Mackinaw River Watershed
Total Maximum Daily Load

Stage 3 Report for Public Review

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Acronyms and Abbreviations

AADG	Animal Agricultural Discussion Group
AFOs	animal feeding operations
AWQMN	Ambient Water Quality Monitoring Network
BMP	best management practice
CAFO	concentrated animal feeding operation
CSA	critical source areas
CWA	Clean Water Act
DAF	design average flow
DMF	design maximum flow
HSG	hydrologic soil group
IAH	Illinois Agronomy Handbook
IDNR	Illinois Department of Natural Resources
IDOA	Illinois Department of Agriculture
IEPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
LDC	load duration curve
MCL	maximum contaminant level
MOS	margin of safety
MS4	municipal separate storm sewer system
MST	microbial source tracking
NOAA	National Oceanic and Atmospheric Administration
NLRS	Nutrient Loss Reduction Strategy
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
RC	reserve capacity
STP	sewage treatment plant
STEPL	Spreadsheet Tool for the Estimation of Pollutant Load
TMDL	total maximum daily load
TSS	total suspended solids
USDA	U.S. Department of Agriculture
U.S. EPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WLA	wasteload allocation
WQS	water quality standards
WTP	water treatment plant
WWTP	wastewater treatment plant

Units of Measure

MGD	million gallons per day
mg/L	milligram per liter
org./100 mL	organisms per 100 milliliters

Executive Summary

The Clean Water Act and U.S. Environmental Protection Agency (U.S. EPA) regulations require that Total Maximum Daily Loads (TMDLs) be developed for waters that do not support their designated uses. In simple terms, a TMDL is a plan to attain and maintain water quality standards (WQS) in waters that are not currently meeting them.

This TMDL study addresses approximately 1,149 square miles in the Mackinaw River watershed located in central Illinois. Two stream segments within the project are receiving TMDLs. One segment receives a fecal coliform TMDL, and one segment receives a nitrate TMDL. The sources of pollutants in the watershed include National Pollutant Discharge Elimination System (NPDES) permitted facilities such as wastewater treatment facilities. In addition, nonpoint pollution resulting from several key sources including stormwater runoff, onsite wastewater treatment systems, and animal feeding operations.

A TMDL identifies the total allowable load that a waterbody can assimilate (the loading capacity) and still meet WQS or targets. The loading capacity for each stream is determined using a load duration curve framework. TMDLs are presented in Section 7. A TMDL is equal to the loading capacity for a waterbody, and that loading capacity is distributed among load allocations to nonpoint and background sources and wasteload allocations to point sources. The required pollutant reductions vary between 44 and 55 percent, depending on the waterbody and pollutant.

An implementation plan is provided in Section 8 which includes potential implementation activities to address sources of pollutants. This plan, when combined with the entire TMDL study, is provided to meet U.S. EPA's Nine Minimum Elements for CWA section 319 funding requirements and includes an analysis of critical areas, extent of needed implementation, schedule, milestones, partners, and estimated costs.

The State of Illinois uses a three-stage approach to develop TMDLs:

> **Stage 1** – Watershed characterization, historical dataset evaluation, data analysis, methodology selection, data gap identification
> **Stage 2** – Data collection to fill in data gaps, if necessary
> **Stage 3** – Model calibration, TMDL scenarios, and implementation plan

This final report represents a compilation of Stage 1, 2, and 3.

1. Introduction

The Clean Water Act (CWA) and U.S. Environmental Protection Agency (U.S. EPA) regulations require that Total Maximum Daily Loads (TMDLs) be developed for waters that do not support their designated uses. In simple terms, a TMDL is a plan to attain and maintain water quality standards (WQS) in waters that are not currently meeting them.

This TMDL study addresses the approximately 1,149 square mile Mackinaw River watershed located in central Illinois (Figure 1). Several waters in the Mackinaw River watershed have been placed on the State of Illinois 303(d) list and require the development of a TMDL. This project addresses two impaired segments along the mainstem of the Mackinaw River.

1.1 TMDL Development Process

The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and instream conditions. This allowable loading represents the maximum quantity of the pollutant that the waterbody can receive without exceeding WQS. The TMDL also includes a margin of safety (MOS), which reflects uncertainty as well as the effects of seasonal variation, and a reserve capacity (RC) to account for future loading. By following the TMDL process, states can establish water quality-based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (U.S. EPA 1991). The Illinois Environmental Protection Agency (IEPA) will be working with stakeholders to implement the necessary controls to improve water quality in the impaired waterbodies and meet WQS. It should be noted that the controls for nonpoint sources (e.g., agriculture) will be strictly voluntary.

The State of Illinois uses a three-stage approach to develop TMDLs:

Stage 1 – Watershed characterization, historical dataset evaluation, data analysis, methodology selection, data gap identification
Stage 2 – Data collection to fill in data gaps, if necessary
Stage 3 – Model calibration, TMDL scenarios, and implementation plan

The full Stage 1 Report is included in Appendix A and includes a summary of the water quality impairments, watershed characterization, pollutant source summary, analysis of water quality data, and information on the approach taken to develop TMDLs. Relevant information from the Stage 1 Report has been included in this full Stage 3 document.

As part of the Stage 2 TMDL development process, additional monitoring was gathered by Illinois State Water Survey on behalf of the IEPA in 2019; Appendix B includes data collected as part of Stage 2. This Stage 3 report includes a brief summary of Stage 2 data collection efforts and the outcome of those efforts.

An implementation plan is also provided that addresses fecal coliform and nitrate in the watershed. This plan, when combined with the entire TMDL study, is provided to meet U.S. EPA's Nine Minimum Elements for CWA section 319 funding requirements and includes an analysis of critical areas, extent of needed implementation, schedule, milestones, partners, and estimated costs.

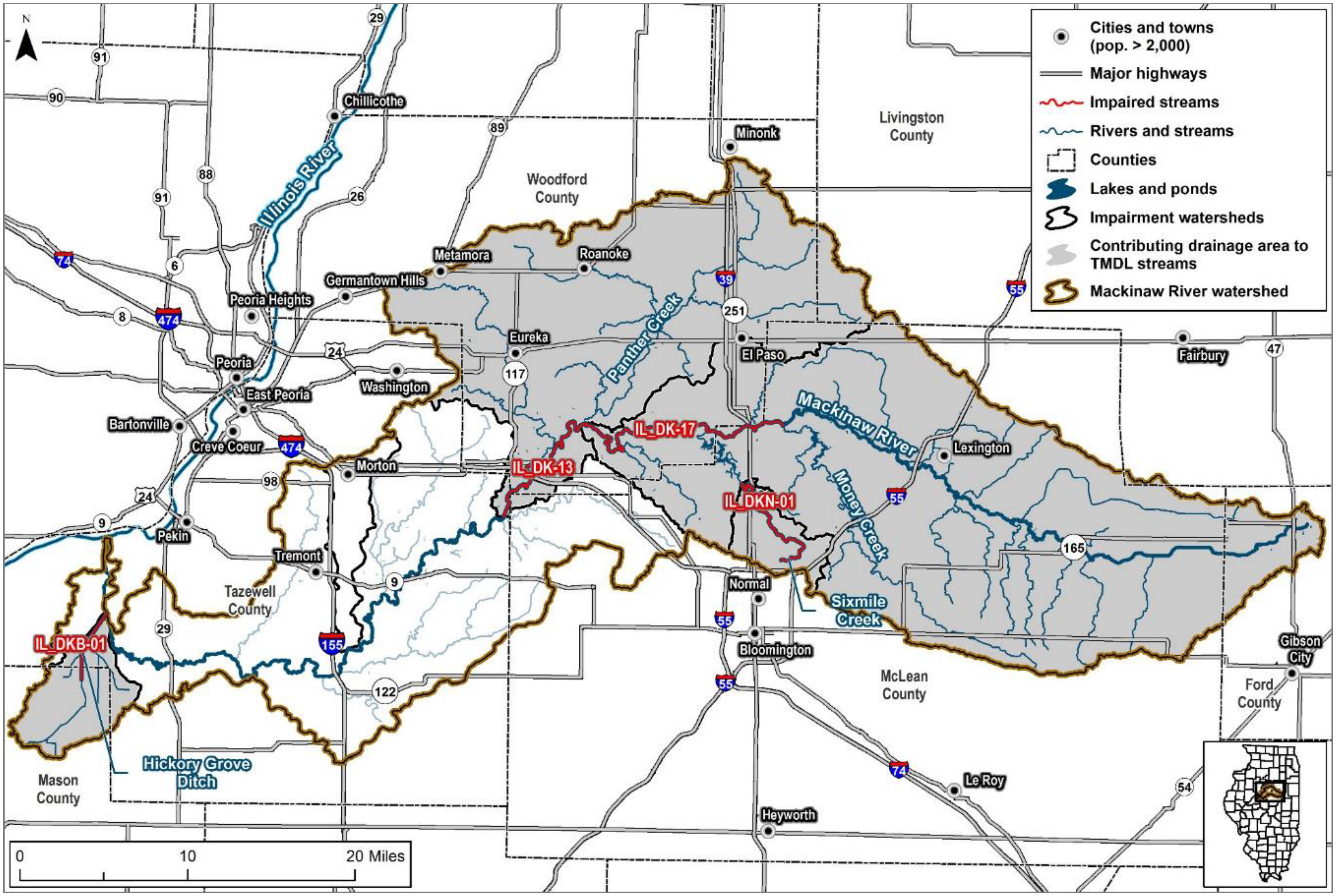

Figure 1. Mackinaw River watershed, TMDL project area.

Note: IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

1.2 Water Quality Impairments

Two TMDLs were developed to address two segments along the mainstem of the Mackinaw River (Table 1 and Figure 1). One segment of Hickory Grove Ditch (IL_DKB-01), impaired for its aquatic life use, is recommended for delisting manganese and recategorizing low dissolved oxygen. See Appendix C for the delistings and recategorization justifications. There are other impaired waters in the Mackinaw River watershed that are not being addressed by this TMDL study.

Table 1. Impairments in the Mackinaw River watershed addressed in this TMDL report

Name	Segment ID	Impaired Designated Uses	Cause(s)	Action
Hickory Grove Ditch	IL_DKB-01	Aquatic Life	Dissolved Oxygen	Recommend recategorization
			Manganese	Recommend delisting
Mackinaw River	IL_DK-13	Primary Contact Recreation	**Fecal coliform**	**TMDL (fecal coliform)**
	IL_DK-17	Public and Food Processing Water Supply	**Nitrate (as Nitrogen)**	**TMDL (nitrate)**

TMDLs presented in this report are **bolded in yellow**.

2. Water Quality Standards and TMDL Endpoints

This section presents information on the WQS that are used for TMDL endpoints. WQS are designed to protect beneficial uses. The authority to designate beneficial uses and adopt WQS is granted through Title 35 of the Illinois Administrative Code. Designated uses to be protected in surface waters of the state are defined under Section 303, and WQS are designated under Section 302 (Water Quality Standards). Designated uses and WQS are discussed below.

2.1 Designated Uses

IEPA uses rules and regulations adopted by the Illinois Pollution Control Board (IPCB) to assess the designated use support for Illinois waterbodies. The following are the use support designations provided by the IPCB that apply to waterbodies in the Mackinaw River watershed:

General Use Standards – These standards protect for aquatic life, wildlife, agricultural uses, primary contact (where physical configuration of the waterbody permits it, any recreational or other water use in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing), secondary contact (any recreational or other water use in which contact with the water is either incidental or accidental and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, commercial and recreational boating, and any limited contact incident to shoreline activity), and most industrial uses. These standards are also designed to ensure the aesthetic quality of the state's aquatic environment.

Public and food processing water supply standards – These standards are cumulative with the general use standards and apply to waters of the state at any point at which water is withdrawn for treatment and distribution as a potable supply to the public or for food processing.

2.2 Water Quality Standards

Environmental regulations for the State of Illinois are contained in the Illinois Administrative Code, Title 35. Specifically, Title 35, Part(s) 302 and 611 contain WQS promulgated by the IPCB for general use and public and food processing water supply, respectively. This section presents the standards applicable to impairments in the study area. WQS and TMDL endpoints to be used for TMDL development are listed in Table 2.

Table 2. Summary of water quality standards for the Mackinaw River watershed

Parameter	Units	Water Quality Standard
General Use		
Fecal Coliform [a]	#/100 mL	400 in <10% of samples [b]
		Geometric mean < 200 [c]
Public and Food Processing Water Supply		
Nitrogen, Nitrate	mg/L	10 - maximum contaminant level (MCL)

a. Fecal coliform standards are applicable for the recreation season only (May through October).
b. Standard shall not be exceeded by more than 10% of the samples collected during a 30-day period.
c. Geometric mean based on minimum of 5 samples taken over not more than a 30-day period.

2.2.1 General Use Standards

According to Illinois WQS, primary contact means ...*any recreational or other water use in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing* (35 Ill. Adm. Code 301.355). The assessment of primary *contact* use is based on fecal coliform bacteria data. The

General Use WQS for fecal coliform bacteria specifies that during the months of May through October, based on a minimum of five samples taken over not more than a 30-day period, fecal coliform bacteria counts shall not exceed a geometric mean of 200 organisms per 100 milliliters (org./100 mL), nor shall more than 10 percent of the samples during any 30-day period exceed 400 org./100 mL (35 Ill. Adm. Code 302.209). This standard protects primary contact use of Illinois waters by humans.

Due to limited state resources, fecal coliform bacteria is not normally sampled at a frequency necessary to apply the General Use standard, i.e., at least five times per month during May through October, and very little data available from others are collected at the required frequency. Therefore, assessment guidelines are based on application of the standard when sufficient data are available to determine standard exceedances; but, in most cases, attainment of primary contact use is based on a broader methodology intended to assess the likelihood that the General Use standard is being attained.

To assess primary contact use, IEPA uses all fecal coliform bacteria from water samples collected in May through October, over the most recent five-year period (i.e., 2012 through 2016 for this report). Based on these water samples, geometric means and individual measurements of fecal coliform bacteria are compared to the concentration thresholds in Table 3 and Table 4. To apply the guidelines, the geometric mean of fecal coliform bacteria concentration is calculated from the entire set of May through October water samples, across the five years. No more than 10 percent of all the samples may exceed 400 org./100 mL for a water body to be considered Fully Supporting.

Table 3. Guidelines for Assessing Primary Contact Use in Illinois Streams and Inland Lakes

Degree of Use Support	Guidelines
Fully Supporting	No exceedances of the fecal coliform bacteria standard in the last five years, and the geometric mean of all fecal coliform bacteria observations in the last five years ≤200 cfu/100 ml, and ≤10% of all observations in the last five years exceed 400 cfu/100 ml.
Not Supporting	At least one exceedance of the fecal coliform bacteria standard in the last five years (when sufficient data is available to assess the standard); or, The geometric mean of all fecal coliform bacteria observations in the last five years >200 cfu/100 ml, or >10% of all observations in the last five years exceed 400 cfu/100 ml.

Source: IEPA 2021 (Table C-16).

Table 4. Guidelines for Identifying Potential Causes of Impairment of Primary Contact Use in Illinois Streams and Freshwater Lakes

Potential Cause	Basis for Identifying Cause - Numeric Standard
Fecal coliform	When *Primary Contact* Use is assessed as Not Supporting based on the criteria in Table C-16, Fecal Coliform is listed as the cause.

Source: IEPA 2021 (Table C-17).

Aquatic life use assessments in streams are typically based on the interpretation of biological information, physicochemical water data and physical-habitat information from the Intensive Basin Survey, Ambient Water Quality Monitoring Network (AWQMN) or Facility-Related Stream Survey programs. The primary biological measures used are the fish Index of Biotic Integrity (Karr et al. 1986; Smogor 2000, 2005), the macroinvertebrate Index of Biotic Integrity (Tetra Tech 2004) and the Macroinvertebrate Biotic Index (MBI; IEPA 1994). Physical habitat information used in assessments includes quantitative or qualitative measures of stream bottom composition and qualitative descriptors of channel and riparian conditions. Physicochemical water data used include measures of conventional parameters (e.g., dissolved oxygen, pH and temperature), priority pollutants, non-priority pollutants, and other pollutants (U.S. EPA 2002 and www.epa.gov/waterscience/criteria/wqcriteria.html). In a minority of streams for which biological information is unavailable, aquatic life use assessments are based primarily on physicochemical water data.

When a stream segment is determined to be Not Supporting aquatic life use, generally one exceedance of an applicable Illinois WQS (related to the protection of aquatic life) results in identifying the parameter as a potential cause of impairment. Additional guidelines used to determine potential causes of impairment include site-specific standards (35 Ill. Adm. Code 303, Subpart C), or adjusted standards (published in the IPCB's Environmental Register at http://www.ipcb.state.il.us/ecll/environmentalregister.asp).

2.2.2 Public and Food Processing Water Supply Use Standards

Attainment of public and food processing water supply use is assessed only in waters in which the use is currently occurring, as evidenced by the presence of an active public-water supply intake. The assessment of public and food processing water supply use is based on conditions in both untreated and treated water. By incorporating data through programs related to both the federal CWA and the federal Safe Drinking Water Act, IEPA believes that these guidelines provide a comprehensive assessment of public and food processing water supply use. Assessments of public and food processing water supply use recognize that characteristics and concentrations of substances in Illinois surface waters can vary and that a single assessment guideline may not protect sufficiently in all situations. Using multiple assessment guidelines helps improve the reliability of these assessments. When applying these assessment guidelines, IEPA also considers the water-quality substance, the level of treatment available for that substance, and the monitoring frequency of that substance in the untreated water. Table 5 includes the assessment guidelines for waters with public and food processing water supply designated uses.

Table 5. Guidelines for assessing public water supply in waters of the State

Degree of Use Support	Guidelines
Fully Supporting	For each substance in untreated water(1), for the most-recent three years of readily available data or equivalent dataset, a) ≤ 10% of observations exceed an applicable Public and Food Processing Water Supply Standard(2); and b) for which the concentration is not readily reducible by conventional treatment, i) no observation exceeds by at least fourfold the Maximum Contaminant Level threshold concentration(3) for that substance; and ii) no quarterly average concentration exceeds the Maximum Contaminant Level threshold concentration(3) for that substance; and (4), For each substance in treated water, no violation of an applicable Maximum Contaminant Level(3) occurs during the most recent four years of readily available data.
Not Supporting	For any single substance in untreated water(1),for the most-recent three years of readily available data or equivalent dataset, a) > 10% of observations exceed a Public and Food Processing Water Supply Standard(2); or b) for which the concentration is not readily reducible by conventional treatment, i) at least one observation exceeds by at least fourfold the Maximum Contaminant Level threshold concentration(3) for that substance; or ii) the quarterly average concentration exceeds the Maximum Contaminant Level threshold concentration(3) for that substance; or, For any single substance in treated water, at least one violation of an applicable Maximum Contaminant Level(3) occurs during the most recent four years of readily available data. or, Closure to use as a drinking-water resource (cannot be treated to allow for use).

Source: IEPA 2021 (Table C-21).
(1). Includes only the untreated-water results that were available in the primary computer database at the time data were compiled for these assessments
(2). 35 I11. Adm. Code 302.304, 302.306 (https://pcb.illinois.gov/SLR/IPCBandIEPAEnvironmentalRegulationsTitle35).
(3). 35 I11. Adm. Code 611.300, 611.301, 611.310, 611.311, 611.325.
(4). Some waters were assessed as Fully Supporting based on treated-water data only.

One of the assessment guidelines for untreated water relies on a frequency-of-exceedance threshold (10 percent) because this threshold represents the true risk of impairment better than does a single exceedance of a water quality criterion. Assessment guidelines also recognize situations in which water treatment that consists only of "*...coagulation, sedimentation, filtration, storage and chlorination, or other equivalent treatment processes*" (35 Ill. Adm. Code 302.303; hereafter called "conventional treatment") may be insufficient for reducing potentially harmful levels of some substances. To determine if a Maximum Contaminant Level (MCL) violation in treated water would likely occur if treatment additional to conventional treatment were not applied (see 35 Ill. Adm. Code 302.305), the concentration of the potentially harmful substance in untreated water is examined and compared to the MCL threshold concentration. If the concentration in untreated water exceeds an MCL-related threshold concentration, then an MCL violation could reasonably be expected in the absence of additional treatment.

Compliance with an MCL for treated water is based on a running 4-quarter (i.e., annual) average, calculated quarterly, of samples collected at least once per quarter (Jan.-Mar., Apr.-Jun., Jul.-Sep., and

Oct.-Dec.). However, for some untreated-water intake locations sampling occurs less frequently than once per quarter; therefore, statistics comparable to quarterly averages or running 4-quarter averages cannot be determined for untreated water. Rather, for substances not known to vary regularly in concentration in Illinois surface waters (untreated) throughout the year, a simple arithmetic average concentration of all available results is used to compare to the MCL threshold. For substances known to vary regularly in concentration in surface waters during a typical year (e.g., nitrate), average concentrations in the relevant sub-annual (e.g., quarterly) periods are used.

2.3 TMDL Endpoints

Two fecal coliform TMDLs were developed for the impaired segment of the Mackinaw River (IL_DK-13). One TMDL was set to a target of 200 cfu/100 mL, which is the value of the geometric mean standard, and one TMDL was set to a target of 400 cfu/100mL, which is the value of the instantaneous standard.

A nitrate TMDL was developed for the impaired segment of the Mackinaw River (IL_DK-17), and the target was set to 10 mg/L as nitrogen, which is the MCL.

3. Watershed Characterization

The Mackinaw River watershed is located in central Illinois (Figure 1). The headwaters for the watershed begin north of Gibson City, IL. The Mackinaw River then flows just north of Bloomington, IL before joining the Illinois River south of Peoria, IL. The watershed covers 1,149 square miles; major tributaries of the river include Henline Creek, Money Creek, Sixmile Creek, Panther Creek, Mud Creek, Prairie Creek, Little Mackinaw River, and Dillon Creek.

3.1 Jurisdictions and Population

Counties with land located in the watershed area include Ford, Livingston, Mason, McLean, Tazewell, and Woodford. Portions of the cities of Bloomington and Normal are located along the south-central boundary of the watershed and Morton Village in the outskirts of Peoria is located almost entirely in the watershed at the headwaters of Prairie Creek. Bloomington, Normal and Peoria are major government units with jurisdiction in the Mackinaw River watershed area. Populations are area weighted to the watershed in Table 6. The McLean County and Tazewell County population numbers were adjusted to only account for the portion of the cities of Bloomington and Normal and Peoria in the watershed, respectively.

Table 6. Area weighted county populations in watershed

County	2000	2010	Percent Change
Ford	299	296	-1%
Livingston	479	471	-2%
Mason	326	298	-9%
McLean	20,702	21,445	4%
Tazewell	13,186	13,518	3%
Woodford	9,774	10,654	9%
TOTAL	***44,766***	***46,682***	***4%***

Source: U.S. Census Bureau

3.2 Climate

Climate data are available from the National Oceanic and Atmospheric Administration (NOAA) Global Historical Climatology Network Database; Station USC00116200 is located in Normal, IL along the south-central boundary of the watershed. Daily data from 1977–2016 for temperature, precipitation and snowfall are summarized in Table 7. In general, the climate of the region is continental with hot, humid summers and cold winters. The average high winter temperature was 36 °F and the average high summer temperature was 85°F. The annual average precipitation at Normal was approximately 38 inches, including approximately 22 inches of snowfall. In general, larger volumes of precipitation tend to occur between the months of April and September.

Table 7. Climate summary for Normal (1977–2016)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High °F	33	37	50	63	74	84	86	85	79	66	51	37
Average Low °F	16	19	29	40	51	61	65	62	54	43	32	21
Mean Temperature °F	24	27	38	49	61	70	73	71	63	52	40	28
Average Precipitation (in)	2.0	1.9	2.6	3.8	4.4	4.0	4.1	3.9	3.2	3.1	3.0	2.4
Average Snowfall (in)	6.9	6.6	2.2	0.6	0.0	0.0	0.0	0.0	0.0	0	0.6	4.9

Source: NOAA Global Historical Climatology Network Database

3.3 Land Use and Land Cover

Land use in the watershed is heavily influenced by agriculture (Figure 2). Urban area is located near the cities of Normal and Morton and several small towns in the watershed. Land use in the watershed includes cultivated crops and pasture/hay (approximately 85%), forest (approximately 6%), and urban (approximately 8%). Corn and soybeans are the most common crops, with much smaller areas of winter wheat, alfalfa and other crops. Table 8 presents area and percent by land cover type as provided in the 2011 National Land Cover Database (MRLC 2015).

Table 8. Watershed land use summary

Land Use / Land Cover Category	Acres	Percentage
Cultivated Crops	594,603	80.9%
Deciduous Forest	42,519	5.8%
Hay/Pasture	30,178	4.1%
Developed, Low Intensity	27,302	3.7%
Developed, Open Space	26,830	3.6%
Developed, Medium Intensity	5,917	0.8%
Open Water	3,054	0.4%
Woody Wetlands	1,869	0.3%
Herbaceous	1,480	0.2%
Developed, High Intensity	1,382	0.2%
Barren Land	189	<0.1%
Emergent Herbaceous Wetlands	52	<0.1%
Evergreen Forest	23	<0.1%
Shrub/Scrub	19	<0.1%

Source: 2011 National Land Cover Database

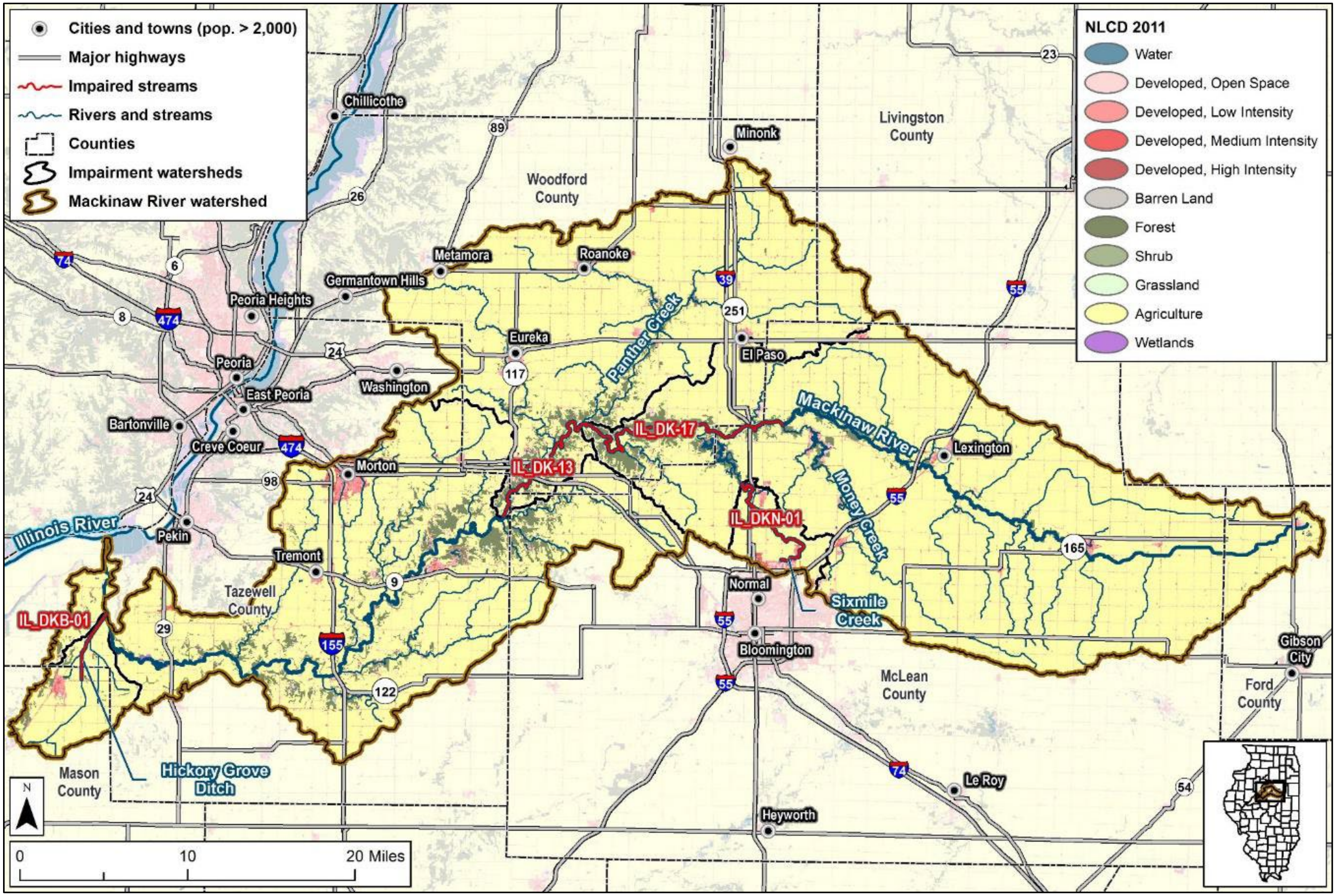

Figure 2. Mackinaw River watershed land cover (2011 National Land Cover Database).

Note: IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

3.4 Topography

Topography is an important factor in watershed management because stream types, precipitation, and soil types can vary dramatically by slope and elevation. The Mackinaw River watershed varies in elevation from 436 to 956 feet above mean sea level (Figure 3). The Mackinaw River water elevation varies from 815 feet to 645 feet above mean sea level and is 63 miles long upstream of the inlet of Panther Creek and water elevation varies from 645 feet to 440 feet above mean sea level and is 66 miles long from Panther Creek to the inlet to the Illinois River, resulting in an upper watershed stream gradient of 2.6 feet per mile and lower watershed stream gradient of 3.2 feet per mile. The watershed topography is a combination of high ridges, low elevation stream valleys and abandoned river terraces resulting from the last continental glaciation (Weibel and Nelson 2009).

3.5 Soils

The National Cooperative Soil Survey publishes soil surveys for each county in the United States. These soil surveys contain predictions of soil behavior for selected land uses. The surveys also highlight limitations and hazards inherent in the soil, general improvements needed to overcome the limitations, and the impact of selected land uses on the environment. The soil surveys are designed for many different uses, including land use planning, the identification of special practices needed to ensure proper performance, and mapping of hydrologic soil groups (HSGs).

HSGs refer to the grouping of soils according to their runoff potential. Soil properties that influence the HSGs include depth to seasonal high water table, infiltration rate and permeability after prolonged wetting, and depth to a slower permeable layer (e.g., finer grained). There are four groups of HSGs: Group A, B, C, and Group D. Table 9 describes those HSGs found in the Mackinaw River watershed. Figure 4 and Table 10 summarizes the composition of HSGs in the watershed. Soils are predominantly B, B/D, C and C/D in the watershed and transition to more A and B type soils towards the outlet to the Illinois River. The high proportion of B/D type soils coupled with agricultural land uses indicate the likelihood of tile drainage.

A commonly used soil attribute is the K-factor, or the soil erodibility index. The distribution of K-factor values in the Mackinaw River watershed range from 0.02 to 0.50, with an average value of 0.37 (Figure 5). The higher the K-factor, the more susceptible the soil is to erosion.

Table 9. Hydrologic soil group descriptions

HSG	Group Description
A	Sand, loamy sand or sandy loam types of soils. Low runoff potential and high infiltration rates even when thoroughly wetted. Consist chiefly of deep, well to excessively drained sands or gravels with a high rate of water transmission.
B	Silt loam or loam. Moderate infiltration rates when thoroughly wetted. Consist chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
C	Soils are sandy clay loam. Low infiltration rates when thoroughly wetted. Consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.
D	Soils are clay loam, silty clay loam, sandy clay, silty clay or clay. Group D has the highest runoff potential. Low infiltration rates when thoroughly wetted. Consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.
A/D B/D C/D	Dual HSGs. Certain wet soils are placed in group D based solely on the presence of a water table within 24 inches of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. The first letter applies to the drained condition and the second to the undrained condition.

Table 10. Percent composition of hydrologic soil groups in watershed

Hydrologic Soil Group (HSG)	Acres	Percentage
A	18,260	2.5%
A/D	1,123	0.2%
B	175,164	23.8%
B/D	210,222	28.6%
C	146,951	20.0%
C/D	177,022	24.1%
D	173	<0.1%
No Data	6,502	0.9%

Source: NRCS SSURGO Database 2011

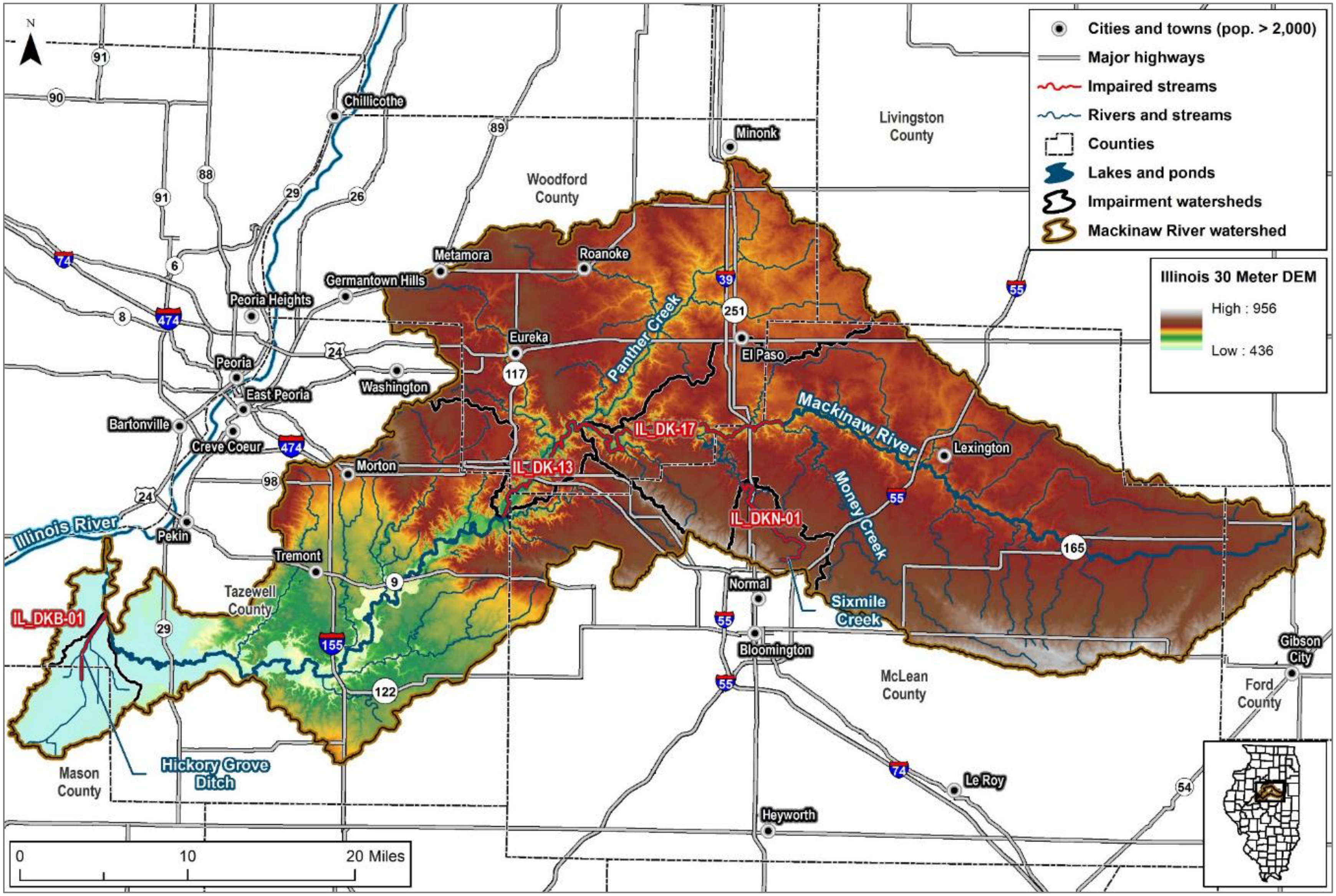

Figure 3. Mackinaw River watershed land elevations (ISGS 2003).

Note: IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

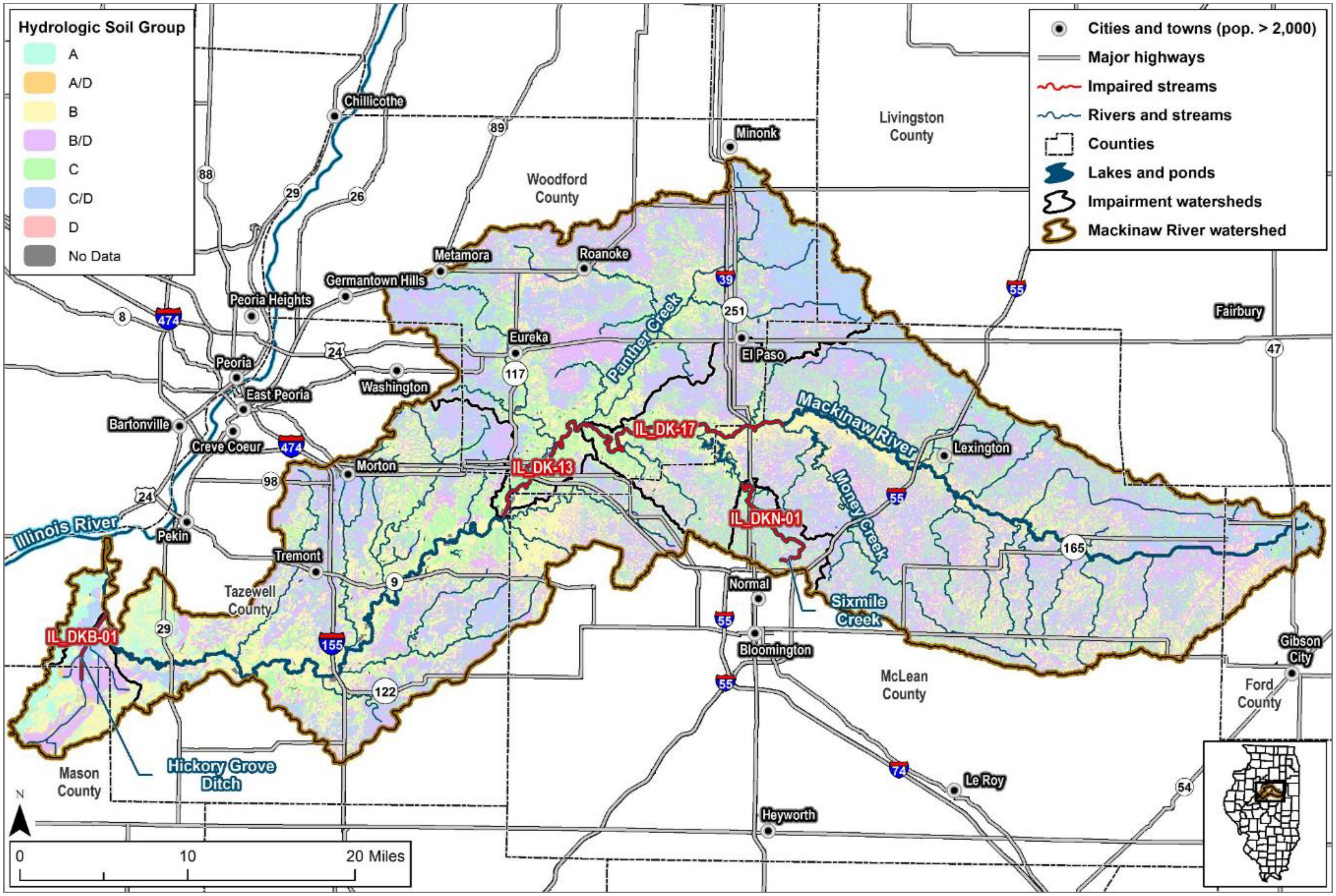

Figure 4. Mackinaw River watershed hydrologic soil groups (Soil Surveys for Ford, Livingston, Mason, McLean, Tazewell and Woodford Counties, Illinois; NRCS SSURGO Database 2011)

Note: IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

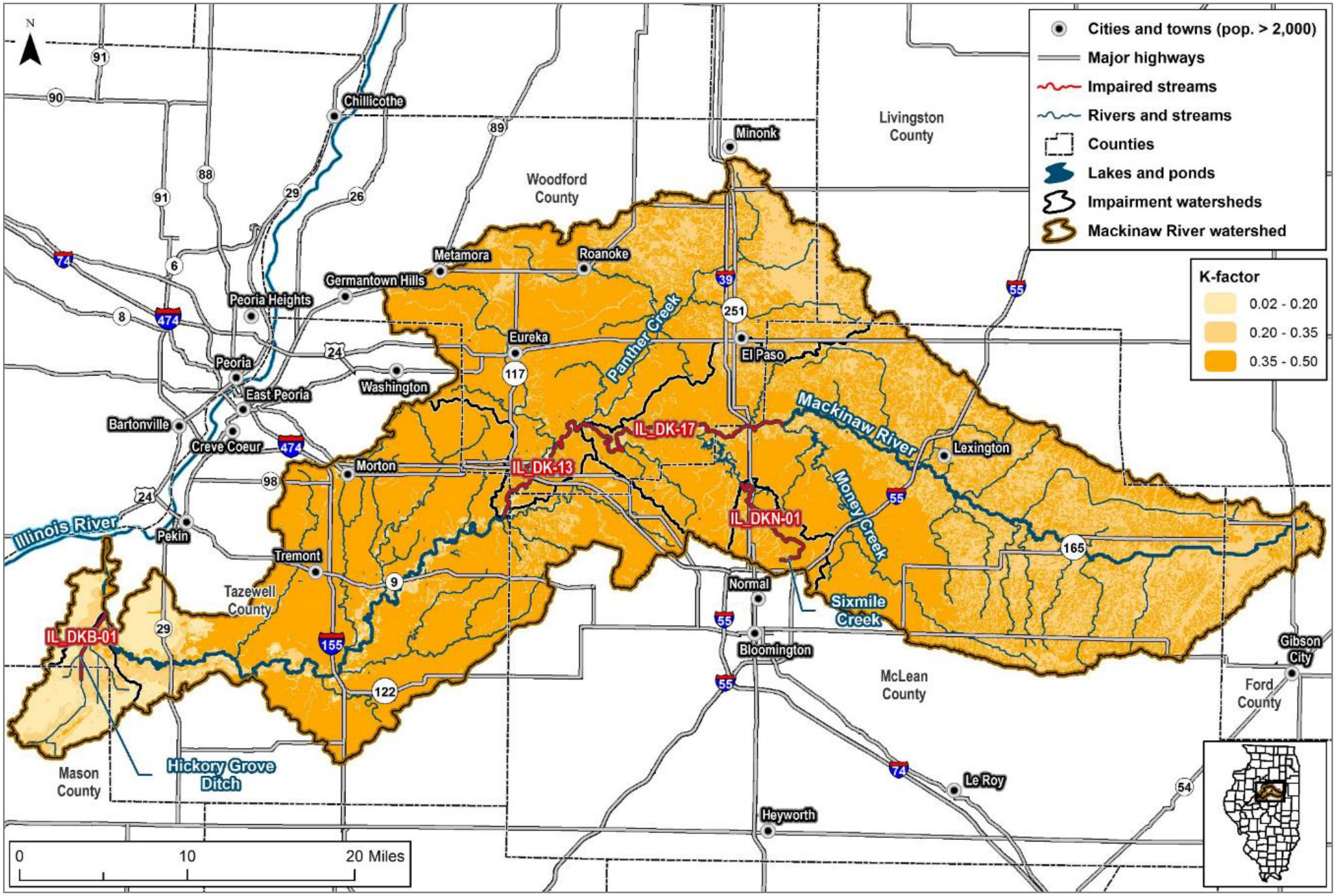

Figure 5. Mackinaw River watershed soil K-factor values (Soil Surveys for Ford, Livingston, Mason, McLean, Tazewell and Woodford Counties, Illinois; NRCS SSURGO Database 2011).

Note: IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

3.6 Hydrology

Hydrology plays an important role in evaluating water quality. The hydrology of the Mackinaw River watershed is driven by local climate conditions and the landscape. The U.S. Geological Survey (USGS) has collected flow and water quality data in this watershed since the 1930s (Table 11 and Figure 11). There is one active USGS gage in the watershed.

The daily average, peak history, and monthly flow data show the inherent variability associated with hydrology. Flow duration curves provide a way to address that variability and flow related water quality patterns. Duration curves describe the percentage of time during which specified flows are equaled or exceeded. Flow duration analysis looks at the cumulative frequency of historic flow data over a specified period, based on measurements taken at uniform intervals (e.g., daily average or 15-minute instantaneous). Duration analysis results in a curve that relates flow values to the percent of time those values have been met or exceeded. Low flows are exceeded a majority of the time, whereas floods are exceeded infrequently. A flow duration curve for active USGS gage 05567500 is presented in Figure 6.

Table 11. USGS stream gages in impairment watersheds

Gage ID	Watershed Area (*mi.*^{2})	Location	Period of Record	Located on Impaired Segment
05564200	87.6	Mackinaw River at Colfax, IL	1980-1981	-
05564300	309	Mackinaw River near Kappa, IL	1997	-
05564400	49	Money Creek near Towanda, IL	1958-1983	-
05564500	53.1	Money Creek above Lake Bloomington, IL	1933-1958 [a]	-
05565000	9.81	Hickory Creek above Lake Bloomington, IL	1938-1958 [a]	-
05565500	69.1	Money Creek at Lake Bloomington, IL	1956-1958 [a]	-
05565700	18.5	Sixmile Creek at Hudson, IL	- [b]	IL_DKN-01
05566000	6.3	East Branch Panther Creek near Gridley, IL	1949-1972 [a]	-
05566500	30.5	East Branch Panther Creek at El Paso, IL	1949-1982	-
05567000	93.9	Panther Creek near El Paso, IL	1949-1998	
05567400	687	Mackinaw River above Congerville, IL	- [b]	IL_DK-13
05567448	- [b]	Walnut Creek at Eureka, IL	1991-1992 [a]	-
05567450	- [b]	Walnut Creek near Mackinaw Dells, IL	- [b]	-
05567500	**767**	**Mackinaw River near Congerville, IL**	**1944-2016**	**IL_DK-13**
05567510	776	Mackinaw River below Congerville, IL	1978-1986	IL_DK-13

BOLD – indicates active USGS gage
a. Flow data only, no water quality data available
b. Information unavailable on USGS National Water Information System (NWIS)

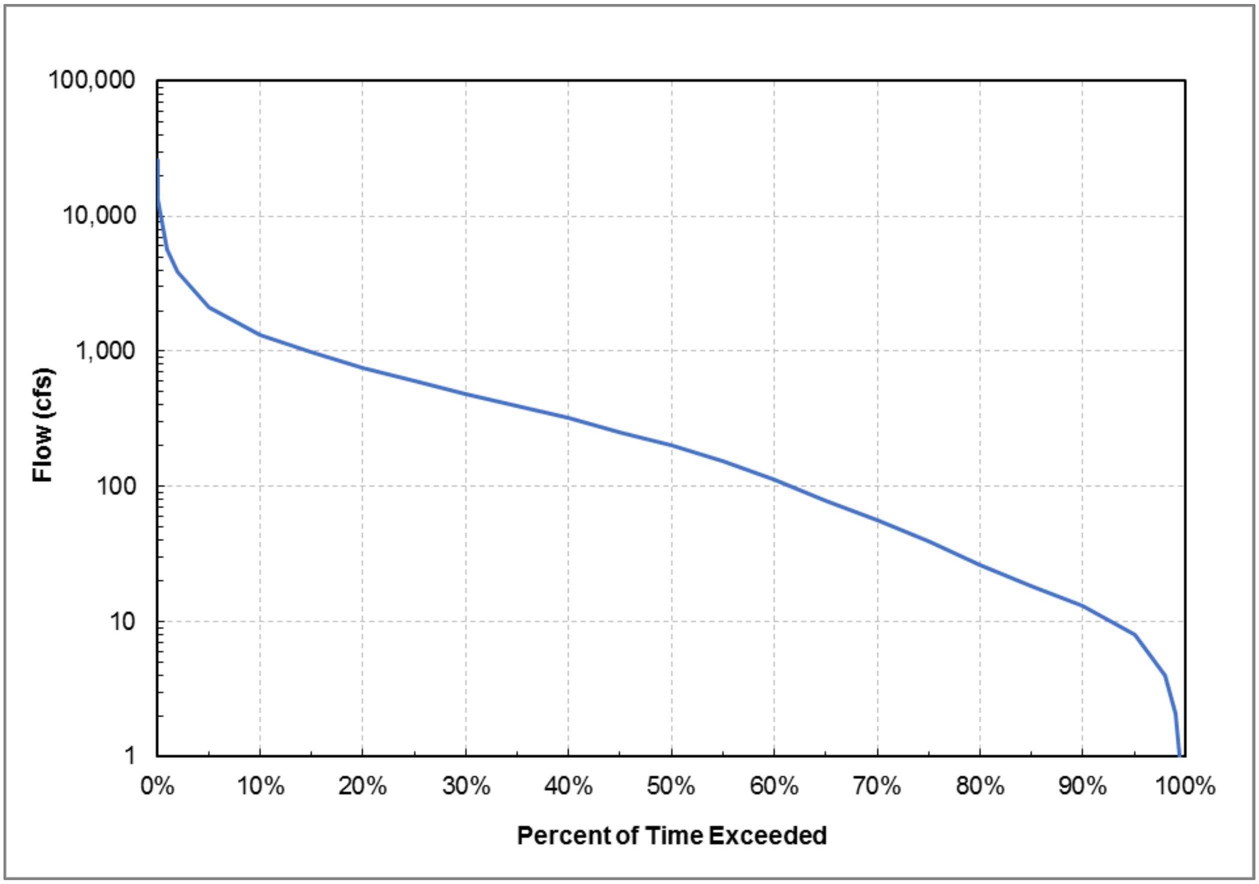

Figure 6. Flow duration curve for USGS gage 05567500, Mackinaw River near Congerville, IL (1944–2016).

An evaluation of annual flow at USGS gage 05567500 from 1944–2016 showed that annual flow in 2001 was nearly at the median; thus, it is assumed that 2001 is a typical year. Flow at USGS gage 05567500 is plotted with precipitation from the NOAA Global Historical Climatology Network Database Station USC00116200 (Normal) in Figure 7. Flows in the Mackinaw River decrease significantly during the late summer and early fall with decreasing precipitation.

