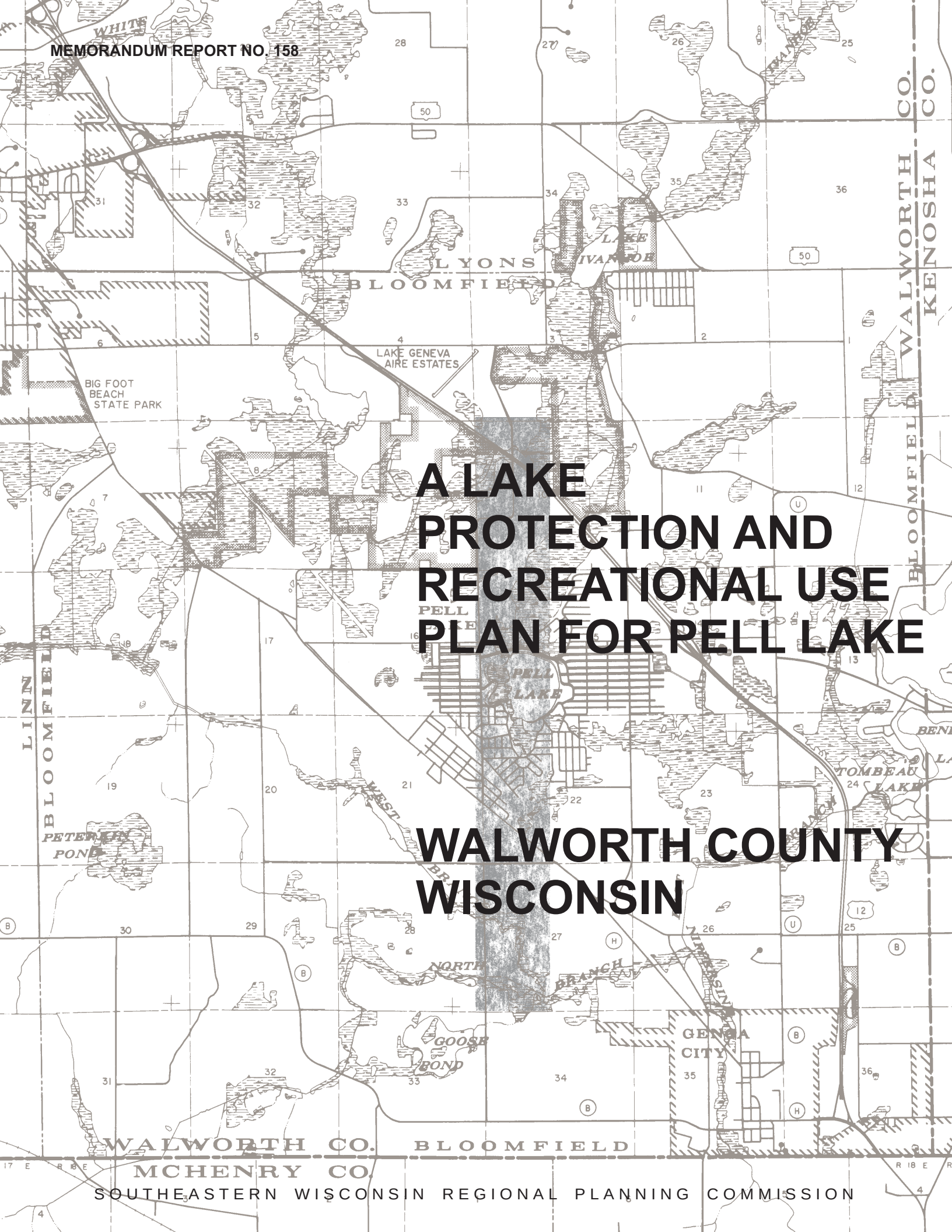
MEMORANDUM REPORT NO. 158



A LAKE PROTECTION AND RECREATIONAL USE PLAN FOR PELL LAKE

WALWORTH COUNTY WISCONSIN

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MEMORANDUM REPORT
NUMBER 158

A LAKE PROTECTION AND RECREATIONAL USE PLAN FOR PELL LAKE

WALWORTH COUNTY, WISCONSIN

Prepared by the

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Chapter I

INTRODUCTION

Pell Lake, located in the Town of Bloomfield, Walworth County, Wisconsin, is a valuable resource offering a variety of recreational and aesthetic opportunities to the resident community within the unincorporated hamlet of Pell Lake, and to its visitors. The Lake is an integral part of this lake-oriented community. However, the recreational and aesthetic values of the Lake are perceived to be adversely affected by changing land use conditions in the drainage area tributary to Pell Lake and diminished water quality conditions within the Lake, as evidenced by the abundant growths of rooted aquatic plants, among other symptoms. Seeking to improve the usability and to prevent deterioration of the natural assets and recreational potential of Pell Lake, the Town of Bloomfield created a Chapter 66, *Wisconsin Statutes*, town sanitary district around the Lake during 1991. The Pell Lake Sanitary District subsequently has undertaken an active, lake-oriented program of community involvement, education, and management.

This report sets forth a lake protection and recreational use plan for Pell Lake, and represents part of the ongoing commitment of the Pell Lake Sanitary District, the Town of Bloomfield, and the Pell Lake community to sound planning with respect to the Lake. This plan was prepared during the period 2001 through 2005 by the Southeastern Wisconsin Regional Planning Commission, in cooperation with the Pell Lake Sanitary District, and includes the results of field surveys conducted by Aron & Associates during July 2000[1] and the Commission staff during 2001. This planning program was funded, in part, by a Wisconsin Department of Natural Resources Lake Management Planning Grant awarded to the Pell Lake Sanitary District under the Chapter NR 190 Lake Management Planning Grant program.

While this plan is intended to form an integral part of any future, comprehensive lake management plan for Pell Lake, 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 Pell Lake will require additional water quality and biological data collection and analysis.

The lake protection and recreational use plan goals and objectives for Pell Lake were developed in consultation with the Pell Lake Sanitary District. The goals and objectives are:

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 Pell Lake;

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[1]*Aron & Associates,* Pell Lake Aquatic Plant Survey—2000, *2000.*

2. To provide a high-quality, water-oriented urban residential setting with recreational and aesthetic opportunities for residents and visitors to Pell Lake, and to manage the Lake in an environmentally sound manner; and,

3. To effectively maintain the water quality of Pell Lake 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.

[2]*This plan has been prepared pursuant to the standards and requirements set forth in the* Wisconsin Administrative Code: *Chapter NR 1, "Public Policy for Waterways;" Chapter NR 103, "Water Quality Standards for Wetlands;" Chapter NR 107, "Aquatic Plant Management;" and Chapter NR 109, "Aquatic Plants Introduction, Manual Removal and Mechanical Control Regulations."*

Chapter II

INVENTORY FINDINGS

INTRODUCTION

Pell Lake is located in U.S. Public Land Survey Sections 15 and 22 of Township 1 North, Range 18 East, Town of Bloomfield, Walworth County, Wisconsin, as shown on Map 1. Pell Lake is a seepage, or internally drained, lake. Waters from the Lake drain through a culvert under Lake Drive, on the southern side of the Lake, into an adjacent wetland. This wetland system, ultimately, drains to Nippersink Creek. On the northern shore of Pell Lake, a culvert under Lake Shore Road allows water from a large wetland complex to the north to flow into and out of the Lake depending upon lake levels. This hydrologic connection is shown on the 1873 plat map, reproduced as Map 2.

The drainage area tributary to Pell Lake is wholly located within the Town of Bloomfield, and is approximately 1,110 acres in areal extent. The land uses in this area are primarily rural, with open lands including wetlands, woodlands, other natural areas, and agricultural lands, forming the largest portion of the tributary area. Lake-oriented urban lands, comprising the unincorporated hamlet of Pell Lake, are the principal urban feature of the area tributary to Pell Lake, and occupy the major portion of the lake shoreland area.

WATERBODY CHARACTERISTICS

Pell Lake is an 86-acre waterbody, the hydrographical characteristics of which are set forth in Table 1. The Lake is a seepage lake, and, as such, the Lake's water level is dependent upon localized surface runoff, the regional groundwater table, and annual precipitation onto the Lake surface with some additional, potential contribution of water from a connected wetland complex to the north. Pell Lake is roughly circular to oval in shape. The deepest portions are located in the eastern one-half of the main lake basin. The waterbody has a maximum depth of 13 feet,[1] a mean depth of four feet, and a volume of 314 acre-feet. The bathymetry of the Lake is shown on Map 3.

LAND USE AND SHORELINE DEVELOPMENT

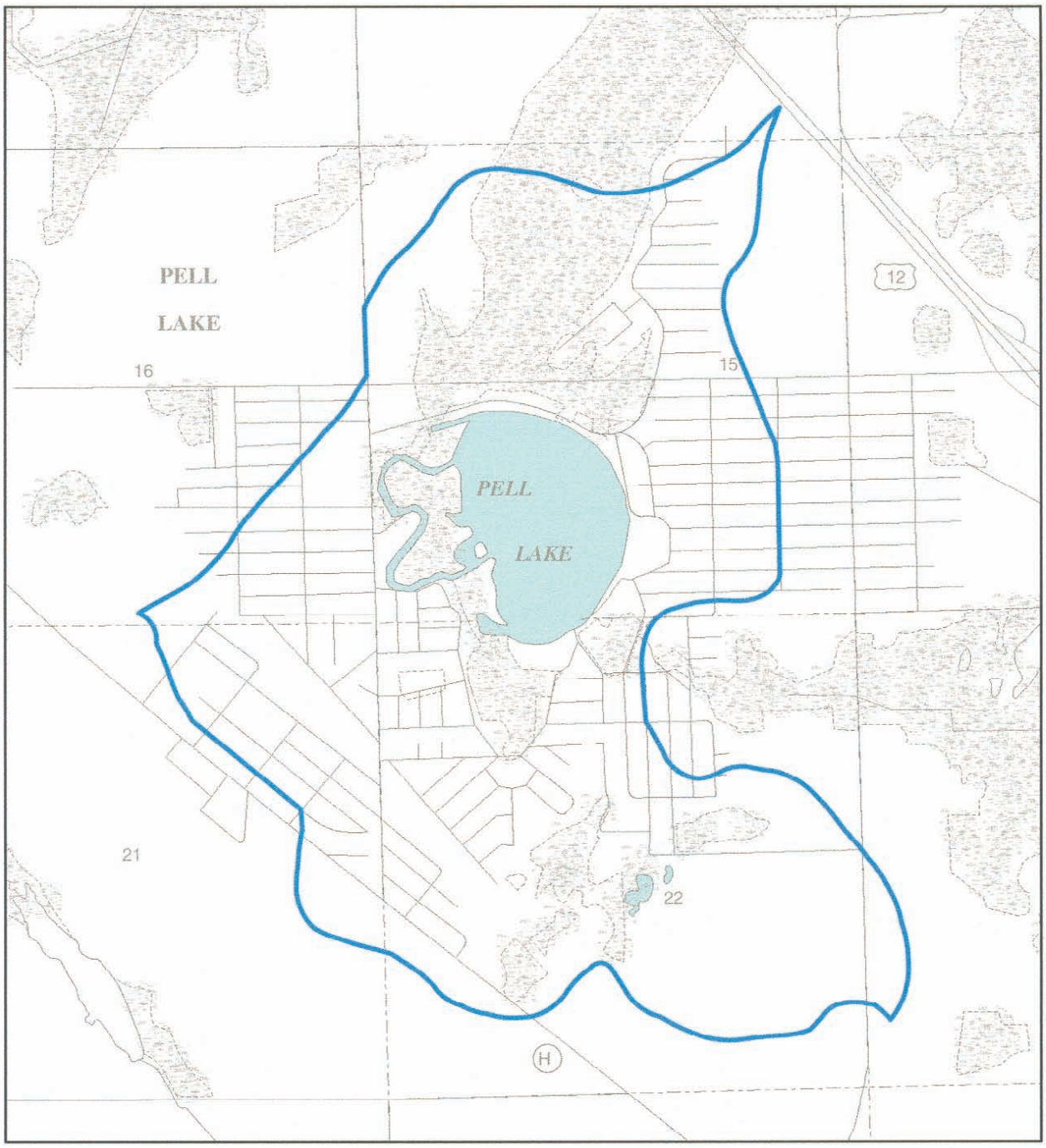
Land Use

The area tributary to Pell Lake is situated entirely within the Town of Bloomfield, in Walworth County. The tributary area is about 1,110 acres. As shown on Map 4, most of the eastern shorelands, and the areas to the

[1]*The Pell Lake Sanitary District Commissioners note that the maximum depth of the Lake is approximately 23 feet based upon recent observations by District staff. This depth was confirmed by Aron & Associates and is documented in Aron & Associates,* Pell Lake Aquatic Plant Survey—2000*, December 2000, p. 1.*

Map 1

LOCATION OF PELL LAKE



Surface Water

Drainage Area Tributary to Pell Lake

N

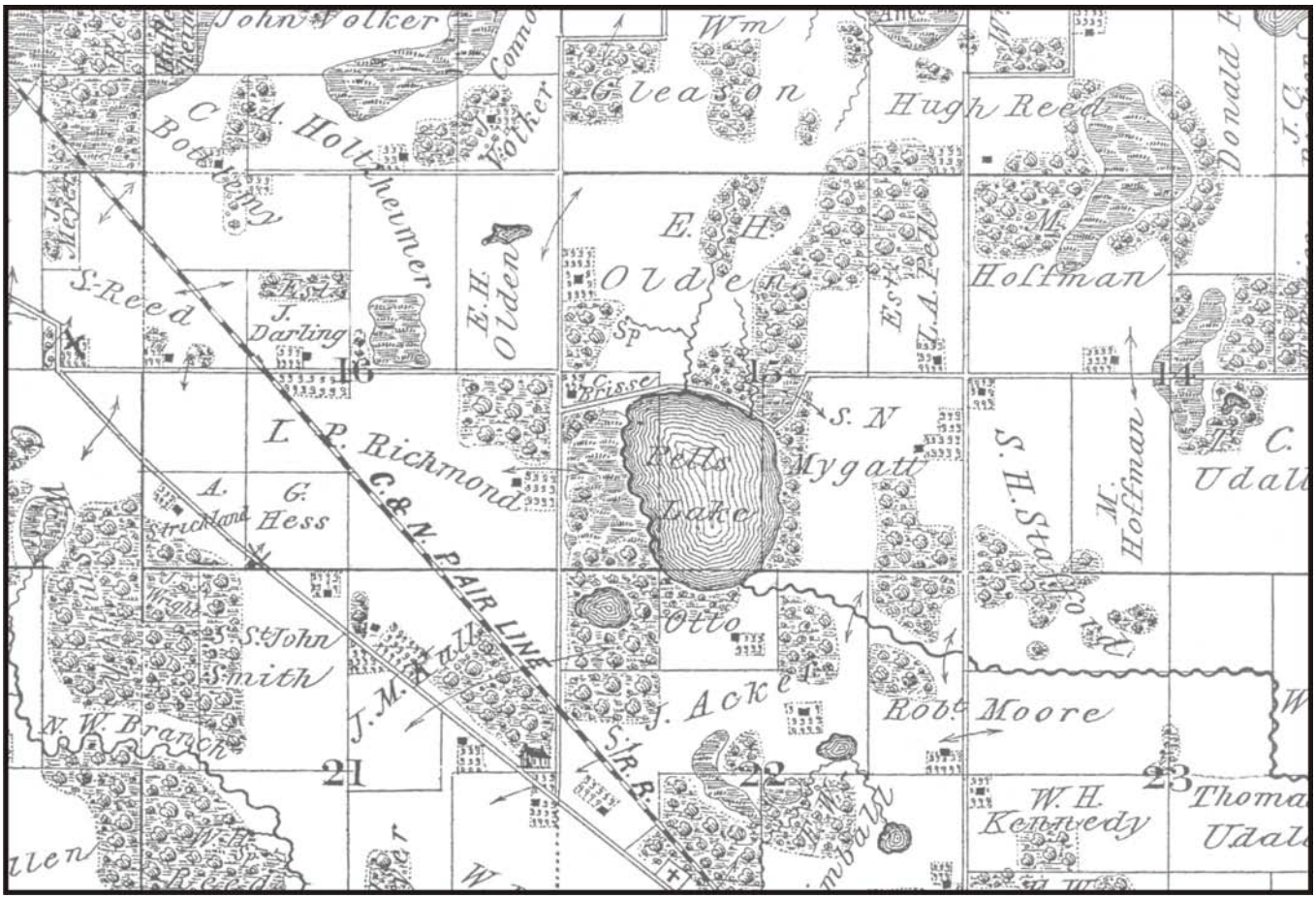
Miles

0 0.3 0.6

Source: SEWRPC.

Map 2

HISTORIC PLAT MAP FOR THE PELL LAKE AREA: 1873



Source: Everts, Baskin, and Stewart, Combination Atlas Map of Walworth County, Wisconsin, 1873.

southwest of the Lake, have been developed for urban residential land uses during the 1940s through the early 1960s. The surrounding land uses within the drainage basin tributary to Pell Lake are rural open space uses and limited urban uses, being comprised primarily of agricultural and open lands, wetlands and woodlands, and single-family residential. Residential lands, and wetlands and woodlands, are primarily centered on the Lake.

The shorelands of Pell Lake are fairly equally divided between residential lands, and wetlands and woodlands. Commercial, as well as governmental and institutional, lands also exist within the area tributary to Pell Lake, and are focused within the unincorporated hamlet of Pell Lake. Existing land uses as of 1995 are shown on Map 5 and are summarized in Table 2. Changes in land use within the area tributary to the Lake since 1995 have been minimal,[2] although limited further residential development of platted lots within the drainage area and, possibly, redevelopment of existing properties may be expected to occur.

[2]*See SEWRPC Community Assistance Planning Report No. 268,* A Land Use Plan for the Town of Bloomfield, Walworth County, Wisconsin: 2020, *August 2003; SEWRPC Community Assistance Planning Report No. 252,* A Land Use Plan for Walworth County, Wisconsin: 2020, *April 2001; and SEWRPC Planning Report No. 45,* A Regional Land Use Plan for Southeastern Wisconsin: 2020, *December 1997.*

Table 1

HYDROGRAPHIC CHARACTERISTICS OF PELL LAKE

Parameter	Measurement
Surface Area	86 acres
Volume	314 acre-feet
Shoreline Length	3.57 miles
Shoreline Development Factor[a]	2.3
Maximum Depth	13 feet[b]
Mean Depth	4 feet
Tributary Drainage Area	1,110 acres

[a]*Shoreline Development Factor is the ratio between the actual circumference of the lake and the circumference of a circle with the same radius. A circular lake would have a Shoreline Development Factor of 1.0, while a dendritic lake would have a Shoreline Development Factor in excess of 1.0.*

[b]*The Pell Lake Sanitary District and Aron & Associates report a maximum depth of approximately 23 feet, recorded during 2000.*

Source: SEWRPC.

As shown on Map 6, under 2020 conditions, only a limited additional conversion of rural lands to urban-density land uses within the drainage area tributary to Pell Lake is envisioned in the adopted Town of Bloomfield, Walworth County, and regional land use plans.[3] The County and regional land use plans were refined through the local Town land use planning effort. These land uses are quantified in Table 2. Limited infilling of existing platted lots, comprising additional low-density, single-family residential development, and some reconstruction on existing built lots can be expected to occur within the area tributary to the Lake, primarily as existing large lots are further subdivided, over time.

WATER QUALITY

Water quality data on Pell Lake were collected during four separate years between 1988 and 1999, as part of the Wisconsin Department of Natural Resources (WDNR) Self-Help Lake Monitoring Program. Based upon Secchi-disc transparency measurements obtained by the Self-Help Lake Monitoring Program volunteer during the years 1988, 1994, 1995, and 1999, Pell Lake had an average transparency of 4.8 feet, which is slightly below the average reported for lakes in the southeastern region of Wisconsin.[4] It should be noted, that lakes within this region were typically rated as having only fair water clarity compared to lakes elsewhere in the State, with nearly one-half of the lakes in this region being reported as having a "green" appearance.

Based upon the average Secchi-disc transparency measurements for these years, Pell Lake had an average Wisconsin Trophic State Index (WTSI) value of about 55.5, indicating that the Lake is likely to be considered a meso-eutrophic waterbody. This trophic classification is supported by the data shown in Table 3 and is shown graphically 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, but may occur in meso-eutrophic lakes. Many of the cleaner lakes in Southeastern Wisconsin are classified as mesotrophic.[6]

POLLUTANT LOADINGS

Pollutant loads to a lake are generated by various natural processes and human activities that take place in the 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

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[3]Ibid.

[4]*See R.A. Lillie, and J.W. Mason,* Limnological Characteristics of Wisconsin Lakes, *Wisconsin Department of Natural Resources Technical Bulletin No. 138, 1983.*

[5]*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.*

[6]*R.A Lillie, and J.W. Mason,* op. cit.

Map 3

BATHYMETRIC MAP OF PELL LAKE

DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

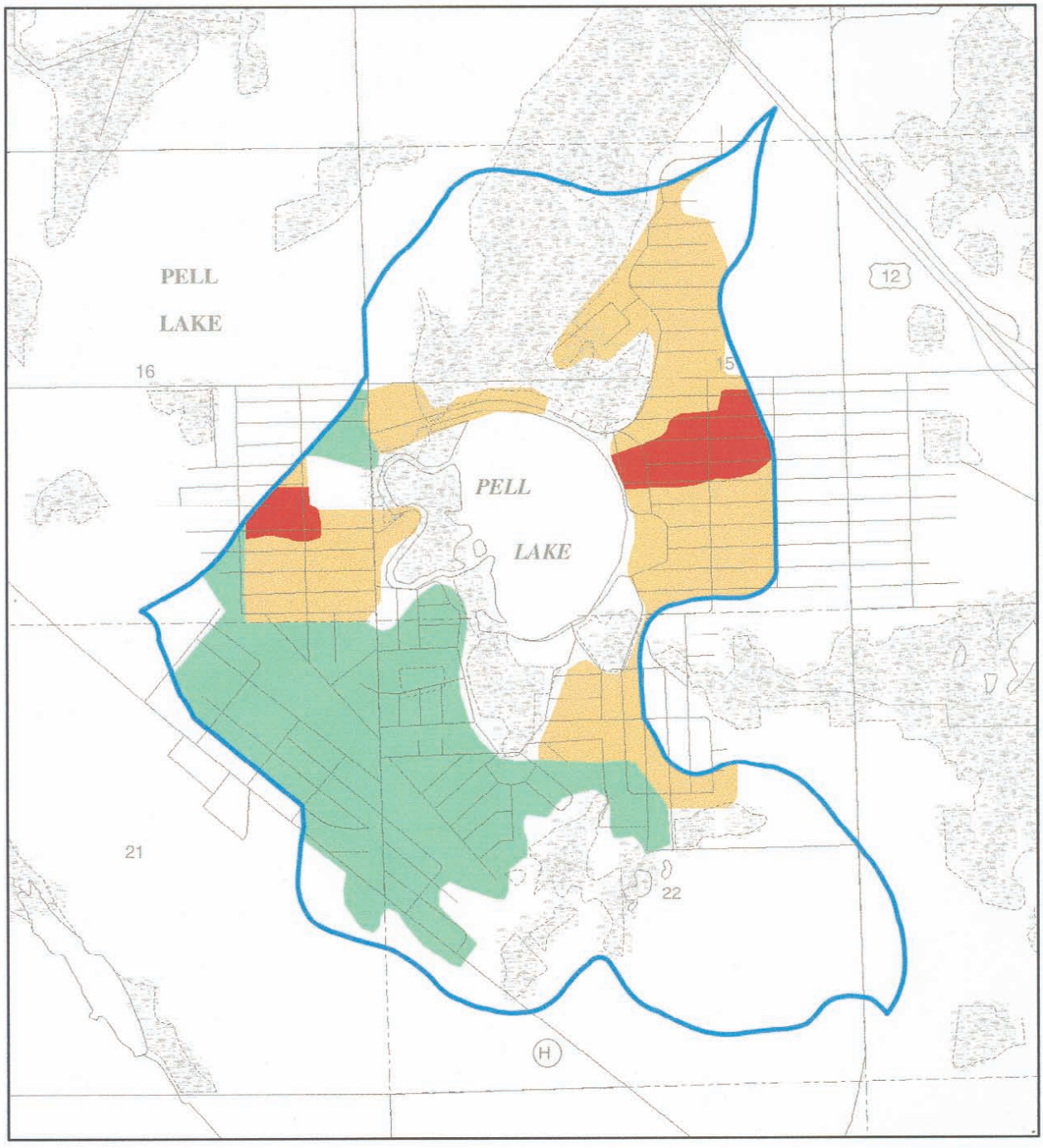
Source: SEWRPC.

