The State of the Southeast Fox River Basin

February, 2002

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

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To: Recipients of *The State of the Southeast Fox River Basin* Report

We are pleased to present our first *State of the Southeast Fox 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 Southeast Fox River Basin. The report is the result of a team effort by staff from a variety of programs within the Department and the Fox River Partnership Team. We would like to thank all of those who contributed their time and expertise to this project.

The information in 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.

Internet links and phone numbers are provided throughout the report so readers wanting more detail on the resources and issues in the basin can easily find the information. As objectives are met and projects are completed, we will provide updates on our Southeast Fox River Basin Internet page at www.dnr.state.wi.us/org/gmu/foxil/. Our goal is to publish an updated plan every five years.

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 Southeast Fox River Basin.

Sincerely,

Jim D'Antuono
Southeast Fox Basin Water Leader

Jim McNelly
Southeast Fox Basin Land Leader

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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/foxil/index.htm

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Summary

The rivers, lakes, groundwater and lands in the Southeast Fox River Basin sustain a wide range of plant and animal life (Figure 1). From the undeveloped rural areas 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.

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 Southeast Fox 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. These components are listed below along with cross references to chapters and appendices. This plan specifically

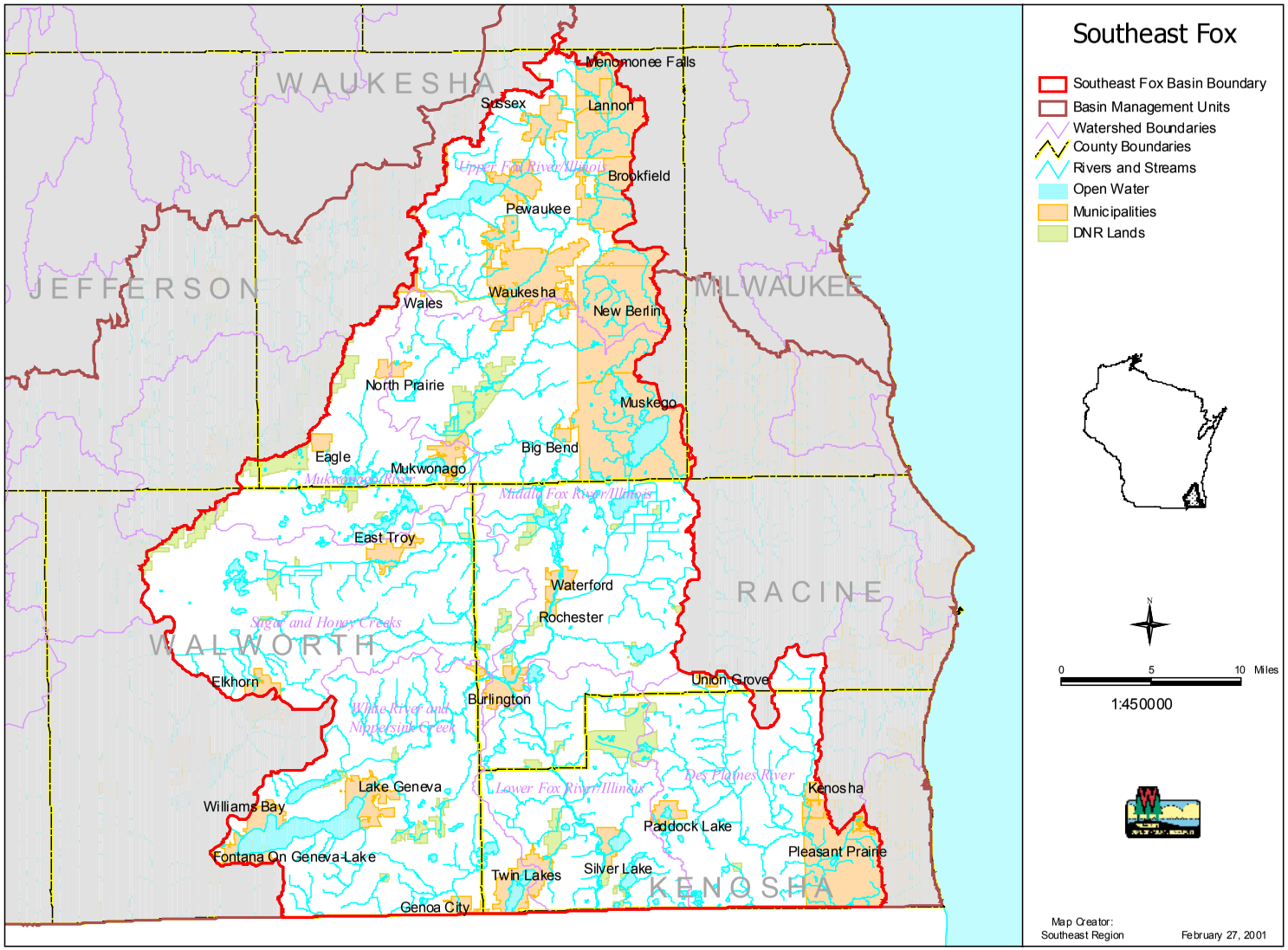
- ✧ Provides an overview of the quality of our land and water resources and our relationships with these resources. **Chapter 1 (page 1), Chapter 2 (page 2), and Chapter 3 (page 39).**

- ✧ 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 2), Chapter 3 (page 39), Appendix A (page 70), Appendix B (page 93).**

- ✧ 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 60), Chapter 5 (page 62).**

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

Figure 1. Southeast Fox River Basin

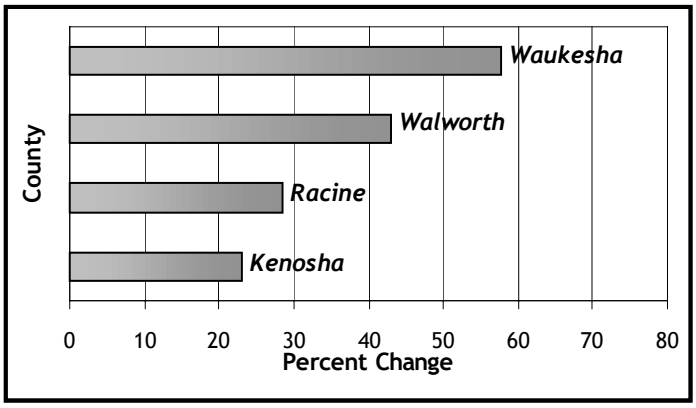


Chapter 1: The Southeast Fox River Basin Overview

The Southeast Fox River Basin is located in portions of seven counties, contains (entirely or portions of) 10 cities, 22 villages, 42 towns, and is home to about 500,000 people. The basin is divided into seven watersheds. Three of the watersheds (Upper, Middle and Lower Fox River) contain the Fox River from start to finish and collectively occupy nearly half the basin area (513 square miles). The other watersheds are named after the major rivers they contain. Collectively the seven watersheds contain about 750 miles of perennial streams, over 600 miles of intermittent streams, 78 named lakes and impoundments and many unnamed lakes and ponds. Wetlands encompass nearly 78,000 acres, or 11 percent of the basin land area.

The Natural Heritage Inventory (WDNR, 2000) has documented 23 endangered, 26 threatened and 70 special concern plant and animal species and 30 rare aquatic and terrestrial communities within the basin (Appendix C, page 103). The Southeastern Wisconsin Regional Planning Commission (SEWRPC) identified over 19,000 acres of high quality natural communities and critical species habitats remaining in the basin (SEWRPC, 1997). About five percent of the land area of the basin is covered by urban uses. Forested areas, wetlands and agriculture are the dominant rural land cover types (WISCLAND land cover data).
Population size of the basin has grown overall by about 43 percent since 1970. Population by county has also changed dramatically since 1970 as more people moved to rural areas (Figure 2). By contrast Milwaukee County lost about seven percent of its population (over 70,000 people) during the same time frame. Waukesha County gained nearly 120,000 people since 1970.

Figure 2. Percent Population Change in Fox River Basin Communities by County: 1970-2000.



The entire population of the Southeast Fox River Basin 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 three percent of the basin (19,000 acres) land resources are under state ownership. The Southern Unit of the Kettle Moraine State Forest, Bong Recreation Area and Vernon Marsh Wildlife Area are the largest state holdings in the basin. In addition several county and local parks provide a wide 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: Southeast Fox River Basin Water Resources

The water resources in the Southeast Fox 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 Bluff Creek and Genesee Creek 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.

SURFACE WATER RESOURCES

The Fox River Basin contains nearly 700 miles of streams draining over 1000 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.

Portions of four streams (9.2 total stream miles) and two lakes within the Southeast Fox River Basin are designated as outstanding or exceptional resource waters (Table 1). 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. ***For more information about outstanding and exceptional resource waters please call the state ORW/ERW coordinator at (608) 266-9270.***

Table 1. Streams and Lakes Designated Outstanding or Exceptional Resource Waters

Waterbody Name	Watershed Name	ORW or ERW	Miles
Genesee Creek	Middle Fox River	Exceptional	2.6
Spring Lake	Middle Fox River	Outstanding	N/A
Mukwonago River	Mukwonago River	Exceptional	4.9
Lulu Lake	Mukwonago River	Outstanding	N/A
Potawatomi Creek	White River/Nippersink Creeks	Outstanding	1.1
Van Slyke Creek	White River/Nippersink Creeks	Outstanding	0.6

Streams that do not meet water quality standards on a consistent basis make up about seven percent of the perennial stream miles in the basin. Nearly all of these stream miles are from the Upper Fox River and Sugar-Honey Creeks watersheds. 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 56 miles of streams and two lakes are included on this list (Table 2). 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 2. Southeast Fox River Basin Streams and Lakes Included on 303(d) List

Waterbody Name	Watershed	Miles affected	Reason for Listing*
Spring Creek	Sugar-Honey Creeks	6.3	HAB, NPS
North Branch Spring Brook	Sugar-Honey Creeks	2.1	HAB, NPS
Various Unnamed Streams	Sugar-Honey Creeks	10.5	HAB, NPS
Little Muskego Lake	Middle Fox River	N/A	NPS
Wind Lake	Middle Fox River	N/A	NPS
Barstow Impoundment (Fox River)	Upper Fox River	4.0	HAB, NPS, PS
Fox River above Brookfield WWTP	Upper Fox River	6.5	HAB, NPS, PS
Fox River (Barstow Impoundment to Brookfield WWTP)	Upper Fox River	4.2	HAB, NPS, PS
Fox River below Barstow Impoundment	Upper Fox River	4.0	HAB, NPS, PS
Fox River (Master Disposal Drainage Canals)	Upper Fox River	1.0	SED
Frame Park Creek	Upper Fox River	2.5	HAB, NPS
Poplar Creek	Upper Fox River	7.5	NPS
Zion Creek	Upper Fox River	1.5	HAB, NPS
Various Unnamed Streams	Upper Fox River	5.5	HAB, NPS

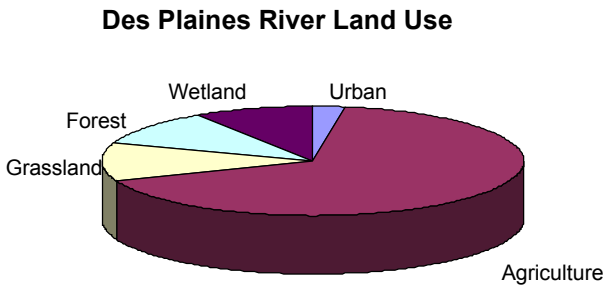
***Abbreviation Key**
HAB = habitat loss
NPS = nonpoint source impacts
PS = point source impacts
SED = contaminated sediment

The following sections give a watershed by watershed overview of the surface water resources within the Southeast Fox River Basin. Additional information for each perennial stream and named lake within the basin is included in Appendices A (page 70) and B (page 93).

Des Plaines River Watershed

The Des Plaines River Watershed lies mainly in Kenosha County, with a small portion in Racine County (Figure 4). Portions of the City of Kenosha and the Villages of Paddock Lake, Pleasant Prairie and Union Grove are the communities found here.

Figure 3. Des Plaines River Watershed Land Cover.



The majority of the land cover in the watershed is agricultural (62%), with grasslands (11%), forests (10%) and wetlands (8%) making up the rest of the rural land uses. Urban uses cover approximately two percent of the land area in the watershed (Figure 3).

There are approximately 85 miles of perennial streams in the watershed. There are no streams listed on the state's 303(d) list . Due to heavy agricultural land use, some stream reaches in this basin are affected by increased nutrient loads, increased sediment loads, drain tile impacts and historic ditching. Since pre-settlement times, many of the wetland areas have been filled or tiled to provide for more agriculture. Some areas of this basin still contain pirate perch, which are relatively rare in the state and historically found in this watershed. For more information about the streams in the Des Plaines River Watershed, please see Appendix A (page 70).

At 154 acres, Lake Shangrila-Benet is the largest of the lakes in the watershed. George, Montgomery and Paddock Lakes have participants in the Self Help Lake Monitoring Program. See Appendix B (page 93) for more information about the lakes and ponds in the watershed.

Figure 4. Des Plaines River Watershed

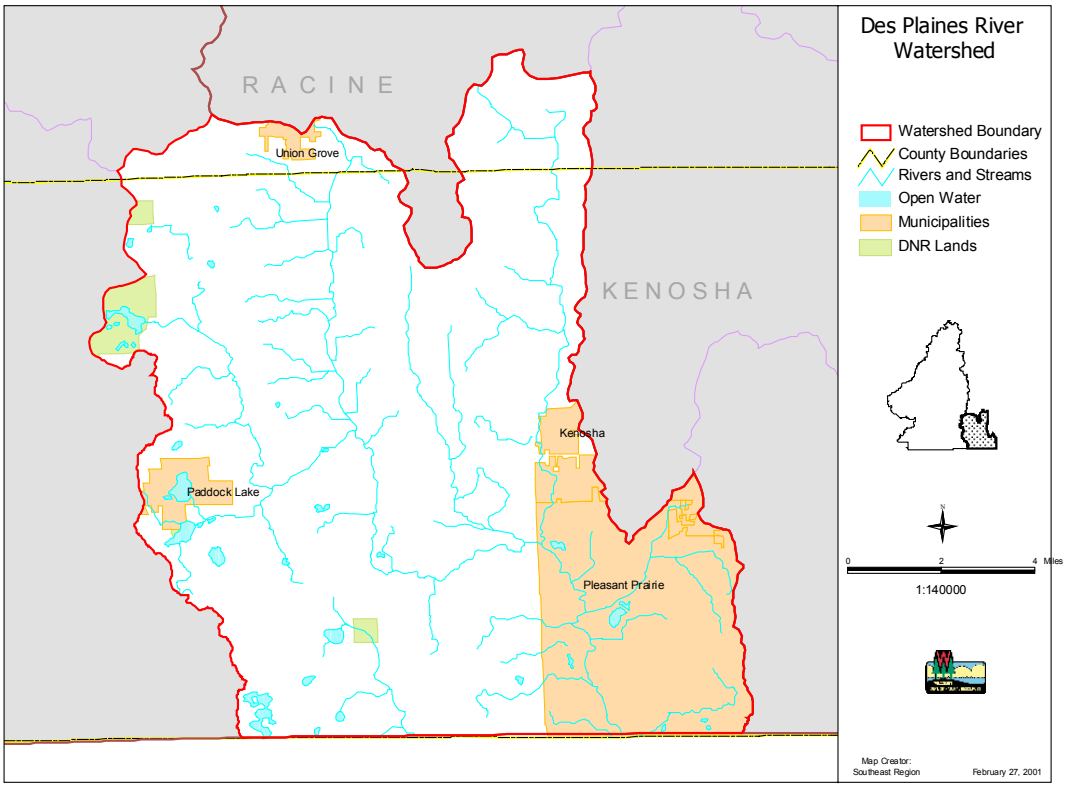
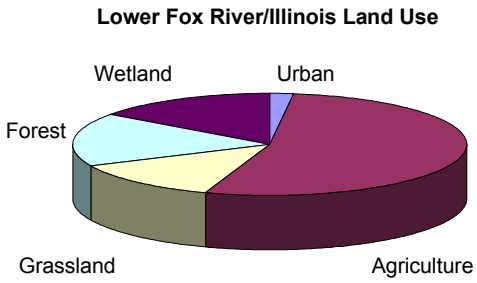


Table 3. Des Plaines River Watershed At A Glance	
Watershed drainage area (Square miles)	133
Miles of streams	69
Miles of streams listed as outstanding or exceptional resource waters	0
Miles of streams or number of lakes on impaired waters list	0
General threats to stream water quality	■ Agricultural and urban runoff ■ Excess nutrients
Number of named lakes	12 named lakes and several ponds.
Threats to lake water quality	■ Heavy shoreline development. ■ Heavy transient pressure. ■ Agricultural and urban runoff. ■ Excess nutrients.

Lower Fox River Watershed

The Lower Fox River Watershed lies in parts of Racine and Kenosha Counties, with a very small portion falling in Walworth County (Figure 6). The City of Burlington and the Villages of Silver Lake and Twin Lakes are the incorporated areas in this watershed.

Figure 5. Lower Fox River Watershed Land Cover.



Rural uses cover most of the land area in this watershed. Agriculture is dominant, covering about 47 percent of the land area, followed by forests (15%), wetlands (13%) and grasslands (11%). Urban uses cover fewer than two percent of the land area (Figure 5).

There are over 90 miles of perennial streams within the watershed. The main branch of the Fox River dominates the area. At this point the Fox is a large river and can carry considerable amounts of water. Small streams in this sub-basin include Hoosier Creek, Wind Lake Canal and Eagle Creek. These small streams drain into the main branch of the Fox and in areas are heavily impacted by agriculture, tiling and ditching. The main stem carries the impacts from the large watershed above and experiences bank erosion and sometimes-flashy water level conditions.

The Fox River still supports a modest fishery with many different forage and game species present. There is a diverse and relatively abundant mussel population in the Fox River that should be thoroughly studied.

No streams in this watershed are listed on the 303(d) list. Agriculture, ditching, development, impoundments, industrial discharges and stormwater runoff are the main impacts to the resources in this area. Implementation of conservation practices and restoration in the sub-basins that feed the Fox River would have positive impacts on the resources that eventually cross the border to our south. For more information about the streams in this watershed, please see Appendix A (page 70).

There are thirteen lakes in the watershed, the largest being Silver Lake in Kenosha County (464 acres). Six lakes have participants in the Self Help Lake Monitoring Program. For more information regarding the lakes in the Lower Fox River Watershed please see Appendix B (page 93).

Figure 6. Lower Fox River Watershed

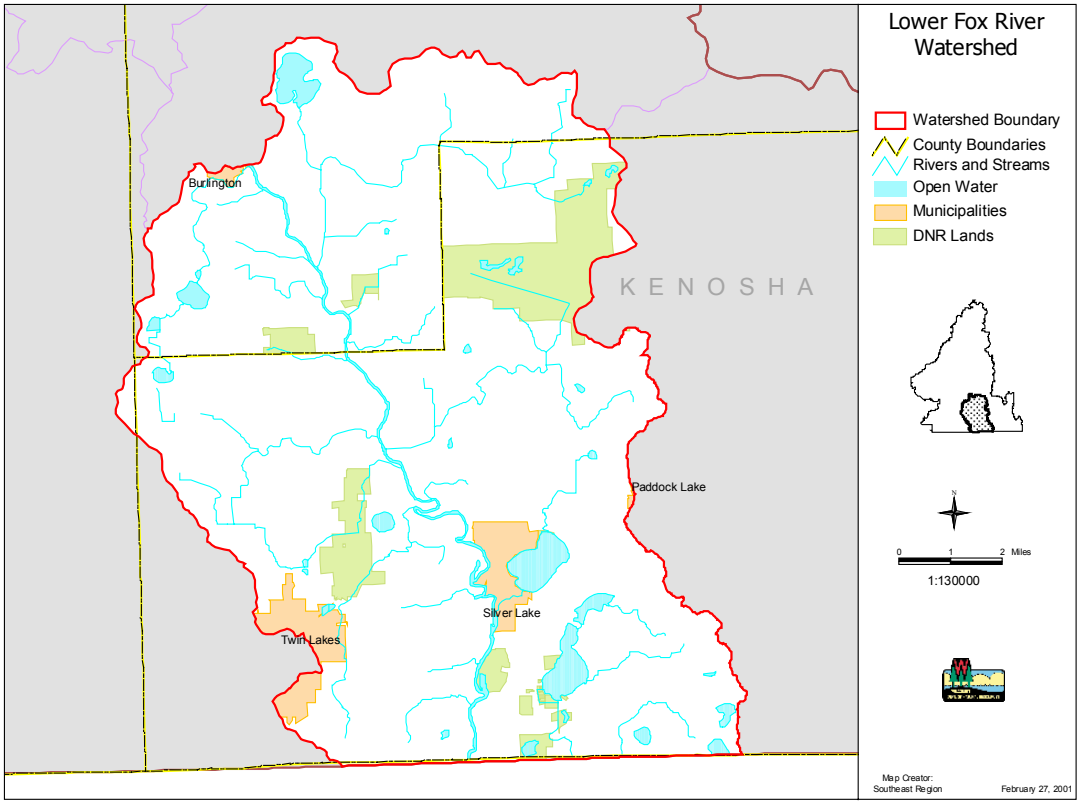


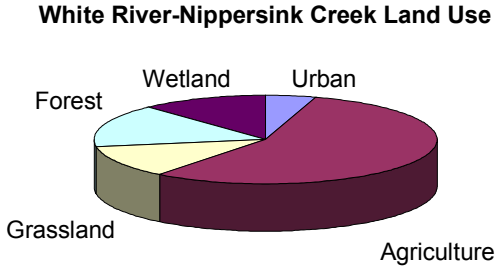
Table 4. Lower Fox River Watershed At A Glance	
Watershed drainage area (Square miles)	114
Miles of streams	92
Miles of streams listed as outstanding or exceptional resource waters	0
Miles of streams or number of lakes on impaired waters list	0
General threats to stream water quality	■ Ditching, channelization ■ Industrial point source discharge ■ Gravel pit ■ Urban and agricultural runoff.
Number of named lakes	13 named lakes
Threats to lake water quality	■ Eurasian water milfoil. ■ Zebra mussels. ■ Heavy recreational use. ■ Heavy shoreline development. ■ Loss of habitat.

White River and Nippersink Creek Watershed

This watershed lies mainly in Walworth County, with small portions falling in Kenosha and Racine Counties (Figure 8). Portions of the Cities of Burlington and Lake Geneva lie within the watershed, along with the Villages of Fontana-on-Geneva Lake, Genoa City, Twin Lakes and Williams Bay.

Rural uses cover most of the land area in this watershed (Figure 7). Agriculture is dominant, covering about 47 percent of the land area, followed by forests (13%), wetlands (10%) and grasslands (10%). Urban uses cover almost four percent of the land area.

Figure 7. Land Cover in White River/Nippersink Creek Watershed.



There are over 120 miles of perennial streams in the watershed. No streams are included on the 303(d) list.

The White River originates from Geneva Lake and has a population of longear sunfish, a state threatened species. Geneva Lake has several tributaries that contain populations of brown trout. The Nippersink River is a good warm water resource that contains large populations of forage and gamefish species. The mussel populations in this system include the state threatened ellipse.

Impacts are mainly from agriculture, development, channelization and impoundments. In recent years there have been increased impacts from development in this area. Best management practices for agriculture are recommended to help decrease sedimentation and nutrient impacts. Implementation of buffer strips and returning the channel to pre-ditching/natural conditions could have positive effects on the resources in this basin. For more information on the streams in this watershed, please see Appendix A (page 70).

