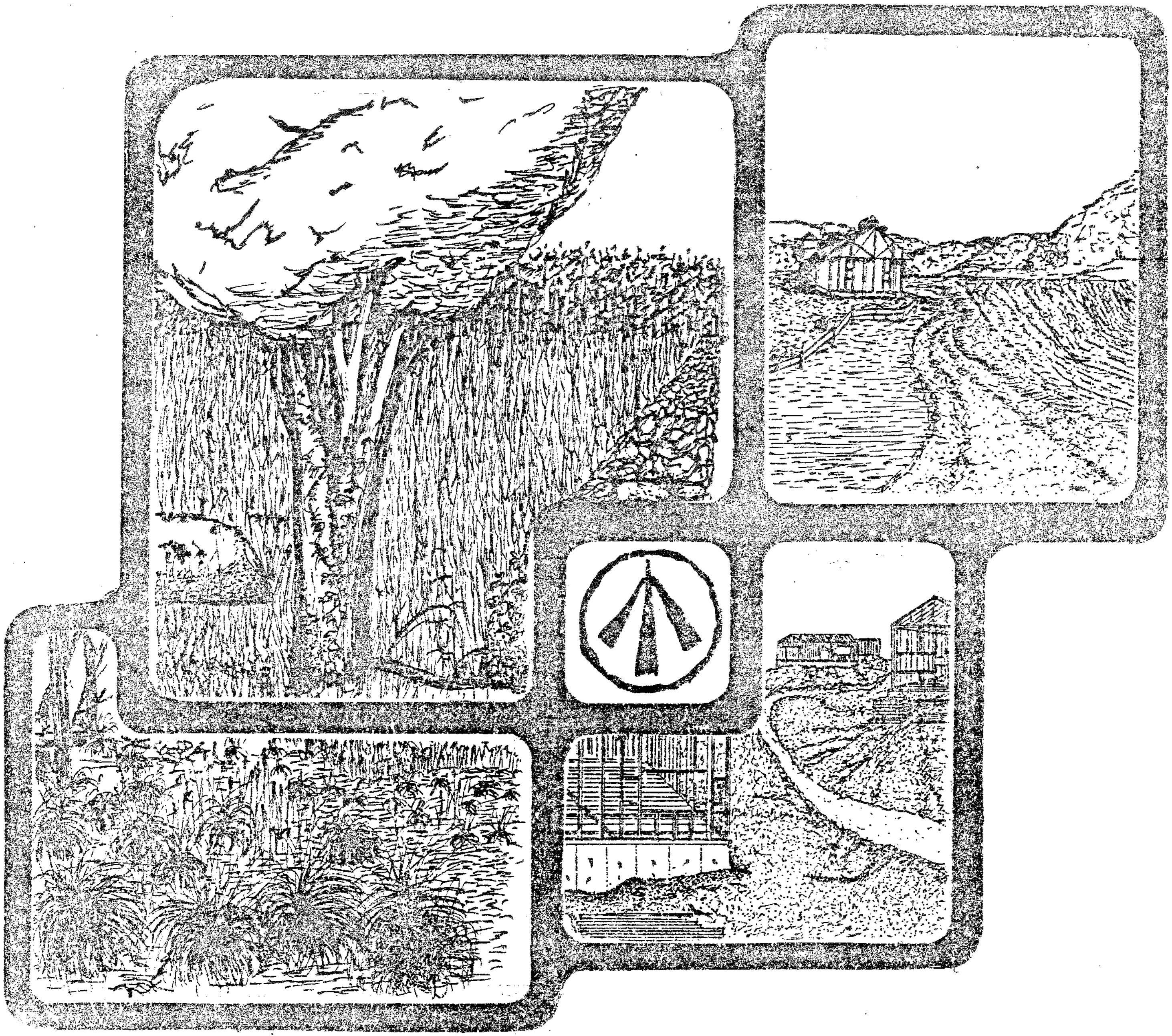
ENVIRONMENTAL REVIEW TEAM REPORT



MAMANASCO LAKE
RIDGEFIELD, CT

KING'S MARK
RESOURCE CONSERVATION & DEVELOPMENT AREA

KING'S MARK
ENVIRONMENTAL REVIEW TEAM REPORT

MAMANASCO LAKE
RIDGEFIELD, CT
FEBRUARY 1985

King's Mark Resource Conservation and Development Area
Environmental Review Team
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Housatonic Valley Council of Elected Officials
Southwestern Regional Planning Agency
Greater Bridgeport Regional Planning Agency
Regional Planning Agency of South Central Connecticut
Central Connecticut Regional Planning Agency
American Indian Archaeological Institute
Housatonic Valley Association

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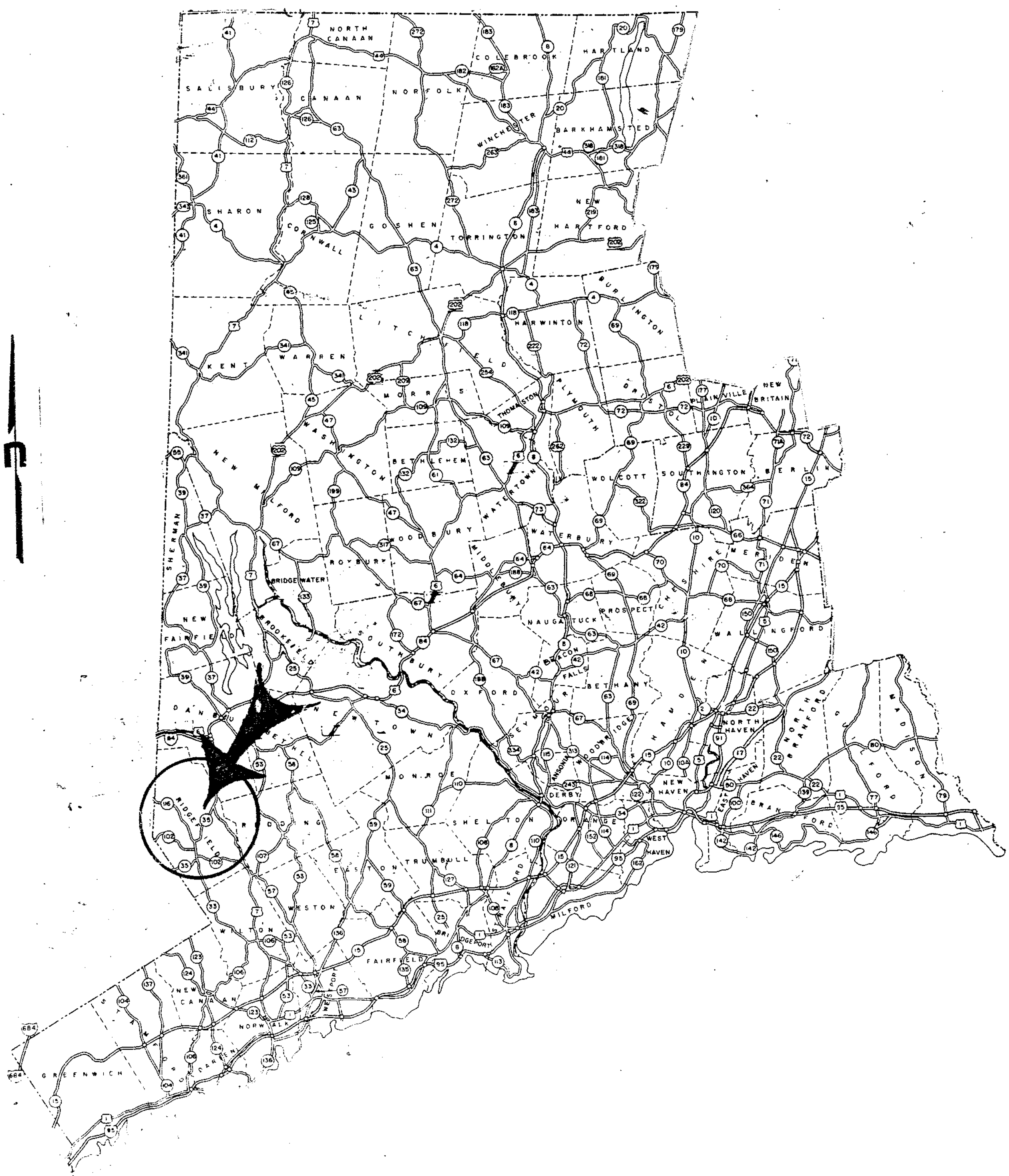
LOCATION OF STUDY SITE



Scale 1" = 10 miles

10 0 5 10 miles

MAMANASCO LAKE

I. Introduction

The preparation of this report on Mamanasco Lake was requested by the 1st Selectman of Ridgefield and the Mamanasco Lake Improvement Fund, Inc.

Mamanasco Lake is ± 96 acres in size and is located approximately 3 miles northwest of the center of town. As shown in Figure 1, the watershed draining to the Lake is about 537 acres in size. Land use in the watershed is characterized by residential development and undeveloped wooded land. The level of the Lake has been raised slightly by a small dam and now reportedly has an average depth of about 5 or 6 feet.

