Stream Water Quality

In

The Shawano Lake Watershed

2013, 2014, 2105

Shawano County, Wisconsin

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NER_2_CMP14
NER_10_CMP15

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Shawano Lake Tributary Assessment Report

Introduction

The Shawano Lake Watershed covers 71.2 square miles in Shawano and Menominee Counties with the 6,178-acre Shawano Lake as the main water resource. Shawano Lake is a lowland drainage lake up to 40 feet deep and is an important year round recreational waterbody. The tributary streams are generally small cool-cold, cool-warm, or warm headwaters with the exception of Loon Creek which is a warm mainstem. These modeled stream communities are based on temperature and flow. The landscape in the watershed is covered by a relatively balanced mix of forests (30%), agriculture (29%), open water (16%), and wetlands (15%). Additionally, within the 71.2 square mile watershed, there are 76 miles of streams, 6,948 acres of wetlands, and 7,528 total lake acres.

Shawano Lake is a lowland drainage lake that experiences annual water quality declines in July and August annually. A comprehensive watershed report was completed by the University of Wisconsin, Stevens Point Center for Watershed Science and Education in 2008. This Report focused on the internal and external factors affecting water quality in Shawano Lake and developed a Phosphorous budget for the lake. The watershed as a whole contributes approximately 50% of the annual load to the Lake but the single greatest contributor is the internal sediment release of Phosphorous. (Watershed Assessment of Shawano Lake, 2008). This assessment of Shawano Lake Tributaries was directed at identifying stream quality impairments for listing purposes and further developing watershed recommendations to improve stream and ultimately lake water quality conditions.

Methods

Water quality monitoring was conducted at 8 wadeable sites throughout the watershed in the spring, summer, and fall of 2013 and follow-up monitoring was conducted during the summer and fall of 2014 and 2015. During each field visit, basic water quality parameters including air temperature, water temperature, conductivity, dissolved oxygen, dissolved oxygen percent, pH, flow, and water clarity were collected. Total Phosphorous samples were collected by a citizen volunteer once per month throughout the growing season from May-October in 2014 and 2015. A continuous temperature HOBO was installed at this site and collected continuous water temperature readings between May-October.

Site Selection – Sites were selected so data would not be biased toward stream order, location, or natural community; however sites were targeted based access and the desire to focus a sample station on that particular stream reach. Sample stations were established to limit outside influences and set-up using DNR field procedures manuals of 35 times the mean stream width (Modified from Simonson, et al. 1994). Stations were no less than the minimum of 100 meters and no more than the maximum of 400 meters.

Continuous Water Temperature Monitoring- An Onset Hobo water temperature data logger was placed within the sample station used for fish and habitat survey. Temperature readings were collected every 15 minutes from May thru October in 2013. Temperature data will be used to determine relative thermal regimes for the sample station and to ascertain average daily summer time maximum temperatures.

Fish Surveys- Fish surveys were completed through the identified sample station. A direct current electrofishing backpack shocker or tow behind stream shocker was used to collect all fish possible through an upstream pass through the sample station. Typically the back pack units were used on the small streams up to 3 meters with a single probe and the stream shockers were used with a generator and 2 probes on the remainder of sites over 3 meters. All fish were collected, identified, and counted. All gamefish were measured. All other WDNR sampling protocols were used to assess the fish community for purposes of calculating the index of biotic integrity.

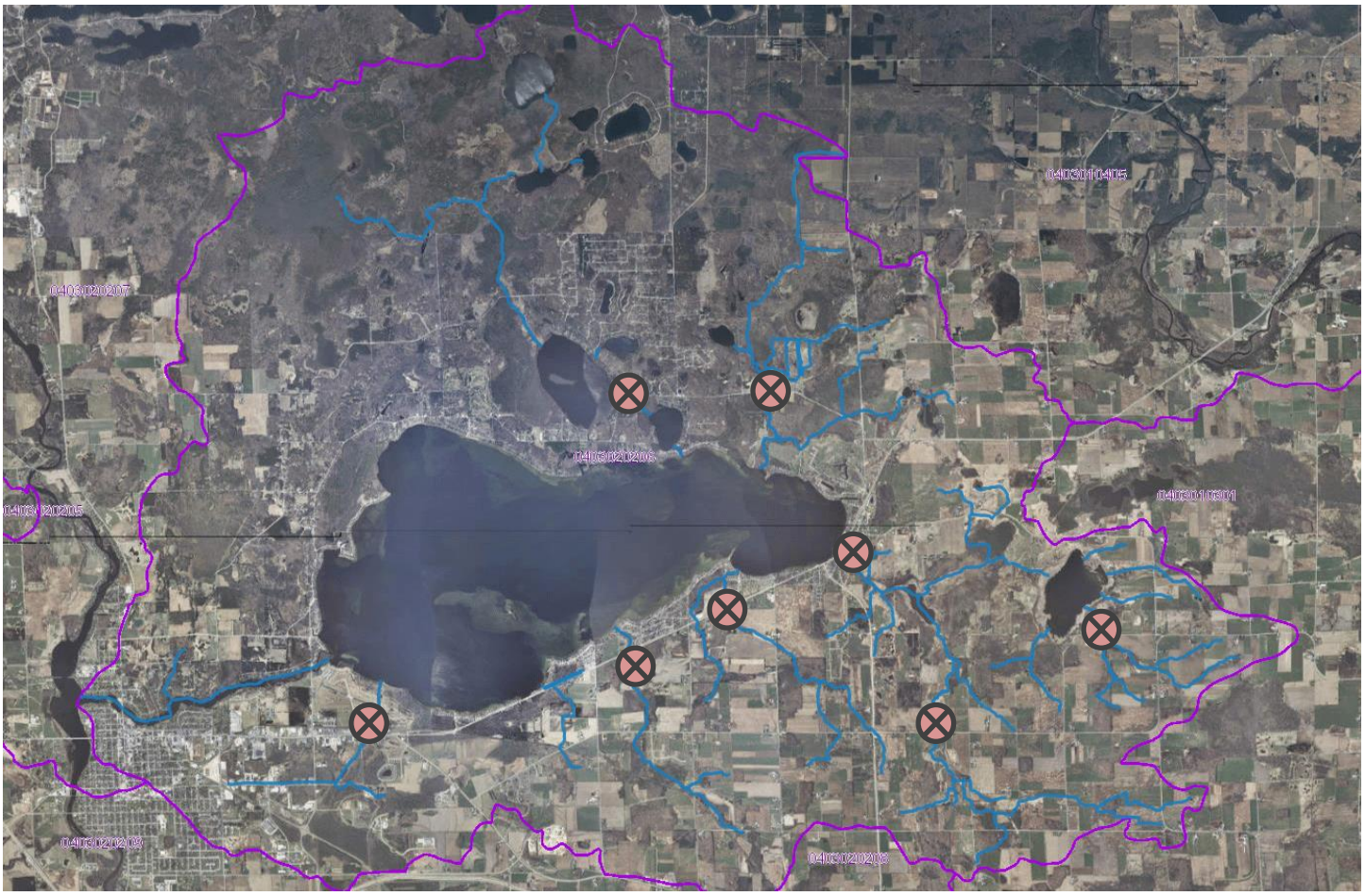
Habitat Surveys- At the established stations, a quantitative habitat evaluation was completed. A total of 12 transects were located equidistant throughout the station to sample representative available habitat. Quantitative habitat metrics were collected such as average stream width and depths, depths of fines, substrate, embeddedness of substrate, macrophyte or algal growth, canopy cover, riparian buffers, land use, stream bank erosion, and fish cover. The station length was established at a distance 35 times the mean stream width.

Macroinvertabrate Sampling- Macroinvertebrate samples were obtained by kick sampling a collection using a D-frame net at all sample sites in the fall. These samples were sent to the University of Wisconsin-Stevens Point for taxonomic classification, analysis, and computation of a Macroinvertabrate (M-IBI) and other usable metrics.

Table 1: Shawano Lake Tributary Sample Sites, 2013, 2104, 2105.

Waterbody	WBIC	Location	Order
Murray Creek	323000	Downstream STH 22	2
UNT to Shawano Lake	325000	Upstream Meadow Road	1
UNT to Shawano Lake	323500	Upstream of Shady Lane	2
Pickerel Creek	325800	Upstream of James Street	3
UNT to Mud Lake	326100	Downstream CTH E	2
UNT to White Clay	5013017	Upstream Lodge Road	3
Duchess Creek	325100	Downstream of CTH H	2
Loon Creek	323600	Downstream CTH HH	2

Figure 1: Shawano Lake Tributary Sample Site Locations, 2013, 2104, 2105.



