The State of the Milwaukee River Basin

August, 2001

PUBL WT 704 2001

A report by the Wisconsin Department of Natural Resources in cooperation with the Milwaukee River Basin Land and Water Partners Team and other stakeholders

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State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

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To: Recipients of *The State of the Milwaukee River Basin* Report

We are pleased to present our first *State of the Milwaukee River Basin* report. This report provides an overview of land and water resource quality, identifies challenges facing these resources, and outlines actions the Wisconsin Department of Natural Resources and its many partners can take over the next few years to protect and restore our natural resources throughout the Milwaukee River Basin.

This report is organized into land and water sections for simplicity, but shows how all our resources are closely linked. This ecosystem approach realizes that environmental, social and economic elements factor into our resource management decision making process. Some of our greatest resource management challenges are related to striking a balance between environmental protection and social considerations.

The general nature of this report does not allow us the opportunity to provide intricate details of all resources and issues. Internet links and phone numbers are provided throughout this report so readers wanting more detail can easily find the information.

This report is a work in progress. As objectives are met and projects are completed, we will provide updates on our Milwaukee River Basin Internet page at www.dnr.state.wi.us/org/gmu/milw/. We look forward to maintaining a relationship with all our partners as we work together to protect, restore and enhance our natural resources throughout the Milwaukee River Basin.

Sincerely,

Sharon Gayan
Milwaukee Basin Water Leader

Greg Pilarski
Milwaukee Basin Land Leader

ACKNOWLEDGMENTS

Preparation of *The State of the Milwaukee River Basin* plan has been an effort of the Wisconsin Department of Natural Resources Milwaukee River Land and Water GMU staff with support from the Milwaukee River Basin Land and Water Partners and DNR field and central office staff in the Divisions of Forestry, Land, and Water. Many individuals contributed information, data analysis or review. Their help is much appreciated.

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This publication was partially funded by 604(b) and 104(b) grants from the U.S. Environmental Protection Agency to fulfill requirements of Areawide Water Quality Management Planning under Section 208 of the Clean Water Act and NR121 of Wisconsin's Administrative Code.

This plan also serves as an implementation component of Wisconsin's Fisheries, Habitat and Wildlife Strategic Implementation Plan.

This report can also be found on the DNR website at
http://www.dnr.state.wi.us/org/gmu/milw/index.htm

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INTRODUCTION

The rivers, lakes, groundwater and lands in the Milwaukee River Basin sustain a wide range of plant and animal life (Figure 1). From the seemingly untouched areas within the Northern Unit of the Kettle Moraine State Forest to the areas near cities challenged by pollution and habitat modification, one thing remains constant: our land and water resources are forever linked. Our activities on the land have an effect not just at the point of origin, but ripple throughout the basin. The quality of our rivers, lakes and groundwater also has influence over what we do on the land.

Today we are challenged with finding ways to balance our use of land and water with our desire to protect, restore and enhance the natural resources in the Milwaukee River Basin. Building and maintaining strong partnerships with shared visions and goals are essential to striking this balance.

MISSION AND GOALS

The Wisconsin Department of Natural Resources (WDNR) operates with a broad mission for managing natural resources of the state (see box, below right). The WDNR recently completed a strategic plan guided by this mission. The four main goals outlined below provide a blueprint for WDNR staff and partners to cooperatively carry out this mission. *The State of the Milwaukee River Basin Report* provides a framework for managing our resources within a context of shared responsibility.

WDNR Mission Statement

To protect and enhance our natural resources:
our air, land and water;
our wildlife, fish and forests
and the ecosystems that sustain all life.
To provide a healthy, sustainable environment
and a full range of outdoor opportunities.
To ensure the right of all people
to use and enjoy these resources
in their work and leisure.
To work with people
to understand each other's views
and to carry out the public will.
And in this partnership
consider the future
and generations to follow.

I. Making People Our Strength

We must promote people, organizations and officials working together to provide Wisconsin with healthy, sustainable ecosystems. In partnership with all publics it is imperative we find innovative ways to set priorities, to accomplish tasks and to evaluate successes to keep Wisconsin in the forefront of environmental quality and science-based management.

II. Sustaining Ecosystems

We must work to ensure the state's ecosystems become and remain balanced and diverse. Sound decisions that reflect long-term considerations of healthy environments and a sustainable economy will help us protect, manage and use these ecosystems in a balanced way.

III. Protecting Public Health and Safety

We must work to ensure our lands, surface waters, groundwater and air are safe for humans and other living things that depend upon them and that people are protected by the laws governing natural resources in their livelihoods and recreation.

IV. Providing Outdoor Recreation

We must provide citizens and visitors with opportunities and access to areas in which they can enjoy a full range of nature-based outdoor recreations.

For the complete text of the WDNR Strategic Plan, please visit us on the web at www.dnr.state.wi.us/aboutdnr/plans.

REPORT STRUCTURE

This report has several components aimed at addressing the WDNR Strategic Planning Goals and the goals of our partners. Information, goals and priorities from many WDNR programs and our partners are reflected throughout this document. Specifically this plan:

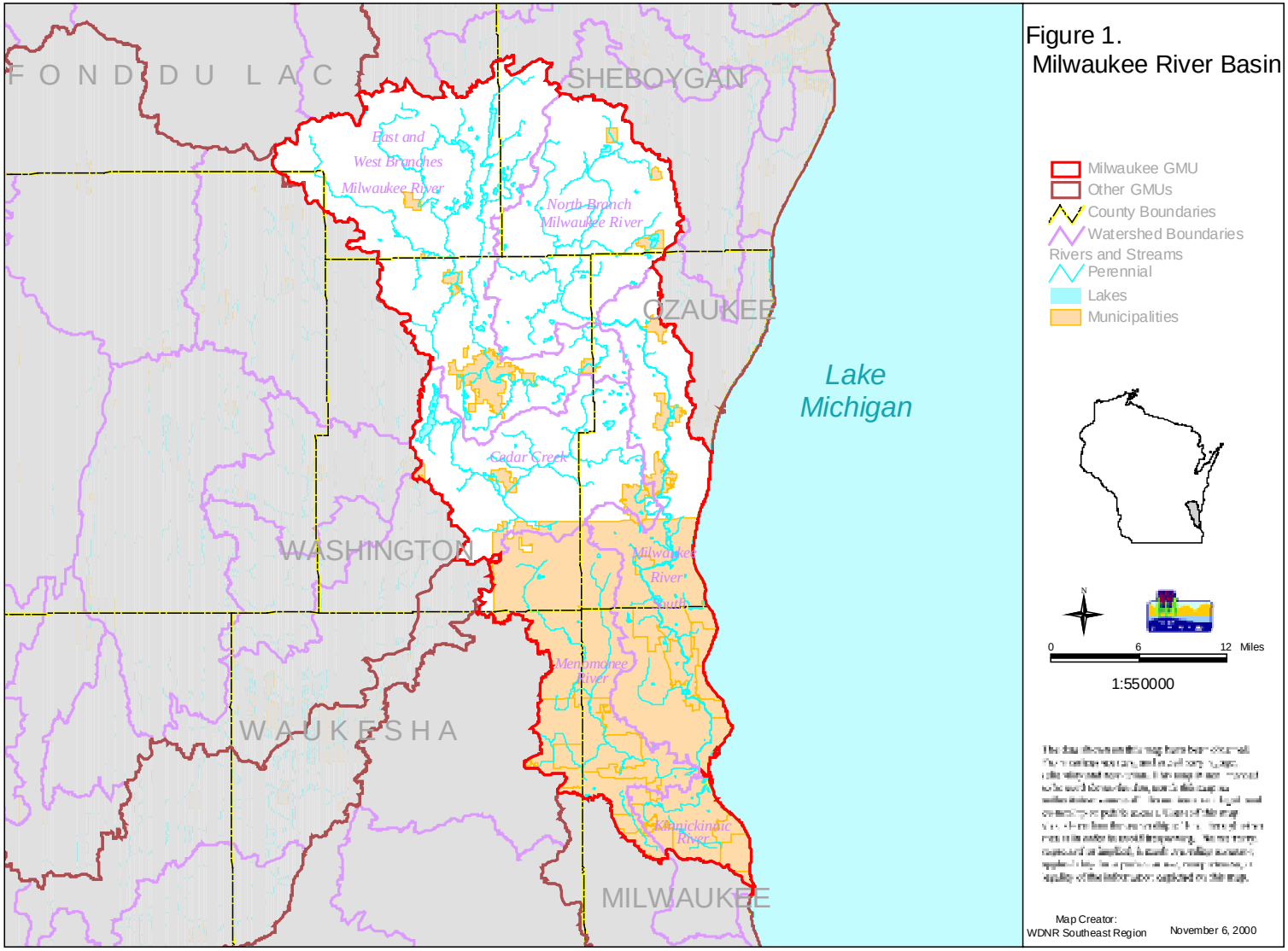
- ✧ Provides an overview of the quality of our land and water resources and our relationships with these resources. **Chapter 1 (page 1), Chapter 2 (page 3), and Chapter 3 (page 32).**

- ✧ Identifies resource issues and threats that keep the land and water resources from meeting their full potential and actions currently underway to address these issues and threats. **Chapter 2 (page 3), Chapter 3 (page 32), Appendix A (page 64), Appendix B (page 81).**

- ✧ Outlines specific actions that the Wisconsin Department of Natural Resources and its many partners can put into practice to improve, protect or maintain the quality of the basin's resources for the next 5 or 6 years. **Chapter 4 (page 51), Chapter 5 (page 56).**

- ✧ Provides links and references throughout the document so those interested in learning more can readily find the information they're seeking.

Figure 1. Milwaukee River Basin



Chapter 1: The Milwaukee River Basin, Past and Present.

PAST

Before intensive settlement the Milwaukee River Basin was much different than it is today. Historic settlements of four Native American groups—the Fox, Mascouten, Potawatomi and Menominee---were documented along the Milwaukee River, and remained in the area for a short time after their lands were ceded to the United States around 1833. Some of these groups became involved in the fur trade with French explorers during the 1700 and 1800s. Pere Jacques Marquette was the first European explorer known to have visited what is now Milwaukee. He and the other explorers who followed found an area rich with upland forests of maple, beech and basswood, and lowland areas dominated by tamarack, cedar and ash.

In addition to the forests, the basin was water and wetland rich. The abundant resources of the forests, rivers and lakes were catalysts for the first settlers' attempts at economic development in the basin. The southernmost portions of the basin, now known as the Milwaukee area, were soon settled and incorporated, while many of the forested riverbanks were cut for lumber or cleared for farming. Further north in the basin the land was rapidly deforested and cleared for agriculture. The relatively flat landscape and rich soils formed by the glaciers in many areas of the basin allowed for farming a variety of crops. By the mid-late 1800s, farming was the main activity in the upper basin, while mill operations were the first industries. The Milwaukee River and Cedar Creek provided excellent hydropower for the mills.

PRESENT

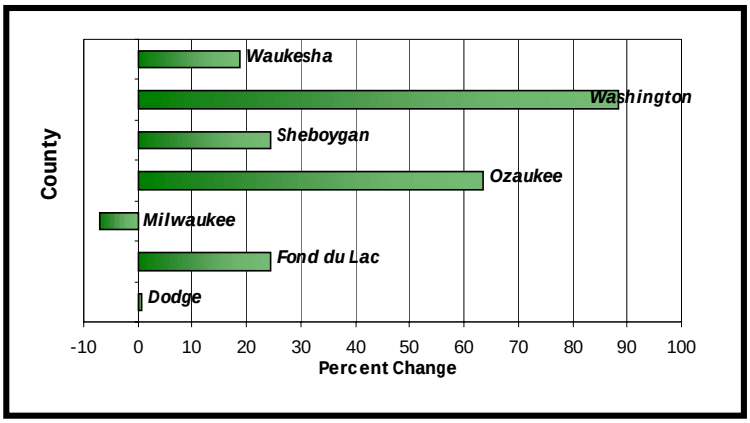
The Milwaukee River Basin is located in portions of seven counties, contains (entirely or portions of) 13 cities, 32 towns, 24 villages and is home to about 1.3 million people. The southern quarter of the basin is the most densely populated area in the state, holding 90 percent of the basin's population (Figure 1, page viii). The basin is divided into six watersheds. Three of the watersheds (Milwaukee River North, Milwaukee River East-West and Milwaukee River South) contain the Milwaukee River from start to finish and collectively occupy two-thirds of the basin area (584 square miles). The other three watersheds (Cedar Creek, Menomonee River and Kinnickinnic River) are named after the major rivers they contain. Collectively the six watersheds contain about 500 miles of perennial streams, over 400 miles of intermittent streams, 35 miles of Lake Michigan shoreline, 57 named lakes and many small lakes and ponds. Wetlands encompass over 68,000 acres, or 12 percent of the basin land area.

The Natural Heritage Inventory (WDNR, 2000) has documented 16 endangered, 26 threatened and 65 special concern plant and animal species and 30 rare aquatic and terrestrial communities within the basin (Appendix C, page 92). The Southeastern Wisconsin Regional Planning Commission (SEWRPC) identified over 18,000 acres of high quality natural communities and critical species habitats remaining in the basin (SEWRPC, 1997). About 18 percent of the land area of the basin is covered by urban uses, while the remainder is considered rural. Agriculture is still dominant in the northern half of the basin.

The topography of the basin was formed by glacial deposits superimposed on underlying bedrock, and ranges from a high of 1360 feet above sea level in the Northern Unit of the Kettle Moraine State Forest to 580 feet at the Milwaukee Harbor. The surface slopes downward from the north and west to the south and east. The physiography is typical of rolling ground moraine, although surface drainage networks are generally well connected, leaving relatively few areas of the watershed that are internally drained.

Population size of the basin has grown overall by 2.2 percent since 1970. Population by county, however has changed dramatically since 1970 as more people moved to rural areas (Figure 3). In 1970 Milwaukee County accounted for about 82 percent of the basin's population, whereas in 2000 (estimate), it accounted for 74 percent of the population. In contrast, the Ozaukee and Washington County communities within the basin grew by 64 and 89 percent, respectively since 1970. Other county population increases in the basin communities since 1970 include Dodge (<1%), Fond du Lac (25%), Sheboygan (24%), and Waukesha (19%).

Figure 2. Percent Change in Milwaukee RIver Basin Communities by County



Lake Michigan supplies drinking water to about 70 percent of basin residents as a function of population size. The remainder of the population receives their drinking water from groundwater sources. As people move to the more rural areas of the basin, groundwater quantity and quality issues will become more important.

Recreational opportunities are abundant throughout the basin. About five percent of the basin (29,000 acres) land resources are under state ownership. Nearly 80 percent of the state owned lands are contained within the Northern Unit of the Kettle Moraine State Forest. In addition county and local parks provide a variety of recreational opportunities.

The next chapters will examine the basin in more detail, including the quality of our water and land resources, issues and resource threats, and recommendations for improvement.

Chapter 2: Milwaukee River Basin Water Resources

The water resources in the Milwaukee River Basin are as diverse as the landscapes in which they reside. The highest quality surface water resources are generally located in the areas least affected by development and with few agricultural impacts, such as in the Northern Unit of the Kettle Moraine State Forest, the Nichols Creek State Wildlife Area, and other rural portions of the basin. As the basin becomes more urbanized, water quality tends to diminish. This chapter will describe the conditions of the surface water and groundwater resources in the basin as we know them today and identify the threats and challenges to these resources.

OVERVIEW

The Milwaukee River Basin contains about 600 miles of perennial streams and 450 miles of intermittent streams draining nearly 900 square miles of land. Most of the stream miles in the basin are considered full fish and aquatic life streams, meaning they are capable of meeting water quality standards and have the ability to support a full range of fish and aquatic life as habitat and water quality allow. Fifty eight percent of basin stream miles are capable of supporting warm water sport fish communities, 12 percent support warm water forage fish communities, and 12 percent are capable of supporting cold water communities. The Milwaukee River North Branch watershed contains most of the cold water streams in the basin (47 miles).

Streams that do not meet water quality standards on a consistent basis make up about 12 percent of the total stream miles in the basin. With the exception of one stream in the North Branch Watershed, all of these lower quality stream miles are located in the most densely populated areas the basin. Many of these streams were modified by straightening, enclosure or concrete lining to move water off the land and more quickly downstream. In response to a U.S. Environmental Protection Agency (U.S. EPA) requirement, the State of Wisconsin maintains a list of impaired waters, also known as the 303(d) list. About 61 miles of streams (10% of the total basin stream miles) are included on this list (Table 1). This list will enable the Wisconsin Department of Natural Resources (WDNR) to set priorities for implementing certain water quality management activities for streams not currently meeting water quality standards. ***For more information about the WDNR impaired waters strategy, please see*** www.dnr.state.wi.us/org/water/wm/wqs/303d***.***

Table 1. Milwaukee River Basin Streams Included on 303(d) List

Waterbody Name	Watershed	Miles affected	Reason for Listing*
Adell Tributary	Milwaukee River North	5.1	HAB
Cedar Creek	Cedar Creek	5.0	SED
Evergreen Creek	Cedar Creek	2.7	NPS
Lehner Creek	Cedar Creek	1.9	NPS
Unnamed tributary to Cedar Creek (Jackson Creek)	Cedar Creek	1.2	NPS
Little Menomonee River	Menomonee River	5.9	SED
Menomonee River portion of Milwaukee River Estuary	Menomonee	1.1	SED, NPS,PS
Milwaukee River	Milwaukee River South	25.0	SED, NPS,PS
Beaver Creek	Milwaukee River South	2.7	NPS
Indian Creek (natural channel downstream of I-43)	Milwaukee River South	1.3	NPS
Lincoln Creek	Milwaukee River South	2.1	HAB,NPS, PS,SED
Southbranch Creek (natural channel reaches)	Milwaukee River South	2.0	NPS
Milwaukee River portion of Milwaukee River Estuary	Milwaukee River South	2.4	SED, NPS,PS
Kinnickinnic River portion of Milwaukee River Estuary	Kinnickinnic River	2.8	SED, NPS/PS

***Abbreviation Key**
HAB = habitat loss
NPS = nonpoint source impacts
PS = point source impacts
SED = contaminated sediment

The following sections give a watershed by watershed perspective of the surface water resources within the Milwaukee River Basin. Additional information for each perennial stream and named lake within the basin is included in Appendices A (page 64) and B (page 81).

Milwaukee River North Watershed

The Milwaukee River North Watershed is located in portions of Sheboygan, Ozaukee and Washington counties (Figure 4). The North Branch Milwaukee River begins in the Nichols Creek State Wildlife Area in Sheboygan County and runs in a southerly direction for 28 miles to its junction with the Milwaukee River in Ozaukee County.

Land cover is primarily rural, with agriculture dominant (57%). Wetlands cover over 14 percent of the land area while grasslands (12%) and forests (11%) represent the other major rural uses. Urban lands cover less than one half of one percent of the land area. The Villages of Adell, Cascade and Random Lake are the only incorporated municipalities.

The quality of rivers and streams in the North Branch Watershed ranges from severely degraded to nearly pristine. Eighty-five miles of perennial streams(86%) partially meet their potential biological uses, and 12 miles (12%) do not meet their potential biological uses (Appendix A, Table 1). An unnamed tributary to the Milwaukee River North Branch (Adell tributary) is listed on the state's impaired waters (303(d))list.

The upper four miles of the North Branch Milwaukee River were formerly known as Nichols Creek, a Class I trout stream. The stretch that runs through the Nichols Creek State Wildlife Area is designated as an Outstanding Resource Water. Outstanding and Exceptional Resource Waters are those that are of such high quality that discharges from municipal and industrial wastewater treatment plants must be of the same or better quality as the receiving water. This designation is based on the quality of the fisheries, protection of recreational uses, water quality and pollution sources. In addition, 8.1 miles of other trout streams (including Mink Creek, Gooseville Creek and Melius Creek) are found in this watershed. Additional streams may support, or have the potential to support cold water fish and aquatic life communities ***For more information about outstanding and exceptional resource waters please call the state ORW/ERW coordinator at (608) 266-9270.***

Fish species found in streams range from highly tolerant to intolerant. Tolerant fish species like common carp, fathead minnow and creek chub are more abundant in degraded streams. Sport fish species found in the watershed include brook trout, brown trout, rainbow trout, smallmouth bass, northern pike, largemouth bass and a variety of panfish. Other fish species found include common shiner, bluntnose minnow, blacknose dace, common shiner, golden redhorse, greater redhorse, black bullhead, fantail darter, johnny darter and blackside darter.

Thirteen named lakes are found in this watershed ranging in size from 212 acres (Random Lake) to six acres (Lake Sixteen). Appendix B, (page 81) has more information about the named lakes in this watershed. With the exception of Huiras Lake and Erler Lake, much of the shoreline of lakes in the watershed is developed.

Figure 3. Milwaukee River North Watershed

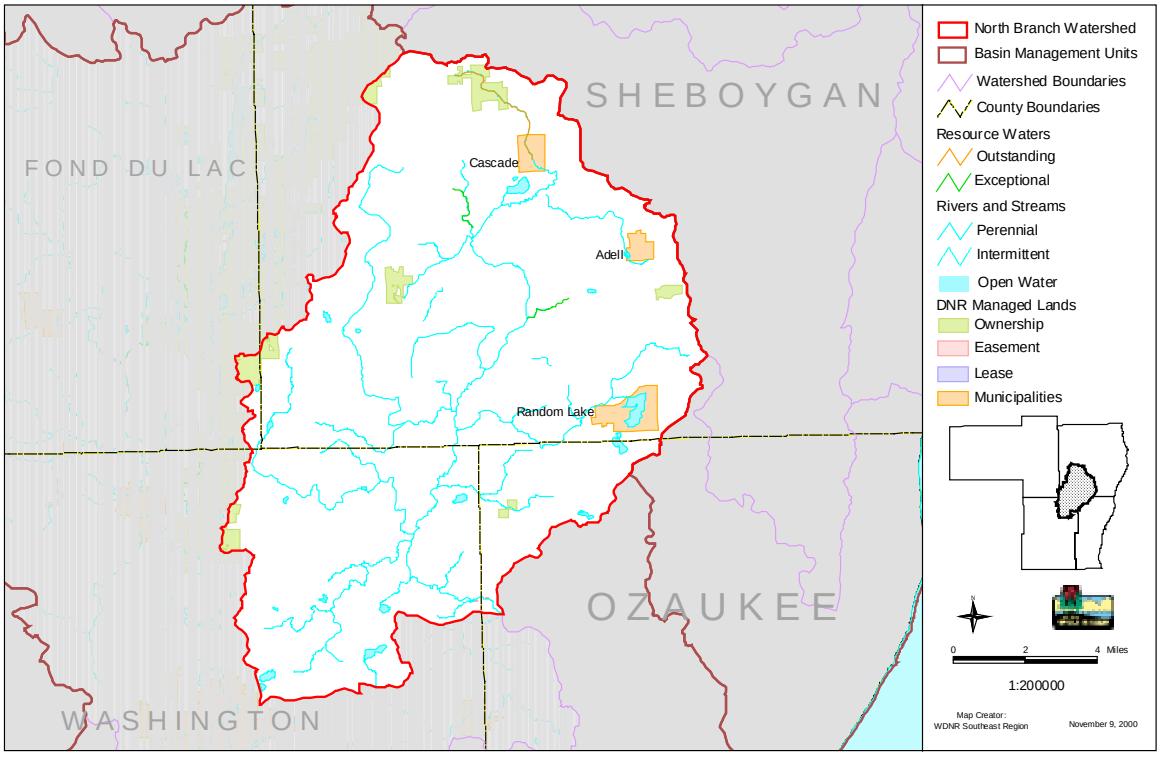


Table 2. Milwaukee River North Watershed At A Glance	
Watershed drainage area	150 square miles
Miles of streams	99
Miles of streams listed as outstanding or exceptional resource waters	ORW: 4.0; ERW:
Miles of streams on impaired waters list	5.1
General threats to stream water quality	■ Stream and wetland modification ■ Agricultural runoff ■ Streambank erosion ■ Construction site erosion
Number of named lakes	13 named lakes, several small ponds
Number of dams	17
Threats to lake water quality	■ Agricultural erosion ■ Failing septic systems ■ Shoreline development ■ Habitat modification ■ Construction site erosion ■ Exotic species
Number of industrial wastewater treatment facilities	3 specific, 6 general
Number of municipal wastewater treatment facilities	3

Milwaukee River East-West Watershed

The Milwaukee River East-West Watershed covers 266 square miles and is located in portions of Dodge, Fond du Lac, Ozaukee, Sheboygan, and Washington counties (Figure 5). The East and West Branches of the Milwaukee River meet the Milwaukee River mainstem near the Village of Kewaskum in Washington County. The Milwaukee River then runs south and east to western Ozaukee County where this watershed meets the Milwaukee River South Watershed.

Rural uses cover most of the land area in this watershed. Agriculture is dominant, covering about 47 percent of the land area, followed by wetlands (19%), grasslands (16%) and forests (12%). Urban uses cover about three percent of the land area. The City of West Bend and the Villages of Campbellsport, Kewaskum and Newburg are the only incorporated areas in the watershed.

The Milwaukee River East-West Watershed contains about 196 miles of perennial streams. Nearly all the stream miles in this watershed (98%) are partially meeting their biological uses, while two percent of the streams have not been evaluated. Even though general evaluations have been conducted on many of the streams in the watershed, thorough assessments have been conducted on just five percent of total stream miles within the last five years. No streams in this watershed are listed as impaired waters on the state's 303(d) list. Portions of two rivers (Auburn Lake Creek and East Branch Milwaukee River) totaling six miles in length are considered exceptional resource waters.

The Milwaukee River mainstem is the longest river in this watershed (53 miles). The Milwaukee River begins in wetlands in Fond du Lac County, and flows in a southeasterly direction until meeting the North Branch Milwaukee River near Waubeka. Upstream of Kewaskum, wetland drainage, river straightening, especially the smaller headwaters streams, dams and agricultural runoff are the major factors keeping the rivers from fully meeting their potential. Downstream of Kewaskum, the river is increasingly affected by urban land uses and five major dams, leading to degraded habitat and water quality from nutrient and sediment inputs.

The headwaters for the Milwaukee River East Branch begin with Watercress Creek, a trout stream, in Sheboygan County. The Milwaukee River East Branch then flows south through Long Lake, Mauthe Lake and the New Fane Millpond until it reaches the Milwaukee River mainstem. Unlike the Milwaukee River mainstem, most of East Branch remains in a relatively natural, unchannelized condition. Agricultural runoff contributing nutrients and sediment are the major sources of water quality degradation in the East Branch.

The West Branch Milwaukee River is located in the rolling glacial topography of Fond du Lac County. The river begins with wetlands and flows southeast through wetlands and Lake Bernice before reaching the Milwaukee River mainstem. This river has been greatly affected by channelization for agricultural purposes, especially in the headwaters. Nutrients and sediment from agricultural runoff and stream modification (channelization and dams) contribute to reduced water quality in the West Branch Milwaukee River.

Fish species found in this watershed range from intolerant species such as brook trout, mottled sculpin, blackchin shiner, Iowa darter, pearl dace and northern redbelly dace in the cool and cold water streams, to more tolerant species such as creek chub, central mudminnow, common shiner and white sucker in the more degraded streams. Other than brook trout, sport fish species found in the watershed include smallmouth bass, black bullhead, northern pike, pumpkinseed and bluegill. The state threatened pugnose shiner, greater redhorse and longear sunfish have also been documented in this watershed.

The East-West Branch Milwaukee River Watershed contains over 30 named lakes ranging in size from 427 acres (Long Lake) to two acres (Mallard Hole Lake), providing many recreational opportunities. Six lakes have active lake associations or districts. ***For more information about the Lakes in the Milwaukee River East-West Branch Watershed, please see Appendix B (page 81).***

Figure 4. Milwaukee River East-West Watershed

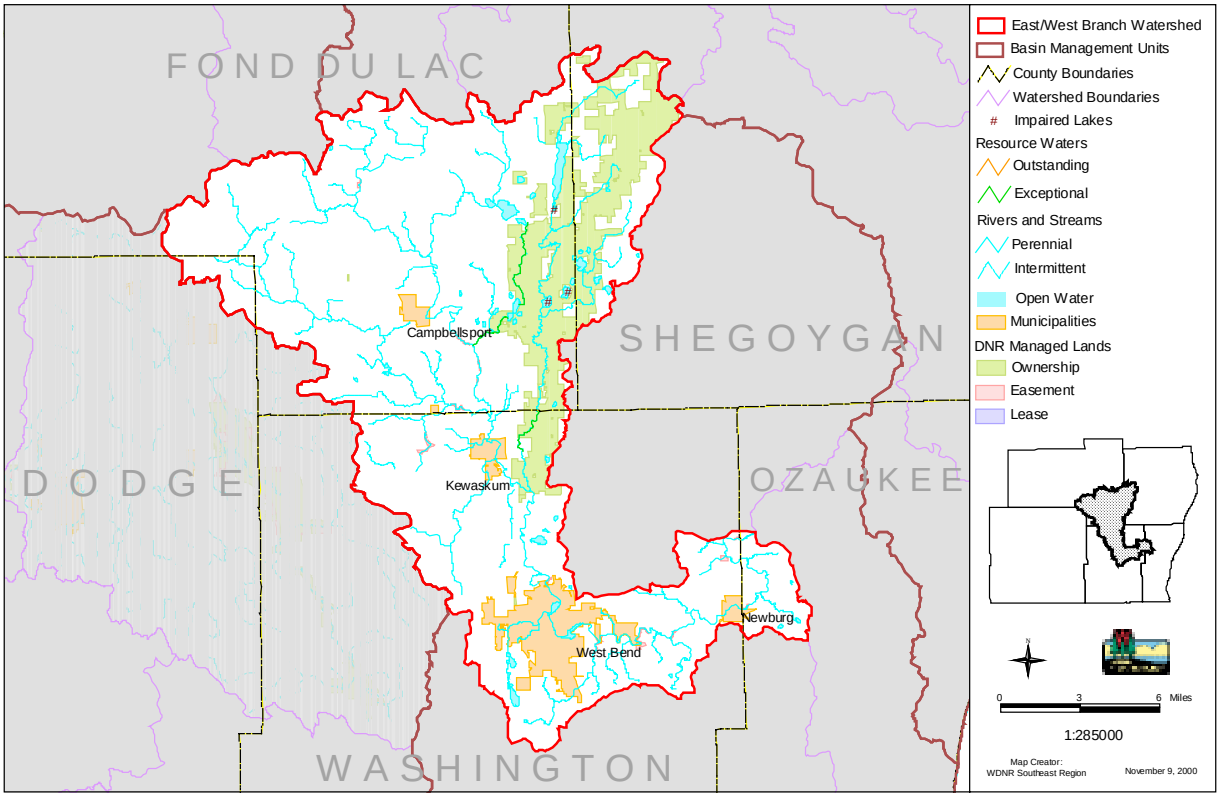


Table 3. Milwaukee River East-West Watershed at a Glance	
Watershed drainage area	266 square miles
Miles of streams	195
Miles of streams listed as outstanding or exceptional resource waters	ERW: 9
Miles of streams on impaired waters list	0
General threats to stream water quality	■ Stream and wetland modification ■ Urban and agricultural runoff ■ Streambank erosion ■ Construction site erosion
Number of lakes	35 named lakes
Number of dams	22
Threats to lake water quality	■ Agricultural and urban runoff ■ Shoreline modification ■ Failing septic systems ■ Exotic species ■ Construction site erosion
Number of industrial wastewater treatment facilities	1 specific permit, 22 general
Number of municipal wastewater treatment facilities	5

Milwaukee River South Watershed

The Milwaukee River South Watershed covers about 168 square miles and is located in portions of Ozaukee and Milwaukee Counties (Figure 6). The Milwaukee River mainstem enters the watershed west of the Village of Fredonia and flows for about 48 miles before entering the Milwaukee Harbor.