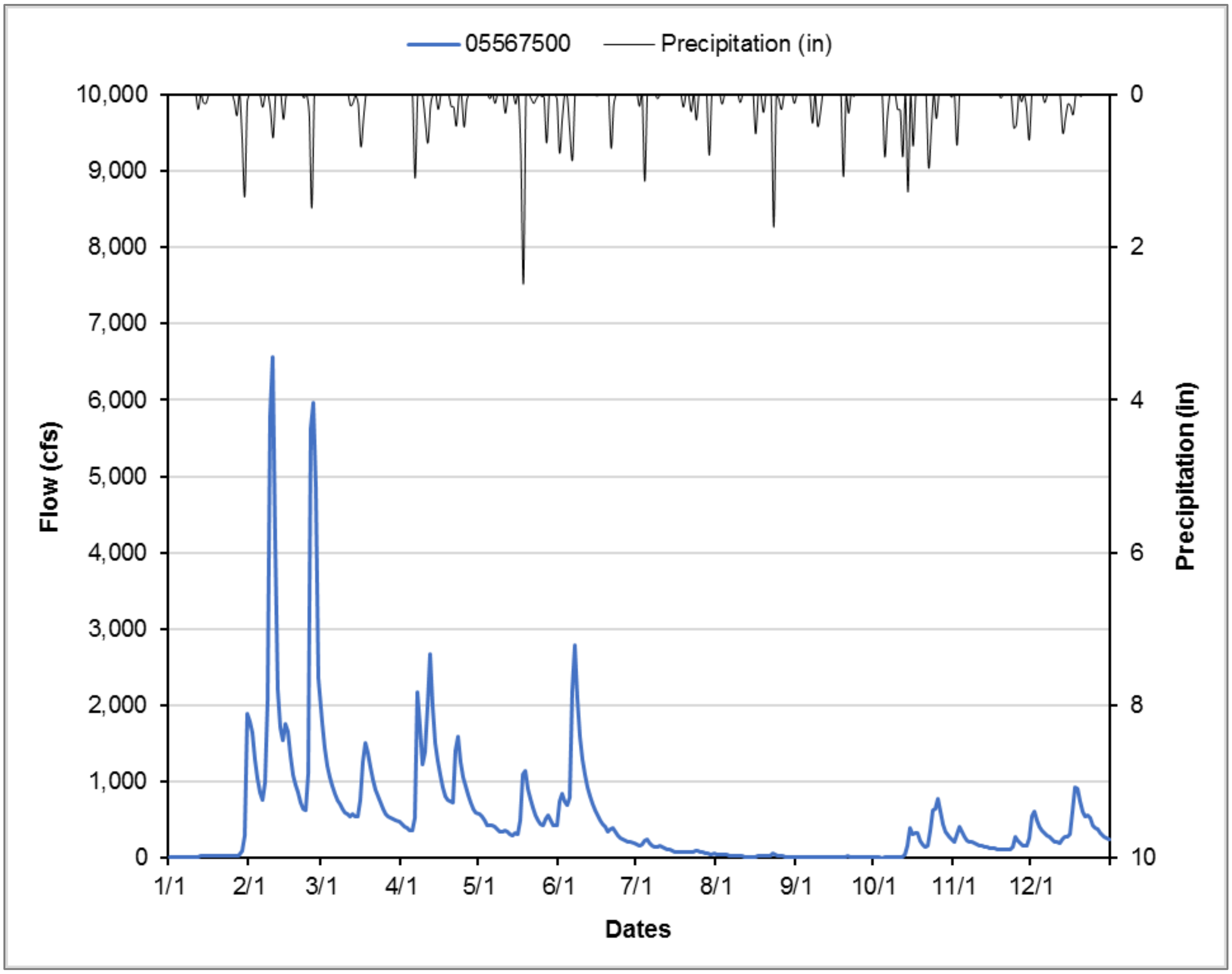

Figure 7. Daily flow in the Mackinaw River with daily precipitation at Normal (USC00116200), 2001.

3.7 Watershed Studies and Other Watershed Information

This section describes some of the studies that have been completed in the watershed.

- **Mackinaw River Watershed Management Plan** (Mackinaw River Project 1998)

  Plan was developed through a collaborative effort with townspeople, farmers, state agencies, and The Nature Conservancy to develop a voluntary watershed plan to address sedimentation and wetland loss. Sources of pollution were identified as agriculture, construction erosion, urban runoff, hydrologic modifications, and resource extraction activities. Strategies, achievable goals, and specific recommendations were made for agriculture, biological diversity, issues in the community, education, and agency coordination. The Mackinaw River Watershed Council, the precursor to the Mackinaw River Ecosystem Partnership, was created along with the development of this plan.

- **Geology of the Mackinaw River Watershed, McLean, Woodford, and Tazewell Counties** (Weibel and Nelson 2009)

  Guidebook was developed for the University of Illinois at Urbana Champaign' Institute of Natural Resources Sustainability. Includes overview of the geologic framework, history, regional drainage, natural resources (minerals and groundwater), and natural areas from the Moraine View State Park, to the Mackinaw River near Heritage Lake.

- **Lake Bloomington Watershed TMDL and Watershed Plan** (Tetra Tech 2008 and Lake Bloomington Watershed Planning Committee 2008)

  This previous TMDL provides information on nutrient loading from Lake Bloomington. The watershed plan provides information and pollutant loading, sources, and watershed characteristics in the Lake Bloomington watershed.

- **Evergreen Lake Watershed TMDL and Watershed Plan** (CDM 2006 and Evergreen Lake Watershed Planning Committee 2006)

  This previous TMDL provides information on nutrient loading from Evergreen Lake. The watershed plan provides information and pollutant loading, sources, and watershed characteristics in the Evergreen Lake watershed.

4. Watershed Source Assessment

Source assessments are an important component of water quality management plans and TMDL development. This section provides a summary of potential sources that contribute listed pollutants to the Mackinaw River watershed.

4.1 Pollutants of Concern

Pollutants of concern evaluated in this source assessment are fecal coliform and nitrate. These pollutants can originate from an array of sources including point and nonpoint sources. Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels. Nonpoint sources are diffuse sources that have multiple routes of entry into surface waters, particularly overland runoff. This section provides a summary of potential point and nonpoint sources that contribute to the impaired waterbodies.

4.2 Point Sources

Point source pollution is defined by the Federal CWA §502(14) as:

> *"any discernible, confined and discrete conveyance, including any ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation [CAFO], or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agriculture storm water discharges and return flow from irrigated agriculture."*

Under the CWA, all point sources are regulated under the National Pollutant Discharge Elimination System (NPDES) program. A municipality, industry, or operation must apply for an NPDES permit if an activity at that facility discharges wastewater to surface water. Point sources can include facilities such as municipal wastewater treatment plants (WWTPs), industrial facilities, CAFOs, or regulated storm water including municipal separate storm sewer systems (MS4s). There are no permitted CAFOs in the watershed.

4.2.1 NPDES Facilities (Non-Stormwater)

NPDES facilities in the study area include municipal and industrial wastewater treatment; bacteria and nutrients can be found in these discharges. There are also public water supply facilities in the watershed. Twenty-one facilities that discharge in the contributing drainage area of the impaired segments (Table 12 and Figure 11). Average and maximum design flows and downstream impairments are included in the facility summaries.

Table 12. Individual NPDES permitted facilities in impairment watersheds

IL Permit ID	Facility Name	Type of Discharge	Receiving Water	Downstream Impairment(s)	Average Design Flow (MGD)	Maximum Design Flow (MGD)
IL0021521	Metamora South WWTP	STP	Walnut Creek	IL_DK-13	0.38	0.96
IL0025119	City of Eureka STP	STP	Walnut Creek	IL_DK-13	0.59	1.84
IL0025666	East Bay Camp Conference Center STP	STP	Lake Bloomington	IL_DK-17, IL_DK-13	0.03	0.05
IL0035904	Village of Manito STP	STP	Manito Ditch tributary to Hickory Grove Ditch	-- [a]	0.2	0.5
IL0036391	COMLARA Park STP	STP	Evergreen Lake	IL_DK-17, IL_DK-13	0.022	0.055
IL0040762	I-74 South Mackinaw Dells Rest Area STP	STP	Unnamed tributary of Mackinaw River	IL_DK-13	0.003	0.0075
IL0048054	Goodfield STP	STP	Unnamed tributary of Mackinaw River	IL_DK-13	0.2	0.4
IL0053899	Forestview Utilities Corporation STP	STP	Unnamed tributary of Mackinaw River	IL_DK-13	0.01	0.25
IL0073032	Westwind Estates STP	STP	Unnamed tributary of Mackinaw River	IL_DK-17, IL_DK-13	0.024	0.048
IL0074365	Prairie View Supplemental Treatment Facility	STP	Sixmile Creek	IL_DK-17, IL_DK-13	0.007	0.017
ILG551035	ILDOT-I74 Woodford Co N WWTP	STP	Unnamed tributary of Mackinaw River	IL_DK-13	0.015	0.03
ILG551095	Timberline MHP WWTP	STP	Unnamed tributary to Walnut Creek	IL_DK-17, IL_DK-13	0.051	0.128
ILG580074	Roanoke WWTP	STP	West Branch Panther Creek	IL_DK-13	0.22	0.8
ILG580078	Village of Colfax WWTP	STP	Mackinaw River	IL_DK-17, IL_DK-13	0.11	0.28
ILG580102	Village of Gridley WWTP	STP	Buck Creek	IL_DK-17, IL_DK-13	0.188	0.47
ILG582005	City of El Paso WWTP	STP	East Branch Panther Creek	IL_DK-13	0.461	1.15
ILG640120	Secor WTP	PWS	Olive Branch	IL_DK-13	--	--
ILG640167	Anchor WTP	PWS	Mackinaw River	IL_DK-17, IL_DK-13	--	--
ILG640231	Eureka WTP	PWS	Walnut Creek	IL_DK-13	--	--
ILG640278	City of Bloomington WTP	PWS	Money Creek	IL_DK-17, IL_DK-13	0.09	--
ILG840187 [b]	Amigoni Construction – Bachman Pit	SPPD	Unnamed tributary to Panther Creek	IL_DK-13	--	--

MGD – Millions of gallons per day; PWS - Public water supply; SPPD - Stormwater and pit pump discharge; STP – Sewage treatment plant.
a. The Village of Manito STP discharges to impaired subwatershed for segment IL_DKB-01 that is not addressed in this TMDL report.
b. The Amigoni Construction - Bachman Pit was terminated in February 2018.

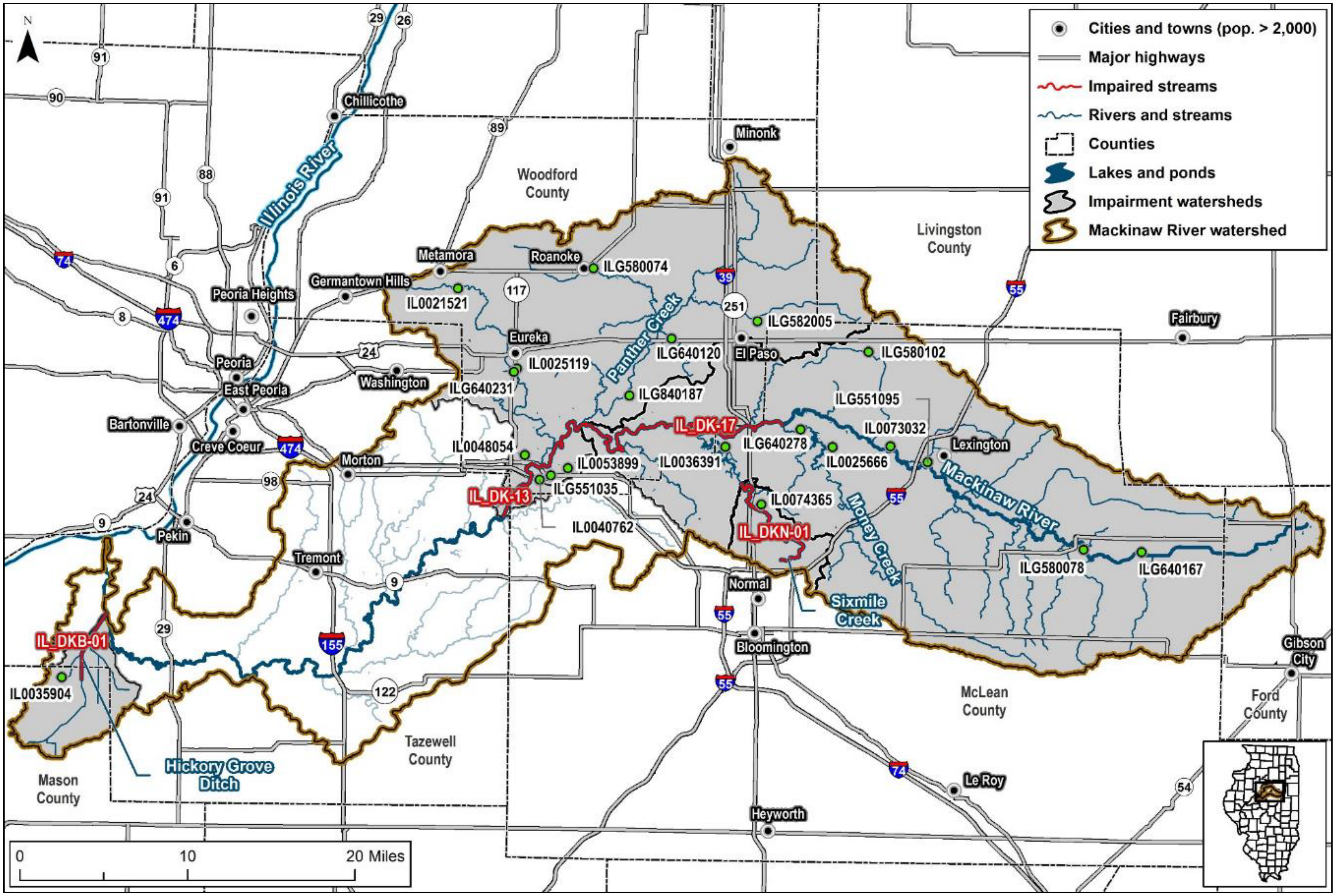

Figure 8. NPDES permitted facilities upstream of impaired segments.

Note: IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

4.2.2 Municipal Separate Storm Sewer Systems

Regulated storm water runoff can contribute to impairments in the project area. As development increases in the watershed, additional pressure will be placed on receiving waters due to storm water. Impervious areas associated with developed land uses can result in higher peak flow rates, higher runoff volumes and larger pollutant loads. Storm water runoff often contains sediment, nutrients, and bacteria amongst other pollutants.

Under the NPDES program, municipalities serving populations over 100,000 people are considered Phase I MS4 communities. In the impairment watersheds, there are no Phase I communities. Municipalities serving populations under 100,000 people are considered Phase II communities. In Illinois, Phase II communities are allowed to operate under the statewide General Storm Water Permit (ILR40) which requires dischargers to file a Notice of Intent, acknowledging that discharges shall not cause or contribute to a violation of WQS.

To assure pollution is controlled to the maximum extent practical, regulated entities operating under the General Storm Water Permit (ILR40) are required to implement six minimum control measures including public education, public involvement, illicit discharge and detection programs, control of construction site runoff, post construction storm water management in new development and redevelopment, and pollution prevention/good housekeeping for municipal operations. Regulated entities operating under the General Storm Water Permit in the impairment watersheds are identified in Table 13 and Figure 9.

Table 13. Permitted MS4s in impairment watersheds

Permit ID	Regulated Entity	Downstream Receiving Waters
ILR400041	Dry Grove Township MS4	Mackinaw River (DK-17, DK-13)
ILR400097	Normal Township MS4	Mackinaw River (DK-17, DK-13)
ILR400146	Washington Township MS4	Mackinaw River (DK-13)
ILR400158	Worth Township MS4	Mackinaw River (DK-13)
ILR400265	McLean County MS4	Mackinaw River (DK-17, DK-13)
ILR400296	Bloomington City MS4	Mackinaw River (DK-17, DK-13)
ILR400399	Normal, Town MS4	Mackinaw River (DK-17, DK-13)
ILR400493	Illinois Department of Transportation (road authority)	Mackinaw River (DK-17, DK-13)
ILR400598	Old Town Township MS4	Mackinaw River (DK-17, DK-13)
ILR400719	Towanda Village	Mackinaw River (IL_DK-17, IL_DK-13)

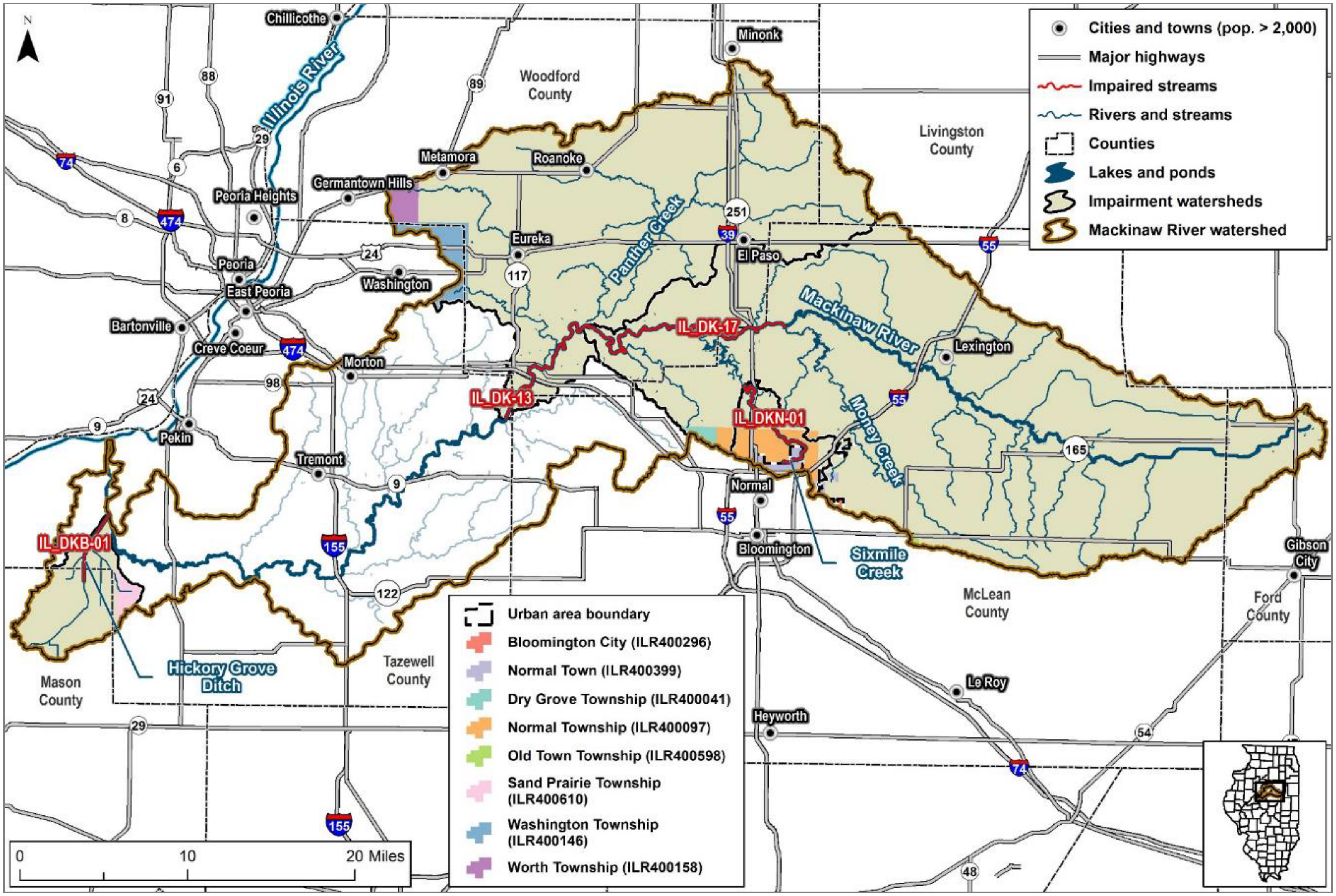

Figure 9. Municipal Separate Storm Sewer Systems (MS4s) in impairment subwatersheds.

Note: McLean County and ILDOT are also regulated MS4s. IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

4.3 Nonpoint Sources

The term nonpoint source pollution is defined as any source of pollution that does not meet the legal definition of point sources. Nonpoint source pollution typically results from overland stormwater runoff that is diffuse in origin, as well as background conditions. It should be noted that stormwater collected and conveyed through a regulated MS4 is considered a controllable point source. As part of the water resource assessment process, IEPA has identified several sources as contributing to the Mackinaw River watershed impairments (Table 14).

Table 14. Potential sources in project area based on the Draft 2016 305(b) list

Watershed	Segment	Pollutant of Concern	Sources
Mackinaw River	IL_DK-13	Fecal coliform	Source unknown
	IL_DK-17	Nitrate nitrogen	Source unknown

A summary of the potential nonpoint sources of pollutants is provided below, additional information on the primary pollutant sources follows.

- Potential nonpoint sources of pollution to fecal coliform in the Mackinaw River (IL_DK-13) include stormwater runoff, onsite wastewater treatment systems, animal agriculture, and wildlife.

- Nonpoint sources of nitrate in the Mackinaw River (IL_DK-17) are primarily related to agricultural runoff and tile discharge as a result of nitrogen fertilizer application. Cropland makes up the majority of the contributing watershed, and the presence of potentially wet soils indicates that tiling is likely common. In addition, stormwater runoff and onsite wastewater treatment systems can also contribute to nitrogen loading.

4.3.1 Stormwater and Agricultural Runoff

During wet-weather events (snowmelt and rainfall), pollutants are incorporated into runoff and can be delivered to downstream waterbodies. The resultant pollutant loads are linked to the land uses and practices in the watershed. Agricultural and developed areas can have significant effects on water quality if proper best management practices (BMPs) are not in place.

In addition to pollutants, alterations to a watershed's hydrology as a result of land use changes, ditching, and stream channelization can detrimentally affect habitat and biological health. Imperviousness associated with developed land uses and agricultural field tiling can result in increased peak flows and runoff volumes and decreased base flow as a result of reduced ground water discharge. Drain tiles also transport agricultural runoff directly to ditches and streams, whereas runoff flowing over the land surface may infiltrate to the subsurface and may flow through riparian areas.

4.3.2 Onsite Wastewater Treatment Systems

Onsite wastewater treatment systems (e.g., septic systems) that are properly designed and maintained should not serve as a source of contamination to surface waters. However, onsite systems do fail for a variety of reasons. Common soil-type limitations which contribute to failure include seasonally high water tables, compact glacial till, bedrock, and fragipan. When these septic systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface waters (Horsley and Witten 1996). Septic systems contain all the water discharged from homes and business and can be significant sources of pollutants. Septic systems installed after Jan 1, 2014 are required to have a documented evaluation by the Illinois Department of Public Health Sewage Code. The owner is required to keep the documentation for the life of the system or pass the documentation to a new owner. County health departments were contacted for information on septic systems and unsewered communities.

- Livingston County reported 6,000 and Tazewell reported 100,000 installed septic systems in their counties. No information was provided on failure rates or results of compliance testing.
- McLean County has 2,780 septic systems within the contributing drainage area to streams addressed in this TMDL (Figure 10). There are 9,709 active septic systems in the entire county, 7,741 of which discharge below the surface and 1,968 that discharge to the surface. All systems were up to code at the time they were installed, however, maintenance is not documented by the County Department of Health.
- Mason County did not provide specific information on septic systems, but noted that the county is mostly rural in only a few major cities on public sewer systems.
- Ford County reported minimal septic systems and no recent complaints in their portion of the watershed.

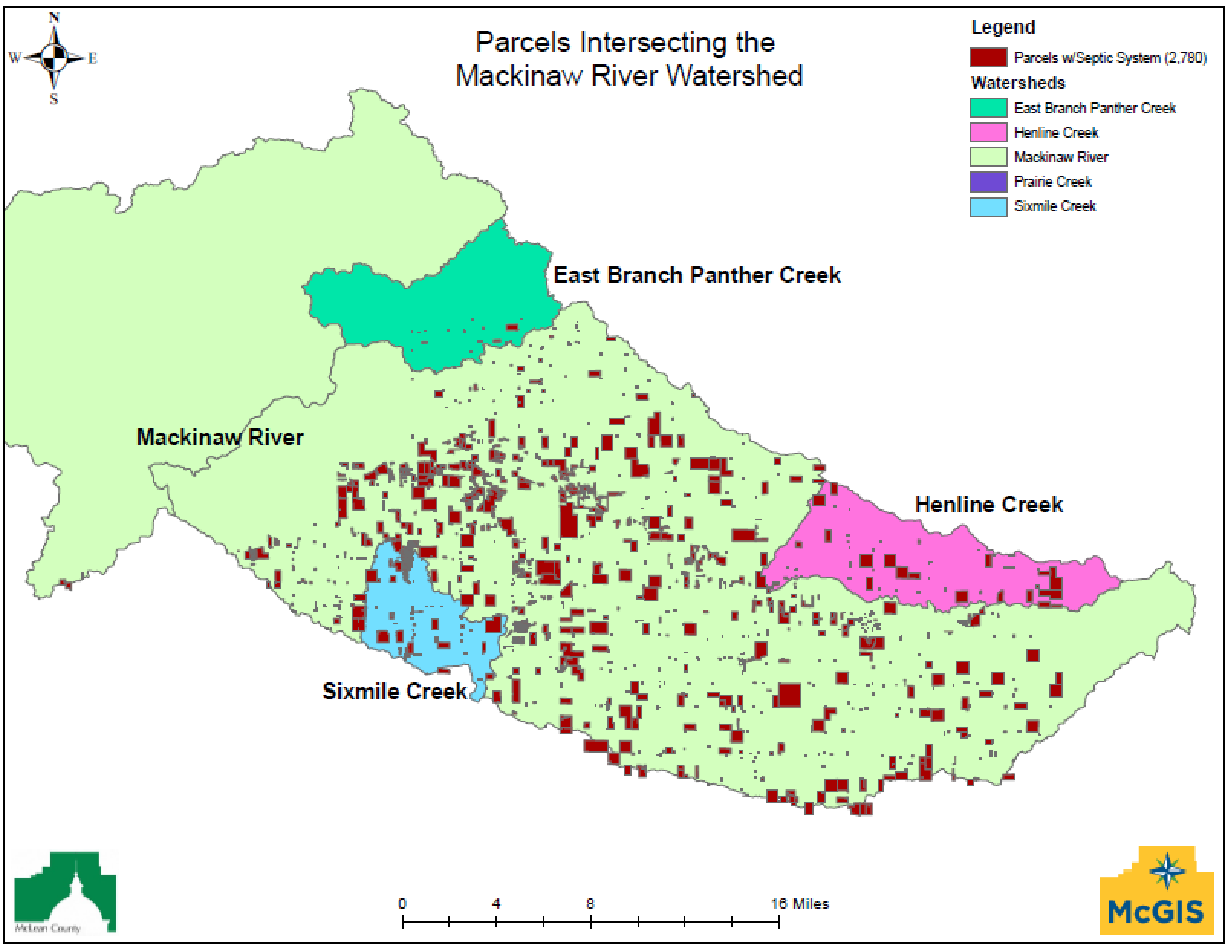

Figure 10. McLean County parcels with septic systems located in the contributing drainage area to impaired streams addressed in this TMDL. Map provided by McLean County GIS department.

4.3.3 Animal Feeding Operations (AFOs)

Animal feeding operations that are not classified as CAFOs are known as animal feeding operations (AFOs) in Illinois. Non-CAFO AFOs are considered nonpoint sources by U.S. EPA. AFOs in Illinois do not have state permits. However, they are subject to state livestock waste regulations and may be inspected by the IEPA, either in response to complaints or as part of the Agency's field inspection responsibilities to determine compliance by facilities subject to water pollution and livestock waste regulations. The animals raised in AFOs produce manure that is stored in pits, lagoons, tanks and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial re-use of manure provides a natural source for crop nutrition. It also lessens the need for fuel and other natural resources that are used in the production of fertilizer. AFOs, however, can pose environmental concerns, including the following:

- Manure can leak or spill from storage pits, lagoons, tanks, etc.
- Improper application of manure can contaminate surface or ground water.
- Manure over application can adversely impact soil productivity.

Livestock are potential sources of bacteria and nutrients to streams, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas. Watershed specific data are not available for livestock populations. However, county wide data available from the 2012 Census of Agriculture were downloaded and area weighted to estimate the animal population in the project area. An estimated 135,333 animals are in the project area.

5. Water Quality

Routine water quality monitoring is a key part of the IEPA assessment program. The goals of IEPA surface water monitoring programs are to determine whether designated uses are supported, identify causes of pollution (toxics, nutrients, sedimentation) and sources (point or nonpoint) of surface water impairments, determine the overall effectiveness of pollution control programs, and identify long term resource quality trends. IEPA has operated a widespread, active long-term monitoring network in Illinois since 1977, known as the AWQMN. The AWQMN is utilized by the IEPA to provide baseline water quality information, to characterize and define trends in the physical, chemical and biological conditions of the state's waters, to identify new or existing water quality problems, and to act as a triggering mechanism for special studies or other appropriate actions.

Additional uses of the data collected by the IEPA through the AWQMN program include the review of existing WQS and establishment of water quality based effluent limits for NPDES permits. The AWQMN is integrated with other IEPA chemical and biological stream monitoring programs including Intensive River Basin Surveys, Facility-related Stream Surveys, Fish Contaminant Monitoring, Toxicity Testing Program and Pesticide Monitoring Subnetwork which are more regionally based (specific watersheds or point source receiving stream) and cover a shorter span of time (e.g. one year) to evaluate compliance with WQS and determine designated use support. Information from this program is compiled by IEPA into a biennial report, known as the Illinois Integrated Water Quality Report and Section 303(d) List, required by the Federal CWA.

Along the impaired stream segments, data were found for numerous stations that are part of the AWQMN (Figure 11 and Table 15). Parameters sampled on the streams include field measurements (e.g., water temperature) as well as those that require lab analyses (e.g., fecal coliform, nutrients). Available data were obtained directly from IEPA.

Table 15. IEPA water quality data along impaired stream segments

Water Body	Impaired Segment	AWQMN Sites	Location	Period of Record
Mackinaw River	IL_DK-13	DK-06	RT 150 Br. 2 Mi. W Congerville	2018
		DK-13	Rocky Ford Br. at River Rd. and Ragar Rd., 4 Mi. SE of Deer Creek	*1999–2006*
		DK-16	RT 150 Br. 1 Mi. NW Congerville	*2000, 2005*, 2010, 2015
	IL_DK-17	DK-02	RT 51 Br. 4.5 Mi. N Hudson	-*
		DK-17	3.5 Mi. NE Congerville	*2000, 2005*, 2010
		DK-18	CO Rd. 9, 5 Mi. WSW Kappa	-*
		DK-25	1.5 Mi. NW Lk. Bloomington	-*

Italics – Data are greater than 10 years old
-* Station location provided in GIS shapefile; however, no data available (1999–2016) as provided by IEPA.

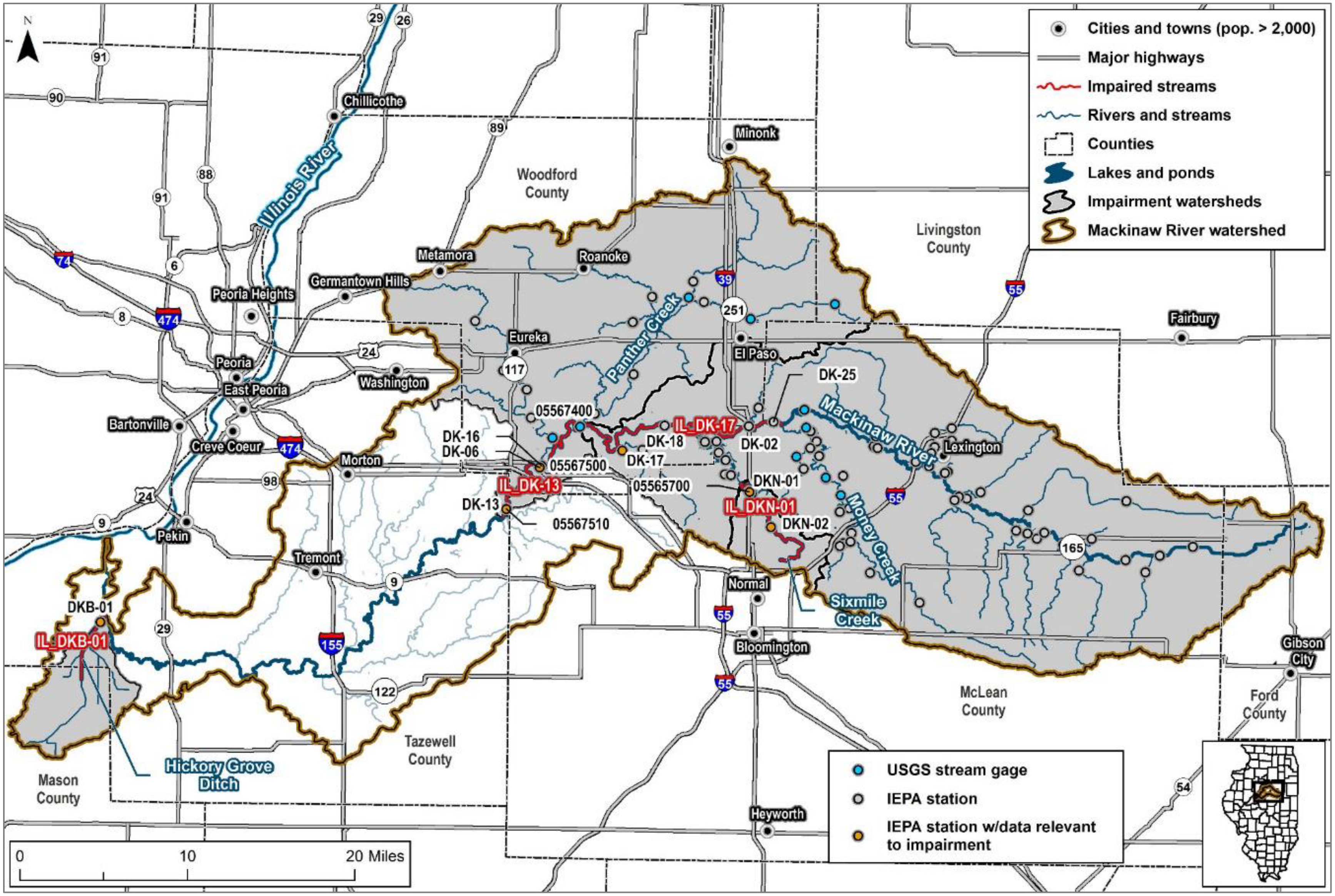

Figure 11. USGS stream gages and IEPA water quality sampling sites in impairment watersheds and along impaired stream segments.
Note: Monitoring stations on impaired segments labeled. IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

An important step in the TMDL development process is the review of water quality conditions, particularly data and information used to list segments. Examination of water quality monitoring data is a key part of defining the problem that the TMDL is intended to address. This section provides a brief review of available water quality information provided by the IEPA. The most recent 10 years of data collection, 2007–2016, were used to evaluate impairment status. Data that are greater than 10 years old are only included where future monitoring efforts are needed to evaluate impairment status. Each data point was reviewed to ensure the use of quality data in the analysis below.

5.1 Mackinaw River (IL_DK-13)

Mackinaw River segment IL_DK-13 is impaired for primary contact recreation due to fecal coliform. Two IEPA sampling sites with relevant data are along segment IL_DK-13.

Forty-three fecal coliform samples were collected at station DK-13 between 1999 and 2006 (Figure 12).

Additional data were collected at site DK-06 in 2018 to verify impairment (Table 16 and Figure 13). Greater than 10 percent of the individual samples exceed the single sample maximum standard, and the geometric mean of the five samples taken within a 30-day period is greater than the monthly geometric mean standard (Table 16). Primary contact recreation impairment on segment IL_DK-13 is verified.

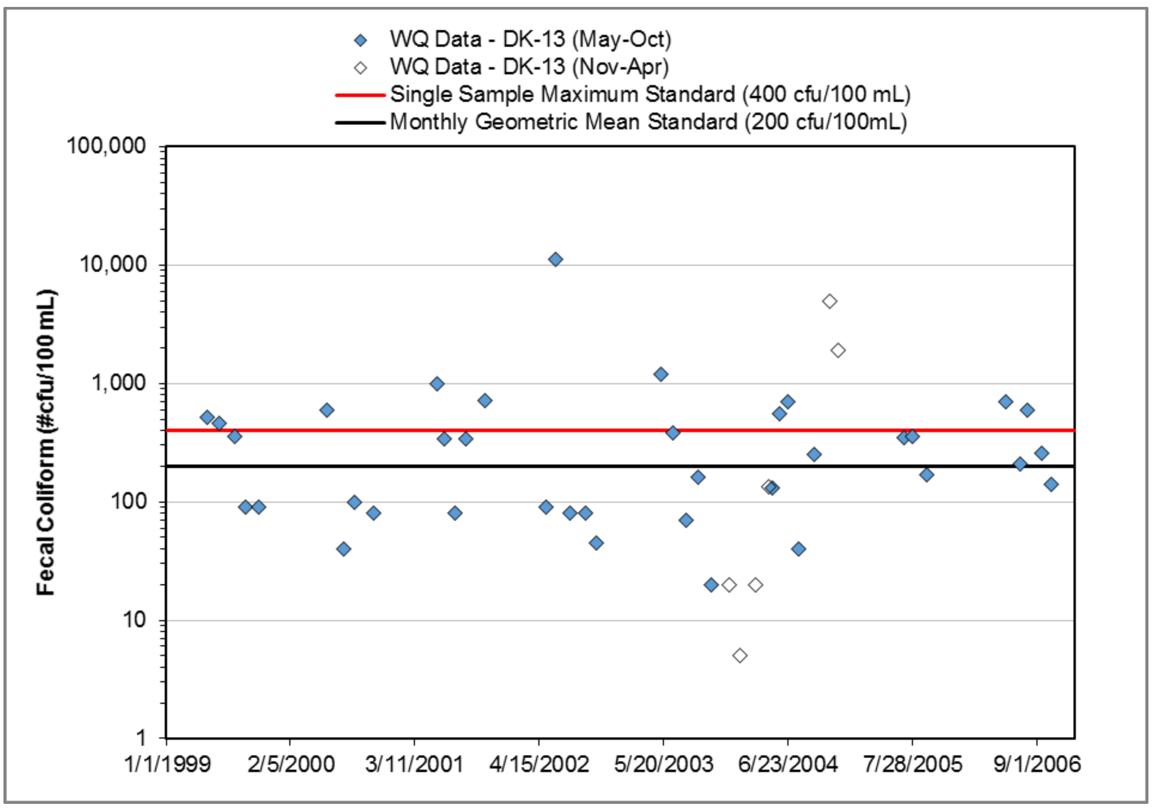

Figure 12. Fecal coliform water quality time series, 1999–2006, Mackinaw River DK-13 segment.

Table 16. Data summary, Mackinaw River IL_DK-13

Sample Site	No. of samples	Minimum (cfu/100 mL)	Geometric Mean (cfu/100 mL)	Maximum (cfu/100 mL)	Number of exceedances of single sample maximum standard (400 cfu/100 mL)
Fecal Coliform					
DK-06	5	205	426	980	8

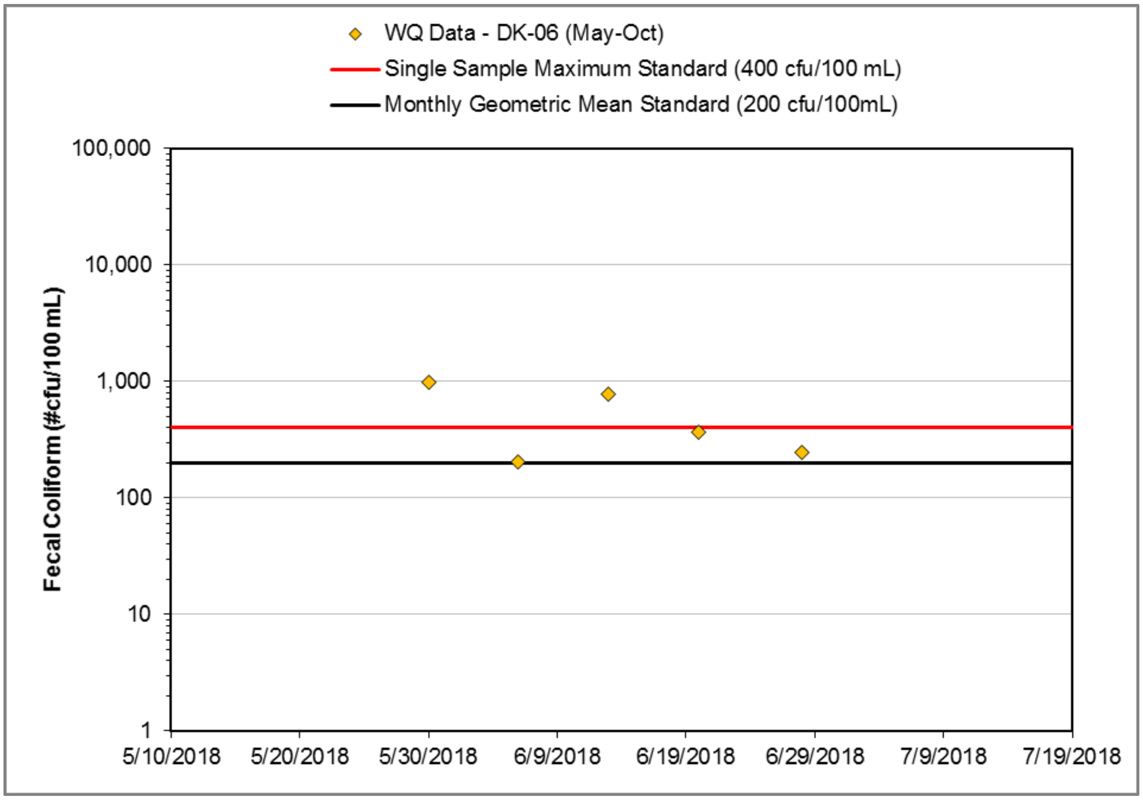

Figure 13. Fecal coliform water quality time series, 2018, Mackinaw River, segment IL_DK-13.

5.2 Mackinaw River (IL_DK-17)

Mackinaw River segment IL_DK-17 is impaired for Public and Food Processing Water Supply use to due to nitrate-nitrogen. The City of Bloomington uses intake IN00400 from segment IL_DK-17 to pump water from the Mackinaw River into Evergreen Lake during times of drought.

Segment IL_DK-17 is upstream of segment IL_DK-13. One IEPA monitoring site with relevant data is on segment IL_DK-17.

Five nitrate nitrite (nitrate + nitrite as N) samples were collected at site DK-17 in 2015 (Table 17 and Figure 14). Greater than 10 percent of samples exceed the 10 milligram per liter (mg/L) drinking water protection MCL, with two individual exceedances of the MCL observed. The April to June quarterly average also exceeds the MCL. Public and food processing water supply use impairment is verified on this segment.

Table 17. Data summary, Mackinaw River, segment IL_DK-17

Sample Site	Date	Result (mg/L)	Quarterly Average (mg/L)
Nitrate/Nitrite (nitrate + nitrite as N)			
DK-17	6/4/2015	**10.5**	**10.5**
	7/2/2015	**10.6**	6.2
	8/12/2015	4.57	
	8/13/2015	4.33	
	9/29/2015	5.24	

Red bolded values indicate samples above the MCL

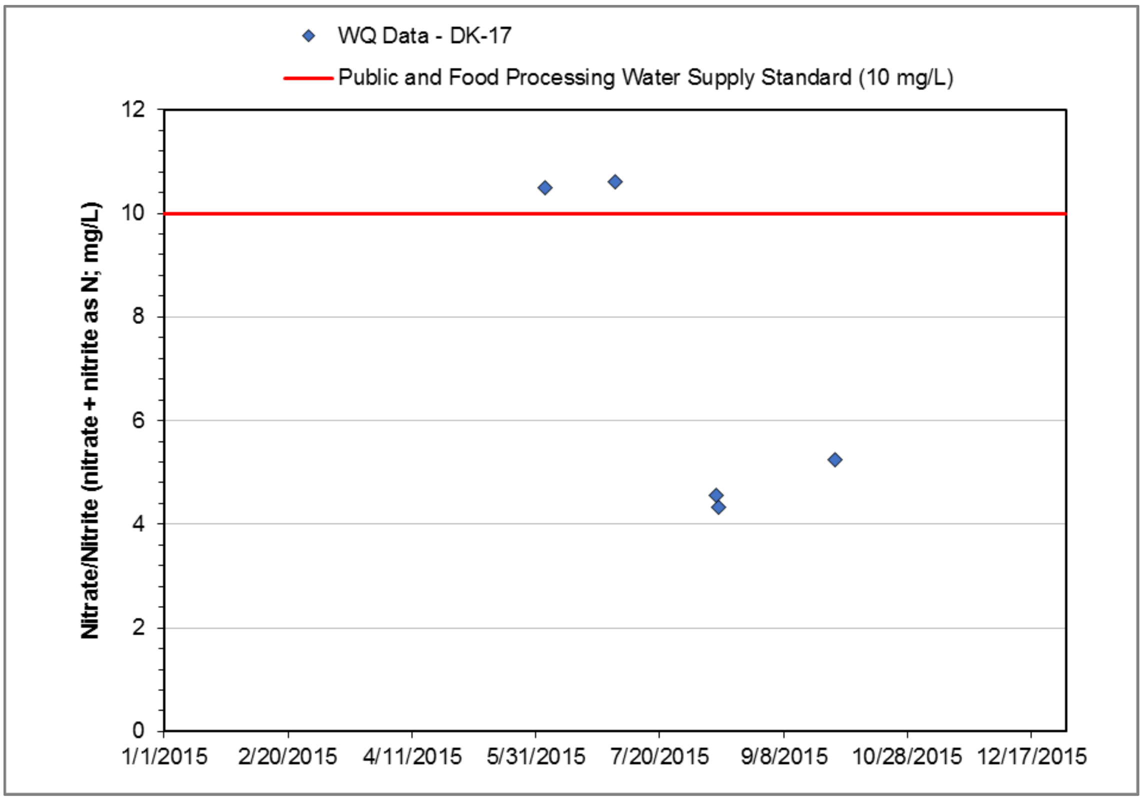

Figure 14. Nitrate water quality time series, Mackinaw River, segment IL_DK-17.

6. TMDL Development

The first stage of this project included an assessment of available data, followed by evaluation of their credibility. The types of data available, their quantity and quality, and their spatial and temporal coverage relative to impaired segments or watersheds drive the approaches used for TMDL model selection and analysis. Credible data are those that meet specified levels of data quality, with acceptance criteria defined by measurement quality objectives, specifically their precision, accuracy, bias, representativeness, completeness, and reliability.

A waterbody's loading capacity represents the maximum rate of pollutant loading that can be assimilated without violating water quality standards (40 CFR 130.2(f)). Establishing the relationship between in-stream water quality and source loading is an important component of TMDL development. It allows the determination of the relative contribution of sources to total pollutant loading and the evaluation of potential changes to water quality resulting from implementation of various management options. The following section describes the methodology used in this analysis; results are then presented by waterbody.

A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs are composed of the sum of individual wasteload allocations (WLAs) for regulated sources and load allocations (LAs) for unregulated sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody and may contain a reserve capacity (RC) if needed. Conceptually, this is defined by the equation:

$$\mathbf{TMDL = \sum WLAs + \sum LAs + MOS + RC}$$

Allowable loads and associated allocations for each of the impaired waterbodies are provided.

The following sections describe the methods used to derive TMDLs.

6.1 Loading Capacity

A duration curve approach is used to evaluate the relationships between hydrology and water quality and calculate the TMDLs for fecal coliform and nitrate impairments. The primary benefit of duration curves in TMDL development is to provide insight regarding patterns associated with hydrology and water quality concerns. The duration curve approach is particularly applicable because water quality is often a function of stream flow. For instance, sediment concentrations typically increase with rising flows as a result of factors such as channel scour from higher velocities. Other parameters, such as chloride, may be more concentrated at low flows and more diluted by increased water volumes at higher flows. The use of duration curves in water quality assessment creates a framework that enables data to be characterized by flow conditions. The method provides a visual display of the relationship between stream flow and water quality.

Streamflow for both Mackinaw River impairments was estimated from USGS gauge 05567500 (Mackinaw River near Congerville, IL). Streamflow for the USGS gauge were downloaded from the National Water Information System (NWIS; https://waterdata.usgs.gov/nwis) and area-weighted to each of the impairment watersheds using the gauge's watershed area relative to the impairment watershed area.

Allowable pollutant loads have been determined through the use of load duration curve (LDCs). Discussions of LDCs are presented in *An Approach for Using Load Duration Curves in the Development* *of TMDLs* (U.S. EPA 2007). This approach involves calculating the allowable loadings over the range of flow conditions expected to occur in the impaired stream by taking the following steps:

1. A flow duration curve for the stream is developed by generating a flow frequency table and plotting the data points to form a curve. The data reflect a range of natural occurrences from extremely high flows to extremely low flows.

2. The flow curve is translated into a load duration (or TMDL) curve by multiplying each flow value (in cubic feet per second) by the WQS/target for a contaminant (mg/L), then multiplying by conversion factors to yield results in the proper unit (i.e., pounds per day). The resulting points are plotted to create a LDC.

3. Each water quality sample is converted to a load by multiplying the water quality sample concentration by the average daily flow on the day the sample was collected. Then, the individual loads are plotted as points on the TMDL graph and can be compared to the WQS/target, or LDC.

4. Points plotting above the curve represent deviations from the WQS/target and the daily allowable load. Those plotting below the curve represent compliance with standards and the daily allowable load. Further, it can be determined which locations contribute loads above or below the WQS/target.

5. The area beneath the TMDL curve is interpreted as the loading capacity of the stream. The difference between this area and the area representing the current loading conditions is the load that must be reduced to meet WQS/targets.

6. The final step is to determine where reductions need to occur. Those exceedances at the right side of the graph occur during low flow conditions, and may be derived from sources such as illicit sewer connections. Exceedances on the left side of the graph occur during higher flow events, and may be derived from sources such as runoff. Using the LDC approach allows IEPA to determine which implementation practices are most effective for reducing loads on the basis of flow regime.

