon is bordered by homes on the eastern side and a park on the western side. The park has an area from which a boat can be launched and numerous places along the shoreline from which to fish. Lake Narriticon is stocked with trout by the State of New Jersey.

LAKE NUM. AND NAME: #3360 LAKE NARRITICON

STUDY PERIOD: SPRING, SUMMER, FALL 1989

LOCATION: SWEDESBORO TWP., GLOUCESTER CO.

U.S.G.S. QUAD: #30 WOODSTOWN

LAKE AREA: 37 ACRES

LAKE MAXIMUM DEPTH: 10 ft.

GEOLOGIC DESIGNATION: KMW MT. LAUREL AND WENONAH SAND/ KMT MARSALLTOWN FORMATION.

TRIBUTARIES: 1) UNNAMED TRIBUTARY CROSSING THE N.J. TURNPIKE
2) OUTLET OF UNNAMED POND FROM WEST

LAKE USE AND HISTORICAL NOTES: FISHING. SAMPLED 1975, 1977 AND 1979.

COMMENTS: WATER ALWAYS APPEARED TURBID. IN SUMMER LARGE AREA OF DUCKWEED ON UPPER LAKE. RUNOFF FROM AGRICULTURE, WOODLANDS, HOMES ON LAKE AND STORM SEWER PIPES. LAKE LOWERED IN FALL.

RESULTS

PHYSICAL/CHEMICAL PARAMETERS

Temperature and Dissolved Oxygen

Temperatures and dissolved oxygen levels were uniform throughout the water column except during the summer, when the lake was stratified. During the summer dissolved oxygen levels in the hypolimnion dropped to 2.6 mg/l.

Secchi Disk

Transparency of the lake's water for each sampling run was poor, ranging between 1.5 feet and 2.0 feet.

Alkalinity and pH

The alkalinity of the water ranged from 16 mg/l to 22 mg/l, offering limited buffering capacity. The pH ranged from 6.97 to 7.32.

Nutrients

Total phosphorus levels, in the water column, ranged from 0.11 mg/l in the spring and fall to 0.17 mg/l during the summer. The levels were also high in the inlets ranging from 0.05 mg/l to 0.32 mg/l, with an average of 0.13 mg/l.

RESULTS

BIOLOGICAL DATA

Chlorophyll a/Algae

Chlorophyll a levels for the summer and fall were 73.36 mg/m^3 and 9.33 mg/m^3 respectively. No analysis was performed for the spring sample due to a lab malfunction. During the summer bloom, Chlorophytes and Euglenophytes were co-dominant. During the fall, there was little diversity with diatoms most prevalent.

Macrophytes

There were small areas of yellow water lilly (Nuphar spp.) along the shoreline of the upper lake. Areal coverage was less than 10%. During the summer, there was an area of duckweed (Lemna minor) covering about 10% of the lake at it's upper end.

Bacteria

Although Fecal coliform counts were high in the inlets, their levels in-lake ranged from 20 mpn/100ml to 80 mpn/100ml, indicating safe swimming conditions on the sampling dates. However, the lake is not utilized for swimming.

CONCLUSION

Lake Narriticon is considered to be in an eutrophic state because of several interrelated factors. High total phosphorus levels enhanced heavy algal productivity during the summer. The productivity is the likely cause of the depressed levels of dissolved oxygen in the hypolimnion. The algae sink and accumulate on the lake bottom. Bacteria, that help to breakdown and decay the accumulated plant material, use oxygen in the process. Due to stratification and turbidity, this part of the lake is difficult to reoxygenate and therefore, becomes anoxic.

The high biological productivity negatively affected the recreational uses of Lake Narriticon in several ways. The turbid appearance imparted to the water by the algae blooms (and possibly from erosion in the watershed) detracted from the lake's appearance. Secondly, low dissolved oxygen levels can stress some of the organisms inhabiting the lake, including favorable fish species. Anoxic conditions in the hypolimnion also helps to release nutrients trapped in the sediments. This could lead to more algal productivity.

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 #1	04/04/89	14.5	9.4	6.74	14	.05	.01	<20	33	1400		
	06/22/89	19.5	8.2	6.48	15	.32	.18	>24000	>2400	>24000		
	10/30/89	13.8	9.5	6.54	16	.09	.10	230	940	540		
INLET #2	04/04/89	13.1	13.9	7.38	22	.11	.03	3500	27	9200	130	
	06/22/89	25.0	9.1	6.94	25	.07	.01	170	170	220	1	
	10/30/89	13.0	7.5	6.67	24	.12	.08	790	350	1700		
LAKE	04/04/89	12.0	8.2	7.00	16	.11	.02	20	5	50		2.0
	06/22/89	27.8	10.1	7.32	20	.17	.07	20	540	790	.04	1.5
	10/30/89	16.1	11.3	6.97	22	.11	.07	80	34	170		1.5

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/06/22
Sample No. 76811
Lakes Management
Narriticon Lake, NJ

Plankton Identification

CHLOROPHYCEAE (green)
- Ankistrodesmus falcatus
- Chlorella vulgaris
- Closterium parvulum
- Nannochloris sp.
- Pandorina morum — **CO-DOMINANT**
- Schroederia setigera

EUGLENOPHYCEAE (motile green)
- Lepocinclus texta — **CO-DOMINANT**
- Trachelomonas hispida — **SUB-DOMINANT**
- T. robusta — **SUB-DOMINANT**

BACILLARIOPHYCEAE (diatom)
- Asterionella formosa
- Fragilaria sp.
- Nitzschia acicularis

CRYPTOPHYCEAE (colorless or brownish)
- Cryptomonas sp.

