Chapter II. Resource Assessment

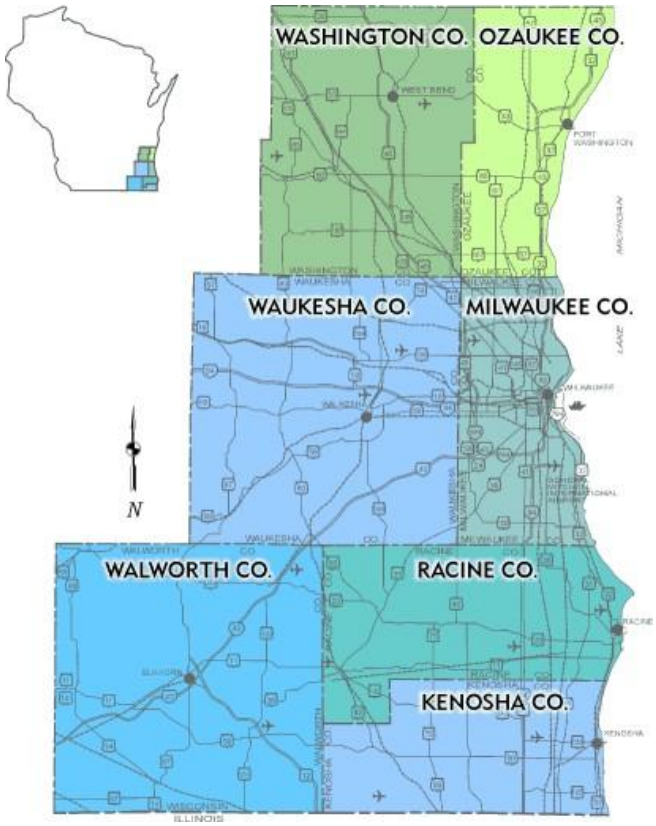
Introduction

Waukesha County is a rapidly urbanizing county bordering the west side of Milwaukee in southeastern Wisconsin, as shown in Figure II-1 below. The county is made up of 16 survey townships, covering approximately 580 square miles or 371,600 acres. Located within its borders are 37 municipalities, including 7 cities, 18 villages and 12 towns, as shown in Map II-1.

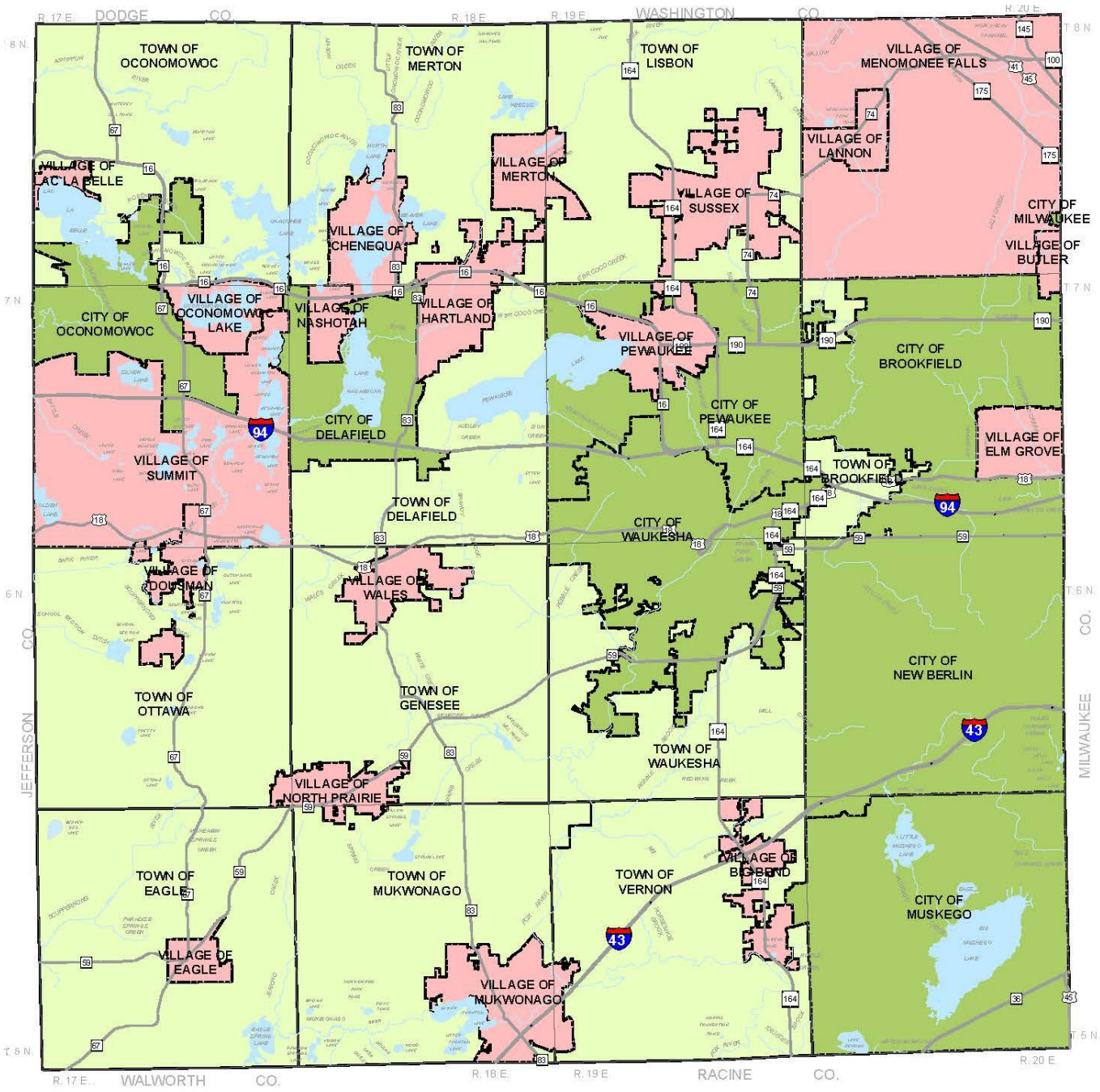
The natural resource base of Waukesha County is one of the most important factors influencing the quality of life and the economy for residents within the county and the region. Without sufficient understanding and recognition of the character and importance of the various elements of the natural resource base, human use and alteration of the natural environment proceeds at the risk of excessive costs in terms of both monetary expenditures and environmental degradation. A sound and meaningful planning effort must therefore acknowledge that natural resources are limited, and that land use decisions be properly adjusted to the natural resource base so that serious and costly environmental problems can be avoided.

This chapter presents descriptive information pertaining to the natural resource base of Waukesha County. This information was used by the LRD and the LWRM Plan Advisory Committees as a basis for identifying resource concerns and generating the goals and objectives presented in Chapter III.

Figure II-1
Location of Waukesha County



Map II-1
Waukesha County Municipalities



Legend

- VILLAGES
- CITIES
- TOWNS

N

0 1 2 Miles

0 4,000 8,000 12,000 16,000 Feet

Source: Waukesha County

Population

Current population estimates for the 37 municipalities and a cumulative total for the county are shown in Table II-1 below. Figure II-2 shows the population growth in Waukesha County between 1960 and 2010, as well as projections for 2035. Figure II-3 shows the number of households (see Appendix for definition) during this same time period. A projection of population and households is important for land use and public facility planning. Households directly influence the demand for urban land as well as the demand for transportation and other public facilities and services. Note that while the population of the county is projected to increase by 24% to 446,800 by 2035, the number of households is projected to increase by 29% to 174,100 due to the projected lower number of persons per household.

Table II-1
2011 Estimated Municipal Populations in Waukesha County

Municipality		2011 Population Estimates	Municipality		2011 Population Estimates
Town of:	Brookfield	6,109	Village of:	Big Bend	1,290
	Delafield	8,374		Butler	1,840
	Eagle	3,510		Chenequa	589
	Genesee	7,331		Dousman	2,304
	Lisbon	10,174		Eagle	1,948
	Merton	8,353		Elm Grove	5,941
	Mukwonago	7,972		Hartland	9,115
	Oconomowoc	8,474		Lac La Belle	290
	Ottawa	3,867		Lannon	1,106
	Vernon	7,600		Menomonee Falls	35,675
	Waukesha	9,133		Merton	3,364
				Mukwonago	7,272
City of:	Brookfield	37,890		Nashotah	1,391
	Delafield	7,092		North Prairie	2,146
	Muskego	24,168		Oconomowoc Lake	595
	New Berlin	39,594		Pewaukee	8,159
	Oconomowoc	15,805		Summit	4,671
	Pewaukee	13,294		Sussex	10,552
	Waukesha	70,735		Wales	2,544
			Waukesha County Total		**390,267**

Source: Wisconsin Department of Administration

The population and household projections were generated by the Southeastern Wisconsin Regional Planning Commission (SEWRPC) as part of the regional land use planning process. These estimates include natural increases in population (births/deaths) and net in-migration to the county from other areas, and represent the intermediate of three projections prepared by SEWRPC.

Figure II-3 shows that the number of households in the County increased by 42% between 1990 and 2010, representing a significant demand for land in the county, especially in the unsewered communities.

Figure II-2
Historical and Projected Population for Waukesha County: 1960-2035

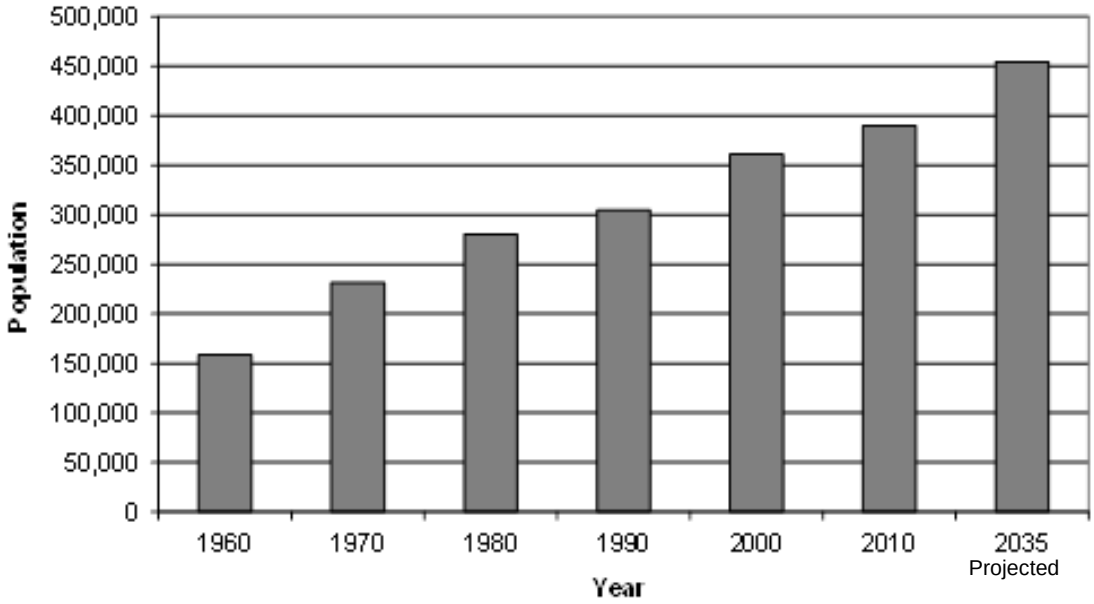
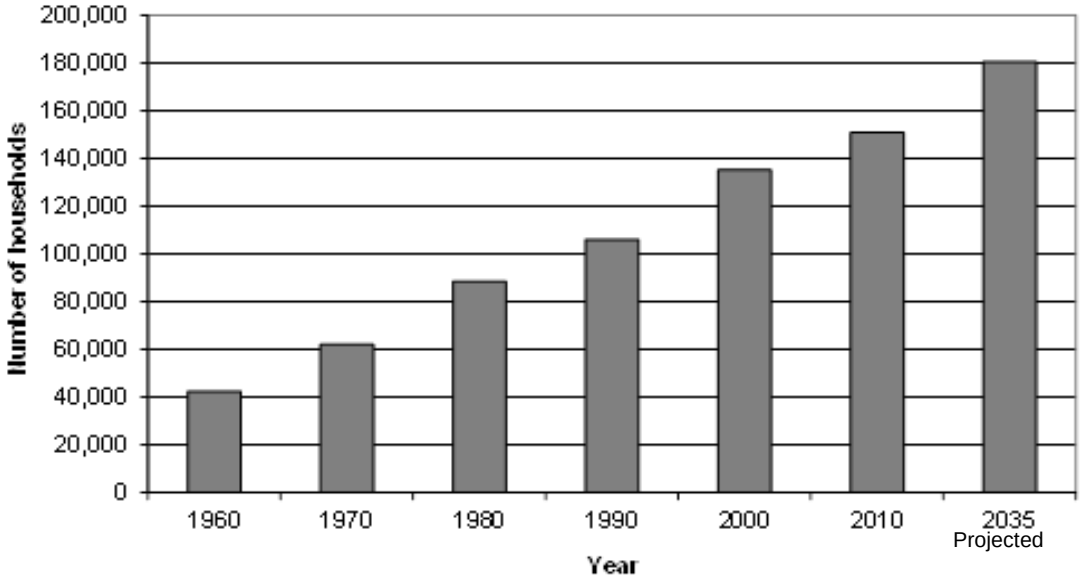


Figure II-3
Historical and Projected Number of Households for Waukesha County: 1960-2035



The remainder of this chapter will review the natural resource features and land use of the county. It should be noted that impacts on many of these resources have been and will continue to be directly or indirectly influenced by the population data presented above.

Geology and Physiography

Topographic elevation in Waukesha County, as depicted in Map II-2, ranges from approximately 730 feet above mean sea level in the extreme eastern portions of the County along tributaries of the Menomonee

River in Brookfield, Elm Grove, and Menomonee Falls, to 1,233 feet at Lapham Peak in the Town of Delafield, a variation of over 500 feet. Most of the high points in the County are located along the Kettle Moraine stretching southwest from the Town of Merton to the Town of Eagle.

Four major stages of glaciation, the last of which was the Wisconsin stage, ending approximately 10,000 years ago in the State, have largely determined the physiography, topography, and soils of Waukesha County. As noted above, the dominant physiographic and topographic feature in Waukesha County is the Kettle Moraine, an interlobate glacial deposit formed between the Green Bay and Lake Michigan lobes of the continental glacier that moved in a generally southerly direction from its origin in what is now Canada. The Kettle Moraine, which is oriented in a general northeast-southwest direction across the western half of the county, is a complex system of kames, or crudely stratified conical hills; kettle holes formed by glacial ice blocks that became separated from the ice mass and melted to form depressions and small lakes as the meltwater deposited material around the ice blocks; and eskers, long, narrow ridges of drift deposited in abandoned drainageways. The remainder of the County is covered by a variety of glacial landforms and features, including various types of moraines, drumlins, kames, outwash plains, and lake basin deposits.

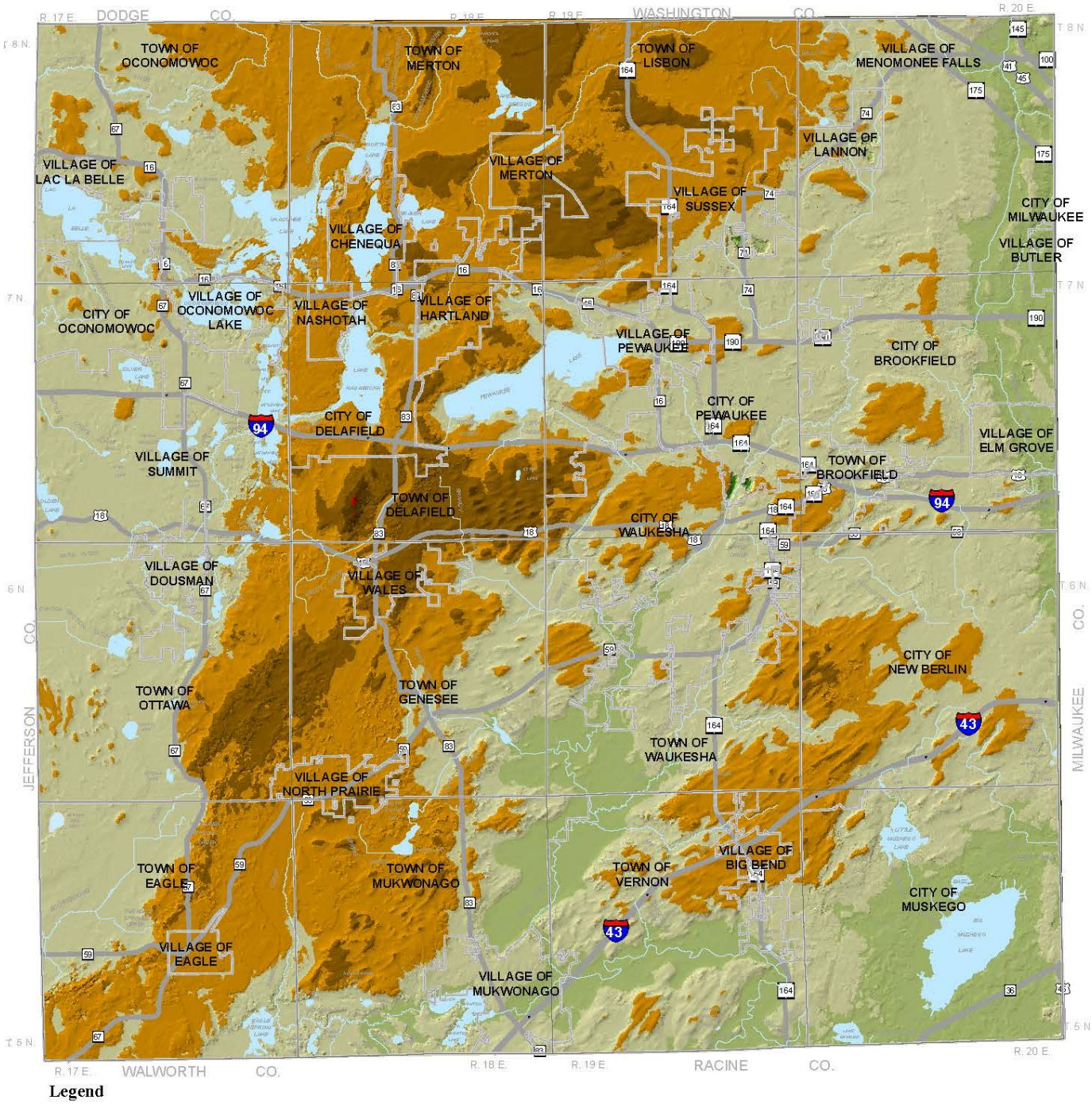
The combined thickness of unconsolidated glacial deposits, alluvium, and marsh deposits overlying bedrock exceeds 50 feet throughout most of the County, as shown in Map II-3. Thicknesses are greatest where glacial materials fill the bedrock valleys and in areas of topographic highs formed by end moraines. The most substantial glacial deposits, from 300 to 500 feet thick, are located in the northwestern part of the County in the lakes area and in portions of the Towns of Mukwonago and Vernon. The thinnest glacial deposits, often less than 20 feet thick, are found along an approximately six-mile-wide band traversing the County in a northeasterly direction from the Village of Eagle to the Villages of Lannon and Menomonee Falls.

