Targeted Watershed Assessment Report for the Pipe Creek Watershed, Fond du Lac County, Wisconsin

November 2018
EGAD #3200-2018-55

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Purpose

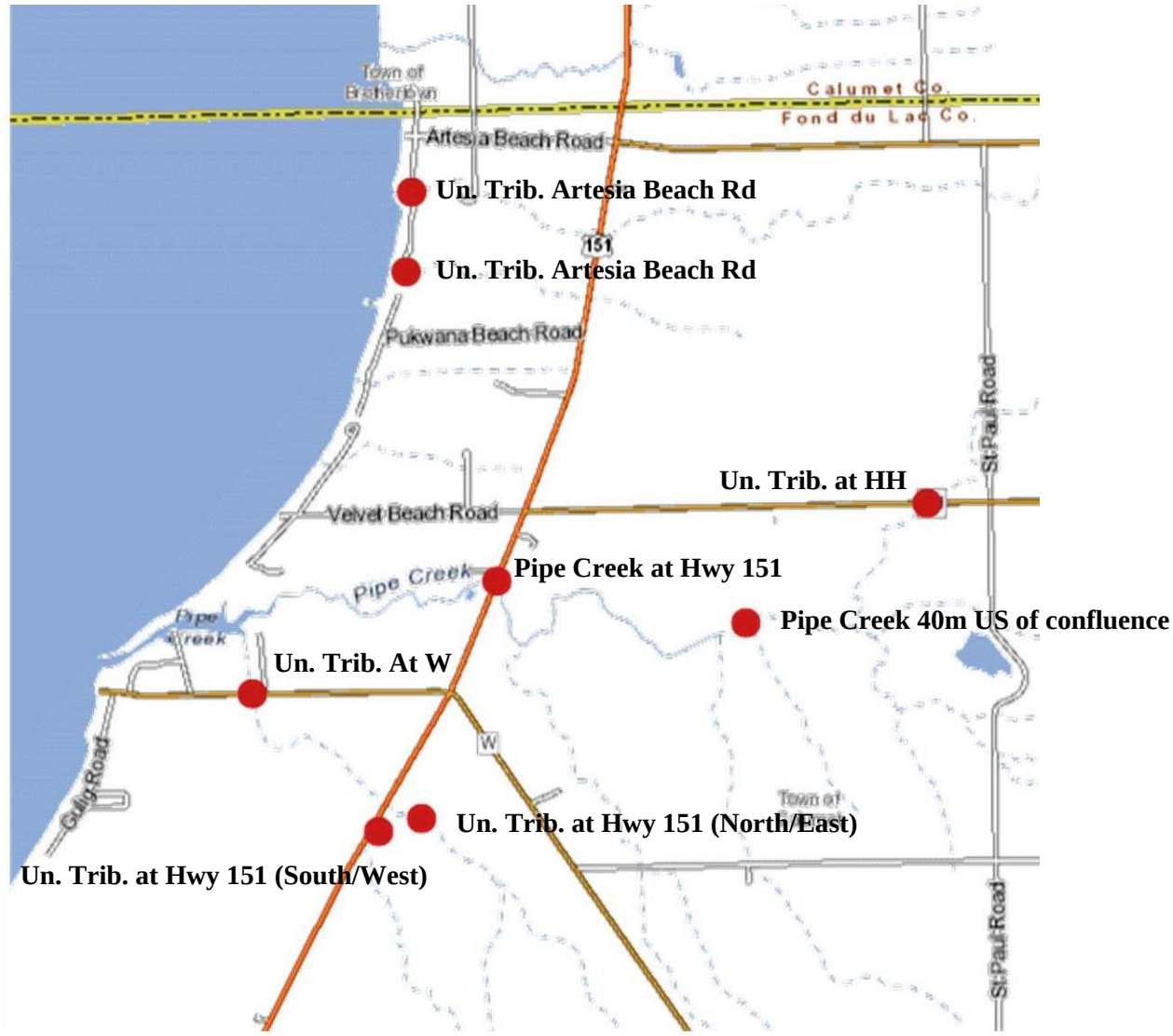
This Targeted Watershed Assessment addressed needs for baseline water quality monitoring of the Pipe Creek Watershed on the East side of Lake Winnebago by collecting in-stream Total Phosphorus (TP) and Total Suspended Solids (TSS), qualitative habitat, temperature, fish, and aquatic macroinvertebrate information. This watershed is included as part of one of the 10% highest yielding watersheds of sediment in the Upper Fox-Wolf River Basin. A secondary goal of this project was to determine Wisconsin Administrative Code ch. NR 102 (NR 102) phosphorus water quality criteria exceedances and degraded biological community and habitat impairments for USEPA Clean Water Act Section 303d (CWA 303d) listing purposes for the creeks in this watershed.

Methods

During the growing season of 2017, TP samples were collected at 6 locations twice per month in May and June, and once per month in July through October (Table 1, Map 1). In addition, TSS samples were collected twice per month in May and June 2017 and once per month in July and October at the 6 locations listed in Table 1. All samples were collected using the standard WDNR grab sampling method for a total of 84 samples (WDNR 2014). Neither baseflow nor storm or snowmelt event sampling were targeted during this project, following the protocol of Wisconsin Consolidated Assessment and Listing Methodology (WisCALM 2016). However, bi-weekly monitoring was conducted in May and June to more intensively collect nutrient and sediment data during the spring rain event period. In addition, the June 14th sampling event was conducted during a significant rain event based upon the National Oceanic and Atmospheric Administration (NOAA) historical precipitation data (NOAA 2017). All nutrient samples were shipped to Wisconsin State Laboratory of Hygiene (WISLOH) for analysis. The WISLOH entered all sample analysis data into the WDNR Surface Water Integrated Monitoring System (SWIMS) database.

SWIMS Station ID	Site Name	Surface Water WBIC
10047730	Unnamed Trib to Pipe Creek US County HH	5025714
10016803	Pipe Creek- Pipe Creek 30 Feet Above Hwy 151 bridge	132800
10047731	Unnamed Trib to Pipe Creek US Hwy 151 (north/east site)	5026041
10047729	Unnamed Trib to Pipe Creek US Hwy 151 (south/west site)	3000189
10047728	Unnamed Trib to Pipe Creek US County W	3000189
10047732	Unnamed Trib to Lake Winnebago US Artesia Beach Rd (north site)	5025580

Table 1: Inorganic Chemistry Monitoring Sites Sampled in the Pipe Creek Watershed May Through October 2017.



Map 1: Pipe Creek Watershed Sample Locations in 2017.

Eight locations were sampled for aquatic macroinvertebrates in October 2017 (Table 2, Map 1). All sites were sampled using the WDNR *Guidelines for Collecting Macroinvertebrate Samples from Wadable Streams* (2000). A D-shaped kicknet with 600 micron mesh was used at all sites by standing upstream from the net and placing it firmly on the stream bed while digging into the substrate with the heel or toe to free the macroinvertebrates from the substrate. Riffles were targeted at each of the sites, but if none were present then, available gravel, overhanging vegetation, woody debris, or other vegetation would be sampled. For a representative sample of the aquatic macroinvertebrate community, a minimum of 100 aquatic macroinvertebrates collected in each sample was targeted. The aquatic macroinvertebrates were preserved in a 70-80% ethanol solution inside quart "Mason" jars. If necessary, multiple "Mason" jars were used per sample depending upon how much sediment and organic material was collected with the aquatic macroinvertebrates. Within the next 24 hours, the samples were re-preserved with another 70-80% ethanol solution. Samples were taken to the UWSP Aquatic Biomonitoring

Laboratory (ABL) for lowest possible taxonomic identification. Staff at the ABL entered the data into the SWIMS database in 2018.