Mamanasco Lake has been classified as a meso-eutrophic lake, characterized by extensive weed growth during the summer months (Frink and Norwell,"Chemical and Physical Properties of CT Lakes", CT Ag. Exp. Station, 1984). A "Management Study for Ridgefield's Mamanasco Lake" was prepared by the Housatonic Valley Council of Elected Officials in September 1981. The HVCEO's study concluded that the major nutrient sources accelerating the eutrophication of the Lake were erosion and septic systems. For control of erosion related sources the HVCEO report recommended the installation and maintenance of catch basins as well as the adoption of strict zoning controls regulating development. For control of septic system sources, the HVCEO report recommended careful septic system management and the use of holding tanks and non-phosphorus detergents in areas within 300 feet of the shore. Recommended in-lake controls included a combination of dredging and capping.

The Mamanasco Lake Improvement Fund has been active for a number of years in managing the Lake. To date, this management has focused on: 1) chemical treatment of the Lake (i.e., copper sulfate to control algae, Aquathol K for lake weeds), and 2) weed harvesting (since 1982 when the MLIF purchased a weed harvestor.) The MLIF has reported good success with these two management measures, and is now in the process of exploring other management alternatives to better control lake water quality. To assist them in this effort, this ERT study was requested. Specifically, the ERT was requested to address four factors. These included:

1) Erosion - extent, effects, and specific alternatives for controlling
2) Septic Systems - how significant is this source of nutrients with regard to lake water quality and what can be done about it
3) Overwinter Drawdown - what potential does this management technique have at Mamanasco Lake

4) Dredging - what are the pros and cons of this management technique

The ERT's analysis of these four factors was requested to assist the Town of Ridgefield and the MLIF in determining how best to manage the Lake and protect future water quality.

The King's Mark Executive Committee considered the town's request and approved the project for review by the Team.

The ERT met and field reviewed the lake and watershed on September 26, 1984. Team members participating on this review included: Marc Beroz, Soil Scientist, U.S.D.A. Soil Conservation Service; Charles Fredette, Lake Ecologist, CT Department of Environmental Protection; William Hyatt, Fishery Biologist, CT Department of Environmental Protection; Richard Lynn, ERT Coordinator, King's Mark RC&D Area; Randy May, Sanitary Engineer, CT Department of Environmental Protection; David Thompson, District Conservationist, U.S.D.A. Soil Conservation Service; William Warzecha, Geohydrologist, CT Department of Environmental Protection.

Prior to the review day, each team member was provided with a summary of the proposed project, a checklist of concerns to address, and a detailed soil survey map and topographic map of the subject area. During the Team's field review, team members toured the Mamanasco Lake watershed and met with representatives from the town to discuss the situation at the Lake. Following the field review, individual reports were prepared by each team member and forwarded to the ERT Coordinator for compilation and editing into this final report.

This report presents the Team's findings. It is important to understand that the ERT is not in competition with private consultants and hence does not perform design work or provide detailed solutions to land use problems. The ERT concept provides for the presentation of natural resources information and preliminary land use analyses. All conclusions and final decisions rest at the local level. It is hoped the information contained in this report will assist the town of Ridgefield and the Mamanasco Lake Improvement Fund, Inc. in making environmentally sound decisions.

The report begins with some preliminary natural resources information on the watershed and then discusses each of the four identified areas of concern individually.

If any clarification of the report is required, please contact Richard Lynn, (868-7342), Environmental Review Team Coordinator, King's Mark RC&D Area, Sackett Hill Road, Warren, Connecticut, 06754.

* * * * * * *

II. Highlights

1. *Mamanasco Lake is classified as Class A water by Connecticut's Water Quality Standards. As Class A water, the Lake is suitable for bathing and other recreation purposes, has excellent aesthetic value, and provides excellent fish and wildlife habitat. The quality of Mamanasco is affected by shallow water depths and dense beds of aquatic plants, consequences of eutrophication which are both natural and man induced. Controllable man made causes of eutrophication at Mamanasco include nutrient enrichment from residential land (septic systems, fertilizers) and sedimentation from road sand and construction related erosion.* (p. 16)

2. *Mamanasco Lake has an excellent fisheries forage base and so long as weed growth is controlled, the growth rates of largemouth bass should be above average. In the opinion of the team's fishery biologist, the objective of the aquatic weed management program in Lake Mamanasco should not be to eliminate macrophyte growth entirely, but rather to contain the vegetation at a level which is both acceptable to area residents and capable of optimizing the fishery value of the Lake. A level of 20% weed cover is preferable from a fisheries standpoint. It is also recommended that the vegetation be divided up rather than confined to one dense area. Doing this will provide a "patchy" environment and thus increase the amount of "edge" habitat. This will most likely increase the number of bass the pond is capable of supporting and will allow anglers access to some of the best bass cover.* (p. 18 & 19)

3. *Erosion and siltation has been identified as a major problem with regard to the environmental health of Mamanasco Lake. Sediment generation within the Lake watershed is entirely from non-point sources. A thick accumulation of leaves has created a protective and absorbent blanket over undeveloped areas. Road sand and eroding road shoulders contribute significant quantities of sediment to the streams and the storm sewer system which, in turn, transport it directly into the Lake.* (p. 19 & 20)

4. *There are three locations within the watershed where sediment basins should be considered for construction: 1) the wetland at the intersection of Blue Ridge Road and Caudatowa Drive, 2) on the down stream side of Old Sib Road at the outlet of Turtle Pond, and 3) in the wetland bordering the easterly side of the state access area. These basins would provide a body of water into which heavy sediment would precipitate. In addition to these basins, additional structures, probably silt*

curtains, would be needed along the westerly shoreline at each stream and culvert discharge. The existing accumulations of sediment would first have to be removed in order to strategically place the silt curtains. A final but very important step would be to create deep sumps at the inlets of all cross culverts under Mamanasco Road. Annual inspection and maintenance of all of these structures would be essential. (p. 20)

5. *The immediate lakeside area has many lots that are too small to support a conventional septic system. It is very difficult to design and install a permanent, code quality system and appurtenances on lots of less than ½ acre. Efforts to continue to affect on-site correction in this area cannot provide a continued reliable, standard method of sewage disposal. On-site systems which can be patched up to function in a manner that mitigates the immediate public health problem will continue to overload the area with sewage and very likely to be transmitting excessive nutrients to the Lake.* (p. 23)

6. *Since Mamanasco Lake is both a public and private resource it is strongly suggested that the Lake Mamanasco Improvement Fund, Inc. and the town of Ridgefield explore the costs and financing of an engineering study to consider the options and costs associated with providing alternate measures of sewage disposal in the immediate lakeside area. Given the general lack of success in alternative on-site methodologies it is further recommended that emphasis be placed on a limited, innovative technology, collection system discharging to a small scale land treatment system.* (p. 24)

7. *The soils in the balance of the watershed are not ideal, however, the room exists to properly engineer and install systems both in code compliance and to minimize environmental impacts.* (p. 23)

8. *Dredging sediment deposits would improve conditions in Mamanasco by reducing aquatic plant habitat and by reopening shallow areas to boating. Dry excavation is relatively simple and inexpensive compared to hydraulic dredging and therefore is the method of choice when feasible. The Lake Association is advised to pursue a sediment removal program of drawdown and excavation. Ideally the project should be scheduled to be completed with one drawdown to minimize the disruption of recreation. A suggested schedule would be to draw the Lake down in late summer, to excavate the sediments during the fall and early winter, and to refill the Lake during the late winter and early spring. Calculations presented in the team's report indicate that such a drawdown is feasible. As identified in the text, however, a number*

of items need to be addressed in a detailed feasibility study prior to implementing such a program. (p. 25 & 26)

9. *In conclusion, weed harvesting plus a well planned draw-down and excavation project appear to be the best "in-lake" management alternatives for controlling the weed growth at Mamanasco Lake. The Mamanasco Lake Improvement Fund, Inc. may also wish to consider adding one or more of the recently developed "light control" technologies to their future management plans for Mamanasco Lake.* (p. 29)

III. General Watershed & Lake Inventory

A. TOPOGRAPHY AND GEOLOGY

TOPOGRAPHY

The terrain throughout most of the Lake's watershed is characterized by slopes which range from moderate to very steep. As shown in Figure 1, however, slopes are gentle along the western shoreline. The topography in the watershed is controlled mainly by the underlying bedrock. Numerous rock outcrops and a generally shallow soil cover are present throughout the watershed area. Maximum and minimum elevations in the watershed area are ± 980 feet and 578 feet above mean sea level respectively.

The only mapped tributary to Mamanasco Lake is the unnamed outlet stream for Turtle Pond. Turtle Pond, which has a surface area of about 5 acres is located southwest of Mamanasco Lake and is the only other surface water body in the watershed.