GRAPHIC SCALE

0 350 700 FEET

Map 4

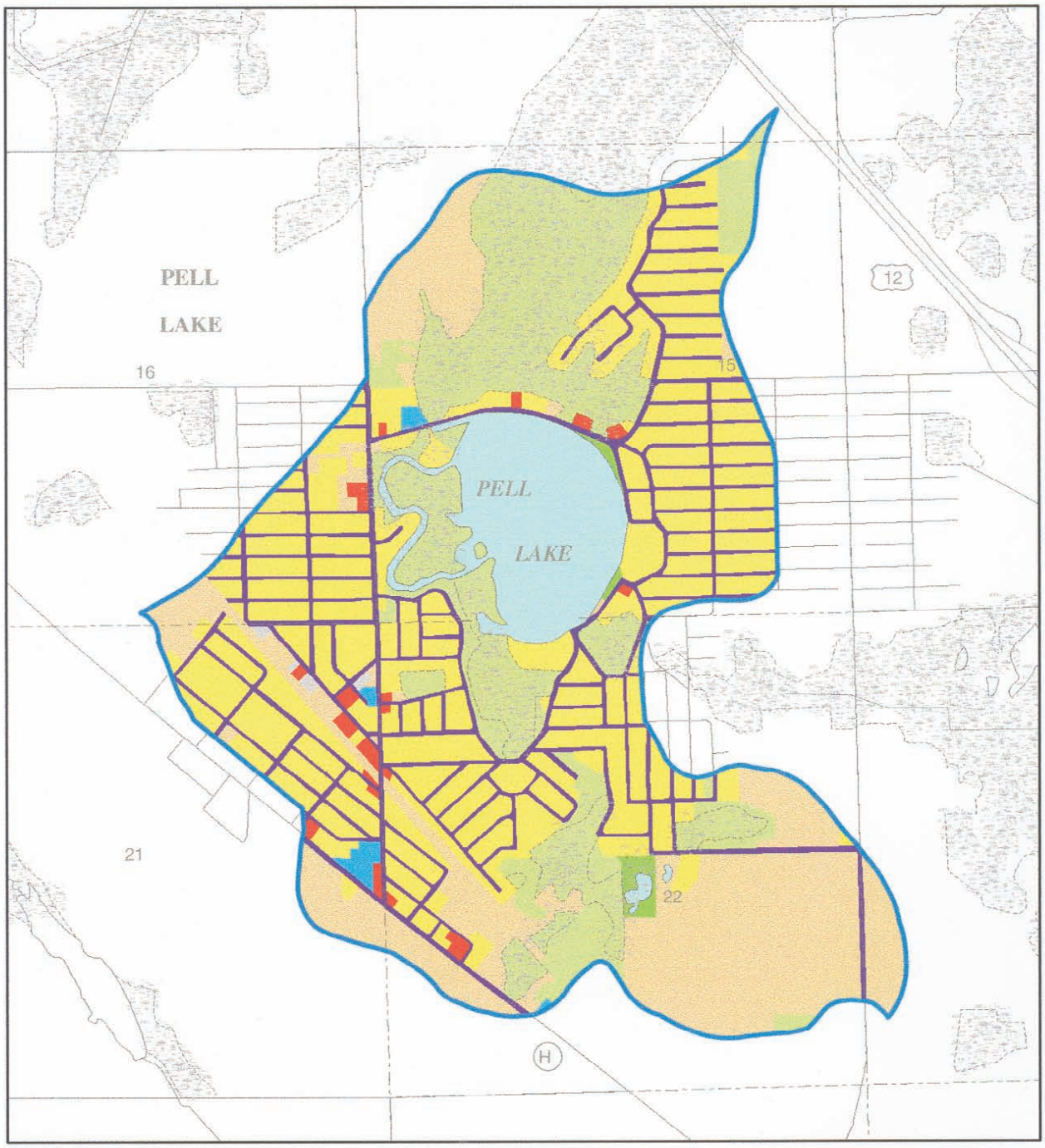
HISTORIC URBAN GROWTH WITHIN THE AREA TRIBUTARY TO PELL LAKE: 1940-1995



Source: SEWRPC.

Map 5

GENERALIZED LAND USE WITHIN THE AREA TRIBUTARY TO PELL LAKE: 1995



Source: SEWRPC.

Table 2

EXISTING AND PLANNED LAND USE WITHIN THE AREA TRIBUTARY TO PELL LAKE: 1995 AND 2020

Land Use Categories[a]	1995		2020	
	Acres	Percent of Total Tributary Drainage Area	Acres	Percent of Total Tributary Drainage Area
Urban				
Residential	382	34.4	412	37.1
Commercial	11	1.0	19	1.7
Industrial	2	0.2	- -	- -
Governmental and Institutional	6	0.5	5	0.5
Transportation, Communication, and Utilities	120	10.8	125	11.3
Recreational	6	0.5	6	0.5
Subtotal	527	47.4	567	51.1
Rural				
Agricultural and Other Open Lands	244	22.0	204	18.3
Wetlands	188	16.9	188	16.9
Woodlands	57	5.2	57	5.2
Water	94	8.5	94	8.5
Extractive	- -	- -	- -	- -
Landfill	- -	- -	- -	- -
Subtotal	584	52.6	543	48.9
Total	1,110	100.0	1,110	100.0

[a]*Parking included in associated use.*

Source: SEWRPC.

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. Pollutants transported across the land surface can also enter a streamcourse and be carried into a lake as surface inflow. However, in seepage or groundwater flow-through lakes, such as Pell Lake, the absence of a clearly identifiable inlet and outlet means that atmospheric deposition, and direct and indirect runoff from the lands surrounding the waterbody, form the primary pathways through which pollutants enter the lake. Since there are no known point sources of water pollutants within the Pell Lake tributary drainage area, and all of the riparian lands are served by public sanitary sewers, the discussion that follows is based upon nonpoint source pollutant loadings to Pell Lake.[7] Nonpoint source pollutants entering the Lake are likely to remain in the Lake, with potentially negative consequences for lake water quality.

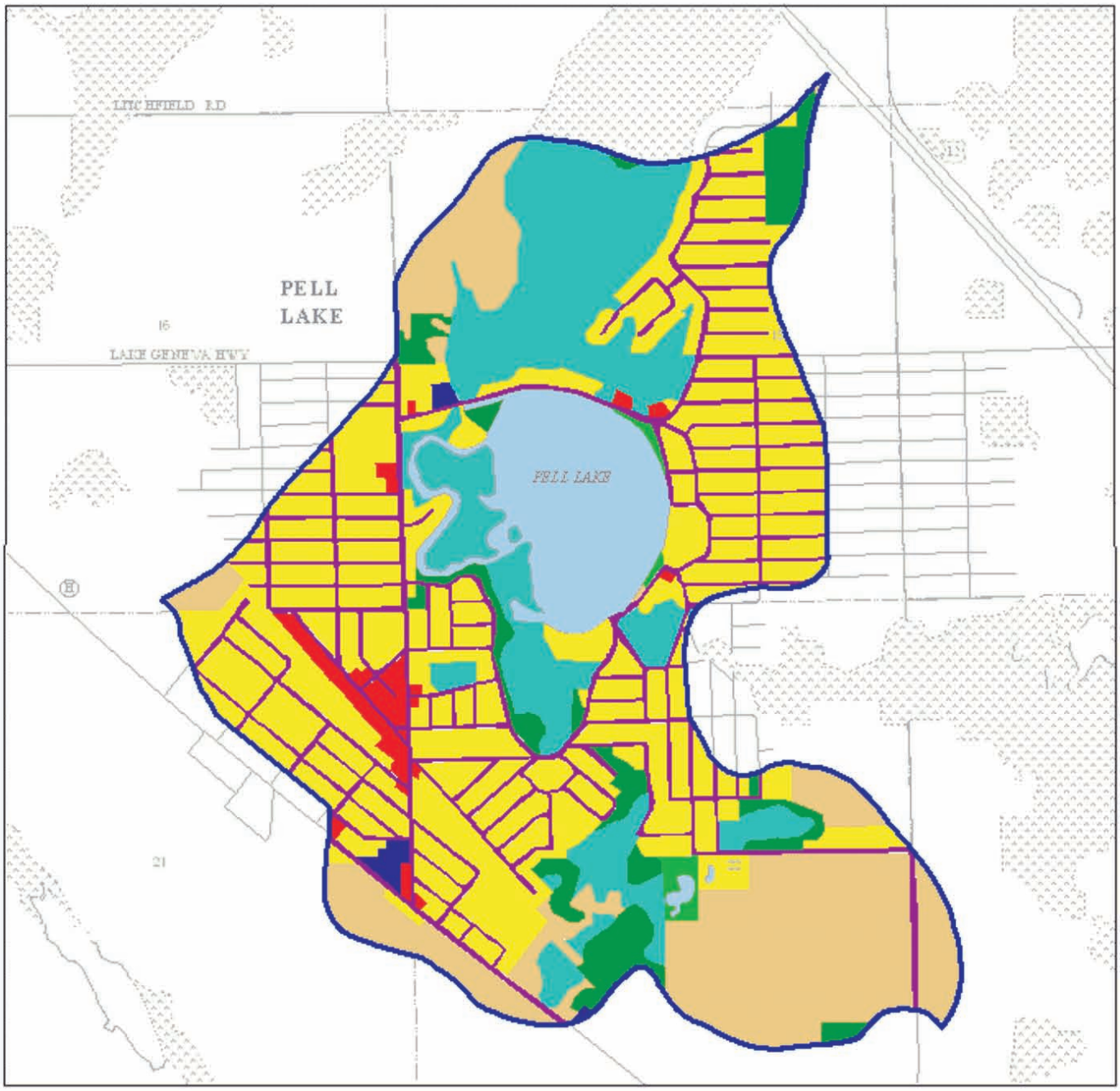
The nonpoint source pollutant loads to Pell Lake were estimated on the basis of land use inventory data and unit area load coefficients determined for southeastern Wisconsin. Total phosphorus loads were estimated using the Wisconsin Lake Spreadsheet Model (WILMS),[8] and a unit area load-based algorithm developed for the Southeastern Wisconsin Region. Annual contaminant loads entering Pell Lake based on 1995 land use data were

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

[8]*Wisconsin Department of Natural Resources Report No. PUBL-WR-363 96 REV,* Wisconsin Lake Model Spreadsheet, Version 2.00, User's Manual, *June 1994.*

Map 6

PLANNED LAND USE WITHIN THE AREA TRIBUTARY TO PELL LAKE: 2020



- SINGLE-FAMILY RESIDENTIAL
- COMMERCIAL
- MANUFACTURING, WHOLESALE, AND STORAGE
- TRANSPORTATION, COMMUNICATION, AND UTILITIES
- GOVERNMENTAL AND INSTITUTIONAL
- RECREATIONAL
- WOODLAND
- WETLAND
- AGRICULTURE AND OTHER OPEN SPACE
- SURFACE WATER

0 0.2 0.4 0.6 Miles

Source: SEWRPC.

Table 3

PELL LAKE WATER QUALITY DATA: 1988-1999

Parameter	1988	1994	1995	1999
Secchi Disc Depth (feet)				
Number of Samples	3	8	4	8
Range	2.0-4.0	3.3-6.8	2.8-5.3	6.0-7.5
Average	3.2	5.1	4.2	6.6
Standard Deviation	1.0	1.2	1.0	0.4
Wisconsin Trophic State Index Value				
Number of Samples	3	8	4	8
Range	57-67	49-60	53-63	48-52
Average	61	54	57	50
Standard Deviation	7.1	3.4	2.1	0.0

Source: Wisconsin Department of Natural Resources, Self-Help Monitoring Program Annual Reports 1988-1999*, 1999.*

calculated to be approximately 75 tons of sediment, 425 pounds of phosphorus, 0.1 pound of cadmium, three pounds of copper, and 28 pounds of zinc, as shown in Table 4. 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 Pell Lake, Southeastern Wisconsin Regional Planning Commission (SEWRPC) staff applied the estimated phosphorus load of approximately 425 pounds in the Vollenweider-type OECD phosphorus budget model to estimate an in-lake Secchi disc transparency.[9] This calculation resulted in an estimated Secchi disc transparency reading of about 3.8 feet, which value compares favorably with the mean 1995 measured value of about 4.2 feet, suggesting that the estimated total phosphorus load is a good approximation of the actual load. This same calculation resulted in a forecast annual average total phosphorus concentration of about 0.08 mg/l, and a forecast annual average chlorophyll-*a* concentration of about 0.018 mg/l, in the Lake. These estimates are consistent with the reported meso-eutrophic, or slightly enriched, status of the Lake.

The data shown in Table 4 indicate that, based on 1995 land use conditions in the drainage area tributary to Pell Lake, 50 percent of the phosphorus load to the Lake is estimated to be contributed from agricultural and open lands within the tributary drainage area, about 36 percent from residential areas, and about 5 percent from wetlands, woodlands, and surface waters. The balance of the load is contributed from other urban lands, including the recreational lands, surrounding the Lake. About 73 percent of the sediment load to Pell Lake is generated from agricultural lands, 15 percent from urban sources, and about 12 percent from woodlands, wetlands, and surface water sources. All of the metals loadings are expected to be generated from urban lands, with about 60 percent of the metals load to Pell Lake being generated from the commercial lands and the remaining 40 percent from other urban uses.

Nonpoint source pollutant loadings projected for the year 2020 are shown in Table 5. These data are based on projected land use data and unit area load coefficients determined for southeastern Wisconsin. Again, total phosphorus loads were estimated using the Wisconsin Lake Spreadsheet Model (WILMS),[10] and a unit area load-based algorithm developed for the southeastern Wisconsin region. Projected annual contaminant loads entering

[9]*S.-O. Ryding and W. Rast,* The Control of Eutrophication in Lakes and Reservoirs, *Unesco Man and the Biosphere Series Vol. 1, Parthenon Press, London, 1989.*

[10]*Wisconsin Department of Natural Resources Report No. PUBL-WR-363 96 REV,* op. cit.

Table 4

ESTIMATED ANNUAL POLLUTANT LOADINGS TO PELL LAKE BY LAND USE CATEGORY: 1995

Land Use Category	Pollutant Loads				
	Sediment (tons)	Phosphorus (pounds)	Cadmium (pounds)	Copper (pounds)	Zinc (pounds)
Urban					
Residential	3.7	151.4[a]	0.0	0.0	3.8
Commercial	4.3	13.2	0.1	2.4	16.4
Industrial	0.8	2.3	<0.1	0.4	3.0
Governmental and Institutional	1.5	8.1	0.0	0.4	4.8
Communications and Utilities	0.6	13.2	0.0	0.0	0.0
Recreational	<0.1	2.2	0.0	0.0	0.0
Subtotal	11.0	190.4	0.1	3.2	28.0
Rural					
Agricultural	54.9	209.8	0.0	0.0	0.0
Wetlands	0.4	7.5	0.0	0.0	0.0
Woodlands	0.1	2.3	0.0	0.0	0.0
Water	8.8	12.2	0.0	0.0	0.0
Subtotal	64.2	231.8	0.0	0.0	0.0
Total	75.2	422.2	0.1	3.2	28.0

[a]*Includes the estimated 1995 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 8 pounds per year to as much as 235 pounds per year, depending upon soil type, system condition, and system locations. For purposes of this analysis, 75 pounds per year were used as that value provided the loading that was best correlated to the measured in-lake phosphorus concentration. By the year 2000, a public sanitary sewer system was installed to serve the Pell Lake area. After that date, the contribution from onsite sewage disposal systems was negligible as shown in the estimated year 2020 scenario set forth in Table 5.*

Source: SEWRPC.

GROUNDWATER RESOURCES

Groundwater resources constitute an extremely valuable element of the natural resource base related to Pell Lake, both as a source of water, and as a component of the surface water system. Groundwater in the vicinity of the Lake moves within two distinct systems: a shallow water table system,[12] and a deep sandstone system. The shallow water table system consists of glacial deposits and the dolomite bedrock nearest the surface. The deep system includes all bedrock, mostly sandstone, directly above the crystalline Precambrian basement rocks. The shallow sand and gravel aquifer,[13] consisting of water-bearing sand and gravel, extends to 100 to 150 feet in thickness in the vicinity of Pell Lake, and is significant in terms of its relationship with the tributary area hydrology of Pell Lake. The groundwater gradient in the surface aquifer is relatively flat in the vicinity of the Lake, indicating limited horizontal movement. As shown in Map 7, groundwater flows generally to the east and southeast. The shallow sand and gravel aquifer also is significant in terms of adjacent wetlands, and is expected to have a direct affect on lake water quality and lake levels.

[12]*The water table is the upper limit of the portion of the ground which is fully saturated with water.*

[13]*An aquifer is a water-bearing stratum of rock, sand, or gravel.*

Table 5

ESTIMATED ANNUAL POLLUTANT LOADINGS TO PELL LAKE BY LAND USE CATEGORY: 2020

Land Use Category	Pollutant Loads				
	Sediment (tons)	Phosphorus (pounds)	Cadmium (pounds)	Copper (pounds)	Zinc (pounds)
Urban					
Residential	4.0	82.4	0.0	0.0	4.1
Industrial	0.0	0.0	0.0	0.0	0.0
Commercial	7.5	22.8	0.2	4.2	28.3
Communications and Utilities	0.6	13.8	0.0	0.0	0.0
Governmental and Institutional	1.3	6.8	0.0	0.4	4.0
Recreational	<0.1	1.6	0.0	0.0	0.0
Subtotal	13.4	127.4	0.2	4.6	36.4
Rural					
Agricultural	45.9	175.4	0.0	0.0	0.0
Wetlands	0.3	7.5	0.0	0.0	0.0
Woodlands	0.1	2.3	0.0	0.0	0.0
Water	8.8	12.2	0.0	0.0	0.0
Subtotal	55.1	197.4	0.0	0.0	0.0
Total	68.5	324.8	0.2	4.6	36.4

Source: SEWRPC.

SOIL TYPES AND CONDITIONS

Soil type, land slope, vegetative cover, and land use and management practices are among the more important factors determining lake water quality conditions and also the rate, amount, and quality of stormwater runoff. The soil texture and soil particle structure influence not only the erodibility of the soils, but also affect permeability, infiltration rate, and, through these attributes, the groundwater recharge and discharge within the groundwatershed of the Lake. This latter impact is especially important in the case of seepage or groundwater fed lakes. Land slopes are also important determinants of stormwater runoff rates and of susceptibility to erosion.

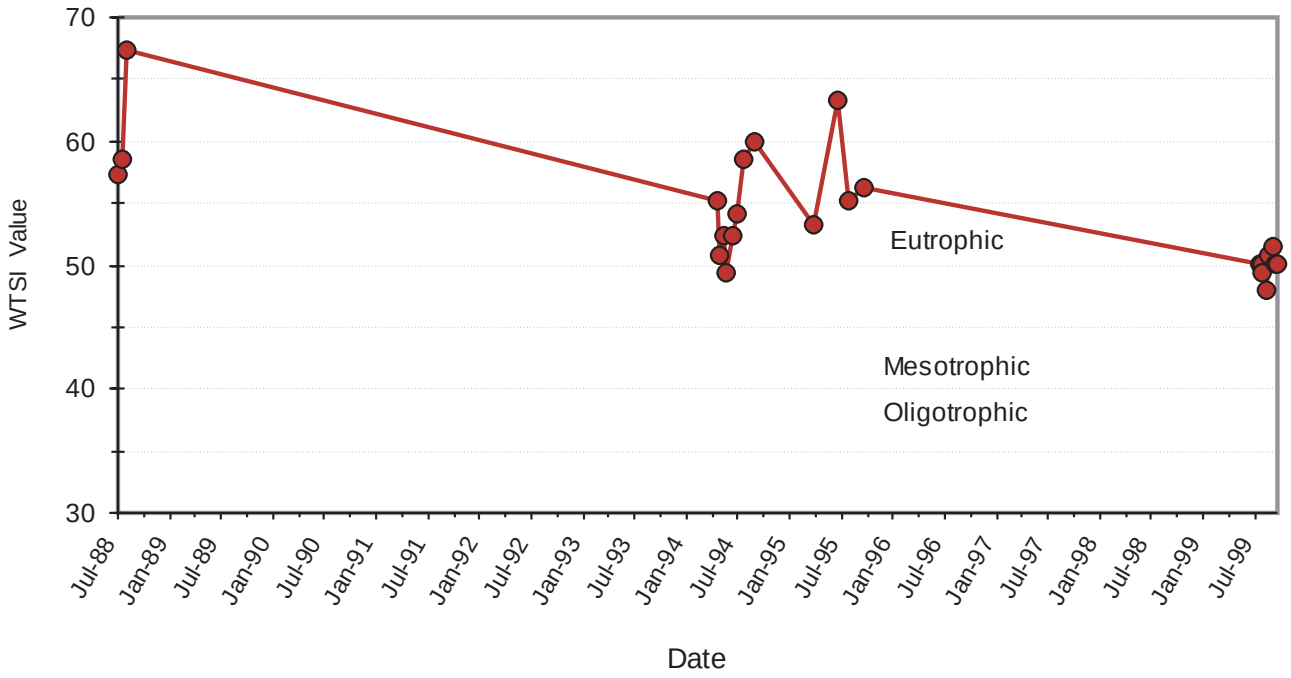
The U.S. Natural Resources Conservation Service, under contract to SEWRPC, completed a detailed soil survey of the Pell Lake area during 1966.[14] Using the regional soil survey, an assessment was made of the hydrologic characteristics of the soils in the area tributary to Pell Lake. Soils within the area tributary to the Lake were categorized into three main hydrologic soil groups, as well as an "other" category which included disturbed and filled lands, as shown on Map 8. Approximately 85 percent of the total tributary drainage area is covered by moderately to well-drained soils, about 7 percent of the tributary drainage area by poorly or very poorly drained soils, with the remaining 8 percent of the area of the watershed being surface water, as shown on Map 8.

Using the regional soil survey, an assessment was made of hydrologic characteristics of the soils in the area tributary to Pell Lake. The suitability of the soils for urban residential development was assessed using three common development scenarios. These ratings reflected the requirements of Chapter Comm 83 of the *Wisconsin*

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

Figure 1

SECCHI DISC-BASED TROPHIC STATE INDEX FOR PELL LAKE: 1988-1999



Source: Wisconsin Department of Natural Resources Self-Help Monitoring Program, Pell Lake, 1988-1999.

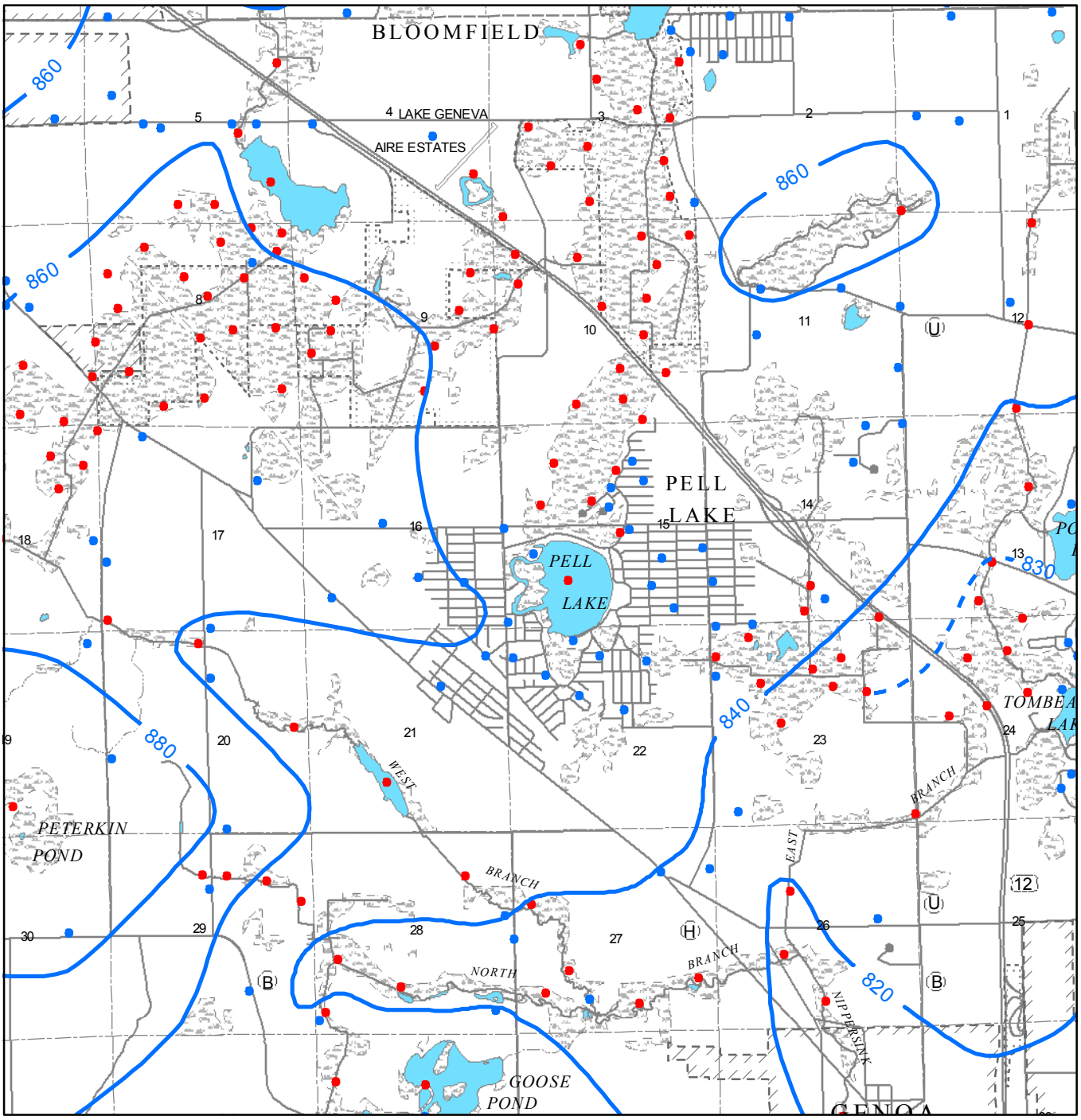
Pell Lake based on 2020 land use data were calculated to be approximately 68 tons of sediment, 325 pounds of phosphorus, 0.2 pounds of cadmium, 5 pounds of copper, and 36 pounds of zinc, as shown in Table 5. As before, copper and zinc were used in this analysis as surrogates for metals and other pollutants that are contributed primarily from urban sources.

