August 2020

Watershed

Mississippi River – La Crescent Area Watershed Total Maximum Daily Load

This report quantifies the total amount of total suspended solids and bacteria that can be received by the streams in the Mississippi River - La Crescent Area Watershed and maintain their ability to support swimming, fishing, and healthy biological communities.

MINNESOTA POLLUTION CONTROL AGENCY

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Acronyms

ACPF	Agricultural Conservation Planning Framework
AFO	Animal Feeding Operation
AU	animal unit
AUID	Assessment Unit Identification
BMP	best management practice
BOD	biochemical oxygen demand
BWSR	Board of Water and Soil Resources
CAFO	Concentrated Animal Feeding Operation
cfs	cubic feet per second
cfu	colony-forming unit
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSP	Conservation Stewardship Program
DNR	Minnesota Department of Natural Resources
E. coli	*Escherichia coli*
EPA	United States Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
EQuIS	Environmental Quality Information System
F-IBI	Fish Index of Biotic Integrity
HUC	Hydrologic Unit Code
IBI	Index of Biological Integrity
IMW	Intensive Watershed Monitoring
IPHT	Imminent Public Health Threat
LA	load allocation
lb	pounds
LC	loading capacity
LDC	load duration curve
MAWQCP	Minnesota Agricultural Water Quality Certification Program
MDA	Minnesota Department of Agriculture
mg/L	milligrams per liter
mL	milliliter
MLCCS	Minnesota Land Cover Classification and Impervious Surface Area
MnDOT	Minnesota Department of Transportation

MOS	Margin of Safety
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer Systems
NRCS	Natural Resources Conservation Service
NPDES	National Pollution Discharge Elimination Systems
org/100mL	organisms per 100 mL
RIM	Reinvest in Minnesota
RNR	River Nutrient Region
SDS	State Disposal System
SID	Stressor Identification
SMWI	Southeast Minnesota Wastewater Initiative
SONAR	Statement of Need and Reasonableness
SEE	Standard Error of the Estimate
SSTS	Subsurface Sewage Treatment Systems
SWCD	Soil and Water Conservation District
SWPPP	Stormwater Pollution Prevention Plan
TAC	Technical Advisory Committee
TMDL	Total Maximum Daily Load
TP	total phosphorus
TSS	Total Suspended Solids
UV	Ultraviolet
USGS	United States Geological Survey
WASCOB	water and sediment control basins
WLA	wasteload allocation
WRAPS	Watershed Restoration and Protection Strategy
WRP	Wetland Reserve Program
WWTF	wastewater treatment facility
WWTP	wastewater treatment plant

Executive summary

The Clean Water Act (1972) requires that each state develop a plan to identify and restore any waterbody that is deemed impaired by state regulations. A total maximum daily load (TMDL) study is required by the United States Environmental Protection Agency (EPA) as a result of the federal Clean Water Act to address impaired waters. A TMDL identifies the pollutant that is causing the impairment and how much of that pollutant can enter the waterbody and still meet water quality standards.

The waterways of the Mississippi River – La Crescent Area Watershed drain to the Mississippi River near La Crescent, Minnesota. Four stream reaches in the watershed were assessed for aquatic life, and a fifth stream reach did not have enough monitoring data available for assessment (Miller Valley Creek). Of the reaches assessed, three are meeting aquatic life water quality standards (Pine Creek in Winona County, Rose Valley Creek, and Dakota Creek). Only one reach (Pine Creek in Houston County) had *Escherichia coli (E. coli)* monitoring data available for aquatic recreation assessment, and is impaired by excess bacteria on Minnesota's 2018 303(d) list of impaired waters. While fish community and turbidity data assessments for Pine Creek in Houston County determined impairment, listing of the impairments on the impaired waters list is being deferred until a proposed use class change from 2B (cool or warm water aquatic biota community) to 2A (cold water aquatic biota community) is finalized. Given this pending change in use class designation, this report proactively includes a TMDL for the total suspended solids (TSS) impacting the fish community in Pine Creek.

Thus this TMDL study addresses a bacteria (in the form of *E. coli*) impairment on Minnesota's 2018 303(d) list of impaired waters, and a TSS stressor of aquatic life and turbidity impairment that are expected to be added to a subsequent impaired waters list. Impairments are impacting one reach of Pine Creek located in Houston County. Information from multiple sources was used to evaluate the ecological health of Pine Creek:

- All available water quality data from the TMDL 10-year time period (2008 through 2017)
- October 2018 Mississippi River - La Crescent Watershed Stressor Identification (SID) Report: https://www.pca.state.mn.us/sites/default/files/wq-ws5-07040006a.pdf
- Upper Iowa River, Mississippi River-Reno, and Mississippi River - La Crescent Watersheds Monitoring and Assessment Report: https://www.pca.state.mn.us/sites/default/files/wq-ws3-07060002b.pdf
- Stakeholder input

The following pollutant sources were evaluated for Pine Creek: point sources, feedlots, septic systems, watershed runoff, and near-stream erosion. This TMDL study used an inventory of pollutant sources to develop a load duration curve (LDC) model for Pine Creek. These models were then used to determine the pollutant reductions needed for Pine Creek to meet water quality standards.

The TMDL study's results aided in the selection of implementation strategies during the Mississippi River - La Crescent Area Watershed Restoration and Protection Strategy (WRAPS) process. The purpose of the WRAPS process is to support local working groups in developing ecologically sound restoration and protection strategies for subsequent implementation planning. Following completion of the WRAPS process, the Mississippi River - La Crescent Area WRAPS Report will be publically available on the Minnesota Pollution Control Agency (MPCA) Mississippi River - La Crescent Area Watershed website: https://www.pca.state.mn.us/water/watersheds/mississippi-river-la-crescent.

1. Project overview

1.1 Purpose

The State of Minnesota has determined that the lower section of Pine Creek in the Mississippi River – La Crescent Area Watershed is impaired because it exceeded established state water quality standards and, in accordance with the Clean Water Act, must conduct a TMDL study. The goals of this TMDL study is to provide wasteload allocations (WLA) and load allocations (LA) for pollutant sources and to quantify the pollutant reductions needed to meet Minnesota water quality standards.

This TMDL study addresses one aquatic recreation use impairment due to *E. coli* on Pine Creek within the Mississippi River – La Crescent Area Watershed (HUC 07040006) that is included in Minnesota's 2018 303(d) list (Figure 1-1). An aquatic life impairment due to TSS and F-IBI on Pine Creek is also addressed by this TMDL study. The aquatic life use assessment for Pine Creek in Houston County proactively used 2A (cold water aquatic biota community) standards due to a proposed use class change of this waterbody from 2B (cool or warm water aquatic biota community). It is expected that the TSS and F-IBI listings will be added to Minnesota's Section 303(d) impaired waters list no sooner than 2022. Given this pending change in use class designation, this report proactively includes a TMDL for the TSS impacting the fish community in Pine Creek.

Other Mississippi River – La Crescent Area Watershed studies referenced in the development of this TMDL include:

- Upper Iowa River, Mississippi River – Reno, and Mississippi River – La Crescent Watersheds Monitoring and Assessment Report (MPCA 2018a)
- Mississippi River – La Crescent Watershed SID Report (MPCA 2018b)

1.2 Identification of waterbodies

Assessments of use support in Minnesota are made for individual waterbodies. The waterbody unit used for river systems, lakes and wetlands is called the "assessment unit." A stream or river assessment unit usually extends from one significant tributary stream to another, from county line to county line, or from the headwaters to the first tributary. Therefore, a stream or river is often segmented into multiple assessment units that are variable in length. Multiple assessment units are identified by assessment unit identification numbers (AUIDs).

Four stream reaches were assessed for aquatic life, and a fifth stream reach did not have enough monitoring data available for assessment (Miller Valley Creek). Of the reaches assessed, three are meeting aquatic life water quality standards (Pine Creek in Winona County, Rose Valley Creek, and Dakota Creek). Only one reach (Pine Creek in Houston County) had *E. coli* monitoring data available for aquatic recreation assessment, and is impaired by excess bacteria on Minnesota's 2018 303(d) list of impaired waters. As noted in the previous section, the aquatic life use impairments for Pine Creek in

Houston County have not been officially listed on Minnesota's Section 303(d) impaired waters list following a proposed use class change from 2B (cool or warm water aquatic biota community) to 2A (cold water aquatic biota community).

Table 1-1. Aquatic Life and Aquatic Recreation Use Assessments in the Mississippi River – La Crescent Area Watershed (MPCA 2018a).

Waterbody Name/ AUID	Reach description	Reach length (miles)	Use class	Aquatic life indicators:										Aquatic life	Aquatic recreation
				Fish IBI	Invert IBI	Dissolved oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia-Nh3	Pesticides	Eutrophication		
Pine Creek 07040006-507	T105 R6W S13, north line to T105 R5W S32, south line	5.79	2Ag	MTS	MTS	IF	IF	IF	--	MTS	IF	--	IF	**SUP**	--
Rose Valley Creek 07040006-511	T105 R5W S22, north line to Pine Creek	4.60	2Ag	MTS	MTS	IF	IF	IF	--	IF	IF	--	IF	**SUP**	--
Pine Creek 07040006-576	T104 R5W S4, north line to Hwy 16	13.14	2Ag*	EXS	MTS	IF	EXS	EXS	MTS	IF	MTS	--	IF	**IMP**	**IMP**
Dakota Creek 07040006-512	T105 R5W S3, south line to Mississippi River	4.26	2Ag	MTS	MTS	IF	IF	IF	--	IF	IF	--	IF	**SUP**	--
Miller Valley Creek 07040003-594	T106 R5W S28, south line to Mississippi River	1.82	2Ag	--	--	--	--	IF	--	--	--	--	--	**IF**	--

Abbreviations for Indicator Evaluations: MTS = meets standard; EXS = fails standard; IF = insufficient information; IBI = Index of Biotic Integrity; TSS = total suspended solids
Abbreviations for Use Support Determinations: -- = no data NA = not assessed, IF = insufficient information, SUP= full support (meets criteria), IMP = impaired (fails standards)
Abbreviations for Use Class: 2Ag = Coldwater general; 2Bg = cool or warmwater general
* There is a proposed use class change for this reach of Pine Creek from 2Bg to 2Ag. The TSS and fish IBI impairments for this reach were based on the Coldwater general water quality standards, and are expected to be added to the impaired waters list following the 2021/2022 assessment cycle.

1.3 Priority ranking

The MPCA's schedule for TMDL completions, as indicated on Minnesota's Section 303(d) impaired waters list, reflects Minnesota's priority ranking of this TMDL. The MPCA has aligned our TMDL priorities with the watershed approach and our WRAPS schedule. The MPCA developed Minnesota's TMDL Priority Framework Report to meet the needs of EPA's national measure (WQ-27) under EPA's Long-

Term Vision for Assessment, Restoration and Protection under the Clean Water Act Section 303(d) Program. As part of these efforts, the MPCA identified water quality impaired segments that will be addressed by TMDLs by 2022. The Mississippi River – La Crescent Area Watershed waters addressed by this TMDL are part of the MPCA prioritization plan to meet EPA's national measure.

1.4 Description of the Impairments and Stressors

The following section identifies and describes the causes of the stream impairments in the Mississippi River – La Crescent Area Watershed, and the pollutant-based stressors that will be addressed by TMDLs in this study. Table 1-2 summarizes the pollutant TMDLs completed for Pine Creek. Stressors not addressed in this TMDL (temperature and habitat) are described in the Mississippi River - La Crescent SID study. These stressors either lack a standard, are connected to a stressor already being addressed, or are not pollutants. Stressors not included in this TMDL are addressed in the WRAPS report.

Table 1-2. Impairments and pollutant/stressors in the Mississippi River - La Crescent Area Watershed.

Waterbody Name	Reach Description	Stream AUID	Use Class	Year Added to List	Proposed EPA Category	Affected Use	Impaired Waters Listing	Pollutant or Stressor	TMDL Developed in this Report
Pine Creek	T104 R5W S4, north line to Highway 16	(07040006-576)	2Bg, 3C*	2018	4A	Aquatic Recreation	*E. coli*	*E. coli*	Yes: *E. coli*
				2022**	4A	Aquatic Life	Total Suspended Solids (TSS)	Total Suspended Solids (TSS)	Yes: TSS
							Fish Index of Biological Integrity (F-IBI)	Total Suspended Solids (TSS)	
								Temperature	No: non-pollutant stressor
								Habitat	No: non-pollutant stressor

*Pine Creek is being proposed for a use class change to 2Ag.

**The aquatic life impairment for this reach is expected to be added to the impaired waters list following the 2021/2022 assessment cycle.

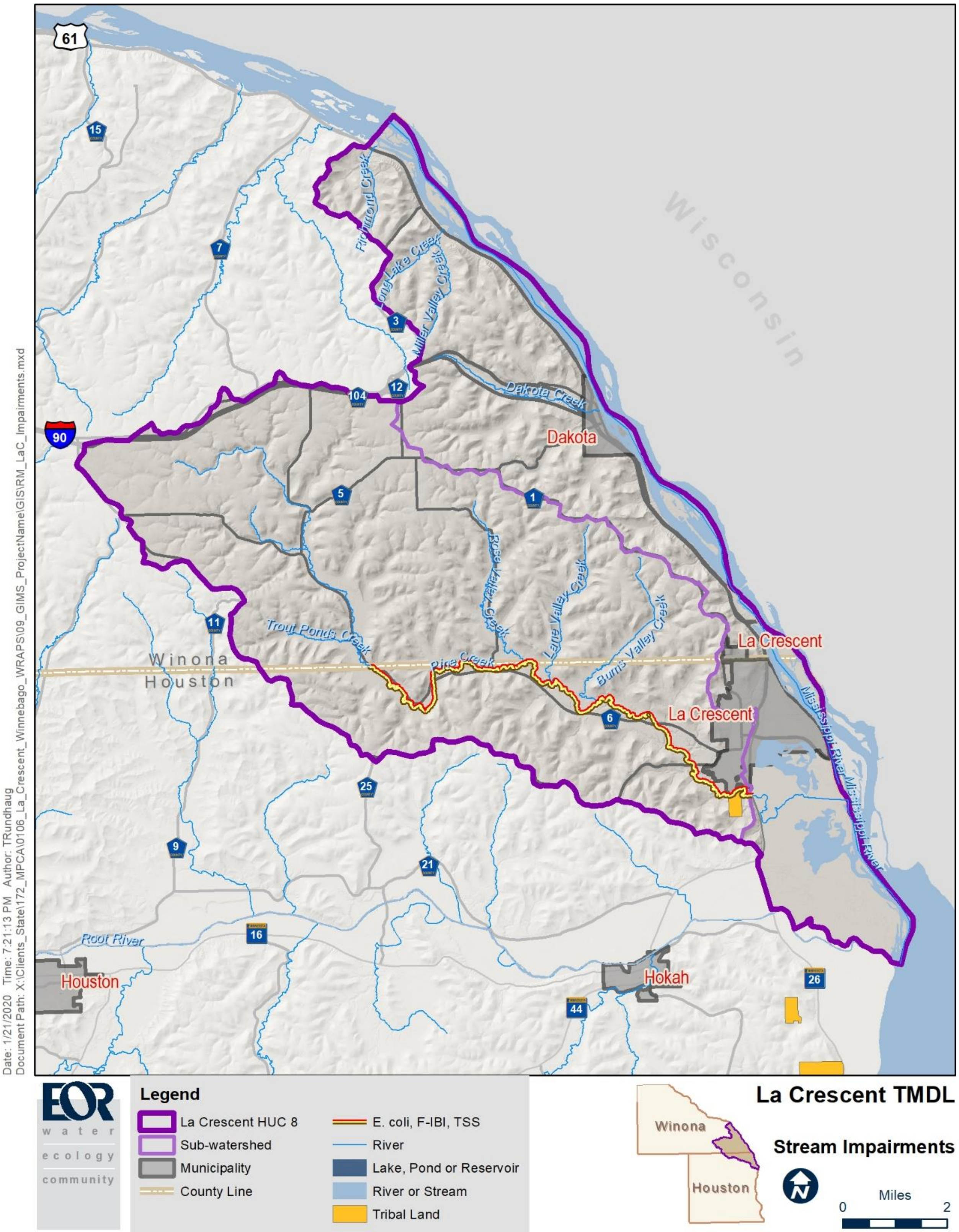


Figure 1-1. Impaired stream in the Mississippi River – La Crescent Area Watershed addressed by this TMDL.

2. Applicable water quality standards and numeric water quality targets

All waterbodies have a Designated Use Classification, defined by the MPCA, which defines the optimal purpose for that waterbody (see Table 1-1). The stream addressed by this TMDL study has the current designation use classifications:

> 2B, 2Bg, 3C – a healthy warm water aquatic community; a warm water aquatic community that can be used for general use; industrial consumption with a high level of treatment

Class 2 waters are protected for aquatic life and aquatic recreation, and Class 3 waters are protected for industrial consumption as defined by Minn. R. ch. 7050.0140. The most protective of these classes is 2B, for which water quality standards are provided below.

The Minnesota narrative water quality standard for all Class 2 waters (Minn. R. 7050.0150, subp. 3) states, "For all Class 2 waters, the aquatic habitat, which includes the waters of the state and stream bed, shall not be degraded in any material manner, there shall be no material increase in undesirable slime growths or aquatic plants, including algae, nor shall there be any significant increase in harmful pesticide or other residues in the waters, sediments, and aquatic flora and fauna; the normal fishery and lower aquatic biota upon which it is dependent and the use thereof shall not be seriously impaired or endangered, the species composition shall not be altered materially, and the propagation or migration of the fish and other biota normally present shall not be prevented or hindered by the discharge of any sewage, industrial waste, or other wastes to the waters".

Pine Creek reach -576 currently has a warmwater (2Bg) designation. Fish, macroinvertebrate and water temperature data support a coldwater (2Ag) designation. The Minnesota Department of Natural Resources (DNR) have recognized that the stream supports coldwater species, but the reach was never changed to coldwater (MPCA 2018a). The MPCA will be proposing a change in use class designation for Pine Creek (07040006-576). This change would reclassify 07040006-576 as a Class 2Ag stream.

> 2Ag – a healthy cold water aquatic community

Water chemistry and biological data collected during Intensive Watershed Monitoring (IWM) was assessed against 2Ag standards. Given that this change in designation has not been approved, this TMDL proactively addresses TSS impacting the fish community.

2.1 Streams

2.1.1 *E. coli*

The State of Minnesota has developed numeric water quality standards for bacteria (Minn. R. 7050.0222), in this case *E. coli*, which are protective concentrations for short- and long-term exposure to pathogens in water. Although most are harmless, fecal indicator bacteria, such as *E. coli*, are used as an easy-to-measure parameter to evaluate the suitability of waters for recreation due to the presence of pathogens and probability of illness. Pathogenic bacteria, viruses, and protozoa pose a health risk to humans, potentially causing illnesses with gastrointestinal symptoms (nausea, vomiting, fever, headache, and diarrhea), skin irritations, or other symptoms. Pathogen types and quantities vary among fecal sources; therefore, human health risk varies based on the source of fecal contamination.

E. coli concentrations are not to exceed 126 organisms per 100 milliliters as a geometric mean of not less than five samples representative of conditions within any calendar month, nor shall more than 10% of all samples taken during any calendar month individually exceed 1,260 organisms per 100 milliliters. The standard applies only between April 1 and October 31. Most analytical laboratories report *E. coli* concentrations in units of colony forming units (cfu) per 100 millilter (mL), which is equivalent to organisms per 100 mL.

Geometric average is used in place of an arithmetic average in order to measure the central tendency of the data, dampening the effect that very high or very low values have on arithmetic averages. *E. coli* can reproduce rapidly (hours to days) when waters become nutrient rich or very warm, and some individual readings can be orders of magnitude greater than the majority of all readings. The MPCA's *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List* provides details regarding how waters are assessed for conformance to the *E. coli* standard (MPCA 2012). See also the MPCA webpage on bacteria: https://www.pca.state.mn.us/water/bacteria.

The *E. coli* concentration standard of 126 organisms (org) per 100 mL was considered reasonably equivalent to the previous fecal coliform standard of 200 org/100 mL, from a public health protection standpoint. Figure III-7 in the July 2007 MPCA SONAR (Statement of Need and Reasonableness) Book III supports this rationale using a log plot that shows a good relationship between these two parameters. The following regression equation was deemed reasonable to convert any data reported in fecal coliform to *E. coli* equivalents:

E. coli concentration (equivalents) = 1.80 x (Fecal Coliform Concentration)

It should also be noted that most analytical laboratories report *E. coli* in terms of cfu/100 mL, not org/100 mL. This TMDL report will present *E. coli* data in cfu/100 mL since all of the monitored data collected for this TMDL was reported in these units. The *E. coli* TMDL was written to achieve the bacteria water quality standard of 126 org/100 mL.

2.1.2 Total Suspended Solids

Although sediment delivery and transport are important natural processes for all stream systems, sediment imbalance (either excess sediment or lack of sediment) can result in the loss of habitat, in addition to the direct harm to aquatic organisms. As described in a review by Waters (1995), excess suspended sediments cause harm to aquatic life through two major pathways: (1) direct, physical effects on biota (i.e. abrasion of gills, suppression of photosynthesis, avoidance behaviors), and (2) indirect effects (i.e. loss of visibility, increase in sediment oxygen demand). Elevated turbidity levels and TSS concentrations can reduce the penetration of sunlight, and thus impede photosynthetic activity and limit primary production (Munavar et al. 1991; Murphy et al. 1981).

TSS criteria for Minnesota are stratified by geographic region and stream class, due to differences in natural background conditions resulting from the varied geology of the state and biological sensitivity. The assessment window for these samples is April-September, so any TSS data collected outside of this period is not be considered for assessment purposes.

