

Fall 2005

# Root River Watershed

State  
of the  
Watershed

Water Quality  
  
INITIATIVE

# The Watershed Approach

The Milwaukee Metropolitan Sewerage District (MMSD), with help from citizens like you, the Wisconsin Department of Natural Resources (WDNR) and the Southeastern Wisconsin Regional Planning Commission (SEWRPC), is in a long-range planning process to look at how we can best meet the future water quality needs of the Greater Milwaukee Watersheds. No single agency, group or person can solve all the water quality issues facing our region. However, by collectively working together in a coordinated and cooperative manner, our common goal to improve water quality can be achieved. Our collaborative planning process is called the **Water Quality Initiative**. The plan focuses on a “watershed approach,” which is endorsed and encouraged by the United States Environmental Protection Agency (USEPA). The watershed approach uses public input and strong science to address and resolve watershed issues. The watershed approach balances environmental protection, sustainable growth, economic prosperity, and quality of life issues within a watershed’s drainage boundaries.

In addition, the watershed approach integrates watershed goals with public expectations and desired outcomes. Since we all live in a watershed, what we do on the land impacts the quality and quantity of our water. Homes, farms, businesses, forests, small towns, and big cities make up the various land uses of our watersheds.

This document is intended to help the general public and other concerned watershed stakeholders ask themselves key environmental and quality-of-life questions as we continue the watershed planning process. It provides information that will assist the public in establishing goals and objectives for the watershed, and later for making water quality improvement recommendations based on drainage-area boundaries.

## What is a Watershed?

A watershed comes in all shapes and sizes. It is an area of land that captures water and drains it to a stream, river, lake or marsh. Similar to a funnel, if a drop of water falls outside of the boundary, it becomes part of another watershed.



# Watershed Health Indicators

*This State of the Watershed Report provides a quick reference and a brief description of current conditions. It is based on specific environmental performance indicators that are related to public uses such as fishing, swimming, and boating.*

To best understand what factors impact water quality and water resource issues facing the Root River Watershed, a common understanding of the current state of the watershed is needed. This "State of the Watershed" report for the Root River is one of a series of reports that provides you with information about the watersheds in the Greater Milwaukee Watersheds. While future assessment activities will provide comprehensive and more detailed information about the Root River Watershed conditions, this report card offers you a quick "snapshot" of conditions within the Root River Watershed today!

The water quality of the watershed is based upon indicators that either relate to recreational use, wildlife habitat potential, or overall quality of the watershed's water. Many of these indicators also have "State Water Quality Standards or recommended criteria" associated with them. This technical report provides information regarding land use, dissolved oxygen, habitat, nutrients (nitrogen and phosphorous), and fecal coliform bacteria. For some of the watershed indicators, the area is also mapped as the percent of time meeting the water quality standards.

*The State of the Watershed Report as presented here is not meant to represent all water quality conditions and complex interactions at all times, but rather it is designed to provide the people who live, work, and play in the watershed with easily understood general information about the land use, habitat, and other water quality indicators within the watershed.*

*For more detailed information please contact the MMSD (see back cover).*

## Examples of Watershed Health Indicators

- **Stream Flow**
- **Dissolved Oxygen**
- **Habitat**
- **Nutrients**
  - Nitrogen
  - Phosphorous
- **Fecal Coliform Bacteria**
- **Others**
  - Heavy Metals
  - Pesticides
  - PCB's & PAH's
  - Chlorides