SUMMARY RESULTS

Results for the fisheries and habitat surveys are summarized in Table 2 and 3. The natural communities model (Lyons, 2008) indicates that the tributary streams to Shawano Lake are classified as cool-cold, cool-warm, and warm headwater streams. Based on the natural community verification draft guidance (Lyons 2014), Loon Creek verifies as a warm mainstem. Other slight changes in the verification of natural communities occurred on most other streams between cool-cold headwater to cool-warm headwaters and cool-warm headwater to warm headwater. This may indicate that the natural community model slightly assigns streams in the watershed toward slightly cooler water than what is observed based on the fish community assemblages.

Based on the verified natural community, the applicable IBI was applied to achieve a score and rating for each stream reach sampled. All streams with the exception of the Loon Creek were evaluated using the small stream IBI. Habitat scores within all reaches of streams with the exception of Loon Creek, were evaluated with the small stream of widths <10 m.

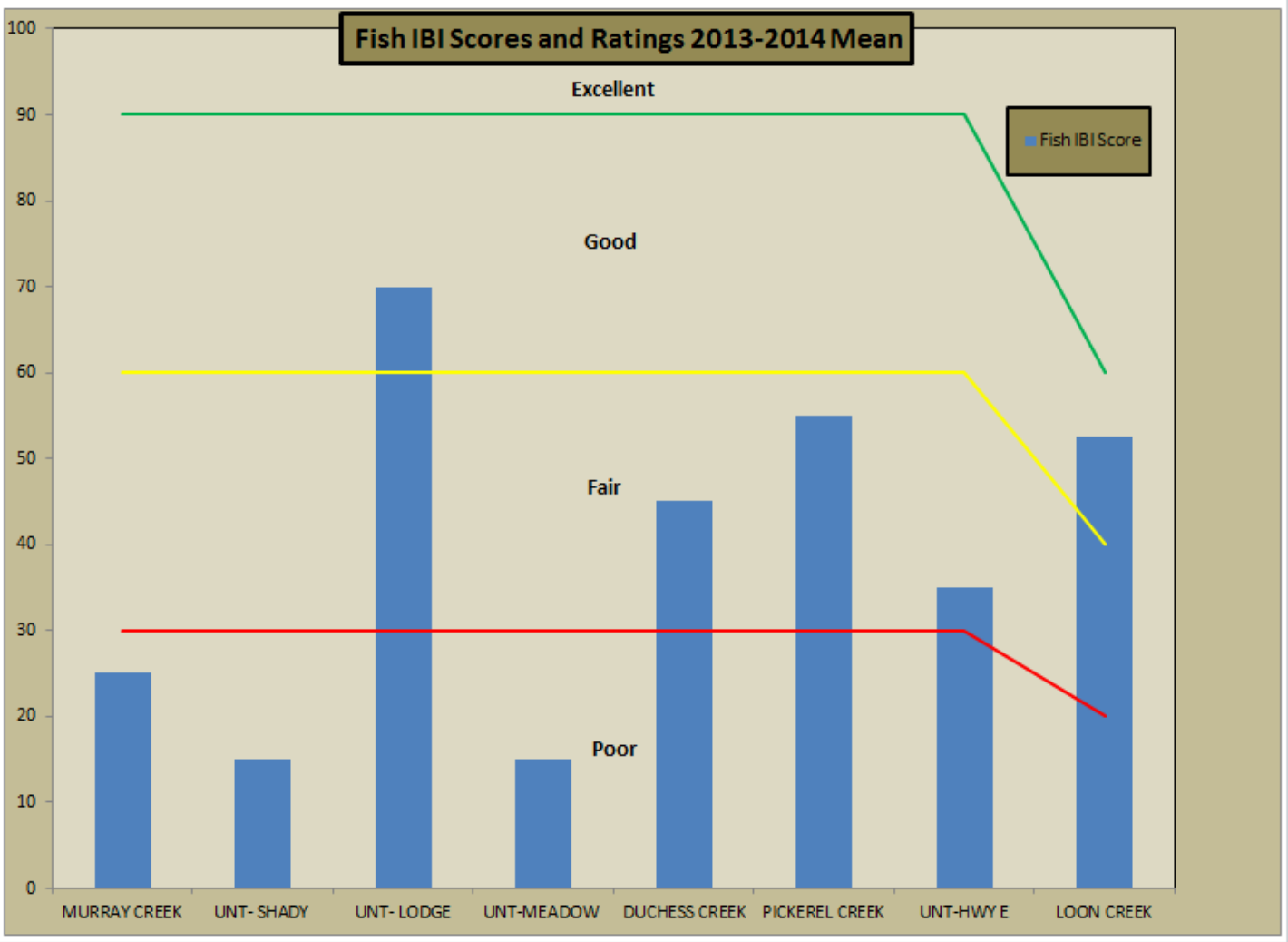


Figure 2- Averaged Fish IBI Scores for Shawano Lake Tributary Streams- 2013 and 2014.

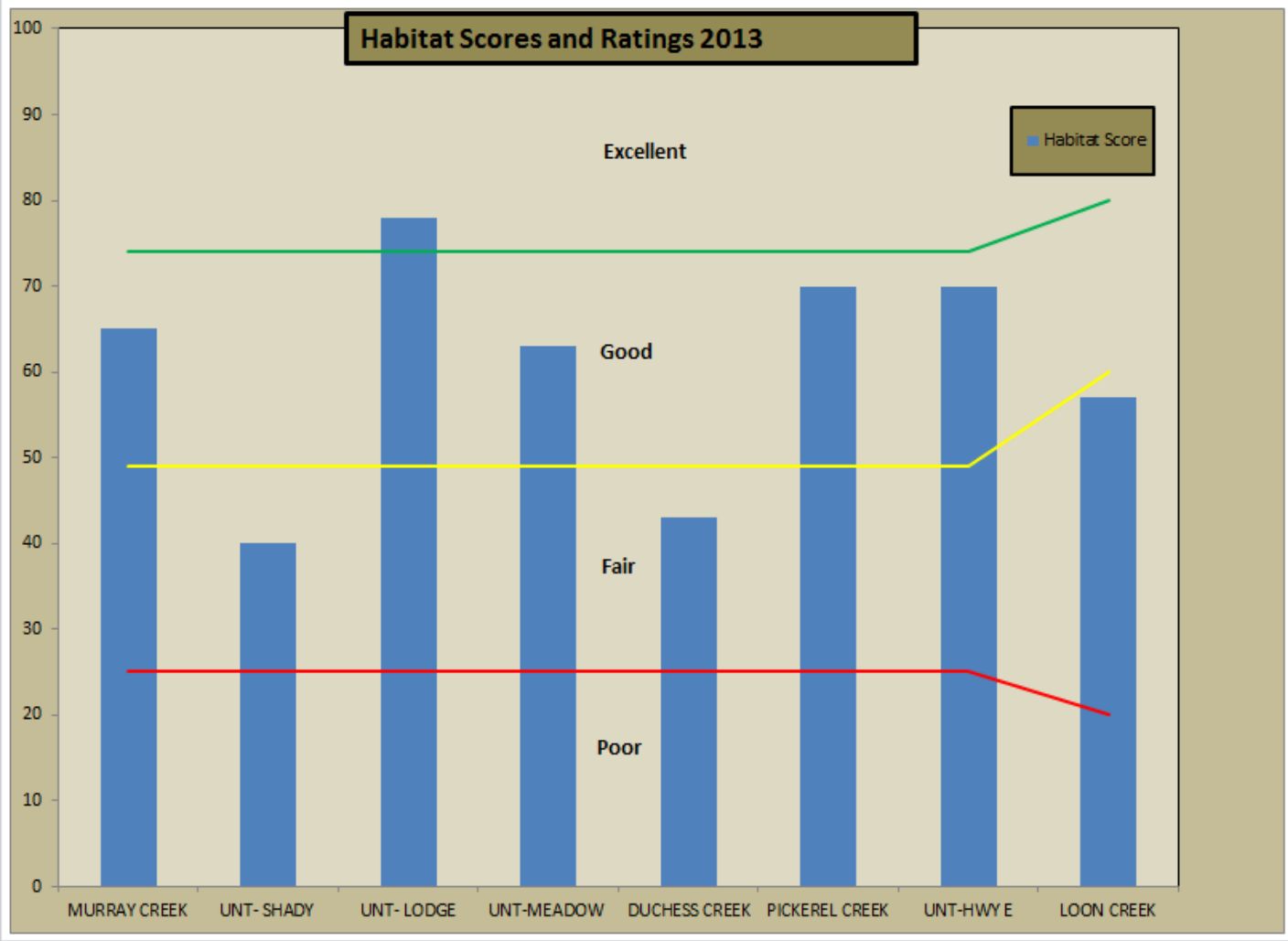


Figure 3- Habitat IBI Scores for Shawano Lake Tributary Streams- 2013 and 2014.

