PLANNING FOR QUALITY IN A RECREATIONAL WATERSHED -- CHAUTAUQUA LAKE, NEW YORK

Thesis for the Degree of M. S.
MICHIGAN STATE UNIVERSITY
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1967

ABSTRACT

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by Leslie G. Monostory

The surface and ground water resources within the Chautauqua Lake Watershed have thus far been utilized independently by the various agricultural, municipal, industrial, and recreational interests, without serious consideration for each other's needs and requirements. No single agency has attempted to coordinate the use of water for all the different user groups, primarily because until recently the supply of water appeared to be more than adequate for everyone. Although the watershed has had problems with spring floods and low summer water levels for some time, these did not attract too much attention until the late 1940's when the rate of waterfront home construction increased rapidly around the shores of Chautauqua Lake. Since the 1950's, a series of unusually dry years combined with increased per capita use of water have led to domestic and industrial water supply problems for the City of Jamestown, the Village of Lakewood, and other communities. Low summer

water levels have also adversely affected the recreational utilization of Chautauqua Lake.

The objective of this thesis is to identify and evaluate water resource management problems within the Chautauqua Lake Watershed. Based to a considerable extent on personal interviews with local watershed authorities in the fields of planning, recreation, public utilities, and public health, the author made a rather broad investigation of the following issues: (1) the pattern of seasonal and permanent waterfront home construction; (2) the major needs and interests of the various water-user groups within the watershed; (3) biological factors which affect the recreational utilization of Chautauqua Lake; (4) the present system of lake regulation and management; and (5) watershed management proposals by local, state, and federal governmental agencies.

Water should be used for the maximum private and public benefit, and in this report it is assumed that a broad watershed or regional approach is the best procedure for handling the problems of water resource use. Independent, uncoordinated development of water resources will eventually lead to overuse, competition and conflict of interest. It is suggested that a watershed planning and administrative agency become established before long, in order to provide purpose and direction for the future utilization of water resources in the Chautauqua Lake Watershed.

PLANNING FOR QUALITY IN A RECREATIONAL WATERSHED-- CHAUTAUQUA LAKE, NEW YORK

By

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Resource Development

March, 1967

ACKNOWLEDGMENTS

I wish to thank Dr. C. R. Humphrys for the permission to work in New York State with a lake which was familiar to me, and for his counseling which guided the direction and scope of my study.

I wish to thank Dr. Milton H. Steinmueller and Dr. Robert C. Ball of Michigan State University, and Dr. Harlan Brumsted and Dr. David J. Allee of Cornell University for all of their information and friendly encouragement.

I wish to extend my appreciation to Mr. John Luensman of the Chautauqua County Department of Planning, and Mr. Homer Stennett of the U.S. Soil Conservation Service in Jamestown, for allowing me the use of their offices during the course of my investigation last summer. I also wish to thank Dr. George Vareska for providing me with a temporary home at Chautauqua Lake.

Finally, I wish to thank the following persons whom I interviewed last summer for their time and the valuable information which they provided:

Mr. Homer Stennett, Work Unit Conservationist, U.S. Soil Conservation Service, Jamestown, New York.

Mr. John R. Luensman, Planning Director, Chautauqua County Department of Planning, Mayville, New York.

Mr. George Weaver, President, Chautauqua Lake Association, Inc., Jamestown, New York.

Mr. Leonard J. Facciani, Director, Environmental Health Services, Chautauqua County Department of Health, Mayville, New York.

Mr. Curtis Bauer, Consulting Forester, and Chairman, Chautauqua Lake-Chadakoin River Watershed Committee, Jamestown, New York.

Mr. Walter C. Shaw, Jr., Chairman, Board of Trustees of the Chautauqua Institution, Chautauqua, New York.

Dr. A. R. Eschner, Associate Professor of Forest Influences, and Professor Henry Williams, Department of Landscape Architecture, of the State University College of Forestry at Syracuse University, Syracuse, New York.

Mr. Merle Smedberg, Superintendent of Utilities, Jamestown, New York; and Mr. Wayne Tyler, Public Works Superintendent, Lakewood, New York.

Mr. Donald White, Cooperative Extension Specialist, Farm and Home Center, Ellicottville, New York.

Mr. John McMann, Civil Engineer, Erie-Niagara Region of the State Water Resources Commission, West Seneca, New York.

Mr. Edward Cherry, Professor of Economics at the Jamestown Community College, and former chairman of the Chautauqua Lake-Chadakoin River Watershed Committee, Chautauqua, New York.

Mr. Raymond Norton, Supervisor, State Fish Hatchery at Prendergast Point, New York.

Mr. Melvin Swanson, Chairman, Chadakoin River Commission, Jamestown, New York.

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CHAPTER I

INTRODUCTION

The Chautauqua Lake Watershed is located in a rural-agricultural area of southwestern New York State, which is included in the northern fringe of the economically depressed Appalachia Region. Most of the land within the watershed and the surrounding Allegheny Plateau is fair to poor farmland situated on gently sloping or rolling topography. Throughout most of the Plateau, a shallow fragipan layer makes the strongly acid soils rather impermeable. In the late nineteenth century most of Chautauqua County surrounding Chautauqua Lake was cleared of timber for farming purposes, but subsequently many of these farms were abandoned due to rapid erosion of the exposed forest soil. Much of the abandoned farmland today is reverting to forest cover, especially those farms which were located on the steeper slopes and hillsides.

Located in the midst of this primarily rural area is Chautauqua Lake, a long, narrow body of water which extends northwest from the City of Jamestown to a point less than 10 miles from the southern shore of Lake Erie. The lake is about 16 miles long, with an average width of 1.3 miles, and it has a total surface area of 20.6 square miles.

Chautauqua Lake is the only large inland natural lake within a 100 mile radius of the City of Jamestown, and it is centrally located within 150 miles of the metropolitan areas of Buffalo, New York, Erie and Pittsburgh, Pennsylvania, and Cleveland, Ohio. The lake is isolated enough to escape the attention of "Sunday afternoon" visitors, but it is within convenient driving distance for weekend or seasonal vacationers.

To countless fishermen, Chautauqua Lake is the home of the king of American freshwater sport fish, the Chautauqua "Tiger" Muskellunge (Esox Masquinongy Ohiensis), or "Muskalonge" as it is spelled locally. A popular sportsmen's magazine recently called Chautauqua the "World's Greatest Musky Lake." Although the St. Lawrence River apparently contains the largest muskellunge, Chautauqua Lake annually produces more sheer numbers and poundage of muskellunge than any other lake in the United States and Canada -- or the world, for that matter, since muskellunge are native only to North America.

Chautauqua Lake is famous for yet another reason. Along the west shore of the lake is the Chautauqua Institution, an internationally known cultural and religious center which attracts about 19,000 - 20,000 visitors at the peak of its eight-week summer season. The Institution features a unique combination of educational and recreational programs.

The shoreline of Chautauqua Lake is heavily developed with seasonal and year-round residences, but these lie almost entirely in

a narrow strip either riparian to the shoreline, or along Highways 17 and 17J, which completely encircle the lake. A band of largely open or undeveloped land, averaging one-fourth mile in width, encircles most of the lake between the lakeshore residences and the two highways. Five villages (Mayville, Chautauqua, Bemus Point, Lakewood, and Celoron) and one city of 43,000 population (Jamestown) lie adjacent to the lake, along with numerous smaller communities. Although the City of Jamestown is situated completely below the south end of the lake along the Chadakoin River, the lakeshore Villages of Celoron and Lakewood are largely residential suburbs of the central city.

The watershed surrounding Chautauqua Lake is somewhat rectangular in shape, nearly paralleling the long axis of the lakeshores. The size of the watershed is small in comparison to the large capacity of the lake, with 1,500 acre feet of storage capacity for every square mile of drainage area. There are approximately 199.3 square miles in the watershed, but in this relatively small area there is a 480 foot variation from the lake level to the surrounding hilltops.[1] Precipitation in the spring of the year flows swiftly down the short streams into the lake, thus creating erosion and flood problems. During late summer, on the other hand, the lake level often drops very low.

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[1]U. S. Department of Agriculture, "Data on the Proposed Chautauqua Lake, Chadakoin River Watershed," (unpublished report by the Chautauqua County District of the U. S. Soil Conservation Service, Jamestown, New York, 1962), p. 1.

In biological or limnological terms, Chautauqua Lake is a shallow, eutrophic warm-water lake -- one of the most productive lakes in New York State. Part of this productivity is due to the large number of lakeshore homes and the thousands of pleasure craft cruising the lake, which discharge organic wastes and nutrients into the lake waters. In all too many cases, raw sewage is still piped directly into the lake or into feeder streams. The sewage outflow from most lakeshore homes receives the rather elementary septic tank treatment, a process which prevents solid effluents from entering the lake but does little or nothing to arrest the flow of liquid effluents. Leaching underground into the lake, these effluents constitute a possible health hazard and also stimulate algae and other aquatic plant growth. Although increased productivity may be desirable for fish production, it is not so desirable in terms of most other recreational and non-recreational water-use interests. Recreational interests are particularly affected by the unsightly scum, thick weed growth, and offensive odors caused by excessive plant and algal production.

The author's original intent in studying the Chautauqua Watershed was to determine the effects of intensive recreational development on water quality in Chautauqua Lake, but because a need existed for a broader analysis of the watershed situation, it was decided instead to conduct a general investigation of water problems. This report is based largely on personal interviews with local leaders

of watershed associations, public utilities directors, county planning and health directors, and representatives of various public and private water-interest groups. In presenting the results of these interviews, an attempt has been made to identify the major lake and watershed management problems from a single independent viewpoint encompassing all of the water-user interests.

The purposes in this study are fourfold:

1. To identify and define lake and watershed management problems in operational terms.
2. To investigate water quality conditions and their effects upon recreational and other uses.
3. To emphasize the need for comprehensive watershed planning, as well as for planning on an individual community basis.
4. To recommend alternate courses of action which may be employed by those public and private agencies which are concerned with the development of the Chautauqua Lake Watershed.

"The future belongs to those who plan for it!"

CHAPTER II

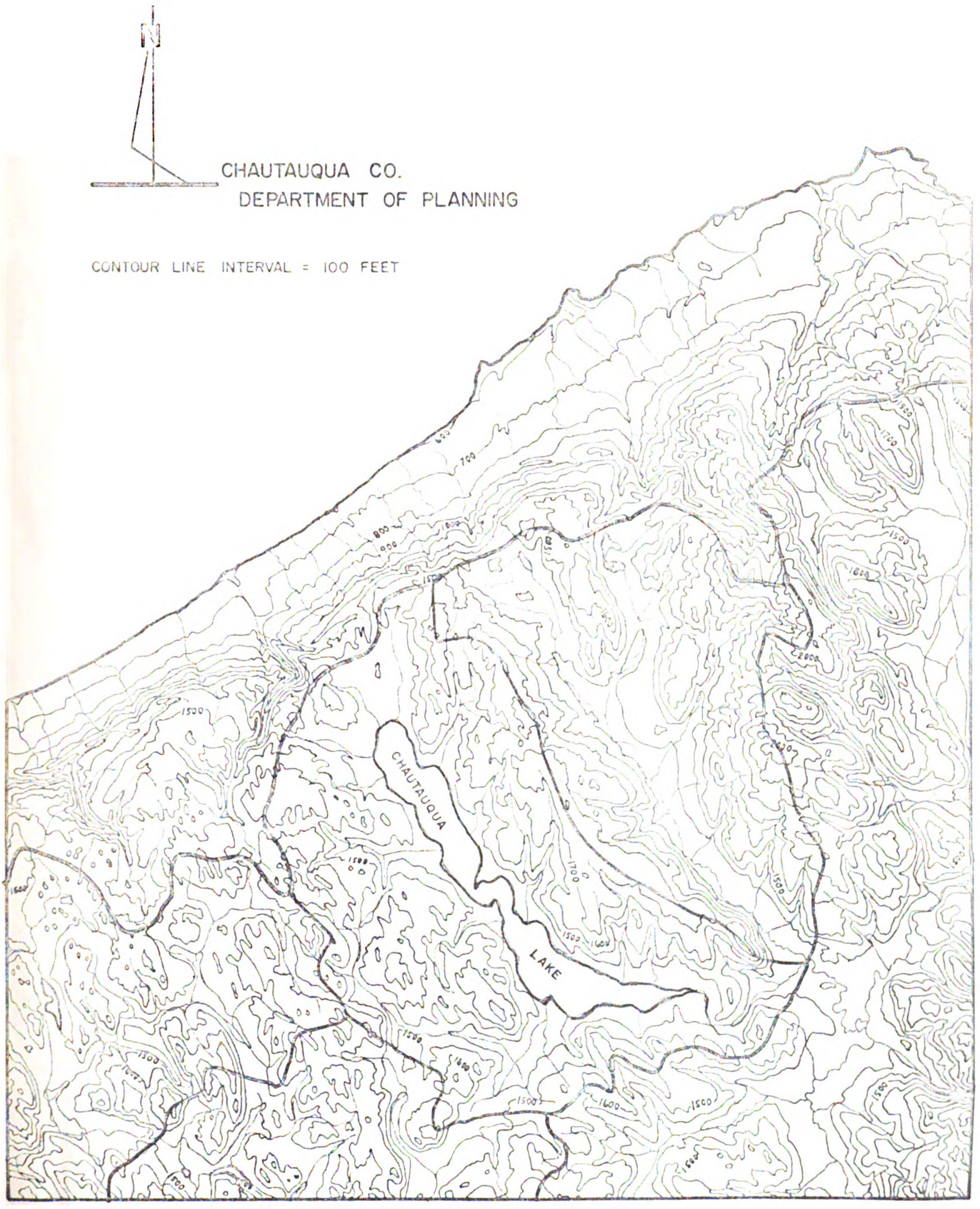
THE CHAUTAUQUA LAKE WATERSHED

Geography

The Chautauqua Lake Watershed lies entirely within Chautauqua County in the southwestern corner of New York State. The Lake itself lies atop the Allegheny Plateau near the western limit of the Plateau Region, at a mean elevation of 1,308 feet. Rolling hills surround the lake, rising another 498 feet to the highest point within the watershed in the Dutch Hollow Creek headwaters.

Chautauqua Lake and its outlet, the Chadakoin River, are tributary to the Allegheny River in the Ohio River Basin. The northern limit of the watershed marks the divide between the Great Lakes Drainage Basin to the north, and the Ohio River Basin which drains south. This northern divide is actually an escarpment approximately 700 feet high which constitutes the northern limit of the Allegheny Plateau. It distinctly divides Chautauqua County into a narrow Lake Plain adjacent to Lake Erie, with the Allegheny Plateau Region extending southward from the escarpment. Less than four miles separate the northern limit of the Chautauqua Lake Watershed from the Lake Erie Shoreline (see Figure 1).

FIGURE 1. -- Topography and Watersheds in Chautauqua County.



With respect to population, the Chautauqua Lake region is situated just east of midway between the Chicago and New York City Metropolitan areas. Within a five hundred mile radius of Chautauqua County lies one-half of the population of the nation.[1] The metropolitan areas of Buffalo and Rochester, New York; Pittsburgh and Erie, Pennsylvania; and Cleveland, Ohio; are all located within 150 miles of Chautauqua Lake. With few exceptions, there are good transportation communications between the Chautauqua Lake region and all of these metropolitan areas. (See Figure 6, page 44.)

Geology

The Allegheny Plateau region consists of nearly level-bedded layers of acid sandstone, siltstone, and coarse-textured shale of the Devonian Age. At least three periods of glaciation crossed this portion of the Allegheny Plateau, and most of the soils are glacial till several hundred feet or more above bedrock.

Throughout the Chautauqua Lake Basin, rounded hills rise at intervals from graded valley floors. The valley floors vary from several hundred feet in width on the smaller tributaries to several thousand or more feet in the lower reaches of the larger tributaries. The local

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[1] J. R. Luensman, Planning Background Report #2 -- Patterns of Use -- Chautauqua County, New York (Mayville, New York: Chautauqua County Planning Board and Department of Planning, 1962), p. 1.

relief varies generally from about 200 to 400 feet above the level of Chautauqua Lake.

Geologists have theorized that Chautauqua Lake is a pre-glacial valley which drained northerly and southerly from a point in the vicinity of Long Point and that morainic deposits closed both ends of the valley to create the lake.

Climate

The general climate of the Plateau Region is humid temperate, with moderate seasonal variation in temperature. There is a marked difference locally between the climate of the Erie Lake Plain and the Plateau. The Erie Lake Plain has a warmer climate and longer growing seasons because of its lower elevation and the moderating effect of Lake Erie. This area is famous as a part of the Chautauqua-Erie Grape Belt, where grapes and other fruits are the primary cash crops. The Plateau Region has a growing season averaging only 148 days, as opposed to 170 days on the Plain. This factor combined with acid, leached soils, makes the Plateau less suitable for fruit or even crop farming.

The mean annual precipitation at Jamestown over a 66-year period was 42.65 inches, and the mean annual snowfall was 96.5 inches. Lately there has been a series of dry years, however, which have caused ground water supply problems in the Jamestown area. During the period 1960-1965, the average annual rainfall in Jamestown was only 35.27 inches,

and the total deficiency over that 6-year period was minus 38.39 inches.

Chautauqua Lake is part of a winter snow belt, particularly along the northern boundary of the watershed near the escarpment. Moisture-laden air rises up this slope from Lake Erie, causing snowstorms of sudden and high intensity. Prevailing wind direction is from the northwest, with maximum short duration velocities of 90 miles per hour, and an average of about 10 miles per hour.[1]

The mean monthly temperature in Jamestown ranges from a maximum of 71.4°F. in July to a minimum of 27.0°F. in February, with an annual mean temperature of 49.9°F. July is usually the only consistently warm month, while periods of fairly cool weather occur in both June and August. Nights are generally cool compared to daytime temperatures, and humidity is usually low even throughout the summer.

Soils

Most of the soils in the Plateau portion of Chautauqua County have developed from glacial till, and are classified as Podsols and Brown Podzolic soils. Along the shorelines and tributary streams of Chautauqua Lake there are areas of "lakelaid" silts and very fine sands, alternating

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[1] U.S. Army Corps of Engineers, Lake Chautauqua and Chadakoin River, Jamestown, New York, General Design Memorandum, Appendix I -- Hydrology (Pittsburgh: U.S. Army Engineer District, 1964), p. 8.

PLATE I. --The rolling topography, and the acidic, impermeable soils of the Upland Plateau are not ideal for farming. This farmer has maintained his buildings in an exceptionally good condition.

PLATE II. -- Low summer stream flows lead to low water levels in Chautauqua Lake. The banks of this feeder stream have also been ransacked for gravel, which increases the amount of silt that is washed into the lake.

with gravelly loams and gravels along glacial beach-ridge deposits. These areas have been largely developed for lakeshore homesites.

The majority of the watershed has the Erie-Landford Soils, which are described as strongly acid silt loams with fragipans, dominantly poorly drained to moderately well-drained.[1] The clayey "fragipan" is 12 to 28 inches below the surface, and most farms have to be tiled for drainage adequate to produce crops.

Topography and elevation have a considerable bearing on the usefulness of the various soils. On steep slopes the topsoil is rapidly eroded away, and this land has little value other than for pasture or forestry. Most of the better cropland soils are located in the larger valleys, but even this advantage is limited because frost is a special hazard in the valleys.

In general, the farms within the Chautauqua Watershed are in marginal to poor economic classes. There is much idle land and many abandoned farms. In many cases the land is probably better suited to forests and to recreational uses than to agriculture.

Forest Cover

The original vegetation was a nearly unbroken expanse of mixed hardwoods interspersed with white pine.

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[1] R. Feuer, W. L. Garman, and M. G. Cline, Soil Association Leaflet 3 -- Chautauqua County Soils (N. Y. S. College of Agriculture at Cornell University, January, 1955), p. 5.

When the white man arrived in Chautauqua County, the white pine was selectively logged, but the hardwood forests were simply felled and burned to open the land for farming. Logs in those days were sawed into boards and floated down the Chadakoin and the Conewango to the Allegheny and Ohio Rivers, where they were sold to the larger communities such as Warren and Pittsburgh, Pennsylvania. Since hardwood logs would not float, they were worthless for lumber.

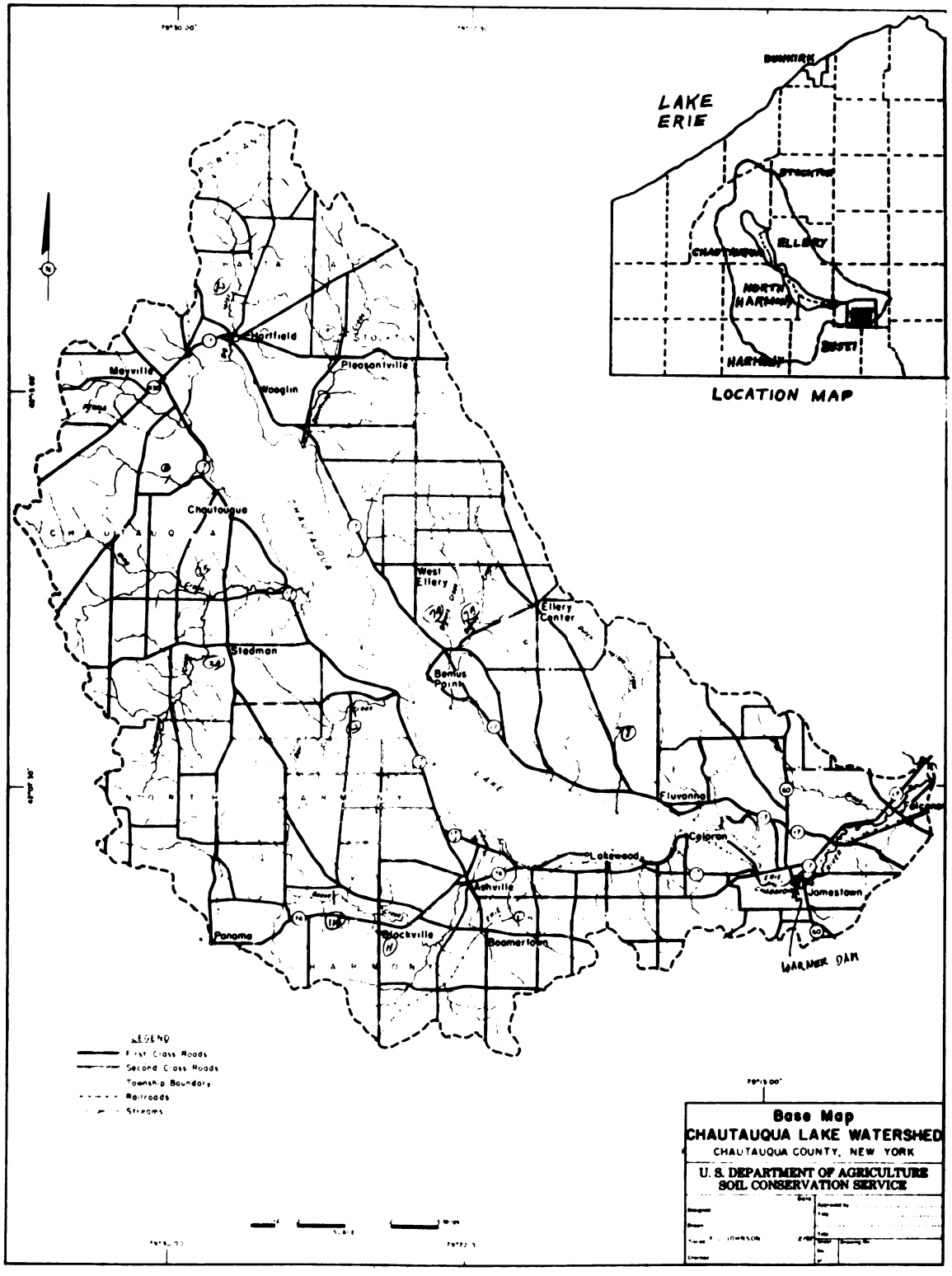
Sometime in the latter 1800's, select hardwood lumber gained value as the City of Jamestown became nationally known for its furniture and cabinet industries. At this time, most of the remaining stands of quality hardwoods within Chautauqua County were also logged off.

Most of the forest cover in the Plateau today consists of second growth mixed hardwoods, concentrated for the most part on the hillsides and hilltops. Since many of the farmlands are being neglected or abandoned, the countryside is being invaded by brush and young forest growth. In other areas, stands of conifers are being actively regenerated through county and state reforestation programs.