Bedrock Geology

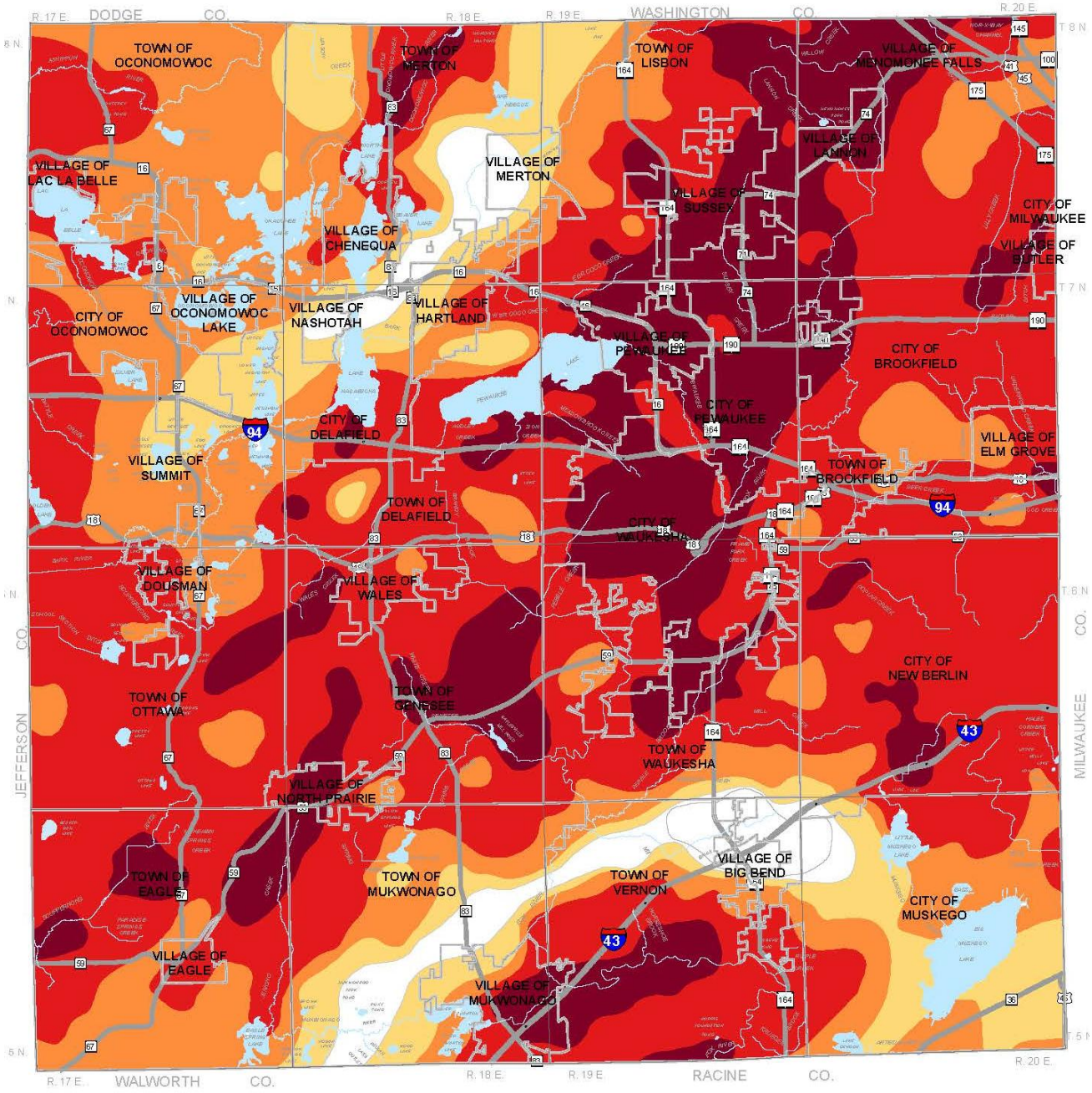
Bedrock topography was shaped by preglacial and glacial erosion of the exposed bedrock. The consolidated bedrock underlying Waukesha County generally dips eastward at a rate of about 10 feet per mile. The bedrock surface ranges in elevation from about 900 feet above mean sea level, at Lapham Peak, to approximately 500 feet above mean sea level in the eastern portion of the County. The bedrock formations underlying the unconsolidated surficial deposits of Waukesha County consist of Precambrian crystalline rocks; Cambrian sandstone; Ordovician dolomite, sandstone, and shale; and Silurian dolomite. Figure II-4 shows a generalized cross-section of the bedrock geology of Waukesha County. The uppermost bedrock unit throughout most of the County is Silurian dolomite, primarily Niagara dolomite, underlaid by a relatively impervious layer of Maquoketa shale, which acts as an aquitard – minimizing groundwater movement into the underlying materials. This is discussed further in the groundwater section. In some of the pre-Pleistocene valleys in the southwestern and central portions of the County, however, the Niagara dolomite is absent and the uppermost bedrock unit is the Maquoketa shale.

Geologic properties can influence the manner in which land is used, since geologic conditions, including the depth to bedrock, can affect the cost and feasibility of building site development and provision of public facilities and infrastructure. As noted in the following sections, the geology of the county can also play a significant role in resource management issues, such as groundwater and mineral extraction.

Map II-2
Topography of Waukesha County



Map II-3
Generalized Depth to Bedrock: Waukesha County



Legend

- 0-50'
- 50'-150'
- 150'-250'
- 250'-350'
- 350'-450'

N

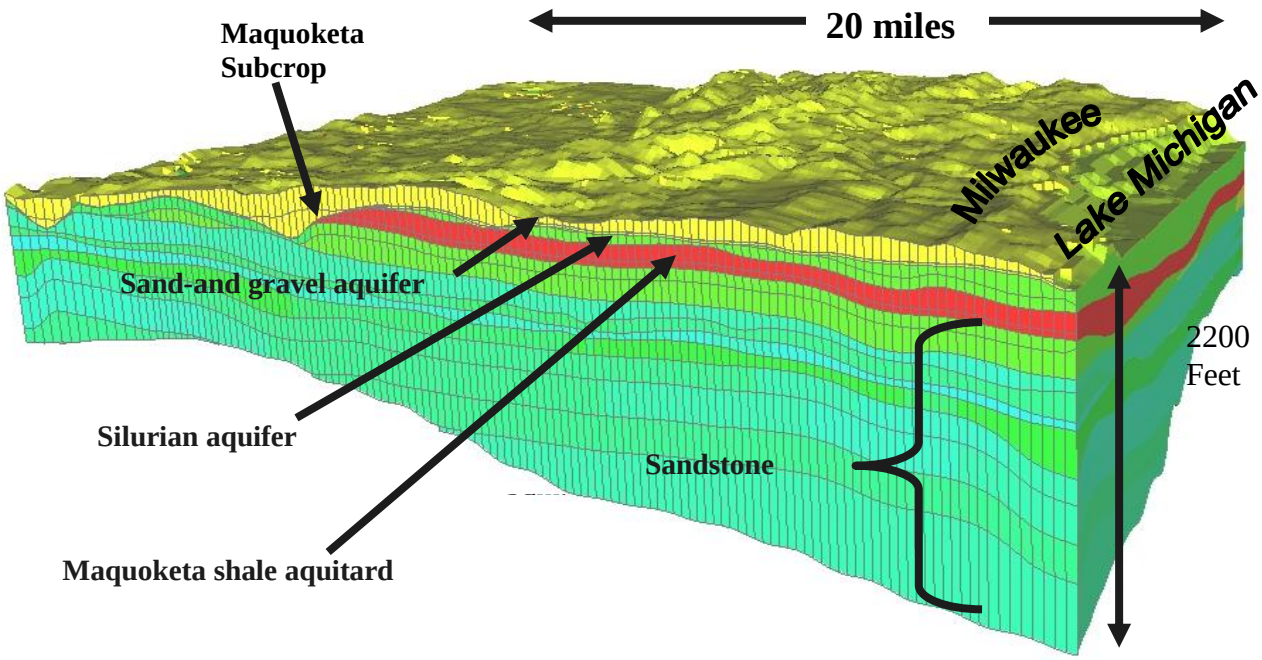
0 1 2 Miles

0 4,000 8,000 12,000 16,000 Feet

Source: Waukesha County & WGNHS

Figure II-4

General Hydrogeology of Southeast Wisconsin

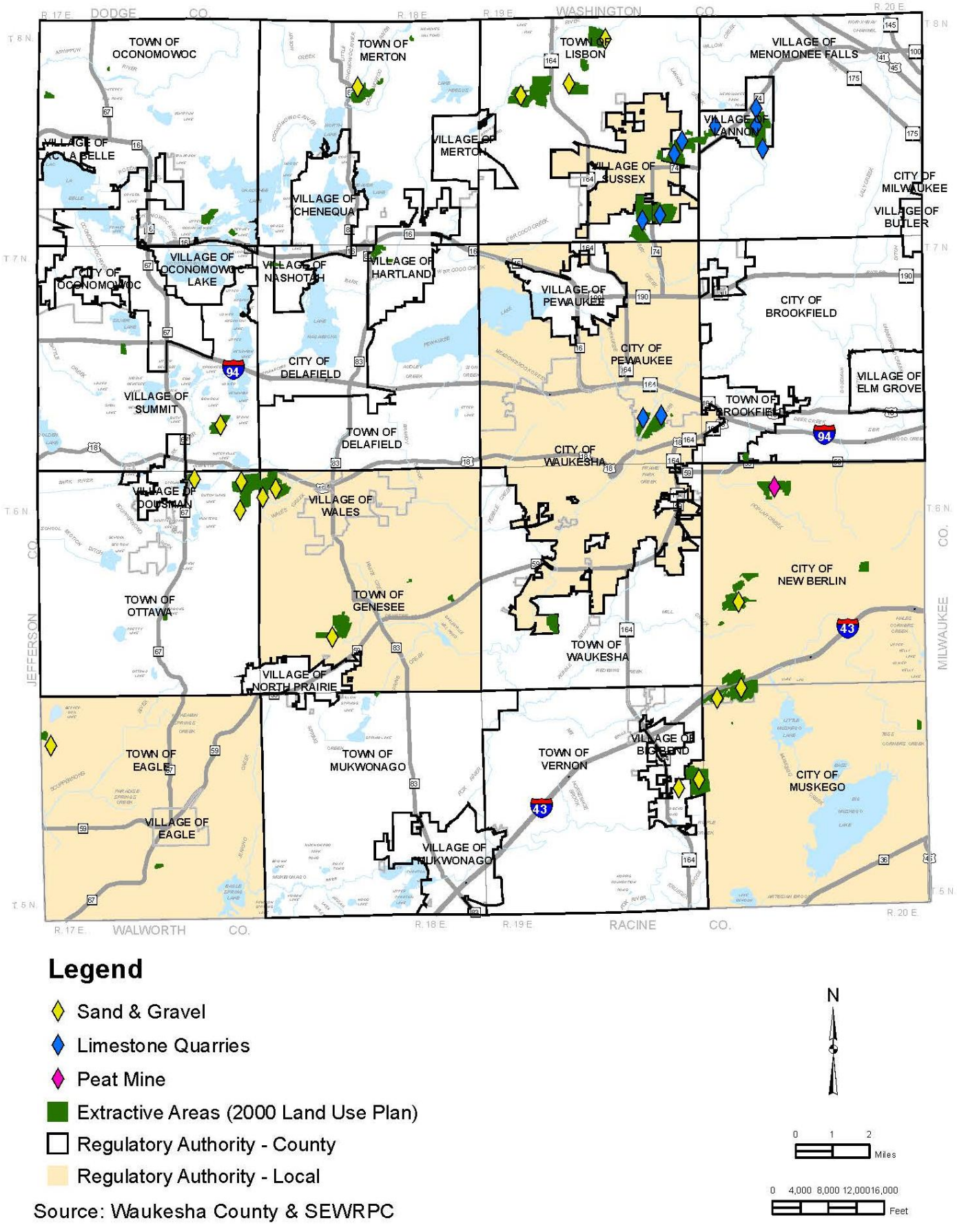


Nonmetallic Mineral Extraction in Waukesha County

In the case of potential mineral extraction areas, the geologic attributes of the County are a valuable and irreplaceable resource. Local land use planning efforts have recognized this fact by planning for future mine expansions and incorporating code provisions to avoid land use conflicts. The Waukesha County Mineral Extraction Advisory Committee (MEAC) was established in the mid-1990's to help facilitate these efforts.

In 2000 extractive land use in Waukesha County totaled about 4000 acres, or approximately 1.1 percent of the total area of the county. This area consists primarily of lands devoted to the extraction of sand, gravel and stone but also includes lands formerly used for such purposes and which lay idle in 2000. By state mandate, Waukesha County adopted a nonmetallic mine reclamation ordinance in 2001 that required new and existing mines to prepare and implement a reclamation plan. These reclamation plans will be implemented over a period of many years depending on the expected operational lifespan of the quarry or gravel pit. At present there are 28 permitted nonmetallic mining operations in the county, 16 issued by the LRD and 12 by other communities that have adopted reclamation ordinances. The general location and type of mining operation are shown in Map II-4. In total, there are currently 10 active limestone quarries, 17 sand and gravel pits and one peat mining operation in the county.

Map II-4
Extractive Areas of Waukesha County: 2012



Source: Waukesha County & SEWRPC

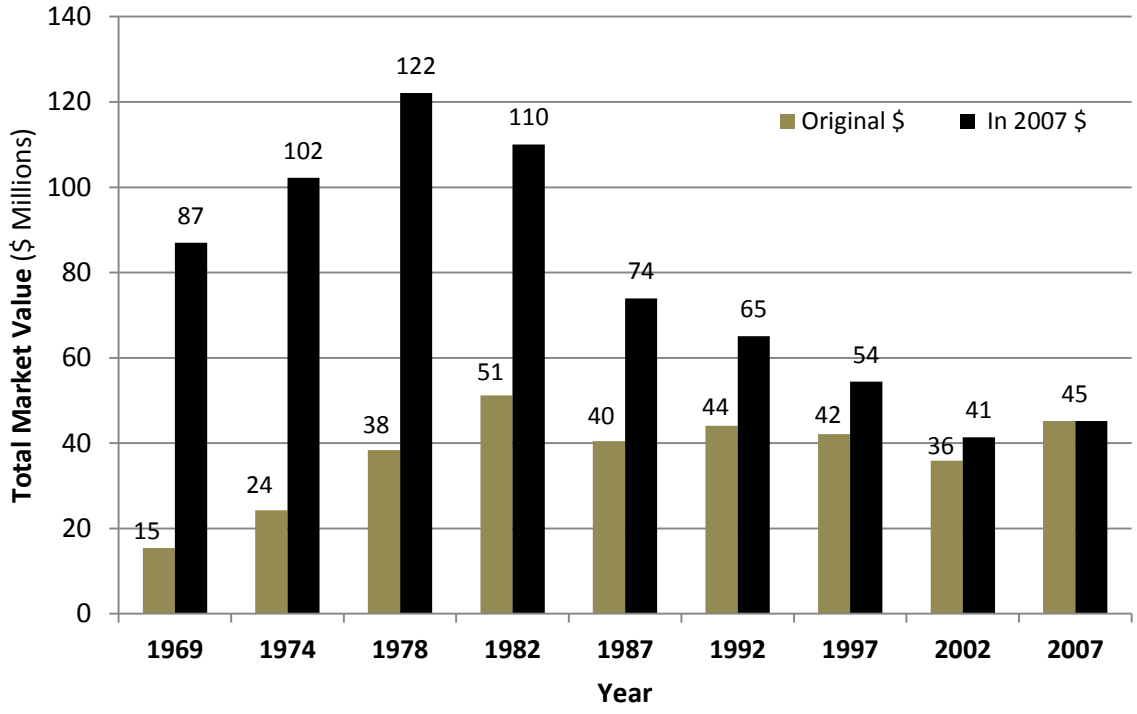
Soils

Soil properties exert a strong influence on the manner in which land is used, since they affect the costs and feasibility of building site development and provision of public facilities. Soils are also an invaluable resource for agricultural and landscaping purposes. Soil surveys have provided definitive data on the physical, chemical, and biological properties of the soils and interpretations of the soil properties for planning, engineering, agricultural and resource conservation purposes. Due to the glaciations of the county, the soil parent material is primarily composed of variations of glacial deposits, with accumulated organics making up most of the lowlands. Soil types vary considerably across the county due to the variations in parent material. For example, the Green Bay glacial lobe left a denser till with higher clay content along the eastern portion of the county, while west of the Kettle Moraine is primarily made up of a more course textured outwash material. Below is a review of some of the soil features, uses and limitations in Waukesha County.

