The natural resources of southeastern Wisconsin. no. 5 June 1963

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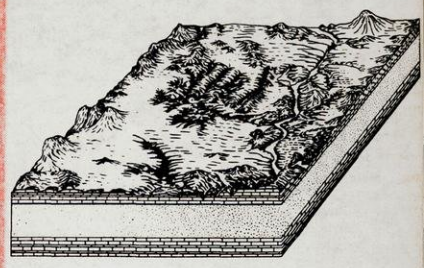

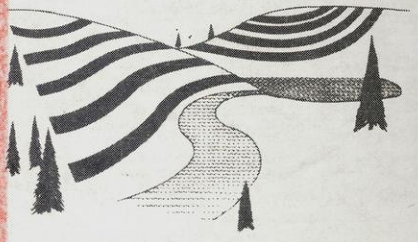

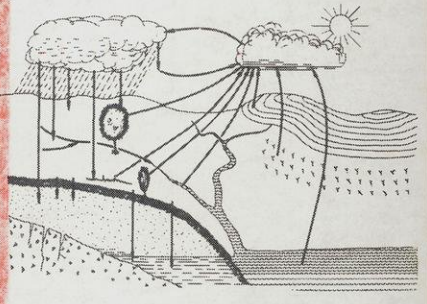

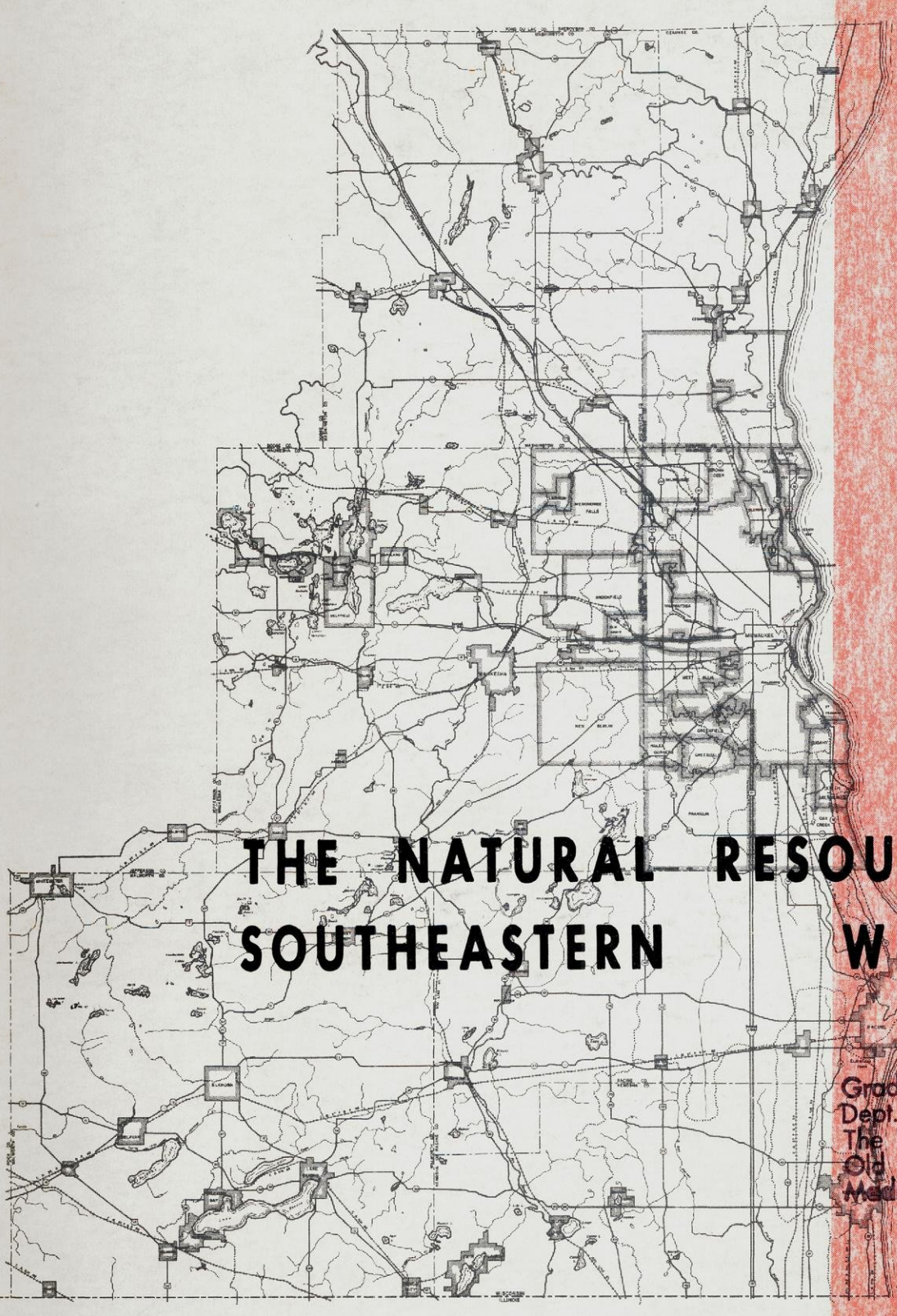

THE NATURAL RESOURCES OF SOUTHEASTERN WISCONSIN

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ERRATA

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THE NATURAL RESOURCES OF SOUTHEASTERN WISCONSIN

Page	82,	Map 32, first entry in legend should read, "Well locations showing elevation of ground water surface," instead of "Depth in feet at well locations."
Page	83,	Map 33, first entry in legend should read, "Well locations showing elevation of ground water surface," instead of "Depth in feet at well locations."
Page	148,	Table 40, though appearing at the end of Chapter XII, is referred to in Chapter XIII.
Page	149,	Table 41, though appearing at the end of Chapter XII, is referred to in Chapter XIII.

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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STATEMENT OF THE EXECUTIVE DIRECTOR

This report presents the results of an extensive survey and analysis of the natural resource base of the seven counties of Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha. These counties form the planning jurisdiction of the Southeastern Wisconsin Regional Planning Commission. This study was one of a series performed under Urban Planning Grant No. Wis. P-6(G) from the Housing and Home Finance Agency. It was initiated in January of 1962 and was completed in July 1963.

The purpose of this study was to inventory and analyze existing data on the natural resources of the seven counties within the planning Region. This report points out resource-based problems, briefly reviews resource studies which have already been completed, and suggests programs for future action which, combined with suitable planning studies, would provide the necessary factual basis for making decisions concerning future resource development and management by governmental officials, businessmen, and private citizens.

The format of this study is designed to present a picture of regional natural resources in a clear and concise manner. Topics covered include those related to the physical environment, such as the geography and geology of the Region, climate and weather, surface and ground water, and those which influence the social sphere of man's activities, such as fish and wildlife, recreation and open space, and flooding conditions.

It is hoped that this report will provide a better understanding of the physical environment of Southeastern Wisconsin Planning Region and will set the framework for wise management and development of its natural assets.

Kurt W. Bauer

K. W. Bauer
Executive Director

PREFACE

The collection of data in this report is for your use--for the government official as an aid in determining public policy as it relates to resource conservation; for the private citizen deciding public questions; and for the businessman as a decision maker in the economic sphere which so closely affects the regional resource base.

Most of the information contained herein has been mapped, graphed, or arranged in tabular form so as to point out its significant aspects, make its meaning more apparent, and increase its usefulness. A limited amount of explanatory text accompanies each chapter.

A number of governmental agencies, public officials, and citizens have been most cooperative and helpful in supplying information for this report.

Special appreciation is extended to the following agencies for their assistance:

Ground Water Branch, U.S. Geological Survey
Health Department, City of Kenosha
Health Department, City of Racine
Kenosha County Park Commission
Milwaukee County Department of Air Pollution Control
Milwaukee County Park Commission
Ozaukee County Park Commission
Public Service Commission of Wisconsin
Racine County Highway Commission
Soil Conservation Service
State Board of Health
State Climatologist
State Committee on Water Pollution
State Highway Commission of Wisconsin
State Soil and Water Conservation Committee
Surface Water Branch, U.S. Geological Survey
U.S. Corps of Engineers, Chicago District
U.S. Weather Bureau
Washington County Park Commission
Waukesha County Park and Planning Commission
Wisconsin Conservation Department
Wisconsin Department of Resource Development
Wisconsin Geological and Natural History Survey
Zoning Office, Walworth County

Note should be made of the generous assistance provided by Dr. Cyril Kabat of the Wisconsin Conservation Department in making available up-to-date information on fish, wildlife, parks and forests within the Region and to Professor Benjamin F. Richason, Chairman, Department of Geography, Carroll College, for his assistance and that of two of his students.

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Chapter I
INTRODUCTION AND SUMMARY

A. Summary

This report presents a picture of the natural resource base of the southeastern Wisconsin Region and suggests some programs needed in order to conserve, manage and further develop these resources. The basic problem facing the Region is not one of actual depletion of the land and water resources available, but a deterioration in the quality of these resources, and an imbalance in their distribution across the Region. Any solution of these problems must take into consideration two factors primarily responsible for the deterioration of the natural resource base: One, the growth and decentralization of population across the Region and, two, the tremendous progress of technology in placing into the hands of man tools with which he can change his environment almost at will. Thus, concerted effort will be needed by governmental bodies and citizen groups to prevent further deterioration and initiate the necessary conservation and resource management programs.

The more pressing areawide resource conservation problems of the Region are:

1. Lack of adequate recreational facilities for a growing population.
2. Lack of sufficient open space.
3. Continuing urban encroachment into productive farm areas.
4. Deterioration and disappearance of wild lands - uplands and wetlands.
5. Soil erosion, land deterioration and stream siltation.
6. Improper and conflicting land use development in relationship to parks, highways, woodlands and other recreation resources within the Region.

Some of the natural resource problems of the Region are water-related and can best be solved within the geographic framework of a watershed. Such watershed problems are:

1. Flood water inundation.
2. Deteriorating water quality and increasing stream pollution.
3. Lack of recreation and open space areas adjacent to the numerous lakes and streams within the Region.

The continued growth and urbanization of southeastern Wisconsin will depend to a considerable extent upon the ability of the Regional resource base to sustain such development without creating severe environmental problems. Thus a sound evaluation and analysis of resource capabilities, formulation of long range resource management programs, and a constructive public policy toward the Region's natural resources will be required. Specific information programs which will be needed for such an evaluation and analysis should include:

1. A Regional Water Resource Study which would include an investigation and appraisal of ground and surface water and provide information on its occurrence, availability, use and quality, and define present and future water use and supply problems.
2. An Operational (Standard) Soil Survey of the entire Region including an interpretation of soils for comprehensive planning purposes. (Presently underway as part of the SEWRPC Land Use-Transportation Study.)
3. A Park and Open Space Survey to provide information relative to the existing supply of both public and private park and open space areas. (Presently underway as part of the SEWRPC Land Use-Transportation Study.)
4. A Weather Observation Network to provide accurate data for conducting micro-climatological studies within the Region.

Some of these studies can be carried out as part

of a comprehensive watershed planning program while others might best be programmed on a regional basis. All are essential to an understanding of the natural resource base of southeastern Wisconsin.

B. Early Wisconsin Planning

Wisconsin has always been considered a progressive state in many people's minds due to its pioneering in the fields of employment legislation, social reform, and education. In this same sense, it might also be considered one of the early states to think and act constructively in developing state and local planning. Even prior to the creation of the National Planning Board by former President Franklin D. Roosevelt in 1933, there existed in this state a Wisconsin Regional Planning Committee established by Governor Philip LaFollette. Membership on this committee consisted of representatives of the State Highway Commission of Wisconsin, the Public Service Commission, the Industrial Commission, the State Chief Engineer, State Health Officer, and a member of the Conservation Commission. There also were three citizen members appointed to this early state planning body, one of whom was Floyd A. Carlson, presently Director of Planning for the City of Racine and at that time Kenosha City Planner. M. W. Torkelson was the secretary for the committee and the State Director of Regional Planning. The first annual report of the Regional Planning Committee was a thorough study of Wisconsin's natural resources along with aspects of the physical, social, and economic background of the state.

In 1934, the committee established the then goals of planning in the state which read in part as follows: "A plan, whether it be for the conduct of a single project, or the development of a city, or the continuation of policies over a period extending beyond a single administration is nothing more than the formulation of a program for orderly development, whether it be for an individual, a city, a state or a nation."

Planning in the 1930's consisted mainly of research reports issued by the State Regional Planning Committee, later the State Planning Board, and assistance by the staff of this body in helping local communities develop suitable zoning ordinances and street plans to meet their needs. In the early 1940's, the state planning services were broadened to include assistance in drawing official maps, help with subdivision ordinances, and statutory subdivision review at the state level. Community planning at the same time was strengthened as a governmental function; and many communities across the state adopted official maps, subdivision regulations and zoning ordinances to guide their growth and development.

County planning in Wisconsin had its beginnings in the early 1920's with the passage by the state legislature of the County Zone Enabling Act in 1923 which was further amended in 1929 to permit the county board of any county in the state to restrict and determine the area within which agriculture, forestry, and recreation could be conducted. Subsequently, many northern and central Wisconsin counties adopted various types of rural zoning and set up restrictive districts within which agriculture and year-around residences were prohibited. This rural zoning was designed specifically to prevent further isolated farm settlements and scattered developments in certain areas of the state. It was distinctly the first attempt at defining through governmental regulation the highest and best use to which the land area of the state could be applied.

Conservancy district zoning is a newer concept and was developed in the 1950's to prevent certain types of occupations and uses for flood plain lands. This was a distinct attempt to regulate and define resource use by local governmental bodies. One of the first counties to adopt conservancy district zoning was Waukesha County which did so in February, 1959. The boundaries of conservancy districts in this county were drawn roughly to represent the edges of swamp, marsh, and historic flood plain lands or high water lines along streams and watercourses.

Modern day regional planning, as it is now known in Wisconsin, had its inception with the creation of the Southeastern Wisconsin Regional Planning Commission in August, 1960. This Commission, and all regional planning commissions which have been set up subsequently, were established for the purpose of solving problems of an intercounty nature in the broad fields of transportation, natural resources, and land and water use. This regional planning concept also embodied the necessity for actively developing a high level of co-ordination between local governmental units to assist them in solving such areawide problems to their mutual satisfaction.

C. Current Southeastern Wisconsin Planning Effort

The organization of the Southeastern Wisconsin Regional Planning Commission (SEWRPC) in August, 1960, under the provision of Section 66.945 of the Wisconsin Statutes, represents an attempt to provide areawide planning services to one of the nation's large urbanizing regions on a voluntary co-operative basis. The Commission exists to serve and assist the local units of government in planning for the orderly and economic development of the Region. The Region comprises the seven counties of Kenosha, Milwaukee, Ozaukee, Racine, Washington, Waukesha, and Walworth.

The initial work program of the Commission, initiated in 1961, included six regional planning studies.

1. The Statistical Program and Data Processing Study, completed in December, 1962, is intended to provide a basis for data collection and analysis through the formulation of a series of mathematical simulation models of the Region. These models will permit alternative plans for the development of the Region as a whole to be quantitatively tested and evaluated.

2. The Base Mapping Program provides maps outlining the key physical features of the Region and the framework upon which all kinds of vital planning and engineering information can be entered. These base maps are the first true maps of the counties within the Region at a uniform scale. They provide a valuable working tool for county and local planning as well as for regional planning.

3. The Economic Structure Study provides data on the economic base and structure of the Region, covering employment, income levels, and investment as well as an analysis of development trends and prospects. It is, in addition, providing preliminary data for the regional activity (economic) model developed under the data processing study previously described.

4. The Population Study provides detailed data in readily useable form on such population characteristics as birth, mortality and net migration rates, family size, age, sex distribution, and gross density patterns. Population projections were prepared for the Region as a whole, for each of the seven counties, and for each of the three urbanized areas within the Region.

5. The Public Utility Study is an inventory and evaluation of existing and planned service areas of public utility systems within the Region and delineates existing and possible future service areas.

6. The Natural Resource Inventory Study inventories, lists, and summarizes resource related data for the Region, points out resource based problems, and suggests future planning programs necessary to provide the basis for sound decision making in resource management by government officials, businessmen, and interested citizens.

The Commission has also adopted an interim policy on community assistance, limiting its services in this respect to functional guidance and advice to local communities and governmental units.

Four planning guides and handbooks are being prepared to provide communities and counties throughout the Region with information helpful in the preparation of sound local codes and ordinances, which will aid in implementation of local as well as regional plans, and to assist local public officials and citizens within the Region in carrying out their day-to-day planning function.

One of the major accomplishments in 1962 was approval of the Regional Land Use-Transportation Study. This is a three and one-half year project and is estimated to cost $1,987,000. It is being carried on by the joint collaboration of the U. S. Bureau of Public Roads, State Highway Commission of Wisconsin, Housing and Home Finance Agency, and the Southeastern Wisconsin Regional Planning Commission. This study will provide an integrated, long-range land use and transportation plan for the Region. This study is currently under way and is scheduled for completion in 1966. Certain elements of this study have important implications for resource planning, particularly the regional soil survey and the regional park and open space study.

Two watershed committees have been formed to advise and assist the SEWRPC in problems of special importance of these particular watersheds. The Root River Watershed Committee was organized in August, 1962, and has developed a program of study for the serious problems of flooding, pollution, and recreational land use

in the Root River basin. The Fox River Watershed Committee was organized in December, 1962, and is presently setting about to define a number of water-related problems in the Fox River basin. Both of these committees receive staff advice and assistance from the Commission and, in turn, advise the Commission regarding any water programs established in their areas.

This agency presently has a small public information program which consists of a bimonthly newsletter, and a weekly staff letter and progress report sent to many persons interested in the day-by-day activities of the Commission.

The Commission sponsors an annual planning conference generally held in November of each year which is attended by 300 to 400 interested public officials and citizens from throughout southeastern Wisconsin.

D. Future Planning Projects

Two planning projects, programmed as part of the Regional Land-Use Transportation Study, include a Regional Soil Survey of the entire planning Region, and an inventory of game and fish habitat and areas of wetland and forests.

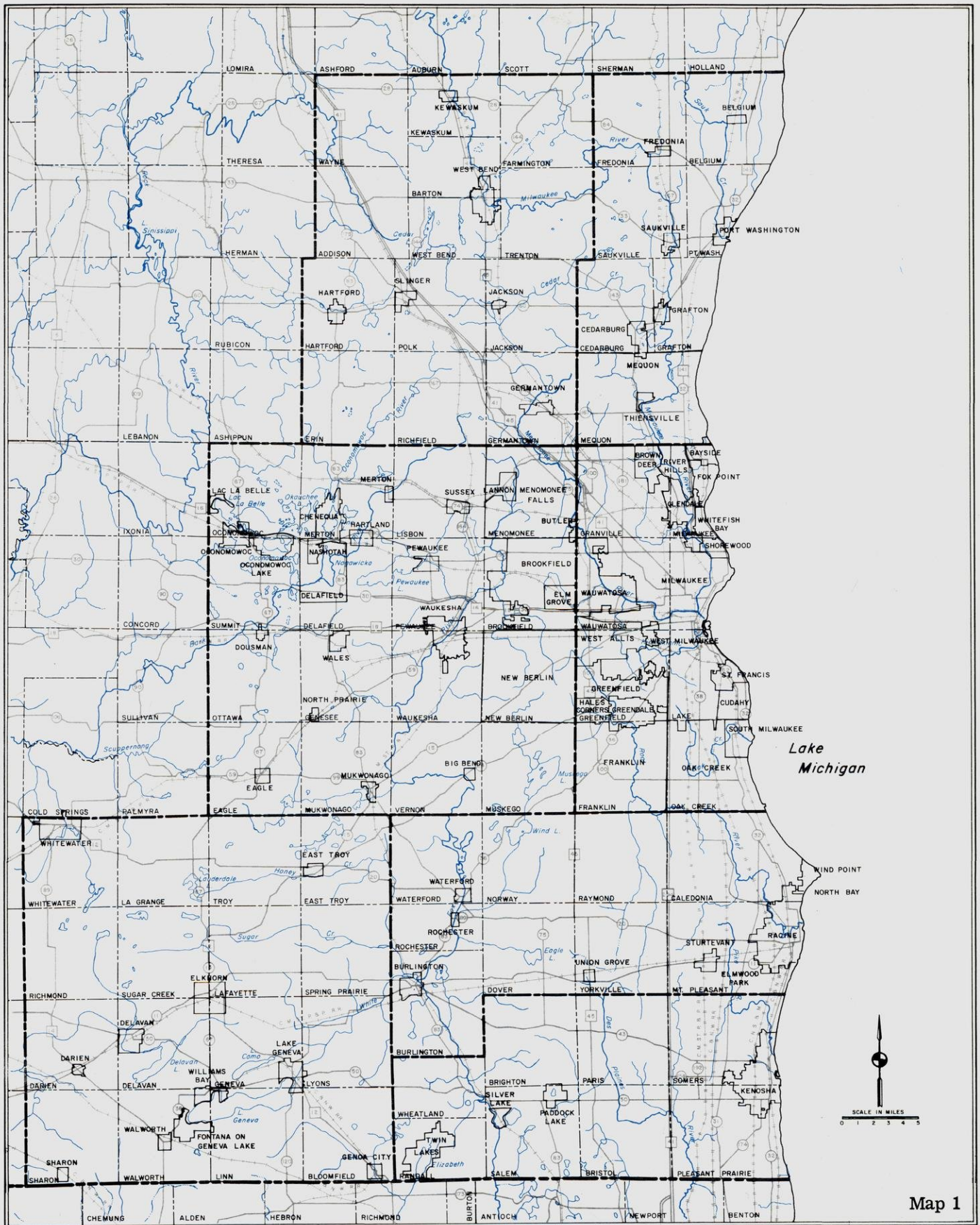
The Regional Soil Survey is presently under contract with the Soil Conservation Service, U. S. Department of Agriculture. This survey will provide agricultural and nonagricultural information, including interpretation of the physical soil properties for plant and wildlife habitat, water management, engineering properties of the soil, and urban and rural land use capabilities. The surveys and interpretations can be used in selecting the best use of land for residential, commercial, industrial, agricultural, and recreational development, and in the selection of the most suitable areas for the location of highway, railway, airport, pipeline and cable facilities. Accurate estimates can also be made of the suitability of soils for private sewage disposal facilities, agricultural tiling, and urban drainage systems, foundations for buildings and structures including transportation facilities, water reservoirs and embankments.

This soil survey will be used by the SEWRPC in all future comprehensive regional planning to insure that regional settlement patterns and land uses are adaptable to the natural resources of the area. This same survey will, in addition, be useful to local units of government, private corporations, and individual citizens in making the proper decisions concerning land use development and management.

The inventory of game and fish habitat and location of wetlands and forests in the Region is being conducted by the Wisconsin Conservation Department in collaboration with the State Department of Resource Development, and the SEWRPC. This study will provide the Commission and other interested individuals with accurate information useful in planning future park, recreation and open space areas.

Upon the completion of the Regional Land Use-Transportation Study project in 1966, it is proposed that all the natural resource, land use, and other types of data collected by this program will be kept up-to-date by a small General Planning Section, functioning as part of the SEWRPC staff. Such a continuing planning program will provide all governmental units and citizens within the Region with up-to-date and accurate data on many natural resource indices.

It is also hoped that at some date in the future a water resource inventory of the Region can be undertaken which will provide much useful information for adequate water resource management programs within the Region and stimulate the development of suitable public policy in this field.



Map 1

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SOUTHEASTERN WISCONSIN REGION

DRAWN: R.S. Humphrey DATE: May, 1962
CHECKED: H.E. Clinkenbeard
ORIGINAL COMPILATION: 1:250,000
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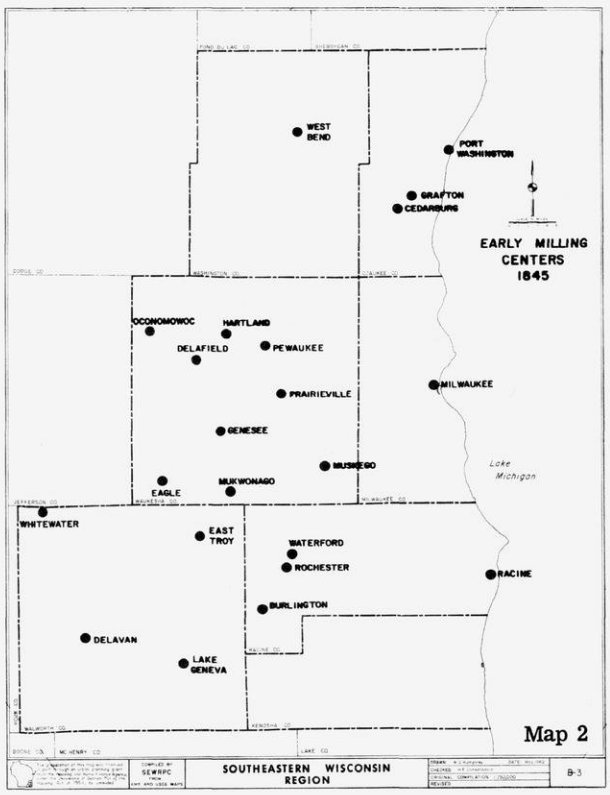
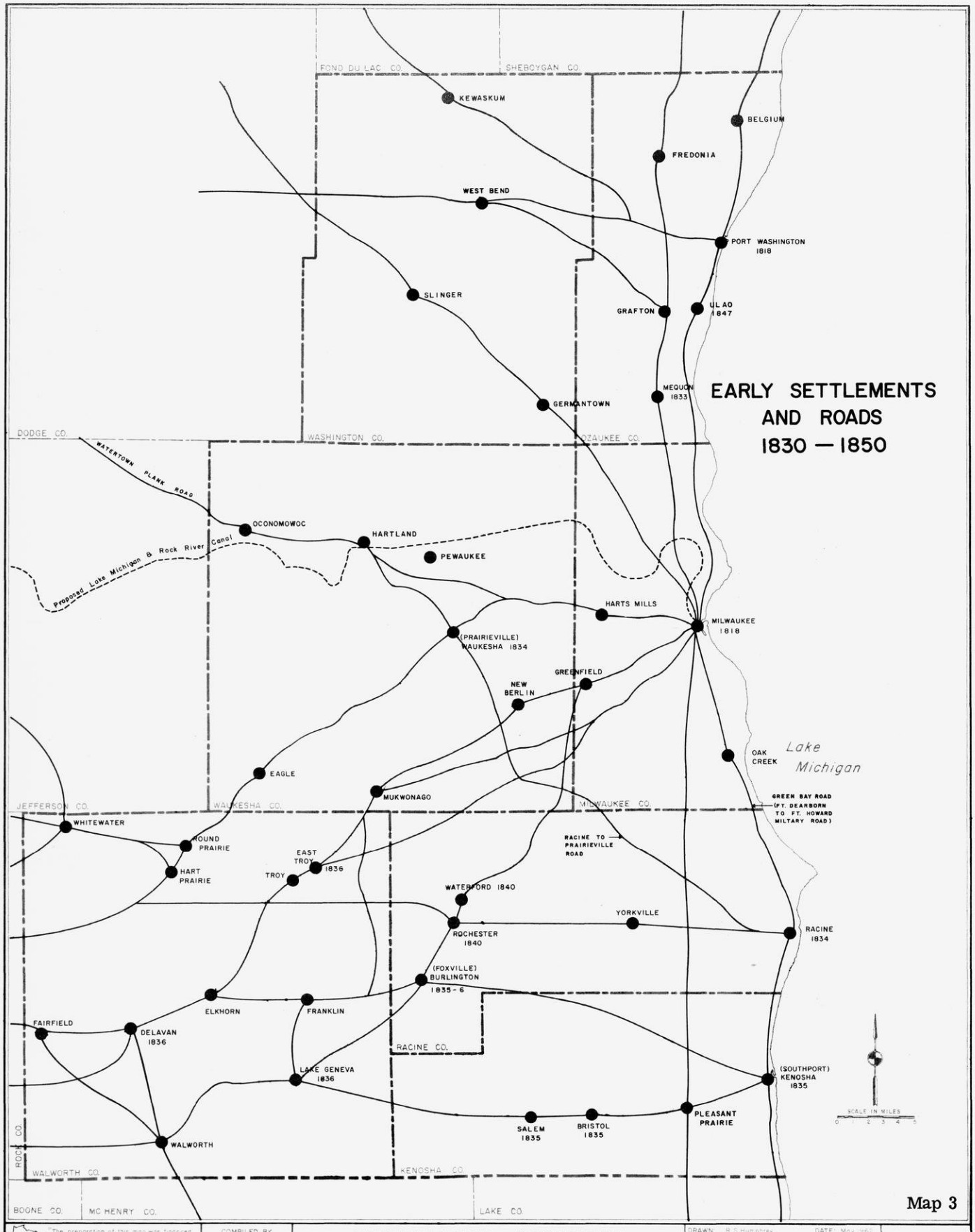
Chapter II
HISTORIC RESOURCE PATTERNS

EARLY SETTLEMENT AND ROADS

Settlement by the white man of the area we now speak of as comprising the seven counties within the southeastern Wisconsin regional planning area was first begun in the period immediately after 1830 (see Map 1). Prior to this time southeastern Wisconsin had been inhabited entirely by various Indian tribes who used the waterways of the area for travel and developed footpaths along the stream courses and across the low divides to engage in a barter form of commerce and tribal warfare. French, English, and later American fur traders had been in contact with the native population of southeastern Wisconsin for 300 years prior to the first intensive white settlement. Most of this contact had taken place with the Indians for purposes of bartering for furs and was necessarily limited to the several inlets and mouths of rivers in the immediate area. The principal post for fur trading activities at this time was in the vicinity of Green Bay, Wisconsin. It was not until the period after the War of 1812 that a permanent fur trading establishment was built at the mouth of the Milwaukee River by Solomon Juneau. The native population of the area in this period prior to white settlement was said to be fairly large considering the primitive techniques of the Indians in utilizing the available resources. Southeastern Wisconsin was quite generously endowed with clear flowing streams, abundant woodlands, consisting primarily of a mixture of maple, beech, and various species of oak, and many varieties of large and small game. There were large areas of open marsh land left from the recent glacial period due to the disruption of the normal drainage pattern by the glaciers. Interestingly, there were several large areas given entirely to prairie grasses (see Map 8). Notable among these were vast expanses of prairies in eastern Racine and Kenosha Counties adjacent to the wetlands along the south branch of the Root River and the upper reaches of the Des Plaines River. Also, prairie lands extended in a wide swath through central Walworth County and in southwestern Waukesha County in the vicinity of North Prairie and Eagle.

As the U.S. Public Land Survey was completed in the early 1830's, lands in this Region were settled at a fairly rapid rate so that by 1835 all lands had been taken up; and there was a fairly even low density settlement of white population throughout the Region (see Map 4). Early settlement was strictly on an agricultural basis, and those farmers who were fortunate enough to settle in prairie areas with good drainage soon had their lands in a higher state of production than those whose areas had to be first cleared of the virgin forest cover. The roads of the period which linked the various settlements or clusters to the developing towns on the shores of Lake Michigan generally followed the former Indian trails used by the immediate Indian predecessors (see Map 3). Many of these roads and Indian trails have been perpetuated today in the form of our county and state trunk highway systems.





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SOUTHEASTERN WISCONSIN REGION

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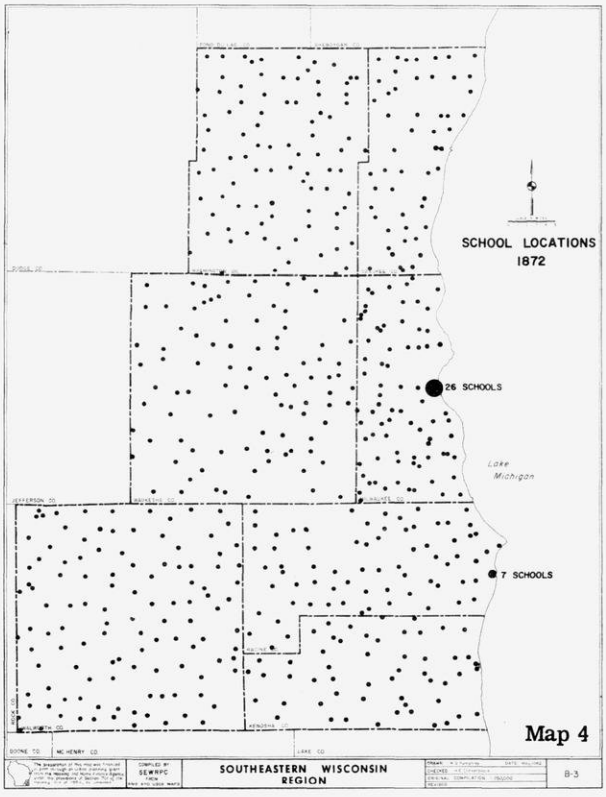
AGRICULTURAL DEVELOPMENT

Early settlement, as mentioned above, was entirely agriculturally orientated; and this development, coupled with the transportation of that day, necessitated a number of agricultural supply centers to meet the limited needs of the population for goods and services which could not be manufactured at home. Prior to the Civil War, wheat was the main and predominant crop in the Region. This led to the early development of processing centers for this product which necessarily also became localized supply depots to serve the needs of the surrounding farm areas. As mills were entirely dependent upon water power for energy, they were usually located on those sections of the streams where a sufficient head of water could be generated for this purpose. Typical of these early milling centers established in the years around 1845 was Prairieville, now called Waukesha, Pewaukee, Delafield, Mukwonago, Waterford, and Rochester, to name a few (see Map 2). Many of these centers survive today, but for other reasons, as the principal inland towns in the Region. It should be noted that the only urban centers engaging in early milling activities along the shores of Lake Michigan were Port Washington, Milwaukee, and Racine.

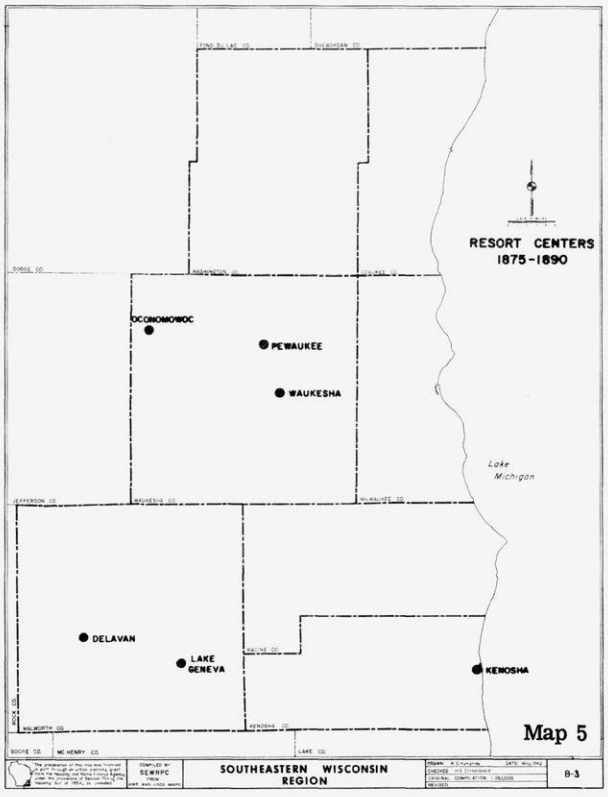
After the Civil War, farmers diversified their crops, engaging in other types of cereal cultivation though wheat still was a main item in the agricultural pattern due to the stimulation of the budding brewery industry in Milwaukee in the 1870's. Hop raising was also a subsidiary activity in many areas to supply the Milwaukee beer industry. By 1900, the predominance of grain farming in most of the counties in this Region gradually gave way to dairying, which by 1920 was the outstanding agricultural pursuit. Of all the seven southeastern Wisconsin counties, Walworth was the most distinctly agricultural in the 1920-1930 period. Waukesha County was also noted for its dairy industry and for the finish feeding of cattle for the Milwaukee meat packing plants. It is interesting to note that, in one period of the Region's agricultural development, sheep raising was a major activity. By 1880, Walworth County had 181,000 sheep on the range; but the industry soon declined, and by 1919 sheep raising as a major activity had practically disappeared from this county and from other interior areas in southeastern Wisconsin.

RESORTS

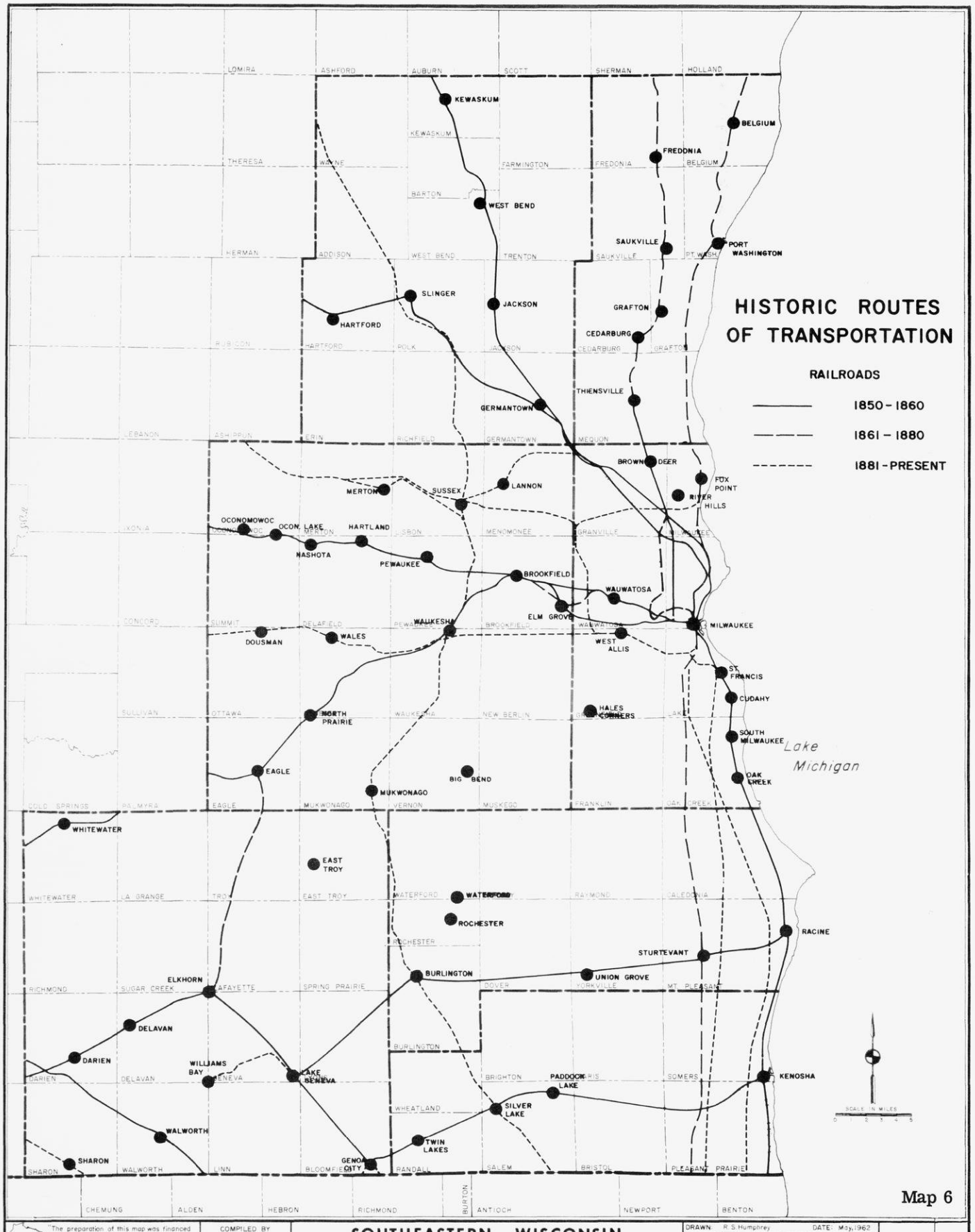
The development of resorts and the tourist



Map 4



Map 5



Map 6

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SOUTHEASTERN WISCONSIN REGION

DRAWN: R.S. Humphrey	DATE: May, 1962
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ORIGINAL COMPILATION: 1:250,000	
REVISED:	

industry, which attracts so many thousands of people to the southeastern Wisconsin area today, had its initial development in the period after the Civil War (see Map 5). Most of the original resort centers of the 1870's and 1880's were primarily spas and connected in most cases with the mineral water springs present in the locality or the presence of beautiful inland lakes along whose shores many large homes with expansive grounds were built for the wealthy families from the Milwaukee and Chicago areas. These resort centers catered mostly to families who would come and spend the summer in that location or take an extended vacation to participate in the activities afforded by the lakeside locations or the healthful waters from the mineral baths.

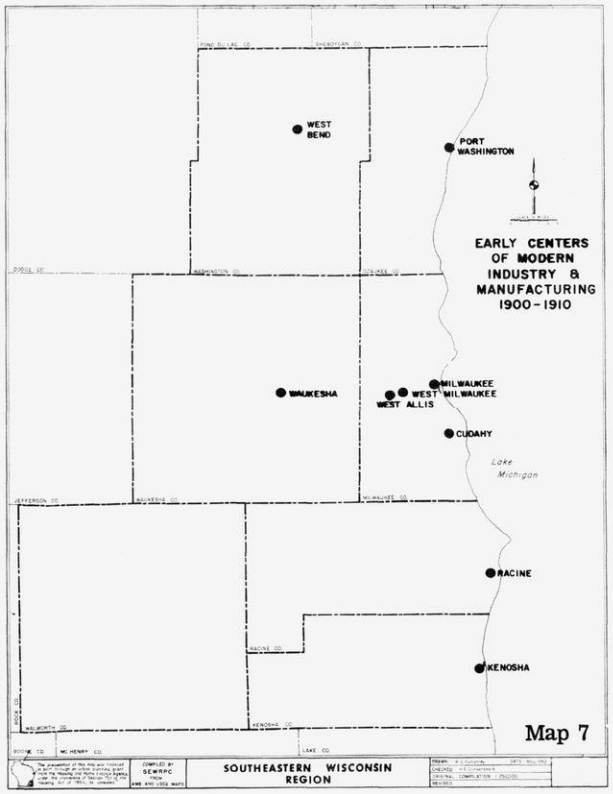
Several cities which flourished in this period as resort centers included Waukesha, noted for its mineral springs; Pewaukee, Oconomowoc, Lake Geneva and Delavan, noted for their lakeside locations; and Kenosha, situated on Lake Michigan, whose mineral baths and sandy beaches attracted many people from the Chicago area (see Map 5). Most of these initial centers still attract many summer visitors and tourists with the exception of Waukesha, whose mineral baths and hostels which catered to summer visitors began to decline by the turn of the century.

INDUSTRY AND MANUFACTURING

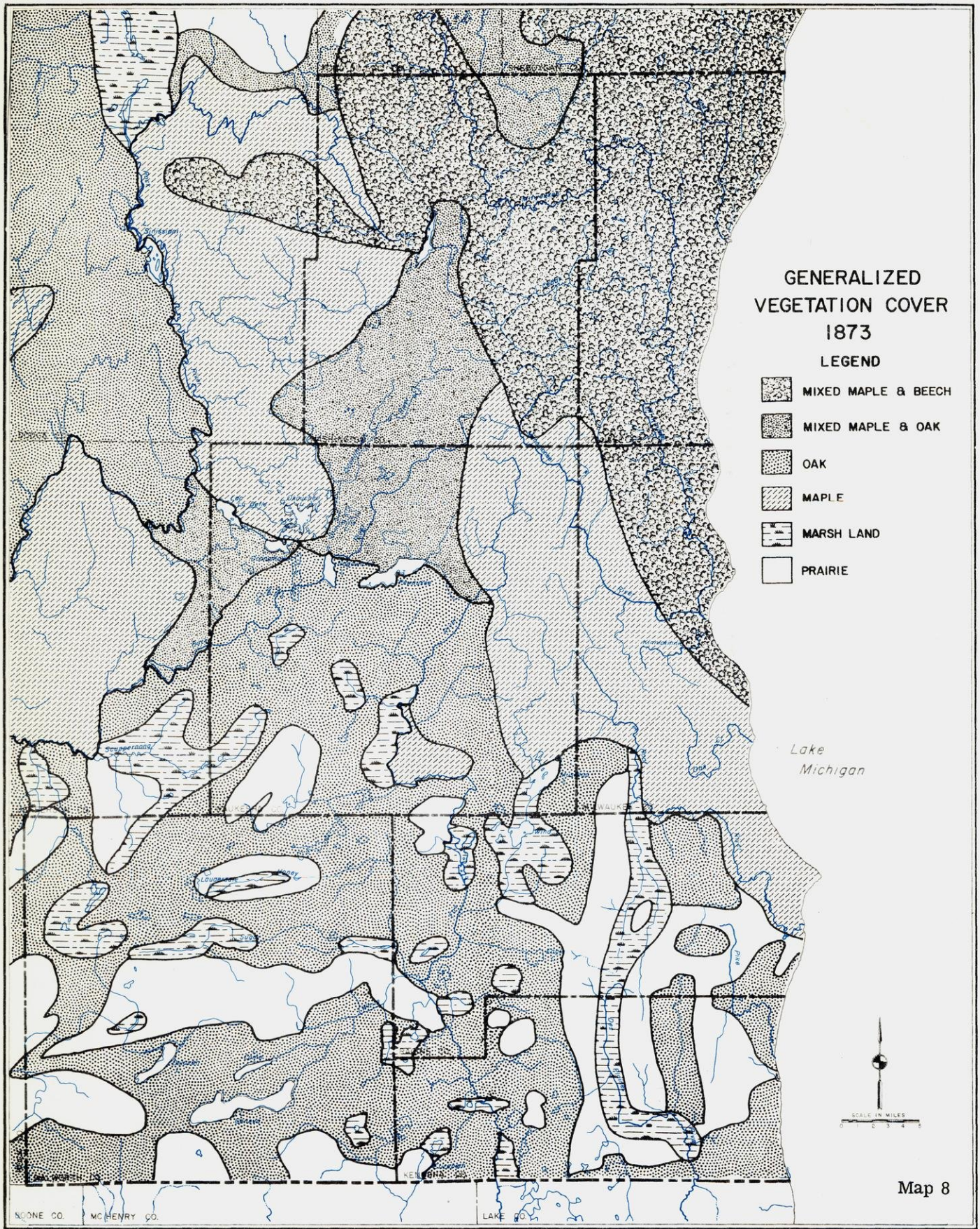
In the period when southeastern Wisconsin settlers primarily depended on agriculture as a means of subsistence living, industrial development was mostly in the form of processing of agricultural products and milling of timber from the native forests of the area. The early milling centers, as noted above, were primarily orientated toward water power sites in order to secure the needed energy. The development of the railroads into the interior in the 1850's and the expansion of this railway net after the Civil War gave better access to towns in the interior from the lakeshore port centers and, thus, helped to develop such Lake Michigan ports as Milwaukee, Racine, Kenosha, and Port Washington into trading centers handling manufactured goods from the East and selling to the farmer in southern and central Wisconsin (see Map 6). This naturally led to the development of a number of service industries in these port cities.

Milwaukee in the early days was primarily a trading center but as early as 1840 had developed a small iron foundry which supplied many local needs. Raw materials for this industry and other early metal industries which developed in the middle part of the nineteenth century were brought in mostly from iron mines in northern Wisconsin and Michigan. At the end of the Civil War Milwaukee became more prominent as a brewing and milling center handling wheat products shipped in from Wisconsin, Iowa, and Minnesota. The period of large industrial enterprise in Milwaukee dates from around 1880. At that time the annual value of products manufactured in that city was $43 million. In the single ten-year period from 1880 to 1890, $54 million of annual value was added so that by the year 1889 industrial products had an annual value of $97 million. By 1890 Milwaukee ranked sixth as a flour milling center in the U.S.; by 1910 it was the third largest flour and milling center in this country.

Other Lake Michigan port cities had a somewhat similar development (see Map 7). Racine, after being an early trading and shipping point, attracted small industrial establishments and machine shops turning out basic machinery for agricultural uses. The settlement in this city of many northern European people with technical skills led to the development by 1900 of many



Map 7



Map 8

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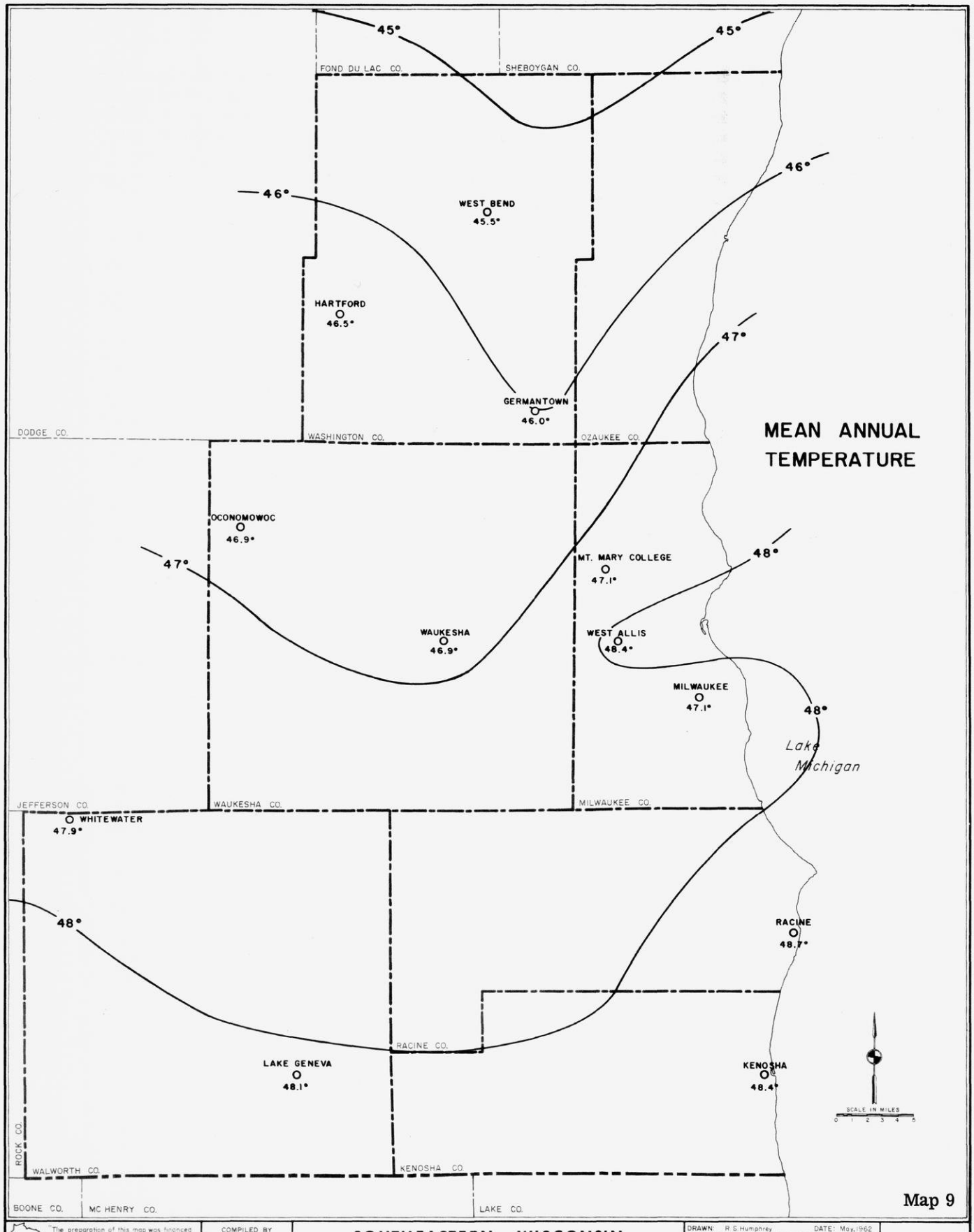
SOUTHEASTERN WISCONSIN REGION

DRAWN:	R.S. Humphrey DATE: May, 1962
CHECKED:	H.E. Clinkenbeard
ORIGINAL COMPILATION:	1:250,000
REVISED:	

fair size industries, producing basic machinery and parts of one type or another. The establishment of a plant to manufacture Nash cars in Kenosha at the turn of the century was a logical outgrowth of its port location, nearness to other industrial centers, and a large labor pool. Since 1900 the development of large industrial enterprises in the Milwaukee-West Allis area, in the City of Waukesha and West Bend, and in the port cities along Lake Michigan has primarily concentrated on the production of various types of internal combustion engines, foundry work, heavy construction machinery, control panels and switch gear, and other precision machinery products.


45°
45°
FOND DU LAC CO.
SHEBOYGAN CO.
46°
46°
WEST BEND
45.5°
HARTFORD
46.5°
47°
GERMANTOWN
46.0°
DODGE CO.
WASHINGTON CO.
OZAUKEE CO.
MEAN ANNUAL TEMPERATURE
OCONOMOWOC
46.9°
47°
MT. MARY COLLEGE
47.1°
48°
WAUKESHA
46.9°
WEST ALLIS
48.4°
MILWAUKEE
47.1°
48°
Lake Michigan
JEFFERSON CO.
WAUKESHA CO.
MILWAUKEE CO.
WHITEWATER
47.9°
48°
RACINE
48.7°
RACINE CO.
LAKE GENEVA
48.1°
KENOSHA
48.4°
SCALE IN MILES
0 1 2 3 4 5
ROCK CO.
WALWORTH CO.
KENOSHA CO.
BOONE CO.
MC HENRY CO.
LAKE CO.
Map 9
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SOUTHEASTERN WISCONSIN REGION
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CHECKED: H.E. Clinkenbeard
ORIGINAL COMPILATION: 1:250,000
REVISED:

Chapter III
CLIMATE AND WEATHER

The location of the Southeastern Wisconsin Planning Region, in the upper Midwest and in the interior of the North American continent approximately 1500 miles in any compass direction from a large ocean body, has a decided influence upon its climate. This area of Wisconsin is astride the main cyclonic storm tracks along which a series of high and low pressure centers move across the continent from west to east. These high and low pressure areas provide the Region with a varied climate and are a major determinant as to the amount of precipitation which it receives. Southeastern Wisconsin, while adjacent to Lake Michigan on the east, is more attached and similar in its weather conditions to the large continental hinterland extending west to the Mississippi River and beyond.

The climatic conditions over most of the Region are typically continental with relatively warm summers and long cold winters. The prevailing winds over the Region are mostly from the southwest, west-southwest, and west-northwest (see Figure 1). Due to this fact, the moderating influence of Lake Michigan on the eastern borders of the Region does not extend for many miles inland. Only in the early spring, when on many days the prevailing winds are from the north-northeast off of Lake Huron and Lake Michigan, is the lake effect felt far inland; and then it mostly serves to retard the advancing warm weather of the season.

The temperature of the Region maintains a uniform range for most weather stations (see Map 9 and Figure 2), and there is little difference between areas of the Region. Winter monthly average temperatures range from about 20 to 30 degrees Fahrenheit in the months of December, January, and February; while monthly summer average temperatures range from 70 to 75 degrees Fahrenheit in the months of July and August. In the month of March the spring retarding influence of the cold north-northeast winds, as mentioned above, is quite noticeable on the records of most stations in this area.

The range of precipitation is also remarkably uniform for all stations in the Region (see Map 10 and Figure 3). For the area as a whole, between 60 and 66 percent of the yearly precipitation occurs during the growing season extending from the months of May through September. Average annual precipitation for the 13 stations in the Region range from a low of 27.35 inches at Germantown in Washington County (see Table 1) to a high of 32.88 inches at Lake Geneva in Walworth County (see Table 4). As over 50 percent of this precipitation coincides with the period of frost free days for this latitude, it is of great benefit to the crops. The frost free days are decidedly influenced by Lake Michigan as spring advances across the Region from the southeast to the northwest (see Map 11). In direct opposition, the earliest frost in the Region occurs in northwestern Washington County; and the frost line advances toward the southeastern part of the area. First frost has been known to occur

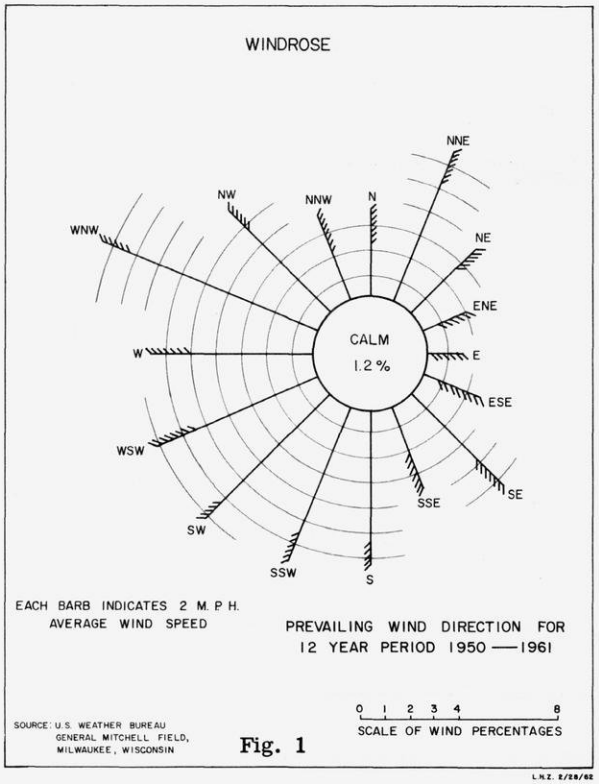
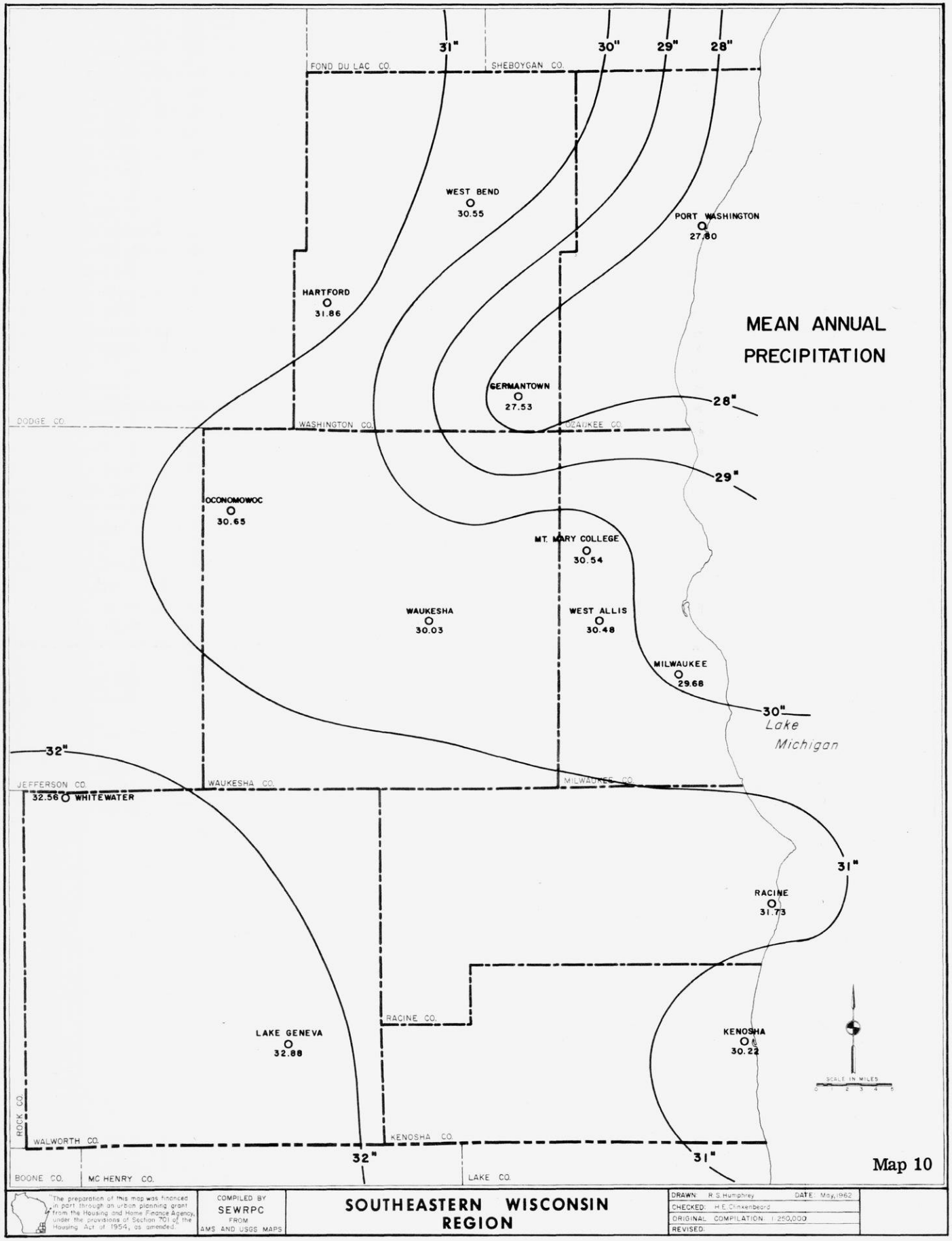


Fig. 1



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SOUTHEASTERN WISCONSIN REGION

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as early as September 1 in Washington County. The length of the growing season varies from from 140-150 days in northwestern Washington County to more than 170 days along the lakeshore plain area in Milwaukee, Racine, and Kenosha Counties.

Corn maturity days over the Region average approximately 110. In Walworth County there is an average of 115 days available in which to ripen corn while this decreases as you move eastward and northward so that there are just 100 days available for this purpose adjacent to Lake Michigan in Milwaukee and Ozaukee Counties (see Map 12).

Active weather observation facilities and stations are fairly uniformly spread across the Region (see Map 13). Many of these stations have records extending back 15 years or more. The oldest weather observation station in the Region was that established in Milwaukee in 1905. The records of temperature and precipitation which are available are adequate for macro-climatic studies, but additional facilities would need to be established and maintained to provide detailed information for most types of micro-climatic or meteorological research. Also, the only complete weather station providing active indices of data for wind direction and velocity, relative humidity, air pressure, and cloud cover, is at General Billy Mitchell Field in Milwaukee.