Macroinvertabrate samples were collected at all sites in 2013 and selected follow-up sites in 2014 and evaluated with the Hilsenhoff Biotic indices (HBI, Hilsenhoff, 1987) and the Macroinvertebrate index of biotic integrity (MIBI, Weigel, 2003). The Hilsenhoff Biotic Index (HBI) provides a relative measure of organic loading to a stream and as the score increases so does the environmental degradation. The macroinvertebrate IBI (MIBI) was developed for streams within specific eco-regions of Wisconsin and uses metrics related to assemblage composition, structure and function and assesses a wide range of environmental conditions including landuse, habitat and water quality (Weigel, 2003). As score decrease, environmental degradation increases and scores below 2.5 are generally considered degraded and impaired. M-IBI results were consistently fair with Loon Creek having a good ranking. (See Figures 4 and 5 and Tables 4 and 5)

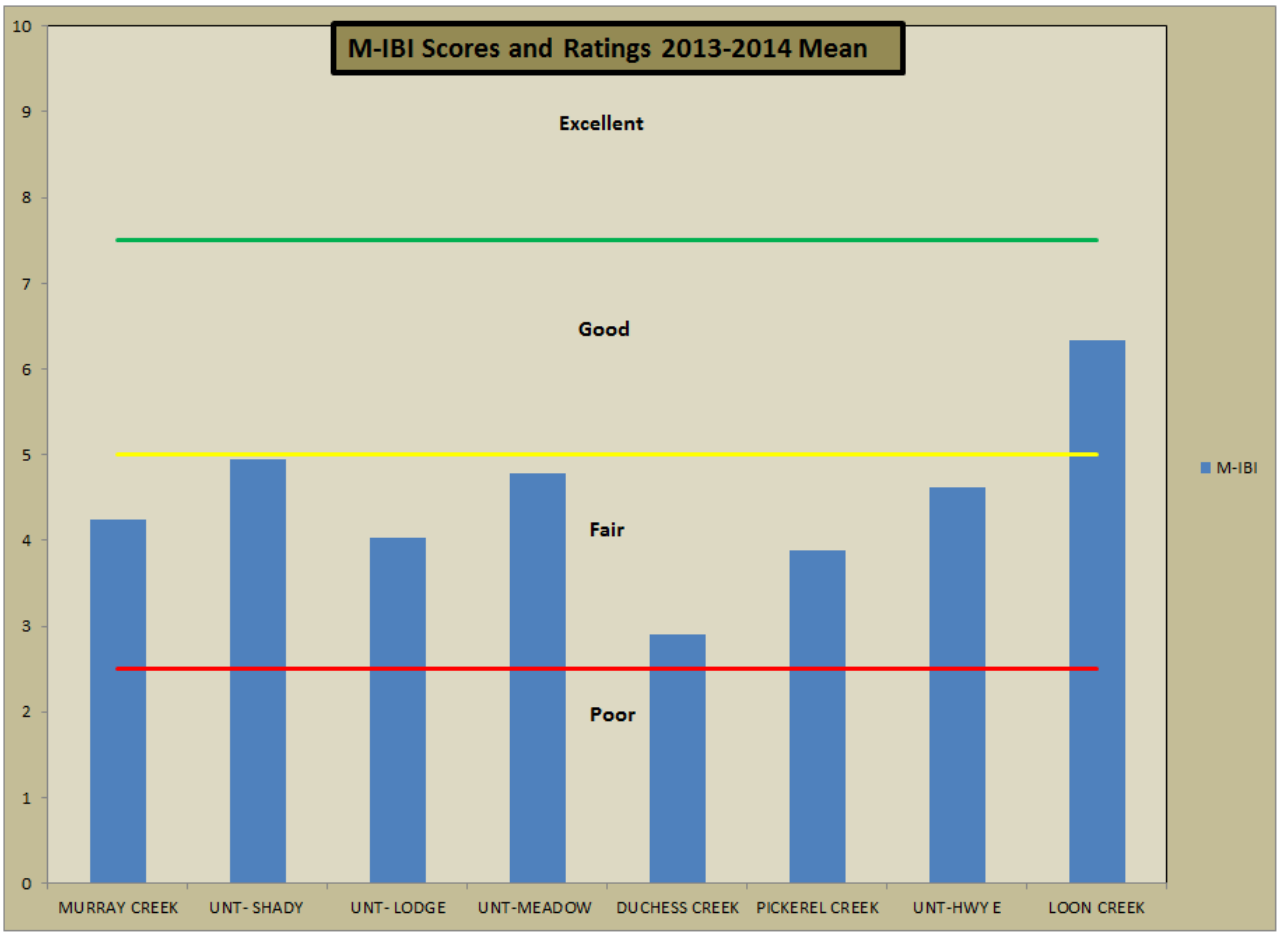


Figure 4- Average Macroinvertabrate IBI Scores for Shawano Lake Tributaries- 2013 and 2014.

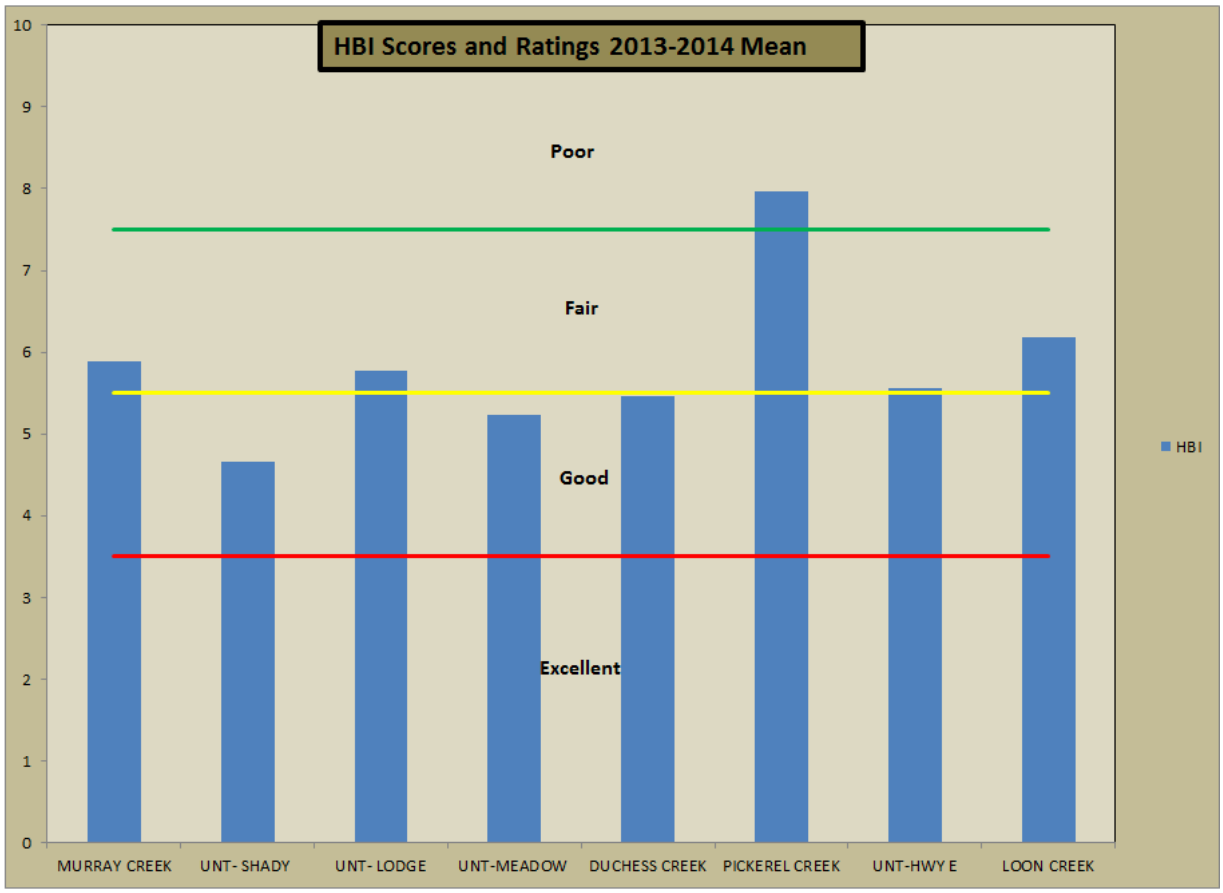


Figure 5- Average Hilsenhoff Biotic Index Scores for Shawano Lake Tributaries- 2013 and 2014.