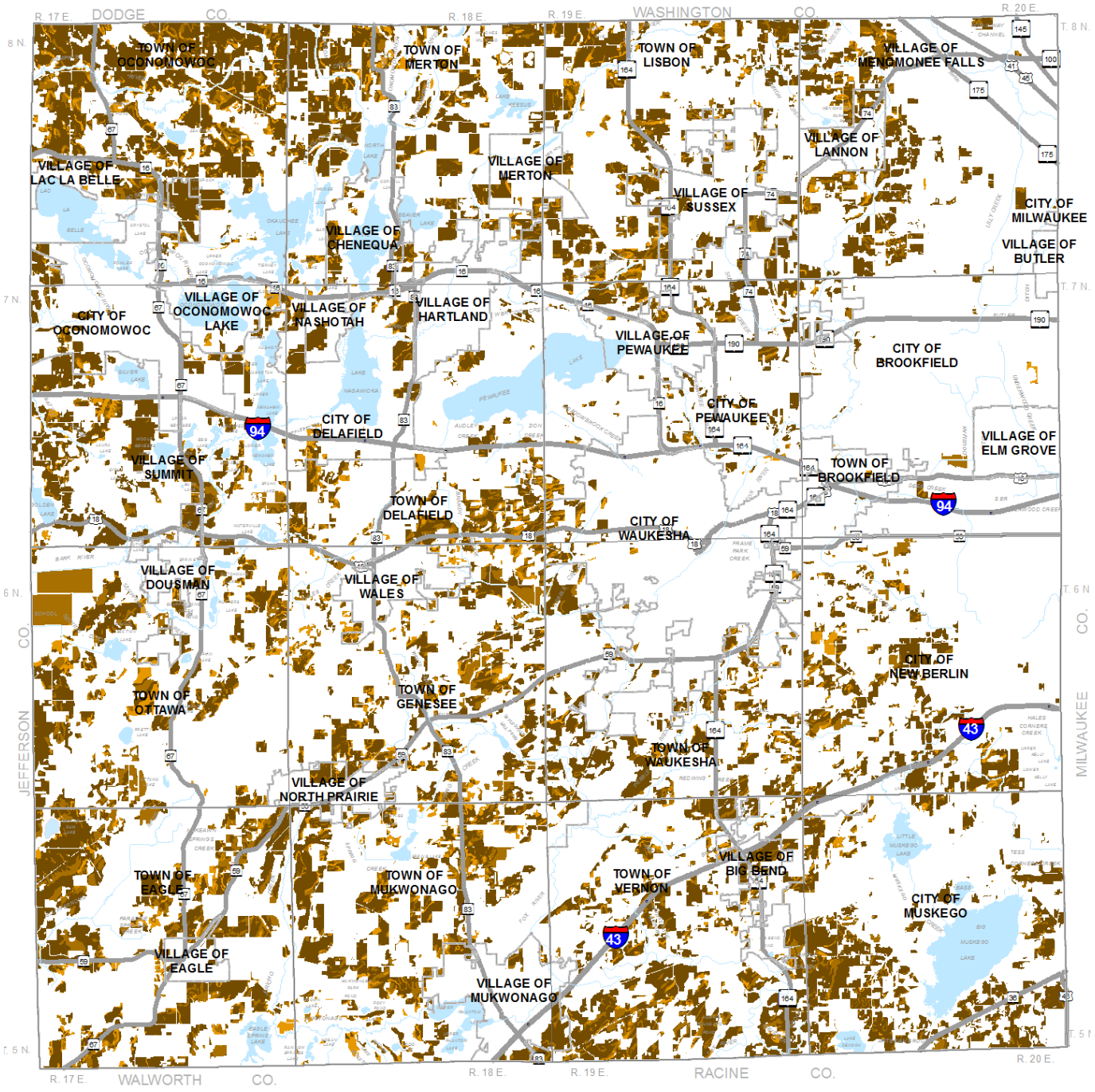
Agricultural Soil Classification and Production

Map II-5 shows the lands in agricultural uses in Waukesha County in 2010 and the classification of those soils for agricultural purposes. This map is based on a generalized agricultural inventory conducted by the LRD during the update of the county Farmland Preservation Plan in 2010. This map shows that 85,526 acres or 23% of the county was in agricultural uses in 2010. Of this total, approximately 70% are classified as "prime" agricultural soils, 19% are classified as "Soils of Statewide Importance, and 11% fall into the "other" category, usually due to steep slopes, high groundwater or droughty soils. These inventory results show there has been a dramatic 57% loss in agricultural lands in the county since 1963. More information on the land use changes is provided near the end of this chapter. Figure II-5 shows that the value of agricultural products sold remained relatively steady over the last three decades without an inflationary adjustment. However, when adjusted for inflation, 2007 sales reflect a 63% reduction over the last 30 years.

Figure II-5
Market Value of Agricultural Products Sold
Waukesha County 1969 - 2007



Map II-5
Agricultural Land Use and Classification - Waukesha County: 2010



Legend

- NRCS Prime Agricultural Soils Group
- Soils of Statewide Importance
- Other Soils

N

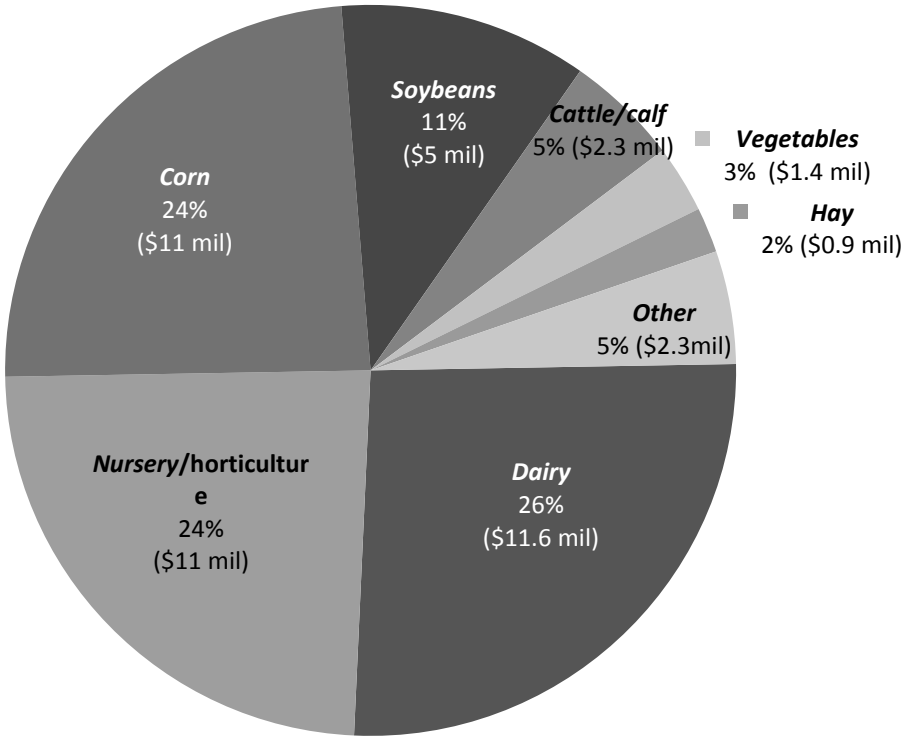
0 1 2 Miles

0 4,000 8,000 12,000 16,000 Feet

Source: Waukesha County & NRCS

Figure II-6 shows how the 2007 agricultural products sold in the county breaks down into the main product categories. It shows almost a three way tie between corn, dairy and nursery/horticultural products – all in the $11 million range. The next closest category is soybean at $5 million, with the remainder groups all a fraction of this.

Figure II-6
Percentage and Market Value of Agricultural Products Sold
Waukesha County: 2007



Source: USDA, National Agricultural Statistics Service

Soil Erosion Rates

Soils also vary in their individual susceptibility to erosion depending on a number of factors including: parent material, vegetative cover, slope, and most all - management. Tolerable soil loss or "T" for a particular soil is the theoretical maximum rate of soil erosion that will permit a high level of crop production without depleting the soil profile. In Waukesha County, "T" values for the different soil types range from 2-5 tons per acre per year.

For decades, conservationists have used a mathematical formula to estimate the amount of soil lost annually from sheet and rill erosion on cropland. The Universal Soil Loss Equation (USLE) takes into consideration the following factors: rainfall, slope, slope length, soil erodibility, crop rotations and crop practices to arrive at an estimate of soil loss. The Revised Universal Soil Loss Equation – version 2 (RUSLE2)

is the current mathematical model also used for soil erosion calculations. It is a software model that incorporates additional years of research in to the soil loss predictions it calculates and is the model prescribed for conservation planning under Chapter ATCP 50 Wisconsin Administrative Code. To determine average soil erosion rates on county cropland, the Land Resources Division conducted its first Transect Survey in the spring of 1999. Normally, this type of survey collects soil loss information for individual cropland fields randomly selected in 0.5-mile intervals along a predetermined driving route in rural areas. However, due to the amount of development in Waukesha County, the interval needed to be shortened to every 0.3-miles in order to obtain the necessary number of sample points for a statistically valid survey. The methodology has been utilized in other states and has proven to be 90% accurate (+/- 5%) in estimating overall soil erosion rates from cropland. The Transect Survey was repeated in 2001. Both results indicated that nearly 90% of the cropland in Waukesha County is less than or equal to "T" or the tolerable soil loss rate. It should be noted however, that "T" is not a water quality standard. An additional 7% of the cropland was determined to be at 1-2 times the T value. The weighted average tolerable soil loss for Waukesha County was 4.2 tons per acre. The weighted average tolerable soil loss is based upon the percentage of sample points in the transect survey with different values for "T". For example, the 2001 Transect Survey conducted in Waukesha County indicated that 2% of the sample points had an average tolerable soil loss (T) of two tons per acre per year, 10% had a T of 3 tons/ac, 58% had a T of 4 tons/ac, and 30% had a T of 5 tons/ac. Survey results also indicated that the average soil loss from cropland was 1.5 tons/ac. This is calculated by examining the soil loss at each sample point in the survey. In 2001 there were 677 sample points examined. Due to the continuing loss of sample points to housing developments, it is uncertain if a Transect Survey can be repeated in future years. It does indicate however, that soil erosion from lands under development is an ongoing issue to be addressed. Studies have shown that an average construction site with no erosion control measures in place erodes 30 tons of sediment per acre. Much of this is delivered to nearby waterways through efficient delivery systems including road ditches and storm sewers.

Over the years, several programs at the state and federal level have been successful in getting agricultural landowners to do conservation planning for soil loss reduction. These programs include the Oconomowoc River, Upper Fox River, and Muskego-Wind Lakes Priority Watersheds, the Farmland Preservation Program, and the Federal Farm Bill with its conservation planning requirements for Highly Erodible Land (HEL) and the Conservation Reserve Program (CRP). It is believed that these program efforts have contributed to the high percentage of farmland currently within tolerable soil erosion rates.

Soil Limitations for Development

Map II-6 shows the primary soil features that present limitations for land development, including depth to water table and bedrock and steep slopes. Hydric soils generally have seasonal depth to water table of 1 foot or less and are capable of supporting wetland vegetation. A more detailed definition is provided in Appendix A. Poorly drained soils have seasonal depth to water table of 3 feet and are concentrated on the eastern part of the county where many of the soils have a high clay content, often causing a perched water table condition. Shallow water table conditions risk groundwater contamination from on-site septic systems and could cause wetness problems for dwellings with basements. Shallow bedrock conditions pose higher construction costs for basements and also risk groundwater contamination from on-site septic systems because of the lack of a filtering soil layer. Steep slopes represent possible increased grading costs and higher risks for soil erosion during land development activities. Note that steep slopes are concentrated near the Kettle Moraine area. Shallow bedrock is concentrated near the northeast part of the county, where a number of quarry operations are also located, as noted earlier.

Map II-6
Soil Limitations for Development: Waukesha County

Legend

- Hydric Soils (< 1 foot to water table)
- Poorly Drained Soils (< 3 feet to watertable)
- Bedrock < 6'
- Slopes > 12%

N

0 1 2 Miles

0 4,000 8,000 12,000 16,000 Feet

Source: Waukesha County & NRCS

Woodlands & Wetlands

Woodlands

Woodlands have both economic and ecological value and can serve a variety of uses providing multiple benefits. Located primarily on ridges and slopes and along streams and lakeshores, woodlands provide an attractive natural resource, accentuating the beauty of the lakes, streams, and the topography of the County. Under balanced use and sustained yield management, woodlands can, in many cases, serve scenic, wildlife, educational, recreational, environmental protection, and forest production benefits simultaneously. In addition to contributing to clean air and water, groundwater recharge and soil conservation, woodlands contribute to the maintenance of a diversity of plant and animal life and provide for important recreational opportunities.

According to the land use inventory prepared by SEWRPC in 2000, woodlands covered approximately 28,931 acres or about 7.7 percent of the County as shown in Table II-7. As indicated on Map II-7, these woodlands exist in large contiguous areas along the Kettle Moraine in the western half of the County and in scattered small areas throughout the remainder of the County. An update of this land use inventory from SEWRPC is scheduled to be completed at the end of 2012.

Wetlands

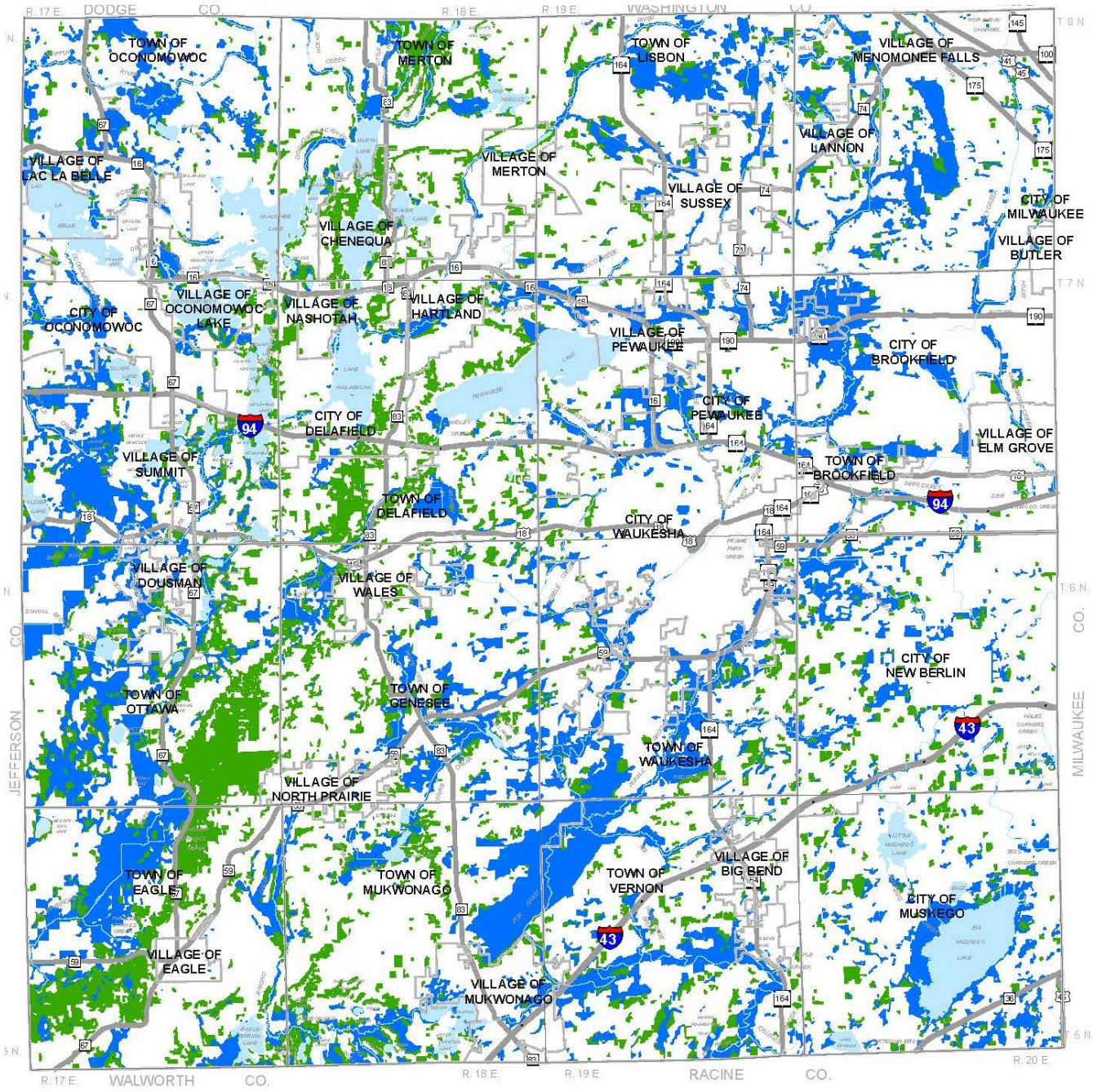
Wetlands perform an important set of natural functions, which make them particularly valuable resources lending to overall environmental health and diversity. Wetlands contribute to the maintenance of good water quality by serving as traps that retain nutrients and sediments, thereby preventing them from reaching streams and lakes. They act to retain water during dry periods and hold it during flooding events, thus keeping the water table high and relatively stable. Some wetlands provide seasonal groundwater recharge or discharge. Those wetlands that provide groundwater discharge often provide base flow to surface waters. They provide essential breeding, nesting, resting, and feeding grounds and predator escape cover for many forms of fish and wildlife. These attributes have the net effect of improving general environmental health; providing recreational, research, and educational opportunities; maintaining opportunities for hunting and fishing; and adding to the aesthetics of an area.

Wetlands pose severe limitations for urban development. In general, these limitations are related to the high water table, and the high compressibility and instability, low bearing capacity, and high shrink-swell potential of wetland soils. These limitations may result in flooding, wet basements, unstable foundations, failing pavements, and failing sewer and water lines. Moreover, there are significant and costly onsite preparation and maintenance costs associated with the development of wetland soils, particularly in connection with roads, foundations, and public utilities. As indicated on Map II-7, wetlands are scattered throughout the County and total approximately 52,661 acres or about 14 percent of the County. See Table II-7. Most of these areas are regulated under state and local codes that restrict development.

Environmental Corridors and Isolated Natural Resource Areas

The most important elements of the natural resource base of the County, including the best remaining woodlands, wetlands, prairies, wildlife habitat, surface water and associated shorelands and floodlands, and related features, including existing park and open space sites, scenic views, and natural areas and critical species habitat sites, occur in linear patterns in the landscape, termed “environmental corridors.” The most important of these have been identified as “primary environmental corridors,” which are by definition at least two miles long, 200 feet wide, and 400 acres in area. Primary environmental corridors are generally located along river and major stream valleys, around major inland lakes, and in the Kettle Moraine. The preservation of these corridors is considered essential to the overall environmental quality of the County and the maintenance of its unique cultural and natural heritage and natural beauty. Because

Map II-7
Major Wetlands and Woodlands in Waukesha County



Source: Waukesha County & SEWRPC

these corridors are generally poorly suited for urban development owing to soil limitations, steep slopes, or flooding potential, their preservation will also help to avoid the creation of new environmental and developmental problems.

In addition to primary environmental corridors, other concentrations of natural resources—referred to as "secondary environmental corridors" and "isolated natural resource areas"—have been identified as warranting strong consideration for preservation. Secondary environmental corridors contain a variety of resource features and are by definition at least one mile long and 100 acres in area. Isolated natural resource areas are concentrations of natural resources of at least five acres in size and 200 feet in width that have been separated from the environmental corridor network by urban or agricultural uses.

Groundwater Resources

Groundwater is a vital natural resource of Waukesha County, which not only sustains lake levels and wetlands and provides the perennial base flow of the streams, but also is a major source of water for local communities. In Waukesha County, any discussion of groundwater should be prefaced on which aquifer is being referenced since the issues with each are different. Below is a brief explanation of the local aquifers.