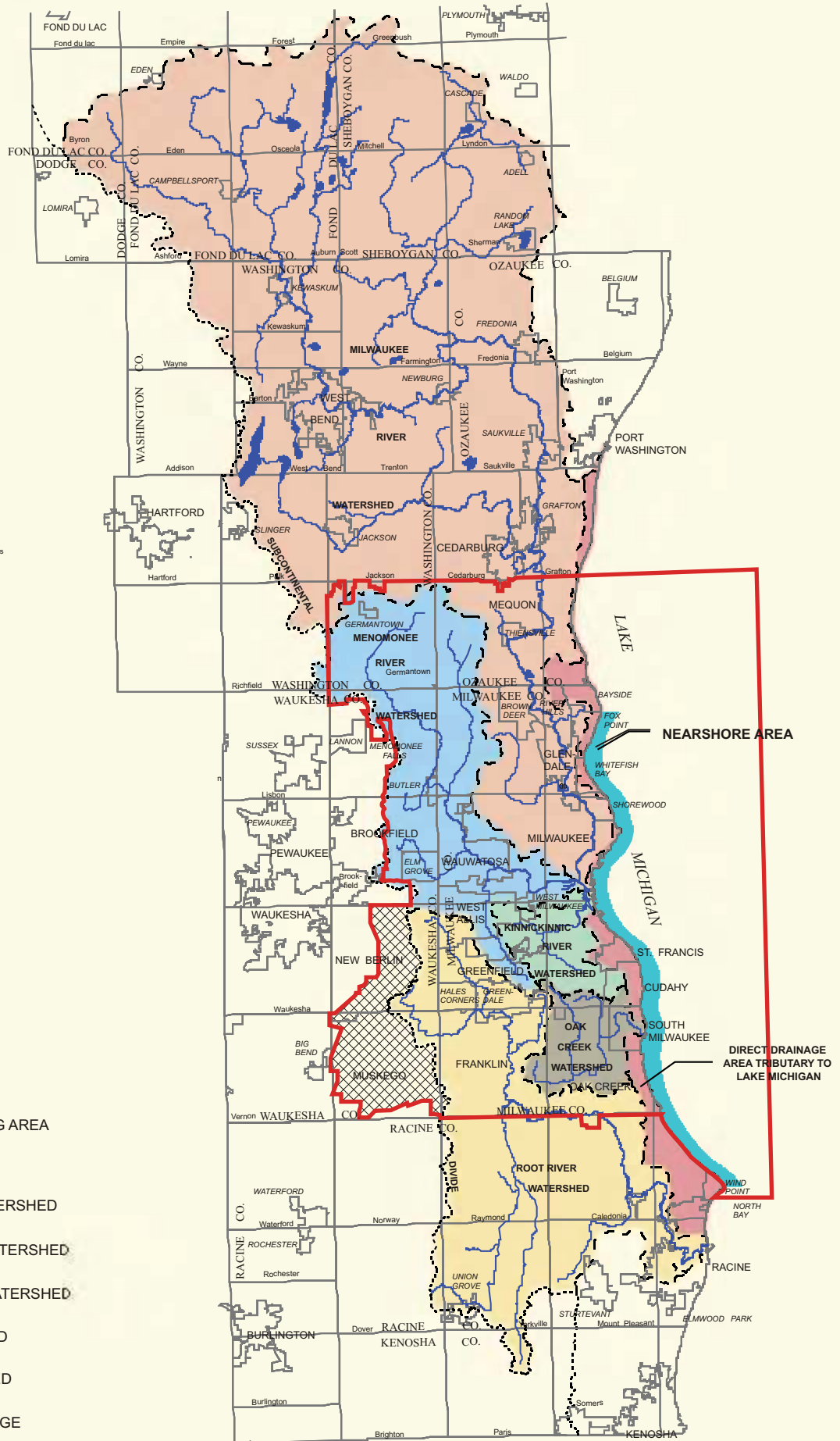
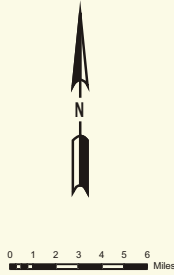
Indicators (Water Quality Standard or Criteria)	Upper Root River (Milwaukee Co.)			Root River Canal	Lower Root River (Racine Co.)	Indicator Description
	Upper	Middle	Lower			
<b>Dissolved Oxygen Warmwater Standard</b> (5 mg/L)	■	▲	●	▲	▲	Dissolved oxygen indicates a waterbody's ability to support desirable life. Consistently high amounts represent healthy water.
<b>Habitat</b>	▲	▲	●	■	▲	A habitat is healthy if it supports a diversity of high quality species. Diversity is directly affected by habitat deterioration.
<b>Nutrient Criteria</b> Eco-Region VII, Sub region 53 Total Phosphorous (0.08 mg/L)	■	▲	■	No Data	No Data	Phosphorous and nitrogen are nutrients that are readily available to biological organisms and best reflect the ability of a waterbody to stimulate aquatic plant or algae growth.
Total Nitrogen (1.59 mg/L)	▲	▲	■	■	▲	
<b>Fecal Coliform Bacteria Standard</b> (200 counts per 100 mL as a geometric mean)	■	■	■	▲	■	These bacteria are a strong indicator for the potential to have other disease-causing organisms in the water. Fecal coliform bacteria are found in human and animal waste and their presence in water indicates fecal contamination.

● Meets Water Quality Standards at least 85% of the time.









▲ Meets Water Quality Standards between 50% and 85% of the time.

■ Meets Water Quality Standards less than 50% of the time.

# Watershed Location Map



## LEGEND

-  MMSD 2020 PLANNING AREA
-  SEWERS ONLY
-  MILWAUKEE RIVER WATERSHED
-  MENOMONEE RIVER WATERSHED
-  KINNICKINNIC RIVER WATERSHED
-  OAK CREEK WATERSHED
-  ROOT RIVER WATERSHED
-  LAKE MICHIGAN DRAINAGE

# At A Glance

## Root River Watershed

### A Few Facts

- The Root River Watershed is located in the south-central portion of the Greater Milwaukee Watersheds planning region and drains a 198-square mile area found within four counties: Kenosha (1%), Milwaukee (30%), Racine (62%), and Waukesha (7%).
- The North Branch of the Root River originates near the intersection of Sunny Slope Road and Ferguson Road in the City of New Berlin, and flows in a southerly direction for a distance of approximately 17.6 miles to the confluence with the Root River Canal in the City of Franklin, where it forms the mainstem of the Root River. As the Root River continues its southeasterly flow past the Milwaukee-Racine County Line, it travels another 27 miles before eventually emptying into Lake Michigan at the City of Racine.
- Significant tributary streams in the watershed include:
  - 104<sup>th</sup> Street Branch (1.2 miles)
  - Crayfish Creek (0.5 mile)
  - East Branch of the Root River (6 miles)
  - E. Br. Root River Canal (11.6 miles)
  - Hale Creek (1 mile)
  - Hoods Creek (9.2 miles)
  - Husher Creek (3.8 miles)
  - Lower Branch of Root River (27 miles)
  - Tess Corners Creek (3 miles)
  - W. Br. Root River Canal (10.4 miles)
  - Whitnall Park Creek (1.8 miles)
  - Upper Branch of the Root River (17.6 miles)

### Population

- There are approximately 172,000 people living in the Root River Watershed, making it one of the least densely populated watersheds in the region. Most of the high-density residential developments are found within Milwaukee County (in the uppermost portion of the watershed) and in the City of Racine.

### Natural History

- Historical records indicate that at the time of European settlement the Root River Watershed was characterized by three distinct native vegetation associations: prairie grasses, hardwood forest, and marshland flora. Deciduous forest once covered about 54% of the pre-settlement landscape. By the early 1920's most of the forests in the watershed were logged for lumber and converted to agricultural land. Prairie and wetlands gave way to field crops and pasture land. Today the native vegetation patterns of the watershed have almost been completely lost due to urban development, cultivation, and other drainage activities.

### Current Land Use

- Although the watershed contains numerous urbanized areas, nearly 62% of the watershed is still in rural other open space land uses. These rural uses include about 47% of the total area of the watershed in agricultural and related rural uses and 15% in outdoor recreational, wetland, woodland, and surface water. The remaining 38% of the watershed is devoted to urban uses.

### Sanitary Sewer Service

- There are five separate sanitary sewer service areas within the Root River Watershed: Milwaukee Metropolitan Sewerage District, Village of Union Grove, City of Racine, Town of Yorkville, and the Center of the Developmentally Disabled. Approximately 46% of the watershed receives sanitary sewer service.