Drainage Basin and Hydrology

The Chautauqua Lake basin is rectangular in shape with a length of about 18 miles and an average width of about 11 miles (see Figure 2). The tributaries to Chautauqua Lake are all small streams

FIGURE 2. -- Base Map of Chautauqua Lake Watershed



from three to eight miles in length, entering the lake at about three or four mile intervals around the lake periphery. Because of the graded valley floors and the short length of the creeks, the rate of flood runoff following a rain is quite rapid. Rapid concentration of runoff is especially serious when heavy spring rains fall on frozen ground in the early spring.[1]

There are conflicting reports about whether Chautauqua Lake is spring fed or if its supply of water is obtained directly from watershed runoff. According to local theory the lake is spring fed, and a Soil Conservation Service report, in discussing low water problems, mentions that "the lake itself is constantly calling for water from underground springs."[2] The U.S. Army Corps of Engineers investigation on the hydrology of Lake Chautauqua and the Chadakoin River found a fairly close correlation between precipitation on the watershed and discharge through the Chadakoin River.[3] A 1937 limnological survey reports that "most of [the lake's] supply of water is obtained from runoff from the land. There is no evidence to support the local theory that it is spring fed."[4]

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[1]State University College of Forestry, The Resources of the Allegheny Plateau (Syracuse, New York, 1962), p. 66.

[2]U.S. Department of Agriculture, op. cit., p. 3.

[3]U.S. Army Corps of Engineers, op. cit., p. 27.

[4]E. Moore, et al., Biological Survey of the Allegheny and Chemung Watersheds (Supplement to the Twenty-seventh Annual Report of the New York State Conservation Department, 1937), p. 196.

Siltation is a serious problem around the mouths of the creeks emptying into Chautauqua Lake because in this short distance the sediment is carried rapidly out into the lake with little chance for deposition along the way. Gravel has also been dredged from many of the streams.

In recent years, low summer flows have attracted more attention than flood problems. Partly as a result of excessive spring runoffs, there is a problem of low summer flow in many streams which limits the supply of water during late summer for maintaining the lake' s water level. Low stream flow is often a sign of lowered water tables, which means that the ground water supply of the lake from underwater springs and seepage is also reduced.

One of the aims of the proposed PL-566 Watershed Program for Chautauqua Lake is to impound a portion of the heavy spring runoff, and then release this water later in the summer to augment the water level. The additional water would have value for domestic, industrial, and recreational purposes.

Chautauqua Lake Characteristics

Physical

The main body of Chautauqua Lake has an overall length of about 16 miles and an average width of about 1.3 miles. About mid-point in the lake, at Bemus Point, a constriction of approximately 1,000 feet in width occurs, but for the most part the lake is relatively uniform

in width. The name "Chautauqua" is said to have come from an Iroquois Indian word meaning "bag-tied-in-the-middle," which pretty accurately describes the lake's shape. With the lake at a normal elevation of 1,308 feet above m.s.l., the surface area is 20.6 square miles or about 13,200 acres, and the shoreline extends for some 42 miles. This surface area of 20.6 square miles is equivalent to 11.0% of the total lake basin drainage area.[1]

Bemus Point literally divides Chautauqua Lake into two nearly equal lake basins, the northern half of which is considerably deeper than the southern half. According to the 1937 Biological and Limnological Survey, the mean depth of the entire lake is 7.1 meters (23.5 feet). The mean depth of the upper portion is 9.1 meters (30 feet) and that of the lower portion only 4.7 meters (15.4 feet). In 1937 the lake had a volume of 14,472 million cubic feet at normal elevation (1,308 feet), with the upper half of the lake making up 68 percent of that volume.[2]

There seems to be a mystery connected with the maximum depth of the lake. According to a 1902 U. S. G. S. survey, the deepest point in the lake was about 90 feet, at a location about two miles north of Bemus Point near Prendergast and Long Points. The same survey shows depths as great as 50 feet continuing northward in the lake for another three miles before the bottom gradually rises. According to

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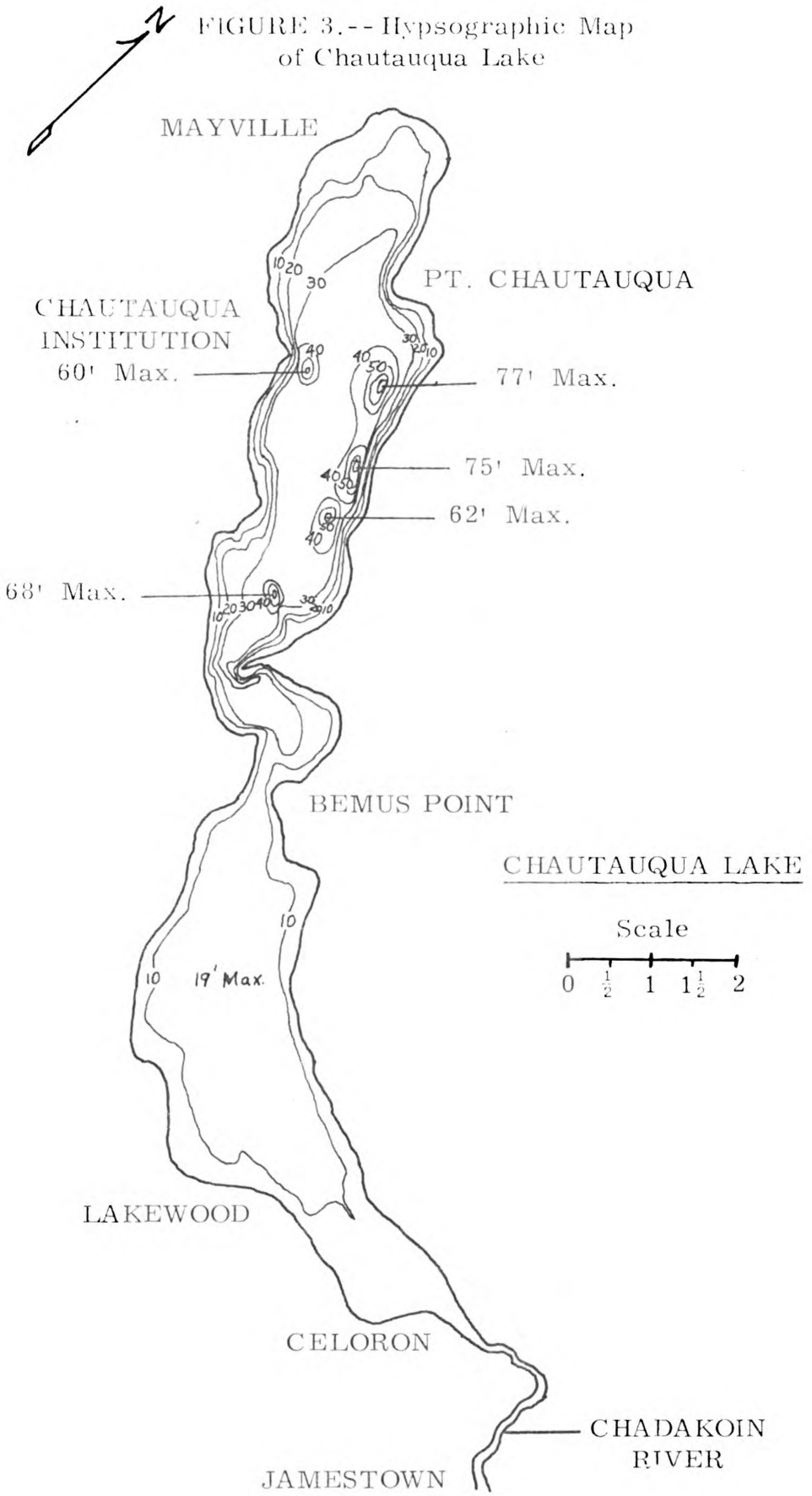
[1]U.S. Army Corps of Engineers, loc. cit., p. 6.

[2]Moore, et al., op. cit., p. 197.

PLATE III. -- Aerial photograph of Tom's Point and the west shore of the lower lake. The automobile ferry which crosses the lake at the Bemus Point-Stow constriction can be seen in the left center of the photograph. (Photo courtesy of the USDA-Soil Conservation Service, Jamestown.)

FIGURE 3.--Hypsographic Map of Chautauqua Lake



the 1937 Survey (see Figure 3), most of the lake above Long Point to a line drawn between Chautauqua and Point Chautauqua is from 36 to 39 feet deep, with the exception of several kettle holes of limited area reaching to a maximum depth of 77 feet. Above Chautauqua and Point Chautauqua, the lake gradually becomes shallower than 35 feet as one proceeds toward the head. Hundreds of soundings made in the upper lake failed to reveal any greater depths than 77 feet and depths of 90 feet shown on older charts of the lake remain unexplained.[1]

Outflow and storage in Chautauqua Lake is controlled by Warner Dam, located on the Chadakoin River about 3.3 miles downstream from the southern end of the lake. The primary function of Warner Dam is to regulate lake elevations and to control the rate of outflow. It is now operated by the City of Jamestown through the Chadakoin River Commission.

Biological

Chautauqua Lake is a warm, relatively shallow lake in contrast with the cold, deep Finger Lakes further east. Limnologists describe it as an eutrophic lake, and it is one of the most productive lakes in terms of fish production in New York State. The New York State Water Resources Commission in 1952 classed Chautauqua Lake as a Class A Lake, which means that with proper treatment it is usable

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[1] Ibid., p. 88.

as a source of domestic water supply. (Class A waters are considered to be suitable for drinking water, while Class B and below are unsuitable as a source of domestic water supply.)

The following information is summarized from "A Limnological Study of Chautauqua Lake," made by W. L. Tressler and Ruby Bere during the summer of 1937 as part of the Biological Survey:

The constriction at Bemus Point may be said to divide the lake into two portions of about equal length, but with very widely varying characteristics. The western or upper half has clear water during the summer, fewer weed areas and is relatively deeper; the eastern or lower half is a broad shallow area very rich in phytoplankton during the summer, and supports extensive weed areas.

Chautauqua Lake has only moderately cool bottom water during the summer, even in the deeper portions. Bottom temperatures as high as 60.8°F. were reached at a depth of 22 meters (75 feet) in mid-summer, which is not low enough for certain cold water fish such as lake trout. The shallow depth of the greater part of the lake and the freedom with which the wind stirs up currents and waves easily explains the high temperatures found at the bottom during the summer. Prevailing winds during the summer sweep either down or up the lake and the returning currents carry warmer water down along the bottom, thus gradually warming the water in the depths. Due to its shallow depth, a true thermocline is not found in Chautauqua Lake.

Dissolved oxygen was sufficient for all forms of life down to 8 meters during the summer. During August the 8-meter water became very low in oxygen but still had an adequate amount for life. Bottom water in mid-June still retained enough oxygen to support fish life, but by June 22 there remained only a trace, a condition which persisted throughout the summer.[1]

Records of the Conservation Department, fishermen's catch records, and collection data indicate that Chautauqua Lake produces a large crop of fish. Panfish are especially abundant, including yellow perch, common sunfish, blue-gill sunfish, bullheads, and black crappie. The common game fish species are the Chautauqua Muskalonge (Esox masquinongy ohiensis Kirtland), and smallmouth and largemouth bass. Carp and long-nosed garpike are the predominant rough-fish species.

A recent problem which is causing fishery biologists concern is the sudden explosion of the lake's walleyed pike population. Apparently these fish have been present in the lake for at least 40 years, but at such a low population that fishermen rarely caught them. Two years ago, however, these fish started spawning in such numbers that they have recently been caught regularly by fishermen. The unknown question is what effect the walleyes will have on the established muskalonge or bass populations.

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[1] Ibid., pp. 196-201.

CHAPTER III

HISTORY AND DEVELOPMENT

Chautauqua Lake was discovered by LaSalle in 1679 and revisited by him in 1681. It remained for the English settlers over a century later to begin building in the area. The land in western New York including Chautauqua County was bought by the Holland Land Company, a syndicate of Dutch bankers, in 1792, and title was bought from the Indians in the Big Tree Treaty in 1797. (The Indians received $100,000 for their rights to about 4,000,000 acres, and they reserved about 200,000 acres in eleven reservations throughout western New York.) The Company hoped to sell their land quickly at a high profit, but they were first forced to build roads into the area to attract settlers from central New York and Pennsylvania. A road which was built into the section in 1802 brought a flood of immigrants into the region in the next few years. The first hamlet of Westfield was settled in 1802. Mayville was settled two years later, in 1804. In 1810 a house was built on the banks of the Chadakoin River near the present site of the Sprague Street Bridge; and according to a tablet at the site, James Prendergast built a mill and a dam there in 1811, thus beginning the settlement of Jamestown.

The settlers came by two main routes. Some came by land from the Mohawk Valley westward, while others came by the way of the Allegheny River to the south. From Warren, Pennsylvania, they paddled up the Conewango and its tributaries to their destination in Chautauqua County.

> The pattern of settlement that was started in the first ten years has never been changed. Three-fourths of the people in the county in 1950 were in one-third of the towns, those along Lake Erie and those around Jamestown, plus the two cities, Dunkirk and Jamestown. These two areas contain all of the sizeable villages. The remainder of the county is almost all farm lands and forest lands.[1]

Agricultural

The Dutch influence in western New York produced a very different result from the patroon system established by the Dutch in eastern New York. The Holland Company's policy of selling on credit and requiring actual settlement and improvement of the land made it a region not of great estates but of small farms worked by the owners.[2]

Farming in pioneer days was a very self-sufficient enterprise, with the individual families growing nearly all of their food and provisions on their own farmstead. Chautauqua County farms were well known for certain speciality products such as beef

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[1] H. McMahon, Chautauqua County, A History (Buffalo: Henry Stewart, Inc., 1958), p. 227.

[2] Ibid., p. 32.

and butter in the early and late 1800's. Following the construction of a railroad along the Lake Plain in 1852, the different parts of the county began to specialize, grapes being the most important specialty. The Plateau Region was not generally a good crop producer; and since the mid-1800's, dairy products in their various forms have been the Region's major farm product. The cities around Chautauqua County provide a tremendous market for fluid milk, which is, of course, perishable and must be produced near the market.

Many of the settlers who first cleared the forests in the Highlands abandoned their hard-earned farmsteads within a few short years because the exposed forest soil rapidly eroded away. This was especially true on the slopes of the hills, where rains quickly washed down the surface organic layer, exposing the relatively unproductive mineral soil underneath. As the railroads opened the way to the rich farmlands farther west, more and more of the original settlers abandoned their farms and moved out of the Plateau Region.

It is important to note that farm abandonment in Chautauqua County is not just a recent phenomenon. In a publication put out by the Chautauqua County Farm Bureau in cooperation with the Supervisor's Committee on Abandoned Land in March of 1932, the basic character of the rural and agricultural areas was described as follows:

> From an extensive survey taken in 1927, the area of abandoned land was conservatively estimated at 100,000 acres. This abandonment has not been due for the most part to the present depressing economic conditions.
>
> Census records indicate that abandonment started practically as soon as the County was settled and has been going on constantly for over fifty years. The fact that most of our idle land was abandoned during a period of prosperous agriculture strongly indicates that this land is not adapted to the growing of annual crops. Shallow surface soil poorly drained because of a hard-pan soil, accompanied by a short growing season due to high elevation, indicates that this land was cleared and settled by mistake. Such land is better adapted to the growing of forest trees . . . .[1]

As is the general case throughout most of the country, the number of farms in Chautauqua County is decreasing and the size of farms is increasing. This is shown in the following table taken from census data.[2]

TABLE 1. -- Number and Size of Farms in Chautauqua County

	1940	1945	1950	1955	1960	1965
No. of Farms	5572	5776	5336	4621	3784	3155
Size of Farms	90	89	94	102	113	125

According to the 1964 census, a farm is defined as at least 10 acres in size with sales of at least $50.00 of agricultural

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[1] Luensman, Planning Background Report #2, op. cit., p. 14.

[2] Data obtained from Federal Censuses.

PLATE IV. -- Many of the farms throughout the watershed are being abandoned or falling into disrepair. Some people prefer to remain on their farms but find employment elsewhere.

PLATE V. -- Dairy farming is the most common type of farming in the Plateau Region, and the most fertile soils are generally found in the valleys. This prosperous farm is located in one of the stream valleys near Dewittville.

products or less than 10 acres that sold $250.00 or more. Of these 3,155 farms, there were 2,180 (69%) classed as commercial farms where the farmer derived over 50% of his total income from farming. The remaining farms are part-time farming operations.

Results from an economic study of land utilization in Chautauqua County in 1939 indicated that the more prosperous farms were clearly associated with the better soils throughout the county.[1] In the Upland Plateau, these better soils are located largely in valleys and outwash plains rather than on the hillsides.

Municipal

The City of Jamestown, located within the Chautauqua Watershed just south of the Lake, is the largest community within Chautauqua County, with a 1960 population of 41,818. The only other city within the county is Dunkirk, located on the Erie Lake Plain, with a 1960 population of 18,205.

Six of the fifteen corporate villages in Chautauqua County are located within the Chautauqua Watershed, and five of these six are situated on the shores of Chautauqua Lake. The fastest growing area within Chautauqua County is the Conewango Basin, which includes seven towns around the City of Jamestown and the lower end of the lake. (The "Towns" in western New York State are

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[1] Alexander Joss, An Economic Study of Land Utilization in Chautauqua County, New York, Cornell University Agricultural Expt. Station, Bulletin 720, June, 1939.

analogous to "Townships" in the Midwest, but they are not necessarily regular in shape or area.) Approximately 49% of the County's population is concentrated in the four villages, seven towns, and one city which comprise the Conewango Basin. These 72,701 citizens are not evenly distributed throughout the land areas. Approximately 90% are concentrated in the City of Jamestown, plus the suburban Villages of Lakewood, Celoron and Falconer, and a corridor one mile in width on either side of Route 17 and Route 17J.[1]

The map on population change in Chautauqua County for the 50 year period between 1910 and 1960 (see Figure 4) shows the county divided into three general regions: The Erie Lake Plain, the Upland Plateau, and the Conewango Basin. It will be immediately apparent that the population growth throughout the County has been slower than the statewide and nationwide averages. The County increased by 72%, from 105,126 residents in 1910 to 143,377 residents in 1960. The New York State gain over the same period was 84%, while the United States population expanded by 95%. The towns along the Erie Lake Plain grew at a rate about one-half of the State average. The towns in the Upland Plateau grew very slowly, if at all, and in four of the towns there was a population loss. Only in the towns of

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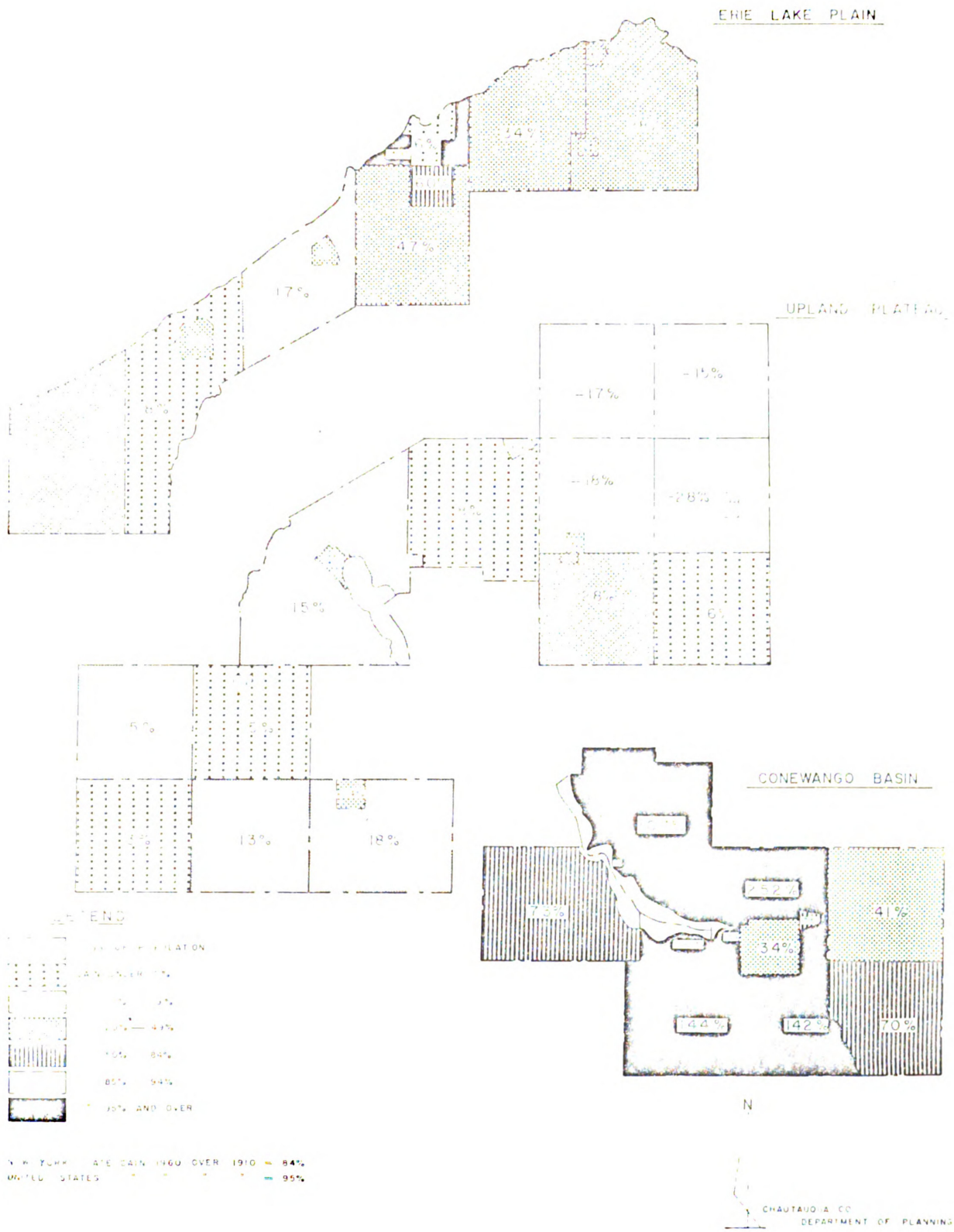
[1] J. R. Luensman, Planning Background Report #1 -- Population, Economy and Housing, Chautauqua County, New York (Mayville, New York: Chautauqua County Planning Board and Department of Planning, 1961), p. 20.

FIGURE 4. -- Chautauqua County Population Change 1910 - 1960



the Conewango Basin did the gain in population exceed the State and National averages, but even here the growth was largely confined to the suburbs of Jamestown, the lakeshore communities, and a narrow corridor along the two highways.

The City of Jamestown reached a peak population of 45, 155 during the 1930 census. Since that time, the central city has lost population to a total of 41, 818 residents in 1960, but the towns and villages of the Conewango Basin gained in population from 19, 402 in 1930 to 30, 253 in 1960. Part of this gain may have been suburban emigration from the City of Jamestown, but part of it was undoubtedly due to home building around Chautauqua Lake by people from outside the Conewango Basin. The towns and villages in the Upland Plateau not adjacent to Chautauqua Lake gained in population by only 2, 501 people during this period, from 13, 414 residents in 1930 to 15, 915 in 1960.

Industrial

Chautauqua County was mainly a lumbering and farming county until the War Between the States. Industries and cities followed only after the first railroad was built into the area. "The coming of the Erie Railroad to Dunkirk in 1851 and the linking of Jamestown to New York by means of the Atlantic and Great Western

in 1860 may be regarded as ending the pioneer period in Chautauqua County."[1]

The City of Jamestown grew rapidly into the largest industrial and population center in Chautauqua County. Swedish immigrants skilled in carpentry and woodworking started the wood furniture plants which soon made Jamestown the furniture capital of the nation. Its textile industry also flourished for many years, but later declined considerably. Today the furniture industry is falling behind other products such as metal furniture, tools, machinery and parts, which now employ more men than wood furniture.[2]

Jamestown is one of the very few cities in the United States which produces its own electric power. The Chadakoin River has a fall of seventy feet in less than four miles between Jamestown and Falconer, and the electric power system which was purchased in 1931 from the Niagara, Lockport and Ontario Power Company is today the Jamestown Municipal Power Plant.

The Village of Falconer, downstream from Jamestown, has closely paralleled its larger neighbor in both industrial and population growth. Between 1910 and 1930 the Village grew from 2,141 residents to 3,579, while Jamestown during the same period

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[1] McMahon, op. cit., p. 237.

[2] Ibid., p. 193.

expanded from 31,279 to 45,155.[1] Both municipalities have since lost in population.

There is one large industrial plant located on Chautauqua Lake upstream from the Chadakoin River -- the Chautauqua Malted Milk Company in Mayville. Milk processing wastes from the plant are discharged into the Little Inlet and thence into Chautauqua Lake. A few smaller plants located in Lakewood may also be discharging wastes into Chautauqua Lake tributaries.

Recreational

Chautauqua Lake has had an intermittent history of recreational growth and development. Great summer hotels once flourished around the lake, and in earlier days many wealthy families vacationed on the lake for the whole summer. At the turn of the century a fleet of steamships plied the lake, making regular trips from one end to the other between Jamestown and Mayville. Both freight and passengers were shipped on scheduled trips to the various resort communities around the lake. Some years later much of the steamship traffic was replaced by an electric train -- the Jamestown, Chautauqua and Lake Erie Railroad -- which completely encircled Chautauqua Lake. In the words of County historian Helen McMahon, "The hotels received their deathblow from the automobile --

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[1] Luensman, Planning Background Report #1, op. cit., pp. 7-9.

people no longer went to the same hotel year after year, but went touring to a different part of the country every summer, and motels replaced summer hotels in Chautauqua."[1]

Along with the motels and the automobile came a changing pattern of lakeshore cottage development. Around 1900, the private homes around Chautauqua Lake were either large estates owned by the wealthy, or else they were farms and year-round homes owned by local residents.

