LAKE WATER QUALITY ASSESSMENT REPORT

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF WATER RESOURCES

MOUNT HOPE POND

ROCKAWAY TOWNSHIP, MORRIS 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 $CaCO3$ 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.

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

Mount Hope Pond is a 17 acre body of water located in Rockaway Township, Morris County. It is fed by underground springs and has a maximum depth of about thirteen feet. The people who live in the area utilize the lake for both swimming and fishing. There is a large beach with a guarded swimming area and many accessible points along the shoreline from which to fish. The lake is stocked with trout by the State.

LAKE NUM. AND NAME: #5480 MOUNT HOPE POND

STUDY PERIOD: SPRING, SUMMER, FALL 1989

LOCATION: ROCKAWAY TWP., MORRIS CO.

U.S.G.S. QUAD: #6 DOVER

LAKE AREA: 17 ACRES

LAKE MAXIMUM DEPTH: 13 ft.

GEOLOGIC DESIGNATION: BYRAM GNEISS/IGN-LOSEE GNEISS/QTM-TERMINAL MORAINES ON WISCONSIN GLACIAL EPO.

TRIBUTARIES: NONE

LAKE USE AND HISTORICAL NOTES: SWIMMING AND FISHING. SAMPLED 1976 AND 1977.

COMMENTS: UPPER LAKE AND WESTERN SIDE OF LAKE HAVE HEAVY GROWTH OF MYROPHILLIUM AND ELODEA (25% OF LAKE). POTENTIAL RUNOFF FROM WOODLANDS.

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. Dissolved oxygen levels that were around 9.0 mg/l in the epilimnion dropped to 4.0 mg/l in the hypolimnion, when sampled during the summer.

Secchi Disk

Transparency of lake's water was fair and ranged from 5.0 feet to 8.5 feet.

Alkalinity and pH

The alkalinity of the water ranged from 10 mg/l to 14 mg/l and therefore, offered little buffering capacity. The pH fluctuated between 7.00 and 8.00 during the monitoring period.

Nutrients

Total phosphorus levels, in the water column, ranged from 0.03 mg/l to 0.05 mg/l.

RESULTS

BIOLOGICAL DATA

Chlorophyll a/Algae

Chlorophyll a levels increased from 3.86 mg/m^3 during the spring to 19.25 mg/m^3 during the fall. There was a large degree of algal species diversity for each sampling.

Macrophytes

Water milfoil (Myriophyllum spp.) and elodia (Elodia canadensis) were growing along the western shoreline and in the upper portion of the lake. Their areal coverage was between 25% and 30% of the lake.

Bacteria

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

CONCLUSION

Mount Hope Pond is utilized heavily as a recreational area. However, the lake is experiencing some problems that help to reduce it's value as a recreational resource. The western side of the lake, which provides the best access for shoreline fishing, has heavy aquatic vegetation growing along it's banks. Since no boats are allowed on the lake, fishing opportunities are somewhat restricted.

Elevated nutrient levels were also contributing to algal productivity. Elevated levels of chlorophyll a, indicating increased algae growth, were observed during the fall. In past years, the lake was treated with algicides to control algal blooms.

Depressed dissolved oxygen levels found in Mount Hope Pond's hypolimnion may be a result of the high biological productivity occurring within the lake. Aquatic plants (algae and macrophytes) become a part of the lake's sediments when they die. The decomposition of these plants by bacteria increases the oxygen consumption in the lower depths of the lake. Stratification of Mount Hope Pond restricts oxygen mixing from the surface with the hypolimnion and it's depth and limited transparency precludes any oxygen producing photosynthesis from occurring here. The dissolved oxygen level of 4.0 mg/l in the Mount Hope Pond's hypolimnion during the summer could negatively impact organisms that inhabit this area, including favorable fish species.

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	D O	pH	ALK	TOT P	ORTHO P	F COLI	F STREP	TOT COLI	FC/FS	SECCHI (feet)
UPPER LAKE	06/12/89	21.2	9.2	7.02	10	.03	<.01	<20	<2	<20	NA	8.5
	07/25/89	26.4	9.1	7.48	12	.04	<.01					7.0
	09/27/89	17.0	8.7	7.97	14	.05	<.01	<20	<2	<20	NA	5.0
LOWER LAKE	06/12/89	21.0	9.2	6.96	11	.03	<.01					8.0
	07/25/89	27.2	8.8	7.65	12	.04	.03	<20	<2	<20	NA	6.5

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/06/12
Sample No. 61484
Lakes Management
Mt. Hope Lake, NJ

Plankton Identification

CHLOROPHYCEAE (green)
- Ankistrodesmus falcatus
- Arthrodesmus incus
- Chlamydomonas sp.
- Chlorella vulgaris
- Pediastrum duplex
- Scenedesmus sp.
- Staurastrum manfeldtii

XANTHOPHYCEAE (yellowish green)
- Ophiocytium capitatum longispinum

CHRYSOPHYCEAE (golden or brown)
- Dinobryon sociale
- Mallomonas acaroides
- M. caudata

BACILLARIOPHYCEAE (diatom)
- Asterionella formosa
- Attheya zachariasi
- Melosira granulata

==

Chlorophyll Analysis

Chlorophyll "a" (mg/m^3) = 3.86

Analyst(s)/Unit ____________________

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/09/27
Sample No. 69343
Lakes Management
Mt. Hope Pond (lower pond), NJ

Plankton Identification

CHLOROPHYCEAE (green)
Ankistrodesmus falcatus
Closteriopsis longissima
Gloeocystis gigas
Nannochloris sp.
Pediastrum biradiatum
P. duplex
Scenedesmus acuminatus
S. quadricauda
Selenastrum capricornutum
Staurastrum manfeldtii
S. orbiculare
Tetraedron constrictum
T. gracile
T. planctonicum

EUGLENOPHYCEAE (motile green)
Phacus pleuronectes
Trachelomonas robusta

CHRYSOPHYCEAE (golden or brown)
Dinobryon cylindricum

BACILLARIOPHYCEAE (diatom)
Asterionella formosa
Melosira sp.
Navicula sp.
Nitzschia acicularis
Rhizosolenia longiseta
Synedra ulna
Tabellaria fenestrata

MYXOPHYCEAE (blue-green or other color)
Oscillatoria chlorina

==

Chlorophyll Analysis

Chlorophyll "a" (mg/m^3) = 19.25

Analyst(s)/Unit ____________________

Picatinny Lake
U S MILITARY RESERVATION
U S MILITAR
RESERVATIO
(PICATINNY ARSENAL
WHARTON
LAKE DENMARK
DENMARK RD
Water
Brook
Green Pond
ROCKA
BM 724
Mount Hope Mine
Water
MT HOPE ROAD
Mt Hope Pond
Mt Hope Lake
Mt Hope
Township Sch
Hilltown
St Bernards Ch
Richard Mine
Water
MINERAL RR
ROAD
NORTHERN
PARKER
Mt Pleasant Sch
MT HOPE RICHARD MINE ROAD
Middle
Reservoir
O Brien Sch
80
Rockaway
MOUNT PLEASANT AVE
700
800
900
1000
1100

MOUNT HOPE POND