4.0 Water Quality Assessment

4.1 Point and Nonpoint Source Water Quality Pollutants

Water quality can be adversely affected by both point and nonpoint source pollutants. Point sources are identified as any discharge that comes from a pipe or permitted outfall, such as municipal and industrial discharges. Municipal and industrial discharges within Wind Point watershed are regulated by Wisconsin's stormwater runoff permits. There are two municipal wastewater treatment plant outfalls in the watershed both located on Lake Michigan in the Cities of Oak Creek and South Milwaukee. Many stormwater discharges are located throughout the Wind Point watershed; however, the location of each discharge is not available for this study.

Wisconsin WPDES Permit Program

Section 402 of the federal Clean Water Act established the National Pollutant Discharge Elimination System. This program regulates point source discharges of pollutants into United States waters and sets specific limits on discharges from point sources, establishes monitoring and reporting requirements, and establishes exceptions. The permitting program is designed to prevent storm water runoff from washing harmful pollutants into local surface waters such as streams, rivers, lakes or coastal waters. It also allows for the USEPA to authorize states to assume many of the permitting, administrative, and enforcement responsibilities of the program (USEPA, 2012).

The Wisconsin Department of Natural Resources (WDNR) developed the Wisconsin Pollutant Discharge Elimination System (WPDES) Storm Water Discharge Permit Program which is administered under the authority of ch. NR 216, Wis. Adm. Code. The WPDES Storm Water Program regulates the discharge of storm water from construction sites, industrial facilities, and municipal separate storm sewer systems (MS4s).

Individual WPDES permits are issued to municipal and industrial facilities discharging to surface water and/or groundwater. General permits are issued for specific categories of industrial, municipal and other wastewater discharges. Municipal Separate Storm Sewer System (MS4) permits require municipalities to reduce polluted storm water runoff by implementing storm water management programs with best management practices. The MS4 permits usually do not contain numerical effluent limits like other WPDES permits (WDNR, 2012).

WPDES Permit Sites
There are two wastewater treatment plant outfalls located in the northern portion of the watershed along Lake Michigan: the South Milwaukee Wastewater Treatment Facility in South Milwaukee and South Shore Wastewater Treatment Plant in Oak Creek (Figure 49). The South Milwaukee facility is owned and operated by the South Milwaukee while the South Shore facility is operated by Milwaukee Metropolitan Sewerage District (MMSD). Both plants discharge directly to Lake Michigan. In addition, fourteen industrial permit sites are located throughout the watershed (Table 22).

The South Milwaukee Wastewater Treatment Facility began as a primary treatment facility constructed in 1936. In 1970, a secondary treatment facility was constructed and in 1985 a new aeration system was installed. A 2.8 million gallon sludge storage dome and a ultra-violet disinfection system were added in 1996. The treatment plant currently treats over 4 million gallons of wastewater every day.

The South Shore Wastewater Treatment Plant is located along Lake Michigan in the City of Oak Creek and began operation in 1968. What is unique about this plant is that biosolids are sent to anaerobic digesters where microorganisms convert a large part of the biosolids into methane gas which is collected and burned to produce electricity for the plant.

Nonpoint Source Pollutants
Nonpoint source pollutants are pollutants that enter a waterway from a source other than a pipe or permitted outfall. Historically these pollutants are the most difficult to control because tracking them back to their source is difficult. Nonpoint source pollutants can include, but are not limited to, illicit discharges into waterways, excess nutrients (such as nitrogen and phosphorus), oils and chemicals washed off of roadways (such as chlorides from deicing agents), and/or excess sediment (from construction sites or streambank destabilization). Most nonpoint source pollutants are monitored via physical-chemical water quality testing.

Below: South Shore Wastewater Treatment Plant (Source: Google Maps). *Far right: South Milwaukee Wastewater Treatment Plant (Source: Google Maps).*

Table 22. WPDES permitted sites in Wind Point watershed.

Permit ID	Site Name	Municipality	Permit Type
S067857	We Energies Oak Creek Power Plant	Oak Creek	Storm Water Industrial Tier 2
S067849	Mid-America Steel Drum Co Inc	Oak Creek	Storm Water Industrial Tier 1
S067857	Cooper Power Systems Inc	S. Milwaukee	Storm Water Industrial Tier 2
S067857	Everbrite Inc	S. Milwaukee	Storm Water Industrial Tier 2
WI-0036820-03-0	South Shore Wastewater Treatment Plant	Oak Creek	Municipal Permit
WI-0047341-04-0	S. Milwaukee Wastewater Treat. Facility	S. Milwaukee	Municipal Permit
S067857	Knapp Mfg	Caledonia	Storm Water Industrial Tier 2
S067849	E C Styberg Engineering Co Inc	Racine	Storm Water Industrial Tier 1
S067857	Racine Container	Racine	Storm Water Industrial Tier 2
S067857	Hi-Standard Machining Co Inc	Racine	Storm Water Industrial Tier 2
S067849	Met Tek Inc	Racine	Storm Water Industrial Tier 1
S067857	Michaels Machine Co Inc	Racine	Storm Water Industrial Tier 2
S067857	John H Batten Airport	Racine	Storm Water Industrial Tier 2
S067857	S C Johnson Wax Aviation Department	Racine	Storm Water Industrial Tier 2
46515	Vulcan Materials Co Racine Quarry	Racine	Nonmetallic Mining Operations
S049158	Wiscon Products Inc	Racine	Storm Water Industrial Tier 3

4.2 Water Quality Report, Designated Use, & Impairments

The Federal Clean Water Act requires Wisconsin and all other states to submit to the United States Environmental Protection Agency (USEPA) a biannual report of the quality of the state's surface and groundwater resources and an updated Section 303 (d) list. *The Wisconsin Water Quality Report to Congress – Year 2012* was compiled by the Wisconsin Department of Natural Resources (WDNR's) Water Division and is the most recent of these reports. These reports must also describe how Wisconsin assessed water quality and whether assessed waters meet or do not meet water quality standards specific to each "Designated Use" of a stream or lake as defined in chs. NR 102, 104, and 105 of the Wisconsin Administrative Code. When a waterbody is determined through biological and/or physical-chemical sampling to be impaired, WDNR must list potential causes and sources for impairment in the 303 (d) impaired waters list.

WDNR developed four general Designated Uses which define the goals for a waterbody for all Wisconsin surface waters: Fish and Aquatic Life, Recreational Use, Public Health and Welfare, and Wildlife. Each designated use is associated with particular water quality criteria that are either numeric or narrative in nature and set the standards a waterbody must meet in order to protect the intended use.

The Fish and Aquatic Life use designation is appropriate for the protection of fish and other aquatic life and is subdivided into further categories – coldwater, warmwater sport fish, warmwater forage fish, limited forage fish, and limited aquatic life. The recreational use designation means a stream is appropriate for recreational use unless a sanitary survey has been completed to show that humans are unlikely to participate in activities requiring full body immersion. The Public Health and Welfare use designation means it is appropriate to protect for incidental contact and ingestion by humans. Finally, the Wildlife use designation means it is appropriate to protect wildlife that relies directly on the water to exist or rely on it to provide food for existence (WDNR, 2012).

Wisconsin also utilizes an anti-degradation policy as a component of protecting waters. This policy is aimed at ensuring that high quality waters are prevented from being degraded by identifying them as either Outstanding Resource Waters or Exceptional Resource Waters. No waterbodies within Wind Point watershed have been classified as either Outstanding or Exceptional Resource Waters.

According to WDNR's 2012 Water Quality Report and Section 303d List (WDNR, 2012), none of the tributary streams in Wind Point watershed are listed as impaired for any of their "Designated Uses" because they have not been assessed by WDNR. However, the findings of this report combined with water quality sampling results suggest moderate impairment of the tributary streams caused by channelization, streambank erosion, draining of wetlands, and high phosphorus and E. coli in agricultural and urban stormwater runoff.

None of the tributaries in Wind Point watershed have been assessed for designated uses by the WDNR. This means that all of the tributaries are classified as default FAL (fish and aquatic life) waters and assumed to support either a coldwater community or warmwater community depending on water temperature and habitat. Currently there are no Designated Use Impairments for the tributaries in Wind Point watershed.

4.3 Physical, Chemical, and Biological Water Quality Monitoring

In Wisconsin, physical, chemical, and biological monitoring, habitat monitoring are all used to assess the health of streams and to determine water quality condition and/or impairment. Fish Indices of Biological Integrity and Macroinvertebrate Indices of Biological Integrity are used to assess the biological health of streams. Biological data is augmented by the physical-chemical sampling results obtained in the field. Several macroinvertebrate surveys have been conducted and many of the nonpoint source pollutants have been tested for via physical-chemical water quality samples conducted at various sites along the tributaries, stormwater outfalls, and Lake Michigan within and along Wind Point watershed.

Table 23 lists all known physical-chemical and biological data collected in the watershed from 2008 to late 2013 while Figure 49 displays the location of each sample site where the data was collected. In general, the most recent data is analyzed and averaged so that recommendations and management strategies are based on the most current depiction of the water quality and biological conditions.

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Table 23. List of most recent chemical, biological, and microbial water quality sample sites from 2008 to 2013.

