LAKE WATER QUALITY ASSESSMENT REPORT

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF WATER RESOURCES

LAKE NUMMY

DENNIS TOWNSHIP, CAPE MAY 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 Nummy is a 26 acre body of water located in the Belleplain State Park, Cape May County. Before the State acquired the area, the lake was a cranberry bog. The lake is fed by Savage's Run and has a maximum depth of about ten feet. It is a typical Pine Barrens lake with the characteristic dark brown cedar water. Lake Nummy has picnic grounds and a beach with guarded swimming area, a boat launch and areas along the shoreline from which to fish.

LAKE NUM. AND NAME: #2408 LAKE NUMMY

STUDY PERIOD: SPRING, SUMMER, FALL 1989

LOCATION: DENNIS TWP., CAPE MAY CO.

U.S.G.S. QUAD: #42 WOODBINE

LAKE AREA: 26 ACRES

LAKE MAXIMUM DEPTH: 10 ft.

GEOLOGIC DESIGNATION: TCH COHANSEY SAND/ QCM CAPEMAY SAND SURFACE

TRIBUTARIES: SAVAGES RUN

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

RESULTS

PHYSICAL/CHEMICAL PARAMETERS

Temperature and Dissolved Oxygen

Temperatures and dissolved oxygen levels were uniform throughout the water column. Dissolved oxygen levels ranged from around 10.0 mg/l in the spring to 5.0 mg/l during the fall.

Secchi Disk

The transparency of the water ranged from 2.5 feet during the fall to 5.5 feet in the spring.

Alkalinity and pH

The alkalinity of the water was less than 1.0 mg/l for each sampling run and therefore, offered poor buffering capacity. The pH levels remained in the 4.2 to 4.3 range.

Nutrients

Total phosphorus levels in the water column ranged from less than 0.02 mg/l during the summer to 0.03 mg/l during the spring and fall.

RESULTS

BIOLOGICAL DATA

Chlorophyll a/Algae

Chlorophyll *a* levels for the summer and fall were 3.25 mg/m^3 and 2.82 mg/m^3 respectively. There was no chlorophyll *a* for spring due to a lab malfunction.

Macrophytes

Bladderwort (Utricularia spp.) and water milfoil (Myriophyllum spp.) were growing throughout the shallow areas of the lake. Their areal coverage was 65% to 70% of the lake.
Some small areas of spatterdock (Nuphar spp.) were growing in the uppermost part of the lake.

Bacteria

Fecal coliform levels were less than 20 mpn/100ml for each sampling run, indicating swimmable waters on each of these dates.

CONCLUSION

Although Lake Nummy has good water quality with relatively low nutrient and chlorophyll a levels, it is considered to be in a eutrophic state because of decreased depth and heavy macrophyte growth. About 70% of the lake has a depth of four feet or less. These areas include the upper end and shoreline of the lake. Heavy growth of macrophytes in these areas precludes most of the boating and fishing opportunities. The swimming area is not affected by the macrophyte growth because it is located at the deeper end of the lake.

The heavy growth of macrophytes may impact the ecology of the lake. As the macrophytes die, they sink and accumulate on the lake bottom. This can increase nutrient levels in the sediments and decrease the overall depth of the lake. Both of these factors can lead to more macrophyte growth.

REFERENCES

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

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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	ACIDITY	TOT P	ORTHO P	F COLI	F STREP	TOT COLI	FC/FS	SECCHI (feet)
INLET #1	04/12/89	8.4	8.3	3.96	82	.03	<.01	20	<2	20	NA	
	07/18/89	18.2	4.2	3.84	36	.03	<.01	460	79	3500	5.82	
	10/05/89	12.9	6.0	3.93	42	.03	<.01	20	5	20	NA	
UPPER	04/12/89	11.6	10.9	4.29	76	.02	<.01					3.0
	07/18/89	21.8	5.1	4.08	34	.02	<.01					2.5
LOWER	04/12/89	12.2	10.4	4.18	86	.03	.01	<20	<2	<20	NA	5.5
	07/18/89	24.1	6.4	4.34	76	.02k	<.01	<20	14	<20	NA	5.0
	10/05/89	16.8	5.9	4.15	22	.03	.02	>20	>2	50	NA	2.5

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/07/18
Sample No. 76837
Lakes Management
Lake Nummi (lower lake), NJ

Plankton Identification

CHLOROPHYCEAE (green)
Chlamydomonas sp.
Chlorella vulgaris
Oocystis lacustris
Schroederia setigera

CHRYSOPHYCEAE (golden or brown)
Mallomonas acaroides

DINOPHYCEAE (dinoflagellate)
Peridinium sp.

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Chlorophyll Analysis

Chlorophyll "a" (mg/m^3) = 3.25

Analyst(s)/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/10/05
Sample No. 53443
Lakes Management
Lake Nummi, NJ

Plankton Identification

CHLOROPHYCEAE (green)
Nannochloris sp.