### Pollution Sources

- Stormwater runoff from impervious urban land areas (parking lots, rooftops, and roadways).
  - Eroding agricultural lands, streambanks, and roadsides.
  - Erosion from construction sites in developing urban areas.
  - Failing septic systems.
  - Waste water treatment plant discharges.
  - Wildlife, pets, and residential lawns.

The map at the left shows the location of the Root River Watershed (shaded in yellow) within the context of the Greater Milwaukee Watersheds (there are six watersheds in all). At 198 square miles, the Root River Watershed is the second largest of the Greater Milwaukee Watersheds and includes all or portions of 18 communities.

# Land Use Map



## ROOT RIVER LAND USE

LAND USE CATEGORY	SQUARE MILES	PERCENTAGE
Agriculture	92	46%
Low Density Residential	26	13%
High Density Residential	4	2%
Commercial	1	1%
Outdoor Recreational, Wetland, Woodland	28	14%
Transportation, Communication, Utilities	18	9%
Manufacturing and Industrial	28	14%
Surface Water	1	1%
<b>Root River Watershed</b>	<b>198</b>	<b>100%</b>

## LEGEND

Root River Watershed

### SEWRPC 2000 Land Use

- Agriculture
- Low Density Residential
- High Density Residential
- Commercial
- Outdoor Recreation, Wetland, and Woodland
- Transportation, Communication, and Utilities
- Manufacturing and Industrial
- Surface Water

# Land Use & Stream Flow

Land use and stream flow are crucial to the health of our water resources. The strong relationship between land use and stream flow directly impacts water quality. How we develop and maintain land within our watersheds affects both the quality and quantity of water in our streams, rivers, and lakes. As the watershed develops, the natural ecology and flow characteristics of our streams and rivers can be greatly altered.

Water quality and stream flow (both high or low) are influenced by numerous factors that include: size of the watershed, climate, meteorological events (e.g. rainstorms), geology (e.g. soil types), polluted discharges, and most notably the type and amount of development within the watershed (e.g. land use).



Consider the amount of rainfall that seeps into the ground, evaporates into the air, and runs off the land. In areas with low levels of development, depending on soil conditions, as much as 50 percent of rainfall can be absorbed directly into the ground, with only about 10

percent of this water running off the land. In contrast, where the land has been extensively developed, as in highly urbanized areas, very little water is absorbed into the ground. Instead, more than half of the water runs off the land because of hard impervious surfaces like buildings, streets, and parking lots.

These increases in runoff volumes from highly developed areas often contribute to frequent and more severe flooding problems. Additionally, this runoff also picks up a variety of pollutants from the surrounding landscape and carries it to the stream.

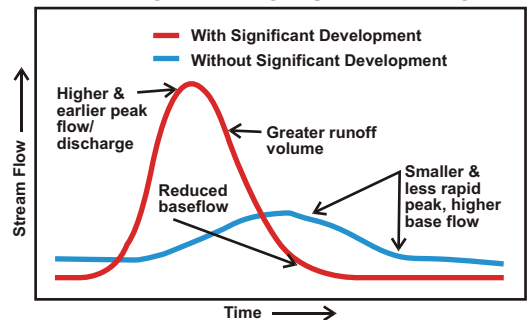
Even small storms in highly developed areas can produce dramatic "pulses" of high flows and pollutant loads.

Because these high flow pulses occur on a more or less regular basis, they can lead to stream channel erosion, bank instability, pollutant-related toxicity to aquatic organisms, and washout

of aquatic organisms that live in the stream upon which fish feed.

While there are environmental consequences to high flows during wet periods, the conditions of lower flow and higher water temperature during dry periods are equally as stressful. This occurs because rainfall flows off the land too quickly in urbanized areas, not having the time to replenish the groundwater flow to the stream in a slow, sustainable manner. This reduction of "baseflow," the drying of streams and streambeds, prevents the formation of diverse aquatic life communities and healthy fish populations.

## IMPACTS OF WATERSHED DEVELOPMENT ON STREAM FLOW



The Root River Watershed is primarily comprised of agricultural and open spaces (i.e. forest, wetland, surface water, parkland) representing 62% of the land use; manufacturing, industrial, transportation, and commercial activities account for 24% of the land use. Low and high density residential development represent the remaining 15% of the land use in the Root River Watershed. The majority of the watershed in the Racine County area is made up of agricultural land use; however, there is an ever-increasing demand for additional residential development.

*It is well known that the quality and quantity of water in a stream are directly related to the physical characteristics of its drainage area. As individuals, perhaps the greatest way we can influence water quality is by being mindful of how we develop and maintain the land within our watersheds.*

# Root River Watershed

# Dissolved Oxygen Map



LAKE MICHIGAN

- Meets Warm Water Quality Standards at least 85% of the time.
- ▲ Meets Warm Water Quality Standards between 50% and 85% of the time.
- Meets Warm Water Quality Standards less than 50% of the time.

# Dissolved Oxygen

Just like humans, fish, and other aquatic organisms need oxygen to live. When fish and aquatic organisms breathe, water moves past their gills, and oxygen in the form of microscopic bubbles (dissolved oxygen or DO) is transferred from the water to their bloodstream. Without enough oxygen in the water, desirable species of fish and other aquatic life cannot survive. The amount of dissolved oxygen in water is one of the most important water quality indicators.

In recent years the Root River provided fishing opportunities for trout and salmon as they move up river in spring and fall to Racine's Horlick Dam. In order to sustain or improve the fish population, fish must have plenty of dissolved oxygen as do the other aquatic organisms that make up the stream (or river's food chain and ecosystem).



*Sport fishing below the City of Racine's Horlick Dam*

Many factors influence the amount of dissolved oxygen in water including: sunlight, water temperature, the presence of aquatic plants, turbulence of the water, and the

amount and type of sediments, to name a few. For example, the amount of dissolved oxygen increases wherever the water flow becomes turbulent; as water rushes over rapids or cascades over a waterfall, oxygen molecules from the air are absorbed by the water. The more turbulence, the more water is brought into contact with the air, this allows more oxygen to dissolve into the water.

