

A LAKE PROTECTION PLAN FOR BENEDICT AND TOMBEAU LAKES

KENOSHA AND WALWORTH COUNTIES WISCONSIN

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**MEMORANDUM REPORT
NUMBER 140**

**A LAKE PROTECTION PLAN FOR BENEDICT AND TOMBEAU LAKES
KENOSHA AND WALWORTH COUNTIES, WISCONSIN**

Prepared by the

**Southeastern Wisconsin Regional Planning Commission
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Chapter I

INTRODUCTION

Benedict Lake, in the Town of Bloomfield, Walworth County, and the Town of Randall, Kenosha County, Wisconsin, is located immediately adjacent to, and upstream of, Tombeau Lake in the Town of Bloomfield, Walworth County, Wisconsin. Tombeau Lake, a through-flow lake, is located on the East Branch of Nippersink Creek. The Creek drains Powers Lake via Tombeau Lake, ultimately discharging to the Fox River in Illinois. Benedict Lake is a drained lake located adjacent to the main stem of the East Branch of Nippersink Creek. Both Lakes are a valuable resource offering a variety of recreational and related opportunities to the resident community and its visitors. The Lakes are an integral part of a lake-oriented community.

During recent years, the Lakes have experienced various management problems, including excessive plant growth, variability in water quality, and degradation of wetland areas. Local concern over the state of the Lakes prompted the formation of a Chapter 33, *Wisconsin Statutes*, lake protection and rehabilitation district during 1996, incorporating lands riparian to both Tombeau and Benedict Lakes. Although sanitary sewer service is proposed to be provided to the urban development and lakeshore properties surrounding Benedict and Tombeau Lakes in the future,¹ both Lakes are currently served by onsite sewage disposal systems. Benedict and Tombeau Lakes are jointly enrolled in the Wisconsin Department of Natural Resources (WDNR) Self-Help Monitoring Program and residents have been carrying out the monitoring prescribed under that program since 1989.

This report sets forth a lake protection plan for Benedict and Tombeau Lakes, and represents part of the ongoing commitment of the Benedict-Tombeau Lakes Management District to sound planning with respect to the Lakes. This plan was prepared during 1998 and 1999 by the Southeastern Wisconsin Regional Planning Commission, in cooperation with the Benedict-Tombeau Lakes Management District and includes the results of field surveys conducted by the Commission during 1998 in addition to the WDNR Self-Help Monitoring Program data. These data are supplemented by an ongoing three-year U.S. Geological Survey trophic state index (TSI) water quality monitoring program designed to quantify the water quality of Benedict and Tombeau Lakes. The planning program was funded, in part, by a Wisconsin Department of Natural Resources Lake Management Planning Grant awarded to the Benedict-Tombeau Lakes Management District under the Chapter NR 190 Lake Management Planning Grant program.

This plan is intended to form an integral part of any future comprehensive lake management plan for Benedict and Tombeau Lakes. The scope of this report is limited to a consideration of those management measures which can be determined to be effective in the protection of lake water quality and lake use based upon the available data. The preparation of a comprehensive lake management plan for Benedict and Tombeau Lakes will require additional water quality and biological data collection and analysis.

The goals and objectives of this lake protection plan for Benedict and Tombeau Lakes were developed in consultation with the Benedict-Tombeau Lakes Management District. The goals and objectives are:

¹SEWRPC, Amendment to the Regional Water Quality Management Plan—2000, Pell Lake Area and Powers-Benedict-Tombeau Lakes Area, Kenosha and Walworth Counties, *December 1994*.

1. To protect and maintain public health, and to promote public comfort, convenience, necessity, and welfare, through the environmentally sound management of the vegetation, fishery, and wildlife populations in and around Benedict and Tombeau Lakes;
2. To provide for high-quality, water-based recreational experiences by residents and visitors to Benedict and Tombeau Lakes, and manage the lakes in an environmentally sound manner; and,
3. To effectively maintain the water quality of Benedict and Tombeau Lakes so as to better facilitate the conduct of water-related recreation, improve the aesthetic value of the resource to the community, and enhance the resource value of the waterbody.

This plan, which conforms to the requirements and standards set forth in the relevant *Wisconsin Administrative Codes*,² should serve as an initial guide to achieving these objectives over time.

²This plan has been prepared pursuant to the standards and requirements set forth in three chapters of the Wisconsin Administrative Code: Chapter NR 1, "Public Access Policy for Waterways;" Chapter NR 103, "Water Quality Standards for Wetlands;" and, Chapter NR 107, "Aquatic Plant Management."

Chapter II

INVENTORY FINDINGS

INTRODUCTION

Benedict and Tombeau Lakes are located on the northwestern border of the Town of Randall, Kenosha County, and southeastern border of the Town of Bloomfield, Walworth County, as shown on Map 1. Benedict Lake is a drained lake, having a clearly defined outlet draining to Tombeau Lake on the East Branch of Nippersink Creek, but lacking a definite inlet. The outlet drains from the southernmost portion of the Lake to Tombeau Lake through a broad channel. Tombeau Lake is located on the East Branch of Nippersink Creek downstream of both Powers and Benedict Lakes. Powers Lake was the subject of a lake management planning effort completed by the Southeastern Wisconsin Regional Planning Commission during 1991.¹ That Lake drains through a short stream section before entering Tombeau Lake. Tombeau Lake drains to the East Branch of Nippersink Creek, which ultimately discharges to the Fox River in Illinois.

Benedict and Tombeau Lakes have a combined direct tributary drainage area of approximately 2,590 acres in areal extent, as shown in Table 1. The surrounding land uses in this area are primarily urban in the areas riparian to the Lakes, with the balance being agricultural and other open lands, and natural areas, wetland, woodlands, and other open natural areas. Lake-oriented urban residential lands are the principle urban feature of the drainage area directly tributary to Benedict and Tombeau Lakes.

WATERBODY CHARACTERISTICS

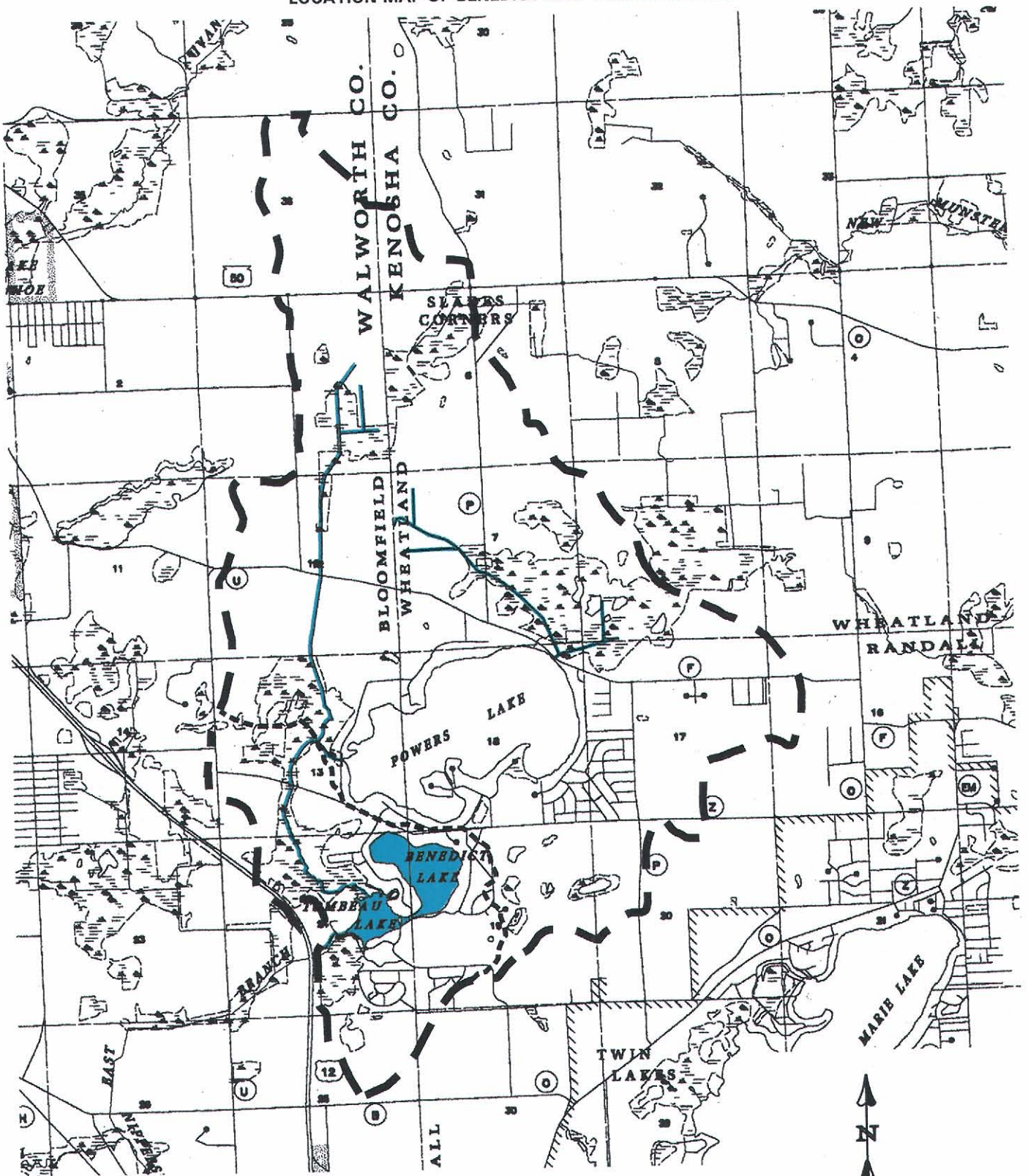
Benedict Lake has a volume of 1,207 acre-feet, a surface area of 78 acres, and a maximum depth of 37 feet. Thirteen percent of the total lake area is three feet or less in depth; 40 percent of the lake area is 20 feet or more in depth. Benedict Lake is a drained lake, with no discrete inlet, but having a visibly flowing outlet to Tombeau Lake. Due to the breadth of the channel connecting Benedict Lake to Tombeau Lake, discharge measurements from Benedict Lake have been reported to be unreliable.² Benedict Lake is separated from Powers Lake, located to the north of the Lake, by a ridge of less than one-quarter of one mile in width. Powers Lake has a surface elevation about 10 feet higher than that of Benedict Lake. Based upon review of the surficial geology of the area, and county-scale groundwater level mapping, it is expected that groundwater moves through readily permeable glacial drift in a southerly and southeasterly direction. The deepest point of Benedict Lake is centrally located, and the shoreline is fairly regular. The hydrographic characteristics of Benedict Lake are summarized in Table 1, and the bathymetry of the Lake is shown on Map 2.

Tombeau Lake, situated downstream of Benedict Lake, has a volume of 670 acre-feet, a surface area of 51 acres, and a maximum depth of 26 feet. Seventeen percent of the total lake area is three feet or less in depth; 35 percent of the lake area is 20 feet or more in depth. The Lake is roughly oval in shape with the deepest area being near the

¹*SEWRPC Community Assistance Planning Report No. 196, A Management Plan for Powers Lake, Kenosha and Walworth Counties, Wisconsin, November 1991.*

²*SEWRPC Lake Use Report No. FX-40, Benedict Lake, 1969.*

LOCATION MAP OF BENEDICT AND TOMBEAU LAKES



- DIRECT DRAINAGE AREA
- TOTAL TRIBUTARY DRAINAGE AREA



Table 1

HYDROLOGY AND MORPHOLOGY CHARACTERISTICS OF BENEDICT AND TOMBEAU LAKES

Parameter	Measurements	
	Benedict Lake	Tombeau Lake
Size (total)		
Surface Area	78 acres	51 acres
Total Drainage Area ^a	1,091 acres	5,595 acres
Direct Tributary Drainage Area	377 acres	1,037 acres
Volume	1,207 acre-feet	670 acre-feet
Residence Time ^b	5.5 years	0.2 year
Shape		
Maximum Length of Lake	0.8 miles	0.2 miles
Length of Shoreline	1.70 miles	2.03 miles
Maximum Width	0.4 miles	0.2 miles
Shoreline Development Factor ^c	1.37	2.02
Depth		
Percentage of Lake Area		
Less than Three Feet	13 percent	17 percent
Three to 20 Feet	47 percent	48 percent
Greater than 20 Feet	40 percent	35 percent
Mean Depth	15.4 feet	13 feet
Maximum Depth	37 feet	26 feet

^aThe total drainage area tributary to Benedict Lake includes 714 acres of internally drained lands.

^bResidence time: the time required for a volume of equivalent to full volume replacement by inflowing water to enter the lakes.

^cShoreline development factor: ratio of shoreline length to that of a circular lake of the same area.

Source: Wisconsin Department of Natural Resources and SEWRPC.

center of the southern half of the Lake. Tombeau Lake is a drainage or through-flow lake, having a discrete inlet and outlet. The outlet to Tombeau Lake drains to the East Branch of Nippersink Creek and eventually into the Fox River in Illinois. A dam, which is located at the Tombeau Lake outlet, currently controls the water surface levels of both Tombeau and Benedict Lakes. The hydrographic characteristics of Tombeau Lake also are summarized in Table 1, and the bathymetry of the Lake is shown on Map 2.

The lake bottom sediment types of both Benedict and Tombeau Lakes were surveyed during 1998 by Commission staff. The lakebed of Benedict Lake was comprised of a mixture of silt and sand, as shown on Map 3. The lakebed of Tombeau Lake was dominated by silt, which appeared to be of a fairly recent origin, especially in the northern one-half of the Lake.

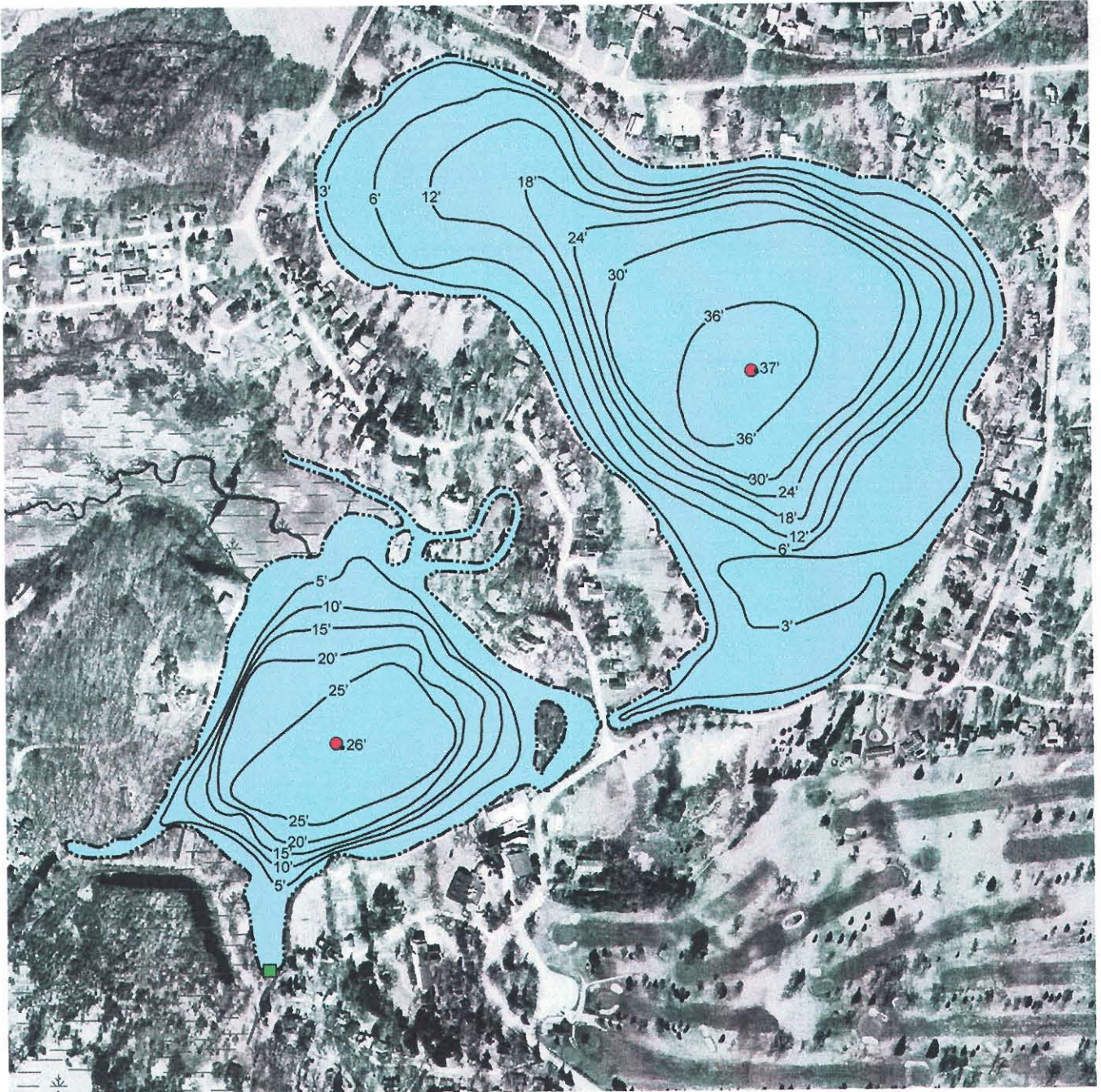
POPULATION, LAND USE, AND SHORELINE DEVELOPMENT

Population

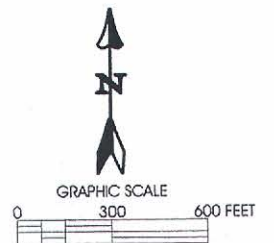
As of 1995, there were approximately 1,700 persons residing in 640 year-round housing units located within the drainage area directly tributary to Benedict and Tombeau Lakes. According to the 1990 census, an additional 480 housing units were reported to be seasonally occupied. Urban development in the drainage area tributary to Benedict and Tombeau Lakes consists primarily of residential development which has occurred since the early

Map 2

BATHYMETRIC MAP OF BENEDICT AND TOMBEAU LAKES



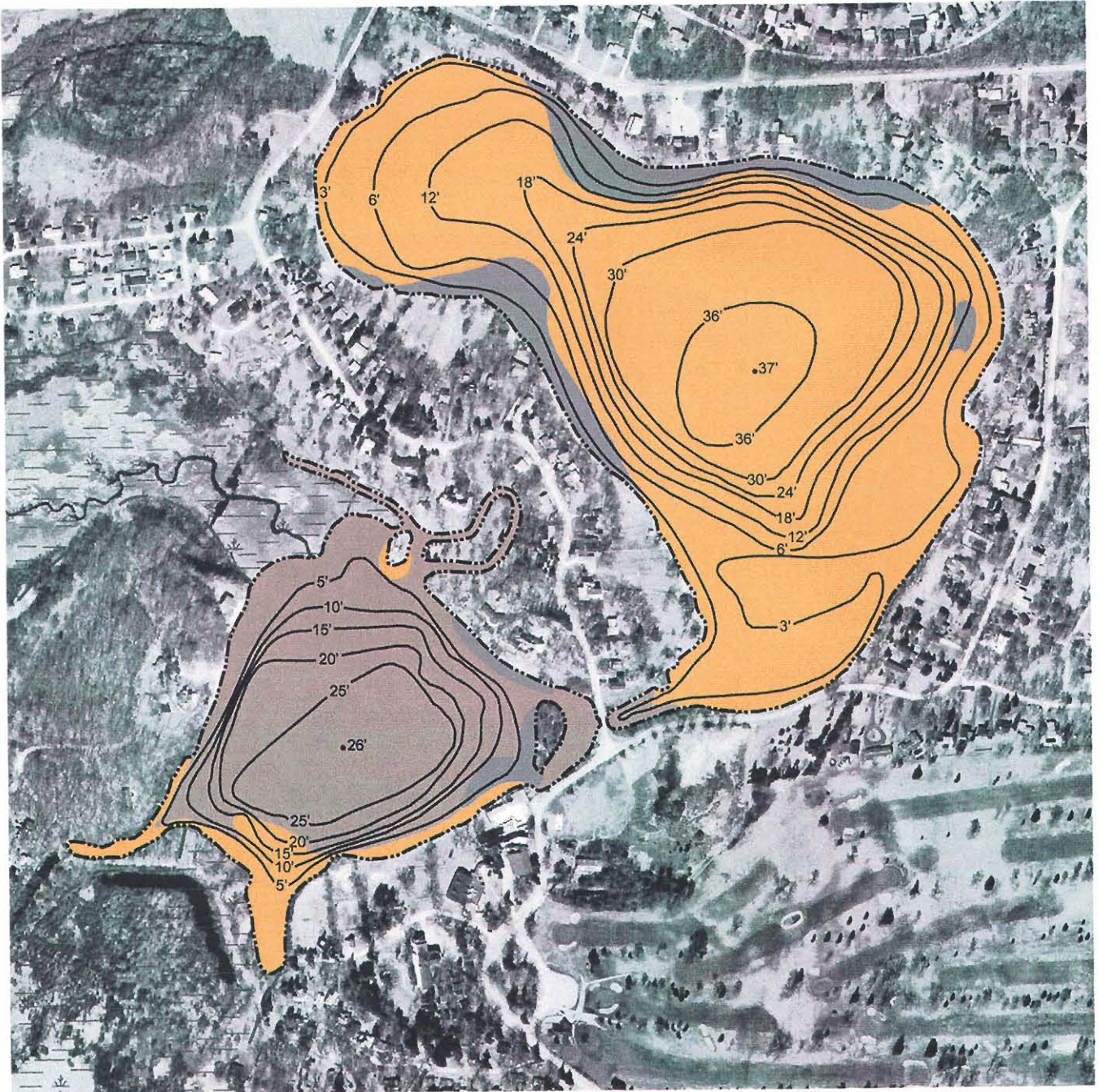
- 15'— WATER DEPTH CONTOUR IN FEET
- SAMPLING SITE LOCATION
- PUBLIC-ACCESS SITE



Source: Wisconsin Department of Natural Resources and SEWRPC.

Map 3

SEDIMENT SUBSTRATES DISTRIBUTION IN BENEDICT AND TOMBEAU LAKES: 1998

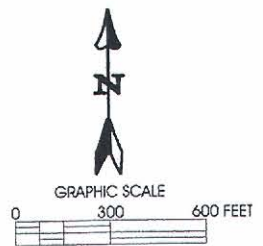


—15'— WATER DEPTH CONTOUR IN FEET

 SILT

 SILT AND SAND

 SAND AND GRAVEL



Source: SEWRPC.

1900s, with substantial portions of the lakeshore being developed between 1940 and 1963, as shown on Map 4. Much of the remaining undeveloped shoreline has been developed subsequently.

Land Use

Residential land uses occupy almost all of the shorelands of Benedict and Tombeau Lakes, with the exception of the Nippersink Country Club and the wetland areas located on northern and western shorelands of Tombeau Lake and the isolated commercial establishments on Benedict Lake. Private access is provided by the Nippersink Country Club to Tombeau Lake. Public access to that Lake is limited to carry-in access provided through the public parklands located to the southwest of the Tombeau Lake basin, and through an undeveloped site at the Tombeau Road bridge that divides the two Lakes.

The existing 1995 land use pattern in the drainage area tributary to Benedict and Tombeau Lakes is shown on Map 5 and is quantified in Table 2. About 1,040 acres, or about 19 percent, of the combined tributary drainage area, were devoted to urban uses. The dominant urban land use within this urbanized area was residential, encompassing 587 acres, or about 57 percent of the area in urban use. About 4,560 acres, or about 81 percent, of the drainage area tributary to Benedict and Tombeau were devoted to rural land uses. About 2,885 acres, or about 63 percent of the rural area, were in agricultural and other open land uses. Woodlands, wetlands, and surface waters, including the surface area of Benedict and Tombeau Lakes, shown on Map 6, accounted for approximately 1,670 acres, or about 37 percent of the rural land uses.

Under year 2020 conditions, only limited additional conversion of rural land to urban land uses within the drainage area tributary to Benedict and Tombeau Lakes is envisioned in the regional land use plan.³ However, infilling of existing platted lots and additional low-density, single-family residential development within the tributary drainage area in the vicinity of the Lakes may be expected to occur.

WATER QUALITY

The data collected during the period from 1966 through 1997 by the Wisconsin Department of Natural Resources (WDNR) and during the period from 1998 through 1999 by the U.S. Geological Survey were used to determine water quality conditions in Benedict and Tombeau Lakes. These data are summarized in Tables 3 and 4 and are shown in Figures 1 through 4. The sampling locations used for data collection are shown on Map 2.

Based upon the recent measurements reported by the U.S. Geological Survey,⁴ Benedict Lake has good to very good water quality. Based upon total phosphorus and chlorophyll-*a* concentration data, the Lake has Wisconsin Trophic State Index (WTSI) values of 46 and 44, respectively, indicating that the Lake is a mesotrophic waterbody, which is supported by data shown in Figure 1.⁵ Mesotrophic lakes are moderately fertile lakes that support abundant aquatic plant growths and may support productive fisheries. Nuisance growths of algae and plants are usually not exhibited by mesotrophic lakes. Many of the cleaner lakes in Southeastern Wisconsin are

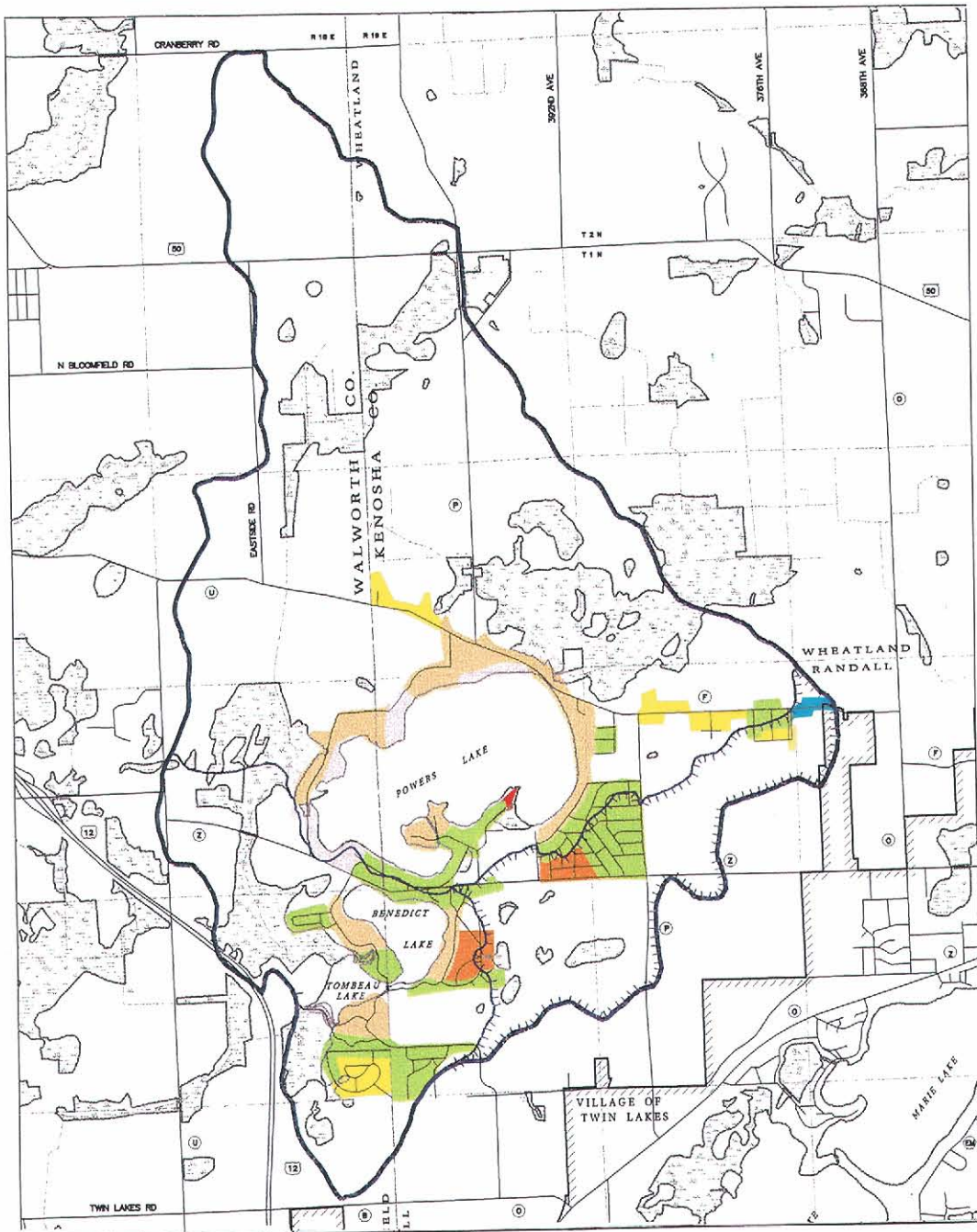
³*SEWRPC Planning Report No. 45, A Regional Land Use Plan for Southeastern Wisconsin, 2020, December 1997.*

⁴*U.S. Geological Survey Open-File Report No. 99-98, Water-Quality and Lake-Stage Data for Wisconsin Lakes, Water Year 1998, 1999; U.S. Geological Survey Open-File Report No. 00-89, Water-Quality and Lake-Stage Data for Wisconsin Lakes, Water Year 1999, 2000.*

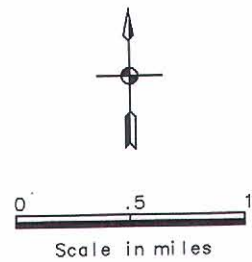
⁵*R.A. Lillie, S. Graham, and P. Rasmussen, "Trophic State Index Equations and Regional Predictive Equations for Wisconsin Lakes," Research and Management Findings, Wisconsin Department of Natural Resources Publication No. PUBL-RS-735 93, May 1993.*

Map 4

HISTORIC URBAN GROWTH WITHIN THE TOTAL TRIBUTARY DRAINAGE AREA TO BENEDICT AND TOMBEAU LAKES: 1850-1995



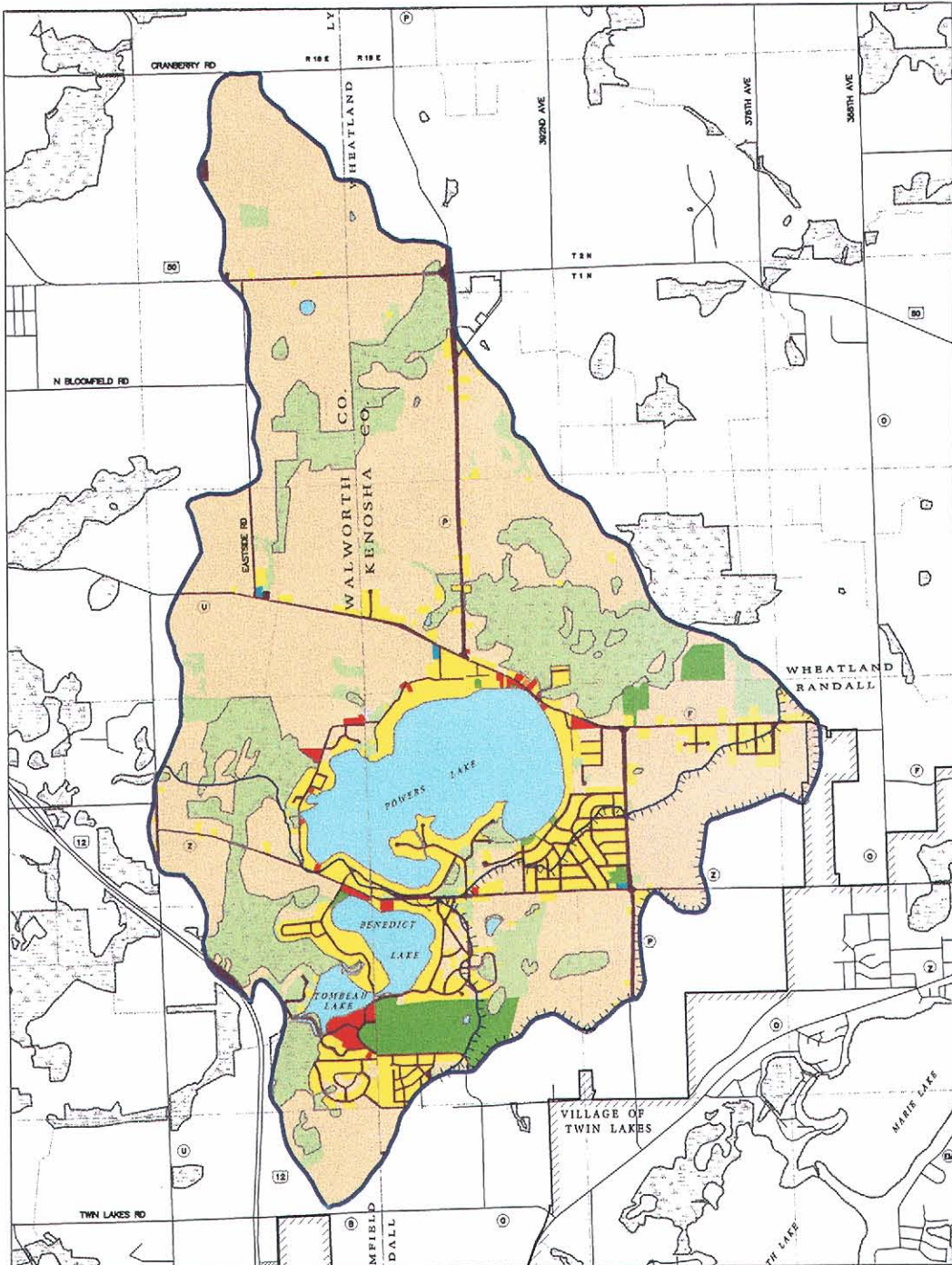
URBAN GROWTH YEARS



Source: SEWRPC.

Map 5

GENERALIZED LAND USE WITHIN THE TOTAL TRIBUTARY DRAINAGE AREA TO BENEDICT AND TOMBEAU LAKES: 1995



- LAND USE CATEGORIES**
- Single-family residential
 - Multi-family residential
 - Commercial
 - Industrial
 - Transportation, communications, and utilities
 - Government and institutional
 - Recreation
 - Surface water
 - Wetlands and woodlands
 - Agricultural, unused, and other open lands
 - Extractive and landfill
 - Internally Drained Area
 - Total Tributary Drainage Area

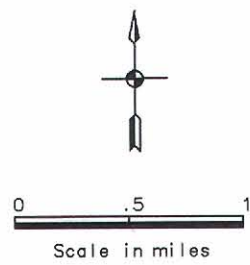


Table 2

EXISTING LAND USE FOR THE DRAINAGE AREA TRIBUTARY TO BENEDICT AND TOMBEAU LAKES: 1995

Land Use Category	Acres	Percent of Category	Percent of Total Area
Urban			
Residential.....	587	57	10
Commercial.....	32	3	1
Governmental and Industrial.....	4	< 1	< 1
Communication, Transportation and Utilities	262	25	5
Recreational.....	154	15	3
Subtotal	1,039	100	19
Rural			
Agricultural and Open Lands	2,885	63	52
Woodlands	272	6	5
Wetlands.....	819	18	14
Surface Water.....	580	13	10
Subtotal	4,556	100	81
Total	5,595	--	100

Source: SEWRPC.

classified as mesotrophic.⁶ Furthermore, the average surface water total phosphorus value for 1998 was approximately 11 micrograms per liter ($\mu\text{g/l}$), with an annual average chlorophyll-*a* concentration of 4.4 $\mu\text{g/l}$, as shown in Table 3. The sampling location used by the U.S. Geological Survey is shown on Map 2. The spring surface water total phosphorus concentration in 1998 was 14 $\mu\text{g/l}$, which is within the standard of 20 $\mu\text{g/l}$ recommended by the Regional Planning Commission as the value below which few water quality problems are likely to occur. Surface water total phosphorus concentrations have never been greater than 14 $\mu\text{g/l}$ and have been as low as one $\mu\text{g/l}$ since 1966. Neither the observed total phosphorus nor chlorophyll-*a* concentrations were indicative of water quality problems.

