MEMORANDUM REPORT NO. 145

LAKE AND STREAM RESOURCES CLASSIFICATION PROJECT FOR WAUKESHA COUNTY WISCONSIN:2000

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION
AND THE
WAUKESHA COUNTY DEPARTMENT OF PARKS AND LAND USE

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Special acknowledgement is due to Dr. Jeffrey A. Thornton, CLM, PH, and Dr. Thomas M. Slawski, SEWRPC Principal Planners; Mr. Robert P. Biebel, SEWRPC Special Projects Environmental Engineer and former Chief Environmental Engineer; Mr. Edward J. Schmidt, SEWRPC GIS Planning Specialist; and Mr. Bradley E. Dunker, former SEWRPC Research Analyst for their contributions to the conduct of this study and the preparation of this report.

MEMORANDUM REPORT
NUMBER 145

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Prepared by the

Southeastern Wisconsin Regional Planning Commission
and the
Waukesha County Department of Parks and Land Use

November 2005

Inside Region $ 10.00
Outside Region $ 20.00

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Chapter I

INTRODUCTION

BACKGROUND

In 1997, the Wisconsin Legislature created a lake classification grant program as described under Chapter NR 191 of the *Wisconsin Administrative Code*. This cost-share program was to be administered by the Wisconsin Department of Natural Resources (WDNR) as part of the existing Lake Protection Grant Program, and was intended to further the degree of protection of lakeshore habitat within the State. Waukesha County successfully applied for funds under the Chapter NR 191 Lake Protection Grant Program during 2000 and, in cooperation with the Southeastern Wisconsin Regional Planning Commission (SEWRPC), initiated a program for the classification of the lakes within the County late in that year. The objective of the Waukesha County program was to develop criteria for determining the sensitivity of lakes within the County to disturbance from land-based activities. Subsequent to the initiation of this planning program, Waukesha County refined their request to include the potential classification of streams, and requested that the planning program also develop criteria for determining the sensitivity of streams within the County to disturbance from land-based activities. Specifically, these criteria were to be used to review and potentially refine the County's shoreland and floodland zoning ordinances to provide an appropriate degree of protection for aquatic ecosystems, thereby maintaining ecosystem structure and function amid a changing landscape.

Prior to establishing the lake classification grant program, the Legislature, in 1959, asked the then Wisconsin Conservation Department, now the Wisconsin Department of Natural Resources, to develop a program for classification of lakes and streams by use. In pursuit of this mandate, the Department prepared a series of water resources inventories to document the necessary basic data from which to formulate generalizations necessary for classification. These inventories were prepared on a county-by-county basis, with the summary of the surface water resources of Waukesha County being completed in June 1963.[1] Subsequently, updated data on the water resources of Waukesha County were developed as part of the comprehensive plans for the Fox,[2] Menomonee,[3]

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[1] *Wisconsin Department of Natural Resources,* Surface Water Resources of Waukesha County, *1963.*

[2] *SEWRPC Planning Report No. 12,* A Comprehensive Plan for the Fox River Watershed, *Volume One,* Inventory Findings and Forecasts, *April 1969; Volume Two,* Alternative Plans and Recommended Plan, *February 1970.*

[3] *SEWRPC Planning Report No. 26,* A Comprehensive Plan for the Menomonee River Watershed, *Volume One,* Inventory Findings and Forecast, *October 1976; Volume Two,* Alternative Plans and Recommended Plan, *October 1976.*

Rock,[4] and Root[5] River watersheds; the regional water quality management plan;[6] the County land and water resources management plan;[7] and, by ongoing subwatershed-level data collection and analysis by the WDNR, U.S. Geological Survey, and local agencies and units of government. These documents formed the starting point for the inventories reported herein, and form the basis for the current lakes classification program in Waukesha County.

The basic motivations for both the current and the 1963 classification programs were similar; namely, the realization that use of, and demand for, surface waters is increasing, and, as uses grow and intensify, conflicts of interests arise. Conflicts of interest occur among various user groups, ranging from irrigators to anglers to recreational boaters to riparian homeowners, among others. Occasionally, such user conflicts are destructive to both the fabric of water-focused communities and the water resources themselves. Mechanisms are required to ensure the future, harmonious coexistence of water usage consistent with the capacities of the water resources to support such uses. In creating the lakes classification program in 1997, the Legislature noted that previously mandated, State-level mechanisms had been only partially successful in achieving the high degree of protection desired for the waterways of the State. They further indicated that additional measures were required to be developed at the local level to achieve the desired degree of protection and rehabilitation of the State's surface water resources.

As indicated above, this inventory is intended to update the lake resource inventories previously completed by the WDNR and SEWRPC in order to provide a summary of the water quantity and quality characteristics of the lake waters of Waukesha County. This inventory also includes an assessment of current use potentials and methods of protection. Due cognizance is given to the adopted regional water quality management plan, the water quality and water use objectives established therein,[8] and the County land and water resources plan.[9] It is intended to be used as a guide in planning for the wise use and good management of the waters of Waukesha County.

SOURCES OF DATA FOR THIS COMPILATION

The data set forth in this inventory are intended to address the seven areas of water resources and watershed development identified by the Legislature in Section 281.69(5)(b) of the *Wisconsin Statutes*; namely, 1) the size, depth, and shape of the waterbody; 2) the size of the watershed; 3) the quality of the water; 4) the potential for recreational use; 5) the potential for land development; 6) the potential for nonpoint source pollution; and 7) the type and size of the fish and wildlife populations in and around the waterbody. These data were gathered from many sources, and form an important element of this study, which collates and analyzes the findings and recommendations of previous studies relating to the water resources of Waukesha County. The principal sources of information are listed below.

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[4]*Wisconsin Department of Natural Resources,* Upper Rock River Basin Areawide Water Quality Management Plan, *May 1989.*

[5]*SEWRPC Planning Report No. 9,* A Comprehensive Plan for the Root River Watershed, *September 1966.*

[6]*SEWRPC Planning Report No. 30,* A Regional Water Quality Management Plan for Southeastern Wisconsin—2000, *Volume One,* Inventory Findings, *September 1978; Volume Two,* Alternative Plans, *February 1979; Volume Three,* Recommended Plan, *June 1979.*

[7]*Waukesha County,* Land and Water Resource Management Plan: 1999-2002, *January 1999.*

[8]*SEWRPC Planning Report No. 30,* op. cit. *and SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: Update and Status Report, *March 1995.*

[9]*Waukesha County,* Land and Water Resource Management Plan: 1999-2002, op. cit.

1. Water resources management plans prepared by the WDNR and SEWRPC, including SEWRPC Planning Report No. 30, *A Regional Water Quality Management Plan for Southeastern Wisconsin—2000,* Volume One, *Inventory Findings*, published in September 1978; Volume Two, *Alternative Plans*, published in February 1979, Volume Three, *Recommended Plan*, published in June 1979; SEWRPC Memorandum Report No. 93, *A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report*, published in March 1995; SEWRPC Community Assistance Planning Report No. 209, *A Development Plan for Waukesha County, Wisconsin*, published in August 1996; SEWRPC Community Assistance Planning Report No. 47, *A Water Quality Management Plan for Lac La Belle, Waukesha County, Wisconsin*, published in December 1980; SEWRPC Community Assistance Planning Report No. 53, *A Water Quality Management Plan for Okauchee Lake, Waukesha County, Wisconsin,* published in August 1981; Wisconsin Department of Natural Resources Publication No. PUBL-WR-194-86, SEWRPC Community Assistance Planning Report No. 48, *A Water Quality Management Plan for Ashippun Lake, Waukesha County, Wisconsin,* published in January 1982; SEWRPC Community Assistance Planning Report No. 54, *A Water Quality Management Plan for North Lake, Waukesha County, Wisconsin,* published in July 1982; SEWRPC Community Assistance Planning Report No. 58, *A Water Quality Management Plan for Pewaukee Lake, Waukesha County, Wisconsin,* published in March 1984; SEWRPC Community Assistance Planning Report No. 181, *A Water Quality Management Plan for Oconomowoc Lake, Waukesha County, Wisconsin,* published in March 1990; SEWRPC Community Assistance Planning Report No. 187, *A Management Plan for Fowler Lake, Waukesha County, Wisconsin,* published in March 1994; SEWRPC Community Assistance Planning Report No. 222, *A Lake Management Plan for Little Muskego Lake, Waukesha County, Wisconsin,* published in June 1996, SEWRPC Community Assistance Planning Report No. 227, *A Lake Management Plan for Lake Keesus, Waukesha County, Wisconsin,* published in June 1998; SEWRPC Community Assistance Planning Report No. 262, *A Lake Management Plan for Nagawicka Lake, Waukesha County, Wisconsin*, published in March 2001; SEWRPC Memorandum Report No. 56, *A Lakefront Recreational Use and Waterway Protection Plan for the Village of Pewaukee*, published in March 1996; SEWRPC Memorandum Report No. 81, *Aquatic Plant Management Plan for Phantom Lakes, Waukesha County, Wisconsin,* published in July 1993; SEWRPC Memorandum Report No. 82, *A Lake Protection Plan for Silver Lake, Waukesha County, Wisconsin,* published in July 1993; SEWRPC Memorandum Report No. 94, *A Recommended Public Boating Access and Waterway Protection Plan for Big Muskego Lake, Waukesha County, Wisconsin*, published in July 1994; SEWRPC Memorandum Report No. 120, *A Lake Protection and Recreational Use Plan for Hunters Lake, Waukesha County, Wisconsin,* published in May 1997; SEWRPC Memorandum Report No. 122, *A Lake Protection Plan for Pretty Lake, Waukesha County, Wisconsin,* published in April 1998; SEWRPC Memorandum Report No. 124, *An Aquatic Plant Inventory for Pine Lake, Waukesha County, Wisconsin,* published in December 1998; SEWRPC Memorandum Report No. 130, *A Lake and Watershed Inventory for Nagawicka Lake, Waukesha County, Wisconsin*, published in March 1999; SEWRPC Memorandum Report No. 134, *An Aquatic Plant Management Plan for Fowler Lake, Waukesha County, Wisconsin*, published in October 2000; SEWRPC Memorandum Report No. 135, *A Lake Protection Plan for the Kelly Lakes, Milwaukee and Waukesha Counties, Wisconsin*, published in October 2000; Wisconsin Department of Natural Resources Publication No. PUBL-WR-194-86, A *Nonpoint Source Control Plan for the Oconomowoc River Priority Watershed Project*, published in March 1986; Wisconsin Department of Natural Resources Publication No. PUBL-WR-255-90, *Upper Fox River Priority Watershed Project: A Nonpoint Source Control Plan*, published in November 1993; and Wisconsin Department of Natural Resources Publication No. PUBL-WR-190-95REV, *Upper Rock River Basin Water Quality Management Plan*, published in July 1995.

2. Data contained in local lake management monitoring and planning program reports, including those programs that are not comprehensive lake management planning programs but that often constitute components of comprehensive plans and provide valuable water resources inventory data.

3. Data contained in the County land and water resources management plan.

4. SEWRPC 1995 orthophotographs available at a scale of one inch equals 400 feet, and related land use and natural areas plans prepared by SEWRPC, including SEWRPC Planning Report No. 45, *A Regional Land Use Plan for Southeastern Wisconsin: 2020*, published in December 1997; SEWRPC Planning Report No. 42, *A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin*, published in September 1997.

5. U.S. Geological Survey reports and maps, including the annual, through 2000, U.S. Geological Survey Open-File Reports, *Water-Quality and Lake-Stage Data for Wisconsin Lakes*, and U.S. Geological Survey Water-Data Reports, *Water Resources Data Wisconsin*.

6. Water resources files of the WDNR Southeast Region Headquarters, including data acquired through the WDNR Self-Help and Long-Term Trend monitoring programs, and SEWRPC, and other relevant data as collected and provided by various public inland lake protection and rehabilitation districts, lake associations, and other collaborating organizations.

The procedures utilized resulted in the collation of a physical and chemical description and a resource value and use assessment for each waterbody inventoried. Available data on all of the major lakes with surface areas of 50 acres in areal extent or greater and the perennial streams were collated during this process. In addition, data on many of the minor lakes and streams were also included in this inventory process.

Chapter II

PHYSICAL DESCRIPTION, CLIMATE, AND NATURAL RESOURCE BASE

INTRODUCTION

Landform, precipitation, freeze-thaw cycles, and land cover and usage are important determinants of water quality and quantity, influencing not only the amount and rate of runoff but also the type and mass of contaminants carried by runoff into the surface and ground waters of the Region. Soil type, land slope, and land use and management practices are among the more important factors to be considered in planning for water quantity and quality conditions. Soil type, land slope, and vegetative cover affect the rate, amount, and quality of stormwater runoff as well as the rate of infiltration into the groundwater system. Land slopes are also important determinants of stormwater runoff rates, and of susceptibility to erosion. Thus, these geographic attributes are the basic components that determine the stream flow patterns, locations of lakes and wetlands, and quality and quantity of the surface water resources of Waukesha County. These elements are reviewed in greater detail in the development plan for Waukesha County,[1] the Waukesha County land and water resource management plan,[2] and the regional natural areas and critical species habitat protection and management and regional land use plans.[3]

TOPOGRAPHY, PHYSICAL GEOGRAPHY AND NATURAL SURFACE WATER DRAINAGE SYSTEMS

The topography of Waukesha County may be described as an undulating plain sloping to the southeast.[4] There are two major drainage systems, and several minor drainage systems, influencing the direction of surface water flow. Of the major drainage systems, the Illinois Fox River and its tributaries drain the central portion of the County to the south, where the River ultimately discharges into the Mississippi River drainage system. Another major drain-

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[1]*SEWRPC Community Assistance Planning Report No. 209,* A Development Plan for Waukesha County, Wisconsin, *August 1996.*

[2]*Waukesha County,* Land and Water Resource Management Plan: 1999-2002, *January 1999.*

[3]*SEWRPC Planning Report No. 45,* A Regional Land Use Plan for Southeastern Wisconsin: 2020, *December 1997; SEWRPC Planning Report No. 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin, *September 1997.*

[4]*S. Weidman and A.R. Schultz,* The Underground and Surface Water Supplies of Wisconsin, *State of Wisconsin, 1915, pages 600-607.*

age system is formed by the Rock River drainage system, which drains the western portions of the County to the west, where the river ultimately discharges into the Mississippi River system. In addition, the northeastern portion of the County drains to Lake Michigan and the Laurentian drainage system through the Menomonee River drainage system. A small portion of the southeastern area of the County drains to Lake Michigan through the Root River drainage system. These waterways are shown on Map 1.

The majority of the natural lakes are located within the northwestern quarter of the County, along the line of the junction of the terminal moraines of the Green Bay and Lake Michigan lobes of the Late Wisconsin Ice Sheet.[5] The moraine ridges are oriented generally in a south-to-north direction across the County. During the late Wisconsin stage of glaciation which occurred approximately 10,000 years before present, the Green Bay glacier moved in a southeasterly direction, and the Michigan glacier moved in a southwesterly direction, across what is now Waukesha County, Wisconsin. As a consequence, most of the natural lakes within the County lie along and within the parallel ridges in the area known as the kettle moraine.[6]

Topographic elevations in Waukesha County, as shown on Map 2, range from approximately 730 feet above the National Geodetic Vertical Datum of 1929 (NGVD-29) in the extreme eastern portions of the County along tributaries of the Menomonee River in Brookfield, Elm Grove, and Menomonee Falls, to 1,233 feet NGVD-29 at Lapham Peak in Delafield, a variation of over 500 feet. Most of the high points in the County are located along the Kettle Moraine in three distinct areas: the southern half of Delafield near Lapham Peak, the southwestern quarter of Lisbon, and between STH 59 and STH 67 in Genesee and Ottawa. Topographic features, particularly slope steepness, have a direct bearing on the potential for soil erosion and the sedimentation of surface waters. Slope steepness affects the velocity, and, accordingly, the erosive potential of runoff. As a result, steep slopes place moderate to severe limitations on urban development and agricultural activities, especially in areas with highly erodible soil types such as in the Kettle Moraine.

Map 3 indicates that significant portions of Waukesha County have slopes exceeding 12 percent, with many such areas located along the Kettle Moraine, in the southwestern portion of the County. Over 57 square miles, or about 10 percent of the total land area of the County, have slopes of 20 percent or greater. About 64 square miles, or about 11 percent of the total land area of the County, have slopes of between 12 and 20 percent. Poorly planned hillside development in these areas can lead to high maintenance costs for public infrastructure development, and severe construction and post-construction erosion problems. Steeply sloped agricultural lands may make the operation of agricultural equipment difficult or even hazardous. Development or cultivation of steeply sloped lands is also likely to negatively impact surface water quality through related erosion and sedimentation.

Geology

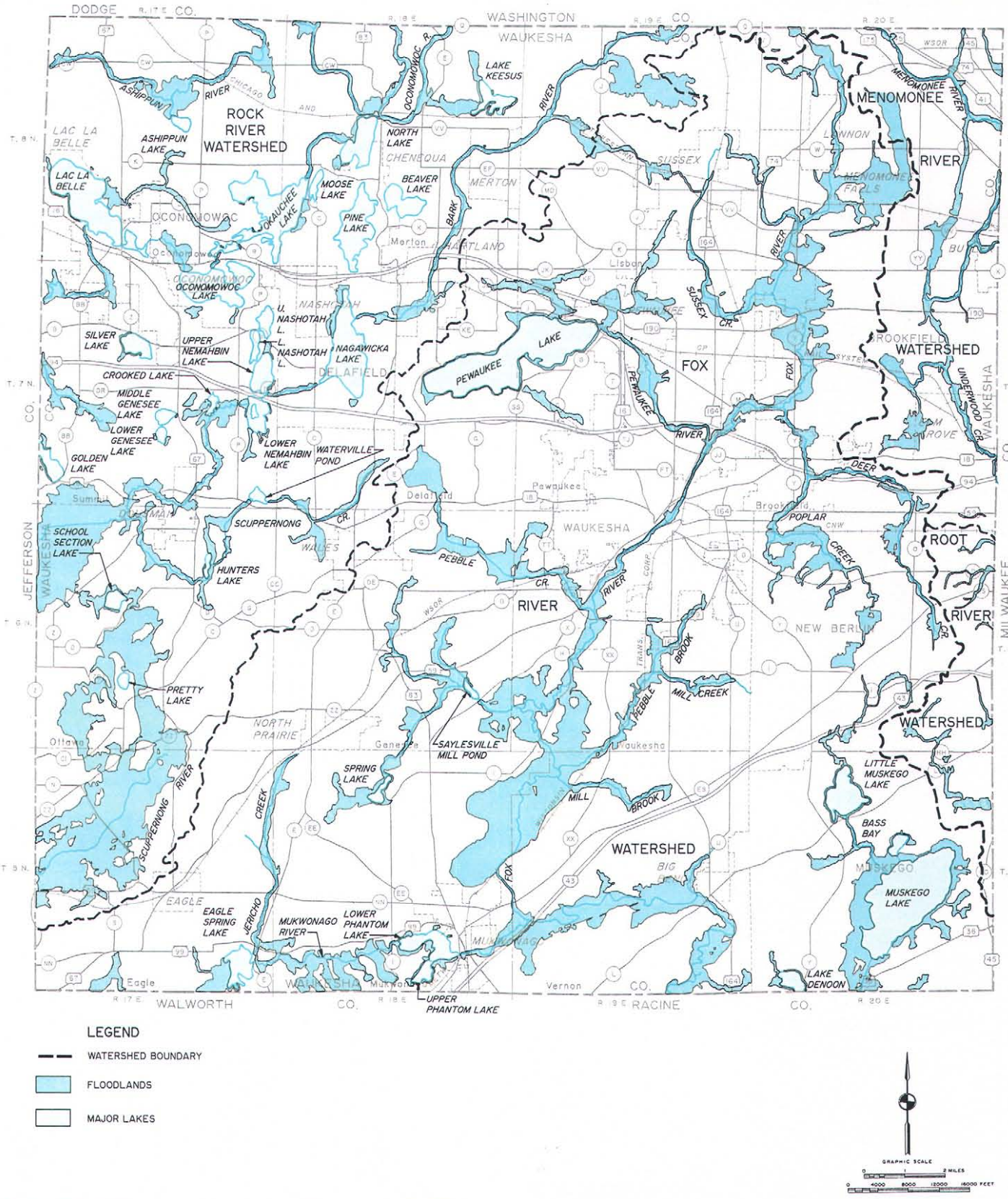
The bedrock and the surfacial deposits overlying the bedrock directly and indirectly affect the quantity and quality of surface water and groundwater in Waukesha County. Water from within the surfacial glacial sand and gravel deposits supplies the shallow wells and springs that occur within the County. Underlying the unconsolidated surfacial deposits is the Niagara limestone (dolomite) formation that immediately underlies more than 90 percent of the surface area of the County. Fissures in the dolomite serve as water storage basins and are frequently tapped by moderately deep wells for water supply purposes. The Niagara dolomite is underlain by a relatively impervious layer of Maquoketa shale. In some pre-Pleistocene valleys in the western portions of the County, however, the Niagara dolomite is absent and the uppermost bedrock unit is the Maquoketa shale. Beneath the Maquoketa shale are dolomite and sandstone formations that constitute the "deep sandstone aquifer." This latter aquifer is relatively unimportant in terms of its influence on the surface water resources of the County since it does not intersect the

[5] *N.M. Fenneman,* Lakes of Southeastern Wisconsin, *State of Wisconsin, 1910, pages 130-139.*

[6] *Wisconsin Conservation Department,* Surface Water Resources of Waukesha County, *1963.*

Map 1

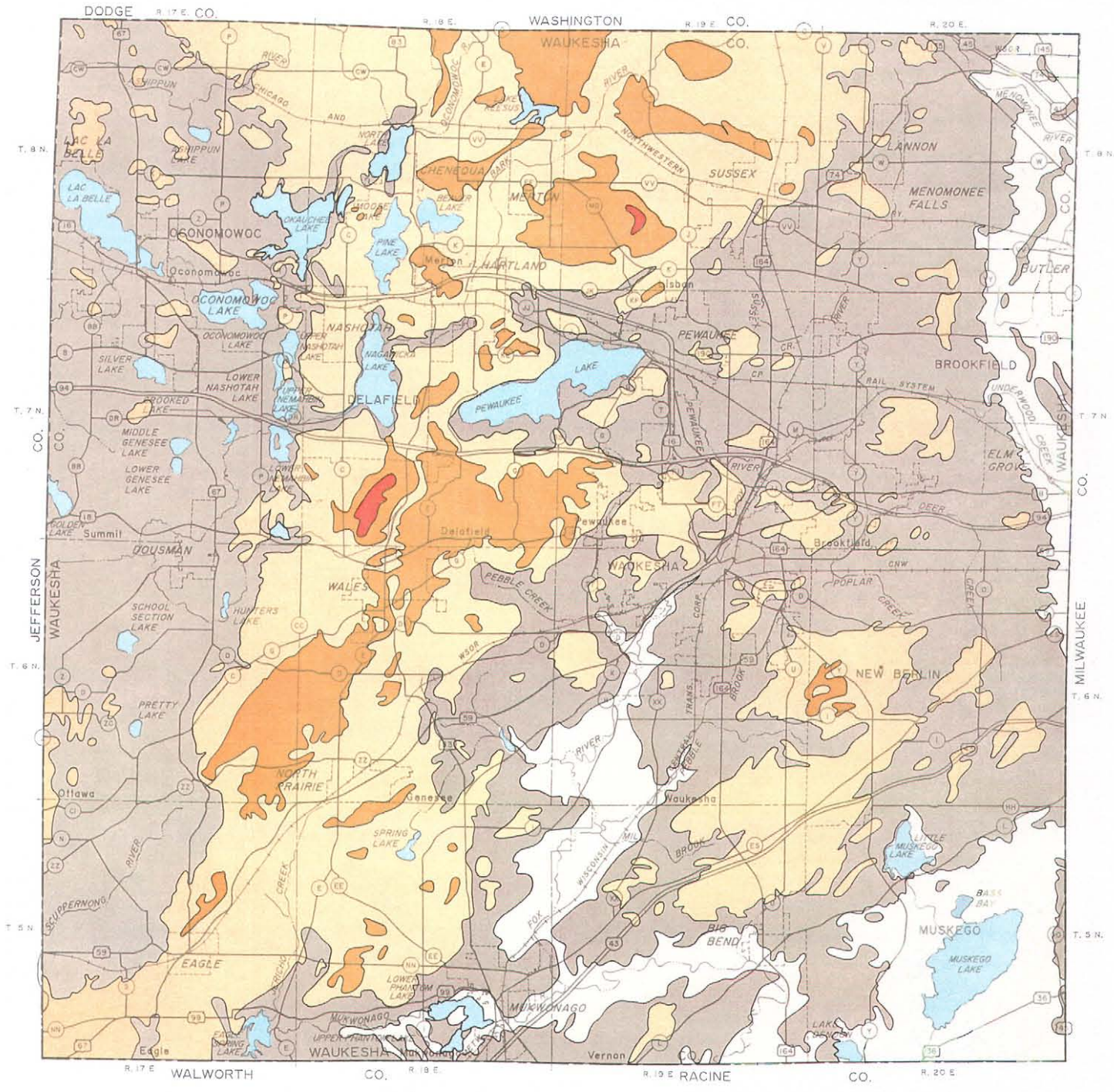
SURFACE WATER RESOURCES AND FLOODLANDS WITHIN WAUKESHA COUNTY: 1995



Source: Federal Emergency Management Agency and SEWRPC.

Map 2

TOPOGRAPHIC CHARACTERISTICS OF WAUKESHA COUNTY



LEGEND

ELEVATION IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM

- 700-800
- 800-900
- 900-1000
- 1000-1100
- 1100-1233

GRAPHIC SCALE

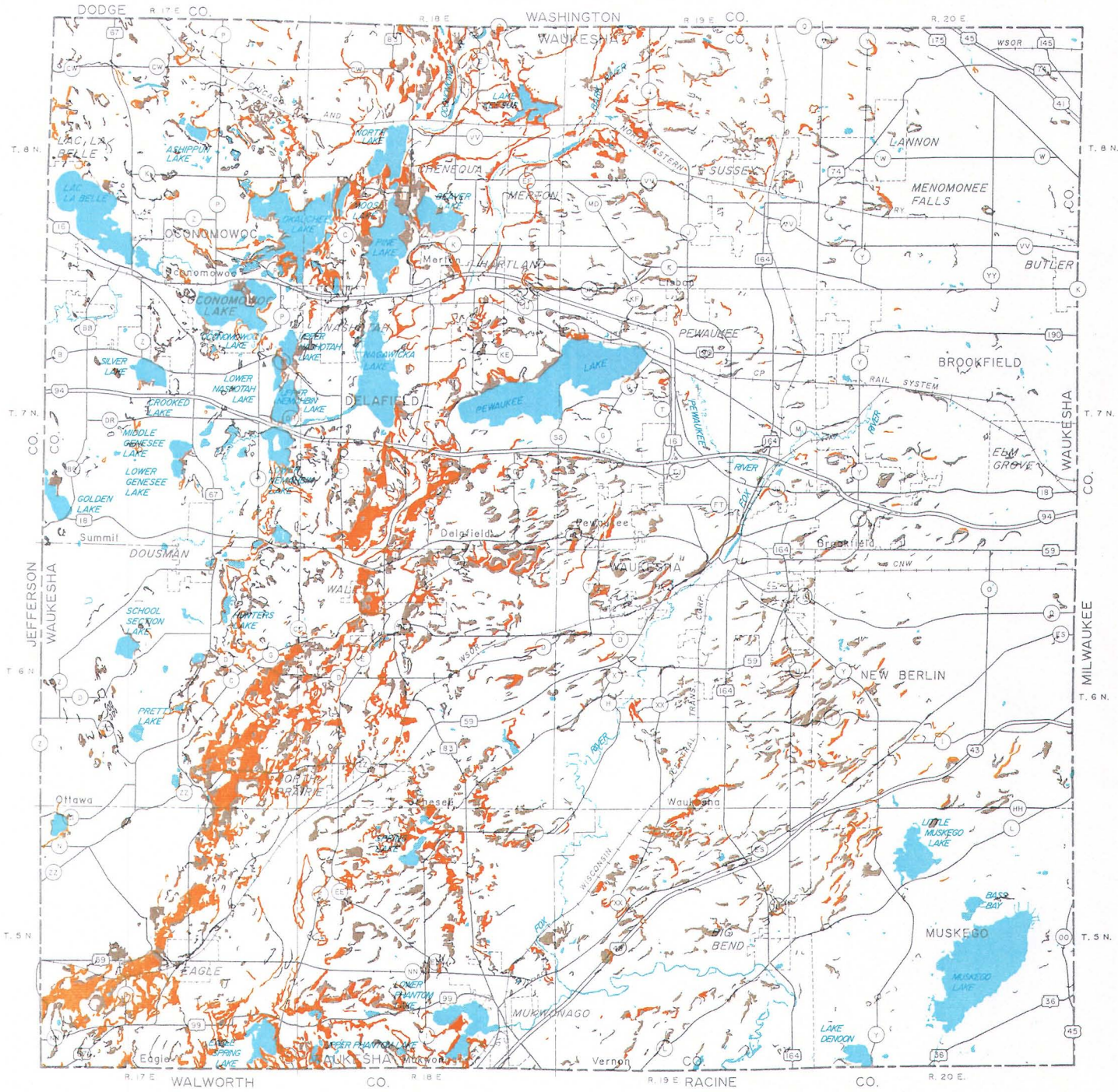
0 1 2 MILES

0 4000 8000 12000 16000 FEET

Source: SEWRPC.

Map 3

SLOPE ANALYSIS FOR WAUKESHA COUNTY



Source: U. S. Soil Conservation Service and SEWRPC.

surface drainage. The general orientation of the aquifers within Waukesha County is shown in Figure 1, which is a cross-sectional view of the bedrock and surfacial deposits,[7] while Map 4 shows the generalized water table elevations.

The bedrock underlying Waukesha County is rich in available carbonate, and contributes to the presence of "mineral" water springs within the County. These waters were exploited for their medicinal value in the early years of the 20th Century, and led to the development of the major urban centers as tourist destinations. Nearly all of the streams in this kettle moraine area generally occur as a result of outflow from the surface intercept of the groundwater table in the glacial drift.

Soils

There are four distinct types of soils that constitute the soil mantle of Waukesha County: lacustrine, glacial, alluvial, and peat soils. Both deep and shallow peat soils are commonly located in the poorly drained kettles situated between the ridges of the moraines, while sandy, alluvial soils are found in the valleys of streams and at the base of the drainage lines that indicate the points of convergence of the two glaciers. The U.S. Natural Resources Conservation Service (NRCS), formerly the U.S. Soil Conservation Service, under contract to SEWRPC, completed a detailed soil survey of the entire seven-county planning region, including Waukesha County in 1966.[8] The soil survey contained interpretations for planning and engineering applications and for suitability for various types of urban land uses, as well as for agricultural applications.

The soils in Waukesha County range from very poorly drained, organic soils to excessively drained, mineral soils. General grouping of these soils into soil associations is useful for comparing the suitability of relatively large areas of the County for various land uses. For this purpose, a soil association, defined as a landscape with a distinctive proportional pattern of soils comprised of one or more major soil types with at least one minor soil type as identified by the NRCS, and named after the major soils, is commonly utilized. Nine such soil associations exist in Waukesha County. Their spatial distribution pattern within the County is shown on Map 5.

Using this regional soil survey, an assessment was made of hydrologic characteristics of the soils in Waukesha County. Soils within the County were categorized into four main hydrologic soil groups, as well as an "other" category, based upon their major soil groups or associations, as indicated on Map 6: moderately well-drained soils, well-drained soils, very poorly drained soils, or disturbed soils for which no hydrologic soil group could be determined.

LAND USE

Development Trends

Early settlements were established in Waukesha County following the completion of the U.S. Public Land survey in 1836. In 1850, urban development was confined largely to settlements within the now incorporated municipalities of Big Bend, Eagle, Hartland, Menomonee Falls, Merton, Mukwonago, Oconomowoc, Pewaukee, and Waukesha. The City of Waukesha was the largest urban center in 1900, and remains so as of 2000. The first half of the 20th century saw additional development around many of these original settlements; the development of settlements in Butler, Dousman, and Wales; and residential and recreational development around many of the County's lakes. Suburban development in the easternmost portion of the County was just starting to materialize in the period between 1940 and 1950.

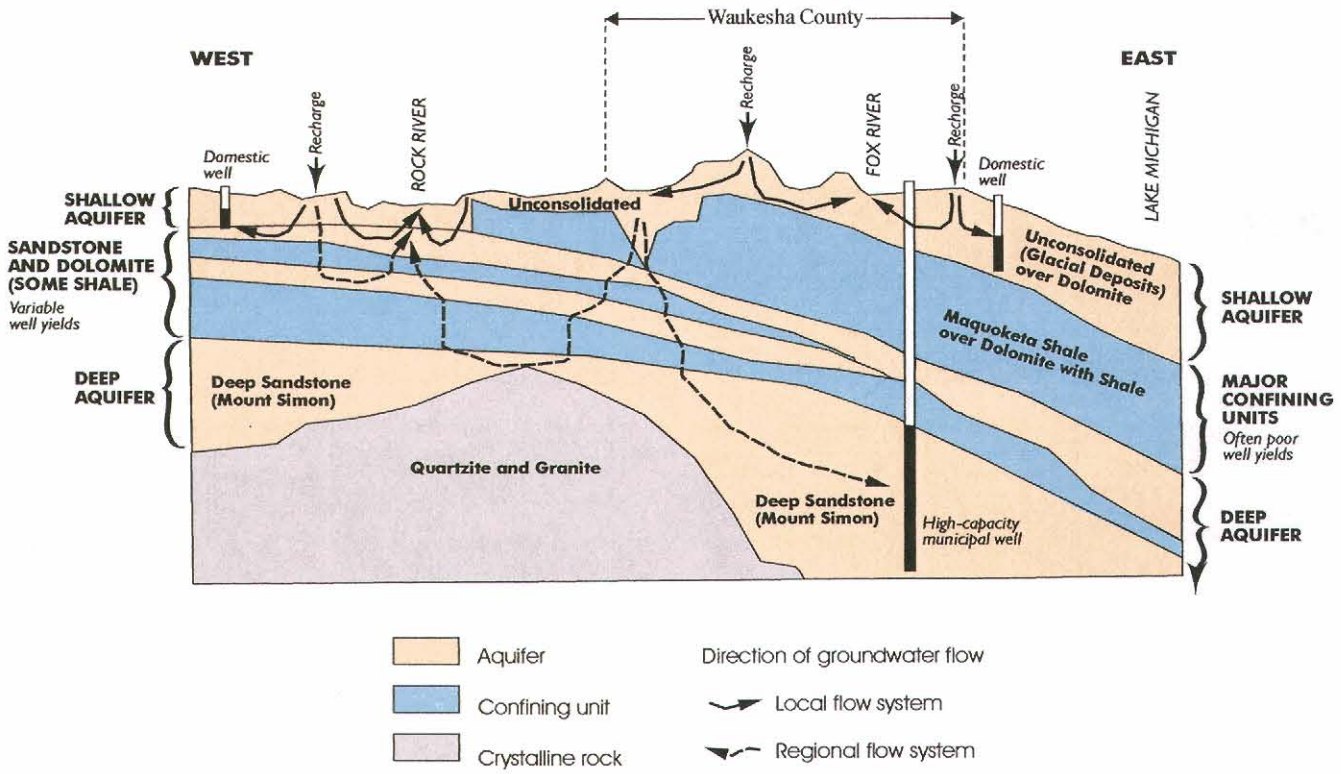
The pace of urban development within the County accelerated after 1950 and has remained rapid since. The 40-year period from 1950 to 1990 saw significant development in the eastern tier of communities in the County,

[7] *SEWRPC Technical Report No. 37,* Groundwater Resources of Southeastern Wisconsin, *June 2002.*

[8] *See SEWRPC Planning Report No. 8,* Soils of Southeastern Wisconsin, *June 1966.*

Figure 1

GEOHYDROLOGIC SECTION THROUGH SOUTHEASTERN WISCONSIN



Source: U.S. Geological Survey, University of Wisconsin-Extension, and SEWRPC.

essentially as an expansion of the Milwaukee metropolitan area, and continued development in and around the City of Waukesha and other established outlying urban centers. In addition, this period saw a proliferation of scattered urban enclaves in many areas of the County far removed from the historic urban centers, particularly after 1963.

The historic increase in the urban land area of the County is shown on Map 7 and is quantitatively summarized in Table 1. The accelerated rate of urban development since 1950 is evident in this table. During the 50-year period from 1900 to 1950, the conversion of land to urban use occurred at an average annual rate of 0.3 square mile per year. Since 1950, urban development has occurred at an average rate of 3.2 square miles per year. This reflects growth in urban lands of about 36 square miles, or a rate of 2.8 square miles per year between 1950 and 1963; 18 square miles, or 2.6 square miles per year, between 1963 and 1970; 48 square miles, or 4.8 square miles per year, between 1970 and 1980; and 24 square miles, or 2.4 square miles per year, between 1980 and 1990. By 1990, the developed area of the County encompassed 144 square miles, or 25 percent of its total area. Between 1990 and 1995, a further 15.4 square miles of urban development was recorded, with urban development occurring at about 3.0 square miles per year during this period.

Map 7 indicates a diffusion of urban development enclaves, away from existing urban centers in the County. This type of development is generally comprised of low-density residential development, reliant upon onsite sewage disposal systems and private wells, located in scattered fashion within otherwise rural areas. Of the approximately

Map 4

GENERALIZED WATER TABLE ELEVATION WITHIN WAUKESHA COUNTY

AVERAGE WATER-TABLE ELEVATION
IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM 1929
(CONTOUR INTERVAL 20 FEET)

SUPPLEMENTAL CONTOUR
(INTERVAL 10 FEET)

WELL DATA POINT
(DATA HAVE NOT BEEN FIELD CHECKED)

SURFACE WATER POINT

GENERAL DIRECTION OF SHALLOW GROUNDWATER FLOW

GROUNDWATER DIVIDE

PRIMARY DIVIDE

SECONDARY DIVIDE

SURFACE WATER DIVIDE

SUBCONTINENTAL DIVIDE

MAJOR WATERSHED DIVIDE

SURFACE WATER

GRAPHIC SCALE

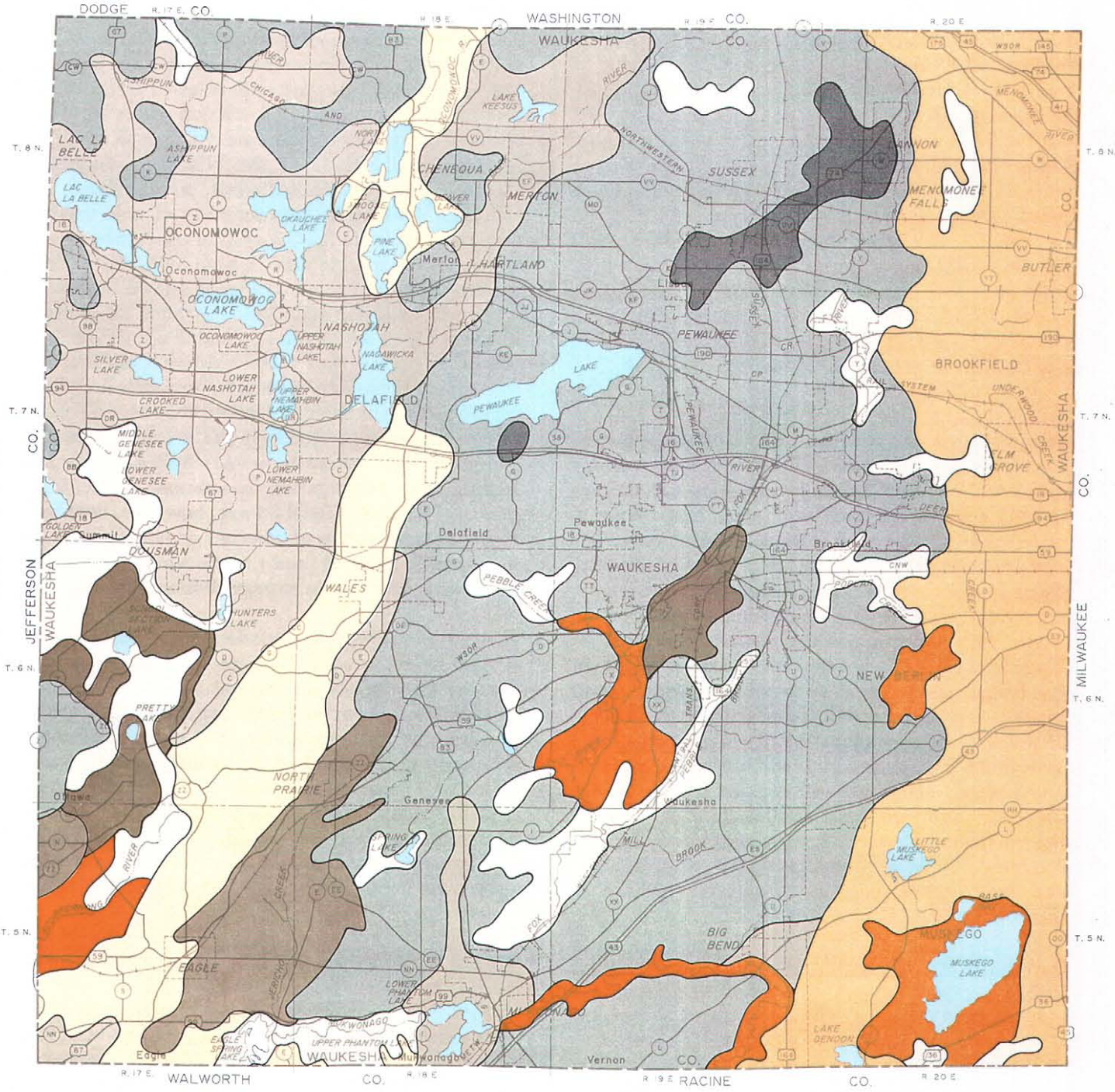
0 1 2 3 4 MILES

0 5 10 15 20 25 30,000 FEET

Source: Wisconsin Geological and Natural History Survey and SEWRPC.

Map 5

GENERALIZED SOIL ASSOCIATIONS WITHIN WAUKESHA COUNTY



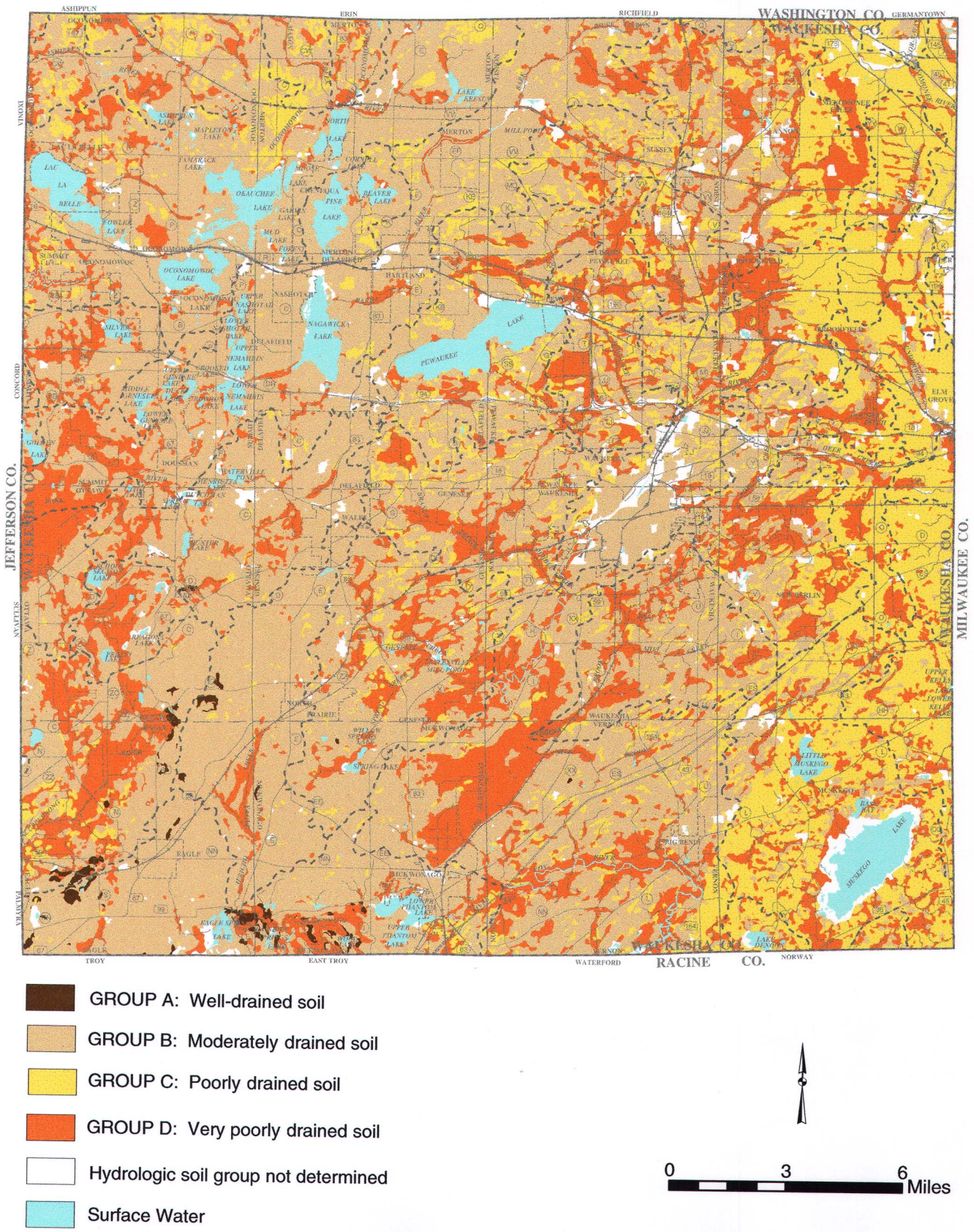
LEGEND

- HOUGHTON-PALMS-ADRIAN ASSOCIATION: VERY POORLY DRAINED ORGANIC SOILS IN DEPRESSIONS ON OLD LAKEBEDS AND ON FLOODPLAINS
- FOX-CASCO ASSOCIATION: WELL-DRAINED SOILS THAT HAVE A SUBSOIL OF CLAY LOAM; MODERATELY DEEP TO SHALLOW OVER SAND AND GRAVEL, ON OUTWASH PLAINS AND STREAM TERRACES
- WARSAW-LORENZO ASSOCIATION: WELL-DRAINED SOILS THAT HAVE A SUBSOIL OF CLAY LOAM; MODERATELY DEEP OVER SAND AND GRAVEL, ON OUTWASH PLAINS AND RIVER TERRACES
- BOYER-OSHTEMO ASSOCIATION: WELL-DRAINED SOILS THAT HAVE A SUBSURFACE OF SANDY LOAM AND SANDY CLAY LOAM; UNDERLAIN BY SANDY MATERIAL, ON OUTWASH PLAINS
- RODMAN-CASCO ASSOCIATION: EXCESSIVELY DRAINED TO WELL-DRAINED SOILS THAT HAVE A SUBSOIL OF GRAVELLY SANDY LOAM AND CLAY LOAM; SHALLOW OVER GRAVEL AND SAND, ON THE KETTLE MORAINE
- OZAUKEE-MORLEY-MEQUON ASSOCIATION: WELL-DRAINED TO SOMEWHAT POORLY DRAINED SOILS THAT HAVE A SUBSOIL OF SILTY CLAY LOAM AND SILTY CLAY; FORMED IN THIN LOESS AND SILTY CLAY LOAM GLACIAL TILL, ON MORAINES
- MONTGOMERY-MARTINTON-HEBRON-SAYLESVILLE ASSOCIATION: POORLY DRAINED TO WELL DRAINED SOILS THAT HAVE A SUBSOIL OF CLAY TO CLAY LOAM; FORMED IN SILTY CLAY OR SILTY CLAY LOAM SEDIMENTS, IN OLD LAKEBEDS
- HOCHHEIM-THERESA ASSOCIATION: WELL-DRAINED SOILS THAT HAVE A SUBSOIL OF CLAY LOAM AND SILTY CLAY LOAM; FORMED IN THIN LOESS AND LOAM GLACIAL TILL, ON GROUND MORAINES
- PELLA, MODERATELY SHALLOW VARIANT-KNOWLES ASSOCIATION: POORLY DRAINED AND WELL-DRAINED SOILS THAT HAVE A SUBSOIL OF SILTY CLAY LOAM OR CLAY LOAM; MODERATELY SHALLOW OVER DOLOMITE BEDROCK

Source: U. S. Soil Conservation Service and SEWRPC.

Map 6

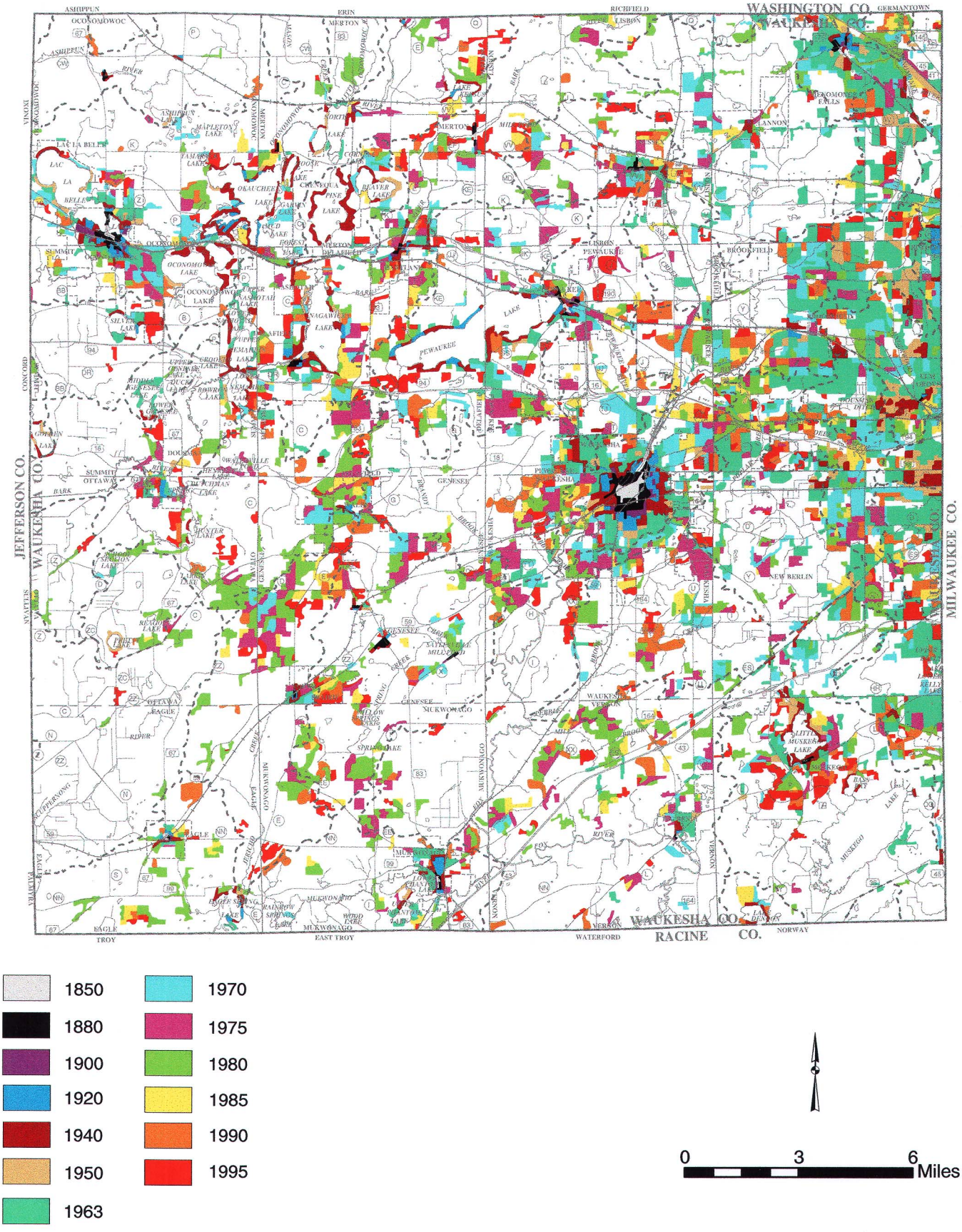
HYDROLOGIC SOIL GROUPS WITHIN WAUKESHA COUNTY



Source: U.S. Natural Resources Conservation Service and SEWRPC.

Map 7

HISTORIC URBAN GROWTH WITHIN WAUKESHA COUNTY: 1850-1995



Source: SEWRPC.

Table 1

HISTORIC URBAN GROWTH IN WAUKESHA COUNTY: 1900-1995

Year	Urban Area[a]			
	Square Miles	Change from Previous Period		Average Annual Change from Previous Year (square miles)
		Square Miles	Percent	
1900	2.44	--	--	--
1920	4.87	2.43	99.6	0.12
1940	13.21	8.34	171.3	0.42
1950	18.39	5.18	39.2	0.52
1963	54.25	35.86	195.0	2.76
1970	72.34	18.09	33.3	2.58
1980	120.05	47.71	66.0	4.77
1990	144.43	24.38	20.3	2.44
1995	159.78	15.35	10.6	3.07

[a]*Based upon urban growth analysis.*

Source: SEWRPC.

105-square-mile increase in urban lands in the County between 1963 and 1995, about one-half was located within planned urban service areas, while the balance was located outside planned urban service areas. With respect to surface water resources, such scattered, unplanned development can tend to focus development on these resources, and the recent tendency to convert seasonal dwelling to year-round usage can overburden onsite sewage disposal systems, contributing to increased nutrient loading to surface water systems. Likewise, intensification of usage associated with year-round habitation can increase nonpoint source pollution of the adjacent waterways.

Due largely to the extent of new low-density residential development, growth in the developed urban land area of the County over the past four decades was proportionately greater than growth in resident urban population. Between 1950 and 1990, the developed urban area within the County increased about eight-fold while the urban population of the County increased about four-fold. As a result, the urban population density of the County has decreased over the past four decades, from about 3,900 persons per square mile in 1950 to about 2,100 persons per square mile in 1990.

Existing Land Use

While the foregoing section of this chapter provides an overview of development trends in the County since 1900, this section provides a more detailed description and analysis of the existing land use base of the County and of changes in that base over the past approximately three decades. The information presented in this section is, to a large extent, based upon land use inventories conducted periodically by the Regional Planning Commission.[9] The Commission conducts detailed inventories of existing land use in the Southeastern Wisconsin Region to determine the type, amount, and spatial location of the major categories of land use at selected points in time. The first such inventory was conducted in 1963; the most recent inventory was conducted in 1995. The trend in the various categories of land use for selected years from 1963 to 1995 for the County, based upon the Commission land use inventories, is presented in Table 2. The pattern of land use that existed within Waukesha County in 1995 is shown on Map 8.

Urban Land Uses

As indicated in Table 2, urban land uses, consisting of residential; commercial; industrial; recreational; governmental and institutional; and transportation, communication, and utility uses, encompassed about 118,600 acres, equivalent to 185 square miles, or about one-third of the total land area of the County, in 1995. Residential land comprised the largest urban land use category in the County in 1995, encompassing about 67,400 acres, or about 57 percent of all urban land and 18 percent of the total area of the County. Commercial and industrial lands encompassed about 8,700 acres, about 7 percent of all urban land use and about 1.5 percent of the total area of the County. Lands used for governmental and institutional purposes encompassed about 3,700 acres, or about 3 percent of all urban uses and about 1 percent of the total area of the County. Lands devoted to intensive

[9]*SEWRPC Community Assistance Planning Report No. 209,* A Development Plan for Waukesha County, Wisconsin, *August 1996, which refines the adopted Regional land use plan, SEWRPC Planning Report No. 41,* A Regional Land Use Plan for Southeastern Wisconsin: 2010, *January 1992, and reflects refinements set forth in SEWRPC Planning Report No. 45,* A Regional Land Use Plan for Southeastern Wisconsin: 2020, *December 1997.*

Table 2

LAND USE IN WAUKESHA COUNTY: 1963, 1970, 1980, 1990, AND 1995

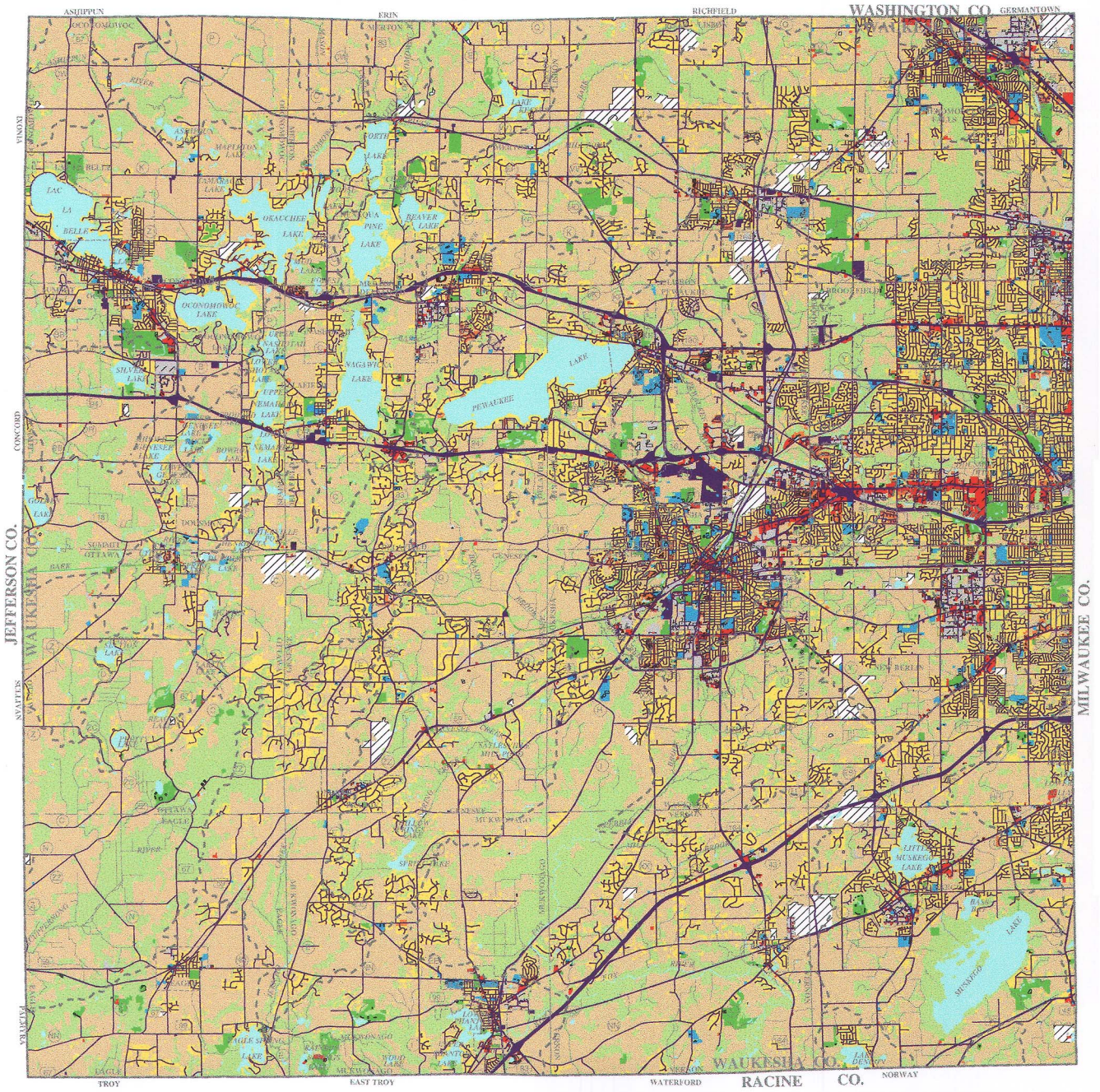
Land Use Category	Existing Land Use														
	1963			1970			1980			1990			1995		
	Acres	Percent of Subtotal	Percent of Total	Acres	Percent of Subtotal	Percent of Total	Acres	Percent of Subtotal	Percent of Total	Acres	Percent of Subtotal	Percent of Total	Acres	Percent of Subtotal	Percent of Total
Urban															
Residential	30,439	55.6	8.2	37,665	55.1	10.1	53,702	59.1	14.5	61,225	59.8	16.5	67,442	56.8	18.2
Commercial	1,199	2.2	0.3	1,857	2.7	0.5	2,773	3.1	0.7	3,840	3.8	1.0	2,405	2.0	0.6
Industrial	924	1.7	0.3	1,765	2.6	0.5	2,756	3.0	0.7	3,806	3.7	1.0	6,327	5.3	0.9
Transportation, Communication, and Utilities	16,141	29.5	4.3	18,575	27.1	5.0	21,902	24.1	5.9	22,864	22.3	6.2	31,740	26.8	8.5
Government and Institutional	2,559	4.7	0.7	3,609	5.3	1.0	4,038	4.4	1.1	4,215	4.1	1.1	3,721	3.2	1.0
Recreational	3,471	6.3	0.9	4,928	7.2	1.3	5,756	6.3	1.6	6,465	6.3	1.8	6,975	5.9	2.0
Subtotal	54,733	100.0	14.7	68,399	100.0	18.4	90,927	100.0	24.5	102,415	100.0	27.6	118,610	100.0	31.2
Nonurban															
Natural Areas															
Surface Water	16,076	5.1	4.3	16,461	5.4	4.4	16,753	6.0	4.5	16,878	6.3	4.5	16,780	6.5	4.5
Wetlands	52,588	16.6	14.2	51,660	17.0	13.9	51,233	18.2	13.8	51,978	19.3	14.0	52,178	20.4	14.0
Woodland	31,181	9.8	8.4	30,818	10.2	8.3	29,472	10.5	7.9	29,584	11.0	8.0	28,679	11.2	7.7
Subtotal	99,845	31.5	26.9	98,939	32.6	26.6	97,458	34.7	26.2	98,440	36.6	26.5	97,637	38.1	26.2
Landfill	205	0.1	0.1	281	0.1	0.1	487	0.2	0.1	625	0.2	0.2	801	0.3	0.2
Extractive	2,405	0.7	0.6	2,863	1.0	0.8	3,068	1.1	0.8	3,424	1.3	0.9	3,651	1.4	1.0
Agricultural	200,242	63.2	53.9	184,389	60.8	49.6	161,558	57.6	43.5	142,429	52.9	38.3	128,389	50.2	34.6
Unused Land	14,161	4.5	3.8	16,720	5.5	4.5	18,093	6.4	4.9	24,258	9.0	6.5	25,508	10.0	6.8
Subtotal	316,858	100.0	85.3	303,192	100.0	81.6	280,664	100.0	75.5	269,176	100.0	72.4	255,986	100.0	42.6
Total	371,591	--	100.0	371,591	--	100.0	371,591	--	100.0	371,591	--	100.0	371,591	--	100.0

NOTE: Data for urban land uses includes related off-street parking areas of more than 10 spaces.

Source: SEWRPC.

Map 8

EXISTING LAND USE WITHIN WAUKESHA COUNTY: 1995



Source: SEWRPC.

recreational uses encompassed about 7,000 acres, some 6 percent of all urban uses and about 2 percent of the County. Lands devoted to transportation, communication, and utility uses, including areas used for streets and highways, railways, airports, and utility and communication facilities totaled about 31,700 acres, or about 27 percent of all urban uses and about 8 percent of the total County area.

Between 1963 and 1995, urban land uses in the County increased from about 54,700 acres to about 118,600 acres, an increase of about 63,900 acres or by more than double the area devoted to urban land uses in 1963. Each of the major urban land use categories increased significantly during this time.

Nonurban Land Uses

Nonurban lands,[10] consisting of agricultural lands, wetlands, woodlands, and surface water, quarries, landfill sites, and other open lands as indicated in Table 2, comprised about 256,000 acres, the equivalent of 400 square miles, or about 69 percent of the total area of the County, in 1995. Agricultural lands comprised the largest nonurban land use category, encompassing about 128,400 acres, or about one-half of all nonurban lands and about 35 percent of the total land area of the County. Wetlands, woodlands, and surface water, in combination, encompassed about 97,600 acres, representing about 38 percent of all nonurban lands and about 26 percent of the County. Quarries and landfill sites, taken together, encompassed about 4,500 acres, representing about 2 percent of all nonurban lands and about 1 percent of the total area of the County. Unused lands, consisting of open lands other than wetlands, woodlands and agricultural lands, encompassed about 25,500 acres, representing about 10 percent of all nonurban lands and about 7 percent of the total area of the County.

Nonurban lands in the County decreased by about 60,900 acres, or by about 20 percent, between 1963 and 1995. Most of this loss resulted from the conversion of agricultural land to urban use. The wetland acreage declined by about 400 acres, or by less than 1 percent, between 1963 and 1995, while the woodland acreage declined by about 2,500 acres, or by about 2 percent.

It should be noted that the change in wetland and woodland acreages between 1963 and 1995, like the change in all land use categories, represents the net change within the County. In this respect, the change in the wetland acreage reported between two inventory years is the net result of decreases in certain areas of the County due, for example, to drainage or filling activity, and increases in other areas due, for example, to the abandonment of agricultural drainage systems or to planned wetland restoration efforts. Similarly, the change in the woodland acreage between two inventory years reflects the net effect of the clearing of woodlands in certain areas and the reforestation of other areas.

Planned Future Land Use

The trends noted above reflect the proposed future condition of lands within Waukesha County. Urban lands are anticipated to continue to increase in areal extent, as shown in Table 3, comprising more than 250,000 acres, or about 67 percent of the total land area of the County, by the year 2020. Map 9 shows the likely future land use pattern within the County as set forth in the adopted County development plan.[11,12] Urban growth is anticipated to occur especially around the periphery of existing urban centers, and include infilling of unused urban lands within urbanized areas of the County. The conversion of rural lands to urban land uses increases the likelihood of certain nonpoint sourced urban pollutants, such as heavy metals, being transported into surface waters, with a

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[10] *Pursuant to the (draft) provisions of Chapter NR 151 of the* Wisconsin Administrative Code, *rural lands are considered "nonurban" for purposes of application of nonpoint source pollution control measures under this Chapter.*

[11] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[12] *It should be noted that the Waukesha County development plan is amended periodically to provide for refinements to the plan shown on Map 9. The amendments are on file with the Waukesha County Department of Parks and Land Use.*

Table 3

PLANNED LAND USE IN WAUKESHA COUNTY: 2020

Land Use Categories	2020		
	Acres	Percent of Subtotal	Percent of Total
Urban			
Residential	120,697	48.1	32.5
Commercial, Industrial, Recreational, Transportation, and Governmental	130,314	51.9	35.1
Subtotal	251,011	100.0	67.6
Nonurban			
Agricultural	14,624	12.1	3.9
Wetlands	52,178	43.3	14.0
Woodlands	26,342	21.8	7.1
Surface Water	16,857	14.0	4.5
Other Rural	10,579	8.8	2.9
Subtotal	120,580	100.0	32.4
Total	371,591	- -	100.0

Source: SEWRPC.

concomitant increase in the risk of deleterious impacts to such systems. Recent data gathered by the U.S. Geological Survey from within the Southeastern Wisconsin Region also suggest the likelihood of increased nutrient loadings as a result of urban landscaping practices.[13]

CLIMATE

Long-term average monthly air temperature and precipitation values for the City of Waukesha are set forth in Table 4. Table 4 also provides long-term runoff data derived from U.S. Geological Survey flow records for the Fox River at Waukesha in Waukesha County, Wisconsin.

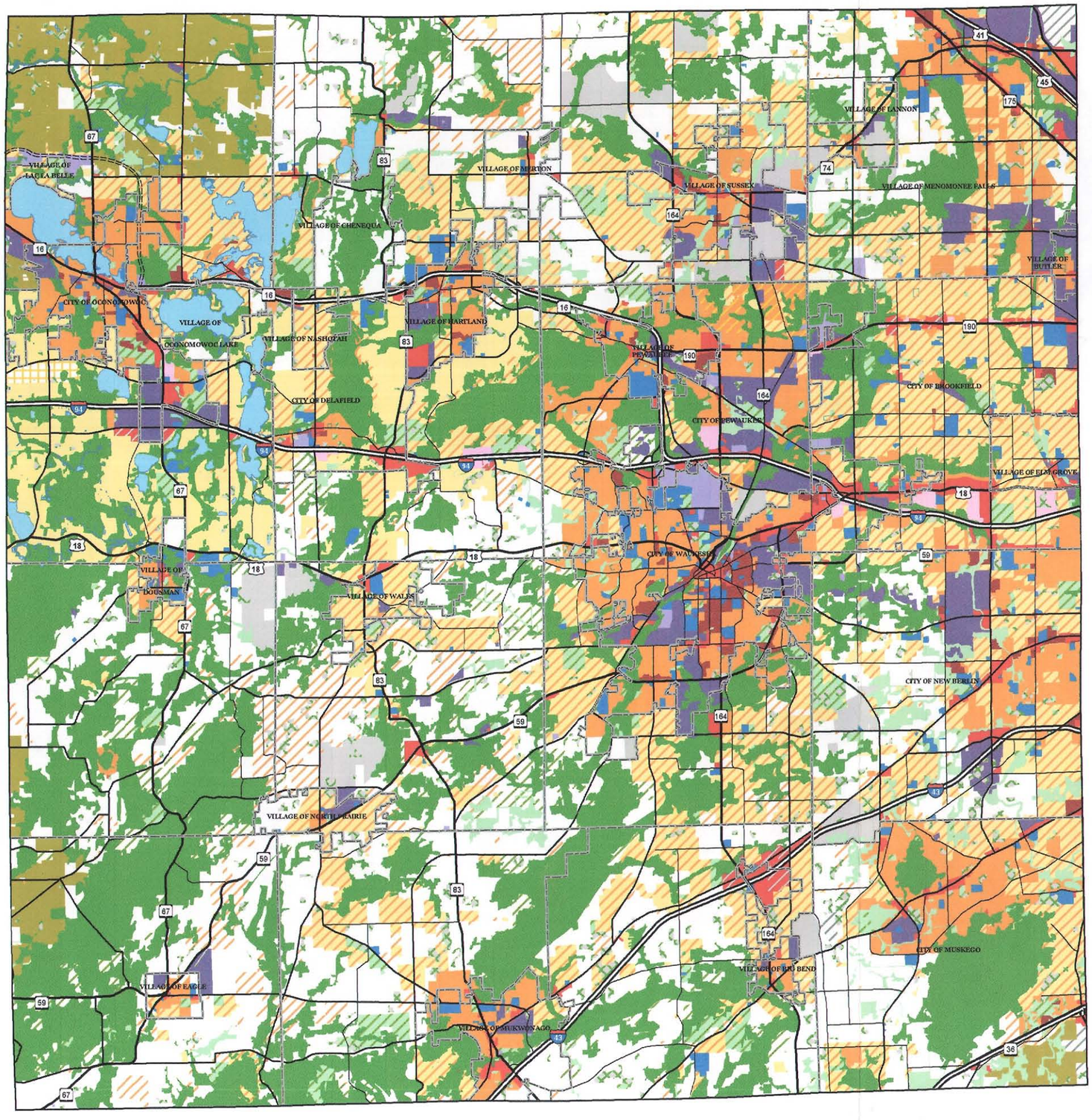
The mean summer and winter temperatures of 68.7°F and 28.2°F at Waukesha are similar to those of other recording locations in Southeastern Wisconsin. Mean annual precipitation at Waukesha is 37.4 inches. More than half of the normal yearly precipitation falls during the growing season, from May through September. Evapotranspiration rates are high during this period because vegetation cover is abundant and soils are not frozen. Surface runoff is generally low during the growing season. However, intense summer storms occasionally produce high percentages of runoff. Peak rates of runoff usually occur during winter and early spring when about 40 percent of the annual precipitation, in the form of snowmelt and/or rain, falls on frozen ground.

NATURAL RESOURCE BASE

Wetlands

Wetlands are defined by the Regional Planning Commission as, "areas that have a predominance of hydric soils and that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of hydrophytic vegetation typically adapted for life in

[13] *U.S. Geological Survey Water-Resources Investigations Report No. 02-4130,* Effects of Lawn Fertilizer on Nutrient Concentration in Runoff from Lakeshore Lawns, Lauderdale Lakes, Wisconsin, *July 2002.*



Map 9

DEVELOPMENT PLAN FOR WAUKESHA COUNTY

BUILD OUT STAGE OF THE WAUKESHA COUNTY DEVELOPMENT PLAN

LAND USE PLAN CATEGORIES

- High Density Residential (Less Than 6,000 Square Feet Of Lot Area Per Dwelling Unit)
- Medium Density Residential (6,000-19,999 Square Feet Of Lot Area Per Dwelling Unit)
- Low - Medium Density Residential (13,000-19,999 Square Feet Of Lot Area Per Dwelling Unit)
- Low Density Urban Residential (20,000 Square Feet To 1.4 Acres Of Lot Area Per Dwelling Unit)
- Suburban I Density Residential (1.5 to 2.9 Acres Of Lot Area Per Dwelling Unit)
- Suburban II Density Residential (3.0 to 4.9 Acres of Lot Area Per Dwelling Unit)
- Rural Density Residential, Other Agricultural and Open Lands
- Urban Reserve
- Other Open Lands To Be Preserved
- Prime Agricultural
- Primary Environmental Corridor
- Secondary Environmental Corridor
- Recreational
- Isolated Natural Resource Area
- Commercial
- Commercial (Office)
- Commercial (Conditional Special Use)
- Transportation, Communication & Utilities
- Governmental And Institutional
- Extractive
- Landfill
- Industrial

N W E S

Waukesha County Development Plan Amended:
6/98, 6/99, 6/00, 6/01, 6/02, 6/03, 4/04, 8/04
Prepared By The Waukesha County Department
Of Parks And Land Use November 2004

0 0.5 1 2 3 4 5 6 Miles

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As a practical matter, experience has shown that application of the Wisconsin Department of Natural Resources, the U.S. Environmental Protection Agency and U.S. Army Corps of Engineers, and the Regional Planning Commission definitions produce reasonably consistent wetland identifications and delineations in the majority of situations within the Southeastern Wisconsin Region. That consistency is due in large part to the provision in the Federal wetland delineation manual that allows for the application of professional judgment in cases where satisfaction of the three criteria for wetland identification is unclear.

Wetlands in Southeastern Wisconsin are classified predominantly as deep marsh, shallow marsh, southern sedge meadow, fresh (wet) meadow, shrub carr, alder thickets, low prairie, fens, bogs, southern wet- and wet-mesic hardwood forests, and conifer swamp. Wetlands form an important part of the landscape in Waukesha County, as shown on Map 10. Wetlands perform an important set of natural functions that make them ecologically and environmentally invaluable resources. Wetlands affect the quality of water by acting as a filter or a buffer zone allowing silt and sediments to settle out. They also influence the quantity of water by providing water during periods of drought and holding it back during periods of flood. When located along shorelines of lakes and streams, wetlands help protect those shorelines from erosion. Wetlands also may serve as groundwater discharge and recharge areas in addition to being important resources for overall ecological health and diversity by providing essential breeding and feeding grounds, shelter, and escape cover for many forms of fish and wildlife.

Wetlands cover a combined area of approximately 82 square miles in Waukesha County, or about 14 percent of the total land area of the County. As shown on Map 10, wetlands are scattered throughout the County. Large concentrations of wetlands occur at the Vernon Marsh, along Scuppernong Creek, and along the Scuppernong River in the extreme western part of the County, at the headwaters of the Fox River in Menomonee Falls and Brookfield, and surrounding Big Muskego Lake.

Wetlands are poorly suited to urban use. This is due to the high soil compressibility and instability, high water table, low load-bearing capacity, and high shrink-swell potential of wetland soils, and, in some cases, to the potential for flooding. In addition, metal conduits placed in some types of wetland soils may be subject to rapid corrosion. These constraints, if ignored, may result in flooding, wet basements and excessive operation of sump pumps, unstable foundations, failing pavements, broken sewer and water lines, and excessive infiltration of clear water into sanitary sewerage systems. In addition, there are significant onsite preparation and maintenance costs associated with the development of wetlands, particularly as they relate to roads, foundations, and public utilities. The Regional Planning Commission maintains an inventory of wetlands within the Region that is updated every five years.

Woodlands

Woodlands are defined by the Regional Planning Commission as those areas containing a minimum of 17 trees per acre with a diameter of at least four inches at breast height (4.5 feet above the ground).[16] Woodlands within Waukesha County are shown on Map 10. These woodlands are classified as dry, dry-mesic, mesic, wet-mesic, wet hardwood, and conifer swamp forests; the last three are also considered wetlands. The Regional Planning Commission also maintains an inventory of woodlands within the Region that is updated every five years.

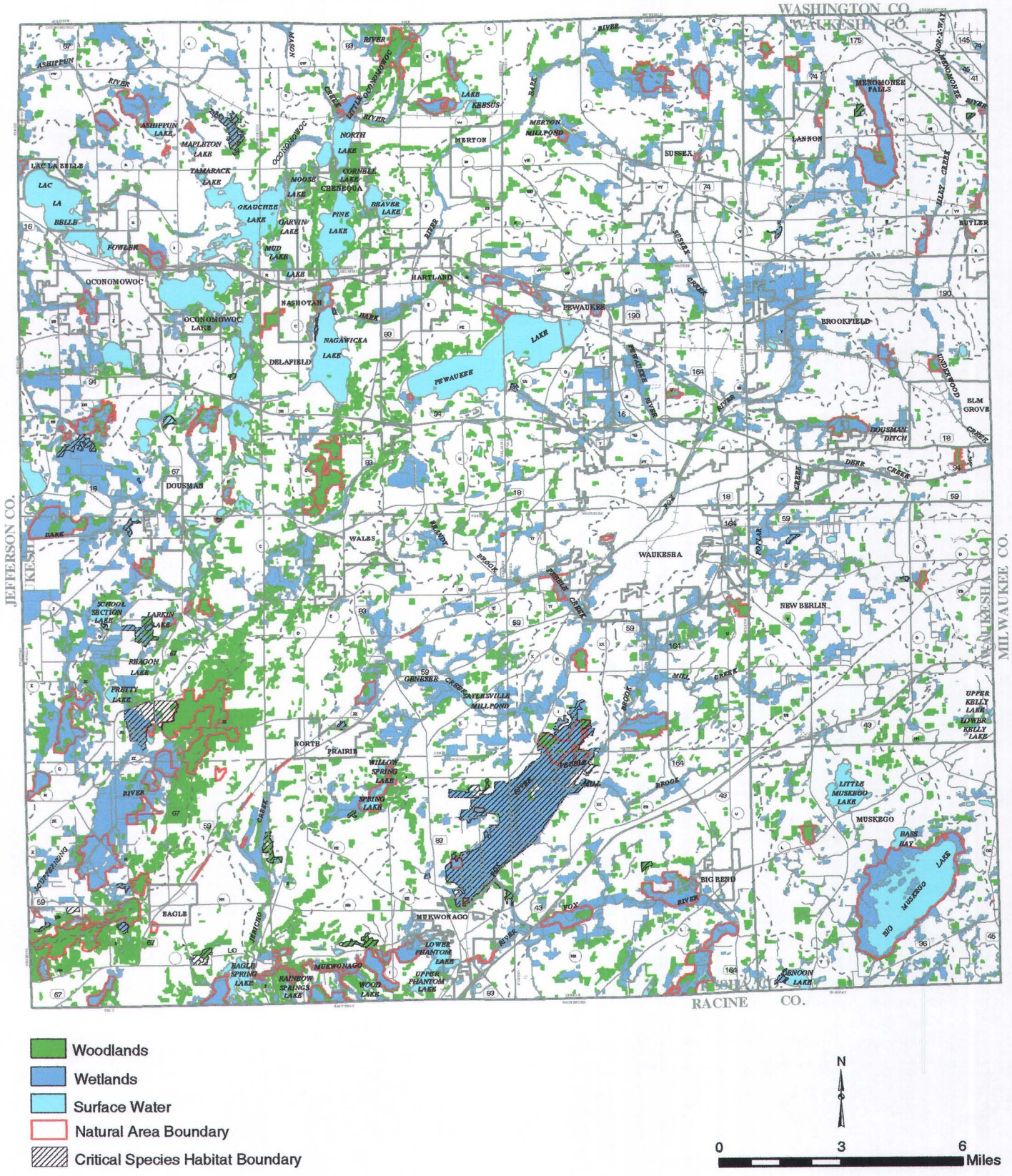
Waukesha County woodlands cover a combined area of about 45 square miles, or approximately 8 percent of the total land area of the County. As shown on Map 10, these woodlands exist in large, contiguous areas along the Kettle Moraine in the western half of the County, and in scattered small areas throughout the remainder of the County.

The major tree species include the black willow (*Salix nigra*), cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), silver maple (*Acer saccharinum*), American elm (*Ulmus americana*), basswood (*Tilia americana*), northern red oak (*Quercus rubra*), and shagbark hickory (*Carya ovata*). Some isolated stands of

[16] *SEWRPC* Technical Record, *Vol. 4, No. 2, March 1981.*

Map 10

WETLANDS AND WOODLANDS WITHIN WAUKESHA COUNTY: 1995



Source: SEWRPC.

tamarack (*Larix laricina*) also exist in the drainage area, together with such other upland species as the white oak (*Quercus alba*), burr oak (*Quercus macrocarpa*), black cherry (*Prunus serotina*), and sugar maple (*Acer saccharum*).