SWIMS Station ID	Site Name	Surface Water WBIC
10047730	Unnamed Trib to Pipe Creek US County HH	5025714
10042194	Pipe Creek 40 meters Upstream of Confluence with Unnamed Cr WBIC 5025913	132800
10016803	Pipe Creek- Pipe Creek 30 Feet Above Hwy 151 bridge	132800
10047731	Unnamed Trib to Pipe Creek US Hwy 151 (north/east site)	5026041
10047729	Unnamed Trib to Pipe Creek US Hwy 151 (south/west site)	3000189
10047728	Unnamed Trib to Pipe Creek US County W	3000189
10047733	Unnamed Trib to Lake Winnebago US Artesia Beach Rd (south site)	5025742
10047732	Unnamed Trib to Lake Winnebago US Artesia Beach Rd (north site)	5025580

Table 2: Aquatic Macroinvertebrate Monitoring Locations Sampled in the Pipe Creek Watershed in 2017.

Between June and September 2017, wadable fish surveys were conducted at 8 sites (Table 3, Map 1). The 8 wadable fish surveys were conducted following the WDNR *Guidelines for Assessing Fish Communities of Wadable Streams in Wisconsin* (2001). All 8 wadable sites were surveyed in June through September 2017 during the guidance-recommended summer time survey period. Stream flow and water chemistry data was recorded at each wadable site prior to conducting the fish survey. The wadable fish survey stations were a minimum of 35 times the mean stream width (overall minimum of 100 meters, overall maximum of 400 meters). A 12 Volt, 18 Amp Hour battery-powered backpack shocker was used for all 8 sites based upon the streams' smaller width and depth. Catch per effort sampling procedures were used for this project (no particular species was targeted, all captured). A single upstream pass was made using 0.125-inch mesh nets to collect the fish. At the end of the station, captured fish were identified and counted and all game fish were measured for length. Once all data was collected, the fish were returned to the creek. Fish survey data was entered into the WDNR Fisheries and Habitat Management Database (FHMD) by WDNR Water Resources staff.

SWIMS Station ID	Site Name	Surface Water WBIC
10047730	Unnamed Trib to Pipe Creek US County HH	5025714
10042194	Pipe Creek 40 meters Upstream of Confluence with Unnamed Cr WBIC 5025913	132800
10016803	Pipe Creek- Pipe Creek 30 Feet Above Hwy 151 bridge	132800
10047731	Unnamed Trib to Pipe Creek US Hwy 151 (north/east site)	5026041
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Table 3: Wadable Fish Survey Locations Sampled in the Pipe Creek Watershed between June and September 2017.

Onset Hobo Pendant thermistors were deployed to collect temperature data from May through October at 4 locations in the Pipe Creek Watershed (Table 4, Map 1). Temperature measurements were taken once per hour at each location from May through October. Temperature measurements were taken with an Onset Hobo Pendant thermistor attached to a fence post driven into the stream bed of the creek. The thermistor was attached to the fence post in such a manner as to suspend the thermistor in the water column low enough to stay under water in low flow conditions and high enough to not get buried in bottom substrate (~ 6 inches above the bottom). The thermistor was placed in a shaded location when possible. Temperature data were uploaded into the SWIMS database by WDNR Water Resources staff.

SWIMS Station ID	Site Name	Surface Water WBIC
10042194	Pipe Creek 40 meters Upstream of Confluence with Unnamed Cr WBIC 5025913	132800
10047731	Unnamed Trib to Pipe Creek US Hwy 151 (north/east site)	5026041
10047729	Unnamed Trib to Pipe Creek US Hwy 151 (south/west site)	3000189
10047733	Unnamed Trib to Lake Winnebago US Artesia Beach Rd (south site)	5025742

Table 4: Temperature Monitoring Locations in the Pipe Creek Watershed Sampled From May through October 2017.

Qualitative habitat surveys were conducted at 8 locations in the Pipe Creek Watershed in June through September 2017 (Table 5, Map 1). All sites were surveyed following the WDNR *Guidelines for Evaluating Habitat of Wadable Streams* (2002). Each qualitative habitat survey station length was 35 times the mean stream width of the survey station. Qualitative habitat surveys rapidly assess characteristics such as bank erosion, width to depth ratio, % fine

sediments, and cover for fish. WDNR Water Resources staff entered the qualitative habitat data into the FHMD.

SWIMS Station ID	Site Name	Surface Water WBIC
10047730	Unnamed Trib to Pipe Creek US County HH	5025714
10042194	Pipe Creek 40 meters Upstream of Confluence with Unnamed Cr WBIC 5025913	132800
10016803	Pipe Creek- Pipe Creek 30 Feet Above Hwy 151 bridge	132800
10047731	Unnamed Trib to Pipe Creek US Hwy 151 (north/east site)	5026041
10047729	Unnamed Trib to Pipe Creek US Hwy 151 (south/west site)	3000189
10047728	Unnamed Trib to Pipe Creek US County W	3000189
10047733	Unnamed Trib to Lake Winnebago US Artesia Beach Rd (south site)	5025742
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Table 5: Qualitative Habitat Survey Locations in the Pipe Creek Watershed Conducted in June through September 2017.

Results

The 2017 TP sample analysis results in the Pipe Creek Watershed ranged from 0.0431 mg/L at the Unnamed Trib at County W in May to 1.31 mg/L at the Unnamed Trib at County HH in September (Table 6, Chart 1). All 6 locations in this project had an average TP concentration exceeding the Wisconsin Administrative Code ch. NR 102.06(3)(b) water quality criteria (WQC) for creeks and rivers at 0.075 mg/L (Table 6, Chart 1). The average TP concentrations for the 6 sites in this project ranged from 0.1078 mg/L at the Unnamed Trib at County W to 0.3781 mg/L in the Unnamed Trib at Artesia Beach Rd. (Table 6, Chart 1).

Sample Event Month	Un. Trib to Pipe Cr. US Cty HH (mg/L)	Pipe Cr. At Hwy 151 (mg/L)	Un. Trib to Pipe Cr. US Hwy 151 (north) (mg/L)	Un. Trib to Pipe Cr. US Hwy 151 (south) (mg/L)	Un. Trib to Pipe Cr. At Cty W (mg/L)	Un. Trib at Artesia Beach Rd. (North) (mg/L)
May (1)	0.123	0.416	0.127	0.127	0.126	0.299
May (2)	0.0472	0.223	0.0551	0.0596	0.0431	0.191
June (1)	0.376	0.534	0.224	0.245	0.212	0.372
June (2)	0.114	0.255	0.0731	0.102	0.0766	0.384
July	0.111	0.324	0.233	0.105	0.104	0.386
Aug	0.157	0.540	0.163	0.145	0.112	0.491
Sept	1.31	0.308	0.0519	0.247	0.0595	0.540
Oct	0.488	0.338	0.180	0.285	0.129	0.362
Ave	0.3408	0.3673	0.1384	0.1645	0.1078	0.3781

Table 6: Total Phosphorus Concentrations and Averages of Samples Collected in the Pipe Creek Watershed in 2017.