Site ID	Location	Date(s)	Water Quality and other Parameters
WDNR-1	Rocky Creek	6/28/08, 7/20/08, 9/6/08, 9/27/08, 5/30/09, 6/21/09, 8/1/09, 9/6/09, 9/27/09, 5/15/10, 6/25/10, 7/31/10 8/21/10, 9/12/10, 10/9/10, 5/30/11, 6/25/11, 7/23/11, 10/9/11, 4/28/13, 7/13/13	DO, DO Sat, pH, Temp, Transparency
WDNR-2	Dominican Creek at Lake Michigan	3/14/09, 5/2/09, 6/21/09, 9/6/09, 7/3/10, 8/7/10, 8/22/10, 9/12/10, 10/10/10, 5/30/11, 6/25/11, 7/23/11, 3/25/12, 4/1/12, 6/5/12, 6/17/12, 8/23/12, 10/21/12, 4/28/13, 6/22/13, 7/14/13	DO, DO Sat, pH, Temp, Transparency
WDNR-3	Sienna Center Creek At Lake Michigan	6/22/08, 7/20/08, 9/6/08, 9/28/08, 10/25/08, 11/1/08, 5/2/09, 6/21/09, 7/18/09, 9/7/09, 9/27/09, 5/15/10, 7/3/10, 8/7/10, 8/22/10, 9/12/10, 10/10/10, 4/9/11, 5/30/11, 6/25/11, 7/23/11, 9/11/11, 3/25/12, 6/3/12, 7/21/12, 8/23/12, 9/16/12, 10/21/12, 4/28/13, 6/22/13	DO, DO Sat, pH, Temp, Transparency
WDNR-4	Unnamed tributary to Lake Michigan at 4 Mile Rd	6/30/12, 7/7/12, 7/21/12, 8/11/12, 8/25/12, 9/8/12, 9/23/12	DO, DO Sat, pH, Temp, TP, Transparency
WDNR-5	Prairie Stream South	7/9/11, 7/23/11, 8/6/11, 8/20/11, 9/3/11, 6/16/12, 6/30/12, 7/7/12, 7/21/12, 8/11/12, 8/25/12, 9/8/12, 9/23/12, 6/8/13, 6/22/13, 7/13/13	DO, DO Sat, pH, Temp, TP, Transparency
WDNR-6	Prairie Stream at Lake Michigan	7/23/11, 8/6/11, 8/20/11, 9/3/11, 4/20/12, 6/16/12, 6/30/12, 7/7/12, 7/21/12, 8/11/12, 8/25/12, 9/23/12, 4/19/13, 6/8/13, 6/22/13, 7/13/13	DO, DO Sat, pH, Temp, TP, Transparency
RHD-1	WWTPS and Marina Rd.	2013: 1/8/, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/7, 2/14, 2/18, 2/21, 2/25, 3/4, 3/7, 311, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, /14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/31, 11/7, 11/14	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS, IBI
RHD-2	5th Ave. S of Edgewood Rd.	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/7, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/31, 11/7, 11/14	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS, IBI
RHD-3s	Bender Park Bridge	2013: 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/7, 3/11, 3/14, 3/18, 3/21, 3/25	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP
RHD-3	Bender Park Creek	2013: 1/10, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/31, 11/7, 11/14	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP
RHD-4	Oakwood Rd at WE Energies	2013:1/21, 2/18, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/31, 11/7, 11/14	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS
RHD-5	WE Energies – Rifle Range	2013: 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/7, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/31, 11/7, 11/14	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS
RHD-6	WE Energies - 7 Mile Rd.	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/7, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/31, 11/7, 11/14	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP
RHD-7s	Cliffside Trib: South (Cliffside Park Upstream)	2013: 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 3/4, 3/7, 3/11, 3/14, 3/18	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*
RHD-7	Cliffside Park Mouth	2013: 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/29, 11/5/, 11/7, 11/12	AAir temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS, IBI
RHD-8	Rocky Creek at Novak Rd.	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/7, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS, IBI
RHD-9	Crestview at 5 ½ Mile Rd.	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS
RHD-10	Klema Ditch at 5 ½ Mile Rd.	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 3/4, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS, IBI
RHD-11	Harvest Lane Branch	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/7, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/24, 10/31, 11/7, 11/14	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS
RHD-12	Matthew Drive Branch	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/7, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/24, 10/31, 11/7, 11/14	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS, IBI

Site ID	Location	Date(s)	Water Quality and other Parameters
RHD-13	Klema Ditch at 4 ½ Mile Rd.	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/7, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS, IBI
RHD-14	Dominican Creek	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 3/4, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS
RHD-15	Siena Center North - Erie	2013: 1/28, 2/14, 2/18, 3/4, 3/11, 3/14, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/24, 10/31, 11/7, 11/14	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS, IBI
RHD-16	Birch Creek - Valley	2013: 1/28, 2/14, 2/18, 3/4, 3/11, 3/14, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/24, 10/31, 11/7, 11/14	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS
RHD-17	Prairie Stream at Shoop Park	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/7, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS, IBI
RHD-18	Sheffield Court	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/7, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS, IBI
RHD-19	Parkway Creek	2013: 1/8, 1/10, 1/15, 1/17, 1/21, 1/24, 1/28, 1/31, 2/4, 2/7, 2/11, 2/14, 2/18, 2/21, 2/25, 2/28, 3/4, 3/7, 3/11, 3/14, 3/18, 3/21, 3/25, 4/1, 4/4, 4/8, 4/11, 4/15, 4/22, 4/25, 4/29, 5/2, 5/6, 5/9, 5/13, 5/16, 5/21, 5/23, 5/29, 6/3, 6/5, 6/10, 6/12, 6/17, 6/19, 6/24, 6/26, 7/1, 7/3, 7/8, 7/10, 7/15, 7/17, 7/22, 7/24, 7/29, 7/31, 8/5, 8/7, 8/12, 8/14, 8/19, 8/21, 8/26, 8/28, 9/3, 9/5, 9/9, 9/17, 9/19, 9/24, 9/26, 10/1, 10/3, 10/8, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, DO Sat, DO Conc., pH, Cond., Turb., *E. coli*, TP, NO2+NO3, TSS, IBI
RHD-A	Pier (outfall)	2013: 6/26, 7/10, 7/17, 7/24, 7/31, 8/7, 8/14, 8/21, 8/28, 9/5, 9/17, 9/26, 10/3, 10/10, 10/22, 11/7, 11/14	Air temp, water temp, pH, Cond., Turb, *E. coli*, Cl, detergent, Cu, phenols, TSS, TP, NO2+NO3
RHD-B	BP1 (outfall)	2013: 6/26, 7/10, 7/17, 7/24, 7/31, 8/7, 8/14, 8/21, 8/28, 9/5, 9/17, 9/26, 10/3, 10/10, 10/22, 11/7, 11/14	Air temp, water temp, pH, Cond., Turb, *E. coli*, Cl, detergent, Cu, phenols, TSS, TP, NO2+NO3
RHD-C	BP2 (outfall)	2013: 6/26, 7/10, 7/17, 7/24, 7/31, 8/7, 8/14, 8/21, 8/28, 9/5, 9/17, 9/26, 10/3, 10/10, 10/22, 11/7, 11/14	Air temp, water temp, pH, Cond., Turb, *E. coli*, Cl, detergent, Cu, phenols
RHD-D	Charles (outfall)	2013: 6/26, 7/10, 7/17, 7/24, 7/31, 8/7, 8/14, 8/21, 8/28, 9/5, 9/17, 9/26, 10/3, 10/10, 10/24, 10/31, 11/7, 11/14	Air temp, water temp, pH, Cond., Turb, *E. coli*, Cl, detergent, Cu, phenols, TSS, TP, NO2+NO3
RHD-E	3 Mile (outfall)	2013: 6/27, 7/11, 7/18, 7/24, 7/31, 8/7, 8/14, 8/21, 8/28, 9/5, 9/17, 9/26, 10/3, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, pH, Cond., Turb, *E. coli*, Cl, detergent, Cu, phenols, TSS, TP, NO2+NO3
RHD-F	Lighthouse (outfall)	2013: 6/27, 7/11, 7/18, 7/24, 7/31, 8/7, 8/14, 8/21, 8/28, 9/5, 9/17, 9/26, 10/3, 10/10, 10/22, 10/29, 11/5, 11/12	Air temp, water temp, pH, Cond., Turb, *E. coli*, Cl, detergent, Cu, phenols
RHD-G	Lombard (outfall)	2013: 6/27, 7/11, 7/18, 7/24, 7/31, 8/7, 8/14, 8/21, 8/28, 9/5, 9/17, 9/26, 10/3, 10/10, 10/22, 10/29, 11/5, 11/12	Air temp, water temp, pH, Cond., Turb, *E. coli*, Cl, detergent, Cu, phenols
RHD-H	Wolff (outfall)	2013: 6/27, 7/11, 7/18, 7/24, 7/31, 8/7, 8/14, 8/21, 8/28, 9/5, 9/17, 9/26, 10/3, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, pH, Cond., Turb, *E. coli*, Cl, detergent, Cu, phenols, TSS, TP, NO2+NO3
RHD-I	Augusta (outfall)	2013: 6/27, 7/11, 7/18, 7/24, 7/31, 8/7, 8/14, 8/21, 8/28, 9/5, 9/17, 9/26, 10/3, 10/10, 10/22, 10/29, 11/5, 11/12	Air temp, water temp, pH, Cond., Turb, *E. coli*, Cl, detergent, Cu, phenols
RHD-J	IEB (outfall)	2013: 5/23, 5/30, 6/6, 6/13, 6/20, 6/27, 7/11, 7/18, 7/24, 7/31, 8/7, 8/14, 8/21, 8/28, 9/5, 9/17, 9/26, 10/3, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, pH, Cond., Turb, *E. coli*, Cl, detergent, Cu, phenols, TSS, TP, NO2+NO3
RHD-K	English St. (outfall)	2013: 5/23, 5/30, 6/6, 6/13, 6/20, 6/27, 7/11, 7/18, 7/24, 7/31, 8/7, 8/14, 8/21, 8/28, 9/5, 9/17, 9/26, 10/3, 10/10, 10/22, 10/29, 11/5, 11/7, 11/12	Air temp, water temp, pH, Cond., Turb, *E. coli*, Cl, detergent, Cu, phenols, TSS, TP, NO2+NO3