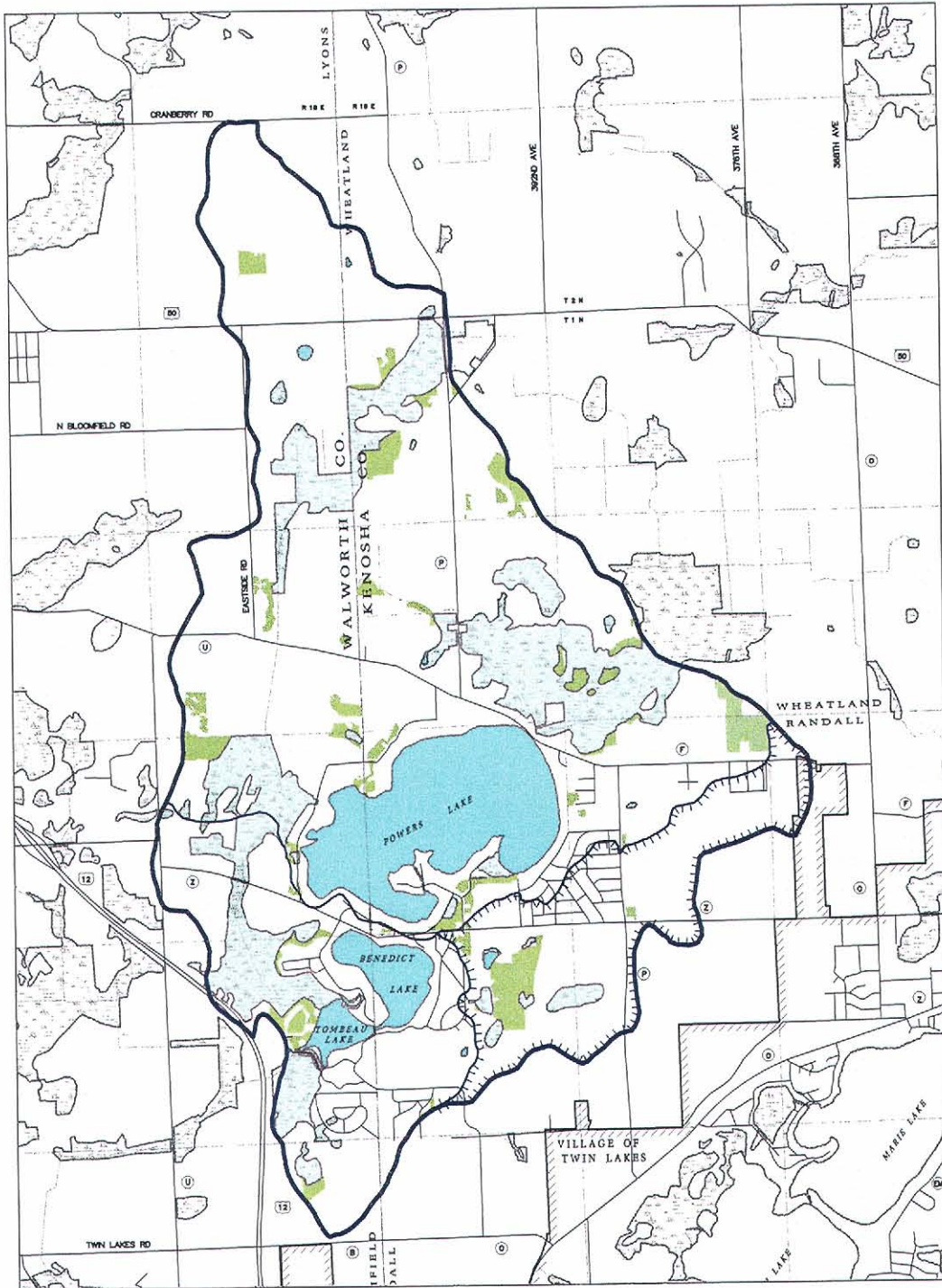
In contrast, the WTSI value of 50, calculated based upon the mean Secchi-disk transparency values recorded during 1998, suggested that the Lake was bordering on becoming an eutrophic, or enriched, lake. Comparison of these data, collected by the U.S. Geological Survey during 1998, with those gathered under the auspices of the WDNR Self-Help Monitoring Program between 1989 and 1996, suggests that the WTSI values calculated from Secchi-disk transparency observations made during 1998 on Benedict Lake were unusually high, as summarized in Figure 2. During the period from 1989 to 1996, data were not available for 1997, only two WTSI values calculated based upon Secchi-disk transparency observations, out of a total of 46 values, or about 4 percent of the data set, resulted in a WTSI value of greater than 50. The annual average Secchi-disk transparency value reported from Benedict Lake between 1989 to 1996 was 9.8 feet, compared to the annual average Secchi-disk transparency value of 6.9 feet recorded during 1998.

In addition, based upon the entire data set, Benedict Lake normally demonstrates a seasonal fluctuation in WTSI values calculated based upon water clarity. WTSI values indicative of lower trophic state levels are typically

⁶See R.A. Lillie, and J.W. Mason, Limnological Characteristics of Wisconsin Lakes, Wisconsin Department of Natural Resources Technical Bulletin No. 138, 1983; also see SEWRPC Memorandum Report No. 93, A Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report, March 1995.

Map 6

WOODLANDS AND WETLANDS WITHIN THE TOTAL TRIBUTARY DRAINAGE AREA TO BENEDICT AND TOMBEAU LAKES: 1995



LAND AREAS

-  Woodland
-  Wetland
-  Surface water

Source: SEWRPC.

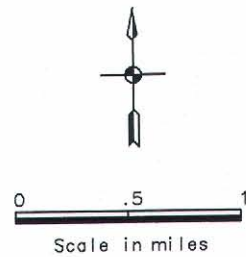


Table 3

BENEDICT LAKE WATER QUALITY DATA: 1966-1999

Parameter ^a	03/31/66		08/25/66		08/26/75	07/27/77			05/07/98		06/26/98		07/28/98	
	Shallow	Deep	Shallow	Deep	Shallow	Shallow	Middle	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Depth of Sample (feet)	10	17	10	30	1.0	1.0	28	38	0.5	10.0	0.5	11.0	0.5	11.0
Specific Conductance (μ S/cm).....	426	423	413	423	407	439	493	515	622	631	601	659	601	716
pH (standard units)	--	--	8.4	8.2	8.3	8.3	7.9	7.6	8.2	7.6	7.9	7.4	8.0	7.2
Water Temperature($^{\circ}$ F).....	--	--	71.4	56.8	--	78.8	57.2	51.8	60.8	47.5	82.6	48.2	78.6	48.7
Turbidity (NTU).....	--	--	--	--	2.5	3.0	3.4	3.9	3.6	--	--	--	--	--
Secchi Depth (feet)	--	--	--	--	--	--	6.9	--	5.6	--	6.2	--	6.2	--
Dissolved Oxygen	--	--	8.5	1.0	--	6.3	2.1	0.1	10.6	0.8	8.1	0.2	9.3	0.2
Hardness, as CaCO ₃	--	--	--	--	--	--	--	--	260	--	--	--	--	--
Calcium, Dissolved.....	33.2	20	19.7	22.3	27	30	40	46	46	--	--	--	--	--
Magnesium, Dissolved.....	26.2	29.5	28.8	28	36	43	41	41	36	--	--	--	--	--
Sodium, Dissolved	4.0	4.0	4.4	4.3	7.0	14	12	12	25	--	--	--	--	--
Potassium, Dissolved.....	1.7	1.7	1.7	1.8	1.7	3.3	1.9	2.3	2.3	--	--	--	--	--
Alkalinity, as CaCO ₃	200	200	180	187	168	170	208	238	--	--	--	--	--	--
Sulfate, Dissolved SO ₄	36.5	36.3	39.5	39	34	35	34	32	33	--	--	--	--	--
Chloride, Dissolved	7.6	7.6	8.1	8.6	19	23	24	24	56	--	--	--	--	--
Fluoride, Dissolved	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silica, Dissolved.....	--	--	--	--	--	--	--	--	3.3	--	--	--	--	--
Solids, Dissolved at 180 $^{\circ}$ C.....	--	--	--	--	--	--	--	--	374	--	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , Dissolved	--	--	--	--	0.26	0.095	0.117	0.074	0.625	--	--	--	0.337	--
Nitrogen, Ammonia Dissolved.....	--	--	--	--	0.03	0.13	0.29	0.69	0.117	--	--	--	0.098	--
Nitrogen, Organic Total	--	--	--	--	0.52	0.70	0.73	1.34	0.08	--	--	--	0.58	--
Total Phosphorus	0.14	--	0.10	0.06	0.01	0.03	0.04	0.04	0.014	0.024	--	--	0.010	0.069
Ortho-Phosphorus, Dissolved.....	0.40	0.08	0.05	0.10	0.005	0.005	0.006	<0.004	<0.002	--	--	--	0.002	--
Iron, Dissolved (μ g/l)	0.02	0.04	0.12	0.12	0.08	<0.06	<0.06	0.41	<10	--	--	--	--	--
Manganese, Dissolved (μ g/l).....	--	--	--	--	0.03	<0.03	<0.03	0.07	<0.040	--	--	--	--	--
Chlorophyll- <i>a</i> (μ g/l).....	--	--	--	--	--	--	--	--	8.53	--	1.79	--	2.96	--

Table 3 (continued)

Parameter ^a	08/25/98			02/19/99		04/15/99		06/10/99		07/07/99		08/04/99		
	Shallow	Middle	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Middle	Deep
Depth of Sample (feet)	0.5	9.0	11.0	0.5	11.0	0.5	11.0	0.5	11.0	0.5	11.0	0.5	8.0	11.0
Specific Conductance (μ S/cm).....	582	631	774	541	679	654	660	612	691	569	695	561	610	733
pH (standard units)	8.2	7.7	7.2	7.9	7.7	8.2	8.1	8.2	7.6	8.2	7.5	8.1	8.0	7.2
Water Temperature($^{\circ}$ F).....	78.4	53.2	49.1	40.1	38.1	52.9	48.6	80.2	49.1	81.5	49.1	81.3	57.2	48.4
Turbidity (NTU).....	--	--	--	--	--	1.5	--	--	--	--	--	--	--	--
Secchi Depth (feet)	8.9	--	--	--	--	6.2	--	7.5	--	6.2	--	6.2	--	--
Dissolved Oxygen	8.8	0.5	0.4	17.9	11.5	12.0	9.3	9.0	0.7	8.6	0.4	9.5	9.0	0.0
Hardness, as CaCO ₃	--	--	--	--	--	260	--	--	--	--	--	--	--	--
Calcium, Dissolved.....	--	--	--	--	--	46	--	--	--	--	--	--	--	--
Magnesium, Dissolved.....	--	--	--	--	--	36	--	--	--	--	--	--	--	--
Sodium, Dissolved	--	--	--	--	--	26	--	--	--	--	--	--	--	--
Potassium, Dissolved.....	--	--	--	--	--	2.2	--	--	--	--	--	--	--	--
Alkalinity, as CaCO ₃	--	--	--	--	--	222	--	--	--	--	--	--	--	--
Sulfate, Dissolved SO ₄	--	--	--	--	--	34	--	--	--	--	--	--	--	--
Chloride, Dissolved	--	--	--	--	--	59	--	--	--	--	--	--	--	--
Fluoride, Dissolved	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silica, Dissolved.....	--	--	--	--	--	5.8	--	--	--	--	--	--	--	--
Solids, Dissolved at 180 $^{\circ}$ C.....	--	--	--	--	--	356	--	--	--	--	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , Dissolved	--	--	--	--	--	0.557	--	--	--	0.512	--	--	--	--
Nitrogen, Ammonia Dissolved.....	--	--	--	--	--	0.353	--	--	--	0.128	--	--	--	--
Nitrogen, Organic Total	--	--	--	--	--	1.2	--	--	--	0.92	--	--	--	--
Total Phosphorus	--	--	--	0.014	0.023	0.018	0.021	0.007	0.075	0.010	0.012	0.020	0.030	0.077
Ortho-Phosphorus, Dissolved.....	--	--	--	--	--	<0.002	--	--	--	0.004	--	--	--	--
Iron, Dissolved (μ g/l)	--	--	--	--	--	<10	--	--	--	--	--	--	--	--
Manganese, Dissolved (μ g/l).....	--	--	--	--	--	0.7	--	--	--	--	--	--	--	--
Chlorophyll- <i>a</i> (μ g/l).....	1.93	--	--	--	--	7.00	--	1.70	--	1.64	--	3.00	--	--

^aUnless otherwise indicated, units are mg/l.

Source: SEWRPC.

Table 4

TOMBEAU LAKE WATER QUALITY DATA: 1975-1999

Parameter ^a	08/26/75	07/27/78			05/07/98		06/26/98		07/28/98	
	Shallow	Shallow	Middle	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Depth of Sample (feet)	1.0	0.0	12	29	0.5	8.0	0.5	8.0	0.5	8.0
Specific Conductance (μ S/cm).....	428	347	385	428	605	630	586	646	547	648
pH (standard units)	8.0	7.8	7.7	7.5	8.1	7.5	8.1	7.4	8.5	7.3
Water Temperature($^{\circ}$ F)	--	75.2	68	44.6	60	44.6	82.0	46.0	77.5	47.3
Turbidity (NTU).....	3.2	1.3	1.7	2.6	1.7	--	--	--	--	--
Secchi Depth (feet)	--	--	4.8	--	10.5	--	10.2	--	4.3	--
Dissolved Oxygen	--	7.3	0.6	0	9.8	0.0	8.2	0.1	12.0	0.1
Hardness, as CaCO ₃	--	--	--	--	280	--	--	--	--	--
Calcium, Dissolved.....	37	48	52	66	57	--	--	--	--	--
Magnesium, Dissolved.....	34	36	37	42	33	--	--	--	--	--
Sodium, Dissolved	7.0	7.0	5.0	8.0	16	--	--	--	--	--
Potassium, Dissolved.....	1.7	1.8	1.3	2.3	2.2	--	--	--	--	--
Alkalinity, as CaCO ₃	180	196	230	262	--	--	--	--	--	--
Sulfate, Dissolved SO ₄	42	39	45	51	40	--	--	--	--	--
Chloride, Dissolved	17	15	16	19	37	--	--	--	--	--
Fluoride, Dissolved.....	--	--	--	--	--	--	--	--	--	--
Silica, Dissolved.....	--	--	--	--	6	--	--	--	--	--
Solids, Dissolved at 180 $^{\circ}$ C.....	--	--	--	--	396	--	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , Dissolved	0.31	0.57	0.77	0.16	1.11	--	--	--	0.096	--
Nitrogen, Ammonia Dissolved.....	0.03	<0.03	0.18	2.93	0.072	--	--	--	<0.013	--
Nitrogen, Organic Total	0.66	0.70	0.79	.83	0.84	--	--	--	0.86	--
Total Phosphorus	0.04	0.03	0.03	0.09	0.024	0.214	0.015	0.597	0.026	0.131
Ortho-Phosphorus, Dissolved.....	0.006	0.01	<0.005	0.053	0.003	--	--	--	0.002	--
Iron, Dissolved (μ g/l)	0.28	0.09	0.09	0.09	<10	--	--	--	--	--
Manganese, Dissolved (μ g/l).....	0.04	<0.03	<0.03	0.53	7.9	--	--	--	--	--
Chlorophyll- <i>a</i> (μ g/l).....	--	15	--	--	10.5	--	--	--	--	--

Table 4 (continued)

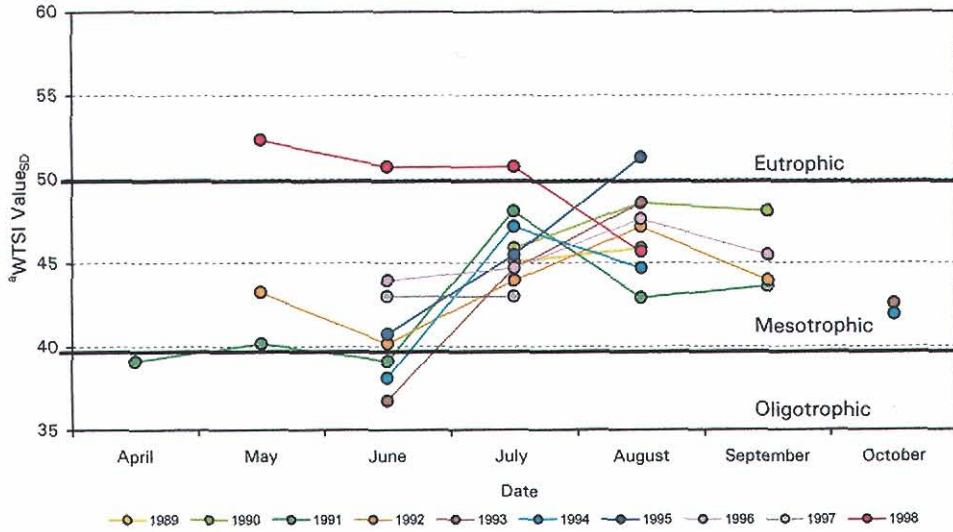
Parameter ^a	08/25/98			04/15/99		06/10/99		07/07/99		08/04/99		
	Shallow	Middle	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Middle	Deep
Depth of Sample (feet)	0.5	5.0	8.0	0.5	8.0	0.5	8.0	0.5	8.0	0.5	6.0	8.0
Specific Conductance (μ S/cm)	568	585	684	637	647	563	668	529	672	542	590	655
pH (standard units)	8.4	7.4	7.1	8.2	7.6	8.2	7.8	8.3	7.3	8.3	7.4	7.1
Water Temperature(^o F)	78.1	59.0	46.9	52.9	44.8	82.0	46.6	82.0	46.4	80.9	49.8	46.7
Turbidity (NTU)	--	--	--	1.2	--	--	--	--	--	--	--	--
Secchi Depth (feet)	8.2	--	--	7.9	--	7.5	--	5.6	--	7.5	--	--
Dissolved Oxygen	8.8	1.3	0.4	12.1	4.6	9.5	0.7	9.8	0.4	10.8	0.1	0.0
Hardness, as CaCO ₃	--	--	--	280	--	--	--	--	--	--	--	--
Calcium, Dissolved	--	--	--	56	--	--	--	--	--	--	--	--
Magnesium, Dissolved	--	--	--	34	--	--	--	--	--	--	--	--
Sodium, Dissolved	--	--	--	16	--	--	--	--	--	--	--	--
Potassium, Dissolved	--	--	--	2.5	--	--	--	--	--	--	--	--
Alkalinity, as CaCO ₃	--	--	--	230	--	--	--	--	--	--	--	--
Sulfate, Dissolved SO ₄	--	--	--	42	--	--	--	--	--	--	--	--
Chloride, Dissolved	--	--	--	41	--	--	--	--	--	--	--	--
Fluoride, Dissolved	--	--	--	--	--	--	--	--	--	--	--	--
Silica, Dissolved	--	--	--	6.8	--	--	--	--	--	--	--	--
Solids, Dissolved at 180 ^o C	--	--	--	358	--	--	--	--	--	--	--	--
Nitrogen, NO ₂ + NO ₃ , Dissolved	--	--	--	1.22	--	--	--	0.283	--	--	--	--
Nitrogen, Ammonia Dissolved	--	--	--	0.053	--	--	--	0.019	--	--	--	--
Nitrogen, Organic Total	--	--	--	0.84	--	--	--	0.82	--	--	--	--
Total Phosphorus	0.020	0.071	0.113	0.028	0.101	0.021	0.014	0.025	0.024	0.024	0.029	0.147
Ortho-Phosphorus, Dissolved	--	--	--	0.002	--	--	--	0.003	--	--	--	--
Iron, Dissolved (μ g/l)	--	--	--	<10	--	--	--	--	--	--	--	--
Manganese, Dissolved (μ g/l)	--	--	--	3.6	--	--	--	--	--	--	--	--
Chlorophyll- <i>a</i> (μ g/l)	--	--	--	6.46	--	4.94	--	6.72	--	6.00	--	--

^aUnless otherwise indicated, units are mg/l.

Source: SEWRPC.

Figure 1

TROPHIC STATE INDEX FOR BENEDICT LAKE: 1989-1998

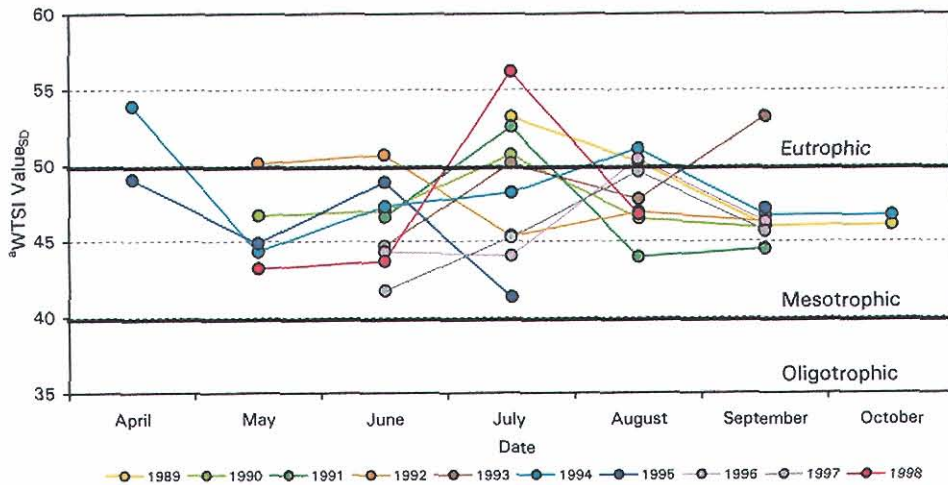


^aSD=Secchi-disk depth, see R.A. Lillie, S. Graham, and P. Rasmussen, "Trophic State Index Equations and Regional Predictive Equations for Wisconsin Lakes," Research and Management Findings, Wisconsin Department of Natural Resources Publication No. PUBL-RS-735 93, May 1993.

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

Figure 2

TROPHIC STATE INDEX FOR TOMBEAU LAKE: 1989-1998

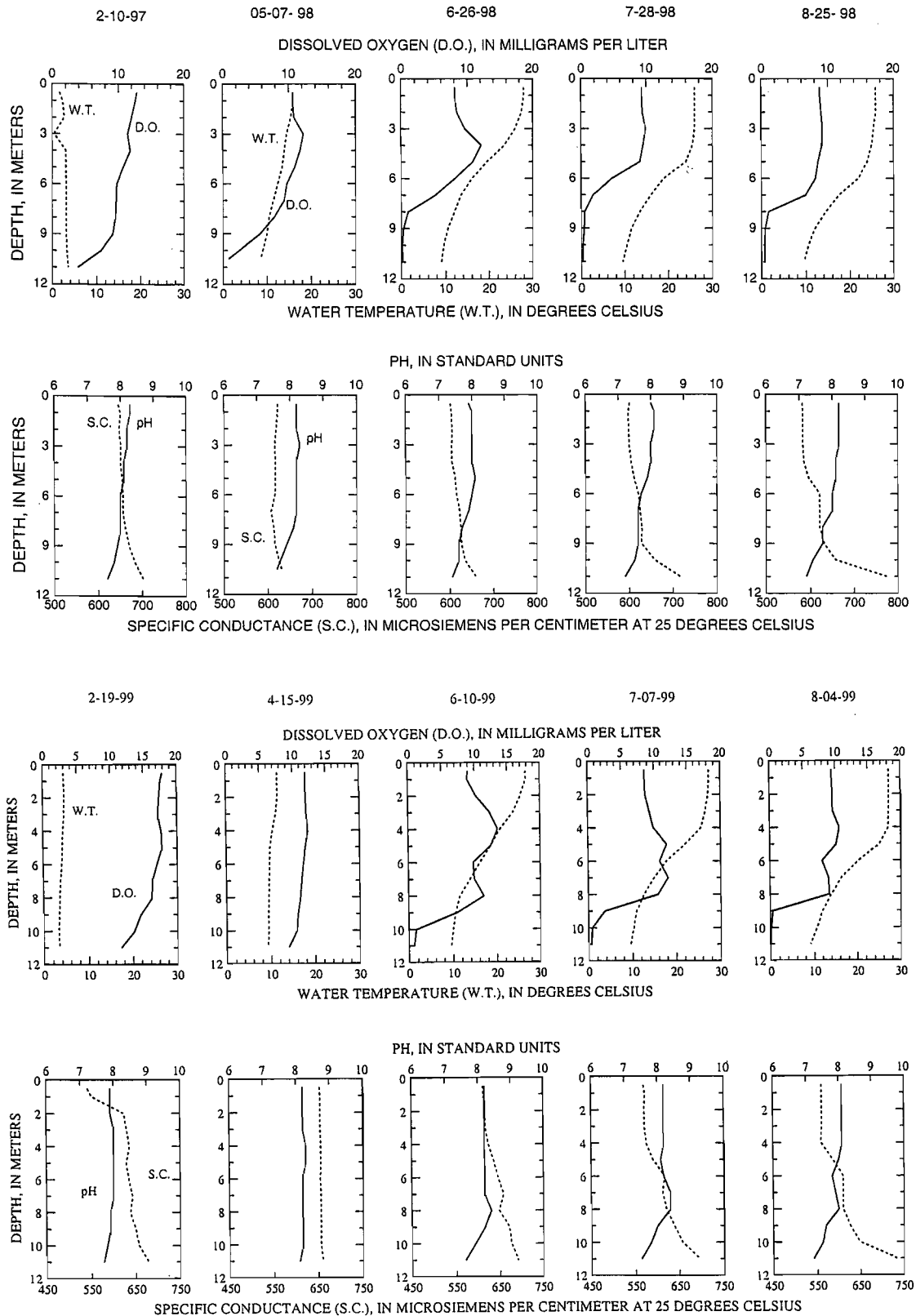


^aSD=Secchi-disk depth, see R.A. Lillie, S. Graham, and P. Rasmussen, "Trophic State Index Equations and Regional Predictive Equations for Wisconsin Lakes," Research and Management Findings, Wisconsin Department of Natural Resources Publication No. PUBL-RS-735 93, May 1993.

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

Figure 3

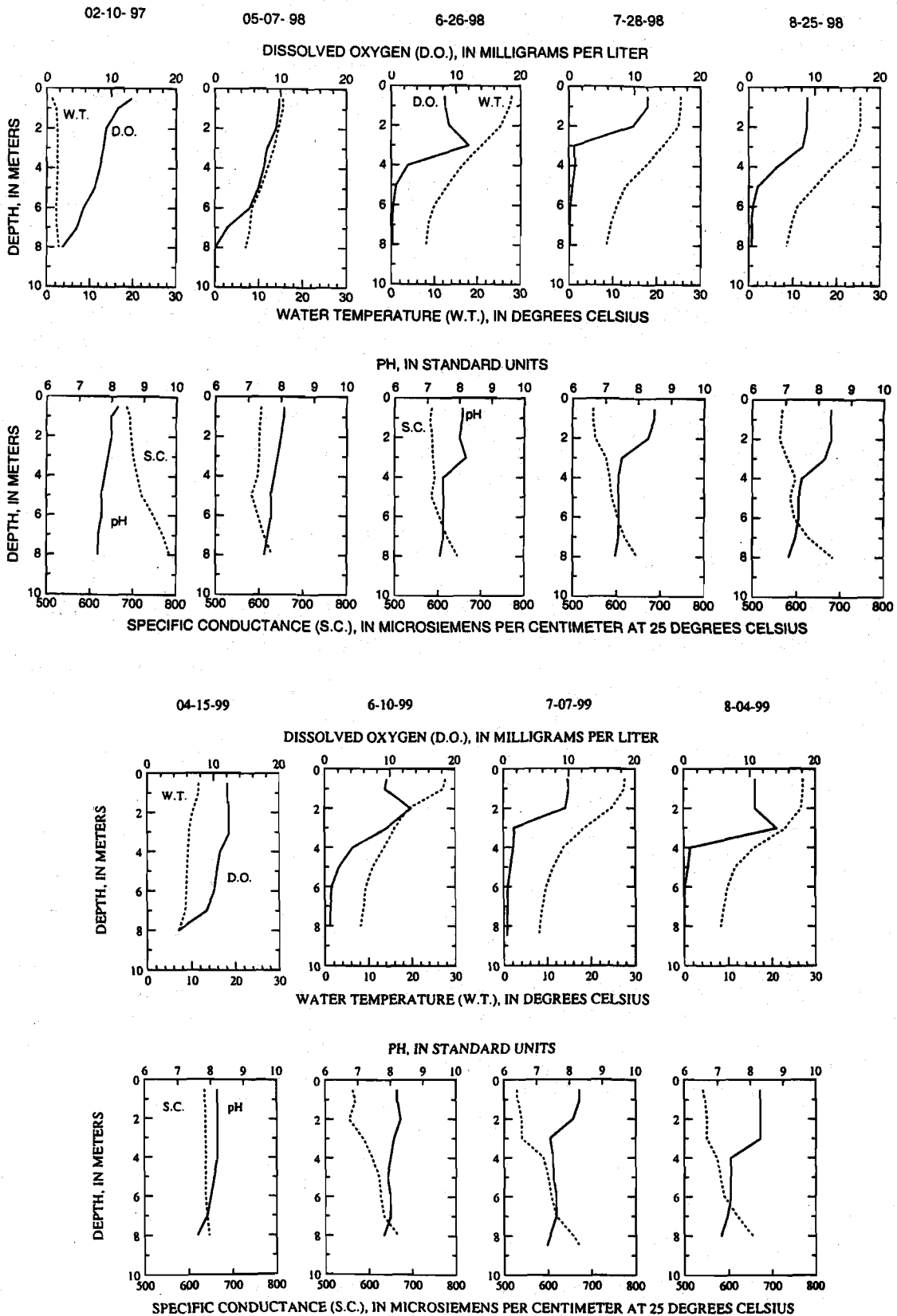
DISSOLVED OXYGEN, TEMPERATURE, pH, AND SPECIFIC CONDUCTANCE PROFILES FOR BENEDICT LAKE: 1997-1999



Source: U.S. Geological Survey.

Figure 4

DISSOLVED OXYGEN, TEMPERATURE, pH, AND SPECIFIC CONDUCTANCE PROFILES FOR TOMBEAU LAKE: 1997-1999



reported during the period from spring to early summer (from April through June), with WTSI values indicative of higher trophic state levels being reported during the period from mid- to late-summer (from July through September), as shown in Figure 1. The seasonal pattern observed during 1998 field study period demonstrated the opposite pattern, with higher trophic state levels being reported from May through July and lower trophic state levels being reported during August. These unusually high trophic level observations reported during May and June 1998 were likely to reflect the abnormally dry and warmer-than-average early summer period observed at that time. Drier, warmer climatic conditions could result in significant increases in algal growth due to increased light and temperature regimes, as well as high concentrations of nutrients in the water column due to evaporative concentration. Because Benedict Lake does not have a discrete inlet, it is particularly susceptible to "drought" conditions. Following the heavier precipitation that occurred following mid-summer, water clarity readings returned to more "normal" levels in August, decreasing the calculated WTSI values. This apparent decrease in water clarity-based WTSI values was also consistent with the perceptions of the local residents, reported during the questionnaire survey of lake management district electors conducted during the summer of 1998, the results of which are set forth in Appendix A, that the water quality of the Lake decreased in comparison to previous years.

Tombeau Lake has water quality ranging from poor to good depending upon the parameters and sampling period considered, based upon measurements reported by the U.S. Geological Survey during 1998 and 1999.⁷ Based upon total phosphorus and chlorophyll-*a* concentration data, the Lake has Wisconsin Trophic State Index (WTSI) values of 54 and 50, respectively, indicating that the Lake is an meso-eutrophic waterbody, which status is supported by the data shown in Figure 2.⁸ Meso-eutrophic lakes are fertile lakes that support abundant aquatic plant growths and may support productive fisheries. Nuisance growths of algae and plants can be exhibited by meso-eutrophic lakes. The sampling location used by the U.S. Geological Survey is shown on Map 2.

The average surface water total phosphorus value reported for Tombeau Lake during 1998 was approximately 34 µg/l, with an annual average chlorophyll-*a* concentration of about 11 µg/l, as shown in Table 4. The spring surface water total phosphorus concentration in 1998 was 24 µg/l, which is above the 20 µg/l standard recommended by the Regional Planning Commission as the value below which few water quality problems are likely to occur. In previous years, the surface water total phosphorus and chlorophyll-*a* concentrations were well below this standard. This suggests that Tombeau Lake, like Benedict Lake, could have been affected by the drier, warmer conditions reported during 1998, even though Tombeau Lake has two discrete inlets, which, under "normal" conditions, might be expected to result in a sufficiently rapid flushing rate so as to dilute the in-lake phosphorus concentrations and reduce the chlorophyll-*a* concentration through washout of algae.

The mean WTSI value for Tombeau Lake, calculated from Secchi-disk transparency data for 1998 study, was 48, indicative of a mesotrophic lake. Comparison of the data collected by the U.S. Geological Survey during 1998 with those gathered under the WDNR Self-Help Monitoring Program from 1989 to 1997 suggests that this Lake has a history of widely ranging Secchi-disk transparency readings, as summarized in Figure 2. Between 1989 and 1998, there were a total of 115 Secchi-disk transparency measurements taken on Tombeau Lake. Within this 10-year period, about 25 percent of the observations resulted in WTSI values of greater than 50, representing an average Secchi-disk transparency of 1.8 meters; about 50 percent resulted in WTSI values of between 45 and 50, representing an average Secchi-disk transparency of 2.5 meters, and about 25 percent resulted in WTSI values of between 40 and 45, representing an average Secchi-disk transparency of 3.3 meters. The annual average Secchi-disk transparency-based WTSI value from 1989 to 1998 was 47, with values ranging from a maximum of 49 to a minimum of 46, as shown in Figure 2. Unlike Benedict Lake, Tombeau Lake does not exhibit any particular seasonal pattern in water clarity.

⁷U.S. Geological Survey Open-File Reports 99-98 and 00-87, op. cit.

⁸R.A. Lillie, S. Graham, and P. Rasmussen, op. cit.

The data show that Tombeau Lake has had significantly poorer water clarity than Benedict Lake over the past 10 years. This is consistent with the perception of the local residents as determined through the questionnaire survey of lake management district electors, and consistent with observations by Commission staff of dark and turbid waters in Tombeau Lake compared with clear, blue-green tinged waters in Benedict Lake.

Despite these differences, both Benedict and Tombeau Lakes stratify during the summer months. During the months of May through August, both water temperature and dissolved oxygen concentrations decrease with depth, as shown in Figures 3 and 4. Dissolved oxygen concentration data obtained during February also suggest a period of winter stratification, as shown in Figures 3 and 4. These data are typical for dimictic lakes in the temperate zone, with depletion of hypolimnetic or lake bottom water oxygen being common in mesotrophic and eutrophic waterbodies.⁹

The increased conductivity in the hypolimnion of Benedict and Tombeau Lakes, also shown in Figures 3 and 4, respectively, indicates a degree of internal loading occurring in these Lakes. The impact of the internal loading is related to the rate at which each Lake mixes from top to bottom during the spring and fall overturn events. When the mixing process is relatively slow, on the order of days to weeks, minerals and nutrients released from the lake sediments into the hypolimnion, or bottom waters, of the lake tend to recombine with the multivalent cations, such as iron, calcium, and aluminum, present in the lake water and precipitate out of the water column. Conversely, if the mixing process is relatively rapid, on the order of hours or days as may occur due to the passage of an intense storm, the minerals and nutrients may be mixed upward into the epilimnion or surface waters where they are available for plant growth. In spring and fall, differential warming and cooling of the lake surface waters, respectively, alters the density of lake waters in such a manner as to promote mixing of lake water. The spring mixing event is usually observed in early May. During 1998, however, both of these Lakes had already established, surface-to-bottom temperature differences by May 7, 1998, as shown in Figures 3 and 4, due to the unusually warm spring temperatures.

POLLUTANT LOADINGS

The water quality conditions of Benedict and Tombeau Lakes suggest that internal loading is not likely to be significant in these Lakes. This hypothesis is supported by the good agreement between predicted and observed total phosphorus concentrations in the Lakes.¹⁰ Predicted total phosphorus concentrations were estimated for each Lake using the Wisconsin Lake Spreadsheet Model (WILMS). Because of its location as a through-flow lake within a proportionately larger watershed, Tombeau Lake receives over 90 percent of the combined total phosphorus load to the Benedict-Tombeau Lake system. This is despite the fact that Tombeau Lake accounts for only about 40 percent of the total combined lake surface area and total combined lake volume. Benedict Lake, due to its limited tributary drainage area and absence of a defined inflowing stream system, receives only a relatively small portion of the total pollutant load.

Pollutant loads to a lake are generated by various natural processes and human activities that take place in the drainage area tributary to a lake. These loads are transported to the lake through the atmosphere, across the land surface, and by way of inflowing streams. Pollutants transported by the atmosphere are deposited onto the surface of the lake as dry fallout and direct precipitation. Pollutants transported across the land surface enter the lake as direct runoff and, indirectly, as groundwater inflows, including drainage from onsite wastewater treatment systems.