Wildlife Habitat

Wildlife habitat areas remaining in the Region were inventoried by the Regional Planning Commission in 1985 in cooperation with the Wisconsin Department of Natural Resources. The five major criteria used to determine the value of these wildlife habitat areas are listed below:

1. Diversity
   An area must maintain a high but balanced diversity of species for a temperate climate, balanced in such a way that the proper predatory-prey (consumer-food) relationships can occur. In addition, a reproductive interdependence must exist.

2. Territorial Requirements
   The maintenance of proper spatial relationships among species, allowing for a certain minimum population level, can occur only if the territorial requirements of each major species within a particular habitat are met.

3. Vegetative Composition and Structure
   The composition and structure of vegetation must be such that the required levels for nesting, travel routes, concealment, and protection from weather are met for each of the major species.

4. Location with Respect to Other Wildlife Habitat Areas
   It is very desirable that a wildlife habitat maintain proximity to other wildlife habitat areas.

5. Disturbance
   Minimum levels of disturbance from human activities are necessary, other than those activities of a wildlife management nature.

On the basis of these five criteria, the wildlife habitat areas in Waukesha County are categorized as either Class I, High-Value; Class II, Medium-Value; or Class III, Good-Value, habitat areas. Wildlife habitat areas within Waukesha County are shown on Map 11. Class I wildlife habitat areas contain a good diversity of wildlife, are adequate in size to meet all of the habitat requirements for the species concerned, are generally located in proximity to other wildlife habitat areas, and meet all five criteria listed above. Class II wildlife habitat areas generally fail to meet one of the five criteria in the preceding list for a high-value wildlife habitat. However, they do retain a good plant and animal diversity. Class III wildlife habitat areas are remnant in nature in that they generally fail to meet two or more of the five criteria for a high-value wildlife habitat, but may, nevertheless, be important if located in proximity to medium- or high-value habitat areas if they provide corridors linking wildlife habitat areas of higher value or if they provide the only available range in an area.

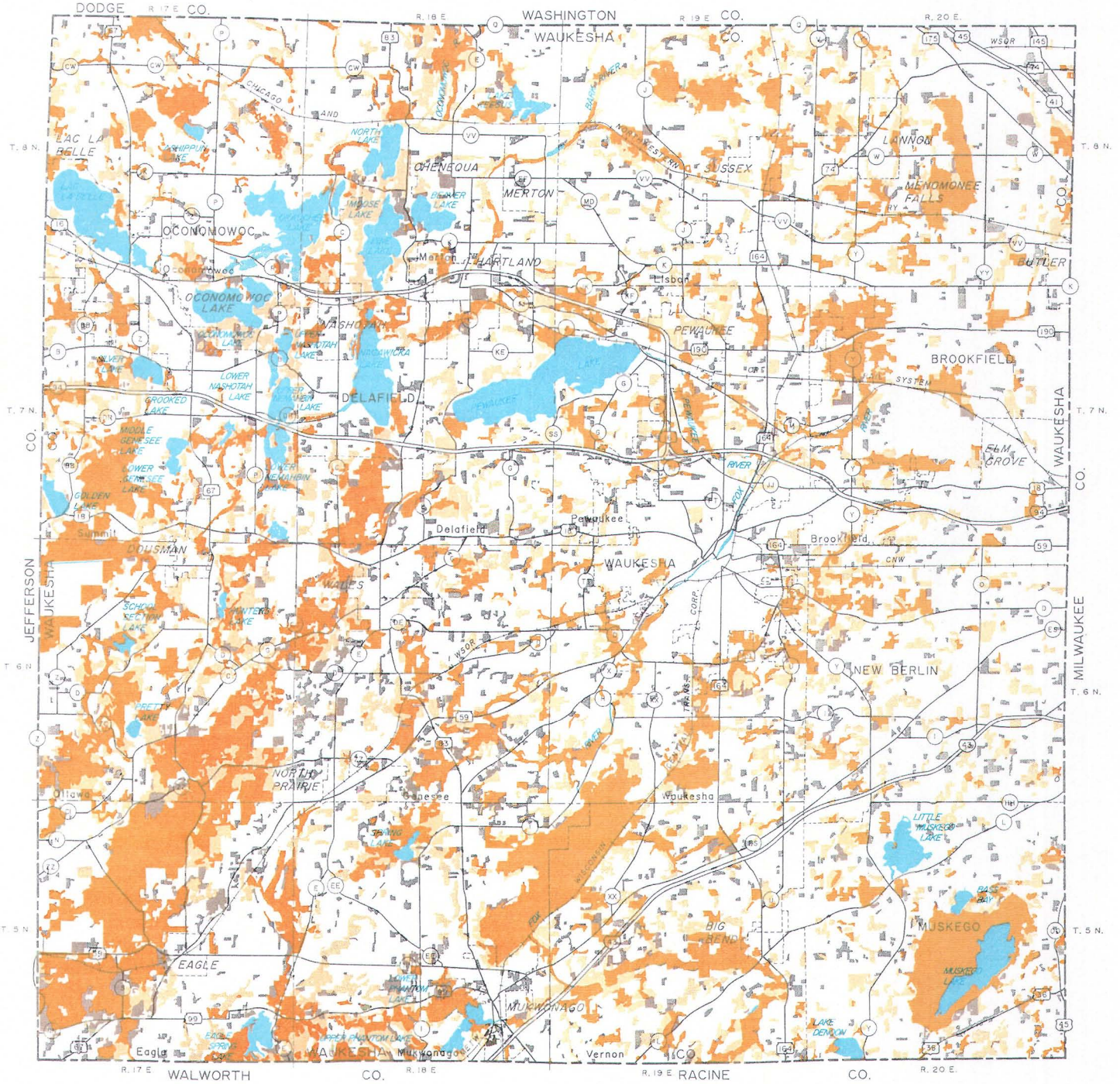
Wildlife habitat areas encompass a combined area of about 182 square miles, or approximately 31 percent of the total land area of the County. As shown on Map 11, these areas are concentrated along the Kettle Moraine, in the Vernon Marsh, along the Scuppernong Creek and Scuppernong River, and around the major lakes in the County. Class I wildlife habitat areas encompassed about 88 square miles, and comprised about one-half of the total wildlife habitat area. Class II wildlife habitat areas encompassed about 61 square miles, and comprised about one-third of the total wildlife habitat area. Class III wildlife habitat areas comprised the balance of the habitat area, or about 33 square miles within the County.

Environmental Corridors

One of the most important tasks undertaken by the Regional Planning Commission in its work program has been the identification and delineation of those areas of the Region having concentrations of natural, recreational, historic, aesthetic, and scenic resources and which, as such, should be preserved and protected in order to

Map 11

WILDLIFE HABITAT AREAS WITHIN WAUKESHA COUNTY: 1985



LEGEND

- CLASS I WILDLIFE HABITAT AREA
- CLASS II WILDLIFE HABITAT AREA
- CLASS III WILDLIFE HABITAT AREA
- SURFACE WATER

NOTE: WILDLIFE HABITAT WITHIN LAKES OF WAUKESHA COUNTY CONSISTS OF DEEP MARSH AREAS HAVING SUBMERGENT, EMERGENT FLOATING, AND FREE-FLOATING VEGETATION.

GRAPHIC SCALE
0 1 2 MILES
0 4000 8000 12000 16000 FEET

Source: SEWRPC.

maintain the overall quality of the environment. Such areas normally include one or more of the following seven elements of the natural resource base which are essential to the maintenance of both the ecological balance and the natural beauty of the Region: 1) lakes, rivers, and streams and the associated undeveloped shorelands and floodlands, 2) wetlands, 3) woodlands, 4) prairies, 5) wildlife habitat areas, 6) wet, poorly drained, and organic soils, and 7) rugged terrain and high-relief topography. While the foregoing seven elements constitute integral parts of the natural resource base, there are five additional elements which, although not a part of the natural resource base per se, are closely related to, or centered on, that base and, therefore, are important considerations in identifying and delineating areas with scenic, recreational, and educational value. These additional elements are: 1) existing outdoor recreation sites, 2) potential outdoor recreation and related open space sites, 3) historic, archaeological, and other cultural sites, 4) significant scenic areas and vistas, and 5) natural and scientific areas.

In Southeastern Wisconsin, the delineation of these 12 natural resource and natural resource-related elements on maps results in an essentially linear pattern of relatively narrow, elongated areas which have been termed "environmental corridors" by the Commission. Primary environmental corridors include a wide variety of the aforementioned important resource and resource-related elements and are, by definition, at least 400 acres in size, two miles in length, and 200 feet in width. The primary environmental corridors identified in Waukesha County are contiguous with environmental corridors and isolated natural resource areas lying within the adjacent counties, and, consequently, meet these size and natural resource element criteria.

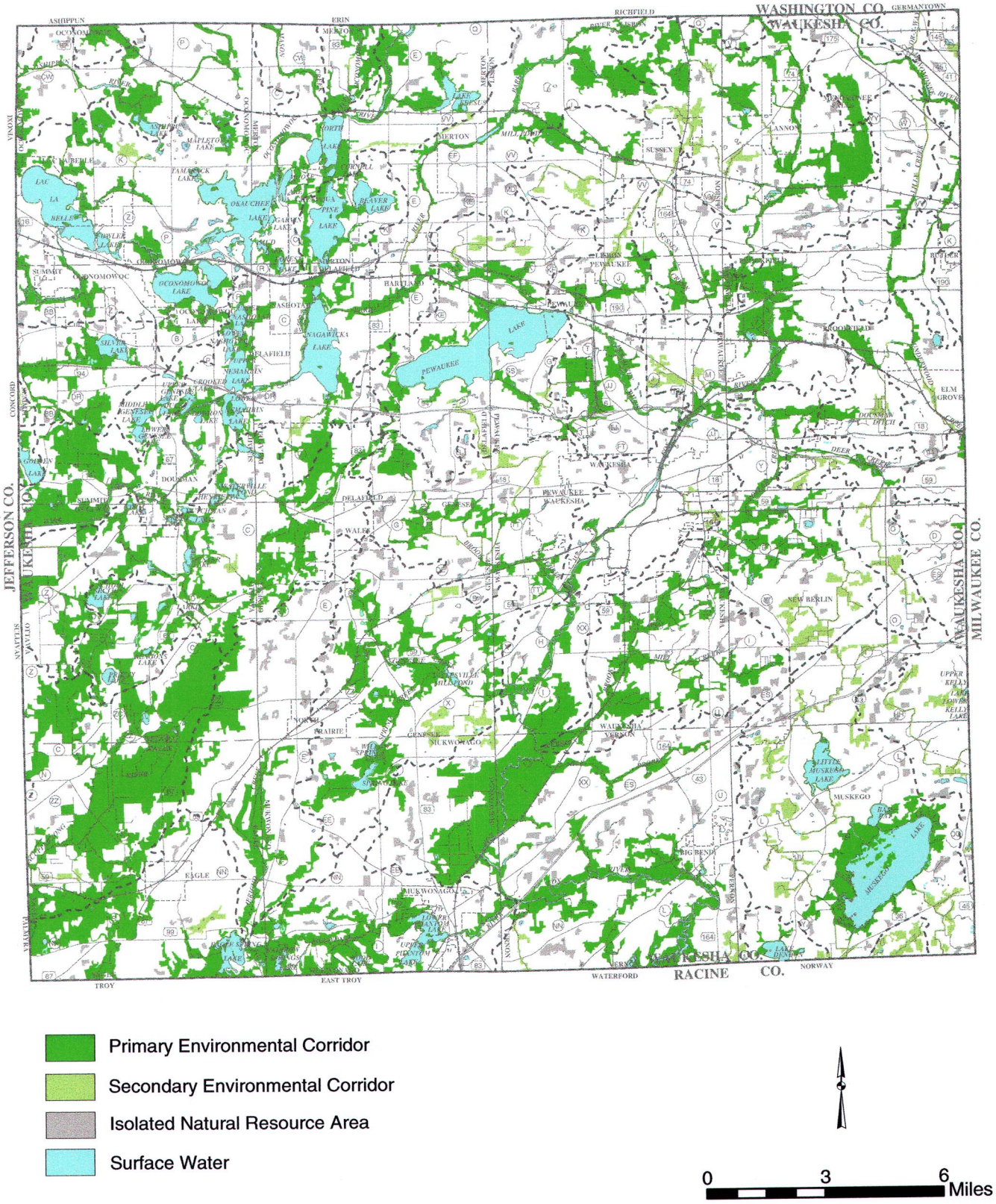
It is important to note here that, because of the many interlocking and interacting relationships between living organisms and their environment, the destruction or deterioration of one element of the total environment may lead to a chain reaction of deterioration and destruction. The drainage of wetlands, for example, may have far-reaching effects, since such drainage may destroy fish spawning grounds, wildlife habitat, groundwater recharge areas, and natural filtration and floodwater storage areas in interconnected lake and stream ecosystems. The resulting deterioration of surface water quality may, in turn, lead to a deterioration of the quality of the groundwater that serves as a source of domestic, municipal, and industrial water supplies and provides a basis for low flows in rivers and streams. Similarly, the destruction of woodland cover, which may have taken a century or more to develop, may result in soil erosion and stream siltation, and in more rapid runoff and increased flooding, as well as in the destruction of wildlife habitat. Although the effects of any one of these environmental changes may not in and of itself be overwhelming, the combined effects may lead eventually to the deterioration of the underlying and supporting natural resource base, and of the overall quality of the environment for life. The need to protect and preserve the remaining environmental corridors within Waukesha County, thus, becomes apparent and critical.

Environmental corridors were first identified within the Region in 1963 as part of the original regional land use planning effort of the Commission and were subsequently refined under the Commission watershed studies and regional park and open space planning programs. The primary environmental corridors in Southeastern Wisconsin generally lie along major stream valleys and around major Lakes and contain almost all the remaining high-value woodlands, wetlands, and wildlife habitat areas, and all the major bodies of surface water and related undeveloped floodlands and shorelands, as shown on Map 12. Primary environmental corridors encompassed about 120 square miles, or about one-fifth of the total land area of the County. Secondary environmental corridors and isolated natural resource areas each comprised about 2 percent of the total land area of the County, or about 11 square miles and 12 square miles, respectively.

Environmental corridors are subject to urban encroachment because of their desirable natural resource amenities. Unplanned or poorly planned intrusion of urban development into these corridors not only tends to destroy the very resources and related amenities sought by the development, but also tends to create severe environmental and developmental problems as well. These problems include, among others, water pollution, flooding, wet basements, failing foundations for roads and other structures, and excessive infiltration of clear water into sanitary sewerage systems. The preservation of as yet undeveloped corridors is one of the major ways in which the water quality can be protected and perhaps improved at relatively little additional cost to the taxpayers of the area.

Map 12

ENVIRONMENTAL CORRIDORS AND ISOLATED NATURAL FEATURES WITHIN WAUKESHA COUNTY: 1995



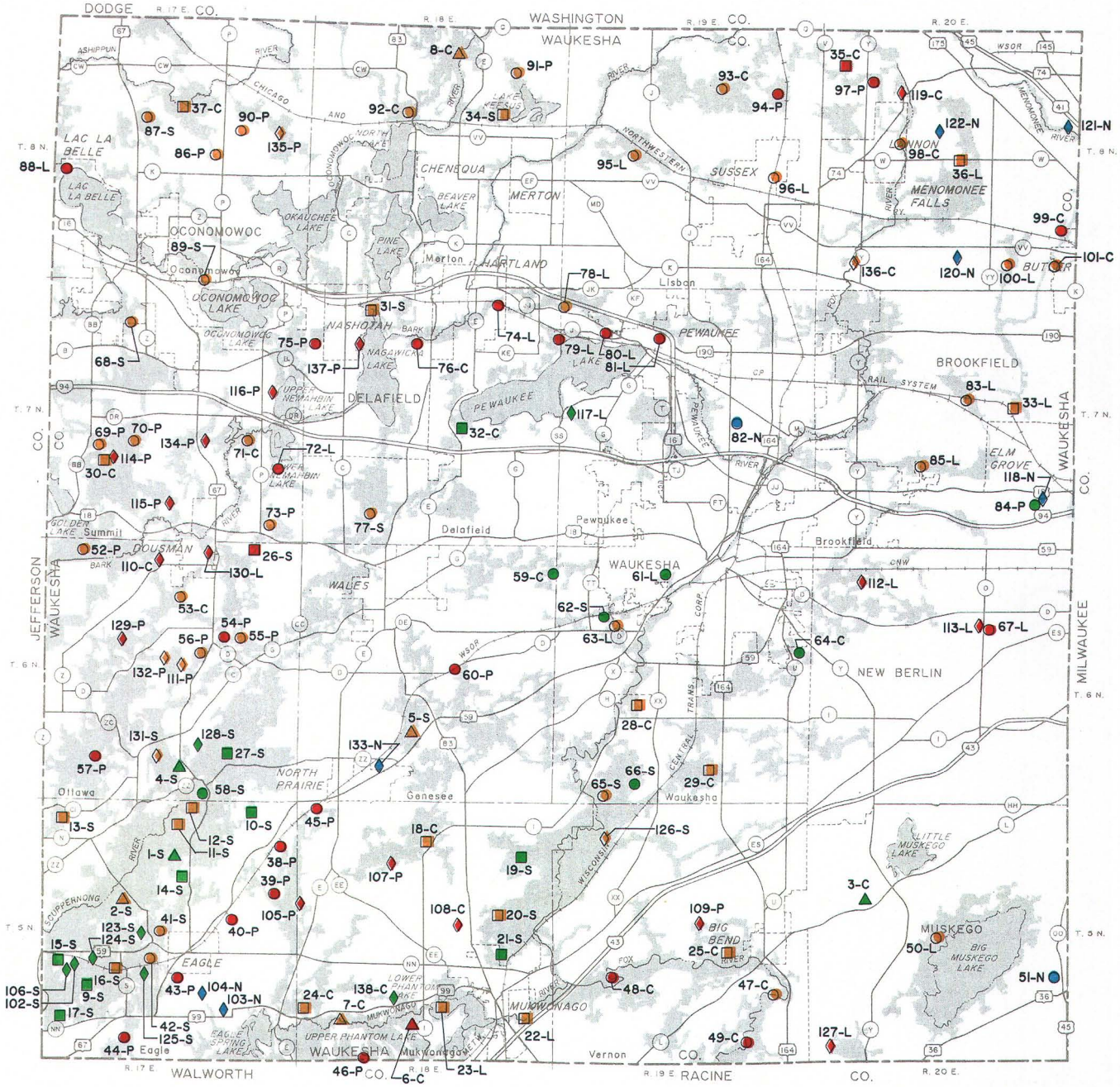
Source: SEWRPC.

The riverbanks and lakeshores located within the environmental corridors should be candidates for immediate protection through proper zoning or through public ownership. Of the areas not already publicly owned, the remaining areas of natural shoreline, and riparian wetland areas, are perhaps the most sensitive areas in need of greatest protection. In this regard, the regional natural areas and critical species habitat protection and management plan recommends public acquisition of specific lands.[17] Within the County, approximately 21 square miles are specifically recommended for acquisition, including Muskego Parks Hardwood State Natural Area in the Town of Muskego, Scuppernong Prairie State Natural Area in the Town of Eagle, Kettle Moraine Fen and Low Prairie State Natural Area in the Town of Eagle, the Upper Mukwonago River in the Town of Eagle and the Town of Mukwonago, Genesee Oak Opening, and Yatzeck's Fen State Natural Area in the Town of Genesee, Monches Woods in the Town of Merton, Mukwonago Fen, Sedge Meadow, and Tamarack Relict in the Town of Mukwonago, and the Ottawa Lake Fen State Natural Area in the Town of Ottawa. In addition to these sites, the acquisition of about a further five square miles of lands of countywide or regional significance by both public agencies and private conservation organizations is recommended. These sites are shown on Map 13.

[17] *SEWRPC Planning Report No. 42,* op. cit.

Map 13

NATURAL AREAS AND CRITICAL SPECIES HABITAT SITES WITHIN WAUKESHA COUNTY: 1995



CURRENT STATUS AND PLAN RECOMMENDATION	NA-1 SITE	NA-2 SITE	NA-3 SITE	CRITICAL SPECIES HABITAT
ENTIRELY UNDER PROTECTIVE OWNERSHIP/PROTECTIVE OWNERSHIP TO BE RETAINED	▲	■	●	♦
PARTIALLY UNDER PROTECTIVE OWNERSHIP/REMAINDER OF SITE TO BE ACQUIRED	△	□	○	◇
NOT UNDER PROTECTIVE OWNERSHIP/ ENTIRE SITE TO BE ACQUIRED	▲	■	●	♦
NOT UNDER PROTECTIVE OWNERSHIP/ TO BE PRESERVED, TO EXTENT PRACTICABLE, WITHOUT PROTECTIVE OWNERSHIP	(NONE)	(NONE)	●	◆

RECOMMENDED OWNERSHIP KEY:

S-STATE GOVERNMENT
C-COUNTY GOVERNMENT
L-LOCAL GOVERNMENT
P-PRIVATE CONSERVANCY ORGANIZATION
N-NO PROTECTIVE OWNERSHIP RECOMMENDED

24-SITE REFERENCE NUMBER

PRIMARY ENVIRONMENTAL CORRIDORS

GRAPHIC SCALE
0 2 MILES
0 4000 8000 12000 16000 FEET

Ninety-nine of the 101 Natural Area sites and 30 of the 37 Critical Species Habitat sites located in Waukesha County are recommended for protective ownership. The two remaining Natural Area sites and the seven remaining Critical Species Habitat sites are recommended to be preserved to the extent practicable without protective ownership.

Source: SEWRPC.

Chapter III

INVENTORY FINDINGS

INTRODUCTION

This chapter presents the collection of data relating to lakes in Waukesha County. Lakes are an important component of the surface water system in Waukesha County which, as shown on Map 14, includes the Cities of Brookfield, Delafield, Milwaukee (part), Pewaukee, New Berlin, and Waukesha; the Villages of Big Bend, Butler, Chenequa, Dousman, Eagle, Elm Grove, Hartland, Lac La Belle, Lannon, Menomonee Falls, Merton, Mukwonago, Nashotah, North Prairie, Oconomowoc Lake, Pewaukee, Sussex, and Wales; and the Towns of Brookfield, Delafield, Eagle, Genesee, Lisbon, Merton, Mukwonago, Oconomowoc, Ottawa, Summit, Vernon, and Waukesha. To the extent that data are available, relevant land use, recreational use, morphometric, water quality, and biological information upon which waterbody classifications are to be based pursuant to the requirements of Section 281.69(5)(b), *Wisconsin Statutes*, is presented for each lake inventoried. These data form the scientific and technical basis for the consideration of alternative lake classification schemes as set forth in Chapter IV.

INVENTORY FINDINGS

Table 5 contains a summary of selected morphometric data available for the major lakes within Waukesha County. Major lakes are defined as those Lakes within the Southeastern Wisconsin Region having a surface area of 50 or more acres in areal extent. These lakes are shown on Map 14, and on the appropriate maps at the township scale, presented as Maps 15 through 30. Where available, similar summary data are provided for minor lakes because of the importance of these smaller waterbodies as a water resource. In some cases, these waterbodies, wherein water levels fluctuate markedly, may be classed as deep-water marshes or wetlands. Wetlands within Waukesha County are shown on Map 10 in Chapter II. The lakes inventoried are further described below with information set forth in paragraphs which address one or more of the factors required to be considered in the waterbody classification process pursuant to Section 281.69(5)(b) of the *Wisconsin Statutes*. Information on the origins of these lakes is based upon detailed geological information provided in various published survey reports and maps of surfacial deposits.

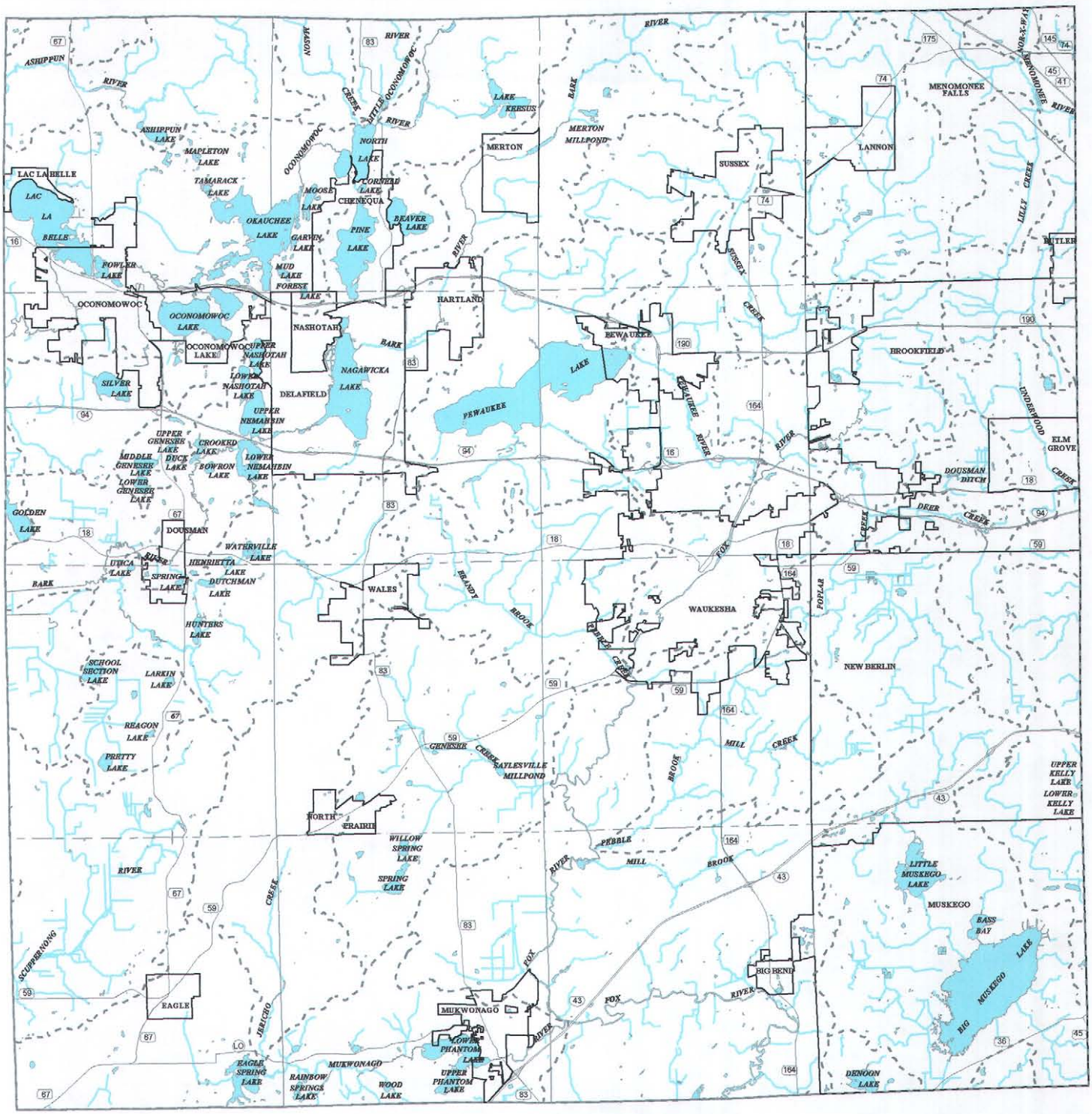
Applebecker Millpond (Roller Mills Dam)

Lake Morphometry

Applebecker Millpond is located in U.S. Public Land Survey Section 19, Township 7 North, Range 18 East, City of Delafield, as shown on Map 20. The Millpond has a surface area of about 12 acres, a maximum depth of five feet, and a shoreline development factor of 1.55. The Millpond is created by the Roller Mills Dam, an impoundment of the Bark River between Nagawicka Lake and Upper Nemahbin Lake. The Millpond was originally constructed to provide hydropower for a mill, but currently provides hydropower for a private power

Map 14

SURFACE WATER RESOURCES WITHIN WAUKESHA COUNTY: 2000



Surface Water

Subwatershed Boundary

0 2 4 Miles

Source: SEWRPC.

Table 5

HYDROLOGY AND MORPHOMETRY OF LAKES WITHIN WAUKESHA COUNTY

Lake	Length (miles)	Width (miles)	Surface Area (acres)	Maximum Depth (feet)	Mean Depth (feet)	Volume (acre-feet)	Shoreline Length (miles)	Shoreline Development Factor
Applebecker Millpond	0.30	0.11	12	5	--	--	0.8	1.55
Ashippun	1.05	0.35	83	40	22	1,848	1.5	1.71
Beaver	1.09	0.70	316	49	15	4,740	3.6	1.45
Beaver Dam	0.77	0.45	36	6	--	--	2.3	2.70
Big Bend Pond	0.15	0.10	7	10	--	--	0.4	1.16
Big Muskego	3.40	1.47	2,260	26	2	4,520	17.7	2.66
Brown	0.19	0.13	12	40	5	60	0.5	1.14
Buth	0.11	0.06	4	5	--	--	0.3	1.11
Cornell	0.53	0.20	41	12	--	--	1.6	1.78
Crooked	0.60	0.30	58	16	7	406	2.3	2.16
Denoon	0.74	0.45	162	60	18	2,916	2.4	1.35
Duck	0.23	0.20	12	1	--	--	0.5	1.06
Dutchman	0.38	0.15	33	42	27	891	1.0	1.24
Eagle Spring	0.85	0.55	311	12	4	908	4.0	1.89
Egg	0.08	0.04	2	3	--	--	0.3	1.23
Etter	0.25	0.08	11	3	3	33	0.6	1.27
Florence	0.30	0.19	21	48	17	323	0.9	1.47
Forest	0.57	0.15	41	17	--	--	1.3	1.45
Fowler	0.60	0.35	99	50	13	1,014	1.7	1.37
Garvin	0.33	0.14	17	36	--	--	0.8	1.38
Genesee Millpond	0.17	0.07	4	5	--	--	0.5	1.37
Golden	1.30	0.43	250	46	14	3,500	3.4	1.53
Henrietta	0.29	0.18	15	7	7	161	0.8	1.19
Hogan	0.17	0.05	8	3	--	--	0.8	2.28
Hunters	0.60	0.16	57	46	20	1,140	1.8	1.68
Keesus	0.90	0.71	237	42	17	3,958	5.3	2.50
Lac La Belle	2.65	1.10	1,117	45	9	12,924	11.2	2.01
Lannon County Park Pond	0.20	0.17	15	50	22	352	0.8	1.52
Larkin	0.33	0.23	57	4	--	--	0.9	1.12
Leota	0.17	0.09	8	12	6	468	0.5	1.26
Linnie Lac	0.19	0.05	6	6	4	24	0.5	1.54
Little Muskego	1.50	1.10	506	65	14	7,170	7.1	1.40
Lower Genesee	0.45	0.32	66	44	18	1,188	1.4	1.23
Lower Kelly	0.08	0.08	3	36	12	--	0.3	1.15
Lower Nashotah	0.83	0.25	90	43	20	1,800	2.0	1.50
Lower Nemahbin	1.00	0.67	271	36	10	2,710	3.3	1.43
Lower Phantom	0.79	0.63	433	12	4	664	3.3	1.81
Merton Millpond	0.80	0.10	38	8	--	--	1.8	2.08
Middle Genesee	0.55	0.43	109	40	8	816	1.6	1.13
Monches Millpond	0.33	0.09	16	4	--	--	0.9	1.29
Monterey Millpond	0.25	0.03	30	8	3	90	1.8	2.37
Moose	0.83	0.20	81	61	40	2,325	2.3	1.82
Mukwonago Park Pond	0.08	0.05	1	5	--	--	0.2	1.01
Nagawicka	2.80	1.05	957	90	36	45,936	8.6	1.98
Norris Foundation Pond	0.10	0.07	3	8	--	--	--	--
North	1.37	0.67	439	73	40	17,480	5.3	1.81
Oconomowoc	1.25	1.05	804	62	32	24,544	7.0	1.80
Okauchee	1.90	1.85	1,187	94	25	30,412	18.5	3.10
Ottawa	0.33	0.15	28	16	7	273	1.0	1.35
Pewaukee	4.50	1.20	2,493	45	15	37,395	12.8	1.85
Pine	4.37	0.89	703	85	39	27,417	7.3	1.96
Pretty	0.40	0.30	64	35	9	576	1.2	1.07
Rainbow Springs	0.43	0.20	25	12	4	140	1.6	1.93
Reagon	0.23	0.20	16	10	5	60	0.5	1.03
Roxy Pond	0.30	0.15	17	3	2	34	0.8	1.38
Saratoga	1.61	0.07	24	6	3	72	3.4	4.82
Saylesville Millpond	0.73	0.28	45	4	2	92	2.2	1.93
School Section	0.60	0.55	125	8	3	375	1.9	1.21
Scuppernong Creek Pond	0.24	0.12	20	5	2	26	0.7	1.45

Table 5 (continued)

Lake	Length (miles)	Width (miles)	Surface Area (acres)	Maximum Depth (feet)	Mean Depth (feet)	Volume (acre-feet)	Shoreline Length (miles)	Shoreline Development Factor
Silver	0.97	0.56	222	44	31	6,882	2.7	1.29
Spahn	0.11	0.07	4	5	--	--	0.3	1.18
Spring	0.77	0.35	105	22	5	500	2.2	1.57
Spring (Dousman)	0.23	0.13	14	8	--	--	0.7	1.25
Sybil	0.10	0.04	2	--	--	--	0.3	1.38
Upper Genesee	0.43	0.18	37	27	14	490	1.1	1.33
Upper Kelly	0.25	0.09	12	31	17	--	0.9	1.14
Upper Nashotah	0.80	0.42	133	53	21	2,793	2.3	1.42
Upper Nemahbin	1.10	0.59	283	60	30	8,377	2.9	1.23
Upper Phantom	0.73	0.40	110	32	10	1,100	2.1	1.42
Utica	0.18	0.17	14	25	--	--	0.6	1.11
Waterville	0.95	--	68	12	4	272	1.9	1.58
Widgeon	0.30	0.20	25	25	--	--	0.8	1.19
Willow Spring	0.35	0.35	46	13	--	--	--	--
Wood	0.22	0.18	20	22	14	266	0.7	1.15

Source: SEWRPC.

plant. This power plant, installed in 1948, utilizes the 11-foot head created by the impoundment to produce electricity for home consumption and delivery to the State grid. Following a Wisconsin Department of Natural Resources dam safety inspection during the early 1990s, the dam was cleared of brush, and other minor repairs were made to the structure to ensure its ongoing operation.

Recreational Use

Applebecker Millpond and the upstream portions of the Bark River below the Nagawicka Lake dam are navigable by canoe or similar watercraft. Public access is provided through a public park that abuts the headwaters of the Millpond.

Development Potential

As of 1995, the land uses within the approximately 540-acre drainage area directly tributary to Applebecker Millpond consisted of about 40 percent rural land uses and about 60 percent urban land uses. Of the urban land uses, residential and recreational uses comprised about 160 acres, or approximately one-third of the land cover in the drainage area directly tributary to the Millpond. Rural land uses included woodlands, wetlands, surface waters, and other open lands that comprised about 210 acres, or also about two-fifths of the land cover in the drainage area directly tributary to the Millpond. The balance of the land use in the direct drainage area was comprised of urban land uses, including commercial lands, roadways and associated infrastructure, institutional, and communications and utility uses. The direct drainage area is partially located within an area planned for urban development, within the City of Delafield, in the adopted County development plan. Recent surveillance indicates that the developable lands within the drainage area directly tributary to the Millpond are largely fully built, with only limited infilling of existing platted lots or redevelopment of currently built lots likely to occur.

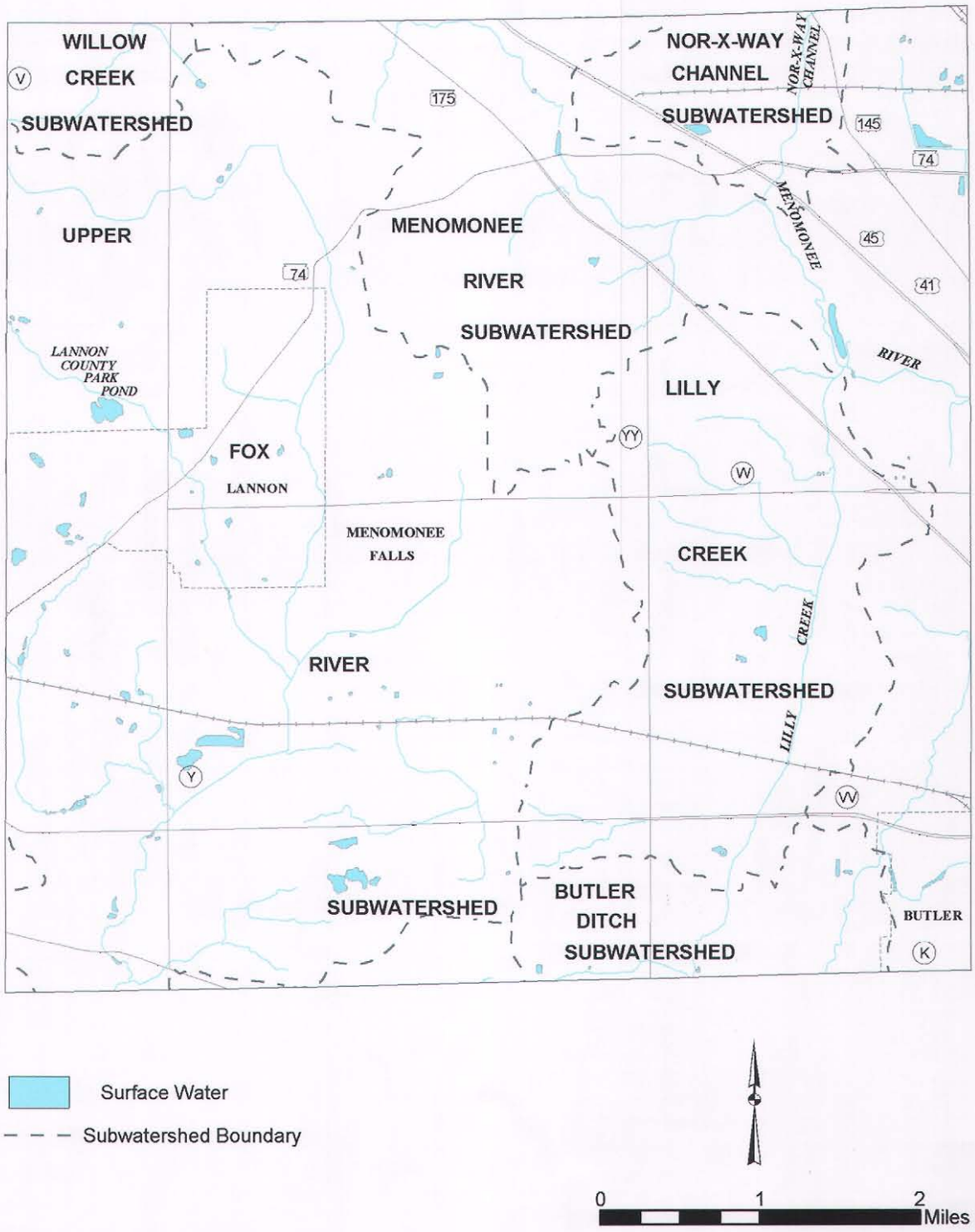
Applebecker Millpond is within the Bark River drainage system, which extends upstream for more than 45 square miles. Within this total tributary drainage area, urban land uses comprise about one-third of the area, while rural land uses comprise the balance. Of these, residential uses account for about one-half of the urban land uses, while agricultural land uses comprise slightly more than one-half of the rural land uses within the total drainage area tributary to Applebecker Millpond.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Applebecker Millpond is generated primarily from both rural agricultural and urban residential lands, which comprise about one-half of the land cover within the total drainage basin tributary to Applebecker Millpond.

Map 15

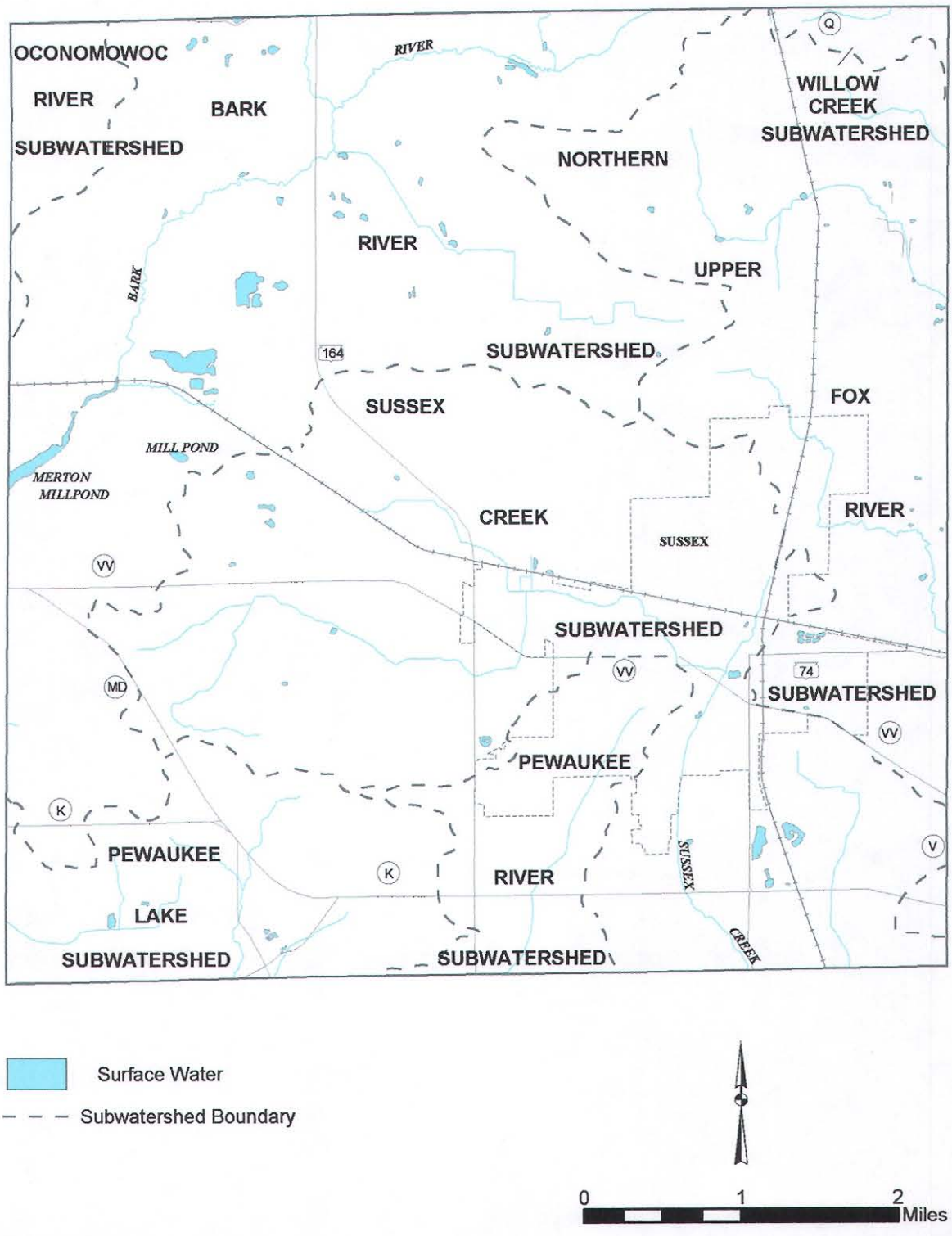
SURFACE WATER RESOURCES OF THE MENOMONEE FALLS AREA: 2000



Source: SEWRPC.

Map 16

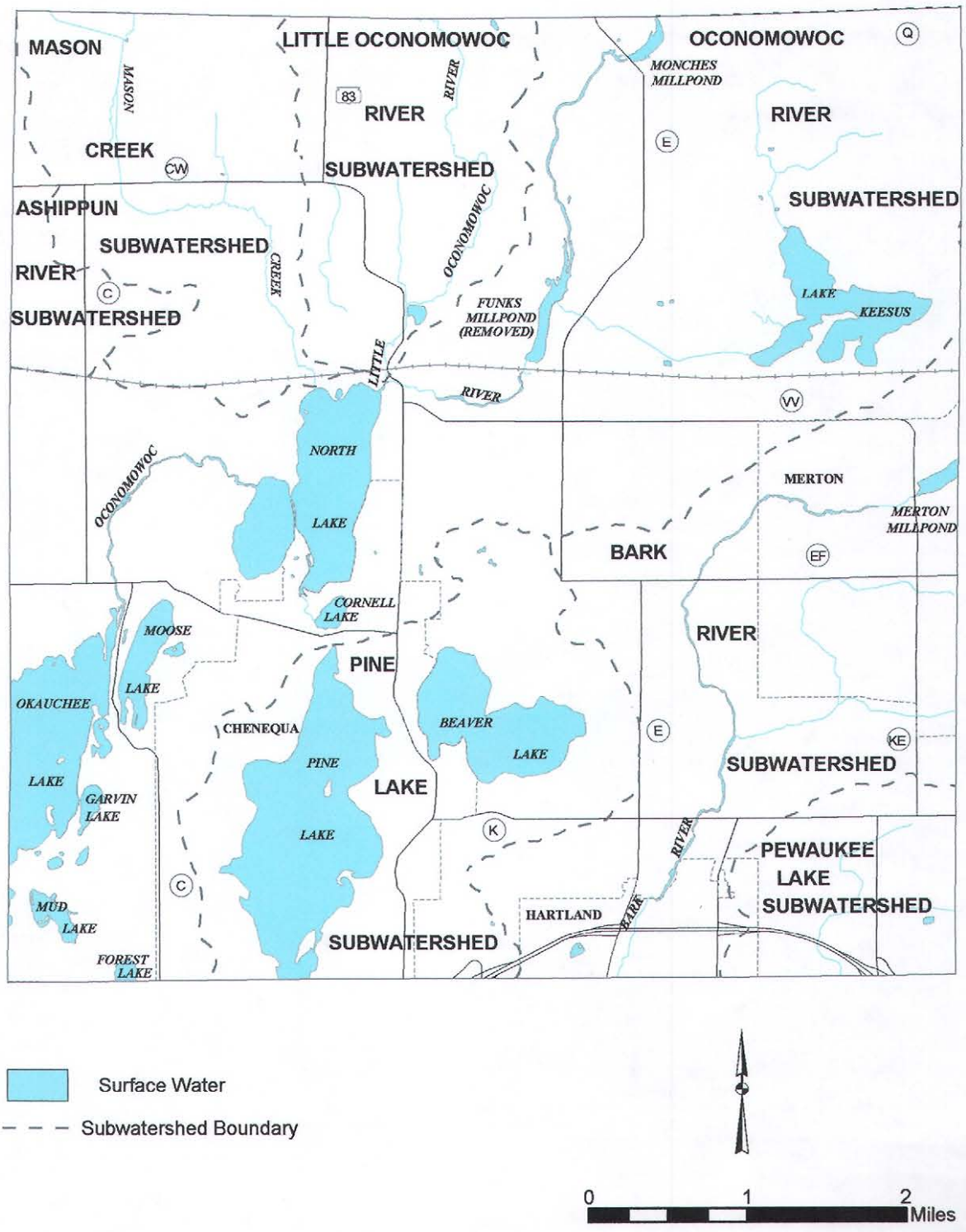
SURFACE WATER RESOURCES OF THE LISBON AREA: 2000



Source: SEWRPC.

Map 17

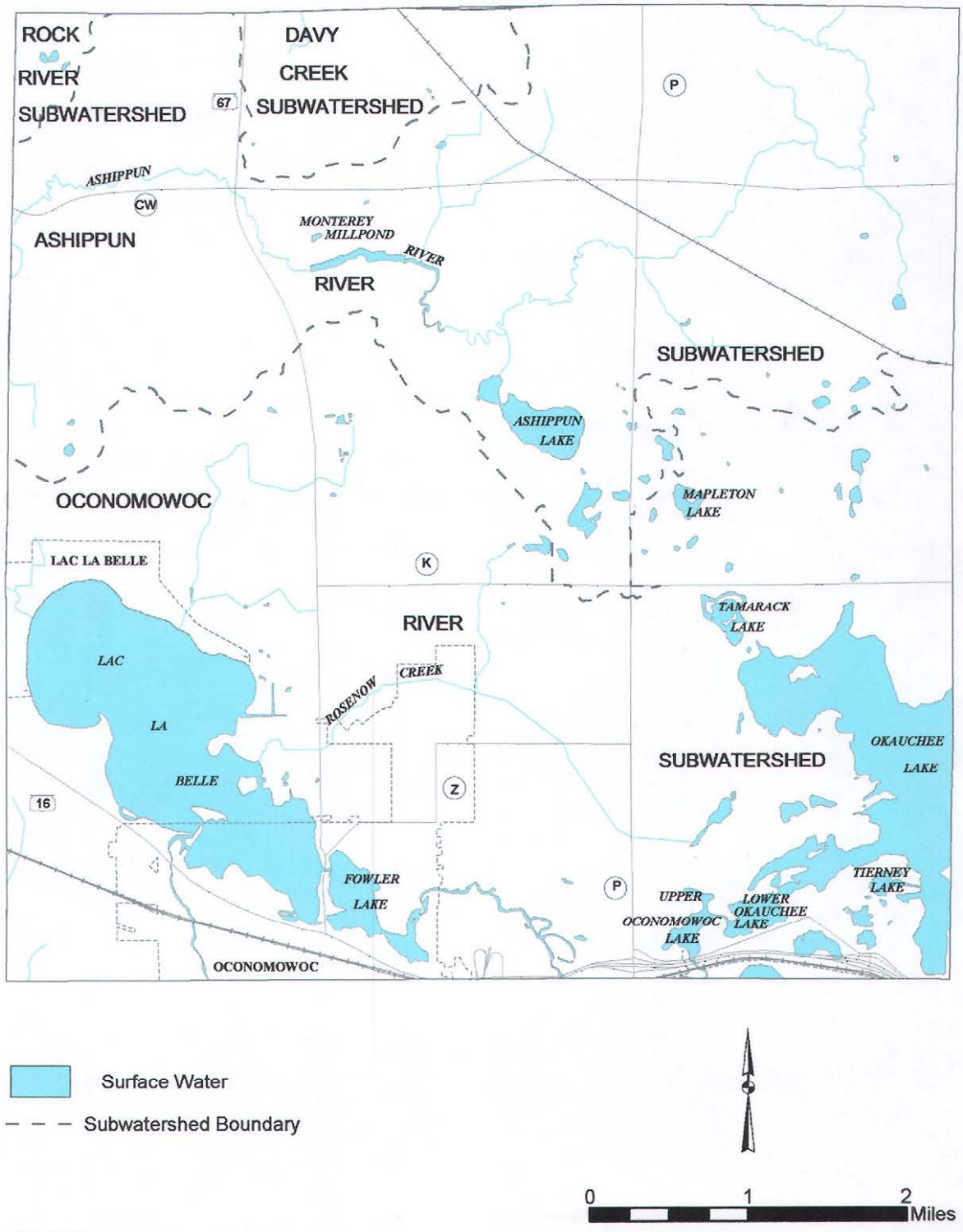
SURFACE WATER RESOURCES OF THE MERTON AREA: 2000



Source: SEWRPC.

Map 18

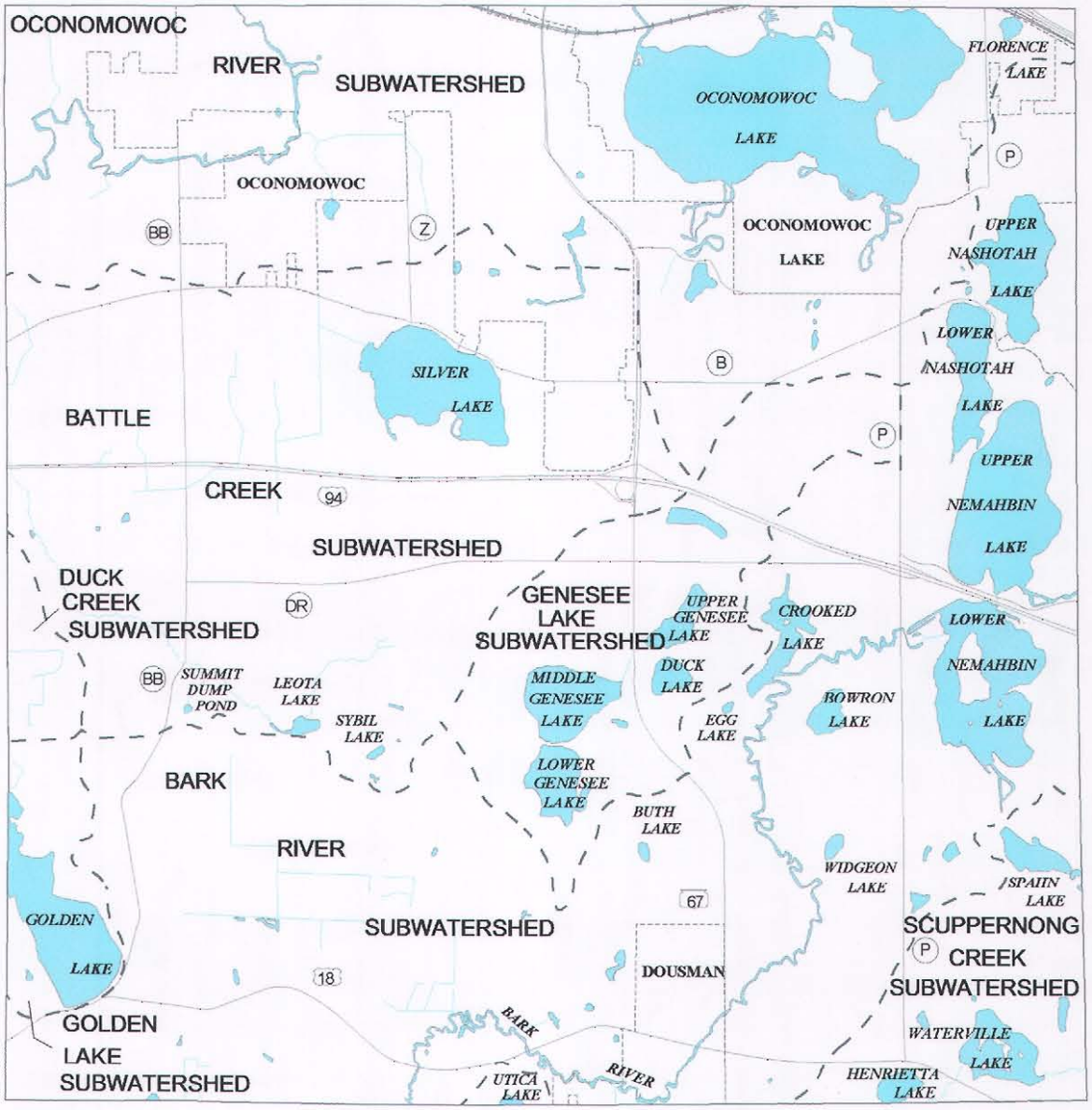
SURFACE WATER RESOURCES OF THE OCONOMOWOC AREA: 2000



Source: SEWRPC.

Map 19

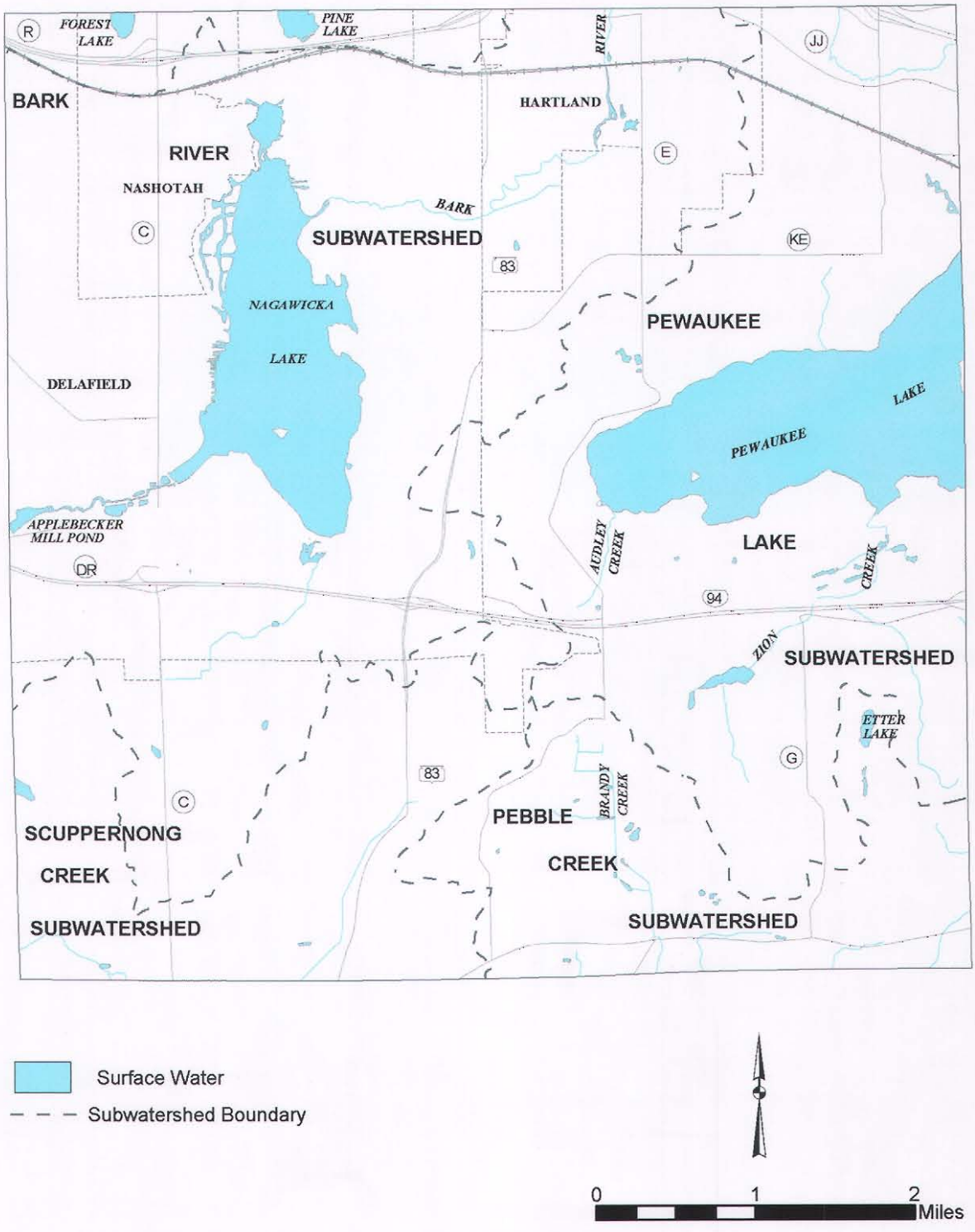
SURFACE WATER RESOURCES OF THE SUMMIT AREA: 2000



Source: SEWRPC.

Map 20

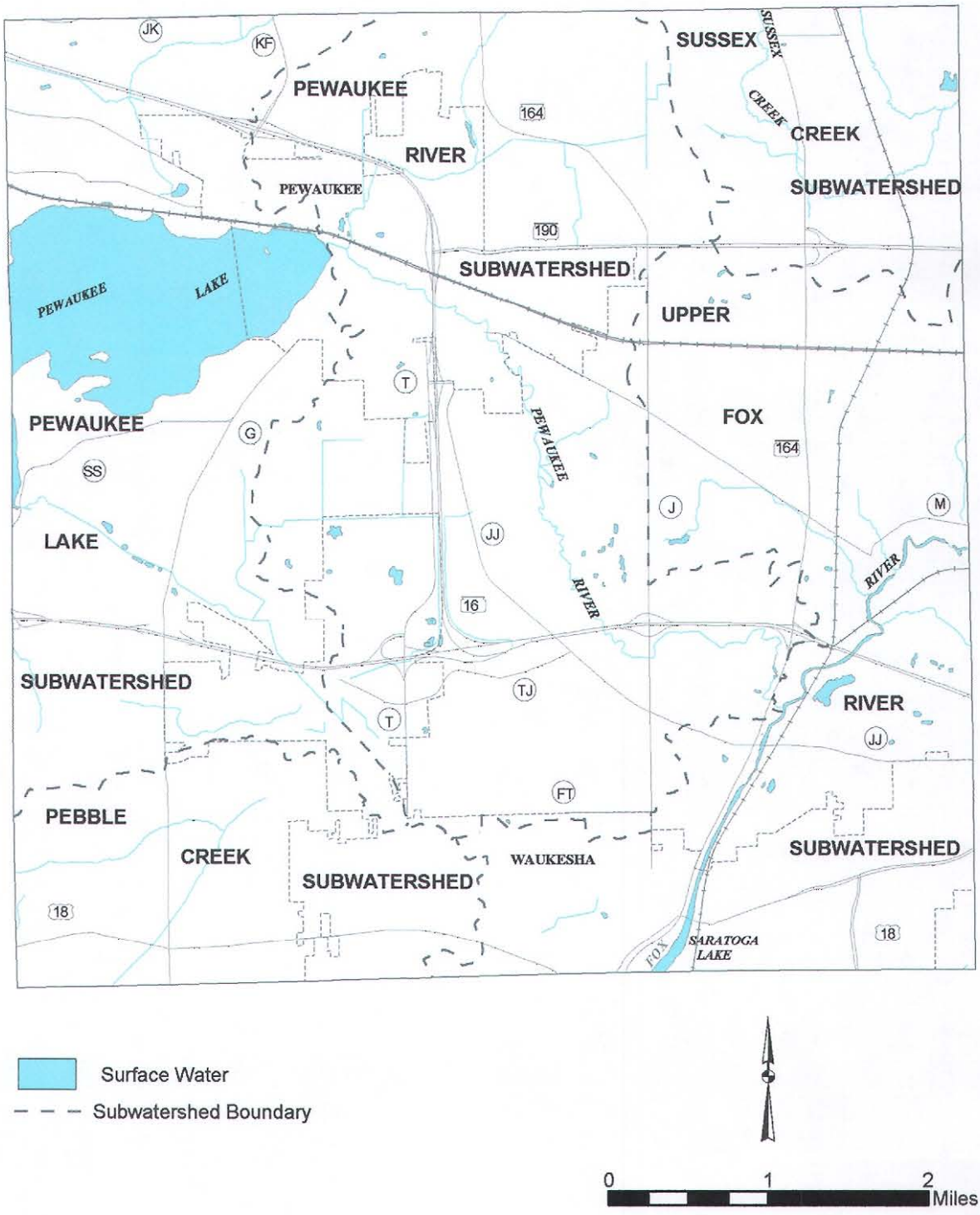
SURFACE WATER RESOURCES OF THE DELAFIELD AREA: 2000



Source: SEWRPC.

Map 21

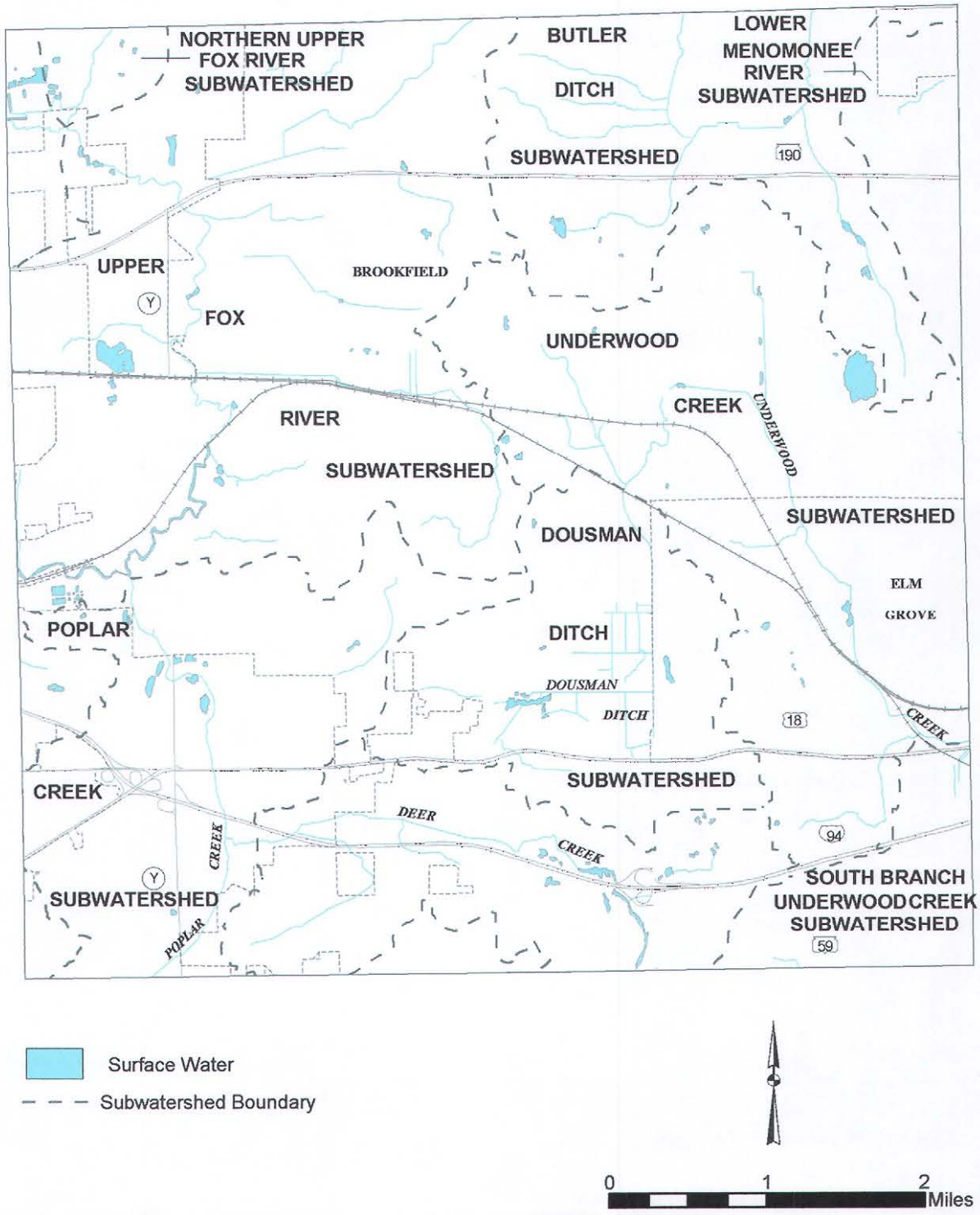
SURFACE WATER RESOURCES OF THE PEWAUKEE AREA: 2000



Source: SEWRPC.

Map 22

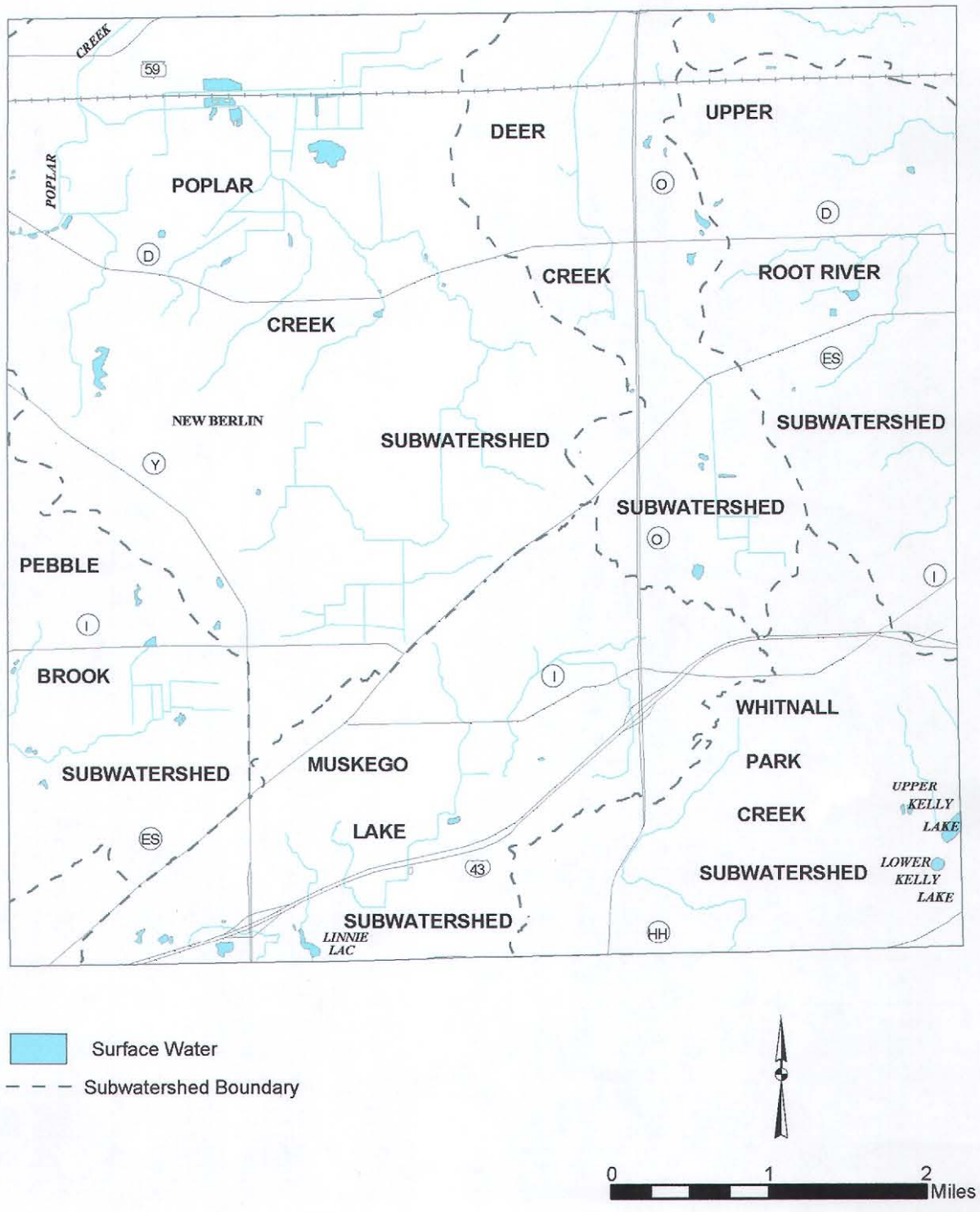
SURFACE WATER RESOURCES OF THE BROOKFIELD AREA: 2000



Source: SEWRPC.

Map 23

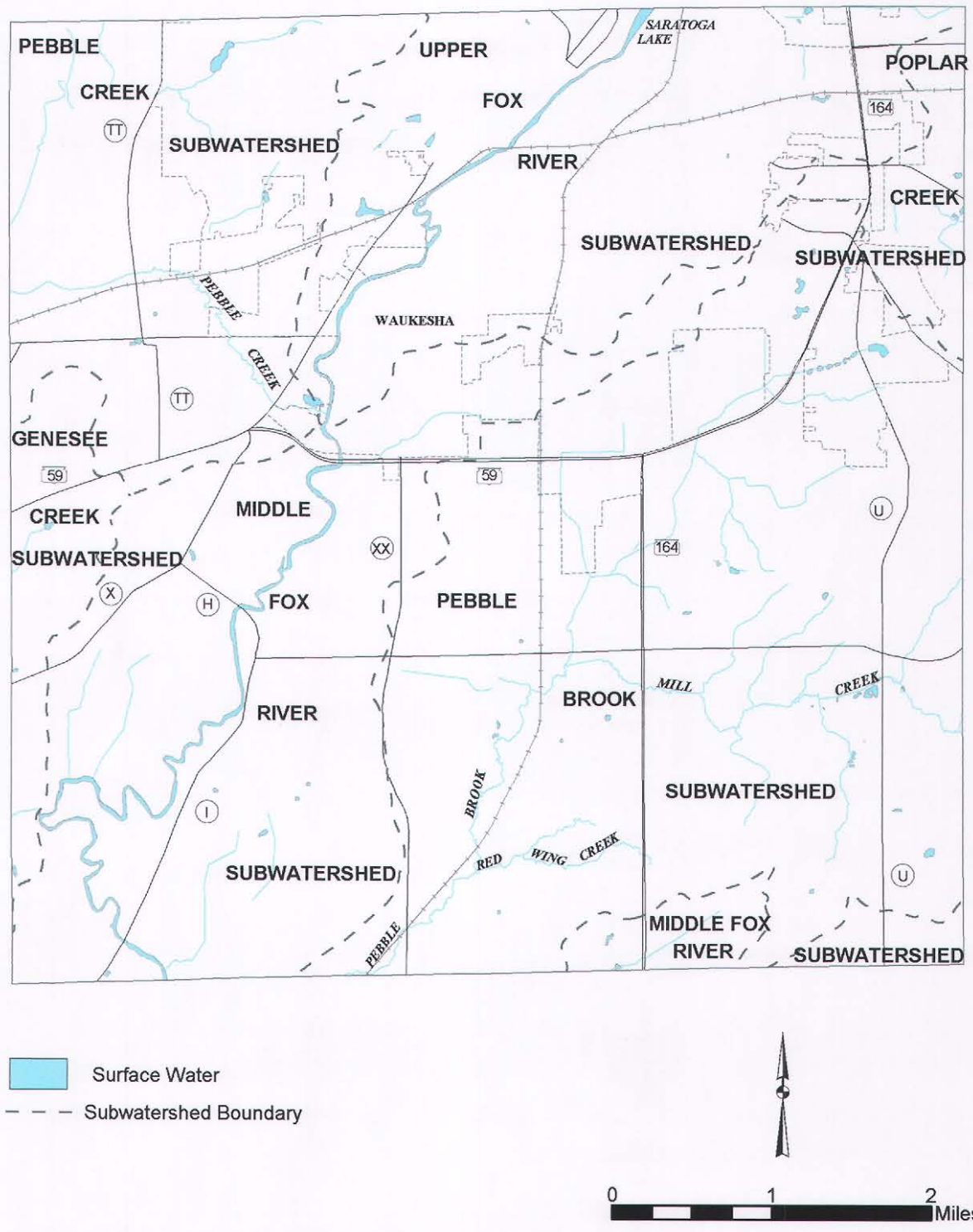
SURFACE WATER RESOURCES OF THE NEW BERLIN AREA: 2000



Source: SEWRPC.

Map 24

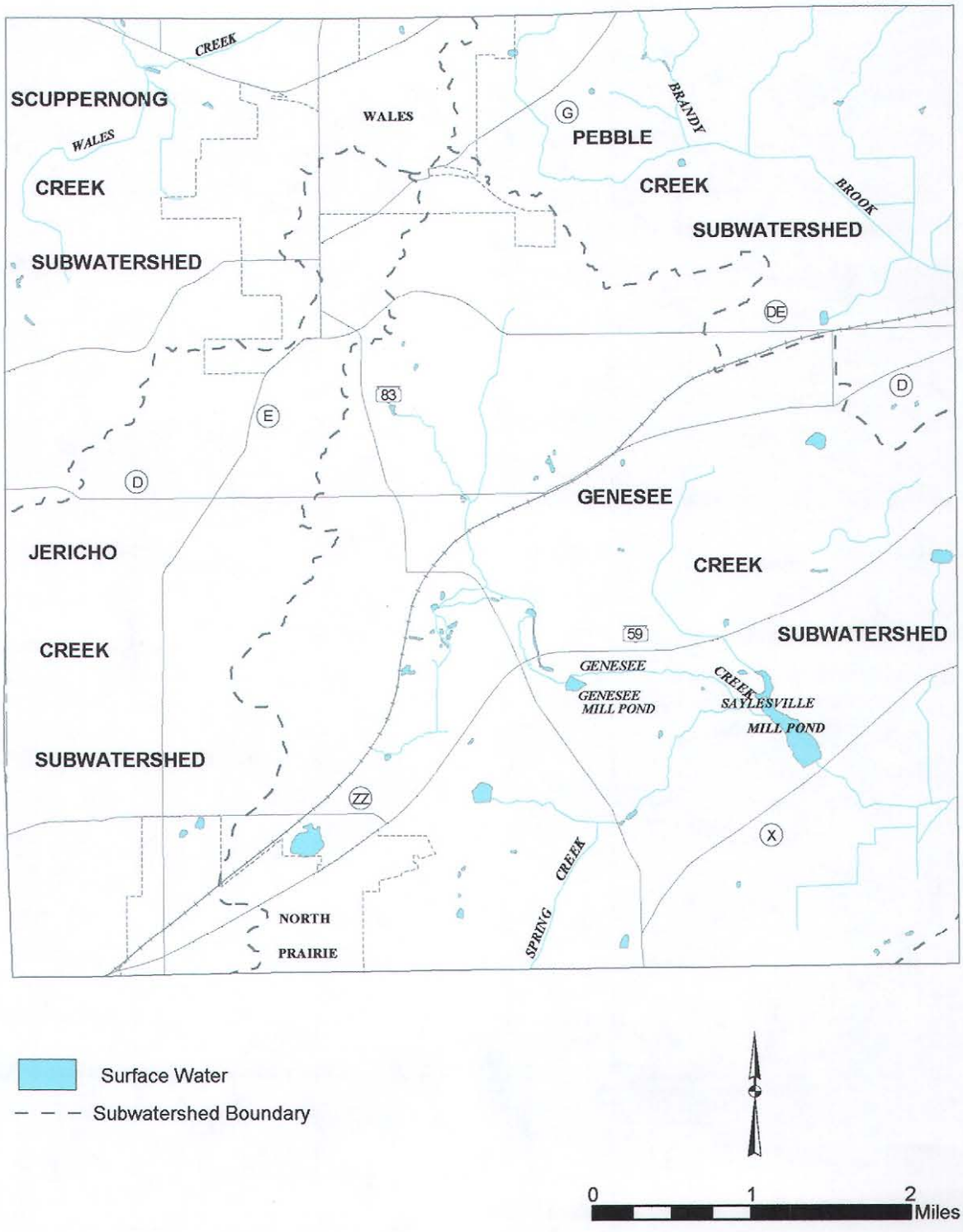
SURFACE WATER RESOURCES OF THE WAUKESHA AREA: 2000



Source: SEWRPC.

Map 25

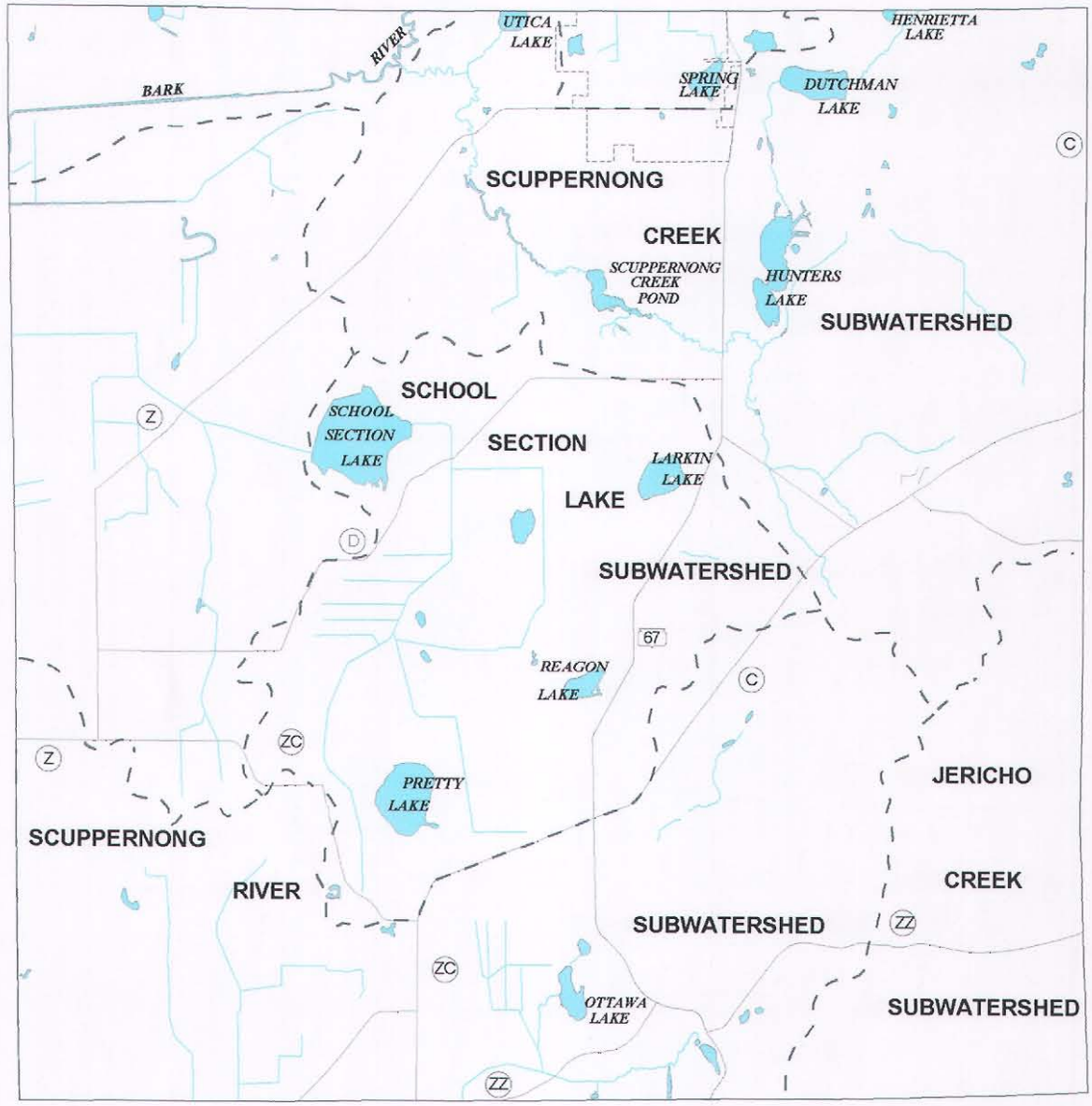
SURFACE WATER RESOURCES OF THE GENESEE AREA: 2000



Source: SEWRPC.