There are nine lakes in the watershed ranging in size from 5,262 acres (Geneva Lake) to 35 acres (Tombeau Lake). There are three lakes with participants in the Self Help Lake Monitoring Program. For more information on the lakes in this watershed, please see Appendix B (page 93).

Figure 8. White River and Nippersink Creek Watershed

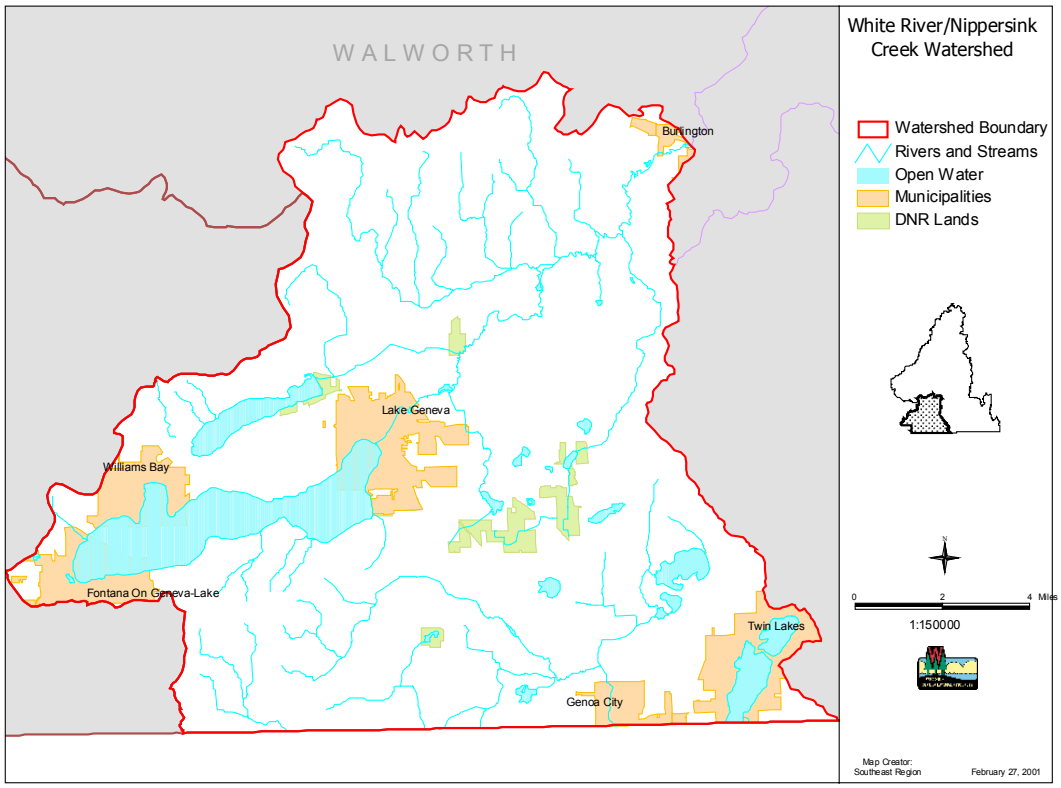


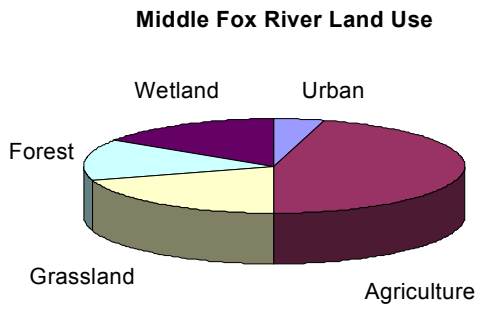
Table 5. White River and Nippersink Creek Watershed At A Glance	
Watershed drainage area (Square miles)	168
Miles of streams	128
Miles of streams listed as outstanding or exceptional resource waters	
Miles of streams or number of lakes on impaired waters list	0
General threats to stream water quality	■ Urban and agricultural runoff ■ Habitat modification ■ Ditching/channelization
Number of named lakes	9 named lakes
Threats to lake water quality	■ Exotic species. ■ Excess nutrients. ■ Heavy boating pressure. ■ Stormwater runoff. ■ Shoreline development. ■ Septic systems.

Middle Fox River Watershed

The Middle Fox River Watershed is the largest of the Fox River Basin watersheds (248 square miles), encompassing portions of Racine and Waukesha Counties, along with a very small portion of Walworth County (Figure 10). Portions of the Cities of Burlington, Muskego, New Berlin and Waukesha lie within the watershed, along with the Villages of Big Bend, Mukwonago, North Prairie, Rochester, Wales and Waterford.

Land cover in the watershed is primarily rural, with agricultural (41%). Other rural uses include grasslands (18%), wetlands (14%) and forests (13%). Urban areas comprise nearly four percent of the land cover in the watershed (Figure 9).

Figure 9. Land Cover in Middle Fox River Watershed.



There are nearly 200 miles of perennial streams in this watershed. Genesee Creek, Mill Brook, Brandy Brook, Pebble Creek, Pebble Brook and Spring Creek are listed as cold water communities. Genesee and Spring Creeks are brook and brown trout fisheries, while the rest contain cold water communities composed of mottled sculpin and American brook lampreys.

No streams in the watershed are listed on the 303(d) list. The main impacts to streams in this watershed include agricultural, development, sedimentation, channelization, elevated temperatures and stormwater runoff.

It is recommended that dam removal and habitat improvements be implemented to improve existing conditions. Where practical, habitat restoration and buffer implementation should be employed to provide multiple benefits including bank stabilization, water quality, fisheries, reduced sedimentation and nutrient loading. For more information about the streams in this watershed, please see Appendix A (page 70).

The largest of the 19 lakes in the watershed is Big Muskego Lake with 2,260 acres. This lake is undergoing intensive management following the principles of "biomanipulation" to improve water quality not only within the lake, but further downstream to Wind Lake and the Fox River. This project included removing rough fish such as carp and bullheads and establishing desirable rooted and emergent aquatic plants. The plants use the nutrients for growth making them unavailable for excessive algae growth and transport to the water column and further downstream. Keeping abundant rooted vegetation and high levels of predator fish maximizes water clarity, grows plants desirable to waterfowl. In addition to the water quality benefits, achieving a more balanced ecosystem for the lake will also maximize opportunities for fishing and other forms of recreation.

This type of lake management is very difficult to achieve on a shallow lake like Big Muskego. The soft bottom sediments are susceptible to disturbance by winds, which leads to decreased water clarity, increased nutrient availability, excessive algae growth, and dissolved oxygen fluctuations. These conditions are highly favorable to carp which further degrade the system by their bottom feeding habits.

Constant observation and management may be necessary to maintain the balanced environment created by the 1996 drawdown, reseeding and rough fish removal restoration project on Big Muskego Lake.

Denoon and Eagle Lakes have participants in the Self Help Lake Monitoring Program. For more information on the lakes in the watershed see Appendix B (page 93).

Figure 10. Middle Fox River Watershed

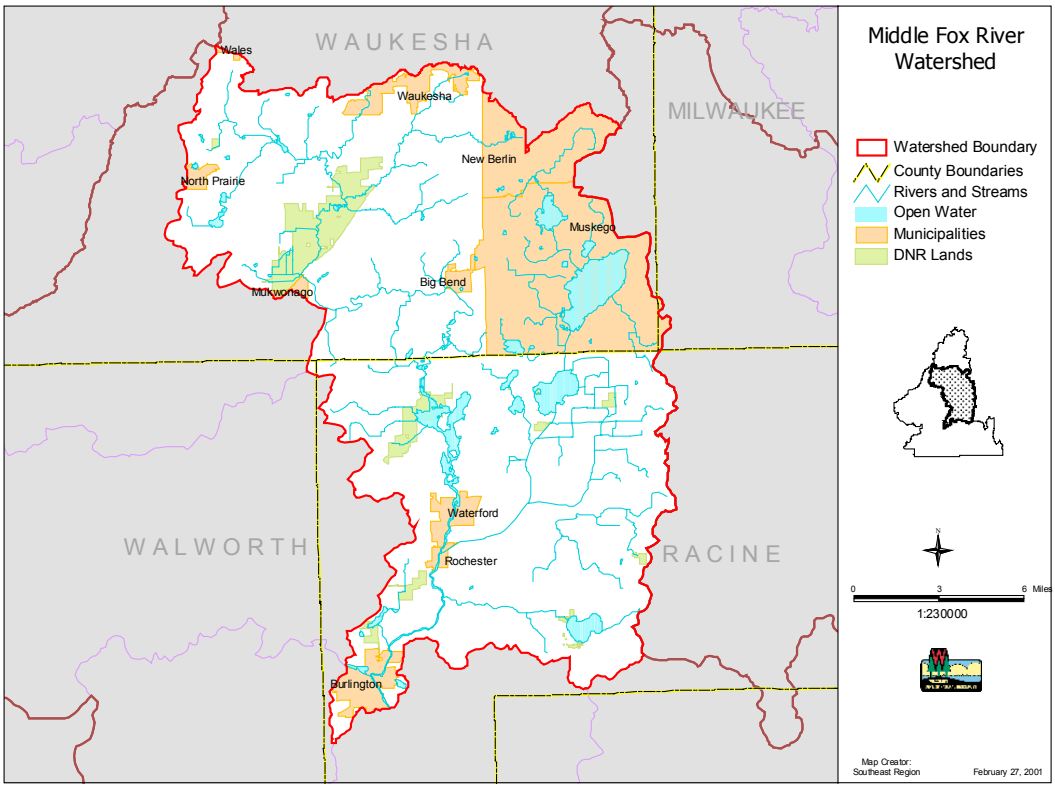


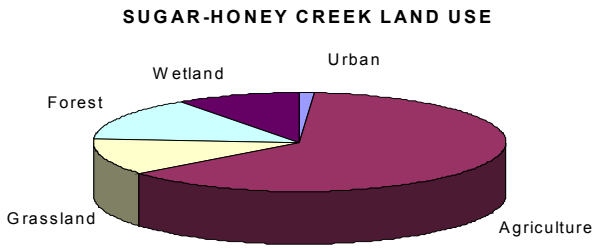
Table 6. Middle Fox River Watershed At A Glance	
Watershed drainage area (Square miles)	248
Miles of perennial streams	191
Miles of streams listed as outstanding or exceptional resource waters	2.6, plus one lake
Miles of streams or number of lakes on impaired waters list	0
General threats to stream water quality	■ Construction site erosion ■ Habitat modification ■ Ditching/channelization ■ Elevated temperatures
Number of named lakes	19 named lakes and several ponds
Threats to lake water quality	■ Historical ditching. ■ Agricultural runoff. ■ Stormwater runoff. ■ Exotic species. ■ Dams.

Sugar and Honey Creeks Watershed

The Sugar-Honey Creeks Watershed covers about 170 square miles and is located in portions of Walworth and Racine Counties (Figure 12). The majority of the watershed (approximately 90%) lies within Walworth County, with the balance in Racine County. Sugar and Honey Creeks come together at the Honey Lake impoundment. Honey Creek continues for a short distance and empties into Echo Lake, which is the downstream limit of the watershed.

Land cover is primarily rural, with agriculture dominant (58%). Forests cover over 13 percent of the land area, while grasslands (11%) and wetlands (9%) represent the other major rural uses. Urban lands cover just over one percent of the land area (Figure 11). The City of Elkhorn and Village of East Troy lie within the watershed.

Figure 11 Land Cover in Sugar and Honey Creeks Watershed..



The Sugar-Honey Creeks Watershed contains over 100 miles of perennial streams. Nearly 19 miles of streams in the watershed are on the 303(d) list. Although these streams are heavily impacted by agriculture, they still maintain a fairly high diversity of warm water forage and game fish species. The main impacts to these streams include agriculture, development, channelization and impoundments. Best management practices in agriculture should be considered to reduce the sedimentation and nutrient impacts. In addition, where possible, habitat restoration and implementation of buffer strips should be considered to help enhance bank stabilization, fish populations and water quality. For more information on the streams of the Sugar and Honey Creeks Watershed, please see Appendix A (page 70).

At 311 acres, Green Lake is the largest of the eleven lakes in the watershed. For more information on the lakes and ponds in the Sugar/Honey Creek Watershed, please see Appendix B (page 93).

Figure 12. Sugar and Honey Creeks Watershed

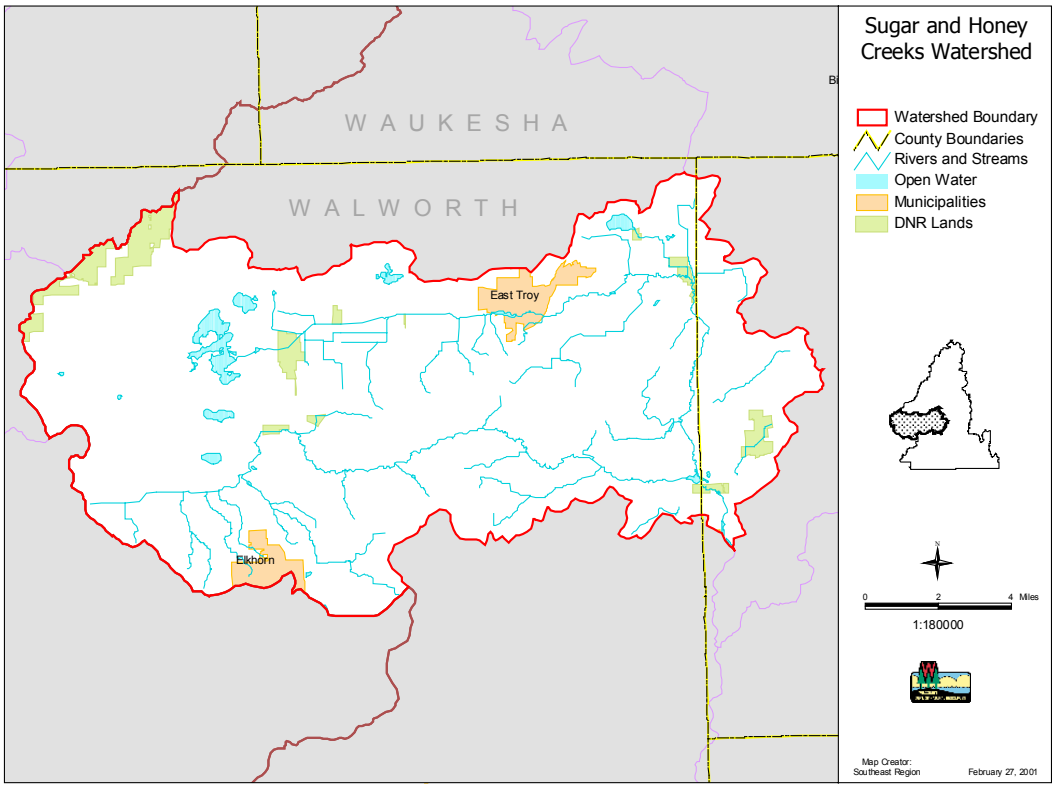


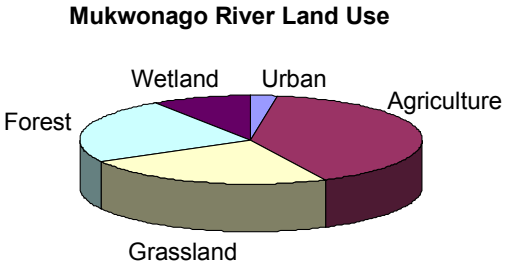
Table 7. Sugar and Honey Creeks Watershed At A Glance	
Watershed drainage area (Square miles)	166
Miles of streams	118
Miles of streams listed as outstanding or exceptional resource waters	0
Miles of streams or number of lakes on impaired waters list	19
General threats to stream water quality	■ Agricultural and urban runoff ■ Ditching/channelization ■ Hydrologic modification ■ Construction site erosion ■ Streambank erosion
Number of named lakes	11 named lakes
Threats to lake water quality	■ Agricultural runoff. ■ Exotic species. ■ Historical ditching.

Mukwonago River Watershed

The Mukwonago River Watershed is the smallest of the Fox River Basin watersheds (86 square miles) and lies mainly in Walworth and Waukesha Counties, with a small portion falling in Jefferson County (Figure 14). The Villages of Eagle, Mukwonago, North Prairie and Wales lie within the watershed.

Rural uses cover most of the land area in the watershed. Agriculture is dominant, covering about 37 percent of the land area, followed by grasslands (22%), forests (22%) and wetlands (9%). Urban uses account for approximately two percent of the land area (Figure 13).

Figure 13. Land Cover in Mukwonago River Watershed.



There are nearly 50 miles of perennial streams in the watershed. Jericho Creek in the Town of Eagle and an unnamed ditch in the Town of Mukwonago are listed as supporting a cold water aquatic community. The Mukwonago River is listed as an outstanding resource water in the state. None of the streams in the watershed are listed as impaired on the 303(d) list.

This may be the least disturbed watershed in the Southeast Fox River Basin. There are diverse and unique populations of warm water forage fish, game fish, mussels, amphibians and invertebrates. Development of this watershed has increased rapidly in the past five to ten years. Impervious surfaces are becoming more abundant and stormwater runoff is increasing. Many of the historic areas that supported agriculture are now supporting suburban housing development. For more information about the streams in this watershed, please see Appendix A (page 70).

There are fifteen lakes in the watershed, the largest being Lake Beulah (834 acres) in Walworth County. For more information on the lakes in the watershed, please see Appendix B (page 93).

The Southeast Fox Partnership Team has taken an active interest in preserving remaining high quality, undeveloped lands and water features. Within the Southeast Fox Basin the Mukwonago River watershed has outstanding remaining natural features the Partnership considers worthy of preservation. Networking with other interested parties, the Partnership anticipates developing a strategy that will preserve these key natural resource features for future generations to study, use and enjoy. Please see page (60) for more information about the Partnership and their activities.

Figure 14. Mukwonago River Watershed

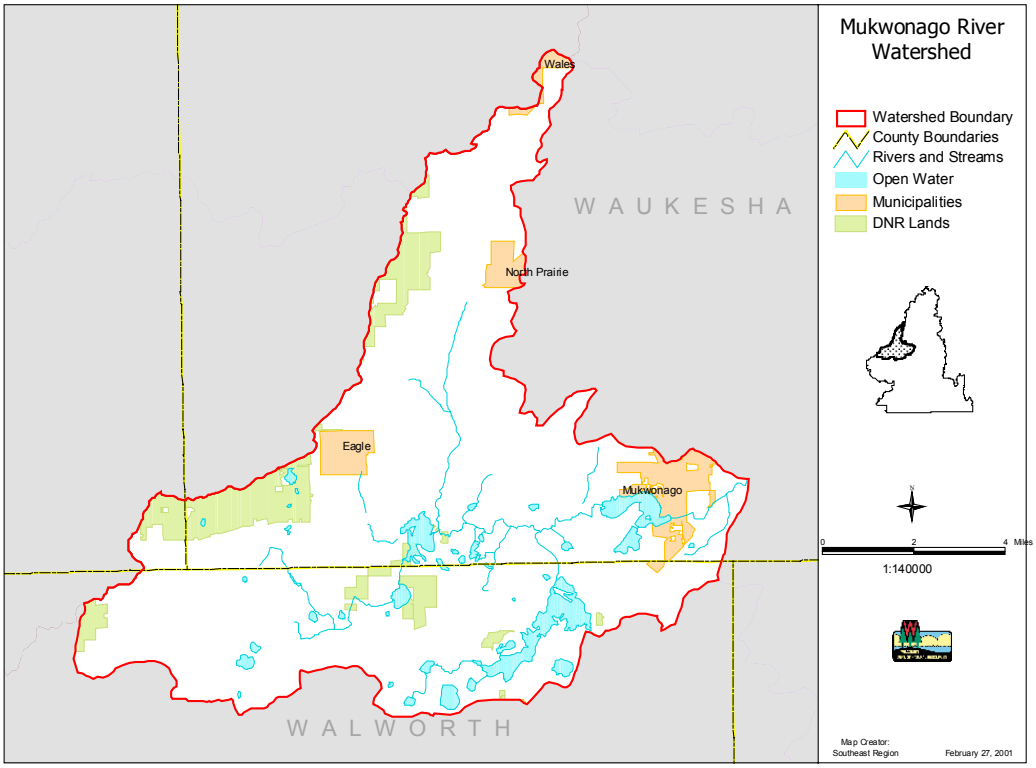


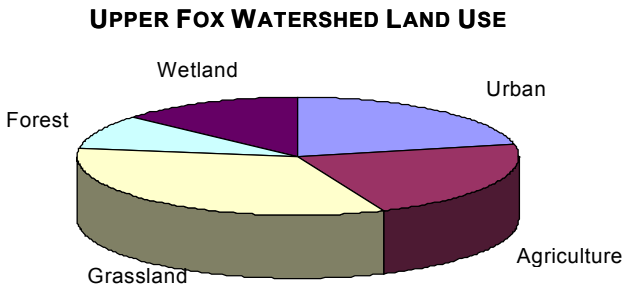
Table 8. Mukwonago River Watershed At A Glance	
Watershed drainage area (Square miles)	86
Miles of streams	49
Miles of streams listed as outstanding or exceptional resource waters	4.9, plus one lake
Miles of streams or number of lakes on impaired waters list	0
General threats to stream water quality	■ Dredging ■ Ditching, channelization ■ Irrigation ■ Agricultural and urban runoff
Number of named lakes	15 names lakes
Threats to lake water quality	■ Stormwater runoff ■ Exotic species ■ Agricultural and urban runoff

Upper Fox River Watershed

The Upper Fox River Watershed is located almost entirely in Waukesha County, with a very small portion located in Washington County (Figure 16). The Upper Fox River is the principal perennial stream in the watershed. Other significant perennial streams include Brandy Brook, Deer Creek, Pebble Creek, Pewaukee River, Poplar Creek and Sussex Creek.

The majority of the land cover is rural, with grasslands dominant (31%). Agriculture (21%), wetlands (12%) and forests (9%) represent the other major rural uses. Urban uses cover approximately twenty percent of the land area (Figure 15). There are many incorporated municipalities within the watershed including the Cities of Brookfield, Delafield, New Berlin, Pewaukee and Waukesha. Also included are the Villages of Hartland, Lannon, Menomonee Falls, Pewaukee, Sussex and Wales.

Figure 15. Land Cover in the Upper Fox River Watershed.



The Upper Fox River Watershed contains over 80 miles of perennial streams exhibiting a wide range of quality. The Fox River, Frame Park Creek and Zion Creek are listed as impaired waters on the state's 303(d) list.

Cocoa Creek, which flows into Pewaukee Lake, has the potential to support a cold water community. The Pewaukee River contains a fairly decent forage and gamefish population. Sussex Creek has been impacted by development and mining in the area. This area is severely impacted by development and by increases in the amount of impervious surfaces. This contributes to the "flashy" nature of the streams in this area. Impoundments contribute to decreased fish migration and degraded water quality. Please see Appendix A (page 70) for more information about the streams in this watershed.

At 2,493 acres, Pewaukee Lake is the only lake of significant size in the watershed. Information on Pewaukee Lake and the other small lakes and ponds in the watershed can be found in Appendix B (page 93).