Following the popular introduction of the automobile in the 1930's, there was a gradual increase in the number of private lakeshore residences. Lakeshore residence building attained a high tempo in the late 40's and 50's as the economy burgeoned following the war. New and improved highways brought floods of tourists from Buffalo, Pittsburgh, Cleveland and beyond. The opening of the Pennsylvania and Ohio Freeways and the New York State Thruway in 1956 further shortened driving time, so that a family could travel the 150-odd miles from Cleveland or Pittsburgh in a matter of about three hours. This opened the lake for the weekend visitor as well as the seasonal cottage owner.

Within the last two decades there has been an increase in second home ownership by urban residents, which in many areas

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[1]McMahon, loc. cit., p. 227.

PLATE VI. -- The internationally famous Chautauqua Institution provides for recreational as well as cultural and religious attractions. Besides the golf course in the background, there are three public beaches along the lakeshore for summer and year-round residents, as well as for the visiting tourists. (Photo courtesy of the USDA-Soil Conservation Service, Jamestown.)

PLATE VII. -- Chautauqua Lake offers a nearly unlimited variety of recreational opportunities.

PLATE VIII. -- This scenic golf course overlooks the upper lake near Point Chautauqua. The row of cottages along the lakeshore is rented out to tourists.

of the Allegheny Plateau has exceeded the rate of farm abandonment.[1] Although many abandoned farm sites are purchased for second homes, the primary attraction seems to be water -- preferably right on a lakeshore or riverbank. Chautauqua Lake has seen a 250% increase in lakeshore residence construction since 1940,[2] plus an increasing conversion from seasonal to permanent residences, the rate of which is difficult to determine.

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[1] State University College of Forestry, op. cit., p. 50.

[2] Author's estimate based on count of houses on topographic maps and aerial photographs.

CHAPTER IV

TRENDS IN LAKESHORE DEVELOPMENT

Man' s utilization of a natural resource is often determined by the type, the extent, and the intensity of human development surrounding that resource. Once a certain pattern of development has been started (such as the existing pattern of seasonal and permanent residences along the Chautauqua Lakeshore), it usually shapes and limits available alternatives for future development. Certain of the problems associated with the utilization of Chautauqua Lake for recreational and other purposes can be related to recent trends in population growth and development within the communities surrounding the lake.

Population Growth

The intensity of lakeshore development around Chautauqua Lake may be inferred from the rate of population growth in the five villages and five towns surrounding the lake, and from the growth of the City of Jamestown and its suburbs. Population trends for these municipalities are available by decades between the years 1910 and

1960,[1] and these figures show two major periods of development around Chautauqua Lake. (See Figure 5.)

The first major period of growth occurred at the south end of the lake between the years 1920 and 1930. The City of Jamestown was thriving following the First World War, and the surrounding Town of Ellicott increased in population by 77%, from 1,964 to 3,476 inhabitants. Nearby on the southwest shore of the lake, the Village of Celoron and the Village of Lakewood were rapidly developing into lakeshore suburbs for people who were employed by Jamestown's industries, but preferred to live on the Chautauqua Lakeshore. During this decade, the Village of Lakewood more than doubled in size, from 714 to 1,827 residents.

In the same period, the Village of Mayville at the north end of the lake grew by only 5%, from 1,207 to 1,273 residents, while at mid-lake, the Village of Bemus Point was just beginning to grow from 227 to 280 inhabitants.

Expansion was halted following the Great Depression, and the City of Jamestown was hit by an industrial recession from which it has never fully recovered. Many people left the small cities and rural areas to move to the central cities such as Buffalo, Erie, and Cleveland, where better job opportunities were available.

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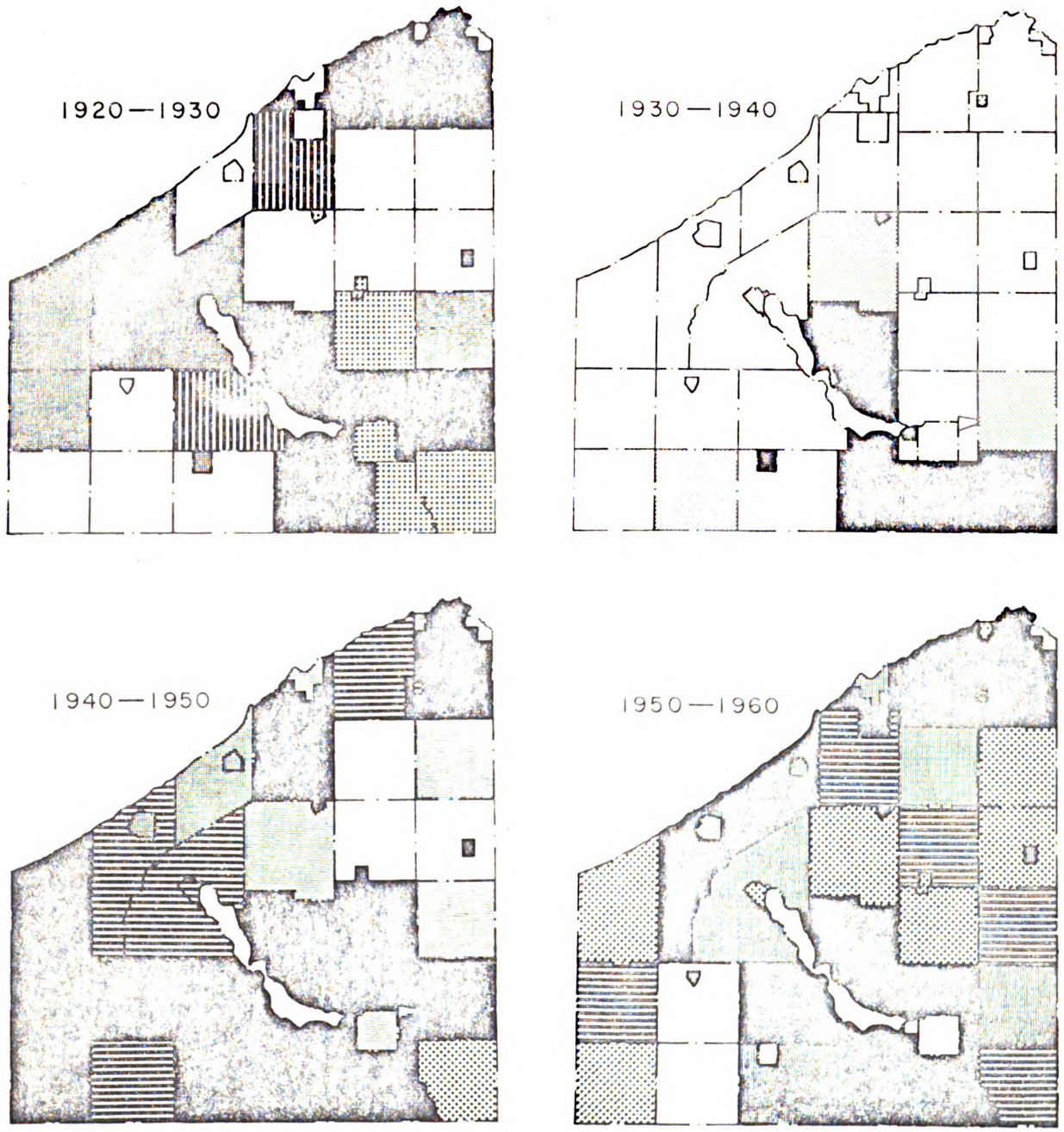
[1] Luensman, Planning Background Report #1, loc. cit., pp. 7-9.

FIGURE 5. -- Population Change by Decade,
Chautauqua County, New York



Between 1940 and 1950, following World War II, there came the second major period which was the period of greatest development around the Chautauqua Lake shoreline. Although the number of people employed in agriculture continued to decline, this loss was more than offset by returning servicemen and former urban residents who were attracted to the Chautauqua area because of the opportunity of living in the country and working in nearby cities. The majority of the population owned automobiles, and government loans and credit for home building were freely available. Demand for suburban living and outdoor recreation really started booming during this decade, and continued into the next. It is interesting to note that although Chautauqua County gained 11,609 new citizens between 1940 and 1950, the two cities of the county attracted only 8.7% of the new citizens as opposed to better than 95% of the population growth of the 1910-1920 decade.[1]

Jamestown residents continued moving into the "suburban" villages of Celoron and Lakewood, and the lakeshore in the Town of Busti was rapidly developing with both year-round and seasonal residences. At the north end of the lake, the Village and the Town of Chautauqua experienced their greatest growth during this decade, although percentage-wise this was an increase of only 10% and 11%

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[1] Ibid., p. 10.

respectively. Unlike the earlier growth period, development following the 1940's occurred at both ends of the lake. Many seasonal homes were built in the Town of Chautauqua, and nearly half of these seasonal home owners were from out of state. The Village of Bemus Point at the halfway point along the lake grew from 290 to 424 residents.

The growth of the 1940's carried over into the next decade. Along the east shore of the lower lake, the Town of Ellery increased by 44.6%, from 2,428 to 3,510 individuals. Most of these people built their new homes along the shoreline. At the lower end of the lake, both the Village of Lakewood and the Town of Busti continued growing. Lakewood grew into the largest lakeshore community, with a population of nearly 4,000 persons. Many people from Jamestown bought cottages around Chautauqua Lake during this decade and either commuted to work or spent the weekend at their lakeshore homes.

Seasonal Home Ownership

The following information on seasonal home ownership is condensed primarily from a recent report prepared by Mr. Luensman of the Chautauqua County Department of Planning. Published in May, 1966, the report is entitled Second Homes and Their Impact on the Economy of Chautauqua County.

Mr. Luensman prepared a short survey questionnaire which was sent to the owners of all properties in the lake-oriented

towns within Chautauqua County which were classed in the tax rolls as Code 8 Seasonal Residence. Figure 6 shows these sixteen survey towns and a line which encompassed 80% of the permanent residence area of all of the out-of-county owners of seasonal residences. (Not included in this survey because of their unusual character were the properties of the Chautauqua Institution, Lily Dale [a religious institution by Cassadaga Lake], and the Loomis Farm in the Town of Busti.)

Mr. Luensman's questionnaire was worded so as to obtain answers to the following questions: (1) Who owns the lake-oriented seasonal residences?; (2) Where do the owners live?; (3) How do they use their property?; and (4) What is their economic impact? The answers to these questions are highly important for obtaining a more accurate concept of the home owner situation around Chautauqua Lake.

The Chautauqua County Department of Planning mailed 2,375 letters to all of the owners of Code 8 Seasonal Residences in the survey towns along Lake Erie, Lake Chautauqua, and around Findley Lake and the Cassadaga Lakes. A subsequent check of the records showed that there were actually 2,408 Code 8 residences in these towns. Of the 2,375 letters which were mailed, a highly respectable return of 1,155, or 49%, was obtained, and 1,016, or 43%, of these were usable.

FIGURE 6. -- Permanent Residences of Seasonal Home Owners in Chautauqua County

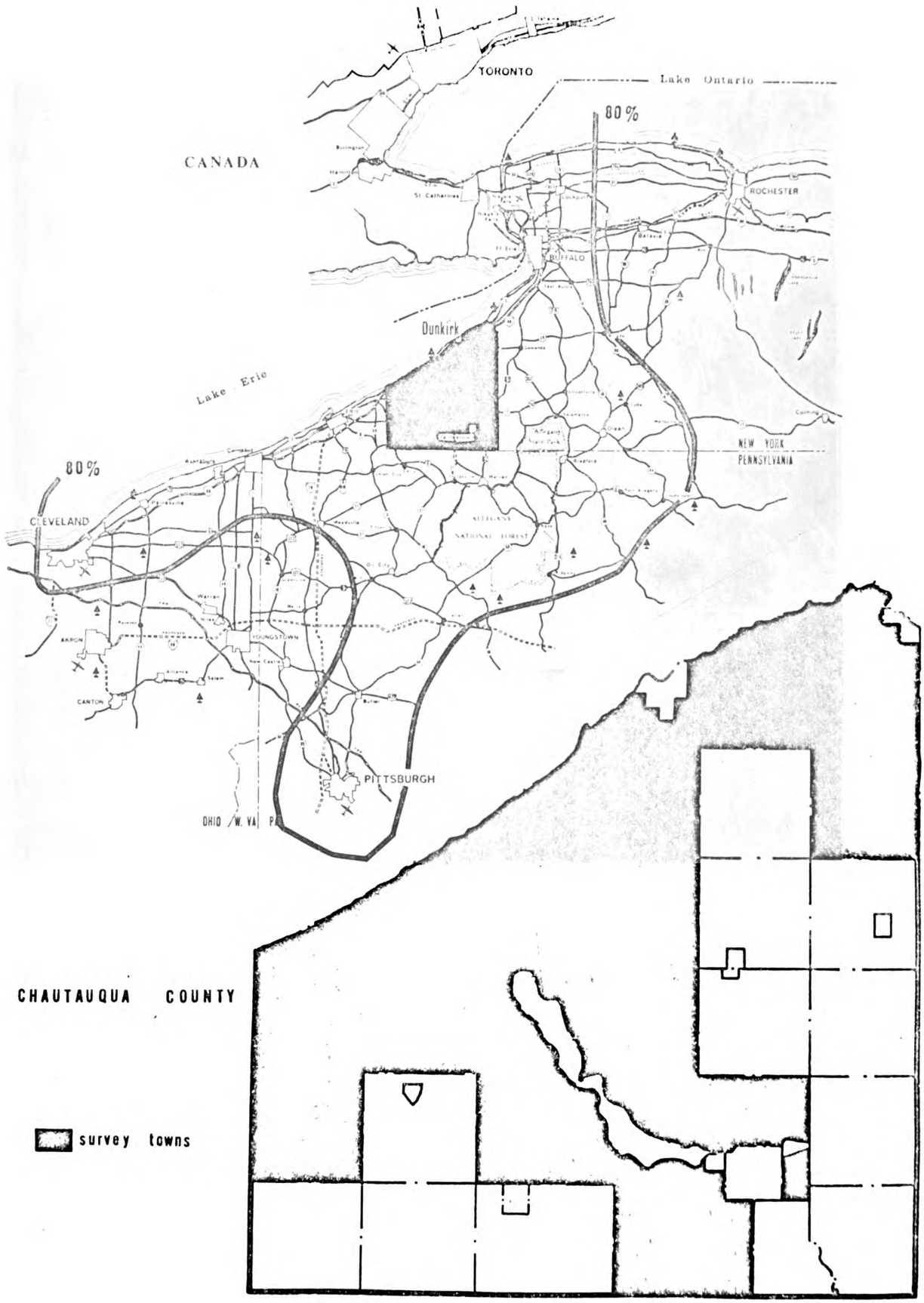

PLATE IX. -- Numerous seasonal cottages and other seasonal homes line the Chautauqua lakeshore. Over half of the seasonal home owners live outside of Chautauqua County.

PLATE X. -- This new housing development is in the Town of Ellery not far from Jamestown. Many of the newer homes are permanent rather than seasonal residences.

The importance of Chautauqua Lake to the recreational economy of Chautauqua County is attested by the fact that 1,261 or 52% of all of the Code 8 Seasonal Residences in the sixteen survey towns were located in the five towns surrounding the lake. Starting around the south end of the lake, the Town of Ellery had two Code 8 residences, Busti had 120, North Harmony had 255, Chautauqua had 493, and Ellery had 391.[1] The Town of Chautauqua had more seasonal residences than any other town in Chautauqua County. Perhaps the population growth in the Town of Chautauqua was not as slow as the figures for the past two decades seemed to indicate, since these seasonal home owners would have their permanent residences elsewhere.

Another verification of the importance of these seasonal homes comes from a count of lakeshore residences around Chautauqua Lake taken by the author from aerial photographs and topographic maps. The author counted all buildings that appeared to be seasonal or permanent residences, between the lakeshore and Highways 17 and 17J which encircle the lake. Excluded from this count were the Villages of Celoron and Lakewood and the Chautauqua Institution. The aerial photographs (which belonged to Mr. Luensman) were

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[1] J. R. Luensman, Second Homes and Their Impact on the Economy of Chautauqua County (Mayville, New York: Chautauqua County Planning Board and Department of Planning, 1966), p. 10.

taken in November, 1961, at a scale of 1:24,000. With a pocket stereoscope the residences were plainly visible even under tree cover. To check the boundary of the Chautauqua Institution and the Villages of Celoron and Lakewood, the author compared features on the aerial photographs with topographic maps.

Although the results obtained with this method cannot be entirely accurate, the total count on the 1961 aerial photographs came to 3,124 residences. If there are 1,261 Code 8 Seasonal Residences in the towns surrounding Chautauqua Lake, then almost one-half of the total residences between the lakeshore and Highways 17 and 17J (excepting the Chautauqua Institution and the Villages of Celoron and Lakewood) are owned by seasonal home owners. About one-fourth of these seasonal home owners live within New York State outside of Chautauqua County, and another one-third are from out-of-state.[1] Since seasonal cottage owners must pay taxes on their temporary homes as well as on their permanent homes, their contribution to the economy of the lakeshore towns is considerable. The survey report estimates that full week occupancy by out-of-county owners and renters of seasonal residences annually contributed $2,550,000 to the economy of Chautauqua County.[2]

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[1] Ibid., p. 9.

[2] Ibid., p. 25.

As a check on the previous periods of lakeshore development around Chautauqua Lake, the author counted the number of residences which were designated on topographic maps in the years 1902 and 1941. These residences were counted on the same areas between the lakeshore and Highways 17 and 17J as was done on the 1961 aerial photographs.

In 1902, the number of lakeshore residences was 489. By 1941, nearly 30 years later, this had increased by only 65%, to 758 residences. The "population explosion" came during the following 20 years, when the number of lakeshore residences increased by 243%, from 758 to 3, 124. It is no wonder that the local town planning boards were caught flatfooted and were unable to direct the course of this sudden burst of lakeshore home construction. People preferred those sites which fronted right on the lake, and as a result the entire lakefront was rapidly encircled by a single tier of cottages. Development of the backlots proceeded more slowly, partly because backlot sites were less desirable and also because most riparian landowners are unwilling to provide free access to the water for backlot owners.

Future Development

Future development around the shores of Chautauqua Lake will depend on the economic future of the entire county, and

also on the continued interest of the general public in outdoor recreation and outdoor living. Possible adverse effects of a growing lakeshore population on the water quality of Chautauqua Lake may become a limiting factor to future recreational development.

Chautauqua County will probably continue growing at a rate not much faster than it has during the past half century. Although growth projections are not always reliable indicators of things to come, they are nevertheless a necessary and useful tool for planning.

For the county as a whole the 30 years of greatest increase between 1910 and 1960 showed a population growth of 9.58% per decade, while the 30 years of lowest increase showed a growth of 4.88% per decade.[1] The lowest point was reached between 1930 and 1940, when the population decreased by -2.27%. Based on the averages for the past 50 years, we may expect a countywide resident population growth of between 5% and 10% per decade to continue into the future.

The population picture for the county, however, is not representative of the local or regional growth. A glance back at Figure 1 will show graphically that the Conewango Basin has grown far faster than any other region of Chautauqua County. The Erie

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[1] Luensman, Planning Background Report #1, loc. cit., p. 22.

Lake Plain during this period grew at a slow but steady pace, while the Upland Plateau towns either grew slowly or lost in population. An indication of the downward trend in the agricultural value of the Upland Plateau soils is that eight of the thirteen towns in that region have less of a population in 1960 than they did in 1875.[1] Significantly, none of these towns are adjacent to Chautauqua Lake.

Growth Predictions

The fertile soils and temperate climate of the Erie Lake Plain provide an agricultural resource which has supported a moderate but steadily increasing population in that area. On the Lake Erie shore, the City of Dunkirk is the second largest city in Chautauqua County, and because of its location only 30 miles from Buffalo it will probably continue growing. The New York State Thruway provides easy access for the people of the Lake Plain either east to Buffalo or west to Erie, Pennsylvania, and Cleveland, Ohio. This region will probably develop at a faster rate in the future than it has in the past because of its location between two expanding metropolitan areas. Its valuable agricultural lands may have to be protected from residential and commercial encroachment.

The other four-fifths of Chautauqua County is on the Allegheny Highlands. The upland soils are poor in productivity

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[1] Ibid., p. 4.

except for certain valley soils, and the climate is more severe than along the Lake Plain. Agriculture may hold its own through increased efficiency and size of farm units, but the number of people employed in agriculture will not likely increase either in the Upland Plateau or in the Lake Plain.

The people of the Conewango Basin have relied mainly on the Jamestown urban-industrial complex for their economic base. Neighboring Chautauqua Lake serves as an important attraction for the residents of the Conewango Basin, and also provides income from out-of-county and out-of-state seasonal residents and tourists. With the exception of the Town of Dunkirk on Lake Erie, the four fastest growing towns in Chautauqua County are the four towns fronting on Chautauqua Lake in the Conewango Basin.

During the last decade, growth within the Conewango Basin has tapered off while at the same time growth along the Erie Lake Plain has increased. This trend will probably continue in those two regions because the City of Jamestown is relatively isolated from neighboring metropolitan areas, while the City of Dunkirk and the Erie lakeshore communities are in the prospective path of suburban progress. The Jamestown area is the only urban complex of over 50,000 in population in New York State which is competing nationally and internationally without the benefit of service by State

or Federal high speed, limited access highway. At the present time the nearest limited access highway is twenty-seven miles away.[1] This situation should be corrected by about 1975 when the Southern Tier Expressway is scheduled to be constructed across the Allegheny Plateau, between Erie, Pennsylvania, and New York City. The proposed plans call for the Expressway to cross Chautauqua Lake at the Bemus Point-Stow constriction, which is presently served by a single automobile ferry. Although the proposed highway is expected to speed up transportation to and from the Chautauqua Lake region, the Conewango Basin will probably have to rely on internal growth for the major share of its industrial development.

Predicted Recreational Development

Approximately 20,000 people lived in the four towns and four villages along Chautauqua Lake north of Jamestown in 1960. This is approximately 14% of the total county population. The Chautauqua County Department of Planning estimates that by 1985, between 26,000 and 38,000 new residents will be living within the county.[2] If the pattern of suburban growth continues along the

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[1] J. R. Luensman, A Dialogue Plan -- Chautauqua County, New York (Mayville, New York: Chautauqua County Planning Board and Department of Planning, 1963), p. 44.

[2] Ibid., p. 17.

lakeshore towns of the Conewango Basin, we may reasonably expect that about one-fourth of these new residents will want to build their homes around Chautauqua Lake. We may expect, therefore, that by 1985 there will be between 5,000 to 10,000 new residents around the lake, which will require between 1,500 and 3,000 new home sites. Most of this new development can be expected to take place in the undeveloped backlot areas between the Chautauqua lakeshore and Highways 17 and 17J. The heaviest development will probably move northward from Jamestown along both sides of the lake, although recreational expansion in the Town of North Harmony is somewhat restricted by the fact that the town is "dry." The two fastest growing towns in recent decades have been Busti on the south shore of the lake and Ellery on the lower east side, both of which are adjacent to the Jamestown metropolitan area.

The recreational appeal of Chautauqua County has been enhanced by the construction of three new ski slopes, which should serve to make recreation a year-round attraction to neighboring city dwellers. If Chautauqua County can successfully provide year-round recreational opportunities for these people, then commercial recreation should be able to replace jobs lost by a declining manufacturing economy, particularly in the Jamestown area.

CHAPTER V

LAKE PROBLEMS -- THE HUMAN ELEMENT

Social and Economic Conditions

The Chautauqua Lake Watershed contains two different social elements which are a considerable distance apart on the social and economic scale. One social element is the rural farm community which resides in the farms and hamlets of the Highlands surrounding Chautauqua Lake. The other element is the urban-industrial-recreational community in the City of Jamestown, the villages and communities adjacent to the lake, and the residences along Highways 17 and 17J. The lakeshore community may be sub-divided into year-round urban residents, year-round rural residents, and seasonal lakeshore residents.

The 1960 Census divided the nation's population into "urban," "rural-farm" and "rural-non-farm" elements. Within Chautauqua County, all persons living in the Cities of Jamestown and Dunkirk, and the Villages of Falconer, Fredonia, Lakewood, Silver Creek, and Westfield were classed as residents of urban places. The rest of the county was classed as rural. The total population of

the county in 1960 was 145,377, of which 57.1% were classed as urban, 34.2 % as rural-non-farm, and only 8.7% as rural-farm residents.