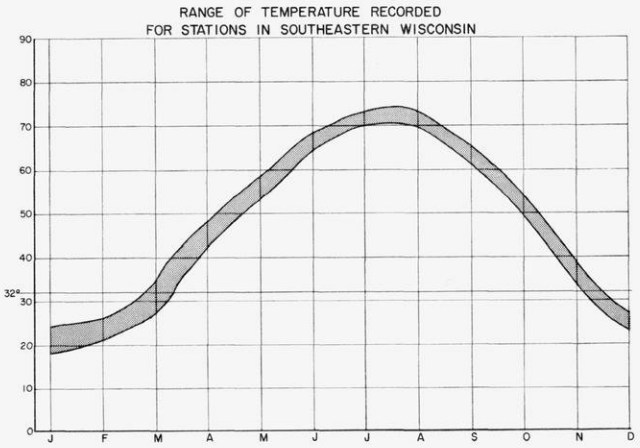


Fig. 2

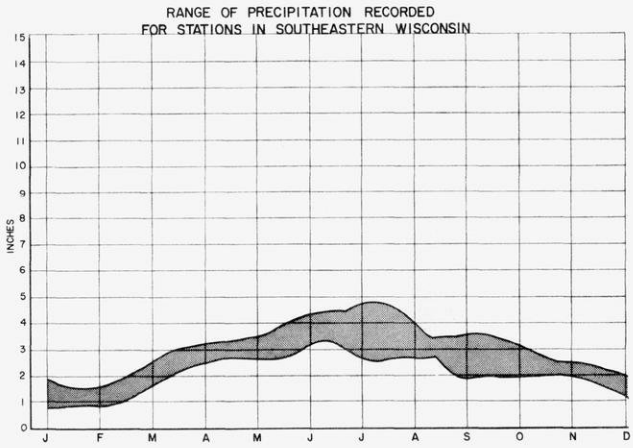
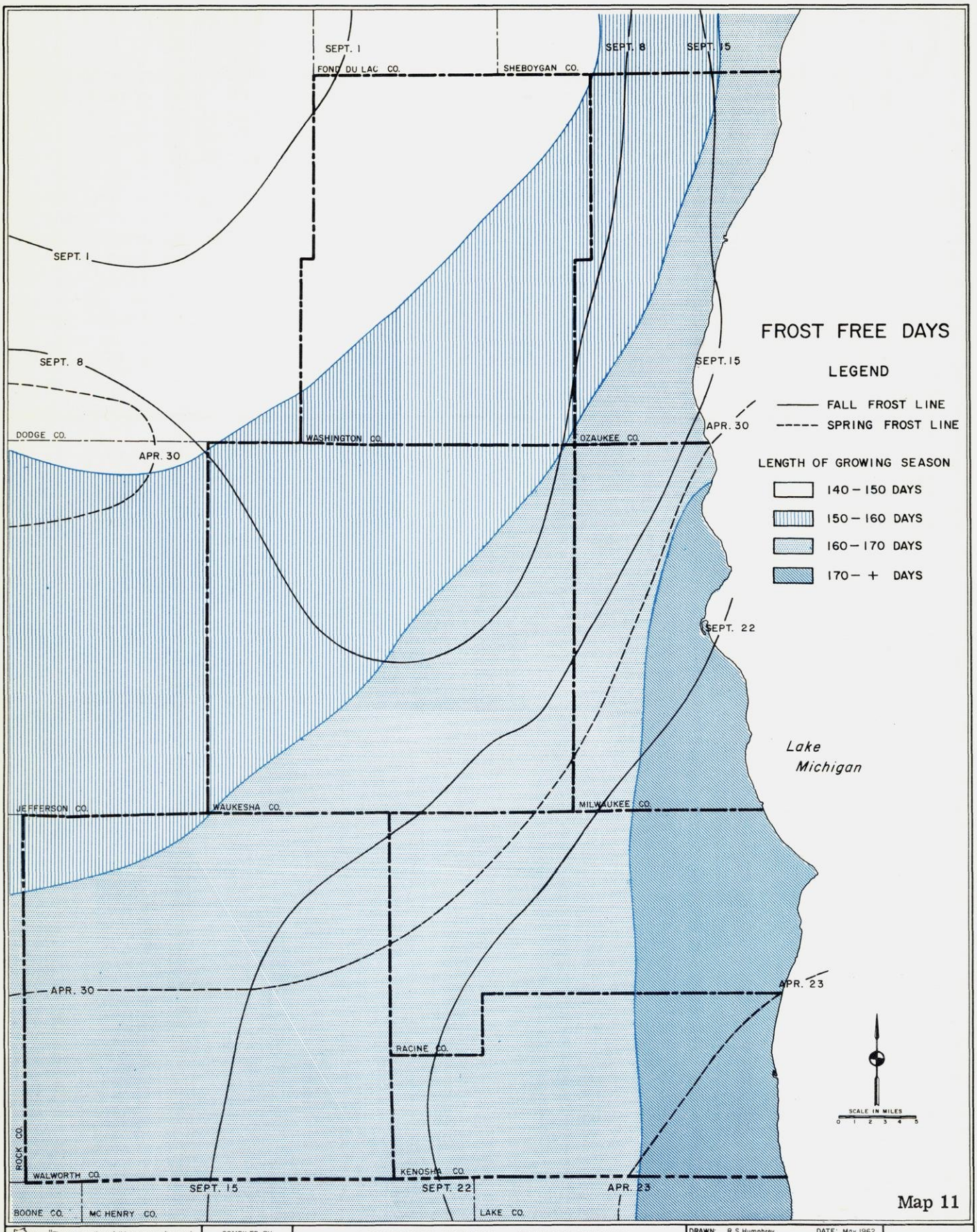


Fig. 3



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SOUTHEASTERN WISCONSIN REGION

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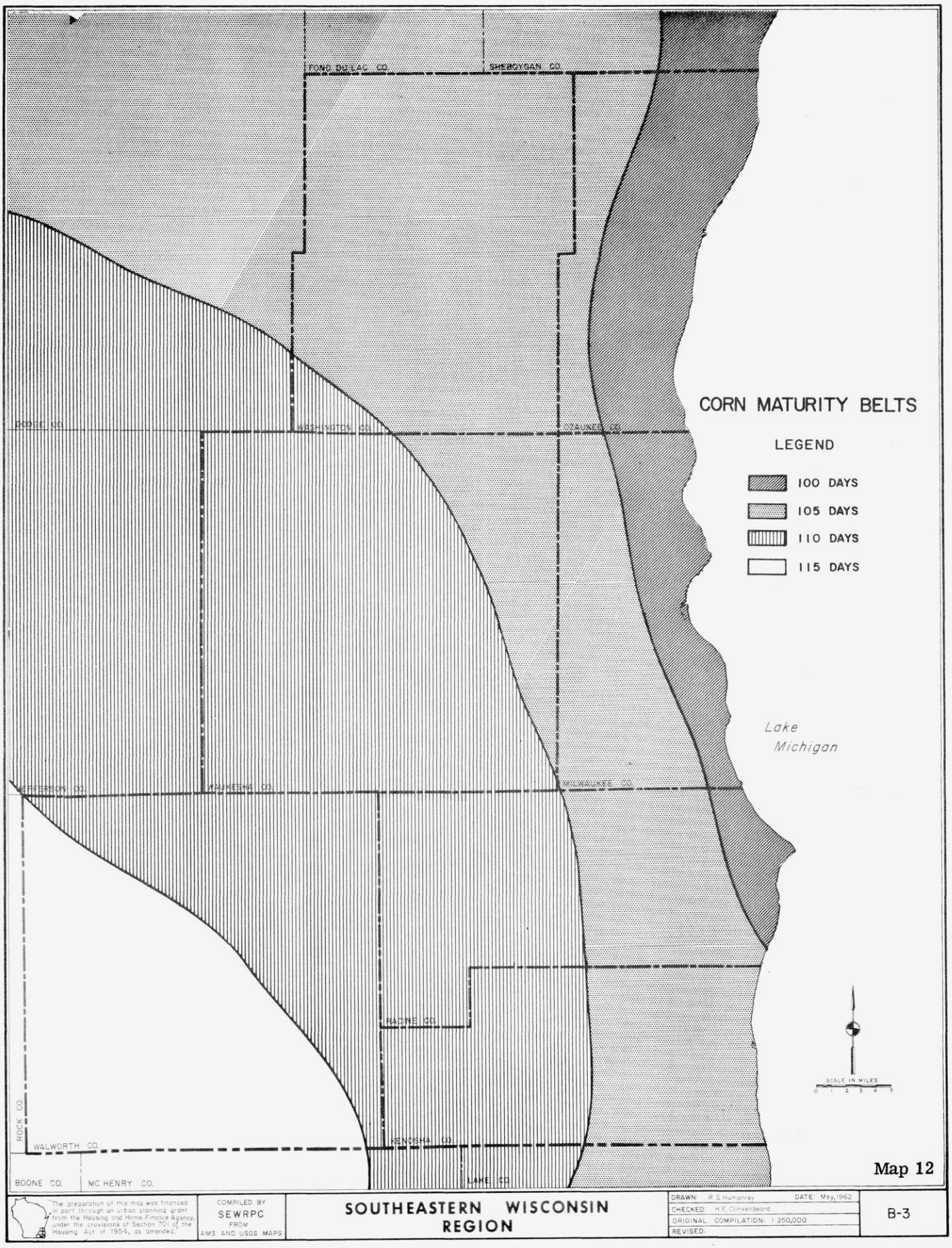
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SHEBOYGAN CO.
DODGE CO.
WASHINGTON CO.
OZAUKEE CO.
WAUKESHA CO.
MILWAUKEE CO.
JEFFERSON CO.
RACINE CO.
KENOSHA CO.
ROCK CO.
WALWORTH CO.
BOONE CO.
MC HENRY CO.
LAKE CO.
CORN MATURITY BELTS
LEGEND
100 DAYS
105 DAYS
110 DAYS
115 DAYS
Lake Michigan
SCALE IN MILES
0 1 2 3 4 5
Map 12
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COMPILED BY SEWRPC FROM AMS AND USGS MAPS
SOUTHEASTERN WISCONSIN REGION
DRAWN: R.S.Humphrey DATE: May, 1962
CHECKED: H.E.Clinkenbeard
ORIGINAL COMPILATION: 1:250,000
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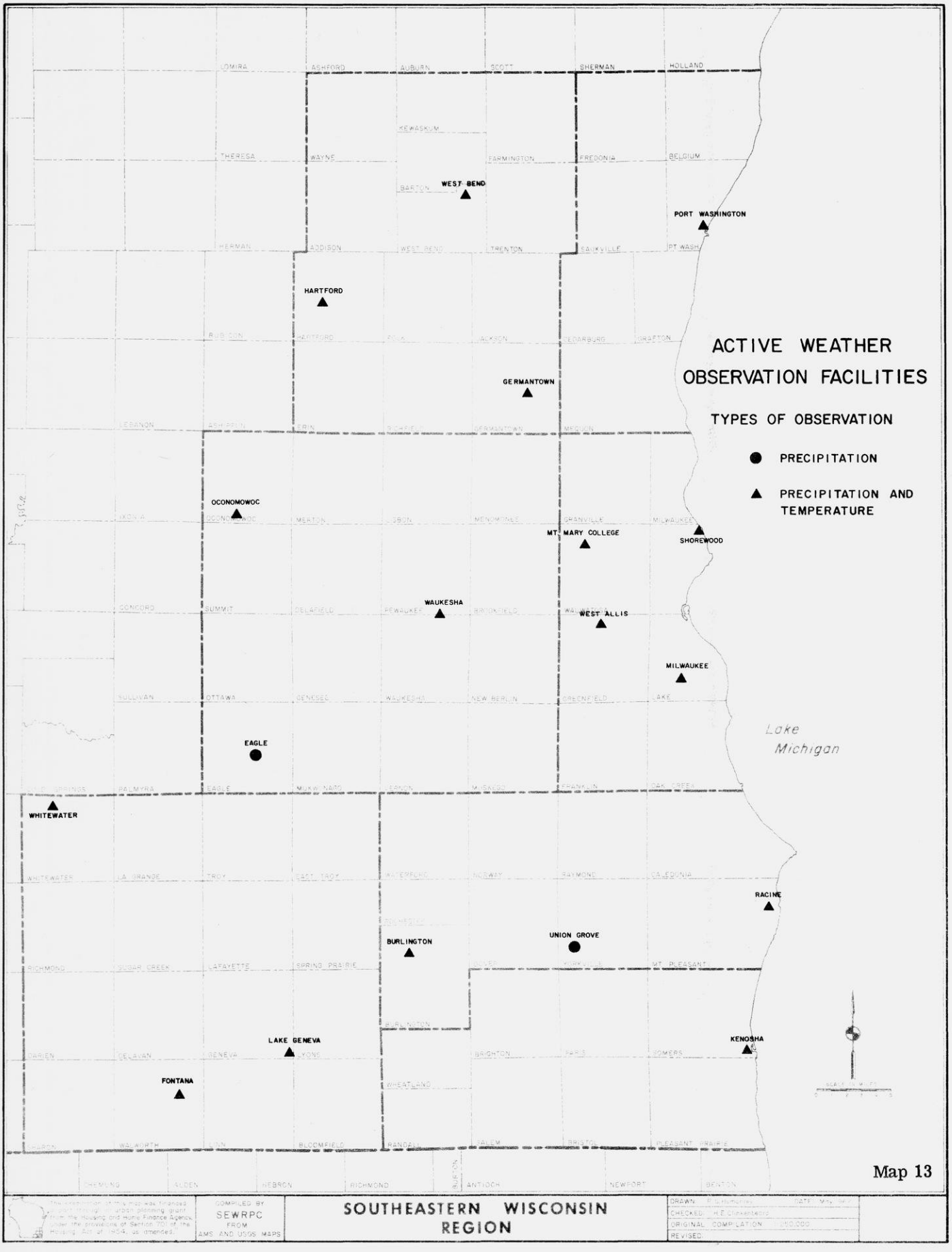

ACTIVE WEATHER OBSERVATION FACILITIES
TYPES OF OBSERVATION
PRECIPITATION
PRECIPITATION AND TEMPERATURE
WEST BEND
PORT WASHINGTON
HARTFORD
GERMANTOWN
OCONOMOWOC
MT. MARY COLLEGE
SHOREWOOD
WAUKESHA
WEST ALLIS
MILWAUKEE
EAGLE
WHITEWATER
RACINE
BURLINGTON
UNION GROVE
LAKE GENEVA
KENOSHA
FONTANA
Lake Michigan
Map 13
SOUTHEASTERN WISCONSIN REGION
COMPILED BY SEWRPC FROM AMS AND USGS MAPS

Table 1

TEMPERATURE AND PRECIPITATION RECORD, 1945 TO 1959 GERMANTOWN, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (^{o}F)													
Maximum monthly	24.90	32.70	45.00	51.50	61.20	68.10	74.90	75.20	66.20	58.50	41.60	31.80	
Mean monthly	20.07	23.07	28.27	45.77	55.23	65.11	70.29	69.83	61.37	52.25	35.85	24.87	46.0
Minimum monthly	13.10	16.20	27.40	38.60	50.6	60.10	66.60	63.70	56.40	46.20	28.50	16.10	
Precipitation (inches)													
Maximum recorded	2.24	1.73	3.74	5.39	4.54	6.72	7.99	7.49	5.76	4.85	3.57	2.10	
Record mean	1.08	.99	1.70	2.87	2.93	3.83	3.29	3.00	2.57	2.01	2.03	1.23	27.53
Minimum recorded	.27	.07	.26	1.21	1.35	1.46	.18	.53	.55	.04	.38	.12	

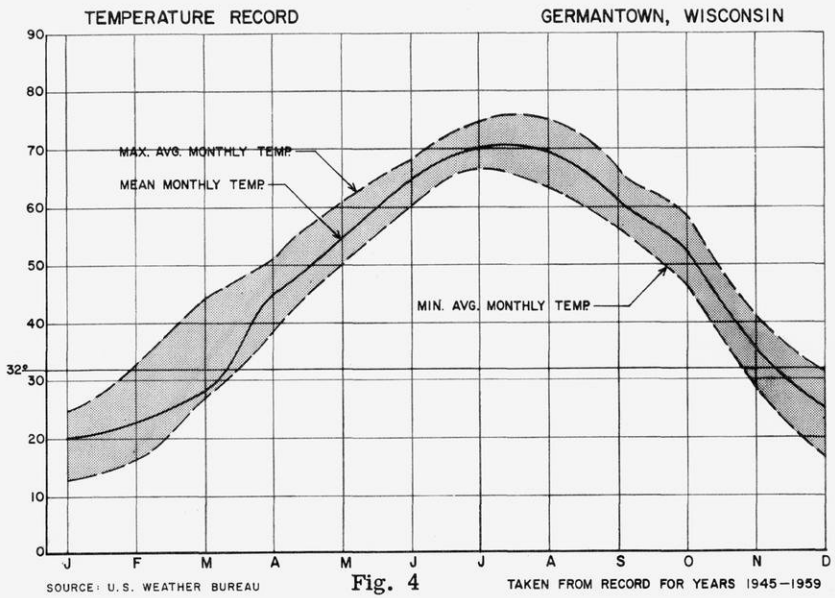


Fig. 4

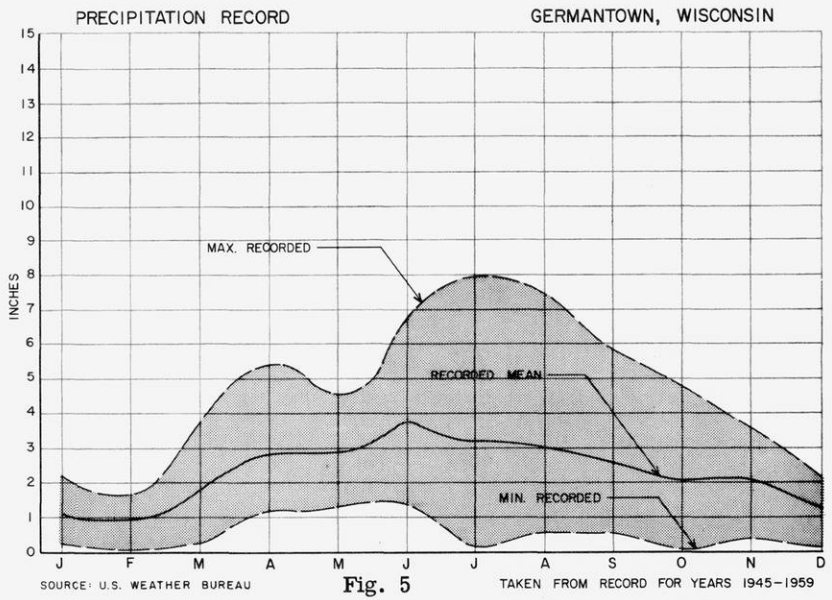


Fig. 5

Table 2

TEMPERATURE AND PRECIPITATION RECORD, 1954 TO 1961 HARTFORD, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (^{o}F)													
Maximum monthly	23.20	31.30	35.10	52.00	62.90	69.70	76.90	75.50	65.10	56.80	39.30	31.60	
Mean monthly	18.48	21.86	30.13	47.29	56.96	66.86	71.36	71.28	62.90	51.55	35.87	24.05	46.5
Minimum monthly	12.10	15.10	19.60	42.20	52.50	62.00	68.80	68.10	59.70	47.80	28.70	17.20	
Precipitation (inches)													
Maximum recorded	1.99	1.92	3.16	4.59	5.07	9.90	6.66	7.45	8.00	5.47	3.11	2.66	
Record mean	.88	.98	1.84	3.33	3.24	3.81	4.34	3.09	3.67	3.29	2.17	1.22	31.86
Minimum recorded	.21	.16	.36	1.82	1.06	1.82	2.04	.45	.85	.23	.53	.27	

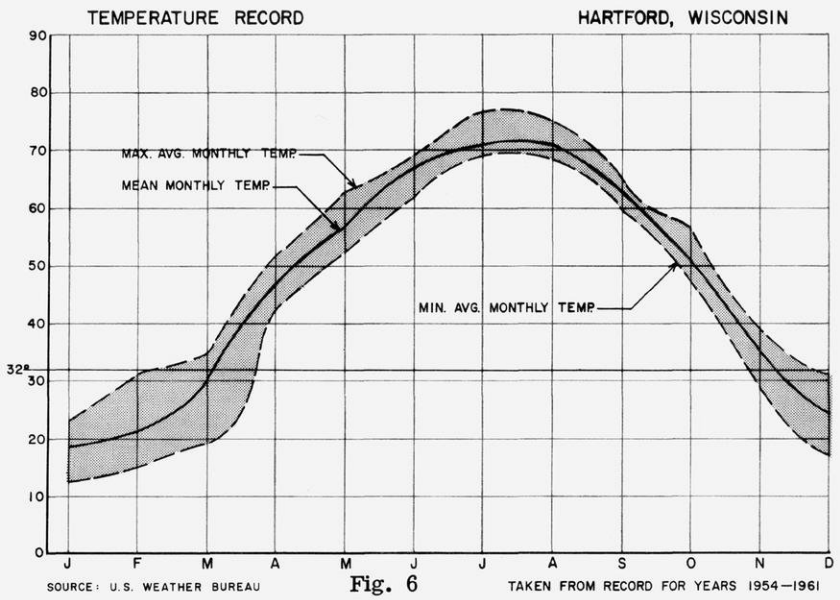


Fig. 6

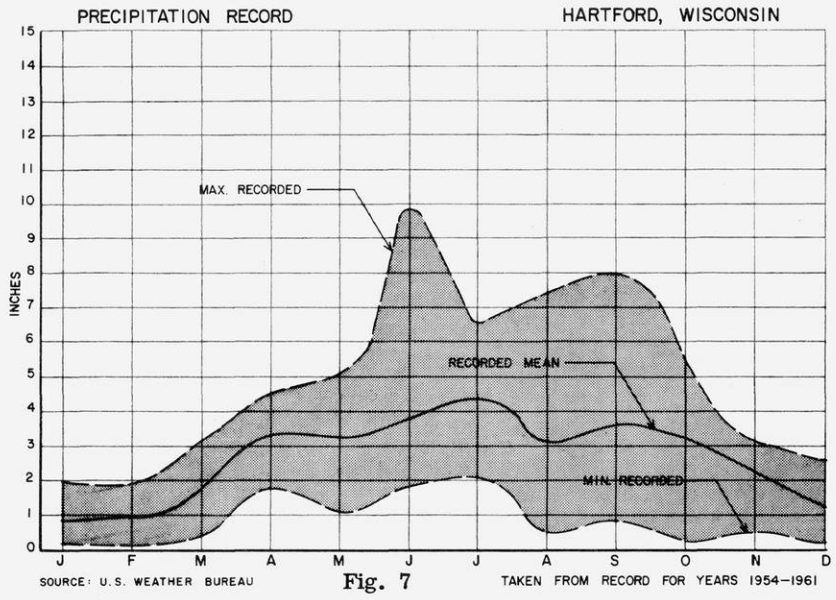


Fig. 7

Table 3

TEMPERATURE AND PRECIPITATION RECORD, 1945 TO 1959 KENOSHA, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (^{O}F)													
Maximum monthly	28.60	29.20	46.30	52.20	59.30	71.40	77.80	77.70	67.20	61.40	43.90	33.20	
Mean monthly	23.48	26.17	34.86	46.48	55.47	65.92	72.02	71.81	63.85	54.15	38.46	27.59	48.4
Minimum monthly	15.50	18.00	30.90	42.00	51.5	59.60	67.40	69.30	59.00	48.60	31.50	19.30	
Precipitation (inches)													
Maximum recorded	3.26	1.75	4.45	5.26	7.10	9.11	6.78	7.51	4.76	4.84	4.03	3.75	
Record mean	1.56	1.08	2.27	3.16	3.61	4.00	3.30	3.10	2.20	1.96	2.03	1.95	30.22
Minimum recorded	.41	.00	.79	.66	1.21	1.66	.66	.67	.30	.08	.55	.43	

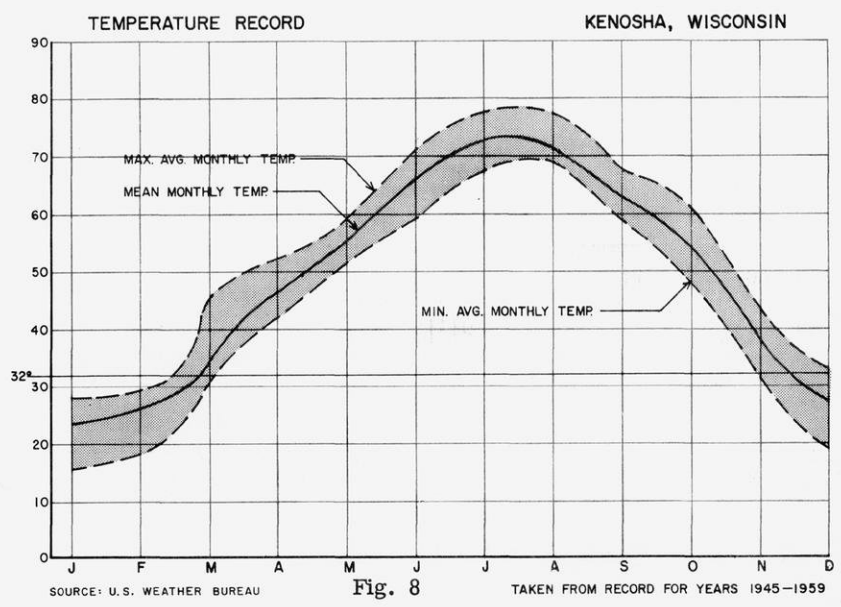


Fig. 8

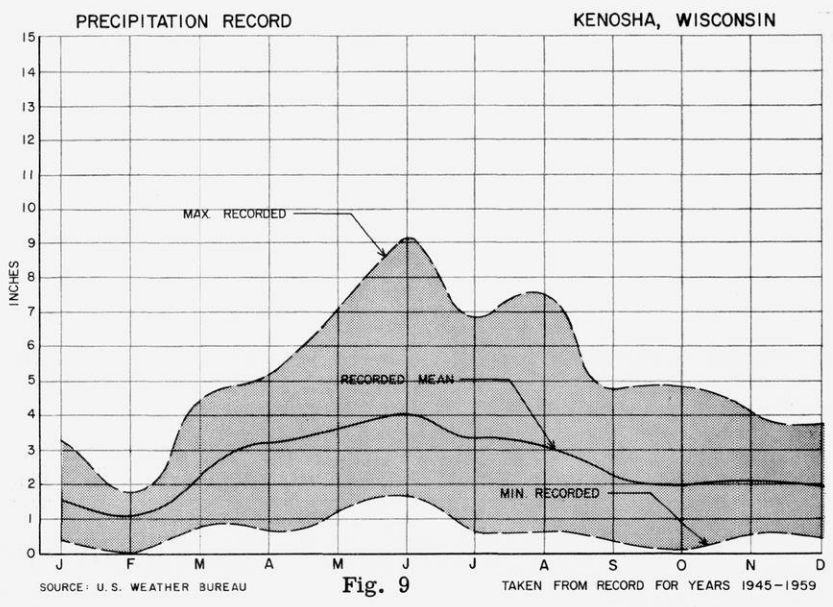


Fig. 9

Table 4

TEMPERATURE AND PRECIPITATION RECORD, 1946 TO 1959 LAKE GENEVA, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (^{O}F)													
Maximum monthly	25.7	34.8	42.5	54.6	63.80	73.0	79.00	77.8	66.1	59.4	42.1	32.4	
Mean monthly	21.56	24.76	33.54	47.55	58.11	68.40	73.16	72.09	63.39	53.49	36.82	24.31	48.1
Minimum monthly	13.9	16.8	29.1	40.4	53.00	63.3	70.00	67.2	59.3	48.0	29.8	17.7	
Precipitation (Inches)													
Maximum recorded	3.42	2.36	4.46	4.71	5.27	8.88	8.65	6.42	4.58	5.70	3.83	3.72	
Record mean	1.73	1.26	2.55	3.24	3.41	4.34	4.37	3.53	1.98	2.22	2.09	2.16	32.88
Minimum recorded	.33	.14	.28	.76	1.47	1.67	2.25	1.39	.16	.09	.58	.46	

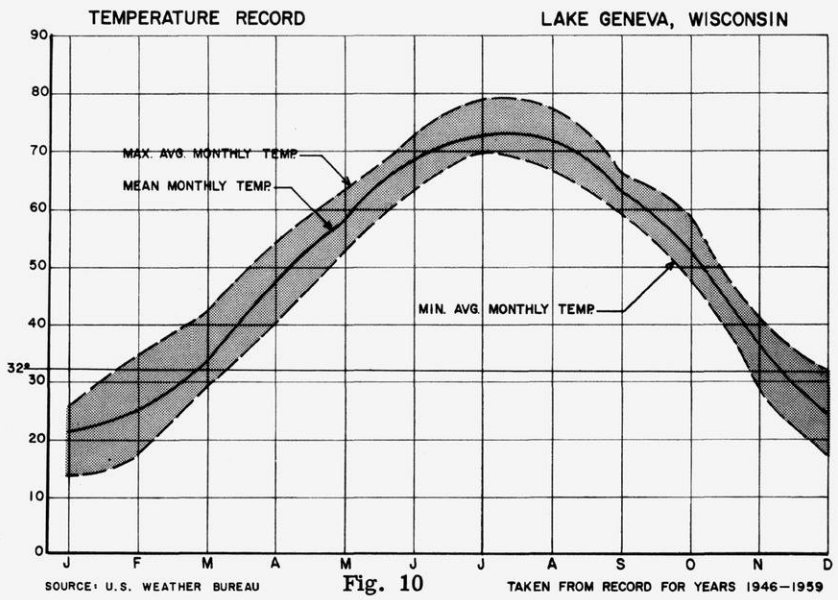


Fig. 10

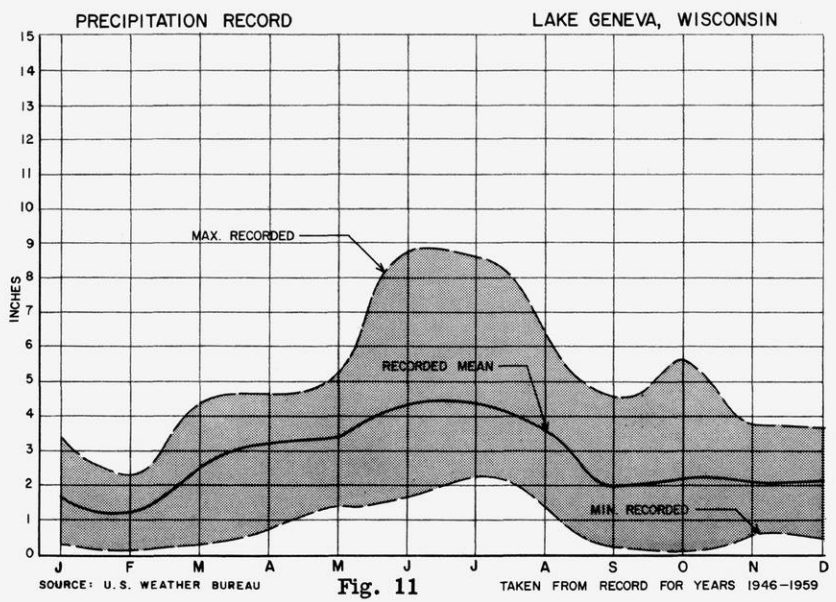


Fig. 11

Table 5

TEMPERATURE AND PRECIPITATION RECORD, 1905 TO 1961 MILWAUKEE, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (°F)													
Maximum monthly	33.70	33.40	44.4	51.30	60.7	73.1	78.6	76.40	69.60	59.40	47.10	36.20	
Mean monthly	21.94	24.16	33.45	44.54	54.39	64.99	71.35	70.41	63.28	51.91	38.17	26.39	47.1
Minimum monthly	5.60	10.80	21.5	37.20	48.2	59.3	66.8	64.40	57.20	42.10	29.50	16.40	
Precipitation (inches)													
Maximum recorded	4.60	3.33	4.76	7.09	9.56	10.03	6.82	8.06	9.87	6.42	8.56	3.34	
Record mean	1.76	1.48	2.31	2.76	3.20	3.43	2.65	2.83	3.27	2.37	2.03	1.59	29.68
Minimum recorded	.15	.15	.05	.46	1.25	.61	.28	.35	.30	.09	.33	.08	

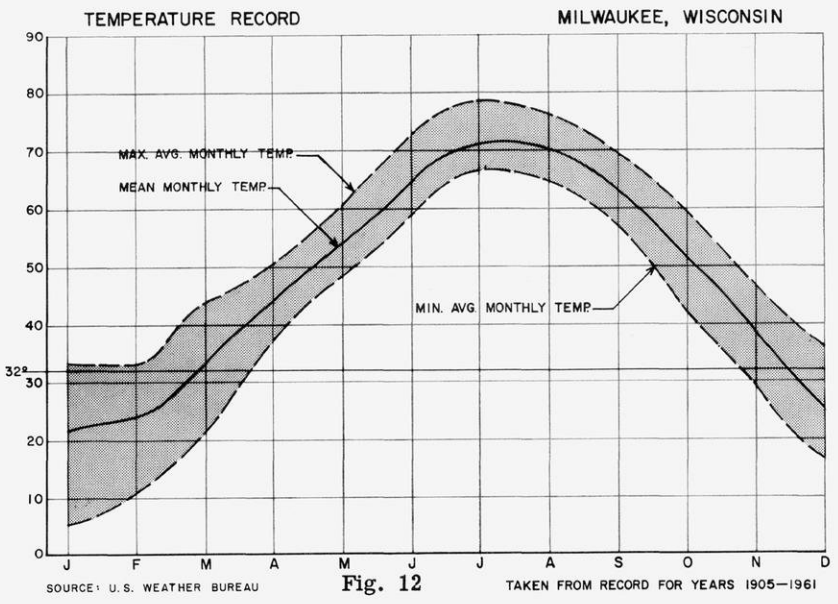


Fig. 12

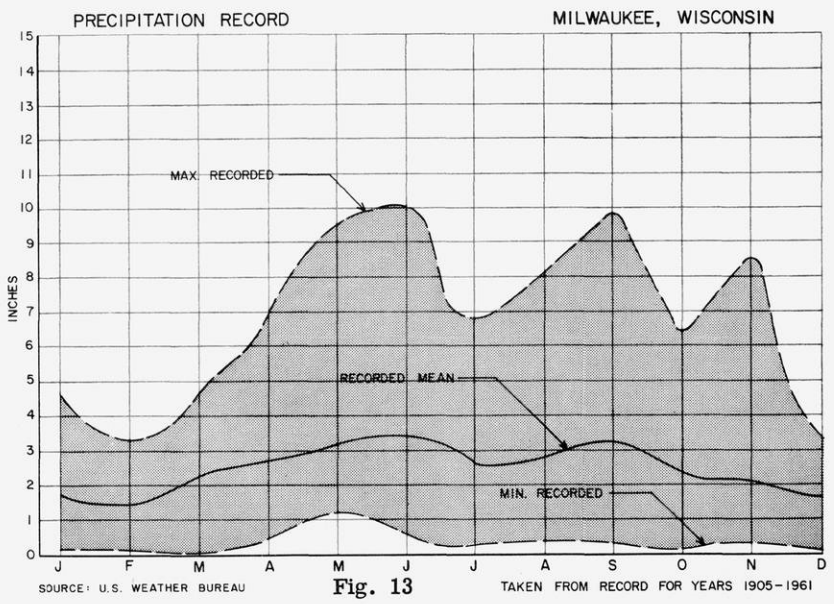


Fig. 13

Table 6

TEMPERATURE AND PRECIPITATION RECORD, 1948 TO 1961 MOUNT MARY COLLEGE, MILWAUKEE, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (^{O}F)													
Maximum monthly	25.5	33.2	35.8	51.6	62.2	69.9	75.9	75.4	65.6	56.3	41.4	32.4	
Mean monthly	20.94	24.84	31.57	46.04	56.29	66.47	71.29	70.52	62.61	51.81	36.94	25.48	47.1
Minimum monthly	13.7	17.3	22.5	40.4	52.1	61.5	68.2	65.6	58.6	45.3	29.3	17.2	
Precipitation (inches)													
Maximum recorded	3.02	2.36	4.17	4.85	5.08	7.65	9.39	6.81	7.68	5.99	3.91	3.24	
Record mean	1.44	1.24	2.36	3.27	2.81	3.61	4.19	3.21	2.52	2.24	2.05	1.60	30.54
Minimum recorded	.19	.13	.42	1.65	1.04	1.32	.79	.58	.23	.10	.42	.21	

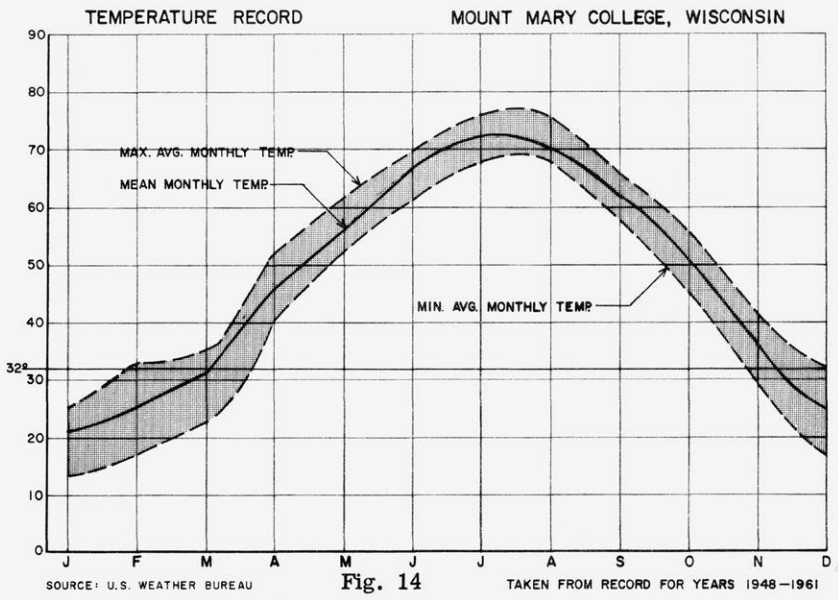


Fig. 14

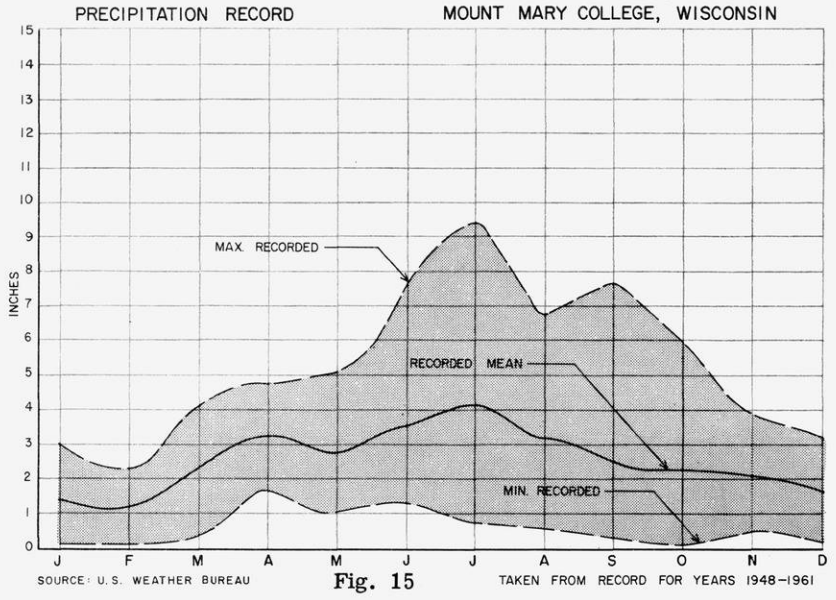


Fig. 15

Table 7

TEMPERATURE AND PRECIPITATION RECORD, 1945 TO 1961 OCONOMOWOC, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (^{o}F)													
Maximum monthly	24.10	32.40	45.90	53.00	63.20	71.10	77.10	77.40	65.60	59.20	40.60	31.30	
Mean monthly	19.52	23.50	32.22	47.01	57.04	66.94	71.85	70.98	62.38	51.88	35.72	23.82	46.90
Minimum monthly	11.90	15.80	20.20	39.70	52.00	62.40	69.10	65.90	56.80	44.70	28.50	14.80	
Precipitation (inches)													
Maximum recorded	2.65	1.81	3.08	5.04	6.73	9.53	10.00	7.36	7.69	6.39	3.77	2.25	
Record mean	1.31	.96	1.80	3.09	3.22	4.00	4.33	3.42	2.95	2.18	2.00	1.39	30.65
Minimum recorded	.26	.09	.49	1.19	1.40	1.47	.89	.83	.71	.11	.45	.10	

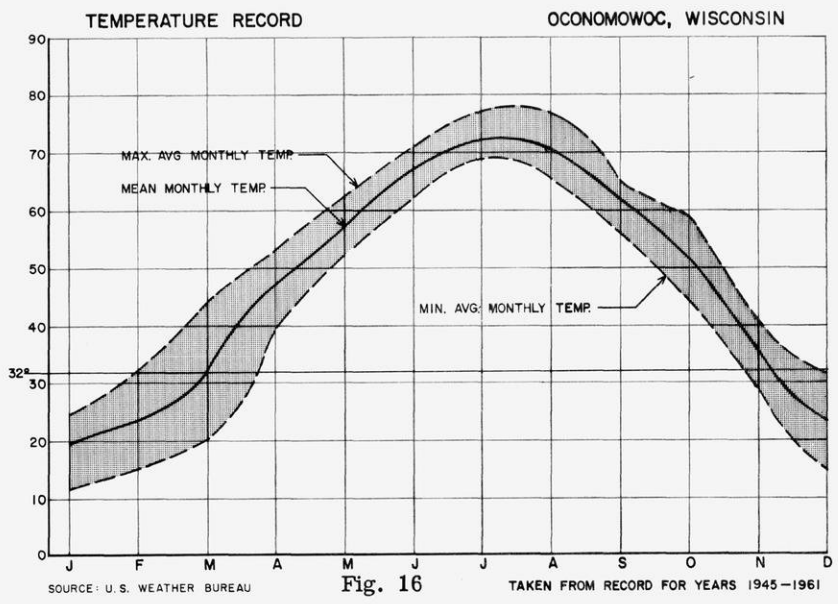


Fig. 16

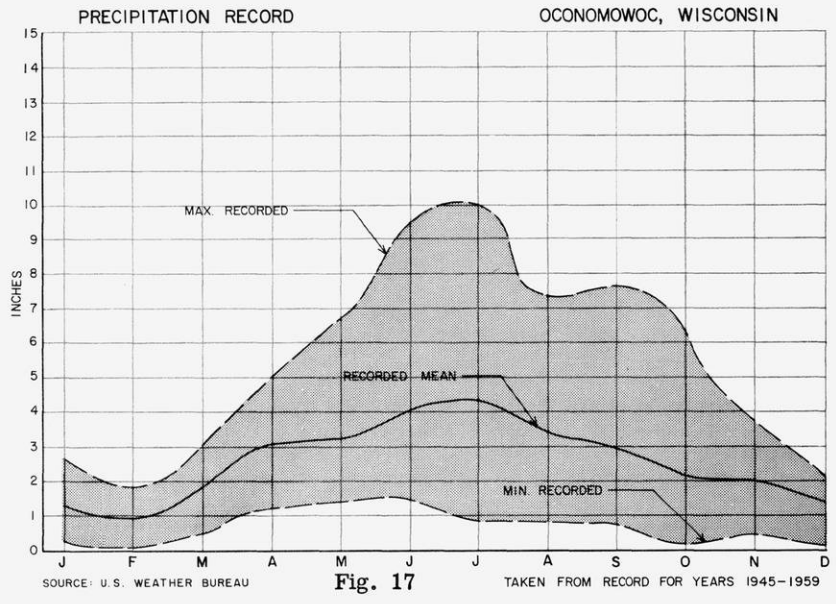


Fig. 17

Table 8

PRECIPITATION RECORD, 1931 TO 1961 PORT WASHINGTON, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Precipitation (inches)													
Maximum recorded	3.35	3.10	3.64	5.34	5.81	8.11	10.14	5.73	7.79	6.40	5.10	3.51	
Record mean	1.37	1.31	1.86	2.59	2.87	3.48	2.86	2.82	3.13	2.13	2.03	1.35	27.80
Minimum recorded	.12	.09	.37	.42	.45	.93	.28	.58	.49	.13	.23	.07	

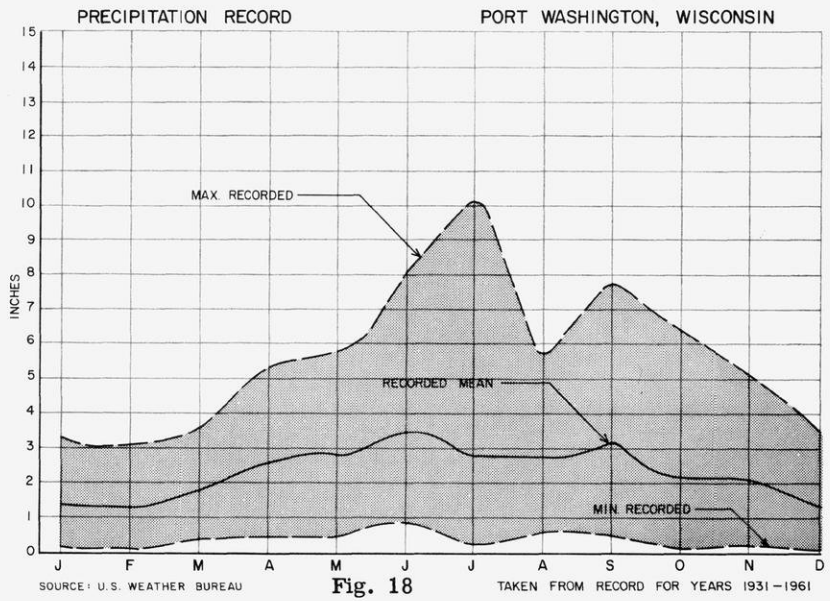


Fig. 18

Table 9

TEMPERATURE AND PRECIPITATION RECORD, 1930 TO 1959 RACINE, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (^{o}F)													
Maximum monthly	33.8	35.2	45.4	52.0	62.1	74.4	77.1	77.8	70.9	57.4	47.6	36.3	
Mean monthly	24.22	26.21	34.45	45.93	56.14	67.05	73.05	72.31	64.62	53.46	38.91	27.81	48.7
Minimum monthly	16.0	12.2	28.6	40.5	50.4	62.0	69.1	66.6	59.0	48.6	30.1	20.2	
Precipitation (inches)													
Maximum recorded	4.12	3.36	5.71	5.42	10.98	5.83	7.67	8.30	8.46	6.18	6.65	4.20	
Record mean	2.00	1.51	2.66	2.82	3.58	3.48	3.06	3.19	3.04	2.06	2.36	1.97	31.73
Minimum recorded	.44	.30	.62	.62	.97	1.19	.42	.63	.30	.07	.52	.34	

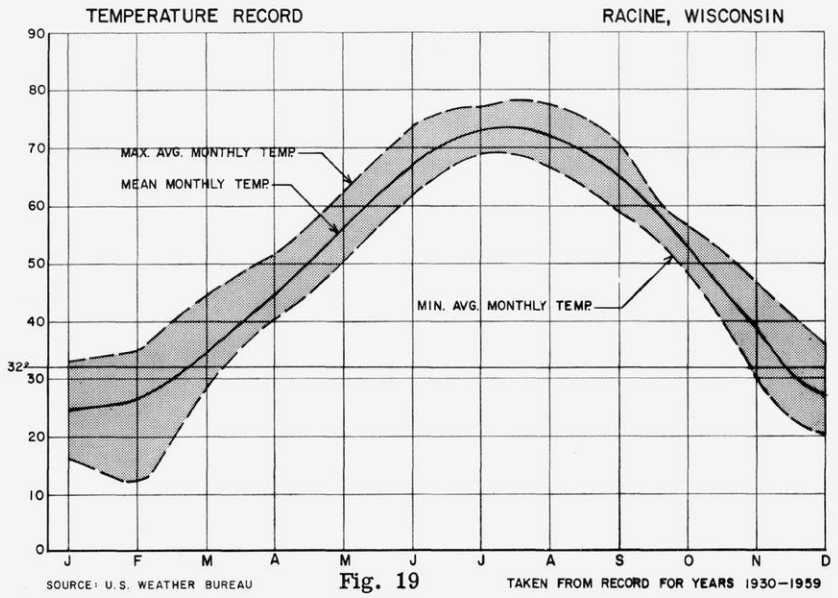


Fig. 19

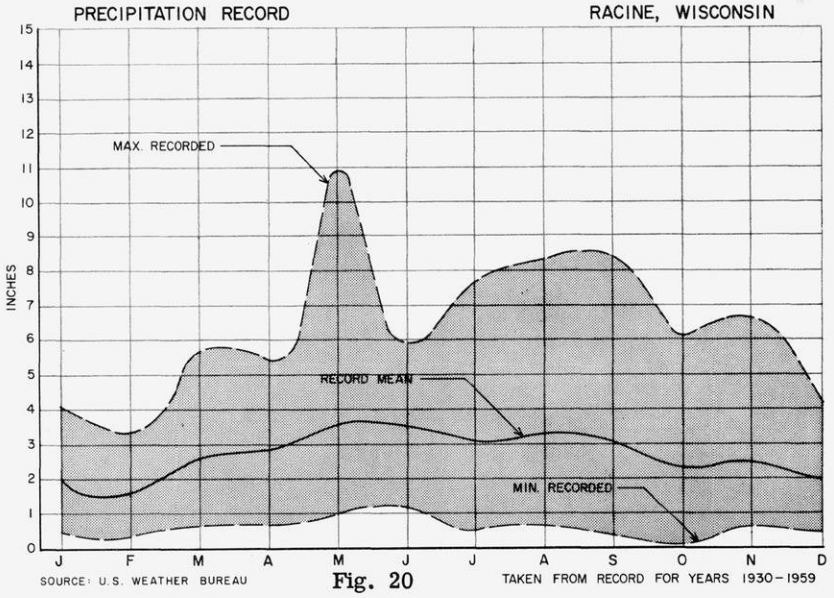


Fig. 20

Table 10

TEMPERATURE AND PRECIPITATION RECORD, 1930 TO 1959 WAUKESHA, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (^{o}F)													
Maximum monthly	32.10	32.00	44.40	52.10	63.60	74.40	77.20	76.40	69.20	59.30	45.20	33.70	
Mean monthly	20.62	23.04	32.12	45.41	56.51	66.87	72.12	70.81	62.35	51.26	36.31	24.90	46.9
Minimum monthly	11.30	8.00	24.80	38.40	50.50	61.00	67.40	64.50	57.00	44.90	28.40	15.10	
Precipitation (inches)													
Maximum recorded	3.91	2.82	4.38	5.01	8.74	7.52	11.41	6.32	7.77	5.68	6.47	3.40	
Record mean	1.70	1.26	2.16	2.52	3.46	3.72	3.31	3.06	2.93	2.08	2.27	1.56	30.03
Minimum recorded	.39	.15	.40	.21	1.16	1.63	.72	.66	.30	.41	.37	.35	

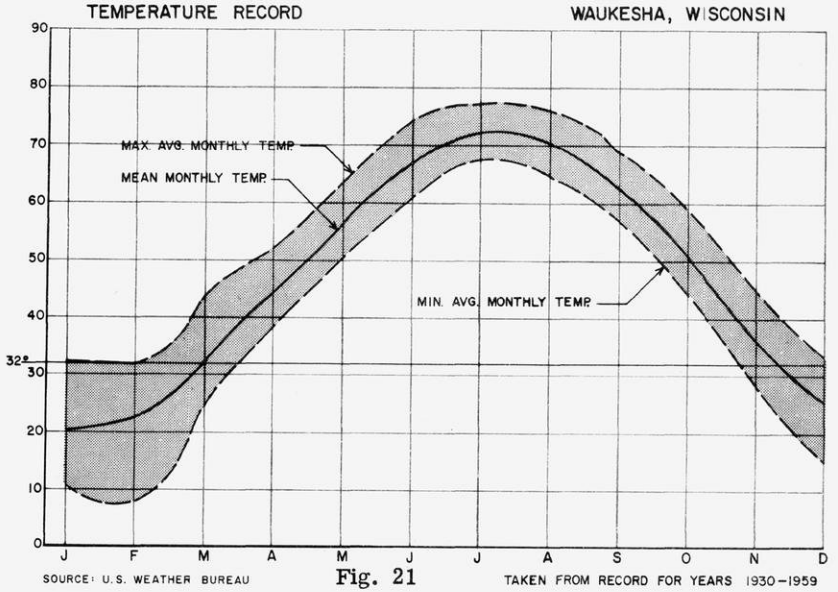


Fig. 21

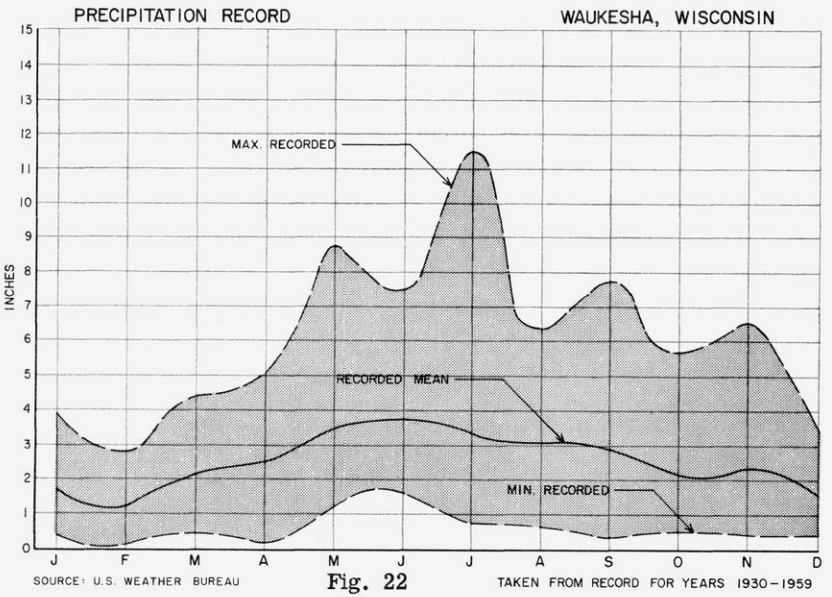


Fig. 22

Table 11

TEMPERATURE AND PRECIPITATION RECORD, 1952 TO 1961 WEST ALLIS, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (°F)													
Maximum monthly	25.4	31.8	36.6	52.5	63.1	71.5	78.9	77.7	65.7	57.7	41.4	33.5	
Mean monthly	22.0	26.5	32.5	47.1	57.1	68.5	73.3	72.7	64.0	52.4	38.0	27.1	48.4
Minimum monthly	15.1	18.2	24.0	41.5	53.7	62.9	70.7	70.9	61.1	46.7	32.2	20.2	
Precipitation (inches)													
Maximum recorded	3.69	3.37	4.44	3.87	4.82	9.63	7.56	7.24	8.20	6.76	3.91	2.37	
Record mean	1.40	1.30	2.32	3.22	2.85	3.58	3.88	3.25	2.82	2.26	2.13	1.47	30.48
Minimum recorded	.27	.15	.44	1.72	1.12	1.45	1.59	1.38	.21	.10	.45	.19	

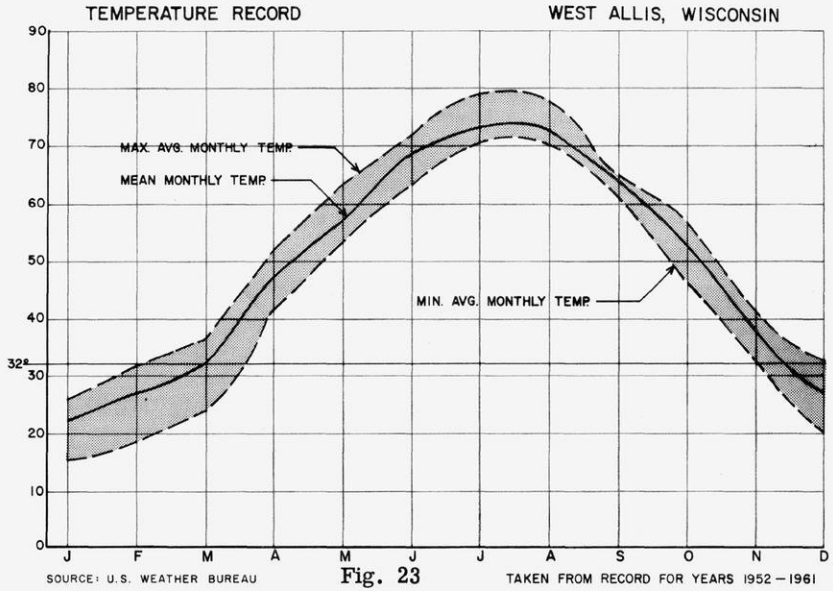


Fig. 23

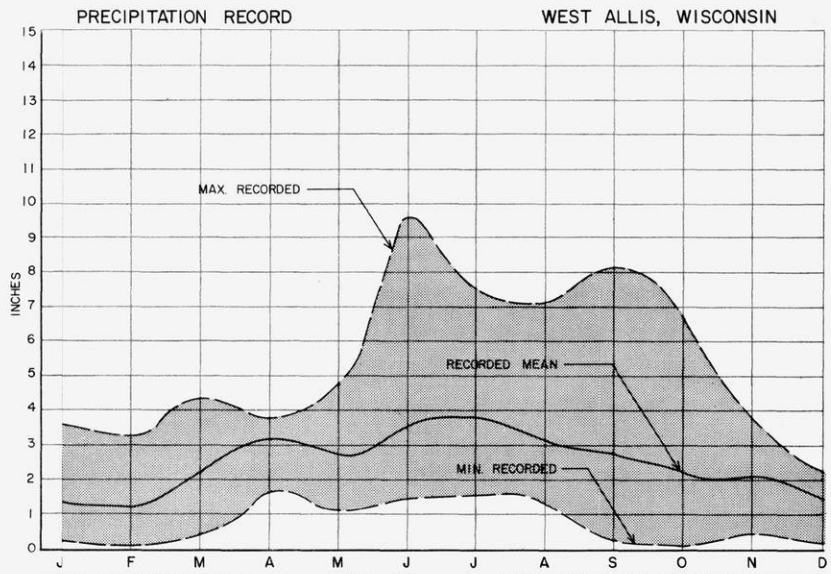


Fig. 24

Table 12

TEMPERATURE AND PRECIPITATION RECORD, 1924 TO 1961 WEST BEND, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (°F)													
Maximum monthly	30.6	31.0	44.4	51.9	63.2	74.2	75.6	74.9	67.9	59.2	44.4	32.7	
Mean monthly	19.59	21.95	29.94	43.39	55.77	65.90	71.34	69.73	61.76	49.28	33.84	23.60	45.5
Minimum monthly	8.4	7.0	24.8	38.3	49.1	60.3	66.8	63.8	55.2	39.2	29.2	15.3	
Precipitation (inches)													
Maximum recorded	3.57	3.49	4.22	6.04	7.30	8.55	12.17	13.77	10.19	5.79	6.58	3.80	
Record mean	1.53	1.37	2.09	2.65	2.99	3.86	3.46	3.12	3.47	2.36	2.21	1.44	30.55
Minimum recorded	.20	.15	.28	.55	1.13	1.82	.37	.82	.50	.06	.09	.26	

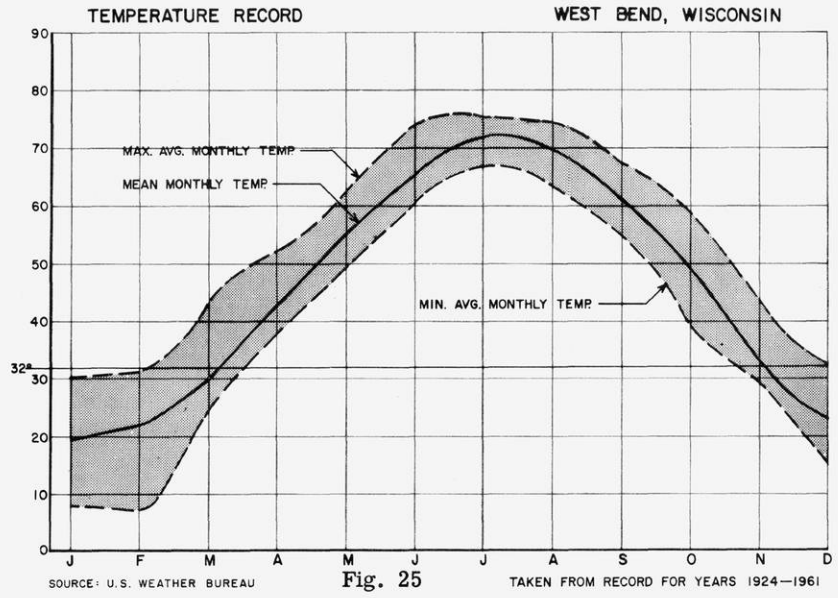


Fig. 25

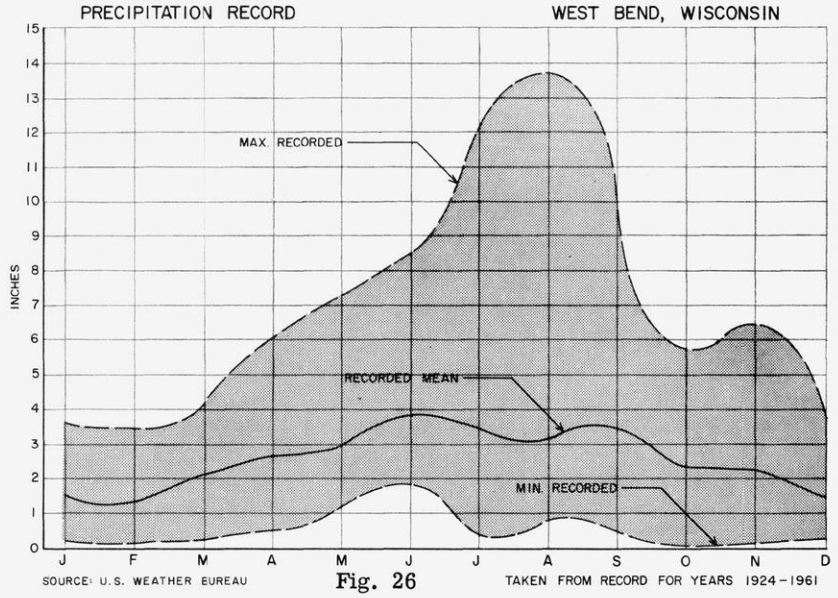


Fig. 26

Table 13

TEMPERATURE AND PRECIPITATION RECORD, 1951 TO 1961 WHITEWATER, WISCONSIN

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (°F)													
Maximum monthly	25.50	34.40	36.60	54.70	64.40	72.00	77.40	75.70	66.20	57.70	42.10	32.60	
Mean monthly	20.64	25.70	32.34	48.38	58.95	68.58	72.65	71.45	63.62	52.72	34.03	25.96	47.9
Minimum monthly	13.90	17.10	21.10	43.60	54.10	63.60	69.80	67.30	60.10	47.50	30.20	20.30	
Precipitation (inches)													
Maximum recorded	3.56	1.91	4.06	4.04	5.19	6.37	8.28	6.45	10.93	8.86	4.06	2.29	
Record mean	1.23	1.02	2.05	3.17	2.93	3.27	4.79	4.00	3.12	3.20	2.31	1.47	32.56
Minimum recorded	.17	.06	.31	1.98	1.20	1.77	1.48	1.35	.44	.10	.46	.22	

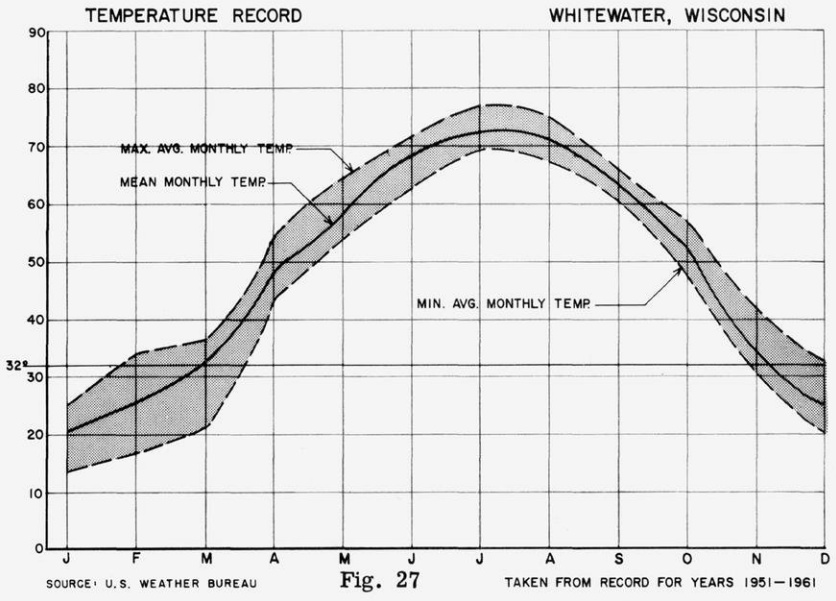


Fig. 27

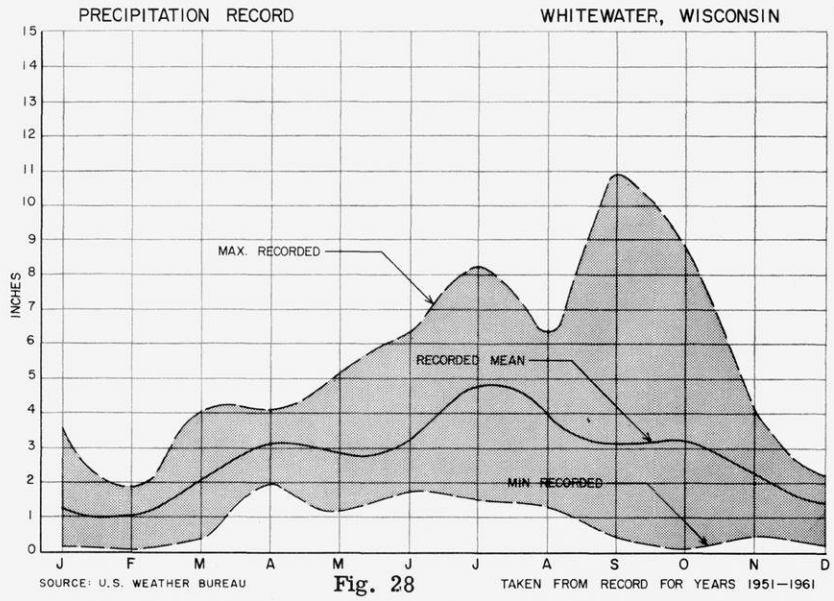


Fig. 28

Chapter IV
GEOGRAPHY

The Southeastern Wisconsin Planning Region is located in the upper Midwest between Lake Michigan on the east, the Green Bay - Lake Winnebago lowlands on the north, the Rock River basin on the west, and the low dunes and swampland at the headwaters of the Illinois River on the south (see Map 14). The seven-county region within the jurisdiction of the Southeastern Wisconsin Regional Planning Commission extends for approximately 52 miles from east to west at its widest extent, and approximately 72 miles from north to south in length. It comprises approximately 2628 square miles of land area[1] and between 66 and 67 square miles of inland water area,[2] excluding Lake Michigan, or a total gross land and water area of approximately 1,720,400 acres.[2] Topographic elevations range from approximately 580 feet above mean sea level at Lake Michigan to approximately 1320 feet above mean sea level at Holy Hill in Washington County (see Map 15).

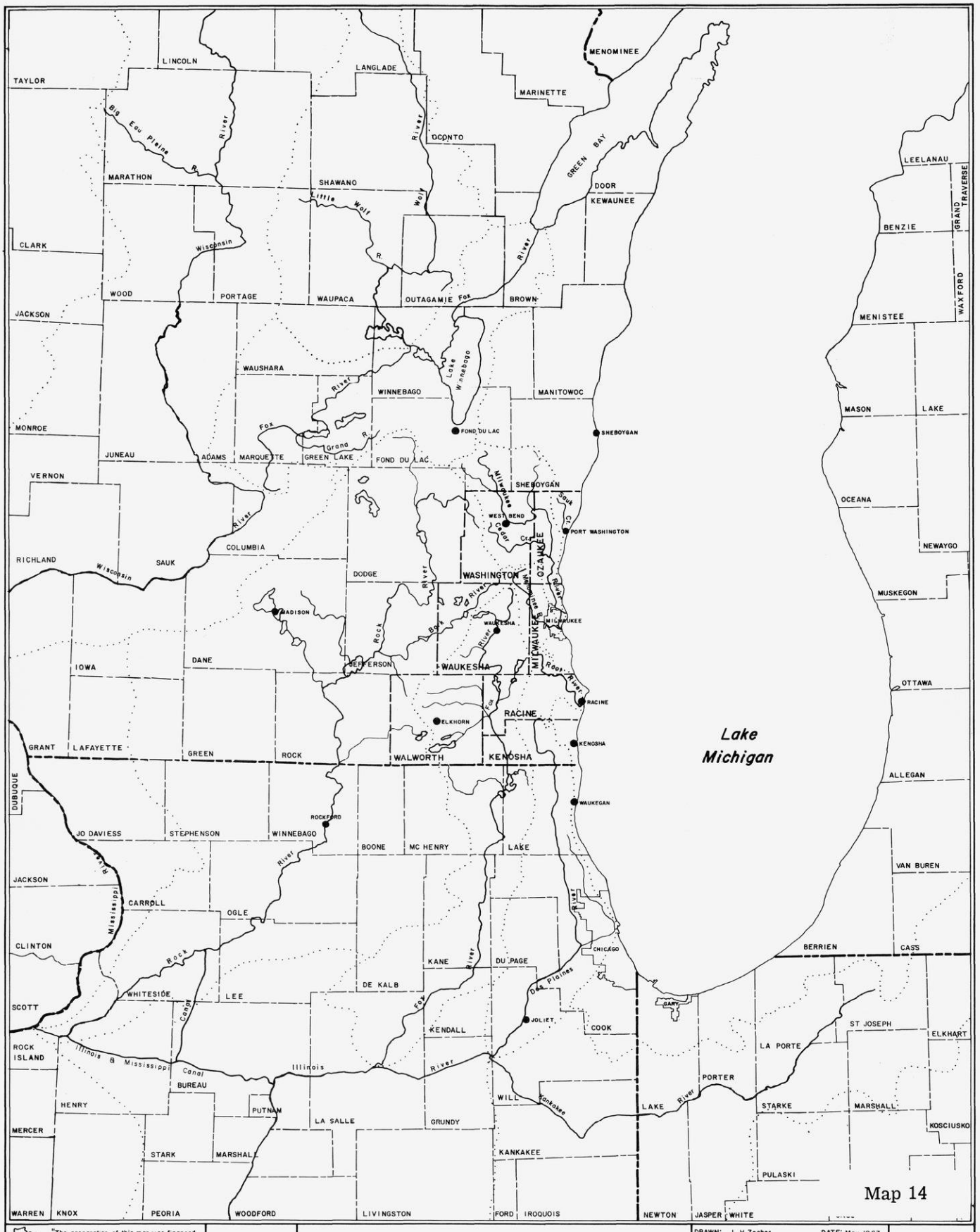
Glaciation has largely determined the topography and soils of this part of the state (see Map 17). Various advances and recessions of the ice sheets, particularly the last glacial advance during the Wisconsin Ice Age, have endowed this area with numerous ridges, intervening lowlands, and extensive areas where depressions called kettles alternate with kames or small hummocks in lending great diversity to the terrain. Many of the larger kettle depressions within the Region have developed into the numerous lakes which dot large areas of western Washington, Waukesha, and Walworth Counties.

The relative relief of the Region (see Map 16) is generally moderate to rolling. It varies from less than 100 feet difference in elevation between the high and low point in a one square mile area of land in the lakeshore plains region of Ozaukee, Milwaukee, and eastern Racine and Kenosha Counties, to more than 200 feet in the Kettle Moraine area. The Kettle Moraine itself is the geographical area of kame and kettle topography which forms part of the Cary End Moraine of the Wisconsin glacial period. This particular morainic feature was formed by the meeting of the Green Bay and the Lake Michigan lobes of the ice sheet. High points in this physical feature include those areas around Lake Geneva in Walworth County, in southwestern Waukesha County north of Eagle, and in central Waukesha County around Lapham Peak, and around Holy Hill and Hartford in southwestern and western Washington County (see Map 15).

The bedrock geology (see Map 19) over most of the Region consists of Niagara dolomite, a type of limestone rich in magnesium carbonate, which is underlain by Maquoketa shale, Galena dolomite and St. Peter sandstone in that order. Except for several outcrops of this bedrock mostly in northeastern Waukesha County, the base rock of the Region is covered over by various depths of glacial debris deposited during the various ice ages (see Map 18). The drainage pattern of the Region exhibits the typical disruption characteristic of a glacially formed topography. The drainage pattern prior to the Ice Age has been completely buried. The present drainage pattern is dendritic in form with the main stream courses of the Region trending in a north-south direction. In this section of Wisconsin the continental divide separating the Great Lakes - St. Lawrence basin from the Mississippi River basin lies very close to Lake Michigan. As an example, in eastern Waukesha County the divide is less than 25 miles from the lake (see Map 14).

[1] Census of 1940, U. S. Bureau of Census.

[2] Forest Management Survey, Wisconsin Conservation Department.