Figure 16. Upper Fox River Watershed

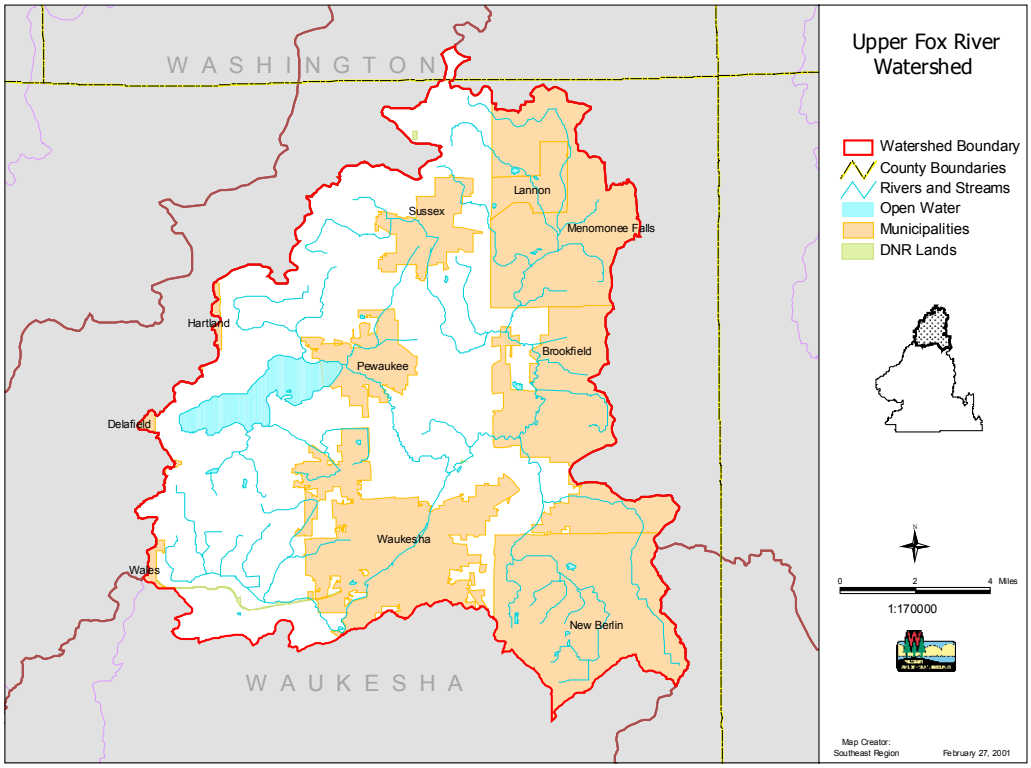


Table 9. Upper Fox River Watershed At A Glance	
Watershed drainage area (Square miles)	151
Miles of perennial streams	86
Miles of streams listed as outstanding or exceptional resource waters	0
Miles of streams or number of lakes on impaired waters list	25
General threats to stream water quality	■ Urban and agricultural runoff ■ Streambank erosion ■ Hydrologic modification ■ Habitat modification ■ Construction site erosion ■ Industrial and municipal point source discharge ■ Ditching, channelization
Number of named lakes	3 named lakes
Threats to lake water quality	■ Urban and agricultural runoff ■ Heavy shoreline development ■ Exotic species ■ Habitat modification

CHALLENGES TO SURFACE WATER QUALITY

Surface water quality in the Southeast Fox River Basin is mostly affected by the way we use the land. 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.

Industrial and Municipal Point Sources of Pollution

Within the Southeast Fox River Basin there are 449 industrial point sources, and 28 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 less than one percent. Nearly 80 percent of the industrial point sources are from industrial stormwater sites and construction sites which are discussed in the stormwater section (beginning on page 21).

General permits are given to industries for discharges that can be broadly categorized and regulated with standard conditions such as non-contact cooling water, non-metallic mining,

concrete products and hydrostatic test water. Non-contact cooling water is not mixed into materials to process a particular product, but rather water that is produced by cooling machinery, byproduct drainage or wash water from related operations. There are 37 industrial facilities collectively discharging between 0.3 and 28 million gallons of cooling water daily to surface and groundwater resources in the Southeast Fox River Basin, and over100 facilities discharging under other general permits in the basin.

Municipal wastewater treatment plants and some industries have specific permits for their waste treatment and discharge activities. Two municipal wastewater plants discharge treated wastewater to groundwater in the Southeast Fox River Basin, and the remaining 26 plants discharge an average of 35.8 million gallons of treated wastewater daily. Of this total, about 55 percent of the flows are discharged by the two largest facilities (Brookfield and Waukesha). Approximately 63,000 pounds of phosphorus is discharged per year by the municipal point sources, with the Brookfield and Waukesha treatment plants accounting for about 53 percent of the municipal phosphorus loading to the basin.

Sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs) to surface waters throughout the state have been receiving increased attention within the last two years. Combined sewer systems are unique to a portion the Milwaukee Metropolitan Sewerage District, and the City of Superior. Sewer overflows do occur statewide, 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, such as those in the Southeast Fox River Basin, 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. 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.

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 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 sewer and combined sewer overflows. The report (WDNR, 2001) contains a series of recommendations to be implement by the WDNR and communities throughout the state to address this issue. ***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 Upper Fox River and Honey Sugar Creeks Watersheds, and the smaller drainage areas surrounding Camp and Center Lakes, the Muskego Lakes and Wind Lakes were selected for participation 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, 1994; 1997). 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.

Barnyards and livestock feeding and some 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.. ***For more information on manure management and WDNR regulations, please contact the Southeast Region Animal Waste Specialist at (414) 263-8625.***

Urban

The Southeast Fox River Basin is rapidly urbanizing 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, oil and grease, pieces of pavement and vehicle tires, and fallout from chimneys and industrial smokestacks, which make it more toxic.

Construction Sites. Most of the sediment load to streams in urban areas comes from active construction sites (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 most sites greater than five acres in size, while the Wisconsin Department of Commerce regulates construction activities on remaining sites five acres or more and smaller lots. As of July 1, 2000, there were 279 active WDNR permitted construction sites in the Southeast Fox River Basin. The total land disturbance permitted was 7042 acres with an average land disturbance of 25 acres per construction site (range of five –312 acres). Residential construction accounted for 49 percent of the active WDNR permits, with other (recreational, institutional, governmental-18%), commercial (16%), industrial (8%), utility (7%) and transportation (2%) 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 Southeast Fox 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.

Municipal Stormwater Permitting. Many communities in Southeast Wisconsin are also responsible for controlling runoff from areas within their municipal boundaries. None of the communities within the Southeast Fox River basin are currently permitted for municipal stormwater, but 11 are in the application process that must be completed by September 2003. These communities are the City of Brookfield, Town of Brookfield, Town of Delafield, Town of Lisbon, Village of Menomonee Falls, City of New Berlin, City of Pewaukee, Village of Pewaukee, Village of Sussex, City of Waukesha and Town of Waukesha. These communities will be 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 keep pollutants from entering stormwater such as street sweeping, catch basin cleaning, and fertilizer reduction are preferred to those that treat polluted runoff, such as stormwater infiltration and detention and treatment tanks.

Some of the activities communities are implementing are construction site erosion control and stormwater ordinances, aggressive street sweeping and catch basin cleaning schedules, installing sediment basins, field screening for illicit connections and information and education programs.
For more information on stormwater and construction site programs in the Southeast Fox River Basin, please contact the Municipal Stormwater Management Coordinator at (414) 229-0880. 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 Southeast Fox River Basin 307 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 Southeast Fox River Basin, please contact the Industrial Stormwater Management Coordinator at (414) 229-0833.

Contaminated Sediments

Contaminated sediments are a concern in urban and industrial areas of the Southeast Fox 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), 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. Fish consumption advisories for PCBs are in effect for the Fox River and Tichigan Lake in the Southeast Fox River Basin.
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 Southeast Fox 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 and straightening to move stormwater off the land and downstream more swiftly. Dams built to perform specific purposes also have noticeable effects on 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 Southeast Fox River Basin contain over 100 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.

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. Dams also have negative effects on temperature regimes in rivers, especially in cool and cold water systems. Dams allow for the water to warm which can harm species such as trout that are sensitive to temperature variations.

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 Southeast Fox River Basin were lined with trees or tall grasses. As land was 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.***

Objectives for Southeast Fox River Basin Surface Water Resources

Below are priority objectives identified by WDNR staff and partners to manage surface water resources over the next five or six years. The objectives are organized under broad subject areas. Please see Chapter Five (page 62) for a summary of all recommendations organized by major issue area.

Water Quality Monitoring and Management

- Conduct baseline monitoring surveys on at least 10 stream sites per year using standardized protocols for stream habitat, fish and macroinvertebrate community sampling.
- Conduct baseline monitoring on at least 20 Lakes per year using standardized protocols.
- Document the links between land based activities and effects on water quality at each monitoring site.
- Evaluate other cool water and cold water streams for their potential to support cold water species and recommend management actions to correct problems and enhance the resource.
- 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, with priority to those in the Upper Fox River Watershed.
- Include chlorides as a component of chemical water quality analysis in Southeast Fox River Basin streams.
- Identify areas within the Southeast Fox River Basin with contaminated sediments and devise clean up strategies.

Industrial and Municipal Point Sources of Pollution

- 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.
- Continue to ensure that the permit backlog in the basin remains under 10 percent.
- Ensure that the municipal and industrial wastewater treatment plants required to remove phosphorus from their effluent remain in compliance with their discharge permit.
- Implement the recommendations outlined in the report *Sewer Overflows in Wisconsin-A Report to the Natural Resources Board* (WDNR, 2001) for sanitary sewer overflows. Specifically:
    - 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 collections 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.

- Upon completion of the updated code for variance streams (NR 104), and promulgation of water quality standards for ammonia, phosphorus and thermal components in wastewater, reissue permits that implement the requirements of the rule changes.
- Continue to support the wastewater discharge database (SWAMP) to track compliance and accountability of dischargers.

Urban and Rural Nonpoint Sources of Pollution (including stormwater)

- Complete the municipal stormwater permitting process and ensure compliance for the eight municipalities identified in the Federal Phase I stormwater regulations.
- Issue permits for up to 11 communities for the Federal Phase II stormwater regulations.
- Ensure that permitted construction sites 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 will increase the number of construction site permits ten-fold over the current numbers. Additional staff will be needed to keep up to date with this requirement.
- Encourage municipalities that are not under a municipal stormwater permit to apply practices outlined in the Draft Model Post-Construction Stormwater Zoning Ordinance.
- 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.

Habitat

- Restore in-stream and terrestrial habitat where dams are being removed.
- As other opportunities arise, assist in abandoning and removing dams and restore the in-stream and near shore areas.
- Establish buffers along all intermittent and perennial streams, wetlands, ponds and lakes through easements, land acquisition and voluntary landowner cooperation.

FISHERIES RESOURCES

The fisheries resources of the Southeast Fox River Basin are as varied in quality as the lakes and streams in which they reside. The streams and lakes with the poorest habitat also have corresponding poor fisheries, while the higher quality waters contain more robust fisheries resources.

While some streams have the ability to sustain some trout populations, very few of the cold water stream miles are able to support trout at the highest, self sustaining level (Class I). Other cold water streams that are not currently supporting trout populations were identified by fisheries staff as capable of supporting cold water sport fish species.

Warmwater streams throughout the basin have the potential for supporting warmwater sport fisheries like smallmouth bass, with the low-flow reaches functioning as rearing habitat for sport fish and forage production.

The lakes in the Southeast Fox River Basin have good quality sport fisheries. Despite generally receiving very heavy fishing pressure, largemouth and smallmouth bass, walleye, northern pike, muskellunge and panfish populations are present in many lakes with good to excellent quality and quantity. These lakes must rely on stocking of at least one species to maintain a viable sport fishery.

Located at the headwaters of the Fox River, Pewaukee Lake is the premier musky lake in southern Wisconsin. With an adult musky density of 0.52 fish per surface acre, its musky population merits "Class A" musky lake designation. Pewaukee Lake ranks sixth in the nation among musky anglers for the number of muskies over 50 inches produced. The musky population is maintained entirely through stocking. Since the lake is located outside the historic range for muskies, it is unlikely that a naturally-reproducing population of muskies could be developed.

Geneva Lake is the largest (5,262 acres) and deepest (135 feet) lake in the Southeast Fox River Basin and the only lake containing cisco and lake trout populations. This lake offers premier angling opportunities for smallmouth bass, largemouth bass and walleye. The Wisconsin inland state record brown trout was caught in Geneva Lake.

Eagle Lake was chemically rehabilitated in 1991 to eradicate the fish community which was dominated by bullheads and carp. Fish stocking and special fishing regulations have resulted in excellent walleye, northern pike and largemouth bass fisheries. After ten years, Eagle is still free of bullheads and carp.

Big Muskego Lake was once highly degraded with 99 percent of the fish biomass represented by carp. A WDNR fishery rehabilitation project initiated in 1996 removed the carp and restocked native fish species. An electrical barrier on the outlet to Wind Lake suppresses carp reinfestation into the lake. Twenty native game and non-game species were restocked to restore fish diversity. The fishery will be maintained through stocking, protective size and bag limits, and exclusion of carp.

Heavy snows during the winter of 2000-2001 caused a large fish kill on Big Muskego Lake. The snow cover did not allow for enough light to penetrate the water column, which is needed for plants to produce oxygen. Instead, plant and animal respiration depleted the oxygen supply

in the water leading to the fish kill. The WDNR has initiated a stocking effort to restore the high quality fishery that was lost during the winter. During winters with heavy snows, the WDNR will initiate aeration in Bass' Bay to maintain fish populations in this deep area of the lake. Fish kills on some lakes are not uncommon. The WDNR recognizes that due to the productive and shallow nature of Big Muskego Lake, periodic winter fish kills may occur during extended periods of severe winter weather.

Challenges to Fisheries Quality

Degraded habitat and surface water quality are the primary factors keeping the streams and lakes in the Southeast Fox River Basin from meeting their full fisheries potential. Lakes in the basin are nearly fully developed with year-round homes and businesses. With extensive development along lakes and streams comes habitat degradation. Natural shorelines are necessary for maintaining healthy fish populations. However, maintaining natural shorelines is often at odds with the wants of landowners. Landowners often require piers and boat docks, swimming areas, lawns and patios. Trees and brush are cut for viewing and to reduce mosquitoes. Natural shorelines are replaced by boulder riprap and seawalls, which eliminate the gradual transition zone in the interface between land and water. Sand or pea gravel blankets replace the cobble, muck and aquatic plants needed for fish spawning and maintaining food chain integrity. Removing all submerged and emergent woody debris and aquatic plants from the near shore areas allows wave action to further erode the shoreline, creating a need for engineered shoreline "protection". Dredging of muck from natural deposition zones is often pursued, leading to further invasion of exotic nuisance plants like Eurasian water milfoil. Nearshore boat traffic causes destruction of emergent and submerged plants and disrupts fish spawning, especially bass and sunfish species. Lake water level manipulations initiated to prevent shoreline erosion and flooding of yards, prevent the natural inundation of nearshore marshes that are essential to northern pike spawning and rearing. Raising water levels in summer to facilitate boating can flood-out shoreline and shallow water plant communities, leading to erosion and invasion by exotics.

Stream side development often removes shoreline trees, shrubs and long grasses needed to keep streams cool. Streams were historically, and in some cases still are, ditched, straightened or relocated to accommodate development. Long stretches of streams are enclosed in culverts and used as drainage ditches for stormwater that can no longer infiltrate due to increases in impermeable surfaces. Loss of the buffering capability of healthy shoreline vegetation leads to erosion of the streambanks which, along with construction site erosion, leads to excessive stream siltation. All of these events work together to limit the capacity of streams to support diverse fisheries populations.

Over harvest of game fish species also has a negative effect on fisheries populations in the basin. The number of quality-size fish decline as they are cropped off at, or below the minimum length limit. Many fish such as walleyes and northern pike are not able to reach adult densities needed to achieve naturally reproducing communities because they reach the minimum size limit before, or soon after, they attain sexual maturity. Consequently, these species must be sustained by stocking.

Recent studies have shown that over harvest of bass and bluegills results in declining growth rates, which further exacerbates the lack of quality-sized fish. As larger fish are harvested there is less competition for prime nesting locations. This decline in nest site competition allows smaller fish to spawn and reach sexual maturity at an earlier age. Once these fish

reach sexual maturity their growth rates slow since they are putting energy into sexual reproduction, therefore leading to slower growth rates.
For more information on the fisheries resources of the Southeast Fox River Basin, please contact the following: **For lakes and streams in the northern portion of the basin please call (262) 594-6206. For information on the lower and middle portions of the basin, please call (262) 884-2364.**

Fisheries Objectives for the Southeast Fox River Basin

Following is a list of priority objectives Fisheries Management Staff have identified to improve fisheries resources in the Southeast Fox River Basin over the next five or six years. Please see Chapter Five (page 62) for a summary of all recommendations organized by major issue area.

- Where appropriate, reduce exploitation of gamefish and panfish by reducing the panfish bag limit, increasing the size limit of some species such as walleyes and bass, and protecting bass from harvest during their spawning season.
- Improve trout habitat in streams capable of supporting cold water fish.
- Rehabilitate lake fisheries communities dominated by rough fish, such as Eagle Spring, Little Muskego, Vern Wolf, Pewaukee lakes and other lakes identified through baseline surveys.
- Repair and augment the 2,000 foot-long dike at the southwest side of Big Muskego Lake. This dike is in poor repair and habitually allows carp to re-infest the lake. Repairing and augmenting this dike is necessary to retard carp migration into the Big Muskego system and prolong life of the restoration project.
- Where appropriate, improve smallmouth bass populations, habitat and spawning activity in lakes and streams by stocking and habitat improvement.
- Improve fish habitat in warmwater streams by removing dams.
- Conduct comprehensive fish surveys on several lakes in the basin. Some lakes needing comprehensive surveys include Powers, Waubeessee, Elizabeth, Mary, Hooker, Paddock, Lilly, Rock, Montgomery, Camp, Center, Shangrila-Benet, Bohner, Rockland, Tichigan, Army, Beulah, Booth, Como, Ivanhoe, Benedict, Pell, Pleasant, Potter, Tombeau, Wandawega and Andrea, Pine, Little Muskego, Upper and Lower Phantom, Eagle Spring, and Silver (Waukesha County).
- Continue to work closely with Lake Associations and local governments to improve and protect lake habitat.
- Enhance shore fishing opportunities at Bong Recreation Area and the Moose Lake and Silver Lake boat access sites.
- Provide and enhance shore fishing and fishing piers at lakes in Southeast Wisconsin.
- Continue to stock fish species where appropriate.
- Conduct musky population surveys on Pewaukee and Silver lakes.
- Conduct fish surveys to evaluate walleye stocking success, natural walleye, northern pike, largemouth and smallmouth bass populations.
- Protect and enhance habitat in warmwater and coldwater streams.
- Encourage lake associations and lake landowners to manage aquatic plants to increase fish habitat, such as cruising lanes.
- Encourage the use of milfoil weevils and limited use of selective herbicides to control the propagation and spread of Eurasian water milfoil.
- Strictly enforce current water regulation and zoning laws and ordinances to prevent further loss of stream and lake habitat.

- Encourage landowners to establish 100 foot or wider buffer zones along all waterways to allow them to retain their natural character. Structure placement or vegetation removal (except exotic species) in the stream or buffer zone should be limited.
- Newly developing areas should encourage infiltration and detention to limit the excessive inflow of stormwater to streams.
- Encourage local communities and counties to eliminate floodplain development.
- Encourage lakeside landowners to use engineered shoreline protection as a last resort after all natural alternatives have proved to be inadequate.
- Where appropriate, encourage local municipalities to establish no wake lakes and slow-no-wake zones in all shallow water and near-shore (within 200 feet of shore) areas of lakes.
- Allow water levels to fluctuate naturally, allowing flooding of nearshore marshes for fish spawning.
- Discourage landowners from removing all shoreline vegetation, with the exception of a viewing/access way.

DRINKING WATER AND GROUNDWATER QUALITY

Groundwater supplies water to all of the Southeast Fox River Basin residents for residential and commercial use. The following sections provide an overview of the drinking water and groundwater resources in the Southeast Fox River Basin.

Groundwater Aquifers

Drinking water in the basin comes from three main groundwater aquifers, the sand and gravel, dolomite and sandstone. The sand and gravel aquifer is the shallowest and is available as a groundwater supply for most areas of the basin, though productivity varies locally. The medium depth aquifer, the Silurian dolomite (or Niagara Dolomite) has a maximum thickness of 500 feet along the eastern edge of the basin, but gradually thins to the west and is generally unavailable west of Highway 83. Its productivity varies with the degree and location of the bedding and fracture zones. 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 with well depths ranging up to 2000 feet. It is primarily tapped by high capacity municipal and industrial wells, though at the western edge of the basin this aquifer is shallower and can be used for residential wells.

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 10). With about 75,000 wells in the basin (10 percent of the statewide total), the private well is the most prevalent of the groundwater systems, serving about 60 percent of the basin's population. These wells serve mainly homes and small businesses where fewer than 25 people per day have access to water. The most activity in private well construction within the basin has been occurring within Waukesha and Walworth Counties, consistent with the large population increases in these areas. Over 1500 wells were drilled in Waukesha County over the last two years and over 800 in Walworth County. These figures are for the entirety of Walworth and Waukesha counties so some of these wells are actually located in the Rock River Basin. The well construction activity in these two counties represent 46 percent of the total number of wells drilled in the eight county southeast region of Wisconsin for 1998 and 1999, consistent with population patterns.

Drinking water systems serving more than 25 people per day are considered public. About 200,000 people are served by over 100 public systems in the basin (Table 10). Municipalities operate 28 of these community systems as utilities, while 96 are privately owned subdivision or apartment-like systems. Nearly 800 non-community public water systems serve businesses, schools and workplaces in the basin. In the last two years 33 new community drinking water projects were approved in the Southeast Fox River Basin, including municipal wells, well reconstruction, pressure booster pumps and chemical feed stations. 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 10. Drinking Water System Types

Type of water System	Example	Number in Basin	Residential Population Served
Private	Individual homes, small businesses	75,000	294,000
Public Community Systems	**Residential**		
■ Municipal	Water provided by a public utility (City or Village).	28	192,000
■ Other than Municipal	Water provided through a subdivision or mobile home park well	72	8,000
Public Non-Community Systems	**Non-residential**		
■ Transient (serving different people daily)	Taverns, restaurants, campgrounds	636	
■ Non-transient (serving the same people daily)	Schools, factories, offices	142	

Groundwater and Drinking Water Quality

The Southeast Fox Basin has natural geologic conditions which are partly responsible for its most severe contamination problems. Prime among these is bedrock outcrops at the surface in many areas. Subdivisions with septic systems located in these rocky areas, as well as stormwater runoff, have resulted in widespread bacteria, nitrate and other contaminants affecting large areas. Quarry operations have affected nearby wells by reducing water levels, introducing bacteria and causing sediment problems due to blasting. Sulfide minerals containing traces of arsenic occur in both the Silurian dolomite and sandstone rock formations. The arsenic problem is under study. If regulations are tightened, a number of Southeast Fox River Basin wells will have to treat their water.

Most significant are the naturally occurring radioactive elements such as radium, in the sandstone aquifer. These produce radon gas and dissolved radium in water from deep wells developed in the sandstone aquifer. While radon levels are typically acceptable, radium exceedences loom as a major issue for some large urban water utilities in the basin (Table 11). Statewide, this basin has the second largest number of systems with radium problems. These community systems must either develop plans to implement central water treatment to remove radium by 2005, or find new sources of groundwater.

Table 11. Community Water Systems Exceeding Standards for Radium.