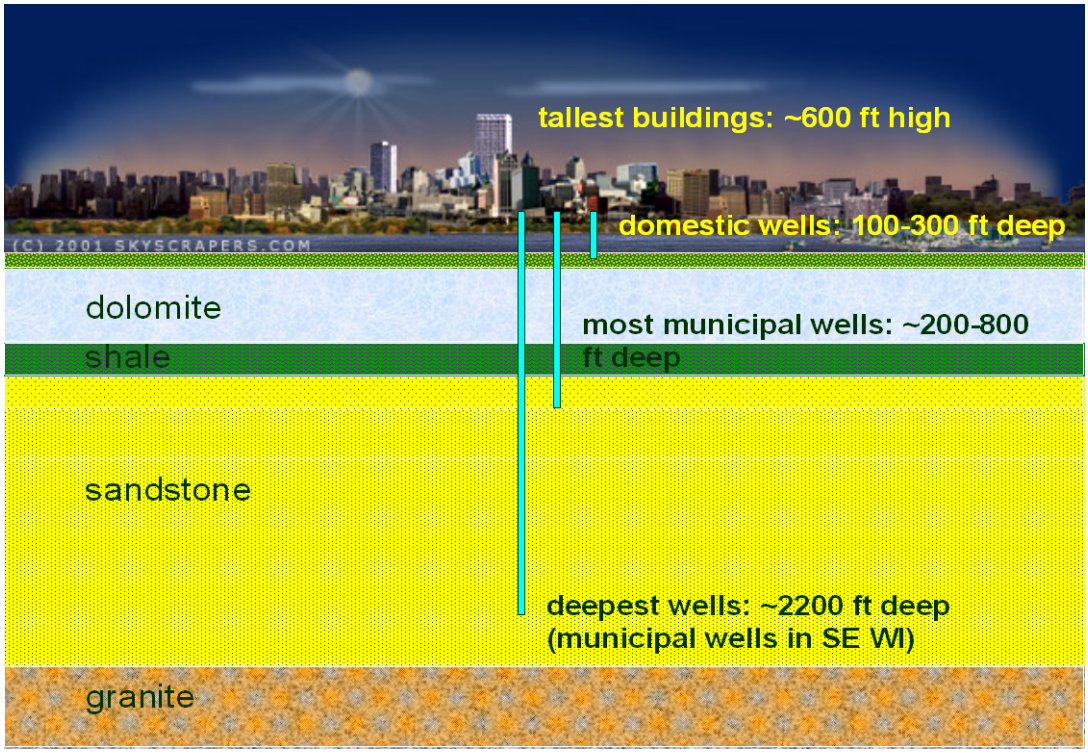
Groundwater Aquifers

Three major aquifers underlie Waukesha County. From the land's surface downward, they are: 1) the sand and gravel deposits in the glacial drift; 2) the shallow dolomite strata in the underlying bedrock; and 3) the deeper sandstone, dolomite, siltstone, and shale strata. Because of their proximity to the land's surface and hydraulic interconnection, the first two aquifers are commonly referred to collectively as the "shallow aquifer," while the latter is referred to as the deep aquifer. The "water table" represents the upper limit of the shallow aquifer, or the beginning of the zone of saturation, and is generally responsible for maintaining stream base flows during dry weather periods and lake water levels in many area lakes. Within most of the County, the shallow and deep aquifers are separated by the Maquoketa shale, which forms a relatively impermeable barrier between the two aquifers (see Figure II-4). That shale layer is absent in the far western portion of the County, representing the recharge area for the deep aquifer. Map II-8 shows a generalized depiction of this recharge area. Figure II-7 depicts the typical well depths as they relate to the groundwater aquifers.

Groundwater Use

The importance of groundwater as a source of water supply in Waukesha County and Southeastern Wisconsin can be shown by analyzing water-use data. According to estimates by the U.S. Geological Survey, water use in Waukesha County in 2005 was approximately 37 million gallons per day (see Table II-2). About 32 mgd, or about 86 percent, was withdrawn from groundwater sources, and 5 mgd, or about 14 percent, from surface water, or Lake Michigan (see Table II-3). Until 2005, nearly all of the water supply in Waukesha County was obtained from the groundwater system. Due to over-pumping of the deep aquifer, the eastern portion of the Village of Menomonee Falls, the Village of Butler, and the eastern portion of the City of New Berlin switched to Lake Michigan water between 1999 and 2005. Table II-3 shows that total water use in the county rose about 19% between 1985 and 2005, from 31 mgd to almost 37 mgd. During this same time period, county population growth was about 29%.

Figure II-7
Relative Well Depths for Waukesha County



Source: SEWRPC

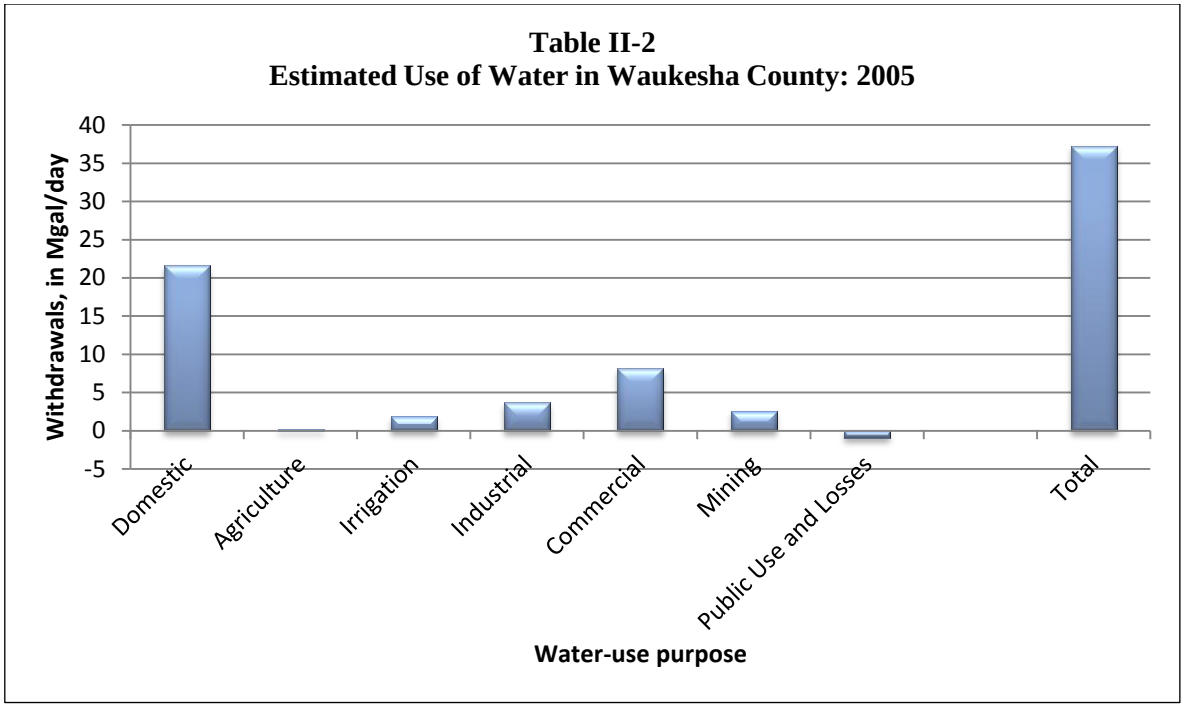
Groundwater Availability

Recharge to groundwater is derived almost entirely from precipitation. Much of the groundwater in shallow aquifers originates from precipitation that has fallen and infiltrated within a radius of about 20 or more miles from where it is found. The deeper sandstone aquifers are recharged by downward leakage of water through the Maquoketa Formation from the overlying aquifers or by infiltration of precipitation beyond the western edge of the County where the sandstone aquifer is not overlain by the Maquoketa Formation and is unconfined (see Map II-8).

On the average, precipitation annually brings about 32 inches of water to the surface area of the County. It is estimated that approximately 80 percent of that total is lost by evapotranspiration. Of the remaining water, part runs off in streams and part becomes groundwater. It is likely that the average annual groundwater recharge to shallow aquifers is 10 to 15 percent of annual precipitation.

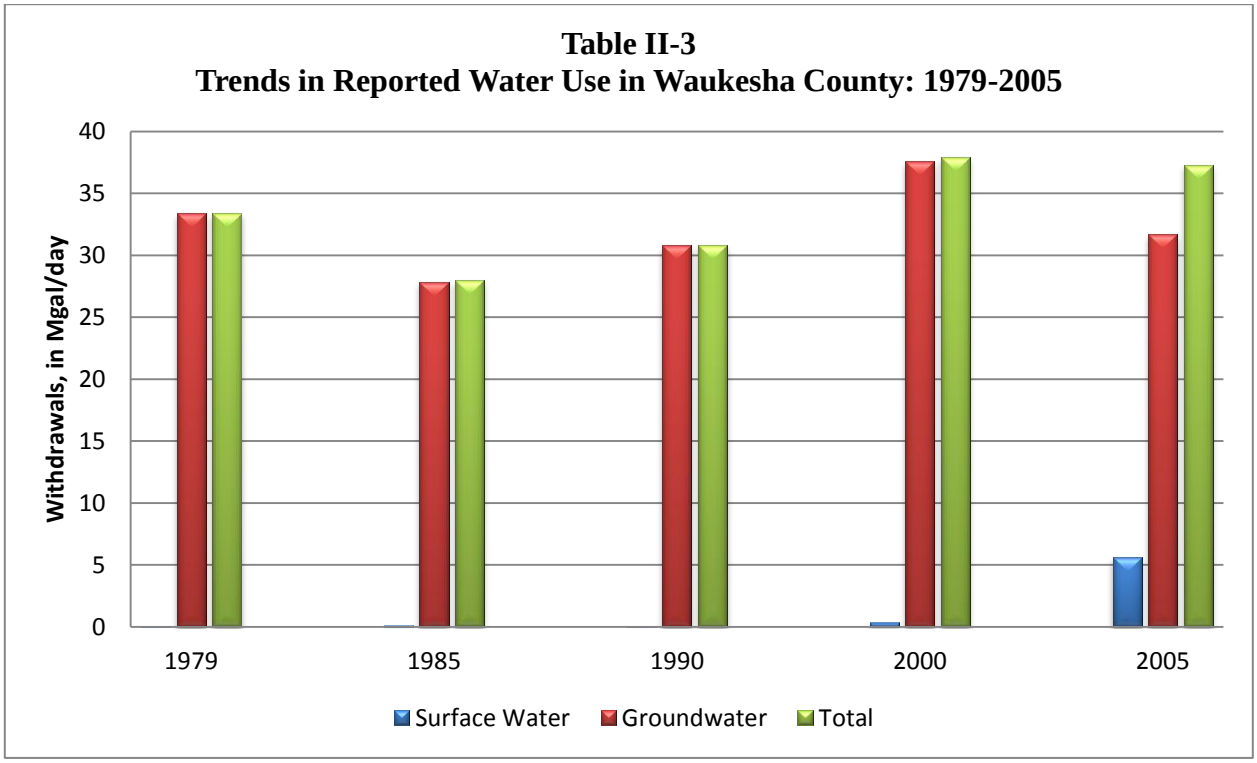
To document the utilization of the shallow aquifers in the County, it may be assumed for example that, on the average, 10 percent of the annual precipitation reaches groundwater. Then, the average groundwater recharge in the County would be about 88 mgd. As previously noted, the estimated daily use of groundwater in 2005 was about 32 mgd, which is about 36 percent of the total amount of groundwater assumed to be recharged in a given year. This indicates that there is an adequate annual groundwater recharge to satisfy water demands on the shallow aquifer system in Waukesha County on a countywide basis. However, the availability on a localized area basis will vary depending upon usage, pumping system configuration, and groundwater flow patterns.

Table II-2
Estimated Use of Water in Waukesha County: 2005



Source: B.R. Ellefson, G.D. Mueller, and C.A. Buchwald, U.S. Geological Survey, "Water Use in Wisconsin, 2005."

Table II-3
Trends in Reported Water Use in Waukesha County: 1979-2005



NOTES: The trends are based on currently available data, but the sources of information and accuracy of data may vary from one reporting period to another. The USGS obtains most of water-use data from files of state agencies, and makes estimates for categories for which data are not reported (private domestic and agricultural uses).

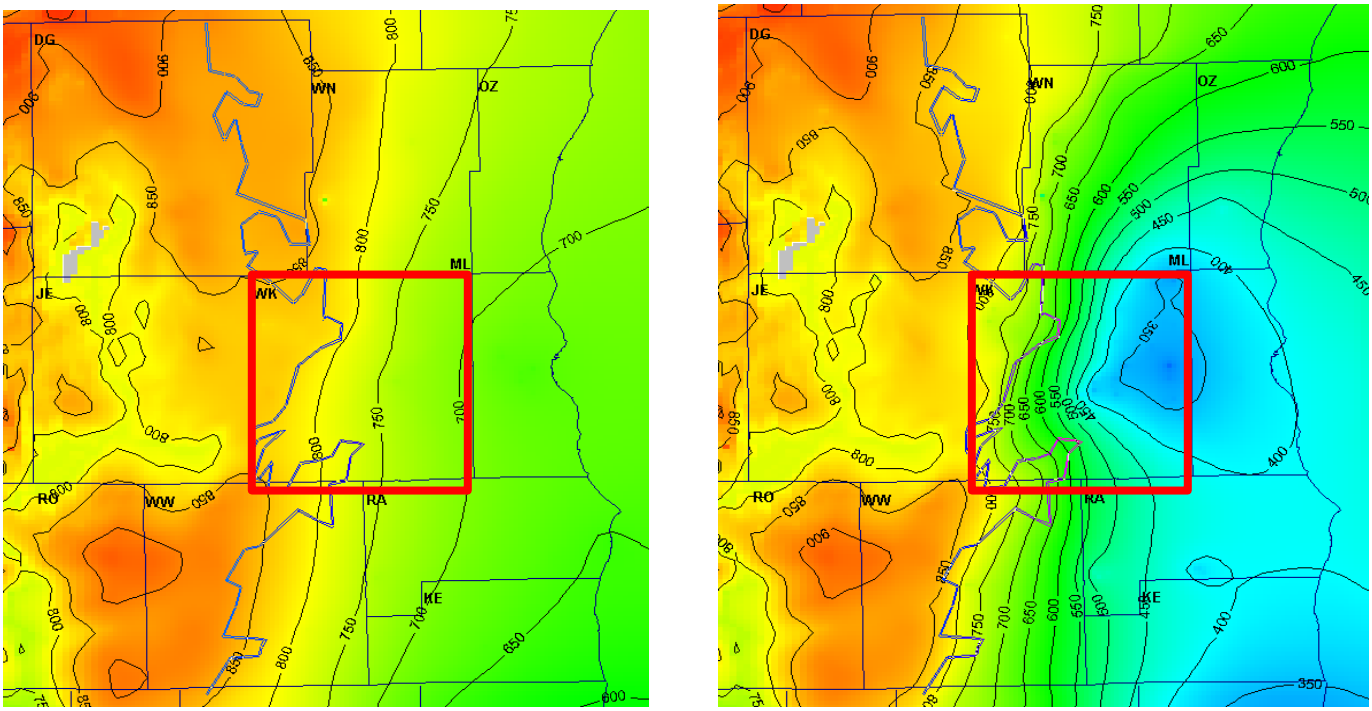
Source: SEWRPC, U.S. Geological Survey, 2005.

The situation is different for the deep aquifers where withdrawals of groundwater cause supply/demand imbalance in areas of concentrated use of groundwater, which has resulted in the declining potentiometric surface and mining of groundwater. Figure II-8 illustrates the cone of depression that has formed in the deep sandstone aquifer in southeast Wisconsin over the past 80 years due to water use in the region.

Figure II-8 shows that the water table elevation in the deep aquifer has dropped over 350 feet in 80 years and that the direction of groundwater flow has actually reversed, drawing water from Lake Michigan rather than draining toward it as it originally did in the early 1900's. The center of the cone of depression slowly progressed to the west and is now near the eastern border of Waukesha County (Brookfield area). Professor Douglas Cherkauer of the University of Wisconsin-Milwaukee, has estimated how much greater the demand is for groundwater from this aquifer than the available supply for Waukesha County, as shown in Table II-4.

Figure II-8
Water Levels in the Sandstone Aquifer in Southeast Wisconsin: 1920-2000
(feet above mean sea level)

1920-1930 1990-2000



Source: SEWRPC

Table II-4
Estimates of Available Groundwater in Waukesha County: 1999

Aquifer	Recharge Area (square miles)	Estimated Recharge Rate (inches per year)	Average Daily Recharge (mgd)	Average Daily Demand (mgd)
Shallow	400	3.1	59	3.5
Deep	100	3.1	14.8	31.5

Source: D.S. Cherkauer, 1999

Radium Concentrations

Certain formations within the Cambrian sandstones in southeastern Wisconsin are known to produce relatively high concentrations of naturally occurring radium, a radioactive metallic element. This naturally occurring radium has been found to exceed U. S. EPA standards in approximately 50 of the 1,300 municipal water supplies in Wisconsin. Most of the water supplies which exceed the radium standard draw water from the deep sandstone aquifer and lie in a narrow band from the Illinois-Wisconsin border through Kenosha, Racine, and Waukesha Counties and north through Green Bay.

Systems serving the portions of the Cities of Brookfield, Delafield, Muskego, Pewaukee, and Waukesha; the Villages of Eagle, Mukwonago, Pewaukee, and Sussex; and a few private water systems have reported violations of the current radium standard. Currently, all water systems that exceed the radium standards in Waukesha County have a consent order agreement with the Department of Natural Resources that details how the water systems will come into compliance. A long legal battle over this issue has resulted in a court order for the City of Waukesha to reduce radium levels in their water supply to comply with EPA standards by 2018.