Water quality duration curves are created using the same steps as those used for LDCs except that concentrations, rather than loads, are plotted on the vertical axis. Flows are categorized into the following five hydrologic zones (U.S. EPA 2007):

- High flow zone: stream flows that plot in the 0 to 10-percentile range, related to flood flows
- Moist zone: flows in the 10 to 40-percentile range, related to wet weather conditions
- Mid-range zone: flows in the 40 to 60-percentile range, median stream flow conditions
- Dry zone: flows in the 60 to 90-percentile range, related to dry weather flows
- Low flow zone: flows in the 90 to 100-percentile range, related to drought conditions

The duration curve approach helps to identify the issues surrounding the impairment and to roughly differentiate between sources. Table 18 summarizes the general relationship between the five hydrologic zones and potentially contributing source areas (the table is not specific to any individual pollutant). For example, the table indicates that impacts from point sources are usually most pronounced during dry and low flow zones because there is less water in the stream to dilute their loads. In contrast, impacts from stormwater are most pronounced during moist and high flow zones due to increased overland flow from stormwater source areas during rainfall events.

Table 18. Relationship between duration curve zones and contributing sources

Contributing source area	Duration Curve Zone				
	High	Moist	Mid-range	Dry	Low
Point source				M	H
Livestock direct access to streams				M	H
On-site wastewater systems	M	M-H	H	H	H
Stormwater: Impervious		H	H	H	
Stormwater: Upland	H	H	M		

Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low).

The load reduction approach also considers critical conditions and seasonal variation in the TMDL development as required by the CWA and U.S. EPA's implementing regulations. Because the approach establishes loads on the basis of a representative flow regime, it inherently considers seasonal variations and critical conditions attributed to flow conditions. An underlying premise of the duration curve approach is correlation of water quality impairments to flow conditions. The duration curve alone does not consider specific fate and transport mechanisms, which may vary depending on watershed or pollutant characteristics.

The fecal coliform TMDL on the Mackinaw River (IL_DK-13) is based on compliance with both the single sample maximum standard (400 org./100 mL) and the geomean standard (200 org./100 mL). For the single sample maximum standard, reductions are based on the 90th percentile of the observed load and the median allowable load in each flow regime based on 2018 data. Reductions relative to the geomean standard are concentration-based and were calculated using the geomean concentration of five samples collected by IEPA during a 30-day period from May to June 2018.

The nitrate TMDL on the Mackinaw River (IL_DK-17) is based on compliance with the Public and Food Processing Water Supply standard (10 mg/L) Reductions are based on the maximum observed load and the median allowable loading in each flow regime.

6.2 Load Allocations

Load allocations represent the portion of the allowable daily load that is reserved for nonpoint sources and natural background conditions. The load allocations are based on subtracting the WLAs, the MOS, and RC (if applicable) from allowable loads. The load allocations are summarized for each of the waterbody pollutant combinations along with the existing, baseline loads and WLAs.

6.3 Wasteload Allocations

Facilities covered by individual NPDES permits (Table 19) and MS4s (Table 20) discharge to or upstream of the impaired segments of the Mackinaw River (i.e., IL_DK-13 and IL_DK-17). As required by the CWA, individual WLAs were developed for these permittees as part of the TMDL development process. Each facility's design maximum flow is used to calculate the WLA for the high flow zone and the design average flow was used for all other flow zones. Illinois assumes that facilities will have to discharge at their maximum flow during both high and moist flows based on the following:

> *For municipal NPDES permits in Illinois, page 2 of the NPDES permit lists 2 design flows: a design average flow (DAF) and a design maximum flow (DMF). These are defined in 35 Ill. Adm. Code 370.211(a) and (b). Since rain (and to a certain extent, high ground water) causes influent flows to wastewater treatment facilities to increase and precipitation also leads to higher river levels, a correlation between precipitation and treatment flows exists. The load limits in these permits gives a tiered load limit, one based on DAF for flows of DAF and below, and another load limit in the permit for flows above DAF through DMF.*

Fecal coliform WLAs are based on compliance with the geometric mean fecal coliform WQS of 200 org./100 mL; the instantaneous WQS requiring that no more than 10% of the samples shall exceed 400 org./100 mL is also required to be met at the closest point downstream where recreational use occurs in the receiving water or where the water flows into a fecal coliform impaired segment. WLAs are provided for both the instantaneous and geomean WQS for those facilities discharging fecal coliform.

Ten (10) of fifteen (15) facilities in the watershed have disinfection exemptions (Figure 15). Disinfection exemptions are either seasonal (November-April) or year-round and allow a facility to discharge without disinfection. Facilities with disinfection exemptions are required to meet the in-stream WQS at the end of the exempted reach (i.e., geometric mean of 200 org./100 mL). WLAs for facilities with disinfection exemptions were based on the design flows for each facility multiplied by the water quality target. The resulting WLAs apply at the end of their respective disinfection exemption reaches (Figure 15). Facilities with year-round disinfection exemptions may be required to provide IEPA with updated information to demonstrate compliance with these requirements, and facilities directly discharging into a fecal impaired segment may have their year-round disinfection exemption reviewed through future NPDES permitting actions.

Ten regulated MS4s are in the impairment watersheds (Table 20, Figure 16). Individual WLAs were established for each MS4 based on the area of the regulated community. The jurisdictional areas of townships and municipalities were used as surrogates for the regulated area of each MS4. These areas were then used to calculate WLAs based on the proportion of the upstream drainage area located within the MS4 boundaries by multiplying that proportional area by the loading capacity of the assessment location. For the regulated road authorities, McLean County and the Illinois Department of Transportation, the MS4 area was determined using the length of applicable roads and estimated right-of-way width.

Table 19. Individual NPDES-permitted facilities discharging to or upstream of impairments

IL Permit ID	Facility Name	Type of Discharge	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Downstream Impairment(s)	Disinfection Exemption
IL0021521	Metamora South WWTP	STP	0.38	0.96	IL_DK-13	Yes [a]
IL0025119	City of Eureka STP	STP	0.59	1.84	IL_DK-13	Yes [a]
IL0025666	East Bay Camp Conference Center STP	STP	0.03	0.05	IL_DK-17, IL_DK-13	No
IL0036391	COMLARA Park STP	STP	0.022	0.055	IL_DK-17, IL_DK-13	No
IL0040762	I-74 South Mackinaw Dells Rest Area STP	STP	0.003	0.0075	IL_DK-13	Yes [a]
IL0048054	Goodfield STP	STP	0.2	0.4	IL_DK-13	Yes [a]
IL0053899	Forestview Utilities Corporation STP	STP	0.01	0.25	IL_DK-13	Yes [a]
ILG551095	Timberline MHP WWTP	STP	0.051	0.128	IL_DK-17, IL_DK-13	No
IL0073032	Westwind Estates STP	STP	0.024	0.048	IL_DK-17, IL_DK-13	Yes [a]
IL0074365	Prairie View Supplemental Treatment Facility	STP	0.007	0.017	IL_DK-17, IL_DK-13	No
ILG551035	ILDOT-I74 Woodford Co N WWTP	STP	0.015	0.03	IL_DK-13	Yes [a]
ILG580074	Roanoke WWTP	STP	0.22	0.8	IL_DK-13	Yes [a]
ILG580078	Village of Colfax WWTP	STP	0.11	0.28	IL_DK-17, IL_DK-13	Yes [a]
ILG580102	Village of Gridley WWTP	STP	0.188	0.47	IL_DK-17, IL_DK-13	Yes [a]
ILG582005	City of El Paso WWTP	STP	0.461	1.15	IL_DK-13	No

a = Year-round disinfection exemption, with recreation season monitoring requirements.

Table 20. Estimated MS4 areas

Permit ID	Regulated Entity	Receiving Waters	Estimated MS4 Area (acres)
ILR400041	Dry Grove Township	Mackinaw River (IL_DK-17, IL_DK-13)	1,033
ILR400097	Normal Township	Mackinaw River (L_DK-17, IL_DK-13)	7,271
ILR400146	Washington Township	Mackinaw River (IL_DK-13)	5,437
ILR400158	Worth Township	Mackinaw River (IL_DK-13)	2,651
ILR400265	McLean County	Mackinaw River (IL_DK-17, IL_DK-13)	83
ILR400296	Bloomington City	Mackinaw River (IL_DK-17, IL_DK-13)	275
ILR400399	Normal, Town	Mackinaw River (IL_DK-17, IL_DK-13)	2,210
ILR400493	Illinois Department of Transportation (road authority)	Mackinaw River (IL_DK-17, IL_DK-13)	329
ILR400598	Old Town Township	Mackinaw River (IL_DK-17, IL_DK-13)	275
ILR400719	Towanda Village	Mackinaw River (IL_DK-17, IL_DK-13)	485

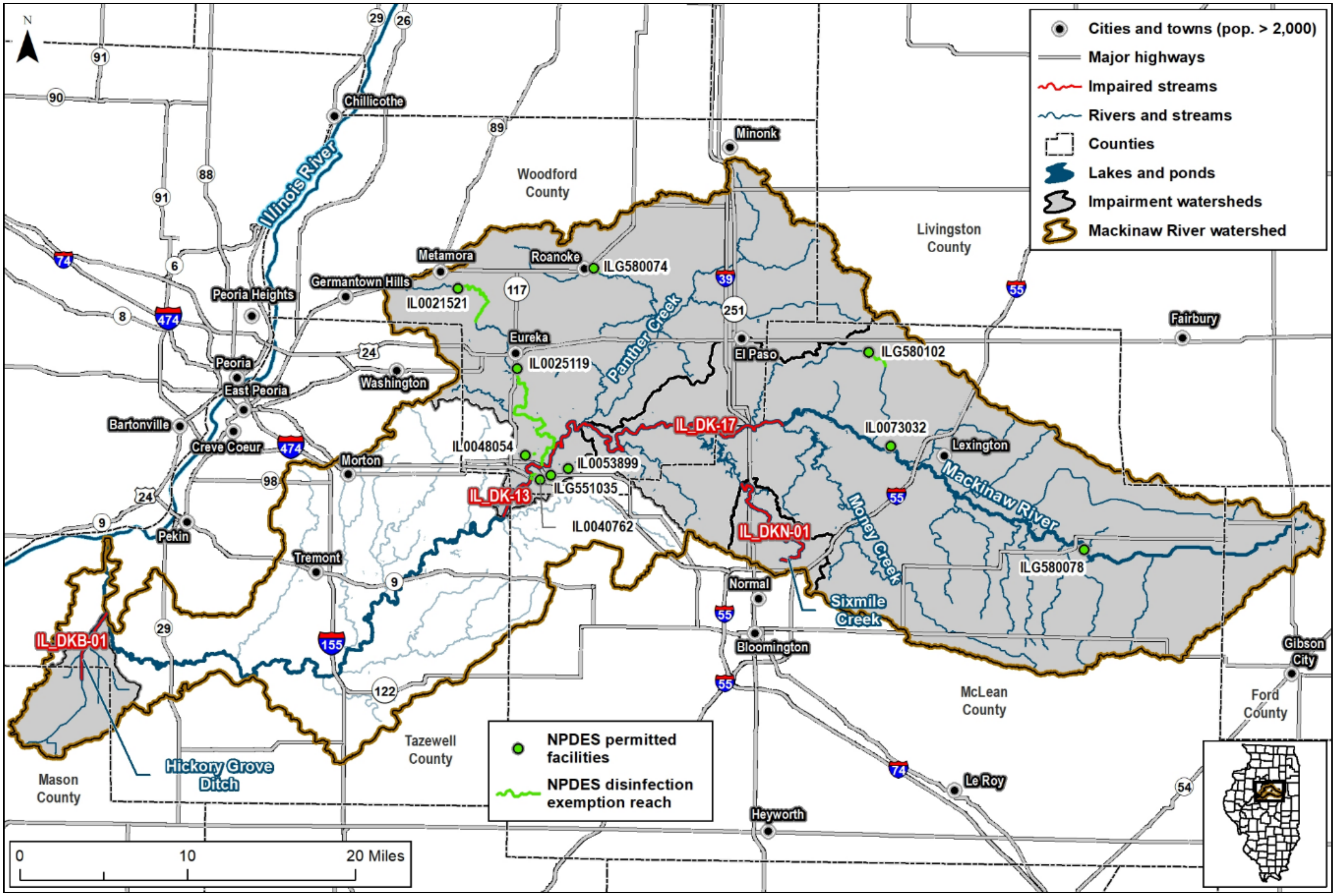

Figure 15. Facilities with disinfection exemption draining to fecal coliform impairment IL_DK-13 on the Mackinaw River.

Note: IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

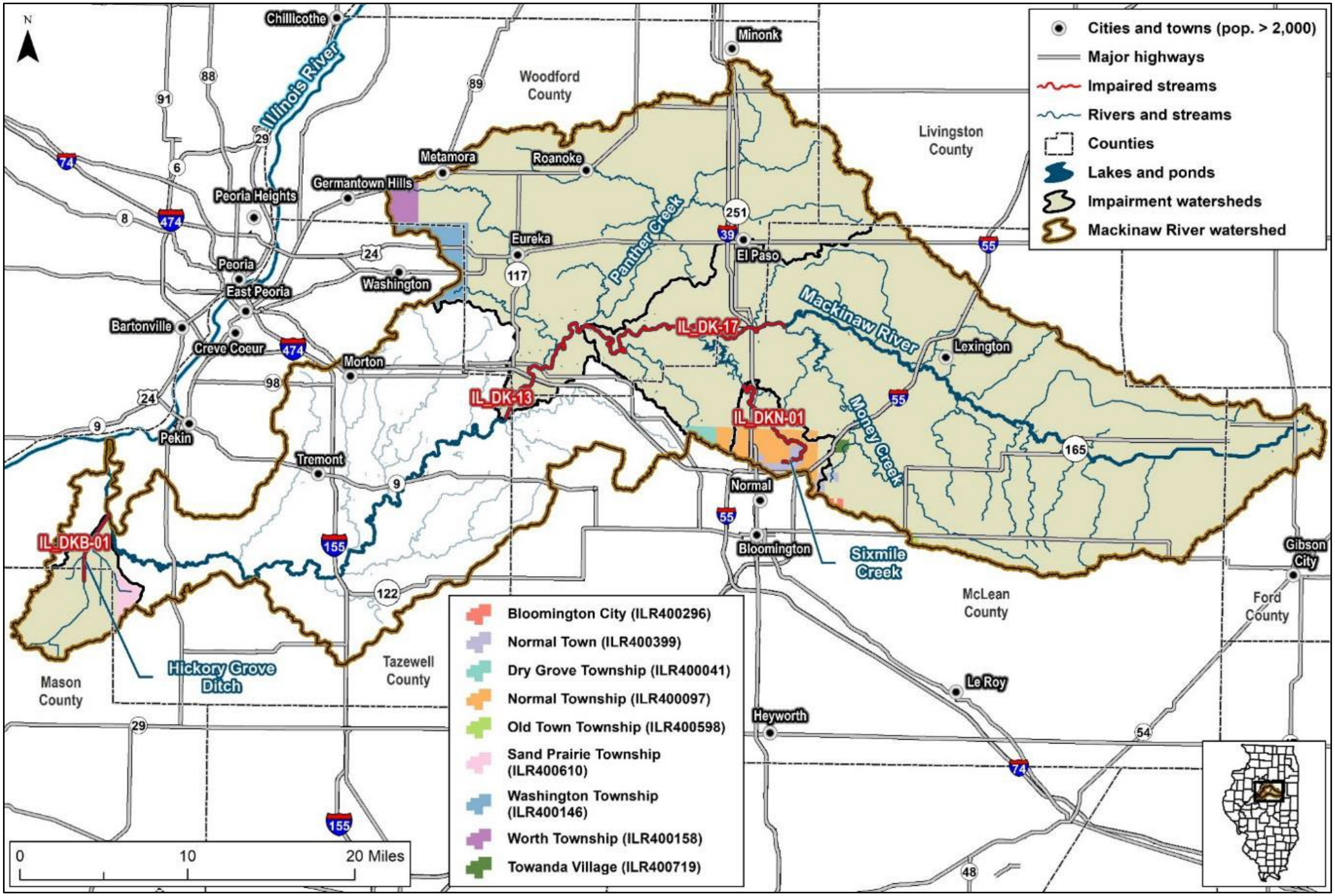

Figure 16. Municipal Separate Storm Sewer Systems (MS4s) in impairment subwatersheds.
Note: IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

6.4 Margin of Safety

The CWA requires that a TMDL include a MOS to account for uncertainties in the relationship between pollutants loads and receiving water quality. U.S. EPA guidance explains that the MOS may be implicit (i.e., incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e., expressed in the TMDL as loadings set aside for the MOS).

A 10% explicit MOS has been applied as part of the TMDLs for fecal coliform and nitrate. A moderate MOS was specified because the use of LDCs is expected to provide accurate information on the loading capacity of the stream, but this estimate of the loading capacity may be subject to potential error associated with the method used to estimate flows. Active USGS gage 05567500 is located on impaired segment IL_DK-13 of the Mackinaw River; the drainage area ratio method was used to estimate flow at the mouths of segment IL_DK-13 and adjacent, upstream impaired segment IL_DK-17. As such, the impact of error associated with flow estimation upon the LDC is expected to be minimal.

The MOS for fecal coliform is also implicit because (1) the load duration analysis does not address die-off and (2) the 30-day geometric mean criterion is applied as a daily target and the single sample maximum criterion with 10% exception is also applied as a daily target. The load duration curve approach assumes that conservative pollutants persist in-stream. However, unlike a conservative pollutant, fecal coliform die-off based upon environmental conditions (e.g., temperature, light, microbial predation) and pathogen density decreases over time.

6.5 Reserve Capacity

RC is provided to those watersheds that are expected to further develop. For fecal coliform and nitrate, any new or expanded discharges will be required to comply with permit limits. As long as the facility is meeting the standard, any new flow and associated load will be in compliance with the TMDL.

A 10% reserve capacity is set aside to accommodate future growth. Future growth could result in a needed expansion of an NPDES facility (i.e., increased flow) which could require a recalculation of the WLA. The reserve capacity provides flexibility to IEPA in these cases.

6.6 Critical Conditions and Seasonality

The CWA requires that TMDLs take into account critical conditions for streamflow, loading, and water quality parameters as part of the analysis of loading capacity. Through the LDC approach it was determined that load reductions are needed for specific flow conditions; however, the critical conditions (the periods when the greatest reductions are required) vary by location and are inherently addressed by specifying different levels of reduction according to flow.

The allocation of point source loads (i.e., the WLA) also takes into account critical conditions by assuming that the facilities will always discharge at their design flows. In reality, many facilities discharge below their design flows.

The CWA also requires that TMDLs be established with consideration of seasonal variations. Seasonal variations are addressed in TMDLs by assessing conditions only during the season when the WQS applies for fecal coliform. The load duration approach also accounts for seasonality by evaluating allowable loads on a daily basis over the entire range of observed flows and by presenting daily allowable loads that vary by flow.

7. Allocations

7.1 Mackinaw River (IL_DK-13) Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for the Mackinaw River segment IL_DK-13. Figure 17 presents the fecal coliform LDC and Table 21 and Table 22 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed under high and mid-range flow conditions to meet the single sample maximum standard. A 53% reduction is needed to meet the geomean standard. Table 23 summarizes the individual NPDES WLAs and Table 24 summarizes the individual MS4 WLAs.

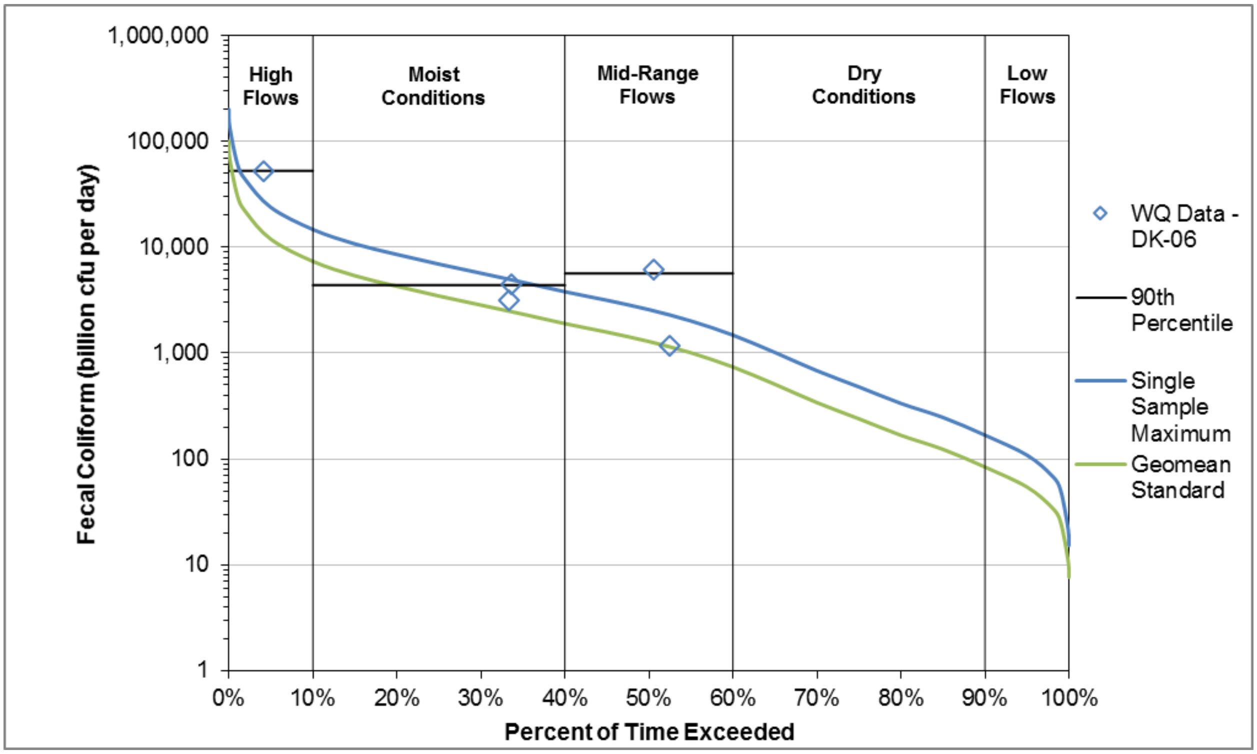

Figure 17. Fecal coliform load duration curve, Mackinaw River (IL_DK-13).
Water quality data presented in the load duration curve were collected in 2018.

Table 21. Fecal coliform TMDL summary (single sample maximum standard; Mackinaw River, IL_DK-13)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facilities	98	35	35	35	35
	MS4	756	220	81	14	2.1
Load Allocation		18,186	5,292	1,946	334	50
RC		2,380	693	258	48	11
MOS		2,380	693	258	48	11
Loading Capacity		**23,800**	**6,933**	**2,578**	**479**	**109**
Existing Load		52,659	4,375	5,670	-	-
Load Reduction [a]		55%	0%	55%	-	-

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 22. Fecal coliform TMDL summary (geomean standard; Mackinaw River, IL_DK-13)

TMDL Parameter		Flow Zones: High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facilities	49	18	18	18	18
	MS4	378	110	40	6.9	1.0
Load Allocation		9,093	2,644	973	166	24
RC		1,190	347	129	24	5.4
MOS		1,190	347	129	24	5.4
Loading Capacity		**11,900**	**3,466**	**1,289**	**239**	**54**
Geomean Concentration (# cfu/100 mL) [a]		426				
Geomean Reduction [b]		53%				

a. Geomean concentration of five samples collected by IEPA in May and June 2018.
b. TMDL reduction is based on the 2018 observed geometric mean concentration and the geomean standard (200 cfu/100 mL).

Table 23. Individual NPDES fecal coliform WLAs, Mackinaw River (IL_DK-13)

Permit ID	Facility Name	Fecal Coliform WLA (billion cfu per day): High Flow Conditions: Design Maximum Flow (MGD)	High Flow: Single Sample Maximum Standard	High Flow: Geomean Standard	Moist to Low Flow Conditions: Design Average Flow (MGD)	Moist to Low Flow: Single Sample Maximum Standard	Moist to Low Flow: Geomean Standard
IL0021521	Metamora South WWTP	0.96	15	7.3	0.38	5.8	2.9
IL0025119	City of Eureka STP	1.84	28	14	0.59	8.9	4.5
IL0025666	East Bay Camp Conference Center STP	0.05	0.76	0.38	0.03	0.45	0.23
IL0036391	COMLARA Park STP	0.055	0.83	0.42	0.022	0.33	0.17
IL0040762	I-74 South Mackinaw Dells Rest Area STP	0.0075	0.11	0.057	0.003	0.045	0.023
IL0048054	Goodfield STP	0.4	6.1	3.0	0.2	3.0	1.5
IL0053899	Forestview Utilities Corporation STP	0.25	3.8	1.9	0.01	0.15	0.076
IL0073032	Westwind Estates STP	0.048	0.73	0.36	0.024	0.36	0.18
IL0074365	Prairie View Supplemental Treatment Facility	0.017	0.26	0.13	0.007	0.11	0.053
ILG551035	ILDOT-I74 Woodford Co N WWTP	0.03	0.45	0.23	0.015	0.23	0.11
ILG551095	Timberline MHP WWTP	0.128	1.9	1.0	0.051	0.77	0.39
ILG580074	Roanoke WWTP	0.8	12	6.1	0.22	3.3	1.7
ILG580078	Village of Colfax WWTP	0.28	4.2	2.1	0.11	1.7	0.83
ILG580102	Village of Gridley WWTP	0.47	7.1	3.6	0.188	2.8	1.4
ILG582005	City of El Paso WWTP	1.15	17	8.7	0.461	7.0	3.5
	Total		**98**	**49**		**35**	**18**

MHP = mobile home park; STP = sewage treatment plant; WWTP = wastewater treatment plant.

Table 24. Individual MS4 WLAs, Mackinaw River (IL_DK-13)

Permit ID	Regulated Entity	Fecal Coliform WLA (single sample maximum/geomean standard; billion cfu per day)				
		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
ILR400041	Dry Grove Township MS4	39 / 20	11 / 5.7	4.2 / 2.1	0.73 / 0.36	0.11 / 0.052
ILR400097	Normal Township	278 / 138	82 / 41	30 / 15	5.1 / 2.5	0.77 / 0.37
ILR400146	Washington Township	208 / 104	60 / 30	22 / 11	3.8 / 1.9	0.58 / 0.27
ILR400158	Worth Township	101 / 51	29 / 15	11 / 5.4	1.9 / 0.92	0.28 / 0.13
ILR400265	McLean County	3.2 / 1.6	0.92 / 0.46	0.34 / 0.17	0.059 / 0.029	0.0088 / 0.0042
ILR400296	Bloomington City	11 / 5.3	3.1 / 1.5	1.1 / 0.56	0.19 / 0.10	0.029 / 0.014
ILR400399	Normal, Town	84 / 42	25 / 12	9.1 / 4.5	1.6 / 0.77	0.23 / 0.11
ILR400493	Illinois Department of Transportation (road authority)	2.2 / 1.1	0.65 / 0.32	0.24 / 0.12	0.041 / 0.020	0.0062 / 0.0029
ILR400598	Old Town Township	11 / 5.3	3.1 / 1.5	1.1 / 0.56	0.19 / 0.10	0.029 / 0.014
ILR400017	Towanda Village	19 / 9.3	5.4 / 2.7	2.0 / 1.0	0.34 / 0.17	0.051 / 0.025
	Total	**756 / 378**	**220 / 110**	**81 / 40**	**14 / 6.9**	**2.1 / 1.0**

7.2 Mackinaw River (IL_DK-17) Nitrate TMDL

A nitrate TMDL has been developed for the Mackinaw River segment IL_DK-17. Figure 18 presents the nitrate LDC and Table 25 summarizes the TMDL and required reductions needed to meet the Public and Food Processing Water Supply standard (10 mg/L). A 44% reduction is needed under moist flow conditions. Table 26 summarizes the individual NPDES WLAs and Table 27 summarizes the individual MS4 WLAs.

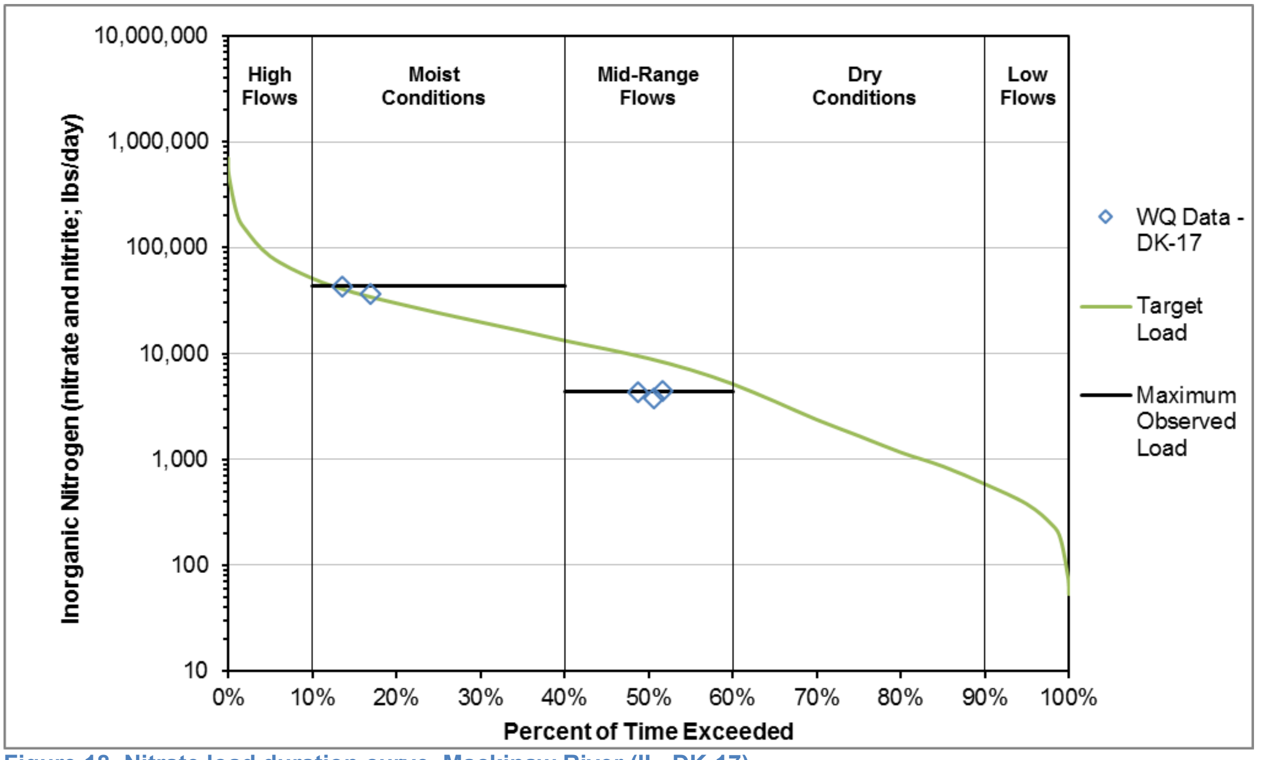

Figure 18. Nitrate load duration curve, Mackinaw River (IL_DK-17).

Table 25. Nitrate TMDL summary, Mackinaw River (IL_DK-17)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Nitrate Load (lbs/day)				
Wasteload Allocation	NPDES-permitted facilities	87	36	36	36	36
	MS4	2,473	810	300	55	11
Load Allocation		63,876	18,506	6,860	1,246	256
RC		8,304	2,419	899	167	38
MOS		8,304	2,419	899	167	38
Loading Capacity		**83,044**	**24,190**	**8,994**	**1,671**	**379**
Existing Load		-	43,466	4,388	-	-
Load Reduction [a]		-	44%	0%	-	-

a. TMDL reduction is based on the maximum observed load in each flow regime.

Table 26. Individual NPDES nitrate WLAs, Mackinaw River (IL_DK-17)

Permit ID	Facility Name	Design Maximum Flow (MGD)	Design Average Flow (MGD)	Nitrate WLA (lbs/day)	
				High Flows – Maximum Design Flow	Moist Conditions to Low Flows – Average Design Flow
IL0025666	East Bay Camp Conference Center STP	0.05	0.03	4.2	2.5
IL0036391	COMLARA Park STP	0.055	0.022	4.6	1.8
IL0073032	Westwind Estates STP	0.048	0.024	4.0	2.0
IL0074365	Prairie View Supplemental Treatment Facility	0.017	0.007	1.4	0.58
ILG551095	Timberline MHP WWTP	0.128	0.051	11	4.3
ILG580078	Village of Colfax WWTP	0.28	0.11	23	9.2
ILG580102	Village of Gridley WWTP	0.47	0.188	39	16
			Total	**87**	**36**

MHP = mobile home park; STP = sewage treatment plant; WWTP = wastewater treatment plant.

Table 27. Individual MS4 nitrate WLAs, Mackinaw River (IL_DK-17)

Permit ID	Regulated Entity	Nitrate WLA (lbs/day)				
		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
ILR400041	Dry Grove Township MS4	219	72	27	4.9	1.0
ILR400097	Normal Township	1,537	503	186	34	6.8
ILR400265	McLean County	18	5.8	2.1	0.39	0.078
ILR400296	Bloomington City	58	19	7.1	1.3	0.26
ILR400399	Normal, Town	468	153	57	10	2.1
ILR400493	Illinois Department of Transportation (road authority)	12	4.0	1.5	0.27	0.055
ILR400598	Old Town Township	58	19	7.1	1.3	0.26
ILR400017	Towanda Village	103	34	12	2.3	0.46
	Total	**2,473**	**810**	**300**	**55**	**11**

8. Implementation Plan and Reasonable Assurance

The objective of this implementation plan is to recommend activities that, when implemented, will reduce pollutant loads and improve conditions in the Mackinaw River watershed in a cost effective and timely manner. These activities will help to achieve reductions and attain WQS and will result in a cleaner, healthier watershed for the people who depend on the resources of the watershed for their livelihood now and in the future.

This implementation plan is a framework that watershed stakeholders may use to guide implementation of BMPs to address the fecal coliform and nitrate TMDLs in the Mackinaw River watershed. This framework is flexible and incorporates adaptive management to allow watershed stakeholders to align the implementation plan with existing priorities and limitations. This flexibility is necessary because the implementation of nonpoint source controls is voluntary. Adaptive management is also necessary because factors unique to specific localities may yield better or worse results for a certain BMP (or suite of BMPs) and the implementation plan will need to be modified to account for such results.

8.1 Clean Water Act Section 319 Eligibility

An important factor for implementation of the recommended BMPs is access to technical and financial resources. One potential source of funding is the CWA Section 319 Nonpoint Source Management grants. Section 319 grant funding supports implementation activities including technical and financial assistance, education, training, demonstration projects, and monitoring to assess the success of nonpoint source implementation projects. To be eligible for these funds, watershed management plans must address nine elements identified by U.S. EPA (2008, revised 2014) as critical for achieving improvements in water quality. These nine elements include:

- Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve load reductions estimated within the plan
- Estimate of the load reductions expected from management measures
- Description of the nonpoint source management measures that will need to be implemented to achieve load reductions estimated in element 2; and identification of critical areas
- Estimate of the amounts of technical and financial assistance needed, associated costs, and the sources and authorities (e.g., ordinances) that will be relied upon to implement the plan
- An information and public education component; early and continued encouragement of public involvement in the design and implementation of the plan
- Implementation schedule
- A description of interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented
- Criteria to measure success and reevaluate the plan
- Monitoring component to evaluate the effectiveness of the implementation efforts over time

While pollutants impacting bacteria and nitrate levels may originate from a combination of point and nonpoint sources, only nonpoint sources will be evaluated further in this plan. The Mackinaw River Watershed TMDL Report, including this implementation plan, is considered a watershed plan that meets U.S. EPA’s nine elements. Table 28 illustrates which sections of the document contain information that fulfills U.S. EPA’s nine elements.

Table 28. Comparison of TMDL study and implementation plan to U.S. EPA's Nine Elements

Section 319 Nine Elements	Applicable Section of the TMDL/Implementation Plan
1. Identification of **causes of impairment and pollutant sources** or groups of similar sources that need to be controlled to achieve **load reductions** estimated within the plan.	Section 8.2
2. Estimate of the load reductions expected from management measures	Section 8.3.4
3. Description of the **nonpoint source management measures** that will need to be implemented to **achieve load reductions** estimated in element 2; and identification of **critical areas**	Section 8.3 and 8.2.4
4. Estimate of the amounts of **technical and financial assistance needed**, associated **costs**, and the **sources and authorities** (e.g., ordinances) that will be relied upon to implement the plan.	Section 8.4
5. An **information and public education component**; early and continued encouragement of public involvement in the design and implementation of the plan.	Section 8.5
6. Implementation schedule	Section 8.6
7. A description of **interim, measurable milestones** for determining whether nonpoint source management measures or other control actions are being implemented.	Section 8.6
8. Criteria to measure success and reevaluate the plan	Section 8.7
9. **Monitoring component** to evaluate the effectiveness of the implementation efforts over time	Section 8.8

8.2 Critical Areas for Implementation

This section contains the requirement for U.S. EPA's ***element one:*** *identification of causes of impairment and pollutant sources.*

Successful implementation begins with identifying and focusing resources in critical areas for implementation. Critical areas are the focus of outcome-based plans because they represent those locations where project funding will provide the greatest environmental benefit. Upon identification of critical areas, BMPs can be evaluated and determined to address the needs of each area. Critical areas for implementation were determined for each impaired subwatershed and then analyzed for any overlapping area or multi-pollutant reduction to further prioritize actions.

Critical areas were determined using the suggested process provided in U.S. EPA's *Critical Source Area Identification and BMP Selection: Supplement to Watershed Planning Handbook* (2018) (Figure 19). In accordance with this guidance, critical source areas (CSAs) were determined for the first five years of implementation. Upon completion of the first five years of implementation, adaptive management principles (outlined in Section

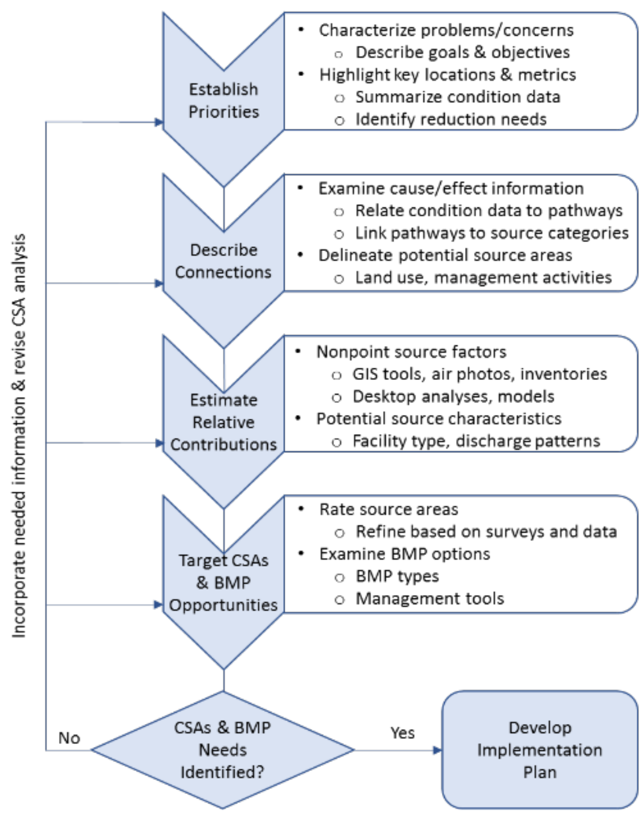

Figure 19. Critical area selection process (U.S. EPA 2018).

8.7) can be used to determine CSAs for the next ten years, and so on. U.S. EPA's (2018) suggested process for CSA selection is summarized by step in this section.

8.2.1 Step 1: Establish Priorities

The Illinois 303(d) list and the Mackinaw River watershed TMDL establish the priorities of this plan. The impaired waters addressed in this implementation plan are two segments of the Mackinaw River (IL_DK-13 and IL_DK-17). The goal of this implementation plan is to achieve the required TMDL reductions which were developed in Section 7 and are summarized in Table 29.

Table 29. Summary of Mackinaw River watershed TMDLs

Name	Designated Uses	Cause of Impairment	Water Quality Standard	Required Reduction
Mackinaw River (IL_DK-13)	Primary Contact Recreation	Fecal Coliform	200 org./100 mL	53% reduction in fecal coliform concentrations
Mackinaw River (IL_DK-17)	Public and Food Processing Water Supply	Nitrogen, Nitrate	10 mg/L	44% reduction in nitrate loading

8.2.2 Step 2: Describe Connections

Understanding the nature of nonpoint source pollutants and the potential pathways to deliver those pollutants to impaired waters can help determine CSAs to target for implementation.

Nonpoint sources of fecal coliform bacteria to Mackinaw River (IL_DK-13) include agricultural runoff, stormwater runoff, onsite wastewater treatment systems, and wildlife. Nonpoint sources of nitrates to Mackinaw River (IL_DK-17) include agricultural runoff, stormwater runoff, and onsite wastewater treatment systems. These potential sources of pollution are connected to Mackinaw River impairments via the following pathways:

- **Agricultural runoff**
    - **Animal agriculture.** Agricultural runoff from animals in both feedlot and pasture-based agricultural operations is a potential source of bacteria to streams, particularly when direct access is not restricted and where feeding structures are located near riparian areas. Additionally, the application of manure from animal agricultural operations to cropland can potentially contribute additional bacterial loading.
    - **Cropland runoff.** Due to application of commercial fertilizer, nitrate loading from agricultural runoff from croplands is significant compared to other land uses. During wet-weather events (snowmelt and rainfall), applied nutrients can easily be incorporated into runoff and delivered to downstream waterbodies. The presence of tile or subsurface drainage systems can further exacerbate nitrate loading from cropland by enabling direct transport of pollutants into nearby waterbodies with minimal infiltration.
- **Stormwater runoff.** In urban areas, sources of fecal coliform bacteria may include pet waste, trash, and other suspended solids which are transported via runoff from a precipitation event to storm sewers and streams; leaky infrastructure is also a potential source of bacteria since untreated domestic wastewater can leak into storm sewers. Nitrate loading from stormwater runoff is commonly due to the application of nitrogen fertilizers on turf grass, lawns, and gardens. Both bacteria and nitrate loading from stormwater runoff are exacerbated by the presence of impervious surfaces which can channelize stormwater flows and reduce the time available for infiltration or evaporation.

- **Onsite wastewater treatment discharge.** Onsite wastewater treatment systems, or septic systems, may contribute bacteria and nitrates to downstream receiving waters. Septic systems that are properly designed and maintained should not serve as a major source of pollution to surface waters. If systems are not properly sited, not regularly maintained, or are connected to surface waters or subsurface drainage systems, septic discharge can have adverse effects on surface waters.
- **Wildlife.** Wildlife are found throughout central Illinois in undeveloped areas and may be a source of bacterial loading to the fecal coliform impairment. Populations of animals such as deer, squirrels, racoons, bats, and migratory and resident waterfowl are common throughout the Mackinaw River watershed.

8.2.3 Step 3: Estimate Relative Contributions

Once the sources and pathways of pollutants are known, estimating the relative contributions from these areas can help to further prioritize areas to target for implementation. U.S. EPA (2018) states that estimates of relative contributions "…can range from narrative descriptors (e.g., high, medium, low) derived from aerial photo analysis or field inventories to quantitative values developed from desktop screening tools or models". The approaches used to estimate the relative contribution of pollutants may vary depending on the size of the contributing area, type of pollutant, and amount of available information.

Table 30 summarizes the relative fecal coliform and nitrate contributions from potential sources.

Table 30. Relative contributions of potential sources to Mackinaw River watershed impairments

Potential Source	Relative Fecal Coliform Contributions to Mackinaw River (IL_DK-13)	Relative Nitrate Contributions to Mackinaw River (IL_DK-17)
Agricultural runoff	High (animal agriculture)	High (cropland runoff)
Stormwater runoff	Low	Moderate
Onsite wastewater treatment systems	Low	Moderate
Wildlife	Moderate	N/A

Fecal Coliform Relative Contributions to Mackinaw River (IL_DK-13)

As the exact nature of fecal coliform loading in the Mackinaw River watershed is unknown, a qualitative approach was developed to identify significant nonpoint sources of fecal coliform bacteria from the contributing watershed. Bacteria exceedances were observed during high and mid-range flows, which indicates that primarily wet weather sources (i.e. runoff) are contributing to bacterial loading.

The impaired subwatershed Mackinaw River (IL_DK-13) is primarily agricultural with forest and shrublands common along riparian areas. Animal agriculture is likely the largest contributor of bacteria to the impaired segment. According to the 2011 National Land Cover Database, approximately 4% of the land cover in the Mackinaw River watershed is dedicated to hay/pasture (MRLC 2015). Additionally, 60 animal agriculture operations were identified within the impaired subwatershed using aerial imagery. These locations were distinguished by the presence of animal housing structures, drainage lagoons, cattle pens, stock ponds, troughs, and other identifiable features that indicated the existence of livestock. According to county-level data from the 2017 Census of Agriculture, an estimated 29,000 agricultural animals are within the impaired subwatershed (NASS 2017).

Stormwater runoff from developed areas may contribute fecal coliform loading to the impaired segment. Approximately 8% of the larger Mackinaw River watershed is covered by developed land uses. Development within the impaired subwatershed is limited to the communities of Eureka and Roanoke, as well as several other small towns.

Onsite wastewater treatment systems are likely contributing low levels of bacteria to the impaired segment. Based on data provided by McLean County, there are approximately 1,403 onsite wastewater treatment systems within the impaired subwatershed (Appendix A). Assuming a failure or non-compliance rate of 20%, approximately 280 of these systems are failing. However, septic systems are not considered a wet weather source of pollutants as they contribute pollutants across all flow zones. Therefore, septic contributions to the fecal coliform impairment are assumed to be relatively low.

Wildlife may also be contributing to fecal coliform impairment to Mackinaw River (IL_DK-13), especially in areas of the watershed with low densities of human population or areas where animals have direct access to riparian areas, such as wooded, wetland, and agricultural lands. While no information is available on the exact distribution of wildlife populations in the Mackinaw River watershed, wooded areas around major rivers, such as the Mackinaw, are home to the highest densities of white tail deer in the state and 40 of Illinois' 62 mammal species are known to occur in the Mackinaw River basin (Post 1997). Additional information on wildlife populations and concerns in Illinois are available in the Illinois Wildlife Action Plan (IDNR 2005).

Nitrate Relative Contributions to Mackinaw River (IL_DK-17)

The relative contributions of nitrates to Mackinaw River (IL_DK-17) from different land cover types were estimated using the *Spreadsheet Tool for the Estimation of Pollutant Load* (STEPL) model, in addition to available literature and watershed characteristics. STEPL provides a simplified simulation of precipitation-driven runoff and nutrient delivery. STEPL has been used extensively in U.S. EPA Region 5 for watershed plan development and in support of watershed studies. Existing BMPs and point sources are not included in the model setup.

Estimated nitrate loading rates are summarized in Figure 20. The STEPL model was also used to estimate yields (load divided by area) across the impaired subwatersheds. Drainage areas were delineated within each subwatershed using USGS topography and National Hydrology Dataset flowlines. Estimated nitrate loading rates for each drainage area are provided in Figure 21.

Based on STEPL estimates, the majority of nitrate contributions is from cropland. Cultivated cropland, commonly corn and/or soybeans, is the primary land cover in the impaired subwatershed, comprising 85% of land cover within the impaired subwatershed (MRLC 2015). While exact data on the presence of tile drainage in the impaired subwatershed is unavailable, the high proportion of silty, loamy, and clay soils and the dominance of corn and other high-quality crops on cultivated cropland indicate that the presence of tile drainage is likely significant. (USDA and NRCS 2009). In addition, a sampling program conducted in by Illinois State University in the nearby Lake Bloomington watershed concluded that the majority of nitrate loading from watershed sources was from tile drained cropland (Tetra Tech and Lake Bloomington Watershed Planning Committee 2008). STEPL estimates indicate that stormwater runoff from urban land uses, such as developed areas around the cities of Bloomington and Normal, may be contributing moderate nitrate pollution to the impaired segment.

In addition to the watershed-based nitrate loading estimated by STEPL, onsite wastewater treatment systems may be contributing moderate levels of nitrates to the impaired segment. Based on data provided by McLean County, an estimated 2,670 onsite wastewater treatment systems are located within the impaired subwatershed (Appendix A). Assuming a failure or non-compliance rate of 20%, approximately 530 of these systems are failing.

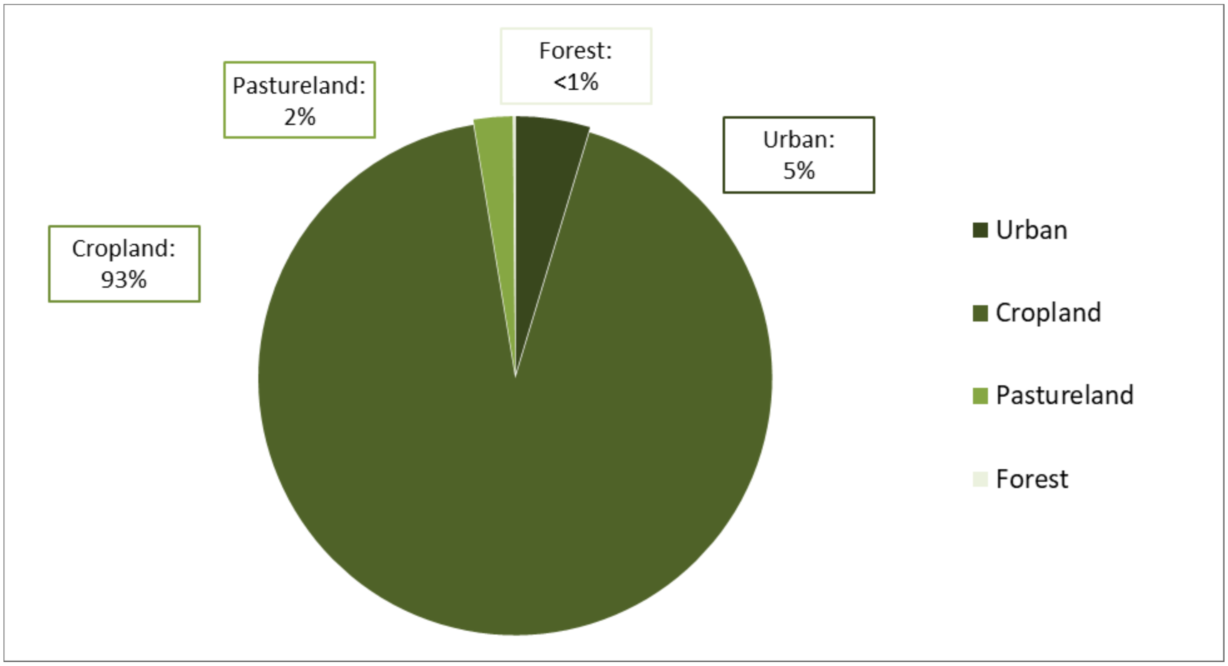

Figure 20. STEPL relative nitrate loading by source category to Mackinaw River (IL_DK-17) (%).