Map 26

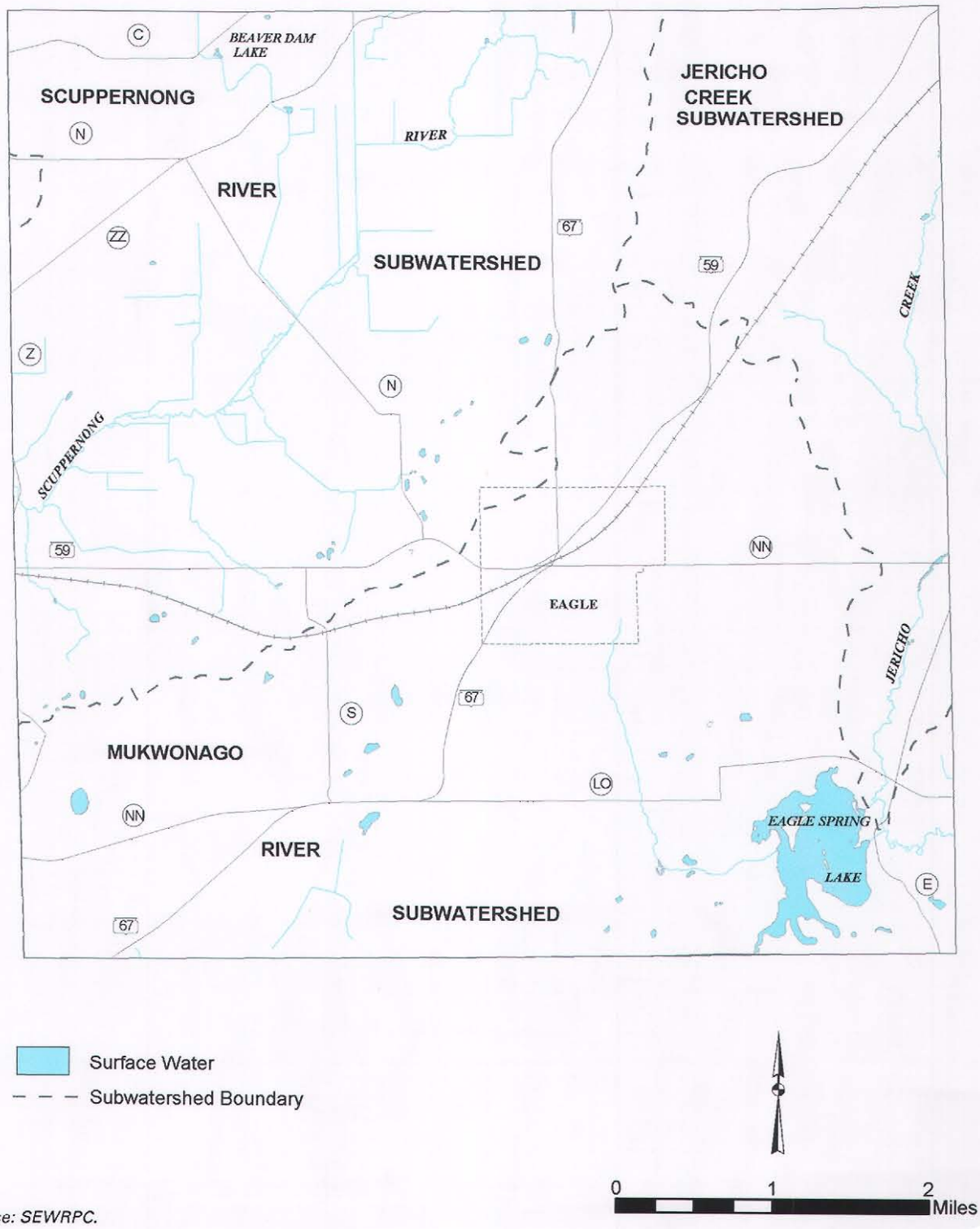
SURFACE WATER RESOURCES OF THE OTTAWA AREA: 2000



Source: SEWRPC.

Map 27

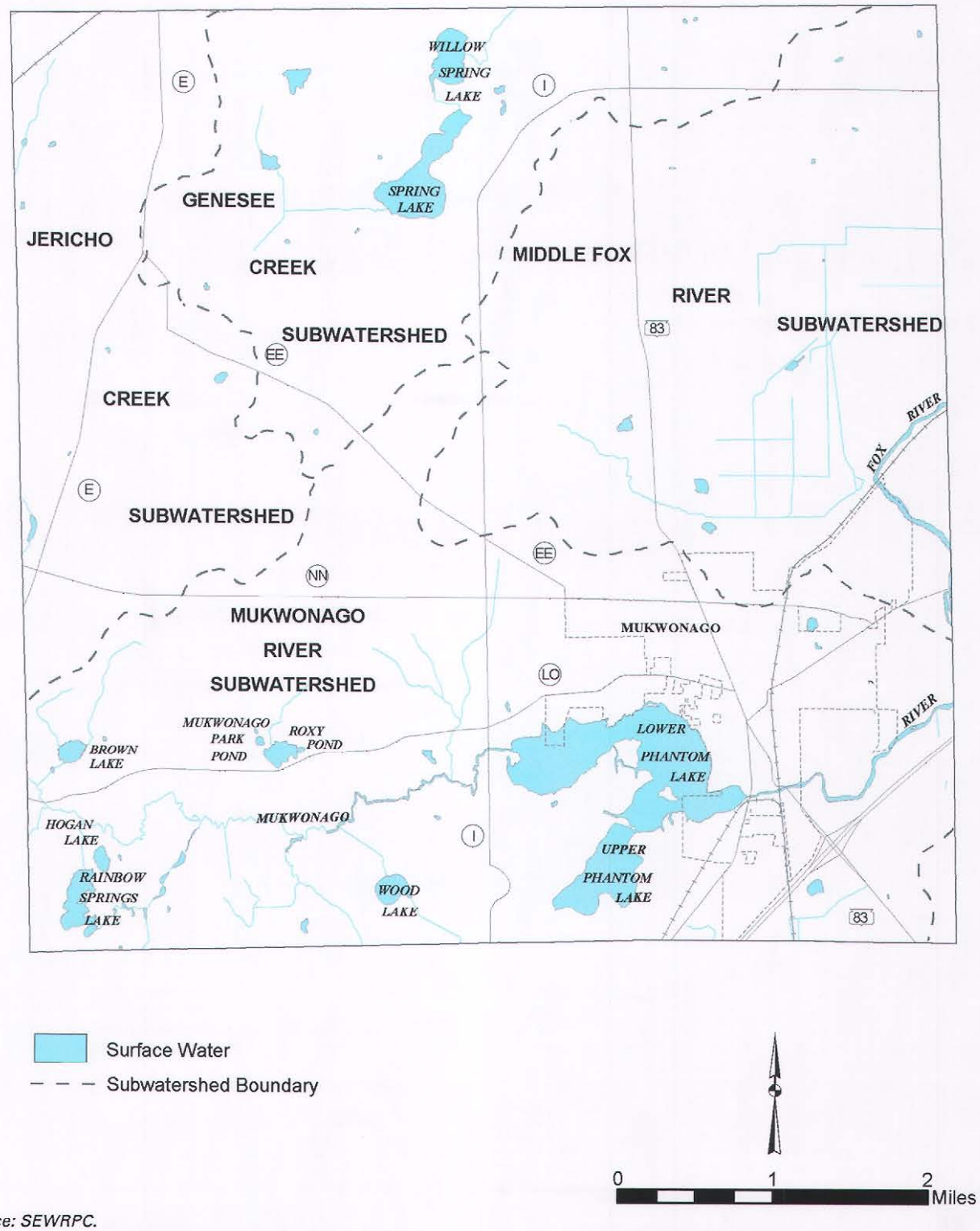
SURFACE WATER RESOURCES OF THE EAGLE AREA: 2000



Source: SEWRPC.

Map 28

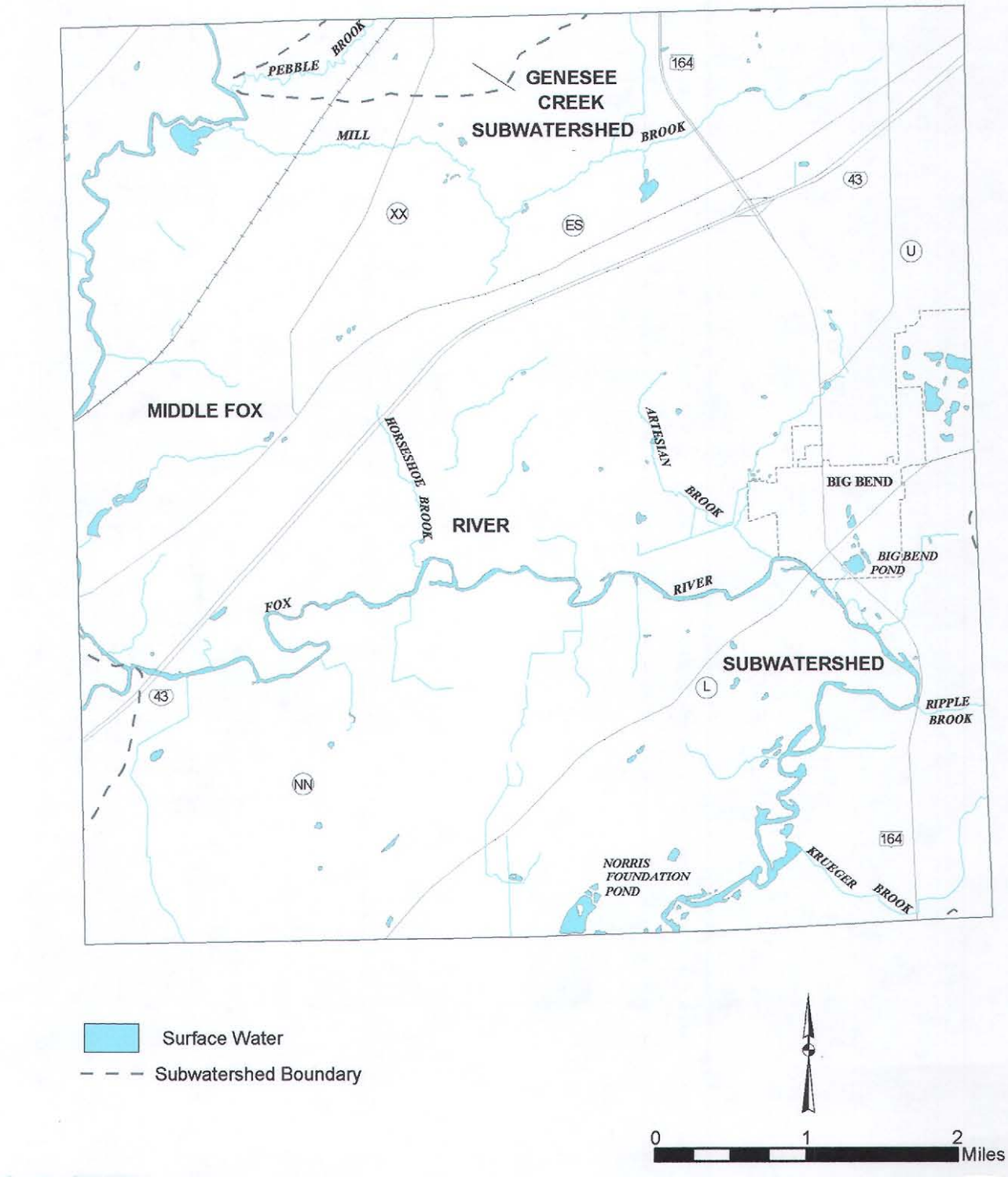
SURFACE WATER RESOURCES OF THE MUKWONAGO AREA: 2000



Source: SEWRPC.

Map 29

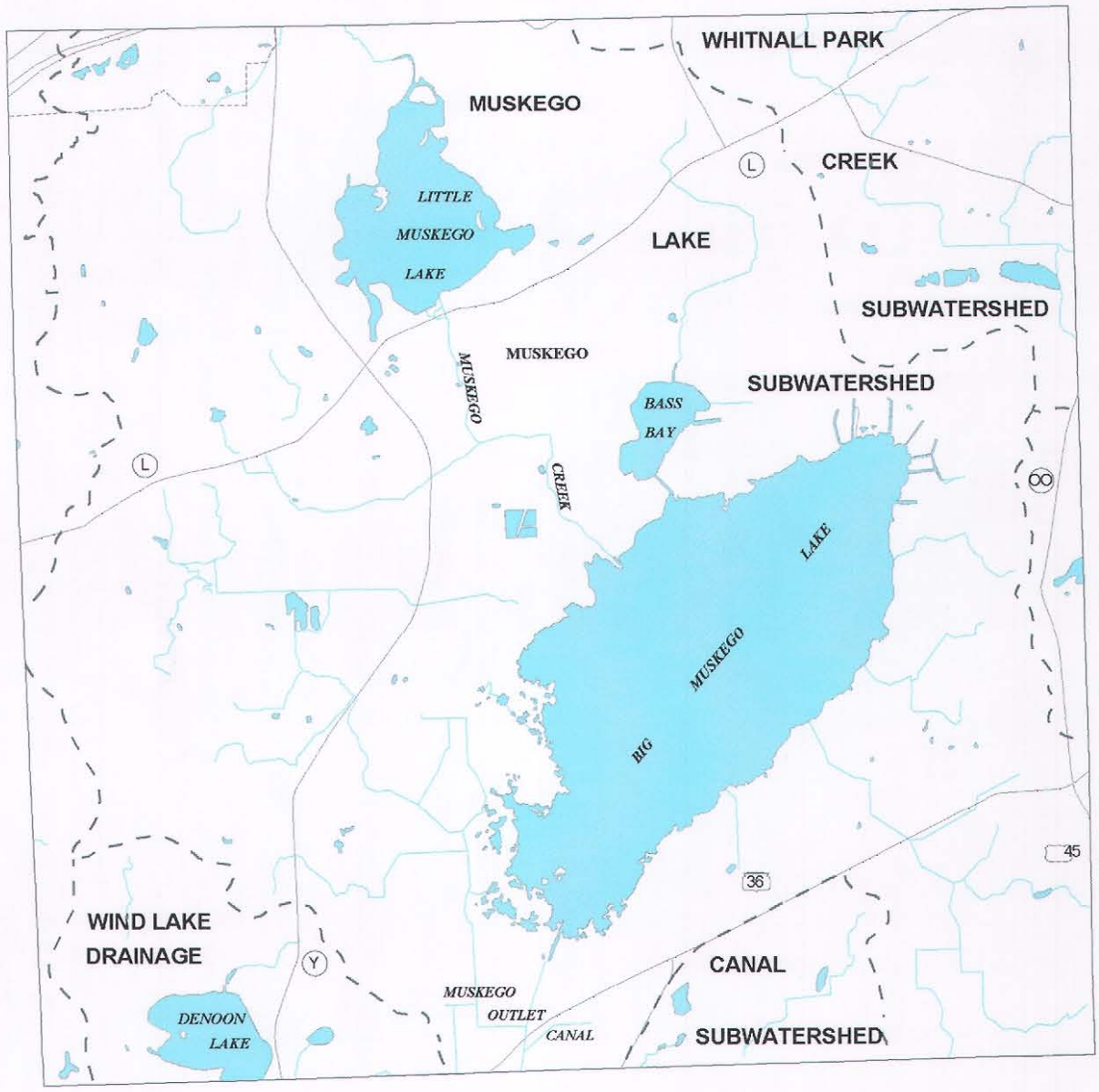
SURFACE WATER RESOURCES OF THE VERNON AREA: 2000



Source: SEWRPC.

Map 30

SURFACE WATER RESOURCES OF THE MUSKEGO AREA: 2000



Source: SEWRPC.

Fish and Wildlife Populations

In 1963, the fishery in Applebecker Millpond consisted largely of largemouth bass, panfish, and northern pike.[1] These same fishes were reported in the Millpond as of 2001,[2] with largemouth bass being reported as common and panfish as abundant. The shorelands to the south and east of the millpond are low and marshy, offering protection to the waterfowl throughout the year.

Ashippun Lake

Lake Morphometry

Ashippun Lake is located in U.S. Public Land Survey Section 15, Township 8 North, Range 17 East, Town of Oconomowoc, as shown on Map 18. The Lake has a surface area of about 83 acres, a maximum depth of 40 feet, and a shoreline development factor of 1.71. Ashippun Lake is a spring-fed natural lake with two basins. The lake bottom is primarily sand, gravel, and marl, with adjoining wetlands and lowlands associated with the Ashippun River valley. The bathymetry of Ashippun Lake is shown on Map 31. The Lake drains through an outlet stream to the Ashippun River.

Water Quality

Available water quality data indicate that Ashippun Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a Wisconsin Trophic State Index (TSI) rating of approximately 49. A water quality management plan was completed for the Lake by the Southeastern Wisconsin Regional Planning Commission (SEWRPC) in 1982,[3] and is currently being updated.

Recreational Use

Ashippun Lake is navigable by boat. Aquatic plant growth within the lake basin has been reported to be problematic for recreational use in the shallow western basin of the Lake, which makes up about one-fifth of the lake surface area. Public access is provided, and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential

As of 1995, the land uses within the approximately 440-acre drainage area directly tributary to Ashippun Lake consisted of about 80 percent rural land uses and about 20 percent urban land uses. Of the rural land uses, agricultural land uses comprised about 150 acres, or about one-third of the land cover in the direct drainage area. Urban residential lands comprised about 70 acres, or about 15 percent of the land cover in the drainage basin directly tributary to Ashippun Lake. Roadways and other open space uses comprised the balance of the urban land uses. The balance of the lands within the direct drainage area was comprised of woodlands, wetlands, and other open lands covering about one-half of the drainage area directly tributary to Ashippun Lake. The drainage area is partially located within an area planned for urban development in the adopted County development plan. Recent surveillance indicates that the developable lands within the drainage area directly tributary to the Lake are largely fully built with only limited infilling of existing platted lots or redevelopment of currently built lots likely to occur.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Ashippun Lake is generated primarily from rural agricultural lands, which comprise about one-third of the land cover within the drainage basin tributary to Ashippun Lake.

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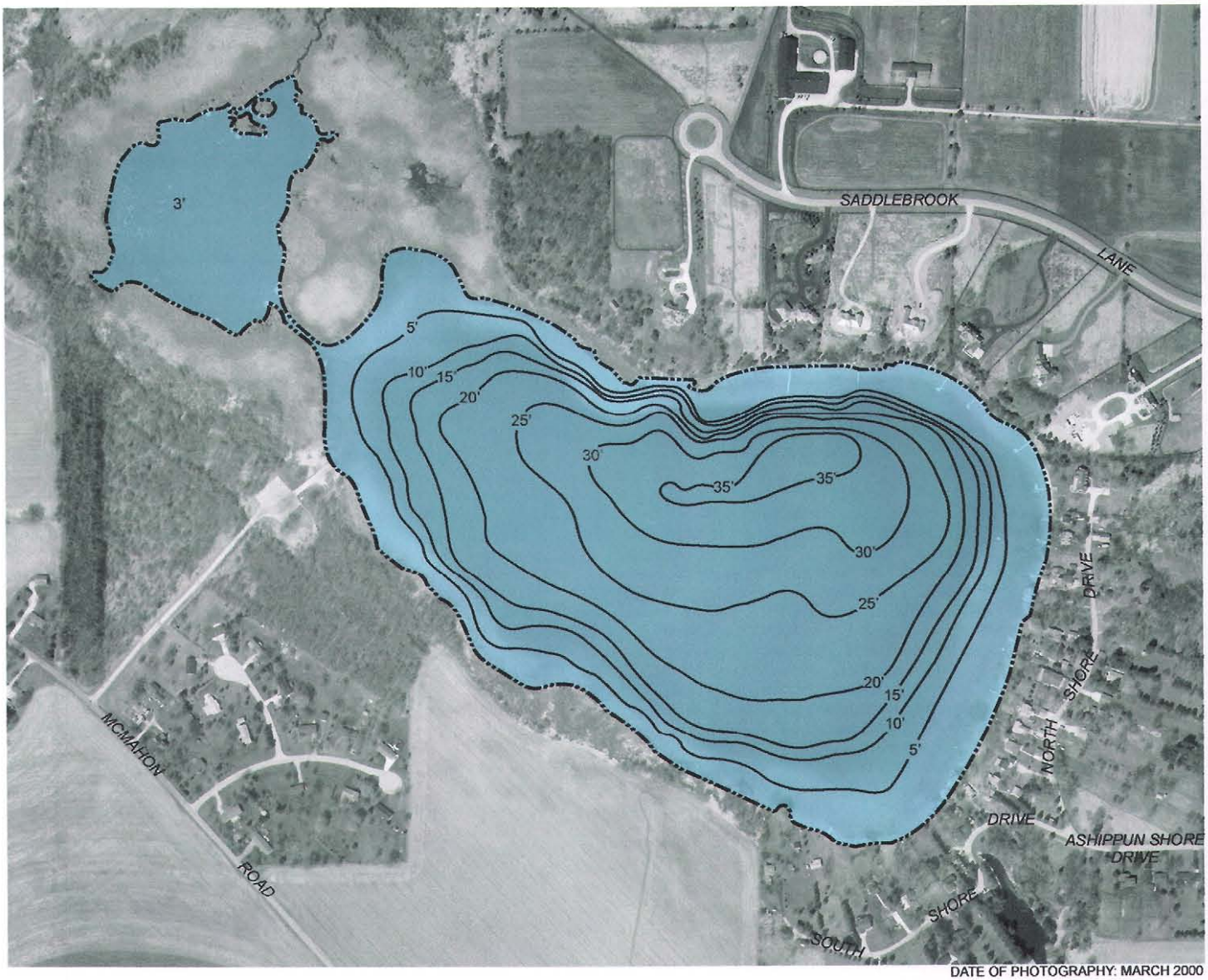
[1] *Wisconsin Conservation Department,* Surface Water Resources of Waukesha County, *1963.*

[2] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* Wisconsin Lakes, *2001.*

[3] *SEWRPC Community Assistance Planning Report No. 48,* A Water Quality Management Plan for Ashippun Lake, Waukesha County, Wisconsin, *January 1982; a second edition of this plan is scheduled for completion in December 2006.*

Map 31

BATHYMETRIC MAP OF ASHIPPUN LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

Source: SEWRPC.

GRAPHIC SCALE

0 300 600 FEET

Fish and Wildlife Populations

In 1963, the fishery of Ashippun Lake consisted largely of panfish with northern pike and largemouth bass.[4] A fish survey in 1975 reported the fishery of Ashippun Lake to consist of bluegill, largemouth bass, blackchin shiner, brook silverside, least darter, grass pickerel, yellow perch, warmouth, yellow bullhead, blackstripe topminnow, bluntnose minnow, black crappie, and green sunfish.[5] The least darter is listed as a State species of special concern. Panfish and northern pike were reported to be common in the Lake as of 2001, with both largemouth bass and walleyed pike being present.[6] Waterfowl have been reported to make limited migratory and resident use of the wetlands adjoining the western end of the Lake.

Beaver Lake

Lake Morphometry

Beaver Lake is located in U.S. Public Land Survey Sections 21, 27, and 28, Township 8 North, Range 18 East, Town of Merton and Village of Chenequa, as shown on Map 17. Beaver Lake has a surface area of 316 acres, a maximum depth of 49 feet, and a shoreline development factor of 1.45. A seepage-fed lake in the kettle moraine, Beaver Lake drains intermittently into Pine Lake through a culvert under STH 83, and, ultimately, into the Oconomowoc River system at North Lake through Pine and Cornell Lakes. The lake bottom consists primarily of sand and marl. The bathymetry of Beaver Lake is shown on Map 32.

Recreational Use

Public access is provided through a carry-in access site, and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential

As of 1995, the land uses within the approximately 1,450-acre drainage area directly tributary to Beaver Lake consisted of about 45 percent urban land uses and about 55 percent rural land uses. Of the urban land uses, residential uses comprised about 440 acres or approximately one-third of the total land cover in the drainage area. Agricultural land uses comprised about 270 acres or about a further one-fifth of the total land cover in the drainage area directly tributary to the Lake. Commercial lands, roadways and associated infrastructure, institutional, and communications and utility uses comprised about 200 acres, while woodlands, wetlands, surface water, and open space uses comprised about 540 acres, or approximately 40 percent of the total land cover in the drainage area directly tributary to Beaver Lake. The drainage area is partially located within an area planned for urban development, in the Village of Chenequa, in the adopted County development plan. Recent surveillance indicates that the developable lands within the drainage area directly tributary to the Lake are largely fully built with only limited infilling of existing platted lots or redevelopment of currently built lots likely to occur.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Beaver Lake is generated primarily from both urban residential lands and rural agricultural lands, which comprise about one-half of the land cover within the drainage basin tributary to Beaver Lake. The Oconomowoc River Priority Watershed Plan recommends minimal interventions within the Beaver Lake watershed to maintain the Lake in a mesotrophic condition.[7]

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[4] *Wisconsin Conservation Department,* op. cit.

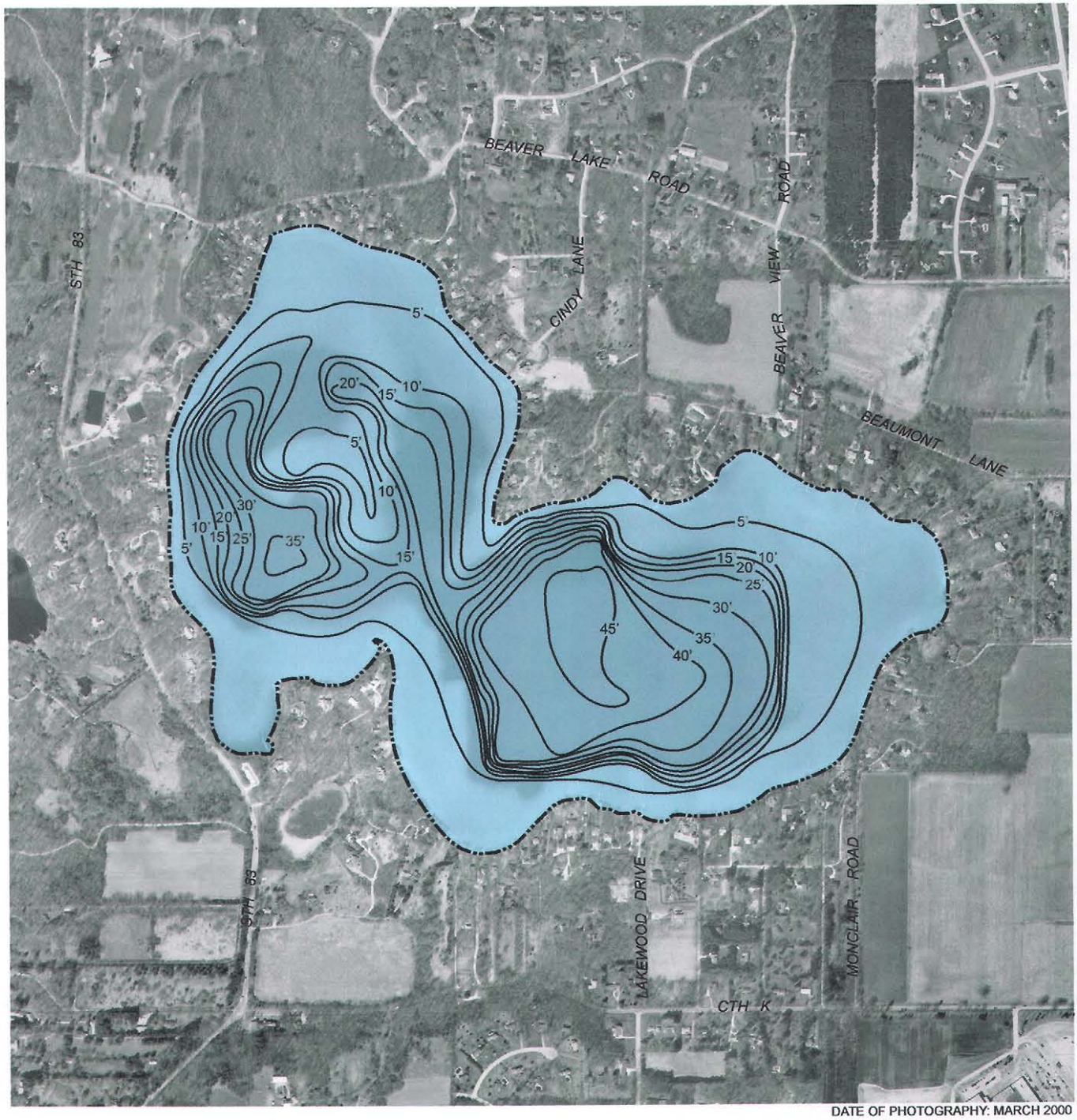
[5] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* Retrieval and Analysis System Used in Wisconsin's Statewide Fish Distribution Survey, Second Edition, *December 1988.*

[6] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[7] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* Nonpoint Source Control Plan for the Oconomowoc River Priority Watershed Project, *March 1986.*

Map 32

BATHYMETRIC MAP OF BEAVER LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

GRAPHIC SCALE

0 600 1200 FEET

Source: SEWRPC.

Fish and Wildlife Populations
In 1963, the fishery consisted largely of largemouth bass, northern pike, and panfish, notably yellow perch and bluegills.[8] A fish survey conducted in 1975 reported the fishery to consist of largemouth bass, blacknose shiner, emerald shiner, mimic shiner, rainbow shiner, johnny darter, pumpkinseed, green sunfish, bluntnose minnow, bluegill, log perch, and yellow perch.[9] As of 2001, panfish were reported to be common, with largemouth bass and northern pike being present in the Lake.[10]

Beaver Dam Lake
Lake Morphometry
Beaver Dam Lake is located in U.S. Public Land Survey Section 6, Township 5 North, Range 17 East, Town of Eagle, as shown on Map 27. The Lake has a nominal surface area of about 36 acres, a maximum depth of six feet, and a shoreline development factor of 2.70, although these attributes vary widely depending upon rainfall, season, growth of wetland vegetation, groundwater flows, and other factors. Beaver Dam Lake is a landlocked, internally drained seepage lake on the edge of a terminal moraine. The lake basin is somewhat dendritic, with the southern end of the basin consisting of a sedge marsh of approximately 160 acres in areal extent. Currently, the waterbody is indicated to be a marsh for mapping purposes, although it is retained within the Wisconsin waterbody index (WIBC) system.[11]

Recreational Use
Public access is not available. Beaver Dam Lake has limited navigability.

Development Potential
As of 1995, the land uses within the approximately 530-acre drainage area directly tributary to Beaver Dam Lake consisted of less than 5 percent urban land uses and about 95 percent rural land uses. Of the urban land uses, urban residential lands comprised less than 10 acres. Agriculture land uses comprised about 300 acres or about three-fifths of the direct drainage area. Roadways and associated infrastructure comprised the balance of the urban land uses or less than 10 acres, while woodlands, wetlands, and other open lands comprised the balance of the rural land uses, or about 210 acres of the direct drainage area. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Beaver Dam Lake is generated primarily from rural agricultural lands, which comprises about three-fifths of the land cover within the drainage basin.

Fish and Wildlife Populations
Waterfowl are likely to make migratory and resident use of the adjoining wetlands within the Lake proper.[12]

Big Bend Pond
Lake Morphometry
Big Bend Pond is located in U.S. Public Land Survey Section 24, Township 5 North, Range 19 East, Village of Big Bend, as shown on Map 29. The Pond has a surface area of seven acres, a maximum depth of 10 feet, and a shoreline development factor of 1.16. Big Bend Pond is a spring-fed impoundment created by a small dam.

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[8] *Wisconsin Conservation Department,* op. cit.

[9] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[10] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[11] Ibid.

[12] *Wisconsin Conservation Department,* op. cit.

Several nearby ponds are also spring-fed and were historically managed as a fish hatchery. The Pond drains to the Fox River drainage system.

Recreational Use
Public access is provided by public road rights-of-way. Big Bend Pond has limited navigability and is generally navigable only by canoe or similar watercraft. Dense aquatic plant growths are reported to present a general use problem.

Development Potential
As of 1995, the land uses within the approximately 2,000-acre drainage area tributary to the Middle Fox River, within which the Big Bend Pond is situated, consisted of about 55 percent rural land uses and 45 percent urban land uses. Of the rural land uses, agricultural uses comprised about 700 acres, or approximately one-third of the land cover in the drainage basin tributary to Big Bend Pond. Other rural land uses included woodlands, wetlands, and open lands that comprised about 420 acres, or about one-fifth of the land cover in the drainage area directly tributary to the Pond. Urban residential lands comprised about 410 acres, or also about one-fifth of the land cover. Roadways and associated infrastructure, commercial, industrial, institutional and utilities, and recreational lands comprised the balance of the urban land uses, or about 470 acres. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Big Bend Pond is generated primarily from both rural agricultural and urban residential lands, which comprise about one-half of the land cover within the drainage basin tributary to Big Bend Pond.

Fish and Wildlife Populations
In 1963, the fishery of Big Bend Pond consisted largely of panfish.[13] As of 2001, panfish were reported to be common in the Pond, with largemouth bass also being reported to be present.[14]

Big Muskego Lake
Lake Morphometry
Big Muskego Lake is located in U.S. Public Land Survey Sections 13, 14, 21, 22, 23, 26, 27, 28, 33, and 34, Township 5 North, Range 20 East, City of Muskego, as shown on Map 30. The Lake has a surface area of about 2,260 acres, a maximum depth of 26 feet, and a shoreline development factor of 2.66.[15] Big Muskego Lake occupies part of a shallow remnant basin of an old glacial lakebed.[16] The Lake originally drained into the Root River and ultimately into the Laurentian Great Lakes drainage basin. However, the construction of a drainage ditch linking Big Muskego Lake to Wind Lake, in Racine County, altered this drainage pattern during the 1890s, and the Lake presently drains into the Fox River and subsequently into the Mississippi River drainage system. Since the late 1920s, a dam on the outlet canal draining to Wind Lake, having a head of about three feet, has

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[13]Ibid.

[14]*Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[15]*The wetland nature of the lakeshore has resulted in various hydrographical and morphometric data being published for the Lake. The Wisconsin Department of Natural Resources reports the Lake surface area as 2,177 acres, which area is used for regulatory purposes including the determination of public recreational boating access pursuant to Chapter NR 1 of the* Wisconsin Administrative Code, *while the adopted regional water quality management plan and Waukesha County land and water resource management plan report the surface area as 2,260 acres, which value is used herein.*

[16]*Wisconsin Department of Natural Resources Lake Use Report No. FX-3,* Big Muskego Lake, Waukesha County, Wisconsin, *1971.*

maintained the level of the Lake. Bass Bay (Bass Bay Lake) is a deep-water embayment located at the northern extreme of Big Muskego Lake. While the Bay is intimately connected to Big Muskego Lake, currently, the Lakes are considered by the Wisconsin Department of Natural Resources to be independent waterbodies with unique waterbody identification system (WBIC) designations. The bathymetry of Big Muskego Lake is shown on Map 33, and that of Bass Bay is shown on Map 34. Big Muskego Lake and Bass Bay drain through Wind Lake to the Fox River drainage system.

Water Quality

Available water quality data indicate that Big Muskego Lake and Bass Bay are eutrophic waterbodies, or enriched waterbodies, with a TSI rating of approximately 70. Following remedial actions implemented during the early 1990s that included a drawdown, rotenone treatment, and application of alum to portions of Bass Bay, water quality of these lakes has improved.[17] The TSI values reported by the Wisconsin Department of Natural Resources for both lakes during and following this program of remediation were indicative of meso-eutrophic waterbodies, with a TSI rating of about 50.[18] Figures 2 and 3 show the trends in water quality within Big Muskego Lake and Bass Bay, respectively, during the period 1988 through 2002.

Recreational Use

Public access is provided through a launch site on Bass Bay in the northwestern portion of the Lake, and through a public recreational boating access site on the northeastern shore of the main basin of Big Muskego Lake. Several private access sites adjacent to the main basin of the Lake also provide access to the Lake. A recreational boating access plan was completed for the Lake by SEWRPC during 1994.[19] Access to Big Muskego Lake is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*. The Lake is considered by the Wisconsin Department of Natural Resources to have a high active recreational value, and the Lake is reported to be especially heavily utilized during the waterfowl hunting season.[20]

Development Potential

As of 1995, the land uses within the approximately 12,150-acre drainage area directly tributary to Big Muskego Lake consisted of agricultural and wetland uses which comprised about 25 percent urban land uses and about 75 percent rural land uses. Of the rural land uses, agricultural lands comprised 4,200 acres or approximately 45 percent of the total land cover in the drainage area directly tributary to Big Muskego Lake. Other rural land uses included woodlands, wetlands, and other open lands, which comprised about one-third of the drainage area directly tributary to Big Muskego Lake. Urban residential land uses comprised about 1,200 acres, or approximately 10 percent of the land cover. Transportation and related infrastructure, commercial, industrial, and institutional and utilities comprised the balance of the land cover in the direct drainage area. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Big Muskego Lake is located within the Muskego-Wind Lake drainage system, a tributary stream system to the Fox River, which extends upstream for about 30 square miles. Within this total tributary drainage area, urban land uses comprise about 40 percent of the area, while rural land uses comprise the balance. Of these, urban residential uses account for about one-quarter of the urban land uses, while rural agricultural land uses comprise slightly less than one-third of the rural land uses within the total drainage area tributary to Big Muskego Lake.

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[17] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-375 95,* Nonpoint Source Control Plan for the Muskego-Wind Lakes Priority Watershed Project, *January 1994.*

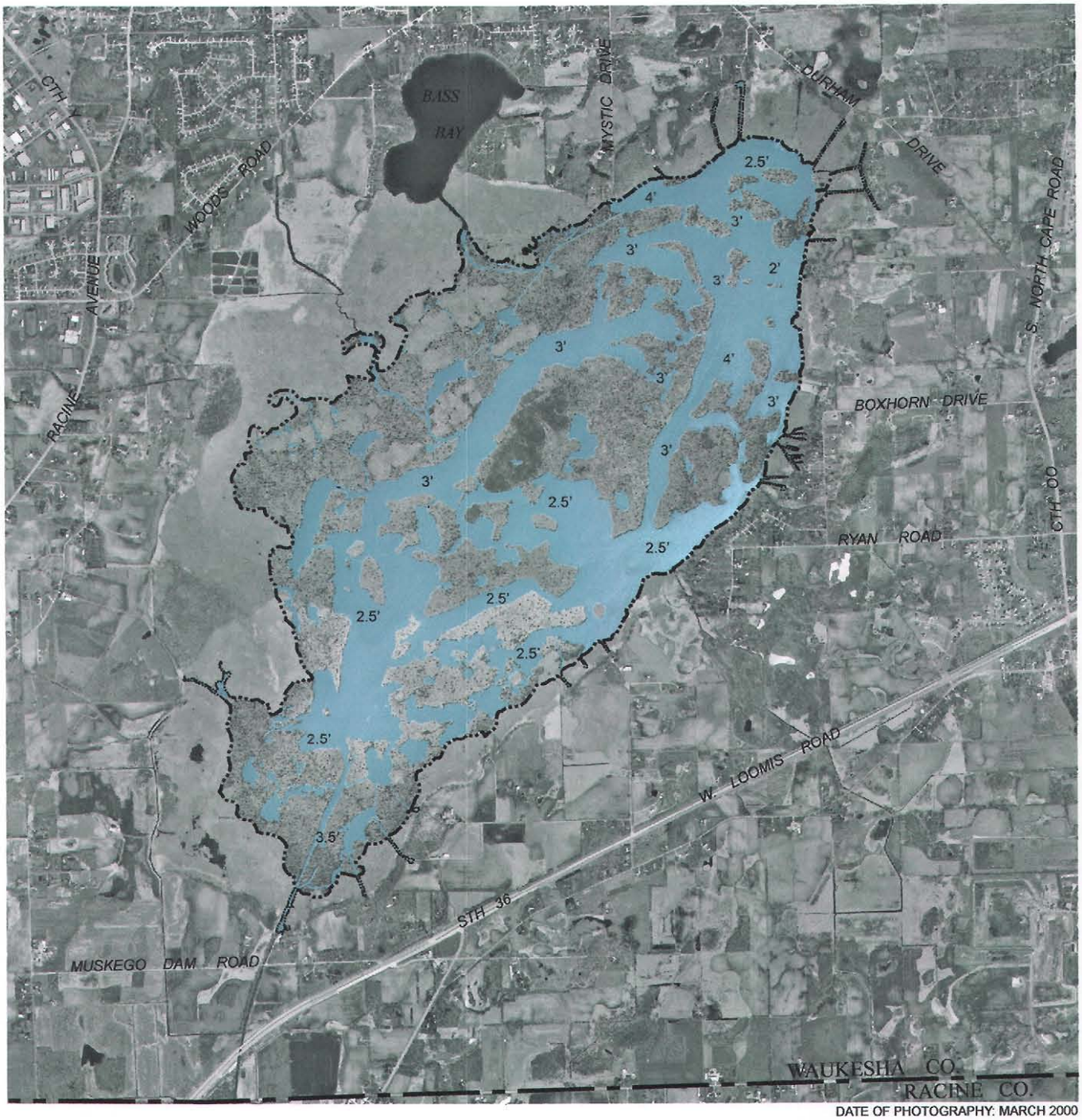
[18] Ibid.

[19] *SEWRPC Memorandum Report No. 94,* A Recommended Public Boating Access and Waterway Protection Plan for Big Muskego Lake, Waukesha County, Wisconsin, *July 1994.*

[20] Ibid.

Map 33

BATHYMETRIC MAP OF BIG MUSKEGO LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

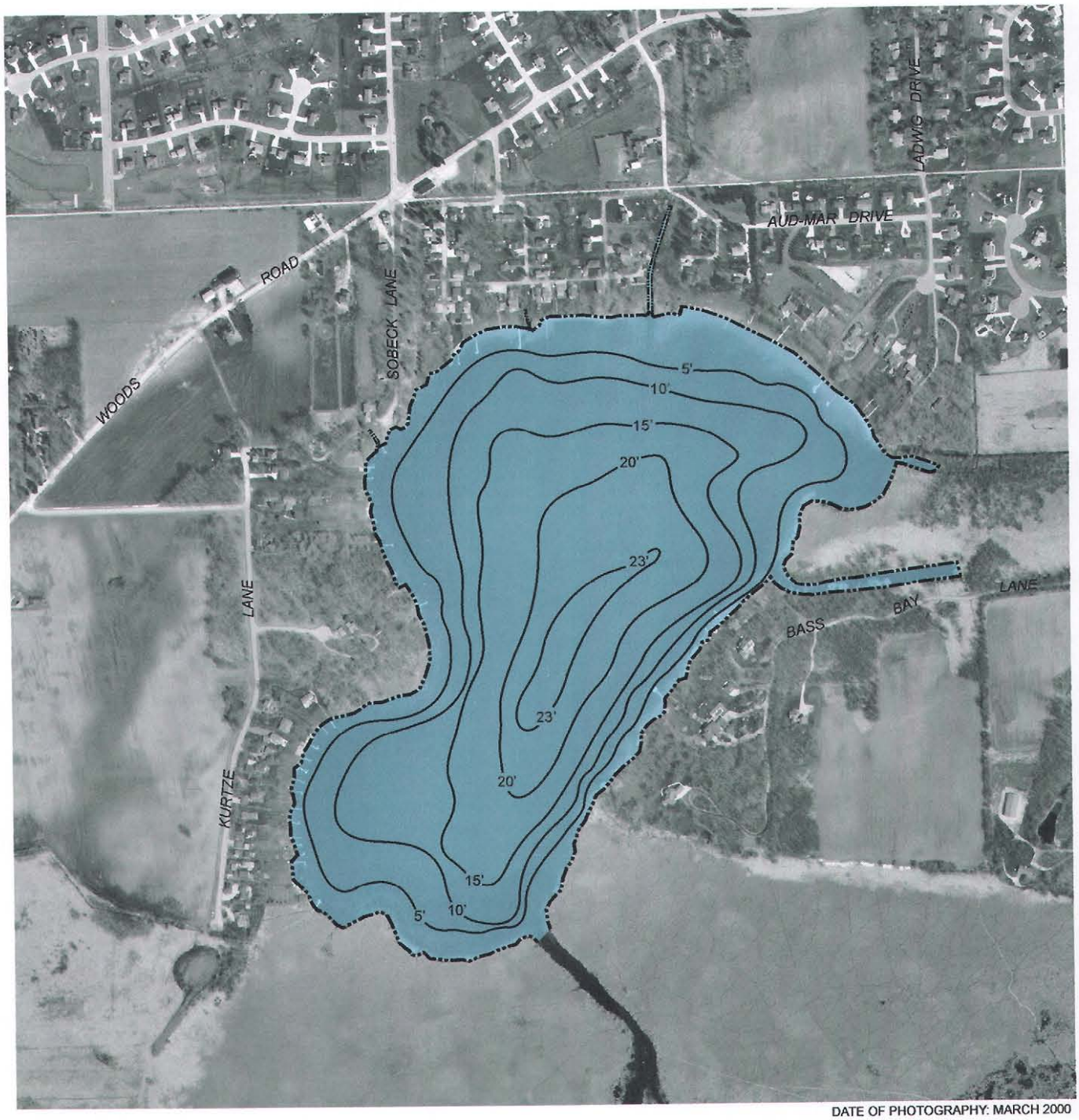
2.5' WATER DEPTH IN FEET

GRAPHIC SCALE
0 1500 3000 FEET

Source: SEWRPC.

Map 34

BATHYMETRIC MAP OF BASS BAY



DATE OF PHOTOGRAPHY: MARCH 2000

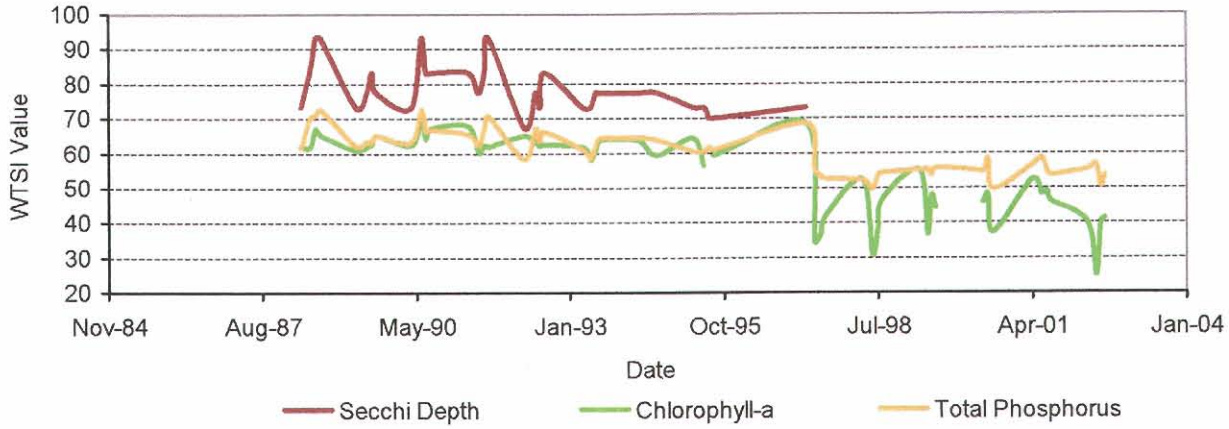
—20'— WATER DEPTH CONTOUR IN FEET

GRAPHIC SCALE
0 350 700 FEET

Source: SEWRPC.

Figure 2

TROPHIC STATE INDEX FOR BIG MUSKEGO LAKE: 1988-2002



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Big Muskego Lake is generated primarily from urban and rural agricultural lands, which comprise about one-third of the land cover within the drainage basin tributary to Big Muskego Lake. The Muskego-Wind Lakes Priority Watershed Plan recommends reductions in sediment loading of 20 percent in the Lake and 50 percent in Bass Bay; reductions in phosphorus loading of 42 percent in the Lake and 68 percent in Bass Bay; control of the carp and bullhead populations to reduce internal loading in both waterbodies; and improvement in fish and wildlife habitat.[21] In addition, the plan recommends enhancement of the habitat for endangered species and waterfowl in Big Muskego Lake. Rehabilitation of Big Muskego Lake to meso-eutrophic conditions, with a total phosphorus concentration of 0.05 milligrams per liter (mg/l); a chlorophyll-*a* concentration of 21 micrograms per liter (µg/l); and a Secchi-disc transparency of four feet, was recommended. Restoration of Bass Bay to a mesotrophic condition, with a total phosphorus concentration of 0.02 mg/l; a chlorophyll-*a* concentration of six µg/l; and a Secchi-disc transparency of 7.5 feet, was recommended.

Fish and Wildlife Populations

In 1963, the fishery of Big Muskego Lake consisted largely of panfish, northern pike, walleyed pike, and largemouth bass.[22] A fish survey conducted in 1978 reported the fishery to consist largely of panfish.[23] As of 2001, panfish, largemouth bass, and northern pike were reported to be common in the Lake, with walleyed pike being present.[24] In Bass Bay, an embayment situated at the northern extreme of Big Muskego Lake, panfish were reported to be abundant as of 2001.[25] The presence of carp and other rough fish has become more common in

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[21] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-375 94,* Nonpoint Source Control Plan for the Muskego-Wind Lakes Priority Watershed Project, *October 1993.*

[22] *Wisconsin Conservation Department,* op. cit.

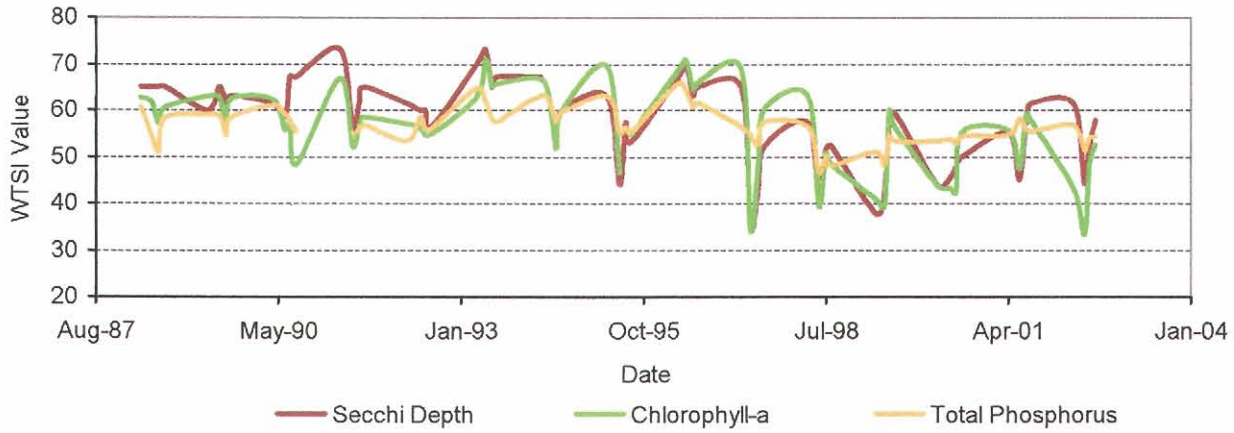
[23] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[24] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[25] Ibid.

Figure 3

TROPHIC STATE INDEX FOR BIG MUSKEGO LAKE BASS BAY: 1988-2002



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

recent years. Rough fish removal operations have been an ongoing process since the early 1950s, culminating in a major rough fish removal effort during the late 1990s. Subsequent stocking efforts and the erection of a carp barrier at the outlet to Big Muskego Lake have been directed at creating and maintaining a more balanced fishery in the Lake. Waterfowl are reported by the Wisconsin Department of Natural Resources to be very common, and peak recreational usage of the Lake coincides with the opening of waterfowl hunting seasons. Over 1,000 acres of wetlands adjoining the lake are reported to be in active migratory and resident use by waterfowl.

Brown Lake

Lake Morphometry

Brown Lake is located in U.S. Public Land Survey Section 30, Township 5 North, Range 18 East, Town of Mukwonago, as shown on Map 28. The Lake has a surface area of about 12 acres, a maximum depth of 40 feet, and a shoreline development factor of 1.14. Brown Lake occupies part of a marshy valley located at the edge of a ground moraine. The Lake drains southward through the valley to its confluence with the Mukwonago River below Eagle Spring Lake. A small spring stream enters the Lake on the east shore providing a major water source for the Lake.

Recreational Use

Public access is not available. Brown Lake has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential

As of 1995, the land uses within the approximately 915-acre drainage area tributary to the Mukwonago River, within which Brown Lake is situated, consisted of about 90 percent rural land uses and about 10 percent urban land uses. Of the rural land uses, woodlands, wetlands, and other open lands comprised about 60 percent of the total land cover within the drainage area tributary to Brown Lake. Rural agricultural land uses comprised about 300 acres, or the balance of the rural land uses. Urban residential lands comprised about 40 acres, or about 5 percent of the land cover in the drainage basin. Commercial, recreational, and transportation and related infrastructure comprised the balance of the land uses. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Brown Lake is generated primarily from agricultural lands which comprise about one-third of the land cover within the drainage basin tributary to Brown Lake.

Fish and Wildlife Populations
In 1963, the fishery of Brown Lake consisted largely of largemouth bass and panfish,[26] and this fishery is reported to be unchanged as of 2001.[27] There are about 19 acres of adjoining wetlands, in which waterfowl are reported to make limited migratory and resident use.

Buth Lake
Lake Morphometry
Buth Lake is located in U.S. Public Land Survey Section 27, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about four acres, a maximum depth of five feet, and a shoreline development factor of 1.11. Buth Lake occupies a small drift basin. Much of the original lake area now consists of a shallow marsh occupying an elongate valley.

Recreational Use
Public access is not available. Buth Lake has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential
As of 1995, the land uses within the approximately 730-acre drainage area tributary to the Bark River, within which Buth Lake is situated, consisted of about 70 percent rural land uses and about 30 percent urban land uses. Of the rural land uses, agricultural uses comprised about 270 acres, or about 40 percent of the total land cover in the drainage area. Wetlands, woodlands, and surface waters comprised the balance of the rural land cover. Urban residential land uses comprised about 80 acres, or about 10 percent of the drainage area tributary to Buth Lake. Commercial, industrial, transportation and related infrastructure, and recreational land uses comprised the balance of the land cover within the drainage basin. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Buth Lake is generated primarily from rural agricultural lands which comprise about two-fifths of the land cover within the drainage area tributary to Buth Lake.

Fish and Wildlife Populations
In 1963, the fishery of Buth Lake consisted largely of panfish and bullheads.[28] Winterkill was reported to be common, although the population of bullheads was reported to be self-sustaining in the Lake. As of 2001, panfish were reported to be present.[29] Waterfowl are reported to make limited migratory and resident use of the adjoining wetlands.

Cornell Lake (Mud Lake)
Lake Morphometry
Cornell Lake is located in U.S. Public Land Survey Sections 20 and 21, Township 8 North, Range 18 East, Town of Merton, as shown on Map 17. The Lake has a surface area of about 41 acres, a maximum depth of 12 feet, and

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[26] *Wisconsin Conservation Department,* op. cit.

[27] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[28] *Wisconsin Conservation Department,* op. cit.

[29] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

a shoreline development factor of 1.78. Cornell Lake is a small marsh-bordered kettle lake in the interlobate moraine. The Lake is a drainage lake with inflow from Pine Lake and an outflow through marshlands to North Lake and the Oconomowoc River, in Waukesha County. The Lake forms a hydraulic and hydrologic link between the upstream Pine and Beaver Lakes and the downstream North Lake on the mainstem of the Oconomowoc River.

Recreational Use
Public access is not available. However, Cornell Lake is accessible by a navigable waterway both from the inlet and outlet of the Lake.

Development Potential
As of 1995, the land uses within the approximately 2,100 acre drainage area tributary to the Oconomowoc River, within which Cornell Lake is situated, consisted of about 25 percent urban land uses and about 75 percent rural land uses. Of the rural land uses within the total drainage area tributary to Cornell Lake, open space land uses, woodlands, wetlands, and surface waters comprised about 950 acres, or about one-half of the total land cover in the drainage area. Agricultural uses comprised the balance of the rural land uses, or about 30 percent of the land cover. Urban residential land uses comprised about 300 acres, or a further 15 percent of the total land cover. Transportation and related infrastructure uses comprised about 90 acres, while commercial and industrial lands comprised the balance of the urban land uses within the total drainage area tributary to Cornell Lake. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Cornell Lake is generated primarily from rural agricultural lands and urban residential lands that comprise about 40 percent of the land cover within the total drainage basin tributary to Cornell Lake.

Fish and Wildlife Populations
In 1963, the fishery of Cornell Lake consisted largely of panfish.[30] Winterkill was reported by the Wisconsin Department of Natural Resources to be common in the Lake at that time. As of 2001, panfish were reported to be common in the Lake and largemouth bass were reported to be present.[31] Waterfowl are reported by the Wisconsin Department of Natural Resources to make very limited use of the adjoining wetlands and marsh.

Crooked Lake
Lake Morphometry
Crooked Lake is located in U.S. Public Land Survey Section 23, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 58 acres, a maximum depth of 16 feet, and a shoreline development factor of 2.16. A natural drainage lake, Crooked Lake occupies a shallow depression in outwash deposits in the course of the Bark River. The bathymetry of Crooked Lake is shown on Map 35.

Water Quality
Available water quality data indicate that Crooked Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a Wisconsin TSI rating of approximately 44. A lake protection plan was completed for the Lake by SEWRPC in 2000.[32] The bottom is mostly muck and marl, and some color has been considered by the Wisconsin Department of Natural Resources to impair the water clarity at times.

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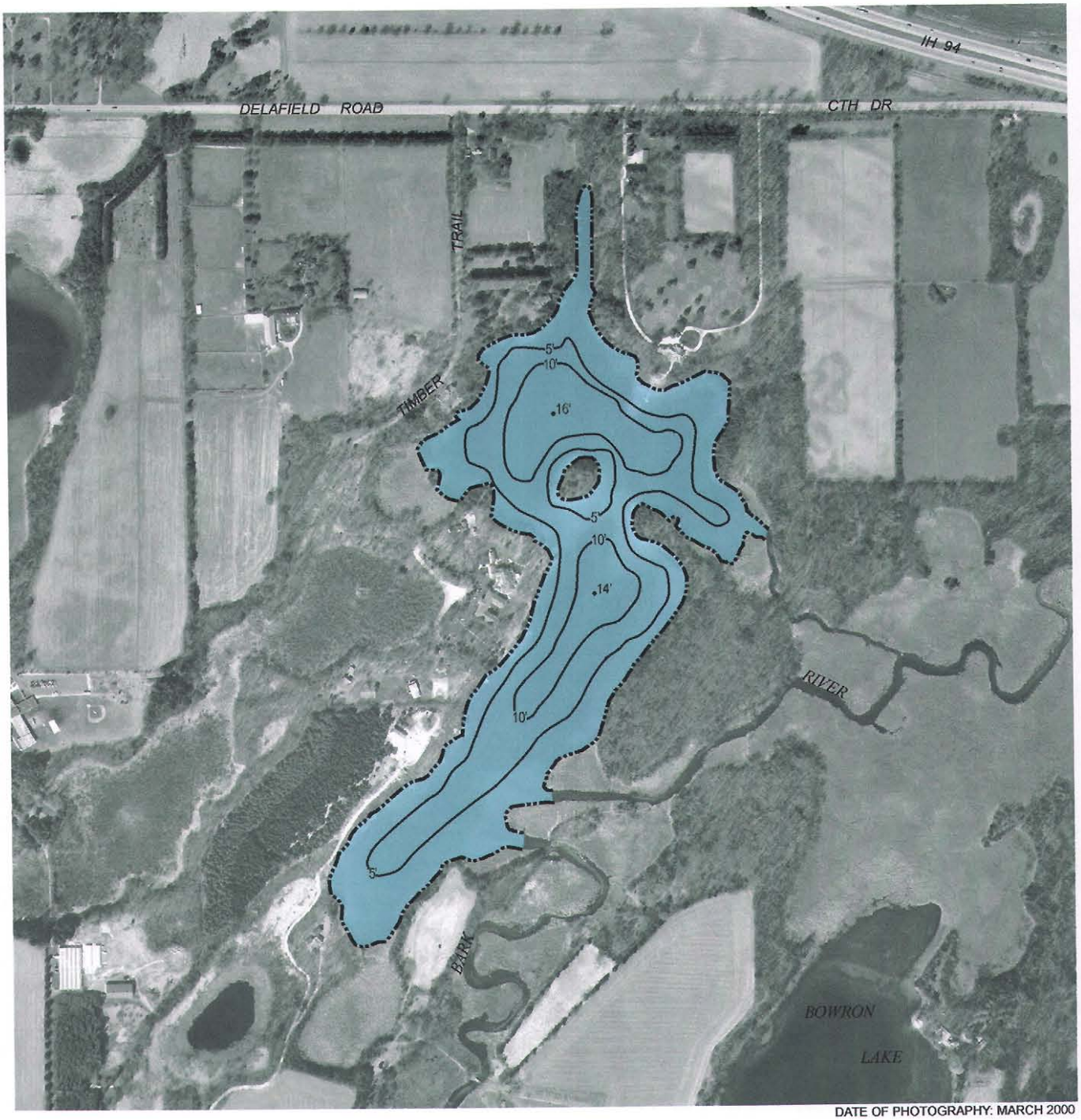
[30] *Wisconsin Conservation Department,* op. cit.

[31] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[32] *SEWRPC Memorandum Report No. 112,* An Aquatic Plant Management Plan for Crooked Lake, Waukesha County, Wisconsin, *April 2000.*

Map 35

BATHYMETRIC MAP OF CROOKED LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—10'— WATER DEPTH CONTOUR IN FEET

GRAPHIC SCALE

0 350 700 FEET

Source: SEWRPC.

Recreational Use
Public access is provided by a navigable section of the Bark River that encompasses both the inlet and the outlet of the Lake. Crooked Lake currently does not have adequate public recreational boating access as set forth in Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential
As of 1995, the land uses within the approximately 530-acre drainage area directly tributary to Crooked Lake consisted of about 10 percent urban land uses and about 90 percent rural land uses. Of the rural land uses, agricultural uses comprised about 60 percent of the total land cover in the direct drainage area. Woodlands and surface waters comprised about 120 acres, or about 25 percent of the land cover, with the balance of the rural land uses being comprised of wetlands. Urban residential land uses, institutional land uses, and transportation and related infrastructure comprised about 50 acres, or about 10 percent of the land cover within the drainage area directly tributary to Crooked Lake. The drainage area is located within an area planned for urban development in the adopted County development plan. Some of these agricultural lands in the northern half of the drainage area tributary to Crooked Lake are expected to be converted to urban land uses as part of the Pabst Farms, Inc., development. These lands are expected to be converted to mixed office/commercial land uses adjacent to IH 94 and to medium-density urban residential land uses in the long-term buildout projections. The Pabst Farms, Inc., development will be subject to stormwater management measures set forth in a site-specific stormwater management plan being prepared pursuant to the County ordinance requirements.

Crooked Lake is located within the Bark River drainage system, which extends upstream for more than 50 square miles. Within this total tributary drainage area, urban land uses comprise about one-third of the area, while rural land uses comprise the balance. Of these, residential uses account for about one-half of the urban land uses, while agricultural land uses comprise slightly more than one-half of the rural land uses within the total drainage area tributary to Crooked Lake.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Crooked Lake is generated primarily by rural agricultural lands which comprise about two-thirds of the land cover within the total drainage basin tributary to Crooked Lake.

Fish and Wildlife Populations
In 1963, the fishery of Crooked Lake consisted largely of panfish, largemouth bass, and northern pike.[33] A fish survey conducted in 1975 reported the fishery to consist of the least darter, pumpkinseed, banded killifish, Iowa darter, green sunfish, grass, pickerel, northern pike, yellow perch, tadpole madtom, largemouth bass, bluegill, johnny darter, and blackstripe topminnow.[34] The least darter and the banded killifish are listed as a species of special concern. As of 2001, panfish and largemouth bass were reported to be common in the Lake, with northern pike being reported to be present.[35] Due to portions of the lake basin being classified as shallow marsh, waterfowl make regular migratory and resident use of the Lake.

Denoon Lake
Lake Morphometry
Denoon Lake is located in U.S. Public Land Survey Sections 31 and 32, Township 5 North, Range 20 East, City of Muskego, as shown on Map 30. The Lake has a surface area of about 162 acres, a maximum depth of 60 feet, and a shoreline development factor of 1.35. Denoon Lake occupies a depression in ground moraine deposits at the

[33] *Wisconsin Conservation Department,* op. cit.

[34] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[35] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

edge of a terminal moraine.[36] The Lake is considered to be a groundwater-fed lake that derives its water from both surface drainage and springs. A low head dam is maintained at the outlet by the riparian owners. The bathymetry of Denoon Lake is shown on Map 36. The bottom is primarily muck. Denoon Lake ultimately drains in a southerly direction to the Fox River system in Racine County.

Water Quality
Available water quality data indicate that Denoon Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a TSI rating of approximately 50. Figure 4 shows the trends in water quality within Denoon Lake during the period 1991 through 1996.

Recreational Use
Public access is provided through a City of Muskego park site and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.[37]

Development Potential
As of 1995, the land uses within the approximately 1,000-acre drainage area tributary to Denoon Lake consisted of about 75 percent rural land uses and about 25 percent urban land uses. Of the rural land uses, agricultural land uses comprised about 490 acres, or about one-half of the land cover within the drainage area tributary to Denoon Lake. Wetlands, woodlands, and surface water comprised about 250 acres, or approximately one-quarter of the land cover. Urban residential lands comprised about 200 acres, or about one-fifth of the land cover within the drainage basin. Transportation and related infrastructure and open space uses comprised the balance of the urban land uses. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage are tributary to Denoon Lake is generated primarily from rural agricultural lands that comprise about one-half of the land cover within the drainage basin tributary to Denoon Lake.

Fish and Wildlife Populations
In 1963, the fishery of Denoon Lake consisted largely of largemouth bass, panfish, and northern pike.[38] As of 2001, northern pike and largemouth bass were reported to be common in the Lake, with walleyed pike and panfish being reported as present.[39] Waterfowl make migratory and resident use of the marshy west shore of the Lake.

Duck Lake
Lake Morphometry
Duck Lake is located in U.S. Public Land Survey Section 22, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 12 acres, a maximum depth of one foot, and a shoreline development factor of 1.06. Duck Lake is a small landlocked basin.

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[36] *Wisconsin Department of Natural Resources Lake Use Report No. FX-23,* Denoon Lake, Waukesha County, Wisconsin, *1969.*

[37] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-507 2001,* Inland Lakes Public Access Guide: Wisconsin Department of Natural Resources Southeast Region, *2001.*

[38] *Wisconsin Conservation Department,* op. cit.

[39] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Map 36

BATHYMETRIC MAP OF DENOON LAKE

DATE OF PHOTOGRAPHY: MARCH 2000

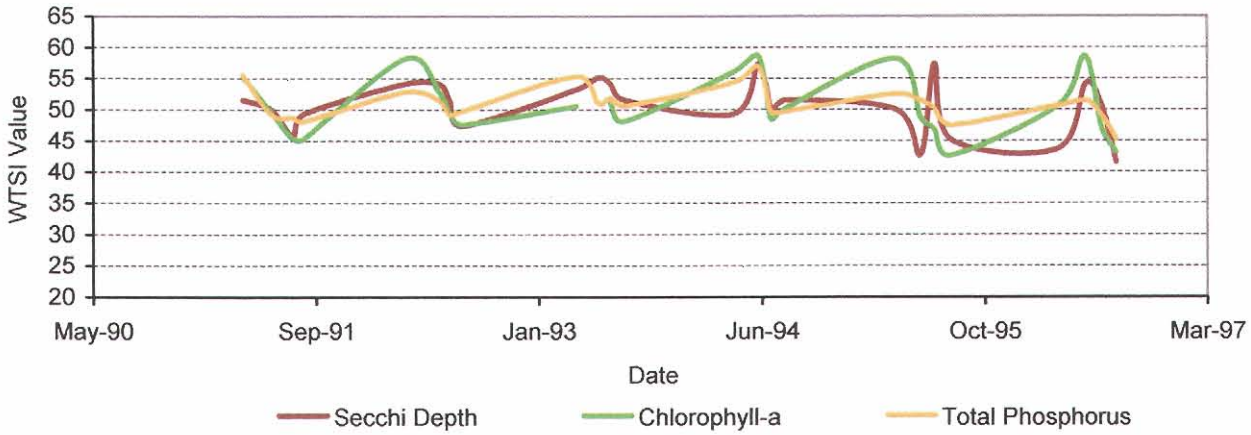
—20'— WATER DEPTH CONTOUR IN FEET

GRAPHIC SCALE
0 400 800 FEET

Source: SEWRPC.

Figure 4

TROPHIC STATE INDEX FOR DENOON LAKE: 1991-1996



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Recreational Use

Public access is not available. Duck Lake has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential

As of 1995, the land uses within the approximately 165-acre drainage area tributary to Duck Lake consisted of about 90 percent rural land uses and about 10 percent urban land uses. Of the rural land uses, agricultural lands comprised about 65 acres, or about 40 percent of the total land cover in the drainage area. Woodlands, wetlands, surface water, and other open lands comprised about 85 acres, or about one-half of the land cover within the drainage basin. Urban land uses were comprised primarily of residential, transportation and related infrastructure, and institutional land uses. The drainage area is located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Duck Lake is generated primarily from agricultural lands which comprise about 40 percent of the land cover within the drainage basin tributary to Duck Lake.

Fish and Wildlife Populations

In 1963, the fishery of Duck Lake was reported by the Wisconsin Department of Natural Resources to be nonexistent.[40] However, waterfowl were reported to make migratory and resident use of the shallow wetlands and marsh that remain around the Lake.

Dutchman (Lad) Lake

Lake Morphometry

Dutchman Lake is located in U.S. Public Land Survey Section 2, Township 6 North, Range 17 East, Town of Ottawa, as shown on Map 26. The Lake has a surface area of about 33 acres, a maximum depth of 42 feet, and a shoreline development factor of 1.24. Dutchman Lake is a small drainage lake in the glacial outwash valley

[40] *Wisconsin Conservation Department,* op. cit.

presently occupied by the Scuppernong River. Dutchman Lake is the second in a chain of three lakes located on the Scuppernong River within Waukesha County, being situated downstream of Waterville Lake and upstream of Hunters Lake.

Recreational Use
Public access is not available.

Development Potential
As of 1995, the land uses within the approximately 1,100-acre drainage area directly tributary to Dutchman Lake consisted of about 75 percent rural land uses and about 25 percent urban land uses. Of the rural land uses, agricultural uses comprised about 45 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised the balance of the rural land uses, or about 450 acres. Urban residential land uses comprised about 120 acres, or approximately 10 percent of the land cover. Commercial, industrial, transportation and related infrastructure, and recreational land uses comprised the balance of the urban land uses, or about 140 acres. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Dutchman Lake is located within the Scuppernong Creek drainage system, which extends upstream for about 20 square miles. Within this total tributary drainage area, urban land uses comprise about 20 percent of the area, while rural land uses comprise the balance. Of these, urban residential uses account for about two-fifths of the urban land uses, while rural agricultural land uses comprise about one-third of the rural land uses within the total drainage area tributary to Dutchman Lake.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Dutchman Lake is generated primarily by both rural agricultural and urban residential lands, which comprise about one-third of the land cover within the total tributary drainage basin to Dutchman Lake.

Fish and Wildlife Populations
In 1963, the fishery of Dutchman Lake consisted largely of panfish.[41] A fish survey conducted in 1970 reported the fishery to consist of bowfin, rock bass, green sunfish, pumpkinseed, largemouth bass, bluegill, bullheads, and black crappie.[42] As of 2001, panfish were reported to be abundant in the Lake, with largemouth bass being common and northern pike being present.[43] Waterfowl were reported to make migratory and resident use of the shallow wetlands and marsh that outline the western shore of the Lake.

Eagle Spring Lake
Lake Morphometry
Eagle Spring Lake is located in U.S. Public Land Survey Sections 25, 26, 35 and 36, Township 5 North, Range 17 East, Town of Eagle, as shown on Map 27. The Lake has a surface area of about 311 acres, a maximum depth of 12 feet, and a shoreline development factor of 1.89. Eagle Spring Lake is an impoundment of the Mukwonago River just above its confluence with Jericho Creek.[44] The dam has a 12-foot head and affects the water level upstream to the Walworth county line. The shoreline is very irregular and there is much additional frontage due to

[41]Ibid.

[42]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[43]*Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[44]*Wisconsin Department of Natural Resources Lake Use Report No. FX-19,* Eagle Spring Lake, Waukesha County, Wisconsin, *1969.*

several small islands. The bathymetry of Eagle Spring Lake is shown on Map 37. Eagle Spring Lake is located immediately downstream of Lulu Lake and upstream of Lower Phantom Lake on the Mukwonago River, a tributary stream of the Fox River system.

Water Quality

Available water quality data indicate that Eagle Spring Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a TSI rating of approximately 52. Figure 5 shows the trends in water quality within Eagle Spring Lake during the period 1991 through 2001. A lake management plan was completed for the Lake by SEWRPC in 1997.[45]

Recreational Use

Public access is provided, and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*. The inlet is navigable and boats can travel between this lake and Lulu Lake which is located in northern Walworth County.

Development Potential

As of 1995, the land uses within the approximately 16,700-acre total drainage area tributary to Eagle Spring Lake consisted of about 90 percent rural land uses and about 10 percent urban land uses. Of the rural land uses, rural agricultural lands comprised about 10,400 acres, or about 60 percent of the total land cover in the drainage area. Wetlands, woodlands, and surface waters comprised about 4,300 acres, or the balance of the rural land uses in the drainage area tributary to Eagle Spring Lake. Of the urban land uses, urban residential lands, and transportation and related infrastructure comprised about 1,700 acres, or about 10 percent of the total land cover in the drainage basin tributary to Eagle Spring Lake. The balance of the urban lands were comprised of commercial, industrial, institutional, and recreational land uses. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Eagle Spring Lake is generated primarily from agricultural lands that comprise almost two-thirds of the land cover within the total tributary drainage area to Eagle Spring Lake.

Fish and Wildlife Populations

In 1963, the fishery of Eagle Spring Lake consisted largely of largemouth bass, panfish, and northern pike.[46] Fish surveys conducted in 1967, 1972, and 1978 reported the fishery to consist of pumpkinseed, johnny darter, golden shiner, warmouth, bluegill, rock bass, white sucker, Iowa darter, largemouth bass, brook silverside, yellow bullhead, emerald shiner, banded killifish, bluntnose minnow, yellow perch, shiners, lake chubsucker, blackchin shiner, grass pickerel, rainbow darter, blacknose shiner, and sunfishes.[47] As of 2001, panfish, largemouth bass, and northern pike were reported to be common in the Lake.[48]

Egg Lake

Lake Morphometry

Egg Lake is located in U.S. Public Land Survey Sections 22 and 23, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about two acres, a maximum depth of three feet, and a shoreline development factor of 1.23. Egg Lake is a landlocked waterbody, with the entire shoreline

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[45]*SEWRPC Community Assistance Planning Report No. 226,* A Lake Management Plan for Eagle Spring Lake, Waukesha County, Wisconsin, *October 1997.*

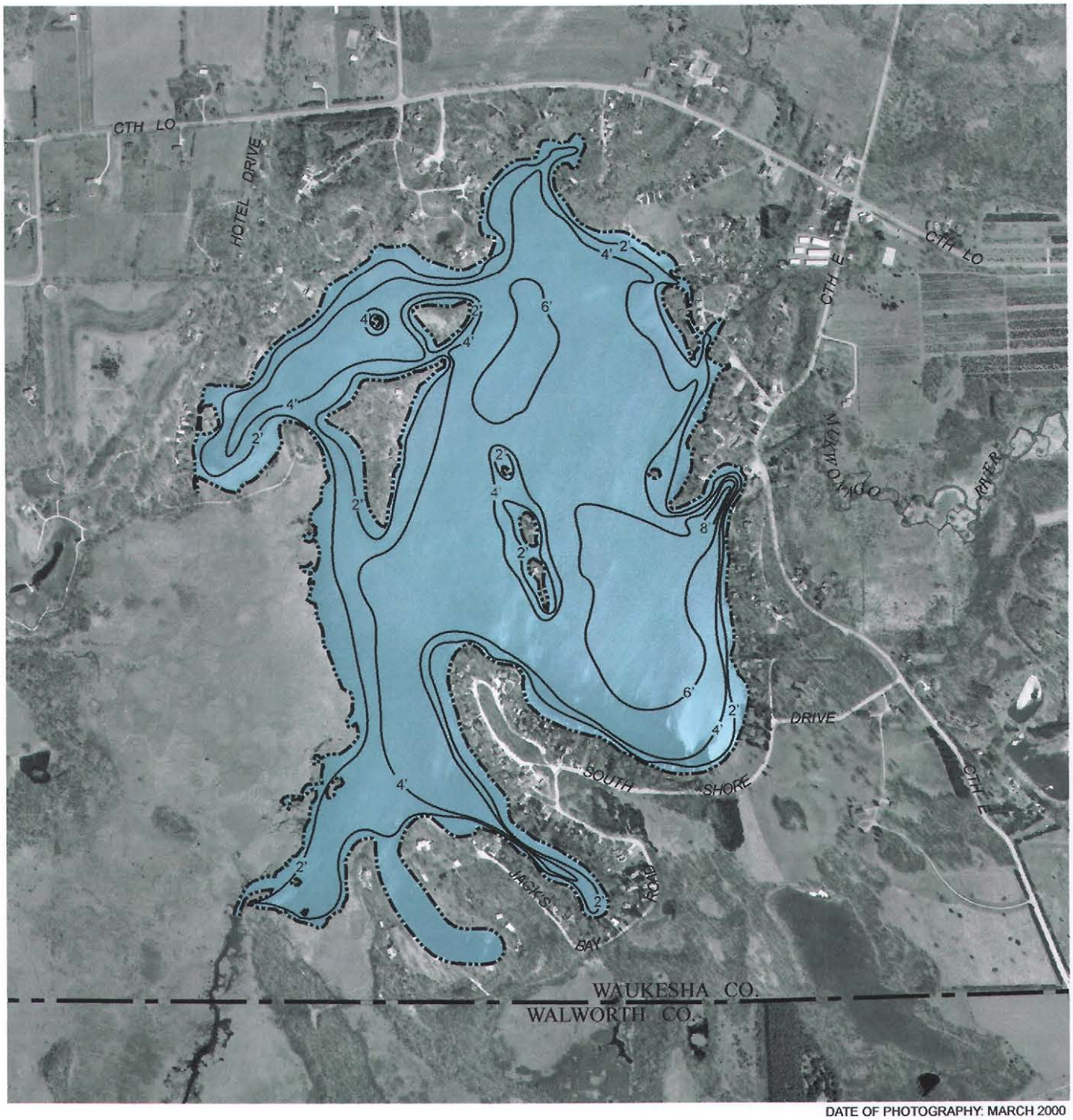
[46]*Wisconsin Conservation Department,* op. cit.

[47]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[48]*Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Map 37

BATHYMETRIC MAP OF EAGLE SPRING LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

— 4' — WATER DEPTH CONTOUR IN FEET

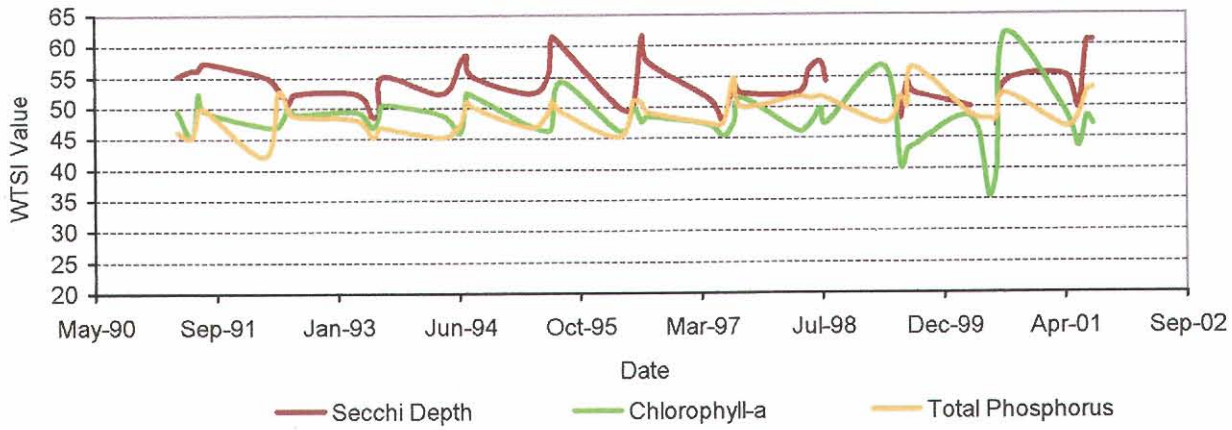
Source: SEWRPC.

GRAPHIC SCALE

0 550 1100 FEET

Figure 5

TROPHIC STATE INDEX FOR EAGLE SPRING LAKE: 1991-2001



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

reported to be a sphagnum bog. An alkalinity of 25 mg/l has been reported by the Wisconsin Department of Natural Resources, and the presence of the water lily, *Brasenia schreberi*, would indicate that Egg Lake is a soft water bog.

Recreational Use

Public access is not available.