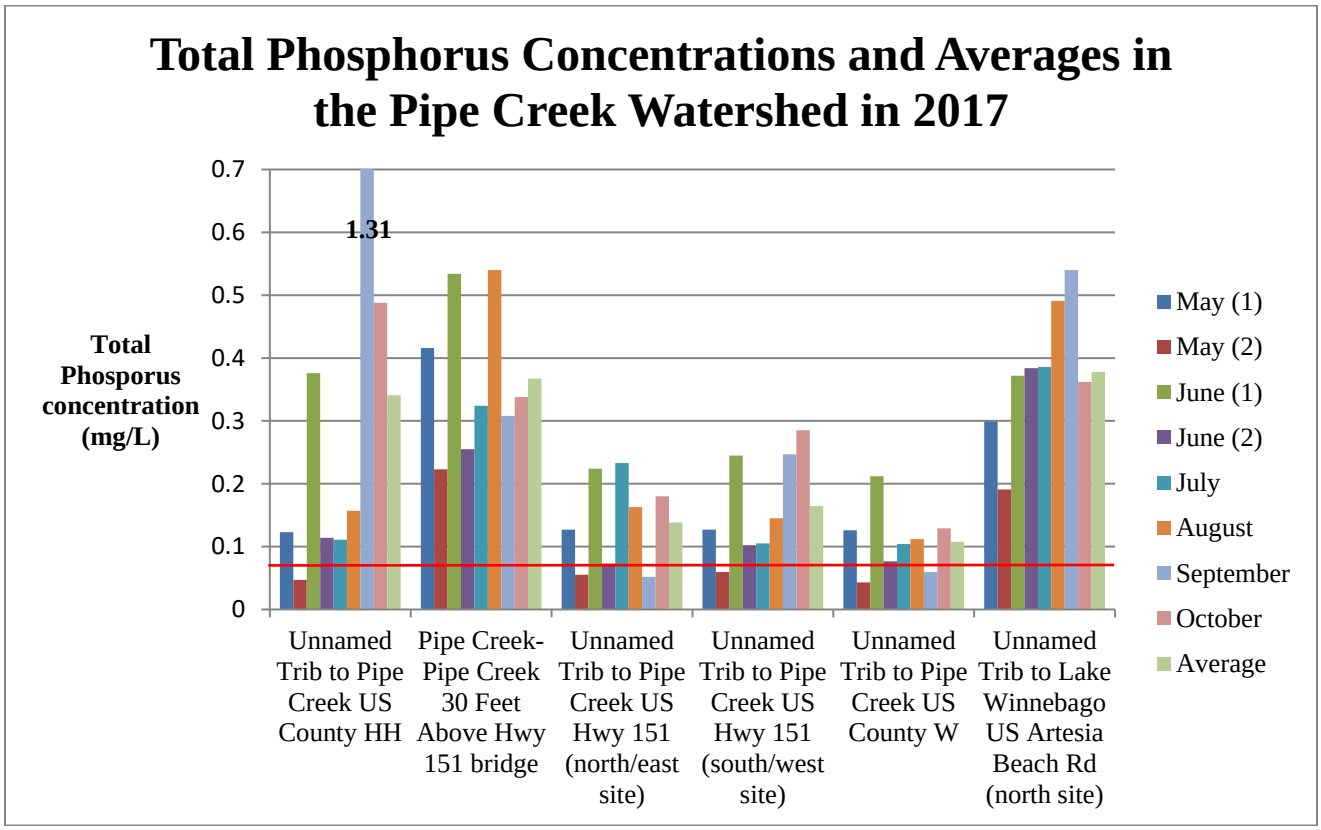

Chart 1: Total Phosphorus Concentrations and Averages of Samples Collected in the Pipe Creek Watershed in 2017 (with 0.075 mg/L WQC red line).

TSS analysis was also conducted on samples collected at all 6 Pipe Creek Watershed project locations during the same sampling events as TP in 2017. TSS samples were collected twice per month in May and June, and once per month in July and October (Table 7, Chart 2). Wisconsin does not have a water quality standard for TSS; however, this data provides useful information about the watershed, background information for future comparison, and additional support for adding these systems to the CWA 303d list for habitat degradation. The TSS concentrations in the Pipe Creek watershed ranged from No Detection (ND), which is <2.0 mg/L, at the Unnamed Trib at County W in June to 119 mg/L in July in the North Unnamed Trib at Hwy 151 (Table 7, Chart 2).

Sample Event Month	Un. Trib to Pipe Cr. US Cty HH (mg/L)	Pipe Cr. At Hwy 151 (mg/L)	Un. Trib to Pipe Cr. US Hwy 151 (north) (mg/L)	Un. Trib to Pipe Cr. US Hwy 151 (south) (mg/L)	Un. Trib to Pipe Cr. At Cty W (mg/L)	Un. Trib at Artesia Beach Rd. (North) (mg/L)
May (1)	10.2	23.2	7.40	6.50	9.00	5.20
May (2)	4.00	5.00	18.0	N/A	3.67	4.25
June (1)	115	50.0	9.00	16.0	19.7	13.5
June (2)	10.7	9.50	2.40	2.60	ND	2.50
July	12.9	7.75	119	10.0	16.0	12.8
Oct	33.3	4.00	4.00	21.0	N/A	2.20
Ave	31.0	16.6	26.6	11.2	10.1	6.74

Table 7: Total Suspended Solids Concentrations and Averages (mg/L) of Samples Collected in the Pipe Creek Watershed in 2017. (ND = No Detection) (Limit of Detection 2.0 mg/L Used for Average Concentration Calculation)