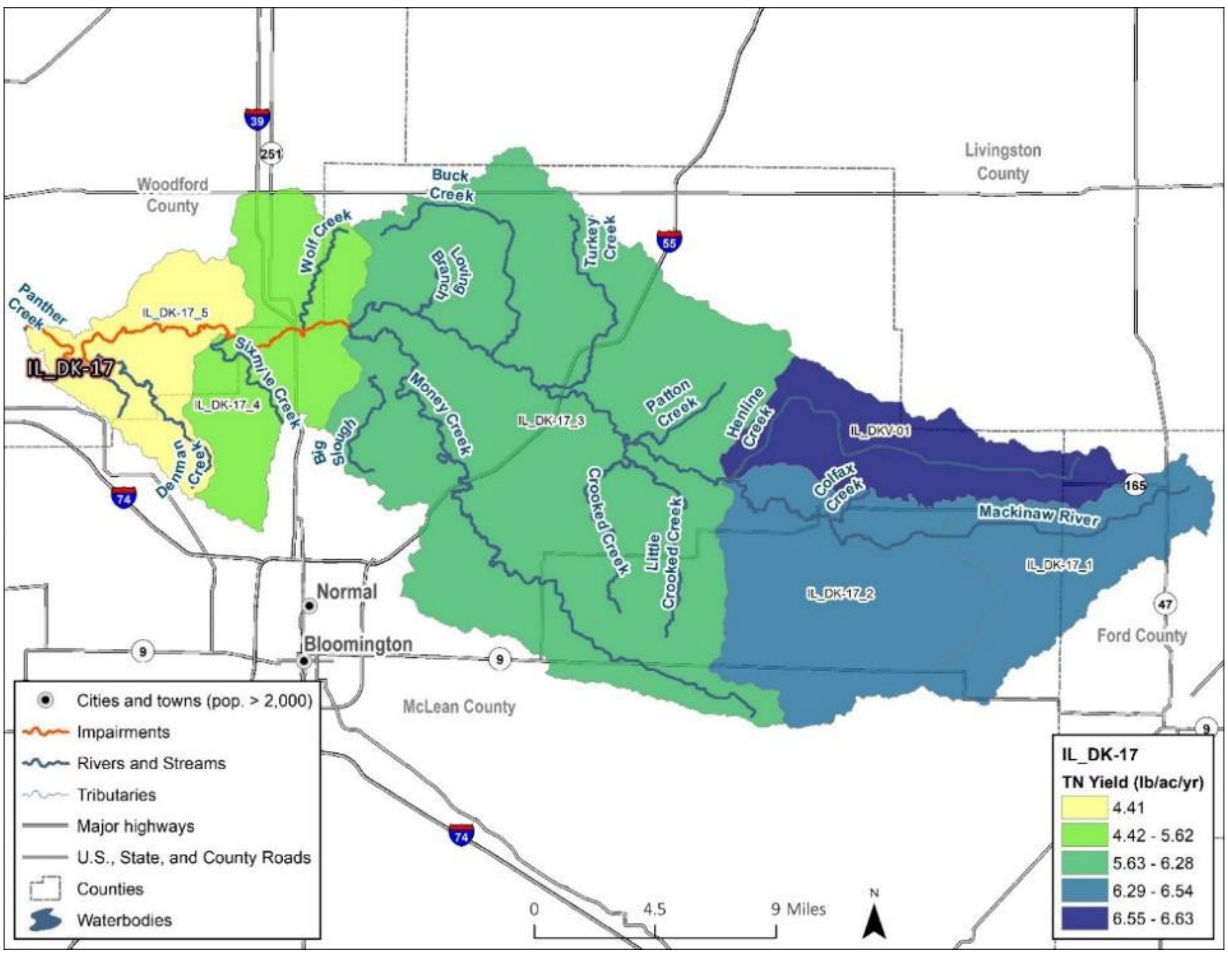

Figure 21. Relative nitrate yields (lb/ac/yr) for drainage areas in Mackinaw River (IL_DK-17).

8.2.4 Step 4: Target Critical Areas and BMP Opportunities

This section contains part of the requirement for U.S. EPA's ***element three:*** *identification of critical areas.*

Critical areas are considered by U.S. EPA (2018) as areas that are 1) large sources of pollutants, 2) have the greatest pollutant transport potential, and 3) provide opportunity for improvements (i.e., areas disproportionately impacting impaired streams, areas with local support and participation, etc.). Sources and pathways of pollutants (Steps 1-3) were used to determine critical areas for the first five years of implementation. CSA selection is an iterative process. When all information is not known or more information is needed, monitoring of plan implementation and use of an adaptive management approach will help to determine what areas to target for implementation.

Animal agriculture has been identified as the most significant source of bacteria loading to Mackinaw River (IL_DK-13). Locations of animal agriculture operations were identified in an aerial imagery assessment and the relative density of these operations across the Mackinaw River (IL_DK-13) impaired subwatershed is provided in Figure 22. Areas with relatively high density of animal agriculture operations, or areas with darker shading, are considered critical areas for implementation. The first priority for implementation is the darker areas in Figure 22 that represent the highest animal operations density. The second priority is the next tier of densities in Figure 22 that are colored orange.

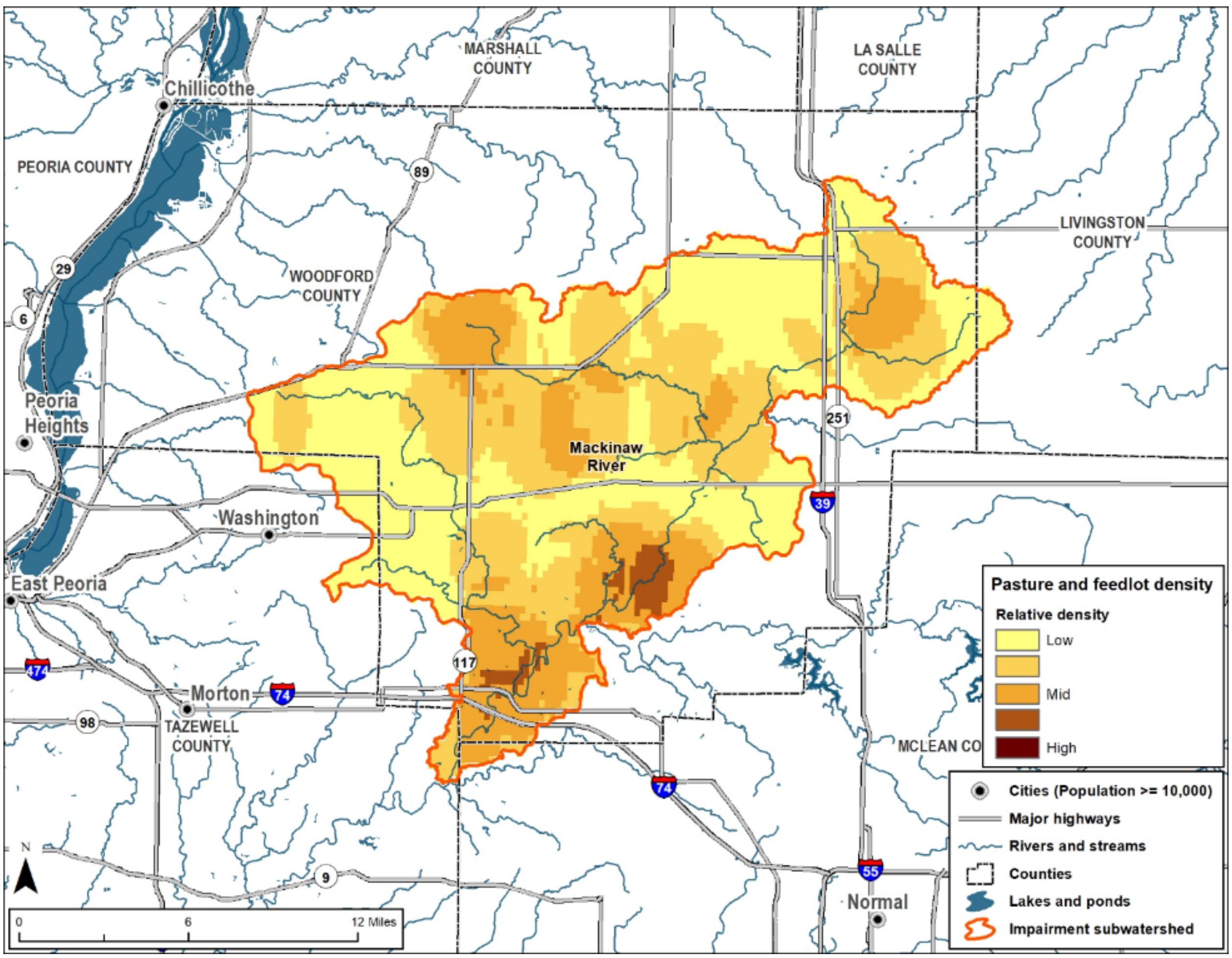

Figure 22. Animal agriculture operations density in Mackinaw River (IL_DK-13).

Agricultural runoff from cropland is the most significant source of nitrate loading to Mackinaw River (IL_DK-17). Critical areas for nitrate-reducing practices are considered drainage areas that contribute the greatest relative nitrate yields as provided by the STEPL modeling results, as indicated in Figure 21. The first priority is for the Henline Creek subwatershed that has the highest relative nitrate yields (colored blue in Figure 21), and the second priority is for the headwaters of the Mackinaw River upstream of the confluence of Henline Creek that has the second highest relative nitrate yields (colored turquoise in Figure 21).

8.3 Best Management Practices

This section contains the second requirement for U.S. EPA's ***element three:*** *description of non-point management measures needed to achieve load reductions.*

Within the watershed planning framework, candidate BMPs are identified and then evaluated to determine which BMPs will best address the causes and sources of pollutant loads. BMPs are presented in this section which address the highest relative sources of fecal coliform and nitrates in each critical area. Table 31 includes a suite of BMPs that could be used to achieve necessary load reductions in the watershed. Descriptions of each BMP are provided in the following sections. The level of effort necessary to achieve required reductions is provided in Section 8.3.4. While there are many different BMP scenarios that could be used to achieve pollutant load reductions, this plan provides one example.

Table 31. BMP removal efficiencies for example practices

Source	Practice	Fecal Coliform Removal Efficiency	Nitrate Removal Efficiency
Agricultural runoff (animal agriculture and cropland runoff)	**Animal agriculture practices**		
	Feedlot and pasture BMPs	90-97% [a]	--
	Livestock exclusion BMPs	24 - 46% [b]	
	Cropland practices		
	Nutrient and fertilizer management	--	15% [d]
	Vegetated buffers and filter strips	34-74% [c]	90% [d]
	Drainage water management	--	46% [d]
	Denitrifying bioreactors	--	40% [d]
Wildlife	**Wildlife management practices**	Varies depending on nature of local wildlife populations	--

a. Source: Meals and Braun 2006
b. Source: U.S. EPA 2003
c. Source: Wenger 1999
d. Source: IEPA and IDOA 2015

8.3.1 Animal Agriculture Practices

Proper management of runoff and waste from animal agriculture is important to improving water quality and reducing bacteria and nutrient loading to the watershed. Animal agricultural operations are typically either pasture-based or confined, or a combination of the two. The operation type dictates the practices needed to manage manure and soil erosion from the facility. A pasture or open lot system with a relatively low density of animals (1 to 2 head of cattle per acre [U.S. EPA 2003]) may not produce manure in quantities that require management for the protection of water quality. If excess manure is produced, then the manure will typically be stored which can then be land applied. Application of manure should be at agronomic rates, taking into account commercial fertilizer application, when the ground is not frozen and precipitation forecasts are low. Rainfall runoff should be diverted around storage facilities with berms or grassed waterways.

Confined facilities (typically dairy cattle, swine, and poultry operations) often collect manure in storage pits. Wash water used to clean the floors and remove manure buildup combines with the solid manure to form a liquid or slurry in the pit. Final disposal of waste usually involves land application on the farm or transportation to another site.

Animal agriculture BMPs generally seek to contain manure and manure wastewater; contain and treat runoff contaminated with manure or manure wastewater; divert clean water; and prevent runoff following manure land application. Feedlot and pasture BMPs include:

- **Composting manure structures and manure management**. Composting manure structures contain manure and other organic materials as they are broken down through aerobic microbial processes. Once decomposed, the organic materials are suitable for storage, on farm use, and application to land as a soil amendment. Composting facilities typically consist of a concrete floor separated by stalls, cover such as a roof or loose tarp is recommended to maintain an environment conducive to aerobic digestion (NRCS 2017a). Other manure management practices include:
    - Grading, earthen berms, and such to collect, direct, and contain manure
    - Installation of concrete pads
- **Runoff management** (runoff from production areas)
    - Grading, earthen berms, and such to collect and direct manure-laden runoff
    - Filter strips
    - Storage ponds
- **Clean water diversion**
    - Roof runoff management
    - Grading, earthen berms, and such to collect and direct uncontaminated runoff
- **Manure land application**
    - Nutrient management strategy (e.g., the 4Rs: **R**ight Source, **R**ight Rate, **R**ight Time, **R**ight Place), see Fertilizer Management
    - Filter strips and grassed waterways
- **Rotational grazing.** Rotational grazing consists of rotating animals through a series of paddocks to allow for reestablishment of vegetation. This practice also reduces concentration of manure, improves pasture cover, and therefore reduces nutrient losses from fields.
- **Forage and biomass planting.** Forage and biomass planting and management establishes diverse, compatible, and resilient species and/or varieties of vegetation on pastures. When managing forage and biomass species, seedbed preparation, seed species and variety selection, grazing requirements, and biomass harvest frequency are all key considerations. Benefits of forage management include:
    - Improvements or maintenance of livestock nutrition and health
    - Increase in forage supply
    - Reduction in soil erosion
    - Improvements in soil and water quality
    - Feedstock for biofuel or energy production

In addition, BMPs for alternative water systems and exclusion fencing can be used to reduce nutrients and fecal coliform from livestock with access to streams. These BMPs limit or eliminate livestock access to a stream or waterbody. Fencing can be used with controlled stream crossings to allow livestock to cross a stream while minimizing disturbance to the stream channel and streambanks. Providing alternative water supplies allows animals to access drinking water away from the stream, thereby minimizing the impacts to the stream and riparian corridor. U.S. EPA (2003) studied the impacts of providing alternative watering sites without structural exclusions and found that cattle spend 90% less time in the stream when alternative drinking water is furnished and estimates that fecal coliform reductions from 29-46% can be expected.

8.3.2 Cropland Practices

Cropland runoff is an important source of nitrate loading to impaired segments in the Mackinaw River watershed. Example cropland BMPs to address nitrate loading are presented in the following subsections and estimated reductions are summarized in Table 31. A subset of the management practices provided in the Illinois Nutrient Loss Reduction Strategy (NLRS) are included for use in the Mackinaw River watershed. Other management practices can also be used to achieve the goals of the TMDL and this implementation plan. The Illinois Council on Best Management Practices provides additional information on these and other BMPs (http://illinoiscbmp.com/). Many of these practices have the added benefit of improving soil health.

Nutrient and Fertilizer Management

Proper application of fertilizer (both commercial and manure) to cropland can greatly reduce nitrogen levels in agricultural runoff. In general, nutrient and fertilizer management aims to optimize application rates and improve storage and disposal of fertilizer to reduce pollution in runoff.

In Illinois, approximately 70% of all nitrogen fertilizer is applied in the form of anhydrous ammonia (ICBMP 2014). The Illinois Agronomy Handbook (IAH) recommends that nitrogen should be applied in the fall and application to frozen ground or snow cover should be strongly discouraged (University of Illinois Extension 2009). IAH guidance for determining the appropriate nitrogen application rates for different fertilizer products is based on an “Maximum Return to Nitrogen” approach which incorporates regional factors and price data to determine a range of appropriate application rates. The implementation of appropriate nutrient and fertilizer management practices should consider recommendations provided by the NRLS and IAH and should incorporate the 4Rs – **R**ight Source, **R**ight Rate, at the **R**ight Time, and in the **R**ight Place.

Fertilizer transport, storage, and disposal practices should also be monitored to reduce potential pollution in runoff. Commercial fertilizers should be stored at least 100 feet from nearby surface waters and should not be stored underground or in pits. Application equipment should be cleaned, inspected, and calibrated regularly, and excess fertilizer from wash water should be recovered for reuse. Disposal of commercialized fertilizers should follow manufacturer guidelines. Improvements to storage and disposal practices may require improvements to existing equipment or storage infrastructure to reduce potential leakages.

Vegetated Buffers and Filter Strips

Vegetated buffers and filter strips provide many benefits and can effectively address water quality degradation. Riparian buffers that include perennial vegetation and trees can filter runoff from adjacent cropland and the root structure of the vegetation in a buffer enhances subsequent trapping of pollutants. However, buffers are only effective in this manner when the runoff enters the buffer as a slow moving, shallow “sheet”; concentrated flow in a ditch or gully and quickly passes through the buffer offering minimal opportunity for retention and uptake of pollutants. The Illinois Natural Resources Conservation Service (NRCS) electronic Field Office Technical Guide recommends the minimum width of a riparian buffer should be 2.5 times the width of the stream (at bank-full elevation) or 35 feet for water bodies to achieve additional water quality improvements (NRCS 2017b).

Filter strips are a strip of permanent vegetation located between disturbed land and environmentally sensitive areas that can effectively address water quality degradation from nutrient loading while also enhancing habitat (NRCS 2017c). Filter strips provide many of the same benefits as vegetated buffers but are also subject to the same design considerations. Determining adequate filter strip widths depends on the slope of the land. Table 32 summarizes the minimum and maximum flow lengths for filter strips according to Illinois NRCS standards.

Table 32. Minimum and maximum filter strip length for land slope (NRCS 2017c)

Slope (%)	0.5	1.0	2.0	3.0	4.0	5.0 or greater
Minimum (feet)	36	54	72	90	108	117
Maximum (feet)	72	108	144	180	216	234

A study completed by The Nature Conservancy in the Mackinaw River watershed concluded that due to the significant presence of tile drainage systems in the region, drainage management practices, such as vegetated buffers and filter strips, should be implemented in combination with subsurface management practices (Lemke et al. 2011). Depending on the nature of pollutant loading, vegetated buffers and filter strips may reduce pollutant loading from a variety of agricultural and non-agricultural sources.

Drainage Water Management

Drainage water management, or controlled drainage, refers to the management of the drainage volume and water table elevation under an agricultural field. Drainage water management is applicable to areas with high water tables and wet soils where tile drains are common, such as the Mackinaw River watershed.

Implementation of drainage water management involves controlling the quantity of water discharged from the outlet structure of a tile drainage system. This often involves the elevation of a drain or use of water control structures to store water prior to being discharged through an outlet (NRCS 2020a). While controlled drainage structures do not directly remove nitrate from cropland runoff, they can provide significant flow volume reduction which reduces the quantity of polluted cropland runoff traveling directly to nearby waterbodies (IDALS et al. 2016).

Denitrifying Bioreactors

Denitrifying bioreactors are structures that improve water quality by reducing the nitrate content of subsurface agricultural drainage flow, such as flow from tile drainage systems. Bioreactors are composed of a below ground media chamber containing woodchips or another carbon media which filters nitrogen from cropland runoff. NRCS (2020b) recommends that bioreactors be designed for a minimum of a 10-year lifespan.

8.3.3 Wildlife Management Practices

Fecal coliform loading from wildlife is commonly from animal waste that is contributed in-stream or is transported to streams from nearby habitats. Management practices targeting wildlife often focus on reducing bacterial loading from surrounding land cover in the watershed by reducing the access of wildlife populations in sensitive ecological areas, including wetlands, croplands, and forested areas (MPCA 2020). Management practices that can reduce bacterial loading from wildlife could include:

- Development of regulatory solutions, such as wildlife feeding bans, control of nuisance populations, or wildlife barriers on storm sewers in urban areas.
- The incorporation of riparian buffers to limit wildlife access to streams and deter waterfowl congregation.
- Development of outreach and education program to address concerns associated with wildlife feeding. This could involve direct outreach to communities where close interactions with wildlife are common and signage in public areas, parks, and other recreational areas.

8.3.4 Level of BMP Implementation

This section contains the requirement for U.S. EPA's ***element two:*** *estimate of the load reductions expected from management measures.*

While critical areas identify locations in which to target implementation activities for the first five years of the plan, it is unlikely that the needed TMDL reductions will be met with only work in these areas. Therefore, a general level of implementation was calculated for each impaired subwatershed to provide an estimate of the effort required to achieve load reductions. These calculations may increase or decrease as management activities are evaluated and monitored through the adaptive management process.

Level of Implementation for Mackinaw River (IL_DK-13)

A 53% reduction in fecal coliform bacteria is required to attain the WQS in Mackinaw River (IL_DK-13). Based on the estimated relative contributions of nonpoint sources and the BMPs identified in previous sections, the following level of implementation is recommended to achieve necessary bacterial load reductions:

- Install livestock exclusion BMPs on 10 miles of streams that are accessible to livestock.
- Treat 7,200 acres of pasture-based animal agriculture operations with vegetated buffers and filter strips.

The required fecal coliform reductions are unlikely to be achieved through implementation which solely addresses the highest contributing sources of bacteria. Therefore, additional feedlot and pasture BMPs (i.e., compost manure structures, feedlot runoff management, and clean water diversions) can also be used to achieve required fecal coliform reductions.

Level of Implementation for Mackinaw River (IL_DK-17)

A 44% reduction in nitrate loading to Mackinaw River (IL_DK-17) is required to attain WQS. Table 33 provides an implementation scenario for select cropland practices.

Table 33. Mackinaw River (IL_DK-17) cropland implementation scenario

BMP	Area treated (acres)	Percent of Cropland Acres Treated
Nutrient and fertilizer management	126,600	50%
Vegetated buffers and filter strips	101,300	40%
Drainage water management	12,650	5%
Denitrifying bioreactors	12,650	5%
Total load reduction from existing conditions = 44%		

Monitoring and public outreach should be incorporated throughout implementation of these recommended practices to further refine and direct the level of BMP implementation needed to achieve necessary load reductions in the watershed. More information on existing and recommended monitoring and outreach activities is available in Section 8.5.

8.4 Technical and Financial Assistance

*This section contains the requirements for U.S. EPA's **element four:** technical and financial assistance needed, associated costs, and the sources and authorities that will be relied upon for implementation.*

This implementation plan focuses on voluntary efforts and a result, technical and financial assistance are essential to successful implementation over time. This section identifies sources of funding and technical assistance to implement the recommended implementation practices. This section also identifies the watershed partners who could play a role in implementation.

8.4.1 Implementation Costs

The total cost to implement the Mackinaw River Watershed TMDL is estimated between $4 - $10 million over the 25-year implementation period recommended in this plan. Total costs were calculated based on the estimated level of implementation needed to achieve required pollutant load reductions and are derived from a variety of sources including the Illinois NLRS, the 2020 EQIP schedule, and other regional cost data.

Table 34 summarizes the estimated cost per recommended BMP. A breakdown of the total estimated cost is provided in Table 35.

Table 34. Implementation costs per BMP

BMP	Cost/Unit
Cropland practices	
Nutrient and fertilizer management	($4.25) - $6.22 per pound of nitrogen removed [a]
Vegetated buffers and filter strips	1.63 per pound of nitrogen removed [a]
Drainage water management	$30 - $75 per acre treated [b]
Denitrifying bioreactors	$1.38 per pound of nitrogen removed [a]
Animal agriculture practices	
Livestock exclusion BMPs [c]	$1.78 per foot [d]
Vegetated buffers and filter strips	$165 per acre treated [b]

a. Source: IEPA and IDOA 2015
b. Source: Tetra Tech and Lake Bloomington Watershed Planning Committee 2008
c. Estimated costs for livestock exclusion in this scenario only include the cost of exclusion fencing. The costs of alternative watering systems may vary depending on site-specific considerations.
d. Source: 2020 EQIP schedule

Table 35. Plan cost estimate

BMP/Activity	Cost Estimate
Cropland practices	$980,000 - $2,900,000
Animal agriculture practices	$1,300,000
Local capacity to implement the plan	$2,400,000 - $5,600,000
Total Costs	**$4,680,000 - $9,800,000**

a. Cropland practices included in this cost estimate are identified in Table 33.
b. Local capacity includes staff time and resources necessary to implement BMPs and other activities. This also includes programmatic costs associated with recommended monitoring, education, and outreach components.

8.4.2 Financial Assistance Programs

There are many existing financial assistance programs which may assist with funding implementation activities. Many involve cost sharing, and some may allow the local contribution of materials, land, and in-kind services (such as construction and staff assistance) to cover a portion or the entire local share of the project. Several of these programs are presented in Table 36. In addition to these programs, partnerships between local governments can help to leverage funds. State and federal grant programs may also be available, depending on the nature of the implementation activity.

Table 36. Potential funding sources

Funding Program	Type of Funding	Entity	Eligible Projects	Eligible Applicants	Available Funding	Website
Federal Programs						
Five Star Wetland and Urban Water Restoration Grant	Grant	U.S. EPA	On-the-ground wetland, riparian, in-stream and/or coastal habitat restoration, education and training activities through community outreach, participation and/or integration with K-12 environmental curriculum. Projects that provide benefits to the community through ecological and environmental efforts, and partnerships.	Non-profits, state government agencies, local and municipal governments, Indian tribes, and educational institutions	$10,000-$40,000 per project	http://www.nfwf.org/fivestar/Pages/home.aspx
Wetland Program Development Grants	Grant	U.S. EPA	Projects that promote the understanding of water pollution through review and refinements of wetland programs. Cause and effects, reduction and prevention, and elimination of water pollution.	States, tribes, local governments, interstate associations, and intertribal consortia (Regional grants) Nonprofits, interstate associations and intertribal consortia (National grants)	$20,000 to $600,000/fiscal year	https://www.epa.gov/wetlands/wetland-program-development-grants
North American Wetlands Conservation Act (standard grant)	Grant through the North American Wetlands Conservation Act	USFWS	Wetlands conservation projects in the United States, Canada, and Mexico. Projects must provide long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats.	Non-profits, state government agencies, local and municipal governments, Indian tribes, and educational institutions	Since 1995 1,025 projects have been funded with a combined total of over $850 million grant dollars. Requires a 1-1 partner contribution	https://www.fws.gov/service/north-american-wetlands-conservation-act-nawca-grants-us-standard
North American Wetlands Conservation Act (small grant)	Grant through the North American Wetlands Conservation Act	USFWS	Wetlands conservation projects in the United States, Canada, and Mexico. Grant requests must not exceed $100,000.	Non-profits, state government agencies, local and municipal governments, Indian tribes, and educational institutions	Since 1996, 750 projects have been funded with a combined total of $43.2 million grant dollars Requires a 1-1 partner contribution	https://www.fws.gov/service/north-american-wetlands-conservation-act-nawca-grants-us-small
Environmental Quality Incentive Program (EQIP)	Cost-share through contract (usually 3 years)	NRCS	Approved conservation practices that are constructed according to NRCS.	Farmers in livestock, agricultural, or forest production who utilize approved conservation practices	Up to 75% of project cost	https://www.nrcs.usda.gov/wps/portal/nrcs/il/programs/financial/eqip/
National and State Conservation Innovation Grants	EQIP funded grants	NRCS	Innovative problem-solving projects that boost production on farms, ranches, and private forests that improve water quality, soil health, and wildlife habitat.	Non-federal governmental or nongovernmental organizations, American Indian Tribes, or individuals. Producers involved in CIG funded projects must be EQIP eligible.	More than $22.6 million was awarded to 33 projects in 2017 Grantees much match funds	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/
Environmental Education Grants Program	Grant	U.S. EPA	Environmental education programs that promote environmental awareness and stewardship and help provide people with the skills to take responsible actions to protect the environment.	• Local education agencies • State education or environmental agencies • Colleges or universities • Non-profit organizations 501(c)(3) • Noncommercial educational broadcasting entities • Tribal education agencies (including schools and community colleges controlled by an Indian tribe, band, or nation)	In 2015, 35 projects in the county were funded for a total of $3,306,594	https://www.epa.gov/education/environmental-education-ee-grants
State/Federal Partnerships						
Nonpoint Source Management Program (319)	Grant	U.S.EPA/ IEPA	Priority given to projects that implement cost-effective corrective and preventative BMPs on a watershed scale. Also available for BMPs on a non-watershed scale and the development of information/education nonpoint source pollution control programs. Projects that meet requirements of a NPDES permit are not eligible for 319 funding.	Units of government and other organizations	Approximately $3,000,000 is available per year, awarded amongst approximately 15 projects. Provides up to 60% project cost share	https://www2.illinois.gov/epa/topics/water-quality/watershed-management/nonpoint-sources/Pages/grants.aspx Supplemental guidance on 319 funding for urban BMPS: http://www.epa.state.il.us/water/watershed/publications/nps-pollution/urban-bmps-supplemental-guidance.pdf
Clean Water State Revolving Fund	Low interest loans, purchase of debt or refinance, subsidization	IEPA	Nonpoint source pollution control. Green infrastructure projects, construction of municipal wastewater facilities and decentralized wastewater treatment systems, watershed pilot projects, stormwater management, technical assistance (qualified nonprofit organizations only).	Corporations, partnerships, governmental entities, tribal governments, state infrastructure financing authorities	Varies	https://www.epa.gov/cwsrf

Funding Program	Type of Funding	Entity	Eligible Projects	Eligible Applicants	Available Funding	Website
Healthy Forest Reserve Program	Easements, 30-year contracts, 10-year contracts	USDA	Projects that restore, enhance and protect forestland reserves on private land to measurably increase the recovery of threatened or endangered species, improve biological diversity, or increase carbon storage.	Private landowners	1. 10-year restoration cost-share agreement: up to 50% of average cost of approved conservation practices 2. 30-year easement: up to 75% of the easement value of the enrolled land plus 75% of the average cost of the approved conservation practices 3. 30-year contract on acreage owned by Indian Tribes 4. Permanent easements: up to 100% of the easement value of the enrolled land plus 100% of the average cost of the approved conservation practices	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/forests/
Healthy Watersheds Consortium Grant	Grant	EPA, NRCS and U.S. Endowment for Forestry and Communities	"Healthy watershed" program development projects that aim to preserve and protect natural areas, or local demonstration/trainings. Conservation easements are *not* eligible. Grants awarded are generally within three categories: 1. Short term funding to leverage larger financing for targeted watershed protection 2. Funds to help build the capacity of local organizations for sustainable, long term watershed protection 3. New replicable techniques or approaches that advance the state of practice for watershed protection.	Consortiums or "one entity who is linked with or in a collaborative partnership with other groups or organizations having similar healthy watersheds protection goals"	$50,000-150,000 per project	https://www.epa.gov/hwp/healthy-watersheds-consortium-grants-hwcg
Partners for Fish and Wildlife Program	Technical and financial support	USFWS	Collaborations and partnerships with private landowners to improve fish and wildlife habitat on their lands. Voluntary, community-based stewardship for fish and wildlife conservation.	Private landowners	Varies per project/partners	https://www.fws.gov/program/partners-fish-and-wildlife
State Programs						
Open Space Lands Acquisition and Development (OSLAD) Grant/Land and Water Conservation Fund Grant	Grant	IDNR	Acquisition and/or development of land for public parks and open space by Illinois governments. *Note: OSLAD program will not be available for Fiscal Year 2021 according to DNR website.*	Local governments	Up to $750,000 for acquisition projects and $400,000 for development/renovation projects. Funding up to 50% of project cost	https://www.dnr.illinois.gov/aeg/pages/openspacelandsaquisitiondevelopment-grant.aspx
Green Infrastructure Grant Opportunities	Grant	IEPA	Improvements to water quality through the construction of BMPs, especially to reduce stormwater runoff.	Units of government and organizations, colleges and universities, conservation/park districts	Reimbursement for a total of $5,000,000 annually starting in 2021.	https://www2.illinois.gov/epa/topics/grants-loans/water-financial-assistance/Pages/igig.aspx
Unsewered Communities Planning and Construction Grant Programs	Grant	Illinois EPA	Funding available through the Rebuild Illinois Capital Plan over five years for Construction Grants for wastewater collection and/or treatment facilities and for the next 4 years for Planning Grants to assist small and disadvantaged communities in developing a Project Plan that identifies a solution to their wastewater collection and treatment needs. A well-developed Project Plan would then allow communities to apply for the Construction Grant	Unsewered communities with inadequate wastewater systems such as individual septic systems	$ 1,000,000 for Planning Grants and $1, 000,000 for Construction Grants	https://www2.illinois.gov/epa/topics/grants-loans/unsewered-communities/Pages/default.aspx
Illinois Buffer Partnership	Cost share, on site assistance from Trees Forever (Iowa) staff, project signs and field days	Illinois Buffer Partnership	Eligible projects include: Installation of streamside buffer plantings on projects including riparian buffers, livestock buffers, streambank stabilization projects, wetland development, pollinator habitat, rain gardens, and agroforestry projects.	Landowners willing to implement projects on their lands which can serve as a demonstration site to showcase benefits of conservation buffers.	Reimbursed up to $2,000 for 50 percent of the expenses remaining after other grant programs are applied	http://www.treesforever.org/Illinois_Buffer_Partnership.

8.4.3 Partners

There are several partners within the Mackinaw River watershed that may provide technical or financial assistance to promote successful TMDL implementation and watershed management:

- Army Corps of Engineers
- County Forest Preserve Districts
- Ecology Action Center
- Farm Service Agency
- Heartlands Conservatory
- Illinois Buffer Partnership
- Illinois Department of Agriculture
- Illinois Department of Natural Resources
- Illinois Certified Crop Adviser Program
- Illinois Council on Best Management Practices
- Illinois Council on Food and Agriculture Research (C-FAR)
- Illinois Department of Public Health
- IEPA
- Illinois Farm Bureau
- Illinois Rural Water Association
- Illinois State Water Survey
- Local and regional governments
- Mackinaw River State Fish & Wildlife Area
- National Great Rivers Research and Education Center
- NRCS
- Parklands Foundation
- Soil and Water Conservation District offices
- The Nature Conservancy
- University of Illinois (and Extension units)
- U.S. EPA Region

8.5 Public Education and Participation

*This section contains the requirements for U.S. EPA's **element five** of a watershed plan: information and education component.*

Raising stakeholders' awareness about issues in the watershed and developing strategies to change stakeholders' behavior is essential to promoting voluntary participation. Successful implementation in the Mackinaw River watershed will rely heavily on effective public education and outreach activities that will encourage participation and produce changes in behavior. This section presents recommendations related to developing and implementing coordinated watershed-wide education and outreach.

The first step to a successful information and education strategy is to identify target audiences and to determine how to best reach these audiences. Potential audiences in the Mackinaw River watershed may include agricultural and row crop producers, Certified Crop Advisors, and riparian landowners. Consideration should be given to the complexity of the water resource concerns of each of these groups. Whenever possible, stakeholder attitudes and preferences should be considered in the implementation of protection activities and should influence message development, selection of outreach platforms, and other aspects of information and education.

Keeping in line with the adaptive nature of a nine-element plan, engagement and outreach strategies should also be flexible to accommodate future changes in stakeholder awareness and behaviors. A pre- and post-implementation survey can be used to measure these changes, and the results of these surveys should be shared between local partners. These surveys can be used to measure changes in the level of stakeholder knowledge and involvement and will help watershed outreach campaign organizers to further develop tailored outreach messages. Other measures of change might include the number of producers signing up for cost-share programs or participating in field days or demonstration projects. Results from these outreach activities should be used to inform potential changes and adaptations to this implementation plan.

Potential targeted audiences, concerns, and communication channels are outlined in Table 37.

Table 37. Potential audience concerns and communication channels

<table>
<tr><th>Key Target Audiences</th><th>Potential Audience Concerns</th><th>Potential Communication Channels</th></tr>
<tr><td>Agricultural producers</td><td>• Potential future regulation
• Cost and programmatic requirements of funding programs
• Water quality issues (safety, aesthetics)</td><td rowspan="2">• University of Illinois Extension
• Commodity groups
• Soil and Water Conservation Districts
• Agricultural associations
• 4-H groups
• Watershed groups
• Demonstration farms
• Field days
• Radio and newspapers
• Word of mouth
• On-site visits
• Informational meetings
• Social media
• Presentations and stakeholder meetings
• Existing community, waterfront, and regional associations</td></tr>
<tr><td>Row crop producers</td><td>• Loss of crops due to pests
• On-field practices to implement
• Costs and programmatic requirements of funding programs
• Water quality issues (safety, aesthetics)
• Loss of cropland acreages
• Flooding</td></tr>
<tr><td>Certified Crop Advisors</td><td>• Areas and practices to target for implementation
• Costs and programmatic requirements for funding programs
• Updated information to pass along to agricultural producers</td><td>• Training sessions
• Outreach and distributed information from research institutions
• Informational meetings</td></tr>
<tr><td>Riparian landowners</td><td>• Streambank erosion
• Surface water issues (safety, aesthetics)
• Property values
• Flooding
• Drinking water quality</td><td>• Social media
• Local media and newspapers
• Local governments and Soil and Water Conservation Districts
• Watershed groups
• Informational meetings and community events
• Brochures and other handouts
• County and state health departments
• Existing community, waterfront, and neighborhood associations</td></tr>
</table>

Resources exist which are relevant to several of these stakeholders which can improve the distribution of information and strengthen communication channels between farmers, permitted entities, and neighboring areas. Training and education programs for crop and livestock producers are also available which can increase implementation and improve long-term maintenance of agricultural BMPs.

Illinois Manure Share

Created by the University of Illinois Extension, Illinois Manure Share is a free manure exchange program between livestock owners who have excess manure and those looking for organic material to use for gardening or landscaping. Its goal is to remove the manure from farms that do not have the acreage to adequately utilize its nutrients on their fields or pastures, benefiting water quality by both reducing nutrient runoff and lowering the amount of commercial fertilizer used by gardeners. For more information visit: http://web.extension.illinois.edu/manureshare/.

Animal Agricultural Discussion Group

The Animal Agricultural Discussion Group (AADG) is an informal and iterative group of individuals from the USDA, all sectors of the animal feeding industry and their association, academia, and states, formed by the U.S. EPA. The goal of the AADG is to develop a shared understanding of how to implement the CWA through open communication and improved two-way understanding of viewpoints.

The group convenes via conference calls and face-to-face meetings twice per year. For more information, visit: https://www.epa.gov/npdes/factsheet-animal-agriculture-discussion-group.

University of Illinois Extension Units

The University of Illinois Extension has several units within the Mackinaw River watershed. Each unit has extensive education and outreach programs in place that range in topic from commercial agriculture, horticulture, energy, and health that can provide meaningful resources to the information and education effort in the watershed.

- Fulton, Mason, Peoria, Tazewell Extension Unit
    - https://extension.illinois.edu/fmpt
- Livingston, McLean, Woodford Extension Unit
    - https://extension.illinois.edu/lmw
- Champaign, Ford, Iroquois, Vermilion Extension Unit
    - https://extension.illinois.edu/cfiv

8.6 Schedule and Milestones

This section contains the requirements for U.S. EPA's element ***six and seven*** *of a watershed plan: implementation schedule and a description of interim measurable milestones.*

A key part of U.S. EPA's nine-elements is interim milestones that provide meaningful evaluation points and a focus for program activities. Interim milestones are steps that demonstrate that implementation measures are being executed in a manner that will ensure progress over time. Milestones are not changes in water quality. Measurable milestones are an important tool for directing limited resources towards the array and number of sources and nonpoint source pollution problems across the watershed. Interim measurable milestones are presented in Table 38.

A 25-year implementation schedule is assumed and divided into three phases: 2020-2025, 2026-2035, and 2036-2045. Each phase will rely on an adaptive management approach and will build upon previous phases. Short-term efforts (Year 1-5) include implementing practices in critical areas. Mid-term efforts (Year 6-15) are intended to build on the results of short-term implementation activities. This includes evaluating the success of Phase 1 projects installed (success rate, BMP performance, improvements or reductions actualized, actual costs, etc.). Long-term efforts (Year 16-25) are those implementation activities that result in the watershed reaching full pollutant load reductions.

Table 38. Schedule and milestones for TMDL implementation

Watershed (AUID)	Source	Milestones		
		Short-Term (Year 1-5)	**Mid-Term (Year 6-15)**	**Long Term (Year 16-25)**
All	All	Conduct public education and outreach to key target audiences. Conduct additional monitoring and assessment to focus implementation activities.		
Mackinaw River (IL_ DK-13)	Agricultural runoff (animal agriculture)	Conduct inventory of livestock access to streams in impaired subwatershed 2 miles of livestock exclusion fencing implemented on identified streams, beginning in critical areas.	5 miles of livestock exclusion fencing implemented on identified streams.	10 miles of livestock exclusion fencing implemented on identified streams.
		Treat 1,500 acres of pasture with vegetated buffers and filter strips, beginning in critical areas.	3,600 acres of pasture treated with vegetated buffers and filter strips.	7,200 acres of pasture treated with vegetated buffers and filter strips.
Mackinaw River (IL_ DK-17)	Agricultural runoff (cropland runoff)	Implement 25,300 acres of nutrient and fertilizer management, beginning in critical areas.	63,200 acres of nutrient and fertilizer management.	126,600 acres of nutrient and fertilizer management.
		Treat 20,200 acres with vegetated buffers and filter strips, beginning in critical areas.	50,600 acres of cropland treated with vegetated buffers and filter strips.	101,300 acres of cropland treated with vegetated buffers and filter strips.
		Treat 2,500 acres of tile drained cropland with drainage water management, beginning in critical areas.	6,300 acres of tile drained cropland treated with drainage water management.	12,650 acres of tile drained cropland treated with drainage water management.
		Treat 2,500 acres of tile drained cropland with denitrifying bioreactors, beginning in critical areas.	6,300 acres of tile drained cropland treated with denitrifying bioreactors.	12,650 acres of tile drained cropland treated with denitrifying bioreactors.

8.7 Progress Benchmarks and Adaptive Management

This section contains the requirements for U.S. EPA's ***element eight*** *of a watershed plan: a set of criteria that can be used to determine whether loading reductions are being achieved over time.*

To guide plan implementation through each of the three phases using adaptive management, water quality benchmarks are identified to track progress towards attaining WQS. Progress benchmarks (Table 39) are intended to reflect the time it takes to implement management practices, as well as the time needed for water quality indicators to respond.

Table 39. Progress benchmarks

Indicator	In-Stream Target	Segments	Timeframe	Progress Benchmark
Fecal coliform	200 org./100 mL	Mackinaw River (IL_DK-13)	Year 1-5	20% of load reductions
			Year 6-15	50% of load reductions
			Year 16-25	Full attainment of water quality standards
Nitrate	10 mg/L	Mackinaw River (IL_DK-17)	Year 1-5	20% of load reductions
			Year 6-15	50% of load reductions
			Year 16-25	Full attainment of water quality standards

To ensure management decisions are based on the most recent knowledge, the implementation plan follows the form of an adaptive and integrated management strategy and establishes milestones and benchmarks for evaluation of the implementation program. U.S. EPA (2008) recognizes that the processes involved in watershed assessment, planning, and management are iterative and that actions might not result in complete success during the first or second cycle. For this reason, it is important to remember that implementation will be an iterative process, relying upon adaptive management.

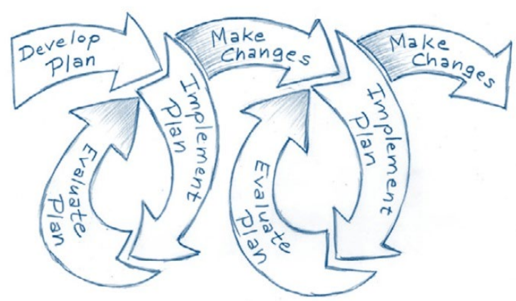

Figure 23. Adaptive management iterative process (U.S. EPA 2008).

Adaptive management is a commonly used strategy to address natural resource management that involves a temporal sequence of decisions (or implementation actions), in which the best action at each decision point depends on the state of the managed system. As a structured iterative implementation process, adaptive management offers the flexibility for responsible parties to monitor implementation actions, determine the success of such actions and ultimately, base management decisions upon the measured results of completed implementation actions and the current state of the system. This process, depicted in Figure 23, enhances the understanding and estimation of predicted outcomes and ensures refinement of necessary activities to better guarantee desirable results. In this way, understanding of the resource can be enhanced over time, and management can be improved.

In addition to focusing future management decisions, with established assessment milestones and benchmarks, adaptive management can include a re-assessment of the TMDLs. Re-assessment of a TMDL is particularly relevant when completion of key studies, projects or programs result in data showing load reductions or the identification/quantification of alternative sources. Reopening/ reconsidering the TMDLs may include refinement or recalculation of load reductions and allocations.

The implementation phases, milestones, and benchmarks will guide the adaptive management process, helping to determine the type of monitoring and implementation tracking that will be necessary to gauge progress over time. Evaluation for adaptive management can include a variety of evaluation components to gain a comprehensive understanding of implementation progress. An implementation evaluation determines if non-structural and structural activities are put in place and maintained by implementation partners according to schedule; this is often referred to as an output evaluation. An outcome evaluation focuses on changes to behaviors and water quality as a result of implementation actions. This type of evaluation looks at changes in stakeholder behavior and awareness (i.e., non-structural BMP effectiveness), structural BMP performance, and changes to ambient water quality.

8.8 Follow-Up Monitoring

*This section contains the requirements for U.S. EPA's **element nine** of a watershed plan: a monitoring component to evaluate the effectiveness of the implementation efforts over time.*

The ultimate measure of success will be documented changes in water quality, showing improvement over time (see Table 39 for progress benchmarks). In addition, long-term monitoring of the overall health and quality of the watershed is important. Monitoring will help determine whether the implementation actions have improved water quality and support future resource management decisions. In addition, monitoring will help determine the effectiveness of various BMPs and indicate when adaptive management should be initiated. The primary goal of the monitoring plan is to assess the effectiveness of source reduction strategies for attaining WQS and designated uses.

8.8.1 Water Quality Monitoring

Progress towards achieving WQS will be determined through ambient monitoring by IEPA. The state conducts studies of ambient conditions across the state by evaluating watersheds on a rotating basis, collecting measurements of physical, chemical, and biological parameters. This ambient monitoring program will continue as the Mackinaw River TMDL is implemented with a particular focus on impaired sites and increasing the understanding of pollutant sources. Water quality monitoring efforts may also be supported through volunteer citizen monitoring efforts that typically allow for more frequent monitoring at a lower cost and the formation of a monitoring committee may help streamline efforts.

Sampling during different flow regimes is also critical to understanding sources. Monitoring flow is also recommended for each stream site when water quality samples are taken. The Illinois NLRS (IEPA and IDOA 2019) Biennial Report recommends increasing the frequency of sampling practices, especially during high flow conditions.

8.8.2 Microbial Source Tracking

Sources of bacteria are widespread and often intermittent. Some sources pose a greater risk to human health than others. Understanding the different source contributions and their potential risk to human health is important to overall TMDL implementation and prioritizing implementation activities that address the recreational use impairments due to fecal coliform. Microbial source tracking (MST) is a useful tool to help differentiate sources of fecal indicator bacteria. Human markers along with a variety of other bird and animal markers can be identified. While human sources of fecal pollution are critical to eliminate, it is also important to minimize other sources that can cause illness in humans, although the actual risk associated with these other sources may fall within "acceptable" levels of risk. MST can help inform selection of BMPs for fecal coliform to best align with the pollution source.

Fecal Bacteroidetes, or fecal indicator bacteria, are used in MST. Two common types of testing are available for bacterial source tracking, quantification tests and presence/absence tests. While presence/absence tests are typically less expensive than a quantification test, they do not measure the relative amount of DNA from various fecal sources, which might be used to estimate the relative abundance of those sources. Neither test, however, can determine exact source location (i.e., this farm is contributing the most fecal coliform loads). Best professional judgement from site surveys and local knowledge can help determine source locations. MST monitoring and sample collection methods are similar to fecal coliform sampling procedures. They should include both dry and wet (samples taken within at least 24 hours of a rainfall of ½ inches or more) samples, and target areas with high levels of fecal coliform. Topography, watershed delineations, and other factors may also influence sample design.

8.8.3 BMP Effectiveness Monitoring

Multiple BMPs will be needed to address the water quality impairments in the Mackinaw River watershed. There are limited local data on the effectiveness of many BMPs; therefore, monitoring the results of programs and representative practices are critical. BMP monitoring can include quantitative monitoring of physical components (e.g., water quality and flow) qualitative (i.e., visual) monitoring of physical components (e.g., vegetation), and monitoring of behaviors. A monitoring program should be put in place as BMPs are implemented to 1) measure success and 2) identify changes that could be made to increase effectiveness.