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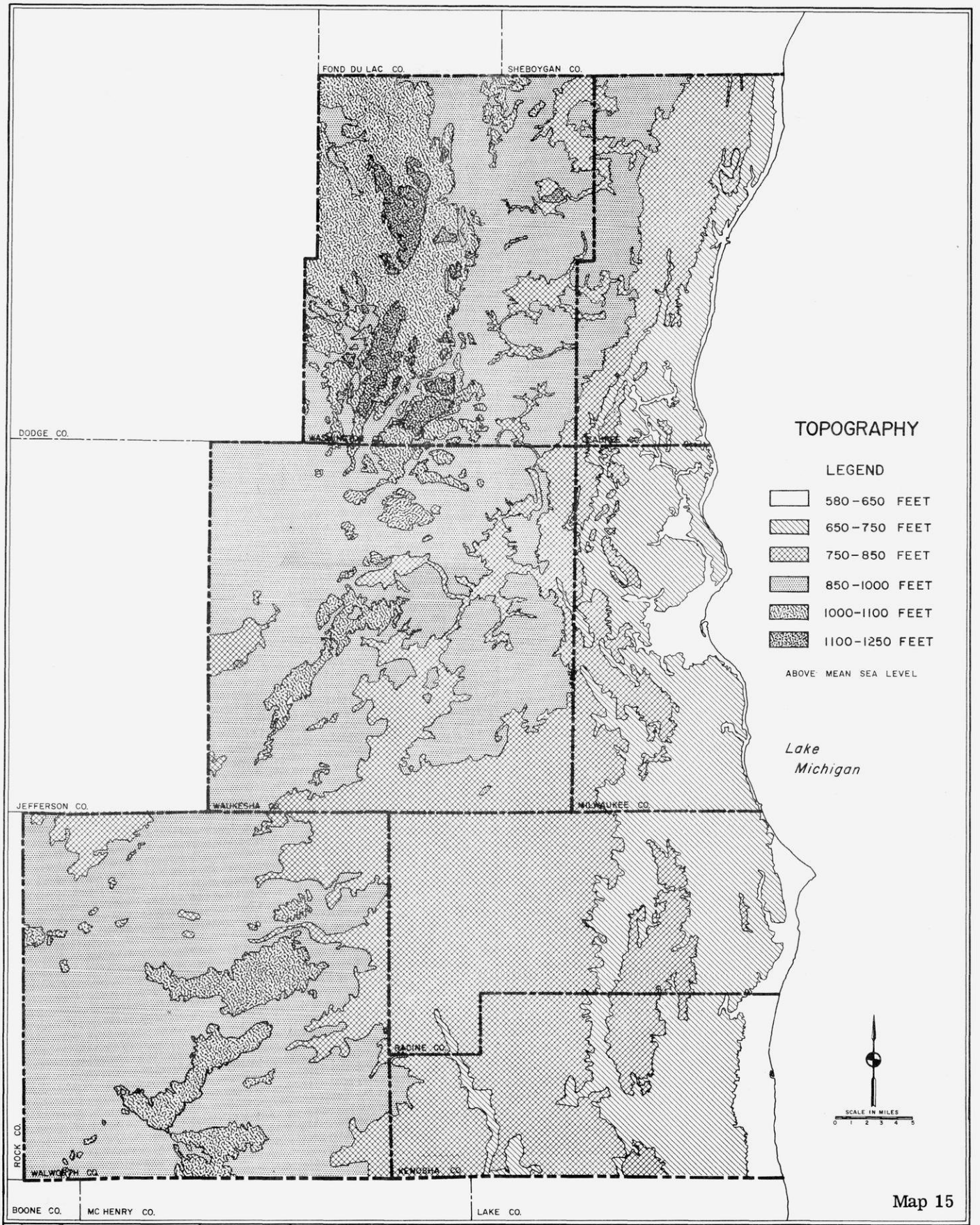

Map 15

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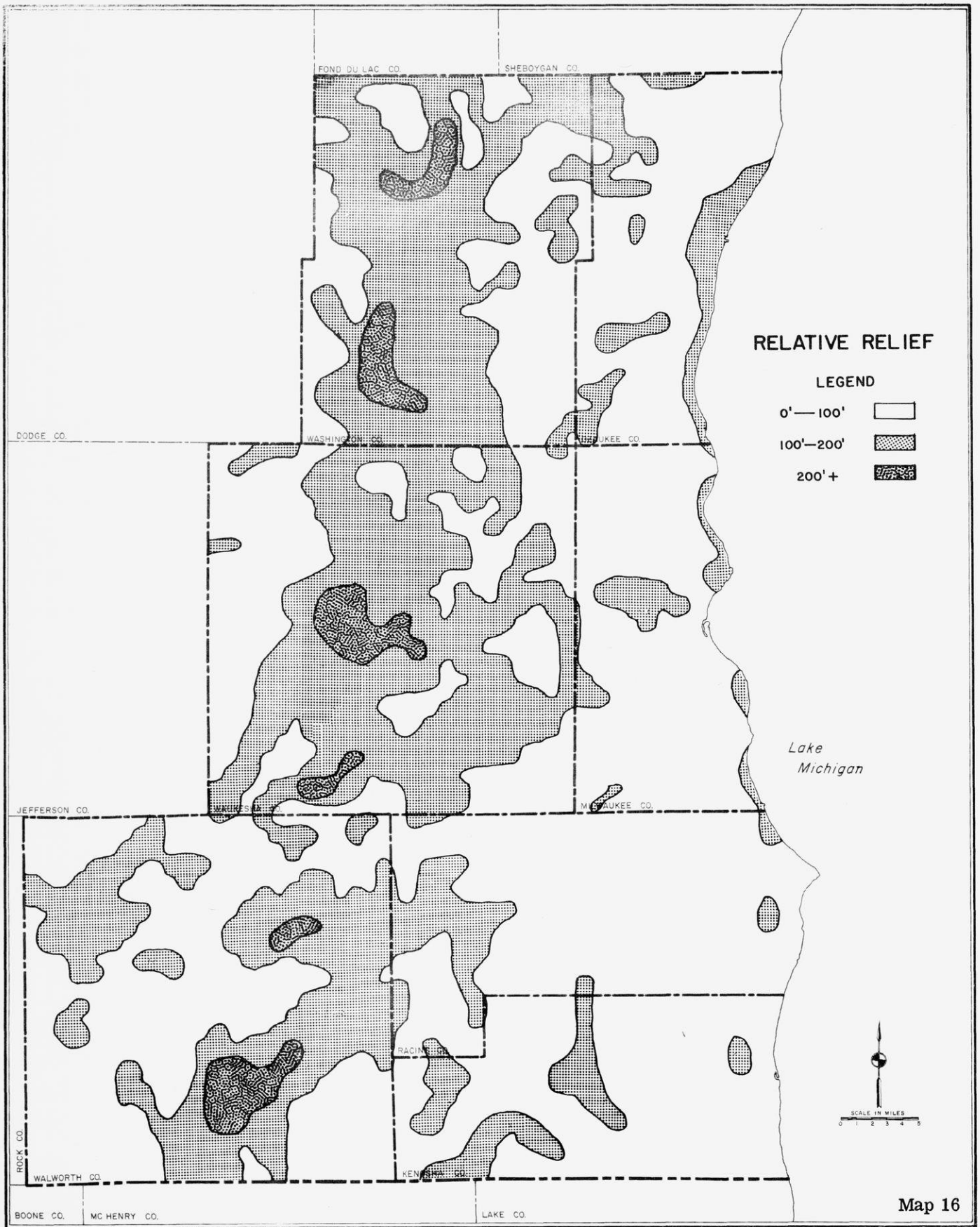

Map 16

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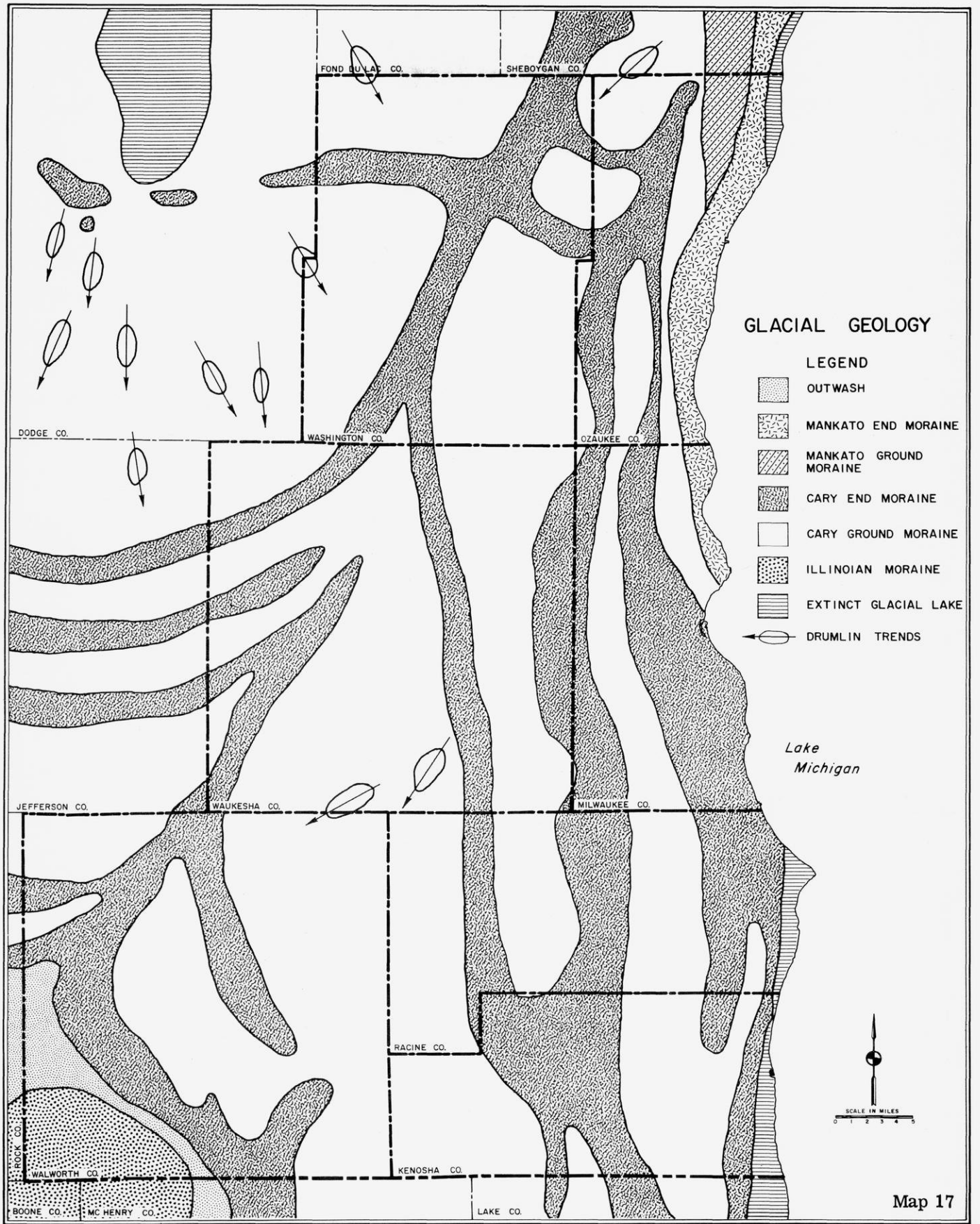

Map 17

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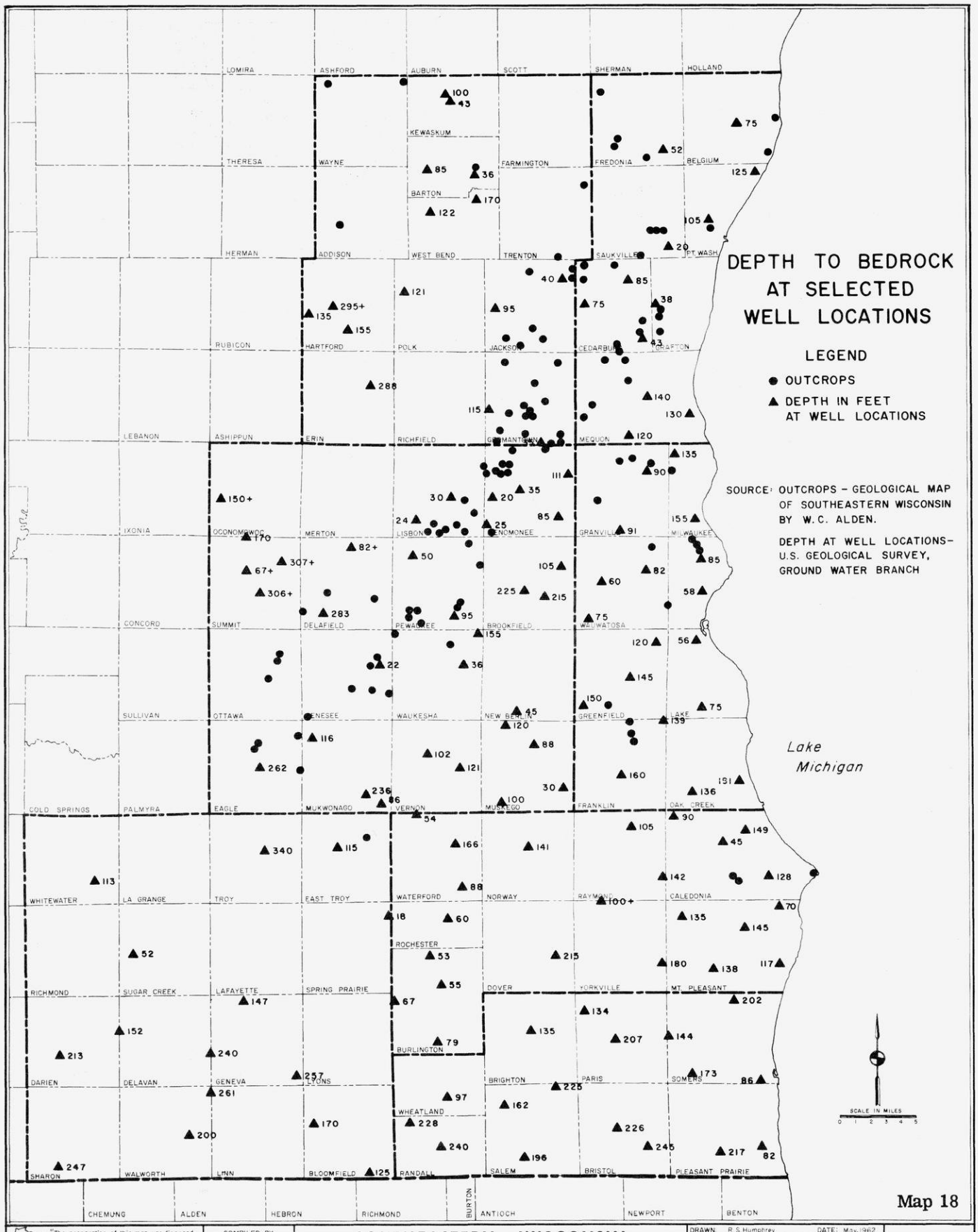

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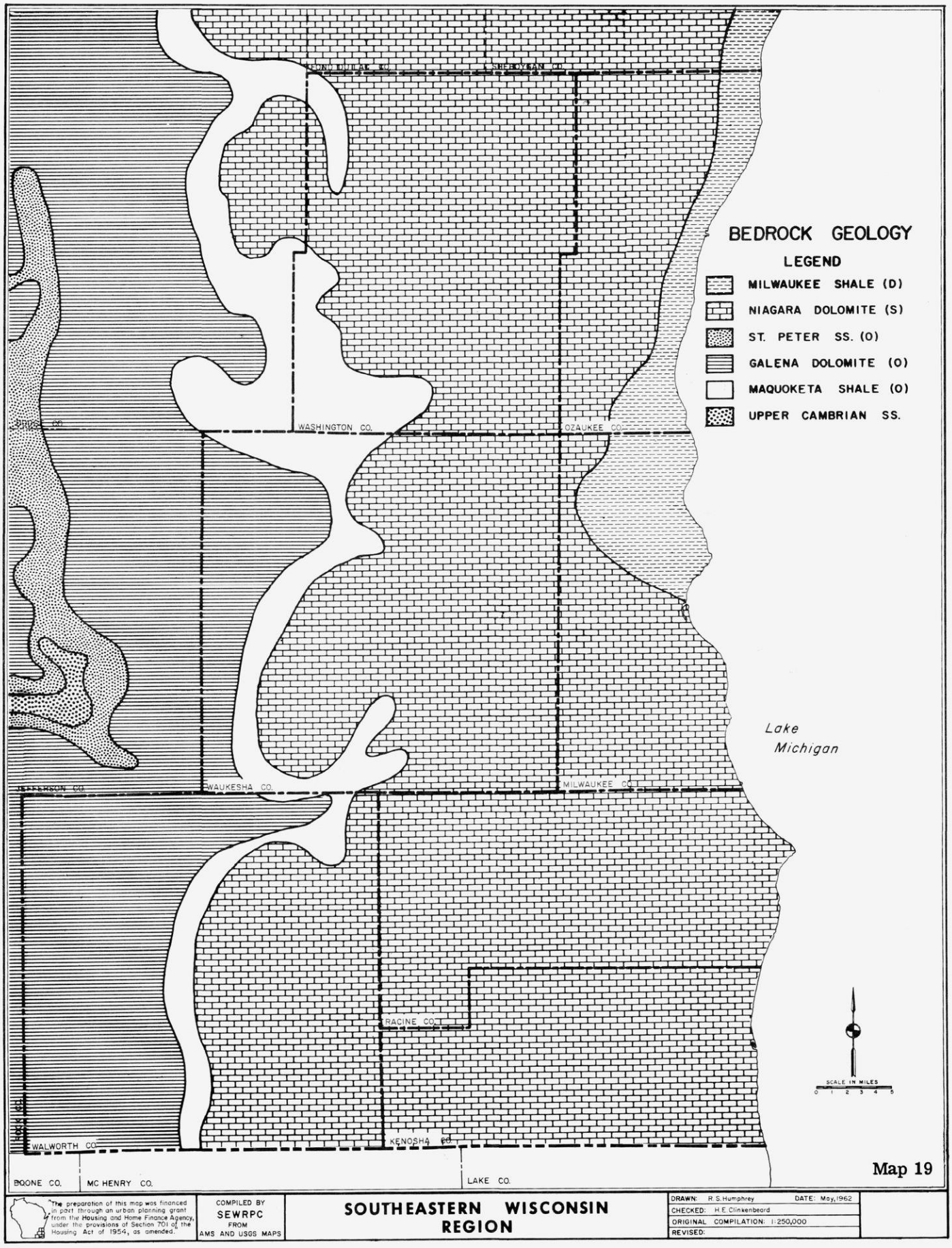
BEDROCK GEOLOGY
LEGEND
MILWAUKEE SHALE (D)
NIAGARA DOLOMITE (S)
ST. PETER SS. (O)
GALENA DOLOMITE (O)
MAQUOKETA SHALE (O)
UPPER CAMBRIAN SS.
FOND DU LAC CO.
SHEBOYGAN CO.
DODGE CO.
WASHINGTON CO.
OZAUKEE CO.
JEFFERSON CO.
WAUKESHA CO.
MILWAUKEE CO.
Lake Michigan
RACINE CO.
WALWORTH CO.
KENOSHA CO.
BOONE CO.
MC HENRY CO.
LAKE CO.
SCALE IN MILES
0 1 2 3 4 5
Map 19
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Table 14

PRODUCTION OF NONMETALLIC MINERALS IN SOUTHEASTERN WISCONSIN COUNTIES, 1960 AND 1961

County	Sand and Gravel[1]		Crushed Limestone[1]		Dimension Limestone[1]		Clay[1]		Peat[1]	
	1960	1961	1960	1961	1960	1961	1960	1961	1960	1961
Kenosha	261,000	169,000	-	-	-	-	-	-	-	-
Milwaukee	281,000	223,000	877,000	-[2]	-[2]	-	-	-	-	-
Ozaukee	309,000	391,000	-	-	-	-	-	-	-	-
Racine	827,000	554,000	-[2]	-[2]	-	-	850	850	-	-
Walworth	947,000	738,000	-	-	-	-	-	-	-	-
Washington	1,321,000	1,373,000	142,000	114,000	-	-	-	-	-	-
Waukesha	5,351,000	5,355,000	955,000	938,000	37,000	46,000	-	-	8,500	[2]
Total	9,297,000	8,793,000	1,974,000[3]	1,052,000[4]	37,000[5]	46,000	850	850	8,500	-

[1] Figures in short tons.
[2] Figure withheld to avoid disclosing individual company confidential data.
[3] Sum total does not include production in Racine County.
[4] Sum total does not include production in Racine and Milwaukee Counties.
[5] Sum total does not include production in Milwaukee County.

Source: U.S. Department of Interior, Bureau of Mines

Chapter V
MINERAL AND NONMETAL RESOURCES

All mineral resource production in the Southeastern Wisconsin Region is of nonmetal material from deposits mined by strip mining methods. Production consists mostly of sand and gravel, crushed limestone and dimensional limestone. No metal production is taking place in this area at present, nor has there been any in the past. All counties in the Region have some activity in sand and gravel production and processing (see Table 14). Crushed limestone is produced and processed in four counties, Milwaukee, Racine, Washington, and Waukesha Counties, mainly to supply the construction industry in the major metropolitan areas, while dimensional limestone for commercial buildings and homes, and known generally in this area as "Lannon stone," is produced only in Waukesha County with most quarries being located in the Lannon, Sussex, and Menomonee Falls area in the northeastern section of the county (see Table 16).

Clay is produced in only one location in this Region by the Union Grove Drain Tile Company at Union Grove in Racine County. Demelco, Inc., produces the only peat mined in the Region at their surface mine located north of Wales, Wisconsin.

Waukesha County leads in the quantity of nonmetal minerals produced, and in the value of such production, and has the largest number of companies either mining or processing these products (see Tables 14 and 15).

Location of sand and gravel pits is primarily determined by the glacial geology of the area. Most of these operations are active in the area

Table 15

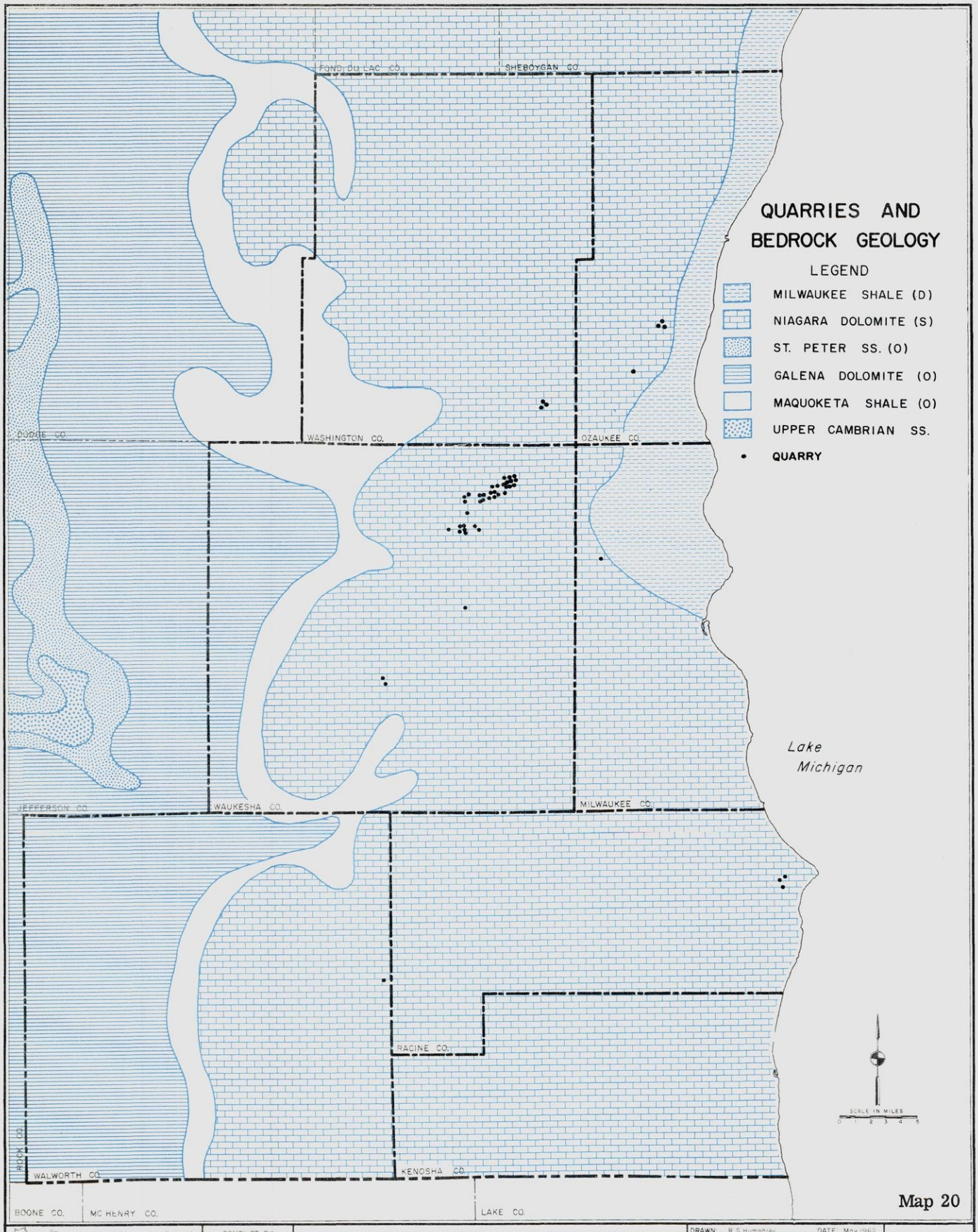
VALUE OF MINERAL AND NON METAL PRODUCTION IN SOUTHEASTERN WISCONSIN COUNTIES, 1959, 1960, 1961

County	1959	1960	1961	Nonmetallic Minerals Produced in 1960 and 1961 in Order of Value
Kenosha	$ 426,650	$ 232,584	$ 90,920	Sand and gravel
Milwaukee	5,637,496	5,568,869	—— [1]	Cement, stone, sand and gravel
Ozaukee	89,895	195,425	283,474	Sand and gravel
Racine	1,677,608	1,822,205	1,296,558	Stone, sand and gravel, clays
Walworth	272,109	591,872	496,538	Sand and gravel
Washington	1,029,451	1,235,010	1,177,241	Sand and gravel, stone
Waukesha	6,382,187	5,848,522	5,986,939	Sand and gravel, stone, peat
Region Total	$15,515,396	$15,494,487	$ 9,331,670[2]	
State Total	$71,959,000	$77,171,000	$72,886,000	
Region Percent of State Total	21.56	20.08	12.80	

[1]Figure withheld to avoid disclosing individual company confidential data

[2]Sum total does not include production in Milwaukee County

Source: U.S. Department of Interior, Bureau of Mines



Map 20

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where the Cary End Moraine borders on the ground moraine left during the most recent period of glacial activity (see Map 21). Quarries are generally located in relationship to bedrock geology, and all operating quarries in this Region extract their material from the Niagara dolomite in those areas where surface overburden is at a minimum (see Map 20). Sand and gravel, crushed limestone, and dimensional limestone are products of large bulk, but have relatively low value in relationship to their weight. Operating deposits are generally located in close relation to the market. As the Region grows, general building and road construction needs will probably create an increased demand for nonmetal products. New sand and gravel pits undoubtedly will come into operation in the future and will be economical in areas not presently being mined (see Map 21), as there proves to be a market for the product in close vicinity.

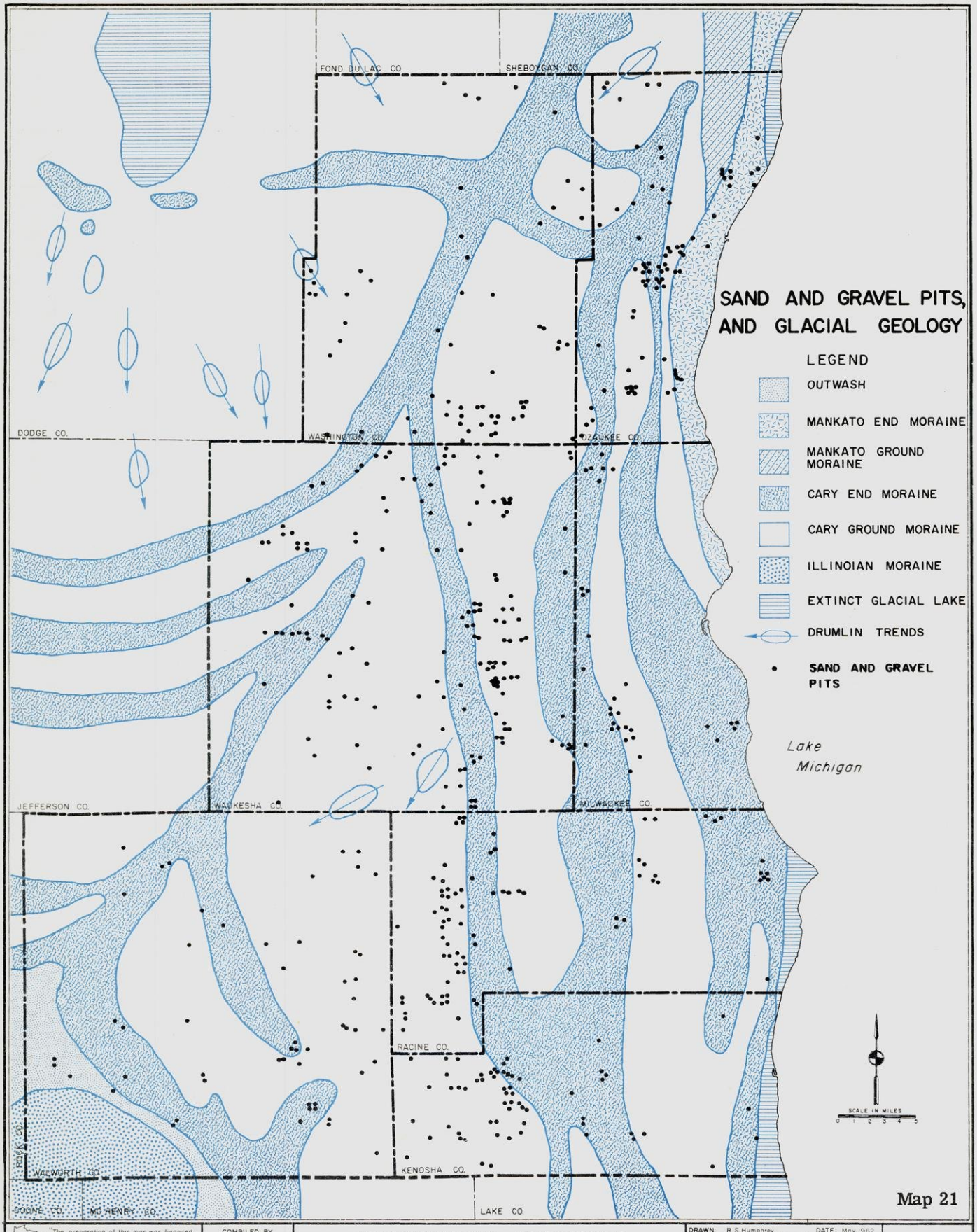
Table 16

MINERAL AND NONMETAL PRODUCERS IN
SOUTHEASTERN WISCONSIN COUNTIES, 1963

Name of Company	Location of Operation (Nearest Town)	Commodity
KENOSHA COUNTY:		
Bloss Sand and Gravel	Salem	Sand and gravel
Kenosha County Highway Dept.	Silver Lake	Sand and gravel
MILWAUKEE COUNTY:		
Ray Anderson and Son Sand and Gravel Co.	Franklin	Sand and gravel
Consumers Company (Div. of Vulcan Materials Co.)	Franklin	Sand and gravel, Crushed limestone
Consumers Company (Div. of Vulcan Materials Co.)	Greendale	Sand and gravel
Franklin Stone Products, Inc.	Franklin	Crushed limestone
Moritz Sand and Gravel	Hales Corners	Sand and gravel
OZAUKEE COUNTY:		
Cedarburg Sand and Gravel	Cedarburg	Sand and gravel
H.O. Muehlberg	Port Washington	Sand and gravel
O & W Gravel Corp.	Saukville	Sand and gravel
Ozaukee County Highway Dept.	Port Washington	Sand and gravel
Rowe Sand and Gravel, Inc.	Grafton	Sand and gravel
Richard Weber, Inc.	Lisbon	Sand and gravel
RACINE COUNTY:		
Consumers Company (Div. of Vulcan Materials Co.)	Racine	Crushed limestone
Hillside Sand Co., Inc.	Racine	Sand and gravel
Jeffries Construction Co.	—	Sand and gravel
Kraemer and Sons, Inc.	—	Sand and gravel
Morrow & Reesman	Burlington	Sand and gravel
J. W. Peters and Sons	Burlington	Sand and gravel
Racine County Highway Dept.	Racine	Sand and gravel
Union Grove Drain Tile Co.	Union Grove	Clay
WALWORTH COUNTY:		
B. R. Amon and Sons	Elkhorn	Sand and gravel
George Booth	Delavan	Sand and gravel
Heart Prairie Sand and Gravel	Whitewater	Sand and gravel
Lake Geneva Sand and Gravel Co.	Fontana	Sand and gravel
Mann Brothers Sand and Gravel, Inc.	Elkhorn	Sand and gravel
Mann Brothers Sand and Gravel, Inc.	Sugar Creek	Sand and gravel
R. W. Miller and Sons	Lake Geneva	Sand and gravel
Ernest Nobis	Fontana	Sand and gravel
Thorpe & Madison	Delavan	Sand and gravel
WASHINGTON COUNTY:		
John B. Jacklin	Richfield	Sand and gravel
Johan Sand and Gravel	West Bend	Sand and gravel
Kleist Sand and Gravel Co.	—	Sand and gravel
C. C. Linck, Inc.	Beaver Dam	Sand and gravel
Northern Sand and Gravel Co.	West Bend	Sand and gravel
O & W Gravel Corp.	Trenton	Sand and gravel
Ozaukee Sand and Gravel Co.	Germantown	Sand and gravel
The Reiske Corp.	Germantown	Sand and gravel
Schmidt Service, Inc.	Germantown	Sand and gravel
Washington County Highway Dept.	West Bend	Crushed limestone, Sand and gravel

Table 16 Continued

Name of Company	Location of Operation (Nearest Town)	Commodity
WAUKESHA COUNTY:		
Bodus Brothers Sand and Gravel	New Berlin	Sand and gravel
Braun Construction Co.	—	Sand and gravel
William Buege	New Berlin	Sand and gravel
Carlson's Stone Co.	Sussex	Dimension limestone
Cawley Stone Quarry	Lannon	Dimension limestone
Frank Clark and Sons	Brookfield	Sand and gravel
Demilco, Inc.	Wales	Peat
Dudovick Stone Co.	Lannon	Dimension limestone
Frank Dudovick & Lindquist Stone Co.	Lannon	Dimension limestone
Fonda Lannon Stone Co.	Lisbon	Dimension limestone
Consumer Company (Div. of Vulcan Materials Co.)	Dousman	Sand and gravel
Hales Corners Sand and Gravel, Inc.	Hales Corners	Sand and gravel
Halquist Lannon Stone Co.	Lisbon	Crushed limestone, Dimension limestone, Sand and gravel
Hartland Sand and Gravel Co.	Hartland	Sand and gravel
Carl Hensel	Dousman	Sand and gravel
Hillview Sand and Gravel Co.	Waukesha	Sand and gravel
Jaeger Sand and Gravel Co., Inc.	New Berlin	Sand and gravel
James Brothers, Inc.	Waukesha	Sand and gravel
Joecks Brothers Stone Co.	Lannon	Dimension limestone
Johnson and Sons	Lannon	Dimension limestone
Johnson Sand and Gravel, Inc.	Waukesha	Sand and gravel
K & N Sand and Gravel, Inc.	Sussex	Sand and gravel
Kindler Brothers Stone Co.	Lannon	Dimension limestone
Kohler Brothers, Sand and Gravel Co., Inc.	New Berlin	Sand and gravel
Lisbon Lannon Stone Corp.	Lannon	Dimension limestone
Edward Kraemer and Sons, Inc.	—	Sand and gravel
Loth Sand and Gravel, Inc.	Brookfield	Sand and gravel
Luebke Sand Co.	Dousman	Sand and gravel
Edward Lutz Sand and Gravel Co., Inc.	Sussex	Sand and gravel
Merget Sand and Gravel Co., Inc.	Menomonee Falls	Sand and gravel
Midwest Lannon Stone Co.	Lannon	Dimension limestone
Northwest Sand and Gravel Co.	Brookfield	Sand and gravel
Ozaukee Sand and Gravel Co.	New Berlin	Sand and gravel
Palmer Crushing Co.	Colgate	Sand and gravel
Frank Pernat, Jr.	Oconomowoc	Sand and gravel
W. G. Perren Quarry	Genesee	Dimension limestone
Walter D. Pett	Eagle	Sand and gravel
Quality Limestone Products, Inc.	Lannon	Dimension limestone
Quality Limestone Products, Inc.	Lisbon	Crushed limestone, Dimension limestone, Sand and gravel
C. Earl Rolefson	Oconomowoc	Sand and gravel
State Sand and Gravel Co.	North Lake	Sand and gravel
Sussex Lannon Stone Corp.	Pewaukee	Dimension limestone
H. Turner and Son	Sussex	Sand and gravel
Valley Sand and Gravel Co.	New Berlin	Sand and gravel
Vogt, Inc.	Okauchee	Sand and gravel
Waukesha Lime and Stone, Inc.	Pewaukee	Crushed limestone
Waukesha County Highway Dept.	Waukesha	Sand and gravel
Weather Rock Lannon Stone Quarry	Lannon	Dimension limestone
West Side Stone Co.	Lannon	Dimension limestone
Wolf Construction Co., Inc.	Dousman	Sand and gravel



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COMPILED BY SEWRPC FROM AMS AND USGS MAPS

SOUTHEASTERN WISCONSIN REGION

DRAWN: R.S.Humphrey DATE: May,1962
CHECKED: H.E.Clinkenbeard
ORIGINAL COMPILATION: 1:250,000
REVISED:

Chapter VI
FORESTS

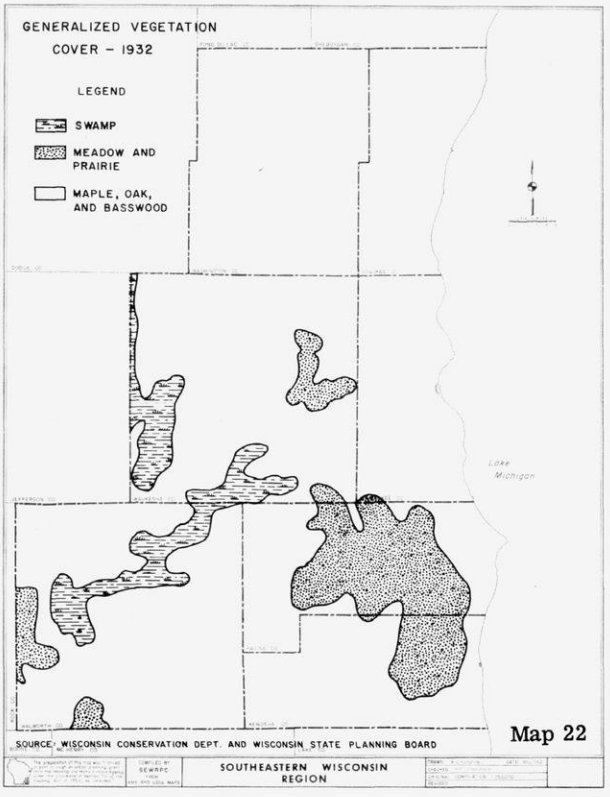
The forests and woodlands of southeastern Wisconsin are found mostly along stream banks and on the poorer soils and rocky knolls located on the more inaccessible portions of agricultural land. The counties where the most intensive form of agricultural activity is found--notably Kenosha, Ozaukee, and Racine--have the least woodland areas (see Figure 29). The Kettle Moraine lands of western Walworth, Waukesha, and Washington Counties support larger blocks of woodland, some of which is in state ownership as part of the Kettle Moraine State Forest unit, administered by the Wisconsin Conservation Department (see Figure 30). Other large forest lands in this area are scheduled for acquisition by the state and eventual inclusion within the Kettle Moraine State Forest. In addition, there are many woodland areas in private ownership in this section. In the Kettle Moraine area the forest cover is associated with rough topography (see Map 15) and greater relative relief (see Map 16). Over the Region as a whole, most of the woodland areas are in private ownership and generally consist of small woodlots of from one to five acres in extent. There are no county forests in the Southeastern Wisconsin Planning Region, and the only extensive public ownership of forest areas is by the State of Wisconsin.

Over most of the Region the trees most commonly found are maple, oak, and basswood forest species (see Map 22). These cover types are only present where the pressure of human use has permitted them to continue. Historically, on the better drained slopes of upland areas, an oak-hickory combination or maple was the climax forest type. This was notably true when the first settlements were made in the Region in the 1830's (see Map 8).

Vegetation associated with wetlands and swampy areas is still quite prevalent throughout the Region, but this type of cover has suffered from extensive drainage, especially in the last 30 years; and if present trends continue, further decreases can be expected. As an example, in Waukesha County there were 55,000 acres classified as wetland in 1939; by 1956, 14,000 acres had been drained and converted to agricultural use. This same trend is noticeable in Walworth County where 8,861 acres have been drained in the 19-year period between 1939 and 1958, reducing the total wetland area from 36,000 acres to 27,139 acres. In Racine and Kenosha Counties wetland acreage amounted to 35,000 in 1934, but in the 20-year period to 1954-55, 50 percent (17,647 acres) of this swamp and wetland area has been drained and diverted to other uses.

The advantages of maintaining a certain amount of wetland and swamp areas in their native state are numerous. Aside from the advantages of providing suitable wildland habitat for fish and wildlife, they serve to maintain ground water at a satisfactory level and to provide for an adequate ecological balance.

The meadow and prairie land areas historically provided the early pioneers with raw land



Map 22

which was much easier to convert to agricultural purposes than the surrounding woodlands and were generally considered some of the most fertile farm lands in southeastern Wisconsin. Most of this land cover type has been converted today to agricultural or pasture use.

Of all the counties in this Region, Washington County has the largest proportion of land area in woods with 14.5 percent of its total area devoted to this type of cover. This county is followed by Waukesha County with 11 percent and Walworth County with 9.5 percent of their land areas respectively devoted to forest cover (see Figure 30).

In total forest area Washington County also leads with 39,000 acres devoted to this purpose, followed by Waukesha County with 38,900 acres and Walworth County with 34,100 acres. Ozaukee County has 18,500 acres of forest land, Racine County 15,800 acres, Kenosha County 11,300 acres, and Milwaukee County 4,600 acres (see Figure 29 and Table 17).

Table 17

FOREST LANDS IN SOUTHEASTERN WISCONSIN BY COUNTY, 1958

(IN ACRES)[1]

County	Gross Area	Land Area	Water Area	Forest Area	Non-Forest[2] Area	Percent Forest Area of Total Land Area
Kenosha	177,900	174,700	3,200	11,300	163,400	6.5%
Milwaukee	153,000	153,000	-	4,600	148,400	3.0%
Ozaukee	151,100	150,400	700	18,500	131,900	12.3%
Racine	219,500	215,700	3,800	15,800	199,900	7.3%
Walworth	369,900	357,100	12,800	34,100	323,000	9.5%
Washington	277,800	272,600	5,200	39,600	233,000	14.5%
Waukesha	371,200	354,500	16,700	38,900	315,600	11.0%
Total	1,720,400	1,678,000	42,400	162,800	1,515,200	9.7%

[1] Figures are approximate results developed from 2% pilot plot survey for each county.
[2] Includes all land area in the following categories; farms, marsh and muskeg, recreational, industrial and residential, transportation right of way, rock outcrop and sand dune.

Source: Wisconsin Conservation Department.

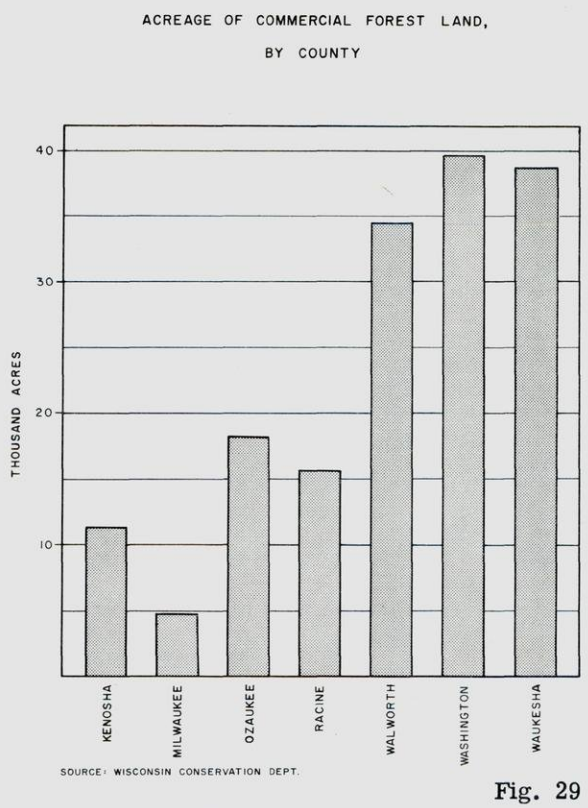


Fig. 29

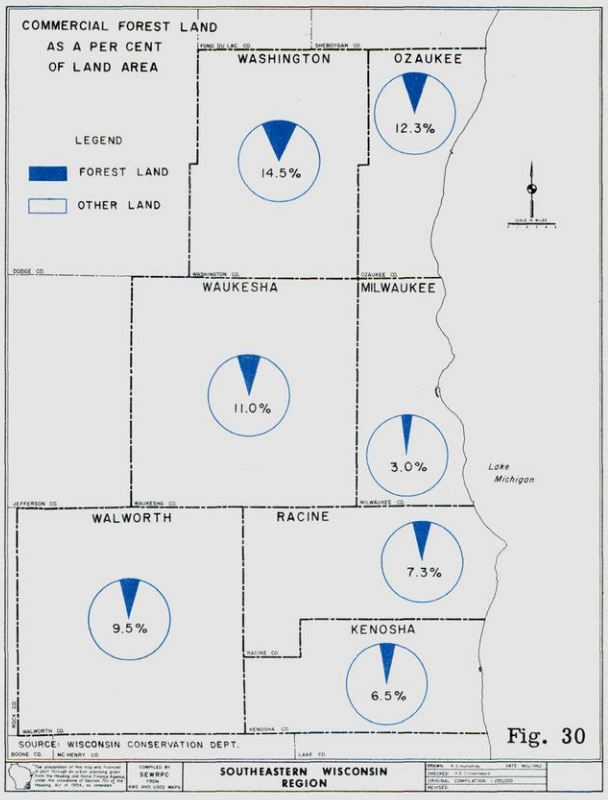


Fig. 30

Table 18

NUMBER OF PRIMARY WOOD-USING INDUSTRIES BY COUNTY, 1960

Counties	Sawmills	Boxes and Crating	Excelsior and Shaving	Posts and Poles	Specialty Products	Wood Treating
Kenosha	1	-	-	-	-	-
Milwaukee	-	-	-	1	-	2
Ozaukee	3	-	-	-	1	-
Racine	1	-	-	-	-	-
Walworth	5	1	-	-	-	-
Washington	5	-	1	-	-	-
Waukesha	2	-	-	-	1	-
Total	17	1	1	1	2	2

Source: Data from Wisconsin Conservation Department

Table 19

NUMBER OF SECONDARY WOOD-USING INDUSTRIES BY COUNTY, 1961[1]

Products	Kenosha	Milwaukee	Ozaukee	Racine	Walworth	Washington	Waukesha
Millwork and prefabricated products	2	30	5	5	-	2	5
Wooden containers	1	9	-	2	-	1	-
Furniture and fixtures	-	7	1	2	2	-	5
Wooden ships, boats and equipment	-	-	-	-	-	-	1
Miscellaneous products	2	39	1	5	1	4	9
Totals	5	85	7	14	3	7	20
Total industries in each county	3	73	5	12	2	7	17

[1] Industries producing products in more than one category are counted in each category.

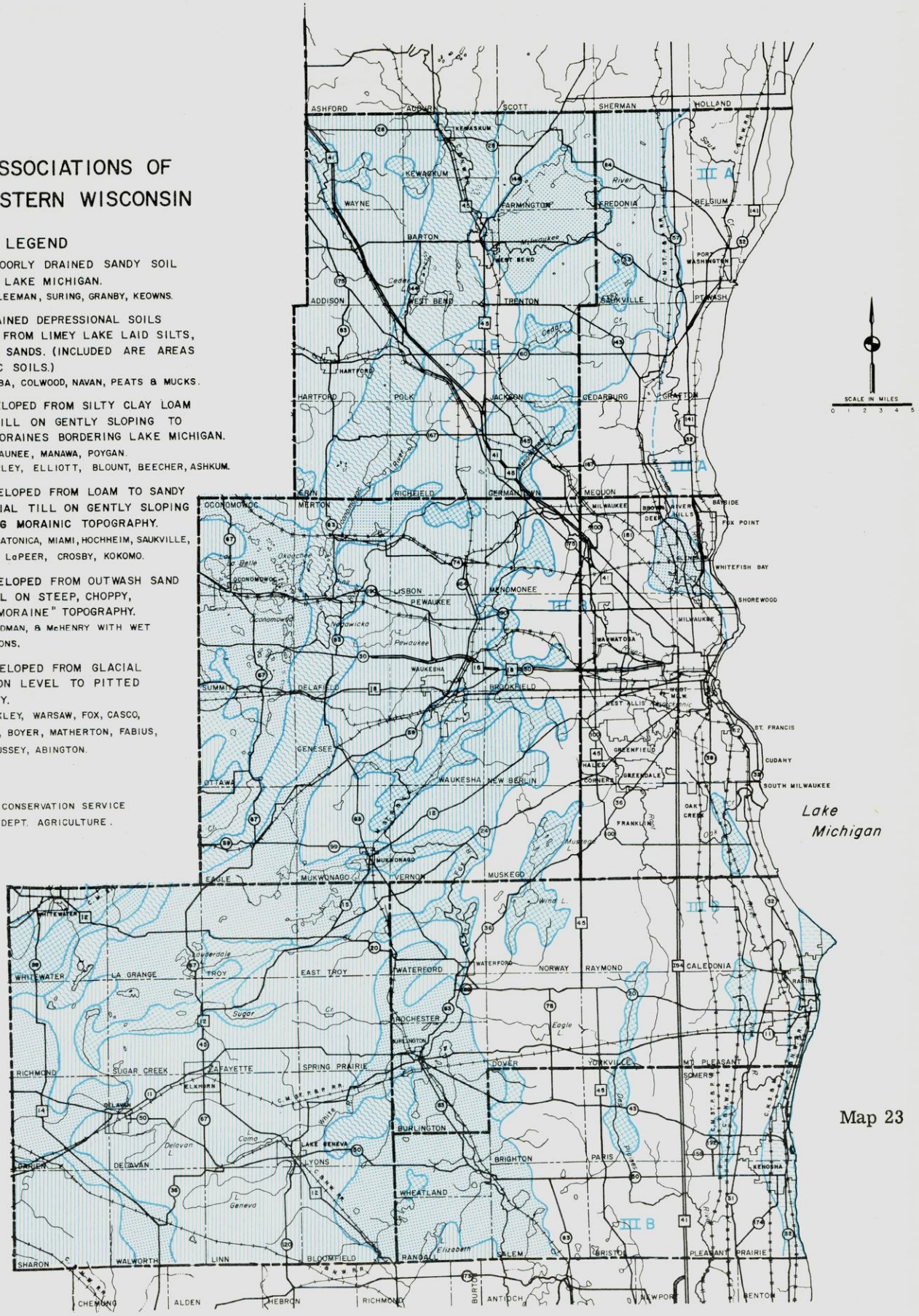
Source: Data from Wisconsin Conservation Department.

SOIL ASSOCIATIONS OF SOUTHEASTERN WISCONSIN

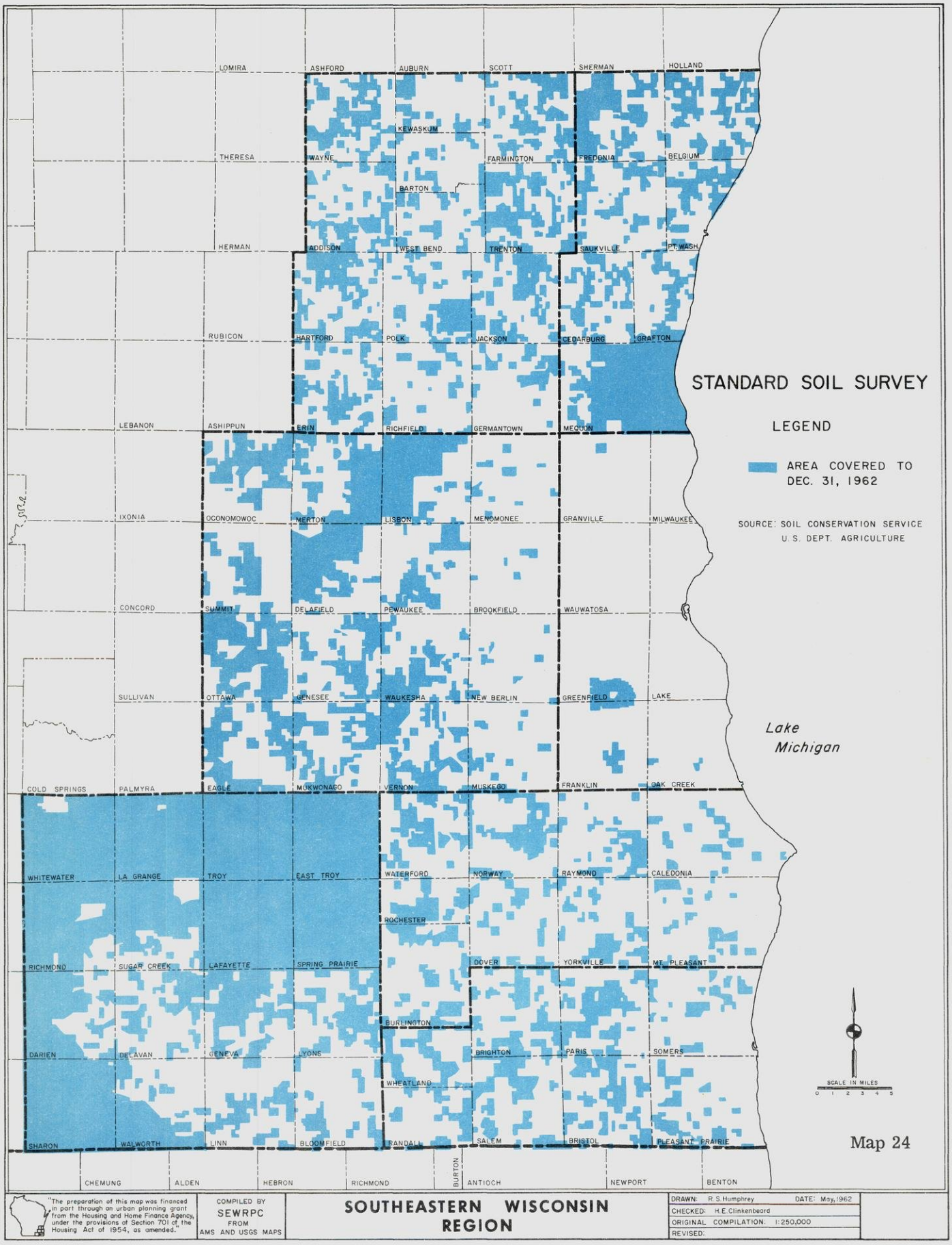
LEGEND

- WELL TO POORLY DRAINED SANDY SOIL BORDERING LAKE MICHIGAN.
  SHAWANO, LEEMAN, SURING, GRANBY, KEOWNS.
- POORLY DRAINED DEPRESSIONAL SOILS DEVELOPED FROM LIMEY LAKE LAID SILTS, CLAYS AND SANDS. (INCLUDED ARE AREAS OF ORGANIC SOILS.)
  BONO, ELBA, COLWOOD, NAVAN, PEATS & MUCKS.
- SOILS DEVELOPED FROM SILTY CLAY LOAM GLACIAL TILL ON GENTLY SLOPING TO ROLLING MORAINES BORDERING LAKE MICHIGAN.
  IIIA KEWAUNEE, MANAWA, POYGAN.
  IIIB MORLEY, ELLIOTT, BLOUNT, BEECHER, ASHKUM.
- SOILS DEVELOPED FROM LOAM TO SANDY LOAM GLACIAL TILL ON GENTLY SLOPING TO ROLLING MORAINIC TOPOGRAPHY.
  PARR, PECATONICA, MIAMI, HOCHHEIM, SAUKVILLE, McHENRY, LaPEER, CROSBY, KOKOMO.
- SOILS DEVELOPED FROM OUTWASH SAND AND GRAVEL ON STEEP, CHOPPY, "KETTLE MORAINE" TOPOGRAPHY.
  CASCO, RODMAN, & McHENRY WITH WET DEPRESSIONS.
- SOILS DEVELOPED FROM GLACIAL OUTWASH ON LEVEL TO PITTED TOPOGRAPHY.
  WEA, OCKLEY, WARSAW, FOX, CASCO, HACKETT, BOYER, MATHERTON, FABIUS, WILL, MUSSEY, ABINGTON.

SOURCE: SOIL CONSERVATION SERVICE
U.S. DEPT. AGRICULTURE.



Map 23



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SOUTHEASTERN WISCONSIN REGION

DRAWN:	R. S. Humphrey DATE: May, 1962
CHECKED:	H. E. Clinkenbeard
ORIGINAL COMPILATION:	1:250,000
REVISED:	

Chapter VII
SOILS

The glaciation of southeastern Wisconsin has to a large extent determined the soil types and patterns which are found in the Region (see Map 23). To a large extent the boundaries of the various soil associations conform to the various glacial deposits left by the Wisconsin ice sheet (see Map 17). The distribution of the various soils does not in all cases conform to drainage and slope of the land, as would be the case in unglaciated areas. Soil types can also be very diverse and complex within relatively small areas.

In general, Racine and Kenosha Counties and the eastern part of Ozaukee County are characterized by soil types which consist of deep to moderately deep, brown to black silt loams. The western parts of Racine and Kenosha Counties, along with Walworth County, are noted primarily for their brown to black prairie loam soils. Waukesha County and Washington County generally have grayish-brown rolling silt loams or gravelly to grayish-brown loams as their primary soil types. Most of the soils in the Region except those within the Kettle Moraine areas are relatively fertile and produce high crop yields if managed correctly. As the rainfall in the Region averages between 30 and 35 inches annually, extensive leaching of surface organic materials is at a minimum.

Table 20

STATUS OF STANDARD SOIL SURVEY MAPPING

County	Total Acreage (Approximate)	Prior to 1961	Acreage Mapped 1961	Acreage Mapped 1962	Total to Date	Total Acres Remaining	Percent Remaining	Completion Date at Present Progress
Kenosha	174,720	46,903	2,673	3,430	53,006	121,714	70%	1980[1]
Milwaukee	152,960	5,260			5,260	147,700	97%	
Ozaukee	150,400	47,593	4,440	17,714	69,747	80,653	54%	1964[2]
Racine	215,680	45,771	1,730	2,125	49,626	166,054	77%	1980[1]
Walworth	358,400	171,196	39,708	41,050	251,954	106,446	30%	1967[3]
Washington	273,920	80,044	4,240	3,195	87,479	186,441	68%	1980[1]
Waukesha	355,840	109,948	2,254	3,639	115,841	239,999	67%	1980[1]
Total	1,681,920[4]	506,715[4]	55,045	71,153	632,913[4]	1,049,007[4]	62%	

[1] Release date for publication.
[2] Completion date for mapping, publication by 1966.
[3] Completion date for mapping, publication by 1969.
[4] Milwaukee County figures included, part of area highly urbanized.

Source: U.S. Department of Agriculture, Soil Conservation Service.

A number of farmers in the Region are presently operating under a basic farm conservation plan (see Map 25). The plan is designed to provide the farmer with information on the best use of each parcel of his land in relation to its capabilities and soil type; thus, by instituting the best soil and water conservation practices, long term maximum yields can be realized. Part of this farm plan is a standard soil survey provided by the Soil Conservation Service, U.S. Department of Agriculture (see Map 24). This type of soil survey presently covers 38 percent of the Region (see Table 20). It should be noted that the location of farms with a basic farm conservation plan, to a certain extent, coincides with those areas of greatest agricultural fertility, though this does not necessarily hold true in the silt loam areas in eastern Racine and Kenosha Counties, nor in many areas in central Walworth County.

The majority of the existing soil survey work with the exception of large blocks in Walworth and Ozaukee Counties was completed, as noted above, upon request of farmers having a basic farm conservation plan. In Walworth County a complete survey of the county had been under way under the Department of Agriculture's long term program of providing soil surveys for all agricultural areas in the United States. The soil survey program in Ozaukee County was also, until recently, under a co-operative matching fund program with this same agency. The percent of remaining areas to be mapped by standard soil survey methods in the seven counties of the Region, prior to the initiation of the SEWRPC regional soil survey, is as follows: Kenosha County, 70 percent; Milwaukee County, 97 percent; Ozaukee County, 54 percent; Racine County, 77 percent; Walworth County, 30 percent; Washington County, 68 percent; and Waukesha County, 67 percent (see Table 20). Completion date for all of these surveys under the previous program has been estimated to be 1980 or later.

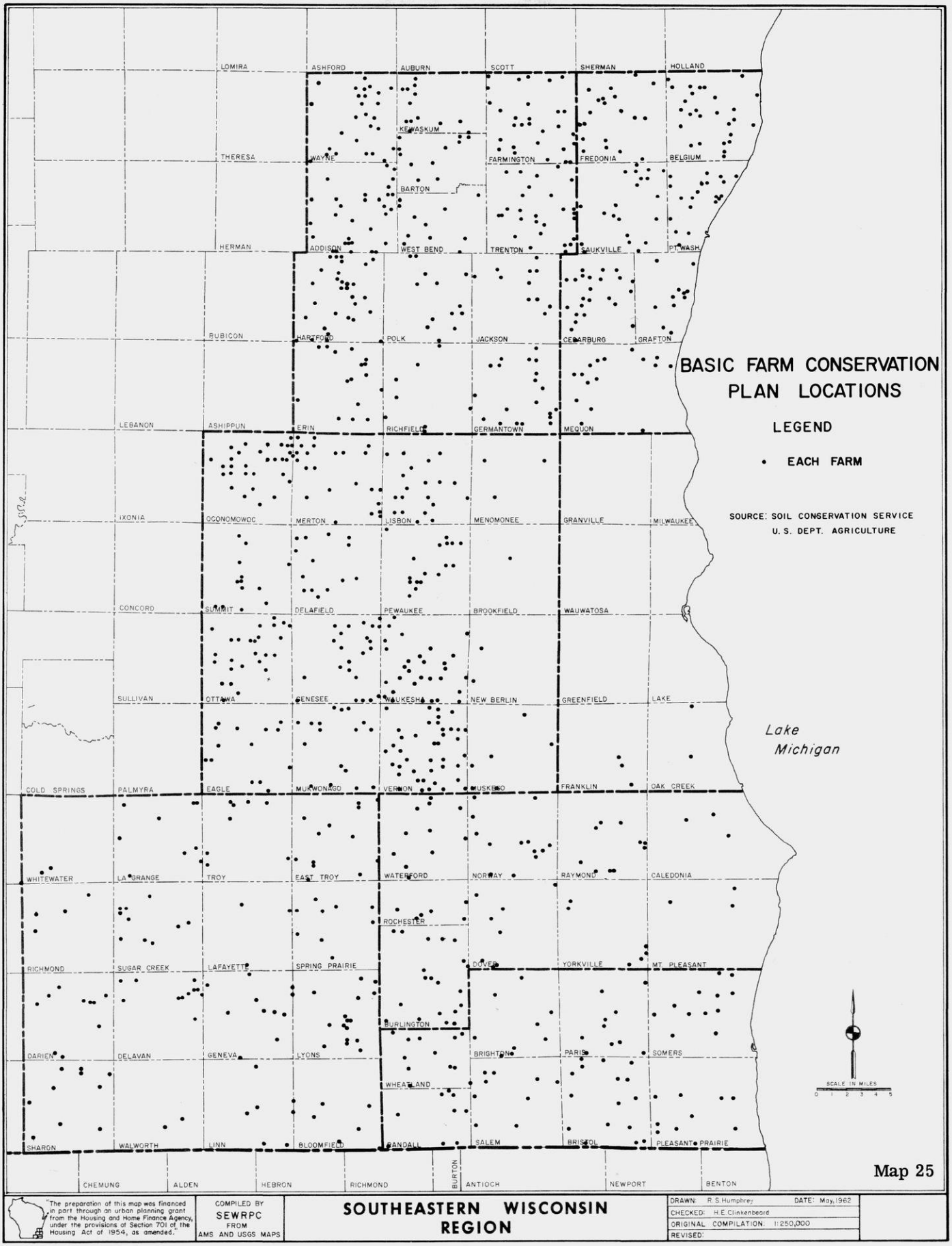
A regional soil survey was recently initiated under a co-operative agreement between the Southeastern Wisconsin Regional Planning Commission and the Soil Conservation Service of the U.S. Department of Agriculture. It will map by standard soil survey methods all areas within the Region not now mapped (see Map 24).

The survey will supply data on the physical properties of each soil type mapped, e.g.: depth of major soil horizons, depth to water table, estimated depth to bedrock, available moisture, infiltration rates, plasticity index, maximum dry density, optimum moisture content, mechanical analysis, pH, percolation rate, bearing strength, shrink-swell ratio, etc. These data will be based in part upon laboratory analyses of samples collected in the field.

The surveys will, in addition, provide agricultural and non-agricultural plant material, wildlife, water management, engineering, and urban and rural land use interpretations of these properties. The surveys and interpretations can, therefore, be used in selecting and developing spatial distribution patterns for industrial, commercial, residential, agricultural and recreational development; and in the selection of highway, railway, airport, pipeline and cable locations; and in the reservation of permanent agricultural and recreational green belts, wildlife areas, and open spaces. Estimates can be made of the suitability of the soils for private sewage disposal facilities, agricultural and urban drainage systems, foundations for buildings and structures including transportation facilities, water storage reservoirs and embankments, and of the need for soil and water management practices such as erosion control and drainage.

The soil surveys will be used by the Commission in comprehensive areawide planning to ensure that planned regional settlement patterns are adapted to the natural resource base. The soil survey will, in addition, be extremely useful to local units of government and to private corporations and individuals in making decisions concerning land use development and management, both rural and urban.

The regional soil survey is scheduled for completion in 1966.



Map 25

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SOUTHEASTERN WISCONSIN REGION

DRAWN:	R. S. Humphrey DATE: May, 1962
CHECKED:	H. E. Clinkenbeard
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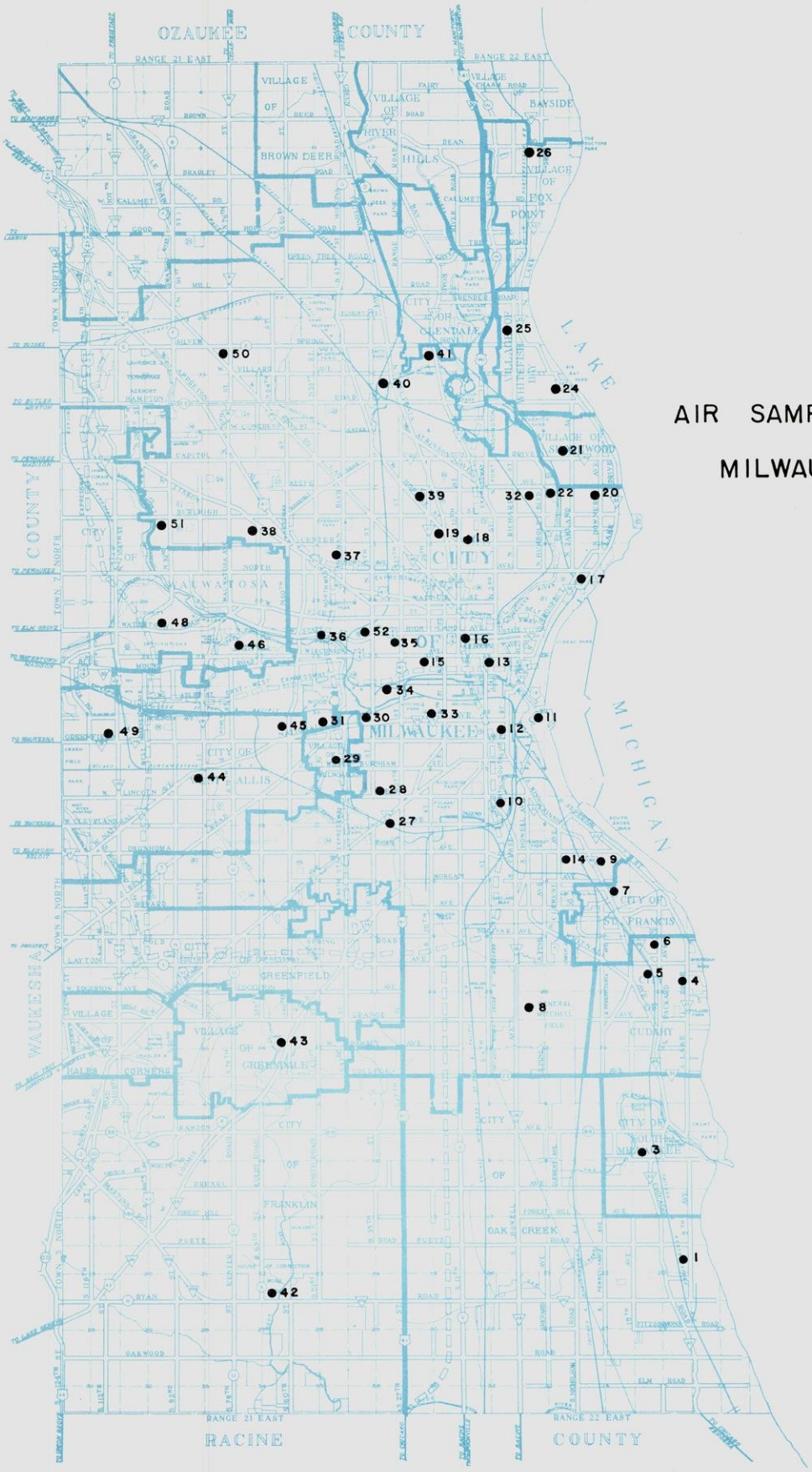


AIR SAMPLING STATIONS

MILWAUKEE COUNTY

Map 26

Chapter VIII
AIR

Air is one of the most important natural resources in our environment. While life on earth would not be possible without it, the condition of the air we breathe, in other words its quality, has a very important part to play in the living conditions in our communities. Fortunately for the Region, the major areas from which air pollutants originate are the industrial zones in the cities of Milwaukee, Racine and Kenosha. Many of these plant locations are in close proximity to Lake Michigan. This location places them on the lee side of the Region since the majority of winds which sweep this area originate in the southwest or northwest quadrants, and thus tend to blow pollution particles out over the lake (see Figure 1), and not over living areas in the surrounding communities.

Since the problem of air quality control is only common to the metropolitan areas of Milwaukee, Racine and Kenosha, it would be reasonable to expect that some form of air pollution control program would be operating for each city.

Air pollution control is a logical successor of what formerly was called "smoke regulation." The City of Milwaukee pioneered in this effort as early as 1904, and their work through the years has developed into the present Milwaukee County Department of Air Pollution Control. This agency presently exercises air pollution control for the entire area of Milwaukee County and has responsibilities which include air pollution from the following sources: marine, motive power, incineration, stationary power and heating.

