February 2022

Watershed

Final Rapid River Watershed Total Maximum Daily Load Study

A quantification of the amount of total suspended solids that can be received by the impaired Lower Rapid River and still maintain its ability to support healthy biological communities.

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

Authors

Trevor Rundhaug
Pat Conrad
Meghan Funke, PhD, PE
Sarah Grandstrand
Etoile Jensen, GISP

Contributors/acknowledgements

Mike Hirst, Lake of the Woods SWCD
Cary Hernandez, Minnesota Pollution Control Agency
Lori Clark, Minnesota Department of Natural Resources
Jason Vinje Minnesota Department of Natural Resources
Joe Vrtacnik, Lake of the Woods SWCD
Mike Sharp, Minnesota Pollution Control Agency
Elizabeth Nebgen, Minnesota Pollution Control Agency

Editing and graphic design

PIO staff
Graphic design staff
Administrative Staff

Cover photo credit: MPCA website

The MPCA is reducing printing and mailing costs by using the Internet to distribute reports and information to wider audience. Visit our website for more information.

The MPCA reports are printed on 100% post-consumer recycled content paper manufactured without chlorine or chlorine derivatives.

Document Number: wq-iw10-19e

Contents

List of tables

List of figures

Acronyms

AUID	Assessment Unit Identification
BMP	best management practice
BWSR	Board of Water and Soil Resources
cfs	cubic feet per second
CRP	Conservation Reserve Program
CSP	Conservation Stewardship Program
CSAH	County State Aid Highway
DNR	Minnesota Department of Natural Resources
HSPF	Hydrologic Simulation Program-Fortran
HUC	Hydrologic Unit Code
ITPHS	imminent threats to public health and safety
IWM	Intensive Watershed Monitoring
LA	load allocation
lb	pound
lb/day	pounds per day
LC	loading capacity
LOW	Lake of the Woods
m	meter
MAWQCP	Minnesota Agricultural Water Quality Certificate Program
MDA	Minnesota Department of Agriculture
mg/L	milligrams per liter
MnDOT	Minnesota Department of Transportation
MOS	Margin of Safety
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer Systems
NLCD	National Land Cover Dataset
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NVSS	Nonvolatile Suspended Solids
PWP	Permanent Wetland Preserve

RRW	Rapid River Watershed
TMDL	total maximum daily load
Tons/yr	tons per year
TSS	total suspended solids
SDS	State Disposal System
SSTS	Subsurface Sewage Treatment Systems
SWAG	Surface Water Assessment Grant
SWCD	Soil and Water Conservation Districts
USFWS	United States Fish and Wildlife Service
VSS	volatile suspended solids
WLA	wasteload allocation
WRAPS	Watershed Restoration and Protection Strategy
WRP	Wetland Reserve Program
WPLMN	Watershed Pollutant Load Monitoring Network
WWTP	wastewater treatment plant
USDA	U.S. Department of Agriculture
EPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

Executive summary

The Clean Water Act (1972) requires that each state identify and restore any waterbody that is deemed impaired for its designated beneficial use according to state regulations. In accordance with the Clean Water Act, states must perform Total Maximum Daily Load (TMDL) studies on their 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 TMDL study also allocates pollutant loads to all sources.

In 2017 and 2018, the Minnesota Pollution Control Agency (MPCA) and local partners conducted intensive watershed monitoring (IWM) of surface waters in the Rapid River Watershed (RRW) Hydrologic Unit Code (HUC) 09030007. The IWM effort sampled a total of 12 stream reaches in the RRW. Of the 12 stream reaches sampled, only the Lower Rapid River (Assessment Unit ID [AUID] 09030007-501) was assessed as being impaired. The Lower Rapid River was assessed as being impaired for aquatic life use due to high levels of total suspended solids (TSS). The Lower Rapid River's aquatic life use impairment has been submitted to the United States Environmental Protection Agency (EPA) for inclusion on the federal 2020 303(d) list of Minnesota's impaired waters.

This TMDL study addresses the TSS-related aquatic life use impairment on the Lower Rapid River. Information from multiple sources was used to evaluate the ecological health of the Lower Rapid River:

- All available water quality data from the TMDL study's 10-year time period (2010 through 2019) available from EQuIS
- 2016 update of the Rainy River Watershed Hydrologic Simulation Program – FORTRAN (HSPF) model (1996 through 2014)
- Rapid River (H-001-011) Initial Fisheries Stream Survey (Topp 2012)
- Published studies
- Stakeholder input

The following pollutant sources were evaluated for the Lower Rapid River: loading from stream bank erosion, point sources, and watershed runoff. This TMDL study used a load duration curve model for the impaired stream based on TSS concentration data from April through September during the TMDL study's 10-year time period of 2010 through 2019, paired with measured flows by date. These models were then used to determine the pollutant reductions needed for the impaired stream to meet water quality standards.

The main source of sediment in the Rapid River was determined to be from near-stream and stream bank erosion. The historical ditching in the watershed has significantly altered the watercourses in the watershed and, subsequently, the flow characteristics. As a result, the channel has become unstable with significant bank erosion and streambed material alteration as it adjusts to the altered conditions. The agricultural land surrounding the lower portions of the river may worsen these conditions. Point sources in the watershed were determined to contribute a small fraction of the total sediment load in the watershed. The TMDL study will not result in new or modified permit limits for point sources in the watershed.

The TMDL study's results aided in the selection of implementation strategies during the Rapid River 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. The Rapid River WRAPS Report is publicly available concurrently with this TMDL report on the MPCA RRW website: https://www.pca.state.mn.us/water/watersheds/rapid-river.

1. Project overview

1.1 Purpose

Section 303(d) of the federal Clean Water Act requires that TMDLs be developed for waters that do not support their designated uses. These waters are referred to as "impaired" and are listed in Minnesota's list of impaired water bodies. The term "TMDL" refers to the maximum amount of a given pollutant a water body can receive on a daily basis and still achieve water quality standards. A TMDL study determines what is needed to attain and maintain water quality standards in waters that are not currently meeting them. A TMDL study identifies pollutant sources and allocates pollutant loads among those sources. The total of all allocations, including wasteload allocations (WLAs) for permitted sources, load allocations (LAs) for nonpermitted sources (including natural background), and the margin of safety (MOS), which is implicitly or explicitly defined, cannot exceed the maximum allowable pollutant load.

In 2017 and 2018, the MPCA and local partners conducted IWM of surface waters in the RRW (HUC 09030007). The IWM effort sampled a total of 12 stream reaches in the RRW. Of the 12 stream reaches sampled, only the Lower Rapid River (AUID 09030007-501) was assessed as being impaired. The state of Minnesota has determined that the Lower Rapid River is impaired for aquatic life use because it exceeds established state water quality standards for TSS.

The MPCA has submitted the proposed Lower Rapid River aquatic life use impairment to the EPA for inclusion on the federal 2020 303(d) list of Minnesota's impaired waterbodies. In accordance with the Clean Water Act, a TMDL study must be conducted on the impaired water.

This TMDL study addresses the aquatic life use impairment in the Lower Rapid River Subwatershed (Figure 1). The goals of this TMDL study are to determine the Lower Rapid River's TMDL of TSS, to provide WLA and LA for pollutant sources within the RRW, and to quantify the pollutant reductions needed to meet Minnesota water quality standards.

In 2015, the MPCA began developing a TMDL study to address the aquatic recreation impairment of the Lake of the Woods (LOW). The LOW aquatic recreation impairment is due to harmful algal blooms resulting from excess nutrients being delivered to the lake from many sources. While the RRW TMDL is focused on TSS, any best management practices (BMP) applied to reduce TSS loading in the RRW would also reduce sediment-bound phosphorus and help achieve the phosphorus load reductions needed for the downstream LOW Excess Nutrients TMDL (MPCA 2021).

Other RRW studies completed that are referenced in this TMDL study include:

- Rapid River Initial Fisheries Stream Survey (Topp 2012)
- Rainy River HSPF Model
- Lower Rainy River and RRWs Monitoring and Assessment Report (Sigl et al. 2020)

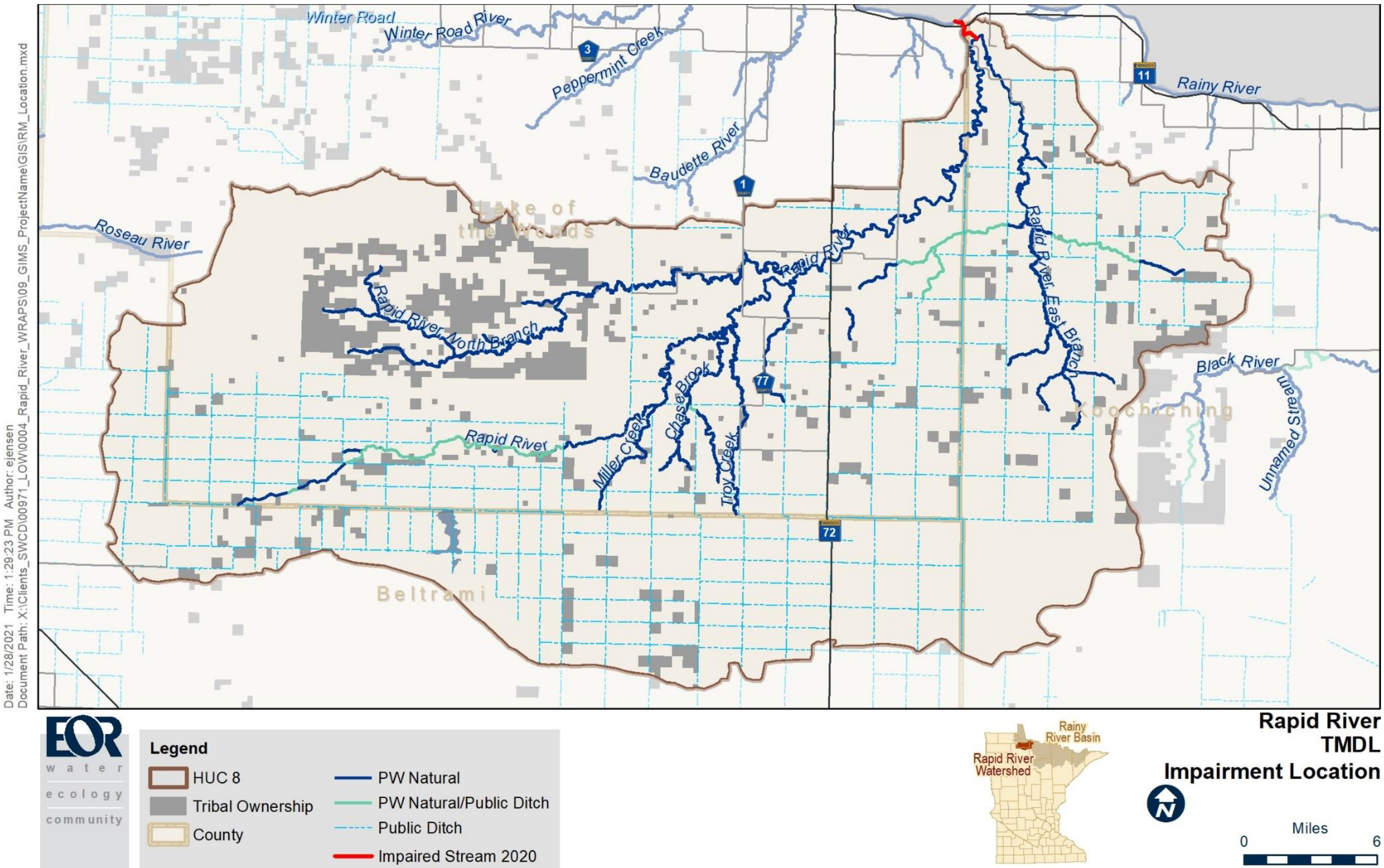


Figure 1. Impaired stream reach in the Rapid River Watershed.

1.2 Identification of waterbodies

Table 1 identifies and describes the stream impairment in the RRW. A TSS TMDL was calculated for this impaired reach to achieve compliance with Minnesota state water quality standards. The MPCA's TMDL process calculates TMDL endpoints to attain water quality standards at the most downstream endpoint of the impaired reach.

Table 1. Rapid River Watershed Impairments

Affected Use: Pollutant/Stressor	AUID[1]	Stream Name	Location/Reach Description	Designated Use Class	Proposed Listing Year	Impairment Addressed by:
Aquatic Life: Total Suspended Solids (TSS)	(09030007-501)	Lower Rapid River	E. Fork Rapid River to Rainy River	2Bg	2020	TSS TMDL

[1] Assessment Unit Identification (AUID)

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 cycle. The schedule for TMDL completion corresponds to the WRAPS report completion following on the 10-year IWM cycle. The MPCA developed a state plan 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 the water quality-impaired segment of the Rapid River that will be addressed by a TMDL by 2022. The RRW waterbody addressed by this TMDL study is part of that MPCA prioritization plan to meet EPA's national measure.

2. Applicable water quality standards and numeric water quality targets

Water quality standards are the fundamental regulatory and policy foundation to preserve and restore the quality of all waters of the state. They consist of three elements:

- Classifying waters with designated beneficial uses;
- Narrative and numeric standards to protect those uses; and
- Antidegradation policies to maintain existing uses, protect high-quality waters, and preserve waters of outstanding value.

2.1 Designated Uses

The beneficial uses for waters in Minnesota are grouped into one or more classes as defined in Minn. R. 7050.0140. The classes and associated beneficial uses are:

- Class 1 – domestic consumption
- Class 2 – aquatic life and recreation
- Class 3 – industrial consumption
- Class 4 – agriculture and wildlife
- Class 5 – aesthetic enjoyment and navigation
- Class 6 – other uses and protection of border waters
- Class 7 – limited resource value waters

The Class 2 aquatic life beneficial use includes a tiered aquatic life uses framework for rivers and streams. The framework contains three tiers—exceptional, general, and modified uses.

All surface waters are protected for multiple beneficial uses, and numeric and narrative water quality criteria are adopted into rule to protect each beneficial use. The TMDLs are developed to protect the most sensitive use of a water body.

2.2 Numeric criteria and state standards

Narrative and numeric water quality criteria for all uses are listed for four common categories of surface waters in Minn. R. 7050.0220. The four categories are:

- Cold water aquatic life and habitat, also protected for drinking water: Classes 1B; 2A, 2Ae, or 2Ag; 3; 4A and 4B; and 5
- Cool and warm water aquatic life and habitat, also protected for drinking water: Classes 1B or 1C; 2Bd, 2Bde, 2Bdg, or 2Bdm; 3; 4A and 4B; and 5
- Cool and warm water aquatic life and habitat and wetlands: Classes 2B, 2Be, 2Bg, 2Bm, or 2D; 3; 4A and 4B; and 5

- Limited resource value waters: Classes 3; 4A and 4B; 5; and 7

The narrative and numeric water quality criteria for the individual use classes are listed in Minn. R. 7050.0221 through 7050.0227. The procedures for evaluating the narrative criteria are presented in Minn. R. 7050.0150.

The MPCA assesses individual water bodies for impairment for Class 2 uses—aquatic life and recreation. Class 2A waters are protected for the propagation and maintenance of a healthy community of cold water aquatic life and their habitats. Class 2B waters are protected for the propagation and maintenance of a healthy community of cool or warm water aquatic life and their habitats. Protection of aquatic life entails the maintenance of a healthy aquatic community as measured by fish and macroinvertebrate indices of biotic integrity (IBIs). Fish and invertebrate IBI scores are evaluated against criteria established for individual monitoring sites by water body type and use subclass (exceptional, general, and modified).

Both Class 2A and 2B waters are also protected for aquatic recreation activities including bathing and swimming, and the consumption of fish and other aquatic organisms. In streams, aquatic recreation is assessed by measuring the concentration of *Escherichia coli* (*E. coli*) in the water, which is used as an indicator species of potential waterborne pathogens. To determine if a lake supports aquatic recreational activities, its trophic status is evaluated using total phosphorus (TP), Secchi depth, and chlorophyll-*a* as indicators. The ecoregion standards for aquatic recreation protect lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential.

2.3 Antidegradation policies and procedures

The purpose of the antidegradation provisions in Minn. R. ch. 7050.0250 through 7050.0335 is to achieve and maintain the highest possible quality in surface waters of the state. To accomplish this purpose:

- Existing uses and the level of water quality necessary to protect existing uses are maintained and protected.
- Degradation of high water quality is minimized and allowed only to the extent necessary to accommodate important economic or social development.
- Water quality necessary to preserve the exceptional characteristics of outstanding resource value waters is maintained and protected.

Proposed activities with the potential for water quality impairments associated with thermal discharges are consistent with Section 316 of the Clean Water Act, United States Code, Title 33, Section 1326.

2.4 TSS water quality standard

The TSS criteria for Minnesota are stratified by geographic region and stream class due to regional differences in geology and biological sensitivity differences based on stream size. The assessment window for these samples is April 1 through September 30, so any TSS data collected outside of this period will not be considered for assessment purposes. The TMDL Study Area is located in the Northern River Nutrient Region with a TSS standard for streams of 15 milligrams per liter (mg/L). For assessment, this concentration is not to be exceeded in more than 10% of samples collected within a 10-year data window (2010 through 2019). The TSS samples are analyzed by state-certified laboratories. The TSS load duration curve and TMDL were developed for one stream impairment.

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

3. Watershed and waterbody characterization

The RRW is located in the Rainy River Basin (Figure 1). The RRW, which covers 573,060 acres, is located in the Laurentian Mixed Forest Ecological Province of northern Minnesota, characterized by extensive wetlands, spruce bogs, and peatlands. Over 79% of the land in the RRW is owned or managed by state entities and approximately 9% of the land is owned by the Red Lake Band of Chippewa.

Like most of the Rainy River Basin, the RRW is characterized by extensive wetlands located on the Glacial Lake Agassiz lakebed. Soils mostly consist of sandy loams, with considerable deposits of glacial till and outwash over a bedrock residuum. The RRW is generally sloped to the northeast. The highest elevations are at approximately 1,310 feet above sea level and the lowest elevations are approximately at 1,060 feet above sea level where the Rapid River and the Rainy River meet (USDA NRCS).

Major alterations to natural conditions in the RRW began after the passage of the Volstad Act of 1908. The act gave property owners the ability to petition the District Court to force the county to dig ditches to drain their land (Alsop 2009). Over the next decade, approximately 657 miles of ditches were built and portions of the South and East Branch of the Rapid River were channelized (Figure 3) (Topp 2012). According to the MPCA, 72% of the watercourses of the RRW have been altered by ditching or straightening. Unfortunately, the majority of the ditches failed to drain the soils sufficiently to support agriculture due to the presence of beaver dams and the general flatness of the land. After 1919, no more ditches were dug in the area and property owners stopped paying the taxes that were supposed to pay off the debt from the ditching efforts. By 1927, the tax delinquency rate reached 77% and Minnesota passed a law to turn over all tax-delinquent land back to the state. The ditches and the high percentage of publicly owned land remain as the two major land management factors that characterize the RRW.