8.9 Reasonable Assurance

U.S. EPA requires that a TMDL provide reasonable assurance that the required pollutant load reductions will be achieved, and water quality will be restored. A number of watershed groups are already active in the Mackinaw River watershed and have projects and on-going programming that will support successful attainment of the WQS outlined in this implementation plan. Examples of relevant groups are summarized below:

- **Illinois Council on Best Management Practices:** Illinois Council on Best Management Practices assists and encourages adoption of BMPs to protect and enhance natural resources and sustainability of agriculture in Illinois. One of the organization's primary goals is to increase voluntary BMP adoption through various programmatic efforts and incentives. Illinois Council on Best Management Practices also partners with several other organizations to implement an enhanced nutrient stewardship program entitled, "Keep It for the Crop (KIC) by 2025". KIC establishes goals for reducing nutrient losses from agricultural lands through adoption of the 4Rs of nutrient management and provides additional resources to support research, education, and monitoring of nutrient management efforts across the state.
- **The Nature Conservancy (TNC):** TNC has been working closely in the Mackinaw River watershed since 1994 to protect the river and its unique ecological resources. TNC continues to support research, BMP implementation, and other nutrient reduction activities in the area. TNC partners with the University of Illinois to support a demonstration farm in the watershed where various conservation methods are implemented and tested. TNC is also involved in the development of a Bloomington Water Fund which, if realized, would be used by local communities to efficiently leverage public and private funding for watershed conservation costs.
- **Ecology Action Center:** The Ecology Action Center, based out of Normal, IL, partners with agencies at the municipal and county level to protect local waterways. They provide educational, financial, and programmatic resources to inspire and assist local communities in making improvements to water, and other natural resources.

The efforts of these organizations will be essential to the success of this implementation plan. Local organizations with a legacy of positive community and watershed impact are more likely to encounter support and acceptance from local communities. While resistance to change and upfront cost can deter participation, educational efforts and cost-share programs can increase participation to levels needed to protect water quality.

Technical and financial assistance, as summarized in Section 8.4, provides the resources needed to improve water quality and meet watershed goals. Additional assurance can be achieved in implementation of the TMDLs through contracts, memorandums of understanding, and other similar agreements. With the support of outside funds and cost share programs, additional outside funding sources, water quality goals and recommended implementation in this plan can reasonably be achieved with the continued efforts of local and regional groups and the engagement of stakeholders and local communities.

Finally, with respect to point sources, IEPA will ensure that future renewals of NPDES permits in this watershed are consistent with the TMDLs. For NPDES permittees in the watershed, in order to meet assigned nitrate (as nitrogen) WLAs (TMDL endpoints), the recommendation is taking an approach as follows. Minor NPDES permittees (DAF <1.0 mgd) in the watershed draining to impaired segment IL_DK-17 with assigned nitrate-nitrogen TMDL WLAs will be required to monitor their effluent for this parameter in the next NPDES permits renewal cycle. Minor dischargers will be required to monitor for nitrate-nitrogen in the receiving stream, upstream and downstream of the discharge point to confirm the outcome of nonpoint source BMPs that have been implemented as outlined in the TMDL report, and document if the WLA is being met.

9. Public Participation

A public meeting was held on December 13, 2018, at the Davis Lodge in Hudson, IL to present the Stage 1 report and findings. A public notice was placed on the Illinois EPA website. There were many stakeholders present including representatives from John Wesley Powell Audubon Society, and Ecology Action Center. The public comment period closed on January 13, 2019. The John Wesley Powell Audubon Society submitted comments; the comments and responses are attached to the end of the Stage 1 report that is in Appendix A of this document.

A virtual public meeting was held on xxxxx at the xxxxx to present the Stage 3 report and findings. A public notice was placed on the IEPA website. The public comment period closed on xxxxx. Comments and response to comments are provided in Appendix D.

10. References

CDM. 2006. Evergreen Lake Watershed TMDL Report.

Evergreen Lake Watershed Planning Committee. 2006. Evergreen Lake Watershed Plan. Retrieved from: https://mcleanwater.org/wp-content/uploads/sites/3/2012/03/Evergreen_Lake_Watershed_Plan.pdf

Horsley and Witten, Inc. 1996. Identification and Evaluation of Nutrient and Bacterial Loadings to Maquoit Bay, Brunswick, and Freeport, Maine. Casco Bay Estuary Project.

ICBMP (Illinois Council on Best Management Practices). 2014. Illinois Agriculture: Our Focus on Water Quality. Available at: https://www.ifca.com/media/files/illinois_agriculture_water_quality_report.pdf

IDALS (Iowa Department of Agriculture and Land Stewardship), Iowa Department of Natural Resources, and Iowa State University College of Agriculture and Life Sciences. 2016. Iowa Nutrient Reduction Strategy: A Science and Technology-based Framework to Assess and Reduce Nutrient to Iowa Waters and the Gulf of Mexico. September 2016.

IDNR (Illinois Department of Natural Resources). 2005. Illinois Comprehensive Wildlife Conservation Plan and Strategy.

IEPA (Illinois Environmental Protection Agency). 1994. Quality assurance project plan. Bureau of Water, Division of Water Pollution Control. Springfield, Illinois.

IEPA (Illinois Environmental Protection Agency). 2016. Draft Illinois Integrated Water Quality Report and Section 303(d) List, 2016. Water Resource Assessment Information and Listing of Impaired Waters. Springfield, IL.

IEPA (Illinois Environmental Protection Agency). 2021. Illinois Integrated Water Quality Report and Section 303(d) List, 2018. Water Resource Assessment Information and Listing of Impaired Waters. Springfield, IL. February 2021. https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Documents/2018_Cycle_Integrated%20Report_FINAL_20210201.pdf.

IEPA (Illinois Environmental Protection Agency) and IDOA (Illinois Department of Agriculture). 2015. Illinois Nutrient Loss Reduction Strategy.

IEPA (Illinois Environmental Protection Agency) and IDOA (Illinois Department of Agriculture). 2019. Illinois Nutrient Loss Reduction Strategy, Biennial Report.

Illinois State Geological Survey (ISGS). 2003. Illinois Statewide 30-Meter Digital Elevation Model. Retrieved from: http://clearinghouse.isgs.illinois.edu/data/elevation/surface-elevation-30-meter-digital-elevation-model-dem.

Karr, J. R., K. D. Fausch, P. L. Angermeier, P. R. Yant, and I. J. Schlosser. 1986. Assessing Biological Integrity in Running Water: a Method and its Rationale. Illinois Natural History Survey Special Publication 5. Champaign, Illinois.

Lake Bloomington Watershed Planning Committee. 2008. Lake Bloomington Watershed Plan. June 22, 2008. Retrieved from: https://mcleanwater.org/wp-content/uploads/sites/3/2018/12/Lake_Bloomington_Watershed_Plan.pdf

Lemke, A., K. Kirkham, T. Lindenbaum, M. Herbert. 2011. Evaluating Agricultural Best Management Practices in Tile-Drained Subwatersheds of the Mackinaw River, Illinois. Journal of Environmental Quality 40(4): 1215-28. DOI: 10.2134/jeq2010.0119

Meals, D.W. and D.C. Braun. 2006. Demonstration of Methods to Reduce E. coli Runoff from Dairy Manure Application Sites. J Environ Qual 35:1088-1100. American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America.

MRLC (Multi-Resolution Land Characteristics Consortium). 2015. National Land Cover Database (NLCD 2011). Retrieved from: http://www.mrlc.gov.

MPCA (Minnesota Pollution Control Agency). 2020. Minnesota Pollution Control Stormwater Manual. Accessed March 16, 2020: https://stormwater.pca.state.mn.us/index.php/BMP_pollutant_removal_for_total_nitrogen

Multi-Resolution Land Characteristics Consortium (MRLC). 2015. National Land Cover Database (NLCD 2011). Retrieved from: http://www.mrlc.gov.

NASS (National Agricultural Statistics Service). 2017. Census of Agriculture: 2017 Census Volume 1, Chapter 2: County Level. United States Department of Agriculture.

NRCS (Natural Resources Conservation Services). 2017a. Natural Resource Conservation Service Conservation Practice Standard for Composting Facility Code 317. Field Office Technical Guide.

NRCS (Natural Resources Conservation Services). 2017b. Natural Resources Conservation Service Standard for Riparian Herbaceous Cover. Field Office Technical Guide.

NRCS (Natural Resources Conservation Services). 2017c. Natural Resources Conservation Service Standard for Filter Strips. Field Office Technical Guide.

NRCS (Natural Resources Conservation Services). 2020a. Natural Resource Conservation Service Standard for Drainage Water Management Code. Field Office Technical Guide.

NRCS (Natural Resources Conservation Services). 2020b. Natural Resource Conservation Service Standard for Denitrifying Bioreactor. Field Office Technical Guide.

Post, S. 1997. The Mackinaw River Basin: an inventory of the region's resources. Illinois Department of Natural Resources, Critical Trends Assessment Program. Available at: https://www.ideals.illinois.edu/handle/2142/13864

Smogor, R. 2000 (draft, annotated 2006). Draft Manual for Calculating Index of Biotic Integrity Scores for Streams in Illinois. Illinois Environmental Protection Agency, Bureau of Water, Division of Water Pollution Control. Springfield, Illinois.

Smogor, R. 2005 (draft). Interpreting Illinois fish-IBI Scores. Illinois Environmental Protection Agency, Bureau of Water, Division of Water Pollution Control. Springfield, Illinois.

Tetra Tech Inc. 2004. Illinois Benthic Macroinvertebrate Collection Method Comparison and Stream Condition Index Revision, 2004.

Tetra Tech and Lake Bloomington Watershed Planning Committee. 2008. Lake Bloomington Watershed TMDL Report. Prepared for the Illinois Environmental Protection Agency.

University of Illinois Extension. 2009. IAH (Illinois Agronomy Handbook), 24th Edition. College of Agricultural, Consumer, and Environmental Sciences.

USDA (United States Department of Agriculture) and NRCS (Natural Resources Conservation Service). 2009. "Illinois Suite of Maps: Potential Tile Drainage Extent" Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/null/?cid=nrcs141p2_030697

U.S. EPA (U.S. Environmental Protection Agency). 1991. Guidance for Water Quality-Based Decisions: The TMDL Process. EPA 440/4-91-001. Office of Water, Washington, DC.

U.S. EPA (U.S. Environmental Protection Agency). 2002. National Recommended Water Quality Criteria: 2002. EPA-822-R-02-047. Office of Water. Office of Science and Technology. Washington, D.C.

U.S. EPA (U.S. Environmental Protection Agency). 2003. *National Management Measures to Control Nonpoint Source Pollution from Agriculture*. EPA 841-B-03-004. U.S. EPA. July 2003.

U.S. EPA (U.S. Environmental Protection Agency). 2007. An Approach for Using Load Duration Curves in the Development of TMDLs. EPA 841-B-07-006. U.S. Environmental Protection Agency, Washington D.C.

U.S. EPA (U.S. Environmental Protection Agency). 2008. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. EPA-841B-08-002. U.S. EPA, Office of Water, Nonpoint Source Control Branch, Washington, DC. March 2008. https://www.epa.gov/nps/handbook-developing-watershed-plans-restore-and-protect-our-waters.

U.S. EPA (U.S. Environmental Protection Agency). 2018. Critical Source Area Identification and BMP Selection: Supplement to Watershed Planning Handbook. EPA 841-K-18-001. U.S. EPA, Office of Water, Nonpoint Source Control Branch, Washington, DC. July 2018.

Weibel, C. P. and R. S. Nelson. 2009. Geology of the Mackinaw River Watershed, McLean, Woodford, and Tazewell Counties, Illinois. Illinois State Geological Survey (ISGS). Geological Science Field Trip Guidebook 2009A.

Wenger, S. 1999. A Review of the Scientific Literature on Riparian Buffer Width, Extent, and Vegetation. For the Office of Public Service & Outreach Institute of Ecology, University of Georgia. Revised version March 5, 1999.

Appendix A—Stage 1 Report

Mackinaw River Watershed Total Maximum Daily Load

Final Stage 1 Report

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TETRA TECH

February 2019

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Acronyms and Abbreviations

AFOs	animal feeding operations
AWQMN	Ambient Water Quality Monitoring Network
CAFO	confined animal feeding operation
CWA	Clean Water Act
HSG	hydrologic soil group
Illinois EPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
MGD	millions of gallons per day
MS4	municipal separate storm sewer system
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
STP	sewage treatment plant
TMDL	total maximum daily load
TSS	total suspended solids
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WQS	water quality standards
WWTP	wastewater treatment plant

1. Introduction

The Clean Water Act and U.S. Environmental Protection Agency (U.S. EPA) regulations require that Total Maximum Daily Loads (TMDLs) be developed for waters that do not support their designated uses. In simple terms, a TMDL is a plan to attain and maintain water quality standards in waters that are not currently meeting them. This TMDL study addresses the approximately 1,149 square miles Mackinaw River watershed located in central Illinois. Several waters within the Mackinaw River watershed area have been placed on the State of Illinois 303(d) list and require the development of a TMDL.

The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and instream conditions. This allowable loading represents the maximum quantity of the pollutant that the waterbody can receive without exceeding water quality standards. The TMDL also includes a margin of safety, which reflects uncertainty as well as the effects of seasonal variation. By following the TMDL process, States can establish water quality-based controls to reduce pollution from both point and nonpoint sources, and restore and maintain the quality of their water resources (U.S. EPA 1991). The Illinois EPA will be working with stakeholders to implement the necessary controls to improve water quality in the impaired waterbodies and meet water quality standards. It should be noted that the controls for nonpoint sources (e.g., agriculture) will be strictly voluntary.

1.1 Water Quality Impairments

Several waters in the Mackinaw River watershed have been placed on the 2016 State of Illinois §303(d) list (Table 1); however, this TMDL only addresses some of these impairments. Illinois EPA currently only develop TMDLs for parameters that have numeric water quality standards, as such, TMDLs are not developed to address sedimentation/siltation, total suspended solids, and total phosphorus in streams. Illinois EPA also does not develop TMDLs in cases where the causes of impairment is not known. In addition, Illinois EPA has submitted a request to USEPA for assistance to develop statewide mercury and polychlorinated biphenyls TMDLs; these two parameters will be addressed once resources become available.

The impairments addressed in this report are provided in Table 2 and Figure 1.

Table 1. Mackinaw River watershed impairments and pollutants (2016 Illinois 303(d) Draft List)

Name	Segment ID	Designated Uses	Cause of Impairment
Mackinaw River	IL_DK-04	Fish Consumption	Polychlorinated biphenyls [a]
	IL_DK-12	Fish Consumption	Polychlorinated biphenyls [a]
	IL_DK-13	Fish Consumption	Polychlorinated biphenyls [a]
		Primary Contact Recreation	**Fecal Coliform**
	IL_DK-15	Fish Consumption	Polychlorinated biphenyls [a]
	IL_DK-17	Fish Consumption	Polychlorinated biphenyls [a]
		Public and Food Processing Water Supply	**Nitrogen, Nitrate**
	IL_DK-19	Fish Consumption	Polychlorinated biphenyls [a]
	IL_DK-20	Fish Consumption	Polychlorinated biphenyls [a]
	IL_DK-21	Fish Consumption	Polychlorinated biphenyls [a]
Hickory Grove Ditch	IL_DKB-01	Aquatic Life	**Dissolved Oxygen,** *Manganese,* Sedimentation/Siltation [a]
Dillon Creek	IL_DKC-01	Aquatic Life	Cause Unknown [a]
Indian Creek	IL_DKD-01	Aquatic Life	Phosphorus (Total) [a], Total Suspended Solids (TSS) [a]
Prairie Creek	IL_DKF-11	Aquatic Life	Chloride [b], Dissolved Oxygen [b]
East Branch Panther Creek	IL_DKKC-02	Aquatic Life	Dissolved Oxygen [b]
Sixmile Creek	IL_DKN-01	Aquatic Life	**Dissolved Oxygen**, Sedimentation/Siltation [a]
Henline Creek	IL_DKV-01	Aquatic Life	Dissolved Oxygen [b]
Lake Bloomington	IL_RDO	Fish Consumption	Mercury [a]
		Public and Food Processing Water Supply	Total Dissolved Solids [b]
Evergreen Lake	IL_SDA	Fish Consumption	Mercury [a]
Eureka Lake	IL_SDS	Aesthetic Quality	Cause Unknown [a], Phosphorus (Total) [a], Total Suspended Solids (TSS) [a]

Italics – Based on evaluation of the last ten years of available data (2007–2016), it was determined that this segment is not impaired (see Appendix A – Unimpaired Stream Data Analysis). A TMDL is not provided for this cause of impairment.
a. These causes of impairment are not being addressed as part of this project.
b. Impairment was removed from the 2018 draft 303(d) list and is not addressed further in this report.
BOLD – TMDLs are addressed in this Stage 1 report.

Table 2. Mackinaw River watershed impairments and pollutants being addressed in this TMDL study

Name	Segment ID	Segment Length (Miles)	Watershed Area (Sq. Miles)	Designated Uses	Cause of Impairment
Mackinaw River	IL_DK-13	11.47	774	Primary Contact Recreation	Fecal Coliform
	IL_DK-17	18.7	490	Public and Food Processing Water Supply	Nitrogen, Nitrate
Hickory Grove Ditch	IL_DKB-01	4.42	33	Aquatic Life	Dissolved Oxygen
Sixmile Creek	IL_DKN-01	10.15	21	Aquatic Life	Dissolved Oxygen

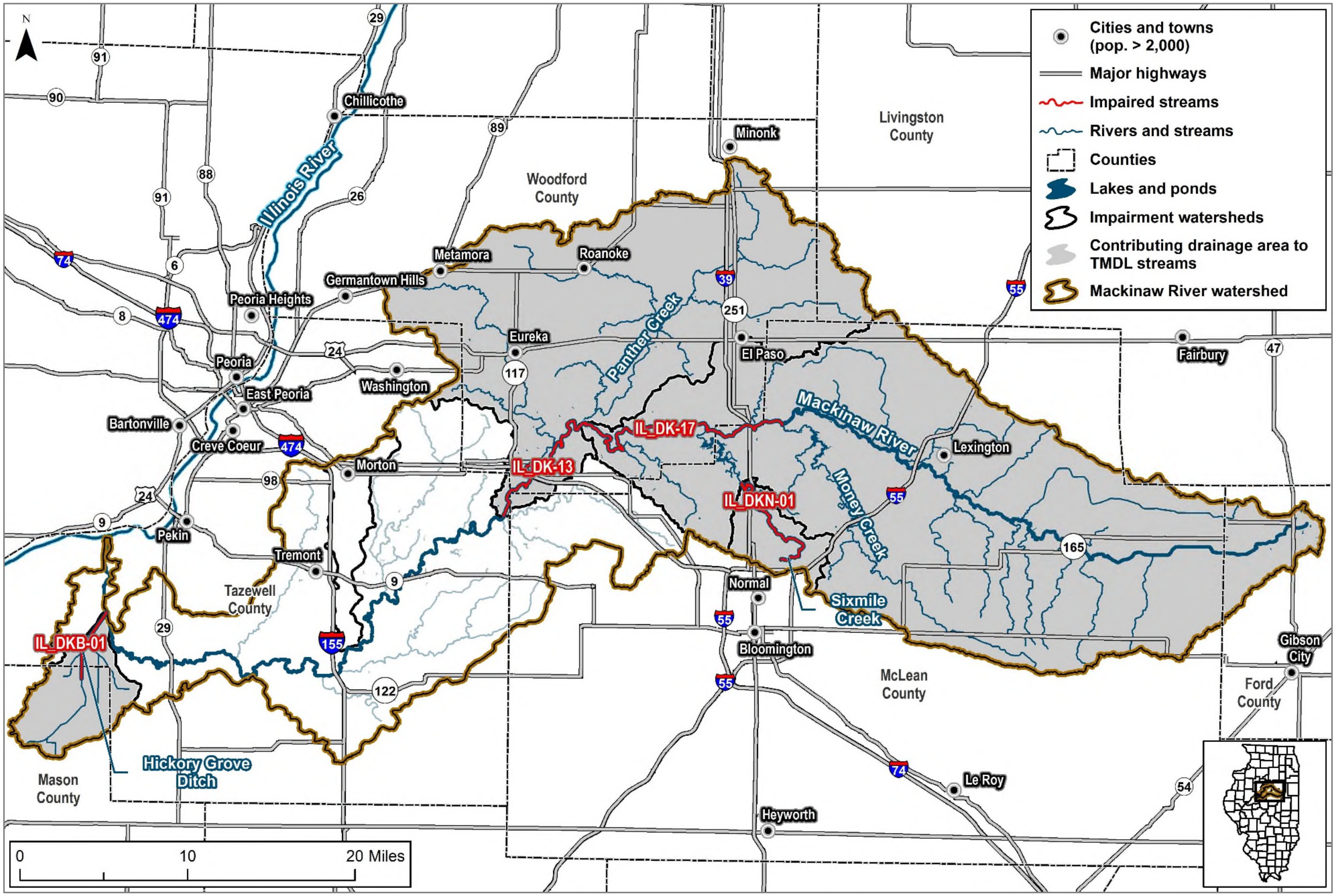


Figure 1. Mackinaw River watershed, TMDL project area.

1.2 TMDL Endpoints

This section presents information on the water quality standards (WQS) that are used for TMDL endpoints. WQS are designed to protect beneficial uses. The authority to designate beneficial uses and adopt WQS is granted through Title 35 of the Illinois Administrative Code. Designated uses to be protected in surface waters of the state are defined under Section 303, and WQS are designated under Section 302 (Water Quality Standards). Designated uses and WQS are discussed below.

1.2.1 Designated Uses

Illinois EPA uses rules and regulations adopted by the Illinois Pollution Control Board (IPCB) to assess the designated use support for Illinois waterbodies. The following are the use support designations provided by the IPCB that apply to water bodies in the Mackinaw River watershed:

General Use Standards – These standards protect for aquatic life, wildlife, agricultural uses, primary contact (where physical configuration of the waterbody permits it, any recreational or other water use in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing), secondary contact (any recreational or other water use in which contact with the water is either incidental or accidental and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, commercial and recreational boating, and any limited contact incident to shoreline activity), and most industrial uses. These standards are also designed to ensure the aesthetic quality of the state's aquatic environment.

Public and food processing water supply standards – These standards are cumulative with the general use standards and apply to waters of the state at any point at which water is withdrawn for treatment and distribution as a potable supply to the public or for food processing.

1.2.2 Water Quality Standards and TMDL Endpoints

Environmental regulations for the State of Illinois are contained in the Illinois Administrative Code, Title 35. Specifically, Title 35, Part(s) 302 and 611 contain water quality standards promulgated by the IPCB for general use and public and food processing water supply, respectively. This section presents the standards applicable to impairments in the study area. Water quality standards and TMDL endpoints to be used for TMDL development are listed in Table 3.

Table 3. Summary of water quality standards for the Mackinaw River watershed

Parameter	Units	Water Quality Standard
General Use		
Fecal Coliform [a]	#/100 ml	400 in <10% of samples [b]
		Geometric mean < 200 [c]
Dissolved Oxygen [d]	mg/L	For most waters: March-July > 5.0 min. and > 6.0- 7-day mean Aug-Feb > 3.5 min, > 4.0- 7-day mean and > 5.5- 30-day mean For enhanced protection waters (): March-July > 5.0 min. and > 6.25- 7-day mean Aug-Feb > 4.0 min, > 4.5- 7-day mean and > 6.0- 30-day mean
Public and Food Processing Water Supply		
Nitrogen, Nitrate	mg/L	10 - maximum contaminant level (MCL)

a. Fecal coliform standards are applicable for the recreation season only (May through October).
b. Standard shall not be exceeded by more than 10% of the samples collected during a 30-day period.
c. Geometric mean based on minimum of 5 samples taken over not more than a 30-day period.
d. Applies to the dissolved oxygen concentration in the main body of all streams, in the water above the thermocline of thermally stratified lakes and reservoirs, and in the entire water column of unstratified lakes and reservoirs. Enhanced dissolved oxygen criteria are found in 35 Ill Adm. Code 302.206, including the list of waters with enhanced dissolved oxygen protection and methods for assessing attainment of dissolved oxygen minimum and mean values

General Use Standards

According to Illinois water quality standards, primary contact means *...any recreational or other water use in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing* (35 Ill. Adm. Code 301.355). The assessment of primary *contact* use is based on fecal coliform bacteria data. The General Use Water Quality Standard for fecal coliform bacteria specifies that during the months of May through October, based on a minimum of five samples taken over not more than a 30-day period, fecal coliform bacteria counts shall not exceed a geometric mean of 200/100 ml, nor shall more than 10 percent of the samples during any 30-day period exceed 400/100 ml (35 Ill. Adm. Code 302.209). This standard protects primary contact use of Illinois waters by humans.

Due to limited state resources, fecal coliform bacteria is not normally sampled at a frequency necessary to apply the General Use standard, i.e., at least five times per month during May through October, and very little data available from others are collected at the required frequency. Therefore, assessment guidelines are based on application of the standard when sufficient data are available to determine standard exceedances; but, in most cases, attainment of primary contact use is based on a broader methodology intended to assess the likelihood that the General Use standard is being attained.

To assess primary contact use, Illinois EPA uses all fecal coliform bacteria from water samples collected in May through October, over the most recent five-year period (i.e., 2012 through 2016 for this report). Based on these water samples, geometric means and individual measurements of fecal coliform bacteria are compared to the concentration thresholds in Table 4 and Table 5. To apply the guidelines, the geometric mean of fecal coliform bacteria concentration is calculated from the entire set of May through October water samples, across the five years. No more than 10 percent of all the samples may exceed 400/100 ml for a water body to be considered Fully Supporting.

Table 4. Guidelines for Assessing Primary Contact Use in Illinois Streams and Inland Lakes

Degree of Use Support	Guidelines
Fully Supporting (Good)	No exceedances of the fecal coliform bacteria standard in the last five years and the geometric mean of all fecal coliform bacteria observations ≤200/100 ml, and ≤10% of all observations exceed 400/100 ml.
Not Supporting (Fair)	One exceedance of the fecal coliform bacteria standard in the last five years (when sufficient data is available to assess the standard) or The geometric mean of all fecal coliform bacteria observations in the last five years ≤200/100 ml, and >10% of all observations in the last five years exceed 400/100 ml or The geometric mean of all fecal coliform bacteria observations in the last five years >200/100 ml, and ≤25% of all observations in the last five years exceed 400/100 ml.
Not Supporting (Poor)	More than one exceedance of the fecal coliform bacteria standard in the last five years (when sufficient data is available to assess the standard) or The geometric mean of all fecal coliform bacteria observations in the last five years >200/100 ml, and >25% of all observations in the last five years exceed 400/100 ml

Table 5. Guidelines for Identifying Potential Causes of Impairment of Primary Contact Use in Illinois Streams and Freshwater Lakes

Potential Cause	Basis for Identifying Cause - Numeric Standard[1]
Fecal Coliform	Geometric mean of at least five fecal coliform bacteria observations collected over not more than 30 days during May through October >200/100 ml or > 10% of all such fecal coliform bacteria observations exceed 400/100 ml or Geometric mean of all fecal coliform bacteria observations (minimum of five samples) collected during May through October >200/100 ml or > 10% of all fecal coliform bacteria observation exceed 400/100 ml.

1. The applicable fecal coliform standard (35 Ill. Adm. Code, 302, Subpart B, Section 302.209) requires a minimum of five samples in not more than a 30-day period. However, because this number of samples is seldom available in this time frame, the criteria are also based on a minimum of five samples over the most recent five-year period.

Aquatic life use assessments in streams are typically based on the interpretation of biological information, physicochemical water data and physical-habitat information from the Intensive Basin Survey, Ambient Water Quality Monitoring Network or Facility-Related Stream Survey programs. The primary biological measures used are the fish Index of Biotic Integrity (fIBI; Karr et al. 1986; Smogor 2000, 2005), the macroinvertebrate Index of Biotic Integrity (mIBI; Tetra Tech 2004) and the Macroinvertebrate Biotic Index (MBI; Illinois EPA 1994). Physical habitat information used in assessments includes quantitative or qualitative measures of stream bottom composition and qualitative descriptors of channel and riparian conditions. Physicochemical water data used include measures of conventional parameters (e.g., dissolved oxygen, pH and temperature), priority pollutants, non-priority pollutants, and other pollutants (USEPA

2002 and www.epa.gov/waterscience/criteria/wqcriteria.html). In a minority of streams for which biological information is unavailable, aquatic life use assessments are based primarily on physicochemical water data.

When a stream segment is determined to be Not Supporting aquatic life use, generally one exceedance of an applicable Illinois water quality standard (related to the protection of aquatic life) results in identifying the parameter as a potential cause of impairment. Additional guidelines used to determine potential causes of impairment include site-specific standards (35 Ill. Adm. Code 303, Subpart C), or adjusted standards (published in the Illinois Pollution Control Board's Environmental Register at http://www.ipcb.state.il.us/ecll/environmentalregister.asp).

Public and Food Processing Water Supply Use Standards

Attainment of public and food processing water supply use is assessed only in waters in which the use is currently occurring, as evidenced by the presence of an active public-water supply intake. The assessment of public and food processing water supply use is based on conditions in both untreated and treated water. By incorporating data through programs related to both the federal Clean Water Act and the federal Safe Drinking Water Act, Illinois EPA believes that these guidelines provide a comprehensive assessment of public and food processing water supply use. Assessments of public and food processing water supply use recognize that characteristics and concentrations of substances in Illinois surface waters can vary and that a single assessment guideline may not protect sufficiently in all situations. Using multiple assessment guidelines helps improve the reliability of these assessments. When applying these assessment guidelines, Illinois EPA also considers the water-quality substance, the level of treatment available for that substance, and the monitoring frequency of that substance in the untreated water. Table 6 includes the assessment guidelines for waters with public and food processing water supply designated uses.

Table 6. Guidelines for assessing public water supply in waters of the State (IEPA 2016)

Degree of Use Support	Guidelines
Fully Supporting (Good)	For each substance in untreated water[a], for the most-recent three years of readily available data or equivalent dataset, a) < 10% of observations exceed an applicable Public and Food Processing Water Supply Standard[b]; and b) for which the concentration is not readily reducible by conventional treatment, i) no observation exceeds by at least fourfold the treated-water Maximum Contaminant Level threshold concentration[c] for that substance; and ii) no quarterly average concentration exceeds the treated-water Maximum Contaminant Level threshold concentration[c] for that substance; and iii) no running annual average concentration exceeds the treated-water Maximum Contaminant Level threshold concentration[d] for that substance; and[d] For each substance in treated water, no violation of an applicable Maximum Contaminant Level[c] occurs during the most recent three years of readily available data.
Not Supporting (Fair)	For any single substance in untreated water[a], for the most-recent three years of readily available data or equivalent dataset, a) > 10% of observations exceed a Public and Food Processing Water Supply Standard[b]; or b) for which the concentration is not readily reducible by conventional treatment, i) at least one observation exceeds by at least fourfold the treated-water Maximum Contaminant Level threshold concentration[c] for that substance; or ii) the quarterly average concentration exceeds the treated-water Maximum Contaminant Level threshold concentration[c] for that substance; or iii) the running annual average concentration exceeds the treated-water Maximum Contaminant Level threshold concentration[c] for that substance.

Degree of Use Support	Guidelines
	or, For any single substance in treated water, at least one violation of an applicable Maximum Contaminant Level[3] occurs during the most recent three years of readily available data.
Not Supporting (Poor)	Closure to use as a drinking-water resource (cannot be treated to allow for use).

a. Includes only the untreated-water results that were available in the primary computer database at the time data were compiled for these assessments
b. 35 I11. Adm. Code 302.304, 302.306 (http://www.ipcb.state.il.us/SLR/IPCBandIEPAEnvironmentalRegulations-Title35.aspx)
c. 35 I11. Adm. Code 611.300, 611.301, 611.310, 611.311, 611.325.
d. Some waters were assessed as Fully Supporting based on treated-water data only.

One of the assessment guidelines for untreated water relies on a frequency-of-exceedance threshold (10 percent) because this threshold represents the true risk of impairment better than does a single exceedance of a water quality criterion. Assessment guidelines also recognize situations in which water treatment that consists only of "*...coagulation, sedimentation, filtration, storage and chlorination, or other equivalent treatment processes*" (35 Ill. Adm. Code 302.303; hereafter called "conventional treatment") may be insufficient for reducing potentially harmful levels of some substances. To determine if a Maximum Contaminant Level (MCL) violation in treated water would likely occur if treatment additional to conventional treatment were not applied (see 35 Ill. Adm. Code 302.305), the concentration of the potentially harmful substance in untreated water is examined and compared to the MCL threshold concentration. If the concentration in untreated water exceeds an MCL-related threshold concentration, then an MCL violation could reasonably be expected in the absence of additional treatment.

Compliance with an MCL for treated water is based on a running 4-quarter (i.e., annual) average, calculated quarterly, of samples collected at least once per quarter (Jan.-Mar., Apr.-Jun., Jul.-Sep., and Oct.-Dec.). However, for some untreated-water intake locations sampling occurs less frequently than once per quarter; therefore, statistics comparable to quarterly averages or running 4-quarter averages cannot be determined for untreated water. Rather, for substances not known to vary regularly in concentration in Illinois surface waters (untreated) throughout the year, a simple arithmetic average concentration of all available results is used to compare to the MCL threshold. For substances known to vary regularly in concentration in surface waters during a typical year (e.g., nitrate), average concentrations in the relevant sub-annual (e.g., quarterly) periods are used.

2. Watershed Characterization

The Mackinaw River watershed is located in central Illinois (Figure 1). The headwaters for the watershed begin north of Gibson City, IL. The Mackinaw River then flows just north of Bloomington, IL before joining the Illinois River south of Peoria, IL. The watershed covers 1,149 square miles; major tributaries of the river include Henline Creek, Money Creek, Sixmile Creek, Panther Creek, Mud Creek, Prairie Creek, Little Mackinaw River and Dillon Creek.

2.1 Jurisdictions and Population

Counties with land located in the watershed area include Ford, Livingston, Mason, McLean, Tazewell, and Woodford. Portions of the cities of Bloomington and Normal, IL are located along the south-central boundary of the watershed and Morton Village in the outskirts of Peoria, IL is located almost entirely in the watershed at the headwaters of Prairie Creek. Bloomington, Normal and Peoria are major government units with jurisdiction in the Mackinaw River watershed area. Populations are area weighted to the watershed in Table 7. The McLean County and Tazewell County population numbers were adjusted to only account for the portion of the cities of Bloomington and Normal and Peoria in the watershed, respectively.

Table 7. Area weighted county populations in watershed

County	2000	2010	Percent Change
Ford	299	296	-1%
Livingston	479	471	-2%
Mason	326	298	-9%
McLean	20,702	21,445	4%
Tazewell	13,186	13,518	3%
Woodford	9,774	10,654	9%
TOTAL	***44,766***	***46,682***	***4%***

Source: U.S. Census Bureau

2.2 Climate

Climate data are available from the National Oceanic and Atmospheric Administration (NOAA) Global Historical Climatology Network Database; Station USC00116200 is located in Normal, IL along the south-central boundary of the watershed. Daily data from 1977–2016 for temperature, precipitation and snowfall are summarized in Table 8. In general, the climate of the region is continental with hot, humid summers and cold winters. The average high winter temperature was 36 °F and the average high summer temperature was 85°F. The annual average precipitation at Normal was approximately 38 inches, including approximately 22 inches of snowfall. In general, larger volumes of precipitation tend to occur between the months of April and September.

Table 8. Climate summary for Normal (1977–2016)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High ºF	33	37	50	63	74	84	86	85	79	66	51	37
Average Low ºF	16	19	29	40	51	61	65	62	54	43	32	21
Mean Temperature ºF	24	27	38	49	61	70	73	71	63	52	40	28
Average Precipitation (in)	2.0	1.9	2.6	3.8	4.4	4.0	4.1	3.9	3.2	3.1	3.0	2.4
Average Snowfall (in)	6.9	6.6	2.2	0.6	0.0	0.0	0.0	0.0	0.0	0	0.6	4.9

Source: NOAA Global Historical Climatology Network Database

2.3 Land Use and Land Cover

Land use in the watershed is heavily influenced by agriculture (Figure 2). Urban area is located near the cities of Normal and Morton and several small towns in the watershed. Land use in the watershed includes cultivated crops and pasture/hay (approximately 85 percent), forest (approximately 6 percent), and urban (approximately 8 percent). Corn and soybeans are the most common crops, with much smaller areas of winter wheat, alfalfa and other crops. Table 9 presents area and percent by land cover type as provided in the 2011 National Land Cover Database (MLRC 2015).

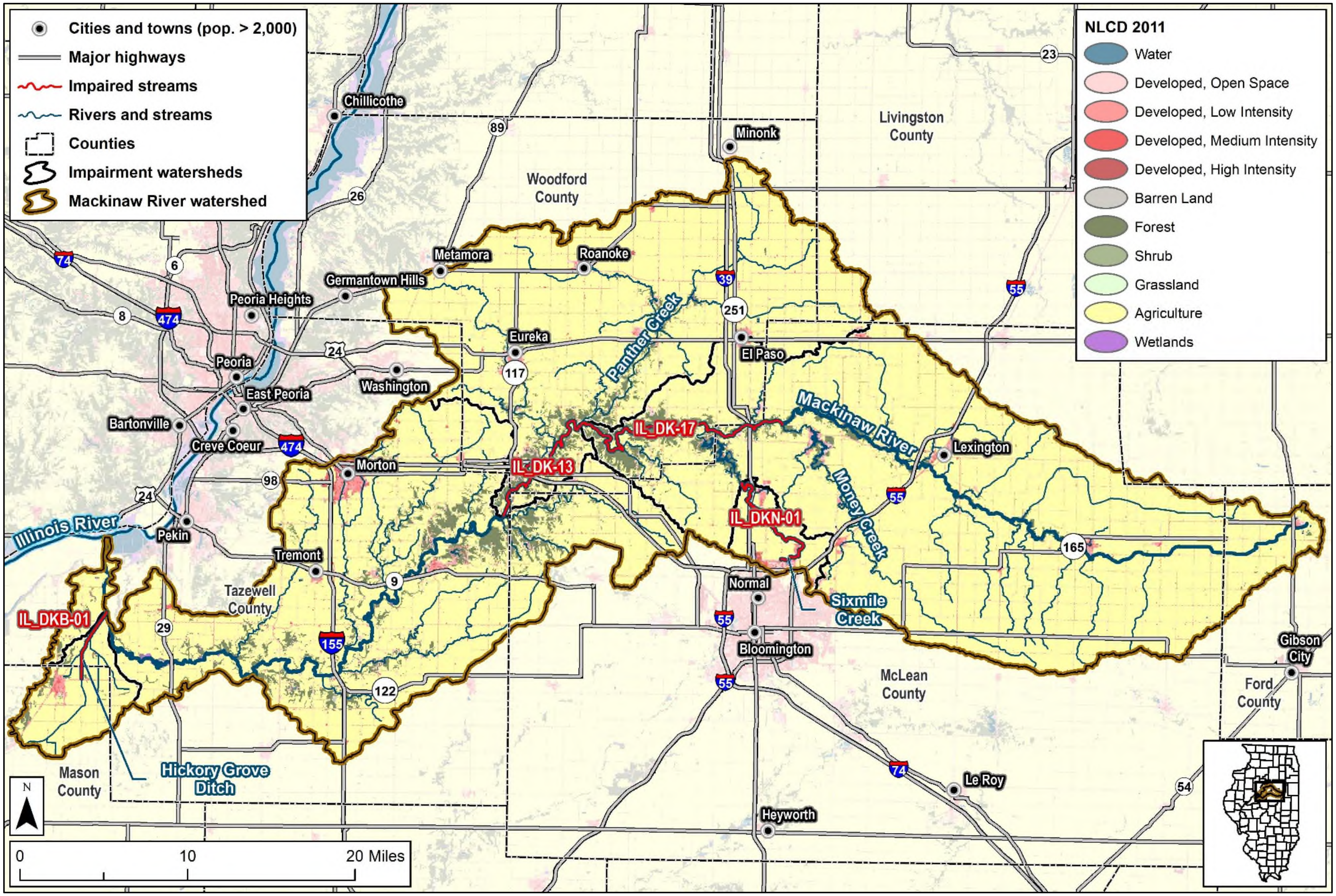


Figure 2. Mackinaw River watershed land cover (2011 National Land Cover Database).

Table 9. Watershed land use summary

Land Use / Land Cover Category	Acres	Percentage
Cultivated Crops	594,603	80.9%
Deciduous Forest	42,519	5.8%
Hay/Pasture	30,178	4.1%
Developed, Low Intensity	27,302	3.7%
Developed, Open Space	26,830	3.6%
Developed, Medium Intensity	5,917	0.8%
Open Water	3,054	0.4%
Woody Wetlands	1,869	0.3%
Herbaceous	1,480	0.2%
Developed, High Intensity	1,382	0.2%
Barren Land	189	<0.1%
Emergent Herbaceous Wetlands	52	<0.1%
Evergreen Forest	23	<0.1%
Shrub/Scrub	19	<0.1%

Source: 2011 National Land Cover Database

2.4 Topography

Topography is an important factor in watershed management because stream types, precipitation, and soil types can vary dramatically by slope and elevation. The Mackinaw River watershed varies in elevation from 436 to 956 feet (Figure 3). The Mackinaw River water elevation varies from 815 feet to 645 feet and is 63 miles long upstream of the inlet of Panther Creek and water elevation varies from 645 feet to 440 feet and is 66 miles long from Panther Creek to the inlet to the Illinois River, resulting in an upper watershed stream gradient of 2.6 feet per mile and lower watershed stream gradient of 3.2 feet per mile. The watershed topography is a combination of high ridges, low elevation stream valleys and abandoned river terraces resulting from the last continental glaciation (Weibel and Nelson 2009).

2.5 Soils

The National Cooperative Soil Survey publishes soil surveys for each county in the U.S. These soil surveys contain predictions of soil behavior for selected land uses. The surveys also highlight limitations and hazards inherent in the soil, general improvements needed to overcome the limitations, and the impact of selected land uses on the environment. The soil surveys are designed for many different uses, including land use planning, the identification of special practices needed to ensure proper performance, and mapping of hydrologic soil groups (HSGs).

HSGs refer to the grouping of soils according to their runoff potential. Soil properties that influence the HSGs include depth to seasonal high water table, infiltration rate and permeability after prolonged wetting, and depth to a slower permeable layer (e.g., finer grained). There are four groups of HSGs: Group A, B, C, and Group D. Table 10 describes those HSGs found in the Mackinaw River watershed. Figure 4 and Table 11 summarizes the composition of HSGs in the watershed. Soils are predominantly B, B/D, C and C/D in the watershed and transition to more A and B type soils towards the outlet to the Illinois River. The high proportion of B/D type soils coupled with agricultural land uses indicate the likelihood of tile drainage.

Table 10. Hydrologic soil group descriptions

HSG	Group Description
A	Sand, loamy sand or sandy loam types of soils. Low runoff potential and high infiltration rates even when thoroughly wetted. Consist chiefly of deep, well to excessively drained sands or gravels with a high rate of water transmission.
B	Silt loam or loam. Moderate infiltration rates when thoroughly wetted. Consist chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
C	Soils are sandy clay loam. Low infiltration rates when thoroughly wetted. Consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.
D	Soils are clay loam, silty clay loam, sandy clay, silty clay or clay. Group D has the highest runoff potential. Low infiltration rates when thoroughly wetted. Consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.
A-C/D	Dual Hydrologic Soil Groups. Certain wet soils are placed in group D based solely on the presence of a water table within 24 inches of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. The first letter applies to the drained condition and the second to the undrained condition.

Table 11. Percent composition of hydrologic soil groups in watershed

Hydrologic Soil Group (HSG)	Acres	Percentage
A	18,260	2.5%
A/D	1,123	0.2%
B	175,164	23.8%
B/D	210,222	28.5%
C	146,951	20.0%
C/D	177,022	24.1%
D	173	<0.1%
No Data	6,502	0.9%

Source: NRCS SSURGO Database 2011

A commonly used soil attribute is the K-factor, or the soil erodibility index. The distribution of K-factor values in the Mackinaw River watershed range from 0.02 to 0.50, with an average value of 0.37 (Figure 5). The higher the K-factor, the more susceptible the soil is to erosion.

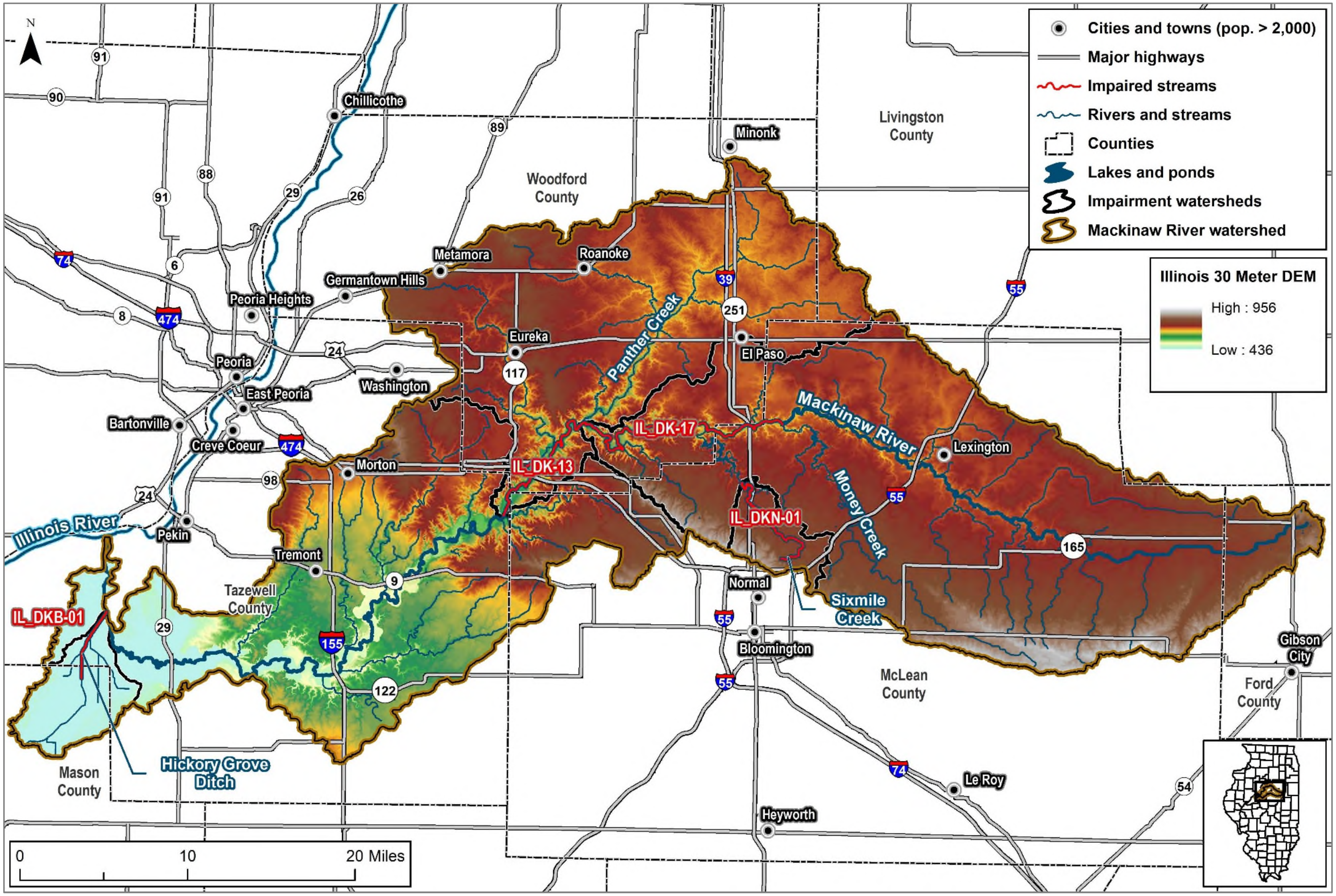


Figure 3. Mackinaw River watershed land elevations (ISGS 2003).

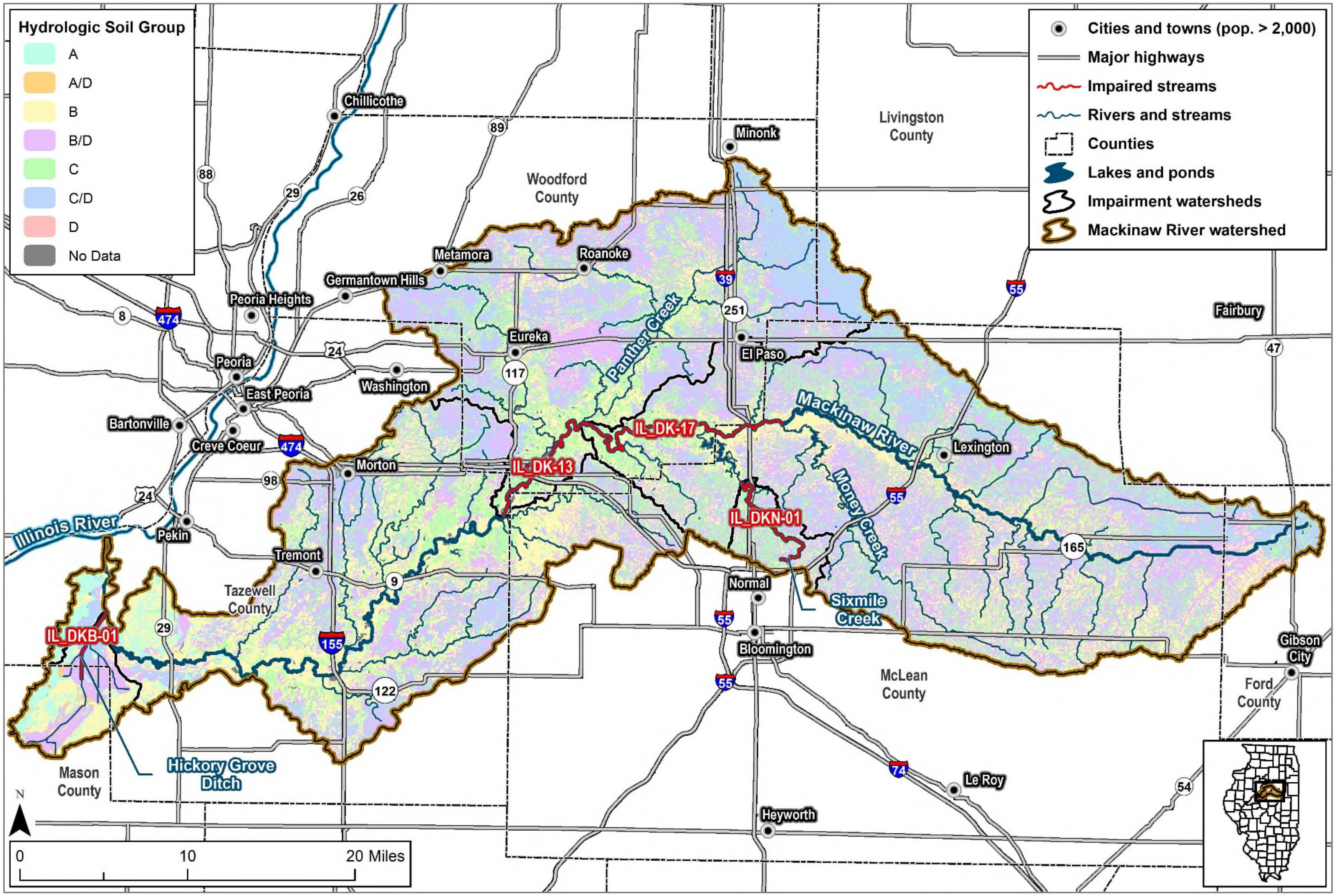


Figure 4. Mackinaw River watershed hydrologic soil groups (Soil Surveys for Ford, Livingston, Mason, McLean, Tazewell and Woodford Counties, Illinois; NRCS SSURGO Database 2011).