BEDROCK GEOLOGY

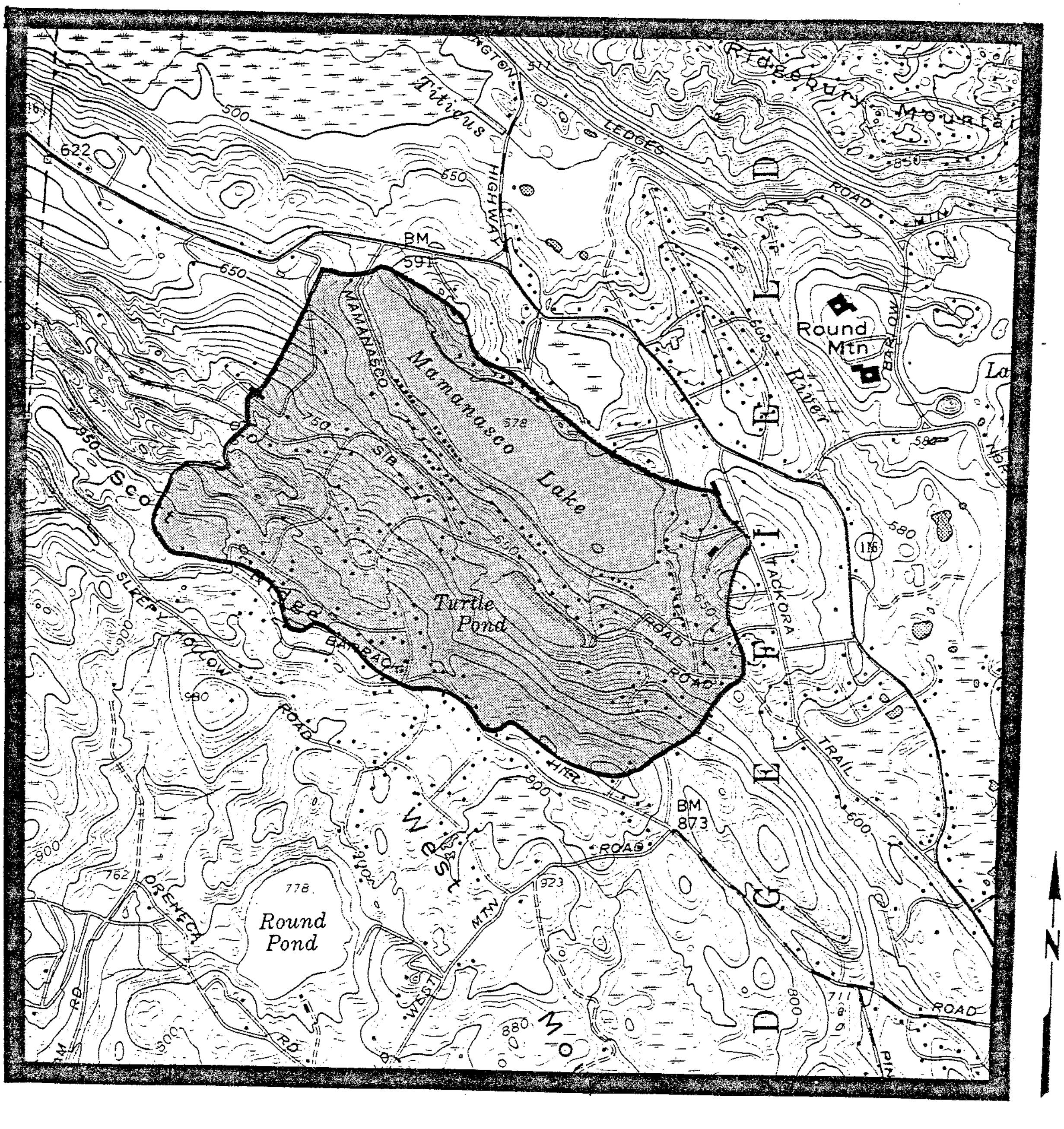
The bedrock geology of the Peach Lake topographic quadrangle, which encompasses the entire lake watershed, was mapped by R.M. Sneider between 1952 and 1956. The U.S. Geological Survey published the map in 1968 (New York Service No. 11). Figure 2 shows the bedrock geology of the watershed, as adapted from Sneider's map.

Bedrock underlying or cropping out within the watershed may be grouped into three principal rock types. The most extensive type is described as the Fordham Gneiss. It outcrops or underlies the western parts of the watershed. This rock consists of a light and dark banded gneiss composed of the minerals hornblende, biotite, quartz and feldspar. The minerals hornblende and biotite represent darker minerals while quartz and feldspar minerals are light-colored. This rock may contain layers of amphibolite (rock containing amphibole minerals), marble, calc-silicate rocks, mica schist, pegmatites and granitic layers. A "gneiss" refers to a metamorphic rock (rock geologically altered by heat and pressure) in which bands of aligned, elongate or flaky minerals alternate with layers of more rounded minerals grains.

The second rock type which underlies or crops out in the eastern parts of the watershed is described as a white to gray calcite to dolomite marble which also contains small amounts of calc-silicate rock. This rock unit is referred to as Inwood Marble. The term "marble" refers to rock created by metamorphic processes. They are formed mainly by re-crystallization of the rock limestone which contains dolomite and/or calcite minerals. The resulting marble rock usually becomes coarser-grained than the original limestone rock.

The third rock type which outcrops within the watershed is described as a white to pink, fine-to very coarse grained granite composed of the minerals biotite, muscovite and microline. A "granite" is an igneous rock (rocks formed from molten magma) which is commonly light colored due to high percentages of the minerals quartz and feldspar. It

FIGURE 1
TOPOGRAPHY

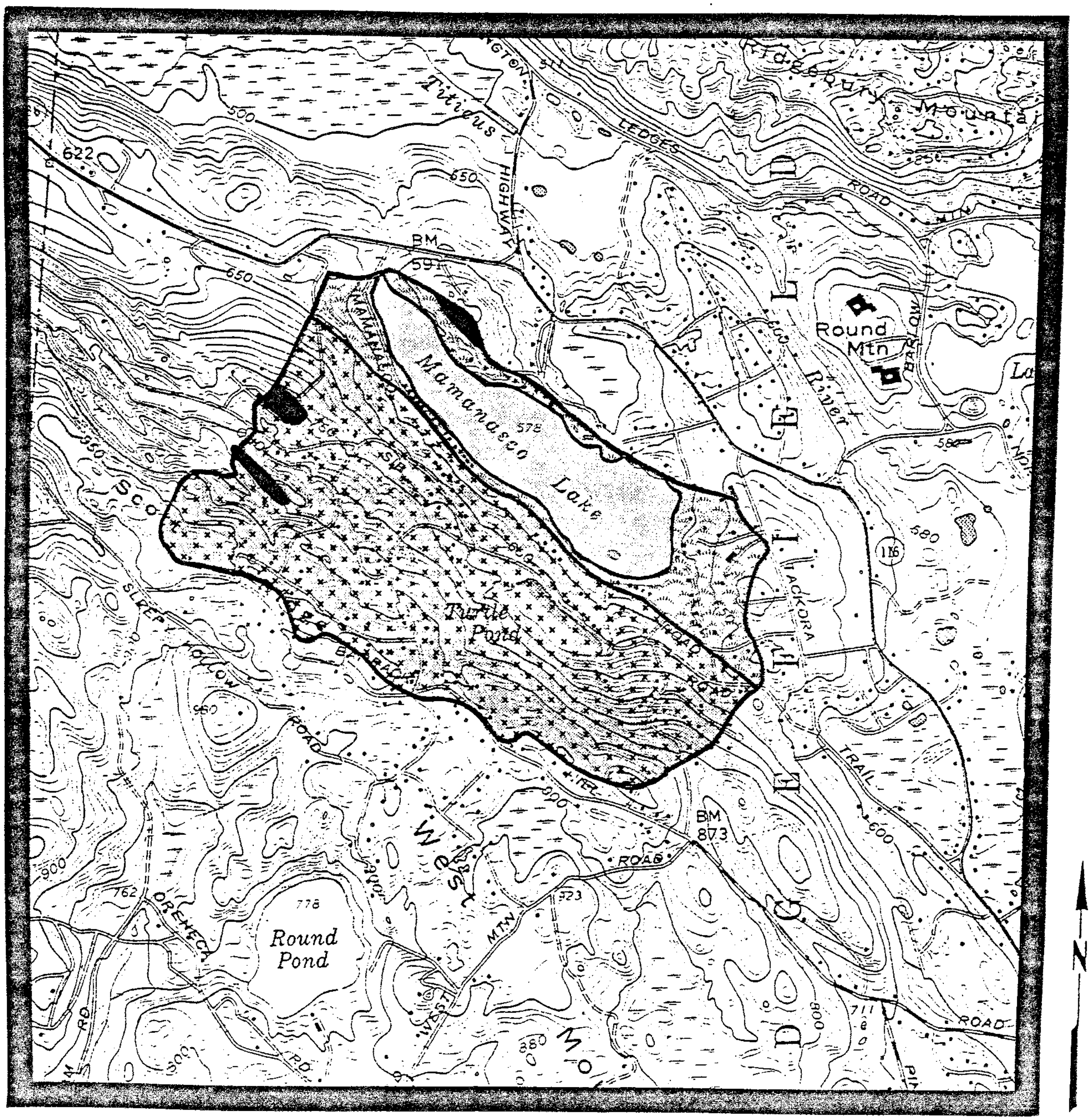


Mamanasco Lake watershed

SCALE

1" = 2000'

FIGURE 2
BEDROCK GEOLOGY



Mamanasco Lake watershed

Inwood Marble

Fordham Gneiss

Microcline Granite

SCALE

1" = 2000'

also contains small amounts of dark-colored minerals, however, such as biotite and hornblende. Because the minerals in this rock are more resistant to the weathering processes than the surrounding rock types (i.e., Inwood Marble and Fordham Gneiss), they make prominent ledges in the watershed.