Chautauqua County is included among the northern-most counties of the economically depressed Appalachia Program. In 1959, the Chautauqua County median family income of $5,626 was $745 below the median family income for all of New York State. In 1960, total employment of Chautauqua County residents was 53,925; in 1950, with 10,188 fewer inhabitants, total employment of the county residents was 54,393. An increase of 10,188 residents and 468 fewer jobs does not balance.[1]

The economic pattern of higher income for urban residents versus rural residents holds true in Chautauqua County. The 1959 median family income of the rural population in Chautauqua County was $5,382, while the median income of the rural-farm population was $4,700.[2] (Rural residents are defined as those people who live outside the densely settled urban fringe, or in communities of less than 2,500 inhabitants. Rural-farm residents are those who depend on their farm for full or part-time income, as was explained on page 26

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[1] Luensman, Planning Background Report #2, loc. cit., p. 91.

[2] A. A. Paydarfer and O. F. Larson, The People of Chautauqua County, New York: Trends in Human Resources and Their Characteristics, 1900-1960 (Department of Rural Sociology, Cornell University Agricultural Experiment Station, Ithaca, New York, Bulletin No. 62-6, 1963), p. 49.

in Chapter III.) Surprisingly enough, the county's rural-farm income exceeded the state-wide farm income, which was $4,504. The median family income for the residents of Jamestown was $5,735, and for the Village of Falconer it was $5,632. The Village of Lakewood, however, had a median family income of $6,267.[1] Lakewood is a suburb of Jamestown situated on the south shore of Chautauqua Lake, and it had the largest gain in population of any community in Chautauqua County during the period 1910-1960.

In a study of Code 8 Seasonal Residence property owners in the lakeshore towns of Chautauqua County, Mr. John Luensman, Chautauqua County Planning Director, found that second home owner families in the towns around Chautauqua Lake had a median income of $9,000, with 29.1% indicating an income of $14,000 and over, and only 14.6% indicating income under $4,000.[2] About 55% of these families came from out-of-state.

The economic and social differences between the urban-recreational and rural-farm elements in the towns surrounding Chautauqua Lake has resulted in a situation whereby there is little or no cooperation between lakeshore communities and the local farmers.

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[1] Luensman, Planning Background Report #2, loc. cit., pp. 96 and 111.

[2] Luensman, Second Homes and Their Impact on the Economy of Chautauqua County, op. cit., p. 4.

This may be partly due to the fact that so many of the lakeshore residents are seasonal visitors living outside the county or outside the state. The farmers are generally opposed to any community projects which would benefit mostly the lakeshore communities, even though these projects could, in the long run, benefit the farmers also. Most of the political leaders in the lakeshore towns are representatives of the rural or farm interests.

The lakeshore communities have the Chautauqua Lake Association to represent recreational interests, as well as a number of smaller community associations such as the Point Chautauqua Association. With respect to lakeshore development, however, these associations do not have any local political power. The local laws regarding zoning rules, subdivisions, property assessment, etc., are entirely in the hands of the local town governments, and so far these have been designed primarily for the farm communities.

One of the main obstructions to a better pattern of housing development around Chautauqua Lake is lack of planning action by the local governments. In the words of Mr. Luensman, the County Planning Director,

> Around Lake Chautauqua we have no constructive, aggressive municipal planning programs. The power for constructive lakeshore development around Chautauqua Lake lies basically in the municipal governments of the three Towns of North Harmony, Chautauqua, and Ellery, but these do not have

active planning boards; they do not even have sound zoning ordinances.[1]

Sewerage Facilities

The main surge of shoreline residence construction around Chautauqua Lake took place within a 15-year period starting in the late 1940's. More recently, the rate of new homesite construction has decreased, partly because most of the shoreline has already been developed, and also because of access problems associated with backlots.[2]

Since none of the lakeshore communities were ready with service facilities to meet the demands of this rapidly expanding population, most of the new lakeshore home owners had to install individual household wells and sewage disposal systems. The household waste disposal systems usually are individual septic tanks, many of which have not been carefully installed. They are often in unsuitable soils, or at an elevation too low or too close to Chautauqua Lake. On many lots there is a very real danger of household contamination from septic tank effluents which diffuse into shallow wells. Another common problem stems from failure of small

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[1] Personal interview with Mr. John Luensman, Planning Director, Chautauqua County Department of Planning, August 26, 1966.

[2] Ibid.

capacity tanks when cottage owners convert from seasonal to year-round residence.

All of the lakeshore villages and the Chautauqua Institution presently have sewage treatment plants of the primary type. According to Mr. Leonard Facciani, of the Chautauqua County Department of Health, five lakeshore plants plan to change to secondary treatment within 7 to 10 years.[1] A sewer project which is planned to encircle the lower half of the lake has been proposed, and a preliminary investigation has been made by an engineering firm. The project is presently at a standstill due largely to disagreement over financing.

Some of the upper lake communities have also expressed an interest in building a sewer system for the upper half of the lake. A tentative plan for this upper lake project calls for a separate system from the lower lake, with a sewage treatment plant in the vicinity of Mayville which would discharge treated wastes back into the upper lake.

If the lower lake project were to receive local approval from the voters (which is questionable because the rural interests will probably oppose the plan), a sewage treatment plant would be constructed near the outlet of the lake, and treatment effluents would be piped into the Chadakoin River. The Chautauqua Lake Watershed

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[1]Personal interview with Mr. Leonard Facciani, Director of Environmental Health Services, Chautauqua County Department of Health, July 18, 1966.

would, therefore, lose a considerable volume of water, but this plan would largely eliminate the household sewage effluents which presently drain into the lower lake. The sewage treatment plant would have to be highly efficient in order to prevent serious pollution of the Chadakoin River above that level which already exists due to sewage from the City of Jamestown and the Villages of Celoron and Falconer. It would also have to be large enough to handle any expected growth in the lower lake region to at least the year 2000.

Water Supply

Although there are presently only two lakeshore communities withdrawing water from Chautauqua Lake, the increasing demand for more domestic and municipal water will probably necessitate withdrawal from the lake by the larger lakeshore communities in the not-too-distant future.[1] Chautauqua Lake is presently classified as a "Class A" lake by the New York State Water Resources Commission, which means that it is suitable as a source of domestic water supply with proper treatment.

The Chautauqua Institution is served by the Chautauqua Utility with water from the lake, and the Point Chautauqua Association

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[1] Interviews with Mr. Luensman, August 26, 1966, and Mr. Wayne Tyler, Public Works Superintendent, Lakewood, New York, August 5, 1966.

withdraws water from the lake during the summer season. The Village of Lakewood has just completed a study of its water needs, and has come to the conclusion that the most feasible and economical source of additional water for the Village is Chautauqua Lake. The present supply of ground water is inadequate for Lakewood's rapidly expanding population, and additional water will be needed for a large new industrial plant which is expected to locate there. A consulting engineering firm hired by the Village proposed a water facility that will provide for an average daily consumption of 2.65 million gallons in 1985 (1.65 million for domestic use and 1.0 million for industrial consumption) with provisions for expansion to 5.0 million gallons average daily water usage in 2015.[1]

The City of Jamestown obtains its water supply from wells. Besides supplying its own residents and industries, the City also supplies water to Celoron, four water districts in the Town of Ellicott, and Falconer. Increasing demands on its well fields plus a series of recent dry years have forced the City to impose restrictions on domestic water consumption during five of the last ten years. In 1960, the City contracted with the U. S. Geological Survey to make a study of additional sources of ground water in the

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[1]Nussbaumer, Clarke, and Velzy Consulting Engineers, Buffalo, New York, "Report on Water Study for Town of Busti -- Village of Lakewood, New York," June, 1966, p. 18.

Jamestown area. A well field with a capacity of 5 million gallons was found in the Town of Poland, and the City plans to obtain water from this new source within a few years. The City consumes an average of 6.5-6.8 million gallons per day, of which half goes to residential and half to industrial and commercial users. Increased per capita use of water has lowered the ground water table below Jamestown so that many industries which previously relied on private wells have had to turn to the City for additional water.[1]

With the two exceptions previously noted, all the communities surrounding Chautauqua Lake presently obtain their water supply from wells. A list of these communities is presented in Table 2 on the following page.

Water-User Groups

The people of the Chautauqua Lake region are proud of their recreation industry -- or as the Jamestown Area Chamber of Commerce calls it, "the 7 million dollar industry without a smokestack." There can be no question that the opportunity for water-based recreation is one of the most important products which the lake region has to sell. Without the presence of Chautauqua Lake,

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[1] L. J. Crain, Ground-Water Resources of the Jamestown Area, New York, with Emphasis on the Hydrology of the Major Stream Valleys (U. S. Geological Survey, in cooperation with the City of Jamestown and the State Water Resources Commission, Bulletin 58, 1966), p. 10.

TABLE 2. -- Sources of Water and Water Consumption by Chautauqua Lake Municipalities[1]

Municipality	Source	1960 Population	% of Population Served	Consumption (1,000 Gallons Per Day)
Chautauqua Institution	Chautauqua Lake	Winter - 600 Summer-15,000	100	207
Celoron	(Jamestown)	1,555	100	---
Lakewood	Wells	3,013	100	292
Busti Water District #1	(Lakewood)	500	100	40
Busti Water District #2	(Lakewood)	500	100	30
Mayville	Wells	1,492	100	150
Point Chautauqua	Chautauqua Lake	425	42	16
Prendergast Point	Driven Wells	100	100	10
Total Consumption				745

it is very doubtful that the City of Jamestown would have been established there, or the Chautauqua Institution; and thousands of recreational residences would surely not have been built in the middle of a rural farming area, no matter how scenic the countryside may be. One would be safe in assuming, therefore, that

[1] Luensman, Planning Background Report #2, loc. cit., pp. 40-42.

recreation is the primary water-user interest in the Chautauqua Lake Watershed. In order to protect the lake for recreational use, it would appear unwise to allow any industrial development along the shores of Chautauqua Lake upstream from the Chadakoin River.

For the recreational user of water, the matter of water quality and the kind of water environment has a lot to do with the degree of enjoyment and satisfaction which that environment provides. In order to fully enjoy the water, a person must also have some kind of access to it.

The second most important water-user group would have to be the City of Jamestown with its 43,000 inhabitants and its industries. The residents of the Conewango Basin depend largely on these industries and related services for the major share of their employment. An adequate water supply for domestic and industrial uses is indispensable to the City's economic well-being and development. The City presently obtains its water supply from a well field which is located northeast of Jamestown in the lower Cassadaga Creek Watershed. If Jamestown is unable to supply its water needs from ground water in the Cassadaga Creek Watershed, or from the Town of Poland in the Conewango Creek Watershed (see Figure 1), it would have to turn to Chautauqua Lake for a source of water.

The communities surrounding Chautauqua Lake have obtained water largely from ground water aquifers up to this time, but increasing per capita demands for water may force some of these communities to turn to the lake for their domestic water supply. Many of the private residences which now have individual household wells may also wish to turn to community associations or nearby municipalities for their water supply in the future.

Agricultural interests have obtained their water from the numerous streams throughout the watershed, as well as from ground water. Since the climate is humid, irrigation farming is not required, and it is unlikely that farmers will have to change their present pattern of water use.

A factor which affects all of these water-user groups is the inherent hydrologic characteristic of the watershed. It is subject to rapid runoff and flood problems in the spring of the year, and conversely to low flow periods (together with lowered water tables) in late summer. The correction of this situation by proper watershed management practices would be in the common interest of farmers, urban residents, and recreationists. Farmers could benefit from land treatment practices which control soil erosion and improve the infiltration of rain into the ground. These same land treatment measures can also aid in recharging the ground water and reducing the rate of flood runoff, thereby benefiting other water-user groups.

Multiple-Use Recreation

A Wisconsin study of the degree of participation in various aquatic activities on its inland lakes rated esthetics and swimming the highest with 50% of the population participating in each. Fishing was third with 25% participation, motorboating fourth with 20%, canoeing and rowing fifth with 10%, and sailing had only 1% participation.[1] Based upon personal observations and several years' residence at Chautauqua Lake, I would estimate that the above ranking would apply generally for Chautauqua Lake, except that I would rank sailing ahead of canoeing and rowing. Sailing is a favorite pastime on the lake due to its elevation and climatic situation, which usually provides an adequate breeze. Sailing regattas and national championships have been held at Chautauqua Lake on numerous occasions. This past summer the lake was the site of the National Snipe-class Championship race.

Boat traffic on the lake often becomes very crowded during the summer, especially on weekends, when both lakeshore residents and visiting tourists are cruising the waters. The volume of this traffic can best be observed in the constricted portion of the lake,

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[1] C. W. Threinen, "An Analysis of Space Demands for Water and Shore," Transactions of the 29th North American Wildlife and Natural Resources Conference, March, 1964, p. 354.

at Bemus Point, where pleasure boaters and fishermen cross from one basin to the other.

By far the most popular method of fishing for muskellunge is by motor trolling, and the flotilla of fishermen cruising the lake on the first week of musky season is something to see and hear. The air is simply pervaded by the low but emphatic drone of hundreds of trolling motorboats. Bass fishing is not done nearly so much by trolling as by casting and still fishing. Panfishermen generally pursue their sport from anchored boats or from numerous private docks. The density of fishermen is usually highest during the first week of July, then tapers off gradually through September.

Fishermen usually have the lake to themselves from sunrise until about noon, and again in the evening after 6:00 or 7:00 p.m. In between, however, the pleasure boaters and water skiers reign supreme. A few hardy musky fishermen keep right on trolling through the afternoon, but most of them pull in their lines when the afternoon sun brings out the speed boaters. Chautauqua Lake is long and wide enough that there is not excessive conflict between fishermen and pleasure boaters, except perhaps in late morning or early evening hours.

The fastest moving sport and the one requiring the largest area for participation is water skiing. Water skiers can pursue their sport in the middle of the lake without interfering unduly with

PLATE XI. -- The volume of boat traffic on Chautauqua Lake can best be observed at the Bemus Point-Stow constriction.

PLATE XII. -- Motor trolling is the most common method of fishing for muskellunge. This couple is trolling while the morning mist has not yet risen from the water.

PLATE XIII. -- Swimming is perhaps the most popular waterfront activity. This community beach is owned and operated by the Village of Mayville. Tourists may enter the grounds for a fee.

PLATE XIV. -- Water skiing is the fastest moving aquatic sport and the one requiring most area for participation. Conflicts sometimes arise between water skiers and fishermen over use of the water.

the fishermen, but on busy weekends and sunny, calm afternoons, the fishermen will usually be driven off the lake by large numbers of water skiers. A more serious conflict occurs between fast moving motorboats and sailboats. Not infrequently, sailboats are swamped or overturned by the wake of fast moving powerboats.

Eleven public and numerous private beaches are located at intervals around the lake. Most of the public beaches are maintained and supervised by a nearby village or community, while the private beaches are maintained by commercial operators or individual home owners. The newest and largest public beach will be opened in 1967 at the Long Point State Park north of Bemus Point. (See Figure 7 for a map of the proposed park.) The private docks around the lake provide an element of safety for swimmers so long as they stay within shallower water. The boundaries of public swimming areas are usually marked by floating buoys in order to keep boats out and swimmers in. Although boats are limited to 5 mph within 200 feet of shore, swimmers venturing much deeper than the five to six foot contour will often be out far enough to face danger from boat traffic.

Lake Access

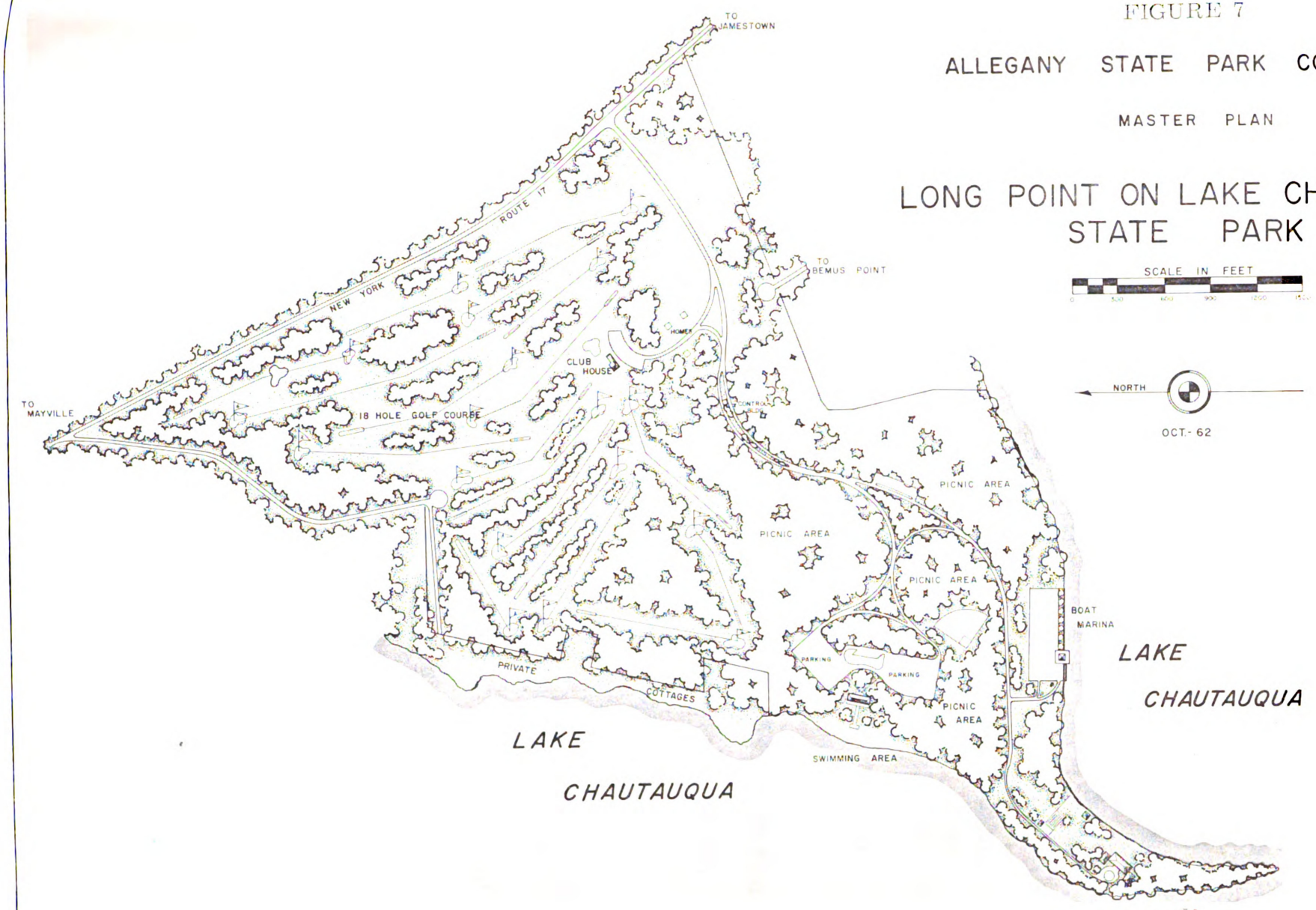
One of the most serious problems around much of Chautauqua Lake is the lack of convenient private access to the water for

FIGURE 7

ALLEGANY STATE PARK COMMISSION

MASTER PLAN

LONG POINT ON LAKE CHAUTAUQUA STATE PARK



backlot property owners. Much of the lakeshore is effectively blockaded by the belt of riparian cottages whose owners are reluctant to allow backlot owners access to the water. The situation is considerably better with respect to public access, via a large number of commercial boat yards and boat liveries. Many of the communities and villages also have public or community boat launching ramps. The State Fish Hatchery has a public boat ramp at Bemus Point and another at Prendergast Point, while a third public ramp will be available when the new Long Point State Park opens.

Public access for swimming is also adequate, although the Burgis Bay beach near Jamestown was closed last year by the Chautauqua County Department of Health. (This was due mainly to its poor location near the outlet of the Lakewood Municipal sewage plant.) The Long Point State Park should be a popular swimming spot for both local residents and visiting tourists when it opens.

Many commercial enterprises are located around the lake, including camps, trailer parks, and lakeshore cottages, which offer private beaches and boating facilities for their patrons.

The lakefront residence owners quite often erect private docks for boat launching, fishing, swimming, etc. Some of them also have "improved" or reinforced beaches. Boats are often anchored 100-150 feet offshore to permanent buoys, or they may be pulled up on shore. The docks are temporary structures, usually

50-100 feet long, made of sections which can be removed and stored on land during the winter. Docks are a necessity around most of the lake because almost the entire lakeshore slopes rather gently into deeper water. They are especially handy for boat launching during periods when the lake is at a low level.

Floodwater and Low Water

High water has been a bothersome problem for many years in this watershed. It has caused damage on the shores of Chautauqua Lake, in the low-lying areas of Jamestown and Falconer, and along the banks of the Chadakoin and Conewango Rivers in the Conewango Valley. Lowlands along the Chadakoin River through Jamestown and Falconer permit flashflooding, and this is a factor in decisions relative to the construction of factories and business establishments in these areas.

The U. S. Army Corps of Engineers tried until 1965 to initiate construction on a flood control project for Lake Chautauqua and the Chadakoin River, with a proposal for releasing excess waters across the divide at the north end of the watershed through the Chautauqua Creek into Lake Erie. The Chautauqua Creek Basin lies along the northwestern edge of the Chautauqua Lake basin, and the Corps planned to construct a gated dam and diversion channel three miles in length, at a cost of nearly $7 million. This plan was

strongly opposed by local watershed associations, who are more in favor of a Federal Public Law 566 Watershed Project. Last year the Corps was finally forced to abandon its project because of "lack of local cooperation."

The Corps of Engineers made a detailed study of the hydrology of the Lake Chautauqua and Chadakoin River basin as recently as 1964. They have found that in the past 30 years, since 1934, the nine highest lake level occurrences were experienced in late winter-early spring during the two month period of March and April. Although snow melt is an important flood factor in the majority of Lake Chautauqua floods, high intensity, short duration rainfall may cause very severe flood conditions.[1]

The Corps has made the following conclusions about high and low water levels on Chautauqua Lake: "Critical elevations on the lake result from high stages during flood storage and low stages during the recreation season. Tangible flood damage occurs above elevation 1310. Inconveniences to recreation begin when the lake falls below elevation 1308.0. An additional fall in the lake to elevation 1307.0 results in drastic curtailment of lake activities."[2]

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[1] U. S. Army Corps of Engineers, (1964), loc. cit., p. 24.

[2] Ibid., p. 32.

They did not elaborate on the extent to which recreational activities would be curtailed, however.

In recent years, floods have not been as serious a problem as low water levels and lowered water tables. Figure 8 shows a series of high water levels for Chautauqua Lake from 1912 to 1962, based on records maintained by the Department of Public Works of the City of Jamestown.[1] It can be seen from this figure that the level of maximum flood stages has been on a continuous downswing since 1913. The last recorded flood above elevation 1310 was in March, 1956; above 1311 in March, 1942; and above 1312 in March, 1918. If we assume that the intensity of spring snowmelts and rainfalls has remained fairly constant over the past half century, there must be some other factors which have caused a reduction in the intensity of runoff from the watershed. Perhaps better farming methods and improved erosion control have helped, but the author believes that the main factor is the increasing area of the watershed coming into brush and forest cover since the turn of the century. The rate of natural reforestation has been enhanced by farm abandonment, particularly on the steeper slopes and hillsides which are difficult to farm. Studies on experimental watersheds throughout

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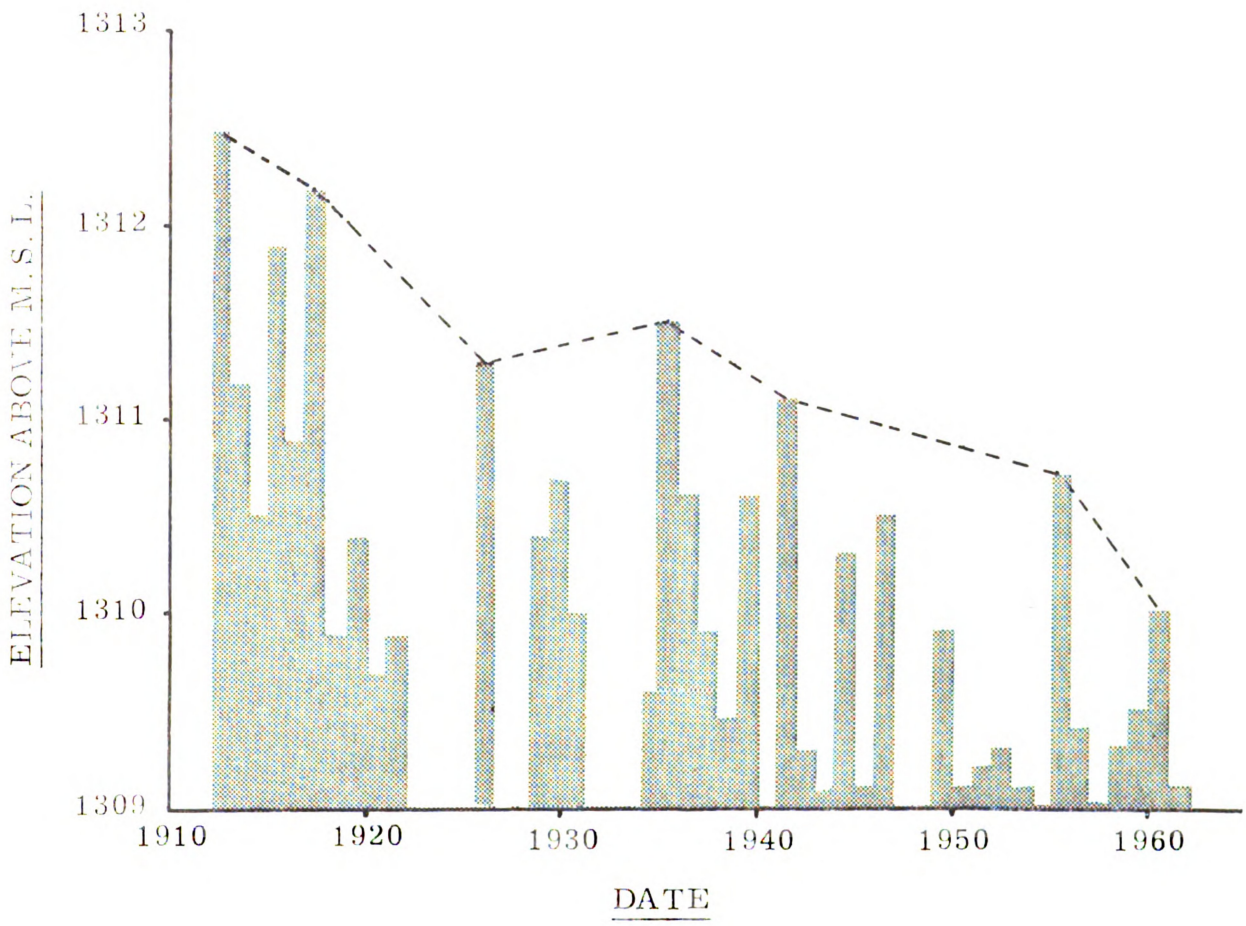
[1] Luensman, Planning Background Report #2, loc. cit., p. 35.

