Big Fork River Watershed Restoration and Protection Strategy Report

October 2017

"Managing natural resources through technical assistance and education."

Itasca Soil & Water Conservation District

KOOCHICHING SOIL & WATER CONSERVATION DISTRICT

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

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The science and analysis described in this report began before the passage of the 2013 Clean Water Accountability Act. Thus, this report may not address all elements of the Clean Water Accountability Act. When this watershed is revisited (according to the 10-year cycle), the information will be updated according to the required elements of a Watershed Restoration and Protection Strategy (WRAPS) Report. This document is only the WRAPS report. It summarizes and references, but does not contain the Total Maximum Daily Load documents.

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Key Terms

Assessment Unit Identifier (AUID): The unique water body identifier for each river reach comprises the U.S. Geological Survey (USGS) eight-digit Hydraulic Unit Code (HUC) plus a three-character code unique within each HUC.

Aquatic life impairment: The presence and vitality of aquatic life is indicative of the overall water quality of a stream. A stream is considered impaired for impacts to aquatic life if the fish Index of Biotic Integrity (IBI), macroinvertebrate IBI, dissolved oxygen, turbidity, or certain chemical standards are not met.

Aquatic recreation impairment: Streams are considered impaired for impacts to aquatic recreation if fecal bacteria standards are not met. Lakes are considered impaired for impacts to aquatic recreation if total phosphorus, chlorophyll-*a*, or Secchi disc depth standards are not met.

Hydrologic Unit Code (HUC): A Hydrologic Unit Code (HUC) is assigned by the United States Geological Survey for each watershed. HUCs are organized in a nested hierarchy by size. For example, the Rainy River Basin is assigned a HUC-4 of 0903, and the Big Fork River Watershed is assigned a HUC-8 of 09030006.

Impairment: Waterbodies are listed as impaired if water quality standards are not met for designated uses, including aquatic life, aquatic recreation, and aquatic consumption.

Index of Biotic integrity (IBI): This method describes water quality using characteristics of aquatic communities, such as the types of fish and macroinvertebrates found in the waterbody. It is expressed as a numerical value from 0 (lowest quality) to 100 (highest quality).

Protection: This term is used to characterize actions taken in watersheds of waters not known to be impaired to maintain conditions and beneficial uses of the waterbodies.

Restoration: This term is used to characterize actions taken in watersheds of impaired waters to improve conditions, eventually to meet water quality standards and achieve beneficial uses of the waterbodies.

Source (or Pollutant Source): This term is distinguished from “stressor” to mean only those actions, places, or entities that deliver/discharge pollutants (e.g., sediment, phosphorus, nitrogen, pathogens).

Stressor (or Biological Stressor): This is a broad term that includes both pollutant sources and nonpollutant sources or factors (e.g., the altered hydrology, dams preventing fish passage) that adversely impact aquatic life.

Total Maximum Daily Load (TMDL): This is a calculation of the maximum amount of a pollutant that may be introduced into a surface water and still ensure that applicable water quality standards for that water are met. A TMDL is the sum of the wasteload allocation for point sources, a load allocation for nonpoint sources and natural background, an allocation for future growth (i.e., reserve capacity), and a margin of safety as defined in the Code of Federal Regulations.

Executive Summary

The Big Fork River Watershed, located in north-central Minnesota, is part of the Rainy River - Lake of the Woods Basin. It covers 2,073 square miles, and is divided between Itasca (49%) and Koochiching Counties (51%). The Big Fork River Watershed is the second largest U.S. tributary, in terms of area size, in the Rainy River- Lake of the Woods system. The largest tributary to the Big Fork River Watershed is the Sturgeon River, which empties into the Big Fork River Watershed in the northwestern portion of the watershed.

The Big Fork River Watershed is located in an isolated part of the state with little land disturbances, and includes the municipalities of Bigfork (population 445), Big Falls (population 232), Effie (population 125), Mizpah (population 56), and Squaw Lake (population 108). There are many unincorporated communities in the Big Fork River Watershed that have populations as large or larger than the incorporated communities in the watershed. There is also a large seasonal flux of community members based upon time of year, summer being the busiest. The river is an outstanding recreational resource, offering fishing and canoeing opportunities for people seeking a northern Minnesota wilderness experience.

The Big Fork River Watershed is divided between two ecoregions: Northern Lakes and Forests, and Northern Minnesota Wetlands. The southern portion of the watershed is primarily dominated by mixed forest. The northern portion is woody wetlands and peat bogs. The Big Fork River starts at Dora Lake and meanders north 165 miles to the Rainy River at the Minnesota/Ontario border.

The assessment results for the Big Fork River Watershed indicate that the condition of the lakes and streams are good to very good, even though there were a few impairments found. The most widespread impairment found in both lakes and rivers is due to high mercury levels, limiting the human consumption of fish. The remaining impairments throughout the watershed consisted of low dissolved oxygen (DO), fish and macroinvertebrate, and nutrient impairments. Many of the aquatic life impairments are the result of natural conditions within the Big Fork River Watershed. More data needs to be collected in these natural background situations in order to re-categorize them from impaired to natural background.

Stream work and intensive monitoring investigation of the Big Fork River Watershed took place in 2010 and 2011. Twelve water chemistry stations were sampled from May through September in 2010, and again June through August of 2011, to provide sufficient water chemistry data to assess all components of the Aquatic Life and Recreation Use Standards. All stations were co-located with or near biological sites. Water chemistry sampling was conducted by Itasca or Koochiching County Soil and Water Conservation District (SWCD) staff. Biological monitoring was conducted at 42 locations along the Big Fork River and its tributaries. In addition to the 2010 and 2011 monitoring, the Big Fork River Board's River Watch Project has conducted routine sampling for conventional pollutants at various main stem monitoring stations for over 20 years.

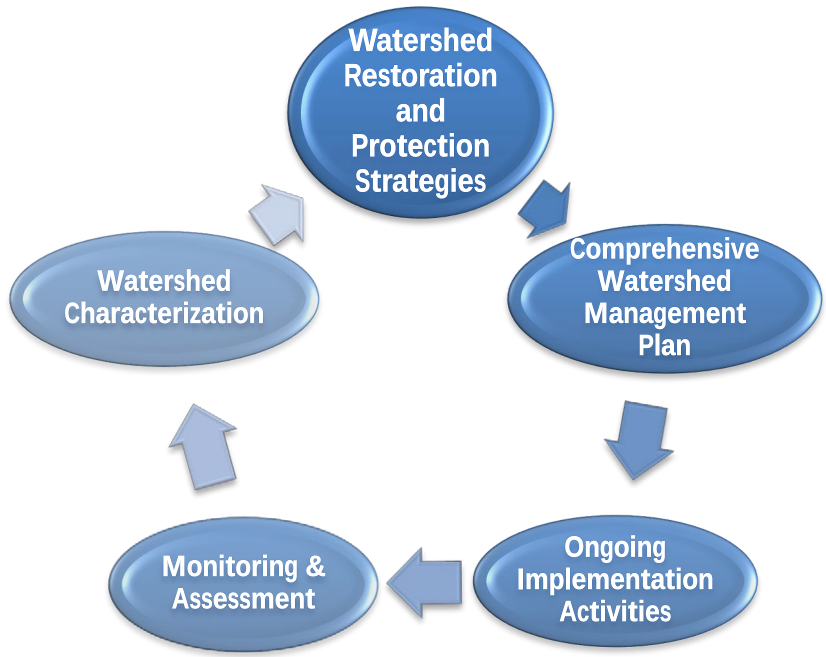
Using data from these sampling efforts, 43 stream reaches were assessed for Aquatic Life and Aquatic Recreation uses, and 6 of the assessed reaches were identified as impaired for aquatic life use. Natural background conditions appear to be responsible for five of these impaired reaches. The remaining one will be studied in detail during the 2020 Intensive Watershed Monitoring study. In general, the streams of the Big Fork River Watershed have good water quality, with 37 of the 43 assessed reaches meeting all water quality standards. However, several stressors could degrade water quality in the future, including climate change, increased riparian development, and an increased forest harvest rate.

Almost all of the lakes in the Big Fork River Watershed are located in the glacial moraine headwaters in Itasca County. The amount of lake monitoring data for this watershed is extensive. One hundred and twenty lakes had sufficient data for assessment (43% of all lakes greater than 10 acres and 100% of the lakes over 100 acres within the watershed). Local partners such as the Itasca County SWCD and Itasca Community College primarily conducted lake monitoring in the watershed. Additionally, volunteers enrolled in the Minnesota Pollution Control Agency's (MPCA's) Citizen Lake Monitoring Program (CLMP) conducted lake clarity monitoring within the watershed. The MPCA staff sampled five of the assessed lakes from 2009 to 2011.

Of the 120 lakes in the Big Fork River Watershed that were assessed in 2010, four were identified as being impaired (Table 2). Of the four impaired lakes in the watershed, three exhibited characteristics of shallow lakes and are being deferred until next Watershed Restoration and Protection Strategies (WRAPS) cycle (starting in 2020), pending the results of an ongoing MPCA investigation to determine if a separate standard for shallow lakes in the Northern Lakes and Forests Ecoregion is warranted. A TMDL investigation for Island Lake was completed concurrent with this WRAPS report development.

Issues of concern in the next cycle of WRAPS, beginning in 2020, include concerns about climate change and its effects on stream and lake water quality, the five streams in need of natural background data to re-categorize them, forest harvest and hydrology issues, and development on sensitive lakes.

What is the WRAPS Report?



The state of Minnesota has adopted a "watershed approach" to address the state's 80 "major" watersheds (denoted by 8-digit hydrologic unit code [HUC]). This watershed approach incorporates **water quality assessment, watershed analysis, civic engagement, planning**, **implementation**, and **measurement of results** into a 10-year cycle that addresses both restoration and protection.

As part of the watershed approach, waters that do not meet state standards are still listed as impaired, and Total Maximum Daily Load (TMDL) studies are performed for them, as they have been in the past; but in addition, the watershed approach process facilitates a more cost-effective and comprehensive characterization of multiple water bodies and overall watershed health. A key aspect of this effort is to develop and use watershed-scale models and other tools to help state agencies, local governments, and other watershed stakeholders determine how to best proceed with restoring and protecting lakes and streams. This report summarizes past assessment and diagnostic work, and outlines ways to prioritize actions and strategies for continued implementation.

Purpose

- Support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning
- Summarize Watershed Approach work completed to date, including the following reports:
  - *Big Fork River Watershed Monitoring and Assessment - 2013*
  - *Big Fork River Watershed - Island Lake - Total Maximum Daily Load - 2017*

Scope

- Impacts to aquatic recreation and impacts to aquatic life in streams
- Impacts to aquatic recreation in lakes

Audience

- Local working groups (local governments, soil and water conservation districts [SWCDs], and watershed management groups)
- State agencies (Minnesotat Pollution Control Agency (MPCA), Minnesotat Department of Natural Resources (DNR), and the Board of Water and Soil Resources (BWSR)
- Big Fork Watershed citizens

1. Watershed Background & Description

The Big Fork River Watershed is located in north-central Minnesota as part of the Rainy River Basin and covers 2,073 square miles, which is almost evenly divided between Itasca (49%) and Koochiching Counties (51%).

The Big Fork River Watershed is located in an isolated part of the state with little land disturbances and includes the municipalities of Bigfork (population 445), Big Falls (population 232), Effie (population 125), Mizpah (population 56), and Squaw Lake (population 108). There are many unincorporated communities in the Big Fork River Watershed that have populations as large or larger than the incorporated communities in the watershed. There is also a large seasonal flux of community members based upon time of year, the summer being the busiest.

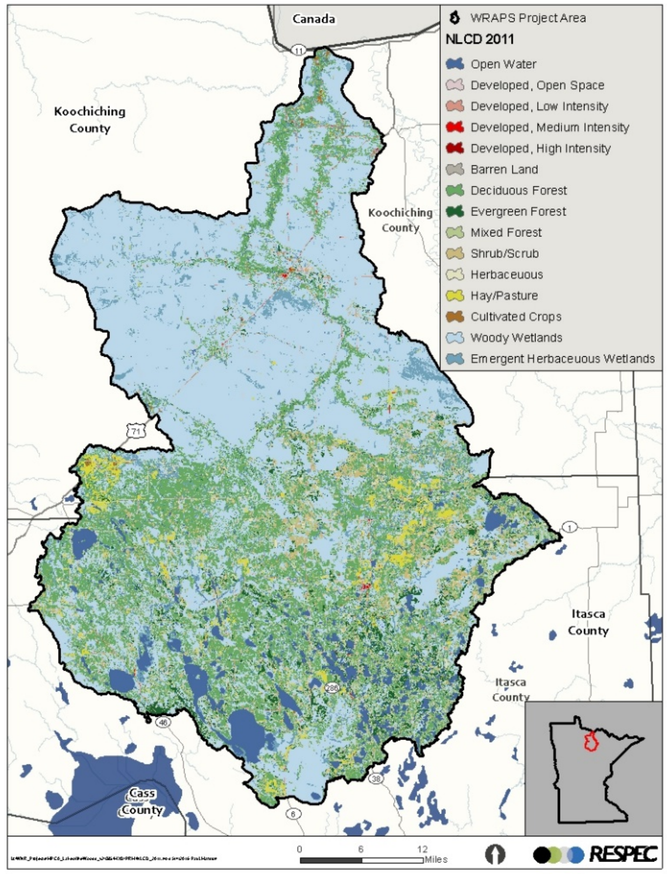


Figure 1: Big Fork Watershed Land Cover.

The Big Fork River Watershed is divided between two ecoregions: Northern Lakes and Forests, and Northern Minnesota Wetlands. The southern portion of the watershed is primarily glacial till, with the land cover dominated by mixed forest (Figure 1). The northern portion is depositional and relatively flat, because it was formed during one of the iterations of Glacial Lake Agassi, with woody wetlands and peat bogs comprising most of the land cover. The Big Fork River starts at Dora Lake and meanders north 165 miles to the Rainy River at the Minnesota/Ontario border.

Additional Big Fork River Watershed Resources

U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Rapid Watershed Assessment for the Big Fork River Watershed: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_022518.pdf

Minnesota Department of Natural Resources (DNR) Watershed Assessment Mapbook for the Big Fork River Watershed: http://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/wsmb77.pdf

Minnesota Pollution Control Agency (MPCA) Big Fork Watershed: https://www.pca.state.mn.us/water/watersheds/big-fork-river

Koochiching Soil and Water Conservation District (SWCD): www.koochichingswcd.org

Itasca Soil and Water Conservation District (SWCD): http://www.itascaswcd.org/

2. Watershed Conditions

Stream condition throughout the watershed was assessed using a range of parameters, including fish and macroinvertebrate index of biotic integrity (IBI), fecal coliform and *E. coli*, DO, and turbidity and total suspended solids (TSS). Water quality measurements from streams were compared to state water quality standards. Stream conditions and impairment assessment for all assessed reaches in the Big Fork River Watershed are summarized in Section 2.1.

Only one lake in the Big Fork River Watershed (Island Lake) that was identified as impaired in the 2013 Watershed Assessment has received a TMDL allocation. Three other lakes in the watershed did not meet water quality standards; however, these lakes behave differently due to their shallow nature. It was decided to defer work on these TMDLs until shallow lakes standards are developed for the Northern Lakes and Forest Ecosystem. One lake (Jessie Lake in the Bowstring Subwatershed) already has a completed TMDL with ongoing restoration activities. Five streams that failed to meet the water quality or biological standards are under consideration for natural background classification as the cause for the impairments. More data needs to be gathered in these streams to determine natural background conditions, therefore TMDLs were deferred. This work will be conducted in the next WRAPS cycle starting in 2020.

Some of the waterbodies in the Big Fork River Watershed are impaired by mercury; however, this report does not cover toxic pollutants. For more information on mercury impairments, see the statewide mercury TMDL (https://www.pca.state.mn.us/water/statewide-mercury-reduction-plan).

One of the objectives of this WRAPS report is to identify waterbodies that need protection. Protection efforts target waters that have been assessed and fully support aquatic life or recreation, as well as waters that have not been assessed. Additional details about protection considerations are discussed in Sections 2.5 and 3.3 of this report.

2.1 Condition Status

Streams

In 2010 and 2011, the MPCA conducted an intensive monitoring investigation of the Big Fork River Watershed. Twelve watershed water chemistry stations were sampled from May through September in 2010, and again June through August of 2011, to provide water chemistry data to assess all components of the Aquatic Life and Recreation Use Standards. All stations were co-located with or near biological sites. Water chemistry data was collected by either the Itasca County or Koochiching County SWCD, separating sites by their respective counties. Biological monitoring was conducted at 42 locations along the Big Fork River and its tributaries. In addition to the 2010 and 2011 monitoring, the Big Fork River Board's River Watch Project has conducted routine sampling for conventional pollutants at various mainstem monitoring stations for over 20 years.

Using data from these sampling efforts, 43 reaches were assessed for Aquatic Life and Aquatic Recreation uses, and 6 of the assessed reaches were identified as impaired for aquatic life (Table 1) use. Natural background conditions appear to be responsible for four of these impaired reaches. The remaining two will be studied in detail during the 2020 Intensive Watershed Monitoring study. In general, the streams of the Big Fork River Watershed have good water quality, with 37 of the 43 assessed reaches meeting all water quality standards. However, several stressors could degrade water quality in the future, including climate change, increased riparian development, and an increased forest harvest rate. Protection needs should be addressed throughout the watershed. More information regarding protection considerations is included in Section 2.5.

Table 1: Assessment status of impaired stream reaches in the Big Fork River Watershed

Name	Reach Description	Assessment Unit ID	Affected Designated Use	Pollutant or Stressor	Year Placed in Impairment Inventory
Popple River	Headwaters to Round Lake	09030006-517	Aquatic life	Fish	2014
Popple River	Natures Lake to Dora Lake	09030006-512	Aquatic life	Dissolved oxygen	2014
Bowstring River	Turtle River to Jessie Brook	09030006-575	Aquatic life	Dissolved oxygen	2014
Rice River	Batson Lake Outlet to Pelton Lake Outlet	09030006-539	Aquatic life	Dissolved oxygen	2014
Gale Brook	Isaac Lake Outlet to Lauchoh Lake Outlet	09030006-547	Aquatic life	Macroinvertebrates	2014
Unnamed Creek	Headwaters to Big Fork	09030006-675	Aquatic life	Macroinvertebrates	2014

Lakes

Almost all of the lakes in the Big Fork River Watershed are located in the glacial moraine headwaters in Itasca County. The amount of lake monitoring data for this watershed is extensive. A total of 120 lakes had sufficient data for assessment (43% of all lakes greater than 10 acres and 100% of lakes larger than 100 acres within the watershed). Lake monitoring in the watershed was primarily conducted by local partners such as the Itasca County SWCD and Itasca Community College. Additionally, many volunteers that were enrolled in the MPCA's CLMP are conducting lake clarity monitoring within the watershed. MPCA staff sampled five of the assessed lakes from 2009 to 2011.

All of the lakes in the Big Fork River Watershed are classified as class 2B waters, for which aquatic life and recreation are the protected beneficial uses. Minnesota standards for all class 2 waters states "…there shall be no material increase in undesirable slime growths or aquatic plants including algae." Class 2B lakes are assessed based on ecoregion specific numeric water quality standards for total phosphorus (TP), chlorophyll-*a*, and Secchi transparency depth. To be listed as impaired, a lake must exceed water quality standards for TP and either chlorophyll-*a* or Secchi depth.

Of the 120 lakes in the Big Fork River Watershed that were assessed in 2010, four were identified as being impaired (Table 2). Of the four impaired lakes in the watershed, three exhibited characteristics of shallow lakes and TMDLs for these lakes were deferred, pending the results of an ongoing MPCA investigation to determine if a separate standard for shallow lakes in the Northern Lakes and Forests Ecoregion is warranted. A TMDL investigation for the remaining impaired lake (Island Lake) was completed concurrently with the completion of this WRAPS report. Please see Section 2.4 for more information on the Island Lake TMDL. Two other lakes (Jessie and Round) had previously been placed on the Impaired Waters List (303(d) Report to Congress). The Jesse Lake TMDL was completed and approved by the Environmental Protection Agency (EPA) in May 2011. Round Lake is one of the lakes deferred until next the WRAPS cycle.

As was mentioned in the Streams section, protection needs for lakes should also be considered. Please see Section 2.5 for more information on protection.

Table 2: Assessment status of impaired lakes in the Big Fork River Watershed

Name	Reach Description	Assessment Unit ID	Affected Designated Use	Pollutant or Stressor	Year Placed in Impairment Inventory
Round Lake	Lake or Reservoir	31-0896-00	Aquatic Recreation	Nutrients	2008
Island Lake	Lake or Reservoir	31-0913-00	Aquatic Recreation	Nutrients	2010
Shallow Pond	Lake or Reservoir	31-0910-00	Aquatic Recreation	Nutrients	2014
Little Spring Lake	Lake or Reservoir	31-0797-00	Aquatic Recreation	Nutrients	2014
Bowstring Lake	Lake or Reservoir	31-0813-00	Aquatic Recreation	Nutrients	2014
Jessie Lake	Lake or Reservoir	31-0786-00	Aquatic Recreation	Nutrients	2004

2.2 Water Quality Trends

The following section summarizes whether lake and stream water quality is improving or declining over the last 10+ years. Of the 298 Big Fork River Watershed lakes with transparency data, 40 had sufficient data to detect a long-term trend. Of those, 28 had no trend, 3 had improving transparency, and 9 had declining transparency. The only stream with sufficient data to detect long-term water quality trends was the Big Fork River mainstem, which has seven sites with sufficient data for statistical analysis. The river had mixed trends results.

Lake Trends

The MPCA has analyzed 40 lakes in the Big Fork River Watershed using data from its CLMP, as listed in Table 3. The analysis of the CLMP data was conducted using statistical software to run a seasonal Kendall test, applied to all June through September Secchi data for each lake that has a minimum of 8 years of data and 25 pairs of data. The median Secchi is calculated and charted along with the minimum and maximum measurements for each year. The summer-median and a smoothing technique are used to draw the regression line. The trend and trend significance are reported for each lake. Translating significance into a narrative description of trend is as follows: 0, ±1 no trend; sig = ± weak evidence for a possible trend; sig = ±3 evidence for a possible trend; sig = ±4 evidence for trend; and sig = ±5 strong evidence for a trend.

Improving water quality trends are highlighted in green, and declining water quality trends are highlighted in red.

Table 3: Transparency trends of lakes in the Big Fork River Watershed, Citizen Lake Monitoring Program (CLMP)

HUC-8	Lake Name	Lake ID	Latitude	Longitude	Trend
09030006	Five Island	31-0183-00	47.84042128	–93.29550991	Declining
09030006	Battle	31-0197-00	47.82801169	–93.34007095	Declining
09030006	Bass	31-0316-00	47.78968619	–93.40249481	No Trend
09030006	Deer	31-0334-00	47.83591183	–93.38292572	No Trend
09030006	Pickerel	31-0339-00	47.82588819	–93.35902312	Declining
09030006	Black Island	31-0416-00	47.52456595	–93.5318658	No Trend
09030006	Ruby	31-0422-00	47.52044416	–93.55318151	No Trend
09030006	Gunn	31-0452-00	47.54169796	–93.53910378	No Trend
09030006	Eagle	31-0454-00	47.60938212	–93.47693599	No Trend

HUC-8	Lake Name	Lake ID	Latitude	Longitude	Trend
09030006	East	31-0460-00	47.61828819	–93.55443715	No Trend
09030006	Mary	31-0473-00	47.58426223	–93.47624813	Declining
09030006	Gum	31-0492-00	47.55898148	–93.53218928	Declining
09030006	Fifth Chain	31-0497-00	47.54899157	–93.54215786	Declining
09030006	Busties	31-0530-00	47.8591586	–93.49722075	No Trend
09030006	Clubhouse	31-0540-00	47.60412424	–93.57102686	No Trend
09030006	East Smith	31-0616-00	47.54178673	–93.61110512	No Trend
09030006	Caribou	31-0620-00	47.52802192	–93.63794924	No Trend
09030006	Little Dead Horse	31-0621-00	47.52819614	–93.65378908	No Trend
09030006	Boy	31-0623-00	47.52231778	–93.66560755	Improving
09030006	Grave	31-0624-00	47.49933196	–93.67922976	No Trend
09030006	North Star	31-0653-00	47.55383987	–93.66495341	No Trend
09030006	Big Dick	31-0656-00	47.61048634	–93.60940378	Improving
09030006	JACK THE HORSE (N)	31-0657-01	47.62280264	–93.63182136	No Trend
09030006	JACK THE HORSE (S)	31-0657-02	47.61059991	–93.64150949	Declining
09030006	Ranier	31-0664-00	47.59158248	–93.68422538	No Trend
09030006	Big Island	31-0671-00	47.57013178	–93.59569953	No Trend
09030006	Johnson	31-0687-00	47.62383625	–93.65575229	No Trend
09030006	Turtle	31-0725-00	47.62497134	–93.72966934	Improving
09030006	Bello	31-0726-00	47.67070403	–93.72032427	Declining
09030006	Little Bowstring	31-0758-00	47.49359838	–93.72508367	No Trend
09030006	Maki	31-0759-00	47.482431	–93.72231728	Declining
09030006	Gunderson	31-0782-00	47.70918105	–93.77795641	No Trend
09030006	Little Jessie	31-0784-00	47.55559236	–93.8214919	No Trend
09030006	Peterson	31-0791-00	47.64308392	–93.84024214	No Trend
09030006	Sand	31-0826-00	47.60836139	–94.00815224	No Trend
09030006	Rush Island	31-0832-00	47.62447594	–93.95822676	No Trend
09030006	Natures	31-0877-00	47.64560008	–94.11575691	No Trend
09030006	Dora	31-0882-00	47.7336123	–94.04662967	No Trend
09030006	Round	31-0896-00	47.61868753	–94.1652426	No Trend
09030006	Island	31-0913-00	47.81988577	–94.23635802	No Trend

Stream Trends

The Big Fork River has 12 water quality stations, and 8 of those stations had at least one water quality constituent with adequate record to conduct trend analysis. The trend analysis was conducted using a seasonal Kendall test using software (version: Kendall_new.exe) developed by the United States Geological Survey (USGS) (http://pubs.usgs.gov/sir/2005/5275/). Trends were only reported for constituents with at least 10 years of data and 90% statistical confidence. The data were analyzed and were not smoothed for streamflow because corresponding streamflow data were not available. The trend is based on the p-value of the data and the seasonal trend is the adjusted p-value considering two seasons (Table 4). Improving water quality trends are highlighted in green and declining water quality trends are highlighted in red.

The site at the Big Fork's confluence with the Rainy River (S000-173) was excluded from the trend analysis because of backwater effects during high flows.

2.3 Stressors and Sources

To develop appropriate strategies for restoring or protecting waterbodies, the stressors and/or sources that impact or threaten them must be identified and evaluated. Biological Stressor Identification is completed for streams with either fish or macroinvertebrate biota impairments, and encompasses evaluating both pollutants and nonpollutant-related factors (e.g., altered hydrology, fish passage, and habitat) as potential stressors. Pollutant source assessments are done where a biological stressor ID process identifies a pollutant as a stressor, as well as for the typical pollutant impairment listings. Section 3 provides further detail on stressors and pollutant sources in the Big Fork River Watershed.

No Stressor Identification Reports were completed for the Big Fork River Watershed because there were no biological impairments found, except for those that were considered to be caused by natural background conditions. This falls under the 4D Category for Consolidated Assessment and Listing Methodology (CALM). If the MPCA Natural Background Review Committee determines that the four stream reaches submitted for review do not meet the natural background threshold, stressor identification studies will be necessary for each reach in the second 10-year cycle of the WRAPS framework.