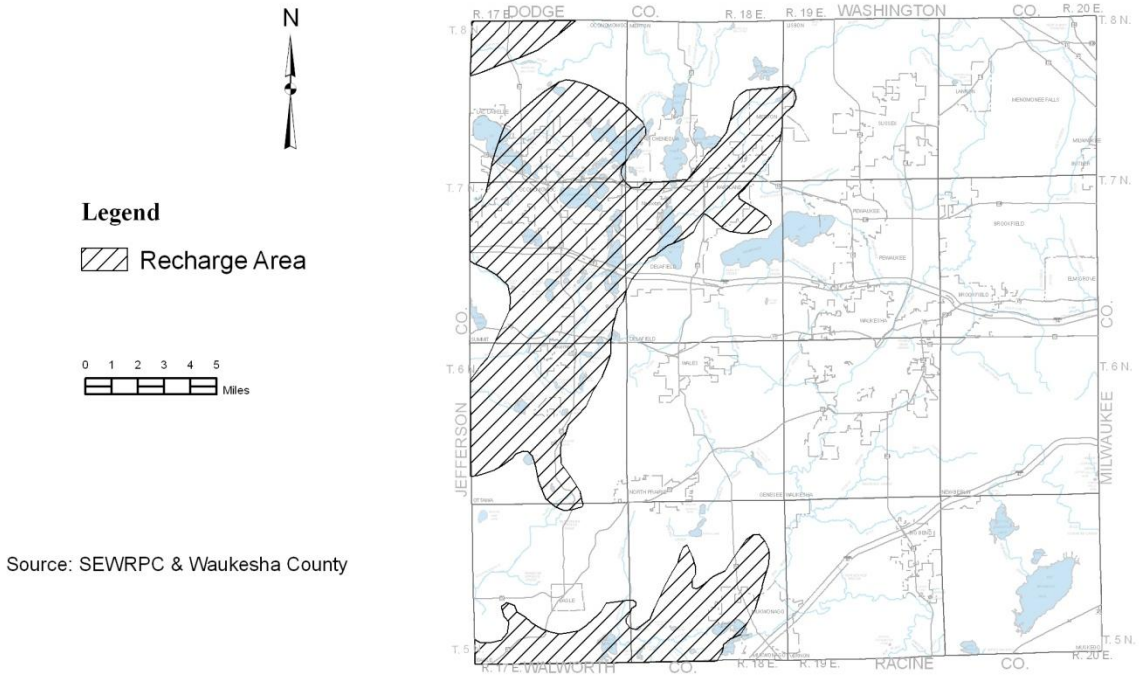
Vulnerability to Contamination

Groundwater quality conditions can through improper construction or management be impacted by such sources of pollution on the surface as infiltration of storm water runoff, landfills, agricultural fertilizer and pesticides (including storage, mixing and loading sites), animal feedlots, manure storage and field application sites, chemical spills, leaking surface or underground storage tanks, silage and crop residue piles, road and parking lot deicing, sumps and dry wells, onsite sewage disposal systems and other below ground waste disposal. The potential for groundwater pollution in the shallow aquifer is dependent on the depth to groundwater, the depth and type of soils through which precipitation must percolate, the location of groundwater recharge areas, and the subsurface geology. Most of Waukesha County exhibits moderate to high potential for contamination of groundwater in the shallow glacial drift and Niagara aquifers. Generally, the areas of the County most vulnerable to groundwater contamination are where both Niagara dolomite and the water table are near the surface.

Compared to the deep aquifer, the shallow aquifers are more susceptible to pollution from the surface because they are nearer to the source in terms of both distance and time, thus minimizing the potential for dilution, filtration, and other natural processes that tend to reduce the potential detrimental effects of pollutants. Isolated cases of contamination have been identified in portions of Waukesha County. Such problems can often be traced to runoff pollution sources, septic system discharges, and chemical spills or leakage.

In the far western portion of the County, there is no confining impermeable layer of rock between the glacial drift and the sandstone aquifer. This is cause for concern in planning for the future development of that area. Urban development adversely affects both the quantity and quality of recharge water, especially where the aquifer is overlaid by outwash, end moraine, or other highly permeable glacial material. An increase in the area of impervious surfaces such as pavement affects the recharge of the sandstone aquifer by diverting larger amounts of precipitation into surface drainage courses as runoff, rather than allowing it to percolate into the ground. Map II-8 shows the approximate area of the county where the impermeable shale layer does not exist and thus, where recharge of the deep sandstone aquifer occurs, feeding municipal water supplies in the eastern portion of the county.

Map II-8
Approximate Area of Recharge for the Sandstone Aquifer



Water Supply Planning

In response to the growing pressures on community water supplies in southeast Wisconsin, SEWRPC recently completed a three-phased multi-agency effort to inventory local groundwater resources, develop a regional groundwater model, and develop and publish a Regional Water Supply Plan for Southeast Wisconsin (2010). The plan is based upon an adopted regional comprehensive plan design year of 2035, recommends a sustainable water supply for every community in southeast Wisconsin, and can be found at: http://www.sewrpc.org/SEWRPC/Environment/RegionalWaterSupplyPlan.htm

For some communities, the Regional Water Supply Plan recommends switching from a deep aquifer groundwater supply to a shallow aquifer or surface water supply – namely Lake Michigan. This type of switch would not only provide a sustainable supply of water to the community, but would also allow the region's deep aquifer to recover from decades of over-pumping. While switching to Lake Michigan for a community water supply may be supported by a tremendous amount of science, it does introduce a level of complexity in the administrative and political arenas due to the adoption of the Great Lakes - St. Lawrence River Basin Water Resources Compact ("Great Lakes Compact") in 2008. Being enacted by the legislatures of all eight states bordering the Great Lakes, as well as the United States Congress and two Canadian provinces, this regional law trumps all other laws relating to the use and "diversion" of water from the Great Lakes basin. Under the Great Lakes Compact, any water diverted outside of the basin must be returned after use and only communities straddling the watershed boundary or located in a county that straddles the watershed are eligible for diverting Great Lakes water. The Compact also established a water diversion application process, requiring all applications to comply with strict technical criteria and be approved by all eight Great Lakes states. A diversion application for Lake Michigan water was submitted by the City of Waukesha in 2010 and is currently under review by the DNR.

Drainage Basins and Watersheds

As shown in Map II-9, Waukesha County river systems drain to three major basins, the Rock River Basin on the western side of the county, the Fox River Basin in the center and the Lake Michigan Basin on the eastern part of the county. The Fox River Basin covers the largest area of the county, encompassing about 58 percent of the total surface area. The Rock River Basin encompasses approximately 34 percent and the Lake Michigan Basin accounts for the remaining 8 percent of the county surface area. The Rock and Fox River Basins both lie west of the sub-continental divide and are part of the Mississippi River drainage area. Everything east of the sub-continental divide, including the Menomonee and Root River Watersheds, are part of the Great Lakes-St. Lawrence River drainage system. The sub-continental divide is critical to the water supply issue noted earlier and sanitary sewer planning. This is because water that is pumped from the Great Lakes system is generally required to be returned after use. For water resource planning purposes, each river basin is further divided into watersheds. There are 10 major watersheds in Waukesha County, as shown in Map II-9. The following sections provide additional detail on the watersheds within each basin. Most of the information presented has been compiled from DNR "State of the Basin" reports.

Rock River Basin

Ashippun River Watershed

The Ashippun River Watershed lies in Dodge, Washington, and Waukesha counties. It covers 69 square miles, of which approximately 16 square miles or 23 percent of the total watershed is located in northwestern Waukesha County. Agriculture is the primary land use and accounts for 66 percent of the land use in the Waukesha County portion of the watershed, according to the Year 2000 SEWRPC land use inventory.

From its headwaters in a small wetland and agricultural area, the Ashippun River flows at a low gradient (6 ft/mile) southwest through Druid Lake in Washington County to the Rock River in Dodge County. The water is stained light brown by tannic acid and the bottom is largely silt. Other than the Ashippun River, none of the major streams in the watershed are found in Waukesha County.

The Ashippun River is classified as a warm water sport fishery. However, little is known about the Ashippun River's water quality or whether the river is meeting its full potential.

Bark River Watershed

This 186-square mile watershed drains portions of Washington, Waukesha, and Jefferson counties and has many natural lakes, some of them large. About 47 percent of the area is in Waukesha County, 45 percent in Jefferson County and the remainder is in Washington County. Many of the watershed's lakes are experiencing heavy development pressure or have extensive development around them. While some wetlands have been drained or filled, a significant amount of wetland remains. The greatest threat to the basin's wetlands is rapid development in Waukesha County.

The watershed is about 44 percent agricultural, but significant rural subdivision development occurs in the Waukesha County portion of the watershed. Of the agricultural lands, about 7 percent have high soil erosion potential. Thus, agriculture use and rural development degrade local surface water quality.

Major streams in the Waukesha County portion of the Bark River watershed include the Bark River, Scuppernong Creek, and Wales Creek. Additional information on each of the streams is included in Table II-5. The Bark River is classified as a warm water sport fishery but is only partially meeting that use, primarily due to urban and rural polluted runoff entering the river and its tributaries. Most of the urban runoff pollution occurs in Waukesha County, where rapid development of urban and suburban "pockets" occurs

along and between its many lakes. There are currently two municipal sewage treatment plants that discharge to the Bark River within Waukesha County, the Village of Dousman and the Delafield-Hartland facility, which discharges just downstream from Nagawicka Lake. Both sites are shown in Map II-9.

Scuppernong Creek rises at the edge of the moraines in central Waukesha County. The creek passes through rural areas much of its length, but subdivisions are developing rapidly in the upstream reach near Wales. Numerous drainage ditch inlets carry agricultural runoff to the stream. There are two impoundments on Scuppernong Creek. Historical records suggest the reach from the headwaters to Waterville Lake supported a viable trout population in the early part of the 20th century. Excessive ditching of tributaries and wetlands and the construction of a dam at Waterville, altered stream habitat so it now supports a warm water sport fishery. From the Waterville dam downstream to Dutchman Lake the stream supports a Class I trout fishery due to a large spring that augments flow and lowers stream temperature. Water quality from Dutchman Lake to the old Dousman Millpond is good. There are many springs and the reach supports a warm water sport fishery. Below the Dousman Millpond water quality is poor due to the large sediment load and a much lower gradient. Wales Creek, a small tributary to Scuppernong Creek, is fed by an extensive system of springs; this stream may support a small population of trout.

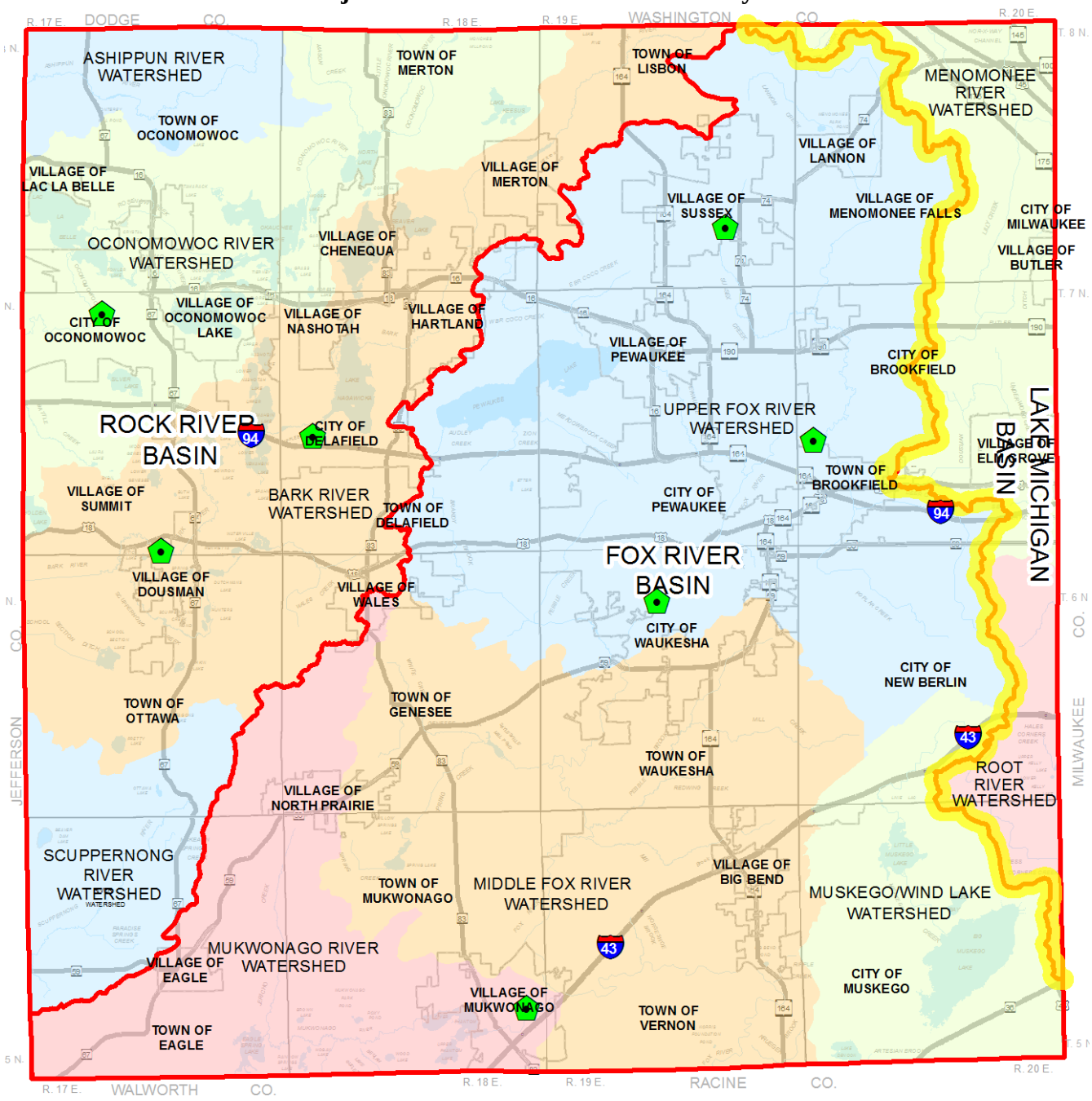
Oconomowoc River Watershed

The Oconomowoc River Watershed drains approximately 128 square miles encompassing portions of Dodge, Jefferson, Washington, and Waukesha counties. The Waukesha County portion of the watershed is approximately 63 square miles in size representing 49 percent of the watershed. According to the Year 2000 SEWRPC land use inventory, nearly 35 percent of the Waukesha County portion of the watershed is agricultural. Residential land use comprises another 16 percent in Waukesha County and open water from the many lakes and streams accounts for another 13 percent. From its origin in the Town of Richfield in Washington County, the Oconomowoc River flows in a southwesterly direction through six major lakes for approximately 49 miles before entering the Rock River in the Town of Ixonia, Jefferson County.

There is one sewage treatment plant discharge in the Oconomowoc River from the City of Oconomowoc, approximately 2 miles downstream of Lac Labelle. Major lakes in the Waukesha County portion of the watershed include Beaver, Fowler, Lac LaBelle, Keesus, Moose, North, Oconomowoc, Okauchee, Pine and Silver lakes. In addition to the Oconomowoc River, major streams in the Waukesha County portion of the watershed include Battle Creek, Little Oconomowoc River, Mason Creek, and Rosenow Creek. Rosenow Creek is a designated trout stream and the location of a recent stream restoration project. When the Wisconsin Department of Transportation initiated work on a highway bypass around the City of Oconomowoc, it necessitated moving approximately 1,000 feet of the existing reach of the tributary to Rosenow creek as part of the proposed new roadway. The channel was relocated west of the new roadway and restored to a length of 1,400 feet in the summer of 2004. The stream restoration project was designed and constructed to create a stable and more “natural” channel that is intended to reduce streambank erosion potential, enhance water quality, and improve habitat for wildlife.

Rapid urbanization of the watershed is continuing, especially on and near lakes. The cumulative effect of this urbanization is threatening water quality and hastening the eutrophication of the lakes. The Oconomowoc River was selected as a priority watershed in 1983. A nonpoint source control plan for the Oconomowoc River was completed in 1986. Major objectives for the nonpoint source pollution control plan included protecting the recreational benefits and improving the fisheries of the water resources. In pursuit of those objectives, landowner contacts were made and conservation plans developed for approximately 3,000 acres of cropland in the Waukesha County portion of the watershed. This resulted in an estimated reduction of soil erosion of approximately 18,500 tons. When the watershed project officially closed in 1995, results seemed mixed on the success of the project. However, spin-off activities which are in part attributable to the watershed project, included formation of new lake districts and the reactivation of another, formation of an environmental foundation and sanitary districts, adoption of construction site erosion control ordinances and the formation of an environmental protection committee.

Map II-9
Major Watersheds in Waukesha County



Legend

- River Basin Boundaries
- Subcontinental Divide
- Sewage Treatment Plant

N

0 1 2 Miles

0 4,000 8,000 12,000 16,000 Feet

Source: Waukesha County & SEWRPC

Scuppernong River Watershed
The Scuppernong River is a tributary of the Bark River in Jefferson County. The watershed is bordered on the southeast by the Kettle Moraine State Forest and lies with in portions of three counties: Jefferson, Walworth, and Waukesha. The predominant land use is agricultural though there is significant public ownership in the state forest and two state wildlife areas with large forested tracts and wetland areas. Other wetland areas have been drained for agriculture. Substantial low-density residential and industrial development is occurring throughout the watershed. According to the Year 2000 SEWRPC land use inventory, approximately 5,723 acres or 38 percent of the Waukesha County portion of the watershed is agricultural. Another 4, 416 acres or 29 percent is considered wetland and, 3,429 acres or 22 percent is classified as woodland.

Major streams found in the Waukesha County portion of the watershed include the Scuppernong River and Paradise Springs Creek. The Scuppernong River rises at the edge of the interlobate moraine in the Kettle Moraine State Forest. Reproducing populations of brown trout inhabit the upper reaches, but habitat is impaired by old hatchery ponds that discharge warmer water to the stream. From the area just below the hatchery pond to the Waukesha County line, the stream is a Class III trout stream.

Paradise Springs Creek is a Class II trout stream in Waukesha County. Trout rearing ponds were constructed at the headwaters of the stream several years ago, resulting in the degradation of water quality due to warming of the water. All but one pond have been removed. Segments of the stream are ditched and straightened. Recent habitat work has been done to counteract the effects of previous ditching.

Fox River Basin

Upper Fox River Watershed
The Upper Fox River Watershed is a 151 square mile drainage area located almost entirely in Waukesha County, with a very small portion (1%) located in Washington County. 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. A priority watershed plan was completed in 1994 with stated goals of reducing sediment loading to streams in rural areas by 50-75 percent, reducing phosphorus loading from barnyards by 75 percent, reducing streambank erosion by 50 –75 percent, and reducing the suspended solids load of urban runoff by 40-90 percent. The watershed project officially ended in 2005 and has resulted in 82 cost-share agreements being signed for conservation practices such as reduced tillage, nutrient management and well decommissioning. On the urban front, a major accomplishment has been the adoption of erosion control and storm water management ordinances by the county and communities within the watershed.

According to the Year 2000 SEWRPC land use inventory, nearly 24 percent of the watershed is mapped as residential land use. Other land use categories include agricultural (23%), wetlands (13%), and transportation related (11%). Commercial and industrial land uses account for another 6 percent of the land area. 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. There are three sewage treatment plant discharges into the Fox River in this watershed. Starting upstream, they are the Village of Sussex, the City of Brookfield and the City of Waukesha, as shown in Map II-9.

The Upper Fox River 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.
Coco 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.

Today, both the main stem and north branch of Frame Park Creek suffer from severe impairments. The majority of wetlands originally present have been drained and filled. The combined effects of stream modifications like channel manipulation, relocation, and enclosure have damaged water and habitat quality. These water bodies are included on WDNR's statewide list of polluted and impaired waters for degraded habitat, chronic toxicity, temperature, and low dissolved oxygen due to point and non-point source discharges.