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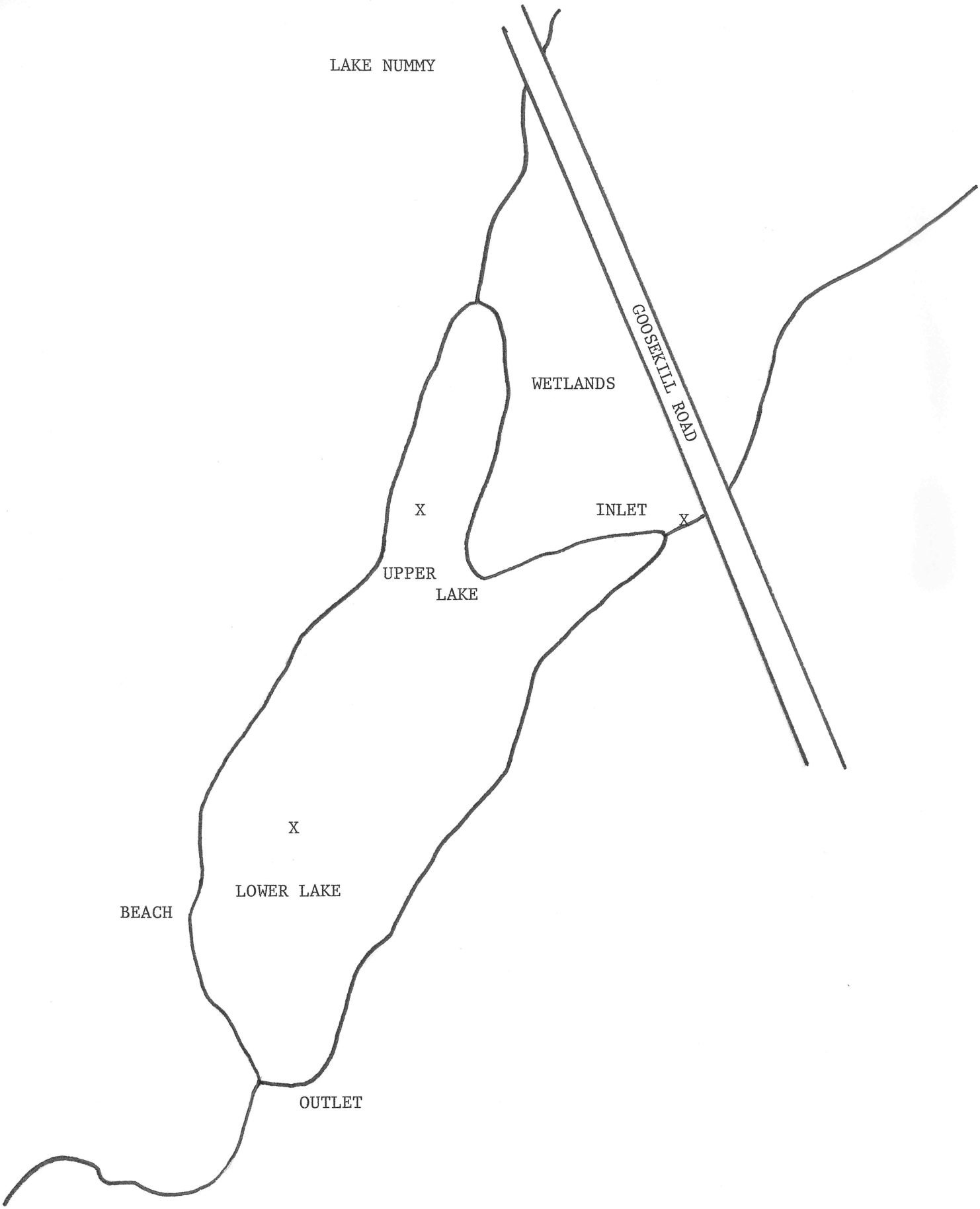
Chlorophyll Analysis

Chlorophyll "a" (mg/m^3) = 2.82

Analyst/Unit _____


74°52'30"
39°15'
511000m E.
BELLEPLAIN 1.8 MI.
514
50'
515
4344000m N.
Savages Run
CHAMPION RD
Lake Nummi
GOOSEKILL RD
550
State Forest Headquarters
Gravel Pit
BELLEPLAIN STATE FOREST
BOUNDARY
United Brotherhood Cem
Cem
BORO
4343
ROAD
SUNSET
STATE FOREST
SWAMP
4342
PINE
4341
4.6 MI. TO N.J. 550
EAST CREEK
MILL
4340
12'30"
BM
DELSEA
47
Branch
MILLVILLE 19 MI.
ELDORA 2.2 MI.
557
North Dennis
DUDUGAN
DENNISVILLE-WOODBINE
Ludlams Pond
BEAVER
GAUSEWAY
DRIVE
Ludlams Sch
Johnson's Pond


LAKE NUMMY
GOOSEKILL ROAD
WETLANDS
X
INLET
X
UPPER
LAKE
X
LOWER LAKE
BEACH
OUTLET