Table 4: Long-term water quality trends along the Big Fork River (Page 1 of 2)

Station	Constituent	Date Range	Trend	Seasonal Trend
MPCA, S002-855, **BIG FORK RIVER** AT CR1 AT LINDFORD	Conductivity (lab), uS/cm	1995–2011	No Trend	No Trend
	Dissolved Oxygen, mg/L	1995–2011	No Trend	No Trend
	pH, Laboratory	1995–2011	No Trend	No Trend
	Fecal Coliform, cfu/100 mL	1995–2011	Declining	Declining
	Total NO2 + NO3, mg/L as N	1998–2011	Improving	Improving
	Total NO3, mg/L as N	1995–2011	No Trend	No Trend
	Temperature, Air, deg C	1995–2011	No Trend	No Trend
	Temperature, Water, deg C	1995–2011	No Trend	No Trend
	Total Phosphorus, mg/L as P	1995–2011	No Trend	No Trend
MPCA, S002-856, **BIG FORK RIVER** AT STURGEON LNDG, 5 MI W OF BIG FALLS	Conductivity (lab), uS/cm	1995–2011	No Trend	No Trend
	Dissolved Oxygen, mg/L	1995–2011	Improving	Improving
	pH, Laboratory	1995–2011	No Trend	No Trend
	Fecal Coliform, cfu/100 mL	1995–2011	Declining	Declining
	Total NO2 + NO3, mg/L as N	1998–2011	Improving	Improving
	Total NO3, mg/L as N	1995–2011	No Trend	No Trend
	Temperature, Air, deg C	1995–2011	No Trend	No Trend
	Temperature, Water, deg C	1995–2011	No Trend	No Trend
	Total Phosphorus, mg/L as P	1995–2011	No Trend	No Trend
MPCA, S004-000, **BIG FORK RIVER** AT BIG FK AVE, 0.3 MI N OF BIG FALLS, MN	Conductivity (lab), uS/cm	2006–2015	Declining	Declining
	Dissolved Oxygen, mg/L	2006–2015	No Trend	No Trend
MPCA, S002-857, **BIG FORK RIVER** AT GRUNDWALD LNDG, 5.5 MI SE BIG FALLS	Conductivity (lab), uS/cm	1995–2011	Declining	No Trend
	Dissolved Oxygen, mg/L	1995–2011	No Trend	No Trend
	pH, Laboratory	1995–2011	No Trend	No Trend
	Fecal Coliform, cfu/100 mL	1995–2011	No Trend	No Trend
	Total NO2 + NO3, mg/L as N	1998–2011	No Trend	No Trend
	Total NO3, mg/L as N	1995–2011	No Trend	No Trend
	Temperature, Air, deg C	1995–2011	No Trend	No Trend
	Temperature, Water, deg C	1995–2011	No Trend	No Trend
	Total Phosphorus, mg/L as P	1995–2011	No Trend	No Trend
MPCA, S002-858, **BIG FORK RIVER** AT CR5, 5 MI N NE OF EFFIE	Conductivity (lab), uS/cm	1995–2011	Declining	Declining
	Dissolved Oxygen, mg/L	1995–2011	No Trend	No Trend
	pH, Laboratory	1995–2011	No Trend	No Trend
	Fecal Coliform, cfu/100 mL	1995–2011	No Trend	No Trend
	Total NO2 + NO3, mg/L as N	1998–2011	Declining	Declining
	Total NO3, mg/L as N	1995–2011	No Trend	No Trend
	Temperature, Air, deg C	1995–2011	No Trend	No Trend
	Temperature, Water, deg C	1995–2011	No Trend	No Trend
	Total Phosphorus, mg/L as P	1995–2011	Declining	No Trend

Table 5: Long-term water quality trends along the Big Fork River (Page 2 of 2)

Station	Constituent	Date Range	Trend	Seasonal Trend
MPCA, S002-859, **BIG FORK RIVER** AT CR237, 4.5 MI NE BIG FORK	Conductivity (lab), uS/cm	1995–2011	Declining	Declining
	Dissolved Oxygen, mg/L	1995–2011	No Trend	No Trend
	pH, Laboratory	1995–2011	No Trend	No Trend
	Fecal Coliform, cfu/100 mL	1995–2011	No Trend	No Trend
	Total NO2 + NO3, mg/L as N	1998–2011	Declining	Declining
	Total NO3, mg/L as N	1995–2011	Declining	Declining
	Temperature, Air, deg C	1995–2011	No Trend	No Trend
	Temperature, Water, deg C	1995–2011	No Trend	No Trend
	Total Phosphorus, mg/L as P	1995–2011	Declining	Declining
MPCA, S002-860, **BIG FORK RIVER** AT CR31 IN WIRT	Conductivity (lab), uS/cm	1995–2011	Declining	Declining
	Dissolved Oxygen, mg/L	1995–2011	No Trend	No Trend
	pH, Laboratory	1995–2011	No Trend	No Trend
	Fecal Coliform, cfu/100 mL	1995–2011	No Trend	No Trend
	Total NO2 + NO3, mg/L as N	1998–2011	Declining	No Trend
	Total NO3, mg/L as N	1995–2011	Declining	No Trend
	Temperature, Air, deg C	1995–2011	No Trend	No Trend
	Temperature, Water, deg C	1995–2011	Declining	Declining
	Total Phosphorus, mg/L as P	1995–2011	Declining	Declining

Pollutant Sources

This section summarizes the sources of pollutants (e.g., phosphorus, bacteria, or sediment) to lakes and streams in the Big Fork River Watershed, including point sources (such as sewage treatment plants) or nonpoint sources (e.g., runoff from the land).

Pollutant sources vary by subwatershed and by stream segment depending on permitted point source dischargers, upstream loading/conditions, near-reach land use, and other nonpoint sources throughout the watershed. Potential pollutant sources in the impaired Island Lake Watershed are identified and discussed in the TMDL in Section 2.4. No point sources were found within the Island Lake Watershed.

Point Sources

Point sources are defined as facilities that discharge stormwater or wastewater to a lake or stream and have a National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) Permit (Permit). There are 5 municipal wastewater facilities and 11 large animal feeding operations that require NPDES permitting located in the Big Fork River Watershed (Table 6). None of the point sources require pollutant reductions beyond their current permit conditions or limits. All permitted facilities are meeting water quality expectations and are accounting for future growth capacity. Figure 2 shows all permitted point sources in the Big Fork River Watershed, including feedlots, overlaid on a map of priority protection needs.

Table 6: Point sources in the Big Fork River Watershed

HUC-11 Subwatershed	Point Source		Pollutant Reduction Needed Beyond Current Permit Conditions/Limits?
	Permit #	Type	
Upper Big Fork River	MN0022811	Municipal wastewater	[No]
Gale Brook	MN0049891	Municipal wastewater	[No]
Middle Big Fork River	MN0067555	Municipal wastewater	[No]
Caldwell Brook	MNG580185	Municipal wastewater	[No]
Lower-Middle Big Fork River	MNG580135	Municipal wastewater	[No]
Upper Bowstring River	061-63184	Feedlot	[No]
Upper Bowstring River	061-65095	Feedlot	[No]
Upper Bowstring River	061-65000	Feedlot	[No]
Caldwell Brook	071-69180	Feedlot	[No]
Caldwell Brook	071-61667	Feedlot	[No]
Upper Big Fork River	061-62905	Feedlot	[No]
Caldwell Brook	071-64996	Feedlot	[No]
Caldwell Brook	071-62061	Feedlot	[No]
Caldwell Brook	071-99200	Feedlot	[No]
Caldwell Brook	071-65237	Feedlot	[No]
Caldwell Brook	071-64840	Feedlot	[No]
Caldwell Brook	071-100480	Feedlot	[No]

Nonpoint Sources

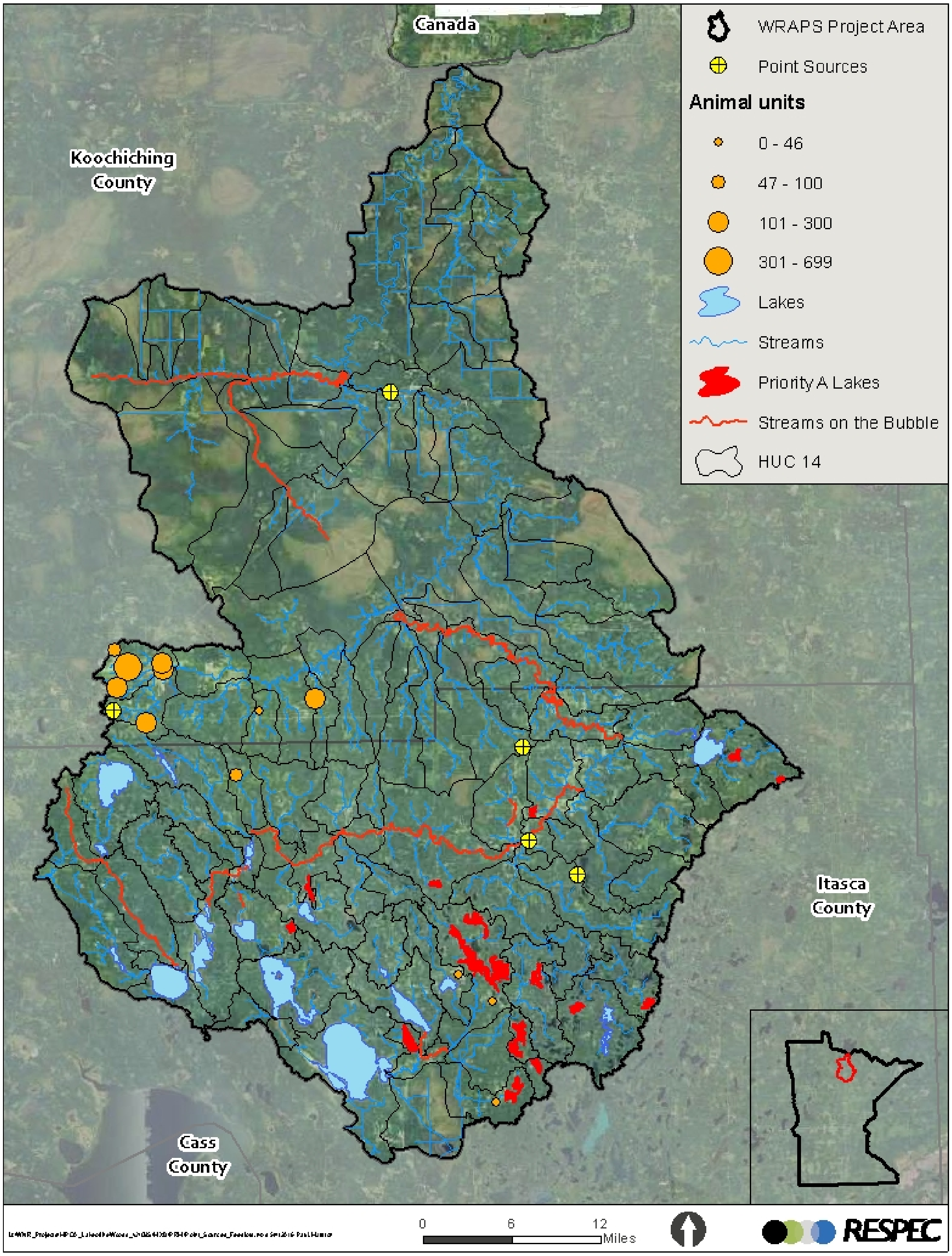
Nonpoint pollution sources, unlike pollution from industrial and municipal sewage treatment plants, comes from many different sources. Nonpoint-source pollution is caused by rainfall or snowmelt moving over and through the ground from a number of diffuse sources. As the runoff moves, it picks up and carries away natural and human-caused pollutants and deposits them into lakes and streams. Common nonpoint and natural pollutant sources in the Big Fork River Watershed are:

- **Fertilizer and/or manure runoff**: Fertilizer and manure contain high concentrations of phosphorus, nitrogen, and bacteria that can run off into lakes and streams when not properly managed.
- **Failing septic systems**: Septic systems that are not maintained or are failing near a lake or stream can contribute excess phosphorus, nitrogen, and bacteria.
- **Peatlands/wetlands**: Peatlands and wetlands in the Big Fork River Watershed have high levels of phosphorus and low levels of DO that can pollute downstream streams and lakes.
- **Internal loading**: Lake sediments contain large amounts of phosphorus that can be released into the lake water through physical mixing or under certain chemical conditions.
- **Upstream lake loading**: Some lakes receive most of their phosphorus from upstream lakes and streams. For these lakes, restoration and protection efforts should focus on improving the water quality of the upstream lakes and streams.

- **Livestock overgrazing in stream**: Livestock grazing/watering in the riparian zone can cause localized damage and erosion of the stream bank, and is a source of phosphorus and bacteria pollutants.
- **Wildlife fecal runoff**: Dense or localized populations of wildlife, such as beavers or geese, can contribute phosphorus and bacteria pollutants to streams or ponds.

Fertilizer and urban and rural stormwater runoff, in-lake sediment phosphorus release (internal loading), and upstream lake loading were identified as common nonpoint pollutant sources to impaired or threatened lakes and streams in the Big Fork River Watersheds.

Figure 2: Map of watershed point sources, including animal units, overlaid on priority lakes and streams



Disturbance

Another water quality protection concern is the cumulative effects of human activities. Typically, cumulative effects are measured in percent of disturbance in a watershed. Human-caused disturbances include development, pastureland, agriculture, and young forest. A concern in the Big Fork River Watershed is parceling and developing the vast tracts of privately owned forestlands. Parcelization that occurs within riparian zones of lakes and streams, which can magnify disturbance effects, are of special concern within the Big Fork River Watershed.

- Development includes: houses and other structures, roads, parking lots, driveways and patios (impervious surfaces; i.e., no rainwater absorption or attenuation), lawns and other native vegetation removal or change that results in increased runoff (reduced stormwater attenuation), and drainage (stream channelization and drainage ditches).
- Wetlands can be a natural source of nutrients (phosphorus), due to the decomposition of plants. In addition, the lack of wetlands can contribute to increased run-off, and therefore can lead to near-bank and in-channel sediment issues.
- Pastureland includes pasture and hay land (reduced stormwater attenuation, increased nutrients).
- Agriculture includes cropland and feedlots (significant stormwater runoff, increased nutrients).
- Young forest includes clear cuts, blowdowns and burned areas (because of wildfires, not controlled burns; significant stormwater runoff). Verry et al. (1983) found that when clearcutting in a watershed exceeded 50% of the watershed, land use peak flows doubled, significantly increasing the likelihood of stream destabilization. Verry et al.'s research showed that, on average, 15 years of regrowth is necessary for flows to return to precut levels. Good forest management practices, such as the timing of pre/post-harvest activities, can have positive influences on water quality, and implementing forestry best management practices (BMPs) can minimize the impact on water quantity and quality.

Table 7: Relative Magnitudes of Disturbance, by activity, in the Big Fork River Watershed. (Page 1 of 2)

HUC-11 Subwatershed	Pollutant	Pollutant Sources				
		Young Forest (under 15 years)	Agriculture	Development	Wetlands	Disturbance (%)
Upper Big Fork	TSS	˜	›	™	™	›
	TP	›	›	™	˜	™
	N	›	›	™	˜	™
	BOD	™	™	™	˜	™
Popple	TSS	˜	™	™	™	›
	TP	›	™	™	›	™
	N	›	™	™	›	™
	BOD	›	™	™	›	™
Upper Bowstring	TSS	›	˜	›	›	™
	TP	™	›	™	˜	™
	N	™	™	™	˜	™
	BOD	™	™	™	˜	™
Bowstring	TSS	›	™	™	™	™
	TP	™	™	™	˜	™
	N	™	™	™	˜	™
	BOD	™	™	™	˜	™
Gale Brook	TSS	›	™	™	™	™
	TP	›	™	™	›	™
	N	›	™	™	›	™
	BOD	›	™	™	›	™
Middle Big Fork	TSS	˜	›	™	™	›
	TP	›	›	™	˜	™
	N	›	›	™	˜	™
	BOD	›	™	™	˜	™

Key: ˜ = High › = Moderate ™ = Low

Table 8: Relative Magnitudes of Disturbance, by activity, in the Big Fork River Watershed. (Page 2 of 2)

HUC-11 Subwatershed	Pollutant	Pollutant Sources				
		Young Forest (under 15 years)	Agriculture	Development	Wetlands	Disturbance (%)
Caldwell Creek	TSS	›	˜	™		›
	TP	™	˜	™	˜	™
	N	™	›	™	˜	™
	BOD	™	›	™	˜	™
Lower-Middle Big Fork	TSS	˜	™	™	˜	™
	TP	™	™	™	˜	™
	N	™	™	™	˜	™
	BOD	™	™	™	˜	™
Dinner Creek	TSS	™	™	›	˜	™
	TP	™	™	™	˜	™
	N	™	™	™	˜	™
	BOD	™	™	™	˜	™
Sturgeon River	TSS	›	™	™	˜	™
	TP	™	™	™	˜	™
	N	™	™	™	˜	™
	BOD	™	™	™	˜	™
Lower Big Fork River	TSS	›	›	›	›	™
	TP	™	™	™	˜	™
	N	™	™	™	˜	™
	BOD	™	™	™	˜	™
Bear River	TSS	˜	›	˜	™	™
	TP	™	™	™	˜	™
	N	™	™	™	˜	™
	BOD	™	™	™	˜	™

Key: ˜ = High › = Moderate ™ = Low

Research shows that once disturbance in a watershed exceeds 40%, destabilization of aquatic communities is likely (Cross and Jacobson 2013). Figure 2 shows the larger subwatersheds in the Big Fork River Watershed, none of which exceed 20% disturbance. However, given the current land uses in the Big Fork River Watershed, a 200-square-mile watershed is unlikely to have 40% of its land use disturbed. Figure 3 shows the HUC11 (~150 sq. miles) watersheds all with less than 20% disturbance. The smaller minor watersheds, which average approximately 40 square miles, are the scale that is required to effectively develop a detailed understanding of the system. These smaller watersheds will be the focus of the next cycle of WRAPS work in the Big Fork Watershed, which will start in 2020.

It is suggested that resource managers determine the current percentage of disturbance and the percentage of disturbance expected from these smaller watersheds. If the disturbance level approaches 40%, avoidance and/or mitigation activities are suggested to be undertaken within the watershed.

2.4 TMDL Summary

Several waterbodies in the Big Fork River Watershed exceeded water quality standards; a TMDL study was carried out on Island Lake, which was impaired by eutrophication. The purpose of a TMDL is to improve water quality so that the waterbody is no longer impaired. Load reductions and allocations necessary to bring the waterbody into compliance are summarized in Table 9, the TMDL load allocation table. A BATHTUB model was developed to model Island Lake's chlorophyll-*a* and Secchi disk depth (transparency) responses to internal and external phosphorus loads. Load allocations of 25%, 30%, and 34% were applied to phosphorus loading from septic systems, internal loading, and watershed sources. An equitable combination of reduction in external phosphorus loading (from watershed and septic sources) and internal loading will provide a higher probability of long-term success than an approach that does not treat both external and internal sources. A very small wasteload allocation is included for stormwater runoff from construction sites (≥ 1 ac).

Table 9: Island Lake Total Maximum Daily Load allocation table

Island Lake Load Allocation		Existing TP Load		Allowable TP Load		Estimated Load Reduction	
		lbs/yr	lbs/day	lbs/yr	lbs/day	lbs/yr	%
Loading Capacity				**2,765.1**	**7.58**		
Margin of Safety				**142.0**	**0.39**		
TOTAL LOAD		**3,565.0**	**9.77**	**2,623.0**	**7.19**	**942.0**	**26**
Wasteload	**Total Wasteload Allocation (WLA)**	**1.0**	**0.0028**	**1.0**	**0.0028**	**0**	**0**
	Construction Stormwater	*1.0*	*0.0028*	*1.0*	*0.0028*	*0*	*-*
Load	**Total Load Allocation (LA)**	**3,564.0**	**9.76**	**2,622.0**	**7.18**	**942.0**	**26**
	Local Watershed	*814.9*	*2.23*	*537.8*	*1.47*	*277.1*	*34*
	SSTS	*66.7*	*0.18*	*50.0*	*0.14*	*16.7*	*25*
	Atmospheric deposition	*535.2*	*1.47*	*535.2*	*1.47*	*0*	*-*
	Internal load	*2147.2*	*5.88*	*1,499.0*	*4.10*	*648.2*	*30*
Total Load		**3,565.0**	**9.77**	**2,623.0**	**7.19**	**942.0**	**26**

2.5 Protection Considerations

Protection considerations were introduced in Section 2.3. Protection activities are most effective when they encompass an entire watershed. Generally, working with minor watersheds (HUC-14, or ~40 square miles) is more cost effective and provides quicker response to water quality protection activities than large-scale projects

In this cycle of WRAPS work, it was determined that the focus of the work was to develop a baseline for the entire watershed on a large scale (HUC 8, or ~1500 sq. miles.) As discussed in Section 2.3, the percent of land use disturbance within a minor watershed is a good indicator of protection needs. The focus of the next WRAPS cycle, starting in 2020, will be to work on smaller subwatersheds (40 sq. miles or less.) This effort will assist local resource managers in developing appropriate protection strategies given the large unpopulated areas of the Big Fork Watershed.

In addition to the small watershed scale work next cycle, MPCA, partners, and citizens will also develop planning efforts to examine the waterbodies which meet standards, but are very close to failing. These waterbodies are in need of protection from becoming impaired.

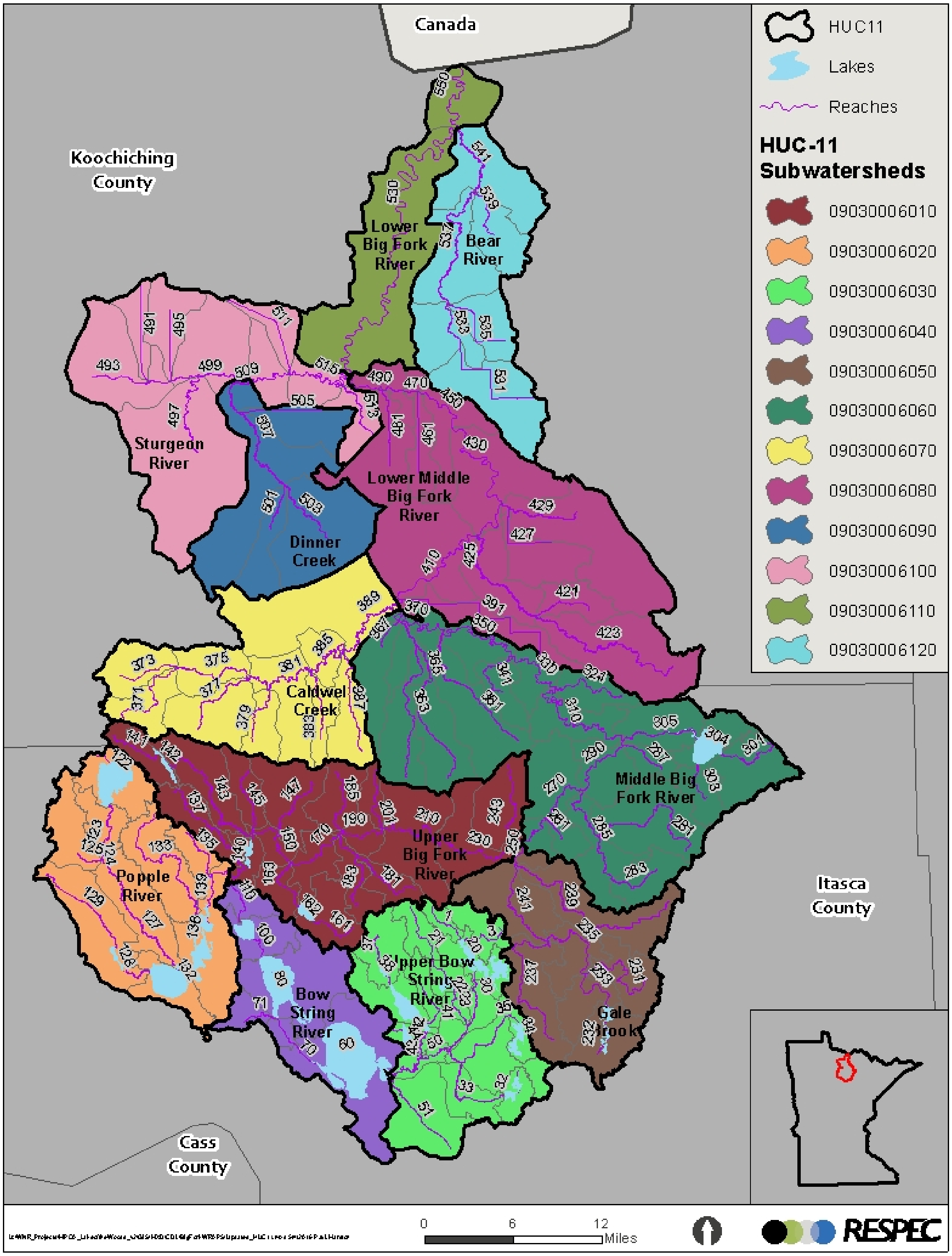


Figure 2: HUC-11 Watersheds within the Big Fork River Watershed, all with a land disturbance less than 20%.

Figure 3 shows the priority lakes and streams for protection in the Big Fork River Watershed. The lakes shown were determined to be a priority by the Minnesota DNR and the MPCA (see Table 10). Because protection and restoration efforts will be focused at the subwatershed level, the subwatersheds with priority lakes and streams are shown in Figure 4 and Figure 5, respectively. For the entire lake assessment for the Big Fork River Watershed, please see Appendix A. The streams were selected based on data assessments conducted for this WRAPS document (see Table 12). Streams "on the bubble" are those streams, which meet our water quality standards for that stream, but are very close to becoming impaired. These streams are candidates for protection and will be the focus of Cycle 2 WRAPs work.

Section 3.2 provides a complete list of specific protection projects identified for this WRAPS report.

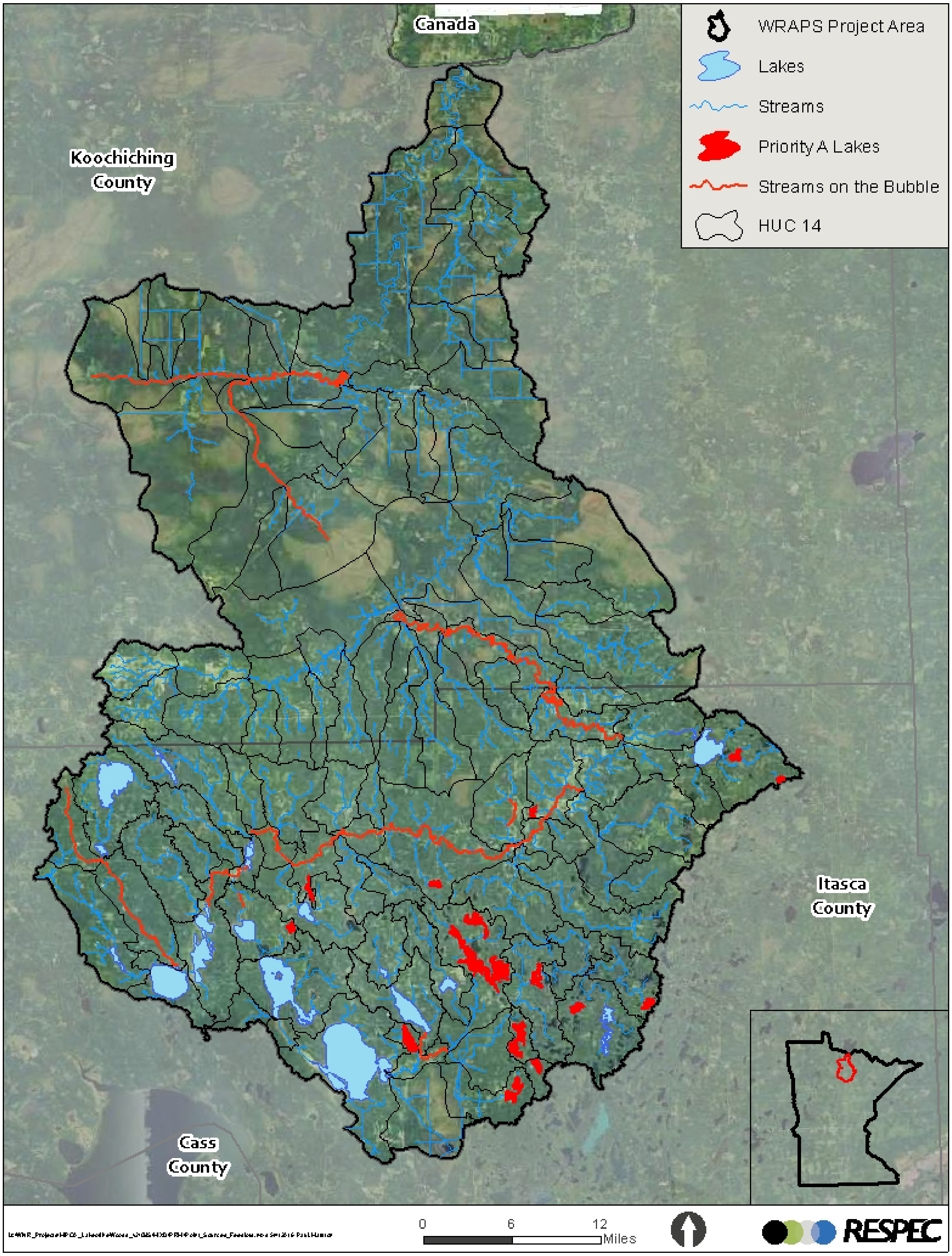


Figure 3: Priority Lakes and Streams for Protection

Table 10: Minnesota multiagency lake prioritization: Big Fork River Watershed priority lakes for protection and restoration (Page 1 of 2)

DNR ID	Name	Depth	Area (acres)	Watershed (acres)	Ecoregion	Disturbed Land use (%)	Mean TP (µg/L)	Years TP	Mean Secchi (ft)	Presence of Trend	Trend Slope Description	Target TP (µg/L)	Load Reduction Target	Load Reduction Target (%)	Priority
31-0160-00	Mirror	DEEP	109	405	NLF	0.05	9.9	3	4.80			8.0	6	19	A
31-0197-00	Battle	SHALLOW	243	5,095	NLF	0.02	15.5	3	2.48	Declining Trend	Evidence for trend	13.2	54	15	A
31-0473-00	Mary	DEEP	212	979	NLF	0.01	9.6	2	3.14	Declining Trend	Evidence for possible trend	9.2	3	4	A
31-0542-00	Three Island	DEEP	250	3,138	NLF	0.03	3.3	2	7.14	Improving Trend	Evidence for trend	2.1	24	35	A
31-0620-00	Caribou	DEEP	246	890	NLF	0.06	7.7	5	9.62	No Evidence of Trend		4.8	24	35	A
31-0624-00	Grave	DEEP	525	3,956	NLF	0.06	12.5	5	3.78	No Evidence of Trend		8.2	104	33	A
31-0653-00	North Star	DEEP	832	3,160	NLF	0.04	13.2	5	4.11	No Evidence of Trend		11.0	53	15	A
31-0657-00	Jack the Horse	DEEP	363	2,276	NLF	0.02	10.8	2	3.85	Declining Trend	Evidence for trend	9.1	28	15	A
31-0710-00	Connors	DEEP	142	652	NMW	0.18	10.4	2	3.66			8.1	11	22	A
31-0725-00	Turtle	DEEP	2,126	15,101	NLF	0.03	10.3	4	4.80	Improving Trend	Strong evidence for trend	9.3	102	8	A
31-0726-00	Bello	DEEP	527	4,243	NLF	0.03	9.8	2	3.20	Declining Trend	Strong evidence for trend	7.8	53	20	A
31-0771-00	Hatch	DEEP	226	2,478	NLF	0.03	5.2	2	4.03			3.2	34	37	A