The TSS standard for cool or warm water streams (2B) in the Central River Nutrient Region (RNR) is 30 milligrams per liter (mg/L), and the TSS standard for cold water streams (2A) in the Central RNR is 10 mg/L. For assessment, the standard concentration is not to be exceeded in more than 10% of samples within a 10-year data window. TSS results are available for the watershed from state-certified laboratories, and the existing data covers a much larger spatial and temporal scale in the watershed. The TSS LDC and TMDL was developed for Pine Creek (07040006-576) based on the TSS standard for its proposed use class of 2Ag (10 mg/L). There is a proposed use class change from 2B (cool or warm water aquatic biota community) to 2A (cold water aquatic biota community) for Pine Creek (07040006-576). Because this change in use class designation has not been approved, this TMDL proactively addresses TSS.

For more information, refer to the *Aquatic Life Water Quality Standards Draft Technical Support Document for Total Suspended Solids* and the *Minnesota Nutrient Criteria Development for Rivers* reports.

2.1.3 Fish Index of Biotic Integrity

The fish bioassessment impairment in the Mississippi River – La Crescent Area Watershed was characterized by low Index of Biological Integrity (IBI) scores for fish compared to general use southern cold water streams. The presence of a diverse and reproducing aquatic community is a good indication that the aquatic life beneficial use is being supported by a stream. The aquatic community integrates the cumulative impacts of pollutants, habitat alteration, and hydrologic modification on a waterbody over time. Characterization of an aquatic community is accomplished using IBI which incorporates multiple attributes of the aquatic community, called "metrics", to evaluate complex biological systems. These metric scores are summed within each class and rescaled to a 0-100 range with 100 being the highest score. For further information regarding the development of stream IBIs, refer to the Development of a Fish-Based Index of Biological Integrity (F-IBI) for Minnesota's Rivers and Streams (MPCA 2014).

Narrative language within Minn. R. 7050.0150, subp. 6, identifies an IBI calculation as the primary determinant for evaluating impairment of aquatic biota. The F-IBI threshold for Pine Creek (07040006-576) in the Mississippi River - La Crescent Area Watershed is listed in Table 2-1 based on the proposed used class change to 2Ag.

Table 2-1. State of Minnesota F-IBI Criteria for Pine Creek (07040006-576).

Impaired Reach Name (AUID)	Fish Class	F-IBI Criteria
Pine Creek (07040006-576)	Southern Coldwater, General Use	50

3. Watershed and waterbody characterization

The Mississippi River – La Crescent Area Watershed drains approximately 95 square miles where 69% of the watershed is located in Winona County and 31% in Houston County. The watershed is located entirely in the Driftless Area, a large region in Minnesota, Iowa, Illinois and Wisconsin that was not impacted by the most recent glaciers. The Driftless Area is known for its karst features (limestone bedrock that has been eroded to produce ridges, valleys, and sinkholes) and coldwater streams. The land use for the watershed is a mixture of deciduous forest, grassland, row crops, and pasture. The watershed is characterized by wooded bluffs and spring fed streams, where trout fishing is a popular recreational activity, and streams are generally too small to canoe (MPCA 2018a).

Within the watershed there are 77 undeveloped acres of Tribal Land owned by the Ho-Chunk Nation; this land is adjacent to the impaired section of Pine Creek (Figure 1-1). Because this land is not developed, reductions through BMP implementation on Tribal property are not expected. The MPCA staff contacted the Ho Chunk Nation Division Manager on October 2019, with a briefing of watershed status and an invitation to participate in development activities for the La Crescent WRAPS Report. The MPCA did not receive communication from Tribal staff indicating an intention to participate.

There are two municipalities in the watershed located on the Mississippi River: La Crescent and Dakota. Dakota is located at the outlet of Dakota Creek to the Mississippi River, and La Crescent is located at the outlet of Pine Creek to the Mississippi River. La Crescent is a National Pollution Discharge Elimination Systems (NPDES) permitted Municipal Separate Storm Sewer Systems (MS4) community (MS400097). The small communities of Dresbach and New Hartford are also located in the watershed.

3.1 Streams

The Mississippi River – La Crescent Area Watershed is comprised of small tributaries that drain directly to the Mississippi River (Figure 3-1). The largest stream is Pine Creek, which begins just south of Interstate 90 and flows south then east before meeting the Mississippi River in La Crescent (MPCA 2018a).

3.2 Subwatersheds

Subwatersheds of Pine Creek (07040006-576) were delineated using the NRCS Engineering Toolbox (Figure 3-1). Water quality monitoring locations are distributed throughout the Pine Creek Subwatershed (Figure 3-2). No stream discharge monitoring locations or flow gages currently exist in the Pine Creek Subwatershed. The TSS and *E. coli* impairment drainage area of Pine Creek includes the entire Pine Creek Subwatershed (Figure 3-1). Note that S008-435 was the only monitoring station located in the Mississippi River - La Crescent Area Watershed with *E. coli* measurements.

Table 3-1. Impaired Stream Reach Direct Drainage and Total Watershed Areas.

Impaired AUID	Name/Description	TSS Impairment Drainage Area (acres)	Upstream AUID	Total *(E. coli* Impairment*)* Drainage Area (acres)
07040006-576	Pine Creek (T104 R5W S4, north line to Highway 16)	23,725	07040006-507	37,617

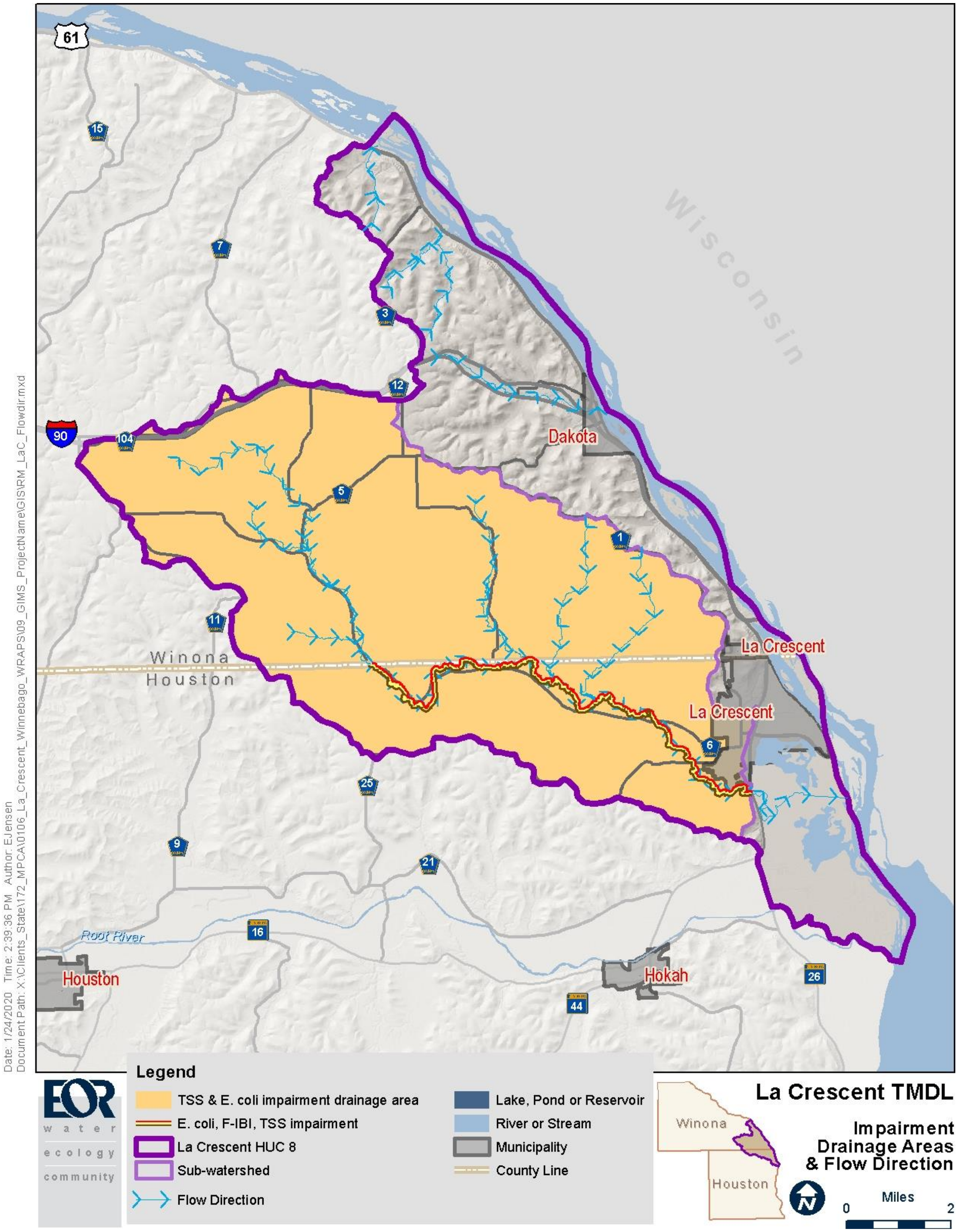


Figure 3-1. Impairment drainage areas and flow direction in the Mississippi River - La Crescent Area Watershed.

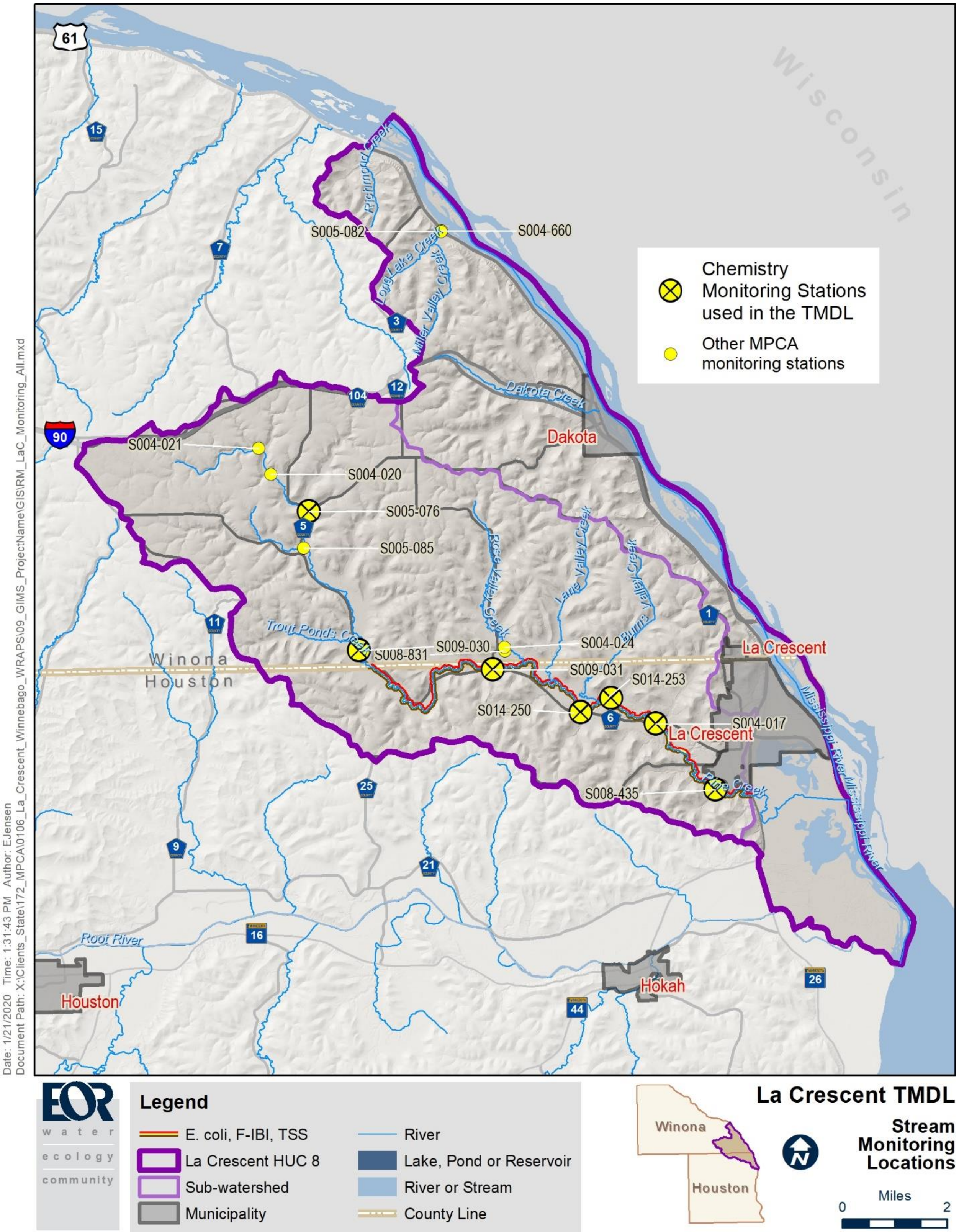


Figure 3-2. Chemistry monitoring locations in the Mississippi River - La Crescent Area Watershed.

Table 3-2. Chemistry monitoring locations used in this TMDL.

Station ID	Description	TSS Monitoring	*E. coli* Monitoring
S005-076	Pine Creek W of CR-125/CSAG-5 intersection, 1 mi N or New Hartford	●	
S009-030	Pine Creek at CSAH 5, 7.5 mi W of La Crescent, MN	●	
S009-031	Pine Creek at CSAH 30, 5 mi NW of La Crescent, MN	●	
S014-250	Pine Creek at Culvert, Just North of CSAH 6, 3.5 mi W of La Crescent, MN	●	
S014-253	Pine Creek, 3 mi UPSTR of CSAH 6, DWSTR of Golf Course, 2.5 mi NW of La Crescent, MN	●	
S004-017	Pine Creek at CSAH-6 BRG, 1.5 mi W of La Crescent	●	
S008-435	Pine Creek at Skunk Hollow RD, 05 MI S of La Crescent, MN	●	●

3.3 Land use

Land cover in the Mississippi River – La Crescent Area Watershed was assessed using the Minnesota Land Cover Classification and Impervious Surface Area by Landsat and Lidar (MLCCS) (Rampi et al. 2016). This information is necessary to draw conclusions about pollutant sources and best management practices (BMPs) that may be applicable within each subwatershed.

The land cover distribution within impaired stream watersheds is summarized in Table 3-3 and Figure 3-3. Generally, the land cover in the Mississippi River – La Crescent Area Watershed is dominated by deciduous forest, with cropland and pasture on the upland plateaus. Pine Creek (07040006-576) has a land cover distribution very similar to the Mississippi River – La Crescent Area Watershed as a whole except for slightly more row crop acres.

Table 3-3. Pine Creek (07040006-576) and Mississippi River - La Crescent Watershed Total Drainage Area Land Cover (MLCCS).

Waterbody Name - AUID	Impervious	Emergent Wetland	Forest and Shrub Wetland	Open Water	Deciduous Forest	Grassland	Hay and Pasture	Row Crops
Pine Creek (07040006-576)	6.4%	2.0%	1.3%	0.3%	47.3%	21.4%	4.7%	16.6%
Watershed	**7.5%**	**5.0%**	**4.5%**	**6.2%**	**44.6%**	**16.6%**	**3.4%**	**12.2%**

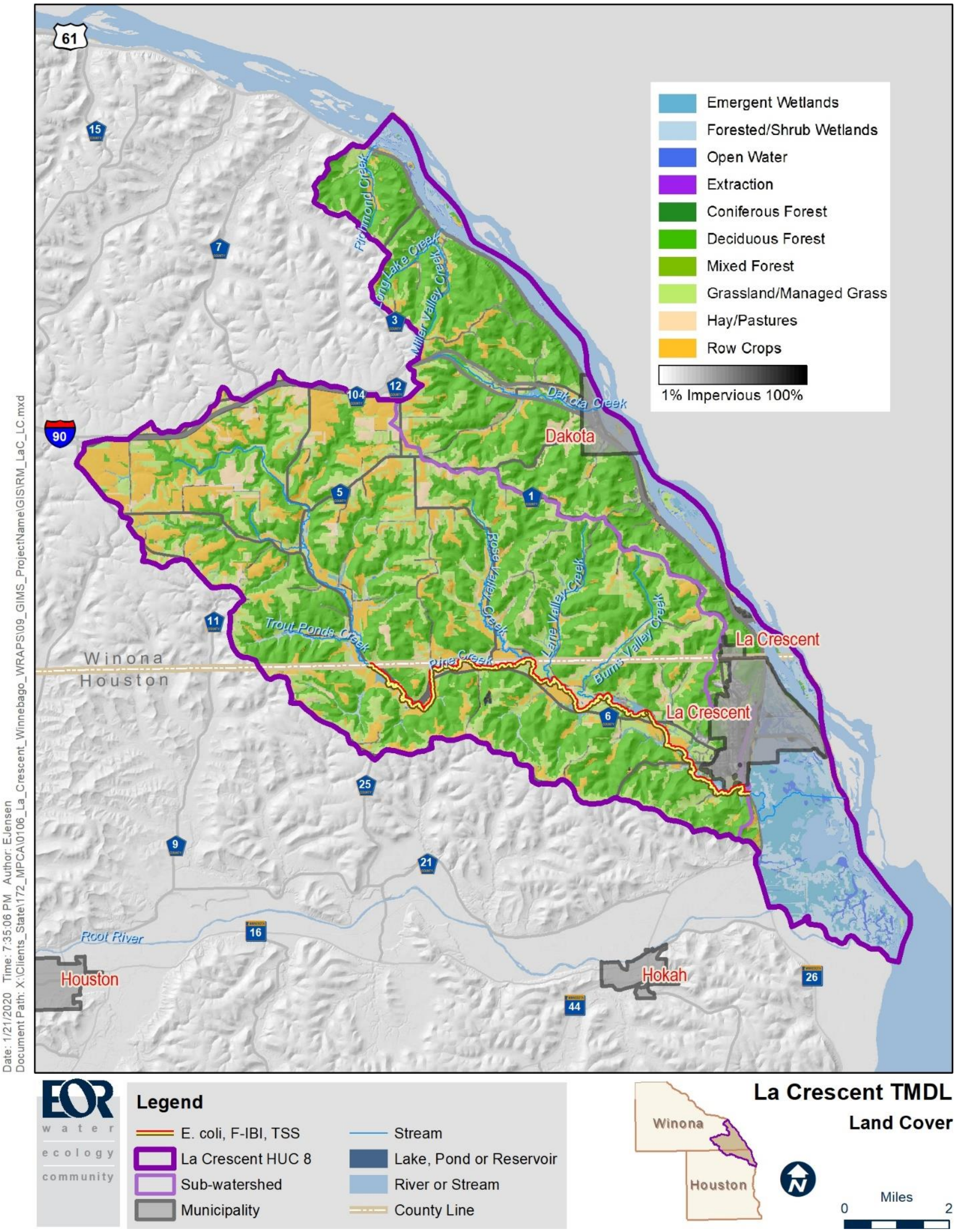


Figure 3-3. MLCCS land cover for the Mississippi River – La Crescent Watershed.

3.4 Current/historical water quality

The existing in-stream water quality conditions were quantified using data downloaded from the MPCA Environmental Quality Information System (EQuIS) database that were available for the most recent 10 year time period (2008 through 2017), and overlapping with the MPCA's most recent intensive monitoring conducted in the watershed from 2015/2016.

3.4.1 Total Suspended Solids

Using data from the 10-year period of 2008 through 2017, the percent of TSS samples exceeding the 10 mg/L standard were calculated for Pine Creek (07040006-576).

3.4.1.1 Pine Creek, T104 R5W S4, north line to Highway 16 (AUID 07040006-576)

Every station on Pine Creek (07040006-576) had greater than 10% of samples exceed the Central RNR 2Ag use class TSS water quality standard of 10 mg/L (Table 3-4). The four farthest downstream stations have median concentrations that exceed the TSS standard (Figure 3-4). The maximum TSS concentration measured on Pine Creek was 2,300 mg/L on 5/18/2017 after a heavy rain event (MPCA 2018b). A week after this event another set of TSS samples were taken. The measured TSS was still elevated even though the flow had returned to normal, indicating that stream bed and banks were likely main contributors of sediment to Pine Creek (MPCA 2018b). The TSS concentrations tend to be highest from April to June (Figure 3-6).

Table 3-4. TSS Water Quality Exceedances by Station (upstream to downstream) in Pine Creek (07040006-507 & 07040006-576), 2011, 2015-2017 (April - September).