SURFICIAL GEOLOGY

Surficial geologic materials consist of those unconsolidated rock particles or other debris overlying bedrock. Till is the surficial geologic material which covers nearly all of the watershed. Till consists of rock particles and fragments that were accumulated by a moving sheet of glacier ice and later redeposited directly by the ice. These materials are non-sorted and consist of particles ranging in size from clay to boulders. The upper few feet of till deposits is commonly sandy, loose and stony, with the lower portions less stony, siltier and tightly compact. Thickness of the till is probably less than 10 feet throughout the watershed. Areas where soil cover is particularly shallow are delineated by the symbol HrE on the accompanying soils map (see Figure 3).

Overlying till in a few areas throughout the watershed are seasonally wet spots. These areas, which are delineated by the symbol Rn in Figure 3 comprise regulated inland-wetland soils.

B. HYDROLOGY

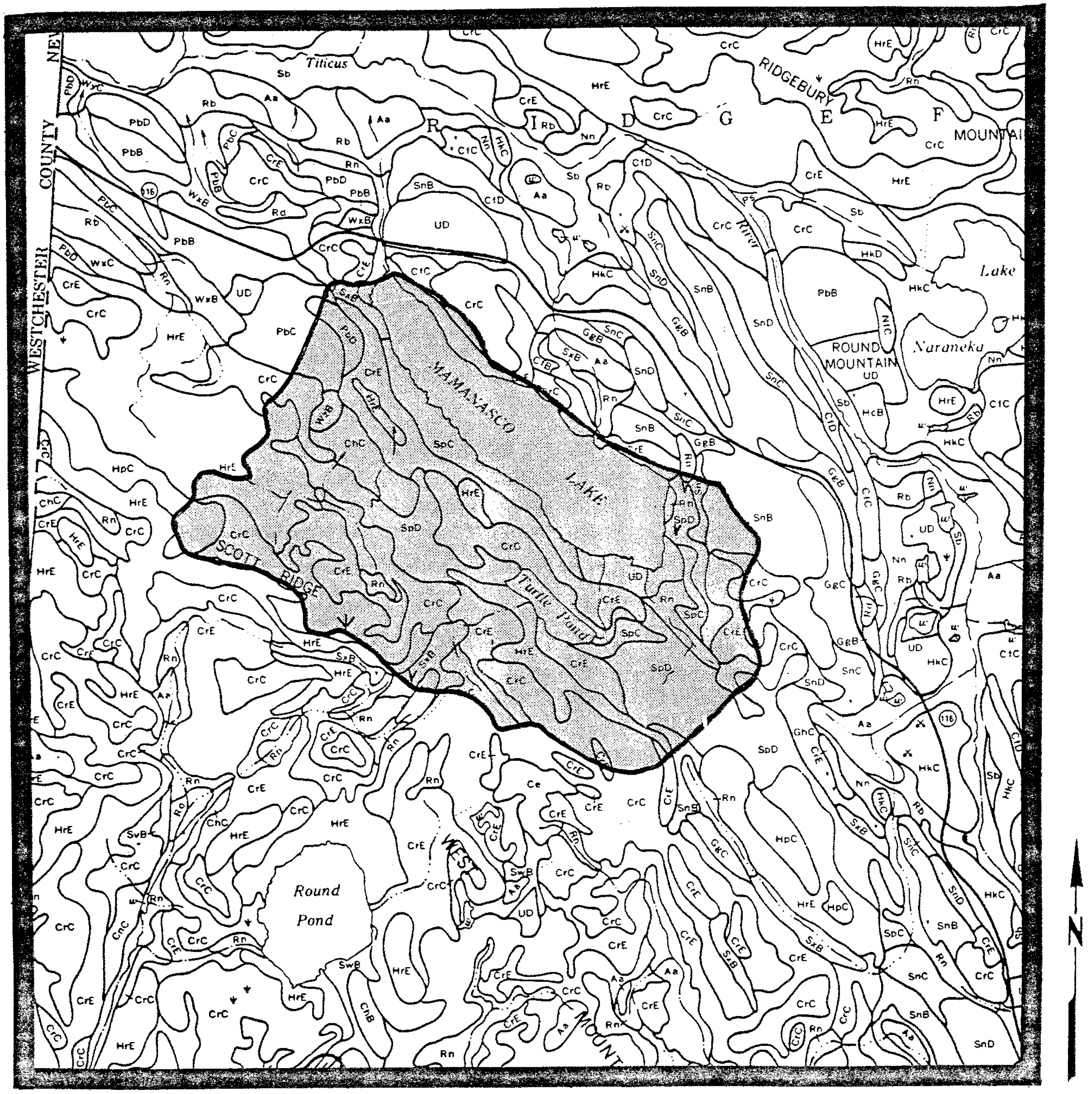
The watershed of Mamanasco Lake may be defined as that land area from which all of the natural water input to the Lake is derived. As shown in Figure 1, the watershed boundary tends to follow along the crests of the local ridges and hills. The watershed as depicted comprises about 537 acres or about .84 square miles.

Precipitation which takes the form of surface runoff flows across the surface of the land until it reaches a brook or other body of water. Precipitation may also be absorbed into the ground. Once it is absorbed, the water may either be returned to the atmosphere through evaporation and transpiration or percolate downward to the water table and become groundwater. Once the water reaches the groundwater table it moves slowly downslope by the force of gravity, ultimately discharging to the surface in the form of a spring, wetland, stream, or directly into the lake. Generally speaking, groundwater flow in the watershed parallels the surface flow pattern and is largely controlled by the underlying bedrock.

As mentioned earlier in the report, the major feeder stream to Mamanasco Lake is the outlet stream for Turtle Pond. Because these two surface water bodies are connected hydraulically, the water quality of Turtle Pond could ultimately influence the water quality of Mamanasco Lake.

There are numerous intermittent drainage channels primarily in the western parts of the watershed which feed the Lake during periods of precipitation and/or wet times

FIGURE 3
SOILS MAP



Mamanasco Lake watershed

SCALE

1" = 2000'

of the year.

Although there is no gaging station at the outlet of Mamanasco Lake, it is possible to estimate the flow duration characteristics of the outlet stream using a method described in Connecticut Water Resources Bulletin No. 20. The estimates are tabulated below in units of both cubic feet per second (CFS) and million gallons per day (MGD).

TABLE 1. Estimated flow duration characteristics of unnamed stream at the outlet of Mamanasco Lake

Percent of time flow equalled or exceeded	1	5	10	30	50	70	90	99
Flow equalled or exceeded in million gallons per day	6.3	3.4	2.35	1.19	.63	.23	.025	0.0
Flow equalled or exceeded, in CFS	9.7	5.3	3.6	1.8	.97	.35	.04	0
Time period (in days) to fill Mamanasco Lake, if completely drained	34	61	91	183	339	942	*	*

*Not calculated

The mean annual outflow from Mamanasco Lake is estimated to be 1.5 cubic feet per second or about 1 million gallons per day.

It is possible to estimate how long it would take Mamanasco Lake to refill if it was completely drained. This estimate can be calculated from the formula for retention time which is equal to $\frac{V}{D \times R \times N}$ where V is the volume of the Lake, R is the rate of runoff in the watershed, D is the approximate drainage area for the impoundment and N is a constant which equals the number of seconds in one day. "Retention time" may be defined as the time period required for a body of water to flush once.

Mamanasco Lake has a watershed area of about .84 square miles, a volume of 28,533,580 cubic feet, and a rate of runoff of 1.80 cubic feet per second per square mile. The latter value is obtained from U.S. Geological streamflow data for the water years 1931 to 1960 for the local geographic area. There are 84,600 seconds in a day. If these values are plugged into the above mentioned, formula, the retention time can be estimated to be 219 days.

It is also possible to estimate the time (in days) for Mamanasco Lake to fill for the flows given in the above table. For example, a flow of 3.6 cubic feet per second, which will be exceeded 30 percent of the time, would fill the Lake in 183 days. Because extremely low flows (i.e., 90 percent and 99 percent) are exceeded most of the time, their time periods were not calculated. Conversely, high flows, i.e., 1 percent and 10 percent are exceeded only a small percent of the time. Time periods (in days) are also shown in Table 1.

A Mamanasco Lake Improvement Fund, Inc. (known hereafter as MLIF) official questioned on the field review day how long it would take Mamanasco Lake to refill if the water level was lowered by 50% (this would reduce the volume of the Lake to about half its present capacity). The purpose of the drawdown would be to maintain beach front property and beaches. In addition, lowering the water level of the lake may be a viable alternative for controlling the weed growth problem (see discussion in a later section of this report).

Based on a flow rate of .35 cubic feet per second (CFS), it is estimated that it would take approximately 472 days to refill the lake to its normal capacity if the volume of the Lake was reduced to about half its present capacity. A flow rate of .35 cubic feet per second, which would be expected during a dry period (fall season) would be equalled or exceeded 70 percent of the time according to Table I.