⁹R.G. Wetzel, *Limnology*, Saunders, Philadelphia, 1975.

¹⁰Estimates of the long-term annual average total phosphorus concentration in Benedict and Tombeau Lakes were derived from the WILMS model, described in Wisconsin Department of Natural Resources Publication No. PUBL-WR-363-96 REV, Wisconsin Lake Model Spreadsheet, Version 2.00, User's Manual, June 1994.

In drainage lakes like Tombeau Lake, in the absence of identifiable or point source discharges from industries or wastewater treatment facilities, the principal routes by which pollutants enter a lake are as surface water inflows from tributary stream systems and as runoff transported across the land surface directly tributary to a lake. Even those pollutants entering a lake through the inflowing stream system, in the absence of identifiable point source discharges from industries or wastewater treatment facilities, originate as runoff transported across the land surface to the lake after having passed through the stream system and/or upstream waterbody. In drained lakes like Benedict Lake, in the absence of identifiable or point source discharges from industries or wastewater treatment facilities, the principal route by which pollutants enter a lake is as pollutant loads transported across the land surface directly tributary to a lake.¹¹ The discussion that follows is based upon nonpoint source pollutant loadings to both Benedict and Tombeau Lakes.

The nonpoint source pollutant loads to Benedict and Tombeau Lakes were estimated on the basis of land use inventory data and unit area load coefficients determined for Southeastern Wisconsin. Annual contaminant loads entering Benedict and Tombeau Lakes were calculated to be approximately 625 tons of sediment, 2,150 pounds of phosphorus, seven pounds of copper, and 54 pounds zinc, as shown in Table 5. Copper and zinc were used in this analysis as surrogates for metals and other pollutants that are contributed primarily from urban sources.

To validate the estimated contaminant loads to Benedict and Tombeau Lakes, Commission staff applied the estimated phosphorus load of 2,146 pounds in the Vollenweider-type OECD phosphorus budget model to estimate an in-lake total phosphorus concentration. This calculation resulted in an estimated annual average phosphorus concentration of about 130 µg/l, which value significantly exceeds the observed whole-lake phosphorus concentration of about 55 µg/l measured in the Lakes. This would suggest that the estimated contaminant loads are not an unreasonable representation of the loads entering Benedict and Tombeau Lakes, and that other pollutant sources, including internal loading, to Benedict and Tombeau Lakes, are relatively small compared to the loading from external sources. The forecast chlorophyll-*a* concentration in the Lakes was about 17 µg/l, which is higher than the observed chlorophyll-*a* concentration of about eight µg/l, further suggesting that the estimated loading rates overestimated the actual loads. This situation is not inconsistent with the characterization of Benedict Lake as a spring-fed, marl lake in which some phosphorus would be present as particulate calcium phosphates and some component of the water load would be from groundwater inflows rather than surface runoff.

Table 5 also shows the relative percentage contributions of the various land uses to the pollutant loads to Benedict and Tombeau Lakes. These data indicate that, based on 1995 land use conditions in the drainage area tributary to Benedict and Tombeau Lakes, about 81 percent of the phosphorus load to Benedict and Tombeau Lakes is contributed from agricultural and open lands within the tributary drainage area. Of the balance, about 6 percent is contributed from wetlands, woodlands, and surface waters, about 2 percent from residential areas, and the balance from commercial-, governmental-, and communication-related sources. Three percent of the sediment load is generated from urban sources, about 90 percent from agricultural and open lands, and about 7 percent from woodlands, wetlands, and surface water sources, as set forth in Table 5. All of the heavy metals delivered to the Lakes are estimated to originate in urban areas.

Of the controllable pollutant sources, the most significant sources under existing land use conditions vary with the particular pollutants of concern. Agricultural and other open rural lands are the principal sources of sediment and phosphorus loads to Benedict and Tombeau Lakes, while urban lands generate the largest percentage of metals loadings. Onsite sewage disposal systems also constitute a potentially significant source of phosphorus from urban areas. Control of contaminants from these various sources can be effected through a variety of measures as set forth in Chapter IV.

¹¹*Sven-Olof Ryding and Walter Rast, The Control of Eutrophication of Lakes and Reservoirs, Unesco Man and the Biosphere Series, Volume 1, Parthenon Press, Carnforth, 1989.*

Table 5

FORECAST ANNUAL POLLUTANT LOADINGS TO BENEDICT AND TOMBEAU LAKES BY LAND USE CATEGORY: 1995

Land Use Category	Pollutant Loads							
	Sediment		Phosphorus		Zinc		Copper	
	Tons	Percent	Pounds	Percent	Pounds	Percent	Pounds	Percent
Urban								
Residential ^a	4.7	23	44.1	16	4.8	9	0.0	0
Commercial	12.1	60	27.7	10	46.2	85	6.8	96
Government and Industrial	1.0	5	1.8	1	3.2	6	0.3	4
Communication, Utilities, and Transportation	1.0	5	186.5	69	0.0	0	0.0	0
Recreational	1.5	7	10.8	4	0.0	0	0.0	0
Subtotal	20.3	100	270.9	100	54.2	100	7.1	100
Rural								
Agricultural and Open Lands	550.5	91	1,743.6	92	--	--	--	--
Wetlands	1.5	<1	70.4	4	--	--	--	--
Woodlands	0.4	<1	10.0	1	--	--	--	--
Surface Water	38.0	6	40.0	2	--	--	--	--
Lakes	16.2	3	11.5	1	--	--	--	--
Subtotal	606.6	100	1,897.9	100	--	--	--	--
Total	626.9	--	2,146.3	--	54.2	100	7.1	100

^aIncludes the contribution from onsite sewage disposal systems. The contribution from onsite sewage disposal systems, based upon the per capita phosphorus contribution contained within wastewater estimated within the WILMS model, could range from approximately 22 pounds per year to as much as 300 pounds per year, depending upon soil type, system condition, and system locations. For purposes of this analysis, 22 pounds per year were used as that value provided the loading that was best correlated to the measured in-lake phosphorus concentration.

Source: SEWRPC.

GROUNDWATER RESOURCES

Groundwater resources constitute an extremely valuable element of the natural resource base related to Benedict and Tombeau Lakes, both as a source of water supply and as a component of the surface water system. Groundwater in the vicinity of the Lakes moves within two distinct systems: a shallow water table system, and a deep system. The shallow water table system consists of glacial deposits and the dolomite bedrock nearest the surface. The deep system is separated from the surface and the water table by a relatively impermeable layer of Maquoketa shale, and includes all bedrock, mostly sandstone, below the Maquoketa shale and above the crystalline Precambrian basement rocks. The shallow sand and gravel aquifer, consisting of water-bearing sand and gravel, is less than 200 feet in thickness in the vicinity of Benedict and Tombeau Lakes, but is the most significant in terms of its relationship with Benedict and Tombeau Lakes and its tributary surface waters and adjacent wetlands. The groundwater in that aquifer flows from northwest to southeast across the Lakes, and is expected to have a direct affect on lake water quality and lake levels.

SOIL TYPES, SHORELINE STRUCTURES, AND CONDITIONS

Soils

Soil type, land slope, and land use and management practices are among the more important factors determining lake water quality conditions. Soil type, land slope, and vegetative cover are also important factors affecting the rate, amount, and quality of stormwater runoff. The soil texture and soil particle structure influence the

permeability, infiltration rate, and erodibility of soils. Land slopes are also important determinants of stormwater runoff rates and of susceptibility to erosion.

The U.S. Natural Resources Conservation Service, under contract to the Southeastern Wisconsin Regional Planning Commission, completed a detailed soil survey of the Benedict and Tombeau Lakes area in 1966.¹² Using the regional soil survey, an assessment was made of the hydrologic characteristics of the soils in the tributary drainage area to Benedict and Tombeau Lakes. Soils within the tributary area to Benedict and Tombeau Lakes were categorized into four main hydrologic soil groups, as well as an "other" category, as indicated on Map 7. Approximately 13 percent of the total tributary drainage area is covered by well-drained soils, and about 75 percent of the tributary drainage area by moderately drained soils. Less than 1 percent is covered with poorly drained or very poorly drained soils. About 1 percent of the drainage area was covered by soils whose attributes could not be determined, with the remaining 11 percent of the watershed being surface water, as shown on Map 7.

The regional soil survey also contained interpretations of the suitability of soils for urban development with conventional onsite sewage disposal systems and with alternative onsite sewage disposal systems, as shown on Maps 8 and 9. At present, all riparian residential lands and adjacent lands in the total tributary drainage area are served by private onsite sewage disposal systems. Those lands are covered by soils which are categorized as having varying suitabilities for onsite sewage disposal systems. The soil ratings for onsite sewage disposal systems presented on Maps 8 and 9 reflect the requirements of Chapter Comm 83 of the *Wisconsin Administrative Code* governing onsite sewage disposal systems as it existed early in the year 2000.

During 2000, the Wisconsin Legislature amended Chapter Comm 83 and adopted new rules governing onsite sewage disposal systems. These rules, which had an effective date of July 1, 2000, increased the number of types of onsite sewage disposal systems that legally could be used from four to nine. The Wisconsin Department of Commerce envisions that other systems also will be approved in the future. These new rules significantly alter the existing regulatory framework, and will increase the area in which onsite sewage disposal systems may be utilized. However, the new rules include a provision that allows counties the option of waiting three years before implementing the new onsite sewage disposal system rules and permitting the use of the new types of systems. This provision would allow local governments more time to enact land use plans that will determine which areas may be developed with onsite sewage disposal systems and to train inspectors on the different types of onsite sewage disposal system designs. Kenosha County has delayed the implementation of the new rules until January 1, 2003. Notwithstanding, the new onsite sewage disposal technologies can be used as replacement systems or for new developments on lots platted at the time the amended code took effect. In Walworth County, the use of the new technologies was not delayed and the new technologies are currently allowed where appropriate in accordance with the new code.

Shoreline Protection Structures

Erosion of shorelines results in the loss of land, damage to shoreland infrastructure, and interference with lake access and use. Such erosion is usually caused by wind-wave erosion, ice movement, and motorized boat traffic. A survey of Benedict and Tombeau Lakes shorelines, conducted by Commission staff in July 1998, identified that about 70 percent of the shoreline remains in a natural condition without shoreline structures, as shown on Map 10. About 23 percent of the shoreline is protected by bulkheads and riprap structures, while 7 percent is maintained as beach. No major areas of shoreline erosion were identified.

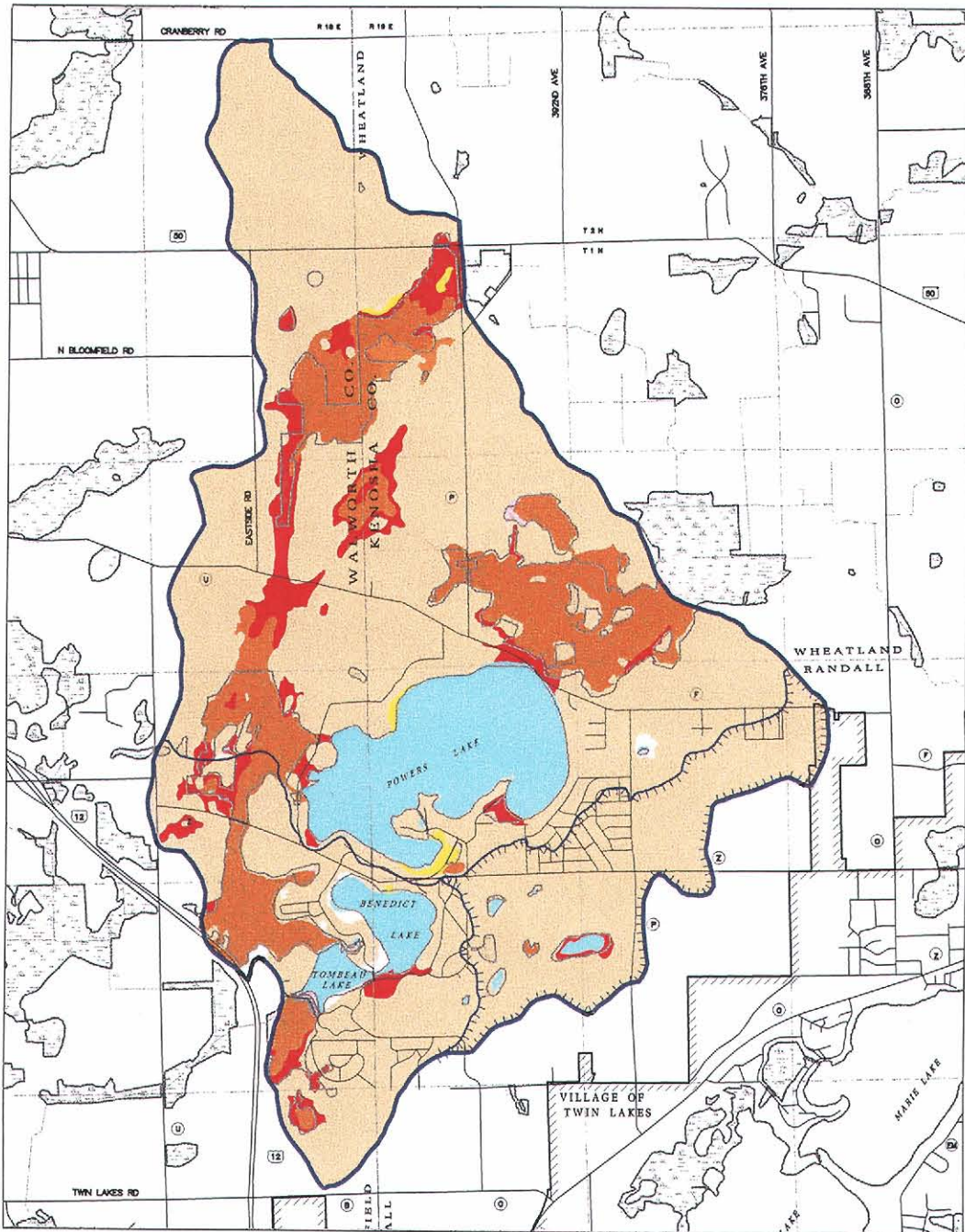
AQUATIC PLANTS, DISTRIBUTION, AND MANAGEMENT AREAS

A survey of aquatic plant species in the Lake basins was conducted by Commission staff during July 1998. The results of this survey are presented in Tables 6 and 7, and graphically depicted on Map 11. Illustrations of the









¹²*SEWRPC Planning Report No. 8, The Soils of Southeastern Wisconsin, June 1966.*

Map 7

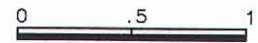
HYDROLOGIC SOIL GROUPS WITHIN THE DRAINAGE AREA TRIBUTARY TO BENEDICT AND TOMBEAU LAKES



HYDROLOGIC SOIL GROUPS

-  GROUP A/D: Well-drained soil/Very poorly drained soil¹
-  GROUP B: Moderately drained soil
-  GROUP B/D: Moderately drained soil/Very poorly drained soil²
-  GROUP C: Poorly drained soil
-  GROUP C/D: Poorly drained soil/Very poorly drained soil³
-  GROUP D: Very poorly drained soil
-  Surface Water
-  Hydrologic soil group not determined

- 1 Well-drained soil if water table is lowered through provision of a drainage system. Very poorly drained soil if water table is not lowered.
- 2 Moderately drained soil if water table is lowered through provision of a drainage system. Very poorly drained soil if water table is not lowered.
- 3 Poorly drained soil if water table is lowered through provision of a drainage system. Very poorly drained soil if water table is not lowered.

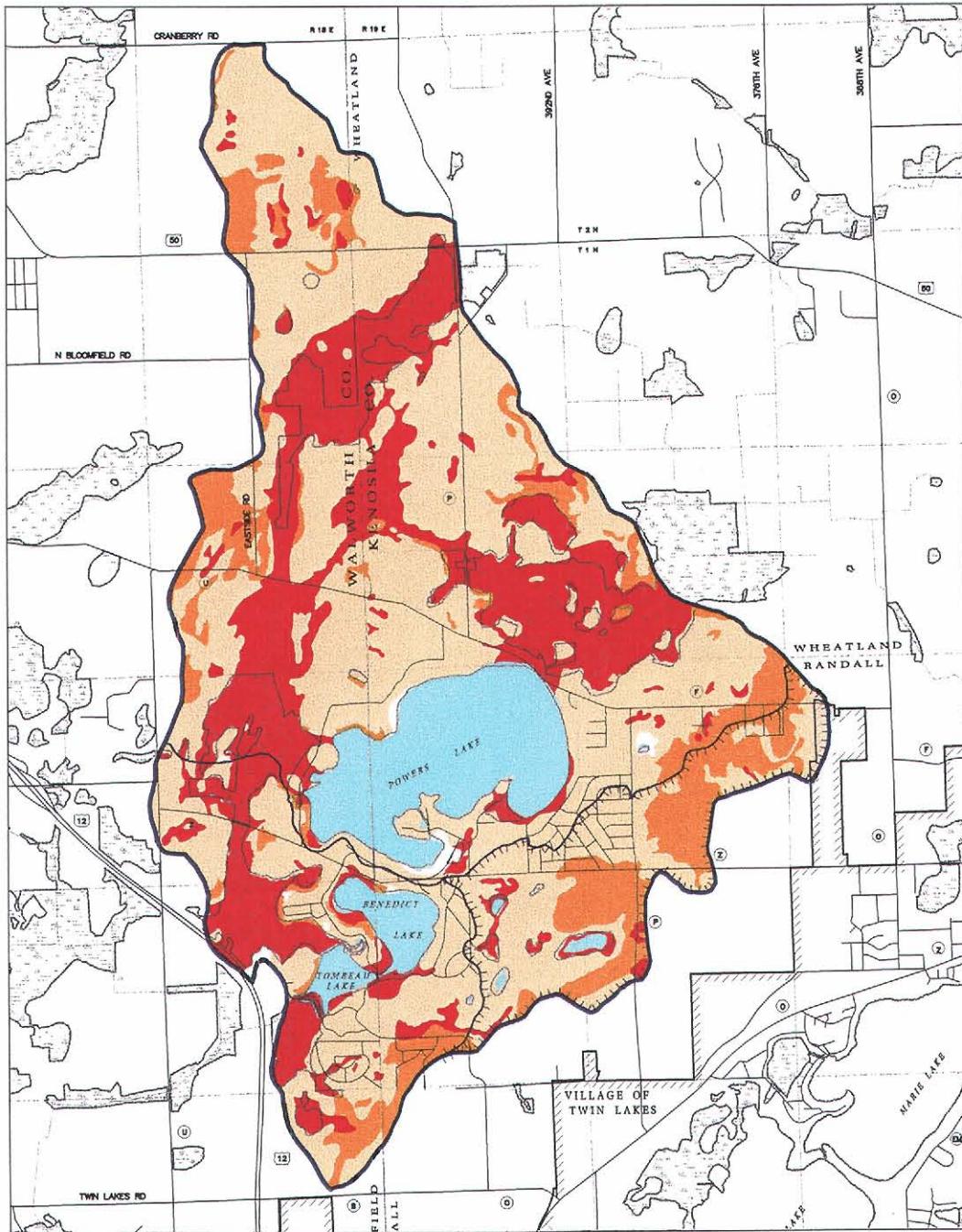


Scale in miles

Source: SEWRPC.

Map 8

SUITABILITY OF SOILS WITHIN THE DRAINAGE AREA TRIBUTARY TO BENEDICT AND TOMBEAU LAKES FOR CONVENTIONAL ONSITE SEWAGE DISPOSAL SYSTEMS



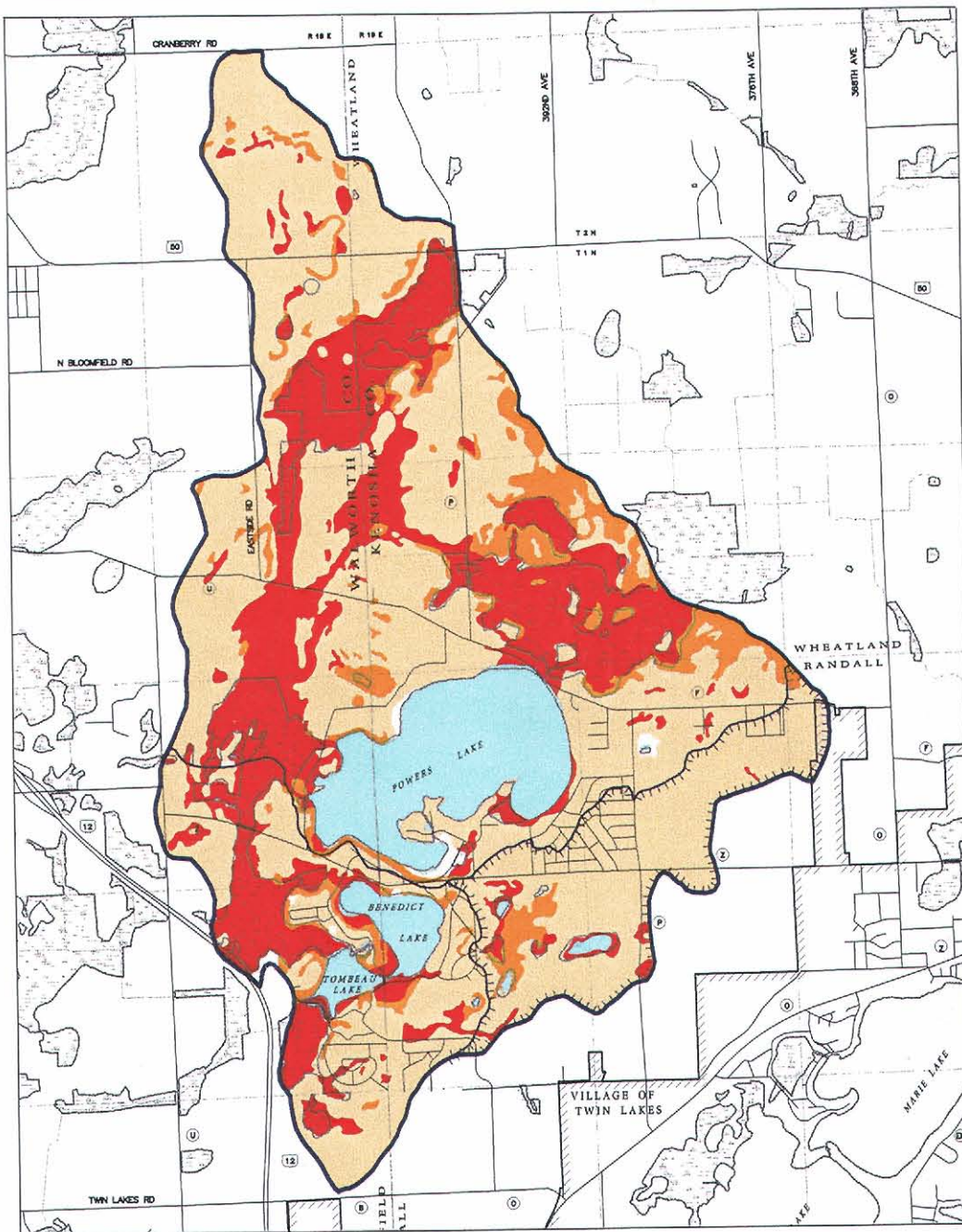
SOIL SUITABILITY CATEGORIES

- UNSUITABLE:** Areas covered by soils which have a high probability of not meeting the June, 2000 criteria of Chapter Comm. 83 of the Wisconsin Administrative Code governing conventional onsite sewage disposal systems
- UNDETERMINED:** Areas covered by soils having a range of characteristics and/or slopes which span the June, 2000 criteria of Chapter Comm. 83 of the Wisconsin Administrative Code governing conventional onsite sewage disposal systems so that no classification can be assigned
- SUITABLE:** Areas covered by soils having a high probability of meeting the June, 2000 criteria of Chapter Comm. 83 of the Wisconsin Administrative Code governing conventional onsite sewage disposal systems
- OTHER:** Areas consisting for the most part of disturbed land for which no interpretive data are available
- SURFACE WATER**



Map 9

**SUITABILITY OF SOILS WITHIN THE DRAINAGE AREA TRIBUTARY TO
BENEDICT AND TOMBEAU LAKES FOR MOUND-TYPE SEWAGE DISPOSAL SYSTEMS**



SOIL SUITABILITY CATEGORIES

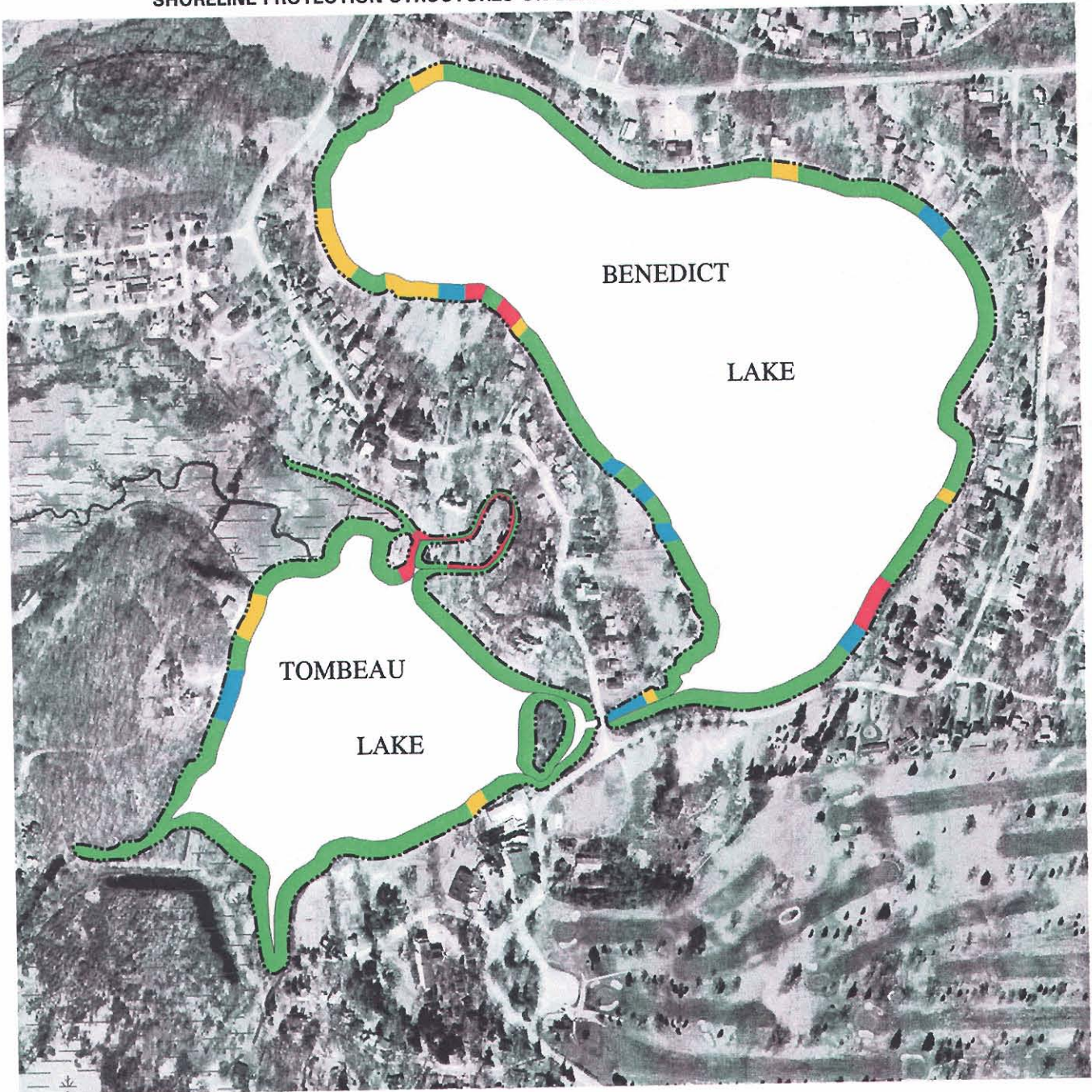
- UNSUITABLE:** Areas covered by soils which have a high probability of not meeting the June, 2000 criteria of Chapter Comm. 83 of the Wisconsin Administrative Code governing conventional mound sewage disposal systems
- UNDETERMINED:** Areas covered by soils having a range of characteristics and/or slopes which span the June, 2000 criteria of Chapter Comm. 83 of the Wisconsin Administrative Code governing conventional mound sewage disposal systems so that no classification can be assigned
- SUITABLE:** Areas covered by soils having a high probability of meeting the June, 2000 criteria of Chapter Comm. 83 of the Wisconsin Administrative Code governing conventional mound sewage disposal systems
- OTHER:** Areas consisting for the most part of disturbed land for which no interpretive data are available
- SURFACE WATER**



Source: SEWRPC.

Map 10

SHORELINE PROTECTION STRUCTURES ON BENEDICT AND TOMBEAU LAKES: 1998



-  RIPRAP
-  BEACH
-  NATURAL
-  BULKHEAD

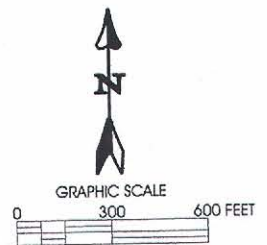


Table 6

AQUATIC PLANT SPECIES PRESENT IN BENEDICT LAKE AND THEIR ECOLOGICAL SIGNIFICANCE

Species	Percent Occurrence ^a	Mean Density ^b	Ecological Significance ^c
<i>Najas marina</i> (spiny naiad)	76.6	2.20	Stems, foliage, and seeds are important duck food
<i>Chara</i> sp. (muskgrass)	67.2	1.66	Excellent producer of fish food, especially for young trout, bluegills, small and largemouth bass; stabilizes bottom sediments; and has softening effect on the water by removing lime and carbon dioxide
<i>Potamogeton pectinatus</i> (Sago pondweed)	57.8	1.44	This plant is the most important pondweed for ducks; provides food and shelter for fish; leaves eaten by bluegills; softens water and removing lime and carbon dioxide and depositing marl
<i>Myriophyllum</i> sp. (native water milfoil)	39.1	0.78	Fruits and foliage are occasionally eaten by wildfowl and provides some cover for fish
<i>Potamogeton illinoensis</i> (Illinois pondweed)	34.4	0.58	Provides shade and shelter for fish; harbor for insects; seeds eaten by wildfowl
<i>Najas flexilis</i> (bushy pondweed)	29.7	0.52	Stems, foliage, and seeds important wildfowl food and produces good food and shelter for fish
<i>Vallisneria americana</i> (water celery)	18.8	0.33	Provides good shade and shelter; supports insects; and is valuable fish food
<i>Potamogeton zosteriformis</i> (flat-stem pondweed)	14.1	0.28	Provides some food for ducks; provides food and shelter for fish; leaves eaten by bluegills; softens water and removing lime and carbon dioxide and depositing marl
<i>Utricularia</i> sp. (bladderwort)	7.8	0.14	Provides food and cover for fish
<i>Myriophyllum spicatum</i> (Eurasian water milfoil)	6.3	0.09	None known
<i>Elodea canadensis</i> (waterweed)	3.1	0.03	Provides shelter and support for insects valuable as fish food
<i>Zosterella dubia</i> (water star grass)	3.1	0.03	Primarily provides good duck food and may also be important for local wildfowl food
<i>Ceratophyllum demersum</i> (coontail)	1.6	0.06	Mostly seeds and some foliage is important food for wildfowl and provides shelter for fish, shrimps, insects, and other small animals

^aMaximum equals 100 percent.

^bMaximum equals 5.0.

^cInformation obtained from A Manual of Aquatic Plants by Norman C. Fassett and Guide to Wisconsin Aquatic Plants, Wisconsin Department of Natural Resources

Source: SEWRPC.

common aquatic plants found in Benedict and Tombeau Lakes are included in Appendix B. WDNR staff also conducted an intensive plant survey of Benedict Lake in 1967,¹³ which allows for some comparative data analysis.

¹³R. Poff, et. al., Wisconsin Department of Natural Resources Lake Use Report No. 35, Benedict Lake, Kenosha and Walworth Counties, An Inventory With Planning Recommendations, 1969.

Table 7

AQUATIC PLANT SPECIES PRESENT IN TOMBEAU LAKE AND THEIR ECOLOGICAL SIGNIFICANCE

Species	Percent Occurrence ^a	Mean Density ^b	Ecological Significance ^c
<i>Myriophyllum spicatum</i> (Eurasian water milfoil)	91.7	2.92	None known
<i>Ceratophyllum demersum</i> (coontail)	79.2	2.08	Mostly seeds and some foliage is important food for wildfowl and provides shelter for fish, shrimps, insects, and other small animals
<i>Vallisneria americana</i> (water celery)	41.7	0.88	Provides food and cover for fish
<i>Potamogeton pectinatus</i> (Sago pondweed)	37.5	0.63	This plant is the most important pondweed for ducks; provides food and shelter for fish; leaves eaten by bluegills; softens water and removing lime and carbon dioxide and depositing marl
<i>Najas marina</i> (spiny naiad)	33.3	0.83	Stems, foliage, and seeds are important duck food
<i>Utricularia</i> sp. (bladderwort)	20.8	0.21	Provides food and cover for fish
<i>Potamogeton illinoensis</i> (Illinois pondweed)	16.7	0.17	Mostly important as duck food, but also attracts marsh birds and song birds
<i>Myriophyllum</i> sp. (native water milfoil)	16.7	0.42	Fruits and foliage are occasionally eaten by wildfowl and provides some cover for fish
<i>Chara</i> sp. (muskgrass)	12.5	0.38	Excellent producer of fish food, especially for young trout, bluegills, small and largemouth bass; stabilizes bottom sediments; and has softening effect on the water by removing lime and carbon dioxide
<i>Najas flexilis</i> (bushy pondweed)	8.3	0.08	Stems, foliage, and seeds important wildfowl food and produces good food and shelter for fish
<i>Potamogeton crispus</i> (curly-leaf pondweed)	4.2	0.04	Provides some food for ducks; provides food and shelter for fish; leaves eaten by bluegills; softens water and removing lime and carbon dioxide and depositing marl
<i>Nuphar</i> sp. (yellow water lily)	--	--	Leaves, stems, and flowers are eaten by deer; roots eaten by beaver and porcupine; seed eaten by waterfowl; leaves provide harbor to insects, in addition to shade and shelter for fish
<i>Nymphaea tuberosa</i> (white water lily)	--	--	Provides shade and shelter for fish; seeds eaten by waterfowl; rootstocks and stalks eaten by muskrat; roots eaten by beaver, deer, moose, and porcupine

^aMaximum equals 100 percent.

^bMaximum equals 5.0.