Monitoring Station (upstream to downstream)	No. of Samples	No. of Samples > 10 mg/L	Percentage of Exceedance (%)	90th Percentile Concentration (mg/L)
S005-076 (Pine Creek W of CR-125/CSAG-5 intersection, 1 mi N or New Hartford)	7	2	29%	22
S009-030 (Pine Creek at CSAH 5, 7.5 mi W of La Crescent, MN)	15	7	47%	73
S009-031 (Pine Creek at CSAH 30, 5 mi NW of La Crescent, MN)	15	11	73%	318
S014-250 (Pine Creek at Culvert, Just North of CSAH 6, 3.5 mi W of La Crescent, MN)	5	5	100%	828
S014-253 (Pine Creek, 3 mi UPSTR of CSAH 6, DWSTR of Golf Course, 2.5 mi NW of La Crescent, MN)	6	6	100%	900
S004-017 (Pine Creek at CSAH-6 BRG, 1.5 mi W of La Crescent, MN)	16	15	94%	290
S008-435 (Pine Creek at Skunk Hollow RD, 05 MI S of La Crescent, MN)	10	10	100%	114
All Stations	**74**	**56**	**76%**	**260**

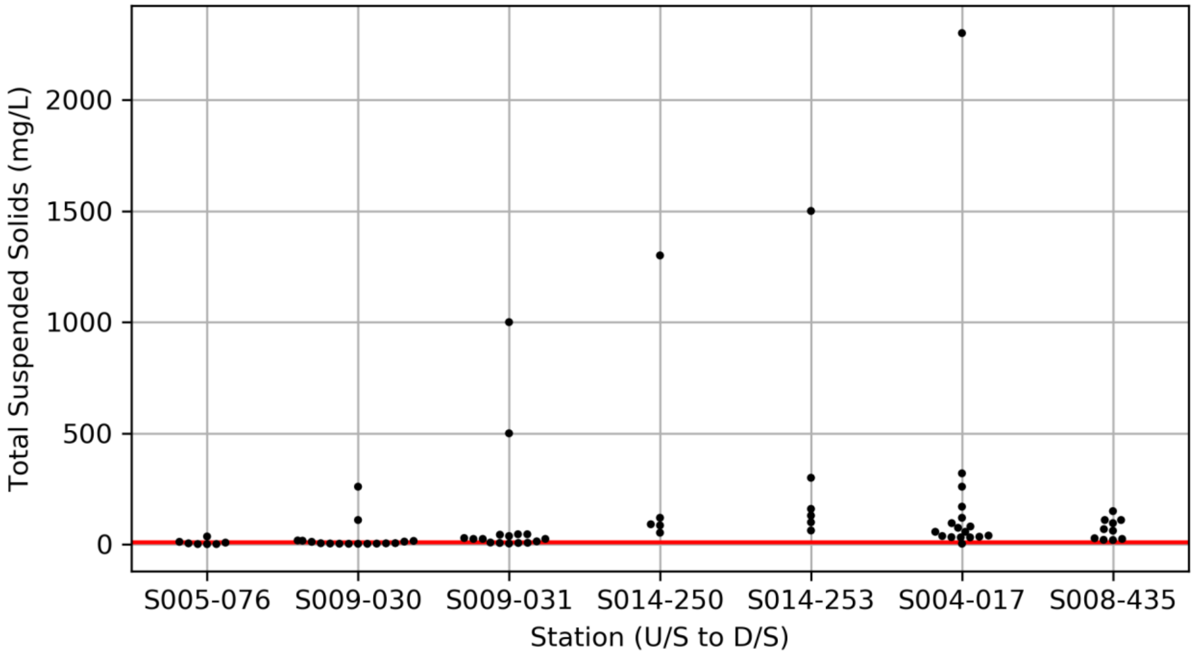


Figure 3-4. TSS concentration distribution by station (upstream to downstream) for the impaired reach of Pine Creek (2011, 2015-2017) (Depicting all TSS samples. Red line = 10 mg/L TSS standard).

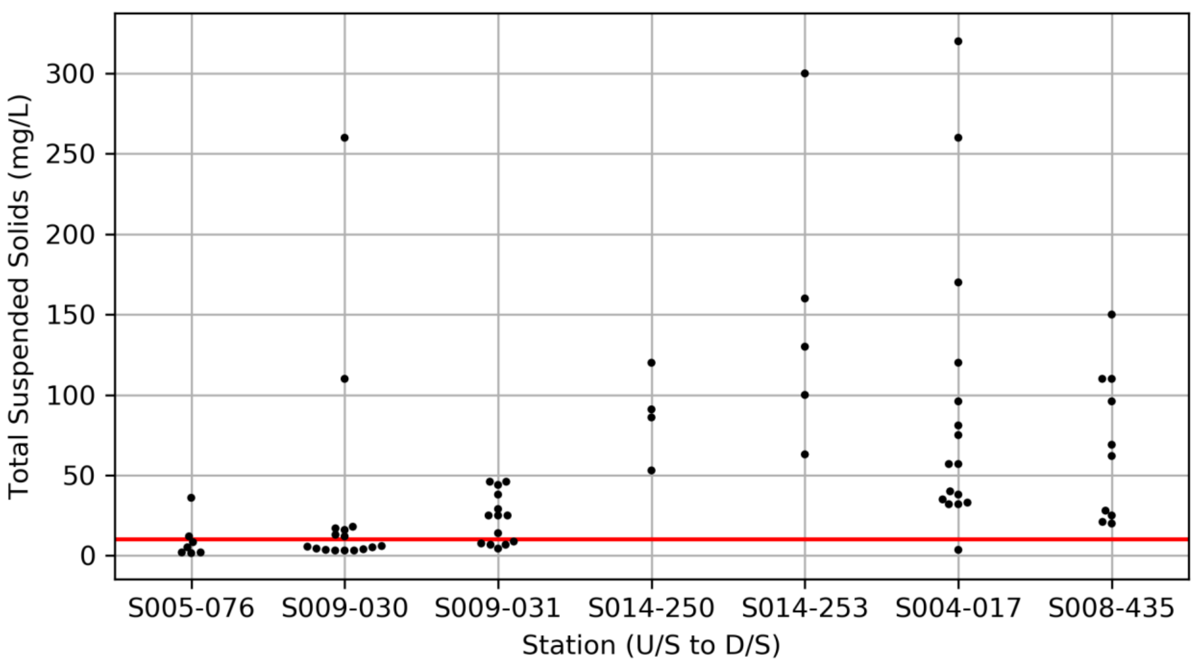


Figure 3-5. TSS concentration distribution by station (upstream to downstream) for the impaired reach of Pine Creek (2011, 2015-2017) (Depicting only TSS samples less than 500 mg/L. Red line = 10 mg/L TSS standard).

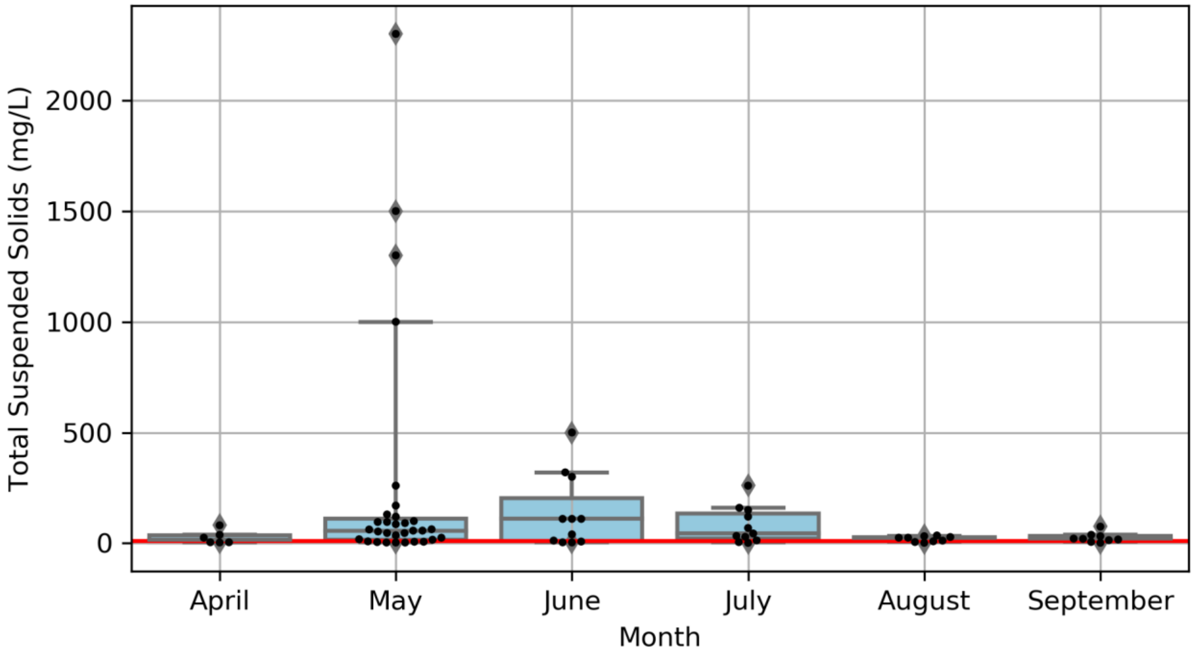


Figure 3-6. TSS concentration distribution by month for the impaired reach of Pine Creek (2011, 2015-2017). Red line = 10 mg/L TSS standard.

3.4.2 *Escherichia coli*

Using data from the most recent 10-year period (2008 through 2017), geometric mean *E. coli* concentrations were calculated by month for Pine Creek (07040006-576).

3.4.2.1 Pine Creek (AUID 07040006-576)

All samples from 2015 through 2016 at station S008-435 of Pine Creek (07040006-576) had *E. coli* concentrations above the water quality standard of 126 org/100 mL (Table 3-5), and 73% of samples were above the acute standard of 1,260 org/100 mL. To illustrate the seasonal variability in *E. coli* concentration, *E. coli* data are shown by month in Figure 3-7.

Table 3-5. Ten-year Geometric Mean *E. coli* (org/100 mL) Concentrations by month in Pine Creek (07040006-576), 2015-2016

Monitoring Station	Month	Number of Samples	Geometric Mean (org/100mL)	Minimum (org/100mL)	Maximum (org/100mL)	Total Samples >1,260 org/100 mL
S008-435 (Pine Creek at Skunk Hollow RD, 0.5 mi S of La Crescent, MN)	June	5	1,413	479	2,620	4
	July	5	1,764	1,120	4,710	4
	August	5	1,300	801	2420	3

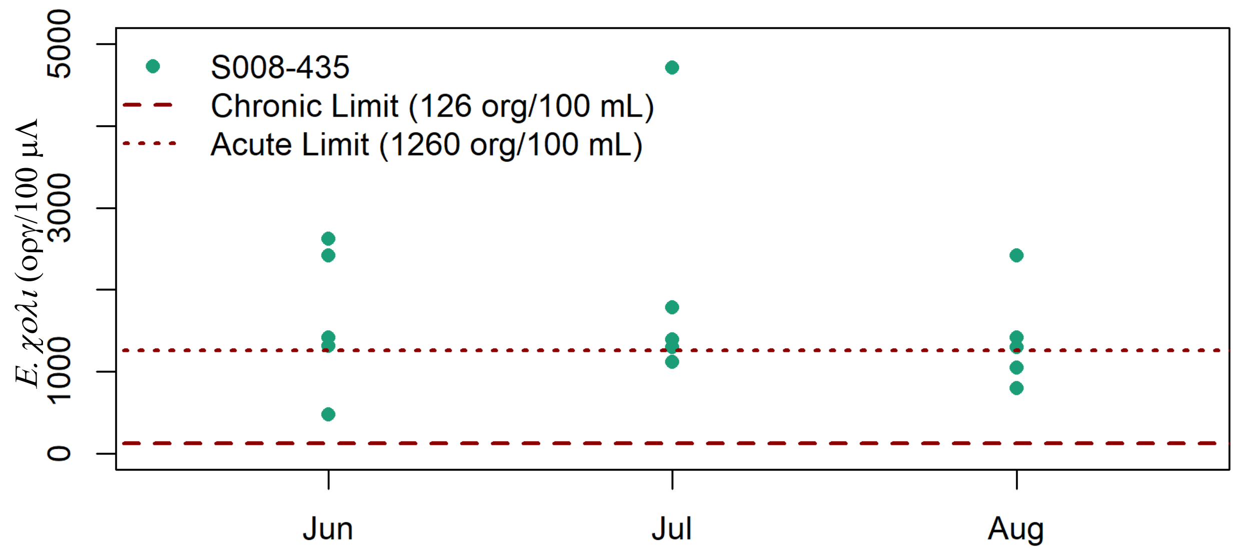


Figure 3-7. *E. coli* (org/100 mL) by month in Pine Creek (07040006-576) at monitoring station S008-435, 2015-2016.

3.5 Pollutant sources and stressors summary

3.5.1 Permitted Source Types

Regulated sources of pollutants, include WWTP effluent, NPDES feedlots, municipal stormwater, construction stormwater, and industrial stormwater. Pollutant loads from NPDES permitted wastewater and stormwater sources were accounted for using the methods described in subsequent Section 4.3.1 and 4.4.1. The contribution of TSS and *E. coli* from regulated sources are quite small compared to non-permitted sources.

3.5.1.1 Regulated Stormwater

There are three types of regulated stormwater in the Mississippi River - La Crescent Area Watershed; municipal, construction, and industrial stormwater:

<u>Municipal Separate Storm Sewer Systems</u>

A MS4 is a stormwater conveyance or system of conveyances (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains, etc.) owned or operated by a regulated public entity, such as a municipality, township, county, or Minnesota Department of Transportation (MnDOT). Regulated stormwater delivers and transports pollutants to surface waters, and is generated in the watershed during precipitation events. The sources of pollutants in stormwater are many, including decaying vegetation (leaves, grass clippings, etc.), domestic and wild animal waste (see Section 3.5.2.2: Pets, and Wildlife), soil, deposited particulates from air, road salt, and oil and grease from vehicles. There are three regulated MS4s in the drainage area to the impaired Pine Creek: La Crescent City (MS400097), Houston County (MS400139), and MnDOT Outstate District (MS400180). All three regulated entities discharge stormwater from a small proportion of the total drainage area of Pine Creek near the confluence with the Mississippi River, and therefore contribute a small fraction of the total TSS and *E. coli* load to Pine Creek.

The TMDL regulated area for La Crescent City was based on the portion of the MS4 permit boundary located within the drainage area to Pine Creek, the 2010 Census urbanized area, and NLCD 2016 developed land uses (open space, developed-low intensity, developed-medium intensity, and developed-high intensity). The regulated area for Houston County and MnDOT roadways was based on the road miles located within their MS4 permit boundary located within the drainage area to Pine Creek and the 2010 Census urbanized area. These road miles were multiplied by a defined width to determine the total regulated area of Houston County and MnDOT roadways that discharge to Pine Creek. The defined widths were based on typical design widths for each road type: 33 feet for Houston County plus a 50 feet buffer on either side for a total width of 133 feet, and 100 feet for MnDOT Outstate District plus a 90 feet buffer on either side of the road for a total width of 280 feet. Note that the area of regulated County and MnDOT roadways that were located within the La Crescent City MS4 permit area were excluded from the calculation of the La Crescent City MS4 regulated area. The regulated MS4 areas used in this TMDL are shown in Figure 3-8 and listed in Table 3-6.

Table 3-6. Regulated MS4 areas in the Pine Creek TMDL.

MS4 (permit #)	TMDL Regulated Area (acres)
La Crescent City (MS400097)	478.46
Houston County (MS400139)	48.10
MnDOT Outstate District (MS400180)	3.27

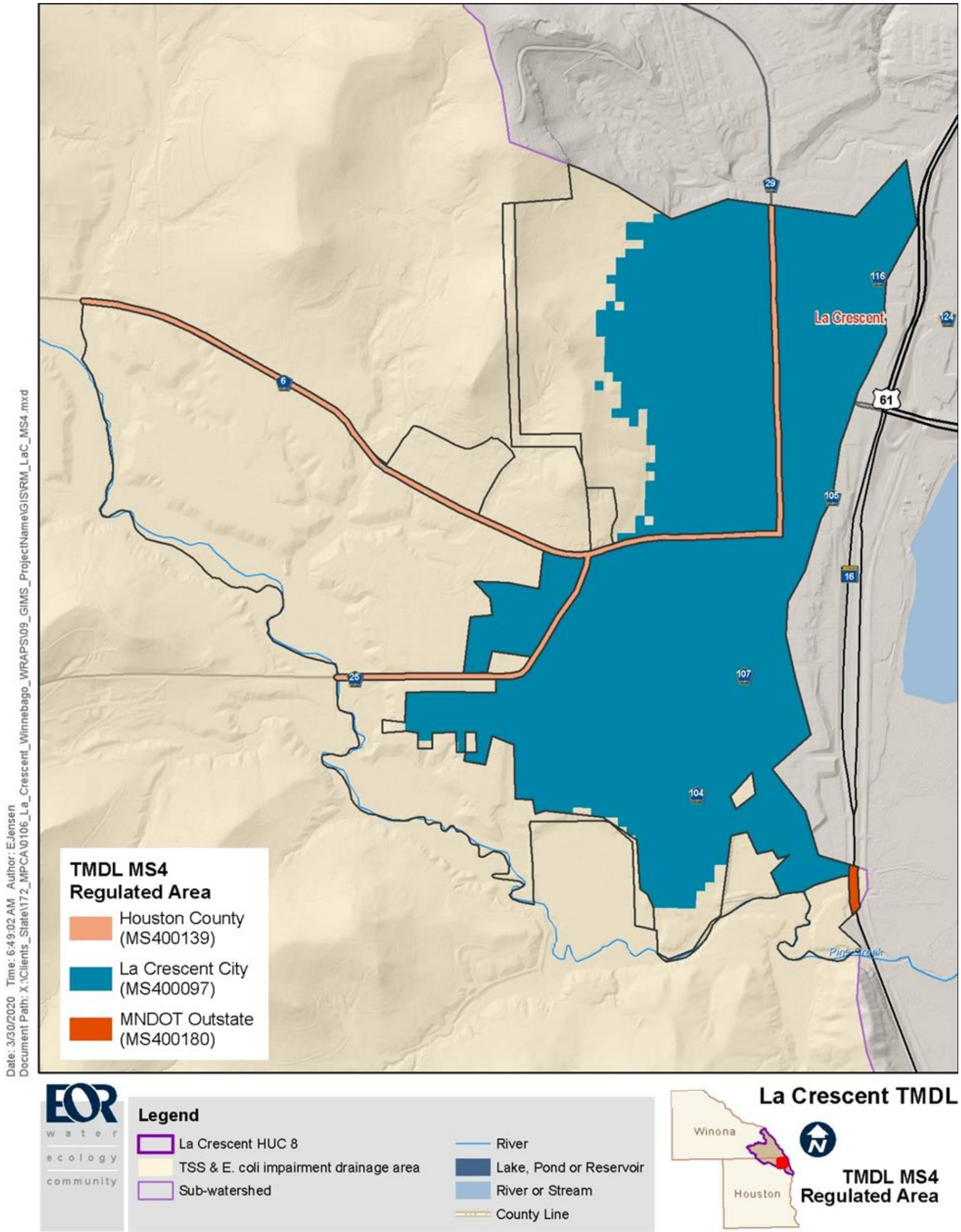


Figure 3-8. MS4 boundaries in the Mississippi River - La Crescent Area Watershed that drain to the impaired stream reach.

A regulated MS4 is required to report on a TMDL if the TMDL is approved by EPA prior to the effective date of the next MS4 permit. For example, if the Mississippi River – La Crescent Area TMDL is approved before the current draft permit is reissued, the regulated MS4s included in this TMDL would be required to report on these. In the event the permit is reissued before the TMDL is approved by EPA, then the regulated MS4s do not need to report on the TMDL until the next MS4 permit.

Regulated Construction Stormwater

Construction stormwater is regulated by NPDES permits (MNR100001) for any construction activity disturbing: (a) one acre or more of soil, (b) less than one acre of soil if that activity is part of a "larger common plan of development or sale" that is greater than one acre, or (c) less than one acre of soil, but the MPCA determines that the activity poses a risk to water resources. The WLA for stormwater discharges, from sites where there are construction activities, reflects the number of construction sites greater than one acre in size that are expected to be active in the impaired stream subwatershed at any one time.

Regulated Industrial Stormwater

In October 2019, there were nine industrial stormwater sites in the Mississippi River – La Crescent Area Watershed. Three of these facilities have claimed a no exposure exclusion; meaning that their facility is not exposed to precipitation. Industrial stormwater is regulated by NPDES Permits (MNR050000) if the industrial activity has the potential for significant materials and activities to be exposed to stormwater discharges. The WLA for stormwater discharges from sites where there is industrial activity reflects the number of sites in an impaired stream subwatershed for which NPDES industrial stormwater permit coverage is required.

3.5.1.2 Municipal Wastewater

Municipal wastewater is the domestic sewage and wastewater collected and treated by municipalities before being discharged to waterbodies as municipal wastewater effluent. The City of La Crescent has a sewer extension that is connected to the city of La Crosse Wastewater Treatment Plant (WWTP). No WWTPs discharge to impaired waterbodies in the Mississippi River - La Crescent Area Watershed.

3.5.1.3 Land Application of Biosolids

The application of biosolids from WWTPs and SSTS are highly regulated, monitored, and tracked (see Minn. R. ch. 7041 *Sewage Sludge Management* and Minn. R. ch. 7080 *Individual Subsurface Sewage Treatment Systems [SSTS]*). Pathogen reduction in biosolids is required prior to spreading on agricultural fields. Disposal methods that inject or incorporate biosolids within 24 hours of land application result in minimal possibility for mobilization of bacteria to downstream surface waters. While surface application could conceivably present a risk to surface waters, little to no runoff or bacteria transport are expected if permit restrictions are followed. Therefore, land application of biosolids was not included as a source of bacteria.

3.5.1.4 Animal Feeding Operations

Animal feeding operations (AFOs) and Concentrated Animal Feeding Operations (CAFOs) are defined by the EPA based on the number and type of animals. The MPCA currently uses the federal definition of a CAFO in its permit requirements of animal feedlots along with the definition of an animal unit (AU). In Minnesota, the following types of livestock facilities are required to operate under a NPDES permit or a state issued State Disposal System (SDS) Permit: a) all federally defined CAFOs that have had a discharge, some of which are under 1000 AUs in size; and b) all CAFOs and non-CAFOs that have 1000 or more AUs.

There are no active NPDES/SDS permitted CAFOs in the Mississippi River - La Crescent Area Watershed.

3.5.2 Non-permitted Sources

3.5.2.1 Total Suspended Solids

The Mississippi River – La Crescent Area Watershed is vulnerable to soil erosion because of the underlying geology of the area where steep slopes, typical of the Driftless area, are combined with shallow, loamy gravel, sand, and silt soils. This vulnerability is exposed by shifting land use and climate. Land use in the watershed has shifted greatly over time. Starting in the 1850s, land use changed from forest to predominantly agriculture. Then a shift in agriculture has converted cropped fields to pasture and reforested the uplands (MPCA 2018a, See Section 3.3). A recent geomorphic survey conducted by the DNR indicated that Pine Creek is in a state of accelerated change, where 68% of the stream is unstable (MPCA 2018a). Evaluation of two reaches along Pine Creek resulted in estimated erosion rates of 0.054 tons per year per foot (unstable) and 0.084 tons per year per foot (highly unstable). This instability is resulting in a loss of sinuosity and historic aerial photos show the change overtime (Figure 3-9). These changes to the streambanks are exacerbated by heavy livestock grazing in riparian areas and changes in stream flow (more frequent high flow events). During large rain events, streams carry larger peak flows which destabilize the soil and erode stream banks.