Development Potential

As of 1995, the land uses within the approximately 530-acre drainage area tributary to the Bark River, within which Egg Lake is situated, consisted of about 10 percent urban land uses and about 90 percent rural land uses. Of the rural land uses, agricultural uses comprised about 60 percent of the total land cover in the direct drainage area. Woodlands and surface waters comprised about 25 percent of the land cover, with the balance of the rural land uses being comprised of wetlands. Urban residential land uses, and institutional land uses comprised about 10 percent of the land cover within the drainage area directly tributary to Egg Lake. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Egg Lake is generated primarily from agricultural lands, which comprise about two-thirds of the land cover within the drainage basin tributary to Egg Lake.

Fish and Wildlife Populations

In 1963, the fishery of Egg Lake was reported by the Wisconsin Department of Natural Resources to be nonexistent, due largely to the alkalinity of the water.[49] Waterfowl are reported to make limited migratory and resident use of the bog.

[49] *Wisconsin Conservation Department*, op. cit.

Etter Lake (Edder Lake)

Lake Morphometry

Etter Lake is located in U.S. Public Land Survey Section 25, Township 7 North, Range 18 East, Town of Delafield, as shown on Map 20. The Lake has a surface area of about 11 acres, a maximum depth of three feet, and a shoreline development factor of 1.27. Etter Lake is formed by a small, very shallow depression in glacial deposits.

Recreational Use

Public access is provided through a carry-in access site. Etter Lake has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential

As of 1995, the land uses within the approximately 180-acre drainage area tributary to Etter Lake consisted of about 95 percent rural land uses and about 5 percent urban land uses. Of the rural land uses, agricultural uses comprised about 55 percent of the total land cover in the drainage area. Woodlands and wetlands comprised the balance of the rural land uses. Urban residential land uses and associated transportation and related infrastructure comprised all of the urban land cover within the drainage basin tributary to Etter Lake. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Etter Lake is generated primarily from agricultural lands which comprise about one-half of the land cover within the tributary drainage basin to Etter Lake.

Fish and Wildlife Populations

In 1963, the fishery of Etter Lake was considered to be absent due to the generally shallow conditions of the Lake and the consequent annual winterkill.[50] However, as of 2001, the Wisconsin Department of Natural Resources reported that the Lake sustained panfish and largemouth bass, which were reported to be present in the Lake.[51] Waterfowl were reported to make limited migratory and resident use of the Lake. The Lake was considered to provide a food resource for waterfowl from nearby Pewaukee Lake.

Florence Lake

Lake Morphometry

Florence Lake is located in U.S. Public Land Survey Section 36, Township 8 North, Range 17 East, Town of Oconomowoc, as shown on Map 19. The Lake has a surface area of about 21 acres, a maximum depth of 48 feet, and a shoreline development factor of 1.47. Florence Lake is a groundwater lake occupying an abandoned gravel pit. Consequently, the lakebed is primarily comprised of sand and gravel.

Recreational Use

Public access is provided through a carry-in access site.

Development Potential

As of 1995, the land uses within the approximately 335-acre drainage area directly tributary to Florence Lake consisted of about 75 percent urban land uses and about 25 percent rural land uses. Of the urban land uses, urban residential lands comprised about 135 acres, or about 40 percent of the total land cover in the drainage area. Commercial, industrial, institutional, and transportation and related infrastructure uses comprised about 100 acres, or the balance of the urban land uses. Wetlands and woodlands comprised about 80 acres, or almost the entirety of the rural land cover in the drainage basin tributary to Florence Lake. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

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[50] Ibid.

[51] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Florence Lake is generated primarily from urban residential lands which comprise about 40 percent of the land cover in the drainage area tributary to Florence Lake.

Fish and Wildlife Populations
In 1963, the fishery of Florence Lake consisted largely of largemouth bass and panfish.[52] The Lake was reported to have been stocked with trout in 1955, although that practice was reported to have been abandoned in 1961. A fish survey conducted in 1975 reported the fishery to consist of green sunfish, bluegill, and bluntnose minnow.[53] As of 2001, northern pike, largemouth bass, and panfish were reported to be present in the Lake.[54]

Forest Lake
Lake Morphometry
Forest Lake is located in U.S. Public Land Survey Section 31, Township 8 North, Range 18 East, Town of Merton, and U.S. Public Land Survey Section 6, Township 7 North, Range 18 East, Town of Delafield, as shown on Maps 17 and 20. The Lake has a surface area of about 41 acres, a maximum depth of 17 feet, and a shoreline development factor of 1.45. Notwithstanding, much of the basin is only about 10 feet deep, with sediments primarily composed of muck. Forest Lake is an internally drained seepage lake occupying a small, dendritic basin in a terminal moraine.

Water Quality
Available water quality data indicate that Forest Lake is an oligo-mesotrophic waterbody, or waterbody bordering on being moderately enriched, with a TSI rating of approximately 40. Figure 6 shows the trends in water quality within Forest Lake during the period 1994 through 1996.

Recreational Use
Public access is not available. This Lake is considered by the Wisconsin Department of Natural Resources to be a wilderness lake in public ownership.[55]

Development Potential
As of 1995, the land uses within the approximately 845-acre drainage area tributary to Forest Lake consisted of about 60 percent rural land uses and about 40 percent urban land uses. Of the rural land uses, woodlands, wetlands, and surface waters comprised about 390 acres, or about 45 percent of the total land cover within the drainage area. Rural agricultural land uses comprised about 130 acres, or about 15 percent of the land cover. Urban land uses consisted of urban residential lands and transportation and related infrastructure, which accounted for about 75 percent of the urban land cover within the drainage basin tributary to Forest Lake. Institutional land uses comprised the balance of the urban land cover in the drainage basin. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Forest Lake is generated primarily from urban residential and transportation-related lands which comprise about one-third of the land cover within the drainage area tributary to Forest Lake.

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[52] *Wisconsin Conservation Department,* op. cit.

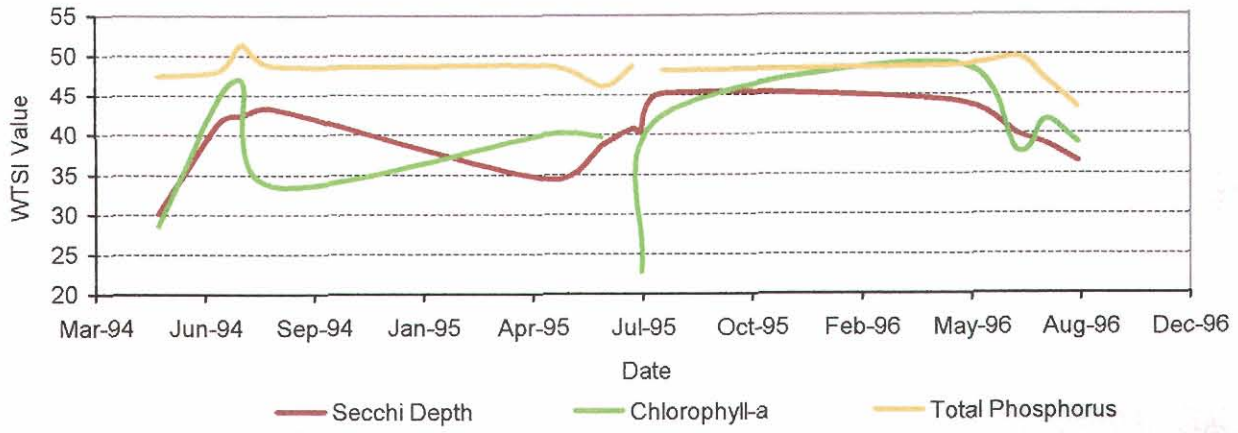
[53] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[54] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[55] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.*; a lake is considered a wilderness lake if there are no structures, including homes and roadways, within 200 feet of the waterbody.*

Figure 6

TROPHIC STATE INDEX FOR FOREST LAKE: 1994-1996



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Fish and Wildlife Population

In 1963, the fishery of Forest Lake consisted largely of northern pike and panfish.[56] Winter fishing was reported to be one of the more popular activities on the Lake. Fish surveys conducted in 1973, 1977, and 1979 reported the fishery to consist of northern pike, largemouth bass, yellow perch, yellow bullhead, and green sunfish.[57] As of 2001, panfish were reported to be common in the Lake, with northern pike and largemouth bass being reported to be present.[58]

Fowler Lake

Lake Morphometry

Fowler Lake is located in U.S. Public Land Survey Section 33, Township 8 North, Range 17 East, City of Oconomowoc, as shown on Map 18. The Lake has a surface area of about 99 acres, a maximum depth of 50 feet, and a shoreline development factor of 1.37. Fowler Lake is a drainage lake on the Oconomowoc River impounded by an eight-foot dam within the City of Oconomowoc. Only about 15 percent of the basin is greater than 20 feet deep. The bathymetry of Fowler Lake is shown on Map 38. Fowler Lake is the fifth lake in the Oconomowoc River chain of lakes, being located downstream of Friess Lake in Washington County and North Lake, Okauchee Lake, and Oconomowoc Lake in Waukesha County.

Water Quality

Available water quality data indicate that Fowler Lake is a mesotrophic waterbody, or moderately enriched, waterbody, with a Wisconsin TSI rating of approximately 40. A lake management plan was completed for the Lake by SEWRPC in 1994, and the aquatic plant management plan element was refined by the Commission in 2000.[59]

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[56] *Wisconsin Conservation Department,* op. cit.

[57] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[58] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[59] *SEWRPC Community Assistance Planning Report No. 187,* A Management Plan for Fowler Lake, Waukesha County, Wisconsin, *March 1994; SEWRPC Memorandum Report No. 134,* An Aquatic Plant Management Plan for Fowler Lake, Waukesha County, Wisconsin, *October 2000.*

Map 38

BATHYMETRIC MAP OF FOWLER LAKE

DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

GRAPHIC SCALE

0 350 700 FEET

Source: SEWRPC.

Recreational Use
Public access is provided, and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential
As of 1995, the land uses within the approximately 1,600-acre drainage area directly tributary to Fowler Lake consisted of approximately equal proportions of urban land uses and rural land uses. Of the urban land uses, urban residential uses comprised about 380 acres or about one-quarter of the total land cover in the drainage area. Commercial, industrial, transportation and related infrastructure, institutional, and recreational lands comprised the balance of the urban land cover, or about 460 acres. Rural agricultural land uses comprised about 250 acres, or about 20 percent of the land cover of the drainage area directly tributary to Fowler Lake. Woodlands, wetlands, and surface waters comprised the balance of the rural land uses. The drainage area is located in an area planned for urban development in the adopted County development plan.

Fowler Lake is located within the Oconomowoc River drainage system, a tributary stream system to the Rock River, which extends upstream for about 80 square miles. Within this total tributary drainage area, urban land uses comprise about 15 percent of the area, while rural land uses comprise the balance. Of these, urban residential uses account for about two-thirds of the urban land uses, while rural agricultural land uses comprise slightly more than one-half of the rural land uses within the total drainage area tributary to Fowler Lake.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Fowler Lake is generated primarily from rural agricultural lands which comprise about one-half of the land cover within the total drainage basin tributary to Fowler Lake. Because the Lake is essentially an urban Lake located within the "downtown" of the City of Oconomowoc, however, the Oconomowoc River Priority Watershed Plan recommends the application of urban good house-keeping practices within the City, including implementation of construction site erosion controls, stormwater management practices in newly developing areas, and highway maintenance and street sweeping programs.[60]

Fish and Wildlife Populations
In 1963, the fishery of Fowler Lake consisted largely of largemouth bass and panfish.[61] Carp were reported to be common within the waterbody. A fish survey conducted in 1981 reported the fishery to consist of walleyed pike, largemouth bass, bluegill, and common carp.[62] As of 2001, panfish were reported to be abundant in the Lake, with northern pike, walleyed pike, and largemouth bass being reported to be common, and muskie being present.[63]

Funks Millpond
Funks Millpond was located in U.S. Public Land Survey Section 15, Township 8 North, Range 18 East, Town of Merton, as shown on Map 17. This Millpond, which had a surface area of about 31 acres, a maximum depth of about five feet, and a shoreline development factor of 2.14, was formed by an impoundment on the Oconomowoc River, immediately upstream of North Lake. The dam was largely removed from the watercourse during the fall of 1992.

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[60] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

[61] *Wisconsin Conservation Department,* op. cit.

[62] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[63] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Garvin Lake

Lake Morphometry

Garvin Lake is located in U.S. Public Land Survey Sections 30 and 31, Township 8 North, Range 18 East, Town of Merton, as shown on Map 17. The Lake has a surface area of 17 acres, a maximum depth of 36 feet, and a shoreline development factor of 1.38. Most of the littoral zone of this Lake is comprised of sand and gravel. Garvin Lake is a small kettle lake in the terminal moraine immediately east of Okauchee Lake.

Recreational Use

Public access is not available.

Development Potential

As of 1995, the land uses within the approximately 930-acre drainage area tributary to the Oconomowoc River, within which Garvin Lake is situated, consisted of about 70 percent urban land uses and about 30 percent rural land uses. Of the urban land uses, urban residential uses comprised about 370 acres or about 40 percent of the total land cover in the drainage area. Commercial, industrial, transportation and related infrastructure, and institutional uses comprised about 170 acres, or about 20 percent of the land cover. Woodlands, wetlands, and surface waters comprised about 290 acres, or about one-third of the land cover in the drainage area tributary to Garvin Lake. Rural agricultural uses comprised the balance of the rural land uses, or about 90 acres. The drainage area is located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Garvin Lake is generated primarily from urban residential lands which comprise about two-fifths of the land cover within the drainage basin tributary to Garvin Lake.

Fish and Wildlife Populations

In 1963, the fishery of Garvin Lake consisted largely of largemouth bass, panfish, and northern pike.[64] A fish survey conducted in 1975 reported the fishery to consist of bluntnose minnow, bluegill, pumpkinseed, green sunfish, blackstripe topminnow, and blackchin shiner.[65] As of 2001, largemouth bass were reported to be common in the Lake, with northern pike and panfish being reported to be present.[66]

Genesee Millpond

Lake Morphometry

Genesee Millpond is located in U.S. Public Land Survey Section 27, Township 6 North, Range 18 East, Town of Genesee, as shown on Map 25. The Millpond has a surface area of about four acres, a maximum depth of five feet, and a shoreline development factor of 1.37. Genesee Millpond was created by an impoundment constructed on White Creek in the Town of Genesee. The dike and dam currently serves as an access road for the only dwelling on the Lake. The Millpond drains to the Genesee Creek which is a headwater tributary to the Fox River, joining the mainstem of the Fox River near the Vernon Marsh downstream of the unincorporated hamlet of Saylesville.

Recreational Use

Public access is not available. However, the Millpond is accessible by water through White Creek. Genesee Millpond has limited navigability and is generally navigable only by canoe or similar watercraft. The entire frontage is reported to be in single private ownership.

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[64] *Wisconsin Conservation Department,* op. cit.

[65] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[66] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Development Potential
As of 1995, the land uses within the approximately 285-acre drainage area directly tributary to Genesee Millpond consisted of about 20 percent urban land uses and about 80 percent rural land uses. Of the rural land uses, wetlands, woodlands, and surface waters comprised about 180 acres, or about 60 percent of the total land cover in the drainage area. Rural agricultural land uses accounted for the balance of the rural land uses in the drainage area, which comprised about 40 acres, or about 15 percent of the land cover. Urban land uses comprised about 60 acres, and included urban residential, transportation and related infrastructure, and institutional land uses. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Genesee Millpond is generated primarily by both rural agricultural and urban residential land uses, which comprise about one-third of the land cover within the drainage basin tributary to Genesee Millpond.

Fish and Wildlife Populations
In 1963, the fishery of Genesee Millpond consisted largely of panfish.[67] As of 2001, panfish were reported to be common in the Millpond, and largemouth bass were reported to be present.[68] Waterfowl were reported to make limited use of the pond, and were observed by the Wisconsin Department of Natural Resources to nest along the undeveloped shorelines and on a small island located near the middle of the pond.

Golden Lake
Lake Morphometry
Golden Lake is located in U.S. Public Land Survey Sections 30 and 31, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 250 acres, a maximum depth of 46 feet, and a shoreline development factor of 1.53. Golden Lake is located in the terminal moraine. A deep marsh at its northwestern extreme, located in Jefferson County, has been ditched and drains intermittently northwest from the Lake to the marshland adjacent to Goose Lake, in Jefferson County. The Lake is a spring-fed lake, with a largely sandy bottom.

Recreational Use
Public access is provided through a public recreational boating access site located on the southeastern shoreline of the Lake.

Development Potential
As of 1995, the land uses within the approximately 490-acre drainage area tributary to Golden Lake consisted of about 85 percent rural land uses and about 15 percent urban land uses. Of the rural land uses, wetlands, woodlands, surface waters, and other open space uses comprised about 300 acres, or about 60 percent of the total land cover in the drainage area. Rural agricultural lands comprised about 120 acres, or the balance of the rural land uses. Urban residential lands comprised about 55 acres, or about 10 percent of the total land cover within the drainage basin. Transportation and related infrastructure, commercial, and recreational lands comprised about 15 acres, or the balance of the urban land uses. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Golden Lake is generated primarily from rural agricultural sources which comprise about one-quarter of the land cover within the drainage area tributary to Golden Lake.

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[67] *Wisconsin Conservation Department,* op. cit.

[68] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Fish and Wildlife Population
In 1963, the fishery of Golden Lake consisted largely of largemouth bass, panfish, northern pike, and walleyed pike.[69] Fish surveys conducted in 1974 and 1978 reported the fishery to consist of grass pickerel, lake chubsucker, bluegill, largemouth bass, walleyed pike, northern pike, rock bass, warmouth, black crappie, golden shiner, mimic shiner, blacknose shiner, pumpkinseed, and yellow perch.[70] As of 2001, northern pike, largemouth bass, and panfish were reported to be common in the Lake, with walleyed pike being reported as present.[71] Waterfowl are reported to make regular migratory and resident use of the extensive wetlands at the northwestern extreme of the Lake.

Henrietta Lake
Lake Morphometry
Henrietta Lake is located in U.S. Public Land Survey Section 35, Township 7 North, Range 17 East, Town of Summit, and U.S. Public Land Survey Section 2, Township 6 North, Range 17 East, Town of Ottawa, as shown on Maps 19 and 26. The Lake has a surface area of about 15 acres, a maximum depth of seven feet, and a shoreline development factor of 1.19. Henrietta Lake is an internally drained, seepage lake occupying a depression in outwash deposits adjoining the Scuppernong Creek Valley. A shallow marsh adjoins the southern end of the Lake.

Recreational Use
Public access is provided through a walk-in trail.

Development Potential
As of 1995, the land uses within the approximately 815-acre drainage area tributary to Henrietta Lake consisted of about 60 percent urban land uses and about 40 percent rural land uses. Of the rural land uses, rural agricultural uses comprised about 300 acres, or about 40 percent of the total land cover in the drainage area. Wetlands, woodlands, and surface waters comprised about 50 acres, or the balance of the rural land uses. Urban residential land uses comprised about 230 acres, or about one-third of the land cover within the drainage basin tributary to Henrietta Lake. Transportation and related infrastructure and recreational lands comprised about 240 acres, or the balance of the urban land uses within the drainage area. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Henrietta Lake is generated primarily from both rural agricultural and urban residential lands which comprise about two-thirds of the land cover within the drainage basin tributary to Henrietta Lake.

Fish and Wildlife Population
In 1963, the fishery of Henrietta Lake was limited to bullheads, due to generally shallow conditions and consequent winterkill.[72] As of 2001, panfish were reported to be common, with largemouth bass and northern pike being reported as present.[73] Waterfowl and marsh fur bearers were reported to make use of the adjoining wetlands.

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[69] *Wisconsin Conservation Department,* op. cit.

[70] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[71] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[72] *Wisconsin Conservation Department,* op. cit.

[73] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Hogan Lake

Lake Morphometry

Hogan Lake is located in U.S. Public Land Survey Section 31, Township 5 North, Range 18 East, Town of Mukwonago, as shown on Map 28. This Lake has a surface area of eight acres, a maximum depth of three feet, and a shoreline development factor of 2.28. Hogan Lake is a shallow, irregular lake occupying a depression in the glacial deposits. The lakebed is comprised primarily of marl. The lake outlet is tributary to the Mukwonago River and ultimately drains to the Fox River system.

Recreational Use

Public access is not available.

Development Potential

As of 1995, the land uses within the approximately 915-acre drainage area tributary to the Mukwonago River, within which Hogan Lake is situated, consisted of about 10 percent urban land uses and about 90 percent rural land uses. Of the rural land uses, wetlands, woodlands, surface water, and open space uses comprised about 530 acres, or about 60 percent of the total land cover in the drainage area. Rural agricultural land uses comprised about 300 acres, or about one-third of the drainage area tributary to Hogan Lake. Urban land uses were comprised of urban residential lands, which included about 40 acres, or about 5 percent of the land cover within the drainage area tributary to Hogan Lake, and commercial and transportation and related infrastructure uses, which comprised the balance. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Hogan Lake is generated primarily from agricultural sources which comprised about 30 percent of the total land cover within the drainage basin tributary to Hogan Lake.

Fish and Wildlife Populations

In 1963, the fishery of Hogan Lake consisted largely of largemouth bass, northern pike, and panfish.[74]

Hunters Lake

Lake Morphometry

Hunters Lake is located in U.S. Public Land Survey Section 11, Township 6 North, Range 17 East, Town of Ottawa, as shown on Map 26. The Lake has a surface area of about 57 acres, a maximum depth of 46 feet, and a shoreline development factor of 1.68. Hunters Lake is a dendritic drainage lake on the Scuppernong Creek. The Lake has two basins connected by shallow narrows. The lake bottom is primarily gravel with wetlands adjoining the Lake on the eastern side. The Lake is the third lake in the chain of lakes along the Scuppernong Creek, the upstream waterbodies including Waterville Lake and Dutchman Lake. The bathymetry of Hunters Lake is shown on Map 39.

Water Quality

Available water quality data indicate that Hunters Lake is a mesotrophic waterbody, or moderately enriched, waterbody, with a Wisconsin TSI rating of approximately 44. A lake protection plan was completed for the Lake by SEWRPC in 1997.[75]

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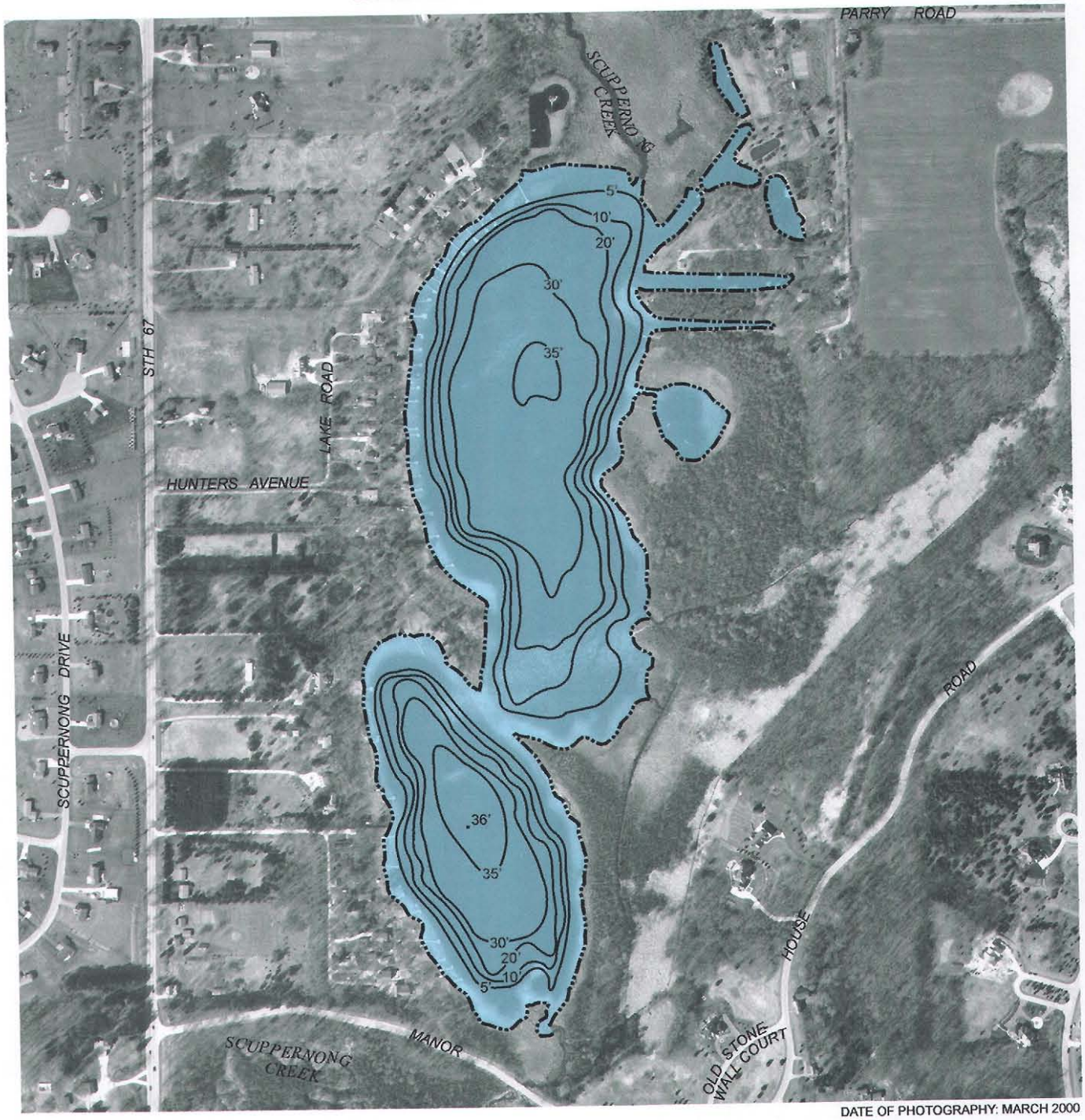
[74]*Wisconsin Conservation Department,* op. cit.

[75]*SEWRPC Memorandum Report No. 120,* A Lake Protection and Recreational Use Plan for Hunters Lake, Waukesha County, Wisconsin, *May 1997.*

Map 39

BATHYMETRIC MAP OF HUNTERS LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

Source: SEWRPC.

GRAPHIC SCALE

0 300 600 FEET

Recreational Use
Public access is not available, although the Lake is accessible via a short reach of the Scuppernong River from an access site located along Parry Road. Provision of recreational boating access through a town park site located at the western extreme of the Lake has been proposed by the Wisconsin Department of Natural Resources.

Development Potential
As of 1995, the land uses within the approximately 860-acre drainage area directly tributary to Hunters Lake consisted of about 60 percent rural land uses and about 40 percent urban land uses. Of the rural land uses, agricultural uses comprised about 370 acres, or about 40 percent of the total land cover in the drainage area. Woodlands and wetlands comprised the balance of the rural land cover, comprising about 100 acres. Urban residential lands comprised about 120 acres, or about 15 percent of the total land cover in the drainage basin directly tributary to Hunters Lake. Industrial lands comprised about 180 acres, or about one-fifth of the land cover. Commercial, transportation and related infrastructure, institutional, and open spaces uses comprised the balance of about 70 acres. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Hunters Lake is located within the Scuppernong Creek drainage system, a tributary stream system to the Rock River, which extends upstream for about 16 square miles. Within this total tributary drainage area, urban land uses comprise about one-quarter of the area, while rural land uses comprise the balance. Of these, urban residential uses account for about three-quarters of the urban land uses, while rural agricultural land uses comprise about one-half of the rural lands within the total drainage area tributary to Hunters Lake.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Hunters Lake is generated primarily from agricultural lands which comprise about two-fifths of the land cover within the total drainage basin tributary to Hunters Lake.

Fish and Wildlife Populations
In 1963, the fishery of Hunters Lake consisted largely of largemouth bass, northern pike, and panfish.[76] As of 2001, northern pike, largemouth bass, and panfish were reported to be present in the Lake.[77] Waterfowl were reported to make limited migratory and resident use of the wetlands adjoining the eastern side of the Lake.

Lake Keesus (Keesus Lake)
Lake Morphometry
Lake Keesus is located in U.S. Public Land Survey Sections 11, 12, 13, and 14, Township 8 North, Range 18 East, Town of Merton, as shown on Map 17. The Lake has a surface area of about 237 acres, a maximum depth of 42 feet, and a shoreline development factor of 2.50. Lake Keesus occupies four shallow basins and two deep basins in outwash deposits that are drained by a small stream tributary to the Oconomowoc River. Frontage is high ground except for a marshy drainage valley and the ditched inlet valley to the north of the Lake. The bathymetry of Lake Keesus is shown on Map 40.

Water Quality
Available water quality data indicate that Lake Keesus is a mesotrophic waterbody, or moderately enriched, waterbody, with a TSI rating of approximately 45. Figures 7 and 8 show the trends in water quality within Lake Keesus during the period 1991 through 1995. A lake management plan was completed for the Lake by SEWRPC in 1996.[78]

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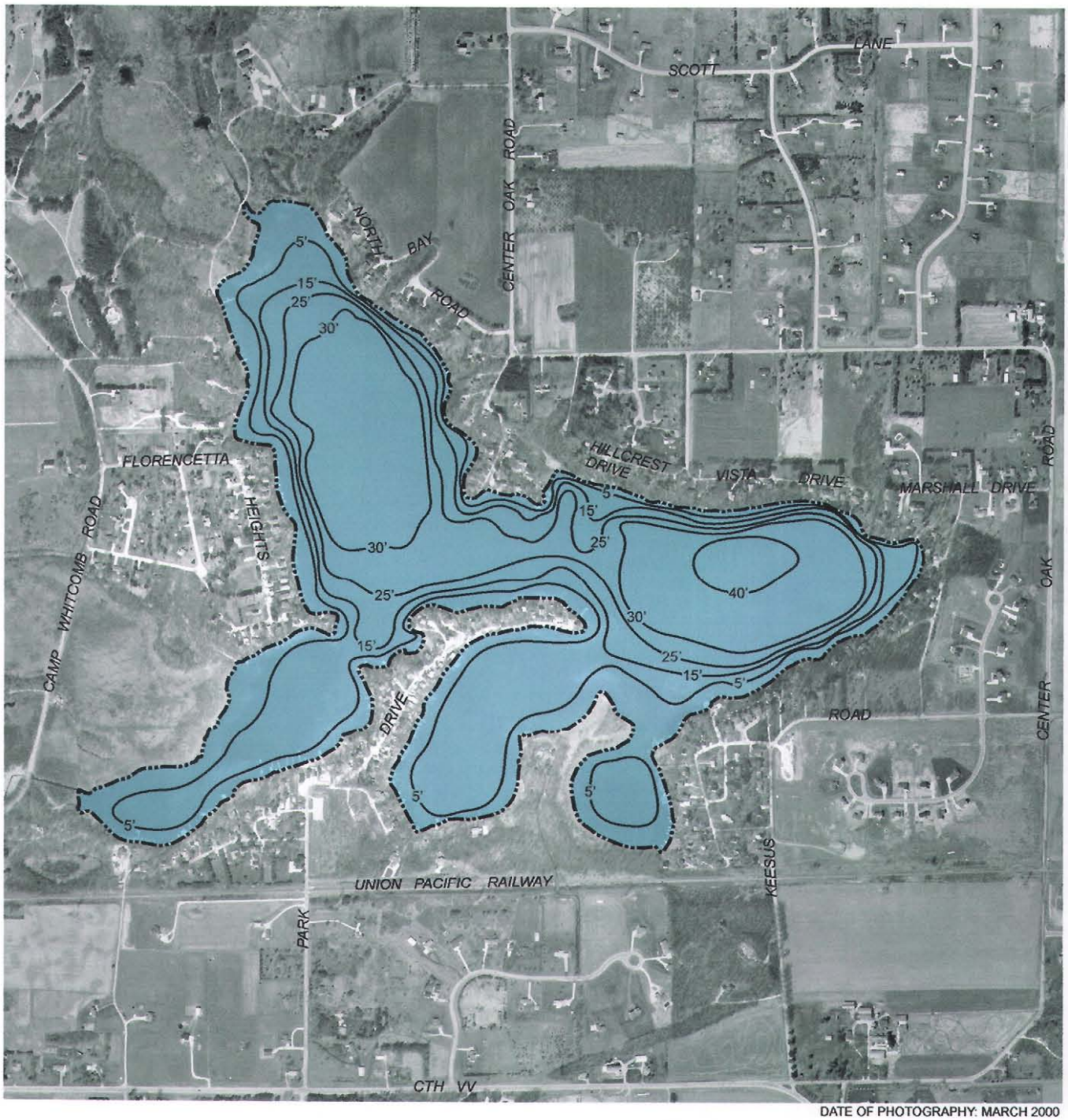
[76] *Wisconsin Conservation Department,* op. cit.

[77] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[78] *SEWRPC Community Assistance Planning Report No. 227,* A Lake Management Plan for Lake Keesus, Waukesha County, Wisconsin, *June 1998.*

Map 40

BATHYMETRIC MAP OF LAKE KEESUS



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

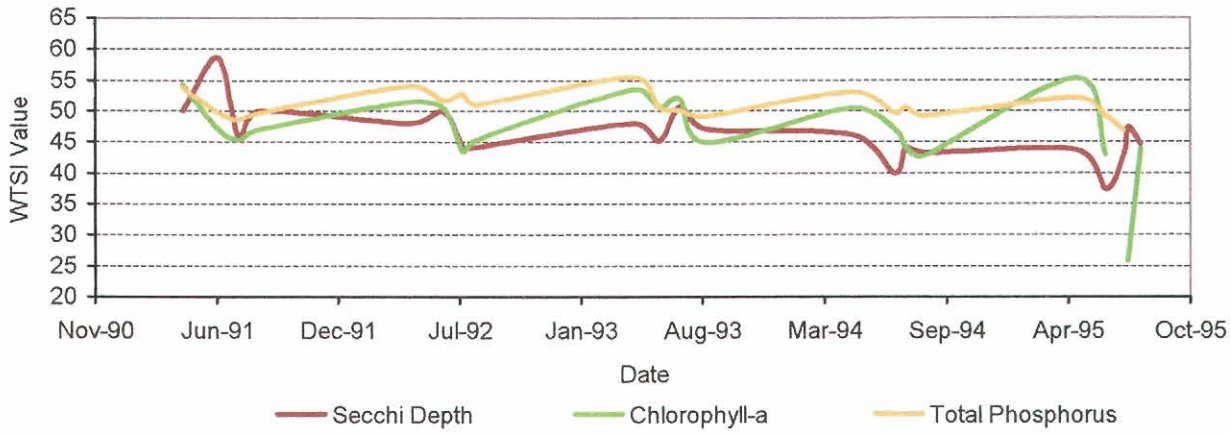
Source: SEWRPC.

GRAPHIC SCALE

0 550 1100 FEET

Figure 7

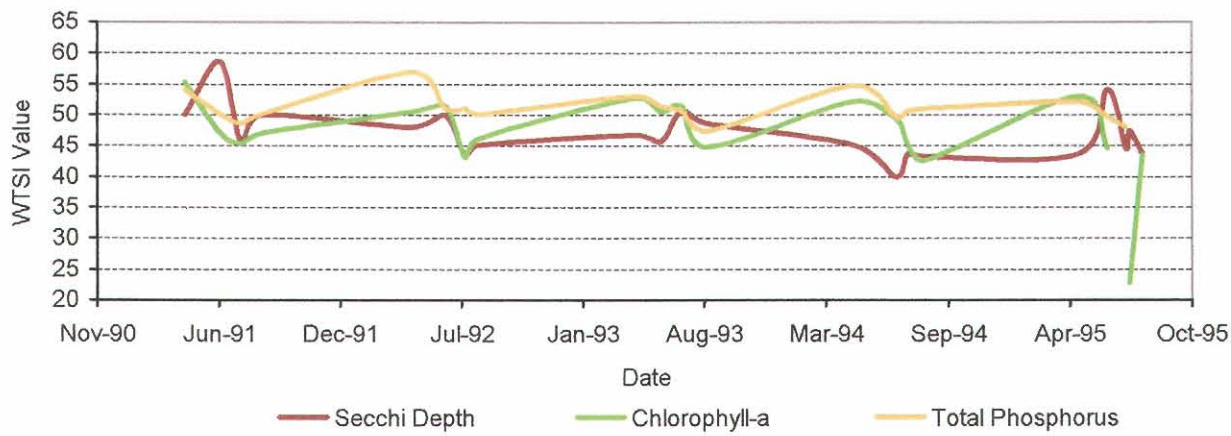
TROPHIC STATE INDEX FOR LAKE KEESUS EAST: 1991-1995



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Figure 8

TROPHIC STATE INDEX FOR LAKE KEESUS NORTH: 1991-1995



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Recreational Use

Public access is provided, and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*. Ice fishing is a popular recreational use, while water-skiing is a major recreational use during open water periods.

Development Potential
As of 1995, the land uses within the approximately 2,100-acre drainage area tributary to Lake Keesus consisted of about 25 percent urban land uses and about 75 percent rural land uses. Of the rural land uses, rural agricultural uses comprised about 750 acres, or about one-third of the total land cover in the drainage area. Wetlands, woodlands, and surface water comprised about 860 acres, or the balance of the rural land cover. Urban residential lands comprised the major portion of the urban land uses, or about 375 acres. Transportation and related infrastructure and recreational lands comprised about 150 acres, or the balance of the urban land uses. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Lake Keesus is generated primarily from both rural agricultural and urban residential lands which comprised about one-half of the land cover within the drainage basin tributary to Lake Keesus. The Oconomowoc River Priority Watershed Plan recommends implementation of onsite sewage treatment system management practices within the urban residential areas to maintain the Lake in a mesotrophic condition, with a total phosphorus concentration of 0.02 to 0.03 mg/l.[79]

Fish and Wildlife Populations
In 1963, the fishery of Lake Keesus consisted largely of panfish and largemouth bass.[80] Northern pike and walleyed pike were reported to be present, but less abundant. An abundant population of small bullheads was also reported. As of 2001, largemouth bass were reported to be abundant in the Lake, northern pike and panfish were reported to be common, and walleyed pike were reported to be present. Waterfowl are reported to make limited migratory and resident use of the adjoining wetlands.

Lac La Belle
Lake Morphometry
Lac La Belle is located in U.S. Public Land Survey Sections 19, 20, 29, 30, and 32, Township 8 North, Range 17 East, City and Town of Oconomowoc and Village of Lac Le Belle, as shown on Map 18. The Lake has a surface area of about 1,117 acres, a maximum depth of 45 feet, and a shoreline development factor of 2.01. Lac La Belle is a natural drainage lake on the Oconomowoc River, being the last lake in the chain of lakes along the Oconomowoc River within the Southeastern Wisconsin Region, being located downstream of Friess Lake in Washington County and North Lake, Okauchee Lake, Oconomowoc Lake, and Fowler Lake in Waukesha County. Rosenow Creek and an unnamed stream, locally known as Golf Course Creek, are also tributary to the Lake. The bathymetry of Lac La Belle is shown on Map 41.

Water Quality
Available water quality data indicate that Lac La Belle is a meso-eutrophic waterbody, or moderately enriched waterbody, with a TSI rating of approximately 50. Figure 9 shows the trends in water quality within Lac La Belle during the period 1984 through 2002. A lake management plan was completed for the Lake by SEWRPC in 1980,[81] and is currently being updated.

Recreational Use
Public access is provided, and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

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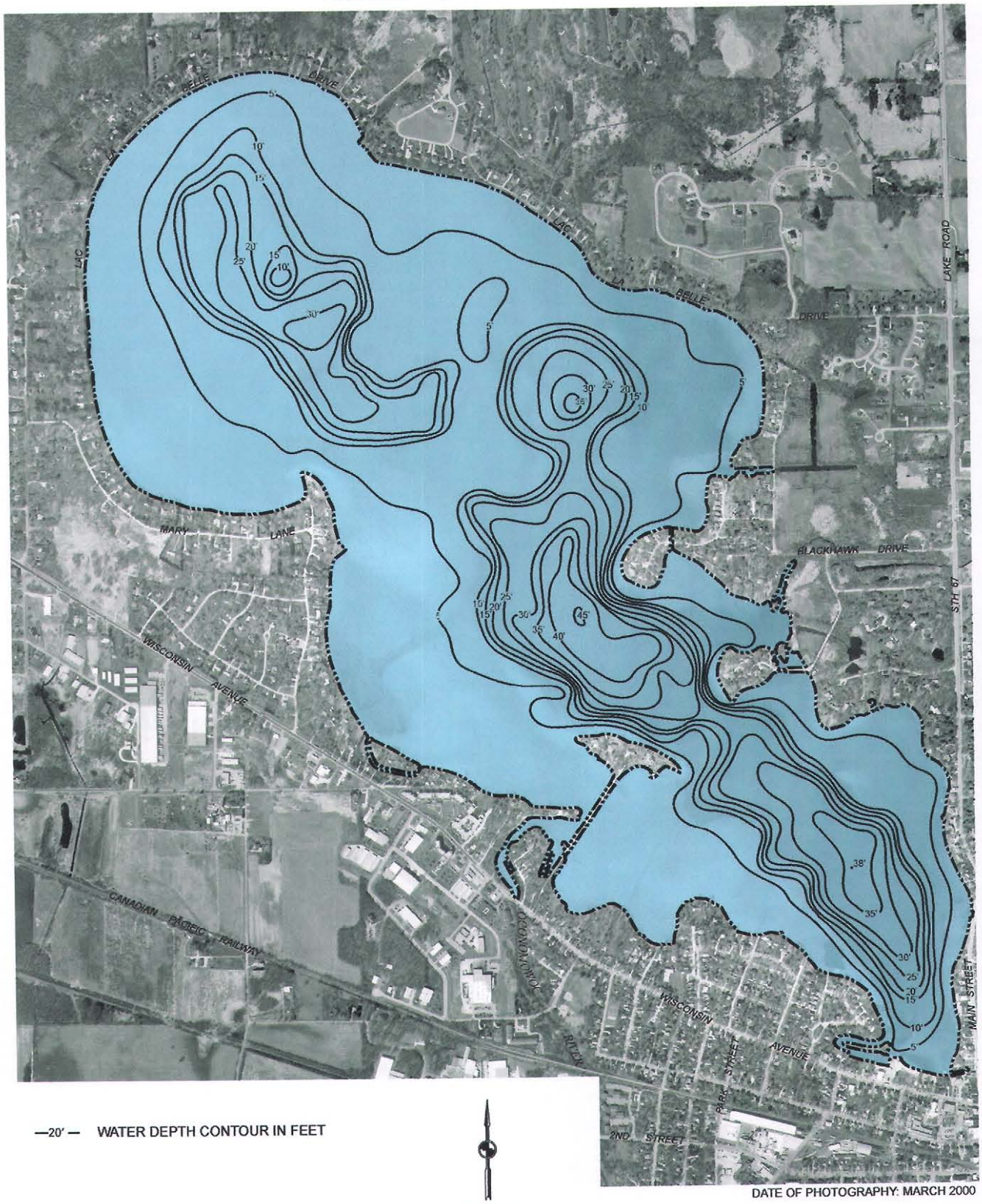
[79] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

[80] *Wisconsin Conservation Department,* op. cit.

[81] *SEWRPC Community Assistance Planning Report No. 47,* A Water Quality Management Plan for Lac La Belle, Waukesha County, Wisconsin, *December 1980.*

Map 41

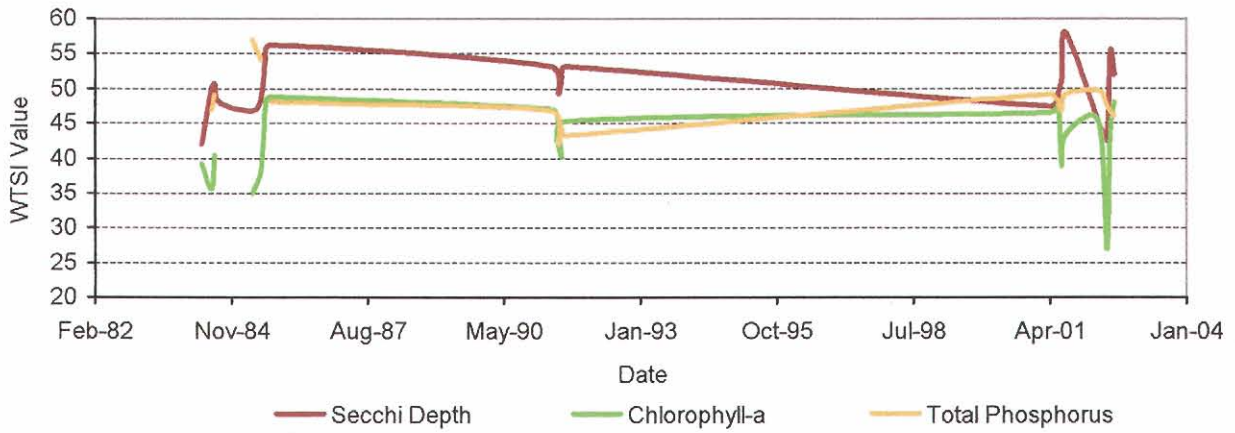
BATHYMETRIC MAP OF LAC LA BELLE



Source: SEWRPC.

Figure 9

TROPHIC STATE INDEX FOR LAC LA BELLE: 1984-2002



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Development Potential

As of 1995, the land uses within the approximately 10,600-acre drainage area directly tributary to Lac La Belle consisted of about 15 percent urban land uses and about 85 percent rural land uses. Of the rural land uses, agricultural uses comprised about 3,300 acres, or about 30 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface water comprised about 1,350 acres, or the balance of the rural land uses in the drainage area directly tributary to Lac La Belle. Of the urban land uses, urban residential development comprised about 1,000 acres, or about 10 percent of the land cover. Commercial, industrial, transportation and related infrastructure, institutional, and recreational lands comprised about 660 acres, or the balance of the urban lands within the direct drainage area tributary to the Lake. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Lac La Belle is located within the Oconomowoc River drainage system, a tributary stream system to the Rock River, which extends upstream for about 98 square miles. Within this total tributary drainage area, urban land uses comprise about 20 percent of the area, while rural land uses comprise the balance. Of these, urban residential uses account for about two-thirds of the urban land uses, while rural agricultural land uses comprise slightly more than one-half of the land cover within the total drainage area tributary to Lac La Belle.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Lac La Belle is generated both from rural agricultural and urban residential lands, which together comprise about two-thirds of the land cover within the total drainage area tributary to Lac La Belle. The Oconomowoc River Priority Watershed Plan recommends reductions in phosphorus loading of 25 percent in the Lake, to maintain the Lake to a mesotrophic condition, with a total phosphorus concentration of 0.02 to 0.03 mg/l.[82] In addition, the plan notes that the application of urban stormwater management practices within the City of Oconomowoc, recommended to be applied for the protection of Fowler Lake, immediately upstream of Lac La Belle, will benefit Lac La Belle.

[82] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

Fish and Wildlife Populations
In 1963, the fishery of Lac La Belle consisted largely of northern pike, largemouth bass, panfish, and walleyed pike.[83] Yellow perch, smallmouth bass, and bullheads were also reported. Fish surveys conducted in 1974, 1976, 1977, and 1980 reported the fishery to consist of yellow bullhead, bluegill, northern pike, yellow perch, common carp, longnose gar, white bass, largemouth bass, smallmouth bass, buffalos, walleyed pike, bigmouth buffalo, black bullhead, bowfin, golden shiner, brook silverside, green sunfish, pumpkinseed, white crappie, black crappie, brown bullhead, johnny darter, rock bass, white sucker, blackstripe topminnow, and central mudminnow.[84] As of 2001, walleyed pike, largemouth bass, smallmouth bass, and panfish were reported to be common in the Lake, and northern pike and muskie were reported to be present.[85]

Lannon County Park Pond
Lake Morphometry
Lannon County Park Pond is located in U.S. Public Land Survey Section 18, Township 8 North, Range 20 East, Village of Menomonee Falls, as shown on Map 15. The Pond has a surface area of about 15 acres, a maximum depth of 50 feet, and a shoreline development factor of 1.52. Lannon County Park Pond is located entirely within, and managed as, an open space site within the Waukesha County park system.

Recreational Use
Lannon County Park Pond is located entirely within Menomonee County Park. Public access is provided by a beach, light boat access, and picnic facilities.

Development Potential
As of 1995, the land uses within the approximately 625-acre drainage area tributary to the Upper Fox River, within which the Lannon County Park Pond is situated, consisted of about 40 percent urban land uses and about 60 percent rural land uses. Of the urban land uses, about 90 acres, or about 15 percent of the drainage area tributary to Lannon County Park Pond, were comprised of recreational lands. Urban residential lands comprised about 70 acres, or about 10 percent of the drainage area. The balance of the urban land uses were comprised of commercial and industrial land uses and transportation and related infrastructure. Wetlands, woodlands, surface water, and open space uses comprised about 250 acres, or about 40 percent of the total land cover in the drainage area. Rural agricultural land uses comprised the balance of the rural land uses, about 100 acres, or about 20 percent of the drainage area. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Lannon County Park Pond is generated primarily from both rural agricultural and urban residential lands which comprise about one-third of the land cover within the drainage basin tributary to the Lannon County Park Pond.

Fish and Wildlife Populations
In 1963, the fishery of Lannon County Park Pond consisted largely of rainbow trout.[86] A fish survey conducted in 1981 reported the fishery to consist of bluntnose minnow, fathead minnow, pumpkinseed, banded killifish, blacknose shiner, brown trout, black bullhead and yellow perch.[87] As of 2001, trout and panfish were reported to

[83] *Wisconsin Conservation Department,* op. cit.

[84] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[85] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[86] *Wisconsin Conservation Department,* op. cit.

[87] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

be common in the Pond, and largemouth bass were reported to be present. Park activity limits the use of the wetlands by waterfowl.

Larkin Lake

Lake Morphometry

Larkin Lake is located in U.S. Public Land Survey Section 15, Township 6 North, Range 17 East, Town of Ottawa, as shown on Map 26. The Lake has a surface area of about 57 acres, a maximum depth of four feet, and a shoreline development factor of 1.12. Larkin Lake is an internally drained seepage lake occupying a remnant basin in an old glacial lakebed.

Recreational Use

Public access is not available.

Development Potential

As of 1995, the land uses within the approximately 120-acre drainage area tributary to Larkin Lake consisted of about 95 percent rural land uses and about 5 percent urban land uses. Of the rural land uses, woodlands, wetlands, surface water, and open space uses comprised about 75 acres, or about two-thirds of the total land cover in the drainage area. Rural agricultural lands comprised about 35 acres, or about one-third of the land cover. Urban residential lands and transportation and related infrastructure comprised about five acres, or less than 5 percent of the land cover within the drainage basin tributary to Larkin Lake. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Larkin Lake is generated primarily from rural agricultural lands that comprise about 30 percent of the land cover within the drainage basin tributary to Larkin Lake.

Fish and Wildlife Populations

In 1963, the fishery of Larkin Lake was reported by the Wisconsin Department of Natural Resources to be absent due to heavy growths of aquatic plants, fluctuating water levels, and recurring winterkill.[88] Waterfowl make regular migratory and resident use of the Lake for nesting.

Leota Lake (Laura Lake)

Lake Morphometry

Leota Lake is located in U.S. Public Land Survey Sections 20 and 29, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about eight acres, a maximum depth of 12 feet, and a shoreline development factor of 1.26. Leota Lake is a small, natural waterbody located within a wetland complex on Battle Creek. The inlet and outlet are reported by the Wisconsin Department of Natural Resources to be slow draining and shallow, with the lake bottom being primarily composed of muck.

Recreational Use

Public access is not available. This Lake is considered to be a wilderness lake in public ownership.[89]

Development Potential

As of 1995, the land uses within the approximately 1,300 acre drainage area tributary to Battle Creek, within which Leota Lake is situated, consisted of about 95 percent rural land uses and about 5 percent urban land uses. Of the rural land uses, rural agricultural uses comprised about 700 acres, or about one-half of the total land cover in the drainage area. Wetlands, woodlands, and surface waters comprised about 525 acres, or the balance of the rural land cover. Urban land uses comprised about 85 acres, of which about 33 acres were urban residential lands,

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[88] *Wisconsin Conservation Department,* op. cit.

[89] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

and 23 acres were devoted to transportation and related infrastructure. Commercial lands and recreational lands comprised about 30 acres, or the balance of the urban land cover. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Leota Lake is generated primarily from rural agricultural lands that comprised about one-half of the total land cover within the drainage basin tributary to Leota Lake.

Fish and Wildlife Populations
In 1963, the fishery of Leota Lake consisted largely of panfish.[90] Infrequent winterkill was reported to occur. As of 2001, panfish were reported to be common in the Lake, and northern pike and largemouth bass were reported to be present.[91] Waterfowl and marshland fur bearers were reported to make limited use of the approximately 70 acres of wooded wetlands adjoining the Lake.

Linnie Lac
Lake Morphometry
Linnie Lac is located in U.S. Public Land Survey Section 36, Township 6 North, Range 20 East, City of New Berlin, as shown on Map 23. The Lake has a surface area of about six acres, a maximum depth of six feet, and a shoreline development factor of 1.54. Linnie Lac is an impoundment on Jewel Creek, a stream tributary to Little Muskego Lake, which ultimately drains to the Fox River system downstream of Wind Lake in Racine County. About one-half of the lake frontage is developed, with the balance being largely comprised of wetlands. The impoundment was recently redesigned and reconstructed during the late 1990s. Recent surveillance of the watershed tributary to Linnie Lac suggests that many of the agricultural lands upstream of the waterbody have been converted to urban land uses, primarily for urban commercial and industrial uses within the Westbrook development area.

Recreational Use
Public access is provided through the right-of-way of a public road, CTH HH (College Avenue).

Development Potential
As of 1995, the land uses within the approximately 180-acre drainage area directly tributary to Linnie Lac consisted of about 25 percent urban land uses and about 75 percent rural land uses. The rural land uses were comprised of about 60 acres of rural agricultural lands, which comprised about one-third of the land cover within the drainage basin directly tributary to Linnie Lac. Wetlands, woodlands, and surface waters comprised the balance of the rural land cover, or about 25 acres. Urban land uses were comprised of urban residential lands, which accounted for about 50 acres, or one-quarter of the land cover within the basin directly tributary to the Lake, and transportation and related infrastructure uses that comprised the balance of the urban land uses. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Linnie Lac is located within the Fox River drainage system, which extends upstream for about eight square miles. Within this total tributary drainage area, urban land uses comprise about 40 percent of the area, while rural land uses comprise the balance. Of these, urban residential uses account for slightly more than one-half of the urban land uses, while rural agricultural land uses comprise about two-thirds of the rural land uses within the total drainage area tributary to Linnie Lac.

[90] *Wisconsin Conservation Department,* op. cit.

[91] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Linnie Lac is generated primarily from both rural agricultural and urban residential lands, which comprise about two-thirds of the land cover within the total drainage basin tributary to Linnie Lac. The Muskego-Wind Lakes Priority Watershed Plan recommends reductions in sediment loading of 75 percent in the Lake; reductions in phosphorus loading of 60 percent in the Lake; and stabilization of the outlet structure to limit the discharge of sediment to Jewel Creek.[92] In addition, restoration of Linnie Lac to a mesotrophic condition, with a total phosphorus concentration of 0.03 mg/l, a chlorophyll-*a* concentration of 10 µg/l, and a Secchi-disc transparency of five feet, was recommended.

Fish and Wildlife Populations
In 1963, the fishery of Linnie Lac consisted largely of panfish.[93] A fish survey conducted in 1966 reported the fishery to consist of black bullhead, largemouth bass, black crappie, northern pike, bluegill, pumpkinseed, brown bullhead, yellow bullhead, warmouth, and green sunfish.[94] As of 2001, panfish were reported to be common in the Lake, and northern pike and largemouth bass were reported to be present.[95] Waterfowl and marshland fur bearers make resident use of the undeveloped shoreline and approximately 45 acres of open marsh adjoining the Lake.

Little Muskego Lake
Lake Morphometry
Little Muskego Lake is located in U.S. Public Land Survey Sections 4, 5, 8, and 9, Township 5 North, Range 20 East, City of Muskego, as shown on Map 30. The Lake has a surface area of about 506 acres, a maximum depth of 65 feet, and a shoreline development factor of 1.40. Little Muskego Lake is a natural drainage lake bordering the terminal moraine.[96] An impoundment at the outlet augments the naturally occurring water level in the Lake and maintains Lake levels. Jewel Creek, which forms the outlet of Linnie Lac, is the principle inflowing stream to Little Muskego Lake. Little Muskego Lake drains to Big Muskego Lake through Muskego Creek, and, ultimately, through Wind Lake to the Fox River drainage system. The bathymetry of Little Muskego Lake is shown on Map 42.

Water Quality
Available water quality data indicate that Little Muskego Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a TSI rating of approximately 50. Figure 10 shows the trends in water quality within Little Muskego Lake during the period 1986 through 2002, including the most recent increases in water clarity as a result of abundant populations of zebra mussel (*Driessena polymorpha*). A lake management plan was completed for the Lake by SEWRPC in 1996.[97]

Recreational Use
Public access is provided, and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

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[92] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-375 94,* op. cit.

[93] *Wisconsin Conservation Department,* op. cit.

[94] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

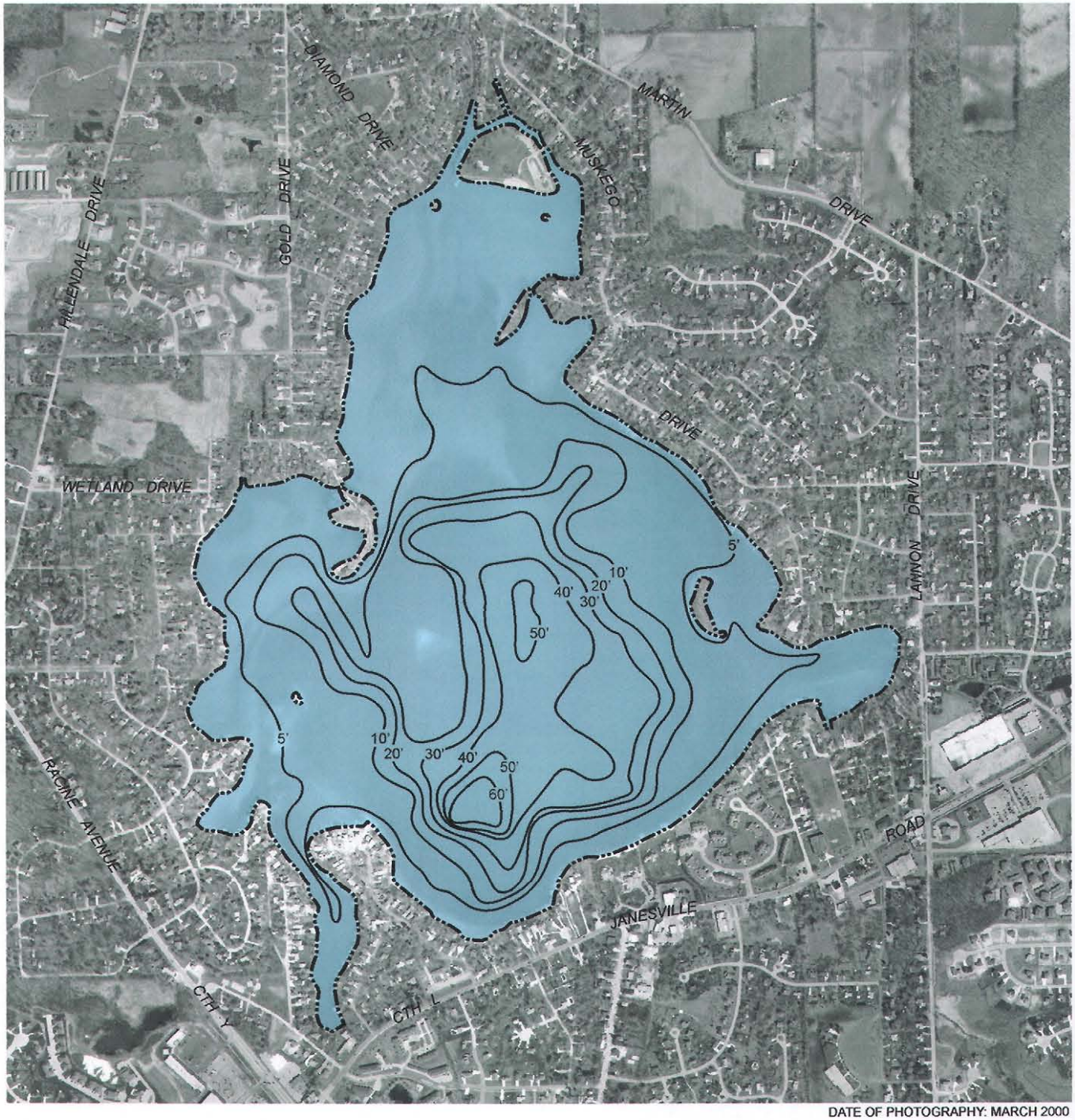
[95] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[96] *Wisconsin Department of Natural Resources Lake Use Report No. FX-10,* Little Muskego Lake, Waukesha County, Wisconsin, *1969.*

[97] *SEWRPC Community Assistance Planning Report No. 222,* A Lake Management Plan for Little Muskego Lake, Waukesha County, Wisconsin, *June 1996.*

Map 42

BATHYMETRIC MAP OF LITTLE MUSKEGO LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

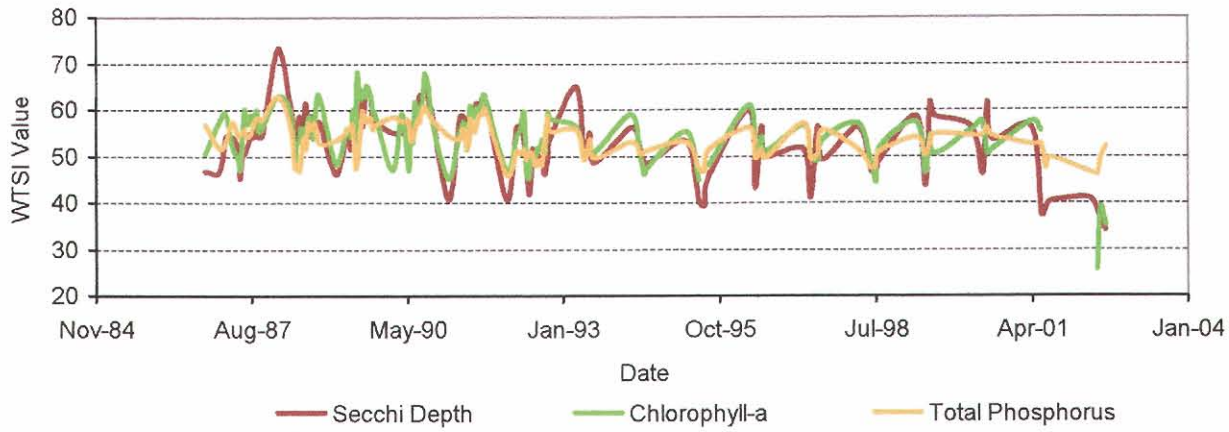
Source: SEWRPC.

GRAPHIC SCALE

0 650 1300 FEET

Figure 10

TROPHIC STATE INDEX FOR LITTLE MUSKEGO LAKE: 1986-2002



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Development Potential

As of 1995, the land uses within the approximately 2,200-acre drainage area directly tributary to Little Muskego Lake consisted of about 50 percent urban land uses and about 50 percent rural land uses. The urban land uses were comprised of about 850 acres of urban residential lands, which comprised about 40 percent of the land cover within the drainage basin directly tributary to Little Muskego Lake. Transportation and related infrastructure, commercial, industrial, and recreational lands comprised about 275 acres, or the balance of the urban lands within the drainage basin. Of the rural land uses, rural agricultural lands comprised about 450 acres, or about 20 percent of the drainage basin. Woodlands, wetlands, and surface waters comprised about 650 acres, or the balance of the rural land cover. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Little Muskego Lake is located within the Fox River drainage system, which extends upstream for about 12 square miles. Within this total tributary drainage area, urban land uses comprise about 40 percent of the area, while rural land uses comprise the balance. Of these, urban residential uses account for about two-thirds of the urban land uses, while rural agricultural lands comprise about two-thirds of the rural land uses within the total drainage area tributary to Little Muskego Lake.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Little Muskego Lake is generated primarily from both rural agricultural and urban residential lands which comprise about two-thirds of the land cover within the total drainage basin tributary to Little Muskego Lake. The Muskego-Wind Lakes Priority Watershed Plan recommends reductions in sediment loading of 75 percent in the Lake; reductions in phosphorus loading of 60 percent in the Lake; enhancement of shoreland and wetland habitat to preserve northern pike spawning areas; and improvement in fish and wildlife habitat through preservation of shoreland buffers.[98] In addition, restoration of Little Muskego Lake to a mesotrophic condition, with a total phosphorus concentration of 0.02 mg/l, a chlorophyll-*a* concentration of six µg/l, and a Secchi-disc transparency of 7.5 feet, was recommended.

[98] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-375 94,* op. cit.

Fish and Wildlife Populations

In 1963, the fishery of Little Muskego Lake consisted of panfish, largemouth bass, and northern pike.[99] Fish surveys conducted in 1973, 1974, 1975, and 1978, reported the fishery to consist of black crappie, bluegill, golden shiner, bluntnose minnow, warmouth, Iowa darter, pumpkinseed, walleyed pike, green sunfish, yellow bullhead, yellow perch, common carp, black bullhead, and largemouth bass.[100] As of 2001, panfish and largemouth bass were reported to be common in the Lake, with northern pike and walleyed pike being reported to be present.[101]

Lower Genesee Lake

Lake Morphometry

Lower Genesee Lake is located in U.S. Public Land Survey Sections 27 and 28, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 66 acres, a maximum depth of 44 feet, and a shoreline development factor of 1.23. Lower Genesee Lake occupies a moderately deep basin in outwash deposits. The bathymetry of Lower Genesee Lake is shown on Map 43. Prior to the construction of a town road, the Lower Genesee and Middle Genesee Lakes were a single waterbody. Currently, the two Lakes are considered by the Wisconsin Department of Natural Resources to be separate, but connected, waterbodies. The Lakes are groundwater-fed and have no natural outlet.[102] Hence, they are subject to significant variations in water level. Consequent upon a period of higher-than-normal water levels experienced in the mid-1980s and again in the early 1990s, studies were conducted to determine the feasibility of constructing an overflow structure to minimize human risk associated with the periodic inundation of onsite wastewater disposal systems located around the Lakes. While these studies indicated a potentially feasible discharge route from Lower Genesee Lake to the Bark River by way of the wetland complex located southwest of Lower Genesee Lake, further actions to implement such a drainageway have not been pursued to date.[103]

Recreational Use

Public access is provided from the town road. Parking is provided at an adjacent lot. Access is considered adequate by the Wisconsin Department of Natural Resources pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential

As of 1995, the land uses within the approximately 490-acre drainage area directly tributary to Lower Genesee Lake consisted of about 15 percent urban land uses and about 85 percent rural land uses. Of the rural land uses, rural agricultural uses comprised 120 acres, or about 25 percent of the land cover in the drainage area. Wetlands, woodlands, and surface water comprised about 300 acres, or about 60 percent of the drainage area tributary to the Lake. Urban land uses were comprised of urban residential land uses, which amounted to about 55 acres or about 10 percent of the drainage basin, with the balance being comprised of commercial land uses and transportation and related infrastructure. However, a significant amount of the agricultural land to the north of the Genesee Lakes is expected to be converted to urban land uses as part of the Pabst Farms, Inc., development. These

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[99] *Wisconsin Conservation Department,* op. cit.

[100] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[101] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[102] *See U.S. Geological Survey Open-File Reports,* Water-Quality and Lake-Stage Data for Wisconsin Lakes, *for each water year; and R.J. Hunt, Y. Lin, J.T. Krohelski, and P.F. Juckem, U.S. Geological Survey Water-Resources Investigations Report 00-4136,* Simulation of the Shallow Hydrologic System in the Vicinity of Middle Genesee Lake, Wisconsin, Using Analytic Elements and Parameter Estimation, *2000.*

[103] *SEWRPC Memorandum Report No. 148,* A Lake Protection Plan for Middle Genesee Lake, Waukesha County, Wisconsin, *August 2003.*

Map 43

BATHYMETRIC MAP OF LOWER GENESEE LAKE

DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

GRAPHIC SCALE

0 250 500 FEET

Source: SEWRPC.

lands are expected to be converted to mixed office/commercial land uses adjacent to IH 94 and to medium-density urban residential land uses in the long-term buildout projections. The Pabst Farms, Inc., development will be subject to stormwater management measures set forth in a site-specific stormwater management plan being prepared pursuant to the County ordinance requirements. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Lower Genesee Lake is generated primarily from rural agricultural lands which comprise about 85 percent of the total drainage area tributary to Lower Genesee Lake.

Fish and Wildlife Populations
In 1963, the fishery of Lower Genesee Lake consisted largely of largemouth bass, northern pike, panfish, and rainbow trout.[104] Fish surveys conducted in 1975, 1980 and 1981, reported the fishery to consist of largemouth bass, yellow bullhead, pumpkinseed, bluegill, golden shiner, northern pike, common carp, black crappie, brown trout, rainbow trout, banded killifish, Iowa darter, green sunfish, blacknose shiner, bluntnose minnow, and johnny darter.[105] The banded killifish is listed as a State species of special concern. As of 2001, trout were reported to be present in the Lake, but northern pike, largemouth bass, and panfish were reported to be common.[106]

Lower Kelly Lake
Lake Morphometry
Lower Kelly Lake is located in U.S. Public Land Survey Section 36, Township 6 North, Range 20 East, City of New Berlin, as shown on Map 23. The Lake has a surface area of about three acres, a maximum depth of 36 feet, and a shoreline development factor of 1.15. Lower Kelly Lake occupies a kettle in glacial deposits and drains to Upper Kelly Lake through an extensive wetland complex linking the two waterbodies. Upper Kelly Lake, in turn, drains to the Root River system and, ultimately, to Lake Michigan through Milwaukee and Racine Counties. The bathymetry of Lower Kelly Lake is shown on Map 44.

Water Quality
Available water quality data indicate that Lower Kelly Lake is a mesotrophic waterbody, or moderately enriched, waterbody, with a Wisconsin TSI rating of approximately 53. A lake protection plan was completed for the Lake by SEWRPC during 2000.[107]

Recreational Use
Public access is not provided.

Development Potential
As of 1995, the land uses within the approximately 25-acre drainage area tributary to Lower Kelly Lake consisted wholly of urban land uses. Urban residential and recreational lands and open space comprised the total land cover in the drainage area. The drainage area is located within an area planned for urban development in the adopted County development plan.

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[104] *Wisconsin Conservation Department,* op. cit.

[105] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[106] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[107] *SEWRPC Memorandum Report No. 135,* A Lake Protection Plan for the Kelly Lakes, Milwaukee and Waukesha Counties, Wisconsin, *October 2000.*

Map 44

BATHYMETRIC MAP OF UPPER AND LOWER KELLY LAKES

DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

GRAPHIC SCALE

0 200 400 FEET

Source: SEWRPC.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Lower Kelly Lake is generated from urban lands which comprise the entirety of the drainage basin directly tributary to Lower Kelly Lake.

Fish and Wildlife Populations
In 1963, the fishery of Lower Kelly Lake consisted largely of largemouth bass and panfish.[108] As of 2001, panfish were reported to be abundant in the Lake, with largemouth bass reported to be present.[109] Waterfowl make limited migratory and resident use of the approximately nine acres of wetland adjoining the Lake due to their close proximity to residences.

Lower Nashotah Lake
Lake Morphometry
Lower Nashotah Lake is located in U.S. Public Land Survey Sections 12 and 13, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 90 acres, a maximum depth of 43 feet, and a shoreline development factor of 1.50. Lower Nashotah Lake occupies a dendritic basin in glacial outwash bordering the terminal moraine. Intermittent inflows to the Lake occur from Upper Nashotah Lake. The Lake discharges through an impounded outlet to Upper Nemahbin Lake. The bathymetry of Lower Nashotah Lake is shown on Map 45. The lake bottom is primarily gravel and marl.

Recreational Use
Public access is provided by CTH B and navigable water access from Upper Nemahbin Lake.

Development Potential
As of 1995, the land uses within the approximately 290-acre drainage area directly tributary to Lower Nashotah Lake consisted of about 40 percent urban land uses and about 60 percent rural land uses. Of the urban land uses, urban residential uses comprised about one-third of the total land cover in the drainage area. Residential uses comprised about one-third of the total land cover. Transportation and related infrastructure, institutional lands, and utilities comprised the balance of the urban lands within the drainage basin directly tributary to the Lake, or about 20 acres. Rural lands were comprised of rural agricultural lands with an areal extent of about 50 acres, or about 20 percent of the land cover, and woodlands, wetlands, and surface water which comprised the balance of the rural land uses. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Lower Nashotah Lake is generated primarily from both rural agricultural and urban residential lands which comprise about three-fifths of the land cover within the total drainage basin tributary to Lower Nashotah Lake.

Fish and Wildlife Populations
In 1963, the fishery of Lower Nashotah Lake consisted largely of largemouth bass, walleyed pike, and rainbow trout.[110] A fish survey conducted in 1975 reported the fishery to consist of rock bass, brook silverside, blacknose shiner, bluegill, yellow perch, Iowa darter, largemouth bass, bluntnose minnow, least darter, pumpkinseed, mimic shiner, and green sunfish.[111] The least darter is listed as a State species of special concern. As of 2001, northern

[108] *Wisconsin Conservation Department,* op. cit.

[109] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[110] *Wisconsin Conservation Department,* op. cit.

[111] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

Map 45

BATHYMETRIC MAP OF LOWER NASHOTAH LAKE

DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

Source: SEWRPC.

GRAPHIC SCALE

0 400 800 FEET

pike, largemouth bass, and panfish were reported to be common in the Lake, and walleyed pike and smallmouth bass were reported to be present.[112] Trout were also reported to be present in the Lake.

Lower Nemahbin Lake

Lake Morphometry

Lower Nemahbin Lake is located in U.S. Public Land Survey Sections 24 and 25, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 271 acres, a maximum depth of 36 feet, and a shoreline development factor of 1.43. Lower Nemahbin Lake is a natural drainage lake, being one of a chain of lakes comprised of Upper and Lower Nashotah Lakes and Upper and Lower Nemahbin Lakes, bordering the terminal moraine that parallels the interlobate moraine. A low head structure on the Bark River maintains the water level of the Lake, which discharges to Crooked Lake through a wetland complex and short reach of the Bark River. Lower Nemahbin Lake is the fourth in a chain of five lakes linked by the Bark River within Waukesha County. The basin is divided by one large island and several lesser islands. The water is considered to be clear by the Wisconsin Department of Natural Resources and much of the bottom is marl. The bathymetry of Lower Nemahbin Lake is shown on Map 46.

Water Quality

Available water quality data for Lower Nemahbin Lake are few, but indicate that the Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a TSI rating of approximately 45, in recent years. Figure 11 shows the trends in water quality within Lower Nemahbin Lake during the period 1973 through 2000.

Recreational Use

Public access is provided by a public recreational boating access site at the inlet to the Lake. Both the Lake and its inlet and outlet are navigable.

Development Potential

As of 1995, the land uses within the approximately 825-acre drainage area directly tributary to Lower Nemahbin Lake consisted of about one-third urban land uses and about two-thirds rural land uses. Of the urban land uses, residential land uses comprised about 240 acres, or about one-quarter of the total land cover in the drainage area. Industrial lands and transportation and related infrastructure comprised the balance of the urban lands, or about 60 acres. Rural agricultural land uses comprised about 75 acres, or about 10 percent of the land cover within the drainage basin directly tributary to Lower Nemahbin Lake. Woodlands, wetlands, and surface water comprised about 450 acres, or the balance of the rural lands. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Lower Nemahbin Lake is within the Bark River drainage system, which extends upstream for more than 53 square miles. Within this total tributary drainage area, urban land uses comprise about one-third of the area, while rural land uses comprise the balance. Of these, residential uses account for about one-half of the urban land uses, while agricultural land uses comprise slightly more than one-half of the rural land uses within the total drainage area tributary to Lower Nemahbin Lake.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Lower Nemahbin Lake is generated primarily from both urban residential and rural agricultural lands which comprise about one-third of the total drainage basin tributary to Lower Nemahbin Lake.

Fish and Wildlife Populations

In 1963, the fishery of Lower Nemahbin Lake consisted largely of panfish, largemouth bass, northern pike, and walleyed pike.[113] A fish survey conducted in 1975 reported the fishery to consist of johnny darter, central

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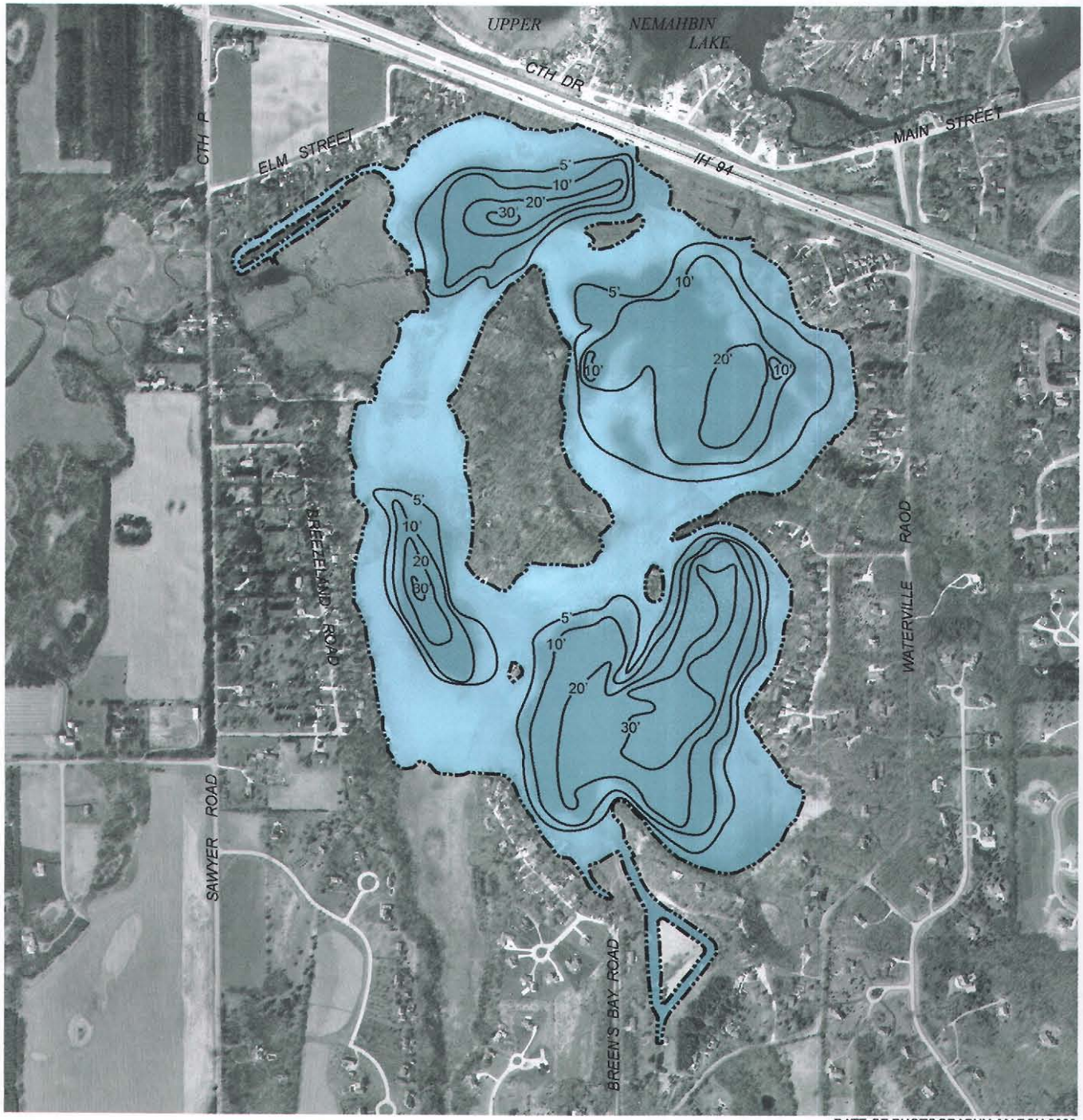
[112] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[113] *Wisconsin Conservation Department,* op. cit.

Map 46

BATHYMETRIC MAP OF LOWER NEMAHBIN LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

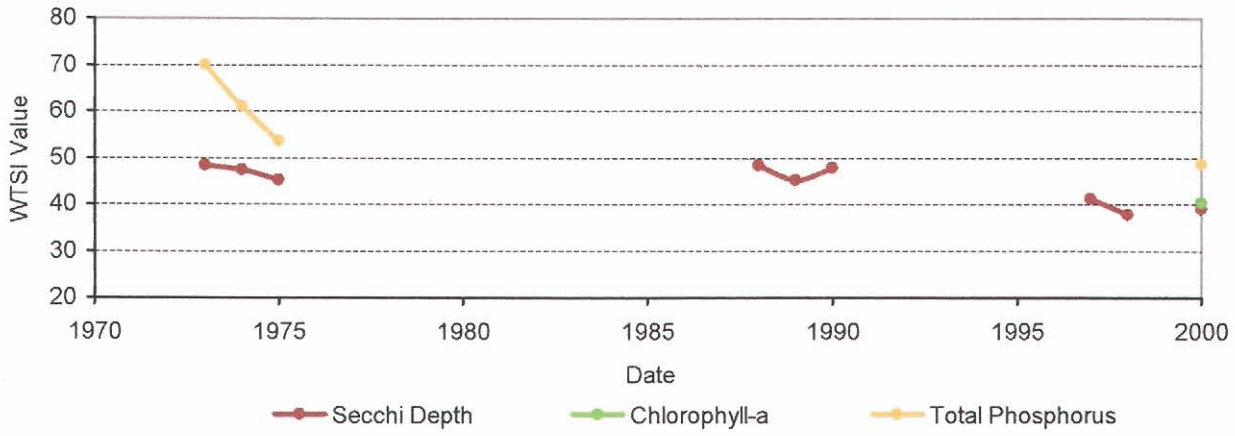
Source: SEWRPC.