KEY:	DO = dissolved oxygen	DO Sat = dissolved oxygen saturation	Turb = turbidity	Cl = chlorine
	TP = total phosphorus	NO2+NO3 = nitrate and nitrite nitrogen	TSS = total suspended solids	Cu = copper
	IBI = Index of Biotic Integrity	Cond.= specific conductivity	pH=acid/base scale	

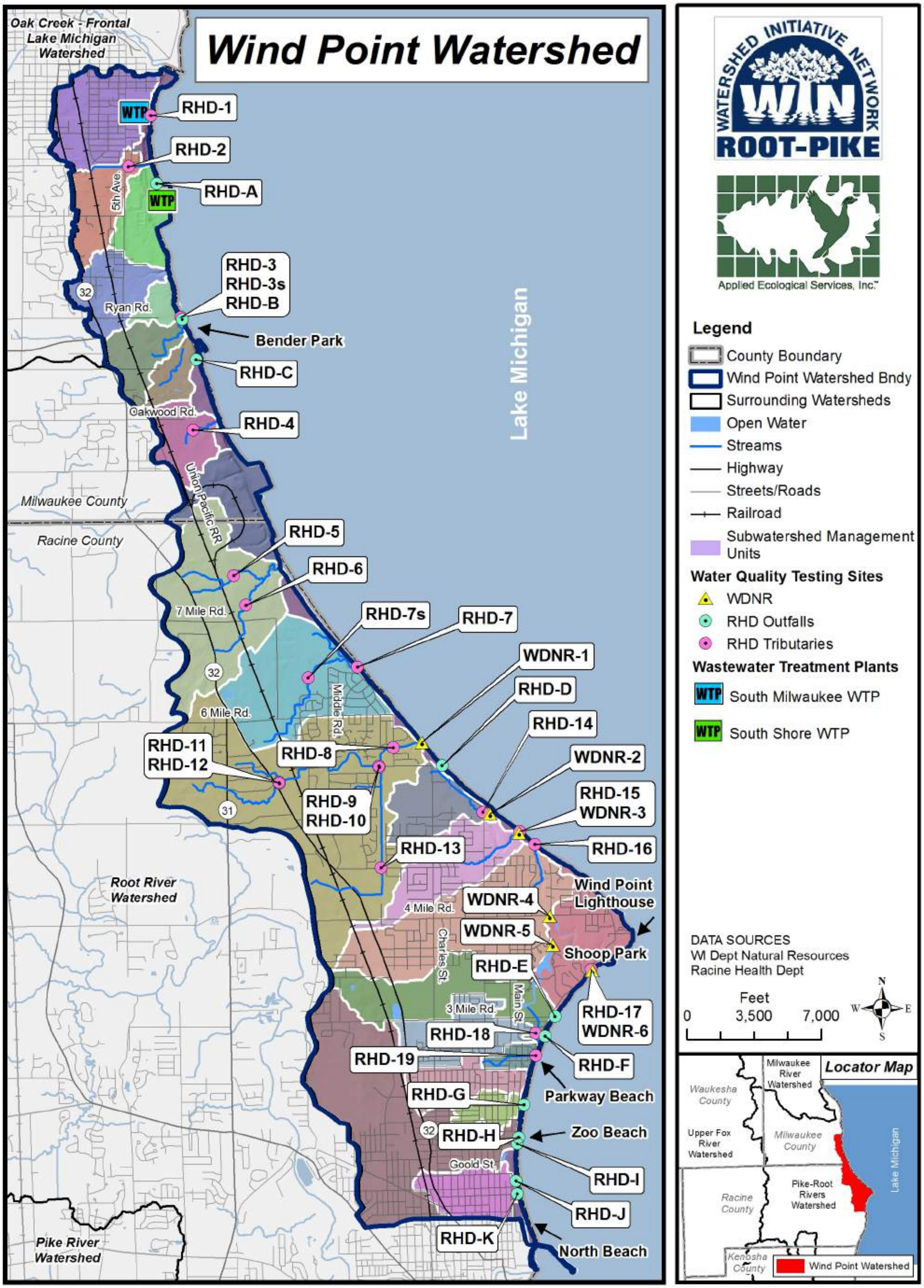


Fig. 49: Water Quality Testing Sites

Numeric Water Quality Standards

USEPA has tasked states to establish *numeric* water quality standards for nutrients (phosphorus and nitrogen) in lakes and streams. Currently, Wisconsin has a numeric phosphorus standard and is working on developing nitrogen criteria for streams by 2015. To date, Wisconsin has not developed *numeric* standards for chlorides, specific conductivity, turbidity, total suspended solids, inorganic nitrogen, kjeldahl nitrogen, and ammonia in streams. *Numeric* criteria have been proposed by USEPA for nutrients based on a reference stream method for the Corn Belt and Northern Great Plains Ecoregion (VI) which includes Wind Point watershed and the USEPA has also established general national guidelines for other criteria.

The USGS has published a document outlining recommended *numeric* criteria for sediment in streams for Ecoregion VI. These reference criteria are used in this report to assess the quality of Wind Point watershed tributaries to develop pollution reduction targets and measure future successes, even though Wisconsin has not adopted these criteria as standards.

Water Chemistry Monitoring

None of the tributary streams in Wind Point watershed are listed as impaired for any of their "Designated Uses" because they have not been assessed by WDNR. However, both chemical-physical and biological water quality sampling results suggest at least moderate impairment of the tributary streams caused by channelization, streambank erosion, draining of wetlands, and high nutrient and E. coli in agricultural and urban stormwater runoff.

Table 24 summarizes the WDNR water quality sample results for Wind Point watershed from 2008 to 2013 and also provides statistical and numerical guidelines for the various criteria. This data meets the data quality guidelines as determined by "WDNR Quality Management Program" and are equivalent to the EPA Quality Assurance Program Plan, including sampling techniques and use of qualified laboratories (WisCalm, 2012). Wisconsin provides numeric guidelines within its administrative code for temperature, dissolved oxygen, pH, and phosphorus within NR 102. Wisconsin has not yet derived their own guidelines for the remaining criteria so national standards were utilized. Criteria for specific conductivity, turbidity, and nitrogen reference general guidelines set forth by the USEPA for the nation or relevant ecoregion where applicable. The United States Geological Survey (USGS) provided the reference conditions for total suspended solids.

Baseline water quality monitoring data was collected by the Racine Health Department, under the direction of Dr. Julie Kinzelman, from December 2012 through December 2013 (see Appendix D for Racine Health Department water quality data and report). Monitoring stations were selected along nineteen tributary sites, eleven stormwater outfalls, and at six Lake Michigan surface water beach sites (Figure 49). Data collected included air temperature, water temperature, dissolved oxygen saturation, dissolved oxygen concentration, pH, conductivity, turbidity, *E. coli*, total phosphorus, total suspended solids, and nitrate and nitrite nitrogen. The results of this data are displayed in Tables 25 and 26 and depicted in terms of water quality exceedences on Figure 50.

Table 24. WDNR water quality sample results for Sites WDNR1 - 6. Temperature is shown as a maximum value while all other testing results are displayed as an average of all available testing data from 2008 through 2013.

Parameter	Statistical, Numerical, or General Use Guidelines	Site WDNR-1	Site WDNR-2	Site WDNR-3	Site WDNR-4	Site WDNR-5	Site WDNR-6
Temp (F)	<86° F*	MAX 89.8	83.3	77.9	84.2	82.4	75.6
Dissolved Oxygen (DO)	>5.0 mg/l*	AVG 8.41	7.74	8.24	3.05	7.84	5.34
pH	>6.0 or <9.0*	AVG 7.73	7.58	7.71	7.63	8.31	7.53
Total Phosphorus (TP)	<0.075 mg/L*	AVG -	-	-	5.365	0.310	1.660
Turbidity (converted from cm)	<14 NTU**	AVG <10	<10	<10	185	17	<10

- Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines
- Temperature listed as the maximum value available for each site, but testing was not always conducted during summer months. Data does not necessarily reflect the warmest actual values of each site.
* Water Quality Standards for WI Surface Waters NR 102 (2012)
** Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)

Table 25. Racine Health Department water quality sample results for tributaries Sites RHD1 - 19. Temperature is shown as a maximum value; all other results are displayed as an average (mean) of all available site data for 2013.