On the other hand, if a flow rate of 1.8 cubic feet per second (CFS) was used, it is estimated that the Lake would refill in approximately 92 days. According to Table I, a flow rate of 1.8 cubic feet per second would be equalled or exceeded 30 percent of the time and would most likely occur during the wet times of the year (spring). It should be pointed out that these flow rates are based on long term observations of conditions in the state. An exceptionally wet fall or dry spring could greatly effect the time period for the Lake to refill.

If the water level of Mamanasco Lake is lowered, whether for beach front maintenance or to control the weed problem, it would be important to conduct a survey to determine if there are any dwellings along the shoreline which are served by dug wells. Because dug wells are usually shallow and tap the local water table, the lowering of Mamanasco Lake may adversely affect the water table of nearby dug wells. As a result, dug wells serving homes around the Lake may be dried up or the volume of water in the well(s) seriously diminished.

C. SOILS

A knowledge of soil types within a lake's watershed is important for effective watershed management . With regard to Mamanasco Lake, soils can affect lake water quality in two ways: 1) through erosion, soils can result in the increased sedimentation and nutrient loading of the Lake, and 2) different soils have varying abilities to renovate septic effluent (i.e., improperly renovated septic effluent reaching the Lake can degrade water quality). The soils located within the Mamanasco Lake watershed are identified in Figure 3 and briefly described in the following narrative. This information is a revision of the data contained in the Soil Survey Report of Fairfield County, Connecticut.

SOIL DESCRIPTIONS

Map Units CrC, CrE, HpC and HrE - These map units are composed of two soils and rock outcrops that are so intermingled on the ground that they could not be separated on the map. The soils have 1 to 5 percent stones and boulders on their surface.

One kind of soil is named Charlton. They are very deep and well drained. Typically the Charlton soil has fine sandy loam or gravelly fine sandy loam textures to a depth of 60 inches or more.

The other soil is named Hollis. They are shallow and somewhat excessively drained. Typically the Hollis soils have fine sandy loam textures overlying hard bedrock at a depth of 10 to 20 inches.

The Hollis soils are poorly suited for septic tank absorption fields due to their shallow depth to bedrock.

The Charlton soils are well suited for leaching fields except on slopes greater than 15 percent. This is because septic effluent may surface downslope before it is fully renovated by the soil.

The CrC and CrE map units are dominanted by the deep Charlton soils with lesser amounts of Hollis soils and rock outcrops. The CrC unit is on 3 to 15 percent slopes and the CrE unit is on 15 to 45 percent slopes.

The HpC and HrE map units are dominantly shallow Hollis soils with lesser amounts of Charlton soils and rock outcrops. The HpC map unit is on 3 to 15 percent slopes and the HrE map unit is on 15 to 45 percent slopes.

Map Unit ChC - This map unit is composed primarily of Charlton soils on 8 to 15 percent slopes. These soils are the same as the Charlton soils described above. These soils are well suited for septic tank absorption fields.

Map Unit SxB - This map unit is composed primarily of Sutton soils on 3 to 8 percent slopes. These soils are very deep and moderately well drained. Typically the Sutton soils are fine sandy loam to a depth of 60 inches or more. They have a seasonally high water table between 18 and 30 inches of the soil surface.

The Sutton soils are poorly suited for septic tank absorption fields because of their seasonally high water tables.

Map Units SnB and SnC - These map units are composed primarily of Stockbridge soils. Stockbridge soils are very deep and well drained. Typically these soils have loam textures to a depth of 60 inches or more. They have a firm layer with its upper surface between the depths of 20 to 36 inches. This firm layer has slow permeability.

The Stockbridge soils have poor potential for septic tank aborption fields due to their slow permeability.

The SnB map unit is on 3 to 8 percent slopes and the SnC map unit is on 8 to 15 percent slopes.

Map Units SpC and SpD - These map units are composed primarily of Stockbridge soils. These soils have the same characteristics as the Stockbridge soils described above except that these soils have 1 to 5 percent stones and boulders covering their surface.

The SpC map unit is on 8 to 15 percent slopes. The SpD map unit is on slopes of 15 to 25 percent slopes.

Map Units PbC and PbD - These map units are composed primarily of Paxton soils. These soils are very deep and well drained. Typically the Paxton soils have fine sandy loam textures to a depth of 60 inches or more. They have a hardpan layer with its upper surface between the depths of 20 and 38 inches. This hardpan layer has slow permeability. Water that enters the soil reaches the hardpan layer and then tends to flow laterally over the hardpan surface. This causes a brief perched water table during the wettest periods of the year. Depth to the water table is 18 to 30 inches.

The Paxton soils are poorly suited for septic tank absorption fields because of their slow permeability. Slopes greater than 15 percent pose an additional problem since septic effluent may surface downslope before it is fully renovated by the soil.

The PbC map unit is on slopes of 8 to 15 percent. The PbD map unit is on slopes of 15 to 25 percent.

Map Units WxB and WzB - These map units are composed primarily of Woodbridge soils. Woodbridge soils are very deep and moderately well drained. Typically they have fine sandy loam textures throughout their depth. Woodbridge soils have a hardpan layer with its upper surface between the depths of 18 to 30 inches. The hardpan has slow permeability and results in a perched water table during the winter and spring months.

The Woodbridge soils are poorly suited for septic system leach fields because of their slow permeability and perched water table.

The WxB map unit is on 3 to 8 percent slopes. The WzB map unit is on 3 to 15 percent slopes. In addition, the WzB unit has 5 to 35 percent of its surface covered with stones and boulders.

Map Unit UD - This map unit is composed primarily of soils that have been disturbed. Much of this area has been filled. These soils are highly variable. Their characteristics depend on the kinds of soil materials that were used here. Their erodibility characteristics and suitability for septic tank absorption fields can only be addressed on a very site specific basis.

Map Unit Rn - This map unit is composed principally of Leicester soils. These soils are very deep and poorly drained. Typically they have fine sandy loam and gravelly fine sandy loam textures to a depth of 60 inches or more.

Leicester soils are moderately erodible. They are poorly suited for septic tank absorption fields because of their high water tables.

Spot Symbols - There are two kinds of spot symbols used on the map. The spot symbols show small areas where the soils are significantly different than what surrounds them.

The wet spot symbol (Y) identifies areas where the soils are poorly or very poorly drained. The rock outcrop symbol (V) identifies areas where bedrock is exposed at the soil surface.

EROSION SUSCEPTIBILITY

The soil erodibility factor or K value was determined for each soil. The K value is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K value classes range from 0.02 to 0.64. Within the Mamanasco Lake watershed, K values for the soil surface layers range from 0.20 to 0.37. These values indicate a low to moderate erosion susceptibility.

LAKE SEDIMENTS

Some of the sediments in the southeast part of the Lake were sampled to determine their particle size distribution. These samples were taken between the property belonging to Charles Sass and a small rocky island about 100 feet off shore.

These samples revealed a lake bottom surface layer 12 to greater than 18 inches thick of highly decomposed organic material. The organic matter had some fine inorganic sediments mixed in with it. There is a stream which enters Mamanasco Lake from Turtle Pond. A sample was taken about 40 feet off shore from where the stream enters the lake. Most of the sediments here were coarse sand. It is likely that the source of this material was road sand spread on the streets within the watershed during the winter months.

D. LAKE FEATURES

1. Major Lake Characteristics

Surface area - 95 acres
*Mean depth - 6.9 feet
*Maximum depth - 10 feet
*Volume - 28.6 million cubic feet
*Retention time - 219 days
Lake bottom characteristics - muck, sand, ledge
Water clarity - 6 feet, midsummer
Bathymetry - see Figure 4

2. General Water Quality Conditions - Lake Mamanasco is classified as a late mesotrophic lake based on a cooperative DEP/CT Agricultural Experiment Station water quality monitoring study conducted in the spring and summer of 1979. A DEP model based on physical characteristics (watershed area, lake surface area, and mean depth) indicates that the Lake has a natural tendency to exhibit late mesotrophic to early eutrophic conditions. Nutrient levels, transparency, and chlorophyll (algae) levels are characteristic of late mesotrophic conditions. The Lake does not stratify thermally in the summer, and the entire water column exhibits high oxygen levels. Dense growths of aquatic macrophyte plants occupy most of the pond bottom, with white water lilly, naiad, and pond weed (Potamogeton sp) reported as dominant species. Dense growths of filamentous algae cover areas of the bottom not inhabited by macrophytes. The aquatic macrophyte condition is not a recent occurrence. The 1959 Fishery Survey reported "This impoundment is almost completely choked with submerged vegetation". The macrophyte condition is aggravated by the development of numerous shoals along the shoreline caused by siltation and sedimentation from nonpoint sources in the Lake watershed.

3. General Environmental Health of Mamanasco - Lake Mamanasco is classified as Class A water by Connecticut's Water Quality Standards. As Class A water, the Lake is suitable for bathing and other recreation purposes, has excellent aesthetic value, and provides excellent fish and wildlife habitat. The quality of Mamanasco is affected by shallow water depths and dense beds of aquatic plants, consequences of eutrophication which are both natural and man induced. Controllable man made causes of eutrophication at Mamanasco include nutrient enrichment from residential land (septic systems, fertilizers) and sedimentation from road sand and construction related erosion.

