Illinois
Environmental
Protection Agency

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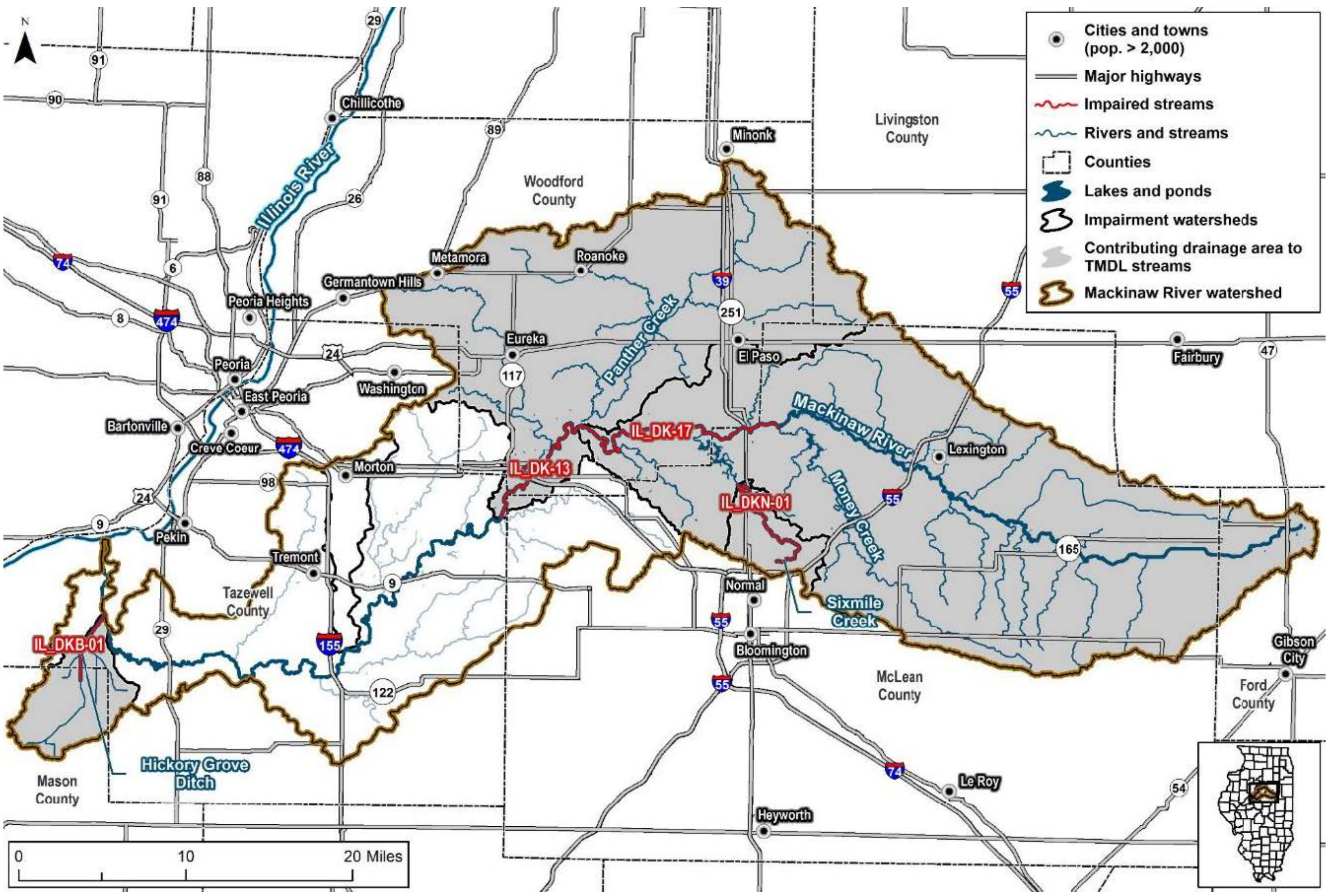
September 2023

IEPA/BOW/IL-2023-001

Mackinaw River Watershed
Total Maximum Daily Load Report



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TMDL Development for the Mackinaw River Watershed in Illinois.

This file contains the following documents:

1) U.S. EPA Approval Letter and Decision Document for the Final TMDL Report
2) TMDL Report

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:
W-16J

Sanjay Sofat, Chief
Bureau of Water
Illinois Environmental Protection Agency
P.O. Box 19276
Springfield, Illinois 62794-9276

Dear Mr. Sofat:

The U.S. Environmental Protection Agency has conducted a complete review of the final Total Maximum Daily Loads (TMDL) for segments within the Mackinaw River Watershed (MRW), including supporting documentation and follow up information. The MRW is in central Illinois in portions of Ford, Livingston, Mason, McLean, Tazewell and Woodford Counties. The MRW TMDLs address impaired primary contact recreation use due to excessive bacteria and impairments to public and food processing water supply use to due to excessive nitrogen (nitrate).

EPA has determined that the MRW TMDLs meet the requirements of Section 303(d) of the Clean Water Act and EPA's implementing regulations set forth at 40 C.F.R. Part 130. Therefore, EPA approves Illinois' one bacteria TMDL and one nitrogen (nitrate) TMDL for a total of two TMDLs. The statutory and regulatory requirements, and EPA's review of Illinois' compliance with each requirement, are described in the enclosed decision document.

EPA acknowledges Illinois's efforts in submitting these TMDLs and looks forward to future TMDL submissions by the State of Illinois. If you have any questions, please contact Mr. Paul Proto, at 312-353-8657 or at proto.paul@epa.gov.

Sincerely,

9/13/2023

X

Tera L. Fong
Division Director, Water Division
Signed by: Environmental Protection Agency

TMDL: Mackinaw River watershed bacteria and nitrate TMDLs in portions of Ford, Livingston, Mason, McLean, Tazewell and Woodford Counties, Illinois
Date: September 13, 2023

DECISION DOCUMENT
FOR THE MACKINAW RIVER WATERSHED TMDLS, FORD, LIVINGSTON, MASON, MCLEAN, TAZEWELL & WOODFORD COUNTIES, IL

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements for approvable TMDLs. Additional information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable. These TMDL review guidelines are not themselves regulations. They are an attempt to summarize and provide guidance regarding currently effective statutory and regulatory requirements relating to TMDLs. Any differences between these guidelines and EPA's TMDL regulations should be resolved in favor of the regulations themselves.

1. Identification of Water body, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL submittal should identify the water body as it appears on the State's/Tribe's 303(d) list. The water body should be identified/georeferenced using the National Hydrography Dataset (NHD), and the TMDL should clearly identify the pollutant for which the TMDL is being established. In addition, the TMDL should identify the priority ranking of the water body and specify the link between the pollutant of concern and the water quality standard (see Section 2 below).

The TMDL submittal should include an identification of the point and nonpoint sources of the pollutant of concern, including location of the source(s) and the quantity of the loading, e.g., lbs/per day. The TMDL should provide the identification numbers of the NPDES permits within the water body. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of the natural background. This information is necessary for EPA's review of the load and wasteload allocations, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as:

(1) the spatial extent of the watershed in which the impaired water body is located;
(2) the assumed distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources;
(4) present and future growth trends, if taken into consideration in preparing the TMDL (e.g., the TMDL could include the design capacity of a wastewater treatment facility); and

(5) an explanation and analytical basis for expressing the TMDL through *surrogate measures*, if applicable. *Surrogate measures* are parameters such as percent fines and turbidity for sediment impairments; chlorophyll a and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

Comment:

Location Description/Spatial Extent:

The Mackinaw River Watershed (MRW) (HUC-8 #07130004) is located in central Illinois in portions of Ford, Livingston, Mason, McLean, Tazewell and Woodford counties. The MRW drains approximately 1,149 square miles (i.e., 735,360 acres) in Illinois. Surface waters in the MRW generally flow from the east to the west where they empty into the main stem of the Illinois River south of Peoria, Illinois. The MRW TMDLs address a total of two (2) impaired segments due to: excessive bacteria (1 segment) and excessive nitrogen (nitrate) (Table 1 of this Decision Document).

Table 1: Mackinaw River Watershed impaired waters addressed by this TMDL

Water body name	Assessment Unit ID	Affected Use	Pollutant or stressor	TMDL
Bacteria (fecal coliform) TMDL				
Mackinaw River	IL_DK-13	Primary Contact Recreation	Fecal Coliform	Fecal Coliform TMDL
Nitrate TMDL				
Mackinaw River	IL_DK-17	Public and Food Processing Water Supply	Nitrogen (Nitrate)	Nitrate TMDL

Land Use:

Land use in the MRW is predominantly agricultural as approximately 81% of the land use is devoted to cultivated crop lands, with corn and soybeans being the most common crops in the MRW. Forested, hay/pasture and developed lands cover approximately 17% of the MRW with open water, wetlands, developed/high and medium intensities making up the remaining approximate 2% of land uses in the MRW (Table 2 of this Decision Document).

Table 2: Mackinaw River Watershed Land Cover - based on 2011 National Agricultural Statistics Service (NASS) Cropland Data Layer

Land Use / Land Cover Category	Acreage	Percentage
Cultivated Crops	594,603	80.85%
Deciduous Forest	42,519	5.78%
Hay/Pasture	30,178	4.10%
Developed, Low Intensity	27,302	3.71%
Developed, Open Space	26,830	3.65%
Developed, Medium Intensity	5,917	0.80%
Open Water	3,054	0.42%
Woody Wetlands	1,869	0.25%
Herbaceous	1,480	0.20%
Developed, High Intensity	1,382	0.19%
Barren Land	189	0.03%

Emergent Herbaceous Wetlands	52	0.01%
Evergreen Forest	23	0.003%
Shrub/Scrub	19	0.003%
TOTALS	**735,417**	**100%**

Problem Identification:
Bacteria TMDL: The Mackinaw River segment (IL_DK-13) identified in Table 1 of this Decision Document was included on the 2020/2022 Illinois 303(d) list due to excessive bacteria. Water quality monitoring within the MRW indicated that this mainstem segment of the Mackinaw River did not attain its designated primary contact recreation use due to exceedances of the bacteria criteria. Excessive bacteria can negatively impact recreational uses (e.g., swimming, wading, boating, fishing etc.) and public health. At elevated levels, bacteria may cause illness within humans who have contact with or ingest bacteria laden water. Recreation-based contact can lead to ear, nose, and throat infections, and stomach illness.