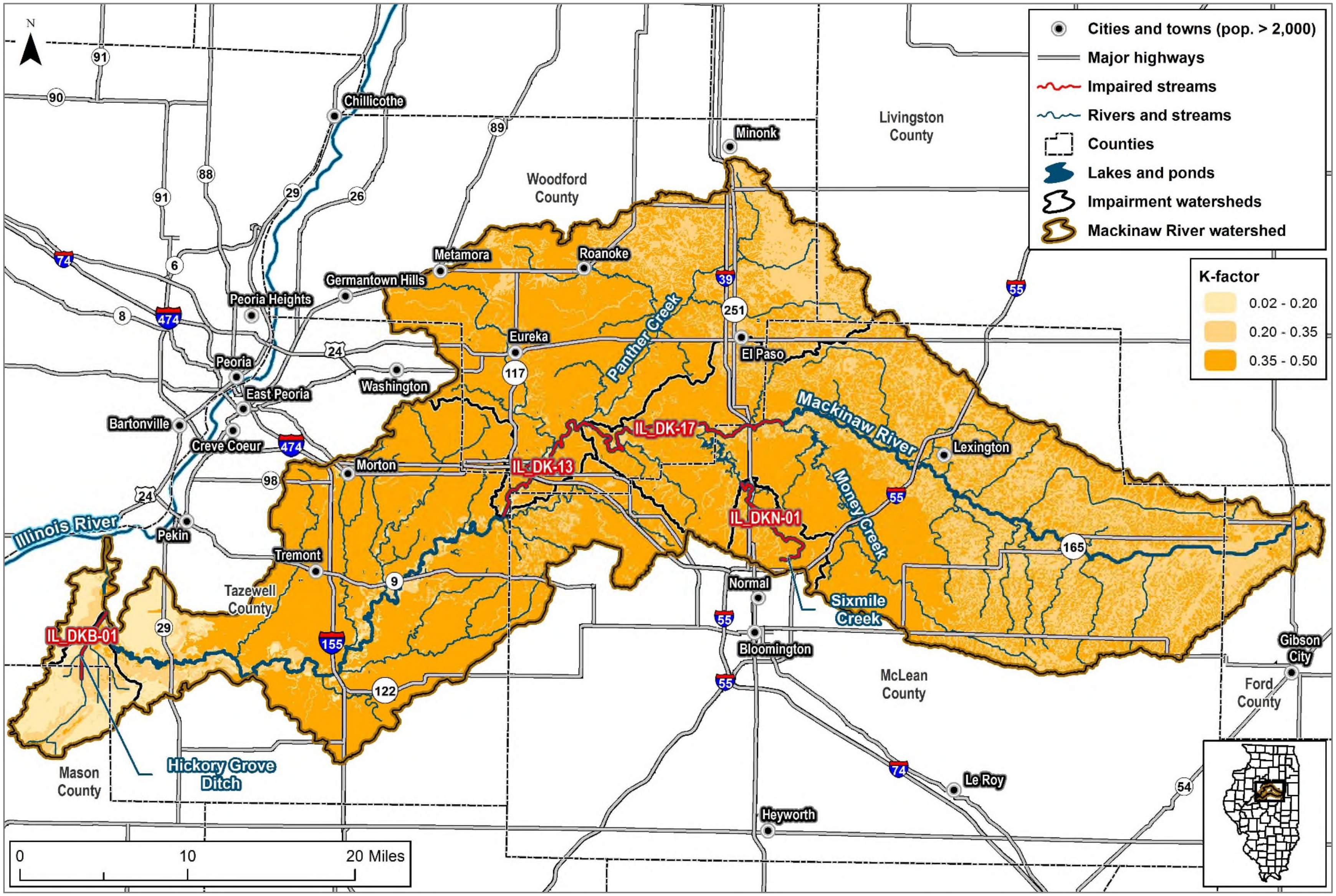


Figure 5. Mackinaw River watershed soil K-factor values (Soil Surveys for Ford, Livingston, Mason, McLean, Tazewell and Woodford Counties, Illinois; NRCS SSURGO Database 2011).

2.6 Hydrology

Hydrology plays an important role in evaluating water quality. The hydrology of the Mackinaw River watershed is driven by local climate conditions and the landscape. The U.S. Geological Survey (USGS) has collected flow and water quality data in this watershed since the 1930s (Table 12 and Figure 11). There is one active USGS gage in the watershed.

The daily average, peak history, and monthly flow data show the inherent variability associated with hydrology. Flow duration curves provide a way to address that variability and flow related water quality patterns. Duration curves describe the percentage of time during which specified flows are equaled or exceeded. Flow duration analysis looks at the cumulative frequency of historic flow data over a specified period, based on measurements taken at uniform intervals (e.g., daily average or 15-minute instantaneous). Duration analysis results in a curve that relates flow values to the percent of time those values have been met or exceeded. Low flows are exceeded a majority of the time, whereas floods are exceeded infrequently. A flow duration curve for active USGS gage 05567500 is presented in Figure 6.

Table 12. USGS stream gages in impairment watersheds

Gage ID	Watershed Area *(mi.^{2})*	Location	Period of Record	Located on Impaired Segment
05564200	87.6	Mackinaw River at Colfax, IL	1980-1981	-
05564300	309	Mackinaw River near Kappa, IL	1997	-
05564400	49	Money Creek near Towanda, IL	1958-1983	-
05564500	53.1	Money Creek above Lake Bloomington, IL	1933-1958 [a]	-
05565000	9.81	Hickory Creek above Lake Bloomington, IL	1938-1958 [a]	-
05565500	69.1	Money Creek at Lake Bloomington, IL	1956-1958 [a]	-
05565700	18.5	Sixmile Creek at Hudson, IL	- [b]	IL_DKN-01
05566000	6.3	East Branch Panther Creek near Gridley, IL	1949-1972 [a]	-
05566500	30.5	East Branch Panther Creek at El Paso, IL	1949-1982	-
05567000	93.9	Panther Creek near El Paso, IL	1949-1998	
05567400	687	Mackinaw River above Congerville, IL	- [b]	IL_DK-13
05567448	- [b]	Walnut Creek at Eureka, IL	1991-1992 [a]	-
05567450	- [b]	Walnut Creek near Mackinaw Dells, IL	- [b]	-
05567500	**767**	**Mackinaw River near Congerville, IL**	**1944-2016**	**IL_DK-13**
05567510	776	Mackinaw River below Congerville, IL	1978-1986	IL_DK-13

BOLD – indicates active USGS gage
a. Flow data only, no water quality data available
b. Information unavailable on USGS National Water Information System (NWIS)

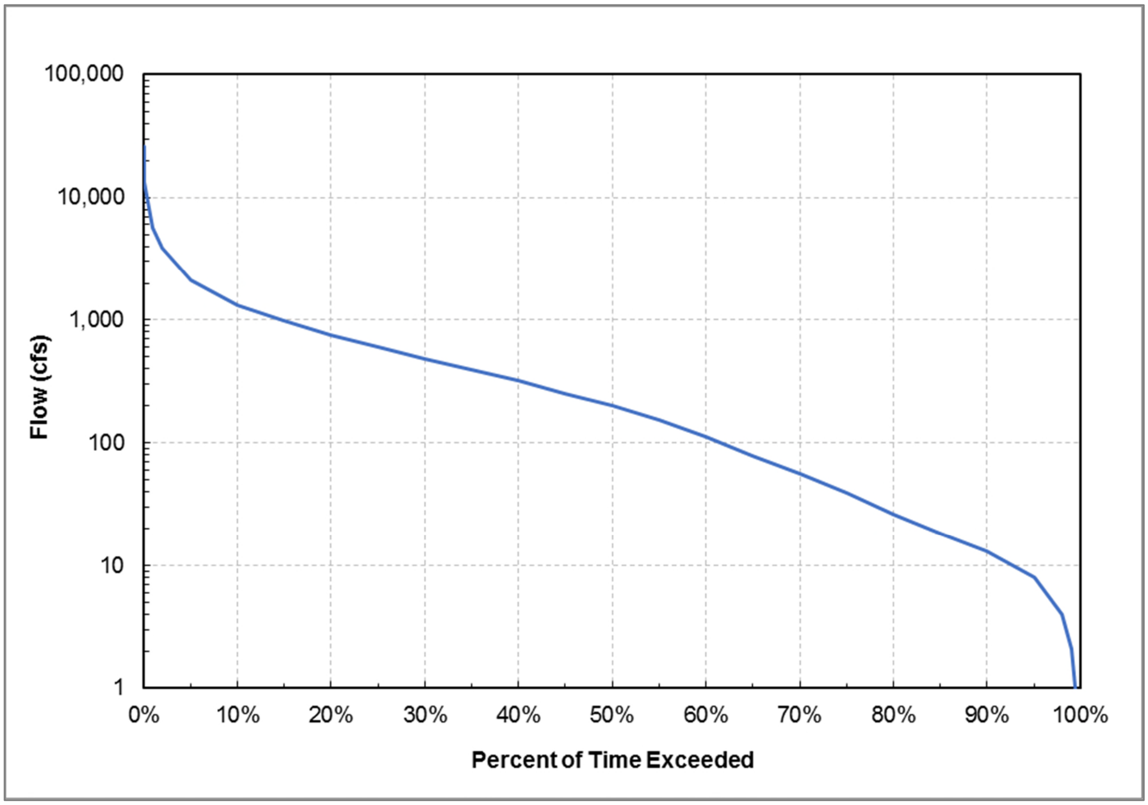


Figure 6. Flow duration curve for USGS gage 05567500, Mackinaw River near Congerville, IL (1944–2016).

An evaluation of annual flow at USGS gage 05567500 from 1944–2016 showed that annual flow in 2001 was nearly at the median; thus, it is assumed that 2001 is a typical year. Flow at USGS gage 05567500 is plotted with precipitation from the NOAA Global Historical Climatology Network Database Station USC00116200 (Normal) in Figure 7. Flows in the Mackinaw River decrease significantly during the late summer and early fall with decreasing precipitation.

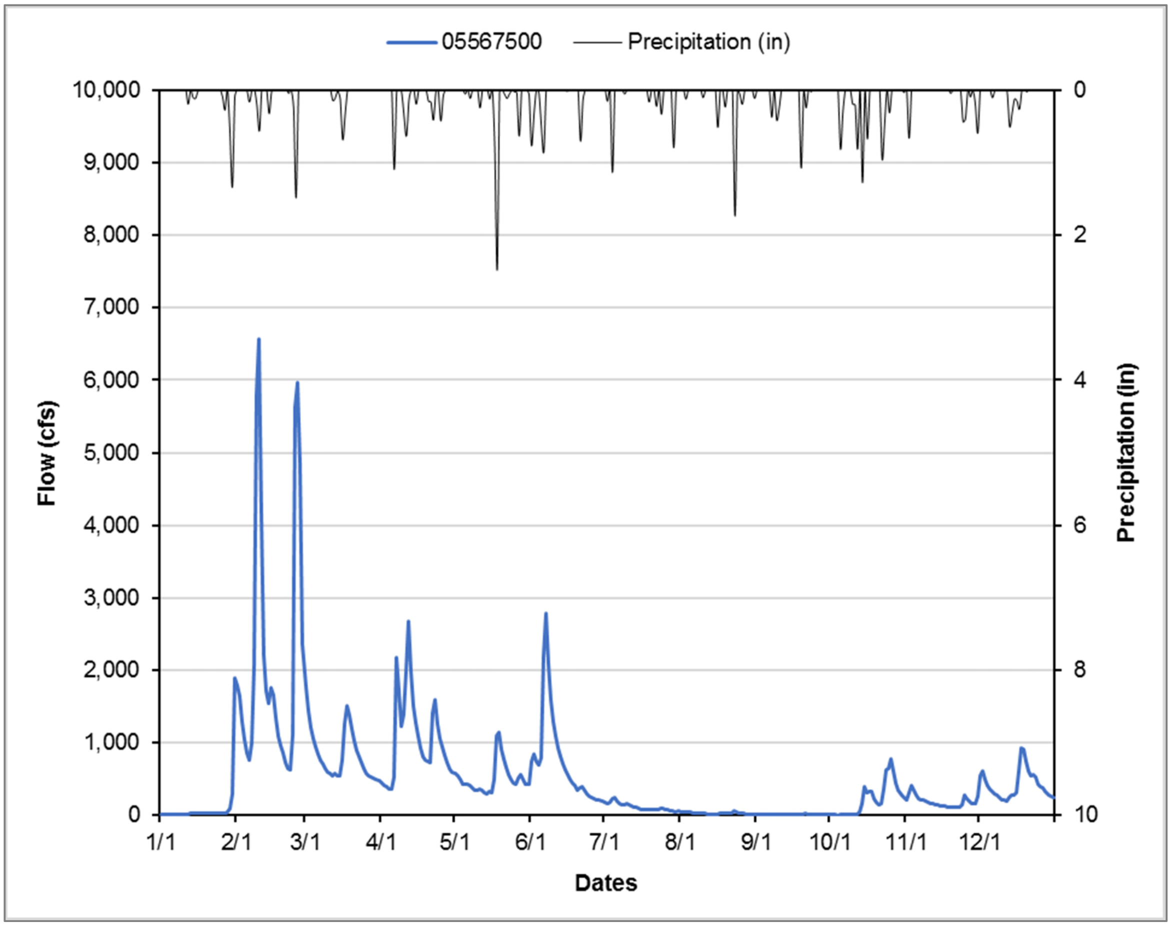


Figure 7. Daily flow in the Mackinaw River with daily precipitation at Normal (USC00116200), 2001.

2.7 Watershed Studies and Other Watershed Information

This section describes some of the studies that have been completed in the watershed.

- **Mackinaw River Watershed Management Plan** (Mackinaw River Project 1998)

  Plan was developed through a collaborative effort with townspeople, farmers, state agencies, and The Nature Conservancy to develop a voluntary watershed plan to address sedimentation and wetland loss. Sources of pollution were identified as agriculture, construction erosion, urban runoff, hydrologic modifications, and resource extraction activities. Strategies, achievable goals, and specific recommendations were made for agriculture, biological diversity, issues in the community, education, and agency coordination. The Mackinaw River Watershed Council, the precursor to the Mackinaw River Ecosystem Partnership, was created along with the development of this plan.

- **Geology of the Mackinaw River Watershed, McLean, Woodford, and Tazewell Counties** (Weibel and Nelson 2009)

  Guidebook was developed for the University of Illinois at Urbana Champaign Institute of Natural Resources Sustainability. Includes overview of the geologic framework, history, regional drainage, natural resources (minerals and groundwater), and natural areas from the Moraine View State Park, to the Mackinaw River near Heritage Lake.

- **Lake Bloomington Watershed TMDL and Watershed Plan** (Tetra Tech 2008 and Lake Bloomington Watershed Planning Committee 2008)

  This previous TMDL provides information on nutrient loading from Lake Bloomington. The watershed plan provides information and pollutant loading, sources, and watershed characteristics in the Lake Bloomington watershed.

- **Evergreen Lake Watershed TMDL and Watershed Plan** (CDM 2006 and Evergreen Lake Watershed Planning Committee 2006)

  This previous TMDL provides information on nutrient loading from Evergreen Lake. The watershed plan provides information and pollutant loading, sources, and watershed characteristics in the Evergreen Lake watershed.

3. Watershed Source Assessment

Source assessments are an important component of water quality management plans and TMDL development. This section provides a summary of potential sources that contribute listed pollutants to the Mackinaw River watershed.

3.1 Pollutants of Concern

Pollutants of concern evaluated in this source assessment include fecal coliform and nitrate and parameters influencing dissolved oxygen such as biochemical oxygen demand, phosphorus, and ammonia. These pollutants can originate from an array of sources including point and nonpoint sources. Eutrophication (high levels of algae) is also often linked directly to low dissolved oxygen conditions and therefore nutrients are also a pollutant of concern. Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels. Nonpoint sources are diffuse sources that have multiple routes of entry into surface waters, particularly overland runoff. This section provides a summary of potential point and nonpoint sources that contribute to the impaired waterbodies.

3.2 Point Sources

Point source pollution is defined by the Federal Clean Water Act (CWA) §502(14) as:

> *"any discernible, confined and discrete conveyance, including any ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation [CAFO], or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agriculture storm water discharges and return flow from irrigated agriculture."*

Under the CWA, all point sources are regulated under the NPDES program. A municipality, industry, or operation must apply for an NPDES permit if an activity at that facility discharges wastewater to surface water. Point sources can include facilities such as municipal wastewater treatment plants (WWTPs), industrial facilities, CAFOs, or regulated storm water including municipal separate storm sewer systems (MS4s). There are no permitted CAFOs in the watershed.

3.2.1 NPDES Facilities (Non-Stormwater)

NPDES facilities in the study area include municipal and industrial wastewater treatment; bacteria and nutrients can be found in these discharges. In addition, permitted facilities may contribute to low dissolved oxygen impairments. There are also public water supply facilities in the watershed.

There is one individual NPDES permitted facility that discharges directly to an impaired segment (IL0074365 [DKN-01]) and 20 other facilities that discharge in the contributing drainage area of the impaired segments (Table 13 and Figure 11). The Prairie View Homeowners Association STP (IL0074365) discharges into the upper reach of Sixmile Creek (DKN-01), which is impaired due to dissolved oxygen. Manito STP (IL0035904) discharges to IL_DKB-01 approximately two miles upstream of where Manito Ditch tributary outlets to Hickory Grove Ditch, and could be contributing to impairment on IL-DKB-01. Facilities that discharge to unimpaired tributaries are assumed to not contribute to impairments. Additional evaluation of these point source will be conducted as part of TMDL development. Note that there are additional NPDES permitted facilities in the Mackinaw River watershed, but these do not discharge directly to or are not located in the drainage area to the impaired waters addressed by this report.

Table 13. Individual NPDES permitted facilities in impairment watersheds

IL Permit ID	Facility Name	Type of Discharge	Receiving Water	Downstream Impairment(s)	Average Design Flow (MGD)	Maximum Design Flow (MGD)
IL0021521	*Metamora South WWTP*	*STP*	*Walnut Creek*	*DK-13*	*0.38*	*0.96*
IL0025119	*City of Eureka STP*	*STP*	*Walnut Creek*	*DK-13*	*0.59*	*1.84*
IL0025666	*East Bay Camp Conference Center STP*	*STP*	*Lake Bloomington*	*DK-17, DK-13*	*0.03*	*0.05*
IL0035904	*Village of Manito STP*	*STP*	*Manito Ditch tributary to Hickory Grove Ditch*	*DKB-01*	*0.2*	*0.5*
IL0036391	*Comlara Park STP*	*STP*	*Evergreen Lake*	*DK-17, DK-13*	*0.022*	*0.055*
IL0040762	*I-74 South Mackinaw Dells Rest Area STP*	*STP*	*Unnamed tributary of Mackinaw River*	*DK-13*	*0.003*	*0.0075*
IL0048054	*Goodfield STP*	*STP*	*Unnamed tributary of Mackinaw River*	*DK-13*	*0.2*	*0.4*
IL0053899	*Forestview Utilities Corporation STP*	*STP*	*Unnamed tributary of Mackinaw River*	*DK-13*	*0.01*	*0.25*
IL0073032	*Westwind Estates STP*	*STP*	*Unnamed tributary of Mackinaw River*	*DK-17, DK-13*	*0.024*	*0.048*
IL0074365	**Prairie View Homeowners Association STP**	**STP**	**Sixmile Creek**	**DKN-01, DK-17, DK-13**	**0.007**	**0.017**
ILG551035	*ILDOT-I74 Woodford Co N WWTP*	*STP*	*Unnamed tributary of Mackinaw River*	*DK-13*	*0.015*	*0.03*
ILG551095	*Timberline MHP WWTP*	*STP*	*Unnamed tributary to Walnut Creek*	*DK-17, DK-13*	*0.051*	*0.128*
ILG580074	*Roanoke WWTP*	*STP*	*West Branch Panther Creek*	*DK-13*	*0.22*	*0.8*
ILG580078	*Village of Colfax WWTP*	*STP*	*Mackinaw River*	*DK-17, DK-13*	*0.11*	*0.28*
ILG580102	*Village of Gridley WWTP*	*STP*	*Buck Creek*	*DK-17, DK-13*	*0.188*	*0.47*
ILG582005	*City of El Paso WWTP*	*STP*	*East Branch Panther Creek*	*DK-13*	*0.461*	*1.15*
ILG640120	*Secor WTP*	*Public water supply*	*Olive Branch*	*DK-13*	*--*	*--*
ILG640167	*Anchor WTP*	*Public water supply*	*Mackinaw River*	*DK-17, DK-13*	*--*	*--*
ILG640231	*Eureka WTP*	*Public water supply*	*Walnut Creek*	*DK-13*	*--*	*--*
ILG640278	*City of Bloomington WTP*	*Public water supply*	*Money Creek*	*DK-17, DK-13*	*0.09*	*--*
ILG840187	*Amigoni Construction – Bachman Pit*	*Stormwater and pit pump discharge*	*Unnamed tributary to Panther Creek*	*DK-13*	*--*	*--*

Italics – NPDES facility draining to unimpaired segment; **BOLD** – NPDES facility draining to impaired segment
STP – Sewage treatment plant; MGD – Million gallons per day

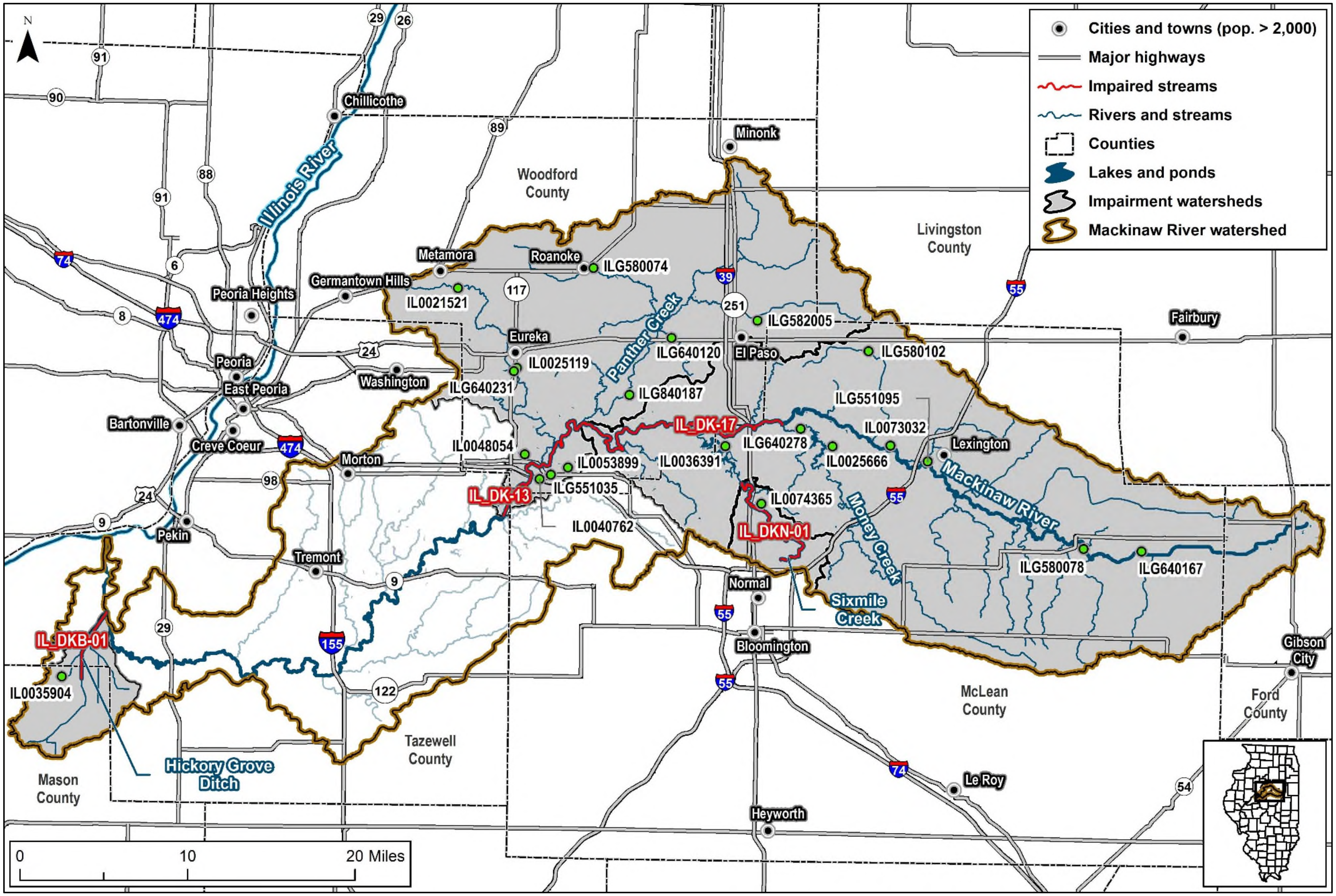


Figure 8. NPDES permitted facilities upstream of impaired segments.

3.2.2 Municipal Separate Storm Sewer Systems

Regulated storm water runoff can contribute to impairments in the project area. As development increases in the watershed, additional pressure will be placed on receiving waters due to storm water. Impervious areas associated with developed land uses can result in higher peak flow rates, higher runoff volumes and larger pollutant loads. Storm water runoff often contains sediment, nutrients, and bacteria amongst other pollutants.

Under the NPDES program, municipalities serving populations over 100,000 people are considered Phase I MS4 communities. In the impairment watersheds, there are no Phase I communities. Municipalities serving populations under 100,000 people are considered Phase II communities. In Illinois, Phase II communities are allowed to operate under the statewide General Storm Water Permit (ILR40) which requires dischargers to file a Notice of Intent, acknowledging that discharges shall not cause or contribute to a violation of water quality standards.

To assure pollution is controlled to the maximum extent practical, regulated entities operating under the General Storm Water Permit (ILR40) are required to implement six minimum control measures including public education, public involvement, illicit discharge and detection programs, control of construction site runoff, post construction storm water management in new development and redevelopment, and pollution prevention/good housekeeping for municipal operations. Regulated entities operating under the General Storm Water Permit in the impairment watersheds are identified in Table 14 and Figure 9.

Table 14. Permitted MS4s in impairment watersheds

Permit ID	Regulated Entity	Downstream Receiving Waters
ILR400296	Bloomington City MS4	Sixmile Creek (DKN-01) and Mackinaw River (DK-17, DK-13)
ILR400041	Dry Grove Township MS4	Sixmile Creek (DKN-01) and Mackinaw River (DK-17, DK-13)
ILR400265	McLean County MS4	Sixmile Creek (DKN-01) and Mackinaw River (DK-17, DK-13)
ILR400097	Normal Township MS4	Sixmile Creek (DKN-01) and Mackinaw River (DK-17, DK-13)
ILR400399	Normal, Town MS4	Sixmile Creek (DKN-01) and Mackinaw River (DK-17, DK-13)
ILR400598	Old Town Township MS4	Sixmile Creek (DKN-01) and Mackinaw River (DK-17, DK-13)
ILR400610	Sand Prairie Township MS4	Hickory Grove Ditch (DKB-01)
ILR400146	Washington Township MS4	Mackinaw River (DK-13)
ILR400158	Worth Township MS4	Mackinaw River (DK-13)
ILR400493	Illinois Department of Transportation (road authority)	Sixmile Creek (DKN-01), and Mackinaw River (DK-17, DK-13)

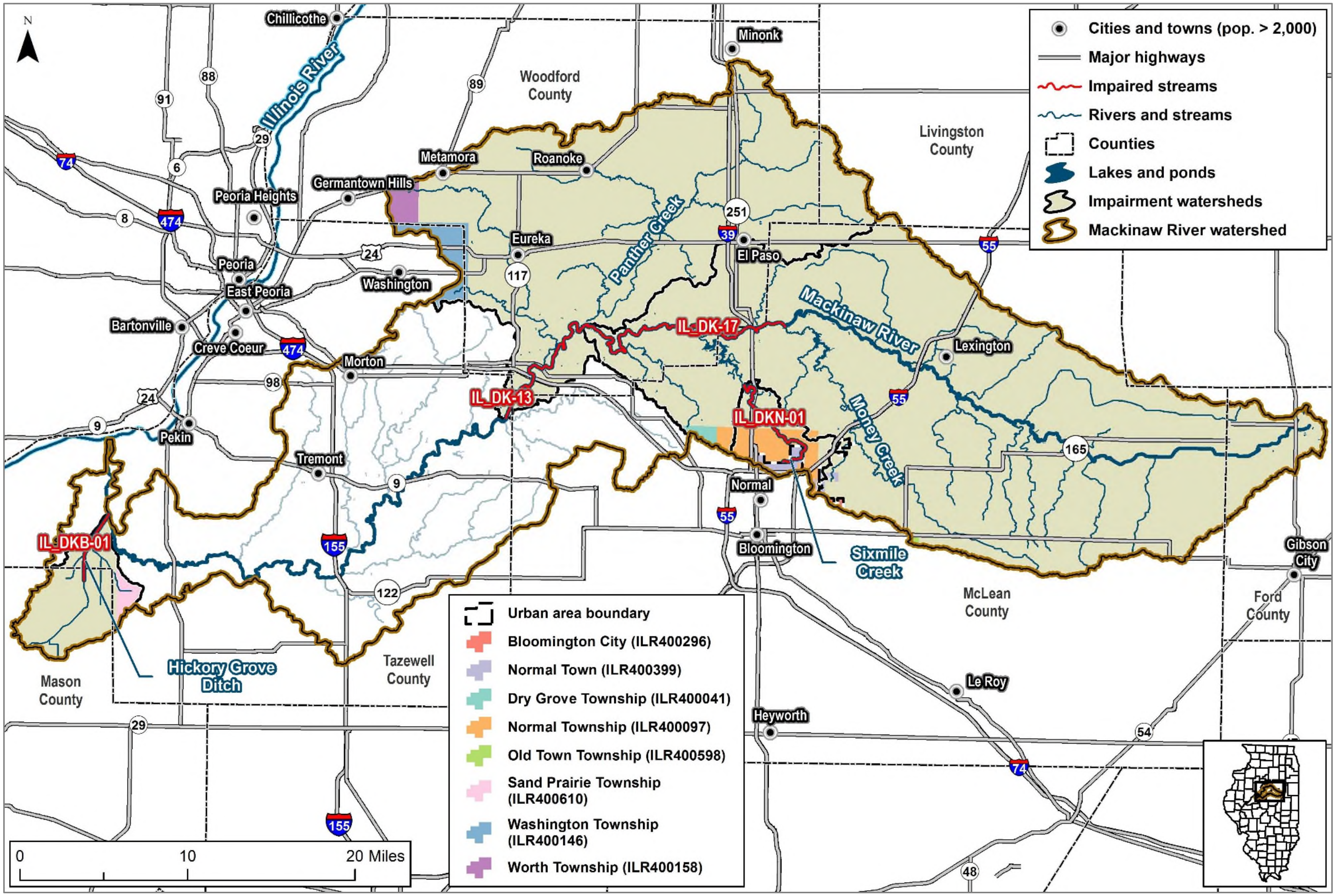


Figure 9. Municipal Separate Storm Sewer Systems (MS4s) in impairment subwatersheds.
McLean County and ILDOT are also regulated MS4s.

3.3 Nonpoint Sources

The term nonpoint source pollution is defined as any source of pollution that does not meet the legal definition of point sources. Nonpoint source pollution typically results from overland stormwater runoff that is diffuse in origin, as well as background conditions. It should be noted that stormwater collected and conveyed through a regulated MS4 is considered a controllable point source. As part of the water resource assessment process, Illinois EPA has identified several sources as contributing to the Mackinaw River watershed impairments (Table 15).

Table 15. Potential sources in project area based on the Draft 2016 305(b) list

Watershed	Segment	Pollutant of Concern	Sources
Mackinaw River	IL_DK-13	Fecal coliform	Source unknown
	IL_DK-17	Nitrate nitrogen	Source unknown
Hickory Grove Ditch	IL_DKB-01	Dissolved oxygen	Channelization, crop production (crop land or dry land), agriculture and source unknown
Sixmile Creek	IL_DKN-01	Dissolved oxygen	Channelization, dam or impoundment, source unknown, crop production (crop land or dry land), and agriculture

A summary of the potential nonpoint sources of pollutants is provided below, additional information on the primary pollutant sources follow.

- Potential nonpoint sources of pollution to fecal coliform in the Mackinaw River (DK-13) include stormwater runoff, onsite wastewater treatment systems, animal agriculture, and wildlife.

- Nonpoint sources of nitrate in the Mackinaw River (DK-17) are primarily related to agricultural runoff and tile discharge as a result of nitrogen fertilizer application. Cropland makes up the majority of the contributing watershed, and the presence of potentially wet soils indicates that tiling is likely common. In addition, stormwater runoff and onsite wastewater treatment systems can also contribute to nitrogen loading.

- Nonpoint sources potentially contributing to low dissolved oxygen conditions in Hickory Grove Ditch (DKB-01) include stormwater and agricultural runoff, onsite wastewater treatment systems, animal agriculture activities, sediment oxygen demand, and channelization. Pollutants typically of concern include phosphorus (leading to eutrophication), ammonia, and carbonaceous biochemical oxygen demand. Sediment oxygen demand, often a result of decaying organic matter, can significantly contribute to low dissolved oxygen conditions. Channelization is a non-pollutant source. Channelization can result in low dissolved oxygen conditions due to lack of in-stream structure that would reaerate the water column. The entire length of Hickory Grove Ditch has been channelized.

- Nonpoint sources potentially contributing to low dissolved oxygen conditions in Sixmile Creek (DKN-01) include stormwater and agricultural runoff, onsite wastewater treatment systems, animal agriculture activities, sediment oxygen demand, channelization, and hydrologic modification (dam or impoundment). Pollutants typically of concern include phosphorus (leading to eutrophication), ammonia, and carbonaceous biochemical oxygen demand. Sediment oxygen demand, often a result of decaying organic matter, can significantly contribute to low dissolved oxygen conditions. Channelization and hydrologic modification are non-pollutant sources. Channelization can result in low dissolved oxygen conditions due to lack of in-stream structure that would reaerate the water column. Stormwater ponds are present in the upper part of the watershed which may lead to altered flow conditions.

3.3.1 Stormwater and Agricultural Runoff

During wet-weather events (snowmelt and rainfall), pollutants are incorporated into runoff and can be delivered to downstream waterbodies. The resultant pollutant loads are linked to the land uses and practices in the watershed. Agricultural and developed areas can have significant effects on water quality if proper best management practices are not in place.

In addition to pollutants, alterations to a watershed's hydrology as a result of land use changes, ditching, and stream channelization can detrimentally affect habitat and biological health. Imperviousness associated with developed land uses and agricultural field tiling can result in increased peak flows and runoff volumes and decreased base flow as a result of reduced ground water discharge. Drain tiles also transport agricultural runoff directly to ditches and streams, whereas runoff flowing over the land surface may infiltrate to the subsurface and may flow through riparian areas.

3.3.2 Onsite Wastewater Treatment Systems

Onsite wastewater treatment systems (e.g., septic systems) that are properly designed and maintained should not serve as a source of contamination to surface waters. However, onsite systems do fail for a variety of reasons. Common soil-type limitations which contribute to failure include seasonally high water tables, compact glacial till, bedrock, and fragipan. When these septic systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface waters (Horsley and Witten 1996). Septic systems contain all the water discharged from homes and business and can be significant sources of pollutants. Septic systems installed after Jan 1, 2014 are required to have a documented evaluation by the Illinois Department of Public Health Sewage Code. The owner is required to keep the documentation for the life of the system or pass the documentation to a new owner. County health departments were contacted for information on septic systems and unsewered communities.

- Livingston County reported 6,000 and Tazewell reported 100,000 installed septic systems in their counties. No information was provided on failure rates or results of compliance testing.
- McLean County has 2,780 septic systems within the contributing drainage area to streams addressed in this TMDL (Figure 10). There are 9,709 active septic systems in the entire county, 7,741 of which discharge below the surface and 1,968 that discharge to the surface. All systems were up to code at the time they were installed, however, maintenance is not documented by the County Department of Health.
- Mason County did not provide specific information on septic systems, but noted that the county is mostly rural in only a few major cities on public sewer systems.
- Ford County reported minimal septic systems and no recent complaints in their portion of the watershed.

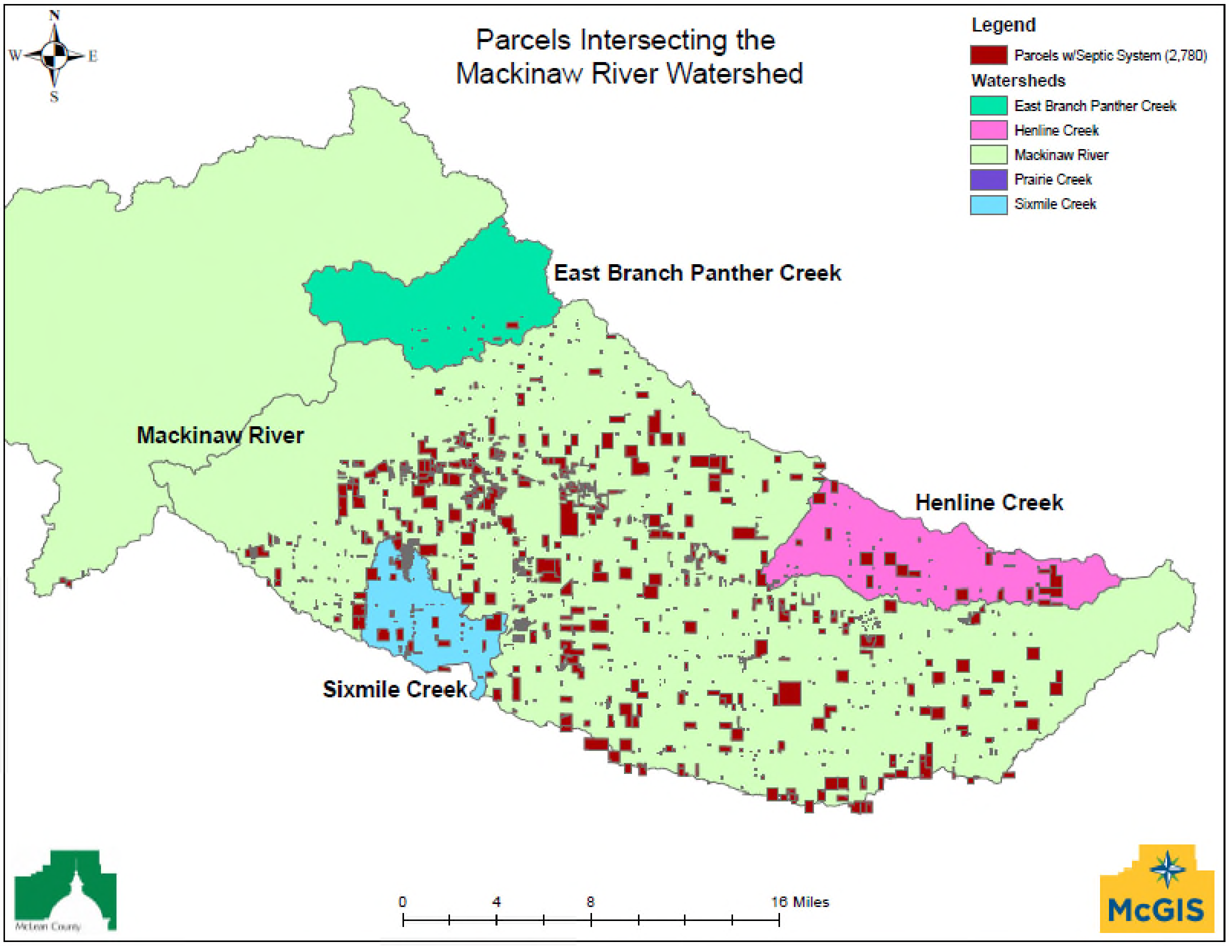


Figure 10. McLean County parcels with septic systems located in the contributing drainage area to impaired streams addressed in this TMDL. Map provided by McLean County GIS department.

3.3.3 Animal Feeding Operations (AFOs)

Animal feeding operations that are not classified as CAFOs are known as animal feeding operations (AFOs) in Illinois. Non-CAFO AFOs are considered nonpoint sources by U.S. EPA. AFOs in Illinois do not have state permits. However, they are subject to state livestock waste regulations and may be inspected by the Illinois EPA, either in response to complaints or as part of the Agency's field inspection responsibilities to determine compliance by facilities subject to water pollution and livestock waste regulations. The animals raised in AFOs produce manure that is stored in pits, lagoons, tanks and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial re-use of manure provides a natural source for crop nutrition. It also lessens the need for fuel and other natural resources that are used in the production of fertilizer. AFOs, however, can pose environmental concerns, including the following:

- Manure can leak or spill from storage pits, lagoons, tanks, etc.
- Improper application of manure can contaminate surface or ground water.
- Manure over application can adversely impact soil productivity.

Livestock are potential sources of bacteria and nutrients to streams, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas. Watershed specific data are not available for livestock populations. However, county wide data available from the 2012 Census of Agriculture were downloaded and area weighted to estimate the animal population in the project area. An estimated 135,333 animals are in the project area.

4. Water Quality

Routine water quality monitoring is a key part of the Illinois EPA assessment program. The goals of Illinois EPA surface water monitoring programs are to determine whether designated uses are supported, identify causes of pollution (toxics, nutrients, sedimentation) and sources (point or nonpoint) of surface water impairments, determine the overall effectiveness of pollution control programs, and identify long term resource quality trends. Illinois EPA has operated a widespread, active long-term monitoring network in Illinois since 1977, known as the Ambient Water Quality Monitoring Network (AWQMN). The AWQMN is utilized by the Illinois EPA to provide baseline water quality information, to characterize and define trends in the physical, chemical and biological conditions of the state's waters, to identify new or existing water quality problems, and to act as a triggering mechanism for special studies or other appropriate actions.

Additional uses of the data collected by the Illinois EPA through the AWQMN program include the review of existing water quality standards and establishment of water quality based effluent limits for NPDES permits. The AWQMN is integrated with other Illinois EPA chemical and biological stream monitoring programs including Intensive River Basin Surveys, Facility-related Stream Surveys, Fish Contaminant Monitoring, Toxicity Testing Program and Pesticide Monitoring Subnetwork which are more regionally based (specific watersheds or point source receiving stream) and cover a shorter span of time (e.g. one year) to evaluate compliance with water quality standards and determine designated use support. Information from this program is compiled by Illinois EPA into a biennial report, known as the Illinois Integrated Water Quality Report and Section 303(d) List, required by the Federal Clean Water Act.

Along the impaired stream segments, data were found for numerous stations that are part of the AWQMN (Figure 11 and Table 16). Parameters sampled on the streams include field measurements (e.g., water temperature) as well as those that require lab analyses (e.g., fecal coliform, nutrients, and total suspended solids). Available data were obtained directly from Illinois EPA.

Table 16. Illinois EPA water quality data along impaired stream segments

Water Body	Impaired Segment	AWQMN Sites	Location	Period of Record
Mackinaw River	DK-13	DK-06	RT 150 Br. 2 Mi. W Congerville	2018
		DK-13	Rocky Ford Br. at River Rd. and Ragar Rd., 4 Mi. SE of Deer Creek	*1999–2006*
		DK-16	RT 150 Br. 1 Mi. NW Congerville	*2000, 2005*, 2010, 2015
	DK-17	DK-02	RT 51 Br. 4.5 Mi. N Hudson	-*
		DK-17	3.5 Mi. NE Congerville	*2000, 2005*, 2010
		DK-18	CO Rd. 9, 5 Mi. WSW Kappa	-*
		DK-25	1.5 Mi. NW Lk. Bloomington	-*
Hickory Grove Ditch	DKB-01	DKB-01	CO Rd. 1100N 4 Mi. NE Manito	*2000, 2005*, 2010, 2015
Sixmile Creek	DKN-01	DKN-01	CO Rd. 12 Br. 0.75 Mi. W Hudson	*2000, 2002*
		DKN-02	CO Rd. 2000N 1.5 Mi. S of Hudson	*2005*, 2010, 2015

Italics – Data are greater than 10 years old
-* Station location provided in GIS shapefile; however, no data available (1999–2016) as provided by Illinois EPA

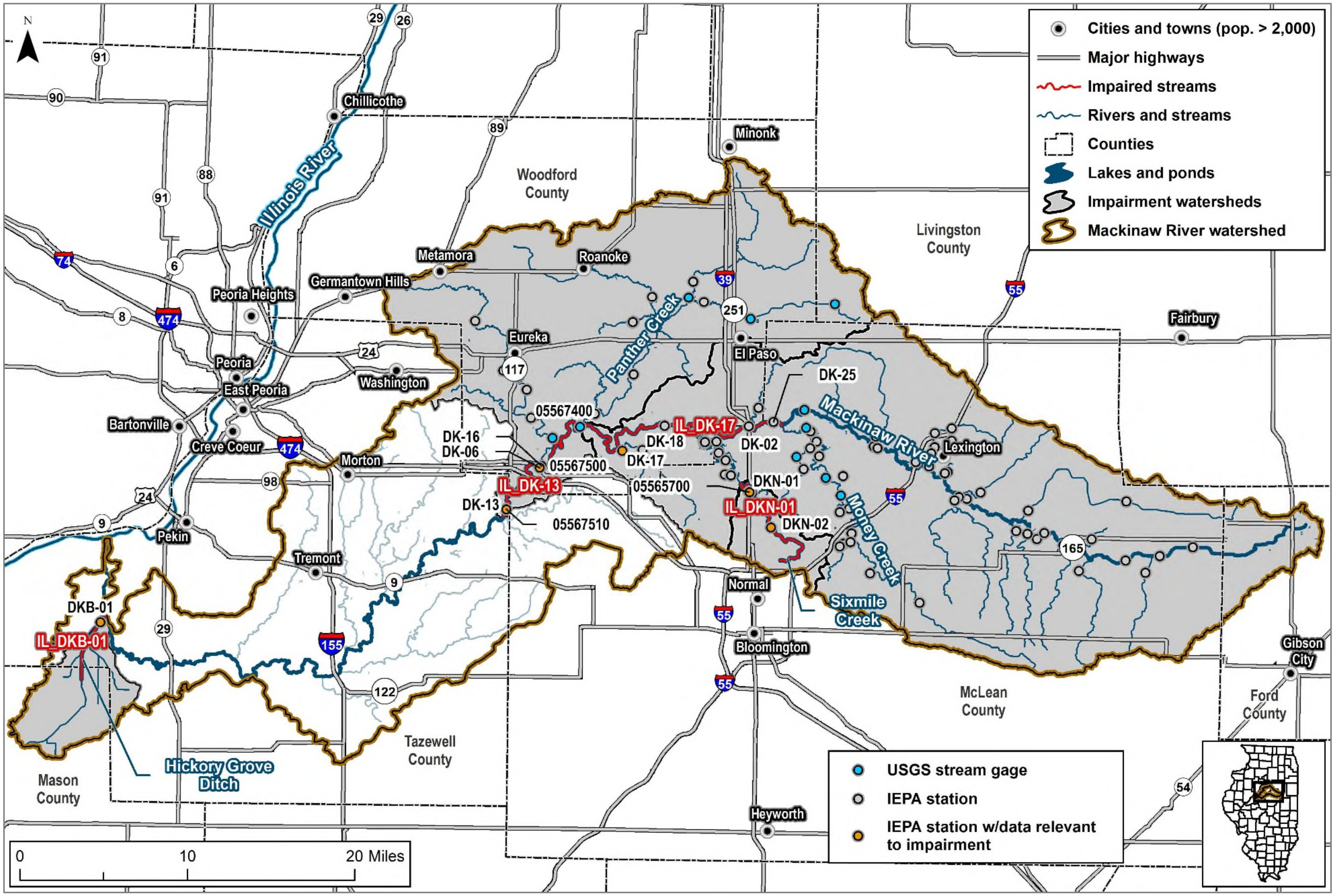


Figure 11. USGS stream gages and Illinois EPA water quality sampling sites in impairment watersheds and along impaired stream segments.
Monitoring stations on impaired segments labeled.

4.1 Data Analysis

An important step in the TMDL development process is the review of water quality conditions, particularly data and information used to list segments. Examination of water quality monitoring data is a key part of defining the problem that the TMDL is intended to address. This section provides a brief review of available water quality information provided by the Illinois EPA. The most recent 10 years of data collection, 2007–2016, were used to evaluate impairment status. Data that are greater than 10 years old are only included where future monitoring efforts are needed to evaluate impairment status. Each data point was reviewed to ensure the use of quality data in the analysis below.

4.1.1 Mackinaw River

The Mackinaw River is listed as impaired along two segments—DK-13 and DK-17. Segment DK-13 is impaired for primary contact recreation due to fecal coliform. Segment DK-17 is upstream of DK-13 and is impaired for public and food processing water supply use to due to nitrate nitrogen. The City of Bloomington uses intake IN00400 from segment DK-17 to pump water from the Mackinaw River into Evergreen Lake during times of drought. There are two Illinois EPA sampling sites with relevant data on segment DK-13 and one on segment DK-17.

Forty-three fecal coliform samples were collected at station DK-13 between 1999 and 2006 (Figure 12). However, all samples collected are greater than 5 years old. Additional data were collected at station DK-06 in 2018 to verify impairment (Table 17). Greater than 10 percent of the individual samples exceed the single sample maximum standard, and the geometric mean of the five samples taken within a 30-day period is greater than the monthly geometric mean standard (Figure 13). Primary contact recreation impairment on segment DK-13 is verified.