Land cover in the watershed is a mix of rural and urban uses. Overall, the watershed is about 33 percent urban, with agriculture (25%), grasslands (21%), forests (12%) and wetlands (6%) making up the rest of the major land cover types. Fourteen cities and villages are found in this watershed.

As with the other watersheds in the basin, the streams in the Milwaukee River South Watershed exhibit a wide range of quality. Over 35 stream miles within the Milwaukee South Watershed are listed on the 303(d) list (Table 1, page 4), including the Milwaukee Estuary, a Great Lakes Area of Concern . The Milwaukee Estuary area of concern encompasses the Milwaukee Harbor, the Milwaukee River downstream from the abandoned North Avenue Dam, the Menomonee River downstream from 25th street and the Kinnickinnic River downstream from Chase Avenue. The International Joint Commission (IJC) and U.S. EPA designated the Milwaukee Estuary in 1987 through the Great Lakes Water Quality Agreement as one of 43 Great Lakes Areas of Concern. These areas are usually industrial in nature, with a history of pollution. In the Milwaukee Estuary, sediments contaminated with polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and heavy metals are linked to degraded water quality, impaired fish and wildlife populations, and restrictions on dredging. A remedial action plan defining the problems with the estuary was published in 1989 by WDNR. A follow up plan further refining impairments and outlining a plan for restoring the estuary was published by WDNR in 1995. ***For more information about Great Lakes Areas of Concern, please visit the U.S. EPA web site at the following address:*** http://www.epa.gov/grtlakes/aoc/.

Nearly 15 percent of all perennial stream miles in this watershed are significantly modified to the extent they have limited ability to sustain diverse biological communities. Many of these streams were straightened, enclosed or lined with concrete to facilitate water movement downstream to alleviate flooding concerns. This method to control flooding, while popular 35 years ago is now considered somewhat ineffective. From a water quality and biological standpoint this type of river modification causes wide fluctuations in water levels over short periods of time, increases channel scour, and provides little to no habitat for aquatic life. Establishing a meandering stream helps create more diverse habitat for biological activities. The Milwaukee Metropolitan Sewerage District (MMSD) is implementing major flood water storage and where possible, river restoration activities in Lincoln Creek, Southbranch Creek and Indian Creek and other area watersheds. ***For more information on the Lincoln Creek flood control project and other MMSD watercourse activities, please visit the mmsd web site at:*** http://www.mmsd.com/lcreek/news_lcreek.html***.***

Although not officially listed as a cold water stream, Mole Creek in Ozaukee County is the only river in the Milwaukee South Watershed with the ability to sustain cool and cold water fish species. Extensive surveys on Mole Creek during the 2000 Baseline Monitoring Program found a wide variety of fish species including species such as mottled sculpin, Iowa darter and brook stickleback that rely on cool water. Temperature and habitat surveys conducted on Mole Creek found that the creek is capable in places, of supporting a diverse cool and cold water fishery.

Most of the tributary streams in the Milwaukee County portion of this watershed are only capable of supporting populations of more tolerant fish species like common carp. Non-native species such as rainbow trout, coho and chinook salmon migrate from Lake Michigan into the Milwaukee River during their seasonal spawning runs. Habitat and water quality are not sufficient to allow for successful reproduction of these species in the rivers where they spawn so annual stocking of these species is needed to maintain recreational fishing opportunities. ***For more information about Lake Michigan***

Fisheries, please visit the WDNR web page at:
http://www.dnr.state.wi.us/org/water/fhp/fish/lakemich/index.htm***, or call the Southern Lake Michigan Fisheries Work Unit at (414) 382-7929.***

There are three small named lakes, several unnamed lakes and many park ponds within the Milwaukee River South Watershed. See Appendix B, page 81 for information about the lakes and ponds in the Milwaukee River South Watershed.

Figure 5. Milwaukee River South Watershed.

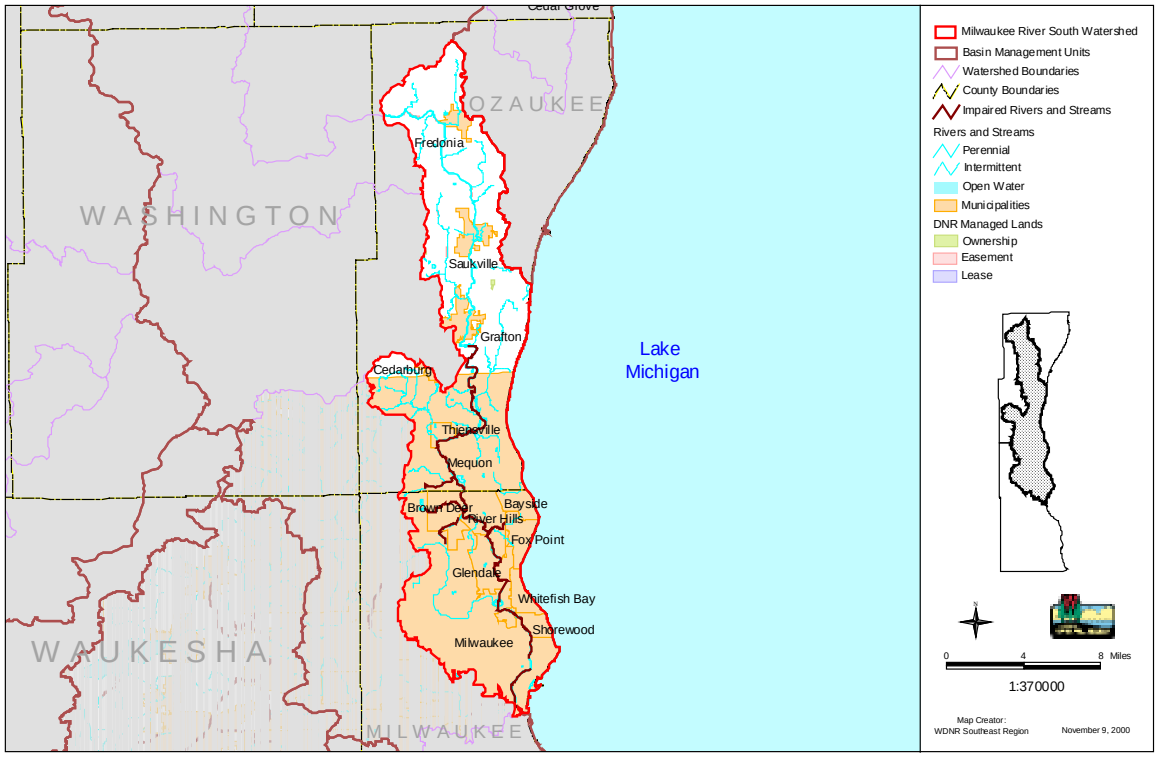


Table 4. Milwaukee River South Watershed	
Watershed drainage area	168 square miles
Miles of streams	108
Miles of streams listed as outstanding or exceptional resource waters	0
Miles of streams on impaired waters list	41.5
General threats to stream water quality	■ Stream and wetland modification ■ Urban and agricultural runoff ■ Municipal and industrial point sources ■ Construction site erosion ■ Stream bank erosion ■ Contaminated sediments
Number of lakes	3 named lakes. Many park ponds and some unnamed lakes greater than 10 acres
Number of dams	12
Threats to lake water quality	■ Urban and agricultural runoff ■ Construction erosion ■ Exotic species
Number of industrial wastewater treatment facilities	5 specific, 122 general
Number of municipal wastewater treatment facilities	4

Cedar Creek Watershed

The Cedar Creek Watershed is the most central of the Milwaukee River Basin watersheds, encompassing portions of central Washington and Ozaukee Counties (Figure 7). Cedar Creek is 28 miles long, beginning its journey from the headwaters downstream from Little Cedar Lake to its confluence with the Milwaukee River near the Village of Newburg.

Land cover in the Cedar Creek Watershed is primarily rural, with agriculture dominant (49%). Other rural uses include wetlands (16%), grasslands (15%) and forest (11%). Two major wetland complexes, the Jackson Marsh State Wildlife Area and Cedarburg Bog State Natural Area, are located within the Cedar Creek Watershed, providing important habitat for fish and wildlife. Urban areas comprise about 3.5 percent of land cover in the watershed. Portions of the Villages of Germantown and Slinger, the City of Cedarburg, and the entire Village of Jackson are the incorporated municipalities in the watershed.

Most of the stream miles in this watershed are capable of supporting a full range of aquatic life if stressors were reduced or eliminated (see Appendix A, page 64 for details about the rivers in the Cedar Creek Watershed). No outstanding or exceptional resource waters are located within the Cedar Creek Watershed. However, nearly 12 stream miles are listed on the state 303(d) list as impaired waters needing attention. Lehner Creek supports a diverse forage fish community, but has the potential in certain areas of supporting cold and cool water fish species if streambanks and in stream habitat were restored. Five miles of Cedar Creek are listed because of PCB contaminated sediments. This stretch of Cedar Creek runs through the Village of Cedarburg, where water is slowed by several dams, allowing contaminated sediments to settle out. The source of the contamination has been identified, and some sediment clean up work has proceeded in the upstream most portion of the contaminated section of Cedar Creek.

Big Cedar Lake (932 acres) and Little Cedar Lake (246 acres) are the largest of the 16 named lakes in the watershed (Appendix B, page 81). Both lakes have active lake associations and have participants in the Self Help Lake Monitoring Program.

Figure 6. Cedar Creek Watershed

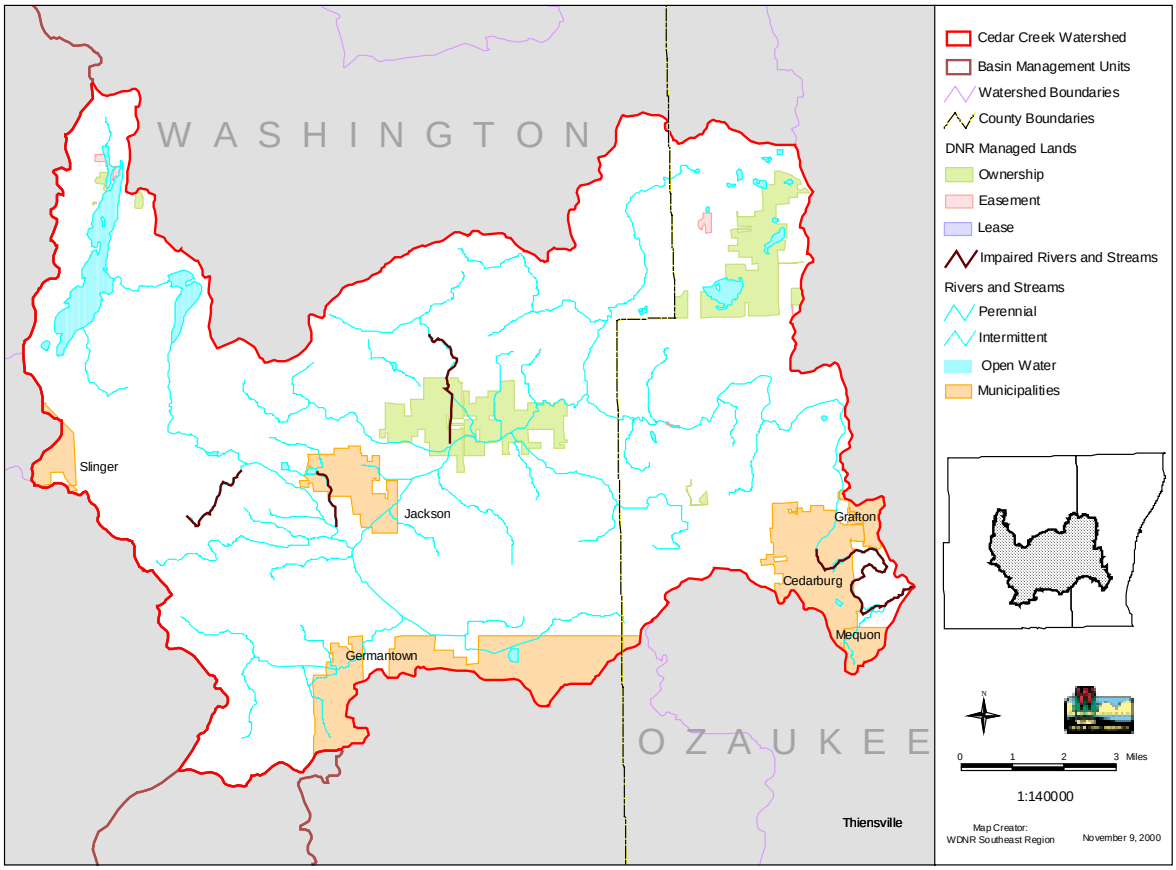


Table 5. Cedar Creek Watershed at a Glance	
Watershed drainage area	129 square miles
Miles of streams	74
Miles of streams listed as outstanding or exceptional resource waters	0
Miles of streams on impaired waters list	11.9
General threats to stream water quality	■ Stream and wetland modification ■ Industrial point sources ■ Contaminated sediments ■ Urban and agricultural runoff
Number of lakes	16 named lakes
Number of dams	13
Threats to lake water quality	■ Urban and agricultural runoff ■ Shoreline development ■ Failing septic systems ■ Exotic species
Number of industrial wastewater treatment facilities	2 specific permit, 13 general
Number of municipal wastewater treatment facilities	2

Menomonee River Watershed

The Menomonee River Watershed covers 136 square miles in portions of Washington, Waukesha and Milwaukee counties (Figure 8). The Menomonee River originates in wetlands in the near the Village of Germantown and the City of Mequon and runs south, south east for about 32 miles where it meets the Milwaukee and Kinnickinnic Rivers in the Milwaukee Harbor.

Nearly all of the land area in this watershed is within incorporated municipalities. Forty-two percent of the land is covered by urban uses. Grasslands (22%), agriculture (17%) forests (8%) and wetlands (7%) make up most of the remaining land uses.

Stream and wetland modification, urban and rural runoff, construction site erosion and industrial point sources of pollution are the major contributors to degraded water and habitat quality within this watershed. Over eight miles of stream are listed on the 303(d) list as impaired. Many streams in this watershed have been concrete-lined, or straightened to convey floodwaters off the land faster. Flooding continues to be a major concern in this watershed. The Milwaukee Metropolitan Sewerage District is implementing several flood control projects in this watershed. Over five miles of the Little Menomonee River has been designated as the Moss American Superfund Site. Creosote contaminated sediments within the river have caused extensive environmental damage, and negotiations are underway with U.S. EPA and the responsible party for implementing a clean up remedy. ***For more information about the Moss American Superfund Site, please see the following:*** http://www.epa.gov/region5superfund/npl/wisconsin/WID039052626.htm***.***

Following the recent removal of the Falk Corporation Dam and concrete drop structure on the Menomonee River, seasonal runs of Lake Michigan trout and salmon create fishing opportunities in publicly accessible areas up to the Lepper Dam in the Village of Menomonee Falls. Most fish species resident in the streams of this watershed are tolerant of pollution and habitat degradation. Some streams within this watershed are enclosed or diverted under roads for some of their length which further restricts habitat for aquatic life.

There are no named lakes within this watershed. Some park ponds provide for some recreational opportunities for urban fishing.

Figure 7. Menomonee River Watershed

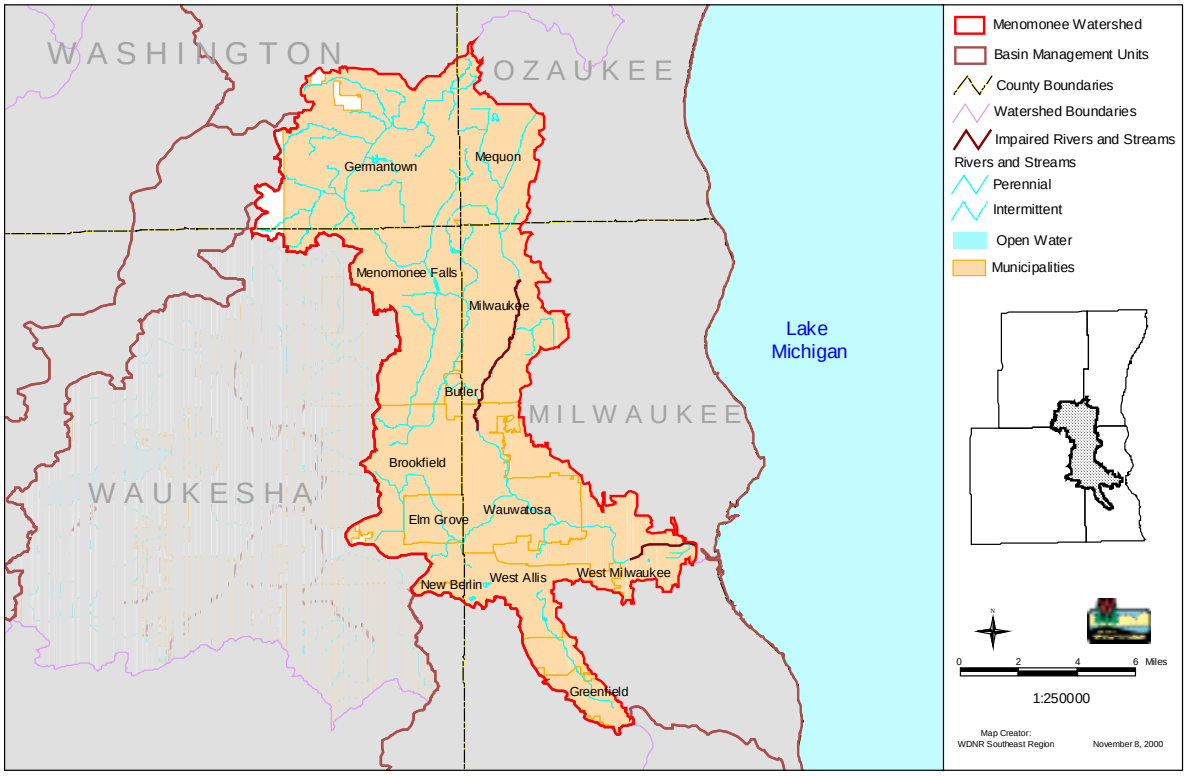


Table 6. Menomonee River Watershed at a Glance	
Watershed drainage area	136 square miles
Miles of streams	96
Miles of streams listed as outstanding or exceptional resource waters	0
Miles of streams on impaired waters list	8.3
General threats to stream water quality	■ Stream and wetland modification ■ Urban and agricultural runoff ■ Construction site erosion ■ Contaminated sediments ■ Industrial and municipal point sources
Number of lakes	0 named lakes, several ponds
Number of dams	6
Threats to lake/pond water quality	• Excess nutrients • Exotic species
Number of industrial wastewater treatment facilities	8 specific
Number of municipal wastewater treatment facilities	All of watershed wastewater flows to MMSD

Kinnickinnic River Watershed

The Kinnickinnic River Watershed is the smallest (33 square miles) and most urban of the Milwaukee River Basin watersheds (Figure 9). The watershed is located within the southern portion of Milwaukee County and contains 25 miles of perennial streams, no lakes and seven park ponds. The Kinnickinnic River is the only named stream, and comprises about half of the total stream miles in the watershed.

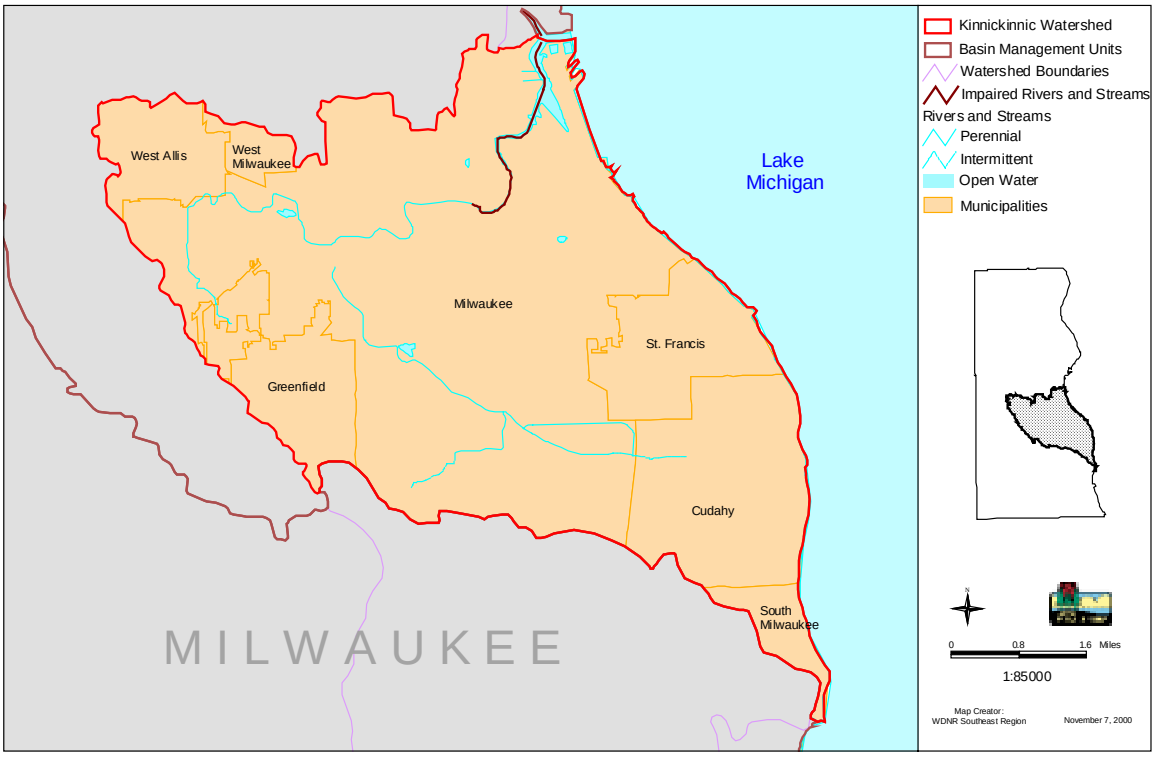
Land cover in this watershed is mostly urban (78%), with grasslands (16%) and forests (4%) creating open spaces. Remaining wetlands comprise only 0.3 percent of the land area. Portions of the cities of Milwaukee, Cudahy, West Milwaukee, West Allis and South Milwaukee, as well as the entire City of St. Francis are the major municipal areas represented within the Kinnickinnic River Watershed.

Most of the streams within this watershed have been extensively modified through straightening, enclosure or concrete lining. This watershed drains the General Mitchell International Airport (GMIA) lands, which has a history of discharging airplane deicing fluid (glycol), associated metals and other contaminants through snowmelt and rainwater to a tributary to the Kinnickinnic River (Wilson Park Creek). The GMIA has implemented management measures over the last few years to reduce the amount of glycol reaching the storm sewers and the tributary draining over 2000 acres of airport lands. A monitoring effort with the U.S. Geological Survey is currently underway to document the changes in water quality in Wilson Park Creek as a result of glycol management practices in place at the airport.

Table 7. Kinnickinnic River Watershed at a Glance

Watershed drainage area	33 square miles
Miles of streams	25
Miles of streams listed as outstanding or exceptional resource waters	0
Miles of streams or number of lakes/ponds on impaired waters list	2.8, 1 park pond
General threats to stream water quality	■ Stream and wetland modification ■ Urban runoff ■ Industrial point sources ■ Contaminated sediments ■ Construction site erosion
Number of lakes	0 named lakes, 7 park ponds
Number of dams/impoundments	0
Threats to lake water quality	■ Exotic plant species in park ponds ■ Contaminated sediments in Jackson Park Pond
Number of industrial wastewater treatment facilities	7 specific
Number of municipal wastewater treatment facilities	All of watershed wastewater flows to MMSD

Figure 8. Kinnickinnic River Watershed



CHALLENGES TO SURFACE WATER QUALITY

Land use has the greatest impact on surface and groundwater resource quality in the Milwaukee River Basin. As population increases and rural lands are converted for homes and business, pollution sources to surface and groundwater increase while habitat and water quality degrades. Streams and lakes with degraded water quality tend to have high populations of a few tolerant species like common carp that are capable of adapting to extremes. In contrast, stable systems generally have a higher diversity of species of all tolerance levels. Exceptions to this include cold water streams and some lakes which, if unaffected by pollution and habitat destruction, have a low diversity of intolerant species.

Pollutants to surface waters come from a single point of origin (point sources), or through many different, or diffuse areas (nonpoint sources). Point sources of pollution are usually associated with industrial discharges or municipal wastewater treatment plants, while nonpoint sources of pollution are associated with materials running off the land and into surface waters. Stormwater is considered both a point and nonpoint source of pollution. Areas with curbs and gutters generally have storm sewer systems that keep the water from pooling on streets, parking lots, rooftops and other areas. Rainfall that runs off of many different areas is often collected in a storm sewer system and ultimately discharged at a single point to a stream or lake. In many areas buildings, parking lots, farm fields and pastures come very close to the waters edge which can negatively affect water quality and habitat for wildlife.

One pollutant that is common in both point and nonpoint sources is phosphorus. Excess phosphorus in freshwater systems causes a chain reaction of events that stresses the whole ecosystem. The nutrient causes plants and algae to multiply. In some areas where shading is limited, these plants can multiply to levels which cause extreme shifts in dissolved oxygen content in the water column. During the day the plants, without shade, multiply and produce oxygen which can supersaturate the water column. In the evening these same plants respire and use the oxygen, along with the other living organisms. Because of their sheer biomass, the plants use a lot of oxygen at night, and cause the concentration in the water to drop to very low levels. The large changes in dissolved oxygen concentrations are detrimental to fish and other species that require a more stable oxygen supply.

The following sections will describe the major sources of pollutants to surface water quality in the basin, followed by actions that should be taken to eliminate or minimize the effects.

Industrial and Municipal Point Sources of Pollution

Within the Milwaukee River Basin there are 965 industrial point sources, and 14 municipal point sources of pollutants to surface and groundwater resources. Industrial point sources are designated as either specific or general. Specific permits are issued to industries that have discharge requirements unique to their site. Of the total number of industrial dischargers, those with specific permits account for four percent. Over 60 percent of the industrial point sources are from industrial stormwater sites and construction sites which are discussed in the stormwater section (beginning on page 22).

General permits are given to industries for discharges that can be broadly categorized and regulated with standard conditions such as non-contact cooling water. This is not water mixed into materials to process a particular product, but rather water that is used to cool machinery. Non-contact cooling water accounts for 13 percent of the discharge permits in the basin. Wastewater discharged under these general permits has characteristics of the municipal water supplies, which often contains phosphorus (orthophosphate or polyphosphate) added by the water utility which prevents lead and copper from leaching into drinking water supplies. Most of the public water utilities within the Milwaukee River Basin add phosphorus to their treated drinking water supply. Phosphorus is also

used to keep iron in solution so it does not deposit on plumbing fixtures. As a result, many single pass cooling water discharges have become new sources of phosphorus to surface waters. The total amount of phosphorus entering streams from non-contact cooling water discharges has not been calculated for rivers in the basin, so the extent of these inputs compared to nonpoint sources of phosphorus is not known.

Municipal wastewater treatment plants and some industries have specific permits for their waste treatment and discharge activities. Two municipal treatment plants discharge treated effluent to groundwater in the Milwaukee River Basin, while the two Milwaukee Metropolitan Sewerage District (MMSD) plants discharge to Lake Michigan. Excluding these, the remaining 10 municipal treatment plants discharge an average of 11.5 million gallons of treated municipal effluent daily. In addition, two industries with specific permits discharge almost 1.3 million gallons per day. Over 40,000 pounds of phosphorus per year are discharged to surface waters in the Milwaukee River Basin upstream of Milwaukee County. This is in contrast to nonpoint sources of phosphorus, contributing over 25,000 pounds per year to waterways. Taken together this is quite significant, but keep in mind this estimate does not include the non-contact cooling dischargers mentioned above.

Sanitary Sewer and Combined Sewer Overflows

Sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs) have been drawing increased attention by the media and citizens over the past two years. Sewer overflows do occur in other areas of the state, but the large size and character of the sewerage system serving the Milwaukee metropolitan area has focused scrutiny on the southeastern part of the state. Overflows generally occur during periods of intense rainfall, but mechanical failure or other circumstances can lead to the release of untreated sewage to surface waters.

Sanitary sewers and combined sewers are distinctly different. Sanitary sewers are designed to carry sewage from residences, commercial buildings, industries and institutions to a treatment facility. Sanitary sewers carry mainly sewage, but some groundwater and storm water leak unintentionally into the sewers through cracks. Most sewer systems in the state consist only of separate sanitary sewers. When a sewer system does not have the capacity needed to carry sewage and the water leaking into the sewers, the system is built to relieve itself by discharging the excess, a sanitary sewer overflow. The excess can end up in basements through sewer backups, in the streets through overflowing manholes, or to nearby surface waters through gravity overflow or pumping.