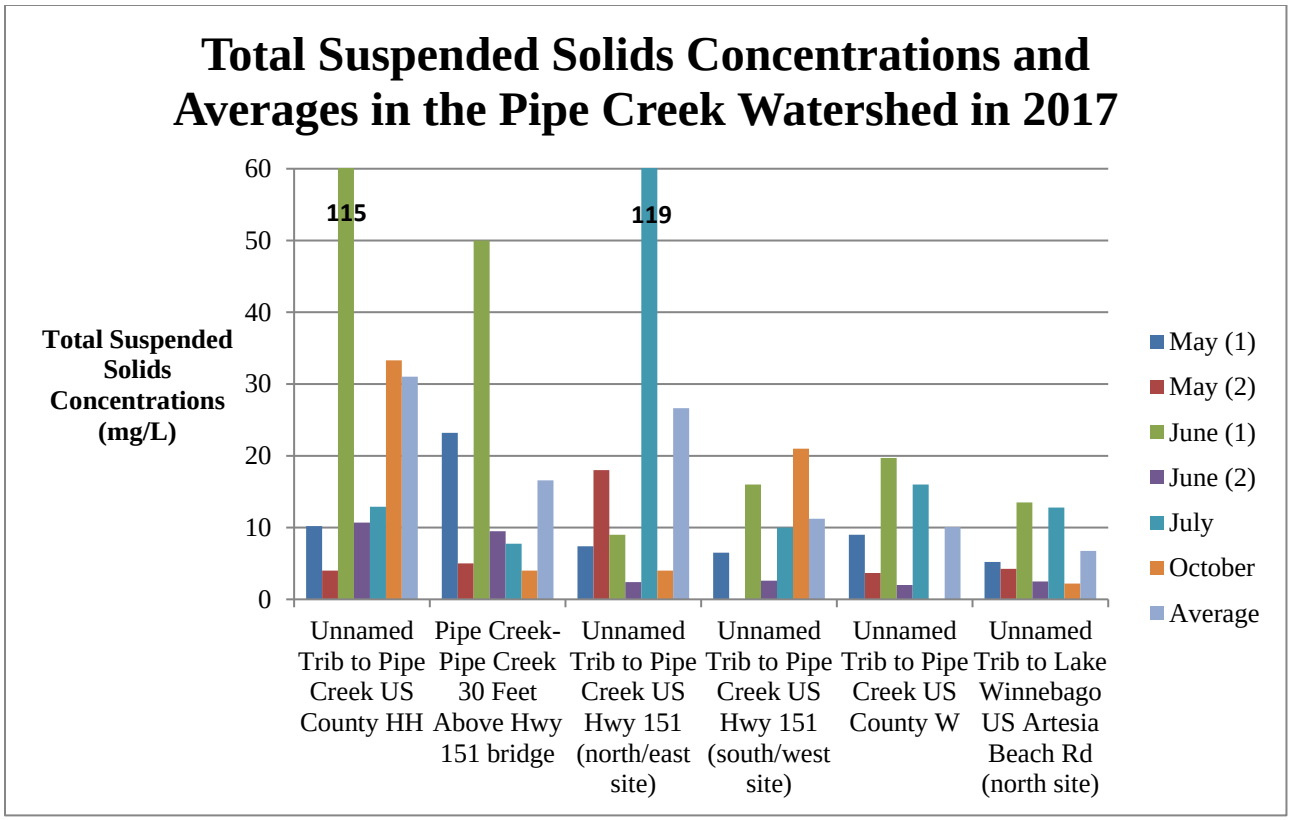

Chart 2: Total Suspended Solids Concentrations and Averages (mg/L) of Samples Collected in the Pipe Creek Watershed in 2017.

Aquatic macroinvertebrate (insect) communities were sampled at 8 locations in October 2017 (Table 2). Some aquatic insect species are tolerant of environmental degradation, while some species are moderately tolerant, and some others are intolerant. Based upon the representative insects collected and their associated tolerance to environmental degradation, an Index of Biotic Integrity (MIBI) was calculated to indicate the water quality condition of the stream (Table 8, Chart 3). In general, the higher the MIBI score, the better the water quality rating for a waterbody. The MIBI scores indicate a water quality condition category as either Poor (<2.5), Fair (2.5 - <5), Good (5 - <7.5), or Excellent (≥7.5). The MIBI scores ranged in the Pipe Creek Watershed from 0.73 in the Un Trib to Pipe Creek upstream of Hwy 151 to 4.11 in the Un Trib to Lake Winnebago upstream Artesia Beach Rd (Table 8, Chart 3, Photo 1-2). The Condition Categories for 3 sites were Fair while 5 indicated Poor water quality. Both categories indicate significant impacts from environmental degradation.

SWIMS Station ID	Stream Name and Location	Macroinvertebrate IBI Score	Condition Category
10047730	Unnamed Trib to Pipe Creek US County HH	1.80	Poor
10042194	Pipe Creek 40 meters Upstream of Confluence with Un. Cr WBIC 5025913	2.09	Poor
10016803	Pipe Creek- Pipe Creek 30 Feet Above Hwy 151 bridge	3.85	Fair
10047731	Unnamed Trib to Pipe Creek US Hwy 151 (north/east site)	0.73	Poor
10047729	Unnamed Trib to Pipe Creek US Hwy 151 (south/west site)	1.60	Poor
10047728	Unnamed Trib to Pipe Creek US County W	2.19	Poor
10047733	Unnamed Trib to Lake Winnebago US Artesia Beach Rd (south site)	3.33	Fair
10047732	Unnamed Trib to Lake Winnebago US Artesia Beach Rd (north site)	4.11	Fair

Table 8: Aquatic Insects Index of Biotic Integrity Scores and Water Quality Condition Categories in the Pipe Creek Watershed in 2017.

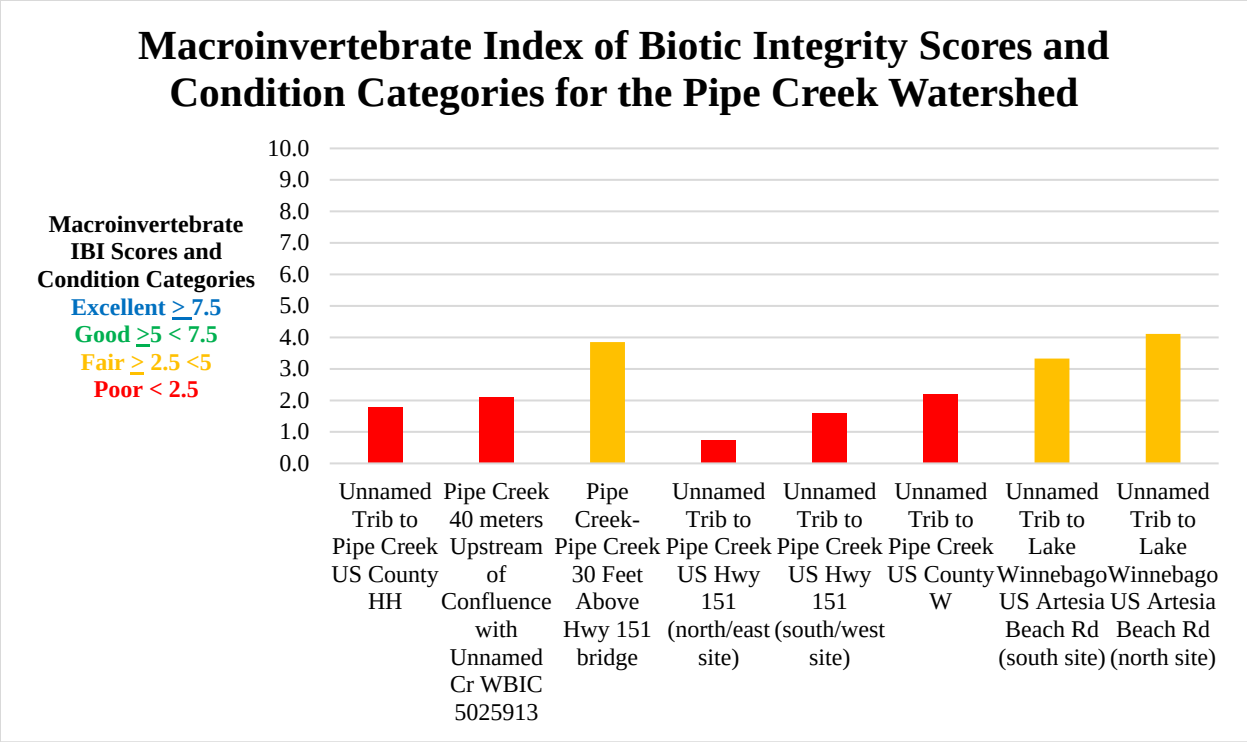

Chart 3: Aquatic Insect Index of Biotic Integrity Scores and Water Quality Condition Category in the Pipe Creek Watershed in 2017.

Between June and September 2017, 8 sites in the Pipe Creek Watershed were surveyed for representative fish communities. Some fish species are tolerant of environmental degradation, while some species are moderately tolerant, and some others are intolerant. Based upon the representative fish collected during the survey and their associated tolerance to environmental degradation, an Index of Biotic Integrity (FIBI) was calculated to indicate the water quality of each creek (Table 9, Chart 4). The FIBI scores ranged from 0 in three of the Unnamed Tributaries, to 50 in the Unnamed Tributary at Artesia Beach Rd-North site (Table 9, Chart 4). No fish were collected at 2 of the 8 fish survey locations. The water quality Condition Category for the streams in this project ranged from Poor to Fair, indicating significant environmental degradation.

Each fish community surveyed was used to verify or update the modeled Natural Community for that stream segment. Verifying or changing the modeled Natural Community was important since the Natural Community determines which FIBI was used to determine the water quality of that stream segment. To verify or update a Natural Community based upon the representative fish community sampled, the water quality of the stream must be in fair enough condition to accurately assess the Natural Community. For example, if the percentage of tolerant fish dominates the sample without any intolerant fish collected, the water quality is too degraded to verify or update the Natural Community. In this situation, the modeled Natural Community is used to calculate the FIBI score. The lack of intolerant and dominance of tolerant fish at all sites surveyed in this project meant the Natural Communities could not be updated or verified at all 8 sites.