Under forecast 2020 load use conditions, the annual average total phosphorus concentration, as estimated using the Vollenweider-type OECD phosphorus budget model, may be expected to decrease slightly, to approximately 0.06 mg/l.[11] Consequently, the forecast annual average chlorophyll-*a* concentration in the Lake also was expected to decline slightly, to about 0.013 mg/l. The decrease in total phosphorus loading and resulting improvements in water quality most likely reflect the change in wastewater treatment from onsite sewage disposal systems to a public sanitary sewerage system. Of the remaining controllable pollutant sources, the most significant sources under existing land use conditions vary with the particular pollutants of concern. Data set forth in Tables 4 and 5 indicate that rural agricultural and open land uses remain the principal source of sediment and phosphorus to Pell Lake, while urban lands, primarily commercial uses, are expected to generate the largest percentage of metals loading. Control of contaminants from these various sources can be effected through a variety of measures as set forth in Chapter IV.

[11] *S.-O. Ryding and W. Rast*, op. cit.

Map 7

WATER TABLE CONTOURS IN THE VICINITY OF PELL LAKE



860 — AVERAGE WATER-TABLE ELEVATION (FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM, 1929) AT A 20-FOOT CONTOUR INTERVAL

830 — SUPPLEMENTAL CONTOUR AT A 10-FOOT INTERVAL

WELL DATA POINT

SURFACE WATER POINT

N

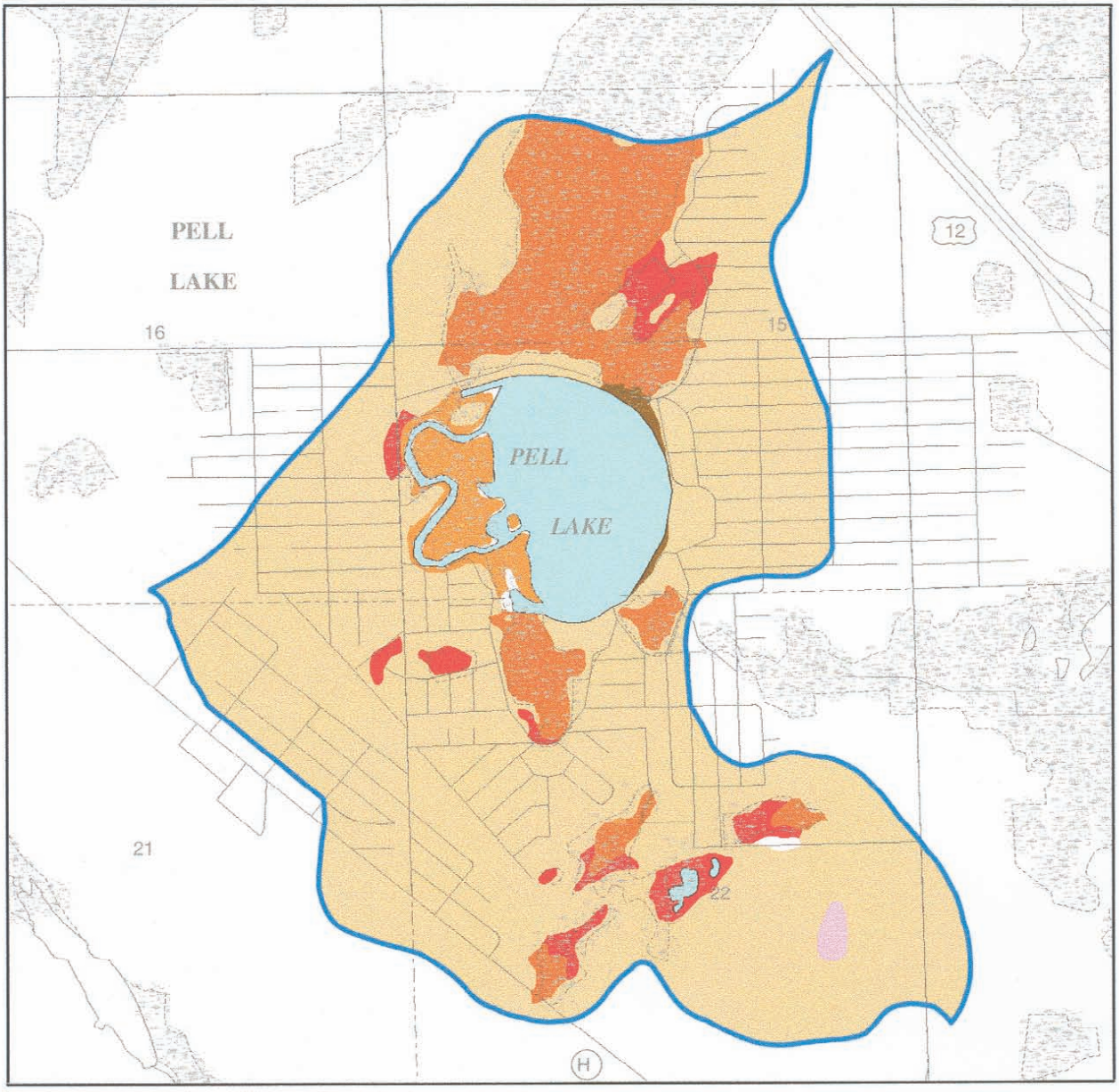
GRAPHIC SCALE

0 2,000 4,000 6,000 Feet

Source: SEWRPC.

Map 8

HYDROLOGIC SOIL GROUPS WITHIN THE AREA TRIBUTARY TO PELL LAKE



GROUP A: Well-drained soil

GROUP A/D: Well-drained soil/Moderately drained [1]

GROUP B: Moderately drained soil

GROUP B/D: Moderately drained soil/Very poorly drained soil [2]

GROUP C/D: Poorly drained soil/Very poorly drained soil [3]

GROUP D: Very poorly drained soil

Surface Water

Mostly Disturbed Lands

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.

N

Miles

0 0.3 0.6

Source: SEWRPC.

Administrative Code governing onsite sewage disposal systems as it existed through 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, significantly altered the existing regulatory framework and have effectively increased the area in which onsite sewage disposal systems may be utilized. Although the urban lands within the area tributary to Pell Lake currently are served by public sanitary sewerage, the interpretations associated with the soil survey are such that they continue to provide insights into the potential for land-based sources of pollution to affect the Lake water quality either as a consequence of overland flows during storm events or through groundwater interflows in the Lake. The soil ratings for onsite sewage disposal systems as determined pursuant to the then-existing requirements of Chapter Comm 83 of the *Wisconsin Administrative Code* governing onsite sewage disposal systems as of early 2000 presented on Map 8 provide an index of the likelihood of contaminated groundwater entering Pell Lake. It is useful to note that about one-half of the lands within the drainage area tributary to Pell Lake are covered by soils that are categorized as having few limitations for onsite sewage disposal systems. However, about one-third of the lands had severe limitations, suggesting a potential sensitivity to disturbance and likelihood of being permeable to pollutants.

The existing year 2001 sanitary sewer service area for the Pell Lake area, and those planned in amendments to the sanitary sewer service area served by the Pell Lake Sanitary District, are delineated on Map 9.

AQUATIC PLANTS, DISTRIBUTION, AND MANAGEMENT AREAS

An aquatic plant survey was conducted by the WDNR within Pell Lake in 1967.[15] This survey indicated that the dominant aquatic plant species observed at that time were muskgrass, *Chara vulgaris;* yellow water lily, *Nuphar advena*; white water lily, *Nymphaea tuberosa*; floating-leaf pondweed, *Potamogeton natans*; American bulrush, *Scirpus americanus;* and broad-leaf cattail, *Typha latifolia*. The southern end of the main basin and the western end of the northern basin were identified as unique areas of aquatic vegetation to be preserved and protected.

More recently, during July 2000, a survey of aquatic plants within Pell Lake was conducted by Aron & Associates with a subsequent reconnaissance survey being conducted by SEWRPC staff during July 2001. The results of these surveys are presented in Table 6, and graphically depicted on Map 10. Illustrations of the common aquatic plants found in Pell Lake are included in Appendix A. The SEWRPC staff also conducted a shoreline vegetation and wetland survey on Pell Lake during July 2001, and a detailed list of the shoreline and wetland plant communities inventoried within Pell Lake is included in Appendix B.

During the year 2000 aquatic plant survey, eighteen aquatic plant species were found in Pell Lake. The ecological significance of the thirteen submergent aquatic plant species is presented in Table 7. The Lake had good floral diversity and the density of aquatic plants throughout the lake was generally at an acceptable level for most recreational uses. The possible exception to this general state relates to Eurasian water milfoil, *Myriophyllum spicatum*, and coontail, *Ceratophyllum demersum*, which potentially could reach nuisance levels.

The presence of Eurasian water milfoil in Pell Lake is cause for concern. Eurasian water milfoil is an exotic, or nonnative, species that can exhibit "explosive" growth under suitable conditions, such as in the presence of organic-rich sediments or where the lake bottom has been disturbed. It reproduces by the rooting of plant fragments, and has been known to cause severe recreational use problems in lakes in Southeastern Wisconsin. It often outcompetes the native aquatic vegetation of lakes in Southeastern Wisconsin, reducing the biodiversity of the lakes and degrading the quality of fish and wildlife habitats.[16]

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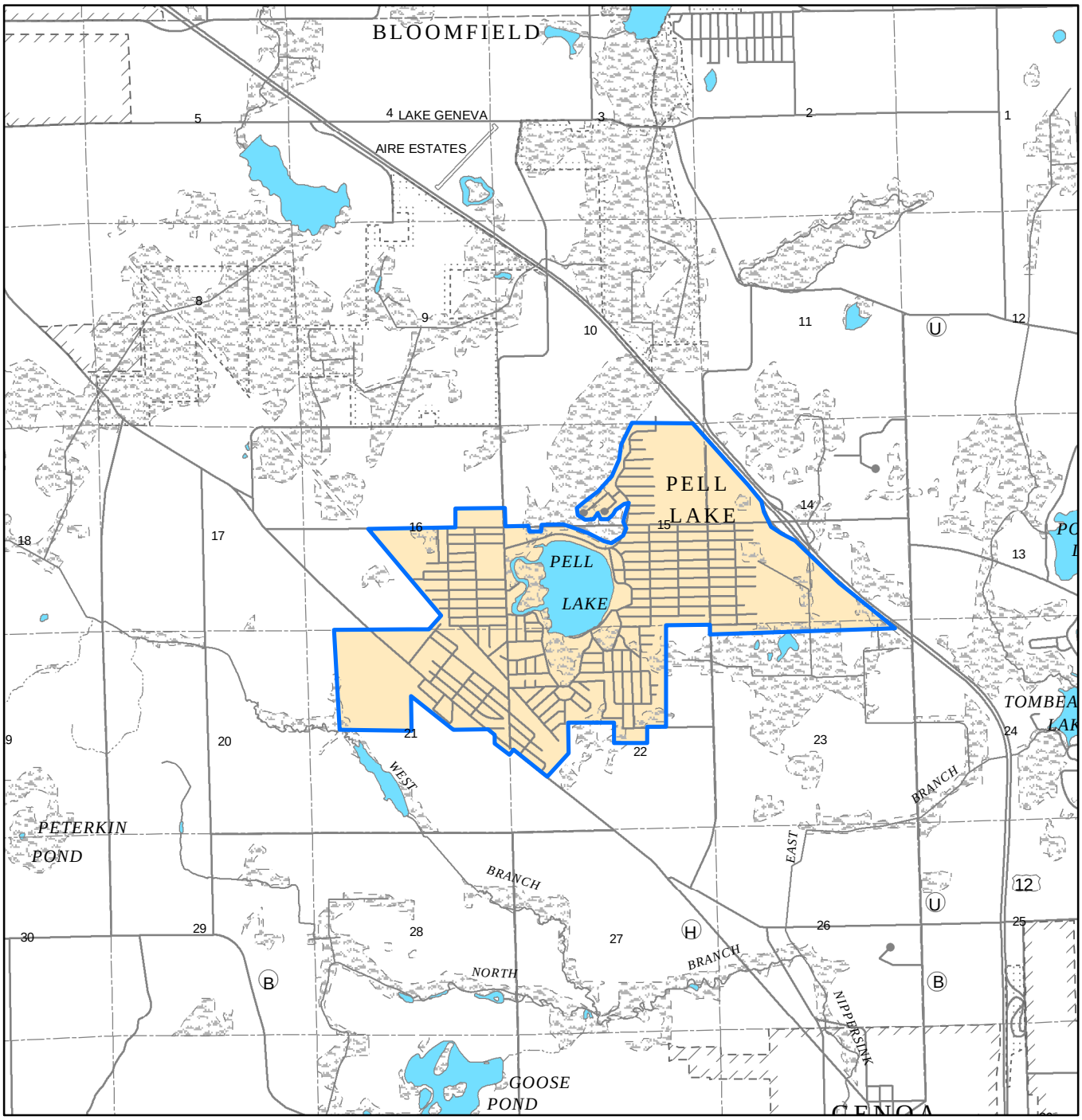
[15]*Wisconsin Department of Natural Resources Lake Use Report No. FX-37,* Pell Lake, Walworth County, Wisconsin, *1969.*

[16]*Wisconsin Department of Natural Resources,* Eurasian Water Milfoil in Wisconsin: A Report to the Legislature, *1993.*

Map 9

PELL LAKE PLANNED SANITARY SEWER SERVICE AREA BOUNDARY



Source: SEWRPC.

Table 6

FREQUENCY OF OCCURRENCE AND DENSITY RATINGS OF SUBMERGENT PLANT SPECIES IN PELL LAKE: JULY 2000

Aquatic Plant Species Present	Sites Found	Frequency of Occurrence (percent)	Relative Density	Importance Value
*Ceratophyllum demersum (*coontail)	43	46.7	1.8	0.83
*Chara vulgaris (*chara or muskgrass)	27	29.3	1.1	0.32
*Elodea canadensis (*waterweed)	21	22.8	1.8	0.41
Myriophyllum spicatum (Eurasian water milfoil)	87	94.6	2.9	2.75
Potamogeton amplifolius (large-leaf pondweed)	14	15.2	1.7	0.26
*Potamogeton crispus (*curly-leaf pondweed)	18	19.6	1.4	0.27
Potamogeton illinoensis (Illinois pondweed)	2	2.2	1.0	0.02
Potamogeton pectinatus (Sago pondweed)	29	31.5	1.6	0.50
Potamogeton richardsoni (clasping-leaf pondweed)	12	13.0	1.6	0.21
*Potamogeton robbinsii (*Robbins pondweed)	20	21.7	1.3	0.27
Potamogeton zosteriformis (flat-stemmed pondweed)	21	22.8	1.3	0.30

NOTE: There were 92 sites sampled during the July 2000 survey.

Source: Aron & Associates and SEWRPC.

Purple loosestrife, *Lythrum salicaria*, another nonnative nuisance plant, was also present in the wetlands and riparian areas surrounding the Lake. 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 ecological benefit. Purple loosestrife is a declared weed in the State of Wisconsin and is subject to an ongoing eradication program. The distributions of both Eurasian water milfoil and purple loosestrife should be monitored as part of the proposed aquatic plant-monitoring program within the WDNR Self-Help Lake Monitoring Program.

FISHERIES

The WDNR Publication No. PUBL-FH-800 2001, *Wisconsin Lakes*, 2001 indicates that largemouth bass, northern pike, and panfish are present in Pell Lake.[17]

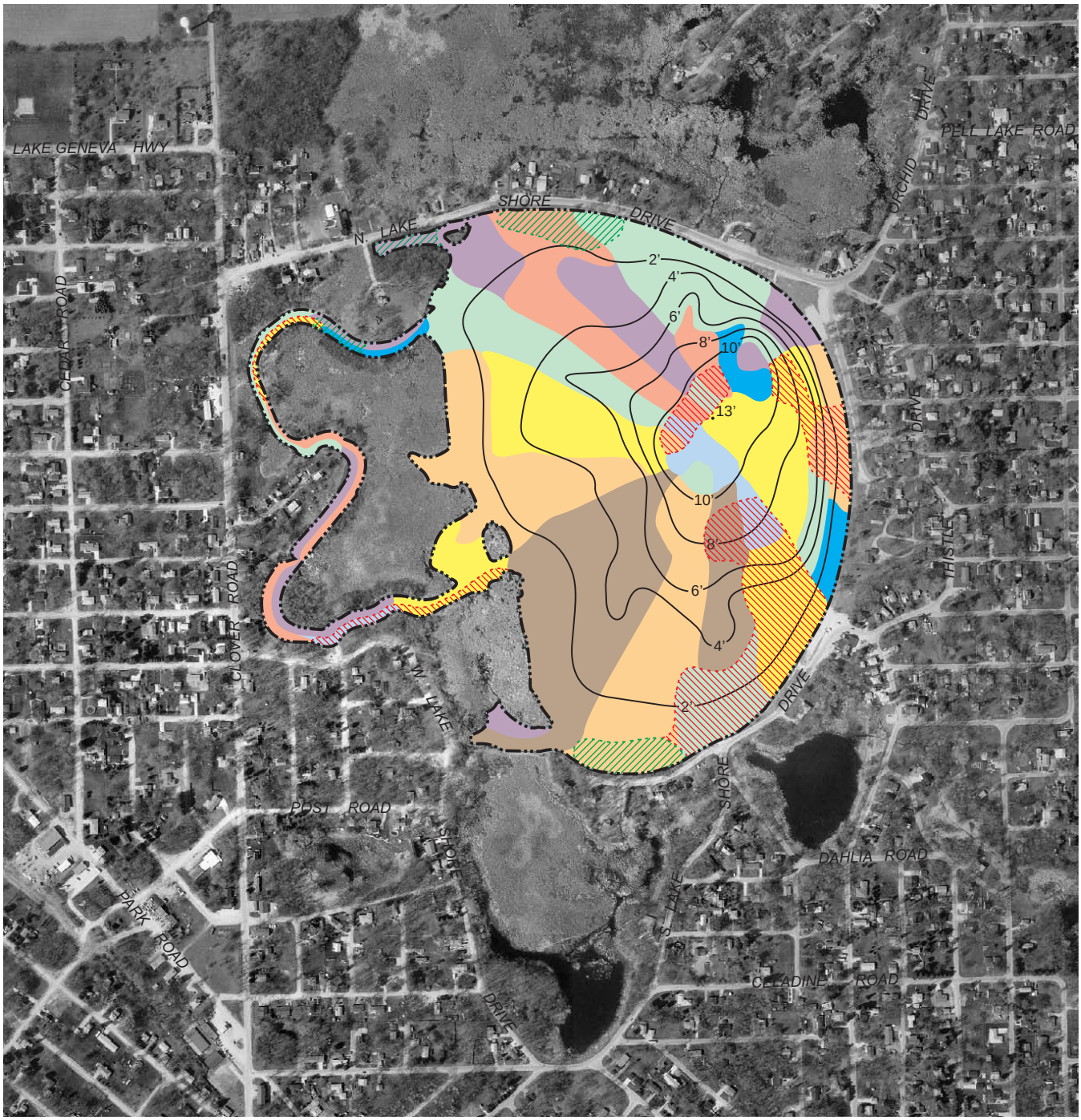
During 1967, the WDNR staff conducted a fisheries survey on Pell Lake identifying a predominantly largemouth bass, northern pike, and bluegill game fishery.[18] The 1967 fisheries inventory indicated that bluegills and yellow and brown bullheads were the dominant species present in the Lake. Other fish species included northern pike, largemouth bass, black crappie, green sunfish, pumpkinseed, and grass pickerel. Bullhead, while common to abundant in the Lake, were reported to be emaciated and in very poor condition. Though carp were not reported during the 1967 survey, local residents have expressed concerns regarding the numbers of carp currently in the Lake. Pell Lake has a history of intermittent winterkills, and has been stocked with largemouth bass by the WDNR. The latest available record of stocking of largemouth bass is from 1959. The emergent wetlands in and around the Lake are considered to provide suitable spawning grounds for northern pike, while the extensive shallow areas in the Lake are considered to provide suitable spawning grounds for largemouth bass and panfish.

[17]*Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 01,* Wisconsin Lakes, *2001.*

[18]*Wisconsin Department of Natural Resources Lake Use Report No. FX-37,* Pell Lake, Walworth County, Wisconsin, *1969.*

Map 10

AQUATIC PLANT COMMUNITY DISTRIBUTION IN PELL LAKE: 2000-2001



DATE OF PHOTOGRAPHY: MARCH 2000

— 20' — WATER DEPTH CONTOUR IN FEET

OPEN WATER

WATER LILIES

CURLY-LEAF PONDWEED

COONTAIL

LARGE-LEAF PONDWEED, SAGO PONDWEED, AND ROBBINS PONDWEED

MUSKGRASS, FLAT-STEM PONDWEED, LARGE-LEAF PONDWEED, ROBBINS PONDWEED, SAGO PONDWEED, AND CLASPING-LEAF PONDWEED

COONTAIL, MUSKGRASS, FLAT-STEM PONDWEED, LARGE-LEAF PONDWEED, ILLINOIS PONDWEED, AND CLASPING-LEAF PONDWEED

COONTAIL, MUSKGRASS, WATERWEED, FLAT-STEM PONDWEED, LARGE-LEAF PONDWEED, SAGO PONDWEED, ROBBINS PONDWEED, AND CLASPING-LEAF PONDWEED

MUSKGRASS, WATERWEED, FLAT-STEM PONDWEED, LARGE-LEAF PONDWEED, SAGO PONDWEED, ROBBINS PONDWEED, AND CURLY-LEAF PONDWEED

COONTAIL, MUSKGRASS, FLAT-STEM PONDWEED, LARGE-LEAF PONDWEED, ILLINOIS PONDWEED, SAGO PONDWEED, ROBBINS PONDWEED, AND CURLY-LEAF PONDWEED

GRAPHIC SCALE

0 350 700 FEET

NOTE: THE ENTIRETY OF PELL LAKE HAS EURASIAN WATER MILFOIL.

Source: Aron & Associates and SEWRPC.

Table 7

PELL LAKE AQUATIC PLANT ECOLOGICAL SIGNIFICANCE

Aquatic Plant Species Present	Ecological Significance
*Ceratophyllum demersum (*coontail)	Provides good shelter for young fish and supports insects valuable as food for fish and ducklings
*Chara vulgaris (*chara)	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
*Elodea canadensis (*waterweed)	Provides shelter and support for insects which are valuable as fish food
Myriophyllum spicatum (Eurasian water milfoil)	None known
Nuphar sp. (yellow water lily)	Leaves, stems, and flowers are eaten by deer; roots eaten by beaver; seeds eaten by wildfowl; leaves provide harbor to insects, in addition to shade and shelter for fish
Potamogeton amplifolius (large-leaf pondweed)	Provides food, shelter and shade for some fish and food for some wildfowl. Provides shelter and support for insects, which are valuable fish food
*Potamogeton crispus (*curly-leaf pondweed)	Provides food, shelter, and shade for some fish and food for wildfowl
Potamogeton illinoensis (Illinois pondweed)	Provides shade and shelter for fish; harbor for insects; seeds are eaten by wildfowl
Potamogeton pectinatus (Sago pondweed)	This is the most important pondweed for ducks, in addition to providing food and shelter for young fish
Potamogeton praelongus (white-stem pondweed)	Provides food and shelter for some fish such as trout; is also a valuable food source for ducks, geese, muskrat, beaver, and deer
Potamogeton richardsoni (clasping-leaf pondweed)	Provides food, shelter and shade for some fish, food for some wildfowl, and food for muskrat; provides shelter and support for insects, which are valuable as fish food
*Potamogeton robbinsii (*Robbins pondweed)	Provides habitat for invertebrates, in addition to providing good cover and foraging opportunities for fish
Potamogeton zosteriformis (flat-stemmed pondweed)	Provides some food for ducks

Source: Aron & Associates and SEWRPC.

WILDLIFE AND WATERFOWL

Given the single-family residential nature of much of the Lake's 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 fox and raccoon; marsh furbearers, such as muskrat; migratory and resident song birds; marsh birds, such as redwing blackbird and great blue heron; raptors, such as great horned owl and red-tailed hawk; and waterfowl. White-tailed deer have 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 11, wildlife habitat areas in the Pell Lake tributary drainage area generally occur in association with the existing surface water, wetland, and woodland resources shown on Map 12. Wildlife habitat areas covered about 310 acres, or 28 percent of the total drainage area. Of that area, about 198 acres, or 18 percent, were rated as Class I, high quality habitat; about 86 acres, or 8 percent, were rated as Class II habitat; and about 26 acres, or 2 percent, were rated as Class III, good quality habitat.

ENVIRONMENTAL CORRIDORS

The habitat areas shown on Map 11 are largely coincident with SEWRPC-delineated environmental corridors in this watershed, as shown on Map 13. Primary environmental corridors extend over 267 acres, or about 24 percent of the drainage area tributary to Pell Lake. SEWRPC recommends that, to the extent practicable, primary environmental corridor lands be maintained in essentially natural, open uses.[19]

RECREATIONAL USES AND FACILITIES

Pell Lake is a multi-purpose use waterbody serving all forms of recreation, including swimming, boating, and fishing in the summer months and ice-skating, cross-country skiing, and ice fishing in the winter months. The Lake is used year-round as a visual amenity, with walking and jogging, bird watching, and picnicking being popular passive recreational uses of the waterbody. The Lake is the site of a local park and beach, and a public recreational boating access site.

Public recreational boating access to Pell Lake consists of a town-owned boat launch site on the southeastern shore of the Lake, off Thistle Road and next to the public beach, as shown on Map 14. Roadside parking is currently allowed, though town road parking restrictions must be followed. Pell Lake is considered to have adequate public access in terms of the criteria set forth in Chapter NR 1 of the *Wisconsin Administrative Code.*

Recreational use surveys were conducted by SEWRPC staff on July 19 and July 21, 2001. These surveys indicated that one to two watercraft of all types were being operated on Pell Lake during the weekday and that three to five watercraft were being operated on Pell Lake during the weekend. Watercraft being operated on Pell Lake included fishing boats and pleasure boats of various types, such as pontoon boats, ski-boats, and personal watercraft. Table 8 summarizes the weekday and weekend boating usage on the Lake. A boat count, conducted during July 2001, indicated that 66 boats were either moored in the water or stored on land adjacent to the Lake. The types of boats included: canoes, fishing boats, paddleboats, pontoon boats, power boats, personal watercraft (jetskis®), and kayaks, as set forth in Table 9.