Brookfield Water Utility Eagle Waterworks Mukwonago Waterworks New Berlin Water Utility Brookfield Hills Apartments	Country Estates Sanitary District-Lyons Lake Lore Water Trust-Muskego Lake Meadows Water Trust-Muskego Sussex Waterworks Waterford Waterworks Waukesha Waterworks

In addition to natural challenges, 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. There are over 200 waste disposal sites in the basin. For a complete list of environmental problem sites, including waste disposal sites and gasoline leaks, please see the WDNR web site at http://www.dnr.state.wi.us/org/aw/rr/archives/pub_index.html - 6

Proper well location, construction and maintenance are essential to delivering high quality drinking water to consumers. The well drilling and pump installing industries are regulated by 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 by conducting well inspections, testing and upgrading substandard 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.

Public wells are inspected at a minimum every five years and are required to monitor for a wide range of contaminants. Waukesha and Kenosha counties participate as delegates to enforce state well codes. Waukesha County's delegation covers private and transient non-community wells while Kenosha County handles only transient non-community systems.

The Well Construction and Pump Installation Code (Wis. Admin. Code NR812) contains minimum construction requirements designed to protect the well and the water supply from contamination. The WDNR has found it necessary over the years to establish special casing depth areas to address contamination situations which may be related to bacteriological or chemical contamination. During well construction, well casing is installed in the well to the depths necessary to protect the groundwater from the contamination source. See Table 13 (page 35) for locations with special well casing requirements and locations needing further investigation.

A concerted effort is underway in the state to protect the quality of the sandstone aquifer, which is the major aquifer for both municipal and high capacity wells in Southeastern Wisconsin. Along the western side of the basin, the Niagara dolomite formation thins and is intermixed with layers of shale. In this area and further to the west the sandstone aquifer is subject to surface contamination. To protect the sandstone aquifer in this area, a boundary along State Highway 83 was established. The boundary runs south through Waukesha County to the intersection with County Highway LO near Lake Beulah and proceeds along the western edges of Racine and Kenosha Counties to the Illinois state line. No casing requirements are in effect for the areas west of Highway 83. East of Highway 83 wells which are constructed into the aquifer below the Maquoketa shale(Galena Platteville and sandstone aquifer) must be cased and grouted through the Niagara dolomite to the top of the Maquoketa shale and preferably cased and grouted through the Maquoketa shale to prevent mixing of groundwater between the upper aquifer (Niagara dolomite) and the Galena Platteville and sandstone aquifer.

The WDNR Drinking and Groundwater Private Well Specialists provide technical assistance to citizens upon request for issues related to private wells. Many of the contacts are related to groundwater aesthetics, mainly taste and odor problems, but more severe issues sometimes

arise. For homeowners 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. ***For information about testing your private groundwater well in the Southeast Fox River Basin, please contact the WDNR Private Well Specialist at (414) 229-0827, or your delegated County Environmental Health Department.***

Each watershed within the Southeast Fox Basin was ranked based on land coverage and groundwater sample analytical results in the WDNR's Groundwater Retrieval Network (GRN) database. The table below lists each watershed score and gives a short description of the land cover and groundwater sample analytical data that determined the score.

Table 12. Groundwater Potential Contamination Rankings for Watersheds in the Southeast Fox Basin.

Watershed Name	Score*	Comments
Lower Fox River	49.34	Land cover in the watershed consists of 48% agriculture and 15% forest.
White River and Nippersink Creek	51.13	Land cover in the watershed consists of 13% forest, 47% agriculture and 4% urban.
Middle Fox River	56.38	There is one confined animal feeding operation (CAFO**) in the watershed. Of 28 wells tested for nitrate, 11% exceeded the groundwater enforcement standard (ES**) and 46% exceeded the groundwater preventive action limit (PAL**). Land cover is 13% forest, 18% grassland, 41% agriculture and 4% urban.
Sugar and Honey Creeks	76.31	Pesticides were detected in 17 wells in the watershed. Of 104 wells tested for nitrate, 27% exceeded the ES and 50% exceeded the PAL. Land cover is 13% forest, 58% agriculture and 1% urban.
Mukwonago River	55.82	There are two CAFOs in the watershed. Pesticides were detected in nine wells. Of 25 wells tested for nitrate, 16% exceeded the ES and 68% exceeded the PAL. Land cover is 22% forest, 22% grassland, 37% agriculture and 2% urban.
Upper Fox River	53.72	Of 77 wells tested for nitrate, 4% exceeded the ES, 49% exceeded the PAL. Land cover in the watershed consists of 31% grassland, 20% agriculture and 20% urban.

**Score based upon land coverage and groundwater sample analytical results for nitrate and pesticides in WDNR GRN database. Score of 30 or greater is considered high for groundwater contamination potential.*

***ES: Groundwater enforcement standard as per NR 140 WI Admin. Code. For nitrate the groundwater ES is 10 ppm.*

PAL: Groundwater Preventive Action Limit as per NR 140 WI Admin. Code. For nitrate the groundwater PAL is 2 ppm.

CAFO: Confined animal feeding operations that consist of the equivalent of 1000 animal units.

Table 13. Locations for Special Well Casing Requirements, and Locations Requiring Investigation.

Location	Requirement
Town of East Troy, portions of Sec. 10 and12 (Miramar subdivision)	Minimum of 80 feet of casing to address bacteriological and detergent contamination of Niagara dolomite.
Town of East Troy, portions of Sec. 15, 16	Minimum casing to top of bedrock to address concern of landfill leachate contamination from Town of East Troy Landfill.
Town of East Troy, portions of Sec. 15, 16, 21	Casing to the top of the bedrock to address potential landfill leachate contamination from Town of East Troy Landfill.
Town of Delafield, portions of Sec. 21, 22, 27, 28	Casing required to the base of the Maquoketa shale to address volatile organic chemical contamination and landfill leachate.
Town of Genesee, portions of Sec. 23, 24, 25, 26	Minimum 200 feet of casing because of bacteriological contamination. Within ½ mile of area need 200 feet or special approval for less casing.
Town of Lisbon, portions of Sec. 35, 36	Wells constructed within 1200 feet of the Halquist and Vulcan Materials quarries required to be grouted and cased to the base of the Maquoketa shale because of the existing depth or approved working depth of the quarries to 200 feet.
Town of Lisbon, Sec. 22, 25, 26, 27, 34 and remainder of 35 and 36.	150 feet of casing required.
Town of Lisbon, remainder of township within ½ mile of quarries or rock outcrops.	Minimum of 100 feet casing or special approval.
Town of Lisbon, remainder of township slightly greater than ½ mile from quarries or rock outcrops.	100 feet of casing recommended.
Town of Pewaukee, portions of Sec. 1, 2.	Minimum casing of 100 feet to address bacteriological contamination.
Town of Pewaukee, portion of Sec. 12 (Hill N Dale Subdivision) and within ¼ mile.	Minimum of 135 feet of casing or municipal water to address bacteriological contamination.
Villages of Lannon and Menomonee Falls, within ½ mile of quarries.	Minimum casing of 100 feet to address bacteriological contamination.
Villages of Lannon and Menomonee Falls, slightly greater than ½ mile from quarries.	100 feet of casing recommended.
Locations Requiring Further Investigation	
City of Muskego, portions of Sec. 17, 18, 19.	Several wells affected by vinyl chloride contamination.
Village of North Prairie.	Contamination from road salt near County Highway Dept.
City of Waukesha.	West Avenue landfill area with volatile organic chemical contamination of the Niagara dolomite bedrock.
Town of Waukesha. Hwy 59 and Hwy 164	Municipal waste site and WPCO fly ash site.

Groundwater Quantity Issues

As with any natural resource, groundwater supplies in the Southeast Fox River Basin are limited. Historically, the Southeast Fox River Basin had an abundant, even famous, groundwater supply with many springs and water bottlers. One bottler supplied water to the 1892 Chicago World's Fair. But paving, building, and destruction of wetlands have reduced vegetated land area and critical zones where infiltration and groundwater recharge occurs. At the same time, record breaking population growth and economic development called for increased water supplies. The result is that in many areas of the basin, groundwater pumpage exceeds natural recharge, or the 'sustained yield' of the aquifer, so water levels are dropping in the Niagara dolomite and sandstone aquifers.

Because of declining water levels in the sandstone aquifer and elevated radium concentrations in drinking water, some municipal utilities in the basin are trying to find alternatives to using the sandstone aquifer as a single drinking water supply source. One alternative is to find a well site where the sand and gravel or a fracture located in the Niagara dolomite aquifer is available. In some cases however, pumping from these shallower aquifers may negatively affect water availability to surface waters and wetlands causing conflicts with wildlife needs and recreational users. Within the basin the WDNR is currently investigating the interactions between test pumping a sand and gravel well and water levels in a portion of the Vernon Marsh State Wildlife Area.

Urban growth and suburban sprawl are increasing the competition for limited groundwater in the Southeast Fox River Basin which will impose economic and social restraints. Unlike coastal areas, Lake Michigan water is not available to the basins west of the sub-continental divide by a treaty with Canada and other Great Lakes states, which prevents diversion of any Great Lakes water outside the Great Lakes drainage basin. No such conservation plan has been developed for the far more limited groundwater aquifers. With sole reliance on diminishing groundwater, political leaders in the Southeast Fox River Basin will soon face major issues over allocations of limited groundwater resources.

For future use the Southeastern Wisconsin Regional Planning Commission, the Wisconsin Geological and Natural History Survey, the United States Geological Survey and WDNR are developing a groundwater model for southeastern Wisconsin to investigate the current and future supplies of groundwater in the region. The groundwater model, expected in 2002, should provide useful planning information for municipalities regarding the long term use of the groundwater supply.

Objectives for Drinking Water and Groundwater

Conservation and planning are needed to protect the long term quality and abundance of the Southeast Fox River Basin water supply. Most powerful is effective community planning to match development to areas capable of being sustained by the resources available. Communities should develop wellhead protection plans to protect their water supply wells. In brief, this includes: 1) delineation of the area contributing to well, 2) inventorying existing and potential sources of contamination, and 3) managing the area to reduce the risk that the well will be contaminated. The WDNR is completing steps 1 and 2 above as part of the state's source water assessment program that will be completed by May, 2003. Local governments cannot act alone, since groundwater resources originate outside local jurisdictions, and contaminants travel without regard for political boundaries. Regional planning and

cooperation between local governments to form groundwater protection and use agreements is essential. Failure to plan cooperatively will surely result in litigation and political strife over the finite groundwater resources available in the growing Southeast Fox River Basin.

Waukesha and Kenosha Counties' continued participation in the well delegation program, with possible additional county governments in the future, provide local control and a close layer of regulation of small public and private water wells. Active enforcement of well abandonment and permitting programs in utility areas prevent old, unused wells from contaminating aquifers and utility wells. Businesses and industries with wells should follow state requirements for testing and inspection. Private well owners have the responsibility for properly maintaining and testing their wells.

Below are priority objectives for groundwater and drinking water in the basin for the next five years. Please see Chapter 5 (page 62) for a summary showing all recommendations for the Southeast Fox River Basin.

- Groundwater quantity issues in the basin must be addressed proactively due to the rapid expansion of residential, commercial and industrial areas and the large volume of water required for developing areas. Potential shortages of water may occur if the groundwater quantity issue is not adequately addressed.
- Local governments, in cooperation with the Southeastern Wisconsin Regional Planning Commission, should begin work on forming a regional groundwater coalition for the purposes of protection and allocation of groundwater.
- Local governments should promulgate ordinances within their jurisdiction and enforce well abandonment.
- The WDNR will work with communities having radium violations to encourage and require elimination of exceedences beginning in December, 2004.
- Continue to implement work plans and work objectives for municipal facilities and some 10 other than municipal systems to maintain compliance with rules and regulations. This includes all other requirements that need to be implemented.
- Continue to remain up-to-date on the latest technologies and regulatory rules and requirements. This is necessary because new technologies are being used to find and develop feasible solutions and alternatives to drinking water-related problems.
- Ensure all public water supplies are tested in accordance with the Federal Safe Drinking Water Act Regulations.
- The WDNR or its county delegate will conduct a sanitary survey at each of the 878 public water systems in the basin every five years.
- Conduct an inspection at each of the 28 municipal waterworks each 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.
- The WDNR will 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 plans to prevent encroachment on wells and their recharge areas and to protect their water supply wells.
- Waukesha, Kenosha, Racine and Walworth Counties should continue to participate, or consider participating as delegates to locally enforce state rules regarding inspection and testing of private and non-community public wells.

Chapter 3. Land Resources of the Southeast Fox 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 Southeast Fox 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.

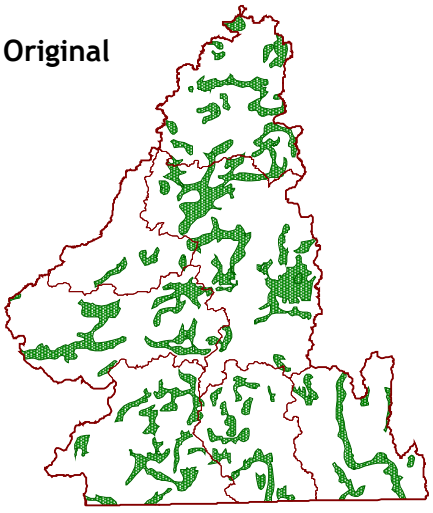
Wetlands:

- 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.

Wetlands Before Settlement

It is difficult to determine exactly how many acres of wetlands were in the Southeast Fox 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 Southeast Fox River Basin, the original surveyors estimated wetlands covered about 122,000 acres or 18 percent of the land area (Figure 17). 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.

Figure 17. Original Wetlands



Wetlands Today

Today, using more modern techniques, we have a pretty good idea of the acreage of remaining wetlands in the Southeast Fox River Basin. Data from the Wisconsin Wetland Inventory indicate that the Southeast Fox River Basin currently contains nearly 78,000 acres of wetlands (Figure 18). The largest wetland complexes in the basin are found in the Vernon Marsh Wildlife Area and near Big Muskego Lake. Vernon Marsh and the land adjacent to the Fox River corridor contain more than 5000 acres of wetland habitat. Big Muskego Lake is a 3500 acre shallow water lake grading into a cattail and sedge wetland complex.

Wetlands of the Southeast Fox River Basin

Wetlands provide many benefits for humans, but are also very important ecologically. For this report we classified wetlands in the Southeast Fox 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 least abundant of all wetlands within the basin (Table 14, Figure 18). Most of the wetlands closely associated with river corridors are of this type. 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 ponded 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 red maple, silver maple 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 14. Southeast Fox River Basin Wetland Vegetation Summary

Wetland Type	Wetland Acreage by Watershed/% of Land Area						
	Des Plaines	Lower Fox	White R Nippersink	Middle Fox	Sugar Honey	Mukwonago	Upper Fox
Coniferous Swamp	0	102	151	83	76	199	113
Hardwood Swamp/ Floodplain Forest	633	1197	806	3355	1027	668	3489
Marsh	3551	2806	2115	7359	1777	1751	569
Shrub Swamp	693	2066	2627	5738	3093	962	2580
Wet Meadow	2181	3534	5010	7154	3591	1062	5756
Totals	**7058/8%**	**9705/13%**	**10709/10%**	**23689/15%**	**9564/9%**	**4642/8%**	**12507/13%**

Figure 18. Major Wetland Classes of the Fox River Basin (1 of 2)

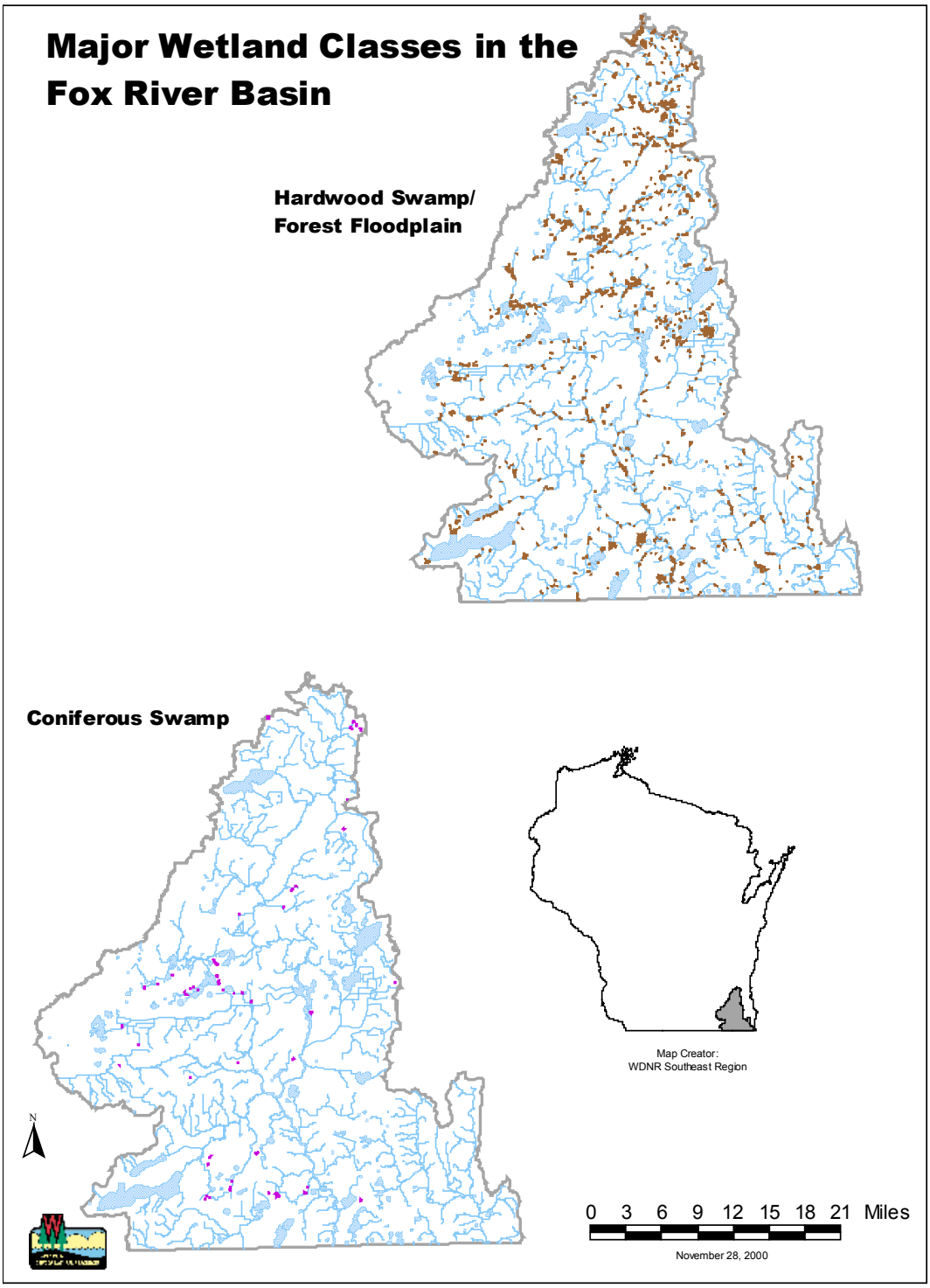
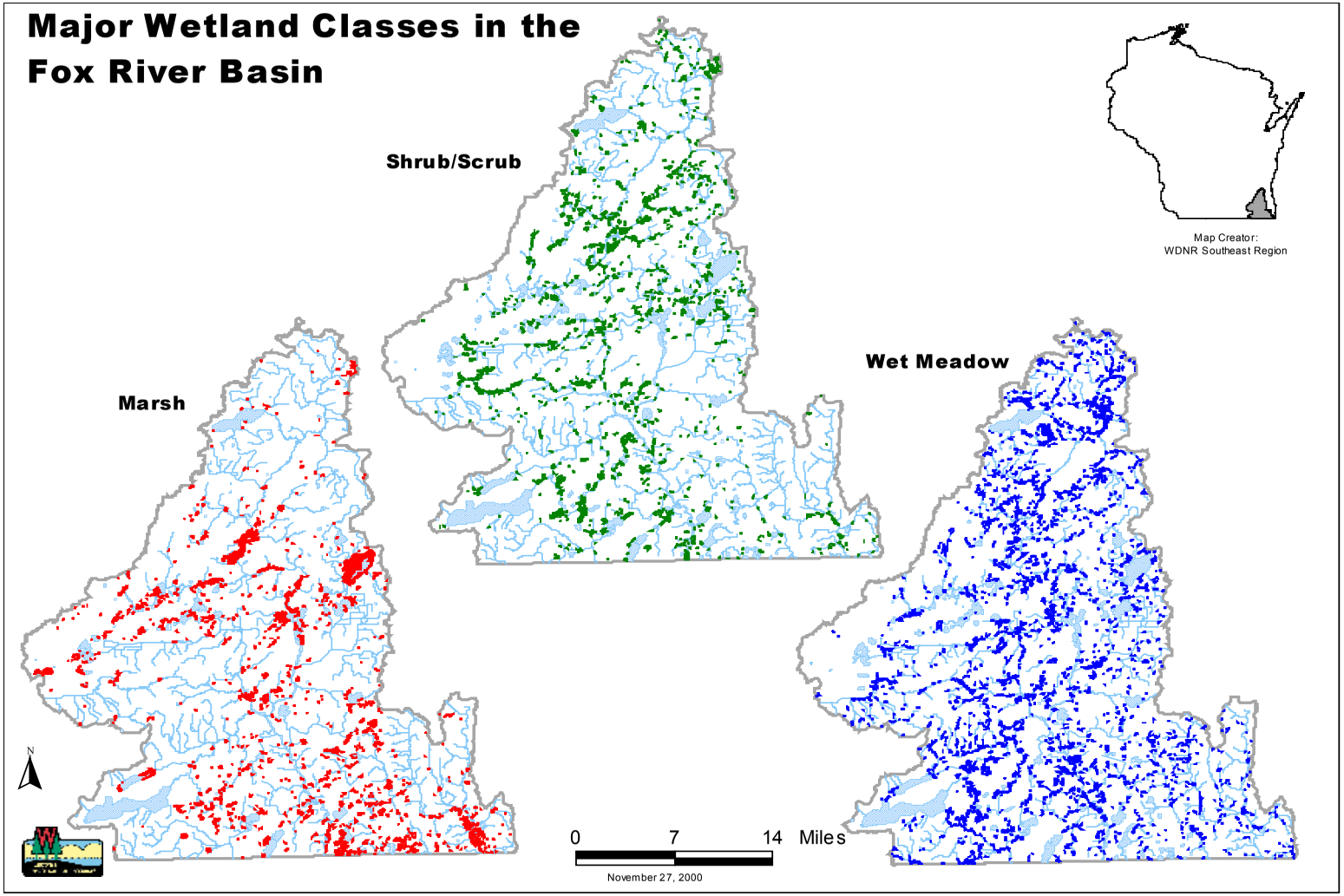


Figure 18. Major Wetland Classes in the Southeast Fox River Basin (page 2 of 2)



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, 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 and the invasive common and glossy buckthorn are dominant in the 17,700 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 songbirds and small mammals, and winter habitat for upland game such as pheasants, white-tailed deer and rabbits and turkeys. American toads, chorus frogs, leopard frogs and eastern tiger salamanders are also found in shrub swamps.

Marshes

At about 20,000 acres, marshes are one of the most abundant wetland types in the basin. Plants such as cattails, sedges and water plantain 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. One example is a large cattail marsh located along Brighton Creek in the Paris Township. The marsh contains mostly emergent vegetation, dominated by cattails but may include arrowhead, plantain, bulrush, water lilies and water shield.