FIGURE 8. -- High Water Levels on
Chautauqua Lake 1912 - 1962



the nation have shown that increased forest cover absorbs more rainfall and thereby reduces the rate of runoff from the land surface. On the other hand, low stream flows during the summer may be due in part to the high evaporation and transpiration rates of forest vegetation.

An important aspect of the low streamflow situation is the recreational interests which are affected by low water levels in Chautauqua Lake. When the lake level drops close to elevation 1307, many areas along the lakefront have extremely shallow water, especially in the bay areas. There is the problem of bringing boats into shore without scraping the hull or breaking propellers. The area suitable for bathing around swimming beaches is reduced, as is the total shallow water area throughout the lake for other recreational purposes. Most activities on water take place near shore; therefore, crowding and conflicts between activities will be most intense in the shallow water zone. This space is used by people for swimming, placement of piers, anchoring of boats, shore and shallow water fishing, wildlife observation, etc. It is also the nesting, feeding and nursery area for fish and waterfowl.[1]

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[1]C. W. Threinen, Lake and Stream Classification, Recommendation No. 2 (Madison: Wisconsin Conservation Department, 1962). (Mimeograph Reports.)

Aquatic weeds often interfere with boat traffic during periods of very low water, especially in the busy Bemus Point-Long Point area. Dense weed beds exposed near the surface have at times slowed down or completely stalled boat traffic in sections of Bemus Bay. At such times special weed cutting machines have had to be employed in order to facilitate navigation. Two of these machines are presently owned by the Chautauqua Lake Association, and are in nearly continuous operation during the summer season.

Decreased water levels also tend to intensify the algae problem in the lower lake. There is less surface water available, and offensive odors are intensified both from the algae and from exposed aquatic weeds decomposing along the lakeshores. Recreational interests would benefit in a number of ways if the water level could be prevented from subsiding too low in the summer, but to estimate the direct monetary benefits from the maintenance of a "normal" water level is a difficult problem which nevertheless needs studying. For one thing, the Soil Conservation Service would like to have an estimate of the recreational value of a stabilized lake level in order to better figure the benefit-cost ratio of its proposed PL-566 Project for the Chautauqua Lake Watershed.

Mr. Luensman, of the Chautauqua County Department of Planning, prepared a brief report on "The Economic Value of a Stable Summer Water Level on Chautauqua Lake," which was released in

PLATE XV. -- Aquatic weeds can sometimes form beds dense enough to interfere with swimming or even with boating. The weed beds offshore from Magnolia in the upper lake show up as light textured patches in this aerial photograph. (Photo courtesy of the USDA-Soil Conservation Service, Jamestown.)

November, 1966. He suggests four major factors related to stabilized water levels which may affect the recreational utilization of Chautauqua Lake. These suggestions are: (1) that there is a correlation between the length of occupancy of seasonal cottages around the shores of Chautauqua Lake with the water levels of the lake; (2) that water levels of the lake alone do affect the amount of surface water available for boating activities; (3) that there may be a correlation between the level of water on the lake and the character and depth and quality of weed accumulation along the shores of the lake; and (4) based upon these estimates it is further suggested that the quality of water and water level on Chautauqua Lake may have an influence on the utilization of the lake, and that this influence factor or rate may be from 3% to 20% per year, depending on the onset of drawdown and the accumulation of matter along the shorelines of the lake.

The cost of fluctuating summer water levels to the recreational economy of Chautauqua Lake is probably in the range of several hundred thousand dollars annually. Mr. Luensman suggests that this figure may rest between $200,000 and $500,000 per annum. (This was based on his previous estimate that Chautauqua Lake's recreational attractiveness exclusive of the Chautauqua Institution

contributes an estimated $4,380,000 annually to the economy of Chautauqua County.)[1]

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[1] J. R. Luensman, "The Economic Value of a Stable Summer Water Level on Chautauqua Lake" (Mayville: Chautauqua County Department of Planning, November, 1966), p. 5.

CHAPTER VI

BIOLOGICAL PROBLEMS

Siltation

Many short streams within the watershed have a fairly high gradient due to the variation in elevation from the lake level to the surrounding hilltops (average variation is 200 to 400 feet). Fast currents combined with a short carrying distance to the lake give these streams considerable erosive force during the spring of the year following heavy rains or snow-melt. Sheet and gully erosion in the watershed result in heavy loads of silt and debris being washed into the lake. The sediments are deposited in the forms of deltas or "Points" around the lake periphery at the mouths of the various creeks. Many of the "Points" in both the upper and lower lake are these deltas which have been formed by centuries of erosional activity.

When the forest cover was removed from much of the watershed following settlement by the white man, the rate of stream erosion and siltation was probably increased considerably. Crop farming and poor soil management in the early 1900's undoubtedly

contributed to a high rate of topsoil erosion. Siltation in Chautauqua Lake and the lake outlet was a problem serious enough that the Soil Conservation Service made a study of Chautauqua Lake sedimentation in 1953. They concluded that the rate of sedimentation in the lake as a whole is relatively low, but in local areas, particularly where the tributaries enter the lake and the lake outlet, the rate is high.[1] The rate of silt deposition was estimated at 30,000 cubic yards per year.

Siltation causes problems around the creek deltas where the shallow water interferes with boat traffic. Aquatic weed growth may be increased by the layers of silt and topsoil which accumulate on the lake bottom, or are dispersed along the lakeshore by wave and wind action. The overall effects of siltation are probably less important in the lake than they are on the watershed from which the valuable topsoil is being eroded.

Probably the best way to reduce siltation in the lake is to apply modern soil conservation techniques on the farms throughout the watershed. This is presently being done by the Chautauqua County Soil Conservation District in cooperation with the U. S. Soil Conservation Service. In the opinion of local watershed authorities, siltation at the mouths of the creeks is no longer the problem

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[1] U. S. Department of Agriculture, loc. cit., p. 2.

PLATE XVI. -- The tributary streams to Chautauqua Lake generally form shallow deltas or "Points" offshore from where they enter the lake. This photograph shows the mouth of Prendergast Creek (with the State Fish Hatchery in the background) and the shallow, marshy Whitney Bay area. (Photo courtesy of the USDA-Soil Conservation Service, Jamestown.)

it once was.[1] The need for erosion control is still serious, however, and a well executed PL-566 Watershed Program may be the best means for achieving this control. One of the requirements of this program is that at least 50% of the land above water storage structure must be under agreement to carry out acceptable soil and water conservation practices.

Aquatic Nuisances

Chautauqua Lake is a relatively shallow lake. Although its total average depth is 23.5 feet, the mean depth of the lower lake is about half that of the upper lake (see Figure 3). In a limnological study of Chautauqua Lake made in 1937, it was noted that the amount of organic matter per unit volume of water trebled at the lower end of the lake when compared with the amount at the upper end.[2] The high organic matter in the lower lake is an indication of its much richer phytoplankton crop, and consequently of its greater productivity.

The 1937 study includes a vegetative survey which lists the various submergent and emergent plants found in the lake at that

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[1] Personal interviews with Mr. Homer Stennett, Director, U. S. Soil Conservation Service, Jamestown, July 5, 1966; and Mr. Curtis Bauer, Consulting Forester, and Chairman of the Chautauqua Lake-Chadakoin River Watershed Association, Jamestown, July 23, 1966.

[2] W. L. Tressler and Ruby Bere, "A Limnological Study of Chautauqua Lake" (in A Biological Survey of the Allegheny and Chemung Watersheds [Supplement to the Twenty-seventh Annual Report of the State of New York Conservation Department] by Emmeline Moore, et al., 1937), p. 196.

time. Apparently the densest beds of submerged aquatic plants were various pondweed (Potamogeton) species. Emergent sedges (Scirpus validus and S. americanus) were found primarily along the exposed stony beaches in the upper lake between Point Chautauqua and Long Point, but these are reduced along shorelines exposed to much swimming or boating activity.

Chautauqua Lake's rich and extensive aquatic weed growth undoubtedly contributes to its high productivity. As these plants die and decompose each year, they continually fill in the lake with an additional layer of organic muck. Although the widespread elimination of these weeds might be dangerous from an ecological viewpoint, local control to benefit swimming and boating interests is highly desirable, especially during periods of very low water. The two mechanical weed harvesters operated by the Chautauqua Lake Association provide one such means of control, and more recently the Association has experimented with chemical herbicides which were found to be very effective. Since the mechanical harvesters do not destroy the weeds permanently, perhaps a carefully controlled chemical herbicide program is the best answer for cleaning up the most serious weed problem areas such as at Bemus Point and the lake outlet.

A problem more serious and widespread than the weed problem is the algae problem, especially in the shallow lower half

of Chautauqua Lake. Dense algal growth, particulary of blue-green algae, is characteristic of highly productive (eutrophic) lakes which have neutral to alkaline waters and are abundant in nutrients. Chautauqua Lake in 1937 showed a decidedly alkaline pH reaction during the summer, and the production of phytoplankton was particularly high in the lower lake.[1]

The Chautauqua Lake Association has been treating the lake with copper sulfate in an attempt to rid the water of noxious algae since 1935. Initial efforts involved the simple procedure of towing 100-pound bags of copper sulfate behind a boat. Later on the Association bought a spraying rig which was in operation until a few years ago. None of these treatments had much of an effect on the lake's algal population.

Chautauqua Lake is too large an area to be effectively treated in this manner, and copper sulfate does not control the basic problem of overfertilization which produces these algae year after year. Partly as a result of pressure from the State Conservation Department, the Association decided to discontinue copper sulfate treatment of Chautauqua Lake. The treatment has not been effective, and copper sulfate has shortcomings in that it may in excessive concentrations poison fish and other aquatic life. It may also accumulate

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[1] Ibid., p. 201.

in bottom muds as an insoluble compound following extensive usage.[1]

A number of studies have shown that the availability of nitrogen and phosphorus is the most critical factor limiting algal production in natural waters.[2] Where natural runoff from a watershed does not provide sufficient nutrients for extensive algal growth, the nutrients contributed by domestic sewage can more than make up the difference. Inorganic forms of nitrogen and phosphorus, which are the main factors in providing fertilizing elements for algal blooms, are present in considerable amounts in treated domestic sewage. It should be noted that percolation of water through the ground does not materially reduce the concentration of various chemical constituents introduced.[3] Research on the movement of nutrients from household septic tanks has been very limited, but it is likely that nitrates diffuse underground into the lake quite readily, while phosphates are largely tied up even if they travel only a short distance through the ground. Leaching of nitrates is associated with

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[1] K. M. Mackenthun, W. M. Ingram and R. Porges, Limnological Aspects of Recreational Lakes (U.S. Public Health Service, Publication No. 1167, 1964), p. 146.

[2] Ibid., pp. 34-38.

[3] K. M. Mackenthun, Nitrogen and Phosphorus in Water (U.S. Public Health Service Publication No. 1305, 1965), p. 57.

soil water movement, but soil particles precipitate soluble phosphorus into insoluble aluminum and iron phosphates which are tied up in the soil.[1] The available information would indicate that the liquid effluents from household septic tanks probably retain much of their original nutrient load when they diffuse underground into the lake basin, but the phosphorus content of this effluent is an unknown factor.

Phytoplankton Indicators

Phytoplankton populations, since they are among the simplest forms in any lake, are usually the first organisms which show changes in a lake, not only in their qualitative but also from their quantitative aspects.[2] G. W. Prescott has studied some of the relationships of phytoplankton to lake productivity, whereby he compares the quality of algal flora with limnological characteristics of lakes. Prescott points out that the physical-chemical factors of the water environment act in selecting not only the quality of a flora, but in the case of algae, sometimes the quality also determines the quantity. The blue-green algae, to be specific, can carry on cell

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[1] R. L. Cook, et al., "The Extent of Water Pollution by Fertilizers Applied to the Soil" (Unpublished Project Report, Soil Science Department, Michigan State University, 1966), pp. 2-3.

[2] W. A. Dence and D. F. Jackson, "Changing Chemical and Biological Conditions in Oneida Lake, New York," School Science Mathematics, 59 (1959), p. 319.

division and vegetative reproduction at an astoundingly high rate in a favorable environment -- more so than the green algae. A lake supporting predominantly blue-green algae is typical of eutrophic lakes, and certain species of blue-green algae in a highly eutrophic lake often predominate at the expense of competing forms.[1]

According to results from a plankton determination made during the 1937 limnological survey, Chautauqua Lake was eutrophic as a whole, but the lower lake was considerably richer than the upper lake in both green and blue-green algae. Only one blue-green genus attained bloom proportions in the upper lake. This was Gloeotrichia, which on one or two occasions, particularly near shore, was abundant enough to form a bloom. Blooms of this colonial form were of common occurrence in the lower portion of the lake.[2]

It is the author's opinion that algal blooms will become an increasingly serious problem in the upper lake as well as in the lower lake unless something is done to reduce the inflow of nutrients from community sewage systems and from individual household septic tanks. Local watershed and water supply authorities interviewed by the author were concerned about the increasing "pollution" of Chautauqua Lake, but this pollution is more likely a problem of eutrophication or overfertilization.

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[1]G. W. Prescott, Algae of the Western Great Lakes Region (Dubuque, Iowa: Wm. C. Brown Co., 1962), pp. 43-44.

[2]Tressler and Bere, op. cit., p. 203.

Although no authoritative proof is available, in recent years the upper lake has shown signs of heading in the direction of the lower lake in terms of water quality. As one indication of this trend, the eastern shore of the upper lake had a bloom of Gloeotrichia throughout most of last August which was greater than any bloom which the author (who has resided periodically for 15 years at Point Chautauqua) or the local residents have yet seen. The bloom followed a heavy wind and rain storm which whipped the lake on August 11, and this apparently was a catalyst for the bloom. Prescott says about Gloeotrichia echinulata (which species this algae probably was) that

> conspicuous growths make a sudden appearance in lake plankton when large numbers of colonies become free-floating. Wind and waters and a change in physiology also act to bring about a scattering and vertical distribution so that a dense surface bloom may disappear as quickly as it developed.[1]

Fish Populations

Chautauqua Lake's sport fishery, particularly its muskellunge fishery, is one of the lake's most important recreational assets. The lake offers literally thousands of fishermen a chance to hunt the "King of Freshwater Game Fish" at a beautiful lake within a few hours' drive of three of the largest cities in the eastern United

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[1]Prescott, op. cit., p. 558.

States. Chautauqua Lake residents may honestly brag about the fact that it is the "world's muskiest lake," because New York State Conservation Department records prove that it produces more muskellunge than any other single lake in the world. Annual catches range from 6,000 to 9,000 legal-size muskellunge, or from 30 to 50 tons of these highly prized sport fish. Since muskellunge are almost completely carnivorous in their feeding habits, Chautauqua Lake has to be an extremely rich lake simply to produce enough food fish to maintain the muskellunge population. Besides muskellunge, the lake has a large population of smallmouth and largemouth bass, and very recently the walleyed pike also seems to have become established. Chautauqua Lake has a tremendous population of panfish which serve as a food supply for the larger predatory species. The most abundant rough fish are the common sucker, carp, and long-nosed garpike. No special control program for these fish is now in effect, but apparently neither the muskellunge nor the bass sport fishing has suffered from their presence.

The management of the fish population in Chautauqua Lake is under the jurisdiction of the New York State Conservation Department. The first muskellunge hatchery in the United States was established at Bemus Point in 1890, and in 1910 the state built the first hatchery designed strictly for muskellunge production.

PLATE XVII. -- A proud fisherman displays this hefty "Tiger" Musky taken from Chautauqua Lake. (Photo courtesy of the Jamestown Post-Journal.)

The hatchery was enlarged and moved across the lake to Prendergast Point, where it became fully operational in 1957.

Each spring the hatchery crew nets adult muskellunge from the lake, strips them of eggs and milt, and incubates the fertilized eggs in a battery of hatching jars. The resulting fry are raised in open ponds to fingerling size (from 3 to 8 inches in length), fin-clipped and then released into Chautauqua Lake. Since 1951 the Prendergast State Fish Hatchery has been stocking an average of 19,000 muskellunge fingerlings per year. Apparently their rate of survival is excellent because, according to Mr. Norton, the hatchery supervisor, 20% of the muskellunge caught in their nets last summer were clipped fish from the hatchery fingerling stock.

I asked Mr. Norton about the sudden appearance of walleyed pike throughout the lake, since many muskellunge fishermen have expressed concern about the possible effect of this new source of competition on the population of their favorite game fish. The regional fishery biologists are concerned also, because they can only speculate on what effects the walleyed pike will have on the other fish populations.

According to Mr. Norton, there has been a very small population of walleyed pike in Chautauqua Lake for at least 40 years because at rare intervals the hatchery crew would catch one or two in their nets. Two years ago, however, the population started to

increase, and last spring the Conservation Department found heavy spawning by walleyed pike in many of the lake's tributary streams. Walleyed pike caught in the hatchery nets last spring averaged 2 to 3 pounds in weight, and one of the largest walleyes measured 26 inches.

Since walleyed pike are common in both eutrophic and oligotrophic lakes, it is difficult to say what biological stimulus has caused this sudden upsurge of the walleyed pike population.

Chironomid "Lake Fly" Control

Certain species of Chironomid "lake flies" which hatch out of Chautauqua Lake each year are regarded as serious pests by the lakeshore home owners because of their great numbers and because of their habit of depositing sticky masses of eggs on windows, walls, and nearly any surface with which they come into contact. The populations of these pests fluctuate considerably from year to year, but during their peak years they can raise havoc with the lakeshore residents.

The Chautauqua Lake Association has attempted to control lake flies with fog or mist blowers in those areas which are hardest hit by these pests, but the success of such control has been limited. In 1956, Ernest Bay, a graduate student from Cornell University, began a study of Chautauqua Lake's lake fly problem which was

culminated by a Ph.D. thesis published in 1960.[1] Although Mr. Bay attempted to obtain permission from the State Conservation Department to conduct limited experiments at controlling lake fly larvae in Chautauqua Lake by means of chemical insecticides, such permission was never granted. The Chironomid larvae are an important source of food for smaller fish, and primarily to protect both the larvae and the fish, the control of lake flies by chemical means has been restricted to spraying and fogging of the flying adults.

Pollution in Chautauqua Lake

With respect to water related problems, no single subject can cause more storm and controversy around Chautauqua Lake than the subject of pollution. Pollution is an ugly word in a community which depends heavily on recreational traffic for its income. In 1964, when Chautauqua Lake received adverse publicity out-of-state with respect to pollution, the recreational business dropped off considerably.[2]

Is Chautauqua Lake polluted? In order to answer this question we must first define pollution, preferably in terms of facts

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[1] E. C. Bay, "The Feasibility and Advisability of Chironomid Control with Special Reference to Chautauqua Lake, New York," (Ph.D. Thesis, Cornell University, 1960), 184 pp.

[2] Personal interview with Mr. Facciani, Director, Environmental Health Services, Chautauqua County Department of Health, July 18, 1966.

and figures that can be measured. There are three primary methods by which we can measure pollution, but unfortunately no single one of these measures is completely reliable or easily comparable to another. Public Health officials may measure pollution in terms of the numbers of harmful bacteria which can make water unfit for drinking or even swimming. The most commonly used method is a test for most probable number (MPN) of coliform bacteria (B. coli), which are found in the mammalian digestive tract and enter the water through sewage effluents. Public health officials recommend that any water with even a trace of B. coli organisms should be treated (at least chlorinated) before it is used for human consumption. The presence of this organism is merely an indication that other more virulent organisms may also be present, such as dysentery, typhoid, and hepatitis. Public swimming is not recommended in waters which contain over 1,000 B. coli per 100 ml.[1] Samples taken at public swimming beaches by the County Health Department last summer show that the MPN coliform bacteria count at most of the beaches around Chautauqua Lake was quite low. With the exception of one unusually high reading at Bemus Point (which may have been due to harmless forms of B. coli), the average count at nine of the public

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[1] J. E. McKee and H. W. Wolf, Water Quality Criteria (Sacramento, California: California State Water Quality Board, Pub. No. 3-A, 1963), p. 119.

beaches was only 33 MPN B. coli per 100 ml.[1] Table 3, below, shows the results of the coliform bacteria analyses.

TABLE 3. -- Most Probable Number (MPN) Coliform Bacteria Counts at Public Swimming Beaches around Chautauqua Lake, May-August, 1966

Public Swimming Beach	Number of Samples	Average Count MPN B. coli per 100 ml.
Lakewood	9	27
Burtis Bay	7	50
Mayville Beach	14	22
Chautauqua Institution	5	42
Point Chautauqua	10	20
Cheney Point	13	23
Bemus Point	5	653
Prendergast Point	8	20
Lakewood YMCA	6	35
Lakewood YWCA	6	61

A second widely used procedure for measuring water quality is a measure of the various physical-chemical characteristics of water, such as dissolved oxygen content, biochemical oxygen

[1]Memorandum from Mr. Facciani of the Chautauqua County Department of Health on results of a bacteriological analysis of Chautauqua Lake. This investigation was conducted by the County Health Department during May through August, 1966.

demand (B.O.D.), alkalinity, conductivity, etc. Other factors such as the concentration of elements and nutrients in the water may also be measured. The determination of the chemical-physical characteristics of water is better known as the field of limnology, or the study of the limnological characteristics of lakes and streams.

Since chemical-physical characteristics of water also determine what plants and animals can exist there, the third method of measuring water quality is the biological method. For example, the trophic condition of a lake or river may be determined from the relative quantity and the quality of its phytoplankton, as was explained in the section on Aquatic Nuisances.

From a biological viewpoint, if we choose to define pollution as any change in the quality of water from its natural state, pollution is inevitable but not necessarily undesirable. As an example, the high productivity of Chautauqua Lake would not be possible without its abundance of aquatic plants and organic material.

From a moral and economic viewpoint, however, if we define pollution as the indiscriminate disposal of domestic and industrial wastes into a body of water, then pollution becomes highly undesirable.

Sources of Organic Wastes

Chautauqua Lake is not polluted in terms of public health. The New York State Department of Health has declared its waters suitable as a source of public water supply, and coliform bacteria counts taken by the Chautauqua County Department of Health averaged well below the level considered dangerous for public bathing. In terms of its biological characteristics, however, the lake is showing some signs of pollution. Pollution has been commonly thought of in terms of industrial and municipal wastes, but the recent nationwide interest in water quality has also brought more focus upon the pollution of lakes by individual households. A leader in the recognition of this problem is the State of Wisconsin, which enacted legislation just last year for the protection of its water resources from the household wastes of individual lakeshore residents, as well as from municipalities and industries. Wisconsin's new water regulations take a much broader view of water quality. They are still concerned with keeping waters healthful and safe, but they are also concerned with the problems of overenrichment of lakes and streams.[1]

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[1] Wisconsin Conservation Department, "Water Law Story," (unpublished mimeo report by the Wisconsin Conservation Department, Madison, July 29, 1966).