Another cold-water resource in the Upper Fox River watershed is Pebble Creek. Pebble Creek, and its major tributary Brandy Brook, drain approximately 18 square miles located in the extreme southwest corner of the Upper Fox River Basin before flowing into the Illinois Fox River just north of State Highway 59. Pebble Creek has the potential to support a coldwater Class I and II brook and brown trout fishery. Although Brook trout have never been recorded in this urbanizing watershed, healthy populations of mottled sculpin, a coldwater indicator species, have been recorded in the headwaters of this stream system. Since the mid 1990s, the WDNR has annually stocked brown trout at CTH TT and the trout have responded well to this effort. While the upper portions of the watershed contain coldwater species, the lower portions of Pebble Creek extending from CTH D to the confluence with the Fox River contain northern pike among several other high-quality warmwater species (Pebble Creek Watershed Protection Plan, Southeastern Wisconsin Regional Planning Commission, Community Assistance Report No. 284, 2008).

At nearly 2500 acres, Pewaukee Lake is the only lake of significant size in the watershed with a maximum depth of 45 feet and an average depth of 15 feet. It is also one of the largest lakes in southeastern Wisconsin and recognized as one of the top musky lakes in the state. The lake level was naturally controlled until 1838 when a dam was constructed at the lake outlet to power a mill. This resulted in lake levels rising about six feet and the surface area of the lake doubling. Present levels are artificially controlled by a dam at the outlet of the Lake to the Pewaukee River, which then flows about 4.4 miles to its confluence with the Fox River. Water quality data collected over the years indicates fair to very good water quality. However, continued development in the watershed and its subsequent increase in runoff have raised concerns about future pollutant loadings. Efforts to protect and improve the watershed include an active wetland acquisition program by the Lake Pewaukee Sanitary District. This program has resulted in the protection of hundreds of acres of wetlands, representing an investment nearing $1 million. The Pewaukee River Watershed is also the subject of an on-going watershed protection planning effort led by SEWRPC. The Pewaukee River Partnership is also active in citizen water quality monitoring and other program efforts to improve the condition of these resources.

Mukwonago River Watershed

The Mukwonago River Watershed covers approximately 86 square miles in Jefferson, Waukesha and Walworth counties. It is the smallest watershed in the Fox River Basin. Approximately 52 square miles or 61 percent of the watershed area lies within Waukesha County. The Villages of Eagle, Mukwonago, North Prairie and Wales are found within the watershed boundary. The Village of Mukwonago has a wastewater treatment plant discharging into the Mukwonago River.

Rural uses cover most of the land area in the watershed. Agriculture is dominant even in the Waukesha County portion where, according to the Year 2000 SEWRPC land use inventory, agriculture accounts for approximately 36 percent of the land use. Residential land use accounts for another 19 percent of the watershed area in Waukesha County followed by woodlands (15%) and wetlands (9%).

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

This is perhaps the least disturbed watershed in the 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 last few years. Impervious surfaces are becoming more abundant and storm water runoff is increasing. Many of the historic areas that supported agriculture are now supporting suburban housing development. Concern over the impact of development pressures in the watershed has led to the formation of the Friends of the Mukwonago River, a group dedicated to the protection of the river and its watershed.

In June of 2010 SEWRPC published the Mukwonago River Protection Plan (Community Assistance Planning Report No. 309). The watershed protection plan focuses on what can be done to prevent future water pollution or resource degradation from occurring. The plan presents recommendations for appropriate and feasible watershed management measures for enhancing and preserving the water quality of the Mukwonago River and for providing the public with opportunities for safe and enjoyable recreation within the Mukwonago River watershed.

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 small portions of Milwaukee and Walworth Counties. The Waukesha County portion of the watershed covers 86,175 acres or approximately 134 square miles. In Waukesha County, portions of the Cities of Muskego, New Berlin, and Waukesha lie within the watershed, along with the Villages of Big Bend, Mukwonago, North Prairie, and Wales.

Agriculture dominates the rural land use, accounting for over 40 percent of the area. Other rural uses include grasslands (18%), wetlands (14%), and forests (13%). Urban areas comprise nearly four percent of the land cover in the watershed.

There are about 40 miles of major perennial streams in this watershed within Waukesha County. Genesee Creek, Mill Brook, Spring Creek and White Creek are listed as cold-water communities. No streams in the watershed are listed on the 303(d) list. Portions of the watershed are subject to flooding due to the extremely low gradient, and severe flooding was experienced in 1997 and 1999. General threats to stream water quality in this watershed include: construction site erosion; habitat modification; ditching and channelization; temperature elevation and storm water runoff.

Concerns over water resource problems in the Fox River system including navigation, water use conflicts, water quality, flooding and drainage led to the formation of the Southeastern Wisconsin Fox River Commission in 1997 by Wisconsin Act 27 (1997-1999 Budget Bill). This Commission was directed by the enabling legislation to develop an implementation plan to address goals including: 1) Protection and rehabilitation of the water quality of the surface waters and groundwater of the Fox River Basin; 2) protection and enhancement of the recreational use of the navigable waters; and 3) increasing water and boating safety on the same navigable waters. Member of the Commission include city, town, and village officials from communities within the watershed, local residents, representatives from the DNR and SEWRPC, and representatives from Racine and Waukesha Counties. Using grant funds from various sources including Targeted Runoff Management grants, Community Development Block grants, and funds allocated to the Commission, several conservation practices have been installed. These include streambank stabilization projects, grassed waterways, and wetland restoration.

Muskego/Wind Lakes Watershed

The Muskego/Wind Lakes Watershed is actually a small portion (41 square miles) of the Middle Fox River Watershed located in Waukesha, Racine, and Milwaukee Counties. The Waukesha County portion of the watershed encompasses approximately 36 square miles and includes portions of the Cities of Muskego and New Berlin. It was designated a “priority watershed” in 1991 under the Wisconsin Nonpoint Source Water Pollution Abatement Program. Overall goals included the reduction of sediment loadings by 55 percent and reducing phosphorus loading by an average 67 percent. Maintenance of stream base flow conditions was also a stated objective of the plan. The watershed project officially closes at the end of 2005 and in the

Waukesha County portion of the watershed has resulted in the development of 36 cost-share agreements primarily for reduced tillage.

Big Muskego Lake is the largest lake in this watershed covering 2,260 acres, but averages only 2.5 feet deep. 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. In addition to the lake rehabilitation project, more than 800 acres of adjacent habitat is being managed cooperatively between the City of Muskego, Wind Lake Management District, the Department of Transportation and the Department of Natural Resources.

Little Muskego Lake appears on the 303(d) list of impaired waters.

Lake Michigan Basin

Menomonee River Watershed
The Menomonee River Watershed covers 136 square miles in portions of Washington, Waukesha, and Milwaukee Counties. The Waukesha County portion of the watershed covers about 37 square miles and includes portions of the Cities of Brookfield and Menomonee Falls as well as the Villages of Butler and Elm Grove. The Menomonee River originates in wetlands near the Village of Germantown in Washington County and runs southeasterly for 32 miles before meeting the Milwaukee and Kinnickinnic Rivers in the Milwaukee Harbor.

Nearly all of the land area in the watershed is within incorporated municipalities. According to the Year 2000 SEWRPC land use inventory, nearly 42 percent of the Waukesha County portion of the watershed is residential. Other land uses in Waukesha County include: transportation related (15%), wetlands (8%), and agriculture (7%). Commercial and industrial land uses each contribute another 6 percent of the total land uses respectively.

Stream and wetland modification, urban and rural runoff, construction site erosion and industrial point sources of pollution are the major contributors to degraded water and habitat quality within this watershed. Ninety-six miles of streams are found within the watershed. Over eight miles of stream are listed on the 303(d) list as impaired. Many streams in this watershed have been concrete lined or straightened to convey floodwaters off the land faster. Flooding continues to be a major concern in this watershed.

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

Root River Watershed
The Root River Watershed is located in portions of Waukesha, Milwaukee, and Racine counties and encompasses 197 square miles. Only about 13 square miles are within Waukesha County covering portions of the Cities of Muskego and New Berlin. According to the Year 2000 SEWRPC land use inventory, residential land use accounts for 46 percent of the land use in the Waukesha County portion of the watershed. Another 15 percent is agricultural and 14 percent is transportation related.

The headwaters begin in west central Milwaukee and eastern Waukesha counties. From there the river flows southeast ultimately emptying into Lake Michigan in the City of Racine. The watershed is heavily urbanized near the headwaters and mouth. However, the middle portion of the watershed has a large

percentage of agricultural land use. This watershed was one of the first Priority Watershed projects funded in the state, with the initial nonpoint source control plan prepared by SEWRPC in 1980 (Planning Report No. 37). Racine County was the Lead Designated Management Agency for the project, which ended in 1990.

Water quality of the 117 miles of rivers and streams in the Root River Watershed ranges from severely degraded to good. The streams in Waukesha County are classified as supporting only a Limited Forage Fish community or Limited Aquatic Life.

Rivers and Streams

Major steams are perennial streams, which maintain, at a minimum, a small contiguous flow throughout the year except under unusual drought conditions. The 50 major streams in Waukesha County are shown in Map II-10 and described in more detail in Table II-5 below**.** Waukesha County has approximately 306 miles of major perennial streams. The longest major streams in the county are the Fox (Illinois) and Bark Rivers, with 50.6 and 29.7 stream miles respectively, as measured using the county Land Information System. Twelve of these streams are listed as "impaired" by the Department of Natural Resources, meaning the stream is not meeting water quality standards. These streams have the label 303(d) in the classification code, named after the applicable section of the federal law. More information on each of these streams is contained in the following sections of this plan.

Table II-5
Major Streams of Waukesha County

Stream Name	Watershed	Township	Length (miles)	Classification Code(s)
1. Ashippun River	Ashippun	Oconomowoc	11.1	FAL, AQ-3 (RSH)
2. Bark River	Bark	Delafield	29.7	FAL, AQ-1 & AQ-2 (RSH)
3. School Section Ditch	Bark	Ottawa	5.7	FAL
4. Scuppernong Creek	Bark	Ottawa	12.8	FAL, AQ-2 (RSH)
5. Wales Creek	Bark	Genesee	2.1	FAL
6. Butler Ditch	Menomonee	Brookfield	3.9	FAL. 303(d)
7. Dousman Ditch	Menomonee	Brookfield	2	FAL
8. Lilly Creek	Menomonee	Menomonee Falls	5.1	FAL, 303(d)
9. Menomonee River	Menomonee	Menomonee Falls	7.8	FAL, AQ-3
10. Nor-X-Way Channel	Menomonee	Menomonee Falls	1.3	FAL, 303(d)
11. Underwood Creek	Menomonee	Brookfield	6.9	Special Variance, 303(d)
12. Willow Creek	Menomonee	Lisbon	2.3	FAL, 303(d)
13. Artesian Brook	Muskego-Wind	Vernon	1	FAL
14. Muskego Creek	Muskego-Wind	Muskego	6.6	FAL

Stream Name	Watershed	Township	Length (miles)	Classification Code(s)
15. Krueger Brook	Middle Fox	Vernon	2.1	FAL
16. Ripple Creek	Middle Fox	Vernon	1	FAL
17. Horseshoe Brook	Middle Fox	Vernon	1.5	FAL
18. Mill Brook	Middle Fox	Vernon	5.7	COLD, AQ-2 (RSH)
19. Pebble Brook	Middle Fox	Vernon	8.7	FAL, AQ-3
20. Redwing Creek	Middle Fox	Waukesha	1.4	FAL
21. Mill Creek	Middle Fox	Waukesha	5.1	FAL, AQ-3
22. Genesee Creek	Middle Fox	Waukesha	6.7	ERW, COLD, AQ-2 (RSH)
23. Spring Creek	Middle Fox	Mukwonago	6	COLD, 303(d)
24. White Creek	Middle Fox	Genesee	1.4	COLD
25. Beulah Lake Outlet	Mukwonago	Mukwonago	1.1	FAL
26. Mukwonago River	Mukwonago	Mukwonago	10.2	ERW, COLD, AQ-1 (RSH)
27. Jericho Creek	Mukwonago	Eagle	5.8	COLD, AQ-2 (RSH)
28. Battle Creek	Oconomowoc	Summit	2.8	FAL
29. Little Oconomowoc	Oconomowoc	Merton	3.5	FAL, AQ-3 (RSH)
30. Mason Creek	Oconomowoc	Merton	4.5	COLD, AQ-2 (RSH)
31. Oconomowoc River	Oconomowoc	Merton	14.3	ERW, FAL, AQ-3 (RSH)
32. Rosenow Creek	Oconomowoc	Oconomowoc	3.5	COLD, AQ-3
33. Hales Corners Creek	Root	New Berlin	1	LAL
34. Tess Corners Creek	Root	Muskego	5.5	LFF
35. Root River	Root	New Berlin	1.5	FAL, 303(d)
36. McKeawn Spring Creek	Scuppernong	Eagle	0.9	COLD
37. Paradise Springs Creek	Scuppernong	Eagle	1.6	COLD
38. Scuppernong River	Scuppernong	Eagle	7.4	COLD, AQ-2 (RSH)
39. Audley Creek	Upper Fox	Delafield	1.2	FAL
40. Brandy Brook	Upper Fox	Genesee	5	COLD, AQ-3
41. Deer Creek	Upper Fox	Brookfield	6.6	FAL, 303(d)

Stream Name	Watershed	Township	Length (miles)	Classification Code(s)
42. Fox (Ill River)	Upper Fox	Waukesha	50.6	FAL, 303(d), AQ-2 (RSH)
43. Frame Park Creek	Upper Fox	Waukesha	1	LFF, 303(d)
44. Lannon Creek	Upper Fox	Menomonee Falls	5.4	FAL
45. Pebble Creek	Upper Fox	Waukesha	6.9	COLD, AQ-3
46. Pewaukee River	Upper Fox	Pewaukee	6.4	FAL, AQ-3 (RSH)
47. Poplar Creek	Upper Fox	Brookfield	8	FAL, 303(d), AQ-3 (RSH)
48. Sussex Creek	Upper Fox	Brookfield	6.6	FAL, 303(d)
49. Coco Creek (East Br.)	Upper Fox	Pewaukee	2	COLD, AQ-3
50. Coco Creek (West Br.)	Upper Fox	Pewaukee	4.8	COLD, AQ-3
51. Zion Creek	Upper Fox	Delafield	1.6	FAL, 303(d)
		Total Miles =	306.1	

Classification Codes

COLD = Includes surface waters capable of supporting a community of cold water fish and other aquatic life.

FAL = Fish & Aquatic Life. Default classification equivalent to Warm Water Sport Fish Community.

LFF = Limited Forage Fishery. Surface waters capable of supporting only a limited community of forage fish.

LAL = Limited Aquatic Life. Marginal surface waters that support only a limited aquatic life community.

303(d) = Water body appears on the Wisconsin Impaired Waters list.

ERW = An Exceptional Resource Water as defined by Chapter NR102 of the WI Administrative Code.

AQ-1 = Identifies Aquatic Areas of statewide or greater significance.

AQ-2 = Identifies Aquatic Areas of countywide or regional significance.

AQ-3 = Identifies Aquatic Areas of local significance.

RSH = Rare Species Habitat. Aquatic areas which support endangered, threatened, or "special concern species" officially designated by the DNR.

Lakes

Major inland lakes are defined as those with a surface area of 50 acres or larger, a size capable of supporting reasonable recreational use with minimal degradation of the resource. Waukesha County contains all or portions of 33 major lakes with a combined surface area of approximately 14,000 acres, or 21.9 square miles, or about 3.8 percent of the total area of the County. This represents about 38 percent of the combined surface area of the 101 major lakes in the seven-county Southeastern Wisconsin Region, more than any other county in the Region. Thirty of the major lakes are located entirely within the County, while three major lakes, Lake Denoon, Golden Lake, and Lake Five, are located only partly within the County. In addition to the major lakes, there are 47 other named water bodies with lake characteristics referenced in the DNR publication, “Wisconsin Lakes”, PUBL-FM-800 91. The 80 total named lakes in Waukesha County are presented in Map II-10 and described in Table II-6.

Because lake water quality is significantly affected by surrounding land use and cover, urban development and agricultural activity on land that drains into lakes and streams has led to a decline in water quality on many lakes in Waukesha County. Water quality often changes as a result of increasing levels of such nutrients as nitrogen and phosphorus entering a lake. Nitrogen is usually the limiting nutrient for rooted aquatic plants while phosphorus is considered the limiting nutrient for algae growth. Eutrophication is the

condition reached by lakes when the accumulation of nutrients produces increasing amounts of aquatic plants. As the resulting lush aquatic plant growth dies each year, organic deposits fill in the lake. This is a natural process that is generally more prevalent in warm, shallow lakes, such as Big Muskego Lake, than in colder, deep lakes, such as Oconomowoc Lake. However, the process can be greatly accelerated by additional nutrients from inadequate or failing onsite sewage disposal systems, lawn fertilizers, agricultural runoff containing fertilizer and animal wastes, construction site runoff, and street debris.

The trophic status of most major lakes in Waukesha County is also presented in Table II-6. The trophic state serves as an indicator of overall water quality, taking into consideration water clarity, phosphorus content, algae content and regional location in Wisconsin.

A mesotrophic lake shows some signs of eutrophication. The presence of a greater amount of nutrients than in an oligotrophic lake results in lowered clarity and the presence of aquatic plants. Swimming and boating can be enjoyed on this type of lake without limitations.

A eutrophic lake has relatively large amounts of aquatic plants because of higher nutrient levels. The water may be cloudy because of suspended algae cells, dying plants may produce unpleasant smells, and mats of plants may interfere with swimming and boating. These lakes are generally shallow, with mucky bottoms. Eutrophic lakes can be excellent warm-water fishing lakes for such fish as bass and bluegills.

All surface waters in the state of Wisconsin can be classified into one of several biological use objectives classification categories. The classification categories include:

- Cold Water Communities (COLD): 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.