Since 1948, air pollution problems in Milwaukee County have changed considerably. Coal

Table 21

AVERAGE ANNUAL PARTICULATE DEPOSITION RATE IN MILWAUKEE COUNTY BY ZONING DISTRICTS, 1951, 1957, 1960, 1961, 1962.

Type of Zoning	Tons/square mile/per month				
	1951	1957	1960	1961	1962
Agricultural - 4 sampling sites	14.0	15.4	13.5	14.1	14.0
Residential - 18 sampling sites	22.4	19.8	14.2	14.5	12.4
Commercial - 2 sampling sites	45.8	47.9	34.6	36.5	38.1
Local Business - 11 sampling sites	36.5	27.1	23.4	23.8	24.4
Industrial - 15 sampling sites	82.1	56.3	36.0	35.3	41.6

Source: Department of Air Pollution Control, Milwaukee County

Table 22

LOCATION OF AIR SAMPLING STATIONS
MILWAUKEE COUNTY

Station Number	Name of Building	Address
1	Peter Cooper Corporation	Carrollville
3	Jr. - Sr. High School Building	South Milwaukee
4	Cudahy High School	Cudahy
5	Cudahy Brothers Company	Cudahy
6	Lincoln School	Cudahy
7	St. Francis Minor Seminary	Cudahy
8	Airport Administration Building	Milwaukee
9	Fernwood School	Milwaukee
10	J. W. Riley School	Milwaukee
11	Sewage Disposal Plant	Milwaukee
12	Meyer Building	Milwaukee
13	Reinhart Mitten Company	Milwaukee
14	American Motors Corporation	Milwaukee
15	Marquette College of Engineering	Milwaukee
16	Lutheran Center	Milwaukee
17	Edgeview Apartments	Milwaukee
18	North Division High School	Milwaukee
19	Riverside High School	Milwaukee
20	University of Wisconsin-Milwaukee	Milwaukee
21	Shorewood High School	Shorewood
22	Huebsch Manufacturing Company	Milwaukee
24	Whitefish Bay High School	Whitefish Bay
25	Richards School	Whitefish Bay
26	Fox Point Safety Building	Fox Point
27	Galland-Henning Company	Milwaukee
28	Eugenia Apartment Building	Milwaukee
29	General Electric X-Ray Company	West Milwaukee
30	Kroening Engineering Company	West Milwaukee
31	Building No. 2	Wood
32	General Machinery Company	Milwaukee
33	Liberty Baking Company	Milwaukee
34	Red Star Yeast Company	Milwaukee
35	Maxon Building	Milwaukee
36	Badger Paint Company	Milwaukee
37	Washington High School	Milwaukee
38	68th Street School	Milwaukee
39	Evangelistic Temple	Milwaukee
40	Globe Union Corporation	Milwaukee
41	St. Nicholas School	Milwaukee
42	House of Correction	Franklin
43	Library Building	Greendale
44	Franklin School	West Allis
45	Roosevelt School	West Allis
46	Wisconsin Telephone Company	Wauwatosa
48	Infants Home	Wauwatosa
49	Lane School	Wauwatosa
50	Browning School	Milwaukee
51	Mount Mary College	Milwaukee
52	Harley-Davidson Motor Company	Milwaukee

fired steam locomotives have given way to the diesel locomotive. The diesel bus has replaced the gasoline engine powered bus as well as the electric trolley. A number of urban buildings have connected up with central steam heat. Also, several hundred additional buildings have ceased to require their own heating plants. Although Milwaukee is not a heavy tonnage marine port, strict enforcement of air pollution regulations has meant that more than 80 ships which dock periodically here and still burn coal have adopted a type of underfeed stoker which has virtually eliminated the smoking steamship.

These changes and strict enforcement of the control ordinance have decreased the annual particulate deposition rate in the county in the 11-year period 1951-1962 for industrial zoned areas by approximately 50 percent, commercial zoned areas by 15 percent, business zoned areas by 33 percent and residential zoned areas by 45 percent. There was no change in agriculturally zoned areas (see Table 21).

The particulate deposition rate refers to those pollutants which are characteristic in soiling premises, buildings and clothing. They are gathered and analyzed from approximately 52 sampling stations located throughout the county (see Map 26 and Tables 22 and 23).

The measure of air pollution in the City of Racine is based on a single sampling station located on the roof of the police headquarters.

This station is part of the National Air Sampling Network of the U.S. Public Health Service. An inventory of sources of air pullution in the community indicate that the main sources of air pollution are municipal refuse burning and primary metal industries. Similar to Milwaukee and Kenosha, Racine also has a high concentration of motor vehicles, with approximately 2500 registered vehicles per square mile, so fumes from their exhaust is also a problem.

The City of Kenosha is also operating an air sampling station as part of the National Air Sampling Network. As this station just became operational in January, 1963, no index of the character or amount of air pollution is available.

Table 23

PARTICULATE DEPOSITION RATE FOR MILWAUKEE COUNTY
BY AIR SAMPLING STATION - 1962

Station No.	Tons/ Square Mile/ Per Month	Station No.	Tons/ Square Mile/ Per Month
Agricultural Zoning		Local Business Zoning	
1	15.8	15	55.3
42	15.2	17	25.5
48	9.5	18	15.1
52	15.4[1]	19	14.4
		23	—[2]
Residential Zoning			
3	14.9	28	18.6
4	24.3	33	62.0
6	14.0	39	15.3
7	13.8	46	8.4
9	8.2	49	14.0
10	14.7	50	15.4
20	14.2	Industrial Zoning	
21	10.7	2	22.6
24	11.8	5	53.1
25	7.5	8	13.5
26	17.1	11	124.2
31	16.3	12	70.7
37	8.4	13	32.7
38	7.5	14	23.2
41	—[2]	22	19.1
43	4.3	27	57.3
44	15.2	29	71.4
45	11.8	30	29.1
51	8.5	34	38.4
Commercial Zoning		35	18.1
16	25.8	36	32.7
32	50.3	40	17.8

[1] Changed to Industrial Zone location recently.
[2] Sites discontinued.
Source: Department of Air Pollution Control, Milwaukee County

Chapter IX
SURFACE WATER

WATERSHEDS

In the area encompassed by the Southeastern Wisconsin Planning Region, there are six major and five minor watersheds, plus a number of small local streams draining the lakeshore plain area immediately adjacent to Lake Michigan (see Map 28). The six major watersheds with their approximate basin areas are as follows:

Fox River (Illinois), 926 square miles[1]
Milwaukee River, 662 square miles[2]
Menomonee River, 128 square miles[3]
Root River, 197 square miles[4]
Des Plaines River, 143 square miles,[1] and the Rock River, whose basin area includes the watersheds drained by the Oconomowoc River and Bark River in Waukesha County, and Turtle Creek in western Walworth County.

The minor watersheds draining sections of the Region are as follows:

Pike Creek in Kenosha County
Pike River in Kenosha County
Oak Creek in Milwaukee County
Kinnickinnic River in Milwaukee County, and Sauk Creek in Ozaukee County.

Of the six major watersheds listed above only two are contained entirely within the planning Region (see Map 27). These are the Root River, which drains a large part of southern Milwaukee and eastern Racine Counties, and the Menomonee River, which drains central Milwaukee and eastern Waukesha and Washington Counties. Both of these streams empty into Lake Michigan. The Milwaukee River is the other major stream draining a section of the Region which empties into Lake Michigan. In the southern part of the Region, the Des Plaines River drains a section of eastern Kenosha County and a small part of southern Racine County and empties into the Illinois River just west of Chicago. The Fox River, draining a large area in Waukesha County, eastern Walworth County, and western Racine and Kenosha Counties is a tributary of the Illinois River (see Map 31). The Bark River, the Oconomowoc River and Turtle Creek are tributaries of the Rock River whose basin drains a large section of southern Wisconsin and northern Illinois and whose mouth is situated near Rock Island on the Mississippi River. All of the minor watersheds listed above empty directly into Lake Michigan and are considered within the Great Lakes - St. Lawrence River basin drainage area.

A point of interest about the watershed areas of the Region and their drainage patterns is the presence of a subcontinental divide separating the Great Lakes - St. Lawrence River drainage basin, which flows to the Atlantic Ocean, from the Mississippi River drainage basin, which flows south to the Gulf of Mexico. This major divide runs from the southeastern part of the Region where it is approximately four miles inland from Lake Michigan in a northwesterly direction, leaving the Region along the ridge line of physical relief associated with the Kettle Moraine. This divide and the resultant drainage patterns play an important role in the water resource use patterns of the Region and emphasize certain legal and water use problems for those inland stream areas which do not drain directly into Lake Michigan.

DRAINAGE PATTERN

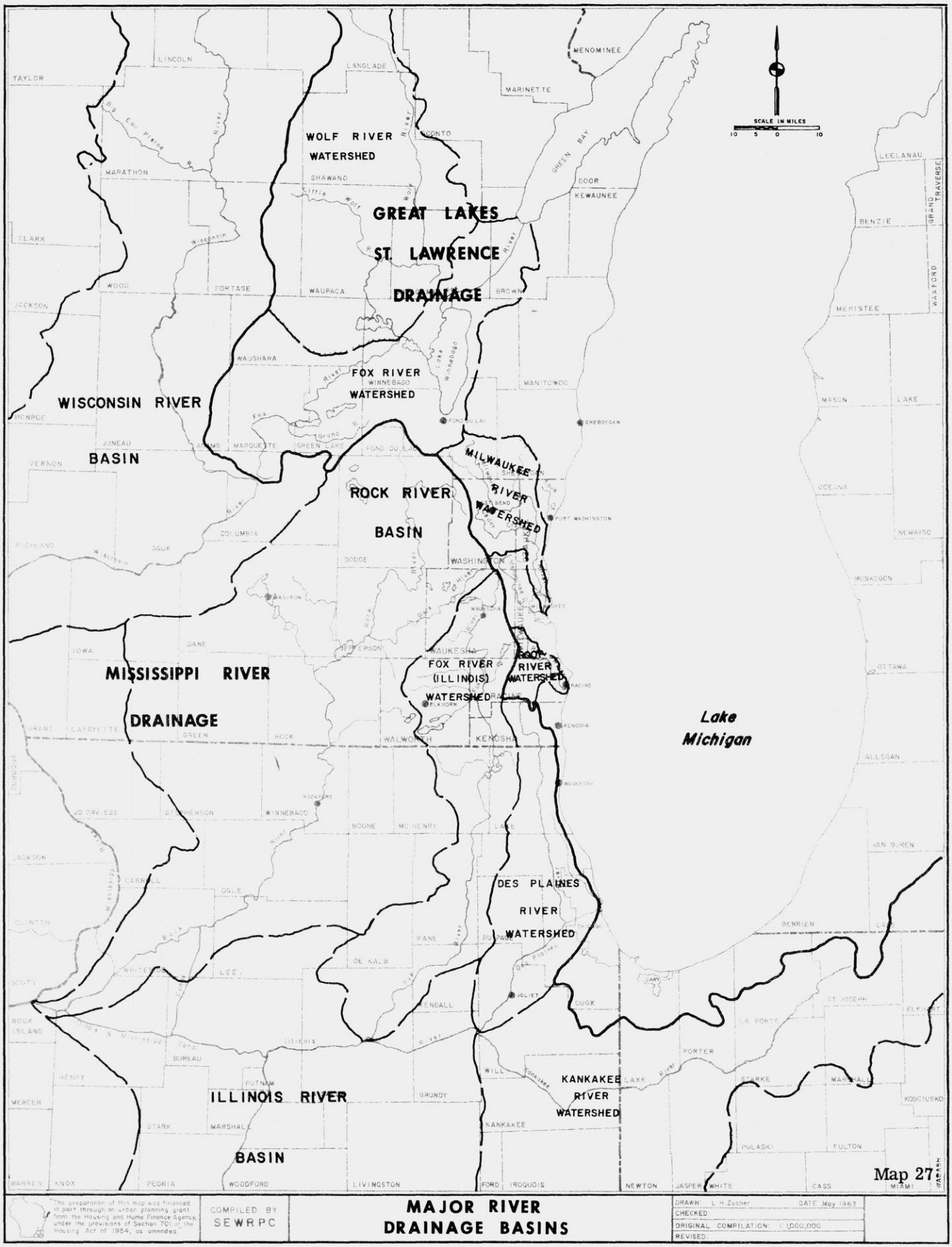
The streams in the Region present some interesting drainage patterns. The trend of stream flow is generally north to south for those streams of major importance (see Map 28). The pattern itself is usually dendritic except for a small area of trellised (rectangular) pattern drainage noticeable in the upper reaches of the Des

[1] Figure from Public Service Commission of Wisconsin, area within the State of Wisconsin.

[2] Figure from Public Service Commission of Wisconsin, total basin including areas in Fond du Lac and Sheboygan Counties.

[3] Figure from Public Service Commission of Wisconsin.

[4] Figure from measuration by SEWRPC.



The preparation of this map was financed in part through an urban planning grant from the Housing and Home Finance Agency, under the provisions of Section 701 of the Housing Act of 1954, as amended.

Plaines River and the Racine County tributaries of the Root River (see Map 30). Both of these patterns exhibit a wandering form typical of young stream valleys flowing on unconsolidated glacial debris. Several instances of river piracy[5] can be noted. This is noticeable in the headwaters area of the Des Plaines River and the south branch of the Root River and in the headwaters area of Cedar Creek in central Washington County (see Map 28). Also, the Muskego Lake drainage has been reversed by artificial ditching; whereas this lake and Little Muskego Lake formerly drained into the Root River, now they drain into the Fox River (Illinois) via the Wind Lake Drainage Canal.

As noted above, the subcontinental divide has a decided effect upon the drainage outlet of all streams in this section of the state.

STREAM FLOWS

The streams within the Region exhibit quite a variance in discharge at different seasons of the year. This is noted from long term records available at three stations within the Region. March and April are the months of highest average monthly runoff and discharge on the Milwaukee River, the Fox River, and on Cedar Creek, while low flow conditions generally prevail in the months of July, August, and September for the same streams (see Tables 30, 31, 32). The Milwaukee River, for its period of record from 1915 to 1961, has the lowest flow in July (see Figures 34, 35), while the Fox River, during its period of record from 1940 to 1961, has the lowest flow in September (see Figures 31, 32). The pattern of record on each of these streams for runoff in inches[6] generally follows the discharge pattern.

These flow characteristics pose certain problems for water management within the Region. Low flows occur during peak summer usage of available water resources for fish and wildlife, irrigation, sewage dilution, and recreation. On the other hand, high flow conditions, as noted, coincide with the period of thaw and spring rains in March and April. In many years this is the period when soil moisture conditions are adequate and need for additional water is at a minimum.

SURFACE WATER MANAGEMENT

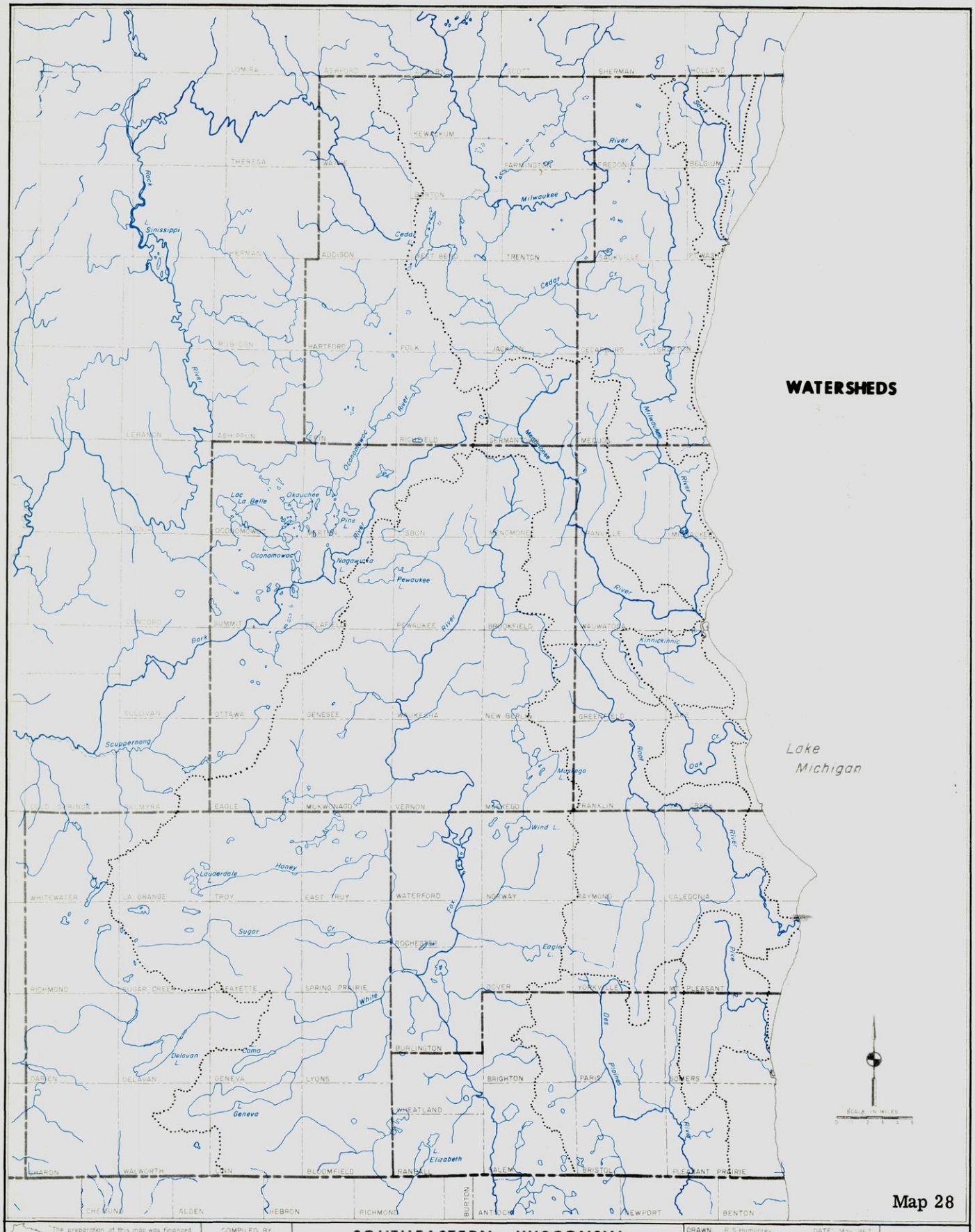
No comprehensive stream gaging network or program exists within the Region, and the few gages which are presently operating have been installed to serve localized demands (see Map 29). There is no watershed in the Region with an adequate network of stream measurement devices, or sufficient water records to meet water resource planning requirements. Gaging stations are essential to measure stream flow characteristics. There is only one continuous recording gage in operation in the Region, located on the Milwaukee River in Estabrook Park in Milwaukee, where a 47-year record has been accumulated (see Tables 26, 27). In addition, two wire-weight gages, read once daily, are in operation. One is located on the Fox River (Illinois) at Wilmot, Wisconsin, and has a 22-year period of record (see Tables 24, 25). The other is situated on Cedar Creek near Cedarburg, Wisconsin, and has a 31-year period of record (see Tables 28, 29). Other than these three gaging facilities, no records of any length are available on stream flow conditions within the Region. Periodic low flow measurements have been made for the past several years at many points within the Region under a program initiated by the U.S. Geological Survey in connection with the State Highway Commission of Wisconsin (see Map 29).

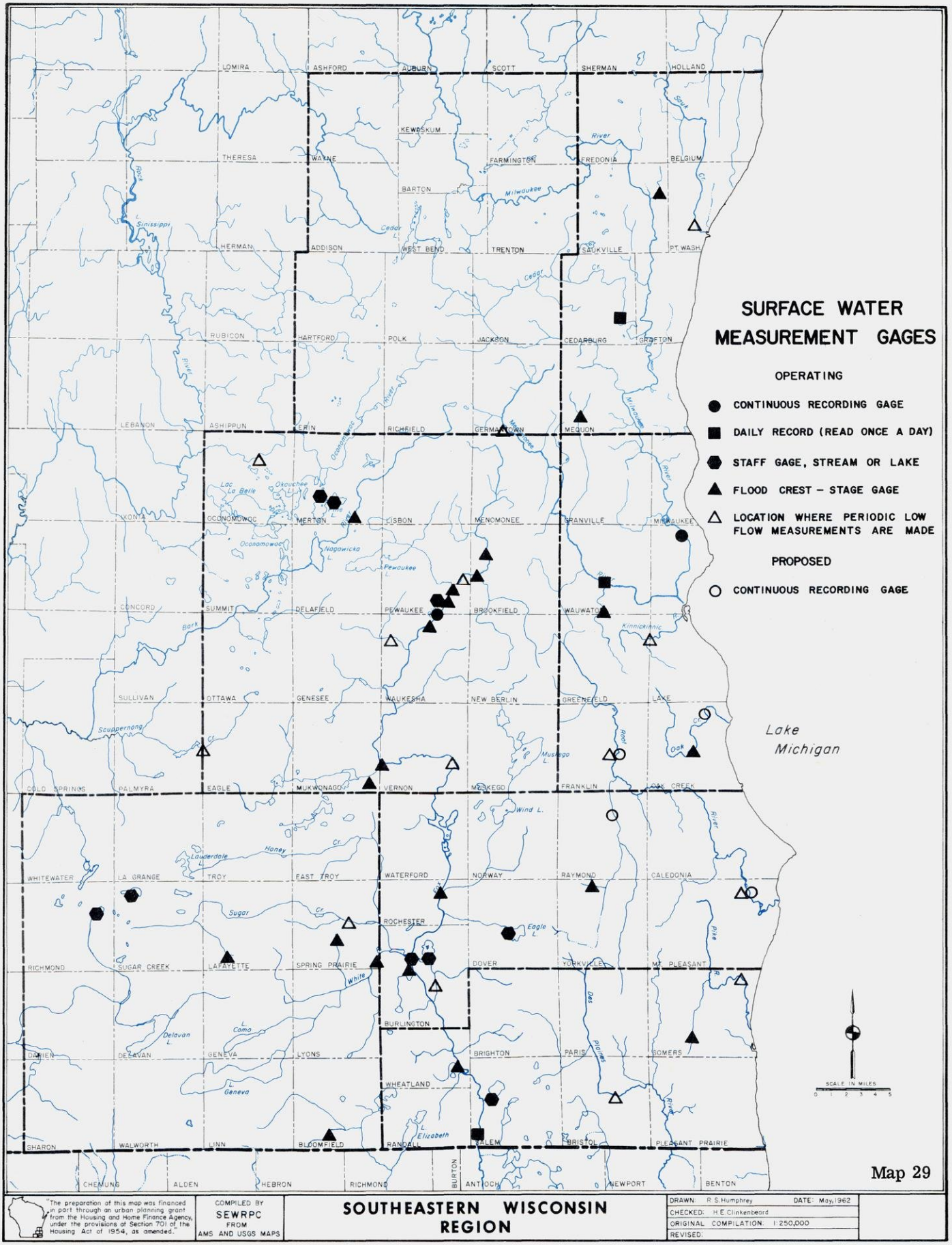
Recently the SEWRPC, in close co-operation with the U.S. Geological Survey and with the assistance of the Waukesha County Park and Planning Commission; the Department of Public Works of the City of Waukesha; the City Engineer's Office, Burlington, Wisconsin; the Wisconsin Conservation Department; and the State Highway Commission of Wisconsin, has established a network of surface water gages along the main stem of the Fox River in Wisconsin. These gages consist of one continuous recording gage, installed at the State Street bridge in Waukesha, and two staff gages and eight flood crest gages, appropriately located along the stream. These staff and flood crest gages measure stage heights (high water) only during periods of peak discharge.

Currently programmed for installation on the Root River and Oak Creek are four continuous recording gages which will provide the first

[5] The action of a river in acquiring the headstreams of a second river by enlarging its drainage area at the expense of the other.

[6] The total stream flow from a drainage basin divided by its area--for convenience in comparing runoff with precipitation, the term is usually expressed in inches of depth over the drainage area during a period of time.


WATERSHEDS
Lake Michigan
Map 28
SOUTHEASTERN WISCONSIN REGION
"The preparation of this map was financed in part through an urban planning grant from the Housing and Home Finance Agency, under the provisions of Section 701 of the Housing Act of 1954, as amended."
COMPILED BY SEWRPC FROM AMS AND USGS MAPS
DRAWN R.S. Humphrey DATE May, 1962
CHECKED H.E. Clinkenbeard
ORIGINAL COMPILATION 1:250,000
REVISED



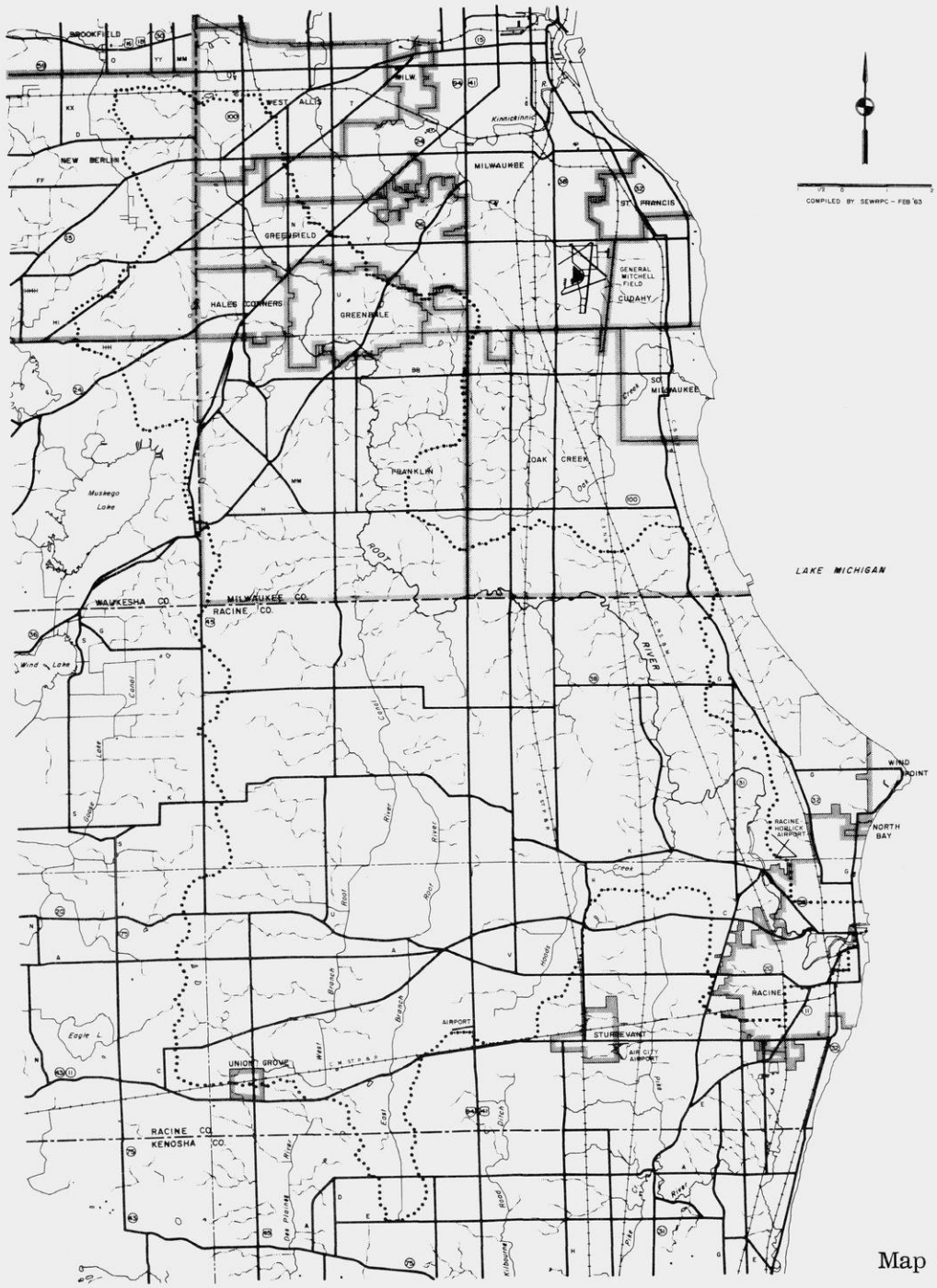
Map 29

"The preparation of this map was financed in part through an urban planning grant from the Housing and Home Finance Agency, under the provisions of Section 701 of the Housing Act of 1954, as amended."

COMPILED BY SEWRPC FROM AMS AND USGS MAPS

SOUTHEASTERN WISCONSIN REGION

DRAWN: R.S.Humphrey DATE: May,1962
CHECKED: H.E.Clinkenbeard
ORIGINAL COMPILATION: 1:250,000
REVISED:

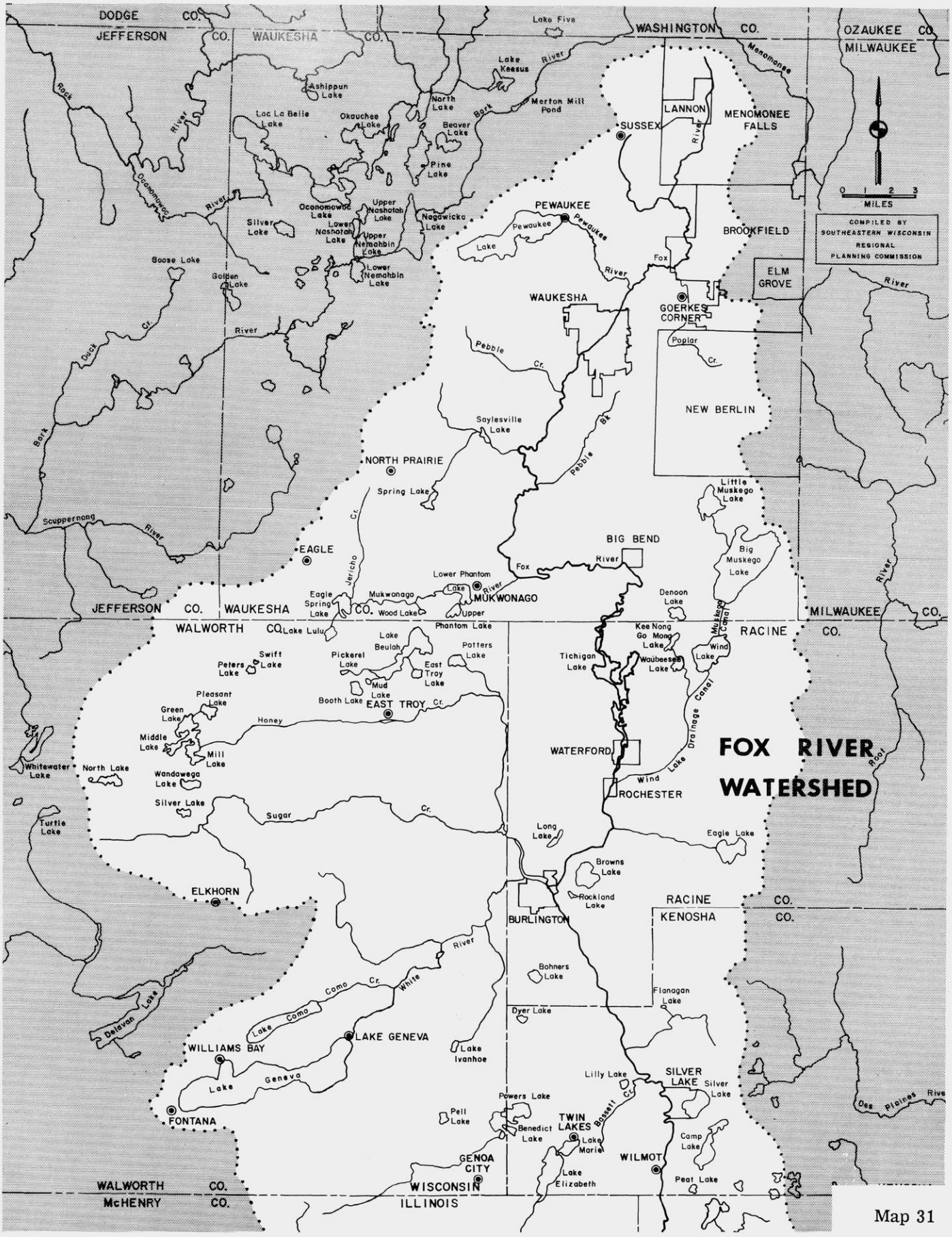


Map 30

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

ROOT RIVER WATERSHED

DRAWN R. S. Huhnke, B. D. R. Behnke DATE
CHECKED K. W. Bauer
ORIGINAL COMPILATION
REVISED


DODGE CO.
JEFFERSON CO.
WAUKESHA CO.
WASHINGTON CO.
OZAUKEE CO.
MILWAUKEE
Lake Five
Lake Keesus
Ashippun Lake
Rock River
Lac La Belle Lake
Okauchee Lake
North Lake
Merton Mill Pond
Bark River
Beaver Lake
Pine Lake
SUSSEX
LANNON
MENOMONEE FALLS
Menomonee River
Oconomowoc River
Oconomowoc Lake
Upper Nashotah Lake
Lower Nashotah Lake
Upper Nemahbin Lake
Lower Nemahbin Lake
Nagawicka Lake
Silver Lake
Goose Lake
Golden Lake
PEWAUKEE
Pewaukee Lake
Pewaukee River
BROOKFIELD
Fox River
ELM GROVE
WAUKESHA
GOERKES CORNER
Poplar Cr.
Pebble Cr.
Duck Cr.
Bark River
NEW BERLIN
Saylesville Lake
Pebble Br.
NORTH PRAIRIE
Spring Lake
Little Muskego Lake
Scuppernong River
EAGLE
Jericho Cr.
BIG BEND
Big Muskego Lake
Lower Phantom Lake
Fox River
Eagle Spring Lake
Mukwonago River
MUKWONAGO
Denoon Lake
JEFFERSON CO.
WAUKESHA CO.
Wood Lake
Upper Phantom Lake
MILWAUKEE CO.
WALWORTH CO.
Lake Lulu
Lake Beulah
Potters Lake
Swift Lake
Peters Lake
Pickerel Lake
East Troy Lake
Mud Lake
Booth Lake
EAST TROY
Pleasant Lake
Green Lake
Honey Cr.
Middle Lake
Mill Lake
Whitewater Lake
North Lake
Wandawega Lake
Silver Lake
Sugar Cr.
Turtle Lake
Kee Nong Go Mong Lake
Waubeesee Lake
Tichigan Lake
Muskego Canal
Wind Lake
RACINE CO.
WATERFORD
Drainage Canal
FOX RIVER WATERSHED
Root River
Wind Lake
ROCHESTER
Long Lake
Eagle Lake
Browns Lake
Rockland Lake
ELKHORN
BURLINGTON
RACINE CO.
KENOSHA CO.
Bohners Lake
Flanagan Lake
Dyer Lake
Delavan Lake
Como Cr.
White River
Lake Como
LAKE GENEVA
WILLIAMS BAY
Lake Ivanhoe
Lake Geneva
Lilly Lake
SILVER LAKE
Silver Lake
Powers Lake
Pell Lake
Benedict Lake
TWIN LAKES
Bassett Cr.
Lake Marie
Des Plaines River
Camp Lake
WILMOT
FONTANA
GENOA CITY
Lake Elizabeth
Peat Lake
WISCONSIN
ILLINOIS
WALWORTH CO.
McHENRY CO.
0 1 2 3
MILES
COMPILED BY SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

Map 31

Table 24

FLOW OF THE FOX RIVER AT WILMOT WISCONSIN BY MONTHS FOR PERIOD 1940 TO 1961

(IN CUBIC FEET PER SECOND)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Total
1940	87.7	105.0	258.0	440.0	414.0	488.0	435.0	617.0	627.0	237.0	285.0	516.0	4509.7
1941	512.0	439.0	1198.0	942.0	282.0	277.0	127.0	87.8	324.0	566.0	566.0	368.0	5688.8
1942	335.0	415.0	863.0	439.0	277.0	529.0	153.0	195.0	189.0	159.0	535.0	415.0	4504.0
1943	744.0	954.0	2185.0	604.0	489.0	476.0	252.0	173.0	137.0	115.0	241.0	158.0	6528.0
1944	137.0	423.0	1090.0	848.0	432.0	279.0	133.0	81.9	90.7	115.0	151.0	114.0	3894.6
1945	94.7	174.0	513.0	284.0	633.0	498.0	237.0	117.0	247.0	545.0	352.0	351.0	4045.7
1946	1098.0	377.0	1780.0	379.0	202.0	238.0	186.0	76.3	62.7	99.3	184.0	129.0	4811.3
1947	185.0	193.0	694.0	985.0	633.0	1108.0	199.0	130.0	187.0	210.0	419.0	497.0	5440.0
1948	230.0	466.0	2201.0	897.0	1091.0	190.0	153.0	100.0	89.6	99.1	160.0	154.0	5830.7
1949	241.0	498.0	1127.0	629.0	213.0	179.0	179.0	100.0	90.8	116.0	113.0	164.0	3649.8
1950	395.0	270.0	1081.0	1228.0	450.0	571.0	633.0	275.0	231.0	176.0	150.0	190.0	5650.0
1951	212.0	645.0	2078.0	1589.0	1087.0	659.0	328.0	285.0	200.0	590.0	1098.0	558.0	9329.0
1952	777.0	691.0	2117.0	1402.0	497.0	436.0	893.0	902.0	227.0	177.0	254.0	430.0	8803.0
1953	290.0	834.0	908.0	550.0	651.0	379.0	140.0	259.0	112.0	105.0	128.0	190.0	4546.0
1954	130.0	246.0	252.0	690.0	357.0	834.0	786.0	556.0	302.0	796.0	415.0	365.0	5729.0
1955	716.0	400.0	829.0	694.0	470.0	776.0	170.0	148.0	106.0	161.0	164.0	127.0	4761.0
1956	125.0	156.0	305.0	337.0	875.0	275.0	220.0	148.0	113.0	195.0	118.0	125.0	2992.0
1957	133.0	290.0	326.0	476.0	558.0	581.0	155.0	157.0	153.0	112.0	285.0	213.0	3439.0
1958	157.0	177.0	427.0	256.0	108.0	164.0	69.2	57.2	65.6	99.2	226.0	106.0	1912.2
1959	98.8	139.0	1575.0	1266.0	610.0	161.0	163.0	268.0	133.0	897.0	896.0	688.0	6894.8
1960	1818.0	707.0	808.0	2841.0	1538.0	607.0	689.0	636.0	461.0	498.0	936.0	337.0	11876.0
1961	221.0	213.0	1330.0	1222.0	611.0	293.0	200.0	196.0	555.0	764.0	1161.0	486.0	7252.0

Source: U. S. Geological Survey

permanently established continuous record of flow characteristics on these streams. Two of these gages will be installed on the Root River in Milwaukee County; and one will be installed on Oak Creek through a co-operative program involving the Metropolitan Sewerage Commission of the County of Milwaukee, the U.S. Geological Survey, and SEWRPC. One will be installed on the Root River in Racine County through a co-operative program involving the Racine County Board, the U.S. Geological Survey, and SEWRPC.

Other areas of the Region need additional measuring devices in the near future in order that adequate data can be established for future water resource planning and management programs.

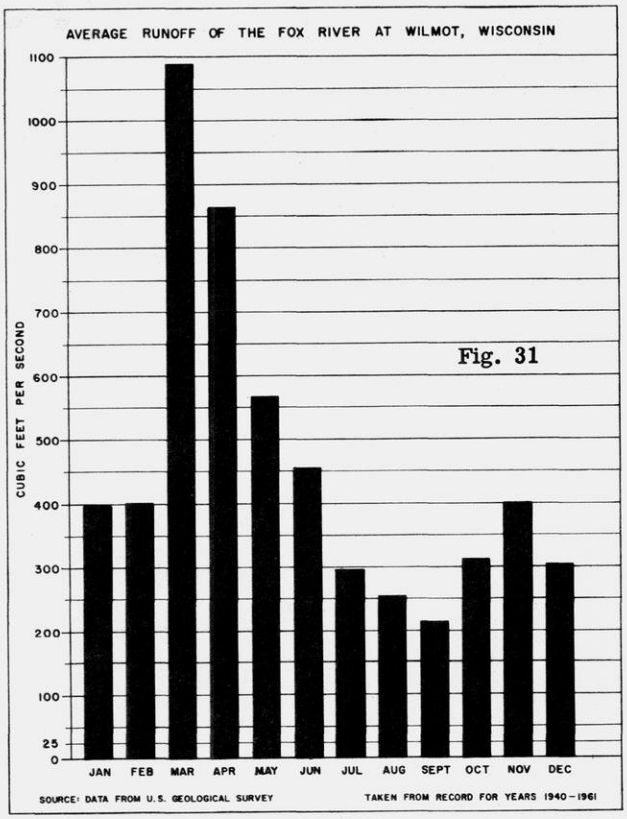


Fig. 31

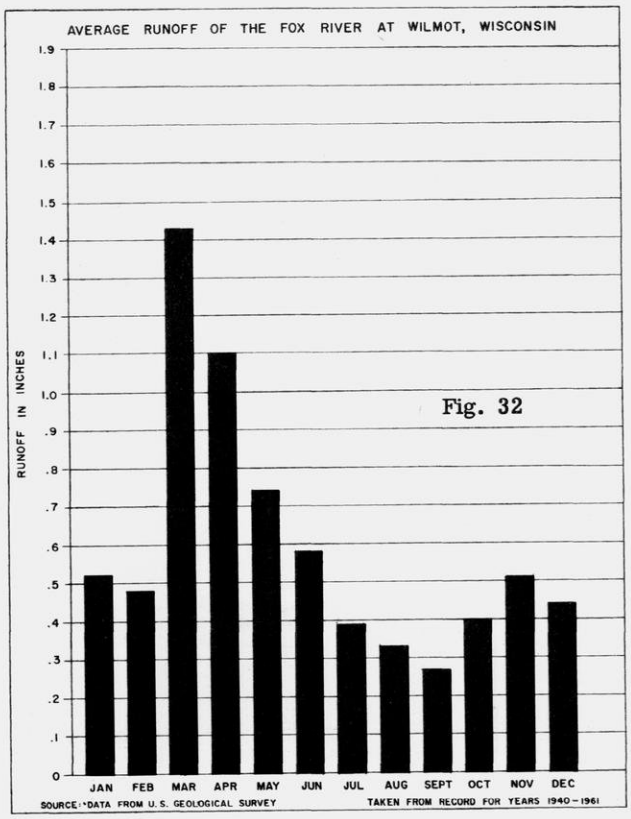


Fig. 32

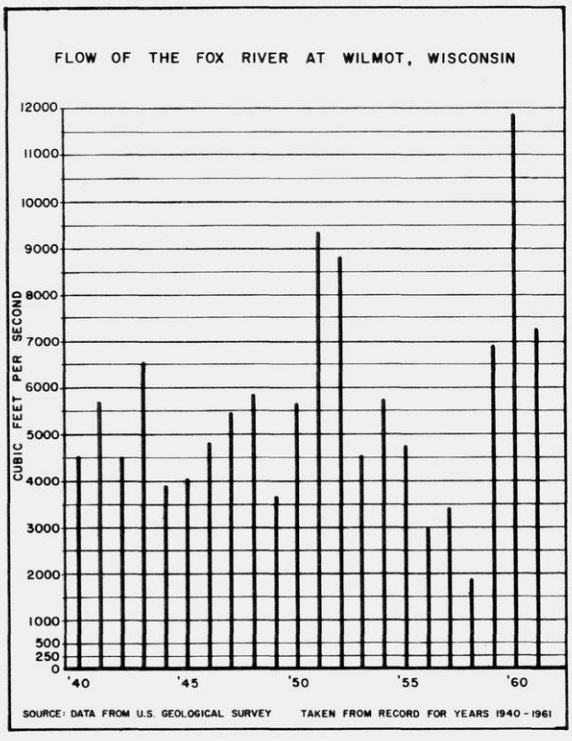


Fig. 33

Table 25

FLOW OF THE FOX RIVER AT WILMOT WISCONSIN BY MONTHS FOR PERIOD 1940 TO 1961

(RUNOFF IN INCHES)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Total
1940	0.12	0.13	0.34	0.56	0.54	0.62	0.57	0.81	0.79	0.31	0.36	0.68	5.83
1941	0.67	0.52	1.57	1.19	0.37	0.35	0.17	0.12	0.41	0.74	0.72	0.48	7.31
1942	0.44	0.49	1.13	0.56	0.36	0.67	0.20	0.26	0.24	0.21	0.68	0.54	5.78
1943	0.97	1.12	2.86	0.77	0.64	0.60	0.33	0.23	0.17	0.15	0.31	0.21	8.36
1944	0.18	0.52	1.43	1.08	0.57	0.35	0.17	0.11	0.11	0.15	0.19	0.15	5.01
1945	0.12	0.21	0.67	0.36	0.83	0.63	0.31	0.15	0.31	0.71	0.45	0.46	5.21
1946	1.44	0.45	2.33	0.48	0.27	0.30	0.24	0.10	0.08	0.13	0.23	0.17	6.22
1947	0.24	0.23	0.91	1.25	0.83	1.41	0.26	0.17	0.24	0.28	0.53	0.65	7.00
1948	0.30	0.57	2.88	1.14	1.43	0.24	0.20	0.13	0.11	0.13	0.20	0.20	7.53
1949	0.32	0.59	1.48	0.80	0.28	0.23	0.23	0.13	0.11	0.15	0.14	0.21	4.67
1950	0.52	0.32	1.42	1.56	0.59	0.72	0.83	0.36	0.29	0.23	0.19	0.25	7.28
1951	0.28	0.76	2.72	2.02	1.43	0.84	0.43	0.37	0.25	0.77	1.39	0.73	11.99
1952	1.02	0.85	2.77	1.78	0.65	0.55	1.17	1.18	0.29	0.23	0.32	0.56	11.37
1953	0.38	0.99	1.19	0.70	0.85	0.48	0.18	0.34	0.14	0.14	0.16	0.25	5.80
1954	0.17	0.29	0.33	0.87	0.47	1.06	1.03	0.73	0.38	1.04	0.53	0.48	7.38
1955	0.94	0.47	1.09	0.88	0.62	0.98	0.22	0.19	0.13	0.21	0.21	0.17	6.11
1956	0.16	0.19	0.40	0.43	1.15	0.35	0.29	0.19	0.14	0.10	0.15	0.16	3.71
1957	0.17	0.34	0.43	0.60	0.73	0.74	0.20	0.21	0.19	0.15	0.36	0.28	4.40
1958	0.21	0.21	0.56	0.32	0.14	0.21	0.09	0.07	0.08	0.13	0.29	0.14	2.45
1959	0.13	0.16	2.06	1.61	0.80	0.20	0.21	0.35	0.17	1.18	1.14	0.90	8.91
1960	2.38	0.87	1.06	3.60	2.02	0.77	0.90	0.83	0.59	0.65	1.19	1.44	16.30
1961	0.29	0.25	1.74	1.55	0.80	0.37	0.26	0.26	0.70	1.00	1.47	0.64	9.33

Source: U. S. Geological Survey

Table 26

FLOW OF THE MILWAUKEE RIVER AT MILWAUKEE, WISCONSIN BY MONTHS FOR PERIOD, 1915 TO 1961

(RUNOFF IN INCHES)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Total
1915	0.28	2.00	2.18	0.77	1.22	0.87	0.28	0.33	0.96	0.43	0.80	0.67	10.79
1916	1.51	1.05	1.80	1.60	1.34	1.47	0.21	0.46	0.23	0.80	1.20	0.41	12.08
1917	0.20	0.19	3.50	1.35	1.10	1.81	0.65	0.16	0.25	0.78	0.68	0.27	10.94
1918	0.11	0.38	5.58	1.12	1.19	0.35	0.17	0.14	0.14	0.17	0.22	0.38	9.95
1919	0.22	0.47	2.13	1.23	1.12	0.31	0.16	0.15	0.15	0.36	0.53	0.20	7.03
1920	0.25	0.26	3.37	1.13	0.53	1.16	0.23	0.21	0.18	0.17	0.39	0.66	8.54
1921	0.93	0.37	1.11	2.14	0.61	0.21	0.12	0.14	0.42	0.44	0.60	1.11	8.20
1922	0.27	1.31	2.64	1.81	0.48	0.47	0.27	0.17	0.36	0.21	0.36	0.18	8.53
1923	0.24	0.32	1.68	3.48	0.51	0.38	0.14	0.11	0.19	0.35	0.26	0.35	8.01
1924	0.16	0.34	1.78	2.16	1.52	0.50	0.30	5.12	0.57	0.36	0.63	0.48	13.92
1925	0.26	1.33	0.97	1.14	0.33	0.23	0.18	0.16	0.17	0.25	0.33	0.45	5.80
1926	0.48	0.74	1.87	1.38	0.88	0.65	0.18	0.15	0.29	0.39	1.10	0.96	9.07
1927	0.61	1.42	2.32	1.43	1.10	0.52	0.21	0.13	0.23	1.34	1.13	1.12	11.56
1928	0.42	0.58	2.06	2.26	0.84	0.97	0.56	0.42	0.21	0.42	1.18	1.71	11.63
1929	0.49	0.26	6.19	3.42	1.36	0.48	0.38	0.19	0.18	0.28	0.34	0.42	13.99
1930	0.19	1.49	0.88	1.08	0.89	0.23	0.15	0.12	0.08	0.19	0.17	0.14	5.61
1931	0.14	0.17	0.36	0.52	0.22	0.21	0.11	0.08	0.20	0.39	1.25	0.93	4.58
1932	1.13	0.64	0.58	0.52	0.37	0.14	0.09	0.06	0.05	0.13	0.14	0.26	4.11
1933	0.39	0.42	0.63	2.23	2.21	0.80	0.38	0.14	0.10	0.13	0.14	0.16	7.73
1934	0.23	0.08	0.36	1.01	0.19	0.09	0.06	0.03	0.08	0.10	0.47	0.48	3.18
1935	0.22	0.21	3.49	1.17	0.79	0.39	0.14	0.14	0.09	0.13	0.20	0.22	7.19
1936	0.14	0.12	2.04	0.70	0.42	0.13	0.04	0.06	0.24	0.30	0.24	0.24	4.67
1937	0.69	2.05	1.09	1.56	1.00	0.70	0.14	0.06	0.09	0.13	0.13	0.11	7.75
1938	0.24	3.47	2.42	0.61	0.27	0.19	0.87	0.33	3.89	0.55	0.68	0.44	13.96
1939	0.84	0.73	1.65	1.32	0.43	0.40	0.10	0.11	0.08	0.15	0.15	0.13	6.09
1940	0.08	0.10	0.32	1.24	0.67	2.03	0.30	0.37	0.25	0.19	0.27	0.59	6.41
1941	0.53	0.29	1.05	1.34	0.39	0.14	0.08	0.06	0.22	0.53	0.64	0.43	5.70
1942	0.44	0.42	1.36	0.53	0.62	1.09	0.18	0.38	0.42	0.34	0.81	0.79	7.38
1943	0.83	1.30	3.02	0.93	0.53	0.67	0.19	0.16	0.11	0.15	0.26	0.15	8.30
1944	0.15	0.48	1.24	1.04	0.43	0.34	0.15	0.09	0.15	0.16	0.24	0.17	4.64
1945	0.13	0.18	1.24	0.49	0.52	0.68	0.13	0.18	0.28	0.40	0.49	0.42	5.14
1946	1.24	0.31	3.62	0.48	0.27	0.22	0.16	0.07	0.08	0.09	0.18	0.12	6.84
1947	0.25	0.18	1.19	1.58	1.03	0.76	0.17	0.09	0.14	0.20	0.33	0.31	6.23
1948	0.20	0.53	2.96	0.98	0.81	0.17	0.12	0.08	0.06	0.09	0.21	0.18	6.39
1949	0.32	0.53	1.49	0.89	0.24	0.29	0.22	0.15	0.07	0.10	0.10	0.12	4.52
1950	0.38	0.17	2.33	1.28	0.68	0.23	0.76	0.18	0.18	0.13	0.13	0.17	6.62
1951	0.16	0.48	2.62	3.55	0.97	0.34	0.30	0.25	0.22	1.13	1.34	0.60	11.96
1952	1.11	0.72	3.40	2.39	0.59	0.34	2.02	0.71	0.25	0.25	0.34	0.52	12.64
1953	0.35	0.79	1.60	0.87	1.35	0.87	0.18	0.32	0.13	0.13	0.15	0.19	6.93
1954	0.12	0.30	0.32	0.55	0.41	1.36	0.77	0.24	0.25	1.75	0.46	0.43	6.96
1955	0.57	0.40	1.23	1.88	0.81	1.26	0.31	0.17	0.11	0.17	0.19	0.15	7.25
1956	0.13	0.15	0.64	1.11	1.72	0.28	0.63	0.44	0.49	0.19	0.32	0.28	6.38
1957	0.18	0.30	0.55	0.86	0.67	0.60	0.19	0.10	0.11	0.13	0.30	0.15	4.14
1958	0.13	0.10	0.37	0.39	0.15	0.16	0.10	0.10	0.14	0.16	0.20	0.09	2.09
1959	0.08	0.07	1.13	4.25	0.43	0.15	0.16	0.11	0.15	0.48	0.60	0.77	8.38
1960	0.93	0.31	1.18	2.78	2.44	0.59	0.55	1.02	1.22	0.64	1.10	0.37	13.13
1961	0.21	0.26	1.77	1.21	0.57	0.32	0.17	0.22	0.46	0.59	1.11	0.40	7.29

Source: U.S. Geological Survey

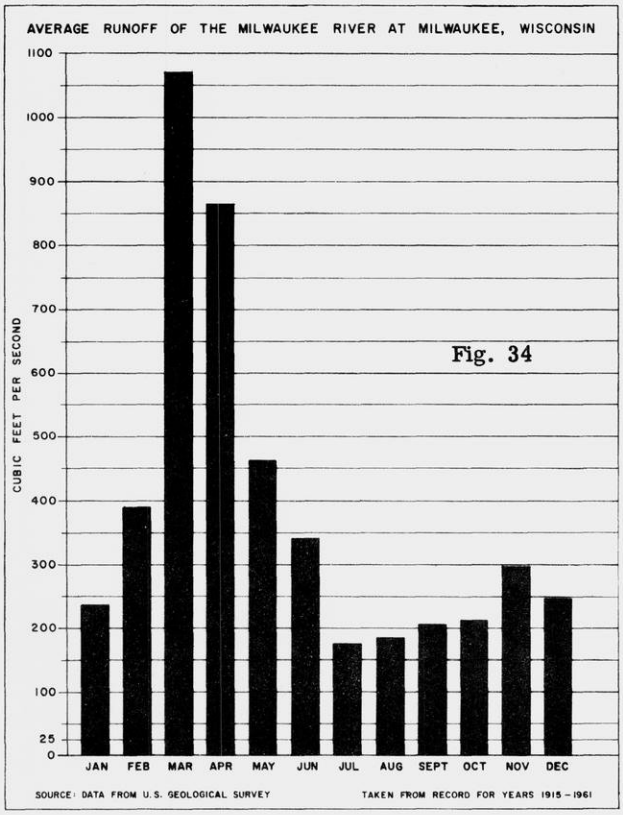


Fig. 34

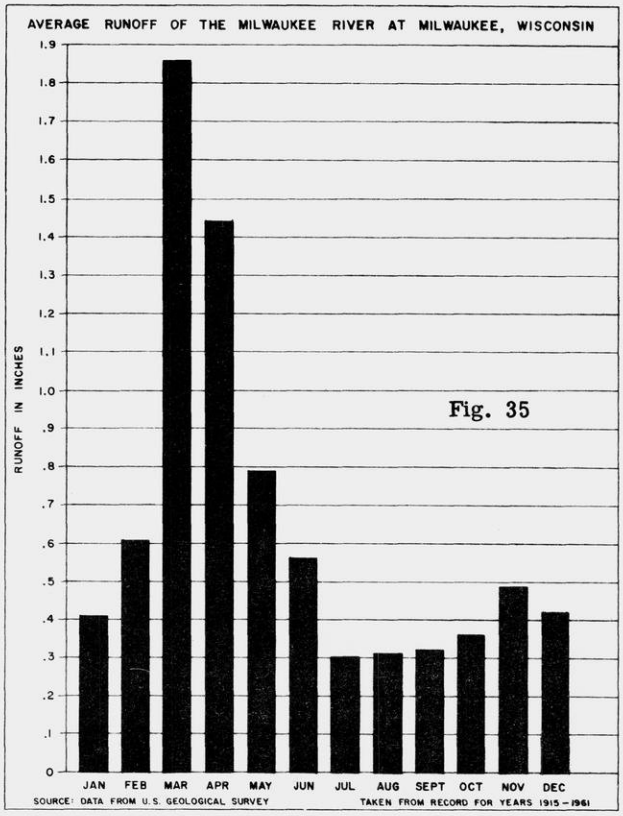


Fig. 35

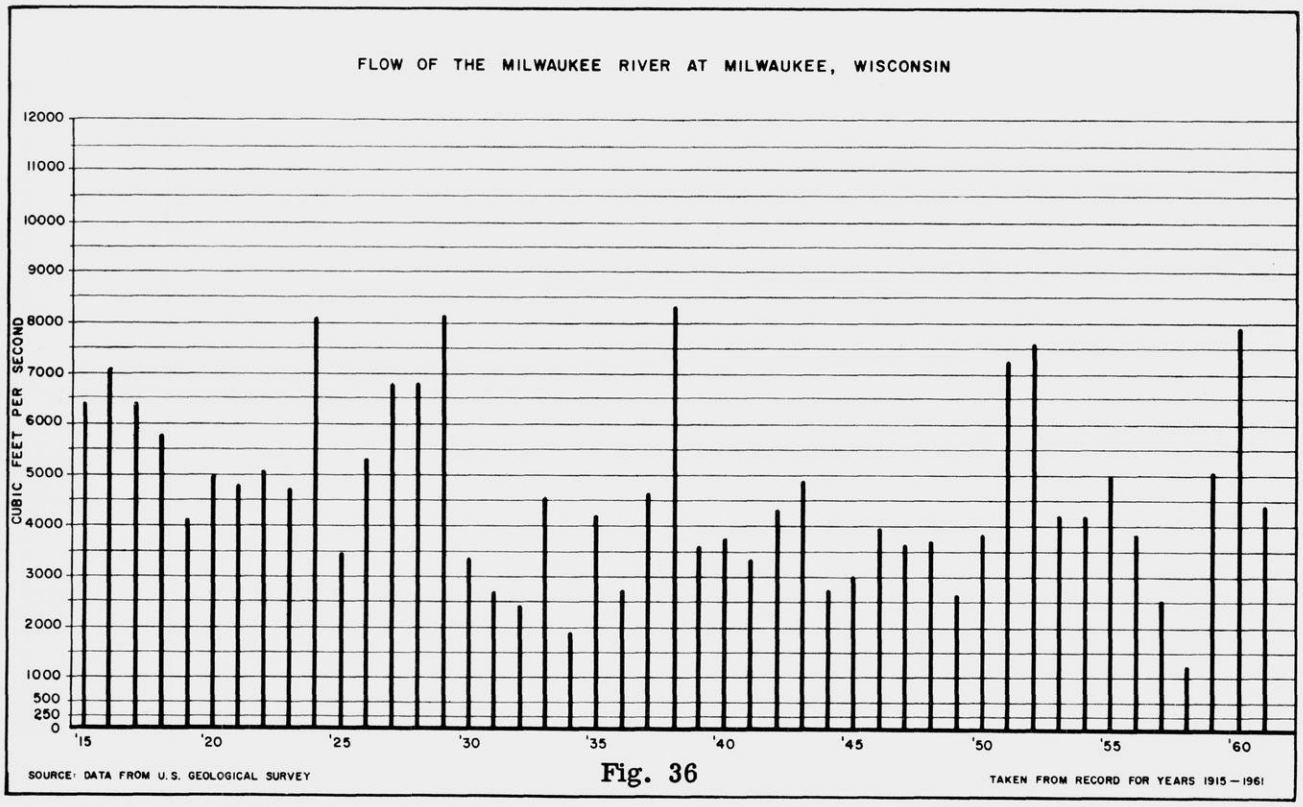


Fig. 36

Table 27

FLOW OF THE MILWAUKEE RIVER AT MILWAUKEE, WISCONSIN BY MONTHS FOR PERIOD, 1915 TO 1961

(IN CUBIC FEET PER SECOND)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Total
1915	158.0	1270.0	1250.0	458.0	699.0	514.0	158.0	192.0	566.0	247.0	474.0	383.0	6369.0
1916	864.0	645.0	1030.0	946.0	764.0	871.0	120.0	261.0	136.0	461.0	715.0	235.0	7048.0
1917	115.0	119.0	2010.0	799.0	633.0	1070.0	371.0	91.6	151.0	448.0	403.0	154.0	6364.6
1918	65.0	239.0	3201.0	661.0	678.0	209.0	97.4	80.3	82.6	99.1	129.0	219.0	5760.4
1919	127.0	297.0	1220.0	729.0	643.0	183.0	92.9	87.8	91.0	209.0	312.0	116.0	4107.7
1920	144.0	157.0	1930.0	699.0	305.0	686.0	132.0	119.0	106.0	96.8	233.0	379.0	4956.8
1921	534.0	233.0	634.0	1270.0	350.0	127.0	68.7	82.6	246.0	254.0	355.0	634.0	4788.3
1922	154.0	835.0	1516.0	1070.0	277.0	278.0	154.0	100.0	214.0	120.0	215.0	106.0	5039.0
1923	140.0	202.0	964.0	2060.0	295.0	226.0	81.8	64.5	115.0	201.0	156.0	200.0	4705.3
1924	92.7	208.0	1020.0	1280.0	873.0	299.0	170.0	2936.0	399.0	206.0	372.0	275.0	8070.7
1925	151.0	846.0	557.0	672.0	188.0	137.0	102.0	94.0	100.0	142.0	197.0	258.0	3444.0
1926	275.0	467.0	1070.0	819.0	506.0	386.0	102.0	84.4	172.0	225.0	653.0	548.0	5307.4
1927	349.0	898.0	1330.0	843.0	628.0	306.0	120.0	77.6	139.0	764.0	669.0	642.0	6765.6
1928	243.0	354.0	1180.0	1340.0	479.0	576.0	319.0	240.0	125.0	242.0	702.0	981.0	6781.0
1929	279.0	163.0	3550.0	2030.0	778.0	282.0	220.0	109.0	104.0	162.0	204.0	239.0	8120.0
1930	107.0	947.0	503.0	637.0	513.0	139.0	83.3	67.2	49.1	111.0	100.0	82.1	3338.7
1931	78.5	111.0	204.0	311.0	127.0	123.0	62.6	47.5	119.0	226.0	738.0	534.0	2681.6
1932	647.0	392.0	334.0	310.0	215.0	79.9	51.5	36.0	27.4	75.9	86.0	150.0	2404.7
1933	225.0	268.0	361.0	1320.0	1270.0	476.0	216.0	83.0	61.3	76.9	80.5	92.5	4530.2
1934	130.0	50.0	205.0	601.0	112.0	56.3	35.4	19.4	49.3	59.9	281.0	274.0	1873.3
1935	127.0	133.0	2003.0	692.0	451.0	231.0	81.7	82.7	54.2	74.6	121.0	124.0	4175.2
1936	81.5	75.8	1172.0	413.0	242.0	77.1	25.0	37.3	141.0	170.0	145.0	138.0	2717.7
1937	397.0	1302.0	626.0	925.0	573.0	416.0	79.6	31.7	54.4	76.6	77.7	64.2	4623.2
1938	135.0	2200.0	1385.0	361.0	152.0	112.0	499.0	187.0	2304.0	317.0	403.0	250.0	8305.0
1939	481.0	461.0	944.0	781.0	248.0	237.0	57.6	60.6	47.9	86.2	91.4	75.2	3570.9
1940	46.2	60.7	181.0	732.0	383.0	1200.0	174.0	212.0	151.0	108.0	161.0	337.0	3745.9
1941	307.0	181.0	604.0	792.0	222.0	83.5	46.2	37.1	131.0	304.0	377.0	245.0	3329.8
1942	250.0	265.0	780.0	313.0	357.0	648.0	105.0	219.0	247.0	196.0	481.0	450.0	4311.0
1943	477.0	826.0	1730.0	549.0	303.0	396.0	111.0	93.0	64.0	85.2	155.0	88.6	4877.8
1944	84.4	294.0	714.0	616.0	248.0	203.0	83.1	53.9	90.4	89.3	140.0	98.6	2714.7
1945	75.0	115.0	716.0	289.0	301.0	401.0	74.8	103.0	164.0	228.0	292.0	241.0	2999.8
1946	711.0	195.0	2076.0	286.0	156.0	132.0	89.6	38.5	47.4	52.8	104.0	70.9	3959.2
1947	145.0	115.0	678.0	938.0	592.0	453.0	97.0	51.7	83.7	114.0	197.0	177.0	3641.4
1948	115.0	328.0	1696.0	583.0	463.0	102.0	66.2	46.5	34.1	53.1	126.0	104.0	3716.9
1949	182.0	337.0	855.0	530.0	136.0	174.0	127.0	85.3	43.7	56.6	62.4	68.6	2657.6
1950	217.0	111.0	1335.0	757.0	389.0	135.0	434.0	104.0	107.2	78.7	80.3	101.0	3849.2
1951	96.8	318.0	1560.0	2183.0	579.0	209.0	181.0	146.0	133.0	672.0	824.0	359.0	7260.8
1952	659.0	455.0	2022.0	1468.0	349.0	208.0	1200.0	421.0	154.0	149.0	207.0	309.0	7601.0
1953	209.0	520.0	954.0	534.0	803.0	537.0	106.0	189.0	78.8	76.7	95.3	110.0	4212.8
1954	71.6	201.0	188.0	340.0	247.0	837.0	460.0	142.0	152.0	1040.0	284.0	258.0	4220.6
1955	338.0	262.0	732.0	1159.0	480.0	777.0	187.0	102.0	653.0	104.0	114.0	91.4	4999.4
1956	79.0	92.6	378.0	682.0	1024.0	174.0	376.0	263.0	299.0	111.0	198.0	168.0	3844.6
1957	110.0	195.0	325.0	526.0	397.0	366.0	114.0	60.2	67.8	79.3	184.0	87.6	2511.9
1958	77.5	68.4	220.0	237.0	86.4	96.6	57.9	57.4	88.1	93.8	126.0	53.5	1262.6
1959	45.8	47.4	675.0	2615.0	257.0	90.7	96.6	65.3	93.8	285.0	366.0	457.0	5094.6
1960	552.0	196.0	702.0	1708.0	1450.0	361.0	326.0	606.0	748.0	378.0	676.0	220.0	7923.0
1961	125.0	169.0	1056.0	746.0	342.0	197.0	104.0	130.0	283.0	350.0	680.0	239.0	4421.0

Source: U.S. Geological Survey

Table 28

FLOW OF CEDAR CREEK NEAR CEDARBURG, WISCONSIN BY MONTHS FOR PERIOD, 1931 TO 1961

(IN CUBIC FEET PER SECOND)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Total
1931	15.80	32.10	29.6	58.6	15.2	21.50	11.00	2.21	6.69	28.10	127.00	106.00	453.80
1932	170.00	94.10	59.1	53.4	29.8	8.87	6.65	2.87	2.48	9.37	12.20	14.60	463.44
1933	31.50	51.20	63.8	217.0	291.0	46.90	60.60	9.57	6.12	7.42	8.45	7.62	801.18
1934	11.30	5.57	28.5	67.4	15.5	3.34	2.23	1.45	3.72	5.65	23.00	42.90	210.56
1935	16.40	30.80	403.0	97.6	98.8	31.00	10.30	8.72	5.79	7.13	14.60	5.67	729.81
1936	6.90	6.71	228.0	46.3	20.8	11.20	1.40	2.46	18.00	27.90	21.20	24.50	415.37
1937	74.80	196.00	162.0	218.0	131.0	73.90	9.95	3.96	4.78	7.10	6.70	6.30	894.49
1938	25.00	234.00	191.0	69.9	33.2	45.10	91.00	21.30	446.00	58.90	76.40	32.70	1324.50
1939	42.50	43.80	191.0	150.0	36.7	32.90	7.43	6.45	4.47	11.60	13.00	11.30	551.15
1940	3.70	5.40	19.9	127.0	108.0	364.00	37.20	28.50	20.70	18.70	29.20	71.80	834.10
1941	63.50	40.70	121.0	140.0	44.7	13.10	4.74	3.52	9.99	47.30	65.00	44.00	597.55
1942	42.30	44.20	148.0	53.8	75.2	169.00	16.80	22.00	36.00	32.80	134.00	82.20	856.30
1943	127.00	189.00	310.0	91.0	45.2	63.30	16.10	13.80	7.55	8.03	20.00	11.10	902.08
1944	9.91	44.70	111.0	118.0	43.2	46.30	13.40	4.75	8.19	8.52	14.10	9.48	431.55
1945	7.10	11.00	129.0	41.6	64.1	61.30	8.66	13.20	35.10	49.30	64.60	48.90	533.86
1946	150.00	38.80	522.0	60.6	24.7	17.80	8.33	2.71	5.73	6.21	10.10	7.73	854.71
1947	14.50	12.30	116.0	179.0	127.0	83.30	14.90	7.11	14.20	11.60	47.60	27.90	655.41
1948	19.80	70.90	383.0	117.0	75.9	13.00	8.37	3.82	5.18	5.92	15.80	14.10	732.79
1949	18.30	33.60	125.0	110.0	25.6	36.10	26.70	21.60	6.25	7.20	8.01	8.33	426.69
1950	38.40	14.10	373.0	137.0	69.0	18.10	97.60	21.60	22.70	13.30	11.70	17.60	834.10
1951	17.90	52.60	299.0	366.0	91.6	28.00	27.40	17.30	23.10	191.00	206.00	62.00	1381.90
1952	134.00	89.50	459.0	286.0	50.8	36.00	298.00	64.40	27.50	24.40	33.60	45.80	1549.00
1953	40.50	113.00	140.0	111.0	180.0	186.00	17.30	14.00	9.10	9.68	11.50	19.90	851.98
1954	10.60	23.50	26.9	57.7	31.6	209.00	92.60	37.40	39.40	306.00	48.60	36.50	919.80
1955	74.40	62.40	235.0	206.0	114.0	205.00	39.00	12.50	8.41	11.90	18.40	11.50	998.51
1956	9.89	12.60	61.3	90.3	138.0	24.20	59.40	49.70	36.70	11.30	19.20	23.00	535.59
1957	21.60	38.80	53.4	99.6	57.4	67.40	18.50	6.75	6.27	7.79	15.19	13.70	406.40
1958	12.60	25.50	82.9	38.9	14.0	13.50	6.34	3.46	7.89	13.70	17.80	5.54	242.13
1959	4.95	5.32	153.0	453.0	42.9	9.63	8.15	7.60	7.93	30.20	40.50	60.30	833.48
1960	134.00	28.10	194.0	306.0	230.0	66.10	51.90	106.00	207.00	61.60	134.00	42.50	1567.20
1961	23.30	30.20	210.0	147.0	53.3	34.40	17.10	15.60	35.20	38.90	96.40	42.40	743.80

