

LAKE WATER QUALITY ASSESSMENT REPORT
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

SMITHVILLE LAKE
EAST HAMPTON 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

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Appendix includes	
-Data	
-Algae identification	
-Map of lake and watershed	
-Map with sampling stations	

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 Criteria 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 equilibrium 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 its 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

Smithville Lake, which is part of the historic area of Smithville Park, is a 25 acre body of water located in Burlington County. The lake is an oxbow of the North Branch of the Rancocas Creek and is listed as a Type 5 Wetland as defined by the U.S. Fish and Wildlife Service Circular 39. It has a maximum depth of 3.5 feet with nearly 70% of the lake less than 1 foot deep. The lake is accessible to fishing from five docks situated along the shoreline. There is a drive-up boat launch area but excessive growth of macrophytes makes access to the main portion of the lake difficult. The Pemberton M.U.A. discharges into the Rancocas Creek upstream of the lake.

LAKE NUM. AND NAME: #1720 SMITHVILLE LAKE

STUDY PERIOD: SPRING, SUMMER, FALL 1989

LOCATION: EASTHAMPTON TWP., BURLINGTON CO.

U.S.G.S. QUAD: #26 MOUNT HOLLY

LAKE AREA: 25 ACRES

LAKE MAXIMUM DEPTH: 3.5 ft.

GEOLOGIC DESIGNATION: CAPE MAY FORMATION

TRIBUTARIES: NORTH BRANCH OF RANCOCAS

POINT SOURCES: PEMBERTON M.U.A. INTO NORTH BRANCH OF
RANCOCAS (2.05 MGD).

LAKE USE AND HISTORICAL NOTES: FISHING, BOATING AND HISTORICAL
SITE. SAMPLED BY NJDEP IN 1975,
1977 AND 1980.

COMMENTS: SPATTERDOCK COVERS 70% OF THE MIDDLE OF THE LAKE.
MIDDLE OF THE LAKE IS FOUR INCHES DEEP. LARGE FLOCK OF
GEESE NESTING HERE DURING THE FALL. POTENTIAL RUNOFF FROM
WOODLANDS AND HOMES.

RESULTS

PHYSICAL/CHEMICAL PARAMETERS

Temperature and Dissolved Oxygen

Because of the shallow depth of the lake, temperatures and dissolved oxygen levels were uniform throughout the water column. Dissolved oxygen levels ranged from 5.1 mg/l in the spring to 8.2 mg/l during the heaviest algal bloom in the summer.

Secchi Disk

The transparency of the water was poor ranging from 1.0 foot to 1.5 feet.

Alkalinity and pH

The alkalinity of the water ranged from 1 mg/l to 9 mg/l and therefore, offered poor buffering capacity. The pH fluctuated from a low of 5.56 during the fall to a high of 6.37 during the summer.

Nutrients

Total phosphorus levels in the lake's water column ranged from 0.15 mg/l to 0.20 mg/l. These numbers were extremely high as were the levels in the lake's inlet which ranged from 0.09 mg/l to 0.18 mg/l.

RESULTS

BIOLOGICAL DATA

Chlorophyll a/Algae

Chlorophyll a levels for the spring, summer and fall were 13.61 mg/m³, 123.37 mg/m³ and 29.38 mg/m³ respectively. There was a moderate degree of species diversity in each sample. During the heavy bloom in the summer, the blue-green algae (*Anabaena planctonica*) was dominant.

Macrophytes

Yellow water lily (*Nuphar* spp.) covered about 70% of the lake. The majority of the growth was in the middle of the lake where the depth was as shallow as four inches.

Bacteria

Fecal coliform counts ranged from less than 20 mpn/100ml to 130 mpn/100ml, indicating safe swimming conditions on these sampling dates. Smithville Lake is not utilized for swimming.

CONCLUSION

Because of the high biological productivity occurring within its boundaries, Smithville Lake is considered to be eutrophic. Smithville Lake's problems include heavy algal blooms and a high percentage of areal coverage by macrophytes. The aquatic plant growth is enhanced by high levels of nutrients in the water column.

The recreational uses of the lake are adversely affected by the high productivity. Navigating a boat from the launching area to the main part of the lake is difficult to impossible. Shallow depths and a heavy area of yellow water lily lie between the lake and the launching ramp. The aesthetic appearance of the lake is also negatively affected by the green color imparted to the water by the algal blooms.

The high productivity is negatively impacting the ecology of the lake. The accumulation of dying aquatic plants is a possible source of sedimentation. Furthermore, the breakdown or decay of the accumulated material by oxygen demanding bacteria may have caused low dissolved oxygen levels during the spring. Low dissolved oxygen can stress favorable fisheries. In 1982 a fish survey was conducted. Bass, pickerel and bluegills were dominant with no carp present. Carp were observed throughout the lake during sampling in 1989. Carp are more tolerant of low dissolved oxygen conditions and are often associated with poorer quality water.