Combined sewers are only found in the City of Superior and in portions of the City of Milwaukee and Village of Shorewood. Combined sewers carry sewage along with storm water runoff from adjacent lands. During dry periods, combined sewers function much like sanitary sewers, carrying concentrated sewage to a treatment plant. During wet weather, when the capacity of the combined sewer system is exceeded, the excess flow is discharged to nearby surface waters.

We should be concerned about these overflows to surface waters for many reasons. Aside from being aesthetically objectionable, untreated sewage can be damaging to the environment and human health. Pollutants like excess solids, nutrients, and toxic substances are found in untreated sewage, and can have a direct effect on water quality, habitat, fish and wildlife. The pathogens found in sewage such as certain types of bacteria, viruses and protozoa can put humans that ingest these organisms at risk. Some skin rashes can also occur from contact with certain water-borne pathogens. State and Federal laws and regulations are intended to prohibit the discharge of untreated sanitary sewage and to minimize these risks to the public.

The Wisconsin Department of Natural Resources submitted a report to the Natural Resources Board addressing the issues surrounding sanitary and combined sewer overflows. The report (WDNR, 2001) contains a series of recommendations to be implemented by the WDNR, communities across the state, the Milwaukee Metropolitan Sewerage District (MMSD) and communities served by the MMSD.

The recommendations are summarized in Chapter 5 (page 56). ***For more information, A copy of the full report to the Natural Resources Board is available on the Internet at*** www.dnr.state.wi.us/org/water/wm/ww/so/.

Nonpoint Sources of Pollution

Most nonpoint sources of pollution to surface waters can be designated as either rural or urban in origin. Some sources, such as eroding streambanks and construction site erosion are found in both urban and rural areas. In rural areas nitrogen, phosphorus, bacteria and soil are the major nonpoint pollutants. These pollutants as well as metals and other man-made compounds, are found in urban runoff. The six watersheds forming the Milwaukee River Basin have participated in the Priority Watersheds Program. Specific information about rural and urban nonpoint pollution sources in each of the watersheds can be found in the Priority Watershed Plans (WDNR 1989a, 1989b, 1991, 1992,1993, 1994). The following sections will highlight the major sources of runoff pollution and the environmental consequences of these pollutants in rural and urban areas.

Rural

Rural nonpoint sources are often, but not always associated with agricultural operations. Barnyards, feedlots, farm fields and direct livestock access to surface waters are the major agricultural sources of runoff to basin surface and groundwater resources and wetlands. Eroding farm fields, streambanks and construction sites also contribute soil and associated pollutants to surface waters and wetlands. Table 8 lists major sources and loads of rural nonpoint pollution to surface waters.

Barnyards and livestock feeding and pasture areas carry significant amounts of nutrients, solids and bacteria to surface waters. Excess nutrients, like phosphorus and nitrogen in surface waters, can lead to excessive plant growth which in turn leads to extreme fluctuations in dissolved oxygen concentrations. Widely fluctuating dissolved oxygen concentrations are detrimental to sensitive fish and other aquatic species that depend on a consistent level of water quality. Streams exhibiting these fluctuations support tolerant fish species such as common carp, yellow bullhead and fathead minnows which are less sensitive to extremes in oxygen concentrations.
Soil erosion from adjacent farm fields, streambanks and construction sites add to the sediment load in streams. This soil settles to the bottom of streams and often covers the rocky and gravely areas needed for many invertebrate and fish species to survive. Only the hardiest species are able to thrive in streams with sediment covering the bottom.

Livestock manure is a cause of high bacteria, nutrient and solids concentrations in water bodies adjacent to agricultural lands. Manure is delivered to streams by direct access of livestock to streams, feedlot runoff, and inadequate manure management. Failing septic systems can also increase bacteria concentrations in streams. Most small farms have enough land on which to properly spread manure. For those that do not, manure storage is an option that landowners can exercise. Farms containing at least 1000 animal units (one animal unit equals a 1000 pound steer) are considered concentrated animal feeding operations (CAFOs) and must receive a permit from the WDNR for meeting specific manure management standards. Two large farms in the Milwaukee River Basin require permits for CAFOs. ***For more information on manure management and WDNR regulations, please contact the Southeast Region Animal Waste Specialist at (414) 263-8625.***

Table 8. Rural Nonpoint Pollution Sources and Loading Estimates*

Runoff Type	Watershed				
	MR North	MR East-West	Cedar Creek	MR South	Menomonee
Upland Soil Erosion (tons soil delivered to streams/year)	5493	6300	11623	3271	2482
Streambank Erosion (tons soil/year)	70	419	38	1643	Not estimated
Winter spread manure, # critical acres	1900	1530	450	505	120
Barnyard runoff (lbs phosphorus) delivered to streams and lakes**	1283	1219	716	816	311

Source: Priority Watershed Plans (WDNR 1989a, 1989b, 1991, 1992, 1993,1994).

**Phosphorus loading estimates are based on a 10 year/24 hour rainfall event.

Urban

The Milwaukee River Basin is one of the most urbanized basins in the state and, therefore, is affected greatly by urban runoff. Unlike rural areas where much of the land allows some rainwater to seep into the ground, urban areas have a higher percentage of hard surfaces impermeable to water. So, when rain falls or snows melt, the water washes pollutants off parking lots, streets, construction sites, storage yards, lawns and golf courses. In order to keep this runoff from flooding streets and yards, storm sewers and roadside ditches carry these untreated pollutants through storm sewers directly to rivers and lakes.

The pollutants found in urban stormwater are different than in rural runoff. Sediment runoff is a major concern in urban areas, but the particles making up sediment contain more than soil and nutrients. Although soil is the largest component of urban sediment, it also contains metal from cars, trucks and rooftops, particles from vehicle exhaust, pieces of pavement, and fallout from chimneys and industrial smokestacks, which make it more toxic. Table 9 shows the major urban nonpoint source pollutant loads in the Milwaukee River Basin.

Construction Sites. Most of the sediment load to streams in urban areas comes from active construction sites (USGS, 2000; UWEX, 1997). Based on research in Dane County, Wisconsin, the sediment yield from construction sites with no erosion controls in place is about 15 tons per acre per year (Roa, 2000). The WDNR has the authority to oversee construction activity on sites greater than five acres in size, while the Wisconsin Department of Commerce regulates construction activities on smaller lots. As of July 1, 2000, there were 133 active WDNR permitted construction sites in the Milwaukee River Basin. The total land disturbance permitted was 3,322 acres with an average land disturbance of 25 acres per construction site (range of five –175 acres). Residential construction accounted for 59 percent of the active WDNR permits, with commercial (28%), other (recreational, institutional, governmental-25%), industrial (14%), and utility (7%) rounding out the list. If permit requirements are followed at these construction sites, the sediment yield can be reduced by 80 percent (Wood, 2000).

Based on inspection of permitted construction sites by WDNR staff, it is unlikely that the permitted construction sites in the Milwaukee River Basin are achieving a sediment yield reduction of 80 percent. Similar to experiences reported by other states (Brown and Caraco, 2000), WDNR staff find erosion control problems at most construction sites. Typical problems include failure to develop appropriate plans, failure to implement plans, and failure to maintain erosion controls. A particular problem is the common practice of stripping topsoil from the entire construction site which leaves large areas of exposed subsoil susceptible to erosion. Better timing of construction activities throughout a site will reduce the potential for erosion.

Table 9. Urban Nonpoint Source Pollutants in Milwaukee River Watersheds.

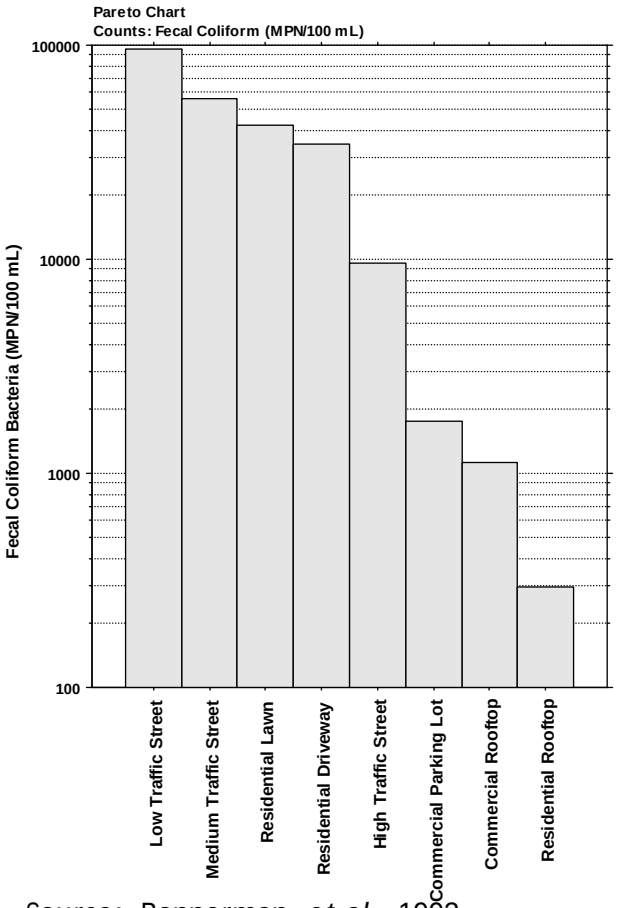
Pollutant	Watershed					
	MR North	MR East-West	Cedar Creek	MR South	Menomonee	Kinnickinnic**
Sediment* (tons/year)	783	656	327	4378	21300	3273
Lead (lbs/year)	153	2803	1313	18524	29900	2936
Phosphorus (lbs/year)	Not estimated	3358	Not estimated	18113	24900	12238

*Does not include sediment from construction sites
**Does not include lands draining to combined sewer areas

Bacteria and Pathogens. Evidence is mounting that stormwater is a significant source of pathogenic microorganisms, particularly in heavily urban areas. The table below lists typical concentrations of microbial indicator organisms that are found in a variety of sources. Urban stormwater generally contains 10 to 100 times less bacteria than raw sewage or combined sewer overflows. However, whereas it is relatively rare that raw sewage or combined sewer overflows flow into area surface waters, *urban stormwater is generated every single time it rains*.

Table 10. Pathogens found in Stormwater Runoff and Other Sources. (*Source:* Watershed Protection Techniques. 3(1): 554-565).

Waste Stream	Total coliform	Fecal coliform	Fecal streptococci
Raw sewage	2.3×10^7	6.4×10^6	1.2×10^6
Combined sewer overflow	$10^4 - 10^7$	$10^4 - 10^6$	10^5
Failed septic systems	$10^4 - 10^7$	$10^4 - 10^6$	10^5
Urban stormwater runoff	$10^4 - 10^5$	2.0×10^4	$10^4 - 10^5$
Forest runoff	$10^2 - 10^3$	$10^1 - 10^2$	$10^2 - 10^3$



Source: Bannerman, *et al* , 1993

Other work suggests that within our urban areas, it is our residential areas that contribute the greatest levels of bacteria.

The chart to the left shows typical fecal coliform levels found in the Monroe Street area of Madison, Wisconsin. The highest bacteria levels are typically found in residential areas.

It is assumed that residential areas are high contributors of bacteria not only because of the high density of pets within these areas, but also because of the habitat that these areas offer to urban wildlife. Indeed, Bannerman *et al* (1993) estimated that no more than 5-10% of the measured bacterial load in the Monroe Street area could be attributed to dogs.

These and other findings underscore the fact that future improvements in water quality will come only when a significant investment is made in improving runoff quality from our urban areas.

Municipal Stormwater Permitting. Many communities are also responsible for controlling runoff from areas within their municipal boundaries. Twenty-seven communities within the Milwaukee River Basin are required by U.S. EPA and WDNR to implement measures to improve the quality of storm water entering area rivers. The communities must determine the pollutant loads from their runoff and propose management programs to reduce the amounts of pollutants entering waterways. Methods to reduce pollutants at their source are preferred to those that treat polluted runoff. Some of the activities communities are implementing are construction site erosion control and stormwater ordinances, aggressive street sweeping and catch basin cleaning schedules, sediment basins, illicit connection field screening and information and education programs.
For more information on stormwater and construction site programs in the Milwaukee Basin, please contact the Municipal Stormwater Management Coordinator at (414) 263-8586. See the U.S. EPA web site (www.epa.gov/ost/stormwater***) for stormwater management practices and their effectiveness in removing pollutants.***

Industrial Stormwater Permitting. Some industries are required to comply with stormwater permit rules. The types of industries required to receive industrial stormwater permits include many heavy manufacturers, light manufacturers, transportation facilities and mining, oil and gas operations. In the Milwaukee River Basin 576 facilities are permitted under the industrial stormwater permitting program. Facilities receiving permits are required to identify best management practices for their facility to prevent contamination of stormwater. The facilities are also required to maintain records of inspections to verify these practices are in place and working.
For more information on industrial stormwater permits in the Milwaukee River Basin, please contact the Industrial Stormwater Management Coordinator at (414) 263-8623.

Contaminated Sediments

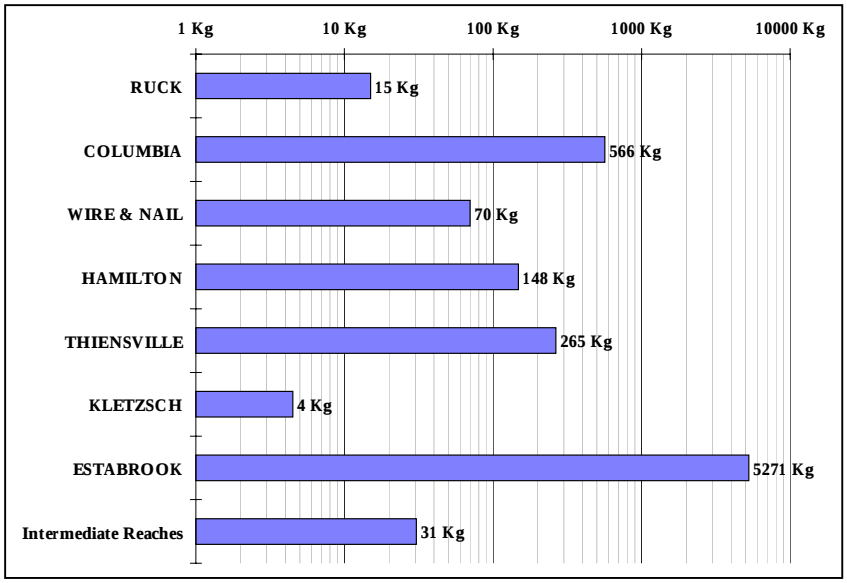
Contaminated sediments are a concern in urban and industrial areas of the Milwaukee River Basin. Many pollutants cling to sediment particles and eventually settle on river and lake bottoms, forming sediment deposits. These deposits serve as a sink for a variety of pollutants, allowing them to collect at elevated levels. When sediment is disturbed through biological, hydrological or human activity, these toxicants can return to the water column and be taken up by fish and other organisms.

Some pollutants no longer in use such as polychlorinated biphenyls (PCBs) do not easily breakdown and can remain in sediments for long periods of time. Over time, fish and other organisms exposed to PCBs accumulate these substances in their bodies, often at extremely elevated levels. Many studies have shown PCBs to cause cancer and possibly contribute to subtle reproductive and neurological problems in animals and people. PCBs were banned from use in the United States in the 1970s, but still remain in the environment. Polycyclic aromatic hydrocarbons (PAHs) are another class of pollutants common in urban areas that accumulate in sediment. Compounds containing PAHs, such as creosote, were often used to preserve wood products. Another source of PAHs is incomplete combustion of fossil fuels from vehicle exhaust and smokestack emissions.

Historically, many compounds we now know to be toxic were improperly handled and allowed to enter waterways where they persist in sediments for long periods of time. Within the Milwaukee River Basin, some rivers, such as Cedar Creek, Lincoln Creek and the Milwaukee River contain elevated levels of PCBs, PAHs and some heavy metals such as lead and zinc. Fish consumption advisories are in effect for PCBs in certain areas of the Milwaukee River Basin. The *Milwaukee Estuary Remedial Action Plan* (WDNR, 1995) contains detailed information about sediment quality issues in the Milwaukee River Basin.

The Wisconsin Department of Natural Resources (WDNR) has known about high levels of PCBs contained in the sediments from Cedar Creek all the way down to the Milwaukee River since the mid-1980s. PCBs were used by industries such as aluminum die-casting operations where high temperatures in equipment demanded hydraulic fluids that do not readily burn. Business practices were not always designed and followed with environmental protection in mind. Therefore, large untreated releases of fluids containing PCBs were not uncommon. Unfortunately PCB contamination caused by releases decades before is still with us today because of the persistent nature of these chemicals.

Figure 9. PCB Sediment Deposits and Volumes in the Milwaukee River Basin



Several sediment deposits with high concentrations of PCBs have been identified in the Milwaukee River Basin (Figure 9). River sediments contaminated with PCBs range from Ruck Pond on Cedar Creek, downstream to the Milwaukee Harbor (about 26 river miles). The sites listed in Figure 9 are those with the most significant volumes of PCBs known to date. Fish and

waterfowl consumption advisories are in effect for most species found in these areas. Studies by WDNR and others show that PCBs continue to be transported downstream from Cedar Creek to the Milwaukee River. In 1994 Mercury Marine, one of the businesses responsible for the Cedar Creek contamination, reportedly spent over seven million dollars to remove 7,500 cubic meters of sediment from Ruck Pond, which is the upstream most source of PCBs to Cedar Creek and the Milwaukee River sediments. The cleanup action removed between 350 and 750 kilograms of PCBs from the creek bottom. Follow-up monitoring shows that the clean up dramatically reduced levels of PCBs following the clean up. The WDNR views the Ruck Pond clean up as an unqualified success.

Much work remains before the fish and waterfowl of Cedar Creek and the Milwaukee River can be deemed safe for all to eat. The three remaining contaminated ponds on Cedar Creek collectively contain nearly as much PCB as was removed from Ruck Pond. The WDNR has documented that a large "hot spot" of PCB in Estabrook Park is unrelated to the contamination in Cedar Creek. The source of the Estabrook Park contamination is unknown.

Several obstacles continue to hamper the cleanup of contaminated sediments within the basin. The single most important of these is the shortage of disposal and treatment options available. Dredging of contaminated sediment is a relatively straightforward process. It is the disposal aspect of projects that is difficult: there are few proven technologies to de-toxify sediments. Therefore, disposal is the most commonly selected option for dealing with contaminated sediments. However, there is currently no landfill in the state that is licensed to take such contaminated waste. Other states, such as Washington state, have developed "multi-user disposal sites" (MUDS), which are designed to specifically deal with dredged material.

Another obstacle that slows cleanup of contaminated sediments is the lack of initiative shown by some companies that were responsible for the initial release of contaminants to waterways. Wisconsin DNR has adopted a "cooperative approach" to the cleanup of contaminated sediment sites. But with no carrots and few sticks to use as incentive, there is little that can be done to convince companies to move forward with sediment cleanups. Wisconsin needs to re-examine its approach to sediment cleanup, expanding the range of incentives it is able to offer responsible parties.

For information about fish consumption advisories, please see the publication, Important Health Information For People Eating Fish From Wisconsin Waters, which is published annually by the Wisconsin Division of Health and the WDNR, or visit the WNDR Fish Consumption Web site at www.dnr.state.wi.us/org/water/fhp/fish/advisories.

Stream and Shoreline Modification

Stream and shoreline modifications are common occurrences throughout the Milwaukee River Basin. Small headwaters streams were ditched to facilitate drainage for agriculture or to supply water for irrigation. Land was often cleared right up to the streambanks to obtain forest products and to maximize the amount of land in agricultural production. Floodplain development and increases in impervious surfaces in urban areas have led to stream channel deepening, straightening and concrete lining to move stormwater off the land and downstream more swiftly. Dams built to perform specific purposes also have noticeable effects of stream ecosystems. This section will briefly touch on the loss of stream corridor habitat, channel modifications and their effects.

Floodplain Development

Flooding is a natural occurrence in all stream ecosystems. The once common practice of floodplain development and resultant loss of wetlands decreases the natural function of the floodplain to store flood waters. The floods of 1997 and 1998 in Southeastern Wisconsin have increased attention for finding solutions to the problems associated with flooding. One way to address this issue is to

increase flood water storage through incorporating stormwater detention on newly developed areas, and building detention into redeveloping and developed areas where feasible. Creating more open space along our streams allows for more floodplain storage and improves the environmental corridor along our streams. Restricting floodplain development is also key to minimizing damage from floodwaters.

Dams

The rivers, ponds and some wetlands in the Milwaukee River Basin contain about 70 dams of varying size and function. Regardless of size, dams can have profound effects on stream ecosystems. Dams can change once flowing streams into bodies of water more resembling lakes. The species that thrive in a flowing environment are displaced by dams. Dam structures prevent or slow migration of fish and other aquatic life within the stream ecosystem thereby having effects throughout the food chains in t he stream.

Streams rely on periodic high flows to move sediment. Dams can dampen that effect. Instead of being suspended in the water column and depositing at river bends, sediments get backed up behind dams and cover the gravel areas many species rely on for reproduction and habitat. A dam on a cold water stream can allow for the water upstream on the dam to warm, which can have a negative effect on species sensitive to temperature fluctuations.

Stream Corridor Modification

The corridor area adjacent to a stream is a very important part of the stream ecosystem that benefit water quality and wildlife. Prior to intensive development, most of the streams in the Milwaukee River Basin were lined with trees such as ash, willow, river birch and black walnut. As forests were cleared, agriculture and urban development along rivers soon took the place of the natural wildlife corridors adjacent to the rivers. Water quality also declined as the streams lost the benefit of shading and soil retention that the vegetation along streams provided.

Trees, shrubs and grasses provide shade to keep the water cool, stabilize streambanks, filter runoff, and attract insects that wildlife feed on and create resting and nesting areas. Trees that fall into the water provide cover for fish and basking areas for snakes and turtles.

The corridor adjacent to streams also provides important travel routes for many wildlife species. Without these continuous wildlife "highways" habitat becomes fragmented and wildlife populations often decline.

The Natural Resources Conservation Service (NRCS), the WDNR, the US Fish and Wildlife Service and many others have recognized the importance of restoring stream corridors to benefit aquatic and terrestrial life and water quality. These agencies have programs to assist landowners willing to protect and restore stream corridors. ***For more information please see*** www.nrcs.usda.gov/ ***or call your local WDNR office.***

Water Quality at Lake Michigan Swimming Beaches

Water quality at Lake Michigan swimming beaches has garnered a lot of attention from the media, politicians, and concerned citizens over the past several years. Driving much of the attention is the fact that many area beaches have been closed on a more frequent basis over the past few years. For example, Milwaukee's South Shore Beach was closed to swimming 32 days in 1999 and 42 days in 2000, while the City of Racine's North Beach was closed 62 days, and the Zoo beach was closed 39 days.

There has been much speculation about the cause of the recent increases in beach closings. The most widely-held belief is that the closings are related to sanitary sewer and combined sewer

overflows. However, there is ample evidence that the beaches would still be closed on a regular basis without any sanitary sewer or combined sewer overflows. Bacteria and viruses are found routinely in urban stormwater samples at very high concentrations.

A report completed by the City of Milwaukee Health Department in 1960 noted that there were two distinct "spikes" or peaks in bacteria levels at area beaches following a rainstorm. The first, largest peak was attributed to bypassing from combined and sanitary sewers. The second peak was attributed to bacteria carried by the Milwaukee, Kinnickinnic, and Menomonee Rivers.

Therefore, we may reasonably expect the investment in the "Deep Tunnel" and other pollution control devices to have reduced the first peak in bacterial levels noted at area beaches. However, the secondary peak, assumed to be attributable to transport by the rivers, remains unaffected by the "Deep Tunnel." In addition, in the 1960 report, beach closings are almost exclusively believed to be caused by discharge of human sewage and waste into area waterways. However, we now know that urban stormwater carries such high levels of bacteria and viruses that the stormwater contribution alone may be expected to make maintaining fishable and swimmable conditions difficult:

> "...it is exceptionally difficult to maintain beneficial uses of water in the face of even low levels of watershed development, given the almost automatic violation of bacterial water quality standards during wet and dry weather. Thus, if a watershed manager has a beach, shellfish bed, or drinking water intake to protect, they can expect that even a modest amount of watershed development is likely to restrict or eliminate that use." Watershed Protection Techniques. 3(1): 554-565

In 2000, the Southeast Wisconsin Beach Task Force was formed to address concerns about the water quality at area beaches. The group's mission is:

> "The pursuit of safe and healthy water conditions at Southeastern Wisconsin coastal beaches through a collaborative effort in coordinating research, implementing best management practices, and successful public outreach."

The ultimate goal is to determine the source of the bacterial pollutants which are responsible for the beach closures, and to develop/encourage mitigative measures to reduce or eliminate these pollutants.

Research is currently under way by members of the Task Force, and will provide some clues about the sources of bacterial contamination at area beaches. Some of the work currently under way includes:

- WDNR "Tributary" Study - will look at the abundance of pathogenic microorganisms in area rivers (Lead agency: Wisconsin DNR).
- Racine Interstital Sand Beach Study - will look at whether E. Coli can survive or possibly even reproduce in beach sands (Lead agency: City of Racine Health Department).
- Source Identification Study - will use genetic techniques to determine whether the E. Coli bacteria found at area beaches is of human or non-human origin (Lead agency: University of Wisconsin-Milwaukee).

Additional work in support of the beach task force is being conducted by Milwaukee Metropolitan Sewerage District, the UW-Milwaukee Great Lakes Water Institute, the City of Milwaukee Health Department, and others. Preliminary results of these efforts will be available by the end of 2001, with more definitive results expected in 2002.

DRINKING WATER AND GROUNDWATER IN THE MILWAUKEE RIVER BASIN

Groundwater supplies water to about 30 percent of basin residents for residential and commercial use. People in most of the western and northern portions of the basin use groundwater as their water source. The remaining 70 percent of the basin's population, centered around the Milwaukee Metropolitan area, rely on water pumped from Lake Michigan.

Groundwater and Drinking Water Supplies

Groundwater under the basin comes from three main aquifers, the sand and gravel, dolomite and sandstone. The sand and gravel aquifer is the shallowest of the three aquifers, with an average depth of 100 feet. This aquifer is available as a groundwater supply for most areas of the basin except in shallow bedrock areas in Germantown and the Town of Jackson, and along Lake Michigan in Ozaukee and Milwaukee counties where the glacial deposits consist of heavy clay. The medium depth aquifer, the Silurian dolomite (or Niagara Limestone) has a maximum thickness of 500 feet. Those areas unable to use the sand and gravel aquifer rely on this aquifer for their drinking water. The sandstone aquifer is the deepest of the aquifers, and is mostly used for high capacity purposes, with well depths ranging up to 1800 feet.

Lake Michigan is the exclusive source of surface water for the municipal treatment plants. Four treatment plants sell their treated drinking water resale and wholesale to nineteen communities resulting in a complex of consecutive public water systems serving nearly one-million people.

Drinking Water System Types

Drinking water systems are described by the WDNR and regulated according to the type of population they serve, mainly private and public (Table 11). The private well is the most prevalent of the groundwater systems, with about 25,000 wells in the basin. These wells serve mainly homes and small businesses where fewer than 25 people per day have access to water. Today, private wells, although the most numerous of system types, serve only 15 percent of the basin's population. The most activity in private well construction within the basin has been occurring within Ozaukee and Washington Counties, consistent with the large population increases in these areas. Over 650 wells were drilled in Washington County over the last two years and over 300 in Ozaukee County. In contrast, 31 wells were constructed in Milwaukee County in the last two years.

Drinking water systems serving more than 25 people per day are considered public. Over one million people are served by over 700 public systems in the basin (Table 11). Public systems are further divided by whether they serve residential customers in houses or apartments (community systems), or non-residential uses like businesses and schools (non-community). In the last two years 34 new community drinking water projects were approved in the Milwaukee River Basin, including municipal wells, water towers, pressure booster pumps and chemical feed stations. The community and non-community systems are further divided by other criteria defined in Table 11. We distinguish between all these water system types because drinking water quality regulations are based on the duration of contact the consumer has with the drinking water source.

Table 11. Drinking Water System Types

Type of water System	Example	Number in Basin	Residential Population Served
Private	Individual homes, small businesses	25,000	200,000
Public Community Systems	**Residential**		
■ Municipal	Water provided by a public utility (City or Village). Could be a well or surface water (Lake Michigan) source	31	1,006,000
■ Other than Municipal	Water provided through a subdivision or mobile home park well	105	94,000
Public Non-Community Systems	**Non-residential**		
■ Transient (serving different people daily)	Taverns, restaurants, campgrounds	174	
■ Non-transient (serving the same people daily)	Schools, factories, offices	412	

Public Drinking Water Surveillance and Monitoring

The quality of our drinking water is dependent on the quality of the surface or groundwater source. Compared to surface waters nationwide, Lake Michigan is an excellent, reliable source of drinking water that is low in solids and organic matter. Any surface water is not pristine however, and must be treated to remove microbial and chemical contaminants to prepare water for drinking. Regular testing ensures that water remains safe for drinking.

WDNR staff or delegated county staff survey public water systems every five years for compliance with sanitary regulations. Municipal systems are inspected annually.
In addition to inspections, each public system in the Milwaukee basin must submit, on a regular schedule, water samples or test results , for a variety of potential contaminants to comply with the Federal Safe Drinking Water Act. Sampling frequency depends on the type of system, population served, and hazard of the contaminant. For example, bacteria testing at a large municipal system can occur several times daily, while at others only monthly or annually. Pesticide or radioactivity testing can occur quarterly to once every nine years.