Parameter	Statistical, Numerical, or General Use Guidelines	Site RHD-1	Site RHD-2	Site RHD-3s	Site RHD-3	Site RHD-4	Site RHD-5	Site RHD-6	Site RHD-7s	Site RHD-7	Site RHD-8	Site RHD-9	Site RHD-10	Site RHD-11	Site RHD-12	Site RHD-13	Site RHD-14	Site RHD-15	Site RHD-16	Site RHD-17	Site RHD-18	Site RHD-19
Temp (F)	<86° F*	MAX 75.2	74.7	-	79.9	70.9	75.2	80.1	-	82.4	80.8	81.3	84.9	81.1	74.8	72.9	73.4	75.9	69.6	80.2	72.9	72.9
Dissolved Oxygen (DO)	>5.0 mg/l*	AVG 10.7	7.1	11.2	9.8	7.0	9.5	10.2	12.5	9.9	10.8	10.1	10.0	11.4	8.6	11.6	8.0	9.6	10.5	9.7	9.1	10.9
pH	>6.0 or <9.0*	AVG 8.1	7.7	7.6	7.9	7.6	7.8	7.7	7.8	8.1	8.0	8.0	7.8	8.0	7.8	7.9	7.7	7.9	8.0	7.9	7.7	7.9
Total Phosphorus (TP)	<0.075 mg/L*	AVG 0.053	1.376	0.025	0.035	0.723	0.167	0.166	-	0.038	0.092	0.071	0.214	0.240	0.197	0.042	0.082	0.096	0.105	0.115	0.668	0.117
Turbidity (converted from cm)	<14 NTU**	AVG 45.9	122.1	7.5	31.9	204.3	93.0	28.7	36.4	60.3	10.1	13.9	22.2	17.9	28.5	26.5	25.6	13.5	8.0	31.9	37.0	14.5
Conductivity	<1,500 μS/cm***	AVG 2079	1,292	577	819	656	1,028	875	1,123	748	1,442	936	1,585	961	1,218	2,343	1,146	1,147	1,279	900	3,483	1,251
Inorganic Nitrogen (NO2+NO3)	<1.798 mg/L**	AVG 0.370	0.026	-	-	0.074	0.151	-	-	0.010	0.176	0.010	0.224	0.052	0.946	0.280	0.265	0.123	2.450	0.339	0.112	0.603
Total Suspended Solids (TSS)	<19 mg/L****	AVG 9.7	692.1	-	-	997.3	54.1	-	-	26.1	3.4	69.7	73.6	121.2	180.4	20.0	80.1	78.0	20.6	11.5	267.3	17.0
E. coli	<235 MPN/100mL*****	AVG 2,931	10,632	60	358	6,581	8,092	4,399	153	1,941	1,521	1,658	630	1,977	1,562	836	4,993	1,806	1,821	713	3,362	1,296

- Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines
- Temperature listed as the maximum value available for each site, but testing was not always conducted during summer months. Data does not necessarily reflect the warmest actual values of each site.
* Water Quality Standards for WI Surface Waters NR 102 (2012)
** Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)
*** USEPA, 2012
**** Present and Reference Concentrations and Yields of Suspended Sediment in Streams in the Great Lakes Region and Adjacent Areas (USGS 2006)
***** WI DNR NR 102.12 (1); (Clayton et al. 2012)

Table 26. Racine Health Department water quality sample results for outfalls Sites RHDA - K. Temperature is shown as a maximum; all other results are displayed as an average (mean) of all available site data for 2013.

Parameter	Statistical, Numerical, or General Use Guidelines	Site RHD-A	Site RHD-B	Site RHD-C	Site RHD-D	Site RHD-E	Site RHD-F	Site RHD-G	Site RHD-H	Site RHD-I	Site RHD-J	Site RHD-K
Temp (F)	<86° F*	MAX 70.2	68.4	66.7	62.6	74.5	70.7	70.7	70.9	70.9	86.9	82.4
pH	>6.0 or <9.0*	AVG 8.2	8.2	7.8	8.0	8.1	8.3	8.3	8.1	8.3	8.0	7.9
Total Phosphorus (TP)	<0.075 mg/L*	AVG 0.099	0.101	-	0.082	0.028	-	-	0.172	-	0.014	0.019
Turbidity (converted from cm)	<14 NTU**	AVG 9.1	34.4	124.0	1.9	5.6	45.9	52.4	72.7	44.9	2.5	6.2
Conductivity	<1,500 µS/cm***	AVG 1,557	697	628	1,144	1,527	504	464	498	301	747	1,172
Nitrate plus Nitrite Nitrogen NO2+NO3	<1.798 mg/L**	AVG 0.508	0.010	-	1.045	0.897	-	-	0.434	-	0.021	0.018
Total Suspended Solids (TSS)	<19 mg/L****	AVG 38.7	229.3	-	3.8	26.1	-	-	17.7	-	10.1	2.3
E. coli	<235 MPN/100mL*****	AVG 2,429	1,825	1,610	4,333	1,090	154	1,569	723	91	1,118	500
Chlorine	≥0.1 mg/L******	AVG 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detergent	≥0.25 ppm*******	AVG 0.16	0.07	0.10	0.10	0.11	0.09	0.09	0.08	0.05	0.07	0.09
Phenols	≥0.25ppm*******	AVG 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copper	>0.2 mg/L*X********	AVG 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

- Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines
- Temperature listed as the maximum value available for each site, but testing was not always conducted during summer months. Data does not necessarily reflect the warmest actual values of each site.
* Water Quality Standards for WI Surface Waters NR 102 (2012)
** Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)
*** USEPA, 2012
**** Present and Reference Concentrations and Yields of Suspended Sediment in Streams in the Great Lakes Region and Adjacent Areas (USGS 2006)
***** WI DNR NR 102.12 (1); (Clayton et al. 2012)
****** NR105.06; Brown et al, 2004
******* Brown et al, 2004
******** NR 105.06; (AECOM,2009)