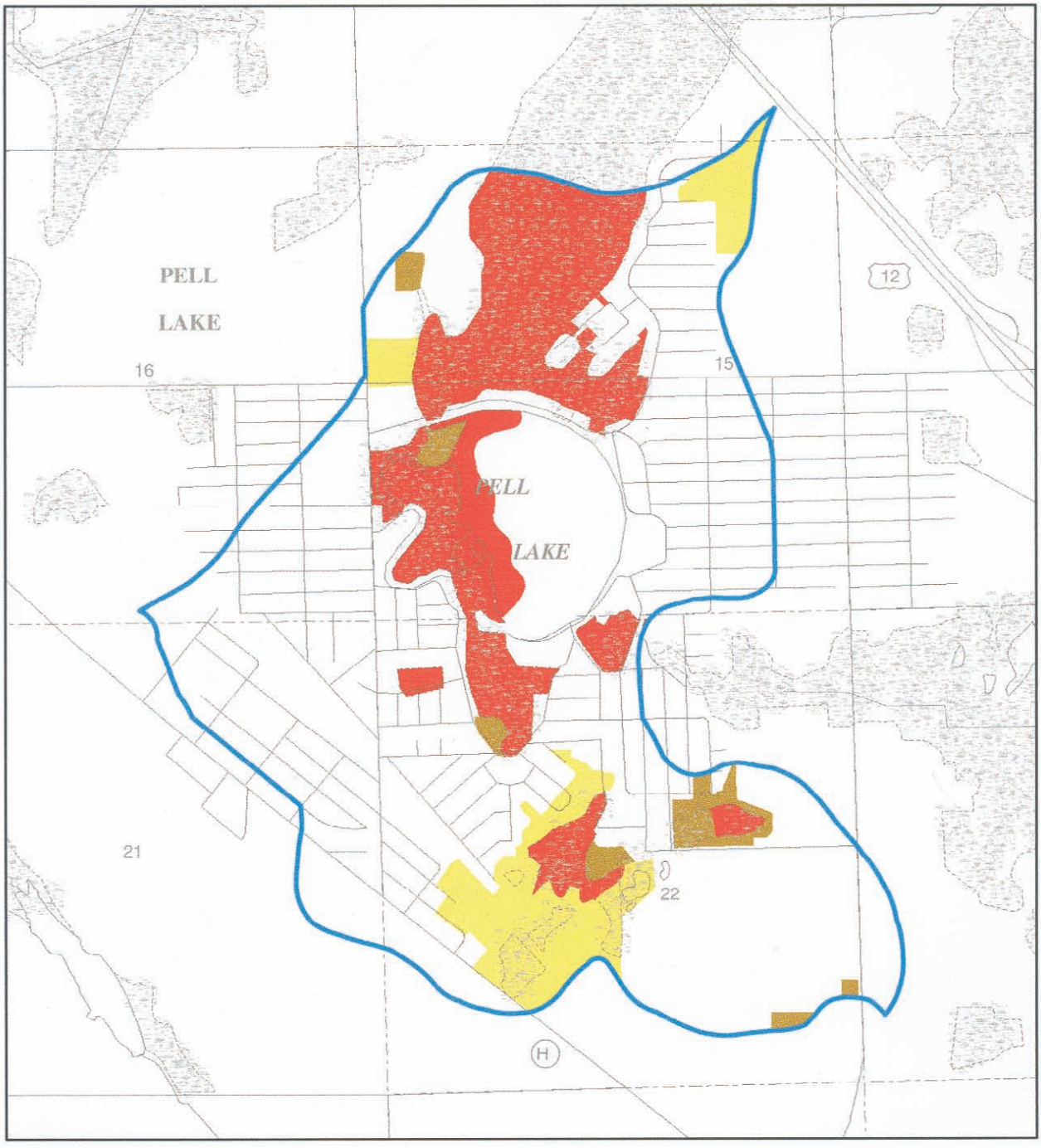
SHORELINE PROTECTION STRUCTURES

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 the Pell Lake shoreline, conducted by SEWRPC staff during July 2001, indicated that about 84 percent of the shoreline remains in a natural condition without shoreline protection structures. About 12 percent of the shoreline consists of sand beach, and the remaining 4 percent of the shoreline is protected by bulkhead, as shown on Map 14. No obvious, significant erosion-related problems were observed.

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

Map 11

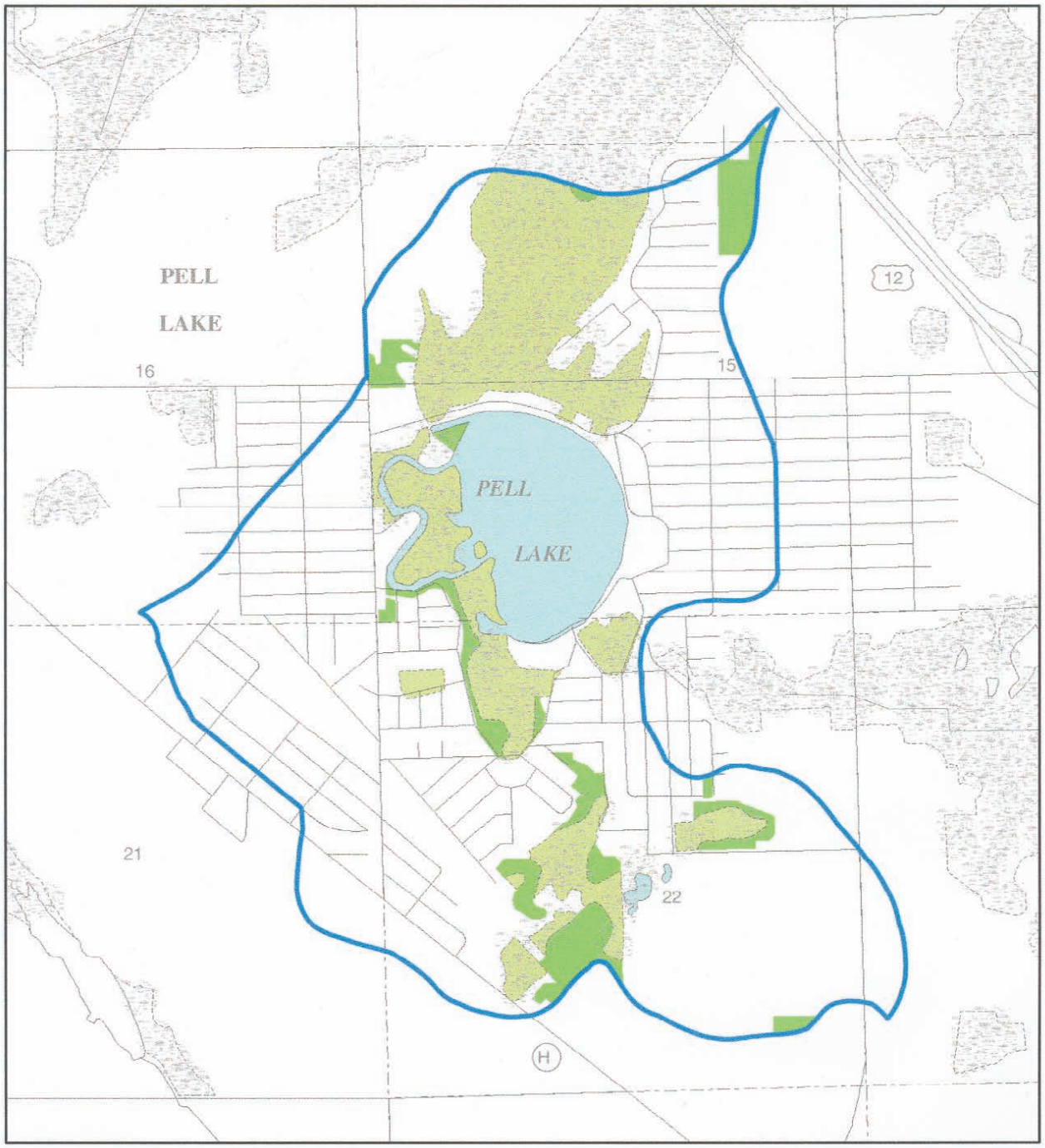
WILDLIFE HABITAT AREAS WITHIN THE AREA TRIBUTARY TO PELL LAKE: 1995



Source: SEWRPC.

Map 12

WETLANDS AND WOODLANDS WITHIN THE AREA TRIBUTARY TO PELL LAKE



Wetlands
Woodlands
Surface Water

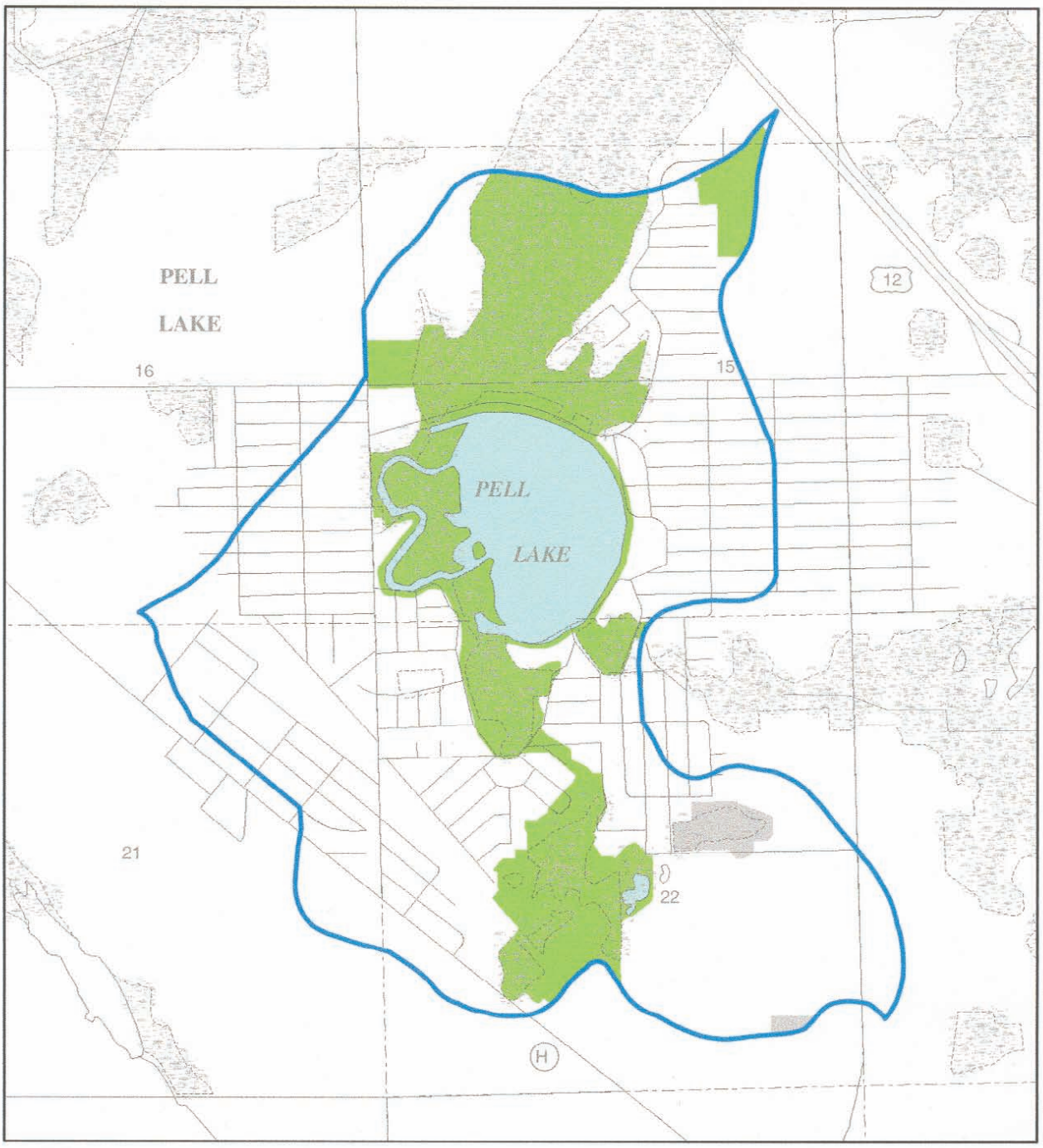
N

0 0.3 0.6 Miles

Source: SEWRPC.

Map 13

ENVIRONMENTAL CORRIDORS AND NATURAL AREAS WITHIN THE AREA TRIBUTARY TO PELL LAKE: 1995



Primary Environmental Corridor

Isolated Natural Resource Area

Surface Water

N

Miles

0 0.3 0.6

Source: SEWRPC.

Map 14

SHORELINE PROTECTION STRUCTURES ON PELL LAKE: 2001

DATE OF PHOTOGRAPHY: MARCH 2000

BEACH

NATURAL

BULKHEAD

PUBLIC BOAT ACCESS

GRAPHIC SCALE

0 350 700 FEET

Source: SEWRPC.

Table 8

RECREATIONAL USE SURVEY ON PELL LAKE: 2001

Date and Time	Weekday Participants							
	Fishing	Pleasure Boating	Skiing	Sailing	Jetskiing	Swimming	Other	Total
July 19, 2001								
9:30 a.m. to 10:30 a.m.	4	0	0	0	0	0	1	5
1:15 p.m. to 2:15 p.m.	8	0	0	0	0	15	11	34
Total	12	0	0	0	0	15	12	39
Percent	31	0	0	0	0	38	31	100

Date and Time	Weekend Participants							
	Fishing	Pleasure Boating	Skiing	Sailing	Jetskiing	Swimming	Other	Total
July 21, 2001								
10:30 a.m. to 11:30 a.m.	1	0	0	0	0	10	5	16
1:15 p.m. to 2:15 p.m.	0	2	1	0	2	23	6	34
Total	1	2	1	0	2	33	11	50
Percent	2	4	2	0	4	66	22	100

Source: SEWRPC.

Table 9

WATERCRAFT ON PELL LAKE: JULY, 2001

Type of Watercraft										
Power Boat	Fishing Boat	Pontoon Boat	Canoe	Paddle Boat	Sailboat	Kayak	Wind Surfboard	Personal Watercraft	Other	Total
1	57	2	1	1	- -	1	- -	1	2	66

Source: SEWRPC.

COUNTY ORDINANCES

County Zoning Ordinance

Zoning represents one of the most important and significant tools available to local units of government in directing the proper use of lands within their areas of jurisdiction.[20] Local zoning regulations include general, or comprehensive, zoning regulations and special-purpose regulations governing floodland and shoreland areas. General zoning may be adopted as a single ordinance or as a series of separate ordinances; they may or may not be contained in the same document. Any analysis of locally proposed land use must take into consideration the provision of both general and special-purpose zoning. Walworth County has adopted general zoning in the unincorporated portions of the County, including the area tributary to Pell Lake, in accordance with Section 59.69 of the *Wisconsin Statutes*.

[20]*SEWRPC Community Assistance Planning Report No. 268,* op. cit.

Through the C-4 zoning district, the County zoning ordinance provides for conservancy zoning of the immediate shoreland area and the open water portion of the Lake itself, as shown on Map 15. The lands surrounding the Lake, beyond the C-4 zoning district, are predominately included within an R-1, single-family residential, zoning district. With the exception of some scattered businesses, zoned as B-1 and B-2; scattered industrial areas, zoned as M-1; and the parkland to the north and east of the main lake basin, zoned as P-1 and P-2, this zoning provides for low-density, single-family residential development around much of the lakeshore. Small areas of land beyond the shorelands are zoned as P-1 and P-2 parkland and institutional lands. Outside of the residential lands, portions of the area tributary to Pell Lake are zoned as A-2, agricultural lands, which permits residential development at very low densities, or C-2, upland resource conservation zoning district, and as C-4, lowland resource conservation district. Small areas of the tributary area also fall within the A-1, prime agricultural, and A-3, agricultural land in holding zoning districts.

County Stormwater Management and Construction Site Erosion Control Ordinance

In addition to the zoning code, the Walworth County Land Disturbance, Erosion Control and Storm Water Management Ordinance applicable to the Town of Bloomfield, 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 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 apply to residential developments of five acres or more, and other developments of three acres or more. Land disturbing activities associated with the development of one- and two-family dwelling and building sites are controlled under the provisions of the Uniform Dwelling Code (UDC). All control measures are administered and enforced by the Walworth County Land Conservation Department.

County Subdivision Control Ordinance

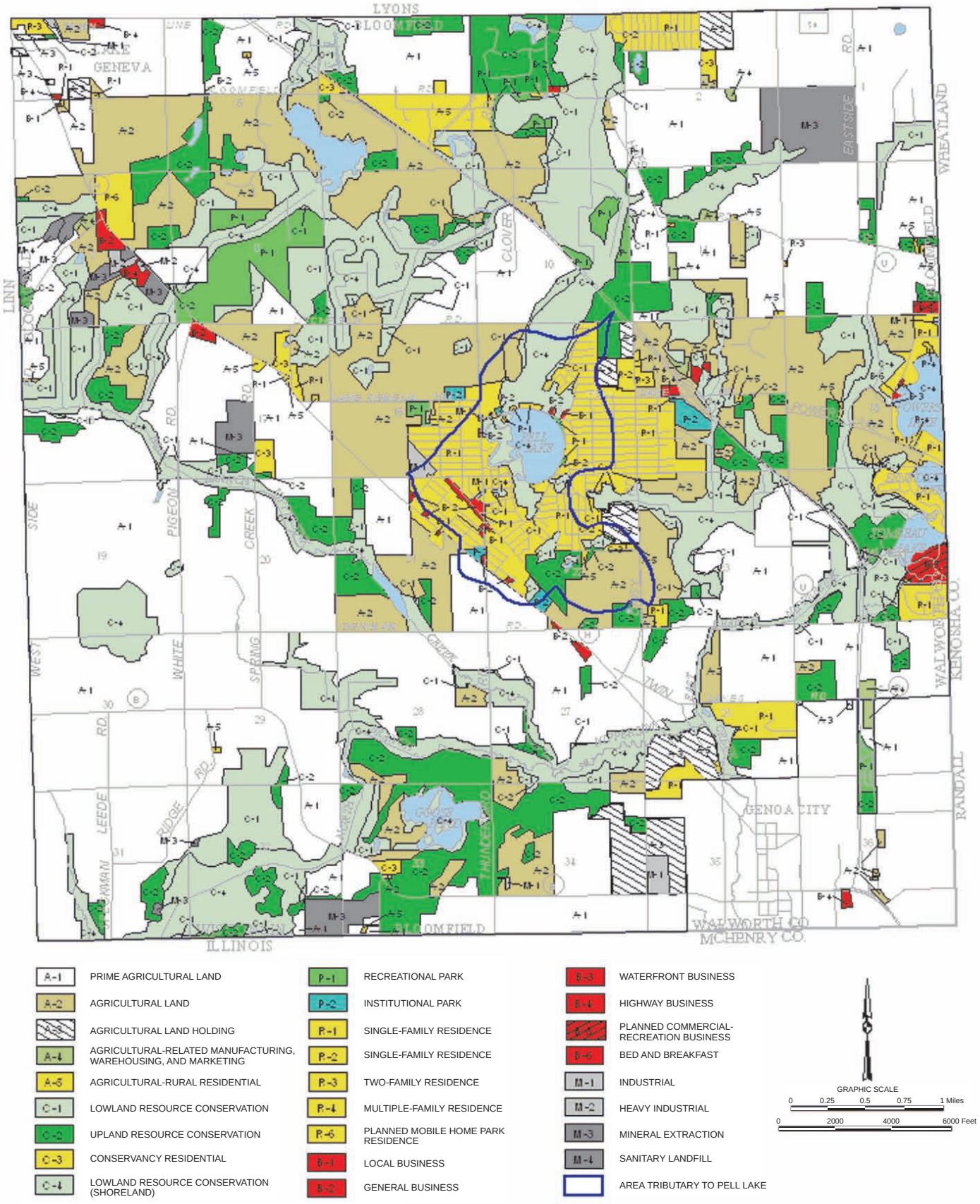
The Walworth County Subdivision Control Ordinance establishes requirements with respect to the design of lots, subdivision access, and necessary internal improvements, such as streets, drainage, and sewerage and water facilities. The ordinance requires the preparation of a subdivision plat for all land divisions that create five or more parcels or building sites each of which is 15 acres or less in size. The ordinance requires the preparation of a certified survey map for a division of land, other than a subdivision, which results in the creation of less than five lots, any one of which is 15 acres or less in size. Most provisions of the ordinance are also applicable to condominium projects. Under the County ordinance, certain requirements, such as those pertaining to road surfacing and to the installation of curbs and gutters, sidewalks, and street lamps, are left to the determination of the town boards of the respective towns.

County Shoreland Zoning Ordinance

Under Section 59.971 of the *Wisconsin Statutes*, counties in Wisconsin are required to adopt zoning regulations within statutorily defined shoreland areas, or, those lands that are within 1,000 feet of the ordinary high water mark 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 Chapter NR 115 of the *Wisconsin Administrative Code*. In Walworth County, shoreland and floodland regulations are set forth in the Walworth County Shoreland Zoning Ordinance. This ordinance includes zoning districts and special regulations for shoreland areas, as defined above. The shoreland regulations include requirements governing the removal of vegetation and earth movements, and structural setbacks, within the shoreland area. Among these requirements are provisions, set forth in Section 2.8 of the Ordinance, that limit tree cutting, shrubbery clearing, and earth movements within the shoreland zone to no more than 30 lineal feet within any 100 feet of shoreline and within an area extending landward 35 feet from the Ordinary High Water Mark, to prevent erosion, minimize sedimentation, and preserve the natural beauty of the County.

Map 15

EXISTING ZONING DISTRICTS WITHIN THE VICINITY OF PELL LAKE: 2000



Source: Walworth County Zoning Ordinance and SEWRPC.

The Walworth County Shoreland Zoning Ordinance also includes the County's floodplain regulations, which apply to all lands within the 100-year recurrence interval flood hazard areas. The existing floodplain regulations prohibit virtually all new structures in the floodplain, including the floodway and flood fringe areas, in accordance with sound floodland management practice.

In addition, counties, pursuant to Chapters 23 and 330 of the *Wisconsin Statutes*, also are required to regulate the use of all wetlands five acres or larger located in the shoreland areas of unincorporated municipalities within 300 feet of a stream and 1,000 feet of a lake, or to the landward side of the floodplain, whichever is greater. Wetland maps for Walworth County were prepared for the WDNR by SEWRPC in 1981. State water quality standards for wetlands are set forth in Chapter NR 103, "Water Quality Standards for Wetlands," of the *Wisconsin Administrative Code*.

FEDERAL WETLAND REGULATIONS

Section 404 of the Federal Clean Water Act requires the U.S. Department of the Army, Corps of Engineers, working in cooperation with the U.S. Environmental Protection Agency, to regulate the discharge of dredged and fill material into waters of the United States, including lakes, rivers, and wetlands. In carrying out this responsibility, the Corps of Engineers determines when permits are required for the discharge of dredged and fill materials. Some silviculture, mining, and agricultural activities in water and wetland areas may be exempt from the individual permit requirement. Certain minor activities, such as boat ramp construction and shore stabilization, may be undertaken under a pre-approved general, or nationwide, permit. Under Section 401 of the Act, the issuance of Federal permits must be consistent with State water quality policies and standards.

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Chapter III

LAKE USE PROBLEMS AND ISSUES

INTRODUCTION

Although Pell Lake is in relatively good condition and is capable of supporting a variety of recreational water uses, there are a number of existing and potential future problems and issues that should be addressed in this lake protection plan. These issues of concern include: potential changes in ecologically valuable areas and the aquatic plant and fisheries communities, nonpoint source pollution and lake water quality, public recreational water use, and protection of the shoreline.

ECOLOGICALLY VALUABLE AREAS, AQUATIC PLANTS, AND FISHERIES

The ecologically valuable areas within the area tributary to Pell Lake, as documented in Chapter II, include wetlands, woodlands, and wildlife habitat. Most of these areas are included in the lands designated as primary environmental corridor. Critical sites within the Lake include the fish spawning habitat; macrophyte beds, especially those containing a diverse flora; and the shoreline areas supporting productive aquatic habitat. Each of these major ecosystem elements are discussed below as issues of concern facing the Pell Lake community.

Protection of Ecologically Valuable Areas

The environmental corridor lands within the drainage area tributary to Pell Lake, together with the isolated natural resource features, contain almost all of the best remaining woodlands, wetlands, and wildlife habitat in the area. As discussed in Chapter II, the wetland areas adjacent to Pell Lake provide important habitat for fish and wildlife. The wetland areas physically connected to the Lake provide especially valuable fish spawning habitat during early spring. In addition, these areas also contribute to the scenic vistas which characterize the Pell Lake watershed. Wetlands provide a nutrient filter and a buffer that protects the Lake from urban runoff, while providing wildlife habitat and maintaining the ecological structure and function of the wetland ecosystems. Shoreland wetlands also help to store floodwaters, and, by retaining sediments and nonpoint source pollutants, can help to protect the Lake from degradation. These attributes provide a broad range of natural resource and aesthetic benefits.[1] Thus, the preservation of the corridor and protection of these lands from additional intrusion by incompatible land uses which degrade and destroy the environmental values of these sites are important issues that should be considered.