The summer season presents special environmental conditions that greatly influence the amount of dissolved oxygen in the water. Warm water holds less oxygen than cold water, and as summer progresses, less oxygen is available for fish and other animals than at summer's onset. Additionally, as people begin to fertilize their lawns, "fertilized" stormwater runoff enters our waterways where it can encourage algae to grow to nuisance levels (blooms) that can further deplete dissolved oxygen. Algae are microscopic aquatic plants that add dissolved oxygen to the water during daylight hours by a process called photosynthesis. However, this process is reversed at night when this same algae consumes dissolved oxygen. Because fish, plants, and other aquatic organisms need oxygen 24-hours a day, the day-to-night fluctuations of dissolved oxygen can be significant, even at times reaching the point where there is no available oxygen! Dissolved oxygen concentrations are generally reported in units of milligrams per liter of water (mg/L). Wisconsin Warm Water Quality Standards require a minimum of 5 mg/L of dissolved oxygen in rivers and streams classified to support full fish and aquatic life.

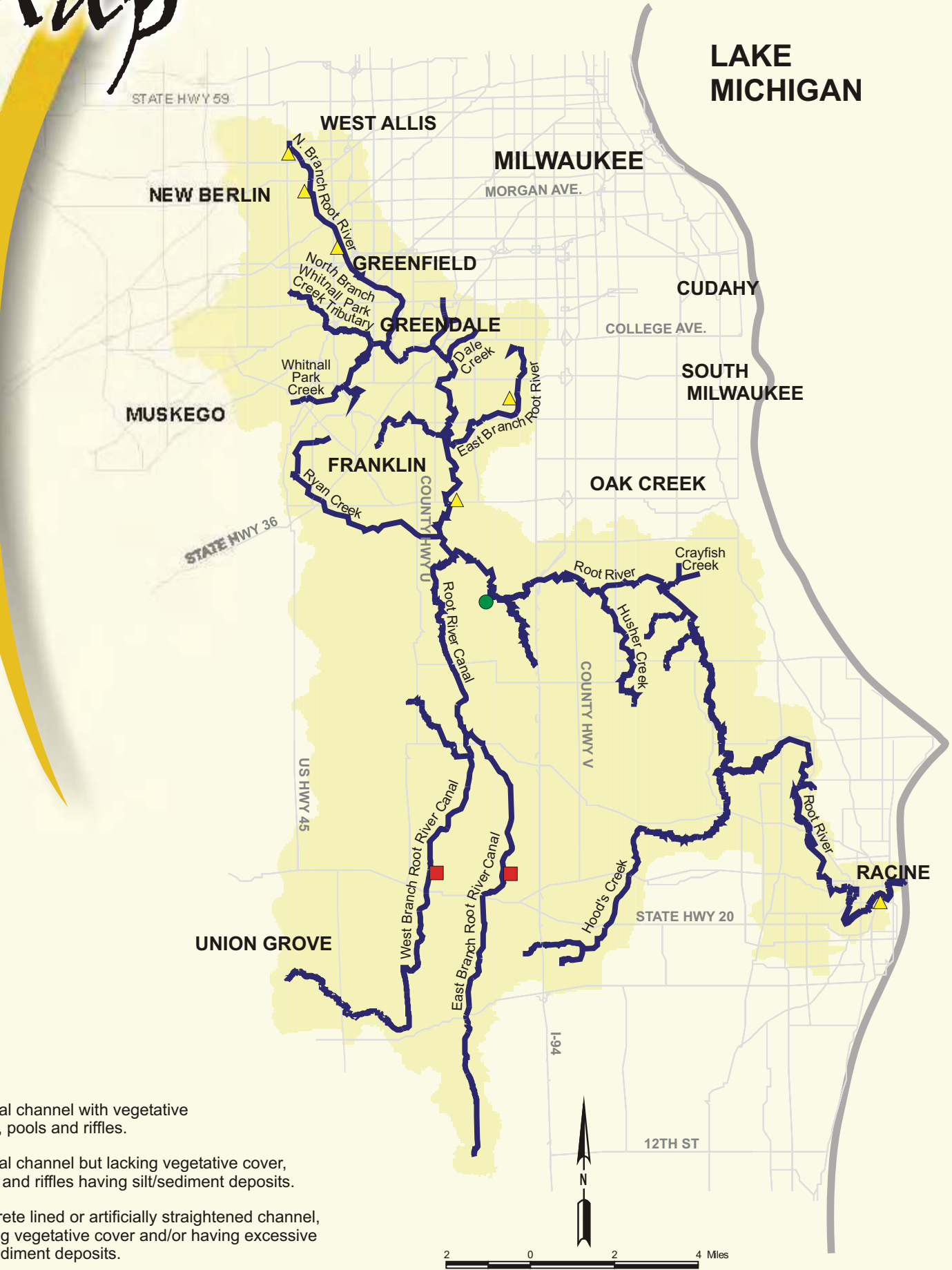
Many factors influence the amount of dissolved oxygen in water, including sunlight, water temperature, the presence of aquatic plants, turbulence of the water, and the amount and type of sediments; to name a few.

## Dissolved Oxygen Stats

The upper Root River Watershed frequently experiences dissolved oxygen levels below Water Quality Standards. During the summer, water levels in the upper watershed become very low; water tends to pool and stagnate, resulting in low dissolved oxygen levels, and high water temperatures. Data is lacking for most of the Root River south of Milwaukee County; however the very lowest portion of the Root River, from its mouth to Racine's Horlick Dam, appears to have adequate dissolved oxygen levels.

# Root River Watershed

# Habitat Map



- Natural channel with vegetative cover, pools and riffles.
- ▲ Natural channel but lacking vegetative cover, pools and riffles having silt/sediment deposits.
- Concrete lined or artificially straightened channel, lacking vegetative cover and/or having excessive silt/sediment deposits.

# Habitat

According to the U.S. EPA, a typical city block generates seven times more runoff than a woodland area of the same size. "Hard surfaces" (impervious) such as roadways, parking lots, roof tops, etc... prevent water from naturally penetrating (infiltrating) into the ground.