Today, as with many areas of northern Minnesota, principal industries include forest product harvesting, forest product manufacturing, farming, and tourism. Much of the land in the RRW is not suited, or is poorly suited, to agricultural uses. Wetlands make up most (97%) of the RRW, while agriculture accounts for only 2% of the total area. Development pressure is low throughout the RRW, with occasional lands being parceled out for timber production or recreational use.

There are several large tracts of land within the RRW owned by various tribal groups, primarily the Red Lake Band of Chippewa Indians (Figure 2). These tribal lands total 52,887 acres, or roughly 9% of the entire watershed. In January 2020, the MPCA sent letters to the Bois Forte Band of Chippewa, the Fond du Lac Band of Lake Superior Chippewa, the Leach Lake Band of Ojibwe, the Minnesota Chippewa Tribe, and the Red Lake Band of Chippewa Ojibwe, which briefly explained the TMDL and WRAPS and invited the tribal contacts to partner with the MPCA on the projects.

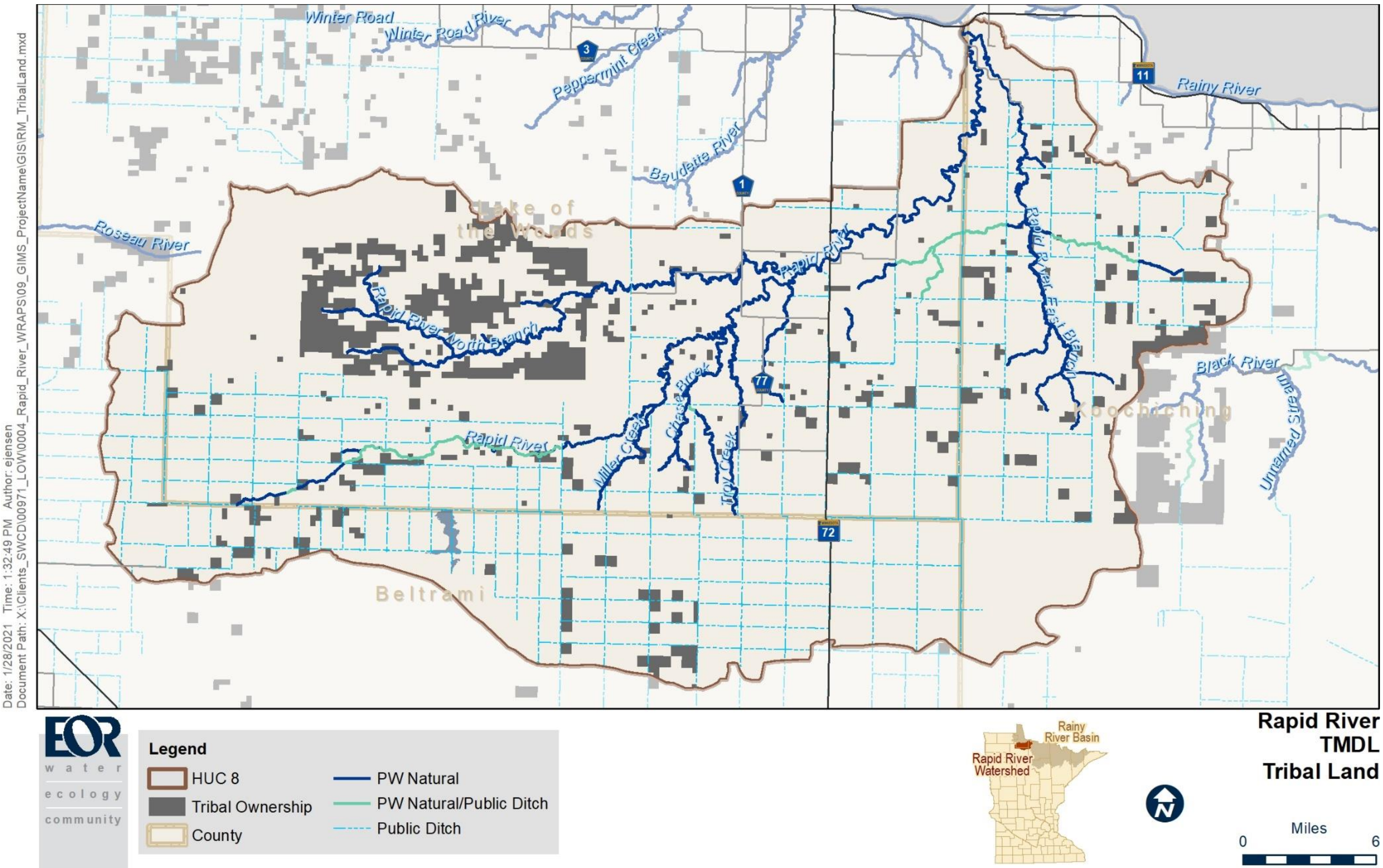


Figure 2. Tribal lands in the Rapid River Watershed.

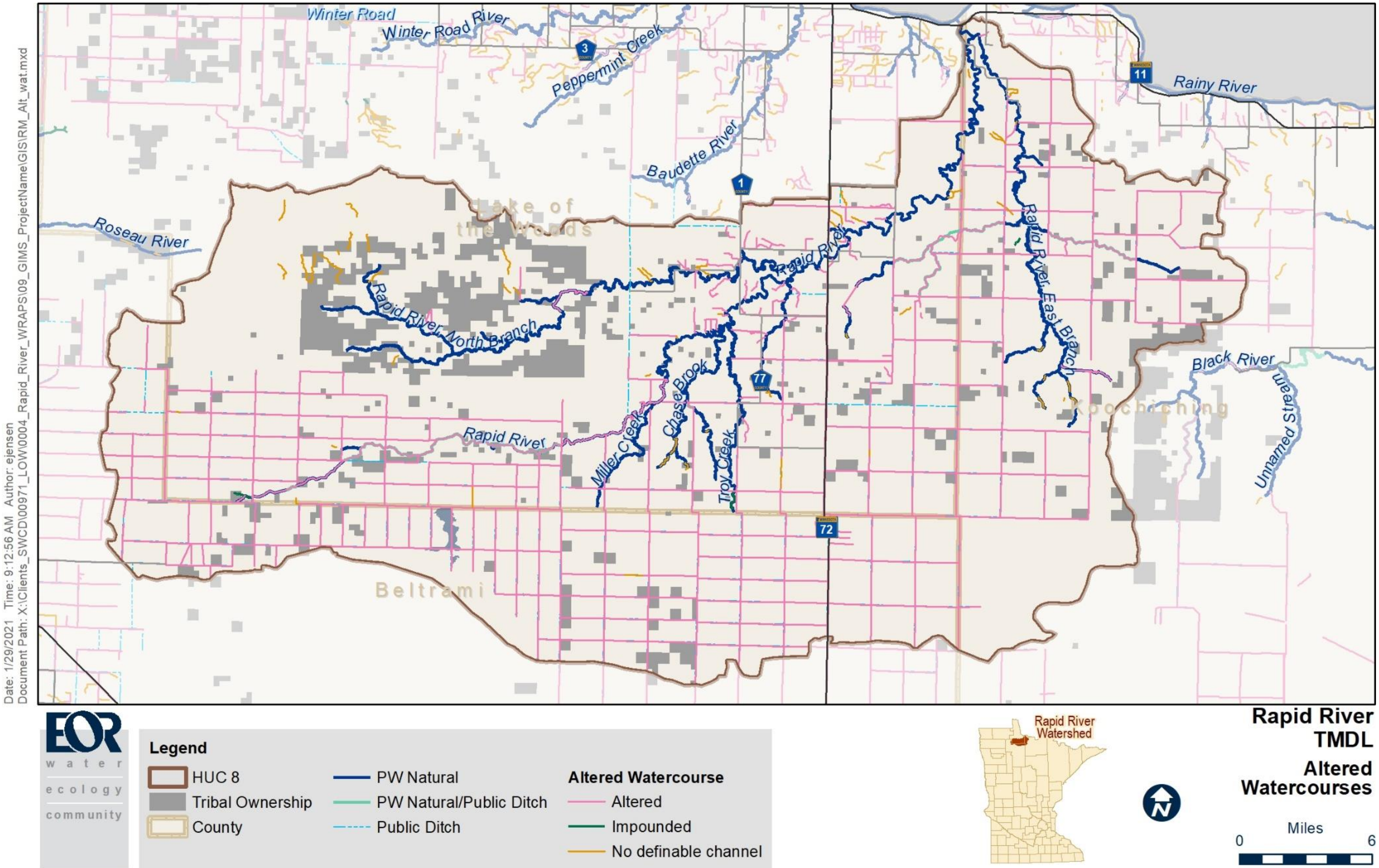


Figure 3. Altered watercourses in the Rapid River Watershed.

3.1 Streams and Subwatersheds

Direct and total drainage areas for the impaired stream reach are listed in Table 2. Direct drainage areas were delineated using the RRW HSPF Model subwatersheds. The direct drainage area includes the area draining directly to the impaired reach. The flow through the watershed is characterized in Figure 4. Directly upstream of the impaired stream reach, the Rapid River has two branches: the main branch of the Rapid River to the west and the East Branch of the Rapid River to the east. The majority of the flow comes from the main branch of the Rapid River. Further upstream, the North Branch of the Rapid River splits off from the main branch. The North Branch of the Rapid River is unique in that ditches are not as widespread as in the rest of the RRW. The percentage of altered streams, which includes ditches and reaches that have been straightened in each HUC-10 subwatershed, is shown in Table 3. The subwatersheds and direct drainage area to the impaired stream are shown in Figure 5.

Table 2. Impaired Stream Reach Direct Drainage and Total Watershed Area

Impaired Reach (AUID)	Name/Description	Direct Drainage Area (ac)	Upstream AUID	Total Drainage Area (ac)
09030007-501	Lower Rapid River (E. Fork Rapid River to Rainy River)	442	(-509) & (-502)	603,844

Assessment Unit Identification (AUID)

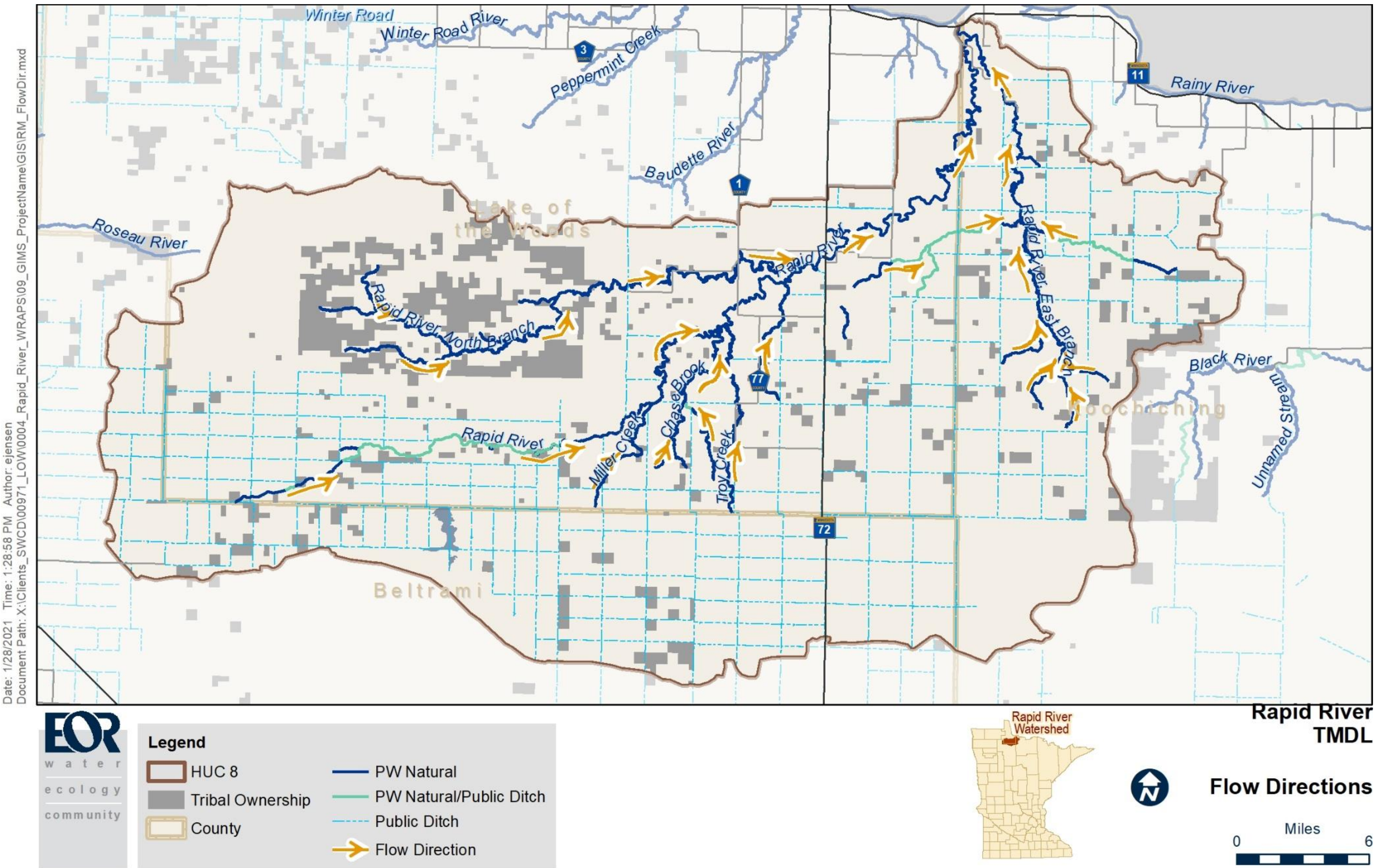


Figure 4. Flow directions in the Rapid River Watershed.

Table 3. Watercourse Types in the Rapid River Watershed

HUC-10 Subwatershed	Subwatershed Acres	Altered	Natural	Impounded	No Definable Channel
East Fork Rapid River	172,661	76.3%	21.1%	0.1%	2.4%
Lower Rapid River	68,098	73.6%	23.2%	0.0%	3.1%
Middle Rapid River	110,791	67.7%	29.7%	0.4%	2.2%
North Branch Rapid River	118,356	14.0%	71.5%	0.0%	14.5%
Upper Rapid River	133,935	95.0%	4.0%	0.3%	0.7%

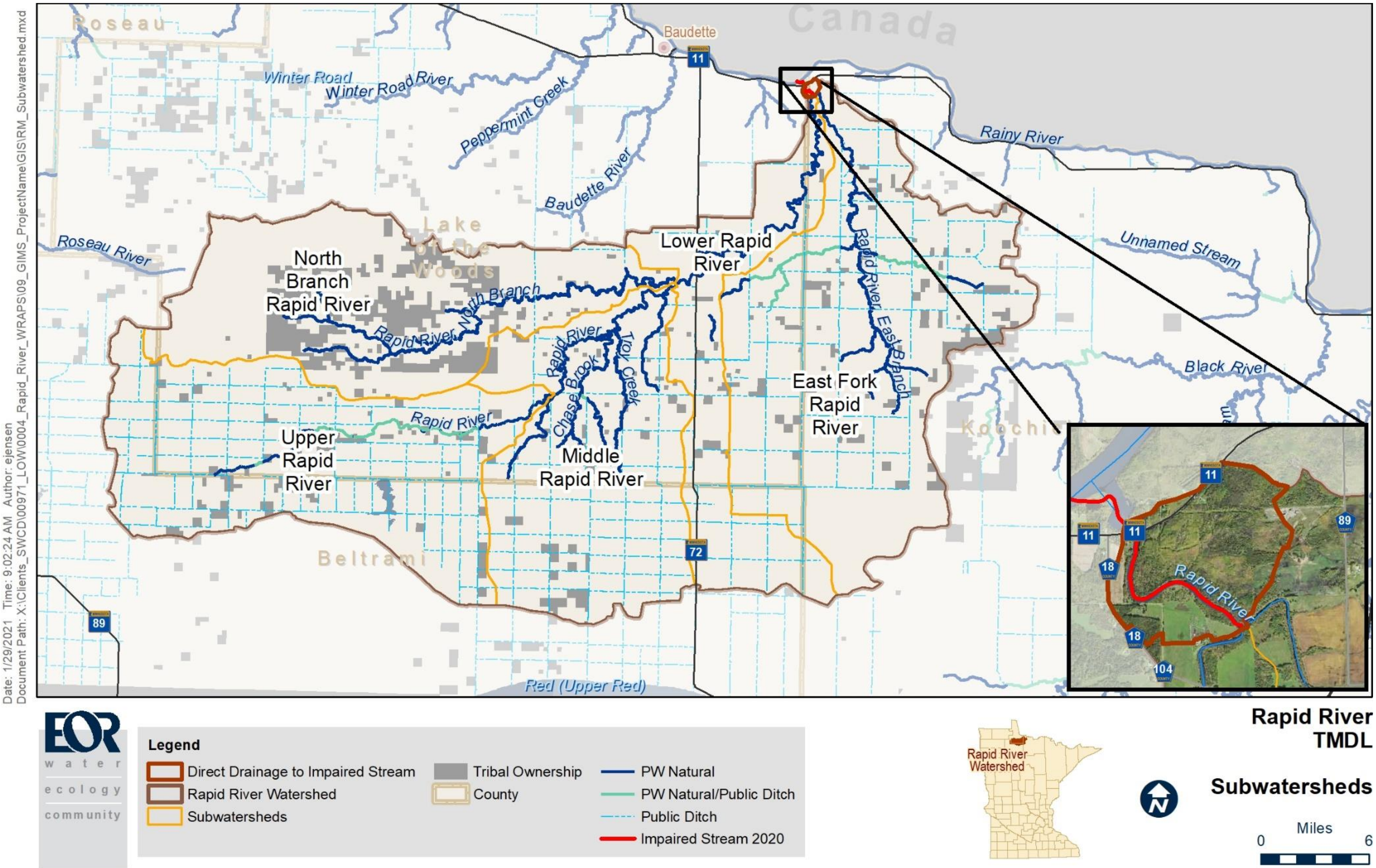


Figure 5. Subwatersheds in the Rapid River Watershed.