The Mississippi River-La Crescent Monitoring and Assessment Report (MPCA 2018a) noted that in 2007 a large flood devastated areas of southeast Minnesota. The Mississippi River - La Crescent Area Watershed was in an area hit with the most rain, ranging from 8-15 inches in 24 hours. The floods washed out roads, buildings, and even railroad tracks. In some locations, streams were entirely changed or moved. Effects from the floods have diminished but can still be seen in parts of the watershed. Subsequent floods in 2009 and 2010 continued the damage done in 2007. Large sections of streams were washed away and people living near the downstream reaches were highly impacted (Winona Soil and Water Conservation District [SWCD]).

A more detailed study of the sediment budget in the Root River basin, located south and west of the Mississippi River – La Crescent Area Watershed, and of similar characteristics, identified similar trends in stream channel widening and migration rates (Dogwiler and Kumarasamy 2016). Furthermore, fingerprinting of the sediment load in the Root River indicated that nearly half of the sediment that reaches the mouth of the river was derived from agricultural fields within the past two to four decades. The next largest portion of the sediment load (also nearly half) was derived from stream banks. About 90% of this portion was originally derived from agricultural fields in the past 150 years. Therefore, a large portion of sediment in the stream has moved from its origin to the floodplain and then is further displaced during flood events. Further complications were identified when looking at sediment loss at different scales. For instance, there was a 50% decrease in sediment yields from the smallest scale (less 0.2 square miles) to the next smallest scale (6 square miles). These trends are expected to be similar in the Mississippi River – La Crescent Area Watershed, and can provide support in identifying strategies to reduce sediment loss.

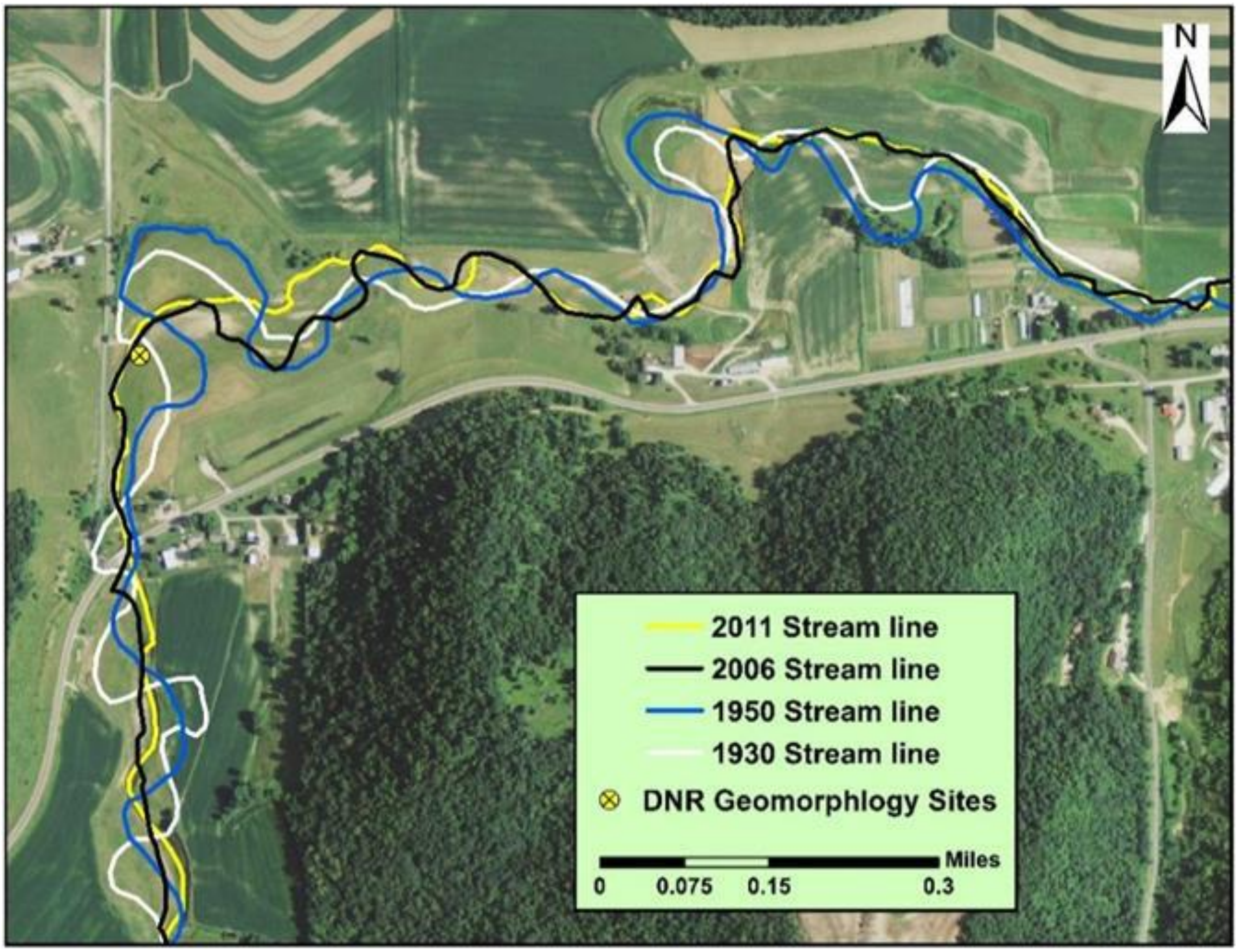


Figure 3-9. Stream centerlines from 1937, 1952, 2006, and 2011 illustrating the lateral movement of the stream overtime and the loss of stream sinuosity (Figure 8 in MPCA 2018b).

3.5.2.2 Stream *E. coli*

Humans, pets, livestock, and wildlife all contribute bacteria to the environment. These bacteria are dispersed throughout the environment by an array of natural and human-made mechanisms. Bacteria fate and transport is affected by disposal and treatment mechanisms, methods of manure reuse, imperviousness of land surfaces, and natural decay and die-off due to environmental factors such as ultraviolet (UV) exposure and detention time in the landscape. These mechanisms add a degree of complexity and variability. Bacterial sources are considered from a general risk perspective that involves both prevalence of the source and the runoff/delivery pathways. Overall, with limited indicator group bacterial data sets at some stream sites in the Mississippi River - La Crescent Area Watershed, this simplified process is appropriate. The following discussion highlights sources of bacteria in the environment and mechanisms that drive the delivery of bacteria to surface waters.

The following text is excerpted and adapted from the *Revised Regional TMDL Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota* (MPCA 2006), and provides a description of nonpoint sources of fecal coliforms, *E. coli*, and associated pathogens. At the time of the study Minnesota’s water quality standard was based on fecal coliform bacteria. Since that time, the standard was changed to *E. coli*.

The relationship between land use and fecal coliform concentrations found in streams is complex, involving both pollutant transport and rate of survival in different types of aquatic environments. Intensive sampling at several of the sites listed above in southeastern Minnesota shows a strongly positive correlation between stream flow, precipitation, and fecal coliform bacteria concentrations. In the Vermillion River Watershed, storm-event samples often showed concentrations in the thousands of organisms per 100 milliliters, far above non-storm-event samples. A study of the Straight River Watershed divided sources into continuous (failing individual sewage treatment systems, unsewered communities, industrial and institutional sources, wastewater treatment facilities) and weather-driven (feedlot runoff, manured fields, urban stormwater categories). The study hypothesized that when precipitation and stream flows are high, the influence of continuous sources is overshadowed by weather-driven sources, which generate extremely high fecal coliform concentrations. However, during drought, low-flow conditions continuous sources can generate high concentrations of fecal coliform, the study indicated. Besides precipitation and flow, factors such as temperature, livestock management practices, wildlife activity, fecal deposit age, and channel and bank storage also affect bacterial concentrations in runoff (Baxter-Potter and Gilliland 1988).

Several studies have found a strong correlation between livestock grazing and fecal coliform levels in streams running through pastures. Several samples taken in the Grindstone River in the St. Croix River Basin, downstream of cattle observed to be in the stream, were found to contain a geometric mean of 11,000 org/100 ml, with individual samples ranging as high as 110,000 org/100ml. A study of southeastern Minnesota streams by Sovell et al. 2000, found that fecal coliform, as well as turbidity, were consistently higher at continuously grazed sites than at rotationally grazed sites, where cattle exposure to the stream corridor was greatly reduced. This study and several others indicate that sediment-embeddedness, turbidity, and fecal coliform concentrations are positively correlated. Fine sediment particles in the streambed can serve as a substrate harboring fecal coliform bacteria. “Extended survival of fecal bacteria in sediment can obscure the source and extent of fecal contamination in agricultural settings,” (Howell et al. 1996).

Despite the complexity of the relationship between sources and in-stream concentrations of fecal coliform, the following can be considered major source categories:

Individual Sewage Treatment Systems

“Failing” SSTSs are specifically defined as systems that are failing to protect groundwater from contamination. Based on County SSTS compliance reports, failing SSTS were not considered a significant source of fecal pollution to surface water because these systems do not discharge partially treated sewage to the ground surface. However, systems which discharge partially treated sewage to the ground surface, road ditches, tile lines, and directly into streams, rivers, and lakes are considered imminent public health threats (IPHT). IPHT systems also include illicit discharges from unsewered communities (sometimes called “straight-pipes”). Straight pipes are illegal and pose an imminent threat to public health as they convey raw sewage from homes and businesses directly to surface water. Community straight pipes are more commonly found in small rural communities.

IPHT data are derived from surveys of county staff and county level SSTS status inventories. Table 3-7 provides the estimated percentage of IPHT septic systems reported by each county in 2016. The number of IPHT within the impaired stream subwatershed was estimated based on county reported IPHT percentages, and the county population estimates from 2010 US Census data area weighted to the portion of the county within the impaired stream drainage area. The percent of IPHT in southeastern Minnesota tend to be higher compared to other areas of Minnesota due to the high porosity of local soils, small lot sizes, and restrictive setbacks which make upgrades unfeasible or cost prohibitive. Many systems in Houston and Winona counties are advanced, mound systems. The City of La Crescent expects to expand its city sanitary sewer system within the near future to accommodate city growth. This expansion may tie in existing private SSTS, resulting in the potential correction of non-compliant systems.

Table 3-7. Estimate of %IPHT septic systems as reported by each County to MPCA in 2016.

County	IPHT (as % of all septics)
Winona	**8%**
Houston	**20%**

Livestock Manure

Runoff from livestock feedlots, pastures, and manure land application areas has the potential to be a significant source of fecal coliform bacteria. There is considerable spatial variation in the type and density of livestock across the Mississippi River - La Crescent Area Watershed. There are 3,398.8 beef cattle, 3,647.0 dairy cattle, 136.1 pigs, 22.5 sheep, and 24 horse AUs registered in the MPCA feedlot database (July 2016) for the Mississippi River - La Crescent Area Watershed (Table 3-8). Very small numbers of chickens, turkeys, and goats are also registered in the watershed. Within the bacteria impaired stream subwatershed, there are an estimated 6,298.83 AUs. The number of actual AUs present at a facility varies with time and is often much smaller than the total number of registered AUs for each facility; therefore, the total number of feedlot facilities per subwatershed are presented in Figure 3-10.

Dairy and beef cattle operations are scattered throughout the Mississippi River – La Crescent Area Watershed (Figure 3-10). The majority of non-NPDES/SDS permitted dairy and beef cattle operations are relatively small with 98% (60 farms) having open lots, presenting a potential for *E. coli* contaminated runoff. Considerable grazing of cattle still occurs, with 75% of operations having pastures as part of their facility. Where over-grazing occurs, severe erosion and manure runoff can result.

Table 3-8. MPCA registered feedlot animals in the Mississippi River – La Crescent Area Watershed (July 2016 MPCA Feedlot Database).

Primary Stock	AU	Animals
Beef Cattle - Calf	143.8	719
Beef Cattle - Feeder/heifer	1,078	1,540
Veal calf	6	30
Beef Cattle - Cow & calf pair	420	350
Beef Cattle - Slaughter/Stock	1,751	1751
Total Beef Cattle	**3,398.8**	**4,390**
Dairy Cattle - Calf	190.6	953
Dairy Cattle - Heifer	774.2	1,106
Dairy Cattle <1000 lbs	88	88
Dairy Cattle >1000 lbs	2,594.2	1,853
Total Dairy Cattle	**3,647.0**	**4,000**
Swine < 55 lbs	1.5	30
Swine 55-300 lbs	129	430
Swine > 300 lbs	5.6	14
Total Swine	**136.1**	**474**
Sheep or lambs	22.5	225
Total Sheep	**22.5**	**225**
Horses	24	24
Total Horses	**24**	**24**
Chicken (over 5 lbs)	**0.6**	**115**
Chicken (under 5 lbs)	**0.5**	**150**
Chicken with liquid manure system	**0.8**	**24**
Turkey (over 5 lbs)	**0.2**	**10**
Total	**7230.4**	**9,412**

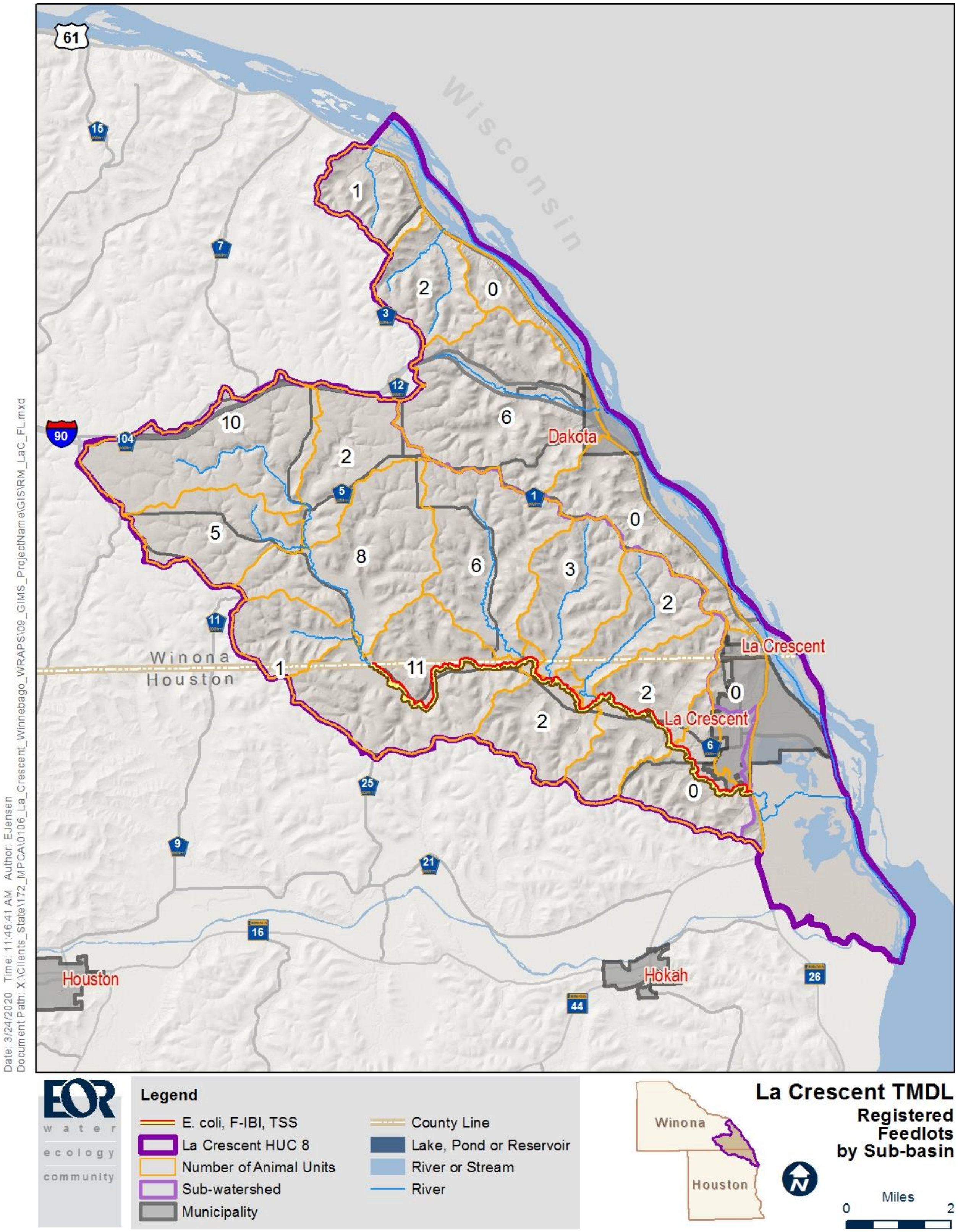


Figure 3-10. Number of registered feedlots by subwatershed.

Natural growth of *E. coli*

When evaluating sources of *E. coli* in the Mississippi River – La Crescent Area Watershed, it is important to recognize the natural growth of *E. coli* in soil and sediment. Research in the last 15 years has found the persistence of *E. coli* in soil, beach sand, and sediments throughout the year in the north central United States without the continuous presence of sewage or mammalian sources. An Alaskan study (Adhikari et al. 2007) found that total coliform bacteria in soil were able to survive for six months in subfreezing conditions. A study near Duluth, Minnesota (Ishii et al. 2010) found that *E. coli* were able to grow in agricultural field soil. A study by Chandrasekaran et al. (2015) of ditch sediment in the Seven Mile Creek Watershed in southern Minnesota found that strains of *E. coli* had become naturalized to the water−sediment ecosystem. Survival and growth of fecal coliform has been documented in storm sewer sediment in Michigan (Marino and Gannon 1991). The growth and persistence of *E. coli* greatly complicates the clear identification of sources of pathogens to surface waters. As such, the information provided in this section includes the most likely sources based on the best available information. The level of natural growth of *E. coli* in Pine Creek is currently unknown. Based on best professional judgement, it is expected that natural growth is not significantly contributing to the *E. coli* impairment.

Pets

Human pets (dogs and cats) can contribute bacteria to a watershed when their waste is not properly managed. When this occurs, bacteria can be introduced to waterways from:

- Dog parks
- Residential yard runoff (spring runoff after winter accumulation)
- Rural areas where there are no pet cleanup ordinances
- Animal elimination of excrement directly into waterbodies

Dog waste can be a significant source of pathogen contamination of water resources (Geldreich 1996). Dog waste in the immediate vicinity of a waterway could be a significant local source with local water quality impacts. Domestic cats, even those that spend some time outdoors, are most likely to have their waste collected indoors and were not considered a source of bacteria for this TMDL study. Feral cats may contribute to bacteria levels in urban streams and rivers (Ram et al. 2007). However, it is generally thought that these sources may be only minor contributors of fecal contamination on a watershed scale, because the estimated magnitude of this source is very small compared to other sources. Dog and cat waste as sources of bacteria to Pine Creek may be more significant within the city of La Crescent.

Wildlife

Wildlife (e.g., waterfowl and large-game species) also contribute bacteria loads directly by defecating while wading or swimming in the stream, and indirectly by defecating on lands that produce stormwater runoff during precipitation events. Bacteria loads that are contributed by wildlife are generally considered to be natural background. Some BMPs that reduce loads from livestock and other sources can also reduce loads from wildlife. Nearly half of the drainage area to Pine Creek is forested and could provide wildlife habitat encouraging congregation, and could be potential sources of higher fecal coliform due to the high densities of animals. Deer densities in the deer permit area within the Mississippi River - La Crescent River Area Watershed were estimated at 29 deer per square mile in 2017 (DNR 2017). This compares to registered livestock animal densities in watershed of approximately 125 animals per square mile. Waterfowl populations are difficult to obtain for this watershed because it is outside the DNR monitored breeding areas. Because of the watershed's proximity to the Mississippi River and floodplain backwaters, it is likely that large waterfowl congregations occur outside of this watershed. Smaller congregations of ducks and geese are potential sources of fecal coliform within the watershed, particularly in public parks and open spaces.

***E. coli* Source Summary**

The most likely contributor of fecal contamination to Pine Creek is livestock manure, due to the large numbers of AUs in the drainage area and the presence of facilities with livestock access directly to or near Pine Creek. Imminent threat to public health septic systems may also contribute fecal contamination to Pine Creek based on the high percentage of imminent threat to public health systems reported by Houston (20%) and Winona (8%) counties. Pets may contribute fecal contamination to Pine Creek within the city of La Crescent if pet waste is not management properly, but are likely minor contributors of fecal contamination on a watershed scale. The contribution of fecal contamination from wildlife sources and natural growth of *E. coli* within Pine Creek are unknown, but are likely minor contributors.