Nitrate TMDL: The Mackinaw River segment (IL_DK-17) identified in Table 1 of this Decision Document was included on the 2020/2022 Illinois 303(d) list due to excessive nitrogen (nitrate). Water quality monitoring within the MRW indicated that this mainstem segment of the Mackinaw River did not attain its designated public and food processing water supply use due to exceedances of the nitrogen (nitrate) water quality standard (WQS). Nitrate (NO_3) can be harmful to humans and some species of macroinvertebrates and fish are sensitive to nitrate levels in coldwater stream environments. Nitrate, if ingested, can transform to nitrite (NO_2) which is toxic to humans. Nitrite has been linked to methemoglobinemia (i.e., blue baby syndrome) in infants.

Priority Ranking:
The water bodies addressed by the MRW TMDLs were given a priority ranking for TMDL development due to: the impairment impacts on recreational and public and food processing water supply uses as well as the public value of the impaired water resource and the timing as part of the Illinois basin monitoring process.

Pollutants of Concern:
The pollutants of concern are bacteria and nitrogen (nitrate).

Source Identification (point and nonpoint sources):

Point Source Identification: The potential point sources to the MRW are:

MRW bacteria TMDL:
National Pollutant Discharge Elimination Systems (NPDES) permitted facilities: NPDES permitted facilities may contribute bacteria loads to surface waters through discharges of treated wastewater. Permitted facilities must discharge treated wastewater according to their NPDES permit. The Illinois Environmental Protection Agency (IEPA) determined that there are fifteen NPDES permitted facilities which contribute bacteria to the IL_DK-13 segment of the main stem of the Mackinaw River. These permittees received a portion of the wasteload allocation (WLA) calculated for the Mackinaw River (IL_DK-13) bacteria TMDL (Tables 3 and 5 of this Decision Document).

Table 3: NPDES facilities which contribute point source pollutant loading in the Mackinaw River Watershed TMDLs

WLAs assigned to NPDES facilities in the MRW			
Permit #	**Facility Name**	**WLA (High Flows, flow regime)**	**WLA (Moist Conditions to Low Flows, flow regime)**
		(billion cfu/day)	
Bacteria (fecal coliform) WLA assigned to NPDES facilities in the MRW – values based on the geometric standard (200 cfu / 100 mL)			
IL0021521	Metamora South WWTP	7.3	2.9
IL0025119	City of Eureka STP	14	4.5
IL0025666	East Bay Camp Conference Center STP	0.38	0.23
IL0036391	COMLARA Park STP	0.42	0.17
IL0040762	I-74 South Mackinaw Dells Rest Area STP	0.057	0.023
IL0048054	Goodfield STP	3.0	1.5
IL0053899	Forestview Utilities Corporation STP	1.9	0.076
IL0073032	Westwind Estates STP	0.36	0.18
IL0074365	Prairie View Supplemental Treatment Facility	0.13	0.053
ILG551035	ILDOT I-74 Woodford Co N WWTP	0.23	0.11
ILG551095	Timberline MHP WWTP	1.0	0.39
ILG580074	Roanoke WWTP	6.10	1.7
ILG580078	Village Colfax WWTP	2.1	0.83
ILG580102	Village of Gridley WWTP	3.6	1.4
ILG582005	City of El Paso WWTP	8.7	3.5
ILR400041	Dry Grove Township MS4	***Variable, dependent on flow regime - See Table 24 of the final TMDL document***	
ILR400097	Normal Township MS4		
ILR400146	Washington Township MS4		
ILR400158	Worth Township MS4		
ILR400265	McLean County MS4		
ILR400296	Bloomington City MS4		
ILR400399	Normal, Town MS4		
ILR400493	ILDOT MS4		
ILR400598	Old Town Township MS4		
ILR400017	Towanda Village MS4		
Permit #	**Facility Name**	**(lbs/day)**	
Nitrogen (nitrate) WLA assigned to NPDES facilities in the MRW			
IL0025666	East Bay Camp Conference Center STP	4.2	2.5
IL0036391	COMLARA Park STP	4.6	1.8
IL0073032	Westwind Estates STP	4.0	2.0
IL0074365	Prairie View Supplemental Treatment Facility	1.4	0.58
ILG551095	Timberline MHP WWTP	11.0	4.3
ILG580078	Village Colfax WWTP	23.0	9.2
ILG580102	Village of Gridley WWTP	39.0	16.0
ILR400041	Dry Grove Township MS4	***Variable, dependent on flow regime - See Table 27 of the final TMDL document***	
ILR400097	Normal Township MS4		
ILR400265	McLean County MS4		

ILR400296	Bloomington City MS4	
ILR400399	Normal, Town MS4	
ILR400493	ILDOT MS4	
ILR400598	Old Town Township MS4	
ILR400017	Towanda Village MS4	

Municipal Separate Storm Sewer (MS4): There are a number of MS4 communities which contribute stormwater runoff to surface waters in the MRW. Stormwater from MS4s can transport bacteria to surface water bodies during or shortly after storm events. IEPA identified MS4 permittees in the MRW (Table 3 of this Decision Document) that were assigned a portion of the WLA.

Concentrated Animal Feedlot Operations (CAFOs): IEPA determined that the MRW does not have CAFOs that contribute bacteria to the surface waters of the MRW (Section 3.2 of the final TMDL document).

Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflows (SSOs): IEPA determined that the MRW does not have CSOs nor SSOs that contribute bacteria to the surface waters of the MRW.

MRW nitrogen (nitrate) TMDLs:
NPDES permitted facilities: NPDES permitted facilities may contribute nitrogen (nitrate) loads to surface waters through discharges of treated wastewater. Permitted facilities must discharge treated wastewater according to their NPDES permit. IEPA determined that there are seven facilities which contribute nitrogen (nitrate) from treated wastewater releases to the IL_DK-17 segment of the main stem of the Mackinaw River. These permittees received a portion of the WLA calculated for the Mackinaw River (IL_DK-17) nitrogen (nitrate) TMDL (Tables 3 and 6 of this Decision Document).

MS4: There are a number of MS4 communities which contribute stormwater runoff to surface waters in the MRW. Stormwater from MS4s can transport nitrogen (nitrate) to surface water bodies during or shortly after storm events. IEPA identified MS4 permittees in the MRW (Tables 3 and 6 of this Decision Document) which were assigned a portion of the WLA.

CAFOs: IEPA determined that the MRW does not have CAFOs that contribute nitrogen (nitrate) to the surface waters of the MRW (Section 3.2 of the final TMDL document).

CSOs and SSOs: IEPA determined that the MRW does not have CSOs nor SSOs that contribute nitrogen (nitrate) to the surface waters of the MRW.

Nonpoint Source Identification: The potential nonpoint sources to the MRW are:

MRW bacteria and nitrogen (nitrate) TMDLs:
Stormwater from agricultural land use practices and feedlots near surface waters: Animal Feeding Operations (AFOs) in close proximity to surface waters can be a source of bacteria and/or nitrogen (nitrate) to water bodies in the MRW. These areas may contribute bacteria and/or nitrogen (nitrate) via the mobilization and transportation of pollutant laden waters from feeding, holding and manure storage sites. Runoff from agricultural lands may contain amounts of bacteria and/or nitrogen (nitrate) which may lead to impairments in the MRW. Feedlots generate manure which may be spread onto fields. Runoff from fields with spread manure can be exacerbated by tile drainage lines, which channelize the

stormwater flows to surface waters. Nutrients, such a fertilizers which contain nitrogen, organic material and organic-rich sediment may be added via surface runoff from upland areas which are being used for Conservation Reserve Program (CRP) lands, grasslands, and agricultural lands used for growing hay or other crops. Stormwater runoff may contribute nutrients and organic-rich sediment to surface waters from livestock manure, fertilizers, vegetation and erodible soils.

Unrestricted livestock access to streams: Livestock with access to stream environments may add bacteria directly to the surfaces waters or resuspend particles that had settled on the stream bottom. Direct deposition of animal wastes can result in very high localized bacteria counts and may contribute to downstream impairments. Smaller animal facilities may add bacteria to surface waters via wastewater from these facilities or stormwater runoff from near-stream pastures.

Discharges from onsite wastewater treatment systems (i.e., septic systems) or unsewered communities: Failing septic systems are a potential source of bacteria and/or nitrogen (nitrate) within the MRW. Septic systems generally do not discharge directly into a water body, but effluents from septic systems may leach into groundwater or pond at the surface where they can be washed into surface waters via stormwater runoff events. Age, construction and use of septic systems can vary throughout a watershed and influence potential contributions of bacteria and/or nitrogen (nitrate) from these systems.

Non-regulated (i.e., areas not covered by a Municipal Separate Storm Sewer System (MS4) NPDES permit) urban runoff: Runoff from urban areas (e.g., urban, residential, commercial or industrial land uses) can contribute bacteria and/or nitrogen (nitrate) to local water bodies. Stormwater from urban areas, which drain impervious surfaces, may introduce bacteria and/or nitrogen (nitrate) derived from wildlife or pet excrement to surface waters.

Wildlife: Wildlife is a known source of bacteria and/or nitrogen (nitrate) in water bodies as many animals spend time in or around water bodies. Deer, geese, ducks, raccoons, and other animals all create potential sources of bacteria and/or nitrogen (nitrate) via contaminated runoff from animal habitats, such as urban park areas, forest, and rural areas.

Future Growth:
IEPA considered information gathered during the 2010 census in determining whether or not to assign reserve capacity (RC) to the TMDL equation to account for future growth in the MRW. IEPA explained that it does not anticipate that significant future population growth will occur in the MRW (Sections 2.1 and 8.3.1.5 of the final TMDL document) but IEPA did assign ten percent of the loading capacity to a RC allocation (Section 6.5 of the final TMDL document and Tables 5 and 6 of this Decision Document). The WLA and load allocations (LA) for the MRW TMDLs were calculated for all current and future sources. Any expansion of point or nonpoint sources will need to comply with the respective WLA and LA values calculated in the MRW TMDLs.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the first criterion.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the water body, the applicable numeric or narrative water quality criterion, and the antidegradation policy (40 C.F.R. §130.7(c)(1)). EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

The TMDL submittal must identify a numeric water quality target(s) – a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as Dissolved Oxygen (DO) criteria). In such cases, the TMDL submittal should explain the linkage between the pollutant of concern and the chosen numeric water quality target.