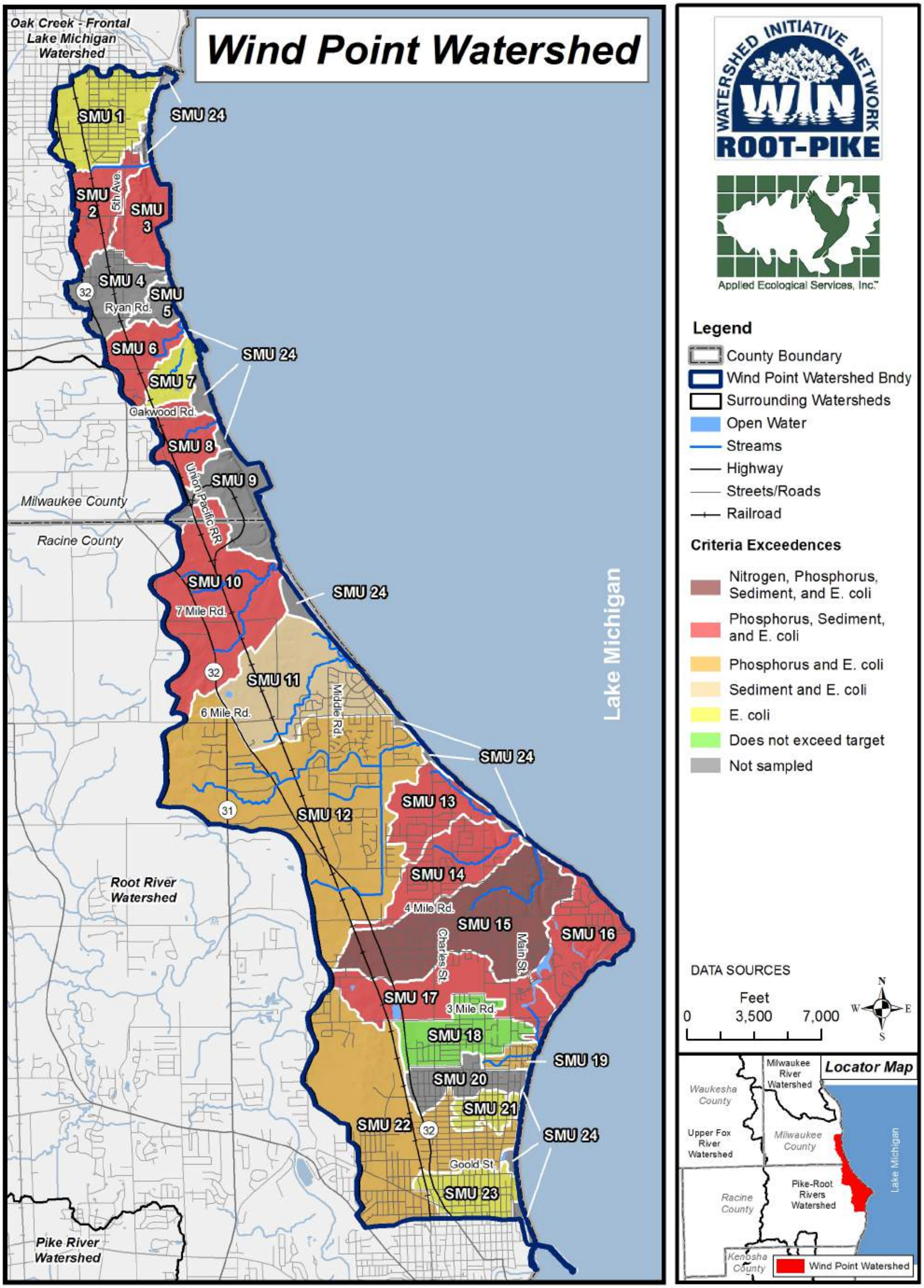


Fig. 50: Water Quality Criteria Exceedences

While nitrogen only exceeds the target in one subwatershed management unit (SMU), phosphorus, sediment and E. coli seem to be an issue throughout the watershed. Additionally, within the subwatersheds that exceed the targets for phosphorus, sediment, and *E. coli*, samples not only exceed the target, but are often substantially higher than target recommendations. Figures 51, 52, and 53 depict not only which subwatersheds exceed the targets for each criteria, but also show to what extent those targets are exceeded. Not only do twelve SMUs exceed the target for phosphorus, but four of them are averaging more than double the guideline and one SMU is averaging more than ten times the standard (Figure 51). Ten SMUs exceed the target guidelines for sediment with 4 of these SMUs testing an average of double the standard and another 4 testing at over ten times the sediment guideline (Figure 52). Finally, for *E. coli* all but one of the SMUs exceeded the recreational standard with 11 of these testing at more than double the standard and 7 of the SMUs testing at more than ten times the standard (Figure 53).

Nutrients such as phosphorus and nitrogen are a necessary component of plant growth and are therefore included in many fertilizers. Unfortunately, both have adverse effects on water quality, with phosphorus being particularly detrimental to aquatic systems in excess quantities. These nutrients are applied as fertilizer, either in an agricultural setting or by applicators or residents and the excess nutrients not absorbed by plants are then washed into waterways. Excess nutrients can cause algal blooms, accelerated plant growth, decreasing oxygen levels, and can lead to fish kills. Currently there is no Wisconsin state standard for nitrogen; however the USEPA recommends a concentration of less than 1.798 mg/l. The Wisconsin state standard for total phosphorus in rivers and streams is less than 0.075 mg/L.

The ability to control erosion and excess sediment, and thereby total suspended solids, in waterways can be linked to the control of how development is handled as well as the condition of streambanks in the watershed. The construction process generally involves significant land disturbance and ecosystem destruction. The grading of sites, removal of vegetation, rerouting of natural drainage systems, and the addition of impervious surfaces, such as roads and parking lots, all interfere with water quality both in the short and long term. Removing vegetation and trees near the stream or floodplain removes the stability of the soil and increases bank erosion and sedimentation to nearby waterways. Alteration of natural drainage patterns can also significantly reduce the ability of the ecosystem to compensate for such increase in contaminants and sedimentation. Eroding streambanks also contribute additional sediments, particularly during and after rain events as peak flows scour away banks. High suspended sediment levels are problematic when light penetration is reduced, oxygen levels decrease, fish and macroinvertebrate gills are clogged, visual needs of aquatic organisms is reduced, and when sediment settles out in streams and lakes. There is no Wisconsin state guideline for total suspended solids, but the United States Geological Survey (USGS) recommends TSS do not exceed 19 mg/l for streams in the Wind Point watershed.

E. coli is used as an indicator that a waterbody is contaminated by sewage which could carry other possible pathogens such as bacteria, viruses, and protozoans. While potential pathogens are too numerous to test for individually, the USEPA recommends *E. coli* testing “as the best indicator of health risk from water contact in recreational waters (USEPA, 2012).” Not only does the presence of excessive *E. coli* counts suggest there is a possible health risk in recreational contact with those waters, but the bacteria “can also cause cloudy water, unpleasant odors, and an increased oxygen demand (USEPA, 2012).” The Wisconsin state standard for recreational waters requires that *E. coli* levels do not exceed 235 most probable number per 100 ml of sample (MPN/100 ml).