This wetland type is the most productive for water birds and furbearers, and also provides important spawning and nursery habitat for northern pike. The species commonly found breeding and feeding in marshes include various ducks, rails, red-winged and yellow-headed blackbirds, swamp sparrows, common yellowthroats, sedge wrens, bittern, herons, muskrat, mink, painted turtle, snapping turtle, soft-shell turtle, chorus frog, spring peeper, green frog, leopard frog, bullfrog, American toad and garter snakes. Upland wildlife like pheasants, turkeys and rabbits uses marshes as winter habitat.

Wet Meadows

This wetland type encompasses over 28,000 acres of land within the basin, making this the most abundant wetland type. 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.

A large wetland complex in the Village of Pleasant Prairie in the Des Plaines River Watershed is an example of this type of wetland. This is an extensive wetland, owned by the Nature Conservancy

that is home to a wide variety of wildlife. Species found here include songbirds (song sparrow, swamp sparrow, sedge wren, common yellow-throat), waterfowl (Canada geese, mallards blue-wing teal, wood duck), wading birds (heron, egret), small mammals (shrews, voles), medium sized mammals (muskrat, beaver, fox, coyote, deer), reptiles (painted turtles, garter snake) and amphibians (green frog, chorus frog, spring peeper). In pre-settlement times the Des Plaines River was diffuse and surrounded by a sedge meadow and prairie.

Coniferous swamp

Conifer swamps are the least abundant types of wetland (765 acres) in the Southeast Fox 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. 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 and reptiles include spring peeper, chorus frogs and northern red-belly snakes.

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 www.dnr.state.wi.us/org/water/fhp/wetlands.

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.

Southeast Fox River Basin Wetland Losses

A review of WDNR permits issued for wetland projects within the Southeast Fox River Basin showed that about 61 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.

Wetland Restoration and Protection Opportunities

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 Southeast Fox River Basin from 1990-1999 show that over 350 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 or acquisitions individual landowners, nature centers, state agencies or foundations have accomplished. Following are brief descriptions of some of the resources available for wetland restoration and protection activities in the Southeast Fox River Basin.

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 300 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. In addition, The U.S. Fish and Wildlife Service provides technical assistance for wetland restorations, permitting and cost-sharing in cooperation with NRCS and WDNR. ***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.

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 Southeast Fox 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 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 wetland areas. Nearly 12,000 acres of wetland dominated lands in the basin 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.

Ten wetland dominated areas within the basin were identified with the highest quality classification of NA-1 (Table 15, page 47), while several other parcels were classified as NA-2 and NA-3. Some of these high quality areas are in public ownership, but most are privately owned.
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."

Wildlife Managers within the WDNR are planning on restoring several large wetlands at the headwaters of Sugar Creek that will help improve water quality and maintain flow rates within the watershed. ***Please contact the WDNR Wildlife Manager at (262) 594-6208 for more information.***

Table 15. High Quality Wetland Natural Areas in the Southeast Fox River Basin (*Source:* SEWRPC, 1997).

Area Name	Size (Acres)	Description and Comments
Beulah Bog State Natural Area	72	Outstanding acid sphagnum bog communities located in a series of four kettle holes. A small open-water bog lake is surrounded by a quaking mat and tamarack swamp. A wet, open moat separates bog from wooded and pastured uplands.
Cherry Lake Sedge Meadow State Natural Area	190	High-quality lowland complex of fen, wet prairie, sedge meadow, shrub-carr, shallow lake and tamarack relict within a matrix of disturbed upland oak woods. A good combination of alkaline- and acid-loving plants is present. The irregular openings of water provide good nesting and escape cover for waterfowl. The western border is a one-mile long esker.
Lulu Lake and Eagle Spring Lake Wetland Complex and Adjacent Uplands	970	Among the most valuable natural areas in the State, containing a large concentration of elements of natural diversity. Uplands support oak woods, oak openings, and dry prairie. Lowlands contain one of the state's finest wetland ecosystems, including bog, springs, fen, deep and shallow marsh, sedge meadow, stream, and high quality lake communities.
Mukwonago Fen, Sedge Meadow, and Tamarack Relict.	232	Large, good quality and relatively undisturbed wetland complex bisected by the Mukwonago River. North of the River, sedge meadow and shallow marsh grade into calcareous fen. South of the river, open wetland grades into tamarack swamp with northern relict species. An integral part of the Mukwonago River corridor.
Peat Lake State Natural Area	140	One of the few undeveloped lakes in Kenosha County, isolated from roads and houses. Shallow and somewhat alkaline, it is bordered by a wide belt of shallow marsh and sedge meadow. Important nesting and feeding refuge for waterfowl.
Pickerel Lake Fen State Natural Area	273	Large, high-quality calcareous fen and associated seepage springs bordering shallow lake. A number of uncommon species are present, including a large population of the State-threatened beaked spike-rush *(Eleocharis rostellata)*.
Silver Lake Bog State Natural Area	18	Lacking many of the typical northern bog species, this area nevertheless remains one of the better acid bogs in the region. Few bogs of this quality occur this far south. Typical species include tamarack, pitcher plant, round-leaved sundew, cranberry, winterberry, and bog buckbean.
Stopa Fen	9	High-quality fen with both seeping and bubbling springs, located adjacent to the Fox River. A large number of unusual species are present, such as beaked spike-rush, bulrush, Ohio goldenrod, false asphodel, and common bog arrow-grass. Threatened by ski-hill operations.
Tichigan Fen	118	A fine example of springs and calcareous fen, with a number of uncommon species present. The site includes the lesser-quality upland woods to the south that protects the water sources of the springs.
Upper Mukwonago River	172	High-quality stream reach between dam at Eagle Spring Lake and Phantom Lake.

PRAIRIES

Wisconsin was once covered with over two million acres of prairie and 5.5 million acres of oak savanna, a transitional community between prairie and forest. Today, less than one percent of the original prairies of Wisconsin remain. Tall grass prairies and oak savannas are the most decimated ecosystems today, with only 0.1 percent of the original acreage remaining. Over 1700 species of vascular plants native to Wisconsin and 28 percent of the endangered and threatened plant species are found in prairie and oak savanna ecosystems. Farming, grazing and fire-suppression were the major factors causing declines in prairies.

Southeast Fox River Basin Prairie Communities

According to the original state surveys, the lands in the Southeast Fox River Basin once contained over 230,000 acres of prairie and oak savanna (35 percent of land area). Today only about 2,000 acres (0.3 percent of land area) of high quality prairie habitat remain in the Southeast Fox Basin. Dry prairies, mesic prairies and oak savannas are the major prairie types found in the basin.

Dry Prairies

Dry prairies are the most common of the remnant prairie types. These prairies are found on sandy soils, glacial till and dolomite bedrock. Some good examples of dry prairie in the basin can be found at the Eagle Dry Prairie in Waukesha County and upland areas in the Lulu Lake State Natural Area.

Plants commonly found in dry prairies include little bluestem, June grass, drop-seed grass, panic grass, sedges, short green milkweed, purple prairie clover, false boneset, heath aster, rough blazing star, goldenrod, lead plant and sumac. Birds and mammals frequenting dry prairies include thirteen-lined ground squirrel, red fox, coyote, grasshopper sparrow, savannah sparrow, eastern meadowlark, bobolink, Henslow's sparrow, upland sandpiper, field sparrow, eastern kingbird, goldfinch, red-wing blackbird, barn swallow and red-tail hawk. Reptiles include Western fox snake, eastern hog nose snake and garter snake.

Mesic Prairies

Mesic prairies have deep mineral soils ranging from dry-mesic and well-drained to wet and very poorly drained. This prairie type is found in areas with flat to gently rolling topography where there is an accumulation of well-developed soils. Because of their deep, fertile soils the once large expanses of mesic prairie were converted to agriculture. The remaining mesic prairies are small, fragmented and scattered, often found along railroad rights-of-way. The privately owned Kansasville Railroad Prairie contains some of the best examples of mesic prairie in Southeastern Wisconsin. The Bong State Recreational Area also contains some mesic prairie remnants.

Mesic prairies are marked by their high plant species diversity and tall grasses and forbs. Plant species found in mesic prairies include big bluestem, little bluestem, needle grass, prairie drop-seed, rough blazing star, compass plant, prairie dock, prairie violet, white wild false indigo, pasture thistle, yellow coneflower, nodding wild onion, stout blue-eyed grass, marsh gay-feather and smooth phlox. Because many mesic prairie remnants are disturbed, invasive species like white campion, sweet clover, red clover, leafy spurge, wild parsnip, common dandelion, bluegrass, smooth brome, orchard grass and quack grass.
Wildlife found in mesic prairies include snipe, woodcock, red fox, coyote, barn swallow, grasshopper sparrow, savannah sparrow, eastern meadowlark, bobolink, Henslow's sparrow, upland sandpiper, field sparrow, eastern kingbird, goldfinch, red-wing blackbird, red-tail hawk, western fox snake, eastern hog-nose snake and garter snake.

Oak Savanna

Savannas are best described as the mid-point in the continuum from prairies to forest. These communities have features of prairies, gradually grading into forest. Because oaks were the dominant trees in most savannas in the Midwest, the term oak savanna became widely used for this transition zone. Wisconsin once had over 5.5 million acres of savanna, which were characterized into four groups based on the composition of their dominant plants: Pine Barrens, oak barrens, oak openings and cedar glades. Oak openings were the most prevalent savanna type within the Southeast Fox River Basin.

Oak openings once covered over one-quarter of the lands in the basin. Today most of these savannas are gone. Major influences since European settlement include clearing and plowing, overgrazing, or invading trees and shrubs due to lack of fire, lack of grazing, or both. The WDNR Natural Heritage Inventory estimates that less than 500 acres of the original oak savanna remain statewide. The Genesee Oak Opening and Yatzick's Fen State Natural Area in Waukesha County, and the Lulu Lake State Natural Area contain the best examples of remaining oak savanna in the basin (SEWRPC, 1997).

The major tree types found in oak savannas are bur oak, white oak and black oak. Major prairie plant species include big bluestem, prairie cord-grass, switch grass, Indian grass, Coreopsis, spiderwort, goldenrod, gentian, wood-betony, birdfoot violet, nodding wild onion, rough blazing star, lead plant and blue-eye grass. Wildlife that would use oak savannas are a mix of species common to oak forests and prairies, including red-headed woodpecker, eastern kingbird, red-tail hawk, kestrel, mourning dove, northern harrier, shrike, field sparrow, savannah sparrow, grasshopper sparrow, song sparrow, bobolink, Eastern meadowlark, goldfinch, oriole, brown-headed cowbird, pheasant, badger, red fox, coyote, thirteen-lined ground squirrel, western fox snake, eastern hog-nose snake and garter snake.

Opportunities and Recommendations for Prairie Management and Restoration

Listed below are some actions WDNR and partners can take to restore and protect prairies in the Southeast Fox River Basin.

- The WDNR has been actively working with the Natural Resources Conservation Service (NRCS) in the Farm Bill/Conservation Reserve Program to encourage landowners to convert highly erodible farmland into permanent cover for a minimum of 10 years. Changes have been made to the program to encourage landowners to use native warm season prairie grasses instead of the non-native cool season grasses previously used. WDNR staff provide technical assistance and offer to plant fields for a nominal rate. Conservation groups such as Wings Over Wisconsin, Pheasants Forever, The Wild Turkey Federation and local groups have provided funding to help defray the costs of seeds and for running equipment.
- WDNR staff will continue to burn several hundred acres of grasslands and prairies each season to restore and maintain native prairie species.

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 Southeast Fox River Basin come in all shapes and sizes.

Forests Before Settlement

The major forest types originally found in the Southeast Fox 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 covered about 70 percent (479,000 acres) of the land area (Figure 19). Oak forests and oak openings (savanna) dominated the landscape prior to settlement, accounting for about 60 percent of the basin land area. 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 end of the 1920s, most of the forests in the basin were logged for lumber and other products and converted to agricultural land.

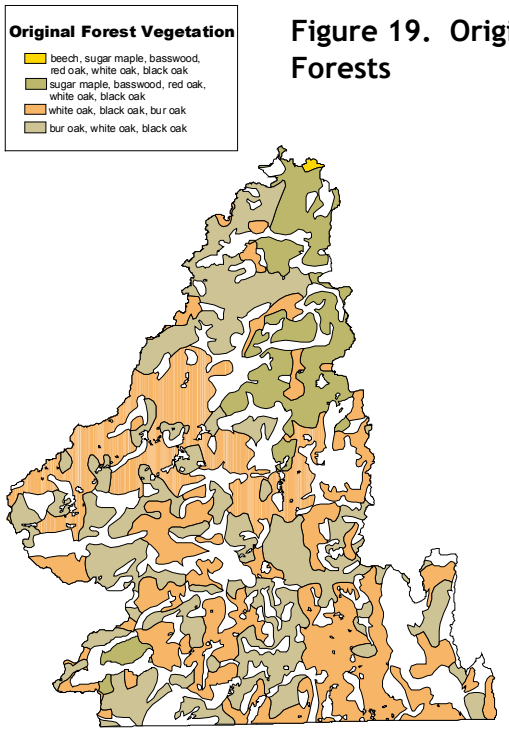


Figure 19. Original Forests

Forests Today

Today about 13 percent of the Southeast Fox River Basin land area is considered forested. Forest types found in the basin include oak and central hardwoods, conifer plantations, aspen and urban forests.

Oak and Central Hardwoods

The oak and central hardwoods forest type is the most common forest type in the basin. Red and white oak dominate these areas, with bur and black oaks often very abundant. Shagbark and bitternut hickory, black cherry and elm, collectively referred to as central hardwoods, are interspersed with the oaks. Heavy pasturing took place in most woodlots until the 1950s or 1960s, which allowed invasive common buckthorn and exotic honeysuckles to take over the understory. As the older oaks (120-140 years) die out, central hardwood species are slowly taking over. These central hardwoods, especially black cherry and shagbark hickory, seem better able to regenerate and compete in the understory than oaks. The oak and central hardwoods forest is very productive for wildlife. White tailed deer, wild turkeys, woodcock, 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 and shelter for woodpeckers, raccoon, squirrels and screech owls.

Conifer Plantations

Tree planting began to occur with regularity in this area during the 1940s, increasing during the 1950s and 1960s as field areas were often taken out of crop production and planted to trees. It was common during that time period to plant red or white pine, or some mix of the two. Occasionally white or Norway spruce was included, but the planting was almost always a pure conifer planting. It was often a common practice at the Kettle Moraine State Forest to purchase land, and then plant conifers on the old field areas. With the increase in cost-sharing programs, more and more private landowners began planting trees on their land. Tree planting in the last 10 to 15 years has included more mixed planting, with hardwoods and conifers planted together, although pure conifer or pure hardwood plantings also occur. These plantations offer a variety of benefits desirable on lads of any ownership. As they go through their periodic thinnings, the plantations provide pulpwood and saw-logs to our state's forest products industry, which is so important to Wisconsin. These stands are also highly valued for their aesthetic value, especially as the trees get older and larger. This is true on state land that is laced with trails and an abundance of trail users, or on private land where the conifers offer a nice privacy barrier and/or windbreak. Wildlife habitat also benefits by these stands.

Conifer plantations consisting of white pine, white spruce and Norway spruce provide cover and nesting habitat for a wide variety of wildlife. Properly managed (thinned) conifer stands can encourage an excellent understory of oak, hickory, cherry, white pine and spruce. Wildlife found in conifer plantations include mourning doves, sharp-shinned and Cooper's hawks, red squirrels and cottontail rabbits. Conifer plantations also provide important nesting cover for forest interior birds, such as the hooded warbler and Acadian flycatcher. 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.

Aspen

The Southeast Fox River Basin contains some small areas dominated by aspen. If not harvested, these stands will transition to the more shade-tolerant cherry/hickory/elm species. If harvested, aspen regenerates well. Young aspen provide brood rearing habitat for woodcock and succulent summer foods for white-tailed deer. Many wildlife species value the winter buds produced by 15 to 25 year old trees.

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. The population growth and increased development not only fragment the land, but affect the ability to manage it properly. Management is desired to encourage the forests to grow in a way pleasing to the users, like encouraging more oak to grow. The central hardwoods will continue to take over in most cases unless active management is done. Landowners with small woodlots are often not interested in this type of active management. The ability to direct the forest growth is lost in these situations. As more subdivisions develop in the "country" people unfamiliar with the needs for forest management often argue against any kind of tree cutting or thinning. Educating the public about the benefits of forest management is a growing challenge.

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 Southeast Fox River Basin.

Wisconsin's Forest Tax Law

Forested lands are often taxed at a higher rate, which can create a financial burden on woodland owners. Some landowners over-harvest lumber, or split their acreage into smaller and smaller parcels in order to meet their property tax payments. The purpose of Wisconsin's Forest Tax Law is to encourage proper forest management on private lands by providing property tax incentives to landowners. This is accomplished with a binding contract between the WDNR and private landowners. Management plans for lands enrolled in the program may include timber harvesting and thinning, tree planting, erosion control, and wildlife measures. ***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

Fourteen communities and other unique participants within the Southeast Fox River Basin are taking advantage of the WDNR Urban Forestry Program. Since 1993, 30 WDNR urban forestry grants totaling more than $350,000 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 tree inventories, tree pruning, educational materials, workshops, and tree planting.

National Arbor Day Foundation Programs

The Tree City USA program, sponsored by the National Arbor Day Foundation is another important urban forestry program, with 11 basin communities participating. This program recognizes towns, cities and villages across America that effectively manages 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. 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.

AGRICULTURAL LANDS

In many areas agriculture plays an important role in shaping the landscape of the Southeast Fox River Basin. Lands in agriculture account for about 45 percent of the basin land cover. As urban development proceeds farmland is lost. The four main counties within the basin (Kenosha, Racine, Walworth and Waukesha) have experienced double-digit percent decreases in the number of farms and corresponding significant decreases of acres in farming (Table 16).

Table 16. Number of Farms, Land in Farming and Farm Size for the Four Major Counties in the Southeast Fox River Basin.

	Racine			Kenosha			Walworth			Waukesha		
	1987	1997	%	1987	1997	%	1987	1997	%	1987	1997	%
NO. of FARMS	710	554	-22	505	388	-23	980	853	-13	818	630	-23
LAND IN FARMS (ACRES)	133167	123012	-8	100678	84744	-16	238787	220089	-8	126734	105608	-17
AVERAGE FARM SIZE (ACRES)	188	222	18	199	218	10	244	258	6	155	168	8

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 (page 21). Some landowners are taking steps to decrease these effects while maintaining their ability to earn a living off their land.

Landowners in the Upper Fox River, Honey and Sugar Creeks, Muskego/Wind Lakes and Camp and Center Lakes Watersheds 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.

Through the Priority Watersheds 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. Watershed or lake projects must be selected by the state Land and Water Conservation Board to receive cost-share assistance. Grant selection is highly competitive, occurring on a statewide basis. Since the beginning of the programs within the Southeast Fox River Basin, more than 100 rural landowners have entered into 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 39 percent on average. Watersheds with more cash crops generally continue to have higher erosion rates than those primarily in dairy. Erosion rates are lower in areas where landowners practice no-till rather than moldboard plowing. 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 48 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. About 17 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 local mechanism to implement nonpoint source conservation practices. The counties within the Southeast Fox 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 Southeast Fox River Basin Report*. Waterbodies or watersheds that are ranked high receive priority consideration for grant funding through the redesigned program. Ranks for the watersheds, streams, lakes and groundwater in the Southeast Fox River Basin are listed below (Table 17). ***For more information on efforts to curb nonpoint source pollution, please see*** www.dnr.state.wi.us/org/water/wm/nps.

Table 17. Watershed and Lake Priority Rankings for the Southeast Fox River Basin.

Watershed Name	Overall Rank	Streams	Lakes	Groundwater
Des Plaines River	High	High	High	High
Lower Fox River	High	Medium	Medium	High
White River/Nippersink Creek	High	High	Medium	High
Middle Fox River	High	High	Medium	High
Sugar and Honey Creeks	High	High	Medium	High
Mukwonago River	High	Medium	High	High
Upper Fox River	High	NA	NA	High

For more information about watershed, stream, lake and groundwater rankings in your area, please see: http://www.dnr.state.wi.us/org/water/wm/nps/npsrank/lakeswatershedlist32801_gwa.pdf.

Recommendations for Agricultural Lands in the Southeast Fox River Basin

- 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.
- 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 to streams where degradation of the streambank has or will occur.

♦ Continue to encourage landowners to develop and implement nutrient management plans.
♦ Work with the 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 Watersheds Program.
♦ 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 completing applications for Targeted Runoff Management (TRM) and Nonpoint Source Grants.
♦ Provide technical assistance and oversight for municipalities and County Land and Water Conservation Departments that have received TRM and Nonpoint Source grants.
♦ Continue to encourage landowners to implement best management practices to reduce the delivery of nutrients to surface waters from agricultural runoff.

RECREATIONAL OPPORTUNITIES IN THE SOUTHEAST FOX RIVER BASIN

Recreational opportunities abound in the Southeast Fox River Basin and others parts of Southeastern Wisconsin. 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 18).

Table 18. Major State-Owned and Managed Lands in the Southeast Fox River Basin.

Property Name	County	Size (Acres)	Contact Information
Beulah Station Wildlife Area	Racine	218	(262) 884-2300
Big Foot Beach State Park	Walworth	264	(262) 248-2528
Bloomfield Wildlife Area	Walworth	1170	(262) 594-6200
Bong Recreation Area	Kenosha	4552	(262) 878-5600
Honey Creek Wildlife Area	Racine	1061	(262) 884-2300
Karcher Marsh Wildlife Area	Racine	292	(262) 884-2300
Kettle Moraine State Forest – SU*	Waukesha/ Walworth	5543*	(262) 594-6200
Lake Ivanhoe Fisheries Area	Walworth	74	(262) 594-6200
Lulu Lake State Natural Area	Walworth	696	(262) 594-6200
Lyons Wildlife Area	Walworth	175	(262) 594-6200
New Munster Wildlife Area	Kenosha	1058	(262) 884-2300
Peterkin Marsh	Walworth	129	(262) 594-6200
Tichigan Wildlife Area	Racine	1232	(262) 884-2300
Troy Wildlife Area	Walworth	661	(262) 594-6200
Turtle Valley Wildlife Area	Walworth	1728	(262) 884-2300
Vernon Marsh Wildlife Area	Waukesha	4084	(262) 594-6200

The Southeast Fox River Basin encompasses about 25% of the 20,000 acres in the Southern Unit of the Kettle Moraine State Forest.

For more information about Wisconsin's State Parks, Forests, Wildlife and Fisheries Areas 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 19.

Table 19. Contact Information For County Parks.

County Department	Phone Number/Internet Address
Kenosha County Parks Division	(262) 653-1869
Racine County Public Works Department	(262) 886-8440
Walworth County Land Conservation Department	(262) 741-2013
Waukesha County Parks Department	www.co.waukesha.wi.us/departments/parks

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 study opportunities. In the winter months these trails also provide opportunities like cross-country skiing, snowshoeing, and snowmobiling. The Southeast Fox 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**.

Chapter 4. Fox River Basin Partnerships

THE IMPORTANCE OF PARTNERSHIPS

Recently the WDNR reorganized into twenty-three Geographic Management Units (GMU's) with a major focus on managing resources on a geographic basis, rather than by programs. The Southeast Fox River Partnership Team was formed in 1998, and represents a wide range of federal, state, county and local agencies, nonprofit organizations and private sector interests (Table 20). 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 Fox 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 20. Fox River Basin Partnership Representation.