Source: U. S. Geological Survey

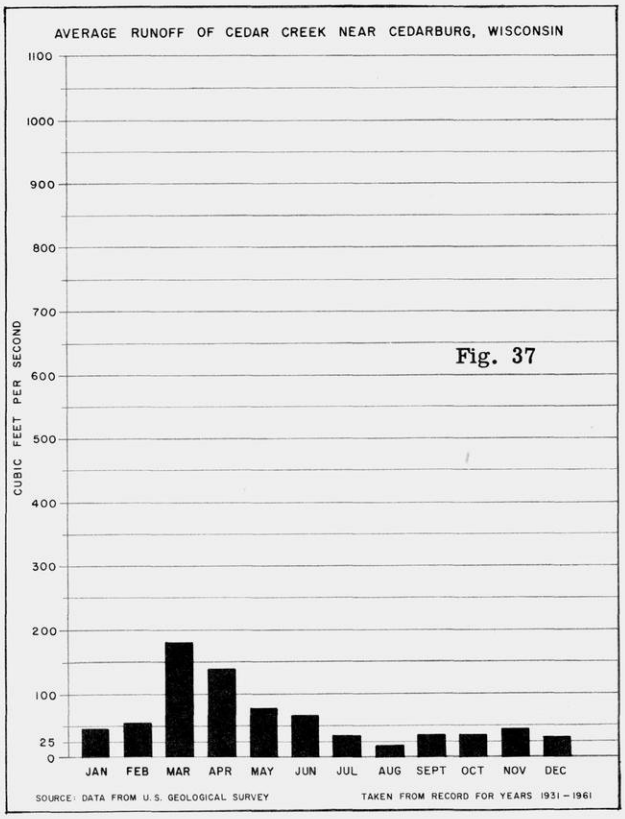


Fig. 37

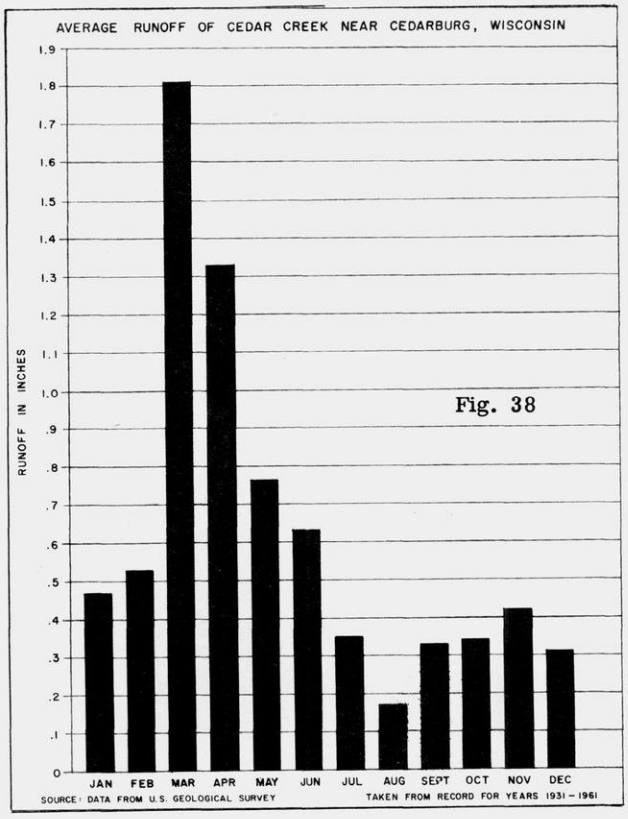


Fig. 38

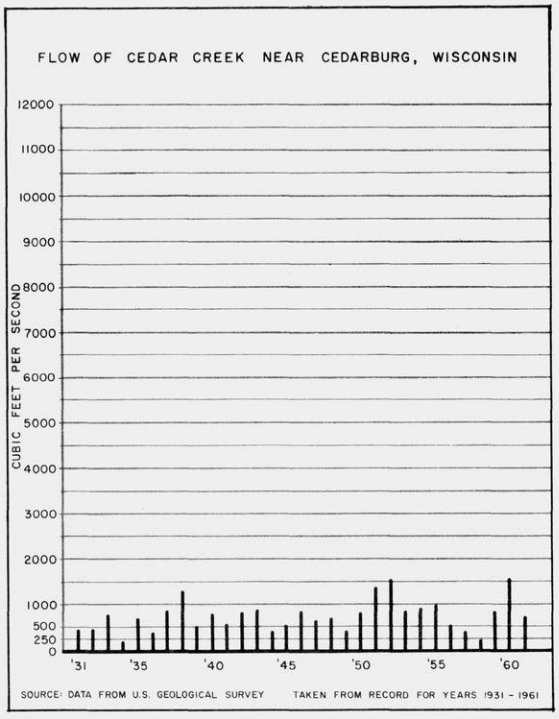


Fig. 39

Table 29

FLOW OF CEDAR CREEK NEAR CEDARBURG, WISCONSIN BY MONTHS FOR PERIOD, 1931 TO 1961

(RUNOFF IN INCHES)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Total
1931	0.16	0.30	0.30	0.58	0.16	0.21	0.11	0.02	0.07	0.29	1.25	1.09	4.54
1932	1.73	0.90	0.60	0.53	0.30	0.09	0.07	0.03	0.02	0.10	0.12	0.15	4.64
1933	0.32	0.47	0.65	2.14	2.97	0.46	0.62	0.10	0.06	0.08	0.08	0.08	8.03
1934	0.12	0.05	0.29	0.66	0.16	0.03	0.02	0.02	0.04	0.06	0.23	0.44	2.12
1935	0.17	0.28	4.12	0.96	1.01	0.31	0.10	0.09	0.06	0.07	0.14	0.06	7.37
1936	0.07	0.06	2.33	0.46	0.21	0.11	0.01	0.03	0.18	0.28	0.21	0.25	4.20
1937	0.76	1.80	1.65	2.15	1.34	0.73	0.10	0.04	0.05	0.07	0.07	0.06	8.82
1938	0.25	2.16	1.95	0.69	0.34	0.45	0.93	0.22	4.41	0.60	0.75	0.33	13.08
1939	0.43	0.40	1.95	1.48	0.37	0.32	0.08	0.07	0.04	0.12	0.13	0.12	5.51
1940	0.04	0.05	0.20	1.25	1.10	3.59	0.38	0.29	0.20	0.19	0.29	0.73	8.31
1941	0.65	0.37	1.23	1.38	0.46	0.13	0.05	0.04	0.10	0.48	0.64	0.45	5.98
1942	0.43	0.41	1.51	0.53	0.77	1.67	0.17	0.22	0.36	0.33	1.33	0.84	8.57
1943	1.29	1.74	3.16	0.90	0.46	0.62	0.16	0.14	0.07	0.08	0.20	0.11	8.93
1944	0.10	0.43	1.13	1.16	0.44	0.46	0.14	0.05	0.08	0.09	0.14	0.10	4.32
1945	0.07	0.10	1.31	0.41	0.65	0.60	0.09	0.13	0.35	0.50	0.64	0.50	5.35
1946	1.53	0.36	5.33	0.60	0.25	0.18	0.09	0.03	0.06	0.06	0.18	0.08	8.67
1947	0.15	0.11	1.10	1.76	1.29	0.82	0.15	0.07	0.14	0.12	0.47	0.28	6.55
1948	0.20	0.68	3.91	1.16	0.77	0.13	0.09	0.04	0.05	0.06	0.16	0.14	7.39
1949	0.19	0.31	1.28	1.09	0.26	0.36	0.27	0.22	0.06	0.07	0.08	0.09	4.28
1950	0.39	0.13	3.80	1.55	0.70	0.18	1.00	0.22	0.22	0.13	0.11	0.17	8.60
1951	0.17	0.45	2.85	3.37	0.87	0.26	0.26	0.16	0.21	1.82	1.90	0.59	12.91
1952	1.27	0.80	4.38	2.64	0.48	0.33	2.84	0.61	0.25	0.23	0.31	0.44	14.58
1953	0.39	0.97	1.34	1.02	1.72	1.72	0.16	0.13	0.08	0.09	0.11	0.19	7.92
1954	0.10	0.20	0.26	0.53	0.30	1.92	0.88	0.36	0.36	2.92	0.45	0.35	8.63
1955	0.71	0.54	2.24	1.90	1.09	1.89	0.37	0.12	0.08	0.11	0.17	0.11	9.33
1956	0.09	0.11	0.58	0.83	1.31	0.22	0.57	0.47	0.34	0.11	0.18	0.22	5.03
1957	0.21	0.33	0.51	0.92	0.55	0.62	0.18	0.06	0.06	0.07	0.15	0.13	3.79
1958	0.12	0.22	0.79	0.36	0.13	0.12	0.06	0.03	0.07	0.13	0.16	0.05	2.24
1959	0.05	0.05	1.45	4.18	0.41	0.09	0.08	0.07	0.07	0.29	0.37	0.57	7.68
1960	1.27	0.25	1.85	2.82	2.19	0.61	0.55	1.01	1.91	0.59	1.24	0.41	14.70
1961	1.22	1.26	2.00	1.36	0.51	0.32	0.16	0.15	0.32	0.37	0.89	0.40	8.96

Source: U. S. Geological Survey

Table 30

MONTHLY AVERAGE RUNOFF OF THE FOX RIVER AT WILMOT, WISCONSIN

FOR 22 YEAR PERIOD, 1940 TO 1961

Months	In Cubic Second Feet	In Inches
January	397.10	0.52
February	400.50	0.48
March	1088.40	1.43
April	863.50	1.10
May	567.20	0.74
June	454.50	0.58
July	295.50	0.39
August	253.00	0.33
September	213.80	0.27
October	310.50	0.40
November	401.70	0.51
December	303.70	0.44
Average Total	5549.40	7.18

Source: Data from U.S. Geological Survey

Table 31

MONTHLY AVERAGE RUNOFF OF THE MILWAUKEE RIVER AT MILWAUKEE, WISCONSIN

FOR 47 YEAR PERIOD 1915 TO 1961

Months	In Cubic Second Feet	In Inches
January	235.60	0.41
February	387.80	0.61
March	1071.80	1.86
April	863.40	1.44
May	458.80	0.79
June	337.80	0.56
July	172.70	0.30
August	180.80	0.31
September	202.30	0.32
October	204.70	0.36
November	294.50	0.49
December	244.40	0.42
Average Total	4659.70	7.88

Source: Data from U.S. Geological Survey

Table 32

MONTHLY AVERAGE RUNOFF OF CEDAR CREEK NEAR CEDARBURG, WISCONSIN

FOR 31 YEAR PERIOD 1931 TO 1961

Months	In Cubic Second Feet	In Inches
January	44.27	0.47
February	54.21	0.53
March	181.60	1.81
April	139.20	1.33
May	76.70	0.76
June	65.78	0.63
July	35.32	0.35
August	17.30	0.17
September	34.77	0.33
October	34.79	0.34
November	44.00	0.42
December	30.90	0.31
Average Total	758.84	7.45

Source: Data from U.S. Geological Survey

Chapter X
GROUND WATER

Ground water in the Region is derived from two main water bearing rock systems or aquifers. The shallower of the two aquifers consists of Niagara dolomite (limestone) strata and overlying glacial deposits of Pleistocene age. This shallow aquifer is separated from what is termed the deep aquifer (or sandstone aquifer) by a layer of impervious rock called the Maquoketa shale. Beneath this shale formation are several permeable rock layers, which include the Cambrian and Ordovician sandstones, from which most of the deep wells in the Region derive their supply of ground water. Water pumpage from the deep or sandstone aquifer is generally limited to large capacity industrial or municipal water users. These deep and, therefore, relatively expensive wells tap this source of supply because the sandstone aquifer has the advantages of providing large volumes of water with a stable temperature range and, thus, is well suited for some industrial processing and cooling, as well as providing a high quality source of water for domestic use. The water level of the deep aquifer is marked by a definite cone of depression centered on the Milwaukee metropolitan area and extending into eastern Waukesha County (see Map 33). This decline in the water level is the result of (1) concentrated withdrawal of water by municipal and industrial users in an area more than 25 miles from the recharge area, and (2) the fairly low transmissibility or rate of water movement in the aquifer from the area of recharge in Jefferson and Dodge Counties to the center of withdrawal in central Milwaukee County (see Tables 33, 34, and Map 37).

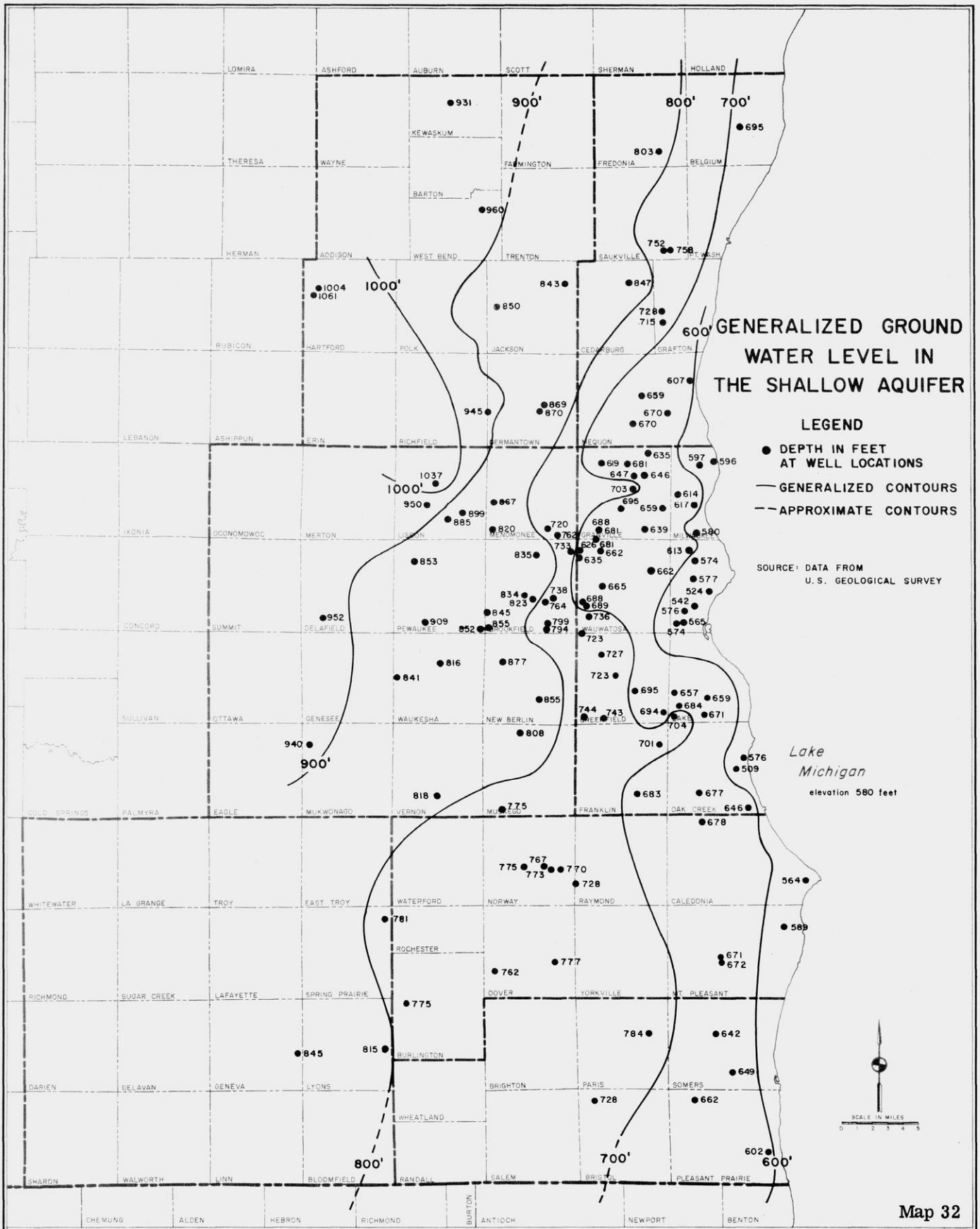
The water level in the shallow aquifer, tapping the Niagara dolomite bedrock and its glacial overburden, does not show any sign of overpumpage; but this condition is somewhat diffi-

Table 33

GROUND WATER CONSUMPTION FOR SELECTED INDUSTRIES IN SOUTHEASTERN WISCONSIN

Company	Annual Pumpage (In Millions of Gallons) 1961	1962
Albert Trostel and Sons Co. Milwaukee 1, Wisconsin	284.5	263.5
Allis-Chalmers Mfg. Co. Milwaukee, Wisconsin	167.4	176.1
Broson Manor Milwaukee, Wisconsin	27.8	25.0
Frank Pure Food Company Franksville, Wisconsin	14.7	13.3
Harley Davidson Motor Co. - Well #1 Milwaukee, Wisconsin - Well #2	56.6 35.8	16.7 17.6
Miller Brewing Company Milwaukee, Wisconsin	433.4	422.8

Source: Ground Water Branch, U. S. Geological Survey



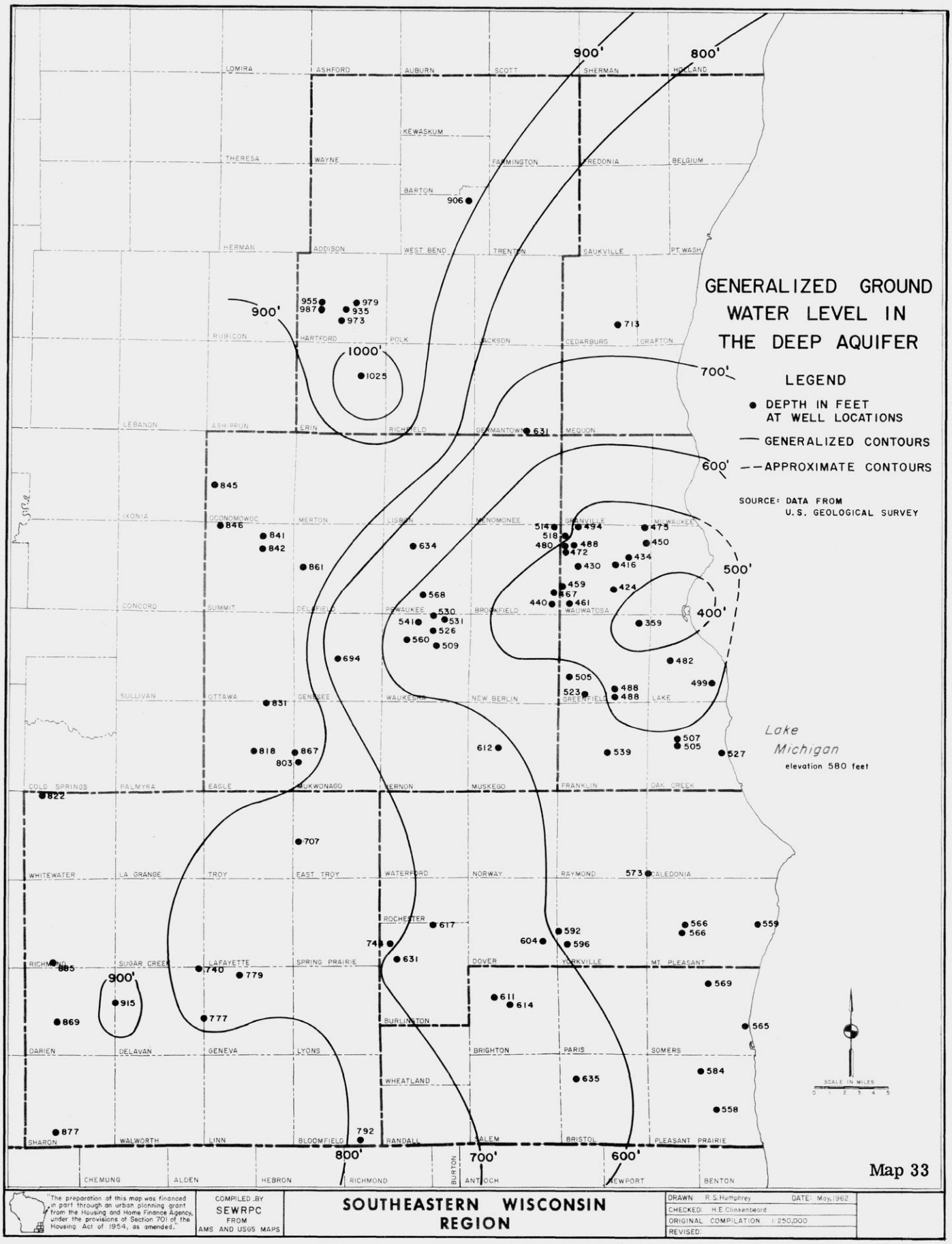
Map 32

"The preparation of this map was financed in part through an urban planning grant from the Housing and Home Finance Agency, under the provisions of Section 701 of the Housing Act of 1954, as amended."

COMPILED BY SEWRPC FROM AMS AND USGS MAPS

SOUTHEASTERN WISCONSIN REGION

DRAWN: R.S.Humphrey DATE: May, 1962
CHECKED: H.E.Clinkenbeard
ORIGINAL COMPILATION: 1:250,000
REVISED:



"The preparation of this map was financed in part through an urban planning grant from the Housing and Home Finance Agency, under the provisions of Section 701 of the Housing Act of 1954, as amended."

COMPILED BY SEWRPC FROM AMS AND USGS MAPS

SOUTHEASTERN WISCONSIN REGION

DRAWN: R.S.Humphrey DATE: May, 1962
CHECKED: H.E.Clinkenbeard
ORIGINAL COMPILATION: 1:250,000
REVISED:

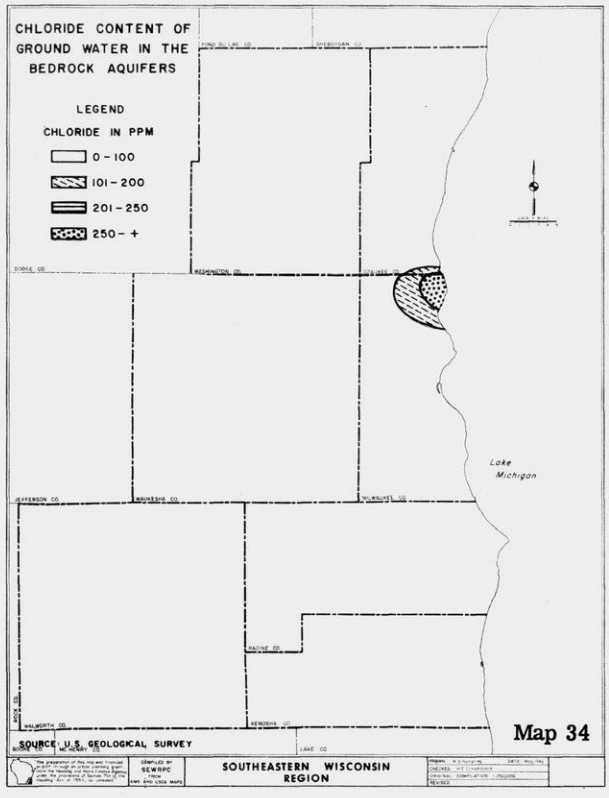
cult to ascertain because of inadequate records presently available (see Map 32). Most private domestic and farm wells in the Region tap this source of ground water (see Table 35). The present trend is for continuing development of the shallow aquifer as a source of water supply especially for many smaller business establishments in the urban-rural fringe area and for scattered subdivision developments depending on private "community" water supply systems.

Several indices of the quality of ground water in southeastern Wisconsin are as shown on the enclosed maps (Maps 34, 35, 36). The parts per million of sulphate, chloride and dissolved solids content were derived from samples taken from selected wells tapping all water bearing formations except the Pleistocene deposits. Information presented here shows extreme conditions in each locality.

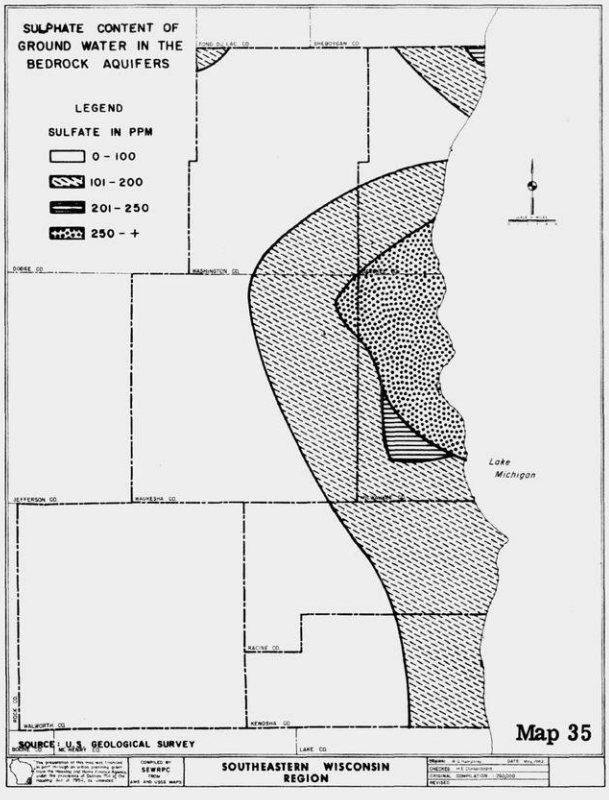
Concentration of sulphates in the ground water supply, especially calcium and magnesium sulphates, tends to cause permanent hardness as boiling does not precipitate these sulphates. In industrial processes hard water with sulphate content is desirable in tanning heavy hides while, on the other hand, a heavy concentration of sulphates tends to interfere with crystallization in sugar making. High calcium sulphate is also objectionable in various types of vegetable canning operations.

Concentrations of chloride in the water are generally accompanied by high sodium and potassium content. Appreciable amounts of chlorides are harmful in many industrial processes. A high content of chlorides in shallow water wells is in some cases a fair index of the amount of pollution present in this source of supply. Chloride concentration can also affect the quality of sugar, the growth of yeast, and the germination of grain in the brewing industry.

A high concentration of dissolved solids in the water supply is a general indication of the hardness content of the water. Hard water is a disadvantage in most industrial processing since it tends to form boiler scale unless treated by softening devices. This condition can lead to extensive machinery maintenance and replacement. Extremely hard water increases the amount of soap needed for domestic washing and all types of laundry processes.



Map 34



Map 35

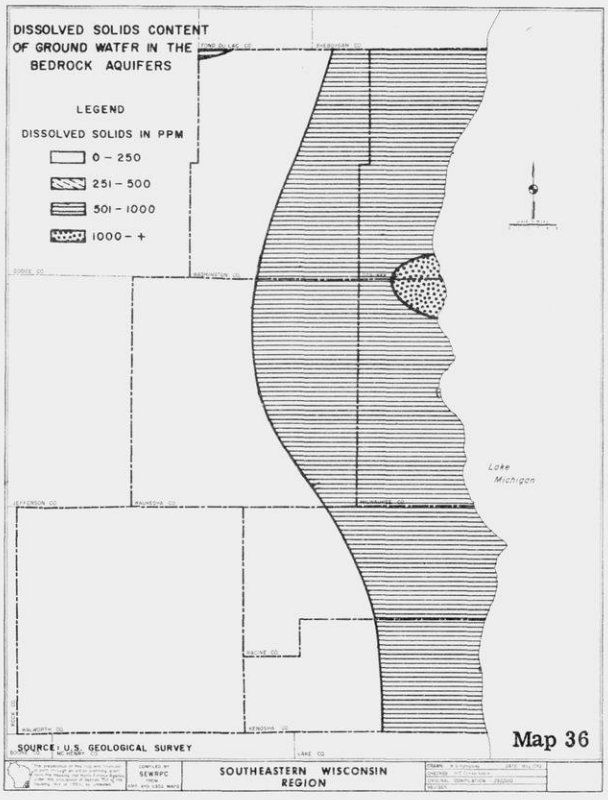

DISSOLVED SOLIDS CONTENT
OF GROUND WATER IN THE
BEDROCK AQUIFERS
LEGEND
DISSOLVED SOLIDS IN PPM
0 – 250
251 – 500
501 – 1000
1000 – +
Lake
Michigan
SOURCE: U.S. GEOLOGICAL SURVEY
SOUTHEASTERN WISCONSIN
REGION
Map 36

Table 34

PUMPAGE FROM GROUND WATER AQUIFER BY SELECTED MUNICIPALITIES

Municipalities	Population 1960	Annual Pumpage 1960 (In Thousands of Gallons)
Kenosha County[1]		
Milwaukee County		
Brown Deer	11,280	145,669
Greendale	6,843	169,560
Oak Creek	9,372	147,282[2]
Wauwatosa	56,923	1,222,507
Ozaukee County		
Cedarburg	5,191	290,007
Fredonia	710	21,053
Grafton	3,748	193,845
Saukville	1,038	39,913
Racine County		
Burlington	5,856	254,709
Caddy Vista		25,100
North Cape		3,000[2]
Racine	89,144	4,218,120
Sturtevant	1,488	34,796
Union Grove	1,970	74,884
Waterford	1,500	43,691
Walworth County		
Delavan	4,846	177,488
East Troy	1,455	64,873
Elkhorn	3,586	118.360
Fontana	1,326	32,695
Genoa City	1,005	18,950
Lake Geneva	4,929	200,020
Sharon	1,167	11,227
Walworth	1,494	58,241
Whitewater	6,380	233,395
Williams Bay	1,347	88,644
Washington County		
Hartford	5,627	271,842
Kewaskum	1,572	161,624
Slinger	1,141	47,612
West Bend	9,969	541,436
Waukesha County		
Brookfield	19,812	30,000
Eagle	620	9,439
Menomonee Falls	18,276	227,802
Mukwonago	1,877	60,000[2]
Oconomowoc	6,682	241,971
Pewaukee	2,484	87,820
Waukesha	30,004	1,461,090

[1] No municipal utilities pumping from ground water aquifer.
[2] Incomplete or estimated pumpage.

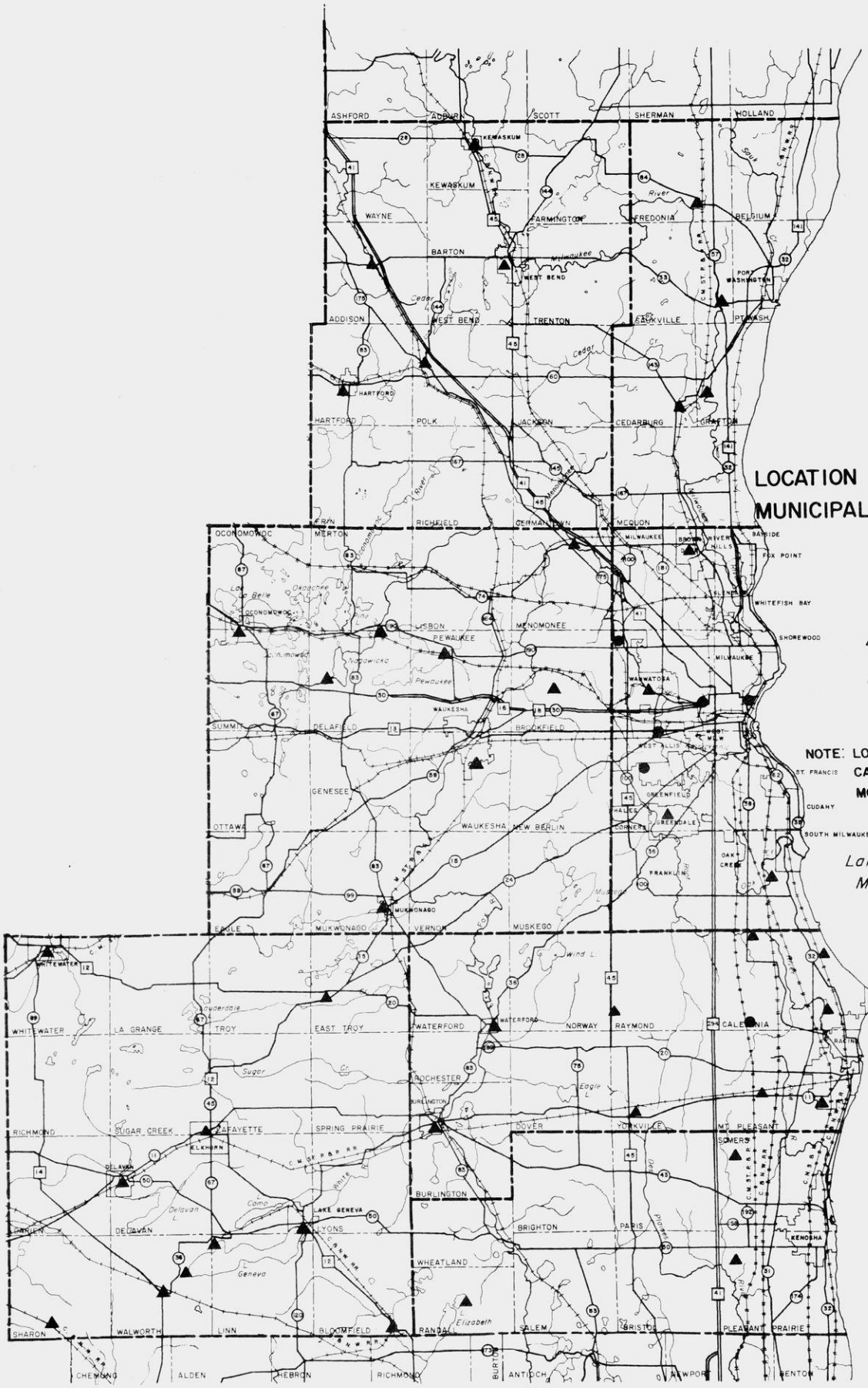
Source: Ground Water Branch, U.S.G.S. and Public Service Commission of Wisconsin

Table 35

HIGH CAPACITY WELLS USED FOR IRRIGATION PURPOSES IN SOUTHEASTERN WISCONSIN

Owner	Location	Pumpage[1] (Gallons Per Day)	Pump Size (Gallons Per Minute)
Kenosha County			
George E. Vincent and Son (Genoa City)	SE 1/4, NW 1/4, S30, TIN, R19E	100,000	250
Milwaukee County			
Robert A. Uihlein Jr.	7003 W. Good Hope Road	92,000	125
Gene Tehan	5007 S. Howell Avenue	72,000	150
Milwaukee Co. Park Comm. (Northwest Golf Course)	SW 1/4, S7, T8N, R21E	200,000	500
Tuckaway Country Club	S25, T6N, R21E	160,000	300
Ozaukee County			
Fromm Orchards	SW 1/4, S2, T9N, R21E	300,000	300
Harold Hahm	SE 1/4, S34, T9N, R21E	171,000	200
Racine County			
H. A. Horner and Sons	NW 1/4, S22, T4N, R20E	1,440,000	500 #1 500 #2
William Burmeister and Son	NE 1/4, S22, T4N, R20E	1,200,000	1000
Willaim Burmeister and Son	SW 1/4, S14, T4N, R20E	750,000	1000
Wind Lake Produce (Frank and Joseph Deak)	NE 1/4, S23, T4N, R20E	1,200,000	1000 #1 850 #2
Edward Walter	SE 1/4, S24, T4N, R20E	500,000	600
Meadowbrook Country Club	SW 1/4, S6, T3N, R23E	100,000	140
Walworth County			
Turtle Valley Farms (J.D. and E.B. Swan)	NE 1/4, S19, T3N, R16E	288,000	1000
Bert Johnson	NE 1/4, S29, T4N, R15E	240,000	500 flowing well
Washington County			
No irrigation high capacity wells			
Waukesha County			
Oconomowoc Golf Club	NE 1/4, S34, T8N, R17E	77,600	250
Mound Zion Cemetery	SE 1/4, S14, T7N, R20E	14,400	80
North Hills Country Club	SW 1/4, S13, T8N, R20E	200,000	200 #1 250 #2
Westmoor Country Club	NE 1/4, S35, T7N, R20E	200,000	

[1] Pumpage which has been approved by the Public Service Commission of Wisconsin for days when irrigation is necessary.



LOCATION OF HIGH CAPACITY MUNICIPAL AND INDUSTRIAL WELLS

LEGEND

▲ MUNICIPAL

● INDUSTRIAL

NOTE: LOCATION SYMBOLS IN MANY CASES STAND FOR ONE OR MORE WELLS IN SAME AREA.

Map 37

Chapter XI
FLOODING

Flooding is a recurring problem along many of the streams in the Region. Flooding can be defined as the overbank flow of water from a stream channel onto its natural flood plain at periodic or seasonal intervals. In this section of the state flooding generally occurs during the period of the "January thaw" in the months of January or the early part of February or at the time of the "spring thaw" which occurs in the months of March and April. Summer thunder storms, while producing short term storm water drainage difficulties, seldom are of the intensity or duration in this part of the country to produce large scale inundation. Flash floods, a product of heavy thunderstorm precipitation and quick runoff, are unknown in this section of Wisconsin because of the heavy vegetation cover and large areas of wetland and swamp which serve as storage and retention basins for storm waters.

Continued urbanization of the Region has had some effect on flood flows and will have an increasing effect upon the peak discharge of many streams during high water conditions.

The flooding phenomenon itself is not detrimental to man and his activities provided man takes into consideration the stream's rights to its natural flood plains at periodic intervals. On the other hand, periodic flooding can actually be of advantage to man when land uses are properly adjusted to the flood plain as in the case of bottom land areas devoted to agriculture, where flooding deposits fertile silt loam on the fields. Occupance of the natural flood plain of a stream by man with residences, commercial establishments, industries and related structures is the main cause of loss of life and property damage, since the streams themselves periodically need to reclaim their flood plains in order to store and move excessive water caused by heavy precipitation or thaw conditions.

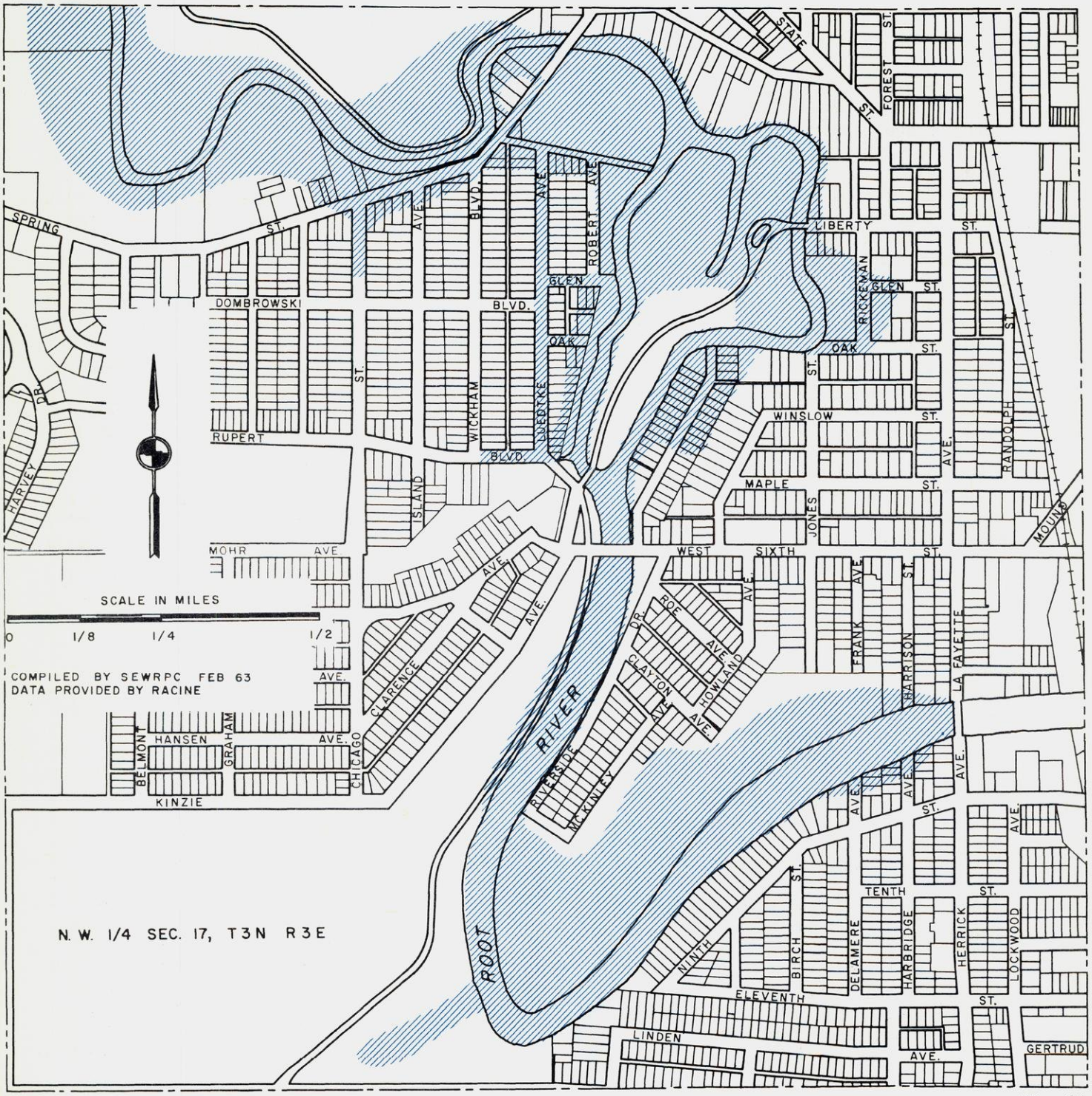
At the present time there is only scattered information on the amount or extent of flood damages within the Region or the type of land use affected most. In the Fox River (Illinois) basin flood damage surveys made on the main stream by the U.S. Corps of Engineers, Chicago District, indicated property damage from high water estimated at $846,000 for the spring flood of 1960, of which $357,240 occurred in the Region, and $154,600 for the spring flood of 1962, of which $43,100 occurred in the Region (see Map 39). Inundation of several state and county trunk highway bridge crossings and adjacent stream bank agricultural lands is an annual affair on various sections of the Fox and Milwaukee Rivers.

Areas adjacent to the Root River have also been subject to periodic flooding. Seasonal damages from high waters are expected to increase as urban development in the headwater area of the stream lying within the Cities of West Allis, Greenfield, Franklin, Oak Creek, and the Villages of Hales Corners and Greendale continues (see Maps 40, 41).

In the spring of 1960, sections of the City of Racine experienced flooding resulting in the inundation of the first floor of several blocks of homes and in basement flooding due to storm sewer backup of an additional 12 blocks of residential development (see Map 38). This flood situation and its recurring threat has generated sufficient citizen interest, so that recently the Commission organized the Root River Watershed Committee as an advisory body to help develop a study project for the stream. This Root River watershed program, outlined in a Commission publication entitled "Root River Watershed Planning Program Prospectus," is presently pending approval by the respective counties.

Two other flood control reports, affecting parts of the Region, are presently in the process of completion by the U.S. Corps of Engineers, Chicago District. The flood control survey for the Fox River (Illinois) watershed was authorized by resolution of the U.S. Congress on July 6, 1949. This survey will investigate the needs for additional flood protection, prevention of ice gouging, abatement of stream pollution, and low flow controls for the entire main stem of the Fox River. The report is scheduled

EXTENT OF FLOODING WITHIN CITY OF RACINE - SPRING 1960



Map 38

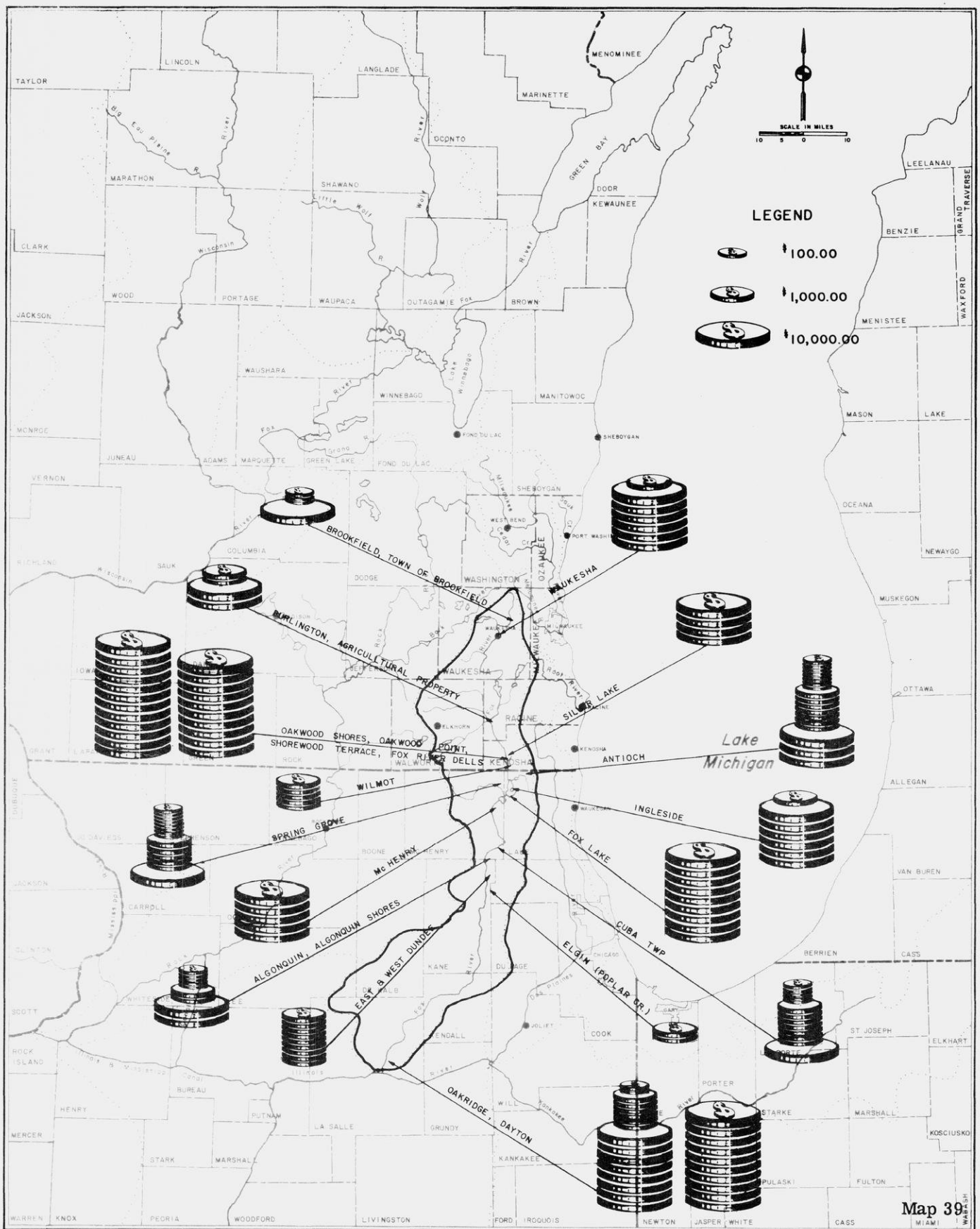
for completion by June 30, 1964. A flood control survey for the Milwaukee River and its tributaries was authorized by the Flood Control Act of 1950, Section 205. This project was initiated about two years ago, and a report is also expected by June 30, 1964. It will investigate additional means for flood protection, abatement of stream pollution, conservation needs, and low flow control in this river basin.

In December, 1962, the SEWRPC requested the Corps of Engineers to extend their currently approved flood plain information study of the Illinois section of the Des Plaines River into the Wisconsin headwaters area of the river which is within the Region. This request was approved in April, 1963, and will be completed in approximately one year. This flood plain information will delimit the extent of historic flood plain inundation on the Des Plaines River and forecast future flood heights and characteristics. This hydrologic information can then be used by local governmental units to regulate urban uses in the flood plain and protect future urban development in these areas.

Additional studies on other streams in the Region are needed to determine flood flow characteristics and to provide information on low flows. Little data is available presently upon which accurate studies could be based, nor is sufficient information available on the extent, amount, and use of land presently subject to flooding within the Region.

FLOOD INUNDATION MAPS OF TOWNSHIPS

Included in this report are 47 maps showing areas of historic flood inundation in townships in the Counties of Kenosha, Ozaukee, Racine, Walworth, and Washington (see Maps 42 through 88). The data on which these maps are based was gathered under a program conducted by the State Highway Commission of Wisconsin in liaison with the county highway commissioners of the respective counties and the respective chairmen of the town boards. Areas mapped show where, in the experience and memory of local residents, inundation had taken place adjacent to the state trunk highways, county trunk highways, and town roads in their areas. Areas shown are generalized and should not be used to determine boundaries for flood plain zoning regulations or other types of planning or governmental control without further detailed hydrologic investigations. These investigations should examine all the characteristics of flooding, including the limits of flood plain inundation, volumes and velocity of flood waters, and duration and frequency of flooding. The township flood mapping program was organized under the auspices of the Natural Resource Committee of State Agencies, which was interested in an appraisal of flooding conditions statewide in Wisconsin in order to better evaluate the need for new legislation in the flood plain regulation field. These maps are presented as a service to the governmental officials and private citizens of the Region in hope that they will help to stimulate further thinking on the need for flood protection and prevention.



Map 39

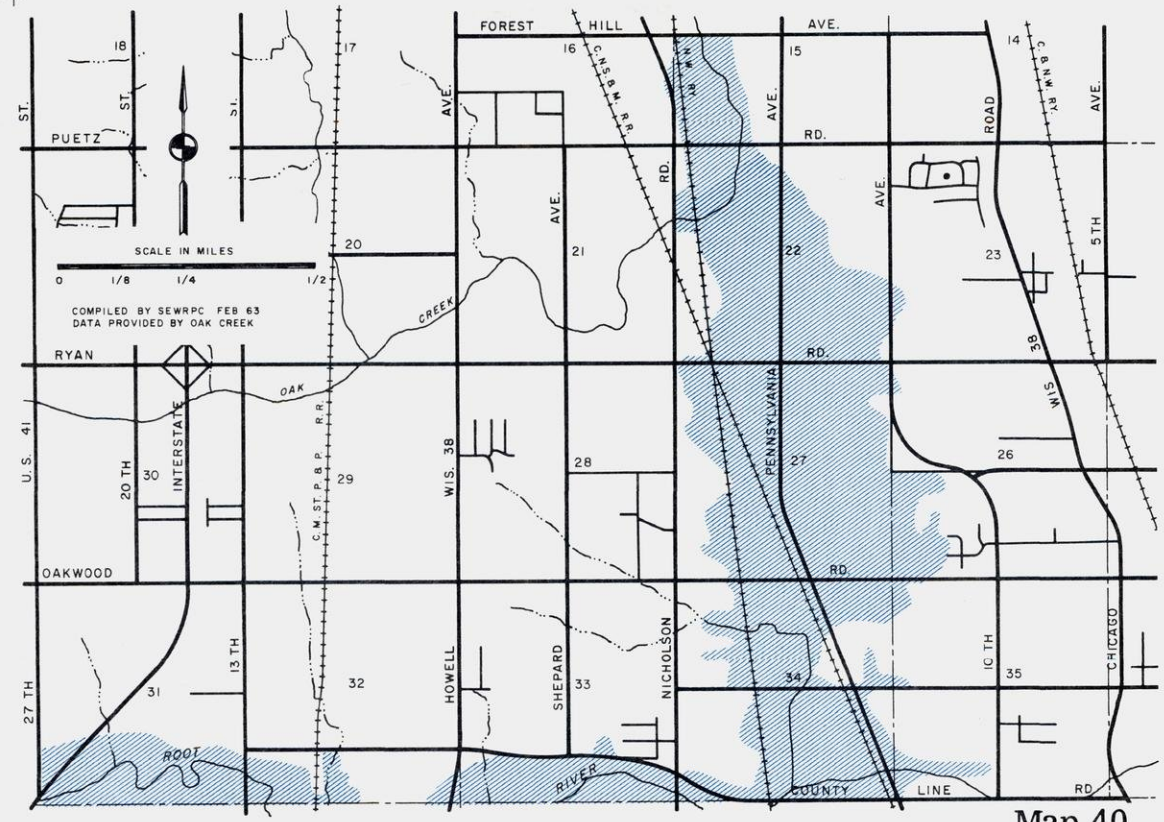
The preparation of this map was financed in part through an urban planning grant from the Housing and Home Finance Agency, under the provisions of Section 701 of the Housing Act of 1954, as amended.

COMPILED BY SEWRPC

DAMAGES, 1960 FLOOD FOX RIVER

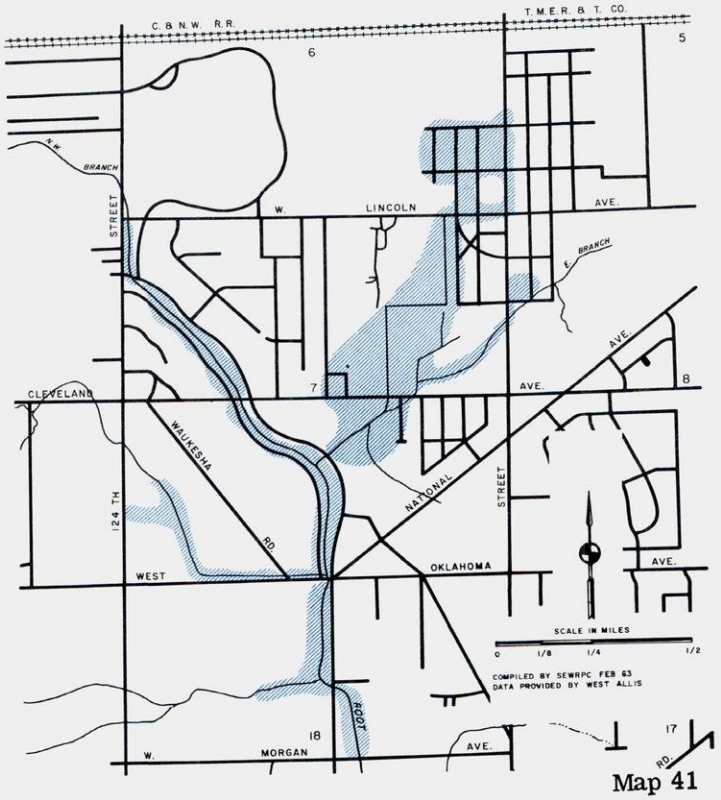
DRAWN: L. H. Zocher DATE: May 1963
CHECKED:
ORIGINAL COMPILATION: 1:1,000,000
REVISED:

APPROXIMATE EXTENT OF PERIODIC FLOODING
WITHIN CITY OF OAK CREEK & ROOT RIVER BASIN



Map 40

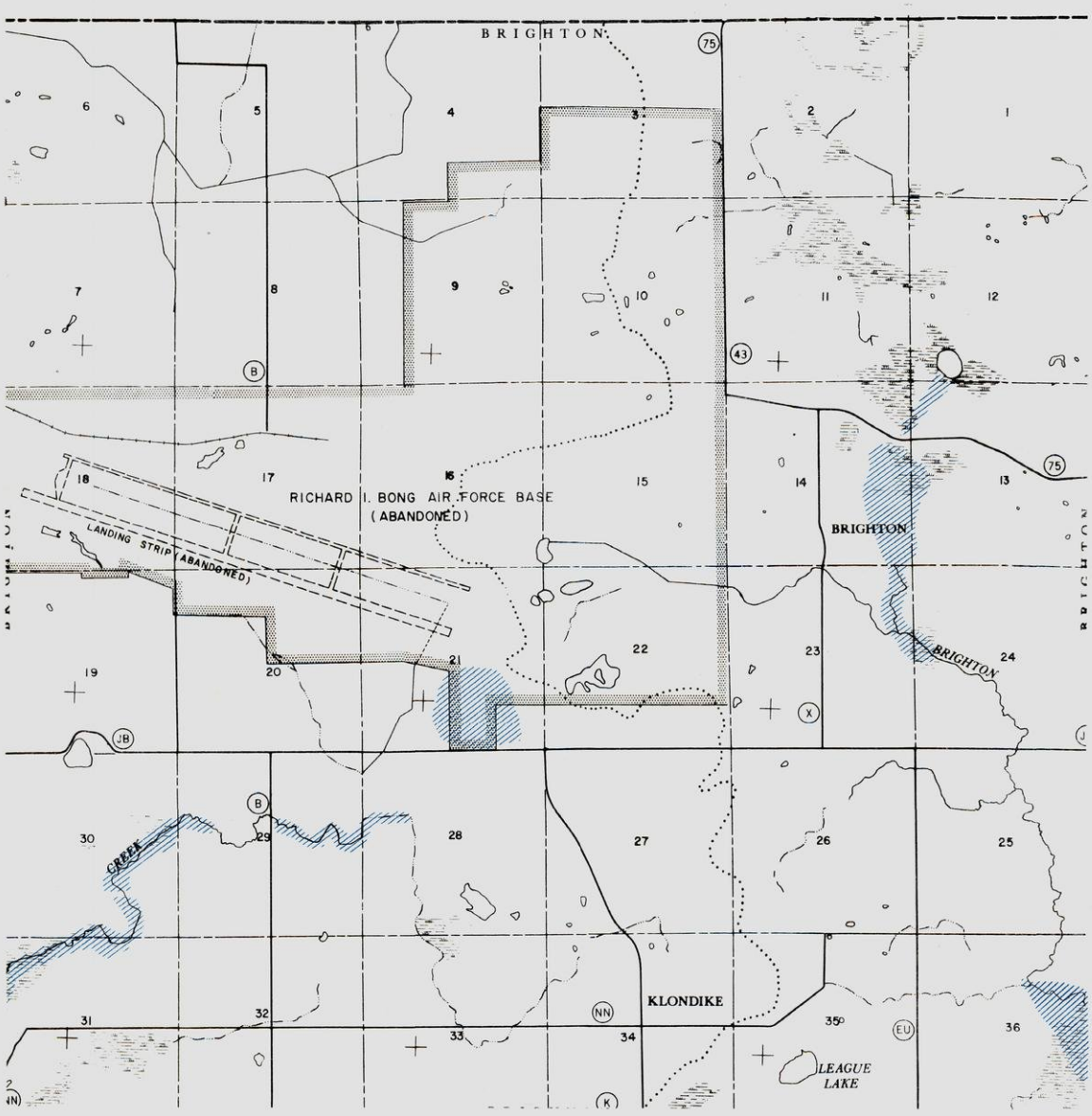
APPROXIMATE EXTENT OF PERIODIC FLOODING
WITHIN CITY OF WEST ALLIS & ROOT RIVER BASIN



