LAKE WATER QUALITY ASSESSMENT REPORT

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF WATER RESOURCES

MERCER COUNTY PARK LAKE

LAWRENCE TOWNSHIP, MERCER 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

Mercer County Park Lake is a 270 acre body of water located in Lawrence Township, Mercer County. The lake has a maximum depth of about 15 feet and is fed by one main source which is the Assunpink Creek. The lake is surrounded by woodlands and a park, and is utilized by both fishermen and boaters.

LAKE NUM. AND NAME: #3952 MERCER CO. PARK LAKE

STUDY PERIOD: SPRING, SUMMER, FALL 1989

LOCATION: LAWRENCE TWP., MERCER CO.

U.S.G.S. QUAD: #18 PRINCETON

LAKE AREA: 270 ACRES

LAKE MAXIMUM DEPTH: 15 ft.

GEOLOGIC DESIGNATION: QPS SURFACE ON KMR MAGOTHY AND RARITAN FORMATION.

TRIBUTARIES: ASSUNPINK CREEK

LAKE USE AND HISTORICAL NOTES: BOATING AND FISHING. SAMPLED BY NJDEP DURING 1976 AND 1978.

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. Although temperatures at the bottom were only about 2.0 degrees (Celsius) lower than those at the surface, there was a large disparity between dissolved oxygen levels. Levels as low as 0.6 mg/l were detected in the hypolimnion while they were 8.0 mg/l or above in the epilimnion.

Secchi Disk

The transparency of the lake's water was 2.0 feet for each monitoring run.

Alkalinity and pH

The alkalinity of the lake's water ranged from 9 mg/l to 18 mg/l and therefore, offered little buffering capacity. The pH ranged from a low of 6.23 during the fall to around 7.60 during the spring and summer.

Nutrients

Total phosphorus levels, in the water column, ranged from 0.06 mg/l to 0.08 mg/l.

RESULTS

BIOLOGICAL DATA

Chlorophyll a/ Algae

Chlorophyll a levels for the summer and fall were 51.52 mg/m^3 and 27.40 mg/m^3 respectively. No analysis was performed on the spring sample due to a lab malfunction. There was a high diversity of algal species during the summer and a fair amount of diversity during the fall.

Macrophytes

There were no aquatic macrophytes observed in the lake during the monitoring period.

Bacteria

The Fecal coliform counts ranged from less than 20 mpn/100ml to 170 mpn/100ml, indicating safe swimming conditions on these sampling dates.

CONCLUSION

Because of heavy algal productivity, Mercer County Park Lake was considered to be in a eutrophic state. High total phosphorus levels enhanced the magnitude of the algal growth.

The heavy algal growth had an adverse effect on the ecology and recreational use of the lake. Several factors, including the algal growth, may have contributed to the low dissolved oxygen in the hypolimnion. As the algae die they become a part of the lake's sediments. The decomposition of the algae by bacteria increases the dissolved oxygen consumption in the lower depths of the lake. The combination of respiration by bacteria and other bottom dwelling organisms requires oxygen replenishment in the hypolimnion. The lack of transparency of the lake's water precludes oxygen producing photosynthesis by plants in the lower depths. Stratification of the lake restricts oxygen mixing from the surface to the hypolimnion. The combination of these factors may have caused the anoxic conditions in the hypolimnion. Dissolved oxygen levels under 4.0 mg/l can stress certain organisms including favorable fish species. Anoxic conditions near the lake's sediments also favor the release of nutrients trapped in the sediments. This in turn, could lead to more algal 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

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/08/22
Sample No. 69328
Lakes Management
Mercer County Lake (lower lake), NJ

Plankton Identification

CHLOROPHYCEAE (green)
- Ankistrodesmus falcatus
- Chlamydomonas sp.
- Gloeocystis gigas
- Golenkinia radiata
- Micractinium pusillum
- Nannochloris sp.
- Scenedesmus bijuga
- S. quadricauda
- Staurastrum chaetoceras
- S. dejectum

EUGLENOPHYCEAE (motile green)
- Lepocinclis texta
- Phacus pleuronectes
- Trachelomonas hispida
- T. volvocina

BACILLARIOPHYCEAE (diatom)
- Eunotia sp.
- Melosira sp.
- Nitzschia acicularis
- Rhizosolenia eriensis
- Synedra sp.