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[1]*The range of benefits to be derived from a sound natural resources base within southeastern Wisconsin is summarized in SEWRPC Planning Report No. 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin*, September 1997.*

Aquatic Plant Management

The presence of Eurasian water milfoil and curly-leaf pondweed in the Pell Lake basin, and the presence of purple loosestrife in the wetlands and shorelands adjoining the Lake, represents another important issue; namely, the invasion of native plant communities by nonnative, competing species. The invasive Eurasian water milfoil often outcompetes native aquatic plants and, without management, frequently dominates the plant communities in the lakes of southeastern Wisconsin, to the detriment of native plant species, and fish and wildlife populations. In addition, the dominance of Eurasian water milfoil in aquatic ecosystems in southeastern Wisconsin commonly interferes with human recreational and aesthetic use of the natural resources. As discussed in Chapter II, this aquatic plant is widespread in Pell Lake and, therefore, its monitoring and management is an issue that should be considered.

Fisheries Management

Based upon the fisheries survey conducted by the Wisconsin Department of Natural Resources (WDNR), and set forth in summary form in Chapter II, it would appear that the fishery in Pell Lake may be limited by past winterkills, even though no winterkills have been reported by WDNR in recent years. The aquatic plant surveys, conducted by Aron & Associates and subsequent reconnaissance conducted by the Commission staff, indicate a diversity of aquatic plant species that can provide good habitat and structure for fishes. The nuisance levels of Eurasian water milfoil threaten this diversity. In addition, residents around the Lake have expressed concern about the perceived numbers of carp present in Pell Lake. Large populations of carp, an introduced species in Wisconsin, disturb the lake bottom substrates and prey upon numerous, smaller native fishes, disrupting their breeding success and disadvantaging their populations in lakes. As angling is a popular recreational activity on Pell Lake, identification of the current state of the fishery on the Lake is an important issue that should be considered.

In addition, the Pell Lake Sanitary District has expressed interest in investigating the feasibility of establishing a connecting waterway on the southeastern shoreline between the lake and a small open water area in the adjoining wetland. Such a plan would potentially involve the removal of fill that was placed during the 1930s. This action could provide a migration route for fishes between the lake and the wetland area, and possibly enhance the lake fishery by providing additional spawning and foraging areas for some species. Further consideration of this proposal is warranted.

NONPOINT SOURCE POLLUTION AND WATER QUALITY

Human activities upon the land surface result in the generation and mobilization of contaminants that are transported to lakes by rainfall, wind, and runoff. Where such activities involve the exposure of the soil surface, larger contaminant loads result. Thus, erosion during construction and generation of nonpoint source pollutants associated with new urban development in the area tributary to Pell Lake represent a potentially significant threat to water quality. Even though future development of open lands within the drainage area tributary to Pell Lake is expected to be limited, unplanned development may occur and impacts on lake water quality could potentially result.

While surface water quality in Pell Lake was reported to be generally good as of 1999, the Lake is within the meso-eutrophic range, indicating that some water quality problems may be expected. Secchi disc data, reported in Chapter II, indicate a gradual improvement in water transparency during the period between 1988 and 1999. This, together with the recent implementation of the public sanitary sewerage system, would tend to support the notion that water quality in Pell Lake is improving. Nevertheless, the citizens within the Pell Lake Sanitary District have expressed ongoing concerns regarding the perceived degradation of water quality and the need for long term maintenance of surface water quality. Hence, control of nonpoint source pollution and lake water quality is an important issue to be considered.

PUBLIC RECREATIONAL USE AND BOATING ACCESS

Overcrowding and excessive recreational boating use create problems 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 area. Given the small surface area of Pell Lake and the nature of the

public recreational boating access site, the potential for the occurrence of problems due to increased or inappropriate boating pressure is considered to be limited. Nevertheless, local use of the Lakes for water-based recreation, and the proximity of the boating access site to the public beach, could result in potentially significant recreational use conflicts should the Lake become better known and more heavily utilized. Currently, citizens within the Pell Lake Sanitary District have expressed concerns regarding the operation of large, high-powered watercraft from outside of the Pell Lake community in proximity to the swimming area. In addition, citizens have voiced their concern that recreational use of Pell Lake might increase as access to neighboring lakes becomes more restrictive or less readily available as a result of heavy recreational use pressures.

With respect to recreational boating activity on Pell Lake, standards set forth in the regional and county park and open space plans[2] would suggest the use of a maximum of not more than five fast boats on Pell Lake. This is consistent with the requirements set forth in Sections NR 1.91(4) and NR 1.91(5) of the *Wisconsin Administrative Code* which establish minimum and maximum recreational boating access standards, respectively.[3] As noted in Chapter II, there is currently one public boating access site on the southeastern shore of Pell Lake providing available roadside parking, subject to town road parking restrictions, equivalent to that specified in Sections NR 1.91(4) and NR 1.91(5) of the *Wisconsin Administrative Code*. There is also an additional private boating access site along Lake Shore Drive, on the northeastern shore of the Lake, currently being utilized for the aquatic plant harvesting equipment. Lakes meeting the Chapter NR 1 standards for public boating access development qualify for resource enhancement services provided by the WDNR.[4] Thus, continuing provision of adequate public parking at Pell Lake, pursuant to Chapter NR 1 standards, is an important consideration since it is a factor in determining eligibility for future lake enhancement grants from the WDNR.

SHORELINE PROTECTION

Periodic changes in precipitation and weather patterns between years often result in fluctuation of water loads to the lake. These fluctuations, in turn, can affect lake levels. Riparian residents and local officials have reported such changes in the water levels of Pell Lake. Most plant and animal species can cope with this level of water surface fluctuation. Water level management of lakes beyond these natural limits, by operation of outlet structures or formalizing outflow channels, for example, is a common technique for managing fish and aquatic macrophytes. However, the consequences of artificially manipulating lake water levels can be both beneficial and deleterious. The major deleterious impacts from the riparian owner standpoint is that the fluctuating water levels affect shoreline erosion, interfere with proper height and placement of piers, and affect the placement of shoreline protection structures. Likewise, negative impacts on the natural ecosystem include the affects of flooding and drawdown on fish breeding habitat, amphibian overwintering habitat, and shoreland vegetation. Positive impacts relate to suppression of nonnative species, for example. As noted in Chapter II, many areas of natural shoreline were identified in the 2001 shoreline survey, some of which appear subject to erosion and undercutting of banks. Such shoreland erosion could be expected to increase as lake usage increases, especially during periods of higher water levels. Consequently, maintenance of water levels within natural limits is an issue of concern from the point of view of protecting aquatic habitat and public access to the Lake, and minimizing the impacts of shoreland erosion on the Lake.

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[2]*SEWRPC Community Assistance Planning Report No. 35,* A Park and Open Space Plan for Walworth County, Wisconsin, *February 1991.*

[3]*For lakes with a boatable surface area similar to that of Pell Lake, maximum and minimum public recreational boating access site standards are the same: recreational boating access sites should accommodate a total of five car-top and/or car-trailer units, plus one handicapped-accessible car-top and/or car-trailer unit.*

[4]*Enhancement services include fish stocking, eligibility for certain grant and cost-share programs, and related services provided by the State.*

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Chapter IV

ALTERNATIVE AND RECOMMENDED LAKE PROTECTION AND RECREATIONAL USE MEASURES

INTRODUCTION

There are a number of issues of concern that impact the protection and recreational use of Pell Lake. These issues were identified in Chapter III and include: protection of ecologically valuable areas, fisheries, and aquatic plant communities, control of nonpoint source pollution and protection of surface water quality; provision of public recreational use opportunities; and shoreline protection.

In some ways, these issues of concern are interrelated. For example, in those areas of the Lake where the nonnative, invasive aquatic plant Eurasian water milfoil is abundant, certain recreational uses may be limited, the aesthetic quality of the Lake impaired, and in-lake habitat degraded. From a boating standpoint, the plant primarily interferes with boating activities by restricting propeller movement and clogging cooling-water intakes, snagging paddles, and slowing sailboats by impeding keels and control surfaces. The plant also causes concern amongst swimmers who can become entangled within the plant stalks. Thus, without control measures, these areas can become problematic for such recreational uses as boating, fishing, and swimming. Native aquatic plants, generally found at slightly deeper depths, pose fewer potential problems for navigation, swimming, and fisheries. Many species of fish depend on the native aquatic plants to provide habitat, food resources, and shelter for juvenile and young-of-the-year fishes. Thus, as native plant species are crowded out and replaced by invasive species like Eurasian water milfoil and curly-leaf pondweed, negative impacts are experienced throughout the lake ecosystem at all levels.

In this chapter, alternative and recommended management measures to address the identified issues of concern are presented. These measures include:

1. Land use management measures designed to limit the inputs of contaminants and protect ecologically valuable areas and biota;

2. Fisheries and aquatic plant management measures designed to mitigate the habitat-related impacts of a changing aquatic flora and maintain an ecologically viable system;

3. Recreational use management measures designed to manage boating behaviors, curtail the spread of invasive species, and provide for continuing public recreational boating access;

4. Aquatic and shoreland plant management measures designed to encourage native plant communities and limit the spread of nonnative, invasive species; and

5. Shoreland protection measures designed to reduce erosion-related problems and encourage the establishment of native shoreline vegetation and habitat.

Alternative and recommended management measures to address these concerns are described below. The alternatives and recommendations set forth herein focus on those measures which are applicable to the Pell Lake Sanitary District and Town of Bloomfield, but include measures applicable to other, general purpose units of government within the Pell Lake community.

PROTECTION OF ECOLOGICALLY VALUABLE AREAS, FISHERIES, AND AQUATIC PLANT COMMUNITIES

Protection of Ecologically Valuable Areas

Array of Land Use Management Measures

The recommended future land use condition for the area tributary to Pell Lake is set forth in the adopted regional and County land use plans.[1] These plans identify environmentally significant corridors and present alternatives for their preservation in essentially natural, open space use. The delineated environmental corridors contain most of the ecologically valuable lands in the vicinity and adjacent to Pell Lake. Alternative protection measures include 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. All lakes, wetlands, and woodlands are recommended to be placed in conservancy protection districts. The existing Walworth County zoning for the lands in the vicinity of Pell Lake and in the drainage area tributary to Pell Lake is consistent with these recommendations.

With respect to the recommended future land use pattern, the adopted County and regional land use plans indicate little new development within the area tributary to Pell Lake. Some limited infilling of existing, platted lots would be expected to occur, and, in addition, the redevelopment and reconstruction of existing single-family homes on lakefront properties may be expected. The existing Walworth County zoning for the lands in the vicinity of Pell Lake and in the drainage area tributary to Pell Lake is consistent with the adopted regional plan. These potential future changes may be expected to result in a minor increase in the pollutant loadings to the Lake associated with urbanization and could potentially increase the pressure for recreational use of the Lake. In addition, these land use changes have the potential to impact the quantity and quality of groundwater inflows to the Lake. Groundwater inflows to the Lake are an important reason why the Lake water quality is maintained at a high level.

Recommended Management Measures

The following land management measures, designed to protect and maintain the environmentally significant corridors and ecologically valuable lands within the area tributary to Pell Lake, are recommended to be considered:

- Implement the guidelines set forth in adopted local and regional land use plans to encourage conservation development within the drainage area, protect environmentally sensitive lands, and minimize nonpoint sourced pollutant loading to Pell Lake;

- Periodically review the sanitary sewer service area plan to continue to provide sanitary sewerage services to the Pell Lake community; and,

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[1]*SEWRPC Planning Report No. 45,* A Regional Land Use Plan for Southeastern Wisconsin: 2020, *December 1997; SEWRPC Community Assistance Planning Report No. 252,* A Land Use Plan for Walworth County, Wisconsin: 2020, *April 2001; and SEWRPC Community Assistance Planning Report No. 225*, Sanitary Sewer Service Area for the Pell Lake Sanitary District No. 1, Walworth County, Wisconsin, *June 1996.*

- Enforce existing ordinances regulating stormwater discharges, including runoff from construction sites, to the Lake and surrounding wetlands.

Fisheries Management

Although the Wisconsin Department of Natural Resources (WDNR) conducted a fish survey in 1967, lack of recent data hinders accurate appraisal of the fish population in Pell Lake. Some of the principal concerns with the present fishery center around possible winterkills, the perceived problem of limited species diversity, and the extent of the carp population. In addition, displacement of native aquatic plant populations by Eurasian water milfoil and the subsequent impact this has not only on the fish population but on the lake ecosystem as a whole, makes the establishment and maintenance of an ecologically viable native aquatic plant population an issue of prime importance. These latter aspects are discussed further below with respect to aquatic plant management measures.

Array of Management Measures

Pell Lake appears to provide a moderate amount of suitable habitat for a warmwater fishery with adequate water quality to support the maintenance of a fish population dominated by desirable sport fish. To this end, a more rigorous fisheries survey should be considered in order to better identify fish population composition, length-weight distributions, community age structure, and related life history information, such as proportion of available spawning habitat, spawning success, and juvenile recruitment, that will be important for making stocking-related decisions. It should be noted that stocking of fishes by the WDNR is considered a lake enhancement service, the provision of which is subject to a lake being deemed to have adequate public access pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Habitat Protection

Habitat protection refers to a range of conservation measures designed to maintain existing fish spawning areas and provide those environmental conditions necessary to maintain a healthy fish population. These measures include a wide array of possible actions, such as: restricting recreational and other intrusions into gravel-bottomed shoreline areas during the spawning season (for bass this is spring, mid-April to mid-June), establishment and maintenance of natural vegetation in shoreline and near shore management zones, and control of those human actions, such as construction of piers, docks, and boathouses, that can result in a degradation of fish habitat.

A berm was reportedly constructed during the 1930s as part of a proposed transportation corridor across the southern portion of the lake basin. That berm has resulted in the isolation of the wetland complex adjacent to Nippersink Creek. While this portion of the lakebed remains connected to the lake basin through a small, approximately one-foot-square cross-section culvert, enhancing this connection could provide additional breeding habitat for some panfish and game fish species, including northern pike, as well as a juvenile rearing habitat that provides food and protection from larger adult species of fish in the Lake. Two options can be considered; namely, creating a wider opening in the vicinity of the current culvert connection, or, alternatively, removing the approximately 400-foot-long by about 10-foot-wide berm. The latter option would eliminate the need for future monitoring and maintenance that would be required should the wider culvert alternative be considered. Culverts have a limited number of functional years based upon materials they are composed of, therefore, all culverts need to be replaced, which may become a cost issue when that time comes. Culverts also could pose a safety issue if persons try to gain access through it, and generally are problematical as fish passages, being sensitive to gradients, flow dynamics, adequate depth, orientation relative to the prevailing winds, silting, and similar considerations. Thus, removal of the fill to natural grade is recommended.

Habitat Creation

In lakes where vegetation is lacking or where plant species diversity is low, artificial habitat may need to be developed. As discussed in Chapter II, the results of the aquatic plant surveys of Pell Lake indicate that there appears to be sufficient diversity of aquatic plants to provide habitat for a healthy fish community.

The use of natural shoreline landscaping techniques also can enhance available fish and wildlife habitat around lakes. Shoreline cover, in the form of deadfalls or other structures to improve fish habitat into the nearshore

waters, would be intended to provide shelter for juvenile fishes and forage fishes, as well as substrate for aquatic invertebrates and algae that serve as their food stocks. As noted in Chapter II, much of the lakeshore is currently maintained in a natural state. Therefore, provision of additional structures is not considered to be warranted. Should this condition change, however, maintenance of sufficient shoreline structure is recommended. It should be noted that placement of such structures may require a WDNR permit pursuant to Chapter 30 of the *Wisconsin Statutes*.

Modification of Species Composition
Species composition management refers to a group of conservation and restoration measures that include surveying the present fish population, controlling nonnative fish species such as carp, and the stocking of desirable species designed to enhance the angling resource value of a lake. Fish surveys need to be conducted and fish populations need to be monitored to attain an accurate representation of the status of the fish population. The mixture of species in the population, in part, determines the stocking objectives: supplement an existing population, maintain a population that cannot reproduce itself, add a new species to a vacant niche in the food web, replace species lost to a natural disaster, or establish a fish population in a depopulated lake. Similarly, selective harvesting of fishes through targeted fisheries can be used to remove fishes from a lake where the fish communities are stunted due to overabundance. Assistance in stocking programs and fisheries management is potentially available through the WDNR.

The ability of Pell Lake to utilize such assistance is dependent, in part, upon adequate public recreational boating access, pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*. It would appear that Pell Lake meets the criterion for adequate public parking at this time. Additionally, stocking assistance may be privately available from local commercial hatcheries. Fish stocking and population management activities may require a WDNR permit.

Regulations and Public Information
The open season, size limits, and bag limits for the fish species of Pell Lake are regulated by the WDNR. Enforcement of these regulations is important to the success of any sound fish management program. Such requirements provide an opportunity for both game and forage fish population to reach a sustainable level.

The conduct of periodic creel surveys using volunteer monitors can provide a cost-effective means of obtaining additional data on the fish populations and fisheries in Pell Lake. Alternative approaches to the conduct of this type of survey could include creel census-takers stationed at the boat access site, the distribution of questionnaires to riparian households, and similar voluntary reporting mechanisms. Examples of available resources for the conduct of such citizen-based surveys are provided in Appendix C.

Recommended Management Measures
The following fisheries management measures, designed to improve and enhance the Lake fishery, are recommended to be considered:

- Conduct a survey of the fish population in Pell Lake to determine the current status of the fishery and monitor the carp population;

- Remove the fill creating a berm across the southern portion of Pell Lake to enhance fish access to shoreland wetland areas and the currently isolated southern portion of the Lake;

- Improve fish habitat by encouraging the growth of native aquatic in-lake and shoreline plants through plantings and control of nuisance species and continue monitoring until habitat improvements are fully in place; and

- Utilize fishing regulations to protect fish populations and improve the opportunity for their populations to become self-sustaining, it is recommended that residents participate in volunteer creel surveys so that an ongoing monitoring of the fish population in Pell Lake can be carried out.

Aquatic and Shoreland Plant Management

Past and Present Aquatic Plant Management Measures

Records of aquatic plant management efforts on Wisconsin lakes were not maintained by the WDNR prior to 1950. Thus, while previous interventions were likely, the first recorded efforts to manage the aquatic plants in Pell Lake have taken place since 1950. Aquatic plant management activities on Pell Lake can be categorized as chemical macrophyte and algal control, and macrophyte harvesting. During the period from 1954 through 1958, approximately 2,900 pounds of sodium arsenite were applied to the Lake, as shown in Table 10. Subsequently, few other chemical herbicide treatments have been applied to Pell Lake, with macrophyte management currently being based upon the use of mechanical harvesters.

A group of volunteers owns and operates the two harvesters presently in use on the Lake. These harvesters remove, on average, approximately 200 loads of aquatic plants each year, each load representing about six to seven tons of plant material. Harvesting takes place from mid-June to early September primarily on weekends, due to the availability of the volunteer operators. Funding for the harvesting operations is achieved through various events sponsored by the volunteer group, as well as with minor assistance from the Town of Bloomfield. Harvested material is transported to local farmers and residents who use it as, among other things, mulch.

Currently, all forms of aquatic plant management are subject to permitting by the WDNR pursuant to authorities granted the Department under Chapters NR 107 and NR 109 of the *Wisconsin Administrative Code*. For this reason, the shoreland and aquatic macrophyte management elements of this plan consider alternative management measures consistent with the provisions of the *Wisconsin Administrative Code*. Further, the alternative aquatic plant management measures are consistent with the requirements of Chapter NR 7 of the *Wisconsin Administrative Code*, with the public recreational boating access requirements relating to the grant program, set forth under Chapter NR 1 of the *Wisconsin Administrative Code*, and with the wetland protection requirements set forth in Chapter NR 103 of the *Wisconsin Administrative Code*.

Array of Management Measures

Aquatic and shoreland plant management should address not only the immediate direct concerns expressed by residents, but also involve consideration for the long term ecological health of the Lake. Few lakes in southeastern Wisconsin lack aquatic plant growth. Low-growing plants, such as spiny naiad and muskgrass, which provide food and shelter for fish and waterfowl, do occur in the Lake. However, because of their low-growing height, these species are often outcompeted by Eurasian water milfoil. Eurasian water milfoil grows rapidly to the lake surface, capturing the available sunlight and shading out the native species. The presence of Eurasian water milfoil in the Pell Lake basin, and the presence of purple loosestrife in wetlands and shorelands adjoining the Lake, represent issues of concern particularly with regard to the effects these two invasive species have on the native flora and, consequently, on the entire natural ecosystem. These invasive species pose direct nuisance threats to humans through their deleterious effects on both recreational activities and the aesthetic qualities of the Lake. Degradation of wetland areas as a result of purple loosestrife infestation, which replaces diverse native plant communities with communities dominated by this single species of nonnative plant, can have serious negative consequences on the ability of these areas to perform their natural functions vital to the health of the Pell Lake ecosystem, including containment of floodwaters, retention of sediments, and filtering of nonpoint pollutants, in addition to habitat loss affecting wildlife and birds. The reduction of native aquatic plant diversity and abundance as a result of Eurasian water milfoil and curly-leaf pondweed colonization seriously reduces the biodiversity, not only of the Lake's plant community, but also of the animal populations that are dependent upon them. Thus, control of the Eurasian water milfoil, curly-leaf pondweed, and purple loosestrife is one means of promoting the growth of native plants. Consequently, ongoing aquatic and shoreland plant management measures are recommended.

Aquatic plant management measures are classed into four groups: **physical measures**, which include lake bottom coverings and water level management; **mechanical measures**, which include harvesting and manual removal; **chemical measures**, which include the use of aquatic herbicides; and **biological control measures**, which include the use of various organisms, including insects. All control measures are stringently regulated and require a State of Wisconsin permit pursuant to Chapters NR 107 and NR 109 of the *Wisconsin Administrative Code*.

Table 10

CHEMICAL CONTROL OF AQUATIC PLANTS IN PELL LAKE: 1950-2000

Year	Algal Control	Macrophyte Control			
	Cutrine or Cutrine-Plus (gallons)	Sodium Arsenite (pounds)	2, 4-D (gallons)	Diquat (gallons)	Endothall (gallons)
1950-1953	- -	- -	- -	- -	- -
1954	- -	800	- -	- -	- -
1955	- -	800	- -	- -	- -
1956	- -	880	- -	- -	- -
1957	- -	- -	- -	- -	- -
1958	- -	424	- -	- -	- -
1959-1980[a]	- -	- -	- -	- -	- -
1981	7.5	- -	5	2.5	18
1982-2000	- -	- -	- -	- -	- -
Total	7.5	2,904	5	2.5	18

[a]*120 pounds of lime were applied in 1970.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

Placement of physical barriers such as bottom covers also requires a WDNR permit under Chapter 30 of the *Wisconsin Statutes*. Each of these measures are discussed further below.

Physical Control Measures

Lake bottom covers and light screens provide limited control of rooted plants by creating a physical barrier which reduces or eliminates the sunlight available to the plants. They have been used to create swimming beaches on muddy shores, to improve the appearance of lakefront property, and to open channels for motor-boating. Sand and gravel are usually readily available and relatively inexpensive to use as cover materials, but plants readily recolonize areas so covered in about a year. Synthetic material, such as polyethylene, polypropylene, fiberglass, and nylon can provide relief from rooted plants for several years. However, synthetic barriers must be placed and removed annually, and such barriers are extremely susceptible to disturbances caused by wind waves and boat wake action. Consequently, physical control measures are not recommended for use in Pell Lake.

Mechanical Control Measures

Aquatic macrophytes may be mechanically harvested with specialized equipment consisting of a cutting apparatus, which cuts up to five feet below the water surface, and a conveyor system that picks up the cut plants and hauls them to shore. Mechanical harvesting can be a practical and efficient means of controlling plant growth as it removes the plant biomass and nutrients from a lake. Mechanical harvesting is particularly effective as a measure to control large-scale growths of aquatic plants.

The advantages of aquatic plant harvesting are that the harvester typically leaves enough plant material in the lake to provide shelter for fish and other aquatic organisms, and to stabilize the lake bottom sediments. The disadvantages of mechanical harvesting are that the harvesting operation may cause fragmentation and facilitate the spread of some plants, including Eurasian water milfoil, and may disturb loosely consolidated bottom sediments increasing turbidity and smothering fish breeding habitat and nesting sites. Disrupting the bottom sediments by plant removal also could increase the risk that an exotic species, such as Eurasian water milfoil, may colonize the disturbed area. Nevertheless, if done correctly and carefully, harvesting has been shown to be of benefit in ultimately reducing the regrowth of nuisance plants. Aquatic plant harvesting operations are subject to State permitting requirements.

Given the extent of shallow water areas needing aquatic plant management, the loosely consolidated nature of the bottom sediments in these shallow areas, and the species composition with correspondingly dense amounts of Eurasian water milfoil in these same areas, mechanical harvesting, while currently the management measure of choice, is not considered a viable management option for the control of aquatic plants in much of Pell Lake, and, therefore, is recommended only for use in deeper water portions of the main Lake basin and in the navigational channels. Mechanical harvesting requires a minimum depth of water in which to operate the harvesting equipment. When the water depth is inadequate depth, as in shoreline areas, manual harvesting provides a reasonable alternative technique.

Manual Control Measures

Manual aquatic plant harvesting also is subject to State permitting requirements, with the exception that manual harvesting of plants along a 30-feet width of shoreline within which a pier, if any, is situated, can be undertaken without a permit, pursuant to the requirements of Chapter NR 109 of the *Wisconsin Administrative Code*. Manual harvesting involves the use of specially designed rakes to remove aquatic plants. The advantage of the rakes is that they are relatively inexpensive, easy and quick to use, and immediately remove the plant material from the lake, without a waiting period. Removal of the plants from the lake avoids the accumulation of organic matter on the lake bottom, which adds to the nutrient pool that favors further plant growth. The use of such rakes also provides a safe and convenient method of controlling aquatic plants in deeper nearshore waters around piers and docks. Should the local lake association or the Sanitary District acquire a number of these specially designed rakes, they could be made available for the riparian owners to use on a trial basis to test their operability before purchasing them. The physical removal of specific types of vegetation by selective harvesting of plants provides a highly selective means of controlling the growths of nuisance aquatic plant species, including purple loosestrife and Eurasian water milfoil.