Comment:
In Section 2 of the final TMDL document, IEPA explained that water bodies in the MRW were not meeting their General Use designation. The Illinois Pollution Control Board (IPCB) defines General Use standards as those that:

> *"will protect the state's water for aquatic life, wildlife, agricultural use, secondary contact use and most industrial uses, and ensure the aesthetic quality of the state's aquatic environment."*

Under the General Use classification, waters are further designated as impaired for aquatic life use, aesthetic quality use and/or primary contact recreational use. Table 1 of this Decision Document summarizes information describing the water body segments and their associated impaired uses.

The applicable General Use water quality standards for the MRW TMDL water bodies are established in Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards, Subpart B. Table 4 of this Decision Document lists all the water quality standards and the TMDL targets/modeling endpoints employed by IEPA in the calculation of loading capacities for MRW TMDLs.

Table 4: Water quality standards and TMDL targets utilized within the Mackinaw River Watershed TMDL

Parameter	Units	Water Quality Standard	Regulatory Reference
Total Fecal Coliform[1]	# / 100 mL	400 in < 10% of samples[2]	302.209
		Geometric Mean[3] < 200	
Nitrogen (Nitrate)	mg/L	10*	Parts 302 & 611

[1] = Fecal Coliform standards apply only between May 1 and October 31
[2] = Standard shall not be exceeded by more than 10% of the samples collected during any 30-day period
[3] = Geometric mean based on minimum of 5 samples taken over not more than a 30-day period
* = maximum contaminant level

<u>Bacteria TMDL target:</u> The fecal coliform TMDL target employed for the Mackinaw River (IL_DK-13) bacteria TMDL is the **<u>200 colony forming units (cfu) per 100 mL</u>** (200 cfu/100 mL) portion of the standard. IEPA believes that using the 200 cfu/100 mL portion of the standard for TMDL calculations will result in the greatest bacteria reductions within the MRW and will result in the attainment of the 400 cfu/100 mL portion of the standard. While the bacteria TMDLs will focus on the geometric mean portion of the water quality standard, attainment of both parts of the water quality standard is required.

<u>Nitrogen (Nitrate) TMDL target:</u> The nitrate TMDL target employed for the Mackinaw River (IL_DK-17) nitrate TMDL was **10 mg/L** (see Table 4 of this Decision Document);

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the second criterion.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a water body for the applicable pollutant. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

The pollutant loadings may be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. §130.2(i)). If the TMDL is expressed in terms other than a daily load, e.g., an annual load, the submittal should explain why it is appropriate to express the TMDL in the unit of measurement chosen. The TMDL submittal should describe the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

The TMDL submittal should contain documentation supporting the TMDL analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling. EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

TMDLs must take into account *critical conditions* for steam flow, loading, and water quality parameters as part of the analysis of loading capacity (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable *critical conditions* and describe their approach to estimating both point and nonpoint source loadings under such *critical conditions*. In particular, the TMDL should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.

<u>Comment:</u>
<u>MRW bacteria TMDL:</u> IEPA used the geometric mean (**200 cfu/100 mL**) of the bacteria (fecal coliform) WQS to calculate loading capacity values for the bacteria TMDL. IEPA believes the geometric mean of the bacteria WQS provides the best overall characterization of the status of the watershed. EPA agrees with this assertion, as stated in the preamble of, *"The Water Quality Standards for Coastal and Great Lakes Recreation Waters Final Rule"* (69 FR 67218-67243, November 16, 2004) on page 67224, "…the geometric mean is the more relevant value for ensuring that appropriate actions are taken to protect and improve water quality because it is a more reliable measure, being less subject

to random variation, and more directly linked to the underlying studies on which the 1986 bacteria criteria were based." IEPA stated that the bacteria TMDLs will focus on the geometric mean portion of the water quality standard (200 cfu/100 mL) and that it expects that by attaining the 200 cfu/100 mL portion of the bacteria (fecal coliform) WQS the 400 cfu/100 mL portion of the bacteria (fecal coliform) WQS will also be attained. EPA finds these assumptions to be reasonable.

Typically loading capacities are expressed as a mass per time (e.g., pounds per day). However, for fecal coliform loading capacity calculations, mass is not always an appropriate measure because fecal coliform is expressed in terms of colony forming units. This approach is consistent with the EPA's regulations which define "load" as "an amount of matter that is introduced into a receiving water" (40 CFR §130.2). To establish the loading capacities for the MRW bacteria TMDLs, IEPA used Illinois's WQS for fecal coliform (200 cfu/100 mL). A loading capacity is, "the greatest amount of loading that a water can receive without violating water quality standards." (40 CFR §130.2). Therefore, a loading capacity set at the WQS will assure that the water does not violate WQS. IEPA's bacteria (fecal coliform) TMDL approach is based upon the premise that all discharges (point and nonpoint) must meet the WQS when entering the water body. If all sources meet the WQS at discharge, then the water body should meet the WQS and the designated use.

Flow duration curves (FDC) were created for the main stem Mackinaw River (IL_DK-13) segment in the MRW via flow data from the USGS gage on the Mackinaw River at Congerville, Illinois (USGS #05567500). Streamflow data was area-weighted where appropriate. Flow data focused on dates within the recreation season (May 1 to October 31). Daily stream flows were necessary to implement the load duration curve (LDC) approach.

FDCs graphs have flow duration interval (percentage of time flow exceeded) on the X-axis and discharge (flow per unit time) on the Y-axis. The FDC were transformed into LDC by multiplying individual flow values by the WQS (200 cfu/100 mL) and then multiplying that value by a conversion factor. The resulting points are plotted onto a load duration curve graph. LDC graphs, for the TCW bacteria TMDLs, have flow duration interval (percentage of time flow exceeded) on the X-axis and bacteria (fecal coliform) concentrations (number of bacteria per unit time) on the Y-axis. The curved line on a LDC graph represents the TMDL of the respective flow conditions observed at that location.

Water quality monitoring was completed in the Mackinaw River (IL_DK-13) and measured fecal coliform concentrations were converted to individual sampling loads by multiplying the sample concentration by the instantaneous flow measurement observed/estimated at the time of sample collection. The individual sampling loads were plotted on the same figure with the created LDC (Figure 17 of the final TMDL document). EPA notes that Figure 17 of the final TMDL document also includes LDCs calculated for the single sample maximum WQS (400 cfu/100 mL).

The LDC plots were subdivided into five flow regimes; high flow conditions (exceeded 0–10% of the time), moist flow conditions (exceeded 10–40% of the time), mid-range flow conditions (exceeded 40–60% of the time), dry flow conditions (exceeded 60–90% of the time), and low flow conditions (exceeded 90–100% of the time). LDC plots can be organized to display individual sampling loads with the calculated LDC. Watershed managers can interpret LDC graphs with individual sampling points plotted alongside the LDC to understand the relationship between flow conditions and water quality exceedances within the watershed. Individual sampling loads which plot above the LDC represent violations of the WQS and the allowable load under those flow conditions at those locations. The difference between individual sampling loads plotting above the LDC and the LDC, measured at the same flow, is the amount of reduction necessary to meet WQS.

The strengths of using the LDC method are that critical conditions and seasonal variation are considered in the creation of the FDC by plotting hydrologic conditions over the flows measured during the recreation season. Additionally, the LDC methodology is relatively easy to use and cost-effective. The weaknesses of the LDC method are that nonpoint source allocations cannot be assigned to specific sources, and specific source reductions are not quantified. Overall, IEPA believes and EPA concurs that the strengths outweigh the weaknesses for the LDC method.

Implementing the results shown by the LDC requires watershed managers to understand the sources contributing to the water quality impairment and which Best Management Practices (BMPs) may be the most effective for reducing bacteria loads based on flow magnitudes. Different sources will contribute bacteria loads under varying flow conditions. For example, if exceedances are significant during high flow events this would suggest storm events are the cause and implementation efforts can target BMPs that will reduce stormwater runoff and consequently bacteria loading into surface waters. This allows for a more efficient implementation effort.

The bacteria TMDL for the Mackinaw River (IL_DK-13) in the MRW was calculated and those results are found in Table 5 of this Decision Document. The LAs were calculated after the determination of the WLA. LAs (e.g., stormwater runoff from agricultural land use practices and feedlots, septic systems, wildlife inputs etc.) were not split among individual nonpoint contributors. Instead, LAs were combined together into a categorical LA to cover all nonpoint source contributions.