FIBI scores are not applicable to Macroinvertebrate Natural Communities; therefore, no score was listed in Table 9 or Chart 4.

SWIMS Station ID	Site Name	Fish IBI Score	Condition Category	Natural Community
10047730	Unnamed Trib to Pipe Creek US County HH	20	Poor	Cool-Warm Headwater
10042194	Pipe Creek 40 meters Upstream of Confluence with Unnamed Cr WBIC 5025913	30	Poor	Cool-Cold Headwater
10016803	Pipe Creek- Pipe Creek 30 Feet Above Hwy 151 bridge	40	Fair	Cool-Warm Headwater
10047731	Unnamed Trib to Pipe Creek US Hwy 151 (north/east site)	N/A	Poor	Macroinvertebrate
10047729	Unnamed Trib to Pipe Creek US Hwy 151 (south/west site)	10	Poor	Cool-Cold Headwater
10047728	Unnamed Trib to Pipe Creek US County W	0 (No fish)	Poor	Cool-Cold Headwater
10047733	Unnamed Trib to Lake Winnebago US Artesia Beach Rd (south site)	N/A	Poor	Macroinvertebrate
10047732	Unnamed Trib to Lake Winnebago US Artesia Beach Rd (north site)	50	Fair	Cool-Cold Headwater

Table 9: Fish Index of Biotic Integrity Results in the Pipe Creek Watershed in 2017.

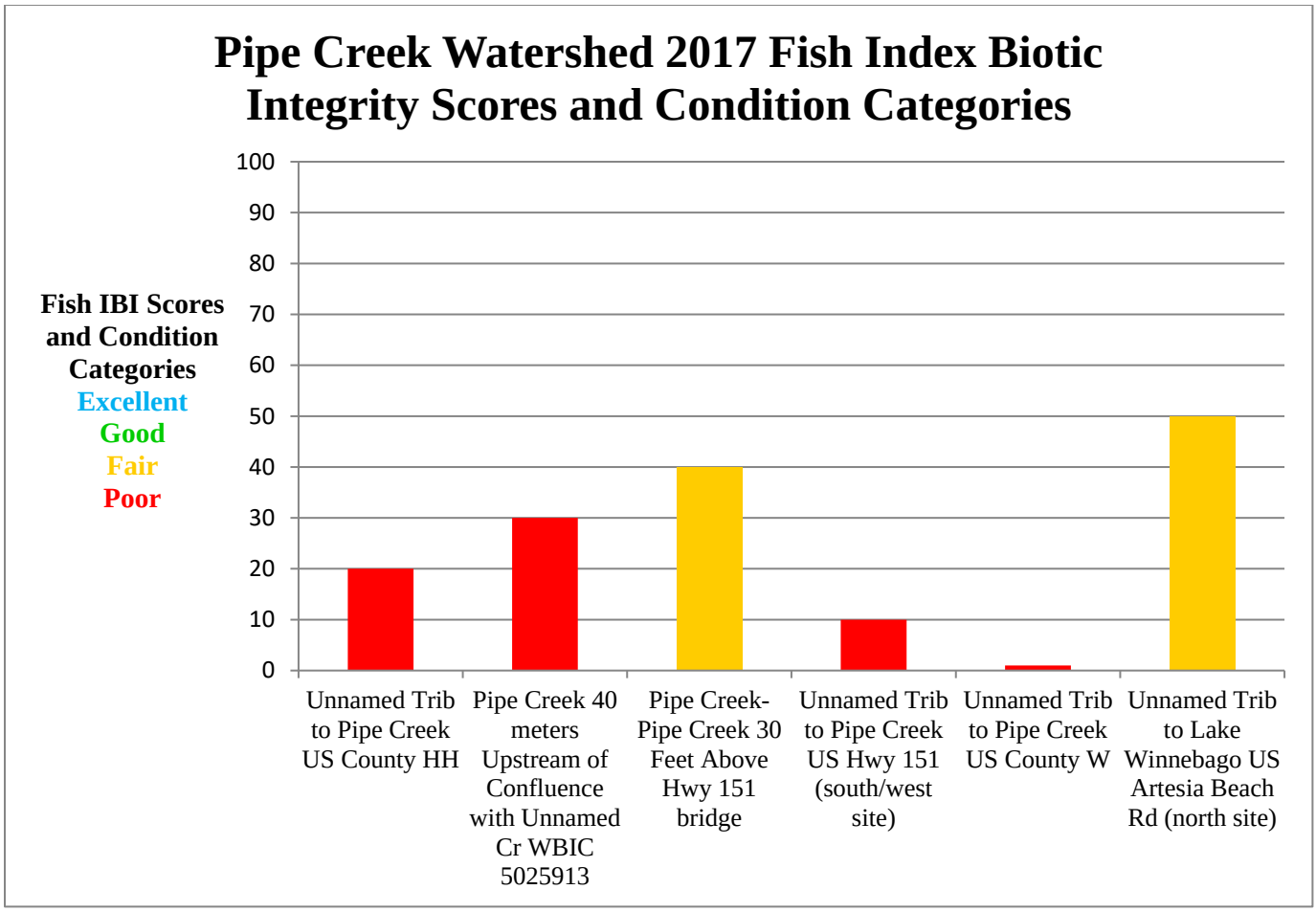

Chart 4: Fish Index of Biotic Integrity Results in the Pipe Creek Watershed in 2017.

Water temperature data was collected from May through October 2017 at 4 locations in the Pipe Creek Watershed (Table 4, Map 1). Monthly average temperatures were reported for months with complete data only (Table 10, Chart 5). The temperatures at the sites monitored in 2017 during the time of deployment ranged from 44.4F on 9/11/2017 to 81.4F on 7/20/2017 and 9/20/2017 in the Unnamed Tributary at Hwy 151, SWIMS Station 10047729 (Map 1). The average monthly temperatures ranged from 61.3F in the Unnamed Tributary at Hwy 151, SWIMS 10044729, in September to 69.8F in Pipe Creek, SWIMS 10042194, in July (Table 10, Chart 5). The Maximum Daily Averages (MDM) ranged from 72.8F in two Unnamed Tributaries to 73.7F in Pipe Creek at SWIMS 10042194 (Table 10, Chart 5).

Location	June Average Temperature	July Average Temperature	August Average Temperature	September Average Temperature	Maximum Daily Average Temperature
Pipe Creek 40 meters Upstream of Confluence with Unnamed Cr WBIC 5025913	65.7	69.8	65.8	63.7	73.7
Unnamed Trib to Pipe Creek US Hwy 151 (north/east site)	-	-	64.1	62.2	-
Unnamed Trib to Pipe Creek US Hwy 151 (south/west site)	64.7	68.7	64.5	61.3	72.8
Unnamed Trib to Lake Winnebago US Artesia Beach Rd (south site)	65.9	69.5	66.0	63.1	72.8

Table 10: Monthly Average and Maximum Daily Average Temperatures in the Pipe Creek Watershed in 2017.