Map 41

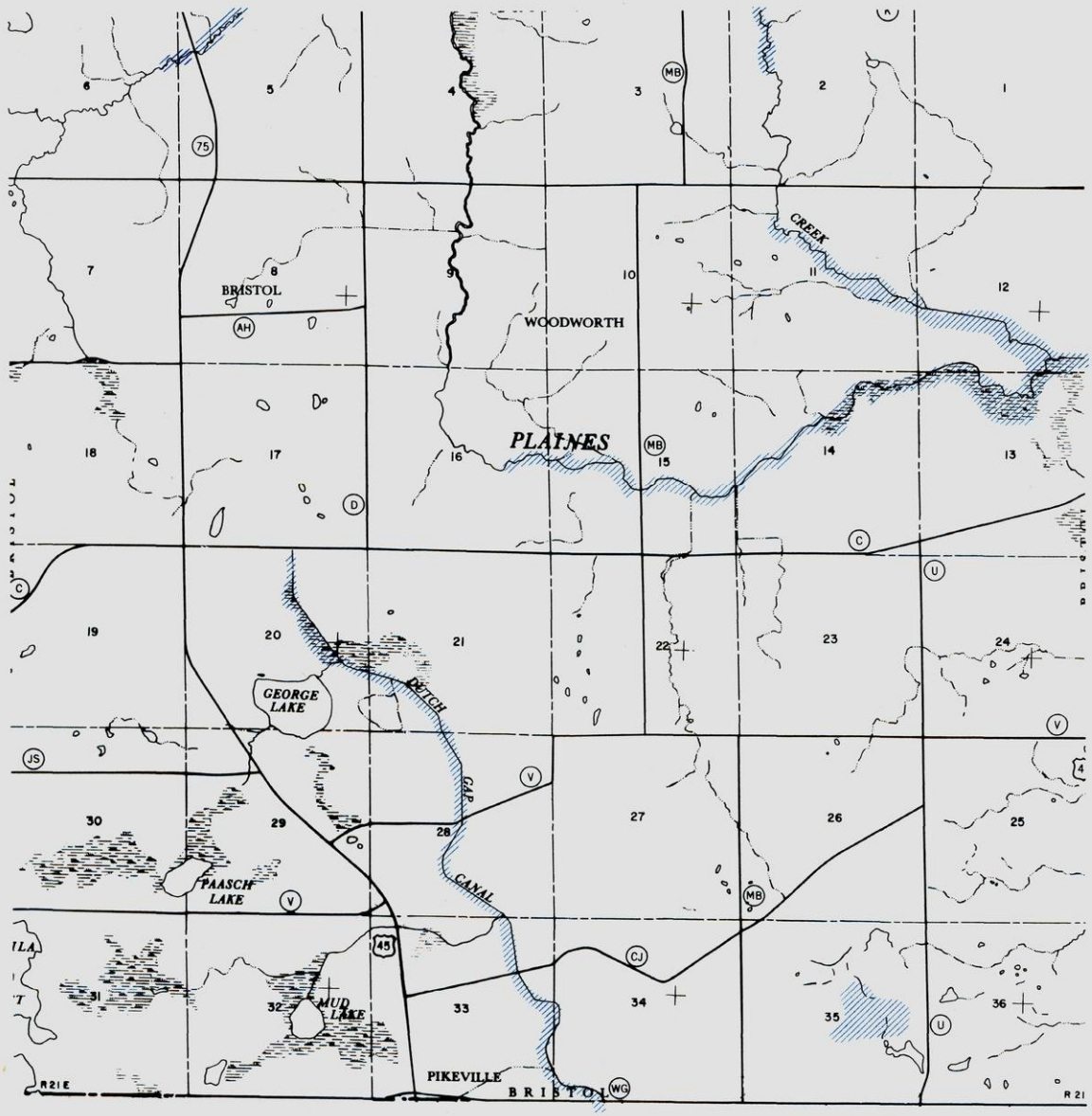
Map 42

FLOOD INUNDATION TOWN OF BRIGHTON



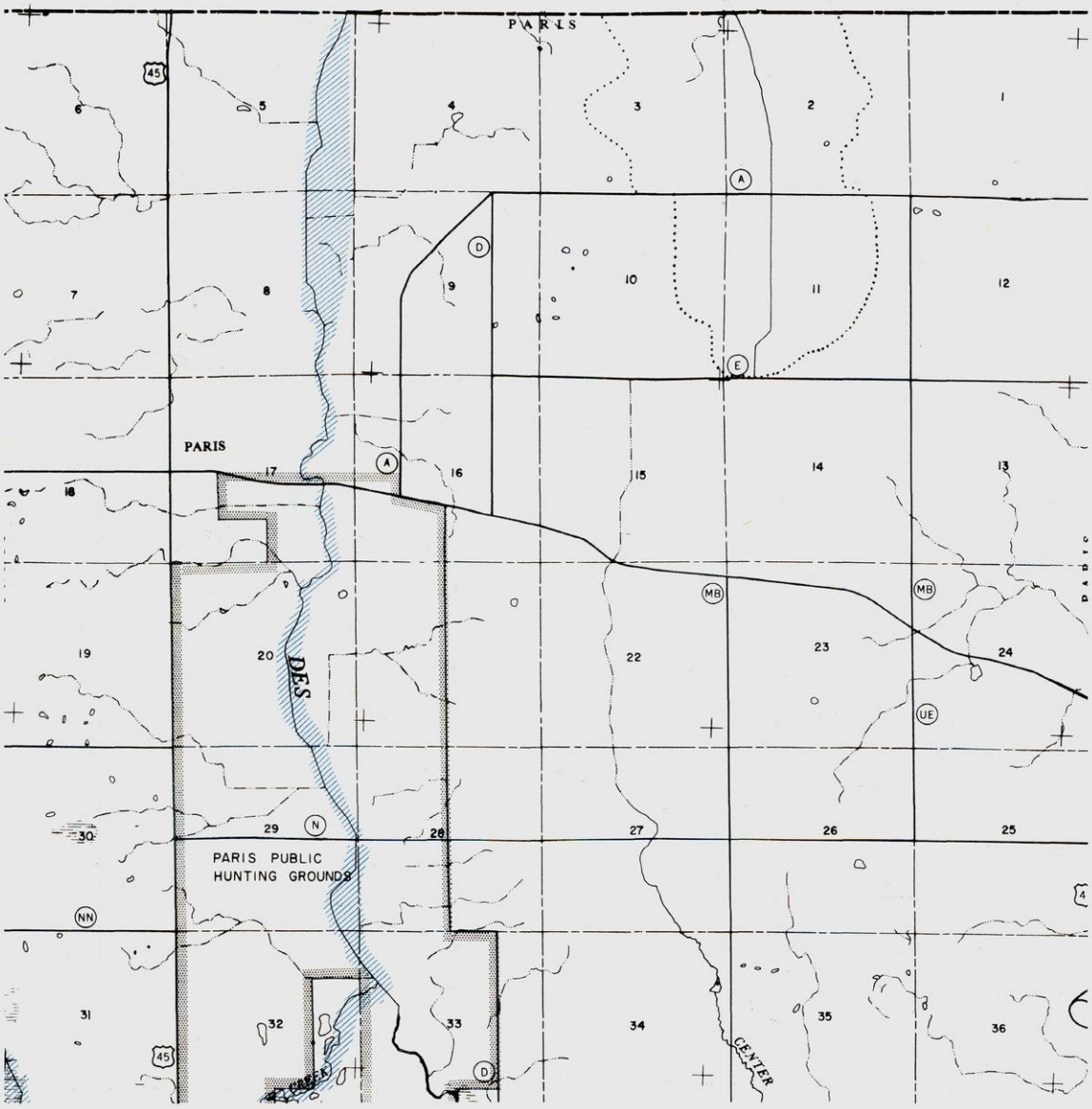
Map 43

FLOOD INUNDATION TOWN OF BRISTOL



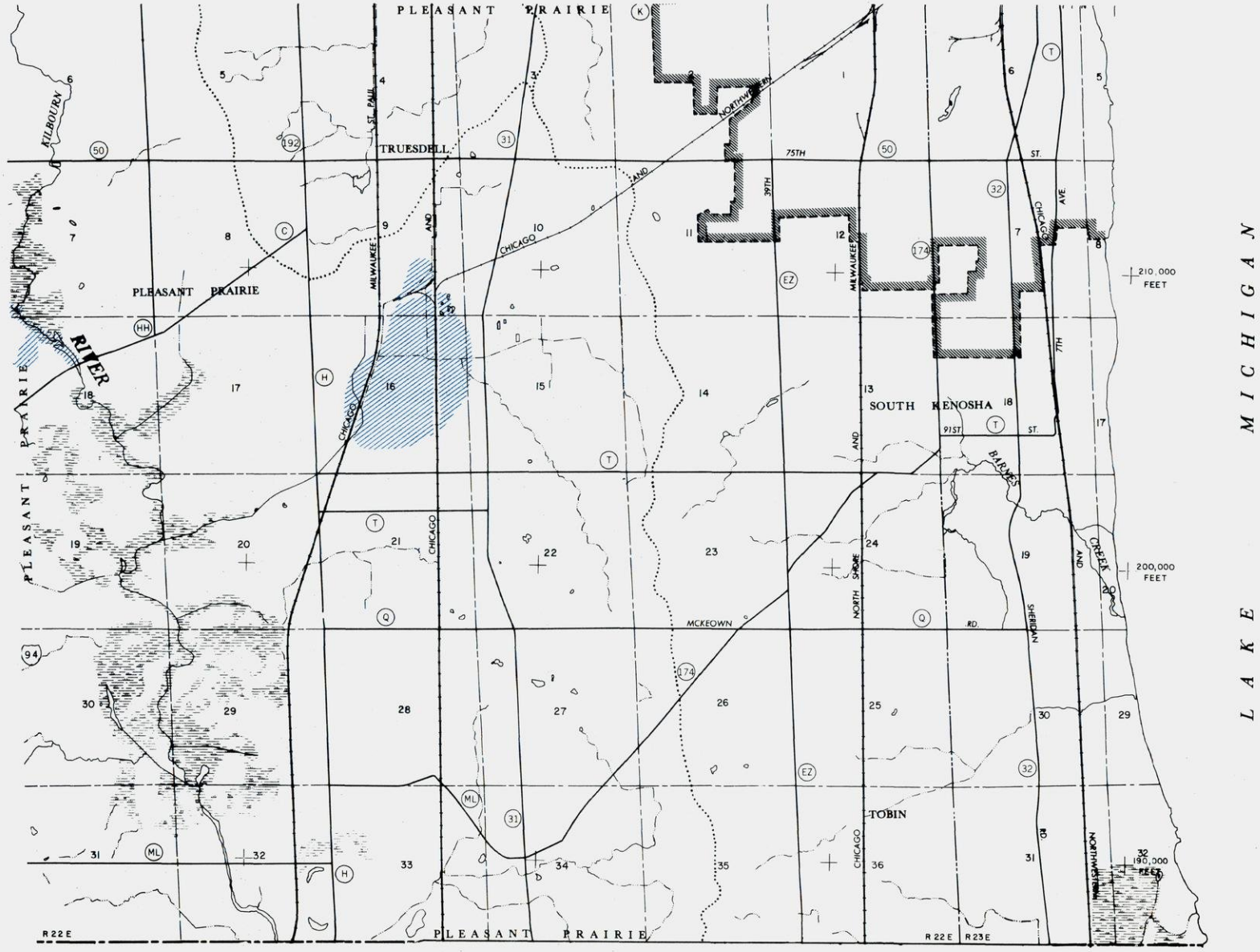
Map 44

FLOOD INUNDATION TOWN OF PARIS



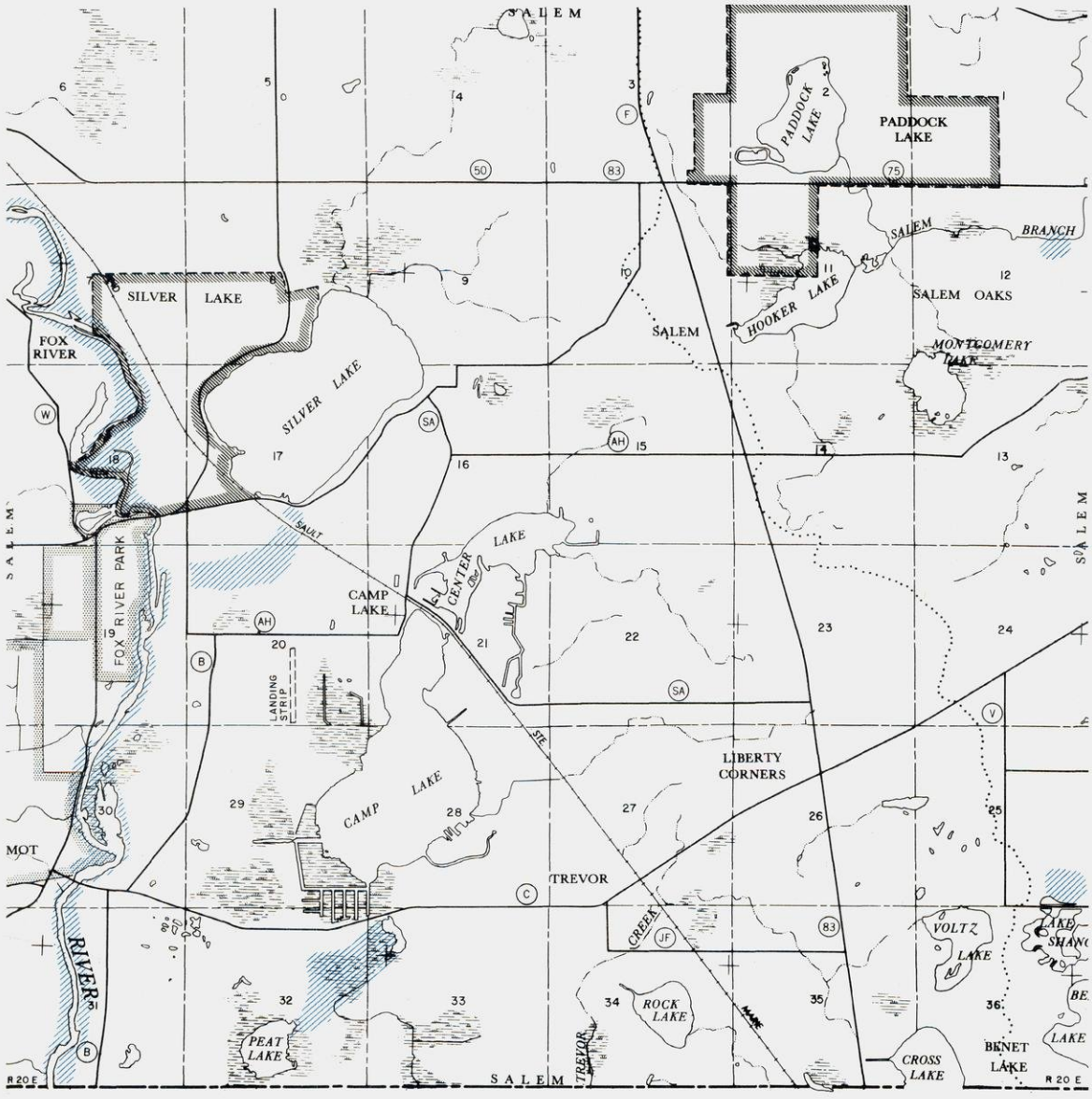
Map 45

FLOOD INUNDATION TOWN OF PLEASANT PRAIRIE



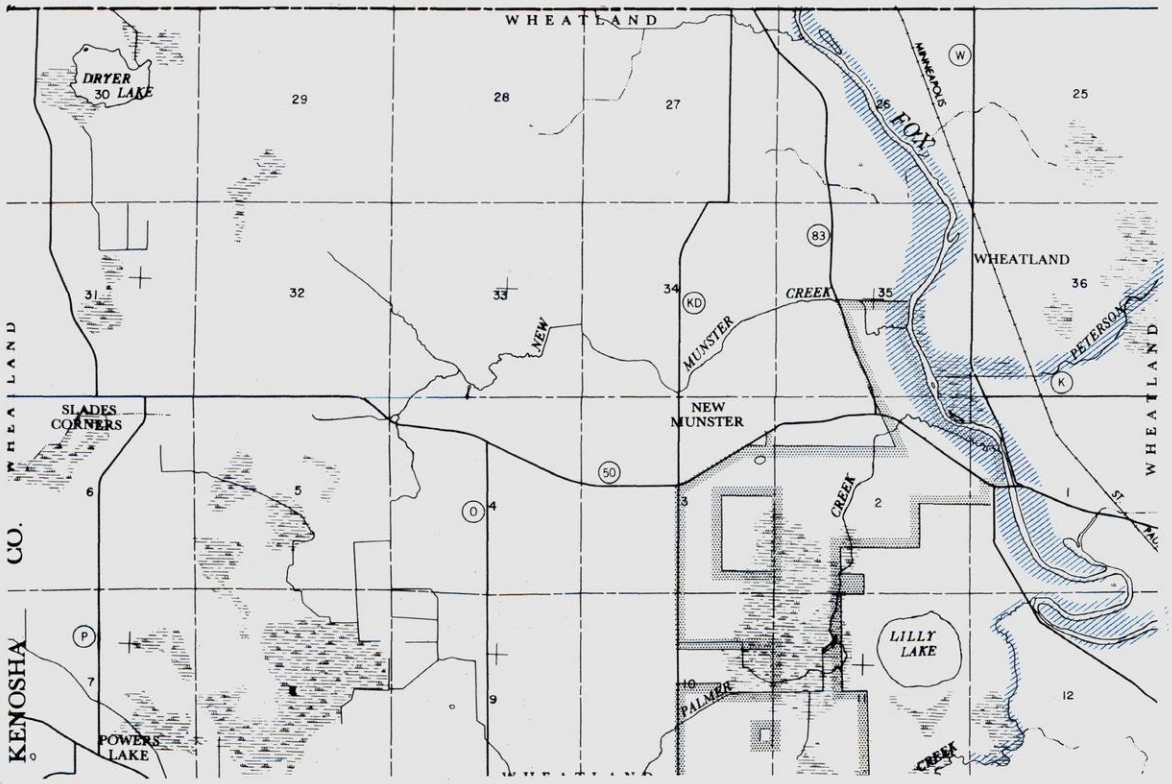
Map 46

FLOOD INUNDATION TOWN OF SALEM



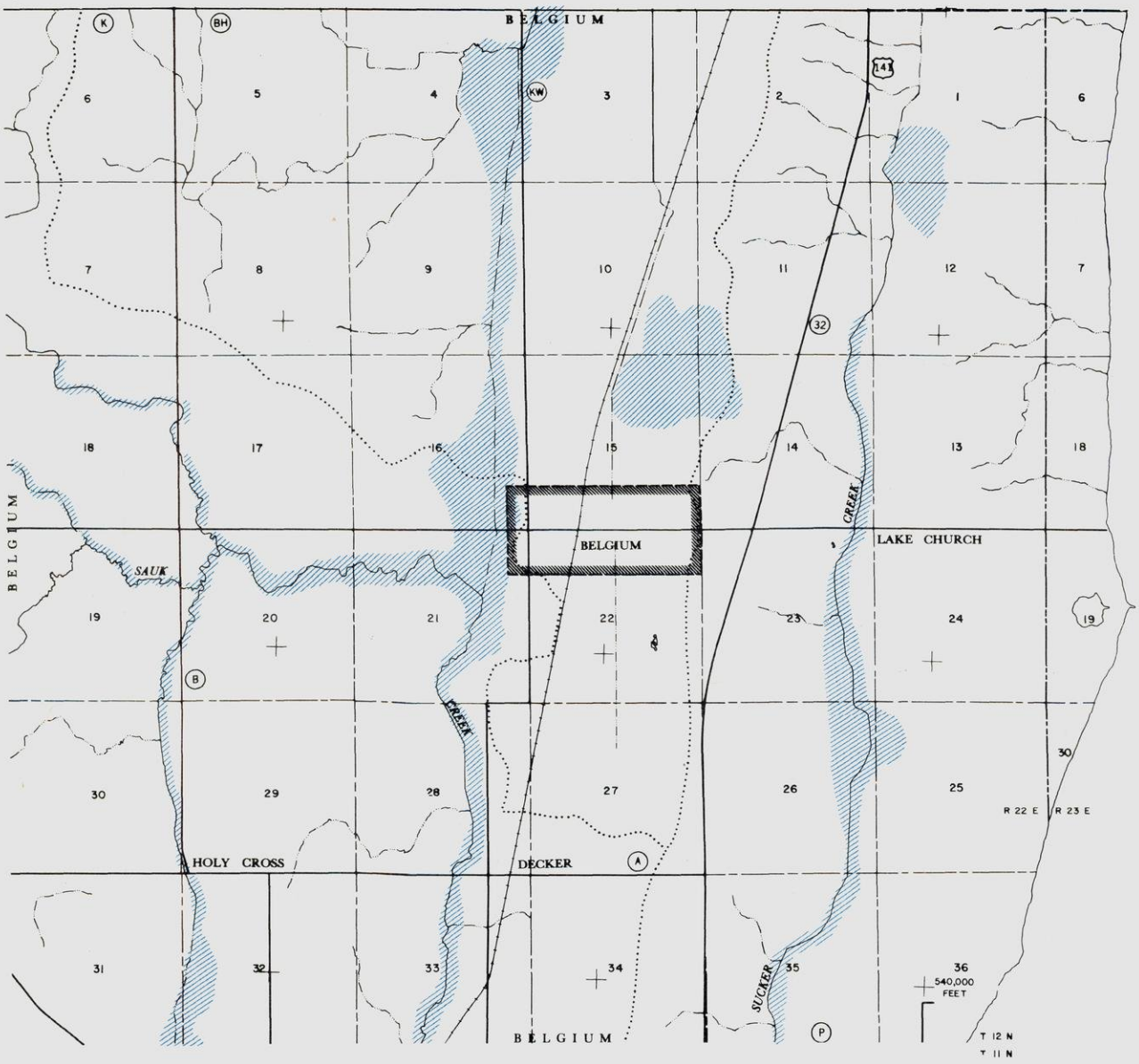
Map 47

FLOOD INUNDATION TOWN OF WHEATLAND



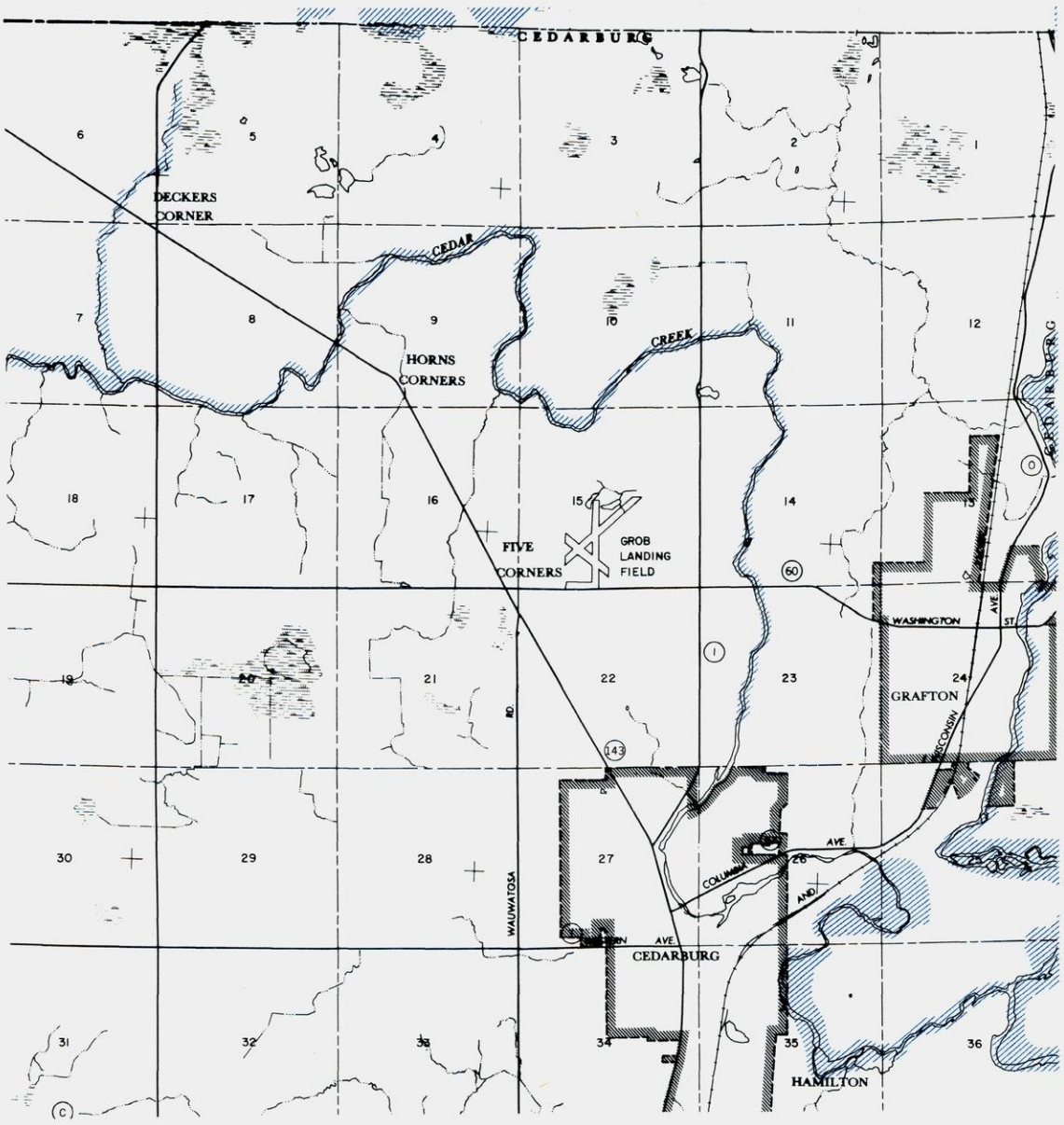
Map 48

FLOOD INUNDATION TOWN OF BELGIUM



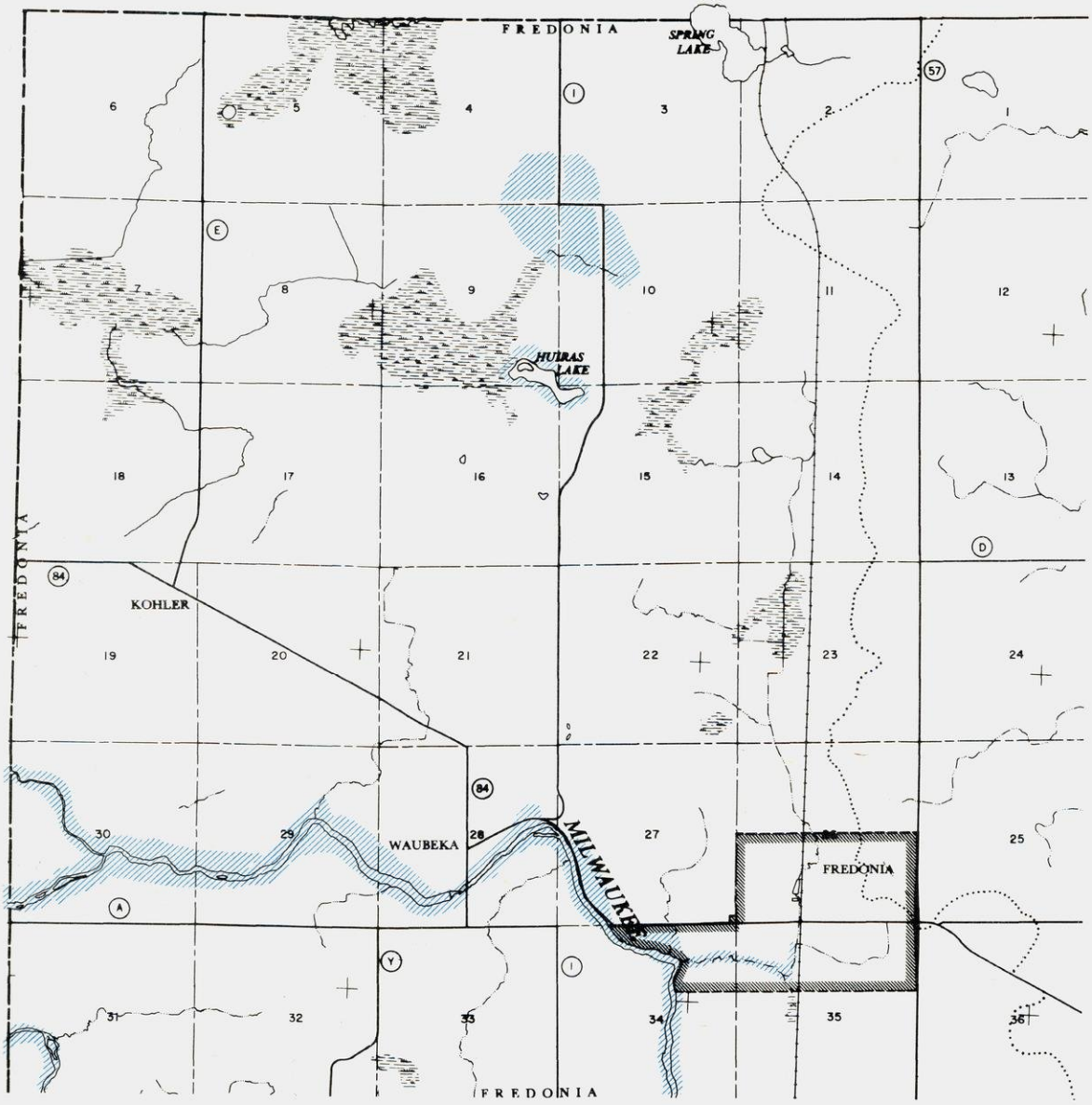
Map 49

FLOOD INUNDATION TOWN OF CEDARBURG



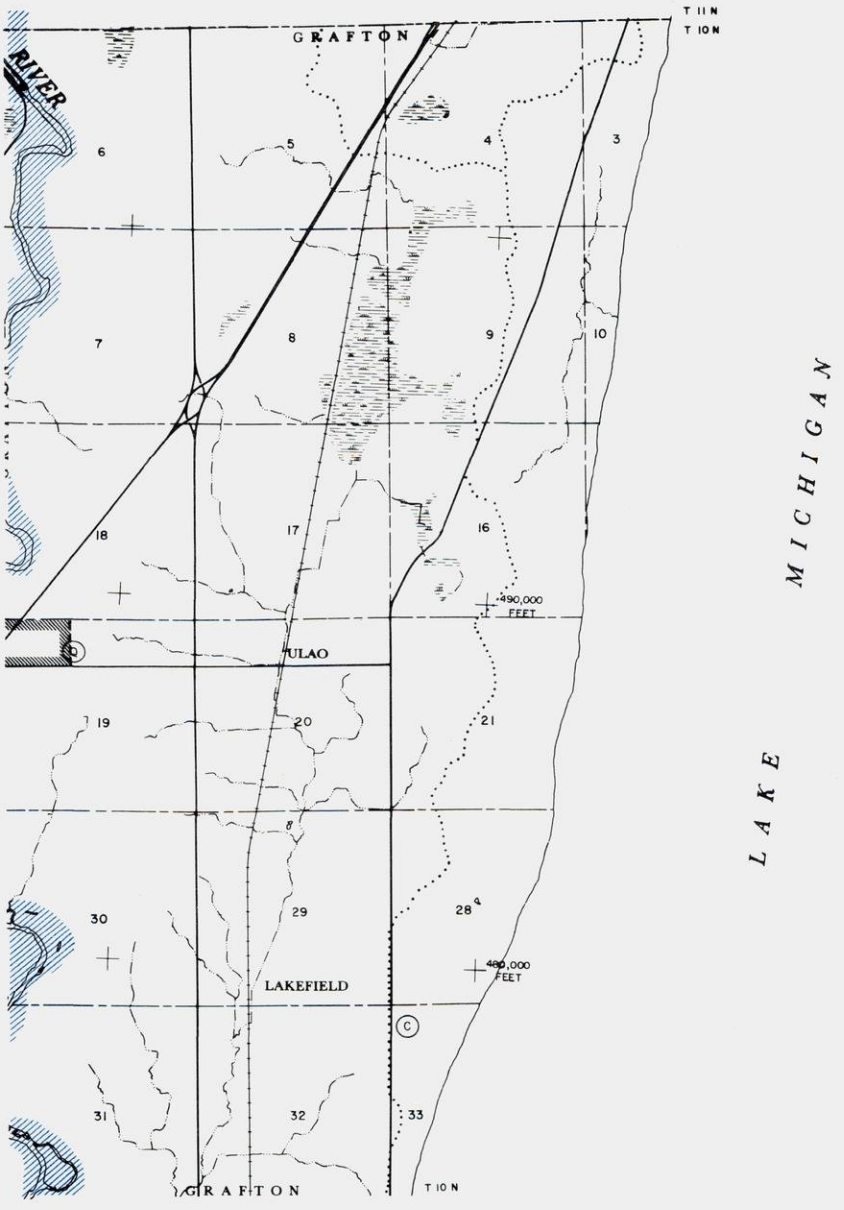
Map 50

FLOOD INUNDATION TOWN OF FREDONIA



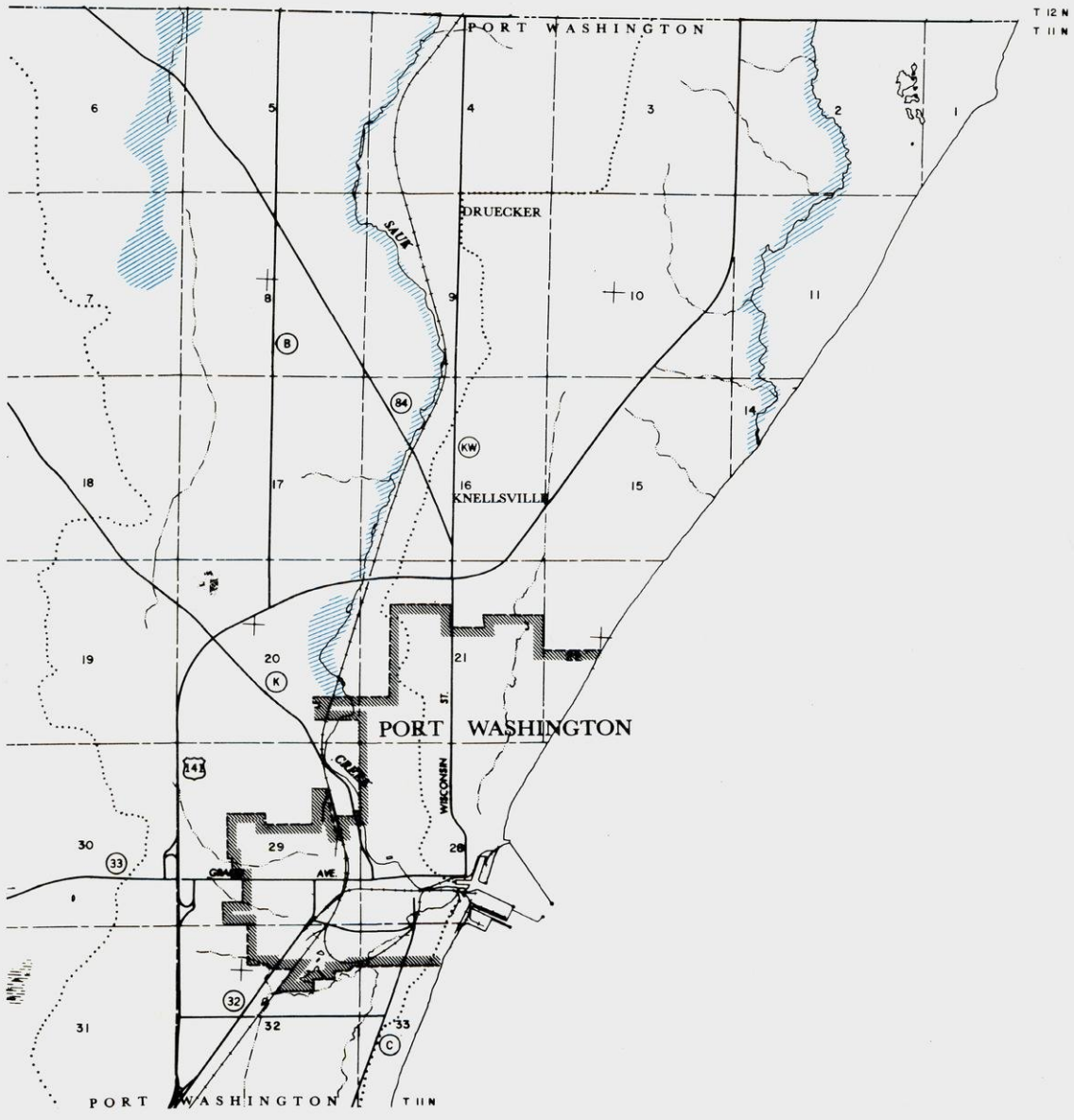
Map 51

FLOOD INUNDATION TOWN OF GRAFTON



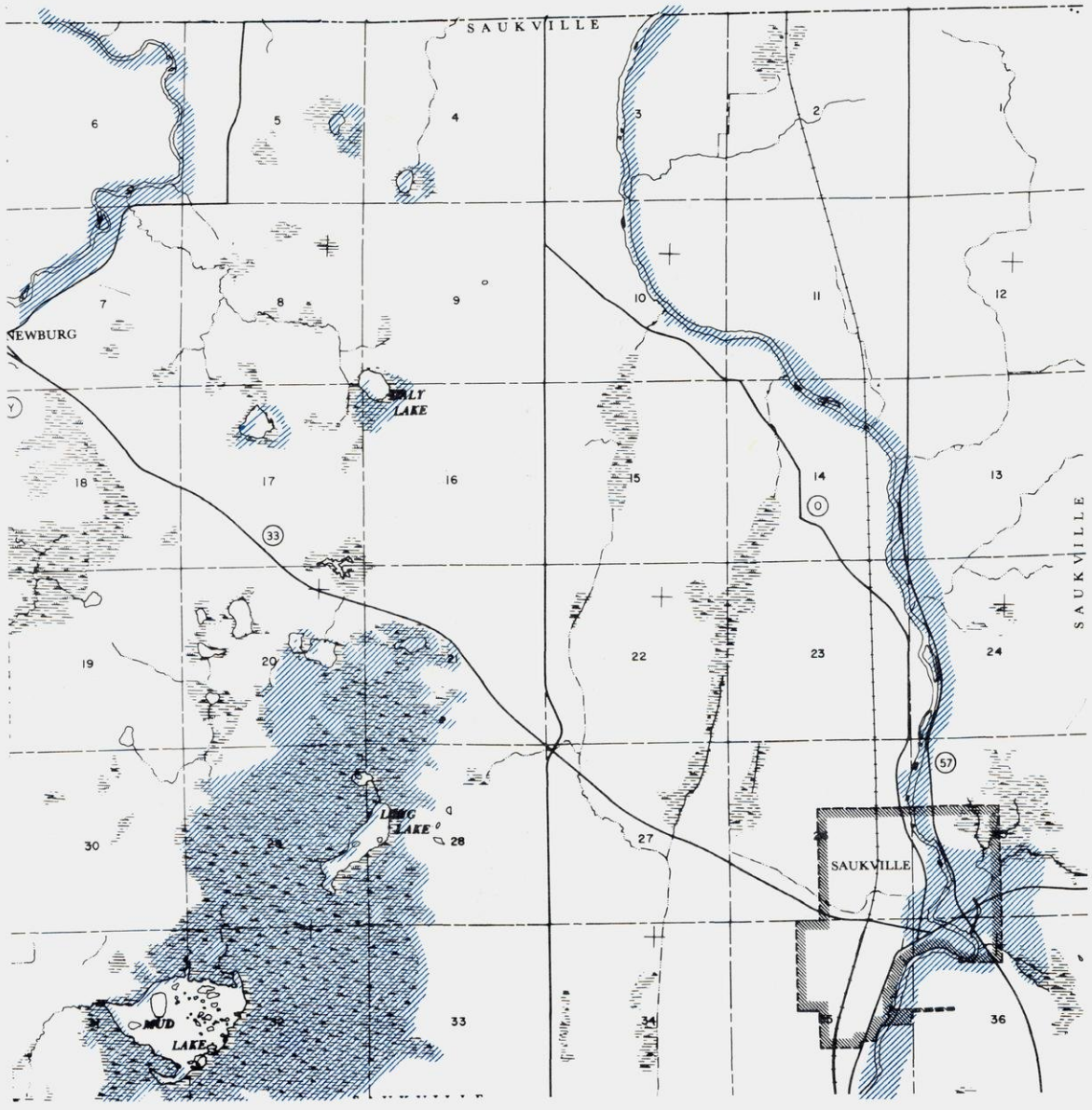
Map 52

FLOOD INUNDATION TOWN OF PORT WASHINGTON



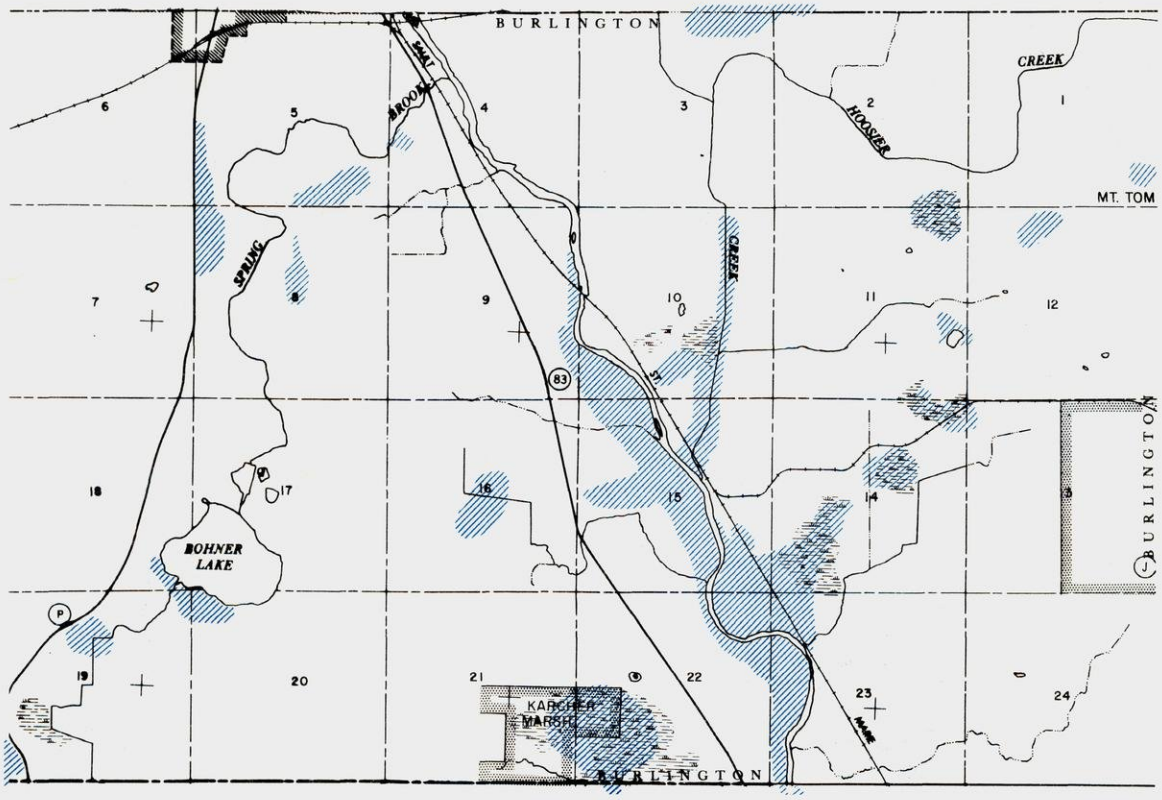
Map 53

FLOOD INUNDATION TOWN OF SAUKVILLE



Map 54

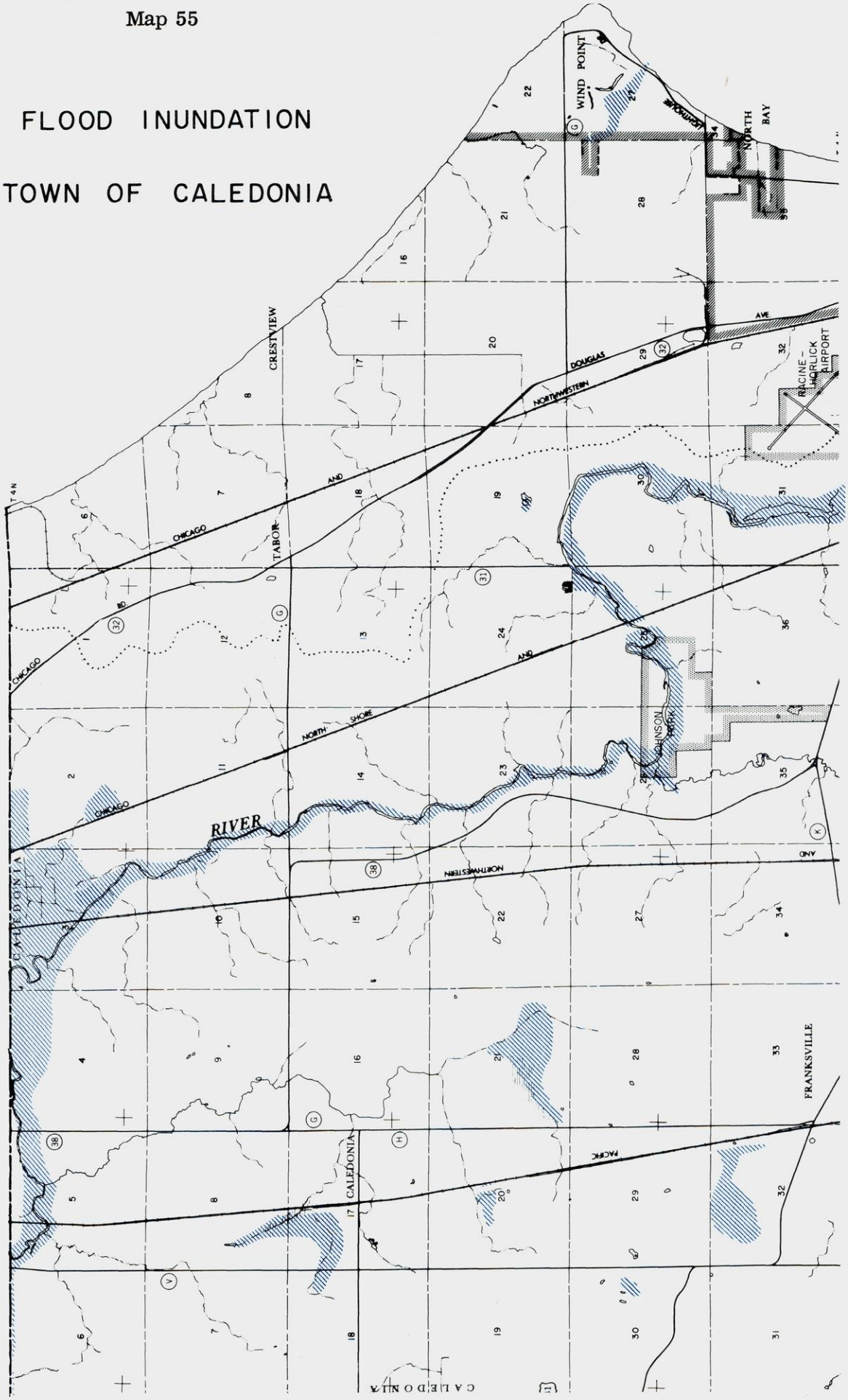
FLOOD INUNDATION TOWN OF BURLINGTON



Map 55

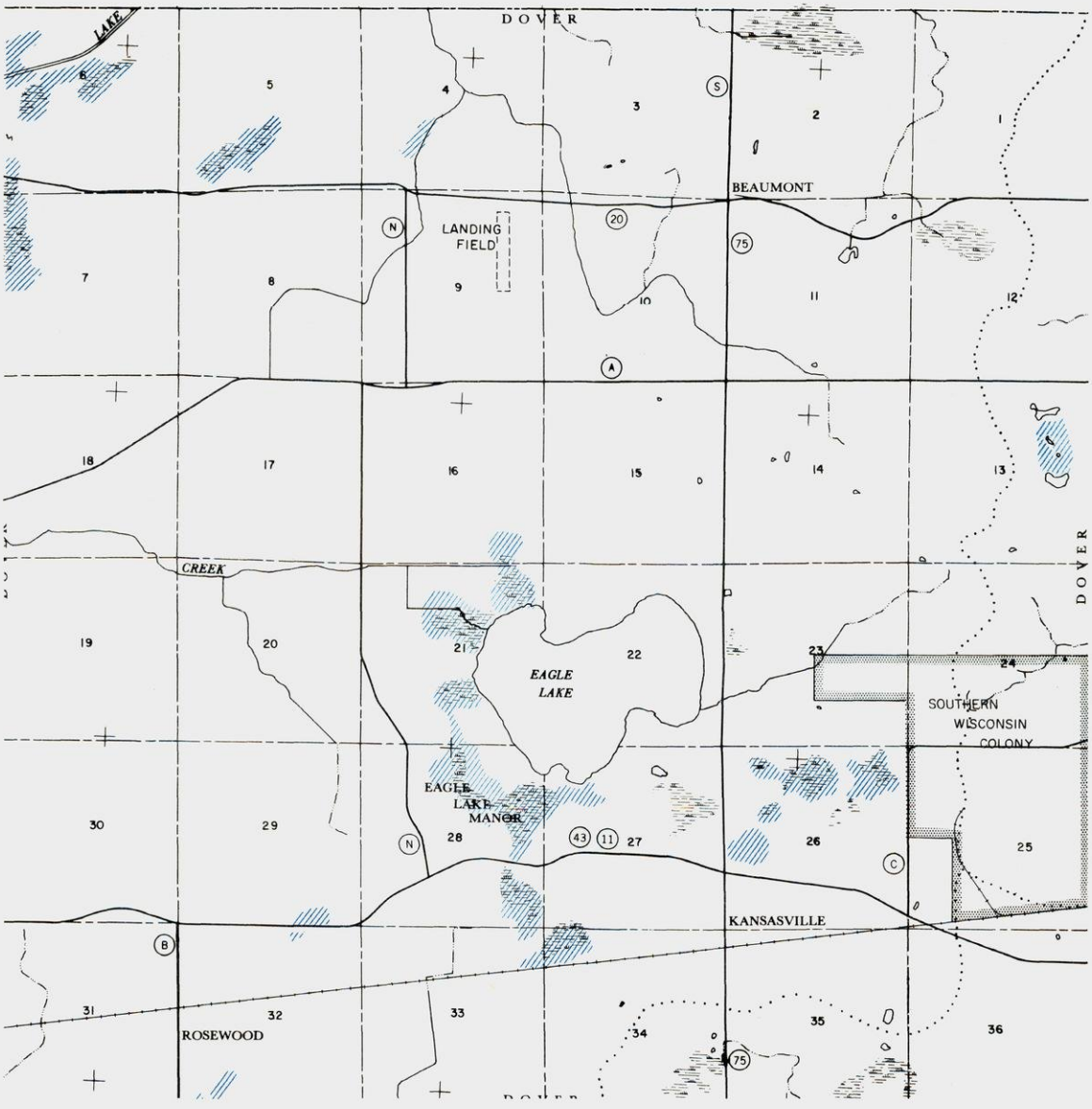
FLOOD INUNDATION

TOWN OF CALEDONIA



Map 56

FLOOD INUNDATION TOWN OF DOVER

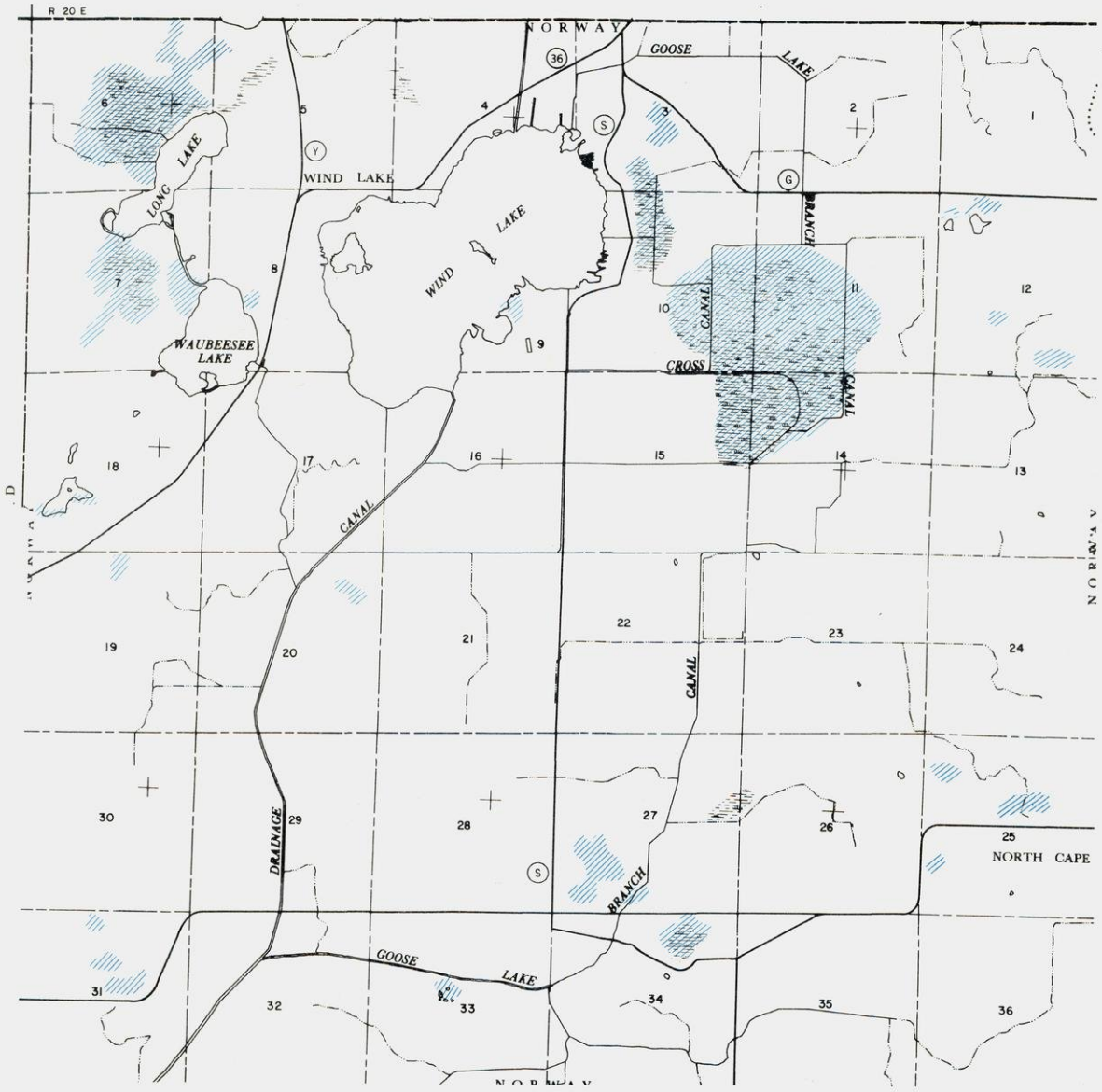


Map 57

FLOOD INUNDATION TOWN OF MOUNT PLEASANT

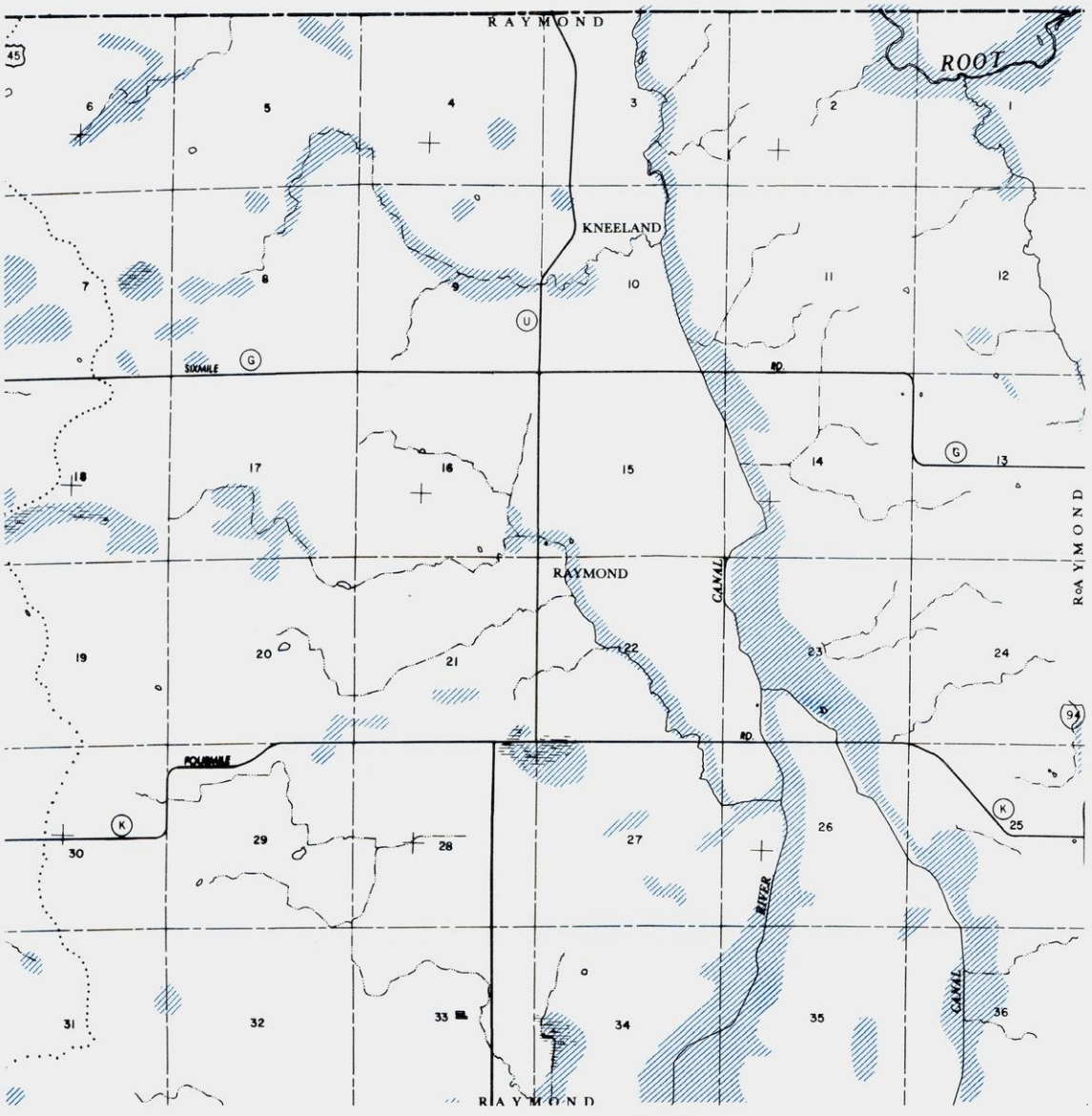
Map 58

FLOOD INUNDATION TOWN OF NORWAY



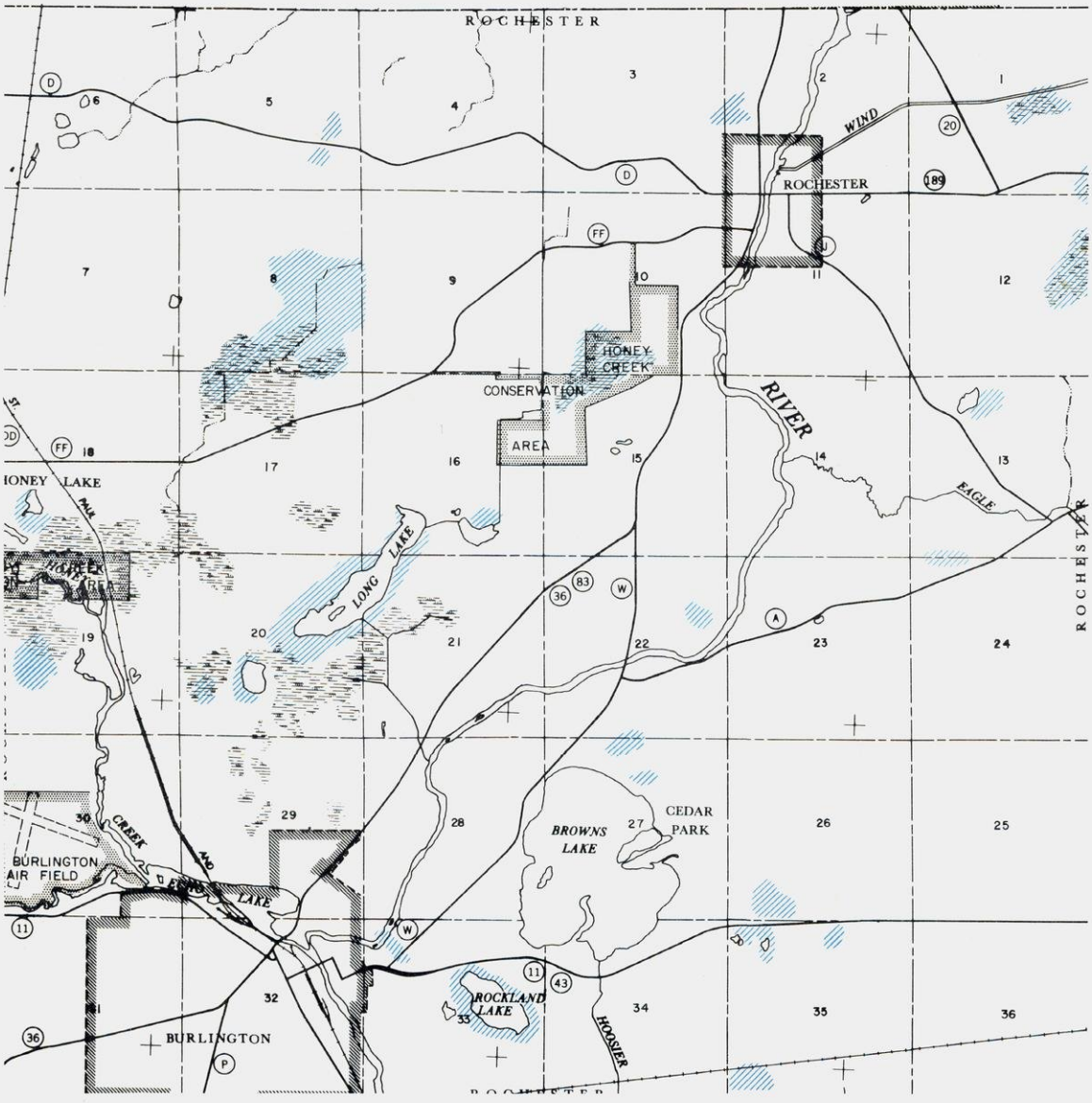
Map 59

FLOOD INUNDATION TOWN OF RAYMOND



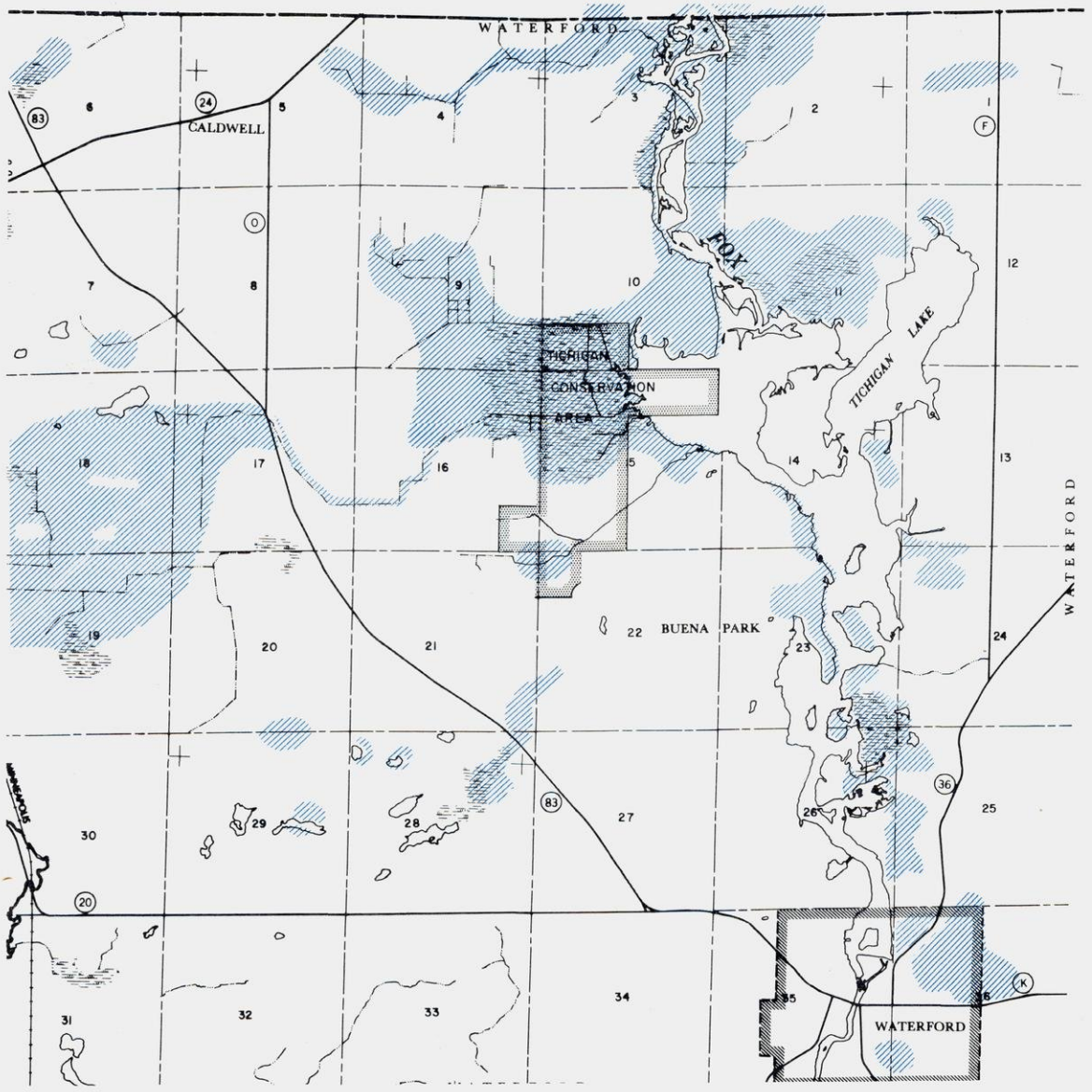
Map 60

FLOOD INUNDATION TOWN OF ROCHESTER



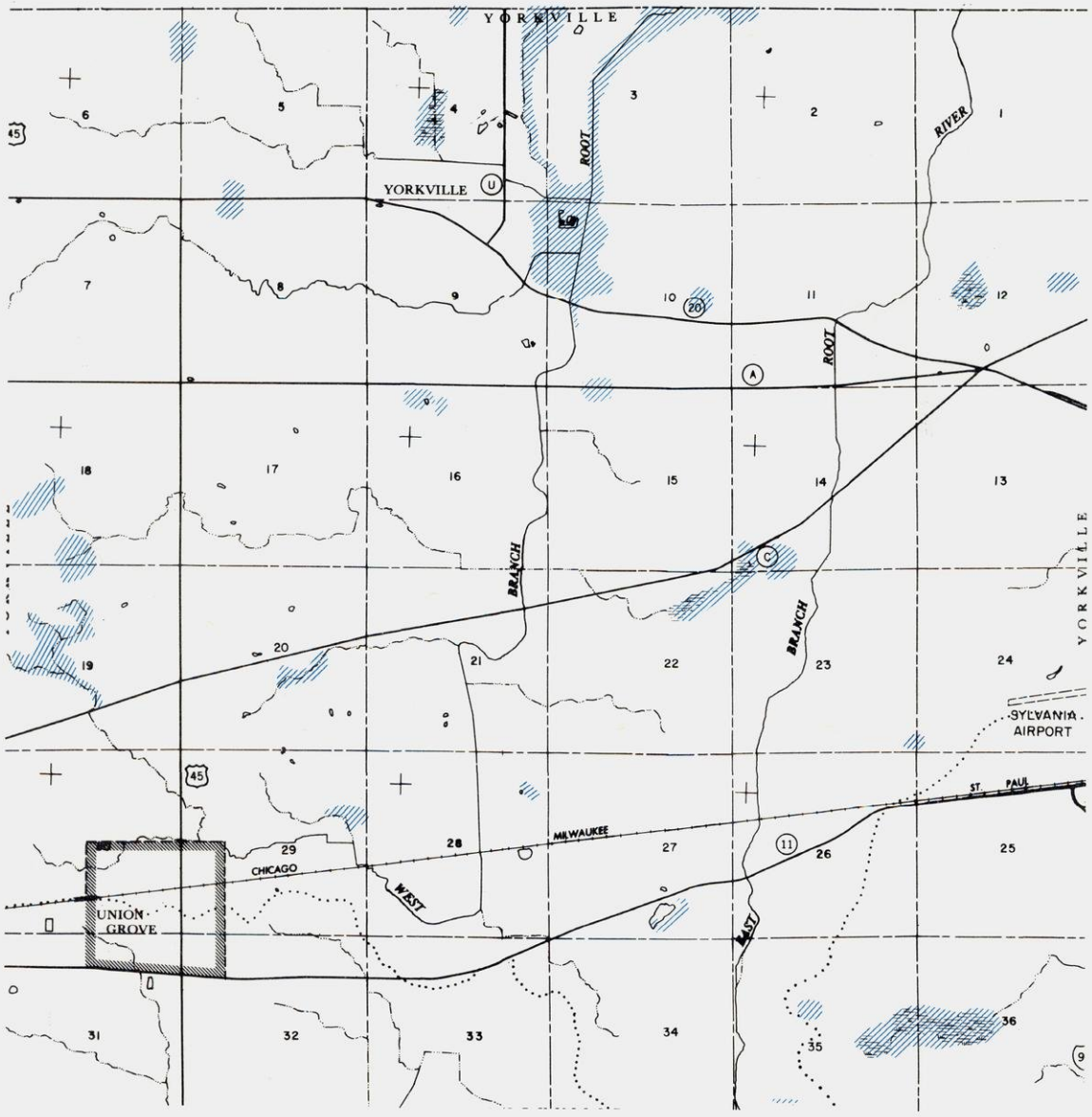
Map 61

FLOOD INUNDATION TOWN OF WATERFORD



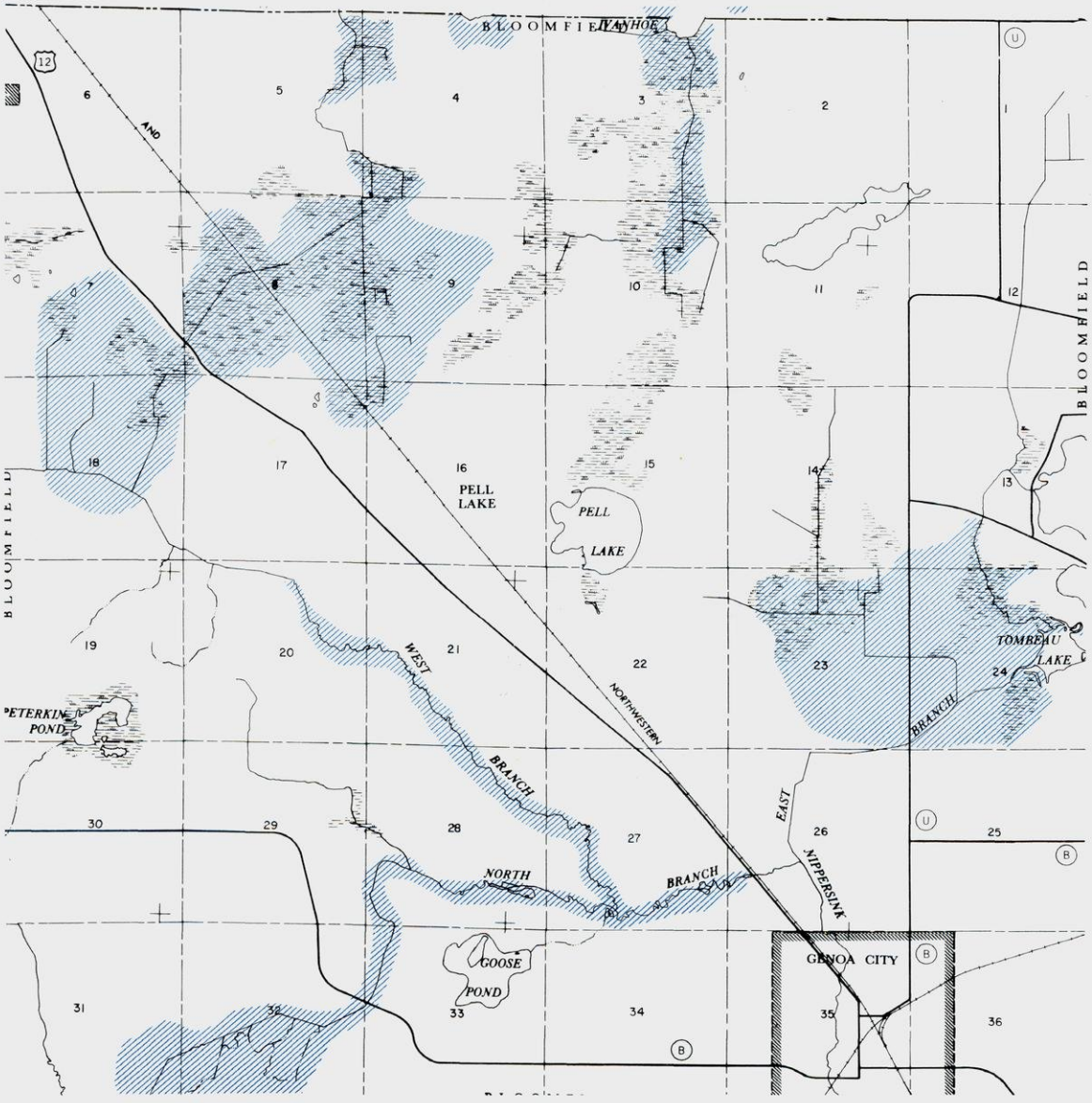
Map 62

FLOOD INUNDATION TOWN OF YORKVILLE



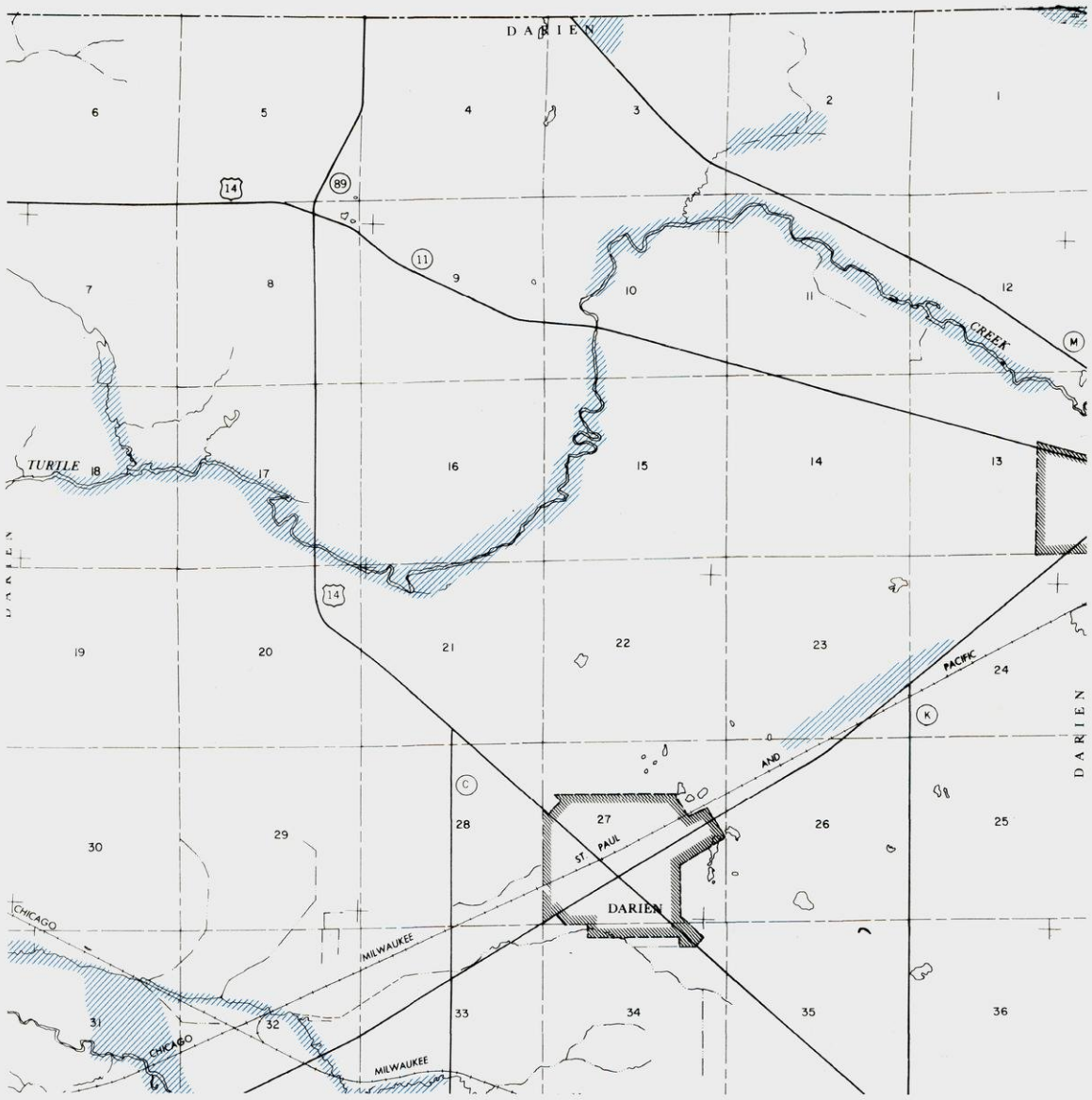
Map 63

FLOOD INUNDATION TOWN OF BLOOMFIELD



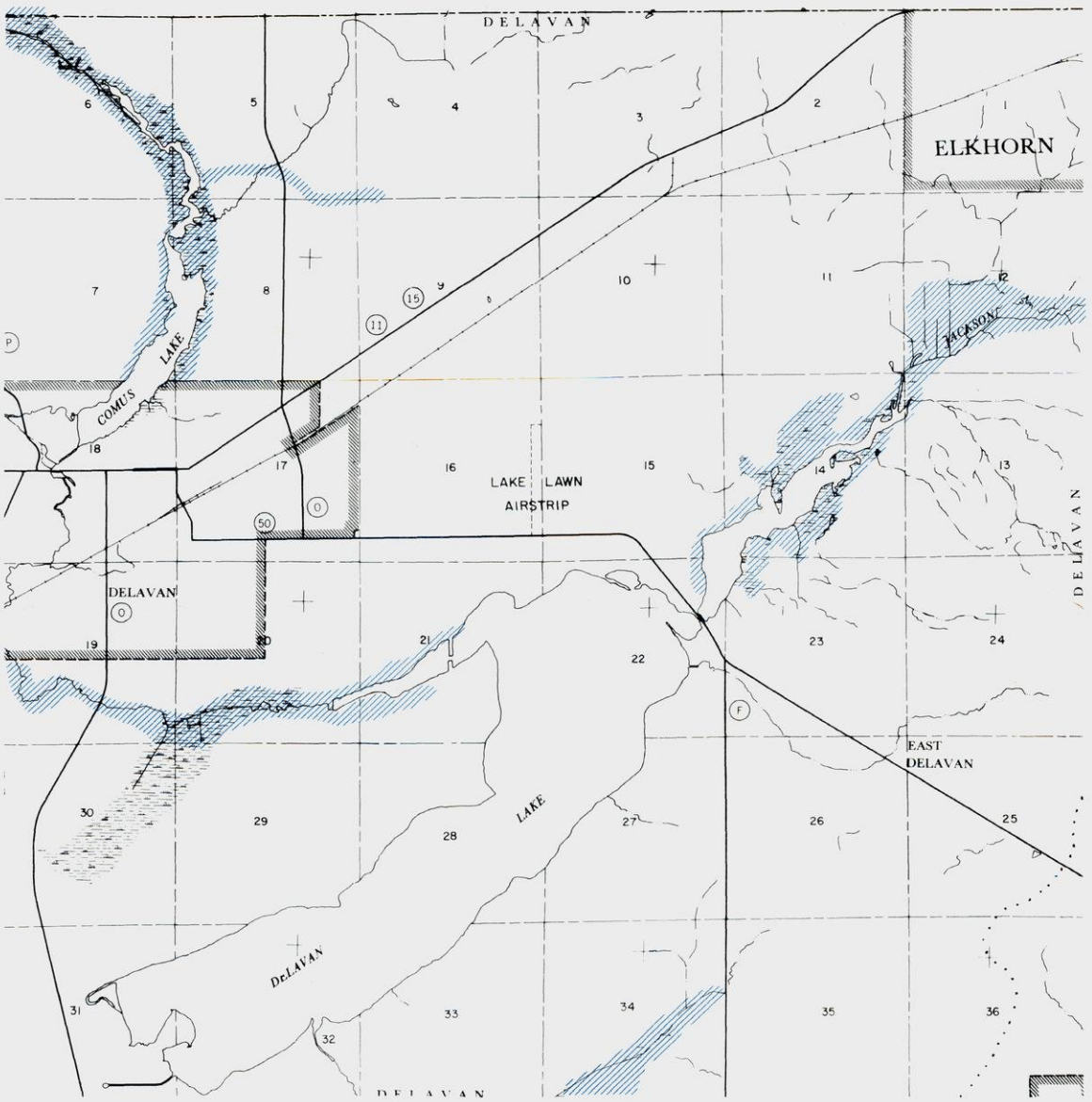
Map 64

FLOOD INUNDATION TOWN OF DARIEN



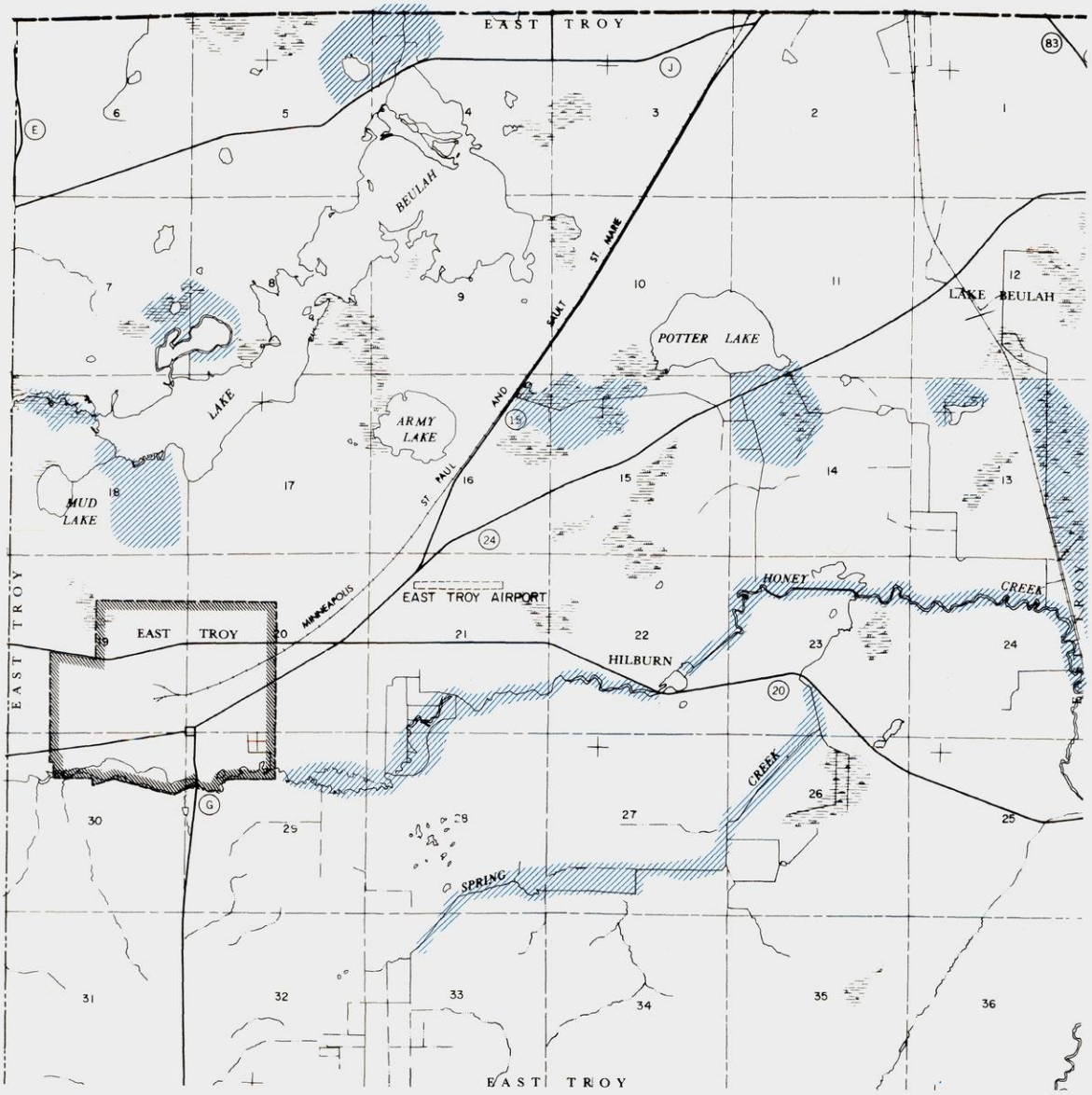
Map 65

FLOOD INUNDATION TOWN OF DELAVAN



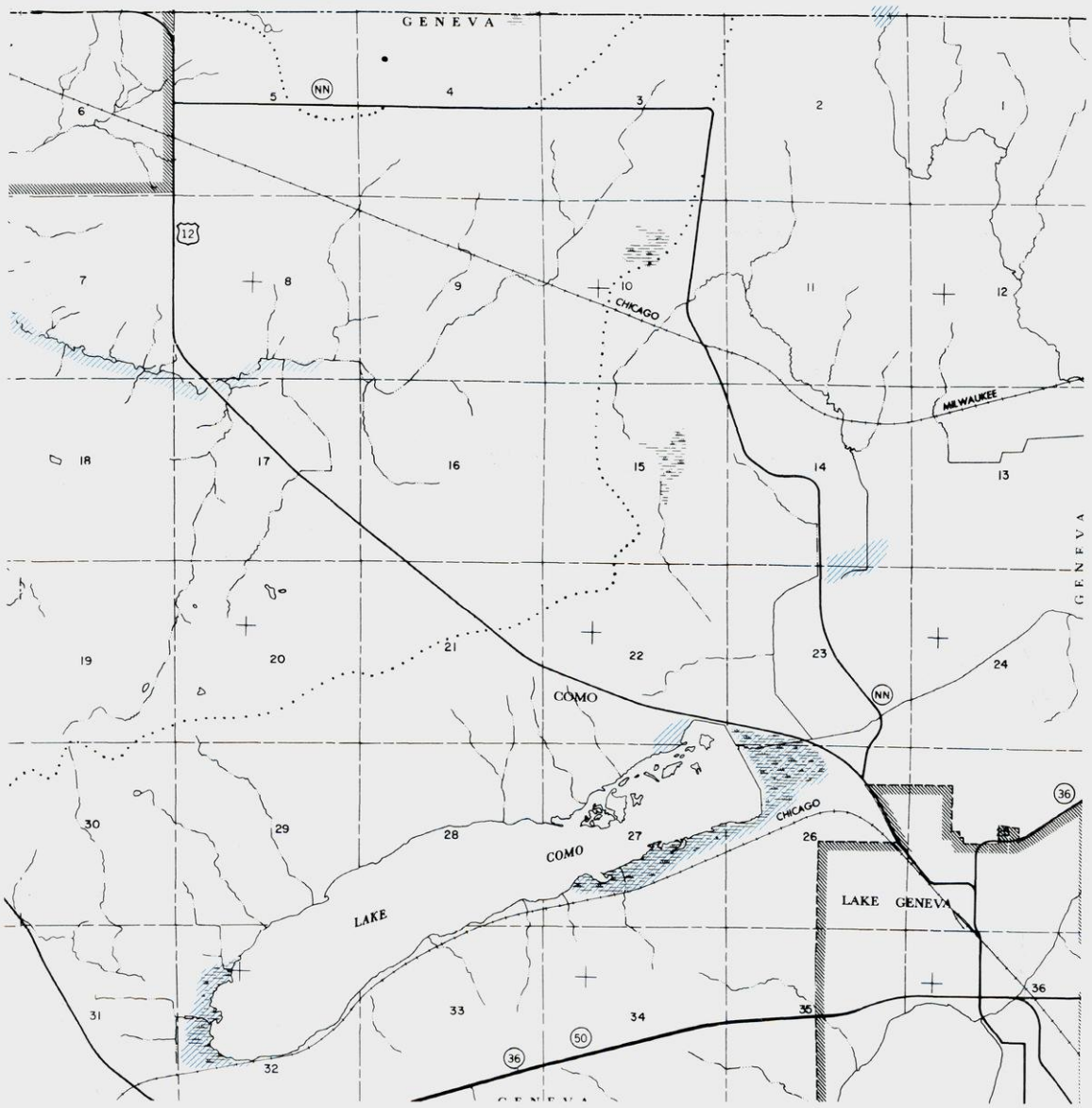
Map 66

FLOOD INUNDATION TOWN OF EAST TROY



Map 67

FLOOD INUNDATION TOWN OF GENEVA

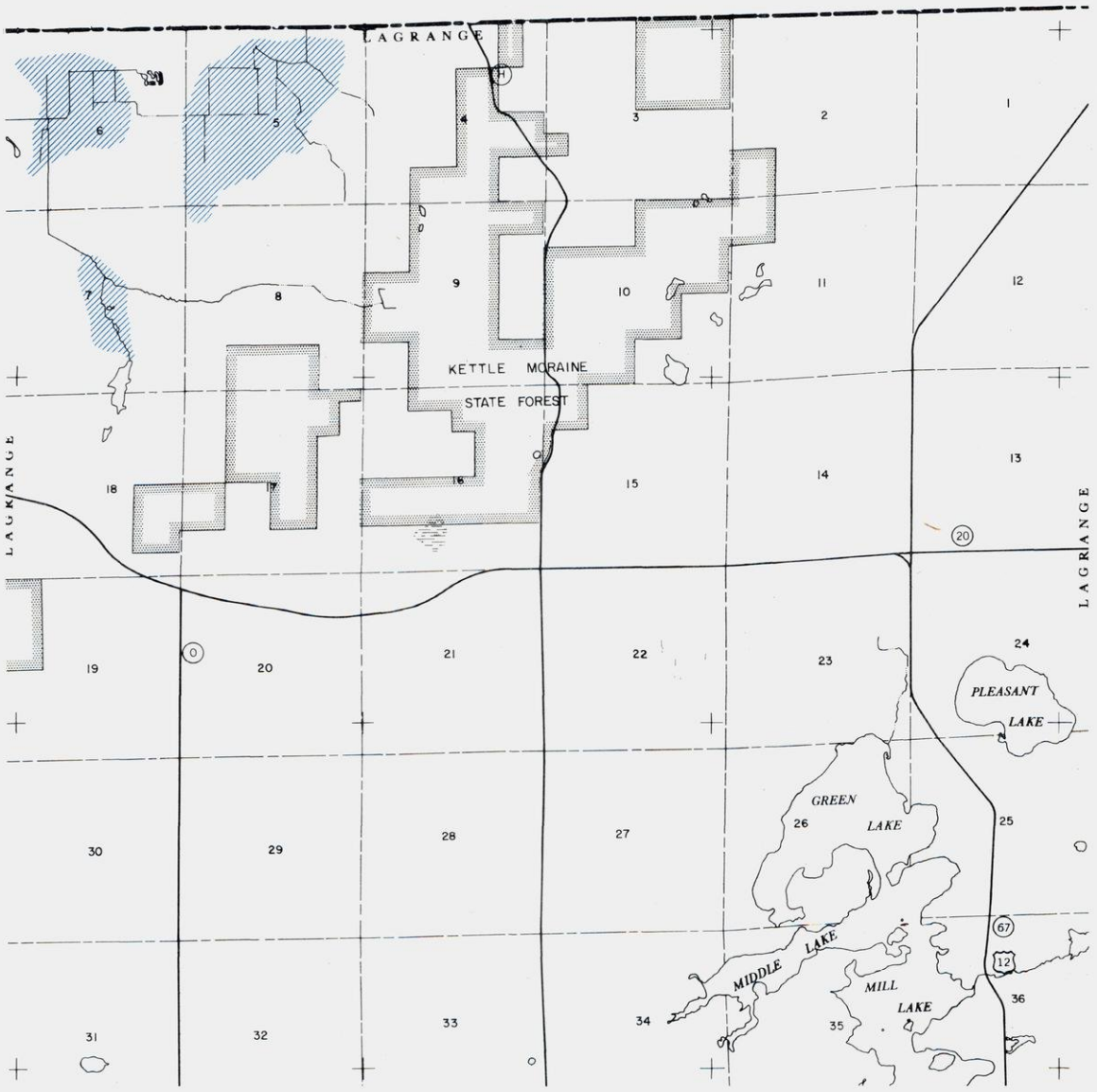


Map 68

FLOOD INUNDATION TOWN OF LA FAYETTE

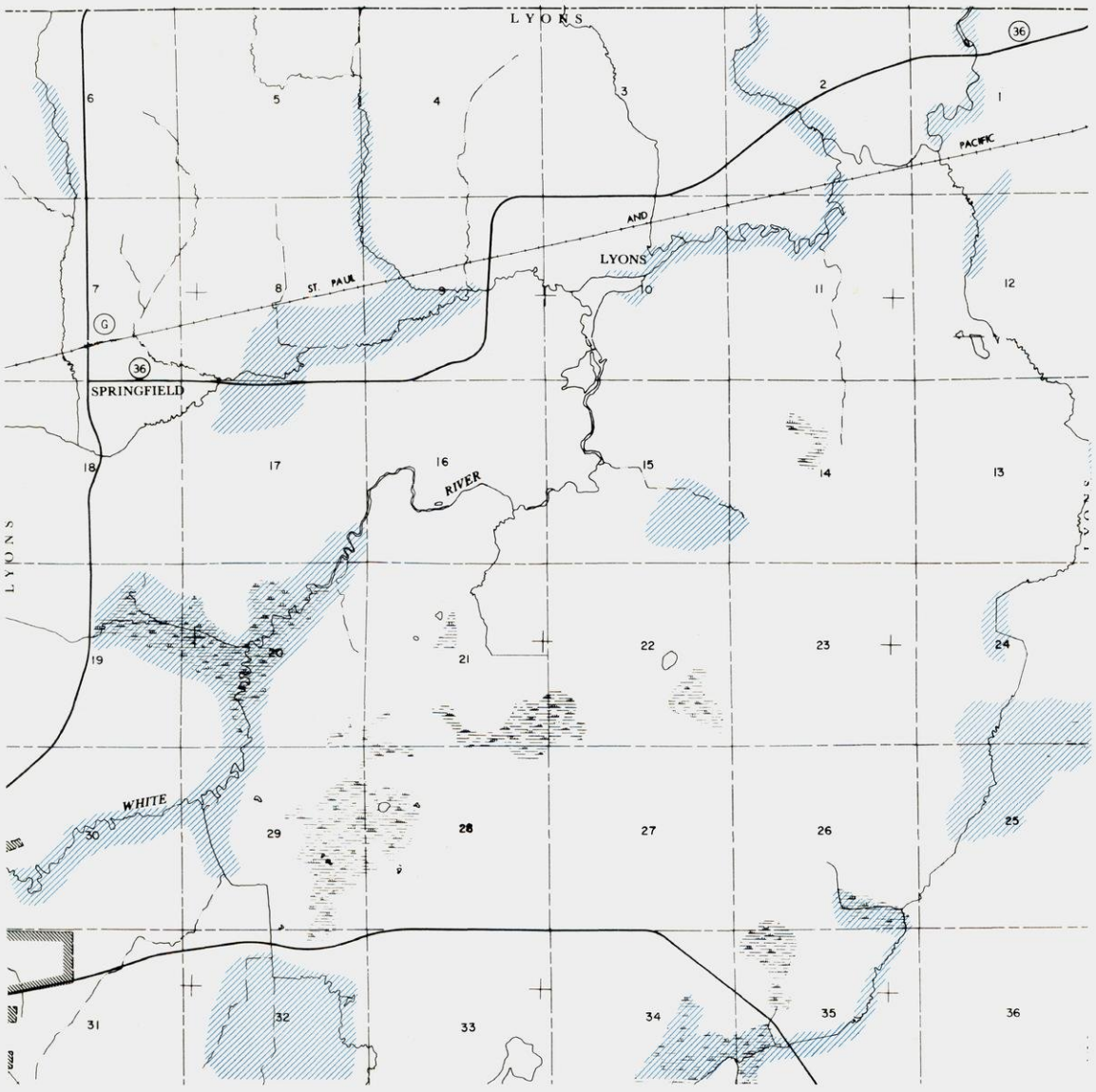
Map 69

FLOOD INUNDATION TOWN OF LA GRANGE



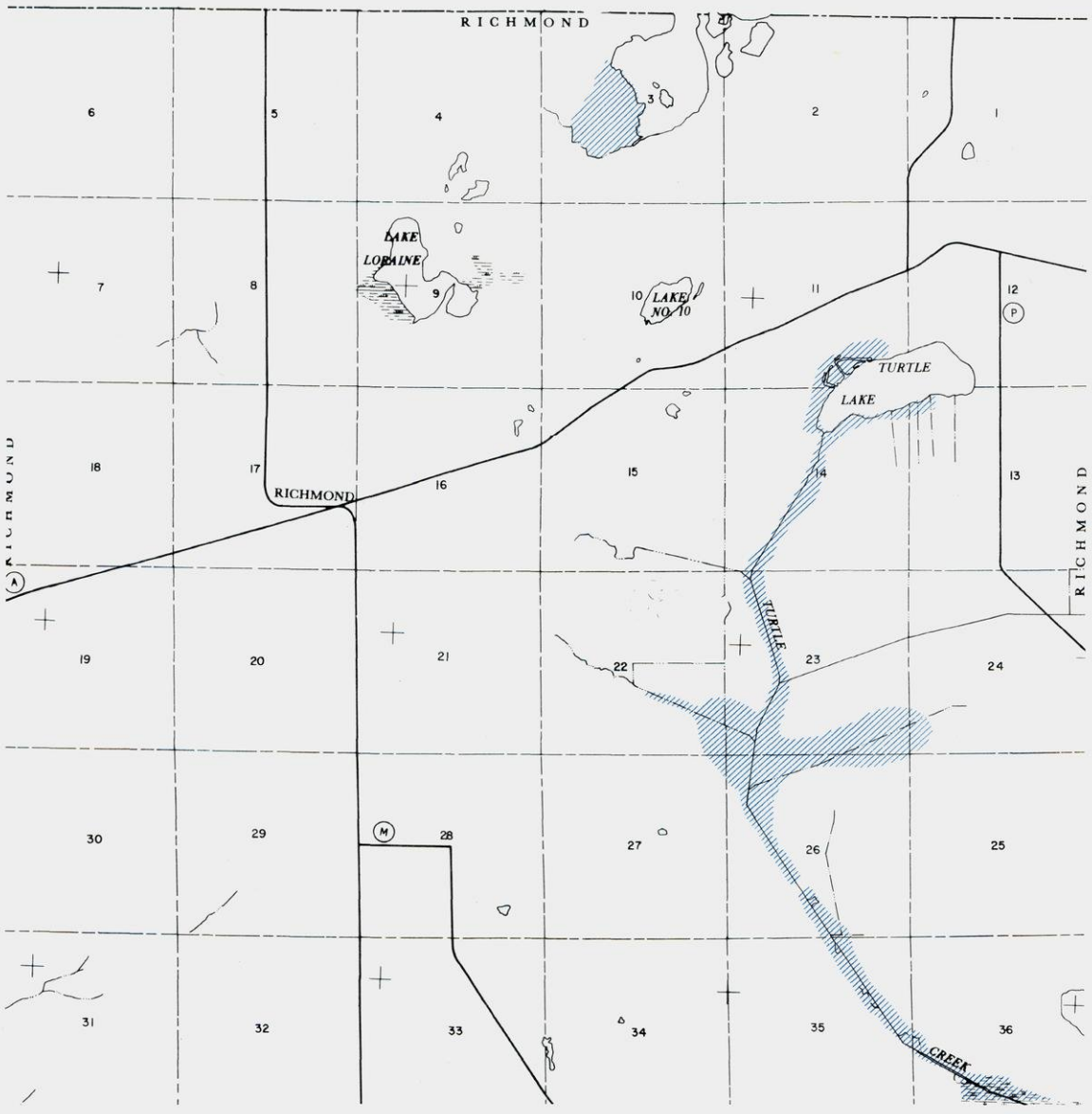
Map 70

FLOOD INUNDATION TOWN OF LYONS



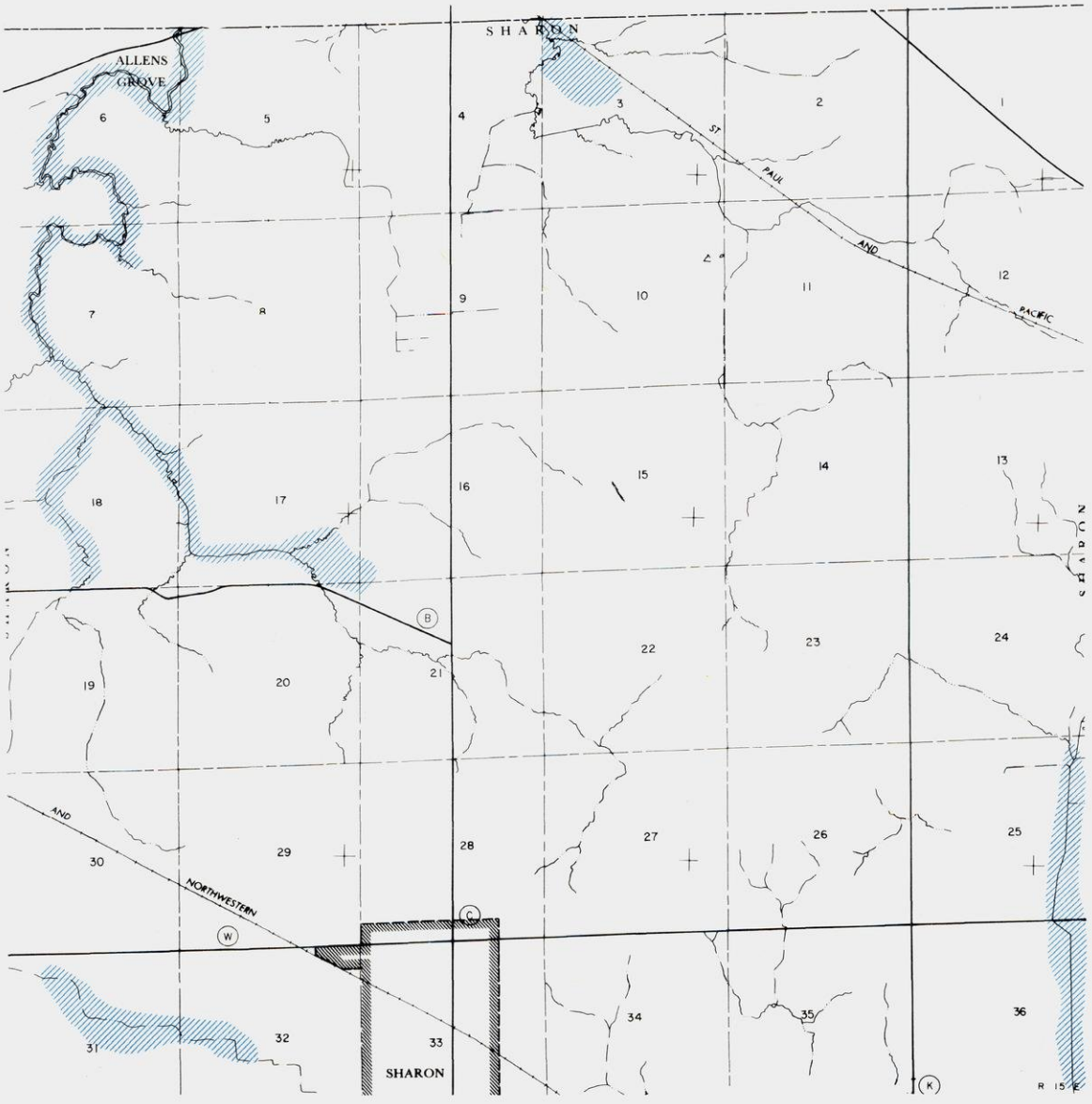
Map 71

FLOOD INUNDATION TOWN OF RICHMOND



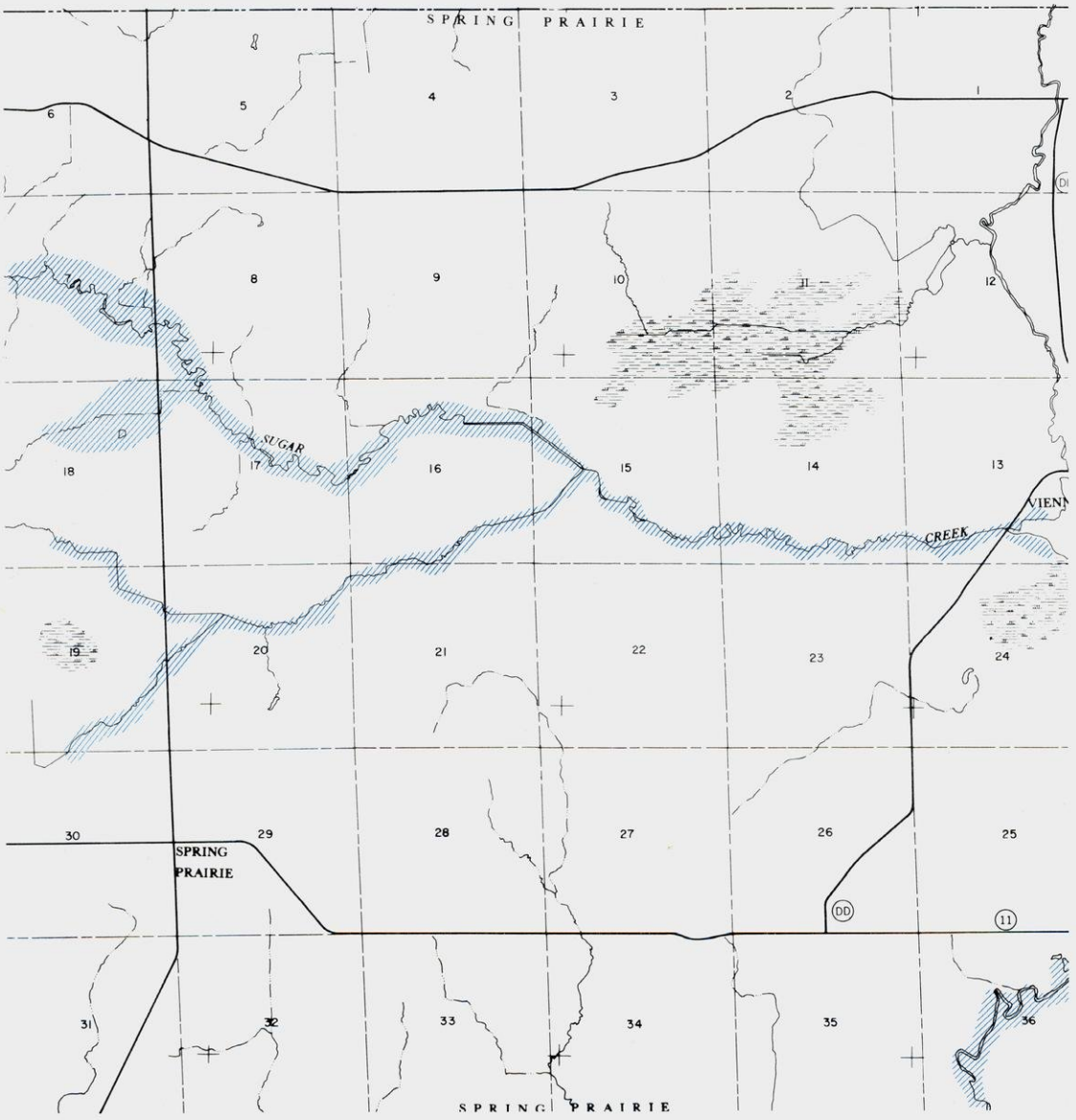
Map 72

FLOOD INUNDATION TOWN OF SHARON



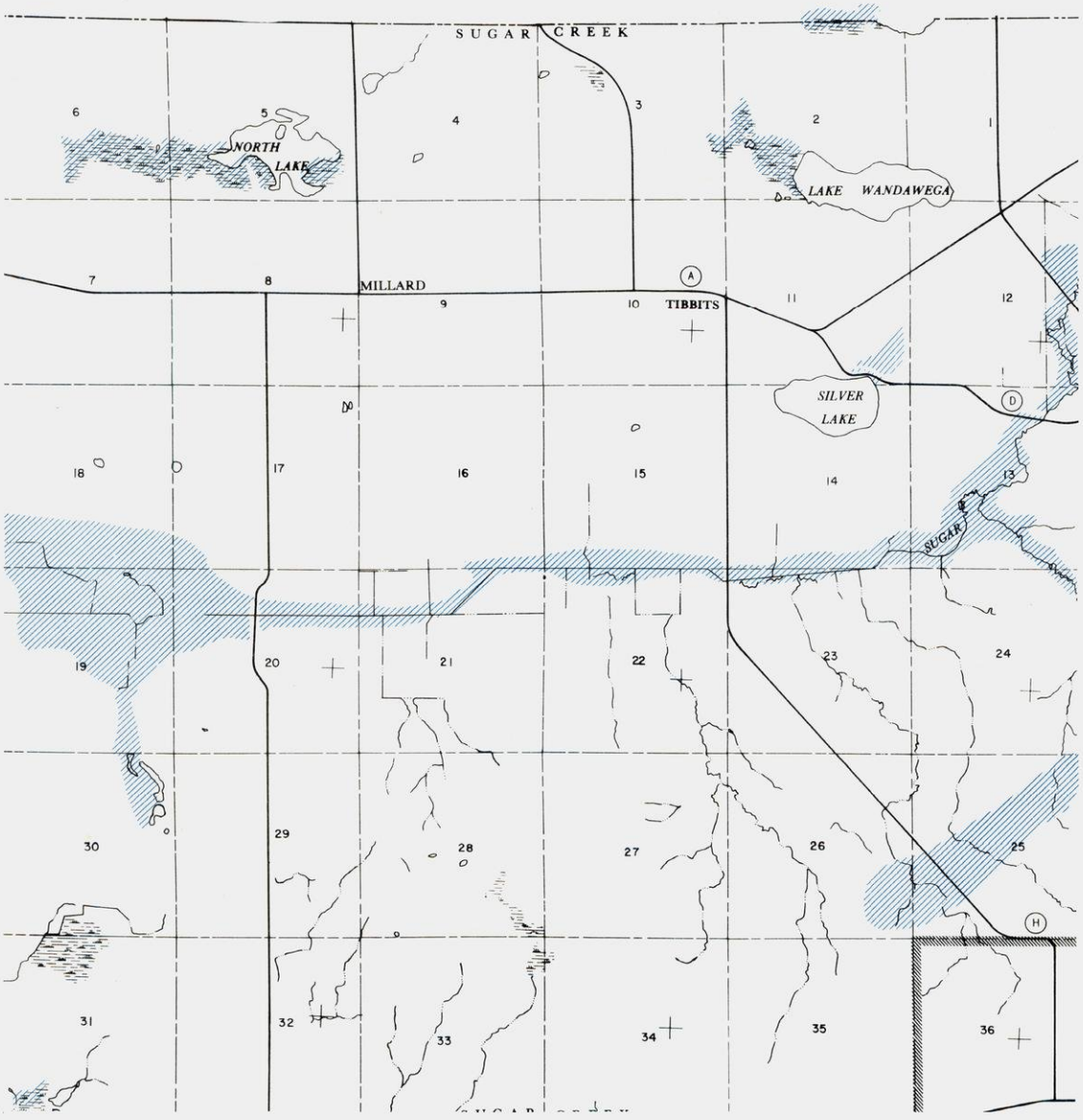
Map 73

FLOOD INUNDATION TOWN OF SPRING PRAIRIE



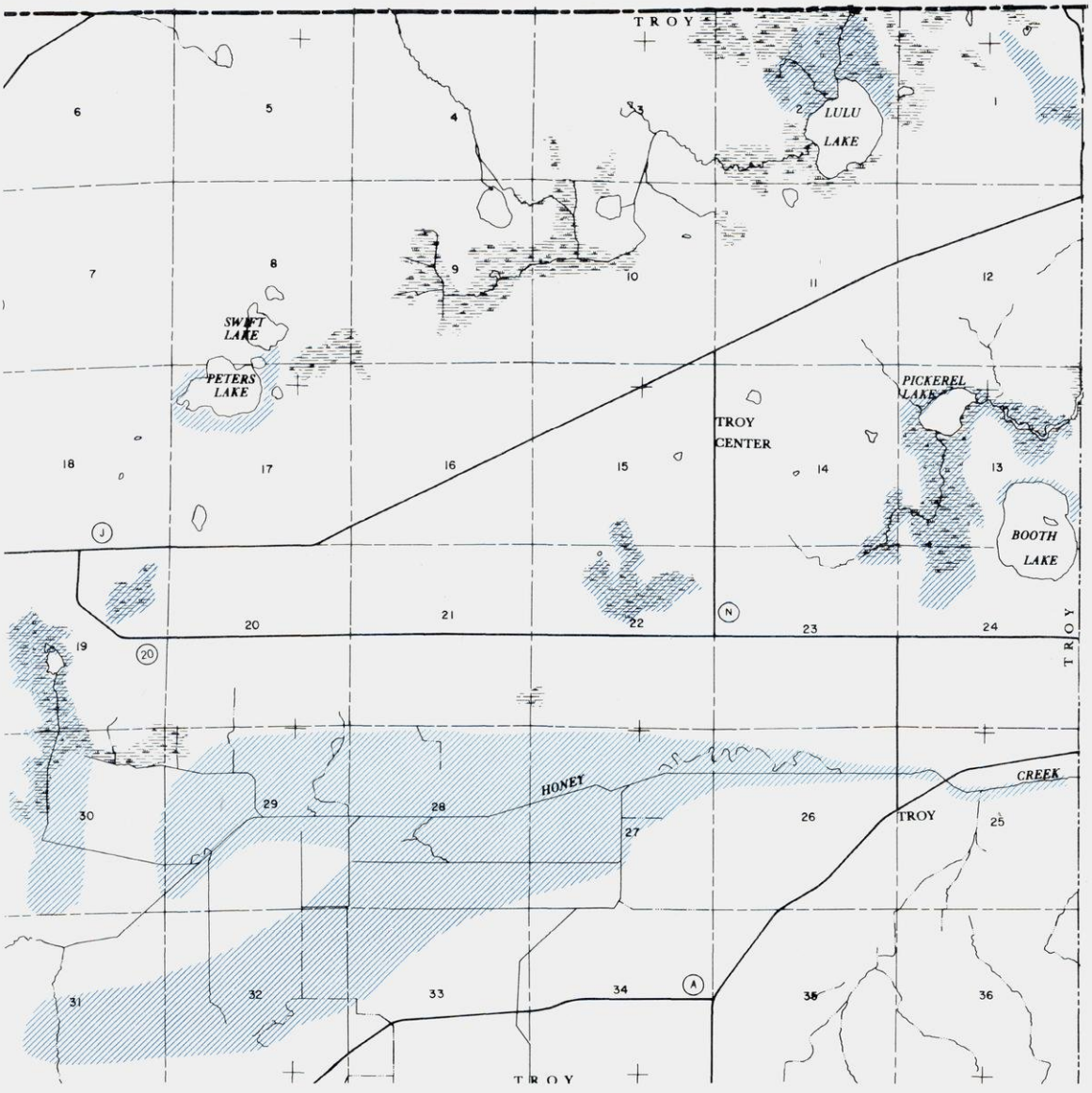
Map 74

FLOOD INUNDATION TOWN OF SUGAR CREEK



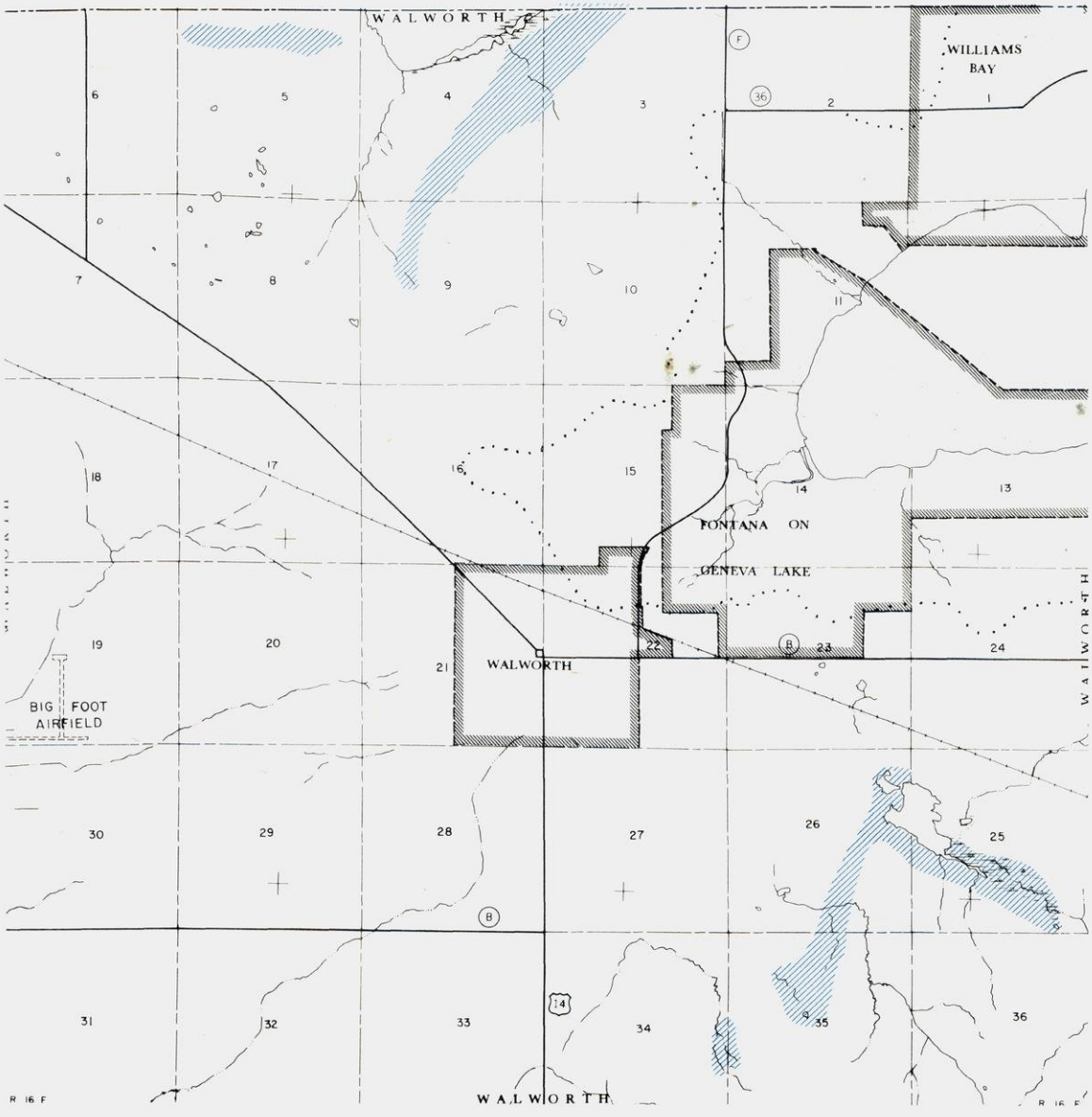
Map 75

FLOOD INUNDATION TOWN OF TROY



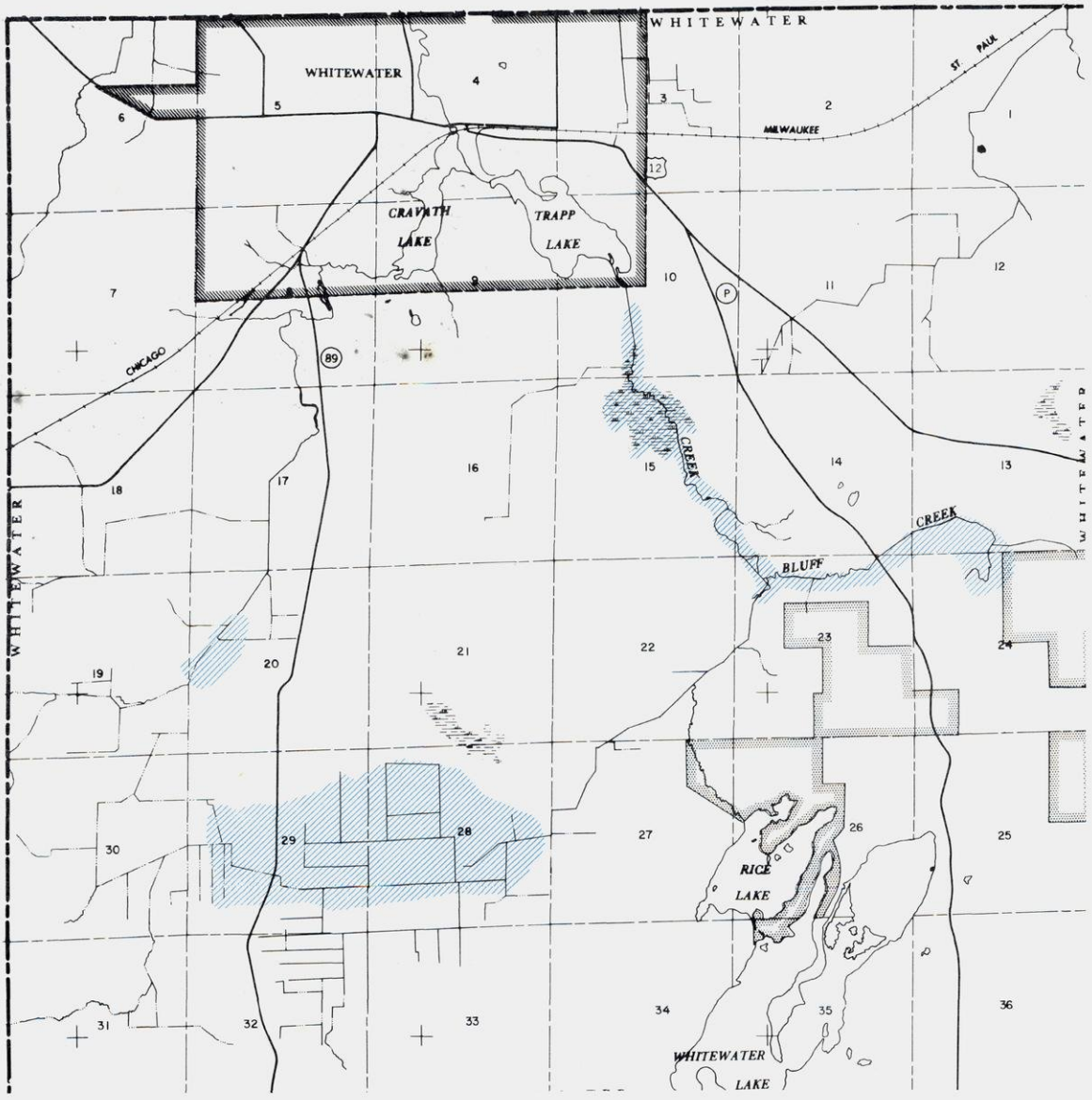
Map 76

FLOOD INUNDATION TOWN OF WALWORTH



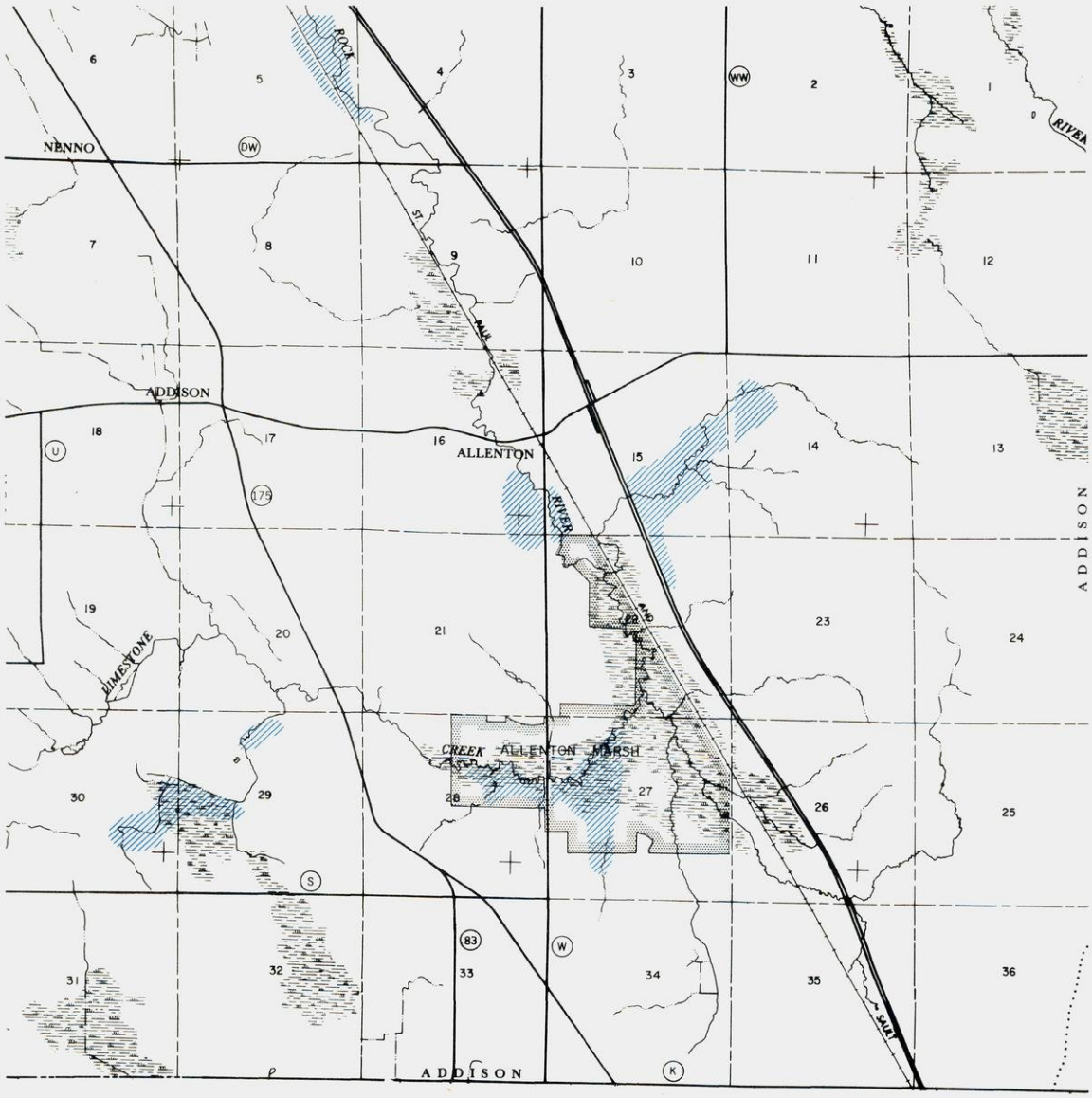
Map 77

FLOOD INUNDATION TOWN OF WHITEWATER



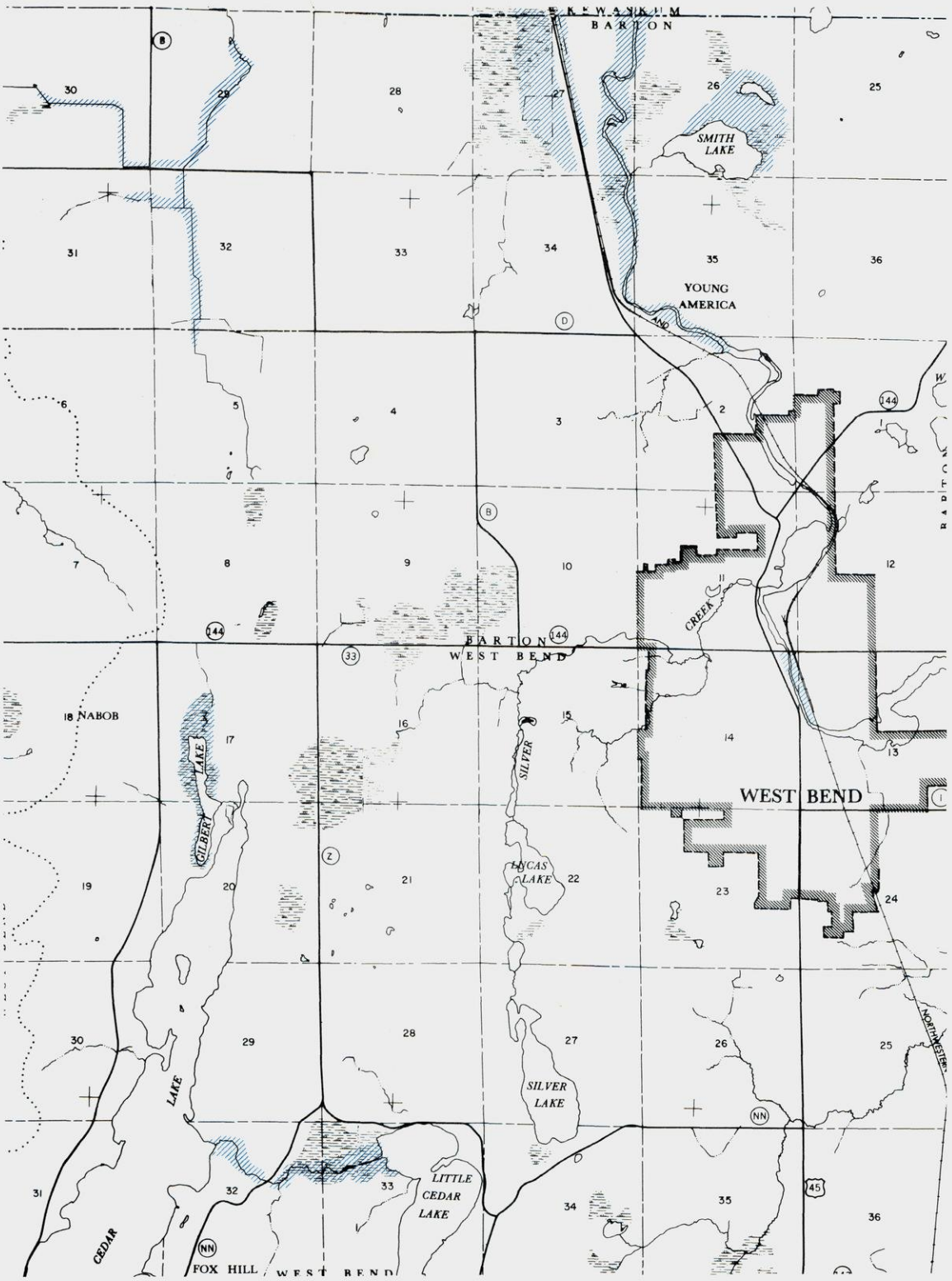
Map 78

FLOOD INUNDATION TOWN OF ADDISON



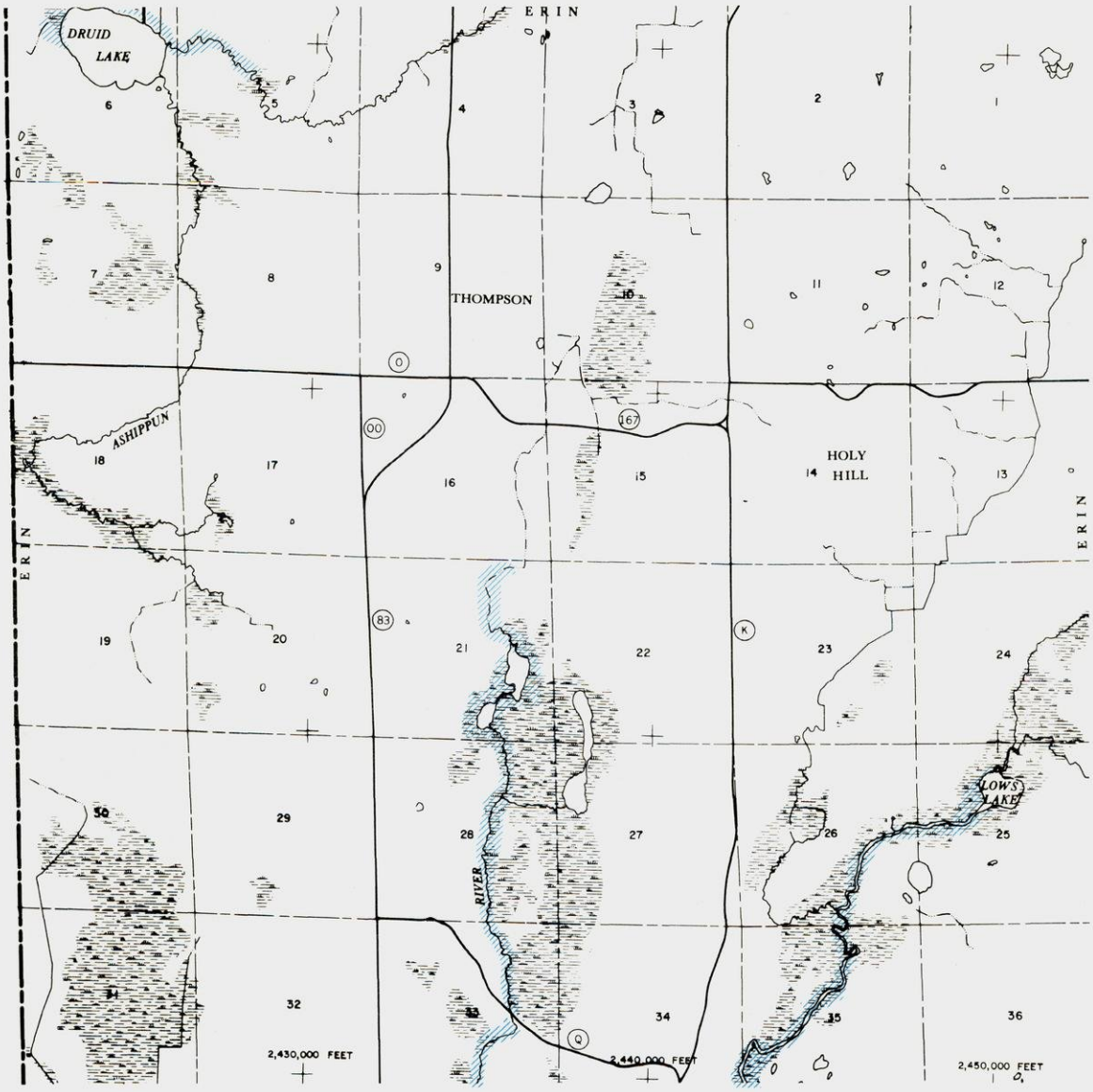
Map 79

FLOOD INUNDATION TOWN OF BARTON
FLOOD INUNDATION TOWN OF WEST BEND



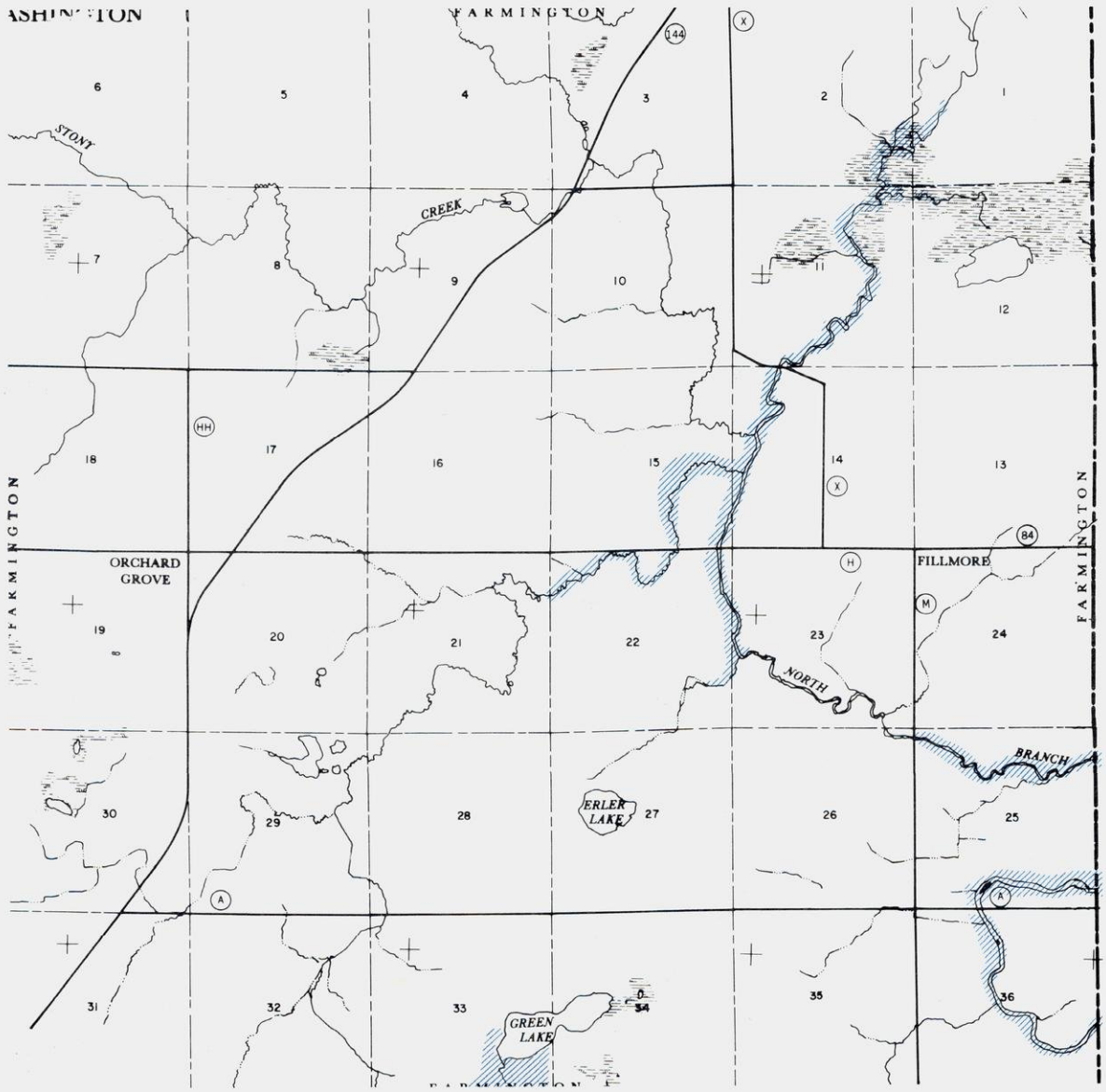
Map 80

FLOOD INUNDATION TOWN OF ERIN



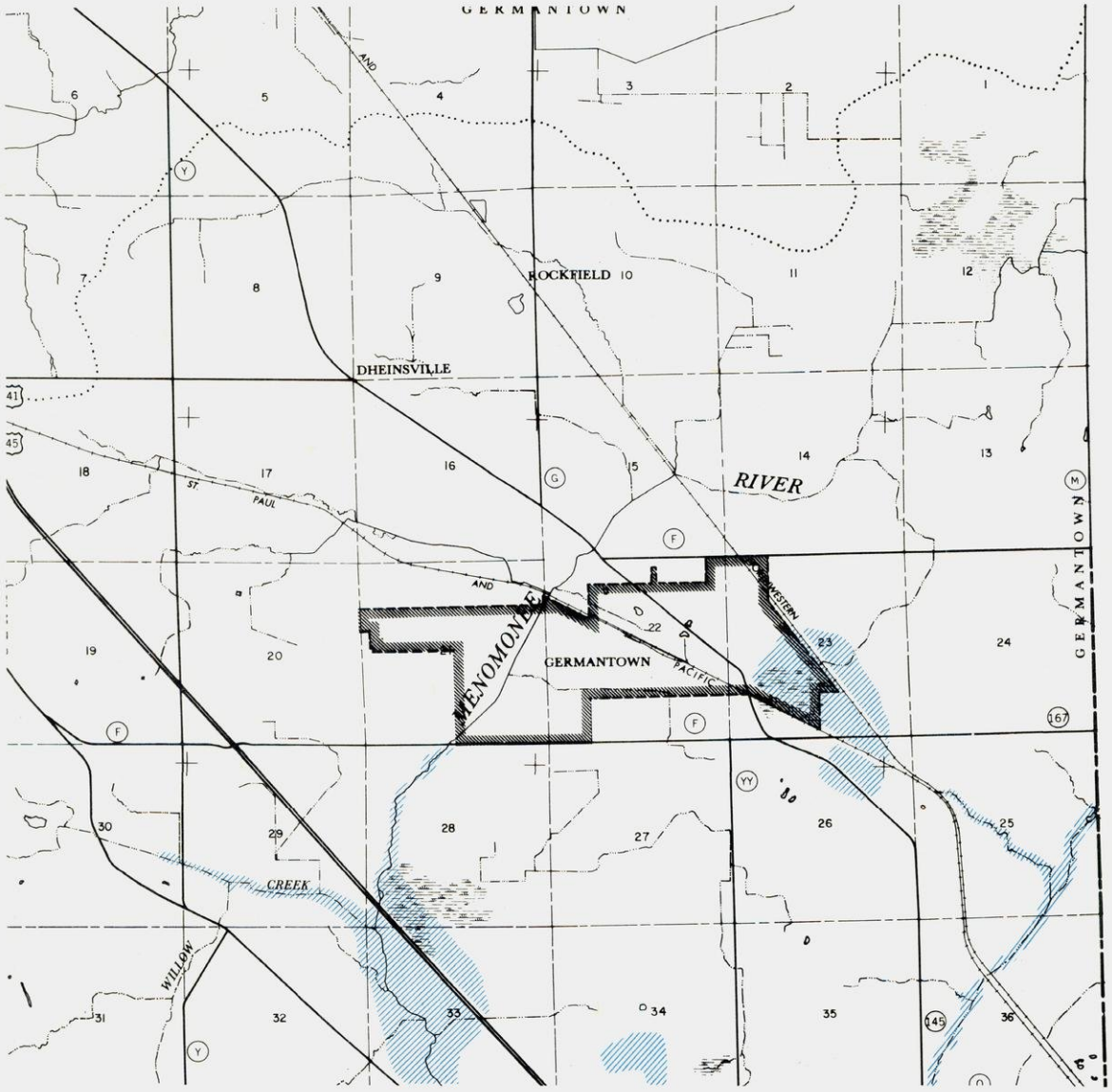
Map 81

FLOOD INUNDATION TOWN OF FARMINGTON



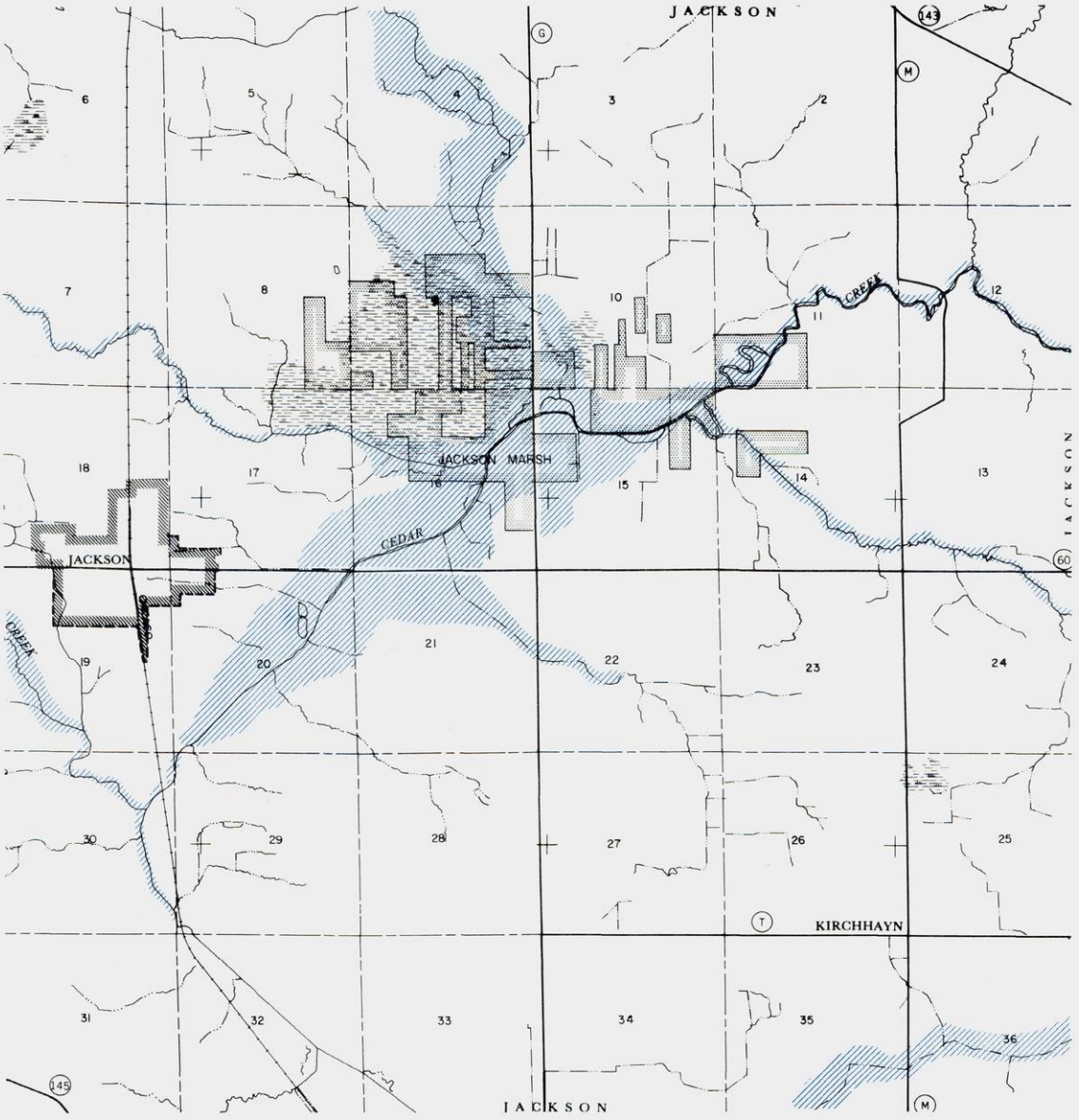
Map 82

FLOOD INUNDATION TOWN OF GERMANTOWN



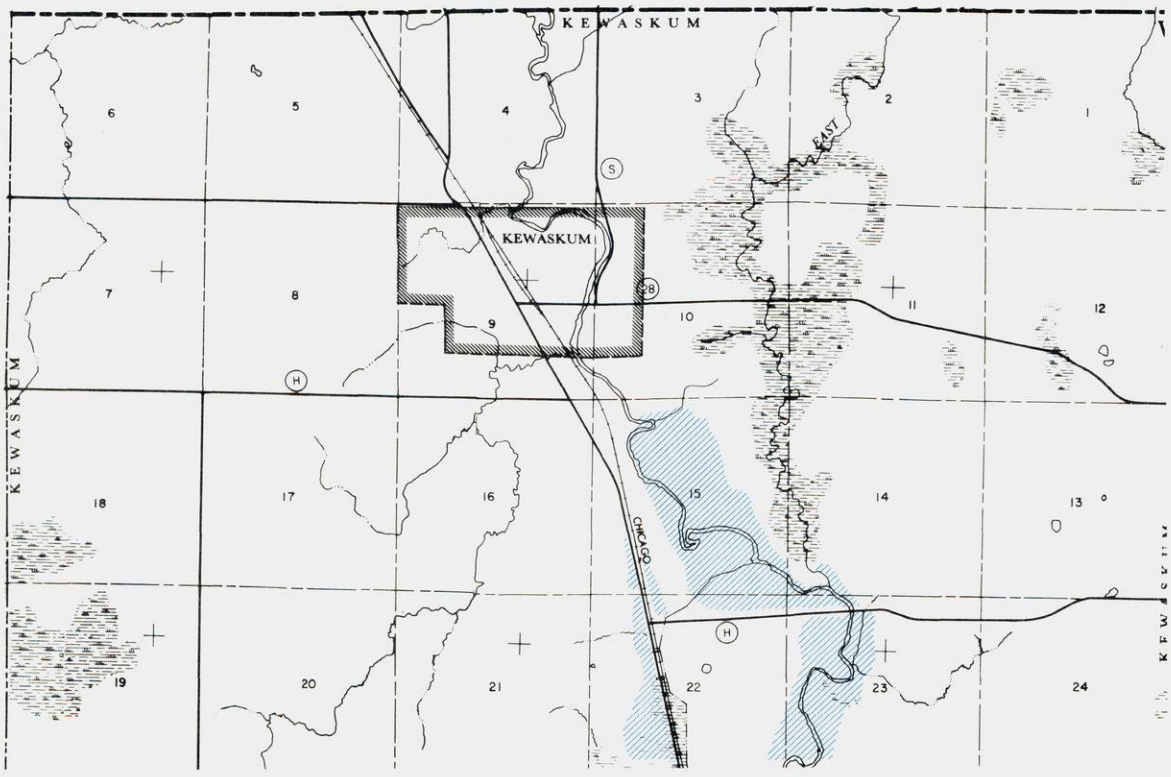
Map 83

FLOOD INUNDATION TOWN OF JACKSON



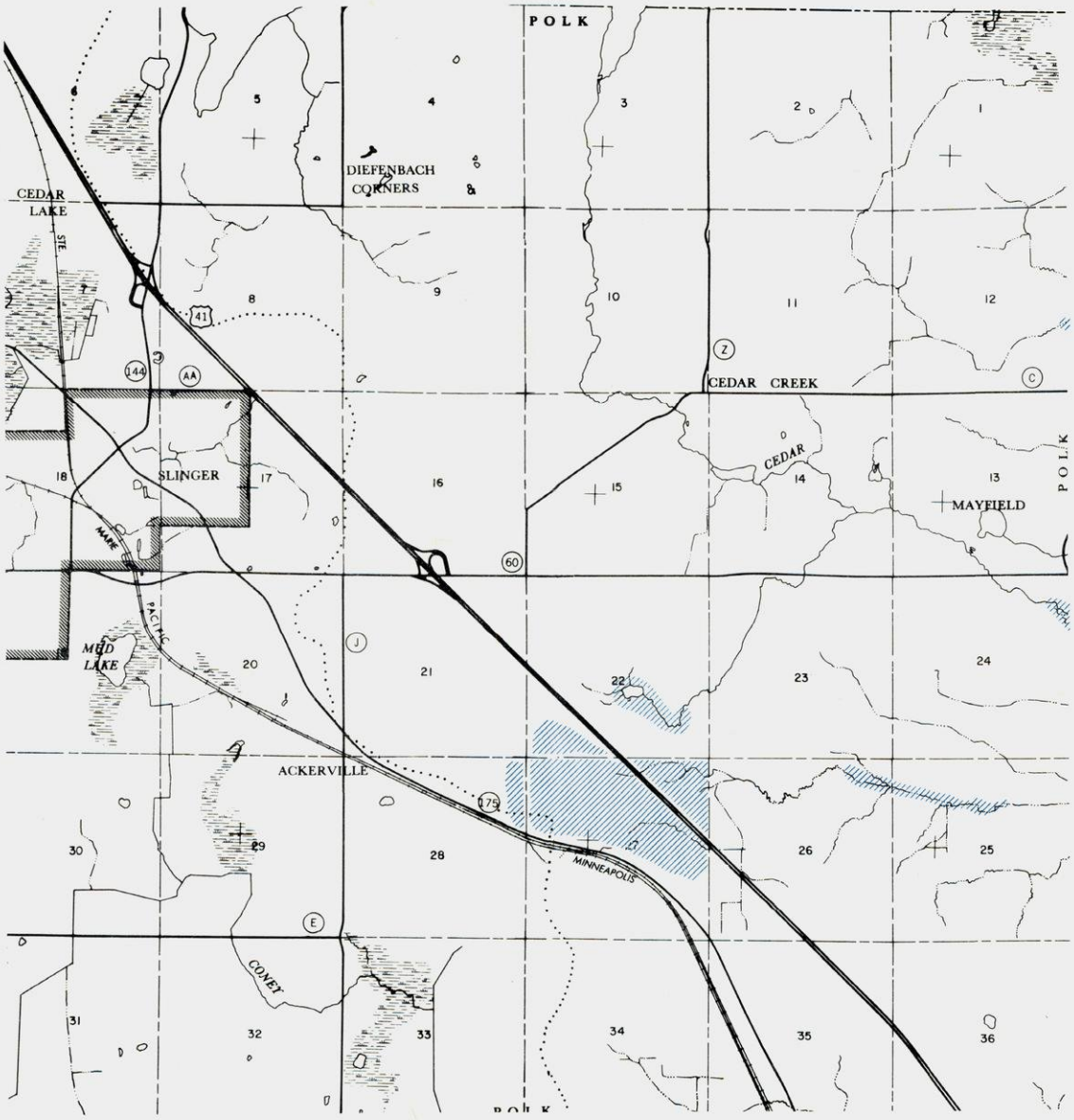
Map 84

FLOOD INUNDATION TOWN OF KEWASKUM



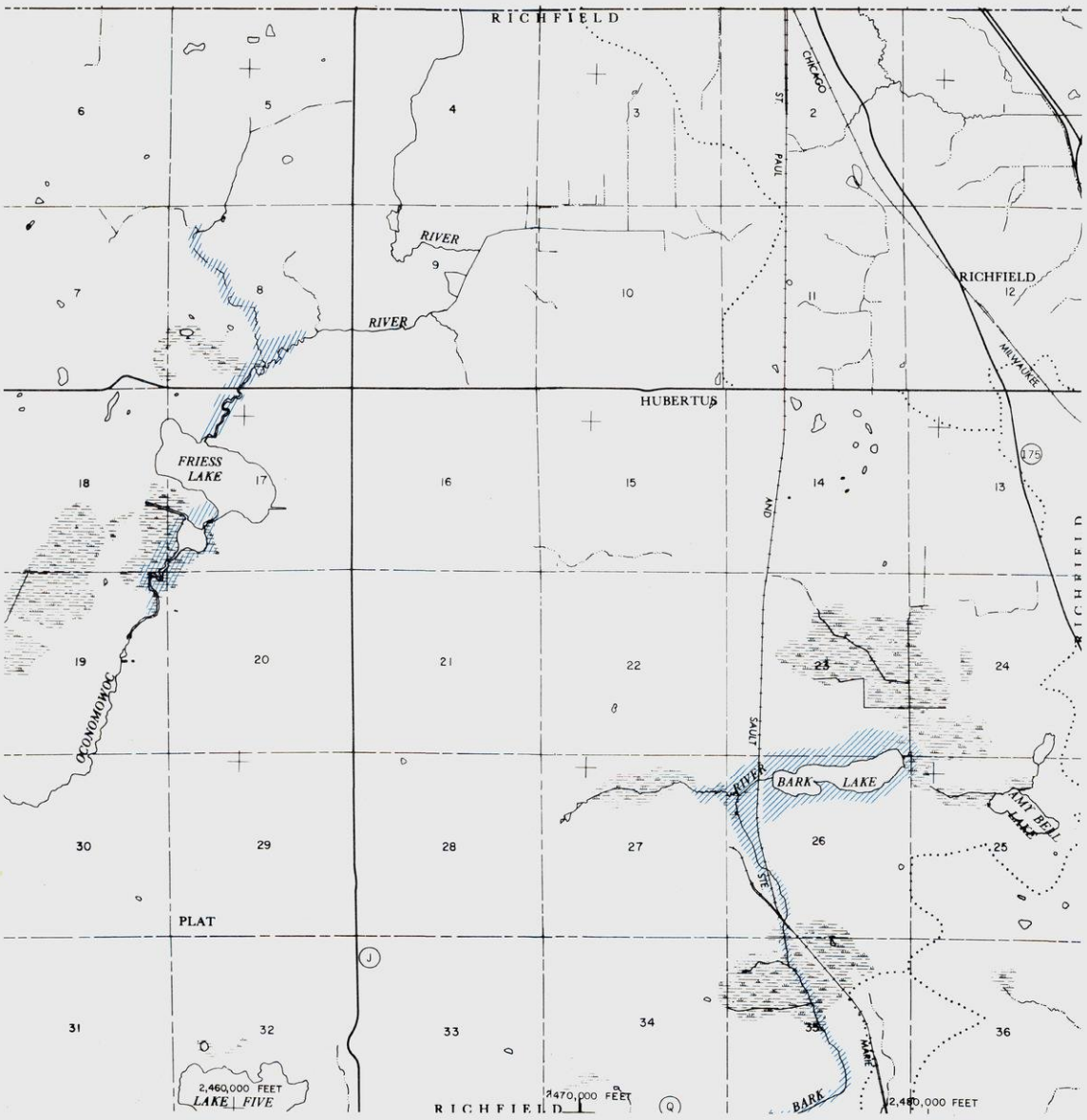
Map 85

FLOOD INUNDATION TOWN OF POLK



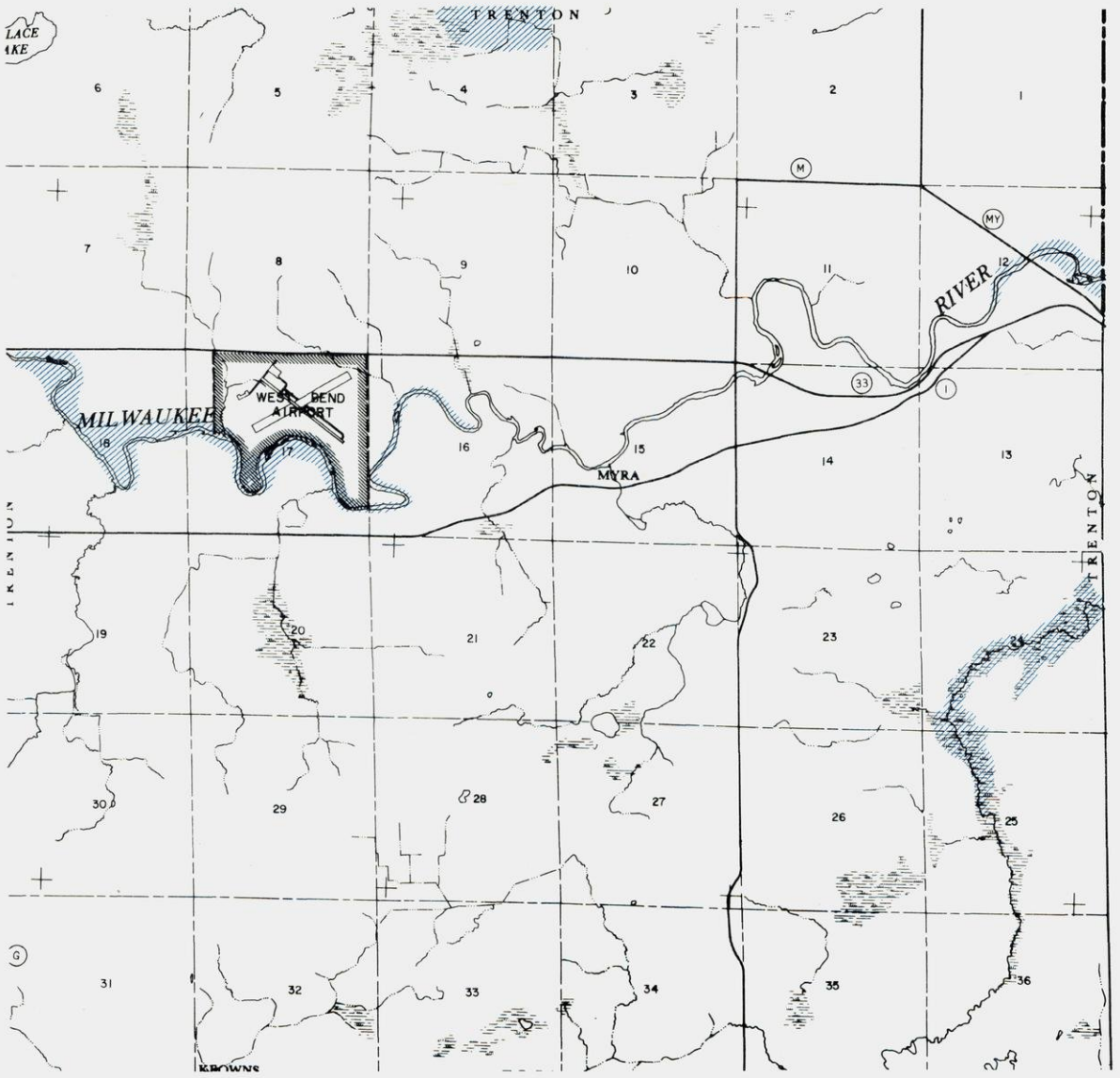
Map 86

FLOOD INUNDATION TOWN OF RICHFIELD



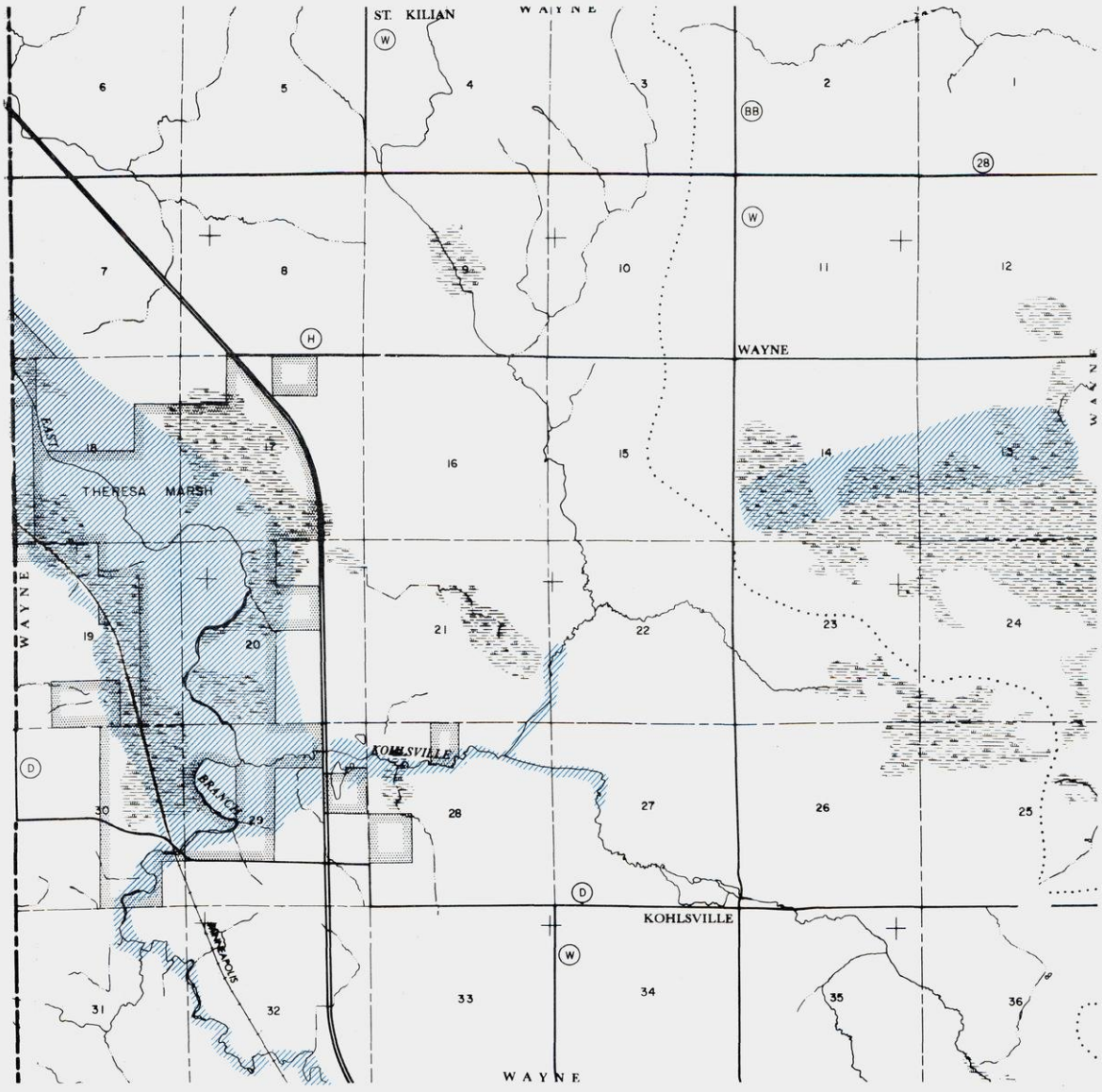
Map 87

FLOOD INUNDATION TOWN OF TRENTON



Map 88

FLOOD INUNDATION TOWN OF WAYNE



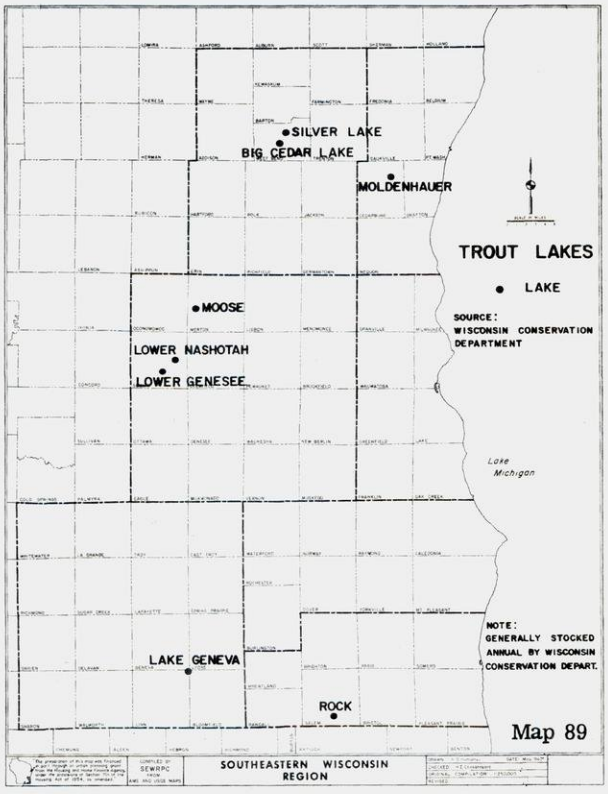
Chapter XII
FISH AND WILDLIFE

Fish and wildlife resources of the Region present a varied picture. Some species of wildlife are more common today than in the pre-settlement period of Wisconsin history (see Table 39) while other species once common have disappeared from this section of the state entirely. Land acreage in public and private ownership, available for wildlife habitat, is in a constant process of change due to the state program in this field under the 1961 Outdoor Resources Act and a longer standing state program of licensing and lease arrangements with private landowners. Lands devoted to wildlife habitat occupy a much smaller percentage of the total area of each county within the Region than is common elsewhere in the state.

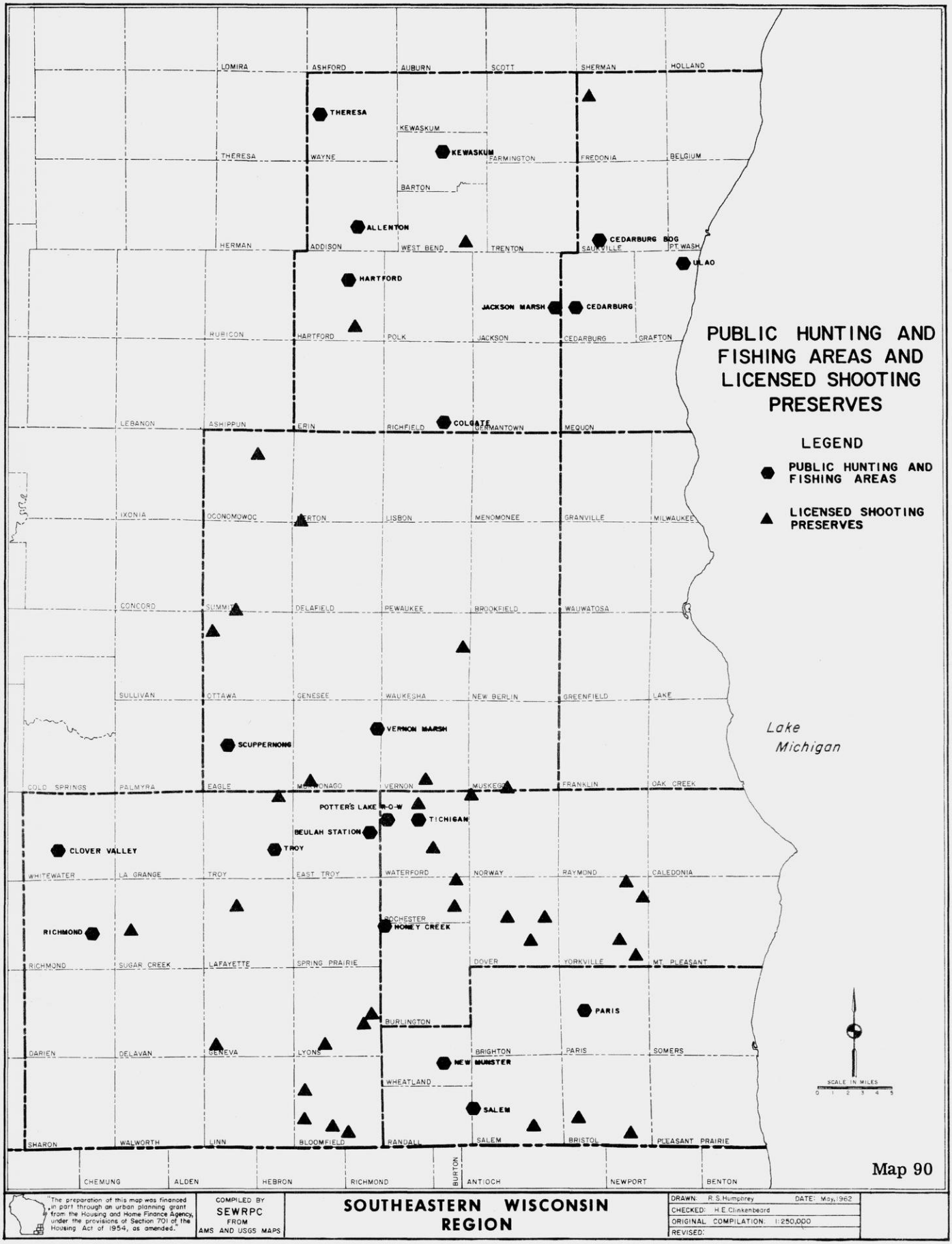
Fish have been better able to maintain themselves in the many streams of the Region than have land mammals. Despite increased pollution and siltation of some lakes and streams, many streams in the Region still support a fair size fishery consisting of panfish, several species of bass, pike, and walleye. There are a number of cold trout streams remaining, and eight lakes in the Region where the conditions of water temperature, depth, bottom conditions, and public access have warranted stocking of trout by the Wisconsin Conservation Department (see Map 89). But an increasing population orientated toward recreation has begun to put heavy pressures upon the available water areas for other competing uses.

Animals common or fairly common in the less densely populated parts of the Region include red fox, gray fox, white-tailed deer, skunk, raccoon, muskrat, gray squirrel, opossum, mink, weasel, woodchuck, jackrabbit, and cottontail rabbit. Game birds which are fairly common include pheasant, Hungarian partridge, and a number of species of geese, dabbling and diving ducks, and coots (see Tables 38, 39). Notable among wildlife species once common in this section of the state but now gone are the prairie chicken, timber wolf, wild turkey and passenger pigeon (extinct world-wide).

Public areas devoted to the management of game and fish resources in the Region are administered by the Wisconsin Conservation Department and are generally classified as public hunting, fishing, or conservation areas (see Map 90). There are 20 project areas of this type where lands have been bought or leased for wildlife or fish management purposes by the state. These areas range in size from 5,581 acres in state ownership in six units in Washington County to 18 acres in two units in Ozaukee County. No acreage is held in Milwaukee County (see Tables 36, 37). Publicly acquired and leased areas in all of these units are in a constant process of change, and it is expected that with the present rate of acquisition and development to have the program completed by around 1980. Besides public hunting and fishing areas operated by the Wisconsin Conservation Department, this agency is responsible for licensing private shooting preserves where individuals upon payment of a fee to the landowner can hunt game under established hunting regulations. In 1963, there were 38 licensed shooting preserves in the Region covering a total land area of 19,139 acres. Racine County has the largest acreage devoted to this purpose with 7,886 acres.



Map 89



Map 90

"The preparation of this map was financed in part through an urban planning grant from the Housing and Home Finance Agency, under the provisions of Section 701 of the Housing Act of 1954, as amended."

COMPILED BY SEWRPC FROM AMS AND USGS MAPS

SOUTHEASTERN WISCONSIN REGION

DRAWN: R.S.Humphrey DATE: May, 1962
CHECKED: H.E.Clinkenbeard
ORIGINAL COMPILATION: 1:250,000
REVISED:

Table 36

STATE OPERATED GAME AND FISH MANAGEMENT PROJECTS BY COUNTY, 1963[1]

	Game Management				Fish Management				Combined Total
	Acreage Goal	Acreage at Present	Acreage Yet To Buy	Project Completion	Acreage Goal	Acreage at Present	Acreage Yet To Buy	Project Completion	Acreage at Present
Kenosha	3384.50	1000.96	2383.54	1973	1249.59	100.60	1148.99	1975	1101.56
Milwaukee	—	—	—	—	—	—	—	—	—
Ozaukee	18.50	18.50	—	—	360.00	—	360.00	1980	18.50
Racine	5988.43	1612.19	4376.24	1973	918.00	27.50	890.50	1975	1639.69
Walworth	4056.50	348.50	3708.00	1973	3164.69	695.48	2469.21	1975	1043.98
Washington	9445.06	5581.02	3864.04	1970	1150.00	—	1150.00	1980	5581.02
Waukesha	8407.71	3032.93	5374.78	1970	717.51	49.30	668.21	1975	3082.23
Total	31300.70	11594.10	19706.60		7559.79	872.88	6686.91		12466.98

[1] Correct to June 30, 1963

Source: Wisconsin Conservation Department

Table 37

ACREAGE OF STATE GAME AND FISH MANAGEMENT PROJECTS, 1963[1]

Units	Present Acres	Acreage Goal	Expected Completion Date
Game Management			
Kenosha			
New Munster	1000.96	1384.50	1968
Scattered Wetlands	——	2000.00	1973
Ozaukee			
Cedarburg	18.50	18.50	Complete
Racine			
Honey Creek	529.66	1529.43	1969
Karcher Marsh	200.23	505.00	1967
Scattered Wetlands	——	2300.00	1973
Tichigan	882.30	1654.00	1971
Walworth			
Clover Valley	201.00	201.00	Complete
Honey Creek	40.00	200.00	1969
Scattered Wetlands	102.00	3650.00	1973
Troy	5.50	5.50	Complete
Washington			
Allenton	876.68	1591.45	1969
Jackson Marsh	1191.48	2400.50	1967
Theresa Marsh	3512.86	5453.11	1965
Waukesha			
Scuppernong	489.00	3652.00	1971
Vernon Marsh	2543.93	4755.71	1965

[1] Some of these projects are also considered as public hunting and fishing areas.

Source: Wisconsin Conservation Department

Table 37 Continued

Fish Management

Units	Present Acres	Acreage Goal	Expected Completion Date
Kenosha			
Silver Lake Marsh	39.00	297.70	1966
Camp Lake Marsh	61.60	451.89	1970
Remnant Fish Habitat Areas	——	500.00	1975
Ozaukee			
Milwaukee River	——	360.00	1980
Racine			
Eagle Lake Marsh	15.00	268.00	1970-75
Wind Lake Marsh	12.50	250.00	1970-75
Remnant Fish Habitat Areas	——	400.00	1970-75
Walworth			
Turtle Creek	695.48	2372.69	1970
Bluff Creek	——	792.00	1973
Beulah Lake	——	Remnant[2]	1970-75
Lauderdale Chain	——	Remnant[2]	1970-75
Washington			
Milwaukee River	——	360.00	1975-80
Green Lake	——	340.00	1970-75
Erler Lake	——	Remnant[2]	1970-75
Gilbert Lake	——	450.00	1970-75
Lucas Lake	——	Remnant[2]	1970-75
Waukesha			
Pewaukee Lake	——	Remnant[2]	1970-75
Eagle Spring Lake	——	Remnant[2]	1970-75
Lower Nemahbin Lake	——	Remnant[2]	1970-75
Mukwonago River	——	Remnant[2]	1970-75
Nagawicka Lake	——	Remnant[2]	1970-75
Oconomowoc River	——	Remnant[2]	1970-75
Okauchee Lake	——	Remnant[2]	1970-75
Lake Keesus	——	37.51	1970-75
Remnant Fish Habitat Areas	49.30	680.00	1975

[2] These areas average about 25 acres. They are fish spawning areas for which no precise acreages have been determined.

Source: Wisconsin Conservation Department

Table 38

SELECTED WILDLIFE SPECIES, CHANGES IN NUMBER IN SOUTHERN WISCONSIN OVER PERIODS IN TIME

Species	Indian Pre-1700	Pre-Settlement 1700 to 1800	Pioneer 1800 to 1860	Agricultural 1860 to 1900	Land and Marsh Development 1900 to 1930	Present 1930 to 1962
Deer	Common	Common	Scarce	Scarce	Scarce	Common
Beaver	Common	Scarce	Scarce	Rare to none	Scarce	Common
Bob White Quail	Common	Common	Very abundant	Common	Scarce	Scarce
Prairie Chicken	Common	Very abundant	Very abundant	Very abundant	Scarce	None
Timber Wolf	Very abundant	Very abundant	Very abundant	Scarce	None	None

Source: Wisconsin Conservation Department

Table 39

FISH AND WILDLIFE OF SOUTHEASTERN WISCONSIN, THEIR RANGE AND PREVALENCE IN 1738, 1938 AND 1962

Species	1738	1938	1962
Big Game -			
Buffalo	Common	None	None
Woodland Caribou	Rare	None	None
Cougar	Rare	None	None
Elk	Common but scattered	None	None
Black Bear	Common	None	None
Timber Wolf	Common	None	None
Lynx	Common	None	None
Bobcat	Common	Rare	None
Red Fox	Common	Common to abundant	Fairly common
Gray Fox	Common	Common to abundant	Fairly common
White-tailed Deer	Rare	Fairly common but scattered	Fairly common but scattered
Small Game -			
Beaver	Common	Rare	Rare
Otter	Common	Rare	Rare
Badger	Fairly Common	Rare	Rare
Skunk	Common	Common, abundant in farm areas	Common
Raccoons	Common	Common	Fairly common
Muskrat	Common	Common	Common
Gray Squirrel	Common	Common	Common
Opossum	Rare	Common	Common
Mink	Common	Fairly common	Fairly common
Weasel	Common	Fairly common	Fairly common
Woodchuck	Rare	Fairly common	Fairly common
Jack Rabbit	Rare	Fairly common	Fairly common
Cottontail Rabbit	Common	Common	Common
Porcupines	Fairly common	None	None
Game Birds -			
Wild Turkey	Common	None	None
Passenger Pigeon	Common	None	None
Pheasant	None[1]	Common	Common
Bob White Quail	None	Fairly common	Fairly common
Hungarian Partridge	None[2]	Common	Common
Ruffed Grouse	Common	Rare	Rare
Sharp-tailed Grouse	Common	Rare	None
Prairie Chicken	Fairly common	None	None
Geese	Common	Fairly common, but greatly reduced	Fairly common
Dabbling Ducks	Common	Fairly common, but greatly reduced	Fairly common, but greatly reduced
Diving Ducks	Common	Fairly common, but greatly reduced	Fairly common, but greatly reduced
Coots	Common	Common	Fairly common, but greatly reduced

[1] Introduced into state from Europe in 1916
[2] Introduced into state from Europe in 1908

Source: Wisconsin Conservation Department

Table 40

STATE AND COUNTY AREAS IN PUBLIC OWNERSHIP OR LEASE AVAILABLE FOR RECREATION, 1963

(IN ACRES)

Units	Kenosha	Milwaukee	Ozaukee	Racine	Walworth	Washington	Waukesha
Water Areas[1]	3,200.00	-	700.00	3,800.00	12,800.00	5,200.00	16,700.00
State Park and Forest Areas	-	-	870.00	-	2,901.66	2,420.00	6,355.00
County Park Area	883.00	11,574.90	410.00	259.50	100.00	-	1,125.00
Public Hunting, Fishing and Conservation Areas							
State Owned	1,101.56	-	18.50	1,639.69	1,043.98	5,581.02	3,082.23
Leased (1963)[2]	4,788.00	-	3,262.00	974.00	11,511.00	4,230.00	2,400.00
Shooting Preserves (Leased 1963)[2]	631.00	-	160.00	7,886.00	5,321.92	429.00	4,704.11
Total	10,603.56	11,574.90	5,420.50	14,559.19	33,678.56	17,860.02	34,366.34
County Gross Area[3]	177,900.00	153,000.00	151,100.00	219,500.00	369,900.00	277,800.00	371,200.00
Percent of County Area	5.96	7.56	3.58	6.63	9.10	6.42	9.25

[1] Figures from Forest Management Summary, Wisconsin Conservation Department.

[2] Acreage leased varies from year to year.

[3] Land and Inland water area combined.

Source: Data from Wisconsin Conservation Department.

Table 41

STATE AND COUNTY RECREATION AREAS AND PROGRAMMED ADDITIONS AS RELATED TO GROSS COUNTY AREA, 1963

(IN ACRES)