3.2 Land use

Land cover in the RRW was assessed using the 2016 National Land Cover Dataset ([NLCD] MLRC 2016). This information is necessary to draw conclusions about pollutant sources and BMPs that may be applicable within each subwatershed.

The land cover distribution within the entire RRW and the direct drainage area to the impaired stream reach is summarized in Table 4 and Figure 6. These data were simplified to reduce the overall number of categories. Wetlands include woody wetlands and emergent herbaceous wetlands. Developed lands include developed open space, and low, medium, and high intensity developed areas. Forest includes deciduous forest, evergreen forest, and mixed forest. Agriculture includes cultivated crops and pasture/hay.

The primary land covers within the RRW are wetlands (97%). The wetlands in the RRW are part of the Red Lake Peatland. The Red Lake Peatland contains many peatland landforms such as, large highly-developed water tracks containing alternating ridges and pools, together with islands of various shapes and sizes (Glaser et al. 1981). Figure 7 shows examples of these landforms in the RRW.

The direct drainage area to the impaired stream reach still has 76% of the drainage area as wetlands; however, agriculture and developed lands make up larger percentages, 14% and 4% respectively, than that of the entire RRW.

Table 4. Rapid River Watershed and Impaired Streams Direct Drainage Area Land Cover (MLRC 2016).

Drainage Area	Drainage Area (acres)	Land Cover (% of drainage area)					
		Wetlands	Open Water	Forest	Developed Land	Shrubland/ Grassland	Agriculture
Direct Drainage Area to Impaired Stream	441	76%	5%	<1%	4%	1%	14%
Rapid River Watershed	603,843	97%	<1%	<1%	1%	<1%	2%

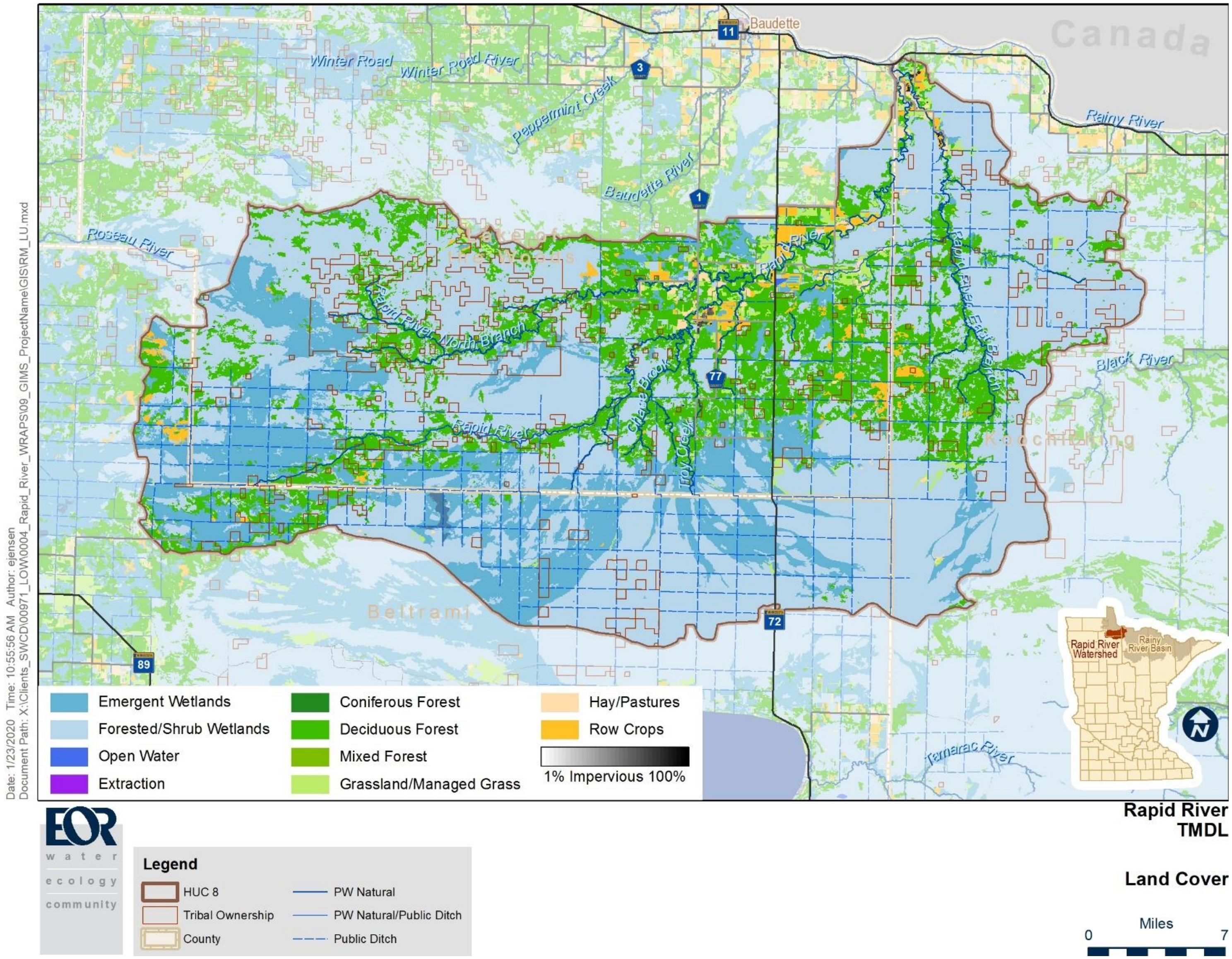


Figure 6. Land cover (NLCD 2016) in the Rapid River Watershed (MLRC 2016).

Figure 7. Peatland landforms in the Rapid River Watershed.

3.3 Current/historical water quality

Sediment transport in a watershed is a naturally occurring process that shapes the landscape. Human activities, such as agriculture, can augment this natural process. In the RRW, the sediment transport process has been altered by logging, agriculture, and historical flow alteration caused by significant ditching in the watershed. High levels of sediment in streams can harm fish and other aquatic life. The IWM effort did not collect fish or macroinvertebrate data in the impaired stream reach (Sigl et al. 2020); however, data collected in the immediate upstream reach (AUID 09030007-502) showed that both fish and macroinvertebrate scores were above their relevant standards, suggesting good conditions for aquatic life in the lowest reaches of the Rapid River.

The RRW monitoring network consists of 7 water quality monitoring stations, 26 biological monitoring stations, and two long-term stream gages (Figure 8). For this TMDL, TSS data were summarized using data from Station S000-184, which is located in the impaired stream reach and is sampled approximately once per week as part of MPCA’s Watershed Pollutant Load Monitoring Network (WPLMN).

The TSS data collected at Station S000-184 for the period of 2010 through 2019 were compared to the water quality standards described in Section 2.4. The percentage of TSS exceedances was greater than the allowable exceedance rate of 10% at the one monitoring site on the Lower Rapid River.

The TSS concentrations in the RRW have a strong increasing relationship with flow (coefficient of determination of 0.586 and a p-value less than 0.001), because the stream has more energy to carry sediment at higher flows (Figure 9). The TSS-discharge relationship is further evident in monthly TSS concentrations and annual TSS concentrations (Figure 10 and Figure 12). Throughout the year, TSS concentrations are typically highest from April through June, when the flow is typically highest (Figure 11). The only month with TSS concentrations below the TSS standard is August, which happens to have the lowest monthly average flow.

The purpose of the TSS standard is to limit harm to fish communities by limiting the concentration of nonvolatile suspended solids (NVSS) in streams. The soils in the RRW have a significant percentage of organic matter, which is considered volatile and less of a concern for aquatic life. The NVSS concentrations of the TSS samples were calculated by subtracting the volatile suspended solids (VSS) concentration from the TSS concentration. The NVSS concentrations were then compared to the TSS standard to determine if they would exceed the TSS standard. Twenty-eight percent of the samples collected had NVSS concentrations greater than the TSS water quality standard; therefore, the TSS concentrations in the Rapid River are likely harmful to the river’s aquatic life. Figure 13 shows the VSS distribution with TSS. The NVSS portion increases with increasing TSS concentrations, further supporting the need for a TSS TMDL in the Rapid River.

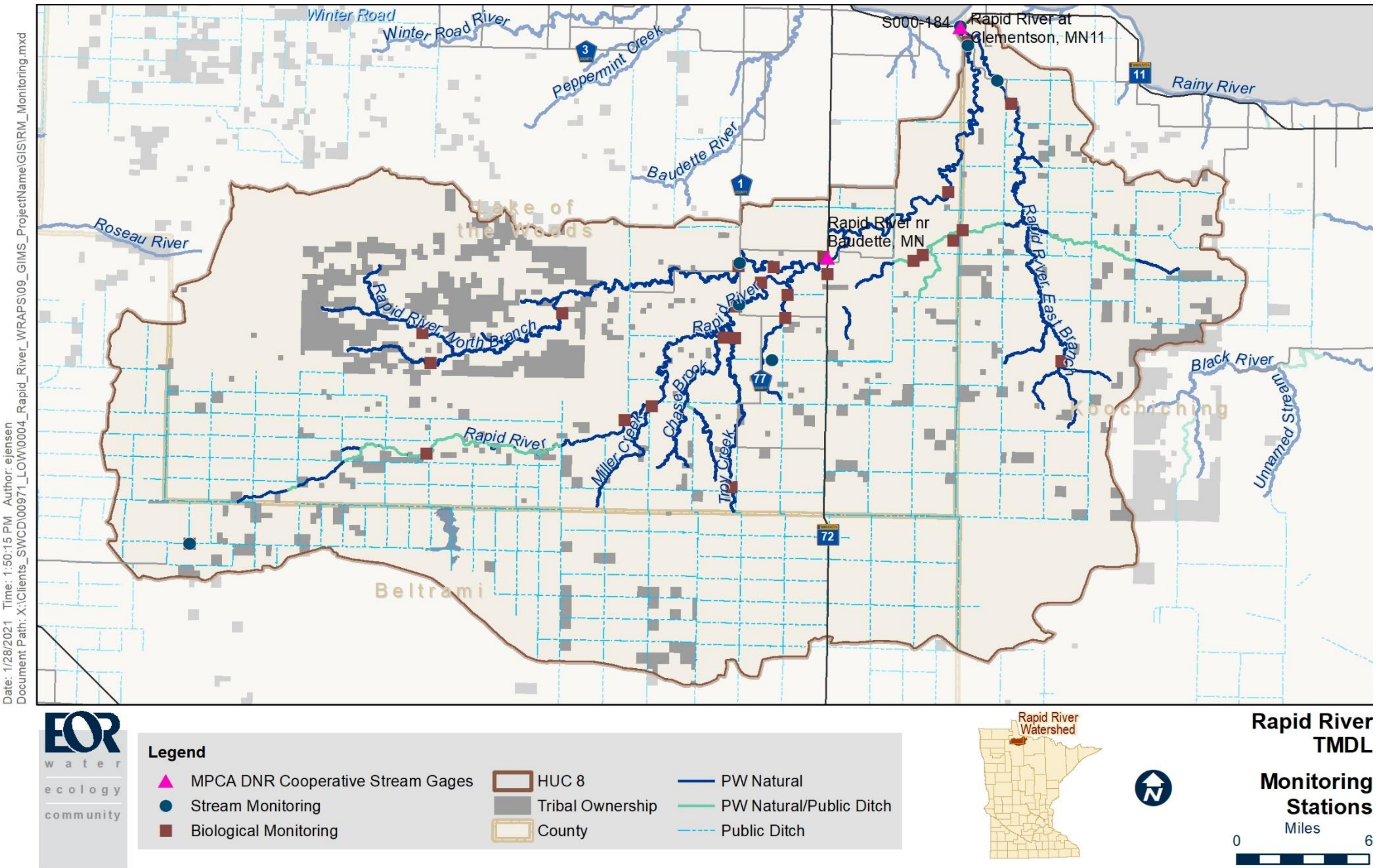


Figure 8. Monitoring locations in the Rapid River Watershed.

Table 5. Observed TSS Exceedances from April to September (2010-2019)

Impaired Reach (AUID)	Monitoring Station	Number of Samples	Number of Exceedances (> 15 mg/L)	Percentage of Exceedances	90th Percentile Concentration (mg/L)
Lower Rapid River (09030007-501)	S000-184	212	83	39%	36.9

Assessment Unit Identification (AUID)

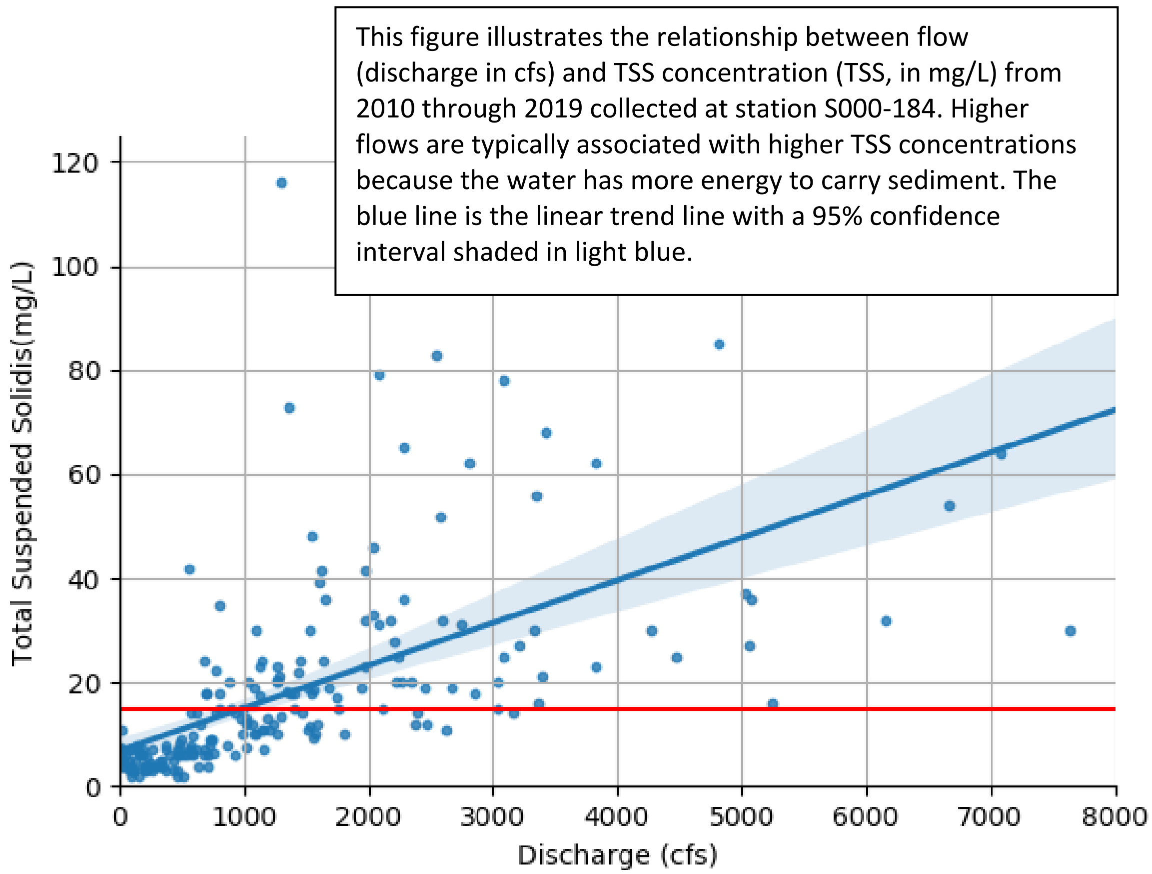


Figure 9. Relationship between discharge and TSS.

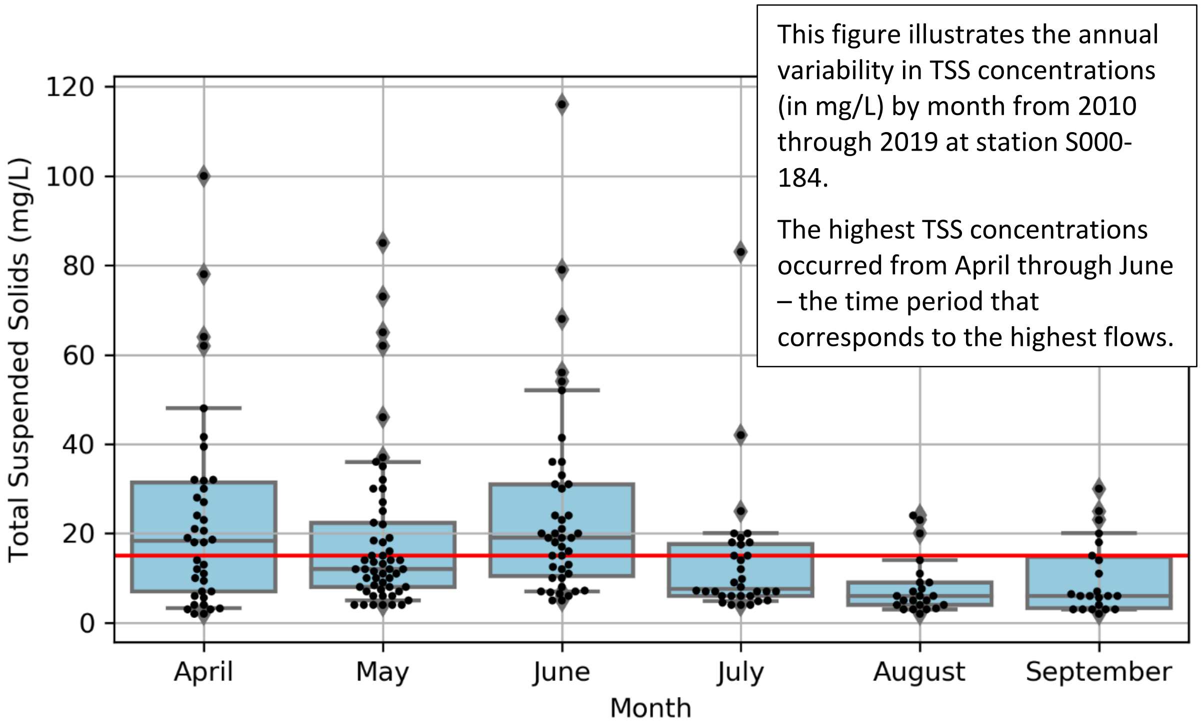


Figure 10. Monthly TSS concentrations (2010-2019). The whiskers represent the 10th and 90th percentiles.