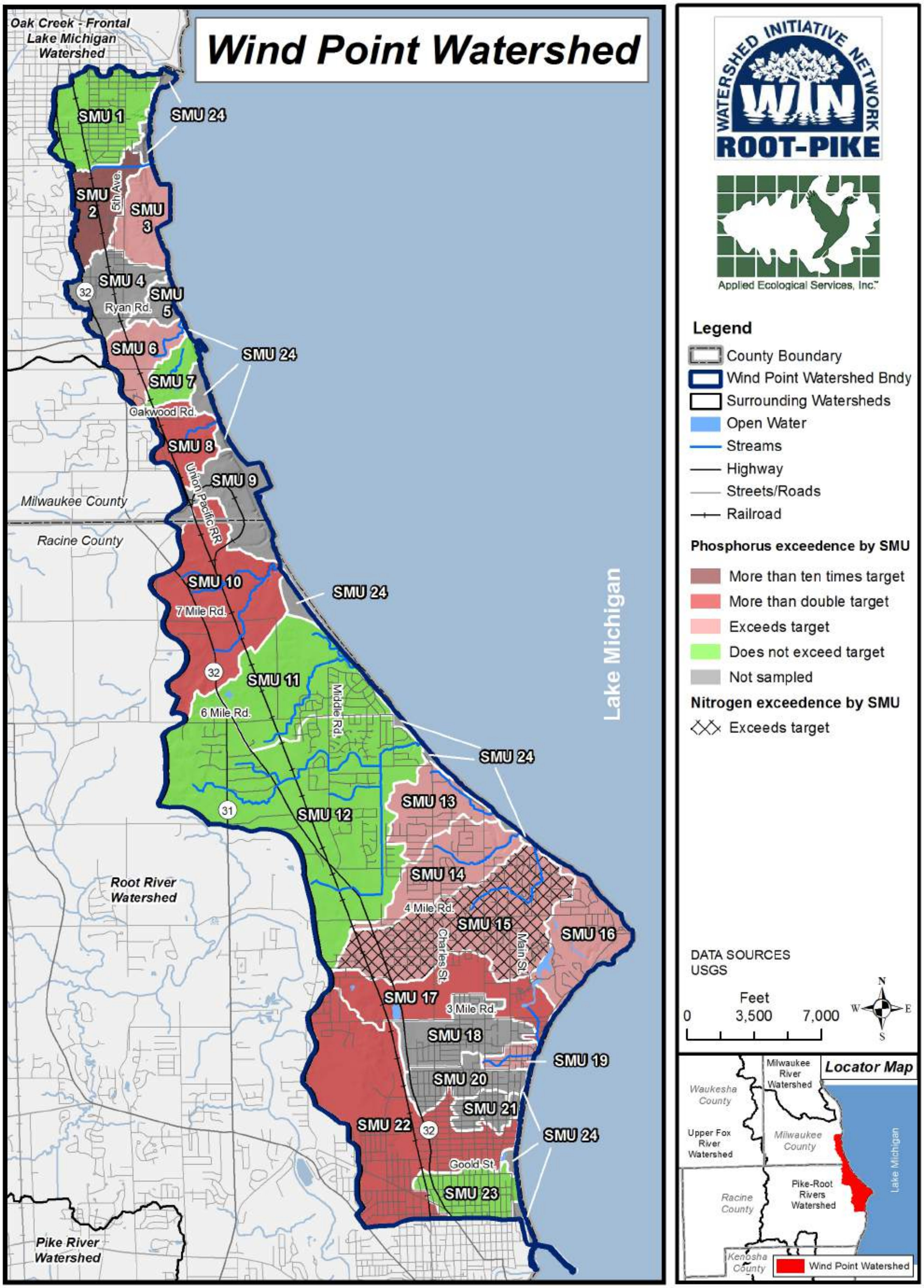


Fig. 51: Phosphorus and Nitrogen Exceedence by SMU

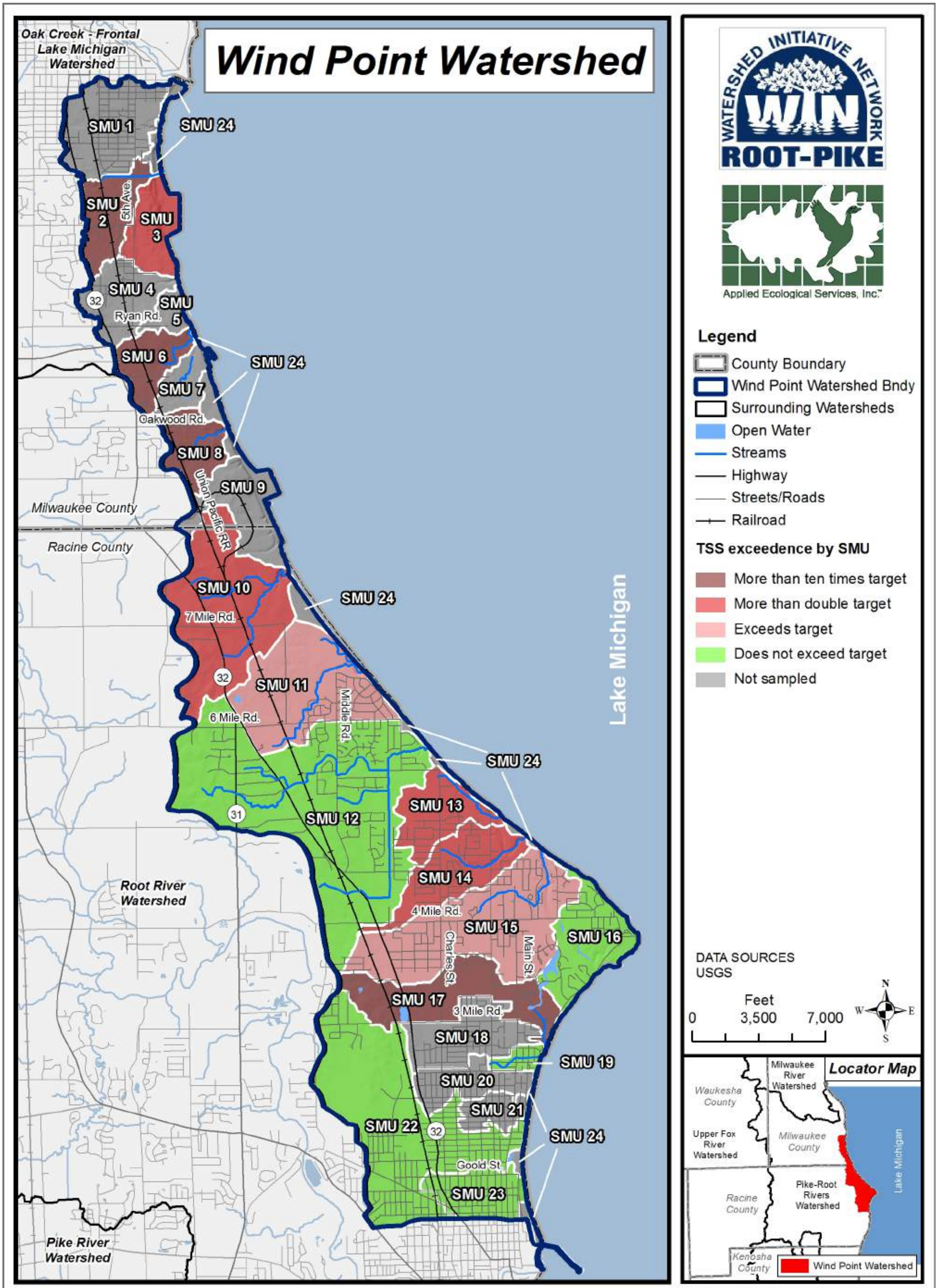


Fig. 52: TSS Exceedence by SMU

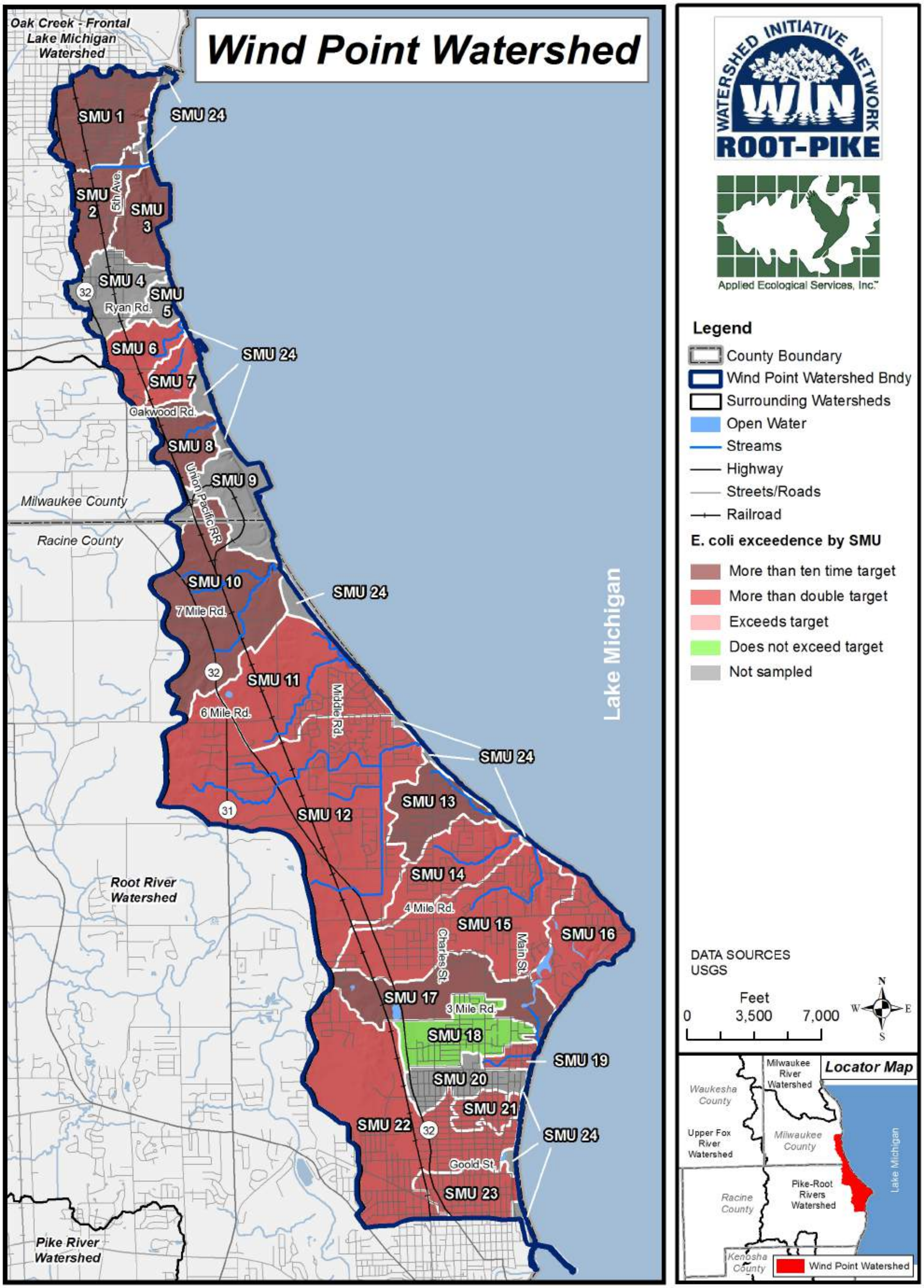


Fig. 53: E. coli Exceedence by SMU

In order to determine watershed-wide reduction targets, pollutant values across the watershed were calculated as a weighted average according to the size of each subwatershed. To summarize these results, while nitrogen sampling exceeds the target at one location, for the watershed as a whole the weighted average of nitrogen values is 0.445 mg/L, which is well under the 1.798 mg/L standard. The average total phosphorus value for the whole watershed is 0.188 mg/L, or more than twice the standard of 0.075 mg/L. The weighted average for total suspended solids across the watershed is 85.8 mg/L while the standard is less than 19mg/L. Finally, the weighted average of E. coli values in Wind Point watershed is 2,417 MPN/100mL which is over ten times the standard of less than 235 MPN/100mL. Reduction targets are discussed in more detail in Section 5.0.

Biological Monitoring

Biological data can be used alone or in conjunction with physical-chemical data to make a water quality impairment assessment on a waterbody in Wisconsin. An index of biotic integrity is one method of assessing biological health and water quality through several attributes of fish or macroinvertebrate communities found in streams. Macroinvertebrate data for Wind Point watershed was available for review. No know stream fish surveys have been completed.

Macroinvertebrate samples were taken by the Racine Health Department throughout Wind Point watershed and evaluated based on the family-level biotic index (FBI) developed by W. Hilsenhoff of the University of Wisconsin (Hilsenhoff, 1988). The FBI is designed to rate water quality using the pollution tolerance of macroinvertebrates and human impacts as an estimate of the degree and extend or organic pollution and disturbance in streams. Following data collection, macroinvertebrates are identified and given a predetermined pollution tolerance rating. The FBI is calculated by taking an average of tolerance ratings weighted by the number of individuals in the sample. Using this system, FBI scores less than 3.75 indicates the likelihood of having excellent water quality while scores greater than 7.26 suggest very poor water quality. Table 27, below, depicts the evaluation of water quality based on the family-level biotic index scoring criteria.

Racine Health Department conducted a total of eleven macroinvertebrate FBI surveys across Wind Point watershed in 2013. The locations and results of these surveys are detailed in Table 28. Of the eleven surveys, one was ranked as Fairly Poor and ten were ranked as Very Poor. Most of the streams within Wind Point watershed are considered intermittent (they are dry for part of the year) which would be a likely cause of the low FBI scores overall. Other factors contributing to these low rankings could include any combination of the following: the pollutants identified in the physical-chemical surveys, stream habitat changes, and/or riparian vegetation changes.

Table 27. Evaluation of water quality using the family-level biotic index (FBI).

Score	Water Quality	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.0	Very poor	Severe organic pollution likely

Source: Hilsenhoff, 1988.

Table 28. 2013 macroinvertebrate sampling and family biotic indexing, Racine Health Department.