Ninety-eight percent of all public drinking water systems in the Milwaukee Basin continuously meet all water quality standards. Occasionally public systems exceed a standard for pollutants like bacteria, nitrates or volatile organic chlorides. This is quite rare within the basin. Temporary violations of the bacteria standard occurred in just two percent of the public drinking water systems in the basin over the last 10 years. Violations for inorganic and organic contaminants occurred in less than one tenth of one percent of the systems. The WDNR maintains a drinking water quality database for all public systems that is accessible to the public on the Internet. ***If you are interested in finding out about the quality of your drinking water, please visit the drinking water database at*** ***www.dnr.state.wi.us/org/water/dwg/dws.htm***

Private Drinking Water and Groundwater

Potential sources of contamination affecting groundwater include unfiltered stormwater that runs into bedrock fractures, leachate from old dumps and landfills, fuel leaks at service stations, industrial spills, manure and salt storage areas, excessive application of fertilizer, inappropriate use of pesticides, septic systems, and even old, improperly abandoned wells.

Surface soils and geology play large roles in protecting groundwater from contamination. Because groundwater is generally more isolated from contaminant sources than surface water, groundwater requires little treatment. In fact, most private wells receive no treatment, while larger systems may only add chlorine or a corrosion inhibitor to keep water safe during distribution.

Proper well location, construction and maintenance is essential to delivering pure groundwater to consumers. The well drilling and pump installing industries are carefully regulated. WDNR staff conduct surveillance of well contractors and investigate well owner complaints. The water industry also conducts professional development and serves the real estate market conducting well inspections, testing and upgrading old systems. For individual homeowners and small businesses with private wells it's important to have the well tested and inspected to make sure it's not being affected by an unknown contaminant source. The WDNR Drinking and Groundwater Private Well Specialists provide technical assistance to citizens upon request for issues related to private wells, receiving about 400 technical assistance contact per year. Most of the contacts are related to groundwater aesthetics, mainly taste and odor problems, but more severe issues sometimes arise. ***For information about testing your private groundwater well in the Milwaukee River Basin, please contact the WDNR Private Well Specialist at (414) 263-8695.***

Groundwater Quantity Issues

The majority of the basin has an abundant groundwater supply, but even groundwater has a limit, so in areas where it is pumped at greater rates than it is replenished wells have gone dry. In southeastern Mequon water levels in the Silurian Dolomite aquifer have dropped as much as 300 feet in the past 50 years. Private wells which were 150 feet deep in 1950 are now drilled to 600 feet, so portions of this community have switched to Lake Michigan public water. In Germantown, once renown for flowing artesian wells, municipal well pumpage needed to supply growing populations have lowered the dolomite aquifer more than 25 feet. In most suburban portions of the basin water levels in the dolomite have dropped about 1 foot per year since 1950. The sandstone aquifer, favored by high capacity industrial and municipal users, has dropped several hundred feet throughout the south portion of the basin, and all the way to Chicago. Rainwater infiltration into wetlands and in vegetated areas is the prime way groundwater is recharged. For the sandstone and some of the dolomite aquifer virtually all recharge is lateral from rainfall to the northwest in Dodge and Waukesha counties. The slow rate of groundwater flow, coupled with loss of local wetlands and conversion of agricultural land to suburban, diminishes recharge and limits supply.

Chapter 3. Land Resources of the Milwaukee River Basin

The previous chapter discussed the different resources and issues related to surface and groundwater quality. It should be apparent from that discussion that land use plays an important role in water quality and habitat protection and degradation. This chapter will focus on the land resources within the Milwaukee River Basin.

WETLANDS

Wetlands are a critical link between our land and water resources. Until very recently, wetlands were considered a sort of wasted land, with little to no value unless altered by draining or filling. Wetlands are very important not just for the plants and animals they sustain, but for their benefits to humans.

Wetlands:

- help protect and enhance water quality by keeping pollutants from reaching lakes, rivers, streams and groundwater;
- help reduce flood damage by storing runoff from rains and snow melt;
- protect shorelines from erosion damage caused by waves and currents;
- provide critical habitat for many wildlife species
- enhance our quality of life, property values and tourism by providing beautiful open spaces that support many plant and animal species.

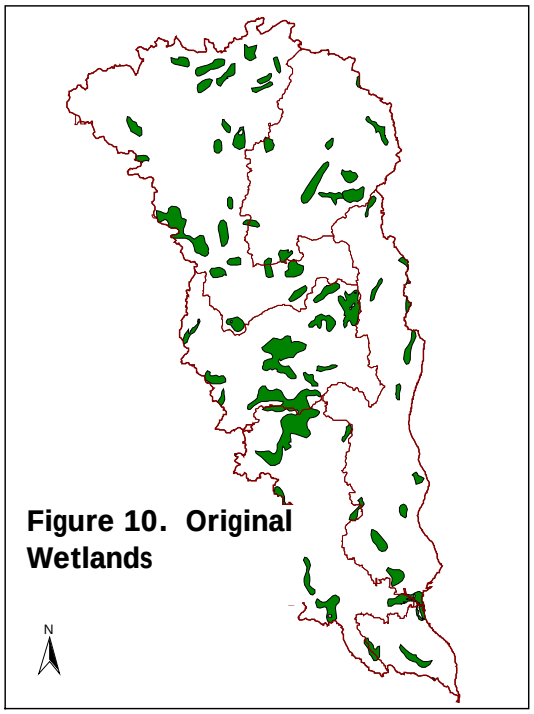


Figure 10. Original Wetlands

Wetlands Before Settlement

It is difficult to determine exactly how many acres of wetlands were in the Milwaukee River Basin prior to European settlement. The statewide estimate of wetland acreage at the time of the surveys was approximately five million acres. We now know these estimates were low by about 100 percent! There are many reasons for this discrepancy. The original surveyors of the state did not use similar interpretations of what were considered wetlands, nor were the survey methods used very accurate. Some surveys were done in winter when wetlands were covered under ice and snow. The surveys were conducted by walking the section lines of the Public Land Survey System (PLSS). As a result, wetlands surveyed along these lines were mapped more accurately than those in the interior. Soil scientists estimate that Wisconsin actually had twice the acreage of wetlands (10 million acres) than originally estimated in the surveys. This was done much more accurately by classifying wet soils (somewhat poorly, poorly and very poorly drained) as wetlands. In the Milwaukee River Basin, the original surveyors estimated wetlands covered about 52,000 acres or nine percent of the land area (Figure 12). We know this estimate is not accurate, since many wetlands that we find in large masses today, and many found along river corridors, were not included in the original surveys.

Wetlands Today

Today, using more modern techniques, we have a pretty good idea of the acreage of remaining wetlands in the Milwaukee River Basin. Data from the Wisconsin Wetland Inventory indicate that the Milwaukee River Basin currently contains more than 68,000 acres of wetlands (Figure 10). Note that wetlands are the most abundant in the northern watersheds, and are least abundant in the urbanized areas. The largest protected wetland complexes remaining in the basin are located in the Jackson Marsh Wildlife Area (Washington County) and the Cedarburg Bog State Natural Area (Ozaukee County). The Northern Unit of the Kettle Moraine State Forest, county and local parks, and nature centers also contain many smaller wetland parcels.

Wetlands of the Milwaukee River Basin

Wetlands provide many benefits for humans, but are also very important ecologically. For this report we classified wetlands in the Milwaukee River Basin by general type: hardwood swamp/floodplain forest, shrub swamp, marsh, wet meadow and coniferous swamp. This section will describe the plant and animal characteristics attributed to each category.

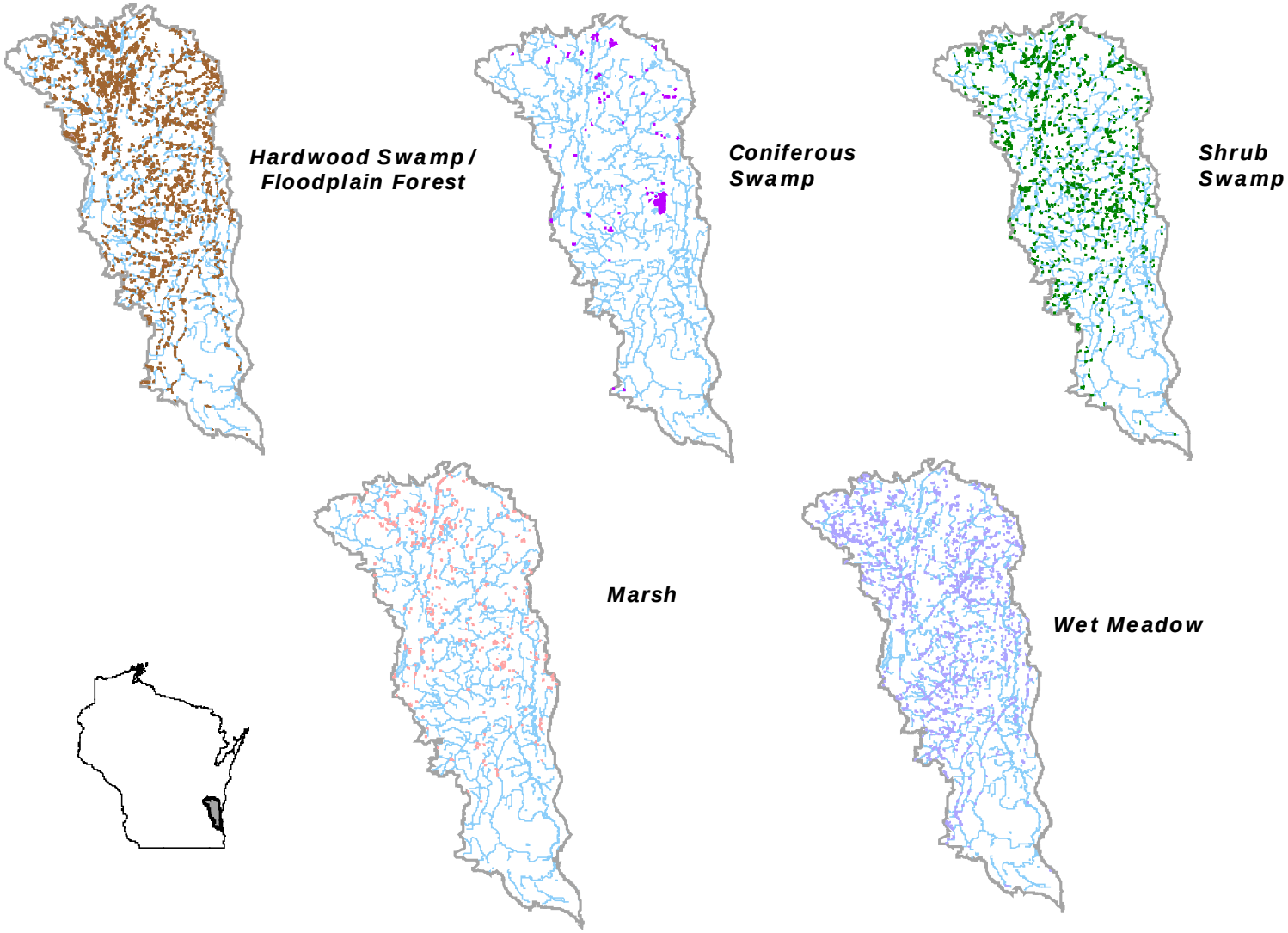
Hardwood Swamp/Floodplain Forest

These wetlands are the most abundant of all wetlands within the basin (Table 12). Most of the wetlands closely associated with river corridors are of this type. Some examples of this wetland type include the Jackson Swamp, Germantown Swamp, Fellenz Hardwood Swamp, the Ulao Lowland Forest and Sherman Road Swamp. Floodplain forests generally occur in river valleys while hardwood swamps are commonly found on old lake basins or oxbows. Both wetland types are important for storing floodwaters. Hardwood swamps have standing water in spring and saturated soils or pooled water for much of the growing season. Floodplain forests are inundated during flood events and receive silt as the waters recede. Soils during most of the growing season are usually well drained. Trees found in hardwood swamps include black ash, red maple, silver maple, yellow birch and elm. These wetlands also have a shrub layer and ground cover similar to wet meadows with species including dogwoods, alder, skunk cabbage, marsh marigold, and sedges, ferns, grasses and forbs.

Table 12. Milwaukee River Basin Wetland Vegetation Summary

Wetland Type	Wetland Acreage by Watershed/% of Land Area					
	East-West	North	Cedar Creek	South	Menomonee	Kinnickinnic
Coniferous Swamp	743/0.4	280/0.3	1489/1.8	27/0.03	26/0.03	0/0
Hardwood Swamp/ Floodplain Forest	16094/9.5	7765/8.1	6030/7.3	3032/2.8	3422/3.9	36/0.2
Marsh	2545/1.5	677/0.7	748/0.9	478/0.5	187/0.2	0/0
Shrub Swamp	6430/3.8	2245/2.3	2423/2.9	1146/1.1	960/1.1	16/0.08
Wet Meadow	3100/1.8	3210/3.4	2281/2.8	1335/1.2	1487/1.7	6/0.03
Totals	**28912/17**	**14177/14.8**	**12971/15.7**	**6018/5.6**	**6082/7.0**	**58/0.3**

Figure 11. Milwaukee River Basin Wetland Vegetation



Common trees in floodplain forests include silver maple, green ash, cottonwood, elm, black willow and box elder. Because of frequent flooding, these wetlands generally lack a shrub layer. Typical ground cover in floodplain forests is stinging nettle and jewelweed.

Both wetland types are important for supporting diverse communities of amphibians and reptiles. Temporary ponds are created during spring floods, providing important breeding grounds for amphibians. Amphibian and reptile species commonly found in these wetlands include American toads, eastern gray tree frogs, spring peepers, wood frogs, blue-spotted salamanders, central newt, redbacked salamanders, painted turtles, snapping turtles, eastern garter snakes, northern ringneck snakes, northern water snakes and red-bellied snakes.

Rare bird species such as the cerulean warbler, Acadian flycatcher and prothonotary warbler and red-shouldered hawk can be found in floodplain forests. Other bird species associated with both wetland types include belted kingfisher, green heron, spotted sandpiper, wood duck, mallard duck, flicker, pileated woodpecker, hooded mergansers and barred owls.

The stream and river corridors created by hardwood swamps and floodplain forests often provide valuable cover and transportation routes for white-tailed deer, muskrat, mink, raccoons, opossums and beaver.

Shrub swamp

Woody vegetation like small willows, red osier and silky dogwoods are dominant in the 13,000 acres of shrub swamps found in the basin. These wetlands occur on saturated or seasonally flooded muck soils and on the mineral soils of floodplains. Drainage and fire suppression may cause wet meadows to become shrub swamps.

These wetlands provide habitat for grouse, songbirds and small mammals, and winter habitat for upland game such as pheasants, white-tailed deer and rabbits and turkeys. American toads and chorus frogs breed in shrub swamps. Other amphibians present include eastern tiger salamander, eastern gray tree frog, pickerel frog and northern leopard frog.

Marshes

At about 4600 acres, marshes are one of the least abundant wetland types in the basin. Some examples of marshes within the basin include fringe areas around lakes like Little Cedar and Gilbert Lakes, and portions of the Jackson Marsh State Wildlife area. Plants such as cattails, sedges and arrowhead growing in permanent to seasonal shallow standing water characterize marshes. These wetlands store floodwater, protect shorelines from erosion and improve water quality by filtering out pollutants.

This wetland type is the most productive for water birds and furbearers, and also provides important spawning and nursery habitat for northern pike. Species commonly found breeding and feeding in marshes include various ducks, rails, songbirds and herons. Upland wildlife like pheasants, turkeys and rabbits uses marshes as winter habitat. Amphibians found in marshes include blue spotted salamander, eastern tiger salamander, central newt, American toad, chorus frog, spring peeper, Cope's gray tree frog, eastern gray tree frog, bullfrog, green frog pickerel frog and northern leopard frog.

Wet Meadows

This wetland type encompasses over 11,000 acres of land within the basin. Wet meadows, with their dense vegetation are often located between upland areas and waterways, thereby serving an important water quality function by keeping soils and associated nutrients from entering lakes and rivers. Standing water is found in wet meadows only during periods of heavy rain. Unless greatly

disturbed, wet meadows lack woody vegetation. Instead, grasses, sedges, goldenrod, asters, and marsh milkweed dominate them. Wet meadows provide habitat for wildlife such as sandhill cranes, shorebirds and small mammals that are important food sources for coyote, fox, mink and hawks. Wet meadows also provide habitat for American toads, chorus frogs, spring peepers and leopard frogs.

Coniferous swamp

Conifer swamps are the least abundant types of wetland (2565 acres) in the Milwaukee River Basin. These are usually white cedar or tamarack wetlands that are often associated with lowland hardwoods. The soils may be under water in spring and saturated for most of the growing season. Tamarack is the dominant tree species in acid soils while white cedar is more common where soils are alkaline. While common in the north, this type of wetland is quite rare in the southern half of the state. The Cedarburg Bog State Natural Area is the largest example of this type of wetland. Other examples include the Gilbert Lake Tamarack Swamp and Paradise Drive Tamarack Swamp. Bog plants such as tamarack, pitcher plant and leatherleaf can be found in conifer swamps, as well as jack in the pulpit, sedge and the rare lady slipper orchid.

Birds found in coniferous swamps include saw-whet owl, hermit thrush, northern water thrush, veery, and many species of sparrows and warblers. Mammals that use these swamps include white-tailed deer, red fox, coyote, and various small mammals. Amphibians found include blue spotted salamander, four-toed salamander, American toad, chorus frog, Cope's gray tree frog, spring peeper, eastern gray tree frog and wood frog.

Challenges to Wetlands

Lands that were perpetually or seasonally wet were historically considered less valuable unless filled for development or drained for agricultural purposes. It wasn't until recently federal and state decision makers recognized the need to provide some protection for wetlands.

The first attempt on a federal level to stem the loss of wetlands was Section 404 of the 1972 Clean Water Act. This section was enacted to regulate the discharge of dredge and fill material into surface waters and wetlands. These regulations, administered by the Army Corps of Engineers (ACOE) may have slowed the rate of wetland loss in the state, but it wasn't until 1991 when Wisconsin adopted state wetland water quality standards that the rate of wetland destruction was really decreased. Many of Some wetland loss statistics compiled for time frames before and after statewide control of wetland loss are presented below. A recent U.S. Supreme Court decision may limit the ability of the Corps of Engineers and WDNR to regulate wetland modifications, putting over four million acres of Wisconsin wetlands in jeopardy. Officials from both agencies are working to fully understand the consequences of the court decision.

For more information about these developments, visit the WDNR web site at http://www.dnr.state.wi.us/org/water/fhp/wetlands/index.htm.

Statewide Wetland Losses

The WDNR examined ACOE permit decisions from 1982 through August 1991 (the year statewide wetland water quality regulations were adopted). During this time period, WDNR estimated that nearly 13,000 wetland acres (1440 acres/year) statewide were filled legally. Note that this estimate does not include illegal wetland filling, wetland drainage, and it is likely that some ACOE wetland permit decisions were overlooked.

Following adoption of statewide wetland water quality standards in 1991 which enabled WDNR in many cases to restrict or modify ACOE permit decisions, permitted wetland losses decreased statewide by 460 percent for the time frame August 1991-April 1998. About 2,000 wetland acres

(312 acres/year) were legally filled statewide. Again, these numbers are considered estimates that do not include illegal wetland filling, wetland drainage and pre-authorized or overlooked ACOE permit decisions.

Regional Wetland Losses

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) examined wetland loss statistics for the period 1970-1985 in their seven county planning area. During this time SEWRPC estimated regional wetland losses at just over 4,000 acres.

Wisconsin Department of Transportation (DOT) wetland loss records from 1990-1999 for the eight counties within the WDNR Southeast Region were examined. Approximately 170 acres of wetland were filled for DOT projects during this time frame.

Milwaukee River Basin Wetland Losses

A review of WDNR permits issued for wetland projects within the Milwaukee River Basin showed that about 33 acres were altered legally between 1991 and 1999. These numbers may not be a complete representation of the extent of wetlands affected in the basin because of jurisdictional restrictions, illegal wetland filling and other unauthorized activities.

Some Consequences of Wetland Losses

Earlier we discussed the important ecological benefits of different wetland types. Because of these important functions, it's easy for many to see why it's important to restore and protect wetlands. Wetlands are also beneficial for stabilizing water levels in lakes and rivers, and for protecting water quality.

While it is now agreed that the water dynamics of the Great Lakes drainage basin have been altered by urban development and agriculture, scientists have not agreed on the role wetland destruction has played in this regard (Hey and Wickencamp, 1996).

Hey and Wickencamp analyzed nine watersheds draining to Lake Michigan in southeastern Wisconsin to better understand the relationships between wetlands, water quantity and water quality. The analysis concluded that watersheds with low percentages of wetlands tended to have higher percentages of impervious surfaces, leading to increased runoff to surface waters. Conversely, watersheds with higher wetland percentages had more water infiltration (less runoff to surface waters). Watersheds with fewer wetlands also showed decreased base flows and higher peak flows.

This indicates that higher percentages of wetlands within a watershed are beneficial for keeping stream flows stable compared to watersheds with lower wetland percentages. Therefore, increasing wetlands within a watershed would stabilize stream flows, and reduce the risk of flooding by providing storage. Increased storage capacity is also beneficial for water quality by increasing detention time, thereby allowing pollutants to settle out of the water column.

In the Milwaukee River Basin, watershed wetland acres as a percent of land area range from less than one percent to about 17 percent (Table 10, page 33). The three least urbanized watersheds have the highest percentages of wetlands. As the basin becomes more developed, wetland acreage substantially decreases. In the northern watersheds, the wetlands are distributed throughout the watershed, while those in the more populated areas are more sporadically distributed (Figure 11).

Within the Milwaukee River Basin, the most severe flooding events have occurred within the Menomonee River and the Milwaukee River South Watersheds. These watersheds have wetlands comprising about seven percent and six percent of the land area, respectively (Figure 11, Table 10).

Although the Kinnickinnic River watershed has the least amount of wetlands (<1%), the watershed area is very small compared to the others, and the main waterways have been substantially altered to convey stormwater toward Lake Michigan at a high rate. While flooding in this watershed occurs less often, the altered rivers and stormwater runoff from intensive urbanization have combined to create an environment inhabited by the most tolerant of organisms (for more information, see section on challenges to water quality, page 18).

Wetland Restoration and Protection

While some of the discussion presented above regarding wetland losses may sound rather grim, more opportunities than ever before are available for landowners to restore and protect wetlands. In fact, estimates for the Milwaukee River Basin from 1990-1999 show that over 250 acres of wetlands have been restored or protected through various state and federal programs. Please note that these numbers are estimates and don't include all wetland restorations individual landowners, nature centers or foundations have accomplished. Following are brief descriptions of some wetland restoration and protection activities accomplished in the southeastern Wisconsin and the Milwaukee River Basin.

Wetland Restorations

WDNR Wildlife Management staff have restored over 200 acres of wetlands within the basin between 1990 and 1999 with the goal of providing high quality habitat for wildlife. Most of these wetland restoration activities were conducted in cooperation with the U.S. Fish & Wildlife Service, private landowners, and conservation organizations such as Ducks Unlimited. The WDNR and partners have been involved in meeting the goals and objectives of the North American Waterfowl Management Plan (NAWMP), which identify habitat loss and degradation as major factors limiting waterfowl populations in North America. The Milwaukee River Basin is included in the Southeast Focus Area of the NAWMP, which is considered a high priority area. ***For more information on restoring wetlands for wildlife in the Milwaukee River Basin, please contact the WDNR Private Lands Wildlife Biologist at (920) 892-8756.***

The Natural Resources Conservation Service (NRCS) offers landowners resources to restore and protect wetlands. The Wetland Reserve Program (WRP) allows landowners the opportunity to receive cost share payments for restoring wetlands on their property. From 1992-1999 over 35 acres of wetlands have been restored in the basin through WRP. The Conservation Reserve Program (CRP) allows the NRCS to enter into contracts with farmers to remove cropped wetlands and highly erodible cropland from production for 10-year periods. Because the landowners do not enter into perpetual easements, acreage figures of enrolled land will vary from year to year. ***For more information on the WRP and CRP programs, please visit the NRCS web site at www.nrcs.usda.gov, or call your county NRCS agent.***

The Wisconsin Department of Transportation is required to compensate for unavoidable wetland loss from transportation projects through wetland mitigation. From 1991 through 1999 over 170 acres of wetland were lost to road projects in WDNR's eight county Southeast Region. To compensate for this loss, the DOT restored over 250 acres of wetlands in the region.

Wetland Protection

Even though the decline of wetlands has slowed as we realize their many benefits and implement protection programs, a comprehensive approach to wetland protection and restoration is needed. In a recent publication, *Reversing the Loss: A Strategy for Protecting & Restoring Wetlands in Wisconsin* (WDNR, 2000) the WDNR Wetland Team outlines a strategy for protecting Wisconsin's remaining wetlands over the long term. The overall strategy recommends that the WDNR:

- strengthen relationships with property owners, nonprofit conservation organizations and local governments ,
- manage wetlands to protect diversity of species, wildlife health and ecological integrity,
- streamline our regulatory approach for permits and restoration activities in wetlands, and
- develop and use modern technology to map, monitor, protect and manage wetlands.

The goals and actions identified in the strategy give WDNR and its many partners a solid foundation from which to work together to protect and restore wetlands throughout the Milwaukee River Basin and the state.
For more information on this strategy and what you can do to protect and restore wetlands, please visit the web at http://www.dnr.state.wi.us/org/water/fhp/wetlands/reversing.pdf.

The Ozaukee Washington Land Trust (OWLT) has been very active in the last decade in preserving over 600 acres of forests, wetlands, stream corridors and wildlife habitat. In the Milwaukee River Basin, the OWLT has protected over 100 acres of land around Huiras Lake. The Huiras Lake Natural Area is an exceptional example of a conifer bog. Not only is this natural area exceptional because bogs are very rare in the southern part of the state, but the quality of the habitat is nearly pristine. The OWLT continues to work to protect this 435 acre wetland jewel.
A 50 acre floodplain forest, a 15 acre lowland forest, and 95 acres of wet meadow along the Milwaukee River in the Town of Trenton have also been protected through the efforts of OWLT. The floodplain forest on the northern edge of the Fellenz Woods area is a great example of what the river shoreline looked prior to intensive settlement. A blue heron rookery found here is one of only 12 such sites known in southeastern Wisconsin. ***For more information about the Ozaukee Washington Land Trust and their projects please see*** www.owlt.org***.***

FORESTS

When discussing forests, some think of large unbroken expanses of land with many species of trees with a wide variety of plants and animals. Others may think of pines planted in neat rows, while others may consider the woodlot in their neighborhood a forest. Whether found in rural areas, suburbs or cities, forests in the Milwaukee River Basin come in all shapes and sizes.

Forests Before Settlement

The major forest types originally found in the Milwaukee River Basin are characterized as southern forests. This forest type is characterized by the absence of conifers, dominance of oak species, and presence of other tree species (shagbark hickory, black walnut, box elder) not normally found in the northern forests (WDNR, 1995). These deciduous forests once dominated the presettlement landscape of the basin, covering about 89 percent (over 500,000 acres) of the land area (Figure 11). The forests supported many types of animals such as bison, elk, cougar, white-tailed deer, black bear, bobcat, mink, otter, beaver, muskrat and a rich diversity of birds. By the early 1920s, most of the forests in the basin were logged for lumber, and other products and converted to agricultural land.

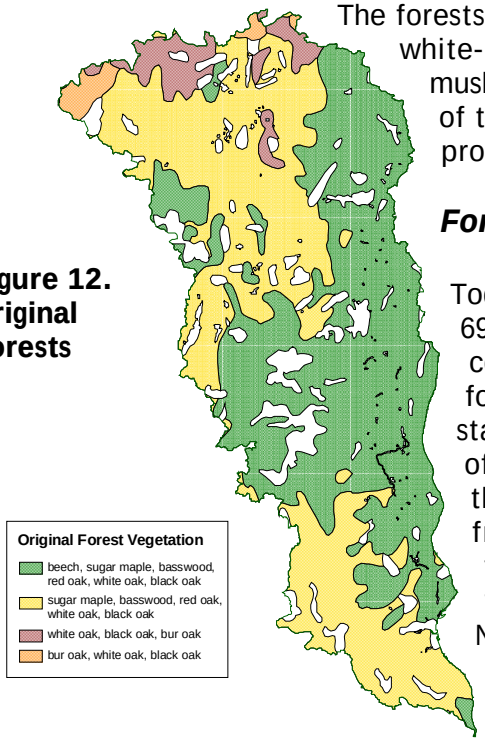


Figure 12. Original Forests

Forests Today

Today only about 11 percent of the Milwaukee River Basin, or 69,000 acres is considered forested, with the largest tracts confined to the northern reaches of the basin. Of the forested acres, 21 percent are in public ownership (federal, state, county) and 79 percent are privately owned. Because of the influences of agriculture and development in the basin, the southern forests of today are characterized by their fragmentation. Remnants of original forest vegetation in the basin are found in small patches with the exception of the Northern Unit of the Kettle Moraine State Forest. The Northern Unit of the Kettle Moraine State Forest contains a wide variety of forest cover types including northern hardwoods, oak and central hardwoods, aspen, upland and lowland conifer plantations and wooded wetlands like floodplain forests and southern hardwood swamp forests.

Northern Hardwoods

The northern hardwoods cover type is also known as southern mesic forest. This forest type is considered a very stable terminal forest. Once sugar maple is established in the canopy, it persists because of its great longevity. Closed canopy mesic forests are highly resistant to fire because of the high moisture content of the litter in winter and spring, and rapid decomposition and high internal humidity in summer. The understory of this forest type is rather sparse so it supports few game species. White tailed deer use these forests as travel routes between feeding and resting areas. Birds found here include songbirds like redstart, scarlet tanager and cerulean warbler, as well as black-capped chickadee, nuthatch, brown creeper and woodpeckers. Red-tailed hawks and great-horned owls can be found near the forest's edge. Mammals found in the forest interior include gray squirrels, flying squirrels and woodland deer mice with chipmunks and woodchucks expected near the edge. This forest community is threatened by fragmentation, stand isolation and clear-cutting. These disturbances allow exotic species to invade, further threatening this cover type.