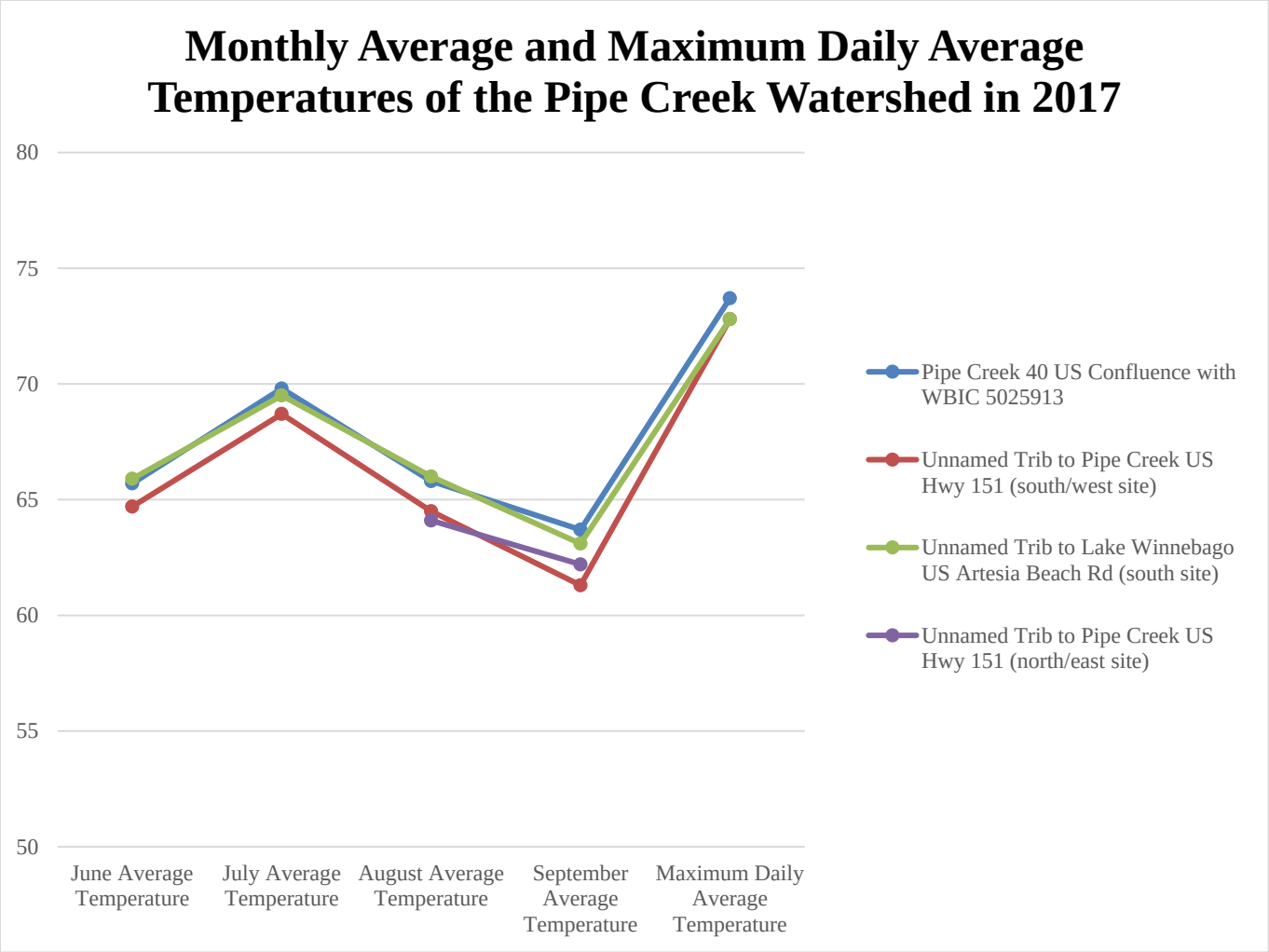

Chart 5: Monthly Average and Maximum Daily Average Temperatures in the Pipe Creek Watershed in 2017.

In June through September 2017, qualitative habitat surveys were conducted at 8 locations in the Pipe Creek Watershed (Table 11, Map 1). The qualitative habitat surveys were conducted at the same locations as the fish sample locations. WDNR Water Resources staff entered the habitat data into the FHMD. Based upon the habitat information collected during the 2017 surveys, a habitat rating was calculated for the 8 locations in Table 5 (Table 11, Chart 6). The habitat scores ranged from 28 at two locations to 60 at the Unnamed Tributary to Lake Winnebago at Artesia Beach Rd (SWIMS 10047733). Five sites had a Condition Category of Fair and three sites had a Condition Category of Good, with no sites rated as excellent or poor (Table 11, Chart 6).

SWIMS Station ID	Stream Name and Site Location	Qualitative Habitat Score	Condition Category
10047730	Unnamed Trib to Pipe Creek US County HH	28	Fair
10042194	Pipe Creek 40 meters Upstream of Confluence with Unnamed Cr WBIC 5025913	37	Fair
10016803	Pipe Creek- Pipe Creek 30 Feet Above Hwy 151 bridge	28	Fair
10047731	Unnamed Trib to Pipe Creek US Hwy 151 (north/east site)	35	Fair
10047729	Unnamed Trib to Pipe Creek US Hwy 151 (south/west site)	38	Fair
10047728	Unnamed Trib to Pipe Creek US County W	52	Good
10047733	Unnamed Trib to Lake Winnebago US Artesia Beach Rd (south site)	60	Good
10047732	Unnamed Trib to Lake Winnebago US Artesia Beach Rd (north site)	57	Good

Table 11: Qualitative Habitat Survey Scores and Condition Categories for the Pipe Creek Watershed in 2017.