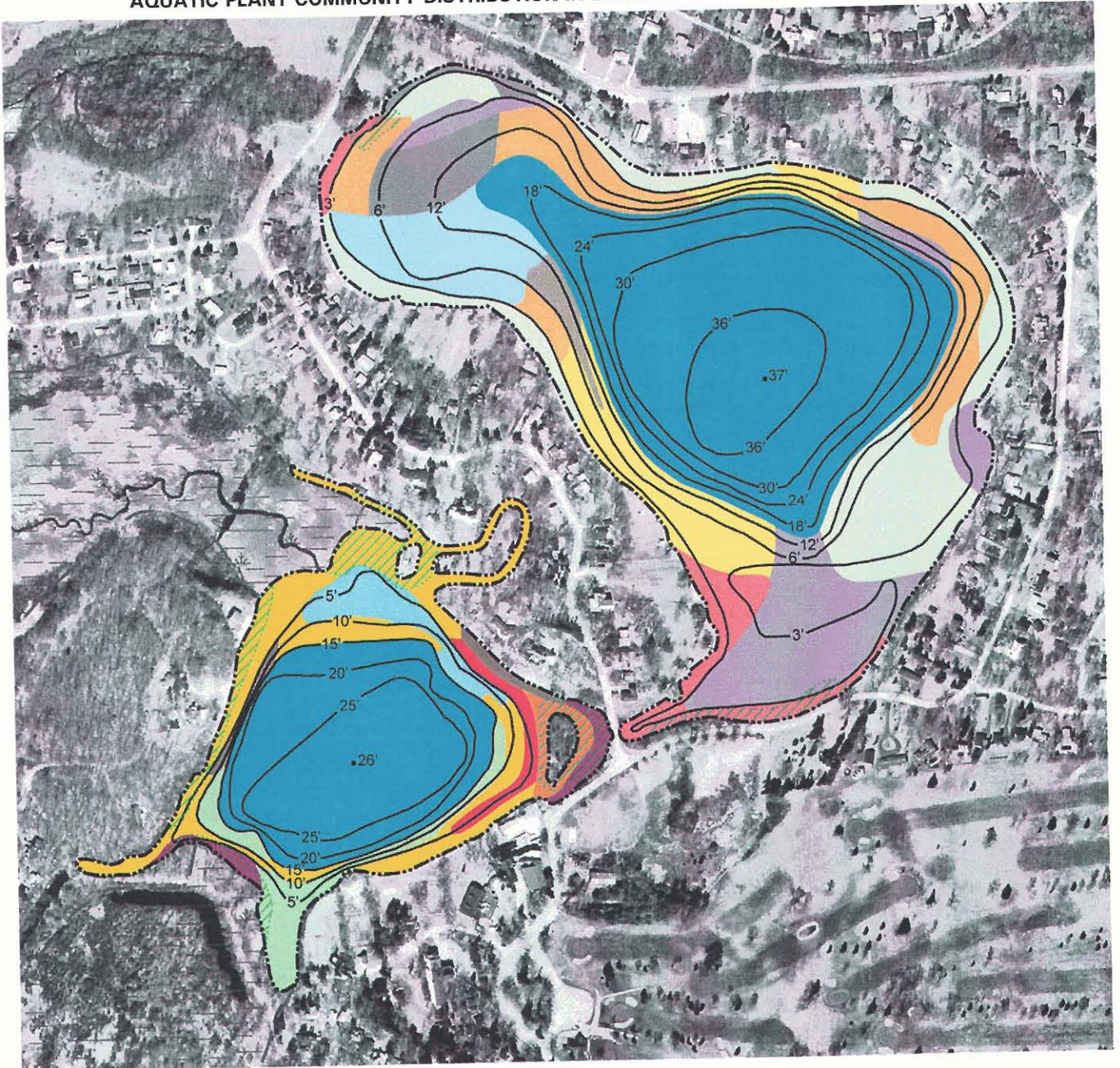
^cInformation obtained from A Manual of Aquatic Plants by Norman C. Fassett and Guide to Wisconsin Aquatic Plants, Wisconsin Department of Natural Resources

Source: SEWRPC.

The northwest bay and southern portions of Benedict Lake contained areas with the most abundant and diverse flora in the basin. Thirteen species of aquatic plants were recorded within the lake basin. All of the plants are commonly observed in lakes within the Region. The Lake was dominated by spiny naiad, *Najas marina*, muskgrass, *Chara vulgaris*, and Sago pondweed, *Potamogeton pectinatus*, which pose little problem for recreational uses of the waterbody and act as ground cover stabilizing the lakebed. Water milfoil, *Myriophyllum* sp.,

Map 11










AQUATIC PLANT COMMUNITY DISTRIBUTION IN BENEDICT AND TOMBEAU LAKES: 1998

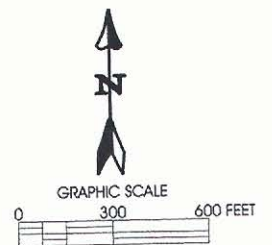


AQUATIC PLANTS FOR TOMBEAU LAKE

-  EURASIAN WATER MILFOIL
-  EURASIAN WATER MILFOIL AND COONTAIL
-  EURASIAN WATER MILFOIL, COONTAIL, AND WILD CELERY
-  EURASIAN WATER MILFOIL, SPINEY NAIAD, SAGO PONDWEED, AND WILD CELERY
-  EURASIAN WATER MILFOIL, SPINEY NAIAD, COONTAIL, AND SAGO PONDWEED
-  EURASIAN WATER MILFOIL, SPINEY NAIAD, COONTAIL, SAGO PONDWEED, AND WILD CELERY
-  EURASIAN WATER MILFOIL, SPINEY NAIAD, COONTAIL, SAGO PONDWEED, BLADDERWORT, AND WILD CELERY
-  WATER LILIES
-  DEPTH GREATER THAN 15 FEET

AQUATIC PLANTS FOR BENEDICT LAKE

-  SPINEY NAIAD AND MUSKGRASS
-  SPINEY NAIAD, MUSKGRASS, AND SAGO PONDWEED
-  SPINEY NAIAD, MUSKGRASS, NATIVE WATER MILFOIL, AND SAGO PONDWEED
-  SPINEY NAIAD, NATIVE WATER MILFOIL, AND SAGO PONDWEED
-  SPINEY NAIAD, MUSKGRASS, AND SAGO, ILLINOIS PONDWEEDS
-  SPINEY NAIAD, MUSKGRASS, AND SAGO, ILLINOIS, AND BUSHY PONDWEEDS
-  SPINEY NAIAD, MUSKGRASS, NATIVE WATER MILFOIL, AND SAGO, ILLINOIS, AND BUSHY PONDWEEDS
-  MUSKGRASS, NATIVE WATER MILFOIL, AND SAGO, ILLINOIS, AND BUSHY PONDWEEDS
-  WATER LILIES
-  DEPTH GREATER THAN 15 FEET



Source: SEWRPC.

Illinois pondweed, *Potamogeton illinoensis*, and bushy pondweed, *Najas flexilis*, were also abundant within this basin. These plant species have been dominating the vegetative community for more than 30 years.¹⁴ All of these species of plants are an excellent source of food for wildlife and fishes as described in Table 6. However, Eurasian water milfoil, *Myriophyllum spicatum*, was present in the Lake, but was not widespread. Purple loosestrife, *Lythrum salicaria*, was present at one site.

Eurasian water milfoil is one of eight milfoil species found in Wisconsin and the only one that is known to be exotic or nonnative. Because of its nonnative nature, Eurasian water milfoil has few natural enemies and can tend to exhibit “explosive” growth under suitable conditions, such as the presence of organic-rich sediments as occur within Tombeau Lake. This plant, which reproduces by rooting of plant fragments, has been known to cause severe recreational use problems in lakes within the Southeastern Wisconsin Region. Purple loosestrife, another nonnative nuisance plant, was also present at one location. Like Eurasian water milfoil, purple loosestrife is known to spread profusely, outcompeting native plant growth and reducing the quality of fish and wildlife habitat, while adding little significant ecological benefit. Purple loosestrife is a declared weed in the State of Wisconsin and is subject to an ongoing eradication program.

The southwest bay and eastern portions of Tombeau Lake contained areas with the most abundant and diverse flora in the basin. Fourteen species of aquatic plants were recorded within the lake basin. All of the plants are commonly observed in lakes within the Region. The lake was dominated by Eurasian water milfoil and coontail, *Ceratophyllum demersum*, which pose some problems for recreational users of this waterbody. Eurasian water milfoil is found throughout the entire basin as shown in Map 11, but is especially prevalent in the northern basin. The Nippersink Creek contributes significant amounts of nutrients and organically rich sediments into the northern basin, which creates suitable conditions for colonization by Eurasian water milfoil as evidenced by its extensive growth in this basin area. The sediments in this area also contain significant amounts of decomposing cattails, *Typha* sp., as well as extensive healthy stands of cattails along the nearshore areas of this basin. Purple loosestrife was found along the western shore at one location.

Water celery, *Vallisneria americana*, Sago pondweed, spiny naiad, *Najas marina*, bladderwort, *Utricularia* sp., Illinois pondweed, *Potamogeton illinoensis*, water milfoil, *Myriophyllum* spp., and muskgrass, *Chara* sp., were also abundant, while bushy pondweed, *Najas flexilis*, and curly-leaf pondweed, *Potamogeton crispus*, were present in the both Lakes. In addition, Tombeau Lake is half-ringed with white water lily, *Nymphaea tuberosa*, and some yellow water lily, *Nuphar* sp. These lily pad beds are especially concentrated along the western and southern shorelines of the Lake and the bay area under the Tombeau Road bridge, making these nearshore areas impassable by boat.

FISHERIES

Benedict and Tombeau Lakes have historically contained similar populations of panfish and game fish, due to their connectivity. Within Benedict and Tombeau Lakes, fisheries surveys conducted during the 1960s indicated that panfish populations were dominated by large sized bluegills, *Lepomis macrochirus*, and represented by several year classes.¹⁵ The gamefish populations in the Lakes were dominated by largemouth bass, *Micropterus salmoides*, northern pike, *Esox lucius*, and, to a lesser extent, walleyed pike, *Stizostedion vitreum vitreum*.¹⁶ Carp, *Cyprinus carpio*, white sucker, *Cattostomus commersoni*, warmouth, *Lepomis gulosus*, and yellow perch, *Perca*

¹⁴Ibid.

¹⁵Ibid.

¹⁶Ronald J. Poff and C.W. Threinen 1961, Wisconsin Conservation Department, Surface Water Resources of Kenosha County, Lake and Stream Classification Project, 1961.

flavescens, in somewhat smaller numbers, were also common, while lake chubsucker, *Erimyzon sucetta*, were a common forage species.

Based upon lake inventories conducted by the Wisconsin Department of Natural Resources between 1975 and 1978,¹⁷ the fish community within Tombeau Lake was comprised of bluegill, pumpkinseed, *Lepomis gibbosus*, green sunfish, *Lepomis cyanellus*, rock bass, *Ambloplites rupestris*, largemouth bass, warmouth, yellow perch, northern pike, grass pickerel, *Esox americanus vermiculatus*, white sucker, lake chubsucker, bowfin, *Amia calva*, common carp, bullhead, *Ictalurus* sp., golden shiner, *Notemigonus crysoleucas*, bluntnose minnow, *Pimephales notatus*, spotfin shiner, *Notropis spilopterus*, brook silverside, *Labidesthes sicculus*, and johnny darter, *Etheostoma nigrum*. The fish community within Benedict Lake contained the same fish community as Tombeau Lake, but, in addition, contained several other species including: longnose gar, *Lepisosteus osseus*, quillback, *Carpoides cyprinus*, banded killifish, *Fundulus diaphanus*, blacknose shiner, *Notropis heterolepis*, spottail shiner, *Notropis hudsonius*, pugnose shiner, *Notropis anogenus*, blackchin shiner, *Notropis heterodon*, and least darter, *Etheostoma microperca*.

Although there have not been any more recent fish assessments on either Benedict or Tombeau Lakes since the 1975 through 1978 fish survey, largemouth bass are currently the most common species and, to a lesser extent, northern pike can be considered the chief gamefish species according to fishing residents. Walleyed pike may be present in the fishery, though none have been encountered in surveys since 1969. Since there has never been any gamefish stocking within this lake system, natural reproduction of both largemouth bass and northern pike is assumed to have been self-sustaining. The associated wetlands and undeveloped shorelines within Tombeau Lake represent a major northern pike and largemouth bass spawning ground area for both Benedict and Tombeau Lakes. In addition, nearly all of the shoreline within Tombeau Lake is also suitable as panfish spawning habitat. Panfish species are also abundant according to local fishing residents. Carp are perceived to be increasing in abundance over the past five years, which may be indicative that the habitat is becoming sufficiently deteriorated within these Lakes, allowing the carp to increase in abundance.

WILDLIFE AND WATERFOWL

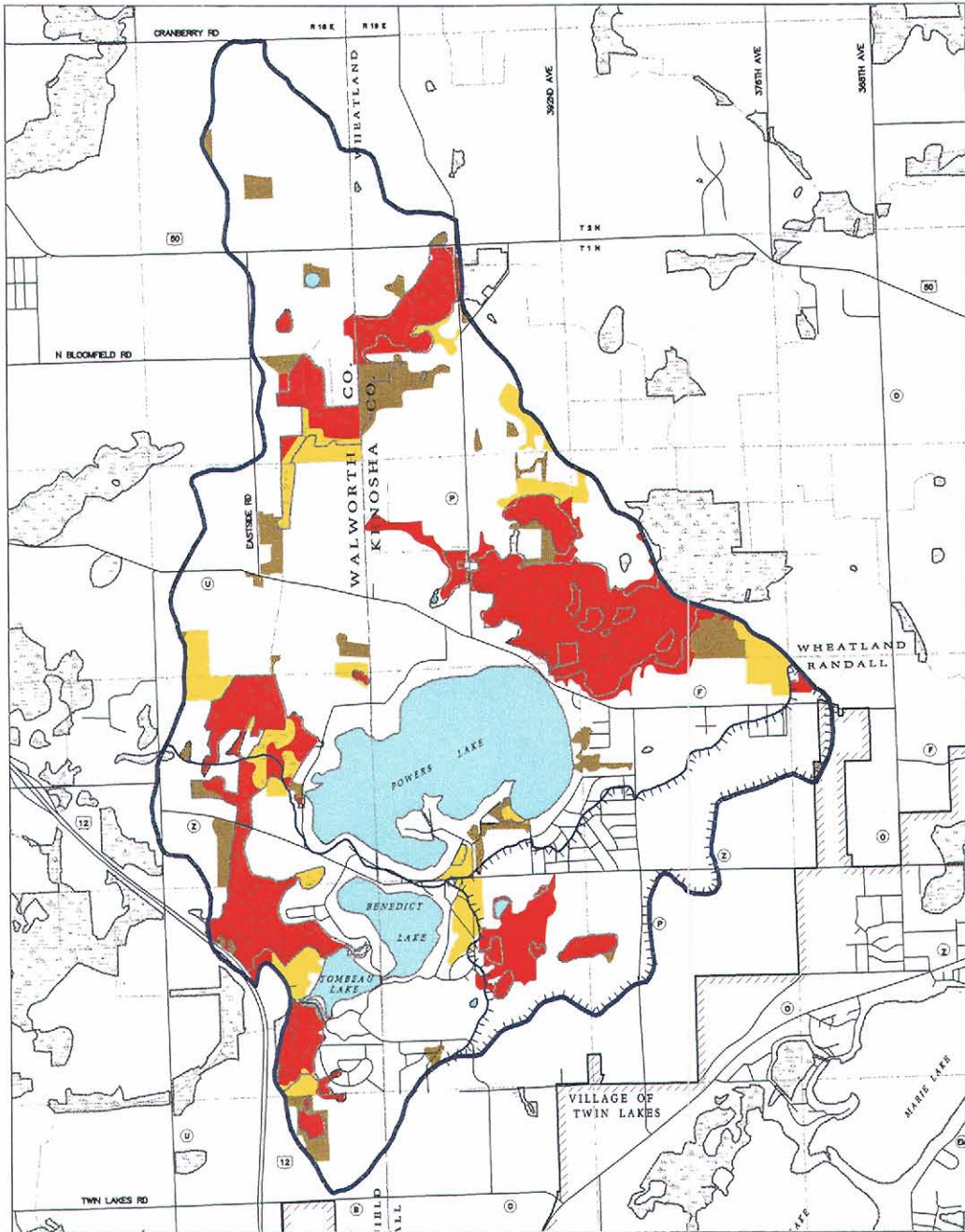
Given the single-family residential nature of much of the Lakes' shoreline and the surrounding woodlands and wetlands in the vicinity, it is likely that the wildlife community is comprised of small upland game animals, such as rabbit and squirrel; predators, such as coyote, fox, and raccoon; game birds, such as pheasant; marsh furbearers, such as beaver and muskrat; migratory and resident song birds; marsh birds, such as red-winged blackbird and great blue heron; raptors, such as great horned owl and red-tailed hawk; and waterfowl. White-tailed deer have also been reported in the area. The character of wildlife species, along with the nature of the habitat, present in the planning area has undergone significant change since the time of European settlement and the subsequent clearing of forests, plowing of the prairie, and draining of wetlands for agricultural purposes. Modern practices that adversely affect wildlife and wildlife habitat include: the excessive use of fertilizers and pesticides, road salting, heavy traffic, the introduction of domestic animals, and the fragmentation and isolation of remaining habitat areas for urban and agricultural uses.

As shown on Map 12, wildlife habitat areas in the drainage area tributary to Benedict and Tombeau Lakes generally occur in association with existing surface water, wetland, and woodland resources located around the Lakes. Such areas covered about 1,387 acres, or about 25 percent, of the drainage area. Of this total habitat acreage, about 892 acres, or about 16 percent of the drainage area, were rated as Class I habitat; about 263 acres,




¹⁷D. Fago, Wisconsin Department of Natural Resources Research Report No. 148, Retrieval and Analysis Used in Wisconsin's Statewide Fish Distribution Survey, Second Edition, December 1988.

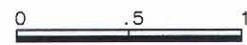
Map 12

WILDLIFE HABITAT AREAS WITHIN THE DRAINAGE AREA
TRIBUTARY TO BENEDICT AND TOMBEAU LAKES: 1995



HABITAT CATEGORIES

-  Class I, high-value habitat
-  Class II, medium-value habitat
-  Class III, good-value habitat



Scale in miles

Source: SEWRPC.

or about 5 percent of the drainage area, were rated as Class II habitat; and about 232 acres, or 4 percent of the drainage area, were rated as Class III habitat.¹⁸

The habitat areas shown on Map 12 are largely coincident with the Commission-delineated environmental corridors in this watershed, as shown on Map 13. Primary environmental corridors extended over 1,025 acres, or 18 percent, of the drainage area tributary to Benedict and Tombeau Lakes. An additional 273 acres, or about 5 percent of the drainage area, were classed as secondary environmental corridor. Isolated natural resource features covered 104 acres, or about 2 percent, of the drainage area. The Commission recommends that, to the extent practicable, primary environmental corridor lands should be maintained in essentially natural, open uses.¹⁹

RECREATIONAL USES AND FACILITIES

Benedict and Tombeau Lakes are multi-purpose recreational use waterbodies serving all forms of recreation, including boating, waterskiing, swimming, and fishing during the summer months; and snowmobiling and ice-fishing during the winter months. The Lakes are used year around as a visual amenity, walking, bird-watching, and picnicking, being popular passive recreational uses of the waterbody.

A boat survey conducted in July of 1998 indicated that 147 boats on Benedict Lake and 23 boats on Tombeau Lake were either moored in the water or stored on land adjacent to the Lake. The types of boats included: gasoline-powered speedboats, fishing boats, paddle boats, canoes, sailboats, and personal watercraft (jetskis), as shown in Table 8. In addition, recreational use surveys were conducted on July 24 and 25, 1998, on Benedict and Tombeau Lakes, respectively, identifying watercraft of various types, fishing, pleasure boating, skiing, sailing vessels, and personal watercraft, in use on the Lakes during weekdays and weekends, as set forth in Table 9.

Recreational boating access to Benedict Lake is limited at present to the privately owned Lake Benedict Manor Restaurant & Wine House on the north shore. On Tombeau Lake public recreational boating access is from the town park located on the southwestern shore of the Lake, as shown on Map 2. Private recreational boating access is also available through the privately owned Nippersink Country Club. The town park site is an undeveloped public access site. Although the carry-in access to Tombeau Lake at the town park site meets the public recreational boating access standards set forth in Chapter NR 1 of the *Wisconsin Administrative Code*, Benedict Lake currently does not have adequate public recreational boating access pursuant to this Chapter of the *Wisconsin Administrative Code*.

WATER AND LAND USE REGULATIONS

Boating and Water Use Regulations

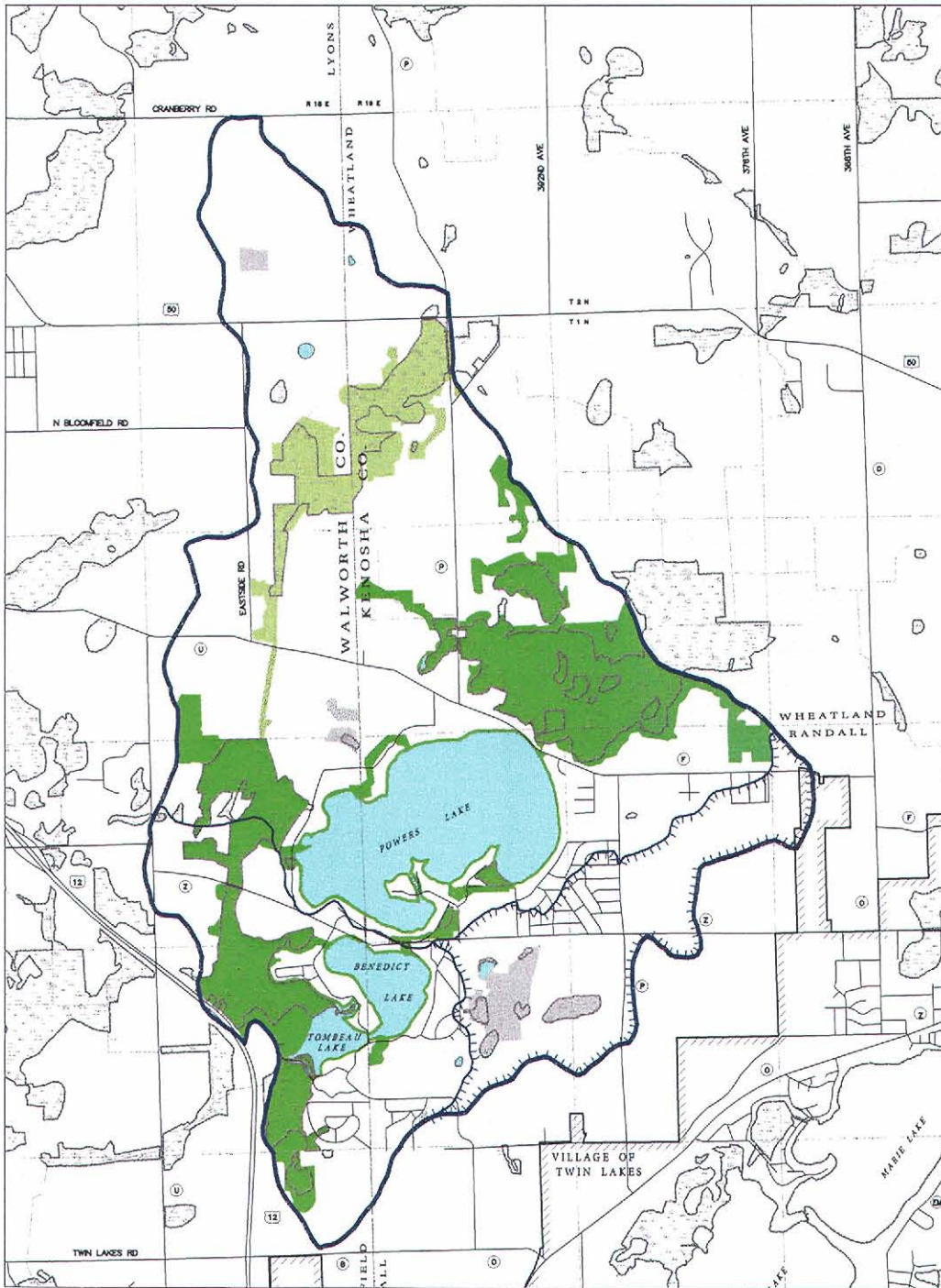
Benedict and Tombeau Lakes, as well as Powers Lake, are subject to a Water Use Ordinance promulgated jointly by the Towns of Randall (Kenosha County) and Bloomfield (Walworth County) as Chapter 20 of the Town Code of Ordinances, as set forth in Appendix C. This ordinance relates to boating and other recreational water uses, and promotes the public health, safety and general welfare of all people engaged in the enjoyment of aquatic recreation. This Ordinance is consistent with Chapter 30 of the *Wisconsin Statutes*. The provisions of the ordinance apply to persons, boats, watercraft, and objects upon, in, and under the waters of Powers Lake, Benedict Lake, and Tombeau Lake within the jurisdictions of the Towns. The provisions of the Ordinance limit

¹⁸For details on these classifications, see *SEWRPC Planning Report No. 40, A Regional Land Use Plan for Southeastern Wisconsin, 2010, January 1992*.





¹⁹*SEWRPC Planning Report No. 40, A Regional Land Use Plan for Southeastern Wisconsin: 2010, January 1992, p. 438.*

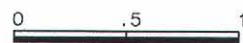
Map 13

ENVIRONMENTALLY VALUABLE AREAS WITHIN THE DRAINAGE
AREA TRIBUTARY TO BENEDICT AND TOMBEAU LAKES: 1995



ENVIRONMENTAL AREAS

-  Primary environmental corridor
-  Secondary environmental corridor
-  Isolated natural resource area
-  Surface water



Scale in miles

Source: SEWRPC.

Table 8

**WATERCRAFT ON BENEDICT
AND TOMBEAU LAKES: JULY 1998**

Type of Watercraft in Use	Number
Benedict Lake	
Power Boat.....	33
Fishing Boat.....	8
Pontoon Boat.....	25
Canoe.....	26
Paddle Boat.....	29
Sail Boat.....	8
Personal Watercraft.....	16
Other.....	2
Total	147
Tombeau Lake	
Power Boat.....	4
Fishing Boat.....	9
Pontoon Boat.....	0
Canoe.....	1
Paddle Boat.....	6
Sail Boat.....	1
Personal Watercraft.....	2
Other.....	0
Total	23

Source: SEWRPC.

ordinances; they may or may not be contained in the same document. Any analysis of locally proposed land use must take into consideration the provisions of both general and special-purpose zoning. As already noted, the drainage area tributary to Benedict and Tombeau Lakes includes portions of the Towns of Randall and Wheatland and a very small portion of the Village of Twin Lakes in Kenosha County, and the Towns of Bloomfield and Lyons in Walworth County. The ordinances administered by these units of government are summarized below.

General Zoning

Counties in Wisconsin are granted comprehensive, or general, zoning powers within their unincorporated areas under Section 59.69 of the *Wisconsin Statutes*. Towns must ratify a county zoning ordinance for it to become effective in the towns. Towns which have not adopted a county zoning ordinance may adopt village powers and exercise zoning authority granted to cities and villages subject, however, to county board approval where a general-purpose county zoning ordinance exists. Alternatively, towns may adopt zoning ordinances under Section 60.61 of the *Wisconsin Statutes* where a general-purpose county zoning ordinance has not been adopted. The Towns of Bloomfield and Lyons are under the jurisdiction of the Walworth County zoning ordinance. The Towns of Randall and Wheatland are under the jurisdiction of the Kenosha County zoning ordinance. The Village of Twin Lakes has its own general zoning ordinance, as provided for under Sections 62.23 and 61.35 of the *Wisconsin Statutes*.

Shoreland Zoning

Under Section 59.692 of the *Wisconsin Statutes*, counties in Wisconsin are required to adopt zoning regulations within statutorily defined shoreland areas, those lands within 1,000 feet of a navigable lake, pond, or flowage, or 300 feet of a navigable stream, or to the landward side of the floodplain, whichever distance is greater, within their unincorporated areas. Minimum standards for county shoreland zoning ordinances are set forth in

the times during which boats may operate on Benedict and Tombeau Lakes, and allow for the enactment and enforcement of boating restrictions and limitations. The only regulatory differences between Lakes Benedict and Tombeau are related to the slow-no-wake restrictions set forth within the general boating provisions of Section 20.06 of the Ordinance. Until the slow-no-wake restrictions were suspended during 1999, no watercraft was to be operated at a speed greater than slow-no-wake at any time on Tombeau Lake. Since 1999, watercraft can be operated on Tombeau Lake in excess of slow-no-wake speeds pending review by the Wisconsin Department of Natural Resources. In contrast, slow-no-wake restrictions on Benedict Lake are determined by the water level of Powers Lake, which contains a benchmark level on the eastern side of the bridge on Powers Lake Road.

Land Use Regulations

The comprehensive zoning ordinance represents one of the most important and significant tools available to local units of government in directing the proper use of lands within their area of jurisdiction. Local zoning regulations include general, or comprehensive, zoning regulations and special-purpose regulations governing floodland and shoreland areas. General zoning and special-purpose zoning regulations may be adopted as a single ordinance or as separate

Table 9

RECREATIONAL USE SURVEY ON BENEDICT AND TOMBEAU LAKES: 1998

Date and Time	Weekday Boating Activity (number of watercraft in use)							Total
	Fishing	Pleasure Boating	Skiing	Sailing	Jetskiing	Swimming	Other	
Benedict Lake July 24, 1998 1:00 p.m. to 1:30 p.m.	1	0	2	0	0	1	1	5

Date and Time	Weekend Day Boating Activity (number of watercraft in use)							Total
	Fishing	Pleasure Boating	Skiing	Sailing	Jetskiing	Swimming	Other	
Benedict Lake July 25, 1998 10:30 a.m. to 11:00 a.m.	3	1	1	0	1	0	1	7
Benedict Lake July 25, 1998 1:10 p.m. to 1:40 p.m.	2	2	0	0	0	0	0	4
Tombeau Lake July 25, 1998 1:00 p.m. to 1:30 p.m.	4	1	0	0	0	0	0	5
Tombeau Lake July 25, 1998 4:00 p.m. to 4:30 p.m.	1	1	0	0	0	0	0	2

Source: SEWRPC.

Chapter NR 115 of the *Wisconsin Administrative Code*. Chapter NR 115 sets forth minimum requirements regarding lot sizes and building setbacks; restrictions on cutting of trees and shrubbery; and restrictions on filling, grading, lagooning, dredging, ditching, and excavating that must be incorporated into county shoreland zoning regulations. In addition, Chapter NR 115 requires that counties place all wetlands five acres or larger and within the statutory shoreland zoning jurisdiction area into a wetland conservancy zoning district to ensure their preservation after completion of appropriate wetland inventories by the Wisconsin Department of Natural Resources.

In 1982, the State Legislature extended shoreland-wetland zoning requirements to cities and villages in Wisconsin. Under Sections 62.231 and 61.351, respectively, of the *Wisconsin Statutes*, cities and villages in Wisconsin are required to place wetlands five acres or larger and located in statutory shorelands into a shoreland-wetland conservancy zoning district to ensure their preservation. Minimum standards for city and village shoreland-wetland zoning ordinances are set forth in Chapter NR 117 of the *Wisconsin Administrative Code*.

It should be noted that the basis for identification of wetlands to be protected under Chapters NR 115 and NR 117 is the Wisconsin Wetlands Inventory. Mandated by the State Legislature in 1978, the Wisconsin Wetlands Inventory resulted in the preparation of wetland maps covering each U.S. Public Land Survey township in the State. The inventory was completed for counties in Southeastern Wisconsin in 1982, the wetlands being delineated by the Regional Planning Commission on its 1980, one inch equals 2,000 feet scale, ratioed and rectified aerial photographs.

As of 2001, county shoreland zoning ordinances were in effect in all unincorporated areas of Kenosha and Walworth Counties. The shoreland areas within the Towns of Randall and Wheatland are regulated by the Kenosha County General Zoning and Shoreland/Floodplain Zoning Ordinance. The shoreland areas within the

Towns of Bloomfield and Lyons are regulated by the Walworth County Shoreland Zoning Ordinance. These zoning ordinances are administered by the Department of Planning and Development, and the Department of Land Management, within Kenosha and Walworth Counties, respectively.

Floodland Zoning

Section 87.30 of the *Wisconsin Statutes* requires that cities, villages, and counties adopt floodland zoning to preserve the floodwater conveyance and storage capacity of floodplain areas and to prevent the location of new flood damage-prone development in flood hazard areas. The minimum standards, which such ordinances must meet, are set forth in Chapter NR 116 of the *Wisconsin Administrative Code*. The required regulations govern filling and development within a regulatory floodplain, which is defined as the area subject to inundation by the 100-year recurrence interval flood event, the event which has a 1 percent probability of occurring in any given year. Under Chapter NR 116, local floodland zoning regulations must prohibit nearly all forms of development within the floodway, which is that portion of the floodplain required to convey the 100-year recurrence peak flood flow. Local regulations must also restrict filling and development within the flood fringe, which is that portion of the floodplain located outside of the floodway that would be covered by floodwater during the 100-year recurrence flood. Permitting the filling and development of the flood fringe area, however, reduces the floodwater storage capacity of the natural floodplain, and may thereby increase downstream flood flows and stages.

Since 1993, floodland ordinances have been in effect in all parts of the drainage area tributary to Benedict and Tombeau Lakes where flood hazard areas have been identified.

Subdivision Regulations

Chapter 236 of the *Wisconsin Statutes* requires the preparation of a subdivision plat whenever five or more lots of 1.5 acres or less in area are created either at one time or by successive divisions within a period of five years. This Chapter sets forth requirements for surveying lots and streets for plat review and approval by State and local agencies and for recording approved plats. Section 236.45 of the *Wisconsin Statutes* allows any city, village, town, or county that has established a planning agency to adopt a land division ordinance, provided the local ordinance is at least as restrictive as the State platting requirements. Local land division ordinances may include the review of other land divisions not defined as "subdivisions" under Chapter 236, such as when fewer than five lots are created or when lots larger than 1.5 acres are created.

The subdivision regulatory powers of towns and counties are confined to unincorporated areas. City and village subdivision control ordinances may be applied to extraterritorial areas, as well as to the incorporated areas.²⁰ It is possible for both a county and a town to have concurrent jurisdiction over land divisions in unincorporated areas, or for a city or village to have concurrent jurisdiction with a town or county in the city or village extraterritorial plat approval area. In the case of overlapping jurisdiction, the most restrictive requirements apply.

Subdivision control ordinances have been adopted by Kenosha and Walworth Counties, the Town of Lyons, and the Village of Twin Lakes.

Construction Site Erosion Control and Stormwater Management Regulations

Sections 62.234, 61.354, and 59.693 of the *Wisconsin Statutes* grant authority to cities, villages, and counties, respectively, to adopt ordinances for the prevention of erosion from construction sites and the management of stormwater runoff from lands within their jurisdictions. Section 60.627 grants similar authority to towns which may enact zoning exercising village powers.

²⁰Under Section 236.02 of the *Wisconsin Statutes*, the extraterritorial plat approval jurisdiction is the area within three miles of the corporate limits of a first-, second-, or third-class city and within 1.5 miles of a fourth class city or a village.

As of 1990, Walworth County adopted a Land Disturbance, Erosion Control and Storm Water Management Ordinance specifically to preserve the natural resources and protect water quality by minimizing the amount of sediment and other pollutants from construction sites and watercourses. As amended through 1998, this ordinance applies to land developing and land disturbing activities on lands situated within the boundaries of Walworth County in unincorporated areas, except those land disturbances and land disturbing activities that fall under the scope and authority of the Walworth County one- and two-family dwelling erosion control ordinance and building sites outside shoreland areas under other municipal enforcement of the Wisconsin Uniform Dwelling Code (UDC).²¹ All control measures are administered and enforced by the Walworth County Land Conservation. Walworth County also has provisions within Section 2.8 of the Walworth County Shoreland Ordinance that govern tree cutting, shrubbery clearing, and earth movements, so as to prevent erosion and sedimentation and preserve the natural beauty of the County.

In Kenosha County, stormwater management and construction site erosion control is covered within stipulations to be met contingent upon permit approval for business, industrial, and manufacturing zoning districts pursuant to Chapter 12.08-2 of the Kenosha County General Zoning and Shoreland/Floodplain Zoning Ordinance, and for subdivisions pursuant to Chapters 14.08-8 and 14.09-5 of the Kenosha County Subdivision Control Ordinance.²²

²¹*Walworth County Land Conservation, Walworth County Land & Water Resource Management Plan, February 1999.*

²²*See SEWRPC Community Assistance Planning Report No. 255, A Land and Water Resource Management Plan for Kenosha County: 2000-2004, September 2000.*

Chapter III

LAKE USE PROBLEMS AND ISSUES

INTRODUCTION

Although Benedict and Tombeau Lakes are in relatively good condition and are capable of supporting a wide variety of water uses, there are a number of existing and potential future problems and concerns which should be addressed. These problems or issues of concern include the potential changes in ecologically valuable areas and aquatic plant problems; nonpoint source pollution, including construction site erosion, water quality, public recreational use, and boating access to the Lakes; and protection of the shoreline.

ECOLOGICALLY VALUABLE AREAS AND AQUATIC PLANTS

The ecologically valuable areas within the drainage area tributary to Benedict and Tombeau Lakes, as documented in Chapter II, include wetlands and woodlands and wildlife habitat. Most of these areas are included in lands designated as primary environmental corridors. Critical sites within the Lakes include prime fish spawning habitat, macrophyte beds, especially those containing a diverse native flora, and shoreline areas supporting the more productive aquatic habitat, primarily the eastern and southern shorelines. Protection of these areas is an important issue which should be considered.

The presence of Eurasian water milfoil in limited areas of the Benedict Lake basin, and its widespread abundance in Tombeau Lake, as well as the presence of purple loosestrife in the wetlands adjoining the Lakes, represents an important issue which should be considered. These plants often outcompete native aquatic plants, dominating the plant communities in lakes and wetlands in Southeastern Wisconsin, and degrade fish and wildlife habitat. The dominance of Eurasian water milfoil and purple loosestrife in aquatic ecosystems in Southeastern Wisconsin contributes to the degradation of the Region's natural resource base and commonly interferes with human recreational and aesthetic use of the natural resources.