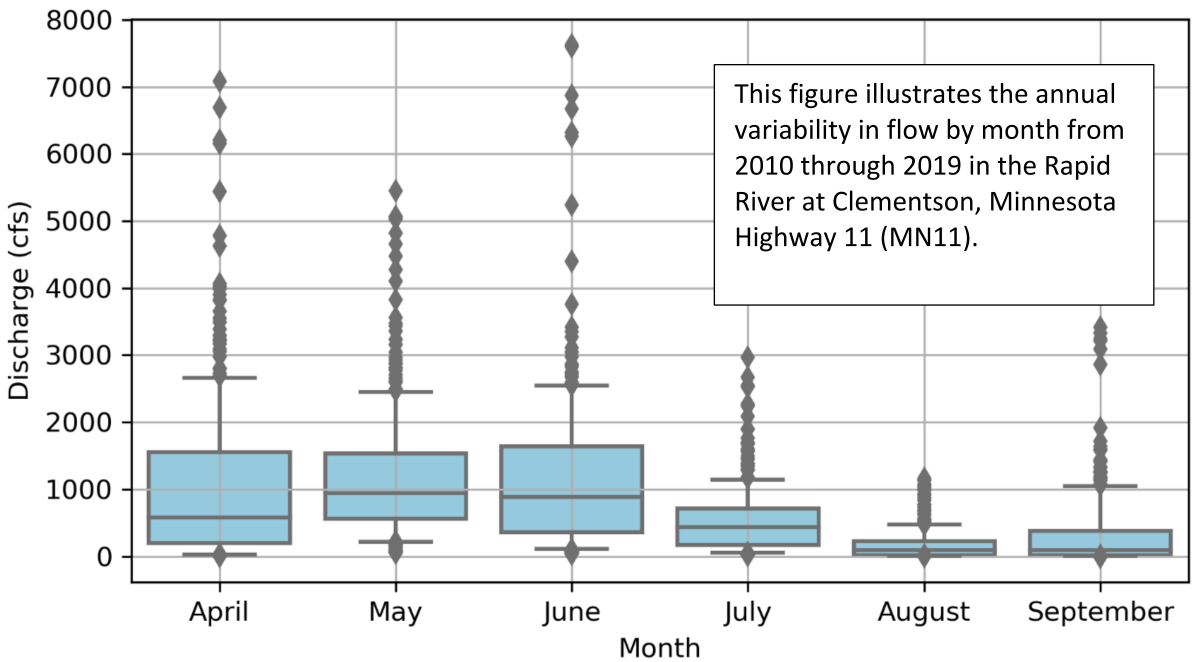


Figure 11. Monthly flow (2010-2019) of the Rapid River at Clementson, MN11 (78007001). The whiskers represent the 10th and 90th percentiles. The boxplots were created using daily flow values.

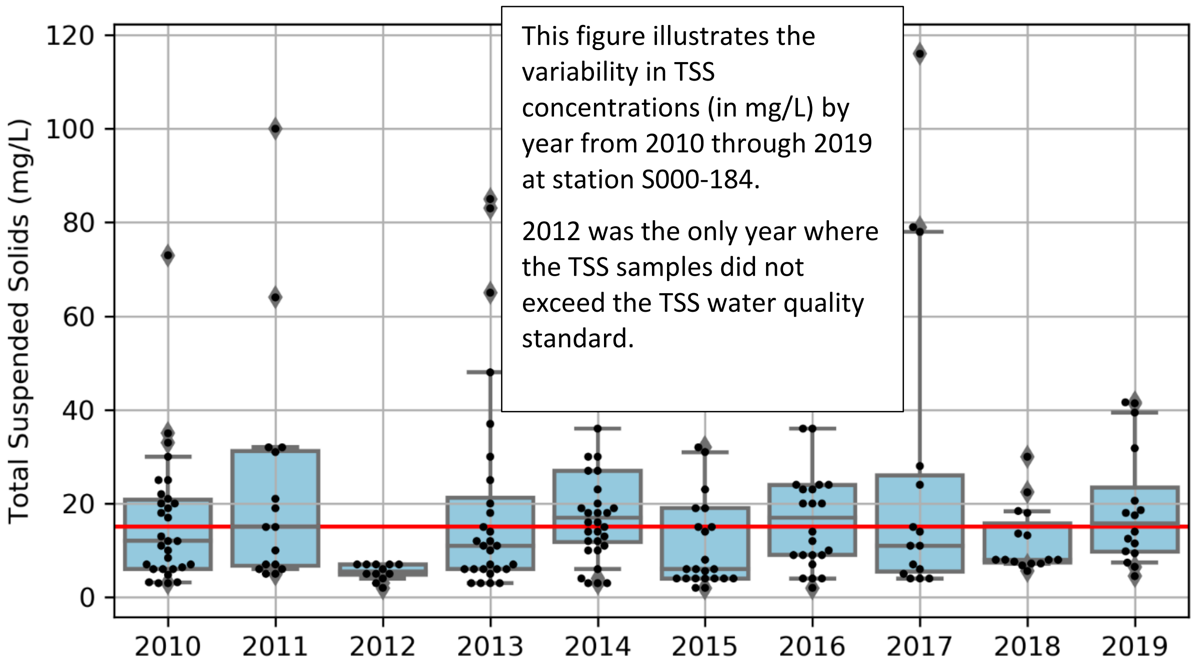


Figure 12. Annual TSS (2010-2019). The whiskers represent the 10th and 90th percentiles.

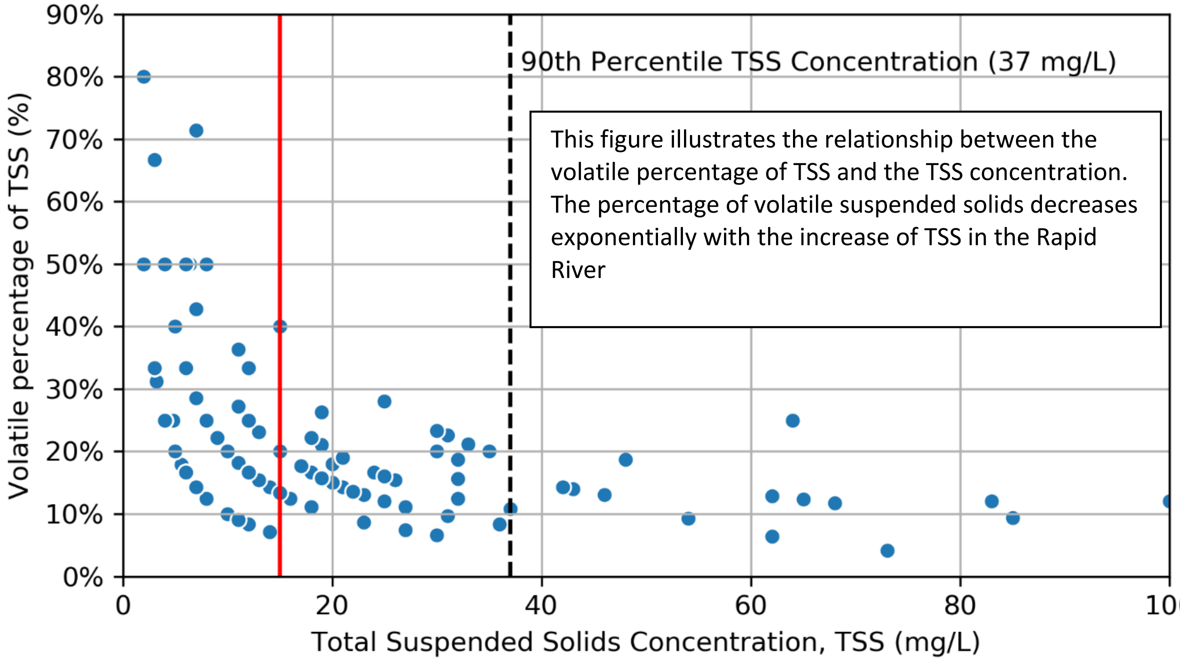


Figure 13. The portion of volatile suspended solids as a percentage of TSS compared to the TSS concentrations for monitoring station S000-184. The red line is the water quality standard.

3.4 Pollutant source summary

3.4.1 Permitted Source Types

Regulated sources of pollutants include wastewater treatment plant (WWTP) effluent, construction stormwater, industrial stormwater, and nonmetallic mining stormwater. Pollutant loads from National

Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) permitted wastewater and stormwater sources were accounted for using the methods described in Section 4.1.3.

3.4.1.1 Regulated Stormwater

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, soil, deposited particulates from air, road salt, and oil and grease from vehicles. There are three possible types of regulated stormwater.

Regulated Municipal Stormwater

Currently, there are no regulated municipal stormwater entities in the RRW. Municipal stormwater can be regulated under the municipal separate storm sewer system (MS4) program, which may require regulated municipalities to implement BMPs that reduce pollutants in stormwater to the maximum extent practicable.

Regulated Construction Stormwater

Construction stormwater is regulated by NPDES/SDS 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

Currently, there are no sites in the RRW regulated through the stormwater general permit. Industrial stormwater is regulated by NPDES/SDS 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/SDS industrial stormwater permit coverage is required.

Regulated Nonmetallic Mining Stormwater

Currently there are two sites in the RRW covered under the nonmetallic mining general permit (MNG490000) (Figure 14). Nonmetallic mining is regulated by NPDES/SDS permits if the facility discharges stormwater, mine site dewatering, or nonstormwater discharges to waters of the state. 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/SDS nonmetallic mining permit coverage is required.

3.4.1.2 Regulated Municipal and Industrial Wastewater

Municipal wastewater is the domestic sewage and wastewater collected and treated by municipalities before being discharged to waterbodies as municipal wastewater effluent. There are no municipal or industrial WWTPs that discharge to any of the waterbodies in the RRW.

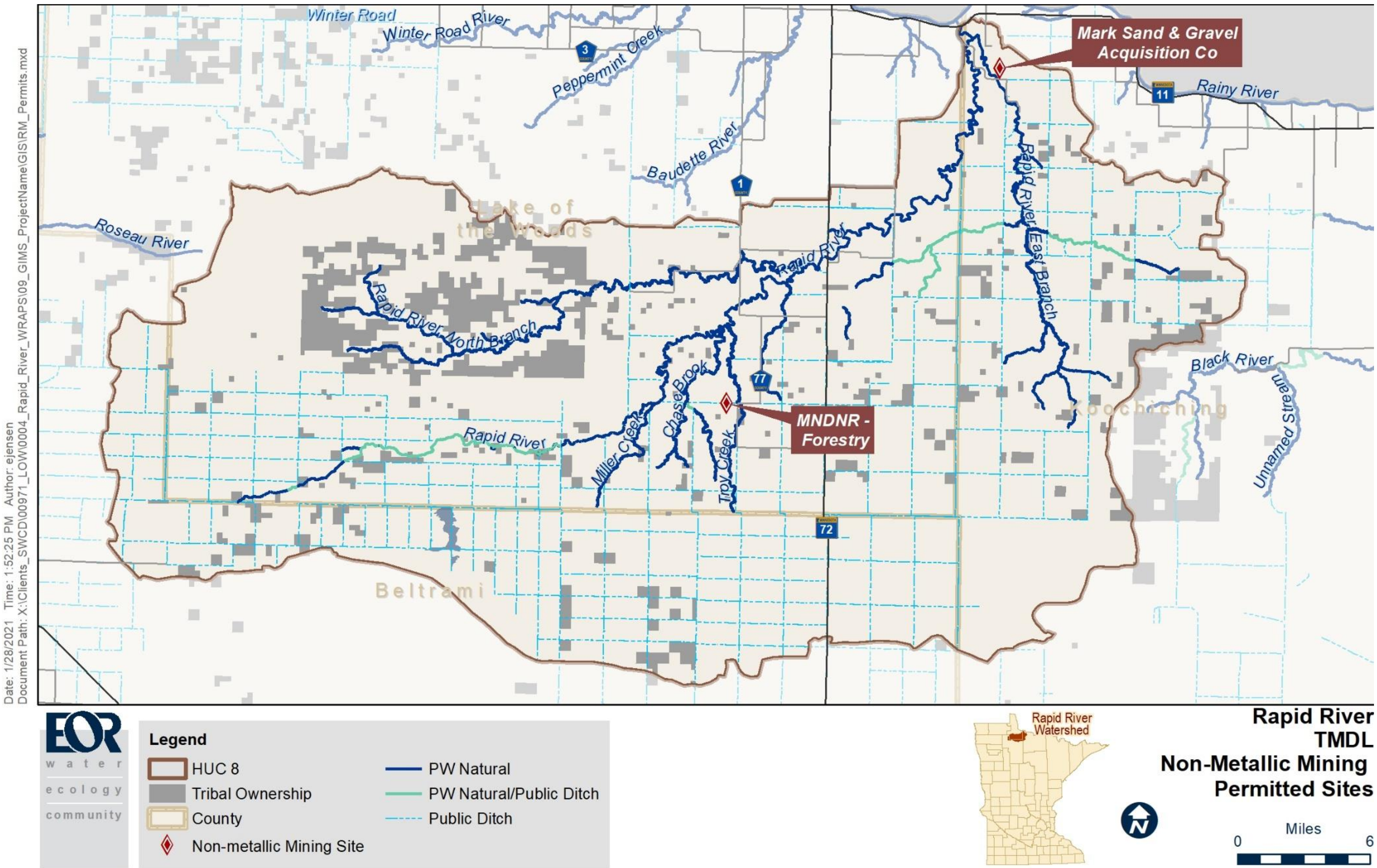


Figure 14. Nonmetallic mining permitted sites in the Rapid River Watershed.

3.4.2 Nonpermitted Source Types

An HSPF model of the RRW was used to estimate nonpermitted sources of TSS in the RRW. The HSPF model generates overland runoff flows on a daily time step for 30 subwatersheds (average area 20,136 acres per subwatershed) in the RRW based on land cover and soil type. Model outputs were based on the 2016 update which was based on 2010 land uses developed for the entire LOW drainage area, including Canada, and calibrated over the 1996 through 2014 time period. The 19-year (1996 through 2014) average annual runoff coefficient and sediment yield were estimated for the RRW (Figure 15 and Figure 16). The average annual runoff coefficient represents the predicted average percentage of rainfall that becomes streamflow each year. Subbasins with higher runoff coefficients are more likely to contribute a higher amount of pollutants downstream. The sediment yield is the amount of sediment exported to the downstream subbasin per area of the subbasin. The highest sediment yields were predicted along the main reach of the Rapid River near Highway 72. Sediment in the stream is not a conservative process and; therefore, sediment can be stored or released in the stream depending on flow. Each subbasins delivered sediment yield was calculated to determine which subbasins contribute the most sediment to the impaired stream reach (Figure 17). The delivered sediment yield accounts for the natural processes that occur as the sediment moves downstream. The largest sediment yields contributing to the impaired stream reach are the sub-basins near Highway 72 and the subbasins directly upstream. The sediment exported from the subbasins directly upstream are less likely to be stored in the stream prior to reaching the impaired stream reach.

In addition to identifying the subbasins which contribute the most sediment, the HSPF model also predicts the sources of sediment based on land use and point sources. The two dominant sources of sediment to the impaired stream reach were stream bank erosion and wetlands (Figure 18). Stream bank erosion is discussed in the following paragraph. Wetlands were the second-highest source of sediment because they were the primary land use in the watershed. It should be noted that the HSPF model uses a land cover data set that was developed by University of Minnesota Remote Sensing and Geospatial Analysis Lab. This land cover data set varies from the MLRC data presented in Table 4. The most notable difference is in the distribution of wetland and forest land. The MLRC estimates the watershed to be 97% wetland and less than 1% forest whereas the land cover data set used in the HSPF estimated the watershed at 79% wetland and 16% forest.

As with any model, HSPF does have some limitations that can impact the results. First it requires extensive data requirements to build a model, and inaccuracies can occur in tributaries with little to no monitoring data. Second, the model is a lumped parameter model, meaning subwatershed parameters are grouped into large areas and site-scale variability is lost, which extends to the stream cross sections as well. The variability in stream cross sections is important for accurately predicting flow and sediment transport in streams. Third, the model assumes one-dimensional flow. This extends to the stream erosion process, which is only modeled to occur in the stream bed and not the stream banks. Fourth, there is a lack of comprehensive parameter guidance and most of the parameters are empirical. Therefore, an HSPF model can be calibrated to fit any dataset even though the model may not be accurately modeling individual processes.

In 2010 and 2011, the Minnesota Department of Natural Resources (DNR) conducted an in-depth fisheries study of the RRW (Topp 2012). As part of this study, the DNR evaluated the stream bank conditions at eight sites. They determined that six of the eight sites had poor channel stability, seven of the eight sites had bank erosion hazard indices of high- or extreme high- entrenchment ratios, and high width-to-depth ratios in most stream reaches. The poor conditions of the streams in the RRW are a result of the extensive alteration from ditches, channel straightening, and lack of floodplain connectivity and the resulting change in flow in the watershed. Compared to other watersheds in the Rainy River Basin, the bankfull flow in the Rapid River was determined to be part of a higher-flow group of tributaries in the watershed that corresponded to more hydrologically altered and agricultural watersheds (Anderson et al. 2006). Bankfull flow is the streamflow that defines the size and shape of the channel. More frequent bankfull flows lead to an increase in stream bank erosion. The HSPF-predicted sediment yield from streambank erosion is concentrated along the main branch of the Rapid River from the confluence with the North Branch of the Rapid River to the outlet of the RRW (Figure 19).

Natural Background

"Natural background" is defined in both Minnesota statute and rule. The Clean Water Legacy Act (Minn. Stat. § 114D.15, 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." Minn. R. 7050.0150, subp. 4, states, "'Natural causes' means the multiplicity of factors that determine the physical, chemical, or biological conditions that would exist in a water body in the absence of measurable impacts from human activity or influence."

Natural background sources are 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, and wetlands. However, 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 water body assessment process. Natural background conditions were evaluated within the source assessment portion of this study. These source assessment exercises indicate that natural background inputs are generally low compared to, cropland, streambank erosion, and other anthropogenic sources.

Based on the MPCA's water body 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 water bodies' ability to meet state water quality standards.