Table 5: Bacteria (fecal coliform) TMDLs for the Mackinaw River Watershed

Allocation	**Flow Zone**	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
	Flow Exceedance Range (%)	**0 - 10**	**10 - 40**	**40 - 60**	**60 - 90**	**90 - 100**
	Source	Fecal coliform *(millions of fecal coliform colonies/day)*				
Mackinaw River (IL_DK-13) - geomean standard (200 cfu/100 mL)						
Wasteload Allocation	Metamora South WWTP (IL0021521)	7.3	2.9	2.9	2.9	2.9
	City of Eureka STP (IL0025119)	14.0	4.5	4.5	4.5	4.5
	East Bay Camp Conference Center STP (IL0025666)	0.38	0.23	0.23	0.23	0.23
	COMLARA Park STP (IL0036391)	0.42	0.17	0.17	0.17	0.17
	I-74 South Mackinaw Dells Rest Area STP (IL0040762)	0.057	0.023	0.023	0.023	0.023
	Goodfield STP (IL0048054)	3.0	1.5	1.5	1.5	1.5
	Forestview Utilities Corporation STP (IL0053899)	1.9	0.076	0.076	0.076	0.076
	Westwind Estates STP (IL0073032)	0.36	0.18	0.18	0.18	0.18
	Prairie View Supplemental Treatment Facility (IL0074365)	0.13	0.053	0.053	0.053	0.053
	ILDOT I-74 Woodford Co N WWTP (ILG551035)	0.23	0.11	0.11	0.11	0.11

	Timberline MHP WWTP (ILG551095)	1.0	0.39	0.39	0.39	0.39
	Roanoke WWTP (ILG580074)	6.1	1.7	1.7	1.7	1.7
	Village Colfax WWTP (ILG580078)	2.1	0.83	0.83	0.83	0.83
	Village of Gridley WWTP (ILG580102)	3.6	1.4	1.4	1.4	1.4
	City of El Paso WWTP (ILG582005)	8.7	3.5	3.5	3.5	3.5
	Dry Grove Township MS4 (ILR400041)	20.0	5.7	2.1	0.36	0.052
	Normal Township MS4 (ILR400097)	138.0	41.0	15.0	2.50	0.37
	Washington Township MS4 (ILR400146)	104.0	30.0	11.0	1.90	0.27
	Worth Township MS4 (ILR400158)	51.0	15.0	5.4	0.92	0.13
	McLean County MS4 (ILR400265)	1.6	0.46	0.17	0.029	0.0042
	Bloomington City MS4 (ILR400296)	5.3	1.5	0.56	0.10	0.014
	Normal, Town MS4 (ILR400399)	42.0	12.0	4.5	0.77	0.11
	ILDOT MS4 (ILR400493)	1.1	0.32	0.12	0.020	0.0029
	Old Town Township MS4 (ILR400598)	5.3	1.5	0.56	0.10	0.014
	Towanda Village MS4 (ILR400017)	9.3	2.7	1.0	0.17	0.025
	WLA TOTAL	427	128	58	24.9	19
Load Allocation	***LA TOTAL***	9,093	2,644	973	166	24
Reserve Capacity		1,190	347	129	24	5.4
Margin of Safety (10%)		1,190	347	129	24	5.4
Loading Capacity		**11,900**	**3,466**	**1,289**	**239**	**54**
Actual Load		426				
Estimated Load Reduction (%)		53%				
Mackinaw River (IL_DK-13) - single sample maximum standard (400 cfu/100 mL)						
Wasteload Allocation	Metamora South WWTP (IL0021521)	15.00	5.80	5.80	5.80	5.80
	City of Eureka STP (IL0025119)	28.00	8.90	8.90	8.90	8.90
	East Bay Camp Conference Center STP (IL0025666)	0.76	0.45	0.45	0.45	0.45
	COMLARA Park STP (IL0036391)	0.83	0.33	0.33	0.33	0.33
	I-74 South Mackinaw Dells Rest Area STP (IL0040762)	0.11	0.045	0.045	0.045	0.045
	Goodfield STP (IL0048054)	6.10	3.00	3.00	3.00	3.00
	Forestview Utilities Corporation STP (IL0053899)	3.80	0.15	0.15	0.15	0.15
	Westwind Estates STP (IL0073032)	0.73	0.36	0.36	0.36	0.36
	Prairie View Supplemental Treatment Facility (IL0074365)	0.26	0.11	0.11	0.11	0.11
	ILDOT I-74 Woodford Co N WWTP (ILG551035)	0.45	0.23	0.23	0.23	0.23
	Timberline MHP WWTP (ILG551095)	1.90	0.77	0.77	0.77	0.77
	Roanoke WWTP (ILG580074)	12.00	3.30	3.30	3.30	3.30
	Village Colfax WWTP (ILG580078)	4.20	1.70	1.70	1.70	1.70

	Village of Gridley WWTP (ILG580102)	7.10	2.80	2.80	2.80	2.80
	City of El Paso WWTP (ILG582005)	17.00	7.00	7.00	7.00	7.00
	Dry Grove Township MS4 (ILR400041)	39.0	11.0	4.2	0.73	0.11
	Normal Township MS4 (ILR400097)	278.0	82.0	30.0	5.10	0.77
	Washington Township MS4 (ILR400146)	208.0	60.0	22.0	3.80	0.58
	Worth Township MS4 (ILR400158)	101.0	29.0	11.0	1.90	0.28
	McLean County MS4 (ILR400265)	3.2	0.92	0.34	0.059	0.0088
	Bloomington City MS4 (ILR400296)	11.0	3.1	1.1	0.19	0.029
	Normal, Town MS4 (ILR400399)	84.0	25.0	9.1	1.60	0.23
	ILDOT MS4 (ILR400493)	2.2	0.65	0.24	0.041	0.0062
	Old Town Township MS4 (ILR400598)	11.0	3.1	1.1	0.19	0.029
	Towanda Village MS4 (ILR400017)	19.0	5.4	2.0	0.34	0.051
	WLA TOTAL	854	255	116	49	37.1
Load Allocation	***LA TOTAL***	18,186	5,292	1,946	334	50
Reserve Capacity		2,380	693	258	48	11
Margin of Safety (10%)		2,380	693	258	48	11
Loading Capacity		**23,800**	**6,933**	**2,578**	**479**	**109**
Actual Load		52,659	4,375	5,670	--	--
Estimated Load Reduction (%)		55%	0%	55%	--	--

Table 5 of this Decision Document reports multiple points (the midpoints of each 10% flow exceedance probability sub-flow regime) on the loading capacity curve. However, it should be understood that the components of the TMDL equation could be illustrated for any point on the entire loading capacity curve. The LDC method can be used to display collected bacteria monitoring data and allows for the estimation of load reductions necessary for attainment of the bacteria water quality targets (Table 3 of this Decision Document). Using this method, daily loads were developed based upon the flow in the water body. Loading capacities were determined for the segment for multiple flow regimes. This allows the TMDL to be represented by an allowable daily load across all flow conditions. Table 5 of this Decision Document identifies the loading capacity for the water body at each flow regime. Although there are numeric loads for each flow regime, the LDC is what is being approved for this TMDL.

Table 5 of the Decision Document presents IEPA's loading reduction estimates for the bacteria TMDL across the seasons (Summer, Spring/Fall and Winter). These loading reductions (i.e., the percent reduction row at the bottom of each TMDL table) were calculated from field sampling data collected in the MRW. IEPA explained that its load reduction estimates are likely more conservative since they are based on a limited water quality data set.

EPA concurs with the data analysis and LDC approach utilized by IEPA in its calculation of loading capacities, wasteload allocations, load allocations and the margin of safety for the MRW bacteria TMDL. The methods used for determining the TMDL are consistent with U.S. EPA technical memos.[1]

[1] U.S. Environmental Protection Agency. August 2007. *An Approach for Using Load Duration Curves in the Development of TMDLs*. Office of Water. EPA-841-B-07-006. Washington, D.C.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the third criterion.

MWR nitrogen (nitrate TMDL): IEPA developed a LDC to calculate a nitrogen (nitrate) TMDL for the Mackinaw River (IL_DK-17) segment. The same LDC strategy was employed for the nitrogen (nitrate) TMDL as was used to calculate the bacteria LDC values. IEPA used flow measurements from USGS gage #05567500 on the Mackinaw River at Congerville, Illinois to calculate the flows which were used in the FDC and the LDC for the Mackinaw River (IL_DK-17) nitrogen (nitrate) TMDL. The FDC were transformed into LDC by multiplying individual flow values by the nitrogen (nitrate) TMDL target (10 mg/L) and then multiplying that value by a conversion factor.

A nitrogen (nitrate) TMDL was calculated (Table 6 of this Decision document) by IEPA. The LA value was calculated after the determination of the WLA, the margin of safety (MOS) and the reserve capacity. Load allocations (e.g., non-MS4 urban stormwater runoff) was not split among individual nonpoint contributors. Instead, load allocations were combined together into one value to cover all nonpoint source contributions. Table 6 of this Decision Document reports five values (i.e., the midpoints of the flow regimes) on the loading capacity curve. However, it should be understood that the components of the TMDL equation could be illustrated for any point on the entire loading capacity curve.

The LDC method can be used to display collected nitrogen (nitrate) monitoring data and allows for the estimation of load reductions necessary for attainment of the WQS. Using this method, daily loads were developed based upon the flow in the water body. Loading capacities were determined for the Mackinaw River (IL_DK-17) for multiple flow regimes. This allows the TMDL to be represented by an allowable daily load across all flow conditions. Although there are numeric loads for each flow regime, the LDC is what is being approved for this TMDL.

Table 6: Nitrate TMDL for the Mackinaw River (IL_DK-17)

Allocation	**Flow Zone**	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
	Flow Exceedance Range (%)	**0 - 10**	**10 - 40**	**40 - 60**	**60 - 90**	**90 - 100**
	Source	Nitrate *(lbs/day)*				
Mackinaw River (IL_DK-17)						
Wasteload Allocation	East Bay Camp Conference Center STP (IL0025666)	4.2	2.5	2.5	2.5	2.5
	COMLARA Park STP (IL0036391)	4.6	1.8	1.8	1.8	1.8
	Westwind Estates STP (IL0073032)	4.0	2.0	2.0	2.0	2.0
	Prairie View Supplemental Treatment Facility (IL0074365)	1.4	0.58	0.58	0.58	0.58
	Timberline MHP WWTP (ILG551095)	11.0	4.3	4.3	4.3	4.3
	Village Colfax WWTP (ILG580078)	23.0	9.2	9.2	9.2	9.2
	Village of Gridley WWTP (ILG580102)	39.0	16.0	16.0	16.0	16.0
	Dry Grove Township MS4 (ILR400041)	219	72	27	4.9	1.0
	Normal Township MS4 (ILR400097)	1,537	503	186	34	6.8

	McLean County MS4 (ILR400265)	18	5.8	2.1	0.39	0.078
	Bloomington City MS4 (ILR400296)	58	19	7.1	1.30	0.26
	Normal, Town MS4 (ILR400399)	468	153	57	10	2.1
	ILDOT MS4 (ILR400493)	12	4.0	1.5	0.27	0.055
	Old Town Township MS4 (ILR400598)	58	19	7.1	1.3	0.26
	Towanda Village MS4 (ILR400017)	103	34	12	2.3	0.46
	WLA TOTAL	2,560	846	336	91	47
Load Allocation	***LA TOTAL***	63,876	18,506	6,860	1,246	256
Reserve Capacity		8,304	2,419	899	167	38
Margin of Safety (10%)		8,304	2,419	899	167	38
Loading Capacity		**83,044**	**24,190**	**8,994**	**1,671**	**379**
Actual Load		--	43,466	4,388	--	--
Estimated Load Reduction (%)		--	44%	0%	--	--

EPA supports the data analysis and modeling approach utilized by IEPA in its calculation of WLA, LA and MOS for the nitrogen (nitrate) TMDL for the Mackinaw River (IL_DK-17). EPA finds IEPA's approach for calculating the loading capacity for the Mackinaw River (IL_DK-17) nitrogen (nitrate) TMDL to be reasonable and consistent with EPA guidance.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the third criterion.