- Conservation Congress
- J W Peters & Sons (Aggregate Producer)
- Lake Pewaukee Sanitary District
- Metropolitan Builders Association
- University of Wisconsin-Extension
- Walworth County Farm Bureau
- Walworth County Land Conservation
- Waukesha Land Conservancy
- Waukesha County Natural Resources Conservation Service
- Waukesha County Department of Parks and Land Use
- Wisconsin Department of Natural Resources

Since the fall of 1998, the Fox River Partnership has met as a full group once a month. The group identified top priorities for which to focus their efforts (Table 21). To guide the work and operations of the partner team, they developed the following vision statement:

"To protect, restore, and enhance the natural resources of the Fox River basin through a cooperative team effort by partners representing federal, state, municipal and private entities. Team efforts are focused on actions that address this vision."

The partnership members divided into several subgroups and worked on the following projects:

- Development of a 'Lakes Brochure' promoting shoreland protection.
- Recruitment and support of a 'Student Summit on Exotic Species'.
- Review and comment to the City of Waukesha on street width requirements.

- Efforts to secure funding for a Walworth County Conservation Technician Lakes position.
- Distribution of Natural Areas Maps to communities in the basin with a letter encouraging protection when land use issues are decided by Plan Commissions.
- Develop an educational video to aid local decision makers with making sound land use decisions.
- Recommendations for shoreland enhancement and protection for a commercial development on the Pewaukee River.

Table 21. Priority Issues Identified by the Southeast Fox River Partnership.

- Encourage good land use planning, zoning and enforcement with inclusion of open space.
- Insufficient public education about local natural resource issues.
- Protection of groundwater quality and quantity.
- Loss of wetlands.
- Loss of wildlife habitat.
- Insufficient population density being achieved in urban development.
- Update the soil classification system used for preserving agricultural operations.

Chapter 5. Recommendations Summary

Many of the land and water resources throughout the Southeast Fox River Basin have been extensively modified or destroyed since the settlers first arrived in the 1800s. 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 and manage to 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 Southeast Fox River Basin contains over 1,000 miles of perennial and intermittent streams, and nearly 80 names 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. Over fifty stream miles and two lakes are listed as impaired on the state 303(d) list. We need to fully understand the factors affecting water quality, and the current status of the biological communities 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.
- Conduct baseline monitoring on at least 20 lakes per year using standardized protocols.
- Document the links between land based activities and effects on water quality at each monitoring site.
- Evaluate cool water and cold water streams for their potential to support cold water species and recommend management actions to correct problems and enhance the resource.
- 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, with priority to those in the Upper Fox River Watershed.
- Include chlorides as a component of chemical water quality analysis in Southeast Fox River Basin streams.
- Identify areas within the Southeast Fox River Basin with contaminated sediments and devise clean up strategies.
- Conduct comprehensive fish surveys on several lakes in the basin. Some lakes needing comprehensive surveys include Powers, Waubeessee, Elizabeth, Mary, Hooker, Paddock, Lilly, Rock, Montgomery, Camp, Center, Shangrila-Benet, Bohner, Rockland, Tichigan, Army, Beulah, Booth, Como, Ivanhoe, Benedict, Pell, Pleasant, Potter, Tombeau, Wandawega and Andrea, Pine, Little Muskego, Upper and Lower Phantom, Eagle Spring, and Silver (Waukesha County.

Issue: There are nearly 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, or have failed to apply for a point source discharge permit required by WI Administrative Code NR 200, and take actions to bring these facilities into compliance.
- Continue to ensure that the permit backlog in the basin remains under 10 percent.
- Ensure that the municipal and industrial wastewater treatment plants required to remove phosphorus from their effluent remain in compliance with their discharge permit.
- Implement the recommendations outlined in the report *Sewer Overflows in Wisconsin-A Report to the Natural Resources Board* (WDNR, 2001) for sanitary sewer overflows. Specifically:
    - The WDNR must create and implement a statewide comprehensive system addressing sanitary sewer overflows (SSOs) that will ensure:
        c) 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
        d) Infiltration and inflow that enters sewage collections 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.
- Upon completion of the updated code for variance streams (NR 104), and promulgation of water quality standards for ammonia, phosphorus and thermal components in wastewater, reissue permits that implement the requirements of the rule changes.
- Continue to support the wastewater discharge database (SWAMP) to track compliance and accountability of dischargers.
- Complete the municipal stormwater permitting process and ensure compliance for the eight municipalities identified in the Federal Phase I stormwater regulations.
- Issue permits for up to 13 communities for the Federal Phase II stormwater regulations.
- Ensure that permitted construction sites 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 will increase the number of construction site permits ten-fold over the current numbers. Additional staff will be needed to keep up to date with this requirement.
- Encourage municipalities that are not under a municipal stormwater permit to apply practices outlined in the Draft Model Post-Construction Stormwater Zoning Ordinance.
- Identify non-complying industrial facilities that have not applied for the required tier 1or 2 industrial stormwater permits and work to bring them into compliance with industrial stormwater regulations.

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.
- As other opportunities arise, assist in abandoning and removing dams and restore the in-stream and near shore areas.
- Establish buffers along all intermittent and perennial streams, wetlands, ponds and lakes through easements, land acquisition and voluntary landowner cooperation.
- Continue to work with NRCS and partners such as Wings Over Wisconsin, Pheasants Forever, the Wild Turkey Federation and local groups to help defray costs and encourage landowners to convert farmland into permanent cover using native warm season prairie grasses.
- Continue to burn several hundred acres of grasslands and prairies each season to restore and maintain native prairie species.
- Where appropriate, improve smallmouth bass populations, habitat and spawning activity in lakes and streams through stocking and habitat improvements.
- Improve trout habitat in streams capable of supporting cold water fish.
- Continue to work closely with Lake Associations and local governments to improve and protect lake habitat.
- Protect and enhance habitat in warmwater and coldwater streams.
- Encourage lake associations and lake landowners to manage aquatic plants to increase fish habitat, such as cruising lanes.
- Encourage a multifaceted approach to control the propagation and spread of Eurasian water milfoil.
- Strictly enforce current water regulation and zoning laws and ordinances to prevent further loss of stream and lake habitat.
- Encourage landowners to establish 100 foot or wider buffer zones along all waterways to allow them to retain their natural character.
- Encourage lakeside landowners to use engineered shoreline protection as a last resort after all natural alternatives have proved to be inadequate.
- Where appropriate, encourage local municipalities to establish no wake lakes and slow-no-wake zones in all shallow water and near-shore (within 200 feet of shore) areas of lakes.
- Allow water levels to fluctuate naturally, allowing flooding of near shore marshes for fish spawning habitat.
- Discourage landowners from removing all shoreline vegetation with the exception of a viewing/access way.
- Encourage governments, non-profit conservation organizations or landowners to protect the remaining high quality natural areas in the basin.
- Repair and augment the 2,000 foot-long dike at the southwest side of Big Muskego Lake. This dike is in poor repair and habitually allows carp to re-infest the lake. Repairing and augmenting this dike is necessary to retard carp migration into the Big Muskego system and prolong life of the restoration project.
- Recruit and support a Student Summit on Exotic Species.

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. Urban runoff and treatment plant objectives are listed on page 63.

Priority Actions:

- 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 anima1 waste to waters and issue Notice of Discharge where applicable.
- 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 to streams where degradation of the streambank has or will occur.
- Continue to encourage landowners to develop and implement nutrient management plans.
- Work with the 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 Watersheds Program.
- 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 completing applications for Targeted Runoff Management (TRM) and Nonpoint Source Grants.
- Provide technical assistance and oversight for municipalities and County Land and Water Conservation Departments that have received TRM and Nonpoint Source grants.
- Implement best management practices to reduce the delivery of nutrients to surface waters from agricultural runoff.

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.
- Work with basin communities, landowners, and WDNR land program staff to establish shoreline buffer demonstration sites.
- Establish buffers along all intermittent and perennial streams, wetlands, ponds and lakes through easements, land acquisition and voluntary landowner cooperation.
- Encourage developers to employ conservation design principles in their site plans.
- 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.
- Review and comment to the City of Waukesha on street width requirements.
- Develop an educational video to aid local decision-makers in making sound land use decisions.
- Make recommendations for shoreland enhancement and protection for a commercial development on the Pewaukee River.
- Distribute SEWRPC Natural Areas Maps to communities in the basin with a letter encouraging protection when Plan Commissions decide land use issues.
- Encourage local communities and counties to eliminate floodplain filling and development.

Issue: Contaminated sediments remain a concern in the Fox 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. Fish consumption advisories for PCBs are in effect for the Fox River and Tichigan Lake.

Priority Actions:

- Identify areas with contaminated sediment and devise clean-up strategies.
- Continue to work with the State Fish Contaminant Specialist to monitor water bodies for contaminated fish species.

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 protection since the early 1990s through state, federal and local initiatives. As upland areas are developed, pressure to encroach on wetlands is becoming more of an issue.

Priority Actions:
- Protect wetland complexes with 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.
- Restore several large wetlands at the headwaters of Sugar Creek that to improve water quality and maintain flow rates within the watershed, and provide habitat for wildlife.

- Implement the strategies outlined in *Reversing the Loss: A Strategy for Protecting & Restoring Wetlands in Wisconsin*. Specifically:
    - Strengthen relationships with property owners, nonprofit conservation organizations and local governments.
    - Manage wetlands to protect diversity of species, wildlife health and ecological integrity.
    - Streamline WDNR regulatory approach for permits and restoration activities in wetlands.
    - Develop and use modern technology to map, monitor, protect and manage wetlands.

Issue: Groundwater resources provide drinking water for over 500,000 Southeast Fox Basin residents. Keeping these resources safe and plentiful are high priorities.

Priority Actions:

- Groundwater quantity issues in the basin must be addressed proactively due to the rapid expansion of residential, commercial and industrial areas and the large volume of water required for developing areas. Potential shortages of water may occur if the groundwater quantity issue is not adequately addressed.
- Local governments, in cooperation with the Southeastern Wisconsin Regional Planning Commission, should begin work on forming a regional groundwater coalition for the purposes of protection and allocation of groundwater.
- Local governments should promulgate ordinances within their jurisdiction and enforce well abandonment.
- The WDNR will work with communities having radium violations to encourage and require elimination of exceedences beginning in December, 2004.
- Continue to implement work plans and work objectives for municipal facilities and some 10 other than municipal systems to maintain compliance with rules and regulations. This includes all other requirements that need to be implemented.
- Continue to remain up-to-date on the latest technologies and regulatory rules and requirements. This is necessary because new technologies are being used to find and develop feasible solutions and alternatives to drinking water-related problems.
- Ensure all public water supplies are tested in accordance with the Federal Safe Drinking Water Act Regulations.
- The WDNR or its county delegate will conduct a sanitary survey at each of the 878 public water systems in the basin every five years.
- Conduct an inspection at each of the 28 municipal waterworks each 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.
- The WDNR will 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 plans to prevent encroachment on wells and their recharge areas and to protect their water supply wells.
- Waukesha, Kenosha, Racine and Walworth Counties should continue to participate, or consider participating as delegates to locally enforce state rules regarding inspection and testing of private and non-community public wells.

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

Priority Actions:

- 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.
- Enhance shore fishing opportunities at Bong Recreation Area and the Silver Lake (Kenosha County) boat access site.
- Provide and enhance shore fishing and fishing piers at lakes in Southeast Wisconsin.
- Continue to stock game fish species where appropriate.

- Rehabilitate lake fisheries communities dominated by rough fish at Eagle Spring, Little Muskego, Vern Wolf, Pewaukee lakes and other lakes identified through baseline surveys.
- Where appropriate, reduce exploitation of gamefish and panfish by reducing the panfish bag limit, increasing the size limit on walleyes, bass, northern pike and musky, and protecting bass from harvest during their spawning season.
- Conduct musky population surveys on Pewaukee and Silver lakes.
- Conduct fish surveys to evaluate walleye stocking success, natural walleye, northern pike, largemouth and smallmouth bass populations.
- Pursue acquisition of public access to lakes and streams when appropriate sites become available.
- Continue to purchase property from willing sellers as it becomes available within WDNR Project Boundaries such as the Turtle Valley Wildlife Area, Big Muskego Wildlife Area, Vernon Wildlife Area, and the Kettle Moraine State Forest-Southern Unit.

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Appendix A. Streams of the Southeast Fox 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. *Note: A blank space anywhere in the table means that data is unassessed or unavailable.*

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 22. Streams of the Des Plaines River Watershed

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess Cat.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Unnamed Creek Lake Shangrila Outlet T1N R21E Sec. 28 SW1/16 SE1/4	734300	3									
Unnamed Ditch Mud Lake Outlet T1N R21E Sec. 32 SW1/16 NE1/4	734400	0									
Unnamed Creek George Lake Outlet T1N R21E Sec. 20 NE1/16 SE1/4	734900	1									
Unnamed Ditch George Lake Inlet T1N R21E Sec. 20 SE1/16 SW1/4	735200	1									
Unnamed Creek Barber Pond Outlet T1N R21E Sec. 29 NE1/16 NW1/4	735300	1									
Unnamed Creek T1N R22E Sec. 29 SW1/16 SW1/4	735800	3									
Unnamed Ditch T1N R22E Sec. 30 SE1/16 SE1/4	735900	0									
Unnamed Creek T1N R22E Sec. 29 NW1/16 NW1/4	736200	1	LAL				M				1
Lower Pleasant Prairie Ditch T1N R22E Sec. 20 SW1/16 SW1/4	736300	2									
Jerome Creek T1N R22E Sec. 19 SE1/16 NE1/4	736500	5									
Unnamed Ditch T1N R22E Sec. 16 NE1/16 NW1/4	736600	1									
Unnamed Creek T1N R22E Sec. 16 SE1/16 NE1/4	736700	2									
Unnamed Ditch T1N R22E Sec. 18 SW1/16 SE1/4	736800	1	WWSF				M			B2, H2, P2	2
Kilbourn Road Ditch T1N R22E Sec. 7 SW1/16 SW1/4	736900	12	WWSF				M			P2, H2	3,4

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess Cat.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Unnamed Creek T2N R22E Sec. 6 NW1/16 SE1/4	737000	1									
Unnamed Creek Paddock Lake Outlet T1N R20E Sec. 11 SE1/16 NE1/4	737000	1									
Unnamed Creek T3N R22E Sec. 31 SW1/16 NE1/4	737100	1									
Root River Center Branch T1N R21E Sec. 12 SW1/16 SE1/4	737200	10									
Brighton Creek T2N R21E Sec. 33 SW1/16 NW1/4	737400	11									
Salem Brook Hooker Lake Outlet T1N R21E Sec. 6 NE1/16 SW1/4	737500	2	WWFF				M			B2, H2, P2	5,6
Unnamed Creek T1N R21E Sec. 7 NW1/16 NW1/4	737600	1	LFF				M			B2, H2, P2	5
Unnamed Creek Montgomery Lake Outlet T1N R20E Sec. 11 SE1/16 NE1/4	738000	1									
Unnamed Creek- League Lake Outlet T2N R21E Sec. 31 SW1/16 SW1/4	738500	2									
Unnamed Creek T2N R20E Sec. 25 NW1/16 NE1/4	738800	1									
Unnamed Creek East Lake Flowage T2N R20E Sec. 23 SE1/16 NE1/4	738900	1									
Unnamed Creek Paulin Pond Outlet T2N R20E Sec. 22 SW1/16 NE1/4	739200	0									
Unnamed Ditch T2N R20E Sec. 12 SW1/16 SW1/4	739600	2									
Unnamed Creek T2N R21E Sec. 20 NW1/16 NE1/4	740100	1									
Des Plaines River -CO BD T3N R21E Sec. 32 SE1/16 SE1/4	740150	0	WWSF							P2, H2, B2,	4

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess Cat.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Unnamed Creek T3N R21E Sec. 32 SE1/16 SE1/4	740155	1									
Pleasant Prairie Ditch T1N R22E Sec 8 NW1/16 SW1/4			LFF/ WWSF							B2, H2, P2	2
Bristol Creek T1N R21E Sec. 8 NE1/16 SW1/4			WWSF				M	PSM		B2, H2, P2	7,8
Unknown Trib to Des Plaines T3N R21E Sec.31			LFF				M			B2, H2, P2	9
Unknown Trib to Des Plaines Union Grove Trib T2N R21E Sec.5 NE1/16 SE1/4			LFF				M			B2, H2, P2	9
Unknown Trib to Center Branch of Desplaines T2N R21E Sec. 26 NW1/16 NW1/4			LAL				M				10
Unknown Trib to Center Branch of Desplaines T2N R21E Sec. 2 NW1/16 NW1/4											
Unknown Trib to Des Plaines T1N R22E Sec. 33											

References

1. Kurz J.1980 Stream Classification for George Connolly Development
2. Galarneau,1995, Stream Classification for Pleasant Prairie Ditch
3. ENCAP 1979-80,
4. Wawrzyn 1987
5. Author Unknown, 1975-Salem, Kenosha County DesPlaines R Basin/
6. Kurz1979(Macroinvert)
7. Variance Survey 1978,
8. Wawrzyn 1998
9. Schultz & Johnson 1975-Fonks,Union Grove Industrial and Union Grove Tributaries
10. Galarneau 1998 Stream Classification for the Unnamed Trib to Center Branch Des Plaines R

Table 23. Streams of the Lower Fox River Watershed.

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess	Use Impairments		Data Level	Ref.
			Ext.	Pot.				Source	Impact		
Unnamed Creek Rock L Outlet T1N R20E Sec.34 SW1/16 NW1/4	745800	0									
Unnamed Creek -Voltz L Outlet T1N 20E Sec.35 SW1/16 NE1/4	746100	1									
Unnamed Creek -Peat L Outlet T1N R20E Sec.32 NE1/16 SE1/4	746800	0									
Unnamed Creek T1N R20 Sec.30 NE1/16 NW1/4	747600	1									
Unnamed Creek -Silver L Outlet T1N R20E Sec.19 NE1/16 NE1/4	747700	1									
Unnamed Creek -Silver L Inlet T1N R20E Sec.8 NE1/16 SE1/4	748000	3									
Basset Creek T1N R19E Sec.12 NE1/16 NW1/4	748200	5									
Palmer Creek T1N R19E Sec.1 SW1/16 NW1/4	748300	7	COLD III	COLD III	COLD III	PART		DCH,PSI,GR.Pit	HAB,FLOW,SED,TEMP	B3	1, 2, 4
Peterson Creek T2N R19E Sec.35 SE1/16 SE1/16	748500	7	LFF/WWSF							B2, H2, P2	3
Unnamed Ditch T2N R 19E Sec.36 SE1/16 NE1/4	748600	1									
Unnamed Ditch T2N R20E Sec.30 SE1/16 NE1/4	748700	1									
New Munster Creek T2N R19E Sec.35 NW1/16 SE1/4	748900	7									
Unnamed Creek T2N R19E Sec.33 SE1/16 SE1/4	749000	2									
Karcher Creek T2N R19E Sec. 26 NW1/16 NW1/4	749100	2									
Unnamed Creek T2N R19E Sec.23 SW1/16 SW1/4	749130	3									

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess	Use Impairments		Data Level	Ref.
			Ext.	Pot.				Source	Impact		
Unnamed Ditch T2N R19E Sec. 23 SW1/16 NW1/4	749300	2									
Unnamed Ditch T2N R19E Sec. 15 NE1/16 NW1/4	749400	2									
Hoosier Creek T2N R19E Sec.15 SW1/16 NE1/4	749500	4									
Hoosier Br Canal T2N R19E Sec.10 SE1/16 SE1/4	749600	1									
Hoosier Creek Canal T2N R19E Sec. 3 SW1/16 NE 1/4	749800	8									
Unnamed Ditch T2N R20E Sec.6 NE1/16 SE1/4	750000	1									
Unnamed Ditch T2N R20E Sec.5 SE1/16 SE1/4	750100	1									
Unnamed Creek T2N R19E Sec.15 NE1/16 NW1/4	750350	1									
Unnamed Creek T2N R19E Sec. 4 SW1/16 SE1/4	750375	1									
Spring Brook Bohner Creek T2N R19E Sec.4 SE1/16 NW1/4	750400	7									
Unnamed Ditch T4N R20E Sec. 34 NW1/16 SW1/4	760500	5									

References

1. Bozek1986
2. Tills 1976
3. Galarneau 1993
4. Southeast Fox Basin Fisheries Management Investigations on File

Table 24. Streams of the White River and Nippersink Creeks Watershed.

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				source	impact		
East Branch Nippersink Creek T1N R18E Sec. 26 NE1/16 SW1/4	743400	4									
Unnamed Ditch Pell Lake Outlet T1N R18E Sec. 24 NW1/16 SW1/4	743500	2									
Unnamed Ditch T1N R18E Sec. 13 SW1/16 NE1/4	744000	2									
Unnamed Ditch Powers Lake Inlet T1N R19E Sec. 18 NE1/16 NE1/4	744300	2									
West Branch Nippersink Creek T1N R18E Sec. 27 SE1/16 SW1/4	744400	10									
Unnamed Creek T1N R17E Sec. 26 SW1/16 NE1/4	744600	2									
Unnamed Creek T1N R18E Sec. 27 SE1/16 SW1/4	744700	1									
Unnamed Ditch T1N R18E Sec. 28 NW1/16 SW1/4	744900	2									
Unnamed Creek T1N R17E Sec. 33 NE1/16 SW1/4	745400	2									
Unnamed Creek T1N R17E Sec.32 NE1/16 SE1/4	745500	1									
White River T3N R19E Sec.32 NW1/16 NE1/4	751200	19					M			B2, H2, P2	1
Spring Valley Creek T2N R18E Sec. 1 SW1/16 SW1/4	756200	10									
Unnamed Creek T2N R18E Sec. 12 NE1/16 SW1/4	756300	0									
Unnamed Ditch T2N R18E Sec. 2 NW1/16 SE1/4	756800	3									
Indian Run Creek T2N R18E Sec. 10 SW1/16 NE1/4	756900	5									
Ore Creek T2N R18E Sec. 10 SW1/16 NE1/4	757000	9					M			B2, H2	2
Second Branch Ore Creek T2N R18E Sec. Sec. 9 SW1/16 NE1/4	757100	3									
Unnamed Creek T2N R18E Sec. 8 SW1/16 SW1/4	757100	2.2					M			B2, H2	2
First Branch Ore Creek T2N R18E Sec. 18 SE1/16 NW1/4	757200	4	WWFF				M			B2	3
Unnamed Creek T2N R18E Sec. 16 NE1/16 SE1/4	757500	2									
Como Creek T2N R18E Sec. 20 SE1/16 NW1/4	757600	4									
Unnamed Ditch T2N R17E Sec. 23 SE1/16 SW1/4	757700	4									
Unnamed Creek T2N R17E Sec.32 SE1/16 NW1/4	757950										

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				source	impact		
Bloomfield Creek T2N R18E Sec. 29 SE1/16 NW1/4	758000	6									
Lightbody Creek T1N R17E Sec. 9 SW1/16 NE1/4	758400	1									
Harris Creek T1N R17E Sec.6 SE1/16 NW1/4	758500	0									
Southwick Creek T1N R17E Sec 6 SW1/16 NW1/4	758600	0									
Unnamed Creek T1N R16E Sec.12 NE1/16 NW1/4	758650	1									
Potowatomi Creek T1N R16E Sec. 14 NE1/16 SW1/4	758700	1									
Van Slyke Creek T1N R16E Sec.14 NW 1/16 SW1/4	758800	0									
Main Branch Nippersink Creek at Robinson Bait Company							M			B2, H2, P2	4

References

1. Kurz, Kierman, Rains-Steven
2. Burzynski, Galarneau 1993
3. Kurz,J 1993
4. Toshner,1999-Baseline Monitoring

Table 25. Streams of the Middle Fox River Watershed.