Table 11: Minnesota multiagency lake prioritization: Big Fork River Watershed priority lakes for protection and restoration (Page 2 of 2)

DNR ID	Name	Depth	Area (acres)	Watershed (acres)	Ecoregion	Disturbed Land use (%)	Mean TP (µg/L)	Years TP	Mean Secchi (ft)	Presence of Trend	Trend Slope Description	Target TP (µg/L)	Load Reduction Target	Load Reduction Target (%)	Priority
31-0782-00	Gunderson	DEEP	183	746	NLF	0.06	11.3	3	4.22	No Evidence of Trend		8.9	14	21	A
31-0784-00	Little Jessie	DEEP	628	1,962	NLF	0.05	10.0	2	4.78	No Evidence of Trend		9.1	16	9	A
31-0836-00	Little Whitefish	DEEP	160	427	NLF	0.08	12.9	3	2.86			11.0	6	15	A
31-0839-00	Bass	DEEP	210	820	NLF	0.11	10.6	3	4.65			9.3	8	12	A

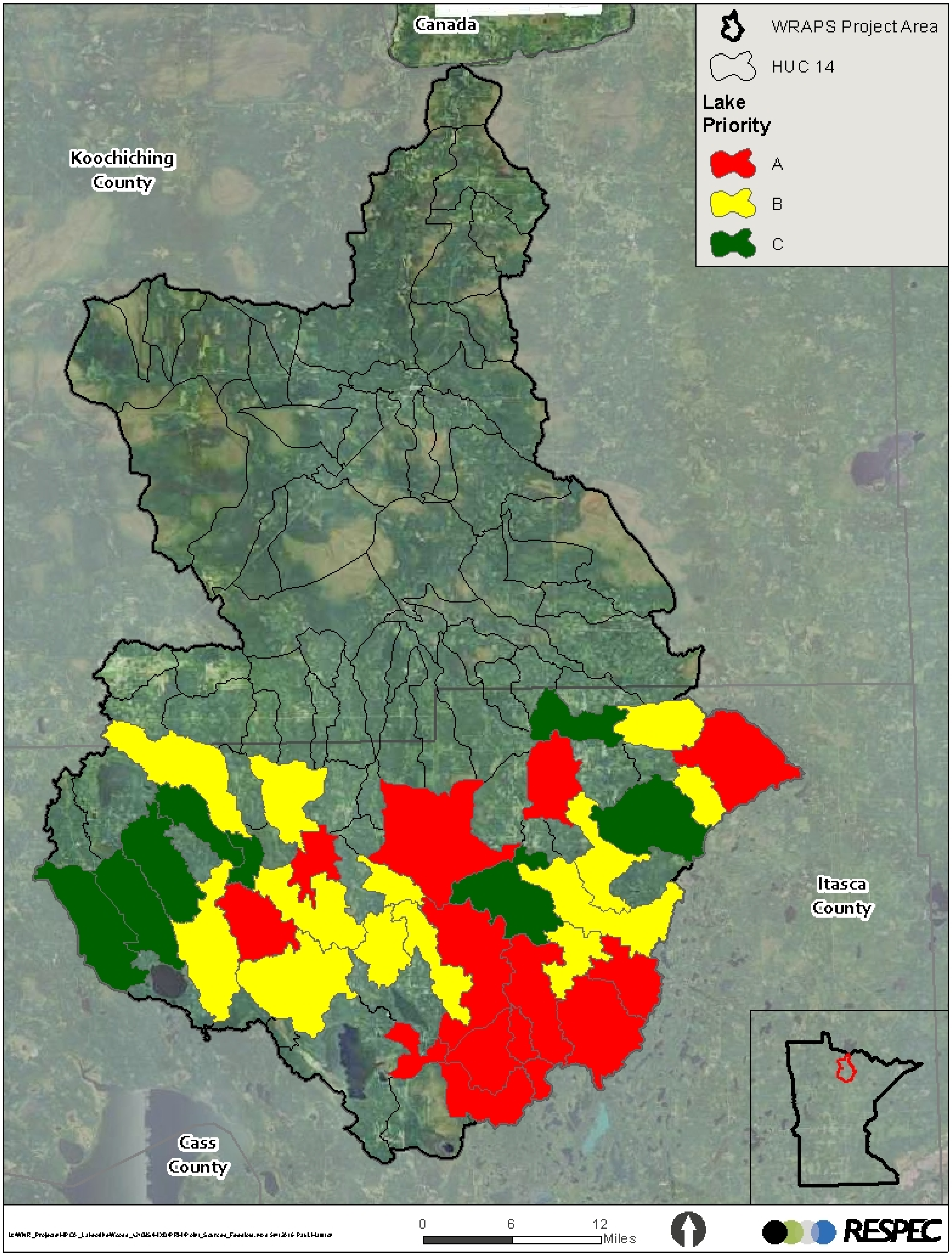


Figure 4: Minor Watershed Map Showing Priorities for Lake Protection.

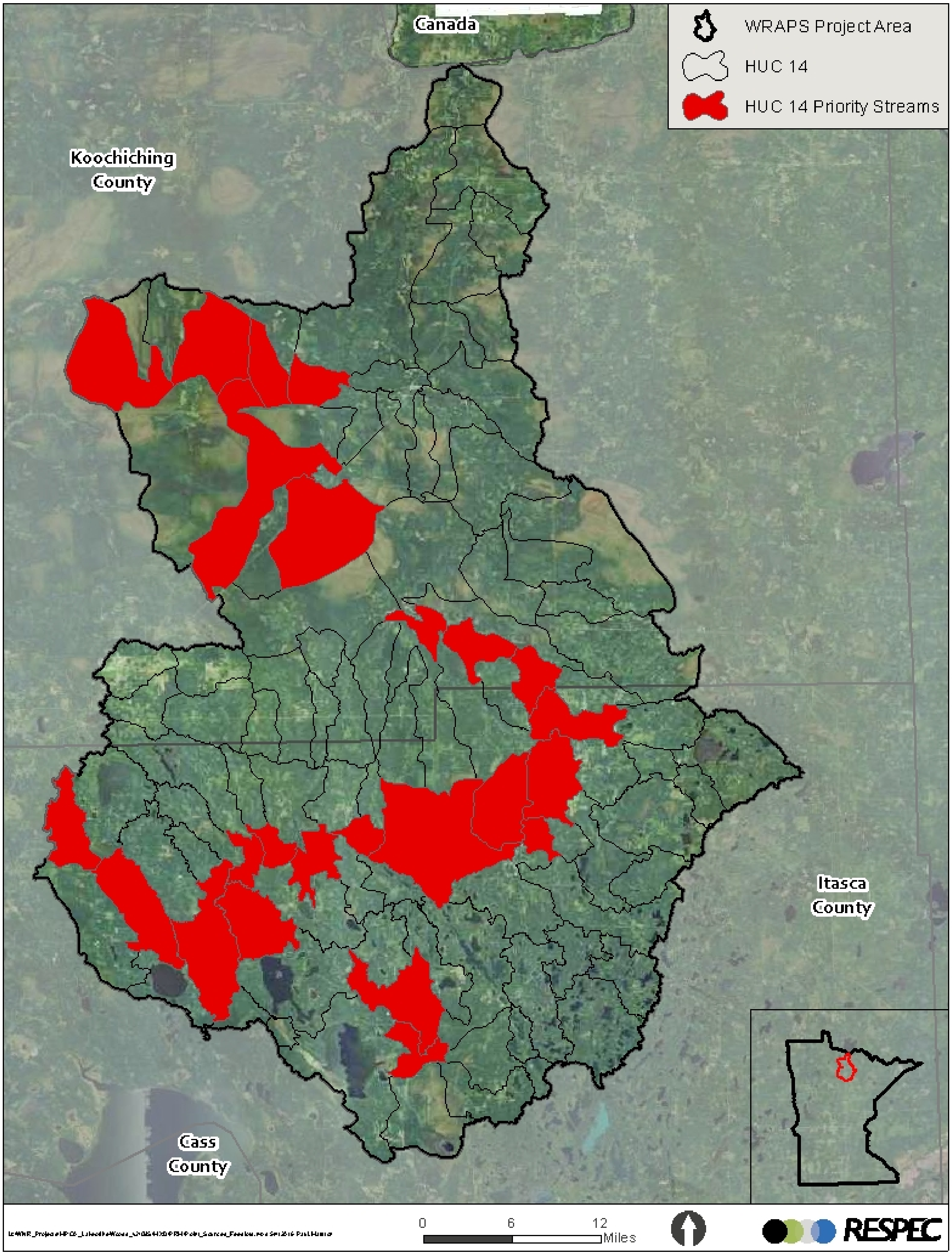


Figure 5: Minor Watershed Map Showing Priorities for Stream Protection.

Table 12: Big Fork River Watershed priority streams for protection or restoration (based on a desktop review of available data and satellite imagery)

Reach	Fish IBI	Macroinvertebrates IBI	Chemistry	MSHA	Geomorphology	Location
Big Fork River (09030006-505)	MTS	MTS	IF	Score: 41 Rating: Poor		10RN032 Between Wirt and Bigfork
Big Fork River (09030006-504)	MTS	MTS	MTS	Score: 52.5 Rating: Fair		10EM137 Downstream of Hwy 6, 15.5 mi. S of Big Falls
Bowstring River (09030006-575)	MTS	–	IF	Score: 44.5 Rating: Poor		10RN007 Downstream of Bowstring Lake
Caldwell Brook (09030006-555)	MTS	MTS	MTS	Score: 38 Rating: Poor		05RN080 Headwaters to Big Fork
Jessie Brook (09030006-586)	MTS	MTS	MTS	Score: 49.5 Rating: Fair		10RN010 Just Jessie Brook
Popple River (09030006-517)	EXS	MTS	–	Score: 62 Rating: Fair		10RN001 Headwaters to Round Lk
Popple River (0903006-512)	–	–	EXS Do, TP	Score: 46.5 Rating: Fair		10RN006 Natures Lake to Dora Lake
Unnamed creek (09030006-613)	Fair	Fair	–	Score: 44 Rating: Poor		05RN019 Downstream of CR 236, 2 miles north of Big Fork, nonassessed, channelized
Unnamed creek (09030006-592)	–	-	–	N/A	Road crossing and channelization	Tributary to Dinner Creek
Sturgeon River (09030006-509)	–	–	–	N/A	Channelization and ditching in the headwaters	Headwaters to Big Fork River

3. Prioritizing and Implementing Restoration and Protection

The Clean Water Legacy Act (CWLA) requires that WRAPS reports summarize priority areas for targeting actions to improve water quality, and identify point sources and nonpoint sources of pollution with sufficient specificity to prioritize and geographically locate watershed restoration and protection actions. In addition, the CWLA requires reports to include an implementation table of strategies and actions that are capable of cumulatively achieving needed pollution load reductions for point and nonpoint sources.

This section provides the results of such prioritization and strategy development. Because much of the nonpoint source strategies that are outlined in this section rely on voluntary implementation by landowners, land users, and residents of the watershed, creating social capital (trust, networks and positive relationships) with those who will be needed to voluntarily implement BMPs is imperative. Thus, effective, ongoing civic engagement is fully a part of the overall plan for moving forward.

The implementation strategies, including associated scales of adoption and timelines that are provided in this section, are the result of watershed modeling efforts and professional judgment based on what is known at this time and, thus, should be considered approximate. Furthermore, many strategies are predicated on needed funding being secured. As such, the outlined proposed actions are subject to adaptive management—an iterative approach of implementation, evaluation and course correction.

Certain issues are not addressed in the strategies tables, including limited local capacity and funding that can greatly affect the outcomes of this report. If resources (e.g., staff and/or funding) are limited or nonexistent in the project area, the strategies and goals laid out in this report will likely take longer to achieve, if they are achieved at all. Much of this work relies on reductions from non-regulated actions in the watershed, and, to achieve those goals, local relationships and trust need to be built where they may not currently exist. Therefore, as these actions are undertaken, all levels (federal, State, and local governments, and nonprofits, and landowners) must continue to find ways to support local entities and individuals to ensure that the waterbodies in the Big Fork River Watershed are restored and protected.

3.1 Targeting of Geographic Areas

The Big Fork River Watershed partners and stakeholders used various tools to identify, locate, and prioritize watershed restoration and protection actions, which are described in the following section. The specific tools that were used were the Big Fork Lake prioritization (developed by the Minnesota Department of Natural Resources (DNR) and the MPCA), the Stream Assessment, and the HSPF model. Implementing protection activities will generally be conducted using the Minor Watershed Approach.

The Minor Watershed Approach provides a strategy for both restoration (when appropriate) and protection in the Big Fork River Watershed that focuses on the areas of human-caused disturbances within minor watersheds (HUC-14),including development, pastureland, agriculture, and young forest. Disturbance is discussed in more detail in Section 2.3. A significant concern in the Big Fork River Watershed is parceling and developing the vast tracts of privately owned forestlands. Parcelization that occurs within riparian zones of lakes and streams, which can magnify disturbance effects, are of special concern within the Big Fork River Watershed.

It is suggested that resource managers determine the current percentage of disturbance and the percentage of disturbance expected from any new action before engaging in activities that might significantly increase the area of disturbance within a small watershed (HUC-14.) If the disturbance level approaches 40%, avoidance and/or mitigation activities are suggested to be undertaken within the watershed using an MPCA-approved modeling system, such as the Hydrologic Simulation Program – Fortran (HSPF) model. Developed and supported by the EPA and USGS, the HSPF model is a watershed scale model that can simulate water flow rates, as well as amounts of sediment (including sand, silt, and clay,) nutrients, and other substances found in a water body. The model uses real world observed data to ensure it properly mimics these interconnected processes. In addition to the HSPF model, the Hydrologic Simulation Program – Fortran Scenario Application Manager (HSPF-SAM) tool can be used.

HSPF-SAM was designed to provide a user-friendly desktop interface to HSPF model applications to facilitate prioritization and placement of BMPs, based on current conditions and under alternative future conditions as predicted by the calibrated model application. HSPF-SAM consists of a Geologic Information System (GIS) component for site selection and spatial visualization of model results, a design component to build user-specified or optimized management scenarios, and an analysis component to graph and tabulate model results.

The tool utilizes a BMP database and an HSPF model application to simulate the impact of the custom management scenarios, including the fate and transport of pollutants to effectively represent downstream impacts. The BMP database includes costs and efficiencies by flow path (surface and subsurface) that allow seasonal and flow based comparisons of the cost benefit scenarios. Alternative scenarios can also be designed to simulate land use, point source, and climate changes to evaluate further conditions and develop comprehensive cost effective protection and restoration strategies.

Modeling efforts in the minor watershed context can guide local restoration and protection efforts. It should be noted that models can be used to project situations into the future, and their effectiveness is often determined by the quality of inputs.

Scale is an important factor when working in watersheds. Restoration and protection activities are most effective when working in smaller watershed scales. Generally, it is more cost effective and provides quicker response to water quality protection activities than large-, multiple-watershed-scale projects. For example, a project to protect a lake in a headwaters watershed, with no watersheds upstream, should address all activities that effect water quality within the watershed. If the problem is on the mainstem, all minor watersheds upstream of the area to be protected need to be included in the project. However, the most effective way to plan and implement a multiple watershed project is to work on the minor watershed scale, ~40 sq. miles or less.

Lake Assessment and Priority Ranking

In 2015, the Minnesota DNR and the MPCA assessed and prioritized all of the lakes within the Big Fork River Watershed with sufficient data (Appendix A). The assessment evaluated depth type (shallow or deep), lake area (acres), watershed area (acres), ecoregion (Northern Lakes and Forests or Northern Minnesota Wetlands), percent disturbed land use (developed, agriculture, hay/pasture land and forest younger than 15 years), mean TP, number of years in the phosphorus record, the presence of a trend, and slope (strength) of the trend. The analysis provides target phosphorus concentrations, load reductions needed to meet the target (in both mass and percentages), and priority ranking.

Stream Assessment

Streams that need protection and restoration were selected based upon fish and macroinvertebrate Index of Biologic Integrity scores, Minnesota State Habitat Assessment scores, and stream channel destabilization (geomorphic) identified via a satellite survey performed for this WRAPS (see Table 12).

Hydrological Simulation Program – FORTRAN (HSPF) Model

An HSPF model was developed by RESPEC to simulate hydrology and sources of phosphorus, nitrogen, and sediment in the Big Fork River Watershed. Annual average pollutant yields (in pounds per acre per year) were mapped and ranked by HUC 14 watershed for TP, total nitrogen (TN), and TSS to guide prioritizing restoration and protection throughout the watershed (see 7 and 8). Runoff and pollutant yields are also shown by model land classification in Table 3.

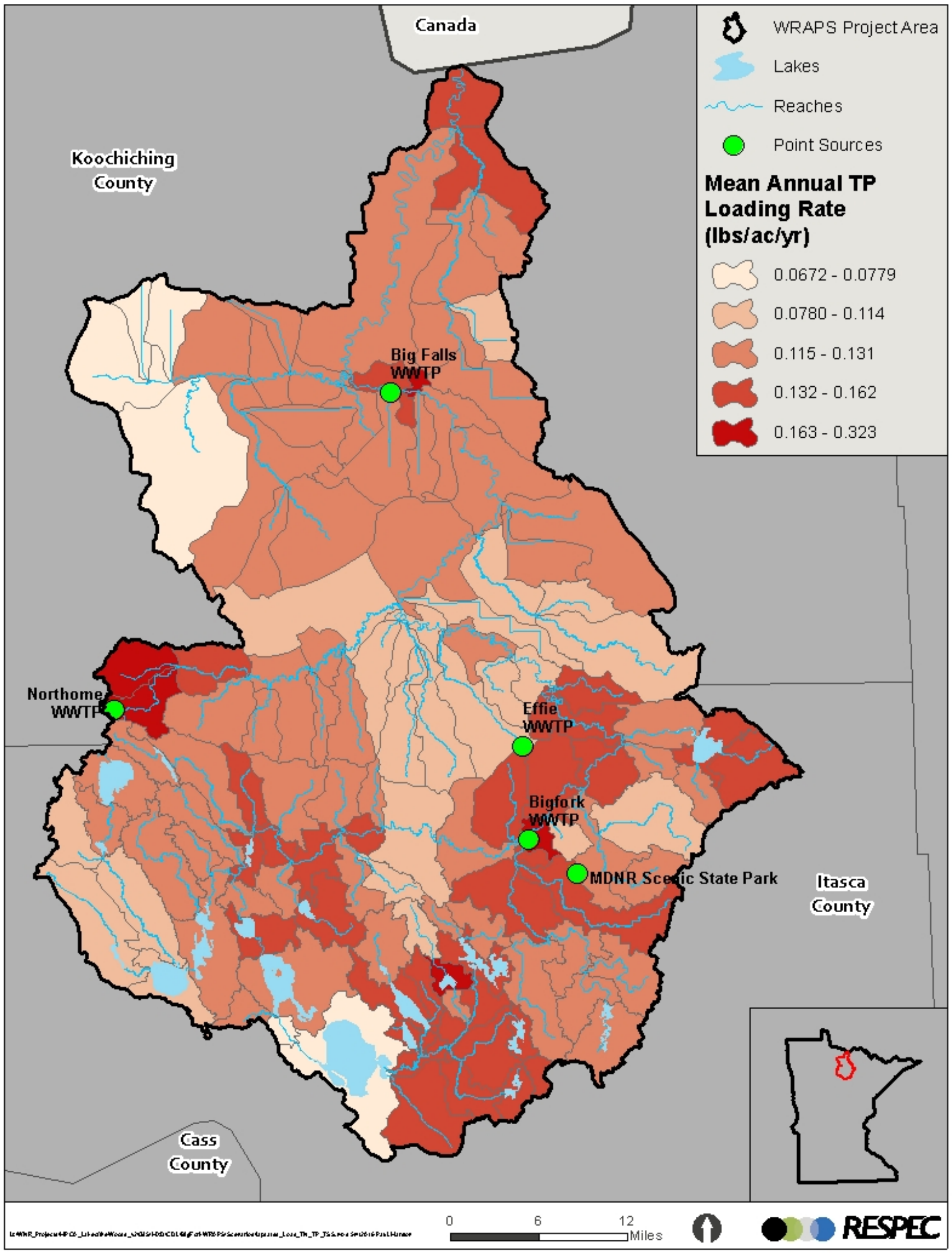


Figure 6: HSPF Loading Rates by Subwatershed for Total Phosphorus

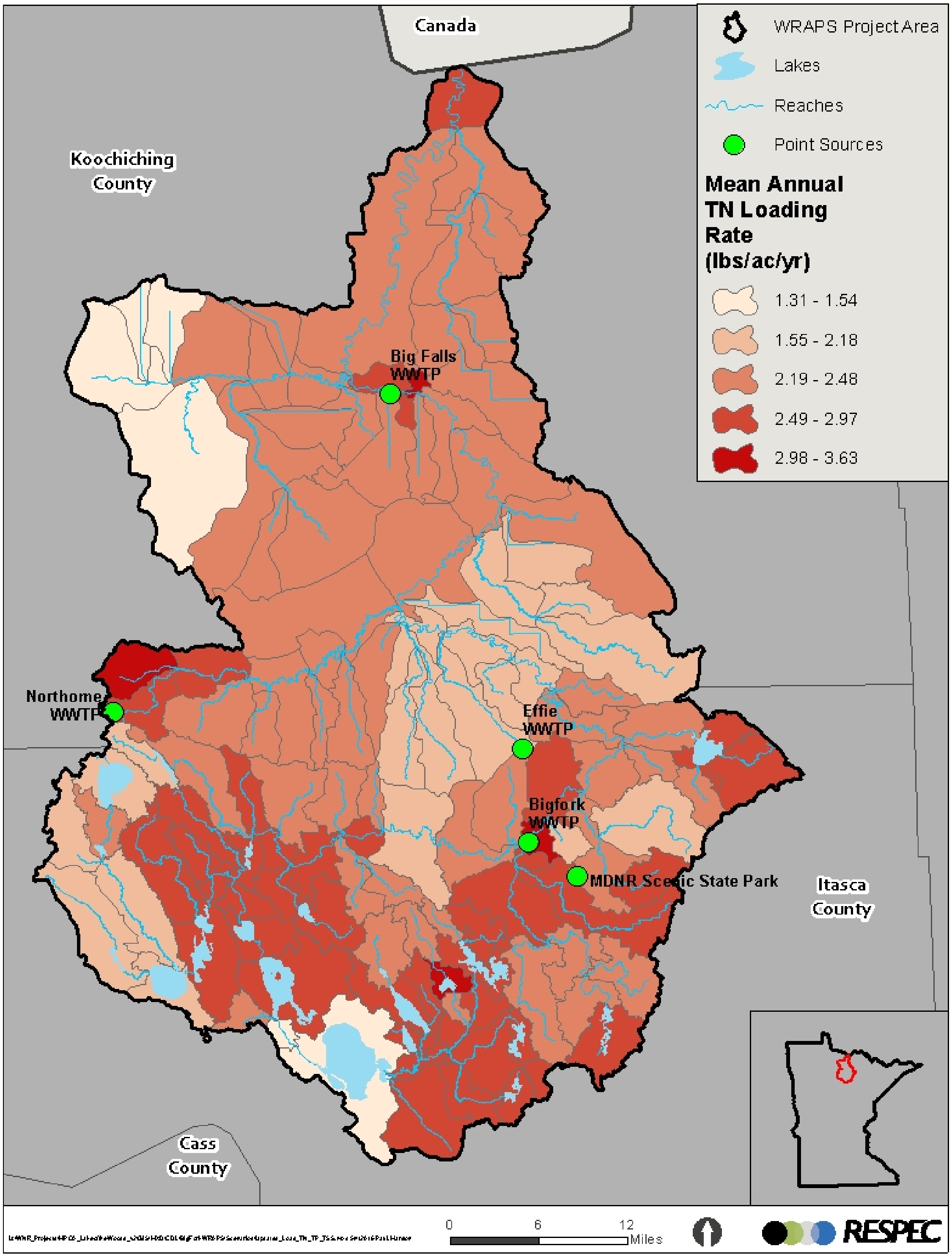


Figure 7: HSPF Loading Rates by Subwatershed for Total Nitrogen.

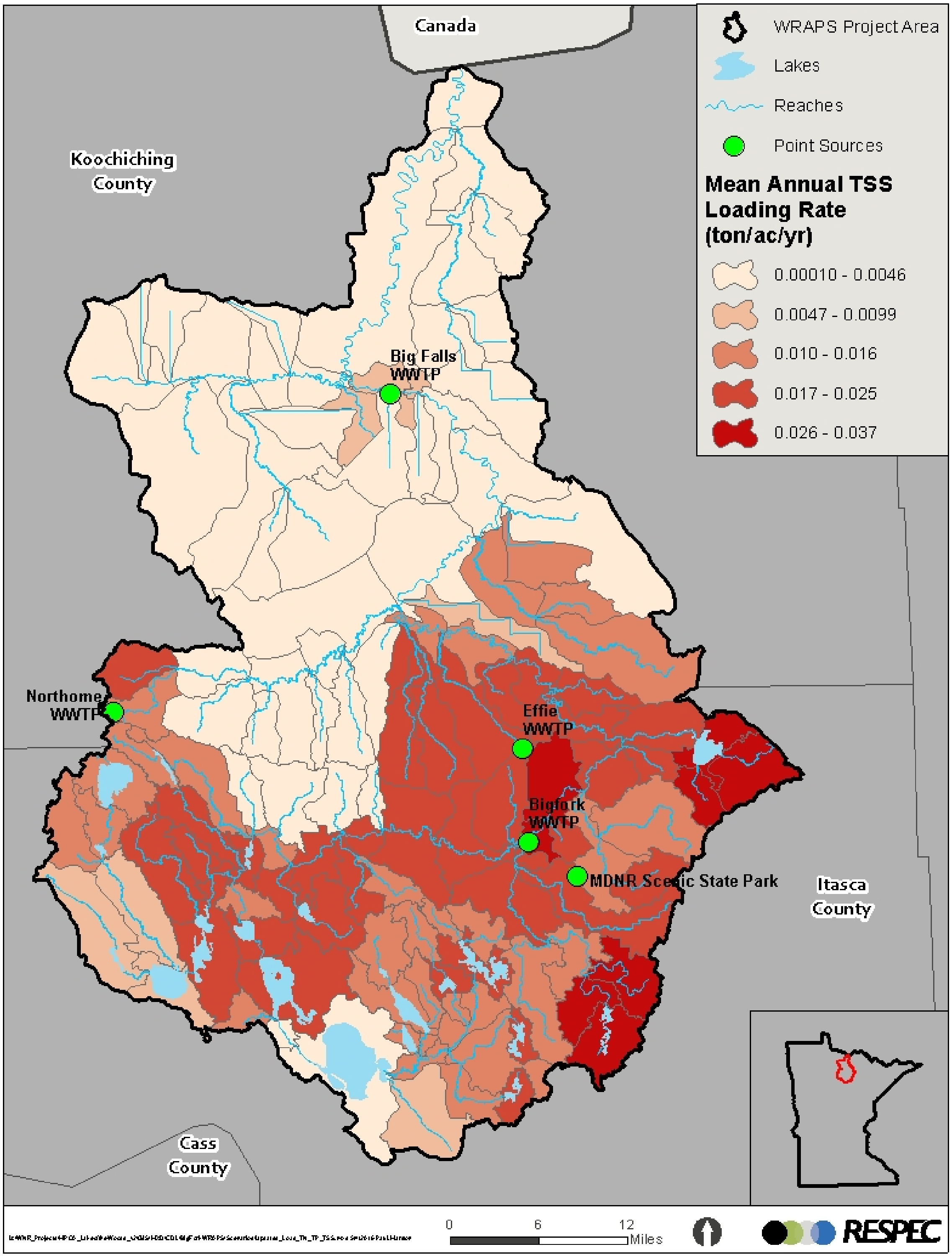


Figure 8: HSPF Loading Rates by Subwatershed for Total Suspended Sediment

Table 13: Average annual runoff and pollutant loading rates by model land class

Source	Runoff (in/yr)	TN (lbs/ac)	TP (lbs/ac)	TSS (lbs/acre)
Developed	13.7	6.22	0.529	334
Mature Deciduous AB	7.94	2.37	0.116	44.2
Mature Deciduous CD	7.34	2.24	0.112	48.0
Young Forest AB	9.35	2.80	0.138	100
Young Forest CD	8.64	2.65	0.133	112
Mature Evergreen AB	7.32	2.18	0.107	41.4
Mature Evergreen CD	6.83	2.08	0.104	43.6
Agriculture	8.20	6.90	0.572	317
Grassland	10.2	4.42	0.262	136
Wetland	8.09	2.36	0.115	9.40
Weighted Total	7.95	2.50	0.131	44.6

Scenarios

While much effort has been focused on characterizing past and present conditions of area water bodies, Big Fork WRAPS Team members have also looked to the future. Realized changes in the landscape and waters provide perspectives for generalizing future conditions. As a part of the future forecasting, stakeholder inputs and local and regional experts' professional judgment were used to define a range of potential future land use changes. The Big Fork River HSPF model, which was calibrated based on 19 years of hydrologic, climate, and monitoring data, was used to predict impacts of future land use changes, as well as restorative or protective effects from employing generalized best practices. For this purpose, estimates are provided by percent change that should be used for a relative comparison of effects, rather than identifying specific loading changes. These assessments allow broad-brush projection of potential impacts: (1) geographically, and (2) propagated along flow networks. These scenarios are not temporally defined but rather they indicate potential land uses that may be realized in the future. This is important in that by understanding the potential impacts of possible land use changes, appropriate planning tools can be developed and implemented in order to mitigate those potential impacts. In the development of this set of scenarios, the incorporation of BMPs was not possible. Future scenario development should include an opportunity to incorporate on-the-ground BMPs. It is understood that voluntary BMPs such as forestry, mining, agriculture, and stormwater are generally applied on the landscape according to guidelines.