GRAPHIC SCALE

0 500 1000 FEET

Figure 11

TROPHIC STATE INDEX FOR LOWER NEMAHBIN LAKE: 1973-2000



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

mudminnow, lake chubsucker, bluntnose minnow, blackstripe topminnow, banded killifish, bluegill, green sunfish, pugnose shiner, rock bass, yellow perch, yellow bullhead, blacknose shiner, pumpkinseed, black crappie, Iowa darter, least darter, mimic shiner, blackchin shiner, golden shiner, and northern pike.[114] As of 2001, largemouth bass were reported to be common in the Lake, and northern pike, walleyed pike, smallmouth bass, and panfish were reported to be present.[115]

Lower Okauchee Lake

Lake Morphometry

Lower Okauchee Lake is located in U.S. Public Land Survey Sections 35 and 36, Township 8 North, Range 18 East, Town of Oconomowoc, as shown on Map 18. The Lake has a surface area of about 43 acres, a maximum depth of 11 feet, and a shoreline development factor of 1.69. Lower Okauchee Lake occupies an impounded area of the Oconomowoc River between Okauchee and Oconomowoc Lakes. The Lake was created to provide aquatic recreational and lakefront housing opportunities for a lake-centered community. Like Tierney Lake and Upper Oconomowoc Lake, this Lake is considered to be an embayment of Okauchee Lake.

Lower Phantom Lake (Howitt Lake)

Lake Morphometry

Lower Phantom Lake is located in U.S. Public Land Survey Sections 26, 27, 34 and 35, Township 5 North, Range 18 East, Town and Village of Mukwonago, as shown on Map 28. The Lake has a surface area of about 433 acres, a maximum depth of 12 feet, and a shoreline development factor of 1.81. Lower Phantom Lake is the second impoundment on the Mukwonago River within Waukesha County, being situated downstream of Eagle Spring Lake in the Town of Eagle, and downstream of Lulu Lake and Lake Beulah, both in Walworth County.[116] The

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[114] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[115] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[116] *Wisconsin Department of Natural Resources Lake Use Report No. FX-14,* Lower Phantom Lake, Waukesha County, Wisconsin, *1969.*

impounding structure maintains about an eight-foot head. The western portion of the Lake and the inlet valley is classified as deep marsh. The Lake discharges through the Mukwonago River to the Fox River system. The bathymetry of Lower Phantom Lake is shown on Map 47.

Water Quality
An aquatic plant management plan was completed for the Lake by SEWRPC in 1993.[117] A lake management plan for the Lake is currently being prepared by SEWRPC.

Recreational Use
Public access is provided, and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential
As of 1995, the land uses within the approximately 2,300 acre drainage area directly tributary to Lower Phantom Lake consisted of about 40 percent urban land uses and about 60 percent rural land uses. Of the rural land uses, agricultural land uses comprised about 580 acres, or about 25 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface water comprised about 850 acres, or the balance of the rural lands within the drainage basin. Urban residential lands comprised about 425 acres, or about 20 percent of the land cover within the drainage basin directly tributary to Lower Phantom Lake. The balance of about 420 acres was comprised of commercial, industrial, institutional, recreational lands, and transportation and related infrastructure. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Lower Phantom Lake is within the Mukwonago River drainage system, a tributary stream system to the Fox River, which extends upstream for more than 32 square miles. Within this total tributary drainage area, urban lands comprise about 20 percent of the land cover, with rural lands comprising the balance. Of the urban lands, residential lands comprise about one-tenth of the area, while rural agricultural lands comprise about two-thirds of the balance.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Lower Phantom Lake is generated primarily from rural agricultural lands which comprise about one-half of the total drainage basin tributary to Lower Phantom Lake.

Fish and Wildlife Populations
In 1963, the fishery of Lower Phantom Lake consisted largely of northern pike, panfish, and largemouth bass.[118] Fish surveys conducted in 1966 and 1978, reported the fishery to consist of black crappie, grass pickerel, northern pike, yellow bullhead, bluegill, green sunfish, pumpkinseed, yellow perch, bowfin, lake chubsucker, starhead topminnow, brook silverside, golden shiner, rock bass, brown bullhead, largemouth bass, walleyed pike, common carp, longnose gar, and warmouth.[119] As of 2001, northern pike and largemouth bass were reported to be common, and walleyed pike and panfish were reported to be present.[120]

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[117] *SEWRPC Memorandum Report No. 81,* Aquatic Plant Management Plan for the Phantom Lakes, Waukesha County, Wisconsin, *July 1993.*

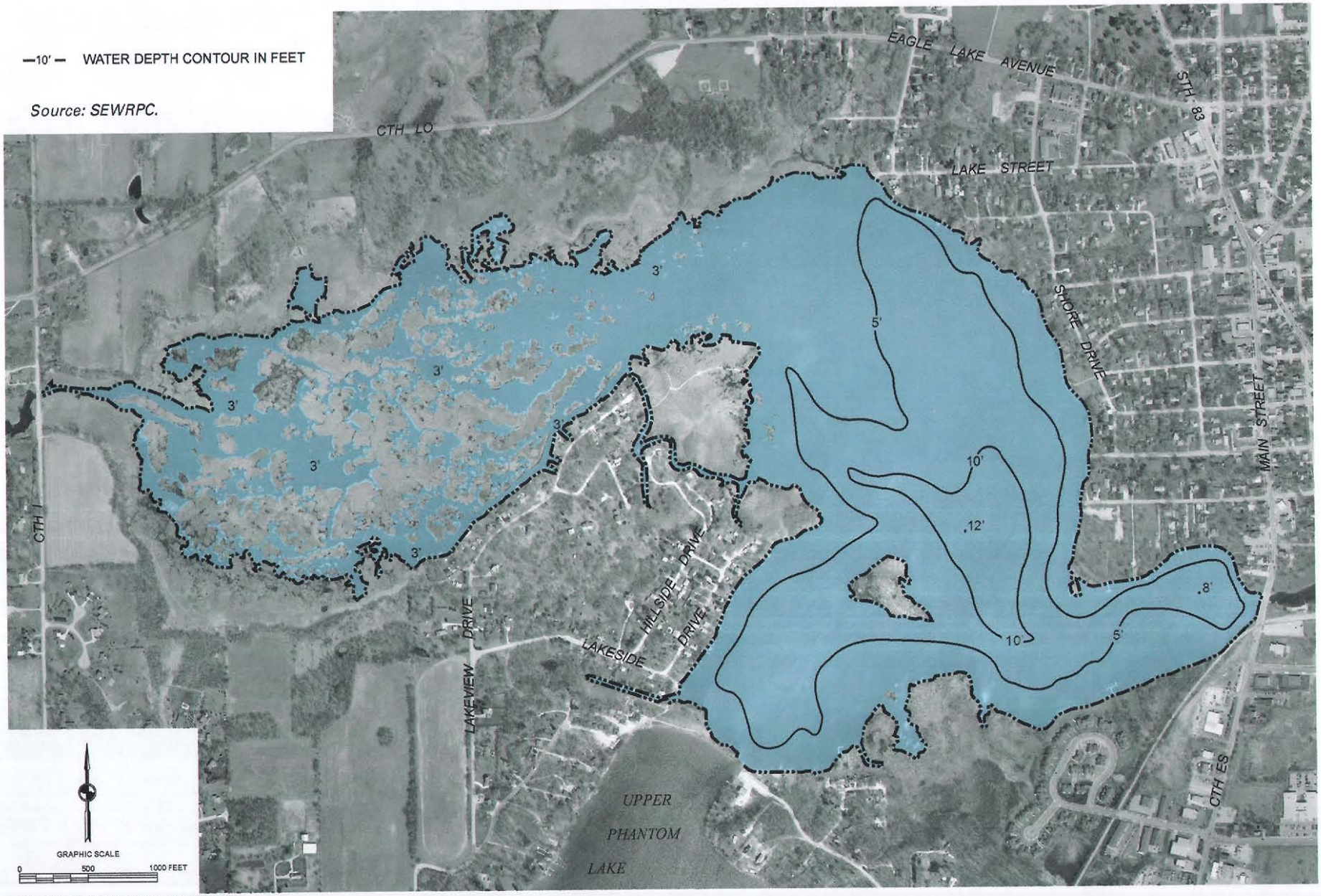
[118] *Wisconsin Conservation Department,* op. cit.

[119] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[120] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Map 47

BATHYMETRIC MAP OF LOWER PHANTOM LAKE



Merton Millpond

Lake Morphometry

Merton Millpond is located in U.S. Public Land Survey Section 13, Township 8 North, Range 18 East, Village of Merton, and U.S. Public Land Survey Section 18, Township 8 North, Range 19 East, Town of Lisbon, as shown on Maps 16 and 17. The Millpond has a surface area of about 38 acres, a maximum depth of eight feet, and a shoreline development factor of 2.08. Merton Millpond is an impoundment of the Bark River created by a dam with about a nine-foot head that originally provided hydropower for a flour and feed mill. The upstream end of the Millpond and the entire River valley are bordered by shallow marsh.

Recreational Use

Public access is provided by a town road bordering the pond.

Development Potential

As of 1995, the land uses within the approximately 810-acre drainage area directly tributary to Merton Millpond consisted of 95 percent rural land uses and about 5 percent urban land uses. Of the rural land uses, agriculture land uses comprised 400 acres, or about one-half of the total land cover in the drainage area. Woodlands, wetlands, and surface water comprised about 350 acres, or the balance of the rural land uses. Urban residential lands comprised about 10 acres, or about 1 percent of the land cover within the drainage basin directly tributary to Merton Millpond, with the balance of the urban land uses being comprised of industrial and recreational uses and transportation and related infrastructure, which covered about 40 acres. The drainage area is not located within an area planned for urban development in the adopted County development plan.

The Merton Millpond is within the Bark River drainage system, a tributary stream system to the Rock River, which extends upstream for more than 24 square miles. Within this total tributary drainage area, urban lands comprise about 25 percent of the land cover, with rural lands comprising the balance. Of the urban lands, residential lands comprise about one-tenth of the area, while rural agricultural lands comprise about four-fifths of the rural land cover.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Merton Millpond is generated primarily from agricultural lands which comprise about two-thirds of the land cover within the total tributary drainage basin to the Merton Millpond.

Fish and Wildlife Populations

In 1963, the fishery of Merton Millpond consisted largely of panfish, with northern pike reported to be present in lesser abundance.[121] As of 2001, panfish were reported to be common in the Millpond, with northern pike and largemouth bass being reported to be present.[122] Waterfowl make migratory and resident use of the wetlands adjoining the Millpond and the River valley.

Middle Genesee Lake

Lake Morphometry

Middle Genesee Lake is located in U. S. Public Land Survey Sections 21 and 22, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 109 acres, a maximum depth of 40 feet, and a shoreline development factor of 1.13. Middle Genesee Lake occupies a basin in glacial outwash deposits previously connected with Lower Genesee Lake. Prior to the construction of a town road, the Middle Genesee and Lower Genesee Lakes were a single waterbody. Currently, the two Lakes are considered by the Wisconsin Department of Natural Resources to be separate, but connected, waterbodies. The Lakes have no natural outlet and are subject to significant variations in water level. Consequent upon a period of higher-than-

[121] *Wisconsin Conservation Department,* op. cit.

[122] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

normal water levels experienced in the mid-1980s and again in the early 1990s, studies were conducted to determine the feasibility of constructing an overflow structure to minimize human risk associated with the periodic inundation of onsite wastewater disposal systems located around the Lakes. While these studies indicated a potentially feasible discharge route from Lower Genesee Lake to the Bark River by way of the wetland complex located southwest of Lower Genesee Lake, further actions to implement such a drainageway have not been pursued to date. Notwithstanding, the investigations did identify the preeminent role of groundwater inflows in the maintenance of lake levels in Middle and Lower Genesee Lakes. This finding prompted the Middle Genesee Lake Management District to undertake further studies of the Lake's geohydrology, which were recently completed by the U.S. Geological Survey.[123] These studies delineated the Lake's groundwatershed, which extends northeastward from the Lake toward Upper Nemahbin Lake, and confirmed the sensitivity of the waterbody to interannual variations in groundwater flows. Fluctuations in Lake level of up to about two feet were forecast due to the effects of climatic variability. The water is clear, with a primarily sand and gravel bottom. The bathymetry of Middle Genesee Lake is shown on Map 48.

Water Quality

Available water quality data indicate that Middle Genesee Lake is a mesotrophic waterbody, or moderately enriched, waterbody, with a TSI rating of approximately 40. Figure 12 shows the trends in water quality within Middle Genesee Lake during the period 1996 through 2002. A lake protection plan has been completed for the Lake by SEWRPC.[124]

Recreational Use

Public access is provided by a town road. Parking is provided at an adjacent lot. Access is considered adequate by the Wisconsin Department of Natural Resources pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential

As of 1995, the land uses within the approximately 950-acre drainage area directly tributary to Middle Genesee Lake consisted of about 20 percent urban land uses and about 80 percent rural land uses. Of the rural land uses, agricultural land uses comprised 435 acres, or about 45 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface water comprised about 330 acres, or the balance of the rural lands. Nevertheless, a significant amount of the agricultural land to the north of the Genesee Lakes is expected to be converted to urban land uses as part of the proposed Pabst Farms, Inc., development currently being planned. These lands are expected to be converted to mixed office/commercial land uses adjacent to IH 94 and to medium-density urban residential land uses in the long-term buildout projections. The Pabst Farms, Inc., development will be subject to stormwater management measures set forth in a site-specific stormwater management plan being prepared pursuant to the County ordinance requirements. Urban lands within the drainage basin as of 1995 were comprised of urban residential lands which extended over 140 acres, or about 15 percent of the drainage basin directly tributary to Middle Genesee Lake. Transportation and related infrastructure, utilities, and industrial lands comprised about 50 acres, or the balance of the urban land uses. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within drainage area tributary to Middle Genesee Lake is generated primarily from agricultural lands which comprise about one-half of the total tributary drainage area to Middle Genesee Lake. As noted above, however, this drainage basin is becoming more urbanized as development continues to occur in the tributary drainage basin to the Lake.

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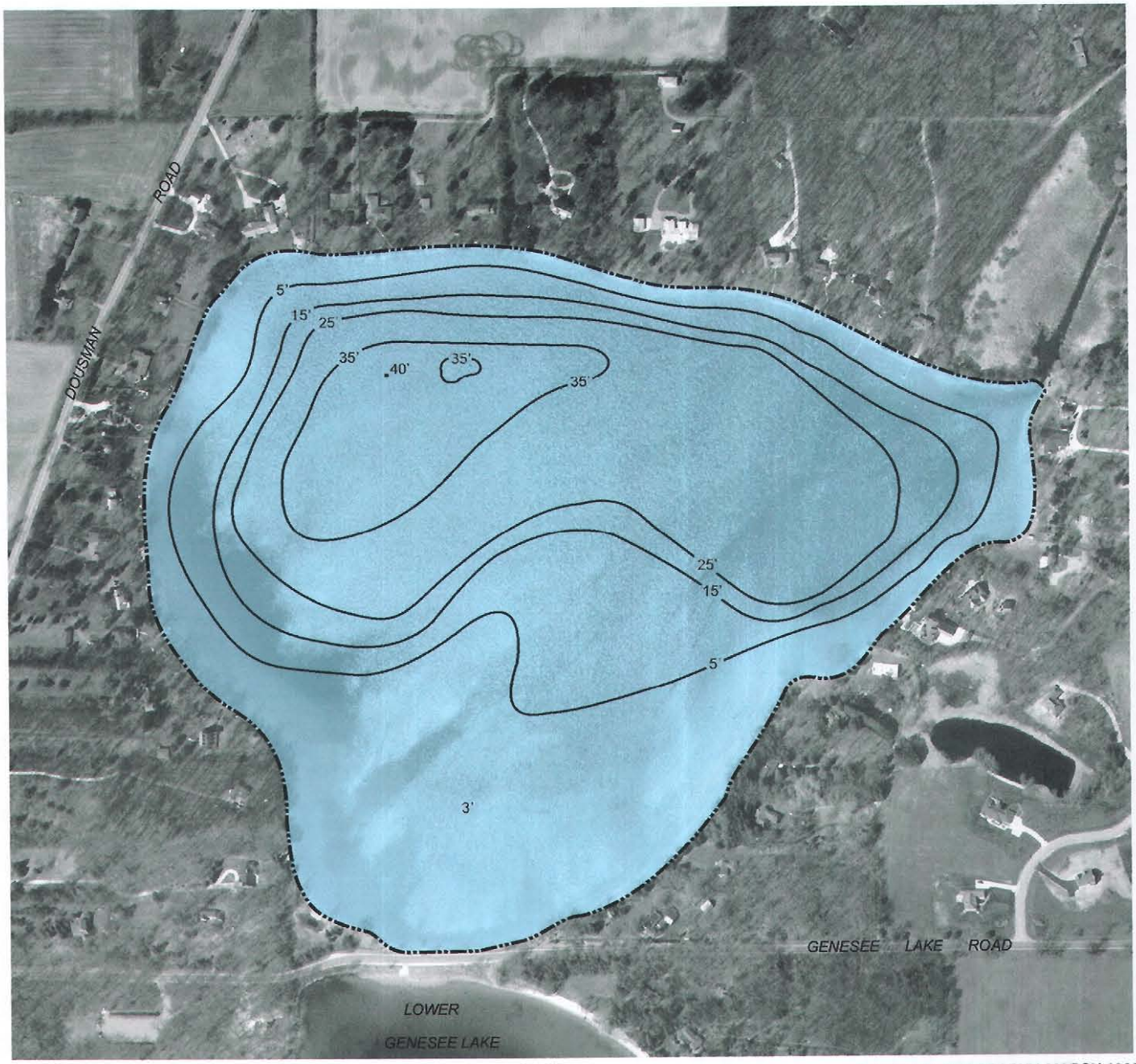
[123] *U.S. Geological Survey Water-Resources Investigations Report No. 00-4136,* Simulation of the Shallow Hydrologic System in the Vicinity of Middle Genesee Lake, Wisconsin, Using Analytic Elements and Parameter Estimation, *2000.*

[124] *SEWRPC Memorandum Report No. 148,* op. cit.

Map 48

BATHYMETRIC MAP OF MIDDLE GENESEE LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

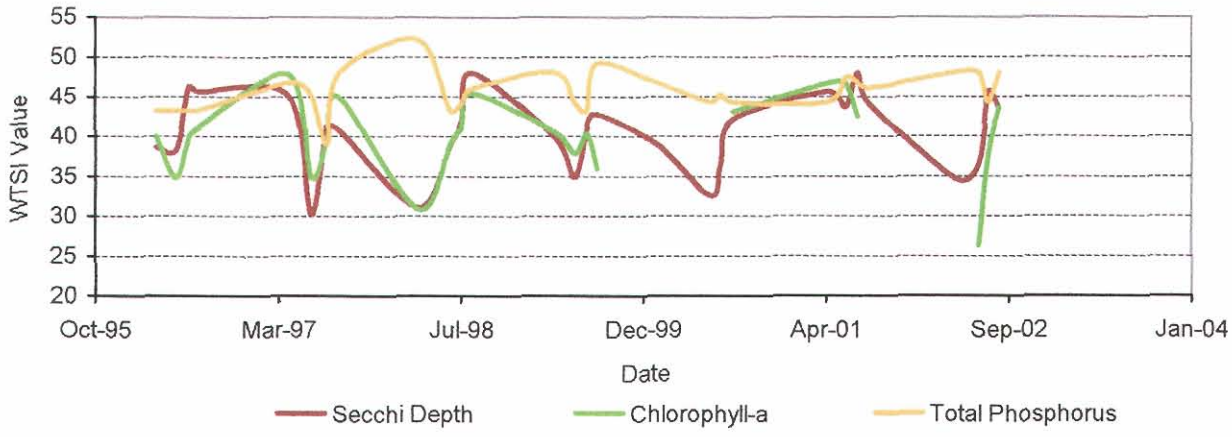
—20'— WATER DEPTH CONTOUR IN FEET

GRAPHIC SCALE
0 250 500 FEET

Source: SEWRPC.

Figure 12

TROPHIC STATE INDEX FOR MIDDLE GENESEE LAKE: 1996-2002



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Fish and Wildlife Populations

In 1963, the fishery of Middle Genesee Lake consisted largely of panfish and largemouth bass.[125] A fish survey conducted in 1975 reported the fishery to consist of northern pike, Iowa darter, yellow perch, golden shiner, largemouth bass, blacknose shiner, pumpkinseed, bluegill, mimic shiner, and bluntnose minnow.[126] As of 2001, panfish were reported to be abundant in the Lake, largemouth bass were reported to be common, and northern pike were reported to be present.[127]

Monches Millpond

Lake Morphometry

Monches Millpond is located in U.S. Public Land Survey Sections 2 and 3, Township 8 North, Range 18 East, Town of Merton, as shown on Map 17. The Millpond has a surface area of about 16 acres, a maximum depth of four feet, and a shoreline development factor of 1.29. Monches Millpond is an impoundment of the Oconomowoc River, near the unincorporated hamlet of Monches on the border between Washington and Waukesha Counties. Monches Millpond is located downstream of Friess Lake in Washington County and upstream of North Lake, Okauchee Lake, Oconomowoc Lake, Fowler Lake, and Lac La Belle in Waukesha County. The impoundment was constructed in 1844 to provide power for a sawmill. The mill is presently a residence.

Recreational Use

Public access is provided through the Oconomowoc River.

Development Potential

As of 1995, the land uses within the approximately 330-acre drainage area directly tributary to Monches Millpond consisted of 30 percent urban land uses and 70 percent rural land uses. Of the rural land uses, rural agricultural

[125] *Wisconsin Conservation Department,* op. cit.

[126] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[127] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

uses comprised about 130 acres, or about 40 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface water comprised about 95 acres, or the balance of the rural land uses in the drainage area directly tributary to Monches Millpond. Urban residential lands comprised about 75 acres, or about 25 percent of the land cover. Transportation and related infrastructure and industrial land uses comprised about 30 acres, or the balance of the urban land uses in the drainage area. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Monches Millpond is located within the Oconomowoc River basin, a tributary stream to the Rock River drainage system, which extends upstream for about 60 square miles. Within this total tributary drainage area, urban land uses comprise about one-third of the area, while rural land uses comprise the balance. Of these, urban residential uses account for about three-quarters of the urban land uses, while rural agricultural lands comprise about 60 percent of the rural land uses within the total drainage area tributary to Monches Millpond.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Monches Millpond is generated primarily from agricultural lands which comprise about two-fifths of the total drainage area tributary to Monches Millpond.

Fish and Wildlife Populations
In 1963, the fishery of Monches Millpond consisted largely of white crappies, bullheads, and an occasional northern pike.[128] As of 2001, northern pike, largemouth bass, and panfish were reported to be present in the Millpond.[129] Waterfowl make limited migratory and resident use of the approximately 20 acres of open wetlands adjoining the Millpond.

Monterey Millpond
Lake Morphometry
Monterey Millpond is located in U. S. Public Land Survey Section 9, Township 8 North, Range 17 East, Town of Oconomowoc, as shown on Map 18. The Millpond has a surface area of about 30 acres, a maximum depth of eight feet, and a shoreline development factor of 2.37. Monterey Millpond is an impoundment of the Ashippun River. The impounding structure maintains a 10-foot head at the unincorporated hamlet of Monterey. The Millpond is located on the mainstem of the Ashippun River downstream of the confluence of the Ashippun Lake outlet.

Recreational Use
Public access is provided by a crossing at STH 67.

Development Potential
As of 1995, the land uses within the approximately 1,300-acre drainage area directly tributary to the Monterey Millpond consisted of about 5 percent urban land uses and about 95 percent rural land uses. Of the rural land uses, rural agricultural uses comprised about 1,225 acres, or about 95 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface water comprised about 200 acres, or the balance of the rural land cover. Urban residential land uses comprised about 30 acres, or about 2 percent of the land cover, with industrial land uses and transportation and related infrastructure comprising the balance of about 50 acres. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Monterey Millpond is located within the Ashippun River basin, a tributary stream to the Rock River drainage system, which extends upstream for about 18 square miles. Within this total tributary drainage area, urban land uses comprise about 10 percent of the area, while rural land uses comprise the balance. Of these, urban residential

[128] *Wisconsin Conservation Department,* op. cit.

[129] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

uses account for about one-half of the urban land uses, while rural agricultural lands comprise about three-quarters of the rural land uses within the total drainage area tributary to Monterey Millpond.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the total drainage area tributary to Monterey Millpond is generated primarily from agricultural lands which comprise about 70 percent of the total tributary drainage area to the Monterey Millpond.

Fish and Wildlife Populations
In 1963, the fishery of Monterey Millpond consisted largely of panfish and northern pike.[130] A fish survey conducted in 1974 reported the fishery to consist of black bullhead, golden shiner, bluntnose minnow, common shiner, green sunfish, bluegill, and pumpkinseed.[131] As of 2001, panfish were reported to be abundant in the Millpond, and northern pike and largemouth bass were reported to be present.[132] Waterfowl and small marshland mammals were reported by the Wisconsin Department of Natural Resources as making resident use of the approximately 45 acres of wetlands adjoining the Millpond.[133]

Moose Lake
Lake Morphometry
Moose Lake is located in U.S. Public Land Survey Sections 19, 20 and 30, Township 8 North, Range 18 East, Town of Merton, as shown on Map 17. The Lake has a surface area of about 81 acres, a maximum depth of 61 feet, and a shoreline development factor of 1.82. Moose Lake is an internally drained, seepage lake occupying a dendritic basin bordering the terminal moraine and outwash deposits. The bathymetry of Moose Lake is shown on Map 49. The bottom is reported by the Wisconsin Department of Natural Resources to be primarily sand and gravel. The entire shoreline is extensively developed for residential use.

Recreational Use
Public access is not available. However, as of 2002, discussions regarding the provision of a public recreational boating access site at the southern extreme of the lake basin were underway.

Development Potential
As of 1995, the land uses within the approximately 650-acre drainage area tributary to Moose Lake consisted of about 20 percent urban land uses and about 80 percent rural land uses. Of the rural land uses, woodlands, wetlands, and surface waters comprised about 350 acres, or about 50 percent of the total land cover in the drainage area. Rural agricultural lands comprised about 140 acres, or about 20 percent of the land cover. Of the urban land uses, urban residential lands comprised about 115 acres, or about 20 percent of the drainage basin tributary to Moose Lake. Commercial, institutional, recreational lands, and transportation and related infrastructure comprised about 50 acres, or the balance of the land cover within the drainage basin. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Moose Lake is generated primarily from both rural agricultural and urban residential lands which comprise about two fifths of the land cover within the drainage basin tributary to Moose Lake. The Oconomowoc River Priority Watershed Plan recommends application of

[130] *Wisconsin Conservation Department,* op. cit.

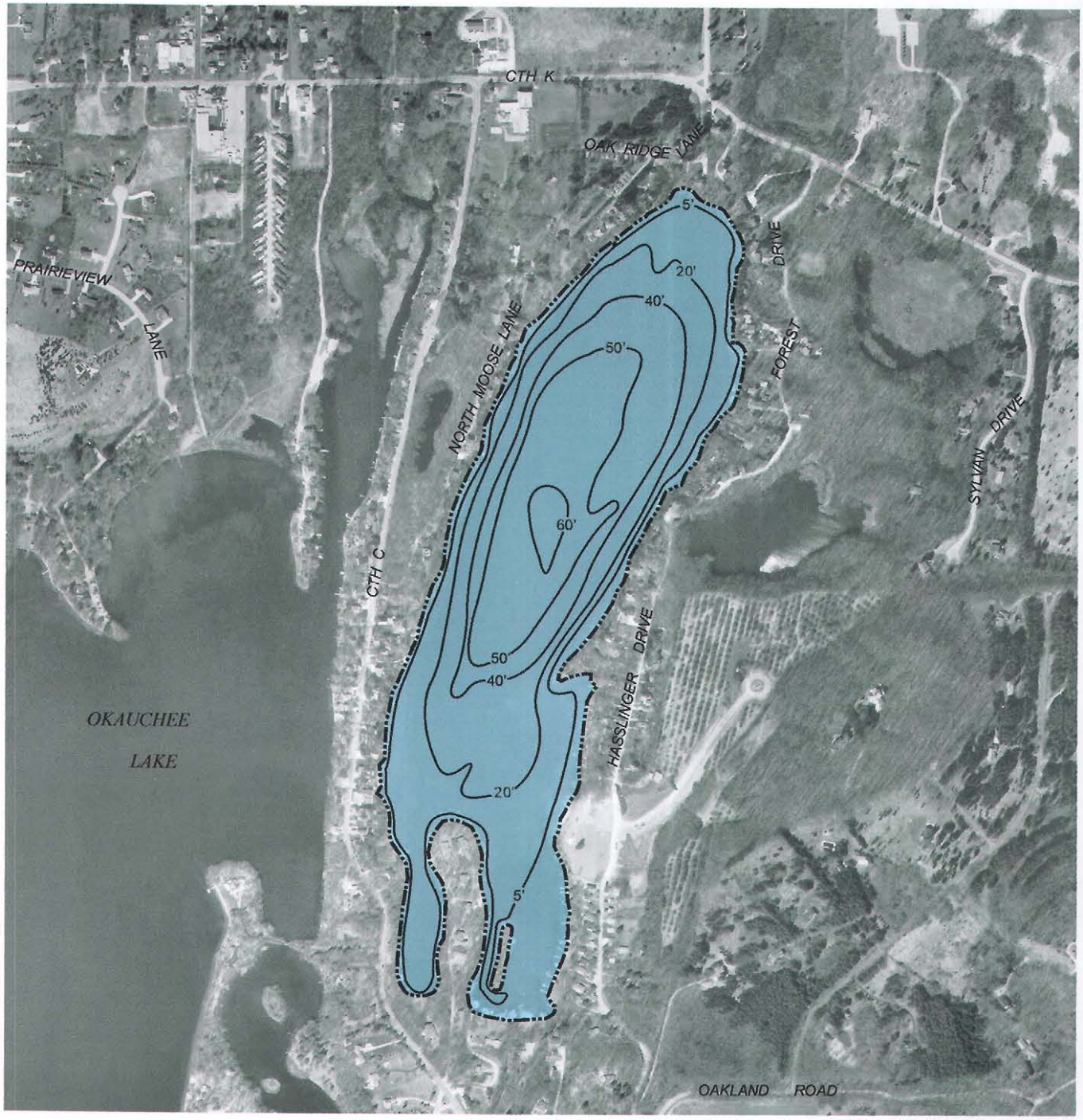
[131] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[132] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[133] Ibid.

Map 49

BATHYMETRIC MAP OF MOOSE LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

Source: SEWRPC.

GRAPHIC SCALE

0 400 800 FEET

appropriate land use and development controls to maintain the Lake in a mesotrophic condition, with a total phosphorus concentration of 0.02 to 0.03 mg/l.[134]

Fish and Wildlife Populations
In 1963, the fishery of Moose Lake consisted largely of panfish, largemouth bass, northern pike, and rainbow trout.[135] Fish surveys conducted in 1973 and 1974 reported the fishery to consist of black crappie, brown trout, least darter, white sucker, blackstripe topminnow, golden shiner, northern pike, yellow perch, bluegill, green sunfish, pumpkinseed, bluntnose minnow, lake chubsucker, rainbow trout, brown bullhead, rock bass, and largemouth bass.[136] As of 2001, panfish and largemouth bass were reported to be common in the Lake, and northern pike were reported to be present.[137]

Mukwonago Park Pond
Lake Morphometry
Mukwonago Park Pond is located in U.S. Public Land Survey Section 29, Township 5 North, Range 18 East, Town of Mukwonago, as shown on Map 28. The Pond has a surface area of about one acre, a maximum depth of five feet, and a shoreline development factor of 1.01. Mukwonago Park Pond is a spring-fed pond completely within the Mukwonago County Park. Its banks are grassed to the waterline and tiling provides an outlet to Roxy Pond, also located entirely within the park.

Recreational Use
Public access is provided through the Mukwonago County Park.

Development Potential
As of 1995, the land uses within the approximately 2,000-acre drainage area tributary to the Mukwonago River, within which the Mukwonago Park Pond is situated, consisted of about 20 percent urban land uses and about 80 percent rural land uses. Of the rural land uses, rural agricultural uses comprised about 1,200 acres, or about 60 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface water comprised about 430 acres, or about 20 percent of the land cover. Urban residential lands comprised about 120 acres, or about 10 percent of the land cover, with commercial and recreational lands and transportation and related infrastructure comprising about 270 acres or the balance of the land cover within the drainage basin. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Mukwonago Park Pond is generated primarily from rural agricultural lands which comprise about three-fifths of the land cover within the drainage basin tributary to the Mukwonago Park Pond.

Fish and Wildlife Populations
In 1963, the fishery of Mukwonago Park Pond consisted largely of largemouth bass and panfish.[138] As of 2001, largemouth bass and northern pike were reported to be present in the Pond.[139] Several good springs are reported by the Wisconsin Department of Natural Resources to generally keep water open year around.

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[134] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

[135] *Wisconsin Conservation Department,* op. cit.

[136] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[137] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[138] *Wisconsin Conservation Department,* op. cit.

[139] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Nagawicka Lake

Lake Morphometry

Nagawicka Lake is located in U.S. Public Land Survey Sections 5, 8, 9, 16, 17, 20 and 21, Township 7 North, Range 18 East, City of Delafield and Village of Nashotah, as shown on Map 20. The Lake has a surface area of about 957 acres, [140] a maximum depth of 90 feet, and a shoreline development factor of 1.98. Nagawicka Lake lies within the middle reaches of the Bark River, a tributary stream to the Rock River system, and occupies the valley drained by the Bark River in the interlobate moraine. The western and northeastern shores of the Lake contain an extensive channel system that drains into the Lake. The bathymetry of Nagawicka Lake is shown on Map 50.

Water Quality

Available water quality data indicate that Nagawicka Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a TSI rating of approximately 45. Figure 13 shows the trends in water quality within Nagawicka Lake during the period 1972 through 2000. A lake management plan was completed for the Lake by SEWRPC in 2001.[141]

Recreational Use

Public access is provided by a County park on the eastern shoreline of the Lake, and by a City access site on the southwestern shoreline. The Lake has adequate public access pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential

As of 1995, the land uses within the approximately 4,800-acre drainage area directly tributary to Nagawicka Lake consisted of about 30 percent urban land uses and about 70 percent rural land uses. Of the rural land uses, rural agricultural uses comprised about 1,300 acres, or about 30 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 2,100 acres, or about 45 percent of the land cover. Urban residential land uses comprised about 1,000 acres, or about 20 percent of the drainage area. Commercial, industrial, institutional, recreational uses, and transportation and infrastructure comprised about 380 acres, or the balance of the urban lands within the drainage basin directly tributary to Nagawicka Lake. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nagawicka Lake is within the Bark River drainage system, which extends upstream for about 45 square miles. Within this total tributary drainage area, urban land uses comprise about one-third of the area, while rural land uses comprise the balance. Of these, residential uses account for about one-half of the urban land uses, while agricultural land uses comprise slightly more than one-half of the rural land uses within the total drainage area tributary to Nagawicka Lake.

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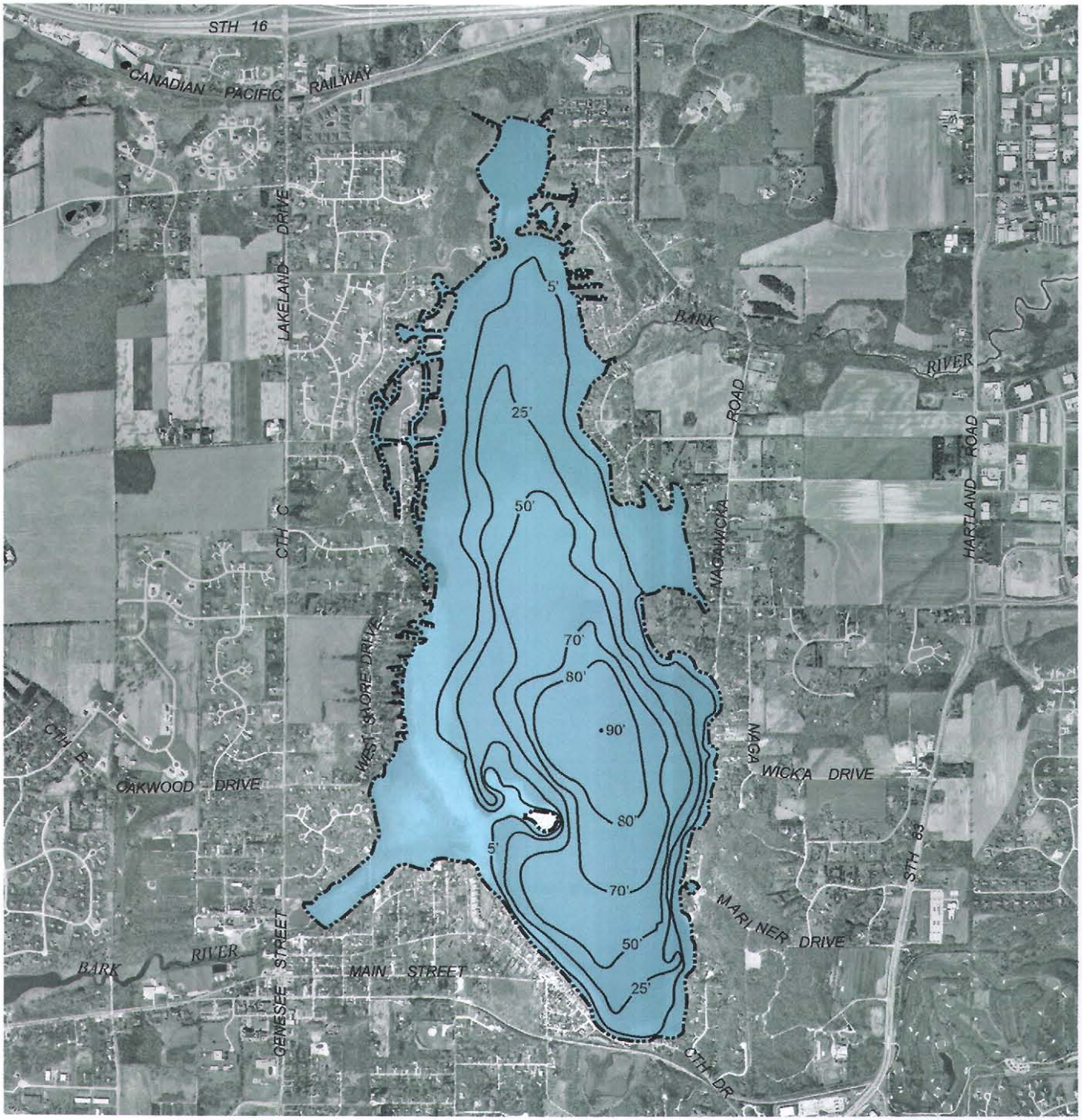
[140] *The inclusion or exclusion of the "kettle" on the northern extreme of the Lake, and of the artificial channels constructed along the western shoreline of the Lake, has resulted in various hydrographical and morphometric data being published for the Lake. The Wisconsin Department of Natural Resources reports the Lake surface area as 917 acres, which area is used for regulatory purposes, including the determination of public recreational boating access pursuant to Chapter NR 1 of the* Wisconsin Administrative Code, *while the adopted regional water quality management plan notes the surface area of the Lake to be about 1,026 acres. The recent Waukesha County land and water resource management plan and the adopted lake management plan for Nagawicka Lake, SEWRPC Community Assistance Planning Report No. 262,* A Lake Management Plan for Nagawicka Lake, Waukesha County, Wisconsin, *March 2001, reports the surface area as 957 acres, which value is used herein.*

[141] *SEWRPC Community Assistance Planning Report No. 262,* op. cit.; *SEWRPC Memorandum Report No. 130,* A Lake and Watershed Inventory for Nagawicka Lake, Waukesha County, Wisconsin, *March 1999.*

Map 50

BATHYMETRIC MAP OF NAGAWICKA LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—25'— WATER DEPTH CONTOUR IN FEET

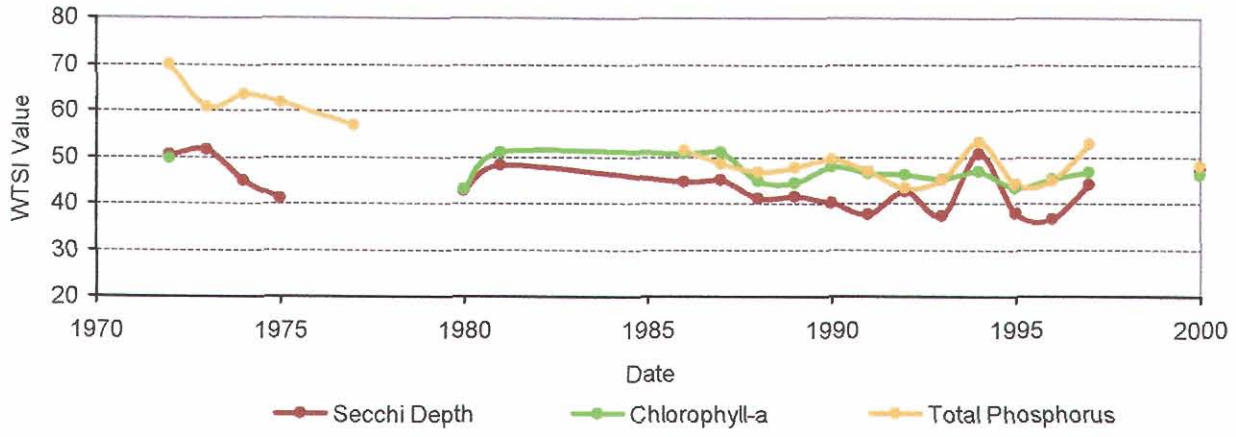
GRAPHIC SCALE

0 1200 2400 FEET

Source: SEWRPC.

Figure 13

TROPHIC STATE INDEX FOR NAGAWICKA LAKE: 1972-2000



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Nagawicka Lake is generated primarily from rural agricultural and urban residential lands which comprise about three-fifths of the land cover within the total tributary drainage area to the Lake.

Fish and Wildlife Populations

In 1963, the fishery of Nagawicka Lake consisted largely of northern pike, walleyed pike, largemouth bass, smallmouth bass, and panfish.[142] Fish surveys conducted in 1970, 1975, and 1995, reported the fishery to consist of pumpkinseed, rainbow darter, largemouth bass, bluegill, yellow perch, blacknose shiner, bluntnose minnow, johnny darter, emerald shiner, mimic shiner, fathead minnow, fantail darter, tadpole madtom, rock bass, Iowa darter, brook silverside, pugnose shiner, black crappie, yellow bullhead, and green sunfish.[143] As of 2001, largemouth bass and panfish were reported to be common in the Lake, and northern pike, walleyed pike, and smallmouth bass were reported to be present.[144] Waterfowl make extensive migratory and resident use of the wetlands and timber swamp that adjoin the northernmost basin of the Lake, locally known as the Kettle.

Norris Foundation Pond (Norris Pond)

Lake Morphometry

Norris Foundation Pond is located in U.S. Public Land Survey Section 34, Township 5 North, Range 19 East, Town of Vernon, as shown on Map 29. The Pond has a surface area of about three acres, and a maximum depth of eight feet. Norris Foundation Pond was created by an artificial dike and, historically, was used as a swimming facility by the Norris Foundation. The Wisconsin Department of Natural Resources has noted that the major part of the water budget of this Pond is supplied by spring runoff from the surrounding land surface.

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[142] *Wisconsin Conservation Department,* op. cit.

[143] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[144] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Recreational Use
Public access is not available.

Development Potential
As of 1995, the land uses within the approximately 1,300-acre drainage area tributary to the Middle Fox River, within which the Norris Foundation Pond is situated, consisted of about 20 percent urban land uses and about 80 percent rural land uses. Of the rural land uses, rural agricultural lands comprised about 730 acres, or about 60 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 350 acres, or the balance of the rural lands in the drainage basin. Urban residential uses comprised about 140 acres, or about 10 percent of the land cover. The balance of about 75 acres was comprised of transportation and related infrastructure, institutional, and recreational lands. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Norris Foundation Pond is generated primarily from agricultural lands which comprised about three-fifths of the land cover within the tributary drainage area to the Pond.

Fish and Wildlife Populations
In 1963, the Pond was dry at the time of investigation.[145]

North Lake
Lake Morphometry
North Lake is located in U.S. Public Land Survey Section 17, Township 8 North, Range 18 East, Town of Merton and Village of Chenequa, as shown on Map 17. The Lake has a surface area of about 439 acres, a maximum depth of 73 feet, and a shoreline development factor of 1.81. North Lake occupies a basin in outwash deposits within the interlobate moraine at the confluence of the Oconomowoc and Little Oconomowoc Rivers. The bottom is primarily sand and gravel save for scattered marl beds. The Lake is the second lake in the Oconomowoc River chain of lakes, being located downstream of Friess Lake in Washington County and upstream of Okauchee Lake, Oconomowoc Lake, Fowler Lake, and Lac La Belle in Waukesha County. North Lake is unimpounded. The bathymetry of North Lake is shown on Map 51.

Water Quality
Available water quality data indicate that North Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a Wisconsin TSI rating of approximately 51. A water quality management plan was completed for the Lake by SEWRPC in 1982.[146]

Recreational Use
Public access is provided only through the navigable outlet (and inlet) of the Lake. North Lake currently does not have adequate public access pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

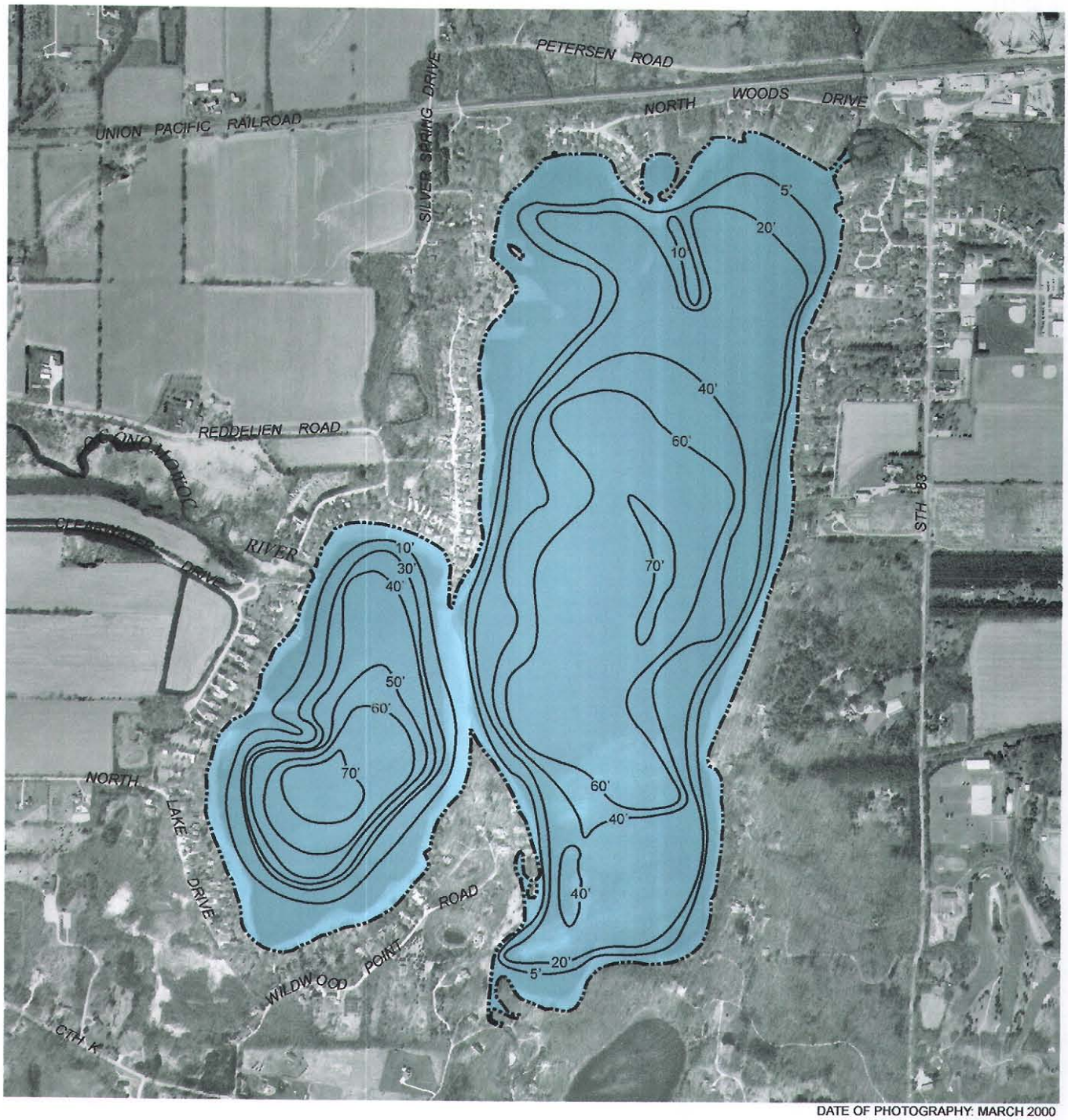
Development Potential
As of 1995, the land uses within the approximately 2,100-acre drainage area directly tributary to North Lake consisted of about 25 percent urban land uses and about 75 percent rural land uses. Of the rural land uses, woodlands, wetlands, and surface water comprised about 950 acres, or about 45 percent of the land cover in the drainage area directly tributary to North Lake. Rural agricultural lands comprised about 600 acres, or about 30

[145]*Wisconsin Conservation Department,* op. cit.

[146]*SEWRPC Community Assistance Planning Report No. 54,* A Water Quality Management Plan for North Lake, Waukesha County, Wisconsin, *July 1982.*

Map 51

BATHYMETRIC MAP OF NORTH LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

Source: SEWRPC.

GRAPHIC SCALE

0 600 1200 FEET

percent of the drainage area. Urban residential lands comprised about 315 acres, or about 15 percent of the land cover, with the balance of the land cover within the drainage basin directly tributary to North Lake comprised of commercial, industrial, institutional, recreational lands, and transportation and related infrastructure. The drainage area is not located within an area planned for urban development in the adopted County development plan.

North Lake is located within the Oconomowoc River basin, a tributary stream to the Rock River drainage system, which extends upstream for about 64 square miles. Within this total tributary drainage area, urban land uses comprise about 10 percent of the area, while rural land uses comprise the balance. Of these, urban residential uses account for about three-fifths of the urban land uses, while rural agricultural lands comprise about one-half of the rural land uses within the total drainage area tributary to North Lake.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to North Lake is generated primarily from rural agricultural lands which comprise about two-fifths of the total drainage basin tributary to North Lake. The Oconomowoc River Priority Watershed Plan recommends reductions in phosphorus loading of 65 percent in the Lake, to restore the Lake to a mesotrophic condition, with a total phosphorus concentration of 0.02 to 0.03 mg/l.[147]

Fish and Wildlife Populations

In 1963, the fishery of North Lake consisted largely of panfish, northern pike, walleyed pike, and largemouth bass.[148] Cisco were also reported. A fish survey conducted in 1975 reported the fishery to consist of brown bullhead, green sunfish, smallmouth bass, northern pike, common carp, yellow bullhead, bowfin, grass pickerel, bluntnose minnow, mimic shiner, brook silverside, johnny darter, common shiner, black crappie, rock bass, largemouth bass, walleyed pike, white bass, yellow perch, pumpkinseed, white sucker, and bluegill.[149] As of 2001, northern pike, largemouth bass, smallmouth bass, and panfish were reported to be common in the Lake, and walleyed pike were reported to be present.[150] Waterfowl and upland game birds make limited migratory and resident use of the wetlands adjoining the outlet.

Oconomowoc Lake

Lake Morphometry

Oconomowoc Lake is located in U.S. Public Land Survey Sections 1, 2, and 3, Township 7 North, Range 17 East, Village of Oconomowoc Lake, and U.S. Public Land Survey Section 35, Township 8 North, Range 17 East, Town of Oconomowoc, as shown on Maps 18 and 19. The Lake has a surface area of about 804 acres, a maximum depth of 62 feet, and a shoreline development factor of 1.80. Oconomowoc Lake is a multiple basin lake in the terminal moraine. The Oconomowoc River enters and drains the Lake and is impounded by a two-foot structure at the outlet. Oconomowoc Lake is the fourth lake in the Oconomowoc River chain of lakes, being located downstream of Friess Lake in Washington County and North Lake and Okauchee Lake in Waukesha County, and upstream of Fowler Lake and Lac La Belle, both in Waukesha County. The water is clear and the bottom is primarily gravel. The bathymetry of Oconomowoc Lake is shown on Map 52.

Water Quality

Available water quality data indicate that Oconomowoc Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a TSI rating of approximately 40. Figures 14 and 15 show the trends in water quality within

[147] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

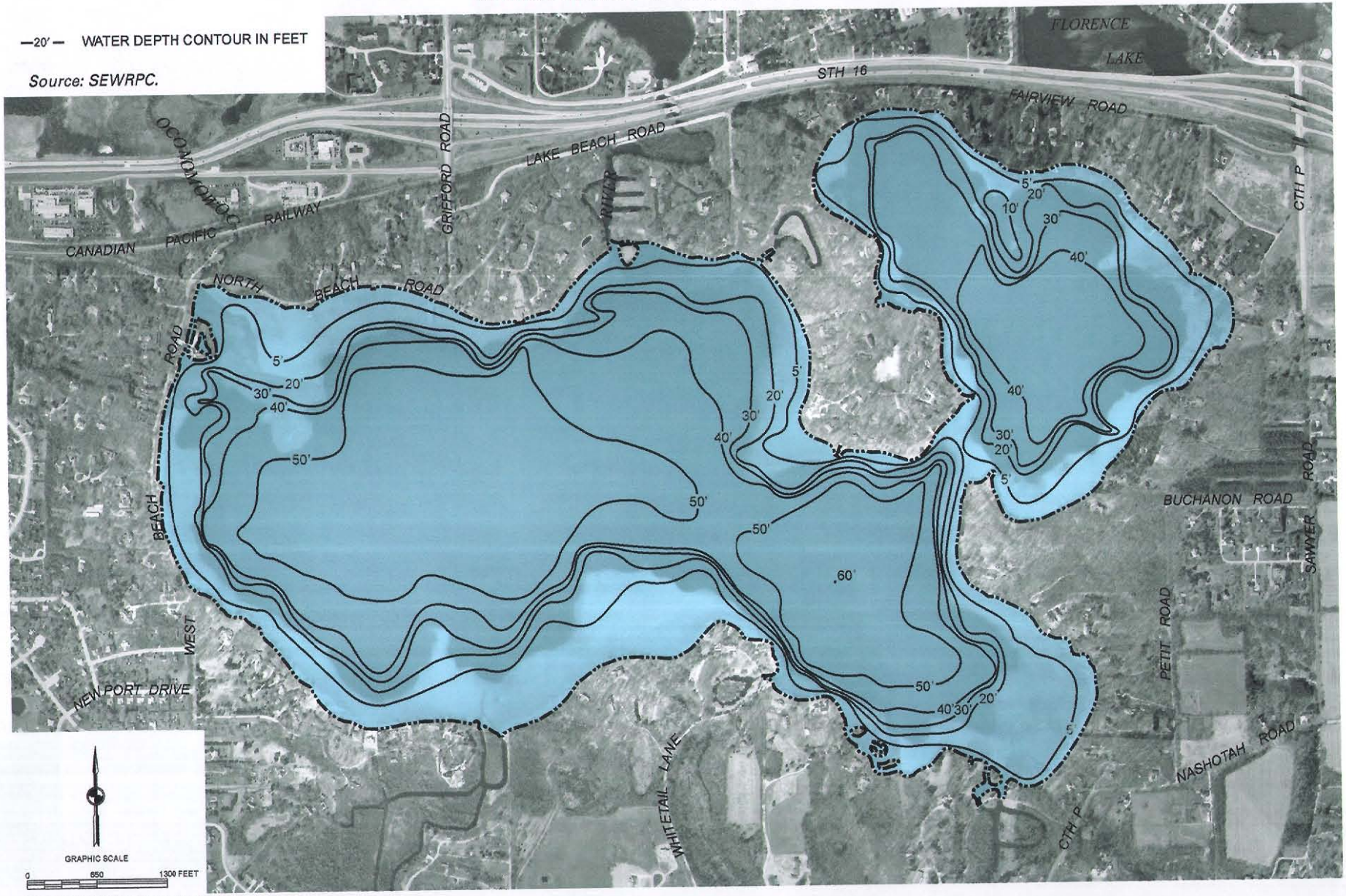
[148] *Wisconsin Conservation Department,* op. cit.

[149] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[150] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Map 52

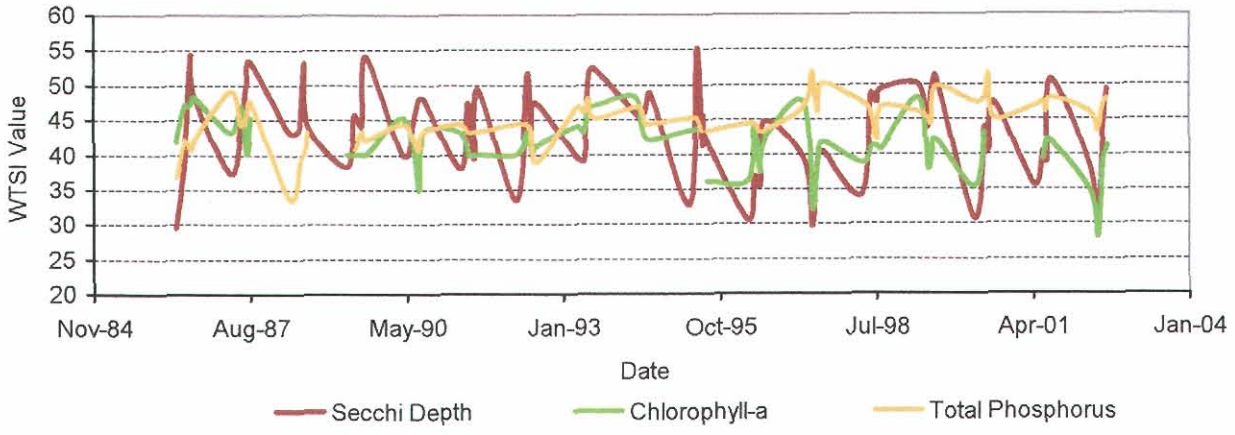
BATHYMETRIC MAP OF OCONOMOWOC LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

Figure 14

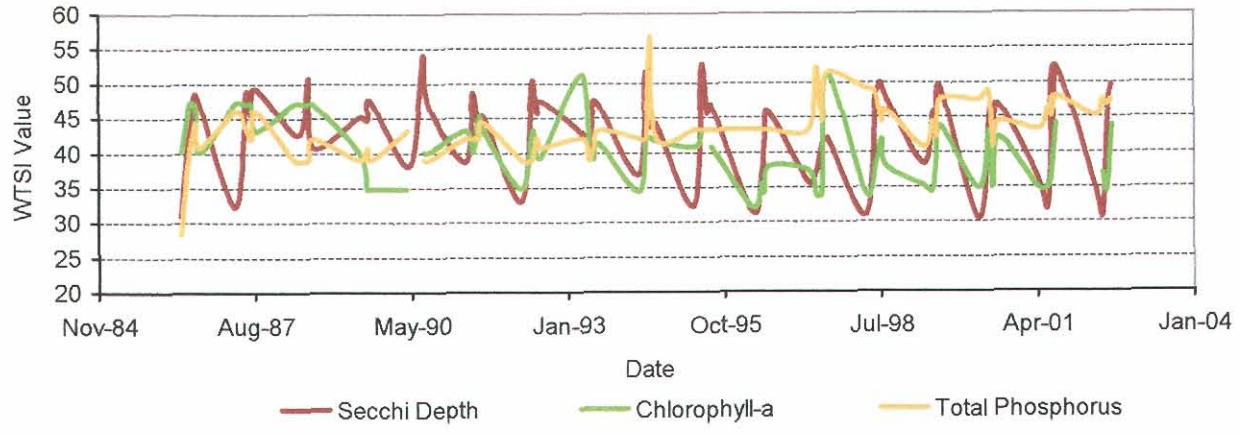
TROPHIC STATE INDEX FOR OCONOMOWOC LAKE CENTER: 1986-2002



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Figure 15

TROPHIC STATE INDEX FOR OCONOMOWOC LAKE HEWITT POINT: 1986-2002



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Oconomowoc Lake during the period 1986 through 2002. A lake management plan was completed for the Lake by SEWRPC in 1990.[151]

Recreational Use
Public access is provided.

Development Potential
As of 1995, the land uses within the approximately 2,300-acre drainage area directly tributary to Oconomowoc Lake consisted of about 40 percent urban land uses and about 60 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised about 790 acres, or about one-third of the land cover in the drainage area. Woodlands, wetlands, and surface waters comprised a further approximately 650 acres, or about 30 percent of the drainage basin directly tributary to the Lake. Of the urban land uses, urban residential lands comprised about 600 acres or about 25 percent of the land cover in the drainage area. Commercial land, utilities, institutional, recreational lands, and transportation and related infrastructure comprised about 270 acres, or the balance of the urban lands within the drainage area. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Oconomowoc Lake is located within the Oconomowoc River basin, a tributary stream to the Rock River drainage system, which extends upstream for about 76 square miles. Within this total tributary drainage area, urban land uses comprise about one-quarter of the area, while rural land uses comprise the balance. Of these, urban residential uses account for about three-fifths of the urban land uses, while rural agricultural lands comprise about one-half of the rural land uses within the total drainage area tributary to Oconomowoc Lake.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Oconomowoc Lake is generated primarily from agricultural lands which comprise about one-third of the total tributary drainage area to Oconomowoc Lake. The Oconomowoc River Priority Watershed Plan recommends reductions in phosphorus loading of 33 percent in the Lake, to restore the Lake to a mesotrophic condition, with a total phosphorus concentration of 0.02 to 0.03 mg/l.[152]

Fish and Wildlife Populations
In 1963, the fishery of Oconomowoc Lake consisted largely of largemouth bass, panfish, and northern pike.[153] Cisco were also reported. Fish surveys conducted in 1967 and 1975 reported the fishery to consist of redhorse, bluegill, common carp, longnose gar, walleyed pike, black bullhead, bluntnose minnow, common shiner, northern pike, warmouth, black crappie, bowfin, green sunfish, pumpkinseed, white sucker, blackchin shiner, brown bullhead, lake chubsucker, rock bass, yellow bullhead, blackstripe topminnow, logperch, least darter, fantail darter, flathead catfish, mimic shiner, banded killifish, pugnose shiner, cisco or lake herring, largemouth bass, smallmouth bass, and yellow perch.[154] The least darter and the banded killifish are listed as State species of special concern. As of 2001, northern pike and largemouth bass were reported to be common in the Lake, and walleyed pike, smallmouth bass, and panfish were reported to be present, the latter being more common in the

[151] *SEWRPC Community Assistance Planning Report No. 181,* A Water Quality Management Plan for Oconomowoc Lake, Waukesha County, Wisconsin, *March 1990; see also SEWRPC Community Assistance Planning Report No. 53, 2nd Edition,* A Water Quality Management Plan for Okauchee Lake, Waukesha County, Wisconsin, *December 2003 (this publication also reports on Lower Okauchee and Upper Oconomowoc Lakes).*

[152] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

[153] *Wisconsin Conservation Department,* op. cit.

[154] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

portion of the Oconomowoc River chain of lakes known as Upper Oconomowoc Lake.[155] Waterfowl make migratory and resident use of the wetlands at the inlet area of the Oconomowoc River and the weedy bays of the Lake are usually a resting place during the fall migration.

Okauchee Lake

Lake Morphometry

Okauchee Lake is located in U.S. Public Land Survey Sections 23, 24, 25, 26, 35, and 36, Township 8 North, Range 17 East, Town of Oconomowoc, and U.S. Public Land Survey Sections 19, 30, and 31, Township 8 North, Range 18 East, Town of Merton, as shown on Maps 17 and 18. The Lake has a surface area of about 1,187 acres, a maximum depth of 94 feet, and a shoreline development factor of 3.10. Okauchee Lake occupies a basin created by a group of ice blocks entrapped in glacial deposits bordering the terminal moraine. Its present level is maintained above the level of the natural lakebed by a dam on the Oconomowoc River. In addition to its irregular shoreline, the lake has five islands, which occupy about 23 acres of the lake basin, and a number of embayments locally known as Tierney Lake, Lower Okauchee Lake, and Upper Oconomowoc Lake. Okauchee Lake is the third lake in the Oconomowoc River chain of lakes, being located downstream of Friess Lake in Washington County and North Lake in Waukesha County, and upstream of Oconomowoc Lake, Fowler Lake and Lac La Belle, all in Waukesha County. The bathymetry of Okauchee Lake is shown on Map 53.

Water Quality

Available water quality data indicate that Okauchee Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a Wisconsin TSI rating of approximately 46 in the main basin of the Lake. The Wisconsin TSI rating increases to between about 49 and 52 in the embayments known as Lower Okauchee Lake and Upper Oconomowoc Lake, respectively. Figure 16 shows the trends in water quality within the main basin of Okauchee Lake during the periods 1972 through 1978, and 1984 through 2002, respectively. A lake management plan was completed for the Lake by SEWRPC in 1991 and was updated in 2003.[156]

Recreational Use

Public access is provided. The Lake has adequate public access pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential

As of 1995, the land uses within the approximately 5,600-acre drainage area directly tributary to Okauchee Lake consisted largely of about 25 percent urban land uses and about 75 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised about 1,900 acres, or about one-third of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 2,000 acres, or about 40 percent of the total land cover. Of the urban land uses, urban residential lands comprised about 1,100 acres, or about 20 percent of the drainage basin. Commercial, industrial, institutional, recreational lands, and transportation and related infrastructure comprised about 500 acres, or the balance of the urban lands within the drainage area directly tributary to Okauchee Lake. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Okauchee Lake is located within the Oconomowoc River basin, a tributary stream to the Rock River drainage system, which extends upstream for about 80 square miles. Within this total tributary drainage area, urban land uses comprise about one-eighth of the area, while rural land uses comprise the balance. Of these, urban residential uses account for about two-thirds of the urban land uses, while rural agricultural lands comprise about three-fifths of the rural land uses within the total drainage area tributary to Okauchee Lake.

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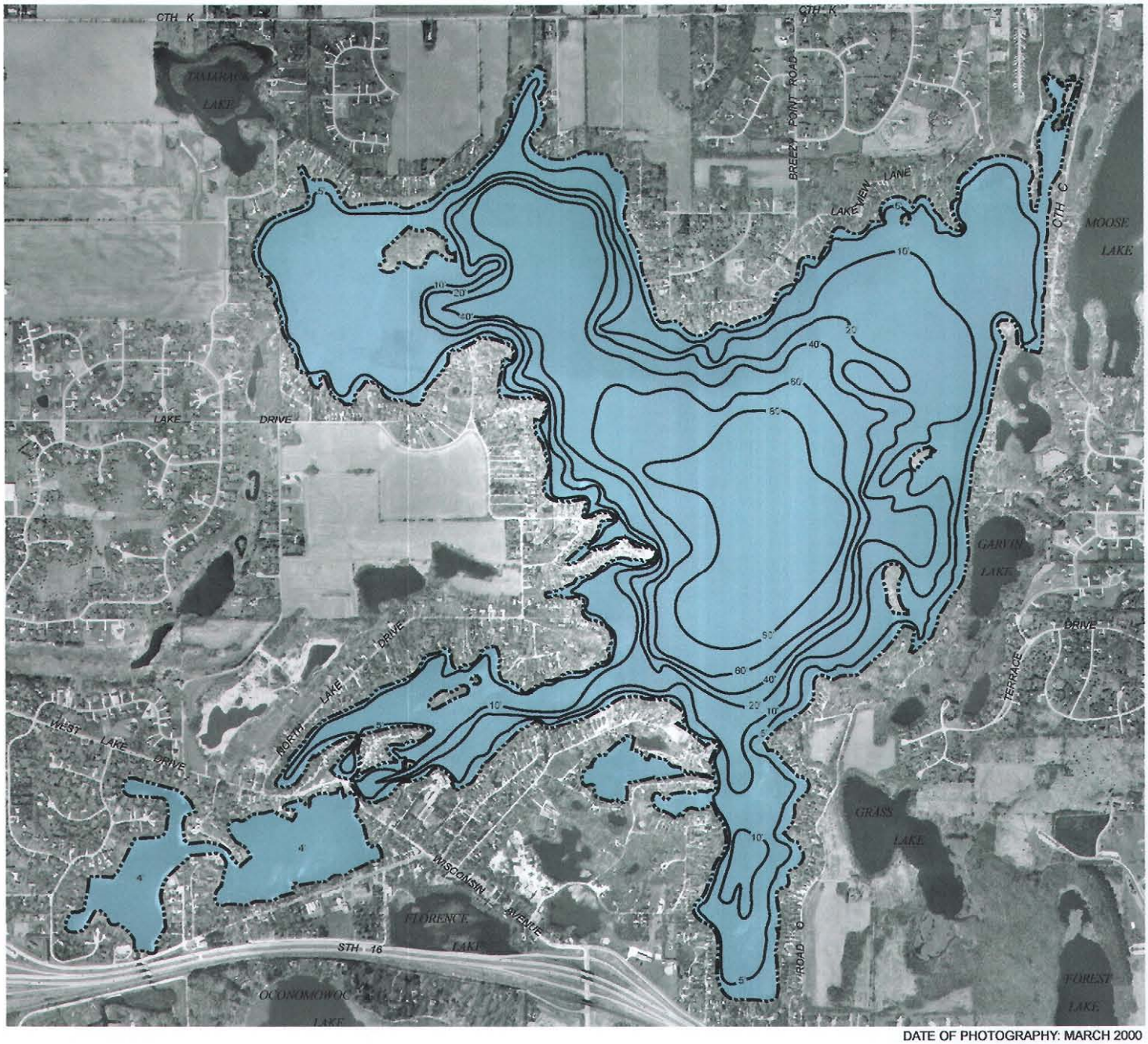
[155] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[156] *SEWRPC Community Assistance Planning Report No. 53,* op. cit.

Map 53

BATHYMETRIC MAP OF OKAUCHEE LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

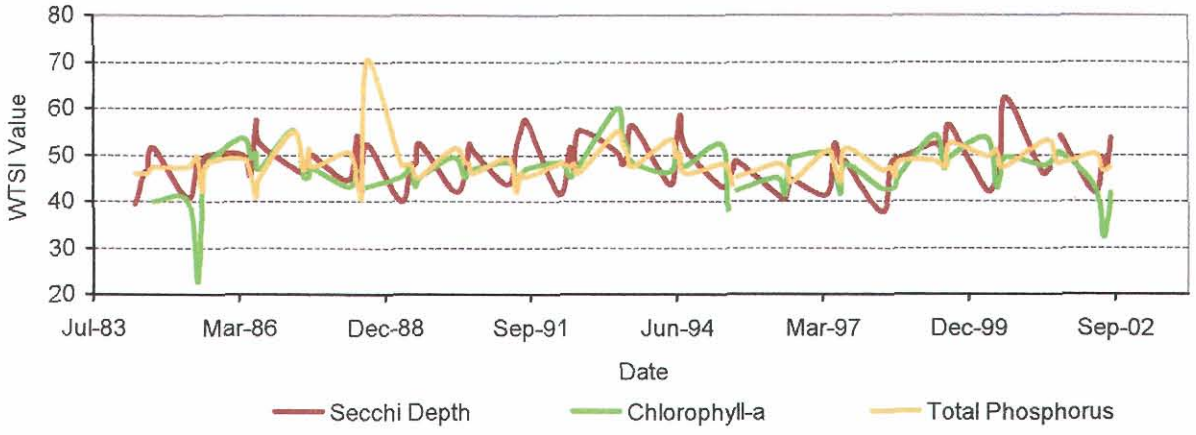
GRAPHIC SCALE

0 1000 2000 FEET

Source: SEWRPC.

Figure 16

TROPHIC STATE INDEX FOR OKAUCHEE LAKE DEEP HOLE: 1994-2002



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Okauchee Lake is generated primarily from rural agricultural lands that comprise about one-half of the land cover within the total drainage basin tributary to Okauchee Lake. The Oconomowoc River Priority Watershed Plan recommends reductions in phosphorus loading of 33 percent in the Lake, to restore the Lake to a mesotrophic condition, with a total phosphorus concentration of 0.02 to 0.03 mg/l.[157] In addition, the plan recommended implementation of urban nonpoint source pollution control measures to limit the impacts of heavy metals and sediment, primarily from construction sites and shoreland erosion, on the Lake and its embayments, including Lower Okauchee Lake and Upper Oconomowoc Lake.

Fish and Wildlife Populations

In 1963, the fishery of Okauchee Lake consisted largely of panfish, northern pike, and largemouth bass.[158] Cisco were also reported. Fish surveys conducted in 1975 and 1979 reported the fishery to consist of black bullhead, cisco or lake herring, grass pickerel, pumpkinseed, yellow perch, black crappie, common carp, green sunfish, rock bass, banded killifish, lake chubsucker, blackchin shiner, pugnose shiner, logperch, rainbow darter, Iowa darter, bluegill, common shiner, largemouth bass, walleyed pike, bowfin, emerald shiner, longnose gar, white sucker, brown bullhead, golden shiner, northern pike, and yellow bullhead.[159] As of 2001, muskie, northern pike, and largemouth bass were reported to be common in the Lake, and walleyed pike, smallmouth bass, and panfish were reported to be present.[160] There are limited wetlands adjoining the Lake. Ducks have been reported by the Wisconsin Department of Natural Resources to inhabit the middle of the Lake during migration.[161]

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[157] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

[158] *Wisconsin Conservation Department,* op. cit.

[159] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[160] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[161] *Wisconsin Conservation Department,* op. cit.

Ottawa Lake (Silver Lake, Lean Lake)

Lake Morphometry

Ottawa Lake is located in U.S. Public Land Survey Section 34, Township 6 North, Range 17 East, Town of Ottawa, as shown on Map 26. The Lake has a surface area of about 28 acres, a maximum depth of 16 feet, and a shoreline development factor of 1.35. Ottawa Lake occupies a remnant glacial lakebed consisting of two depressions connected by deep marsh and shrub swamp. A small outlet stream flows west to a ditching system that drains into the Scuppernong River. The entire shoreline is in public ownership as part of the southern unit of the Kettle Moraine State Forest.

Recreational Use

Public access is provided by a boat launch, beach, and picnic area located in the Ottawa Lake Recreation Area within the State Forest.

Development Potential

As of 1995, the land uses within the approximately 1,700-acre drainage area tributary to the Scuppernong River, within which Ottawa Lake is situated, consisted of about 15 percent urban land uses and about 85 percent rural land uses. Of the rural land uses, wetlands, woodlands, and surface waters comprised about 650 acres, or about 40 percent of the total land cover in the drainage area. Rural agricultural uses comprised about 780 acres, or about 50 percent of the land cover. Of the urban land uses, urban residential land uses comprised about 150 acres, or about 10 percent of the drainage area. Commercial and recreational lands and transportation and related infrastructure comprised about 115 acres, or the balance of the urban land uses within the drainage basin tributary to Ottawa Lake. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Ottawa Lake is generated primarily from agricultural lands which comprise about one-half of the land cover within the drainage basin tributary to Ottawa Lake.

Fish and Wildlife Populations

In 1963, the fishery of Ottawa Lake consisted largely of panfish.[162] Fish surveys conducted in 1978 and 1988 reported the fishery to consist of blackchin shiner, lake chubsucker, green sunfish, yellow bullhead, common shiner, bluntnose minnow, pumpkinseed, bluegill, golden shiner, blacknose shiner, black crappie, rock bass, black bullhead, northern pike, largemouth bass, grass pickerel, walleyed pike, and white sucker.[163] As of 2001, panfish were reported to be common in the Lake, and northern pike, walleyed pike, and largemouth bass were reported to be present.[164] Trout were also reported to be present in the Lake. Waterfowl and upland game birds make extensive migratory and resident use of the wetlands and swamp adjoining the Lake.

Pewaukee Lake

Lake Morphometry

Pewaukee Lake is located in U.S. Public Land Survey Sections 7, 8, 17, and 18, Township 7 North, Range 19 East, City and Village of Pewaukee, and U.S. Public Land Survey Sections 12, 13, 14, 15, 22, 23, and 24, Township 7 North, Range 18 East, Town of Delafield, as shown on Maps 20 and 21. The Lake has a surface area of about 2,493 acres, a maximum depth of 45 feet, and a shoreline development factor of 1.85. Pewaukee Lake is a large dendritic lake created by moraine blocking of a preglacial erosion valley causing impoundment and reversal of drainage.[165] A dam with a six-foot head on the outlet stream, the Pewaukee River, creates more than

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[162]Ibid.

[163]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[164]*Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[165]*Wisconsin Department of Natural Resources Lake Use Report No. FX-2,* Pewaukee Lake, Waukesha County, Wisconsin, *1970.*

half of the current acreage of the Lake, which drains, ultimately, to the Fox River system within Waukesha County. In addition to springs, there are three small tributary streams that contribute to the supply of water to the Lake. The bathymetry of Pewaukee Lake is shown on Map 54.

Water Quality

Available water quality data indicate that Pewaukee Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a Wisconsin TSI rating of approximately 35. Figure 17 shows the trends in water quality within Pewaukee Lake during the period 1972 through 1979. A lake management plan was completed for the Lake by SEWRPC in 1984, and was updated in 2003.[166]

Recreational Use

Pewaukee Lake is the largest lake in Waukesha County, and is considered to have adequate recreational boating access pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*. Public recreational boating access is provided through a County park site at the western extreme of the Lake, while numerous private marinas and boating facilities exist around the Lake. A public swimming beach is located within the Village of Pewaukee at the eastern extreme of the Lake.[167]

Development Potential

As of 1995, the land uses within the approximately 15,700-acre drainage area tributary to Pewaukee Lake consisted of about 35 percent urban land uses and about 65 percent rural land uses. Of the urban land uses, urban residential uses comprised about 3,400 acres, or about 20 percent of the total land cover in the drainage area. Commercial, industrial, institutional, recreational land uses, and transportation and related infrastructure comprised about 1,950 acres, or about 10 percent of the drainage area. Rural agricultural lands comprised about 5,800 acres, or about one-third of the land cover. Woodlands, wetlands, and surface water comprised about 4,600 acres, or the balance of the rural lands within the drainage basin tributary to Pewaukee Lake. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Pewaukee Lake is generated both from urban residential and rural agricultural lands which comprise about three-fifths of the land cover within the drainage basin tributary to Pewaukee Lake. The Upper Fox River Priority Watershed Plan recommends reductions in sediment loading of 50 to 75 percent in the Lake, and application of appropriate land use and development controls to maintain the Lake in a mesotrophic condition, with a total phosphorus concentration of 0.02 to 0.03 mg/l.[168]

Fish and Wildlife Populations

In 1963, the fishery of Pewaukee Lake consisted largely of northern pike, panfish, largemouth bass and walleyed pike.[169] Fish surveys conducted in 1977 and 1981 reported the fishery to consist of green sunfish, muskellunge, northern pike, bluegill, white crappie, yellow bullhead, pumpkinseed, black crappie, black bullhead, bowfin, brown bullhead, lake chubsucker, johnny darter, bluntnose minnow, golden shiner, brook silverside, goldfish, spottail shiner, fathead minnow, creek chub, blackchin shiner, tadpole madtom, emerald shiner, mimic shiner,

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[166] *SEWRPC Community Assistance Planning Report No. 58, 2nd Edition,* A Water Quality Management Plan for Pewaukee Lake, Waukesha County, Wisconsin, *May 2003; see also SEWRPC Memorandum Report No. 56,* A Lakefront Recreational Use and Waterway Protection Plan for the Village of Pewaukee, *March 1996.*

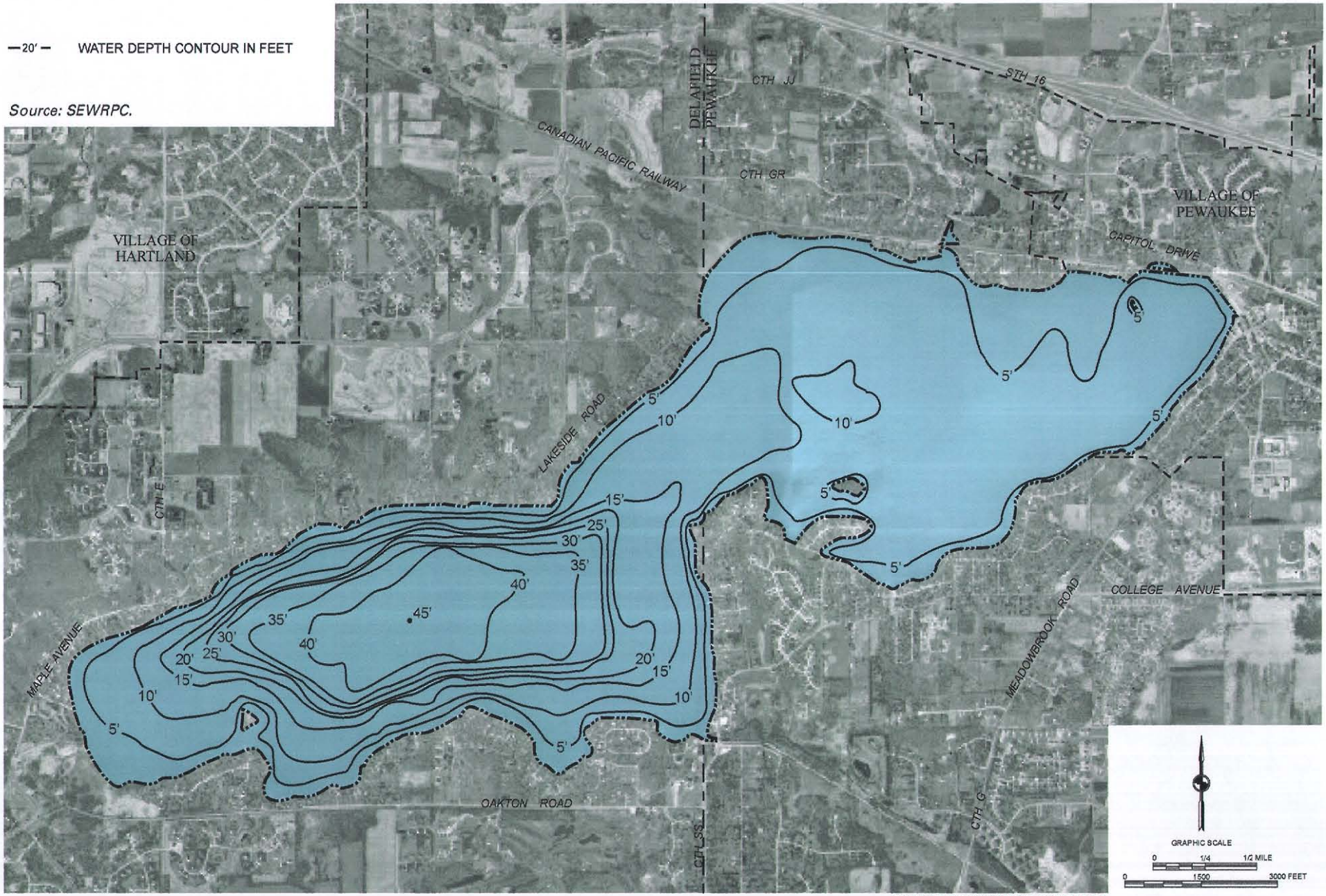
[167] *SEWRPC Memorandum Report No. 56,* op. cit.