Oak and Central Hardwoods

The oak and central hardwoods cover type (southern xeric forest) is very productive for wildlife. These forests are dominated by red oak and white oak, are less shady and have lower humidity than southern mesic forests. This cover type is found in stands of less than 50 acres in size and is distributed over a large area enhancing its value to wildlife. White-tailed deer, wild turkeys, wood ducks, ruffed grouse, squirrels, rodents and songbirds use this forest type for food and shelter. Stands that are more open with dense underbrush provide habitat for birds like towhee, brown thrasher, blue jay and phoebe. Mature trees provide nesting cavities for woodpeckers, raccoon, squirrels and screech owls.

Aspen

The aspen dominated cover type is preferred by a variety of wildlife species. Young aspen provide brood rearing habitat for woodcock and ruffed grouse, and succulent summer foods for white-tailed deer. Because of the lack of ground cover in mid-age stands of aspen, male ruffed grouse can be found drumming for mates here. Wildlife value the winter buds produced by 15 to 25 year old trees.

Conifer Plantations

Upland and lowland conifer plantations provide some cover and nesting habitat for wildlife. Young stands provide the best cover with many lower branches. With age, most conifers lose their cover value for wildlife, with the exception of Norway spruce which retain their lower branches. Wildlife found here include mourning doves, sharp-shinned and Cooper's hawks, red squirrels and cottontail rabbits. Wild turkeys, wintering birds and migratory songbirds use this type for cover during inclement weather. Wild turkeys prefer white pine plantations near open water for winter roosting habitat, while white-tailed deer find cover during cold weather in dense conifer plantations.

Wooded Wetlands

The water resources and relatively open canopy make floodplain forests an extremely diverse habitat for many species. The flooding regime benefits amphibians by creating temporary breeding ponds, while the abundance of large, woody debris provides cover for amphibians and their prey . Hardwood swamps also provide important habitat for many species including white-tailed deer, cottontail rabbits, raccoons, white-footed mice and shrews. Birds such as ruffed grouse, woodcock, white-breasted nuthatches, downy, hairy and pileated woodpeckers and red-shouldered hawks use hardwood swamps and floodplain forests for food and cover. Please see the discussion of hardwood swamps and floodplain forests (page 33) for more information.

Remnant Forest Communities

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) recently published the findings of a technical advisory committee that identified high quality natural areas and critical species habitats in their seven county planning area (SEWRPC, 1997). The main purpose of this effort was to identify areas of significant resource value (natural areas), and provide recommendations for protecting and managing these areas. Natural areas are defined by SEWRPC as "tracts of land or water which were so little modified by human activity, or which have sufficiently recovered from the effects of such activity, that they contain intact native plant and animal communities believed to be representative of the pre-European settlement landscape." Many of the areas identified in the report are remnant forests.

Within the three Milwaukee River Basin counties in the SEWRPC planning area, over 5,000 acres of forested land were found to possess natural resource features of such quality to merit natural areas designation. These parcels were designated a classification of NA-1, NA-2 or NA-3.

NA-1 parcels are the highest quality areas of statewide or greater significance. They represent nearly complete and virtually undisturbed plant and animal communities resembling presettlement vegetation. NA-2 sites are classified as having countywide or regional significance. These areas have some apparent human disturbance, but generally have somewhat complete native biotic communities. Sites classified as NA-3 have obviously been altered by human activities, but still maintain good wildlife habitat and may contain small pockets of plants that no longer exist in adjacent areas. These sites are considered of local significance.

Fifty-seven parcels identified as forests or woodlands within the Milwaukee River Basin were identified in the SEWRPC report. Three parcels within the basin were identified as NA-1, while 19 and 35 parcels were classified as NA-2 and NA-3 respectively. Most of the parcels are privately owned, or contain a combination of public and privately held lands. About half of these parcels also contain habitats that support rare plant and animal species considered endangered, rare, or special concern. ***For more detailed information on the natural areas within the SEWRPC planning area, please see SEWRPC Planning Report No. 42. "A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin."***

Urban Forests

The urban forest is all of the trees and other vegetation in and around a city, village or development. Traditionally it has meant tree-lined streets, but it is important to remember that this forest is a complex network of green space extending beyond property lines and involving many different landowners. An urban forest also includes home and corporate landscapes, schoolyards, parks, cemeteries, vacant lots, riparian corridors, utility rights-or-way, adjacent woodlots and anywhere else trees can grow in and around a community. Shrubs, flowers, vines, ground covers, grass and a variety of wild plants and animals are also part of the urban forest. Streets, sidewalks, buildings, utilities, soil, topography and, most importantly, *people* are an integral part of the urban forest.

The urban forest is, in fact, an *ecosystem.* To maintain the quality of the environment and the quality of life for the vast majority of Wisconsin residents, the urban forest must be managed.

Challenges to Forests

The basin forests prior to intensive development provided large tracts of habitat to support a wide variety of plant and animal species. The ecological makeup of these forests, along with natural occurrences (e.g. fires), provided the means to keep the forest communities diverse with a variety of tolerant and intolerant plant and animal species. The fragmented state of forests and woodlots today tend to favor adaptive animal species such as white-tailed deer, coyote, raccoon, skunk, blue jay, and cowbird. Many of the mammals that require large territories, once abundant in the forests,

are now confined to northern areas or are absent from the state altogether. Forest plant species have also changed. Non-native species like garlic mustard and buckthorn are threatening to eliminate the native flowers and shrubs.

A major cause of habitat fragmentation is residential development. This not only creates habitat more favorable to species like white-tailed deer, but also limits the ability of wildlife managers to control high populations of these adaptable species.

Forest Management, Restoration and Protection

Many opportunities are available to private landowners, municipalities and non-profit organizations for managing, restoring and protecting Wisconsin's Forests. Below is just a sampling of some programs available, along with some specific objectives for forest management within the Milwaukee River Basin.

Wisconsin's Forest Tax Law

Wisconsin used to have a property tax policy that required landowners with forests to pay higher taxes on their lands. This often was a financial burden for many property owners who over cut their timber to pay for their taxes. This resulted in over-harvesting of trees and prompted the state legislature to enact laws to promote timber growing. Forest cover types enrolled with the forest tax law programs include northern hardwoods, central hardwoods, bottomland hardwoods, swamp hardwoods, oak, white ash, aspen, red pine, white pine, white spruce, fir/spruce, herbaceous vegetation, upland brush, lowland brush, dogwood and willow. For more detailed information, please see www.dnr.state.wi.us/org/land/forestry/ftax, or contact your local WDNR forester.

Conservation Reserve Program

The Conservation Reserve Program (CRP) provides financial incentives to landowners to voluntarily establish and maintain vegetative cover on lands that need protection from erosion, to act as windbreaks, or in places where vegetation can improve water quality or provide food and habitat for wildlife. This is a federally funded cost share program, administered by the Natural Resources Conservation Service (NRCS).

Wisconsin Forest Landowner Grant Program

The Wisconsin Forest Landowner Grant Program provides cost share assistance to landowners in managing their woodlots. Landowners must have an approved management plan before applying for funding. Practices often approved include tree planting, vegetative control, timber stand improvement, soil and water protection, wetland protection, restoration and enhancement, stream and stream bank protection, wildlife habitat creation or improvement and protection of rare natural communities and species.

Stewardship Program

Some of the most popular ways to protect high quality forest areas are through easement and acquisition. Wisconsin's Stewardship Program is a competitive program available to non-profit entities and local governments to acquire property for resource protection. ***For more information on the Stewardship Program, please see:*** www.dnr.state.wi.us/org/caer/cfa/LR/stewardship.

WDNR Urban Forestry Assistance

Forty-eight communities and other unique participants within the Milwaukee River Basin are taking advantage of the WDNR Urban Forestry Program (Appendix D, page 95). Since 1993, 123 WDNR urban forestry grants totaling more than one million dollars have been awarded to these communities. Cities, villages, towns, counties, tribal governments and nonprofit organizations are eligible to participate in this 50/50 matching grant program, which emphasizes developing or expanding management capacity for long-term urban forestry programs at the local level. Projects have

included initiating volunteer tree boards, conducting tree inventories, developing management plans, organizing tree workshops, training for personnel and youth, and tree planting projects.

National Arbor Day Foundation Programs

The Tree City USA program, sponsored by the National Arbor Day Foundation is another important urban forestry program within the basin. This program recognizes towns, cities and villages across America that effectively manage their public tree resources. It also encourages them to implement a community tree management program based on four Tree City USA standards. These standards include developing a tree board or having a forestry department; developing a tree ordinance; budgeting at least two dollars per capita for a forestry program and celebrating Arbor Day and reading a proclamation. A community must meet each of these standards every year to qualify for the program. Twenty-eight communities in the basin participate in this program (Appendix D, page 95).

The National Arbor Day Foundation also sponsors the Growth Award which recognizes communities that have gone above and beyond the four Tree City USA standards. The communities of Brookfield, Brown Deer, Cedarburg, and West Bend have received the Growth Award because of their dedication to community forestry.

AGRICULTURAL LANDS AND GRASSLANDS

Agriculture continues to play a very important role in shaping the landscape of the Milwaukee River Basin. Together, lands in agriculture and grasslands account for about 56 percent of the basin land cover. As urban development proceeds further into the countryside, farmland decreases. The four main counties within the basin (Milwaukee, Ozaukee, Sheboygan and Washington) have experienced double-digit percent decreases in the number of farms and acres in farming (Table 13). With the exception of Milwaukee County, the decrease of land in farming follows the patterns of increasing county population (see Figure 3, page **Error! Bookmark not defined.**).

Table 13. Number of Farms, Land in Farming and Farm Size for the Four Major Counties in the Milwaukee River Basin.

	MILWAUKEE			OZAUKEE			SHEBOYGAN			WASHINGTON		
	1987	1997	%	1987	1997	%	1987	1997	%	1987	1997	%
NO. of FARMS	132	83	-37	483	427	-12	1213	968	-20	967	787	-19
LAND IN FARMS (ACRES)	8763*	6334	-38	85201	39930	-22	209508	182460	-15	156317	127127	-23
AVERAGE FARM SIZE (ACRES)	90*	76	-16	176	164	-7	173	188	9	162	162	0

Farms don't only provide us with most of our dairy, meat, grain and vegetables, but also play an important role in water quality and wildlife management. You've already learned that soil erosion, poor manure management and livestock access have major effects on water quality in rural areas (see page 20). Many landowners are taking steps to decrease these effects while maintaining their ability to earn a living off their land.

Since the late 1980s landowners throughout the Milwaukee River Basin have been participating in the Nonpoint Source Water Pollution Abatement, or Priority Watersheds program. The program is a joint effort of the Department of Natural Resources (DNR), Department of Agriculture, Trade and Consumer Protection (DATCP), the University of Wisconsin Extension (UWEX), counties (usually through their Land Conservation Departments), municipalities, and lake districts with assistance from a variety of federal, state, and local agencies. Since the program started in the basin over county staff has personally visited 80 percent of all rural landowners with cropland or livestock facilities.

Through this program cost-share grant funding assistance is available to rural landowners at up to 70 percent to employ *best management practices* (BMPs) to control nonpoint sources of pollution to area waterways in high priority watersheds. The six watersheds within the Milwaukee River Basin continue to be high ranking watersheds. Since the beginning of the programs within the Milwaukee River Basin, more than 200 rural landowners have entered into over 300 voluntary cost-share agreements to control agricultural nonpoint pollution sources. Below are some accomplishments and considerations for the future

Upland erosion and sediment transport from farm fields have been reduced by 35-40 percent on average throughout the basin. Watersheds with more cash crops continue to have higher erosion rates than those primarily in dairy. Agricultural market conditions have an effect on the erosion and sediment transport to surface waters. For instance, with a decline in dairy prices, many landowners convert fields that were once planted with hay and grains (low erosion rates) to a more profitable rotation of continuous corn and soybeans. Each spring and fall the fields that had been cash cropped have exposed soil that is more prone to erosion.

Phosphorus delivery from barnyards has been reduced by 50 percent. This is due to improved barnyard runoff management systems and the declining animal based agriculture in the basin. Many of the smaller livestock operations have gone out of business due to poor financial returns. Those that remain are better managed or are the larger total confinement operations with manure storage capabilities.

Critical acres spread with manure have been reduced by 40 percent. This pertains to winter manure spreading, and manure spreading on steeply sloped fields at any time, where the manure is more prone to running off into surface waters. More than 35 percent of the livestock operations in the basin continue to do some sort of "daily haul." Some of the largest livestock operations in the basin must winter spread at times due to undersized manure storage structures.

Direct access of animals to surface waters has been reduced. Fewer than 25 percent of livestock operations allow unlimited or uncontrolled access to streams and lakes. Many marginal wet pasture areas (wetlands) are commonly grazed throughout the basin, especially in mid summer to late fall.

The Nonpoint Source Water Pollution Abatement Program is in the process of undergoing some changes. In 1997 the Wisconsin legislature called for the cooperating agencies in the Nonpoint Source Pollution Abatement Program to redesign the program. Part of this redesign directed the agencies to give counties the opportunity to develop their own Land and Water Resource Management Plans, which would provide a mechanism for the counties to implement nonpoint source conservation practices. The counties within the Milwaukee River Basin have developed their Land and Water Resource Management Plans to identify priorities for implementing nonpoint source pollution reduction and resource conservation efforts. These plans have received formal approvals from their respective County Boards and the state Land and Water Conservation Board. The goals and priorities of the county plans are reflected throughout this *State of the Milwaukee River Basin Report*. Waterbodies or watersheds that are ranked high receive priority consideration for grant funding through the redesigned program. ***For more information on efforts to curb nonpoint source pollution, please see*** www.dnr.state.wi.us/org/water/wm/nps***.***

Local land trusts such as the Ozaukee Washington Land Trust and other WDNR programs are finding some other ways to protect and preserve both our natural resources and our farming heritage. Using techniques such as purchasing easements and development rights from area farmers allow the landowner to continue to use the land while farming. In the cases of development rights, uses other than for agricultural purposes are restricted. If the landowner decides to give up farming, the development rights revert to the purchaser.

Wisconsin DNR staff are conducting a feasibility study to determine whether a new property should be established in the North Branch Milwaukee River Watershed. The project entitled *The North Branch Milwaukee River Wildlife and Farming Heritage Area* is examining the possibility developing an area for resource protection, recreation and farmland preservation. About 12 miles of the Milwaukee River North Branch, two and one-half miles of the Milwaukee River mainstem, five tributary streams, three lakes, large expanses of lowland floodplain forests, other wetlands, upland forests and agricultural areas are within the study area. Twenty-two existing and potential natural areas are identified within the boundaries of the study area.
For more information on this study please see www.dnr.state.wi.us/org/gmu/milw/nbranch.htm***.***

Grasslands

Wisconsin was once covered with over two million acres of prairie. Only one percent of the native prairie remains. Also gone are the many wildlife species associated with prairies. Grassland bird species populations have also drastically declined. Changes in agricultural practices and rural land

use have resulted in eliminating grassland habitat and destroying many nests and chicks. By converting former croplands into grasslands, we can bring back some grassland wildlife.

Grassland bird species such as pheasants, bobolinks, meadowlarks, dickcissels and upland sandpipers need undisturbed grasslands for nesting and raising broods. Many waterfowl species such as blue-winged teal and mallards nest in grasslands that are located near wetlands. Besides being valuable for wildlife, grasslands near streams improve water quality by trapping soil that would otherwise enter wetlands, lakes and rivers.

Grasslands and prairies are slowly being restored or established within the Milwaukee River Basin. Since 1995 over 1300 acres of grassland have been established within Fond du Lac, Ozaukee, Sheboygan and Washington counties.

RECREATIONAL OPPORTUNITIES IN THE MILWAUKEE RIVER BASIN

Recreational opportunities abound in the Milwaukee River Basin and others parts of Southeastern Wisconsin. The state, county and city parks throughout the basin provide for a wide variety of recreational opportunities. Those of us drawn to the water are able to enjoy a wide variety of pursuits. This section provides a sampling of recreational resources in the basin.

Parks and Forests

Lands owned by the state provide year round opportunities for wildlife watching, hiking, fishing, hunting (excluded in some areas), bicycling, horseback riding, snowmobiling, skiing, camping, picnicking and water sports (Table 14). The State Parks and Forests provide many folks with a way to get away from the hustle and bustle of modern life. For those of us not able to leave the city but still in need of a connection with the natural world, Havenwoods State Forest is an island of nature within an urban Milwaukee environment. The 215 acres offer environmental education programs and walking trails for educators, youth groups, families and adults. Dozens of plant, bird and mammal species call Havenwoods home.

Table 14. Major State-Owned and Managed Lands in the Milwaukee River Basin.

Property Name	Size (Acres)	Contact Information
Nichols Creek Wildlife Area	615	No contact station. Call (414) 263-8500 for more information.
Cedarburg Bog Natural Area	1656	No contact station. Call (414) 263-8500 for more information.
Jackson Marsh Wildlife Area	2088	No contact station. Call (414) 263-8500 for more information.
Havenwoods State Forest	215	(414) 527-0232
Kettle Moraine State Forest-Northern Unit	29528	(262) 626-2116

For more information about Wisconsin's State Parks and Forests, please visit the State Parks and Forests web site at www.dnr.state.wi.us/org/land/parks/specific.

County parks provide recreational opportunities in both rural and urban settings. These parks offer many outdoor opportunities for camping, golfing, hiking, fishing, team sports, cross-country skiing, sledding, and picnicking. Many parks adjacent to lakes offer boat launches, swimming beaches and fishing opportunities. In addition, many larger county parks offer indoor activities within facilities such as aquatic centers, sports complexes and ice arenas.

For more information your county parks have to offer, please contact them directly using the information in Table 15.

Table 15. Contact Information For County Parks.

County Department	Phone Number/Internet Address
Milwaukee County Department of Parks, Recreation and Culture	(414) 257-6100 www.co.milwaukee.wi.us/depart/d-parks.htm
Ozaukee County Park Commission	(414) 284-8258 www.co.ozaukee.wi.us/parks.html
Sheboygan County Parks Department	http://www.co.sheboygan.wi.us/
Fond du Lac County Parks Department	(920) 929-3135
Washington County Planning and Parks Department	(262) 335-4445 www.co.washington.wi.us/landuse/park.html

Trails

The 2000+ miles of recreational trails within the Southeast Region provide for a myriad of opportunities. These trails, owned by state, county, local governments and non-profit organizations meander through many state forests, parks, wildlife and natural areas to provide scenic wildlife viewing, biking, horseback riding and nature hunting opportunities. In the winter months these trails also provide opportunities like cross-country skiing, snowshoeing, and snowmobiling. The Milwaukee River Basin contains a portion of the 1000 mile long Ice Age Trail. This trail is known for its distinctive glacial features and unique recreational opportunities. This National Scenic Trail meanders along the terminal moraine left by the Wisconsin glacier over 10,000 years ago. It begins at Potawatomi State Park on the shores of Lake Michigan and winds south through the Kettle Moraine State Forest. It turns north along the driftless area of the state, and passes through the Chequamegon National Forest before ending at Interstate Park along the St. Croix River. ***For more information about the Ice Age Trail, please see the Ice Age Park and Trail Foundation web site at*** **www.iceagetrail.org.**

The Hank Aaron State Trail is Wisconsin's newest state trail. The trail is currently in development and will cover about 7 miles, beginning at Lake Michigan, running along the Menomonee River and linking to the Milwaukee County Oak Leaf Trail at its West End. Once complete, this trail will make it possible to bike or hike from Lake Michigan, along several trails across the state, and eventually link to the Ice Age and Military Ridge Trails. This trail contributes to the restoration, protection and enhancement of the natural, scenic, historical and cultural resources of the Menomonee River corridor while providing the public with recreational opportunities and access to the river. The White House Millennium Council designated the Hank Aaron State Trail a Millennium Legacy Trail in October 1999. These trails represent the essence and spirit of each of the fifty states. The Hank Aaron State Trail was selected as Wisconsin's representative because of its respectful celebration of the past, its connection to the community and its far reaching vision for the future. *For more information about the Hank Aaron State Trail, or other state trails within the Southeastern part of the state, please contact the WDNR Trail Manager at (414) 263-8559.*

Fishing

Fishing is one of the most popular participation activities in the state. Anglers can be found testing their luck at the smallest trout streams in the northern portions of the basin to the shores of Lake Michigan, and many areas in between. Lake Michigan tributaries like the Milwaukee and Menomonee Rivers enjoy seasonal runs of trout and salmon. Spring and fall are the seasons supplying the most action, but some steelhead can be caught in the summer. The WDNR Lake Michigan Fisheries Work Unit maintains a Lake Michigan Fishing hotline that is updated regularly. Call (414) 382—7920 for the latest information.

Walleye fishing in the lower Milwaukee River and Harbor is gaining in popularity. From 1995 through 2000, over 38,000 extended growth walleye fingerlings have been stocked in the lower Milwaukee River below the former North Avenue Dam. Studies are underway to determine walleye survival and movement patterns. ***For more information about the walleye population restoration effort in the lower Milwaukee River and Harbor, call the WDNR Lake Michigan Fisheries Work Unit at (414) 382-7929.***

Smallmouth bass are plentiful in the Milwaukee River mainstem from the Town of Waubeka down to the City of Milwaukee. Some of the best smallmouth habitat on the Milwaukee River is located in Estabrook and Kletsch Parks. ***For more information on smallmouth bass or other fishing opportunities throughout the basin, call the Milwaukee River Basin Fisheries Biologist at (414) 263-8699.***

Many park ponds throughout the basin are stocked with sport fish to provide fishing opportunities to individuals in urban areas. The WDNR also lends fishing equipment to groups or individuals interested in getting hooked on fishing. ***For more information, please call the WDNR Urban Fishing Coordinator at (414) 263-8679, or the Regional Fisheries Expert at (414) 263-8614..***

Chapter 4. Milwaukee River Basin Partnerships

THE IMPORTANCE OF PARTNERSHIPS

Recently the WDNR reorganized into twenty-three Geographic Management Units (GMUs) with a major focus on managing resources on a geographic basis, rather than by programs. The Milwaukee River Basin Land and Water Partners Team (Partners Team) was formed in 1998, and represents a wide range of federal, state, county and local agencies, nonprofit organizations and private sector interests (Table 16). The Partner Team was formed to give citizens, environmental and conservation groups, businesses and local governments the ability to directly participate in setting priorities for work conducted throughout the Milwaukee River Basin. The use of such partner teams is an effective way to bring interested parties together within a defined geographic area to share resources while working toward common goals. It is not uncommon for public and private organizations to compete for limited funding to finance their projects. Working on projects together, rather than competing with each other to meet common goals is a major strength of a valuable partnership.

Table 16. Milwaukee River Basin Land and Water Partners Representation

- Citizens for a Better Environment
- City of Milwaukee
- Conrad Technologies
- Conservation Congress
- Federation of Environmental Technologists
- Friends of Milwaukees' Rivers
- Greater Milwaukee Convention & Visitor Bureau
- Metropolitan Association of Realtors
- Metropolitan Builders Association
- Milwaukee County Conservation Alliance
- Milwaukee County Parks, Recreation & Culture Department
- Milwaukee Metropolitan Sewerage District
- National Park Service
- Natural Resources Conservation Service
- Ozaukee County Farm Bureau
- Ozaukee County Land Conservation Dept.
- Ozaukee Washington Land Trust
- River Revitalization Foundation Inc.
- Schlitz Audubon Nature Center
- 16th Street Community Health Center
- Southeastern Wisconsin Regional Planning Commission
- U.S. Fish and Wildlife Service
- University of Wisconsin-Extension
- UW-Sea Grant Institute
- Village of Menomonee Falls
- Washington County Land Conservation Committee
- West Bend Chamber of Commerce
- Wisconsin Department of Natural Resources
- Wisconsin Wastewater Operators Association
- Wisconsin Well Water Association
- Wisconsin Woodland Owners Association

From 1998 until summer 2000 the Milwaukee River Basin Land and Water Partners Team met as a full group at least every other month. To guide the work and operations of the Partner Team, they defined the group's purpose and developed a vision statement and a guideline for action plans (listed below).

Purpose: The Milwaukee River Basin Partnership is a voluntary coalition of businesses, nonprofit groups, public agencies, educational institutions, organizations and individuals committed to restoring and sustaining the ecosystem of the Milwaukee River Basin while ensuring economic viability. Toward that end, the Partnership promotes comprehensive resource management, information exchange, intergovernmental coordination and citizen involvement.

Vision: "A Milwaukee River basin with a sustained and restored ecosystem that offers a healthy environment, strong economy and high quality of life for current and future generations."

Action: The Milwaukee River Basin Partnership will foster collaborations which lead to the protection, restoration and enhancement of Wisconsin's most populated river basin. Envisioned activities include on-the-ground projects, environmental education, research and public policy recommendations. We, the undersigned, mutually agree to provide assistance, as available, to support the efforts of the Partnership for the Milwaukee River Basin. Assistance may take many forms including technical expertise, financial support, volunteers, staff time, publicity or implementing projects supported by the Partnership.

The Partner Team worked diligently to define the priorities of issues and needs facing the Milwaukee River Basin. These resource protections as well as educational priorities are listed in Table 17. This list of priorities has guided the Partner Team as they develop various action plans. The Partner Team has considered sponsoring or supporting specific resource enhancement projects, natural resource education programs, and reviews of land use controls and policies.

Past projects that the Partner Team has been involved in include:

- Developing a summer internship position through the University of Wisconsin-Madison Department of Urban and Regional Planning.
- Presentations and invitations to municipalities to sign the partnership agreement stating that they will commit to considering resource functions and values in their decisions.

Table 17. Priorities Identified by the Milwaukee River Basin Land and Water Partners.

1. **Protect Natural Lands.**
   - Encourage the protection of environmental corridors and isolated natural areas.
   - Help to implement the Kettle Moraine Task Force goals related to protecting the Mid-Kettle Moraine through public education and fund raising activities.
   - Encourage WDNR and other agencies to purchase more of the environmental corridor areas.
   - Establish a natural area in the North Branch Watershed.
   - Encourage municipalities in the basin to adopt the Partnership Agreement and Goals.
   - Encourage municipalities in the basin to adopt *Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin* (SEWRPC, 1997).

2. **Promote "smart growth" initiatives in the basin.**
   - Develop strategies to change existing zoning laws and policies to promote sound local and county land use development.
   - Ecourage sound local and county land use planning**.**
   - Adopt land use management practices that guarantee clean water and healthy ecosystems in the future.
   - Encourage adoption of comprehensive stormwater management plans by all cities, villages, towns and counties in the basin.

3. **Educate citizens about the importance of the basin as a resource and support efforts to improve, maintain and enhance its quality.**
   - Develop an educational strategy focusing on a range of publics to increase awareness of the resource and how to protect it.
   - Improve people's perception of the river as an asset.

4. **Improve water quality by controlling both point and nonpoint sources of pollution.**
   - Address problems associated with milk house waste.
   - Encourage training and enforcement of more uniform erosion control ordinances.
   - Develop a "user-friendly" method for addressing failing septic systems.
   - Implement the Milwaukee Estuary Remedial Action Plan.
   - Implement a clean-up of contaminated sediments on Cedar Creek.
   - Implement the remainder of the Cedar Creek PCB contaminated sediment clean-up by Mercury Marine and Amcast Corporation.
   - Complete feasibility study for the remediation of contaminated sediment in the Estabrook Impoundment.
   - Support efforts to have safe, fishable and swimmable waters.

5. **Protect riparian areas.**
   - Restore degraded riparian areas.
   - Adopt county agricultural shoreland management ordinances.
   - Support purchase of conservation easements for riparian areas.

During the summer of 2000, the Partner Team members selected the following high-priority educational projects for 2001.

1. **Conduct a Milwaukee River Basin Workshop.** Help organize and co-sponsor a workshop focusing on the Milwaukee River Basin. The purpose of the workshop will be to share information about ongoing projects and opportunities in the basin. Small groups will meet and discuss specific areas of interest/concern and will make suggestions for future Partners Team work. This conference has been scheduled for November 9, 2001.

2. **Create a Virtual Map of the Milwaukee River Basin..** Expand the Partner Team web site (http://clean-water.uwex.edu/milwaukee) to include geographic information system based maps of the basin, exhibiting the results of overlaying various resource and data maps. These maps, directed to an audience which includes the general public, upper level students and decision makers would function to reveal the fascinating and critical resource and land use management issues facing the basin.

The Partners Team also identified a second tier of projects for the year ahead.

- Resubmit a grant proposal to develop a web site providing information on land use development ordinances which directly or indirectly affect water quality.

- Represent the Partners Team for the Mid-Kettle Moraine Project.

The Partner Team recently decided to meet as a full group annually, and formed an Executive Committee to guide the full Partner Team. The Executive Committee (Table 18) meets quarterly and furthers priorities and projects identified by the full Partner Team. The Executive Committee members have committed to serving for two years.

Table 18. Milwaukee River Basin Land and Water Partners Executive Committee

Name	Affiliation
Robert Boucher	Friends of Milwaukee's Rivers
Elizabeth Cheek	Schlitz Audubon Center
Kevin Dittmar	Metropolitan Association of Realtors
Mary Beth Driscoll or Steve Skavroneck	Citizens for a Better Environment (shared position)
Dave Fowler (co-chair)	Milwaukee Metropolitan Sewerage District
Joseph Greco	Village of Menomonee Falls
Andy Holschbach	Ozaukee County Land Conservation Department
Jim Lubner	University of Wisconsin Sea Grant Institute
Gretchen Messer	University of Wisconsin-Extension
Matt Maroney	Metropolitan Builders Association of Greater Milwaukee
Dave Schilling	Southeastern Wisconsin Regional Planning Commission
Walter Schmitt	Federation of Environmental Technologists
Steve Seyfert	Ozaukee Washington Land Trust
Angie Tornes (co-chair)	National Parks Service
Frank Trcka or Sharon Gayan	Wisconsin Department of Natural Resources (shared position)

For more information about the Milwaukee River Basin Land and Water Partners on the Internet see… http://clean-water.uwex.edu/milwaukee.

The Milwaukee River Revitalization Council

Formed in 1987 by the Wisconsin Legislature, the governor appointed 13 member Milwaukee River Revitalization Council (Council) continues to advise the WDNR on matters relating to revitalizing the Milwaukee River corridor. The first major accomplishment of the Council was *The Riverway Plan* (1991). This plan outlines a multifaceted approach to encourage recreational, entrepreneurial and cultural activities along the Milwaukee River corridor while creating more publicly accessible open space. The vision created by the many participants during development of *The Riverway Plan* is now becoming a reality. One only need to visit Milwaukee's downtown to experience the changes along the lower Milwaukee River. Where businesses used to have their backs to the river, the riverwalk development is encouraging us to see the river as an amenity. Along with this focus on the cultural and entertainment aspects associated with the river comes a renewed sense of environmental stewardship.