Most of the focus of these future projections is based on changes in loading for TSS and TP, which are well defined in the scientific literature and by Minnesota water quality rules.

Four future land use change scenarios that can be appropriately evaluated with the HSPF model were developed to predict potential impacts to watershed flows and water quality, as estimated by percent change in annual average loading for TSS and TP. Evaluated scenarios included the following changes:

- Scenario 1A: Intensify agriculture (see Figure 9, 10, and 11)
- Scenario 1B: Intensify agriculture while adding riparian buffers (see Figure 12, 13, and 14)

- Scenario 2: Intensify forest harvest rate (see Figure 15, 16, and 17)
- Scenario 3: Intensify mining operations (see Figure 18, 19, and 20)
- Scenario 4A: Increase in development around lakes (see Figure 21, 22, and 23)
- Scenario 4B: Increase in development around lakes while adding Minimal Impact Development Standards (MIDS) (see Figure 24, 25, and 26).

Each scenario was developed from information provided by stakeholders and local experts, and are described herein by scenario. Stakeholders used land use, ownership, soils, geology/deposits, and mining lease maps as well as local expert knowledge to provide the necessary input. Not all subwatershed areas were predicted as having substantial land use changes; hence, no changes will be noted in summary graphics unless impacted by upgradient changes. Those subwatersheds that were explicitly modeled have been indicated as hashed areas in graphics for each scenario.

Scenario 1

Scenario 1A estimates the impacts from the conversion of 25% of forest to agriculture. This was applied to subwatersheds identified by stakeholders to be at risk for intensified agriculture and is indicated by the hashed areas in Figures 10 through 12. For the purposes of this modeling, agricultural land is broadly defined as a mix of pasture/hay, cultivated crops, and feedlots. Cultivated crops and pasture/hay were grouped during initial model development due to their relatively small area contributions of 0.22% and 1.73% respectively.

Scenario 1B estimates the impacts of buffers being applied to 50% of the converted cropland in subwatersheds selected in scenario 1A. Buffer pollutant reductions used in this assessment were based on values cited by the Minnesota Department of Agriculture's (MDA's) Agricultural BMP Handbook [Miller et al. 2012] and included 76% for TSS, 67% for TP, 68% for TN, and 0% reductions for flow.

Modeled watershed responses by subwatershed are depicted first for Scenario 1A and then for Scenario 1B in Figures 10 through 15 for discharge (flow,) TSS and, TP respectively.

- Runoff increases of 2.9% were seen in subwatersheds with agricultural conversion (Scenario 1A), while overall discharge into the Rainy River increased just 0.6%. Percent increase in runoff is mainly a function of the extent of forested land in the selected subwatersheds, of which 25% was converted to agriculture. Runoff depth estimates were not affected by buffer implementation (Scenario 1B) as the Agricultural BMP Handbook reported that buffers had no effect on runoff.

- Substantial increases of TSS loading were widely noted for assessed subwatersheds, with a maximum TSS increase of 136% in one subwatershed. Seven subwatersheds were estimated to have TSS loading increases of greater than 100%. These impacts were propagated downstream along flow paths. TSS loading at the confluence with the Rainy River was estimated to increase 15%. Implementation of buffers on agricultural lands would reduce negative impacts, yet TSS export to the Rainy River would still increase by 6% over the current condition. Maximum TSS loading increases at the subwatershed level would be reduced by buffers to 78%.

- Substantial increases in TP (up to 118%) loading were widely noted in the selected subwatersheds. Twenty-three subwatersheds were estimated to have TP loading increases of greater than 50%, and TP loading was estimated to increase by 18% at the confluence with the Rainy River. Implementation of buffers on agricultural lands would reduce negative impacts, while still increasing TP export to the Rainy River by 8%. Maximum TP loading increases at the subwatershed level would be reduced by buffers from 118% to 48%.
- Subwatershed impacts were greatest for headwater watersheds in the central part of the watershed, with other increases noted in the southern and southwestern parts of the watershed. Subwatersheds draining to Caldwell Brook showed particularly large increases in runoff and loading. Runoff and loading increases in the lower part of the Big Fork River are due to increased loading from upstream, while percent changes drop along the river as it approaches the Rainy River due to in-stream processes and dilution effects. Buffer implementation showed the potential to reduce increases in TP and TSS exports to the Rainy River by more than 50% if land use changes were to occur.

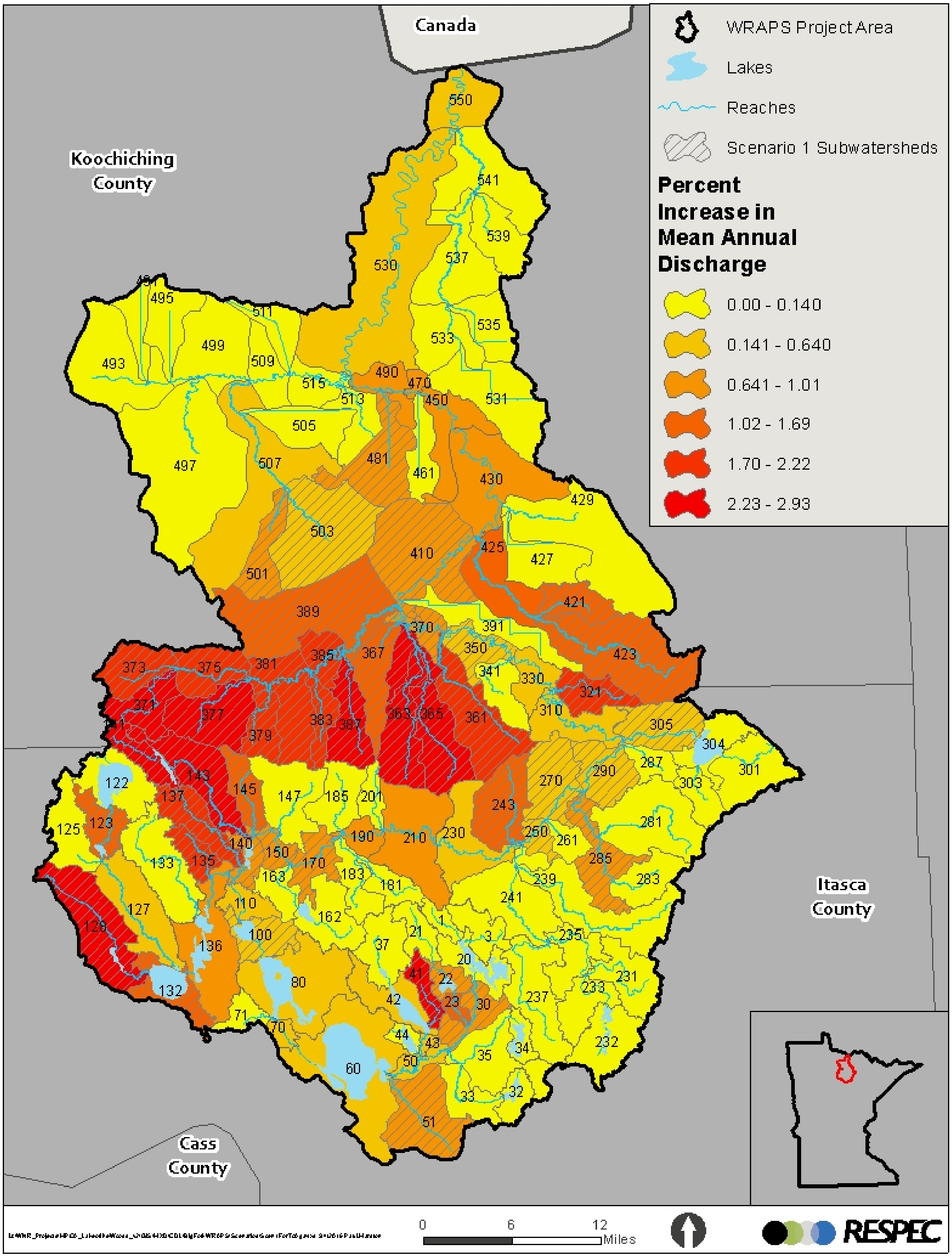


Figure 9: Scenario 1A – Conversion from Forest to Agriculture – Discharge.

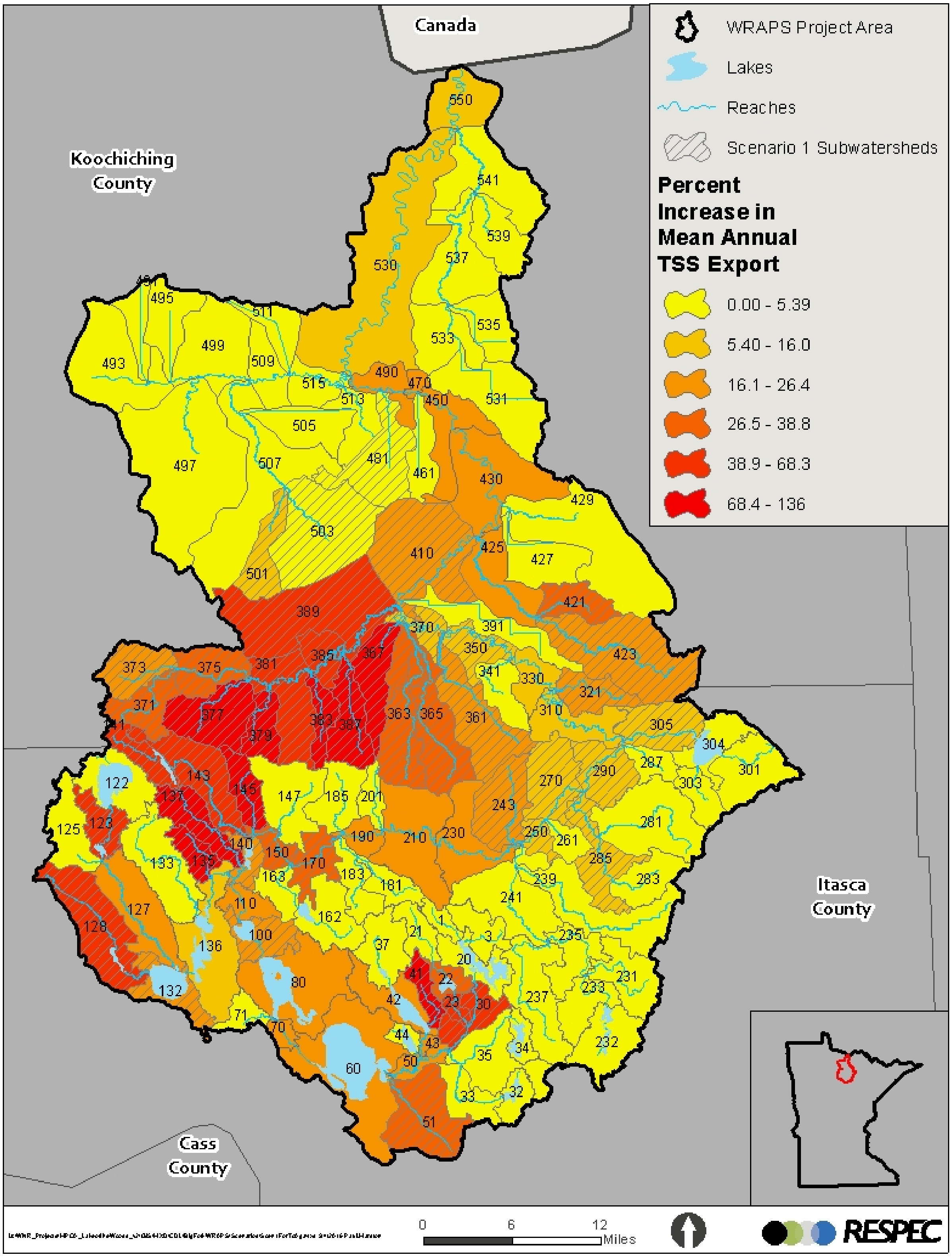


Figure 10: Scenario 1A – Conversion from Forest to Agriculture – Total Suspended Solids (TSS).

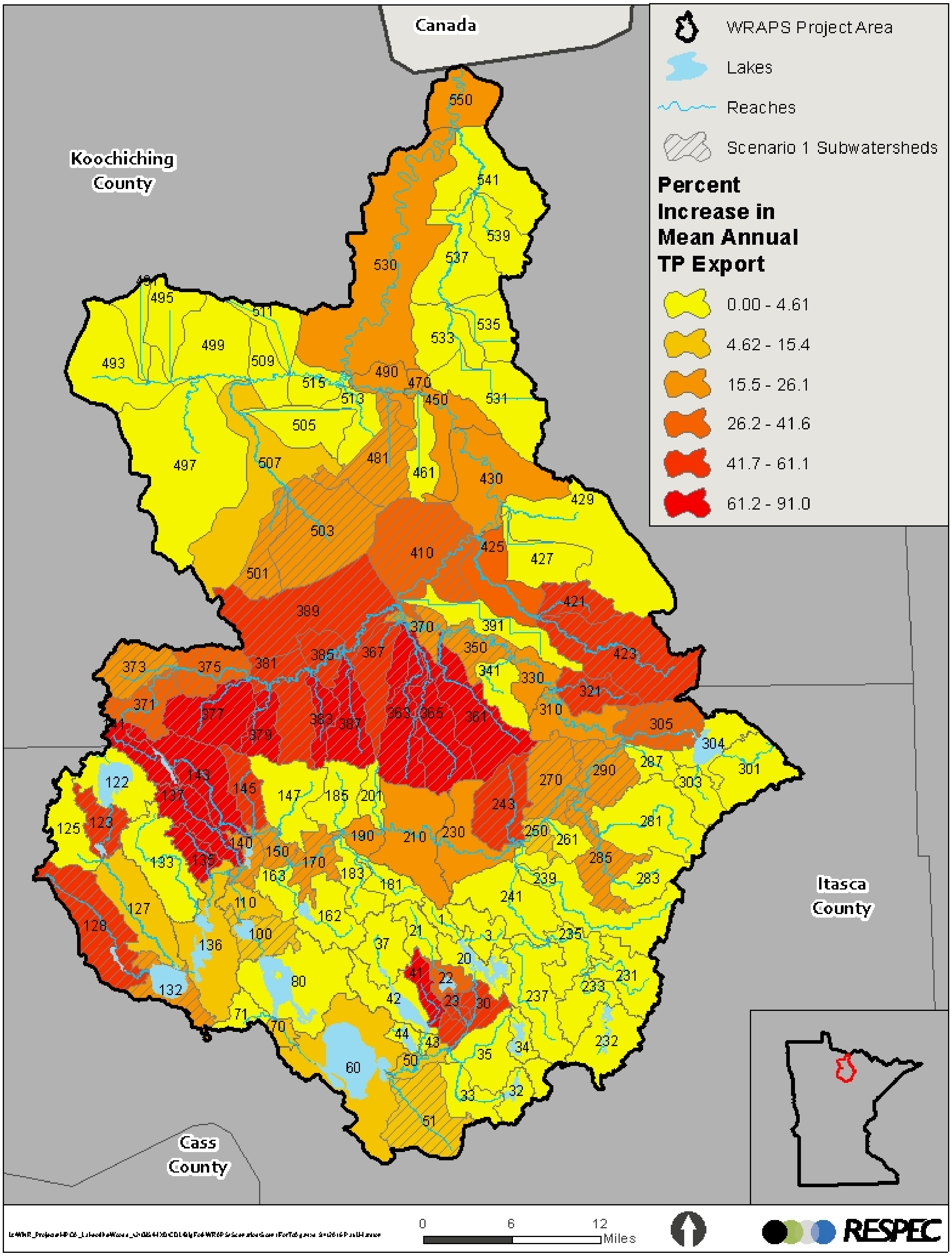


Figure 11: Scenario 1A – Conversion from Forest to Agriculture – Total Phosphorus (TP).

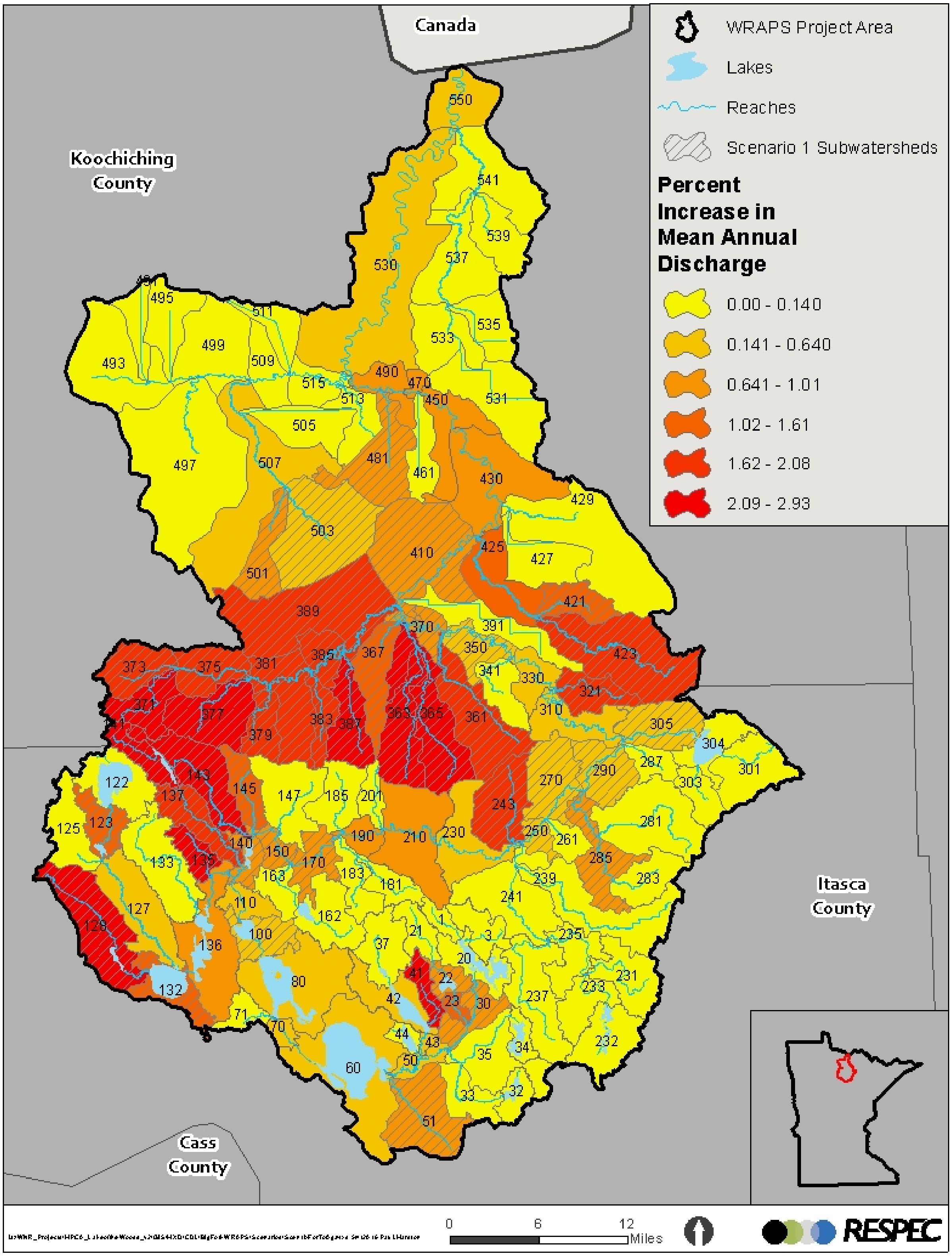


Figure 12: Scenario 1B - Conversion from Forest to Agriculture with Riparian Buffers – Discharge.

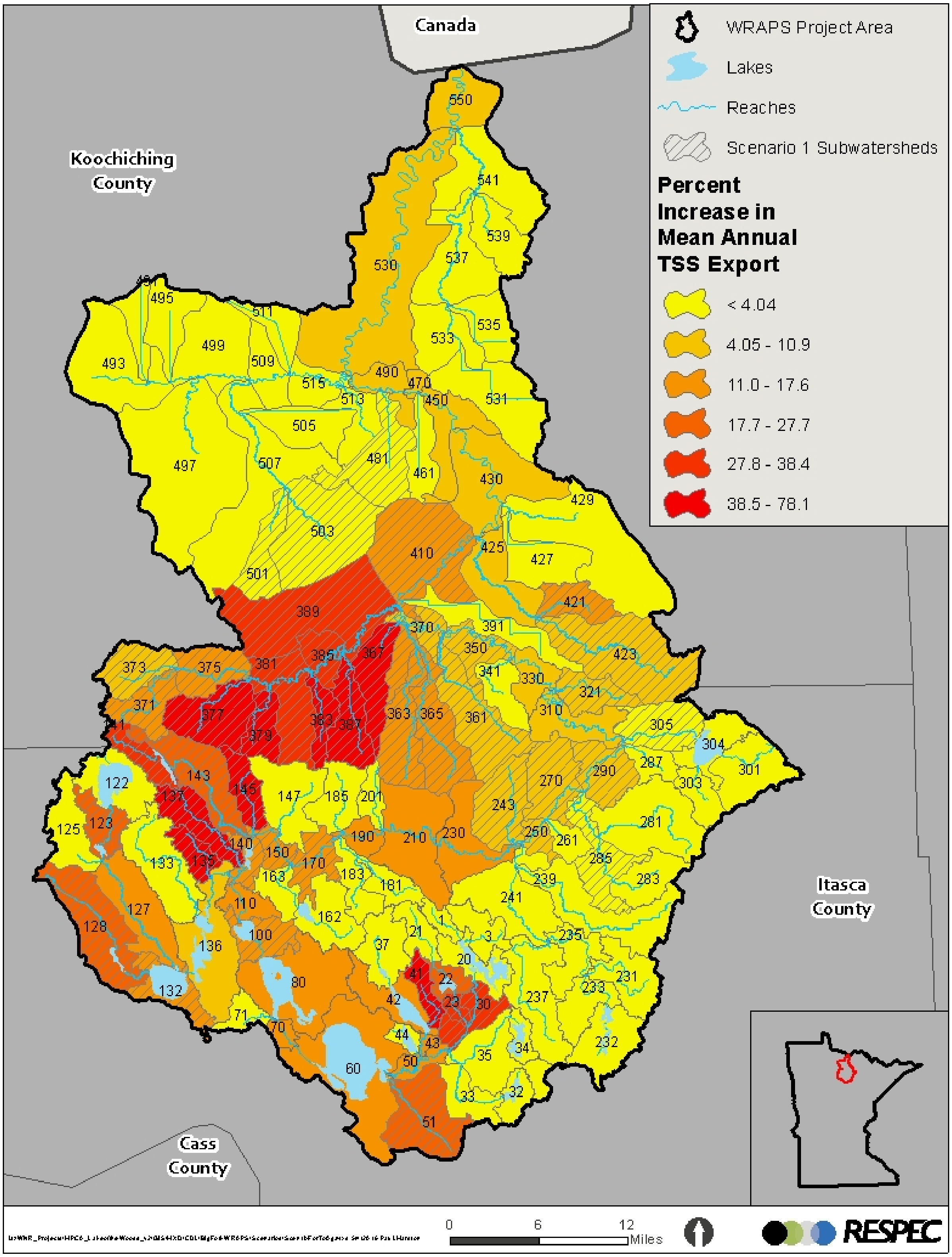


Figure 13: Scenario 1B – Conversion from Forest to Agriculture with Riparian Buffers – Total Suspended Sediments (TSS).

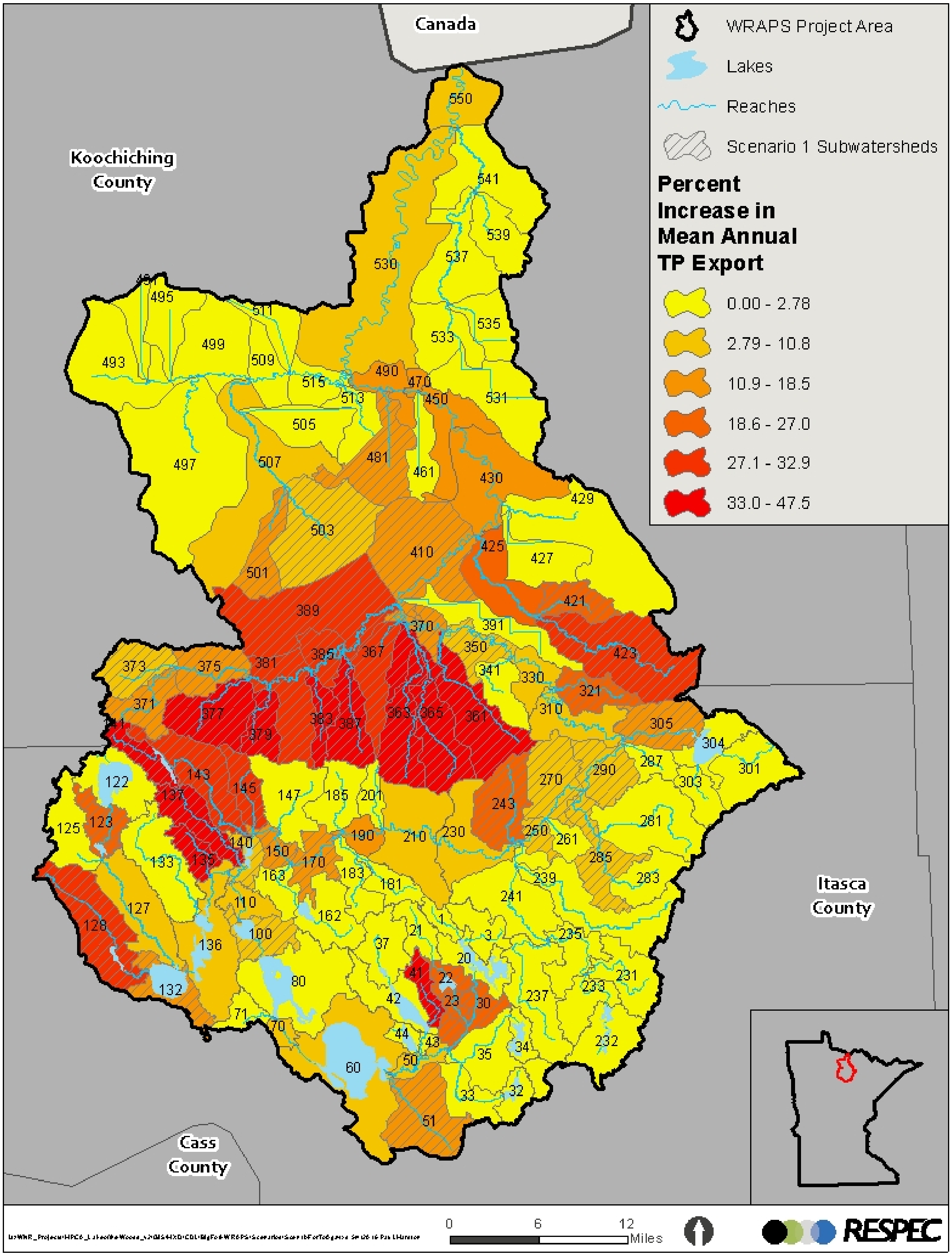


Figure 14: Scenario 1B – Conversion from Forest to Agriculture with Riparian Buffers – Total Phosphorus (TP).

Scenario 2

Scenario 2 estimates impacts from converting 25% of mature forest to young forest in subwatersheds identified by stakeholders to be at risk for intensified forest harvest, as indicated by the hashed areas in the graphics for this scenario. In addition to the stakeholder selection, School Trust Lands were also used to identify potential areas for conversion. Subwatersheds with more than 10% of their forested areas within School Trust Lands classified for forestry were selected. It should be noted that this scenario does not include the use of forestry BMPs. It is desired in future modelling efforts to understand how to include forestry BMPs in order to more accurately reflect the landscape.

HSPF estimated watershed responses for modeled parameters are depicted by subwatershed in Figures 16 through 18 for discharge (flow,) TSS, and TP, respectively.

- Runoff increases of up to 4.6% were noted in the selected subwatersheds. Runoff increases of more than 2% were noted in more than half (68 out of 129) of all subwatersheds. The increase in discharge from the Big Fork River to the Rainy River was estimated to be 1.4%.
- TSS loading to Rainy River was estimated to increase by 7%. Increases as high as 30% were noted on a subwatershed level. More than half (71) of all subwatersheds were estimated to have TSS loading increases of 10% or more.
- Percent changes in TP loading were similar in magnitude to changes in runoff, with an estimated increase at the Big Fork River mouth of 1.4%. Maximum subwatershed TP loading increases of 5.3% were observed, while increases at the subwatershed level averaged approximately 1.8%.
- Subwatershed impacts were greatest for headwater watersheds in the southern part of the watershed. Runoff and loading increases in the lower part of the Big Fork River are caused by increased loading from upstream, while percent changes drop along the river as it approaches the Rainy River because of in-stream processes and dilution effects.