MYXOPHYCEAE (blue-green or other color)
- Chroococcus minutus

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Chlorophyll Analysis

Chlorophyll "a" (mg/m^3) = 73.36

Analyst(s)/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/10/30
Sample No. 79054
Lakes Management
Narriticon Lake, NJ

Plankton Identification

CHLOROPHYCEAE (green)
Nannochloris sp.

CHRYSOPHYCEAE (golden or brown)
Synura uvella

BACILLARIOPHYCEAE (diatom)
Asterionella formosa
Melosira sp.
Nitzschia palea

CRYPTOPHYCEAE (colorless or brownish)
Cryptomonas ovata

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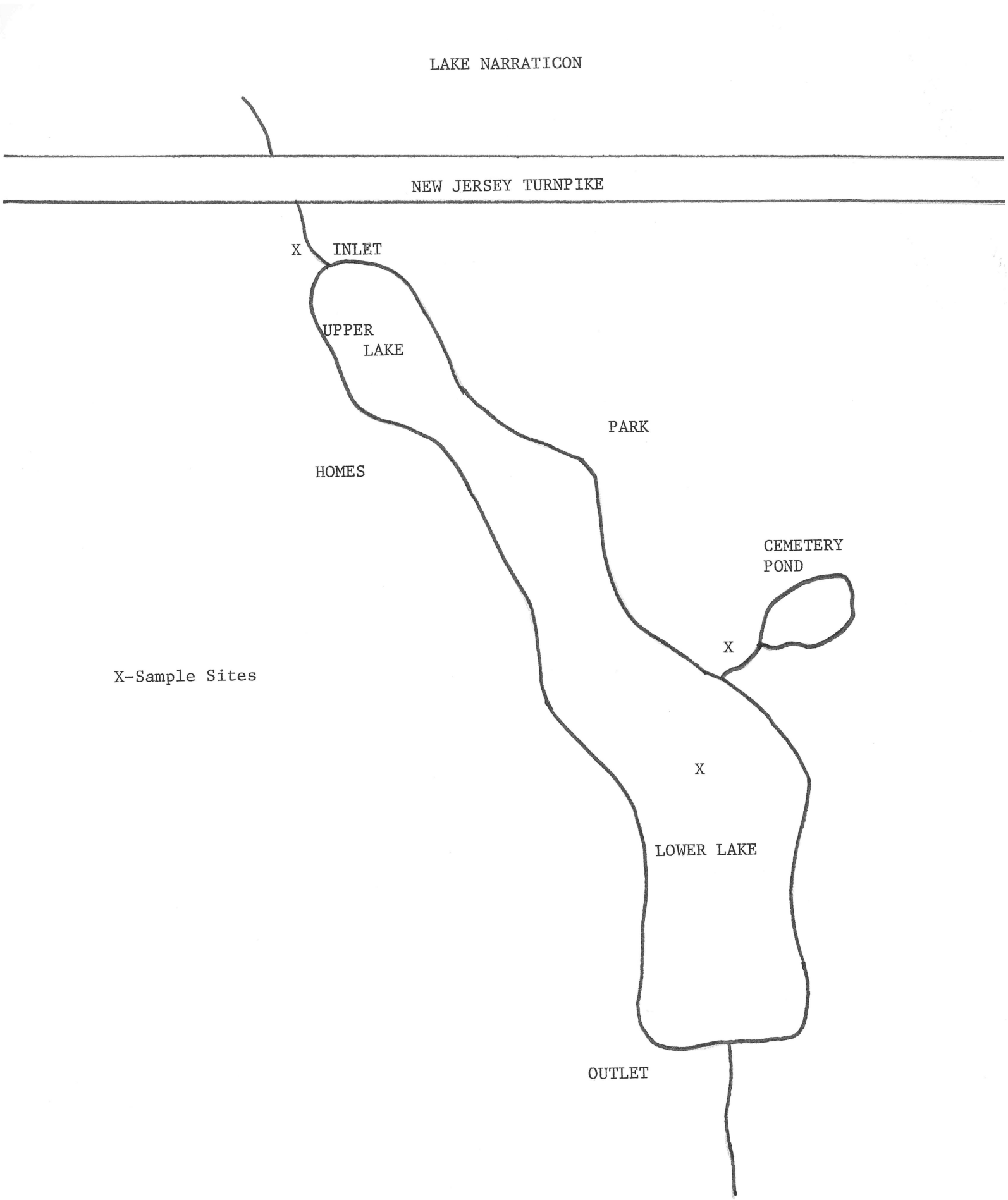
Chlorophyll Analysis

Chlorophyll "a" (mg/m^3) = 9.33

Analyst/Unit _____


Swedesboro
Lake Narraticon
Lake Park Cem
High Sch
BM 68
BM 79
BM 63
BM 86
BM 97
BM 144
BM 54
Gravel Pit
Gravel Pit
Swedesboro Golf Club
Porches Mill
Cem
CORP BDY
BOUNDARY
TURNPIKE
DAVIDSON ROAD
TOLL ROAD
NEW JERSEY
HIGHWAY
ROAD
KINGS
ROAD
SEASHORE LINES
MILL
RUSSEL
MILL
OLIPHANT
MILL ROAD
ROAD
VESTRY
ROAD
4 LANE
Creek
O O L W I C H


LAKE NARRATICON
NEW JERSEY TURNPIKE
X
INLET
UPPER
LAKE
PARK
HOMES
CEMETERY
POND
X
X-Sample Sites
X
LOWER LAKE
OUTLET