Five nitrate nitrite (nitrate + nitrite as N) samples were collected at DK-17 in the most recent three years of data collection during 2015 (Table 18 and Figure 14). Greater than 10 percent of samples exceed the 10 mg/L drinking water protection MCL, with two individual exceedances of the MCL observed. The April to June quarterly average also exceeds the MCL. Public and food processing water supply use impairment is verified on this segment.

Table 17. Data summary, Mackinaw River IL_DK-13

Sample Site	No. of samples	Minimum (cfu/100 mL)	Geometric Mean (cfu/100 mL)	Maximum (cfu/100 mL)	Number of exceedances of single sample maximum standard (400 cfu/100 mL)
Fecal Coliform					
DK-06	5	205	426	980	8

Table 18. Data summary, Mackinaw River IL_DK-17

Sample Site	Date	Result (mg/L)	Quarterly Average (mg/L)
Nitrate/Nitrite (nitrate + nitrite as N)			
DK-17	6/4/2015	10.5	10.5
	7/2/2015	10.6	6.2
	8/12/2015	4.57	
	8/13/2015	4.33	
	9/29/2015	5.24	

Red values indicate samples above the MCL

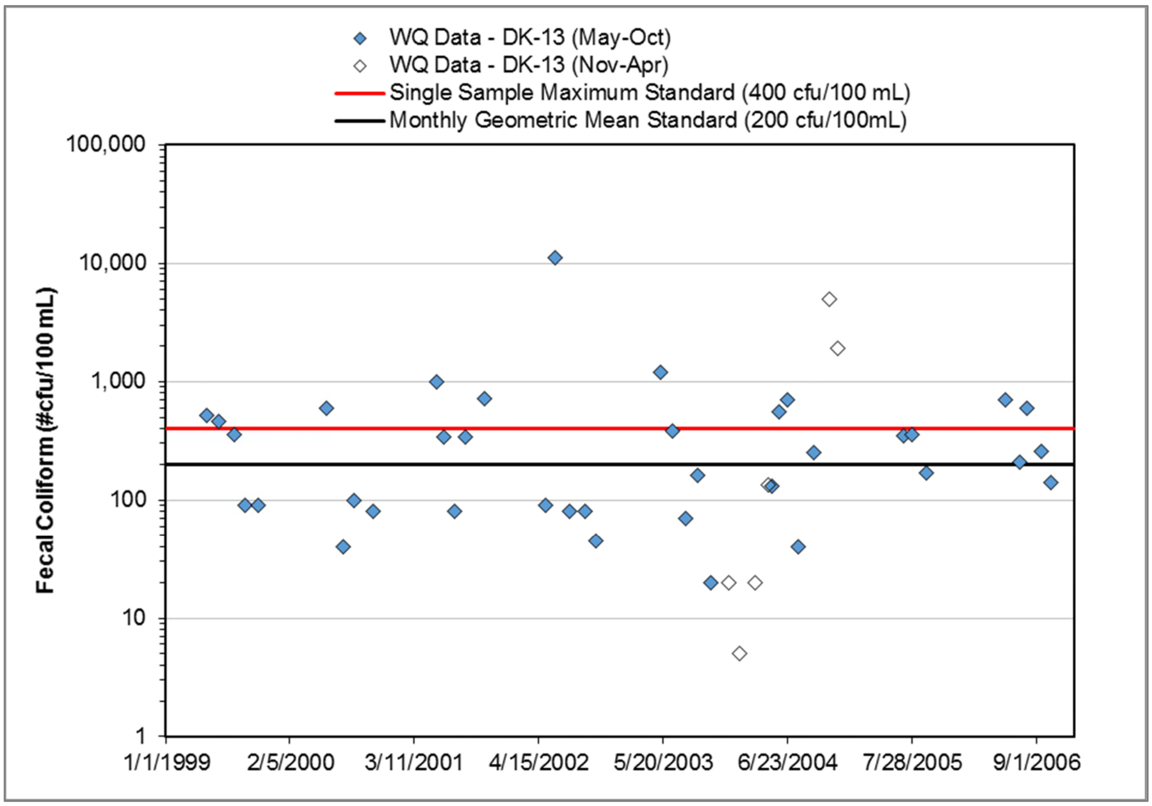


Figure 12. Fecal coliform water quality time series, 1999–2006, Mackinaw River DK-13 segment.

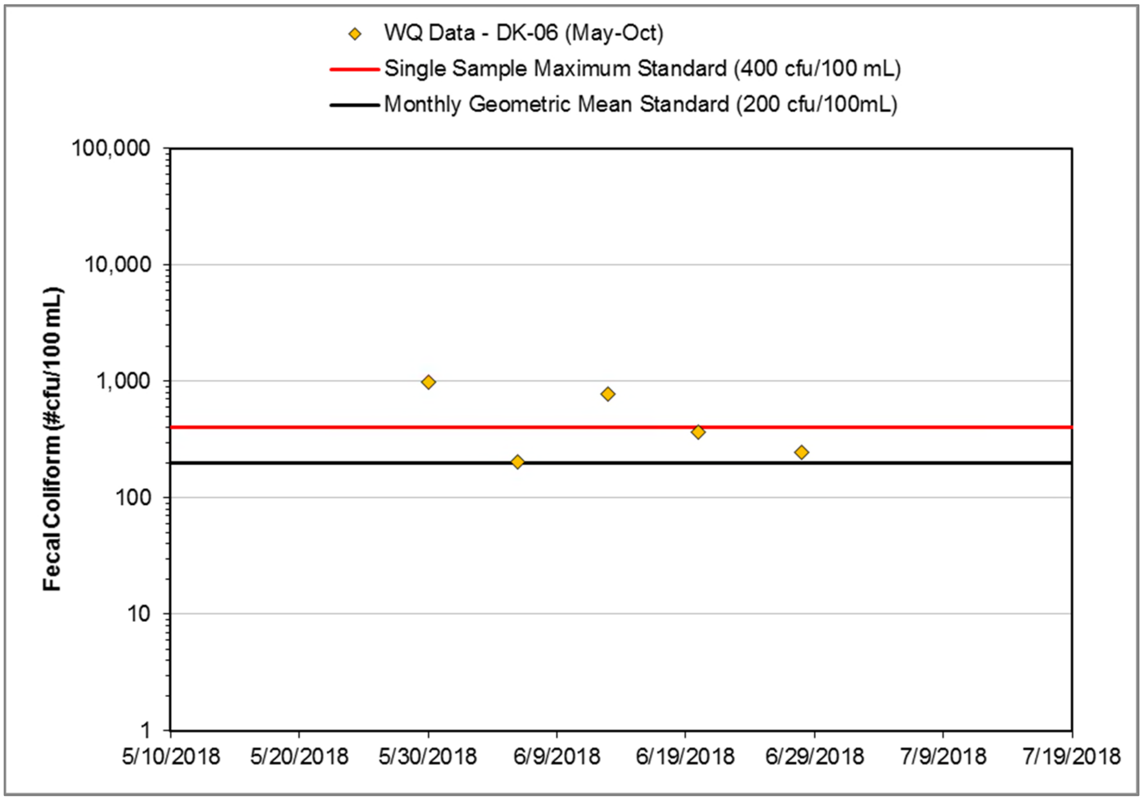


Figure 13. Fecal coliform water quality time series, 2018, Mackinaw River DK-13 segment.

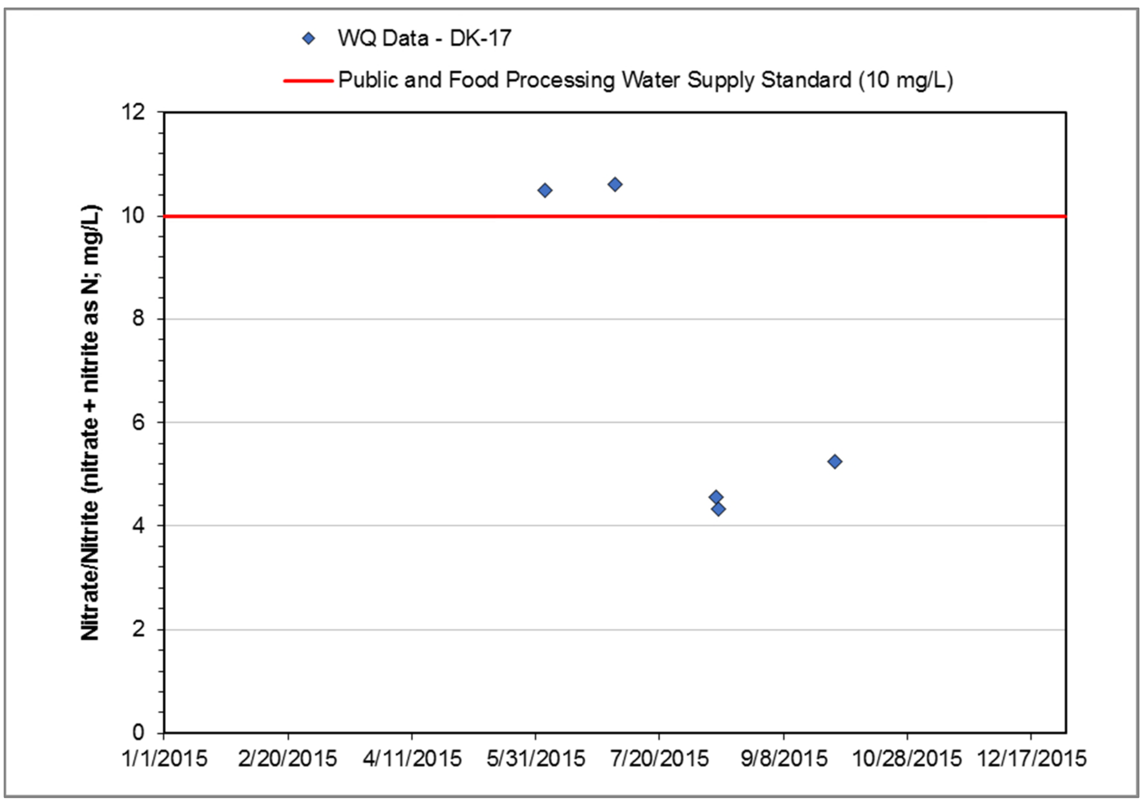


Figure 14. Nitrate water quality time series, Mackinaw River DK-17 segment

4.1.2 Hickory Grove Ditch (DKB-01)

Hickory Grove Ditch DKB-01 is listed as impaired for aquatic life use due low dissolved oxygen. One IEPA sampling site was identified on the stream, DKB-01. Continuous dissolved oxygen data were collected at site DKB-01 in 2010 and 2015. Multiple violations of the standard were observed in June 2010 and 2015 (Figure 15). Aquatic life use impairment is verified on this segment.

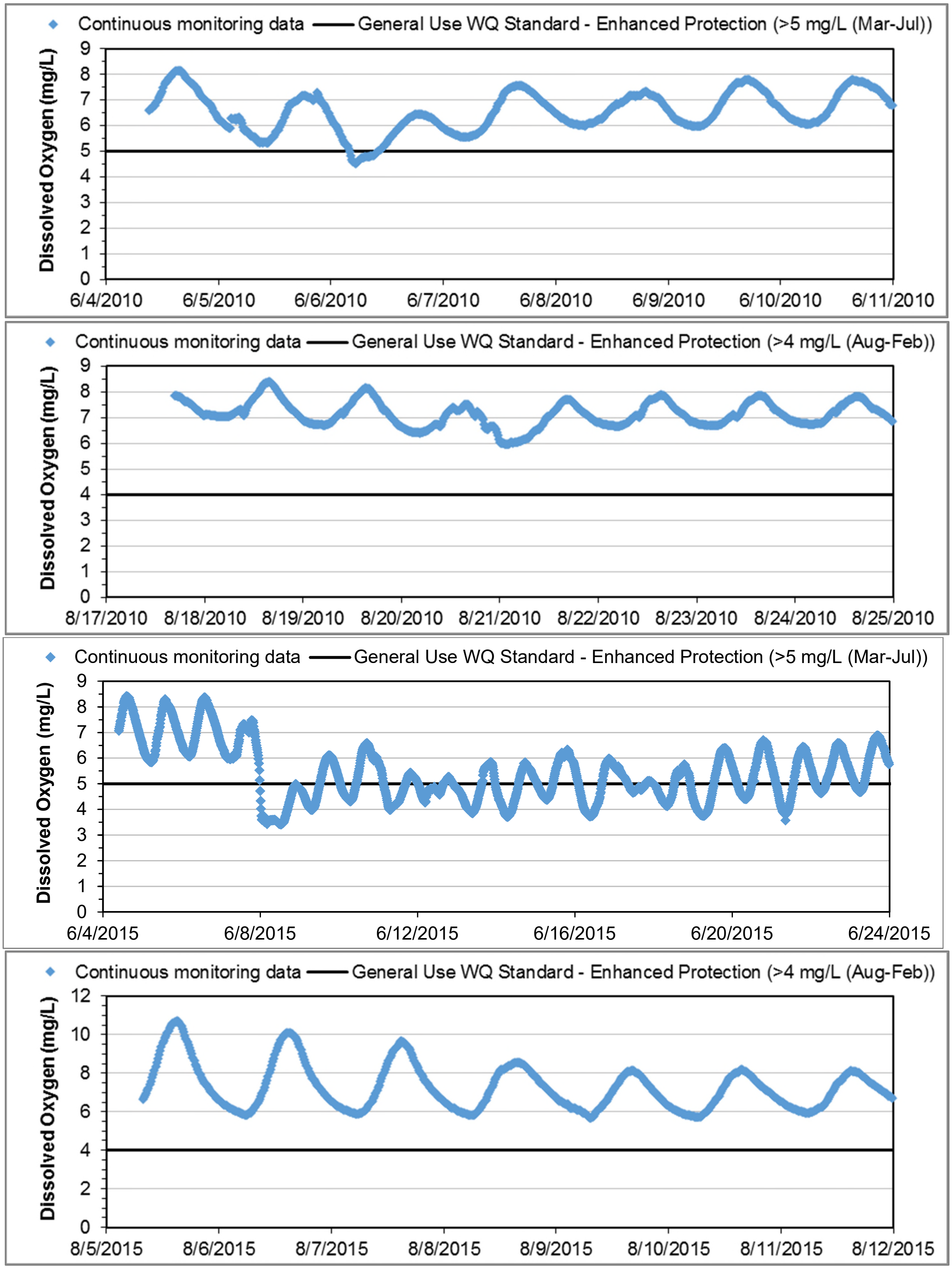


Figure 15. Continuous dissolved oxygen water quality time series, Hickory Grove Ditch DKB-01.

4.1.3 Sixmile Creek (DKN-01)

Sixmile Creek (DKN-01) is listed as impaired for aquatic life due to low levels of dissolved oxygen. One Illinois EPA sampling site with relevant data was identified on Sixmile Creek at DKN-02. This station is located in the upper part of the stream segment, well above Evergreen Lake. Eight dissolved oxygen samples were collected at the site between 2010 and 2015 (Table 19 and Figure 16). Two samples violated the general use water quality standard in 2010. Continuous dissolved oxygen was monitored in June and August of 2010; dissolved oxygen regularly violated the standard in August 2010 (Figure 18). Available phosphorus data were evaluated to determine if eutrophication was contributing to low dissolved oxygen conditions; however, no correlation was found between phosphorus and dissolved oxygen (Figure 17). Aquatic life use impairment is verified on this creek.

Table 19. Data summary, Sixmile Creek IL_DKN-01

Sample Site	No. of samples	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	CV (standard deviation/ average)	Number of exceedances of general use water quality standard (>5 mg/L (Mar-Jul) and >3.5 mg/L (Aug-Feb))
Dissolved Oxygen						
DKN-02	8	1.3	7.2	10.2	0.45	2

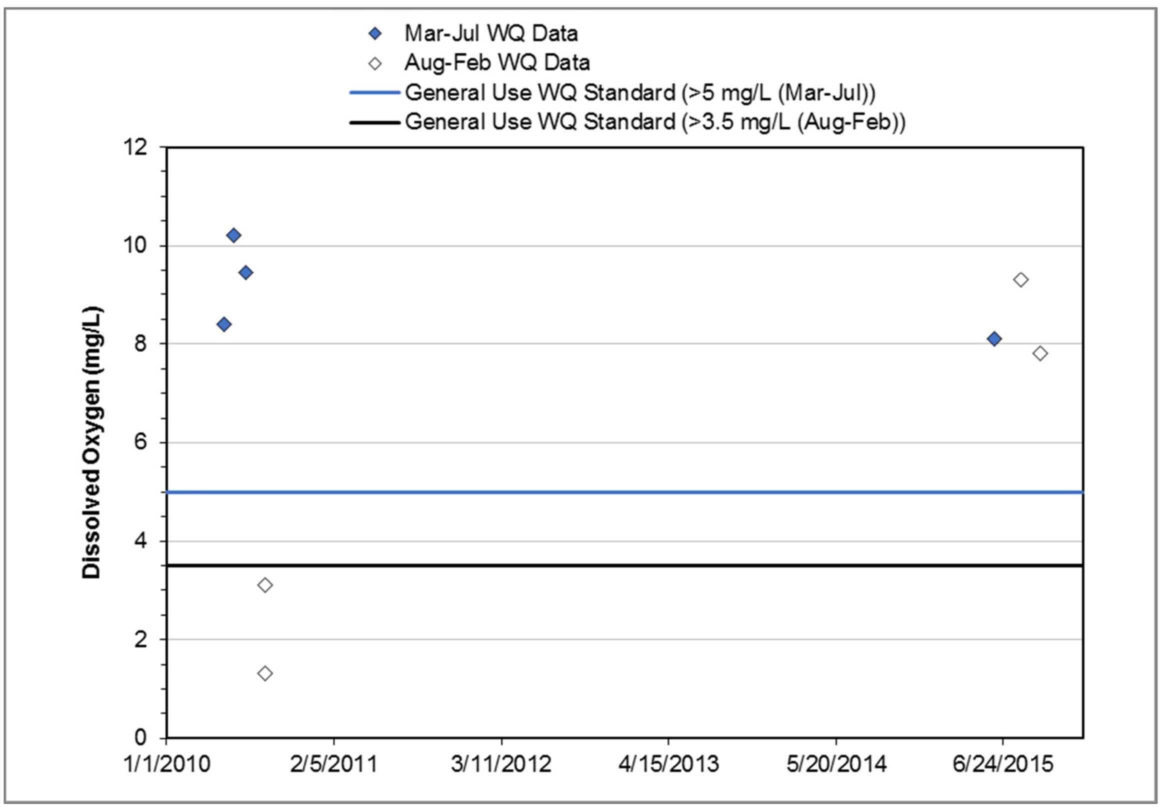


Figure 16. Dissolved oxygen water quality time series, Sixmile Creek DKN-01.

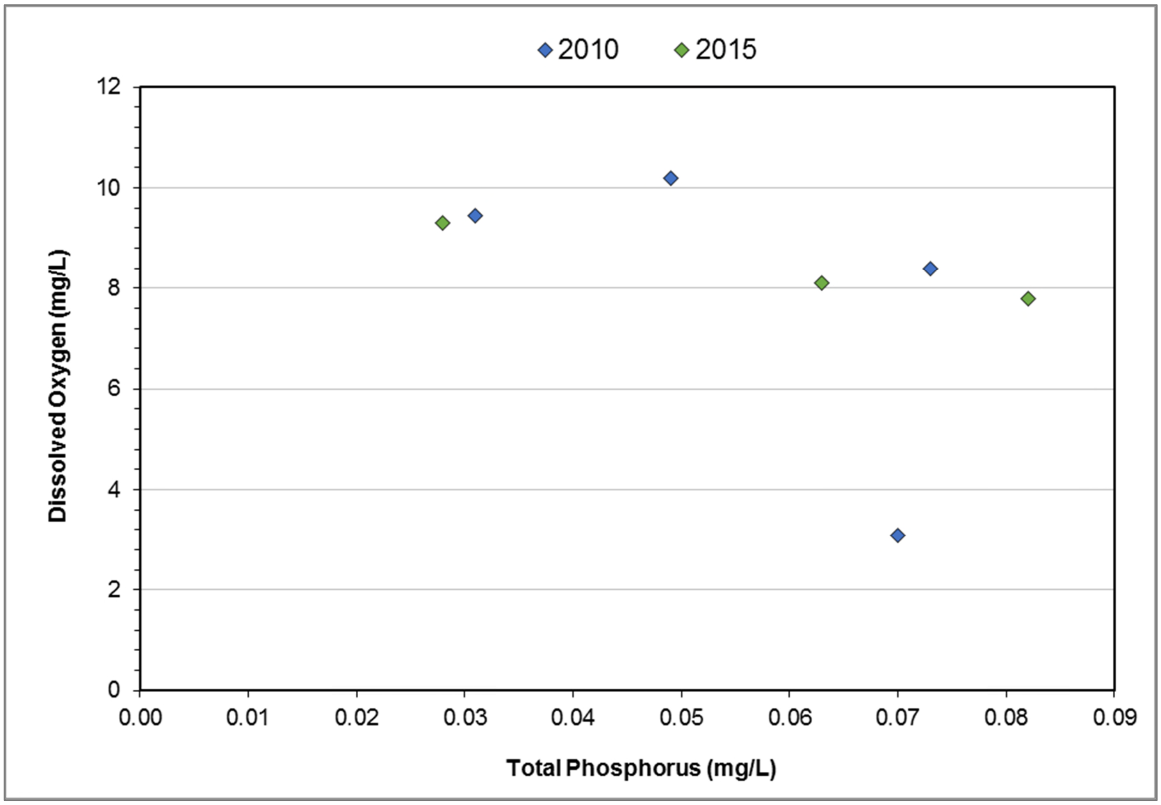


Figure 17. Total phosphorus versus dissolved oxygen, Sixmile Creek DKN-01.

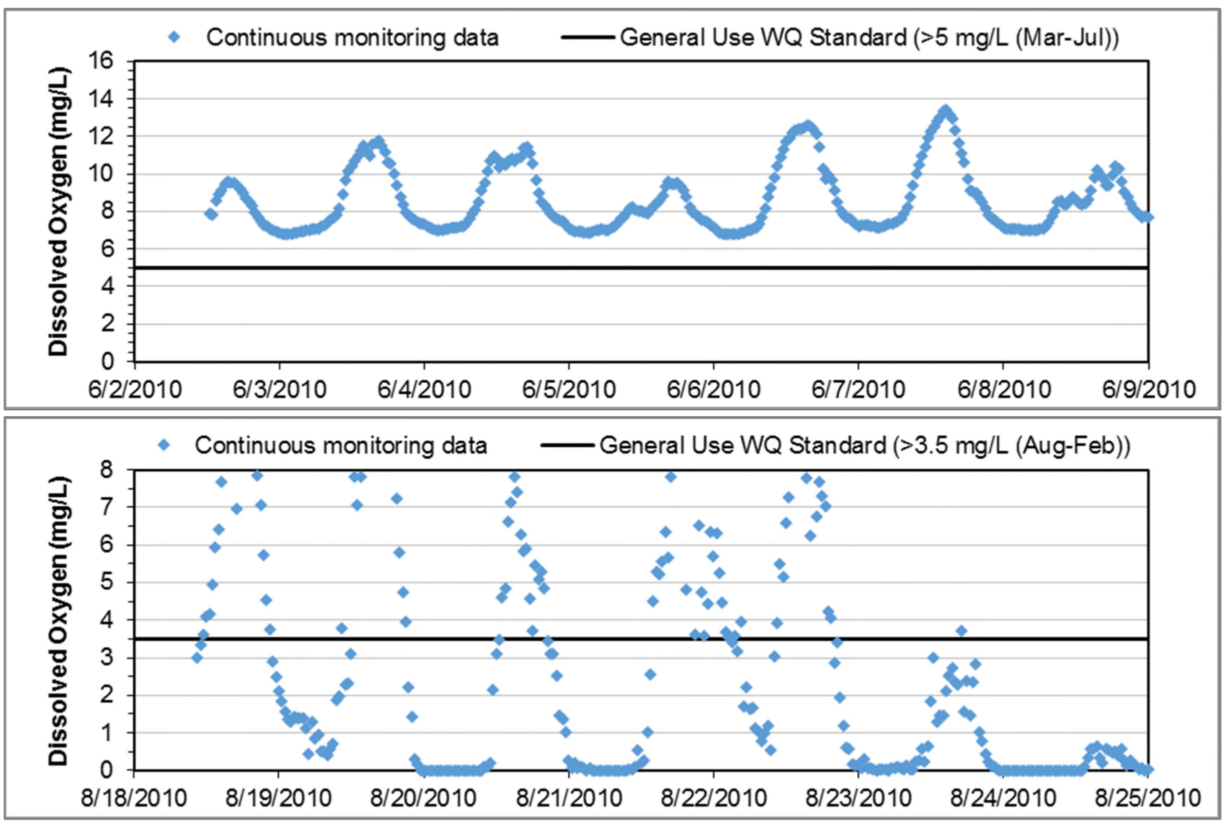


Figure 18. Continuous water quality time series for dissolved oxygen, Sixmile Creek (DKN-01).

5. TMDL Methods and Data Needs

The first stage of this project has been an assessment of available data, followed by evaluation of their credibility. The types of data available, their quantity and quality, and their spatial and temporal coverage relative to impaired segments or watersheds drive the approaches used for TMDL model selection and analysis. Credible data are those that meet specified levels of data quality, with acceptance criteria defined by measurement quality objectives, specifically their precision, accuracy, bias, representativeness, completeness, and reliability. The following sections describe the methods that will be used to derive TMDLs, the additional data needed to develop credible TMDLs, and data needed to further refine the source of impairments in order to develop an effective TMDL implementation plan.

5.1 Stream Impairments

TMDLs are proposed for all segments with verified impairments (Table 20). A duration curve approach is suggested to evaluate the relationships between hydrology and water quality and calculate the TMDLs for fecal coliform and nitrate impairments.

The Qual2K model is proposed to evaluate the confirmed low dissolved oxygen impairments where point sources are present. If point sources are not present and if there is a correlation with eutrophication (i.e., phosphorus concentration or high levels of algae and/or plant growth), a duration curve approach is suggested to develop a phosphorus TMDL. The phosphorus target will be derived from the relationship between phosphorus and dissolved oxygen in the impaired stream. TMDLs are not proposed for dissolved oxygen impairments that are not affected by point sources and do not show a correlation with eutrophication. In these cases, it is assumed that the cause of impairment is non-pollutant based (e.g., the effect of lack of re-aeration in low-gradient streams or the effect of hydromodification).

Table 20. Proposed Model Summary

Name	Segment ID	Designated Uses	TMDL Parameter(s)	Proposed Model	Proposed Pollutant
Mackinaw River	IL_DK-13	Primary contact recreation	Fecal coliform	Load duration curve	Fecal coliform
	IL_DK-17	Public and food processing water supply	Nitrogen, Nitrate	Load duration curve	Nitrogen, Nitrate
Hickory Grove Ditch	IL_DKB-01	Aquatic life	Dissolved Oxygen	Qual2K	Biochemical oxygen demand, ammonia, phosphorus
Sixmile Creek	IL_DKN-01	Aquatic life	Dissolved Oxygen	Qual2K or load duration curve or 4C impairment, pending data collection	Biochemical oxygen demand, ammonia, phosphorus; or phosphorus; or non-pollutant, pending data collection

5.1.1 Load Duration Curve Approach

The primary benefit of duration curves in TMDL development is to provide insight regarding patterns associated with hydrology and water quality concerns. The duration curve approach is particularly applicable because water quality is often a function of stream flow. For instance, sediment concentrations typically increase with rising flows as a result of factors such as channel scour from higher velocities.

Other parameters, such as chloride, may be more concentrated at low flows and more diluted by increased water volumes at higher flows. The use of duration curves in water quality assessment creates a framework that enables data to be characterized by flow conditions. The method provides a visual display of the relationship between stream flow and water quality.

Allowable pollutant loads have been determined through the use of load duration curves. Discussions of load duration curves are presented in *An Approach for Using Load Duration Curves in the Development of TMDLs* (USEPA 2007). This approach involves calculating the allowable loadings over the range of flow conditions expected to occur in the impaired stream by taking the following steps:

1. A flow duration curve for the stream is developed by generating a flow frequency table and plotting the data points to form a curve. The data reflect a range of natural occurrences from extremely high flows to extremely low flows.

2. The flow curve is translated into a load duration (or TMDL) curve by multiplying each flow value (in cubic feet per second) by the water quality standard/target for a contaminant (mg/L), then multiplying by conversion factors to yield results in the proper unit (i.e., pounds per day). The resulting points are plotted to create a load duration curve.

3. Each water quality sample is converted to a load by multiplying the water quality sample concentration by the average daily flow on the day the sample was collected. Then, the individual loads are plotted as points on the TMDL graph and can be compared to the water quality standard/target, or load duration curve.

4. Points plotting above the curve represent deviations from the water quality standard/target and the daily allowable load. Those plotting below the curve represent compliance with standards and the daily allowable load. Further, it can be determined which locations contribute loads above or below the water quality standard/target.

5. The area beneath the TMDL curve is interpreted as the loading capacity of the stream. The difference between this area and the area representing the current loading conditions is the load that must be reduced to meet water quality standards/targets.

6. The final step is to determine where reductions need to occur. Those exceedances at the right side of the graph occur during low flow conditions, and may be derived from sources such as illicit sewer connections. Exceedances on the left side of the graph occur during higher flow events, and may be derived from sources such as runoff. Using the load duration curve approach allows Illinois EPA to determine which implementation practices are most effective for reducing loads on the basis of flow regime.

Water quality duration curves are created using the same steps as those used for load duration curves except that concentrations, rather than loads, are plotted on the vertical axis. Flows are categorized into the following five hydrologic zones (U.S. EPA 2007):

- High flow zone: stream flows that plot in the 0 to 10-percentile range, related to flood flows
- Moist zone: flows in the 10 to 40-percentile range, related to wet weather conditions
- Mid-range zone: flows in the 40 to 60-percentile range, median stream flow conditions
- Dry zone: flows in the 60 to 90-percentile range, related to dry weather flows
- Low flow zone: flows in the 90 to 100-percentile range, related to drought conditions

The duration curve approach helps to identify the issues surrounding the impairment and to roughly differentiate between sources. Table 21 summarizes the general relationship between the five hydrologic zones and potentially contributing source areas (the table is not specific to any individual pollutant). For example, the table indicates that impacts from point sources are usually most pronounced during dry and low flow zones because there is less water in the stream to dilute their loads. In contrast, impacts from stormwater are most pronounced during moist and high flow zones due to increased overland flow from stormwater source areas during rainfall events.

Table 21. Relationship between duration curve zones and contributing sources

Contributing source area	Duration Curve Zone				
	High	Moist	Mid-range	Dry	Low
Point source				M	H
Livestock direct access to streams				M	H
On-site wastewater systems	M	M-H	H	H	H
Stormwater: Impervious		H	H	H	
Stormwater: Upland	H	H	M		
Field drainage: Natural condition	H	M			
Field drainage: Tile system	H	H	M-H	L-M	

Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low).

The load reduction approach also considers critical conditions and seasonal variation in the TMDL development as required by the Clean Water Act and U.S. EPA's implementing regulations. Because the approach establishes loads on the basis of a representative flow regime, it inherently considers seasonal variations and critical conditions attributed to flow conditions. An underlying premise of the duration curve approach is correlation of water quality impairments to flow conditions. The duration curve alone does not consider specific fate and transport mechanisms, which may vary depending on watershed or pollutant characteristics.

5.1.2 Qual2K

Qual2K is a steady-state water quality model that simulates eutrophication kinetics and conventional water quality parameters and is maintained by U.S. EPA. Qual2K simulates up to 15 water quality constituents in branching stream systems. A stream reach is divided into a number of computational elements, and for each computational element, a hydrologic balance in terms of stream flow (e.g., m3/s), a heat balance in terms of temperature (e.g., degrees C), and a material balance in terms of concentration (e.g., mg/l) are written. Both advective and dispersive transport processes are considered in the material balance. Mass is gained or lost from the computational element by transport processes, wastewater discharges, and withdrawals. Mass can also be gained or lost by internal processes such as release of mass from benthic sources or biological transformations.

The program simulates changes in flow conditions along the stream by computing a series of steady-state water surface profiles. The calculated stream-flow rate, velocity, cross-sectional area, and water depth serve as a basis for determining the heat and mass fluxes into and out of each computational element due to flow. Mass balance determines the concentrations of constituents at each computational element. In addition to material fluxes, major processes included in the mass balance are transformation of nutrients, algal production, benthic and carbonaceous demand, atmospheric reaeration, and the effect of these processes on the dissolved oxygen balance. The nitrogen cycle is divided into four compartments: organic nitrogen, ammonia nitrogen, nitrite nitrogen, and nitrate nitrogen. The primary internal sink of dissolved oxygen in the model is biochemical oxygen demand (BOD). The major sources of dissolved oxygen are algal photosynthesis and atmospheric reaeration.

The model is applicable to dendritic streams that are well mixed. It assumes that the major transport mechanisms, advection and dispersion, are significant only along the main direction of flow (the longitudinal axis of the stream or canal). It allows for multiple waste discharges, withdrawals, tributary flows, and incremental inflow and outflow.

Hydraulically, Qual2K is limited to the simulation of time periods during which both the stream flow in river basins and input waste loads are essentially constant. Qual2K can operate as either a steady-state or a quasi-dynamic model, making it a very helpful water quality planning tool. When operated as a steady-state model, it can be used to study the impact of waste loads (magnitude, quality, and location) on instream water quality. By operating the model dynamically, the user can study the effects of diurnal variations in meteorological data on water quality (primarily dissolved oxygen and temperature) and also can study diurnal dissolved oxygen variations due to algal growth and respiration. However, the effects of dynamic forcing functions, such as headwater flows or point loads, cannot be modeled in Qual2K. A Qual2K steady-state model is proposed for Sixmile Creek (DKN-01), if needed.

Qual2K is an appropriate choice for certain types of dissolved oxygen and organic enrichment TMDLs that can be implemented at a moderate level of effort. Use of the Qual2K models in TMDLs is most appropriate when (1) full vertical mixing can be assumed, and (2) water quality excursions are associated with identifiable critical flow conditions. Because these models do not simulate dynamically varying flows, their use is limited to evaluating responses to one or more specific flow conditions. The selected flow condition should reflect critical conditions, which for dissolved oxygen occurs when flows are low and the ambient air temperature is warm, typically in July or August.

5.2 Additional Data Needs

Data satisfy two key objectives for Illinois EPA, enabling the agency to make informed decisions about the resource. These objectives include developing information necessary to:

- Determine if the impaired areas are meeting applicable water quality standards for their respective designated use(s); and
- Support modeling and assessment activities required to allocate pollutant loadings for all impaired areas where water quality standards are not being met.

Additional data may be needed to verify impairment, understand probable sources, calculate reductions, develop calibrated water quality models, and develop effective implementation plans. Table 22 summarizes the additional data needed for each impaired segment.

Table 22. Additional data needs

Name	Segment ID	Designated Uses	TMDL Parameters	Additional Data Needs
Mackinaw River	IL_DK-13	Primary contact recreation	Fecal coliform	None
	IL_DK-17	Public and food processing water supply	Nitrogen, Nitrate	None
Hickory Grove Ditch	IL_DKB-01	Aquatic life	Dissolved Oxygen	To support Qual2K model
Sixmile Creek	IL_DKN-01	Aquatic life	Dissolved Oxygen	To determine effect of point source and to support Qual2K model if needed
All	All	All	All	Implementation monitoring

Specific data needs include:

Support Qual2K Model Development (DKB-01)—Four monitoring stations are needed. Ideally, there would be two separate data collection periods, each time period lasting roughly one week during critical conditions (low flow, warm conditions). Although these monitoring locations are a minimum, adding more locations along the reach of interest will help determine how heterogeneous the system is and what dynamics are occurring along the reach. Monitoring stations can be located downstream of key tributaries, at road crossings, etc. as deemed necessary.

Recommended monitoring includes:

- Site DKB-01 and a new station where Hickory Grove Ditch crosses East County Road 2550 N (just upstream of the upstream end of the impaired segment):
  - Continuous dissolved oxygen, stream temperature, conductivity, and pH monitoring during a warm, low flow period in July; monitoring should take place over approximately two weeks
  - Flow monitoring (depth and velocity) at least twice during dissolved oxygen monitoring; the number of measurements will be dependent on weather and stream conditions
  - Multiple samples of organic nitrogen, ammonia nitrogen, nitrate nitrogen, organic phosphorus, soluble reactive phosphorus, total inorganic carbon, carbonaceous biochemical oxygen demand (5-day and 20-day if possible), inorganic solids, chlorophyll-*a*, and alkalinity. Depending on the monitoring station, grab samples could be collected twice per day during the first and last days of sonde deployment or throughout the week.
  - Macrophyte and attached algae survey, survey of groundwater and tributary contributions, if any
  - Channel geometry, shade/vegetative survey, cloud cover, and channel substrate and bottom material, both upstream and downstream of the monitoring stations(s)
- New site on Manito Ditch where it crosses County Road 900 North (just upstream of where Manito Ditch outlets into Hickory Grove Ditch):
  - Continuous dissolved oxygen, stream temperature, conductivity, and pH monitoring during the same period as data collected on the main stem sites.
  - Multiple samples of organic nitrogen, ammonia nitrogen, nitrate nitrogen, TKN, organic phosphorus, soluble reactive phosphorus, total inorganic carbon, total organic carbon, carbonaceous biochemical oxygen demand (5-day and 20-day if possible), inorganic solids, chlorophyll-*a*, and alkalinity. Depending on the monitoring station, grab samples could be collected twice per day during the first and last days of sonde deployment or throughout the week.

  - Flow monitoring (depth and velocity) at least twice during the monitoring period.
- Monitoring downstream of the Manito STP discharge (relatively close to the discharge point):
  - One set of the following parameters, taken on the same day as grab sampling downstream: organic nitrogen, ammonia nitrogen, nitrate nitrogen, TKN, organic phosphorus, soluble reactive phosphorus, total inorganic carbon, total organic carbon, carbonaceous biochemical oxygen demand (5-day and 20-day if possible), inorganic solids, chlorophyll-*a*, and alkalinity.
  - Flow monitoring (depth and velocity) at least twice during the monitoring period.
- A longitudinal/synoptic survey of DO concentrations along the entire reach (hand-sampling by probe on foot or from a row-boat periodically along the entire reach extent)
- Funding permitted: *in-situ* measurements of stream reaeration (via diffusion dome technique) and *in-situ* measurements of sediment oxygen demand (via chambers deployed on the streambed). Sediment bed surveys can be conducted potentially in lieu of SOD sampling (sediment total organic carbon sampling for instance could be a rough proxy for SOD if needed).
- Photo documentation of the system

Support Qual2K Model Development (DKN-01)–Prairie View Homeowners Association STP (IL0074365) discharges to IL_DKN-01 downstream of monitoring station DKN-02, where the low dissolved oxygen impairment was observed. Additional monitoring downstream of the point source is needed to determine the extent of impairment and to support Qual2K model development if it is determined that the point source contributes to the impairment.

A minimum of two monitoring stations (DKN-01 and DKN-02) are needed on the impaired segment. Ideally, there will be two separate data collection periods, each time period lasting roughly 1 week during critical conditions (low flow, warm conditions). Although two monitoring locations are a minimum, adding more locations along the reach of interest will help determine how heterogeneous the system is and what dynamics are occurring along the reach. Monitoring stations can be located downstream of key tributaries, at road crossings, etc. as deemed necessary.

Recommended monitoring includes:

- Continuous dissolved oxygen, stream temperature, conductivity, and pH monitoring during a warm, low flow period in July; monitoring should take place over approximately two weeks at a minimum of two locations.
- Flow monitoring (depth and velocity) during dissolved oxygen monitoring at least twice at two locations, the number of measurements will be dependent on weather and stream conditions
- Multiple samples of organic nitrogen, ammonia nitrogen, nitrate nitrogen, TKN, organic phosphorus, soluble reactive phosphorus, total inorganic carbon, total organic carbon, carbonaceous biochemical oxygen demand (5-day and 20-day if possible), inorganic solids, chlorophyll-a, and alkalinity. Depending on the monitoring station, grab samples could be collected twice per day during the first and last days of sonde deployment or throughout the week.
- Macrophyte and attached algae survey, survey of groundwater and tributary contributions, if any
- Channel geometry, shade/vegetative survey, cloud cover, and channel substrate and bottom material, both upstream and downstream of the monitoring stations(s)
- A longitudinal/synoptic survey of DO concentrations along the entire reach (hand-sampling by probe on foot or from a row-boat periodically along the entire reach extent)
- Funding permitted: *in-situ* measurements of stream reaeration (via diffusion dome technique) and in-situ measurements of sediment oxygen demand (via chambers deployed on the streambed).

Sediment bed surveys can be conducted potentially in lieu of SOD sampling (sediment total organic carbon sampling for instance could be a rough proxy for SOD if needed).

- Photo documentation of the system

Implementation Monitoring - Further in-field assessment may be needed to better determine the source of impairments in order to develop an effective TMDL implementation plan. Additional monitoring includes:

- Wind shield surveys
- Streambank surveys and stream assessments for Mackinaw River IL_DK-13 fecal coliform impairment and dissolved oxygen impairments on Hickory Grove Ditch and Sixmile Creek
- Farmer/landowner surveys
- Word of mouth and in-person conversations with local stakeholders and landowners

6. Public Participation

A public meeting was held on December 13, 2018 at the Davis Lodge in Hudson, IL to present the Stage 1 report and findings. A public notice was placed on the Illinois EPA website. There were many stakeholders present including representatives from John Wesley Powell Audubon Society, Ecology Action Center, and others. The public comment period closed on January 13, 2019. Written comments and responses are provided in Appendix B.

7. References

CDM. 2006. Evergreen Lake Watershed TMDL Report.

Evergreen Lake Watershed Planning Committee. 2006. Evergreen Lake Watershed Plan. Retrieved from: https://mcleanwater.org/wp-content/uploads/sites/3/2012/03/Evergreen_Lake_Watershed_Plan.pdf

Horsley and Witten, Inc. 1996. Identification and Evaluation of Nutrient and Bacterial Loadings to Maquoit Bay, Brunswick, and Freeport, Maine. Casco Bay Estuary Project.

IEPA (Illinois Environmental Protection Agency). 1994. Quality assurance project plan. Bureau of Water, Division of Water Pollution Control. Springfield, Illinois.

IEPA (Illinois Environmental Protection Agency). 2016. Draft Illinois Integrated Water Quality Report and Section 303(d) List, 2016. Water Resource Assessment Information and Listing of Impaired Waters. Springfield, IL.

Illinois State Geological Survey (ISGS). 2003. Illinois Statewide 30-Meter Digital Elevation Model. Retrieved from: http://clearinghouse.isgs.illinois.edu/data/elevation/surface-elevation-30-meter-digital-elevation-model-dem.

Karr, J. R., K. D. Fausch, P. L. Angermeier, P. R. Yant, and I. J. Schlosser. 1986. Assessing Biological Integrity in Running Water: a Method and its Rationale. Illinois Natural History Survey Special Publication 5. Champaign, Illinois.

Lake Bloomington Watershed Planning Committee. 2008. Lake Bloomington Watershed Plan. June 22, 2008. Retrieved from: https://web.extension.illinois.edu/lmw/downloads/22860.pdf

Multi-Resolution Land Characteristics Consortium (MRLC). 2015. National Land Cover Database (NLCD 2011). Retrieved from: http://www.mrlc.gov.

Smogor, R. 2000 (draft, annotated 2006). Draft Manual for Calculating Index of Biotic Integrity Scores for Streams in Illinois. Illinois Environmental Protection Agency, Bureau of Water, Division of Water Pollution Control. Springfield, Illinois.

Smogor, R. 2005 (draft). Interpreting Illinois fish-IBI Scores. Illinois Environmental Protection Agency, Bureau of Water, Division of Water Pollution Control. Springfield, Illinois.

Tetra Tech Inc. 2004. Illinois Benthic Macroinvertebrate Collection Method Comparison and Stream Condition Index Revision, 2004.

Tetra Tech Inc. 2008. Lake Bloomington Watershed TMDL Report.

U.S. EPA (U.S. Environmental Protection Agency). 1991. Guidance for Water Quality-Based Decisions: The TMDL Process. EPA 440/4-91-001. Office of Water, Washington, DC.

U.S. EPA (U.S. Environmental Protection Agency). 2002. National Recommended Water Quality Criteria: 2002. EPA-822-R-02-047. Office of Water. Office of Science and Technology. Washington, D.C.

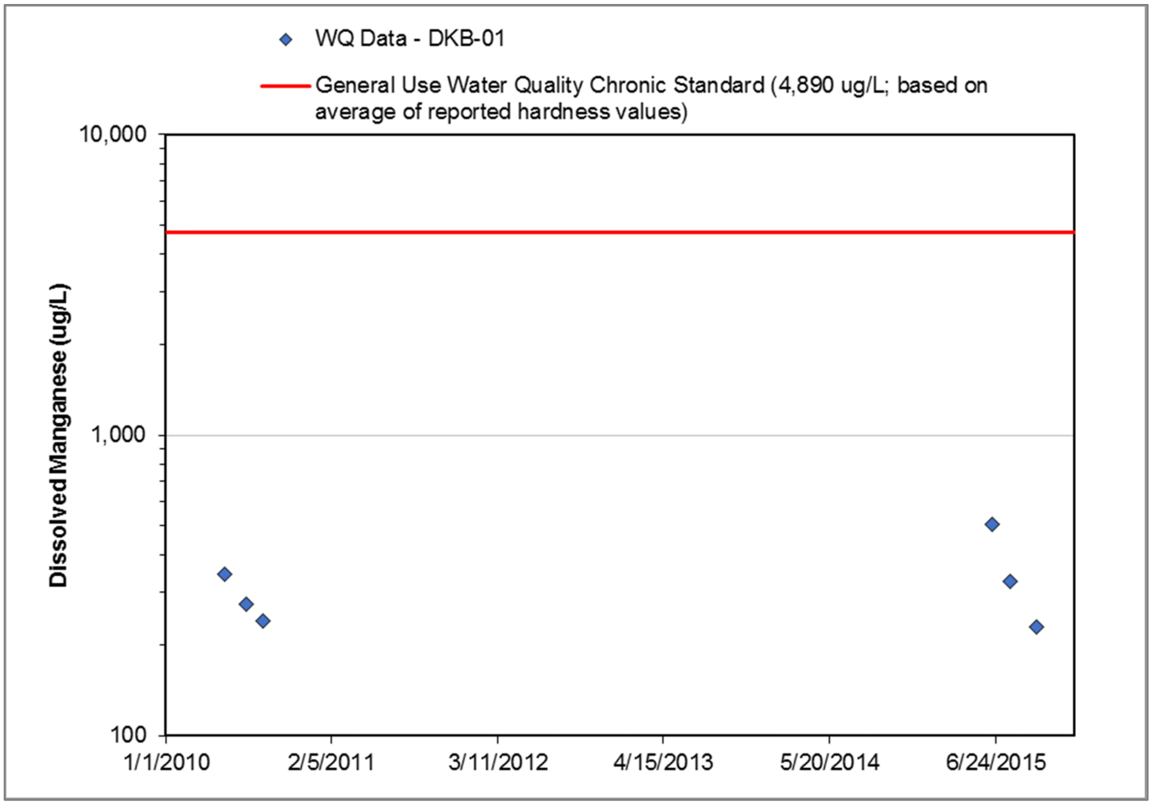
U.S. EPA (U.S. Environmental Protection Agency). 2007. An Approach for Using Load Duration Curves in the Development of TMDLs. EPA 841-B-07-006. U.S. Environmental Protection Agency, Washington D.C.

Weibel, C. P. and R. S. Nelson. 2009. Geology of the Mackinaw River Watershed, McLean, Woodford, and Tazewell Counties, Illinois. Illinois State Geological Survey (ISGS). Geological Science Field Trip Guidebook 2009A.

Appendix A – Unimpaired Stream Data Analysis

Hickory Grove Ditch (DKB-01)

Hickory Grove Ditch DKB-01 is listed as impaired for aquatic life use due to high manganese. One IEPA sampling site was identified on the stream, DKB-01. No samples during data collection in 2010 and 2015 were recorded above the general use chronic standard for manganese. It is therefore recommended that the segment be delisted for manganese and no TMDL be developed.



Manganese water quality time series, Hickory Grove Ditch DKB-01.

Appendix B – Comments and Response to Comments

Comments on the Stage 1 Report

John Wesley Powell
Audubon Society

P.O. BOX 142 • NORMAL, ILLINOIS 61761

January 8, 2019

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JAN 10 2019
SW/WS/IFAS

Abel Haile, Manager, Planning (TMDL) Unit
Watershed Management Section, Bureau of Water
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

RE: Comments on the November 2018 "Mackinaw River Watershed Total Maximum Daily Load DRAFT Stage 1 Report".

I am writing as Conservation Chair for the JWP Audubon Society, a chapter of the National Audubon Society whose chapter service area includes the Mackinaw River in McLean County.

1. Page 1, Section 1.1. Why is Lake Evergreen not referenced as having a TMDL prepared for it (a citation is given on page 19)? It is still listed on the 2018 303(d) list, although for a different impairment than that resulting in the original TMDL.

2. Page 2, Table 1:
A. Please list somewhere *all* of the impaired waterbodies in the Mackinaw River watershed that are on the 2018 303(d) list, including the listed causes for their impairment, otherwise the reader unfamiliar with 303(d) lists would assume that Table 1 is a comprehensive list of impaired parts of the watershed.

B. Please explain why only a subset of listed waterbodies *and* listed impairment causes are being considered in this project. In doing that, specific reference to the relevant sections of Title 35, Part 302 would be helpful to understand which ones are legally excluded from needing a TMDL.

C. At least two pollutants listed on the 2018 303(d) list do have numeric standards: mercury and PCBs. Please explain why these two are not being considered as part of this project.

3. Page 20: The statement is made: "The remaining facilities that discharge to upstream unimpaired tributaries are assumed to not contribute to project impairments." What is the basis for this assumption?

4. Page 26: I would recommend that you follow up on contacting county health departments that did not respond to your initial request for information on septic systems and unsewered communities. I did contact the McLean County Health Department on December 8, 2018 and they said they do not recall receiving such a request, but would provide that information. Checking again with other counties, therefore, might help in case the request got misplaced.