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*Based on measurements reported in 1959 Fishery Survey

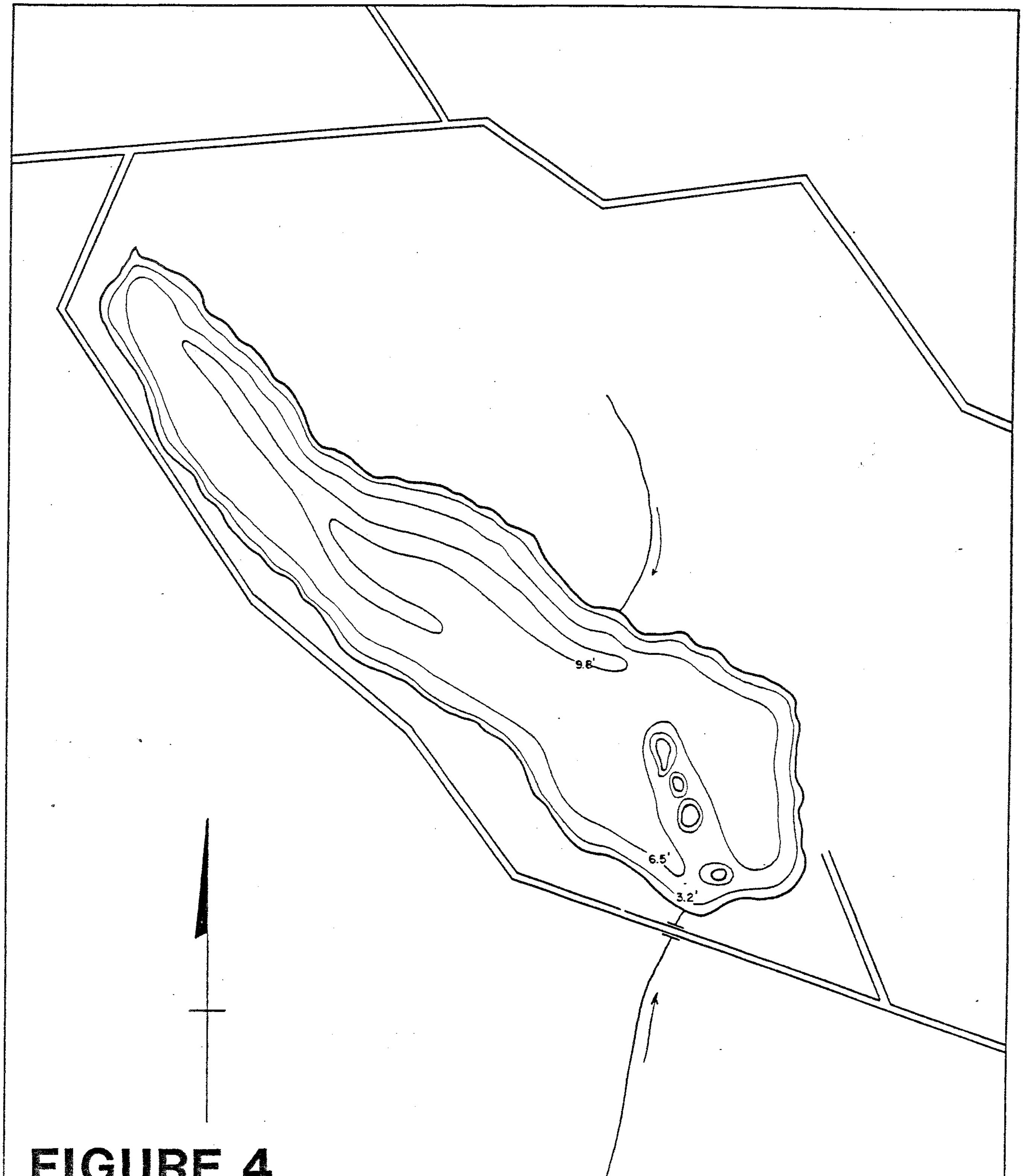

FIGURE 4
BATHYMETRIC MAP

Reproduced from "Chemical and Physical Properties of Connecticut Lakes" by C.R. Frink and W.A. Norvell, The Connecticut Agricultural Experiment Station, New Haven, Bulletin 817, April 1984

E. FISHERIES

Historically, Lake Mamanasco has been stocked at one time or another with lake trout, salmon, chain pickerel, white perch, largemouth bass, bullhead, yellow perch and calico bass. A 1959 survey of the lakes and ponds of Connecticut found Mamanasco to be inhabited by largemouth bass (abundant and above average growth), chain pickerel (scarce but exhibiting good growth), yellow perch (abundant with average growth), calico bass (scarce), pumkinseed sunfish (abundant and rapid growth), bullhead (common) and golden shiners (abundant). In the same survey, comments were made stating that submerged vegetation was excessive and it would be desirable from a fisheries standpoint to reduce the weed cover by 50%. A subsequent fishery survey conducted in September of 1970 revealed Mamanasco to be inhabited by a large population of bluegill sunfish (not found in the lake in 1959). The bluegills grew well and appeared to have taken over part of the niche previously occupied by pumkinseed sunfish (these fish were no longer abundant in the Lake). Other changes in the fish population occurring between 1959 and 1970 were that yellow perch had become scarce and chain pickerel could no longer be found in the lake, while large golden shiners were very abundant. Reports made by anglers to the Western District of the D.E.P. during 1984 indicate that bass fishing in the Lake is presently quite good. Overall, it appears that Lake Mamanasco has an excellent forage base and so long as weed growth is controlled, the growth rates of largemouth bass should be above average.

Weed growth becomes detrimental to the fisheries of a lake at a density where efficient predation by bass and pickerel on forage species is inhibited. When this density is reached overcrowded and stunted populations of sunfish, bullheads and perch (where present), and depressed growth rates in bass often result. Additionally, large numbers of stunted sunfish tend to prey heavily on bass eggs and fry, drastically reducing spawning success and the subsequent recruitment of bass into the fishery. A population made up of a few old bass, unable to produce a large successful spawn and insufficient in number to support truely good fishing, often results. Moderate weed growth however, should be considered beneficial in that it provides escape cover for all fish species, and spawning habitat for pickerel, largemouth bass and yellow perch. Recent research has shown that the total biomass of largemouth bass, and the numbers of legal sized bass, increase with corresponding increases in the amount of macrophyte cover until vegetation exceeds 20% of the entire Lake surface. Once weed cover exceeds 20% of the total Lake acreage, decreases in the capture rate of prey are likely to lead to prey overabundance and to a decrease in bass biomass.

A second means by which weed growth may become detrimental to the fisheries of a lake or pond is via the inducement of "winterkill" in bodies of water having marginal depth.

Winterkill occurs when light penetration into the water is reduced under the cover of ice and snow. This results in conditions where life supporting oxygen is being removed from the water by bacterial decay of abundant plant matter, while it is not being added by photosynthesis. A fish kill results when oxygen concentrations drop to critical levels. A bass fishery can be severely impacted by winterkill as the larger fish present are particularly sensitive to low oxygen concentrations.

In the opinion of the team's fishery biologist, the objective of the aquatic weed management program in Lake Mamanasco should not be to eliminate macrophyte growth entirely, but rather to contain the vegetation at a level which is both acceptable to area residents and capable of optimizing the fishery value of the Lake. A level of 20% weed cover is preferable from a fisheries standpoint. It is also recommended that the vegetation be divided up rather than confined to one dense area. Doing this will provide a "patchy" environment and thus increase the amount of "edge" habitat. This will most likely increase the number of bass the pond is capable of supporting and will allow anglers access to some of the best bass cover.

IV. Selected Lake Management Considerations

A. EROSION

Erosion and siltation has been identified as a major problem with regard to the environmental health of Mamanasco Lake.* Eroded soils which are transported directly or via streams into Mamanasco Lake contribute to the physical "filling in" of the Lake and can also accelerate lake eutrophication by enriching the water with nutrients. This nutrient loading of the Lake can accelerate the nuisance growth of aquatic weeds and algae. The ERT was requested to identify the major sources of erosion in the watershed and discuss specific alternatives for correction.

There are no significant point sources of sediment within the watershed. The watershed is primarily wooded with the soil surface protected by a deep leaf layer.

There are four principal non-point sediment sources contributing to the Lake. The greatest volume of sediment is generated by the road system. This source alone constitutes three of the four major non-point sediment sources: paved roads and driveways, gravel and earth driveways and road shoulders.

Road sand is the single greatest source of sediment; driveways rank third. The second greatest source is earthen road shoulders (curbs). Runoff concentrates along the edge of the pavement, and as the velocity increases on sloping

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*HVCEO, "Management Study for Ridgefields's Mamanasco Lake", Bulletin No. 15, September 1981.

sections, the shoulders are eroded. In some instances, gullies have formed along the pavement edge.