4. TMDL Development

This section presents the overall approach to estimating the components of the TMDL. The pollutant sources were first identified and estimated in the pollutant source assessment. The loading capacity (LC; TMDL) of the stream was then estimated using a LDC and was divided among WLAs and LAs. A TMDL for a waterbody that is impaired, as the result of excessive loading of a particular pollutant, can be described by the following equation:

$$\text{TMDL} = \text{LC} = \sum \text{WLA} + \sum \text{LA} + \text{MOS}$$

Where:

Loading capacity (LC): the greatest pollutant load a waterbody can receive without violating water quality standards;

Wasteload allocation (WLA): the pollutant load that is allocated to point sources, including wastewater treatment facilities (WWTF), regulated municipal stormwater, regulated construction stormwater, and regulated industrial stormwater, all covered under NPDES permits for a current or future permitted pollutant source;

Load allocation (LA): the pollutant load that is allocated to sources not requiring NPDES permit coverage, including non-regulated stormwater runoff, atmospheric deposition, and internal loading;

Margin of Safety (MOS): an accounting of uncertainty about the relationship between pollutant loads and receiving water quality;

4.1 Natural background consideration

The LA includes "natural background" sources. "Natural background" is defined in both Minnesota rule and statute: Minn. R. 7050.0150, subp. 4 "Natural causes" means the multiplicity of factors that determine the physical, chemical or biological conditions that would exist in the absence of measurable impacts from human activity or influence." The Clean Water Legacy Act (Minn. Stat. § 114D.10, subd. 10) defines natural background as "characteristics of the water body resulting from the multiplicity of factors in nature, including climate and ecosystem dynamics that affect the physical, chemical or biological conditions in a water body, but does not include measurable and distinguishable pollution that is attributable to human activity or influence."

Natural background conditions refer to inputs that would be expected under natural, undisturbed conditions. Natural background sources can include inputs from natural geologic processes such as soil loss from upland erosion and stream development, atmospheric deposition, and loading from forested land, wildlife, etc. For each impairment, natural background levels are implicitly incorporated in the water quality standards used by the MPCA to determine/assess impairment and therefore natural background is accounted for and addressed through the MPCA's waterbody assessment process. Natural background conditions were also evaluated, where possible, within the source assessment portion of this study. These source assessment exercises indicate natural background inputs are generally low compared to livestock, cropland, streambank, WWTF, failing SSTSs, and other anthropogenic sources.

Based on the MPCA's waterbody assessment process and the TMDL source assessment exercises, there is no evidence at this time to suggest that natural background sources are a major driver of any of the impairments and/or affect the waterbodies' ability to meet state water quality standards. For all impairments addressed in this TMDL study, natural background sources are implicitly included in the LA portion of the TMDL allocation tables, and TMDL reductions should focus on the major anthropogenic sources identified in the source assessment.

4.2 Loading capacity and load allocation

4.2.1 Loading capacity

The loading capacities for the impaired reach of Pine Creek were determined using LDCs. Flow and LDCs are used to determine the flow conditions (flow regimes) under which exceedances occur. Flow duration curves provide a visual display of the variation in flow rate for the stream. The x-axis of the plot indicates the percentage of time that a flow in cubic feet per second (cfs) that exceeds the corresponding flow rate as expressed by the y-axis. LDCs take the flow distribution information and factor in pollutant loading to the analysis. A standard curve is developed by applying a particular pollutant standard or criteria to the stream flow duration curve, and is expressed as a load of pollutant per day. The standard curve represents the upper limit of the allowable in-stream pollutant load (LC) at a particular flow. Monitored loads of a pollutant are plotted against this curve to display how they compare to the standard. Monitored values that fall above the curve represent an exceedance of the standard.

For the stream TMDL derivation, there were no monitored or modeled flow data available. Instead, regression equations developed for the state of Minnesota by the United States Geological Survey (USGS) were used to develop flow duration curves ranging from 0.01% to 99.99% probability of exceedance in the Mississippi River – La Crescent Area Watershed (Figure 4-1) (Ziegeweid et al. 2015). The USGS study divided Minnesota into five hydrologic regions. The southeastern corner of the State which contains the Mississippi River – La Crescent Area Watershed was located in region F. The primary watershed attributes used to estimate flow in this region were drainage area, percentage of forest, and percentage of low-lying flat area. By comparing the standard error of the estimate (SEE) between the regression equations and the drainage area ratio method, the study determined that the regression equations developed for Southeastern Minnesota were more accurate at determining both high flows and low flows because of the impacts of karst topography on flow (Ziegeweid et al. 2015). The loading capacities were determined by applying the water quality standard for each respective pollutant TMDL. The existing loads were plotted in the LDC by assuming that flow durations in the Mississippi River – La Crescent Area Watershed occurred concurrently with the flow measured at the Middle Fork Whitewater River near Elba, SPRK1 (USGS gage 40019002). More information is provided in Appendix A.

Existing loads were calculated from TSS and *E. coli* concentration data collected within the 10-year TMDL timeframe of 2008 through 2017 from the monitoring stations listed in

Table 3-2 and described in Section 3.4. These concentrations were multiplied by the estimated existing flow on the monitoring sample date.

TSS loading capacities presented in the allocation tables represent the median TSS load (kg/day) along the TSS standard curve within each flow regime. A TSS LDC and a TMDL allocation table are provided in Section 4.3.4. The *E. coli* allocation tables represent the geometric mean *E. coli* load (billion org/day) along the standard curve within each flow regime. An *E. coli* LDC and a TMDL allocation table are provided in Section 4.4.4. It is assumed that practices that are implemented to meet the *E. coli* geometric mean standard will also address the individual sample standard (1,260 org/100 mL), and that the individual sample standard will also be met.

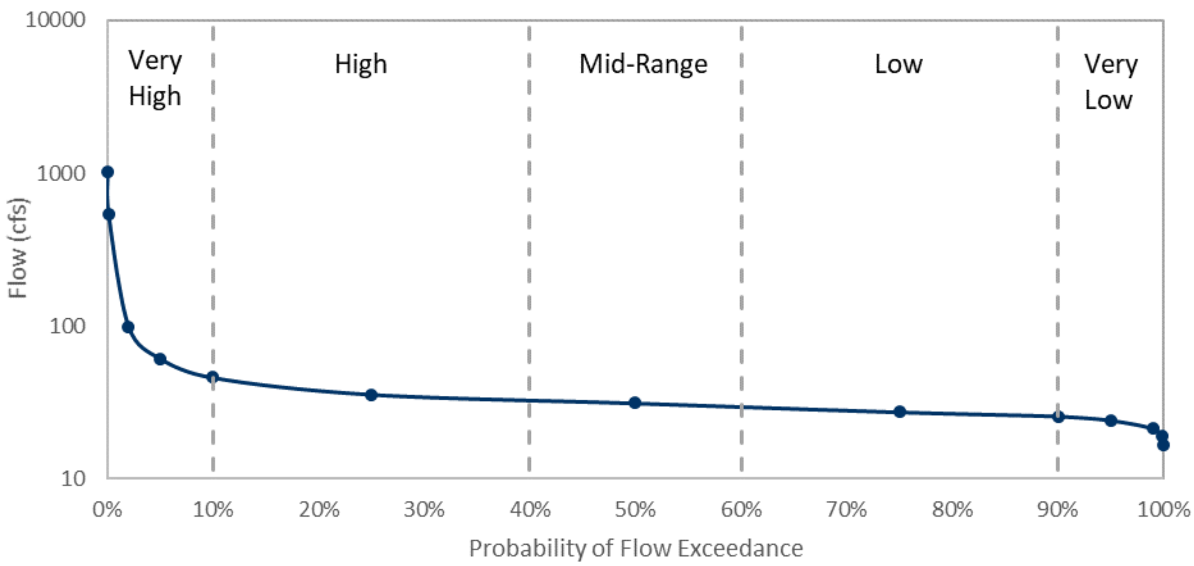


Figure 4-1. Flow duration curve for Pine Creek developed from regression equations (Ziegeweid et al. 2015).

The LDC method is based on an analysis that encompasses the cumulative frequency of historical flow data over a specified period. Because this method uses a long-term record of daily flow, virtually the full spectrum of allowable loading capacities is represented by the resulting curve. In the TMDL tables of this report, only five points on the entire LC curve are depicted (the midpoints of the designated flow zones). However, it should be understood that the entire curve represents the TMDL and is what is ultimately approved by the EPA. More pollutant specific information regarding the WLA, MOS, seasonal variation, and TMDL summary are provided in the following sections.

4.2.2 Load allocation

LAs represent the portion of the LC that is designated for non-NPDES permitted sources of TSS and *E. coli* (as described in Section 3.5.2 and Section 3.5.2.2 respectively). The remainder of the LC (TMDL) after subtraction of the MOS and calculation of the WLA was used to determine the LA for the impaired stream on an areal basis.

4.3 TSS

4.3.1 Wasteload allocation methodology

The contributions of TSS and *E. coli* from regulated sources are quite small compared to non-permitted sources. Each regulated source received a WLA based on the proportion of their regulated contributing area to the impaired stream reach.

4.3.1.1 Regulated Municipal Stormwater

WLAs were assigned to La Crescent City (MS400097), Houston County (MS400139), and MnDOT (MS400180) based on the percent of the impaired drainage area that is an MS4 regulated area multiplied by the LA (Table 3-6 in Section 3.5.1.1). The LA is equal to the total TMDL (LC) minus the MOS. To meet the WLAs, TSS and *E. coli* loading does not need to be reduced, but is not allowed to increase relative to the baseline year of 2013. Regulated MS4s cover a small (1%) proportion of the total drainage area of Pine Creek.

4.3.1.2 Regulated Construction Stormwater

Construction stormwater is regulated by NPDES Permits for any construction activity disturbing a) one acre or more of soil, b) less than one acre of soil if that activity is part of a "larger common plan of development or sale" that is greater than one acre, or c) less than one acre of soil, but the MPCA determines that the activity poses a risk to water resources. The WLA for stormwater discharges from sites where there is construction activities reflects the number of construction sites greater than one acre expected to be active in the impaired lake or stream subwatershed at any one time.

A categorical WLA was assigned to all construction activity in the impaired stream subwatershed. First, the average annual fraction of the watershed area under construction activity over the past five years, was calculated based on the MPCA Construction Stormwater Permit data from January 1, 2014, to January 1, 2019. This fraction, calculated to be 0.17% of the entire Mississippi River - La Crescent Area Watershed, was multiplied by the LA to determine the construction stormwater WLA. The LA is equal to the total TMDL (LC) minus the MOS.

4.3.1.3 Regulated Industrial Stormwater

Industrial stormwater is regulated by NPDES Permits if the industrial activity has the potential for significant materials and activities to be exposed to stormwater discharges. The WLA for stormwater discharges from sites where there is industrial activity reflects the number of sites in an impaired stream subwatershed for which NPDES Industrial Stormwater Permit coverage is required.

A categorical WLA was assigned to all industrial activity in the impaired stream subwatershed. First, the fraction of the watershed area under industrial activities, was calculated based on 2017, FSA aerial imagery of mining activity near industrial permit locations. This fraction, calculated to be 0.26% of the direct drainage area watershed, was multiplied by the LA to determine the industrial stormwater WLA. The LA is equal to the total TMDL (LC) minus the MOS.

4.3.1.4 Regulated Wastewater

There are no regulated WWTFs in the Mississippi River – La Crescent Area Watershed that discharge to the impaired Pine Creek.

4.3.1.5 Feedlots Requiring NPDES/SDS Permit Coverage

There are no NPDES/SDS permitted feedlots in the Mississippi River – La Crescent Area Watershed.

4.3.2 Margin of safety

An explicit MOS equal to 30% of the LC was used for the stream TMDLs based on the uncertainty in the flow estimates. The flow duration curve is created from regression equations. For most of the flows the standard error of estimate (SEE) for the regression equations developed for southeast Minnesota (Region F) are approximately 30±3% with the SEE increasing for higher flows (Ziegeweid et al. 2015). The allocations are a function of flow, which varies from high to low flows. This variability is accounted for through the development of a TMDL for each of five flow regimes.

4.3.3 Seasonal variation

The TSS water quality standard applies for the period April through September, which corresponds to the open water season when aquatic organisms are most active and when high stream TSS concentrations generally occur. TSS loading varies with the flow regime and season. Spring is typically associated with large flows from snowmelt, the summer is associated with the growing season as well as periodic storm events and receding streamflows, and the fall typically brings increasing precipitation and rapidly changing agricultural landscapes. However, there is an increased frequency of extreme rain events in southeastern Minnesota (Villarini et al. 2013), and changing typical seasonal precipitation patterns historically observed in the Mississippi River – La Crescent Area Watershed.

Critical conditions and seasonal variation are addressed in this TMDL through several mechanisms. The TSS standard applies during the open water months, and data was collected throughout this period. The water quality analysis conducted on these data evaluated variability in flow through the use of five flow regimes: from high flows (such as flood events), to low flows (such as baseflow). Through the use of LDCs and monthly summary figures, TSS loading was evaluated based on estimated flow conditions at the time of sampling (and by month).

4.3.4 TMDL summary

4.3.4.1 Pine Creek (07040006-576)

- **303(d) listing year: 2022** (There is a proposed use class change to 2A. The aquatic life impairment for this reach is expected to be added to the impaired waters list following the 2021/2022 assessment cycle. See Table 1-1)
- **Baseline year:** 2013 based on the mid-point of the TMDL 10-year timeframe of 2008 through 2017

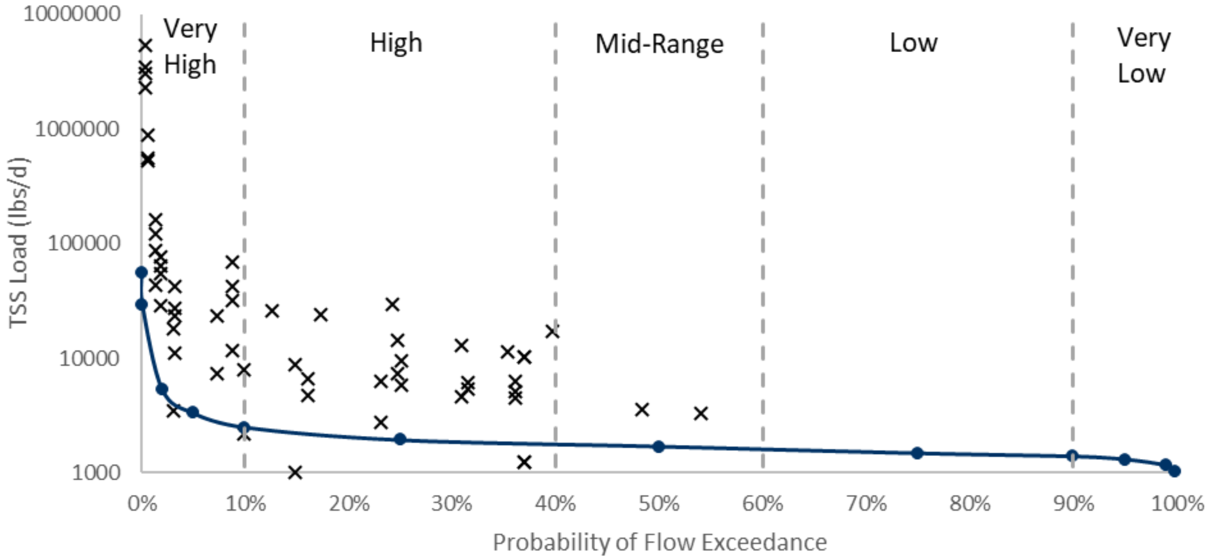


Figure 4-2. TSS load duration curve for Pine Creek (07040006-576) based on a 10 mg/L TSS standard.

Table 4-1. Pine Creek (07040006-576) TSS TMDL and Allocations.

Pine Creek 07040006-576		Flow Regime				
		Very High (cfs)	High (cfs)	Mid (cfs)	Low (cfs)	Very Low (cfs)
		61.3	35.7	31.3	27.4	24.2
Load Component		lbs/day				
Existing Load		*41,762.3*	*8,253.2*	*5,608.6*	*4,130.8*	*NA*
	Houston County (MS400139)	*4.2*	*2.5*	*2.2*	*1.9*	*1.7*
	MnDOT Outstate District (MS400180)	*0.3*	*0.2*	*0.15*	*0.13*	*0.11*
	La Crescent City (MS40097)	*42.0*	*24.5*	*21.4*	*18.8*	*16.6*
	Construction stormwater (MNR100001)	*9.2*	*5.3*	*4.7*	*4.1*	*3.6*
	Industrial Stormwater (MNG490000)	*5.4*	*3.1*	*2.7*	*2.4*	*2.1*
	Total WLA	**61.1**	**35.6**	**31.15**	**27.33**	**24.11**
Load Allocations	*Watershed runoff*	*2,253.4*	*1,312.3*	*1150.6*	*1007.2*	*889.6*
	Total LA	**2,253.4**	**1312.3**	**1150.6**	**1007.2**	**889.6**
30% MOS		**991.9**	**577.7**	**506.5**	**443.4**	**391.6**
Total Loading Capacity		**3,306.4**	**1,925.6**	**1,688.25**	**1,477.93**	**1,305.31**

* Based on the median concentration of all monitoring data available for each flow regime from 2008-2017 multiplied by the mid-point flow of each flow regime. See Section 3.4 for a summary of available monitoring data.
NA – no water quality grab samples were collected during very low flow conditions.

4.3.5 TSS Reductions

The observed 90th percentile concentrations of water quality samples exceeding the TSS standard range from 22 to 900 mg/L (Table 4-2). The estimated percent reduction needed to meet the TMDL ranges from 55% to 99%. The percent reduction does not necessarily apply to each of the sources/allocations individually and is based on existing data.

Due to the small fraction of runoff from permitted sources, the majority of reductions needed to meet the assumptions of this TMDL is from non-permitted sources.

Table 4-2. Estimated TSS reductions by station for Pine Creek, Mississippi River – La Crescent Area Watershed.

Monitoring Station (upstream to downstream)	Observed 90th Percentile Concentration (mg/L)	Estimated Reduction to Achieve 10 mg/L
S005-076 **(Pine Creek W of CR-125/CSAG-5 intersection, 1 mi N or New Hartford)**	22	55%
S009-030 **(Pine Creek at CSAH 5, 7.5 mi W of La Crescent, MN)**	64	84%
S009-031 **(Pine Creek at CSAH 30, 5 mi NW of La Crescent, MN)**	273	96%
S014-250 **(Pine Creek at Culvert, Just North of CSAH 6, 3.5 mi W of La Crescent, MN)**	828	99%
S014-253 **(Pine Creek, 3 mi UPSTR of CSAH 6, DWSTR of Golf Course, 2.5 mi NW of La Crescent, MN)**	900	99%
S004-017 **(Pine Creek at CSAH-6 BRG, 1.5 mi W of La Crescent**	284	96%
S008-435 **(Pine Creek at Skunk Hollow RD, 05 MI S of La Crescent, MN)**	114	91%
All Stations	**260**	**96%**

4.4 *E. coli*

4.4.1 Wasteload allocation methodology

All regulated stormwater were assigned a WLA based on the methods described in the following section.

4.4.1.1 Regulated Municipal Stormwater

See Section 4.3.1.1 for WLA methodology for regulated municipal stormwater.

4.4.1.2 Regulated Construction Stormwater

E. coli WLAs for regulated construction stormwater (MNR100001) were not developed since *E. coli* is not a typical pollutant from construction sites.

4.4.1.3 Regulated Industrial Stormwater

There are no *E. coli* benchmarks associated with the industrial stormwater permit because no industrial sectors regulated under the permit are known to be *E. coli* sources. Therefore, *E. coli* TMDLs will not include an industrial stormwater WLA.

4.4.1.4 Regulated Wastewater

There are no regulated WWTFs in the Mississippi River – La Crescent Area Watershed that discharge to the impaired Pine Creek.

4.4.1.5 Feedlots Requiring NPDES/SDS Permit Coverage

There are no NPDES/SDS permitted feedlots in the Mississippi River – La Crescent Area Watershed.

4.4.2 Margin of safety

An explicit MOS equal to 30% of the LC was used for the stream TMDLs based on the uncertainty in the flow estimates. The flow duration curve is created from regression equations. For most of the flows the SEE for the regression equations developed for southeast Minnesota (Region F) are approximately 30±3% with the SEE increasing for higher flows (Ziegeweid et al. 2015). In addition, the load duration analysis does not address bacteria re-growth in sediments, die-off, and natural background levels. The MOS helps to account for the variability associated with these conditions. The allocations are a function of flow, which varies from high to low flows. This variability is accounted for through the development of a TMDL for each of five flow regimes.

4.4.3 Seasonal variation

The stream water quality standards for aquatic recreation applies April through October. *E. coli* loading varies with the flow regime and season.

Critical conditions and seasonal variation are addressed in this TMDL through several mechanisms. The *E. coli* standard applies during the recreational period, and data was collected throughout this period. Through the use of LDCs and monthly summary figures, *E. coli* loading was evaluated at estimated flow conditions at the time of sampling (and by month), and monthly *E. coli* concentrations were evaluated against precipitation and streamflow.