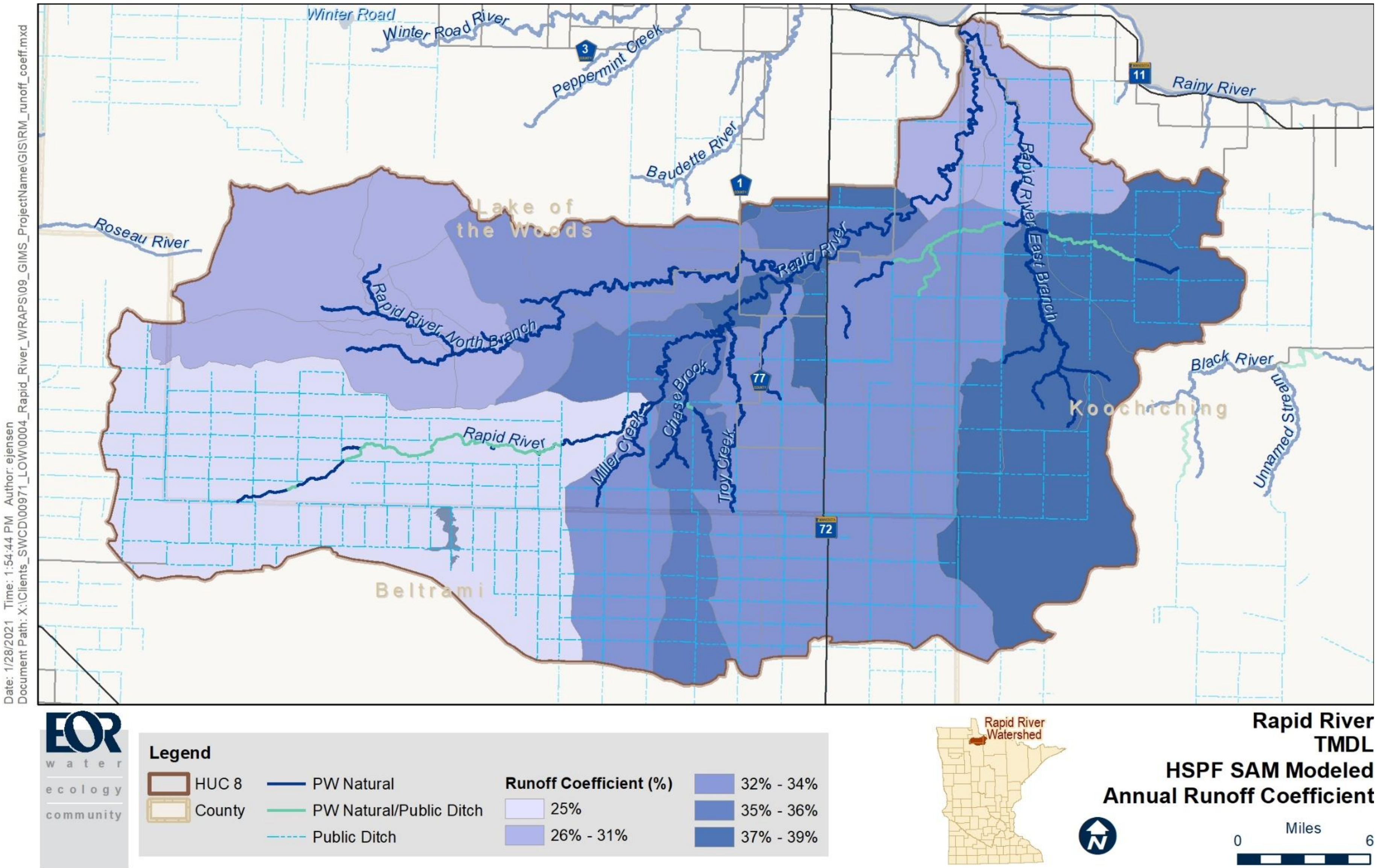


Figure 15. HSPF-modeled subbasin annual runoff coefficients (%) in the Rapid River Watershed (Data retrieved 04/06/2020).

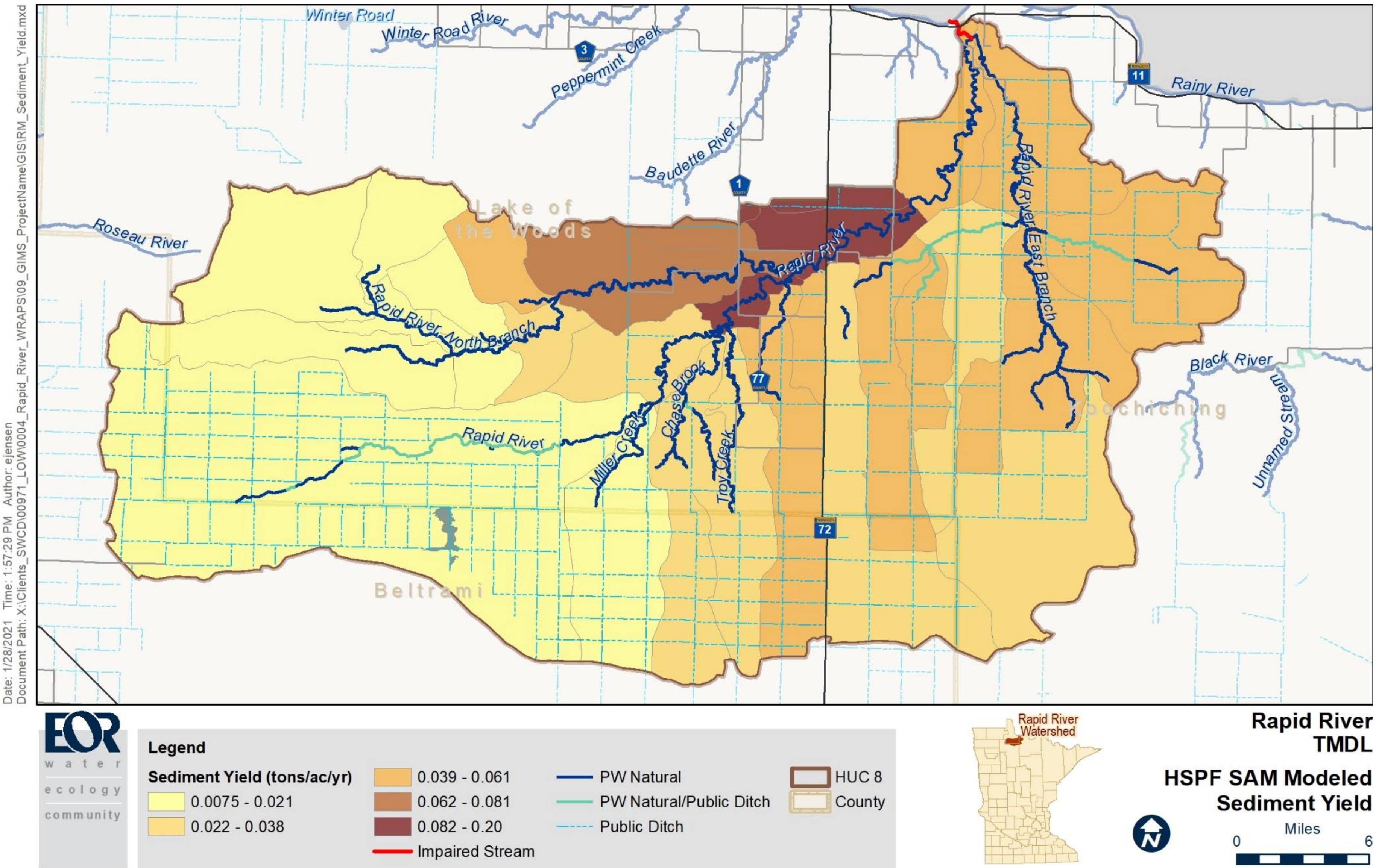


Figure 16. HSPF-modeled subbasin sediment yield (tons/ac/yr) in the Rapid River Watershed (Data retrieved 04/06/2020).

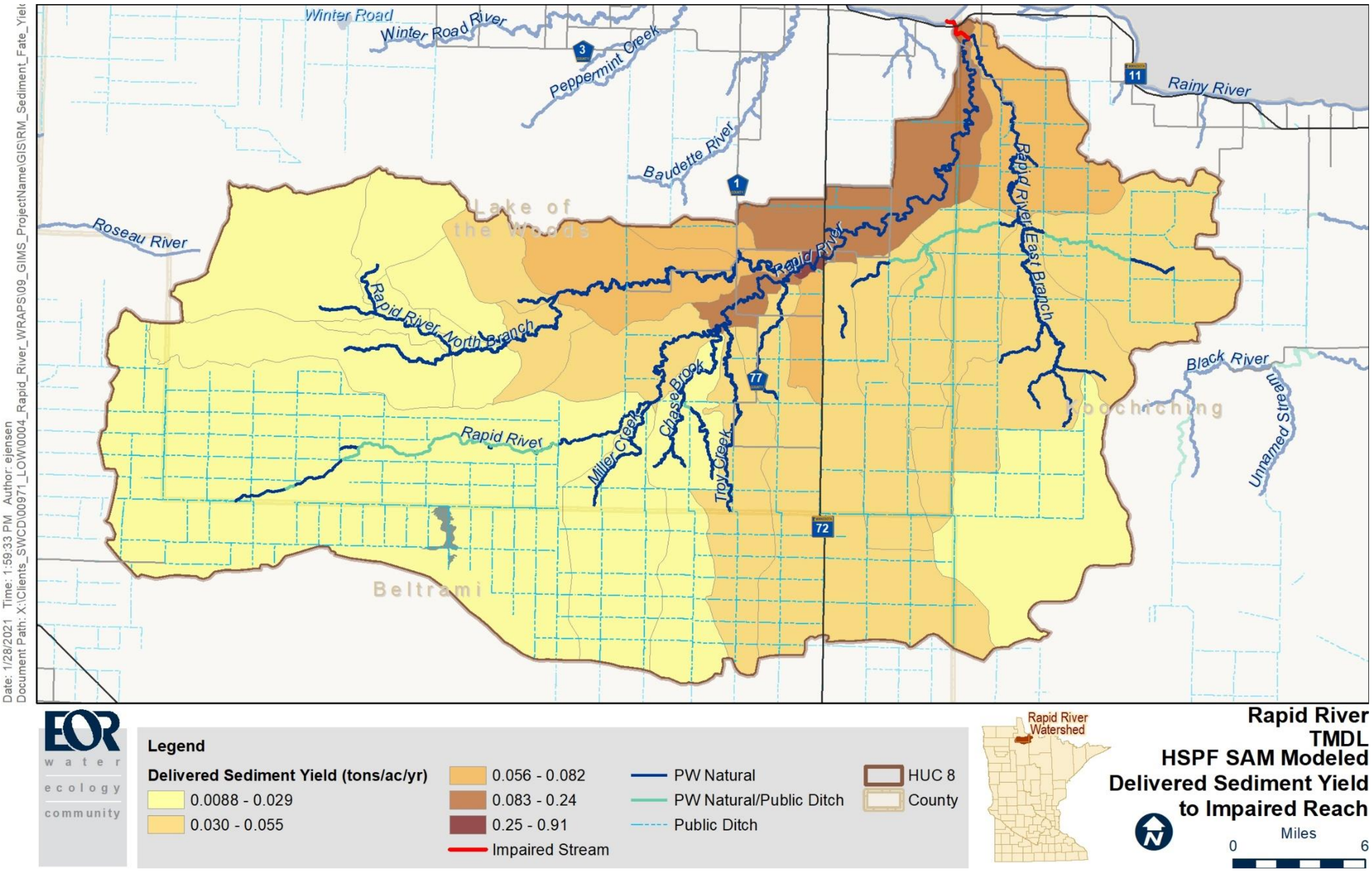


Figure 17. HSPF-modeled delivered subbasin sediment yield to the impaired stream reach (Data retrieved 04/06/2020).

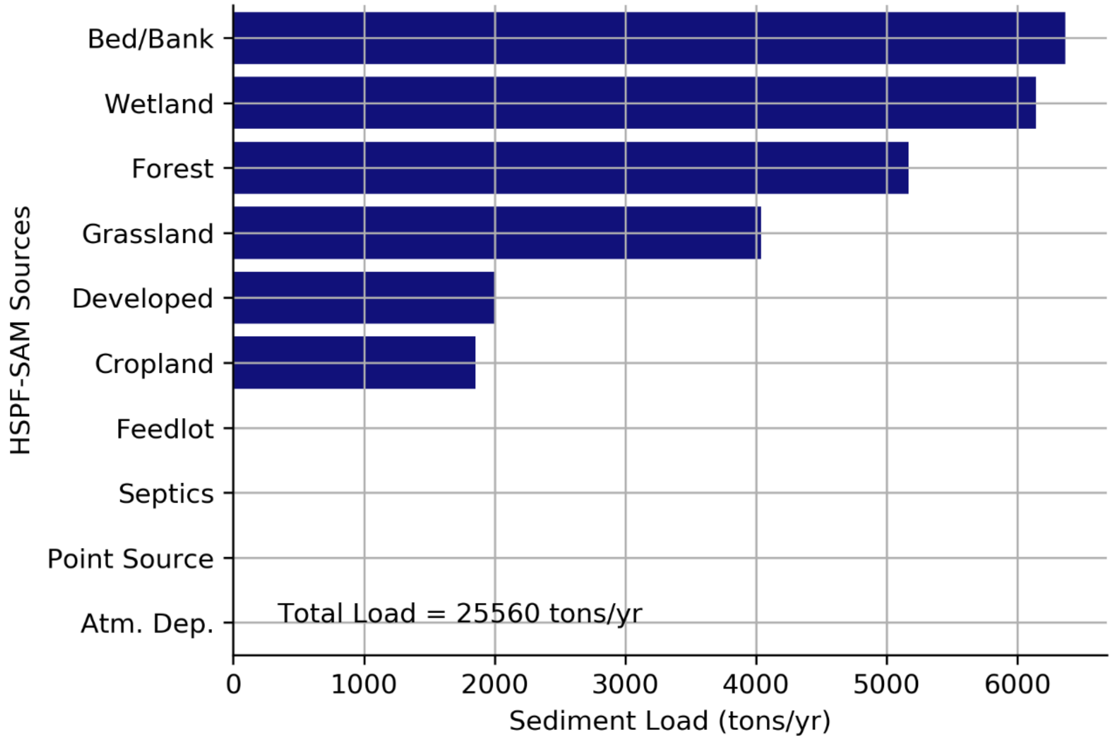


Figure 18. HSPF 1996-2014 average annual predicted sediment source fate contribution (tons/yr) for the Lower Rapid River (Subbasin A370). Sources ordered based on magnitude.

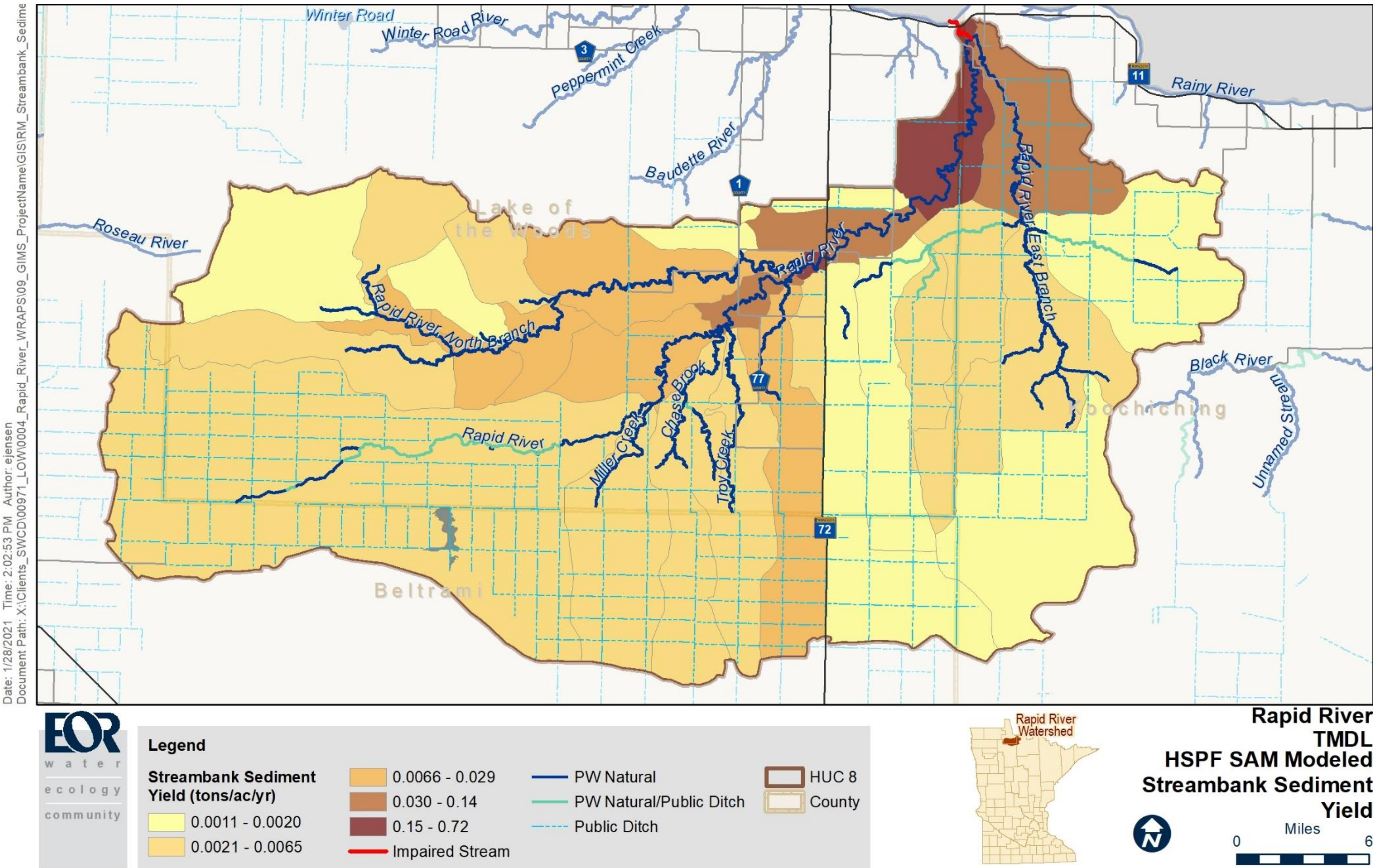


Figure 19. HSPF-modeled subbasin sediment yield from streambanks (tons/ac/yr) in the Rapid River Watershed (Data retrieved 04/06/2020).

3.4.3 Sediment Source Summary

The dominant source of sediment in the RRW is near-stream and stream bank erosion. The historical ditching in the watershed has significantly altered the watercourses in the watershed and subsequently the flow characteristics. As a result, the channel has become unstable with significant bank erosion and streambed material alteration as it adjusts to the altered conditions. These unstable conditions are most common in the RRW along the main branch of the Rapid River from the confluence with the North Branch of the Rapid River to the outlet of the watershed. The agricultural land surrounding the lower portions of the river may worsen these conditions. Point sources in the watershed were determined to contribute a small fraction of the total sediment load in the watershed.