Total Phosphorous samples were collected once per month in 2014 and 2015 on selected Shawano Lake Tributaries based on rankings of poor or fair on the fish or macroinvertebrate IBI's. Total Phosphorous concentration exceeded the standards 0.075 mg/l consistently at the Unnamed Tributaries to Shawano Lake at Shady Lane and Meadow Road, commonly at the Unnamed Tributary to Mud Lake and White Clay Lake, once at Pickerel Creek and never at Murray or Duchess Creek. Based upon 2014 WisCalm guidance, the Unnamed Tributaries at Shady Lane, Meadow Road, Lodge Road, and CTH E (2014) all exceed the listing threshold and will be up for consideration for listing as impaired on the State's 303(d) list of impaired waters in 2016.

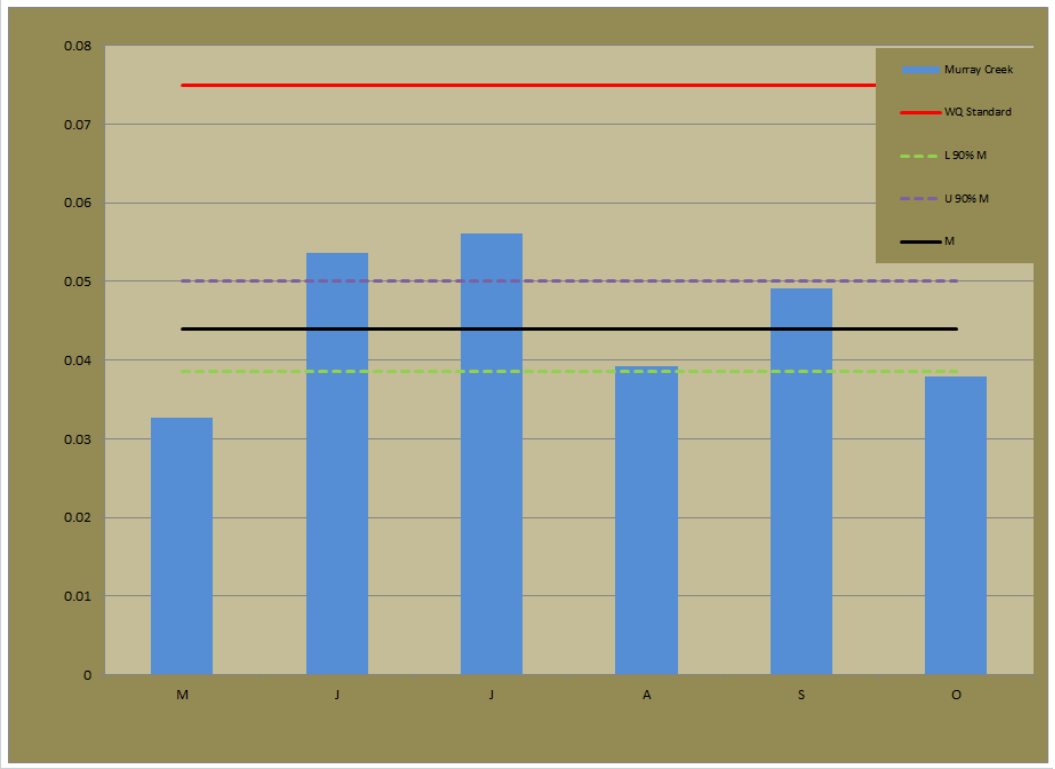


Figure 6. Total Phosphorous results from growing season samples Murray Creek 2014.

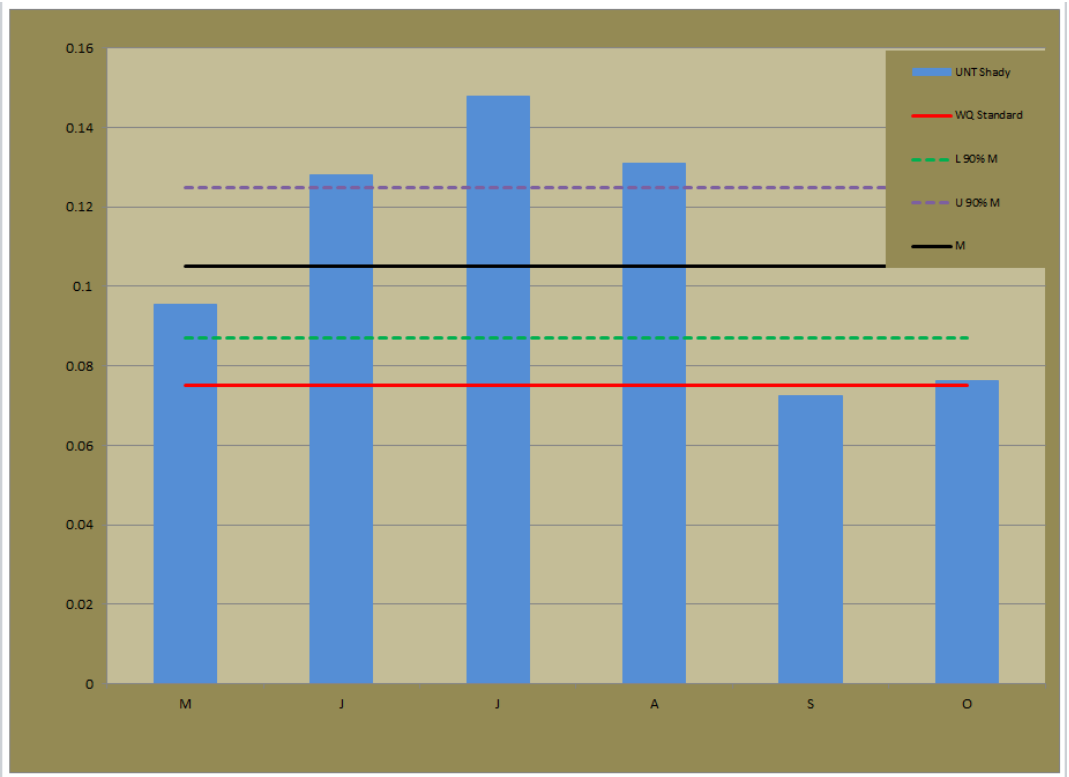


Figure 7. Total Phosphorous results from growing season samples UNT to Shawano Lake @ Shady Lane 2014.

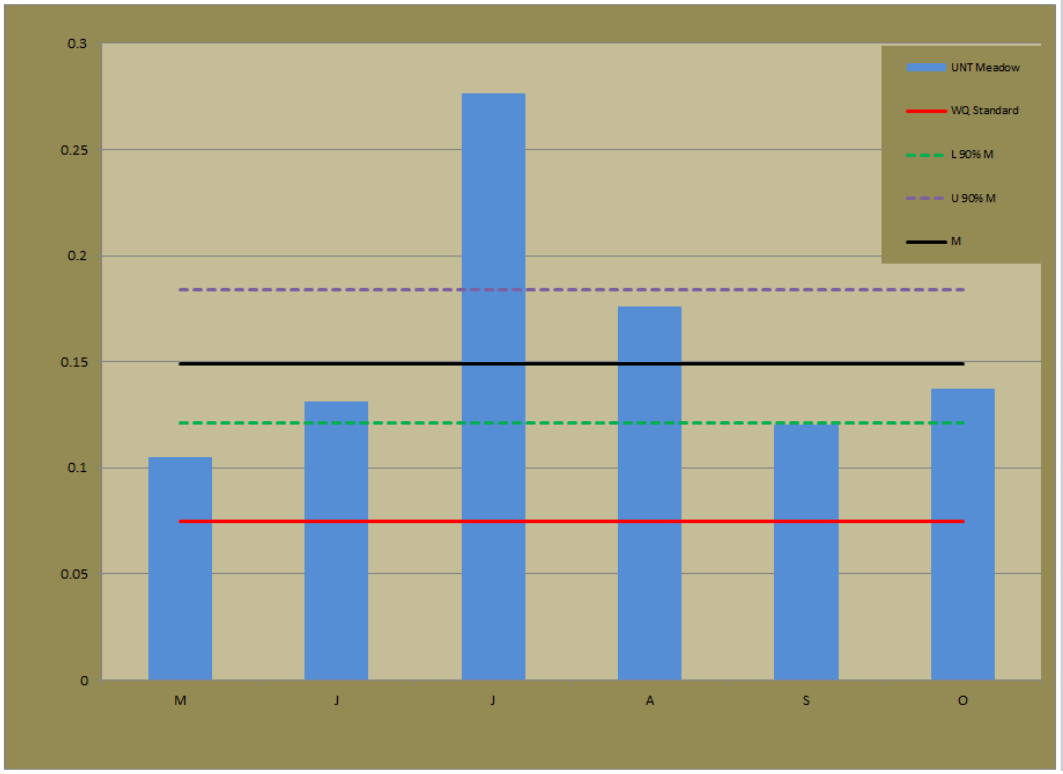


Figure 8. Total Phosphorous results from growing season samples UNT to Shawano Lake @ Meadow Road 2014.