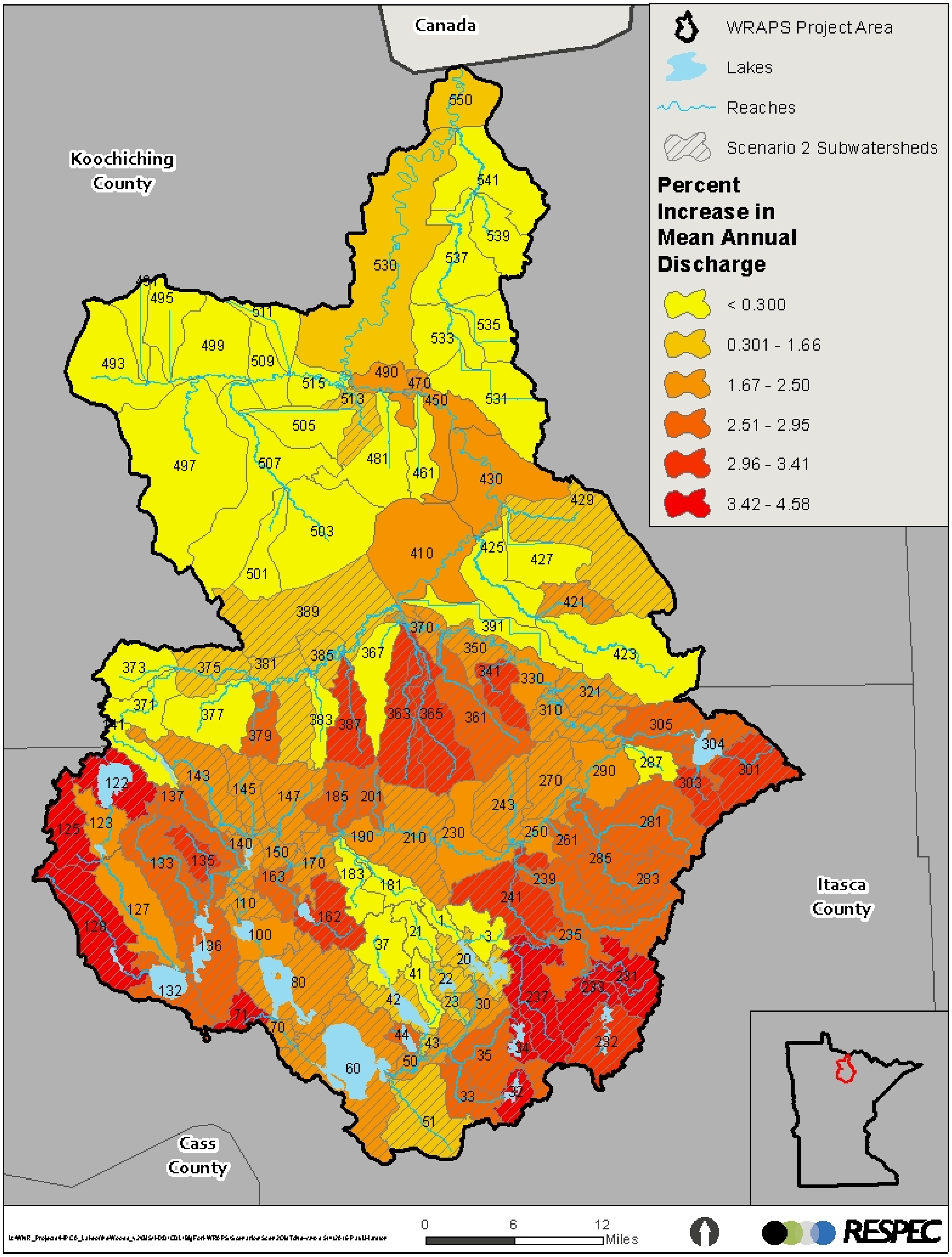


Figure 15: Scenario 2 – Conversion from Mature Forest to Young Forest – Discharge.

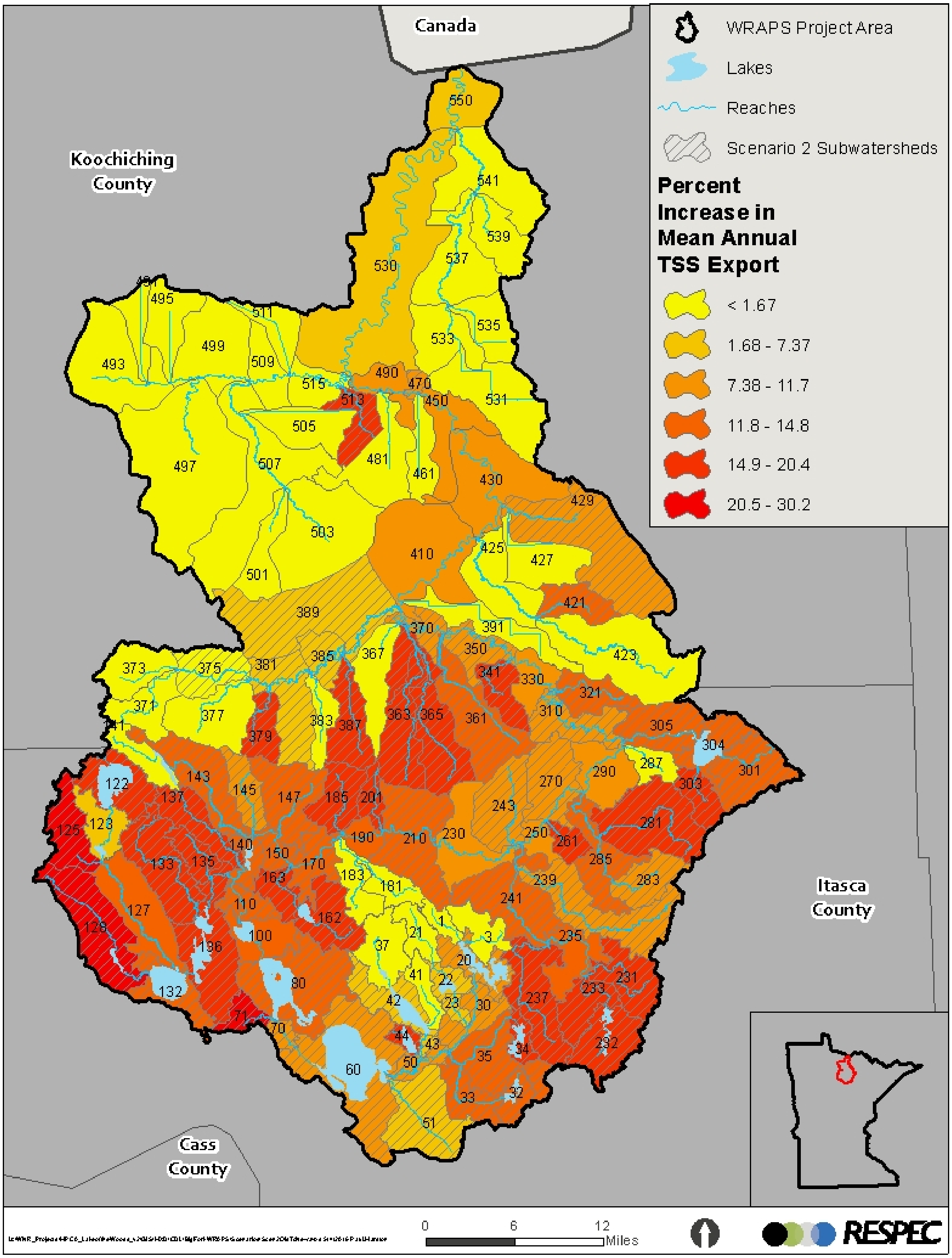


Figure 16: Scenario 2 – Conversion from Mature Forest to Young Forest – Total Suspended Solids (TSS).

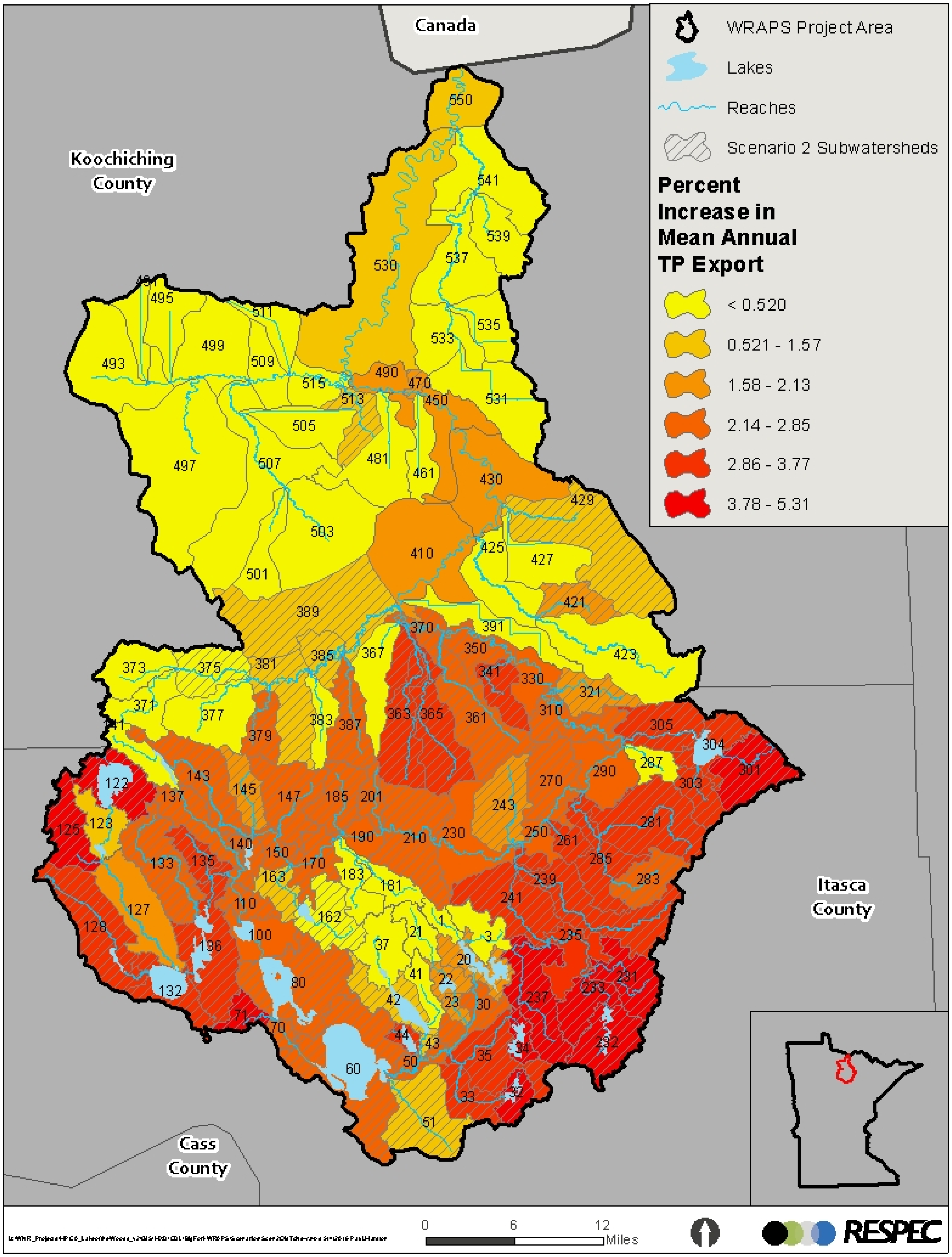


Figure 17: Scenario 2 – Conversion from Mature Forest to Young Forest – Total Phosphorus (TP).

Scenario 3

Scenario 3 estimates the impacts from the conversion of mature deciduous forestland cover to developed lands, in subwatersheds identified by stakeholders to be at risk for intensified mining. Stakeholders selection was based on aggregate and metal deposits, and a DNR map of mining leases. School Trust Lands were used to finalize the selection and to estimate the percent of land cover to be changed. Subwatersheds were intersected with the School Trust Lands and 25% of the area designated for mining use was used to determine the percent land use change. This resulted in an average of 8% conversion across the 15 selected subwatersheds.

HSPF estimated watershed responses for modeled parameters are depicted by subwatershed in Figures 19 through 21 for discharge (flow,) TSS and, TP, respectively.

- Runoff increases as high as 11% were estimated for selected subwatersheds, while the percent increase in discharge to the Rainy River was only 0.7%.
- Increases in TSS loading were as high as 84%, with 10 subwatersheds having increases of 25% or more. The estimated increase in TSS loading at the mouth of the Big Fork River is 4.1%.
- TP loading increases as high as 48% were estimated. The estimated increase in TP loading to Rainy River is 2.3%.
- Subwatershed impacts were greatest for headwater watersheds in the southeastern part of the watershed. Runoff and loading increases in the lower part of the Big Fork River are because of increased loading from upstream, while percent changes drop along the river as it approaches the Rainy River because of in-stream processes and dilution effects.

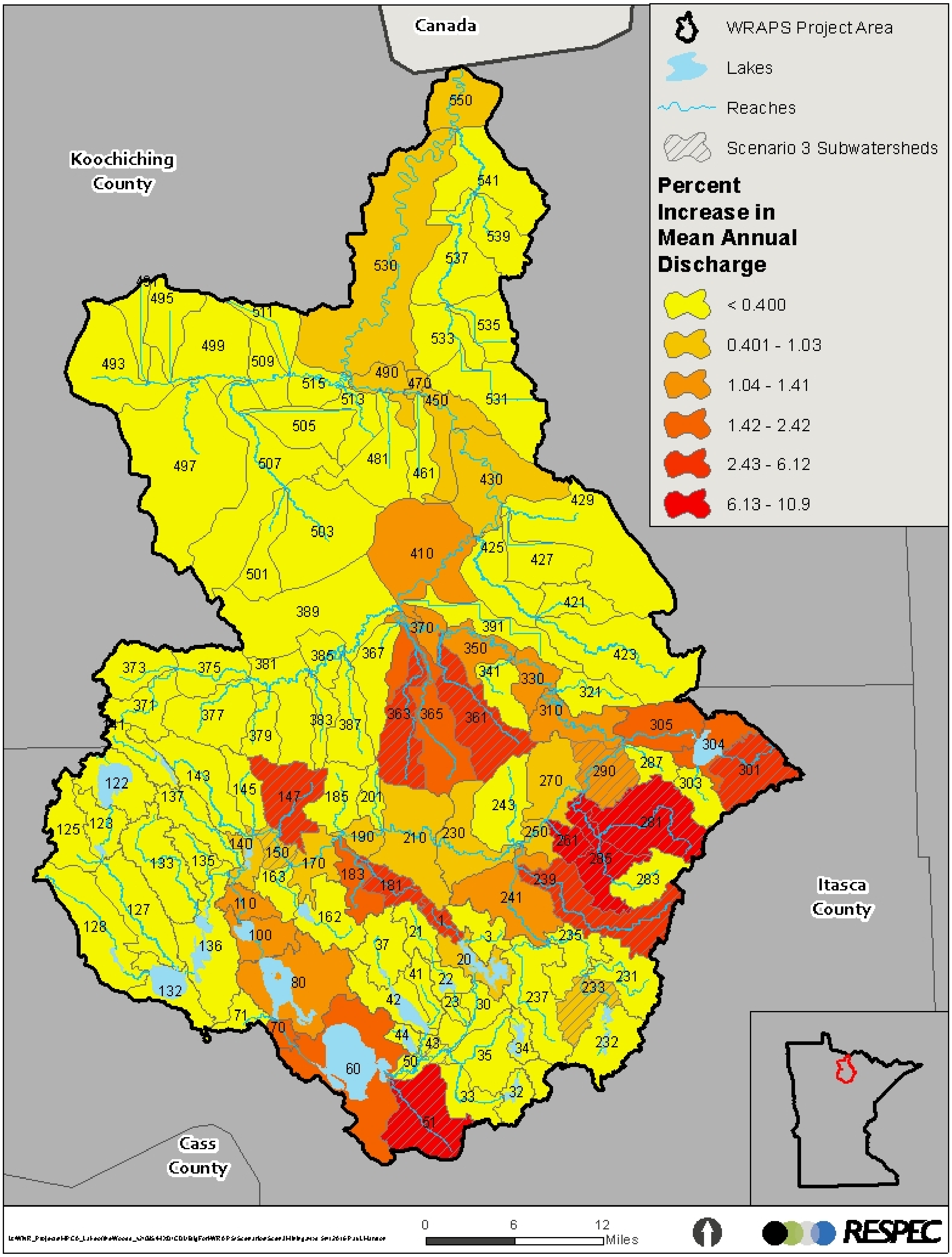


Figure 18: Scenario 3 – Mining – Discharge.

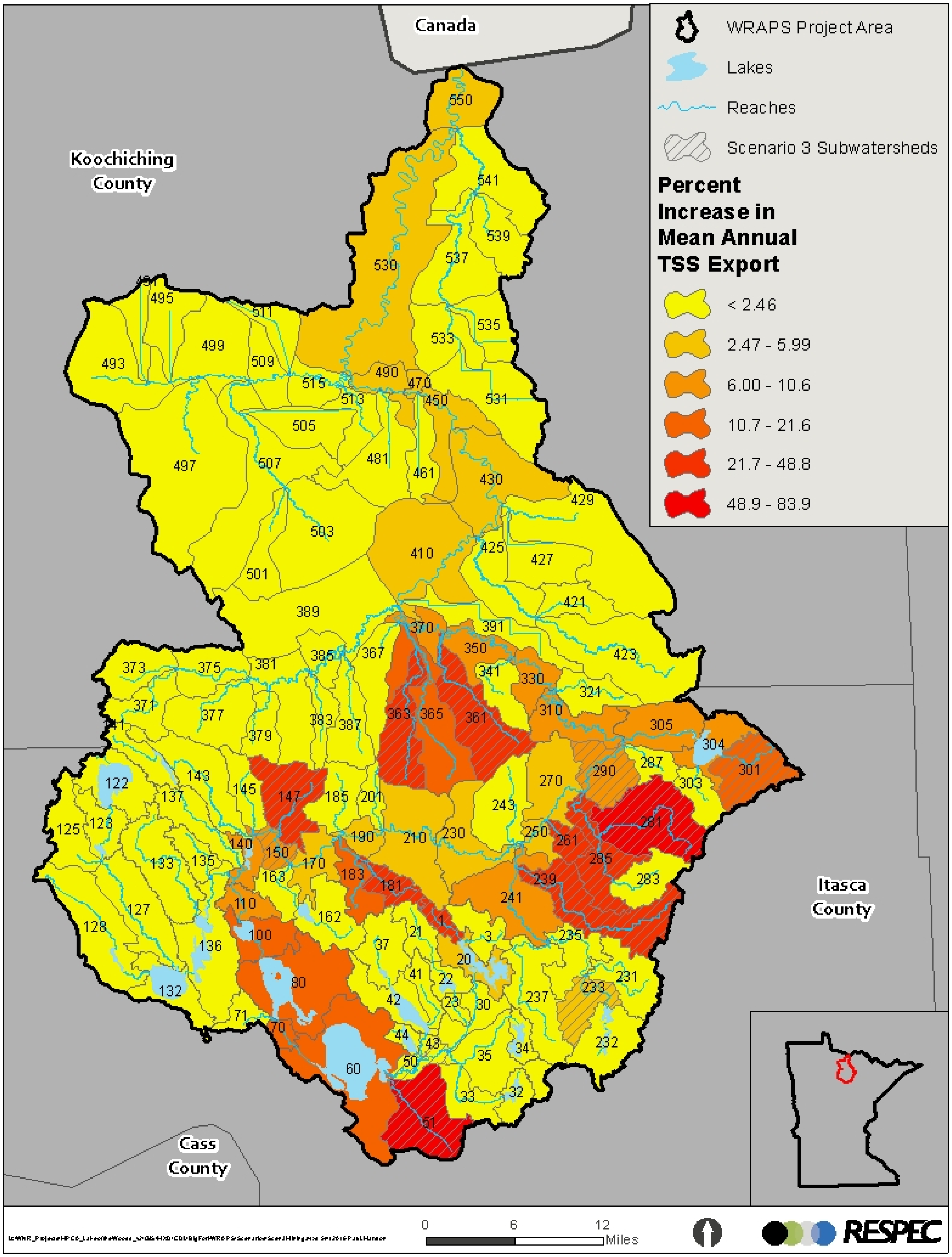


Figure 19: Scenario 3 – Mining – Total Suspended Solids (TSS).

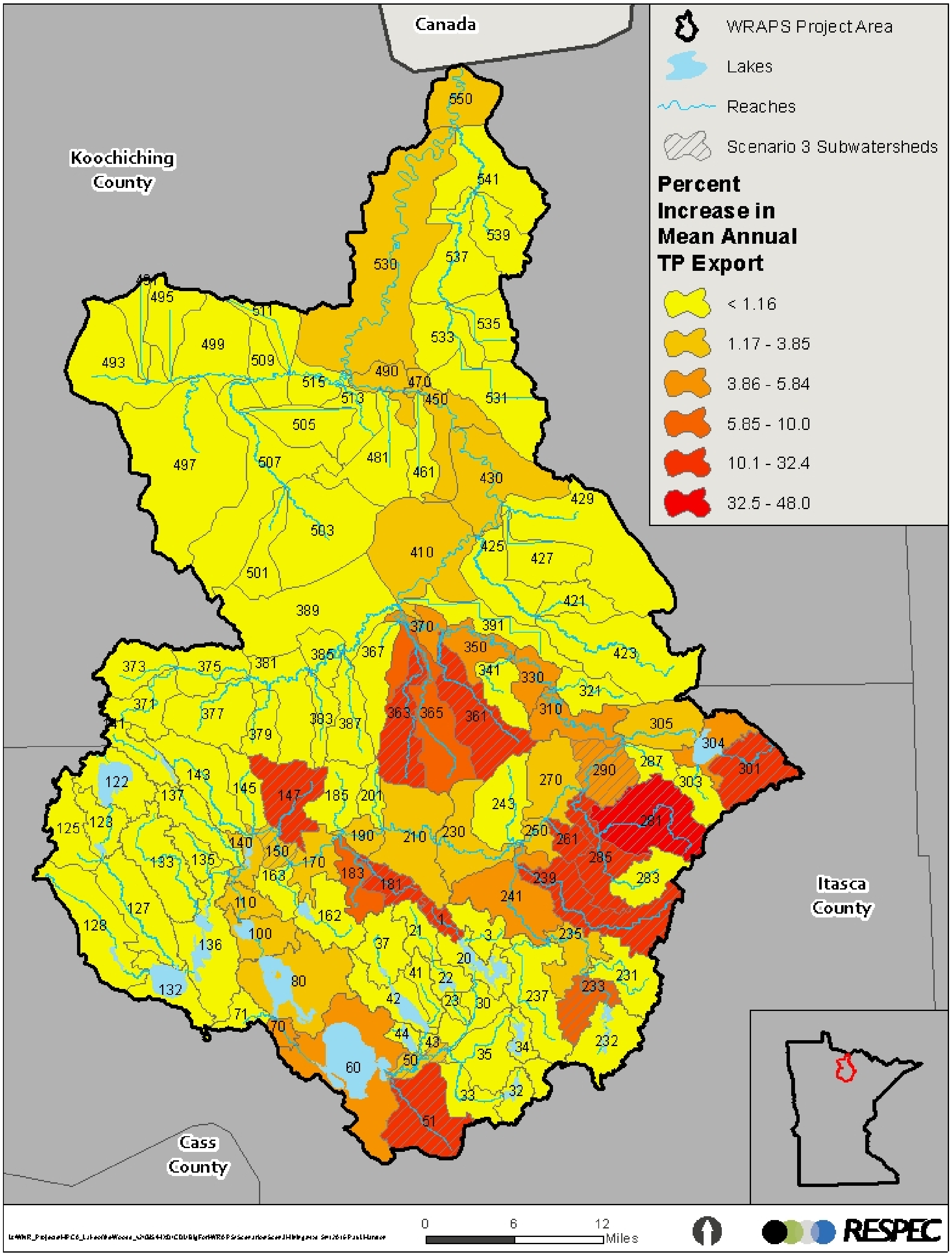


Figure 20: Scenario 3 – Mining – Total Phosphorus (TP).

Scenario 4

Scenario 4A is an estimation of watershed response that results from increased developed land covers around lakes identified by stakeholders to be at risk for lakeshore development. The effect was simulated by converting mature deciduous forest to developed land. The percent area was obtained by buffering lakes 200 feet to represent approximately 1-acre-square lots. In addition to these conversions, septic systems inputs were increased by 25% in selected subwatersheds, which resulted in a total average of 7% conversion to developed land uses across eight subwatersheds.

Scenario 4B is an estimation of the combined impacts of developing Scenario 4A, as moderated by broadly implementing urban BMPs as defined by Minimum Impact Development Strategies (MIDS), over 20% of developed lands in subwatersheds identified by stakeholders to be at risk for conversion to developed. MIDS reductions used in this analysis included 81% for total phosphorus, 91% for TSS, 20% for TN, and 91% for flows. TP, TSS, and flow reductions were based upon removal efficiencies to match present day native forest and prairie conditions (Barr Engineering Inc. 2011). Conservative TN removal efficiencies for multiple best practices were based on Chesapeake Bay recommendations (Hirschman et al. 2008). For more information on MIDS, please see [https://www.pca.state.mn.us/water/enhancing-stormwater-management-minnesota .](https://www.pca.state.mn.us/water/enhancing-stormwater-management-minnesota)

Modeled watershed responses by subwatershed are depicted first for Scenario 4A and then for Scenario 4B in Figures 22 through 27 for discharge (flow,) TSS, and TP respectively.

- Runoff increases as high as 8% were noted in affected subwatersheds. The mean increase in runoff for the eight selected subwatersheds was 3.9%. While impacts at the subwatershed level were not insignificant, the cumulative increase in discharge to the Rainy River was estimated at only 0.3%. Implementing MIDS standards reduced the increase in discharge to the Rainy River to less than 0.2%.
- TSS loading increases ranged from 4% to 42% for the eight selected subwatersheds, while the increase in TSS export to the Rainy River was estimated at only 1.2%. Implementing MIDS standards reduced the maximum TSS increase to 26% and showed an increase of 0.8% in TSS export to the Rainy River (versus 1.2% without MIDS implementation).
- TP loading increases ranged from 3% to 25% for the eight selected subwatersheds and total TP export to the Rainy River was estimated to increase by just 0.8%. With implementing MIDS standards, the estimated increase in TP export dropped from 0.8% to 0.6%.
- The largest subwatershed impacts occur in the southern part of the watershed, where lakes are most concentrated. Increases are propagated downstream, while percent changes decrease because of dilution effects and in-channel processes. Implementing MIDS standards reduced the increases in discharge, TSS, and TP loading caused by development by 47%, 36%, and 18%, respectively.

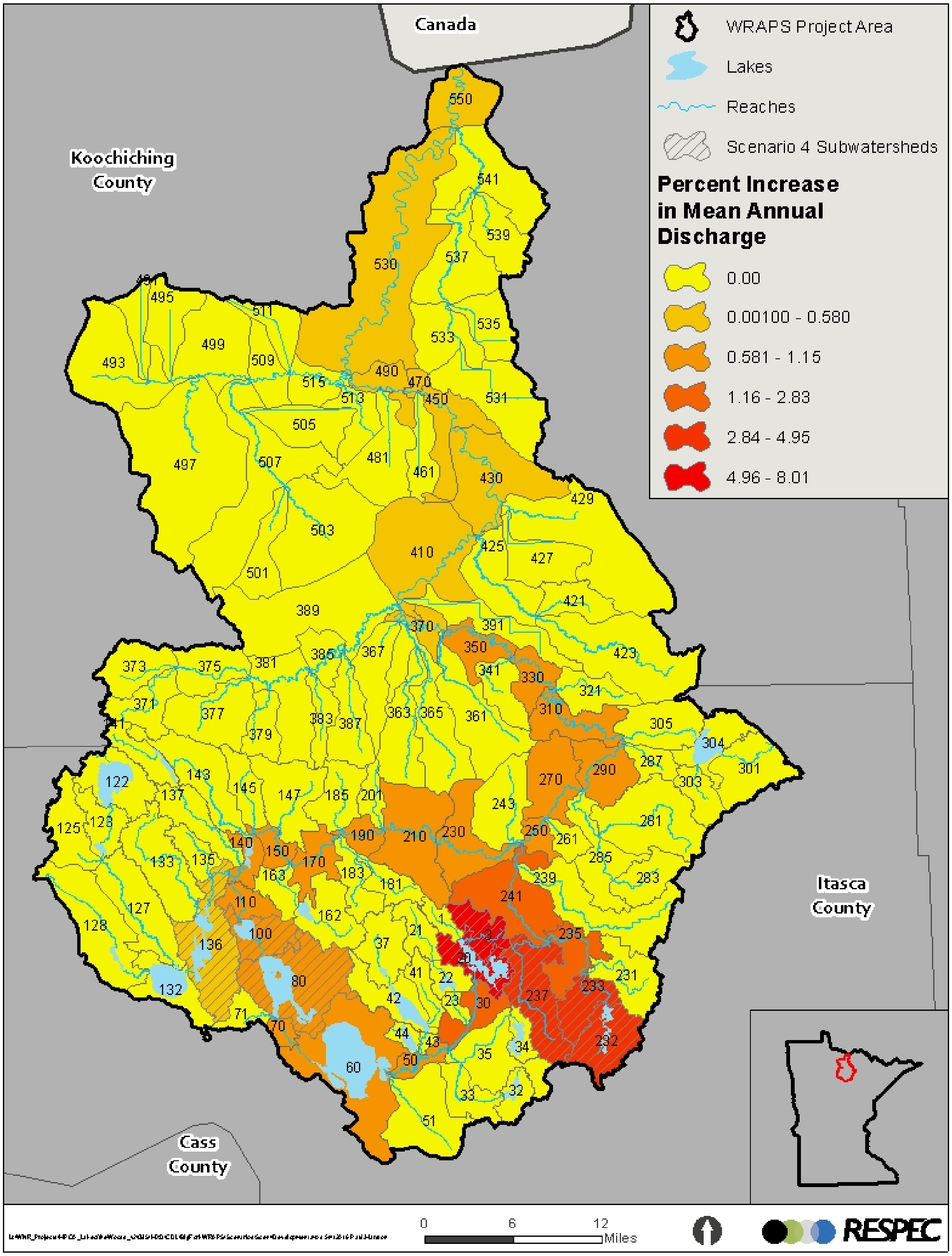


Figure 21: Scenario 4A – Development – Discharge.