The fourth non-point source includes stream beds and banks. Increased runoff in general, but manipulation and diversion of stream channels specifically, has stressed the stability of the stream system. Stone and log obstructions within the stream channels have helped to curb velocity and thus preserve the stream beds and banks from all but peak flows. The streams are basically self cleansing, there is little in-stream storage of sediment. There are no significant areas of stream bank erosion, but there are a number of sites that are abraded during peak runoff periods.

With the exception of Turtle Pond and a few wetlands that cause the settling of sediment, runoff flows express from its source to the Lake. The limited storm drainage system consists of catch basins and cross culverts that only facilitate the process.

There are three locations within the watershed where sediment basins should be considered for construction: 1) the wetland at the intersection of Blue Ridge Road and Caudatowa Drive, 2) on the down stream side of Old Sib Road at the outlet of Turtle Pond, and 3) in the wetland bordering the easterly side of the state access area. These basins would provide a body of water into which heavy sediment would precipitate. Technical assistance in the design and construction of sediment basins is avilable from the USDA Soil Conservation Service office in Bethel (743-5453).

In addition to these basins, additional structures, probably silt curtains, would be needed along the westerly shoreline at each stream and culvert discharge. The existing accumulations of sediment would first have to be removed in order to strategically place the silt curtains.

A final but very important step would be to create deep sumps at the inlets of all cross culverts under Mamanasco Road.

Annual inspection and maintenance of all of these structures would be essential. Strict enforcement of wetland regulations as they pertain to stream diversion, and of erosion and sediment control regulations at new construction sites will circumvent new problems.

In conclusion, sediment generation within the lake watershed is entirely from non-point sources. A thick accumulation of leaves has created a protective and absorbent blanket over undeveloped areas. Road sand and eroding road shoulders contribute significant quantities of sediment to the streams and the storm sewer system which, in turn, transport it directly into the lake.

The creation of sediment basins at available locations in combination with less sophisticated sediment traps along the shoreline of the Lake will substantially reduce the sediment load entering the Lake.

B. SEPTIC SYSTEMS

Comments regarding the suitability of soils for on site disposal in the Lake Mamanasco area must follow on a gereral discussion of the mapped soil information juxtaposed with the available land areas. The majority of the land areas in this drainage basin are categorized by the Cooperative Soil Survey as having severe limitations for on site sewage disposal. This phrase is often interpreted as meaning that on site sewage disposal is well nigh impossible. This is not the intent of this classification. The true meaning of this phrase is that great care in the engineering and installation of spetic systems is required for these systems to work. For careful design and installation to become the rule two critical elements must be in place. The first of these is a high quality, adequately staffed local health department, well versed in the engineering principals of subsurface sewage disposal. The second is that sufficient land area must be available to allow the utilization of good engineering practice. With regard to the first requirement Ridgefield is singularly fortunate. The town has, for the past decade been served by two of the most competent and knowledgeable chief sanitarians in the state in the opinion of the ERT's sanitary engineer. Both of these individuals and their staffs have far more than a knowledge of code requirements - they have understood the current engineering methodologies for evaluating a system's workability and impact. In addition the Ridgefield Health Department has been willing to undertake the required permitting and enforcement action needed to protect both the public health and the environment. This is most important since the best of natural resources will be fouled if human administration is faulty.

The second critical issue, available land area, follows a clear demarcation between the acceptable and the inadequate. The immediate Lake area has 60 plus dwellings placed on land areas as small as .09 acres (3920 ft^2) with typical lots running roughly .25 acres (10900 ft^2). This area also includes a considerable number of vacant lots in the same size range. The balance of the watershed area features development ranging from 1 to 2 acres. The areas immediately around the Lake have properties that are too small to allow good engineering practice to provide septic systems that will overcome the limitations present, minimizing the public health and environmental problems. The balance of the area has lot sizes and soil conditions which allow a good engineer and sanitarian to overcome limitations, and eliminate environmental and health problems with septic systems.

The reasoning behind this conclusion demands considerable explanation. Historically public health codes were based on empirical studies of what seemed to make a septic system work. Work was de facto considered to mean that sewage was not on the surface of the ground, and that some travel through soil

These are either life-style modification forms of waste abatement or the transport of sewage for off-site treatment. There is, at present no availability of state or federal funding for the study of potential problems in this area and/or of study of alternative methods of correction. This unfortunate fact is mitigated by the limited extent of the study area and the limited options available. Since this Lake is both a public and private resource it is strongly suggested that the Lake Mamanasco Improvement Fund, Inc. and the town of Ridgefield explore the costs and financing of an engineering study to consider the options and costs associated with providing alternate measures of sewage disposal in the immediate lakeside area. Given the general lack of success in alternative on-site methodologies it is further recommended that emphasis be placed on a limited, innovative technology, collection system discharging to a small scale land treatment system. In considering such a system great care should be taken to minimize any additional development pressure from unbuilt lots. Such additional development could contribute additional nutrient loads even if sewage is removed from the watershed. Control over additional development can probably be achieved by a combination of design features and institutional controls.

C. IN-LAKE MANAGEMENT

The Lake Association recognizes the need to improve conditions in Mamanasco by managing nuisance aquatic plant growths and removing accumulated sediment deposits. In this regard, the Environmental Review Team was requested to comment on the feasibility of harvesting, dredging, and water level control.

The Lake Association presently manages aquatic plants by mechanical harvesting. It is reported that this program has successfully improved conditions in the Lake and that the program is generally supported by the Lake community. This is not surprising since similar experiences have been reported by several lake associations in Connecticut in recent years.

Commercial weed harvesters, such as the one purchased by the Lake Improvement Association, have many advantages over the use of chemical herbicides to control nuisance vegetation. Among these are that: 1) chemicals foreign to the ecosystem are not being introduced to the water, 2) the harvester allows greater control over where and when the weeds are to be removed, and 3) the removal of harvested plant material prevents the quick release of nutrients into the water as dead plant matter decays (and thus prevents the often associated increase in phosphorus levels and phytoplankton productivity). With this method of control, harvested plant material should be transported far enough from the pond so as to prevent the re-entry of nutrient rich leechate (as the Lake Improvement Association is aware). Still, it is possible that a problem could develop which may require the use of chemical herbicides to alleviate. In a lake or pond ecosystem macrophytes act as buffers of exogenous nutrients and may thus repress phytoplankton productivity by limiting nutrient availability. If the biomass of plants and the corresponding foliar uptake of nutrients is reduced, runoff will proceed to enrich the water column. Phytoplankton may increase due to the greater availability of limiting nutrients. Algae blooms and turbidity may then serve to reduce both the fishing quality and aesthetic value of the pond, particularly if blue-green blooms occur. The use of copper sulfate is most often recommended for the control of algae in lakes and ponds not containing trout. The D.E.P. has available a publication entitled "Control of Water Weeds and Algae" which provides information on the chemicals which may be used in the control of different types of nuisance vegetation, instructions for determining the proper dosage, and the procedures to follow in applying for a permit.

Another alternative to harvesting is early winter drawdown. This technique involves dropping the water level to expose plant beds to subfreezing air temperatures. Since plants occupy most of the Lake bottom at Mamanasco, the Lake would need to be drained completely to successfully control growth throughout the Lake. The resultant adverse effects on fish and aquatic life would be unacceptable in the opinion of the ERT's lake ecologist. Complete water level drawdown is therefore not considered a feasible alternative to harvesting. The Lake Association is advised to continue their mechanical harvesting program.

Dredging sediment deposits would improve conditions in Mamanasco by reducing aquatic plant habitat and by reopening shallow areas to boating. Hydraulic dredging and dry excavation are two methods which are used to remove lake sediments. Hydraulic dredging employs a floating cutterhead dredge which pumps a sediment/water slurry to earthern wall basins on shore for separation of sediment and water by physical settling and chemical floculation. Dry excavation involves lowering the lake water level and removing dewatered sediments with conventional earth moving equipment. Dry excavation is relatively simple and inexpensive compared to hydraulic dredging and therefore is the method of choice when feasible.

The feasibility of excavation depends on the occurrence of a firm, stable material underlying the sediments. The surficial geological deposits underlying soils in the Mamanasco watershed consist of shallow-to-bedrock glacial till. This substrate should support bulldozers, frontend loaders, and other earth moving vehicles. Peat and muck deposits which exceed several feet in thickness can present difficulties, but these probably do not occur at Mamanasco.

The feasibility of excavation also depends on the ability to lower the Lake water level to dewater sediment deposits. Lake Mamanasco is a natural waterbody but the water level has been artificially raised by an earth and stone dam. The dam is not equipped with a drawdown appurtenance. Drawdown could be accomplished either by temporarily breaching the dam or by siphoning. Temporary breaching would involve removing the spillway area to allow the Lake to return to its natural level. However, this may not drop the Lake level low enough to dewater the sediments which are to be removed. It appears that the water level at Mamanasco should be drawn down six to seven feet to enable excavation.* Breaching may not be able to lower the Lake to this extent. Siphoning would involve installation of a pipe from the Lake across the dam to the outlet stream. Preliminary calculations show that the water level could be dropped 7 feet in approximately 6 weeks using 250 feet of 8" diameter pipe and a hydrostatic head of 20 feet (see Table 2). This would provide a flow of approximately 2.5 mgd. Normal runoff from the watershed would be able to refill the Lake during the period January 15 to April 15, according to the calculations presented in Table 3.