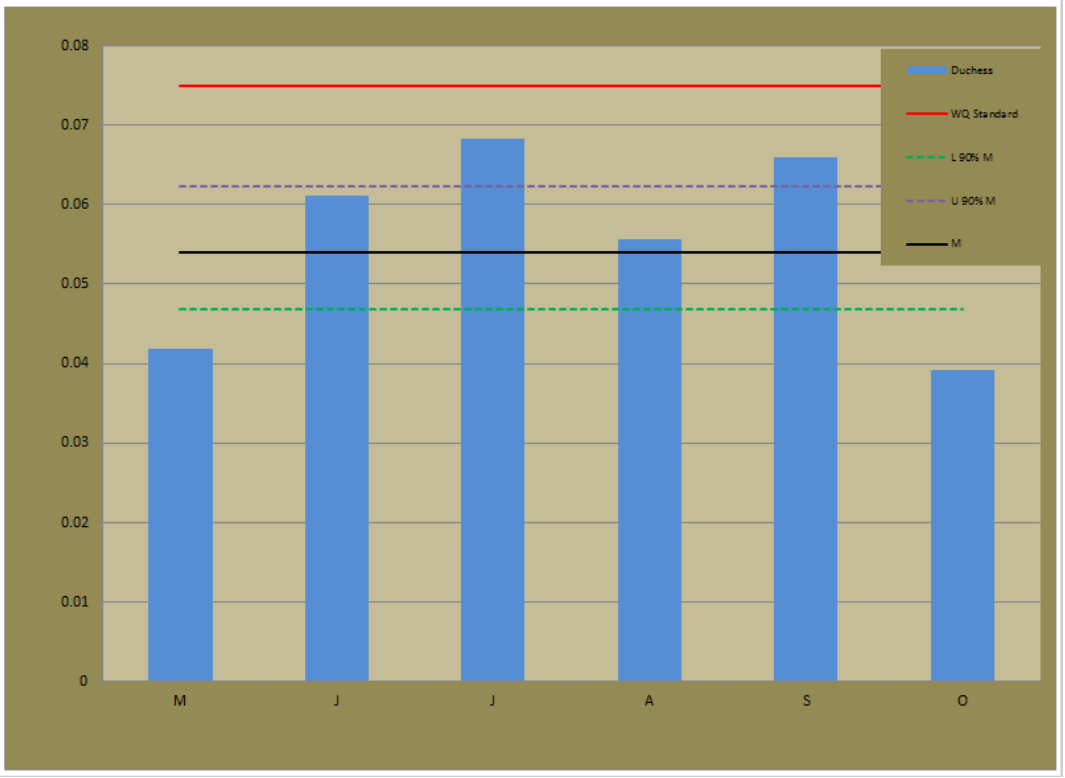


Figure 9. Total Phosphorous results from growing season samples Duchess Creek 2015.

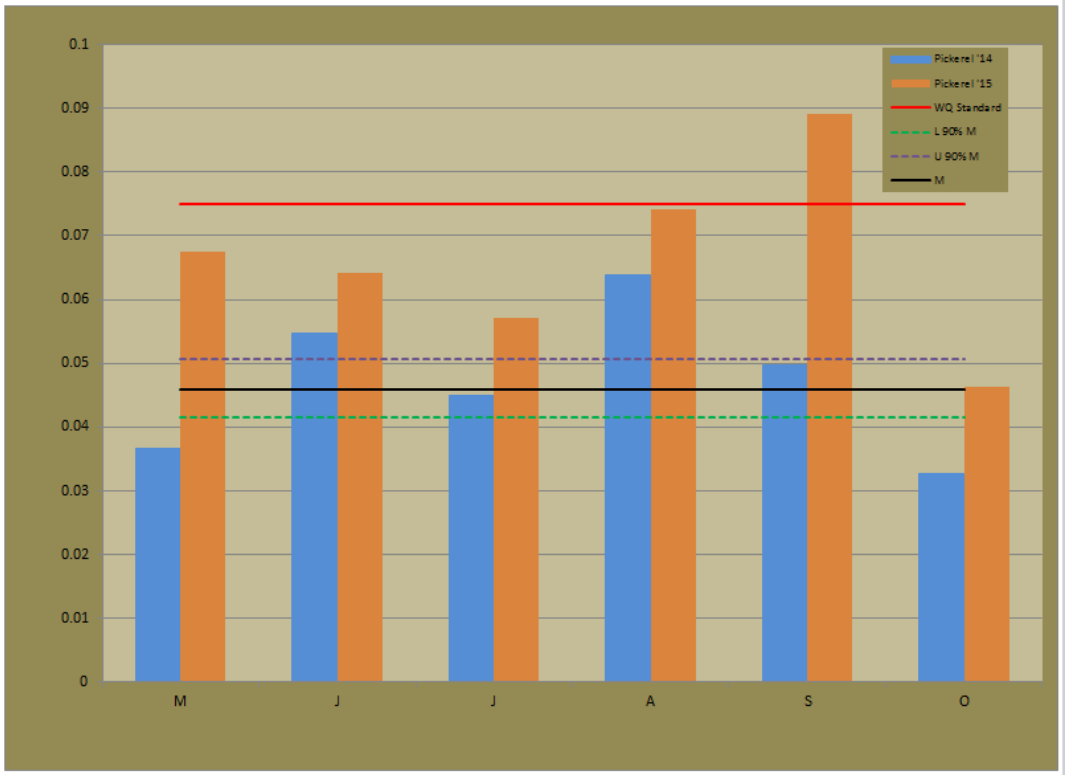


Figure 10. Total Phosphorous results from growing season samples Pickerel Creek 2014 and 2105.

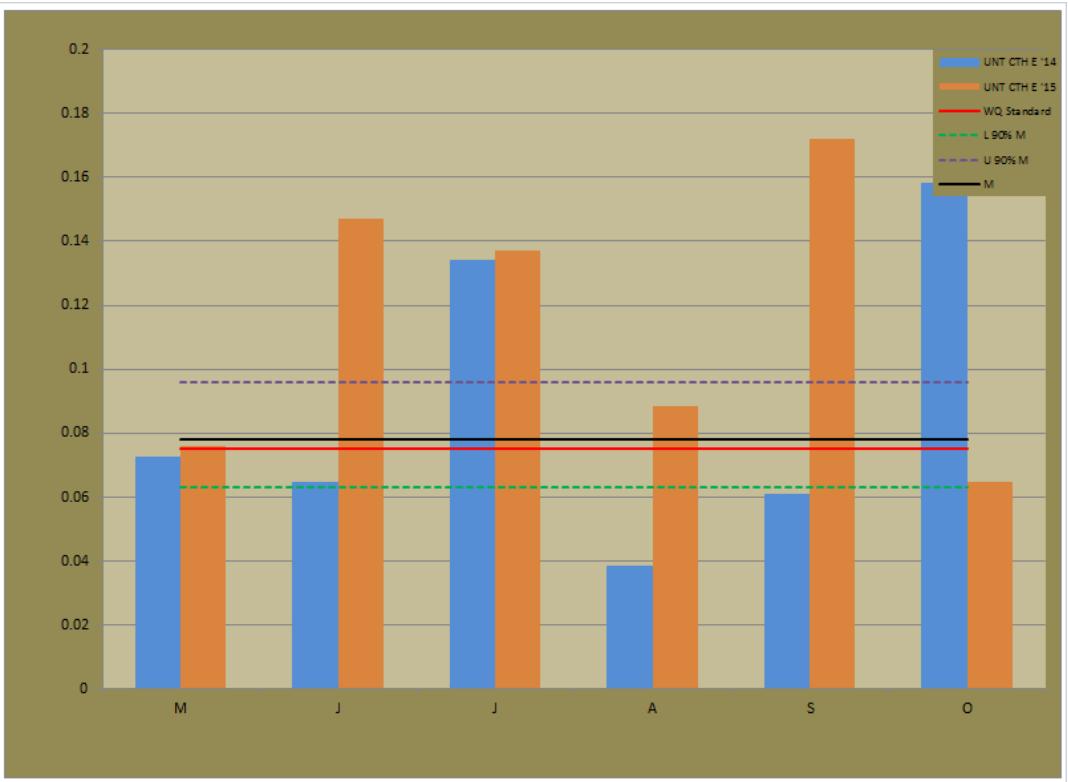


Figure 11. Total Phosphorous results from growing season samples UNT to Mud Lake @ CTH E 2014 and 2015.