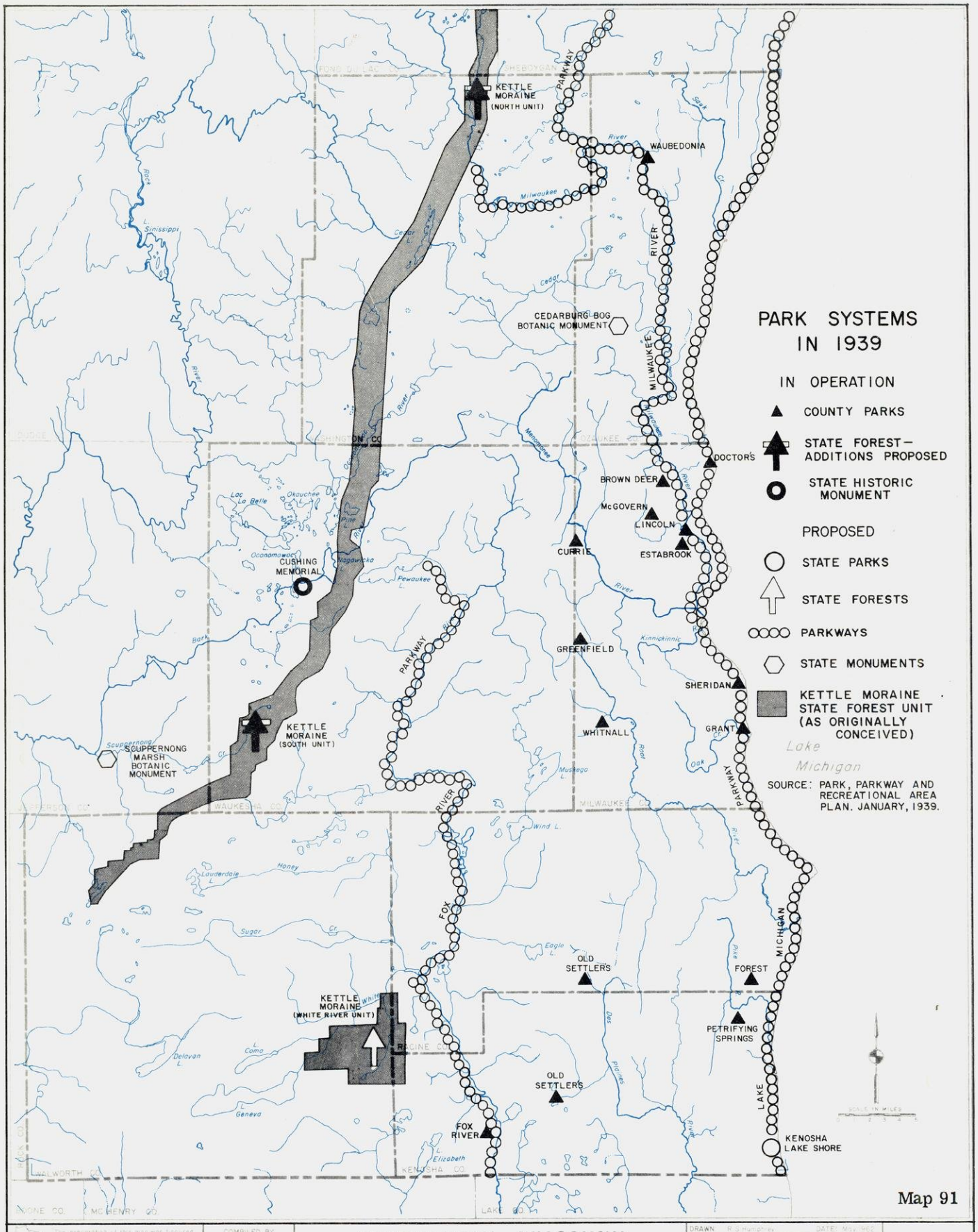
Units	Kenosha	Milwaukee	Ozaukee	Racine	Walworth	Washington	Waukesha
Water Areas[1]	3,200.00	–	700.00	3,800.00	12,800.00	5,200.00	16,700.00
State Park and Forest Areas	–	–	870.00	–	7,125.00	3,630.00	13,009.00
County Park Areas	1,427.00	11,574.90	410.00	259.00	100.00	–	1,125.00
Public Hunting, Fishing and Conservation Areas							
Owned or to be purchased	4,634.09	–	378.50	5,988.43	7,221.19	10,595.06	9,125.22
Leased (1963)[2]	4,788.00	–	3,262.00	974.00	11,511.00	4,230.00	2,400.00
Shooting Preserves (Leased 1963)[2]	631.00	–	160.00	7,886.00	5,321.92	429.00	4,704.11
Total	14,680.09	11,574.90	5,780.50	18,907.93	44,079.11	24,084.06	47,063.33
County Gross Area	177,900.00	153,000.00	151,100.00	219,500.00	369,900.00	277,800.00	371,200.00
Percent of Gross Area[3]	8.25	7.56	3.82	8.61	11.91	8.66	12.67

[1] Figures from Forest Management Summary, Wisconsin Conservation Department.

[2] Acreage leased varies from year to year.

[3] Land and Inland water area combined.

Source: Data from Wisconsin Conservation Department



The preparation of this map was financed in part through an urban planning grant from the Housing and Home Finance Agency under the provisions of Section 701 of the Housing Act of 1954, as amended.	COMPILED BY SEWRPC FROM AMS AND USGS MAPS	SOUTHEASTERN WISCONSIN REGION	DRAWN R.S. Humphrey DATE: May 1962 CHECKED H.F. Dinkenberg ORIGINAL COMPILATION 1:250,000 REVISED

Chapter XIII
RECREATION AND OPEN SPACE

The acquisition and development of suitable recreation areas by state and county government for the growing population of the Region received its initial stimulation during the 1930's. The assistance of the federal government through its Works Progress Administration and Civilian Conservation Corps and the broad interest at the state level in expansion of state park and forest units by the Wisconsin Conservation Department were vital contributing factors during this initial development period. Prior to this time, the Milwaukee County park system had its beginning in the 1920's and was providing some park areas for the recreational needs of the people in that county. The greater interest in recreation during the period prior to World War II led to the further establishment of park units in Milwaukee County and the beginnings of a parkway system adjacent to many of the streams. Racine and Kenosha Counties also established park agencies and with the help of the C.C.C. developed several parks in their respective counties (see Map 91).

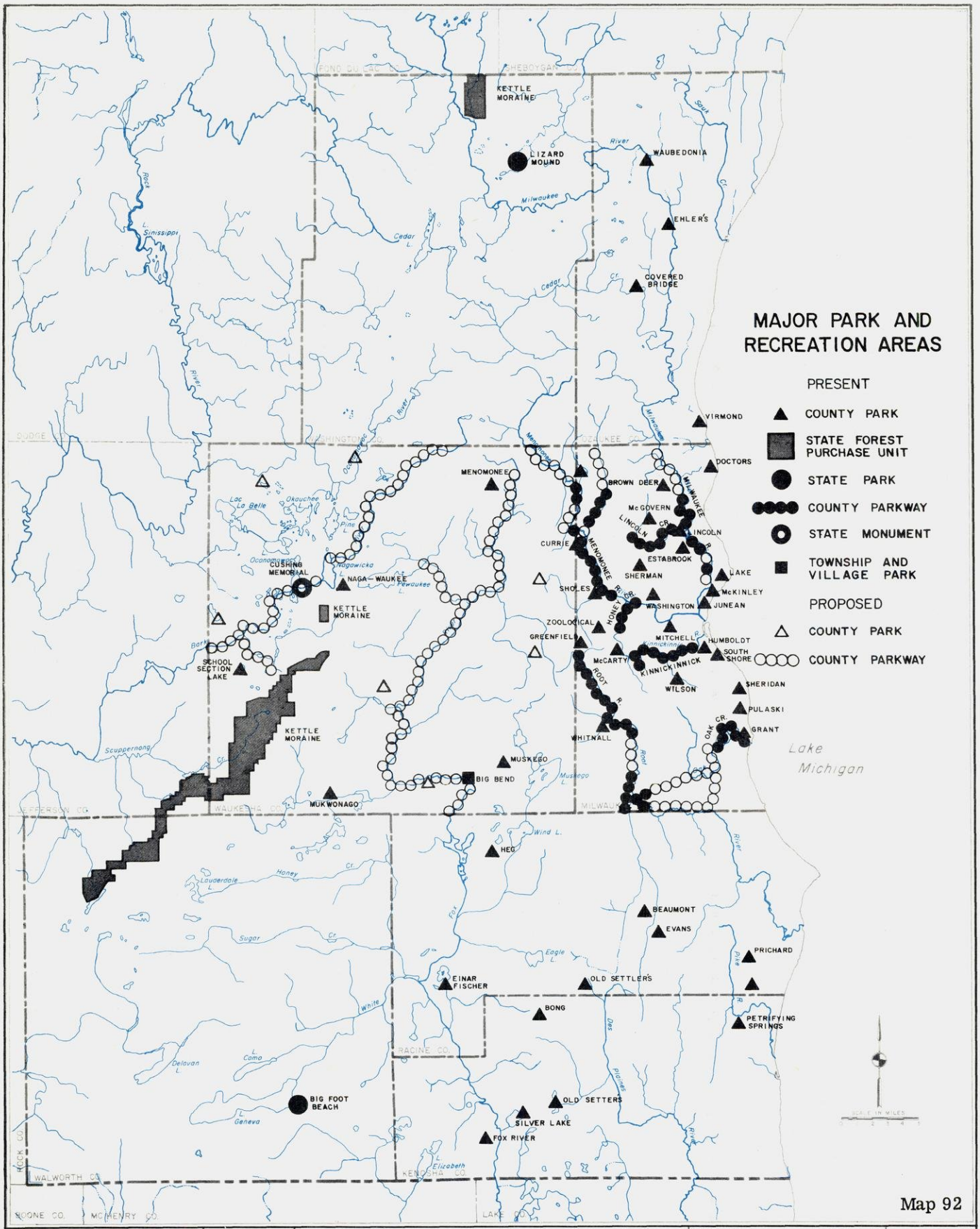
The proposed State Park, Parkway and Recreational Plan of January, 1939, shows a series of parkways extending along the valleys of the Fox and Milwaukee Rivers and the lakeshore of Lake Michigan and the suggested reservation of a long belt of land in western Walworth, Waukesha, Washington, Fond du Lac, and Sheboygan Counties to form the Kettle Moraine State Forest. The parkway proposals of 1939 were never realized except in several small areas in Milwaukee County where lands have been acquired and developed in accordance with the plan by the Milwaukee County Park Commission. In Waukesha County the Waukesha County Park and Planning Commission has incorporated a Fox River parkway as part of its future park plan (see Map 92).

The continuous belt of state forest land which was proposed as the Kettle Moraine State Forest has also not materialized as of this date. Instead, in 1963, there are two separate forest units in state ownership--a southern unit in Walworth and Waukesha Counties and a northern unit in Washington, Fond du Lac, and Sheboygan Counties. It is doubtful if the middle section of the proposed forest unit, which was originally conceived to stretch for 85 miles from north to south, will ever be acquired and the two existing units jointed. Land available in 1939 for $25 an acre is now costing the Washington Conservation Department, the administrator of the park lands, as much as $234 an acre for unimproved land and up to$ 2,400 for improved land.

The five units of the state park and forest system within the Region total 12,546 acres and comprise 3.02 percent of the state park and forest lands in the state (see Table 42). These units presently serve a region which has 39.8 percent of the population of the state and further draws large numbers of people from the Chicago metropolitan area which has a population of approximately 7 million people. State park and forest unit acreage goals in the Region under present programs will total approximately 24,000 acres by 1969, or an increase of 100 percent over present available areas. This acreage will then serve a 1970 population estimated at 2,079,000 people and comprising approximately 46 percent of the population of the state as a whole. These state units, though, will only make up 3.63 percent of the total state park and forest lands which will be available to the people of Wisconsin in 1970 under the present programs.

County park and recreation areas also had their initial development in the 1930's in this area. At the present time all the counties in the Region with the exception of Washington County are operating or developing county administered park areas. Washington County, although it has an active park and planning commission, does not operate any public county parks (see Table 43). Lands in county parks in the Region in 1963 totaled 14,352.4 acres. Of this amount the majority of the lands are in Milwaukee County where the county park systems serving most of the municipalities in the county total 11,574.9 acres.

State and county areas in public ownership or under lease arrangements for recreation in 1963 total 128,063.07 acres for the Region


MAJOR PARK AND RECREATION AREAS
PRESENT
COUNTY PARK
STATE FOREST PURCHASE UNIT
STATE PARK
COUNTY PARKWAY
STATE MONUMENT
TOWNSHIP AND VILLAGE PARK
PROPOSED
COUNTY PARK
COUNTY PARKWAY
KETTLE MORAINE
LIZARD MOUND
WAUBEDONIA
EHLER'S
COVERED BRIDGE
VIRMOND
DOCTORS
MENOMONEE
BROWN DEER
McGOVERN
LINCOLN
CURRIE
ESTABROOK
SHERMAN
LAKE
McKINLEY
JUNEAN
SHOLES
WASHINGTON
ZOOLOGICAL
GREENFIELD
MITCHELL
HUMBOLDT
SOUTH SHORE
McCARTY
KINNICKINNICK
WILSON
SHERIDAN
PULASKI
GRANT
WHITNALL
CUSHING MEMORIAL
NAGA-WAUKEE
SCHOOL SECTION LAKE
MUSKEGO
BIG BEND
MUKWONAGO
Lake Michigan
HEG
BEAUMONT
EVANS
PRICHARD
EINAR FISCHER
OLD SETTLER'S
BONG
PETRIFYING SPRINGS
BIG FOOT BEACH
OLD SETTERS
SILVER LAKE
FOX RIVER
WALWORTH CO.
RACINE CO.
KENOSHA CO.
LAKE CO.
ILL.
MCHENRY CO.
Map 92
SOUTHEASTERN WISCONSIN REGION
COMPILED BY SEWRPC FROM AMS AND USGS MAPS
DRAWN R.S. Humphrey
CHECKED H.F. Dinkelberg
ORIGINAL COMPILATION 1:250,000
REVISED

and comprise 7.44 percent of the gross area of the seven counties. In the Region, Waukesha County has the largest portion of acreage devoted to recreation or wildlife with 9.52 percent. It is closely followed by Walworth County with 9.10 percent of the total county area in use for recreation. Ozaukee County, on the other hand, has only 3.58 percent of its total area in recreation and open space (see Table 40). Taking into consideration programmed additions as of 1963 to the above areas, there will be 166,169.92 acres in state or county ownership or under lease arrangement devoted to recreation or open space by 1980 or 9.66 percent of the gross land area of the Region. Waukesha County will still lead in recreational lands with 12.67 percent of the total county area, followed by Walworth County with 11.91 percent of its area in recreation and open space (see Table 41).

There are a number of municipal and private park developments within the Region which due to lack of data were not included in the above analysis. These areas, however, are being inventoried by the SEWRPC in connection with its land use survey, presently under way.

Table 42

STATE PARK AND FOREST AREAS, 1963[1]

County	Units	Present Acres	Acreage Goal	Expected Completion Date
Ozaukee	Cedarburg Bog Wildlife Area	870.00	870.00	-
Walworth	Big Foot Beach State Park	268.66	325.00	1965
	Kettle Moraine State Forest (Southern Purchase Unit)	2633.00	6800.00	1969
Washington	Lizard Mound State Park	20.00	30.00	1964
	Kettle Moraine State Forest (Northern Purchase Unit)	2400.00	3600.00	1968
Waukesha	Cushing Memorial State Park	9.00	9.00	Completed
	Kettle Moraine State Forest (Southern Purchase Unit)	6346.00	13000.00	1969
Total		12546.00	24634.00	-
Total all state parks and forests in Wisconsin		414829.41	680401.97	-
S. E. Wisconsin percent of state total		3.02%	3.63%	-

[1] Figures as of April 1, 1963

Source: Data from Wisconsin Conservation Department

Table 43

COUNTY PARK AND RECREATION AREAS, 1963

Units	Present Acres	Programmed Additions	Total Programmed Acres
Kenosha County			
Fox River	148.5	--	148.5
Old Settler's	8.0	--	8.0
Petrifying Springs	350.0	--	350.0
Bong	360.0	--	360.0
Silver Lake	16.5	244.0	260.5
Bristol Township (new park)	--	[1]	--
Pleasant Prairie Township (new park)	--	300.0	300.0
Total	883.0	544.0	1427.0
Milwaukee County[2]			
Armour	16.3	--	--
Atkinson Triangle	1.2	--	--
Baran	30.6	--	--
Big Bay	7.5	--	--
Bluff	6.7	--	--
Brown Deer	368.1	--	--
Burns Triangle	0.6	--	--
Ceasar's	1.8	--	--
Carver	10.0	--	--
Cathedral Square	2.3	--	--
Center Street	5.0	--	--
Clark Square	2.1	--	--
Columbus	8.1	--	--
Concordia	8.3	--	--
Cooper	8.4	--	--
Cudahy	18.4	--	--
Currie	217.3	--	--
Dineen	59.4	--	--
Doctors	49.5	--	--
Estabrook	115.1	--	--
Euclid	9.2	--	--
Franklin Nursery	10.0	--	--
Garden Homes Square	1.9	--	--
Garfield	9.1	--	--
Gilman Triangle	0.4	--	--
Gordon	13.7	--	--
Grant	360.3	--	--
Grantosa Creek Parkway	9.7	--	--
Greene	37.8	--	--
Greenfield	286.9	--	--
Highland	3.4	--	--
Holler	16.4	--	--
Holt	26.8	--	--
Honey Creek Parkway	161.6	--	--
Hoyt	35.1	--	--
Humboldt	70.6	--	--
Jackson	117.4	--	--
Jacobus	29.5	--	--
Juneau	17.3	--	--
Kern	28.3	--	--
Kinnickinnic River Parkway	240.6	--	--
Kletzsch	118.9	--	--
Kosciuszko	34.7	--	--
Lake	136.8	--	--

Table 43 Continued

Units	Present Acres	Programmed Additions	Total Programmed Acres
Milwaukee County Continued			
Lincoln	304.2	--	--
Lincoln Creek Parkway	128.6	--	--
Lincoln Memorial Drive (North)	107.6	--	--
Lincoln Memorial Drive (South)	290.8	--	--
Lindberg	2.5	--	--
Lindsay	10.4	--	--
Little Menomonee River Parkway	567.3	--	--
Lyons	12.9	--	--
Manitoba	5.0	--	--
Marquette Square	1.2	--	--
Menomonee River Parkway	656.6	--	--
Milwaukee River Parkway	107.5	--	--
Mitchell	60.8	--	--
Morgan Triangle	1.0	--	--
McCarty	60.6	--	--
McGovern	73.5	--	--
McKinley	14.8	--	--
Nash	7.2	--	--
North Golf Course	326.6	--	--
Noyes	20.1	--	--
Oak Creek Parkway	911.1	--	--
Park Site #32	48.1	--	--
Park Site #33	47.4	--	--
Park Site #34	35.9	--	--
Park Site #35	11.9	--	--
Park Site #36	115.2	--	--
Park Site #37	16.4	--	--
Park Site #38	11.5	--	--
Park Site #39	10.1	--	--
Park Site #40	16.2	--	--
Park Site #42	100.0	--	--
Park Site #43	8.5	--	--
Pleasant Valley	7.3	--	--
Prospect	0.6	--	--
Pulaski - Cudahy	16.0	--	--
Pulaski - Milwaukee	17.8	--	--
Rawson	28.1	--	--
Red Arrow	3.5	--	--
Riverside	21.1	--	--
Root River Parkway	2839.8	--	--
Saveland	3.9	--	--
Service	3.5	--	--
Sheridan	66.3	--	--
Sherman	20.8	--	--
Smith	20.2	--	--
South Golf Course	278.3	--	--
South Shore	77.2	--	--
Tippecanoe	14.9	--	--
Underwood Parkway	224.0	--	--
Valley	1.3	--	--
Vogel	9.1	--	--
Wahl	13.7	--	--
Walker Square	2.1	--	--
Warnimont	34.8	--	--
Washington	148.8	--	--
Wedgewood	6.2	--	--
West Milwaukee	20.1	--	--
Whitnall	635.2	--	--

Table 43 Continued

Units	Present Acres	Programmed Additions	Total Programmed Acres
Milwaukee County Continued			
Wilson	78.5	--	--
Wisconsin Avenue	3.4	--	--
Zoo	174.1	--	--
		--	--
Total	11,574.9	--	--
Ozaukee County			
Covered Bridge	12.0	--	12.0
Ehlers	6.0	--	6.0
Virmond	62.0	--	62.0
Waubedonia	45.0	--	45.0
(New Park)	285.0	--	285.0
Total	410.0	--	410.0
Racine County			
Beaumont	1.0	--	1.0
Evans	22.0	--	22.0
Einar Fischer	5.0	--	5.0
Forest	80.0	--	80.0
Heg Memorial	13.5	--	13.5
Old Settler's	12.0	--	12.0
Prichard	45.0	--	45.0
Sanders	80.0	--	80.0
Tabor	1.0	--	1.0
Total	259.5	--	299.5
Walworth County			
Section 3, Richmond Township	100.0	-- [4]	100.0
Total	100.0	--	100.0
Washington County			
No publicly operated parks, none planned at present			
Waukesha County			
Menomonee	314.0	--	314.0
Mukwonago	222.0	--	222.0
Muskego	159.0	--	159.0
Naga-waukee	416.0	--	416.0
School Section Lake Access Point	14.0	--	14.0
Total	1,125.0	--	1,125.0
S.E. Wisconsin Total	14,352.4	544.0	14,896.4

[1] Acreage not determined yet.
[2] Figures for Milwaukee County to December 31, 1962.
[3] Additional acreage to be purchased not determined.
[4] Comprehensive plan for park development in preparation.

Source: Respective County Park Agencies

Chapter XIV
CONCLUSIONS

The problems related to the conservation, management and further development of the natural resources of the Region as presented in this report are many and varied. The basic problem facing the Southeastern Wisconsin Region is not one of actual depletion of the sum total of all land and water resources available, but a deterioration of the quality of these resources, and of imbalance in their distribution across the Region. At the present time there is a sufficient supply of surface and ground water in the Region; but it is not always available in specific geographic locations, in the proper amounts, at the required time and in suitable quality. A similar condition might be said to exist in regard to living space. The Region has over 2600 square miles of land area, with less than 20 percent of this land in urban incorporated places, and approximately one half of this incorporated area highly urbanized. Consequently, the sheer undeveloped space within the Region is adequate for a growing population. However, the supply of good buildable land, properly drained and serviced by adequate transportation and utility facilities, and with access to good recreation areas, is much more limited. Moreover, the most productive land areas should be preserved for agricultural uses, other land areas need to be preserved as open space to enhance the total quality of the environment and to give form and structure to urban development. Thus, as with the water resources, the problem is one of the quality of land presently available for development, in the proper amounts, and with due consideration for maintaining an ecological balance between the activities of man and the natural environment which supports him.