In the shoreland area, where purple loosestrife may be expected to occur, bagging and cutting loosestrife plants, for example, prior to the application of chemical herbicides to the cut stems, can be an effective control measure for small infestations of this plant. Loosestrife management programs, however, should be followed by an annual monitoring and control program for up to 10 years following the initial control program to manage the regrowth of the plant from seeds. Manual removal of such plants is recommended for isolated stands of purple loosestrife when and where they occur.

Hand pulling of stems, where they occur in isolated stands, also provides an alternative means of controlling plants, such as Eurasian water milfoil in the Lake and purple loosestrife on the lakeshore.

Chemical Control Measures and Aquatic Herbicides

Chemical treatment with aquatic herbicides is a short-term method of controlling heavy growths of aquatic macrophytes and algae. Chemicals are applied to the growing plants in either liquid or granular form. The advantages of using chemical herbicides to control aquatic macrophyte growth are the relatively low cost and the ease, speed, and convenience of application. However, the disadvantages associated with chemical control include unknown long-term effects on fish, fish food sources, and humans; a risk of increased algal blooms due to the eradication of macrophyte competitors; an increase in organic matter in the sediments, possibly leading to increased plant growth, as well as anoxic conditions which can cause fish kills; adverse effects on desirable aquatic organisms; loss of desirable fish habitat and food sources; and, finally, a need to repeat the treatment the following summer due to existing seed banks and/or plant fragments. To minimize the collateral impacts of deoxygenation, loss of desirable plant species, and contribution of organic matter to the sediments, early spring or late fall applications should be considered. Such applications also minimize the concentration and amount of chemicals used due to the colder water temperatures that enhance the herbicidal effects. Use of chemical herbicides in aquatic environments is subject to State permitting requirements. Widespread chemical treatment is not recommended as a means of controlling aquatic plant growth. Consideration may be given, however, to the limited use of early spring chemical controls especially in those shoreline areas of shallow water where mechanical harvesting would not be deemed viable and targeting growths of Eurasian water milfoil would be possible.

Biological Control Measures

Biological control measures include the use of natural predators to control undesirable flora and fauna, as well as the artificial introduction of species where natural reproduction may be limited by habitat loss or other factors. To a degree, the protection and preservation of the native flora and fauna both in the Lake and in the adjacent wetlands, as recommended above, form a major biological control mechanism, limiting environmental degradation in the vicinity of Pell Lake. Of these measures, the use of natural predators is by far the most common and well known form of biological control.

Classical biological control has been successfully used to control both weeds and herbivorous insects.[2] Recent evidence shows that *Galerucella pucilla* and *Galerucella calmariensis*, beetle species, and *Hylobius transversovittatus* and *Nanophyes brevis*, weevil species, have potential as biological control agents for purple loosestrife, while *Eurhychiopsis lecontei*, an aquatic weevil species, has potential as a biological control agent for Eurasian water milfoil.[3] Extensive field trials conducted by the WDNR in the Southeastern Wisconsin Region during 1999 and 2000 have indicated that insects can provide effective management of large infestations of purple loosestrife. In contrast, studies completed using *Eurhychiopsis lecontei* as a means of aquatic plant control have suggested that the weevil is extremely susceptible to disturbances and wash-off by recreational watercraft, limiting their application to low-traffic areas of the Lake. Thus, while the use of insects as a means of wetland plant management is considered to be viable, the use of *Eurhychiopsis lecontei* as a means of aquatic plant management control is not recommended at this time. Grass carp, *Ctenopharyngodon idella*, an alternative biological control used elsewhere in the United States, are not permitted in Wisconsin.

In terms of species modification, while there have been some attempts, notably in Lac La Belle in Waukesha County, to transplant native aquatic plants between Lakes within the Region, these attempts largely have proven less than successful, and the use of such measures in Pell Lake is not recommended. Transplantation of aquatic plants is extremely labor-intensive, and may require WDNR permits for the collection of the plant materials as well as a Chapter NR 109 permit for the reintroduction of the plants into the waterbody. In contrast, a variation of this approach, the use of aquatic plant harvesters to remove the canopy of the Eurasian water milfoil thereby promoting the growth of the lower growing native aquatic plants, as illustrated in Figure 2, has proven successful, notably in Lauderdale Lakes in Walworth County. However, repeated application of the canopy harvesting, at approximately monthly intervals, is required to maintain the native plant community. Use of this "top-chopping" methodology is recommended in the deeper water portions of Pell Lake, as recommended in the aquatic plant harvesting section above.

Public Informational and Educational Programming

As part of the overall citizen informational and educational programming to be conducted in the Pell Lake community, residents and visitors in the vicinity of Pell Lake should be made aware of the value of the ecologically significant areas in the overall structure and functioning of the ecosystems of Pell Lake. Specifically, informational programming related to the protection of ecologically valuable areas in and around Pell Lake should focus on the need to minimize the spread of nuisance aquatic species, such as purple loosestrife and Eurasian water milfoil.

Educational and informational brochures and pamphlets, of interest to homeowners and supportive of the lake management program, are available from the University of Wisconsin-Extension, the WDNR,

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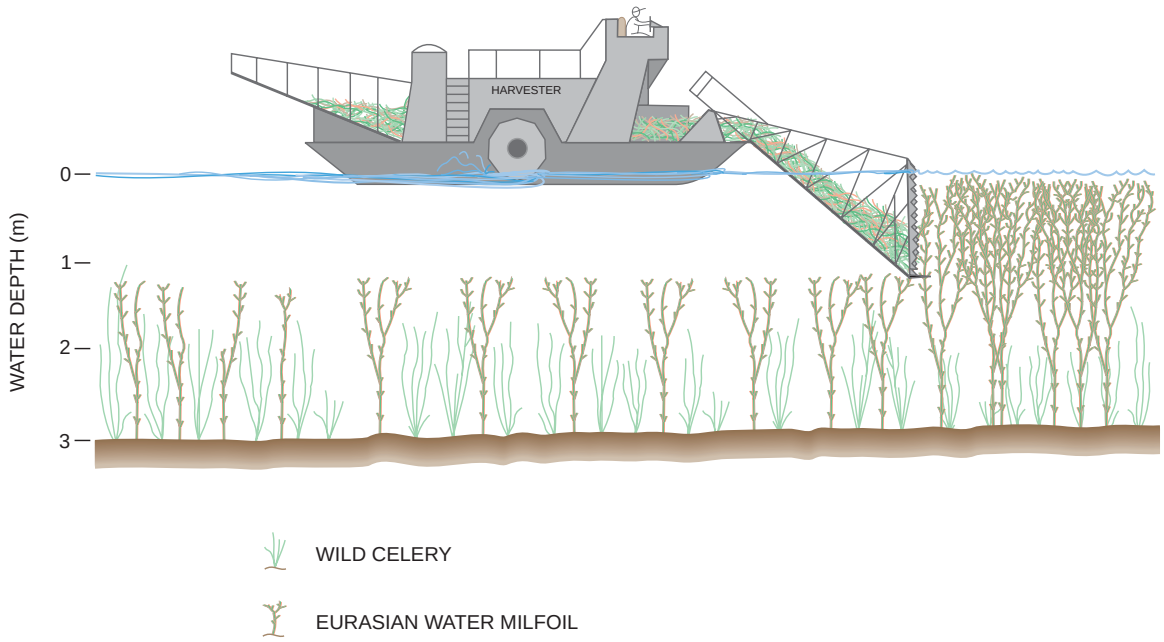
[2]*Sally P. Sheldon, "The Potential for Biological Control of Eurasian Water Milfoil (*Myriophyllum spicatum*) 1990-1995 Final Report," Department of Biology Middlebury College, February 1995.*

[3]*B. Moorman, "A Battle with Purple Loosestrife: A Beginner's Experience with Biological Control,"* LakeLine, *Vol. 17, No. 3, September 1997, pp. 20-21, 34-37.*

Figure 2

PLANT CANOPY REMOVAL WITH AN AQUATIC PLANT HARVESTER



NOTE: Selective cutting or seasonal harvesting can be done by aquatic plant harvesters. Removing the canopy of Eurasian water milfoil may allow native species to reemerge.

Source: Wisconsin Department of Natural Resources and SEWRPC.

the Walworth County Offices, and many Federal government agencies. These brochures could be provided to homeowners through local media, direct distribution, or targeted library/civic center displays. Alternately, they could be incorporated into newsletters. Many of the ideas contained in these publications can be integrated into ongoing, larger-scale activities, such as anti-littering campaigns, recycling drives and similar pro-environment activities.

In addition, the WDNR, Walworth County, and the University of Wisconsin-Extension, offer other informational programming, such as the Adopt-A-Lake program and Project WET (Water Education Training) curriculum, and can contribute to an informed public, actively involved in the protection of ecologically valuable areas within the drainage area tributary to Pell Lake. Citizen monitoring and awareness of the positive value of native aquatic plant communities can be important opportunities for public informational programming and participation.

Recommended Management Measures

In response to the threat posed by Eurasian water milfoil and purple loosestrife on native plants in the Pell Lake basin and adjoining shorelands and wetlands, and in an effort to maintain a healthy ecosystem, improve the aesthetic qualities of the Lake, restore native populations, and provide for enhanced recreational uses, the following recommendations are made:

- Manually remove Eurasian water milfoil and purple loosestrife plants, where feasible, in shallow water areas and wetlands. Special attention should be given to swimming areas and around shoreline structures such as piers during summer and fall. Any fragments of Eurasian water milfoil that arise

from this activity or that are produced as a result of propeller-driven power boat activity, should be removed from the Lake;

- Mechanically harvest aquatic plants in the deeper water areas of the main Lake basin and navigational channels to maintain boating access. Harvesting of lanes perpendicular to such channels may also prove beneficial as a fisheries management measure, as such fish lanes enhance the ability of visual predators, such as northern pike to harvest panfish and other prey organisms;

- Limited use of chemical herbicides is recommended in areas where manual or mechanical harvesting is not feasible, but such applications should be targeted toward the control of Eurasian water milfoil, curly-leaf pondweed and purple loosestrife, as State-designated nonnative invasive species, pursuant to Chapter NR 109 of the *Wisconsin Administrative Code*;

- Promote practices that encourage native plant growth in and adjacent to Pell Lake. Use available media resources to inform the citizenry of the importance of native communities to the overall health and well-being of the Lake ecosystem and the impact this has on the human population around Pell Lake;

- Participate in citizen-based monitoring programs, and promote the use of appropriate educational opportunities within the local school system.

CONTROL OF NONPOINT SOURCE POLLUTION AND PROTECTION OF SURFACE WATER QUALITY

Pell Lake is a meso-eutrophic waterbody. As such, by definition, it may be considered to be in need of protection to maintain and enhance its ability to support and sustain current aesthetic and recreational uses. The extent of urbanization of the watershed, as set forth in the aforereferenced regional land use and County development plans, when viewed in light of the recent U.S. Geological Survey findings regarding the potential impacts of suburban lawn care practices on stormwater runoff in urbanized watersheds in Wisconsin,[4] has heightened concern among Lakeshore residents that the water quality of the Lake may deteriorate. Thus, consideration is given in this section to those actions that will protect lake water quality and potentially reduce contaminant loads to the Lake.

As described in Chapter II, the primary sources of pollutant loadings to Pell Lake are nonpoint sources generated within the area tributary to the Lake. 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. To control nonpoint source pollution to Pell Lake and its tributary area, application of both urban and rural nonpoint source controls is considered a viable option. In addition, options to control nonpoint source pollution loading during land development activities are discussed.

Urban Nonpoint Source Controls

Potentially applicable urban nonpoint source control measures include wet detention basins, stormwater infiltration facilities, 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 informational programs can be developed to encourage 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.

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

Proper design and application of urban nonpoint source control measures such as grassed swales, wet detention basins, and infiltration facilities requires the preparation of a detailed stormwater management system plan that addresses stormwater drainage problems and controls nonpoint sources of pollution. Preparation of such plans, as necessary, is recommended. Additional urban nonpoint source pollution management measures that can be applied within the Town of Bloomfield in the immediate vicinity of Pell Lake are limited largely to good urban housekeeping practices and grassed swales. Good 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; street sweeping; and reduced use of street deicing salt.

In addition, developing areas can generate significantly higher pollutant loadings than established areas of similar size. These areas include a wide array of activities, including individual site development within the existing urban area, and new land subdivision development. Such construction sites may be expected to produce suspended solids and phosphorus loadings at rates several times higher than established urban lands, and control of sediment loss from construction sites is recommended. Construction erosion controls are important pollution control measures that can minimize localized loadings of phosphorus and sediment from the drainage area, and minimize the cumulative impacts of such loadings. The control measures include such revegetation practices as temporary seeding, mulching, and sodding; such runoff control measures as placement of filter fabric fences, straw bale barriers, storm sewer inlet protection devices, diversion swales, sediment traps, and sedimentation basins; and such site management practices as placement of tracking pads to limit the movement of soils from work sites. Adequate construction site erosion controls that are strictly enforced may be expected to reduce pollutant loadings from construction sites by about 75 percent. Application of such measures at construction sites within the Town of Bloomfield is required pursuant to the Chapter NR 151, of the *Wisconsin Administrative Code*. Review of construction site erosion control provisions of both Town and County ordinances, to ensure conformity with Chapter NR 151 of the *Wisconsin Administrative Code* also is recommended.

Rural Nonpoint Source Controls

Upland erosion from agricultural and other rural lands currently is a contributor of sediment and other contaminants within the area tributary to Pell Lake. Estimated phosphorus and sediment loadings from croplands, pastures, and grasslands in the tributary area were presented in Chapter II. As set forth, some of the remaining agricultural lands within the tributary area to Pell Lake will be replaced, over time, with urban-density residential and commercial development. While such development could potentially reduce the agro-chemical loadings to Pell Lake, this benefit maybe offset by the fact that urban lands generally result in increased rates of surface runoff and they contribute a wider range of contaminants to surface waters.

Public Informational Programming

Public informational and educational programming also forms a major element of the lake management program. For example, additional actions can be undertaken by individual citizens, homeowners, and householders to minimize nutrient and pollutant loadings from source areas within the area tributary to Pell Lake. Based upon the aforereferenced findings of the U.S. Geological Survey, residential lawns can form a major source of phosphorus to watercourses in urban areas. In some cases, this phosphorus source is enhanced as a consequence of the lawn care practices employed within the drainage area. For this reason, informational programming directed at alternative and appropriate lawn care practices should be provided. Such programming should be predicated upon a knowledge of the soil chemistry and soil nutrient requirements for urban residential lawns and gardens. These nutrient requirements can be determined through a relatively simple soil testing procedure conducted by the University of Wisconsin-Extension. Soil test results allow householders to apply appropriate levels of fertilization to their lawns and gardens, generally saving the householder some level of expense and effort, while providing additional protections to the Lake. In addition, distribution of lawn care pamphlets within the area, providing

information on composting, yard care, and maintenance of the grassed swale stormwater system, would apprise householders of alternative means of maintaining their properties for water quality purposes.[5]

Programming should also be developed to keep the Pell Lake community informed of the current state of their Lake's water quality. To this end, continued participation in the WDNR Self-Help Program is recommended as a means of assessing the health of Pell Lake on a regular basis. Such programs can provide an early warning of undesirable changes in lake water quality. Additional data compiled from regular, three- to five-yearly interval surveys of the aquatic species composition form an important complementary assessment tool. Review of these data annually by the Sanitary District Board of Commissioners can permit the District, and the Town, to initiate appropriate responses in a timely manner.

To supplement and facilitate the conduct of these informational and educational efforts and to enable possible implementation of the activities listed below, it is recommended that the Pell Lake Sanitary District consider the acquisition of lake management district powers, as provided under Section 60.782. Provided that at least 60 percent of the shoreline of the Lake is within the Sanitary District, the Pell Lake Sanitary District can adopt such powers that would permit the District to create and operate a water safety patrol unit, undertake projects to enhance the recreational uses of the Lake, appropriate money for the conservation of natural resources, and acquire lands through easement or fee simple purchase that may be needed for these purposes.[6]

Recommended Management Measures

Insofar as future land use reflects these latter recommendations, it is recommended that development proceed so as not to impair the water quality of the Lake. To wit, it is recommended that the community, pursuant to Town and County plans and ordinances:

- Implement future development within the area tributary to Pell Lake in a manner and at densities consistent with those set forth in the adopted Town and County land use plans, and review development and redevelopment proposals around the shoreline of the Lake for potential impacts on the Lake;

- Adopt the principles of conservation development for residential development within the shoreland area of the Lake, preserving portions of the open space on each property or group of properties considered for development and, thereby, preserving the natural and cultural resources of the drainage area of the Lake to the extent practicable;[7]

- Encourage rural nonpoint source pollution control measures, including integrated agricultural nutrient and pest management practices, to minimize pollutant loadings while maintaining water loadings to the Lake; and

- Encourage urban nonpoint source pollution control measures, including wet detention basins, infiltration facilities, grassed swales, and good urban "housekeeping" practices, to minimize pollutant loadings while maintaining water loadings to the Lake;

- Enforce construction site erosion control and stormwater management ordinances to minimize pollutant loadings while maintaining water loadings to the Lake.

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[5]*University of Wisconsin-Extension Publication No. GWQ007,* Practical Tips for Home and Yard, *1993, and related publications in the "Yard Care and the Environment" series.*

[6]*Currently, within Walworth County, the Delavan Lake Sanitary District has adopted such powers to facilitate their lake management program on Delavan Lake.*

[7]*See SEWRPC Planning Guide No. 7,* Rural Cluster Development Guide, *December 1996.*

Where new development or redevelopment is proposed, it is recommended that the provisions of the relevant Walworth County land division and construction site erosion control ordinances be strictly enforced within the drainage area tributary to Pell Lake. These control measures are administered and enforced by the Walworth County Land Conservation Department. In these areas, it would be desirable to maintain open space areas within the area tributary to the Lake and cluster the development beyond the area tributary to the Lake. It is also recommended that the relevant performance standards set forth in the adopted County land and water resource management plan be enforced as necessary. These practices would be intended to minimize the impact of development on the surface and ground water flows to Pell Lake. Consequently, the following additional recommendations are made:

- Periodically review and continue to monitor existing public sanitary sewerage plans providing sanitary sewerage services to urban areas of the drainage area tributary to Pell Lake;

- Continue to enforce development control ordinances pertinent to the area tributary to Pell Lake.

RECREATIONAL USE MANAGEMENT

Pell Lake provides opportunities for high-quality, water-based recreational use to the residents of Pell Lake, the Town of Bloomfield and the Southeastern Wisconsin Region. As described in Chapter III, citizens' concerns associated with recreational boating on Pell Lake include the operation of large, high-powered boats in proximity to the swimming area and overcrowding of boat traffic especially as a result of the perceived overflow of boats from nearby lakes. Such overcrowding also poses problems of an environmental nature. Wakes and surface water turbulence created by large power boats and personal water craft, especially when operating near shore can cause damage to ecologically sensitive shoreline areas. In addition, propeller-driven watercraft, when operating in areas where Eurasian water milfoil is abundant, can fragment the surface-floating portions of the plant leading to the spread of this nuisance species as the fragments float to new areas where they eventually take root and establish colonies. Measures to address the environmental concerns are set forth in the aquatic plant management and shoreland management portions of this plan. Measures to address the human utilization of the Lake are set forth below.

Array of Management Measures

The control of recreational boating traffic on Pell Lake is a significant concern and overlaps into issues of public safety, aesthetics, and environmental protection. The WDNR regulates the operation of power boats and personal watercraft in regards to proximity to shoreline, other boats, and swimming areas. The use of buoys to identify swimming areas, slow no-wake zones, and environmentally sensitive areas is a common practice on many Wisconsin lakes. Two general types of buoyage exist: *regulatory buoys*, such as those used to demarcate slow-no-wake or exclusionary areas; and *informational buoys*, such as those used to enhance public awareness. Buoys must be 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 activity in specific areas, and control the movement of watercraft. Regulatory buoys are enforceable, but informational buoys are not.

Buoyage has the advantage of being visible to recreational boaters, and affected areas can be clearly demarcated. Local authorities have jurisdiction over the waters involved, and may place buoys subject to WDNR permitting. Buoys placed within the waters of the State of Wisconsin are subject to the requirements set forth in Chapter 30, *Wisconsin Statutes*, and require a WDNR permit prior to placement.

In addition to managing recreational boating traffic, consideration should be given to limiting potential recreational boating use conflicts associated with the proliferation of piers and other shore structures around the Lake. Current guidance provided by the Wisconsin Department of Natural Resources suggests that a maximum of two boat slips be allowed for each 50 feet of shoreline frontage owned by an individual property owner, provided

any such pier does not obstruct navigation channels or important natural habitat.[8] In the channelized (western) portions of Pell Lake, use of wharves parallel to the shoreline rather than piers might be indicated. For each additional 50 feet of frontage, a property owner would be able to accommodate one additional boat slip. Application of this guidance seeks to ensure equality of opportunity for lake access, and is recommended.

Recommended Management Measures
In accordance with concerns expressed by the citizenry and in the interests of promoting recreational boating use on Pell Lake that is consistent with promoting public safety, maintaining the aesthetic integrity of the lake, and encouraging environmentally sound management, the following measures are recommended:

- Minimize boating traffic in areas of the Lake where Eurasian water milfoil is prevalent in order to prevent its further spread within the lake basin. Limited use of herbicides and provision of harvested boating access and navigation lanes to control this species in these areas also is recommended;

- Utilize informational buoys to demarcate swimming areas, ecologically valuable areas, and other areas where regulation is deemed necessary. Appropriate signage at the public recreational boating access site to supplement the buoyage, and inclusion of information on Eurasian water milfoil and zebra mussel, consistent with the informational programming measures set forth above, is also recommended.

- Enforce slow-no-wake ordinances and other ordinances that pertain to use of power boats and personal watercraft on the Lake to protect shorelands and enhance public safety.

- Consider adopting the guidance set forth in the WDNR Publication Number FH-017 Rev. 04/2005, *Pier Planner*, as a basis for managing shoreland impacts due to pier placement on the shores of Pell Lake.

SHORELAND PROTECTION MEASURES

Among the problems associated with shorelands is erosion which leads to: loss of land, damage to shoreline infrastructure, interference with lake access and use, and susceptibility to influx of nonpoint source pollutants, among other concerns. Wind-wave erosion, ice movement, and motorized boat traffic usually contribute to such erosion. In addition, absence of native shoreline vegetation adversely affects the aesthetic quality of the Lake and negatively impacts other native biota. With over three fourths of the shoreline of Pell Lake considered to be in a natural state, maintenance of native plant populations along the shoreline is of importance.

Array of Management Measures
Protection of shorelands can be accomplished using biological materials or through placement of physical structures at the water's edge, where the land meets the water. This point is generally described in Chapter 30 of the *Wisconsin Statutes* as the ordinary high water mark. Actions lakeward of the ordinary high water mark require a WDNR permit, while certain actions conducted to landward of the ordinary high water mark, within the 1,000-feet regulatory shoreland zone may require both state and local permits. Chapter NR 115 of the *Wisconsin Administrative Code* provides legislative authority for ordinances governing setbacks of principle structures, vegetation management in the setback zone, and placement of secondary structures, as well as shoreline protection structures. Walworth County has a shoreland protection ordinance in place, as noted in Chapter II. Enforcement of the provisions of this ordinance is recommended.

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[8]*Wisconsin Department of Natural Resources Publication No. FH-017 Rev. 04/2005,* Pier Planner*, April 2005; as of autumn of 2005, this guidance was being included within the proposed refinements to Chapter NR 326 of the* Wisconsin Administrative Code *and would become a requirement for piers placed after February 6, 2004, upon adoption. At the time of writing, the proposed rule was included in the public hearing process.*

Physical shoreline protection measures involve placing protective barriers along the water line to limit wind and wave action at the point. Riprap, rock revetment, and various types of wooden materials are common methods that have been used historically by lakefront property owners across the State. Continued maintenance of existing revetments and other protection structures is recommended. Replacement of revetments and bulkheads with riprap or vegetated alternatives, over time, is recommended where appropriate, as the solid structures of the bulkheads and revetments can form physical barriers for wildlife utilizing the shoreland habitat.

Biological shoreline protection methods act not only as a means of erosion control, but have the added advantages of restoring native flora and thus maintaining habitat value, creating a natural ambiance along the lakeshore, and providing a natural filtering and trapping device for possible pollutant runoff. These measures primarily involve maintaining or planting natural vegetation along the lakeshore. Typically, this method involves planting a strip of indigenous vegetation along the shore above the ordinary high water line, generally three to 10 feet in width, with an adjoining two- to six-foot-wide strip of native emergent vegetation in the water. There are variations of this basic approach. Lakefront property owners are encouraged to utilize native vegetated buffer strips where feasible.

Two alternative shoreline erosion control techniques are considered potentially viable for use on Pell Lake: vegetated buffer strips, and rock revetments or riprap. These alternatives, as shown in Figure 3, were considered to be potentially viable because they can be constructed, at least partially, by local residents; because most of the construction materials involved are readily available; because the techniques would, in many 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 lake shoreline. These measures may be combined with selected regrading of the eroded banks and accumulated soils, designed to facilitate navigation and recreational boating access, on a site-by-site basis. These management measures require permits from the WDNR pursuant to Chapter 30 of the *Wisconsin Statutes*. Selection of appropriate shoreland protection structures should be guided by the worksheet included within Chapter NR 328 of the *Wisconsin Administrative Code*, which sets forth a methodology for determining appropriate shoreline protection structures for inland lakes based upon wind wave action and fetch, substrate, and likely boat wake action. Utilizing the erosion intensity worksheet promulgated as Section NR 328.08(2) of the *Wisconsin Administrative Code*, much of the shoreline of Pell Lake would be rated as low-intensity shoreline, although portions of the north shore are borderline low- to moderate-intensity. Consequently, pursuant to Chapter NR 328, vegetative shoreland protection structures would be indicated for the majority of the lakeshore.