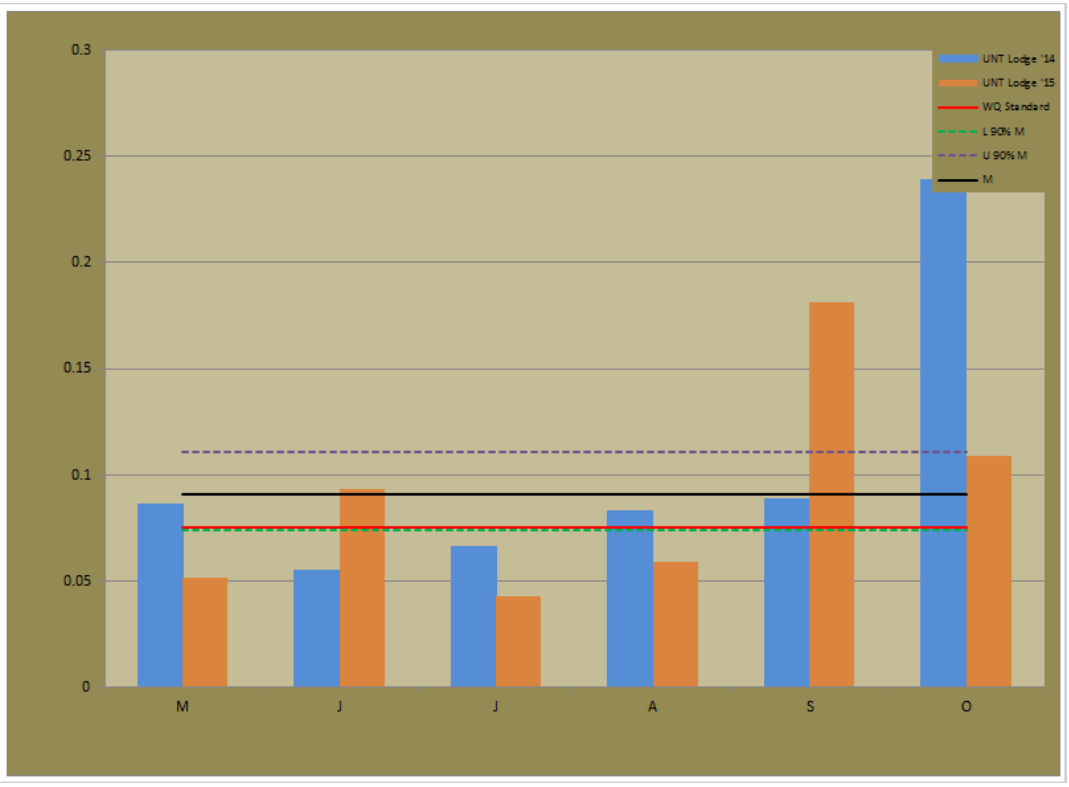


Figure 12. Total Phosphorous results from growing season samples UNT to White Clay @ Lodge Road 2014 and 2015.

DISCUSSION

Monitoring of Shawano Lake Tributary streams in this project followed guidance in 2014 WisCalm for evaluating streams for impairments. Based on the recommendation from the Shawano Lake Watershed Report, 2008, a Watershed-scale management approach may bring water quality in Shawano Lake closer to the desired levels. The Unnamed Tributaries to Shawano Lake at Shady Lane and Meadow Road, the Unnamed Tributary to Mud Lake at CTH E and the Unnamed Tributary to White Clay at Lodge Road will be considered for listing on the state's 303(d) list of impaired waters in 2018. The streams showed either a degraded biological community, exceedances of the Total Phosphorous Criteria or both. Murray Creek and Duchess Creek should be monitored again in the future to ensure these streams continue to meet water quality standards. Pickerel Creek and its watershed should be prioritized for conservation activity. Pickerel Creek is the largest drainage and contributor to Shawano Lake and also exhibits the largest loads. During this monitoring project, the stream did not meet the listing criteria to be considered impaired; however this stream was also one of the most variable in observed conditions. Within this sub-watershed upstream of Mud Lake, two tributaries and White Clay Lake will be listed as impaired and opportunities may be present to control watershed contributions from non-point sources.

RECCOMENDATIONS

- Propose listing Unnamed Tributaries to Shawano Lake at Shady Lane and Meadow Road, the Unnamed Tributary to Mud Lake at CTH E and the Unnamed Tributary to White Clay at Lodge Road on the 2018 impaired waters list.
- Support the development of a 9- Key Elements Plan for the Watershed by Shawano County Land Conservation Department
- Develop understanding of agricultural producer operations in the watershed and foster partnerships between Shawano Area Waterway Management Association, White Clay Lake P and R District, Loon Lake Wescott Management District, Lulu Lake Management District, Washington Lake Management District, Shawano Lake Sanitary District, Shawano County, Menominee Nation, and Agricultural producers in the watershed.
- Utilize all available land modeling tools to help support identification of direct drainage areas vs internally drained areas within smaller sub-watersheds around the southern end of the Shawano Lake.
- Develop tile line maps within the watershed
- Promote soil health and buffer quality enhancements within direct surface water drainage areas to Shawano Lake.
- Develop strategy to support partnerships with willing producers to achieve contributory reductions in nutrient loads to Shawano Lake through Tributary reductions.

STREAM NARRATIVES

Murray Creek

Murray Creek is a small, 2.4 mile long highly manipulated cool-warm headwater to Shawano Lake that drains approximately 8.7 square km. The headwaters to Murray Creek originate to the south and west of the Lake in an industrial park and residential neighborhood which historically was an intact wooded wetland complex. The entire 2.4 miles of stream have been either straightened or realigned at some point for the development of residential neighborhoods, an industrial park, roads, or the Shawano Airport. Historically, Murray Creek was a small stream that served to drain wooded wetlands to the north toward the lake. Currently Murray Creek runs through roadside ditches and realigned stream channels until it makes it way to the lake. The overall quality of Murray Creek is fair. The stream does not appear to be impacted by excessive nutrients but the destruction of habitat, channelization, and straightening has impacted the fish and macroinvertebrate community. It is in close proximity to the Lake so recruitment from fish does allow some utilization within the stream but its potential is highly limited due to the overlying manipulation factors.

UNT to Shawano Lake Shady Lane

The Unnamed Tributary to Shawano Lake at Shady Lane is a small 2.71 mile long cool-cold to cool-warm headwater stream to Shawano Lake that drains approximately 7.3 square km. The stream flows through and mainly drains agricultural lands to the south of the Lake. Buffers are somewhat intact and the stream corridor is wooded until it approaches the lake where land use shifts to residential. The overall quality of this stream is poor. Total Phosphorous concentration within the stream exceeds the state's listing criteria and the stream is likely impaired. The fish community was assessed and a poor rating was achieved both in 2013 and 2014. The potential for a diverse fish assemblage in this stream is limited by available habitat and cooler water temperatures. Currently excessive fines and lack of stream feature diversity may not be conducive to supporting fish species other than Brook Stickleback and Central Mudminnow. Two young of the year Bluegills were sampled in 2014 which migrated up from the Lake. Other species may migrate from Shawano Lake in this stream from time to time when conditions allow for various purposes.

UNT to Shawano Lake Meadow Road

The Unnamed Tributary to Shawano Lake at Meadow Road is a small 3.3 mile long cool-cold to cool-warm headwater stream to Shawano Lake that drains approximately 9 square km. The stream flows through and mainly drains agricultural lands to the south of the Lake. Buffers are somewhat intact and the stream corridor is wooded in parts however portions of the stream flow through active pasture with unlimited livestock access to the stream and runs adjacent to a few concentrated feedlots. The overall quality of this stream is poor. Total Phosphorous concentration within the stream exceeds the state's listing criteria and the stream is likely impaired. The fish community was assessed and a poor rating was achieved both in 2013 and 2014. The potential for a diverse fish assemblage in this stream is limited by available habitat, bank slumping and cooler water temperatures. In 2013, only one adult northern pike was sampled which in all likelihood migrated upstream from the lake in search of suitable spawning habitat. It was noted during this survey that although only one fish was observed within the sample station, the width to depth ratio was good, bottom substrate was a good, and small meandering stream offered a complexity of habitat features which should have yielded more fish. In 2014, panfish consisting of Bluegill, Pumpkinseed and yellow perch were sampled along with log perch. These are all species that likely migrated up from the Lake for various reasons.