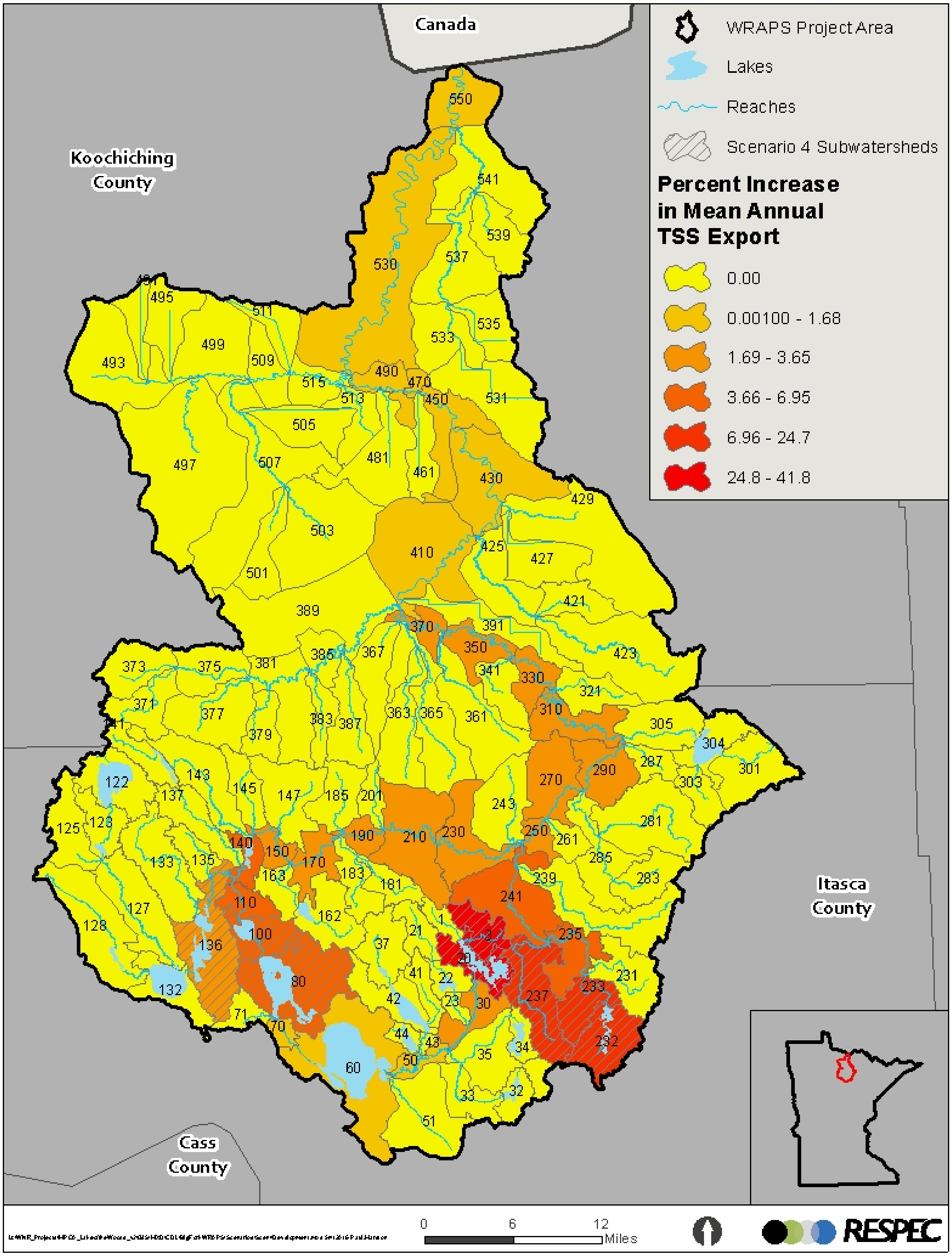


Figure 22: Scenario 4A – Development Total Suspended Solids (TSS).

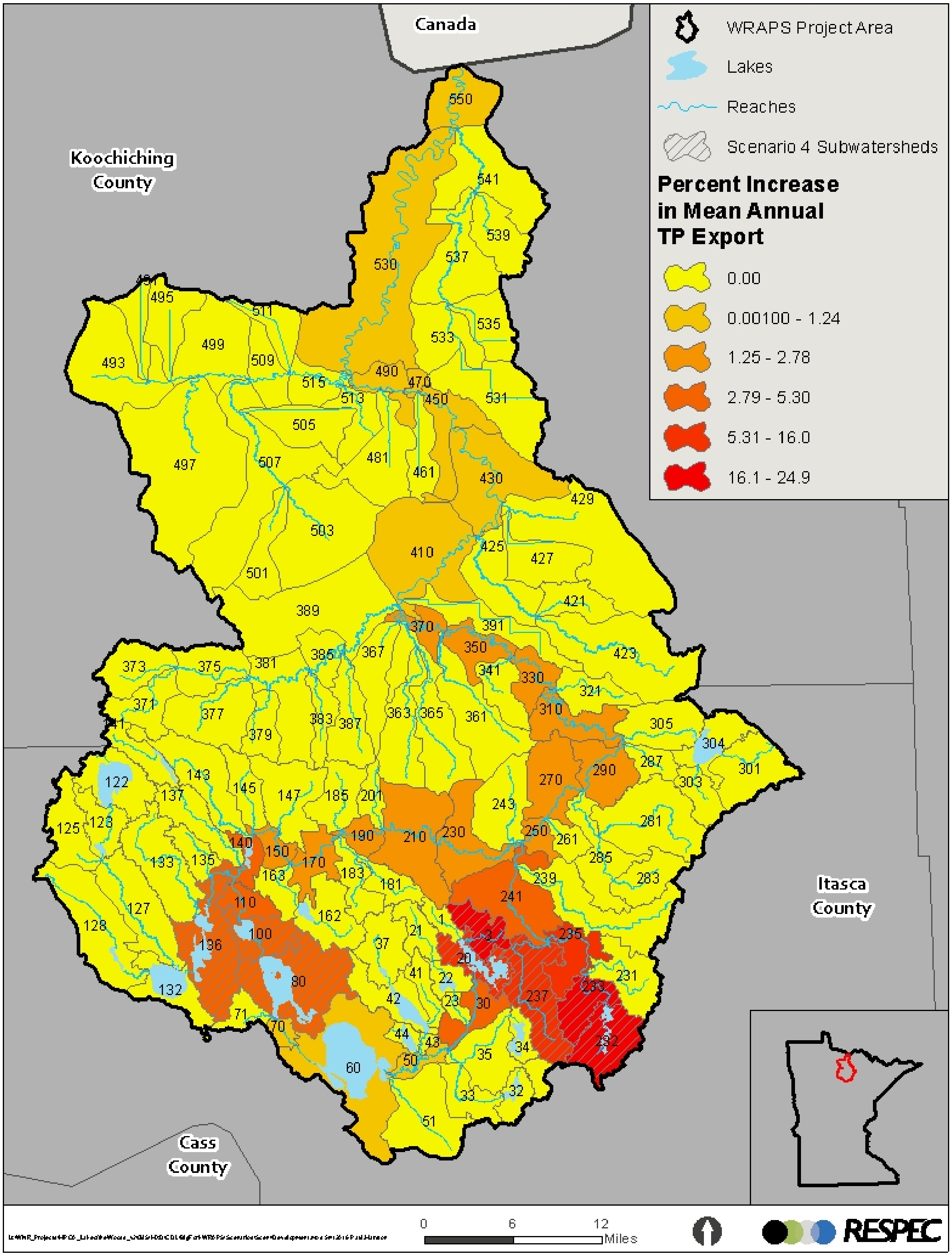


Figure 23: Scenario 4A – Development – Total Phosphorus (TP).

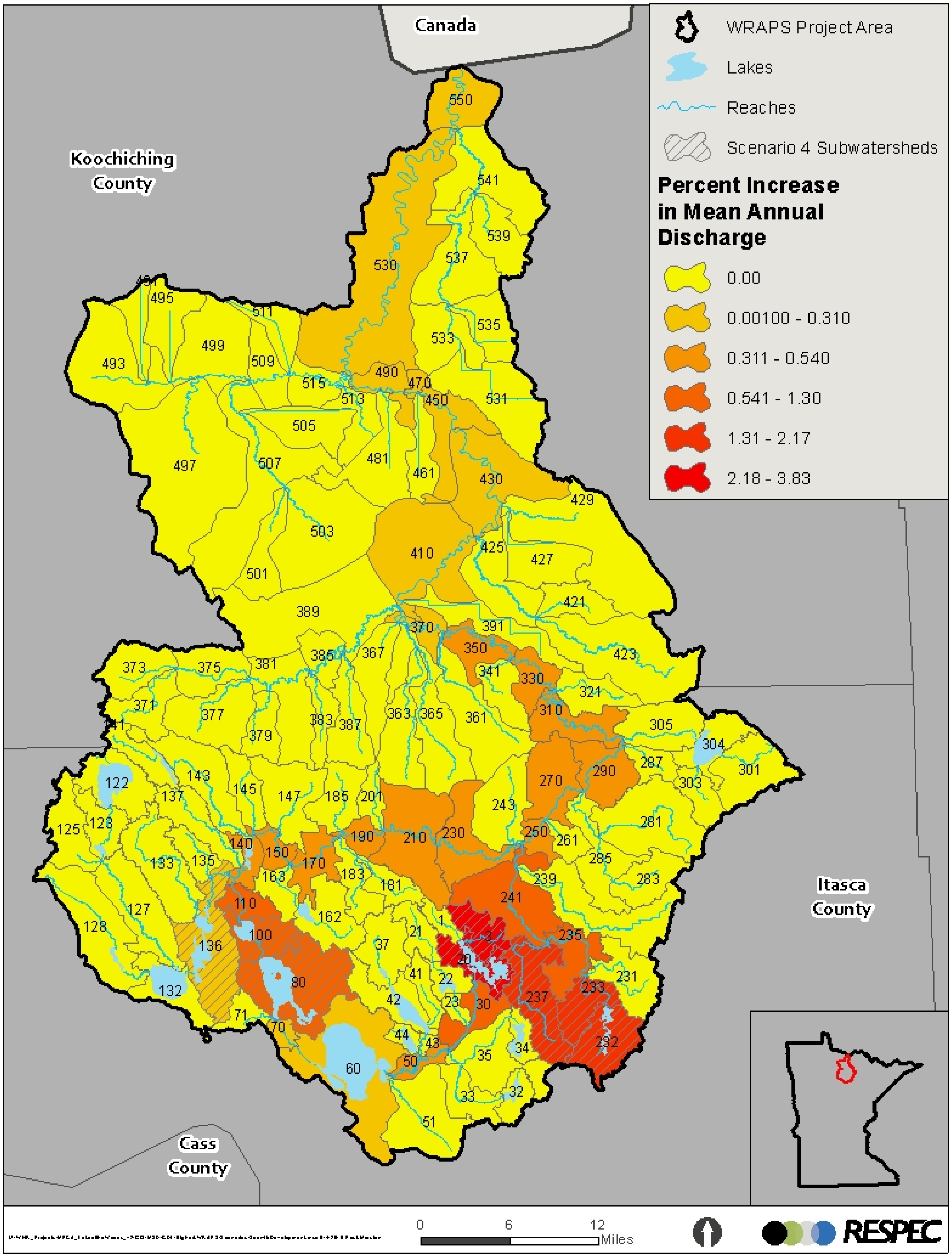


Figure 24: Scenario 4B – Development with Minimal Impact Development Standards – Discharge.

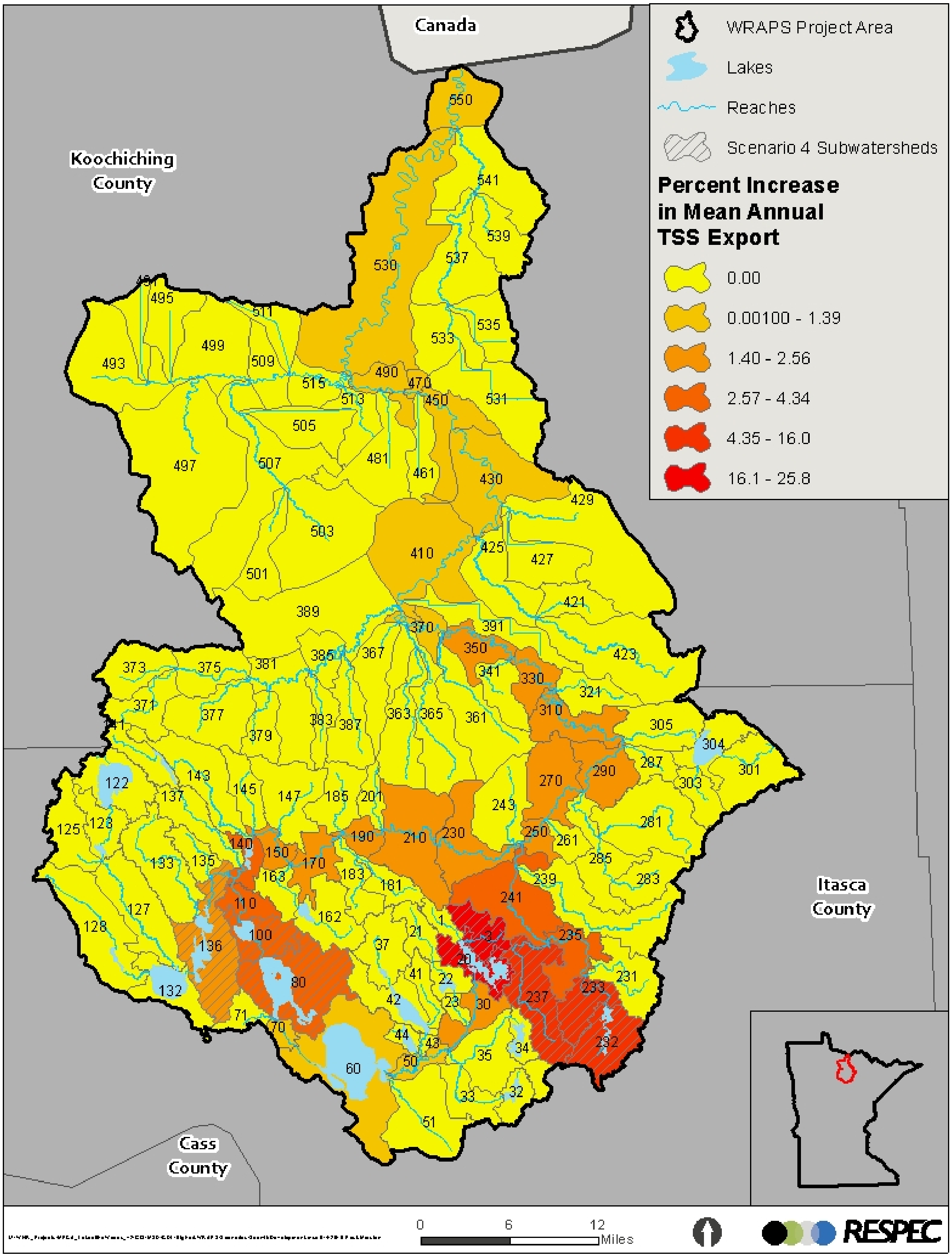


Figure 25: Scenario 4B – Development with Minimal Impact Development Standards – Total Suspended Sediments (TSS).

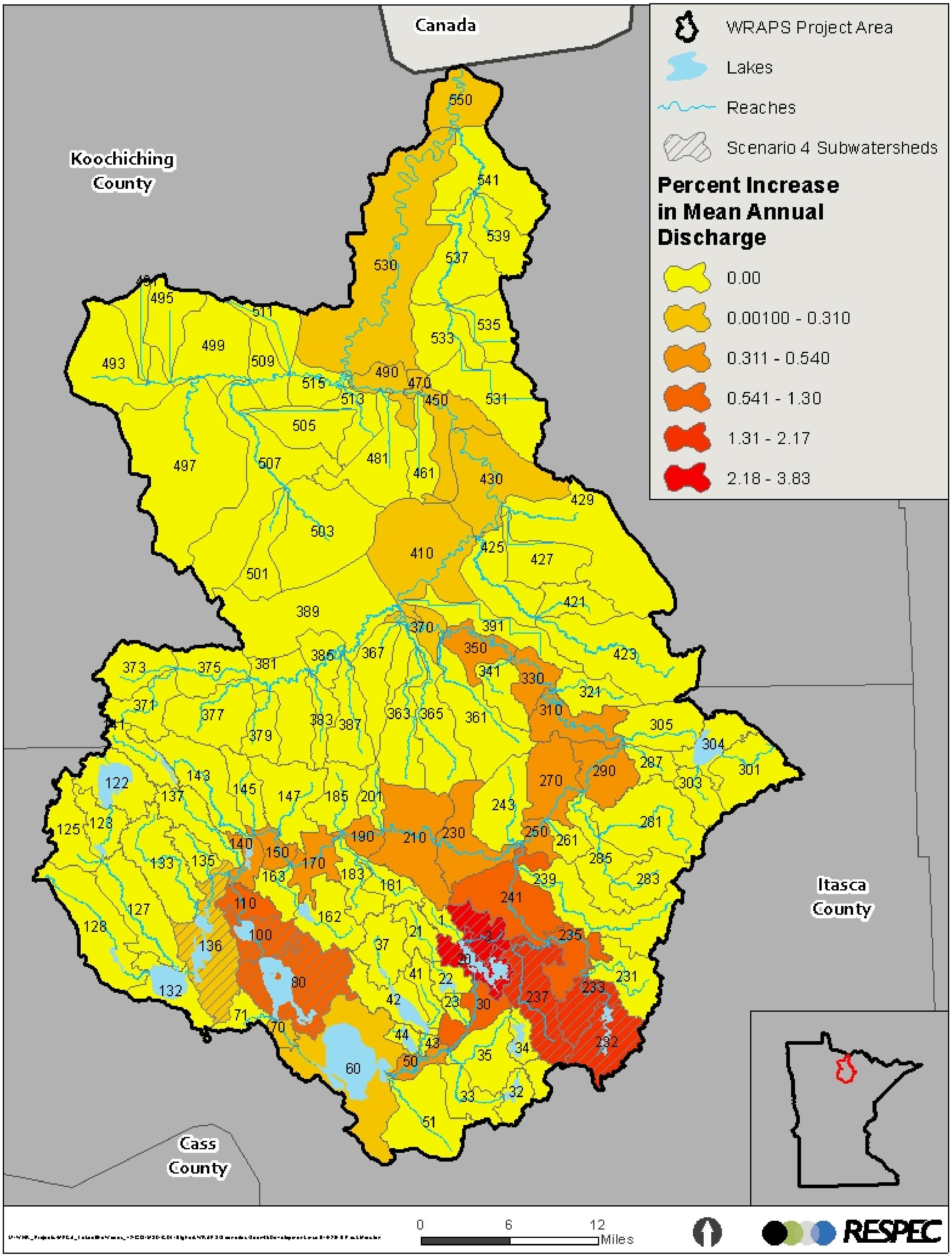


Figure 26: Scenario 4B – Development with Minimal Impact Development Standards – Total Phosphorus (TP).

Summary of Scenario Results:

To provide context for scenario results, an analysis was carried out to estimate flow-weighted mean TSS and TP concentrations at key locations throughout the watershed. Flow-weighted mean concentrations were estimated as mean annual load divided by mean annual discharge for the 19-year modeling period. To provide context for the flow-weighted mean concentration values, applicable water quality standards are 15 mg/L for TSS and 50 µg/L for TP. It is important to note that the river water quality standards apply only from April 1 to September 30, during which time water quality standards "may be exceeded for no more than 10% of the time" (Minn. R. 7050.0222). Flow-weighted mean concentrations reported here are based on mean annual values and therefore do not correspond to the river water quality standard time period. An important takeaway from flow-weighted mean concentration results is the relative change that each scenario produces at different points throughout the Big Fork Watershed.

Flow-weighted mean concentration estimates for TSS and TP are shown in Figure 27 and 28, respectively. Results shown in Figure 27 and 28 correspond to locations with much larger drainage areas (10 or more subwatersheds) than the subwatershed results discussed above. Changes in TSS and TP concentrations are muted compared to individual subwatersheds that are disproportionately affected by individual scenarios. Scenario 1A shows the greatest impact at all locations for both TSS and TP. Particularly large impacts are seen at the Caldwell Brook Mouth, which enters the Big Fork River approximately 10 miles northwest of Craigsville. Caldwell Brook drains a large area that was identified as being at risk for agricultural conversion; TSS and TP concentration increases of approximately 60% (37 to 59 µg/L) and 51% (65 to 98 mg/L) were estimated. Implementation of agricultural buffers on 50% of converted agricultural land is estimated to reduce the negative impact by approximately 50%, although negative water quality impacts would still be substantial.

Following agricultural conversion, conversion from mature to young forest (Scenario 2) showed the greatest impact on TSS concentration, with large changes in the upper half of the watershed and an increase from approximately 30 mg/L to 32 mg/L at the confluence with the Rainy River. Smaller impacts are seen from expanded mining (Scenario 3) and lakeshore development (Scenario 4A) at the Bowstring River and in the middle reaches of the Big Fork River, while impacts at the mouth are relatively muted (increases of < 1 mg/L for TSS and < 1 µg/L for TP). Compared to lakeshore development (Scenario 4A), Lakeshore development in accordance with MIDS standards (Scenario 4B) showed very small decreases in TSS and TP at larger scales, which contrasts with large decreases seen at the subwatershed scale in headwater lakes in the Bowstring River drainage area.

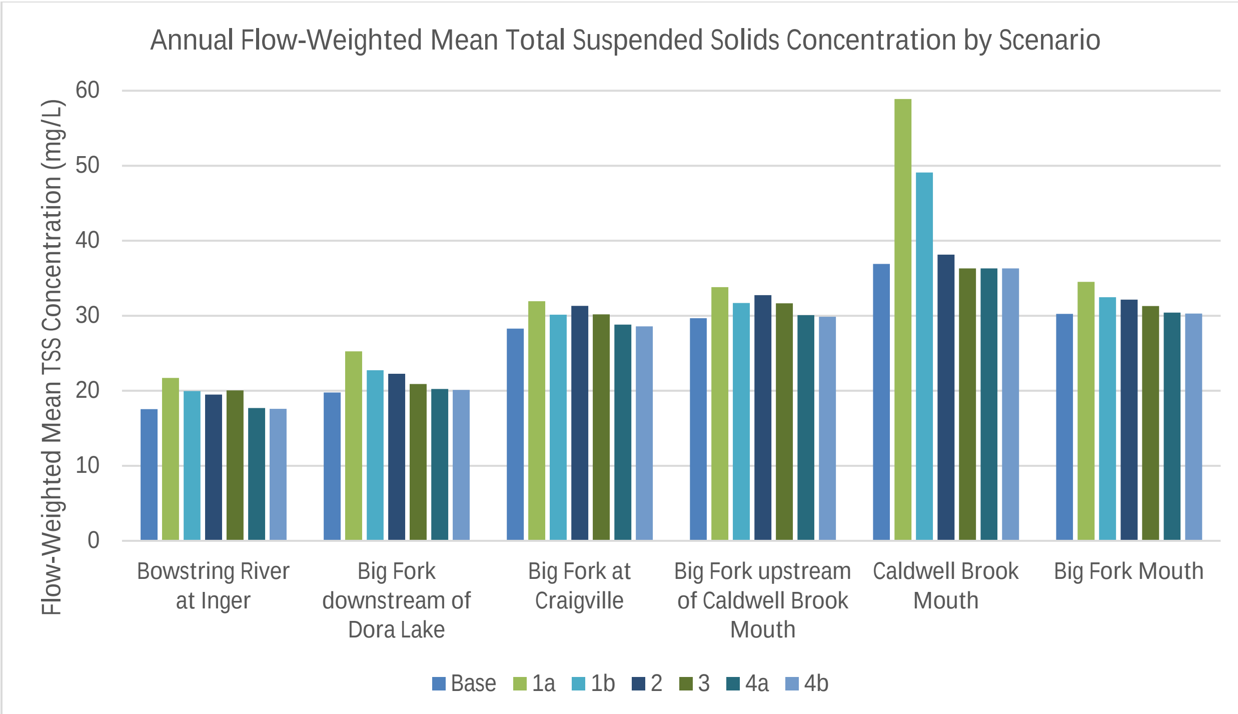


Figure 27: Total Suspended Solids Flow-weighted Mean Concentration by Scenario at Key Locations in the Watershed.

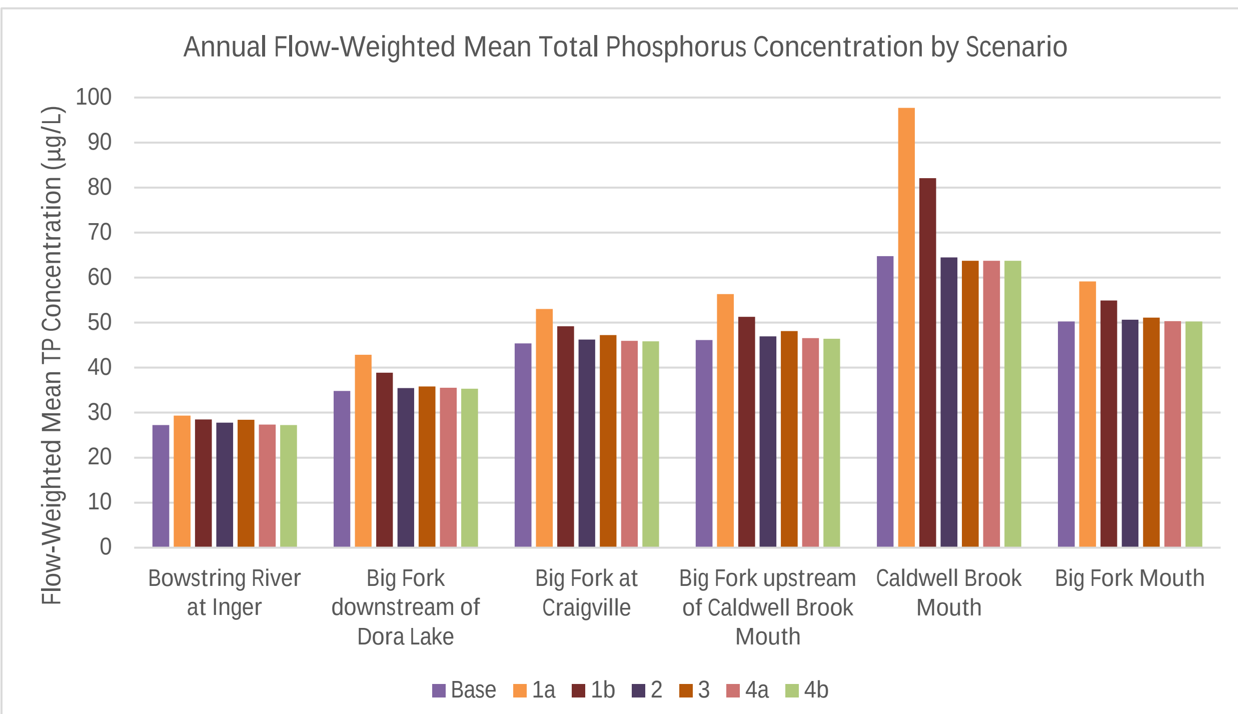


Figure 28: Total Phosphorus Flow-weighted Mean Concentration by Scenario at Key Locations in the Watershed.

Impaired Lake Phosphorus Load Reductions

Necessary phosphorus load reductions (Table 14) were calculated for each source of phosphorus loading to Island Lake. Potential BMPs to achieve these load reductions are listed in Table 15.