The MPCA staff conducted discreet water quality monitoring in the RRW along the Rapid River and its major tributaries, North Branch Rapid River and East Fork Rapid River. Five sites were sampled on 10 different dates between August 2019 and June 2020; most of the samples were collected following storm events. Each sample was analyzed for TSS and VSS. Review of these data indicates that the largest component of the TSS load in the impaired reach of the Rapid River (-501) is in the inorganic fraction. The data also suggests that at higher-flow levels (above 2,000 cubic feet per second [cfs]) TSS contributions appear to be driven by the mainstem of the Rapid River, particularly between the County State Aid Highway (CSAH) CSAH-1 and CSAH-18 crossings. Finally, the data suggests that the East Fork Rapid River and North Branch Rapid River are not contributing excessive amounts of TSS to the impaired reach of the Rapid River (-501).

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] i.e., TMDL) of the stream was then estimated using a load duration curve and was divided among WLAs and LA. 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 WWTPs, regulated municipal stormwater, regulated construction stormwater, and regulated industrial stormwater, all covered under NPDES/SDS permits for a current or future permitted pollutant source;

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

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

4.1 Total Suspended Solids

4.1.1 Loading capacity

The LC for the impaired stream reach receiving a TMDL as a part of this study was determined using a load duration curve. Flow and load duration curves 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 exceeds the corresponding flow rate as expressed on the y-axis. Load duration curves take the flow distribution information, constructed for the stream, 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. Each point along the curve represents a load of pollutant per day. The standard curve represents the upper limit of the allowable in-stream pollutant load (i.e., 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. The TSS load duration curve was based on continuous flow data collected at the MPCA and DNR cooperative stream gage, Rapid River at Clementson, MN11 (78007001) between 2010 and 2019. The existing TSS loads were based on TSS concentration data collected at monitoring station S000-184 (see Table 5) during the months of April through September for the years 2010 through 2019. The TSS concentration data were then multiplied by the paired mean daily flow recorded for the corresponding sample dates at the Rapid River at Clementson MN11 (78007001) stream gage. The load duration curve is based on the state's regional water quality standard of 15 mg/L multiplied by the mean daily flow for the Rapid River at Clementson MN11 (78007001) stream gage from 2010-2019. The TSS loading capacities presented in the allocation table represent the median TSS load (in pounds per day [lbs/day]) along the TSS standard curve within each flow regime. The TSS load duration curve and the TMDL allocation table for the Lower Rapid River are provided in Section 4.1.5.

Limitations of the load duration curve method mostly occur in watersheds where large reductions in nonpoint sources are needed. The use of daily loads to generate the standard curve are more appropriate for point sources with daily effluent limits. Translating the standard curve to an annual reduction, which are more applicable to nonpoint sources, can be difficult. Another weakness is that when modeled flows are coupled with monitoring data, the datasets must overlap to see any reductions. In addition, when taking the median of the load duration curve in the allocation table it can appear that no reduction is needed in a stream even though the concentrations exceed the standard.

The load duration curve 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 allocation table of this study, 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.

4.1.2 Load allocation methodology

The LA represents the portion of the LC that is designated for nonregulated sources of TSS, as described in Section 3.4.2. 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. The LA includes nonpoint pollution sources that are not subject to permit requirements, including near-channel sources and watershed runoff (as described in Section 3.4.2).

Minnesota TSS standards inherently address some amount of natural background TSS loading. Minnesota's regional TSS standards are based on reference or least-impacted streams and take into account differing levels of sediment present in streams and rivers in the many ecoregions across the state, depending on factors such as topography, soils, and climate (Markus 2011). Natural background conditions were evaluated, where possible, within the modeling and source assessment portion of this study (see Section 3.4.2). Natural background sources are implicitly included in the LA portion of the TMDL allocation table, and TMDL reductions should focus on the major anthropogenic sources identified in the source assessment.

4.1.3 Wasteload allocation methodology

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

4.1.3.1 Municipal Separate Storm Sewer Systems Regulated Stormwater

There are no MS4 regulated stormwaters located within the TSS impaired reach subwatershed in the RRW.

4.1.3.2 Regulated Construction Stormwater

A categorical WLA was assigned to all regulated construction activity in the impaired subwatershed. The average annual fraction of the watershed area under regulated construction activity was based on reported values from January 1, 2015, through December 31, 2019, for each county in the watershed according to the Minnesota Stormwater Manual (Table 6) (MPCA 2020 Apr 16). To determine the 2014 through 2018 annual average percent of the TMDL Study Area under construction activity, the fraction of each county area under regulated construction activity was area weighted by the percent of each county within the impaired subwatershed (Table 7). This value was then multiplied by the watershed runoff load component to determine the construction stormwater WLA. The watershed runoff load component is equal to the total TMDL (LC) minus the sum of the WLAs and the MOS. Based on the average for the past five years, 0.0071% (42.7 acres) of RRW was estimated to be under construction annually.

Table 6. 2015-2019 annual average percent of total county area under construction activity (Data retrieved 8/16/2020)

Parameter	Beltrami County	Koochiching County	Lake of the Woods County
2015-2019 annual average percent of total county area under construction activity	0.006%	0.006%	0.008%

Table 7. Percent of TMDL Study Area within each county

Percent of TMDL Study Area within each county	Beltrami County	Koochiching County	Lake of the Woods County
Lower Rapid River, E. Fork Rapid River to Rainy River (09030007-501)	23%	23%	54%

4.1.3.3 Regulated Industrial Stormwater

There are currently no industrial stormwater permits in the watershed. In the event of future industrial stormwater activity, a categorical industrial stormwater WLA was estimated by the percentage of each county with an active industrial stormwater permit (Table 8) based on permits accessed on February 20, 2020, from the MPCA Industrial Permit webpage. The categorical stormwater WLA was determined by the area weight of ISW permits in the counties of the RRW. The fraction of the TMDL Study Area within each county (Table 8) was multiplied by the watershed runoff load component to determine the industrial stormwater WLA. The watershed runoff load component is equal to the total TMDL (LC) minus the sum of wastewater WLAs and the MOS. Approximately 0.035% (210 acres) of RRW was estimated to contribute industrial stormwater in 2020.

Table 8. County Industrial Stormwater Permit Area as a percent of the Total County Area for Rapid River Watershed

Parameter	Beltrami County	Koochiching County	Lake of the Woods County
Percent of County under an Industrial Stormwater Permit in 2020	0.024%	0.045%	0.035%

4.1.3.4 Regulated Nonmetallic Mining

There are two active regulated nonmetallic mines in the RRW (Table 9). A categorical WLA was assigned based on the fraction of the watershed with mining activity, using 2017 Farm Service Agency aerial imagery for each mine. The fraction was multiplied by the LC to determine the industrial stormwater WLA. The TMDL study will not result in new or modified permit limits for two active regulated nonmetallic mines in the watershed.

Table 9. Nonmetallic Mining Sites in the Rapid River Watershed

Site	NPDES Permit Number	Approximate Area contributing Stormwater (acres)
Mark Sand & Gravel Acquisition Company	MNG490126	12.5
DNR - Forestry	MNG490239	28.4

4.1.3.5 Regulated Municipal and Industrial Wastewater

There are no WWTPs located within the TSS impaired reach subwatershed in the RRW.

4.1.4 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. The TSS loading varies with the flow regime and season. Spring is associated with high flows from snowmelt, the summer is associated with the growing season as well as periodic storm events and receding streamflows, and the fall brings increasing precipitation and rapidly changing agricultural landscapes.

Critical conditions and seasonal variation are addressed in this TMDL through several mechanisms. The TSS standard applies during the open water months, and data were 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 load duration curves and monthly summary figures, TSS loading was evaluated at actual flow conditions at the time of sampling (and by month).

4.1.5 Margin of safety

The MOS accounts for uncertainty about pollutant loadings and waterbody response. It reflects the degree of characterization and accuracy of the estimates of the source loads and the level of confidence in the analysis of the relationship between the source loads and the impact upon the receiving water. In concept, it ensures attainment and maintenance of water quality standards for the allocated pollutant. As such, it reduces the remaining pollutant allocation to nonpoint and point sources.

An explicit MOS equal to 10% of the LC was used for the impaired stream TMDL based on the following considerations:

- 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;
- There was sufficient monitoring data available for the impaired reach and the HSPF model has adequate calibration and verification;
- Best professional judgement of the overall TMDL development; and

  A reasonable and achievable LA and WLA.

In addition to the explicit MOS, an implicit MOS is factored into the TMDL through the use of critical conditions and seasonal variability in the establishment of water quality standards by the state of Minnesota and the use of conservative assumptions in the determination of critical conditions using the monitoring data and the use of a watershed pollutant loading model to determine the contribution of TSS from point and nonpoint sources.

4.1.6 TMDL summary

4.1.6.1 Lower Rapid River (09030007-501)

- 303(d) listing year: 2020 (proposed)
- Baseline year: 2015, based on the mid-range year of the data used for the development of the TSS load duration curve

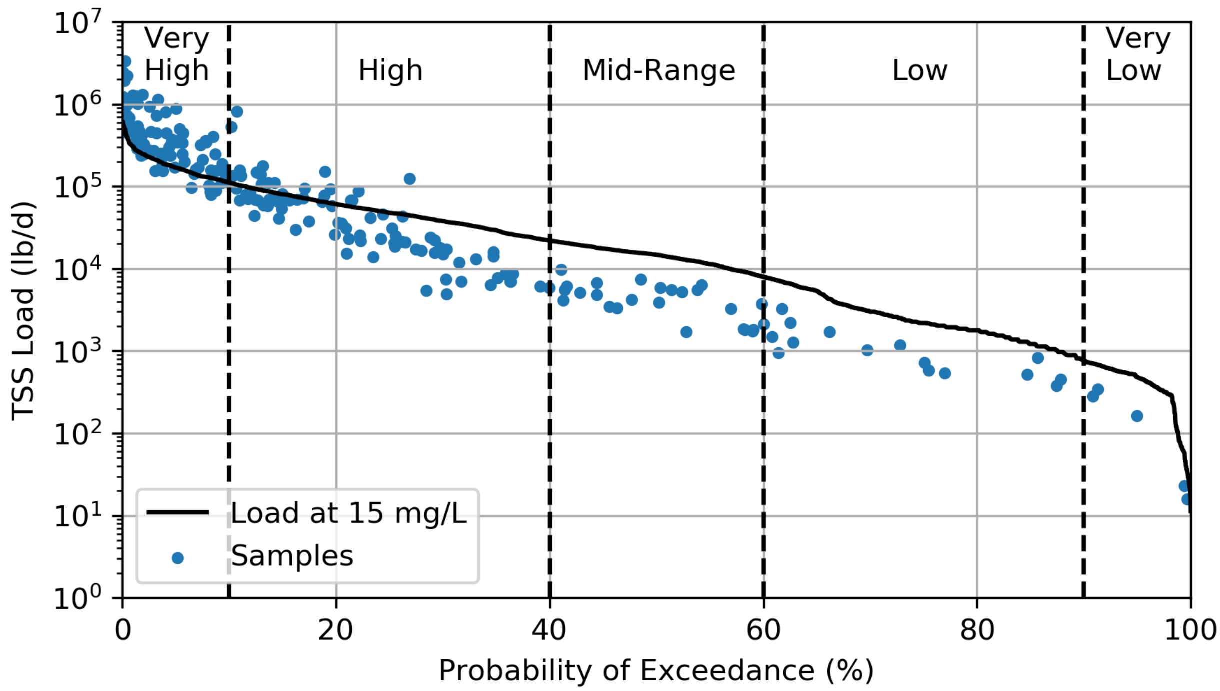


Figure 20. Total Suspended Solids load duration curve: Lower Rapid River (09030007-501).
Existing TSS loads are based on all samples collected at S000-184 (see Table 5) during the months of Apr-Sept for the years 2010-2019, multiplied by the paired mean daily flow recorded for the sample dates at the Rapid River at Clementson MN11 (78007001) stream gage. The LDC is based on the state's regional water quality standard of 15 mg/L multiplied by the mean daily flow at the Rapid River at Clementson MN11 (78007001) stream gage from 2010-2019.

Table 10. Lower Rapid River (09030007-501) Total Suspended Solids TMDL and Allocations.

Lower Rapid River (09030007-501)		Flow Regime				
		Very High (cfs)	High (cfs)	Mid-Range (cfs)	Low (cfs)	Very Low (cfs)
		2090	592	183	27	5.9
Load Component		**Total Suspended Solids (TSS) (lbs per day)**				
Existing Load*		**415,972.2**	**117,726.0**	**36,422.5**	**5,373.9**	**1,174.2**
Wasteload Allocations	*Construction stormwater (MNR1000001)*	*12.0*	*3.4*	*1.0*	*0.2*	*0.03*
	Industrial stormwater (MNR050000)	*58.8*	*16.6*	*5.1*	*0.8*	*0.2*
	Nonmetallic Mining (MNG490000)	*11.5*	*3.3*	*1.0*	*0.15*	*0.03*
	Total WLA	**82.3**	**23.3**	**7.1**	**1.15**	**0.26**
Load Allocations	*Nonregulated sources*	*152,102.7*	*43,047.2*	*13,318.2*	*1964.95*	*429.34*
	Total LA	**152,102.7**	**43,047.2**	**13,318.2**	**1964.95**	**429.34**
10% Margin of Safety		**16,909.4**	**4,785.6**	**1,480.6**	**218.4**	**47.7**
Total Loading Capacity		**169,094.4**	**47,856.1**	**14,805.9**	**2,184.5**	**477.3**

*Existing TSS loads were based on 90th percentile TSS concentration from Table 5 of all samples collected at S000-184 during the months of Apr-Sept for the years 2010-2019 multiplied by the median flow for each flow regime at the Rapid River at Clementson MN11 (78007001) stream gage.

4.1.7 TSS Reductions

The average annual TSS load reduction needed to meet the TMDL was estimated for the impaired reach, based on achieving the TSS standard 90th percentile concentration of 15 mg/L from the existing 90th percentile concentration of 37 mg/L, from samples collected between April and September from 2010 through 2019 for the existing load monitoring station S000-184 (Table 11). An annual TSS load reduction of 59% is needed to meet the TSS standard.

The estimated percent reduction provides a rough approximation of the overall reduction needed for the water body to meet the TMDL. The percent reduction is a means to capture the level of effort needed to reduce the TSS concentration in the impaired reach. The percent reduction should not be construed to mean that each of the separate sources listed in the TMDL table needs to be reduced by that amount.

Table 11. TSS reduction needed by impaired reach

Impaired Reach (AUID)	Existing Load Monitoring Station	90th Percentile Concentration (mg/L)	TSS Standard 90th Percentile Concentration (mg/L)	TSS Reduction needed to meet TMDL (%)
Lower Rapid River, E. Fork Rapid River to Rainy River (09030007-501)	S000-184	36.9	15	**59%**

5. Future growth considerations

The top economic activities in the RRW are forest product harvesting, forest product manufacturing, farming, and tourism. Land use is not expected to change significantly in the future, as it has not changed significantly recently. The RRW is sparsely populated and has experienced a decrease in population (-4.09%) from 2010 through 2018 (Table 12) (U.S. Census Bureau 2018). Large increases in population or significant changes in land use are not expected in the RRW; therefore, no reserve capacity was calculated for this TMDL study.

Sections 5.1 and 5.2 describe the procedures the MPCA will follow to address unexpected changes in the population or land use in the RRW.

Table 12. Projected Population Change by County from 2010 through 2018 (U.S. Census Bureau 2018).

County	Projected Growth 2010-2018)
Beltrami	5.41%
Koochiching	-6.54%
Lake of the Woods	-7.10%
Watershed	-4.09%

5.1 New or expanding permitted MS4 WLA transfer process

While there are currently no MS4s in the RRW, in general, 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. One or more nonregulated MS4s become regulated. If this has not been accounted for in the WLA, then a transfer must occur from the LA.
2. 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.
3. A new MS4 or other stormwater-related point source is identified and is covered under a NPDES/SDS 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 Loads will be transferred on a simple land area basis. 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

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

"Reasonable assurance" shows that elements are in place, for both permitted and nonpermitted sources, that are making (or will make) progress toward needed pollutant reductions.

6.1 Reduction of permitted sources

6.1.1 Permitted MS4s

There are no municipalities or organized townships in this watershed, therefore there are no existing or future MS4 permittees.

6.1.2 Permitted construction stormwater

Regulated construction stormwater was given a categorical WLA is this study. Construction activities disturbing one acre or more are required to obtain NPDES permit coverage through the MPCA. Compliance with TMDL requirements are assumed when a construction site owner/operator meets the conditions of the Construction General Permit and properly selects, installs, and maintains all BMPs required under the permit, including any applicable additional BMPs required in Section 23 of the Construction General Permit for discharges to impaired waters, or compliance with local construction stormwater requirements if they are more restrictive than those in the State General Permit.

6.1.3 Permitted industrial stormwater

Industrial stormwater was given a categorical WLA in this study. Industrial activities require permit coverage under the state's NPDES/SDS Industrial Stormwater Multi-Sector General Permit (MNR050000) or NPDES/SDS Nonmetallic Mining/Associated Activities General Permit (MNG490000). If a facility owner/operator obtains stormwater coverage under the appropriate NPDES/SDS permit and properly selects, installs, and maintains BMPs sufficient to meet the benchmark values in the permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL report.

6.1.4 Permitted wastewater

6.1.5 There are no permitted wastewater discharges in the RRW. Permitted feedlots

See the discussion of the state's Feedlot Program in Section 6.2.2, which applies to both permitted and nonpermitted feedlots.

6.2 Reduction of nonpermitted sources

Elements are in place for both point sources and nonpoint sources to make progress toward needed pollutant reductions in this TMDL study. Partnerships among local governmental units, state, and federal agencies aid in the success of implementation efforts. A range of local partners are involved in water resource management and implementation, including Soil and Water Conservation Districts (SWCDs) and county governments from LOW, Beltrami, and Koochiching counties. 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.

Federal agencies such as the Natural Resources Conservation Service (NRCS), and U.S. Fish and Wildlife Service (USFWS) also have programs that can be implemented to address pollutant loads.

There is currently only one listed impairment in the RRW. Restoration of the impaired reach may be feasible; however, much of the watershed is wetland or forest lands which are relatively low sediment-loading landscapes thus limiting opportunities for large-scale restoration efforts. Most of the sediment loading is the result of in-stream or near-stream erosion and is expressed at the higher flow regimes. Implementation should focus on addressing ditching and channelization in the subwatersheds that the model identifies as the highest yielding.