4. Load Allocations (LA)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Where possible, load allocations should be described separately for natural background and nonpoint sources.

Comment:
IEPA determined the LA calculations for each of the TMDLs based on the applicable WQS. IEPA recognized that LAs for each of the individual TMDLs addressed by the MRW TMDLs can be attributed to different nonpoint sources.

MRW bacteria TMDL: The calculated LA values for the bacteria TMDLs are applicable across all flow conditions in the MRW (Table 5 of this Decision Document). IEPA identified several nonpoint sources which contribute bacteria nonpoint source loads to the surface waters of the MRW, including; stormwater from agricultural areas and feedlots, failing septic systems, non-regulated urban runoff and wildlife (e.g., deer, geese, ducks, raccoons, turkeys and other animals). IEPA did not determine individual LA values for each of these potential nonpoint source considerations, but aggregated the nonpoint sources into a categorical LA value.

MRW nitrogen (nitrate) TMDL: The calculated LA values for the nitrogen (nitrate) TMDL are applicable across all flow conditions in the MRW (Table 6 of this Decision Document). IEPA identified several nonpoint sources which contribute nitrogen (nitrate) nonpoint source loads to the surface waters in the MRW, including; stormwater from agricultural areas and feedlots, failing septic systems, non-regulated urban runoff and wildlife (e.g., deer, geese, ducks, raccoons, turkeys and other animals). IEPA did not determine individual load allocation values for each of these potential nonpoint source considerations, but aggregated the nonpoint sources into one categorical LA value.

EPA finds IEPA's approach for calculating the LA to be reasonable and consistent with EPA guidance.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the fourth criterion.

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit.

The individual WLAs may take the form of uniform percentage reductions or individual mass based limitations for dischargers where it can be shown that this solution meets WQSs and does not result in localized impairments. These individual WLAs may be adjusted during the NPDES permitting process. If the WLAs are adjusted, the individual effluent limits for each permit issued to a discharger on the impaired water must be consistent with the assumptions and requirements of the adjusted WLAs in the TMDL. If the WLAs are not adjusted, effluent limits contained in the permit must be consistent with the individual WLAs specified in the TMDL. If a draft permit provides for a higher load for a discharger than the corresponding individual WLA in the TMDL, the State/Tribe must demonstrate that the total WLA in the TMDL will be achieved through reductions in the remaining individual WLAs and that localized impairments will not result. All permittees should be notified of any deviations from the initial individual WLAs contained in the TMDL. EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA, as expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA.

Comment:
MRW bacteria TMDL: IEPA identified several NPDES permitted facilities (Table 3 of this Decision Document) which contribute bacteria to the Mackinaw River (IL_DK-13) impaired segment. IEPA used each facility's design maximum flow multiplied by the bacteria TMDL target (i.e., 200 organisms/100 mL for the geometric mean and 400 org/100 mL for the instantaneous fecal coliform WQS) to calculate a WLA for the high flow zone of the LDC (Table 5 of this Decision Document). For the moist to low flow zones of the LDC, IEPA used the facility's design average flow multiplied by the bacteria target to calculate a WLA. IEPA completed these calculations to generate WLA for both the geomean (200 org/100 mL) and the single sample maximum portions of the WQS (Table 5 of this Decision Document). IEPA explained that certain facilities have disinfection exemptions (Table 19 of the final TMDL document) and that those facilities with exemptions are required to meet in-stream WQS (200 org/100 mL) at the end of the exempted reach.

IEPA calculated WLAs for MS4 communities (Table 3 of this Decision Document) in the Mackinaw River watershed. Individual WLAs were calculated based on the MS4's jurisdictional areal footprint of each town or municipality. The proportion of each MS4 jurisdictional area divided by the total area of the Mackinaw River Watershed was multiplied by the loading capacity of the assessment location. For the calculation of MS4 assigned to the road authorities of McLean County and the Illinois Department of Transportation (IDOT), IEPA used the length of road and estimated right-of-way width to calculate the areal extent of those surfaces and then completed the proportional areal calculation multiplied by the loading capacity.

EPA finds IEPA's approach for calculating the WLAs for the Mackinaw River (IL_DK-13) bacteria TMDL to be reasonable and consistent with EPA guidance.

MRW nitrogen (nitrate) TMDL: IEPA identified several NPDES permitted facilities (Table 3 of this Decision Document) which contribute nitrogen (nitrate) to the Mackinaw River (IL_DK-17) impaired segment. IEPA used each facility's design maximum flow multiplied by the nitrogen (nitrate) TMDL target (i.e., 10 mg/L) to calculate a WLA for the high flow zone of the LDC (Table 6 of this Decision Document). For the moist to low flow zones of the LDC, IEPA used the facility's design average flow multiplied by the nitrogen (nitrate) target to calculate a WLA.

IEPA employed a similar strategy (i.e., proportional area estimate multiplied by the loading capacity) for calculating the MS4 WLAs for the nitrogen (nitrate) TMDLs as was used to calculate the MS4 WLAs for the bacteria TMDLs.

EPA finds IEPA's approach for calculating the WLA for the Mackinaw River (IL_DK-17) nitrogen (nitrate) TMDL to be reasonable and consistent with EPA guidance.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the fifth criterion.

6. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL 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. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

Comment:
The final TMDL submittal outlines the determination of the Margin of Safety for the bacteria and nitrogen (nitrate) TMDLs.

<u>MRW bacteria and nitrogen (nitrate) TMDLs:</u> IEPA employed an explicit MOS set at 10% of the loading capacity before allocating the remaining load to point, nonpoint sources and RC (Tables 5 to 6 of this Decision Document).

IEPA explained that using a LDC framework is expected to provide accurate estimates of loading capacities of surface waters, but there may be some error associated in how flows were estimated, especially for the Mackinaw River (IL_DK-17) reach which employed a drainage area ratio method to estimate flows in segment IL_DK-17. Additionally, IEPA cited that the load duration analysis did not address bacteria die-off but bacteria die-off does occur under certain environmental conditions and is influenced by temperature, light and microbial predation which can result in bacteria decreases, depending on the environmental conditions. In general, the LDC approach minimizes variability associated with TMDL development because the calculation of the loading capacity is a function of flow multiplied by a target value.

The MOS was set at 10% to account for uncertainty due to field sampling error, basing assumptions on water quality monitoring with low sample sizes, and imperfect water quality targets. A 10% MOS was considered appropriate, because the target values used in this TMDL had a firm technical basis and the estimated flows are believed to be relatively accurate because they were estimated based on a USGS gage located within or just outside of the subwatershed with the impaired segments.

The margin of safety is appropriate because the use of the LDC provides an accurate account of existing stream conditions (calculated by multiplying daily flows by existing pollutant levels), and an accurate account of the stream's loading capacity (calculated by multiplying daily flows by the appropriate water quality target). In other words, there is a good fit between observed (existing) data and predicted data using the LDC approach, thus, providing a relatively accurate determination of the TMDL reductions needed. IEPA accounts for any uncertainty in this method by incorporating the MOS.

The EPA finds that the TMDL document submitted by IEPA contains an appropriate MOS satisfying the requirements of the sixth criterion.

7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variations. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

<u>Comment:</u>

<u>MRW bacteria and nitrogen (nitrate) TMDLs:</u> The bacteria and nitrogen (nitrate) TMDLs accounted for seasonality via the LDC framework which inherently accounts for seasonal variation by using daily flows over a multi-year period. The LDC process used streamflows over a wide range of flow conditions across the entire water year. For the LDC-based TMDLs in the MRW, runoff (e.g., agricultural runoff from animal and/or cropland practices) is the main transport mechanism which delivers pollutant loading into the surface water environment. LDC graphs can provide insight toward understanding under which flow regimes/conditions exceedances of the WQS or water quality targets are occurring, and whether or not there is any seasonal flow component to those flow conditions (i.e., spring melt, summer precipitation events during lower flow periods, etc.)

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the seventh criterion.

8. Reasonable Assurance

When a TMDL is developed for waters impaired by point sources only, the issuance of a NPDES permit(s) provides the reasonable assurance that the wasteload allocations contained in the TMDL will be achieved. This is because 40 C.F.R. 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with, "the assumptions and requirements of any available wasteload allocation" in an approved TMDL.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

EPA's August 1997 TMDL Guidance also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by nonpoint sources. However, EPA cannot disapprove a TMDL for nonpoint source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved, because such a showing is not required by current regulations.

Comment:
The MRW bacteria and nitrogen (nitrate) TMDLs provide reasonable assurance that actions identified in the implementation section of the final TMDL (i.e., Section 8 of the final TMDL document), will be applied to attain the loading capacities and allocations calculated for the impaired reaches within the MRW. The recommendations made by IEPA will be successful at improving water quality if the appropriate local groups work to implement these recommendations. Those mitigation suggestions, which fall outside of regulatory authority, will require commitment from state agencies and local stakeholders to carry out the suggested actions.

IEPA outlines its reasonable assurance efforts in Section 8 of the final TMDL document. IEPA outlines management measures and programs which will be employed to attain the loading capacities and allocations calculated for the impaired reaches within the MRW. Section 8 also includes components of a more formal Implementation Plan for the MRW.

Reasonable assurance that the WLA set forth will be implemented is provided by regulatory actions. According to 40 C.F.R. 122.44(d)(1)(vii)(B), NPDES permit effluent limits must be consistent with assumptions and requirements of all WLAs in an approved TMDL. IEPA's NPDES permit program is one of the implementing programs for ensuring WLA are consistent with the TMDL. Current NPDES permits will remain in effect until the permits are reissued, provided that IEPA receives the NPDES permit renewal application prior to the expiration date of the existing NPDES permit.