The Council is continuing to work toward achieving the vision of a revitalized Milwaukee River. The Council, in concert with the River Revitalization Foundation and many other partners, recently completed a river front parkway plan. The current focus of the Council's activities is to acquire additional public park lands along the Milwaukee River, enhance the open space created by removing the North Avenue Dam, creating public access to the river from existing parks and urban neighborhoods, and expanding the public trail systems from North Avenue to Estabrook and Lincoln Parks. In addition, the Council is actively involved with developing a river front parkway system connecting the Milwaukee River communities in Ozaukee County.

Chapter 5. Milwaukee River Basin Priorities and Actions

Many of the land and water resources throughout the Milwaukee River Basin have been extensively modified or destroyed since the settlers first arrived in the 1600s. We now recognize the effects our actions have on the environment, and many groups and individuals are taking action. This chapter identifies the high priority issues and actions that the Wisconsin Department of Natural Resources and partners have identified to monitor, manage, restore and protect the basin's resources for the present and future. The following represent priority issues and actions identified for the next five years. These actions are not listed in any particular order, and will be updated as needed to reflect emerging issues and shifting priorities.

Issue: The Milwaukee River Basin contains over 1,000 miles of perennial and intermittent streams, and over 50 named lakes. Understandably, we have only begun to really scratch the surface at understanding the processes affecting ecosystem quality. Of the streams previously monitored in the basin, most are only partially meeting their potential. Ten percent of the perennial stream miles in the basin are listed as impaired on the state 303(d) list. We need to fully understand the factors affecting water quality in the basin in order to make sound management decisions.

Priority Actions:

- Conduct baseline monitoring surveys on at least 10 stream sites per year using standardized protocols for stream habitat, fish and macroinvertebrate community sampling. Focus on streams with little available historical data, and reference sites.
- Conduct baseline monitoring on at least one lake per year using standardized protocols.
- Document the links between land based activities and effects on water quality at each of the monitoring sites.
- Continue to evaluate the effects of illegal ponds on the cold water resources of Mole Creek, and recommend management actions to alleviate the negative effects of these ponds.
- Evaluate other cool water streams for their potential to support cold water species and recommend management actions to correct problems.
- Provide data to central office modeling staff as determined by statewide priorities to develop total maximum daily loads and TMDL implementation plans for high priority waterbodies on the 303(d) list.

Issue: There are over 1000 discharge permits to surface waters in the basin covering a wide range of activities from animal waste handling to construction sites to treating effluent. The permitting, monitoring and compliance process helps minimize the negative effects of these discharges on water quality, however keeping up with the workload is a major challenge.

Priority Actions:

- Identify the industrial and municipal wastewater treatment plants that are not in compliance with their discharge permits and take actions to bring these facilities into compliance.
- Complete the municipal stormwater permitting process and ensure compliance for the 27 municipalities permitted as a result the Federal Phase I stormwater regulations.
- Issue permits to up to 10 communities as a result of the Federal Phase II stormwater regulations. This will address the communities in the upper watersheds making this a basin-wide approach for addressing municipal stormwater.
- Within the next five years, work with all the Phase I communities to reissue permits to comply with upcoming urban stormwater performance standards.
- Ensure that permitted construction sites greater than five acres are in compliance with their permit. Since problems are found at many inspected construction sites, take action to bring these sites into compliance.
- Issue permits for construction sites greater than one acre beginning March, 2003 to comply with the Federal Phase II stormwater regulations. This may increase the number of construction site permits ten-fold over current numbers.
- Identify non-complying industrial facilities in the scrap metal processing and auto dismantling industries and work to bring them into compliance with industrial stormwater regulations.
- Continue to ensure that the permit backlog in the basin remains under 10 percent.
- Issue permits for livestock operations with over 1000 animal units and ensure water quality protection and compliance through annual permit review and annual report review.
- Work with expanding livestock operations to ensure compliance with water quality protection laws.
- Continue to respond to complaints alleging a discharge of animal waste to waters and issue Notice of Discharge where applicable.

Issue: It is time-consuming and costly to restore degraded aquatic and terrestrial habitat, but it is well worth the effort. Protecting high quality and rare habitat and preventing further destruction are equally important.

Priority Actions:

- Restore in-stream and terrestrial habitat where dams are being removed, including the Milwaukee River in Grafton (Chair Factory), Cedar Creek near Jackson (Schweitzer Dam), and the Milwaukee River East Branch near New Fane.
- As other opportunities arise, assist in abandoning and removing dams and restore the in-stream and near shore areas.
- Identify stream miles in urban and rural areas that have been modified and work with partners to develop priorities and funding mechanisms for implementing actions to restore degraded stream and corridor habitat.
- Continue to work with other WDNR staff and partners to make the *North Branch Milwaukee River Wildlife and Farming Heritage Area* a reality.
- Conduct prescribed burning every spring on several hundred acres of public and private lands within the basin to help restore and maintain native prairie communities.
- Encourage governments, non-profit conservation organizations or land owners to protect the high quality natural areas identified in the SEWRPC Natural Areas Report.
- Restore and protect at least 100 acres of grasslands within the Milwaukee River Basin over the next five years. Some tools include encouraging landowners to enroll in set-aside programs such as the Federal Conservation Reserve Program, Wetland Reserve Program and Wildlife Habitat Incentives Program to protect and restore grasslands for wildlife and water quality.

Issue: Land use and effects on aquatic and terrestrial ecosystems are closely linked. Some of the most severely impaired waterbodies in the basin are found in the urbanized or developing areas. Agricultural practices also have an effect on water quality.

Priority Actions

- Work with basin communities to develop land use plans in accordance with the recent Smart Growth legislation.
- Establish buffers along all intermittent and perennial streams, wetlands, pond and lakes with a minimum of 10 meters through easements, land acquisition and voluntary landowner cooperation.
- Encourage developers to employ conservation design principles in their site plans.
- Continue to submit requests to purchase lands within the Jackson Marsh Wildlife Area and Cedar Creek Streambank Protection Area. Try to purchase 10 to 15 parcels during the next five years to protect wildlife habitat, water quality and provide recreational opportunities in a rapidly developing area of the basin.
- Initiate the Master Planning process on Jackson Marsh, the largest state-owned wildlife area in the Milwaukee River Basin, within the next five years. Planning and possible boundary modifications are neeed to protect the marsh from the effects of residential development.
- Continue to work with County Land Conservation Departments and rural landowners to encourage using conservation practices like minimum tillage, delayed mowing, rotational grazing and establishing buffers around wetlands and waterbodies to benefit wildlife and improve water quality.
- Annually Assist municipalities and County Land and Water Conservation Departments in successfully competing for Targeted Runoff Management (TRM) and Urban Nonpoint Source Grants.
- Continue to work with municipalities through the TRM and Urban Nonpoint Source Grant programs to refine stormwater and erosion control ordinances, develop stormwater management plans and utilities, construct structural best management practices and conduct information and education efforts.
- Implement the municipal, industrial and construction site stormwater permit programs described in priorities listed under the permitting issue on the previous page.
- Provide technical assistance and oversight for municipalities and County Land and Water Conservation Departments that have received TRM and Nonpoint Source Grants.
- Implement the recommendations outlined in *The Riverway Plan* to protect and restore land to benefit water quality and wildlife habitat.

Issue: Excess inputs of nutrients to surface waters encourage excessive plant growth and initiate a cascade of negative water quality effects. Known major sources of excess nutrients are urban and rural runoff, and industrial and municipal treatment plants.

Priority Actions:

- Determine the sources of excess nutrients to the Milwaukee River in the East-West Branch Watershed where excessive aquatic plant growth is apparent and make recommendations to reduce inputs.
- Calculate the loads of phosphorus entering streams in the basin from the 128 non-contact cooling water discharges.
- Implement best management practices to reduce the delivery of nutrients to surface waters from agricultural runoff.
- Ensure that the municipal and industrial wastewater treatment plants required to remove phosphorus from their effluent remain in compliance with their discharge permit.
- Bring farms in the basin into compliance with the Animal Waste Advisory Council prohibitions. Specifically ensure that:
  - all livestock operations have no overflowing manure storage facilities;
  - no unconfined manure stacks are located within Agricultural Water Quality Management Areas (300 feet from streams, 1000 feet from lakes);
  - runoff from feedlots or stored manure will not enter water resources; and
  - no animals can have unrestricted access streams where degradation of the streambank has or will likely occur.
- Continue to encourage landowners to develop and implement nutrient management plans.
- Work with county Land and Water Conservation Districts to ensure individual landowners' compliance with operation and maintenance agreements for structural water quality practices cost-shared through the Priority Watershed Program.
- Work with municipalities to ensure compliance with their municipal stormwater permit requirements by striving to reduce nutrients in their runoff.
- Continue to work with municipalities through the Urban Nonpoint Source Grant Program to implement best management practices to reduce stormwater pollutants.

Issue: Bacterial contamination of surface waters is commonly found throughout the basin. Some swimming beaches have been closed to protect public health many times because of high bacteria counts. We need to better understand the issue in order to make informed decisions for preventing future problems.

Priority Actions:

- Investigate the sources of bacterial contamination to swimming beaches in the Milwaukee Area. Report the findings and develop an action plan in cooperation with partners on the Beach Task Force.
- Ensure that industrial and municipal dischargers are in compliance with bacterial limits in their permits, and work with those not in compliance to come into compliance.
- Work with the United States Geological Survey and other partners to examine the contribution of pathogenic bacteria and other pollutants to surface waters in the Milwaukee area during wet weather events.

Issue: Sanitary sewer and combined sewer overflows to surface waters are a major concern for environmental and human health reasons. The report, ***Sewer Overflows in Wisconsin—A Report to the Natural Resources Board*** (WDNR, 2001) identifies several actions that should be taken to prevent wet weather bypasses to surface waters. The major actions recommended are summarized below.

Priority Actions:

- The WDNR must create and implement a statewide comprehensive system addressing sanitary sewer overflows (SSOs) that will ensure:
    a) sewage collection systems are maintained, operated and managed to prevent the entry of groundwater infiltration and stormwater inflow to sewer systems to the extent practicable, and
    b) infiltration and inflow that enters sewage collection systems does not cause or contribute to overflows.
- The WDNR must initiate an outreach program to ensure that all communities submit timely reports about SSOs from their sewer systems as required by their discharge permits, and become more aggressive in correcting the root causes of overflows, particularly excessive infiltration and inflow.
- Communities in the service area of the Milwaukee Metropolitan Sewerage District (MMSD) must, together with MMSD, identify and remove the sources of infiltration and inflow to their sanitary sewers so they do not overflow directly to surface waters.
- The Milwaukee Metropolitan Sewerage District must continue to improve the operation of its conveyance, storage and treatment facilities to maximize the amount of combined and sanitary sewage that is captured, stored and treated before discharge to surface waters. MMSD must also work with its contract and service communities to design and implement cost-effective ways to significantly reduce the excessive infiltration and inflow that currently enters local sewers tributary to MMSD's system.

Issue: Contaminated sediments remain a concern in the Milwaukee River Basin. Some pollutants found in the sediments such as polychlorinated biphenyls (PCBs) accumulate through the food chain, while others are more volatile but toxic to aquatic life. Many fish species in the Milwaukee River, Menomonee River, Cedar Creek and some tributary waters are listed on the state fish consumption advisory.

Priority Actions:

- Continue to implement the Sediment Strategy outlined in the *Milwaukee Estuary Remedial Action Plan*.
- Conduct a pre-design feasibility study for removing contaminated sediment from the Milwaukee River upstream of the Estabrook Park Dam, and seek partnerships for implementing clean-up actions.
- The WDNR should accelerate its efforts with responsible parties for removing the remaining PCB contaminated sediments from Cedar Creek.

Issue: Wetlands provide critical habitat for wildlife, provide water storage to prevent flooding and protect water quality and provide many opportunities to observe and interact with wildlife. Only about half of the wetlands once present in Wisconsin remain today. Many acres of wetland have

been protected since the early 1990s through state, federal and local initiatives. However, a recent U.S. Supreme Court decision may put more wetlands into jeopardy.

Priority Actions:

- Develop a GIS based decision model to protect and restore wetlands, using the Milwaukee River Basin as a pilot for eventual statewide deployment.
- Continue to work with private landowners to restore at least 100 acres of wetlands in conjunction with wildlife management programs and conservation associations.
- Protect wetland complexes through acquisition, easement and other incentives in partnership with local communities, non-profit conservation organizations and other agencies. Protecting rare and high quality wetland complexes identified through other planning efforts such as the SEWRPC Natural Areas Report, and state master plans are high priorities.
- Implement the strategies outlined in *Reversing the Loss: A Strategy for Protecting & Restoring Wetlands in Wisconsin.*

Issue: Groundwater resources and Lake Michigan provide drinking water for over 1.3 million people. Keeping these resources safe for drinking and plentiful are high priorities for the Milwaukee River Basin.

Priority Actions:

- Ensure all public water supplies are tested in accordance with the Federal Safe Drinking Water Act regulations.
- Conduct a sanitary survey at each of the 712 public water systems in the basin every five years.
- Conduct an inspection at each of the 31 municipal waterworks every year.
- Contact each of the well drillers licensed in the basin each year at a job site to ensure proper well location and construction techniques are being employed to comply with regulations.
- Contact ten percent of the pump installers licensed in the basin each year, with half of the contacts made at a job site to ensure compliance with regulations.
- Complete a review and issue a decision for all complete public drinking water plans submitted within 90 days of receipt.
- Make contact with at least one municipal building/plumbing inspection department per year within the basin to ensure that unused wells are being properly abandoned.
- Continue to provide technical assistance to private well owners to address questions and concerns related to groundwater and drinking water quality.
- Encourage development and implementation of well head protection ordinances to prevent encroachment on wells and their recharge areas.

Issue: Recreation is a very important part of life for Milwaukee River Basin residents and visitors. We must work together to provide a wide variety of high quality recreational opportunities.

Priority Actions:

- Improve access lanes, parking lots, enhance grassland and wetland habitat and provide new signs at the Jackson Marsh State Wildlife Area.
- Continue development work on the Hank Aaron State Trail project.
- Continue to work with Milwaukee County to stock park ponds with fish to provide angling opportunities.

- Implement the Deer 2000 recommendations for the affected areas in the basin to provide for increased hunting opportunities and deer population control near urban areas.
- Continue to implement the vision outlined in *The Riverway Plan* (MRRC, 1991) to provide multiple recreational and cultural activities along the Milwaukee River that also preserves environmental integrity.

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Appendix A. Streams of the Milwaukee River Basin

HOW TO USE THE STREAM WATERSHED TABLES

The following information will help you interpret the specific information included in the stream tables for each watershed.

Name of Stream: All named streams and some unnamed streams are listed. Stream names are those found on U.S. Geological Survey (USGS) quadrangle maps unless the Wisconsin Geographic Names Council established a different name. Unnamed streams are identified by location of the stream mouth as indicated by township, range, section and quarter-quarter section.

Length: Stream length is either the total length of the stream, or the starting and ending mile of the portion of the stream described. The stream mile at the stream mouth is zero ("0") and increases as one moves upstream.

Existing Use: This column indicates the existing biological use supported by the stream as defined in NR 102(04)(3) under fish and aquatic life uses. If the existing use is unknown, a blank space indicates the existing use is unassessed. The following abbreviations for stream uses are used in the tables:

> **COLD**; Cold Water Community; includes surface waters capable of supporting a community of cold water fish and other aquatic life or serving as a spawning area for cold water fish species.
>
> **WWSF;** Warm Water Sport Fish Communities; includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning area for warm water sport fish.
>
> **WWFF**; Warm Water Forage Fish Communities; includes surface waters capable of supporting an abundant diverse community of forage fish and other aquatic life.
>
> **LFF;** Limited Forage Fishery (intermediate surface waters); includes surface waters of limited capacity because of low flow, naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of forage fish and aquatic life.
>
> **LAL;** Limited Aquatic Life (marginal surface waters); includes surface waters severely limited because of very low or intermittent flow and naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of aquatic life.
>
> **DEF**; Default; All streams not formally classified are assumed to meet the default federal Clean Water Act goals of supporting aquatic life and recreational uses. The DEF classification is the same as WWSF.

The table also includes the "class" of trout streams based on "Wisconsin Trout Streams" [DNR Publ. 6-3600(80)] and Outstanding/Exceptional Resource Waters, Wisconsin Administrative Code NR 102.10 and NR 102.11.

> **Class I** streams are high-quality streams where populations are sustained by natural reproduction.
> **Class II** streams have some natural reproduction but need stocking to maintain a desirable fishery.

Class III streams sustain no natural reproduction and require annual stocking of legal-size fish for sport fishing. The approximate length or portion of stream meeting each of the use classes is indicated.

Potential Use: This column indicates the biological use, and trout stream class a stream or stream segment could achieve if it was well managed and pollution sources were controlled. In many cases potential use is the same as the existing use classification. In other streams potential use may be higher than the existing use. Abbreviations are the same as those used in the existing use columns. The sources of information are indicated by footnotes on each table. The classification for trout streams came from "Wisconsin Trout Streams" [DNR Publ. 6-3600(80)], Wisconsin Administrative Code NR 102.10 and NR 102.11 and the professional judgments of area Fish Managers. If the potential biological use is unknown, a blank space indicates the potential biological use is unassessed.

Supporting Potential Use: This column indicates whether a stream is threatened (THR), or is fully (FULL), partially (PART), or not (NOT) meeting its potential biological use. An entry in any of the columns indicates the relationship between actual stream use and potential use. For example, if the entire length of a stream is listed under the "Fully" column, the stream has no problems which can be controlled. When a portion or all of a stream length is listed under another heading, the stream is affected or threatened by some manageable factor and the biological use of the stream can probably be improved. If use support is unknown, a blank space indicates it is unassessed.

Codified Use (water quality standard designation): This column indicates the formal stream classification of a particular stream. Streams considered to be formally classified are those listed in Adm. Codes NR 102 and NR 104, all those referenced in Wisconsin Trout Streams, NR 102 and other formal stream classifications which will be added to the codes upon the next revision. This column also indicates if the stream is classified as an outstanding resource water (ORW) or an exceptional resource water (ERW) in NR 102.10 and NR 102.11. All streams not formally classified assume the default federal clean water act classification of FAL (full fish and aquatic waters).

Streams classified as Outstanding Resource Waters (ORW) or Exceptional Resource Waters (ERW) in NR102.10 and NR 102.11 are:

Outstanding Resource Waters have the highest value as a resource, excellent water quality and high quality fisheries. They do not receive wastewater discharges and point source discharges will not be allowed in the future unless the quality of such a discharge meets or exceeds the quality in the receiving water. This classification includes national and state wild and scenic rivers and the highest quality Class I trout streams in the state.

Exceptional Resource Waters have excellent water quality and valued fisheries but already receive wastewater discharges or may receive future discharges necessary to correct environmental or public health problems. This classification includes about 1,400 trout stream segments not classified as Outstanding Resource Waters.

Assessment Category/Monitored or Evaluated: It is important to detail what information was used to derive a potential biological use designation and the degree to which a stream meets that potential use. If the potential use decision was based upon site-specific data, then "M," for monitored, is entered. If the decision is based on information other than site-specific data (citizen complaints, best professional judgment of a biologist or fish manager) then "E," for evaluated, is entered. "Evaluated" includes decisions based on data more than five years old.

Use Problems, Source/Impact: This column indicates the probable sources of pollution in the stream and the types of water quality problems present (impact). Some streams shown as fully meeting potential use may still show up in this column as having a use problem. When this occurs it may mean

there is a problem but it cannot be managed for some reason, or there is a potential threat to the use. These situations are explained in the narrative or in the references.

Following is a key to the abbreviations in the watershed tables:

Source (cause of problem):

BDAM - Beaver dam
CM - Cranberry marsh
DCH - Ditched
DRDG - Dredging
GR.Pit - Gravel Pit Washing Operation
HM - Hydrologic modification
IRR - Irrigation
LF – Landfill
NMM - Non-metallic mining
NPS - Unspecified nonpoint sources
BY - Barnyard or exercise lot runoff
CL - Cropland erosion
CON - Construction site erosion
PSB - Stream bank pasturing
PWL - Woodlot pasturing
RS - Roadside erosion
SB - Stream bank erosion
URB - Urban storm water runoff
WD - Wind erosion
PSM - Point source, municipal treatment plant discharge
PSI - Point source, industrial discharge
SS - Storm sewer

Impact (effect or impact of source on a stream)

BAC - Bacteriological contamination
CL - Chlorine toxicity
DO - Dissolved oxygen
FAD - Fish advisory
FLOW - Stream flow fluctuations caused by unnatural conditions
HAB - Habitat (lack of cover, sedimentation, scouring, etc.)
HM - Heavy metal toxicity
MAC- Undesirable rooted aquatic plant (macrophyte) or algae growth
MIG - Fish migration interference
NH3 - Ammonia toxicity
NUT - Nutrient enrichment
ORG - Organic chemical toxicity or bioaccumulation
PCB - PCB bioaccumulation
pH - pH (fluctuations or extreme high or low)
PST - Pesticide/herbicide toxicity
SC - Sediment contamination
SED - Sedimentation
TEMP - Temperature (fluctuations or extreme high or low)
TOX - General toxicity problems
TURB – Turbidity

References (Ref.) The numbers listed in this column are the references cited on the page below the table. Please refer to the references section for the full citation.

Data Level: This column indicates the level of data used to make decisions on the stream. The key below describes the meaning of column entries.

Bioassessments:

BI: Visual observations of biota, limited monitoring and extrapolations from other sites – unknown or low precision and sensitivity – professional biologist not required.

B2: One assemblage required with reference conditions of available, biotic index or narrative evaluation of historical records; limited to single sampling and site specific studies; low to moderate precision and sensitivity, professional biologist may provide oversight.

B3: Single assemblage, reference condition preferred; biotic index used or supplemented by historical records. Monitoring targeted sites during a single season; may be site specific study but may include spatial coverage for watershed level assessments. Moderate precision and sensitivity; professional biologist performs survey or training for sampling and assessment.

B4: generally two assemblages, may be one if data quality high. Regional reference conditions use; biotic index used. Monitoring over 1 –2 sampling seasons; broad coverage of sites for site specific or watershed specific assessments; use of probabilistic design. High precision and sensitivity; professional biologist surveys and assesses.

Habitat:

H1: Visual observation of habitat characteristics; no true assessment; documentation or readily discernible land use characteristics that might alter habitat quality, no reference conditions.

H2: Visual observation of habitat characteristics and simple assessment; use of land use maps for characterizing watershed condition; reference condition preestablished by professional scientist.

H3: Visual-based habitat assessment using SOPs; may be supplemented with quantitative measurements of selected parameters; conducted with bioassessment; data on land use compiled and used to supplement assessment; reference condition used as a basis for assessment.

Toxicological Approaches:

T1: Any one of the following: Acute or chronic WET, Acute ambient, or acute sediment

T2: Any of the following: Acute or chronic ambient, acute sediment, acute and chronic WET for effluent dominated stream

T3: chronic ambient or acute or chronic sediment, acute and chronic WET for effluent dominated stream

T4: Both of the following: acute and chronic ambient and acute or chronic sediment

Physical/Chemical

P1: any one of the following: water quality with grab sample or water data extrapolated from upstream or downstream, monitoring data more than five years old, BPJ based on land use data, etc.

P2: Any one of the following: water quality with grab sample or rotating basin surveys with multiple visits or automatic sampling synthesis of existing or historical info on fish contaminant levels, screening models based on loading data (not calibrated or verified)

P3: Any one of the following, composite or a series of grab water samples (diurnal coverage as appropriate), calibrated models

P4: All of the following: water quality monitoring used composite or series of grabs, limited sediment quality samples and fish tissue analyses at sites with high probability of contamination.

Table A1. Streams of the Milwaukee River North Branch Watershed.

Stream Name/Location (T, R, QQ, Q, Sec.)	WBIC	Length	Biological Use		Codified	Supp.	Assess Cat.	Use Impairments		Ref.	Data Level
			Existing	Potential				Source	Impact		
Adell Tributary	33000	5.1	LFF	WWSF	DEF	NOT	E	PSI, HM,NPS	DO, HAB	1	B1, H1
Batavia Creek	31400	4.1	WWSF	WWSF	DEF	PART	E	HM, NPS, CL, PSB	HAB, NUT, BAC	1	B1, H1
Chambers Creek	32200	2.0	COLD I	COLD I	Cold I	PART	M	PSB	HAB, TEMP, BAC	1,2	B3, H3
Gooseville Creek (South Br.)		0.9	COLD II	COLD I	DEF(1)	PART	E	NPS, HM	HAB	1	B1, H1
Gooseville Creek (North Br. & Mainstem to Milwaukee R.)	32200	1.0	COLD I	COLD I	Cold I	PART	E	NPS, HM	HAB	1	B1, H1
Melius Creek	32100	3.3	COLD II	COLD I	DEF(1)	PART	E	NPS, HM, CL	HAB	1	B1, H1
Mink Creek	30600	13.2	COLD	COLD	DEF	PART	M	HM, BY, PSB,SB,CL,NPS	NUT, BAC,HAB,MAC	1,2	B3, H3
N. Branch Milwaukee River	27100	23.5	WWSF	WWSF	DEF	PART	E	NPS, HM, SB, CL	TURB,HAB,MIG	1	B1, H1
N. Branch Milwaukee River (Nichols Creek)	27100	4.4	COLD	COLD	Cold I	PART	E	HM, BY, PSB,NPS	HAB, MIG, MAC	1	B1, H1
Silver Creek	29900	10.5	WWSF	WWSF	LFF WWSF (2)	PART	E	NPS,PSM,CL,HM	HAB, BAC,MIG	3	B1, H1
Stony Creek	28700	13.6	COLD	COLD	DEF	PART	M	HM,CL,NPS	HAB,TEMP	1,4	B2, H2
Un. Cr. (T13N R20E NW NE 11)		0.9	COLD	COLD	DEF	PART	E	HM	TEMP	5	B1, H1
Un. Cr. (T12N R20E SE SE 2)		0.8	WWFF	WWFF	DEF	PART	E			5	B1, H1
Un. Cr. (T12N R20E SW NW 8)		0.4			DEF						
Un. Cr. (T12N R20E SW SW 3)	28800	2.6	WWFF	COLD	DEF	NOT	E	HM	TEMP, HAB	5	B1, H1
Un. Cr. (T13N R20E SE NE 34)	30900	3.6	COLD	COLD	DEF	PART	E			5	B1, H1
Un. Cr. (T13N R21E NE NW 11)		0.5	WWFF	WWFF	DEF	PART	E			5	B1, H1
Un. Cr. (T13N R21E NE NW 32)	30000	1.3	WWFF	WWFF	DEF	PART	E	BY	NUT,BAC	5	B1, H1
Un. Cr. (T13N R21E NW SE 27)	30200	0.6	WWSF	WWSF	DEF	PART	E			5	B1, H1

Stream Name/Location (T, R, QQ, Q, Sec.)	WBIC	Length	Biological Use		Codified	Supp.	Assess Cat.	Use Impairments		Ref.	Data Level
			Existing	Potential				Source	Impact		
Un. Cr. (T13N R21E SE NE 23)		1.4									
Un. Cr. (T14N R21E SW NE31)	32400	0.5	WWSF	WWSF	DEF	PART	E			1	B1, H1
Wallace Creek	27600	4.5	COLD	COLD	DEF	PART	M	PSB,HM,CL,NPS	HAB	1,2	B3, H3
TOTALS		**98.7**									

(1) Trout streams as defined in Wisconsin Trout Streams (1980) but not listed in NR 102. These streams may be classified as trout streams under 1.02(7) since publication of Wisconsin Trout Streams (1980), but are not formally classified as trout waters. These streams will be added to NR 102 and/or NR 104 during code revision.

(2) Currently listed as a variance stream in NR 104.07(2) as LFF from the Random Lake POTW discharge at STH 144 (T13N R21E NE NW 34) to the first crossing of Creek Road (T13N R21E NE SW 33), a distance of 1.6 miles. This entire length of Silver Creek has been re-classified as a WWSF and the existing variance is proposed to be deleted from NR 104.

References:

1. WDNR, 1986. North Branch Watershed Water Quality Appraisals.

2. Year 2000 Baseline Monitoring by WDNR Staff. Data on file.

3. WDNR, 1980. Wisconsin Trout Streams.

4. Formal stream classification on file.

5. Assessment made with best professional judgment by water quality and/or fisheries biologist.

Table A2. Streams of the Milwaukee River East-West Branch Watershed.