Biotic Indexing Results by Site in Wind Point Watershed

09/30/2013 - 11/04/2013

Site Number	Site		Ephemeroptera					Plecoptera			Trichoptera				Mollusca			Diptera		Coleoptera									
			Caenidae	Ephemerellidae	Ephemeridae	Heptageniidae	Siphlonuridae	Perlidae	Perlodidae	Plecoptera	Hydropsychidae	Leptoceridae	Hemiptera	Decapoda	Lymnaeidae	Physidae	Corydalidae	Chironomidae	Simulidae	Elmidae	Coleoptera	Hirudinea	Turbellaria	Planorbidae	Bivalvia	Isopoda	Amphipoda	Puparium	Family Biotic Index
1	WWTPS and Marina Rd.										3				2	1					1				1	146			7.8
2	5th Ave. S of Edgewood Rd.														1	57					3		1	2	11	7	60		7.9
7	Cliffside Park Mouth															4					3		1			310			8.0
8	Rocky Creeky at Novak Rd.	Rocky Creek			5					1						2	1	1		9	3		109		2	176			7.7
10	Klema Ditch at 5 ½ Mile Rd.				1		7							1		30					7		20	1	3	150			7.8
12	Matthew Ln. Branch														11	24			1		1			2	5	41	27		7.7
13	Klema Ditch at 4½ Mile Rd.			1		25							1			64					2		7	2	10	156		1	7.5
15	Siena Center North - Erie			1		3		1	2			1	1			32						1	1		6	98	1		7.7
16	Birch Creek - Valley			2											1	59							2	2	1	45	25		7.9
17	Prairie Stream at Shoop Park			2		1									3	30								11	42	111	5		7.8
18	Sheffield Dr.		1	4											6	112		17					1	2		3			7.6

Samples sorted by taxonomic order and family. Organism counts are provided by family.

Classification and Color Code:	Excellent	Very good	Good	Fair	Fairly poor	Poor	Very poor

Source: See Evaluation of Water Quality Using Family-Level Biotic Index (Table 18)

4.4 Beach Water Quality

Wind Point watershed has six beaches: North Beach, Zoo Beach, Shoop Park Beach, Parkway Beach, Wind Point Beach, and Bender Park Beach. Many beaches along Lake Michigan are routinely monitored for *Escherichia coli* (*E. coli*) according to federal criteria set for open waters of the Great Lakes. *E. coli* tests are used as an indicator that fecal matter may be present in the water, thereby suggesting an elevated risk to people due to harmful bacteria, viruses, or protozoans. When including beaches on the Impaired Waters List, WDNR relies on long-term data defined as long-term geometric mean maximum of 126 colony forming units (cfu)/100 mL, which is consistent with EPA-established criteria and a valid method of recognizing where recreational activities in water might pose chronic risk to human health (WisCALM 2012). None of the beaches within Wind Point watershed are listed as impaired.

In addition to tributary and outfall monitoring, the Racine Health Department conducted regular testing of the beaches within Wind Point watershed between the end of May and the beginning of September 2013 (Table 29). Note that while North Beach is not currently listed as impaired, the average *E. coli* value at the site was almost double the standard for 2013.

Table 29. Racine Health Department water quality sample results for beaches in Wind Point, late May through the beginning of September 2013.

Parameter	Statistical, Numerical, or General Use Guidelines	Bender Park	Wind Point Light House	Shoop Park	Parkway Beach	Zoo Beach	North Beach
Turbidity (converted from cm)	<14 NTU*	AVG 74.2	37.4	55.3	10.2	-	-
Conductivity	<1,500 µS/cm**	AVG 310	303	317	309	-	-
E. coli	<235 MPN/100mL***	AVG 200	95	106	68	172	522

- Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines
* Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)
** USEPA, 2012
*** WI DNR NR 102.12 (1); (Clayton et al. 2012)

4.5 Pollutant Loading Analysis

A Wisconsin Department of Natural Resources (WDNR) approved modeling tool known as Source Loading and Management Model for Windows (WinSLAMM) version 9.4.0 was used to estimate the existing nonpoint source load of nutrients (nitrogen & phosphorus) and sediment for Wind Point watershed by individual subwatershed management unit (SMU) for all categories of land use except agricultural. The model evaluates runoff volume and pollutant loading for each SMU according to its land use, impervious surfaces, and utilizes Milwaukee 1969 rainfall data as compiled by the United States Geological Survey (USGS). WinSLAMM, however, does not account for agricultural areas or streambanks so the EPA approved Spreadsheet Tool for Estimating Pollutant Load (STEPL) model was used in order to model pollutant loading for the agricultural areas and streambanks for each SMU. The models both output average annual pollutant load for each of the land use/cover types. The results of the WinSLAMM and STEPL modeling were then aggregated in order to achieve complete modeling for each SMU. The results of this analysis were used to estimate the total watershed load for nitrogen, phosphorus, and sediment and to identify and map pollutant load "Hot Spot" SMU's. It is important to note that neither WinSLAMM or STEPL are calibrated models; they also do not estimate *E. coli* loading which is beyond the scope of this watershed plan.

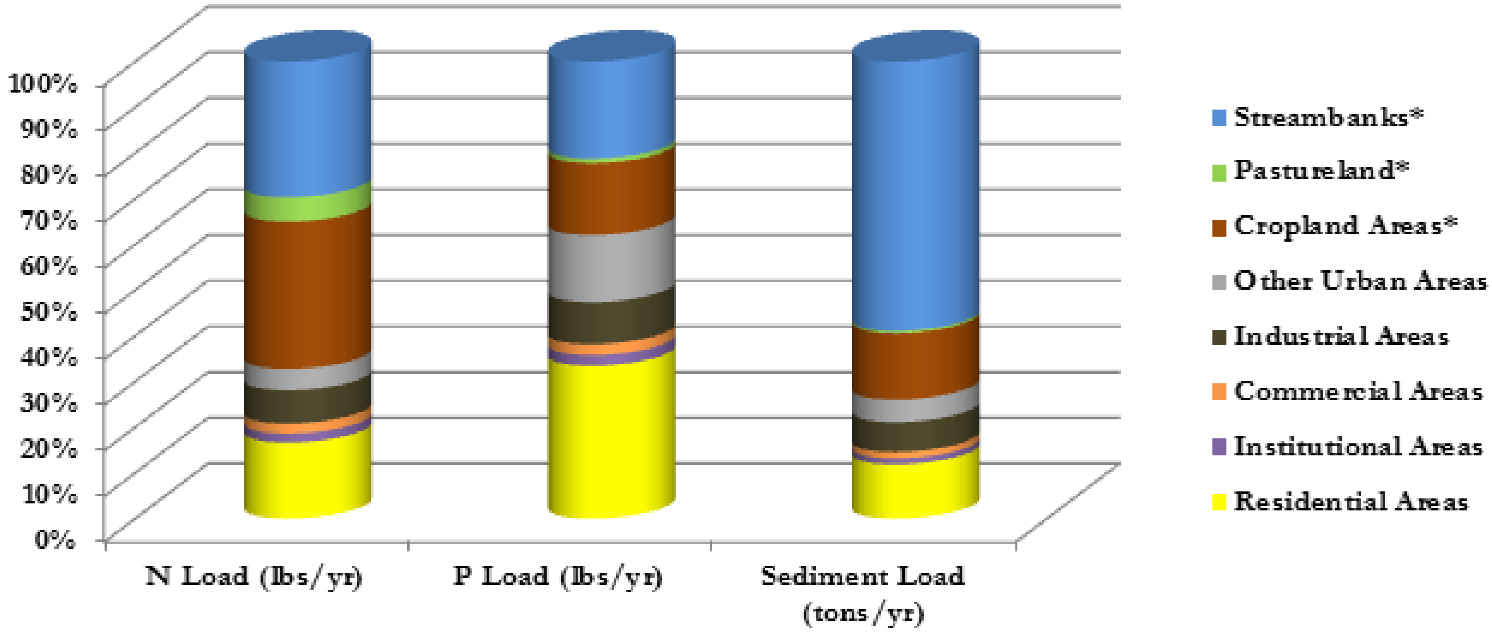
The results of the combined WinSLAMM and STEPL models indicate that existing land use/cover in Wind Point watershed produces 29,807 lbs/yr of nitrogen, 16,058 lbs/yr of phosphorus, and 9,531 tons/yr of sediment (Table 30; Figure 54). Streambank areas contribute the highest sediment load (5,617 tons/yr; 59%) and the second highest nitrogen (8,857 lbs/yr; 30%) and phosphorus (3,410 lbs/yr; 21%) loads in the watershed. Cropland areas contribute the highest nitrogen (9,603 lbs/yr: 32%) load in the watershed, the second highest sediment load (1,386 lbs/yr: 15%), and the third highest phosphorus load (2,523 lbs/yr; 16%). Residential areas contribute the highest phosphorus loads (5,364 lbs/yr: 33%) and third highest loads of nitrogen (4,947 lbs/yr: 17%) and sediment (1,130 tons/yr: 12%). Institutional, commercial, industrial, and other urban areas contribute on a smaller scale to overall pollutant loading. Both WinSLAMM and STEPL Model results can be found in Appendix E.

Table 30. Estimated existing (2012) annual pollutant load by source at the watershed scale based on combined WinSLAMM and STEPL modeling.