An important element of a waterway is the condition of the *habitat*. Good quality habitats are necessary to achieve balance and diversity in the aquatic ecosystem. Your fishing days will be numbered if the habitat quality of the small plants and animals that fish eat begins to disappear.

Unfortunately, the breakdown or loss of many habitats is caused by human activities. Multiple activities that affect our waterways include: urbanization (the construction of residential, commercial and industrial developments, roadways, and supporting infrastructure), the loss or filling of wetlands, removal of forested land cover, poor agricultural practices and water diversions, such as damming and channelizing. Of these, urbanization (the physical growth of cities, towns and villages) within the watershed appears to be one of the greatest contributing factors that affects water quality and quantity and aquatic habitat.

## Characteristics of Good Habitat

- **Stable natural banks.**
- **Natural vegetative cover and tree canopy that provides stream shading.**
- **Streambed not heavily covered over with silt and muck.**
- **Diverse stream structure that has riffle areas and pools for fish refuge.**
- **Wide vegetated buffer area along waterway that filters out polluted stormwater runoff.**



East Br. Root River Canal



Whitmill Park lagoon and falls

With human activity comes an increase in hard (impervious) surfaces (i.e., rooftops and roadways). Hard surfaces increase runoff, pollutants, and the risk of flooding. Flooding can damage streambeds and banks, causing the river's natural channel to become unstable. Past attempts to manage flooding in the Root River Watershed led to stream beds and banks being channelized (straightened and deepened). This process eliminated habitats within and along waterways. As a rapidly urbanizing watershed, the Root River Watershed contains many streams that have been ditched and straightened; however, recent efforts have been initiated that include creating stormwater runoff rules and conservation of open land in the Root River Watershed.

## Habitat Stats

Much of the natural habitat in the Root River Watershed has been replaced by either urban development or agricultural cultivation practices. Many of the tributary streams within the watershed have been straightened or deepened to provide drainage. Additionally, considerable sections of the Root River and its tributaries have accumulated substantial silt deposits that cover suitable fish spawning habitat and impede flow.

# Nutrients Map

## Root River Watershed



# Nutrients

*Just by limiting the amount of fertilizer we apply to our lawns, we can help improve the state of our waterways. High levels of nutrients in rivers and lakes can promote excessive plant and algae growth, resulting in dissolved oxygen deficiencies, loss of habitat, and noxious odors.*

Another factor that affects water quality is the amount of **nutrients** in the water. Two of the major nutrients found in water are **phosphorous and nitrogen**. Both are necessary for living things to be healthy and grow. However, too much of these nutrients can cause excessive aquatic plant growth or algae blooms.



Algae blooms can decrease the amount of oxygen in the water, resulting in too little oxygen for fish and other aquatic animals to survive. These blooms can also create noxious odor problems once they begin to die off.

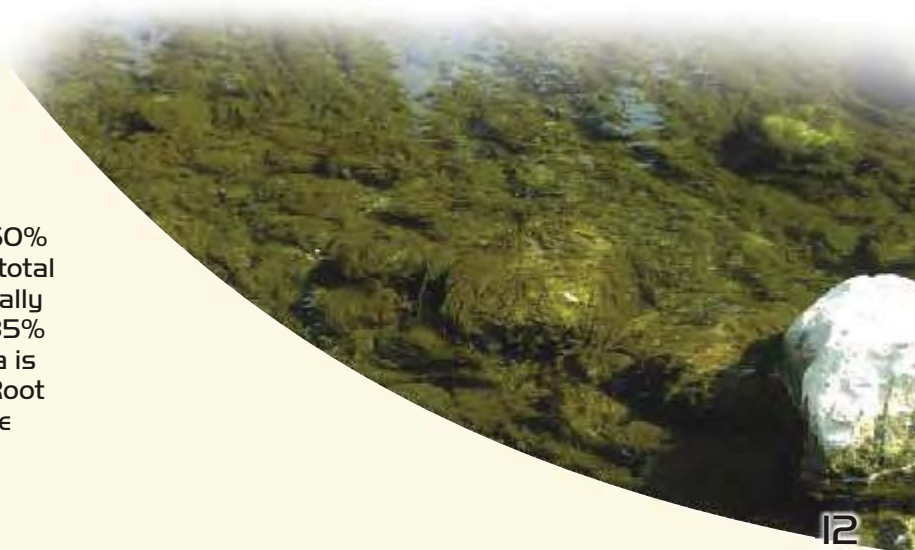
The concentration of nutrients and the form they are found in changes continually. How and why they change depends on a variety of complex factors. The total input of nutrients varies with land use and other factors. For example, during the summer, nutrient input may increase due to fertilization of cropland or lawns and gardens. During the autumn, rainfall causes the increased wash-off of organic matter such as leaves, twigs, grass, and other

debris. Because decomposition of this organic matter releases nutrients, it constitutes an important source of nutrient loading to the waterway.

Phosphorous and nitrogen are abundant in the waste material treated at the local or regional wastewater treatment plants. Municipal and industrial discharges, as well as sewer overflows, are also contributors of nutrients to our waterways. Urban stormwater runoff is another major concern because it too contains high nutrient levels. Nutrients in stormwater runoff come from lawn and garden fertilizers, pet and other animal wastes, organic leaf material, and soil from construction sites. This stormwater runoff enters the waterways every time it rains. Rural and agricultural areas also contribute to nutrient increases through failing septic systems, livestock feedlot operations, poor manure spreading techniques, fertilizing practices, and increased erosion from plowed surfaces or unstable stream banks. The EPA's recommended nutrient criteria for the eco-region that includes the Root River Watershed is 1.59 mg/L for total nitrogen and 0.08 mg/L for total phosphorus. These are only recommended criteria that have not as yet been adopted or put into law.

## Nutrient Stats

Most locations in the upper Root River Watershed exceed the recommended total phosphorus criteria by 50% or more of the time. The total nitrogen criteria is generally met between 50% and 85% of the time. Nutrient data is lacking for most of the Root River south of Milwaukee County.