Chautauqua Lake presents a situation similar to many of Wisconsin's recreational lakes. The problem is not so much one of industrial pollution as of lake fertilization from the accumulated waste discharges of municipal sewage plants and lakeshore residences. Only one industrial plant presently discharges its wastes into the lake. This is the Chautauqua Malted Milk Company, Inc., in Mayville. This plant discharges a considerable load of organic processing wastes into the lake, and according to Mr. Facciani of the County Health Department, its B.O.D. load is equal to that of the Villages of Mayville and Lakewood put together. Some action should be taken to prevent the plant from discharging its processing wastes into the shallow north end of the lake.

The municipal wastes of the Villages of Mayville, Lakewood, and Celoron, the Chautauqua Institution, and the Chautauqua Shores community, presently receive only primary treatment. Primary treatment is a minimal treatment in which organic matter is reduced 20-40% by screening and settling. The larger and heavier particles of sewage may settle out, but the liquid effluents which end up in Chautauqua Lake contain nearly 100% of their raw nutrient load -- there is no nutrient removal from the liquid. If these plants were to convert to secondary treatment, the organic matter would be further reduced, but the liquid effluents from treated domestic sewage would still retain a high concentration of phosphorus and

PLATE XVIII. -- The collective wastes from individual septic tanks along a heavily developed shoreline may add up to a considerable load of nutrients. Boats with private toilet facilities also add to this problem.

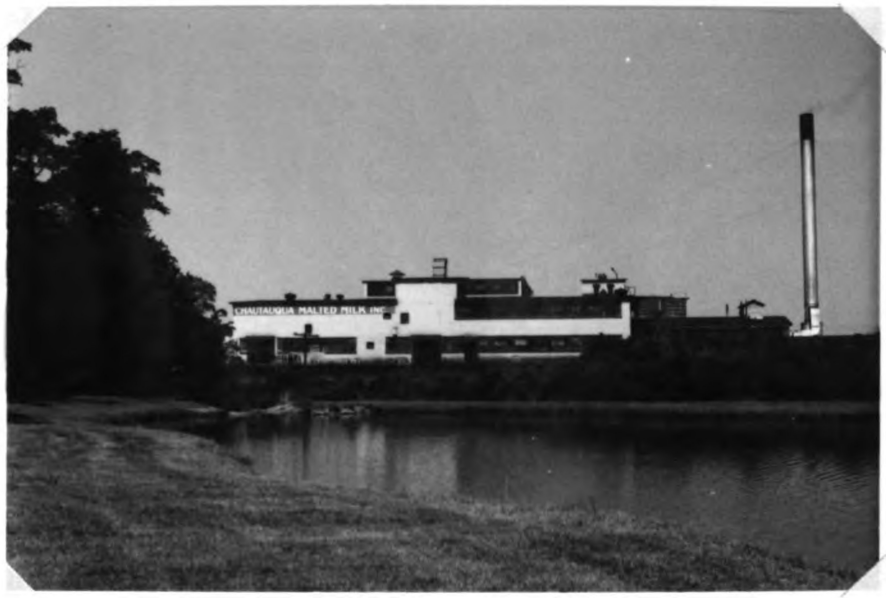

PLATE XIX. -- This industrial plant near Mayville discharges milk processing wastes into the Little Inlet which flows into the north end of Chautauqua Lake.

nitrogen nutrients.[1] Nutrients should be removed from sewage effluents as completely as possible (by various forms of tertiary treatment), but no inexpensive method for doing this has yet been developed.

Household septic tanks afford about the same level of treatment as primary sewage plant treatment, depending on the type of soil and the method of tank construction and installation. Solid wastes may be settled, digested, and filtered out in the soil, but contrary to popular belief, the septic tank does not remove a large proportion of harmful microorganisms from the waste.[2] Studies have also shown that nitrates appear to be transported by ground waters without significant reduction by earth materials, and that percolation of water through the ground effects only partial removal of nutrients.[3] Since the ground water beneath the lake-shore residences does not have to flow far in order to reach the lake, a considerable load of nutrients may continually enter the lake by this means.

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[1] Mackenthun, (1965), op. cit., p. 5.

[2] J. M. Cain and M. T. Beatty, "Disposal of Septic Tank Effluent in Soils," Journal of Soil and Water Conservation, Vol. 20, No. 3, May-June, 1965, p. 101.

[3] Mackenthun, (1965), loc. cit., p. 57.

Eutrophication

Eutrophication is a scientific term for the natural process of accelerated enrichment and filling of lakes which occurs in the latter stages of their geologic existence or "life span." In terms of geologic time, every lake has a period of creation (such as the lakes created by glaciers throughout much of the northern United States and Canada), followed by an indefinite period of geologic time which will sooner or later end up in the filling of that lake by sediments and organic matter. Open lakes serve as "settling basins" for sediments introduced by inflowing streams. As a tributary stream loses its carrying capacity at the entrance to the lake, the suspended materials carried by the stream settle out and gradually fill in the lake basin.

As a lake becomes shallower from introduced sediments and organic material, it generally becomes increasingly productive for plant and animal organisms. Increasing amounts of nutrients are released from the bottom muds during the spring and fall overturn periods, thereby triggering a cycle of increased organic production. Organic materials settle to the bottom after death, thereby adding another layer of bottom sediments and nutrients each year. The extinction of a lake by way of eutrophication is probably hastened by

organic sedimentation to a greater degree than by inorganic processes.[1]

Chautauqua Lake taken as a whole is eutrophic in terms of its productivity, but the upper lake is considerably less eutrophic than the lower lake. The 1937 limnological survey showed that organic matter and the associated phytoplankton increased steadily from north to south down the length of the lake (see Figure 9).[2] A series of 11 stations were sampled on August 12, 1937, from the upper end of the lake to the lower end, and samples for phytoplankton and organic matter were taken at one meter depth. Table 4 on page 107 shows the results of this investigation.

Lake Fertilization

Although eutrophication is basically a natural process which man cannot readily control, the rate of eutrophication can be accelerated considerably if domestic sewage wastes are allowed to enter a body of water. Hasler in 1947 made an extensive study of the eutrophication of lakes by domestic sewage throughout the United States and Europe. The conclusion of his study was that "from all evidence so far received, where there is a heavy flow of surface

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[1] A. D. Hasler, "Eutrophication of Lakes by Domestic Drainage," Ecology, Vol. 28, 1947, p. 391.

[2] Tressler and Bere, loc. cit., p. 206.

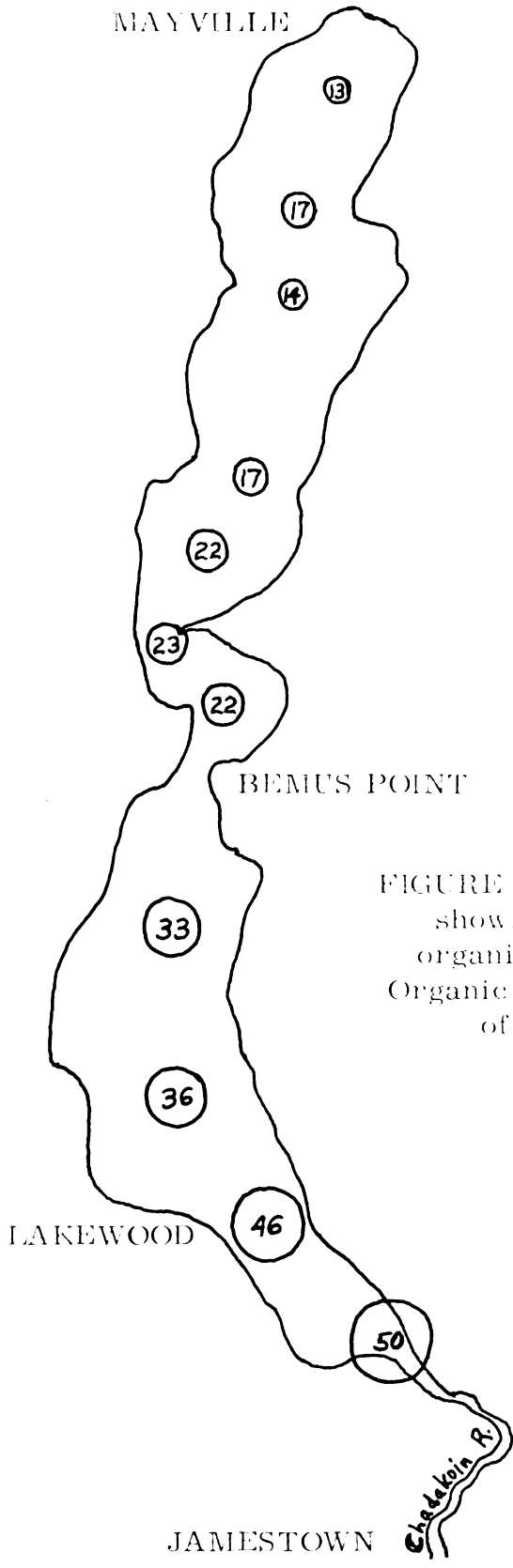

FIGURE 9. -- A Map of Chautauqua Lake showing horizontal distribution of organic matter on August 12, 1937. Organic matter is shown as the number of thousands of milligrams per cubic meter.*

*Adapted from E. Moore, et al., A Biological Survey of the Allegheny and Chemung Watersheds, p. 206.

drainage from agricultural lands or especially from urban sewage, oligotrophy [low level of lake enrichment] may change to strong eutrophy in the short period of a few decades."[1]

TABLE 4. -- Horizontal Distribution of Phytoplankton and Organic Matter in Chautauqua Lake at One Meter Depth on August 13, 1937

(Plankton figures are in terms of thousands of organisms per liter; organic matter is shown as milligrams per cubic meter. Station 1 is at the north end, Station 11 off Celoron dock.)*

Station	Greens	B. Greens	Diatoms	Copepoda	Cladocera	Org. Mat.
1	95	103	467	24	13	1,360
2	95	95	570	33	24	1,760
3	86	259	562	25	15	1,440
4	79	199	631	43	19	1,750
5	103	337	770	25	12	2,220
6	173	588	527	36	18	2,370
7	173	441	553	13	16	2,220
8	103	622	1,020	13	40	3,280
9	181	484	994	19	53	3,590
10	224	612	752	35	86	4,580
11	164	1,245	190	24	39	4,950

*Table adapted from Tressler and Bere, "A Limnological Study of Chautauqua Lake," p. 212.

The rapid acceleration of this process is not in the best interests of a recreational lake such as Chautauqua Lake, because

[1]Hasler, op. cit., p. 391.

there is no way known at present for reversing the process of eutrophy. Figure 10 shows a hypothetical curve of the course of eutrophication in a lake. The broken lines show the rapid increase in productivity characteristic of lakes which receive domestic fertilization (a) in the oligotrophic stage, or (b) in the eutrophic state.

Domestic wastes speed up the eutrophication process by fertilizing the lake with nutrients which are required for increased plant growth. Algae require nitrogen and phosphorus for their best growth, but in many natural waters these elements are not common enough to permit extensive algal development. If enough domestic wastes are allowed to fertilize the water, however, noxious algal blooms may develop far in excess of what the lake could produce naturally. Another common source of artificial nutrients is the runoff from agricultural lands.

There is no fine line which can be drawn between human-caused eutrophication and pollution. Some measure of increased eutrophication is bound to occur wherever a body of water is surrounded by human habitation. Perhaps pollution may be best defined as anything which would degrade the primary uses of a lake or stream.

If we assume that recreation is the best use of Chautauqua Lake waters, we would <u>not</u> want to increase the rate of eutrophication primarily because of the associated algal and aquatic plant problems. Water quality in terms of recreational use is not usually

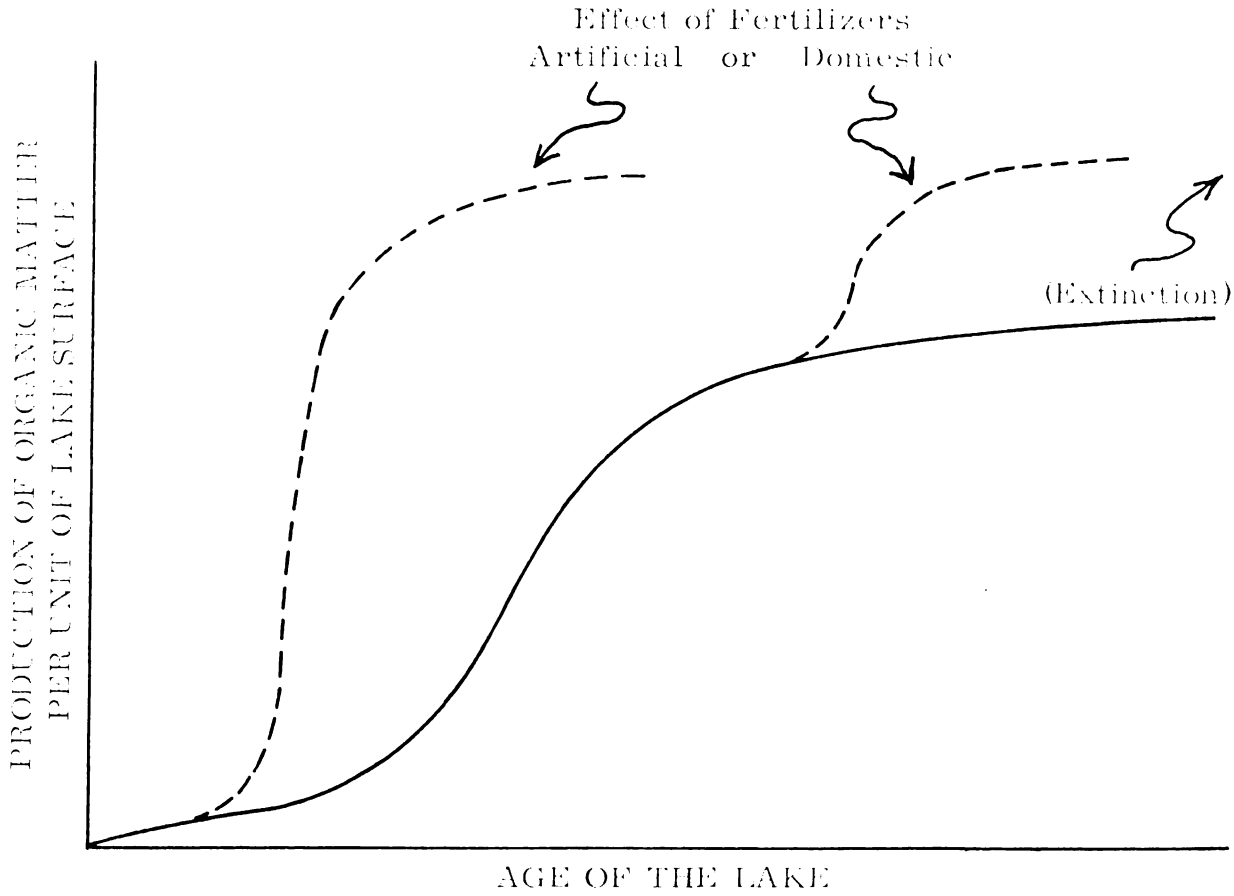

FIGURE 10. -- Hypothetical Curve of the Course of Eutrophication in a Lake

The broken lines show the rapid increase in productivity characteristic of lakes which receive domestic fertilization (a) in the oligotrophic stage or (b) in the eutrophic stage.*

*Taken from Hasler, "Eutrophication of Lakes by Domestic Drainage," p. 391.

enhanced by lake fertilization, and in this respect the artificial eutrophication of Chautauqua Lake definitely is a form of pollution.

Author's Conclusions

In summary, the author has no quantitative evidence to prove that the rate of eutrophication in Chautauqua Lake has been accelerated by fertilization from domestic sewage. I have attempted to point out the possibility that the expanded lakeshore population has increased the amount of organic nutrients entering the lake, and that this may cause problems which can affect the quality of the water in Chautauqua Lake. The heavy and extended bloom of the blue-green algae, Gloeotrichia, which occurred in the upper lake last summer, is an unhealthy sign that the upper lake may have reached a certain trophic stage whereby similar algal blooms may be expected to continue in the future. Swimming in the algal "pea soup" was not too inviting for the author last August, and most upper lake residents would probably want to prevent algae from becoming as much of a nuisance in the upper basin as they are in the lower basin of Chautauqua Lake.

About the only way that the nutrient load from the lakeshore homes and communities could be reduced significantly would be by the construction of a public sewer system completely around the lower and the upper lake basins. This would be worthwhile only

if the collected wastes could be treated so as to remove nitrogen and phosphorus nutrients. The author would suggest that if separate public sewer systems were to be constructed around Chautauqua Lake, the one around the upper lake should be constructed first because it has a higher quality of water which should be protected immediately. The lower lake is already in such a eutrophic condition that a public sewer system would not likely benefit water quality as much as in the upper lake.

CHAPTER VII

PRESENT LAKE MANAGEMENT

Although Chautauqua Lake is the single most important resource within the watershed region, to date there has been no specific agency or agencies charged with the planning and guidance for this valuable resource. Developments around the lake have thus far come about largely by three means: (1) without planning or by accident, (2) as a result of agitation by single-interest groups, or (3) as a result of action taken in the wake of natural disasters or serious problems and nuisances. No program has yet been developed to best meet the needs and desires of all the interest groups who have a stake in proper lake management. It is hoped that the proposed Watershed District Association will be the first important step forward in this direction.

County and Local Agencies

Some of the county agencies involved in one form or another with Chautauqua Lake are the following: the Chautauqua County Department of Planning, the Chautauqua County Department of Health, and the County Sewer Agency.

Under the able guidance of Planning Director, John R. Luensman, the Department of Planning has produced several excellent reports and publications to which the author has referred freely in the course of his own study. Although the Department of Planning can draw up plans and make recommendations, it has no legal powers to enact them. Legal authority for zoning, platting, and building restrictions in New York State is entirely in the hands of the local cities, towns and villages.

The Chautauqua County Department of Health first became effective in January, 1965, and the Department has not yet had the time or the manpower to make any comprehensive studies for detecting sources of pollution around Chautauqua Lake. Their activities now are mainly limited to checking up on complaints of alleged pollution. One of their most widely publicized actions was the condemnation of the Burtis Bay beach near Jamestown last summer, but the primary reason for this condemnation was not so much a high coliform count as the health hazard due to the poor location of the public swimming beach. It is located within 2,000 feet of the Lakewood sewage plant outlet.[1] More recently, the County Health Department also completed a coliform bacteria survey at all of the public swimming beaches around Chautauqua Lake. The results of this survey have already been discussed.

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[1]Personal interview with Mr. Facciani of the Chautauqua County Department of Health, July 18, 1966.

A County Sewer Agency has been operating for eight years, and has participated in the survey for a proposed sewer district in the lower lake. The agency is powerless to act without permission from the lakeshore towns, and no action yet has been taken on the proposed sewer project.

The actual legal and political power for enacting zoning regulations or governing the pattern of lakeshore development around Chautauqua Lake lies in the hands of the governments of the Towns of Ellicott, Busti, North Harmony, Chautauqua, and Ellery. These Towns may appoint planning boards and zoning commissions which have the legal authority to enact and enforce regulations regarding the use of their respective waterfronts. The major difficulty with this sort of government is that no single town has to follow the same guidelines as the others, and unified action is often difficult to achieve.

Among the local agencies, the most active organizations presently working on lake problems are the Chautauqua Lake Association, the Chautauqua Lake-Chadakoin River Watershed Committee, and the Chadakoin River Commission, which is appointed by the City of Jamestown to operate Warner Dam.

The Chautauqua Lake Association, Inc., is a "Federation of organizations, business firms and individuals working to improve Chautauqua Lake." The Association was chartered in 1953 as a

non-profit membership corporation for the purpose of improvement and maintenance of Chautauqua Lake. It is not a promotional organization. (The Chautauqua County Vacationlands Association, with headquarters in Jamestown, is the chief promotional organization for advertising the county's recreational assets.) An advisory group affiliated with the Chautauqua Lake Association is the Chautauqua Lake Council, which consists of member community associations, civic groups, etc. Each of these member groups send delegates to the Council, who have one vote apiece. The purpose of this Council is to gain community support for the maintenance programs of the Association. (The Chautauqua Lake Association has no lake management programs or authority.) Other than sportsmen's clubs, the Chautauqua Lake Association is the only organization which has been able to get any political and economic backing for the interests of the recreational segment of the lakeshore population. Although its program is largely one of remedial action to combat problems which have attracted sufficient public concern, the Association fulfills a very important role with its clean-up and maintenance programs.

Most of the Association's work is done through various committees which are appointed to investigate such problems as pest control (to control lake flies), weed control, pollution control, soil conservation, legislative affairs, etc. These committees are also charged with carrying out the various programs, using funds

collected annually from Chautauqua Lake residents on a voluntary basis.

The Association' s Legislative Affairs Committee drafted a $250,000 Chautauqua Lake Improvement Authorization Bill which was passed by the New York State Legislature in 1955 to carry on projects beyond the capacity of local funds to handle. To date the State has spent over $175,000 of this authorization for dredging, weed control and pile removal. The Association was also instrumental in launching a watershed district proposal which first promulgated the PL-566 Watershed Plan.

From 1953 through 1965, the Association has spent $241,150, while the State of New York has spent $175,000. Since 1959, the Association has spent $82,000 for the control of nuisance weeds. Last year the Association purchased a second weed harvester at a cost of $24,500 to be used on the lake all summer. The weed control committee also experimented with new chemical herbicides. 2, 4-D had been used previously, but a new chemical called Ortho-diquat was found to be more effective.

The Chautauqua Lake-Chadakoin River Watershed Committee was first formed by local people who were opposed to the Corps of Engineers Flood Control Program. These people maintained that although the Corps of Engineers program would undoubtedly provide the best method of controlling floods in the Chautauqua

Watershed, it would not solve some of the watershed's more important problems such as stream erosion and sedimentation, the need for a summer flow of water through the Chadakoin River, and the most serious problem of low water levels in late summer. The Corps proposed to maintain the lake level at a fixed elevation of about 1308.6, but one wonders how they could have maintained that elevation after the end of June when the rate of evaporation from the lake exceeds the rate of inflow from the watershed. Primarily for these reasons, the Watershed Committee was more in favor of a Federal PL-566 Watershed Project, which could provide the necessary additional water for raising the summer lake level by means of stored water in a series of small upstream impoundments. Three years ago, in 1964, the Corps of Engineers attempted to go ahead with their Flood Control Project, but the Watershed Committee succeeded in raising enough local opposition to force the Corps to abandon its proposed project for an indefinite period.

At the present time, the Chautauqua Lake-Chadakoin River Watershed Committee is the principal local organization working to raise interest and cooperation in the Chautauqua Lake PL-566 Watershed Project. It is cooperating in this endeavor with the local Soil Conservation Service office in Jamestown.

The regulation of Warner Dam is presently in the hands of the Chadakoin River Commission, which is in turn appointed by

the City of Jamestown. The State of New York built the existing Warner Dam in 1913, but since the site on which the dam was built was owned by a group of riparian industries and other land owners known as the Warner Dam Association, the State allowed that Association to take charge of regulating the dam. The Association was instructed to keep the lake level within a 2 foot limit between elevation 1308 and 1310. For several decades the Association operated the dam with no special effort to control floods or low levels. Apparently the dam was operated on a day to day basis depending on the needs of the interested parties downstream. Several years ago, the Warner Dam Association wanted to discontinue the operation and maintenance of the dam. They tried to get the City of Jamestown to take over its operation, without any success, until eventually they declared an ultimatum saying that they would cease operating the dam. Since the City's municipal power plant uses water from the Chadakoin River, the City had no choice but to take over control of the lake level by default. They had to repair the dam first; and after it was repaired, they appointed the Chadakoin River Commission to operate it.

The Chadakoin River Commission has done a much better job of regulating the lake level than the Warner Dam Association, but the dam is still operated on the basis of personal judgment and

experience rather than on a scientific basis.[1] Presently the Chautauqua Lake-Chadakoin River Watershed Committee is working in cooperation with the Soil Conservation Service to develop a scientific schedule for operating the Warner Dam.

According to Mr. Melvin Swanson, Chairman of the Chadakoin River Commission, the City of Jamestown can handle a flow of 2,000 cubic feet per second (c.f.s.) without flooding. The maximum flow of the Chadakoin River since 1934 was recorded in the Village of Falconer in April, 1947, when the maximum discharge was 2,050 c.f.s. The minimum flow of 2.7 c.f.s. was recorded in August, 1960.[2] In more recent years, the average maximum flow has been about 1,500 c.f.s., and the minimum flow has sometimes gone below 5 c.f.s. When the level of Chautauqua Lake drops below 1308 during the summer, the gates on Warner Dam are raised to prevent the lake level from dropping further down. This means that the flow through the Chadakoin River is reduced. When the lake level goes down near 1307, the flow through the Chadakoin is almost nil, and the industries which normally withdraw their processing water from the river must turn to the city water supply at the very time when domestic demand is at its peak. Mr. Swanson believes

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[1] Personal interview with Mr. Melvin Swanson, Chairman, Chadakoin River Commission, September 22, 1966.