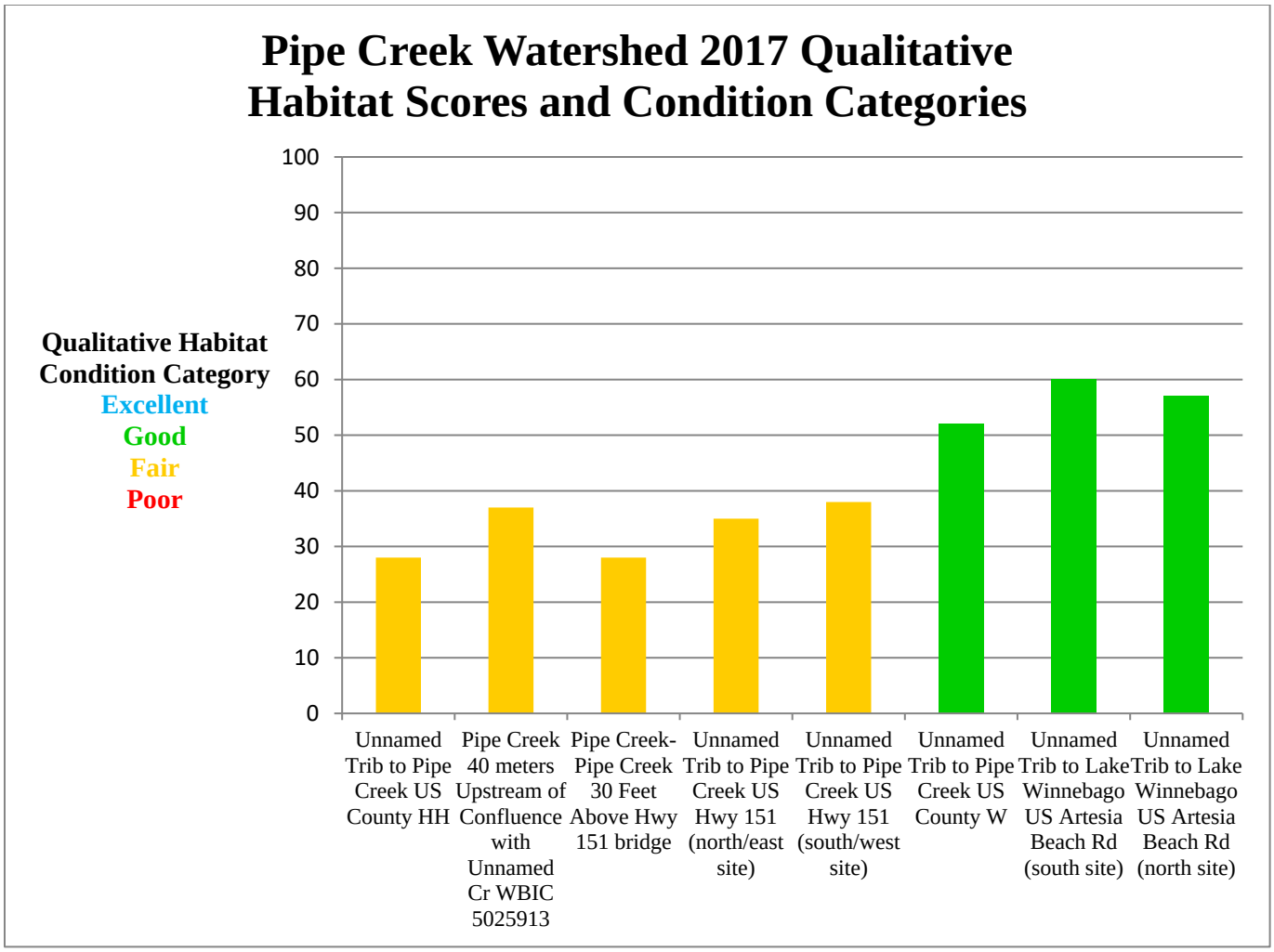

Chart 6: Qualitative Habitat Survey Scores and Condition Categories for the Pipe Creek Watershed in 2017.

Discussion

This Targeted Watershed Assessment addressed needs for baseline water quality monitoring of the Pipe Creek Watershed on the East side of Lake Winnebago by collecting nutrient and sediment concentrations, and habitat, temperature, and biological information. The monitoring in this project will be used to show future water quality enhancements from watershed improvements. Fond du Lac County Land and Water Conservation Department (LWCD) received a Great Lakes Commission Grant in 2016 to reduce the sediment and phosphorus reaching Pipe Creek, Lake Winnebago, and eventually Green Bay downstream. To accomplish the goals of this grant, considerable creek restoration and watershed agricultural Best Management Practice (BMP) work has been planned and is being implemented by multiple agencies, including the Fond du Lac County LWCD and the Natural Resource Conservation Service (NRCS). In addition, Fond du Lac County LWCD has been awarded a 2017 Great Lakes Restoration Initiative Focus Area 3 Grant to write a Nine Key Element (9KE) plan for the Pipe Creek Watershed, which was submitted for DNR review in October 2018. A secondary goal of this project was to determine Wisconsin Administrative Code ch. NR 102 (NR 102)

phosphorus water quality criteria exceedances and degraded biological community and habitat impairments for USEPA Clean Water Act Section 303d (CWA 303d) listing purposes for the creeks in this watershed. The phosphorus and biological monitoring in this project demonstrated that the water quality is between fair and poor.

The Pipe Creek Watershed drains a 27,368 acre area covering the immediate drainage into Lake Winnebago from the East. The focus area of this project is the area around Pipe Creek itself (~5800 acres in Fond du Lac County). The Pipe Creek Watershed is located in the Southeastern Wisconsin Till Plains (USGS 2006) and the Southeast Glacial Plains Ecological Landscapes (WDNR 2014). The Southeast Glacial Plains (WDNR 2014) correlates loosely with the Southeastern Wisconsin Till Plains (USGS 2006). The land use for the Southeast Wisconsin Till Plains (SWTP) is dominated, 54%, by cropland (USGS 2006); however, the Pipe Creek Watershed is 74% agricultural land use (WDNR 2014). Typically, as increases in agricultural land use occur, there is a correlating increase in TP concentration in creeks in the watershed. Water clarity decreases and chlorophyll a concentration (which is an indication of algae populations) increases as TP increases.

Reference conditions (sometimes referred to as background or potential) for wadable streams in Wisconsin ranges from 0.03-0.04 mg/L Total Phosphorus (USGS 2006). All 6 of the average TP concentrations in this project were above reference range for wadable streams in Wisconsin (Table 6, Chart 1). Water quality has been impacted by the TP concentrations in the creeks of this project. Therefore, an impairment assessment was conducted to evaluate if Pipe Creek and the surrounding Tributaries should be placed on the CWA 303d list for biological community impairments due to the pollutant phosphorus. The sampling requirements to demonstrate if WQC for TP were being met, clearly exceeded, or overwhelmingly exceeded were accomplished through this project.

The impairment assessment protocol requires a parametric statistical approach to assess stream and river TP data against the applicable water quality criterion found in NR 102 (WisCALM 2016). This approach involves the calculation of a 90% confidence limit around the median of a TP sample dataset. If the lower 90% confidence limit (LCL) exceeds the criterion for TP, then that stream or river segment (assessment unit) is considered to be exceeding the criterion. If the LCL is more than double (>0.15 mg/L) the criterion then that stream or river is considered to be overwhelmingly exceeding the criterion. If the LCL exceeds the criterion, but does not overwhelmingly exceed, then biological confirmation of impairment is needed to add the waterbody to the CWA 303d list. If the LCL overwhelmingly exceeds the criterion, no biological confirmation is needed (Table 13). Following the 2016 WisCALM guidance, the LCLs were calculated for each set of TP samples using the data from the date closest to the middle of the month (Table 12, Chart 7). For this project, the sample dates used to calculate the LCL at each location were May 17th, June 14th, July 12th, August 9th, September 7th, and October 4th. Four of the 6 locations monitored for TP had a LCL exceeding 0.075mg/L. The TP data collected at the Unnamed Tributary to Pipe Creek upstream of County HH demonstrated such variability (ranging from 0.0472-1.31 mg/L) that the calculated LCL for this dataset was not applicable. Also, the Unnamed Tributary to Pipe Creek (WBIC 3000189) upstream of County W and Hwy 151 had different LCL values. Another summer of monthly sampling is needed at these two Unnamed Tributaries (WBIC 3000189 and 5025714). Two of the 5 tributary LCL

overwhelmingly exceeded (LCL of >0.15mg/L) the water quality criterion for TP (Table 12, Chart 7). Pipe Creek and the Unnamed Tributary to Lake Winnebago (WBIC 5025580) overwhelmingly exceeded the water quality criterion for TP and will be recommended for the 2020 CWA 303d list (Table 13). The Unnamed Tributary to Pipe Creek (WBIC 5026041) exceeded the criterion and the Poor MIBI result is the biological confirmation of impairment; therefore, this waterbody also will be recommended for the 2020 CWA 303d list (Table 13).