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Long Lake Channel T3N R19E Sec.28 NE1/16 NW1/4	758900	1									
Unnamed Ditch T3N R19E Sec. 20 SW1/16 NE1/4	759100	0									
Unnamed Ditch T3N R19E Sec. 16 SE1/16 SW1/4	759300	2									
Eagle Creek Lake Outlet T3N R19E Sec. 14 SE1/16 NW 1/4	759500	6					M			B2, H2	1,2
Unnamed Ditch T3N R20E Sec. 20 NE1/16 NW1/4	759600	2									
Unnamed Creek T3N R20E Sec.27 NW1/16 NW1/4	759900	1									
East Eagle East Lake T3N R30 Sec.22 SE1/16 SE1/4	760000	2									
Wind Lake Muskego Canal T3N R19E Sec. 2 SE1/16 SW1/4	760200	7	WWSF				M				
Goose L Wind L Branch Canal T4N R20E Sec.32 SE1/16 NW1/4	760300	9									
Goose Ditch T4N 20E Sec.33 SE1/16 NE1/4	760400	3									
Unnamed Ditch T3N R20E Sec. 4 SW1/16 NE1/4	760600	2									
Unnamed Creek T4N 20E Sec.34 SE1/16 SE1/4	760625	1									
Unnamed Creek T4N R20E Sec.35 NE1/16 SE1/4	760635	2									
Unnamed Ditch T4N R20E Sec.27 SW1/16 NE1/4	760660	1									
Unnamed Creek T4N 20E Sec.22 NE1/16 SE1/4	760670	3									
Unnamed Ditch T4N R20E Sec.10 NE1/16 NW1/4	760680	1									

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Unnamed Ditch T4N R20E Sec. 20 NW1/16 NE1/4	760700	4									
Cross Channel T4N R20E Sec.17 SW1/16 SE1/4	761400	4									
Unnamed Ditch T4N R20E Sec. 16 NW1/16 SW1/4	761500	1									
Muskego Creek T4N R20E Sec.4 NW1/16 SE1/4	761800	1									
Artesian Brook T5N R19E Sec. 23 NW1/16 NE1/4	762000	2	WWSF	COLD	DEF	PART	E	HM, SS, NPS	TEMP, HAB	B1	4
Unnamed Ditch T5N R20E Sec.33 SE1/16 SE1/4	762000	2									
Unnamed Ditch T5N R20E Sec.33 SE1/16 SE1/4	762200	1									
Muskego Creek T5N R20E Sec.22 NE1/16 NW1/4	762500	7	WWSF	WWSF	DEF	PART	M	CON, NPS, DCH	HAB, TEMP, BAC	B3	4
Unnamed Ditch T6NR20E Sec.32 SE1/16 SE1/4	763000	2									
Unnamed Ditch T5N 20E Sec.15 SW1/16 SE1/4	763100	1									
Tichigan Creek T4N R19E Sec.15 SE1/16 NE1/4	763700	1									
Unnamed Ditch T4N R19E Sec. 15 NE1/16 NW1/4	763800	3									
Unnamed Ditch T4N R10E Sec. 15 SE1/16 SW1/4	763900	2									
Unnamed Ditch T4N R19E Sec.3 SW1/16 NE1/4	764000	2									
Unnamed Ditch T4N R19E Sec. 3 NE1/16 NW1/4	764100	0									
Unnamed Ditch T4N R19E Sec. 4 NE1/16 NE1/4	764400	2									
Krueger Brook T5N R19E Sec.35 NE1/16 SE1/4	764700	1									

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Ripple Brook T5N R19E Sec.25 NE1/16 NW1/4	764800	1									
Unnamed Creek T5N 19E Sec.24 SW1/16 SW1/4	764900	0									
Horseshoe Brook T5N 19E Sec.21 NE 1/16 SW1/4	765300	2									
Unnamed Ditch T5N R19E Sec. 30 SW1/16 NE1/4	765400	2									
Unnamed Ditch T5N R18E Sec. 24 NW 1/16 NE1/4	769000	2									
Unnamed Ditch T5N R19E Sec. 18 NE1/16 NW1/4	769100	1									
Unnamed Ditch T5N R19E Sec. 7 SW 1/16 NW1/4	769200	2									
Unnamed Ditch T5N R19E Sec. 7 NW 1/16 NW1/4	769300	1									
Mill Brook T5N R19E Sec. 6 NE1/16 SE 1/4	769400	5	COLD	COLD		PART	M	CON, BDAM, NPS	SED, TEMP	B3	4
Pebble Brook T5N R19E Sec. 5 SW 1/16 NW 1/4	769500	9									
Redwing Creek T6N R19E Sec 33 SE1/16 NE1/4	769600	1									
Mill Creek T6N R 19E Sec.27 NW 1/16 NE1/4	769700	4									
Genesee Creek T6N R19E Sec.30 SW1/16 SE1/4	769800	6	COLDI/ COLDII	COLD	ERW	PART	M	CON, BDAM, NPS	SED, TEMP, HAB	B4, H2, P2	2, 3, 4
Unnamed Ditch T6N R18E Sec.36 NE1/16 NE1/4	769900	2									
Unnamed Ditch T6N R18E Sec.26 NW1/16 NE1/4	770200	2									
Spring Creek	770300	6	COLD	COLD	COLD	PART	M	CON, BDAM, NPS	SED, TEMP, HAB	B4, H2	2, 4
Spring Brook Stony Creek T6N R18E Sec.26 NW1/16 NE1/4	770300	6	COLD	COLD	COLD	PART	M	CON, BDAM, NPS	SED, TEMP, HAB	B4	4
White Creek T6N R18E Sec.22 NW 1/16 SW1/4	771100	1	COLD	COLD	COLD	PART	M	CON, BDAM, NPS	SED, TEMP, HAB	B4	4

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Unnamed Ditch T6N R19E Sec. 16 SW 1/16 SW1/4	771200	1									
Pebble Creek T6N R19E Sec. 16 SE1/16 SE1/4	771300	6	COLD	COLD	COLD	PART	M	NPS, SED, BDAM	HAB, TEMP	B3, H2, P2	2, 4
Brandy Brook T6N R18E Sec. 12 NE1/16 SE1/4	771400	5	COLD	COLD	COLD	PART	M	NPS, SED, BDAM	HAB, TEMP	B3, H2, P2	2, 4

References

1. Author Unknown 1980
2. Baseline 1999
3. Macroinvertebrate Data 1980
4. Southeast Fox Basin Fisheries Management Investigations on File

Table 26. Streams of the Sugar and Honey Creeks Watershed.

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Uses		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref
			Ex.	Pot.				Source	Impact		
Honey Creek (TMHC1) @Pleasant Lake Rd. T4N R16E Sec.36 SE1/16 NW1/4	751500	27	WWSF	WWSF	DEF	Part	M	CL,DCH,DRDG, HM	HAB,NUT,SED,MIG, HM,SC,TEMP	B2, H2, P2	1,2,3
Unnamed Perenial Stream A (TM1) T4 R17E Sec.31 NE1/16 NW 1/4	751500	0.9	COLD III	COLD III	DEF	Part	M	CON	SED	B2, H2, P2	1
Unnamed Perenial Stream B (TM2) T4N R17E Sec. 29 NW1/16 SW1/4	751500	1.9	WWFF	WWFF	DEF	Part	M	CL,DCH,NPS,SB	HAB,BAC,NUT,SED	B2, H2, P2	1
Unnamed Perenial Stream C (TM4) T4N R17E Sec. 29 SE1/16 NW1/4	751600	0.45	LFF	LFF	DEF	Full	M	CL,DRDG,DCH	HAB,BAC,NUT,SED	B2, H2, P2	1
Unnamed Perenial Stream D (TM5) T4N R17E Sec. 29 SE1/16 NE1/4	751900	1.2	LFF	LFF	DEF	Full	M	CL,DRDG,DCH	HAB,BAC,NUT,SED	B2, H2, P2	1
Unnamed Perenial Stream E (TM6) T4N R17E Sec.29 NE1/16 SE1/4	752100		WWFF	WWFF	DEF	Part	M	HM,DCH,DRDG, CL,NPS	SED,BAC,FLOW,HAB ,MIG,NUT,TEMP	B2, H2, P2	1
Honey Creek @Marsh Rd. T4N R17E Sec.27 SE1/16 NW1/4	752400		WWSF	WWSF	DEF	Full	M			B2	1
Unnamed Perenial Stream F (TM7) T4N R17E Sec.27 SW1/16 NE1/4	752500	5.9	WWFF	WWFF	DEF	Full	M	DCH	FLOW,TEMP	B2, H2, P2	1
Unnamed Intermittent Stream G (TM3) T4N R17E Sec.27 SW1/16 NE 1/4	752600	0.9									
Honey Creek (TMHC2) @CTH ES T4N R17E Sec.25 SE1/16 NW 1/4	752900										
Unnamed Ditch T4N R 17E Sec. 25 SE1/16 NW 1/4	753000	2									
Unnamed Ditch T4N R 17E Sec. 28 SW1/16 SW 1/4	753100	1									
Unnamed Ditch T4N R 18E Sec. 23 NW1/16 NW 1/4	753200	2									
Spring Creek T4N R 18E Sec. 23 NW1/16 NE 1/4	753500	6									
Unnamed Ditch T4N R18E Sec.24 SE 1/16 NE 1/4	753600	2									
Unnamed Ditch T4N R18E Sec.24 SE 1/16 NE 1/4	753700	3									

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Uses		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref
			Ex.	Pot.				Source	Impact		
Unnamed Ditch T4N R18E Sec.24 SE 1/16 NE 1/4	753900	0									
Unnamed Creek T3N R18E Sec.12 SE1/16 NW1/4	754000	2									
Unnamed Creek T3N R18E Sec.12 SE1/16 NW1/4	754500	3									
Sugar Creek T3N R18E Sec. 13 SE1/16 SE1/4	754600	27					M			B2, H2, P2	3
Spring Brook T3N R18E Sec. 13 NE1/16 SW1/4	754700	4									
Unknown Creek T3N R18E Sec.20 Se1/16 NW1/4	755000	2									
Unnown Creek T3N R 17E Sec. 20 SW 1/16 NE 1/4	755000	2									
Baker Creek T3N R 16E Sec.13 NE1/16 SW1/4	755000	5									
Unnamed Ditch T3N R19E Sec.19 NW1/16 NW1/4	755000	0									
Unnamed Ditch T3N R19E Sec.18 SW1/16 SW1/4		0									
Honey Creek T3N R19E Sec. 30 NE1/16 SE1/4		27									
Unnamed Creek T3N R17E Sec.17 NW1/16 NW1/4		0									

References

1. Galarneau, S. 1996. Non-point Source Priority Watershed Project - Stream Apprasial Report.
2. 1992 Fish Sample.
3. Toshner, S. 1999 Baseline Monitoring Sampling Site

Table 27. Streams of the Mukwonago River Watershed.

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Mukwonago River T5N R19E Sec.30 NE1/16 NW1/4	765500	17	COLD	COLD	ERW	PART	M	PSM, NPS, CON	HAB, SED, TEMP	B4, H2, P2	1, 5
Unnamed Ditch T5N R18E Sec.25 NE1/16 SE1/4	765600	2									
Unnamed Ditch T5N R18E Sec. 33 SW1/16 NW1/4	766100	1									
Lake Beulah Outlet T5N R18E Sec. 32 SE1/16 NE1/4	766300	2	WWSF	WWSF	DEF	PART	E	BDAM, NPS	SED, NPS	B1	5
Unnamed Ditch T5N R18E Sec.32 NW1/16 NE1/4	767300	0									
Unnamed Ditch T5N R18E Sec.32 NW1/16 NW1/4	767600	2	COLD	COLD		PART	M	DRDG,DCH, IRR, BDAM	NUT,TEMP, HAB, SED	B3, H2, P2	2, 5
Unnamed Creek T5N R18E Sec. 31 SW1.16 NE1/4	767700		WWSF	COLD	DEF	PART	M	BDAM, NPS	SED, HAB, TEMP	B3	5
Unnamed Creek T5N R18E Sec.31 NE1/16 NW1/4	767900		WWSF	COLD	DEF	PART	M	BDAM, NPS	SED, HAB, TEMP	B3	5
Unnamed Creek T5N R18E Sec.31 NW1/16 NW1/4	768100	1	WWSF	COLD	DEF	PART	M	BDAM, NPS	SED, HAB, TEMP	B3	5
Jericho Creek T5N R17E Sec.36 NW1/16 NE1/4	768300	6	COLD	COLD	DEF	PART	M	BDAM, CON, NPS	TEMP, HAB, SED	B3	3,4, 5
Unnamed Ditch T5N R17E Sec.13 NE1/16 SE1/4	768400	1	WWSF	COLD	DEF	PART	M	BDAM, CON, NPS	TEMP, HAB, SED	P3	5
Unnamed Ditch T4N R17E Sec.10 SE1/16 NW1/4	768900	3									

References

1. Seeburger,G. 1976
2. Kurz,J 1981
3. Author Unknown 1979
4. Wawrzyn, 1990
5. Southeast Fox Basin Fisheries Management Files

Table 28. Streams of the Upper Fox River Watershed.

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Brandy Brook/ T6N R18E Sec. 12 NE1/16 SE1/4	771400	4.8	COLD	COLD	COLD	PART	M	CL,HM,BY,PSB,URB, PSI,RS	HAB,PST,NUT,TEMP, FLOW,TOX,BAC	B2, H2, P2	1, 2, 5
Deer Creek/ T7N R20E Sec. 32 NE1/16 NW1/4	772900	8	LAL	WWSF	DEF	NOT	M	URB,HM,DCH,CL,SB, CON,PSI	NUT,HAB,TEMP,TOX, BAC,HM,PST	B2, H2, P2	1
Fox/Ill River/ T6N R19E Sec.16 NW1/16 SW1/4	742500	5.3	WWSF	WWSF	DEF	PART	M	CL,URB,HM,SB,CON, LF,NPS	HAB,HM,TOX,BAC, NUT	B2, H2, P2	1,2,3
Frame Park Creek/ T7N R19E Sec. 35 SE1/16 SW1/4	771650	2.5	LFF	LFF	DEF	PART	M	URB,HM,NPS,RS,SB,C L,LF,PSI	HAB,NUT,SED,SC,TOX ,BAC,HM,PST	B2, H2, P2	1,4
Intermittent Trib.(#UF003)/ T7N R20E Sec.17 NW1/16NW1/4	773200	0.66	WWSF	WWSF	DEF	PART	M	HM,DCH,CON,URB,N PS	TOX,BAC,HAB	B2, H2, P2	1
Intermittent Trib.(#UF007)/ T7N R20E Sec.8 NW1/16NW1/4	773300	1.12	WWSF	WWSF	DEF	PART	M	DCH,HM,RS	HAB,TOX,BAC	B2, H2, P2	1
Intermittent Trib.(#UF008)/ T7N R20E Sec.8 NW1/16NW1/4	773300	0.75	WWSF	WWSF	DEF	PART	M	CON,DCH,URB	HAB,TOX	B2, H2, P2	1
Intermittent Trib.(#UF010)/ T7N R20E Sec.20 NW1/16 NW1/4		0.6	WWSF	WWSF	DEF	PART	M	HM,DCH,CON,URB,N PS	HAB,TOX,BAC	B2, H2, P2	1
Intermittent Trib.(#UF009)/ T7N R20E Sec. 17 SW1/16 SW1/4		0.7	WWSF	WWSF	DEF	PART	M	HM,DCH,CON,URB,N PS	HAB,TOX,BAC	B2, H2, P2	1
Intermittent Trib./ T6N R18E Sec.12 NW1/16 SE1/4		2.5	COLD	COLD	COLD	PART	M	CL,HM,BY,PSB	HAB,PST,TOX,NUT, BAC,FLOW, TEMP	B2, H2, P2	1, 5
Intermittent Trib./ T6N R18E Sec.2 NW1/16 SW1/4		0.5	COLD	COLD	COLD	PART	M	HM, NPS, CL, SB	TEMP	B3	1, 5
Intermittent Trib./ T6N R18E Sec.2 SE1/16 SW1/4		2.5	COLD	COLD	COLD	PART	M	HM, CL, SB	PST, HAB, TOX, TEMP	B3, H2, P2	1, 5
Intermittent Trib./ T6N R18E Sec.2 SW1/16 SE1/4		1.5	COLD	COLD	COLD	PART	M	PSB,CL,SB,BY, HM	HAB,NUT,BAC	B3, H2, P2	1, 5
Intermittent Trib./ T6N R20E Sec.10 SE1/16 SE1/4		0.3	LAL	LAL	DEF	PART	M	URB,HM,CON	HAB,FLOW,TOX,PST,H M	B2, H2, P2	1
Intermittent Trib./ T6N 20E Sec.15 NW1/16 NW1/4		0.5									
Intermittent Trib./ T6N R20E Sec.16 NE1/16 SE1/4		1									

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Intermittent Trib./ T6N R20E Sec. 21 SW1/16 NE1/4		2									
Intermittent Trib./ T6N R20E Sec.9 SW1/16 NW1/4		1.3	LAL	LAL	DEF	PART	M	HM,URB,DCH	PST,HAB,TEMP,DO,NUT,TOX)	B2, H2, P2	1
Intermittent Trib./ T7N R19E Sec.12 NW1/16 NW1/4		0.3									
Intermittent Trib./ T7N R19E Sec.2 SE1/16 SE1/4		0.5									
Intermittent Trib./ T7N R19E Sec.24 NE1/16 SW1/4		2	LFF	LFF	DEF	PART	M	CON,DCH,URB	HAB,SED,TOX	B2, H2, P2	1
Intermittent Trib./ T7N R19E Sec.24 NW1/16 SE1/4		0.5	LAL	LAL	DEF	PART	M	URB,HM,DCH,CON	HAB,SED,TOX,MIG,HM	B2, H2, P2	1
Intermittent Trib./ T7N R19E Sec.24 SE1/16 NE1/4		0.8	LAL	LAL	DEF	PART	M	CL,DCH,CON,HM, URB	HAB,SED,TOX	B2, H2, P2	1
Intermittent Trib./ T7N R19E Sec.24 SE1/16 SW1/4		0.5	LAL	LAL	DEF	PART	M	URB,HM	HAB,SED,TOX	B2, H2, P2	1
Intermittent Trib./ T7N R20E Sec.19 SW1/16 NW1/4		0.5	LAL	LAL	DEF	PART	M	CON,DCH,URB,HM,CL	HAB,SED,TOX	B2, H2, P2	1
Intermittent Trib./ T7N R20E Sec.32 NE1/16 NE1/4	772900	1	WWSF	WWSF	DEF	PART	E	URB, DCH, SS	HAB, SED		1, 5
Intermittent Trib./ T7N R20E Sec.33 NE1/16 NW1/4		0.5									
Intermittent Trib./ T7N R20E Sec.34 NE1/16 SE1/4		0.5	LAL	LAL	DEF	PART	M	URB,DCH	HAB,TOX,HM	B2, H2, P2	1
Intermittent Trib./ T8N R20E Sec.31 SE1/16 SE1/4		2.3									
Intermittent Trib./ T8N R20E Sec.17 SE1/16 NE1/4		0.8									
Intermittent Trib./ T8N R20E Sec.19 NE1/16 NE1/4		6	LFF	WWSF	DEF	NOT	M	DCH,HM,CL,URB,HM, BY,CON	HAB,MIG,FLOW,TOX,NUT,BAC	B2, H2, P2	1
Intermittent Stream A./ T7N R19E Sec.15 SE1/16 SW1/4		0.5	LAL	LAL	DEF	PART	M	BY,HM,URB	FLOW,BAC,NUT,SED,TOX,HM	B2, H2, P2	1
Intermittent Stream A/ T7N R19E Sec.7 SW1/16 NW1/4	772100	0.5									

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Intermittent Stream B/ T7n R18E Sec.13 NW1/16 NW1/4		0.5	LAL	LAL	DEF	PART	E	DCH,CON,CL	HAB,FLOW	B2, H2, P2	1
Intermittent Stream C/ T7n R18E Sec.14 NW1/16 NE1/4		0.5	LAL	LAL	DEF	PART	M	CL,DCH,HM,CON,URB	SED,TOX,BAC,PST	B2, H2, P2	1
Intermittent Stream D/ T7N R18E Sec.14 SW1/16 NW1/4		0.5	LAL	LAL	DEF	PART	M	DCH,URB,SB	HAB,FLOW	B2, H2, P2	1
Intermittent Stream E/ T7n R18E Sec.22 NE1/16 NE1/4	772700	1									
Intermittent Stream F/ T7N R19E Sec.18 SE1/16 NW1/4		0.5	LAL	LAL	DEF	PART	M	URB,DCH,HM	HAB,FLOW,TOX,PST	B2, H2, P2	1
Pebble Creek/ T6N R19E Sec.16 NW1/16 SW1/4	771300	6.5	COLD	COLD	COLD	PART	M	CON,CL,HM,PSB, URB,BY	NUT,HAB,TOX,BAC, SED,HM	B2, H2, P2	1,2, 5
Pewaukee River/ T7N R19E Sec.26 SE1/16 NE1/4	771700	6.4	WWSF	WWSF	DEF	PART	M	DCH,CON,CL,BY, URB,HM,NPS,SS	HAB,NUT,SED,FLOW, BAC,TURB,TOX,PST	B2, H2, P2	1
Poplar Creek/ T7N R20E Sec.19 SW1/16 NE1/4	772800	7.5	WWSF	WWSF	DEF	PART	M	URB,SB,DCH,CL,CON ,RS,LF	HAB,NUT,SED,TOX,TURB,BAC	B2, H2, P2	1
Sussex Creek/ T7N R20E Sec.6 NE1/16 SW1/4	773400	10.9	WWSF	WWSF	DEF	PART	M	DCH,CL,HM,URB,PSI, NPS	HAB,FLOW,NUT,BAC, TOX,HM	B2, H2, P2	1
Unnamed Creek A/ T8N R20E Sec.20 SE1/16 SE1/4	773800	1.5									
Unnamed Creek A/ T6N R20E Sec.5 SW1/16 SE1/4	773100	5	WWSF	WWSF	DEF	PART	M	DCH,BY,CL,URB,HM	HAB,SED,NUT,TOX ,FLOW,BAC,PST,MIG	B2, H2, P2	1
Unnamed Creek A/ T7N R19E Sec.9 SW1/16NW1/4	771800	4.5	WWSF	WWSF	DEF	PART	M	DCH,CL,HM,NPS	HAB,NUT,SED,TOX, PST	B2, H2, P2	1
Unnamed Creek B/ T6N R20E Sec.5 SW1/16 SE1/4		0.5									
Unnamed Creek B/ T7N R19E Sec.15 SE1/16 SW1/4		1.5	WWSF	WWSF	DEF	PART	M	DCH,CL,URB,HM, CON	HAB,SB,FLOW,TOX, HM	B2, H2, P2	1
Coco Creek-East Branch/ T7N R19E Sec.6 SE1/16 NE1/4	772200	2	COLD	COLD	COLD	PART	M	BDAM, DCH, LF, URB	HAB, TEMP	B3, H2, P2	1, 5