4.4.4 TMDL summary

4.4.4.1 Pine Creek (07040006-576)

- **303(d) listing year: 2018**
- **Baseline year:** 2013 based on the mid-point of the TMDL 10-year timeframe of 2008 through 2017

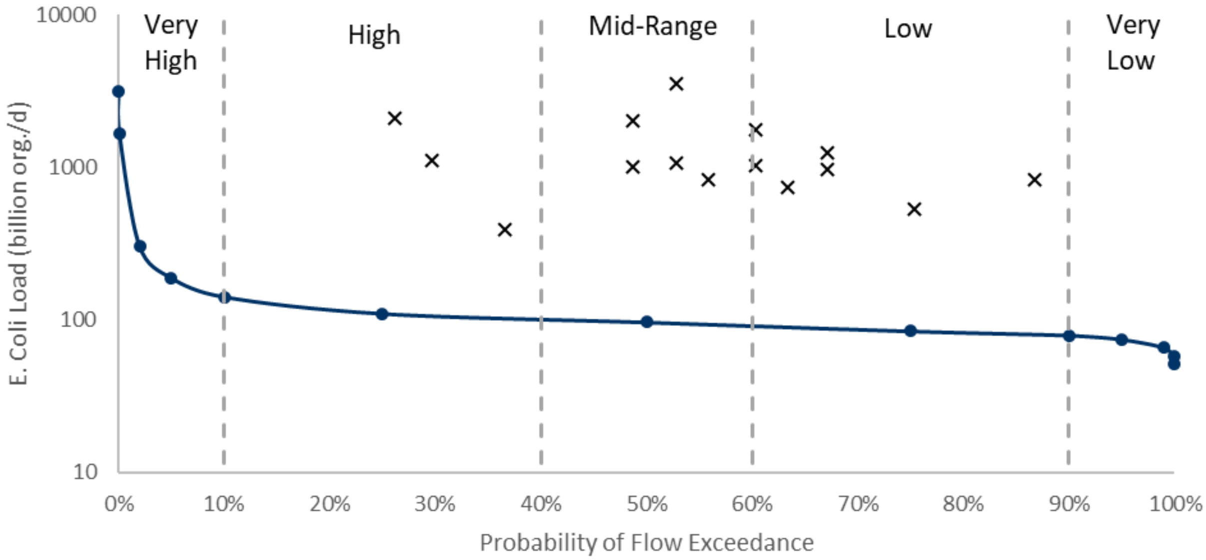


Figure 4-3. ***E. coli*** **load duration curve for Pine Creek (07040006-576).**

Table 4-3. Pine Creek (07040006-576) ***E. coli*** **TMDL and Allocations.**

Pine Creek 07040006-576		Flow Regime				
		Very High (cfs)	High (cfs)	Mid (cfs)	Low (cfs)	Very Low (cfs)
		61.3	35.7	31.3	27.4	24.2
Load Component		billion org./day				
Existing Load		*NA*	*955*	*1,448*	*975*	*NA*
	Houston County MS4 (MS400139)	*0.148*	*0.086*	*0.075*	*0.066*	*0.059*
	MnDOT Outstate District (MS400180)	*0.010*	*0.006*	*0.005*	*0.004*	*0.004*
	La Crescent City MS4 (MS400097)	*1.473*	*0.857*	*0.748*	*0.655*	*0.585*
	Total WLA	**1.631**	**0.949**	**0.828**	**0.725**	**0.648**
Load Allocations	**Watershed runoff**	**130.7**	**76.1**	**66.4**	**58.1**	**51.9**
30% MOS		**56.7**	**33.0**	**28.8**	**25.2**	**22.5**
Total Loading Capacity		**189.031**	**110.049**	**96.028**	**84.025**	**75.048**
Estimated Load Reduction		*NA*	*845*	*1,352*	*891*	*NA*
		NA	*88%*	*93%*	*91%*	*NA*

* Based on the geometric average of all monitoring data available for each flow regime from 2008-2017 multiplied by the mid-point flow of each flow regime. See Section 3.4 for a summary of available monitoring data.
NA – no water quality grab samples were collected during very high or very low flow conditions.

4.4.5 *E. coli* Reductions

Observed *E. coli* concentrations are more than 10 times higher than the water quality standard for Pine Creek (Table 4-4). The monthly estimated percent reduction needed to meet the TMDL was based on the percent reduction needed to meet the *E. coli* standard (126 org/100 mL). The percent reduction does not necessarily apply to each of the sources/allocations individually and is based on existing data. For all months where monitoring data were available (June through August), significant reductions in *E. coli* concentrations (90% to 93%) are needed. Reduction estimates for *E. coli* should be considered approximate given the highly dynamic nature of *E. coli* growth. Additional monitoring data should be collected to understand the existing *E. coli* concentrations in April, May, and September.

Due to the small fraction of runoff from permitted sources, the majority of reductions needed to meet the assumptions of this TMDL is from non-permitted sources.

Table 4-4. Estimated *E. coli* reductions by month for Pine Creek, Mississippi River – La Crescent.

Impaired Reach (AUID)	Month	Observed Geometric Mean *E. coli* (org/100 mL)	Estimated Reduction Needed to Achieve 126 org/100 mL	
			Concentration (org/100 mL)	Concentration as Percentage (%)
Pine Creek (07040006-576)	June	1,413	1,287	91%
	July	1,764	1,638	93%
	August	1,300	1,174	90%

5. Future growth considerations

According to the Minnesota State Demographic Center, since 2010, both Houston and Winona counties have projected decreases in population (2019) with rural areas decreasing more rapidly (Hansen 2017). One area of the watershed that may see future growth is the city of La Crescent. La Crescent's future growth plans are described in the 2016 City of La Crescent Comprehensive Plan. This area may expand because of its close proximity to La Crosse, Wisconsin, a college town with a population of 51,834. However, most of the watershed is still expected to remain in rural land uses (forest, row crops, etc.; see Table 3-3).

5.1 New or expanding permitted MS4 WLA transfer process

Future transfer of watershed runoff loads in this TMDL may be necessary if any of the following scenarios occur within the project watershed boundaries:

1. New development occurs within a regulated MS4. Newly developed areas that are not already included in the WLA must be transferred from the LA to the WLA to account for the growth.
2. One regulated MS4 acquires land from another regulated MS4. Examples include annexation or highway expansions. In these cases, the transfer is WLA to WLA.
3. One or more non-regulated MS4s become regulated. If this has not been accounted for in the WLA, then a transfer must occur from the LA.
4. Expansion of a U.S. Census Bureau Urban Area encompasses new regulated areas for existing permittees. An example is existing state highways that were outside an urban area at the time the TMDL was completed, but are now inside a newly expanded urban area. This will require either a WLA to WLA transfer or a LA to WLA transfer.
5. A new MS4 or other stormwater-related point source is identified and is covered under a NPDES Permit. In this situation, a transfer must occur from the LA.

Load transfers will be based on methods consistent with those used in setting the allocations in this TMDL. In cases where WLA is transferred from or to a regulated MS4, the permittees will be notified of the transfer and have an opportunity to comment.

5.2 New or expanding wastewater (TSS and *E. coli* TMDLs only)

The MPCA, in coordination with the EPA Region 5, has developed a streamlined process for setting or revising WLAs for new or expanding wastewater discharges to waterbodies with an EPA approved TMDL (MPCA 2012). This procedure will be used to update WLAs in approved TMDLs for new or expanding wastewater dischargers whose permitted effluent limits are at or below the instream target and will ensure that the effluent concentrations will not exceed applicable water quality standards or surrogate measures. The process for modifying any and all WLAs will be handled by the MPCA, with input and involvement by the EPA, once a permit request or reissuance is submitted. The overall process will use the permitting public notice process to allow for the public and EPA to comment on the permit changes based on the proposed WLA modification(s). Once any comments or concerns are addressed, and the MPCA determines that the new or expanded wastewater discharge is consistent with the applicable water quality standards, the permit will be issued and any updates to the TMDL WLA(s) will be made.

For more information on the overall process, visit the MPCA's TMDL Policy and Guidance webpage.

6. Reasonable assurance

A TMDL needs to provide reasonable assurance that water quality targets will be achieved through the specified combination of point and nonpoint source reductions reflected in the LAs and WLAs, respectively. According to EPA guidance (EPA 2002a):

> "When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint-source load reductions will occur ... the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for the EPA to determine that the TMDL, including the LA and WLAs, has been established at a level necessary to implement water quality standards."

In order to address pollutant loading in the Mississippi River - La Crescent Area Watershed, considerable reductions in nonpoint source loading will be required for existing point source controls to be effective. Reasonable assurance for permitted sources, namely stormwater, is provided via compliance with their respective NPDES permit programs, as described in Section 3.5.

The following sections provide reasonable assurance that implementation will occur and result in pollutant load reductions in the Mississippi River - La Crescent Area River Watershed.

6.1 Examples of source reduction programs

Elements are in place for both point sources and nonpoint sources to make progress toward needed pollutant reductions in this TMDL. A range of local partners is involved in water resource management and implementation, including Houston and Winona counties and SWCDs, and La Crescent City. In addition, state agencies (MPCA, Board of Water and Soil Resources (BWSR), DNR and Minnesota

Department of Agriculture (MDA)) receive Clean Water Funds for various water resource management duties, including technical assistance.

6.1.1 Non-regulatory

Watershed load reductions will be achieved through management of septic systems, shoreline erosion, and agricultural BMPs. At the local level, the Winona SWCD, Houston SWCD and Natural Resources Conservation Service (NRCS) currently implement programs that target improving water quality and have been actively involved in projects to improve water quality in the past. The following examples describe large-scale programs that have proven to be effective and will reduce pollutant loads going forward.

6.1.1.1 Agricultural Water Quality Certification Program

The Minnesota Agricultural Water Quality Certification Program (MAWQCP) is a voluntary opportunity for farmers and agricultural landowners to take the lead in implementing conservation practices that protect waters. Those who implement and maintain approved farm management practices are certified and in turn obtain regulatory certainty for a period of 10 years.

Through this program, certified producers receive:

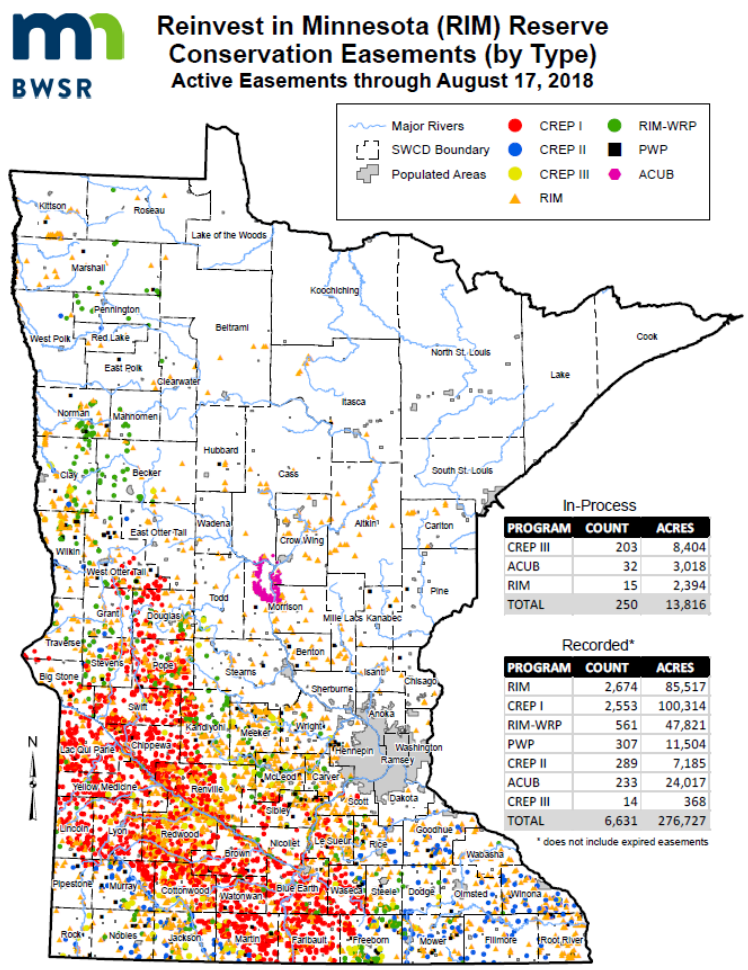
- **Regulatory certainty**: Certified producers are deemed to be in compliance with any new water quality rules or laws during the period of certification
- **Recognition**: Certified producers may use their status to promote their business as protective of water quality
- **Priority for assistance**: Producers seeking certification can obtain specially designated technical and financial assistance to implement practices that promote water quality

Through this program, the public receives assurance that certified producers are using conservation practices to protect Minnesota's lakes, rivers, and streams. Since the start of the program in 2014, statewide, the Ag Water Quality Certification Program has (Redlin 2020):

- Enrolled over 500,000 acres;
- Included 755 producers;
- Added more than 1,500 new conservation practices;
- Kept over 66 million pounds (lbs) of sediment out of Minnesota rivers;
- Saved 163 million lbs of soil and 39,766 lbs of phosphorus on farms; and
- Reduced nitrogen losses by up to 49%.

6.1.1.2 Conservation Easements

Conservation easements are a critical component of the state's efforts to improve water quality by reducing soil erosion, phosphorus and nitrogen loading, and improving wildlife habitat and flood attenuation on private lands. Easements protect the state's water and soil resources by permanently restoring wetlands, adjacent native grassland wildlife habitat complexes and permanent riparian buffers. In cooperation with county SWCDs and the NRCS, BWSR's programs compensate landowners for granting conservation easements and establishing native vegetation habitat on economically marginal, flood-prone, environmentally sensitive or highly erodible lands. These easements vary in length of time from 10 years to permanent/perpetual easements. Types of conservation easements in Minnesota include: Conservation Reserve Program (CRP); Conservation Reserve Enhancement Program (CREP); Reinvest in Minnesota (RIM); and the Wetland Reserve Program (WRP) or Permanent Wetland Preserve (PWP). As of August 2019, there were 7,464 acres of short-term conservation easements such as CRP and 2,003 acres of long term or permanent easements (CREP, RIM, WRP) in Winona County, and 11,980 acres of short-term conservation easements such as CRP and 2,726 acres of long term or permanent easements (CREP, RIM, WRP) in Houston County.



6.1.2 Regulatory

Reasonable assurance for permitted sources, such as stormwater and wastewater, is provided via compliance with their respective NPDES permit programs, as described in Section 8.1. Other regulations for non-permitted sources include:

6.1.2.1 MS4 stormwater

The MPCA is responsible for applying federal and state regulations to protect and enhance water quality in Minnesota. The MPCA oversees all regulated MS4 entities in stormwater management accounting activities. All regulated MS4s in the watershed fall under the category of Phase II. The MS4 NPDES/SDS Permits require regulated municipalities to implement BMPs to reduce pollutants in stormwater runoff.

All owners or operators of regulated MS4s (also referred to as "permittees") are required to satisfy the requirements of the MS4 general permit. The MS4 general permit requires the permittee to develop a Stormwater Pollution Prevention Program (SWPPP) that addresses all permit requirements, including the following six minimum control measures:

- Public education and outreach;
- Public participation;
- Illicit Discharge Detection and Elimination Program;
- Construction-site runoff controls;
- Post-construction runoff controls; and
- Pollution prevention and municipal good housekeeping measures

A SWPPP is a management plan that describes the MS4 permittee's activities for managing stormwater within their jurisdiction or regulated area. In the event a TMDL study has been completed, approved by EPA prior to the effective date of the general permit, and assigns a WLA to an MS4 permittee, that permittee must document the WLA in their application and provide an outline of the BMPs to be implemented in the current permit term to address any needed reduction in loading from the MS4.

The MPCA requires applicants submit their application materials and SWPPP document to the MPCA for review. Prior to extension of coverage under the general permit, all application materials are placed on 30-day public notice by the MPCA, to ensure adequate opportunity for the public to comment on each permittee's stormwater management program. Upon extension of coverage by the MPCA, the permittees are to implement the activities described within their SWPPP, and submit annual reports to the MPCA by June 30 of each year. These reports document the implementation activities which have been completed within the previous year, analyze implementation activities already installed, and outline any changes within the SWPPP from the previous year. For more information on the MPCA MS4 program see: The Municipal Stormwater page.

This TMDL assigns TSS WLAs to permitted MS4s in the Pine Creek TSS drainage area. The MS4 General Permit requires permittees to develop compliance schedules for EPA approved TMDL WLAs not already being met at the time of permit application. A compliance schedule includes BMPs that will be implemented over the permit term, a timeline for their implementation, and a long term strategy for continuing progress towards assigned WLAs. For WLAs being met at the time of permit application, the same level of treatment must be maintained in the future. Regardless of WLA attainment, all permitted MS4s are still required to reduce pollutant loadings to the maximum extent practicable. No additional TSS reductions were assigned to the permitted MS4s in the TMDL Study Area, and therefore compliance with their existing permits is expected to meet the assumptions of this TMDL.

The MPCA's stormwater program and its NPDES Permit program are regulatory activities providing reasonable assurance that implementation activities are initiated, maintained, and consistent with WLAs assigned in this study.

6.1.2.2 Construction stormwater

The WLA for construction site stormwater reflects the number of active construction sites greater than one acre in size, in the watershed at any one time, and the BMP) and other stormwater control measures that should be implemented to limit the discharge of pollutants of concern. The BMPs and other stormwater control measures that should be implemented at construction sites are defined in the State's NPDES/SDS General Stormwater Permit for Construction Activity (MNR100001). If a construction site owner/operator obtains coverage under the NPDES/SDS General Stormwater Permit and properly selects, installs and maintains all BMPs required under the permit, including those related to impaired waters discharges and any applicable additional requirements found in the Construction General Permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL. All local construction stormwater requirements must also be met.

6.1.2.3 Industrial stormwater

Currently, there are three MNG49 nonmetallic mining and associated activities permitted sites whose TSS discharges are covered by the TMDL's categorical industrial stormwater WLA. The WLA for stormwater discharges from sites where there is industrial activity reflects the number of sites in the watershed for which NPDES industrial stormwater permit coverage is required, and the BMPs and other stormwater control measures that should be implemented at the sites to limit the discharge of pollutants of concern. The BMPs and other stormwater control measures that should be implemented at the industrial sites are defined in the State's NPDES/SDS Industrial Stormwater Multi- Sector General Permit (MNR050000), or NPDES/SDS General Permit for Construction Sand & Gravel, Rock Quarrying and Hot Mix Asphalt Production facilities (MNG490000). If a facility owner/operator obtains stormwater coverage under the appropriate NPDES/SDS Permit and properly selects, installs and maintains all BMPs required under the permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL. All local stormwater management requirements must also be met.

6.1.2.4 Subsurface Sewage Treatment Systems Program

SSTSs are regulated through Minn. Stat. §§ 115.55 and 115.56. Regulations include:

- Minimum technical standards for individual and mid-size SSTS
- A framework for local units of government to administer SSTS programs
- Statewide licensing and certification of SSTS professionals, SSTS product review and registration, and establishment of the SSTS Advisory Committee
- Various ordinances for septic installation, maintenance, and inspection

In 2008, the MPCA amended and adopted rules concerning the governing of SSTS. In 2010, the MPCA was mandated to appoint a SSTS Implementation and Enforcement Task Force (SIETF). Members of the SIETF include representatives from the Association of Minnesota Counties, Minnesota Association of Realtors, Minnesota Association of County Planning and Zoning Administrators, and the Minnesota Onsite Wastewater Association. The group was tasked with:

- Developing effective and timely implementation and enforcement methods to reduce the number of SSTS that are an IPHT and enforce all violation of the SSTS rules (See report to the legislature; MPCA 2011).
- Assisting MPCA in providing counties with enforcement protocols and inspection checklists.

Both Winona and Houston counties within the Mississippi River – La Crescent Area Watershed have ordinances establishing minimum requirements for regulation of SSTS, for the treatment and dispersal of sewage within the applicable jurisdiction of the county, to protect public health and safety, groundwater quality, and prevent or eliminate the development of public nuisances. Ordinances serve the best interests of the county's citizens by protecting its health, safety, general welfare, and natural resources. In addition, each county zoning ordinance prescribes the technical standards that on-site septic systems are required to meet for compliance and outlines the requirements for the upgrade of systems found not to be in compliance. This includes systems subject to inspection at transfer of property, upon the addition of living space that includes a bedroom and/or a bathroom, and at discovery of the failure of an existing system.

From 2000 through 2016, the number of upgraded/replaced systems per year for Houston County and Winona County are illustrated in Figure 6-1. From 2002 to 2016, a total of 381 septic systems have been replaced in Houston County and 739 in Winona County. In 2016, the percent of failing septic systems was 45% in Houston County and 31% in Winona County; and the percent of IPHT was 20% in Houston County and 8% in Winona County. The city of La Crescent expects to expand its city sewer system within the near future to accommodate city growth. This expansion may tie in existing private SSTS, resulting in the potential correction of non-compliant systems.

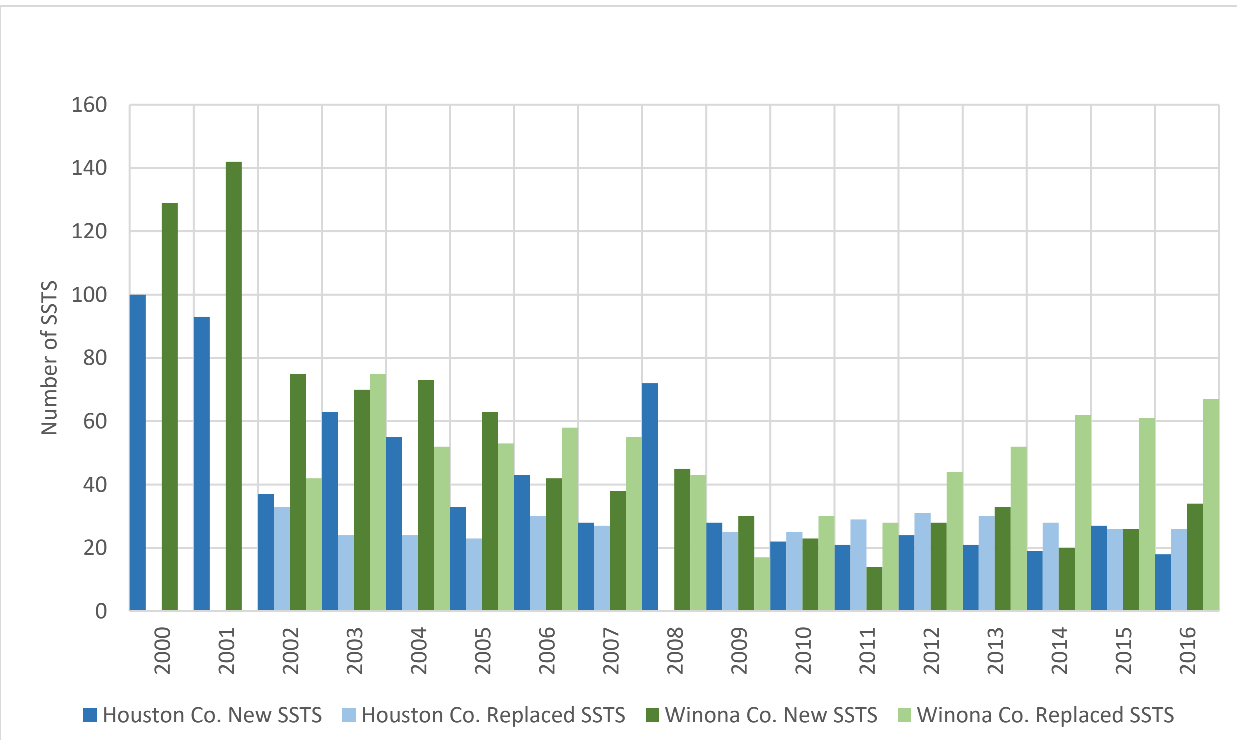


Figure 6-1. Number of upgraded or replaced SSTS in Houston County and Winona County by year.