Table 14: Big Fork River Watershed phosphorus load reductions

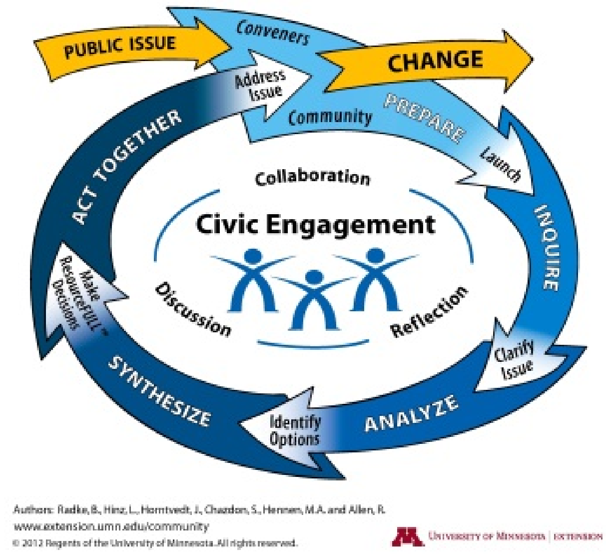
Source	Island Lake
Direct Drainage Area (ac)	10,547 (includes 3,108 ac surface area of Island Lake)
Construction Stormwater (lb/yr)	1.0
Watershed Load (lb/yr)	814.9
Septic Load (lb/yr)	66.7
Atmospheric Deposition (lb/yr)	535.2
Internal Load (lb/yr)	2147.2
Total Load (lb/yr)	3565.0
Watershed Load Reduction (lb/yr)	277.1
Septic Reduction (lb/yr)	16.7
Internal Load Reduction (lb/yr)	648.2
Total Reduction (lb/yr)	942.0
Total Reduction (% of Total Load)	26

Table 15: Impaired lake phosphorus load reduction data sources and assumptions

Implementation Category	Example Activities	Phosphorus Load	Removal Efficiency
Cropland Management	Buffers, conservation tillage, nutrient management planning, cover crops, and other agricultural BMPs	Area-Weighted HSPF modeled load by the percent of cultivated crops land cover (NLCD 2006)	50%
Urban Management	Shoreline buffers, biofilters (buffers and vegetated swales), rain gardens, and other infiltration BMPs, MIDS performance standards	Area-weighted HSPF modeled load by the percent of developed, open space and developed, low intensity land covers (NLCD 2006)	50%
Wetland Management	Water level management, invasive species management, assess wet/dry cycle impacts	Area-weighted HSPF modeled load by the percent of wetland land cover (NLCD 2006)	Variable dissolved P removal
Septic System Management	Upgrade failing shoreline septic systems	Phosphorus loads of shoreline septic system based on assumptions in MPCA 2004, country average % failing rates from MPCA 2012 SSTS Annual Report, and county parcels	0.45 lb/ capita-year
Internal Load Management	Assess upland discharge for dissolved phosphorus, assess lake waters for iron, consider chemical enhancement by iron or alum treatment	Internal load	variable

3.2 Civic Engagement

A key prerequisite for successful strategy development and on-the-ground implementation is meaningful civic engagement, which is distinguished from the broader term "public participation" in that civic engagement encompasses a higher, more interactive level of involvement. Specifically, the University of Minnesota Extension's definition of civic engagement is "Making 'resourceFULL' decisions and taking collective action on public issues through processes that involve public discussion, reflection, and collaboration." A resourceFULL decision is one based on diverse sources of information and supported with buy-in, resources (including human), and competence. Further information on civic engagement is available at: http://www1.extension.umn.edu/community/civic-engagement/



Accomplishments and Future Plans

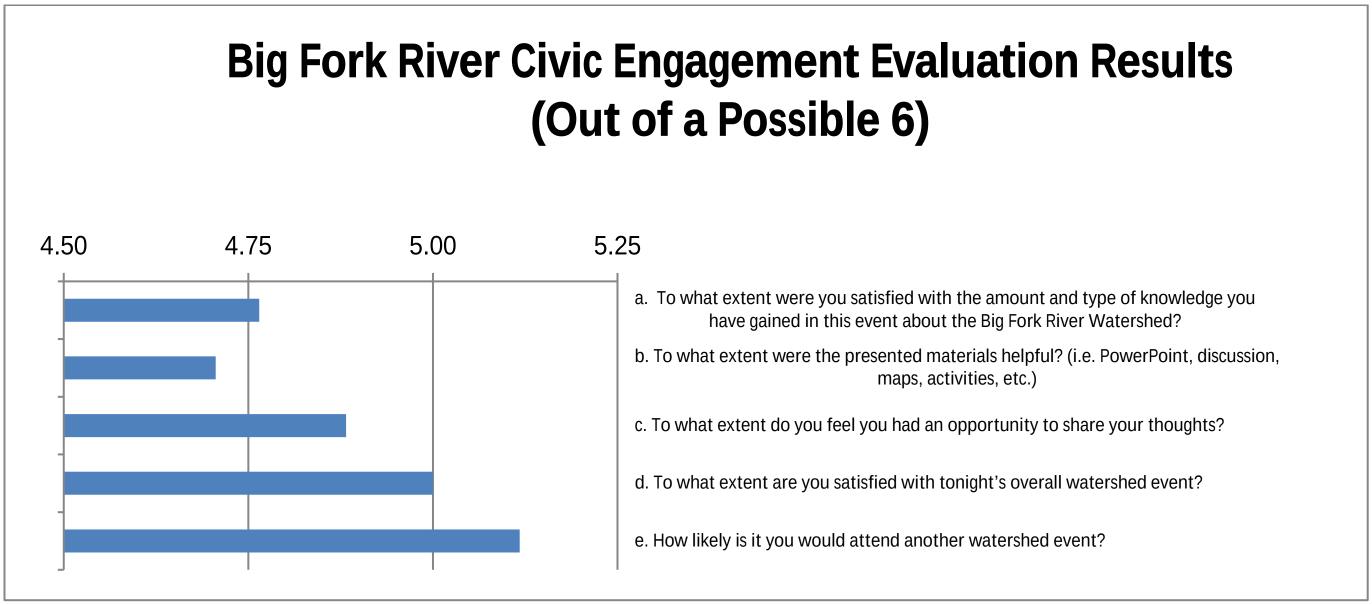
Several different groups have been involved in the public outreach process. The groups have included: Itasca Coalition of Lake Associations (ICOLA), Koochiching County Soil and Water Conservation Districts (KSWCD), Itasca Soil and Water Conservation District (ISWCD), North St. Louis Soil and Water Conservation District (NSTLSWCD), Koochiching County Environmental Services Department, Itasca County Environmental Services Department, Koochiching County Commissioners Office, Itasca County Commissioners Office, Big Fork River Board, Packaging Corporation of America (formally known as Boise Paper), U.S. Forest Service (USFS), and the DNR. Below is a summary of the local involvement and some potential public outreach strategies moving forward.

- Summary of local involvement thus far:
  - Kick-off meetings (4/23/14 – Carpenter Township Coffee with the Commissioners, 9/10/14 – Big Falls, 9/17/14 – Marcell).
  - The Assessment/TMDL meeting (8/21/15 – Marcell).
  - TMDL meetings (1/8/16 – Marcell, 1/12/16 Resource Professional WebEx Meeting, 1/13/16 – Big Falls).
  - Initial monitoring and assessment information to the Koochiching County Fair in 2014.
  - Watershed and WRAPS information provided to public at the Itasca County Fair in 2014, 2015, and 2016.
  - Numerous one-on-one meetings with local citizens.
- Moving forward:
  - Additional efforts to find projects and volunteers for cost share projects or MPCA CLMP will occur.
  - Promotion of the WRAPS process to the general public and other targeted audiences.

- o Other efforts will include the revision of the Itasca County Water Plan and the Koochiching County Water Plan.
- o Other educational/outreach efforts such as: County Fair, Envirothon, Youth Water Summit, Big Fork River Board Meetings, Itasca Coalition of Lake Associations (ICOLA) meetings.
- o Articles in the local newspapers about watershed issues.
- o Local radio stations granted interviews and ads to promote events.

Efforts were made to have meetings in both Koochiching and Itasca Counties to serve both communities. Attendees who completed the evaluation survey at events gave an overall average rating of 4.89 out of a possible 6. See below for compiled results on each question asked.

The Civic Engagement Team encountered difficulties attracting large audiences throughout this watershed despite tactics used for promotion (see above) and food was provided at each event sponsored by the Koochiching County Farm Bureau. Future efforts will include the use of a watershed-wide website, and possibly the use of other media.



Public Notice for Comments

An opportunity for public comment on the draft WRAPS report was provided via a public notice in the State Register from May 30, 2017 through June 29, 2017.

3.3 Restoration & Protection Strategies

This section focuses on specific strategies that were identified by Itasca and Koochiching SWCD staff, Core Team members (staff from supporting agencies), residents and stakeholders within the Big Fork River Watershed as the best way to address the restoration and protection needs identified earlier in Section 3. They are listed in Tables 16 through 24. However, several contributors stressed that since this WRAPS document constitutes multi-year efforts, it is imperative that the implementation be flexible enough to adapt to changing conditions and new data. To that end, the strategies are not intended to be project work plans. The appropriate strategies should be determined as local water plans are developed. The document also anticipates that some strategies may not be implemented and that new ones may be added as we gain a better understanding of the watershed.

Tables 16 through 24 have three sections. Section 1 applies to the entire Big Fork River Watershed, while Section 2 applies to Itasca County and Section 3 applies to Koochiching County.

Table 16: Strategies and actions proposed for the Big Fork River Watershed (Page 1 of 9)

Rank	HUC-12 Subwatershed	County Location and Upstream Influence Counties	Waterbody (ID)	Water Quality Parameter (Including Nonpollutant Stressors)	Water Quality Current Conditions (based on data collected between 2002–2014 Monitoring and Assessment Report)	Water Quality Goals/Targets	Strategies (See Table 15 for Descriptions and Implementation Tools; See link on pg. 6 for Applicable NRCS Codes)	Estimated Scale of Adoption Needed	Governmental Units With Primary Responsibility									Timeline	Interim 10-Year Milestones
									MPCA	DoAg	SWCD	NRCS	County	DNR	Cities/ Townships	Landowners	Nonprofits		
		Watershed Wide Strategies																	
High	Island Lake - Popple River 90300060201	Itasca County	Island Lake (31-0913)	Phosphorus	Impaired	TP < 30 µg/l (ppb) Chl-a < 9.0 µg/l Secchi > 2.0 meters	Implement TMDL Strategies	Island Lake - Popple River Watershed		X	X		X			X		2017 - Continuing	Implement at least two restoration/protection projects
High	All	Itasca and Koochiching Counties	Specific HUCs TBD	% Disturbance	Varies	Maintain or Improve	Explore the opportunity to implement a minor watershed approach pilot project.	One minor (HUC-14 or smaller) watershed in each county			X		X			X		2017 - 2018	Completion of Pilot
High	All	Koochiching and Itasca Counties	Select HUC – 12 watersheds	Disturbance	Determined via project	Sediment reduction, nutrient load reduction	Big Fork River Canoe Carry down Access Point and Camp Site Assessments	Big Fork River Watershed			X		X	X				2017-2019	Phase I completed, Phase II in Progress where 6 BMPs are implemented

Table 17: Strategies and actions proposed for the Big Fork River Watershed (Page 2 of 9)

Rank	HUC-12 Subwatershed	County Location and Upstream Influence Counties	Waterbody (ID)	Water Quality Parameter (Including Nonpollutant Stressors)	Water Quality Current Conditions (based on data collected between 2002–2014 Monitoring and Assessment Report)	Water Quality Goals/Targets	Strategies (See Table 15 for Descriptions and Implementation Tools; See link on pg. 6 for Applicable NRCS Codes)	Estimated Scale of Adoption Needed	Governmental Units With Primary Responsibility									Timeline	Interim 10-Year Milestones
									MPCA	DoAg	SWCD	NRCS	County	DNR	Cities/ Townships	Landowners	Nonprofits		
High	All	Koochiching and Itasca Counties	All HUC – 12 watersheds	All Parameters	Varies	The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides financial and technical assistance to agricultural producers to plan and implement conservation practices that improve soil, water, plant, animal, air and related natural resources on agricultural land and non-industrial private forestland. EQIP may also help producers meet Federal, State, Tribal, and local environmental regulations.	NRCS EQIP Projects	Big Fork River Watershed		X		X				X		Continuing	Forestry practices applied to 70 acres, prescribed grazing applied to 40 acres, forest management plans written for 1,500 acres, and upland wildlife habitat management practices applied to 5,000 acres.
High	All	Koochiching and Itasca Counties	All HUC – 12 Watersheds	Invasive Species	Protection of the aquatic ecosystem	Increase resources and habitat for native aquatic species	Aquatic Invasive Species Prevention Aid	Big Fork River Watershed			X	X		X			X	Continuing	Prevention of invasive species within the Big Fork River Watershed.
High	All	Koochiching and Itasca Counties	All HUC – 12 Watersheds	All parameters	Varies	Landowner and Agency Involvement, monitor for changes in water quality	The Continuation of the Big Fork River Watch Program by the Big Fork River Board and Citizen Lake Monitoring Program	Big Fork River Watershed	X		X			X	X	X	X	Continuing	Landowner-based assessments have continued and add to existing monitoring data
High	All	Koochiching and Itasca Counties	All HUC – 12 Watersheds			The Conservation Reserve Program (CRP) provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner.	NRCS CRP Projects	Big Fork River Watershed		X		X				X		Continuing	Itasca County - Contracts applied to 20 acres of land Koochiching County - Contracts applied to 20 acres of land

Table 18: Strategies and actions proposed for the Big Fork River Watershed (Page 3 of 9)

Rank	HUC-12 Subwatershed	County Location and Upstream Influence Counties	Waterbody (ID)	Water Quality Parameter (Including Nonpollutant Stressors)	Water Quality Current Conditions (based on data collected between 2002–2014 Monitoring and Assessment Report)	Water Quality Goals/Targets	Strategies (See Table 15 for Descriptions and Implementation Tools; See link on pg. 6 for Applicable NRCS Codes)	Estimated Scale of Adoption Needed	Governmental Units With Primary Responsibility										Timeline	Interim 10-Year Milesto
									MPCA	BWSR	DoAg	SWCD	NRCS	County	DNR	Cities/ Towns hips	Landowners	Non-profits		
High	All	Koochiching and Itasca Counties	All HUC – 12 Watersheds	All Parameters	Varies	Sustainable Forest Incentive Act (SFIA) new contracts and renewals (maintain or improve)	SFIA will protect privately held forest lands from being developed or otherwise converted through tax relief incentives to property owners	Big Fork River Watershed				X					X		Continuing	Itasca County - 20 new contracts Koochiching Coun 20 new contracts
High	All	Koochiching and Itasca Counties	All HUC – 12 Watersheds	All Parameters	Varies	Reinvest in Minnesota (RIM) Conservation Easements new contracts and renewals (maintain or improve)	RIM will protect privately held environmentally sensitive lands from being developed and maintained in the natural state through financial incentives to the property owners	Big Fork River Watershed		X	X	X					X		Continuing	Itasca County - 20 new contracts Koochiching Coun 20 new contracts
High	All	Koochiching and Itasca Counties	All HUC – 12 Watersheds	All Parameters	Varies	Public Education	Create an editorial series about water quality & watershed issues in the Big Fork River Watershed to be distributed by media.	Big Fork River Watershed				X						X	Continuing	Release at least f articles
High	All	Koochiching and Itasca Counties	Specific HUCs TBD	All Parameters	Varies	Vegetated Buffer Management	Provide landowners information and assistance with implementation of vegetated buffers for all public waters	Big Fork River Watershed	X	X	X	X	X	X	X	X	X	X	2017 - Continuing	Full compliance v the implementati of buffers on all p waters across the Fork River Waters
Medium	All	Koochiching and Itasca Counties	All HUC – 12 watersheds	Varies	Varies	Maintain or Improve or improve water quality	Pilot Volunteer River Monitoring Program	Big Fork River Watershed	X			X					X		Continuing	- Ongoing voluntee monitoring of all H 12 watersheds - Establishment o Watershed Associations for e HUC-12
Medium	All	Koochiching and Itasca Counties	All HUC-12 Watersheds	Invasive Species	Determined via Project	Increase viability of terrestrial habitat and in turn aquatic habitat. Reduce erosion by eliminating monoculture of root systems.	Terrestrial Invasive Species Inventory	Big Fork River Watershed				X		X		X			Continuing	Assessment comp and a plan in plac eradication and prevention

Table 19: Strategies and actions proposed for the Big Fork River Watershed (Page 4 of 9)

Rank	HUC-12 Subwatershed	County Location and Upstream Influence Counties	Waterbody (ID)	Water Quality Parameter (Including Nonpollutant Stressors)	Water Quality Current Conditions (based on data collected between 2002–2014 Monitoring and Assessment Report)	Water Quality Goals/Targets	Strategies (See Table 15 for Descriptions and Implementation Tools; See link on pg. 6 for Applicable NRCS Codes)	Estimated Scale of Adoption Needed	Governmental Units With Primary Responsibility										Timeline	Interim 10-Year Milestor
									MPCA	SWCD	BWSR	DoAg	NRCS	County	DNR	Cities/ Townships	Landowners	Nonprofits		
Medium	Where needed	Koochiching and Itasca Counties	Where needed	Flow Rates/Sedimentation	Will be determined by culvert assessment	Correct flow rates in system and assist in improving turtle habitat (culverts as a safe passage for turtles)	Culvert Repair for Sedimentation reduction and Improved Wildlife Habitat	Big Fork River Watershed, as needed from culvert assessment		X				X	X				Upon completion of culvert assessments by 2022	Culverts replaced/resized based on what is needed from previous culvert assessment
Medium	All	Koochiching and Itasca Counties	All HUC – 12 Watersheds	All Parameters	Varies	CRP/CREP new contracts and renewals (maintain or improve)	Conservation Reserve Program (CRP) & Conservation Reserve Enhancement Program (CREP) will protect privately held lands by promoting native ground cover in environmentally sensitive areas through financial incentives to property owners	Big Fork River Watershed		X	X	X	X				X		Continuing	Itasca County - 20 new contracts Koochiching Coun 20 new contracts
Low	All	Koochiching and Itasca Counties	All HUC – 12 Watersheds	All	Varies	Maintain or Improve	School-age Watershed Education	Big Fork River Watershed		X						X	X	X	Continuing	Provide for stude who are now nea adult age to beco better stewards o the land.
Itasca County Strategies																				
High	All	Itasca County	Specific HUCs TBD	All Parameters	Varies	Civic Engagement	Engage Leech Lake Band and Bois Forte Band in watershed discussions	Tribal lands within the Big Fork River Watershed	X	X									2017 - Continuing	Begin regular meetings betwee the MPCA, SWCD and Tribal Representatives
High	Specific HUC TBD (090300060170)	Itasca County	Wetland North of Main-stem and east of CR 31 Approximate River Mile 162.5	All parameters	Fully supports and meets all criteria	White Cedar Restoration	Improve forest road segment to restore hydrologic function of cross-flow through the cedar grove adjacent to the Big Fork Main-stem in Wirt.	HUC – 14: 09030006020170 and Main-stem of Big Fork River		X	X				X	X			2017	Restore hydrolog function to the wetland adjacent the Big Fork River and stimulate regeneration of White Cedar with the wetland. Cooperation of; BWSR, Itasca SWC Lake SWCD, JPB Engineers, US For Service - Chippew National Forest, N DNR, and Itasca County Land Department

Table 20: Strategies and actions proposed for the Big Fork River Watershed (Page 5 of 9)

Rank	HUC-12 Subwatershed	County Location and Upstream Influence Counties	Waterbody (ID)	Water Quality Parameter (Including Nonpollutant Stressors)	Water Quality Current Conditions (based on data collected between 2002–2014 Monitoring and Assessment Report)	Water Quality Goals/Targets	Strategies (See Table 15 for Descriptions and Implementation Tools; See link on pg. 6 for Applicable NRCS Codes)	Estimated Scale of Adoption Needed	Governmental Units With Primary Responsibility										Timeline	Interim 10-Year Milestones
									MPCA	SWCD	DoAg	BWSR	NRCS	County	DNR	Cities/ Townships	Landowners	Nonprofits		
High	All	Itasca County	Specific HUCs TBD	TSS & TP	Varies	Shore-land Project Planning Assistance	Shore-land stabilization and storm water management with landowners	Big Fork River Watershed		X		X			X		X		Continuing	Project planning assistance provided t 60 landowners, with a least 30 projects implemented. These projects will result in 2,000 linear feet of frontage stabilized an approximately 7,500 square feet stabilized from sheet erosion, with established buffers.
High	All	Itasca County	Specific HUCs TBD	TSS & TP	Varies	Shore-land Projects Cost Shared by SWCD	Shore-land stabilization and storm water management on priority sites	Big Fork River Watershed		X		X			X		X		Continuing	At least three project implemented of bio-stabilization to reduc & prevent wave actio erosion and ice push (100 lineal feet/project). At least three projects implemented of rock rip-rap stabilization o sites with excessive ic & wave erosion (100 lineal feet/project). A least two riparian buf plantings (1,000 squa feet/project).
High	All	Itasca County	Specific HUCs TBD	TSS & TP	Varies	Variance Condition Planning	Native buffer re-establishment	Big Fork River Watershed		X	X	X					X		Continuing	At least 10 plans implemented, with approximately 7,500 total square feet of buffer established
High	All	Itasca County	Specific HUCs TBD	All Parameters	Varies	Farm Certification	Agricultural water quality certification	Big Fork River Watershed		X	X						X		2017 - Continuing	Two or more farm certifications, with at least 80 acres certifie and 4 acres of soil stabilization
High	All	Itasca County	Specific HUCs TBD	TSS & TP	Varies	Buffer Law Assistance	Buffer law assistance, verification, and violation remediation	Big Fork River Watershed		X		X	X	X	X		X		2017 - Continuing	Assist at least one landowner or 45,000 square feet of riparia buffer establishment

Table 21: Strategies and actions proposed for the Big Fork River Watershed (Page 6 of 9)

Rank	HUC-12 Subwatershed	County Location and Upstream Influence Counties	Waterbody (ID)	Water Quality Parameter (Including Nonpollutant Stressors)	Water Quality Current Conditions (based on data collected between 2002–2014 Monitoring and Assessment Report)	Water Quality Goals/Targets	Strategies (See Table 15 for Descriptions and Implementation Tools; See link on pg. 6 for Applicable NRCS Codes)	Estimated Scale of Adoption Needed	Governmental Units With Primary Responsibility										Timeline	Interim 10-Year Milestone
									MPCA	SWCD	DoAg	BWSR	NRCS	County	DNR	Cities/ Townships	Landowners	Nonprofits		
High	All	Itasca County	Specific HUCs TBD	All Parameters	Varies	Shore land Alterations Site Visits	Provide technical assistance for sustainable development and shore land use	Big Fork River Watershed		X		X		X	X		X		2017 - Continuing	At least ten site visi per year resulting i assistance planning water diversions, pa design, water acces rip rap shore stabilization, and biological stabilizati geared towards minimal impact
High	All	Itasca County	Specific HUCs TBD	TSS & TP	Varies	Soil loss Ordinance Assistance	Assist land owners with soil loss ordinance violations, project assistance and verification	Big Fork River Watershed		X	X	X					X		2017- Continuing	At least 0.5 acres of improved soil stabilization
High	All	Itasca County	Specific HUCs TBD	All Parameters	Varies	Forest and Watershed Management Assistance	Assist landowners with stewardship and management plans	Big Fork River Watershed		X		X					X		Continuing	Assist at least 50 landowners with management and stewardship plans, resulting in maintained and improved watershe functions on approximately 2,00 acres
High	All	Itasca County	Specific HUCs TBD	TSS & TP	Varies	Supply Native Planting Stock	Supply property owners with native plants for projects and watershed benefits	Big Fork River Watershed		X							X		Continuing	Supply property owners in the Big Fo River Watershed wi native planting stoc of approximately 10,000 plants/500 orders
High	All	Itasca County	Specific HUCs TBD	All Parameters	Varies	Wetland Impact Avoidance	Potential wetland impacts avoided by conversations, site visits, and replacement plans	Big Fork River Watershed		X		X					X		Continuing	Approximately five acres of potential impacts avoided
High	All	Itasca County	HUC 09030006060 – 290	All Parameters	Varies	Wetland Mitigation Site Creation	New wetland creation to mitigate wetland impact	HUC 09030006060 – 290		X		X					X		2017 - 2020	Completed creation 1.5 acres of new wetland to mitigate 0.97 acres of wetlar impacts in the same subwatershed area

Table 22: Strategies and actions proposed for the Big Fork River Watershed (Page 7 of 9)

Rank	HUC-12 Subwatershed	County Location and Upstream Influence Counties	Waterbody (ID)	Water Quality Parameter (Including Nonpollutant Stressors)	Water Quality Current Conditions (based on data collected between 2002–2014 Monitoring and Assessment Report)	Water Quality Goals/Targets	Strategies (See Table 15 for Descriptions and Implementation Tools; See link on pg. 6 for Applicable NRCS Codes)	Estimated Scale of Adoption Needed	Governmental Units With Primary Responsibility										Timeline	Interim 10-Year Milestones
									MPCA	SWCD	DoAg	BWSR	NRCS	County	DNR	Cities/ Townships	Landowners	Nonprofits		
High	All	Itasca County	09030006020 – 122	All Parameters	Impaired (Nutrients & Mercury)	Restoration & protection Projects	Work with landowners to plan and implement projects to reduce sediment loading to Island Lake and stream tributaries	09030006020 – 122		X							X		2017	1-2 projects implemented
High	All	Itasca County	09030006020 – 122	TP, TSS, TN, Secchi, and Chl-a	Impaired (Nutrients & Mercury)	Restoration & protection Projects	Work with landowner to install approximately 150 ft. of rock Rip Rap on the North shore of Island Lake to protect from Ice push and bank erosion.	09030006020 – 122		X							X		2017	1 project completed
High	All	Itasca County	Specific HUCs TBD	All Parameters	Varies	Forest Management	Forest management assistance to private landowners	Big Fork River Watershed		X					X		X		Continuing	100 forest stewardsh plans implemented
High	Varies	Itasca County	All Medium Priority lakes listed in the Appendix: Appendix - A – Big Fork Lake Prioritization	TP, Chl-a, & Secchi	Varies	Water Quality Monitoring	Monitor water quality and continue building towards establishing long-term trends	Entire Big Fork River Watershed	X	X					X				Continuing	Sufficient data to establish a trend.
Medium	Varies	Itasca County	All Medium Priority lakes listed in the Appendix: Appendix - A – Big Fork Lake Prioritization	TP, Chl-a, & Secchi	Varies	Water Quality Monitoring	Monitor water quality and continue building towards establishing long-term trends	Entire Big Fork River Watershed	X	X					X				Continuing	Sufficient data to establish a trend.
Medium	All	Itasca County	Specific HUCs TBD	TSS & TP	Varies	Wetland Road Impacts Remediation	Culvert replacement/upgrade or alternative methods to restore hydrologic function and remove impediments to cross-flow and wildlife passage	Big Fork River Watershed		X				X	X	X			2017 - Continuing	Identify and invento areas where roads have impeded cross- flow and hydrologic function of wetlands and plan to remedia at least 2 sites

Table 23: Strategies and actions proposed for the Big Fork River Watershed (Page 8 of 9)

Rank	HUC-12 Subwatershed	County Location and Upstream Influence Counties	Waterbody (ID)	Water Quality Parameter (Including Nonpollutant Stressors)	Water Quality Current Conditions (based on data collected between 2002–2014 Monitoring and Assessment Report)	Water Quality Goals/Targets	Strategies (See Table 15 for Descriptions and Implementation Tools; See link on pg. 6 for Applicable NRCS Codes)	Estimated Scale of Adoption Needed	Governmental Units With Primary Responsibility										Timeline	Interim 10-Year Milestones
									MPCA	SWCD	DoAg	BSWR	NRCS	County	DNR	Cities/ Townships	Landowners	Nonprofits		
Medium	All	Itasca County	Specific HUCs TBD	TSS & TP	Varies	Boat Landing Survey	Survey boat landings in Itasca County for potential to re-design, implement BMPs, or reduce erosion and sediment transport.	Big Fork River Watershed		X				X	X		X		2017 - 2036	Assess water access sit for potential improvements, and wo with MNDNR and Itasca Land Department to improve landings, and reduce sediment transport to lakes
Low	Varies	Itasca County	All Low Priority lakes listed in Appendix - A – Big Fork Lake Prioritization	TP, Chl-a, & Secchi	Varies	Water Quality Monitoring	Monitor water quality and continue building towards establishing long-term trends	Big Fork River Watershed	X	X					X				Continuing	Continue Monitoring to acquire water quality data sufficient to establish a trend, with annual sampling, five times May-September
Koochiching County Strategies																				
High	All	Koochiching County	All HUC – 12 watersheds	TSS & TP	Determined via project	Increase stream connectivity, sediment reduction, nutrient loading reduction	Koochiching County Culvert Assessment	Big Fork River Watershed in Koochiching County		X				X					2017-2018	Phase I completed, Pha II in Progress
High	All	Koochiching County	All HUC – 12 watersheds	Varies	Varies	Increase capacity for forestry needs in Koochiching County	Koochiching SWCD will hire 1 FTE-Forest Resource Specialist	Big Fork River Watershed		X									2017 - continuing	The Forest Resource Specialist will have completed 10-year updates to SFIA plans f local landowners
High	All	Koochiching County	All HUC – 12 watersheds	Varies	Varies	Increase water quality education among private foresters	Best Management Practices Workshops for Private Foresters held by MLEP	Big Fork River Watershed		X								X	2017 - continuing	Interested landowners will have had an opportunity to attend workshops on forest stewardship.
Medium	City of Big Falls-Big Fork River 90300060705	Koochiching County	Main-stem of Big Fork River	Improve spawning habitat, Turbidity/TSS	Stream channel erosion and dewatering of spawning beds due to channelization	Decrease flow rate in spillway, decrease sedimentation	Form a technical committee to explore Big Falls Spillway Diversion Project	Big Falls Area	X	X			X	X	X	X	X	X	2021-2023	Project completed

Table 24: Strategies and actions proposed for the Big Fork River Watershed (Page 9 of 9)

Rank	HUC-12 Subwatershed	County Location and Upstream Influence Counties	Waterbody (ID)	Water Quality Parameter (Including Nonpollutant Stressors)	Water Quality Current Conditions (based on data collected between 2002–2014 Monitoring and Assessment Report)	Water Quality Goals/Targets	Strategies (See Table 15 for Descriptions and Implementation Tools; See link on pg. 6 for Applicable NRCS Codes)	Estimated Scale of Adoption Needed	Governmental Units With Primary Responsibility										Timeline	Interim 10-Year Milestones
									MPCA	SWCD	DoAg	BSWR	NRCS	County	DNR	Cities/ Townships	Landowners	Nonprofits		
Medium	All	Koochiching County	All HUC – 12 Watersheds	Turbidity	Varies	Reduce erosion on county forest roads	Koochiching SWCD will work with Koochiching County to assess forest roads and complete assist with projects to fix those found to be failing within funding ability.			X				X					Continuing	5 forest roads will b completed
Low	City of Big Falls-Big Fork River 90300060705)	Koochiching County	Main-stem of Big Fork River	Turbidity	TSS	Decrease the likelihood of sedimentation in park and along trails by assisting as needed with park restoration and adding a boardwalk on birding trails	Big Falls Park and Trails Restoration Assistance	Big Falls area		X					X	X			Continuing	Bog walk installed a park safely renovate Erosion control BMF in place.