The Lake Association is advised to pursue a sediment removal program of drawdown and excavation. Ideally the project should be scheduled to be completed with one drawdown to minimize the disruption of recreation. A suggested schedule would be to draw the Lake down in late summer, to excavate the sediments during the fall and early winter, and to refill the Lake during the late winter and early spring. The following items need to be addressed in a detailed feasibility study:

1) Identification of areas to be excavated and depths of excavation, plus quantification of sediment volume to be removed.

2) Identification of soft sediment deposits exceeding several feet which may be difficult to excavate.

3) Design of siphon including locations of inlet and discharge, pipe length, pipe diameter, pipe material, valves, and priming.

4) Hydrological evaluation of the receiving stream's capacity to accept the discharge without flooding or bank erosion.**

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*This recommendation assumes a mean depth of 7 feet in the Lake as reported in the 1959 Fisheries Survey. A drawdown of 7 feet would remove approximately ½ the volume of the Lake.

**It should be noted that this becomes of significant concern as the wetland area downstream of Mamanasco Lake reportedly is inhabited by rare or endangered species of both flora and fauna. Flooding and erosion in this area will be important to control to avoid negatively impacting these species. For additional information on this matter, the biologists at DEP's Natural Diversity Data Base should be contacted at 566-3540.

TABLE 2.

Installation of a temporary siphon across the spillway could be accomplished by installing a pipe from the Lake, across the dam and to the outlet stream. Preliminary calculations indicate that drawdown could be accomplished in about 6 weeks based on the following:

lake mean depth = 7 feet
lake volume = 28.6×10^6 ft^3
pipe invert (lake drawdown) = 7 foot depth
outflow volume = $\frac{1}{2} \times 28.6 \times 10^6$ ft^3 100 million gallons
pipe length = 250'
pipe diameter = 8"
mean hydrostatic head = 20'
friction factors = .04
inflow to lake = 0
where $20' = f \times \frac{l}{d} \times \frac{V^2}{2g}$

$$20' = .04 \frac{250}{.66} \times \frac{½}{2g} \qquad V = 9 \text{ ft/sec}$$

Q (flow in pipe) $= AV = \pi (1/3)^2 (9)$
= 3cfs = 2.5 mgd

100/2.5 = 40 days = time required to drawdown lake volume to ½ its present volume

mean inflow $= 47 \times 10^6 \text{ ft}^3/\text{yr} \times \frac{2 \text{ mos}}{12 \text{ mos}}$
$= 8 \times 10^6 \text{ ft}^3 =$ 5.2 million gallons

$\frac{5.2}{2.5}$ = 2 days = additional time required to drain inflow during drawdown period

∴ 42 days required for drawdown

Using this method, the water level could be drawn down any desired depth using appropriate head, pipe diameter and pipe length.
drawn off earlier.

TABLE 3. Lake recharge following late summer drawdown

1. total lake volume = 28,553,580 ft^3

2. volume to be drawn off = approximately ½ the total - 0.5 x 28,553,580.= 14,277,679. ft^3

3. Monthly runoff - Upper Houstonic River Basin

MONTH	PERCENT	
October	4	
November	7.3	
December	8.8	
January	10.0	1/2 January
February	8.7	
March	16.5	TOTAL PERCENT = 38.6
April	16.8	
May	10.6	1/2 April
June	6.7	
July	3.8	
August	3.5	
September	3.5	

4. mean annual streamflow = 1.8 cfs/mi^2

watershed area = 0.84 mi^2

$1.8\ cfs/mi^2 \times 0.84\ mi^2 = 1.5\ cfs$

on a yearly basis for W.A:

$$\frac{1.5\ cfs}{sec} \times \frac{60\ sec}{min} \times \frac{60\ min}{hr} \times \frac{24\ hr}{day} \times \frac{365\ days}{yr} =$$

47,304,000 ft^3/yr

.386 x 47,304,000. = 18,290,565. ft^3 = inflow anticipated from January 15 - April 15. This would satisfactorily replace the 14,277,679 ft^3

5) Consideration of fisheries impact - A drawdown of 7 feet would likely result in a fish kill with the larger game fish being most susceptible. It should be noted, however, that the fish population would likely recover within 5 years should a drawdown of this magnitude occur. The fisheries impact of the drawdown may therefore be viewed as short-term. Should a smaller scale drawdown occur, the impact would be less significant. A drawdown of 3-4 feet would likely not result in a significant winter kill effect, in the opinion of the ERT's fishery biologist.

6) Hydrological evaluation of wells near the Lake to determine if yields will be adversely affected by drawdown.

7) Identification of final disposal site(s) for excavated sediments.

8) Development of final cost estimates and implementation schedules. (A DEP excavation project of Gorton Pond in East Lyme is realizing a cost of approximately $5.00 per cubic yard, exclusive of drawdown costs. Disposal costs are relatively low due to the suitability of sediments as fill material).

In conclusion, weed harvesting plus a well planned drawdown and excavation project appear to be the best "in-lake" management alternatives for controlling the weed growth at Mamanasco Lake. It should be noted, however, that some new methods of in-lake weed control are being developed. These methods focus on light-control and include:

1) "Aquascreening" - vinyl coated fiberglass mesh placed on pond bottom can be effective in compressing weeds and blocking sunlight. Thus existing weeds are killed and potential weeds inhibited from growing. The screen was most effective against Eurasian watermilfoil (biomass reduction of 75%) when used in shallow Union Bay, Washington. This can be a very expensive method for a pond of any size; for more information, see article by Perkins, Boston & Curren, "The Use of Fiberglass Screens for Control of Eurasian Watermilfoil", in the Journal of Aquatic Plant Management, Vol. 18: 13-19, 1980; and brochure from Menardi-Southern Corp., Box 240, Augusta, Georgia, 30903.

2) "Black plastic" with perforations to allow gases to escape is another, less expensive, product used to control weed growth. This can be weighted down to keep it on the pond bottom.

3)"Dartek" is a black nylon film which has negative buoyancy, making it easier to keep on the bottom. This material absorbs water, making it more flexible for contouring to a lake bottom. For more information, contact DuPond Canada, Inc., Box 2200, Streetsville, Mississauga, Ontario L5M 2H3, telephone 416-821-5276.

4) "Aquashade" is an inert blue liquid dye, registered by EPA as a "general use" pesticide for small natural or man made ponds. This substance is not a poison and has no direct chemical action on plants or animals, but controls aquatic plant growth by absorbing the sunlight which would otherwise

get to the plant tissue and stimulate growth. It lasts from six to ten weeks in a pond and is slowly broken down into carbon dioxide and water. Of course, its effectiveness would be diminished in proportion to the flow through rate in the pond. Approximately 75% reduction of Nymphoides (waterlily-like plants) was accomplished using "Aquashade" in one pond in southeastern New York. For more information, see "Summary of Aquashade Trials in Myriophyllum spicatum (milfoil)" by Dr. John Peverly of the Dept. of Agronomy, Cornell University, Ithaca, New York, 14853; or contact Brad Robinson, Senior Analyst, Pesticide Compliance Section, DEP, 122 Washington St., Hartford, CT., 06106.

The Mamanasco Lake Improvement Fund, Inc. may wish to consider adding one or more of these "light control" technologies to their future management plans for Mamanasco Lake.

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ABOUT THE TEAM

The King's Mark Environmental Review Team (ERT) is a group of environmental professionals drawn together from a variety of federal, state, and regional agencies. Specialists on the team include geologists, biologists, foresters, climatologists, soil scientists, landscape architects, recreation specialists, engineers, and planners. The ERT operates with state funding under the aegis of the King's Mark Resource Conservation and Development (RC&D) Area - a 47 town area in western Connecticut.

As a public service activity, the team is available to serve towns and developers within the King's Mark Area --- free of charge.

PURPOSE OF THE TEAM

The Environmental Review Team is available to help towns and developers in the review of sites proposed for major land use activities. To date, the ERT has been involved in the review of a wide range of significant activities including subdivisions, sanitary landfills, commercial and industrical developments, and recreation/open space projects.

Reviews are conducted in the interest of providing information and analysis that will assist towns and developers in environmentally sound decision-making. This is done through identifying the natural resource base of the project site and highlighting opportunities and limitations for the proposed land use.

REQUESTING A REVIEW

Environmental Reviews may be requested by the chief elected official of a municipality or the chairman of an administration agency such as planning and zoning, conservation, or inland wetlands. Requests for reviews should be directed to the Chairman of your local Soil and Water Conservation District. This request letter must include a summary of the proposed project, a location map of the project site, written permission from the landowner/developer allowing the team to enter the property for purposes of review, and a statement identifying the specific areas of concern the team should address. When this request is approved by the local Soil and Water Conservation District and the King's Mark RC&D Executive Committee, the team will undertake the review. At present, the ERT can undertake two reviews per month.

For additional information regarding the Environmental Review Team, please contact your local Soil Conservation District Office or Richard Lynn (868-7342), Environmental Review Team Coordinator, King's Mark RC&D Area, P.O. Box 30, Warren, Connecticut 06754.