6.1.2.5 Feedlot Rules

The MPCA Feedlot Program implements Minn. R. 7020 governing the collection, transportation, storage, processing, and disposal of animal manure and other livestock operation wastes. All feedlots capable of holding 50 or more AUs, or 10 AUs in shoreland areas, are subject to this rule. A feedlot holding 1,000 or more AUs is required to be permitted in the state of Minnesota. Smaller feedlot operations are registered by counties and do not have permits.

The Feedlot Program is implemented through a delegation agreement between MPCA and county governments in 50 counties in the state. The MPCA works with county representatives to provide training, program oversight, policy and technical support, and formal enforcement support when needed. A county participating in the program, known as a delegated county, has been given authority by the MPCA to delegate administration of the feedlot program. These delegated counties receive state grants to help fund their feedlot programs based on the number of feedlots in the county and the level of inspections they complete. Since 2012, annual grants given to these counties totaled about two million dollars (MPCA et al. 2018). Both Houston and Winona counties are delegated counties.

Since 2009, there have been 42 feedlot facility inspections in the Mississippi River - La Crescent Area Watershed with 28 inspections deemed compliant, 3 inspections deemed major non-compliance (the facility does not meet water quality discharge standards, and 11 inspections deemed minor non-compliance (a record keeping violation). One of the 3 facilities assessed as having major non-compliance is located within direct drainage area of the impaired section of Pine Creek. This major non-compliance has been addressed, the remaining two feedlots with major non-compliance require re-visit to assess current compliance status.

6.1.2.6 Buffer Program

The Buffer Law signed by Governor Dayton in June 2015 was amended on April 25, 2016, and further amended by legislation signed by Governor Dayton on May 30, 2017. The Buffer Law requires the following:

- For all public waters, the more restrictive of:
  - a 50-foot average width, 30-foot minimum width, continuous buffer of perennially rooted vegetation, or
  - compliance with the state shoreland standards and criteria.
- For public drainage systems established under Minn. Stat. 103E, a 16.5-foot minimum width continuous buffer.

Alternative practices are allowed in place of a perennial buffer in some cases. The amendments enacted in 2017 clarify the application of the buffer requirement to public waters:

- provide additional statutory authority for alternative practices,
- address concerns over the potential spread of invasive species through buffer establishment,
- establish a riparian protection aid program to fund local government buffer law enforcement and implementation, and
- allowed landowners to be granted a compliance waiver until July 1, 2018, when they filed a compliance plan with the SWCD.

BWSR provides oversight of the buffer program, which is primarily administered at the local level; compliance with the Buffer Law in the state is displayed at the Buffer Program Update webpage. As of January 2019, 99% of parcels in Houston County (SWCD communication) and all parcels but four in Winona County are in compliance with the buffer law.

6.2 Prioritizing and Focusing Management

As part of the complementary Mississippi River - La Crescent Area WRAPS report, EOR worked with representatives from Houston and Winona County SWCD, Houston and Winona counties, DNR, BWSR, MPCA, and New Ground to identify proposed BMPs in the Mississippi River - La Crescent Area Watershed.

6.3 Implementation Strategy

The WRAPS, TMDLs and all supporting information provide a starting point for improving water quality in the watershed. Future local watershed plans, such as the One Water One Plan process, will further develop tools, identify ways to improve water quality, and provide a detailed implementation plan. The WRAPS report provides a baseline strategy to provide reasonable assurance of this TMDL.

6.4 Funding Availability

There are many funding opportunities in the Mississippi River – La Crescent Area Watershed that are used to reduce pollutant loads. Federal conservation funding programs include CRP, Environmental Quality Incentives Program (EQIP) and Conservation Stewardship Program (CSP). More information on federal conservation funding in the two counties can be found on the Minnesota's Board of Soil and Water Resources (BWSR) website.

Additional funds to improve water quality are available through Minnesota's Legacy Fund. The Legacy Fund is an amendment passed by Minnesota's voters in 2008 that provides funding to protect drinking water sources; protect, enhance, and restore wetlands, prairies, forests, and fish, game, and wildlife habitat; preserve arts and cultural heritage; support parks and trails; and protect, enhance and restore lakes, rivers, streams, and groundwater. Since 2010, the Clean Water Fund, one of the funds funded through the Legacy amendment, has received $943.8 million (MPCA et al. 2018).

Since 2004, over $4.5 million implementation dollars have been spent addressing water quality issues in the Mississippi River - La Crescent Area Watershed (Figure 6-2).

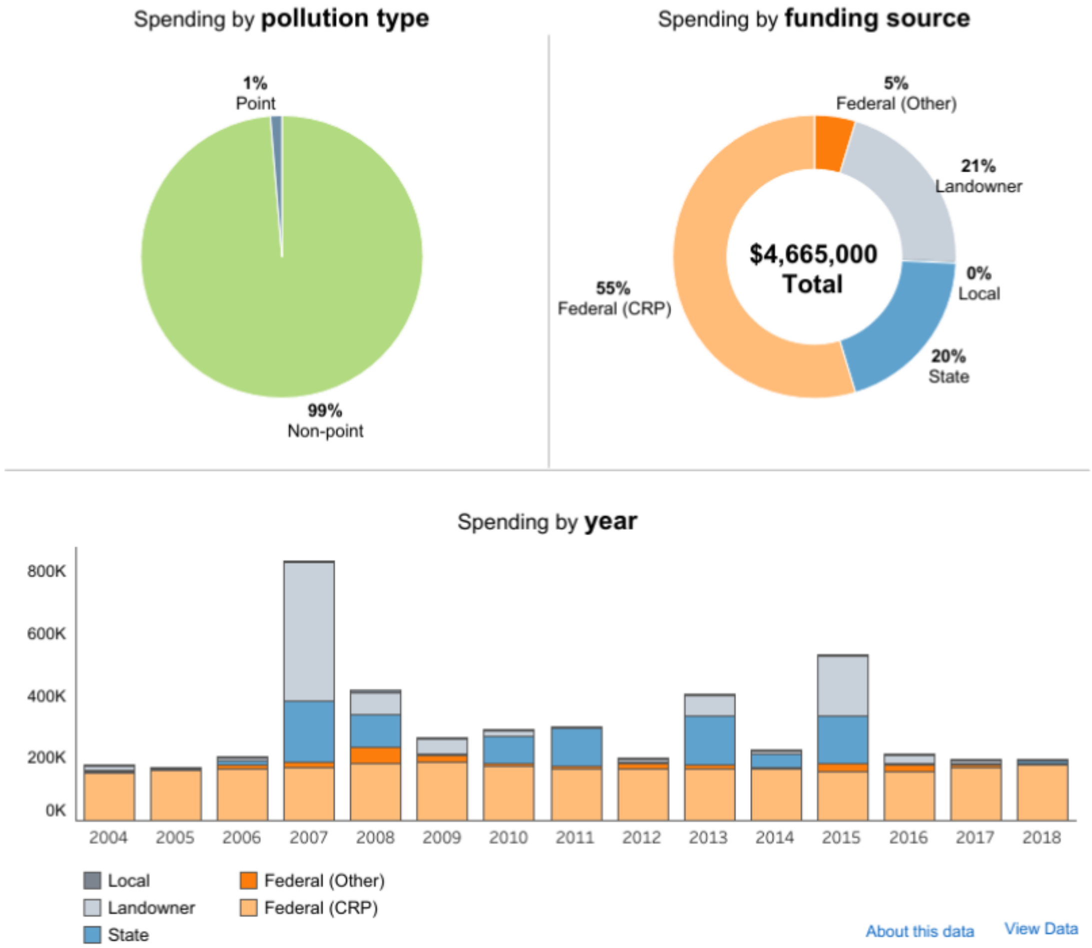
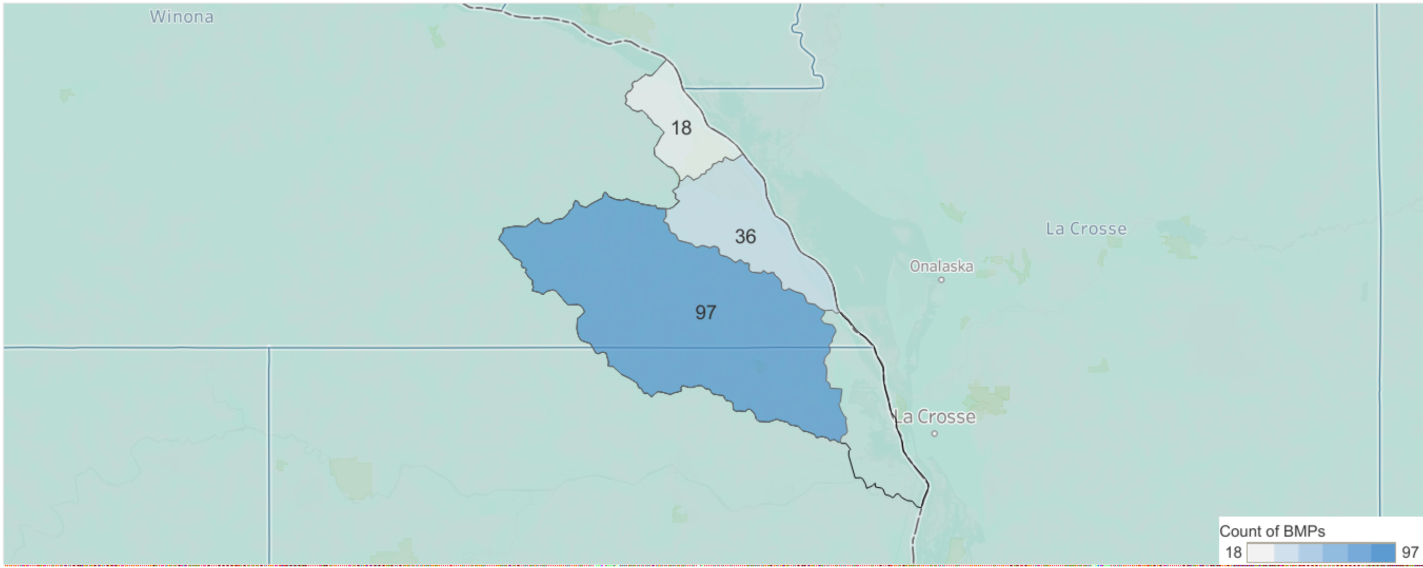


Figure 6-2**. Mississippi River - La Crescent Watershed water quality funding by pollution type, funding source, and year. Note that this spending does not include stormwater BMPs that may have already been implemented in the MS4s.**

6.5 Tracking Progress and Monitoring Water Quality Response

The MPCA has established the IWM program to monitor and assess water quality throughout Minnesota. More information about monitoring in the watershed is provided in Chapter 7. In addition, the MPCA maintains an online database of BMPs implemented by major watershed since 2004: Healthier Watersheds. A summary of BMPs implemented in the Mississippi River - La Crescent Area Watershed since 2004 is shown in Figure 6-3 below. The three most commonly implemented strategies used are designed erosion control (22), Septic System Improvements (21), and Stream banks, bluffs and ravines stabilization (12).



Reducing pollution from nonpoint sources

Best Management Practices (BMPs) are designed to reduce nonpoint sources of pollution from agricultural and urban runoff. This report provides information for BMPs funded through federal and state programs.

BMP strategies are proposed in Watershed Restoration and Protection Strategy (WRAPS) reports as scenarios to meet water quality goals, while specific BMP actions are prioritized in local water plans. Landowners working with local government select and install BMPs to help reduce pollution runoff from their land.

The table to the right displays specific BMPs in each watershed since 2004. Move the date slider to focus on BMP implementation in a specific range of years.

Mississippi River - La Crescent watershed

						Reported Pollution Reductions		
Strategy	Practice Description	Total BMPs	Number of BMPs (by unit)	Installed Amount (by unit)	Units	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment (tons/yr)
Designed erosion control	Contour Buffer Strips	2	2	10	ac	100	100	
	Grassed Waterway	12	12	7	ac			
	Stripcropping	6	6	220	ac	300	100	100
	Terrace	1	1	400	ft			
	Water & Sediment Control ..	1	1	1	count			
Septic System Improvements	Septic System Improveme..	21	21	21	count			
Stream banks, bluffs & ravines	Grade Stabilization Structure	9	1	1	ac			
			8	9	count	200	100	100
	Streambank and Shoreline..	3	3	447	ft	7,800	3,900	4,500
Converting land to perennials	Critical Area Planting	9	9	2	ac	5,700	2,900	2,600
Pasture management	Prescribed Grazing	7	7	297	ac			
Lliving cover to crops in fall/spri..	Cover Crop	6	6	64	ac			
Nutrient management (cropland)	Nutrient Management	4	4	981	ac			
Tillage/residue management	Residue and Tillage Mana..	4	4	429	ac			

Figure 6-3. Mississippi River – La Crescent Watershed BMP implementation.
Note that these do not include stormwater BMPs that may have already been implemented in the MS4s.

6.6 Nonpoint Source Pollution Reduction

Analysis of water quality data from 80 monitoring locations across Minnesota has shown that overall TSS, total phosphorus (TP), ammonia, biochemical oxygen demand (BOD), and bacteria have significantly decreased. These trends continue in the Lower Mississippi River Basin (Christopherson 2014) and are a result of efforts to control municipal and industrial discharges and reduce nonpoint source pollution. Several examples of projects that are contributing to these decreasing trends, are discussed.

As a response to the findings of the Revised Regional Fecal Coliform TMDL, Goodhue SWCD received federal Clean Water Act Section 319 Grant funding to provide technical assistance to design, plan and implement feedlot runoff controls on feedlots with less than 500 AUs. The total cost of the project was $572,743 and as a result 25 feedlot fixes were completed. Using MinnFarm and the average of four farm improvements, the estimated reduction in fecal coliforms was 83% per feedlot fix. Furthermore, MinnFarm calculations predicted a reduction of 906 lbs of phosphorus, 2,234 lbs of nitrogen, 29,474 lbs of chemical oxygen demand and 16,547 lbs of BOD (Timm 2017).

Another example of a regional project set to reduce *E. coli* loadings in southeast Minnesota are efforts by the Southeast Minnesota Wastewater Initiative (SMWI). Over twelve years the SMWI has helped 22 communities improve their sewage treatment system, with an estimated benefit of eliminating 317,290 gallons of untreated sewage a day. In 2016 the program received $286,487 to continue to help five communities construct new sewage treatment systems. The estimated benefit is the elimination of 156,600 gallons/day of untreated sewage discharge to the Lower Mississippi River and the Cedar River basins (SMWI 2016).

At a local level, the Winona County SWCD promotes soil and water conservation through technical, educational and financial assistance. In 2018 the SWCD helped 16 landowners improve riparian buffers to comply with the Minnesota Buffer law; they determined that 2,230 of 2,276 parcels were already compliant with the law. Furthermore, through county and state cost-sharing programs they assisted with the completion of three grade stabilization structures, seven grassed waterways, and the planting of more than 400 acres of cover crop. The SWCD also assisted with federal farm bill implementation by assisting landowners in the county signup for CRP contracts up to 222 acres. More information about local projects can be found on the Winona SWCD website (https://winonaswcd.org/). All of these efforts contribute to improved water quality in the Mississippi River – La Crescent Area Watershed.

Winona County has led an effort to investigate areas for potential BMP placement and identify strategies to strengthen social capacity and effectively engage citizens in the watershed. A contract funded by the MPCA has produced a community capacity survey report, a civic engagement recommendation report and community outreach programs (including a raingarden educational video). Continued work under this contract will assist future work in restoring and protecting the Mississippi River – La Crescent Area Watershed.

In summary, significant time and resources have been devoted to identifying the best BMPs, providing means of focusing them in Mississippi River – La Crescent Area Watershed, and supporting their implementation via state initiatives and dedicated funding. The Mississippi River – La Crescent Area Watershed WRAPS and TMDL processes engaged partners to arrive at reasonable examples of BMP combinations that attain pollutant reduction goals. Minnesota is a leader in watershed planning, as well as monitoring and tracking progress toward water quality goals and pollutant load reductions. Finally, examples cited herein confirm that BMPs and restoration projects have proven to be effective over time and as stated by the State of Minnesota Court of Appeals in A15-1622 Minnesota Center for Environmental Advocacy vs MPCA and Metropolitan Council Environmental Services:

> "We conclude that substantial evidence exists to conclude that voluntary reductions from nonpoint sources have occurred in the past and can be reasonably expected to occur in the future. The Nutrient Reduction Strategy (NRS) […] provides substantial evidence of existing state programs designed to achieve reductions in nonpoint source pollution as evidence that reductions in nonpoint pollution have been achieved and can reasonably be expected to continue to occur."

7. Monitoring plan

The Mississippi River – La Crescent Area Watershed was part of the MPCA IWM effort in 2015-2016. There were eight stream sites monitored for biology (fish and macroinvertebrates) in the watershed. The IWM is a 10-year rotation for monitoring and assessing waters of the state. The strategy utilizes a nested watershed design that allows the aggregation of watersheds from a coarse to a fine scale. More detail about the MPCA IWM strategy can be found in the Upper Iowa River, Mississippi River – Reno, Mississippi River – La Crescent Watersheds Monitoring and Assessment Report.

7.1 Future Monitoring

Further monitoring of groundwater and stream flow is needed in the watershed especially because of the correlation between in-stream flow and sediment in southeast Minnesota (Dogwiler & Kumarasamy 2016; Ellison et al. 2014).

One of the monitoring strategy recommendations is a sediment fingerprinting analysis in Pine Creek. Sediment fingerprinting is an analytical method used to determine different sources of sediment from various erosion processes, both natural and management-related. The underlying principle is that different sediment sources (i.e. stream banks, in-stream channel beds, floodplains, and uplands) can be characterized using a number of chemical and physical properties. Each source of sediment has a unique set of properties, referred to as a "fingerprint". The source sampling can be used to: a) better define the concentrations of the tracers derived from different sources of sediment within the watershed; b) characterize floodplain deposition rates and floodplain/bank tracer concentrations; and c) determine the extent to which groundwater seeps may influence fingerprinting estimates. An example of a completed sediment fingerprinting study from Minnesota is MDA's Root River Integrated Sediment Budget.

As for *E. coli*, more research is needed to fully understand the watershed dynamics behind *E. coli* concentrations in streams. In the revised *Regional TMDL Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota Implementation Plan,* several research and development needs were identified including:

- Sources of fecal coliform in urban areas
- The effectiveness of structural and non-structural BMPS in reducing *E. coli* loads
- Models to evaluate loading sources and track fecal coliform load reduction

- Source identification techniques with "DNA fingerprinting" and additional methods to assess pollutant movement through the watershed from source to surface water.

The next round of IWM (Cycle 2) for the Mississippi River - La Crescent Area Watershed will begin in 2021. Revisiting the watershed before the 10 year interval concluded was done to synchronize sampling years with the neighboring Mississippi River – Winona Area Watershed. Monitoring stations are proposed for Dakota Creek, Miller Valley Creek and Pine Creek. It is recommended during Cycle 2 to prioritize filling data gaps for sites that had insufficient information to complete an assessment. Additional sampling is needed throughout the watershed to identify hot spot sources of TSS and *E. coli*, and to collect additional monitoring data from waters that did not have sufficient monitoring data for assessment during the first round of IWM.

7.2 BMP Monitoring

Limited on-site monitoring of implementation practices could be performed to better assess BMP effectiveness. A variety of criteria such as land use, soil type, and other watershed characteristics, as well as monitoring feasibility, would be used to determine which BMPs to monitor. Under these criteria, monitoring of a specific type of implementation practice can be accomplished at one site but can be applied to similar practices under similar criteria and scenarios. Effectiveness of other BMPs can be extrapolated based on monitoring results.

8. Implementation Strategy Summary

The TMDL results and the WRAPS report will support local working groups in developing scientifically supported restoration and protection strategies for subsequent implementation planning. Concurrent with this TMDL report, the Mississippi River – La Crescent Area Watershed WRAPS Report will be publically available on the MPCA Mississippi River – La Crescent Area Watershed website: https://www.pca.state.mn.us/water/watersheds/mississippi-river-la-crescent.

8.1 Permitted sources

The City of La Crescent has been classified as a MS4 community. As such, the city has developed a SWPPP designed to develop, implement and enforce a SWPPP that is intended to minimize the discharge of pollutants from its storm sewer system, in order to protect the water quality of the receiving waters in accordance with the Federal Clean Water Act and its amendments. This SWPPP is a local plan that has been prepared with the purpose of meeting the requirements of the Federal NPDES Phase II Permit.

BMPs, including education, maintenance, pollution control techniques, system designs and engineering methods as well as local provisions deemed appropriate, are to be used to meet the minimum requirements of the NPDES Phase II permit. The La Crescent SWPPP is a plan to meet each of the six Minimum Control Measures described by the permit. The tasks described are not one-time efforts; they will continue throughout the permit period and beyond to maintain water quality.