4. Monitoring Plan

Data from five monitoring programs will continue to be collected and analyzed for the Big Fork River Watershed. These monitoring programs are summarized below:

1. ***Intensive Watershed Monitoring*** collects water quality and biological data throughout each major watershed for the first two years of each 10-year cycle. This work is scheduled for its second iteration in the Big Fork River Watershed in 2020. This data provides a periodic but intensive "snapshot" of water quality throughout the watershed.
2. The ***Watershed Pollutant Load Monitoring Network*** intensively collects pollutant samples and flow data to calculate daily sediment and nutrient loads on either an annual or seasonal (no-ice) basis. In cycle one, there were two actively monitored seasonal subwatershed pollutant load monitoring sites in the Big Fork River Watershed, one in Itasca County and one in Koochiching county, with an additional major watershed pollutant load monitoring site in Koochiching.
3. The ***Citizen Surface Water Monitoring Program*** is a network of volunteers who make monthly lake and river transparency readings. Several dozen data collection locations exist in the Big Fork River Watershed. This data provides a continuous record of this one water quality parameter throughout much of the watershed.
4. Ongoing **Local Monitoring Efforts:**
    a. The Big Fork River Board River Watch Program monitors water quality at eight sites on the mainstem during the ice-free period.
    b. There are many Lake Associations that collect volunteer water quality data in Itasca County.
    c. Several sportsman's clubs exist in both counties and can contribute valuable watershed information.
5. **WRAPS** identified local monitoring needs in addition to the ongoing efforts of the two SWCDs and the MPCA:
    a. Island Lake

        The TMDL Report (see Section 2.4) that was developed for Island Lake calls for future monitoring, subject to funding availability, to track: (1) Island Lake's water quality trends; (2) performance of future remedial and protection projects to improve water quality; and (3) compliance to surface and groundwater quality standards. The scope and nature of future remedial actions will rely on comparisons of monitored conditions to management goals as adjusted for changing land uses, weather, and runoff patterns. The ability to detect changes and the reliability of comparisons will depend on the design of the monitoring program, including potential adjustment for hydrologic and climatologic variations. An abbreviated monitoring plan is defined that should be further developed, and includes monitoring site locations, sampling schedules, and responsible persons.

- Volunteer Secchi monitoring can be used to record algal blooms by reporting recreational suitability and physical appearance at the time of their Secchi measures.
- Additional lake monitoring data needs include the following:
  - Lake TP and chlorophyll-*a* monitoring paired with Secchi transparency measurements need to be obtained six times over the growing season (June through September) with two samples per month in August and September. Bottom waters should be sampled for TP and total iron.
  - Future monitoring should consider quantification of lake sediment internal phosphorus loading including (1) diffusive P fluxes from deposited sediment and (2) equilibrium P fluxes from re-suspended sediment.
- Tracking the Effects of Weather Patterns: Recent and monthly weather reporting events will be tracked by volunteer monitoring and weather station data.

b. Popple River – 09030006-512 – Natures Lake to Dora Lake – aquatic life – DO

The 2010 Intensive Watershed Monitoring data indicated the need for a TMDL. The TMDL was deferred to the next WRAPS process, which will begin following the 2020 Intensive Watershed Monitoring. Monitoring needs for this reach are included in the TMDL Report.

c. Popple River – 09030006-517 – Headwaters to Round Lake

A desktop natural background review was conducted in 2015. The review recommended assigning this reach to CALM Category 4D; however:

- If modeled data are judged insufficient to justify CALM Category 4D, recommend two years of additional sampling at:
  - Optional – S007-352, CSAH 149 to provide data for Round Lake TMDL adaptive management
  - Optional – New site at CSAH 29 Popple River crossing (47°44'14.04" N/94°15'22.79" W (Google Earth coordinates) to determine Shallow Lake loads to lower Popple Headwaters reach to provide data for Round Lake TMDL adaptive management
  - 10RN001 (or at MN 46 Popple River crossing) to identify potential loads from Ogle's pit
  - New site on logging road crossing at 47°44'51.71" N / 94°71'38.33" W (Google Earth coordinates) to provide WQ data upstream of Ogle's pit
  - Sampling regimen – minimum: twice monthly, May through September. If a flow gage could be installed on the reach, storm event sampling is recommended
  - Parameters – standard 10X parameters plus BOD, CBOD and SBOD.
- Consider revisiting the fish score of 0 from 10RN001. The 2010 fish sampling resulted in 19 fish from only 3 species (white sucker, central mudminnow, and yellow perch, all of

which relatively tolerant to low DO). Typically a bioassessment needs a minimum of 25 fish to determine a score, but this site was deemed reportable and a good sample at the time. This site was scored using the low gradient class. Are the data sufficient to support the “reportable” conclusion?

5. References and Further Information

Baratono, N., 2016. Water Quality Review of Select Streams for Natural Background Exceedances of Water Quality Standards in the Big Fork River Watershed, prepared by RESPEC, Roseville, MN, for the Minnesota Pollution Control Agency, St. Paul, MN.

Barr Engineering, Inc. 2011. *Assessment of MIDS Performance Goal Alternatives: Runoff Volumes, Runoff Rates, and Pollutant Removal Efficiencies*, prepared by Barr Engineering, Inc., Minneapolis, MN, for the Minnesota Pollution Control Agency, St. Paul, MN.

Cross T. K. and P. C. Jacobson, 2013. "Landscape Factors Influencing Lake Phosphorus Concentrations Across Minnesota," *Lake and Reservoir Management*, Vol. 29, No. 1.

Heiskary, S. and B. Wilson, 2005. *Minnesota Lake Water Quality Assessment Report: Developing Nutrient Criteria*, prepared by the Minnesota Pollution Control Agency, St. Paul, MN.

Hirschman, D., K. Collins, and T. Schueler, 2008. *The Runoff Reduction Method*, technical memorandum prepared by the Center for Watershed Protection, Ellicott City, MD, and the Chesapeake Stormwater Network, Ellicott City, MD.

Lupo, C. D., 2015. *Model Extension and Recalibration for the Big Fork and Little Fork Watersheds Model Applications*, Letter RSI(MPO)-2597/7-15/7, prepared by RESPEC, Rapid City, SD, for the Minnesota Pollution Control Agency, St. Paul, MN, June 20.

Miller, T. P., J. R. Peterson, C. F. Lenhart, and Y. Nomura, 2012. *The Agricultural BMP Handbook for Minnesota*, prepared by the Minnesota Department of Agriculture, St. Paul, MN.

Minnesota Pollution Control Agency, 2016. *Island Lake Draft (Pre-Public Notice) TMDL*, RSI-2587, prepared by the Minnesota Pollution Control Agency, St. Paul, MN (draft).

Verry, E. S., J. R. Lewis, and K. N. Brooks, 1983. "Aspen Clearcutting Increases Snowmelt and Storm Flow Peaks in North Central Minnesota," *Water Resources Bulletin*, Volume 19, No 1.

Big Fork River Watershed Reports

All Big Fork River Watershed reports referenced in this watershed report are available at the Big Fork River Watershed webpage: https://www.pca.state.mn.us/water/watersheds/big-fork-river

Appendix – A: Big Fork Lake Prioritization Tables

Lake ID	Lake Name	Watershed	HUC-8	Depth Type	Lake Area (acres)	Watershed Acres	Ecoregion	Disturbed Land use (%)	Mean TP (µg/L)	Years TP	Mean Secchi (ft)	Presence of Trend	Trend Slope Description	Target TP (µg/L)	Load Reduction to Meet Target	Percent Load Reduction to Meet Target	Priority
31-0160-00	Mirror	Big Fork River	09030006	DEEP	109	405	NLF	0.05	9.9	3	4.80			8.0	6	19	A
31-0197-00	Battle	Big Fork River	09030006	SHALLOW	243	5,095	NLF	0.02	15.5	3	2.48	Declining Trend	Evidence for trend	13.2	54	15	A
31-0473-00	Mary	Big Fork River	09030006	DEEP	212	979	NLF	0.01	9.6	2	3.14	Declining Trend	Evidence for possible trend	9.2	3	4	A
31-0542-00	Three Island	Big Fork River	09030006	DEEP	250	3,138	NLF	0.03	3.3	2	7.14	Improving Trend	Evidence for trend	2.1	24	35	A
31-0620-00	Caribou	Big Fork River	09030006	DEEP	246	890	NLF	0.06	7.7	5	9.62	No Evidence of Trend		4.8	24	35	A
31-0624-00	Grave	Big Fork River	09030006	DEEP	525	3,956	NLF	0.06	12.5	5	3.78	No Evidence of Trend		8.2	104	33	A
31-0653-00	North Star	Big Fork River	09030006	DEEP	832	3,160	NLF	0.04	13.2	5	4.11	No Evidence of Trend		11.0	53	15	A
31-0657-00	Jack the Horse	Big Fork River	09030006	DEEP	363	2,276	NLF	0.02	10.8	2	3.85	Declining Trend	Evidence for trend	9.1	28	15	A
31-0710-00	Connors	Big Fork River	09030006	DEEP	142	652	NMW	0.18	10.4	2	3.66			8.1	11	22	A
31-0725-00	Turtle	Big Fork River	09030006	DEEP	2,126	15,101	NLF	0.03	10.3	4	4.80	Improving Trend	Strong evidence for trend	9.3	102	8	A
31-0726-00	Bello	Big Fork River	09030006	DEEP	527	4,243	NLF	0.03	9.8	2	3.20	Declining Trend	Strong evidence for trend	7.8	53	20	A
31-0771-00	Hatch	Big Fork River	09030006	DEEP	226	2,478	NLF	0.03	5.2	2	4.03			3.2	34	37	A
31-0782-00	Gunderson	Big Fork River	09030006	DEEP	183	746	NLF	0.06	11.3	3	4.22	No Evidence of Trend		8.9	14	21	A
31-0784-00	Little Jessie	Big Fork River	09030006	DEEP	628	1,962	NLF	0.05	10.0	2	4.78	No Evidence of Trend		9.1	16	9	A
31-0836-00	Little Whitefish	Big Fork River	09030006	DEEP	160	427	NLF	0.08	12.9	3	2.86			11.0	6	15	A
31-0839-00	Bass	Big Fork River	09030006	DEEP	210	820	NLF	0.11	10.6	3	4.65			9.3	8	12	A
31-0183-00	Five Island	Big Fork River	09030006	DEEP	214	939	NLF	0.01	7.9	3	3.60	Declining Trend	Weak evidence for possible trend	4.2	24	47	B
31-0316-00	Bass	Big Fork River	09030006	DEEP	122	294	NLF	0.03	13.1	5	5.30	No Evidence of Trend		10.4	8	20	B
31-0339-00	Pickerel	Big Fork River	09030006	DEEP	241	11,802	NLF	0.02	21.2	4	3.02	Declining Trend	Weak evidence for possible trend	12.6	443	40	B
31-0350-00	Anderson	Big Fork River	09030006	DEEP	295	2,901	NLF	0.02	13.3	2	1.67			11.4	32	14	B
31-0422-00	Ruby	Big Fork River	09030006	DEEP	235	2,412	NLF	0.02	8.7	3	6.79	No Evidence of Trend		6.2	41	27	B
31-0454-00	Eagle	Big Fork River	09030006	DEEP	285	2,026	NLF	0.03	21.3	4	2.71	No Evidence of Trend		16.1	67	24	B
31-0460-00	East	Big Fork River	09030006	DEEP	192	9,790	NLF	0.03	7.2	3	3.78	No Evidence of Trend		3.9	143	45	B
31-0463-00	Fox	Big Fork River	09030006	DEEP	262	12,867	NLF	0.03	8.4	3	3.30			6.0	125	28	B
31-0466-00	Horseshoe	Big Fork River	09030006	DEEP	142	5,029	NLF	0.03	6.3	2	3.80			4.8	38	25	B
31-0490-00	Elizabeth	Big Fork River	09030006	DEEP	193	2,006	NLF	0.02	8.8	4	3.03			7.5	16	15	B
31-0514-00	Brush Shanty	Big Fork River	09030006	DEEP	149	672	NLF	0.04	14.2	2	2.89			14.0	1	1	B
31-0524-00	Coon-Sandwick	Big Fork River	09030006	DEEP	594	1,769	NLF	0.02	17.3	3	2.96			14.6	35	15	B
31-0529-00	Shine	Big Fork River	09030006	DEEP	74	1,428	NLF	0.07	17.0	1	2.63			13.4	29	22	B
31-0530-00	Busties	Big Fork River	09030006	DEEP	245	1,428	NLF	0.07	24.6	4	2.70	No Evidence of Trend		17.8	64	27	B
31-0543-00	Crooked	Big Fork River	09030006	DEEP	134	2,281	NLF	0.02	9.0	2	4.02			6.5	28	28	B
31-0616-00	East Smith	Big Fork River	09030006	DEEP	152	1,322	NLF	0.03	13.3	3	3.91	No Evidence of Trend		12.1	10	9	B

Lake ID	Lake Name	Watershed	HUC-8	Depth Type	Lake Area (acres)	Watershed Acres	Ecoregion	Disturbed Land use (%)	Mean TP (µg/L)	Years TP	Mean Secchi (ft)	Presence of Trend	Trend Slope Description	Target TP (µg/L)	Load Reduction to Meet Target	Percent Load Reduction to Meet Target	Priority
31-0621-00	Little Dead Horse	Big Fork River	09030006	DEEP	79	2,669	NLF	0.05	10.2	2	4.32	No Evidence of Trend		8.8	18	15	B
31-0650-00	Smith	Big Fork River	09030006	DEEP	209	2,528	NLF	0.03	12.8	2	3.90			12.0	11	6	B
31-0656-00	Big Dick	Big Fork River	09030006	DEEP	260	1,045	NLF	0.02	9.6	2	3.34	Improving Trend	Evidence for possible trend	9.2	3	4	B
31-0658-00	Little Dick	Big Fork River	09030006	DEEP	101	835	NLF	0.03	15.8	2	2.70			13.9	9	12	B
31-0666-00	Unnamed	Big Fork River	09030006	DEEP	128	3,160	NLF	0.04	12.0	3	3.78			11.0	18	9	B
31-0670-00	Big Ole	Big Fork River	09030006	DEEP	217	4,275	NLF	0.02	7.4	2	5.30			5.4	44	26	B
31-0671-00	Big Island	Big Fork River	09030006	DEEP	243	899	NLF	0.03	17.0	5	4.31	No Evidence of Trend		11.0	38	35	B
31-0687-00	Johnson	Big Fork River	09030006	DEEP	304	11,199	NLF	0.03	9.4	2	3.56	No Evidence of Trend		6.7	150	28	B
31-0696-00	Horseshoe	Big Fork River	09030006	DEEP	260	613	NLF	0.03	19.0	1	3.05	Improving Trend	Weak evidence for possible trend	14.9	19	22	B
31-0706-00	Mike	Big Fork River	09030006	DEEP	109	1,221	NLF	0.04	15.2	3	2.32			12.6	15	18	B
31-0727-00	Grass	Big Fork River	09030006	DEEP	120	566	NLF	0.02	13.3	2	3.36			9.6	13	29	B
31-0758-00	Little Bowstring	Big Fork River	09030006	DEEP	327	6,687	NLF	0.09	23.7	4	2.32	No Evidence of Trend		19.3	149	18	B
31-0773-00	Maple	Big Fork River	09030006	DEEP	255	5,066	NLF	0.03	8.2	2	3.52			4.4	103	46	B
31-0778-00	Little Too Much	Big Fork River	09030006	DEEP	79	8,051	NLF	0.08	10.0	2	4.05			6.2	119	39	B
31-0779-00	Little Turtle	Big Fork River	09030006	DEEP	492	8,051	NLF	0.08	20.2	2	2.16	Improving Trend	Strong evidence for trend	14.2	244	29	B
31-0781-00	Long	Big Fork River	09030006	DEEP	155	1,063	NLF	0.02	8.3	2	3.89			8.0	2	4	B
31-0789-00	Spring	Big Fork River	09030006	DEEP	132	3,875	NLF	0.05	12.5	3	3.36			11.0	28	12	B
31-0793-00	Big Too Much	Big Fork River	09030006	DEEP	292	4,742	NLF	0.02	10.3	2	4.07			8.1	59	20	B
31-0798-00	East	Big Fork River	09030006	DEEP	111	954	NLF	0.03	18.2	2	3.08			11.1	43	40	B
31-0803-00	Trestle	Big Fork River	09030006	DEEP	111	811	NLF	0.04	14.8	2	3.63			10.4	23	30	B
31-0829-00	Cedar	Big Fork River	09030006	DEEP	178	1,915	NLF	0.04	12.6	3	3.43			10.4	26	17	B
31-0843-00	Whitefish	Big Fork River	09030006	DEEP	564	9,711	NLF	0.04	13.4	2	2.53			10.7	137	19	B
31-0845-00	Clear	Big Fork River	09030006	DEEP	140	287	NMW	0.03	13.5	2	4.09			11.1	6	18	B
31-0877-00	Natures	Big Fork River	09030006	SHALLOW	2,250	95,652	NLF	0.04	30.4	2	1.45	No Evidence of Trend		28.1	656	7	B
31-0898-00	Moose	Big Fork River	09030006	DEEP	412	5,612	NLF	0.05	14.9	2	4.49			14.4	18	4	B
31-0188-00	Tank	Big Fork River	09030006	DEEP	38	5,095	NLF	0.02	18.5	2	6.90			15.2	69	19	C
31-0196-00	Poplar	Big Fork River	09030006	DEEP	112	2,335	NLF	0.01	8.7	2	4.20			7.5	16	14	C
31-0311-00	Erskine	Big Fork River	09030006	DEEP	40	5,244	NLF	0.02	14.0	1	4.97			11.0	64	22	C
31-0314-00	Duck	Big Fork River	09030006	DEEP	13	5,244	NLF	0.02	10.0	1	2.57			7.9	36	23	C
31-0317-00	Larson	Big Fork River	09030006	DEEP	208	1,063	NLF	0.01	7.1	5	6.52			4.6	23	34	C
31-0318-00	Coon	Big Fork River	09030006	DEEP	345	1,977	NLF	0.00	18.0	2	1.45			17.1	12	5	C
31-0328-00	Elbow	Big Fork River	09030006	DEEP	32	35,015	NLF	0.04	16.0	1	3.00			12.6	318	23	C
31-0329-00	Unnamed (Little Horseshoe)	Big Fork River	09030006	DEEP	12	24,617	NLF	0.02	50.0	1	1.98			39.3	713	23	C
31-0334-00	Deer	Big Fork River	09030006	DEEP	1,855	24,617	NLF	0.02	21.7	8	2.82	No Evidence of Trend		14.5	827	31	C
31-0416-00	Black Island	Big Fork River	09030006	DEEP	117	1,668	NLF	0.02	17.8	7	2.91	No Evidence of Trend		12.7	46	29	C

Lake ID	Lake Name	Watershed	HUC-8	Depth Type	Lake Area (acres)	Watershed Acres	Ecoregion	Disturbed Land use (%)	Mean TP (µg/L)	Years TP	Mean Secchi (ft)	Presence of Trend	Trend Slope Description	Target TP (µg/L)	Load Reduction to Meet Target	Percent Load Reduction to Meet Target	Priority
31-0417-00	Nose	Big Fork River	09030006	DEEP	114	956	NLF	0.01	15.5	6	3.89			10.1	33	35	C
31-0451-00	Three Island	Big Fork River	09030006	DEEP	68	956	NLF	0.01	13.4	2	2.40			11.6	10	14	C
31-0452-00	Gunn	Big Fork River	09030006	DEEP	108	4,216	NLF	0.02	12.5	2	3.94	No Evidence of Trend		12.0	10	4	C
31-0455-00	Mink	Big Fork River	09030006	DEEP	111	6,311	NLF	0.03	8.2	3	3.97			5.2	87	37	C
31-0456-00	Alice	Big Fork River	09030006	DEEP	59	6,311	NLF	0.03	7.0	1	5.43			5.5	41	22	C
31-0459-00	Little East	Big Fork River	09030006	DEEP	65	9,790	NLF	0.03	9.3	2	4.52			6.7	108	27	C
31-0464-00	Oar	Big Fork River	09030006	DEEP	38	6,311	NLF	0.03	6.6	2	4.35			3.7	71	46	C
31-0470-00	Unnamed (Nickel)	Big Fork River	09030006	DEEP	14	2,026	NLF	0.03	10.1	3	4.72			4.8	40	56	C
31-0478-00	Pine	Big Fork River	09030006	DEEP	74	12,867	NLF	0.03	13.1	3	3.08			11.3	85	14	C
31-0480-00	Gunn	Big Fork River	09030006	DEEP	382	10,719	NLF	0.02	24.1	3	3.36			6.6	879	71	C
31-0481-00	Highland	Big Fork River	09030006	DEEP	105	2,572	NLF	0.02	15.0	3	2.97			9.7	66	36	C
31-0482-00	Doe	Big Fork River	09030006	DEEP	16	2,006	NLF	0.02	17.0	1	1.15			13.4	26	24	C
31-0487-00	Lum	Big Fork River	09030006	DEEP	51	2,006	NLF	0.02	14.2	2	2.39			12.7	14	11	C
31-0502-00	Slauson	Big Fork River	09030006	DEEP	106	31,909	NLF	0.03	11.3	3	3.30			9.1	220	20	C
31-0507-00	Marie	Big Fork River	09030006	DEEP	51	17,656	NLF	0.03	12.4	3	2.85			10.4	117	17	C
31-0511-00	Bass	Big Fork River	09030006	DEEP	64	17,656	NLF	0.03	16.0	1	3.13			12.6	206	22	C
31-0512-00	Erickson	Big Fork River	09030006	DEEP	29	36,794	NLF	0.03	12.7	3	3.18			11.5	121	10	C
31-0513-00	Gale	Big Fork River	09030006	DEEP	80	17,656	NLF	0.03	8.2	2	4.59			5.3	180	35	C
31-0522-00	La Barge	Big Fork River	09030006	DEEP	59	9,790	NLF	0.03	18.0	3	1.52			15.6	83	14	C
31-0528-00	Round	Big Fork River	09030006	DEEP	55	605,855	NLF	0.04	15.9	2	3.09			13.9	2174	13	C
31-0540-00	Clubhouse	Big Fork River	09030006	DEEP	265	17,596	NLF	0.03	13.9	4	4.54	No Evidence of Trend		10.6	258	23	C
31-0541-00	Little Bass	Big Fork River	09030006	DEEP	19	17,596	NLF	0.03	19.0	1	3.70			14.9	175	24	C
31-0544-00	Cameron	Big Fork River	09030006	DEEP	64	34,916	NLF	0.03	11.2	2	3.35			8.5	257	25	C
31-0622-00	Dead Horse	Big Fork River	09030006	DEEP	105	2,669	NLF	0.05	22.3	3	3.00			17.4	64	23	C
31-0623-00	Boy	Big Fork River	09030006	DEEP	43	3,956	NLF	0.06	19.1	3	4.49	Improving Trend	Evidence for trend	12.0	111	39	C
31-0649-00	Dock	Big Fork River	09030006	DEEP	30	1,322	NLF	0.03	11.5	2	3.96			11.0	3	4	C
31-0654-00	Burns	Big Fork River	09030006	DEEP	181	1,584	NLF	0.02	15.6	3	4.83			7.2	98	52	C
31-0660-00	Little Ranier	Big Fork River	09030006	DEEP	53	15,101	NLF	0.03	13.7	3	4.41			10.6	159	23	C
31-0663-00	Forest	Big Fork River	09030006	DEEP	39	11,199	NLF	0.03	35.0	1	3.23			27.5	271	23	C
31-0664-00	Ranier	Big Fork River	09030006	DEEP	90	31,041	NLF	0.05	16.2	4	5.60	No Evidence of Trend		6.5	976	61	C
31-0665-00	Little North Star	Big Fork River	09030006	DEEP	55	3,160	NLF	0.04	12.4	4	3.42			10.7	22	14	C
31-0679-00	Little Smith	Big Fork River	09030006	DEEP	40	2,528	NLF	0.03	18.0	1				14.1	43	22	C
31-0686-00	Bevo	Big Fork River	09030006	DEEP	64	2,276	NLF	0.02	15.1	3	3.51			10.7	48	29	C
31-0692-00	Lauchoh	Big Fork River	09030006	DEEP	43	83,378	NLF	0.03	13.3	2	2.94			2.6	2048	82	C
31-0704-00	Batson	Big Fork River	09030006	DEEP	114	14,468	NLF	0.03	23.9	3	3.32			11.5	705	52	C

Lake ID	Lake Name	Watershed	HUC-8	Depth Type	Lake Area (acres)	Watershed Acres	Ecoregion	Disturbed Land use (%)	Mean TP (µg/L)	Years TP	Mean Secchi (ft)	Presence of Trend	Trend Slope Description	Target TP (µg/L)	Load Reduction to Meet Target	Percent Load Reduction to Meet Target	Priority
31-0705-00	Lundeen	Big Fork River	09030006	DEEP	85	14,468	NLF	0.03	16.6	3	2.70			11.5	251	32	C
31-0713-00	Bustic	Big Fork River	09030006	DEEP	84	410,341	NLF	0.04	10.8	2	3.52			8.9	1446	18	C
31-0764-00	Jingo	Big Fork River	09030006	DEEP	79	83,378	NLF	0.03	11.6	2	4.85			6.5	1171	44	C
31-0768-00	Big Rose	Big Fork River	09030006	DEEP	73	2,478	NLF	0.03	12.2	2	2.76			5.2	78	59	C
31-0774-00	Elbow	Big Fork River	09030006	SHALLOW	69	15,101	NLF	0.03	11.2	2	1.94			10.4	33	7	C
31-0788-00	La Croix	Big Fork River	09030006	DEEP	142	2,926	NLF	0.01	10.7	3	3.50			7.7	45	28	C
31-0791-00	Peterson	Big Fork River	09030006	DEEP	163	1,604	NLF	0.02	18.9	2	2.84	No Evidence of Trend		16.8	19	11	C
31-0802-00	Lac a Roy	Big Fork River	09030006	DEEP	90	387,283	NLF	0.04	12.7	3	3.69			10.8	1414	16	C
31-0804-00	Holland	Big Fork River	09030006	DEEP	27	4,791	NLF	0.02	9.5	2	5.73			6.4	55	35	C
31-0805-00	Arrowhead	Big Fork River	09030006	DEEP	138	778	NLF	0.01	15.7	2	3.80			13.0	15	18	C
31-0808-00	Little Round	Big Fork River	09030006	SHALLOW	26	387,283	NLF	0.04	21.0	2	2.02			17.6	1859	18	C
31-0809-00	Crooked	Big Fork River	09030006	DEEP	104	1,357	NLF	0.01	13.5	2	4.30			12.6	7	6	C
31-0824-00	Portage	Big Fork River	09030006	DEEP	714	155,382	NLF	0.04	21.0	2	3.42			10.6	3639	51	C
31-0826-00	Sand	Big Fork River	09030006	DEEP	3,575	155,382	NLF	0.04	22.8	8	2.72	No Evidence of Trend		18.8	2445	15	C
31-0832-00	Rush Island	Big Fork River	09030006	DEEP	297	5,478	NLF	0.03	20.4	3	2.59	No Evidence of Trend		14.1	175	30	C
31-0834-00	Bird's Eye	Big Fork River	09030006	DEEP	80	6,086	NLF	0.03	10.4	1	3.72			8.2	55	22	C
31-0837-00	Noma	Big Fork River	09030006	DEEP	60	343,086	NMW	0.04	14.2	3	3.67			13.7	345	4	C
31-0848-00	Wirt	Big Fork River	09030006	DEEP	36	12,323	NMW	0.03	22.0	1	0.90			17.3	181	23	C
31-0853-00	Little Sand	Big Fork River	09030006	DEEP	353	159,025	NLF	0.04	19.0	3	2.38			16.3	1123	14	C
31-0876-00	Rice	Big Fork River	09030006	SHALLOW	775	162,610	NLF	0.04	23.0	1	0.76			18.1	1991	21	C
31-0882-00	Dora	Big Fork River	09030006	DEEP	430	281,470	NLF	0.04	40.1	6	2.73	No Evidence of Trend		36.0	2716	10	C
31-0886-00	Eel	Big Fork River	09030006	DEEP	37	6,276	NLF	0.01	13.5	2	2.72			11.1	55	18	C
31-0889-00	Glove	Big Fork River	09030006	SHALLOW	18	18,763	NLF	0.07	28.2	3	1.18			24.3	180	16	C
31-0904-00	Dunbar	Big Fork River	09030006	DEEP	268	16,269	NLF	0.06	33.2	3	1.61			28.2	319	15	C
31-0911-00	Hamrey	Big Fork River	09030006	DEEP	67	39,646	NLF	0.04	13.7	2	3.46			8.7	611	37	C
31-0912-00	Wagner	Big Fork River	09030006	DEEP	73	14,453	NLF	0.02	17.2	2	1.92			11.7	298	32	C
31-0917-00	Hendrickson	Big Fork River	09030006	DEEP	103	14,453	NLF	0.02	21.0	1	2.30			16.5	205	23	C