Stream Name/Location (T, R, QQ, Q, Sec.)	WBIC	Length	Biological Use		Codified	Supp.	Assess. Cat.	Use Impairments		Ref.	Data Level
			Ex.	Pot.				Source	Impact		
Auburn Lake Creek (Lake Fifteen Creek) downstream of Auburn Lake	41600	2.2	WWSF	WWSF	DEF	PART	E	NPS, PSB, HM, URB	MAC, DO, HAB, MIG, FLOW	1	B1, H1
Auburn Lake Creek (Lake Fifteen Creek) upstream of Auburn Lake	41600	7.1	COLD II	COLD I	DEF(1)	PART	M	NPS, HM	HAB	1,2	B3, H3
Kewaskum Creek	39800	8.2	WWFF	WWFF	DEF	PART	M	PSB, HM, SB	HAB	1,2	B3, H3
Milwaukee River East Branch From Long Lake (T14N R19E NW SW 25) to STH 28 (T12N R21E SE NE 10)	36900	15.5	WWSF	WWSF	NR 102.11	PART	E	HM, PSB, BY	MIG, BAC, HAB	1	B1, H1
Milwaukee River East Branch From STH 28 (T12N R21E SE NE 10) to confluence with Milwaukee R. West Br. (T12N R19E SE SW 14)	36900	2.5	WWSF	WWSF	DEF	PART	M	HM, PSB, BY	MIG, BAC, HAB	1,2,3	B3, H3
Milwaukee River Mainstem	15000	52.8	WWSF	WWSF	DEF	PART	M	BY, PSM, SB, HM, URB, NPS, PSB, DEV	BAC, MAC, DO, MIG, HAB, FLOW, TURB	1,2	B3, H3
Milwaukee River West Branch	40400	20.6	WWSF	WWSF	DEF	PART	E	BY, PSM, PSB, SB, URB	BAC, NUT, MAC, DO, HAB, MIG, FLOW	1	B1, H1
Myra Creek	34400	2.9	WWFF	WWFF	DEF	PART	E	HM, SB	HAB, MIG	1	B1, H1
Quas Creek	34900	6.6	COLD	COLD	DEF	PART	M	HM, URB, NPS, SB, DEV	HAB, TEMP, TURB	1,4	B3, H3
Silver Creek	35500	4.5	WWFF	WWFF	DEF	PART	E	HM, SB, NPS, DEV, URB	HAB, BAC, MIG	1	B1, H1
Un. Cr. (T13N R18E NW SE 7)	41100	1.9									
Un. Cr. (T14N R18E SW NE 28)	44300	1.0	WWSF	WWSF	DEF	PART	E	HM, SB	NUT, HAB, DO, MAC	1	B1, H1
Un. Cr. (Lake Seven Outlet)	37700	0.4	WWSF	WWSF	DEF	PART	E	HM	HAB, TOX, TURB, SC	1	B1, H1
Un. Cr. (Riveredge Creek)	34000	2.2	WWFF	WWFF	DEF	PART	E	SB	HAB	1	
Un. Cr. (T11N R19E NE NW 14)	35700	1.1	WWFF	WWFF	DEF	PART	E	PSB, HM, NPS	HAB, TOX, TURB, SC	1	B1, H1
Un. Cr. (T11N R20E SW SE 17)	34800	2.2	LFF	LFF	DEF	PART	E	PSB, HM, SB	HAB	1	B1, H1
Un. Cr. (T12N R19E NW NE 9)	40100	1.2	WWFF	WWFF	DEF	PART	E	HM, SB	HAB	1	B1, H1
Un. Cr. (T12N R19E SE NE 4)	40200	1.7	LFF	LFF	DEF	PART	E	BY, PSM, HM, URB	BAC, MAC, NUT, HAB, FLOW	1	B1, H1

Stream Name/Location (T, R, QQ, Q, Sec.)	WBIC	Length	Biological Use		Codified	Supp.	Assess. Cat.	Use Impairments		Ref.	Data Level
			Ex.	Pot.				Source	Impact		
Un. Cr. (T12N R20E NE SW 36)	33800	1.5	WWFF	WWFF	DEF	PART	E	PSB, HM, SB	HAB	1	B1, H1
Un. Cr. (T13N R18E NW NE 26)	41000	1.7	WWFF	WWFF	DEF	PART	E	BY, PSM, PSB, HM, SB	BAC, HAB	1	B1, H1
Un. Cr. (T13N R19E NE NE 13)		0.2									
Un. Cr. (T13N R19E NE NW 13)	37500	0.1									
Un. Cr. (T13N R19E NW NE 06)	43500	10.9	WWSF	WWSF	DEF	PART	E	BY, PSM, HM, SB, URB	NUT, BAC, MAC, DO HAB, MIG, FLOW	1	B1, H1
Un. Cr. (T13N R19E NW NE 17)	42900	0.4	WWSF	WWSF	DEF	PART	E	HM, URB	DO, HAB, FLOW	1	B1, H1
Un. Cr. (T13N R19E NW SE 33)		0.4	WWSF	WWSF	DEF	PART	E	HM, URB	DO, HAB, FLOW	1	B1, H1
Un. Cr. (T13N R19E NW SE 6)	43400	2.0	WWSF	WWSF	DEF	PART	E	BY, PSM, HM, SB, URB	BAC, HAB, DO	1	B1, H1
Un. Cr. (T13N R19E SE NE 14)	37400	1.0									
Un. Cr. (T13N R19E SE NE 16)		1.0	WWSF	WWSF	DEF	PART	E	URB, HM	DO, HAB, FLOW	1	B1, H1
Un. Cr. (T13N R19E SE NW 18)		0.6	WWSF	WWSF	DEF	PART	E	URB	DO, FLOW	1	B1, H1
Un. Cr. (T13N R19E SE NW 23)		0.4									
Un. Cr. (T13N R19E SE SW 34)	40300	1.2	LFF	LFF	DEF	PART	E	HM, URB	HAB, FLOW	1	B1, H1
Un. Cr. (T13N R19E SW NE 10)	42500	0.4	WWSF	WWSF	DEF	PART	E	URB	DO, FLOW	1	B1, H1
Un. Cr. (T13N R19E SW NE 14)	37300	8.3	WWSF	WWSF	DEF	PART	E	PSB, HM, SB	MIG, HAB	1	B1, H1
Un. Cr. (T14N R17E SE NE 36)	41400	1.6	WWSF	WWSF	DEF	PART	E	BY, PSM, PSB, SB, URB	BAC, DO, FLOW, HAB	1	B1, H1
Un. Cr. (T14N R18E NW NE 27)	44200	5.7	WWSF	WWSF	DEF	PART	E	BY, PSM, PSB, HM, SB, URB	NUT, MIG, MAC, DO, HAB, FLOW	1	B1, H1
Un. Cr. (T14N R18E NW SE 22)		1.3	WWSF	WWSF	DEF	PART	E	BY, PSM, PSB, HM, SB, URB	NUT, BAC, MAC, DO, HAB, MIG, FLOW	1	B1, H1

Stream Name/Location (T, R, QQ, Q, Sec.)	WBIC	Length	Biological Use		Codified	Supp.	Assess. Cat.	Use Impairments		Ref.	Data Level
			Ex.	Pot.				Source	Impact		
Un. Cr. (T14N R18E NW SW 14)	44400	1.9	WWSF	WWSF	DEF	PART	E	BY, PSM, HM, PSB, SB, URB	BAC, NUT, MAC, DO, HAB, MIG, FLOW	1	B1, H1
Un. Cr. (T14N R18E SE NW 36)	44100	1.0	WWSF	WWSF	DEF	PART	E	BY, PSM, PSB, HM, SB, URB	NUT, MAC, BAC, DO, HAB, MIG, FLOW	1	B1, H1
Un. Cr. (T14N R18E SE SE 36)	44000	2.7	WWSF	WWSF	DEF	PART	E	BY, PSM, PSB, HM, SB, URB	BAC, NUT, MAC, DO, HAB, MIG, FLOW	1	B1, H1
Un. Cr. (T14N R19E NW NE 36)		0.2	WWSF	WWSF	DEF	PART	E	SB	HAB	1	B1, H1
Un. Cr. (T14N R19E NW SE 35)		0.3									
Un. Cr. (T14N R19E SE NW 36)	38300	7.8	WWSF	WWSF	DEF	PART	E	HM, BY, PSM	HAB, BAC	1	B1, H1
Un. Cr. (T14N R19E SE SW 36)		0.4									
Un. Cr. (T14N R20E NE SW 20)	38400	0.7									
Virgin Creek	42000	4.1	WWSF	WWSF	DEF	PART	E	HM, URB	DO, HAB, FLOW	1	B1, H1
Watercress Creek	39000	3.3	COLD II	COLD I	DEF(1)	PART	E	NPS, HM	HAB	1	B1, H1
TOTALS		**195.9**									B1, H1

(1) Trout streams as defined in Wisconsin Trout Streams (1980) but not listed in NR 102. These streams may be classified as trout streams under 1.02(7) since publication of Wisconsin Trout Streams (1980), but are not formally classified as trout waters. These streams will be added to NR 102 and/or NR 104 during code revision.

References

1. WDNR, 1989. Nonpoint Source Appraisals for the East-West Branch Watershed.
2. Year 2000 Baseline Monitoring. Data on file.
3. New Fane Dam removal assessment. Information on file.
4. UW-Milwaukee, 1998-1999.

Table A3. Streams of the Cedar Creek Watershed

Stream Name/Location (T, R, QQ, Q, Sec.)	WBIC	Length	Biological Use		Codified	Supp.	Assess. Cat.	Use Impairments		Ref.	Data Level
			Ex.	Pot.				Source	Impact		
Cedar Cr.	21300	28.5	WWSF	WWSF	DEF (1)	PART	M	HM, PSI, NPS, URB, BY, CL, PSB, SB	HAB, MIG, PCB, SC, BAC, TOX, TURB, NUT, MAC, FAD	1,2,3	B3, H3
Cedarburg Cr.	22900	4.5	WWSF	WWSF	DEF	PART	E	NPS, CL, SB, BY, HM	HAB, BAC	1	B1, H1
Evergreen Cr.	23000	5.2	WWFF	WWSF	DEF	PART	E	CL, BY, HM	HAB, MIG, BAC	1	B1, H1
Friedens Cr.	23300	3.8	WWSF	WWSF	DEF	PART	E	CL, BY, NPS, HM	HAB, BAC	1	B1, H1
Jackson Cr.	23900	1.3	WWFF	WWFF	DEF	PART	E	BY, CL, NPS, URB, HM, DEV	HAB, BAC	1	B1, H1
Kressin Cr.	23500	3.4	WWSF	WWSF	DEF	PART	E	BY, CL, NPS, HM	HAB, TEMP, NUT	1	B1, H1
Lehner Cr.	24400	0.3	WWFF	COLD	DEF	PART	M	NPS, BY, CL, SB, HM	HAB, BAC, NUT	1,3	B3, H3
Little Cedar Cr.	23400	8.7	WWSF	WWSF	DEF	PART	E	CL, BY, NPS, PSB, DEV, HM	HAB, TEMP, BAC	1	B1, H1
North Branch Cedar Cr.	22500	8.1	WWSF	WWSF	DEF	PART	M	PSB, BY, HM, NPS	HAB, NUT, BAC	3	B3, H3
Polk Spring Cr.	23800	1.9	WWFF	WWFF	DEF	PART	M	BY, CL, NPS, SB	TEMP, HAB, NUT	3	B3, H3
Un. Cr. (T10N R19E NW NE 5)	25400	1.7	WWFF	WWFF	DEF	PART	E	SB, CL, HM	NUT, HAB, TEMP	1	B1, H1
Un. Cr. (T10N R20E NE NE 1)	22600	1.0	WWFF	WWFF	DEF	PART	E	CL, BY, NPS	HAB, TEMP, NUT, BAC	1	B1, H1
Un. Cr. (T11N R21E NW NW 32)	22000	0.7									
Un. Cr. (T11N R19E NE NE 20)	25500	0.5									
Un. Cr. (T10N R19E SE NE 14	24200	0.2									
Un. Cr. (T09N R20 E NE SW 06)	23600	2.1									
TOTALS		**71.9**									

(1) Exceeds water quality standards for PCBs
(2) Previously assessed in 1987 as potential coldwater stream. More assessment needed to confirm this potential use.

References

1. WDNR, 1988. Nonpoint Source Appraisals. Information on file.
2. PCB Study-USGS and Baird. Report on file.
3. WDNR Year 2000 baseline monitoring. Data on file.

Table A4. Streams of the Milwaukee River South Watershed.

Stream Name/Location at mouth (T, R, QQ, Q, Sec.)	WBIC	Length	Biological Use		Codified use	Supp.	Assess. Cat.	Use Impairments		Ref.	Data Level
			Ex.	Pot.				Source	Impact		
Indian Cr. Concrete channel upstream of I-43 (T08N R22E S8 NE SW 08) to headwaters	19600	1.3	LAL	LAL	NR 104.06(2)(a)[5]	PART	E	HM, NPS, PSM, URB	HAB, BAC, FLOW	1,2	B2, H2
Indian Cr. Natural channel from confluence with Milwaukee R. (T08N R22E NW NE 18) to I-43 and concrete channel (T08N R22E S8 NE SW 08)	19600	1.3	WWSF	WWSF	NR 104.06(2)(a)[6]	PART	E	HM, NPS, SB, URB	HAB, FLOW, HM, BAC	1,2	B2, H2
Lincoln Cr. Natural channel from confluence with Milwaukee R. (T08N R22E NE SE 31) to concrete channel at Teutonia Ave. (T08N R22E NE SE 36)	19400	1.3	WWSF	WWSF	NR 104.06(2)(a)[2]	PART	E	NPS, SB, URB, HM, PSM	SC, FLOW, HAB, MIG, TOX, HM, DO, PCB, FAD	1,2	B2, H2
Lincoln Cr. Concrete channel at Teutonia Ave. (T08N R22E NE SE 36) to natural channel at 32nd St. (T07N R21E NW NE 01)	19400	0.6	LAL	LAL	NR 104.06(2)(a)[3]	PART	E	HM, URB, PSM, SB	HAB, TOX, HM, MIG, BAC	1,2	B2, H2
Lincoln Cr. Natural channel at 32nd St. (T07N R21E NW NE 01) to concrete channel at Hampton Ave. (T08N R21E SE SE 34)	19400	2.5	LFF	LFF	NR 104.06(2)(a)[4]	PART	E	NPS, SB, URB, HM, PSM	SC, FLOW, HAB, TOX, HM, BAC	1,2	B2, H2
Lincoln Cr. Concrete channel at Hampton Ave. (T08N R21E SE SE 34) to natural channel upstream of Silver Spring Dr. (T08N R21E SW SW 26)	19400	1.3	LAL	LAL	NR 104.06(2)(a)[3]	PART	E	HM, URB, PSM	HAB, TOX, HM, BAC	1,2	B2, H2
Lincoln Cr. Natural channel upstream of Silver Spring Dr. (T08N R21E SW SW 26) to concrete channel upstream of Brynwood Country Club pond (T08N R21E NE SW 15)	19400	2.8	LFF	LFF	NR 104.06(2)(a)[4]	PART	E	HM, NPS, SB, LF, URB	HAB, SC, FLOW, HM, TOX, BAC	1,2	B2, H2
Lincoln Cr. Concrete or enclosed channel upstream of Brynwood Country Club pond (T08N R21E NE SW 15) to headwaters.	19400	0.5	LAL	LAL	NR 104.06(2)(a)[3]	PART	E	HM, URB	HAB, TOX, HM, BAC	1,2	B2, H2
Milwaukee River from abandoned North Avenue Dam (T07N R22E NW NE 21) to confluence with Lake Michigan.	15000	3.2	WWSF	WWSF	NR 104.06(2)(b)[1]	PART	E	HM, URB, NPS, PSM, CE, BY, CL, SB	HAB, MIG, HM, NUT, BAC, SC, PCB, DO, FAD, MAC	1,2	B2, H2
Milwaukee River from River Mile 47.5 to abandoned North Avenue Dam (T07N R22E NW NE 21)	15000	44.3	WWSF	WWSF	DEF	PART	E	HM, URB, NPS, PSM, CE, BY, CL, SB	HAB, MIG, HM, NUT, BAC, SC, PCB, FAD, MAC	1,2	B2, H2

Stream Name/Location at mouth (T, R, QQ, Q, Sec.)	WBIC	Length	Biological Use		Codified use	Supp.	Assess. Cat.	Use Impairments		Ref.	Data Level
			Ex.	Pot.				Source	Impact		
Pigeon Creek (T09N R21E SW NW 23)	20500	3.8	WWFF	WWFF	DEF	PART	E	CL, HM, BY, DEV, URB	HAB, BAC, MIG, FLOW, NUT, BAC	1,2	B2, H2
Un. Cr. (Beaver Creek) Natural channel from confluence with Milwaukee R. (T08N R21E SE SW 01) to concrete channel (T08N R21E NW SW 01)	20000	0.4	WWFF	WWFF	DEF	PART	E	HM, URB, NPS, PSM	HAB, HM, BAC, FLOW	1,2	B2, H2
Un. Cr. (Beaver Creek) Concrete channel reach (T08N R21E SE SW 01) to North Ridge Lake dam (T08N R21E SE SW 03)	20000	2.2	LAL	LAL	DEF	PART	E	HM, URB, NPS, PSM	HAB, HM, BAC, FLOW	1,2	B2, H2
Un. Cr. (Brown Deer Creek) (T08N R22E SW NW 07)	19700	2.2	WWFF	WWFF	DEF	PART	E	NPS, HM, URB	SC, HAB, HM, TOX, BAC, FLOW	1,2	B2, H2
Un. Cr. (Fredonia Creek) T12N R21E NW NE 34)	26600	4.1	WWFF	WWFF	DEF	PART	E	HM, SB, CL, URB, BY, LF, DEV	HAB, FLOW, NUT, BAC	1	B1, H1
Un. Cr. (Mole Creek) (T10N R21E NE NE 13)	26300	4	COLD	COLD	DEF	PART	M	CL, CE, HM, LF, SB, BY, DEV, URB	HAB, BAC, HM, TEMP	1,2, 3	B3, H3
Un. Cr. (Southbranch Creek) Natural channel from confluence with Milwaukee R. (T08N R21E SW NW 12) to concrete channel at Churchill Rd. (T08 R21E NE SE 11)		0.2	LFF	LFF	DEF	PART	E	HM, NPS, PSM, URB	HAB, BAC, HM, FLOW, SB	1,2	B2, H2
Un. Cr. (Southbranch Creek) Concrete channel Reaches (T08N R21E SE NW 12) to headwaters		1.3	LAL	LAL	DEF	PART	E	HM, NPS, PSM, URB	HAB, BAC, HM, FLOW	1,2	B2, H2
Un. Cr. (T08N R 21E SW NE 13)	19800	0.1									
Un. Cr. (T09N R21E SE SW 36)	20200	1.4									
Un. Cr. (T09N R21E SW SE 10)	20700	2.5									
Un. Cr. (T09N R22E NW SE 33)	44700	3.4									
Un. Cr. (T10N R21E NW NE 13)	26300	4									
Un. Cr. (T11N R21E SW SE 3)	26500	1.7									
Un. Cr. (T12N R21E NW NE 34)	26725	1.1									
Un. Cr. (T9N R22E NW NW 18)	21100	3.1									
Un. Cr. (Trinity Creek) (T09N R21E SE NE 35)	20400	3.1	LFF	LFF	DEF	PART	E	CL, SB, CE, HM	HAB, FLOW, BAC, URB, DEV, EX	1	B1, H1
Un. Cr. (Ulao Creek) (T09N R21E NE NE 12)	21200	8.6	WWSF	WWSF	DEF	PART	E	CL, SB, HM, BY, PSB, URB, MAC, DEV	HAB, BAC, NUT, FLOW, DO	1	B1, H1

Stream Name/Location at mouth (T, R, QQ, Q, Sec.)	WBIC	Length	Biological Use		Codified use	Supp.	Assess. Cat.	Use Impairments		Ref.	Data Level
			Ex.	Pot.				Source	Impact		
Un.Cr. (T08N R 22E SW NE 31)	19450	1.3									
Un.Cr. (T11N R21E NE NW 36)	26450	1									
TOTALS		**108.6**									

[1]Currently listed as a variance stream in NR 104.06(2)(b). This reach has been re-classified as a WWSF and the existing variance is proposed to be deleted.
[2]Currently listed in NR 104.06(2)(a) as variance stream in its entirety. The variance assigned to this reach is proposed to be deleted and replaced with WWSF
[3]Currently listed in NR 104.06(2)(a) as variance stream in its entirety. The variance assigned these three reaches are proposed to be revised to LAL. The LAL classification will be re-evaluated following removal of the 2.4 miles of concrete lined channel and drop structures.
[4]Currently listed in NR 104.06(2)(a) as variance stream in its entirety. The variance assigned these two reaches are proposed to be revised to LFF. The LFF classification will be re-evaluated following removal of the approximate 2.4 miles of concrete lined channel and drop structures in other sections of the stream.
[5]Currently listed in NR 104.06(2)(a) as variance stream in its entirety. The variance assigned to this reach is proposed to be deleted and replaced with default WWSF.
[6]Currently listed in NR 104.06(2)(a) as variance stream in its entirety. The variance assigned to this reach is proposed to be deleted and replaced with default WWSF.

References:

1. WDNR, 1988. Nonpoint Source Stream Appraisals.
2. WDNR. Stream classification on file.
3. Year 2000 Baseline Monitoring.

Table A5. Streams of the Menomonee River Watershed.

Stream Name/Location (T, R, QQ, Q, Sec.)	WBIC	Length	Biological Use		Codified	Supp.	Assess. Cat.	Use Impairments		Ref.	Data Level
			Ex.	Pot.				Source	Impact		
Burnham Canal (T07N R22E SW SE 29)		1.2	WWSF	WWSF	NR 104.06(2)(b)[1]	PART	E	PSI, URB, HM	SC, TOX, TEMP, DO, ORG, HM, HAB, FAD	1,2	B2, H2
Honey Cr. Natural channel from confluence with Menomonee R. (T07N R21E NW NW 27) to concrete channel at Honey Cr. Parkway (T07 R21E SW SE 28)	16300	0.9	WWFF	WWFF	NR 104.06(2)(a)[2]	PART	E	URB, SB, PSM, PSI	HAB, NUT, TOX, HM, BAC	1,2	B2,H2
Honey Cr. Concrete or enclosed channel at Honey Cr. Parkway (T07 R21E SW SE 28) to natural channel at I-894 (T06N R21E SW SW 23)	16300	6.1	LAL	LAL	NR 104.06(2)(a)[3]	PART	E	PSM, HM, PSI	BAC, FLOW, HAB, HM	1,2,	B2,H2
Honey Cr. Natural channel from I-894 (T06N R21E SW SW 23) to headwaters	16300	3.0	LFF	LFF	NR 104.06(2)(a)[4]	PART	E			1,2,	B2,H2
Lilly Cr.	18400	4.7	WWFF	WWFF	DEF	PART	E	SB, URB, CE, DEV, PSI	NUT, BAC, TOX, HAB	1	B1, H1
Little Menomonee Creek	17900	3.9	WWFF	WWFF	DEF	PART	E	CL, SB, RS, CE	BAC, NUT, HAB	1	B1, H1
Little Menomonee R.	17600	11.2	LAL	WWSF	DEF	NOT	E	LF, URB, HM, SB, DEV	ORG, TOX, BAC, SC, HM, FLOW, HAB	1	B1, H1
Menomonee R. From confluence with Honey Cr. (T07N R21E NW NW 27) to confluence with Milwaukee R. (T07 R22E SE SE 29)	16000	32.2	WWSF	WWSF	NR 104.06(2)(a)[5]	PART	E	URB, PSM, HM, PSI, DEV, CE	HM, PCB, BAC, TOX, HAB, NUT, SC, FLOW, TEMP, DO, FAD	1,2	B2, H2
Nor-X-Way Channel Concrete channel reach	18450	0.1	LFF	LFF	DEF	PART	E	HM, URB, DEV	HAB, FLOW, TOX	1	B1, H1
Nor-X-Way Channel / All natural channel reaches	18450	3.0	WWFF	WWFF	DEF	PART	E	PSI, URB, HM, DEV	NUT, FLOW, HAB, TOX	1,	B1, H1
South Menomonee Canal (T07N R22E NE NW 32)		0.4	WWSF	WWSF	NR 104.06(2)(b)[1]	PART	E	PSI, URB, HM	SC, TOX, TEMP, DO, ORG, HM, HAB, FAD	1,2	B2, H2
Southbranch of Underwood Cr. From confluence with Underwood Cr. (T07N R21E NW SW 30) to headwaters	16800	1.0	LAL	LAL	DEF[6]	PART	E	PSI, HM, URB	HAB, BAC	1	B1, H1
Un. Cr. (Butler Ditch) (T08N R20E SE NW 36)	18100	2.9	LFF	LFF	DEF	PART	E	URB, CE, HM, DEV	HAB	1	B1, H1

Stream Name/Location (T, R, QQ, Q, Sec.)	WBIC	Length	Biological Use		Codified	Supp.	Assess. Cat.	Use Impairments		Ref.	Data Level
			Ex.	Pot.				Source	Impact		
Un. Cr. (Goldenthal Creek) (T09N R20E NW NW 22)	18900	3.5	WWFF	WWFF	DEF	PART	E	HM, SB	HAB	1,2	B2, H2
Un. Cr. (T07N R 20E SE SE 15)	17100	2.5	LFF	LFF	DEF	PART	E	URB, CE, RS, HM, DEV	NUT, BAC, TOX, HM, FLOW, HAB, TEMP	1,2	B2, H2
Un. Cr. (T07N R20E SW NE 14)	17000	1.1									
Un. Cr. (T07N R21E NW SW 30))	16800	1.1									
Un. Cr. (T08N R21E NE SW 18)	18200	0.5									
Un. Cr. (T8N R21E NE NE 18)	18350	3.4									
Un. Cr. (T9N R20E SW NE 15)		3.8									
Un. Cr. (Wood Creek) (T07N R21E SW NW 36)	16100	0.5	LAL	LAL	DEF	PART	E	HM, URB	FLOW, HAB	1	B1, H1
Underwood Cr. Concrete channel from confluence with Menomonee R.(T07N R21 E NW NE 20) to drop structure at Milwaukee-Waukesha County line (T07N R21E NW SW 30)	16700		WWFF	WWFF	NR 104.06(2)(a)[7]	PART	E	URB, CE, HM, PSM	NUT, MET, HAB, BAC	1, 2	B2, H2
Underwood Cr. From drop structure at Milwaukee-Waukesha County line (T07N R21 E NW NE 20) to headwaters.	16700		WWFF	WWFF	DEF	PART	E	PSM, URB, HM, CE, SB	BAC, NUT, MET, HAB	1	B1, H1
Willow Cr.	18800	2.8	WWFF	WWFF	DEF	PART	E	CL, HM, DEV, CE	NUT, HAB	1	B1, H1
TOTALS		**89.8**									

[1]Currently listed as a variance waterbodies in NR 104.06(2)(b). These reaches have been re-classified as a WWSF and the existing variance is proposed to be deleted.
[2]Currently listed as a variance waterbody in NR 104.06(2)(a). This reach has been re-classified as a WWFF and the existing variance is proposed to be deleted.
[3]Currently listed in NR 104.06(2)(a) as variance stream in its entirety. The variance assigned this reach is proposed to be maintained but revised to be LAL.
[4]Currently listed in NR 104.06(2)(a) as variance stream in its entirety. The variance assigned this reach is proposed to be maintained but revised to be LFF.
[5]Currently listed as a variance waterbody in NR 104.06(2)(b). This reach has been re-classified as a WWSF and the existing variance is proposed to be deleted. This reach is proposed to be maintained but revised to be LAL and only for the reach described.
[6]Not currently listed in NR 104 as a variance stream. A variance is proposed for this stream in its entirety as LAL.
[7]Currently listed in NR 104.06(2)(a) as variance stream from its confluence with Menomonee R. to Juneau Blvd. in Elm Grove. The variance assigned

References:

1. WDNR, 1988. Nonpoint Source Appraisals.
2. Formal Stream Classification on File.

Table A6. Streams of the Kinnickinnic River Watershed.

Stream Name/Location	WBIC	Length	Biological Use		Codified	Supp.	Assess. Cat.	Use Impairments		Ref.	Data Level
			Ex.	Pot.				Source	Impacts		
Kinnickinnic River Natural/earthen channel reaches from confluence with Milwaukee R. to 6th St. (T6N R22E NE SW 08)	15100	7.4	WWSF	WWSF	NR 104.06 (2)(a)[1]	PART	2.8	URB, PSM, PSI, HM, SB	BAC, NUT, HM, PCB, TOX, HAB, FLOW, MIG, SC, FAD	1,2	B2, H2
Kinnickinnic River Concrete channel reaches upstream of 6th St. (T06N R22E NE SW 08) to headwaters	15100	5.2	LAL	LAL	NR 104.06 (2)(a)[2]	PART	3.5	URB, PSM, PSI, HM,	BAC, NUT, HM, TOX, HAB, FLOW, MIG	1,2	B2, H2
Un. Cr. (Cherokee Park Creek)(T06N R21E SE NE 13)	15250	1.6	LAL	LAL	DEF	PART	1.6	URB, SB, HAB	BAC, NUT, HAB, FLOW	1,2	B2, H2
Un. Cr. (Edgerton Ditch)(T06N R22E SW NE 28)	15575	1.4	LFF	LFF	DEF[6]	PART	0.5	URB, PSI, HM	BAC, HAB	1,2	B2, H2
Un. Cr. (Holmes Ave Creek)(T06N R22E SE SE 20)	15550	1.8	LAL	LAL	DEF	PART	1.8	URB, PSM, PSI, HM	BAC, NUT, TOX, HAB, FLOW	1,2	B2, H2
Un. Cr. (Lyons Park Creek)(T06N R21E SW NW 11)	15950	1.5	LAL	LAL	DEF	PART	1.5	URB, PSM, HM, SB	BAC, NUT, HAB, FLOW, MIG	1,2	B2, H2
Un. Cr. (South 43rd St. Ditch)(T06N R21E NW NW 12)	15900	1.1	LAL	LAL	DEF[3]	PART	1.1	URB, PSI, PSM, HM, SB	BAC, NUT, SC, HM, PCB, TOX, HAB, FLOW, MIG	1,2	B2, H2
Un. Cr. (Villa Mann Cr.)(T06N R22E NW NE 19)	15300	1.2	LAL	LAL	DEF	PART	1.2	URB, HM, SB	BAC, NUT, HAB, FLOW, MIG	1,2	B2, H2
Un. Cr. (Wilson Park Creek) Concrete or enclosed channel reaches from confluence with Un. Cr. (Edgerton Ditch) (T06N R22E SE NW 27) to 6th St. (T06N R22E SW SE 20)	15200	3.5	LAL	LAL	DEF[4]	PART	3.5	URB, PSI, PSM, HM	BAC, NUT, HM, TOX, HAB, FLOW, MIG	1,2,3	B2, H2, P2
Un. Cr. (Wilson Park Creek) Natural/earthen channel reaches from 6th St. (T06N R22E SW SE 20) to 20th St. (T06N R22E NW NE 19)	15200	2	LFF	LFF	DEF[5]	PART	2	URB, PSI, PSM, HM, SB	BAC, NUT, SC, HM, PCB, TOX, HAB, FLOW, MIG	1,2,3	B2, H2, P2
TOTALS		**26.7**									

[1]Currently listed in NR 104.06(2)(a) as variance stream in its entirety. The variance assigned this reach is proposed to be deleted and replaced with WWSF.
[2]Currently listed in NR 104.06(2)(a) as variance stream in its entirety. The variance assigned this reach is proposed to be maintained but revised to be LAL.
[3] Not currently codified in NR 104. Proposed to be re-classified as LAL and included in NR 104 revision.
[4]Not currently codified in NR 104. Proposed to be re-classified as LAL and included in NR 104 revision.
[5]Not currently codified in NR 104. Proposed to be re-classified as LAL and included in NR 104 revision.
[6]Not currently codified in NR 104. Proposed to be re-classified as LFF and included in NR 104 revision.