STEPL Source	N Load (lbs/yr)	% of Total Load	P Load (lbs/yr)	% of Total Load	Sediment (tons/yr)	% of Total Load
Residential Areas	4,947.2	16.6%	5,364.3	33.4%	1,130.1	11.9%
Institutional Areas	601.2	2.0%	375.4	2.3%	124.2	1.3%
Commercial Areas	648.4	2.2%	387.0	2.4%	134.4	1.4%
Industrial Areas	2,168.7	7.3%	1,480.2	9.2%	622.9	6.5%
Other Urban Areas	1,387.9	4.7%	2,351.8	14.6%	469.8	4.9%
Cropland Areas*	9,603.4	32.2%	2,523.4	15.7%	1,385.7	14.5%
Pastureland*	1,593.7	5.3%	165.9	1.0%	46.7	0.5%
Streambanks*	8,856.6	29.7%	3,409.8	21.2%	5,617.4	58.9%
Total	**29,807.0**	**100.0%**	**16,057.6**	**100.0%**	**9,531.1**	**100.0%**

NOTE: All results were modeled using WinSLAMM except for * which were modeled using STEPL.

Figure 54. Estimated percent contributions to existing (2012) pollutant load by source based on combined WinSLAMM and STEPL modeling.



The results of the WinSLAMM and STEPL models were also analyzed for nonpoint source pollutant loads at the Subwatershed Management Unit (SMU) scale. This allows for a more refined breakdown of nonpoint pollutant sources and leads to the identification of pollutant load "Hot Spots." Hot Spot SMUs were selected by examining pollutant load concentration (load/acre) for each pollutant. Next, pollutant concentrations exceeding the 75% quartile and 50% quartile were calculated resulting in "High Concentration" and "Moderate Concentration" nonpoint source pollutant load Hot Spot SMUs. Any SMU exhibiting pollutant load concentrations below the 50% quartile contribute "Low Concentration" of pollutants relative to other SMUs. Table 31 and Figure 55 depict and summarize the results of the SMU scale pollutant loading analysis. Four of the 24 SMUs comprising Wind Point watershed are considered "High Concentration" pollutant load Hot Spots for nitrogen, phosphorus, and sediment based on combined WinSLAMM and STEPL modeling. Five SMUs are considered "High to Moderate Concentration" pollutant load Hot Spots for various combinations of nitrogen, phosphorus, and sediment. Another 9 SMUs are considered "Moderate" or "Moderate to Low Concentration" pollutant load Hot Spots. The remaining six SMUs contribute "Low Concentrations" based on modeling.

Table 31. Pollutant load "Hot Spot" SMUs.

Hot Spot SMU	Size (acres)	N Load (lb/yr)	N Load (lb/yr)/ acre	P Load (lb/yr)	P Load (lb/yr)/ acre	Sediment Load (t/yr)	Sediment Load (t/yr)/ acre
High Concentration Hot Spot SMUs							
SMU 8	242.7	566	2.33	308	1.27	290	1.20
SMU 10	947	8,591	9.07	3,176	3.35	3,884	4.10
SMU 11	788.6	2,806	3.56	1,185	1.50	806	1.02
SMU 12	2,138.4	7,350	3.44	3,324	1.55	2,164	1.01
High to Moderate Concentration Hot Spot SMUs							
SMU 6	238.5	593	2.49	239	1.00	125	0.52
SMU 13	332.1	865	2.60	406	1.22	141	0.43
SMU 17	573.9	1,287	2.24	635	1.11	257	0.45
SMU 21	134.8	158	1.17	173	1.28	38	0.28
SMU 22	1,324.0	1,657	1.25	1,730	1.31	446	0.34
Moderate Concentration Hot Spot SMUs							
SMU 23	274.5	345	1.26	340	1.24	82	0.30
Moderate to Low Concentration Hot Spot SMUs							
SMU 1	493.9	594	1.20	563	1.14	147	0.30
SMU 4	310.3	532	1.72	263	0.85	75	0.24
SMU 9	374.9	456	1.22	270	0.72	126	0.34
SMU 14	442.8	838	1.89	498	1.12	170	0.38
SMU 15	1,040.3	1,301	1.25	1,063	1.02	295	0.28
SMU 18	382.2	416	1.09	480	1.26	99	0.26
SMU 19	71.5	88	1.23	82	1.15	30	0.43
SMU 20	242.3	301	1.24	295	1.22	70	0.29

High Concentration Hot Spot SMUs exceed the 75% quartile: N=2.33 lbs/yr/acre, P=1.27 lbs/yr/acre, Sediment= 0.45 t/yr/acre
Moderate Concentration Hot Spot SMUs exceed the 50% quartile: N=1.25 lbs/yr/acre, P=1.14 lbs/yr/acre, Sediment= 0.3 t/yr/acre

A brief summary of "High Concentration" pollutant loading Hot Spots follows:

- SMU 8 comprises 243 acres. Nonpoint source pollutants in this SMU originate from a combination of industrial areas and moderate to severe streambank erosion. Eroded sediment also carries with it attached nitrogen and phosphorus.
- Pollutants coming from SMU 10 (947 acres) originate primarily from cropland, industrial areas, and eroded streambanks throughout the SMU.
- SMU 11 (789 acres) contributes pollutants at high concentrations originating from cropland areas and highly eroded streambanks.
- SMU 12 is the largest subwatershed (2,138 acres). Pollutants in the SMU originate from a mix of residential areas, cropland, and eroded streambanks.

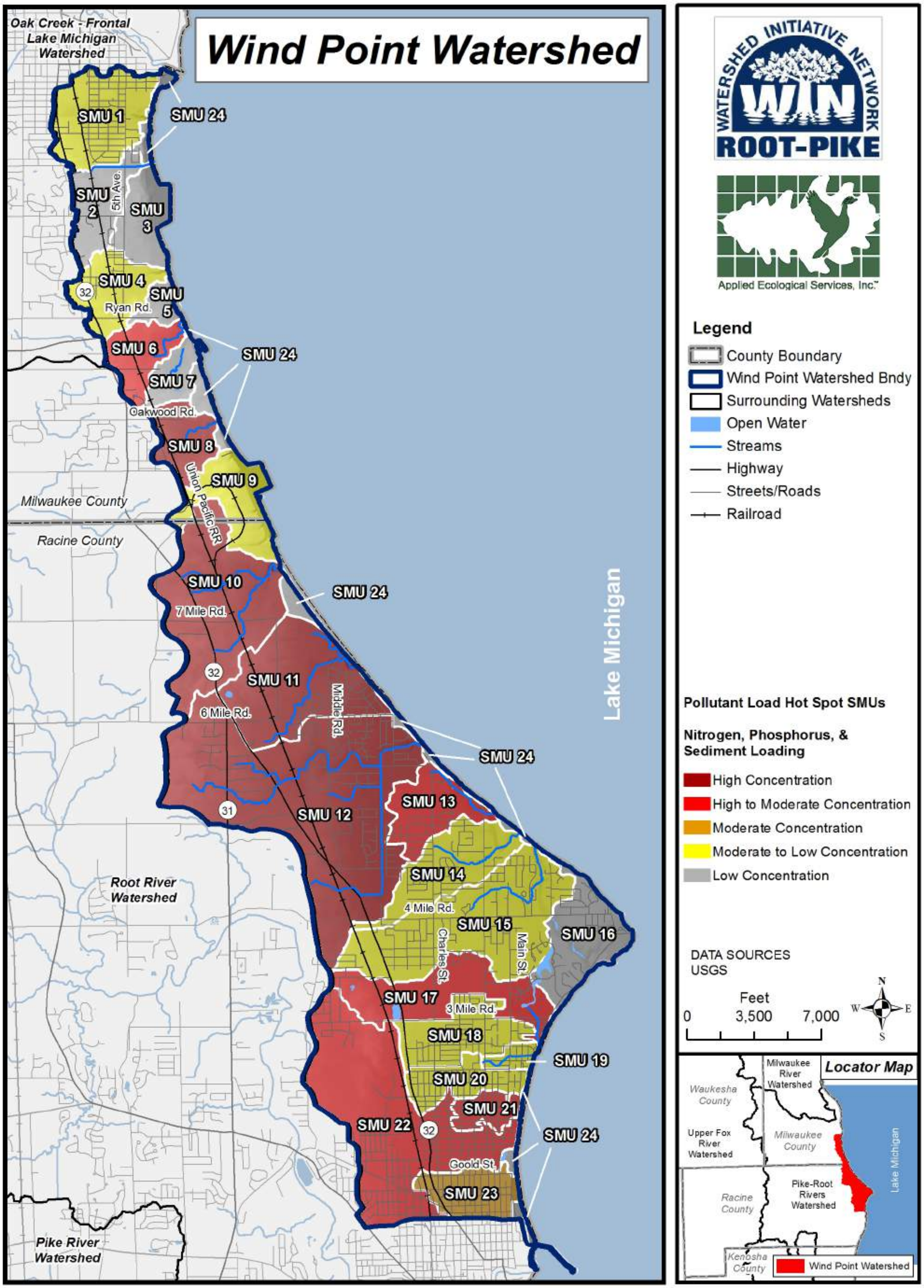


Fig. 55: Nonpoint Source Pollutant Loading "Hot Spot" SMUs