Pickerel Creek

Pickerel Creek is a 3.0 mile long tributary to Shawano Lake that drains approximately 13 square miles. Pickerel Creek originates as the outlet to White Clay Lake and then flows through Mud Lake before it drains out to the north towards Shawano Lake. Land use surrounding Pickerel Creek is extensively wetland with agriculture occurring near the headwaters and surrounding the headwater lake of White Clay. Habitat within Pickerel Creek scored on the high side of good with good buffers, good substrate, and good cover for fish. It should be noted the White Clay Lake is listed on the 303(d) list of impaired waters for Total Phosphorous and the water quality in White Clay has a direct correlation to conditions observed in Mud Lake and Pickerel Creek. Although Pickerel Creek does not appear to be impaired by total phosphorous, a few sample events exceeded or approached the criteria of 0.075 mg/l. Pickerel Creek likely suffers from diurnal oxygen swings and organic loading from the extensive wetland contributions from Mud Lake and the large shallow marsh wetland complex upstream. This is evident in looking at instantaneous dissolved oxygen grab readings that commonly have been measured below the state standard of 5.0 mg/l. The Hilsenhoff Biotic Index (HBI) provides a relative measure of organic loading to a stream and in both 2013 and in 2014, the HBI ranked was poor. The macroinvertebrate IBI (MIBI) was developed for streams within specific eco-regions of Wisconsin and uses metrics related to assemblage composition, structure and function and assesses a wide range of environmental conditions including landuse, habitat and water quality (Weigel, 2003). Pickerel Creek achieved a poor ranking in 2013 and a good ranking in 2014. The fish community in Pickerel Creek is dominated by transitional, tolerant to intermediately tolerant fish species that are adapted to conditions observed in Pickerel Creek. Only two Iowa Darters, which are an intolerant species, were observed in 2014 which helped the stream achieve a good rating while in 2013 the stream had a poor rating. It is important to note the role that Mud Lake plays in the water quality dynamic of Pickerel Creek and ultimately Shawano Lake. Mud Lake and surrounding wetlands play a pivotal role to absorbing watershed impacts from various unnamed tributaries and White Clay Lake. Organic loading and dissolved oxygen swings originating from the natural conditions as flow exits Mud Lake likely are the controlling factor in any given year leading to the macroinvertebrate and fish community assemblages and biotic index scores.

Unnamed Tributary to Mud Lake

The Unnamed Tributary to Mud Lake is a 5.33 mile long stream that drains approximately 4.3 square miles. Land use surrounding the Tributary is primarily agriculture with several small dairy operations. Cattle have free access to the stream at CTH E and banks are denuded of vegetation and severely trampled. Habitat within the sample station was good with adequate cover for fish and intact buffers. Fines dominated the substrate but a small riffle comprised of cobble and gravel was present near the end of the station below the farm at CTH E. Water Chemistry samples indicate that the stream is impaired by total phosphorous and the fish and macroinvertebrate community are rated as poor to fair. A high HBI score indicate that the stream is impacted by organic loading. The fish community was dominated by species tolerant to poor water quality and degraded habitat.

Unnamed Tributary to White Clay Lake

The Unnamed Tributary to White Clay is a 2.52 mile long stream that drains approximately 2.0 square miles. Land use surrounding the Tributary is primarily agriculture with several small and one medium sized dairy operation. Upstream from Lodge, a permitted dam exists on the Tributary that creates an approximate 4 acre impoundment. The fish and macroinvertebrate indices indicate that the biological community is fair. Tolerant species to environmental degradation and limited habitat dominate while the macroinvertebrate community indicates impacts from organic loading are present. Water Chemistry sampling indicates that the stream is impaired from Total Phosphorus by exceeded the listing threshold of 0.075 mg/l. The headwaters to the stream 100 meters above the impounded section are seasonally intermittent and cultivation occurs directly through the stream.

Duchess Creek

Duchess Creek is a 3 mile long tributary that drains approximately 8.75 square miles. Land use surrounding Duchess Creek is primarily undeveloped and wetlands however the headwater originates in an extensively drained and ditched muck farm. A Tributary to Duchess Creek drains land to the east and originates from the discharge of three small lakes prior to flowing adjacent to agricultural land, light residential, and a golf course. Generally, water quality within Duchess appears to be fair with both the Fish IBI and the MIBI scoring in that category. While in 2013, the fish IBI was rated as good and scored 70, in 2014 is rated poor and scored a 20. The drop in score is reflective of the non-capture of five species in 2014 including two intolerant species, Rock Bass and Weed Shiner. The stream may be impacted by slight levels of organic loading based on the fair rating in the HBI. Wetland drainage and lake discharge may be factors in this contribution. Water Chemistry grab samples for total phosphorous had no exceedances of water quality criteria of 0.075 mg/l during the growing season sample events in 2014. Although this stream does not meet the 303(d) listing criteria and is currently not recommended for listing, this stream should be classified as a watch water and monitored routinely.

Loon Creek

Loon Creek is a 7.0 mile long Tributary to Washington Lake that drains approximately 15 square miles and is the largest Tributary in the watershed. The single sample location was located between Loon Lake and Washington Lake. Land use in the Loon Creek drainage is highly undeveloped with the only development occurring as lakeshore development as it flows through Loon and Washington Lake and a light residential development north and east of Loon Lake. The fish IBI was rated as fair approaching good when applying a Warmwater IBI considering the verified natural community as a Warm Mainstem. The proximity of the sample location and lakes likely influenced the fish community assemblage. Other influencing factors include a beaver dam and activity located near the start of the station. The M-IBI scores on Loon Creek indicate a good score while the HBI indicate a fair score. The influences on the HBI score can likely be attributed to discharge from wetlands, the sample location being downstream of Loon Lake, and recent beaver activity. No water chemistry grab samples were collected from Loon Creek.

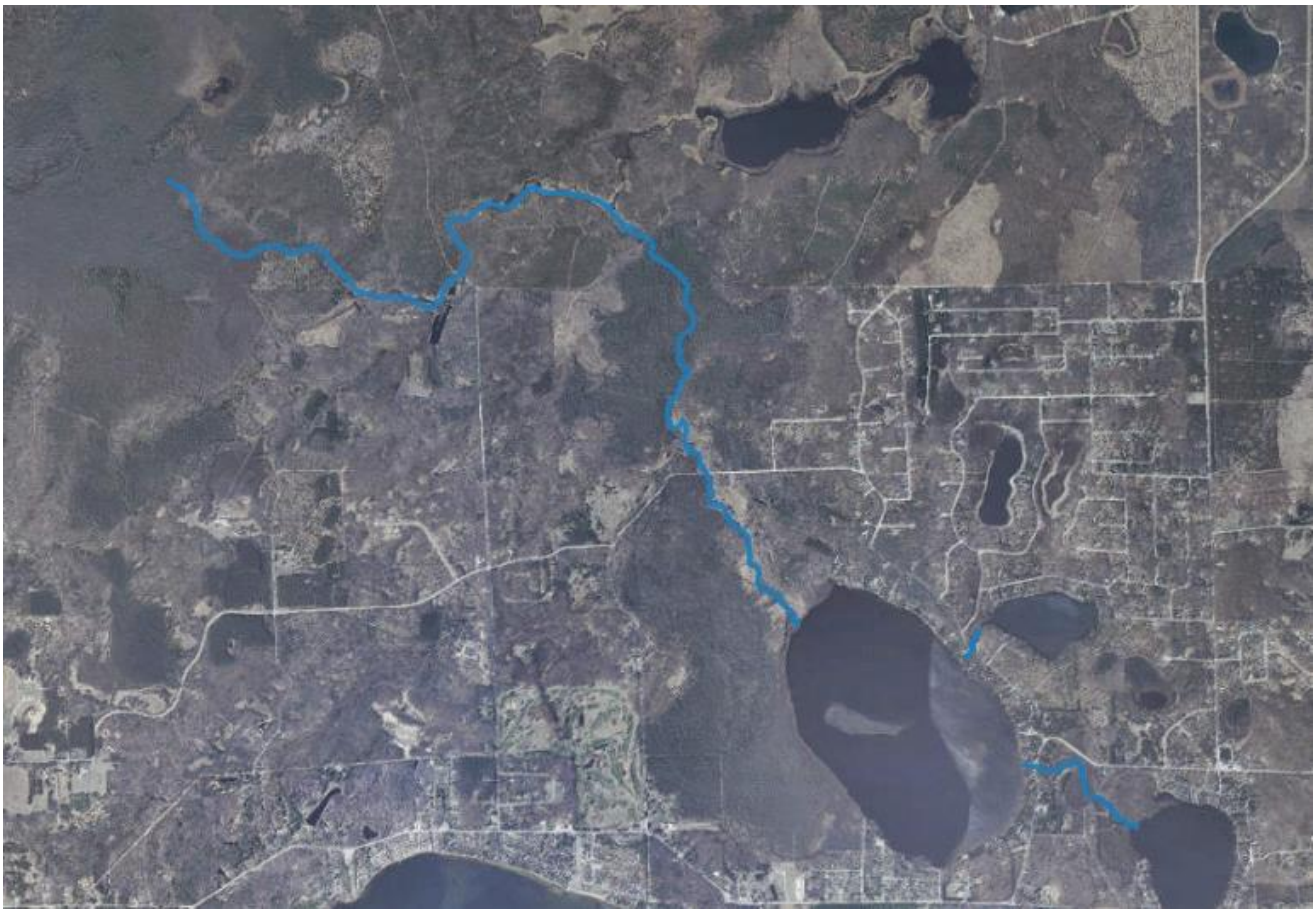


Table 2. Fish IBI for the Shawano Lake Tributaries, 2013.