1

CONSERVATION/APPRECIATION OF WILDLIFE • NATURAL RESOURCES • NATURAL DIVERSITY

Comments on the November 2018 "Mackinaw River Watershed Total Maximum Daily Load DRAFT Stage 1 Report", page 2

5. Page 40: The statement is made: "A steady-state model is proposed for Sixmile Creek (DKN-01), if needed." Does this mean that you will first try a Qual2K model before determining if a steady-state model is more appropriate for this stream segment?

6. Page 41, Table 21: It is stated "none" for additional data needs regarding DK-13 and DK-17. However, earlier on page 25 it is stated "source unknown" for the pollutant of concern, along with some postulated sources. Why do you not need additional data, focused on those postulated sources, in order to do the modelling?

7. There are two documents not referenced in the report that is likely to have useful data.

A. Lake Bloomington Watershed Plan (https://web.extension.illinois.edu/lmw/downloads/22860.pdf) prepared by the Lake Bloomington Watershed Planning Committee. For example, there is a stream bank survey/stream assessment for the Lake Bloomington watershed that is Appendix III—Rap M.

B. Evergreen Lake Watershed Plan (https://web.extension.illinois.edu/lmw/downloads/22857.pdf) prepared by the Evergreen Lake Watershed Planning Committee. For example, it mentions a report "Stream Inventory and Analysis Lake Evergreen 9 Watershed". I do not know where to find a copy of that specific report, but I suggest you contact Rick Twait (rtwait@cityblm.org), Superintendent of Water Purification, Bloomington, IL.

Thanks for the opportunity to comment on this document.

Sincerely,

Angelo Capparella

Angelo Capparella, Conservation Chair
JWP Audubon Society

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JAN 10 2019
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2

Response to comments on the Stage 1 Report

The following corresponds to the comment numbers above:

1. The Lake Evergreen TMDL and watershed plan is referenced in section 2.7. Evergreen Lake is no longer identified as impaired for nutrients.

2. A. All impairments have been added to a new Table 1. Note that Lake Bloomington (IL_RDO) is no longer listed as impaired for Total Dissolved Solids in the Draft 2018 Integrated Report and a TMDL will not be developed. Public and Food Processing Water Supply Use is fully supporting.

   B. Rationale has been added to section 1.1:

   Illinois EPA is currently only developing TMDLs for parameters that have numeric water quality standards. Where the cause of impairment is not known, no TMDLs are developed at this time. The TMDL goal is to identify pollutant sources, develop load capacity and implementation plans to bring impaired waterbodies into full support for their designated uses. However, the implementation plan that will be completed during the Stage 3 TMDL development process for the watershed may address some of the other potential causes of impairments.

   C. Rationale has been added to section 1.1:

   Illinois EPA has submitted a request to USEPA – Region 5, for assistance to develop Statewide Mercury and PCBs TMDLs, and these two parameters will be addressed once resources become available.

3. Additional explanation has been added to the document. We may determine as part of 2019 monitoring and Stage 3 that upstream facilities are indeed having an effect on the impairments, at that time we will revise this section.

4. Counties were contacted again for further information on septic systems and the report was updated with new information received.

5. The approach recommends using Qual2K in steady-state mode, it can also be run in a quasi-dynamic mode. Clarification has been added.

6. Table 14 (where "source unknown" is stated for the Mackinaw River impairments) is based on the state's Draft 2016 305(b) list. Evaluation of the impairments was conducted for this project, and the potential pollutant sources to the Mackinaw River impairments are listed below Table 15. For fecal coliform and nitrate load duration curve approaches, additional source information is not needed to develop load duration curves (the TMDL model in these cases). More detailed data are needed to develop Qual2K models for dissolved oxygen impairments. Please see Section 5.1.1 and 5.1.2 for more information on both approaches.

7. The Lake Bloomington and Evergreen Lake Plans have been added to section 2.7. Findings and recommendations will be included in the Stage 3 implementation plan as applicable.

Appendix B – Stage 2 Monitoring Data

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702   217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	08/06/19 15:50 by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	5.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19H0224-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	08/06/19 12:24
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Alkalinity by Standard Method 310.2

Method: 310.2 Prepared: 08/08/19 15:04
Units: mg/L Analyzed: 08/09/19 14:27

Analyte	Result	Qualifier	Reporting Limit	MDL
Alkalinity	**160**		10.0	7.48

Carbonaceous BOD, 5 day, by Standard Method 5210B

Method: 5210B Prepared: 08/07/19 13:59
Units: mg/L Analyzed: 08/12/19 09:48

Analyte	Result	Qualifier	Reporting Limit	MDL
CBOD, 5 day	ND		2.00	

Nitrate-Nitrite, Colorimetric, Automated Cadmium by EPA Method 353.2

Method: 353.2 Prepared: 08/08/19 13:58
Units: mg/L Analyzed: 08/08/19 15:14

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	**2.47**		0.100	0.0247

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Reported:
08/30/19 16:22

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	08/06/19 15:50 by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	5.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19H0224-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	08/06/19 12:24
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Nitrogen, Ammonia, Colorimetric, Automated Phenate by EPA Method 350.1

Method: EPA 350.1 | Prepared: 08/07/19 14:59

Units: mg/L | Analyzed: 08/09/19 15:19

Analyte	Result	Qualifier	Reporting Limit	MDL
Ammonia as N	ND		0.10	0.06

Nitrogen, Kjeldahl, Total, Colorimetric, Semi- by EPA Method 351.2

Method: 351.2 | Prepared: 08/27/19 08:00

Units: mg/L | Analyzed: 08/27/19 16:57

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Kjeldahl	ND		0.50	0.37

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1 | Prepared: 08/27/19 10:00

Units: mg/L | Analyzed: 08/27/19 15:22

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.0560**		0.0050	0.0042

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	08/06/19 15:50 by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	5.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL
Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19H0224-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	08/06/19 12:24
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Total Suspended Solids by Standard Method 2540D

Method: SM 2540D   Prepared: 08/07/19 08:25

Units: mg/L   Analyzed: 08/07/19 08:25

Analyte	Result	Qualifier	Reporting Limit	MDL
Total Suspended Solids	**13**		4	

Volatile Suspended Solids by Standard Method 2540E

Method: SM 2540E   Prepared: 08/07/19 09:41

Units: mg/L   Analyzed: 08/07/19 09:41

Analyte	Result	Qualifier	Reporting Limit	MDL
Volatile Suspended Solids *	**4**		4	

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Reported:
08/30/19 16:22

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	08/06/19 15:50 by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	5.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

J	Estimated value. The laboratory cannot support the validity of this number. The result is between the method detection limit and the reporting limit.
ND	Analyte NOT DETECTED at or above the method detection limit
*	Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
08/30/19 16:22

Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code:	DKB-01			Received :	08/06/19 15:50 by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	5.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19H0225-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	08/06/19 7:47
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Alkalinity by Standard Method 310.2

Method: 310.2 | Prepared: 08/08/19 15:04

Units: mg/L | Analyzed: 08/09/19 14:27

Analyte	Result	Qualifier	Reporting Limit	MDL
Alkalinity	**253**		10.0	7.48

Carbonaceous BOD, 5 day, by Standard Method 5210B

Method: 5210B | Prepared: 08/07/19 13:59

Units: mg/L | Analyzed: 08/12/19 09:48

Analyte	Result	Qualifier	Reporting Limit	MDL
CBOD, 5 day	ND		2.00	

Nitrate-Nitrite, Colorimetric, Automated Cadmium by EPA Method 353.2

Method: 353.2 | Prepared: 08/08/19 13:58

Units: mg/L | Analyzed: 08/08/19 15:15

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	**2.55**		0.100	0.0247

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Reported:
08/30/19 16:22

Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code:	DKB-01			Received :	08/06/19 15:50 by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	5.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL
Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19H0225-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	08/06/19 7:47
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Nitrogen, Ammonia, Colorimetric, Automated Phenate by EPA Method 350.1

Method: EPA 350.1 — Prepared: 08/07/19 14:59

Units: mg/L — Analyzed: 08/09/19 15:19

Analyte	Result	Qualifier	Reporting Limit	MDL
Ammonia as N	ND		0.10	0.06

Nitrogen, Kjeldahl, Total, Colorimetric, Semi- by EPA Method 351.2

Method: 351.2 — Prepared: 08/27/19 08:00

Units: mg/L — Analyzed: 08/27/19 16:59

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Kjeldahl	**0.37**	J	0.50	0.37

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1 — Prepared: 08/27/19 10:00

Units: mg/L — Analyzed: 08/27/19 15:23

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.0560**		0.0050	0.0042

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Reported:
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LABORATORY RESULTS

Station Code:	DKB-01			Received :	08/06/19 15:50 by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	5.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19H0225-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	08/06/19 7:47
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Total Suspended Solids by Standard Method 2540D

Method: SM 2540D — Prepared: 08/07/19 08:25

Units: mg/L — Analyzed: 08/07/19 08:25

Analyte	Result	Qualifier	Reporting Limit	MDL
Total Suspended Solids	**18**		4	

Volatile Suspended Solids by Standard Method 2540E

Method: SM 2540E — Prepared: 08/07/19 09:41

Units: mg/L — Analyzed: 08/07/19 09:41

Analyte	Result	Qualifier	Reporting Limit	MDL
Volatile Suspended Solids *	**4**		4	

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Reported:
08/30/19 16:22

Illinois Environmental Protection Agency Laboratory
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LABORATORY RESULTS

Station Code:	DKB-01			Received :	08/06/19 15:50 by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	5.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

J	Estimated value. The laboratory cannot support the validity of this number. The result is between the method detection limit and the reporting limit.
ND	Analyte NOT DETECTED at or above the method detection limit
*	Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code:	DKB-01			Received :	08/06/19 15:50 by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	CHLOROPHYLL	Collected By:	MFS	Lab Sample ID:	**19H0235-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	08/06/19 7:47
Sample Fraction:	Total	Chlorophyll volume filtered (ml):	200	Sample Depth:	

Chlorophyll by Standard Method 10200 H

Method:	10200 H	Prepared:	08/20/19 10:13
Units:	ug/L	Analyzed:	08/21/19 10:41

Analyte	Result	Qualifier	Reporting Limit	MDL
Chlorophyll-A (corr)	**10.7**		0.50	
Chlorophyll-A (unco)	**11.4**		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	**2.56**		0.50	
Pheophytin-A	**0.53**		0.50	

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Reported:
08/30/19 16:19

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received : 08/06/19 15:50	by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

* Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
08/30/19 16:19

Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code:	DKB-01			Received :	08/06/19 15:50 by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	CHLOROPHYLL	Collected By:	MFS	Lab Sample ID:	**19H0236-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	08/06/19 12:24
Sample Fraction:	Total	Chlorophyll volume filtered (ml):	200	Sample Depth:	

Chlorophyll by Standard Method 10200 H

Method:	10200 H	Prepared:	08/20/19 10:13
Units:	ug/L	Analyzed:	08/21/19 10:41

Analyte	Result	Qualifier	Reporting Limit	MDL
Chlorophyll-A (corr)	**10.7**		0.50	
Chlorophyll-A (unco)	**11.4**		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	**2.18**		0.50	
Pheophytin-A	**0.53**		0.50	

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Reported:

08/30/19 16:19

Illinois Environmental Protection Agency Laboratory
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LABORATORY RESULTS

Station Code:	DKB-01			Received :	08/06/19 15:50 by LAUREN AIELLO
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190806INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

* Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
08/30/19 16:19

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	6.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	Visit Number:	001	Monitoring Program:	TMDL
Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19I0835-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/19/19 13:15
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Alkalinity by Standard Method 310.2

Method: 310.2 | Prepared: 09/23/19 12:00

Units: mg/L | Analyzed: 09/23/19 14:49

Analyte	Result	Qualifier	Reporting Limit	MDL
Alkalinity	**174**		10.0	7.48

Biochemical Oxygen Demand, 5 day, by Standard Method 5210B

Method: 5210B | Prepared: 09/20/19 10:56

Units: mg/L | Analyzed: 09/25/19 08:44

Analyte	Result	Qualifier	Reporting Limit	MDL
BOD 5DAY	ND	J5	2.00	

Nitrate-Nitrite, Colorimetric, Automated Cadmium by EPA Method 353.2

Method: 353.2 | Prepared: 09/24/19 12:24

Units: mg/L | Analyzed: 09/24/19 13:17

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	**0.354**		0.100	0.0247

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Reported:
10/31/19 11:51

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	6.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19I0835-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/19/19 13:15
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Nitrogen, Ammonia, Colorimetric, Automated Phenate by EPA Method 350.1

Method: EPA 350.1 Prepared: 09/30/19 15:13

Units: mg/L Analyzed: 10/01/19 15:14

Analyte	Result	Qualifier	Reporting Limit	MDL
Ammonia as N	ND		0.10	0.06

Nitrogen, Kjeldahl, Total, Colorimetric, Semi- by EPA Method 351.2

Method: 351.2 Prepared: 10/15/19 08:00

Units: mg/L Analyzed: 10/16/19 13:46

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Kjeldahl	ND	J5	0.50	0.37

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1 Prepared: 10/16/19 10:00

Units: mg/L Analyzed: 10/16/19 16:34

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.0370**		0.0050	0.0042

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Reported:
10/31/19 11:51

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	6.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19I0835-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/19/19 13:15
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Total Suspended Solids by Standard Method 2540D

Method: SM 2540D | Prepared: 09/23/19 07:25

Units: mg/L | Analyzed: 09/23/19 07:25

Analyte	Result	Qualifier	Reporting Limit	MDL
Total Suspended Solids	**9**		4	

Volatile Suspended Solids by Standard Method 2540E

Method: SM 2540E | Prepared: 09/23/19 07:26

Units: mg/L | Analyzed: 09/23/19 07:26

Analyte	Result	Qualifier	Reporting Limit	MDL
Volatile Suspended Solids *	ND		4	

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Reported:
10/31/19 11:51

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	6.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

J5	Blank spike failed high, result was less than the reporting limit - impact on data may be minimal.
J	Estimated value. The laboratory cannot support the validity of this number. The result is between the method detection limit and the reporting limit.
ND	Analyte NOT DETECTED at or above the method detection limit
*	Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
10/31/19 11:51

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	6.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	VIT	Lab Sample ID:	**19I0836-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/19/19 10:04
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Alkalinity by Standard Method 310.2

Method: 310.2 | Prepared: 09/23/19 12:00

Units: mg/L | Analyzed: 09/23/19 14:49

Analyte	Result	Qualifier	Reporting Limit	MDL
Alkalinity	**184**		10.0	7.48

Biochemical Oxygen Demand, 5 day, by Standard Method 5210B

Method: 5210B | Prepared: 09/20/19 10:56

Units: mg/L | Analyzed: 09/25/19 08:44

Analyte	Result	Qualifier	Reporting Limit	MDL
BOD 5DAY	ND	J5	2.00	

Nitrate-Nitrite, Colorimetric, Automated Cadmium by EPA Method 353.2

Method: 353.2 | Prepared: 09/24/19 12:24

Units: mg/L | Analyzed: 09/24/19 13:21

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	**0.310**		0.100	0.0247

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Reported:
10/31/19 11:51

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	6.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	Visit Number:	001	Monitoring Program:	TMDL
Client Sample ID:	TOTAL	Collected By:	VIT	Lab Sample ID:	**19I0836-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/19/19 10:04
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Nitrogen, Ammonia, Colorimetric, Automated Phenate by EPA Method 350.1

Method: EPA 350.1 | Prepared: 09/30/19 15:13

Units: mg/L | Analyzed: 10/01/19 15:14

Analyte	Result	Qualifier	Reporting Limit	MDL
Ammonia as N	**0.08**	J	0.10	0.06

Nitrogen, Kjeldahl, Total, Colorimetric, Semi- by EPA Method 351.2

Method: 351.2 | Prepared: 10/15/19 08:00

Units: mg/L | Analyzed: 10/18/19 13:46

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Kjeldahl	**0.64**	Q	0.50	0.37

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1 | Prepared: 10/16/19 10:00

Units: mg/L | Analyzed: 10/16/19 16:34

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.0650**		0.0050	0.0042

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Reported:
10/31/19 11:51

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	6.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	VIT	Lab Sample ID:	**19I0836-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/19/19 10:04
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Total Suspended Solids by Standard Method 2540D

Method: SM 2540D — Prepared: 09/23/19 07:25
Units: mg/L — Analyzed: 09/23/19 07:25

Analyte	Result	Qualifier	Reporting Limit	MDL
Total Suspended Solids	**29**		4	

Volatile Suspended Solids by Standard Method 2540E

Method: SM 2540E — Prepared: 09/23/19 07:26
Units: mg/L — Analyzed: 09/23/19 07:26

Analyte	Result	Qualifier	Reporting Limit	MDL
Volatile Suspended Solids *	**6**		4	

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Reported:
10/31/19 11:51

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	6.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

Q	Maximum holding time exceeded.
J5	Blank spike failed high, result was less than the reporting limit - impact on data may be minimal.
J	Estimated value. The laboratory cannot support the validity of this number. The result is between the method detection limit and the reporting limit.
ND	Analyte NOT DETECTED at or above the method detection limit
*	Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
10/31/19 11:51

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	CHLOROPHYLL	Collected By:	MFS	Lab Sample ID:	**19I1112-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/26/19 10:55
Sample Fraction:	Total	Chlorophyll volume filtered (ml):	200	Sample Depth:	

Chlorophyll by Standard Method 10200 H

Method:	10200 H	Prepared:	10/02/19 14:30
Units:	ug/L	Analyzed:	10/04/19 11:14

Analyte	Result	Qualifier	Reporting Limit	MDL
Chlorophyll-A (corr)	ND		0.50	
Chlorophyll-A (unco)	**1.78**		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	ND		0.50	
Pheophytin-A	**2.80**		0.50	

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Reported:

10/15/19 11:18

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND	Analyte NOT DETECTED at or above the method detection limit
*	Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
10/15/19 11:18

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	2.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19I1113-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/26/19 10:55
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Alkalinity by Standard Method 310.2

Method: 310.2 Prepared: 10/01/19 12:30

Units: mg/L Analyzed: 10/02/19 14:23

Analyte	Result	Qualifier	Reporting Limit	MDL
Alkalinity	**156**		10.0	7.48

Carbonaceous BOD, 5 day, by Standard Method 5210B

Method: 5210B Prepared: 09/27/19 10:18

Units: mg/L Analyzed: 10/02/19 08:36

Analyte	Result	Qualifier	Reporting Limit	MDL
CBOD, 5 day	ND		2.00	

Nitrate-Nitrite, Colorimetric, Automated Cadmium by EPA Method 353.2

Method: 353.2 Prepared: 09/27/19 10:29

Units: mg/L Analyzed: 09/27/19 13:44

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	**0.206**		0.100	0.0247

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Reported:
10/31/19 11:50

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	2.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19I1113-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/26/19 10:55
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Nitrogen, Ammonia, Colorimetric, Automated Phenate by EPA Method 350.1

Method: EPA 350.1 — Prepared: 10/04/19 14:30

Units: mg/L — Analyzed: 10/08/19 11:07

Analyte	Result	Qualifier	Reporting Limit	MDL
Ammonia as N	**0.13**		0.10	0.06

Nitrogen, Kjeldahl, Total, Colorimetric, Semi- by EPA Method 351.2

Method: 351.2 — Prepared: 10/21/19 08:00

Units: mg/L — Analyzed: 10/22/19 12:29

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Kjeldahl	**0.66**	J3	0.50	0.37

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1 — Prepared: 10/22/19 09:00

Units: mg/L — Analyzed: 10/22/19 16:56

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.0540**		0.0050	0.0042

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Reported:
10/31/19 11:50

Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	2.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL
Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19I1113-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/26/19 10:55
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Total Suspended Solids by Standard Method 2540D

Method: SM 2540D — Prepared: 09/30/19 08:04

Units: mg/L — Analyzed: 09/30/19 08:04

Analyte	Result	Qualifier	Reporting Limit	MDL
Total Suspended Solids	**20**		4	

Volatile Suspended Solids by Standard Method 2540E

Method: SM 2540E — Prepared: 09/30/19 08:06

Units: mg/L — Analyzed: 09/30/19 08:06

Analyte	Result	Qualifier	Reporting Limit	MDL
Volatile Suspended Solids *	**5**		4	

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Reported:
10/31/19 11:50

Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	2.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

J3	The reported value failed to meet the established quality control criteria for either precision or accuracy possibly due to matrix effects.
J	Estimated value. The laboratory cannot support the validity of this number. The result is between the method detection limit and the reporting limit.
ND	Analyte NOT DETECTED at or above the method detection limit
*	Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
10/31/19 11:50

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	2.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL
Client Sample ID:	TOTAL	Collected By:	VIT	Lab Sample ID:	**19I1114-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/26/19 13:40
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Alkalinity by Standard Method 310.2

Method: 310.2 Prepared: 10/01/19 12:30

Units: mg/L Analyzed: 10/02/19 14:23

Analyte	Result	Qualifier	Reporting Limit	MDL
Alkalinity	**158**	J3	10.0	7.48

Carbonaceous BOD, 5 day, by Standard Method 5210B

Method: 5210B Prepared: 09/27/19 10:18

Units: mg/L Analyzed: 10/02/19 08:36

Analyte	Result	Qualifier	Reporting Limit	MDL
CBOD, 5 day	ND		2.00	

Nitrate-Nitrite, Colorimetric, Automated Cadmium by EPA Method 353.2

Method: 353.2 Prepared: 09/27/19 10:29

Units: mg/L Analyzed: 09/27/19 13:45

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	**0.212**		0.100	0.0247

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Reported:
10/31/19 11:49

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702   217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	2.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	VIT	Lab Sample ID:	**19I1114-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/26/19 13:40
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Nitrogen, Ammonia, Colorimetric, Automated Phenate by EPA Method 350.1

Method: EPA 350.1 — Prepared: 10/04/19 14:30

Units: mg/L — Analyzed: 10/08/19 11:07

Analyte	Result	Qualifier	Reporting Limit	MDL
Ammonia as N	**0.06**	J	0.10	0.06

Nitrogen, Kjeldahl, Total, Colorimetric, Semi- by EPA Method 351.2

Method: 351.2 — Prepared: 10/21/19 08:00

Units: mg/L — Analyzed: 10/22/19 12:29

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Kjeldahl	**0.71**	J3	0.50	0.37

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1 — Prepared: 10/22/19 09:00

Units: mg/L — Analyzed: 10/22/19 16:56

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.0430**		0.0050	0.0042

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Reported:
10/31/19 11:49

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	2.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL
Client Sample ID:	TOTAL	Collected By:	VIT	Lab Sample ID:	**19I1114-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/26/19 13:40
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Total Suspended Solids by Standard Method 2540D

Method: SM 2540D — Prepared: 09/30/19 08:04

Units: mg/L — Analyzed: 09/30/19 08:04

Analyte	Result	Qualifier	Reporting Limit	MDL
Total Suspended Solids	**8**		4	

Volatile Suspended Solids by Standard Method 2540E

Method: SM 2540E — Prepared: 09/30/19 08:06

Units: mg/L — Analyzed: 09/30/19 08:06

Analyte	Result	Qualifier	Reporting Limit	MDL
Volatile Suspended Solids *	ND		4	

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Reported:
10/31/19 11:49

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	2.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

J3	The reported value failed to meet the established quality control criteria for either precision or accuracy possibly due to matrix effects.
J	Estimated value. The laboratory cannot support the validity of this number. The result is between the method detection limit and the reporting limit.
ND	Analyte NOT DETECTED at or above the method detection limit
*	Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
10/31/19 11:49

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	CHLOROPHYLL	Collected By:	VIT	Lab Sample ID:	**19I1115-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/26/19 13:40
Sample Fraction:	Total	Chlorophyll volume filtered (ml):	200	Sample Depth:	

Chlorophyll by Standard Method 10200 H

Method: 10200 H — Prepared: 10/02/19 14:30

Units: ug/L — Analyzed: 10/04/19 11:14

Analyte	Result	Qualifier	Reporting Limit	MDL
Chlorophyll-A (corr)	ND		0.50	
Chlorophyll-A (unco)	ND		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	ND		0.50	
Pheophytin-A	ND		0.50	

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Reported:
10/15/19 11:18

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKN-01			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	SIX MILE CREEK	County:	MCLEAN	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190925INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

* Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
10/15/19 11:18

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19G1047-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	07/30/19 12:10
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Alkalinity by Standard Method 310.2

Method: 310.2 Prepared: 07/31/19 14:46

Units: mg/L Analyzed: 08/05/19 10:11

Analyte	Result	Qualifier	Reporting Limit	MDL
Alkalinity	**262**		10.0	7.48

Carbonaceous BOD, 5 day, by Standard Method 5210B

Method: 5210B Prepared: 07/31/19 13:31

Units: mg/L Analyzed: 08/05/19 08:36

Analyte	Result	Qualifier	Reporting Limit	MDL
CBOD, 5 day	ND		2.00	

Nitrate-Nitrite, Colorimetric, Automated Cadmium by EPA Method 353.2

Method: 353.2 Prepared: 07/31/19 10:19

Units: mg/L Analyzed: 07/31/19 12:11

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	**2.83**		0.100	0.0247

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Reported:
08/30/19 16:31

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19G1047-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	07/30/19 12:10
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Nitrogen, Ammonia, Colorimetric, Automated Phenate by EPA Method 350.1

Method: EPA 350.1 — Prepared: 08/05/19 15:09

Units: mg/L — Analyzed: 08/07/19 10:32

Analyte	Result	Qualifier	Reporting Limit	MDL
Ammonia as N	ND		0.10	0.06

Nitrogen, Kjeldahl, Total, Colorimetric, Semi- by EPA Method 351.2

Method: 351.2 — Prepared: 08/21/19 08:00

Units: mg/L — Analyzed: 08/22/19 13:11

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Kjeldahl	ND		0.50	0.37

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1 — Prepared: 08/22/19 11:00

Units: mg/L — Analyzed: 08/26/19 11:34

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.0780**		0.0050	0.0042

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Reported:
08/30/19 16:31

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19G1047-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	07/30/19 12:10
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Total Suspended Solids by Standard Method 2540D

Method:	SM 2540D	Prepared:	07/31/19 09:49
Units:	mg/L	Analyzed:	07/31/19 09:49

Analyte	Result	Qualifier	Reporting Limit	MDL
Total Suspended Solids	**23**		4	

Volatile Suspended Solids by Standard Method 2540E

Method:	SM 2540E	Prepared:	07/31/19 09:50
Units:	mg/L	Analyzed:	07/31/19 09:50

Analyte	Result	Qualifier	Reporting Limit	MDL
Volatile Suspended Solids *	**5**		4	

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Reported:
08/30/19 16:31

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

* Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
08/30/19 16:31

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	CHLOROPHYLL	Collected By:	MFS	Lab Sample ID:	**19G1048-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	07/30/19 12:10
Sample Fraction:	Total	Chlorophyll volume filtered (ml):	200	Sample Depth:	

Chlorophyll by Standard Method 10200 H

Method:	10200 H	Prepared:	08/12/19 10:46
Units:	ug/L	Analyzed:	08/15/19 10:55

Analyte	Result	Qualifier	Reporting Limit	MDL
Chlorophyll-A (corr)	**4.00**		0.50	
Chlorophyll-A (unco)	**3.91**		0.50	
Chlorophyll-B	**0.99**		0.50	
Chlorophyll-C	**0.73**		0.50	
Pheophytin-A	ND		0.50	

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Reported:
08/16/19 08:18

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

* Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
08/16/19 08:18

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19G1049-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	07/30/19 8:26
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Alkalinity by Standard Method 310.2

Method: 310.2 | Prepared: 07/31/19 14:46
Units: mg/L | Analyzed: 08/05/19 10:11

Analyte	Result	Qualifier	Reporting Limit	MDL
Alkalinity	**268**		10.0	7.48

Carbonaceous BOD, 5 day, by Standard Method 5210B

Method: 5210B | Prepared: 07/31/19 13:31
Units: mg/L | Analyzed: 08/05/19 08:36

Analyte	Result	Qualifier	Reporting Limit	MDL
CBOD, 5 day	ND		2.00	

Nitrate-Nitrite, Colorimetric, Automated Cadmium by EPA Method 353.2

Method: 353.2 | Prepared: 07/31/19 10:19
Units: mg/L | Analyzed: 07/31/19 12:13

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	**2.70**		0.100	0.0247

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Reported:
08/30/19 16:30

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19G1049-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	07/30/19 8:26
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Nitrogen, Ammonia, Colorimetric, Automated Phenate by EPA Method 350.1

Method: EPA 350.1 | Prepared: 08/05/19 15:09
Units: mg/L | Analyzed: 08/07/19 10:32

Analyte	Result	Qualifier	Reporting Limit	MDL
Ammonia as N	ND		0.10	0.06

Nitrogen, Kjeldahl, Total, Colorimetric, Semi- by EPA Method 351.2

Method: 351.2 | Prepared: 08/21/19 08:00
Units: mg/L | Analyzed: 08/22/19 13:11

Analyte	Result	Qualifier	Reporting Limit	MDL
Nitrogen, Kjeldahl	ND		0.50	0.37

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1 | Prepared: 08/22/19 11:00
Units: mg/L | Analyzed: 08/26/19 11:35

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.0680**		0.0050	0.0042

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Reported:
08/30/19 16:30

Illinois Environmental Protection Agency Laboratory
825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL
Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19G1049-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	07/30/19 8:26
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

Total Suspended Solids by Standard Method 2540D

Method: SM 2540D
Units: mg/L
Prepared: 07/31/19 09:49
Analyzed: 07/31/19 09:49

Analyte	Result	Qualifier	Reporting Limit	MDL
Total Suspended Solids	**19**		4	

Volatile Suspended Solids by Standard Method 2540E

Method: SM 2540E
Units: mg/L
Prepared: 07/31/19 09:50
Analyzed: 07/31/19 09:50

Analyte	Result	Qualifier	Reporting Limit	MDL
Volatile Suspended Solids *	**5**		4	

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Reported:
08/30/19 16:30

Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

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Laboratory Manager

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702   217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	CHLOROPHYLL	Collected By:	MFS	Lab Sample ID:	**19G1050-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	07/30/19 8:26
Sample Fraction:	Total	Chlorophyll volume filtered (ml):	200	Sample Depth:	

Chlorophyll by Standard Method 10200 H

Method:	10200 H	Prepared:	08/12/19 10:46
Units:	ug/L	Analyzed:	08/15/19 10:55

Analyte	Result	Qualifier	Reporting Limit	MDL
Chlorophyll-A (corr)	**2.67**		0.50	
Chlorophyll-A (unco)	**3.99**		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	ND		0.50	
Pheophytin-A	**2.00**		0.50	

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Reported:
08/16/19 08:18

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702   217.782.9780

LABORATORY RESULTS

Station Code:	DKB-01			Received :	07/30/19 14:45 by ADAM LUCCHESI
Waterbody Name:	HICKORY GROVE DITCH	County:	TAZEWELL	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190730INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

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Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
08/16/19 08:18

Appendix C - Recommendations for Recategorization and Delisting

C.1 Hickory Grove Ditch (IL_DKB-01) – Dissolved Oxygen

Hickory Grove Ditch (IL_DKB-01) is listed as impaired for aquatic life use due low dissolved oxygen (DO). One IEPA sampling site was identified on the stream, DKB-01. Continuous DO data were collected at site DKB-01 in 2010 and 2015. Multiple violations of the standard were observed in June 2010 and 2015 (Figure C - 1).

To support TMDL development, additional monitoring at four stations along Hickory Grove Ditch was recommended in order to determine the impact of the Manito sewage treatment plant (STP) on Manito Ditch that is tributary to Hickory Grove Ditch. Additional data were collected at site DKB-01 in 2019. Continuous DO was observed at concentrations less than the WQS 9 (Figure C - 2).

The potential impact of the Manito STP on the DO impairment was further evaluated. For DO impairments, IEPA considers the critical conditions to be the seven-day low flow at a ten-year recurrence interval (i.e., 7Q10), which is the 7-day average (arithmetic mean) low-flow that occurs approximately once every ten years. The public noticed NPDES permit for the Village of Manito (IL0035904) identified the 7Q10 low flow for the Manito Ditch tributary to Hickory Grove Ditch as 0 cubic feet per second (i.e., dry). Due to a lack of flow, the impact of the STP is assumed to be negligible under low flow, critical conditions.

As described in the Stage 1 Report, low in-stream DO can be the result of eutrophication due to high phosphorus concentrations. When DO is linked to phosphorus, a phosphorus TMDL can be developed that results in improved DO conditions. Data were available to evaluate the relationship between DO and total phosphorus (TP) at site DKB-01. A continuously recording data sonde was used to collect DO measurements for one week in July and August 2019. Dissolved oxygen data were paired for each grab sample evaluated for TP and chlorophyll-*a* (Table C - 1).

Table C - 1. Dissolved oxygen and total phosphorus data (Hickory Creek at DKB-01)

Date	Time of Day	Dissolved oxygen (mg/L)	Total phosphorus (mg/L)	Chlorophyll-*a* (corrected) (ug/L)
7/30/2019	AM	6.97	0.068	2.67
	PM	9.10	0.078	4.00
8/6/2019	AM	4.22	0.056	10.70
	PM	10.03	0.056	10.70

No excursions of the instantaneous minimum DO standard were measured (refer to the Stage 1 Report for a discussion of standards). Paired DO, TP, and chlorophyll-*a* data were evaluated. Relationship between DO and TP (Figure C - 3) and between DO and chlorophyll-*a* (Figure C - 4) were not evident; thus nutrient eutrophication and algal growth and die-off do not appear to be the causes of low DO. Therefore, this segment is recommended to be recategorized as Consolidated Assessment and Listing Methodology (CALM) Category 4C because the impairment is due to a non-pollutant.

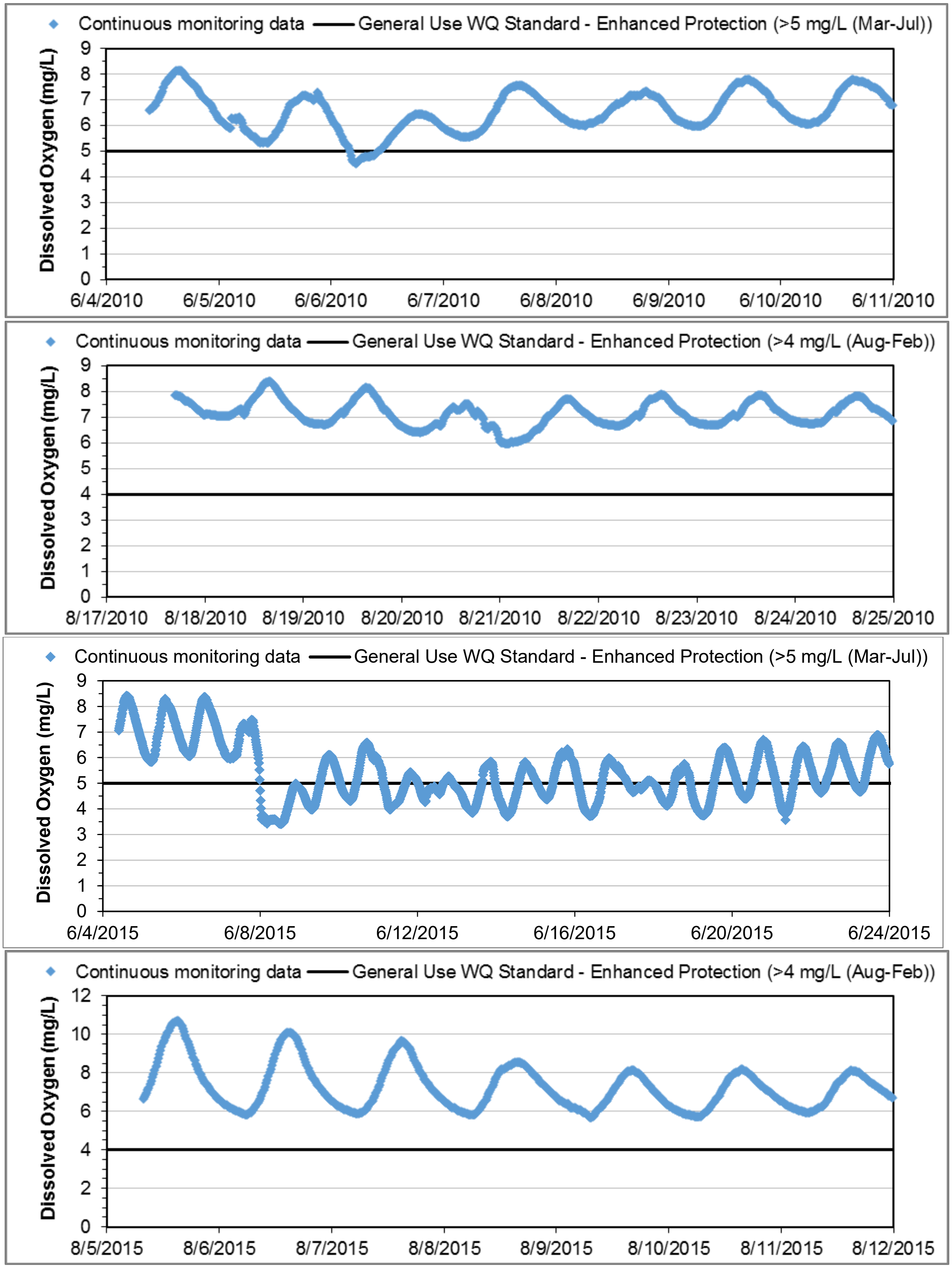

Figure C - 1. Continuous dissolved oxygen water quality time series, Hickory Grove Ditch (IL_DKB-01).

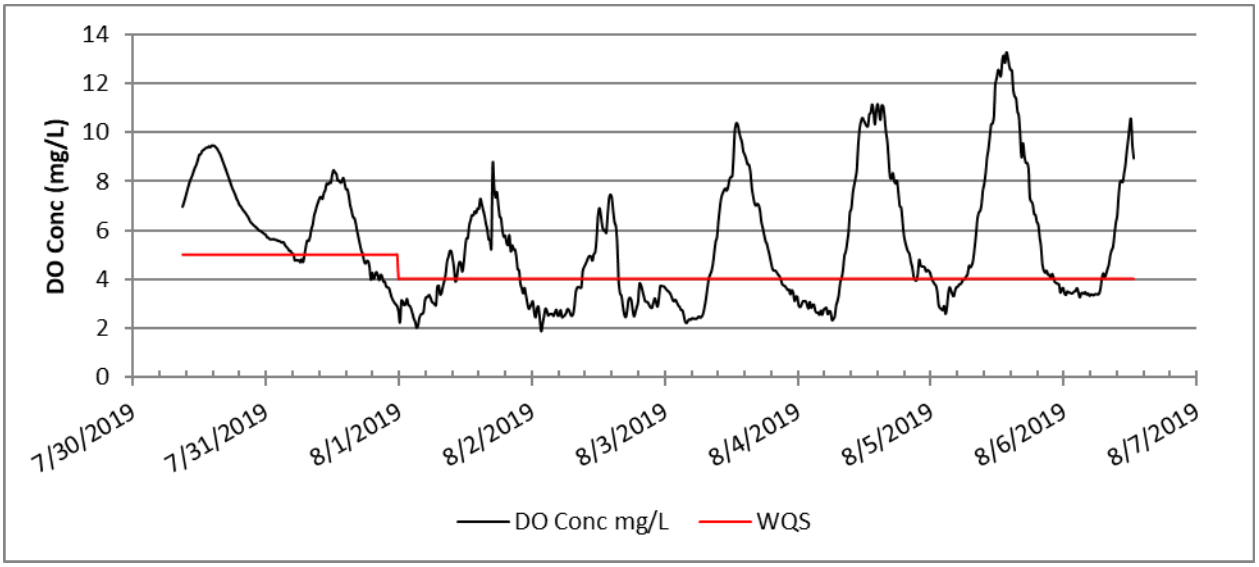

Figure C - 2. Continuous dissolved oxygen data; Hickory Grove Ditch (IL_DKB-01).

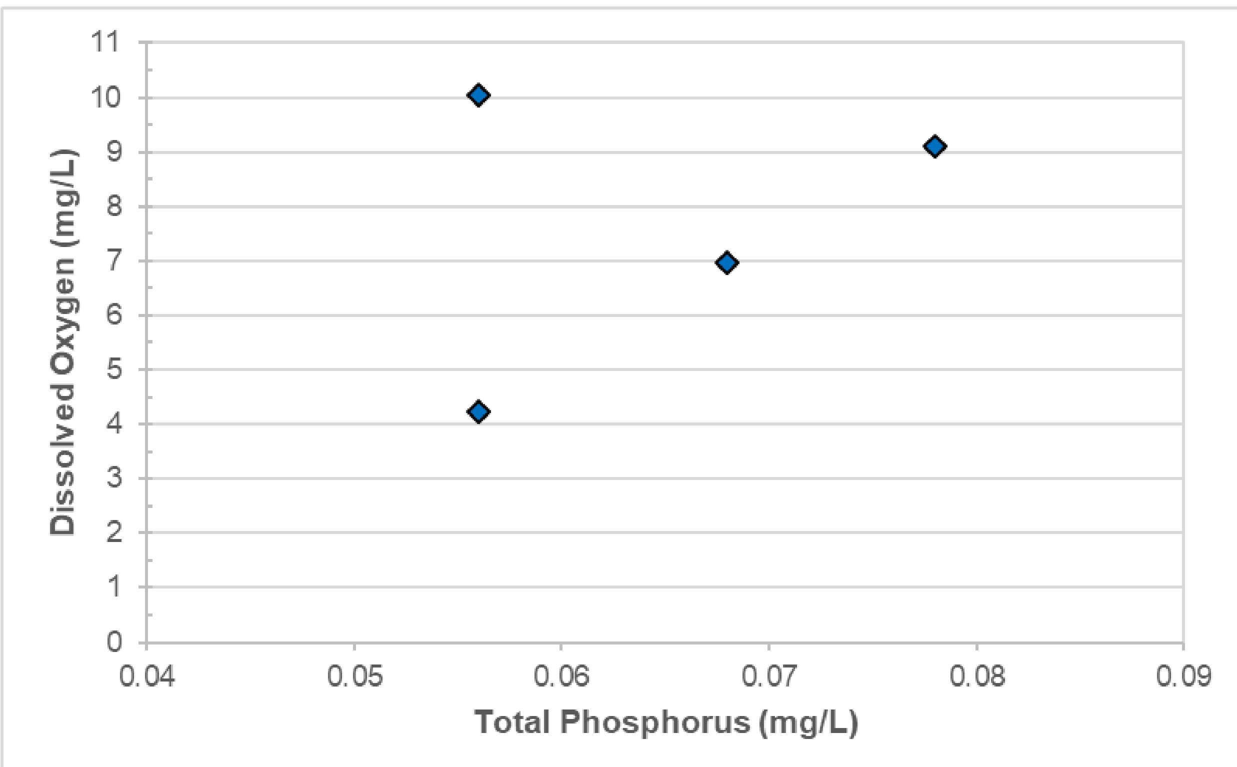

Figure C - 3. Total phosphorus versus dissolved oxygen—2019, Hickory Grove Ditch (IL_DKB-01).

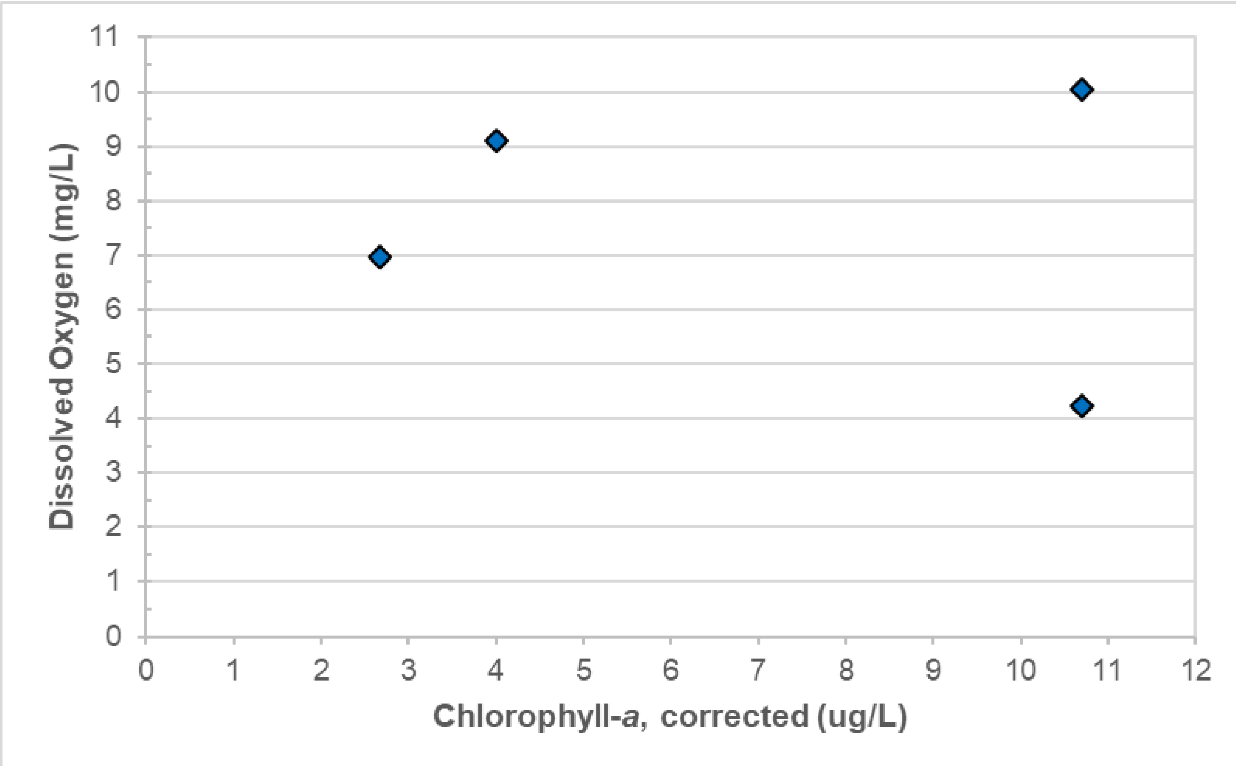

Figure C - 4. Chlorophyll-*a* versus dissolved oxygen—2019, Hickory Grove Ditch (IL_DKB-01).

C.2 Hickory Grove Ditch (IL_DKB-01) – Manganese

Hickory Grove Ditch DKB-01 is also listed as impaired for aquatic life use due to high manganese. One IEPA sampling site was identified on the stream, DKB-01. No samples during data collection in 2010 and 2015 were recorded above the general use chronic standard for manganese (Figure C - 5). It is therefore recommended that the segment be delisted for manganese

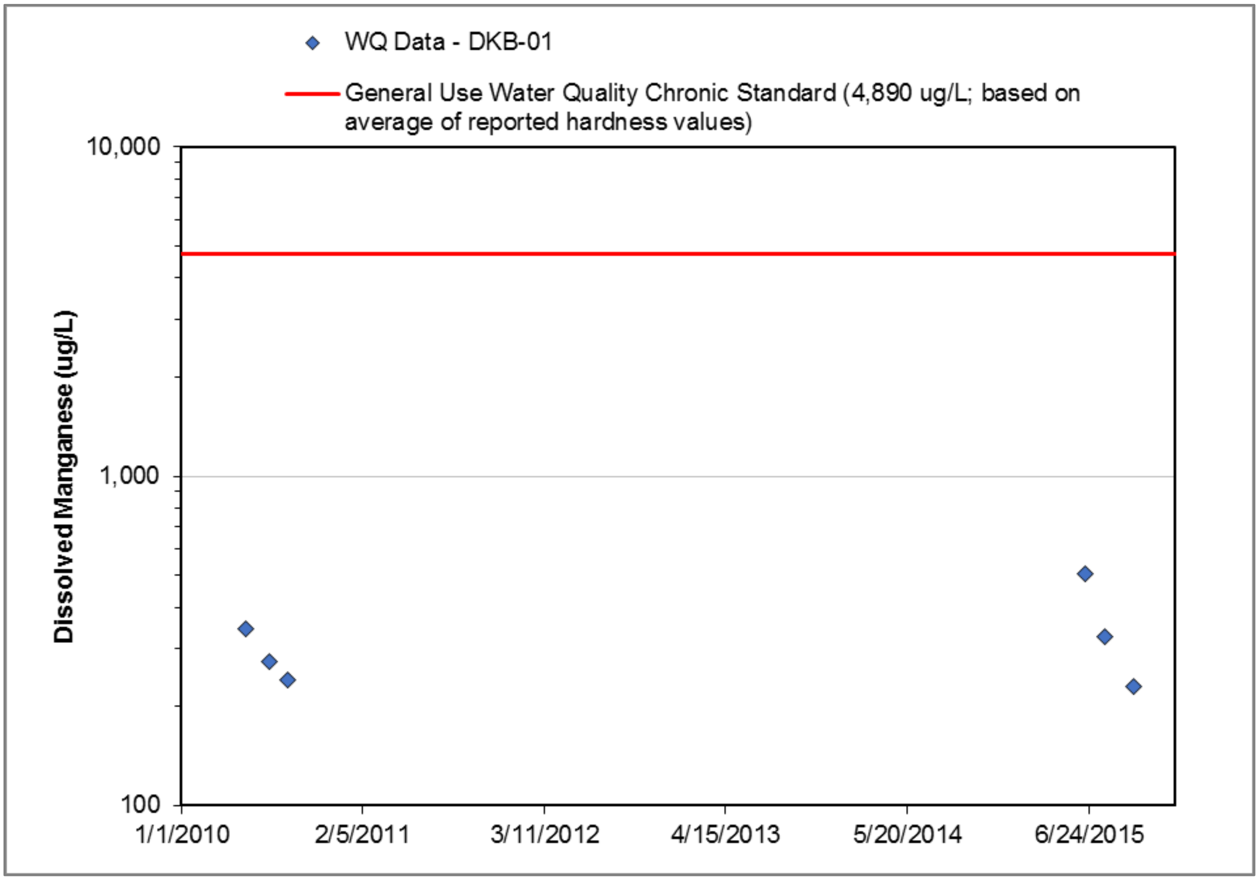

Figure C - 5. Dissolved manganese, Hickory Grove Ditch (IL_DKB-01).

Appendix D – Stage 3 Comments and Responses

<to be included once developed>