[2] U. S. Army Corps of Engineers, loc. cit., p. 19.

that a minimum summertime flow of 60 c.f.s. would be enough to satisfy present industrial demands. He is very much in favor of the proposed PL-566 plan for impounding the necessary water to maintain this minimum flow in the Chadakoin River.

State and Federal Agencies

Among the governmental agencies of the State of New York, the two most directly concerned with Chautauqua Lake are the State Conservation Department and the State Water Resources Commission.

The work of the Conservation Department at the Prendergast State Fish Hatchery has been discussed under Fish Populations. The Department also has jurisdiction over any kind of biological regulation such as weed and algal control that would affect fish life. Another Conservation Department Project is the building of the new Long Point State Park. With the two State Hatchery facilities, this brings to three the number of State-owned public sites on the shores of Chautauqua Lake.

The New York State Water Resources Commission consists of the heads of the Departments of Conservation, Agriculture and Markets, Health, Commerce, Law, and Public Works, and is the major governing body for handling the State's water resources. It is assisted by the Temporary State Commission on Water Resources

Planning, which has been working to develop a comprehensive, multipurpose planning program for management of New York's water resources on a statewide or regional basis.

The Water Resources Commission is working primarily through a regional approach to water resource management under the provisions of the 1962 Water Resources Planning Law (now Part V of Article V of the N.Y.S. Conservation Law).[1] This Law outlines the procedures by which a regional water resources board can be established. So far three of these regional boards have become effective -- the Erie-Niagara Region around Buffalo, the Cayuga Region around one of the Finger Lakes, and the Wa-Ont-Ya Region (Wayne-Ontario-and Yates Counties) in central New York. The regional board is composed of seven members nominated by county boards of supervisors, at least five of whom must represent special interest groups including municipal corporations within the region, agricultural and farming interests, industry, outdoor recreation, and public water supply. In effect, the Water Resources Planning Law provides for a regional approach to meeting local water problems.

In order to form a regional water resources board, an interested county or counties must first prove to the Water Resources

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[1]New York State Water Resources Commission, Water Resources Planning, Today -- Key to a Better Tomorrow (Albany: State of New York Conservation Department, Division of Conservation Education, 1962), p. 6.

Commission that there is a real need for water resources development in its area, and that local people have the interest and initiative to do something about it. The interested parties must then go through a series of procedures which are outlined in Part V of Article V of the Conservation Law.

Chautauqua County has applied for a regional program, together with Cattaraugus and Allegany Counties, through the Southwestern New York Resource Development Project. The program is still in a preliminary stage, although the Boards of Supervisors of the three counties involved have passed a resolution to make an application together for a regional program. When the author interviewed the regional extension agent this summer, the regional office in Ellicottville was working with the Boards of Supervisors of the three counties to make the application for a water resources study.

The Water Resources Commission is also the official state representative for cooperating with the Soil Conservation Service in the Federal Watershed Protection and Flood Prevention Act (Public Law 566).

Federal Agencies

The U. S. Army Corps of Engineers and the U. S. Soil Conservation Service have been the two federal agencies primarily

involved in watershed planning for the Chautauqua Lake region. The projects proposed for the watershed by these two agencies will be discussed in the following chapter.

CHAPTER VIII

PROPOSED WATERSHED MANAGEMENT PROGRAMS

Corps of Engineers Flood Control Project

The U. S. Army Corps of Engineers has been working on a project to control flooding around Chautauqua Lake since the early 1940's. In 1950 they proposed a plan for control and diversion of flood waters from Chautauqua Lake to Lake Erie via Little Chautauqua and Chautauqua Creeks, and systematic seasonal regulation of the water surface elevations of Chautauqua Lake. This was to be combined with improvement of the Chadakoin River from Warner Dam to Boatlanding and rehabilitation of Warner Dam at Jamestown, at an estimated federal cost of $5,650,000 and an estimated non-federal cost of about $1,020,000.[1]

The Chautauqua Creek Basin lies along the northwestern edge of the Chautauqua Lake Basin. Chautauqua Creek flows down

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[1]U. S. Army Corps of Engineers, Water Resources Development by the Army Corps of Engineers in New York (U. S. Army Engineer Division, North Atlantic, 1961), p. 62.

the escarpment through a precipitous channel known as the Chautauqua Gorge, down to the Lake Plain through the Village of Westfield, and enters Lake Erie at Barcelona, New York. The proposed diversion would release flood waters at the north end of Chautauqua Lake by a gated dam and diversion channel 3 miles in length, through the northern divide of the basin into the small eastern branch of Chautauqua Creek. Systematic regulation of the Chautauqua Lake level was to be achieved by the combined operation of the proposed diversion dam together with Warner Dam on the Chadakoin River.

There is little doubt that the flood control program proposed by the Corps would be fully able to handle all but the most unlikely storms, since the diversion channel alone would be able to release a maximum of 4,500 c.f.s. of storm water. The maximum discharge in the Chadakoin River since 1934, when a continuous recorder was installed at Falconer, has only been 2,050 c.f.s. However, one wonders how the Corps plans to maintain the lake level above 1308 in late summer, when loss from the lake through evaporation exceeds the inflow from precipitation. It would seem obvious that when the lake level starts receding in late June or July, the Corps would have to close up the release gates on the diversion channel and do the same at Warner Dam, but the lake level would keep on dropping nevertheless, as it always has in

August. The recreational interests would be left high and dry, and the industries along the Chadakoin River would again have to turn to the City of Jamestown for their water supply. In other words, the Corps of Engineers' program may be the right solution in terms of flood control, but it does nothing to solve the watershed's low water problems.

It is primarily for this reason that the Chautauqua Lake Association, the Chautauqua Lake-Chadakoin River Watershed Committee, and the City of Jamestown fought against the Corps Project, and finally succeeded in having it postponed indefinitely in 1964. Other reasons for opposing the Flood Control Project were the following:

1. Flood problems have been on a continuous decrease since the turn of the century. Few local people believed that annual flood damages along Chautauqua Lake and the Chadakoin River amounted to $250,000 per year.
2. The Corps Project had no provisions for controlling erosion and sedimentation from the lake's tributary streams.
3. The Corps Project had no solution for the area's water supply problems, nor would recreational demands be met during the important summer tourist season.
4. Flood damages could be largely eliminated at a much lower cost if better zoning laws could be enacted and

enforced in order to prevent development on the flood plain of Chautauqua Lake and the Chadakoin River. Building in these areas should not have been allowed in the first place.

5. The local people viewed the Corps Project as a rather expensive federal flood control project which offered no solutions to many of the other important local water problems.

U. S. Soil Conservation Service Watershed Protection and Flood Control Program (PL-566)

The Watershed Protection and Flood Prevention Act (Public Law 566) is designed for "protecting, managing, improving and developing the water and related land resources of a watershed up to 250,000 acres in size through a project-type undertaking."[1] A project is planned and carried out jointly by local, state and federal agencies with the full understanding and support of a large majority of the landowners and citizens of the community. One of the outstanding features of this program is that it is designed to be a local program with federal assistance rather than a federal program

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[1] U. S. Department of Agriculture, Soil Conservation Service, "Multiple-Purpose Watershed Projects Under Public Law 566" (U. S. Department of Agriculture Pub. PA-575, May, 1963), p. 1.

with local assistance. The Soil Conservation Service was chosen by Congress to carry out this program. This was an excellent choice because the S.C.S. has had considerable experience in working with individual landowners through their Soil Conservation Districts, and watershed management is basically soil and vegetation management to a considerable extent. One of the possible drawbacks of the PL-566 program, especially in the eastern states, is that it is heavily agriculturally oriented. The basic purposes of this program are the following: flood prevention, agricultural water management, municipal and industrial water supply (both for present and future use), recreation and fish and wildlife development.

The recreational development covered by federal funds is limited to: (1) a single reservoir, a single lake, a single reach of shoreline, or a well-defined reach of a single perennial stream (but not the entire stream system of the entire watershed); (2) land required for basic shore facilities.[1] However, additional developments may be included at local expense.

According to Mr. Curtis Bauer, Chairman of the Chautauqua Lake-Chadakoin River Watershed Committee, the Chautauqua Watershed is unique in many respects primarily because its purpose is to maintain and enhance an existing facility -- Chautauqua Lake.

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[1] Ibid., p. 6.

Apparently it is the only PL-566 project in the nation with a large lake as its central and focal point. The project is further unique because it is planned not only to control floods but also to raise the lake level during the summer recreation season, and to augment streamflow in the Chadakoin River for industrial use. In other words, the Watershed Committee is pushing for a three-point program of: (1) flood control; (2) lake level stabilization, and (3) streamflow augmentation. The latter two points are proposed for solving the watershed's late summer low flow problem, for which the Corps of Engineers Program had no provisions. (The Corps is restricted in this respect because it may build structures only for the purposes of flood control, power and navigation.)

The Soil Conservation Service plan for the Chautauqua Lake Watershed calls for a series of six water retarding and water storage structures located on five of the major streams feeding into Chautauqua Lake. These structures would have gates for controlled water release to provide both flood control and water flow augmentation benefits, depending on the time of the year and the water level situation. Approximately 32% of the total watershed would be upstream from these six dam sites.[1] The S.C.S. proposes that the sites would provide flood protection from all storms except

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[1]U. S. Army Corps of Engineers (1964), loc. cit., p. 50.

those that may be expected to occur once in 25 years. In their opinion, complete flood protection cannot be obtained short of using the Corps proposed diversion into Lake Erie.[1]

The total cost of the proposed program would be $5,400,000, according to the S.C.S. Sites and easements will have to be paid by local people at an estimated cost of $411,000, but the State of New York will pay half of this amount.

The construction of the dams for flood control purposes will cost $1,500,000, which will be paid by the federal government. The recreational cost for lake level stabilization will cost an additional $2,000,000, half of which will be a federal expense, and one-half local. The third proposal for streamflow augmentation is not covered by the federal government, and will cost local taxpayers another $1,400,000. Water for all three of these purposes will be impounded by the same structures, but the extra costs will be charged for enlarging the basic structures to store additional water for recreational and industrial use.

Under New York State Law, the Federal PL-566 program is carried out by County Small Watershed Districts. In order for a District to be formed, a Small Watershed application must first be approved by the County Board of Supervisors, then by the State

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[1]Letter from R. D. Perry, Assistant State Conservationist, to Mr. Donald Crowell, Chairman, Chautauqua County Soil Conservation District, South Dayton, New York, February 24, 1964.

Water Resources Commission, and also by the Soil Conservation Service through the Department of Agriculture. When the application has been approved by all three levels of government, the Water Resources Commission cooperatively with the Soil Conservation Service assigns a planning priority rating to the application. All County Small Watershed applications within the state are periodically rated and assigned priority designations on the basis of local interest, project feasibility and other considerations. The planning priority determines the order followed by the S.C.S. in furnishing watershed planning assistance to watersheds within the state.

Under provisions of Public Law 566, the Soil Conservation Service may provide all or nearly all of the technical assistance required for the development of plans for a watershed. For development of municipal water supplies, sewage or waste treatment or recreation water uses, local or non-federal help must be furnished by the watershed agency or local interests. An alternate source of planning assistance to a watershed is provided under Part V of Article V of the New York State Conservation Law. Under the provisions of this law, one or more counties may create a Regional Planning and Development Board. This Board, acting for local watershed interests, secures assistance from and works with the State of New York Water Resources Commission technical staff in development of a comprehensive water use and development plan

for the watershed region. The cost-sharing arrangements for planning under this program are 25% county and 75% state.

The use of this alternative may be of particular interest where federal planning assistance is delayed or in watersheds involving water uses such as municipal water supply, sewage treatment, recreational development, or other uses where federal assistance is not available.[1] Hopefully, Chautauqua Lake will be included in this regional water resources program in the near future.

At a monthly meeting of the Chautauqua Lake-Chadakoin River Watershed Committee on September 22, 1966, Chairman Bauer disclosed that the watershed application had received federal approval and that the next step for their project was to receive a priority rating from the Water Resources Commission and the Soil Conservation Service. Mr. Bauer noted that the S.C.S. had asked for seven points to be clarified before they would give the Chautauqua Watershed a rating. These points were the following:

1. Definition of the low flow needs of the Chadakoin River.
2. Scientific operation of Warner Dam.
3. Documentation of benefits derived from a stabilized lake level.

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[1] New York State Water Resources Commission, op. cit., p. 47.

4. Clarification of a $25,000 advance payment for local watershed costs offered by the Chautauqua County Board of Supervisors.
5. Additional future needs within the watershed. (These might include additional water for domestic or industrial needs.)
6. Local financing of the Watershed Project.
7. Public information relating to flood control.

In effect the Soil Conservation Service is asking the Watershed Committee to do its own planning, because the answer to several of these questions provides the key to the future operation and management of the entire watershed.

With regard to point number one on the low flow needs of the Chadakoin River, the present plans call for a storage adequate to provide a flow of 41 million gallons per day, or 60 cubic feet per second for a 60 day period. The S.C.S. wants to know if this flow will be sufficient for present and future industrial needs.

According to Melvin Swanson, Chairman of the Chadakoin River Commission, a continuous flow of 60 c.f.s. would satisfy the industries who presently draw on the river for process water. The author does not know if anyone has asked the industries along the Chadakoin River how much water they need for processing, but

a check of the records on the operation of Warner Dam since 1963 shows that the gates have been completely closed anywhere from 53 to 90 days, and in one year since 1957 Warner Dam was closed from mid-summer through January.[1] Although the desired lake level for mid-summer would be 1308.5, the dam gates have been closed during the past three years between July 16 and August 1 when the lake elevation started dropping below 1308.2 When the gates are closed, the flow in the Chadakoin River drops down to nil and industries along the river must turn to private wells or the City of Jamestown for their water supply. Although the author might accept Mr. Swanson's estimate of 60 c.f.s. as adequate for the industries, he would recommend that this flow should be maintained for a minimum of 90 days rather than for only 60 days, as is presently planned. Of course, the additional storage needed to maintain this longer flow would raise the local cost of the proposed impoundments.

Point number two on the scientific operation of Warner Dam is in the process of being worked out. The Soil Conservation Service has promised to set up a system of guidelines for a field survey to be carried out (with local funds) to measure creek flow

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[1]Personal interview with Mr. Saxton, Dam Operator, Jamestown Municipal Power Plant, September 22, 1966.

into Chautauqua Lake, the rate of snow melt, precipitation, etc. Obviously this sort of information would take a few years to accumulate, although some information is already available from the U. S. Geological Survey and the Corps of Engineers.

The third point on benefits derived from a stabilized lake level has been discussed in part and will be further explored in a later chapter. This is a difficult problem to analyze economically, because the author believes that a stabilized lake level would have benefits largely attributable to greater convenience for recreational boating of all kinds, as well as the esthetic benefits of a water surface and shoreline free of aquatic plant nuisances. Perhaps an added foot of water would also reduce the intensity of the algal problem in both basins of Chautauqua Lake.

The matter on clarification of the $25,000 advance payment offered by the County Board of Supervisors has been cleared by the Watershed Committee.

Point five on additional future needs within the watershed will be discussed in the final chapters.

Points number six and seven will have to be solved by the local watershed interests. Mr. Bauer pointed out that local cost sharing can be worked out in a number of different ways. One method may be a system of cost sharing based on the ratio of benefits received. This is presently being done in the Ishua Watershed in

Cattaraugus County. He also mentioned that the size of the tax base -- the population -- in the Chautauqua Lake Watershed is greater than in most watersheds. This should lower the cost of the program per individual taxpayer.

As far as costs are concerned, the author feels that the Watershed Committee should canvass the industries along the Chadakoin River for funds. If the industries were guaranteed of a certain water flow throughout the year, perhaps they would be willing to forward a share of the local costs for streamflow augmentation. Another possibility is that the necessary water storage costs could be worked out on an appropriation basis, depending on the needs of the individual industries.

Besides the water impoundment structures, land treatment is another important part of a watershed program. Before floodwater retarding dams and retention reservoirs can be installed, at least one-half of the land above the dams must be under basic conservation plans. These plans would be made by local farmers with technical help from the Chautauqua County Soil Conservation District. Such measures as contour plowing, terracing, tree planting, or the stabilization of streambanks, can enhance the effectiveness of dams and retention reservoirs considerably. Some of the important reasons for conducting land treatment are to: (1) reduce

soil erosion and stream siltation; (2) improve streamflow; (3) decrease the rate of water runoff; and (4) increase the amount of water soaking into the soil, thereby augmenting ground water supplies.

The Corps of Engineers proposed to solve the lake's flood problems for $7 million. For $5\frac{1}{2}$ million, the PL-566 Program will provide not only for flood control, but it will also provide for lake level stabilization, industrial water supply for the City of Jamestown, reduction of sedimentation and erosion, and add considerably to the recreational value of the lake.

One important problem which is not being solved by the PL-566 Program is the domestic pollution of Chautauqua Lake. Federal funds are not available for pollution abatement, and therefore the Watershed Project does not include provisions for storing the amount of water that would be required to operate the sewer system and sewer treatment plant proposed for the lower lake. Perhaps the present proposal for piping the treatment plant effluents into the Chadakoin River should be reconsidered because a huge supply of water would have to be stored annually for operating such a large sewer system. A better plan might be to return the treatment plant effluents to the lake, but with the effluent treated so as to remove nitrogen and phosphorus nutrients.

Survey of the Ground Water Resources of the Jamestown Area

Mention should also be made of the work of the U. S. Geological Survey, which recently completed an investigation of the ground water resources of the lower Chautauqua Watershed and the adjacent Cassadaga and Conewango Creek valleys at the request of the City of Jamestown. The City has been quite concerned about the series of recent dry years, which, together with the ever increasing water demands, has lowered the ground water level in the Cassadaga Creek valley where the Jamestown well field is located. The Cassadaga Creek valley is not within the Chautauqua Watershed, but had the U.S.G.S. found that a serious shortage of ground water was imminent, then Jamestown would have had to look more closely towards Chautauqua Lake as a potential source of water. Fortunately, however, the investigators concluded that larger yields may be obtained from the present Jamestown aquifer, and the Poland Center aquifer (in the Conewango Creek valley) is a promising source of large supplies.[1]

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[1]Crain, op. cit., p. 126.

CHAPTER IX

WATERFRONT USES AND LIMITATIONS

Water is a vital and useful resource. Its uses are both economic and esthetic. Yet while demands for water are becoming greater, the supplies of water and waterfront land remain relatively stable. This makes it essential that the best use of water and water frontage be achieved.[1]

Because of its many vital uses, water is sought after for all sorts of purposes. Very often groups of people who wish to use water for one purpose fail to heed the desires or needs of other water-user groups. In this sort of a situation, the most logical solution is to try to accommodate all the water-user groups with one plan which will best serve the various individual interests. Best use of water often means that water must be used for several beneficial purposes; misuse of water can restrict the variety of possible uses. There are many factors which limit the usefulness of water to man. These factors may come from wholly natural or from

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[1] D. F. Wood, et al., Waterfront Renewal Technical Supplement (Madison: Wisconsin Department of Resource Development), p. 42.

man-made causes, or may result from natural phenomena that have been disturbed by man.

Uses of Surface Water

Perhaps before the human uses of surface water are considered, it should be pointed out that approximately half of the annual precipitation which falls on the Chautauqua Watershed is lost to the atmosphere by evapotranspiration. The natural vegetation transpires water into the atmosphere, and water is also lost by evaporation from the land surface and by evaporation from streams and lakes. The U.S. Army Corps of Engineers has estimated for the 25 year period from 1939 to 1963 that the Chautauqua rainfall average was 42.4 inches annually, of which 18.5 inches were lost to evapotranspiration and 23.9 inches appeared as runoff in the streams flowing into Chautauqua Lake.[1] The average annual runoff from Chautauqua Lake over this same period was computed to be 19.63 inches; therefore, Chautauqua Lake annually lost 4.3 inches of the total basin runoff by evaporation from the lake surface. According to these estimates, only about 48% of the total annual precipitation on the Chautauqua Watershed ends up as streamflow in the Chadakoin River.

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[1] U.S. Army Corps of Engineers (1964), loc. cit., pp. 27-30.

Having thus eliminated about half of the annual precipitation, we can discuss the major uses of the remaining water:

1. Human Consumption. Water consumption and use for domestic purposes is generally accepted as the highest or most important form of water use. "Domestic purposes" includes not only the water used for household drinking, cooking, and washing, but also that which is needed to keep the air conditioner and the automatic dish washer working, plus that used for lawn sprinkling, car washing, etc. The average urban family will probably use from 60 to 100 gallons of water per person per day.

   Although Chautauqua Lake has hardly been tapped as a source of domestic water, the Village of Lakewood plans to convert to lake water in the near future, and other villages around the lakeshore may follow suit. If the City of Jamestown is unsuccessful in obtaining its water requirements from ground water in the adjacent Conewango watershed, it may also be forced to use Chautauqua Lake water for both domestic and industrial consumption. Between 1940 and 1965, the City of Jamestown increased its annual pumpage from 1.17 to 2.16

billion gallons per year.[1] Some authorities predict that the need for domestic and industrial water will double within the next 25 years, so the City may expect to need an additional supply of 2 billion gallons per year by the year 1990.

2. Industrial and Commercial Uses. If the industrial segment of the Jamestown community is to maintain or expand its rate of growth in future years, this rate will depend to a considerable extent on the amount of water which will be available for industrial processing, cooling, and other purposes. Industries need tremendous quantities of water. A consulting engineer firm which studied the water needs of the Village of Lakewood estimated that a single large industry which has plans of opening a plant there would need nearly as much water (100,000,000 gallons per year) as was consumed by the entire Village water system in 1965 (134,000,000 gallons).[2]

Under commercial uses would be included such things as boat marinas, lakeshore restaurants, private amusement parks, numerous lakeshore camps,

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[1] Personal interview with Mr. Merle Smedberg, Superintendent of Utilities, Jamestown, August 5, 1966.

[2] Nussbaumer, Clarke, and Velzy, op. cit., p. 57.

and perhaps the Chautauqua Institution. Some of these would overlap with recreational and esthetic considerations.

Throughout the Chautauqua Watershed, water is also used for agricultural purposes such as stock watering, farm ponds, etc. Should technology or necessity make the farming of the Upland Plateau soils profitable, irrigation may become an important use of water.

3. Sewage Disposal. Although dumping of raw sewage into Chautauqua Lake is illegal, there are still some homes on the small feeder streams flowing into the lake which pipe their wastes untreated into these streams. Fluid wastes from the lakeshore homes and communities also end up in the lake either by infiltration through the ground water or by direct discharge from community sewage plants following primary treatment.

Chautauqua Lake is used for waste assimilation by the Chautauqua Malted Milk Company near Mayville, and perhaps by some smaller industries at the lower end of the lake.

4. Waterfront Recreation. Some of the major categories of aquatic recreational use include esthetics, swimming, fishing, boating, aquatic life study and observation, and

waterfowl hunting. These activities have spatial demands, some of which can be measured, and each activity competes to some extent with another activity.[1]

Most recreational activities occur in the littoral or shallow water zone of a lake. The shallows are used for erecting docks, for boat mooring, for beaches, and for many other purposes. Shallow water is also used most intensively for all of the activities listed in the previous paragraph, except that water skiing generally calls for deeper and more open water. Because esthetic considerations are very closely tied to aquatic recreation, the appearance of the shoreline and the quality of the water have an important bearing on choice of a particular lake by the recreational public.

The Chautauqua Institution represents a unique cultural-recreational community which is oriented to waterfront recreation. Many camps sponsored by church, social, or civic service organizations surround the lake, and these also rely on the attraction of the waterfront to provide a pleasant setting for the achievement of cultural or educational goals. Aquatic sports and activities can provide many pleasant memories, while such activities

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[1]Threinen, op. cit., p. 354.

PLATE XX. -- The Miller Bell Tower on the lakefront of the Chautauqua Institution is perhaps the most famous landmark on Chautauqua Lake. A fleet of sailboats race with each other in the background.

PLATE XXI. -- Commercial launching ramps are available at numerous marinas around the lake. Most of these enterprises also provide docking space for traveling tourists and vacationers.

PLATE XXII. -- A semi-private launching ramp near the Village of Bemus Point. Docking facilities here are owned by local residents. Lack of parking space restricts the amount of traffic.

PLATE XXIII. -- Esthetics are highly important for the full enjoyment of living on the waterfront. This beautiful home is on the Bemus Point lakeshore.

as swimming or canoeing develop physical fitness at the same time. Children especially enjoy hiking along a natural lakeshore where there is no end of interesting new things to see and learn about.

5. Fish and Game Habitat. Fishes and many forms of wildlife live in and around water. Different types of littoral bottom materials are required for spawning by various fish species. Many species need marshes or unpolluted tributary streams in which to spawn. Both emergent and submergent weed beds are used for cover and as a source of food by nearly all fish.