Of particular concern within the Benedict and Tombeau Lakes basins is the presence of Eurasian water milfoil in Tombeau Lake, and the potential for this plant to be carried into Benedict Lake by boat traffic using both Lakes for recreational purposes. Because Benedict Lake currently has an high quality aquatic plant flora, the control of Eurasian water milfoil in Tombeau Lake is an especially important issue which should be considered.

As shown on Map 6, wetland areas adjacent to Benedict and Tombeau Lakes provide important habitat for wildlife. The wetland areas which are physically connected to Tombeau Lake provide valuable fish spawning habitat, especially during the early spring. In addition to providing habitat, these areas also contribute to the scenic vistas which characterize the Benedict and Tombeau Lakes watershed. Those wetlands situated between upland areas and the Lakes also help to absorb runoff, and, by retaining sediments and nonpoint source pollutants, can help to protect Benedict and Tombeau Lakes and downstream waters from degradation.

The environmental corridors in the Benedict and Tombeau Lakes tributary drainage area, as shown on Map 13, contain almost all of the best remaining woodlands, wetlands, and wildlife habitat. The protection of these resources from additional intrusion by incompatible land uses which degrade and destroy the environmental values, and the preservation of the corridors in an essentially open and natural state, is an important issue to be considered.

In addition, the growth of aquatic plants in portions of the Lakes have been documented as limiting recreational uses. Thus, aquatic plant management is an important issue to be considered.

NONPOINT SOURCE POLLUTION

Land use activities associated with urban development within the drainage area tributary to Benedict and Tombeau Lakes generate nonpoint source pollution loadings that represent a potentially significant threat to the Lakes' water quality. Sources of nonpoint source pollutants include both rural and urban land uses, including land disturbing activities associated with construction and redevelopment within the drainage area. Based upon recommendations set forth in the regional land use plan, future development of open lands within the drainage area tributary to Benedict and Tombeau Lakes is proposed to be limited. However, unplanned development, and redevelopment of existing properties, could occur and impacts on lake water quality could potentially result. In addition, onsite sewage disposal systems constitute a potentially significant source of phosphorus to the Lakes. Hence, control of nonpoint source pollution is an important issue to be considered.

SURFACE WATER QUALITY

As of 1999, surface water quality in Benedict Lake was reported to be good to very good, while water quality in Tombeau Lake was reported to be poor to good, depending upon the water quality indicators and period of analysis. As described in Chapter II, Benedict Lake was well within the mesotrophic range, indicating that few water quality problems are expected. Tombeau Lake was in the meso-eutrophic range, indicating that nuisance growths of algae and plants can be expected. The trophic status of both Benedict and Tombeau Lakes appears to have declined slightly from previous water quality investigations, both Lakes appearing to be affected by the reportedly drier and warmer conditions extant during the study period. The citizens within the Lake Benedict/Tombeau Lake Protection and Rehabilitation District have expressed concerns regarding water quality in the Lakes, principally related to the excessive aquatic plant growth. Thus, water quality impairment is an important issue to be considered.

PUBLIC RECREATIONAL USE AND BOATING ACCESS

Overcrowding and excessive recreational boating use is a problem in many lakes in the Southeastern Wisconsin Region, especially those offering high-quality recreational opportunities within a one- to two-hour drive of the Chicago-Milwaukee metropolitan areas. Given the location and good water quality of Benedict and Tombeau Lakes, recreational and boating use pressures on the Lake may be expected to increase in the future.

Current requirements contained in Sections NR 1.91(4) and NR 1.91(5), respectively, of the *Wisconsin Administrative Code*, mandate standards for public recreational boating access development to qualify waters for resource enhancement services provided by the Wisconsin Department of Natural Resources. For lakes with a boatable surface area similar to that of Benedict and Tombeau Lakes, public recreational boating access sites should accommodate car, or car-trailer, units totaling five units, plus one handicapped accessible unit. Where exceptional circumstances exist, Section NR 1.91(6) of the *Wisconsin Administrative Code* provides procedures for determining alternative public access standards which may differ from the minimum and maximum standards set forth in Sections NR 1.91(4) and NR 1.91(5). Such alternative standards are determined on a site-specific basis, in cases where unusual environmental or developmental factors preclude provision of access within the standards.

Standards set forth in the regional and county park and open space plans¹ would provide for the use of a maximum of not more than five fast boats on Benedict Lake and not more than three fast boats on Tombeau Lake.

¹SEWRPC Community Assistance Planning Report No. 135, A Park and Open Space Plan for Walworth County, February, 1991.

There is one publicly owned, carry-in recreational boating access site adjacent to the park on the southwestern shore of Tombeau Lake, that meets the State access standards. A further site provided by the Tombeau Road bridge right-of-way site lacks parking and has significant public safety concerns with respect to potential conflicts between road traffic and lake users. This site does not meet State access standards and should not be considered to be access to those Lakes. Benedict Lake lacks adequate public access under State access standards.

Further, there are currently two privately owned access sites, one each on both Benedict and Tombeau Lakes. The site on Benedict Lake is owned and operated by the Lake Benedict Manor Restaurant & Wine House, while the site on Tombeau Lake is owned and operated by the Nippersink Country Club. Such privately owned facilities can be considered as meeting the State recreational boating access standards if a private provider agreement, as set forth in Section NR 1.91(7), is concluded between the provider and the Wisconsin Department of Natural Resources. However, neither the Lake Benedict Manor Restaurant & Wine House nor the Nippersink Country Club are currently subject to private provider agreements, and, hence, are not considered in evaluating the current access suitability under the provisions of Chapter NR 1 of the *Wisconsin Administrative Code*.

Public recreational boating opportunities on Benedict Lake are limited due to the lack of adequate public access. This circumstance limits the ability of the Lake Benedict/Tombeau Lake Protection and Rehabilitation District, and Towns of Bloomfield and Randall, to access State funding for lake enhancement services. Hence, public recreational boating access on Benedict and Tombeau Lakes is considered an important issue to be considered.

SHORELINE PROTECTION

The 1998 survey of the Benedict and Tombeau Lakes shoreline identified many regions of natural shorelines with limited reaches that appeared to be subject to erosion and undercutting of banks. Shoreline erosion could be expected to increase as lake usage increases, and erosion-related problems could worsen in the future. In addition, concerns have been expressed by the electors of the Lake Benedict/Tombeau Lake Protection and Rehabilitation District with respect to resident populations of geese, which create nuisance conditions for lake property owners and visitors to the Lakes. Control of such nuisance goose populations can be effected by introduction of shoreline landscaping measures designed to discourage goose populations. Measures such as provision of shoreland buffer strips, rather than maintenance of grassed shorelines, can be effect deterrents. Hence, shoreline protection and landscaping is an issue to be considered.

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Chapter IV

ALTERNATIVE AND RECOMMENDED LAKE PROTECTION MEASURES

INTRODUCTION

Chapter III described five issues of concern to be considered as part of this lake protection and recreational use plan. These issues are related to: 1) ecologically valuable areas and aquatic plants; 2) nonpoint source pollution; 3) surface water quality; 4) public recreational use and boating access; and 5) shoreline protection. Following a brief summary of the ongoing lake management program activities, alternative and recommended measures to address each of these issues and concerns are described in this chapter. The alternatives and recommendations set forth herein are focused primarily on those measures which are applicable to the Lake Benedict/Tombeau Lake Protection and Rehabilitation District. In addition, measures which are applicable to the Towns of Randall and Bloomfield, and to Kenosha and Walworth Counties, are presented. Lesser emphasis is given to measures which are applicable to other jurisdictions within the drainage area tributary to Benedict and Tombeau Lakes.

PAST AND PRESENT LAKE MANAGEMENT ACTIONS

The residents of Benedict and Tombeau Lakes, in conjunction with the Towns of Bloomfield and Randall, have long recognized the importance of informed and timely action in the management of Benedict and Tombeau Lakes. The initial action in this regard was the formation of the Lake Benedict and Tombeau Lake Protection and Rehabilitation District, pursuant to Chapter 30, *Wisconsin Statutes*, which provides the forum for many of the lake management activities of the Lakes' residents. The District is currently enrolled in the water quality monitoring program conducted under the auspices of the Wisconsin Department of Natural Resources Self-Help Monitoring Program. This volunteer monitoring program is presently being augmented by a trophic state index (TSI) monitoring program being carried out by the U.S. Geological Survey, funded, in part, through the Chapter 190 Lake Management Planning Grant Program. The Lake Benedict and Tombeau Lake District holds a Phase I Lake Management Planning Grant to conduct studies on the water quality and aquatic plant communities in Benedict and Tombeau Lakes. These studies form the basis of this report and will eventually become part of a comprehensive lake management plan for Benedict and Tombeau Lakes. Information gathered through these sampling programs is regularly reported to the community through meetings of the Lake Benedict and Tombeau Lake Management District Commissioners, the annual meeting of the Lake Benedict and Tombeau Lake District electors, and the local media, as part of an ongoing citizen education and involvement program related to lake management activities.

ECOLOGICALLY VALUABLE AREAS AND AQUATIC PLANTS

Benedict and Tombeau Lakes and its tributary drainage area contain ecologically valuable areas, including significant areas of diverse aquatic and wetland vegetation suitable for fish spawning and located within and immediately adjacent to the Lake. As described in Chapter III, the potential problems associated with ecologically valuable areas in and near Benedict and Tombeau Lakes include the potential loss of wetlands and other important ecologically valuable areas due to urbanization or other encroachments; the degradation of wetlands and aquatic habitat due to the presence of invasive species, including purple loosestrife and Eurasian water milfoil; and the impacts of aquatic plants on recreational boating.

Array of Protection Measures

Four measures to protect and maintain the biodiversity of Benedict and Tombeau Lakes and its tributary drainage area have been identified as being potentially viable: 1) protection of ecologically valuable areas through control of boating usage of the Lakes by effective enforcement of local boating ordinances, 2) protection of ecologically valuable areas through appropriate land use control measures, 3) moderation of deleterious changes in the aquatic plant and animal communities, and mitigation of aquatic plant impacts on recreational boating within the Lakes through in-lake management measures, and 4) promotion of good housekeeping practices by riparian residents and residents within the drainage area tributary to Benedict and Tombeau Lakes through citizen informational and educational programming. These latter measures would encourage actions on the part of riparian residents that would benefit by maintenance of ecologically valuable areas within the Lakes.

Boating Ordinances

The promulgation of more stringent controls on the use of powered watercraft is one means of regulating boat traffic in areas which could be harmful to the most important ecologically valuable areas of the Lakes. These areas include the shore zones along the shallow northern and western shores of Benedict and Tombeau Lakes, and the northern embayments. In addition to the provisions already set forth in Chapter 20 of the Town of Randall Water Use Ordinance, controls on boat traffic could be put in place by limiting boating activity within specific areas of the Lakes, such as in "boat excluded areas" or "motorboat prohibition zones", and/or defining specific traffic lanes within the Lakes.¹ For example, boat traffic between Benedict and Tombeau Lakes could be restricted to necessary boat traffic only to prevent the further colonization and proliferation of Eurasian water milfoil.

Boat restricted- or motorboat prohibited-areas must be designated by approved regulatory markers, as they can lead to legal challenges based on the right of free use of navigable waters. Similarly, slow-no-wake restrictions are preferable to speed limits designated in miles-per-hour terms owing to implementation and enforcement considerations. Placement of regulatory markers must conform to Section NR 5.09 of the *Wisconsin Administrative Code* and all restrictions placed on the use of the waters of the State must be predicated upon the protection of public health, safety, or welfare. Boating ordinances, enacted in conformity with State law, must be clearly posted at public landings in accordance with the requirements of Section 30.77(4) of the *Wisconsin Statutes*.

Buoyage has the advantage of being visible to recreational boaters, but can be expensive to obtain, install, and maintain. Affected areas can be clearly demarcated. Two general options exist regarding the use of buoyage: the establishment of regulated areas using regulatory buoys, such as slow-no-wake or exclusionary areas; or the enhancement of public awareness using informational buoys. Establishment of additional slow-no-wake areas within Benedict and Tombeau Lakes, outside of the statutory slow-no-wake shoreland zone, will require amendment of the Town boating ordinances and a Wisconsin Department of Natural Resources permit. Only regulatory markers are enforceable.

Buoys placed within the waters of the State of Wisconsin are subject to the requirements set forth in Chapter 30, *Wisconsin Statutes*. Such buoys are white in color, cylindrical in shape, seven or more inches in diameter, and extend 36 or more inches above the water line. Regulatory buoys include buoys used to demarcate restricted areas, prohibit boating or types of boating activities in specific areas, and control the movements of watercraft. Buoys used to demarcate regulated areas display their instructions in black lettering. Prohibition buoys display an orange diamond with an orange cross inside. Control buoys display an orange circle. Local authorities having jurisdiction over the waters involved may place danger buoys or informational buoys without an ordinance, although a Wisconsin Department of Natural Resources permit is still required. Informational buoys are similar in

¹ *Wisconsin Department of Natural Resources, Guidelines: Ordinance Writing and Buoy Placement for Wisconsin Waters, s.d.*

construction to the regulatory buoys, but contain an orange square on the white background. Informational buoys are not enforceable.

With respect to watercraft, it is recommended that the Towns of Bloomfield and Randall continue to limit boat speeds within 150 feet of the shore, and personal watercraft speeds within 200 feet of the shore, to slow-no-wake as defined in Chapter 30 of the *Wisconsin Statutes*. It is also recommended that the Towns reduce motorized boat traffic within the Eurasian water milfoil control areas shown on Map 14 to essential traffic only. It is further recommended that the Towns define watercraft transit speed lanes consistent with the milfoil control areas and establish patterns of recreational boating usage on the Lakes so as to minimize the likelihood of the spread of Eurasian water milfoil. Such regulation may require buoyage, depending on the sufficiency of the signage and notices provided to lake users, and the resulting level of compliance achieved. Copies of such ordinance provisions must be placed at the Tombeau Lake public recreational boating access site as set forth in Section 30.77(4) of the *Wisconsin Statutes*, and are recommended to be voluntarily posted at the private boating access sites.

Land Management Measures

Environment Corridors and Critical Species Habitat Protection

The recommended future condition land use plan for the drainage area tributary to Benedict and Tombeau Lakes is set forth in the regional land use plan.² That plan recommends the preservation of primary environmental corridor lands in essentially natural, open space use. Most of the wetlands and other ecologically valuable lands adjacent to Benedict and Tombeau Lakes and within the drainage area tributary to Benedict and Tombeau Lakes are included within these primary environmental corridors. The plan recommends that such protection be afforded through the placement of these lands in appropriate zoning districts, depending upon the type and character of the natural resource features to be preserved and protected.

The Lake Benedict and Tombeau Lake Protection and Rehabilitation District, in cooperation with the Towns and Counties, should support the preservation of the primary environmental corridor lands within the drainage area tributary to Benedict and Tombeau Lakes in essentially natural, open-spaces uses, primarily through public land use controls. Such preservation should be promoted through the enforcement of existing regulations intended to protect such natural resources, and could be further promoted through the support by the District of complementary land protection actions within the drainage area tributary to the Lakes.³ Current county zoning is likely to adequately protect wetland and riparian portions of the primary environmental corridor lands in conservancy districts.

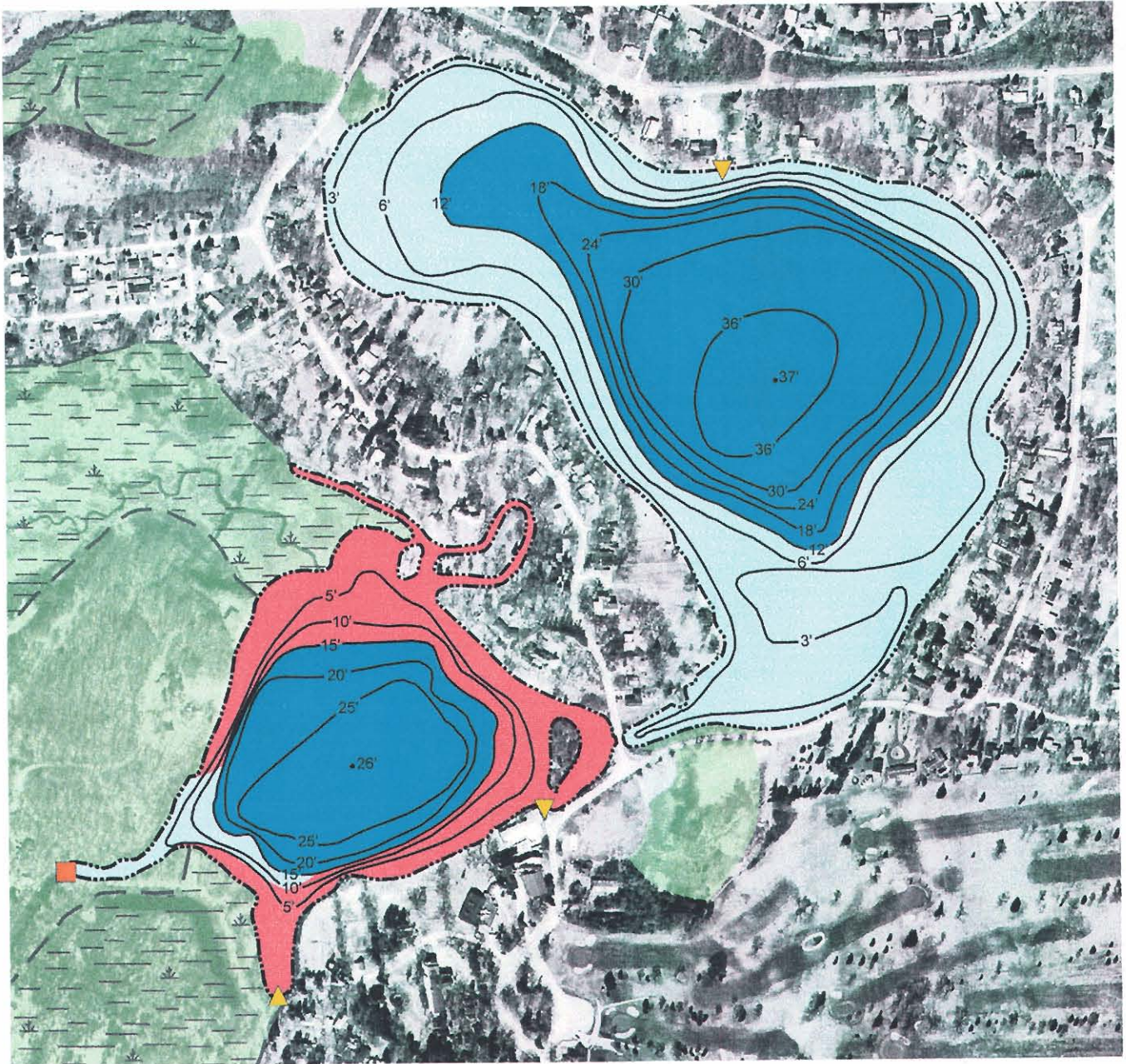
All lakes, rivers, streams, wetlands, and associated undeveloped floodlands and shorelands are recommended to be placed in conservancy or floodplain protection districts. The existing zoning for the lands in the vicinity of Benedict and Tombeau Lakes and in the drainage area directly tributary to Benedict and Tombeau Lakes is generally consistent with the recommended future land use pattern set forth in the regional land use plan. The zoning in the Town of Randall, Kenosha County, and the Town of Bloomfield, Walworth County, for the drainage area directly tributary to Benedict and Tombeau Lakes generally provides for conservancy zoning of the wetland portions of the primary environmental corridors.

²*SEWRPC Planning Report No. 45, A Regional Land Use Plan for Southeastern Wisconsin: 2020, December 1997.*

³*For example, the Lake Benedict and Tombeau Lake Protection and Rehabilitation District could support the acquisition and preservation of the Powers Lake Tamarack Relict by the Powers Lake Management District, as recommended in the regional natural areas and critical species habitat protection and management plan. As this wetland area lies partially within the total drainage area tributary to Tombeau Lake, its acquisition represents prudent watershed-based action to protect water quality in Benedict and Tombeau Lakes.*

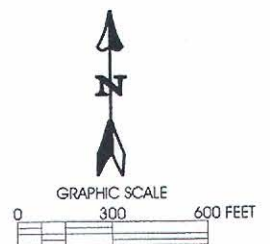
Map 14

RECOMMENDED LAKE MANAGEMENT PLAN FOR BENEDICT AND TOMBEAU LAKES



- 15'— WATER DEPTH CONTOUR IN FEET
- SURFACE WATER
- WATER LEVEL CONTROL STRUCTURE
- PUBLIC-ACCESS SITE
- PRIVATE-ACCESS SITE
- AQUATIC PLANT MANAGEMENT**
- EURASIAN WATER MILFOIL CONTROL AREA
CHEMICALS: LIMITED
- OPEN WATER RECREATIONAL AREA
- PUBLIC INFORMATION AND EDUCATION**
- CONTINUE PUBLIC AWARENESS PROGRAMS

- LAND USE MANAGEMENT**
- PROTECT ECOLOGICALLY VALUABLE AREAS
- PROMOTE GOOD HOUSEKEEPING PRACTICES IN WATERSHED
- SHORELINE PROTECTION**
- MAINTAIN EXISTING STRUCTURES
- PROTECT UNSTABLE AREAS, RESTORE SHORELAND VEGETATIVE BUFFERS
- MONITORING PROGRAM**
- CONTINUE WATER QUALITY MONITORING
- CONDUCT FISH SURVEY
- CONDUCT AQUATIC PLANT MONITORING AND REFINE AQUATIC PLANT MANAGEMENT PLAN EVERY THREE TO FIVE YEARS



Within the Town of Randall, Benedict Lake and portions of the northern shoreline of the Lake, encompassing the town park, are zoned as C-1, lowland conservancy, as recommended in the adopted regional land use plan. However, the majority of the lakeshore of Benedict Lake is zoned R-3, residential, wherein there is a minimum lot size of 20,000 square feet. This zoning district comprises lands located along the eastern and western shorelines of Benedict Lake within the Town. Portions of the southern shoreline of Benedict Lake are zoned as R-5, residential, wherein there is a minimum lot size of five acres, and PR-1, park and recreational, comprising the Nippersink Country Club golf course. A small portion of the northern shoreline is zoned as B-1, neighborhood business, within which the Benedict Manor Restaurant & Wine House is situated.

Within the Town of Bloomfield, the wetlands located to the north of Tombeau Lake, and portions of the upland woodland corridor west of Tombeau Lake, are included in conservancy zoning districts, as recommended in the adopted regional land use plan. Wetlands are zoned as C-4, lowland resource conservation, while upland areas are zoned as C-2, upland resource conservation, within the Town of Bloomfield, the upland resource conservation district allows residential development on five-acre lots. However, as in neighboring Kenosha County, the majority of the drainage area directly tributary to Benedict and Tombeau Lakes within the Town of Bloomfield is included in the R-1 zoning district, which provides for single-family residential development on 40,000 square foot lots. Other portions of the drainage area are zoned as A-2, agricultural, wherein there is a minimum lot size of 20 acres, and B-5, planned commercial-recreational business lands, encompassing the Nippersink Country Club resort.

In addition to such zoning protections, it is recommended that the Lake Benedict/Tombeau Lake Protection and Rehabilitation District support future management actions that may be necessary to ensure the habitat quality of that wetland and other wetland areas within the drainage area tributary to Benedict and Tombeau Lakes. These actions would include actions, such as the control of purple loosestrife or other invasive plants which might degrade the habitat quality of the wetlands and protect critical species habitat areas, as well as specific land acquisition activities, as recommended in the regional natural areas and critical species habitat protection and management plan.⁴ The purchase of specific critical properties or the acquisition of conservation easements, as a means of protecting them from encroachment or further degradation, or as a means of facilitating their rehabilitation and restoration, is possible through the Chapter NR 50/51 Stewardship Grant and Chapter NR 191 Lake Protection Grant programs. Outright purchase or the purchase of conservation easements, are both possible options. Lands proposed for purchase must be appraised using standard governmental land acquisition procedures as established by the Wisconsin Department of Natural Resources, and must be subject to a land management plan setting forth the processes and procedures for their long-term maintenance and development. The Chapter NR 191 grant program provides State cost-share funding for the purchase up to a maximum State share of \$200,000 at up to a 75 percent State cost-share. The Chapter NR 50/51 grant program provides State cost-share funding up to a maximum State share of \$100,000 at up to a 50 percent cost-share.

Water Quality Protection

The regional water quality management plan recommended the White River and the East Branch Nippersink Creek subwatershed, including Benedict and Tombeau Lakes, for implementation of significant urban point source and rural nonpoint source pollution controls.⁵ Such controls were recommended to reduce heavy metals and sediment loads from the watershed.

The recommended urban measures were directed largely at the urban and urbanizing areas in the lower reaches of the system, including those in the Benedict-Tombeau Lake direct tributary area. These measures included the

⁴*SEWRPC Planning Report No. 42, A Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin, September 1997.*

⁵*SEWRPC Memorandum Report No. 93, A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report, March 1995.*

future provision of public sanitary sewerage services.⁶ The provision of public sanitary sewerage services within the drainage area tributary to Benedict and Tombeau Lakes is supported by the phosphorus loading analysis set forth in Table 5. This analysis shows that the potential phosphorus load from onsite sewage disposal systems serving urban residential development within the drainage area could potentially contribute up to 300 pounds of phosphorus per year, or more than double the existing phosphorus load from all other urban sources combined, to the Lakes. While the analysis suggests that the majority of onsite sewage disposal systems within the drainage area are functioning within normal operating parameters, continuing efforts to inspect, maintain, and replace as necessary such onsite sewage disposal systems, pursuant to applicable State and County requirements, will be required.

The recommended rural measures were directed largely at rural nonpoint sources within the drainage area tributary to Benedict and Tombeau Lakes, and were estimated to achieve about a 50 percent reduction in nonpoint source pollutant loads to the Lakes. Similar measures were also recommended for the Pell Lake drainage area within the White River and East Branch Nippersink Creek subwatershed.⁷

In-Lake Management Measures

Various potential in-lake management actions may be considered for purposes of control of aquatic plants. These actions include harvesting, chemical treatment, lake drawdown, and lake bottom covering. Because the current aquatic plant problems on Benedict and Tombeau Lakes, as described in Chapters II and III, generally are limited in nature, these in-lake measures are not considered to be widely applicable. The only in-lake measures related to aquatic plant management considered viable are manual harvesting of selected nuisance species such as Eurasian water milfoil and purple loosestrife, and limited chemical treatment of these two species in situations where extensive infestations occur.

The Lake Benedict and Tombeau Lake District and the Wisconsin Department of Natural Resources should work with private property owners to promote and encourage limited, manual control of aquatic plants within the Lake basins. Selected manual harvesting of these plant species is recommended in areas where this level is appropriate to the abundance of plants.

Should more aggressive actions be warranted, the Lake Benedict and Tombeau Lake Management District, in cooperation with the Wisconsin Department of Natural Resources, should develop a reasonable herbicide usage policy to control the expansion of purple loosestrife and Eurasian water milfoil growths in the Lakes. Early spring treatment to control Eurasian water milfoil growths in the lakes in Southeastern Wisconsin has proven effective and is recommended, primarily to limit the growth of Eurasian water milfoil in Tombeau Lake. Early spring herbicide treatments result in a reduced biomass subject to decomposition and limit the accumulation of organic materials on the lake bottom. Treatment is specifically recommended in the channel between the two Lakes to limit the spread of Eurasian water milfoil to Benedict Lake by motorboats using the channel. The use of chemical herbicides should be limited to small areas for the control of purple loosestrife and Eurasian water milfoil in the Lakes, and is subject to the issuance of a Wisconsin Department of Natural Resources permit. Such control measures encourage the resurgence of native plant species and enhance the value of the habitat areas within the Lake.

Citizen Information and Education

As part of the overall citizen information and education programming to be conducted in the Benedict and Tombeau Lakes community, residents and visitors in the vicinity of Benedict and Tombeau Lakes should be made

⁶SEWRPC, Amendment to the Regional Water Quality Management Plan—2000, Pell Lake Area and Powers-Benedict-Tombeau Lakes Area, Kenosha and Walworth Counties, *December 1994*.

⁷SEWRPC, Amendment to the Regional Water Quality Management Plan—2000, *op. cit.*; *SEWRPC Memorandum Report No. 93*, *op. cit.*

aware of the value of the ecologically significant areas in the overall structure and functioning of the ecosystems of Benedict and Tombeau Lakes. The Lake Benedict and Tombeau Lake Protection and Rehabilitation District, in cooperation with the Towns of Bloomfield and Randall, through a joint education and information program, should discourage human disturbances in ecologically valuable areas. Disturbances of ecologically valuable areas should be limited to only such disturbances as may be necessary to provide riparian residents with a reasonable level of access to the main body of the Lake. Specifically, informational programming related to the protection of ecologically valuable areas in and around Benedict and Tombeau Lakes should focus on need to minimize the spread of nuisance aquatic species, such as purple loosestrife in the wetlands and Eurasian water milfoil in the Lakes.

Citizens participating in water-based recreation on Benedict and Tombeau Lakes should also be encouraged to participate in boater education programs. Boating access, as noted above, as well as other water sports, is recommended to be limited in the ecologically valuable areas. Lake residents and visitors should be made aware of the invasive nature of species such as purple loosestrife and Eurasian water milfoil, and be encouraged to participate in citizen-based control programs coordinated by the Wisconsin Department of Natural Resources and University of Wisconsin-Extension. Other informational programming offered by the Wisconsin Department of Natural Resources, University of Wisconsin and University of Wisconsin-Extension, and other agencies also can contribute to an informed public, actively involved in the protection of ecologically valuable areas within the drainage area tributary to, and lake basins of, Benedict and Tombeau Lakes.

Recommended Protection Measures

The following actions are recommended for the management of ecologically valuable areas and aquatic plants:

1. The Lake Benedict and Tombeau Lake Management District, in cooperation with the Wisconsin Department of Natural Resources, should support the preservation and rehabilitation of the primary environmental corridor lands and isolated natural resource features in the Benedict and Tombeau Lakes tributary drainage area. These lands, and especially their associated wetland areas located adjacent to the East Branch Nippersink Creek, are recommended to be protected and preserved to the extent practicable as set forth in the applicable regional and county plans. It is also recommended that sensitive area delineations pursuant to Chapter NR 107, *Wisconsin Administrative Code*, be conducted in selected areas of the Lakes to protect habitat and promote appropriate lake usage.
2. The Lake Benedict and Tombeau Lake Management District should consider aquatic plant management practices that includes the periodic review and refinement of aquatic plant management practices within the Lakes. It is recommended that an aquatic plant survey be conducted every three to five years in order to track the success of the current aquatic plant management program, as well as any other changes in the tributary drainage area that may affect Benedict and Tombeau Lakes.
3. The Lake Benedict and Tombeau Lake Management District should monitor the distribution of Eurasian water milfoil and purple loosestrife as part of an ongoing aquatic plant monitoring program under the auspices of the Wisconsin Department of Natural Resources Self-Help Aquatic Plant Monitoring Program.
4. The Lake Benedict and Tombeau Lake Management District should consider manual control of aquatic plant growth to maintain boating access channels in selected areas of Tombeau Lake. In this regard, the Lake Management District could consider purchasing several specialty rakes designed for the removal of vegetation from shoreline property and make these available to riparian owners. This would allow riparian owners to use the rakes on a trial basis before purchasing their own. The rakes cost approximately \$90 each, and do not require a permit for use.
5. Should Eurasian water milfoil be determined to reach nuisance proportions, the use of chemical herbicides could be considered, but should be limited to small areas. Early spring or late fall treatments to control the growth of Eurasian water milfoil have proven effective in other lakes in

Southeastern Wisconsin and are recommended. Early spring herbicide treatments reduce the biomass subject to decomposition and limit the accumulation of organic materials on the Lake bottom. Based upon the aquatic plant distribution shown on Map 11, and the potential for Eurasian water milfoil to be transported by watercraft from Tombeau Lake into Benedict Lake, an area of about 16.3 acres, about 13.8 acres of which is within a 125 foot arc from the lakeshore, would be recommended for targeted, herbicide-based, Eurasian water milfoil control in Tombeau Lake.

6. The Lake Benedict and Tombeau Lake Management District should consider chemical treatment of selected areas of Lake Benedict and Tombeau Lake targeting control of purple loosestrife infestations. In this regard, the use of chemical herbicides could be considered, but should be limited to small areas of the shoreline.

NONPOINT SOURCE POLLUTION CONTROLS

Benedict Lake is a mesotrophic, and Tombeau Lake a meso-eutrophic, waterbody. As such, they may be considered, by definition, to be in need of protection and preservation if their current aesthetic and recreational uses are to be maintained and enhanced. As described in Chapter II, the primary pollutant loading sources to Benedict and Tombeau Lakes are nonpoint sources generated in the drainage area tributary to the Lakes, including areas draining into the East Branch Nippersink Creek. While the regional land use plan does not anticipate any significant increase in urban residential lands in the drainage area tributary to Benedict and Tombeau Lakes, such development, or redevelopment of existing lands that may occur, has the potential to result in increased loadings of some pollutants associated with urban development and construction sites.

Array of Control Measures

To control nonpoint source pollution to Benedict and Tombeau Lakes and its tributary drainage area, both urban and rural nonpoint source controls are considered viable options. Watershed management measures may be used to reduce nonpoint source pollutant loadings from such rural sources as runoff from cropland and pastureland; from such urban sources as runoff from residential, commercial, transportation, and recreational land uses; and from construction activities. The alternative, nonpoint source pollution control measures considered in this report are based upon the recommendations set forth in the regional water quality management plan,⁸ the Kenosha County soil erosion control plan and land and water resources management plan,⁹ the Walworth County soil erosion control plan and land and water resource management plan,¹⁰ and information presented by the U.S. Environmental Protection Agency.¹¹

⁸*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; and Volume Three, Recommended Plan, June 1979.*

⁹*SEWRPC Community Assistance Planning Report No. 164, Kenosha County Agricultural Soil Erosion Control Plan, April 1989; SEWRPC Community Assistance Planning Report No. 255, A Land and Water Resource Management Plan for Kenosha County: 2000-2004, September 2000.*

¹⁰*Walworth County Land Conservation Department and R.A. Smith & Associates, Inc., Walworth County Soil Erosion Control Plan, November 1988; Walworth County Land Conservation Department, Land & Water Resource Management Plan, February 1999.*

¹¹*U.S. Environmental Protection Agency, Report No. EPA-440/4-90-006, The Lake and Reservoir Restoration Guidance Manual, 2nd Edition, August 1990; and its technical supplement, U.S. Environmental Protection Agency, Report No. EPA-841/R-93-002, Fish and Fisheries Management in Lakes and Reservoirs: Technical Supplement to the Lake and Reservoirs Restoration Guidance Manual, May 1993.*

The control of nonpoint source pollution to Benedict and Tombeau Lakes and their tributary drainage areas which are considered viable can be classified in two categories: namely, 1) urban nonpoint source controls, and 2) rural nonpoint source controls.

Urban Nonpoint Source Controls

The regional water quality management plan recommends that the nonpoint source pollutant loadings from the urban areas tributary to Benedict and Tombeau Lakes be reduced by about 25 percent in addition to reductions from urban construction erosion control, and streambank and shoreline erosion control measures.

Potentially applicable urban nonpoint source control measures include wet detention basins, grassed swales, and good urban "housekeeping" practices. Generally, the application of low-cost urban housekeeping practices may be expected to reduce nonpoint source loadings from urban lands by about 25 percent. Public education programs can be developed to encourage such good urban housekeeping practices, to promote the selection of building and construction materials which reduce the runoff contribution of metals and other toxic pollutants, and to promote the acceptance and understanding of the proposed pollution abatement measures and the importance of lake water quality protection. Urban housekeeping practices and source controls include restricted use of fertilizers and pesticides, improved pet waste and litter control, the substitution of plastic for galvanized steel and copper roofing materials and gutters, proper disposal of motor vehicle fluids, increased leaf collection, and reduced use of street deicing salt. In addition, the regular inspection, maintenance and replacement as necessary of onsite sewage disposal systems, as noted above, should form an important element of urban good housekeeping practices.

Proper design and application of urban nonpoint source control measures, such as grassed swales and detention basins, requires the preparation of a detailed stormwater management system plan that addresses stormwater drainage problems and controls nonpoint sources of pollution. Based on a preliminary evaluation, however, it is estimated that the practices which could be effective in the existing urban areas within the immediate vicinity of Benedict and Tombeau Lakes are limited largely to good urban housekeeping practices.