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Coco Creek-West Branch/ T7N R19E Sec.6 SE1/16 NE1/4		2.3	COLD	COLD	COLD	PART	M	BDAM, DCH, LF, URB	HAB, TEMP	B3, H2, P2	1, 5
Unnamed Creek D/ T6N R20E Sec.6 NE1/16 SE1/4		4	LFF	WWSF	DEF	PART	M	CL,BY,SB,CL,PSB	HAB FLOW NUT BAC TOX(potential) PST SED	B2, H2, P2	1
Unnamed Creek- UF002/ T7N R20E Sec.8 NW1/16 NW1/4	773300	2	LFF	WWSF	No	NOT	E	URB,DCH,HM,CL	HAB	B2, H2, P2	1
Unnamed Creek- UF005/ T7N R20E Sec.17 NW1/16 NW1/4	773200	3	WWSF	WWSF	No	Part	M	CON,DCH,HM,CL	HAB	B2, H2, P2	1
Unnamed Creek/ T6N R18E Sec.12 NW1/16 SE1/4		0.8	COLD	COLD	COLD	PART	M	HM,DCH,DAM,CL, BDAM	HAB SED DO TEMP	B3, H2, P2	1, 5
Unnamed Creek/ T6N R18E Sec.2 SW1/16 NW1/4		1	COLD	COLD	COLD	PART	M	BY,CL,HM, BDAM	BAC MIG TEMP TOX(potential) FLOW	B3, H2, P2	1,5
Unnamed Creek/ T6N R19E Sec.6 SW1/16 NE1/4		2	COLD	COLD	COLD	PART	M	URB,DCH,HM,CON,NPS,SB	HAB TEMP DO TOX(potential) FLOW SED NUT BAC	B3, H2, P2	1, 5
Unnamed Creek/ T6N R19E Sec.8 NE1/16 SW1/4		2.5	COLD	COLD	COLD	PART	M	DCH,HM,URB,CON, SB,RS	HAB FLOW TOX(potential) SED NUT PST	B2, H2, P2	1, 5
Unnamed Creek/ T6N R20E Sec.5 NW1/16 NW1/4		2	LFF	WWSF	DEF	NOT	E	URB,DCH,HM,LF,CL	HAB TOX(potential) DO	B2, H2, P2	1
Unnamed Creek/ T7N R19E Sec.1 NE1/16 SE1/4		2.5	LFF	LFF	DEF	PART	M	DCH,CL,SED,URB,PSI	HAB TURB SED FLOW TOX(potential) BAC	B2, H2, P2	1
Unnamed Creek/ T7N R19E Sec.19 NW1/16 NW1/4	772300	1.3	WWSF	WWSF	DEF	PART	M	URB,HM,BDAM,SB,CON	HAB MIG TEMP DO NUT SED FLOW TOX(potential)	B2, H2, P2	1
Unnamed Creek/ T7N R19E Sec.7 NE1/16 NE1/4	772100	0.5	WWSF	WWSF	DEF	PART	M	LF,URB,CON,CL,HM, BY	HAB NUT DO SED TOX(potential) BAC	B2, H2, P2	1
Unnamed Creek/ T7N R20E Sec.17 NW1/16 NW1/4	773200	3	WWSF	WWSF	DEF	PART	M	URB,DCH,HM,CL	HAB	B2, H2, P2	1

Stream Name/Location at Mouth	WBIC	Length (mi)	Biological Use		Codified	Supp.	Assess.	Use Impairments		Data Level	Ref.
			Ex.	Pot.				Source	Impact		
Unnamed Creek/ T7N R20E Sec.8 NW1/16 NW1/4	773300	2	LFF	WWSF	DEF	NOT	E	HM,DCH,URB LF	SED HAB HM(potential) TOX(potential) ORG	B2, H2, P2	1
Unnamed Creek/ T8N R19E Sec.22 NE1/16 SW1/4		2	LFF	LFF	DEF	PART	E	CON,URB,HM,CL,DCH,BY	HAB FLOW SED TOX(potential) BAC	B2, H2, P2	1
Unnamed Creek/ T8N R19E Sec.26 NW1/16 NE1/4		1	LFF	LFF	DEF	PART	E	URB,DCH,HM	HAB MIG BAC FLOW TOX(potential)	B2, H2, P2	1
Unnamed Creek/ T8N R20E Sec.20 SE1/16 SE1/4	773800	1.5	LFF	WWSF	DEF						1
Unnamed Creek/ T8N R20E Sec.29 NE1/16 SE1/4	773700	2									
Unnamed Creek/ T8N R20E Sec. 29 SW1/16 SW1/4	773500	5	WWSF	WWSF	DEF	PART	M	SB,PSB,BY,CL,URB,CON,RS,HM	HAB SED TOX(potential) TEMP FLOW BAC	B2, H2, P2	1
Zion Creek/ T7N R18E Sec.13 SE1/16 SW1/4	772400	1.5	LFF	WWSF	DEF	NOT	M	URB,DCH,HM,CL,RS,SB	HAB MIG FLOW TEMP DO SED BAC TOX(potential)	B2, H2, P2	1

References

1. Aartila, T. 1990. Upper Fox River Water Quality Apprasial
2. Toshner S. 1999 Baseline Survey
3. Galarneau, S. 1996 Ambient Trend Monitoring
4. Wawrzyn, W. 1999. Sediment Investigation
5. Southeast Fox Basin Fisheries Management Investigations on File

Appendix B. Lakes of the Southeast Fox 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 data is unassessed or unavailable*.

LAKE NAME: All named and unnamed lakes are listed. 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.

COUNTY (CO): Indicates the county in which the lake is located.
TOWNSHIP, RANGE, SECTION: Lake locations are identified by township, range, and 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).

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.

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
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
XX Multiple fish populations have been tested for mercury content and a fish consumption advisory DOES EXIST due to mercury contamination.

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.

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.

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 29. Lakes of the Des Plaines River Watershed.

Name	County	Location T/R/S	Area (Acres)	Max Depth (ft)	Access	Lake Type	Winter kill	Self Help	Hg	MAC	LMO	TSI Class	Comments
BARBER POND	Kenosha	01 21E 30	2	5		DN	Y				N		
FRIENDSHIP LAKE	Kenosha	02 20E 12	11	9		DG	Y				N		
GEORGE LAKE	Kenosha	01 21E 20	59	16	R	DG		C		EM, PL	Y	EU	
HOOKER LAKE	Kenosha	01 20E 11	87	27	BR	DG		R		EM, PL	Y		
LAKE SHANGRILA -BENET	Kenosha	01 21E 31	154	24	BR	DN	Y	R			Y		
LEAGUE LAKE	Kenosha	02 20E 35	14	22		DN					N		
MONTGOMERY LAKE	Kenosha	01 20E 12	46	23	BR	DN	Y	C		EM, PL	Y	EU	
MUD LAKE	Kenosha	01 21E 32	22	15		DN	Y				N		
PAASCH LAKE	Kenosha	01 21E 29	21	20		DN	Y				N		
PADDOCK LAKE	Kenosha	01 20E 02	112	32	BR	DN		C		EM, PL	Y	ME	

Table 30. Lakes of the Lower Fox River Watershed.

Name	County	Location T/R/S	Area (Acres)	Max. Depth (ft)	Type	Winter kill	Access	Self Help	Hg	MAC	LMO	TSI Class	Comments
BOHNER LAKE	Racine	0219E 17	135	30	DG		BR	C	R/X	EM, PL	Y	48	
BROWNS LAKE	Racine	03 19E 34	396	50	DN		BR	R	R/X	EM	Y	46	
CAMP LAKE	Kenosha	01 20E 32	461	17	DG		BR	C		EM, PL	Y	53	
CENTER LAKE	Kenosha	01 20E 21	120	28	DG		BR	C		EM, PL	Y		
CROSS LAKE	Kenosha	01 20E 35	87	35	DN			R			N		
DYER LAKE	Kenosha	02 19E 30	56	13	DG	Y		R			N		
FLANAGAN LAKE	Kenosha	02 20E 30	16	24	SE			R			N		
LILLY LAKE	Kenosha	01 19E 11	87	22	SE		BR	C		EM, PL	Y	42	
PEAT LAKE	Kenosha	01 20E 32	92	8	DN	Y					N		
ROCK LAKE	Kenosha	01 20E 34	46	33	DN		T	C		EM, PL	N	45	
SILVER LAKE	Kenosha	01 20E 17	464	43	DG		BR	C	R/X	EM, PL	N	47	Zebra Mussels
VOLTZ LAKE	Kenosha	01 20E 36	52	24	DN			R		EM, PL	Y		

Table 31. Lakes of the White River and Nippersink Creeks Watershed.

Name	County	Location T/R/S	Area (Acres)	Max. Depth (ft)	Type	Winter kill	Access	Self Help	Hg	MAC	LMO	TSI Class	Comments
CEYLON LAGOON	Walworth						BR	R		EM			
COMO LAKE	Walworth	02 17E 26	946	9	SE		BR	C		EM, PL	Y		
GENEVA LAKE	Walworth	02 17E 36	5262	135	SP		BR	C	R/X	EM	Y	ME	Zebra Mussels
IVANHOE LAKE	Walworth	02 18E 34	42	10	DG		T	C		EM, PL	Y		
PELL LAKE	Walworth	01 18E 15	86	13	SE		BR	C		EM, PL	Y		
PETERKIN POND	Walworth												
POWERS LAKE	Walworth	01 18E 13	459	33	DG		BR	C		EM, PL	Y	ME	Zebra Mussels
TOMBEAU LAKE	Walworth	01 18E 24	35	26	DG		BR	C		EM, PL	Y		
BENEDICT LAKE	Kenosha	01 19E 19	78	38	DN			C			Y		
ELIZABETH LAKE	Kenosha	01 19E 32	638	32	DG		R	C	R/X	EM, PL	Y	ME	Zebra Mussels
LAKE MARY	Kenosha	01 19E 28	297	33	DN		BR	C	R/X	EM	Y	ME	

Table 32. Lakes of the Middle Fox River Watershed.

Lake Name	County	Location T/R/S	Area (Acres)	Max. Depth (ft)	Type	Winter kill	Access	Self Help	Hg	MAC	LMO	TSI Class	Comments
BASS BAY	Waukesha	05 20E 15	100	23	DG	Y	NW	C		EM	Y		
BIG MUSKEGO LAKE	Waukesha	05 20E 33	2260	4	DG	Y	BF	C		EM	Y	ME-EU	
BISANABI LAKE	Racine	0420E 18	13	9	SE			R			N		
BROCK LAKE	Racine	03 19E 16	13	12	DG	Y	NW	R			N		
BUENA LAKE	Racine	04 19E 23	108	8	DG		BR	R		PL	N		
EAGLE LAKE	Racine	03 20E 21	515	12	DG		BR	C	R/X	EM, PL	Y	EU	
ECHO LAKE	Racine	03 19E 32	71	11	DG		BR				N		
HAYSLOPE LAKE	Waukesha												
LAKE DENOON	Racine	04 20E 05	162	55	SE		BR	C	R/X	EM, PL	Y		
LEDA LAKE	Racine	03 19E 20	12	22	DN						N		
LINNIE LAC	Waukesha	06 20E 32	5	6	DG		BR				Y		
LITTLE MUSKEGO LAKE	Waukesha	05 20E 09	506	65	DG		BF	R	R	EM, PL	Y	EU	Zebra Mussels
LONG LAKE	Racine	03 19E 20	102	7	DG		W				N		
ROCKLAND LAKE	Racine	03 19E 33	40	28	DN		T	R		EM	N		
SAYLESVILLE MILLPOND	Waukesha	06 18E 25	45	4	DG		NW						
SPRING LAKE	Waukesha	05 18E 04	105	20	SE			R		EM	Y		
TICHIGAN LAKE	Racine	04 19E 14	1132	65	DG		BR	C	R/X	EM, PL	Y	EU	
WAUBEESEE LAKE	Racine	04 20E 08	129	75	DG		BR	C	R/X	EM, PL	Y	ME	Zebra Mussels
WILLOW SPRING LAIKE	Waukesha	05 18E 04	43	13	DG	Y		C			Y	ME	
WIND LAKE	Racine	04 20E 16	936	50	DG		BR	R	R/X	EM, PL	Y		Zebra Mussels

Table 33. Lakes of the Sugar and Honey Creeks Watershed.

Lake Name	County	Location T/R/S	Area (Acres)	Max. Depth (ft)	Type	Winter kill	Access	Self Help	Hg	MAC	LMO	TSI Class	Comments
DELMONTE LAKE	Racine	03 19E 18	4	5	DG	Y					N		
GREEN LAKE	Walworth		311	55								ME	
HONEY LAKE	Walworth	03 18E 13	44	6*	DH		T	R			Y		
MIDDLE LAKE	Walworth		259	42								ME	
MILL LAKE	Walworth		271	44								ME	
NORTH LAKE	Walworth	03 16E 05	191	11	SE	Y	R						
PLEASANT LAKE	Walworth	04 16E 24	155	29	SP		BR	C	R/X	EM, PL	Y	ME	
POTTER LAKE	Walworth	04 18E 11	162	26	SE		BR	C		PL	Y		
SILVER LAKE	Walworth	03 16E 14	85	3	SE	Y	T						
TAHOE LAKE	Racine	03 19E 18	6	3	DG	Y					N		
WANDAWEGA LAKE	Walworth	03 16E 02	119	8	SE	Y	BR			EM, PL			

Table 34. Lakes of the Mukwonago River Watershed.

Lake Name	County	Location T/R/S	Area (Acres)	Max. Depth (ft)	Type	Winter kill	Access	Self Help	Hg	MAC	LMO	TSI Class	Comments
ARMY LAKE	Walworth	04 18E 16	78	17	SP		T	R		EM, PL			
BEULAH LAKE	Walworth	04 18E 04	834	58	DG		BR	C	R	EM-W, PL	Y	EU	Zebra Mussels
BOOTH LAKE	Walworth	04 17E 13	113	24	SE		BR	C		EM, PL	Y	ME	
LULU LAKE	Walworth	04 17E 02	84	40	DG		NW	R		EM			
PETERS LAKE	Walworth	04 17E 17	64	8	SE	Y							
PICKEREL LAKE	Walworth	04 17E 13	30	31	SP		NW	R					
SWAN LAKE	Walworth	04 18E 18	27	7	SP								
SWIFT LAKE	Walworth	04 17E 08	19	8	SE	Y							
EAGLE SPRING LAKE	Waukesha	05 17E 36	311	8	DG	Y	BR	C		EM-W, PL	Y	ME-EU	
LOWER PHANTOM LAKE	Waukesha	05 18E 35	433	12	SE		BR	C		EM, PL	Y	ME	
RAINBOW SPRINGS LAKE	Waukesha	05 18E 31	25	16	SE	Y		R					
UPPER PHANTOM LAKE	Waukesha	05 18E 34	107	29	SE		NW	C		EM	Y	ME-EU	
WOOD LAKE	Waukesha	05 18E 33	20	22	SP			R					

Table 35. Lakes of the Upper Fox River Watershed.

Lake Name	County	Location T/R/S	Area (Acres)	Max. Depth (ft)	Type	Winter kill	Access	Self Help	Hg	MAC	LMO	TSI Class	Comments
PEWAUKEE LAKE	Waukesha	07 19E 09	2493	45	SP		BR	R	R	EM, PL	Y	ME-EU	Zebra Mussels

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

Common Name	Status	Group Name
BARN OWL	END	BIRD
FORSTER'S TERN	END	BIRD
SWAMP METALMARK	END	BUTTERFLY
SLENDER MADTOM	END	FISH
STARHEAD TOPMINNOW	END	FISH
STRIPED SHINER	END	FISH
BLANCHARD'S CRICKET FROG	END	FROG
SILPHIUM BORER MOTH	END	MOTH
CANADA HORSE-BALM	END	PLANT
FALSE HOP SEDGE	END	PLANT
HAIRY WILD-PETUNIA	END	PLANT
HEMLOCK PARSLEY	END	PLANT
PRAIRIE WHITE-FRINGED ORCHID	END	PLANT
PURPLE MILKWEED	END	PLANT
RAVENFOOT SEDGE	END	PLANT
ROUGH RATTLESNAKE-ROOT	END	PLANT
SMALL SKULLCAP	END	PLANT
SMOOTH PHLOX	END	PLANT
SQUARESTEM SPIKERUSH	END	PLANT
TUSSOCK BULRUSH	END	PLANT
WILD HYACINTH	END	PLANT
EASTERN MASSASAUGA RATTLESNAKE	END	SNAKE
WESTERN RIBBON SNAKE	END	SNAKE
ACADIAN FLYCATCHER	THR	BIRD
CERULEAN WARBLER	THR	BIRD
HENSLOW'S SPARROW	THR	BIRD
HOODED WARBLER	THR	BIRD
GREATER REDHORSE	THR	FISH
LONGEAR SUNFISH	THR	FISH
PUGNOSE SHINER	THR	FISH
REDFIN SHINER	THR	FISH
RIVER REDHORSE	THR	FISH
ELLIPSE	THR	MUSSEL
AMERICAN FEVER-FEW	THR	PLANT
BEAKED SPIKERUSH	THR	PLANT
BLUE ASH	THR	PLANT
FORKED ASTER	THR	PLANT
KITTEN TAILS	THR	PLANT
MARSH VALERIAN	THR	PLANT
PALE GREEN ORCHID	THR	PLANT
PRAIRIE INDIAN PLANTAIN	THR	PLANT
SEASIDE CROWFOOT	THR	PLANT
SMALL WHITE LADY'S-SLIPPER	THR	PLANT
STICKY FALSE-ASPHODEL	THR	PLANT

Common Name	Status	Group Name
WOOLY MILKWEED	THR	PLANT
YELLOW GENTIAN	THR	PLANT
YELLOW GIANT HYSSOP	THR	PLANT
BUTLER'S GARTER SNAKE	THR	SNAKE
BLANDING'S TURTLE	THR	TURTLE
BIRD ROOKERY	SC	OTHER
ADDER'S-TONGUE	SC	PLANT
AMERICAN GROMWELL	SC	PLANT
AUTUMN CORAL-ROOT	SC	PLANT
CAPITATE SPIKERUSH	SC	PLANT
CHRISTMAS FERN	SC	PLANT
COMMON BOG ARROW-GRASS	SC	PLANT
CRAWE SEDGE	SC	PLANT
CROSSLEAF MILKWORT	SC	PLANT
CUCKOOFLOWER	SC	PLANT
DOWNY WILLOW-HERB	SC	PLANT
EARLEAF FOXGLOVE	SC	PLANT
FARWELL'S WATER-MILFOIL	SC	PLANT
HAIRY BEARDTONGUE	SC	PLANT
INNOCENCE	SC	PLANT
KENTUCKY COFFEE-TREE	SC	PLANT
LARGE ROUNDLEAF ORCHID	SC	PLANT
LEAFY WHITE ORCHIS	SC	PLANT
LESSER FRINGED GENTIAN	SC	PLANT
LOW NUTRUSH	SC	PLANT
MANY-HEADED SEDGE	SC	PLANT
MARSH BLAZING STAR	SC	PLANT
MARSH HORSETAIL	SC	PLANT
OHIO GOLDENROD	SC	PLANT
PIN OAK	SC	PLANT
PRAIRIE SAGEBRUSH	SC	PLANT
PURPLE MEADOW-PARSNIP	SC	PLANT
REFLEXED TRILLIUM	SC	PLANT
ROCK STITCHWORT	SC	PLANT
SHOWY LADY'S-SLIPPER	SC	PLANT
SLENDER BOG ARROW-GRASS	SC	PLANT
SLENDER SEDGE	SC	PLANT
SMALL YELLOW LADY'S-SLIPPER	SC	PLANT
SPARSE-FLOWERED SEDGE	SC	PLANT
SWAMP AGRIMONY	SC	PLANT
SWAMP ROSE MALLOW	SC	PLANT
SWAMP-PINK	SC	PLANT
SYCAMORE	SC	PLANT
TUFTED HAIRGRASS	SC	PLANT
TWINLEAF	SC	PLANT
UPLAND BONESET	SC	PLANT
WAFER-ASH	SC	PLANT

Common Name	Status	Group Name
WAXLEAF MEADOWRUE	SC	PLANT
WHIP NUTRUSH	SC	PLANT
WILCOX PANIC GRASS	SC	PLANT
BULLFROG	SC/H	FROG
BLACK TERN	SC/M	BIRD
BLACK-CROWNED NIGHT-HERON	SC/M	BIRD
COMMON MOORHEN	SC/M	BIRD
GRASSHOPPER SPARROW	SC/M	BIRD
NORTHERN HARRIER	SC/M	BIRD
UPLAND SANDPIPER	SC/M	BIRD
BROAD-WINGED SKIPPER	SC/N	BUTTERFLY
DION SKIPPER	SC/N	BUTTERFLY
MULBERRY WING	SC/N	BUTTERFLY
SMOKEY EYED BROWN	SC/N	BUTTERFLY
TWO-SPOTTED SKIPPER	SC/N	BUTTERFLY
PRAIRIE CRAYFISH	SC/N	CRUSTACEAN
DOUBLE-STRIPED BLUET	SC/N	DRAGONFLY
FRAGILE FORKTAIL	SC/N	DRAGONFLY
LILYPAD FORKTAIL	SC/N	DRAGONFLY
BANDED KILLIFISH	SC/N	FISH
LAKE CHUBSUCKER	SC/N	FISH
LAKE HERRING	SC/N	FISH
LEAST DARTER	SC/N	FISH
PIRATE PERCH	SC/N	FISH
PUGNOSE MINNOW	SC/N	FISH
WEED SHINER	SC/N	FISH
FRANKLIN'S GROUND SQUIRREL	SC/N	MAMMAL
LIATRIS BORER MOTH	SC/N	MOTH
CALCAREOUS FEN	NA	COMMUNITY
CEDAR GLADE	NA	COMMUNITY
DRY PRAIRIE	NA	COMMUNITY
DRY-MESIC PRAIRIE	NA	COMMUNITY
EMERGENT AQUATIC	NA	COMMUNITY
FLOODPLAIN FOREST	NA	COMMUNITY
LAKE--DEEP, HARD, DRAINAGE	NA	COMMUNITY
LAKE--HARD BOG	NA	COMMUNITY
LAKE--SHALLOW, HARD, DRAINAGE	NA	COMMUNITY
LAKE--SHALLOW, HARD, SEEPAGE	NA	COMMUNITY
LAKE--SOFT BOG	NA	COMMUNITY
MESIC PRAIRIE	NA	COMMUNITY
NORTHERN WET FOREST	NA	COMMUNITY
OAK OPENING	NA	COMMUNITY
OPEN BOG	NA	COMMUNITY
SHRUB-CARR	NA	COMMUNITY
SOUTHERN DRY FOREST	NA	COMMUNITY
SOUTHERN DRY-MESIC FOREST	NA	COMMUNITY
SOUTHERN HARDWOOD SWAMP	NA	COMMUNITY

Common Name	Status	Group Name
SOUTHERN MESIC FOREST	NA	COMMUNITY
SOUTHERN SEDGE MEADOW	NA	COMMUNITY
SPRINGS AND SPRING RUNS, HARD	NA	COMMUNITY
STREAM--FAST, HARD, COLD	NA	COMMUNITY
STREAM--FAST, HARD, WARM	NA	COMMUNITY
TAMARACK FEN	NA	COMMUNITY
TAMARACK FEN	NA	COMMUNITY
WET PRAIRIE	NA	COMMUNITY
WET-MESIC PRAIRIE	NA	COMMUNITY
BOG RELICT	zNA	COMMUNITY