[168] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-366 94,* Nonpoint Source Control Plan for the Upper Fox River Priority Watershed Project, *June 1994.*

[169] *Wisconsin Conservation Department,* op. cit.

Map 54

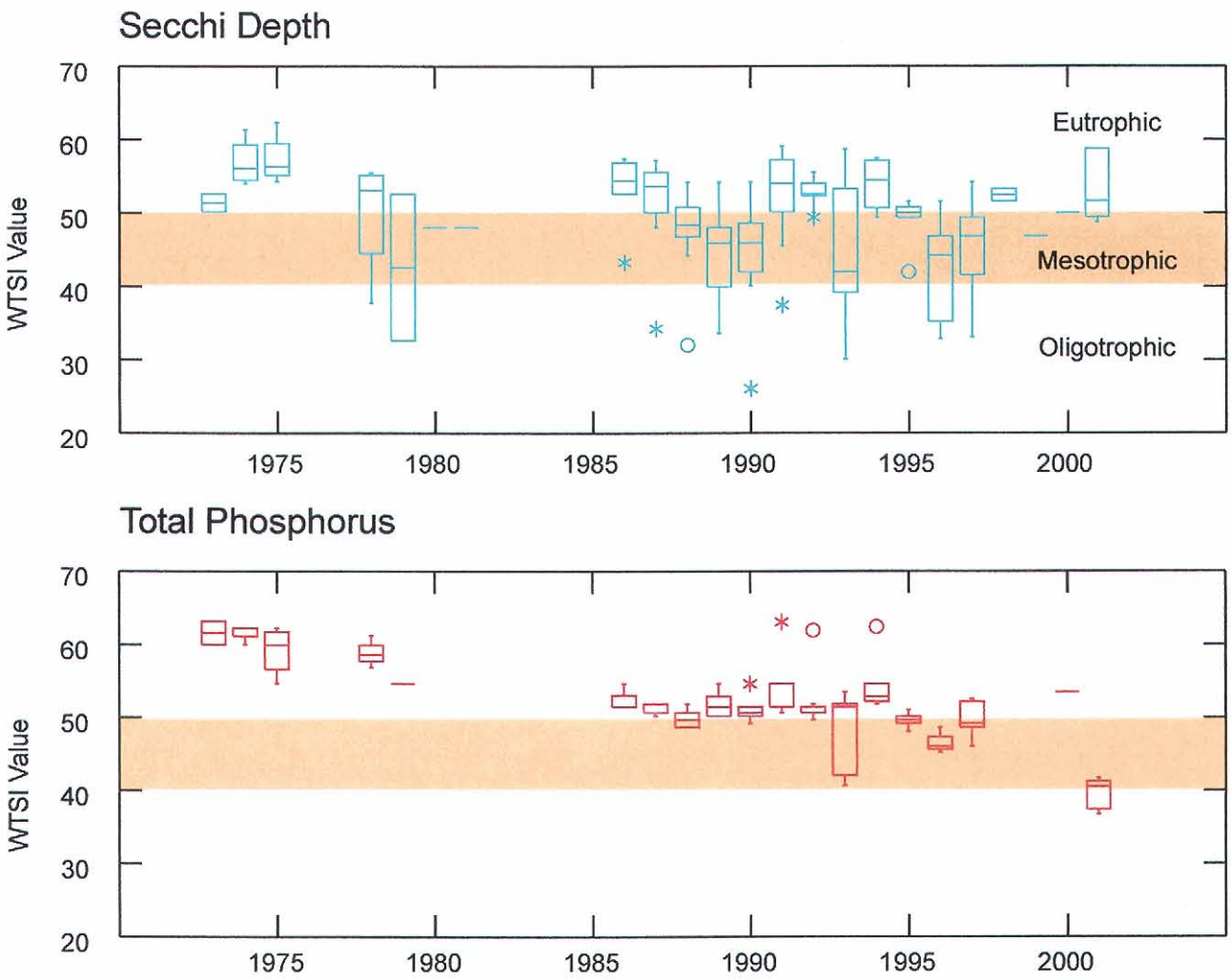
BATHYMETRIC MAP OF PEWAUKEE LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

Figure 17

WISCONSIN TROPHIC STATE INDEX FOR PEWAUKEE LAKE: 1973-2001



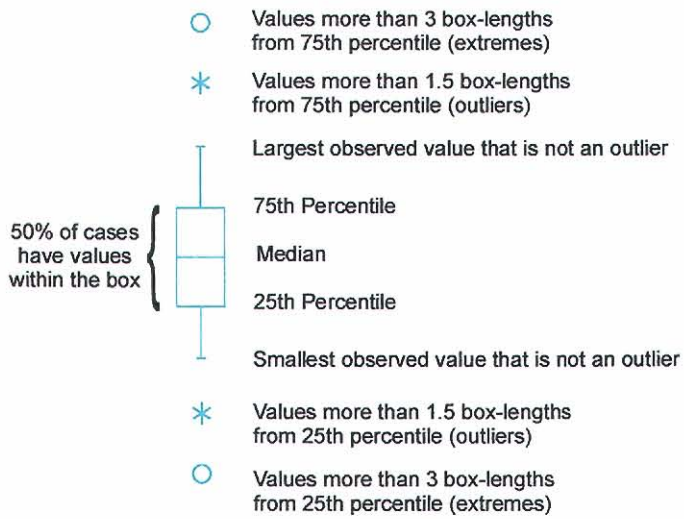
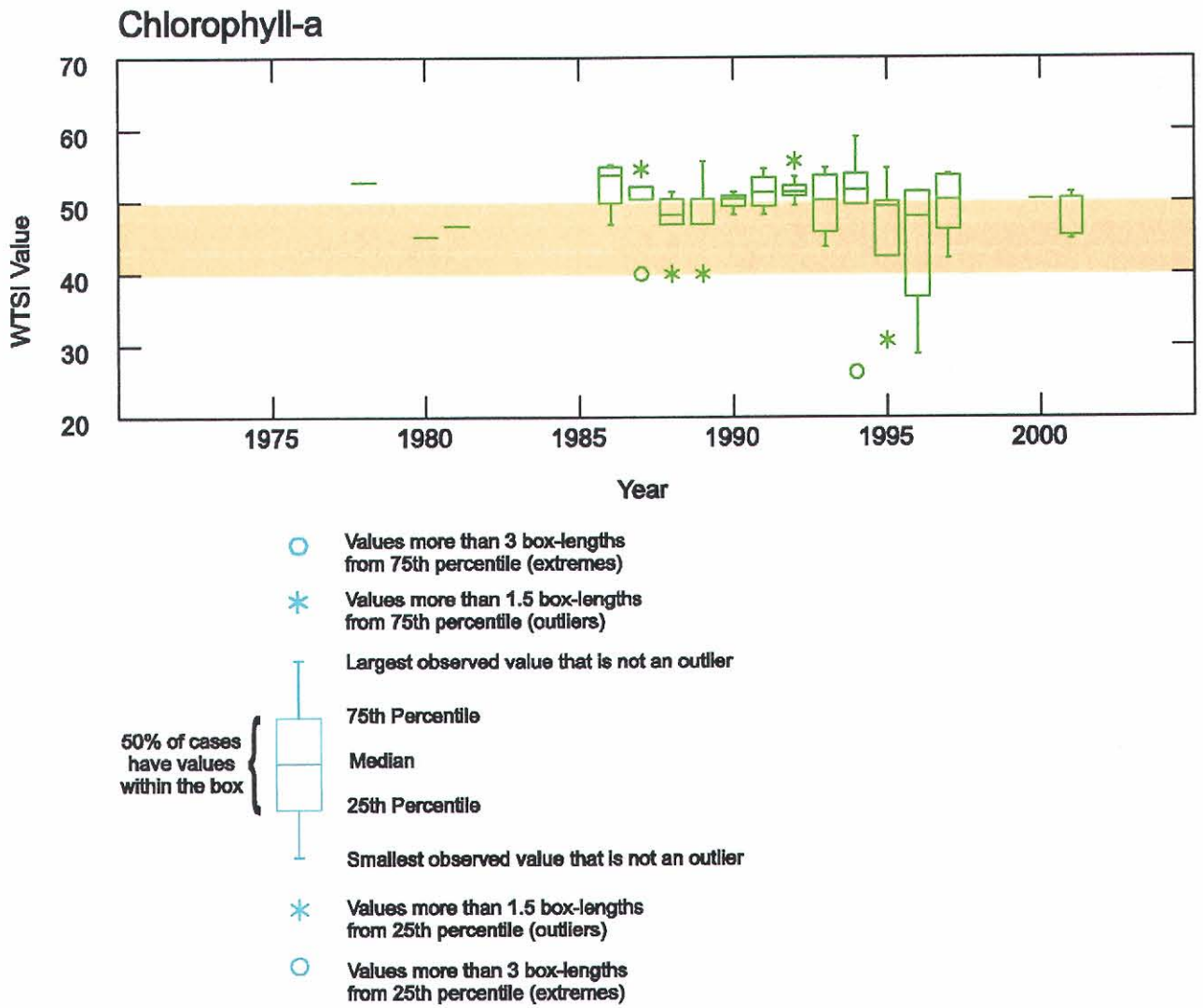


Figure 17 (continued)



Source: Wisconsin Department of Natural Resources and SEWRPC.

pugnose minnow, spotfin shiner, longnose gar, pugnose shiner, banded killifish, blacknose shiner, common carp, white bass, walleyed pike, freshwater drum, largemouth bass, white sucker, and yellow perch.[170] As of 2001, muskie, northern pike, largemouth bass, smallmouth bass, and panfish were reported to be common in the Lake and walleyed pike were reported to be present.[171] More than 1,000 homes border the Lake, limiting the waterfowl nesting and migration areas. Although limited, waterfowl are known to make migratory use of the Lake.

[170] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[171] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Pine Lake

Lake Morphometry

Pine Lake is located in U.S. Public Land Survey Sections 21, 28, 29, 32, and 33, Township 8 North, Range 18 East, and in U.S. Public Land Survey Section 5, Township 7 North, Range 18 East, Village of Chenequa, as shown on Maps 17 and 20. The Lake has a surface area of about 703 acres, a maximum depth of 85 feet, and a shoreline development factor of 1.96. Pine Lake occupies a dendritic basin in the interlobate moraine. The bays, which make up the irregular shore, are smaller adjoining basins. The Lake is primarily spring-fed, although intermittent inflow from Beaver Lake and outflow to Cornell Lake and North Lake occurs. The lake bottom is primarily gravel. The bathymetry of Pine Lake is shown on Map 55.

Water Quality

Available water quality data indicate that Pine Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a Wisconsin TSI rating of approximately 48. An aquatic plant inventory was completed for the Lake by SEWRPC in 1998.[172]

Recreational Use

Public access is provided, and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential

As of 1995, the land uses within the approximately 2,200-acre drainage area directly tributary to Pine Lake consisted of about 25 percent urban land uses and about 75 percent rural land uses. Of the rural land uses, woodlands, wetlands, and surface waters comprised about 1,280 acres, or about 60 percent of the total land cover in the drainage area. Rural agricultural lands comprised about 400 acres, or the balance of the rural land uses in the drainage area. Urban residential lands comprised about 400 acres, or about 20 percent of the land cover. Commercial, industrial, institutional, recreational lands, and transportation and related infrastructure comprised about 140 acres, or the balance of the urban lands within the drainage basin directly tributary to Pine Lake. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Pine Lake is generated primarily from both rural agricultural and urban residential lands which comprise about one-half of the land cover within the total drainage basin tributary to Pine Lake. The Oconomowoc River Priority Watershed Plan recommends implementation of soil erosion and heavy metal control practices, especially along roadways through application of appropriate stormwater management practices, to maintain the Lake in a mesotrophic condition, with a total phosphorus concentration of 0.02 to 0.03 mg/l.[173]

Fish and Wildlife Populations

In 1963, the fishery of Pine Lake consisted largely of panfish, largemouth bass, northern pike, walleyed pike, and cisco.[174] There are no adjoining wetlands. Fish surveys conducted in 1975 and 1984 reported the fishery to consist of cisco or lake herring, golden shiner, yellow perch, bluntnose, minnow, bluegill, logperch, pumpkinseed, brook silverside, largemouth bass, northern pike, banded killifish, mimic shiner, black crappie, lake chubsucker, green sunfish, blackchin shiner, common carp, and blacknose shiner.[175] The banded killifish is listed as a State species

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[172] *SEWRPC Memorandum Report No. 124,* An Aquatic Plant Inventory for Pine Lake, Waukesha County, Wisconsin, *December 1998.*

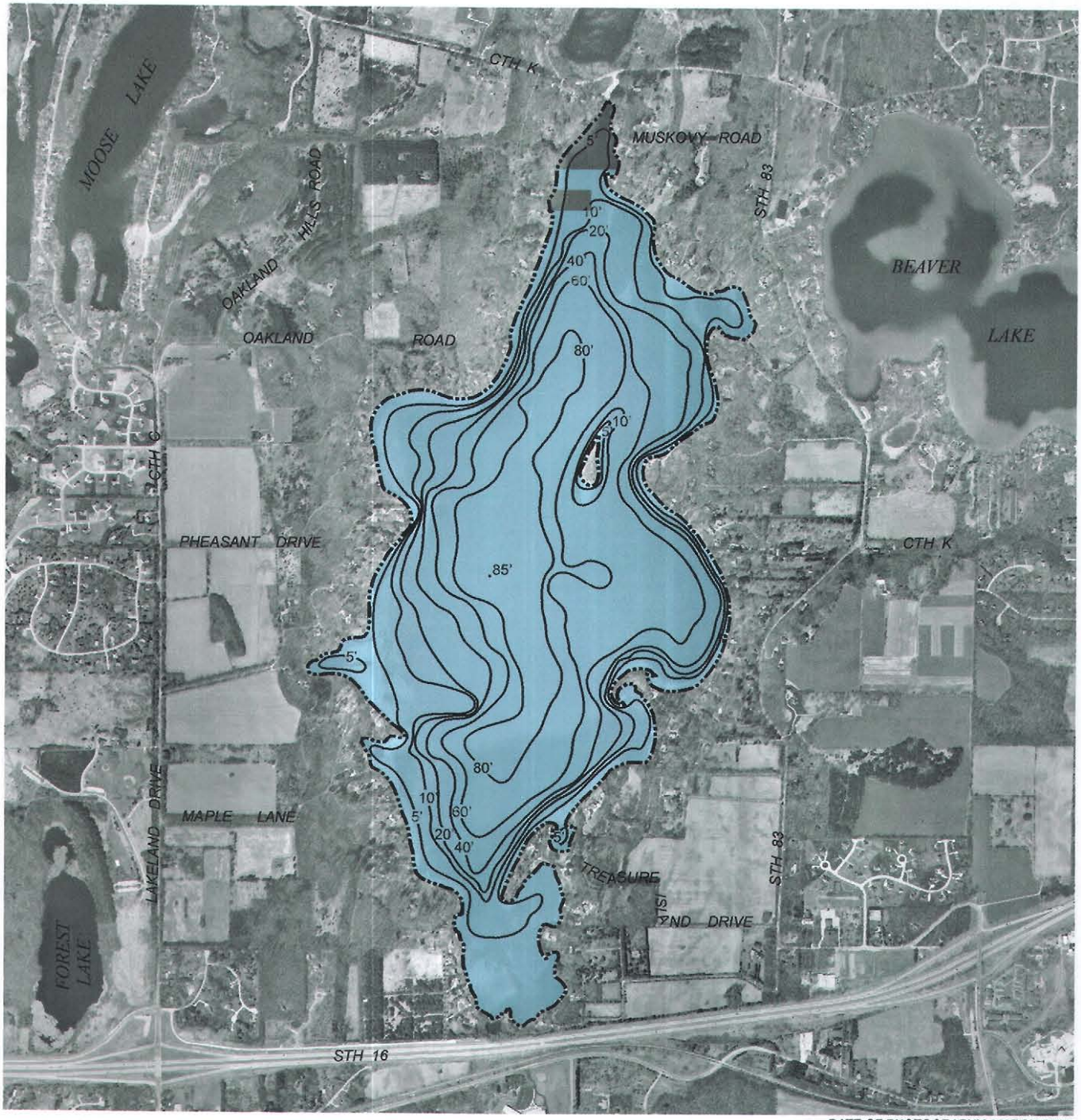
[173] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

[174] *Wisconsin Conservation Department,* op. cit.

[175] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

Map 55

BATHYMETRIC MAP OF PINE LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

Source: SEWRPC.

GRAPHIC SCALE

0 1000 2000 FEET

of special concern. As of 2001, largemouth bass and smallmouth bass were reported to be common in the Lake, and northern pike, walleyed pike, and panfish were reported to be present.[176]

Pretty Lake

Lake Morphometry

Pretty Lake is located in U.S. Public Land Survey Section 28, Township 6 North, Range 17 East, Town of Ottawa, as shown on Map 26. The Lake has a surface area of about 64 acres, a maximum depth of 35 feet, and a shoreline development factor of 1.07. Pretty Lake occupies a remnant basin in one of several depressions of an old glacial lakebed. The bottom is primarily sand. The bathymetry of Pretty Lake is shown on Map 56.

Water Quality

Available water quality data indicate that Pretty Lake is a oligo-mesotrophic waterbody, or moderately enriched waterbody, with a TSI rating of approximately 40. Figure 18 shows the trends in water quality within Pretty Lake during the period 1993 through 1997. A lake protection plan was completed for the Lake by SEWRPC in 1998.[177] Lake levels within Pretty Lake are augmented during low rainfall periods by water pumped into the Lake from the deep sandstone aquifer using a high-capacity pump located on the western shores of the Lake.

Recreational Use

Public access is provided, and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*. Additional access is provided through private access sites.

Development Potential

As of 1995, the land uses within the approximately 170-acre drainage area tributary to Pretty Lake consisted of about 35 percent urban land uses and about 65 percent rural land uses. Of the rural land uses, woodlands, wetlands, and surface waters comprised about 85 acres, or about 50 percent of the total land cover in the drainage area. Rural agricultural lands comprised about 25 acres, or about 15 percent of the total land cover. Urban residential land uses comprised about 55 acres, or about 35 percent of the drainage area. Commercial lands and transportation and related infrastructure comprised about 10 acres, or the balance of the lands within the drainage area. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Pretty Lake is generated primarily from both rural agricultural and urban residential lands, which comprise about one-half of the land cover within the drainage basin tributary to Pretty Lake.

Fish and Wildlife Populations

In 1963, the fishery of Pretty Lake consisted largely of panfish, northern pike, and largemouth bass.[178] Fish surveys conducted in 1976, 1977, and 1978 reported the fishery to consist of black crappie, rock bass, bluegill, walleyed pike, largemouth bass, brown bullhead, pumpkinseed, northern pike, yellow perch, bluntnose minnow, brook silverside, channel catfish, green sunfish, yellow bullhead, white sucker, and warmouth.[179] As of 2001, panfish were reported to be abundant in the Lake, largemouth bass were reported to be common, and northern

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[176] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[177] *SEWRPC Memorandum Report No. 122,* A Lake Protection Plan for Pretty Lake, Waukesha County, Wisconsin, *April 1998.*

[178] *Wisconsin Conservation Department,* op. cit.

[179] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

Map 56

BATHYMETRIC MAP OF PRETTY LAKE

DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

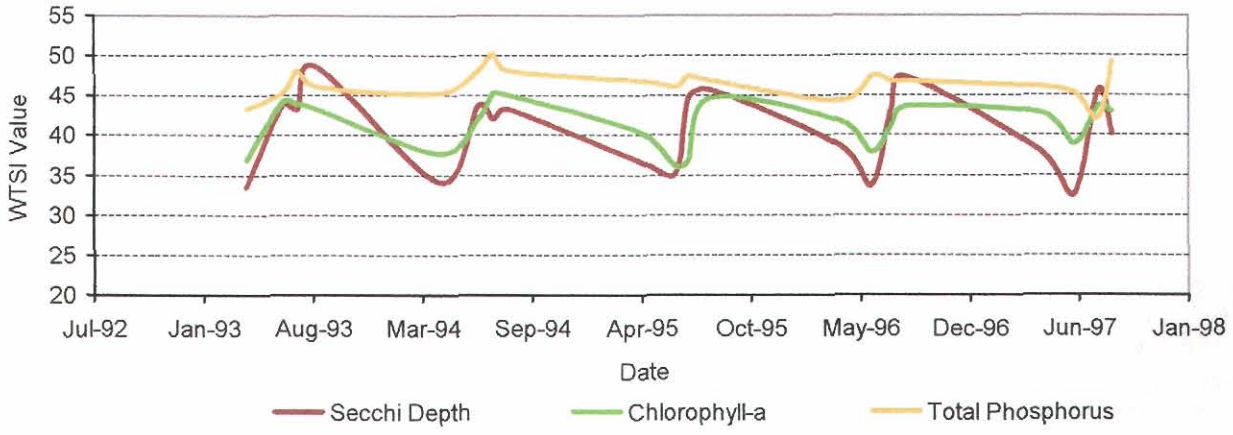
GRAPHIC SCALE

0 300 600 FEET

Source: SEWRPC.

Figure 18

TROPHIC STATE INDEX FOR PRETTY LAKE: 1993-1997



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

pike were reported to be present.[180] The shoreline is completely developed, limiting the use of the Lake by waterfowl and other wildlife, although the proximity of Pretty Lake to the Ottawa Lake Recreation Area within the Kettle Moraine State Forest encourages transient use of the Lake by both waterfowl and wildlife.

Rainbow Springs Lake

Lake Morphometry

Rainbow Springs Lake is located in U.S. Public Land Survey Section 31, Township 5 North, Range 18 East, Town of Mukwonago, as shown on Map 28. The Lake has a surface area of about 25 acres, a maximum depth of 12 feet, and a shoreline development factor of 1.93. Rainbow Springs Lake occupies an irregular marshy valley in glacial deposits. The Lake is located entirely within a golf course and conference center complex. A number of proposals to develop this area into a residential community have been tabled in recent years.

Recreational Use

Rainbow Springs Lake has limited public access as the entire shoreline is in single, private ownership.

Development Potential

As of 1995, the land uses within the approximately 360-acre drainage area tributary to Rainbow Springs Lake consisted of about 20 percent urban land uses and about 80 percent rural land uses. Of the rural land uses, woodlands, wetlands, and surface waters comprised about 240 acres, or about two-thirds of the total land cover in the drainage area. Rural agricultural lands comprised about 40 acres, or about 10 percent of the land cover. Recreational lands and transportation and related infrastructure comprised about 60 acres, or about 20 percent of the drainage area, with urban residential lands comprising about 15 acres, or the balance of the urban lands within the drainage area tributary to Rainbow Springs Lake. The drainage area is not located within an area planned for urban development in the adopted County development plan.

[180] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Rainbow Springs Lake is generated primarily from urban residential and recreational lands, and agricultural lands, which comprise about one-third of the land cover within the drainage basin tributary to Rainbow Springs Lake.

Fish and Wildlife Populations
In 1963, the fishery of Rainbow Springs Lake consisted largely of largemouth bass and panfish.[181] As of 2001, largemouth bass and panfish were reported to be common in the Lake, and northern pike were reported to be present.[182] Waterfowl and marsh fur bearers make migratory and resident use of the adjoining wetlands.

Reagon Lake (Reagons Lake)
Lake Morphometry
Reagon Lake is located in U.S. Public Land Survey Section 22, Township 6 North, Range 17 East, Town of Ottawa, as shown on Map 26. The Lake has a surface area of about 16 acres, a maximum depth of 10 feet, and a shoreline development factor of 1.03. Reagon Lake is a groundwater-fed seepage lake, being a small remnant basin occupying a depression in an old glacial lakebed. The Lake occupies one lobe of an extensive system of shrub swamp and shallow marsh.

Recreational Use
Public access is not available. Reagon Lake has limited public recreational boating access potential due to the location of the Lake within an extensive system of shrub swamp and shallow marsh.

Development Potential
As of 1995, the land uses within the approximately 1,700-acre drainage area tributary to the Scuppernong Creek, within which Reagon Lake is situated, consisted of about 20 percent urban land uses and about 80 percent rural land uses. Of the rural land uses, rural agricultural lands comprised about 670 acres, or about 40 percent of the total land cover in the drainage area. Wetlands, woodlands, and surface waters comprised about 720 acres, or also about 40 percent of the land cover. Urban land uses were comprised of urban residential lands which covered about 145 acres, or about 10 percent of the drainage area, and commercial, industrial, recreational lands, and transportation and related infrastructure which covered about 170 acres, or the balance of the lands within the drainage area. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Reagon Lake is generated primarily from agricultural lands which comprise about two-fifths of the land cover within the drainage area tributary to Reagon Lake.

Fish and Wildlife Populations
In 1963, the fishery of Reagon Lake consisted largely of panfish and largemouth bass.[183] As of 2001, panfish were reported to be common in the Lake, and largemouth bass were reported to be present.[184] Waterfowl make migratory and resident use of the adjoining shrub swamp.

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[181] *Wisconsin Conservation Department,* op. cit.

[182] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[183] *Wisconsin Conservation Department,* op. cit.

[184] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Roxy Pond (Mukwonago Park Pond)

Lake Morphometry

Roxy Pond is located in U.S. Public Land Survey Section 29, Township 5 North, Range 18 East, Town of Mukwonago, as shown on Map 28. The Pond has a surface area of about 17 acres, a maximum depth of three feet, and a shoreline development factor of 1.38. Roxy Pond is a small, elongate lake entirely encompassed by the Mukwonago County Park. The Lake is spring and seepage-fed with a tiled outlet draining to the Mukwonago River. The Pond receives intermittent inflows from the Mukwonago Park Pond.

Recreational Use

Public access is provided through the Mukwonago County Park. Roxy Pond is located entirely within the Mukwonago County Park and is generally navigable by canoe or similar watercraft. A County park system beach provides swimming access to the Pond.

Development Potential

As of 1995, the land uses within the approximately 2,000-acre drainage area tributary to the Mukwonago River, within which Roxy Pond is situated, consisted of about 20 percent urban land uses and about 80 percent rural land uses. Of the rural land uses, rural agricultural uses comprised about 1,200 acres, or about 60 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface water comprised about 430 acres, or about 20 percent of the land cover. Urban residential lands comprised about 120 acres, or about 10 percent of the land cover, with commercial and recreational lands and transportation and related infrastructure comprising about 270 acres, or the balance of the land cover within the drainage basin. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Roxy Pond is generated primarily from rural agricultural lands which comprise about three-fifths of the land cover within the drainage basin tributary to Roxy Pond.

Fish and Wildlife Populations

In 1963, the fishery of Roxy Pond consisted largely of bullheads and northern pike.[185] The Pond was chemically treated in the early 1960s to remove the then existing fish population, and largemouth bass were introduced. As of 2001, largemouth bass were reported to be abundant in the Pond, and northern pike were reported to be present.[186] Waterfowl make limited use of the Pond due to park activity.

Saratoga Lake

Lake Morphometry

Saratoga Lake is located in U.S. Public Land Survey Section 35, Township 7 North, Range 19 East, and U.S. Public Land Survey Sections 1 and 2, Township 6 North, Range 19 East, City of Waukesha, as shown on Maps 21 and 24. The Lake has a surface area of about 24 acres, a maximum depth of six feet, and a shoreline development factor of 4.82. Saratoga Lake is a narrow impoundment on the Fox River within the City of Waukesha. The Lake was created to run a millrace for a flour and feed mill, which has subsequently been removed. A City park occupies most of the frontage.

Recreational Use

Most of the frontage of Saratoga Lake is in public ownership and is used for a river walk and open space uses.

Development Potential

As of 1995, the land uses within the approximately 2,300-acre drainage area directly tributary to Saratoga Lake consisted of about 75 percent urban land uses and about 25 percent rural lands uses. Of the urban land uses,

[185] *Wisconsin Conservation Department,* op. cit.

[186] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

residential land uses comprised about 615 acres, or about 25 percent of the land cover. Commercial, industrial, institutional, and recreational lands, utilities, and transportation and related infrastructure comprised about 1,100 acres, or about 50 percent of the drainage area. Rural land uses were comprised of woodlands, wetlands, and surface waters which encompassed about 640 acres, or about 25 percent of the drainage area tributary to Saratoga Lake. The drainage area is located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Saratoga Lake is generated primarily from urban residential lands and rural agricultural lands which comprise about one-half of the land cover within the total drainage area tributary to Saratoga Lake.

Fish and Wildlife Populations

In 1963, the fishery of Saratoga Lake consisted largely of panfish and northern pike, with channel catfish and smallmouth bass present in lesser abundance.[187] A fish survey conducted in 1978 reported the fishery to consist of yellow perch, northern pike, white sucker, pumpkinseed, common carp, creek chub, rainbow darter, johnny darter, largescale stoneroller, striped shiner, common shiner, black crappie, spottail shiner, yellow bullhead, black bullhead, and rock bass.[188] As of 2001, northern pike, largemouth bass, and panfish were reported to be present in the Lake.[189] Waterfowl make limited use of the Lake due to the extensive use of the park and the urban noise.

Saylesville Millpond

Lake Morphometry

Saylesville Millpond is located in U.S. Public Land Survey Sections 25 and 26, Township 6 North, Range 18 East, Town of Genesee, as shown on Map 25. The Millpond has a surface area of about 45 acres, a maximum depth of four feet, and a shoreline development factor of 1.93. Saylesville Millpond is an impoundment of the Genesee Creek at its confluence with Spring Creek, downstream of the Genesee Millpond and Spring and Willow Spring Lakes. The Millpond was originally created to power a grist mill.

Recreational Use

Saylesville Millpond has limited navigability and is generally navigable only by canoe or similar watercraft. Public access is not available, although access is possible through the inflowing and outflowing streams.

Development Potential

As of 1995, the land uses within the approximately 440-acre drainage area directly tributary to Saylesville Millpond consisted of about 25 percent urban land uses and about 75 percent rural land uses. Of the rural land uses, wetlands, woodlands, and surface waters comprised about 215 acres, or about 50 percent of the total land cover in the drainage area. Rural agricultural uses comprised about 120 acres, or about 30 percent of the land cover. Of the urban land uses, urban residential lands comprised about 85 acres, or about 20 percent of the land cover in the drainage area directly tributary to Saylesville Millpond. Commercial and recreational lands and transportation and related infrastructure comprised about 20 acres, or the balance of the lands in the drainage area. The drainage area is not located within an area planned for urban development in the adopted County development plan.

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[187] *Wisconsin Conservation Department,* op. cit.

[188] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[189] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Saylesville Millpond is generated primarily from agricultural lands which comprise about two-fifths of the land cover within the total drainage area tributary to the Saylesville Millpond.

Fish and Wildlife Populations
In 1963, the fishery of Saylesville Millpond consisted largely of panfish and carp.[190] As of 2001, panfish were reported to be abundant in the Millpond, and largemouth bass and northern pike were reported to be present.[191] Waterfowl make migratory and resident use of the approximately 230 acres of wetlands adjoining the Millpond.

School Section Lake
Lake Morphometry
School Section Lake is located in U.S. Public Land Survey Sections 16 and 17, Township 6 North, Range 17 East, Town of Ottawa, as shown on Map 26. The Lake has a surface area of about 125 acres, a maximum depth of eight feet, and a shoreline development factor of 1.21. School Section Lake occupies a depression in the bed of a minor glacial lake. The bathymetry of School Section Lake is shown on Map 57. In 1938, a dike and spillway were constructed raising the water level four feet. A ditching system created around the Lake has supplemented the natural water supply. One of these ditches created an outlet to the Scuppernong Creek, while others formed an informal and intermittent hydrologic linkage between the upgradient Pretty Lake and downgradient School Section Lake. The Lake was deepened during the late 1990s in order for it to continue to support recreational boating activities. The dam and appurtenances are owned by Waukesha County and provide public access to the Lake.

Recreational Use
Public access is available, and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*. School Section Lake was recently dredged to better accommodate recreational boating traffic.

Development Potential
As of 1995, the land uses within the approximately 250-acre drainage area directly tributary to School Section Lake consisted of about 20 percent urban land uses and about 80 percent rural land uses. Of the rural land uses, woodlands, wetlands, and surface waters comprised about 220 acres, or about 85 percent of the total land cover in the drainage area. Rural agricultural lands comprised a further 10 acres of the balance of the rural lands within the drainage area directly tributary to School Section Lake. Urban land uses were comprised of urban residential lands which extended over about 45 acres, or about 20 percent of the drainage basin, and recreational lands and transportation and related infrastructure which comprised about 10 acres, or the balance of the urban land cover. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to School Section Lake is generated primarily from agricultural lands which comprise about one-third of the land cover within the total drainage area tributary to School Section Lake.

Fish and Wildlife Populations
In 1963, the fishery of School Section Lake is managed for northern pike, largemouth bass, and panfish.[192] Carp were also present, but were not considered a use problem for the Lake. Fish surveys conducted in 1973 and 1977

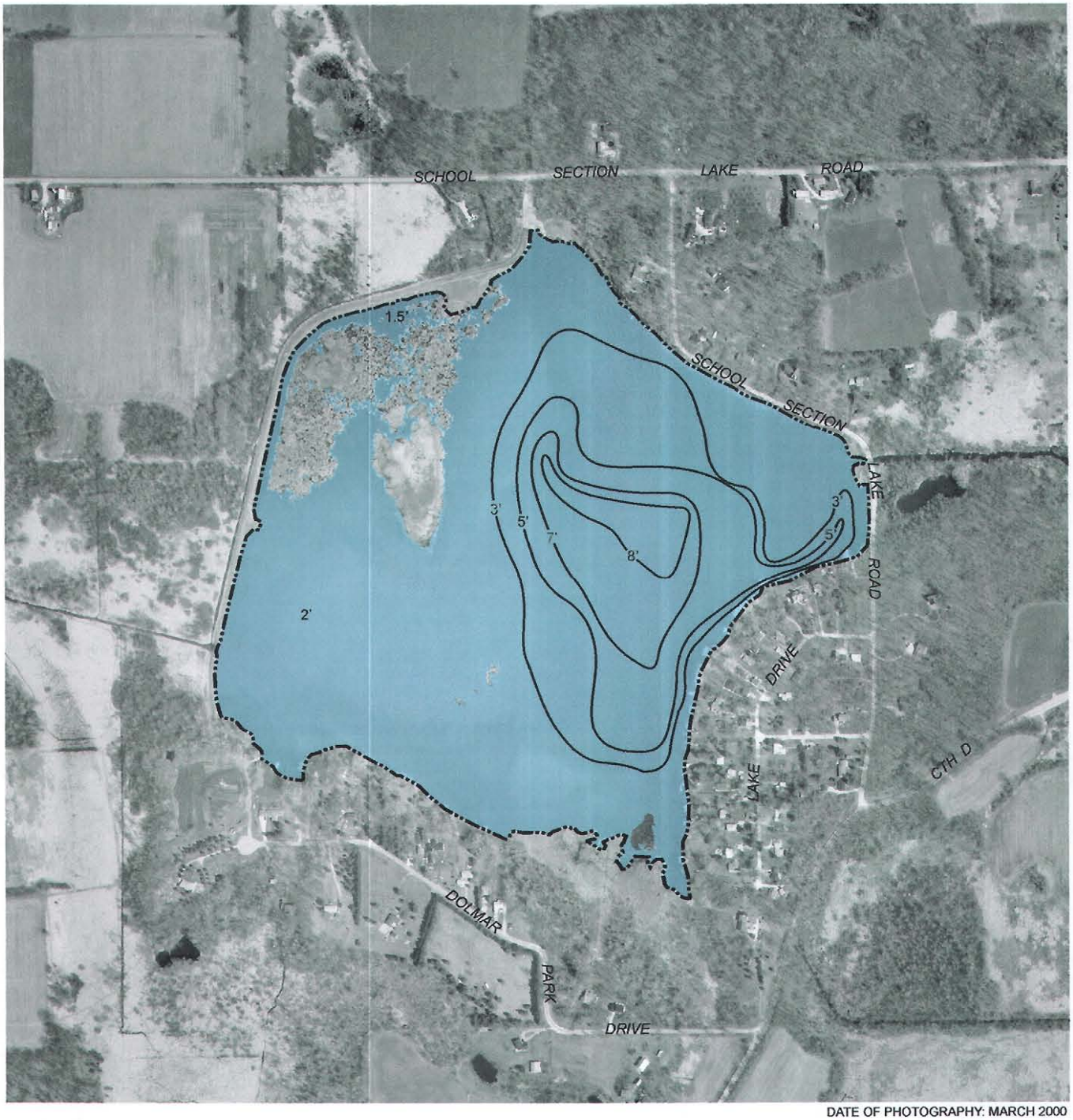
[190] *Wisconsin Conservation Department,* op. cit.

[191] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[192] *Wisconsin Conservation Department,* op. cit.

Map 57

BATHYMETRIC MAP OF SCHOOL SECTION LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

— 5' — WATER DEPTH CONTOUR IN FEET

GRAPHIC SCALE

0 350 700 FEET

Source: SEWRPC.

reported the fishery to consist of bluegill, white sucker, yellow perch, pumpkinseed, green sunfish, bowfin, black bullhead, brown bullhead, northern pike, grass pickerel, black crappie, and largemouth bass.[193] As of 2001, panfish were reported to be abundant in the Lake, and largemouth bass and northern pike were reported to be present.[194]

Scuppernong Creek Pond

Lake Morphometry

Scuppernong Creek Pond is located in U.S. Public Land Survey Section 10, Township 6 North, Range 17 East, Town of Ottawa, as shown on Map 26. The Pond has a surface area of about 20 acres, a maximum depth of five feet, and a shoreline development factor of 1.45. Scuppernong Creek Pond is an impoundment of Scuppernong Creek created to provide hydropower. The Pond is the fourth lake in the chain of lakes along the Scuppernong Creek, the upstream waterbodies including Waterville Lake, Dutchman Lake, and Hunters Lake.

Recreational Use

Public access is available through the right-of-way of a public roadway. Scuppernong Creek Pond has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential

As of 1995, the land uses within the approximately 1,300-acre drainage area directly tributary to Scuppernong Creek Pond consisted of about 20 percent urban land uses and about 80 percent rural land uses. Of the rural land uses, rural agriculture land uses comprised about 550 acres, or about 45 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 460 acres, or about 35 percent of the land cover. Urban residential land comprised about 200 acres, or about 15 percent of the land cover within the drainage area directly tributary to Scuppernong Creek Pond. Commercial and recreational lands and transportation and related infrastructure comprised about 80 acres, or the balance of the urban land uses in the drainage area. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Scuppernong Creek Pond is located within the Scuppernong Creek drainage system, a tributary stream system to the Rock River, which extends upstream for about 18 square miles. Within this total tributary drainage area, rural land uses comprise about two-thirds of the area, while urban land uses comprise the balance. Of these, urban residential uses account for about one-half of the urban land uses, while rural agricultural land uses comprise about two-thirds of the rural lands within the total drainage area tributary to Scuppernong Creek Pond.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Scuppernong Creek Pond is generated primarily from agricultural lands which comprise about 45 percent of the land cover within the total drainage basin tributary to Scuppernong Creek Pond.

Fish and Wildlife Populations

In 1963, the fishery of Scuppernong Creek Pond consisted largely of panfish and northern pike.[195] As of 2001, panfish were reported to be common in the Pond, and northern pike were reported to be present.[196] Waterfowl and upland game birds make migratory and resident use of the adjoining shrub swamp.

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[193] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[194] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[195] *Wisconsin Conservation Department,* op. cit.

[196] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Silver Lake

Lake Morphometry

Silver Lake is located in U.S. Public Land Survey Sections 8, 9, and 16, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 222 acres, a maximum depth of 44 feet, and a shoreline development factor of 1.29. Silver Lake occupies a small depression partially in the terminal moraine. The water is clear and the bottom is primarily sand. The bathymetry of Silver Lake is shown on Map 58.

Water Quality

Available water quality data indicate that Silver Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a TSI value of about 40. Figure 19 shows the trends in water quality within Silver Lake during the period 1992 through 1996. A lake protection plan was completed for the Lake by SEWRPC in 1993.[197]

Recreational Use

Public access is provided. A Boy Scout camp and a resort also make recreational use of the Lake during the summer months.

Development Potential

As of 1995, the land uses within the approximately 1,400-acre drainage area tributary to Silver Lake consisted of about 45 percent urban land uses and about 55 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised about 200 acres or about 15 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 600 acres, or about 40 percent of the land cover. However, a significant amount of the agricultural land in the eastern portion of the drainage area directly tributary to Silver Lake is expected to be converted to urban land uses as part of the Pabst Farms, Inc., development. These lands are expected to be converted to mixed office/commercial land uses adjacent to IH 94 and to medium-density urban residential land uses in the long-term buildout projections. The Pabst Farms, Inc., development will be subject to stormwater management measures set forth in a site-specific stormwater management plan being prepared pursuant to the County ordinance requirements. Of the urban land uses, urban residential land uses comprised about 140 acres, or about 10 percent of the drainage area. Commercial, industrial, institutional, and recreational lands and transportation and related infrastructure comprised about 500 acres, or the balance of the urban lands within the drainage area tributary to Silver Lake. The drainage area is partially located within an area planned for urban development in the adopted County development plan and the riparian community has recently completed a feasibility study for a public sanitary sewerage system.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Silver Lake is generated primarily from both rural agricultural and urban residential lands which comprise about one-quarter of the land cover within the drainage area tributary to Silver Lake. The Oconomowoc River Priority Watershed Plan recommends implementation of onsite sewage treatment system management practices to maintain the Lake in a mesotrophic condition, with a total phosphorus concentration of 0.02 to 0.03 mg/l.[198] Application of appropriate land use and development controls to protect the Lake's water quality was also recommended given the likelihood of future urban development in the drainage area tributary to Silver Lake.

Fish and Wildlife Populations

In 1963, the fishery of Silver Lake consisted largely of largemouth bass and panfish.[199] A fish survey conducted in 1975 reported the fishery to consist of fantail darter, rock bass, spotfin shiner, sand shiner, green sunfish,

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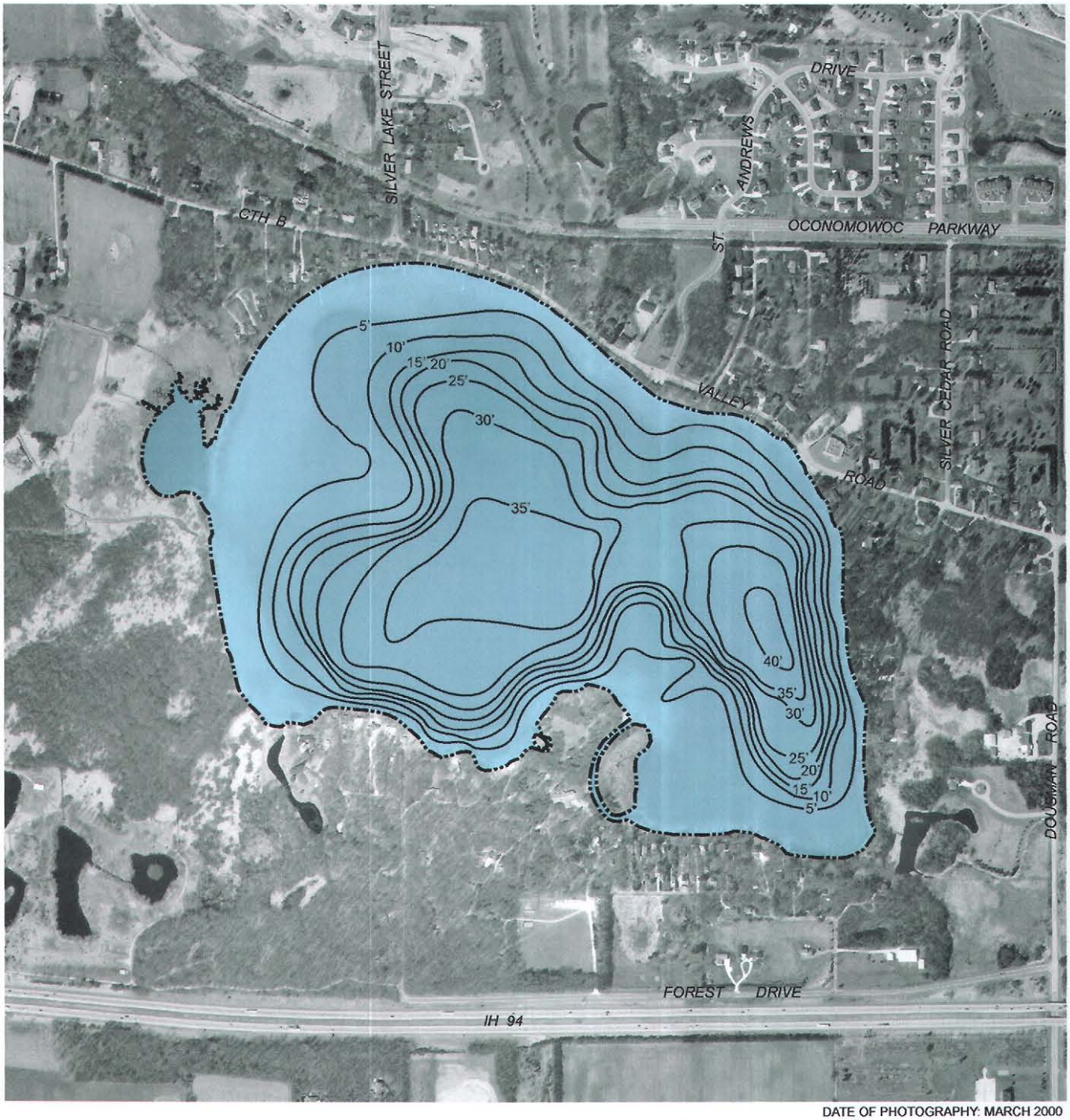
[197] *SEWRPC Memorandum Report No. 82,* A Lake Protection Plan for Silver Lake, Waukesha County, Wisconsin, *July 1993.*

[198] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

[199] *Wisconsin Conservation Department,* op. cit.

Map 58

BATHYMETRIC MAP OF SILVER LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

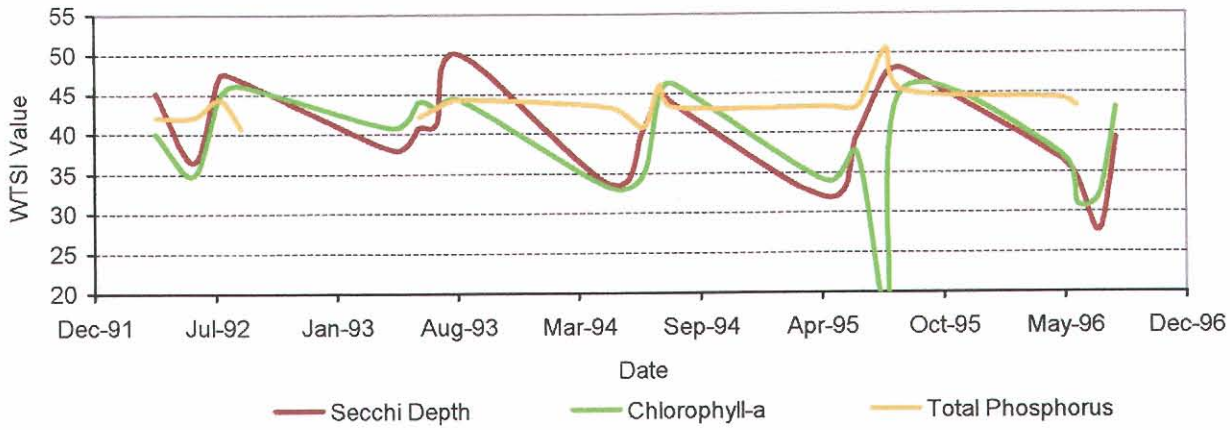
GRAPHIC SCALE

0 450 900 FEET

Source: SEWRPC.

Figure 19

TROPHIC STATE INDEX FOR SILVER LAKE: 1992-1996



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

central mudminnow, blacknose shiner, johnny darter, brook silverside, bluntnose minnow, pumpkinseed, banded killifish, largemouth bass, rainbow darter, yellow perch, and mimic shiner.[200] The banded killifish is listed as a State species of special concern. As of 2001, panfish and largemouth bass were reported to be common in the Lake and northern pike and walleyed pike were reported to be present.[201] Waterfowl make migratory and resident use of the wetlands adjoining the western shore of the Lake. In 1943, a wildlife refuge was suggested for this area, but was not implemented.

Spahn Lake

Lake Morphometry

Spahn Lake is located in U.S. Public Land Survey Section 25, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about four acres, a maximum depth of five feet, and a shoreline development factor of 1.18. Spahn Lake occupies a small kettle in drift deposits south of Lower Nemahbin Lake. Over 80 percent of the Lake is reported by the Wisconsin Department of Natural Resources to be less than three feet deep.[202] The bottom is primarily muck.

Recreational Use

Public access is not available. Spahn Lake has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential

As of 1995, the land uses within the approximately 730-acre drainage area tributary to the Bark River, within which Spahn Lake is situated, consisted of about 30 percent urban land uses and about 70 percent rural land uses. Of the rural land uses, agricultural land uses comprise about 270 acres, or about 40 percent of the total land cover

[200] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[201] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[202] *Wisconsin Conservation Department,* op. cit.

in the drainage area. Woodlands, wetlands, and surface waters comprised about 260 acres, or about 35 percent of the land cover. Urban land uses were comprised of urban residential lands which extended over about 85 acres, or about 10 percent of the drainage area, with the balance being comprised of commercial, industrial, recreational lands and transportation and related infrastructure which comprised about 115 acres. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Spahn Lake is generated primarily from both rural agricultural lands and urban residential lands which comprise about one-half of the land cover within the drainage area tributary to Spahn Lake.

Fish and Wildlife Populations
In 1963, the fishery of Spahn Lake was reported to be nonexistent due to generally shallow conditions.[203]

Spring Lake
Lake Morphometry
Spring Lake is located in U.S. Public Land Survey Sections 4 and 9, Township 5 North, Range 18 East, Town of Mukwonago, as shown on Map 28. The Lake has a surface area of about 105 acres, a maximum depth of 22 feet, and a shoreline development factor of 1.57. Spring Lake is an Outstanding Resource Water of the State pursuant to Chapter NR 102 of the *Wisconsin Administrative Code*. The Lake occupies a small basin in the terminal moraine.[204] Spring Creek forms the outlet from the Lake and flows into Willow Spring Lake through a marshy valley to the north of the Lake. The Creek drains to Genesee Creek and ultimately to the Fox River drainage system. The bathymetry of Spring Lake is shown on Map 59.

Water Quality
A lake protection plan has been prepared for the Lake by SEWRPC.[205]

Recreational Use
Public access is available, but the site is not maintained. Public recreational boating access is not considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential
As of 1995, the land uses within the approximately 3,100-acre drainage area tributary to Spring Lake consisted of about 30 percent urban land uses and about 70 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised about 1,100 acres, or about 35 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 1,000 acres, or about a further 35 percent of the land cover. Urban residential lands comprised about 450 acres, or about 15 percent of the drainage area. Commercial, institutional, and recreational lands and transportation and related infrastructure comprised about 200 acres, or the balance of the land uses in the drainage basin tributary to Spring Lake. The drainage area is not located within an area planned for urban development in the adopted County development plan.

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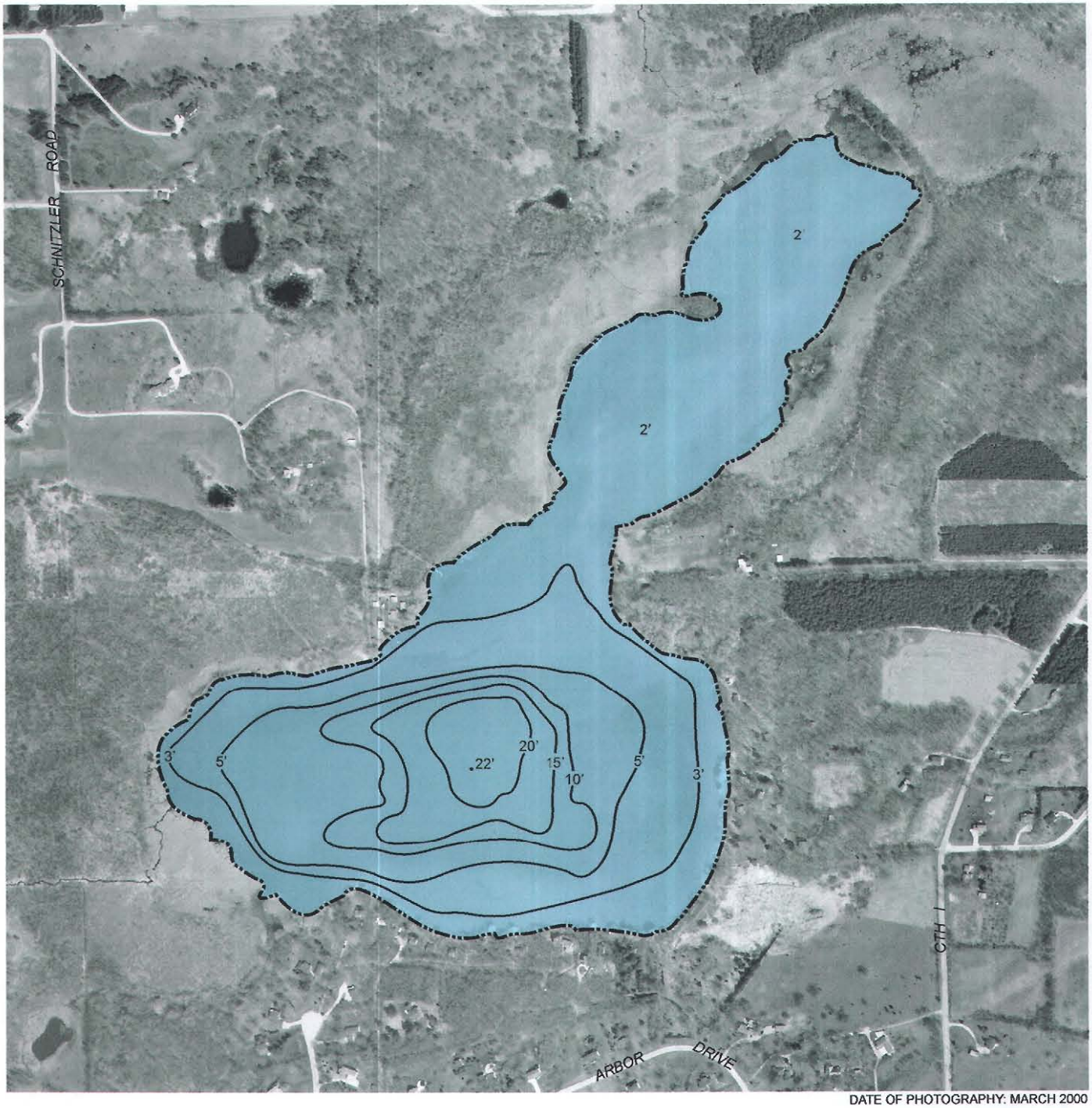
[203]Ibid.

[204]*Wisconsin Department of Natural Resources Lake Use Report No. FX-34,* Spring Lake, Waukesha County, Wisconsin, *1969.*

[205]*SEWRPC Memorandum Report No. 149,* A Lake Protection Plan for Spring and Willow Spring Lakes, Waukesha County, Wisconsin, *August 2004.*

Map 59

BATHYMETRIC MAP OF SPRING LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

GRAPHIC SCALE
0 350 700 FEET

Source: SEWRPC.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Spring Lake is generated primarily from both rural agricultural lands and urban residential lands that comprise about three-fifths of the land cover in the drainage area tributary to Spring Lake.

Fish and Wildlife Populations
In 1963, the fishery of Spring Lake consisted largely of panfish.[206] As of 2001, panfish were reported to be common in the Lake, and northern pike, largemouth bass, and smallmouth bass were reported to be present.[207] Waterfowl and upland game birds make migratory and resident use of the wetlands adjoining the Lake.

Spring Lake (Dousman Lake)
Lake Morphometry
Spring Lake is located in U.S. Public Land Survey Section 3, Township 6 North, Range 17 East, Village of Dousman, as shown on Map 26. The Lake has a surface area of about 14 acres, a maximum depth of eight feet, and a shoreline development factor of 1.25. Spring Lake occupies a small, shallow drift basin. The water is clear and much of the bottom consists of muck-marl material.

Recreational Use
Public access is not available.

Development Potential
As of 1995, the land uses within the approximately 590-acre drainage area tributary to Spring Lake consisted of about 50 percent urban land uses and about 50 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised about 70 acres, or about 10 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 240 acres, or about 40 percent of the land cover. Urban residential lands comprised about 140 acres, or about 25 percent of the drainage area tributary to Spring Lake, while commercial, industrial, institutional, and recreational lands and transportation and related infrastructure comprised the balance of about 140 acres. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Spring Lake is generated primarily from urban residential lands which comprised about one-quarter of the land cover within the drainage basin tributary to Spring Lake.

Fish and Wildlife Populations
In 1963, the fishery of Spring Lake was reported to be absent due to fluctuating water levels and presumed winterkill.[208] Waterfowl were reported to make limited migratory and resident use of the adjoining wetlands, however, much of this land has been converted to urban residential uses.

Sybil Lake
Lake Morphometry
Sybil Lake is located in U.S. Public Land Survey Section 28, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about two acres and a shoreline development factor of 1.38. Sybil Lake is a small kettle lake in the interlobate moraine. There is no inlet or outlet to the Lake which is part of an extensive wetland complex forming the headwaters of Battle Creek, a tributary stream system to the Rock River drainage basin.

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[206] *Wisconsin Conservation Department,* op. cit.

[207] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[208] *Wisconsin Conservation Department,* op. cit.

Recreational Use
Public access is not provided. Sybil Lake has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately 1,300-acre drainage area tributary to Battle Creek, within which Sybil Lake is situated, consisted of about 10 percent urban land uses and about 90 percent rural land uses. Of the rural land uses, wetlands, woodlands, and surface waters comprised about 525 acres, or about 40 percent of the total land cover in the drainage area. Rural agricultural lands comprised about 670 acres, or about 50 percent of the total land cover. Urban residential lands comprised about 35 acres, or less than 5 percent of the land cover within the drainage basin. Commercial, industrial, and recreational lands and transportation and related infrastructure comprised about 50 acres, or the balance of the urban lands within the drainage basin tributary to Sybil Lake. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Sybil Lake is generated primarily from agricultural lands which comprise about one-half of the land cover within the drainage area tributary to Sybil Lake.

Fish and Wildlife Populations
In 1963, the fishery of Sybil Lake consisted largely of panfish.[209] Winterkill and stunted fish were reported by the Wisconsin Department of Natural Resources to limit the fishery. Waterfowl make migratory and resident use of the adjoining wetlands.

Tierney Lake (Tierney Bay)
Lake Morphometry
Tierney Lake is located in U.S. Public Land Survey Section 36, Township 8 North, Range 17 East, Town of Oconomowoc, as shown on Map 18. The Lake has a surface area of about 15 acres, a maximum depth of five feet, and a shoreline development factor of 1.11. Tierney Lake occupies a small kettle in the terminal moraine on the south shore of Okauchee Lake, and is generally considered to be an embayment of that Lake.

Upper Genesee Lake (Otis Lake)
Lake Morphometry
Upper Genesee Lake is located in U.S. Public Land Survey Section 22, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 37 acres, a maximum depth of 27 feet, and a shoreline development factor of 1.33. Upper Genesee Lake is a groundwater-fed seepage lake occupying a depression in outwash deposits within the Bark River Valley. An extensive wetland complex link this lake with the downgradient Middle Genesee Lake, located to the southwest, and provides an intermittent watercourse linking these two waterbodies.

Recreational Use
Public access is limited to nonmotorized, carry-in vessels.

Development Potential
As of 1995, the land uses within the approximately 680-acre drainage area directly tributary to Upper Genesee Lake consisted of 10 percent urban land uses and about 90 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised about 470 acres, or about 70 percent of the total land cover in the drainage area. However, a significant amount of the agricultural land in the northern portion of the drainage area directly tributary to Upper Genesee Lake is expected to be converted to urban land uses as part of the Pabst Farms, Inc., development. These lands are expected to be converted to mixed office/commercial land uses adjacent to IH 94

[209]Ibid.

and to medium-density urban residential land uses in the long-term buildout projections. The Pabst Farms, Inc., development will be subject to stormwater management measures set forth in site-specific stormwater management plans being prepared pursuant to the County ordinance requirements. Woodlands, wetlands, and surface waters comprised the balance of the rural lands within the drainage basin tributary to Upper Genesee Lake and covered about 140 acres. Urban residential lands comprised about 25 acres, or about 5 percent of the drainage area. Commercial, institutional, and recreational lands, and transportation and related infrastructure comprised about 50 acres or the balance of the urban lands within the drainage area. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Upper Genesee Lake is generated primarily from rural agricultural lands which comprise about three-quarters of the land cover within the drainage basin tributary to Upper Genesee Lake. However, this drainage area is urbanizing as development continues to occur in the drainage basin tributary to the Lake.

Fish and Wildlife Populations

In 1963, the fishery of Upper Genesee Lake consisted largely of panfish, primarily yellow perch.[210] Fish surveys conducted in 1975 and 1980 reported the fishery to consist of bluntnose minnow, green sunfish, black crappie, yellow perch, pumpkinseed, largemouth bass, yellow bullhead, bluegill, northern pike, warmouth, johnny darter, central mudminnow, Iowa darter, least darter, mimic shiner, and blacknose shiner.[211] The least darter is listed as a State species of special concern. As of 2001, panfish were reported to be abundant in the Lake, with largemouth bass and northern pike being reported as common.[212] Wildlife populations make limited use of the area due to heavily traveled county and interstate trunk highways bordering the Lake.

Upper Kelly Lake

Lake Morphometry

Upper Kelly Lake is located in U.S. Public Land Survey Section 36, Township 6 North, Range 20 East, City of New Berlin, in Waukesha County, and in U.S. Public Land Survey Section 31, Township 6 North, Range 21 East, Village of Hales Corners, in Milwaukee County, as shown on Map 23. The Lake has a surface area of about 12 acres, a maximum depth of 31 feet, and a shoreline development factor of 1.14. Upper Kelly Lake occupies a marshy valley in glacial drift in the headwater reaches of the Root River system draining to Lake Michigan. The bathymetry of Upper Kelly Lake is shown on Map 44.

Water Quality

Available water quality data indicate that Upper Kelly Lake is an eutrophic waterbody, or relatively enriched waterbody, with a Wisconsin TSI rating of approximately 60. A lake protection plan was completed for the Lake by SEWRPC in 2000.[213]

Recreational Use

Public access is provided. As of 2000, the Kelly Lakes Association, Inc., in cooperation with the City of New Berlin and Village of Hales Corners, has developed a plan for provision of additional parking space for transient recreational users and for the acquisition of shoreland wetlands for conservation purposes within the Waukesha

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[210]Ibid.

[211]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[212]*Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[213]*SEWRPC Memorandum Report No. 135,* A Lake Protection Plan for the Kelly Lakes, Milwaukee and Waukesha Counties, Wisconsin, *October 2000.*

County portion of the Lakes.[214] In addition, the City of New Berlin and the Wisconsin Department of Natural Resources have proposed to place a fishing pier at the southern extreme of the Lake, within the City of New Berlin parklands.

Development Potential
As of 1995, the land uses within the approximately 980-acre drainage area tributary to Upper Kelly Lake consisted of about 60 percent urban land uses and about 40 percent rural land uses. Of the urban land uses, urban residential land uses comprised about 500 acres, or about 50 percent of the total land cover in the drainage area. Commercial, institutional, and recreational lands and transportation and related infrastructure comprised about 75 acres, or the balance of the urban land cover. Rural agricultural lands comprised about 150 acres, or about 15 percent of the drainage area. Wetlands, woodlands, and surface waters comprised the balance of the rural land cover of about 250 acres. The drainage area is located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Upper Kelly Lake is generated primarily from urban residential lands that comprise about one-half of the land cover within the drainage area tributary to Upper Kelly Lake.

Fish and Wildlife Populations
In 1963, the fishery of Upper Kelly Lake consisted largely of largemouth bass and panfish.[215] A fish survey conducted in 1969 reported the fishery to consist of black crappie, grass pickerel, warmouth, bluegill, largemouth bass, yellow bullhead, bluntnose minnow, northern pike, yellow perch, common carp, pumpkinseed, golden shiner, and rock bass.[216] As of 2001, panfish were reported to be abundant in the Lake with largemouth bass also reported to be present.[217] Waterfowl make limited use of the Lake due to its urban location.

Upper Nashotah Lake
Lake Morphometry
Upper Nashotah Lake is located in U.S. Public Land Survey Sections 1 and 12, Township 7 North, Range 17 East, Town of Summit and City of Delafield, as shown on Map 19. The Lake has a surface area of about 133 acres, a maximum depth of 53 feet, and a shoreline development factor of 1.42. The bathymetry of Upper Nashotah Lake is shown on Map 60. Upper Nashotah Lake is the uppermost of a chain of four lakes bordering the terminal moraine and outwash deposits. This chain of lakes parallels the interlobate moraine and includes Upper and Lower Nashotah Lakes and Upper and Lower Nemahbin Lakes. The Lake is a groundwater-fed seepage lake with no inlet and a seasonal outlet to Lower Nashotah Lake. The outlet was impounded in 1925 and about a two-foot difference in water level elevation above that which would naturally occur is maintained in Upper Nashotah Lake.

Recreational Use
Public access is provided by the right-of-way of CTH B on the southern shore of the Lake.

Development Potential
As of 1995, the land uses within the approximately 990-acre drainage area tributary to the Bark River, within which Upper Nashotah Lake is situated, consisted of about 45 percent urban land uses and about 55 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised 80 acres, or about 10 percent of the total

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[214]Ibid.

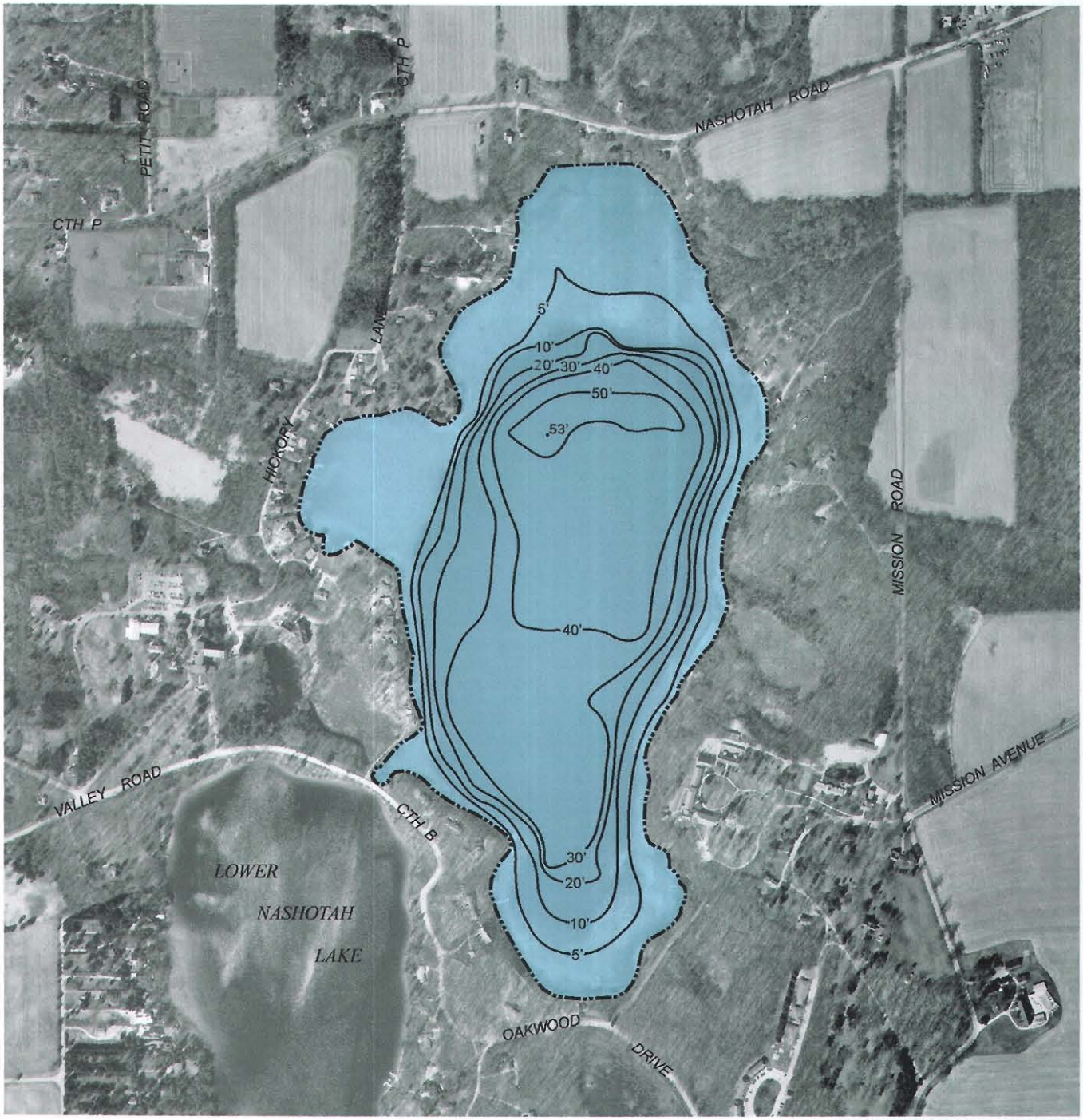
[215]*Wisconsin Conservation Department,* op. cit.

[216]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[217]*Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

Map 60

BATHYMETRIC MAP OF UPPER NASHOTAH LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

Source: SEWRPC.

GRAPHIC SCALE

0 400 800 FEET

land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 460 acres, or about 50 percent of the land cover. Urban residential land uses comprised about 475 acres, or about 30 percent of the drainage area. Commercial, institutional, and recreational lands and transportation and related infrastructure comprised the balance of the land cover, or about 170 acres. The drainage area is located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint sources of water pollution within the drainage area tributary to Upper Nashotah Lake are primarily from rural agricultural lands and urban residential lands that comprise about one-third of the land cover within the drainage basin tributary to Upper Nashotah Lake.

Fish and Wildlife Populations

In 1963, the fishery of Upper Nashotah Lake consisted largely of largemouth bass, panfish, and northern pike.[218] A fish survey conducted in 1975 reported the fishery to consist of black crappie, largemouth bass, brook silverside, bluntnose minnow, fathead minnow, rock bass, mimic shiner, yellow perch, Iowa darter, golden shiner, banded killifish, least darter, green sunfish, blacknose shiner, johnny darter, pumpkinseed, and bluegill.[219] The banded killifish and the least darter are listed as State species of special concern. As of 2001, northern pike, largemouth bass, and panfish were reported to be common in the Lake, with walleyed pike also reported to be present.[220] Wetlands are limited to a very small sedge marsh near the outlet.

Upper Nemahbin Lake

Lake Morphometry

Upper Nemahbin Lake is located in U.S. Public Land Survey Sections 13 and 14, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 283 acres, a maximum depth of 60 feet, and a shoreline development factor of 1.23. Upper Nemahbin Lake is one of the chain of lakes comprised of Upper and Lower Nashotah Lakes and Upper and Lower Nemahbin Lakes, bordering the terminal moraine that parallels the interlobate moraine. The Bark River enters from Nagawicka Lake and exits, unimpounded, to Lower Nemahbin Lake. The bathymetry of Upper Nemahbin Lake is shown on Map 61.

Water Quality

Available water quality data indicate that Upper Nemahbin Lake is a mesotrophic waterbody, or moderately enriched waterbody, with a TSI rating of approximately 40. Figure 20 shows the trends in water quality within Upper Nemahbin Lake during the period 1970 through 2000. A watershed inventory was completed for the Lake by SEWRPC in 1995.[221]

Recreational Use

Public access is provided from a public recreational boating access site at the outlet to the Lake. Upper Nemahbin Lake is considered to have adequate public access pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*

Development Potential

As of 1995, the land uses within the approximately 1,700-acre drainage area directly tributary to Upper Nemahbin Lake consisted of about 30 percent urban land uses and about 70 percent rural land uses. Of the rural land uses,

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[218] *Wisconsin Conservation Department,* op. cit.

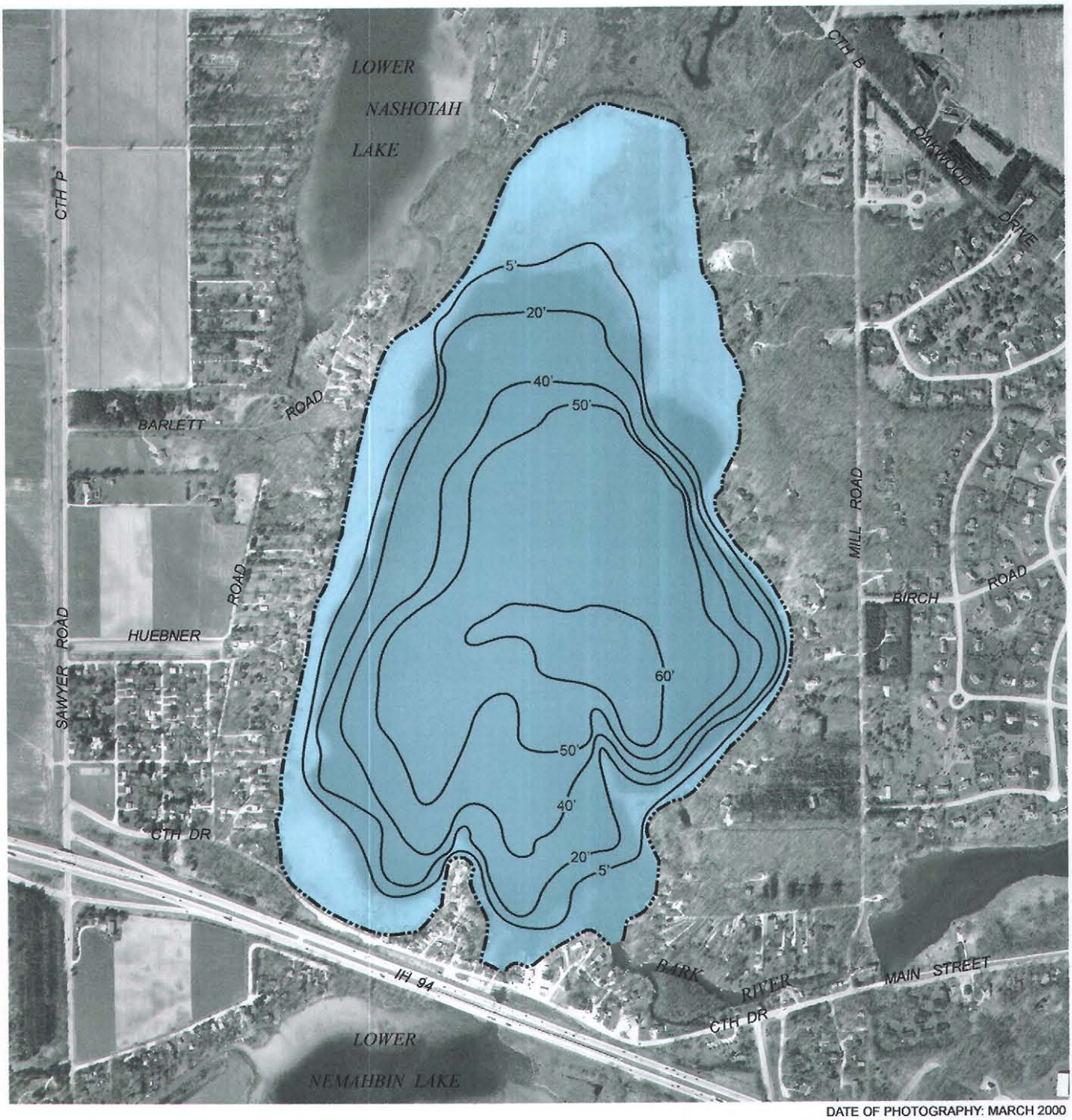
[219] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[220] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[221] *SEWRPC Memorandum Report No. 101,* Upper Nemahbin Lake Watershed Inventory Findings, Waukesha County, Wisconsin, *May 1995.*

Map 61

BATHYMETRIC MAP OF UPPER NEMAHBIN LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

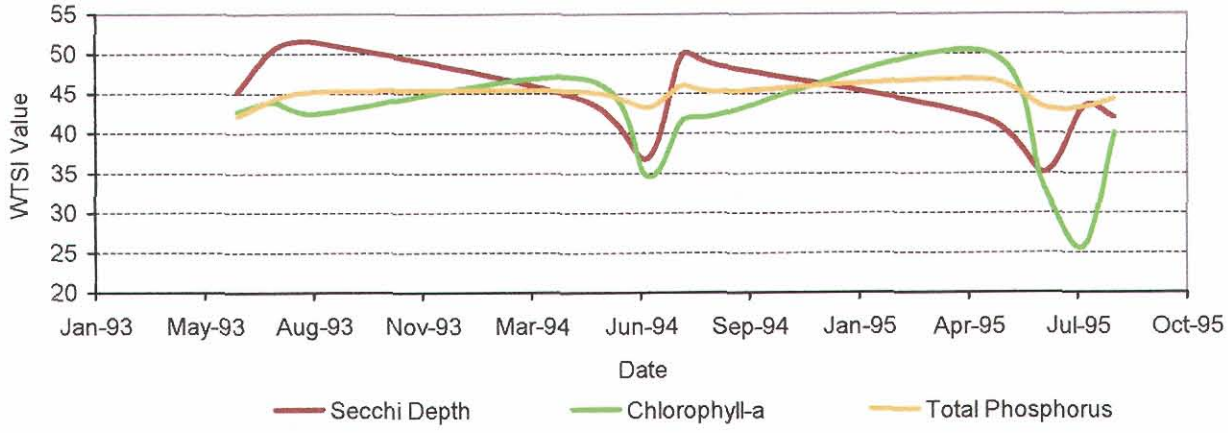
—20'— WATER DEPTH CONTOUR IN FEET

Source: SEWRPC.

GRAPHIC SCALE
0 500 1000 FEET

Figure 20

TROPHIC STATE INDEX FOR UPPER NEMAHBIN LAKE: 1970-2000



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

woodlands, wetlands, and surface waters comprised about 540 acres, or about 30 percent of the total land cover in the drainage area. Rural agricultural uses also comprised about 540 acres, or about a further 30 percent of the drainage basin. Urban residential land uses comprised about 240 acres, or about 15 percent of the land cover. Commercial, institutional, and recreational lands and transportation and related infrastructure comprised about 300 acres, or the balance of the urban land uses in the drainage area directly tributary to Upper Nemahbin Lake. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Upper Nemahbin Lake is located within the Bark River drainage system, a tributary stream system to the Rock River, which extends upstream for about 40 square miles. Within this total tributary drainage area, rural land uses comprise about three-quarters of the area, while urban land uses comprise the balance. Of these, urban residential uses account for about two-thirds of the urban land uses, while rural agricultural land uses comprise about one-half of the rural lands within the total drainage area tributary to Upper Nemahbin Lake.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Upper Nashotah Lake is generated primarily from rural agricultural and urban residential lands which comprise about 55 percent of the land cover within the total drainage basin tributary to Upper Nemahbin Lake.