Developing areas can generate significantly higher pollutant loadings than established areas of similar size. Developing areas include a wide array of activities, including individual site development within the existing urban area and new land subdivision development. As previously noted, little additional residential development is planned for within the drainage area tributary to Benedict and Tombeau Lakes. Nevertheless, because construction sites, especially, may be expected to produce suspended solids and phosphorus loadings at rates several times higher than established urban land uses, control of sediment loss from construction sites is recommended. Such controls are currently provided by measures set forth in the Performance Standards of Walworth and Kenosha Counties general zoning authority. These controls include temporary measures taken to reduce pollutant loadings from construction sites during stormwater runoff events as set forth in the construction site management handbook developed by the Wisconsin Department of Natural Resources.¹² Construction erosion controls may be expected to reduce pollutant loadings from construction sites by about 75 percent. However, such practices are expected to have only a minimal impact on the total pollutant loading to Benedict and Tombeau Lakes due to the relatively small amount of land proposed to be developed. Nevertheless, such controls are important pollution control measures that can abate localized short-term loadings of phosphorus and sediment from the drainage area and the upstream tributary area. The control measures include such revegetation practices as seeding, mulching, and sodding and such runoff control measures as filter fabric fences, straw bale barriers, storm sewer inlet protection devices, diversion swales, sediment traps, and sedimentation basins.

The Walworth County-adopted Land Disturbance, Erosion Control and Storm Water Management Ordinance governs the amount of sediment and other pollutants from construction sites and land disturbing activities in the County that occur on platted lots within a subdivision plat; lots developed under a certified survey map; areas of

¹²*Wisconsin Department of Natural Resources, Wisconsin Construction Site Best Management Practices Handbook, latest revision April 1994.*

4,000 square feet or greater; works where fill and/or excavation volumes exceed 400 cubic yards; public streets, roads or highways; watercourses; and utilities. In addition, the soil erosion control and stormwater management provisions of the Walworth County land division ordinance would apply to residential developments of five acres or more, and other developments of three acres or more. All control measures are administered and enforced by the Walworth County Land Conservation, and ongoing enforcement of these provisions within the drainage area tributary to Benedict and Tombeau Lakes is recommended.

The Kenosha County General Zoning and Shoreland/Floodplain Zoning Ordinance, and the Kenosha County Subdivision Control Ordinance, provide for urban nonpoint source pollution control as a condition of the permitting process. For this reason, the County has not adopted a specific construction site erosion control ordinance, preferring to deal with the issue of construction site erosion control as a permit condition. This approach has been relatively successful in minimizing soil loss from construction sites. Notwithstanding, as the level of urban development increases within the County, the need for specific ordinance language setting urban construction site performance standards becomes more important. Therefore, it is recommended that the Town of Randall and Lake Benedict and Tombeau Lake Protection and Rehabilitation District encourage Kenosha County to adopt appropriate stormwater management and construction site erosion control ordinance provisions. This recommendation is consistent with the recommended actions set forth in the adopted County land and water resources management plan.¹³

Rural Nonpoint Source Controls

The regional water quality management plan recommends that the nonpoint source pollutant loadings from the rural areas tributary to Benedict and Tombeau Lakes be reduced by about 50 percent. Achieving such a level of rural nonpoint source pollution reduction will require the implementation of practices in addition to the minimum practices recommended in the regional water quality management plan. These practices are summarized in Appendix D, and include streambank and shoreline erosion control measures, modified crop rotations, use of grassed waterways, and protections against wind erosion.

Upland erosion from agricultural and other rural lands is a contributor of sediment to streams and lakes in the tributary drainage area to Benedict and Tombeau Lakes. Estimated phosphorus and sediment loadings from croplands, woodlots, pastures, and grasslands in the drainage area tributary to Benedict and Tombeau Lakes were presented in Table 5. These loadings are recommended to be reduced to the target level of agricultural erosion control identified in the Kenosha and Walworth County land and water resource management plans. Implementation of these recommendations is considered to be an important water quality management measure for Benedict and Tombeau Lakes.

Preparation of detailed farm conservation plans to adapt and refine erosion control practices for individual farm units are recommended. Generally prepared with the assistance of the U.S. Natural Resources Conservation Service or County Land Conservation Department staffs, such plans identify desirable tillage practices, cropping patterns, and rotation cycles, considering the specific topography, hydrology, and soil characteristics of the farm; identify the specific resources of the farm operator; and articulate the operator objectives of the owners and managers of the land. Within Kenosha County, preparation of such plans, including integration into such plans of integrated nutrient and pest management measures, is recommended in the adopted County land and water resources management plan.

Recommended Control Measures

The following management actions are recommended for the management of nonpoint source pollution sources:

1. The construction site erosion control and water quality protection ordinances adopted by Walworth County should continue to be strictly enforced to reduce sediment and contaminant loadings from the

¹³SEWRPC Community Assistance Planning Report No. 255, op. cit.

urbanizing areas in the tributary drainage area to Benedict and Tombeau Lakes, especially in those areas nearest to the Lakes.

2. Lake Benedict and Tombeau Lake Protection and Rehabilitation District should encourage the development and adoption of a construction site erosion control ordinance for Kenosha County. The construction site erosion control practices currently used by Kenosha County as part of its zoning permit process should be continued and enforced pending development and adoption of a construction site erosion control ordinance at some future date.
3. The Lake Benedict and Tombeau Lake Protection and Rehabilitation District, in conjunction with the Towns of Bloomfield and Randall and Kenosha and Walworth Counties, should assume the lead in the development of a public educational and informational program for the residents around and in the immediate vicinity of Benedict and Tombeau Lakes, which encourages the institution of good urban housekeeping practices including, pesticide and fertilizer use management, improved pet waste and litter control, and yard waste management, as well as other lake management-related topics. It is recommended that informational programming related to nonpoint source pollution abatement and other lake management topics be included at the annual meetings of Lake Benedict and Tombeau Lake Management District. Such action would be fully consistent with recommendations set forth in the Kenosha and Walworth County land and water resource management plans.
4. The Lake Benedict and Tombeau Lake Protection and Rehabilitation District should support the implementation of the Kenosha County land and water resources management plan within those portions of the drainage area situated in Kenosha County, and encourage the Towns and Counties to implement the recommended land uses set forth in the adopted regional land use plan.
5. The Lake Benedict and Tombeau Lake Protection and Rehabilitation District should promote, through appropriate informational programming, State and County efforts related to the regular inspection, maintenance and replacement as necessary of onsite sewage disposal systems; encourage electors to regularly inspect and maintain such systems; and, support the future implementation of a public sanitary sewerage system within the drainage area tributary to the Lakes.

SURFACE WATER QUALITY

Benedict Lake, as a mesotrophic waterbody, may be considered an high water quality lake and Tombeau Lake, as a meso-eutrophic waterbody, may be considered a relatively unpolluted lake, in the context of Southeastern Wisconsin.¹⁴ Further, the available water quality data, summarized in Chapter II, suggest that lake water quality conditions in Benedict Lake have generally remained stable while water quality in Tombeau Lake has tended to fluctuate somewhat, due to a number of possible weather and connected stream conditions. In addition to these changes in water quality, accumulations of organic material, and leaf and plant litter, thought to be of largely terrestrial, but also partially of aquatic, origin, near the inlet of Tombeau Lake, and the general shallowness of the Lake basin especially in nearshore areas, have heightened concern amongst the lakeshore residents of Tombeau Lake.

Protection of the surface water quality of Benedict and Tombeau Lakes can be accomplished through the protection of ecologically valuable areas, and the adoption of good housekeeping practices within the drainage area tributary to Benedict and Tombeau Lakes, as set forth above. In addition, the installation and maintenance of appropriate shoreline protection structures and vegetated buffer zones would limit degradation of water quality due to human activities in the riparian areas adjacent to the Lakes. Specific public information programming with an emphasis on composting of leaves and yard waste would complement riparian good housekeeping practices,

¹⁴SEWRPC Memorandum Report No. 93, op. cit.

and potentially reduce the rate at which terrestrial leaf litter accumulates within the Lake basins. Similar programming promoting the ongoing inspection, maintenance, and replacement as necessary of onsite sewage disposal systems is indicated.

Continued participation in the Wisconsin Department of Natural Resources Self-Help Monitoring Program is also recommended as a means of assessing the health of Benedict and Tombeau Lakes on a regular basis. These programs can provide an early warning of undesirable changes in lake water quality and aquatic species composition and initiate appropriate responses in a timely manner. Such data can supplement and be coordinated with data gathered by the U.S. Geological Survey under the current trophic state index monitoring program.

Recommended Control Measures

The following management actions are recommended for surface water quality management:

1. Continued participation in the Wisconsin Department of Natural Resources Self-Help Monitoring Program is recommended. It is also recommended that the results obtained through this volunteer water quality monitoring program be shared with the electors of the District at the annual meeting of the Lake Benedict and Tombeau Lake Protection and Rehabilitation District.
2. The conduct of relevant public informational programming emphasizing good housekeeping practices within the drainage area tributary to Benedict and Tombeau Lakes, that minimize the transfer and transmission of pollutants to the Lakes and stream, is recommended.

PUBLIC RECREATIONAL BOATING ACCESS

Benedict and Tombeau Lakes provide opportunities for high-quality, water-based recreational use to the residents of the Towns of Bloomfield and Randall and within the Southeastern Wisconsin Region. As described in Chapter III, potential concerns associated with recreational boating use of Benedict and Tombeau Lakes include the lack of adequate public recreational boating access to Benedict Lake, as defined in Chapter NR 1 of the *Wisconsin Administrative Code*, and potential environmental damage arising from intrusion of boats into ecologically valuable areas. This latter concern is further heightened by the potential for boating traffic from Tombeau Lake to transfer Eurasian water milfoil fragments from Tombeau Lake to Benedict Lake. Tombeau Lake currently has adequate public recreational boating access pursuant to Chapter NR 1.

Array of Options

Two options to provide public recreational boating access to Benedict Lake have been identified: namely, 1) to provide a level of access fully consistent with the standards set forth in Chapter NR 1 of the *Wisconsin Administrative Code*, and 2) to provide a level of access that differs from the standards set forth in Chapter NR 1.

Access Standards

Determination of the amount of access that should be accommodated at Benedict and Tombeau Lakes is dependent on the areal extent of the open water lake surface. Benedict Lake, with a surface area of 78 acres, falls into the 50- to 99-acre category for recreational use lakes established in Section NR 1.91 of the *Wisconsin Administrative Code*. As previously noted, the number of car-trailer units to be accommodated at Benedict Lake, in a manner consistent with the Section NR 1.91 guidelines, would be a combination of five vehicle and car-trailer units, plus a handicapped accessible unit, for a total of six units. Guidelines set forth in the regional and county park and open space plans indicate that the fast or high-speed boating capacity of the Lake is five boats. These levels of boating usage, consistent with the safe use capacity, are likely to be met with consideration of only riparian-owned boat usage. Assuming that 2.5 percent of the approximately 147 watercraft moored or trailered at Benedict Lake are likely to be in operation at any given time during daylight hours, and that these watercraft are likely to be fast or high-speed boats, the numbers of watercraft currently using Benedict Lake are likely to approximate the safe-use capacity. Observations by Commission staff, conducted during July 1998, indicated that, indeed, between three and six watercraft were in operation during both weekdays and weekend days on Benedict Lake. Notwithstanding, Benedict Lake currently does not meet the minimum public recreational boating access

standards set forth under Chapter NR 1 of the *Wisconsin Administrative Code*. Provision of public recreational boating access to the standard set pursuant to Chapter NR 1 of the *Wisconsin Administrative Code* is necessary for Benedict Lake to be considered for State water resources enhancement aids.

Tombeau Lake, with a surface area of 51 acres, falls in the 50- to 99-acre category for recreational use lakes established in Section NR 1.91 of the *Wisconsin Administrative Code*. As previously noted, the number of car-trailer units that could be accommodated at Tombeau Lake, in a manner consistent with the Section NR 1.91 guidelines, would be a combination of five car and/or car-trailer units, plus a handicapped accessible unit, for a total of six units. Guidelines set forth in the regional and county park and open space plans indicate that the fast or high-speed boating capacity of the Lake is limited to three boats. These levels of boating usage, consistent with the safe use capacity, are likely to be met with consideration of only riparian-owned boat usage. Assuming that 2.5 percent of the approximately 23 watercraft moored or trailered at Tombeau Lake are likely to be in operation at any given time during daylight hours, and that these watercraft are likely to be fast or high-speed boats, the numbers of watercraft currently using Tombeau Lake are likely to approximate the safe use capacity. Observations by Commission staff, conducted during July 1998, indicated that, indeed, between two and five watercraft were in operation during both weekdays and weekend days on Tombeau Lake. Tombeau Lake currently meets the minimum standards for public recreational boating access established under Chapter NR 1 of the *Wisconsin Administrative Code*.

Recommended Boating Access

The following actions are recommended for the public recreational use of Benedict and Tombeau Lakes:

1. It is recommended that conclusion of a private provider access agreement be considered by the Lake Benedict Manor Restaurant as a private recreational boating access provider. It is recommended that the proposed access site provide parking for six car-trailer units.
2. It is recommended that parking facilities at the Tombeau Lake carry-in public recreational boating access site be improved. Use of the Tombeau Road bridge right-of-way for access is not recommended given the limitations of road width and poor visibility at this site.
3. It is further recommended that any public recreational boating facilities upgrade on Tombeau Lake, and at any access site developed for Benedict Lake, conform to the guidance on accessibility contained in Wisconsin Department of Natural Resources Publication No. CA-003-88, *Handbook for Accessibility...A Reference to Help Develop Outdoor Recreation Areas to Include People with Disabilities*. Such access facilities as may be developed would provide for the greater public convenience of the residents of Benedict and Tombeau Lakes community, as well as for the convenience and safety of the public at large. Selected deepening of the boating access lane through the nearshore portions of Tombeau Lake may be required to ensure access to the main basin by certain types of watercraft.
4. It is recommended that provision be made at these and other access sites on the Lake for the posting of such boating regulations as may be adopted by the Lake Benedict and Tombeau Lake Management District and other notices as necessary.

SHORELINE PROTECTION

The shoreline of Benedict and Tombeau Lakes presents a largely natural aspect to lake users and residents. As described in Chapter III, portions of the shorelines of Benedict and Tombeau Lakes appear to be subject to erosion and undercutting of banks. In addition, concerns about the presence of waterfowl and aesthetic degradation arising from the activities of these waterfowl along the shorelands of the Lakes indicate a need for alteration of current shoreland management practices employed on certain riparian lands.

Alternative Protection Measures

The need for maintenance of the shoreline in order to avoid erosion is important in order to protect the structure and functioning of the aquatic ecosystem of the Lakes, and, especially, to preserve the nearshore and wetland aquatic vegetation in and around the Lakes. Such protections also contribute to preserving and enhancing water quality and the essential structure and functioning of the waterbody and adjacent areas, and provide habitat for fishes and other aquatic life. Certain shoreland landscaping practices have also been shown to be effective deterrents to resident waterfowl populations, as well as attractive means of preserving and providing habitat for desirable aquatic species.

Two alternative shoreline erosion control techniques are considered potentially viable: vegetative buffer strips and rock revetments or riprap. These alternatives, as shown in Figure 5, were considered because they can be constructed, at least in part, by local residents; because most of the construction materials involved are readily available; because the techniques would, in most cases, enable the continued use of the immediate shoreline; and because the measures are visually "natural" or "semi-natural" and should not significantly affect the aesthetic qualities of the Lakes' shoreline. These measures may be combined with selected removal of eroded and accumulated soils, designed to facilitate navigation and recreational boating access on a site-by-site basis.

Recommended Protection Measures

The following actions are recommended for the public recreational use of Benedict and Tombeau Lakes:

1. It is recommended that the Lake Benedict and Tombeau Lake Management District provide lakeshore residents with information on the methods of proper construction and maintenance of shoreland protection structures. Adoption of the vegetated buffer strip method of shoreline protection is recommended, with the use of the riprap or rock revetment method in areas exposed to heavy boating traffic volumes or wind waves. Enforcement of the existing boating ordinances, as set forth above, should provide a further degree of protection to some of the unprotected shoreland areas of the Lakes by limiting high-speed boating in nearshore areas.
2. Maintenance of existing shoreland structures is recommended. Replacement of existing shoreline protection structures may require State or County shoreland permits, depending upon the degree to which the structures need to be repaired or replaced.

AUXILIARY PLAN RECOMMENDATIONS

Public information, education, and involvement remains an important component of any lake management program. It is recommended that informational brochures and pamphlets, of interest to homeowners and supportive of the recommendations contained herein, be provided to homeowners through direct distribution or targeted civic center outlets such as the Town Halls.

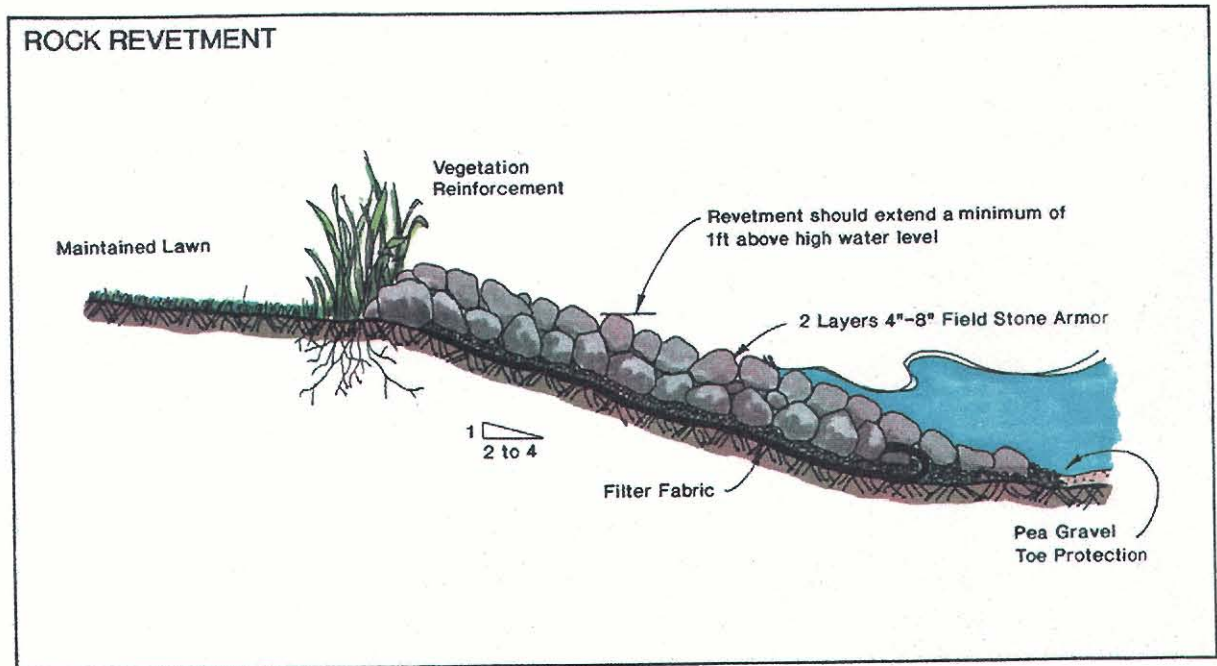
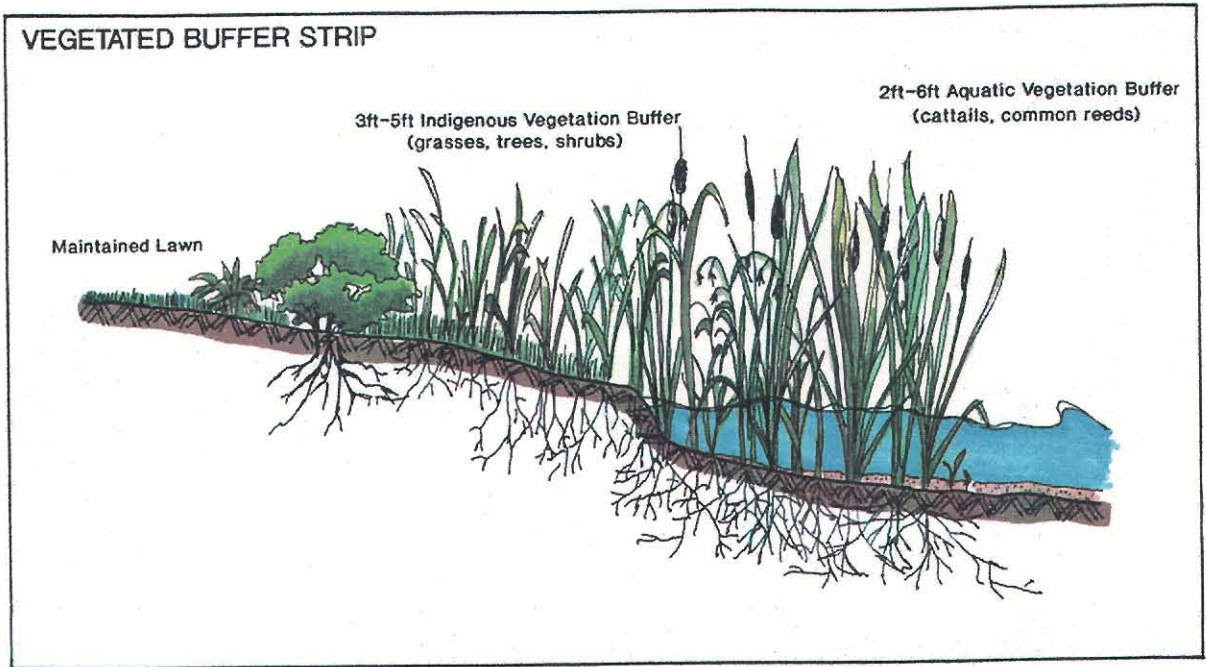
Further, it is recommended that the public meetings convened by the Lake Benedict and Tombeau Lake Management District and Towns of Bloomfield and Randall at regular intervals be continued and that informational issues identified above be presented as a regular part of such meetings. Informational programming has been a priority at the annual meeting of the Lake Benedict and Tombeau Lake Protection and Rehabilitation District. Public inland lake protection and rehabilitation are required to hold an annual meeting of the electors of the District pursuant to the provisions of Chapter 33, *Wisconsin Statutes*. This plan and its subsequent iterations should be made available for public inspection at the District's annual meetings.

SUMMARY

The Benedict and Tombeau Lakes protection plan is summarized on Map 14 and in Table 10. The plan, which documents the findings and recommendations of a study requested by the Lake Benedict and Tombeau Lake Management District, examines existing and anticipated conditions and potential management problems of Benedict and Tombeau Lakes and presents a recommended plan for the resolution of these problems.

Figure 5

PLAN ALTERNATIVES FOR SHORELINE EROSION CONTROL



NOTE: Design specifications shown within are for typical structures. The detailed design of shore protection measures must be based on detailed analysis of local conditions.

Source: SEWRPC.

Table 10

RECOMMENDED MANAGEMENT PLAN ELEMENTS FOR LAKE BENEDICT AND TOMBEAU LAKES

Plan Element	Subelement	Location	Management Measures	Management Responsibility
Land Use Control and Management	Land use development planning	Entire watershed	Observe guidelines set forth in the regional land use plan	Kenosha and Walworth Counties, Towns of Randall, Wheatland, and Bloomfield
	Density management	Lakeshore areas	Maintain historic lake front residential dwelling densities to extent practicable	Kenosha and Walworth Counties, Towns of Randall and Bloomfield
Watershed Land Management	Construction site erosion control	Entire watershed within Walworth County	Enforce construction site erosion control ordinance	Walworth County
	Construction site erosion control	Entire watershed within Kenosha County	Continue to enforce site specific construction erosion control measures as a component of the zoning permitting programs, and encourage development and adoption of a construction site erosion control ordinance	Lake Benedict and Tombeau Lake Management District and Kenosha County
	Urban nonpoint source controls	Entire watershed	Promote sound urban housekeeping and yard care practices through informational programming	Lake Benedict and Tombeau Lake Management District, Kenosha and Walworth Counties, Towns of Randall, Wheatland, and Bloomfield
	Rural nonpoint source controls	Entire watershed	Promote sound rural land management practices through encouraging preparation of individual farm plans, conducting informational programming, and implementing the County land and water resource management plans	Lake Benedict and Tombeau Lake Management District, Kenosha and Walworth Counties, Towns of Randall, Wheatland, and Bloomfield
	Environmentally sensitive lands	Entire watershed	Establish adequate protection of wetlands and shorelands within the environmental corridors as set forth in the regional land use plan	Kenosha and Walworth Counties, Towns of Randall, Wheatland, and Bloomfield
Surface Water Quality Management	Water quality monitoring	Lake Benedict and Tombeau Lake	Continue participation in WDNR Programs including the Self-Help Monitoring Program; review U.S. Geological Survey data and monitoring recommendations and conduct detailed monitoring as necessary	Lake Benedict and Tombeau Lake Management District, Wisconsin Department of Natural Resources
Aquatic Plant Management	Comprehensive plan refinement	Lake Benedict and Tombeau Lake	Monitor aquatic plant conditions and update aquatic plant management plan every three to five years	Lake Benedict and Tombeau Lake Management District
	Boating channel harvesting	Selected areas of Tombeau Lake	Harvest aquatic plants as required to facilitate recreational boating access	Lake Benedict and Tombeau Lake Management District
	Chemical treatment	Selected areas of Lake Benedict and Tombeau Lake	Limited to control of nuisance aquatic plant growth where necessary; specifically target purple loosestrife infestations	Lake Benedict and Tombeau Lake Management District
	Chemical treatment	Selected areas of Lake Benedict	Limited to control of nuisance aquatic plant growth where necessary; specifically target Eurasian water milfoil in the channel to/from Tombeau Lake	Lake Benedict and Tombeau Lake Management District

Table 10 (continued)

Plan Element	Subelement	Location	Management Measures	Management Responsibility
Boating Access	Public recreational boating access	Public access site on Tombeau Lake	Maintain carry-in recreational boating access from both the public park access site and the access site on Tombeau Avenue pursuant to Chapter NR 1	Town of Bloomfield
		Private access site on Lake Benedict	Consider development of a private provider recreational boating access agreement pursuant to Chapter NR 1 with the Lake Benedict Manor Restaurant or develop an access site pursuant to Chapter NR 1	Town of Bloomfield, Lake Benedict and Tombeau Lake Management District
		Selected nearshore areas of Tombeau Lake	Maintain recreational boating access channels where necessary—subject to WDNR permitting pursuant to Chapter 30, <i>Wisconsin Statutes</i>	Private landowners
Habitat Protection and Lake Use Management	Sensitive area delineations	Selected areas of the Lakes	Conduct an NR 107 delineated sensitive area delineation on the Lakes	Wisconsin Department of Natural Resources
Shoreland Protection	Maintain structures	Lake shorelines	Maintain existing shoreline structures and repair as necessary	Lake Benedict and Tombeau Lake Management District, private landowners
	Minimize shoreland impacts on lake water quality and habitat	Lake shorelines	Restrict pollutant loading from stormwater discharges to the Lakes through implementation of stormwater management practices	Walworth County, Towns of Randall, Wheatland, and Bloomfield, and Wisconsin Department of Natural Resources
			Enforce adequate setbacks in shoreland areas	Kenosha and Walworth Counties, Towns of Randall, Wheatland, and Bloomfield
			Install construction site erosion control measures as required by local ordinance; enforce construction site erosion control and stormwater ordinance provisions	Walworth County, Towns of Randall, Wheatland, and Bloomfield, Wisconsin Department of Natural Resources
Encourage shoreline restoration projects and creation of buffer strips, and promote consistency in application of landscaping practices in sensitive shoreland areas, through informational programming and demonstration sites	Lake Benedict and Tombeau Lake Management District, Kenosha and Walworth Counties, Towns of Randall, Wheatland, and Bloomfield, Wisconsin Department of Natural Resources, University of Wisconsin-Extension			
Informational and Educational Program	Public informational and educational programming	Entire watershed	Continue public awareness and informational programming	Lake Benedict and Tombeau Lake Management District, Wisconsin Department of Natural Resources, University of Wisconsin-Extension

Source: SEWRPC.

Benedict Lake was found to be a mesotrophic, largely deep water lake of relatively good quality. Tombeau Lake was found to be meso-eutrophic. Both Lakes are located in close proximity to the progressively urbanizing portions of Kenosha and Walworth Counties in which its tributary drainage area is wholly located. Surveys indicated that the Lakes and their tributary drainage areas contain significant areas of ecological value, including wetlands and high-quality wildlife habitat surrounding the Lakes.

For these reasons, the recommended plan sets forth actions be taken to protect ecologically valuable areas within and adjacent to the Lakes and within their watershed. Notwithstanding, the development of a public recreational boating access site to serve Benedict Lake, through the conclusion of a private provider agreement pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*, is specifically recommended. The recommended plan also includes continuation of the ongoing program of public information and education being conducted by the Lake Benedict and Tombeau Lake Management District, providing riparian residents with alternatives to traditional lake and land management actions. In this way, the recommended plan seeks to balance the demand for high-quality residential and recreational opportunities at Benedict and Tombeau Lakes while maintaining an high-quality lake environment.

APPENDICES

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Appendix A

PUBLIC OPINION OF WATER USE AND QUALITY IN BENEDICT AND TOMBEAU LAKES WALWORTH AND KENOSHA COUNTIES, WISCONSIN

SUMMARY OF STATISTICAL DATA AND RESULTS

I. METHODOLOGY

- A. Questionnaire survey using a mail-back survey during summer 1998.
- B. Analysis based upon 42 responses out of 93 possible.

II. RESPONDENT PROFILE

- A. Majority of respondents (54 percent) were annual residents; 24 percent were part-time summer residents; and 22 percent were weekend residents.
- B. Majority of respondents (71 percent) had used Benedict-Tombeau Lakes for more than 10 years.
- C. Majority of respondents (78 percent) used the Lakes with family.

III. LAKE USE

A. Categories of Use

- 1. Swimming was the personally most important use (rated 4.5 on a five-point scale, where 5.0 is the most important use), closely followed by power boating and water skiing (both rated 4.2); walking/jogging and rowing/canoeing were rated third and fourth with a rank of 4.0 and 3.9, respectively. Picnic/barbecuing, and snowmobiling were often mentioned.
- 2. Sailing was the least personally most important use (rated 3.2 on a five-point scale, where 1.0 was the least important use), closely followed by jet skiing and cross-country skiing (both rated 3.3).

B. Intensity of Use

- 1. Moderate (76 percent) to heavy (15 percent) use.

C. Frequency of Use

- 1. On an annual basis, walking/jogging was the most frequently engaged-in activity (averaging 126 days per year), which included more than 21 percent of the respondents. The frequency of bird watching and picnicking/barbecuing was actually higher than walking/jogging (averaging

253 and 182 days per year, respectively), however, each of these activities were represented by less than 1 percent of the respondents.

2. During spring and summer, power boating was the most frequently engaged-in activity (averaging 44 days), closely followed by swimming (40 days), water skiing (31 days), jet-skiing (31 days), walking/jogging (22 days).
3. During autumn and winter, snowmobiling was the most frequently engaged-in activity (averaging 20 days).
4. On average, 60 percent of the respondents spent 33 days per year fishing during open water periods, and 24 percent of the respondents spent seven days ice fishing.

D. Use of Lakes

1. Overall, 26 percent of respondents use both Benedict and Tombeau Lakes. Nearly 50 percent of respondents only use Benedict Lake, whereas less than five percent only use Tombeau Lake.

E. Levels of Satisfaction

1. Majority of respondents rated the fishing quality of the Lakes fair (33 percent) to good (14 percent); panfish (caught by 92 percent of fishing respondents), largemouth bass (caught by 80 percent), northern pike (caught by 72 percent), and smallmouth bass (caught by 48 percent) were the most common angling species. Largemouth bass, panfish, and bullhead species were generally thought to have remained at the same abundance over the last five years. Carp seem to have been increasing their numbers in this system. In contrast, northern pike and smallmouth bass are perceived to have declined in abundance over the last several years.
2. The perceived level of law enforcement on this lake ranged from 33 percent satisfied, 34 percent had no strong feeling, and 33 percent were dissatisfied.
3. Majority of respondents (74 percent) were not dissatisfied with the level of land use regulation in the watershed; 29 percent were satisfied with current regulations.

IV. WATER QUALITY

A. Assessment

1. Based on water clarity, the majority of respondents (74 percent) rated the Lakes as having good water quality. However, a number of residents have emphasized Benedict Lake has much better water quality than Tombeau Lake.
2. Based on aquatic plant growth, the majority of respondents (52 percent) rated the Lakes as having good water quality.
3. Based on biological conditions, the majority of respondents (40 percent) rated the Lakes as having good water quality.
4. The majority of respondents (45 percent) perceived a decline in water quality over time; an equal number of respondents felt that the Lakes had stayed the same or improved.
5. Most respondents (65 percent) felt that Benedict Lake did not have excessive plant growth, but the same percentage also stated that Tombeau Lake did have excessive plant growth.