# Root River Watershed

# Fecal Coliform Map



# Fecal Coliform & E. coli Bacteria

One of the greatest threats to swimmable water is the presence of bacteria or other pathogens in the water. Common indicators used to determine the potential presence of human pathogens (disease-causing organisms) are *fecal coliform* and *E. coli* bacteria. These microscopic organisms live in the intestines of warm-blooded animals, including humans, and can be found in fecal waste. Although these bacteria don't necessarily cause disease themselves, they do indicate the possible presence of other disease-carrying organisms that live in the same environment.



Testing water for either fecal coliform or E. coli bacteria is important for public safety. Fecal coliform or E. coli bacteria in high numbers, whether from stormwater runoff, agricultural or livestock management practices, or combined and sanitary sewer

overflows, indicates a potential health risk for drinking, bathing, and swimming in contaminated water.

Fecal coliform and E. coli bacteria survival is dependent on specific environmental conditions that are highly variable and change quickly. This makes predicting bacteria populations within the waterways difficult. For example, although spring rains may wash more fecal matter into the waterway, cool water temperatures may prevent it from flourishing. During the summertime, increased exposure to sunlight (with its ultraviolet disinfection properties) may limit bacterial numbers even though warmer water temperatures exist.



Higher amounts of fecal contamination normally occur during wet weather from contaminated runoff reaching the waterways. The monitoring of stormwater runoff in urbanized areas has shown surprisingly high levels of fecal coliform bacteria. Common sources for these high bacterial levels found in urban and rural stormwater runoff include pet wastes, gull and goose droppings, wildlife or livestock operations, or manure spreading on farmlands. Other major sources include; sanitary sewer (SSO) overflows and failing septic systems.

Fecal coliform bacteria is routinely tested in the upper Root River while E. coli is not. Fecal coliform concentrations are reported in units of bacterial colonies per 100 milliliters of water. The Wisconsin Water Quality Standard for fecal coliform for most surface water designated for recreational use is 200 counts per 100 milliliters of water.

All locations in the upper Root River Watershed exceed the fecal coliform Water Quality Standard 50% or more of the time. Fecal coliform data is lacking for most of the Root River south of Milwaukee County; however, it is suspected that most of the waterways within the Root River Watershed would not meet Water Quality Standards more than 50% of the time. Bacteria sources include stormwater runoff, domestic and wildlife inputs, manure from livestock, failing septic system, and sanitary sewer overflows.

## Fecal Coliform Stats

*Fecal Coliform bacteria levels in urban stormwater runoff can range from several 100 counts per 100 milliliters of water to well over a million counts!*



# Other Indicators

There are many other factors that affect water quality in the Root River Watershed. Some of the more notable indicators include; heavy metals (i.e. lead, mercury, copper, and zinc), pesticides, polycyclic aromatic hydrocarbons (PAH's), and polychlorinated biphenyls (PCB's). Even in low to moderate concentrations many of these materials are harmful to aquatic organisms, fish, and people because they concentrate in fatty tissue and move up the aquatic and terrestrial food chain, as predator eats prey.

**Heavy Metals:** In highly industrialized and urban areas, these materials come from a variety of sources that include: industrial discharges, scrap metal storage or salvage operations, the incomplete combustion of fossil fuels, sewage overflows, and farmland runoff. Dust, in the form of atmospheric deposition, also contributes these materials to the waterways as it settles on the water, or is carried by precipitation. Cars, trucks, and other vehicles add heavy metals to the environment by their exhaust, in the wear and tear of their tires, brakes, and body frames.

**Pesticides:** Pesticides are used to control fungi, weeds, insects, plant diseases, and rodents. However, the improper use of these chemicals can also have unintended consequences by killing desirable organisms or contaminating their food sources. Pesticide residues and their byproducts can remain in the environment for long periods and accumulate in the tissue of living organisms.

**PAH's:** Just like pesticides, PAH's also stay in the environment for long periods and move up the food chain where they can become toxic or cause cancer. PAH's are formed from the incomplete combustion of fossil fuels and organic matter. They are also a component of many petroleum products, creosote, asphalt, and vehicle exhaust. Residential wood burning is also a source of PAH's in rural and urban environments.

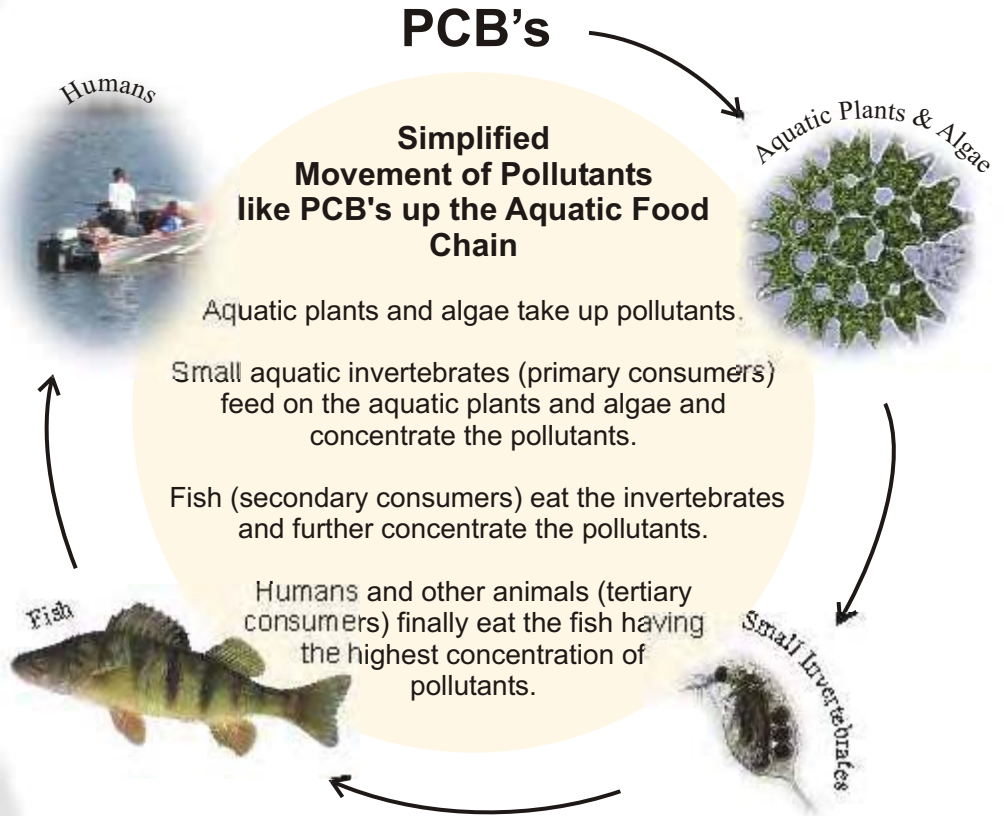


The increase in paved surfaces has been spurred not only by urban and suburban development, but also by a steady increase in the use of automobiles, the primary mode of daily transportation for most Americans.