In addition, the City of La Crescent is part of the Minnesota GreenStep Cities program, a voluntary challenge, assistance and recognition program to help cities achieve their sustainability and quality-of-life goals. The City also participates in the Lawn to Legumes program, a new program to help Minnesota residents plant native vegetation and pollinator friendly forbs and legumes to protect a diversity of pollinators. Demonstration neighborhoods are community projects that will enhance pollinator habitat and showcase best practices. The City of La Crescent expects to expand its city sanitary sewer system within the near future to accommodate city growth. This expansion may tie in existing private SSTS, resulting in the potential correction of non-compliant systems.

8.2 Non-permitted sources

This section provides an overview of key strategies identified by local partners to reduce sediment and *E. coli* to Pine Creek as part of the Mississippi River - La Crescent Area Watershed WRAPS process. Additional details regarding the targeting and level of implementation needed for these strategies can be found in the WRAPS report.

8.2.1 Riparian buffers (NRCS code 390):

Riparian buffers and filter strips that include perennial vegetation and trees can filter runoff from adjacent cropland, provide shade and habitat for wildlife, and reinforce streambanks to minimize erosion. The root structure of the vegetation uses enhanced infiltration of runoff and subsequent trapping of pollutants.

Enhancing existing buffers on public waters and establishing buffers on nonpublic waters with long-rooted, native vegetation will stabilize the banks and reduce erosion. Increasing shading from buffer vegetation on Pine Creek between New Hartford and CR16 will also improve aquatic habitat.

8.2.2 Livestock access control/fencing (NRCS codes 472 and 382)

Fencing can be used with controlled stream crossings to allow livestock to cross a stream while minimizing disturbance to the stream channel and streambanks. Providing alternative water supplies for livestock allows animals to access drinking water away from the stream, thereby minimizing impacts to the stream and riparian corridor. Some researchers have studied the impacts of providing alternative watering sites without structural exclusions and found that cattle spend 90% less time in the stream when alternative drinking water is furnished (EPA 2003).

8.2.3 Water and sediment control basins (NRCS code 638)

Water and sediment control basin (WASCOBs) are vegetative embankments that are placed perpendicular to water’s flow path to pool and slowly release water. This practice reduces erosion and sediment loss from agricultural fields. The Agricultural Conservation Planning Framework (ACPF) tool was used to identify existing and potential WASCOBs in the Pine Creek Subwatershed and are summarized in the WRAPS report.

8.2.4 Grade stabilization (NRCS code 410)

According to the Minnesota Ag BMP Handbook (Lenhart and Peterson 2017), a grade control structure is used to control the grade and head cutting in natural or artificial channels by arresting upstream movement of the “knickpoint” though natural or artificial means. NRCS Practice Standard 410 also applies to both grade control structures and side inlet controls. Design of side inlet controls is contained in a separate chapter in this document. Grade control structures are used to prevent the advancement of gullies that result from concentrated flow.

8.2.5 Conservation cover (327), conservation/reduced tillage (329 and 345), and cover crops (340)

Conservation cover, conversation/reduced tillage, and cover crops are all on-field agricultural BMPs that aim to reduce erosion and sediment loss by increasing and/or maintaining vegetative cover and root structure. Conservation cover is the process of converting previously row crop agricultural fields to permanent perennial vegetation. Conservation or reduced tillage can mean any tillage practice that leaves additional residue on the soil surface; 30% or more cover is typically considered conservation tillage. In addition to reducing erosion, conservation tillage preserves soil moisture. Cover crops refer to "the use of grasses, legumes, and forbs planted with annual cash crops to provide seasonal soil cover on cropland when the soil would otherwise be bare" (Lenhart and Peterson 2017).

8.2.6 Livestock waste storage facilities (NRCS code 313)

Manure management strategies depend on a variety of factors. A pasture or open lot systems with a relatively low density of animals (one to two head of cattle per acre [EPA 2003]) may not produce manure in quantities that require management for the protection of water quality. For mid-size and large facilities, additional waste storage is needed. A waste storage facility is "an impoundment created by excavating earth or a structure constructed to hold and provide treatment to agricultural waste" (Lenhart and Peterson 2017). Waste storage facilities hold and treat waste directly from animal operations, process wastewater, or contaminated runoff.

Dairies in the Mississippi River - La Crescent Area Watershed store and handle manure in both liquid and solid form to be land applied at a later date. Other potential sources of wastewater include process wastewater such as parlor wash down water, milk-house wastewater, silage leachate, and runoff from outdoor silage feed storage areas. There are potential runoff problems associated with these wastewater sources if not properly managed. In addition, many small dairy operations have limited to no manure storage.

Minn. R. 7020.2225 contains several requirements for land application of manure. These requirements vary depending on feedlot size and include provisions on manure nutrient testing, nutrient application rates (based on determination of crop needs and phosphorus soil testing), manure management plans, recordkeeping, and various limitations in certain areas or near environmentally-sensitive areas.

The MDA has recently developed an interactive model to assist livestock producers to evaluate the potential runoff risk for manure applications, based on weather forecasts for temperature and precipitation along with soil moisture content. The model can be customized to specific locations. It is advised that all producers applying manure utilize the model to determine the runoff risk, and use caution when the risk is "medium" and avoid manure application during "high" risk times. For more information and to sign up for runoff risk alerts from the MDA Runoff Risk Advisory Forecast, please see the MDA website:
https://www.mda.state.mn.us/protecting/cleanwaterfund/toolstechnology/runoffrisk.

8.2.7 Septic system maintenance and compliance

A watershed-wide inventory of current systems and continuation of inspection programs in the area are necessary to help locate IPHTs. It is recommended that LGUs target inventories in watershed areas identified as high *E. coli* priorities (see WRAPS). Once found, all known IPHTs must be brought into compliance within a 10-month period (see Section 6.1.2.4). The reductions in loading resulting from upgrading or replacing failing systems in the watershed depend on the level of failure present. Upgrading or replacing IPHTs systems will result in reductions of fecal bacteria loading. The MPCA offers the Clean Water Partnership 0% interest loan program to LGUs for SSTS upgrades and compliance. See Section 6.1.2.4 for more information on the program.

The most cost-effective BMP for managing loads from septic systems is regular maintenance. The EPA recommends that septic tanks be pumped every three to five years, depending on the tank size and number of residents in the household (EPA 2002b). When not maintained properly, septic systems can cause the release of pathogens and excess nutrients into surface water. Annual inspections, in addition to regular maintenance, ensure that systems function properly. Compliance with state and county code is essential to reducing *E. coli* and phosphorus loading from septic systems. Septic systems are regulated under Minn. Stat. §§ 115.55 and 115.56. Counties must enforce ordinances in Minn. R. 7080 to 7083.

8.3 Education and Outreach

A crucial part in the success of restoring impaired streams will be participation from local citizens. In order to gain support from these citizens, education and civic engagement opportunities will be necessary. A variety of educational avenues can and will be used throughout the Mississippi River – La Crescent Area Watershed. These include (but are not limited to):

- Events, meetings, workshops, focus groups, trainings
- Publications
    - Annual reports
    - County newsletters
- Websites
    - Winona County SWCD
    - Root River SWCD
    - Winona County
    - Houston County
    - City of La Crescent

Local staff (conservation district, watershed, county, etc.) and board members work to educate the residents of the watersheds about ways to clean up their streams on a regular basis. Education will continue throughout the Mississippi River – La Crescent Area Watershed.

8.3.1 Recent Accomplishments

The following education and outreach activities were accomplished between 2015 and 2019 in conjunction with the Mississippi River - La Crescent Area Watershed Restoration and Protection Project:

- Watershed Report: A Social Science-based Assessment of Conservation Practices in the La Crescent and Reno watersheds (Pradhananga etal 2019).

- Civic Engagement Report: Next Wise Steps for Engaging People in Southeast Minnesota. (NewGround 2019).
- Winona County Raingarden Educational Video.
- Houston County MS4 website.
- Root River SWCD Environmental Day.

8.4 Technical Assistance

The SWCDs, NRCS, and county staff within the watershed provide assistance to landowners for a variety of projects that benefit water quality. Assistance provided to landowners varies from agriculture to residential BMPs. This technical assistance includes education and one-on-one training. Many opportunities for technical assistance are as a result of educational workshops or trainings. It is important that these outreach opportunities for watershed residents continue. Marketing is necessary to motivate landowners to participate in voluntary cost-share assistance programs.

Programs such as state cost share, CREP, and RIM are administered through the county. In addition assistance is available for Clean Water Legacy funding, EQIP, CRP, State Buffer Law Implementation, MAWQCP, and CSP. All of these programs are available to help implement the best conservation practices that each parcel of land is eligible for to target the best conservation practices per site.

Conservation practices may include, but are not limited to: septic system upgrades, feedlot improvements, wastewater treatment practices, agricultural BMPs, and shoreline restorations. More information about types of practices and implementation of BMPs will be discussed in the Mississippi River – La Crescent Area WRAPS Report.

8.5 Partnerships

Partnerships with counties, cities, townships, citizens, and co-ops are one mechanism through which the Winona and Houston SWCDs will protect and improve water quality. Strong partnerships with state and local government to protect and improve water resources and to bring waters within the Mississippi River – La Crescent Area Watershed into compliance with state standards will continue. Active partnerships between counties, Cities, and SWCDs promote and support watershed-wide efforts.

8.6 Cost

The Clean Water Legacy Act requires that a TMDL study include an overall approximation of the cost to implement the TMDL study (Minn. Stat. 2007, § 114D.25).

8.6.1 TSS

Key implementation strategies to reduce TSS loads to Pine Creek include riparian buffers, livestock access control/fencing, WASCOB, conservation cover, conservation/reduced tillage, and cover crops. The FY2020 Minnesota EQIP Payment Schedules for these NRCS practices are listed in Table 8-1. Based on the range of implementation for these practices noted in the MRLC WRAPS, the total cost to address the TSS impairment in Pine Creek is estimated to be $22M to $63M dollars.

Table 8-1. FY2020 Minnesota EQIP Payment Schedule for select NRCS practices.

NRCS Code	Practice	Unit	Unit Cost
327	Conservation cover with native species	Ac	$106.47
329	Residue and tillage management, no till/strip-till	Ac	$13.82
340	Cover crop – basic (organic and non-organic	Ac	$24.02
382	Livestock fencing – multi strand barbed or smooth wire difficult terrain	Ft	$1.81
390	Riparian herbaceous cover – native species with forgone income	Ac	$298.74
472	Livestock access control	Ac	$23.75
638	Water and sediment control basin – berm less than 4 feet tall, grassed	Ft	$6.59

8.6.2 *E. coli*

The initial estimate for implementing the Lower Mississippi River Fecal Coliform TMDL was $240M; the Mississippi River - La Crescent Area Watershed is approximately 1.3% (95 sq. mi. out of 7,266 sq. mi.) of the basin. Given the regional and ubiquitous nature of pathogen impairments in southeast Minnesota, a 1.3% apportionment of the overall cost (or $3.14 million dollars) is a reasonable estimate for addressing the issue at the HUC-8 Mississippi River - La Crescent Area Watershed scale.

8.7 Adaptive management

This list of implementation elements and the more detailed WRAPS report prepared concurrently with this TMDL assessment focuses on adaptive management (see Figure 8-8). Continued monitoring and “course corrections” responding to monitoring results are the most appropriate strategy for attaining the water quality goals established in this TMDL. Management activities will be changed or refined to efficiently meet the TMDL and lay the groundwork for de-listing the impaired water bodies. Evaluation of practices will occur approximately every five years after the commencement of implementation actions and continue for the next 25 years.

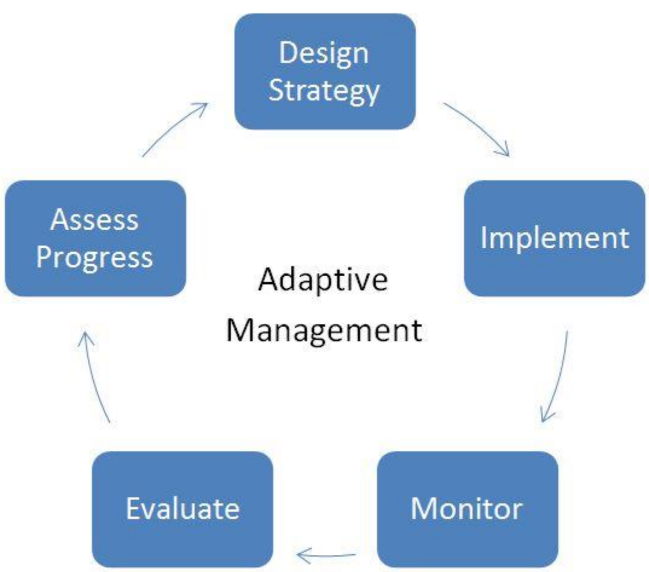


Figure 8-8. Adaptive Management

9. Public participation

9.1 Public notice

An opportunity for public comment on the draft TMDL report was provided via a public notice in the State Register from June 1, 2020 through July 1, 2020. No comment letters were received during the public comment period.

9.2 Technical Committee Meetings

The Technical Advisory Committee (TAC) was comprised of representatives from the Root SWCD, Winona County SWCD, Winona County, Houston County, New Ground Inc., DNR, BWSR, and MnDOT. Table 9-1 outlines the date, location and meeting focus of TAC meetings held during the TMDL development process.

Table 9-1. Mississippi River - La Crescent Area Watershed TMDL TAC Meetings.

Date	Location	Meeting Focus
7/23/2019	Winona County Government Center	TMDL and WRAPS Kick-off meeting
12/12/2019	Winona County Government Building	Reviewing draft TMDL and discussing preliminary comments

9.3 Civic Engagement/Public Participation

The MPCA along with the local partners and agencies in the Mississippi River - La Crescent Area Watershed recognize the importance of public involvement in the watershed process. Table 9-2 outlines the opportunities used to engage the public and targeted stakeholders in the watershed.

Table 9-2. Mississippi River – La Crescent Area Watershed TMDL Civic Engagement Opportunities.

Date	Event	Description
2016 - 2018	Watershed-wide interviews with local officials & conservation leaders within MRLC Watershed	1. Identify what is working to engage people in water protection; 2. Learn what local leaders need to meet goals; 3. Inform and pave the way for WRAPS development
2017-2019	Connect with Agriculture Retail & Conservation Sectors in southeast Minnesota.	NewGround Inc. staff worked to connect agriculture retailers, crop advisors and conservation staff to build shared work across sectors for nutrient efficiency on southeast Minnesota farms.

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APPENDIX A. STREAM STATS RESULTS

Table A-1. Pine Creek Flow-Duration Statistics Parameters.

Parameter Name	Pine Creek Value	Minimum Limit	Maximum Limit
Drainage Area, DRNAREA (mi^2)	58.45	2.28	1540
Percent Forest from NLCD2006, LC06FOREST (%)	50.4*	0.69	48.9
Flat Lands Below Median Elevation, PFLATLOW (%)	2.66	0	15.2

*Parameter was outside of suggested range.

Table A-2. Pine Creek Flow-Duration Statistics Flow.

Percent Duration	Discharge (cfs)	Standard Error of the Estimate, SEE (%)
0.01%	1,030	31%
0.1%	542	28%
2%	99.1	33%
5%	61.3	34%
10%	46	33%
25%	35.7	31%
50%	31.3	30%
75%	27.4	30%
90%	25.7	27%
95%	24.2	28%
99%	21.4	32%
99.9%	18.9	42%
99.99%	16.6	55%

*Flow calculated using regression equations from Region F (Ziegeweid et al. 2015).

Table A-3. Comparison of the Middle Fork White Water River near Elba, SPRK1 and Pine Creek.

Parameter	Whitewater River and Pine Creek Comparison	Lower Limit	Upper Limit
Drainage Area Ratio (-)	0.67	0.25	4
Distance (mi)	41	NA	50

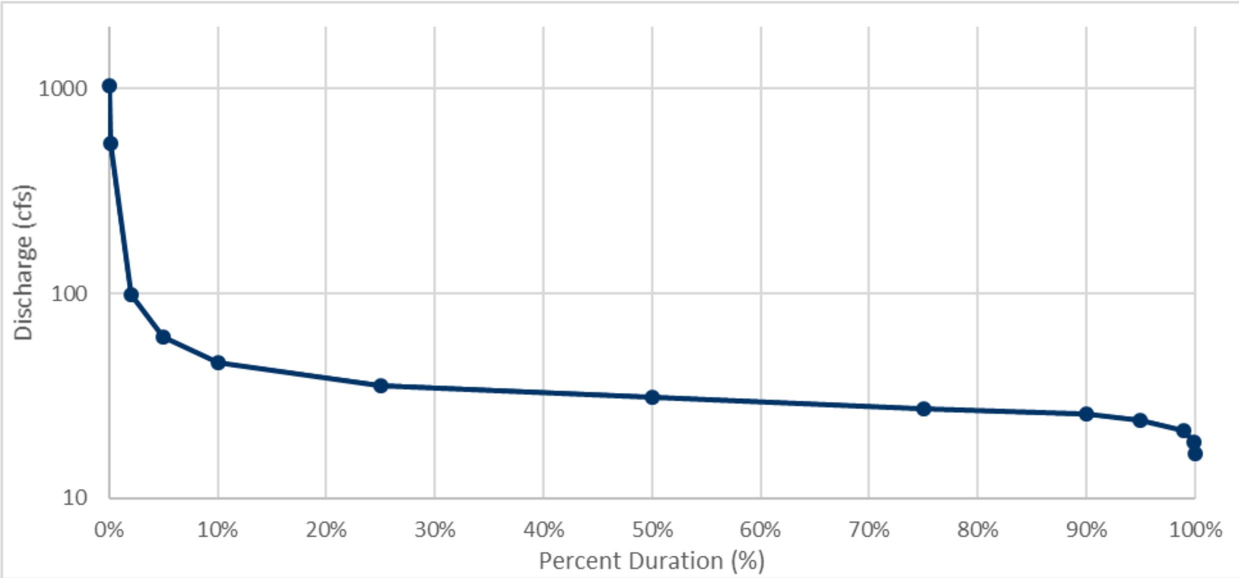

Figure A-1. Flow-Duration Curve for Pine Creek. Discharge values between the normal duration statistics were interpolated using loq-q-interpolation method (Ziegeweid et al. 2015).

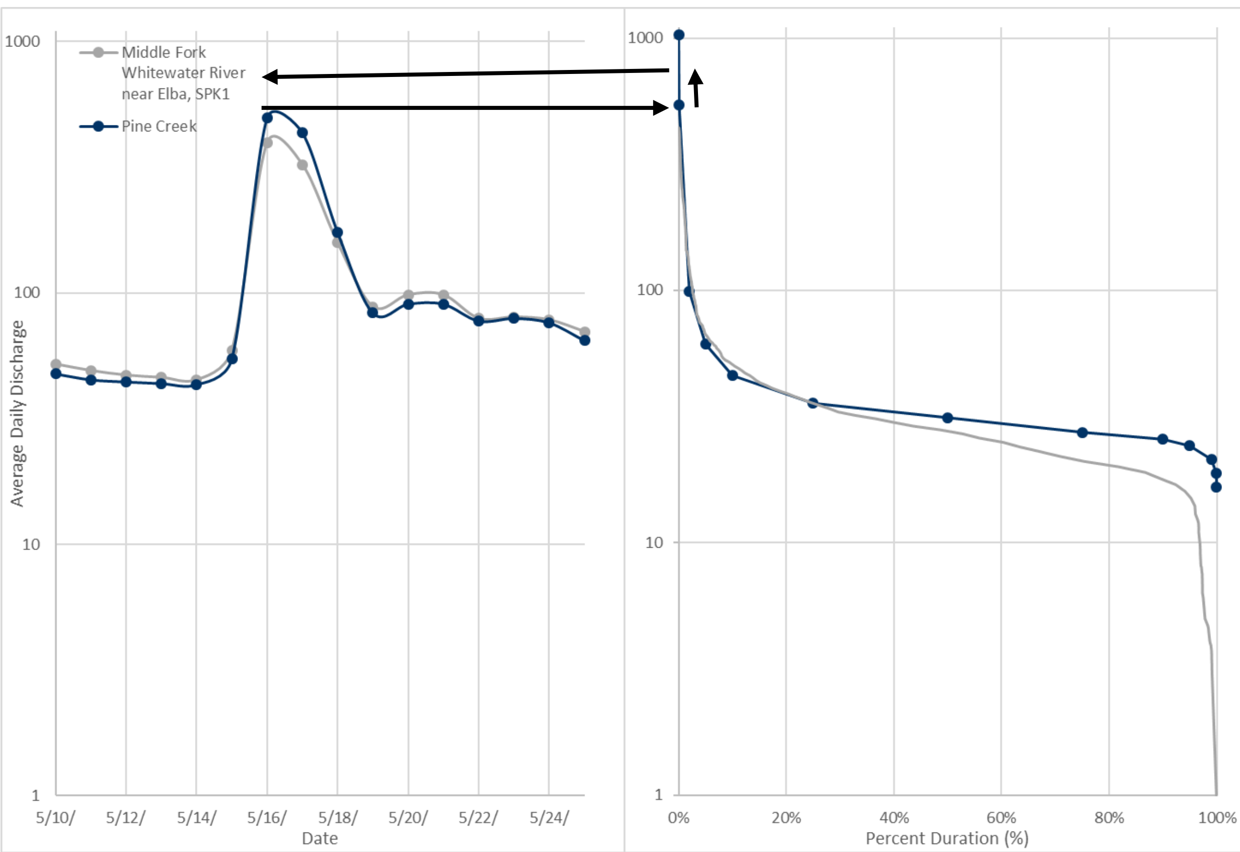

Figure A-2. Pine Creek Flow estimation using the QPPQ method (Lorenz and Ziegeweid 2016), transferring gaged flow from the Middle Fork Whitewater River near Elba, SPK1, MN, (MN40019001), (2013-2018) to flow at Pine Creek.