B. Management

- 1. The majority of those respondents indicating excessive aquatic plant growth preferred controlling it by fertilizer (95 percent) and development controls (83 percent) primarily targeted at the watershed levels; secondarily by dredging (67 percent) and mechanical harvesting (55 percent); while less than 25 percent of respondents preferred use of chemicals as an alternative.**
- 2. Respondents were almost equally divided between those willing (45 percent) and those unwilling (49 percent) to pay more for lake-related improvements.**
- 3. Many respondents (43 percent of those commenting) indicated a desire for a greater monetary contribution from the State.**
- 4. Some respondents (26 percent of those commenting) suggested a lake use charge, such as increased boat launch fees, as a means of raising money for lake improvements.**
- 5. The majority of respondents (86 percent of those commenting) thought that the Lake Management District was doing a good job. However, 31 percent of those commenting either did not know there was a Lake Management District or were unaware of their activities or accomplishments.**
- 6. Some respondents (29 percent of those commenting) felt that Tombeau Lake should receive greater attention, generally with regard to regulation of the dam to maintain consistent water levels (20 percent of those commenting), dredging (17 percent of those commenting), and aquatic plant management (11 percent of those commenting).**

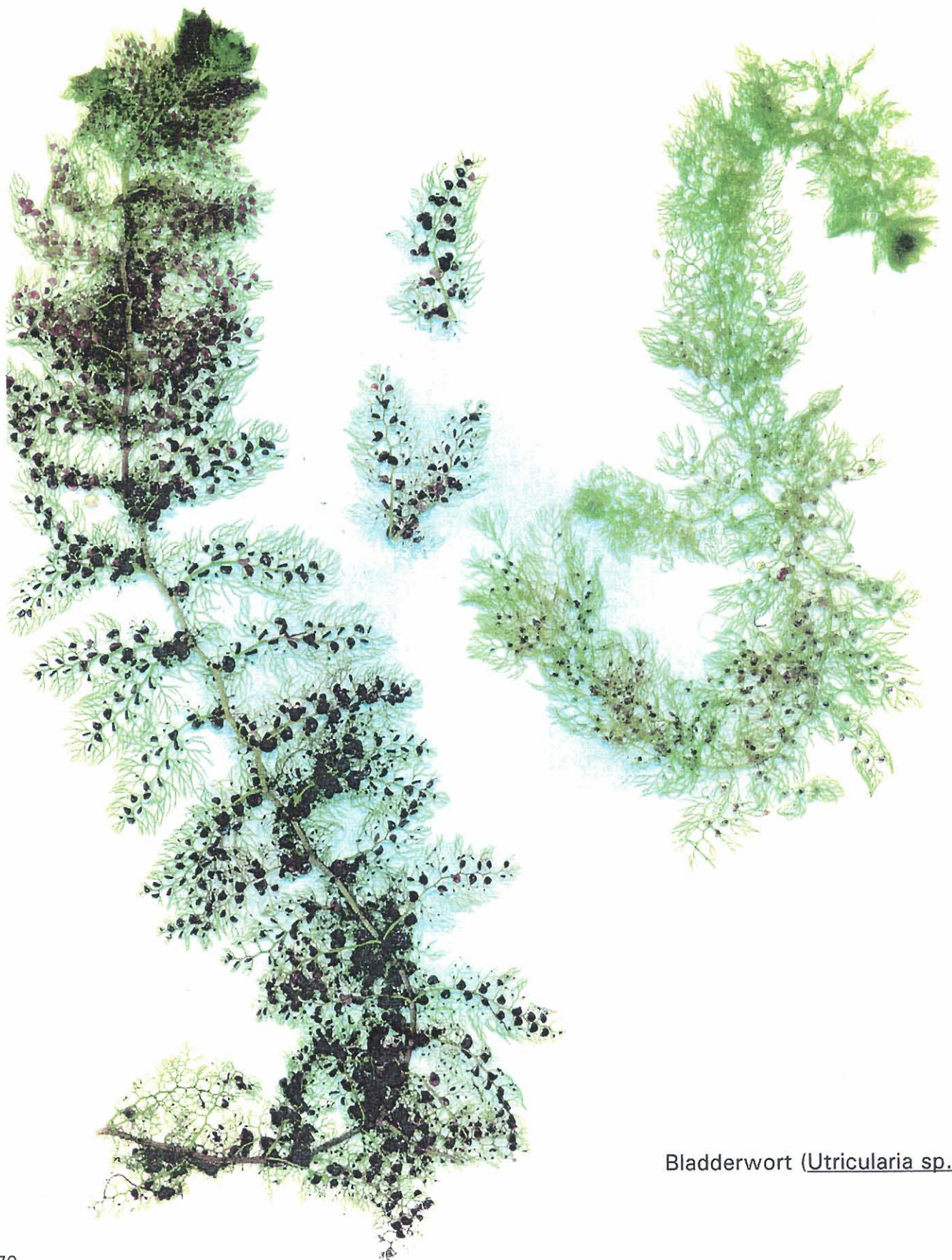
C. Concerns

- 1. The majority of respondents (64 percent) were concerned about both general water quality and the number of jet-skiers, number of boats (59 percent), and access sites by non-residents (52 percent); about half (40-45 percent) were concerned about the size of boats, fluctuating water level, decline of fishery, and speed of boats.**
- 2. A number of respondents (17 percent of those commenting) indicated a desire to install public sanitary sewers, develop a fisheries management program (11 percent of those commenting), and expressed great concern over shoreline erosion (9 percent of those commenting).**
- 3. A number of respondents (31 percent of those commenting) suggested better enforcement of ordinances, especially on the weekends when lake usage is at its maximum. These same respondents emphasized enacting greater restrictions to better control jet skiers on both Benedict and Tombeau Lakes.**

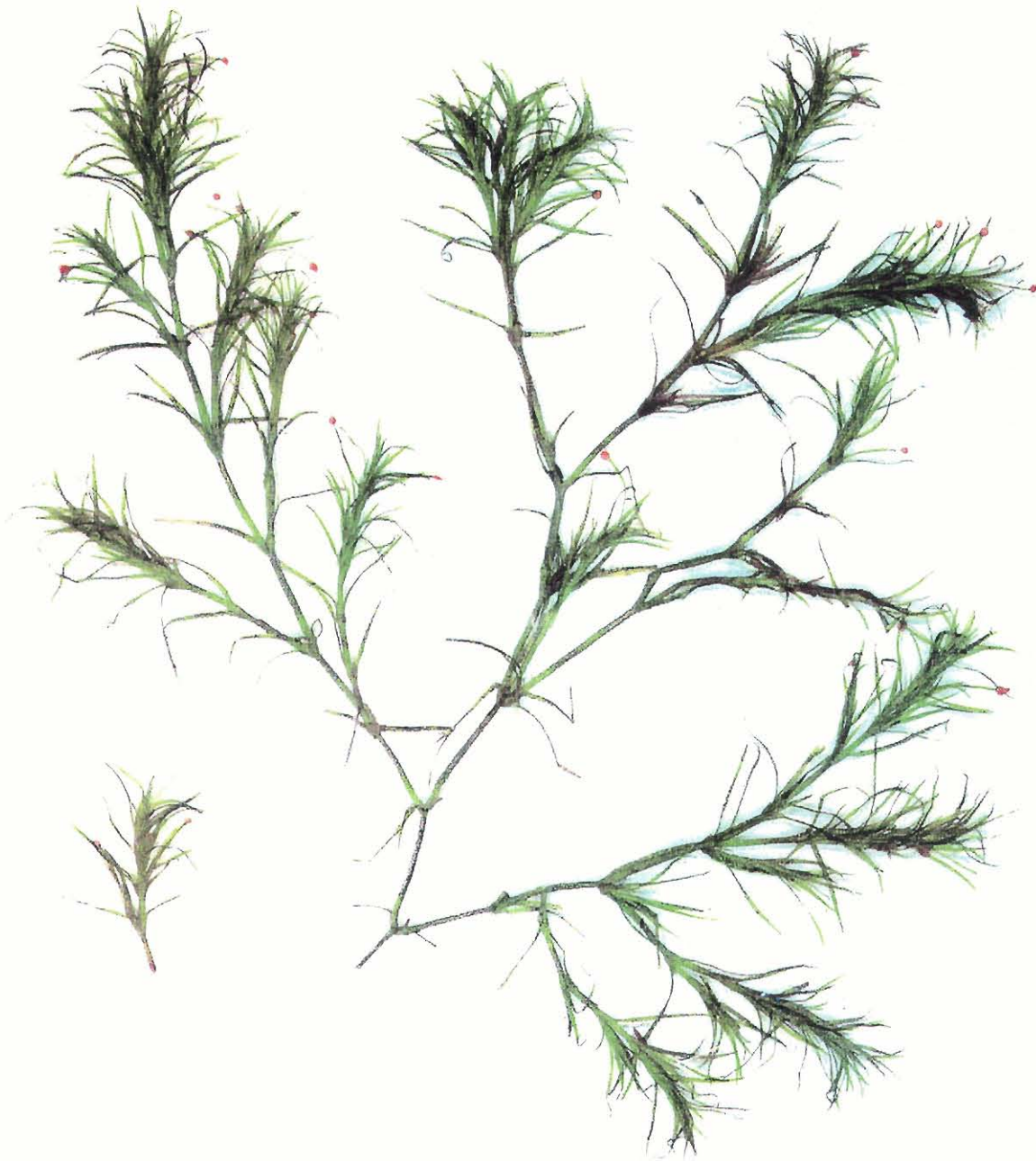
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Appendix B

AQUATIC PLANT ILLUSTRATIONS



Bladderwort (Utricularia sp.)



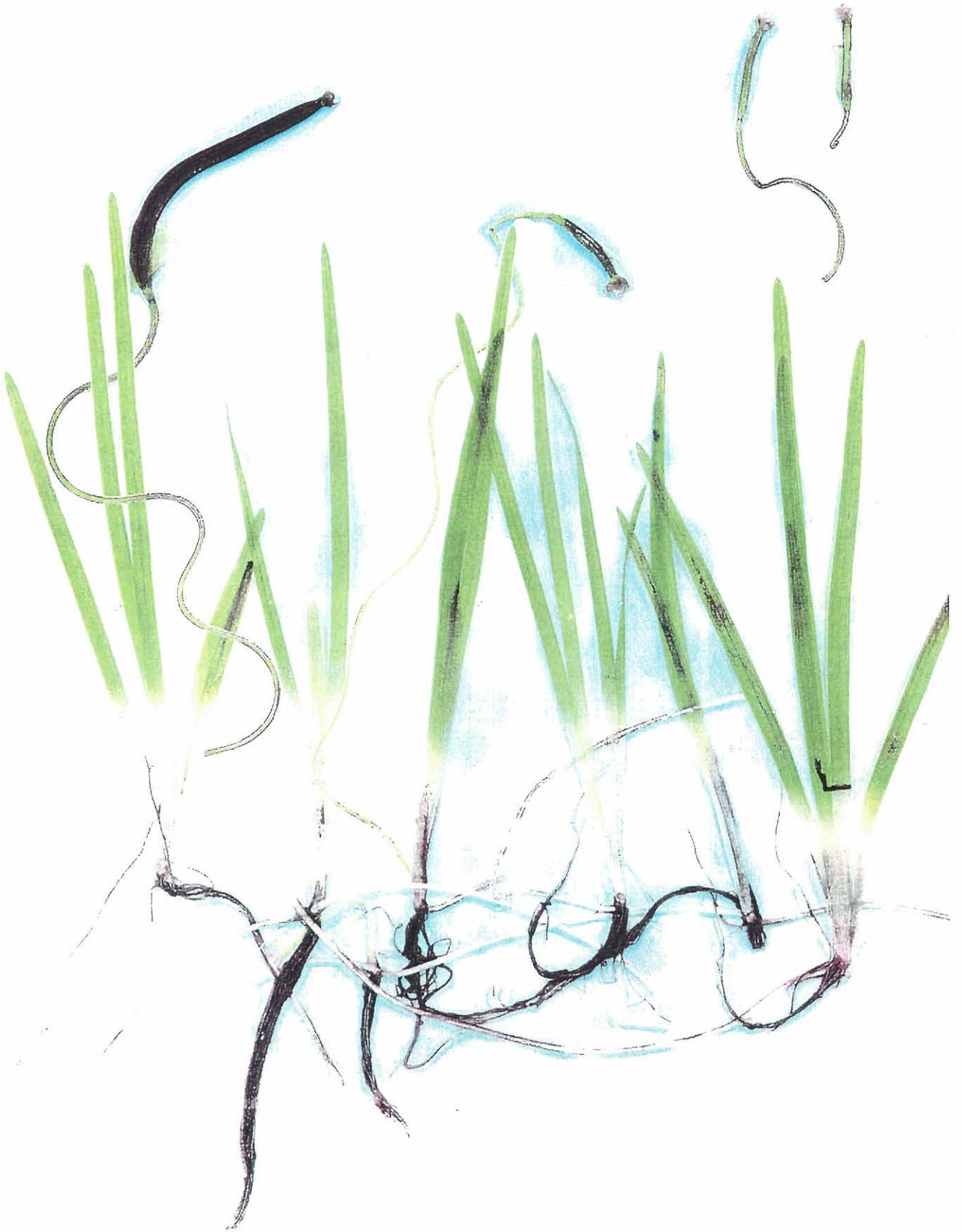
Bushy Pondweed (Najas flexilis)



Coontail (*Ceratophyllum demersum*)



Curly Leaf Pondweed (Potamogeton crispus)



Eel Grass / Wild Celery (Vallisneria americana)



Eurasian Water Milfoil (Myriophyllum spicatum)



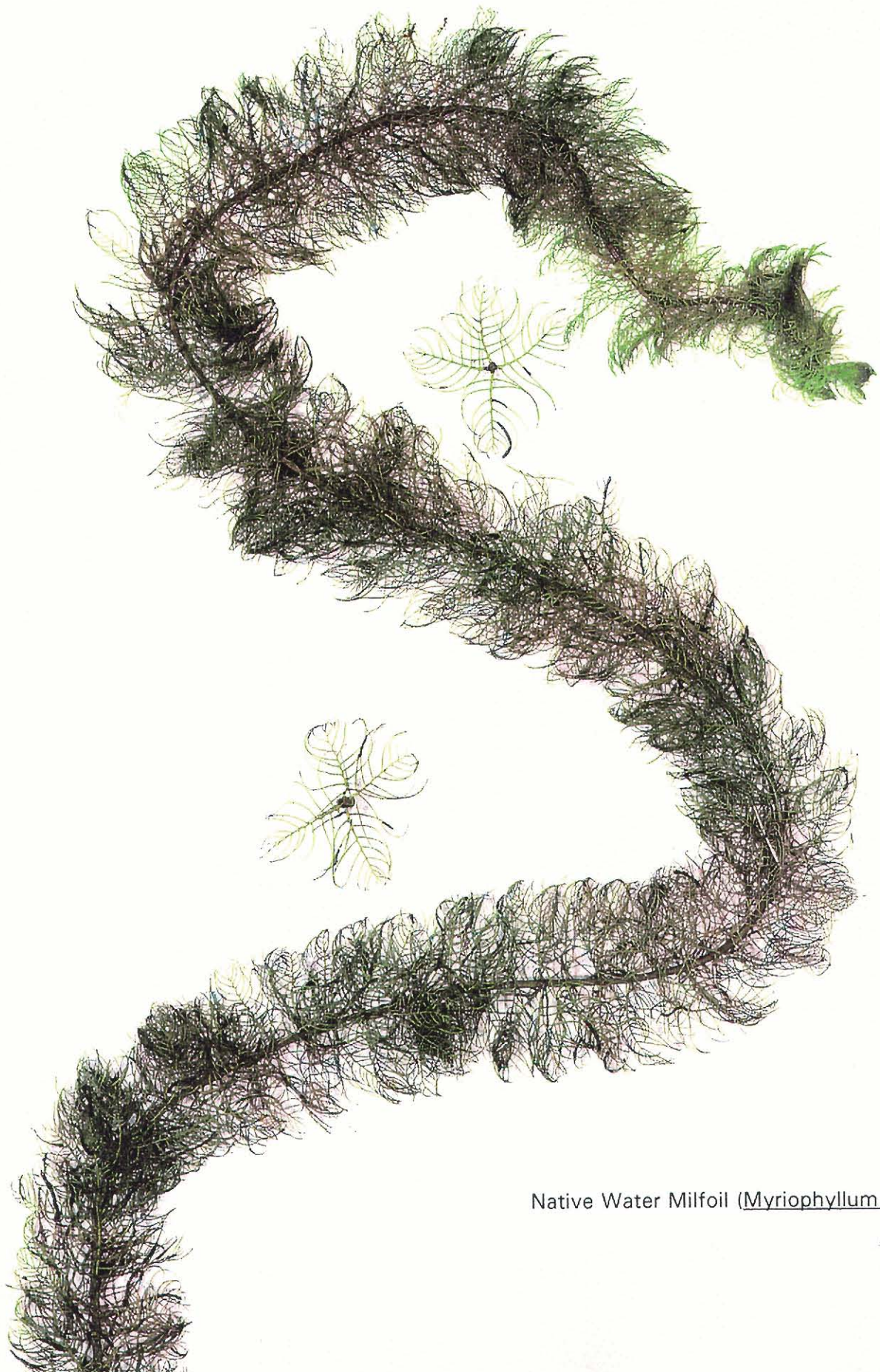
Flat-stem Pondweed (Potamogeton zosteriformis)



Illinois Pondweed (Potamogeton illinoensis)



Muskgrass (Chara vulgaris)



Native Water Milfoil (Myriophyllum sp.)



Sago Pondweed (Potamogeton pectinatus)



Spiney Naiad (Najas marina)



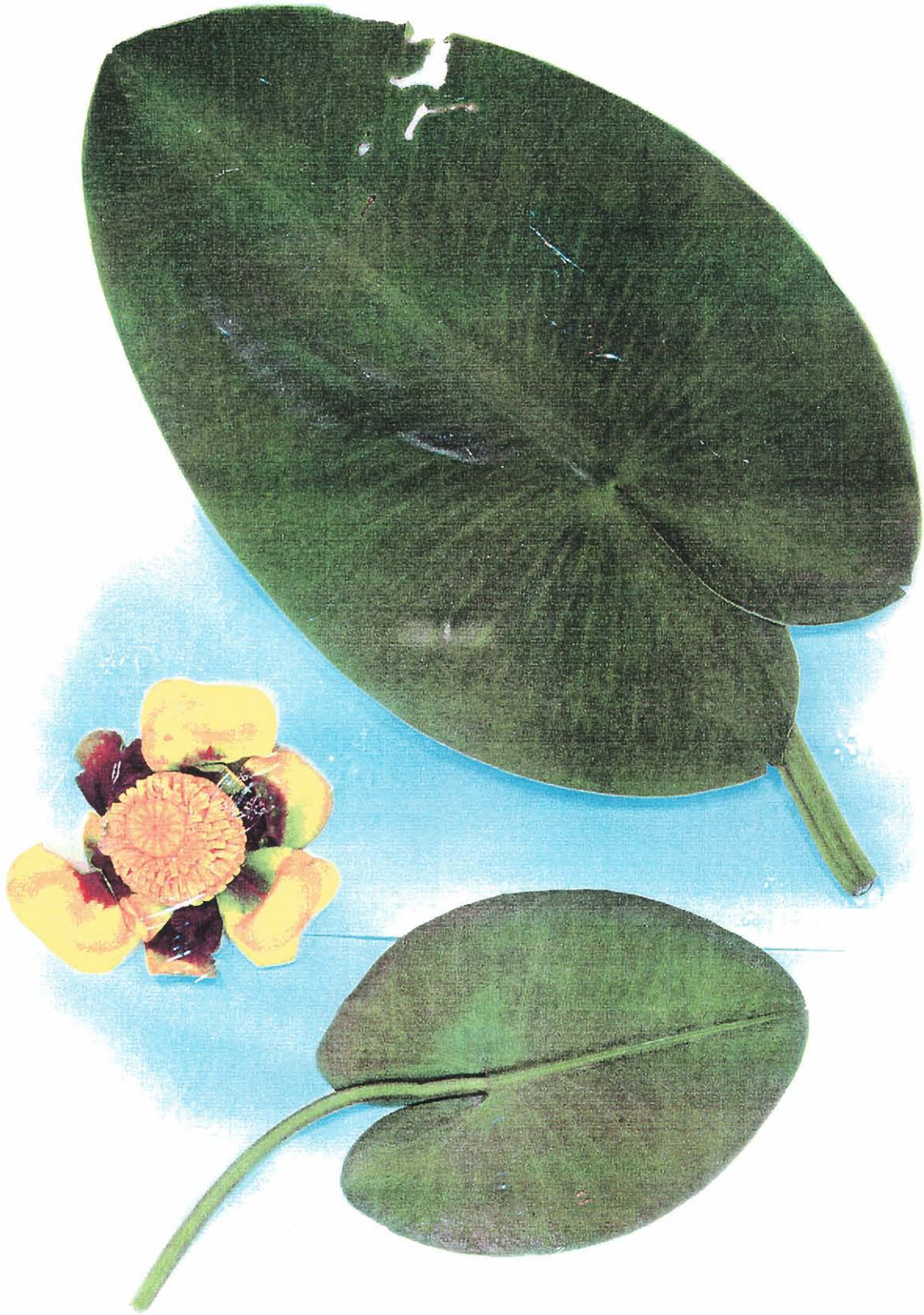
Water Star Grass (*Zosterella dubia*)



Waterweed (Elodea canadensis)



White Water Lilly (Nymphaea tuberosa)



Yellow Water Lilly (Nuphar variegatum)

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Appendix C

CHAPTER 20 OF THE TOWN CODE OF ORDINANCES

CHAPTER 20

WATER USE

20.01	Title/Purpose
20.02	Authority
20.03	Adoption of Ordinance
20.04	Applicability and Enforcement
20.05	State Statutes Adopted
20.06	General Boating Provisions
20.07	Miscellaneous Water Provisions
20.08	Swimming Regulations
20.09	Water Skiing
20.10	Permit for Special Activity
20.11	Pollution/Littering Provisions
20.12	General Artificial Structure in Water Provisions
20.13	Water Safety Patrol, Markers and Navigation Aids
20.14	Repeal of Conflicting Ordinances
20.15	Separability
20.16	Money Deposits
20.17	Penalties

CHAPTER 20
WATER USE ORDINANCE

20.01 Title/Purpose

This ordinance is entitled the "Water Use Ordinance". The purpose of this ordinance relating to the boating and water code is to provide for the public health, safety and general welfare of all people for the enjoyment of aquatic recreation consistent with statutes of the State of Wisconsin and the rights of the public in interest of Powers Lake, Lake Benedict, and Lake Tombeau.

20.02 Authority

The Town Board has the specific statutory authority, powers and duties, pursuant to Chapter 30, (1991-1992) Wis. Stats., the specific sections noted in this ordinance and/or by its adoption of village powers under Sec. 60.10, (1991-1992) Wis. Stats., to regulate, control, license, register or permit persons engaged in certain uses, activities, businesses and operations, to assess these persons with appropriate fees for licenses, registrations or permits as noted herein and to enforce, by revocation or penalty, the provisions of these ordinances and the provisions of the licenses, registrations and permits. These ordinances related to boating, pursuant to Sec. 30.77, (1991-1992) Wis. Stats., must be submitted to the State Department of Natural Resources for advisory review at least sixty (60) days prior to final approval of these ordinances. These ordinances related to boating once adopted, pursuant to Sec. 30.77, (1991-1992) Wis. Stats., must be prominently posted and filed with the State Department of Natural Resources.

20.03 Adoption of Ordinance

The Town Board has, by adoption of this ordinance, confirmed the specific statutory authority, powers and duties noted in the specific sections of this ordinance and has established by these sections and this ordinance license, registration and permit ordinances to regulate and control, by ordinance:

- (1) Persons engaged in certain uses, activities, businesses and operations in the Town,
- (2) To regulate, by these licenses, registrations and permits, the persons engaged in these uses, activities, businesses and operations at certain locations within the Town,
- (3) To assess these persons with appropriate fees for the licenses, registrations or permits, and
- (4) To enforce, by revocation or penalty, the provisions

of these ordinances and the provisions of the license, registration and permits.

20.04 Applicability and Enforcement

(1) The provisions of this ordinance are adopted in the interest of public health and safety and shall apply to persons, boats, watercraft and objects upon, in and under the waters of Powers Lake and Lake Benedict within the jurisdiction of the Townships of Randall, Kenosha County, and Bloomfield, Walworth County, respectively, which are all of the townships having jurisdiction over the waters of said lakes and Lake Tombeau within the jurisdiction of the Town of Bloomfield, Walworth County, Wisconsin.

(2) Any reference in this chapter made to the word "lake" or "water" shall be construed also in the plural and shall apply to all of the lakes and waters within the territorial jurisdiction of the respective municipalities.

(3) The provisions of this chapter shall be enforced by the officers, employees and agents of the municipalities who are authorized to do so and they shall be properly designated as the Water Safety Patrol.

20.05 State Statutes Adopted

(1) Except where more stringent provisions of this chapter apply, the statutory provisions describing and defining regulations with respect to water traffic, boats, watercraft, boating and related activities in the following enumerated sections of the Wisconsin Statutes, exclusive of any provisions therein relating to the penalties to be imposed or the punishment for violation of such statutes, are hereby adopted and by reference made a part of this chapter as if fully set forth herein:

- 30.50 (Definitions)
- 30.501 (Capacity plates on boats)
- 30.51 (Certificate of number and registration; requirements; exemptions)
- 30.52 (Certificate of number and registration; application; certification and registration period; fees; issuance)
- 30.523 (Certification or registration card to be on board; display of stickers or decals and identification number)
- 30.53 (Certificate of origin; requirements; contents)
- 30.531 (Certificate of title; requirements; exemptions)
- 30.533 (Application for certificate of title; hull and engine identification numbers)

- 30.539 (Contents of certificate of title)
- 30.54 (Lost, stolen or mutilated certificates)
- 30.541 (Transfers of boat titles)
- 30.543 (Report of stolen or abandoned boats)
- 30.544 (Inspection of boats purchased out-of-state)
- 30.549 (Transfer of ownership of boats with a certificate of title, certificate of number or registration)
- 30.55 (Notice of abandonment or destruction of boat or change of address)
- 30.60 (Classification of motor boats)
- 30.61 (Lighting equipment)
- 30.62 (Other equipment)
- 30.625 (Rental of personal watercraft)
- 30.63 (Sales and use of certain outboard motors restricted)
- 30.64 (Patrol Boats)
- 30.65 (Traffic rules)
- 30.66 (Speed restrictions)
- 30.67 (Accidents and accident reports)
- 30.675 (Distress signal flag)
- 30.68 (Prohibited operation)
- 30.681 (Intoxicated boating)
- 30.682 (Preliminary breath screening test)
- 30.683 (Implied consent)
- 30.684 (Chemical tests)
- 30.686 (Report arrests to department)
- 30.687 (Officier's action after arrest for violating intoxicated boating law)
- 30.69 (Water skiing)
- 30.70 (Skin diving)
- 30.71 (Boats equipped with toilets)

(2) All rules and orders created by the Department of Natural Resources designated Chapter NR 5 of the Wisconsin Administrative Code, modifying or supplementing the foregoing provisions of the state law or which may be adopted or made in the future are hereby incorporated in and made a part of this ordinance by reference to the same as if they are or were to be set out herein verbatim.

(3) All deletions, additions and amendments which may be made to the sections of the State laws enumerated under subsection 20.05(1) above, are hereby adopted and incorporated herein by reference as of the time of their respective effective dates, as if they were to be set out herein verbatim.

20.06 General Boating Provisions

(1) Capacities

No person shall operate nor shall any owner of a boat or watercraft allow a person to operate a boat or watercraft on the waters where the boat or watercraft leaves its docked location for operation on the waters with passengers in excess of the capacity recommended by the manufacturer of the boat or watercraft.

This section applies to vessels manufactured after January 1, 1966 and prior to November 1, 1972. All vessels manufactured after November 1, 1972, shall comply with appropriate federal regulations.

(2) Horsepower

No person shall operate nor shall any owner of a boat or watercraft allow a person to operate a boat or watercraft on the waters where the boat or watercraft leaves its docked location on the waters for operation on the waters powered by a motor with horsepower in excess of the capacity recommended by the manufacturer of the boat or watercraft.

(3) Traffic Lane

A traffic lane is hereby established on Powers Lake embracing the waters of said lake in its entirety, excepting that area between the shore and a line two hundred (200) feet in distance from and parallel to the shoreline or as posted by navigation aids or identifying buoys. A traffic lane is hereby established on Lake Benedict embracing the waters of said lake in its entirety, excepting that area between the shore and a line one hundred and fifty (150) feet in distance from and parallel to the shoreline or as posted by navigation aids or identifying buoys.

(4) Speed Restriction

(a) No motorboat or watercraft shall be operated within the traffic lane at a speed greater than "slow-no-wake" between the hours of sunset and 10 o'clock a.m..

(b) Outside the traffic lane, no motorboat or watercraft shall be operated at any time at a speed greater than "slow-no-wake".

(c) No person shall operate a motorboat or watercraft on the waters of the lakes at a speed greater than is reasonable and prudent under the

conditions, and having regard for the actual and potential hazards then existing.

(d) Speed Exception

The speed limit set forth in this chapter shall not apply to Water Safety Partol watercraft or other authorized Police Patrol or emergency watercraft in situations involving emergencies, or while engaged in law enforcement, nor to boats participating in a duly authorized race, regatta or water ski meet duly authorized by a permit while operating in the designated area authorized by said permit.

(e) Slow No Wake

1. No watercraft shall be operated at a speed greater than "slow-no-wake" at any time:

a. On Jefferson Bay when the water level of Powers Lake reaches a water elevation level of twenty four (24) inches as determined and calculated in accordance with subparagraph 2., below;

b. On Powers Lake, within 400 feet of the shore, when the water level on Powers Lake reaches a water elevation level of twenty (20) inches as determined and calculated in accordance with subparagraph 2., below.

c. On Lake Tombeau at any time.

2. There is a bench mark "x" chisled square in the center of the east side of the bridge outlet on Powers Lake Road (County Trunk Highway "FF") which is at an assumed elevation of 100.00 according to the records on file with the Wisconsin Department of Natural Resources and specifically as designated on the lake survey map of Powers Lake dated May, 1960, revised July 1967. The water elevation level referred to in subparagraph 1., above shall mean that water elevation level in relation to and measured from the benchmark "x" referred to in this section.

3. When the lake level elevation is at or greater than the water elevation level set forth in subparagraph 1., above, the Town of Randall, in respect to Powers Lake and Lake Benedict, and the Town of Bloomfield, in respect to Lake Tombeau, shall cause a notice to be posted, at

all public access points on the lake or lakes affected thereby stating that the "slow-no-wake" speed restriction is in effect. Notices shall be posted in conspicuous places at all public access points. Such notices shall be removed upon the lowering of the lake elevation level to a point below that in subparagraph 1., above.

4. Slow-No-Wake Defined

In this chapter, "slow-no-wake" means that speed at which a boat or watercraft moves as slowly as possible while still maintaining steering control.

(f) No person may operate a boat at a speed in excess of slow-no-wake within 100 feet of any other boat. A "boat" is defined as every description of watercraft used or capable of being used as a means of transportation on water. (Created 10 Sept 1998)

(5) Mooring Lights

No person shall moor or anchor any boat, watercraft, raft, buoy or other floating object or permit the same to drift in the traffic lane between sunset and sunrise, unless there is prominently displayed a white light of sufficient size and brightness to be visible from any direction for a distance of two (2) miles on a dark night with clear atmosphere. This provision shall not apply to authorized structures within the pierhead line nor to boats, watercraft or objects moored or anchored in mooring areas approved by the Town Board when the entire area is marked by lights or other markers.

(6) Mooring and Anchoring of Watercraft (Recreated 8 July 1999)

(a) No person shall operate or cause, allow or permit any person to operate a boat or watercraft on the waters where the boat or watercraft is moored or anchored at any private or public beach, park, landing, pier, raft or wharf without approval of the owner of the beach, park, landing, pier, raft or wharf. No watercraft or boat shall be moored or anchored at any private or public beach, park, landing, pier, raft, wharf or other location other than the landings, piers or wharves designated by the Town Board as public boat landing areas. This provision shall not apply in an emergency situation

where the public health and public safety of persons on the boat or watercraft is in jeopardy.

(b) No person may moor or anchor or stop a boat or watercraft at or in or along any Town owned pier unless said person is the Lessee. This provision shall not apply in an emergency situation where the public health and public safety of persons on the boat or watercraft is in jeopardy.

(7) Unnecessary Horns and Whistles

No person shall cause, allow or permit any person to unnecessarily sound a horn, whistle or other sound-producing device on any boat or watercraft while at anchor or underway on the waters. The use of any siren on any boat or watercraft on the water, except duly authorized Water Safety Patrol watercraft or other authorized Police Patrol watercraft on patrol or on duty is prohibited.

(8) Circuitous Operation

No person shall operate repeatedly a motorboat on the waters in a circuitous course around any boat, watercraft or around any person swimming if such circuitous course is within two hundred (200) feet of such boat or watercraft or swimmer; nor shall any person or waterskier operate or approach closer than one hundred (100) feet to any skindiver's flag or any swimmer unless the boat or watercraft is part of the skindiving operation or is accompanying the swimmer or unless other conditions make compliance impossible.

(9) Public Landings

The anchoring or mooring of any boat or watercraft in the waters within fifteen (15) feet of a public landing is prohibited except that boats may be tied to piers within such public landing areas upon approval of the Town Board.

(10) Swimming Areas

No person shall operate or cause, allow or permit any person to operate any boat or watercraft on the water marked by buoys or otherwise reserved and designated by the Town Board as areas for persons to swim.

(11) Secure Anchoring

No person shall anchor or cause, allow or permit any person to anchor any boat or watercraft on the water without

causing such boat or watercraft to be at all times tied, secured and anchored with proper care and with proper equipment and in a manner to prevent the boat or watercraft from escaping moor or anchor.

20.07 Miscellaneous Water Provisions

(1) Molesting or Destroying Aids to Navigation and Regulatory Markers

No person shall cause, allow or permit any person to move, remove, molest, tamper with, destroy, moor or fasten a boat or watercraft (except to mooring buoys) to any navigation aids or regulatory markers, signs or other devices established and maintained to aid boaters on the waters.

(2) Obstructions to Navigation

No person shall cause, allow or permit any person:

(a) To unlawfully obstruct any navigable waters and thereby impair the free navigation on the waters.

(b) To unlawfully place in navigable waters any substance that may float into and obstruct any such waters or impede the free navigation on the waters.

(c) To construct or maintain in navigable waters any boom not authorized by law.

(d) To obstruct or interfere, by a watercraft or float, with free navigation of any river, canal, water channel or slip within the waters.

(3) Parasailing and Paragliding

No person shall engage in the activity known as parasailing or paragliding except as a special activity for which a permit has been obtained.

(4) Shooting of Projectiles Prohibited

No person by use of a contrivance or device, or otherwise in any manner, shall throw, propel, send forth or shoot any missile, projectile or object toward or in the direction of a person, boat, watercraft or other property.

(5) Ice Racing

No person shall conduct or participate in a race,

rally, endurance contest or other competitive event involving the use of any motor driven device, which shall include, but not be limited to, automobiles, motorcycles, minibikes and snowmobiles, upon the ice covering the surface of Powers Lake, Lake Benedict and Lake Tombeau, which lakes are located in the Towns of Randall and Bloomfield except as a special activity for which a permit has been obtained.

(6) Driving Automobiles or other Motor-driven Vehicle on the Ice

(a) No person shall use or operate any automobile or other motor-driven vehicle in any manner so as to endanger persons engaged in skating or in any other winter sport or recreational activity upon the ice, nor shall any person, while using or operating an automobile or motor-driven vehicle, tow, pull or push any person or persons on skates, sled, skis, toboggan, or device or thing of any kind designed or utilized to carry or support one or more persons.

(b) No person shall use or operate any automobile at a speed in excess of twenty (20) miles per hour on the ice.

(c) No person shall operate any aerodynamic propeller-driven vehicle, device or thing, whether or not designed for the transportation of a person or persons, on the ice of the waters.

(d) "Automobile" as used in this chapter shall be construed to mean all motor vehicles of the type and kind permitted to be operated on the highways in the State as defined in Sec. 340.01(4) and 340.01(35) (1991-1992) Wis. Stats.

(e) All traffic on the ice bound waters of the lakes shall be at the risk of the traveler as set forth in Sec. 30.81(3) (1991-1992), Wis. Stats.

(7) Dilapidated Structures

No person shall cause, allow or permit any person to maintain any dilapidated structure or building near the shores of the waters wherein such structure, due to its condition and proximity to shore, may be washed into the waters and which may hinder, obstruct or destroy navigation by boats or other watercraft in the waters. For purposes of this section, "near the shores" shall mean within twenty (20) feet from the shoreline (ordinary highwater mark) of the waters.

(8) Lakeside Park (Created 8 July 1999)

(a) No watercraft or boat is allowed to be placed or located at or on the shoreline of Powers Lake or on the waters of Powers Lake as located between Lakeside Park and the Town of Randall owned piers, except as provided in (b) below. The shoreline is defined as the intersection of the land surface abutting the water mark. The waters of Powers Lake is defined as that area of water located between the beach/swim area of Lakeside Park and the Town of Randall owned piers.

(b) No watercraft or boats, except rubber rafts under six (6) feet in length may be placed on the land surface of Lakeside Park.

20.08 Swimming Regulations(1) Competent Persons; Personal Flotation Devices; Distances from Boat

No operator of a boat or watercraft or any person within the boat or watercraft shall cause, allow or permit any person to swim, float, snorkel or engage in other swimming operations on the waters from any boat or watercraft on the waters except if the boat or watercraft is properly anchored and then only if the person remains within fifty (50) feet of the boat or watercraft during the swimming, floating, snorkeling or other swimming operations. Said boat or watercraft shall be manned by a competent person. In addition, no person shall cause, allow or permit any person to swim, float, snorkel or engage in other swimming operations on the waters from any boat or watercraft unless the boat or watercraft is fully equipped with the proper amount and type of U.S. Coast Guard approved personal flotation equipment or devices to be used in water rescue emergency.

Exception: A person is permitted to swim in the traffic lane on the waters if the person is accompanied by a competent person in the boat or watercraft and swims within twenty five (25) feet of said boat or watercraft.

(2) Distances Allowed when Swimming

No person shall swim on Powers Lake more than one hundred (100) feet from the shore or more than fifty (50) feet from any pier, raft or wharf, unless within marked authorized areas. No person shall swim on Lake Benedict more than one hundred (100) feet from the shoreline inclusive of any pier, raft, or wharf, unless within marked authorized areas.

(3) Time of Day for Swimming

No person shall swim in the water traffic lane between sunset and sunrise.

(4) Scuba Diving

No person shall be engaged in scuba diving activities unless that person is certified or is under the direct supervision of a certified scuba diver. This section shall not apply to rescue, emergencies, or enforcement activities.

20.09 Water Skiing(1) Operators and Observers; Towlines

No person shall operate or cause, allow or permit any person to operate a boat or watercraft on the waters for the purpose of towing a person or persons on waterskis, aquaplanes or similar water recreation devices unless there are at least two (2) persons present in the boat or watercraft at the time of the towing operation, with one (1) person to operate the boat or watercraft and with one (1) competent person to observe the towed person. In addition, no person shall permit himself or herself to be towed by a boat or watercraft unless there are at least two (2) persons in the boat or watercraft at the time of the towing operation with one (1) person to operate the boat or watercraft and with one (1) competent person to observe the towed person.

(2) Prohibition as to Time of Day

No person shall operate a boat or watercraft for the purpose of towing a water skier or engage in water skiing between the hours of sunset and 10:00 a.m..