Several nonpermitted reduction programs exist to support implementation of nonpoint source reduction BMPs in the RRW. These programs identify BMPs, provide means of focusing BMPs, and support their implementation via state initiatives, ordinances, and/or dedicated funding. Figure 21 shows the number of BMPs implemented thus far per subwatershed as of 2020, as tracked on the MPCA's Healthier Watersheds website (https://www.pca.state.mn.us/water/healthier-watersheds). Greater detail on these BMPs implemented is available at the website.

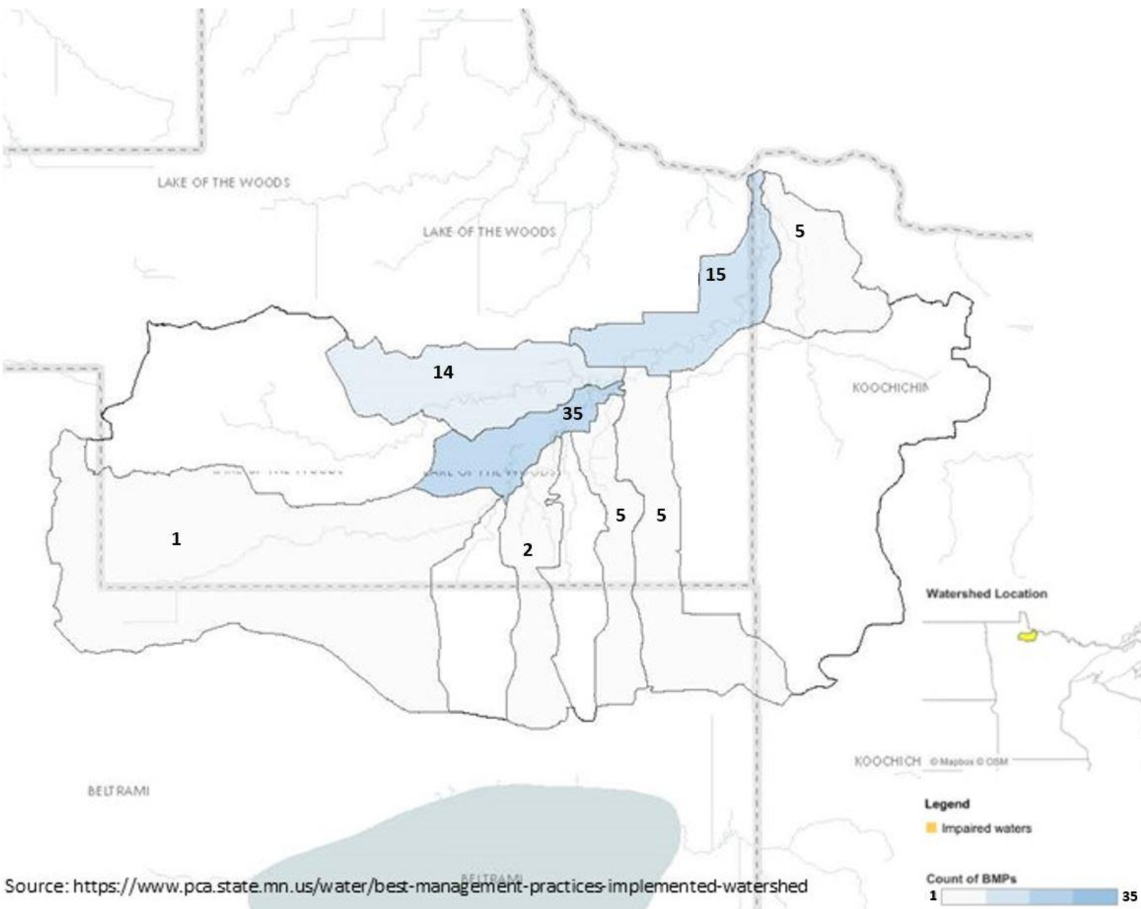


Figure 21. Number of BMPs per subwatershed; data from the MPCA's Healthier Watersheds website); data from the MPCA's Healthier Watersheds website.

There are three (LOW, Koochiching, and Beltrami) SWCDs in the project area that can provide technical and financial assistance on topics such as septic system upgrades, ditch abandonment pollutant assessments.

The following subsections describe large-scale programs that have proven to be effective and/or will reduce pollutant loads going forward.

6.2.1 Subsurface Sewage Treatment Systems regulation

Subsurface Sewage Treatment Systems (SSTS) are regulated through Minn. Stat. §§ 115.55 and 115.56. SSTS specific rule requirements can be found in Minn. R. 7080 through 7083. Regulations include the following:

- 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 SSTS installation, maintenance, and inspection

Each county maintains an SSTS ordinance, in accordance with Minnesota Statutes and Minnesota Rules, 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, to protect groundwater quality, and to prevent or eliminate the development of public nuisances. Ordinances serve the best interests of the county’s citizens by protecting 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. Since 2002, the counties within the RRW have, on average, replaced 31 systems per year (Figure 22). While Figure 22 represents county-wide SSTS replacements (i.e., not limited to the RRW), the numbers reflect the counties’ commitment to replacing failing systems.

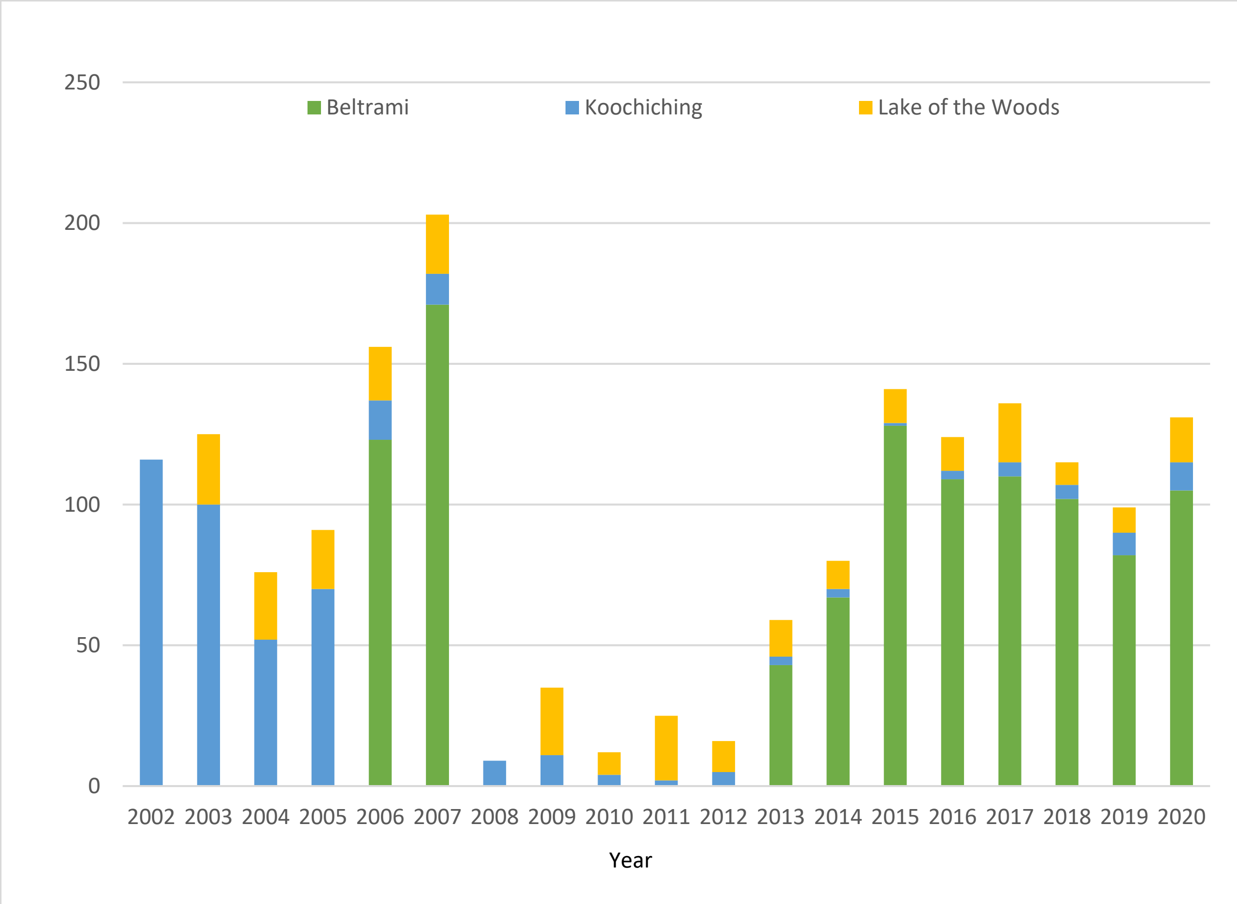


Figure 22. SSTS replacements by county by year

All known imminent threats to public health and safety (ITPHS) are recorded in a statewide database by the MPCA. From 2006 to 2019, 797 alleged straight pipes were tracked by the MPCA statewide, 765 of which were abandoned, fixed, or were found not to be a straight pipe system. The remaining known, unfixed, straight pipe systems have received a notice of noncompliance and are currently within the 10-month deadline to be fixed, have been issued Administrative Penalty Orders, or are docketed in court. The MPCA, through the Clean Water Partnership Loan Program, provides low interest loans for SSTS upgrades. The CWP loan program has not been used by the counties within the RRW since 2010. More information on SSTS financial assistance can be found at the following address: https://www.pca.state.mn.us/water/ssts-financial-assistance. LOW County has a septic upgrade program for low income residents that has funded three septic upgrades in the last 10 years at a cost of $27,000.

6.2.2 Feedlot Program

The MPCA's Feedlot Program addresses both permitted and nonpermitted feedlots. The Feedlot Program implements rules governing the collection, transportation, storage, processing, and disposal of animal manure and other livestock operation wastes. Minn. R. ch. 7020 regulates feedlots in the state of Minnesota. All feedlots capable of holding 50 or more AUs, or 10 in shoreland areas, are subject to this rule. The focus of the rule is on animal feedlots and manure storage areas that have the greatest potential for environmental impact. A feedlot holding 1,000 or more AUs is permitted in Minnesota.

The Feedlot Program is implemented through cooperation between MPCA and delegated 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 has been delegated authority by the MPCA to administer 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. In recent years, annual grants given to these counties statewide totaled about two million dollars (MPCA 2017). The delegated county in the project area for this report is LOW County, and the counties that are not delegated are Koochiching and Beltrami Counties. In the counties that are not delegated, the MPCA is tasked with administering the Feedlot Program.

From 2011 through 2020, there were nine feedlot facility inspections in the RRW, with all of those inspections occurring at non-CAFO facilities. There have been an additional three manure application reviews within the watershed, all of which were conducted at non-CAFO facilities.

6.2.3 Minnesota buffer law

Minnesota's buffer law (Minn. Stat. § 103F.48) requires perennial vegetative buffers of up to 50 feet along lakes, rivers, and streams and buffers of 16.5 feet along ditches. These buffers help filter out phosphorus, nitrogen, and sediment. Alternative practices are allowed in place of a perennial buffer in some cases. 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 appropriate SWCD.

The BWSR provides oversight of the buffer program, which is primarily administered at the local level. Compliance with the buffer law is in the 95% to 100% range for counties in the RRW as of March 2021 (Table 13).

Table 13. Compliance with Minnesota buffer law as of March 2021 (data from BWSR, available on BWSR website under Buffer Program Update)

County	Compliance with buffer law (%)
Beltrami	95% – 100%
Lake of the Woods	95% – 100%
Koochiching	95% – 100%

6.2.4 Minnesota Nutrient Reduction Strategy

The Minnesota Nutrient Reduction Strategy (MPCA 2014) guides activities that support nitrogen and phosphorus reductions in Minnesota water bodies and those water bodies downstream of the state (e.g., Lake Winnipeg, Lake Superior, and the Gulf of Mexico). The Nutrient Reduction Strategy was developed by an interagency coordination team with help from public input. Fundamental elements of the Nutrient Reduction Strategy include:

- Defining progress with clear goals
- Building on current strategies and success

- Prioritizing problems and solutions
- Supporting local planning and implementation
- Improving tracking and accountability

Included within the strategy discussion are alternatives and tools for consideration by drainage authorities, information on available tools and approaches for identifying areas of phosphorus and nitrogen loading and tracking efforts within a watershed, and additional research priorities. The Nutrient Reduction Strategy is focused on incremental progress and provides meaningful and achievable nutrient load reduction milestones that allow for better understanding of incremental and adaptive progress toward final goals. The strategy has set a reduction of 10% for phosphorus and 13% for nitrogen in the Lake Winnipeg Basin (relative to 2003 conditions).

Successful implementation of the Nutrient Reduction Strategy will require broad support, coordination, and collaboration among agencies, academia, local government, and private industry. The MPCA is implementing a framework to integrate its water quality management programs on a major watershed scale, a process that includes:

- IWM
- Assessment of watershed health
- Development of WRAPS reports
- Management of NPDES/SDS and other regulatory and assistance programs

This framework will result in nutrient reduction for the Rainy Lake Basin as a whole and the major watersheds within the basin including the RRW.

6.2.5 Conservation easements

Conservation easements are a critical component of the state’s efforts to improve water quality by reducing soil erosion, reducing 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, 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), Reinvest in Minnesota (RIM), and the Wetland Reserve Program (WRP) or Permanent Wetland Preserve (PWP). As of August 2020, in the counties that are located in the RRW, there were 3,313 acres of short-term conservation easements such as CRP and 314 acres of long term or permanent easements (RIM, WRP). There are also 16,393 acres currently enrolled in working land forestry easements.

6.3 Summary of local plans

Minnesota has a long history of water management by local government, which included developing water management plans on a county basis since the late 1980s. The BWSR-led One Watershed, One Plan (1W1P) program is rooted in work initiated by the Local Government Water Roundtable

(Association of Minnesota Counties, Minnesota Association of Watershed Districts, and Minnesota Association of SWCD). The Roundtable recommended that local governments organize to develop focused implementation plans based on watershed boundaries. That recommendation was followed by the legislation (Minn. Stat. § 103B.801) that established the 1W1P program, which provides policy, guidance, and support for developing comprehensive watershed management plans to:

- Align local water planning purposes and procedures on watershed boundaries to create a systematic, watershed-wide, science-based approach to watershed management;
- Acknowledge and build off existing local government structure, water plan services, and local capacity;
- Incorporate and make use of data and information, including WRAPS;
- Solicit input and engage experts from agencies, citizens, and stakeholder groups; focus on implementation of prioritized and targeted actions capable of achieving measurable progress; and
- Serve as a substitute for a comprehensive plan, local water management plan, or watershed management plan developed or amended, approved, and adopted.

Until the completion of a comprehensive watershed management plan in the RRW, county water plans remain in effect per the Comprehensive Local Water Management Act (Minn. Stat. § 103B.301). Those plans may be updated with new information, or their expiration dates may be extended pending future participation in the 1W1P program. Local water plans incorporate implementation strategies aligned with or called for in TMDL studies and WRAPS reports and are implemented by SWCDs, counties, state and federal agencies, and other partners. The Rainy-Rapid Watershed planning area was selected to receive 1W1P planning funding in late 2021.

The following is a list of local county water plans for major counties in the RRW and a brief description on how each plan addresses the water quality issues identified in this TMDL study:

- LOW County Local Water Management Plan: 2010 through 2020 Update. This plan focuses specifically on the top five priority concerns that were developed through a scoping process; Erosion and Sedimentation, Land Use Management, Sewage Treatment Systems, Water Quality, and Education. Erosion and sedimentation in rivers and ditch systems is a top priority of the plan's implementation schedule, with several projects identified to reduce sediment loading to the Rapid River.
- Koochiching County Comprehensive Local Water Management Plan: 2018 through 2028. The purpose of this plan is to address existing and/or potential water resource related issues, threats, and concerns. The plan includes objectives of supporting the Rapid River WRAPS process and conducting education and outreach activities in the RRW.
- Beltrami County Local Water Management Plan: September 27, 2017, through September 27, 2027. The purpose of this plan is to identify and address water resource concerns within the context of watershed units. The plan includes objectives for improving water quality of impaired resources through implementation of BMPs.

6.4 Examples of pollution reduction efforts

Local agencies have been active in promoting BMPs and completing projects for the purpose of improving and protecting water quality along the Rapid River and its tributaries. Below, is a list of projects that have been completed in recent years within the RRW:

- Besser Ravine Stabilization Project 2015 (LOW County and SWCD)
    - Reduction: Estimated 31.88 tons of sediment per year
    - Cost: $25,087.21
- Gingerich Grade Stabilization Project 2014 (LOW County, Minnesota Department of Transportation [MnDOT], and LOW SWCD)
    - Reduction: Estimated 2.13 tons of sediment per year
    - Cost: $7,581.89
- Low Income Septic Upgrade Program (LOW County)
    - 3 septic upgrades in last 10 years
    - Cost: $26,795.00
- Well Sealings (LOW SWCD)
    - 2 well sealings in last 5 years
- Sustainable Forestry Incentives Act
    - 16,393 acres currently enrolled in working land forestry easements
- Legal Ditch Abandonment (Beltrami, LOW and Koochiching Counties)
    - Ditch 30 abandon 19.5 miles of ditch
    - Ditch 36 abandon 48 miles of ditch

Planning tools have been developed to help target and prioritize projects that will reduce the amount of pollutant loading throughout the watershed.

- Culvert inventories
- HSPF developed for the LOW TMDL
- Stream Power Index
- DNR 2019-2020 Geomorphology Assessment

These tools will be used to guide future implementation efforts. The geomorphology assessment identified stream banks with high erosion potential and made recommendations for improving stream channel stability. Ongoing professional and volunteer monitoring programs will provide the data needed to measure the success of restoration and protection efforts, especially the WPLMN.

6.5 Funding

Funding sources to implement TMDLs can come from local, state, federal, and/or private sources. Examples include BWSR's Watershed-based Implementation Funding, Clean Water Fund Competitive Grants (e.g., Projects and Practices), and conservation funds from NRCS (e.g., Environmental Quality Incentives Program and Conservation Stewardship Program [CSP]).

Watershed-based implementation funding is a noncompetitive process to fund water quality improvement and protection projects for lakes, rivers/streams, and groundwater. This funding allows collaborating local governments to pursue timely solutions based on a watershed's highest priority needs. The approach depends on the completion of a comprehensive watershed management plan developed under the 1W1P program or the Metropolitan Surface Water framework to provide assurance that actions are prioritized, targeted, and measurable.

BWSR has begun the transition of moving toward watershed-based implementation funding to accelerate water management outcomes, enhance accountability, and improve consistency and efficiency across the state. This approach allows more clean water projects to be implemented and helps local governments spend limited resources where they are most needed.