Location	TP 90% Lower Confidence Limit	Exceedance Level
Un. Trib. to Pipe Cr. US Cty HH	N/A*	N/A
Un. Trib. to Pipe Cr. US Hwy 151 (North/East Site)	0.123	Exceeds
Un. Trib. to Pipe Cr. US Hwy 151 (South/West Site) (WBIC 3000189)	0.14*	Exceeds
Un. Trib. to Pipe Cr. US Cty W (WBIC 3000189)	0.072*	Meets
Pipe Creek US Hwy 151	0.253	Overwhelmingly Exceeds
Un. Trib. to Lake Winnebago US Artesia Beach Rd (North Site)	0.306	Overwhelmingly Exceeds

Table 12: Total Phosphorus Lower 90% Confidence Limits in the Pipe Creek Watershed.
***More Monitoring Needed to Determine Exceedance Level.**

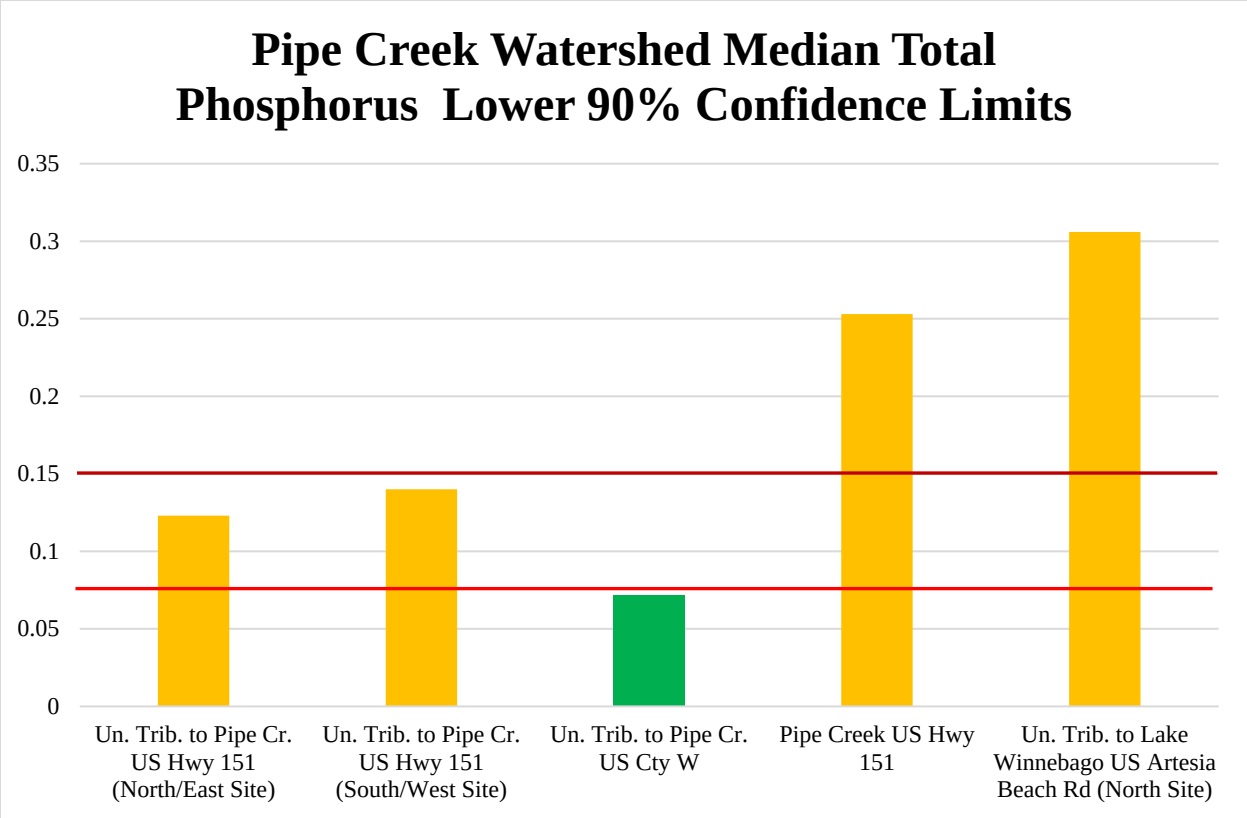

Chart 7: Total Phosphorus Lower 90% Confidence Limits in the Pipe Creek Watershed. Red line indicates the NR 102 WQC for Total Phosphorus for Pipe Creek and its Tributaries. Maroon line indicates an Overwhelming Exceedance of NR 102 WQC for Total Phosphorus.

	Biological Response Indicators	Overall Assessment Result & EPA Listing Category	Pollutant
Meets TP Criteria	None indicate impairment	Not Impaired (Fully Supporting) Category 2	NA
	One or more indicate impairment	Impaired—Biology Only (Not Supporting) Category 5A	Unknown
Exceeds TP Criteria (not an overwhelming exceedance)	One or more indicate impairment	Impaired—TP & Bioconfirmation (Not Supporting) Category 5A	TP
	None indicate impairment	Impaired—Exceeds TP but has insufficient or conflicting biological data (Not Supporting) Category 5P	TP
Exceeds TP Criteria by an Overwhelming Amount	None needed	Impaired—TP Only (i.e. Overwhelming exceedance (Not Supporting) Category 5A	TP

Table 13: Assessment of Phosphorus and Biology in Combination to Determine Impairment Status and Pollutant (WisCALM 2016).

The Total Suspended Solids, biota, and habitat monitoring throughout the Pipe Creek Watershed in this project will provide the information needed to make an assessment of habitat degradation of tributaries within the watershed. Suspended solids (most commonly comprised of sediment and algae) absorb heat from sunlight, which increases water temperature and subsequently decreases levels of dissolved oxygen. Photosynthesis also decreases because TSS decreases light penetration, which thereby reduces dissolved oxygen levels. Additionally, TSS can destroy fish habitat because the solids settle to the bottom, smothering the eggs of fish and insects. Suspended solids can also clog fish gills and increase the difficulty for fish and insects to find food. Water quality in the Pipe Creek Watershed has been impacted by the habitat degradation and elevated temperatures due to sedimentation. The Unnamed Tributary to Pipe Creek (WBIC 5025714) had an average TSS concentration of 31 mg/L, Fair habitat, and both FIBI and MIBI indicated poor water quality (Photo 1). Extensive bank erosion and fine sediments in the stream channel contribute to the degraded habitat and biological community. The Unnamed Tributary to Pipe Creek (WBIC 5025714) will be recommended for the 2020 CWA 303d list for Habitat Degradation due to the pollutant TSS. All of the sites in this project were affected by active streambank erosion (Photos 2-4).

Conclusions

The monitoring in 2017 demonstrates water quality in the Pipe Creek Watershed ranges from poor to fair, indicating significant impacts from environmental degradation. Some of the land use characteristics observed during the 2017 monitoring project that can have a negative impact to the water quality of Pipe Creek and its tributaries were limited buffer protection along the stream corridors, eroding streambanks, cropland erosion, channelization, tile drainage, presence

of aquatic invasive species, and sedimentation of fish and aquatic life habitat (Photo 1-5). There are opportunities to install practices to lower the nutrients and sediment reaching Pipe Creek and Lake Winnebago. Efforts should be made to continue to work with landowners, farmers, municipalities, the County Land and Water Conservation Department and Natural Resource Conservation Service staff to promote protection and restoration of the streams and wetlands by practices including, but not limited to, streambank and buffer protection, cover crops, nutrient management planning, reduced tillage, wetland restoration, and water and sediment control basins.

Photo 1: Unnamed Tributary to Pipe Creek at County Hwy HH (WBIC 5025714). Photo taken by D. Bolha on March 29th, 2017.

Photo 2: Unnamed Tributary to Lake Winnebago at Artesia Beach Road (WBIC 5025580). Photo taken by D. Bolha on May 31st, 2017.

Photo 3: Streambank erosion along Pipe Creek upstream of Hwy 151. Photo taken by D. Bolha on July 18th, 2017.

Photo 4: Streambank erosion along an Unnamed Tributary to Pipe Creek upstream of Hwy 151 (WBIC 3000189). Photo taken by D. Bolha on July 7th, 2017.

Photo 5: Sediment plume in Pipe Creek upstream of Hwy 151 following a heavy rain event. Photo taken by D. Bolha on June 16th, 2017.

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