Section 8.3 of the TMDL discusses various BMPs that, when implemented, will significantly reduce bacteria and nitrogen (nitrate) inputs to surface waters of the MRW. In Tables 34 and 36 of Section 8.4.1 of the final TMDL document, IEPA lists site-specific BMP costs, the programming which typically provide financial assistance for these BMPs (e.g., USDA-NRCS - Conservation Reserve Program, USDA- NRCS-Environmental Quality Incentives Program (EQIP), IDA-Conservation Practices Program (CPP)) and potential sponsors. These BMPs included; nutrient and fertilizer management, vegetated buffers and filter strips, drainage water management, denitrifying bioreactors and livestock exclusion practices.

Table 38 of the TMDL provides an estimated implementation schedule of actions and activities in the watershed that can reduce bacteria and nitrogen (nitrate) loads into water bodies in the MRW. These actions address short-term goals (1-5 years), mid-term goals (6-15 years) and long-term goals (16 to 25 years).

The EPA finds that this criterion has been adequately addressed.

9. Monitoring Plan to Track TMDL Effectiveness

EPA's 1991 document, *Guidance for Water Quality-Based Decisions: The TMDL Process* (EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur. Such a TMDL should provide assurances that nonpoint source controls will achieve expected load reductions and, such TMDL should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.

<u>Comment:</u>
The final TMDL document contains discussion on future monitoring within the MRW and milestones (Section 8.8 of the final TMDL document). Continued water quality monitoring within the basin is supported by IEPA. Additional water quality monitoring results will provide insight into the success or failure of BMP systems designed to reduce bacteria and nitrogen (nitrate) loading into the surface waters of the watershed. Local watershed managers will be able to reflect on the progress of the various pollutant removal strategies and will have the opportunity to change course if observed progress is unsatisfactory.

IEPA anticipates that it will continue to measure water quality in the MRW via its ambient monitoring program (Section 8.8.1 of the final TMDL document). Progress of TMDL implementation will be measured through monitoring efforts focused on:

- Tracking implementation of BMPs in the watershed;
- Estimating the effectiveness of BMPs;
- Additional monitoring of point source discharges in the watershed;
- Continued monitoring of impaired stream segments and tributaries;

- Monitoring storm-based high flow events; and
- Low flow monitoring in impaired stream segments.

Water quality monitoring is a critical component of the adaptive management strategy employed as part of the implementation efforts utilized in the MRW. Water quality information will aid watershed managers in understanding how BMP pollutant removal efforts are impacting water quality. Water quality monitoring combined with an annual review of BMP efficiency will provide information on the success or failure of BMP systems designed to reduce pollutant loading into water bodies of the MRW. Watershed managers will have the opportunity to reflect on the progress or lack of progress, and will have the opportunity to change course if progress is unsatisfactory.

The EPA finds that this criterion has been adequately addressed.

10. Implementation

EPA policy encourages Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired by nonpoint sources. Regions may assist States/Tribes in developing implementation plans that include reasonable assurances that nonpoint source LAs established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. In addition, EPA policy recognizes that other relevant watershed management processes may be used in the TMDL process. EPA is not required to and does not approve TMDL implementation plans.

Comment:
The findings from the MRW TMDLs will be used to inform the selection of implementation activities in the watershed. The TMDL outlined some implementation strategies in Section 8 of the final TMDL document. IEPA outlined the importance of prioritizing areas within the MRW, education and outreach efforts with local partners, and partnering with local stakeholders to improve water quality within the watershed. The reduction goals for the bacteria and nitrogen (nitrate) TMDLs may be met via a combination of the following strategies:

MRW bacteria and nitrogen (nitrate) TMDLs: The potential BMPs which, if installed and maintained, would likely result in decreases in bacteria and nitrogen (nitrate) inputs to surface waters of the MRW are:

- ***Nutrient management*** **–** These strategies involve reducing bacteria and nitrogen (nitrate) transport from fields and minimizing soil loss. Specific practices would include; erosion control through conservation tillage, reduction of winter spreading of fertilizers, elimination of fertilizer spreading near open inlets and sensitive areas, installation of stream buffer and filter strips, streambank stabilization practices (gully stabilization and installation of fencing near streams), and nutrient management planning.
- ***Pasture management and fencing*** - Reducing livestock access to stream environments will lower the opportunity for direct transport of bacteria and nitrogen (nitrate) to surface waters. The installation of exclusion fencing near stream and river environments to prevent direct access for livestock, installing alternative water supplies, and installing stream crossings between pastures, would work to reduce the influxes of bacteria and nitrogen (nitrate) and improve water quality

within the watershed. Additionally, introducing rotational grazing to increase grass coverage in pastures, and maintaining appropriate numbers of livestock per acre for grazing, can also aid in the reduction of bacteria and nitrogen (nitrate) inputs.

- ***Filter strips, riparian buffers, bank stabilization and erosion control*** **–** Protection of streambanks within the watershed through planting of vegetated/buffer areas with grasses, legumes, shrubs or trees will mitigate bacteria and nitrogen (nitrate) inputs into surface waters. These areas will filter stormwater runoff before the runoff enters the main stem or tributaries of the MRW. An assessment of stream channel, river channel, and lakeshore erosional areas should be completed to evaluate areas where erosion control strategies could be implemented in the MRW. Implementation actions (e.g., planting deep-rooted vegetation near water bodies to stabilize streambanks) could be prioritized to target areas which are actively eroding. This strategy could prevent additional sediment inputs into surface waters of the MRW and minimize or eliminate degradation of habitat.
- ***Urban/Residential Nutrient Reduction Strategies:*** These strategies involve reducing stormwater runoff from lakeshore homes and other residences within the MRW. These practices would include; rain gardens, lawn fertilizer reduction, lake shore buffer strips, vegetation management and replacement of failing septic systems. Municipal programs, such as street sweeping, can also aid in the reduction of nutrients to surface water bodies within the MRW. Municipal partners can team with local watershed groups or water district partners to assess how best to utilize their monetary resources for installing new stormwater BMPs (e.g., vegetated swales) or retro-fitting existing stormwater BMPs.
- ***Private septic system inspection and maintenance program*** - Septic systems are believed to be a source of nutrients to waters in the MRW. Failing systems are expected to be identified and addressed via upgrades to those septic systems not meeting local health ordinances. Septic system improvement priority should be given to those failing systems adjacent to surface waters (i.e., streams or lakes).
- ***Stormwater volume control and infiltration BMPs:*** To mitigate the impact of stormwater in the MRW, IEPA recommends the installation of stormwater BMPs, including some combination of; rain gardens, vegetated swales/bioswales/bioretention areas, detention ponds, rain barrels, pervious pavement and infiltration trenches. Reducing peak flow stormwater inputs within the MRW may be accomplished via reducing impervious cover or employing other low impact development/ green technologies which allow stormwater to infiltrate, evaporate or evapotranspire before reaching the stormwater conveyance system.

Education and Outreach Efforts **-** Increased education and outreach efforts to the general public bring greater awareness to the issues surrounding bacteria and nitrogen (nitrate) contamination and strategies for reducing loading and transport of these pollutants should be prioritized as part of the overall implementation strategy.

The EPA finds that this criterion has been adequately addressed. The EPA reviews but does not approve implementation plans.

11. Public Participation

EPA policy is that there should be full and meaningful public participation in the TMDL development process. The TMDL regulations require that each State/Tribe must subject calculations to establish TMDLs to public review consistent with its own continuing planning process (40 C.F.R. §130.7(c)(1)(ii)). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval should describe the State's/Tribe's public participation process, including a summary of significant comments and the State's/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. §130.7(d)(2)).

Provision of inadequate public participation may be a basis for disapproving a TMDL. If EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

Comment:

The public participation section of the TMDL submittal is found in Section 9 of the final TMDL document. Throughout the development of the MRW TMDLs the public was given various opportunities to participate. IEPA and its TMDL contractor held a series of public meetings in the MRW during TMDL development, where IEPA described the watershed plan and TMDL process. The public comment period for the draft TMDL was held between December 12, 2022 and February 10, 2023. IEPA posted the draft TMDL online at (https://www2.illinois.gov/epa/public-notices/Pages/general-notices.aspx) for the public comment period.

IEPA received public comments during the public comment period and summarized those comments in Appendix D of the final TMDL. IEPA authored responses to individual comments and revised the final TMDL document where appropriate (e.g., Comment #18 on p. D-9 and IEPA's efforts to modernize Section 8.4.3 to remove organizations which are no longer active within the MRW). EPA reviewed IEPA's response to the comment and has determined that IEPA responded appropriately to the comment.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of this eleventh element.

12. Submittal Letter

A submittal letter should be included with the TMDL submittal, and should specify whether the TMDL is being submitted for a *technical review* or *final review and approval*. Each final TMDL submitted to EPA should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final review and approval, should contain such identifying information as the name and location of the water body, and the pollutant(s) of concern.

Comment:
The EPA received the final Mackinaw River Watershed TMDL document, submittal letter and accompanying documentation from IEPA on August 21, 2023. The submittal letter explicitly stated that the final TMDLs referenced in Table 1 of this Decision Document were being submitted to EPA pursuant to Section 303(d) of the Clean Water Act for EPA review and approval. The submittal letter also included the name and location of the water bodies and the causes/pollutants of concern. This TMDL was submitted per the requirements under Section 303(d) of the Clean Water Act and 40 C.F.R. 130.

The EPA finds that the TMDL transmittal letter submitted for the Mackinaw River Watershed TMDLs by IEPA satisfies the requirements of this twelfth element.

13. Conclusion

After a full and complete review, the EPA finds that the 1 bacteria TMDL and the 1 nitrogen (nitrate) TMDL satisfy all elements for approvable TMDLs. This TMDL approval is for **two (2) TMDLs**, addressing segments for primary contact recreation and public and food processing water supply use impairments (Table 1 of this Decision Document).