References

1. 1984-1985 Water Quality Standards Reviews
2. 1991 Nonpoint Source Appraisals
3. Milwaukee Mitchell International Airport Runoff Study

Appendix B. Lakes of the Milwaukee River Basin

HOW TO USE THE LAKES TABLE

The following explains the information used in the following lakes table. *Note: A blank space anywhere in the table means that the lake is unassessed or data are unavailable.*

LAKE NAME/LOCATION: Lake names are those found on U.S. Geological Survey quadrangle maps unless the Wisconsin Geographic Names Council has established a different name. Some lakes are known locally by other names; where available, local names have been listed with the official name. Lake locations are identified by township, range, and section.

WBIC: named and unnamed lakes are listed with Wisconsin DNR water body identification code (WBIC).

COUNTY (CO): Indicates the county in which the lake is located.

TOWNSHIP, RANGE, SECTION:

SURFACE AREA: The surface area is the size of the lake, in acres, as listed on the WDNR Master Waterbody File, *Wisconsin Lakes* PUB-FM-900 (1995), Surface Water Resources of Dane County (WDNR, 1985), and *A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report* (SEWRPC, 1995).

MAX/MEAN DEPTH: Maximum depths are those listed in *Wisconsin Lakes*, WDNR PUBL-FM-800-95REV and *A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report* (SEWRPC, 1995).

ACCESS:
BR = Boat Ramp
BF = Barrier-free boat ramp (boating dock and/or wheelchair access)
P = Barrier-free pier (wheelchair access)
T = Walk-in trail
R = Roadside
W = Wilderness
BW = Barrier-free wilderness access (wheelchair access)
NW = Navigable water access to lake
X = Some type of access available, but not specified

LAKE TYPE: Each lake type displays unique limnological characteristics based on physical and chemical properties. Production of plant and animal life generally varies in accordance with lake type. Basic classifications and qualifying criteria are:

Drainage lake (DG): Impoundments and natural lakes with the main water source from stream drainage. Has at least one inlet and one outlet.

Drained lake (DR): Natural lake with the main water source dependent on the groundwater table and seepage from adjoining wetlands. Seldom has an inlet but will have an outlet of very little flow similar to the seepage lake except for the outlet.

Seepage lake (SE): Landlocked. Water level maintained by groundwater table and basin seal. Intermittent outlet may be present.

Spring lake (SP): Seldom has an inlet, but always has an outlet of substantial flow. Water supply dependent upon groundwater rather than surface drainage.

WINTERKILL: Winterkill (winter oxygen depletion) is a common problem in many shallow Wisconsin lakes. A kill can occur when at least four inches of snow cover the lake, which prevents sunlight from reaching the water. All photosynthesis stops and plants begin to die and decompose. The extent of oxygen loss depends on the total amount of plant, algae and animal matter that decays. Drought increases the chance of winterkill by reducing the volume of water in the lake. Y indicates the lake has experienced winterkill at least once. If blank, winterkill is not known to have occurred.

SH (Self Help Monitoring) This column identifies existing or recommended Self-Help monitoring. The following letters in each column signify that Self-Help monitoring is:
R = recommended
X = completed
C = currently being done

HG (Mercury) Numerous lakes in Wisconsin contain fish with elevated levels of mercury. Fish consumption advisories are issued semi-annually for lakes with fish mercury levels of 0.5 parts per million (ppm) or greater. Generally, predator fish from soft water, poorly buffered, low pH lakes have the highest concentrations of mercury. The most updated listing of waterbodies with fish consumption advisories can be obtained by writing to: Fish Advisory, Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, WI 53707.

Groups:
R Fish mercury monitoring is recommended.
X Multiple fish populations have been tested for mercury content and a fish consumption advisory DOES NOT exist
SA Monitoring has been conducted and a special advisory exists for this body of water.
GA (general advisory) This waterbody falls under a general statewide fish consumption advisory for mercury.

MAC (Macrophytes): This column identifies the status of macrophytes or aquatic plants in the lake. Specifically, it indicates if the lake experiences Eurasian water milfoil and/or purple loosestrife, two invasive non-native species of plants that can impair the lake's aesthetic, ecological, and recreational values.

EM = indicates that Eurasian water milfoil is present in the lake and may be a problem
EM-W = lake part of research project to study the effectiveness of Eurasian water milfoil weevil in reducing and/or eradicating this plant from the lake.
PL = indicates that purple loosestrife is present in the lake and may be a problem

LMO (LAKE MANAGEMENT ORGANIZATION): Indicates whether or not a lake management organization (LMO) exists for the lake. An LMO can range from a small, loosely organized group of lake property owners to an association to a district, complete with by-laws and taxing authority. In the lakes table, the following letters are used to indicate whether the LMO is an association or district. If the type of organization is not known, but one does exist, a Y is used.

Y Indicates that a LMO does exist
ASSC Indicates that a lake management association exists
DIST Indicates that a lake management district exists
R Recommends that a LMO be developed; this recommendation is usually accompanied by a narrative recommendation in the watershed analysis section.

LAKE PLAN OR PROTECTION: This column refers to whether the lake has been the recipient of a lakes planning or lakes protection grant in the past and if either of these grants are recommended for the lake. If a lakes planning or protection grant is recommended, a narrative in the lake's respective watershed section will describe the recommended purpose of the grant.
PLAN = Lake has received a Lakes Management Program Planning Grant in the past.

PROT = Lake has received a Lakes Management Program Protection Grant in the past.
PLAN-R = A Lakes Management Planning Grant is recommended for a specific purpose.
PROT-R = A Lakes Management Protection Grant is recommended for a specific purpose.

TROPHIC STATUS INDEX (TSI) CLASS: Lakes can be divided into three categories based on trophic state: oligotrophic, mesotrophic and eutrophic. These categories are general indicators of lake productivity.
Oligotrophic (OL) lakes are generally clear, cold and free of many rooted aquatic plants or large blooms of algae. Because they are low in nutrients, oligotrophic lakes generally do not support large fish populations. However, they often have an efficient food chain with a very desirable fishery of large predator fish.
Mesotrophic (ME)lakes are in an intermediate stage between oligotrophic and eutrophic. The bottoms of these lakes are often devoid of oxygen in late summer months, limiting cold water fish and resulting in phosphorus cycling from sediments.
Eutrophic EU) lakes are high in nutrients. They are likely to have excessive aquatic vegetation or experience algae blooms, sometimes both. They often support large fish populations, but are also susceptible to oxygen depletion. Small, shallow lakes are especially vulnerable to winterkill, which can reduce the number and types of fish. Lakes with a TSI less than or equal to 39 are generally considered oligotrophic, those with a TSI of 40-49 are considered mesotrophic, and those with a TSI equal to or greater than 50 are generally considered eutrophic.

All lakes naturally age, or progress from being oligotrophic to eutrophic. In many places, people have accelerated this process by allowing nutrients from agriculture, lawn fertilizers, streets, septic systems, and urban storm drainage to enter lakes.

PHOSPHORUS SENSITIVITY (P SENS): This analysis classifies lakes according to their relative sensitivity to phosphorus loading and existing trophic condition. The screening identifies high quality lakes that should receive highest priority for nutrient control management. The analysis first separates lakes into two major categories: lakes that are sensitive to increased phosphorus loading (Class I) and lakes less responsive to changes in phosphorus loading (Class II). Lakes in each general classification are then subdivided into management groups based on data needs or existing water quality conditions.

Class I:
A = existing water quality fair to excellent; potentially most sensitive to increased phosphorus loading.
B = existing water quality poor to very poor; less sensitive to increased phosphorus loading than Group A.
Ins = data are inadequate or insufficient to assess trophic condition; classification monitoring recommended.
Class II:
A = existing water quality fair to excellent; may not be as sensitive to phosphorus loading as Class I lakes.
B = existing water quality poor to ery poor; low sensitivity to increased phosphorus loading.
Ins = data inadequate or insufficient o establish appropriate management recommendations and priorities.

COMMENTS: Additional information that was available for the lakes has been included in the comments column. Abbreviations were used to conserve space as follows:

Source - sources are the facilities or activities that contribute pollutants or stressors, resulting in impairment of designated uses in a waterbody.
AGSPR - Agricultural land spreading site
HM - Hydrological modification (dam, ditching, wetland drainage)

NPS - Unspecified nonpoint sources
CL - Cropland erosion
SB - Streambank erosion
PSB - Streambank pasturing
PWL - Woodlot pasturing
BY - Barnyard or exercise lot runoff (animal operations)
CE - Building construction site erosion
RS - Roadside construction erosion
SEP - Septic systems are or may be causing water quality problems
URB - Urban storm water runoff
DEV - Intense development pressure
WLF - Water level fluctuations

Causes/Stressors - causes are those pollutants or other conditions that contribute to the impairment of designated uses in a lake. Stressors are factors or conditions - other than specific pollutants - that cause impairment of designated uses in a lake.
HAB - Habitat
MAC - Undesirable macrophyte
ALG - Undesirable algae growth
NUT - Nutrient enrichment
SED - Sedimentation
TOX - General toxicity problems
TURB - Turbidity
DO - low dissolved oxygen
ACC - Access problems relate to the general public's inability to access the lake, which as a navigable waterbody is considered a water of the state.

Table B1. Lakes of the Milwaukee River North Branch Watershed

NAME/Location	WBIC	County	AREA (acres)	Max/Mean Depth (ft)	Access	Lake Type	Winter kill	SH	Hg	MAC	LMO	PLAN /PROT	P SENS	TSI	Comments
Batavia Pond T13 R20E 13	31600	Sheboygan	1	5		DG									BY,SED,AGSPR,SB,NUT
Beechwood Lake T13 R20E 17	8000	Sheboygan	11	20	BR	SE	Y								BY,SED,AGSPR,SB,TURB,CL
Boltonville Pond T12 R20E 09	29000	Washington	6	10/5		DG									SED,TURB,MAC,BY,CL,NUT,ABS PR,URB
Cascade Millpond T14 R21E 20	33400	Sheboygan	4	13	T	DG									
Ehne Lake T12 R20E 29	27900	Washington	18	15/5		SP									
Ellen, Lake T14 R12E 31	32500	Sheboygan	121	42/16	BR	DG	Y	X						EU	NUT,BY,SED,CL,TURB,AGSPR,U RB
Erler Lake T12 R20E 27		Washington	37	34/14		SP									
Gooseville Millpond T13 R21E 17	31900	Sheboygan	38	7		DG									
Green Lake T12 R20E 33	28100	Washington	71	37/17	BR	SE		C		EM	ASSC			EU	NPS, CL,SED,SB
Haack Lake T13 R20E 31	29300	Sheboygan	16	18/7		DG	Y								TURB,NUT,BY,CL,SED,AGSPR,U RB
Huiras Lake T12 R21E 09	9600	Ozaukee	26	7		SE	Y								NUT,BY,SB,AGSPR,SED,TURB
Lenwood, Lake T11 R19E 01	28600	Washington	15	38/19		SP									NPS
Miller Lake T12 R20E 30	10400	Washington	3	16		SE									
Random Lake T13 R21E 26	30300	Sheboygan	209	21/6	BR	DG	Y	X		EM	ASSC	PLAN		EU	NPS,SED,NUT,URB,CE
Sixteen, Lake T13 R20E 16	11800	Sheboygan	8	13		SE									
Spring Lake T12 R21E 02	30500	Ozaukee	57	22/7		SE		X						EU	SED,BY
Twelve, Lake T12 R20E 12	29700	Washington	53	20/6		SP								EU	NUT,BY,SB,AGSPR,SED,TURB
Wallace Lake T11 R20E 06	28300	Washington	52	35/11	BR	SP		X		EM	DIST			EU	ALG,SED,TURB,URB

Table B2. Lakes of the Milwaukee River East-West Watershed

NAME/LOCATION	WBIC	County	Area (acres)	Max /Mean Depth (ft)	Access	Lake Type	Winter kill	SH	Hg	Mac.	LMO	PLAN OR PROT	P SENS	TSI	Comments
Allis Lake T11 R19E 01	7900	Washington	9	34		SE									
Auburn Lake T13 R19E 15	42400	Fond du Lac	107	29/14	T	DG								MESO	NPS,SED
Barton Pond T11 R19 E11	35400	Washington	67	5/3	T	DG			X						
Birchwood Lake T14 R19E 26	8100	Fond du Lac	31												
Brickyard Lake T11 R19E 12	8200	Washington	1	4		SE									
Butler Lake T14 R20E 20	38500	Sheboygan	7	13	T	DG									
Buttermilk Lake T13 R19E 15	8300	Fond du Lac	13	6/2	R	SE									
Butzke Lake T13 R19E 16	42200	Fond du Lac	16	8/4	T	DG									
Campbellsport Millpond T13 R19 E18	43300	Fond du Lac	22	10/4	T	IMP-DG									URB,NPS,SED,NM,CL
Cedar Lake T14 R19E 26	42800	Fond du Lac	19	19/6	T	SE									
Cedar Lake T13 R20E 06	8400	Sheboygan	10	10/6	W	SE	Y								BY,SED
Crooked Lake T13 R20E 06	37900	Sheboygan	91	32/12	BR	SE				EM					DO,BY,SED,CL
Daly Lake T11 R21E 17	34100	Ozaukee	13	8		SE	Y								NPS,BY,SED,CL,SB,PSB
Dickman Lake T13 R19E 16	41900	Fond du Lac	9	12/7		SE									
Forest Lake T13 R19E12	8900	Fond du Lac	51	32/11	T	SE		X	XX	EM	ASSC				
Kelling Lakes #1 T14 R20E 31	9900	Sheboygan	2	7	W	SE	Y				ASSC				BY,SED,CL
Kelling Lakes #2 T14 R20E 31	9900	Sheboygan	2	7	W	SE	Y				ASSC				BY,SED,CL
Kelling Lakes #3 T14 R20E 31	9900	Sheboygan	3	7	W	SE	Y				ASSC				BY,SED,CL
Kettle Moraine Lake T14 R19E 27	43900	Fond du Lac	227	30/6	R	SE	Y		X						NUT,SED,NPS,CL

NAME/LOCATION	WBIC	County	Area (acres)	Max /Mean Depth (ft)	Access	Lake Type	Winter kill	SH	Hg	Mac.	LMO	PLAN OR PROT	P SENS	TSI	Comments
Kewaskum Millpond T12 R19E 09	39700	Washington	5	8	T	DG									
Lake Bernice T13 R18E 26	40900	Fond du Lac	35	11/5	R	IMP-DG									NUT,MAC,ALG,CL,NPS,BY,URB,SED
Lake Seven T13 R20 E07	37800	Sheboygan	27	25/12	BR	SE	Y								BY,SED,CL
Little Drickens Lake T12 R19E 26	36800	Washington	9	20		SE									
Little Mud Lake T13 R19E 12	10200	Fond du Lac	18	5		SE	Y								BY,SED,CL
Long Lake T14 R19E 25	38700	Fond du Lac	427	47/22	BR	DG		C	XX		Y			EU	NPS,BY,SED
Lucas Lake T11 R19E 22	35900	Washington	78	15/6		DG		X						ME	NPS
Mallard Hole Lake T13 R19E 13	37600	Fond du Lac	2	6	T	SE									BY,SED,CL
Mauthe Lake T13 R19E 14	38200	Fond du Lac	78	23/12	BR	DG			XX	EM					NPS,CL,NUT,SED,DO,SB,
Mud Lake T14 R19E 28	43700	Fond du Lac	55	17/8		DG	Y								NUT,BY,SED,NPS,CL
New Fane Millpond T13 R19E 35	37200	Fond du Lac	5												
Newburg Pond T11 R20E 12	34300	Washington	7	8	T	DG									
Paradise Valley Lake T11 R19E 22	36000	Washington	9	35		DG									NPS
Proschinger Lake T11 R20E 22	34500	Washington	6	23		SE									
Quas Lake T11 R19E 34	35000	Washington	7	12		SP	Y								NPS,SED,DEV,SB,TOX,URB,RS,CE
Radtke Lake T11 R20E 22	34700	Washington	10	14/7		SE									
Senn Lake T13 R18E 27	11600	Fond du Lac	16	8/6		DG									
Silver Lake T11 R19E 27	36200	Washington	118	47/20		DG		X			ASSC-DIST	PLAN		EU	NPS
Smith Lake T12 R19E 26	36700	Washington	86	5/3	BR	SE								ME	

NAME/LOCATION	WBIC	County	Area (acres)	Max /Mean Depth (ft)	Access	Lake Type	Winter kill	SH	Hg	Mac.	LMO	PLAN OR PROT	P SENS	TSI	Comments
Spring Lake T13 R19E 15	11900	Fond du Lac	10	2/2		SE									
Spruce Lake T14 R19E 23	12000	Fond du Lac	34	4/3	T	SE									NUT,SED,NPS,CL
Tittle Lake T14 R19E 12	38900	Fond du Lac	17	26	NW	DG									
Unnamed T11 R21E 17	12500	Ozaukee	12												
West Bend Pond T11 R19E 13	35200	Washington	67												

Table B3. Lakes of the Cedar Creek Watershed

NAME/ LOCATION	WBIC	County	Area (acres)	Max/ Mean Depth (ft)	Access	Lake Type	Winter kill	SH	Hg	MAC	LMO	PLAN OR PROT	P SENS	TSI	Comments
Big Cedar Lake T11 R19E 32	25300	Washington	932	105/34	BR	SP		C		EM	ASSC-DIST			EU	NPS,NUT,SED,MAC
Cedarburg Pond T10 R21E 26	21700	Ozaukee	15												
Cedarburg Stone Quarry T10 R21E 35	8500	Ozaukee	6												
Donut Lake T11 R21E 28	22300	Ozaukee	4												
Gilbert Lake T11 R19E 20	25600	Washington	40	30/3	NW	SP				EM					NPS,NUT,SED,MAC
Gough Lake T11 R21E 17	9100	Ozaukee	5												
Hasmer Lake T10 R20E 18	24000	Washington	15	34/17	NW	DG									
Hawthorn Lake T11 R20E 36	9200	Washington	8	12		SE									
Horn Lake T11 R21E 20	9500	Ozaukee	12												
Keowns Pond T11 R20E 32	23200	Washington	1	15		DG									
Lehner Lake T10 R19E 22	24500	Washington	3	22/15		SP									
Lent Lake T10 R19E 15	24900	Washington	8	7	NW	DG									
Little Cedar Lake T10 R19E 03	23400	Washington	246	56/13	NW	DG		X			DIST	PLAN		EU	MAC,NPS,SEP
Long Lake T11 R21E 29	22200	Ozaukee	34												
Moldenhauer Lake T10 R21E 11	10600	Ozaukee	3												
Mud Lake T11 R21E 31	22100	Ozaukee	245											EU	
Roeckl Lake T11 R21E 19	11400	Ozaukee	3												
Schwietzer Pond T10 R19E 14	24300	Washington	8	4		DG									SED,TURB,ALG,MAC
Tilly Lake T10 R19E 13	24100	Washington	13	48/24		SP									

Table B4. Lakes of the Milwaukee River South Watershed

NAME/ LOCATION	WBIC	County	AREA (acres)	Max/ Mean Depth	Access	Lake Type	Winter kill	SH	Hg	MAC	LMO	PLAN OR PROT	P SENS	TSI	Comments
Brown Deer Park Pond T8 R21E 13	19900	Milwaukee	6	6/4	X	DG			X	EM					MAC,ALG,DO
Chair Factory Millpond T10 R21E 24	26000	Ozaukee	6	7		DG									NPS,SED,HAB
Dineen Park Pond T7 R21E 10	8600	Milwaukee	2	5		DG			X	EM					MAC,ALG,DO
Drzewiceki Lake T10 R21E 03	8700	Ozaukee	2	17		SP									MAC,DO
Estabrook Park Lagoon T7 R22E 04	8800	Milwaukee	1	6	X	DG				EM					DO,MAC,SED
Fromm Pit T09 R21E 10	9000	Ozaukee	4	28		SP									
Grafton Millpond T10 R21E 24	26200	Ozaukee	25	8	BR	DG									NPS,SED,MAC,DO
Haneman Lake T10 R21E 03	26400	Ozaukee	6	18		SE	Y								DO,MAC
Hansen Lake T11 R21E 04	26900	Ozaukee	6	9		SE	Y								DO,MAC
Hawthorne Hills Pond T11 R21E 03	9300	Ozaukee	0												
Juneau Park Lagoon T7 R22E 28	44600	Milwaukee	11	6/4	X	DG									
Lime Kiln Millpond T10 R21E 25	25800	Ozaukee	4	7	T	DG									NPS,SED,HM,HAB
Linden Pond T8 R22E 07	10100	Milwaukee	2	15		SP				EM					MAC,ALG,DO
McGovern Park Pond T8 R21E 35	10300	Milwaukee	5	5/3	X	DG				EM					MAC,ALG,DO
Mee-Quon Park Pond T09 R21E 10	20800	Ozaukee	0												
Milwaukee Harbor Outer T07 R22E 33	15010	Milwaukee	0												
Milwaukee R -Lincoln Park Lagoon T08 R22E 32	19300	Milwaukee	0												URB,NPS,HM,TOX,SED,DO
Pit Lake T09 R22E 07	11200	Ozaukee	35	14		SE									SED,HAB

NAME/ LOCATION	WBIC	County	AREA (acres)	Max/ Mean Depth	Access	Lake Type	Winter kill	SH	Hg	MAC	LMO	PLAN OR PROT	P SENS	TSI	Comments
Theinsville Millpond T09 R21E 23	21000	Ozaukee	45	8	BR	DG									NPS,SED,MAC,HM,HAB
Washington Park Pond T7 R21E 23	14400	Milwaukee	11	5/3	X	DG			X	EM					

Appendix C. Rare Plants, Animals and Communities in the Milwaukee River Basin.

Common Name	Type	Status
Regal Fritillary	Butterfly	Endangered
Swamp Metalmark	Butterfly	Endangered
Striped Shiner	Fish	Endangered
Blanchard's Cricket Frog	Frog	Endangered
Bluestem Goldenrod	Plant	Endangered
Cooper's Milkvetch	Plant	Endangered
Giant Pinedrops	Plant	Endangered
Harbinger-Of-Spring	Plant	Endangered
Purple False Oats	Plant	Endangered
Purple Milkweed	Plant	Endangered
False Hop Sedge	Plant	Endangered
Heart-Leaved Plantain	Plant	Endangered
Hemlock Parsley	Plant	Endangered
Prairie White-Fringed Orchid	Plant	Endangered
Ravenfoot Sedge	Plant	Endangered
Queen Snake	Snake	Endangered
Acadian Flycatcher	Bird	Threatened
Kentucky Warbler	Bird	Threatened
Cerulean Warbler	Bird	Threatened
Hooded Warbler	Bird	Threatened
Red-Shouldered Hawk	Bird	Threatened
Greater Redhorse	Fish	Threatened
Longear Sunfish	Fish	Threatened
Pugnose Shiner	Fish	Threatened
Redfin Shiner	Fish	Threatened
Ellipse	Mussel	Threatened
Clustered Broomrape	Plant	Threatened
Dwarf Lake Iris	Plant	Threatened
Forked Aster	Plant	Threatened
Handsome Sedge	Plant	Threatened
Pale Green Orchid	Plant	Threatened
Prairie Parsley	Plant	Threatened
Snow Trillium	Plant	Threatened
Yellow Gentian	Plant	Threatened
Bog Bluegrass	Plant	Threatened
Ram's-Head Lady's-Slipper	Plant	Threatened
Round-Leaved Orchis	Plant	Threatened
Slenderleaf Sundew	Plant	Threatened
Small White Lady's-Slipper	Plant	Threatened
Sticky False-Asphodel	Plant	Threatened
Butler's Garter Snake	Snake	Threatened
Blanding's Turtle	Turtle	Threatened
Northern Harrier	Bird	Special Concern
Broad-Winged Skipper	Butterfly	Special Concern

Common Name	Type	Status
Dion Skipper	Butterfly	Special Concern
Great Copper	Butterfly	Special Concern
Little Glassy Wing	Butterfly	Special Concern
Mulberry Wing	Butterfly	Special Concern
Prairie Crayfish	Crustacean	Special Concern
Amber-Winged Spreadwing	Dragonfly	Special Concern
Elegant Spreadwing	Dragonfly	Special Concern
Gilded River Cruiser	Dragonfly	Special Concern
Great Spreadwing	Dragonfly	Special Concern
Green-Striped Darner	Dragonfly	Special Concern
Slaty Skimmer	Dragonfly	Special Concern
Slender Bluet	Dragonfly	Special Concern
Swamp Spreadwing	Dragonfly	Special Concern
Unicorn Clubtail	Dragonfly	Special Concern
Bloater	Fish	Special Concern
American Eel	Fish	Special Concern
Banded Killifish	Fish	Special Concern
Lake Chubsucker	Fish	Special Concern
Least Darter	Fish	Special Concern
Redside Dace	Fish	Special Concern
Weed Shiner	Fish	Special Concern
Buck Moth	Moth	Special Concern
American Gromwell	Plant	Special Concern
American Sea-Rocket	Plant	Special Concern
Autumn Coral-Root	Plant	Special Concern
Christmas Fern	Plant	Special Concern
Cuckooflower	Plant	Special Concern
Great Indian-Plantain	Plant	Special Concern
Hairy Beardtongue	Plant	Special Concern
Heart-Leaved Skullcap	Plant	Special Concern
Hooker Orchis	Plant	Special Concern
Large Roundleaf Orchid	Plant	Special Concern
Marbleseed	Plant	Special Concern
One-Flowered Broomrape	Plant	Special Concern
Reflexed Trillium	Plant	Special Concern
Seaside Spurge	Plant	Special Concern
Slender Sedge	Plant	Special Concern
Smooth Black-Haw	Plant	Special Concern
Twinleaf	Plant	Special Concern
Wafer-Ash	Plant	Special Concern
Capitate Spikerush	Plant	Special Concern
Common Bog Arrow-Grass	Plant	Special Concern
Downy Willow-Herb	Plant	Special Concern
Few-Flower Spikerush	Plant	Special Concern
Green Arrow-Arum	Plant	Special Concern
Leafy White Orchis	Plant	Special Concern
Lesser Fringed Gentian	Plant	Special Concern
Livid Sedge	Plant	Special Concern

Common Name	Type	Status
Many-Headed Sedge	Plant	Special Concern
Marsh Blazing Star	Plant	Special Concern
Northern Bog Sedge	Plant	Special Concern
Ohio Goldenrod	Plant	Special Concern
Showy Lady's-Slipper	Plant	Special Concern
Slim-Stem Small-Reedgrass	Plant	Special Concern
Small Yellow Lady's-Slipper	Plant	Special Concern
Sparse-Flowered Sedge	Plant	Special Concern
Swamp-Pink	Plant	Special Concern
Tufted Hairgrass	Plant	Special Concern
Variegated Horsetail	Plant	Special Concern
Waxleaf Meadowrue	Plant	Special Concern
White Adder's-Mouth	Plant	Special Concern
Wild Licorice	Plant	Special Concern
Tapered Vertigo	Snail	Special Concern
Great Lakes Beach	Community	Rare
Northern Dry-Mesic Forest	Community	Rare
Northern Mesic Forest	Community	Rare
Southern Dry-Mesic Forest	Community	Rare
Southern Mesic Forest	Community	Rare
Bog Relict	Community	Rare
Calcareous Fen	Community	Rare
Emergent Aquatic	Community	Rare
Ephemeral Pond	Community	Rare
Floodplain Forest	Community	Rare
Hardwood Swamp	Community	Rare
Lake--Deep, Hard, Drainage	Community	Rare
Lake--Hard Bog	Community	Rare
Lake--Shallow, Hard, Drainage	Community	Rare
Lake--Shallow, Hard, Seepage	Community	Rare
Lake--Soft Bog	Community	Rare
Northern Wet Forest	Community	Rare
Northern Wet-Mesic Forest	Community	Rare
Open Bog	Community	Rare
Shrub-Carr	Community	Rare
Southern Hardwood Swamp	Community	Rare
Southern Sedge Meadow	Community	Rare
Spring Pond	Community	Rare
Springs And Spring Runs, Hard	Community	Rare
Stream--Fast, Hard, Cold	Community	Rare
Stream--Fast, Soft, Cold	Community	Rare
Stream--Slow, Hard, Cold	Community	Rare
Stream--Slow, Hard, Warm	Community	Rare
Tamarack Fen	Community	Rare
Lake--Shallow, Soft, Seepage	Community	Rare

Appendix D. Communities and Organizations Participating in Urban Forestry Programs

Community or Organization	WDNR Urban Forestry Participant	Tree City USA Participant
Brown Deer	X	X
Butler	X	X
Cedarburg	X	X
City of Brookfield	X	
Elm Grove	X	X
Fox Point	X	X
Fredonia	X	X
Germantown	X	
Grafton,	X	X
Glendale	X	X
Greendale	X	X
Greenfield	X	X
Greening Milwaukee – MCSC	X	
Jackson		X
Kewaskum	X	
Menomonee Falls	X	X
Mequon	X	X
Milwauee DCD-OYI	X	
Milwaukee	X	X
Milwaukee County Parks	X	
Milwaukee OYI	X	
Milwaukee Zoological Society	X	
River Hills	X	
Saukville	X	X
Shorewood	X	X
South Milwaukee	X	
South Milwaukee	X	
South Milwaukee Women's Club	X	
St. Francis	X	
The Park People	X	
Town of Brookfield	X	
Wauwatosa	X	
West Allis		X
West Bend	X	
Whitefish Bay		X
Wisconsin Arborists Association	X	