# Other Indicators

**PCB's:** PCB's constitute a family of 209 manmade, fat soluble, chlorinated compounds. Because of their insulating and non-flammable properties, PCB's were widely used in the past as hydraulic fluids, coolants, and lubricants in transformers, capacitors, and other electrical equipment. PCB's were banned from production in the United States in 1976, so PCB's found in the environment today are from past uses and former spills.

*Industrial processes, salvage scrap metal piles, metal roof tops, normal wear of automobile brake linings and tires, and vehicle emissions all can add heavy metals to the environment.*



**Chlorides:** Chloride (salt) levels are yet another indicator of water quality. In freshwater systems chlorides occur naturally at low levels; however, chloride concentrations have been steadily increasing in our waterways, largely due to winter roadway salting. Chlorides in fresh water systems also come from other human-related activities



including irrigational practices, water softeners, discharges of domestic and industrial effluents, and sewer overflows.

Excessively high concentrations of chlorides from road salt can damage vegetation along the waterways and can also cause shock to freshwater organisms when sudden winter thaw conditions create highly salty runoff.

## Other Indicators

The impact upon the aquatic ecosystem from any or all of these substances individually or in combination may include sensitive life stage mortality, damage to reproductive systems and general population declines.

# Watershed Terms

**Algae:** Algae are simple single-celled, multi-celled or colonial, aquatic plants that contain the green pigment chlorophyll. They grow by absorbing nutrients (nitrogen and phosphorus) from the water or sediments, add oxygen to the water during the process of photosynthesis and represent the basic component of the aquatic food chain.

**Algae Blooms:** Refers to noxious and excessive growths of algae generally caused by excessive nutrients in the water. Algae blooms often result in scum forming on the water surface and associated foul odors. Blooms can be potentially harmful to fish and wildlife (and people) in extreme situations.

**Aquatic Respiration:** Refers to the use of oxygen in an aquatic system including the decomposition of organic matter and the use of oxygen by fish, aquatic invertebrates, algae and microorganisms for metabolism.

**Bioaccumulation:** The progressive increase in the amount of a substance or chemical in an organism resulting from repeated exposures to that substance or chemical. Certain chemicals, such as PCB's, mercury, and some pesticides, can be concentrated from very low levels in the water to toxic levels in animal tissues through this process.

**Chloride:** Chlorides are a form of salt that can be harmful to freshwater life at high levels. Large concentrations of chlorides in freshwater systems come from manmade sources such as roadway salting, irrigational practices and through discharge of domestic and industrial wastes.

**Chlorophyll:** Green pigment in plants and algae that transforms light energy into chemical energy during the process of photosynthesis.

**Combined Sewers:** Combined sewers capture both wastewater from your home or business along with all the rain that runs off of streets, yards and parking lots. Found mostly in the older sections of the City of Milwaukee and Village of Shorewood, combined sewers represent about 5% of the Milwaukee Metropolitan Sewerage District's total service area. One of the great benefits of the combined sewer system is that it delivers highly polluted stormwater runoff to the wastewater treatment plant for cleaning during rainstorms.

**Combined Sewer Overflows:** During heavy rains, there may be combined sewer overflows (CSO's). When this happens, stormwater pollutants along with some untreated sewage overflow into area waterways. It's estimated that combined sewer overflows consist of about 85% stormwater and 15% sewage. In this region, up to six CSO's are allowed per year.

**Decomposition:** Breakdown of organic matter by bacteria and fungi. Generally uses oxygen in the breakdown process.

**Dissolved Oxygen (DO):** The dissolved oxygen content is an indication of the status of the water with respect to the balance between oxygen-consuming and oxygen-producing processes. Fish and other desirable clean-water biota require relatively high dissolved oxygen levels at all times.

**Dry Deposition:** Fine particulate matter settling from the atmosphere onto land surfaces or water bodies during periods with no precipitation.

**Ecosystem:** All of the interacting systems and organisms in association with their interrelated physical and chemical environment.

**Eutrophication:** The process by which lakes and streams are enriched by nutrients (usually phosphorus and nitrogen) which leads to excessive plant growth or algae blooms.

**Fecal Coliform Bacteria:** Fecal coliform bacteria are found in the intestinal tracts of warm-blooded animals. Fecal coliform bacteria, like *E. coli* bacteria, are used as microbiological indicators that determine the safety of water for drinking or swimming. Fecal coliform bacteria in waterways originate from many sources that include bird droppings, pet waste, livestock waste, failing septic systems, stormwater runoff, and sanitary and combined sewer overflows.

**Food Chain:** The transfer of food energy from successive levels of organisms. An example of the food chain sequence is algae being eaten by aquatic invertebrates, which in turn are eaten by small fish, which are then eaten by larger fish, which are eventually eaten by people.

**Habitat:** Every stream has its own set of unique characteristics that evolve in concert with and in response to surrounding ecosystems. For example, deep pools provide space, cover, and a place for fish to seek protection during storms or droughts. Likewise the amount of vegetation and trees that line the banks defines the available cover and shading of the stream. These factors in combination with many others create the habitat of the stream.

**Impervious Surfaces:** Hard land surfaces such as roads, parking lots, buildings, etc. that prevent rainwater from soaking into the soil. Runoff from impervious surfaces carries deposited contaminants from those surfaces to the local waterways.