Fish and Wildlife Populations

In 1963, the fishery of Upper Nemahbin Lake consisted largely of panfish, northern pike, and largemouth bass.[222] Carp were also reported, but not considered a use problem. A fish survey conducted in 1975 reported the fishery to consist of black bullhead, pumpkinseed, Iowa darter, least darter, common carp, rainbow darter, rock bass, bluntnose minnow, white sucker, banded killifish, green sunfish, bluegill, and yellow perch.[223] The least darter and the banded killifish are listed as a State species of special concern. As of 2001, northern pike, largemouth

[222] *Wisconsin Conservation Department,* op. cit.

[223] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

bass, and panfish were reported to be common in the Lake, with walleyed pike and smallmouth bass also reported to be present.[224]

Upper Oconomowoc Lake

Lake Morphometry

Upper Oconomowoc Lake is located in U.S. Public Land Survey Section 35, Township 8 North, Range 17 East, Town of Oconomowoc, as shown on Map 18. The Lake has a surface area of about 43 acres, a maximum depth of 11 feet, and a shoreline development factor of 1.69. Upper Oconomowoc Lake occupies an impounded area of the Oconomowoc River between Okauchee and Oconomowoc Lakes. The Lake was created to provide aquatic recreational and lakefront housing opportunities for a lake-centered community. Like Tierney Lake and Lower Okauchee Lake, this lake is considered to be an embayment of Okauchee Lake.

Upper Phantom Lake

Lake Morphometry

Upper Phantom Lake is located in U.S. Public Land Survey Section 35, Township 5 North, Range 18 East, Town of Mukwonago, as shown on Map 28. The Lake has a surface area of about 110 acres, a maximum depth of 32 feet, and a shoreline development factor of 1.42. Upper Phantom Lake is a groundwater-fed lake occupying an irregular depression in outwash deposits.[225] The Lake drains to Lower Phantom Lake through a narrow, sand-filled channel created as a consequence of the impoundment of Lower Phantom Lake. A church camp and a YMCA camp occupy parts of the shoreline. The bathymetry of Upper Phantom Lake is shown on Map 62.

Water Quality

Available water quality data indicate that Upper Phantom Lake is a mesotrophic waterbody, or moderately enriched waterbody. An aquatic plant management plan was completed for the Lake by SEWRPC in 1993.[226] A lake management plan for the Lake is currently being prepared by SEWRPC.

Recreational Use

Public access is provided by a county road and a boat launch and is considered adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*. Additional public recreational boating access is provided through private access sites, and water access through Lower Phantom Lake.

Development Potential

As of 1995, the land uses within the approximately 1,000-acre drainage area tributary to Upper Phantom Lake consisted of about 30 percent urban land uses and about 70 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised about 520 acres, or about 50 percent of the total land cover in the drainage area. Wetlands, woodlands, and surface waters comprised about 215 acres, or about 20 percent of the land cover. Urban residential lands comprised about 165 acres, or about 15 percent of the drainage area tributary to Upper Phantom Lake. Commercial, institutional, and recreational lands and transportation and related infrastructure comprised the balance of the urban lands within the drainage area, or about 120 acres. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

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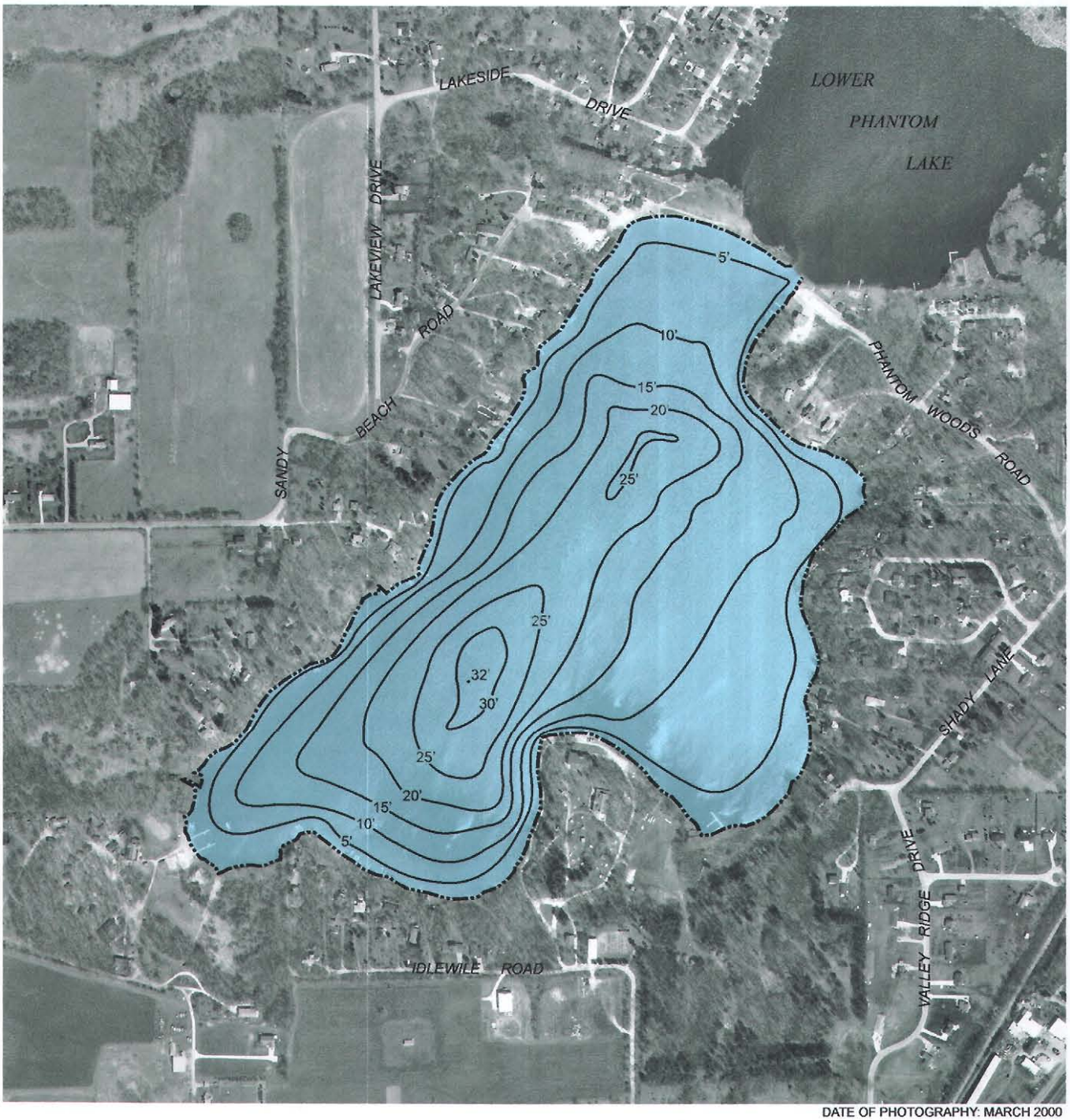
[224] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[225] *Wisconsin Department of Natural Resources Lake Use Report No. FX-33,* Upper Phantom Lake, Waukesha County, Wisconsin, *1969.*

[226] *SEWRPC Memorandum Report No. 81,* Aquatic Plant Management Plan for the Phantom Lakes, Waukesha County, Wisconsin, *July 1993.*

Map 62

BATHYMETRIC MAP OF UPPER PHANTOM LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

Source: SEWRPC.

GRAPHIC SCALE

0 350 700 FEET

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Upper Phantom Lake is generated primarily from rural agricultural and urban residential lands that comprise about two-thirds of the land cover within the drainage area directly tributary to Upper Phantom Lake.

Fish and Wildlife Populations
In 1963, the fishery of Upper Phantom Lake consisted largely of panfish, northern pike, and largemouth bass.[227] Fish surveys conducted in 1969 and 1978 reported the fishery to consist of green sunfish, black crappie, blacknose shiner, grass pickerel, warmouth, banded killifish, bluegill, lake chubsucker, blackstripe topminnow, bluntnose minnow, rock bass, blackchin shiner, warmouth, common shiner, emerald shiner, starhead topminnow, bowfin, channel catfish, longnose gar, brown bullhead, yellow bullhead, shortnose gar, brook silverside, pumpkinseed, yellow perch, golden shiner, pugnose shiner, and largemouth bass.[228] As of 2001, northern pike and largemouth bass were reported to be common in the Lake and walleyed pike and panfish were reported to be present.[229]

Utica Lake
Lake Morphometry
Utica Lake is located in U.S. Public Land Survey Section 33, Township 7 North, Range 17 East, Town of Summit, and U.S. Public Land Survey Section 4, Township 6 North, Range 17 East, Town of Ottawa, as shown on Maps 19 and 26. The Lake has a surface area of about 14 acres, a maximum depth of 25 feet, and a shoreline development factor of 1.11. Utica Lake occupies a small kettle in outwash deposits in the Bark River Valley. A small, unimpounded outlet flows to the Scuppernong Creek, a tributary stream to the Rock River drainage basin, through a wetland.

Recreational Use
Public access is not available. This Lake is considered by the Wisconsin Department of Natural Resources to be a wilderness lake in public ownership.[230]

Development Potential
As of 1995, the land uses within the approximately 1,020-acre drainage area tributary to the Scuppernong Creek, within which Utica Lake is situated, consisted of about 15 percent urban land uses and about 85 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised about 560 acres, or about 55 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 310 acres, or about 30 percent of the land cover. Urban residential lands comprised about 100 acres, or about 10 percent of the drainage area tributary to Utica Lake. Recreational lands and transportation and related infrastructure comprised about 50 acres, or the balance of the urban lands within the drainage basin. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Utica Lake is generated primarily from rural agricultural lands which comprise more than one-half of the land cover within the drainage basin tributary to Utica Lake.

Fish and Wildlife Populations
In 1963, the fishery of Utica Lake consisted largely of largemouth bass and panfish.[231] As of 2001, panfish were reported to be abundant in the Lake, with largemouth bass being reported to be common, and northern pike being

[227] *Wisconsin Conservation Department,* op. cit.

[228] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[229] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[230] Ibid.

[231] *Wisconsin Conservation Department,* op. cit.

reported to be present.[232] Waterfowl make migratory and resident use of the wetlands and vegetated shore areas upstream.

Waterville Lake

Lake Morphometry

Waterville Lake is located in U.S. Public Land Survey Section 36, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 68 acres, a maximum depth of 12 feet, and a shoreline development factor of 1.58. Waterville Lake is an impoundment of the Scuppernong Creek and was created as part of a subdivision plat. This waterbody forms the headwater lake in a chain of lakes that includes Dutchman Lake, Hunters Lake, and the Scuppernong Creek Pond.

Recreational Use

Public access is not available.

Development Potential

As of 1995, the land uses within the approximately 270-acre drainage area directly tributary to Waterville Lake consisted of about 45 percent urban land uses and about 55 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised about 110 acres, or about 40 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 40 acres, or about 15 percent of the land cover. Commercial and industrial lands, and transportation and related infrastructure comprised about 125 acres, or about 45 percent of the drainage area directly tributary to Waterville Lake; urban residential lands comprised about 0.5 acre. The drainage area is partially located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution

Nonpoint pollution within the drainage area tributary to Waterville Lake is generated from both rural agricultural and urban residential lands which comprise about two-thirds of the land cover within the total tributary drainage basin to Waterville Lake.

Fish and Wildlife Populations

In 1963, the fishery of Waterville Lake consisted largely of largemouth bass and panfish.[233] As of 2001, largemouth bass were reported to be common in the Lake, with panfish and northern pike also reported to be present.[234] Waterfowl are reported by the Wisconsin Department of Natural Resources to make migratory and resident use of the wetlands adjoining the Lake.[235]

Widgeon Lake (Bowron Lake)

Lake Morphometry

Widgeon Lake is located in U.S. Public Land Survey Section 23, Township 7 North, Range 17 East, Town of Summit, as shown on Map 19. The Lake has a surface area of about 25 acres, a maximum depth of 25 feet, and a shoreline development factor of 1.19. Widgeon Lake occupies a small basin in outwash deposits in the Bark River Valley and drains to the Bark River through a wetland complex. The water is clear and most of the bottom is sand. The shoreline remains undeveloped, save for one seasonal home.

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[232] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[233] *Wisconsin Conservation Department,* op. cit.

[234] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[235] *Wisconsin Conservation Department,* op. cit.

Recreational Use
Public access is not provided. Widgeon Lake has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential
As of 1995, the land uses within the approximately 330-acre drainage area tributary to Widgeon Lake consisted of about 20 percent urban land uses and about 80 percent rural land uses. Of the rural land uses, woodlands, wetlands, and surface waters comprised about 200 acres, or about 60 percent of the total land cover in the drainage area. Rural agricultural land uses comprised about 74 acres, or about 25 percent of the total land cover. Urban residential lands comprised about 40 acres, or about 10 percent of the drainage area tributary to Widgeon Lake, while transportation and related infrastructure comprised the balance of the urban lands, or about 15 acres of the drainage area. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Widgeon Lake is generated primarily from rural agricultural lands and urban residential lands which comprise about one-third of the land cover within the drainage basin tributary to Widgeon Lake.

Fish and Wildlife Populations
In 1963, the fishery of Widgeon Lake consisted largely of panfish and largemouth bass.[236] As of 2001, panfish were reported to be abundant in the Lake, with largemouth bass being reported to be common, and northern pike being reported to be present.[237] Waterfowl make migratory and resident use of the adjoining wetlands.

Willow Spring Lake
Lake Morphometry
Willow Spring Lake is located in U.S. Public Land Survey Sections 4 and 9, Township 5 North, Range 18 East, Town of Mukwonago, as shown on Map 28. The Lake has a surface area of about 46 acres, and a maximum depth of 13 feet. Willow Spring Lake was constructed on Spring Creek, which forms both the outlet from the Lake and the inlet to the Lake, which is situated downstream of Spring Lake. The bathymetry of Willow Spring Lake is shown on Map 63.

Water Quality
A lake protection plan has been prepared for the Lake by SEWRPC.[238]

Recreational Use
Public access is available. Public recreational boating access is considered to be adequate pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Development Potential
As of 1995, the land uses within the approximately 355-acre drainage area directly tributary to Willow Spring Lake consisted of about 35 percent urban land uses and about 65 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised about 60 acres, or about 15 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 170 acres, or about 50 percent of the land cover. Urban residential lands comprised about 95 acres, or about 30 percent of the drainage area. Recreational lands and

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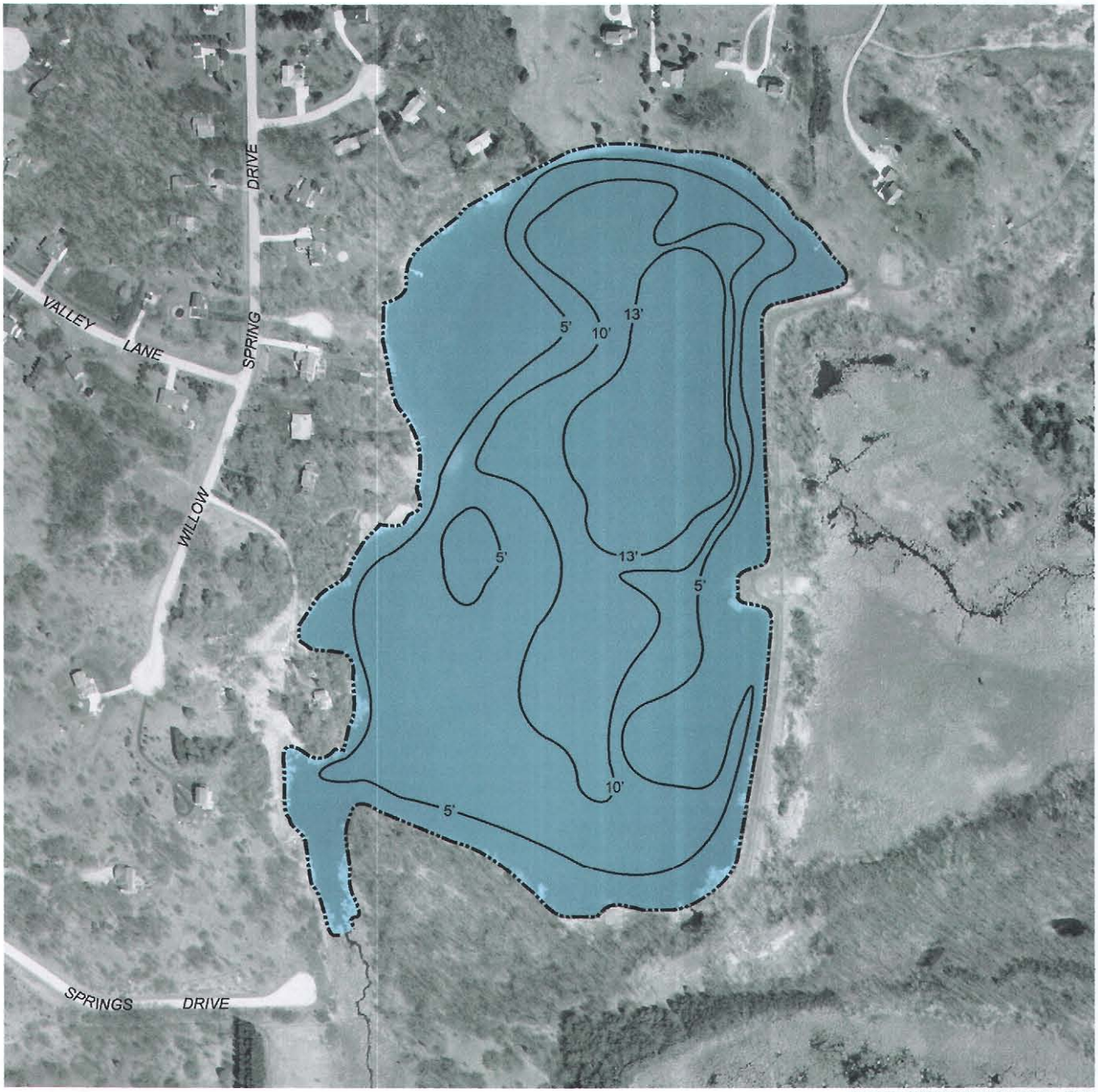
[236]Ibid.

[237]*Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[238]*SEWRPC Memorandum Report No. 149,* op. cit.

Map 63

BATHYMETRIC MAP OF WILLOW SPRING LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—10'— WATER DEPTH CONTOUR IN FEET

Source: SEWRPC.

GRAPHIC SCALE
0 200 400 FEET

transportation and related infrastructure comprised the balance of the urban lands which extended over about 25 acres. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Willow Spring Lake is located within the Spring Creek drainage system, a tributary stream system to the Fox River, which extends upstream for about five square miles. Within this total tributary drainage area, rural land uses comprise about two-thirds of the area, while urban land uses comprise the balance. Of these, urban residential uses account for about four-fifths of the urban land uses, while rural agricultural land uses comprise about one-half of the rural lands within the total drainage area tributary to Willow Spring Lake.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Willow Spring Lake is generated primarily from both rural agricultural and urban residential lands which comprise about three-fifths of the land cover within the total drainage basin tributary to Willow Spring Lake.

Fish and Wildlife Populations
As of 2001, panfish and largemouth bass were reported to be common in the Lake, and northern pike were reported to be present.[239] Waterfowl and upland game birds make migratory and resident use of the wetlands adjoining the Lake.

Wood Lake
Lake Morphometry
Wood Lake is located in U.S. Public Land Survey Section 33, Township 5 North, Range 18 East, Town of Mukwonago, as shown on Map 28. The Lake has a surface area of about 20 acres, a maximum depth of 22 feet, and a shoreline development factor of 1.15. Wood Lake occupies a small kettle in moraine drift. A small outlet stream drains the Lake into the Mukwonago River, a tributary stream to the Fox River drainage system. The lake bottom is primarily gravel.

Recreational Use
Public access is not available. All frontage remains in private ownership.

Development Potential
As of 1995, the land uses within the approximately 1,680-acre drainage area tributary to Wood Lake consisted of 15 percent urban land uses and about 85 percent rural land uses. Of the rural land uses, rural agricultural land uses comprised about 740 acres, or about 45 percent of the total land cover in the drainage area. Woodlands, wetlands, and surface waters comprised about 735 acres, or also about 45 percent of the land cover. Urban residential lands comprised about 120 acres, or about 10 percent of the land cover. Recreational lands and transportation and related infrastructure comprised the balance of the urban land uses, or about 85 acres. The drainage area is not located within an area planned for urban development in the adopted County development plan.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the drainage area tributary to Wood Lake is generated primarily from rural agricultural lands which comprise about one-half of the land cover within the drainage basin tributary to Wood Lake.

Fish and Wildlife Populations
In 1963, the fishery of Wood Lake consisted largely of largemouth bass and panfish.[240] As of 2001, panfish and largemouth bass were reported to be common in the Lake, and northern pike were reported to be present.[241] Waterfowl and marsh fur bearers make moderate migratory and resident use of the wetlands adjoining the Lake.

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[239] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

[240] *Wisconsin Conservation Department,* op. cit.

[241] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001,* op. cit.

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Chapter IV

INVENTORY FINDINGS: STREAMS

INTRODUCTION

This chapter presents the collection of data relating to streams systems of the Waukesha County area, as shown on Map 14 in Chapter III of this report. These streams form an important element of the natural resource base of Waukesha County which includes the Cities of Brookfield, Delafield, Milwaukee (part), Muskego, New Berlin, Oconomowoc, Pewaukee, and Waukesha; the Villages of Big Bend, Butler, Chenequa, Dousman, Eagle, Elm Grove, Hartland, Lac La Belle, Lannon, Menomonee Falls, Merton, Mukwonago (part), Nashotah, North Prairie, Oconomowoc Lake, Pewaukee, Sussex, and Wales; and the Towns of Brookfield, Delafield, Eagle, Genesee, Lisbon, Merton, Mukwonago, Oconomowoc, Ottawa, Summit, Vernon, and Waukesha. To the extent that data are available, relevant land use, recreational use, morphometric, water quality, and biological information upon which waterbody classifications are to be based pursuant to the requirements of Section 281.69(5)(b), *Wisconsin Statutes*, is presented for each stream inventoried. These data form the scientific and technical basis for the determination of the alternative stream classification schemes set forth in Chapter V.

INVENTORY FINDINGS

Table 6 contains a summary of basic stream morphometry data available for the major streams within Waukesha County. Descriptive paragraphs for each stream follow, providing a physical description of the stream, an interpretation of its present fishery, and a statement of existing use problems and conditions detrimental to the stream community. Table 6 also provides a compilation of information on minor waters tributary to named streams discussed below. The U.S. Public Land Survey Township, Range, and Section designation locates the mouth of the stream or the point at which it exits the County. Map 14 in Chapter III of this report shows the locations of the named streams within Waukesha County, and Maps 15 through 30 in Chapter III of this report show the locations of the named stream at the township scale.

Artesian Brook

Stream Morphometry

Artesian Brook is located in the south-central portion of Waukesha County, as shown on Map 29 in Chapter III of this report. The Brook has a surface area of about 1 acre, a length of 2.0 miles, and a gradient of 7.4 feet per mile. Artesian Brook is a small, low-flow stream tributary to the Fox River, joining the Fox River drainage system near Big Bend.

Recreational Use

Artesian Brook has limited navigability and is generally navigable only by canoe or similar watercraft.

Table 6

PHYSICAL CHARACTERISTICS OF STREAMS WITHIN WAUKESHA COUNTY[a]

Stream	Stream Length (miles)	Average Width (feet)	Surface Area (acres)	Gradient (feet/mile)	Average Depth (feet)	Drainage Area (square miles)	Location (U.S. Public Land Survey)	Map Number	Subdrainage Area	Major Drainage Area
Artesian Brook	2.0	3	0.7	7.4	1.0	2.5	T5 N, R19 E, Sec. 23	29	Lower Fox	Fox
Ashippun River	9.5	27	31.1	2.0	2.0	14.0	T8 N, R17 E, Sec. 7	18	Oconomowoc	Rock
Audley Creek	1.2	3	0.4	2.0	0.3	1.0	T7 N, R18 E, Sec. 22	20	Upper Fox	Fox
Bark River	24.6	17	50.7	5.1	3.0	47.0	T6 N, R17 E, Sec. 6	19[c]	Bark	Rock
Battle Creek	3.6	3	1.3	3.6	0.5	9.0	T7 N, R17 E, Sec. 18	19	Oconomowoc	Rock
Beulah Lake Outlet	1.0	25	3.0	2.0	2.5	1.0	T5 N, R18 E, Sec. 33	28	Mukwonago	Fox
Brandy Brook	1.5	4	0.7	0.7	0.3	2.0	T6 N, R18 E, Sec. 2	20[c]	Upper Fox	Fox
Fox River	45.6	65	359.2	3.8	2.8	72.0	T5 N, R19 E, Sec. 34	21[c]	Fox	Fox
Genesee Creek[b]	6.0	27	19.6	8.0	0.8	24.0	T6 N, R19 E, Sec. 31	24[c]	Lower Fox	Fox
Horseshoe Brook	1.5	--	--	6.0	--	2.0	T5 N, R19 E, Sec. 21	29	Lower Fox	Fox
Jericho Creek	5.0	7	4.2	21.0	1.0	22.0	T5 N, R17 E, Sec. 36	27[c]	Mukwonago	Fox
Krueger Brook	0.5	2	0.1	8.0	0.5	1.0	T5 N, R19 E, Sec. 35	29	Lower Fox	Fox
Lannon Creek	2.0	5	1.2	10.0	1.0	7.0	T8 N, R20 E, Sec. 29	15	Upper Fox	Fox
Little Oconomowoc River	3.1	6	2.3	19.4	1.7	3.0	T8 N, R18 E, Sec. 16	17	Oconomowoc	Rock
Mason Creek	3.5	8	3.4	7.0	1.1	3.5	T8 N, R18 E, Sec. 17	17	Oconomowoc	Rock
Menomonee River	6.2	26	19.5	19.4	1.5	1.0	T8 N, R20 E, Sec. 36	15	Menomonee	Milwaukee
Mill Brook	8.5	12	12.4	9.4	1.5	7.0	T5 N, R19 E, Sec. 5	29	Lower Fox	Fox
Mill Creek	2.8	12	4.1	25.0	0.8	7.0	T6 N, R19 E, Sec. 27	24	Lower Fox	Fox
Mukwonago River	9.7	42	49.4	2.1	0.7	30.0	T5 N, R19 E, Sec. 30	27[c]	Mukwonago	Fox
Muskego Creek	1.5	8	1.5	1.0	1.5	30.0	T5 N, R20 E, Sec. 33	30	Lower Fox	Fox
Oconomowoc River	14.3	70	121.3	5.9	3.0	45.0	T7 N, R17 E, Sec. 7	17[c]	Oconomowoc	Rock
Pebble Brook	1.3	18	2.8	7.7	2.5	15.0	T5 N, R19 E, Sec. 5	24[c]	Lower Fox	Fox
Pebble Creek	6.5	10	7.9	21.5	0.8	18.0	T6 N, R19 E, Sec. 17	21[c]	Upper Fox	Fox
Pewaukee River	4.8	45	26.2	6.7	0.8	18.0	T7 N, R19 E, Sec. 25	16[c]	Upper Fox	Fox
Poplar Creek	7.5	26	23.6	4.0	3.5	18.0	T7 N, R20 E, Sec. 19	22[c]	Upper Fox	Fox
Redwing Creek	1.5	2	0.4	5.0	0.5	1.0	T6 N, R19 E, Sec. 33	24	Lower Fox	Fox
Ripple Creek	0.5	4	0.2	4.0	0.5	3.0	T5 N, R19 E, Sec. 25	29[c]	Lower Fox	Fox
Rosenow Creek	3.6	4	1.7	5.0	0.5	5.0	T8 N, R17 E, Sec. 28	18	Oconomowoc	Rock
School Section Ditch	5.1	8	5.0	2.5	1.0	6.0	T6 N, R17 E, Sec. 7	26	Bark	Rock
Scuppernong Creek	5.5	15	9.7	3.6	1.2	18.0	T5 N, R17 E, Sec. 19	26	Bark	Rock
Scuppernong River	9.5	13	14.9	13.2	1.7	23.5	T6 N, R20 E, Sec. 4	26[c]	Bark	Rock
Sussex Creek	5.0	5	3.0	14.0	0.3	18.0	T7 N, R20 E, Sec. 6	16[c]	Upper Fox	Fox
Underwood Creek	5.1	8	4.9	7.1	1.0	10.8	T7 N, R18 E, Sec. 25	22	Menomonee	Milwaukee
Wales Creek	1.6	5	1.0	6.0	0.5	2.5	T7 N, R18 E, Sec. 6	25[c]	Bark	Rock
Zion Creek	1.5	4	0.7	10.0	0.7	4.0	T7 N, R18 E, Sec. 24	20	Upper Fox	Fox

[a] *Stream data are for the portion of the stream within Waukesha County only. The U.S. Public Land Survey Township, Range, and Section designation included in each description locates the mouth of the stream at its confluence with another named stream or at the point at which it exits the County.*

[b] *Genesee Creek includes the Spring Creek drainage system which rises in Spring Lake, in the Town of Mukwonago, and drains in a northerly and easterly direction to its point of confluence with the Genesee Creek upstream of Saylesville Lake, in the Town of Genesee.*

[c] *Stream rises in the U.S. Public Land Survey Section shown and continues into adjacent U.S. Public Land Survey Sections.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

Development Potential
As of 1995, the land uses within the approximately 2.5-square-mile Artesian Brook subwatershed consisted of about 35 percent urban land uses and about 65 percent rural land uses. Agricultural land uses comprised about two-thirds of the rural land cover. Urban residential lands comprised about three-quarters of the urban land cover. The drainage area is partially located within an area planned for urban development in the adopted county development plan.[1]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Artesian Brook subwatershed is generated primarily from both urban residential and rural agricultural lands which comprise about two-thirds of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Artesian Brook was reported to consist largely of forage fish.[2] Waterfowl were reported by the Wisconsin Department of Natural Resources to make limited use of the approximately 28 acres of wetlands that adjoin the stream.

Ashippun River
Stream Morphometry
The Ashippun River is located in the extreme northwest corner of Waukesha County, as shown on Map 18 in Chapter III of this report. The River has a surface area of about 31 acres, a length of 9.5 miles, and a gradient of 2.0 feet per mile. The Ashippun River is a low-gradient, moderate-sized stream tributary to the Rock River. The impoundment creating Monterey Lake, as well as several other upstream structures, has allowed the River to develop water quality and fisheries conditions more characteristic of a lake than of a stream system. The Ashippun River is included within the Upper Rock River basin areawide water quality management planning area.[3]

Recreational Use
The Ashippun River has limited navigability and is generally navigable only by canoe or similar watercraft. Public recreational boating access is provided by the rights-of-way of several roads intersecting the River.

Development Potential
As of 1995, the land uses within the approximately 14-square-mile Ashippun River subwatershed within Waukesha County consisted of about 10 percent urban land uses and about 90 percent rural land uses. Agricultural land uses comprised about four-fifths of the rural land cover in the subwatershed. Urban residential uses comprised about one-half of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[4]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Ashippun River subwatershed is generated primarily from rural agricultural lands which comprise about 70 percent of the land cover within the watershed.

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[1]*SEWRPC Community Assistance Planning Report No. 209,* A Development Plan for Waukesha County, Wisconsin, *August 1996.*

[2]*Wisconsin Conservation Department,* Surface Water Resources of Waukesha County, *1963.*

[3]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-190 95REV,* Upper Rock River Basin Water Quality Management Plan, *December 1995.*

[4]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

Fish and Wildlife Populations
In 1963, the fishery of the Ashippun River was reported to consist largely of northern pike, largemouth bass, and smallmouth bass.[5] Fish surveys conducted in 1973, 1974, 1975, and 1995 reported the fishery to consist of banded darter, common carp, hornyhead chub, rock bass, white crappie, black bullhead, common shiner, johnny darter, shorthead redhorse, white sucker, blackside darter, creek chub, largemouth bass, smallmouth bass, yellow bullhead, brassy minnow, grass pickerel, northern pike, spotfin shiner, central mudminnow, green sunfish, pumpkinseed, stonecat, southern redbelly dace, fantail darter, bluntnose minnow, rainbow darter, creek chub, slender madtom, yellow perch, fathead minnow, and stonerollers.[6] The slender madtom is listed as a state endangered species. Waterfowl make migratory and resident use of the approximately 700 acres of wetlands adjoining the River.

Audley Creek
Stream Morphometry
Audley Creek is located in the central portion of Waukesha County, as shown on Map 20 in Chapter III of this report. The Creek has a surface area of about 0.5 acre, a length of 1.2 miles, and a gradient of 2.0 feet per mile. Audley Creek is a low gradient stream tributary to Pewaukee Lake. The stream flows into a shallow marsh pocket adjoining the south shore of the Lake. The bottom of the Creek is primarily comprised of muck and silt.

Recreational Use
Audley Creek has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential
As of 1995, the land uses within the approximately one-square-mile Audley Creek subwatershed consisted of about 55 percent urban land uses and about 45 percent rural land uses. Urban residential lands comprised about two-thirds of the urban land cover in the subwatershed. Rural agricultural lands comprised about one-tenth of the rural land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[7]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Audley Creek subwatershed is generated primarily from urban residential lands which comprise about one-third of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Audley Creek was reported to consist largely of forage species.[8]

Bark River
Stream Morphometry
The Bark River is located in the north-central, central, and west-central portions of Waukesha County, as shown on Maps 19, 20 and 26 in Chapter III of this report. Originating in southern Washington County, the River has a surface area of about 51 acres, a length of 24.6 miles, and a gradient of 5.1 feet per mile. The Bark River is a high gradient stream flowing from Washington County through Waukesha County, and then west into Jefferson County until its confluence with the Rock River. There are six lakes and impoundments on the course of the River

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[5] *Wisconsin Conservation Department,* op. cit.

[6] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* Retrieval and Analysis System Used in Wisconsin's Statewide Fish Distribution Survey, *Second Edition, December 1988, and subsequent updates.*

[7] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[8] *Wisconsin Conservation Department,* op. cit.

within Waukesha County. Much of the River is navigable by boat. The Bark River is included within the Lower Rock River basin areawide water quality management planning area.[9]

Recreational Use
Public recreational boating access is provided by navigable waterways and through public recreational boating access sites on some lakes and impoundments.

Development Potential
As of 1995, the land uses within the approximately 47-square-mile Bark River subwatershed within Waukesha County consisted of about 30 percent urban land uses and about 70 percent rural land uses. Agricultural land uses comprised about one-half of the rural land cover in the subwatershed. Urban residential uses comprised about 55 percent of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[10]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Bark River subwatershed is generated primarily from both rural agricultural lands and urban residential lands which comprise about 55 percent of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of the Bark River was reported to consist largely of common lake species.[11] Forage fish, especially suckers, were the most common. Annual fish surveys conducted between 1972 and 1977, and other surveys conducted in 1981, 1994, and 1995, reported the fishery to consist of channel catfish, rock bass, white bass, bluntnose minnow, common carp, fathead minnow, spottail shiner, bluegill, emerald shiner, golden shiner, walleye, spotfin shiner, black crappie, northern pike, white crappie, bowfin, warmouth, black bullhead, yellow bullhead, white sucker, blackstripe topminnow, brook silverside, slenderhead darter, buffalo, white bass, logperch, rainbow darter, johnny darter, stonecat, sand shiner, rosyface shiner, northern hog sucker, hornyhead chub, banded darter, largescale stoneroller, grass pickerel, slender madtom, brown bullhead, sunfish, lake chubsucker, brassy minnow, tadpole madtom, banded killifish, common shiner, central stoneroller, least darter, smallmouth bass, bluntnose minnow, Iowa darter, green sunfish, pumpkinseed, largemouth bass, shorthead redhorse, and orangespotted sunfish.[12] The banded killifish and the least darter are listed as state species of special concern. The slender madtom is listed as state endangered species. Waterfowl and marsh fur bearers make migratory and resident use of the approximately 2,000 acres of wetlands that adjoin the River. Deer are also found in some of the larger wooded wetland areas.

Battle Creek
Stream Morphometry
Battle Creek is located in the northwest portion of Waukesha County, as shown on Map 19 in Chapter III of this report. The Creek has a surface area of about one acre, a length of 3.6 miles, and a gradient of 3.6 feet per mile. Battle Creek is a low-gradient stream, which originates in wetlands near Leota Lake and flows, unimpounded, into the Oconomowoc River within Jefferson County. Battle Creek is included within the Upper Rock River basin

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[9]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-280 98-REV,* Lower Rock River Basin Water Quality Management Plan, *October 1998.*

[10]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[11]*Wisconsin Conservation Department,* op. cit.

[12]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

areawide water quality management planning area,[13] and within the Oconomowoc River Priority Watershed project area.[14]

Recreational Use
Battle Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately nine-square-mile Battle Creek subwatershed consisted of about 15 percent urban land uses and about 85 percent rural land uses. Agricultural land uses comprised about three-fifths of the rural land cover. Urban residential land uses comprised about one-quarter of the urban land uses. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[15]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Battle Creek subwatershed is generated primarily from agricultural lands which comprise about one-half of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Battle Creek consisted largely of forage species.[16] Fish surveys conducted in 1973 and 1975 reported the fishery to consist of white sucker, northern pike, johnny darter, central mudminnow, common carp, yellow bullhead, fantail darter, black bullhead, Iowa darter, bluntnose minnow, yellow perch, blackstripe topminnow, bluegill, green sunfish, and blackside darter.[17] Waterfowl make limited migratory and resident use of the approximately 176 acres of wetlands adjoining the Creek.

Beulah Lake Outlet
Stream Morphometry
Beulah Lake Outlet is located in the south-central portion of Waukesha County, as shown on Map 28 in Chapter III of this report. The stream has a surface area of about three acres, a length of 1.0 mile, and a gradient of 2.0 feet per mile. Beulah Lake Outlet is a short stream connecting the Beulah Lake in Walworth County to the Mukwonago River within Waukesha County.

Recreational Use
Beulah Lake Outlet has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately one-square-mile Beulah Lake Outlet subwatershed consisted of about 5 percent urban land uses and about 95 percent rural land uses. Agricultural land uses comprised about one-third of the rural land cover. Urban residential land uses comprised about two-fifths of the urban land uses.

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[13]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-190 95REV,* op. cit.

[14]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* Nonpoint Source Control Plan for the Oconomowoc River Priority Watershed Project, *March 1986.*

[15]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[16]*Wisconsin Conservation Department,* op. cit.

[17]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

The subwatershed is not located within an area planned for urban development in the adopted county development plan.[18]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Beulah Lake Outlet subwatershed is generated primarily from agricultural lands which comprise about one-third of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Beulah Lake Outlet was reported to consist largely of panfish, largemouth bass, and an occasional northern pike.[19]

Brandy Brook
Stream Morphometry
Brandy Brook is located in the central portion of Waukesha County, as shown on Maps 20 and 25 in Chapter III of this report. The Brook has a surface area of about one acre, a length of 1.5 miles, and a gradient of 0.7 foot per mile. Brandy Brook is a small stream tributary to Pebble Creek, and is located east of the Village of Wales. The bottom is primarily silt. Brandy Brook is in the Upper Fox River Priority Watershed project area.[20]

Recreational Use
Brandy Brook has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential
As of 1995, the land uses within the approximately two-square-mile Brandy Brook subwatershed consisted of about 15 percent urban land uses and about 85 percent rural land uses. Agricultural land uses comprised about two-fifths of the rural land cover. Urban residential land uses comprised about four-fifths of the urban land uses. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[21]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Brandy Brook subwatershed is generated primarily from both rural agricultural lands and urban residential lands which comprise about two-fifths of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Brandy Brook was reported to consist largely of forage fish with an occasional panfish.[22] Fish surveys conducted in 1972 and 1978 reported the fishery to consist of central mudminnow, common shiner, white sucker, johnny darter, brook stickelback, blacknose dace, central stoneroller, pumpkinseed, mottled sculpin, fathead minnow, and creek chub.[23]

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[18]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[19]*Wisconsin Conservation Department,* op. cit.

[20]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-366 94,* Nonpoint Source Control Plan for the Upper Fox River Priority Watershed Project, *June 1994.*

[21]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[22]*Wisconsin Conservation Department,* op. cit.

[23]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

Fox River

Stream Morphometry

The Fox River is located in the central portion of Waukesha County, as shown on Maps 21, 22, 24, 28, and 29 in Chapter III of this report. The Fox River watershed is comprised of the Northern Upper Fox River Subwatershed, the Upper Fox River Subwatershed, and the Middle Fox River Subwatershed, as well as the subwatersheds of a number of major tributary stream systems discussed elsewhere in this report.[24] Originating in the extreme south-central portion of Washington County, the River has a surface area of about 359 acres, a length of 45.6 miles, and a gradient of 3.8 feet per mile. The Fox River is the major stream draining much of the eastern half of the County. The shoreline is relatively undeveloped save for a few cottages and small homes. The Department of Natural Resources manages about 9.0 miles of frontage, encompassing approximately 5,250 acres, of wetlands along the stream as the Vernon Marsh Wildlife Area. The Waukesha County portion of the Fox River is included within the Upper Fox River Priority Watershed project area.[25]

Recreational Use

Public recreational boating access is provided by a boat launch within the City of Waukesha, which gives access to the portion of the River above the impoundment located in downtown Waukesha. County and City roads and parks provide additional access opportunities.

Development Potential

As of 1995, the land uses within the approximately 72-square-mile Fox River watershed[26] within Waukesha County consisted of about 40 percent urban land uses and about 60 percent rural land uses. Agricultural land uses comprised about one-half of the rural land cover. Urban residential land uses comprised about one-half of the urban land uses. The watershed is partially located within an area planned for urban development in the adopted county development plan.[27]

Nonpoint Sources of Water Pollution

Nonpoint pollution within the Fox River watershed is generated by both rural agricultural lands and urban residential lands which comprise about one-half of the land cover within the watershed.

Fish and Wildlife Populations

In 1963, the fishery of the Fox River was reported to consist largely of northern pike, channel catfish, largemouth bass, and panfish.[28] Fish surveys conducted annually in 1972 through 1974, and in 1976, 1977, 1980, 1985, 1988, and 1992, reported the fishery to consist of central mudminnow, largemouth bass, bluntnose minnow, fantail darter, hornyhead chub, banded darter, weed shiner, bluegill, common shiner, brook stickelback, southern redbelly dace, pearl dace, northern pike, johnny darter, yellow perch, white sucker, rainbow darter, and rock bass.[29] Waterfowl and marsh fur bearers make migratory and resident use of the Vernon Marsh Wildlife Area.

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[24] *These major tributary stream systems include, among others, Sussex Creek, Pewaukee River, Brandy Brook and Pebble Creek, Pebble Brook and Mill Creek, Mill Brook, Genesee Creek, and Mukwonago River and their attendant subwatersheds.*

[25] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-366 94,* op. cit.

[26] *Watershed area is for the main stem Fox River reaches designated as the Northern Upper Fox River, Upper Fox River and Middle Fox River within Waukesha County; the watershed area excludes the land surface area of the tributary stream systems that are individually named elsewhere in this report.*

[27] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[28] *Wisconsin Conservation Department,* op. cit.

[29] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.; *Wisconsin Department of Natural Resources Publication No. PUBL-WR-366 94,* op. cit.

The American bullfrog and the Forester's tern, both listed on the national threatened and endangered species list, make migratory and resident use of the wildlife area as well.

Genesee Creek

Stream Morphometry

Genesee Creek is located in the south-central portion of Waukesha County, as shown on Maps 24 and 25 in Chapter III of this report. The Creek has a surface area of about 20 acres, a length of 6.0 miles, and a gradient of 8.0 feet per mile. Genesee Creek is a medium-sized stream tributary to the Fox River, the upper reaches of which are comprised of several tributary stream systems, one of which—draining Spring and Willow Spring Lakes—is known as Spring Brook. Three impoundments with a combined head of about 44 feet remain on the stream. Genesee Creek, upstream of STH 59, has been designated as an Exceptional Resource Water of the state pursuant to Chapter NR 102 of the *Wisconsin Administrative Code*.

Recreational Use

Genesee Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential

As of 1995, the land uses within the approximately 24-square-mile Genesee Creek subwatershed consisted of about 25 percent urban land uses and about 75 percent rural land uses. Agricultural land uses comprised about three-fifths of the rural land cover. Urban residential land uses comprised about two-thirds of the urban land uses. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[30]

Nonpoint Sources of Water Pollution

Nonpoint pollution within the Genesee Creek subwatershed is generated primarily from agricultural lands which comprise about two-fifths of the land cover within the watershed.

Fish and Wildlife Populations

In 1963, the fishery of Genesee Creek was reported to consist largely of northern pike, suckers, and largemouth bass.[31] These fish were reported by the Wisconsin Department of Natural Resources to make spawning and resident use of the stream. Trout also were reported to potentially inhabit small tributaries to the Creek. Forage fishes were reported to comprise the fishery in the Spring Brook portion of the Genesee Creek system.[32] Fish surveys conducted in Genesee Creek during 1974, 1978, and 1996 reported the fishery to consist of bluegill, green sunfish, pumpkinseed, banded darter, northern pike, rainbow darter, bluntnose minnow, hornyhead chub, rosyface shiner, largemouth bass, suckermouth minnow, blackside darter, central mudminnow, johnny darter, sand shiner, longear sunfish, logperch, rock bass, common shiner, largescale stoneroller, blacknose shiner, tadpole madtom, lake chubsucker, golden shiner, channel catfish, blackstripe topminnow, blackside darter, creek chub, brown trout, brook trout, mottled sculpin, brook stickleback, fantail darter, spotfin shiner, creek chub, stonecat, fantail darter, mimic shiner, white sucker, grass pickerel, and yellow bullhead.[33] A survey conducted in the Spring Brook portion of the Genesee Creek system during 1975 reported the fishery to consist of bluegill, banded darter, spotfin shiner, brook stickleback, bluntnose minnow, common carp, common shiner, golden redhorse, fathead minnow, black crappie, and green sunfish.[34] The longear sunfish is listed as a state threatened species. The tadpole madtom

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[30] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[31] *Wisconsin Conservation Department,* op. cit.

[32] Ibid.

[33] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[34] Ibid.

is listed as a state endangered species. Waterfowl and marsh fur bearers make migratory and resident use of the approximately 290 acres of wetlands adjoining the Creek.

Horseshoe Brook

Stream Morphometry

Horseshoe Brook is located in the southwestern portion of Waukesha County, as shown on Map 29 in Chapter III of this report. The Brook is about 1.5 miles in length with a gradient of 6.0 feet per mile. The Brook is a tributary stream to the Fox River drainage system and is considered by the WDNR to be intermittent.

Recreational Use

Horseshoe Brook has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential

As of 1995, the land uses within the approximately two-square-mile Horseshoe Brook subwatershed consisted of about 30 percent urban land uses and about 70 percent rural land uses. Agricultural land uses comprised about 70 percent of the rural land cover in the subwatershed. Urban residential lands comprised about 55 percent of the urban land cover. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[35]

Nonpoint Sources of Water Pollution

Nonpoint pollution within the Horseshoe Brook subwatershed is generated primarily from rural agricultural lands which comprise about one-half of the land cover within the watershed.

Fish and Wildlife Populations

In 1963, the fishery of Horseshoe Brook was reported by the Wisconsin Department of Natural Resources to be absent due to the intermittent nature of the stream.[36]

Jericho Creek (Jericho River)

Stream Morphometry

Jericho Creek is located in the southwest portion of Waukesha County, as shown on Maps 27 and 28 in Chapter III of this report. The Creek has a surface area of about four acres, a length of 5.0 miles, and a gradient of 21.0 feet per mile. Jericho Creek is a high gradient spring stream tributary to the Mukwonago River, which joins the Mukwonago River immediately downstream of Eagle Spring Lake. The stream is reported by the WDNR to have good water quality, but a bottom of primarily silt.

Recreational Use

Jericho Creek has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential

As of 1995, the land uses within the approximately 22-square-mile Jericho Creek subwatershed consisted of about 30 percent urban land uses and about 70 percent rural land uses. Agricultural land uses comprised about three-fifths of the rural land cover in the subwatershed. Urban residential lands comprised about four-fifths of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[37]

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[35]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[36]*Wisconsin Conservation Department,* op. cit.

[37]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Jericho Creek subwatershed is generated primarily from rural agricultural lands which comprise about 45 percent of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of the Jericho Creek consisted largely of forage species.[38] Fish surveys conducted in 1972, 1973, and 1980 reported the fishery to consist of brown trout, yellow bullhead, central stoneroller, fantail darter, central mudminnow, green sunfish, stonerollers, creek chub, grass pickerel, largemouth bass, bluntnose minnow, common shiner, pumpkinseed, johnny darter, blacknose shiner, rock bass, white sucker, hornyhead chub, spottail shiner, blacknose dace, bluegill, brook stickelback, and mottled sculpin.[39] Nearly the entire bank is associated with wetland habitat, comprising about 390 acres adjoining the Creek.

Krueger Brook
Stream Morphometry
Krueger Brook is located in the south-central portion of Waukesha County, as shown on Map 29 in Chapter III of this report. The Brook has a surface area of about 0.1 acre, a length of 0.5 mile, and a gradient of 8.0 feet per mile. Krueger Brook is a shallow, possibly intermittent, stream tributary to the Fox River. Krueger Brook joins the Fox River below the Village of Big Bend. The stream enters a shallow arm of the Fox River separate from the main channel and surrounded by shallow marsh.

Recreational Use
Krueger Brook has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately one-square-mile Krueger Brook subwatershed consisted of about 10 percent urban land uses and about 90 percent rural land uses. Agricultural land uses comprised about three-quarters of the rural land cover in the subwatershed. Urban residential lands comprised about three-fifths of the urban land cover. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[40]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Krueger Brook subwatershed is generated primarily from rural agricultural lands which comprise about 70 percent of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Krueger Brook was reported to consist largely of forage species.[41] Northern pike may also make spawning use of the Brook.

Lannon Creek
Stream Morphometry
Lannon Creek is located in the north-central portion of Waukesha County, as shown on Map 15 in Chapter III of this report. The Creek has a surface area of about one acre, a length of 2.0 miles, and a gradient of 19.4 feet per mile. Lannon Creek is a drainage stream tributary to the Fox River. The bottom is mostly sand and gravel. During

[38] *Wisconsin Conservation Department,* op. cit.

[39] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[40] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[41] *Wisconsin Conservation Department,* op. cit.

dry periods, parts of the stream may become intermittent. The portion of the stream that runs through Lannon County Park is intermittent and serves solely for carrying spring runoff. Lannon Creek is included within the Upper Fox River Priority Watershed project area.[42]

Recreational Use
Lannon Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately seven-square-mile Lannon Creek subwatershed consisted of about 30 percent urban land uses and about 70 percent rural land uses. Agricultural land uses comprised about one-half of the rural land cover in the subwatershed. Urban residential lands comprised about three-fifths of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[43]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Lannon Creek subwatershed is generated primarily from both rural agricultural lands and urban residential lands which comprise about one-half of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Lannon Creek was reported by the Wisconsin Department of Natural Resources to consist largely of forage species.[44]

Little Oconomowoc River
Stream Morphometry
The Little Oconomowoc River is located in the northwestern portion of Waukesha County, as shown on Map 17 in Chapter III of this report. Originating in southwestern Washington County, the River has a surface area of about two acres, a length of 3.1 miles, and a gradient of 19.4 feet per mile within Waukesha County. The Little Oconomowoc River is a high gradient stream discharging to the Oconomowoc River at its inlet on North Lake. The Little Oconomowoc River is included within the Upper Rock River basin areawide water quality management planning area,[45] and within the Oconomowoc River Priority Watershed project area.[46]

Recreational Use
The Little Oconomowoc River has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty. Public recreational boating access is provided by a boat launch on North Lake and through navigable waterways.

Development Potential
As of 1995, the land uses within the approximately three-square-mile Little Oconomowoc River subwatershed within Waukesha County consisted of about 10 percent urban land uses and about 90 percent rural land uses. Agricultural land uses comprised about one-half of the rural land cover in the subwatershed. Urban residential

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[42]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-366 94,* op. cit.

[43]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[44]*Wisconsin Conservation Department,* op. cit.

[45]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-190 95REV,* op. cit.

[46]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

lands comprised about three-fifths of the urban land cover. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[47]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Little Oconomowoc River subwatershed is generated primarily from rural agricultural lands which comprise about two-fifths of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of the Little Oconomowoc River was reported to consist largely of forage species.[48] Fish surveys conducted in 1975 and 1994 reported the fishery to consist of black crappie, central mudminnow, yellow bullhead, Iowa darter, johnny darter, bluegill, central stoneroller, smallmouth bass, logperch, brook silverside, northern pike, creek chub, rock bass, rainbow darter, slender madtom, lake chubsucker, largemouth bass, white sucker, green sunfish, fantail darter, and common shiner.[49] Northern pike were considered by the Wisconsin Department of Natural Resources to be likely to enter the stream to spawn. The slender madtom is listed as a state endangered species.

Mason Creek
Stream Morphometry
Mason Creek is located in the north-central portion of Waukesha County, as shown on Map 17 in Chapter III of this report. Originating in Washington County, the Creek has a surface area of about three acres, a length of 3.5 miles, and a gradient of 7.0 feet per mile. Mason Creek has been straightened in portions to drain wetlands immediately north of North Lake. There are about 113 acres of fresh meadow adjoining the stream in a narrow belt extending its entire length within the County. Mason Creek is included within the Upper Rock River basin areawide water quality management planning area,[50] and within the Oconomowoc River Priority Watershed project area.[51]

Recreational Use
Mason Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately 3.5-square-mile Mason Creek subwatershed within Waukesha County consisted of about 10 percent urban land uses and about 90 percent rural land uses. Agricultural land uses comprised about four-fifths of the rural land cover in the subwatershed. Urban residential lands comprised about three-fifths of the urban land cover. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[52]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Mason Creek subwatershed is generated primarily from agricultural lands which comprise about three-quarters of the land cover within the watershed.

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[47] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[48] *Wisconsin Conservation Department,* op. cit.

[49] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[50] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-190 95REV,* op. cit.

[51] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

[52] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

Fish and Wildlife Populations
In 1963, the fishery of Mason Creek was reported to consist largely of forage species.[53] Fish surveys conducted in 1975, 1981, 1994, and 1995 reported the fishery to consist of brown bullhead, black bullhead, rock bass, crappies, common carp, slender madtom, bluntnose minnow, hornyhead chub, fantail darter, stonecat, rainbow darter, brook trout, common shiner, bluegill, green sunfish, largemouth bass, northern pike, lake chubsucker, creek chub, pumpkinseed, yellow perch, yellow bullhead, and white sucker.[54] The slender madtom is listed as a state endangered species.

Menomonee River
Stream Morphometry
The Menomonee River is located in the northeast portion of Waukesha County, as shown on Map 15 in Chapter III of this report. Originating in Washington County, the River has a surface area of about 20 acres, a length of 6.2 miles, and a gradient of 19.4 feet per mile. The Menomonee River is a major tributary to the Milwaukee River, which joins the parent stream in Milwaukee County less than a mile from its debouchment into Lake Michigan. The stream historically received treated effluents from the Village of Menomonee Falls in Waukesha County and from the Village of Germantown in Washington County. Of the three wastewater treatment plants discharging to the Menomonee River, the two plants within the Village of Menomonee Falls, were abandoned in 1981, and the plant within the Village of Germantown was abandoned in 1986, pursuant to the recommendations set forth in the adopted regional water quality management plan.[55] Wetlands comprise only about 67 acres of the immediate floodplain along the river course. The Waukesha County portion of the Menomonee River is included within the Menomonee River Priority Watershed project area.[56]

Recreational Use
Public access is provided through public parks within the incorporated municipalities adjoining the River.

Development Potential
As of 1995, the land uses within the approximately one-square-mile Menomonee River subwatershed within Waukesha County, which is part of a larger drainage system originating within Washington County, consisted of about 90 percent urban land uses and about 10 percent rural land uses. There are no agricultural lands, and the few rural lands within this subwatershed are designated for eventual urban development. Urban residential lands comprised about one-fifth of the urban land cover. The watershed is partially located within an area planned for urban development in the adopted county development plan.[57]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Menomonee River subwatershed is generated primarily from urban land uses which comprise almost all of the land cover within the portion of the watershed within Waukesha County.

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[53] *Wisconsin Conservation Department,* op. cit.

[54] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[55] *SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report, *March 1995.*

[56] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-244 92,* A Nonpoint Source Control Plan for the Menomonee River Priority Watershed Project, *March 1992.*

[57] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

Fish and Wildlife Populations
In 1963, the fishery of the Menomonee River was reported to consist largely of rough fish and forage species.[58] Fish surveys conducted in 1971, 1973, 1976, 1979, 1984, 1988, and annual surveys from 1991 through 1993 reported the fishery to consist of black bullhead, central mudminnow, green sunfish, sand shiner, common shiner, blacknose dace, bluegill, goldfish, creek chub, common carp, johnny darter, northern pike, brook stickelback, hornyhead chub, brassy minnow, golden shiner, redhorse, catfish, bluntnose minnow, white sucker, pearl dace, pumpkinseed, and fathead minnow.[59] There are approximately 41 acres of frontage in public ownership for open space use along the River.

Mill Brook
Stream Morphometry
Mill Brook is located in the south-central portion of Waukesha County, as shown on Map 29 in Chapter III of this report. The Brook has a surface area of about 12 acres, a length of 8.5 miles, and a gradient of 9.4 feet per mile. Mill Brook is a small wetland drainage stream tributary to the Fox River in the vicinity of the Vernon Marsh. Parts of the stream have been straightened to drain through about 250 acres of marshland.

Recreational Use
Mill Brook has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential
As of 1995, the land uses within the approximately seven-square-mile Mill Brook subwatershed consisted of about 40 percent urban land uses and about 60 percent rural land uses. Agricultural land uses comprised about two-thirds of the rural land cover in the subwatershed. Urban residential lands comprised about 70 percent of the urban land cover. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[60]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Mill Brook subwatershed is generated primarily from rural agricultural lands which comprise about two-fifths of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Mill Brook was reported to consist largely of forage species.[61] A fish survey conducted in 1978 reported the fishery to consist of brook stickelback, green sunfish, pumpkinseed, grass pickerel, central mudminnow, johnny darter, creek chub, northern pike, mottled sculpin, and white sucker.[62]

Mill Creek
Stream Morphometry
Mill Creek is located in the south-central portion of Waukesha County, as shown on Map 24 in Chapter III of this report. The Creek has a surface area of about 4 acres, a length of 2.8 miles, and a gradient of 25.0 feet per mile. Mill Creek is a high gradient stream tributary of Pebble Brook south of the City of Waukesha. The bottom is primarily sand and gravel. There are about 200 acres of wetland within the immediate watershed.

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[58] *Wisconsin Conservation Department,* op. cit.

[59] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[60] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[61] *Wisconsin Conservation Department,* op. cit.

[62] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

Recreational Use
Mill Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately seven-square-mile Mill Creek subwatershed consisted of about 35 percent urban land uses and about 65 percent rural land uses. Agricultural land uses comprised about three-fifths of the rural land cover in the subwatershed. Urban residential lands comprised about four-fifths of the urban land cover. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[63]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Mill Creek subwatershed is generated from both rural agricultural lands and urban residential lands which comprise about two-thirds of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Mill Creek was reported to consist largely of forage species.[64] Fish surveys conducted in 1972 and 1978 reported the fishery to consist of blacknose dace, bluntnose minnows, stonerollers, blackside darter, central stoneroller, white sucker, johnny darter, largemouth bass, mottled sculpin, creek chub, northern pike, brook stickelback, central mudminnow, green sunfish, fathead minnow, and common shiner.[65]

Mukwonago River
Stream Morphometry
The Mukwonago River is located in the southern portion of Waukesha County, as shown on Maps 27 and 28 in Chapter III of this report. The River has a surface area of about 49 acres, a length of 9.7 miles, and a gradient of 2.1 feet per mile. The Mukwonago River originates in Walworth County and flows through Eagle Spring Lake and Lower Phantom Lake before joining the Fox River in southern Waukesha County. The River, between Eagle Spring Lake and Lower Phantom Lake, has been designated as an Exceptional Resource Water of the state pursuant to Chapter NR 102 of the *Wisconsin Administrative Code*. Downstream from the Village of Mukwonago, treated sewage effluent from the Village of Mukwonago wastewater treatment plant is discharged into the River immediately upstream of its confluence with the Fox River.

Recreational Use
Public recreational boating access is provided within the Village of Mukwonago.

Development Potential
As of 1995, the land uses within the approximately 30-square-mile Mukwonago River subwatershed within Waukesha County consisted of about 20 percent urban land uses and about 80 percent rural land uses. Agricultural land uses comprised about one-half of the rural land cover in the subwatershed. Urban residential lands comprised about one-half of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[66]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Mukwonago River subwatershed is generated primarily from both rural agricultural lands and urban residential lands which comprise about one-half of the land cover within the watershed.

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[63] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[64] *Wisconsin Conservation Department,* op. cit.

[65] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[66] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

Fish and Wildlife Populations

In 1963, the fishery of the Mukwonago River was reported to consist largely of largemouth bass, panfish, and northern pike.[67] Rainbow trout are also present; however, they are most likely a population from a fish hatchery located on the banks of the River. Fish surveys conducted in 1972 through 1975, 1978, 1980, 1982, 1986, 1987, and 1994 reported the fishery to consist of black crappie, sand shiner, bowfin, starhead topminnow, bluntnose minnow, tadpole madtom, central mudminnow, blackchin shiner, blacknose shiner, stonecat, white sucker, johnny darter, rock bass, longear sunfish, golden redhorse, pugnose shiner, suckermouth minnow, green sunfish, yellow bullhead, fantail darter, common shiner, lake chubsucker, rainbow darter, northern pike, grass pickerel, blackstripe topminnow, rosyface shiner, hornyhead chub, quillback, rainbow trout, orangespotted sunfish, banded killifish, pumpkinseed, warmouth, largescale stoneroller, mottled sculpin, banded darter, least darter, bluegill, blackside darter, and logperch.[68] The least darter and banded killifish and are listed as state species of special concern. The longear sunfish and pugnose shiner are listed as a state threatened species.

Muskego Creek

Stream Morphometry

Muskego Creek is located in the southeast portion of Waukesha County, as shown on Map 30 in Chapter III of this report. The Creek has a surface area of about 2 acres, a length of 2.25 miles, and a gradient of 1.0 foot per mile. Muskego Creek is a small stream draining Little Muskego Lake to Big Muskego Lake. The Muskego Outlet Canal forms a continuation of this stream system, draining wetlands and Big Muskego Lake into Wind Lake in Racine County. The Outlet Canal has a surface area of about 1 acre, a length of 0.75 miles, and a gradient of 1.0 foot per mile. The Creek and the Outlet Canal have very low flows during dry seasons. Muskego Creek and the Muskego Outlet Canal are included within the Muskego-Wind Lakes Priority Watershed project area.[69]

Recreational Use

Muskego Creek and the Muskego Outlet Canal have limited navigability and are generally navigable only by canoe or similar watercraft with difficulty.

Development Potential

As of 1995, the land uses within the approximately 30-square-mile Muskego Creek subwatershed within Waukesha County consisted of about 30 percent urban land uses and about 70 percent rural land uses. Agricultural land uses comprised about three-fifths of the rural land cover in the subwatershed. Urban residential lands comprised about three-fifths of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[70]

Nonpoint Sources of Water Pollution

Nonpoint pollution within the Muskego Creek subwatershed is generated from both urban residential and rural agricultural lands which comprise about three-fifths of the land cover within the watershed.

Fish and Wildlife Populations

In 1963, the fishery of Muskego Creek was reported to consist largely of panfish.[71] Northern pike and largemouth bass make spawning use of the stream during spring spawning runs. Fish surveys conducted in 1972 and 1978 reported the fishery to consist of brook stickleback, creek chub, yellow bullhead, northern pike, black bullhead,

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[67] *Wisconsin Conservation Department,* op. cit.

[68] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[69] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-375 94,* Nonpoint Source Control Plan for the Muskego-Wind Lakes Priority Watershed Project, *October 1993.*

[70] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[71] *Wisconsin Conservation Department,* op. cit.

redfin shiner, bluntnose minnow, central mudminnow, brown bullhead, fathead minnow, yellow perch, bowfin, largemouth bass, common carp, white crappie, green sunfish, pumpkinseed, white sucker, and bluegill.[72] The redfin shiner is listed as a state threatened species.

Oconomowoc River

Stream Morphometry

The Oconomowoc River is located in the northwest portion of Waukesha County, as shown on Maps 17 through 19 in Chapter III of this report. The River has a surface area of about 121 acres, a length of 14.3 miles, and a gradient of 5.9 feet per mile. Originating in Washington County, the Oconomowoc River is the major waterway of northwest Waukesha County. There are seven impounding structures and, in all, eight waterbodies on this stream. The River receives treated effluent from the City of Oconomowoc. The Oconomowoc River is in the Upper Rock River basin areawide water quality management planning area.[73] In addition, the Waukesha County portion of the Oconomowoc River is included within the Oconomowoc River Priority Watershed project area.[74] The River, between North Lake and Okauchee Lake, has been designated as an Exceptional Resource Water of the state pursuant to Chapter NR 102 of the *Wisconsin Administrative Code*.

Recreational Use

The Oconomowoc River has limited navigability in areas, but is generally navigable by canoe or similar watercraft. Public access is provided through public parks within the City of Oconomowoc, and by the rights-of-way of county and town roads outside the City limits.

Development Potential

As of 1995, the land uses within the approximately 45-square-mile Oconomowoc River subwatershed within Waukesha County consisted of about 30 percent urban land uses and about 70 percent rural land uses. Agricultural land uses comprised about one-half of the rural land cover in the subwatershed. Urban residential lands comprised about three-fifths of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[75]

Nonpoint Sources of Water Pollution

Nonpoint pollution within the Oconomowoc River subwatershed is generated primarily from both rural agricultural and urban residential land uses which comprise about one-half of the land cover within the watershed.

Fish and Wildlife Populations

In 1963, the fishery of the Oconomowoc River was reported to consist largely of largemouth bass, panfish, channel catfish, and northern pike.[76] Rough fish are also common and may be considered a use problem in selected areas. Fish surveys conducted in 1971, 1973, 1975, 1976, 1985, 1994, and 1995 reported the fishery to consist of bluegill, largemouth bass, shorthead redhorse, yellow bullhead, brook silverside, common shiner, black bullhead, bluntnose minnow, brown bullhead, northern pike, blackside darter, common carp, golden redhorse, yellow perch, fathead minnow, banded darter, stonecat, slenderhead darter, rainbow darter, slender madtom, blackchin shiner, banded killifish, logperch, Iowa darter, largescale stoneroller, emerald shiner, longnose gar, lake chubsucker, golden shiner, sand shiner, green sunfish, spotfin shiner, johnny darter, smallmouth bass, and

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[72] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[73] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-190 95REV,* op. cit.

[74] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

[75] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[76] *Wisconsin Conservation Department,* op. cit.

blackstripe topminnow.[77] The banded killifish is listed as a State species of special concern. The slender madtom is listed as a state endangered species.

Pebble Brook

Stream Morphometry

Pebble Brook is located in the central portion of Waukesha County, as shown on Maps 24 and 29 in Chapter III of this report. The Brook has a surface area of about 3 acres, a length of 1.3 miles, and a gradient of 7.7 feet per mile. Pebble Brook is a low gradient tributary to the Fox River south of the City of Waukesha. It has two major tributaries: Redwing Creek and Mill Creek.

Recreational Use

Pebble Brook has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential

As of 1995, the land uses within the approximately 15-square-mile Pebble Brook subwatershed consisted of about 40 percent urban land uses and about 60 percent rural land uses. Agricultural land uses comprised about one-half of the rural land cover in the subwatershed. Urban residential lands comprised about two-thirds of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[78]

Nonpoint Sources of Water Pollution

Nonpoint pollution within the Pebble Brook subwatershed is generated from both rural agricultural and urban residential lands which comprise about three-fifths of the land cover within the watershed.

Fish and Wildlife Populations

In 1963, the fishery of Pebble Brook was reported to consist largely of forage species.[79] Fish surveys conducted in 1972 and 1978 reported the fishery to consist of black bullhead, fathead minnow, creek chub, rock bass, hornyhead chub, largemouth bass, pumpkinseed, fantail darter, johnny darter, stonecat, sand shiner, Iowa darter, central mudminnow, common carp, northern pike, grass pickerel, common shiner, rainbow darter, white sucker, green sunfish, brook stickelback, bluntnose minnow, and common shiner.[80]

Pebble Creek

Stream Morphometry

Pebble Creek is located in the south-central portion of Waukesha County, as shown on Maps 21, 24 and 25, in Chapter III of this report. The Creek has a surface area of about 7.9 acres, a length of 6.5 miles, and a gradient of about 21.5 feet per mile. Pebble Creek is a high gradient tributary to the Fox River, entering the Fox River southwest of the City of Waukesha. The headwaters are ditched and straightened, and the gradient increases in the downstream direction. The stream bottom is primarily gravel. Pebble Creek is included within the Upper Fox River Priority Watershed project area.[81]

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[77] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[78] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[79] *Wisconsin Conservation Department,* op. cit.

[80] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[81] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-366 94,* op. cit.

Recreational Use
Pebble Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately 18-square-mile Pebble Creek subwatershed consisted of about 30 percent urban land uses and about 70 percent rural land uses. Agricultural land uses comprised about three-fifths of the rural land cover in the subwatershed. Urban residential lands comprised about two-thirds of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[82]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Pebble Creek subwatershed is generated from both rural agricultural and urban residential lands that comprise about three-fifths of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Pebble Creek was reported to consist largely of forage species with northern pike making use of the stream during spring spawning runs.[83] Fish surveys conducted in 1972, 1973, 1978, and 1990 reported the fishery to consist of common shiner, black bullhead, rock bass, green sunfish, central stoneroller, johnny darter, largemouth bass, smallmouth bass, mottled sculpin, pumpkinseed, bluegill, rainbow darter, blacknose dace, hornyhead chub, fathead minnow, white sucker, orangespotted sunfish, sand shiner, brook stickleback, rosyface shiner, creek chub, and bluntnose minnow.[84]

Pewaukee River
Stream Morphometry
The Pewaukee River is located in the north-central portion of Waukesha County, as shown on Maps 16 and 21 in Chapter III of this report. The River has a surface area of about 26 acres, a length of 4.8 miles, and a gradient of 6.7 feet per mile. The Pewaukee River originates as the outlet of Pewaukee Lake and is a major tributary stream to the Fox River. The River is generally wide and silty, although it is also rapidly flowing in places. The Pewaukee River is included within the Upper Fox River Priority Watershed project area.[85]

Recreational Use
The Pewaukee River has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty. Public recreational boating access is provided through a public park within the Village of Pewaukee, which provides the venue for an annual canoe race down the River.

Development Potential
As of 1995, the land uses within the approximately 18-square-mile Pewaukee River subwatershed consisted of about 30 percent urban land uses and about 70 percent rural land uses. Agricultural land uses comprised about one-third of the rural land cover in the subwatershed. Urban residential lands comprised about two-thirds of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[86]

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[82] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[83] *Wisconsin Conservation Department,* op. cit.

[84] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[85] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-366 94,* op. cit.

[86] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Pewaukee River subwatershed is generated primarily from both rural agricultural lands and urban residential lands which comprise about two-fifths of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of the Pewaukee River was reported by the Wisconsin Department of Natural Resources to be limited due to shallow and silty conditions.[87] Fish surveys conducted in 1978 and 1990 reported the fishery to consist of orangespotted sunfish, creek chub, white sucker, black bullhead, largemouth bass, emerald shiner, golden shiner, tadpole madtom, pumpkinseed, yellow perch, goldfish, grass pickerel, brown bullhead, rock bass, johnny darter, central mudminnow, common shiner, bluegill, common carp, green sunfish, yellow bullhead, northern pike, and hornyhead chub.[88] The residents of the Village of Pewaukee, including the students of the Pewaukee School District acting in cooperation with the Lake Pewaukee Sanitary District and Waukesha County, have significantly improved the fishery habitat in the stream below Pewaukee Lake.

Poplar Creek
Stream Morphometry
Poplar Creek is located in the southeast portion of Waukesha County, as shown on Maps 22 and 23 in Chapter III of this report. The Creek has a surface area of about 24 acres, a length of 7.5 miles, and a gradient of 4.0 feet per mile. Poplar Creek is a slow flowing, muddy system of drainage ditching and streambed tributary to the Fox River. Fluctuating water levels present a use problem and much of the system is intermittent. Poplar Creek is included within the Upper Fox River Priority Watershed project area.[89]

Recreational Use
Poplar Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately 18-square-mile Poplar Creek subwatershed consisted of about 40 percent urban land uses and about 60 percent rural land uses. Agricultural land uses comprised about two-fifths of the rural land cover in the subwatershed. Urban residential lands comprised about one-half of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[90]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Poplar Creek subwatershed is generated from both rural agricultural lands and urban residential lands which comprise about one-half of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Poplar Creek was reported to consist largely of forage and rough fish species.[91] A fish survey conducted in 1978 reported the fishery to consist of central mudminnow, black bullhead, white sucker, and johnny darter.[92]

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[87] *Wisconsin Conservation Department,* op. cit.

[88] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[89] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-366 94,* op. cit.

[90] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[91] *Wisconsin Conservation Department,* op. cit.

[92] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

Redwing Creek

Stream Morphometry

Redwing Creek is located in the south-central portion of Waukesha County, as shown on Map 24 in Chapter III of this report. The Creek has a surface area of about 1 acre, a length of 1.5 miles, and a gradient of 5.0 feet per mile. Redwing Creek is a small, intermittent tributary to Pebble Brook.

Recreational Use

Redwing Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential

As of 1995, the land uses within the approximately one-square-mile Redwing Creek subwatershed consisted of about 20 percent urban land uses and about 80 percent rural land uses. Agricultural land uses comprised about one-fifth of the rural land cover in the subwatershed. Urban residential lands comprised about three-quarters of the urban land cover. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[93]

Nonpoint Sources of Water Pollution

Nonpoint pollution within the Redwing Creek subwatershed is generated primarily from both rural agricultural lands and urban residential lands that comprise about one-third of the land cover within the watershed.

Fish and Wildlife Populations

In 1963, the fishery of Redwing Creek was reported to consist largely of forage fish.[94]

Ripple Creek

Stream Morphometry

Ripple Creek is located in the southeast portion of Waukesha County, as shown on Maps 29 and 30 in Chapter III of this report. The Creek has a surface area of about 0.2 acres, a length of 0.5 miles, and a gradient of 4.0 feet per mile. Ripple Creek is a small, spring-fed tributary to the Fox River, joining the Fox River to the south of the Village of Big Bend. The Creek has been ditched through a housing development.

Recreational Use

Ripple Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential

As of 1995, the land uses within the approximately three-square-mile Ripple Creek subwatershed consisted of about 45 percent urban land uses and about 55 percent rural land uses. Agricultural land uses comprised about two-thirds of the rural land cover in the subwatershed. Urban residential lands comprised about one-half of the urban land cover. The subwatershed is located within an area planned for urban development in the adopted county development plan.[95]

Nonpoint Sources of Water Pollution

Nonpoint pollution within the Ripple Creek subwatershed is generated from both rural agricultural lands and urban residential lands that comprise about 55 percent of the land cover within the watershed.

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[93] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[94] *Wisconsin Conservation Department,* op. cit.

[95] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

Fish and Wildlife Populations
In 1963, the fishery of Ripple Creek was reported by the Wisconsin Department of Natural Resources to be absent due to ditching and the then-recent development of the shoreline for a housing development.[96]

Rosenow Creek
Stream Morphometry
Rosenow Creek is located in the northwest portion of Waukesha County, as shown on Map 18 in Chapter III of this report. The Creek has a surface area of about 2 acres, a length of 3.6 miles, and a gradient of 5.0 feet per mile. Rosenow Creek is a small spring-fed stream, which enters Lac La Belle along the northern shoreline. Ditching for drainage purposes has severely damaged the stream. Rosenow Creek is included within the Upper Rock River basin areawide water quality management planning area,[97] and within the Oconomowoc River Priority Watershed project area.[98]

Recreational Use
Rosenow Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately five-square-mile Rosenow Creek subwatershed consisted of about 25 percent urban land uses and about 75 percent rural land uses. Agricultural land uses comprised about four-fifths of the rural land cover in the subwatershed. Urban residential lands comprised about three-fifths of the urban land cover. The subwatershed is partially located within an area planned for urban development in the adopted county development plan.[99]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Rosenow Creek subwatershed is generated primarily from both rural agricultural lands and urban residential lands which comprise about three-quarters of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Rosenow Creek was reported to consist largely of forage fish with a few native trout[100] The Creek was managed for trout during the 1950s. However, a decline in water quality and volume has limited the active trout management program, although breeding populations of trout continue to exist in the stream. Fish surveys conducted in 1973, 1975, and 1981 reported the fishery to consist of central mudminnow, white sucker, golden shiner, fathead minnow, bluegill, black bullhead, yellow perch, common carp, brown trout, green sunfish, and brook stickleback.[101]

School Section Ditch
Stream Morphometry
School Section Ditch is located in the west-central portion of Waukesha County, as shown on Map 26 in Chapter III of this report. The Ditch has a surface area of about 5 acres, a length of 5.1 miles, and a gradient of 2.5

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[96]Ibid.

[97]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-190 95REV,* op. cit.

[98]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-194 86,* op. cit.

[99]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[100]*Wisconsin Conservation Department,* op. cit.

[101]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

feet per mile. School Section Ditch is a small drainage system tributary to the Bark River that drains School Section Lake. Flows fluctuate due to water levels within the impoundment and as a consequence of the intermittent flows of upstream drainage ditches. The Bark River, into which School Section Ditch drains, is included within the Lower Rock River basin areawide water quality management planning area.[102]

Recreational Use
School Section Ditch has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty due to intermittence.

Development Potential
As of 1995, the land uses within the approximately six-square-mile School Section Ditch subwatershed consisted of about 15 percent urban land uses and about 85 percent rural land uses. Agricultural land uses comprised about two-fifths of the rural land cover in the subwatershed. Urban residential lands comprised about three-fifths of the urban land cover. Since 1995, the number of active farms within the drainage area has diminished. Residential uses continue to be at suburban densities. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[103] An extensive system of wetlands links the upgradient Pretty Lake to School Section Lake, and the Bark River system.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the School Section Ditch subwatershed is generated primarily from both rural agricultural lands and urban residential lands which comprise about 45 percent of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of School Section Ditch was reported to consist largely of forage fish species.[104] However, the Wisconsin Department of Natural Resources has reported that northern pike are likely to make spawning use of the Ditch during spring spawning runs.

Scuppernong Creek
Stream Morphometry
Scuppernong Creek is located in the southwest portion of Waukesha County, as shown on Map 26 in Chapter III of this report. The Creek has a surface area of about 10 acres, a length of 5.5 miles, and a gradient of 3.6 feet per mile. Scuppernong Creek is a tributary to the Bark River. The stream is impounded south of the Village of Dousman and at Hunters Lake. Scuppernong Creek is included within the Lower Rock River basin areawide water quality management planning area.[105]

Recreational Use
Scuppernong Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty. However, the Creek does provide public recreational boating access to Hunters Lake from the Parry Road bridge crossing site.

Development Potential
As of 1995, the land uses within the approximately 18-square-mile Scuppernong Creek subwatershed consisted of about 30 percent urban land uses and about 70 percent rural land uses. Agricultural land uses comprised about

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[102]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-280 98-REV,* op. cit.

[103]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[104]*Wisconsin Conservation Department,* op. cit.

[105]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-280 98-REV,* op. cit.

two-thirds of the rural land cover in the subwatershed. Urban residential lands comprised about one-half of the urban land cover. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[106]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Scuppernong Creek subwatershed is generated primarily from both rural agricultural lands and urban residential lands which comprise about three-fifths of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Scuppernong Creek was reported to consist largely of northern pike, panfish, and largemouth bass.[107] Rough fish are common in the downstream portions of the Creek. Fish surveys conducted in 1973, 1975, and 1981 reported the fishery to consist of black crappie, rainbow darter, banded darter, fantail darter, blackstripe topminnow, common shiner, brook silverside, stonerollers, blacknose shiner, mimic shiner, hornyhead chub, grass pickerel, fathead minnow, pearl dace, creek chub, Iowa darter, common shiner, pumpkinseed, brook stickelback, mottled sculpin, green sunfish, white sucker, yellow bullhead, bluegill, bluntnose minnow, johnny darter, and northern hog sucker.[108] About 400 acres of wetland are found adjacent to the stream corridor.

Scuppernong River
Stream Morphometry
The Scuppernong River is located in the extreme southwest portion of Waukesha County, as shown on Maps 26 and 27 in Chapter III of this report. The River has a surface area of about 15 acres, a length of 9.5 miles, and a gradient of 13.2 feet per mile. The Scuppernong River is a small, spring-fed stream, which originated from spring ponds at the base of the terminal moraine. The River joins the Bark River within Jefferson County. There are about 3.0 miles of River in public ownership as part of the Kettle Moraine State Forest and the Scuppernong Wildlife Area. The Scuppernong River is included within the Lower Rock River basin areawide water quality management planning area.[109]

Recreational Use
Public recreational boating access is provided through the Kettle Moraine State Forest and the Scuppernong Wildlife Area. The Scuppernong River has limited navigability and is generally navigable only by canoe or similar watercraft.