2013 Stream - Site	Murray Creek DS STH 22	UNT to Shawano Lake US Shady Lane	UNT to Shawano Lake US Meadow Road	Pickerel Creek US James Street	UNT to Mud Lake DS CTH E	UNT to White Clay Lake US Lodge Road	Duchess Creek DS CTH H	Loon Creek DS CTH HH
Stream Order	2	2	2	5	3	2	5	10
Mean Stream Width	3	2	2.5	3	2	3	2	2
Station Length	105	100	130	175	100	100	175	350
Modeled Natural Community	CWHW	CCHW	CCHW	WHW	CCHW	CCHW	CWHW	CWHW
Verified Natural Community	**CWHW**	**CCHW**	**CCHW**	**WHW**	**CWHW**	**CCHW**	**CWHW**	**WMS**
Fish Species								
Black Bullhead	1					1		
Central Mudminnow		2		12	29	5	14	
Brook Stickleback		3			21	106		
Bluegill				3			5	181
Black Crappie								12
Yellow Perch				1				2
Bluntnose Minnow								10
Yellow Bullhead				3			3	5
Rock Bass							1	7
Pumpkinseed						3	2	1
Bowfin								1
Weed Shiner								2
Spotfin Shiner								2
Largemouth Bass							1	8
Northern Pike			1	1			1	
Weed Shiner							1	
Common Shiner							1	
Bluegill x Pumpkinseed							3	
Logperch				8				
Fathead Minnow						104		
Total # Fish Sampled	1	5	1	28	50	219	32	231
Total # Species	1	2	1	6	2	5	10	11
IBI Score								
Coldwater	-	-	-	-	-	-	-	-
Coolwater (CC)	-	-	-	-	-	-	-	-
Coolwater (CW)	-	-	-	-	-	-	-	-
Warmwater	-	-	-	-	-	-	-	50 (F)
Small Stream	0 (VP)	10 (P)	10 (P)	30 (P)	20 (P)	40 (F)	70 (G)	-

CWMS= Cool-Warm Mainstem
CWHW= Cool-Warm Headwater
CCMS= Cool-Cold Mainstem
CCHW= Cool-Cold Headwater
WMS- Warm Mainstem
WHW- Warm Headwater
CW= Coldwater

E= Excellent
G= Good
F= Fair
P= Poor

Green value represents verified natural community score other with applicable IBI

Table 3. Fish IBI for the Shawano Lake Tributaries, 2014.

2014 Stream - Site	Murray Creek DS STH 22	UNT to Shawano Lake US Shady Lane	UNT to Shawano Lake US Meadow Road	Pickerel Creek US James Street	UNT to Mud Lake DS CTH E	UNT to White Clay Lake US Lodge Road	Duchess Creek DS CTH H	Loon Creek DS CTH HH
Stream Order	2	2	2	5	3	2	5	10
Mean Stream Width	3	2	2.5	3	2	3	2	2
Station Length	105	100	130	175	100	100	175	350
Modeled Natural Community	CWHW	CCHW	CCHW	WHW	CCHW	CCHW	CWHW	CWHW
Verified Natural Community	**CWHW**	**CWHW**	**CWHW**	**CWHW**	**CWHW**	**CCHW**	**CWHW**	**WMS**
Fish Species								
Black Bullhead	1			3				
Central Mudminnow	94	30		68	50	16	1	4
Bluegill	2	2	8	5			56	104
Pumpkinseed	1		7	1		2	1	
Yellow Perch	2		7	71		1		20
Iowa Darter	2			2		3		
Tadpole Madtom	1							
Brook Stickleback		2			29	101		
Black Crappie								7
Brown Bullhead								1
Bluntnose Minnow								
Yellow Bullhead				1			1	
Rock Bass								7
Pumpkinseed								
Lake Chubsucker								1
Weed Shiner								
Spotfin Shiner								1
Bluegill x Pumpkinseed				2				2
Brook Silverside								5
Yellow Bullhead								4
Largemouth Bass				2				15
Muskellunge								1
Northern Pike				1				4
Bowfin				1				
Logperch			5					
Fathead Minnow				2	1	112		
Green Sunfish						3	1	
Northern Redbelly Dace					7	4		
White Sucker					1			
Walleye								1
Total # Fish Sampled	103	34	27	159	88	242	60	177
Total # Species	7	3	4	12	5	8	5	15
IBI Score								
Coldwater	-	-	-	-	-	-	-	-
Coolwater (CC)	-	-	-	-	-	-	-	-
Coolwater (CW)	-	-	-	-	-	-	-	-
Warmwater	-	-	-	-	-	-	-	55 (F)
Small Stream	50 (F)	20 (P)	20 (P)	80 (G)	50 (F)	100 (E)	20 (P)	-

CWMS= Cool-Warm Mainstem
CWHW= Cool-Warm Headwater
CCMS= Cool-Cold Mainstem
CCHW= Cool-Cold Headwater
WMS- Warm Mainstem
WHW- Warm Headwater
CW= Coldwater

E= Excellent
G= Good
F= Fair
P= Poor

Green value represents verified natural community score other with applicable IBI

Table 4. Macroinvertabrate Ratings on the Shawano Lake Tributaries 2013.

2013 Stream - Site	Murray Creek DS STH 22	UNT to Shawano Lake US Shady Lane	UNT to Shawano Lake US Meadow Road	Pickerel Creek US James Street	UNT to Mud Lake DS CTH E	UNT to White Clay Lake US Lodge Road	Duchess Creek DS CTH H	Loon Creek DS CTH HH
Stream Order	2	2	2	5	3	2	5	10
Mean Stream Width	3	2	2.5	3	2	3	2	2
Station Length	105	100	130	175	100	100	175	350
HBI Rating [1]	FP	G	F	P	VG	F	G	F
HBI Score [1]	6.8	4.98	5.52	7.93	4.01	5.62	5.46	6.19
MIBI Rating [2]	F	F	F	P	F	F	F	G
MIBI Score [2]	3.69	4.8	4.81	2.27	3.74	3.25	2.9	6.34

1) E= Excellent (0-3.5)
VG= Very Good (3.51-4.50)
G= Good (4.51-5.50)
F= Fair (5.51-6.50)
F= Fairly Poor (6.51-7.50)
P= Poor (7.51-8.50)
VP= Very Poor (8.51-10)

2) E= Excellent (7.5-10)
G= Good (5.0- 7.49)
F= Fair (2.51- 4.99)
P= Poor (0- 2.5)

Table 5. Macroinvertabrate Ratings on the Shawano Lake Tributaries 2014.

2014 Stream - Site	Murray Creek DS STH 22	UNT to Shawano Lake US Shady Lane	UNT to Shawano Lake US Meadow Road	Pickerel Creek US James Street	UNT to Mud Lake DS CTH E	UNT to White Clay Lake US Lodge Road
Stream Order	2	2	2	5	3	2
Mean Stream Width	3	2	2.5	3	2	3
Station Length	105	100	130	175	100	100
HBI Rating [1]	VG	VG	G	P	FP	F
HBI Score [1]	4.11	4.33	4.95	7.99	7.11	5.93
MIBI Rating [2]	F	G	F	G	F	F
MIBI Score [2]	4.81	5.08	4.75	5.49	4.69	4.8

1) E= Excellent (0-3.5)
VG= Very Good (3.51-4.50)
G= Good (4.51-5.50)
F= Fair (5.51-6.50)
F= Fairly Poor (6.51-7.50)
P= Poor (7.51-8.50)
VP= Very Poor (8.51-10)

2) E= Excellent (7.5-10)
G= Good (5.0- 7.49)
F= Fair (2.51- 4.99)
P= Poor (0- 2.5)

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