The EPA's approval of these TMDLs extends to the water bodies which are identified above with the exception of any portions of the water bodies that are within Indian Country, as defined in 18 U.S.C. Section 1151. The EPA is taking no action to approve or disapprove TMDLs for those waters at this time. The EPA, or eligible Indian Tribes, as appropriate, will retain responsibilities under the CWA Section 303(d) for those waters.

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Mackinaw River Watershed Total Maximum Daily Load

Final Report

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Report Prepared by:

TETRA TECH

August 2023

Contents

Figures

Tables

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.

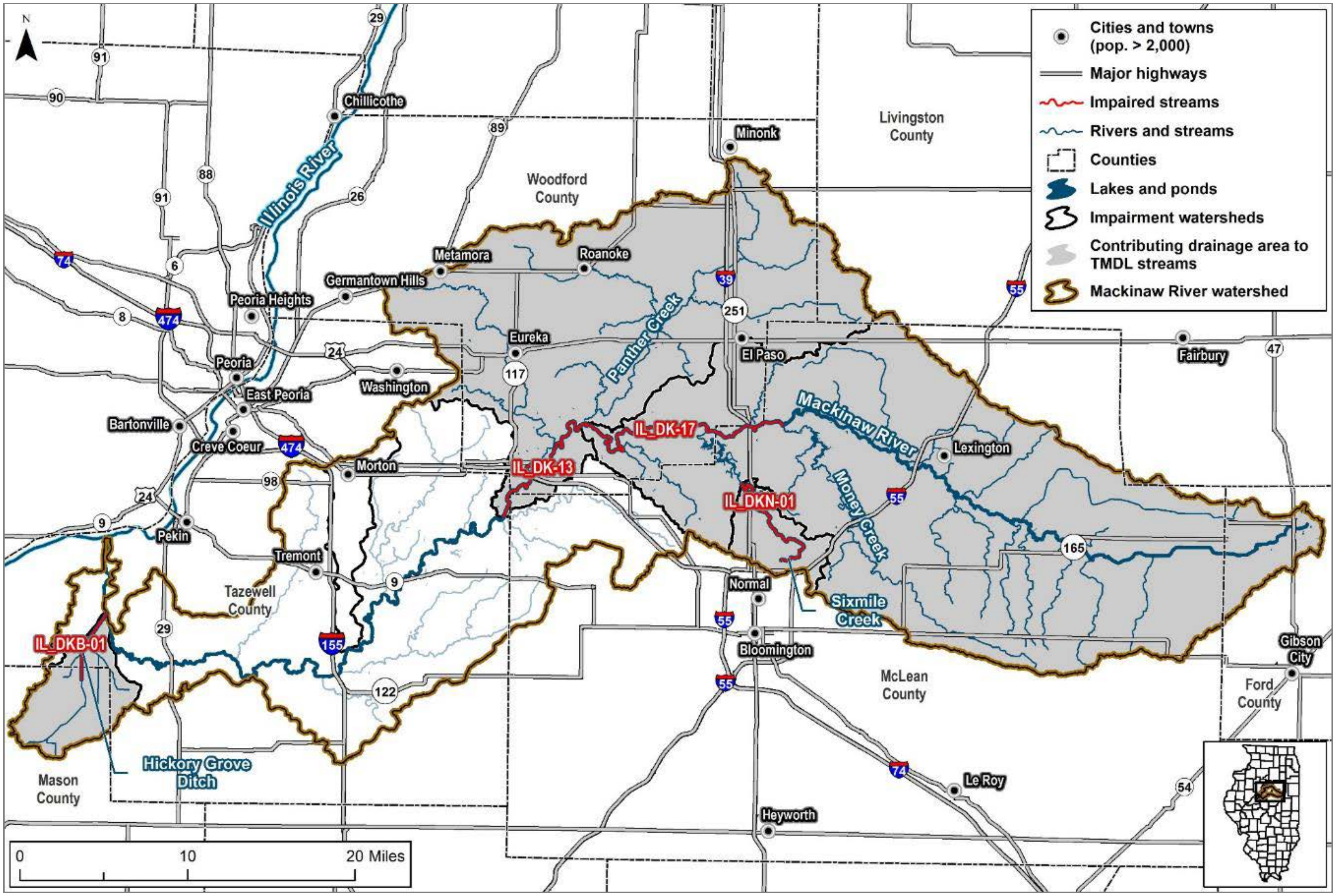

Figure 1. Mackinaw River watershed, TMDL project area.

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. The public and food processing water supply (PFPWS) standards protect human consumption of drinking water and food that is processed using drinking water. As such, the standards are only applicable in a river at the location that water is withdrawn for potable use (i.e., where the water supply intake pipe is located).

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 the Mackinaw River 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 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

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

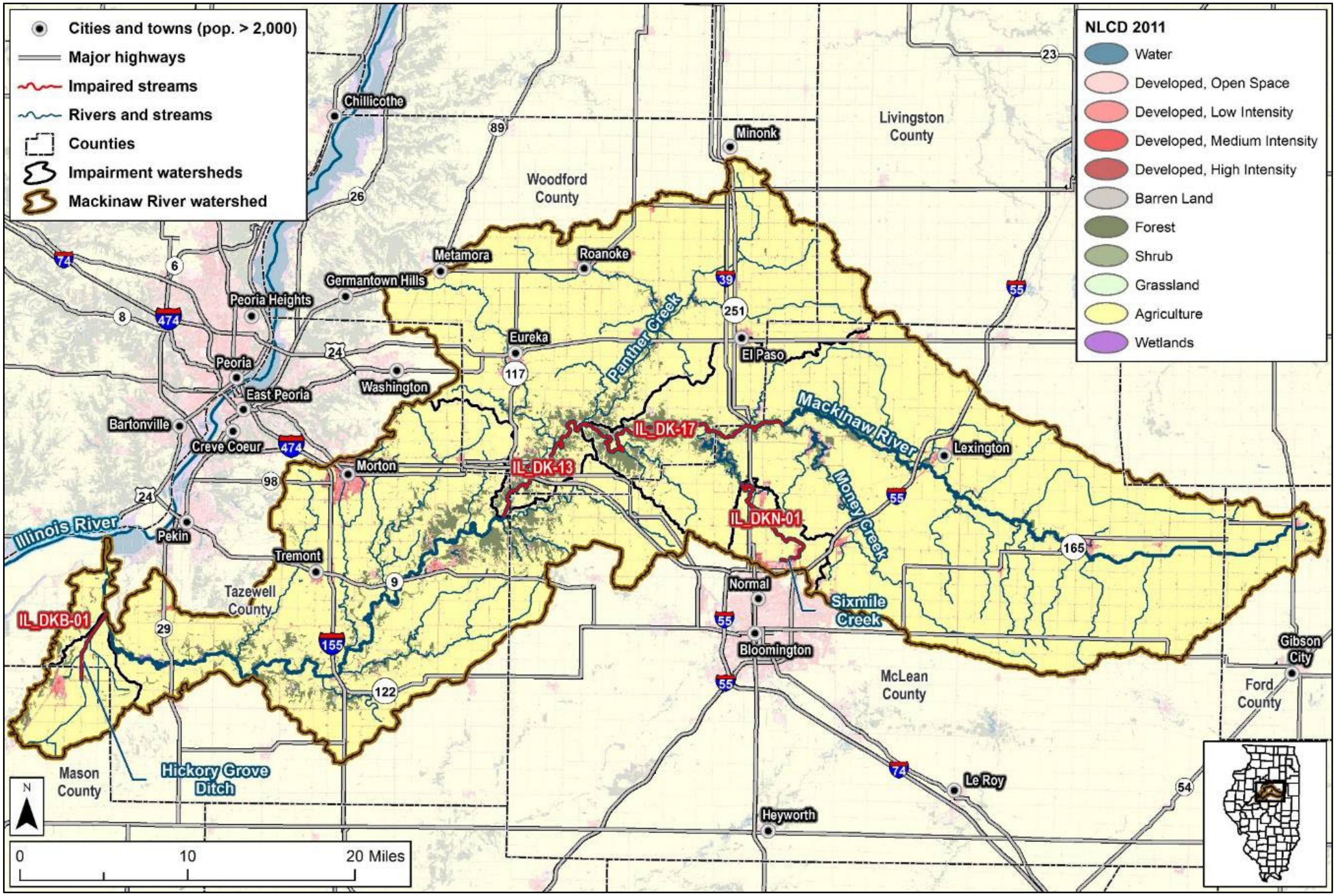

Figure 2. Mackinaw River watershed land cover (2011 National Land Cover Database).
Note: IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