Watershed-based implementation funding assurance measures are based on fiscal integrity and accountability for achieving measurable progress towards water quality elements of comprehensive watershed management plans. Assurance measures will be used as a means to help grantees meaningfully assess, track, and describe use of these grant funds to achieve clean water goals through prioritized, targeted, and measurable implementation. The following assurance measures are supplemental to existing reporting and on-going grant monitoring efforts:

- Understand contributions of prioritized, targeted, and measurable work in achieving clean water goals.
- Review progress of programs, projects, and practices implemented in identified priority areas.
- Complete Clean Water Fund grant work on schedule and on budget.
- Leverage funds beyond the state grant.

Over $2,362,000 has been spent on watershed implementation projects in the RRW since 2004 (Figure 23).

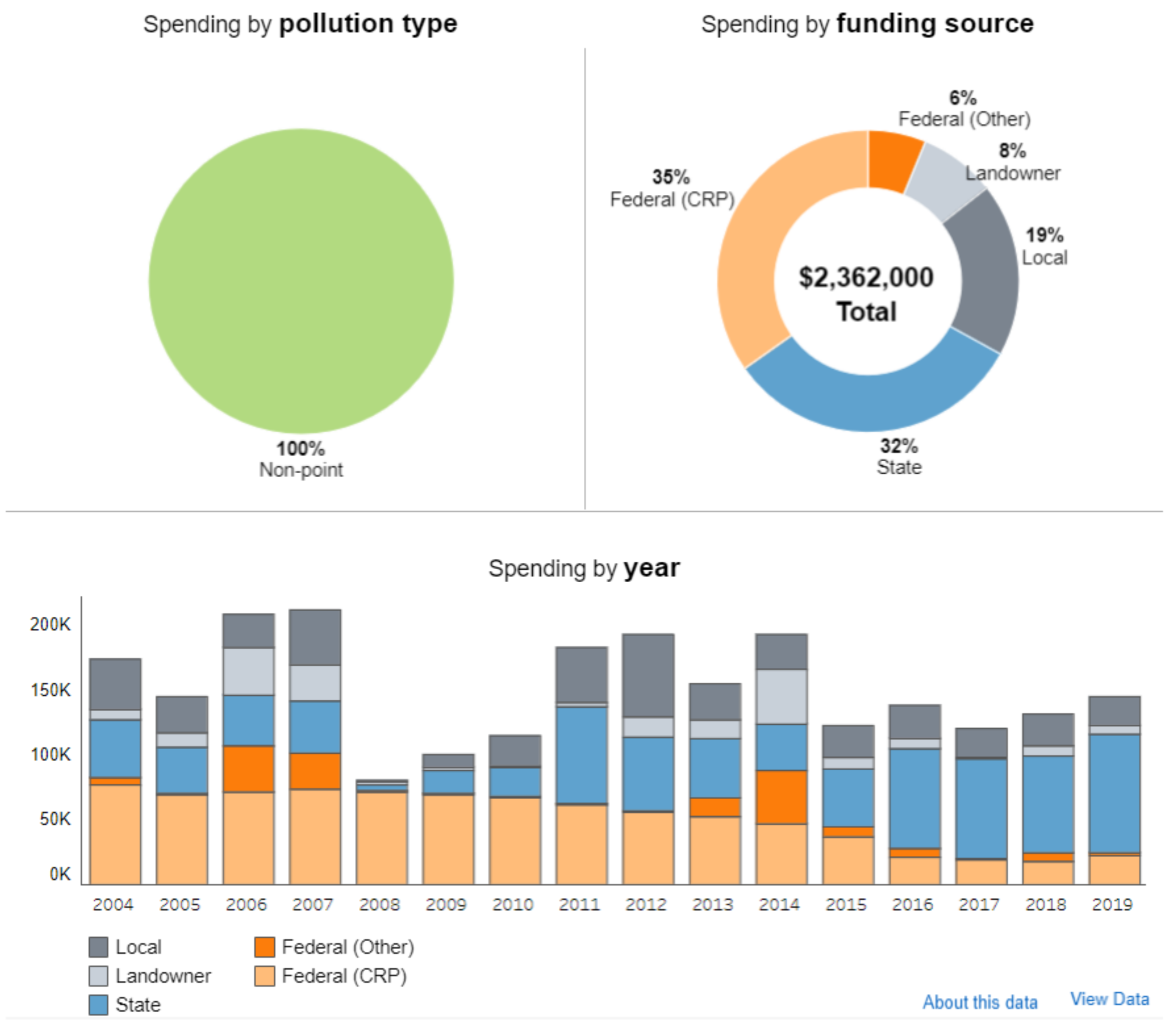


Figure 23. Spending for watershed implementation projects in the Rapid River Watershed; data from the MPCA's Healthier Watersheds website

6.6 Reasonable assurance conclusion

In summary, significant time and resources have been devoted to identifying the best BMPs, providing means of focusing them in the RRW, and supporting their implementation via state initiatives and dedicated funding. The RRW WRAPS and TMDL process 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. Significant state and federal resources are available for future local water planning and implementation efforts. Thus, there is reasonable assurance that the TMDL for Lower Rapid River will be met.

7. Monitoring plan

In 2017 and 2018, as part of the IWM strategy, the MPCA and local partners conducted IWM of surface waters within the RRW. A total of 12 stream reaches were sampled in the RRW. The resulting water chemistry and biological data were used to assess the quality and use support of these waters. Details about the MPCA IWM strategy are available in the monitoring and assessment report on the MPCA RRW website.

The second round of intensive water quality monitoring in the RRW is scheduled to begin in 2028.

Several types of monitoring will be important to measuring success. The six basic types of monitoring listed below are based on the EPA's Protocol for Developing Sediment TMDLs (EPA 1999).

1. **Baseline monitoring**—identifies the environmental condition of the water body to determine if water quality standards are being met and identify temporal trends in water quality. Every 10 years, the MPCA will complete intensive monitoring of each major watershed in Minnesota. More information about MPCA's Watershed Approach to Condition Monitoring and Assessment is available online: https://www.pca.state.mn.us/water/watershed-approach-restoring-and-protecting-water-quality

2. **Implementation monitoring**—tracks implementation of sediment reduction practices using BWSR's eLINK or other tracking mechanisms. The BMP implementation monitoring is conducted by both BWSR (i.e., eLINK) and USDA. Both agencies track the locations of BMP installations. Discharges from permitted wastewater sources are reported through discharge monitoring records; these records are used to evaluate compliance with NPDES/SDS permits. Summaries of discharge monitoring records are available through the MPCA's Wastewater Data Browser: https://www.pca.state.mn.us/data/wastewater-data-browser.

3. **Flow monitoring**—is combined with water quality monitoring at the sites to allow for the calculation of pollutant loads. Long-term flow monitoring within the RRW occurs at two locations, Rapid River near Baudette, Minnesota (USGS 05134200) and Rapid River at Clementson, MN11 (78007001). Flow data is available from United States Geologic Survey (USGS): https://waterdata.usgs.gov/mn/nwis/rt and from the DNR: https://www.dnr.state.mn.us/waters/csg/index.html.

4. **Effectiveness monitoring**—determines whether a practice or combination of practices are effective in improving water quality. Effectiveness monitoring would be completed by the International Rainy – LOW Watershed Board or SWCDs on a project specific basis, contingent on funding availability.

5. **Trend monitoring**—allows the statistical determination of whether water quality conditions are improving. The MPCA's WPLMN measures and compares data on pollutant loads from Minnesota's rivers and streams and tracks water quality trends. The WPLMN data will be used to assist with assessing impaired waters, watershed modeling, determining pollutant source contributions, developing watershed and water quality reports, and measuring the effectiveness of water quality restoration efforts. Data are collected along major river mainstems, at major watershed (i.e., HUC-8) outlets to major rivers, and in several subwatersheds. This long-term monitoring program began in 2007. Long-term trend records are available from MPCA's WPLMN: https://www.pca.state.mn.us/water/watershed-pollutant-load-monitoring.

6. **Validation monitoring**—validates the source analysis and linkage methods in sediment source tracking to provide additional certainty regarding study findings. One possible example is a sediment fingerprinting analysis to verify the contribution of sediment bed and bank erosion in the RRW, particularly erosion within the stream channel versus watershed runoff. 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 stream 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 completed in Minnesota is MDA's Root River Integrated Sediment Budget: https://www.mda.state.mn.us/integrated-sediment-budget-root-river-southeastern-minnesota. This type of monitoring would need to be determined to be necessary, and be contingent on funding priorities and availability.

8. Implementation strategy summary

8.1 Permitted sources

8.1.1 Construction stormwater

The WLA for stormwater discharges from sites where there is construction activity reflects the number of construction sites greater than one acre expected to be active in the watershed at any one time, 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 construction sites are defined in Minnesota'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 Section 23 of the Construction General Permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL. Construction activity must also meet all local government construction stormwater requirements.

8.1.2 Industrial stormwater

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. Minnesota's NPDES/SDS Industrial Stormwater Multi-Sector General Permit (MNR050000) and NPDES/SDS Nonmetallic Mining/Associated Activities General Permit (MNG490000) establish benchmark concentrations for pollutants in industrial stormwater discharges. If a facility owner/operator obtains stormwater coverage under the appropriate NPDES/SDS Permit and properly selects, installs, and maintains BMPs sufficient to meet the benchmark values in the permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL report. Industrial activity must also meet all local government stormwater requirements.

8.2 Nonpermitted sources

The TMDL study's results aided in the selection of implementation strategies during the Rapid River WRAPS process. The purpose of the WRAPS process is to support local working groups in developing scientifically-supported restoration and protection strategies for subsequent implementation planning. The Rapid River WRAPS Report is publicly available on the MPCA RRW website:

https://www.pca.state.mn.us/water/watersheds/rapid-river

8.3 Education and Outreach

A crucial part in the success of the Implementation Strategy that will restore the impaired river reaches will be participation from local citizens. In order to gain support from these citizens, education and public participation opportunities will be necessary. A variety of educational avenues have been and will continue to be used throughout the RRW. These include (but are not limited to): press releases, meetings, workshops, focus groups, trainings, websites, etc. Local staff (conservation district, county, etc.) and board members work to educate the residents of the watersheds about ways to improve their waters on a regular basis.

Websites:

- International Rainy – LOW Watershed Board: https://ijc.org/en/rlwwb
- LOW SWCD: http://www.lakeofthewoodsswcd.org/
- Koochiching SWCD: https://koochichingswcd.org/
- Beltrami SWCD: https://www.co.beltrami.mn.us/Departments/SWCD/SWCD%20home.html
- MPCA's RRW webpage: https://www.pca.state.mn.us/water/watersheds/rapid-river

8.4 Technical Assistance

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

Programs such as state cost share are administered through the county. In addition, assistance is available from state and federal sources, including: Clean Water Legacy funding, Environmental Quality Incentives Program, CRP, State Buffer Law Implementation, Minnesota Agricultural Water Quality Certification Program (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: stormwater bio-retention, septic system upgrades, feedlot improvements, invasive species control, WWTPs, agricultural BMPs, forest stewardship planning, and shoreline/streambank restorations.

8.5 Cost

The Clean Water Legacy Act (Minn. Stat. 2007, §114D.25) requires that a TMDL assessment provide a range of implementation costs to address the TMDL study.

The estimated of costs of BMP implementation, by HUC-10 subwatershed and total for the RRW, needed to achieve the sediment load reduction in the Lower Rapid River reach are summarized in Table 14. The estimated total cost for the RRW is $8,568,000.00.

Table 14. Estimated Cost of BMPs Needed to Meet the Lower Rapid River TSS Reduction Goal

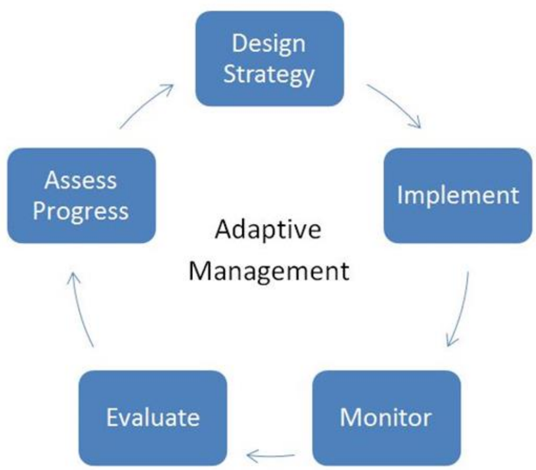
HUC-10 Name	HUC-10 Number	Total Cost ($)
Upper Rapid River	0903000701	$49,000.00
Middle Branch Rapid River	0903000702	$3,260,000.00
North Branch Rapid River	0903000703	$636,000.00
East Fork Rapid River	0903000704	$147,000.00

HUC-10 Name	HUC-10 Number	Total Cost ($)
Lower Rapid River	0903000705	$5,112,000.00
Rapid River Watershed	09030007	$8,568,000.00

8.6 Adaptive management

This list of implementation elements and the more detailed WRAPS report prepared concurrently with this TMDL assessment will be implemented in a context of adaptive management (Figure 24). Continued monitoring and "course corrections" responding to monitoring results are the most appropriate strategy for attaining the water quality goals established in this TMDL study. Management activities will be changed or refined to efficiently meet the TMDL and lay the groundwork for de-listing the impaired water body.

Figure 24. Adaptive Management



9. Public participation

Public notice

An opportunity for public comment on the draft TMDL report was provided via a public notice in the State Register from December 13, 2021 to January 12, 2022. There were no comment letters received as a result of the public comment period.

9.1 Core Team and Core Group meetings

The Core Team was a subset of the traditional Core Group comprised of representatives from the SWCDs and state agencies. Table 15 outlines the date, location and meeting focus of Core Team meetings held during the Surface Water Assessment Grant (SWAG) and TMDL development process.

Table 15. Rapid River TSS TMDL Core Team Meetings.

Date	Location	Meeting Focus
3/30/2020	WebEx	Project Planning Meeting
4/16/2020	WebEx	Project Planning Meeting
5/15/2020	WebEx	Project Planning Meeting
7/30/2020	WebEx	Project Planning Meeting
9/1/2020	WebEx	Core Group Meeting
9/17/2020	WebEx	Project Planning Meeting
9/24/2020	WebEx	Public Meeting Planning
10/8/2020	WebEx	Public Meeting Planning
1/21/2021	Zoom	WRAPS Targeting Tools Review

9.2 Public Participation

The MPCA along with the local partners and agencies recognize the importance of public involvement in the watershed process. Table 16 summarizes the opportunities used to engage the public and targeted stakeholders in the watershed.

Table 16. Rapid River TSS TMDL Public Participation Meetings

Date	Location	Meeting Focus
5/18/2017	Baudette	SWAG Open House
5/22/2017	Ranier	SWAG Open House
10/23/2017	Ranier	WRAPS Open House
10/24/2017	Birchdale	WRAPS Kick-off
4/25/2019	Baudette	Professional Judgment Group Meeting – review proposed impairments

Date	Location	Meeting Focus
12/17/2019	WebEx in International Falls	Impairments Public Meeting
3/17/2020	Baudette (canceled due to COVID-19)	Forestry Management / WRAPS public meeting
3/18/2020	Ranier (canceled due to COVID-19)	Forestry Management / WRAPS public meeting
10/20/2020	WebEx	Public informational meeting
10/20 – 11/03 2020	Online	Public Survey
10/27/2020	WebEx	Public Input Meeting
11/9/2021	Baudette	Presenting draft TMDL/WRAPS prior to public notice period

10. Literature cited

Alsop W. 2009. The Great Ditch Experiment. The LOW ~down. 12(2):3.

Anderson J, Baratono N, Streitz A, Magner J, Verry ES. 2006. Effect of Historical Logging on Geomorphology, Hydrology, and Water Quality in the Little Fork River Watershed. Minnesota Pollution Control Agency (MPCA) Report No.: wq-s1-04. https://www.pca.state.mn.us/sites/default/files/wq-s1-04.pdf.

Glaser PH, Wheeler GA, Gorham E, Wright HE. 1981. The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry and Landforms. The Journal of Ecology. 69(2):575. doi:10.2307/2259685.

Markus HD. 2011. Aquatic Life Water Quality Standards Draft Technical Support Document for Total Suspended Solids (Turbidity). Minnesota Pollution Control Agency (MPCA) Report No.: wq-s6-11.

MLRC. 2016. National Land Cover Database (NLCD). Multi-Resolution Land Characteristics (MRLC) Consortium. [accessed 2019 Nov 16]. https://www.mrlc.gov/national-land-cover-database-nlcd-2016.

MPCA. 2012. Zumbro River Watershed Total Maximum Daily Loads for Turbidity Impairments. St. Paul, Minnesota: Minnesota Pollution Control Agency Report No.: wq-iw9-13e. [accessed 2020 Dec 18]. https://www.pca.state.mn.us/sites/default/files/wq-iw9-13e.pdf.

MPCA. 2020 Apr 16. Construction activity by county - Minnesota Stormwater Manual. [accessed 2020 Aug 15]. http://stormwater.pca.st ate.mn.us/index.php/Construction_stormwater_permit.

MPCA. 2021. Draft Lake of the Woods Excess Nutrients Total Maximum Daily Load. Saint Paul, MN: Minnesota Pollution Control Agency (MPCA) Report No.: wq-iw10-14b. [accessed 2021 Apr 16]. https://www.pca.state.mn.us/sites/default/files/wq-iw10-14b.pdf.

Sigl W, Mielke N, Donatell J, Grayson S, Bourdaghs M, Vaughan S, Monson B, Nerem K. 2020. Lower Rainy River and Rapid River Watersheds Monitoring and Assessment Report. Saint Paul, MN: Minnesota Pollution Control Agency Report No.: wq-ws3-09030008b. https://www.pca.state.mn.us/sites/default/files/wq-ws3-09030008b.pdf.

Topp D. 2012. Rapid River (H-001-011) Initial Fisheries Stream Survey. MN DNR Division of Fish and Wildlife Report No.: F-29-30.

U.S. Census Bureau. 2018. American FactFinder - Results. [accessed 2020 Feb 12]. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.

US EPA. 1999. Protocol for Developing Sediment TMDLs. Washington DC: US EPA Report No.: EPA 841-B-99-004. [accessed 2020 Jun 2]. https://nepis.epa.gov/Exe/ZyPDF.cgi/20004P3U.PDF?Dockey=20004P3U.PDF.

USDA NRCS. Rapid Watershed Assessment Rapid River (MN) HUC: 09030007. Washington D.C.: USDA Natural Resources Conservation Service. [accessed 2020 Aug 11]. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_022947.pdf.