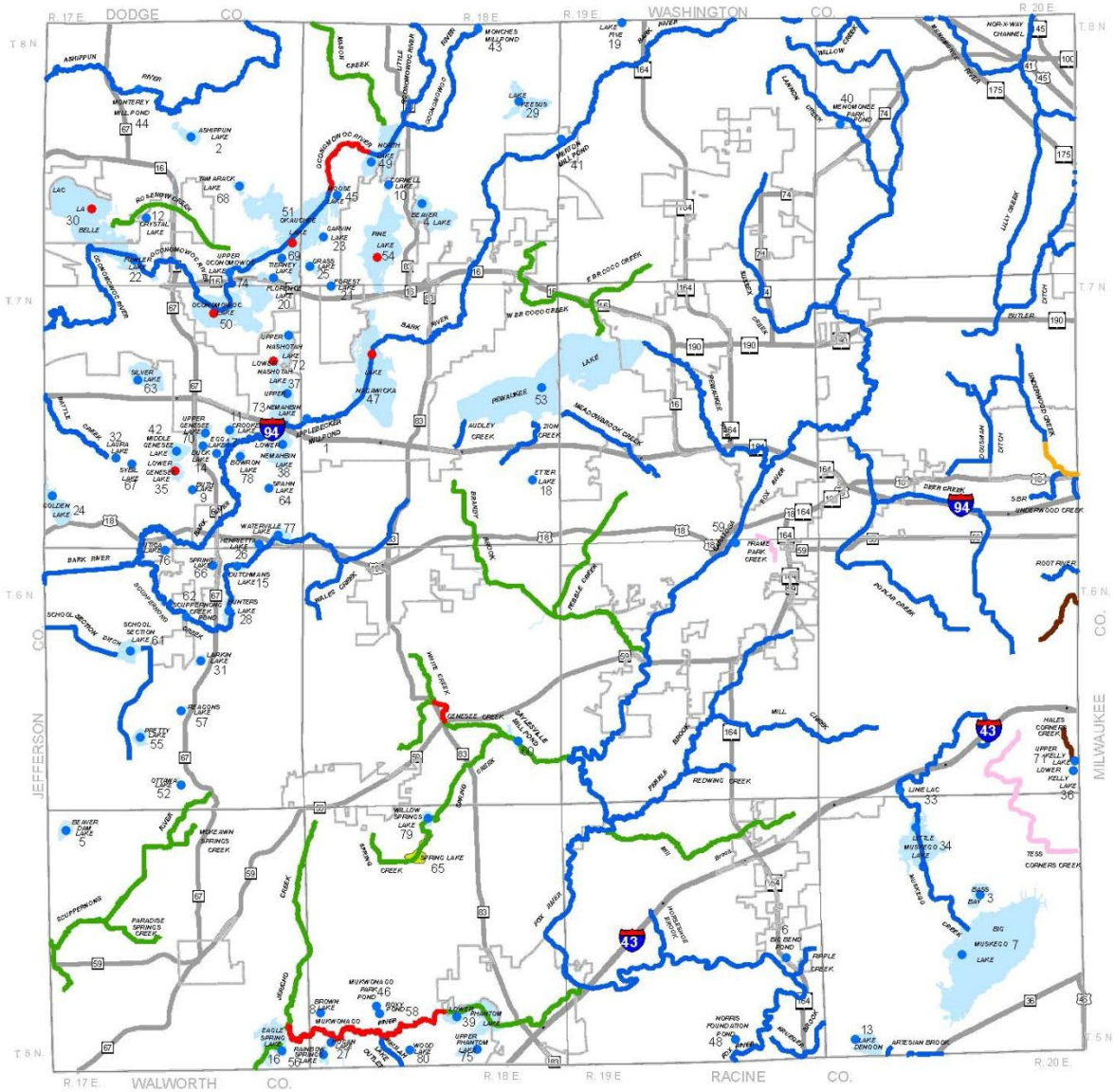
- Warm Water Sport Fish Communities (WWSF): Includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning area for warm water sport fish. This category is the default listing for all streams that have not been formally classified according to the process outlined in meeting the federal Clean Water Act goals. Is also the equivalent of full fish and aquatic waters (FAL) classification.

- Warm Water Forage Fish Communities (WWFF): Includes surface waters capable of supporting an abundant diverse community of forage fish and other aquatic life.

- Limited Forage Fishery (LFF): 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.

- Limited Aquatic Life (LAL): 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.

Map II-10
Surface Water Resources of Waukesha County



Water Resource Classification Codes

- Outstanding Resource Water (ORW)
- Exceptional Resource Water (ERW)
- Lake Supports Fish and Aquatic Life (FAL)
- Lake Supports Cold Water Species (Cold)
- Cold Water Streams (Cold)
- Fish and Aquatic Life (FAL)
- Special Variance Waters
- Limited Forage Fish (LFF)
- Limited Aquatic Life (LAL)

N

0 1 2 Miles

0 4,000 8,000 12,000 16,000 Feet

Source: Waukesha County, SEWRPC & WDNR

Table II-6
Named Lakes in Waukesha County

Lake	Watershed	Township	Surface Area (acres)	Max. Depth (feet)	Lake Type	Trophic State	Classification Code(s)
1. Applebecker Millpond	Bark	Delafield	12	5	DG	Eutrophic	FAL
2. Ashippun*	Ashippun	Oconomowoc	83	40	SP	Mesotrophic	FAL, AQ-2 (RSH)
3. Bass Bay	Muskego-Wind	Muskego	100	23		Eutrophic	FAL, AQ-3
4. Beaver	Oconomowoc	Merton	316	49	SP	Mesotrophic	FAL, AQ-3 (RSH)
5. Beaver Dam	Bark	Eagle	36		SE	Eutrophic	FAL
6. Big Bend Pond	Middle Fox	Vernon	7	10	SP	N/A	FAL
7. Big Muskego*	Muskego-Wind	Muskego	2,260	4	DG	Eutrophic	FAL, AQ-2 (RSH)
8. Brown	Mukwonago	Mukwonago	12	15	SP	Eutrophic	FAL
9. Buth	Bark	Summit	4	5	SE	N/A	FAL
10. Cornell	Oconomowoc	Merton	16	12	DG	Mesotrophic	FAL
11. Crooked	Bark	Summit	58	16	DG	Mesotrophic	FAL, AQ-2 (RSH)
12. Crystal	Oconomowoc	Oconomowoc	17	30		N/A	FAL
13. Denoon	Middle Fox	Muskego	162	55	SE	Mesotrophic	FAL, AQ-3 (RSH)
14. Duck	Bark	Summit	12	1	SE	N/A	FAL, AQ-3 (RSH)
15. Dutchman	Bark	Ottawa	33	43	SE	Eutrophic	FAL, AQ-2 (RSH)
16. Eagle Spring*	Mukwonago	Eagle	311	8	DG	Eutrophic	FAL, AQ-2 (RSH)
17. Egg	Bark	Summit	2	3	SE	N/A	FAL
18. Etter	Upper Fox	Delafield	11	5	SE	Eutrophic	FAL
19. Five	Oconomowoc	Merton	102	23	SE	Mesotrophic	FAL, AQ-3
20. Florence	Oconomowoc	Oconomowoc	21	48	SE	Mesotrophic	FAL
21. Forest	Oconomowoc	Merton	41	17	SE	Eutrophic	FAL, AQ-3 (RSH)
22. Fowler*	Oconomowoc	Oconomowoc	99	50	DG	Mesotrophic	COLD, AQ-3
23. Garvin	Oconomowoc	Merton	17	36	SE	Mesotrophic	FAL
24. Golden	Bark	Summit	250	46	SP	Mesotrophic	FAL, AQ-2 (RSH)
25. Grass (Mud)	Oconomowoc	Merton	33		SE	N/A	FAL
26. Henrietta	Bark	Summit	15	7	SE	Eutrophic	FAL, AQ-3 (RSH)
27. Hogan	Mukwonago	Mukwonago	8	3	SE	N/A	FAL
28. Hunters	Bark	Ottawa	57	46	SP	Mesotrophic	FAL, AQ-2 (RSH)
29. Keesus*	Oconomowoc	Merton	237	42	SP	Mesotrophic	FAL, AQ-3
30. Lac La Belle*	Oconomowoc	Oconomowoc	1,117	45	DG	Eutrophic	FAL, 303(d), AQ-3
31. Larkin	Bark	Ottawa	57	4	SP	N/A	FAL, AQ-3 (RSH)
32. Leota (Laura)	Oconomowoc	Summit	8	11	DG	N/A	FAL
33. Linnie Lac*	Muskego-Wind	New Berlin	6	6	DG	Eutrophic	FAL
34. Little Muskego*	Muskego-Wind	Muskego	506	65	DG	Mesotrophic	FAL, 303(d)
35. Lower Genesee	Bark	Summit	66	45	SP	Mesotrophic	Cold, AQ-3 (RSH)
36. Lower Kelly	Root	New Berlin	3	36	SE	Eutrophic	FAL
37. Lower Nashotah	Bark	Summit	90	43	SP	Oligotrophic	Cold, AQ-2 (RSH)
38. Lower Nemahbin	Bark	Summit	271	36	DG	Eutrophic	FAL, AQ-2 (RSH)
39. Lower Phantom*	Mukwonago	Mukwonago	433	12	DG	Oligotrophic	FAL, AQ-1 (RSH)
40. Menomonee Park Pond	Upper Fox	Menomonee Falls	15	50	SP	N/A	FAL
41. Merton Millpond	Bark	Lisbon	38	8	DG	Eutrophic	FAL, AQ-2 (RSH)
42. Middle Genesee*	Bark	Summit	109	40	SE	Mesotrophic	FAL, AQ-3 (RSH)
43. Monches Millpond	Oconomowoc	Merton	16	4	DG	Eutrophic	FAL
44. Monterey Millpond	Ashippun	Oconomowoc	30	8	DG	N/A	FAL
45. Moose	Oconomowoc	Merton	81	61	SP	Oligotrophic	FAL, AQ-3 (RSH)
46. Mukwonago Park Pond	Mukwonago	Mukwonago	1	5	SP	N/A	FAL, AQ-3 (RSH)
47. Nagawicka	Bark	Delafield	957	90	DG	Mesotrophic	FAL, AQ-1 (RSH)

Lake	Watershed	Township	Surface Area (acres)	Max. Depth (feet)	Lake Type	Trophic State	Classification Code(s)
48. Norris Foundation Pond	Middle Fox	Vernon	3	8	DG	N/A	FAL
49. North*	Oconomowoc	Merton	439	78	DG	Mesotrophic	FAL, AQ-2 (RSH)
50. Oconomowoc	Oconomowoc	Oconomowoc	804	62	DG	Mesotrophic	FAL, 303(d), AQ-2 (RSH)
51. Okauchee*	Oconomowoc	Oconomowoc	1,187	94	DG	Eutrophic	FAL, AQ-2 (RSH)
52. Ottawa	Scuppernong	Ottawa	28	16	SP	Mesotrophic	FAL, 303(d) AQ-2 (RSH)
53. Pewaukee	Upper Fox	Delafield	2,493	45	SP	Mesotrophic	FAL, AQ-2 (RSH)
54. Pine	Oconomowoc	Merton	703	85	SP	Oligotrophic	FAL, AQ-2 (RSH)
55. Pretty*	Bark	Ottawa	64	35	SE	Mesotrophic	FAL
56. Rainbow Springs	Mukwonago	Eagle	25	16	SE	Eutrophic	FAL, AQ-3 (RSH)
57. Reagon	Bark	Ottawa	16	10	SP	Eutrophic	FAL, AQ-3 (RSH)
58. Roxy Pond	Mukwonago	Mukwonago	17	3	SP	Hypereutrophic	FAL
59. Saratoga	Upper Fox	Waukesha	24	6	DG	N/A	FAL
60. Saylesville Millpond	Middle Fox	Genesee	45	4	DG	Eutrophic	FAL, AQ-3 (RSH)
61. School Section*	Bark	Ottawa	125	8	DG	Eutrophic	FAL, AQ-2 (RSH)
62. Scuppernong Creek Pond	Bark	Ottawa	20	5	DG	N/A	FAL
63. Silver	Oconomowoc	Summit	222	44	SE	Mesotrophic	FAL, AQ-2 (RSH)
64. Spahn	Bark	Summit	4	5	SE	N/A	FAL, AQ-3 (RSH)
65. Spring	Middle Fox	Mukwonago	105	22	SP	Eutrophic	ORW, AQ-2 (RSH)
66. Spring (Dousman)	Bark	Ottawa	14	8	SE	Eutrophic	FAL, AQ-3 (RSH)
67. Sybil	Bark	Summit	2		SE	N/A	FAL
68. Tamarack	Oconomowoc	Oconomowoc	30	15	SE	Eutrophic	FAL
69. Tierney	Oconomowoc	Oconomowoc	15	5	DG	Eutrophic	FAL
70. Upper Genesee	Bark	Summit	37	27	SP	Mesotrophic	FAL, AQ-3 (RSH)
71. Upper Kelly	Root	New Berlin	12	9	SP	Eutrophic	FAL
72. Upper Nashotah	Bark	Summit	133	53	SP	Oligotrophic	FAL, AQ-2 (RSH)
73. Upper Nemahbin*	Bark	Summit	283	61	DG	Mesotrophic	FAL, AQ-2 (RSH)
74. Upper Oconomowoc	Oconomowoc	Oconomowoc	43	11	DG	Eutrophic	FAL
75. Upper Phantom*	Mukwonago	Mukwonago	110	29	SP	Mesotrophic	FAL, AQ-1(RSH)
76. Utica	Bark	Summit	14	25	SP	Mesotrophic	FAL, AQ-3
77. Waterville	Bark	Summit	68	12	DG	Eutrophic	FAL, AQ-3 (RSH)
78. Widgeon/Bowron	Bark	Summit	25	25	SP	Eutrophic	FAL, AQ-3 (RSH)
79. Willow Spring*	Middle Fox	Mukwonago	46	13	DG	Eutrophic	FAL, AQ-3 (RSH)
80. Wood	Mukwonago	Mukwonago	20	22	SP	Mesotrophic	FAL, AQ-3 (RSH)

Classification Codes

Cold = Supports a cold water community either naturally occurring or artificially stocked.

FAL = Fish & Aquatic Life. Default classification equivalent to Warm Water Sport Fish Community.

303(d) = Water body appears on the Wisconsin Impaired Waters List

ORW = An Outstanding Resource Water as defined by Chapter NR102 of the WI Administrative Code.

AQ-1 = Identifies Aquatic Areas of statewide or greater significance.

AQ-2 = Identifies Aquatic Areas of countywide or regional significance.

AQ-3 = Identifies Aquatic Areas of local significance.

RSH = Rare Species Habitat. Aquatic areas that support endangered, threatened, or "special concern" species designated by DNR.

* = Lake has a Lake Management District formed under Chapter 33 Wisconsin Statutes.

Lake Type

Drainage lake (DG): Impoundments and natural lakes with the main water source from stream drainage.

Seepage lake (SE): Landlocked. Water level maintained by groundwater table and basin seal. May have intermittent outlet.

Spring lake (SP): Groundwater fed lakes always with an outlet of substantial flow.

Outstanding and Exceptional Resource Waters

Chapter NR 102 of the Wisconsin Administrative Code lists water quality standards for all surface waters in the state of Wisconsin. The two highest classification categories are Outstanding Resource Waters (ORW) and Exceptional Resource Waters (ERW).

An outstanding resource water (ORW) is defined as a lake or stream which has excellent water quality, high recreational and aesthetic value, high quality fishing, and is free from point source or nonpoint source pollution. The only outstanding resource water in Waukesha County is Spring Lake.

An exceptional resource water (ERW) is defined as surface waters which exhibits the same high quality resource values as outstanding resource waters, but which may be impacted by point source pollution or have the potential for future discharge from a small sewer community. Exceptional resource waters found in Waukesha County include specific portions of the following streams:

Genesee Creek	(Above STH 59)
Mukwonago River	(From Eagle Springs Lake to Upper Phantom Lake)
Oconomowoc River	(From below North Lake to Okauchee Lake)

Impaired Waters List (303d)

The Department of Natural Resources (DNR) is required every two years to submit a list to the Environmental Protection Agency (EPA) which identifies waters which are not meeting water quality standards, including both water quality criteria for specific substances or the designated biological and recreational uses. This list is known as the "impaired waters list" or simply the "303(d) list" in reference to the particular section of the Clean Water Act.

Table II-7 shows all the water resources in Waukesha County that were included on the Wisconsin 303(d) list as of 2012. The list includes 15 stream reaches and 3 lakes which suffer from a variety of pollutants and impairment indicators, as shown in Table II-7. Most of the pollutants are nonpoint sources, with the exception of PCBs, which come primarily from industrial sources and bioaccumulate in the environment.

Many of the water resources on the 303(d) list have been targeted by water pollution control programs, as discussed in previous sections of this plan. However, in urban areas, it is very difficult and often prohibitively expensive to control nonpoint pollution sources to a level that will bring the water resource into compliance with water quality standards. TMDL plans are currently being developed for some of the water resources to address this issue.

Land Use

SEWRPC conducts a regular land use inventory of southeast Wisconsin that is intended to serve as a relatively precise record of land use at selected points in time, using aerial photographs augmented by field surveys as appropriate. The first regional land use inventory was prepared by SEWRPC in 1963 and has been updated every five years following the preparation of new aerial photography. While aerial photography was completed in the spring 2010, this detailed level of land use data was not yet available for this planning effort. To fill the temporary data void from a decade of development in the county, the LRD conducted a generalized inventory of agricultural and urban lands as part of the Farmland Preservation Plan update completed in 2011.

Table II-7
303(d) Listed Impaired Waters in Waukesha County: 2012

Water Body	Start Mile	End Mile	Pollutant	Impairment Indicator
Fox River (Illinois)	151.34	171.45	PCBs	Contaminated Fish Tissue
Fox River (Below Barstow Impoundment)	171.45	175.32	PCBs, Total Phosphorus, Sediment/Total Suspended Solids	Contaminated Fish Tissue, Degraded Habitat, Low DO
Lower Barstow Impoundment	175.32	176.13	Mercury, Total Phosphorus, Sediment/Total Suspended Solids	Contaminated Fish Tissue, Low DO, Turbidity
Fox River, Upper Barstow Impoundment	176.13	180.1	PCBs, Total Phosphorus, Sediment/Total Suspended Solids	Contaminated Fish Tissue, Low DO
Fox River	180.1	187.16	PCBs, Total Phosphorus, Sediment/Total Suspended Solids	Contaminated Fish Tissue, Low DO
Fox River	187.16	196.64	PCBs	Contaminated Fish Tissue
Lannon Creek	0	5.48	Sediment/Total Suspended Solids	Degraded Habitat
Poplar Creek	0	8.06	Unknown Pollutant	Low DO
Spring Creek	0	6.57	Total Phosphorus	Low DO
Master Disposal Drainage Channel	0	0.99	Unknown Pollutant	Chronic Aquatic Toxicity
Frame Park Creek	0	1.26	PAHs, Total Phosphorus, Unspecified Metals	Contaminated Sediment, Low DO, Chronic Aquatic Toxicity
Butler Ditch	0	2.9	Fecal Coliform	Recreational Restrictions Pathogens
Lilly Creek	0	4.47	Fecal Coliform	Recreational Restrictions Pathogens
Deer Creek	0	8.09	Sediment/Total Suspended Solids, Elevated Water Temp, Total Phosphorus	Elevated Water Temps, Degraded Habitat, Excess Algal Growth
Zion Creek	0	1.65	Sediment/Total Suspended Solids, Elevated Water Temp, Total Phosphorus	Elevated Water Temps, Degraded Habitat, Low DO
Root River	20.48	43.95	Total Phosphorus, Sediment/Total Suspended Solids	Low DO, Degraded Biological Community
Little Muskego Lake			Total Phosphorus	Low DO
Oconomowoc Lake			Mercury	Contaminated Fish Tissue
Lac La Belle			PCBs	Contaminated Fish Tissue

Source: WDNR

Land Use Trends

There is no ambiguity regarding the land use trends in Waukesha County. The numbers and maps tell the story well. Table II-8 shows the changes in land use that occurred in Waukesha County from 1963 to 2000. It shows the rate of land conversion from rural to urban uses during the 1990s was about 3000 acres per year, or about 4.7 square miles per year – more than any other decade since SEWRPC has been collecting land use data. Figure II-9 shows the loss in dairy farms in the county from 1969 to 2007 according to USDA. The NET loss during this period was 92% of the dairy farms, with only 33 dairy still in operation in 2007.