CRYPTOPHYCEAE (colorless or brownish)
- Cryptomonas ovata

MYXOPHYCEAE (blue-green or other color)
- Merismopedia minima
- Microcystis aeruginosa
- Oscillatoria minima
- O. putrida

==========

Chlorophyll Analysis

Chlorophyll "a" (mg/m^3) = 51.52

Analyst(s)/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/11/02
Sample No. 76032
Lakes Management
Mercer County Lake, NJ

Plankton Identification

CHLOROPHYCEAE (green)
Nannochloris sp.
Scenedesmus quadricauda

EUGLENOPHYCEAE (motile green)
Euglena caudata

BACILLARIOPHYCEAE (diatom)
Asterionella formosa
Eunotia sp.
Fragilaria sp.
Frustulia rhomboides
Melosira sp.
Nitzschia acicularis

CRYPTOPHYCEAE (colorless or brownish)
Cryptomonas erosa
C. ovata

MYXOPHYCEAE (blue-green or other color)
Oscillatoria chlorina

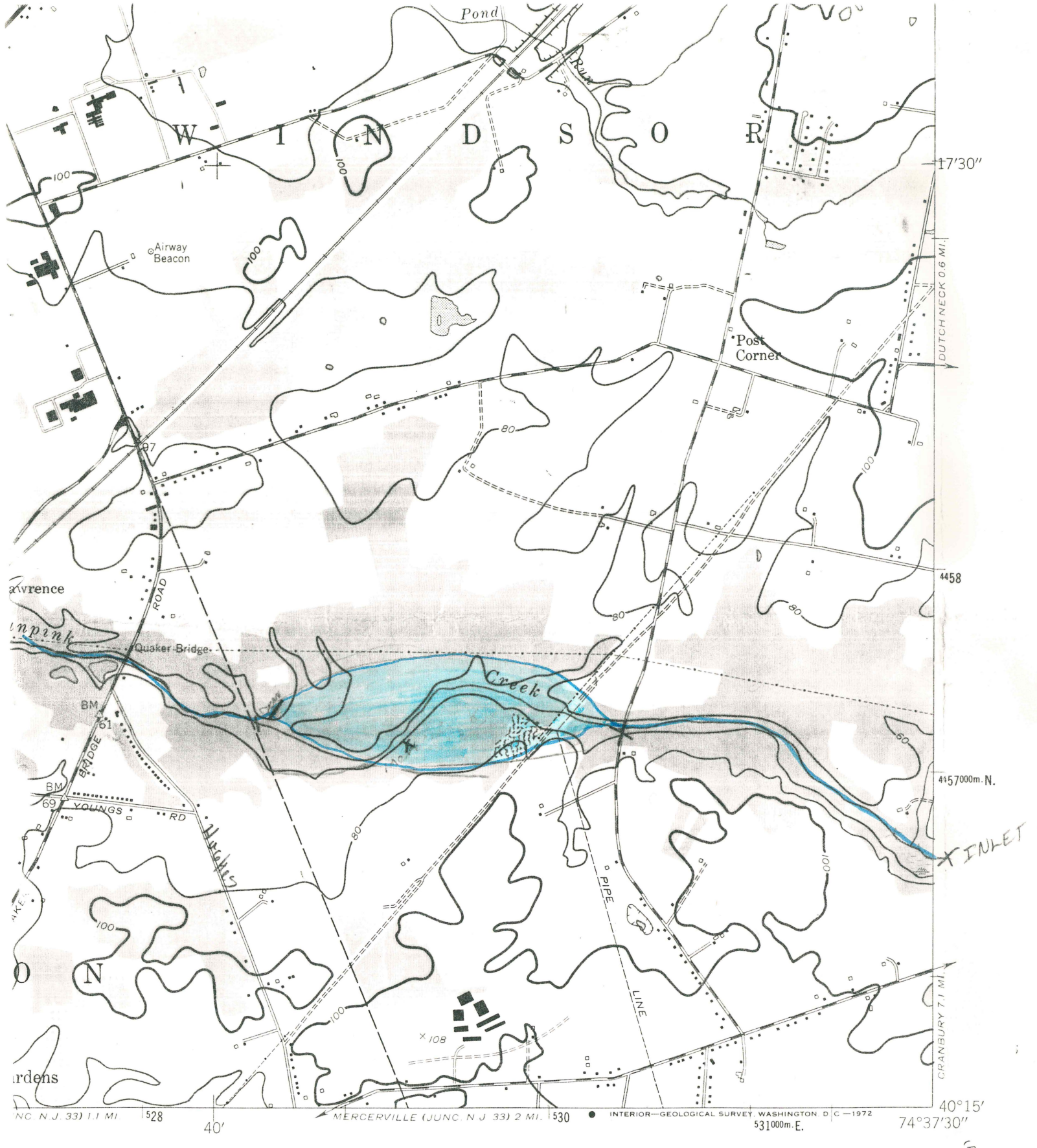
==========

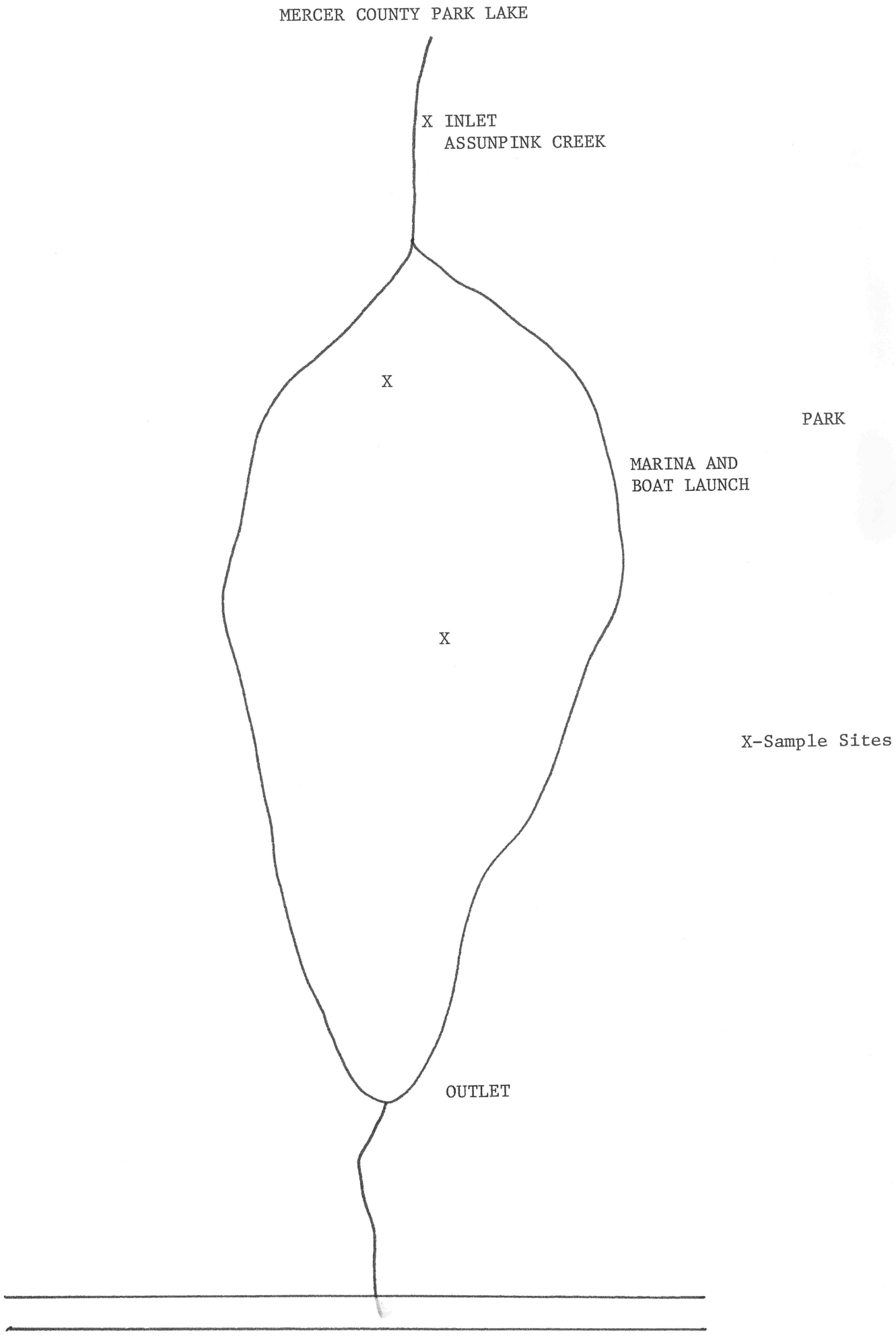
Chlorophyll Analysis

Chlorophyll "a" (mg/m^3) = 27.40

Analyst/Unit _____