Recommended Management Measures

In order to provide for shoreline erosion protection, encourage natural habitat and enhance the aesthetic qualities of Pell Lake, the following recommendations are made:

- Repair and maintain shoreline protection structures already in existence, and replace vertical barriers with more natural alternatives as replacement of structures is required;
- Where feasible, plant vegetative buffer strips along shoreline areas using native species where new shoreline protection measures are needed and where it is necessary to replace existing physical structures.
- Provide lakeshore residents with information on the methods of proper construction and maintenance of shoreline protection structures. Conduct of shoreland vegetative buffer development workshops for riparian homeowners and householders is recommended.

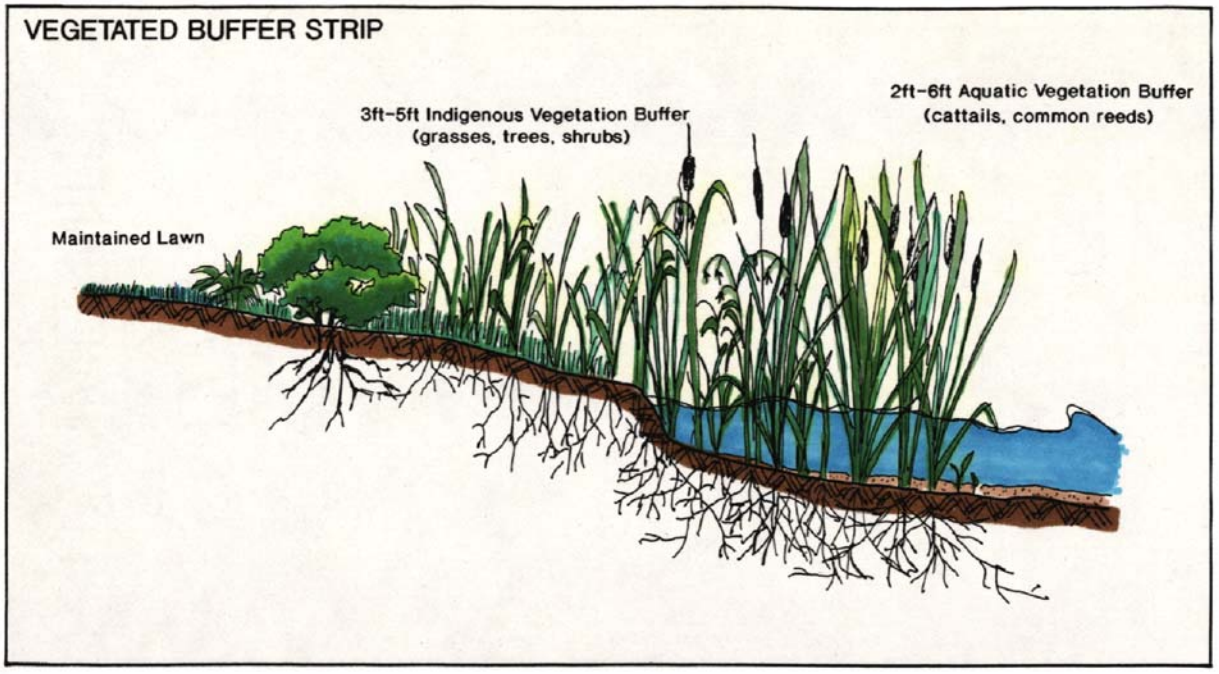
ANCILLARY MANAGEMENT MEASURES

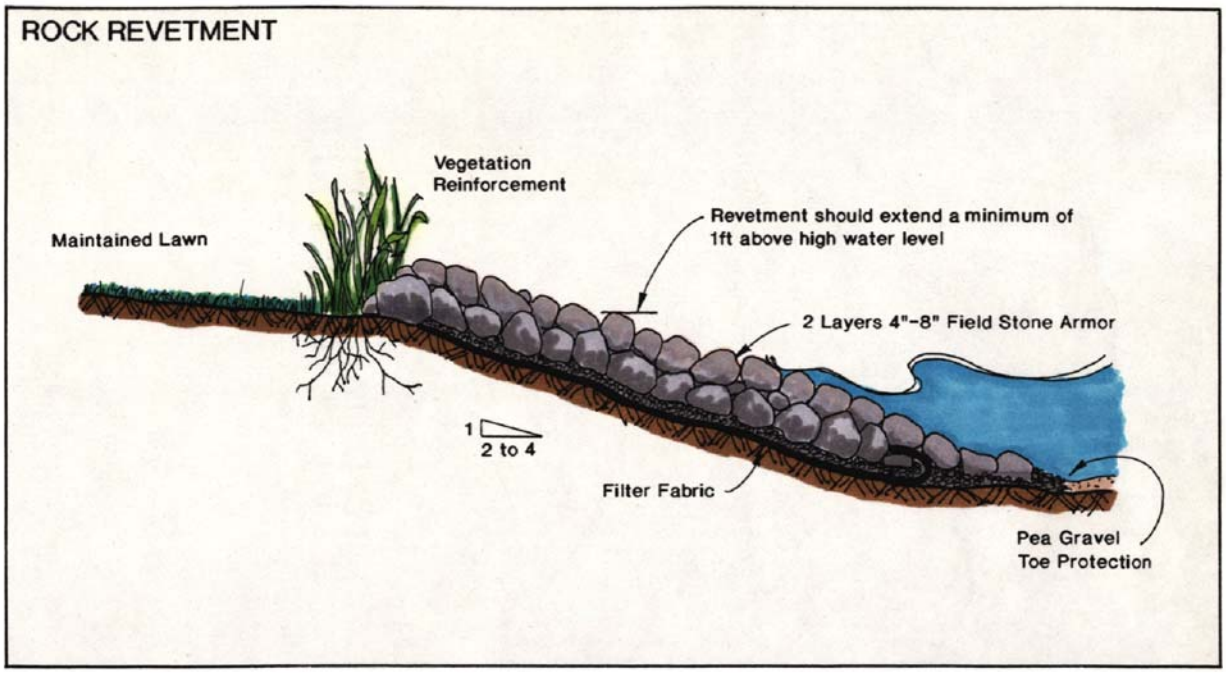
Lake Water Quality Monitoring

The participation of the Pell Lake community in the WDNR Self-Help Monitoring Program, which involves citizen volunteers making Secchi disc transparency measurements in the Lake at regular intervals, should be continued. Data gathered as part of this program should be presented annually by the volunteers to the Pell Lake

Figure 3

RECOMMENDED ALTERNATIVES FOR SHORELINE EROSION CONTROL FOR PELL LAKE





NOTE: Design specifications shown herein are for typical structures. The detailed design of shoreline protection structures must be based upon analysis of local conditions.

Source: SEWRPC.

Sanitary District Commissioners, where the citizen monitors could be recognized for their work. The Lake Coordinator of the WDNR, Southeast Region, could assist in enlisting more volunteers in this program. The information gained at first hand by the public from participation in this and similar programs can increase the credibility of the proposed changes in the nature and intensity of uses to which the Lake is subjected. Similarly, as has been noted above, participation of the Pell Lake community in various school-based educational programs should also be considered as a means of building public awareness of lake issues and lake protection measures applicable to the household level. Information gained through such programs forms a valuable addition to the knowledge base of the community and serves to underpin future management actions, both at the community level and at the larger scale.

Public Informational Programming

With respect to informational programming, distribution of posters and pamphlets, available from the University of Wisconsin-Extension and WDNR, that provide information and illustrations of aquatic plants, their importance in providing habitat and food resources in aquatic environments, and the need to control the spread of undesirable and nuisance plant species is recommended. Currently, many lake residents seem to view all aquatic plants as "weeds" and residents often spend considerable time and money removing desirable plant species from a lake without considering their environmental impact. In addition, posting warning signs at the public access sites, informing lake users of concerns such as Eurasian water milfoil and zebra mussel, is recommended. Appropriate signage can be obtained from the WDNR.

Inclusion of specific public informational and educational programming within the activities of the Pell Lake Sanitary District also is recommended. These programs should focus on the value and the impacts of these plants on water quality, fish, and on wildlife; and on alternative methods for controlling existing nuisance plants, including the positive and negative aspects of each method. These programs can be incorporated into the comprehensive informational and educational programs that also would include information on related topics, such as water quality, recreational use, fisheries, and other lake-related topics.

Lastly, it is recommended that aquatic plant surveys be conducted at about three- to five-year intervals, depending upon the observed degree of change in the aquatic plant communities. In addition, information on the aquatic plant control program should be recorded and should include descriptions of major areas of nuisance plant growth and areas chemically treated.

SUMMARY

This plan, which documents the findings and recommendations of a study requested by the Pell Lake Sanitary District and Town of Bloomfield, examines existing and anticipated conditions, lake protection measures, and recreational use problems on Pell Lake. The plan sets forth recommended actions and management measures for the resolution of those problems. The recommended plan is summarized in Table 11 and shown graphically on Map 16.

Pell Lake was found to be a meso-eutrophic waterbody, with average to slightly below average water quality in comparison with other lakes in the Southeastern Wisconsin Region. Groundwater inflows to the Lake are an important factor in maintaining high-quality lake water. Consequently, preservation of environmental corridor lands, and especially groundwater recharge areas within the shoreland and nearshore areas situated immediately adjacent to the Lake, is recommended. Walworth County and the Town of Bloomfield, together with the Pell Lake Sanitary District, should support appropriate land management practices designed to reduce nonpoint source pollutant discharges and maintain the current inflow of high-quality groundwater to the Lake. Further, the Pell Lake Sanitary District should promote appropriate shoreline management practices, including the use of vegetative buffer strips, where applicable.

The Pell Lake protection plan recommends actions be taken to reduce human impacts on ecologically valuable areas in and adjacent to the Lake, and reduce human impacts on the in-lake macrophyte beds, especially those

Table 11

RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN ELEMENTS FOR PELL LAKE

Plan Element	Subelement	Location	Management Measures	Management Responsibility
Land Use Management[a]	Protection of ecologically sensitive areas	Entire Watershed	Observe guidelines set forth in the regional and local land use plans, and Walworth County land and water resource management plan; protect environmentally sensitive lands as recommended in the regional natural areas and critical species habitat protection and management plan; encourage conservation development practices providing for the clustering of any new development beyond the lake drainage area to minimize nonpoint pollution impacts on, and potential losses of, groundwater recharge	Walworth County, Town of Bloomfield
Fisheries Management	Fisheries survey	Pell Lake	Conduct fisheries survey to determine the status of the fishery; implement recommendations as necessary Monitor carp populations through fish surveys; consider developing a Lake resident volunteer creel census program	Wisconsin Department of Natural Resources, Pell Lake Sanitary District
	Enhance and protect fish habitat	South shore	Remove berm to enhance circulation and reconnect habitat areas currently isolated by the abandoned transportation corridor	Town of Bloomfield, Wisconsin Department of Natural Resources, Pell Lake Sanitary District
		Pell Lake	Enhance existing shoreline and nearshore structure through native aquatic and shoreland vegetation plantings and control of nuisance aquatic plants to improve the fishery forage base	Wisconsin Department of Natural Resources, Pell Lake Sanitary District
	Develop a fishery enhancement program based upon survey	Pell Lake	Review survey data and habitat protection measures for improved fisheries as needed; continue to enforce fishing regulations and review as necessary	Wisconsin Department of Natural Resources, Pell Lake Sanitary District
Aquatic and Shoreland Plant Management	Manual harvesting[b]	Areas of nuisance growth around piers, docks, and beaches; and wetlands	Harvest nuisance plants, including Eurasian water milfoil and purple loosestrife, as required around docks and piers especially during summer and fall; collect plant fragments arising from boating and harvesting activities	Pell Lake Sanitary District, private landowners
	Major and minor channel harvesting	Selected, deep water areas of Lake	Harvest aquatic plants as required to facilitate recreational boating access; restrict harvesting in spring and autumn to avoid disturbances in fish breeding areas and WDNR-delineated sensitive areas	Lake Association (Mud Hens)
	Chemical control of nonnative plants	Eurasian water milfoil control zone and areas containing purple loosestrife	Consider limited use of herbicides for the control of nonnative plants, especially during spring	Pell Lake Sanitary District
	Native aquatic plant community establishment	Areas lacking native aquatic plant diversity and numbers of plants	Encourage shoreland management practices that promote native plant growth in and adjacent to the Lake	Pell Lake Sanitary District and private lakeshore homeowners
	Comprehensive plan refinement	Entire Lake	Update aquatic plant management plan every three to five years	WDNR, Pell Lake Sanitary District, Lake Association
Nonpoint Source Pollution Control	Rural nonpoint source controls	Entire watershed	Promote sound rural land management practices to reduce soil loss and contaminant loadings through preparation of farm conservation plans in accordance with the county land and water resource management plan	USDA, WDATCP, Walworth County

Table 11 (continued)

Plan Element	Subelement	Location	Management Measures	Management Responsibility
Nonpoint Source Pollution Control (continued)	Urban nonpoint source controls	Entire watershed	Promote sound urban housekeeping and yard care practices through informational programming	Walworth County, Town of Bloomfield, Pell Lake Sanitary District
	Construction site erosion control and stormwater management ordinances	New clustered developments in conservation subdivisions	Develop and enforce construction site erosion control and stormwater management ordinances; review ordinances for concurrency with NR 152 model ordinance	Walworth County, Town of Bloomfield
	Land use management	Entire Watershed	Observe guidelines set forth in the regional and local land use plans, and Walworth County land and water resource management plan; adopt the principles of conservation development to minimize nonpoint pollution impacts	Walworth County, Town of Bloomfield
	Public sanitary sewage system management	Entire Watershed	Periodically review current public sanitary sewerage service area plan to continue to provide sanitary sewerage services to urban areas of the watershed.	Walworth County, Pell Lake Sanitary District
	Ordinance enforcement	Entire Watershed	Enforce construction site erosion control, stormwater management, development control.	Walworth County
Recreational Use Management	Public Boating Access	Pell Lake	Continue to provide adequate parking facilities to meet Chapter NR 1 public recreational boating access standards	Town of Bloomfield
	Recreational use zoning	Pell Lake	Enforce slow-no-wake ordinance within 100 feet of shoreline or 200 feet for personal water craft; refine ordinance as appropriate; consider placement of buoys	Town of Bloomfield
	Nonnative aquatic plant management program	Eurasian water milfoil control zone	Limit recreational boating through Eurasian water milfoil areas to minimize the spread of the plant throughout the Lake; limited use of herbicides in spring, and manual removal during summer and fall recommended	Town of Bloomfield
Shoreland Protection	Shoreline erosion control	Pell Lake	Construct, maintain and repair structures where needed; consider replacement of bulkheads and revetments with riprap Encourage maintaining or reestablishing native shoreline vegetation	Individual landowners, Wisconsin Department of Natural Resources Pell Lake Sanitary District
Ancillary Management Measures	Monitoring programs[c,d]	Pell Lake	Continue to participate in the WDNR Self-Help monitoring program; conduct an aquatic plant survey every 3 to 5 years	Pell Lake Sanitary District, Wisconsin Department of Natural Resources
	Public informational programming	Direct drainage area tributary to Pell Lake	Continue public awareness and informational programming; consider participation in Project WET or Adopt-A-Lake programs	Walworth County, Pell Lake Sanitary District

[a]*Land use recommendations are those set forth in the regional land use, water quality management, and natural areas and critical species habitat protection and management plans. See also the land use and management measures set forth under the Nonpoint Source Pollution Control plan element.*

[b]*Measures recommended generally involve low or no cost and would be borne by private property owners. Cost is included under public informational and educational component.*

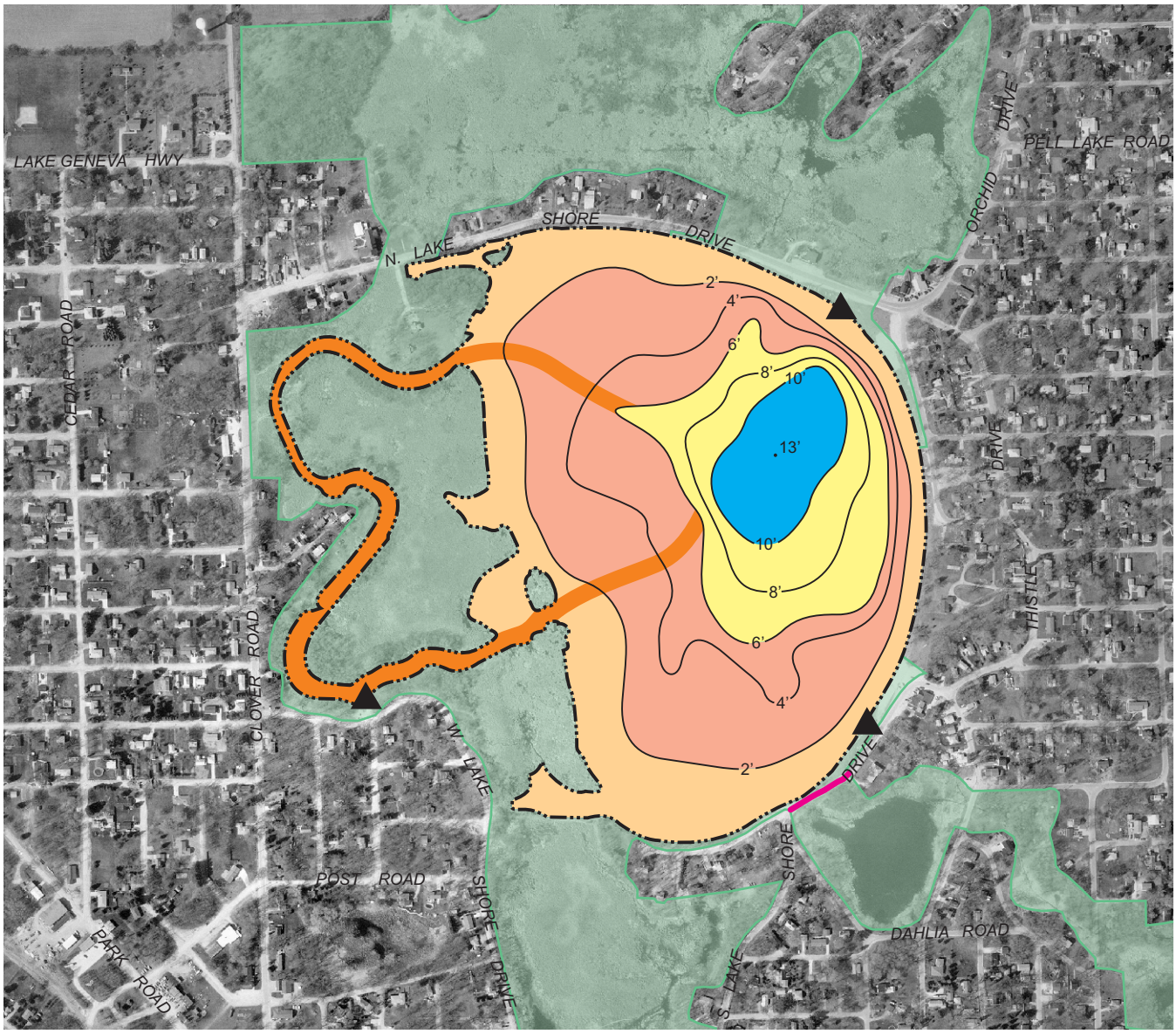
[c]*Partial funding available through the Wisconsin Department of Natural Resources grant programs.*

[d]*Periodic additional surveys are recommended annually for water clarity, and at three- to five-year intervals for aquatic plant communities, and five- to 10-year intervals for fish communities.*

Source: SEWRPC.

Map 16

RECOMMENDED LAKE MANAGEMENT PLAN FOR PELL LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20' — WATER DEPTH CONTOUR IN FEET

LAND USE MANAGEMENT

- PROTECT ENVIRONMENTAL CORRIDOR LANDS
- OBSERVE GUIDELINES IN REGIONAL AND LOCAL LAND USE PLANS

FISHERIES MANAGEMENT

- MONITOR FISH POPULATIONS, MODIFY STOCKING/ HARVESTING PROGRAM AND REGULATIONS AS NECESSARY
- REMOVE BERM

AQUATIC PLANT MANAGEMENT

- MANUALLY HARVEST AROUND PIERS AND DOCKS
- CONSIDER LIMITED USE OF HERBICIDES TO CONTROL NONNATIVE INVASIVE SPECIES
- ACCESS: HARVEST AQUATIC PLANTS AS NECESSARY TO FACILITATE RECREATIONAL BOATING ACCESS
- RIPARIAN ACCESS: PROMOTE NATIVE AQUATIC AND SHORELAND PLANT GROWTH FOR HABITAT PROTECTION
- HABITAT: HARVEST AQUATIC PLANTS AS NECESSARY TO PROMOTE FISH HABITAT

WATER QUALITY MANAGEMENT

- CONTINUE PARTICIPATION IN WISCONSIN DEPARTMENT OF NATURAL RESOURCES SELF-HELP MONITORING PROGRAM
- PROMOTE GOOD HOUSEKEEPING PRACTICES IN URBAN AND RURAL AREAS
- PROMOTE RURAL AND URBAN NONPOINT SOURCES CONTROL MEASURES WHERE APPROPRIATE
- PERIODICALLY REVIEW SEWER SERVICE AREA
- ENFORCE LOCAL ORDINANCES RELATED TO SHORELANDS AND CONSTRUCTION EROSION CONTROL

RECREATIONAL USE MANAGEMENT

- MAINTAIN PUBLIC RECREATIONAL ACCESS
- BOATING: HARVEST AQUATIC PLANTS AS NECESSARY TO PROMOTE NAVIGATION
- OPEN WATER GREATER THAN 10 FEET
- ENFORCE SUMMER AND WINTER USE ORDINANCES

PUBLIC INFORMATION AND EDUCATION

- CONTINUE PUBLIC AWARENESS PROGRAM

GRAPHIC SCALE

0 350 700 FEET

Source: Wisconsin Department of Natural Resources, and SEWRPC.

beds dominated by Eurasian water milfoil, to limit the spread of nonnative invasive plant species. The plan recommends that boating traffic be restricted where Eurasian water milfoil is prevalent, and where navigational channels and access lanes have not been harvested. The plan also recommends limited chemical aquatic plant management measures associated specifically with the control of Eurasian water milfoil and purple loosestrife be employed in addition to manual harvesting. Use of chemical herbicides is recommended to be limited mainly to areas where nonnative invasive species are present. The plan also recommends establishing nearshore native aquatic floating and emergent vegetation to increase species diversity and numbers, and provide beneficial aquatic habitat for fishes and wildlife.

The plan recommends strict enforcement of regulations designed to promote safe boating activities, and limit potential, boating-related threats to shorelands as a result of wave and wake action. Limiting recreational boating activity in areas where Eurasian water milfoil populations are dominant can help to minimize fragmentation of the plant by propellers and help to reduce the spread of this nuisance species.

The recommended plan includes the continuation of an ongoing program of public information and education, focusing on providing riparian residents and lake users with an improved understanding of the lake ecosystem. For example, additional options regarding household chemical usage, lawn and garden care, shoreland protection and maintenance, and recreational usage of the Lake should be made available to riparian property owners, thereby providing riparian residents with alternatives to traditional activities.

Pell Lake is a valuable natural resource in the Southeastern Wisconsin Region. Increases in population, urbanization, income, leisure time, and individual mobility forecast for the Region may be expected to result in additional pressure for development in the area tributary to the Lake and for water-based recreation on the Lake. Adoption and administration of an effective lake protection and management program for Pell Lake, based upon the recommendations set forth herein, will provide the water quality protection needed to maintain conditions in Pell Lake suitable for recreational use and for fish and other aquatic life.