The generalized land use inventory conducted by Waukesha County in 2010 shows the rate of land conversion increased to almost 6 square miles per year during the first decade of the new millennium. The 85,526 acres that remained in agricultural or rural land uses in 2010 represents a 46% loss of the agricultural lands since the first Farmland Preservation Plan was adopted by the Waukesha County Board in 1984 – a loss of 81,672 acres in three decades.

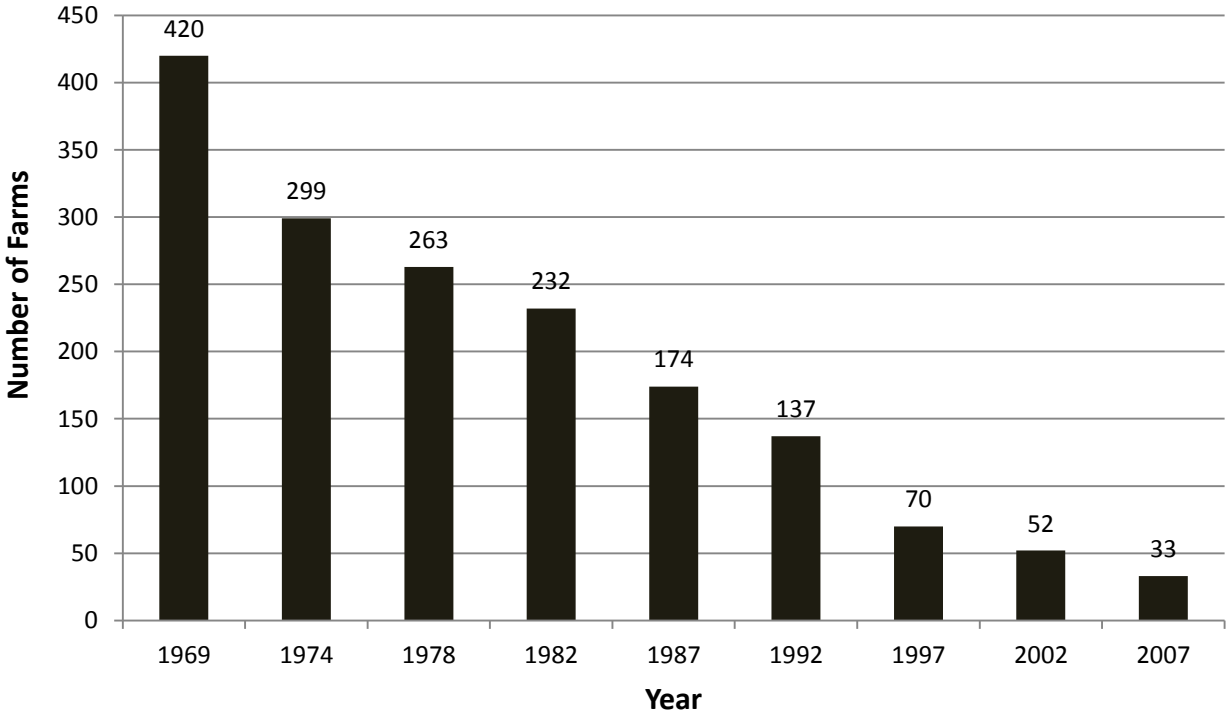
Table II-8
Change in Land Use in Waukesha County: 1963-2000
(Acres)

Land Use Category[a]	1963	1970	1980	1990	2000
Urban					
Residential	28,148	35,476	50,745	59,247	75,221
Commercial	1,197	1,831	2,754	3,827	5,351
Industrial	924	1,758	2,747	3,802	5,525
Transportation, Communication, and Utilities	16,079	18,545	21,867	22,805	30,001
Governmental and Institutional	2,550	3,587	4,037	4,215	4,887
Recreational	3,311	4,605	5,756	6,465	8,253
Unused Urban Land	8,509	8,516	8,017	7,025	7,806
Subtotal Urban	60,718	74,318	95,923	107,386	137,044
Nonurban					
Natural Areas					
Surface Water	16,076	16,461	16,753	16,878	16,891
Wetlands	52,588	51,660	51,233	51,978	52,661
Woodlands	31,181	30,818	29,472	29,584	28,931
Subtotal Natural Areas	99,845	98,939	97,458	98,440	98,483
Agricultural	200,241	184,390	161,558	142,428	112,611
Unused Rural and Other Open Lands	10,786	13,943	16,651	23,336	23,397
Subtotal Nonurban	310,872	297,272	275,667	264,204	234,491
Total	371,590	371,590	371,590	371,590	371,535

[a]Off-street parking is included with the associated land use.

Source: SEWRPC.

Figure II-9
Dairy Farms in Waukesha County
1969 - 2007

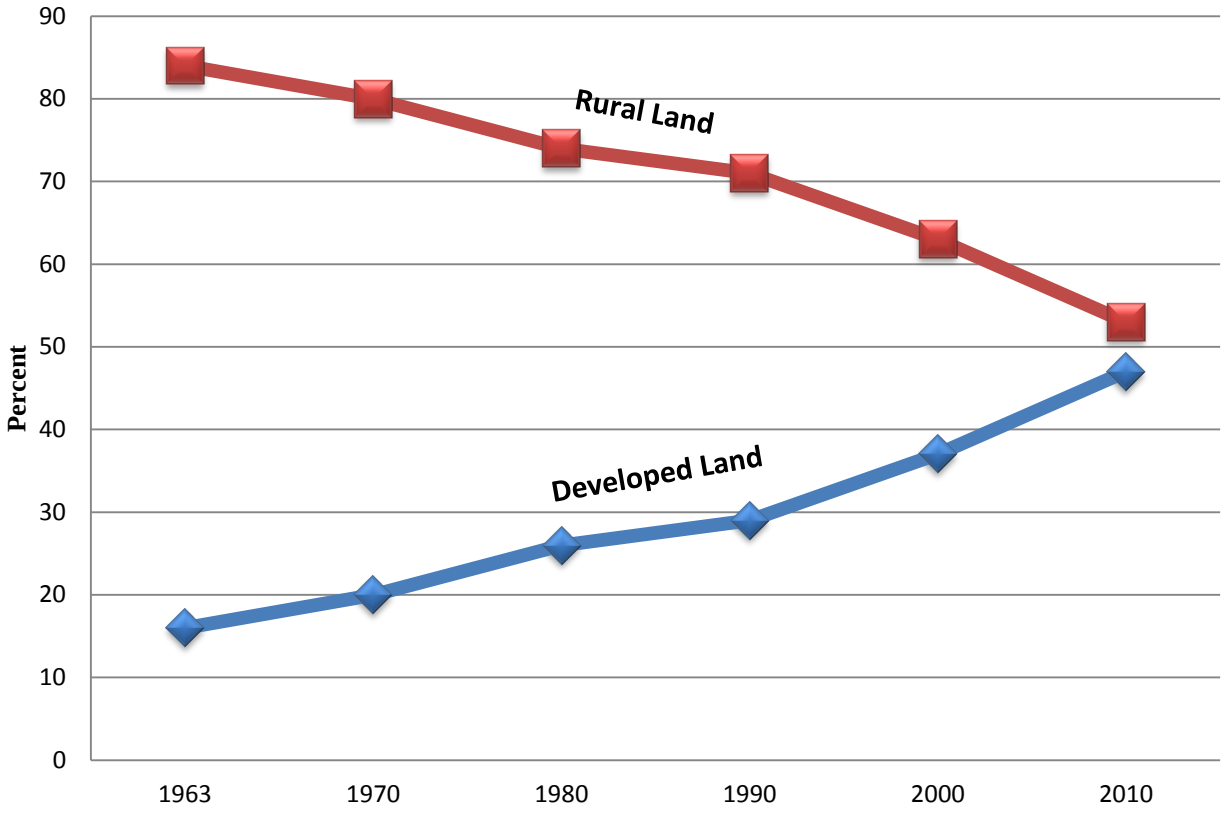


Source: USDA, National Agricultural Statistics Service

Map II-11 shows the pattern and area of land conversion from rural to urban uses from 1963-2010. In general, since 1963 the acres of land in urban categories have almost tripled from 60,718 acres in 1963 to 174,621 acres in 2010, an increase of about 290%. Much of the increase can be attributed to the amount of land used for residential purposes.

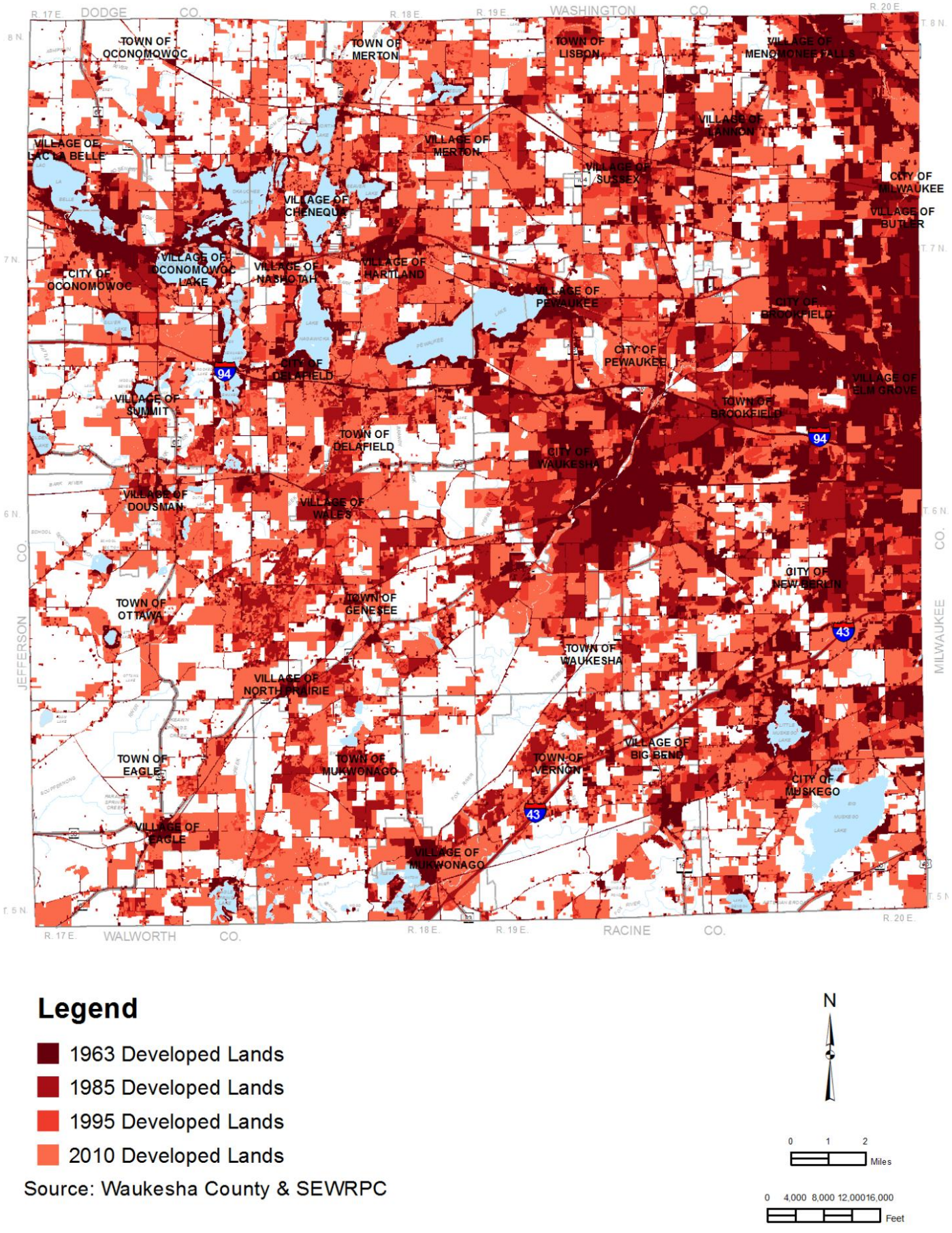
Figure II–10 charts the acres of developed lands against the rural lands from 1963-2010. It shows in 1963 the land use ratio was about 84% rural to 16% developed, while in 2010, it is very near 50/50 ratio with the rural portion closely split between natural areas and agricultural lands. Map II-12 shows how these three very general land use categories are distributed in the county as of 2010.

Figure II-10
Land Use Trends in Waukesha County: 1963-2010



Source: SEWRPC and Waukesha County

Map II-11
Rural to Urban Land Use Conversion in Waukesha County: 1963-2010



Legend

- 1963 Developed Lands
- 1985 Developed Lands
- 1995 Developed Lands
- 2010 Developed Lands

Source: Waukesha County & SEWRPC

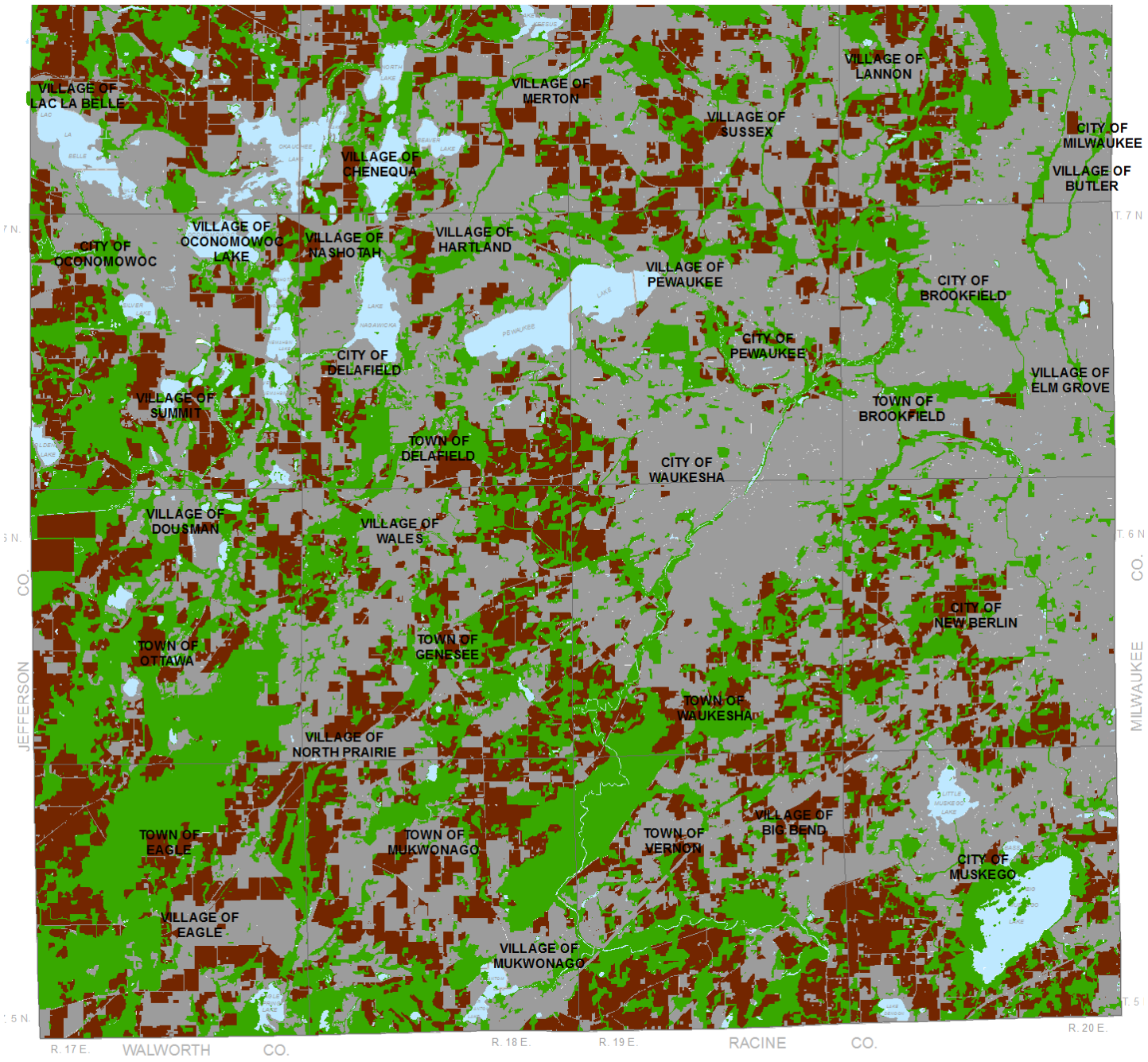
N

0 1 2 Miles

0 4,000 8,000 12,000 16,000 Feet

Map II-12

Agricultural Lands, Developed Lands and Natural Areas
Waukesha County: 2010



Legend

- Natural Areas (27% of County)
- Agricultural Lands (23% of County)
- Developed Lands (47% of County)

N

0 1 2 Miles

0 4,000 8,000 12,000 16,000 Feet

Source: Waukesha County & SEWRPC

Exotic and Invasive Species

Waukesha County, like many other counties around the state of Wisconsin, has become home to a number of exotic and invasive species of plants and animals. These pests invade lakes, rivers, forests, wetlands and grasslands. They displace native species, disrupt ecosystems, and affect people's livelihoods and quality of life. They hamper boating, swimming, fishing, hunting, hiking, and other recreation and take an economic toll on commercial, agricultural, forestry, and aquacultural resources.

Invasive species found in Waukesha County include: Purple loosestrife, zebra mussels, Eurasian water milfoil, garlic mustard, rusty crayfish, gypsy moth, buckthorn, wild parsnip, and multiflora rose among many others. Humans have created conditions where plants and animals can aggressively invade and dominate natural areas and waterways in three ways:

1. Introducing exotic species that lack natural competitors and predators to keep them in check.
2. Disrupting native ecosystems by changing environmental conditions.
3. Spreading invasive species through various methods.

Controlling invasive species can be difficult and expensive. Learning how to prevent the introduction of new invasive species and controlling the spread of those already in Waukesha County will take education. One source of information is the Department of Natural Resources at http://dnr.wi.gov/invasives/.

Summary

While presenting a general overview of the local natural resource features, population growth and land use data, this chapter brings light to the urbanizing pressures faced in Waukesha County. The number one source of water pollution in most county watersheds is runoff from urban lands and construction sites. While the recession that began in 2008 has definitely slowed the land conversion process, history tells us it is only a matter of time before the urbanization pressures return. These pressures played a key role in the identification of resources issues and concerns and the formulation of the goals, objectives and activity plan presented in Chapter III.