The various recreational demands made on water have a space requirement in the form of required fish and game habitat. Most of the original marshes surrounding Chautauqua Lake have been drained or filled in. Emergent vegetation has been destroyed along the parts of the shoreline where seasonal or permanent residences are densely spaced. This includes nearly all of the Chautauqua shoreline except for the east shore along the upper lake, where many large camps are located.

6. Esthetic Considerations. If one were to rate esthetics in relation to other uses of water, it would rate high. Almost all waterfront activities rely to some extent on

the esthetic appeal of the water and the watershore. Scenic roads and parks, and cottages and resorts all crowd the lakeshore. Homes built by the water's edge are more valuable than those in the backlots, partly because of the access to the water, but also because of the esthetic considerations such as the sights, sounds, and smells of the aquatic environment.

Limitations on Recreational Use of the Chautauqua Waterfront

Recreational use of Chautauqua Lake is highly important to the people of Chautauqua County, although it should be kept in mind that this is only one phase of water use within the watershed. The use of water for recreational purposes should always be considered in context with other water uses. There are two major factors, nonetheless, which are important enough to merit a separate analysis since they greatly affect the recreational utilization of water in Chautauqua Lake, as well as in most other recreational lakes. These two factors are the pattern of lakeshore development and the quality of the water.

Pattern of Lakeshore Development

The main surge of lakeshore home building around Chautauqua Lake occurred in a 10-15 year period following the Second World

War. The pattern of this development was completely unplanned, other than the fact that people preferred to have their cottages right on the waterfront, and the greatest population concentration happened to be around the lower end of the lake. The pattern which evolved is typical not only of Chautauqua Lake, but of nearly all recreational lakes in the United States which have attracted large numbers of lakeshore home enthusiasts.

The author interviewed Mr. John Luensman, Chautauqua County Planning Director, about the characteristics of the development around Chautauqua Lake, and what effects this may have on the future development of the waterfront. In this particular discussion it is assumed that further private development of the land between the lake and Highways 17 and 17J would be desirable, primarily from the point of view that additional new homes would mean additional tax income. From a realistic viewpoint, further development is also highly probable.

Chautauqua Lake has a few examples of "good" lakeshore development, and many examples of "poor" or haphazard development. A classification of development into good or bad categories depends on the viewpoints and interests of the person performing the classification, but from an idealistic viewpoint we may loosely define "good" development as a method of providing private or community access without completely encircling the lakeshore with a belt or zone of

private riparian residences. "Poor" development would be defined as the side-by-side development of a single tier of riparian lots which restrict access for backlot property owners and also destroy many of the scenic and esthetic qualities of the lakeshore.

One factor which is immediately apparent from an inspection of the Chautauqua Lake shoreline is that only the lake frontage has been intensely developed. Cottage owners would prefer to have a cottage right on the lake, or if they cannot get it on the lake, then they would like to have some form of title interest in riparian land, rather than merely an easement providing access. Since very few backlot owners have a fee title interest in lake frontage (unless they are members of an organized lakeshore community or association), there are large areas of vacant land surrounding Chautauqua Lake which have yet to be developed.

Examples of Poor Development

Prendergast Point is a tract of land on the west side of the upper lake which was all subdivided as one unit. It is the "proudest" development around Chautauqua Lake, most expensive, with the most capital investment, but the backland toward Highway 17J is not developed at all. The majority of the development is on the shoreline, on the Highway itself, and along the road just west of the fish hatchery. The interior land has not been developed for two main

PLATE XXIV. -- One of the most prominent lakeshore communities is the Prendergast Point development north of the State Fish Hatchery. The closely spaced private docks belong to a single row or "tier" of waterfront home owners. (Photo courtesy of USDA-Soil Conservation Service, Jamestown.)

PLATE XXV. -- Poor pattern of lakeshore development. A single tier of waterfront homes restricts access for potential backlot home owners.

PLATE XXVI. -- Large quasi-publicly owned properties occupy much of the land along the east shore of the upper lake. One advantage is that much of this shoreline remains in a fairly natural condition.

reasons: (1) the prime land was sold off originally, and (2) there is no good access left to the lake for people who might want to develop the backlots. In many cases the only means of access which the backlot owners have is a five or ten foot easement over which they may travel to erect a dock or to go swimming. They do not own the land in fee, but own it in joint as an easement.

On the east side of the lower lake, one farm family owns a half mile of shoreline which is completely undeveloped except for two private lakeshore cottages maintained by the owners. Although the waterfront land is now being farmed, its potential value for recreational development is inordinately greater than its present value as farmland. If the land were assessed for its true lakefront property value, the owners very likely would not be able to pay the required taxes. But the Town of Ellery has never revised its assessment procedures to account for the higher values of lakeshore property, and because this land is still under cultivation, it is assessed as "undeveloped" farmland.

A similar situation exists across the lake at the mouth of Goose Creek, where another farmer has 115 cottage sites on his land which he leases on a seasonal basis. The rentees each pay a tax on their cottage as house improvement, but the land is all assessed as farmland because the backland is undeveloped. A change in assessment procedure would undoubtedly change the pattern of

development here, especially since this property is only a mile away from the Village of Lakewood.

Examples of Good Development

Chautauqua Lake does have a few examples of good lakeshore development, although the best of these were laid out before the turn of the twentieth century. The Point Chautauqua development on the east side of the upper lake was laid out before 1900 by Frederick Law Olmstead, the famous architect who designed Central Park in New York City. The original subdivision was a large farm property, of which about 200 acres were laid out in a symmetrical arrangement along a hillside overlooking the lake. None of the residences in the original subdivision fronted right on the lakeshore, but some of the properties extended all the way down to the lake, and this riparian land is owned by those individuals. The one exception is a piece of lakefront land which was reserved, and this land is owned in fee by all people who own land in the original Point Chautauqua subdivision. Ownership of this land is on an equal basis, and the members assess fees through an association to maintain that common frontage. Access to the lake is available for all members of the Point Chautauqua community, and because the Point Chautauqua shoreline is not overcrowded with cottages, it is more scenic and natural looking than most other waterfront communities around the lake.

PLATE XXVII. -- Point Chautauqua is a good example of the community access type development. The entire community is laid out in a picturesque architectural pattern, and the community beach may be seen along the lower left shore in the photograph. Although the private docks and beaches belong to individual home owners, the immediate waterfront has only one home fronting right on the lake. (Photo courtesy of the USDA-Soil Conservation Service, Jamestown.)

PLATE XXVIII. -- Many lakeshore home owners are attempting to overcome access and other water use problems by joining with community groups such as lakeshore associations.

PLATE XXIX. -- Commercial trailer camps are becoming an increasingly popular means of spending a vacation. These camps are best run by a community access procedure in order to eliminate low class waterfront "slums."

Across the lake from Point Chautauqua is the Chautauqua Institution, a unique corporate entity chartered by the State of New York, which has title to all of the land within its subdivision. It is laid out in a pattern similar to Point Chautauqua, but the lake frontage is all owned by the Institution, and it is accessible to everybody within the development. People who desire to live on the grounds of the Chautauqua Institution can lease the land on a 99-year lease, on the condition that they must put in their own improvements.

There are many kinds of developments around Chautauqua Lake besides these examples. Mobile home sites are becoming increasingly popular, and some mobile homes are being leased on a year-round basis. Since nearly all of these people are interested in docking and swimming facilities, some sort of community access is usually provided for a fee.

One type of access problem is caused by quasipublic lands owned by religious groups or public service organizations. Many of these lands are large camps which occupy considerable acreage of potentially valuable land, particularly along the lakeshore in the Town of Ellery.

Lakeshore Development and Water Quality

There is a tendency for the average person to believe that a city or a region which grows in population is economically

stable, while an area which barely stays even or loses in population is economically depressed. Growth in population is therefore considered to be desirable for the economic welfare of a community. In the majority of cases this presumption is probably true, but there is also a limit to the population density which a given area can conveniently support. A city park, for example, can only stand the trampling of so many people before it will lose its park-like qualities and perhaps become leveled or blacktopped for some more intensive form of use. A wilderness forest can maintain its wilderness qualities only so long as road and trail construction is kept within limits. If visitors to the wilderness could conveniently drive into every corner of the area, it would soon lose its wilderness attributes.

In a similar manner, a lake can support only a limited population along its shores if overcrowding and overfertilization are to be prevented. A term which is used to describe this concept is the carrying capacity of a lake or stream.

Carrying Capacity

An old and proven dictum which has been the basic guideline for conservation and public service policies in the United States is that we should "provide the maximum benefits to the maximum number of people." This policy has worked out very well except when the word "maximum" has been interpreted as

meaning any number of people who desire to use a recreational area. In too many cases this has meant that the managers of overused public recreational areas have had to get along the best they could with more people than they could handle. This type of situation is most prevalent in the immediate vicinity of our larger cities.

A more scientific approach to the question of "maximum" numbers is the concept of a limited resource which has a certain "carrying capacity." With respect to water resources, the carrying capacity of a lake is exceeded when the quality of the recreational experience (and usually the quality of the water) is reduced by overcrowding, littering, and uncontrolled or poorly planned lakeshore development. When the carrying capacity of a lake is exceeded, conflicts often develop between different recreational groups such as bathers, boaters, and fishermen.

Any lake is a limited resource in terms of the number of people it can support, especially if its major use is for recreation. A lake has a limited shoreline and a limited volume of water with which to absorb the spatial demands and the quality demands of recreational use. There is a certain threshold or maximum carrying capacity beyond which recreationists will feel that a lake is too crowded, and many of them will likely move to another lake which is less crowded. The possibilities for moving to less crowded lakes are pretty slim, however, especially near cities, but throughout the lower Great Lakes Region in general.

Chautauqua Lake is no exception to the "carrying capacity" concept, although with such a large lake the point of maximum population is very difficult to determine. It would probably be impossible to prevent more people from using the lake even if a maximum carrying capacity were determined. The concept nevertheless is a useful one because it can be applied to determine how overuse of Chautauqua Lake may lead to serious restrictions on its recreational value. We might consider a few questions such as the following: How is Chautauqua Lake being overused, and how many people can the lake support before its recreational value will be degraded?

There are certain categories of lake use which would not apply to Chautauqua Lake. It is definitely not a wilderness or primitive lake, where the goal would be a natural environment with no modification by man.[1] It is not a single use lake, where a single use would be selected, and management would be directed towards maximizing the benefits for this single use. Chautauqua Lake is a multiple use lake, where such recreational uses as swimming, boating, and fishing are all important. Perhaps one of the best methods for determining the carrying capacity of Chautauqua Lake would be to interview a large number of recreationists, and find

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[1] C. R. Humphrys, "Waterfront Uses and Abuses," (Dept. of Resource Development, Michigan State University, 1965), p. 6.

PLATE XXX. -- New housing developments are beginning to fill in the land between Highway 17 and the lower lake. In order to avoid problems in future years, the planning for attractive communities should precede the actual development.

out what level of quality (or quantity) they desire in the way of swimming and boating facilities, fishing, sports, social activities, and in the type of lake environment. When these services can no longer be provided to the recreationists' satisfaction, the lake may be said to be over its maximum carrying capacity, and certain regulations (such as time or area restrictions) may have to be put into effect.

Water Quality

One of the most significant indexes of the recreational value of a lake is the quality of the lake environment. Pure water and a natural shoreline are the qualities most desired for recreational purposes. Although most of the shoreline around Chautauqua Lake has been developed, people still find those shorelines most attractive where some tree or forest cover has been maintained. Fishermen often anchor off those shorelines where bulrushes or other emergent plants are still present, partly because these shores are usually more productive, but also because of the esthetic attributes of a natural shoreline. It is unfortunate that in some of the newer lakeshore developments, such as in the Town of Ellery, most of the tree cover has been removed. (See Plate XXX.)

Some states have attempted to establish water quality criteria for such waterfront uses as swimming, fishing, boating,

and waste disposal,[1] but although these criteria may be useful as guidelines, they are difficult to apply to a particular lake situation. Lakes vary in their ability to absorb human organic wastes, depending on their size, volume, and physical-chemical composition. Eutrophic lakes can usually absorb more organic materials without upsetting their ecological balance than can oligotrophic lakes. From a practical standpoint, this means that eutrophic lakes are capable of supporting more intensive recreational development than oligotrophic lakes.

Changes in water quality affect the aquatic organisms in a lake. With sufficient pollution, certain species of fish may be reduced in number or eliminated completely. Probably the most reliable indicators of a change in water quality are the green and blue-green algae. These organisms are very sensitive to changes in the chemical composition of the water, and blue-green algae are fairly reliable indicators not only of fertilization per se, but also of the degree of fertilization.

In an earlier chapter it was mentioned that the lower half of Chautauqua Lake has had problems with algae blooms and excessive weeds for at least several decades. It was also pointed out that the upper lake had a serious bloom of Gloeotrichia in August

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[1]McKee and Wolf, op. cit., pp. 118-122.

of 1966, which may be an indication that the northern half of the lake has reached a certain nutrient threshold that will mean even greater algal blooms in the future. If we wish to speak of the carrying capacity of the upper lake in terms of excessive algal blooms, we could say that the upper lake has probably reached its maximum capacity for the present level of water quality. Unless something is done to restrict the further addition of nutrients to the upper lake, chances are that the quality of its water will change for the worse in the near future. The upper lake may soon undergo a change in its trophic level, and if this does occur, the process may be nearly impossible to reverse.

In the opinion of the author, Chautauqua Lake has just about reached its carrying capacity in the upper lake, while in the lower lake the carrying capacity has already been exceeded. Further development of the lakeshore should not be encouraged unless the existing lakeshore home owners are willing to pay for a public sewer system and for adequate sewage treatment facilities. This action is necessary in order to deter the further eutrophication of Chautauqua Lake waters.

CHAPTER X

WATERSHED PLANNING

The following paragraph is a quote from A Dialogue Plan -- Chautauqua County, New York, which was prepared by the Chautauqua County Planning Board and Department of Planning for the purpose of stimulating public interest and participation in the future development of the county:

> The resources upon which Chautauqua County may grow are not the old stand-bys of minerals, sand, gravel, oil, gas, forestry or farming. These resources have been developed to their economic peak and the ever changing picture of modern technology indicates that there will be a decline in some of these resource fields. The basic resources to which the citizens must be alerted and help to fully utilize are the annual precipitation, expressed as water resources, the present pattern of developed facilities, and the land space, expressed in the esthetic terms of being open, unconfused, or cluttered by the intensity of urban or metropolitan activity.[1]

Problems in Policy

In planning for the future development of the Chautauqua lakeshore, there are a few questions of policy which must be settled before recommendations for action can be proposed. Much of the

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[1] Luensman, A Dialogue Plan, op. cit., p. 1.

discussion in this report has been based on the assumption that local people would benefit from continued development around Chautauqua Lake. This does not mean, however, that the majority of the local people are in favor of further lakeshore development. The question of development could be discussed from a number of different viewpoints:

1. From an economic viewpoint, new people and additional homes around Chautauqua Lake will contribute to the tax base and therefore bring additional money to the local towns and municipalities.
2. From a social and esthetic viewpoint, the present lakeshore home owners may not be in favor of having additional residents crowd around their lake, particularly if the original owners bought their properties with the intent of enjoying the open space and solitude of country living.
3. From the viewpoint of water quality, additional homes would be undesirable at present because they would add to the pollution load of a lake which is already highly enriched. Further household pollution around the upper lake will undoubtedly reduce the quality of the water unless public sewers are constructed or some better method of waste collection and treatment is

developed. Perhaps it is not unreasonable to expect that better methods of household waste disposal will be developed in the future, but it is unlikely that this will come soon enough.

4. From a realistic viewpoint, we may expect that the nation's growing population, together with the longing of many people for a home in the country, will lead to greater in-depth development around Chautauqua Lake whether this is desirable or not.

Water policy should be comprehensive enough to relate multiple purpose uses of land and water into one overall management plan. Planning for new uses of water can be guided by a number of goals, which should reflect the problems and interests of all the water user groups within the Chautauqua Watershed. Many of these watershed problems were discussed in the previous chapters, and based on an analysis of these problems we may wish to achieve certain goals in the future:

Goal One: Making the Best Use of Surface Water. -- Surface water is a public asset which can be used in a number of ways, such as for navigation, consumption, industrial use, and recreation. Water should be used for the maximum public benefit and all land uses along the water should be arranged to make the best use of

surface water. A broad watershed or regional approach is the best procedure for handling the problems of surface water use.[1]

Goal Two: Pollution Abatement. -- Attempting to reduce or control pollution should be a major objective of waterfront planning. Lakeshore homes and cottages should not be allowed to discharge wastes into the lake without proper treatment. New waterfront uses which might increase pollution should be required to provide adequate waste treatment facilities. Gross pollution may be less of a danger in Chautauqua Lake than gradual eutrophication.

Although pollution may have some short-term beneficial effects by increasing fish productivity, the long-term effect on water quality is not so desirable.

Goal Three: Increasing Public Recreational Facilities. -- This goal may be generally desirable, but not without some qualifications. In a legal sense it means the protection of public rights of access to the waterfront. In terms of actual planning policy it means filling the demands of increased space for waterfront parks, beaches, and marinas.

Around certain heavily used lakes, however, additional public recreational facilities may lead to overcrowding, overuse, and reduction of esthetic appeal. Perhaps a better distribution of

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[1] Wood, et al., op. cit., p. 2.

public facilities can be devised to prevent overcrowding and to distribute the recreational load more evenly.

Goal Four: Realization of Esthetic Potential. -- Our "Great Society" is becoming increasingly aware of the quality of both its natural and artificial environment. The quality of the water in a lake has much to do with its esthetic appeal for swimming and recreation, and the scenery around a lakeshore can be enhanced or degraded depending on the manner of its development. Esthetic considerations should be given great weight, not as a sole consideration in waterfront development, but in combination with action to achieve other goals.

Goal Five: Control Flooding and Siltation. -- The prevention of local flood damage is an essential part of community planning and development. Measures should be taken to regulate the use of flood plains, and to construct flood control structures where necessary.

Proper land management throughout the Chautauqua Watershed will help to arrest soil erosion, and will aid in controlling siltation and runoff from agricultural lands.

Reconciling Conflicting Goals

Although the achievement of one of the above goals will often help to attain some of the others, there invariably arise conflicts between one use of water as opposed to another. What is

more important -- additional lakefront homes or better water quality? Is the recreational-economic value of Chautauqua Lake sufficient to justify the construction of a public sewer system around the lake? Should the lakeshore villages or the City of Jamestown be allowed to withdraw water from Chautauqua Lake for domestic and industrial use when recreational interests are already suffering from low summer water levels? What benefits will farmers receive for land treatment measures and for allowing floodwater storage dams to be constructed on their properties? What is the value of an additional foot of water in Chautauqua Lake during late summer?

These and many other conflicts will have to be resolved before we can reach our planning decisions. In some instances the values of conflicting goals can be calculated by estimating the costs and benefits derived from pursuing them. We may look at the problem from a democratic viewpoint and decide that those goals which benefit the greatest number of people deserve prior consideration. It is important that the needs and interests of all water-user groups be considered in the formulation of a comprehensive watershed plan.

The author is in no position to propose a comprehensive plan for the future management of the Chautauqua Lake Watershed. This is a job not for one person but for a team of experts in all

phases of watershed planning, engineering, law, economics, and sociology. It is a job for numerous local, state, and federal agencies, but it is primarily up to local people to spell out their needs and to coordinate the work of these agencies at the various governmental levels.

The Chautauqua Lake Watershed is faced with serious problems of future water supply, pollution control, and recreational development. The author does not believe that the present system of merely attempting to control the most serious problems is adequate or realistic for a lake environment as valuable as that of Chautauqua. Some kind of an authoritative planning agency should be established, either on a watershed or on a regional basis, instead of the present system of fragmented jurisdiction and responsibility. The Chautauqua Lake Association has done an excellent job of maintenance on Chautauqua Lake, but it is essential that a watershed planning and administrative agency become effective as soon as possible.

CHAPTER XI

SUMMARY OF MAJOR PROBLEMS AND RECOMMENDATIONS FOR THEIR SOLUTION

Major Watershed Problems

In the course of writing this thesis, the author has attempted to use as guidelines the four basic objectives originally designated in the introduction. It is difficult for one person to present a comprehensive and unbiased appraisal of the basic water issues in the Chautauqua Lake Watershed, but so far no governmental agency has attempted to investigate watershed problems other than on an individual basis. Some of the basic issued discussed in this report were the problems associated with (1) the pattern of seasonal and permanent waterfront home development; (2) the water needs of various water-user groups; (3) water quality factors affecting the recreational use of Chautauqua Lake; (4) management of Chautauqua Lake by existing agencies; and (5) alternate proposals for further management of the Chautauqua Lake Watershed.

Rather than attempt to summarize these issues individually, the following list is presented as a synopsis of watershed problems which the author considered to be most significant:

1. What are the advantages and limitations of the Corps of Engineers Flood Control Program and the Soil Conservation Service PL-566 Program?
2. Is a biological-limnological study of Chautauqua Lake needed to determine changes in water quality, fish populations, aquatic plants, etc.?
3. Should the adequacy of present sewer facilities and waste treatment plants be critically surveyed and new regulations proposed?
4. How can a better pattern of lakeshore development be encouraged? Can the lakeshore towns be encouraged to enact the necessary regulations?
5. What may be expected in the way of future recreational and lakeshore development?
6. How important is "pollution" and water quality with respect to recreational interests?
7. Should recreational use be restricted or extended over a larger area in those locations which are used most intensively?
8. What is the economic value of recreation to the Chautauqua Lake area?

9. How many recreationists visit the Chautauqua Lake area? Where do they come from? What do they expect in the way of services, etc.?
10. Would lake level regulation be worth the cost? What benefits would it provide?
11. What are the major deterrents to the recreational utilization of Chautauqua Lake? What conflicts need to be resolved?
12. What is the recreational "carrying capacity" of Chautauqua Lake?
13. What controls should be established over the conversion of seasonal to permanent residences around the Chautauqua lakeshore?
14. How critical is the individual household pollution of Chautauqua Lake as compared with municipal and industrial pollution?
15. Should a public sewer system be built around the lower lake? Is one needed around the upper lake also?
16. What is the necessary duration and volume of flow through the Chadakoin River to supply the present and future needs of the industries in Jamestown?

17. How much water will be required for domestic and industrial use around Chautauqua Lake within the next 25 years? What effects will this demand have on the recreational use of the lake?

Management Recommendations

The following list of recommendations is proposed for the consideration of those public and private agencies who will be involved with the future planning and management of the Chautauqua Lake Watershed:

1. A single watershed agency should be established to guide water resource planning and management.
2. Execution of the Federal PL-566 Watershed Program, with the triple objective of:
   a. Flood control;
   b. Lake level stabilization;
   c. Streamflow augmentation in the Chadakoin River.
3. Construction of a sewer system, particularly around the upper lake, in order to maintain the quality of the water. This would be worthwhile only if a sewage treatment plant with tertiary treatment (for the removal of nitrogen and phosphorus nutrients) can also be constructed.

4. Participation in the New York State Regional Water Resources Program. Funds for pollution control and the construction of a tertiary treatment plant for Chautauqua Lake may be available under this program, or perhaps through the recent Federal Water Quality Acts.

5. The towns bordering on the Chautauqua Lake shore should establish waterfront building and zoning ordinances to prevent deterioration of the waterfront from poor access, uncontrolled lakefront development and home building on the lake flood plain.

6. Septic tank installation should be carefully regulated by the County Health Department. Regulations are particularly important for those home owners who are planning to convert from seasonal to permanent residence.

7. Lakeshore development of community access type should be encouraged in future housing developments.

8. Industrial development on Chautauqua Lake upstream of the Chadakoin River should be prohibited.

9. The management of water quality and other factors in Chautauqua Lake should be primarily directed toward enhancing recreational uses of the lake, and secondarily for water supply.

10. A weed control program employing modern chemicals should be applied in the most serious weed problem areas.

11. Algal control should be directed toward reducing the amount of nutrients entering the lake, rather than toward control by copper sulfate or other algicides.

12. A new biological-limnological study of Chautauqua Lake is recommended to evaluate changes in water quality since the 1937 study, and also to investigate such biological problems as the effects of the new walleye population on the muskellunge fishery. A renewed attack on Chironomid (lake fly) control could also be proposed.

13. Local town authorities should establish zoning regulations which would prohibit the construction of homes or the disposal of septic tank effluents below the lake flood plain (elevation 1310).

14. A scientific procedure for the regulation of Warner Dam should be developed. This would have to be correlated with controlled release from upstream reservoirs if the PL-566 Watershed Program is implemented.

15. Because low summer lake levels often extend up to 90 days in dry years, the planned diversion of waters

(60 c.f.s.) through the Chadakoin River should be extended to 90 days rather than only 60 days.

16. If conflicts between water skiers and fishermen or other users of water become excessive, time or area regulations may have to be put into effect to limit the use of water by the various groups involved.

17. Efforts for the recreational management of Chautauqua Lake should be directed toward improving the quality of the lake environment and of the recreational experience. Chautauqua Lake is in direct competition with many other recreational areas for a share of the annual tourist traffic.

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