STATION	DATE	TEMP	D O	pH	ALK	TOT P	F COLI	F STREP	TOT COLI	FC/FS	SECCHI (feet)
INLET	03/20/89	7.5	11.8	6.50	8	.05	<20	2	1400	NA	
	08/22/89	24.0	5.6	6.67	17	.10	170	920	790	.18	
	11/02/89	12.7	8.9	6.45	10	.07	<20	22	<20		
UPPER	03/20/89	8.2	11.5	6.50	6	.07	<20	2	210	NA	2.0
	08/22/89	25.0	8.6	7.32	18	.07					2.0
LOWER	03/20/89	12.0	12.1	7.58	9	.06					2.0
	08/22/89	24.9	8.0	7.55	18	.08	<20	11	<20	NA	2.0
	11/02/89	12.9	8.3	6.23	13	.07	170	48	330		2.0


Pond
Run
W I N D S O R
17'30"
Airway Beacon
DUTCH NECK 0.6 MI.
Post Corner
4458
ROAD
Quaker Bridge
Creek
BM 61
BRIDGE
BM 69
YOUNGS RD
4457000m. N.
INLET
PIPE LINE
CRANBURY 7.1 MI.
40°15'
74°37'30"
MERCERVILLE (JUNC. N.J. 33) 2 MI.
INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1972
531000m. E.
1 MILE
6000 7000 FEET
1 KILOMETER
ROAD CLASSIFICATION
Heavy-duty
Light-duty
Medium-duty
Unimproved dirt
U.S. Route
State Route
NEW JERSEY
(ALLENTOWN) 6064 II NE


MERCER COUNTY PARK LAKE
X INLET
ASSUNPINK CREEK
X
X
PARK
MARINA AND
BOAT LAUNCH
X-Sample Sites
OUTLET