**Land use:** Land use describes the dominant character of a geographic area and describes the dominant types of human activities which are prevalent in the area or region. Examples of various land uses include cropland, forest, pastureland, suburban and urban developments.

**Landscape:** All the natural geographical features, such as fields, hills, forest, and water that distinguish one part of the earth's surface from another part. These characteristics are a result not only of natural forces but of human use of the land as well.

**Mercury:** Mercury is one of several heavy metals widely distributed in the environment which can bioconcentrate. Mercury is used in fungicides, bactericides, and slimicides because of its toxic properties. Fuel combustion, coal burning and smelting processes release mercury to the atmosphere, where it can subsequently be transported and/or deposited to the water.

**Nitrogen:** Nitrogen is one of several nutrients needed by all plants and animals. Nitrogen is a key component of proteins, and as plants and animals live and die, they release many nitrogen compounds to the surrounding environment.

**Nonpoint Source Pollution:** Nonpoint source pollution comes from diffuse, undefined sources; it is associated mainly with the surrounding land use such as urban development or agriculture. Nonpoint source pollution or polluted stormwater runoff is considered the greatest threat to water quality both nationally and in Wisconsin.

**pH:** pH is an important factor in the chemical and biological systems of natural water and is the measure of hydrogen ion activity. Whether the water is acidic (low pH) or basic (high pH) affects the toxicity of many compounds (i.e. heavy metals). A pH range of 6.0 to 9.0 appears to provide adequate protection for the life of freshwater fish and bottom-dwelling invertebrates.

**PAH's:** PAH's (Polycyclic Aromatic Hydrocarbons) are formed from the incomplete combustion of fossil fuels and organic matter. They are also a component of many petroleum products, creosote, asphalt, cigarette smoke and vehicle exhaust. Forest fires and residential wood combustion are thought to be a major source of PAH's in rural and urban environments. PAH's are considered carcinogens.

**PCB's:** PCB's (Polychlorinated Biphenyls) are a group of fat-soluble chlorinated chemicals. PCB's have been used as dielectric fluids in capacitors and transformers, and in hydraulic fluids. PCB's are persistent and bioconcentrate in the aquatic food chain because of their stability and ability to concentrate in fatty tissue. PCB's are only moderately acutely toxic; however, they cause chronic toxic effects such as developmental and reproductive toxicity.

**Phosphorus:** Phosphorus is one of the major nutrients required for plant nutrition. Excess concentrations of phosphorus can stimulate rapid algae and plant growth which can lead to a condition of accelerated aging of waters (eutrophication). Phosphorus can enter waterways from multiple sources including domestic and industrial wastewater discharges and from agricultural practices and fertilization of urbanized and suburban areas.

**Photosynthesis:** The process by which green plants convert carbon dioxide (CO<sub>2</sub>) dissolved in water to sugars and oxygen using sunlight for energy. Photosynthesis is essential in producing the aquatic food chain base, and is an important source of oxygen for many waterbodies.

**Sanitary Sewer Overflow:** Sanitary sewer overflows (SSO's) occur when leaky sanitary sewer lines fill beyond their capacity during heavy rains. These sewers are designed to carry wastewater, not rainwater. Leaks occur through illegal sewer connections, cracks in sewer lines or connection joints and through poorly sealed manhole covers in streets. Rather than allowing the rainwater and sewage to back up into people's basements, relief is provided to the system through an overflow point to an area waterway.

**Separate Sanitary Sewers:** Sanitary sewers take wastewater from your home or business to the wastewater treatment plants for processing. About 95% of Milwaukee Metropolitan Sewerage District's total service area has separate sewers, a system that consists of two separate sewer pipes (a sanitary sewer and a storm sewer).

**Solids:** Solids are an important water quality variable that can originate from soil particles or other sources. High solids concentrations can reduce spawning habitat when settling in a stream or to a lake bottom and can clog gills of fish and invertebrates or make drinking water supplies undesirable, reduce light penetration, and may cause adverse effects for irrigation and industrial processes.

**Storm Sewers:** The storm sewer collects stormwater runoff from streets and yards and delivers that water directly to a river or lake every time it rains or the snow melts.

**Stormwater Runoff:** Precipitation and snowmelt runoff from farm fields, roadways, parking lots, roof drains that is collected in gutters and drains. Polluted stormwater runoff is considered the greatest threat to water quality in Wisconsin.

**Temperature:** Water temperature is important to aquatic organisms because it affects the solubility of dissolved oxygen and the toxicity of various substances found in the water. Water temperature influences the rate of biochemical processes, metabolism, respiration and reproduction of aquatic organisms.

**Turbidity:** Turbidity is suspended particles found in water and is measured by a particle's ability to scatter sunlight. Excessive turbidity can clog the gills of fish and mussels, and can cover bottom habitats of invertebrates and fish spawning areas.

**Watershed:** Defined by nature's boundaries, a watershed is an area of land that captures water and drains to a river or lake. If a drop of water falls outside of the boundary, it becomes part of another watershed. Also called Drainage Basin or Water Basin.

## *How You Can Be Watershed Friendly*

- Use fertilizers and pesticides sparingly, follow directions and avoid over-spray or spreading from getting in waterways or on paved surfaces that can run off into waterways.
- Dispose of waste oil, gasoline, paints, and other household products properly. Take material to authorized collection centers. Never pour materials down storm drains.
- Reduce the amount of paved surfaces around your home and business.
- Where possible, landscape with swales (low vegetated areas) to catch and filter stormwater and reduce runoff to and from paved areas.
- Plant ground cover to eliminate bare ground and prevent erosion.

## *What Can You Do to Help?*

- Conduct or participate in clean-ups of the streams and river banks around where you live.
- Monitor the health of the streams and rivers around where you live.
- Learn how to prevent water pollution around your home or business.
- Participate in the Greater Milwaukee Watersheds "Water Quality Initiative."  
For more information go to [www.mmsd.com/wqi](http://www.mmsd.com/wqi).



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