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APPENDICES

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Appendix A

ILLUSTRATIONS OF COMMON AQUATIC PLANTS FOUND IN PELL LAKE

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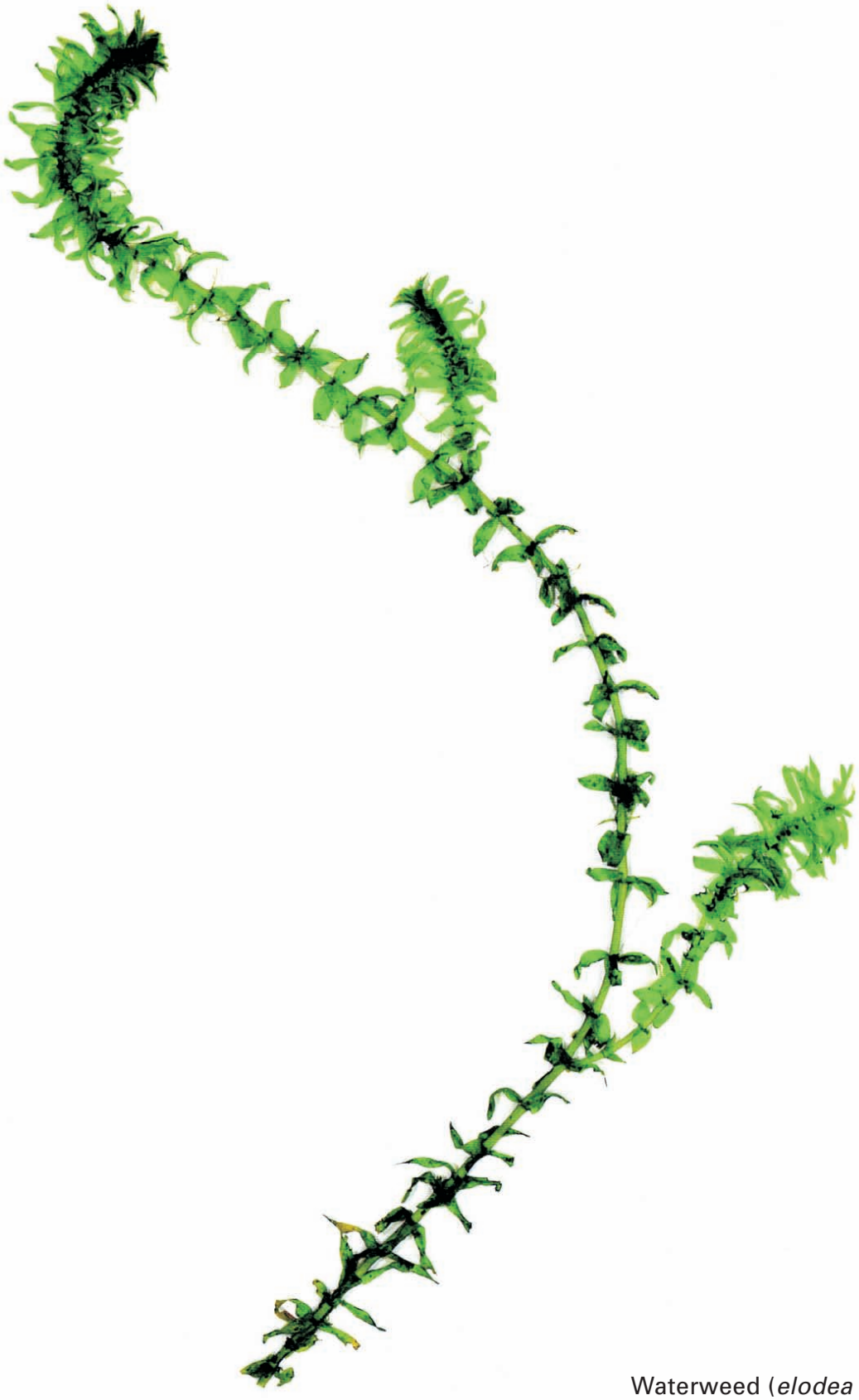

Waterweed (*elodea canadensis*)

Eurasian Water Milfoil (*myriophyllum spicatum*)

Coontail (*ceratophyllum demersum*)

Large-Leaf Pondweed (*potamogeton amplifolius*)

Curly-Leaf Pondweed (*potamogeton crispus*)

Illinois Pondweed (*potamogeton illinoensis*)

Sago Pondweed (*potamogeton pectinatus*)

Muskgrass (*chara vulgaris*)

Clasping-Leaf Pondweed
(*potamogeton richardsonii*)

Robbins Pondweed (*potamogeton robbinsii*)

Flat-Stem Pondweed (*potamogeton zosteriformis*)

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Appendix B

PRELIMINARY VEGETATION SURVEY: PELL LAKE WETLAND AND SHORELAND SURVEY

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PRELIMINARY VEGETATION SURVEY
PELL LAKE WETLAND AND SHORELINE SURVEY

Date: July 19, 2001

Observer: Rachel E. Lang, Senior Specialist-Biologist
Southeastern Wisconsin Regional Planning Commission

Location: Town of Bloomfield in parts of south one-half and the north one-half U.S. Public Land Survey Section 15 and 22, respectively, Township 1 North, Range 18 East, Walworth County, Wisconsin.

Species List:

POLYPODIACEAE
Thelypteris palustris – Marsh fern

TYPHACEAE
Typha latifolia – Broad-leaved cat-tail

GRAMINEAE
Spartina pectinata – Prairie cordgrass
Phalaris arundinacea[1] – Reed canary grass

CYPERACEAE
Eleocharis sp. – Spike-rush
Scirpus americanus – Chairmakers rush
Scirpus fluviatilis – River bulrush
Scirpus atrovirens – Green bulrush
Carex vulpinoidea – Fox sedge
Carex stricta – Tussock sedge
Carex spp. – Sedges

PONTEDERIACEAE
Pontederia cordata[2] – Pickerel-weed

IRIDACEAE
Iris virginica – Virginia blueflag

SALICACEAE
Salix nigra – Black willow

URTICACEAE
Urtica dioica – Stinging nettle

POLYGONACEAE
Polygonum amphibium – Smartweed
Polygonum pericardia – Lady's thumb

NYMPHAEACEAE
Nymphaea tuberosa – White water lily

BALSAMINACEAE
Impatiens capensis – Jewelweed

RHAMNACEAE
Rhamnus frangula[1] – Glossy buckthorn

VITACEAE
Vitis riparia – River-bank grape

LYTHRACEAE
Lythrum salicaria[1] – Purple loosestrife

ASCLEPIADACEAE
Asclepias incarnata – Marsh milkweed

VERBENACEAE
Verbena hastata – Blue vervain

LABIATAE
Scutellaria galericulata – Marsh skullcap
Lycopus americanus – Cutleaf bugleweed

CAPRIFOLIACEAE
Sambucus canadensis – Elderberry

Total number of plant species: 27
Number of nonnative plant species: 4 (15 percent)

The Pell Lake wetland and shoreline plant community area is part of a larger wetland complex and consists of shallow marsh, fresh (wet) meadow, and second growth, Southern wet to wet-mesic lowland hardwoods. Disturbances to the plant community area include mowing. No Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection.

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[1]Nonnative plant species.

[2]Uncommon plant species.

SVY2640

Appendix C

PROTOCOL FOR THE CONDUCT OF A CITIZEN-BASED CREEL CENSUS OF PELL LAKE

INTRODUCTION

Creel surveys are records of the types and conditions of fishes caught in a lake, and may include records of fishes kept or released back into the lake.[1] Such records are compiled from anglers, and generally include information on the species of fishes caught, their length, weight, and condition. Location information may also be collected as part of such a census. These records provide fisheries managers with data on the abundance, angling pressures, and condition of fishes in a lake. A group of records from a waterbody comprise a census that allows fisheries managers to determine the essential characteristics of a fishery and develop management plans based upon these specific characteristics. For example, using these data, fisheries managers can create and/or modify stocking and harvesting programs to best reflect prevailing conditions at a specific lake.

DATA ACQUISITION AND REPORTING

Data are typically gathered and entered onto a form by either the individual angler or a volunteer monitor who interviews individual anglers, say, at the recreational boating access site or along the lakeshore. A typical data entry form that could be used in the conduct of a creel census on Pell Lake is shown in Figure C-1. The data form provides space for the monitor or angler to enter a variety of information about the Lake and its fishery. The initial data to be entered describe the type of fishing experience and weather conditions at the time of the fishing experience. The date and times of the fishing experience are entered onto the form, together with the type of fishing, boat fishing, shore fishing, open-ice fishing, ice shanty fishing, or wading fishing, and the numbers of persons in the fishing party. The time data allow calculation of the rate of catch per unit of effort, or time, devoted to the catch. If known, the air and water temperatures, and the water clarity based upon a Secchi disc measurement, are also entered on the form. These data provide insights into light conditions and other water quality conditions that may be influencing the fishery at the time of the survey.

The body of the form, shown in Figure C-1, provides space for recording data on individual fishes caught during the angling experience. The major fish species present in Pell Lake are listed in the right hand column, together with a numeric code that represents that fish species. Not all fish species reported from the Lake are listed,

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[1] *Bradley T. Eggold and Matthew Coffaro,* A Manual for Creel Clerks and Contest Monitors, *Wisconsin Department of Natural Resources, undated.*

Figure C-1

CREEL SURVEY FORM

Lake Name: PELL LAKE

Interviewer/person submitting report:_____

Date:_____
(Month/Day/Year)

Type of Fishing: (1) Boat fishing (2) Shore fishing
(2) Open-ice fishing (4) Ice shanty fishing
(5) Wading

Weather:_____

Number in Fishing Party:_____

Air Temperature (°F):_____

Start Fishing Time:____:____am/pm

Water Temperature (°F):_____

End Fishing Time:____:____am/pm

Secchi Depth (ft):_____

Total Fish Time (hour):_____hrs. _____min.

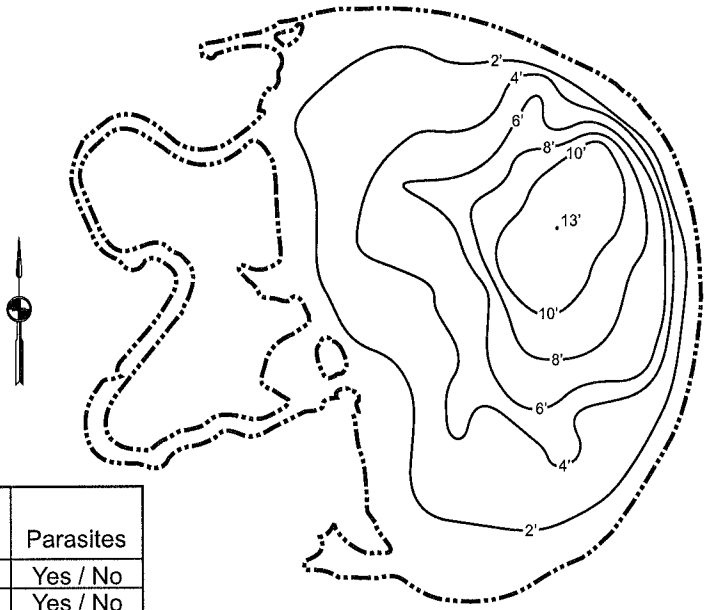
Measurements for all Fish Caught

Species Code	Total Length (in)	Weight (lbs)

Species List

Species	Code	% of Time Fished For	# Caught	# Kept
Bluegill	1			
Yellow Perch	2			
Green Sunfish	3			
Pumpkinseed	4			
Rock Bass	5			
Largemouth Bass	6			
Smallmouth Bass	7			
Musky	8			
Northern Pike	9			
Walleye	10			
Warmouth	11			
White Sucker	12			
Bullhead	13			
Carp	14			
	15			
	16			
	17			
	18			

Show Location of Area Fished on Map below:



Fish Condition Observations

Species Code	Deformities	Eroded Fins	Lesions/ Tumors	Parasites
	Yes / No	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No	Yes / No

Figure C-2

PICTORIAL IDENTIFICATION FOR SUNFISHES

Green Sunfish

Adult

Mouth reaches to or beyond the middle of the eye

2 dorsal fins that appear as one

Light blue to whitish streaks emanating from the head

No tooth patch on the tongue

Relatively elongated gill rakers

Adult

Breeding male

Similar Species

Bluegill
The bluegill is somewhat similar to the green sunfish. The green sunfish has a somewhat larger mouth reaching the middle of the eye), a more elongated body, a rounded pectoral fin, and an opercular tab fringed with white. The bluegill has a smaller mouth (reaching the front of the eye), a more rounded body, an elongated and pointed pectoral fin, and a solid dark blue opercular tab.

Pumpkinseed
The pumpkinseed is somewhat similar to the green sunfish. The pumpkinseed has a red dot at the back of its dorsal tab, and it has short and knobby gill rakers. The green sunfish has an opercular tan fringed with white, and its gill rakers are relatively elongated.

Orangespotted sunfish
The orangespotted sunfish is somewhat similar to the green sunfish. The orangespotted sunfish has 8 or 9 soft rays in its anal fin, conspicuous orange spots, and an overall lighter body color. The green sunfish has 10-12 soft rays in its anal fin, lacks orange spots, and has an overall darker body color.

Warmouth
The warmouth is somewhat similar to the green sunfish. The warmouth has a tooth patch on its tongue; the green sunfish does not.

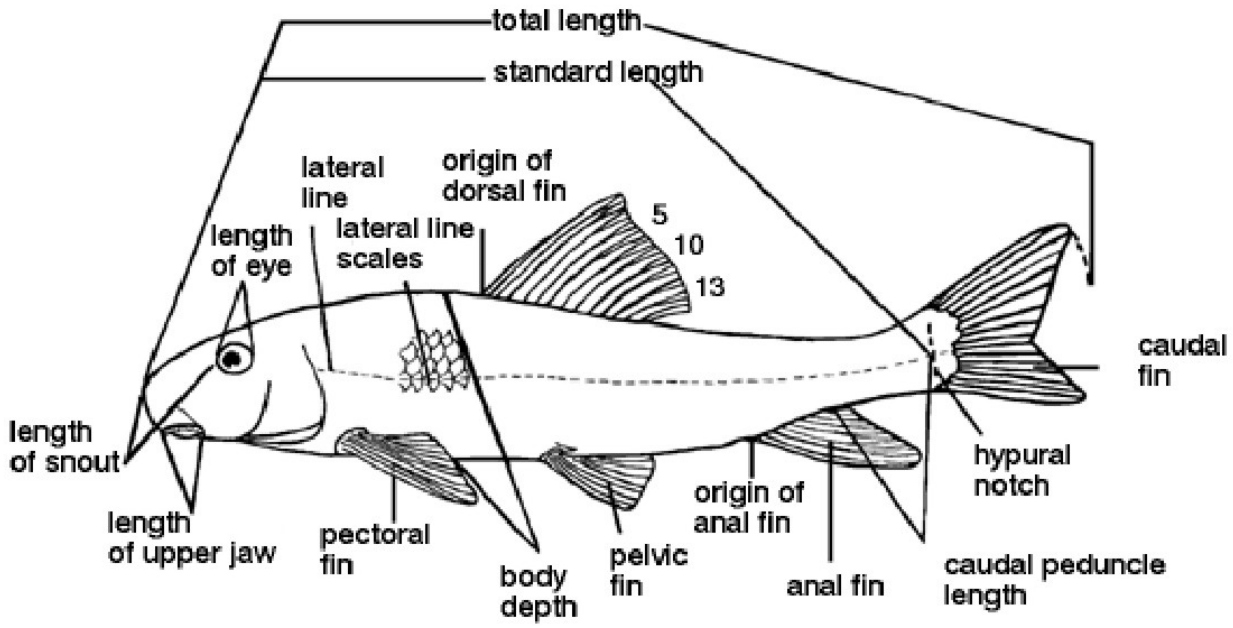
Longear sunfish
The longear sunfish is somewhat similar to the green sunfish. The longear sunfish has a reddish margin around its opercular tab (which is elongated in large specimens but not in small ones) and 34-38 lateral line scales. The green sunfish has a white to yellow margin around its opercular tab and 44-51 lateral line scales.

NOTE: The above information can be found at http://limnology.wisc.edu/research/newresearch.htm

Source: Wisconsin Department of Natural Resources, University of Wisconsin Center for Limnology and Sea Grant Institute, and SEWRPC.

Figure C-3

EXTERIOR ANATOMY FEATURES OF WHITE SUCKERS GENERALLY USED IN IDENTIFICATION OF FISHES



Source: Wisconsin Department of Natural Resources, University of Wisconsin Center for Limnology and Sea Grant Institute, and SEWRPC.

however. Fishes not listed can be added in the blank spaces provided. Some species, such as the bullheads, have a number of variants, e.g., yellow bullheads, brown bullheads, and black bullheads, that have been reported in the Lake as documented in Chapter II. There are specific taxonomic difficulties in distinguishing these varietals, and, from a fisheries management point of view, little difference between their habitat, feeding, and reproductory requirements. However, should the census taker have access to an appropriate taxonomic key and be able to determine these varietals, each could be listed in the spaces provided. Aides to taxonomic identification of fishes are available either on-line or in book form;[2] an example of a taxonomic key to distinguish green sunfish from bluegill, pumpkinseed, orange spotted sunfish, longear sunfish, and warmouth is shown as Figure C-2.

Against each fish species, spaces are provided for the respondent, whether the angler or census taker, to indicate the percentage of time spent fishing for a specific species of fish, the numbers caught, and the numbers kept. These latter numbers could reflect strikes by fishes that may be smaller than the regulatory limit, or fishes captured during a "catch-and-release" fishing experience. As noted above, the total time spent fishing is recorded in the header of the survey form, and the percentage of time spent angling for the various target species is reflected in the right hand column.

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[2]*George C. Becker,* Fishes of Wisconsin, *The University of Wisconsin Press, 1983; see also http:// limnology.wisc.edu/, then select Great Lakes, On-line System for Identifying Wisconsin Fishes, for an electronic version of this taxonomic key.*

The left hand column provides additional spaces for recording specific details about individual fishes captured. Using the code number provided in the right hand column for the specific type of fish, the angler or census taker should enter the appropriate information on each fish captured in the spaces provided. Total length is measured as the distance, in inches, between the tip of the snout to the tip of the tail. For those species having flexible tail fins, the recommended method of estimating total length is to group or bunch the tail fin and record the overall length. This dimension is shown in Figure C-3. Length is commonly reported in inches and tenths of inches.

In addition, the left hand column provides space to enter the weight of the individual fishes next to the overall length. As with length, weight is indicated in pounds and tenths of pounds using the following conversions:

1 to 2 ounces	=	0.1 pound	9 to 10 ounces	=	0.6 pound
3 ounces	=	0.2 pound	11 ounces	=	0.7 pound
4 to 5 ounces	=	0.3 pound	12 to 13 ounces	=	0.8 pound
6 to 7 ounces	=	0.4 pound	14 to 15 ounces	=	0.9 pound
8 ounces	=	0.5 pound	16 ounces	=	1.0 pound.

By examining length and weight data, the fisheries manager can make an estimate of the condition factor of the fishes.

The lower left hand portion of the form provides additional space for the angler or census taker to note any abnormalities observed, including deformities, damaged or eroded fins, lesions and tumors, and any visible parasites. Space is also provided for the observer to record the species of fish affected.

Finally, the lower right hand side of the form provides a bathymetric map of Pell Lake that can be used by the angler or census taker to record locations of fishing efforts. Because this survey is based upon catches made by casual anglers, it is not subject to the potential bias introduced to sampling by more formalized sampling techniques. This is beneficial for assessment purposes as it results in a truly random sample of fishes and fisheries conditions within the Lake over time.

Data acquired should be reported on forms similar to that shown in Figure C-1 to the Secretary of the Pell Lake Sanitary District. Data should be compiled in spreadsheets using standard statistical programs for personal computers. This will facilitate sharing the data with Wisconsin Department of Natural Resources fisheries staff or other fisheries professionals using electronic media.

DATA ANALYSIS AND INTERPRETATION

As noted above, the data gathered through the creel census process can be compiled and analyzed in a number of ways. While some of the more complex interpretations of the data should be undertaken by persons trained to conduct such an analysis, there are some basic facts that the census takers can glean from the data that will be of interest to the electors and property owners of the Pell Lake Sanitary District. These analyses are briefly described below.[3]

Species Caught

The most basic piece of information that can be gleaned from the census data is the numbers and types of fishes being caught from the Lake. Tabulating information on the types of fishes from year to year will provide information of how the fish communities may be changing over time. Data need not be compiled on an annual basis, but can also be assessed by comparing similar months or other periods of time, see analysis of catch per unit effort below. Simply listing the types of fishes and the numbers caught, and calculating the percentage of the

[3]*See Richard C. Lathrop, Susan B. Nehls, Clifford L. Brynildson, and Karen R. Plass, Wisconsin Department of Natural Resources Technical Bulletin No. 181,* The Fishery of the Yahara Lakes, *1992.*

catch represented by each species, can provide useful information on the dominance of specific types of fishes. Major changes in the percentage represented by specific fishes can provide an indication of an ecosystem level change that should be investigated further. The percentage of the catch represented by a species, P, is calculated as:

P = number of species A caught / total number of fishes caught x 100 (1)

The data used to calculate these percentages can be found on the data sheet, shown as Figure C-1, using the numbers reported in the "# Caught" column in the right hand column in the body of the form (= number of species A caught), and the sum of the numbers shown in the "# Caught" column. Calculating this latter figure will require adding up the total of the numbers shown in the "# Caught" column.

Catch per Unit Effort

Catch per unit effort, or CPUE as it is often referred to, represents the ratio of the number of fishes of a particular species captured during a fishing excursion to the number of hours that each angler in the party spends fishing. This number is calculated using the data from the header box in combination with the numbers of fishes shown in the "# Caught" column. This number is calculated for individual fish species. Multiple forms can be added to provide estimates of catches of specific fishes per angler per hour (or day).

To calculate the number of hours fished, or "Total Fish Time," data shown in the header block as "Start Fish Time" and "End Fish Time" will allow determination of the numbers of hours fished:

Total Fish Time = End Fish Time – Start Fish Time (2)

Using a 24-hour clock (also known as "military time") will help in calculating the hours fished, although the hours fished can be calculated using the more traditional a.m. and p.m. time format. If more than one person is shown in the "Number in Fishing Party" block, the hours fished must be adjusted accordingly to produce a number of hours fished per angler. This statistic can be determined as:

Hours per Angler = Total Fish Time / Number in Fishing Party (3)

To calculate the catch per unit effort for a particular species, the numbers of fishes caught is divided by the time spent fishing:

CPUE = # Caught of species A / Hours per Angler (4)

The catch per unit effort is most often expressed in terms of the number of fishes of a particular species per angler-hour.

Average Total Length and Average Weight

Another statistic that is easily calculated, and which has value in determining the age and quality of the fishery, is the average total length and average weight for each species of fish. Using the data presented in the left hand column of the creel survey form shown in Figure C-1, data for each species can be totaled and averaged to generate these average values:

Average Total Length = Σ (Total Length for species A) / total number of fishes of species A caught (5)

Average Weight = Σ (Weight for species A) / total number of fishes of species A caught (6)

In a lake where conditions are not changing dramatically, these average total length and average weight values would be likely to remain somewhat similar over time. This similarity is due to the fact that anglers are as likely to catch young fishes as well as older fishes in a random manner. Provided all of these data are recorded, the numbers of younger and older fish would tend to remain somewhat constant over time. Dramatic changes in these numbers would suggest that a summer kill or winter kill may have occurred, or that a particular species of fish had

had a poor breeding season where few young survived. Dramatic changes could also indicate a change in angling pressure, such as would be expected in the case where anglers capture larger (or smaller) numbers of fishes in a given year, altering the make up of the fish community. These latter changes can be evaluated using total length and weight data "classes," since the length and weight of fishes is proportionate to their age. By plotting the data in the form of bar graphs or histograms, missing or abnormal age classes (see below) can be identified. Such instances should be reported to the Wisconsin Department of Natural Resources fisheries managers or other trained individuals for further investigation.

Age Classes

This statistic is analogous to the average growth curves many parents are familiar with through visits to their child's pediatrician. Statistically, over a large enough population, average body sizes can be determined and used to assess the progress of children as they mature. These same statistics can be employed in fisheries management to determine if recruitment, or the addition of new fishes to a population, is occurring, and the degree of breeding success. Successive years generally result in large numbers of young fish, distinguished by greater number of shorter, lighter fishes, that mature into fewer numbers of older fish, distinguished by longer, heavier fishes. The numbers of fishes decline due to natural mortality, angling pressures, and predation by piscivorous fishes and birds. These losses are normal and natural, and result in a relatively smooth transition from large numbers of young fishes to fewer numbers of older fishes over time. Gaps or major changes in this transition would indicate some traumatic occurrence, such as a year in which there was poor breeding success or a loss of the necessary habitat that would promote successful breeding, among other impacts. In Pell Lake, preliminary age-growth data were compiled from the fish survey completed during this planning project for three fish species:

Bluegill	6.2 – 6.9 inches	Three-year old fishes
	7.0 – 7.7 inches	Four-year old fishes
	7.7 – 7.75 inches	Five-year old fishes
	7.9 – 9.1 inches	Six-year old fishes
Green Sunfish	4.75 inches	Two-year old fishes
	6.2 inches	Three-year old fishes
	6.7 inches	Four-year old fishes
	7.25 – 7.5 inches	Five-year old fishes
	7.6 – 7.7 inches	Six-year old fishes
Largemouth Bass	11.25-11.75 inches	Three-year old fishes
	12.25 inches	Four-year old fishes
	13.25 inches	Five-year old fishes

These data can be refined and further developed over time as additional creel census data are added to the data set, and the District citizen monitors should seek the assistance of the Wisconsin Department of Natural Resources fisheries managers or other trained individuals in the determination and interpretation of the age classes and age class data.

Condition Factor

The information compiled from the creel survey form shown in Figure C-1 can also be used to estimate the condition factor of the fish species in the Lake. In like manner to the age classes based upon length or size of fishes, information on both the length and weight can be used to estimate the "condition" of the fishes captured. These data are also analogous to those compiled by physicians who record a patient's height and weight. Condition factor, CF, is determined as:

$$CF = \text{Total Length} / \text{Weight} \quad (7)$$

The ratio between length and weight would be expected to remain relatively constant in a healthy population, length increasing in proportion to the increased weight attained with age. Graphing this relationship would result in a straight-line graph, beginning at zero and increasing steadily over time. Changes in this ratio, or deviations

from the straight line graph, would provide warning of a change in the fishery, such as stunting of the population, that should be evaluated further by Wisconsin Department of Natural Resources fisheries managers or other trained individuals.

Miscellaneous Information

The creel survey form shown in Figure C-1 also includes a block for the census taker or angler to record any abnormalities observed in the fishes captured. Consistent notations of deformities, eroded fins, lesions and tumors, and parasites should be reported to the Wisconsin Department of Natural Resources fisheries managers or other trained individuals for further investigations.

PUBLIC INFORMATIONAL PROGRAMMING

The data gathered, compiled, and analyzed through the conduct of the foregoing citizen-based volunteer fisheries survey could be presented annually at a meeting of the Pell Lake Sanitary District Board of Commissioners in like manner to the Wisconsin Department of Natural Resources Self-Help volunteer monitoring program data. Information on the fishery combined with water quality information gathered through the volunteer water quality monitoring program can provide an early warning to the District and Pell Lake community of changes in the Lake ecosystem. These changes should ultimately encourage the District to initiate further investigations into the causes and nature of the changes underlying the observed conditions and can help to correct undesirable conditions before they become critical. In this way, programs such as the volunteer monitoring programs can help to protect and maintain the water quality and appeal of Pell Lake.