REFERENCES

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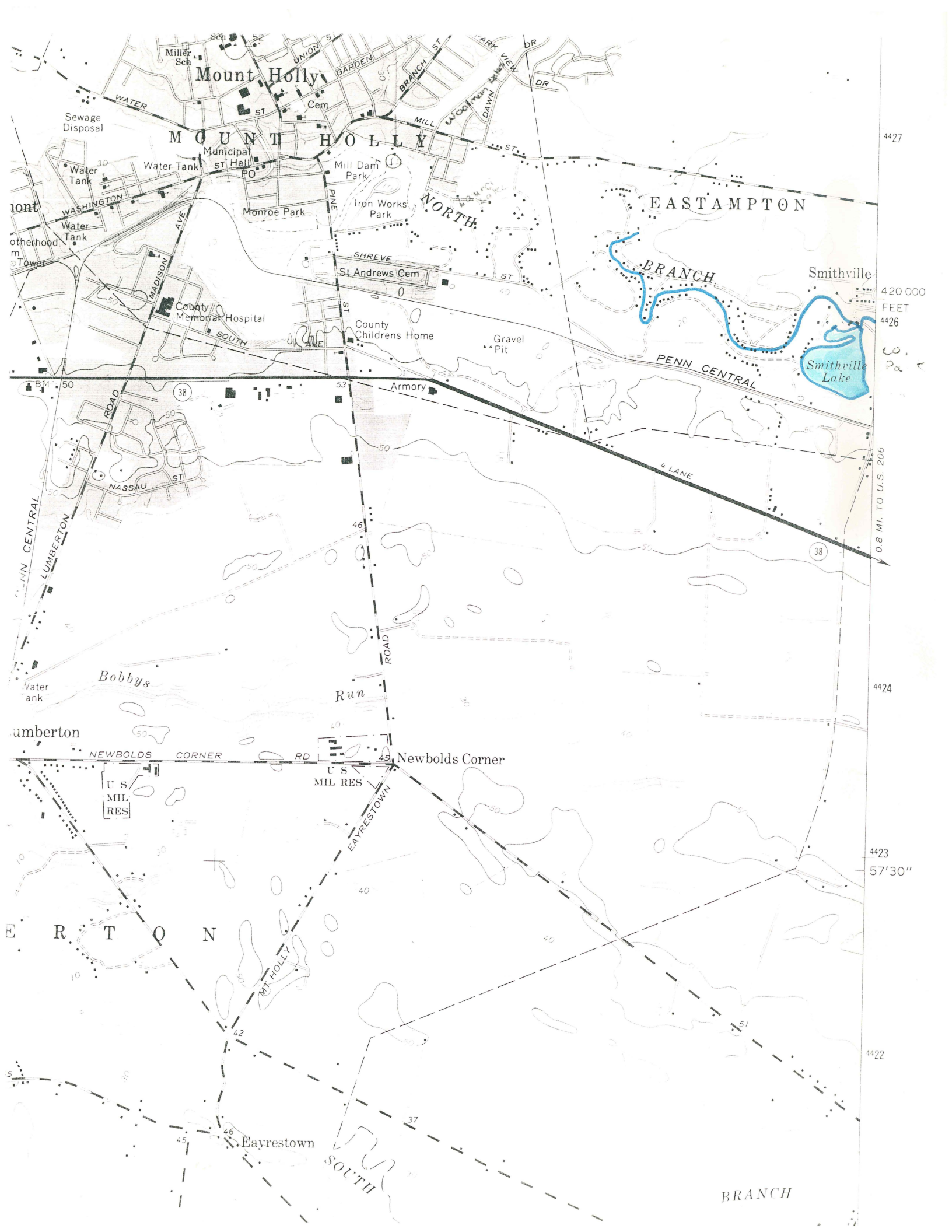
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Wetzel, Robert G. 1983. Limnology. Saunders College Publishing, New York.

APPENDIX

STATION	DATE	TEMP	DO	pH	ALK	TOT P	ORTHO P	F COLI	F STREP	TOT COLI	FC/FS	SECCHI (ft.)
INLET	06/08/89	21.0	7.0	5.48	4	.18	.07	1400	1600	5400	.9	
	08/16/89	21.7	7.0	5.60	5	.12	.06	310	540	1400	.6	
	10/26/89	10.9	10.3	4.92	4	.09	.03	130	110	330	.4	
LAKE	06/08/89	24.0	5.1	5.67	9	.15	.05	<20	5	<20	NA	1.0
	08/16/89	27.5	8.2	6.37	1	.16	.06	50	8	170	6.3	1.0
	10/26/89	11.6	7.2	5.56	8	.20	.10	130	4	1300	NA	1.5



Mount Holly

MOUNT HOLLY

EASTAMPTON

Smithville

BRANCH

Smithville Lake

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PENN CENTRAL

Mount

PENN CENTRAL

Lumberton

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SMITHVILLE LAKE

HISTORIC PARK AREA

INLET (RANCOCAS CREEK)

UPPER LAKE

X

LOWER LAKE

ROUTE 206

X-Sample Sites