(3) Towlines and Personal Flotation Devices

No person shall operate a boat or watercraft with more than two (2) tow lines or allow more than one (1) person per tow line as a means of waterskiing or similar sport. An exception is allowed for two (2) person on one tow line while on devices designed for two person to be towed by a boat or watercraft. The persons being towed shall wear U. S. Coast Guard approved personal flotation devices, either of Type I, Type II, Type III or Type V while being towed.

(4) Direction of Travel

No operator of a boat or watercraft and no person

shall engage in water skiing, aquaplaning, or similar sport or activity outside of the traffic lane as defined in this Ordinance, and said persons must operate in a counterclockwise pattern in the traffic lane, as well as conform to all sections of this Ordinance. A counterclockwise direction is determined by viewing the direction of the boat or watercraft as that direction as viewed from a bird's-eye view of the entire lake.

(5) Length of Tow Rope

No person shall use any tow rope of more than one hundred (100) feet for purposes of water-skiing, aquaplaning, or similar activity. No operator of a boat or watercraft shall cause, allow or permit any person to be towed when the towed person is using a tow rope of more than one hundred (100) feet.

(6) Conformity

The operators of all boats or watercraft by means of which water skis, surfboards, aquaplanes or similar objects are being towed, and the riders of such objects, must conform to the same rules and clearances as provided in this chapter for motorboats or watercraft.

(7) Careful and Prudent Operation of Person Towed

No person shall waterski, aquaplane or engage in other similar water recreation operations on the waters in such an improper, careless, negligent or willful and wanton manner that in any way may endanger the health or safety of persons or property.

(8) Careful and Prudent Operation by Operator

No person shall operate or cause, allow or permit any person to operate a motorboat or watercraft on the waters having in tow a person on waterskis, aquaplane or similar water recreation device unless the person is operating the boat or watercraft in a careful and prudent manner and at a reasonable distance from person and property so as not to endanger the life or property of any person.

(9) Exceptions

The limitations of this section shall not apply to participants in ski meets or exhibitions authorized and conducted as provided in Section 20.10.

20.10 Permit for Special Activity

(1) Required Permits

No person shall conduct or participate in any motorboat race, motorboat regatta, water-ski meet, sailboat race, sailboat regatta or other water sporting event or exhibition unless such event has been authorized by the Town Board or their authorized agent and a permit issued.

(2) Issuance of Permits

A permit issued under this section shall specify the course or area of water to be used by participants in such event. Permits shall be issued only when, in the opinion of the respective Town Boards or their authorized agents, the proposed use of the water can be carried out safely and without danger to or substantial obstruction of other watercraft or persons using the lake. Permits shall be valid only for the day or days and hours and areas specified thereon.

(3) Rights of Participants

Watercraft and participants in any such permitted event shall have the right-of-way in the marked area.

20.11 Pollution/Littering Provisions(1) Solid Waste Pollution

No person shall cause, allow or permit any person to discharge any solid waste or any other waste in any waters, on the ice of any waters or upon other public or private property adjacent to waterways. This provision does not apply to a person who deposits or discharges solid waste or any other waste in conformance with Chapters 30, 31, 144, and 147, (1991-1992) Wis. Stats., or has a permit, license or other approval by the State Department of Natural Resources under these chapters.

(2) Motor Vehicles and Watercraft Abandonment

Any person who has placed or who has cause, allowed or permitted any person to place any motor vehicle, boat, watercraft or other vehicle into the waters shall remove said motor vehicle, boat, watercraft or other vehicle from the waters within ten (10) days of the discharge, deposit, placement or abandonment of the motor vehicle, boat, watercraft or other vehicle into the waters.

(3) Solid Waste Discharge from Watercraft

No person shall cause, allow or permit any person to

deposit or discharge any solid waste or any other waste from any boat or watercraft into the waters, nor shall any person operating any boat or watercraft cause, allow or permit any such deposit or discharge into the waters.

(4) Solid Waste from Adjoining Land

No person shall cause, allow or permit any person to deposit or discharge or allow any such deposit or discharge of any solid waste or any other waste on land owned or occupied by that person wherein such solid waste or other waste will naturally flow or will, by aid of an artificial structure, flow into the waters or onto the ice of the waters.

(5) Overboard Discharge Inactivation

No boat or watercraft equipped with a means of discharging sewage directly from a toilet or holding tank into the water upon which the boat or watercraft is moored or is moved shall enter the lake until such means of discharge is inactivated. An owner or operator of a boat equipped with such means of discharge shall contact a representative of the Department of Natural Resources or a local law enforcement official with respect to inactivation before entering the lake. Overboard discharge inactivation shall include as a minimum either disconnection of the toilet piping, removal of the pumping device, securely plugging the discharge outlet, sealing the toilet bowl, with wax or other method approved by the official contacted. The inspecting official shall provide the boat or watercraft owner or operator with a signed written statement as to the method of inactivation accepted. The owner or operator shall give information as to the lake he or she plans to navigate and as to the time of stay on such waters. (Pursuant to Wisconsin Administrative Code Provisions, Ch. ILHR 86.07.)

(6) Sanitation

No person shall deposit, place or throw away from the shore, boat, watercraft, raft, pier or platform or similar structure any cans, bottles, debris, refuse, garbage, solid or liquid waste, sewage or effluent into the waters of the lake or upon the ice when formed, or cause or permit the same to be done by any agent or employee.

20.12 General Artificial Structure in Water Provisions

(1) Regulation of Artificial Structures, Rafts, Buoys, Platforms

No person shall cause, allow or permit any person to maintain rafts, buoys, platforms or any other artificial structure (other than a wharf or pier) in or upon waters of the lake of the Town without first obtaining a written permit from the Town Board or its agent having jurisdiction over the lake. This provision does not apply to those structures regulated by the Department of Natural Resources under Chapter 30, (1991-1992) Wis. Stats.

(a) Any person required to seek and obtain a permit under these provisions shall file an application with the Town Clerk. The application shall request, at minimum, the following information from the applicant:

1. The name of the applicant
2. The address of the applicant
3. The business and residential telephone number of the applicant
4. The age of the applicant
5. The type of proposed structure
6. The location of the proposed structure
7. The projected commencement and termination dates of the construction of the project
8. The design and dimension of the project with attached maps and diagrams, including the type and amount of construction material to be used. Such maps and diagrams shall include a scale drawing indicating the survey stakes nearest the lake, if possible, and the distances from such stakes to the proposed structure.
9. The height of the project above and below the water line
10. The width of the project
11. The permanency of the structure, including projected time period for removal, if any
12. The purpose and uses of the structure, including estimated number of persons to use the structure at any one time
13. The type and nature of the anchorage of the structure
14. The safety equipment to be used in the structure, if any

(b) The Town Board shall consider the following items in reaching its written determination and in reaching its decision to issue a permit, issue a permit upon conditions or deny the permit:

1. The interference with the public right to navigate in navigable waters
2. The interference with the riparian rights of other riparian proprietors
3. If a mooring buoy is involved:
 - a. The mooring buoy, on Powers Lake shall not be more than one hundred and fifty (150) feet from the shoreline (ordinary high water mark) and the mooring buoy, on Lake Benedict shall not be more than one hundred (100) feet from the shoreline (ordinary high water mark).
 - b. Such buoys shall be all white with a blue stripe midway between the top and the water-line. They will be spherical or ovate in shape with a minimum of eighteen (18) inches above the water-line.
 - c. There shall be only one mooring permit issued for the lake frontage of the riparian owner unless a variance is requested and subsequently granted by the Town Board.
 - d. There shall be no more than one boat or watercraft attached to a single mooring.
 - e. The mooring lines or chains shall not exceed in length more than three (3) times the depth of the water in which the boat or watercraft is moored.
4. Whether there will be interference with other property, marked swimming areas, structures, piers, ramps, docks or wharves.
5. If a raft or platform is involved:
 - a. The structure shall be so anchored so that at least twelve (12) inches of freeboard extends above the water line.
 - b. The structure shall be painted white or kept its original color if made of reflective aluminum. If not of either above mentioned configuration then a red reflector of not less than three (3) inches in

diameter shall be attached thereto no more than twelve (12) inches from each corner or projection.

c. The structure shall be placed within the lot lines of the riparian owner.

d. The structure shall no be greater than one hundred (100) from the shoreline (ordinary highwater mark).

6. The Town Board within fifteen (15) days of receipt of the application for permit shall:

a. Review the application for permit

b. Personally inspect the subject premises or request the designee of the Town Board to inspect the premises if deemed an inspection is necessary

7. The Town Board within thirty (30) days of the receipt of the application for permit shall:

a. Provide a written determination whether the proposed structure or structures will be detrimental to the public health or safety, will constitute an unreasonable obstruction or interference of the waters or will cause injury to persons or damage to property

b. Issue the permit, issue the permit upon conditions or deny the permit

c. The permit, if issued by the Town Board, may be revoked or suspended by the Town Board at anytime for cause after a public hearing. The permittee shall be given ten (10) days written notice of the hearing.

d. Permits under this section shall be issued for a term, unless specifically otherwise noted in the permit, of three (3) years from the date of issuance and shall automatically renew from year to year unless revoked for cause as outlined in subsection c. above.

(2) Regulation of Wharves and Piers

No person shall cause, allow or permit any person to construct, place, extend or maintain any wharf or pier in

the waters in the Town without first obtaining a written permit from the Town Board or its agent having jurisdiction over the lake. This provision does not apply to those piers or wharves regulated by the Department of Natural Resources under Chapter 30, (1989-1990) Wis. Stats.

(a) Any person required to seek and obtain a permit under these provisions shall file an application with the Town Clerk. The application shall request, at minimum, the following information from the applicant:

1. The name of the applicant
2. The address of the applicant
3. The business and residential telephone number of the applicant
4. The age of the applicant
5. The tax parcel number of the property
6. The location of the proposed pier or wharf
7. The design and dimension of the project with attached maps and diagrams, including the type and amount of construction material to be used. Such maps and drawings shall include a scale drawing indicating the survey stakes nearest the lake, if possible, and the distances from such stakes to the proposed structure.
8. The height of the project above the water line
9. The estimated number of persons to use the pier or wharf at any one time
10. The type and nature of the anchorage of the structure
11. The safety equipment to be used in the structure, if any

(b) The Town Board shall consider the following items in reaching its written determination and in reaching its decision to issue a permit, issue a permit upon conditions or deny the permit:

1. The interference with the public right to navigate in navigable waters
2. The interference with the riparian rights of other riparian proprietors
3. The structure shall extent not more than one hundred (100) feet from the shoreline (ordinary highwater mark) unless the person has a permit

issued by the Department of Natural Resources under Sec. 30.12, (1989-1990) Wis. Stats.

4. The structure shall not interfere with the free movement of water underneath the pier or wharf
5. The structure shall be placed within the lot lines of the riparian owner.
6. Whether the structure will create a public nuisance.

(c) The Town Board within fifteen (15) days of receipt of the application for permit shall:

1. Review the application for permit
2. Personally inspect the subject premises or request the Building Inspector of the Town to inspect the premises if deemed an inspection is necessary

(d) The Town Board within thirty (30) days of the receipt of the application for permit shall:

1. Provide a written determination whether the proposed structure or structures will be detrimental to the public health or safety, will constitute an unreasonable obstruction or interference of the waters or will cause injury to persons or damage to property
2. Issue the permit, issue the permit upon conditions or deny the permit
3. The permit, if issued by the Town Board, may be revoked or suspended by the Town Board at anytime for cause after a public hearing. The permittee and also the neighboring owners of abutting riparian lands shall be given ten (10) days written notice of the hearing.
4. Permits under this section shall be issued for a term, unless specifically otherwise noted in the permit, of three (3) years from the date of issuance and shall automatically renew from year to year thereafter unless revoked for cause as outlined in subsection 3. above.

(3) Location of Wharves, Piers, Swimming Rafts and Structures Attached Thereto

(a) No wharf, pier, swimming raft, or any structure attached thereto, shall be located, built, constructed or maintained on a lot or parcel within a distance of twelve and one-half (12-1/2) feet from a riparian proprietor's property line where such property line intersects the shoreline, nor shall the above be located, built, constructed or maintained within a distance of twelve and one-half (12-1/2) feet from a riparian proprietor's property line, as extended waterward from the shoreline. This restriction shall not apply to permissible preexisting wharves, piers, swimming rafts and structures attached thereto pursuant to the provisions in paragraph (3)(c) below.

(b) The provisions of Chapter NR 326 of the Wisconsin Administrative Code as amended from time to time shall apply in establishing the riparian proprietor's property line as extended waterward from the shoreline.

(c) A wharf, pier, swimming raft or structure attached thereto is a permissible preexisting wharf, pier, swimming raft or structure attached thereto, if it existed prior to January 1, 1993, if it is not extended or expanded after that date, and if the ownership of the land to which it is attached did not change after that date, except that a wharf, pier, swimming raft or structure attached thereto continues its status as a permissible preexisting wharf, pier, swimming raft or structure attached thereto for one year after the date of the change of ownership is recorded. The seasonal removal of a wharf, pier, swimming raft or structure attached thereto does not affect its status as a permissible preexisting wharf, pier, swimming raft or structure attached thereto if it is reestablished in substantially the same form. The owner of a wharf, pier, swimming raft or structure attached thereto may submit evidence to the Town Board that it is a permissible preexisting wharf, pier, swimming raft or structure attached thereto at any time after the effective date of this ordinance.

(4) Fire Lane Obstructed

No pier, wharf, raft, platform, mooring buoy, vehicle or other structure shall be placed in the waters located

within the boundary of a designated fire lane unless so approved by the Town Board.

(5) Removal of Piers and Shore Stations

All piers, their supports and all shore stations shall either be completely removed from the water by December 1st of each year, or allowed to remain completely intact in the water through the winter months. If left in the water after December 1st, the pier or shore station shall be marked by readily visible red reflective flags, spaced at intervals of not less than ten (10) feet, at a height of at least thirty (30) inches above the deck in such a manner as to give a warning to other users of the Lake. All buoys shall be removed from the water by December 1st of each year. Any pier, shore station or buoy removed from the water pursuant to this section may be replaced in the next year after the ice is out of the waters.

(6) Interference with Public Rights

No person shall cause, allow or permit any person to construct or maintain any wharf, pier, beach, mooring or any other structure in the waters which interferes with the public right to navigate in navigable waters unless the person has a permit issued by the Department of Natural Resources under Sec. 30.12, (1991-1992) Wis. Stats.

(7) Interference with Riparian Rights

No person shall cause, allow, or permit any person to construct or maintain a wharf, pier, beach, mooring or any other structure which interferes with the riparian rights of other riparian proprietors on waters unless the person has a permit issued by the Department of Natural Resources under Sec. 30.12, (1989-1990) Wis. Stats.

(8) Removal of wharves and Piers in Navigable Waters

No person shall cause, allow or permit any person to maintain any wharf or pier in the waters if the wharf or pier is so old, dilapidated or is in such need of repair that it is dangerous, unsafe or unfit for use by the public. The Town Board may proceed under Sec. 66.0495, (1991-1992) Wis. Stats., or may proceed under Chapter 823, (1991-1992) Wis. Stats.

20.13 Water Safety Patrol, Markers and Navigation Aids

(1) Duty of Chief of Water Safety Patrol (Recreated 8 July 1999)

(a) The Chief of Water Safety Patrol is authorized and directed to place and maintain suitable regulatory markers, navigation aids and signs, and waterway markers in such areas of the lake as shall be necessary under this ordinance, state law and state administrative code provisions, and to advise the public of the provisions of this ordinance and such state law and state administrative code provisions, and he or she shall post and maintain a copy of this ordinance at all public access points to the lake within the jurisdiction of the Town Board.

(b) Water Safety Patrol watercraft and authorized personnel of the Water Safety Patrol when on duty, are exempt from provision of this instant chapter when said watercraft and personnel are used and employed in the lawful execution of their duties and responsibilities during the enforcement of this instant chapter.

(2) Standard Markers

All buoys, regulatory markers, aids to navigation or waterway markers shall conform to requirements of NR 5.09 Wisconsin Administrative Code and shall have affixed thereto such numbers as are assigned to them by the chief of the Water Safety Patrol; such numbers are to be located at least twelve (12) inches above the waterline.

(3) Interference with Markers

No person shall, without authority, remove, damage or destroy or moor or attach any watercraft to any buoy, beacon or marker placed in the waters of the lake by the authority of the United States, the State, municipality or by any private person pursuant to the provisions of this chapter.

20.14 Repeal of Conflicting Ordinances

Any ordinance conflicting with the provisions of this ordinance or any part thereof is hereby repealed.

20.15 Separability

If any section, subsection, sentence, clause, phrase or portion of this ordinance is for any reason held to be invalid or unconstitutional, by reason of any decision of any court of competent jurisdiction, such decision shall not affect the

validity of any other section, subsection, sentence, clause, or phrase or portion thereof. The Town Board hereby adopting this ordinance declares that they would have passed this ordinance and each section, subsection, sentence, clause, phrase or portion thereof irrespective of the fact that any one or more sections, subsections, sentences, clauses, phrases or portions thereof may be declared invalid or unconstitutional.

20.16 Money Deposits

(1) If a person is cited or arrested, the person may deposit the amount of money the enforcing officer directs by mailing the deposit and a copy of the citation to the office of the municipal court having jurisdiction or by going to the municipal court or the office of the Water Safety Patrol.

(2) The person receiving the deposit shall prepare a receipt in triplicate showing the purpose for which the deposit is made, stating that the defendant may inquire at the office of the municipal court regarding the disposition of the deposit and notifying the defendant that if he or she fails to appear in court at the time fixed in the citation, he or she will be deemed to have tendered a plea of no contest and submitted to a forfeiture and a penalty assessment plus costs not to exceed the amount of the deposit which the court may accept. The original of the receipt shall be delivered to the defendant in person or by mail. If the defendant pays by check, the check shall be considered a receipt.

(3) If the court does not accept the deposit as a forfeiture for the offense, a summons shall be issued. If the defendant fails to respond to the summons, an arrest warrant shall be issued.

20.17 Penalties

(1) The statutory provisions set forth in Sec. 30.80, (1991-1992) Wis. Stats., describing and defining penalties with respect to violations of the provisions of Sections 30.50 through 30.71, (1991-1992) Wis. Stats., as adopted by subsection 20.05(1) of this ordinance, are hereby adopted and by reference made a part of this chapter as if fully set forth herein.

(2) Any person who shall violate any provisions of this ordinance set forth in sections 20.01 through 20.13, inclusive, except as specified in paragraphs 20.17(1) of this subsection, shall, upon conviction thereof, forfeit not

20.17(2) (Cont)

more than Fifty Dollars (\$50.00) for the first offense and not more than One Hundred Dollars (\$100.00) upon the conviction of the same offense a second and subsequent time within one (1) year.

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Appendix D

NONPOINT SOURCE POLLUTION CONTROL MEASURES

Nonpoint, or diffuse, sources of water pollution include urban sources such as runoff from residential, commercial, industrial, transportation, and recreational land uses; construction activities; and onsite sewage disposal systems and rural sources such as runoff from cropland, pasture, and woodland, atmospheric contributions, and livestock wastes. These sources of pollutants discharge to surface waters by direct overland drainage, by drainage through natural channels, by drainage through engineered stormwater drainage systems, and by deep percolation into the ground and subsequent return flow to the surface waters.

A summary of the methods and estimated effectiveness of nonpoint source water pollution control measures is set forth in Table D-1. These measures have been grouped for planning purposes into two categories: basic practices and additional. Application of the basic practices will have a variable effectiveness in terms of control level of pollution control depending upon the subwatershed area characteristics and the pollutant considered. The additional category of nonpoint source control measures has been subdivided into four subcategories based upon the relative effectiveness and costs of the measures. The first subcategory of practices can be expected to generally result in about a 25 percent reduction in pollutant runoff. The second and third subcategory of practices, when applied in combination with the minimum and additional practices, can be expected to generally result in up to a 75 percent reduction in pollutant runoff, respectively. The fourth subcategory would consist of all of the preceding practices, plus those additional practices that would be required to achieve a reduction in ultimate runoff of more than 75 percent.

Table D-1 sets forth the diffuse source control measures applicable to general land uses and diffuse source activities, along with the estimated maximum level of pollution reduction which may be expected upon implementation of the applicable measures. The table also includes information pertaining to the costs of developing the alternatives set forth in this chapter.¹ These various individual nonpoint source control practices are summarized by group in Table D-2.

Of the sets of practices recommended for various levels of diffuse source pollution control presented in Table D-2, not all practices are needed, applicable, or cost-effective for all watersheds, due to variations in pollutant loadings and land use and natural conditions among the watersheds. Therefore, it is recommended that the practices indicated as needed for nonpoint source pollutant control be refined by local level nonpoint source control practices planning, which would be analogous to sewerage facilities planning for point source pollution abatement. A locally prepared plan for nonpoint abatement measures should be better able to blend knowledge of current problems and practices with a quickly evolving technology to achieve a suitable, site-specific approach to pollution abatement.

¹Costs are presented in more detail in the following SEWRPC Technical Reports: No. 18, State of the Art of Water Pollution Control in Southeastern Wisconsin, Volume Three, Urban Storm Water Runoff, July 1977, and Volume Four, Rural Storm Water Runoff, December 1976; and No. 31, Costs of Urban Nonpoint Source Water Pollution Control Measures, June 1991.

Table D-1

**GENERALIZED SUMMARY OF METHODS AND EFFECTIVENESS
OF NONPOINT SOURCE WATER POLLUTION ABATEMENT**

Applicable Land Use	Control Measures ^a	Summary Description	Approximate Percent Reduction of Released Pollutants ^b	Assumptions for Costing Purposes
Urban	Litter and pet waste control ordinance	Prevent the accumulation of litter and pet wastes on streets and residential, commercial, industrial, and recreational areas	2 to 5	Ordinance administration and enforcement costs are expected to be funded by violation penalties and related revenues
	Improved timing and efficiency of street sweeping, leaf collection and disposal, and catch basin cleaning	Improve the scheduling of these public works activities, modify work habits of personnel, and select equipment to maximize the effectiveness of these existing pollution control measures	2 to 5	No significant increase in current expenditures is expected
	Management of onsite sewage treatment systems	Regulate septic system installation, monitoring, location, and performance; replace failing systems with new septic systems or alternative treatment facilities; develop alternatives to septic systems; eliminate direct connections to drain tiles or ditches; dispose of septage at sewage treatment facility	10 to 30	Replace one-half of estimated existing failing septic systems with properly located and installed systems and replace one-half with alternative systems, such as mound systems or holding tanks; all existing and proposed onsite sewage treatment systems are assumed to be properly maintained; assume system life of 25 years. The estimated cost of a septic tank system is \$5,000 to \$6,000 and the cost of an alternative system is \$10,000. The annual maintenance cost of a disposal system is \$250. An in-ground pressure system is estimated to cost \$6,000 to \$10,000 with an annual operation and maintenance cost of \$250. A holding tank would cost \$5,500 to \$6,500, with an annual operation and maintenance cost of \$1,800
	Increased street sweeping	On the average, sweep all streets in urban areas an equivalent of once or twice a week with vacuum street sweepers; require parking restrictions to permit access to curb areas; sweep all streets at least eight months per year; sweep commercial and industrial areas with greater frequency than residential areas	30 to 50	Estimate curb-miles based on land use, estimated street acreage, and Commission transportation planning standards; assume one street sweeper can sweep 2,000 curb-miles per year; assume sweeper life of 10 years; assume residential areas swept once weekly, commercial and industrial areas swept twice weekly. The cost of a vacuum street sweeper is approximately \$120,000. The cost of the operation and maintenance of a sweeper is about \$25 per curb-mile swept
	Increased leaf and clippings collection and disposal	Increase the frequency and efficiency of leaf collection procedures in fall; use vacuum cleaners to collect leaves; implement ordinances for leaves, clippings, and other organic debris to be mulched, composted, or bagged for pickup	2 to 5	Assume one equivalent mature tree per residence, plus five trees per acre in recreational areas; 75 pounds of leaves per tree; 20 percent of leaves in urban areas not currently disposed of properly. The cost of the collection of leaves in a vacuum sweeper and disposal is estimated at \$180 to \$200 per ton of leaves
	Increased catch basin cleaning	Increase frequency and efficiency of catch basin cleaning; clean at least twice per year using vacuum cleaners; catch basin installation in new urban development not recommended as a cost-effective practice for water quality improvement	2 to 5	Determine curb-miles for street sweeping; vary percent of urban areas served by catch basins by watershed from Commission inventory data; assume density of 10 catch basins per curb-mile; clean each basin twice annually by vacuum cleaner. The cost of cleaning a catch basin is approximately \$10
	Reduced use of deicing salt	Reduce use of deicing salt on streets; salt only intersections and problem areas; prevent excessive use of sand and other abrasives	Negligible for pollutants addressed in this plan, but helpful for reducing chlorides and associated damage to vegetation	Increased costs, such as for slower transportation movement, are expected to be offset by benefits, such as reduced automobile corrosion and damage to vegetation

Table D-1 (continued)

Applicable Land Use	Control Measures ^a	Summary Description	Approximate Percent Reduction of Released Pollutants ^b	Assumptions for Costing Purposes
Urban (continued)	Improved street maintenance and refuse collection and disposal	Increase street maintenance and repairs; increase provision of trash receptacles in public areas; improve trash collection schedules; increase cleanup of parks and commercial centers	2 to 5	Increase current expenditures by approximately 15 percent
	Parking lot stormwater temporary storage and treatment measures	Construct gravel-filled trenches, sediment basins, or similar measures to store temporarily the runoff from parking lots, rooftops, and other large impervious areas; if treatment is necessary, use a physical-chemical treatment measure, such as screens, dissolved air flotation, or a swirl concentrator	5 to 10	Design gravel-filled trenches for 24-hour, five-year recurrence interval storm; apply to off-street parking acreages. For treatment, assume four-hour detention time. The capital cost of stormwater detention and treatment facilities is estimated at \$40,000 to \$80,000 per acre of parking lot area, with an annual operation and maintenance cost of about \$200 per acre
	Onsite storage—residential	Remove connections to sewer systems; construct onsite stormwater storage measures for subdivisions	5 to 10	Remove roof drains and other connections from sewer system wherever needed; use lawn aeration, if applicable; apply dutch drain storage facilities to 15 percent of residences. The capital cost would approximate \$500 per house, with an annual operation and maintenance cost of about \$25
	Stormwater infiltration—urban	Construct gravel-filled trenches for areas of less than 10 acres or basins to collect and store temporarily stormwater runoff to reduce volume, provide groundwater recharge and augment low stream flows	45 to 90	Design gravel-filled trenches or basins to store the first 0.5 inch of runoff; provide at least a 25-foot grass buffer strip to reduce sediment loadings. The capital cost of stormwater infiltration is estimated at \$12,000 for a six-foot-deep, 10-foot-wide trench, and at \$70,000 for a one-acre basin, with an annual maintenance cost of about \$10 to \$350 for the trench and about \$2,500 for the basin
	Stormwater storage—urban	Store stormwater runoff from urban land in surface storage basins or, where necessary, subsurface storage basins	10 to 35	Design all storage facilities for a 1.5-inch runoff event, which corresponds approximately to a five-year recurrence interval event, with a storm event being defined as a period of precipitation with a minimum antecedent and subsequent dry period of from 12 to 24 hours; apply subsurface storage tanks to intensively developed existing urban areas where suitable open land for surface storage is unavailable; design surface storage basins for proposed new urban land, existing urban land not storm sewered, and existing urban land where adequate open space is available at the storm sewer discharge site. The capital cost for stormwater storage would range from \$35,000 to \$110,000 per acre of basin, with an annual operation and maintenance cost of about \$40 to \$60 per acre
	Stormwater treatment	Provide physical-chemical treatment which includes screens, microstrainers, dissolved air flotation, swirl concentrator, or high-rate filtration, and/or disinfection, which may include chlorination, high-rate disinfection, or ozonation to stormwater following storage	10 to 50	To be applied only in combination with stormwater storage facilities above; general cost estimates for microstrainer treatment and ozonation were used; some costs were applied to existing urban land and proposed new urban development. Stormwater treatment has an estimated capital cost of from \$900 to \$7,000 per acre of tributary drainage area, with an average annual operation and maintenance cost of about \$35 to \$100 per acre

Table D-1 (continued)

Applicable Land Use	Control Measures ^a	Summary Description	Approximate Percent Reduction of Released Pollutants ^b	Assumptions for Costing Purposes
Rural	Conservation practices	Includes such practices as strip cropping, contour plowing, crop rotation, pasture management, critical area protection, grading and terracing, grassed waterways, diversions, woodlot management, fertilization and pesticide management, and chisel tillage	Up to 50	Cost for Natural Resources Conservation Service (NRCS) recommended practices are applied to agricultural and related rural land; the distribution and extent of the various practices were determined from an examination of 56 existing farm plan designs within the Region. The capital cost of conservation practices ranges from \$3,000 to \$5,000 per acre of rural land, with an average annual operation and maintenance cost of from \$5.00 to \$10 per rural acre
	Animal waste control system	Construct streambank fencing and crossovers to prevent access of all livestock to waterways; construct a runoff control system or a manure storage facility, as needed, for major livestock operations; prevent improper applications of manure on frozen ground, near surface drainageways, and on steep slopes; incorporate manure into soil	50 to 75	Cost estimated per animal unit; animal waste storage (liquid and slurry tank for costing purposes) facilities are recommended for all major animal operations within 500 feet of surface water and located in areas identified as having relatively high potential for severe pollution problems. Runoff control systems recommended for all other major animal operations. It is recognized that dry manure stacking facilities are significantly less expensive than liquid and slurry storage tanks and may be adequate waste storage systems in many instances. The estimated capital cost and average operation and maintenance cost of a runoff control system is \$100 per animal unit and \$25 per animal unit, respectively. The capital cost of a liquid and slurry storage facility is about \$1,000 per animal unit, with an annual operation and maintenance cost of about \$75 per unit. An animal unit is the weight equivalent of a 1,000-pound cow
	Base-of-slope detention storage	Store runoff from agricultural land to allow solids to settle out and reduce peak runoff rates. Berms could be constructed parallel to streams	50 to 75	Construct a low earthen berm at the base of agricultural fields, along the edge of a floodplain, wetland, or other sensitive area, design for 24-hour, 10-year recurrence interval storm; berm height about four feet. Apply where needed in addition to basic conservation practices; repair berm every 10 years and remove sediment and spread on land. The estimated capital cost of base-of-slope detention storage would be \$500 per tributary acre, with an annual operation and maintenance cost of \$25 per acre
	Bench terraces	Construct bench terraces, thereby reducing the need for many other conservation practices on sloping agricultural land	75 to 90	Apply to all appropriate agricultural lands for a maximum level of pollution control. Utilization of this practice would exclude installation of many basic conservation practices and base-of-slope detention storage. The capital cost of bench terraces is estimated at \$1,500 per acre, with an annual operation and maintenance cost of \$100 per acre

Table D-1 (continued)

Applicable Land Use	Control Measures ^a	Summary Description	Approximate Percent Reduction of Released Pollutants ^b	Assumptions for Costing Purposes
Urban and Rural	Public education programs	Conduct regional and county-level public education programs to inform the public and provide technical information on the need for proper land management practices on private land, the recommendations for management programs, and the effects of implemented measures; develop local awareness programs for citizens and public works officials; develop local contract and education efforts	Indeterminate	For first 10 years, includes cost of one person, materials, and support for each 25,000 population. Thereafter, the same cost can be applied for every 50,000 population. The cost of one person, materials, and support is estimated at \$55,000 per year
	Construction erosion control practices	Construct temporary sediment basins; install straw bale dikes; use fiber mats, mulching, and seeding; install slope drains to stabilize steep slopes; construct temporary diversion swales or berms upslope from the project	20 to 40	Assume acreage under construction is the average annual incremental increase in urban acreage; apply costs for a typical erosion control program for a construction site. The estimated capital cost and operation and maintenance cost for construction erosion control is \$250 to \$5,500 and \$250 to \$1,500 per acre under construction, respectively
	Materials storage and runoff control facilities	Enclose industrial storage sites with diversion; divert runoff to acceptable outlet or storage facility; enclose salt piles and other large storage sites in crib and dome structures	5 to 10	Assume 40 percent of industrial areas are used for storage and to be enclosed by diversions; assume existing salt storage piles enclosed by cribs and dome structures. The estimated capital cost of industrial runoff control is \$2,500 per acre of industrial land. Material storage control costs are estimated at \$75 per ton of material
	Stream protection measures	Provide vegetative buffer zones along streams to filter direct pollutant runoff to the stream; construct streambank protection measures, such as rock riprap, brush mats, tree revetment, jacks, and jetted willow poles, where needed	5 to 10	Apply a 50-foot-wide vegetative buffer zone on each side of 15 percent of the stream length; apply streambank protection measures to 5 percent of the stream length. Vegetative buffer zones are estimated to cost \$21,200 per mile of stream and streambank protection measures cost about \$37,000 per stream mile
	Pesticide and fertilizer application restrictions	Match application rate to need; eliminate excessive applications and applications near or into surface water drainageways	0 to 3	Cost included in public education program
	Critical area protection	Emphasize control of areas bordering lakes and streams; correct obvious erosion and other pollution source problems	Indeterminate	Indeterminate

^aNot all control measures are required for each subwatershed. The characteristics of the watershed, the estimated required level of pollution reduction needed to meet the applicable water quality standards, and other factors will influence the selection and estimation of costs of specific practices for any one subwatershed. Although the control measures costed represent the recommended practices developed at the regional level on the basis of the best available information, the local implementation process should provide more detailed data and identify more efficient and effective sets of practices to apply to local conditions.

^bThe approximate effectiveness refers to the estimated amount of pollution produced by the contributing category (urban or rural) that could be expected to be reduced by the implementation of the practice. The effectiveness rates would vary greatly depending on the characteristics of the watershed and individual diffuse sources. It should be further noted that practices can have only a "sequential" effect, since the percent pollution reduction of a second practice can only be applied against the residual pollutant load which is not controlled by the first practice. For example, two practices of 50 percent effectiveness would achieve a theoretical total effectiveness of only 75 percent control of the initial load. Further, the general levels of effectiveness reported in the table are not necessarily the same for all pollutants associated with each source. Some pollutants are transported by dissolving in water and others by attaching to solids in the water; the methods summarized here reflect typical pollutant removal levels.

^cFor highly urbanized areas which require retrofitting of facilities into developed areas, the costs can range from \$400,000 to \$1,000,000 per acre of storage.

Source: SEWRPC.

Table D-2

**ALTERNATIVE GROUPS OF DIFFUSE SOURCE WATER POLLUTION CONTROL MEASURES
PROPOSED FOR STREAMS AND LAKE WATER QUALITY MANAGEMENT**

Pollution Control Category	Level of Pollution ^a Control	Practices to Control Diffuse Source Pollution from Urban Areas ^b	Practices to Control Diffuse Source Pollution from Rural Areas ^a
Basic Practices	Variable	Construction erosion control; onsite sewage disposal system management; streambank erosion control	Streambank erosion control
	25 percent	Public education programs; litter and pet waste control; restricted use of fertilizers and pesticides; construction erosion control; critical areas protection; improved timing and efficiency of street sweeping, leaf collection, and catch basin cleaning; material storage facilities and runoff control	Public education programs; fertilizer and pesticide management; critical area protection; crop residue management; chisel tillage; pasture management; contour plowing; livestock waste control
Additional Diffuse Source Control Practices ^c	50 percent	Above, plus: Increased street sweeping; improved street maintenance and refuse collection and disposal; increased catch basin cleaning; stream protection; increased leaf and vegetation debris collection and disposal; stormwater storage; stormwater infiltration	Above, plus: crop rotation; contour strip-cropping; grass waterways; diversions; wind erosion controls; terraces; stream protection
	75 percent	Above, plus: An additional increase in street sweeping, stormwater storage and infiltration; additional parking lot stormwater runoff storage and treatment	Above, plus: Base-of-slope detention storage
	More than 75 percent	Above, plus: Urban stormwater treatment with physical-chemical and/or disinfection treatment measures	Bench terraces ^b

^aGroups of practices are presented here for general analysis purposes only. Not all practices are applicable to, or recommended for, all lake and stream tributary watersheds. For costing purposes, construction erosion control practices, public education programs, and material storage facilities and runoff controls are considered urban control measures and stream protection is considered a rural control measure.

^bThe provision of bench terraces would exclude most basic conservation practices and base-of-slope detention storage facilities.

^cIn addition to diffuse source control measures, lake rehabilitation techniques may be required to satisfy lake water quality standards.

Source: SEWRPC.