Development Potential
As of 1995, the land uses within the approximately 23.5-square-mile Scuppernong River subwatershed consisted of about 5 percent urban land uses and about 95 percent rural land uses. Agricultural land uses comprised about 45 percent of the rural land cover in the subwatershed. Urban residential lands comprised about 40 percent of the urban land cover. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[110]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Scuppernong River subwatershed is generated primarily from rural agricultural lands which comprise about two-fifths of the land cover within the watershed.

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[106]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[107]*Wisconsin Conservation Department,* op. cit.

[108]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[109]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-280 98-REV,* op. cit.

[110]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

Fish and Wildlife Populations
In 1963, the fishery of the Scuppernong River was reported to consist largely of trout.[111] However, the low gradient and exposure of the stream bed is considered by the Wisconsin Department of Natural Resources to have resulted in warming of the water beyond optimum levels for trout, although trout remain in the stream. Fish surveys conducted in 1975 and 1977 reported the fishery to consist of banded darter, bluntnose minnow, northern pike, fathead minnow, rosyface shiner, common carp, sand shiner, green sunfish, yellow bullhead, spotfin shiner, rock bass, rainbow darter, bluegill, white sucker, northern hog sucker, fantail darter, black bullhead, stonecat, golden redhorse, pumpkinseed, lake chubsucker, golden shiner, black crappie, grass pickerel, hornyhead chub, common shiner, johnny darter, brown trout, mottled sculpin, and creek chub.[112] The lake chubsucker is listed as a state species of special concern.

Sussex Creek
Stream Morphometry
Sussex Creek is located in the east-central portion of Waukesha County, as shown on Maps 16 and 21 in Chapter III of this report. The Creek has a surface area of about 3 acres, a length of 5.0 miles, and a gradient of 14.0 feet per mile. Sussex Creek is a small stream and system of drainage ditches tributary to the Fox River. The stream originates in the vicinity of Sussex and one branch intermittently drains through a small retention pond in the Village. The stream receives treated effluent from the Village of Sussex. Sussex Creek is included within the Upper Fox River Priority Watershed project area.[113]

Recreational Use
Sussex Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately 18-square-mile Sussex Creek subwatershed consisted of about 30 percent urban land uses and about 70 percent rural land uses. Agricultural land uses comprised about two-thirds of the rural land cover in the subwatershed. Urban residential lands comprised about one-half of the urban land cover. The subwatershed is located within an area planned for urban development in the adopted county development plan.[114]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Sussex Creek subwatershed is generated primarily from both rural agricultural lands and urban residential lands which comprise about three-fifths of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Sussex Creek was reported to consist largely of forage species.[115]

Underwood Creek
Stream Morphometry
Underwood Creek is located in the east-central portion of Waukesha County, as shown on Map 22 in Chapter III of this report. The Creek has a surface area of about five acres, a length of 5.1 miles, and a gradient of 7.1 feet per

[111] *Wisconsin Conservation Department,* op. cit.

[112] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[113] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-366 94,* op. cit.

[114] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[115] *Wisconsin Conservation Department,* op. cit.

mile. Underwood Creek is a small stream, which serves as drainage for much of the City and Town of Brookfield and the Village of Elm Grove within Waukesha County. The Creek is tributary to the Menomonee River.

Recreational Use
Underwood Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately 11-square-mile Underwood Creek subwatershed consisted of about 80 percent urban land uses and about 20 percent rural land uses. Rural land uses were comprised almost exclusively of woodlands, wetlands, and surface waters. Urban residential lands comprised about two-thirds of the urban land cover. The subwatershed is located within an area planned for urban development in the adopted county development plan.[116]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Underwood Creek subwatershed is generated primarily from urban residential lands that comprise about one-half of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Underwood Creek was reported to consist largely of forage fish.[117] A fluctuating flow was reported to be a major use problem. Fish surveys conducted in 1973, 1984, and annually from 1991 through 1994 reported the fishery to consist of brook stickleback, white sucker, central mudminnow, blacknose dace, bluegill, creek chub, pumpkinseed, green sunfish, johnny darter, fathead minnow, northern pike, and largescale stoneroller.[118]

Wales Creek
Stream Morphometry
Wales Creek is located in the west-central portion of Waukesha County, as shown on Maps 25 and 26 in Chapter III of this report. The Creek has a surface area of about 1 acre, a length of 1.6 miles, and a gradient of 6.0 feet per mile. Wales Creek is a small spring-fed drainage stream tributary to Scuppernong Creek. Much of the stream has been ditched. Scuppernong Creek, into which Wales Creek flows, is included within the Lower Rock River basin areawide water quality management planning area.[119]

Recreational Use
Wales Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately 2.5-square-mile Wales Creek subwatershed consisted of about 45 percent urban land uses and about 55 percent rural land uses. Agricultural land uses comprised about three-fifths of the rural land cover in the subwatershed. Urban residential lands comprised about two-thirds of the urban land cover. The subwatershed is not located within an area planned for urban development in the adopted county development plan.[120]

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[116]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[117]*Wisconsin Conservation Department,* op. cit.

[118]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

[119]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-280 98-REV,* op. cit.

[120]*SEWRPC Community Assistance Planning Report No. 209,* op. cit.

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Wales Creek subwatershed is generated primarily from both rural agricultural lands and urban residential lands which comprise about three-fifths of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Wales Creek was reported to consist largely of forage fish.[121] However, the Wisconsin Department of Natural Resources considered the potential of this stream to support trout to be high.

Zion Creek
Stream Morphometry
Zion Creek is located in the central portion of Waukesha County, as shown on Map 20 in Chapter III of this report. The Creek has a surface area of about 1 acre, a length of 1.5 miles, and a gradient of 10.0 feet per mile. Zion Creek is a small intermittent tributary to Pewaukee Lake. Highways, IH 94 and CTH G, have considerably altered the nature of this stream; however, it still maintains a gravelly bottom.

Recreational Use
Zion Creek has limited navigability and is generally navigable only by canoe or similar watercraft with difficulty.

Development Potential
As of 1995, the land uses within the approximately four-square-mile Zion Creek subwatershed consisted of about 40 percent urban land uses and about 60 percent rural land uses. Agricultural land uses comprised about three-fifths of the rural land cover in the subwatershed. Urban residential lands comprised about three-fifths of the urban land cover. The subwatershed is partially located within an area planned for urban development.[122]

Nonpoint Sources of Water Pollution
Nonpoint pollution within the Zion Creek subwatershed is generated from both rural agricultural lands and urban residential lands that comprise about three-fifths of the land cover within the watershed.

Fish and Wildlife Populations
In 1963, the fishery of Zion Creek was reported to consist largely of forage fish.[123] Other fishes were considered by the Wisconsin Department of Natural Resources to be likely to enter the stream during spring spawning runs. A fish survey conducted in 1977 reported the fishery to consist of pumpkinseed, bluegill, hornyhead chub, yellow perch, brook stickleback, green sunfish, black bullhead, and largemouth bass.[124]

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[121] *Wisconsin Conservation Department,* op. cit.

[122] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[123] *Wisconsin Conservation Department,* op. cit.

[124] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* op. cit.

Chapter V

ALTERNATIVE CLASSIFICATION SYSTEMS AND POTENTIAL CLASSES

INTRODUCTION

This chapter sets forth the statutory criteria required to be considered in the classification of lakes and streams pursuant to Section 281.69(5) of the *Wisconsin Statutes*, summarizes the inventory data set forth in the preceding chapters, and presents alternative methodologies for the classification of lakes and streams within Waukesha County. The purpose of these alternative lake and stream classification methodologies is to serve as a "sorting mechanism" to systematically divide types of lakes and streams within the County into regulatory classes that reflect the sensitivity of the water resources to human impacts. The alternatives were developed pursuant to the requirements of Section 281.69, *Wisconsin Statutes*, and were derived from the statistical analysis of the scientific and technical inventory data presented heretofore.

LAKE CLASSIFICATION CRITERIA

Under Section 281.69(5)(b), *Wisconsin Statutes* directed the Wisconsin Department of Natural Resources (WDNR) to establish guidelines for lake classification based upon consideration of certain specific minimum criteria to be used in a classification project. These minimum criteria include seven parameters commonly used to describe a lake and its watershed:

1. The size, depth, and shape of the lake.
2. The size of the lake's watershed.
3. The quality of the water in the lake.
4. The potential of the lake to become overused for recreational purposes.
5. The potential for the development of lands surrounding the lake.
6. The potential of the lake to suffer from nonpoint source water pollution.
7. The type and size of the fish and wildlife population in and around the lake.

These criteria were subsequently embodied in an amendment of Chapter NR 191 of the *Wisconsin Administrative Code*, the provisions of which governed the analyses underlying the development of a lake classification scheme for Waukesha County. Each of these criteria is set forth in more detail below.

Size, Depth, and Shape of Lakes

Surface Area

Surface area is a measure of the size of a lake, describing the areal extent of a lake within the landscape. This criterion has relevance to the recreational use of lakes, being the criterion used in Chapter NR 1 of the *Wisconsin Administrative Code* to determine maximum and minimum public recreational boating access standards. In addition, this criterion is related to water quality as smaller lakes are generally more likely to be susceptible to water pollution than the larger lakes within Waukesha County. Surface area also is used in the calculation of lake volume, mean depth, and water retention time. Surface area data were abstracted from the adopted regional water quality management plan, surface water inventories, lake management reports, and lake use reports for the Fox River basin.[1]

Maximum Depth

The maximum depth of a lake is a measure of the depth of water at the deepest point within a lake. This criterion is related to the ability of a lake to assimilate pollutants as shallow lakes are generally more susceptible to pollution than deeper lakes within Waukesha County. Maximum depth also is used in the calculation of lake volume. Maximum depth is generally considered as a separate criterion to another lake depth descriptor, mean depth, that is the dividend of lake volume divided by lake surface area. Maximum depth data were abstracted from the adopted regional water quality management plan, surface water inventories, lake management reports, and lake use reports for the Fox River basin.[2]

Mean Depth

The mean depth of a lake is a measure of the average depth of water within a lake. As with the closely related criterion of maximum depth, this criterion is related to the ability of a lake to assimilate pollutants, as shallow lakes are generally more susceptible to pollution than deeper lakes within Waukesha County. However, mean depth is generally considered as a separate criterion to maximum depth. Mean depth is determined as the dividend of lake volume divided by lake surface area. Mean depth data were abstracted from the adopted regional water quality management plan, surface water inventories, lake management reports, and lake use reports for the Fox River basin.[3]

Shoreline Development Factor (SDF)

Shoreline development factor is a measure of the shape of a lake, describing the ratio of the shoreline length of a lake to the circumference of a circle with the same area as the lake surface area. A higher number indicates a more irregular lakeshore as the shoreline length is greater than the circular reference. The lower the number, the more circular a lake is in shape. SDF is related to the amount of shoreline available for development, with more irregular shorelines offering more shoreline length along which development could occur. SDF also is related to water quality and shoreline habitat, as both of these can be negatively affected by urban development. Shoreline development factor data were abstracted from the adopted regional water quality management plan, surface water inventories, lake management reports, and lake use reports for the Fox River basin.[4]

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[1]*SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report, *March 1995; Wisconsin Conservation Department,* Surface Water Resources of Waukesha County, *1963; SEWRPC-WDNR Lake Use Reports Nos. FX-3,* Big Muskego Lake, *1971; FX-10,* Little Muskego Lake, *1969; FX-14,* Lower Phantom Lake, *1969; FX-19,* Eagle Spring Lake, *1969; FX-23,* Denoon Lake, *1970; FX-33,* Upper Phantom Lake, *1969; and FX-34,* Spring Lake, *1969.*

[2]Ibid.

[3]Ibid.

[4]Ibid.

Size of the Watershed

Watershed area, or the surface area of the drainage basin tributary to the lake, is a measure of the areal extent of the land surface surrounding the lake and draining into it. Larger watersheds generally result in higher pollutant loads given comparable land uses within the watersheds. Land use activities within a watershed are directly correlated to the generation and delivery of contaminants from the land surface to waterways. Watershed area is used in the calculation of water residence time and flushing rate. Watershed areas were determined by the Southeastern Wisconsin Regional Planning Commission based upon subbasin delineations prepared by Commission staff for the adopted regional water quality management plan and selected lake management plans.[5]

Water Quality

The Trophic State Index (TSI) is an empirical means of comparing the water quality of lakes. It is based upon a scale of 1 to 100, where values of less than 50 indicate an oligotrophic, or nutrient poor, state or mesotrophic state, and where values of greater than 50 indicate a eutrophic, or nutrient rich, state. Two forms of the TSI equation are used in Wisconsin; namely, the Carlson TSI which is based upon equations developed in Ohio lakes,[6] and the Wisconsin TSI (WTSI) which is based upon equations developed specifically for Wisconsin conditions, taking into consideration the humic character of Wisconsin lakes versus the clearer water character of

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[5]*SEWRPC Memorandum Report No. 93,* op. cit.; *SEWRPC Community Assistance Planning Report No. 47,* A Water Quality Management Plan for Lac La Belle, Waukesha County, Wisconsin, *December 1980; SEWRPC Community Assistance Planning Report No. 53,* A Water Quality Management Plan for Okauchee Lake, Waukesha County, Wisconsin, *August 1981; Wisconsin Department of Natural Resources Publication No. PUBL-WR-194-86,* A Nonpoint Source Control Plan for the Oconomowoc River Priority Watershed Project, *March 1986; SEWRPC Community Assistance Planning Report No. 48,* A Water Quality Management Plan for Ashippun Lake, Waukesha County, Wisconsin, *January 1982; SEWRPC Community Assistance Planning Report No. 54,* A Water Quality Management Plan for North Lake, Waukesha County, Wisconsin, *July 1982; SEWRPC Community Assistance Planning Report No. 58,* A Water Quality Management Plan for Pewaukee Lake, Waukesha County, Wisconsin, *March 1984; SEWRPC Community Assistance Planning Report No. 181,* A Water Quality Management Plan for Oconomowoc Lake, Waukesha County, Wisconsin, *March 1990; SEWRPC Community Assistance Planning Report No. 187,* A Management Plan for Fowler Lake, Waukesha County, Wisconsin, *March 1994; SEWRPC Community Assistance Planning Report No. 222,* A Lake Management Plan for Little Muskego Lake, Waukesha County, Wisconsin, *June 1996, SEWRPC Community Assistance Planning Report No. 227,* A Lake Management Plan for Lake Keesus, Waukesha County, Wisconsin, *June 1998; SEWRPC Community Assistance Planning Report No. 262,* A Lake Management Plan for Nagawicka Lake, Waukesha County, Wisconsin, *March 2001; SEWRPC Memorandum Report No. 56,* A Lakefront Recreational Use and Waterway Protection Plan for the Village of Pewaukee, *March 1996; SEWRPC Memorandum Report No. 81,* Aquatic Plant Management Plan for Phantom Lakes, Waukesha County, Wisconsin, *July 1993; SEWRPC Memorandum Report No. 82,* A Lake Protection Plan for Silver Lake, Waukesha County, Wisconsin, *July 1993; SEWRPC Memorandum Report No. 94,* A Recommended Public Boating Access and Waterway Protection Plan for Big Muskego Lake, Waukesha County, Wisconsin, *July 1994; SEWRPC Memorandum Report No. 120,* A Lake Protection and Recreational Use Plan for Hunters Lake, Waukesha County, Wisconsin, *May 1997; SEWRPC Memorandum Report No. 122,* A Lake Protection Plan for Pretty Lake, Waukesha County, Wisconsin, *April 1998; SEWRPC Memorandum Report No. 124,* An Aquatic Plant Inventory for Pine Lake, Waukesha County, Wisconsin, *December 1998; SEWRPC Memorandum Report No. 130,* A Lake and Watershed Inventory for Nagawicka Lake, Waukesha County, Wisconsin, *March 1999; SEWRPC Memorandum Report No. 134,* An Aquatic Plant Management Plan for Fowler Lake, Waukesha County, Wisconsin, *October 2000; and SEWRPC Memorandum Report No. 135,* A Lake Protection Plan for the Kelly Lakes, Milwaukee and Waukesha Counties, Wisconsin, *October 2000.*

[6]*R.E. Carlson, "A Trophic State Index for Lakes,"* Limnology and Oceanography, *Vol. 22, No. 2, 1977.*

taking into consideration the humic character of Wisconsin lakes versus the clearer water character of Ohio lakes.[7] Both indices are based upon Secchi disk transparency measurements, and total phosphorus and chlorophyll-*a* concentrations. This Index serves as a well-established indicator of the productivity of a lake. The greatest potential impact of recreational activities will occur in mesotrophic and oligotrophic lakes which are characterized as having sparse to moderate aquatic plant growth and low to moderate nutrient concentrations, and relatively good water quality. If a lake is eutrophic, the impact from recreational activities may be obscured by other factors, rendering the effects from motorized watercraft insignificant. TSI data were determined by the Regional Planning Commission staff using data provided through the WDNR Self-Help Monitoring Program, the WDNR Long-Term Trends Lake Monitoring Program, unpublished WDNR data compiled for the preparation of WDNR Priority Watershed Nonpoint Source Pollution Control plans and basin plans, and U.S. Geological Survey data published annually as water-data reports.[8]

Potential to be Overused for Recreational Purposes

Chapter NR 1 of the *Wisconsin Administrative Code* sets maximum and minimum public recreational boating access standards based upon lake surface area. Existing public recreational boating opportunities were compared to these standards, based upon records maintained by the WDNR Southeast Region headquarters.

Potential for the Development of Lands

Lakeshore development was assessed quantitatively using 1995 land use data compiled by the Regional Planning Commission and forecasts of the likely land use changes to be expected based upon the adopted county development plan. Both urban and rural agricultural development within the watershed is related to water quality in that human activities on the land surface generate and mobilize phosphorus and other contaminants that can enter the aquatic environment. These contaminants can either stimulate biological production, in the case of plant nutrients, for example, or diminish biological production, as in the case of toxicants. Excessive levels of both can modify the biotic community in a lake system and are generally viewed as negative. It should be noted, however, that all lands contribute materials to aquatic ecosystems. Because of their location immediately adjacent to lakes, though, lakeshore or riparian lands in particular can most directly influence water quality and biological communities dependent upon water quality.

Potential for Nonpoint Source Pollution

Lake Hydrologic Type

Lake type designations are related to the primary source of the water flowing into a lake. Lake type data were abstracted from WDNR inventories.[9] The WDNR uses four lake type categories; namely, 1) seepage lakes, 2) drainage lakes, 3) spring lakes, and 4) drained lakes:

1. **Seepage lakes** are primarily rainwater-fed lakes, having neither an inlet or outlet stream. Rainwater enters these lakes either directly as precipitation onto the lake surface or indirectly as interflow, or groundwater flow, from rainfall onto and percolating through the surrounding land area. These lakes

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[7] *R.A. Lillie, S. Graham, and P. Rasmussen, "Trophic State Index Equations and Regional Predictive Equations for Wisconsin Lakes,"* Research and Management Findings, *Wisconsin Department of Natural Resources Publication No. PUBL-RS-735 93, May 1993.*

[8] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-194-86,* op. cit.; *PUBL-WR-320-93,* Upper Fox River Priority Watershed Project: A Nonpoint Source Control Plan, *November 1993; U.S. Geological Survey Water-Data Reports WI-90-1 through WI-99-1,* Water Resources Data-Wisconsin, Water Year 1990 *through* Water Year 1999, *published annually, March 1991 through March 2000; U.S. Geological Survey Open-File Reports 95-190, 96-168, 97-123, 98-78, 99-98 and 00-89,* Water Quality and Lake-Stage Data for Wisconsin Lakes, Water Year 1994 *through* Water Year 1999, *published annually, 1995 through 2000.*

[9] *Wisconsin Department of Natural Resources Publication No. PUBL-FM-800-95 REV,* Wisconsin Lakes, *1995.*

have small to very small watersheds and low flushing rates, longer water residence times, that make these lakes hypersensitive to pollutant loadings. Pollutants entering these lakes tend to remain in these lakes. These lakes share many of the same characteristics as spring lakes and are often indistinguishable from such lakes.

2. **Drainage lakes** are those lakes that most people would visualize as lakes. They have a permanent inlet and outlet, and are primarily stream-fed. They tend to have large to very large watersheds and higher flushing rates, shorter water residence times, that make these lakes less sensitive to pollutant loadings. Pollutants entering these lakes are rapidly flushed through these lakes.

3. **Spring lakes** are primarily groundwater-fed lakes. Some spring lakes have an outlet that flows intermittently as a result of high lake levels overflowing a low section of lakeshore. Spring lakes have relatively small watersheds and low to moderated flushing rates, moderate water residence times, that make these lakes relatively sensitive to pollutant loadings. Pollutants entering these lakes tend to remain in these lakes, although some flushing can occur. These lakes share many of the same characteristics as seepage lakes and are often indistinguishable from such lakes.

4. **Drained lakes** are lakes having a defined outlet with perennial stream flow; however, the lakes lack a defined inflow. Drained lakes are generally associated with headwater streams. Drained lakes have small to moderately-sized watersheds and moderate flushing rates, moderate water residence times, make them relatively insensitive to pollutant loadings. Pollutants entering these lakes can be flushed through these lakes over time.

Phosphorus Sensitivity

Phosphorus sensitivity is a measure of the degree to which a lake is likely to experience increased aquatic plant growth as a result of increased in the in-lake phosphorus concentration. Phosphorus tends to be the primary nutrient limiting the growth of aquatic plants in north temperate lakes. That is, the addition of phosphorus to most lake systems will stimulate additional algal growth. Phosphorus sensitivity is related to aquatic habitat and water quality, if there is abundant phosphorus, there is likely to be abundant algal or aquatic plant growth that can result in nuisance conditions for recreational users. Phosphorus sensitivity is generally estimated as a function of the flushing rate, water residence time.[10] For purposes of this study, phosphorus sensitivity is expressed as the areal loading rate of phosphorus to a lake, using the mass of phosphorus estimated to be entering a lake from its watershed divided by lake surface area. There is a strong positive correlation between both shoreline development and land usage within the watershed and the levels of phosphorus in a lake. As shoreline development and intensity of land usage increases, so to do the concentrations of phosphorus in the lake.

Flushing Rate

Flushing rate is an estimate of the number of times per year a volume of water equal to the total volume of a lake enters the lake. The converse of flushing rate is water residence time; that is, an estimate of the length of time a volume of water equal to the total volume of the lake remains in the lake. Lakes with low flushing rates, longer water residence times, are more susceptible to pollutant loadings as the pollutants remain in the lakes for a longer period, increasing the length of exposure of lake organisms to potentially deleterious affects or the length of availability of nutrients and other elements that cause increased biological responses, such as aquatic plant growth. Water residence time is calculated as the volume of the lake divided by the volume of water entering the lake on an annual basis. Flushing rate is the inverse of this dividend. For the purposes of this study, flushing rate was calculated from long-term average annual rainfall data using the algorithms set forth within the Wisconsin Lake Model Spreadsheet (WILMS), version 3.0.[11]

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[10] *Organization of Economic Cooperation and Development (OECD),* Eutrophication of Waters: Monitoring, Assessment and Control, *Paris, 1982.*

[11] *Wisconsin Department of Natural Resources Publication No. PUBL-WR-363-96 REV,* Wisconsin Lake Model Spreadsheet Version 2.00 User's Manual, *June 1994, as amended for use with Version 3.0.*

Type and Size of Fish and Wildlife Populations
The biological condition of a lake includes both types and abundance of aquatic plant species, fish species, and wildlife species that utilize the lake and surrounding habitat. As levels of enrichment increase, the likelihood of less desirable changes in the composition of the flora and fauna increases; generally, enriched or polluted systems contain large numbers of few species, particularly those species considered as "rough" fish or nuisance plants. As lakes age, these types of changes occur. Humans can accelerate these changes through modification to the watershed. Paved surfaces, for example, limit groundwater recharge and increase surface runoff, warming the water and increasing the nature and ability of the runoff to carry contaminants. Such changes can alter a coldwater fishery to a warmwater fishery. As development has taken place, fewer coldwater systems remain. In many cases, these changes result in the plant and animal species living within these systems to becoming threatened or endangered. For this reason, the species of special concerns should also be considered in an assessment of plant and animal populations, types and numbers. Fisheries data were abstracted from records maintained by the WDNR,[12] while other wildlife and fisheries information was obtained from the adopted regional natural areas and critical species habitat protection and management plan.[13]

STREAM CLASSIFICATION CRITERIA

Stream Length, Width, and Depth
Stream systems consist of reaches having a range of characteristics. Many streams consist of a series of pools and riffles, or rapids, linking the pools. Generally only artificial channels, such as agricultural drainageways, have standard dimensions throughout their length. Thus, to estimate stream width and depth, a series of measurements are obtained over a known length of stream. These values are averaged and reported as average width and average depth. Average width, when multiplied by stream length, provides an estimate of stream surface area. Stream surface area, when multiplied by average depth, provides an estimate of stream volume. The ratio of stream width to stream depth provides information on the shape of the stream channel, which, in turn, is related to the type of habitat provided within a stream reach. In general, water in narrower stretches of stream flows at higher velocities than water in broader stream reaches. Stream length, width, and depth data were abstracted from the surface water inventories.[14]

Watershed Area
Watershed area, or the surface area of the drainage basin tributary to the waterbody, is a measure of the areal extent of the land surface surrounding the waterbody and draining into it. Larger watersheds generally result in higher pollutant load, given comparable land uses within the watershed, as land use activities are directly correlated to the generation and delivery of contaminants. Watershed area is also used in the calculation of flushing rates. Watershed areas were determined by the Regional Planning Commission based upon subbasin delineations prepared by the Commission staff for the adopted regional water quality management plan.

Threatened and Endangered Species, and Species of Special Concern
The biological condition of a waterbody is characterized by both the types and abundance of 1) aquatic plant species, 2) fish species, and 3) wildlife species that utilize the lake and surrounding habitat. As levels of nutrient enrichment increase, the likelihood of less desirable changes in the composition of the flora and fauna increases. Generally, enriched or polluted systems contain large numbers of few species, particularly those species considered as "rough" fish or nuisance plants. As waterbodies age, these types of changes occur. Humans can

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[12] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* Retrieval and Analysis Used in Statewide Fish Distribution Survey, *2nd Edition, December 1988; Wisconsin Department of Natural Resources Publication No. FM-800-95 REV,* op. cit.

[13] *SEWRPC Planning Report No. 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin, *September 1997.*

[14] *Wisconsin Conservation Department,* Surface Water Resources of Waukesha County, *1963.*

accelerate these changes through modification to the watershed. Paved surfaces, for example, limit groundwater recharge, increase surface runoff, warm the water, and increase the ability of the runoff to carry contaminants. Such changes can alter a coldwater fishery to a warmwater fishery. As development has taken place, fewer coldwater systems remain. In many cases, these changes result in the plant and animal species living within these systems becoming threatened or endangered. For this reason, the species of special concern should also be considered in an assessment of plant and animal populations, types and numbers. Fisheries data were abstracted from records maintained by the WDNR,[15] while other wildlife and fisheries information was obtained from the adopted regional natural areas and critical species habitat protection and management plan.[16]

Biotic Indices

In an effort to better integrate the biological communities and the habitat conditions conducive to specific community types, a number of biological indices have been created. The WDNR adopted the Hilsenhoff Biotic Index (HBI) as an integrated assessment tool for benthic, or bottom-dwelling, organisms.[17] Benthic organisms include insect larvae, microcrustaceans, and other organisms that form the food base for fish communities in flowing water environments. Fish communities are also evaluated using a biological index. The Index of Biotic Integrity (IBI), like the HBI, provides an integrated assessment of the fish community and habitat characteristics of a flowing water environment.[18] The warmwater IBI has been adopted by the WDNR for stream assessments and is the most widely used version of this index. A coldwater community IBI also has been developed and is in use where applicable.[19] A lake version of this index has been mooted for development, but remains in the conceptual stage. Data on the HBI and IBI ratings of streams in Waukesha County were abstracted from the adopted regional water quality management plan, and from the data base maintained by the College of Natural Resources at the University of Wisconsin-Stevens Point.[20]

SUMMARY OF INVENTORY FINDINGS

The water resources within Waukesha County have their origin during the late Wisconsin stage of the last glaciation approximately 10,000 years before present. Waukesha County was included in the interlobate area between the Green Bay and Lake Michigan glaciers. This geographic positioning created an area of moraine separating two major drainage basin systems and forming the headwaters of numerous minor tributary drainage systems.

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[15] *D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* Retrieval and Analysis Used in Statewide Fish Distribution Survey, 2nd Edition, *December 1988; Wisconsin Department of Natural Resources Publication No. FM-800-95 REV,* Wisconsin Lakes, *1995.*

[16] *SEWRPC Planning Report No. 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin, *September 1997.*

[17] *Wisconsin Department of Natural Resources Technical Bulletin No. 132,* Using a Biotic Index to Evaluate Water Quality in Streams, *1982.*

[18] *U. S. Department of Agriculture, Forest Service General Technical Report No NC-149,* Using the Index of Biotic Integrity (IBI) to Measure Environmental Quality in Warmwater Streams of Wisconsin, *April 1992.*

[19] *John Lyons, Lizhu Wang, and Timothy D. Simonson, "Development and Validation of an Index of Biotic Integrity for Coldwater Streams in Wisconsin,"* North American Journal of Fisheries Management, *volume 16, number 2, pages 241-256, May 1996.*

[20] *SEWRPC Memorandum Report No. 93, op. cit.; College of Natural Resources, University of Wisconsin-Stevens Point,* DNR Biotic Index Database, Version 6.01, *November 1999.*

The manner of creation of these drainage systems has created a remarkable uniformity in the surface water resources of Waukesha County, albeit one characterized by a striking dichotomy. Many lakes and streams formed in the valleys between the moraines, and are fed by rainfall, overland flow, and groundwater. These systems are generally considered to be river-run lakes or larger stream systems such as the Rock River and its major tributaries—the Oconomowoc River and Bark River systems—and the Fox River system. In addition, the glacial moraines and valleys also gave rise to smaller stream systems and isolated waterbodies, commonly referred to as "kettles." Nevertheless, the similarity of these sources of water results not only in a physical similarity as apparent within these two major waterbody groupings, but also in a similarity of water quality, which has contributed to a general similarity in the biotic elements of the waters of Waukesha County.

The similarities within the data set are reflected in the limited ranges observed in the published data as shown in Figure 21 for lakes and in Figure 22 for streams. Consequently, the ranges of values observed in both water quality indicators and biological community indicators within Waukesha County do not sufficiently differentiate between lakes and streams to be considered good indicators for the purposes of classifying waters.

CONCEPTUAL LAKE AND STREAM CLASSIFICATION APPROACHES

There are three potential systems for applying classification systems to the lakes of Waukesha County, each with a number of variations; namely, 1) using simple, site-specific criteria or criteria to allow for site-specific determinations of regulatory actions, 2) using a countywide multimetric or multiple criteria, preassigned class system to determine regulatory action, and 3) a hybrid scheme using a combination of simple, site-specific measurements to augment a multi-criteria classification system. Each of these options has strengths and weaknesses. The key features of each alternative are set forth below.

Site-Specific Classification

Site-specific determinations have the advantage that appropriate regulatory actions can be undertaken based upon the specific conditions prevailing at any given site. This system would remain applicable to new waters entering the regulatory arena. For example, conversion of a nonregulated agricultural drainage system into a regulated system at the time of rezoning for residential development would not pose a problem under this type of classification system as a few simple measurements could readily establish a relevant class. Likewise, creation of a new lake within a flooded quarry, a not uncommon occurrence in Southeastern Wisconsin, could be accommodated using this classification system. Due to the site-specific basis of this system, there would be no need to modify or amend the County ordinance pertaining to the classification system to accommodate new entrants. This system, if based on physical measurements, is likely to be easily understood by most citizens. Also, measurements can be taken at any time of the year to facilitate the permitting process. Analysis of the available data for Waukesha County lakes suggests that specific indices can be defined that differentiate discrete classes of waters using simple, site-specific, physical criteria, such as surface area or maximum depth.

County-Based Classification

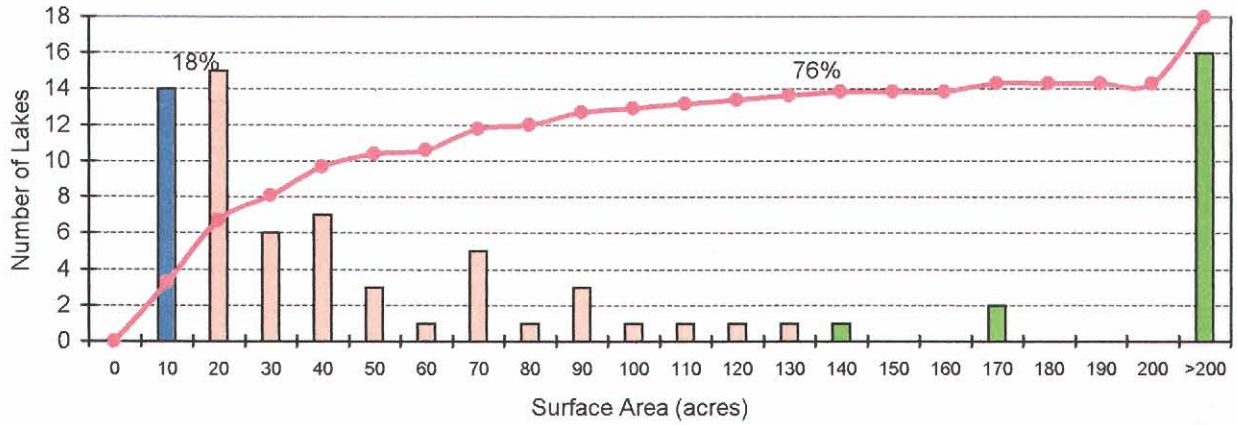
A County-based classification system has the advantage of being map-based, which contributes to a very visual display. Waterbodies are classified multiple parameters. Use of multiple parameters also better integrates the physical, chemical, and biological characteristics of a lake into the regulatory framework. This system is most similar to the current State regulatory framework such as that established under Chapter NR 104 of the *Wisconsin Administrative Code* for setting water use objectives for inland lakes and streams.

The disadvantage of this system is largely related to its complexity and, to a lesser extent, to its inflexibility. Once the classes are established using a combination of measures, the results are either mapped or described as stream reaches or specific lakes. Addition of new entrants to the system is difficult, as it requires the conduct of field investigations. Because these systems are data intensive, they demand costly and time consuming field investigation. To overcome this limitation, the Chapter NR 104 approach provides a "catch-all" class that automatically includes lakes; it may not appropriately classify specific waterways. Likewise, the ability of this system to accommodate changing environmental conditions is limited as a result of having to amend the legal language

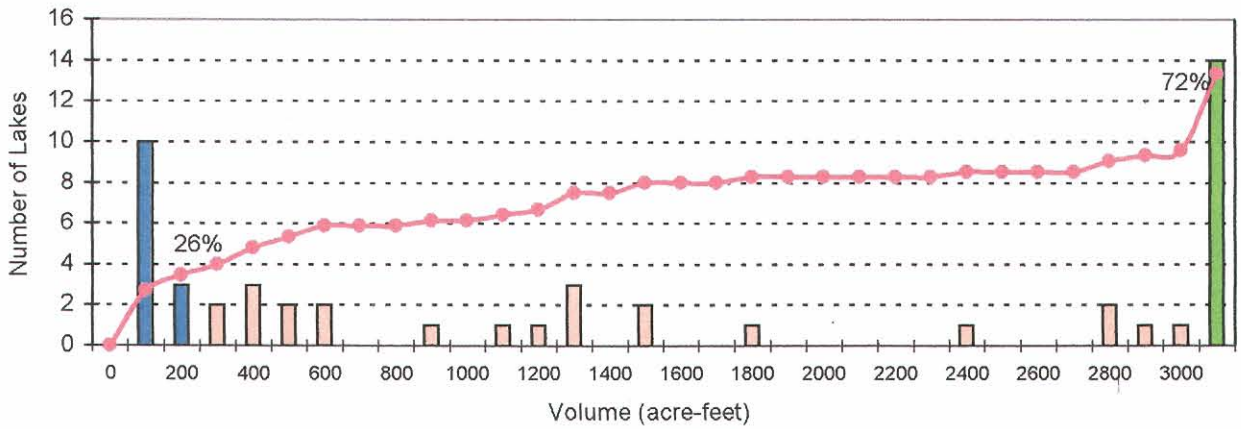
Figure 21

FREQUENCY DISTRIBUTION FOR SELECTED CHARACTERISTICS OF LAKES WITHIN WAUKESHA COUNTY FOR USE IN WATERBODY CLASSIFICATION: 2002

LAKE SURFACE AREA



LAKE VOLUME



SHORELINE DEVELOPMENT FACTOR

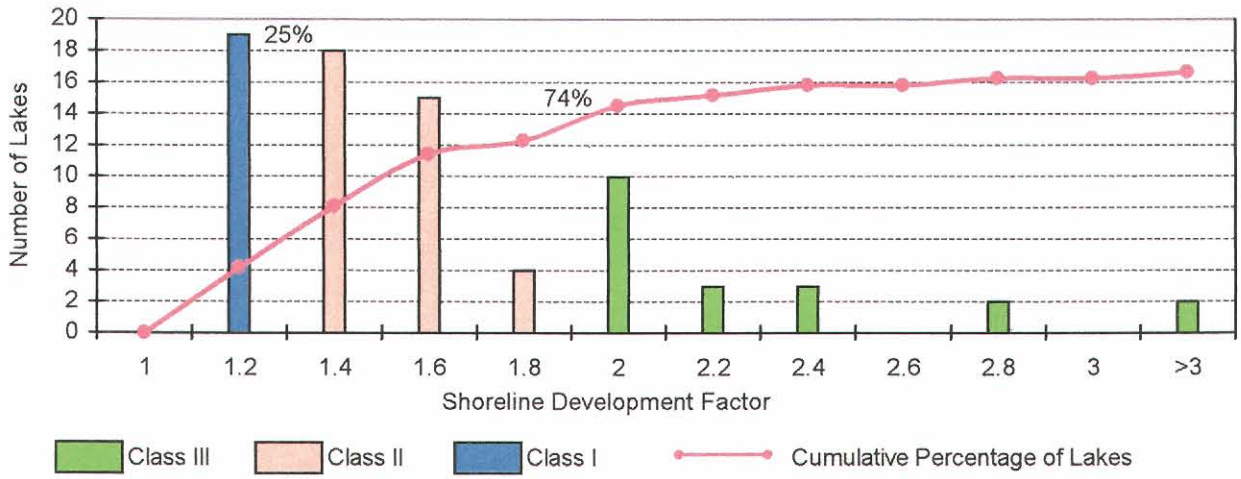
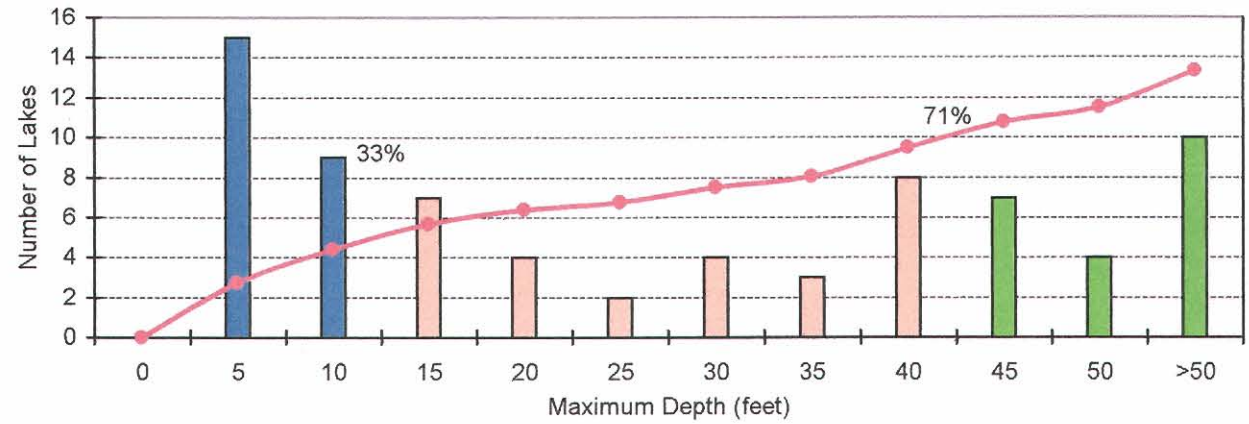
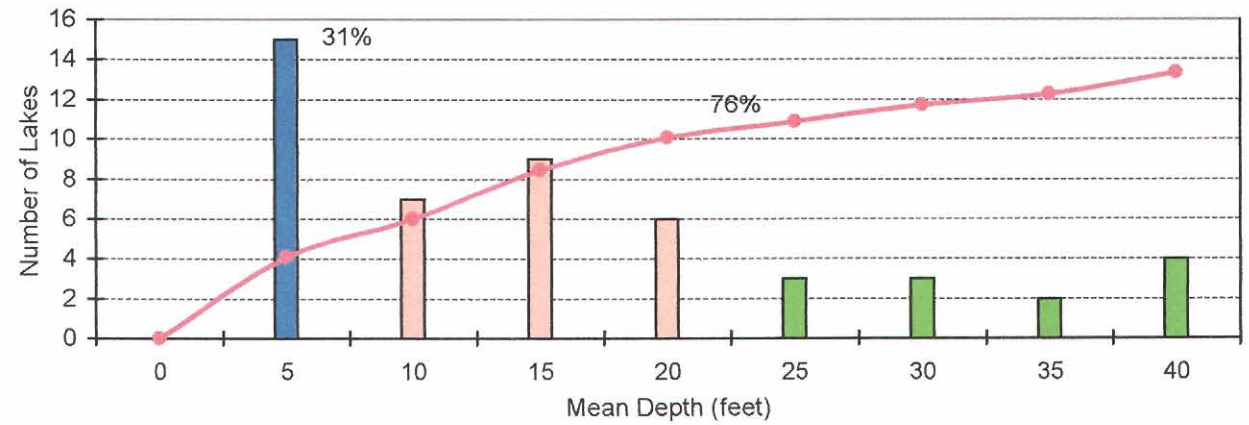


Figure 21 (continued)

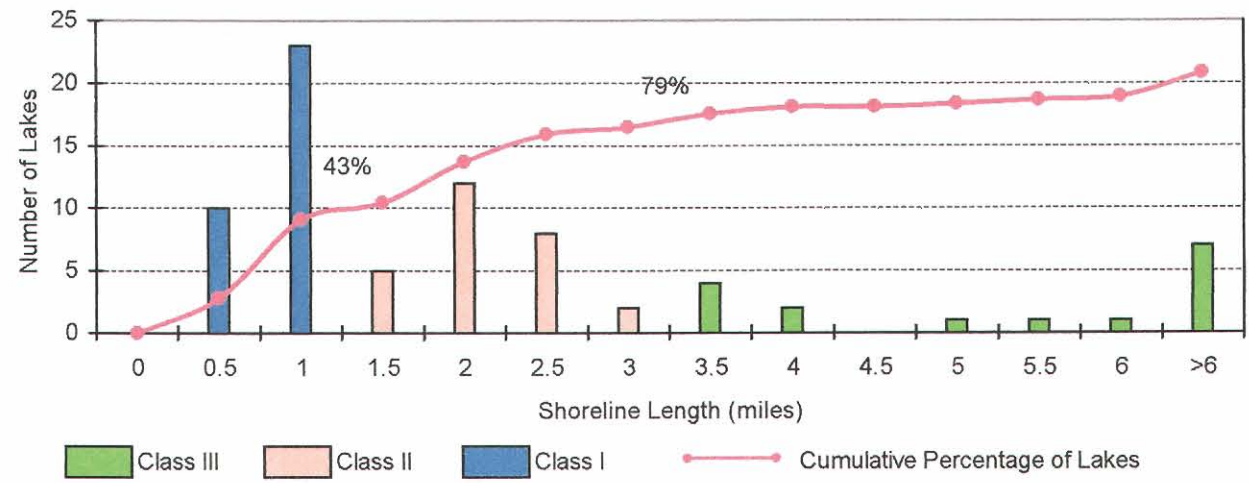
LAKE MAXIMUM DEPTH



LAKE MEAN DEPTH



SHORELINE LENGTH

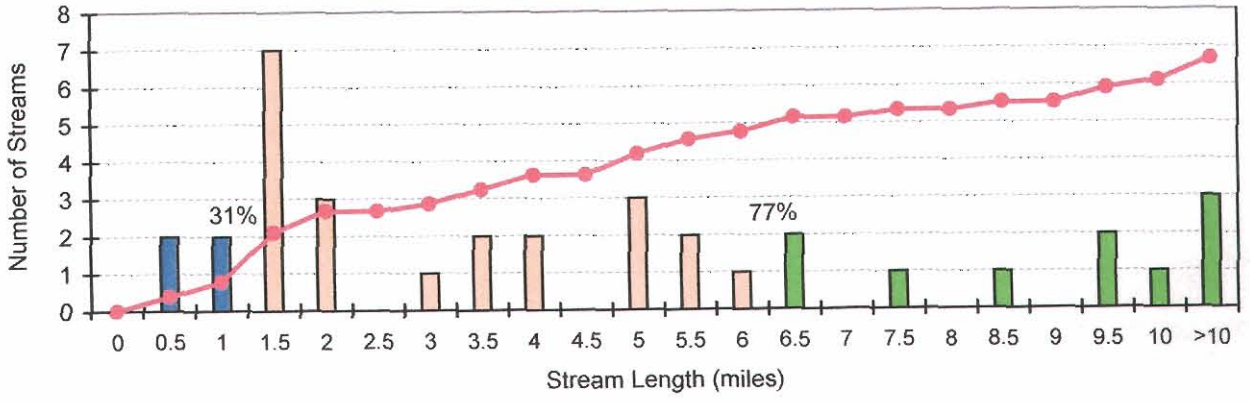


Source: Wisconsin Department of Natural Resources and SEWRPC.

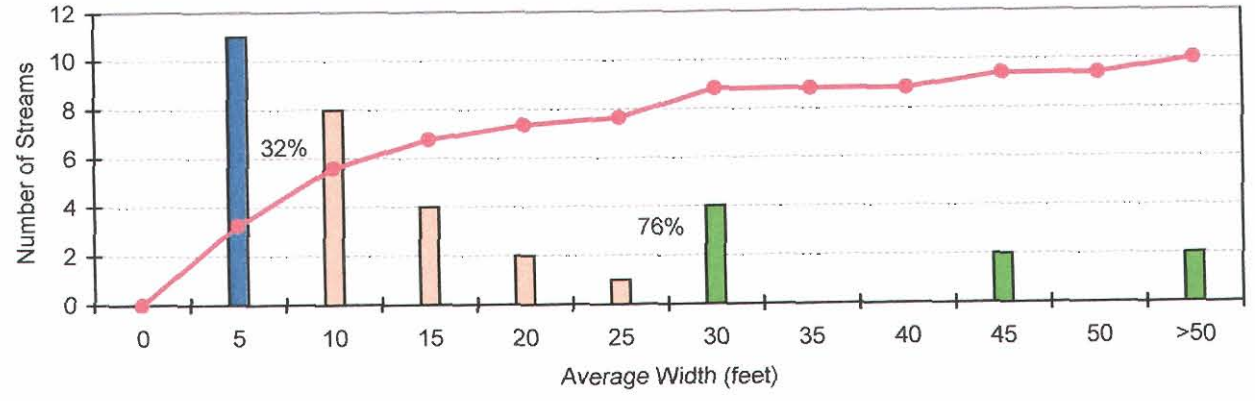
Figure 22

FREQUENCY DISTRIBUTION FOR SELECTED CHARACTERISTICS OF STREAMS WITHIN WAUKESHA COUNTY FOR USE IN WATERBODY CLASSIFICATION: 2002

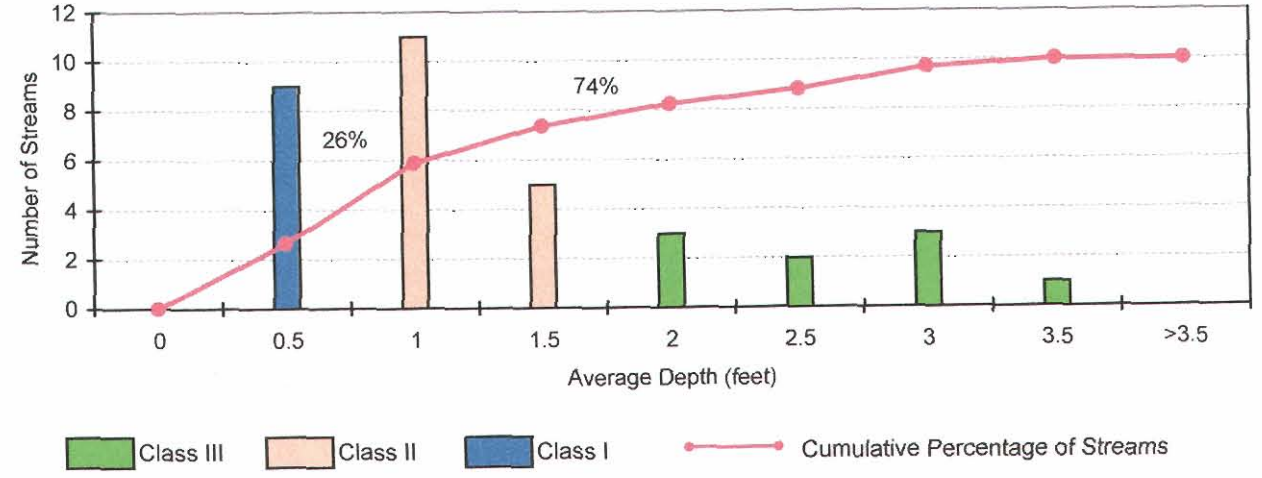
STREAM LENGTH



STREAM WIDTH



STREAM DEPTH



Source: Wisconsin Department of Natural Resources and SEWRPC.

establishing the initial classification. The need for extensive data and the difficulty in accommodating new entrants to the classification system are substantial drawbacks to this system that could potentially encourage neglect of the required regulatory actions or lack of enforcement of such actions by the regulatory agency.

Hybrid Classification
Hybrid schemes have an advantage of being integrated into the current regulatory framework in so much as they can recognize existing State classifications of waters as outstanding or exceptional resource waters under Chapter NR 104 of the *Wisconsin Administrative Code*, as trout waters, or as other types of water identified under various existing classification systems. In the respect that they can employ multiple metrics for certain types of determinations, while at the same time incorporating additional measures to assign classes to new entrants into the system with limited data. In some ways, this system reflects the layered approach to regulation that is familiar to most users, being best suited to integrate a County-based system into a wider regulatory framework. By including classes based upon multiple metrics, this hybrid scheme can incorporate coldwater fisheries currently identified under State law while maintaining the flexibility of making site-specific determinations outside of these listed streams and lakes.

A disadvantage of this system is the difficulty of ensuring consistent enforcement of the classifications. While specific sites may be classified based upon discrete, site-specific characteristics, there is a chance that it falls under a broader classification applied based upon a named lake or stream reach class. While this is not insurmountable, it does require a higher degree of administrative oversight than the site-specific classification system, but not as extensive a data set as the County-based system.

ALTERNATIVE LAKE CLASSIFICATION SYSTEMS

Based upon the three approaches set forth above, four alternatives for the classification of lakes in Waukesha County were identified. The alternatives identified are set forth below and are presented under each of the three conceptual approaches defined above. Examples of waters classed using each of these alternative classification systems are provided.

Alternative I: Status Quo
Under this alternative, the current ordinance requirements for the protection of lakes and streams would be maintained; some modification of the current requirements may be considered. Other implementation and administrative factors may also be revisited.

Positive aspects of this alternative are that implementation of the program is facilitated under the existing administrative structure of the County. Revision of the *status quo* may be easily understood by the general public as well as the administrators of the policy. The County ordinance would not require significant amendment to incorporate the new policy initiatives, and the waters within Waukesha County stand to potentially benefit from the more effective administration of a familiar management tool. The application of a uniform approach reduces the possibility of erroneous application of standards and human error. Maintaining the *status quo* also reduces the potential for opposition due to changes in the Code.

Negative impacts of implementing this system include maintaining the existing inconsistencies between lake condition and the Waukesha County Code. These inconsistencies arise from current conditions that reflect historic land and lake usage, and conflicting visions of appropriate land and lake usage among communities and municipal entities. The inconsistencies inherent in the existing system would be carried forward into the classification process, limiting the ability of the system to assimilate new entrants into the regulatory arena in a meaningful manner.

Alternative II: Single-Criterion Method
This alternative uses a single criterion to discriminate between classes of lakes. Based on the analysis of the available data on Waukesha County surface waters, these criteria have been identified. In the case of lakes, this criterion is surface area, while, in the case of the streams, this criterion is total stream length. The measurement of

lake surface area is taken at "normal" lake levels, and, likewise, the measurement of total stream length is taken at normal flow levels. Three classes of waters were defined under this system using breakouts defined by statistical analysis of the available data. The Classes are defined by the quartiles of the frequency distributions of lake surface area and total stream length reported for the County, with the smaller lakes and shorter streams, typically headwater lakes and streams, being proposed for protection. Class 1 waters are proposed to be provided with the highest level of protection under this alternative, while Class 3 waters are proposed to be provided with a lower level of protection. The data presented in Table 7 indicate examples of Waukesha County lakes classified using this system.

Positive aspects of this alternative include its easily understandable nature, its defensibility, its ability to assimilate new entrants into the classification system based upon a measurement that is relatively insensitive to time of year, and its efficiency, created by avoiding time consuming field investigations. The correlations between lake surface area and total stream length and other physical, chemical and biological lake and stream attributes underlie this alternative. The method could be easily explained in a chart or table showing the criteria and the correlation between the data presented. This system would facilitate incorporation of new entrants into the system, with the classification of individual waters being done on a site-specific basis. Field investigations for data collection could be completed easily at almost any time of the year. Timely and precise responses to permit applications could be provided as a result. From an administrative perspective, the simplicity of this method promotes the efficiency and understanding, and provides ready answers to questions that may arise from stakeholders, enhancing the ability of the County to respond to citizen concerns.

Negative aspects of this system include the limitations inherent in taking physical measurements only. This limits the consideration of biological and chemical aspects of lakes and streams in the classification process. In addition, factors such as flushing rate or water residence time are not well or explicitly reflected in the analysis. This may limit the ability of this system to adequately recognize waters of exceptional quality and biological community composition.

Alternative III: Multiple-Criteria Method
This alternative uses multiple criteria to discriminate between classes of lakes; however, not all of the statutory criteria are utilized for this purpose. Based upon analysis of the available data for Waukesha County lakes, specific criteria that best reflect the distinguishing characteristics of the lakes in the County are proposed to be used to discriminate between classes.

This system places lakes into the most protective class in the absence of data, while placing lakes for which data are available into classes based upon their physical, chemical, and biological characteristics. This system employs all seven of the statutorily required variables pursuant to Section 281.69(5)(b) 1 through 5, *Wisconsin Statues*, namely, the size, depth and shape of the lake; the size of the lake's watershed; the quality of water in the lake; the potential for the lake to be overused for recreational purposes; the potential for development of the land surrounding the lake; the potential of the lake to suffer from nonpoint source pollution; and the type and size of the fish and wildlife population in and around the lake.

This alternative assigns a point score based on a scale from one to three to each individual criterion for each lake within the classification system. These point scores are summed and an aggregate total is calculated to determine the classification of the lake within the aforementioned three class system. Class 1 waters are afforded the highest protection, while Class 2 and Class 3 waters are afforded levels of protection commensurate with their classification. Weighting occurs when default values are entered in the absence of data on a given lake. These values are generally more restrictive, but can also be mean values. In the case of this alternative, these values are a "2," the mean value in the three-point system. Table 8 presents examples of Waukesha County lakes classified using this system.

Positive impacts of implementing this method include the comprehensive coverage of biological, chemical, and physical characteristics, and inclusion of all seven of the statutorily required criteria. The comprehensiveness of this alternative is beneficial to the understanding of the resources being regulated by both the stakeholders in the

Table 7

EXAMPLES OF WAUKESHA COUNTY LAKES CLASSIFIED USING THE SINGLE-CRITERION METHOD

Lake	Surface Area (acres)	Class 1: Less than or Equal to 15 Acres	Class 2 16-129 Acres	Class 3: Greater than or Equal to 130 Acres
Lower Kelly Lake	3	1	- -	- -
Brown Lake	12	1	- -	- -
Spring Lake (Dousman)	14	1	- -	- -
Upper Genesee Lake	37	- -	2	- -
Hunters Lake	57	- -	2	- -
Lower Nashotah Lake	90	- -	2	- -
Okauchee Lake	1,187	- -	- -	3
Big Muskego Lake	2,260	- -	- -	3
Pewaukee Lake	2,493	- -	- -	3

Source: SEWRPC.

Table 8

EXAMPLES OF WAUKESHA COUNTY LAKES CLASSIFIED USING THE MULTIPLE-CRITERIA ALTERNATIVE

Lake	Biological Characteristics	Physical Characteristics			Total	Class Rank
	Fisheries Significance	Surface Area (acres)	Maximum Depth (feet)	Shoreline Length (miles)		
Okauchee Lake	2	1	1	1	5	3
Pewaukee Lake	3	1	1	1	6	3
Big Muskego Lake	2	1	3	1	7	3
Lower Nashotah Lake	2	2	1	2	7	3
Hunters Lake	2	2	2	2	8	2
Upper Genesee Lake	3	2	2	2	9	2
Brown Lake	2	3	1	3	9	2
Lower Kelly Lake	2	3	2	3	10	1
Spring Lake (Dousman)	2	3	3	3	11	1

NOTE: Scores are assigned as follows:
Biological Characteristics—Coldwater Fishery = 3 points, Warmwater Fishery = 2 points, Limited Fishery = 1 point;
Physical Characteristics—Lake Surface Area less than 15 acres = 3 points, 15-130 acres = 2 points, greater than 130 acres = 1 point; Maximum Depth less than 10 feet = 3 points, 10-40 feet = 2 points, greater than 40 feet = 1 point; Shoreline Length less than 1 mile = 3 points, 1-3 miles = 2 points, greater than 3 miles = 1 point

Classes are assigned as follows: Class 3 = less than 8 points, Class 2 = 8-9 points, Class 1 = greater than 9 points.

Source: SEWRPC.

matter, as well as the regulators that must implement and enforce these regulations. The comprehensive nature of this alternative also lends itself to including all seven of the statutorily required criteria. This ensures some level of defensibility and allows the policy to be flexible enough to accommodate changes such as new entrants.

Negative impacts of implementing this method include the data intensive nature of the system and the indirect weighting of the criteria due to selection of the criteria from a larger pool of potential analysis variables. This system is data intensive, which leads to extensive and costly field investigations. Depending on the criteria selected, the results could be delayed due to systematic inefficiencies such as cost, multiple field investigations, and use of analysis tools. This method does indirectly weigh the physical parameters since there are more physical attributes which data are required to be examined under the statute.

Alternative IV: Selected Multiple-Criteria Method
This alternative uses multiple criteria to discriminate between classes of lakes; however, not all of the statutory criteria are used for this purpose. Based upon an analysis of the available data for Waukesha County lakes, specific criteria that best reflect the distinguishing characteristics of the lakes within the county are proposed to be used to discriminate between classes.

Under this alternative, relevant criteria were selected from the list of criteria outlined in Section 281.69(5)(b), *Wisconsin Statutes*. These criteria were assigned point scores based upon the characteristics of Waukesha County lakes. Points were then awarded to each lake based upon the reported physical, biological, and chemical characteristics of that lake. The class rank of each lake was determined by the aggregate score. The criteria selected more narrowly focuses the classification system on the specific characteristics of Waukesha County than the more general list of physical, biological, and chemical characteristics required to be considered by the *Statutes*.

Points were awarded to lakes based upon a three-point scale, with the highest point values being awarded to those lake classes considered to require the highest levels of protection under ordinance. For each criterion, point scores were assigned on the basis of the statistical analysis of the data. For purposes of this system, three classes were established based upon ranges determined by either the mean value of the criterion within the Waukesha County data set, plus or minus the standard deviation of the criterion, or the division of the data set based on quartile ranges. The selection of the particular method of analysis was determined by the range of the data. As noted, classification of a lake under this system was based upon the total point scores for each lake. Class 1 waters were considered to be those waters falling into the 90th percentile or greater. Class 2 waters were considered to be those waters falling between the 60th and 90th percentiles. Class 3 waters were considered to be those waters falling below the 60th percentile. Class 1 waters are proposed to be provided with the highest level of protection under this alternative, while Class 3 waters are proposed to be provided with a lower level of protection. Table 9 presents examples of Waukesha County lakes classified using this system.

Positive aspects of this alternative include the inclusion of additional physical, biological, and chemical data not included in any of the aforementioned alternatives. This alternative, therefore, better addresses the capacity of a lake to assimilate point and nonpoint source pollutants without being considered degraded.

Negative aspects of this alternative include the indirect weighting of the criteria. The metrics selected for use in this alternative are inherently weighted as a consequence of being selected from a pool of criteria available for use in the analysis. For example, the selection of shoreline development factor as a criterion, rather than of the ratio of length of shoreline to the number of platted lots abutting the shoreline, may influence the aggregate score and shift a lake between classes. However, analysis of the available data has shown that the outcomes of this analysis were within an acceptable degree of statistical significance.

A POSSIBLE APPROACH TO LAKE AND STREAM CLASSIFICATION IN WAUKESHA COUNTY

As noted above, lake classification systems are largely intended to segregate lakes into regulatory groups or classes. Thus, key considerations include the ability of the system to clearly determine discrete groupings of similar lakes, the ease and feasibility of creating such groupings, and the relationship of the groupings to, and within, the regulatory framework. The latter two considerations can be merged into the consideration of potential applicability of the classification system. To this end, a potentially applicable lake classification system for Waukesha County is outlined in this section. Such a system could be implemented as a refinement of the current Waukesha County shoreland and floodland ordinance to provide an added degree of protection for aquatic ecosystems, thereby maintaining ecosystem structure and function amid a rapidly changing landscape.

Sorting Mechanisms
Upon analysis of the available data for lakes within Waukesha County, and upon consideration of the required criteria pursuant to Section 281.69(5)(b), *Wisconsin Statutes*, a single, site-specific physical criterion can be

Table 9

EXAMPLES OF WAUKESHA COUNTY LAKES CLASSIFIED USING THE SELECTED MULTIPLE-CRITERIA ALTERNATIVE

Lake	Physical Characteristics			Total	Class Rank
	Surface Area (acres)	Maximum Depth (feet)	Shoreline Length (miles)		
Okauchee Lake	1	1	1	3	3
Pewaukee Lake	1	1	1	3	3
Lower Nashotah Lake	2	1	2	5	3
Big Muskego Lake	1	3	1	5	3
Upper Genesee Lake	2	2	2	6	2
Hunters Lake	2	2	2	6	2
Brown Lake	3	1	3	7	2
Lower Kelly Lake	3	2	3	8	1
Spring Lake (Dousman)	3	3	3	9	1

NOTE: Scores are assigned as follows:

Lake Surface Area less than 15 acres = 3 points, 15 – 130 acres = 2 points, greater than 130 acres = 1 points
Maximum Depth less than 10 feet = 3 points, 10 – 40 feet = 2 points, greater than 40 feet = 1 point
Shoreline length less than 1 mile = 3 points, 1 – 3 miles = 2 points, greater than 3 miles = 1 point

Classes are assigned as follows: Class 3 = less than 6 points, Class 2 = 6 - 7 points, Class 1 = greater than 7 points.

Source: SEWRPC.

identified to distinguish discrete classes of lakes within Waukesha County. This criterion is lake surface area, measured in acres. In the case of Waukesha County lakes, this descriptor is highly correlative to other physical criteria such as lake length, width, depth, and Shoreline Development Factor, and usefully distinguishes waterbodies in a manner consistent with their current and projected future states of development and recreational uses.

Likewise, upon analysis of the available data for streams within Waukesha County, and upon consideration of the aforementioned criteria derived from Section 281.69(5)(b), *Wisconsin Statutes*, a single, site-specific physical criterion can be identified to distinguish discrete classes of streams within Waukesha County. This criterion is stream length, measured in miles. In the case of Waukesha County lakes, this descriptor is highly correlative to other physical criteria such as stream surface area, width, and depth, and usefully distinguishes waterbodies in a manner consistent with their current and project future states of development and recreational use.

Applicability to Lakes in Waukesha County

The application of the lake surface area criterion to lakes within Waukesha County results in the identification of three discrete classes of waterbodies. These classes are determined based upon the statistical analysis of Waukesha County lake surface area data. The three classes are as follows:

- **Class 3 Lakes**: Lakes with a surface area of greater than or equal to 130 acres. These lakes tend to be the lakes that have historically seen the most development and heavier levels of recreational use within the County. This historical development and recreational usage has influenced the aesthetic and habitat values of the lakes thus impacting their human use as well as the natural environment. A Class 3 listing potentially warrants a basic level of protection,[21] which may include rehabilitation measures to restore habitat and aesthetic value.

[21] *The provisions of Chapter NR 115 of the* Wisconsin Administrative Code *reflect the minimum level of protection to be afforded to lakes within the State. Currently, these statewide minima cannot be superseded.*

- **Class 2 Lakes**: Lakes with a surface area of 15 to 130 acres. These lakes tend to be the lakes that have experienced moderate historical development and recreational use. Class 2 lakes have preserved some or most of their aesthetic and habitat values thus having moderate impact on the human and natural environment. A Class 2 listing warrants maintenance of the current land use and recreational conditions on the lake and may include measures to enhance the existing aesthetic and habitat values of these lakes.

- **Class 1 Lakes**: Lakes with a surface area of less than or equal to 15 acres. These lakes tend to be the lakes that have seen little or no historical development and recreational use. Class 1 lakes often remain in or near pristine condition and maintain the aesthetic and habitat values with little or no human impact on the natural environment. A Class 1 listing warrants preservation measures to ensure the pristine conditions of the surrounding environs.

This class system sorts the lakes into distinct groups based upon site-specific data that can be related to possible levels for protection in order to maintain the recreational use of the resource while protecting the aesthetic and natural values of the area. This system allows the flexibility to address the site-specific problems associated with large, heavily utilized lakes such as shoreline stabilization, vegetative buffers, boathouses, and other relevant matters concerning the protection and recreational use of the lake. Simultaneously, this class system addresses the needs of smaller, less heavily utilized lakes and their need for protection and preservation. A worked example of the application of this alternative to selected lakes within Waukesha County is presented in Table 10.

Applicability to Streams in Waukesha County

The application of the stream length criterion to streams within Waukesha County results in the identification of three discrete classes of waterbodies. These classes are determined based upon the statistical analysis of Waukesha County lake surface area data. The three classes are as follows:

- **Class 3 Streams**: Streams with a length of greater than or equal to 6 miles. These streams tend to be the larger rivers that have historically seen the most urban development within the County. This historical development has influenced the aesthetic and habitat values of the streams thus impacting their human use as well as the natural environment. A Class 3 listing potentially warrants a basic level of protection, which may include rehabilitation measures to restore habitat and aesthetic value.

- **Class 2 Streams**: Streams with a length of between 1.5 and 6.0 miles. These streams tend to be the brooks and creeks that have experienced moderate historical development. Class 2 streams have preserved some or most of their aesthetic and habitat values thus having moderate impact on the human and natural environment. A Class 2 listing warrants maintenance of the current land use conditions along the stream and may include measures to enhance the existing aesthetic and habitat values of these streams.

- **Class 1 Streams**: Streams with a length of less than or equal to 1.5 miles. These streams tend to be the headwater streams that have seen little or no historical development and recreational use. Class 1 streams remain in or near pristine condition and maintain the aesthetic and habitat values with little or no human impact on the natural environment. A Class 1 listing warrants preservation measures to ensure the pristine conditions of the surrounding environs.

This class system sorts the streams into distinct groups based upon site-specific data that can be related to possible levels for protection in order to maintain the use of the resource while protecting the aesthetic and natural values of the area. This system allows the flexibility to address the site-specific problems associated with large, heavily utilized rivers such as shoreline stabilization, vegetative buffers, and other relevant matters concerning the protection and recreational use of the streams. Simultaneously, this class system addresses the needs of smaller, less heavily utilized streams and their need for protection and preservation. A worked example of the application of this alternative to selected streams within Waukesha County is presented in Table 11.

Table 10

EXAMPLE OF BREAKOUTS FOR AREAL-BASED CLASSES OF LAKES WITHIN WAUKESHA COUNTY

Lake	Surface Area (acres)	Class 1: Less than or equal to 15 Acres (3 points)	Class 2 15-130 Acres (2 points)	Class 3: Greater than or equal to 130 Acres (1 point)	Total Point Scores	Class Rank
Lower Kelly Lake	3	3	--	--	3	1
Brown Lake	12	3	--	--	3	1
Spring Lake (Dousman)	14	3	--	--	3	1
Upper Genesee Lake	37	--	2	--	2	2
Hunters Lake	57	--	2	--	2	2
Lower Nashotah Lake	90	--	2	--	2	2
Okauchee Lake	1,187	--	--	1	1	3
Big Muskego Lake	2,260	--	--	1	1	3
Pewaukee Lake	2,493	--	--	1	1	3

NOTE: Classes are assigned as follows: Class 3 = 1 point, Class 2 = 2 points, Class 1 = 3 points.

Source: SEWRPC.

Table 11

EXAMPLES OF BREAKOUTS FOR LENGTH-BASED CLASSES OF STREAM WITHIN WAUKESHA COUNTY

Stream	Stream Length (miles)	Class 1: Less than or equal to 1.5 Miles (3 points)	Class 2 1.5-6.0 Miles (2 points)	Class 3: Greater than or equal to 6.0 Miles (1 point)	Total Point Score	Class Rank
Audley Creek	1.2	3	--	--	3	1
Muskego Creek	1.5	3	--	--	3	1
Brandy Brook	1.5	3	--	--	3	1
Little Oconomowoc River	3.1	--	2	--	2	2
Jericho Creek	5.0	--	2	--	2	2
Menomonee River	6.2	--	2	--	2	2
Ashippun River	9.5	--	--	1	1	3
Bark River	24.6	--	--	1	1	3
Fox River	45.6	--	--	1	1	3

Source: SEWRPC.

Modified Single-Criterion Variant

While other descriptors can be added to formulate a multiple criteria classification system, the addition of descriptors to which lake surface area is correlated is unlikely, in most instances, to substantially alter the outcome of the classification process. Comparison of Tables 7, 8, and 9 suggests only modest differences between the use of a single criterion and the use of multiple criteria. This is consistent with the observations that, as hydrological and biological units, the lakes of Waukesha County have similar source water characteristics and, hence, provide similar habitat for aquatic organisms, such as fishes and aquatic plants. The similarity in geography and source waters among these waterbodies also contributes to a consistency among the waterbodies in terms of water quality, nutrient status, and thermal regime.

Notwithstanding, the addition of other considerations, such as the allocation of "bonus points" to waterbodies that meet certain criteria, may be useful to distinguish particular waters that may not fit well into a single criterion classification system, or refine the classification system. For example, additional consideration could be given to waters that sustain or could potentially sustain a coldwater fishery, that are wholly located within natural areas

and in critical species habitat areas identified in the regional natural areas and critical species habitat protection and management plan, or that are identified as exceptional or outstanding resource waters of the state pursuant to Chapter NR 102 of the *Wisconsin Administrative Code*. Use of such supplemental criteria may provide a mechanism to better fit the single criterion-based classification system to aquatic systems with unique characteristics. One example of the use of such an additional criterion would be in recognition of the status of Spring Lake as an Outstanding Resource Water within Waukesha County, which could potentially move Spring Lake from the Class II category to a Class I category, or to the highest level of protection, should the lake classification system be used in ordinance development, as suggested below. Such a system would be consistent with the criteria established pursuant to Section 281.69, *Wisconsin Statutes*, recognizing the type and size of the fish and wildlife populations in and around a lake as a distinguishing characteristic.

CONCLUSION

The purpose of waterbody classification in Waukesha County is to prepare the basis for possibly refining the current County ordinance regarding shorelands and floodlands to provide an added degree of protection for aquatic ecosystems, thereby maintaining ecosystem structure and function amid a rapidly changing landscape. Implementation of a tiered approach to shoreland regulation would: 1) assure the protection and preservation of the surface water resources and the natural resources associated with those streams within Waukesha County; 2) enable the maintenance and rehabilitation of heavily urbanized streams within the County; 3) prevent damage to private property located within floodplain and floodway areas; and 4) meet the existing recreational and aesthetic needs of the citizens of Waukesha County. Based upon the data available on streams and lakes, and their ecosystems, within the County, examples of such a classification system are presented.

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ACRONYMS AND GLOSSARY

ACRONYMS

A	Lake surface area in acres
BMPs	Best Management Practices
CTH	County Trunk Highway
D	Stream depth in feet
DATCP	Wisconsin Department of Agriculture, Trade and Consumer Protection
EPA	U.S. Environmental Protection Agency
°F	Temperature expressed in degrees Fahrenheit
GIS	Geographic Information System
HBI	Hilsenhoff Biotic Index
HEL	Highly Erodable Lands
IBI	Index of Biotic Integrity
IH	Interstate Highway
NGVD, NGVD-29	National Geodetic Vertical Datum of 1929
N:P	Nitrogen to Phosphorus concentration ratio, a determinant of nutrient limitation of aquatic plant communities
NPS	Nonpoint Source Pollution
NRCS	Natural Resources Conservation Service, formerly the Soil Conservation Service, of the U.S. Department of Agriculture
SDF	Shoreline Development Factor
SEWRPC	Southeastern Wisconsin Regional Planning Commission
SL:PL	Shoreline Length to number of Platted Lots (ratio)
STH	State Trunk Highway
TMDL	Total Maximum Daily Load
TSI	Trophic State Index developed by Professor Robert E. Carlson
T_W	Water residence time in years
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UWEX	University of Wisconsin-Extension
VOCs	Volatile Organic Compounds

W	Stream width in feet
WDNR	Wisconsin Department of Natural Resources
WILMS	Wisconsin Lake Model Spreadsheet, version 2.00
WTSI	Wisconsin Trophic State Index
WQMA	Water Quality Management Area
Z	Maximum lake depth in feet

GLOSSARY

Best Management Practices (BMPs) – The most effective practice or combination of practices for reducing nonpoint source pollution to acceptable levels, generally at a reasonable cost to the polluter, including:

Conservation Tillage – The practice of leaving at least 30 percent residue from the preceding crop. This is typically accomplished though a variety of tillage methods, including, mulch tillage and no-tillage. this practice requires the use of a chisel plow or a no-till planter instead of a moldboard plow.

Conservation Cropping – Planting crop rotations that minimize soil erosion. Examples include hay rotations with corn and oats, or adding small grains such as winter wheat to a corn-soybean rotation.

Contour Farming – the practice of farming sloping soils, including planting, tillage, cultivation, and harvesting along the contour of the slope.

Grassed Waterways – A natural or constructed channel that is shaped, graded, and established with vegetation to prevent erosion from occurring in concentrated flow areas.

Diversions – Structural measures used to divert clean water around barnyards, barns, and other buildings.

Nutrient Management – Managing and crediting nutrients from all sources, including legumes, manure, and soil reserves for the application of manure and commercial fertilizers. Management includes the rate, method and timing of the application of all sources of nutrients to minimize the amount of nutrients entering surface and groundwater. This practice includes manure nutrient testing, routine soil testing, and residual nitrogen soil testing.

Rotational Grazing – Rotational grazing involves the short intensive use of paddocks, followed by a rest period from the animals for the forage to revegetate. Rotational grazing systems can correct existing pasturing practices that result in degradation and should replace the practice of summer dry-lots when this practice results in water quality degradation.

Shoreline Buffers – A permanently vegetated area immediately adjacent to lakes, streams, channels, and wetlands designed and constructed to manage critical nonpoint sources or to filter pollutants from nonpoint sources.

Street Sweeping – The municipal practice of physically or mechanically sweeping and collecting sediment and debris from the road surface.

Environmental Corridors – Areas of the Southeastern Wisconsin Region having concentrations of natural, recreational, historic, aesthetic, and scenic resources and which, as such, should be preserved and protected in order to maintain the overall quality of the environment.

Eutrophication – The process by which a body of water becomes enriched in dissolved nutrients (such as nitrogen and phosphorus) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen.

Geographic Information Systems (GIS) – A computerized system of maps and layers of data about land including soils, land cover, topography, field boundaries, roads and streams, zoning and land use, etc.

Highly Erodible Land (HEL) – Lands that are over 6 percent in grade. According to the NRCS, a farm field is considered to be HEL if more than one-third of that field has land slopes that exceed 6 percent.

Lake – As used herein, the term lake means any natural or artificial lentic waterbody regulated under Chapter 30 of the *Wisconsin Statutes*, including lakes, ponds, millponds, flowages or reservoirs and impoundments, and other standing waters.

Natural Resources Conservation Service (NRCS) – The NRCS is under the direction of the U.S. Department of Agriculture (USDA) and is responsible for soil survey inventory and information, farm conservation planning, and providing technical assistance to landowners regarding best management practices.

Nonpoint Source Pollution (NPS) – Pollution resulting from many small and diffuse sources, unlike point source pollution, which results from one identifiable source. Soil erosion, livestock waste, stormwater runoff, nutrients such as nitrogen and phosphorus, and other pollutants are all examples of nonpoint source pollution.

Section 303(d) List – The Section 303(d) list is prepared by the WDNR under requirements of Section 303(d) of the Federal Clean Water Act and identifies waters which are not currently meeting water quality standards, including both water quality criteria for specific substances or the designated fishable and swimmable uses.

Southeastern Wisconsin Regional Planning Commission (SEWRPC) – Governmental organization providing regional scale planning services to the seven-county Southeastern Wisconsin Region. These services include land use planning, transportation, environmental (wetlands, engineering, soils, and lake management), economic development, and GIS.

Stream – As used herein, the term stream means any natural or artificial lotic waterbody regulated under Chapter 30 of the *Wisconsin Statutes*, including rivers, streams, brooks, creeks, ditches, and canals or channel, that flow at least periodically or intermittently within a defined bed or channel having banks and supporting fish or other aquatic life.

Total Maximum Daily Load (TMDL) – The maximum allowable concentration of a particular pollutant for an individual water resource as determined by the EPA.

U.S. Department of Agriculture (USDA) – Branch of Federal government with responsibilities in the areas of food production, forestry, and wildlife and fisheries.

U.S. Environmental Protection Agency (EPA) – The agency of the Federal government responsible for carrying out the nation's pollution control laws. It provides technical and financial assistance to reduce and control air, water, and land pollution, and is responsible for administering the Clean Water Act.

U.S. Geological Survey (USGS) – The agency of the Federal government, within the Department of the Interior, responsible for data acquisition and analysis, mapping, and technical information dissemination. The U.S. Geological Survey assists local communities in lake water quality monitoring, stream gaging, and stream water quality monitoring, as well as groundwater modeling and monitoring.

University of Wisconsin-Extension – The outreach program of the University of Wisconsin that is responsible for formal and informal educational programs throughout the State.

Urban Land Use – Urban development is defined in the adopted regional land use plan as a concentration of residential, commercial, industrial, governmental or institutional buildings or structures, together with their associated yards, parking areas, and service areas, having a combined area of five acres or more. In the case of residential uses, the area must contain at least ten structures located in a relatively compact group, typically in a residential subdivision. In the case of residential uses located along a linear feature such as a roadway or lakeshore, the area must contain at least ten structures located within a distance of one-half mile.

Volatile Organic Compounds (VOCs) – Organic solvents such as tetrachloroethylene, trichloroethylene and chloroform that are used for degreasing, dry-cleaning, and other farm, industrial and domestic applications, many of which are considered to be carcinogens.

Water Quality Management Area (WQMA) – The area that is within 300 feet of a navigable stream or river or 1,000 feet from a lake. In addition WQMAs also include lands adjacent to ponds, or areas that are susceptible to groundwater contamination, such as a wetland, sinkhole, or an area that is shallow to bedrock.

Watershed – The geographic area which drains to a particular river, stream, or waterbody.

Wetlands – Areas that have a predominance of hydric soils and that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions.

Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) – The State agency responsible for establishing statewide soil and water conservation policies and administering the State's soil and water conservation programs. The DATCP administers State cost-share funding for a variety of land and water conservation operations, including support for staff, materials and conservation practices. Programs administered by the DATCP include the Chapter ATCP 50 Land and Water Resource Management program.

Wisconsin Department of Commerce (WDOC) – The State agency responsible for, among other things, the administration of onsite sewage disposal systems under Chapter Comm 83 of the *Wisconsin Administrative Code*.

Wisconsin Department of Natural Resources (WDNR) – The State agency responsible for establishing statewide natural resource management policy and enforcement of environmental protection regulations. The WDNR manages State-owned lands and the public waters of the State. The WDNR also administers programs to regulate, guide and assist land conservation programs within individual counties, as well as landowners in managing land, water, fish, and wildlife. Programs administered by the WDNR include the Chapter NR 190 and 191 Lake Management Planning Grant and Lake Protection Grant programs, the Chapter NR 195 River Protection Grant program, the Chapter NR 120 Wisconsin Nonpoint Source Pollution Abatement program, the Chapter NR 50/51 Stewardship program, and the Chapter NR 7 Recreational Boating Facilities Grant program.

Woodlands – Areas containing a minimum of 17 trees per acre with a diameter of at least four inches at breast height (4.5 feet above the ground).