Two factors are primarily responsible for the deterioration of and imbalance in the Region's natural resource base. One is the unprecedented growth and decentralization of population in the Region and the second is the tremendous progress of American technology which has placed into the hands of man tools with which he can manipulate and change his environment almost at will. Any solutions to the natural resource problems of the Region must consider these two factors which serve to make the resource problems very complex. In any case, concerted effort will be needed on the part of governmental bodies, citizens' groups, and individuals alike to prevent the further deterioration of the Region's resource base and to initiate the necessary programs to enhance and conserve what remains.

Some of the more pressing natural resource problems of the Region are listed below, categorized by those problems of an areawide nature and those applying more specifically to one or more of the major watersheds within the Region. This listing is followed by recommended future resource oriented programs which could furnish the information essential to the development of constructive public policy for resources conservation and initiation of suitable programs for land and water management in the Region.

A. Regional Resource Problems

Major resource conservation problems presently facing the Region on an areawide basis include:

1. Lack of adequate recreational facilities to meet the needs of a growing population with increasing amounts of leisure time and a rising income level.

2. Lack of sufficient open space to ensure the preservation of those unique rural areas which can refresh the human spirit, and which are essential to shape and order urban development.

3. Conversion of the most productive farm lands to other than agricultural uses.

4. Deterioration and disappearance of wild lands - uplands and wetlands - and other conservation areas suitable for fish and and wildlife habitat, forest cover, water storage, recreation and scenic development.

5. Soil erosion, land deterioration and stream siltation.

6. Improper and conflicting land use development in relationship to the following regional features and facilities: public park and recreation areas; federal and state trunk highways; woodlands and other recreation resources with unique values suitable for future public and private acquisition and development.

B. Watershed Problems

Certain water related resource problems require that a planning area smaller than the Region but larger than the individual county, namely, the watershed or drainage basin, be recognized and considered as a unit. Storm water drainage and flood control facilities must form a single integrated system over an entire watershed, a system capable of carrying both the present runoff loads generated by existing land use development and the future runoff loads that may be generated by changing land use patterns in the watershed. Moreover, drainage and flood control is a problem closely related to other watershed problems such as land and water use, sanitary sewerage and sewage disposal, water quality and stream pollution, and recreation and open space reservation. It is the belief of the Commission that many of these problems can best be solved within a watershed context. A watershed, as such, has certain homogeneous physical features which serve to create a community of interest among its inhabitants and which facilitate problem solving. It is the hope of the Commission that interest citizens and governmental officials will form, with Commission assistance, local watershed committees to attack these problems.

It should be the responsibility of these committees to advise the Commission regarding the most urgent problems in their respective watersheds and to recommend programs of action for the solution of these problems. To date two such watershed committees have been formed. The first of these watershed committees to be created, the Root River Watershed Committee, has defined the problems in the Root River basin and recommended a program for their solution. The second such committee, the Fox River Watershed Committee is presently in the process of defining the problems of that watershed.

1. Root River Watershed.

   Major water related problems, as determined by the Root River Watershed Committee and cited in their report entitled "Root River Watershed Planning Program Prospectus," are as follows:

   a. Drainage and flood control.

   b. Land use development in relation to the Root River and its floodways and flood plains.

   c. Recreation and public open space reservation.

   d. Stream pollution and water quality.

2. The other major watersheds in the Region including the Fox (Illinois), Milwaukee, Menomonee, Des Plaines and Rock Rivers share some of the following general resource conservation and water related problems. These problems are listed as guidelines for future consideration by the citizens in each watershed and are not intended to be definitive or to imply that other problems not so listed might not be of equal importance in one or more basin areas.

   a. Flooding.

      Flood water inundation has taken place along many of the Region's streams in a number of lowland areas and has affected both agricultural and urban land uses. Areas of special flood hazard exist on the Fox River in the vicinity of Waukesha and Burlington, and in that stretch of the river between State Trunk Highway 50 and the Fox River park near Silver Lake in Kenosha County; on the Milwaukee River in the vicinity of West Bend, Saukville, and northern Milwaukee County where some transportation facilities and residences have been subject to flooding; and on the Menomonee, Des Plaines and Rock Rivers where some areas devoted to industrial, residential, transportation and agricultural uses have been subject to flooding.

   b. Stream Pollution

      Deteriorating water quality and increasing pollution is a common problem on many of the streams and water courses of the Region. The main con-

tributing sources of pollution are: drainage of agricultural chemicals from crop land, liquid wastes from plants processing agricultural products including milk, liquid wastes from manufacturing industries, effluent from municipal sewage treatment plants, seepage from private septic tanks, overflow from combined sanitary and storm water sewers and unregulated dumping of trash and garbage in the watercourses and their flood ways and flood plains.

c. Recreation and Open Space

Generally, within each watershed there is a need for more water related picnic areas, campsites, points of public access, and swimming facilities in close proximity to the major centers of population in the Region. Such recreation and open space can often be developed in conjunction with floodway and flood plain protection and reservation.

C. Future Resource Orientated Programs

Further regional growth and urbanization will depend to a considerable extent upon the ability of the Regional resource base to sustain such development without creating severe environmental problems. Sound evaluation of the resource capability, formulation of long range resource conservation and management programs, and development of a constructive public policy toward the Region's natural resources will require more definitive knowledge about the Region's resources than now exists. Specific information relating to the land and water resources of the Region should be assembled and acted upon.

Studies necessary to provide data essential for sound resource planning and management within the Region include:

1. Water Resources Study

An investigation and appraisal of the water resources of the Region and its watersheds is necessary to supply hydrologic and hydraulic information not now available. These investigations are needed to provide quantitative information on the occurrence, availability, use, and quality of water and should define present and anticipated water use and supply problems. Such investigations should include:

a. The establishment of an adequate network of surface water gages for continuous measurement of stream flow characteristics within the watersheds of the Region.

b. The delineation of floodway and flood plain areas by a scientific flood hazard mapping program.

c. The establishment of an adequate network of well observation stations for continuous measurement of ground water characteristics including fluctuations in ground water levels.

d. The establishment of an adequate program for monitoring surface water quality.

e. The investigation of the interrelationships of the surface and ground water bodies, including quantitative assessment of the effects of ground-water withdrawals on stream flow, of the drainage of wetlands on ground-water levels, and of the movement of pollution between the surface and ground water bodies.

f. A continuing inventory of sources of surface water pollution.

g. A continuing inventory of sources of ground water pollution.

h. Complete survey of all existing water control structures, including collection of data on their present condition and use, their effect on flood hazards, the extent of backwater and an assessment of the effect of any changes in the control structures on the flow characteristics of the stream systems and on adjacent land uses.

2. Operational Soil Survey

Completion of an operational soil survey for the entire Region, including interpretation for comprehensive planning purposes, is necessary if regional settlement patterns and land use development is to be adjusted to the resource base

and environmental problems avoided.

Note: This study is presently underway as part of the SEWRPC Regional Land Use-Transportation Study and is scheduled for completion in 1966. Results of the study will, however, be available as work proceeds.

3. Park and Open Space Survey

A preliminary park and open space survey is necessary to provide data not now available on a Regional basis relative to the existing supply of both public and private park and open space facilities. Such a survey should include:

a. The determination of the size, location, ownership and primary use of all existing public and private park, recreation and open space areas in the Region, including mapping at a uniform scale.

b. The development of park, recreation and open space planning standards for the various types of recreation space encompassed by the survey.

c. The location and mapping of all potential park, recreation and open space areas within the Region.

d. The field survey of each potential site mapped for further consideration as potential state, county or community level facilities.

Note: This project is also underway as part of the SEWRPC Regional Land Use - Transportation Study and is scheduled for completion in 1965.

4. Weather Observation Network

The expansion of the existing network of meteorological stations should be encouraged to provide accurate data for conducting micro-climatological studies within the Region. Such studies for planning purposes should include data on such factors as: snow depth, evapo-transpiration, precipitation and its relation to storm water runoff, and relative humidity conditions and analyses of this data for planning purposes.

Some of these studies can best be carried out as an integral part of comprehensive watershed planning programs. Others can best be carried out on a regional basis. Some are simple and relatively inexpensive, considering the benefits to be derived. All are essential to a complete understanding of the underlying Regional resource base, to any meaningful resource planning programs, and to the establishment of intelligent resource conservation and management programs. The quantitative information provided by these studies can provide the basis for further state, regional, county and community planning programs.

Appendix A
CHEMICAL ANALYSES OF STREAMS IN SOUTHEASTERN WISCONSIN

Date of Collection	Discharge (cfs)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Alkyl benzene sulfonate (ABS)	Hardness		Specific conductance at 25°C	Sediment		
						Calcium, magnesium	Non-carbonate		PH	ppm	Tons per day
				Root River near Franklin							
Sept. 15, 1961	50[1]	160	83	30	0.2	220	89	513	7.3	84	12
				Root River at Racine							
Sept. 15, 1961	200[1]	160	85	31	0.2	220	89	540	7.1	159	86
				Ashippun River near Montery							
Sept. 14, 1961	100[1]	170	60	5.0	--	204	64	397	7.3	44	12
				Oconomowoc River at Oconomowoc							
Sept. 14, 1961	90[1]	218	39	9.0	--	218	40	422	7.7	17	0.4
				Turtle Creek near Delavan							
Sept. 15, 1961	80[1]	218	35	11	--	211	32	420	7.6	32	7
				Turtle Creek near Clinton							
Sept. 15, 1961	458	232	42	8.5	--	239	49	456	7.6	111	137
				Fox River near Sussex							
Sept. 14, 1961	40[1]	164	58	6.5	0.1	193	58	389	7.3	144	16
				Fox River near Waukesha							
Sept. 14, 1961	75[1]	178	89	18	0.2	241	95	513	7.1	--	--

APPENDIX A

CHEMICAL ANALYSES OF STREAMS IN SOUTHEASTERN WISCONSIN* CONTINUED

Date of Collection	Discharge (cfs)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Alkyl benzene sulfonate (ABS)	Hardness: Calcium, magnesium	Hardness: Non-carbonate	Specific conductance at 25°C	PH	Sediment: ppm	Sediment: Tons per day
Fox River near Mukwonago											
Sept. 15, 1961	75[1]	192	90	14	0.1	261	103	524	7.3	44	9
Fox River at Wilmot											
Sept. 15, 1961	1220	225	68	10	0.1	259	74	508	7.6	161	530
Mukwonago River at Mukwonago											
Sept. 15, 1961	75[1]	278	23	5.0	--	251	22	457	7.8	--	--
Honey Creek at Vienna											
Sept. 15, 1961	75[1]	212	85	6.0	--	266	92	506	7.5	44	9
Sugar Creek at Vienna											
Sept. 15, 1961	--	204	51	6.0	--	223	56	419	7.7	--	--
White River near Burlington											
Sept. 15, 1961	60[1]	214	53	7.0	--	232	56	444	7.6	79	13
Des Plaines River at Pleasant Prairie											
Sept. 15, 1961	90[1]	164	166	18	--	314	179	652	7.5	40	10

Source: U. S. Geological Survey, Quality of Water Branch

[1] Estimated.

NOTE: This recently gathered data is presented as a service to government officials and technicians, no water quality or planning interpretations are made.

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