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

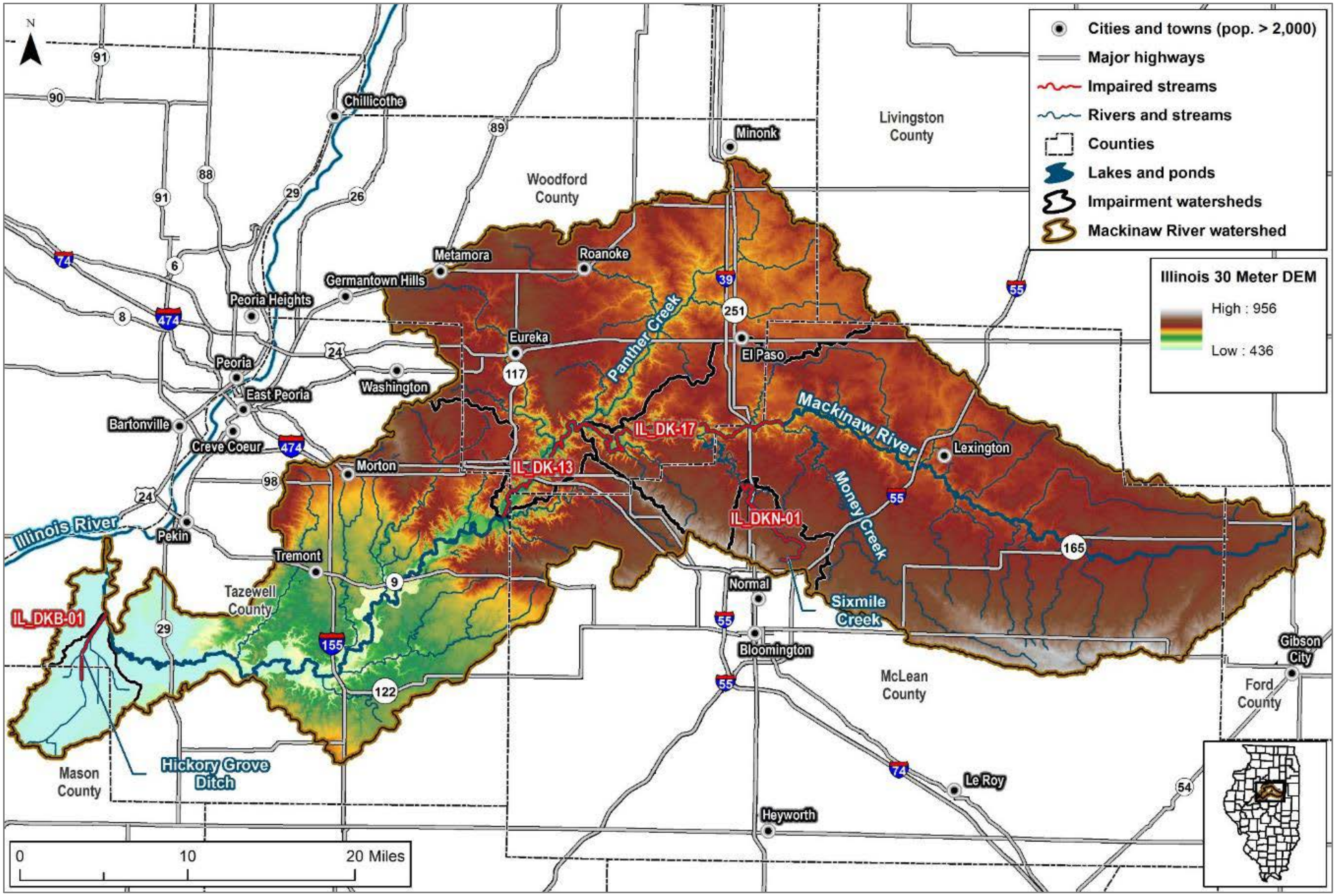

Figure 3. Mackinaw River watershed land elevations (ISGS 2003).

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

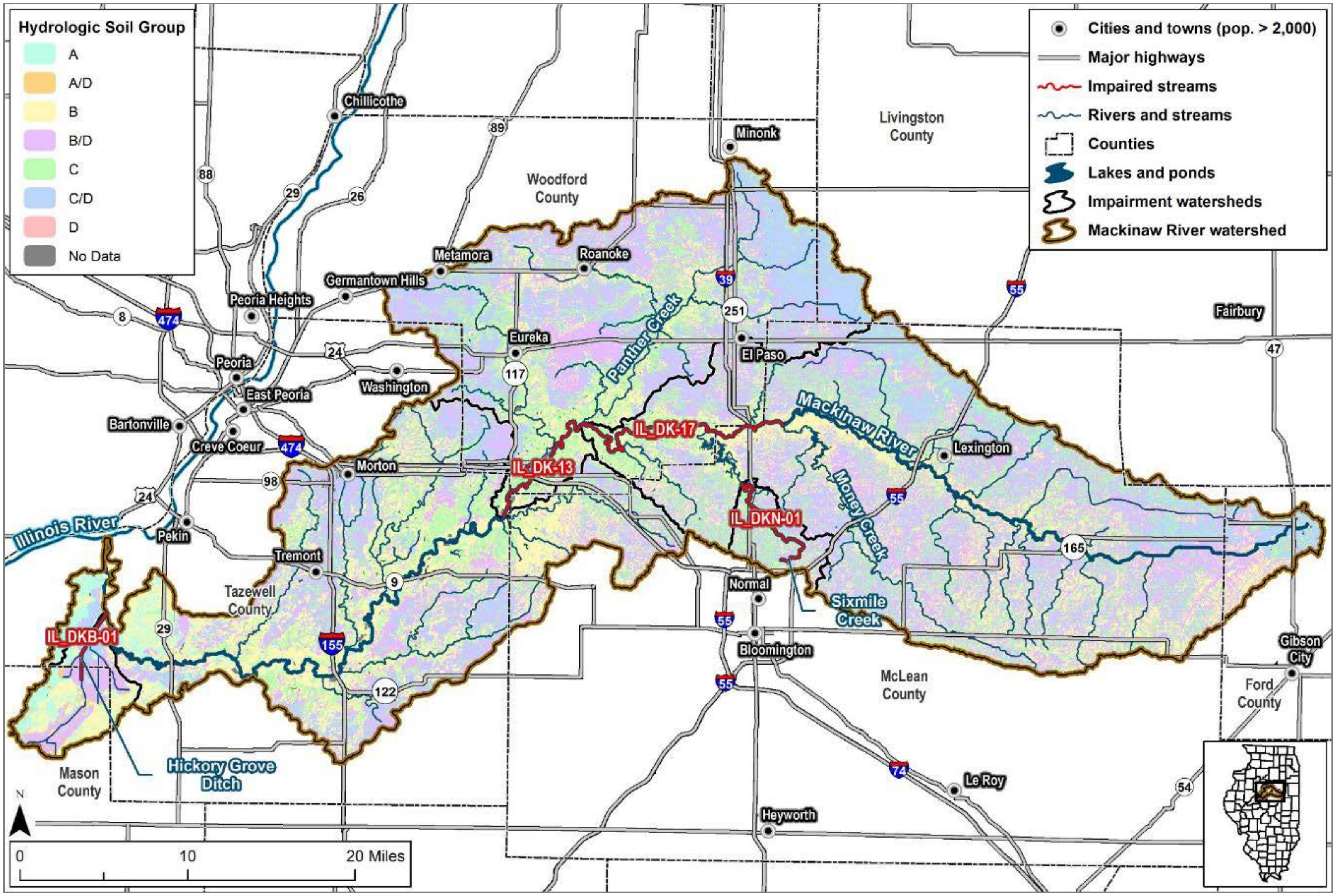

Figure 4. Mackinaw River watershed hydrologic soil groups (Soil Surveys for Ford, Livingston, Mason, McLean, Tazewell and Woodford Counties, Illinois; NRCS SSURGO Database 2011)

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

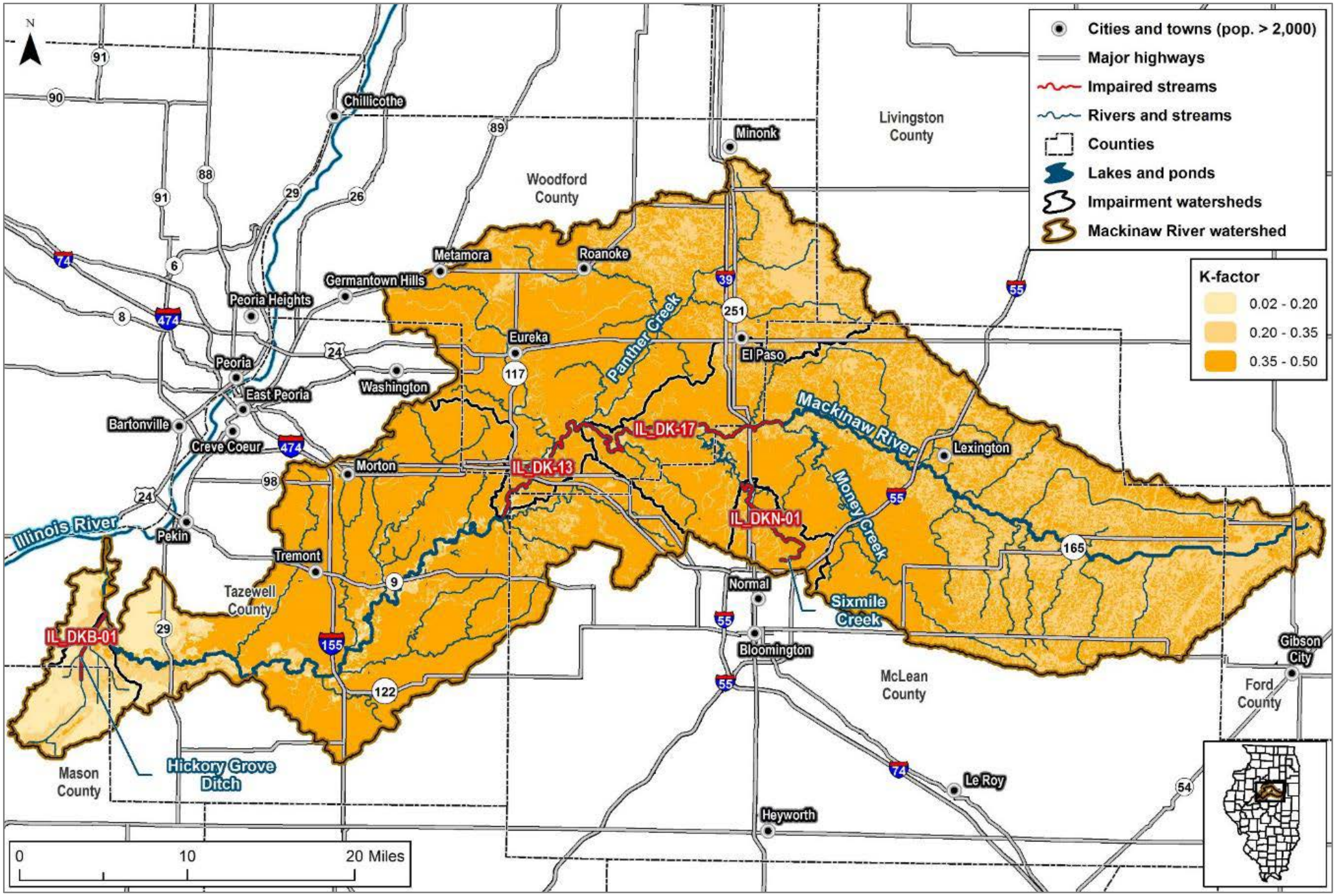

Figure 5. Mackinaw River watershed soil K-factor values (Soil Surveys for Ford, Livingston, Mason, McLean, Tazewell and Woodford Counties, Illinois; NRCS SSURGO Database 2011).

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)

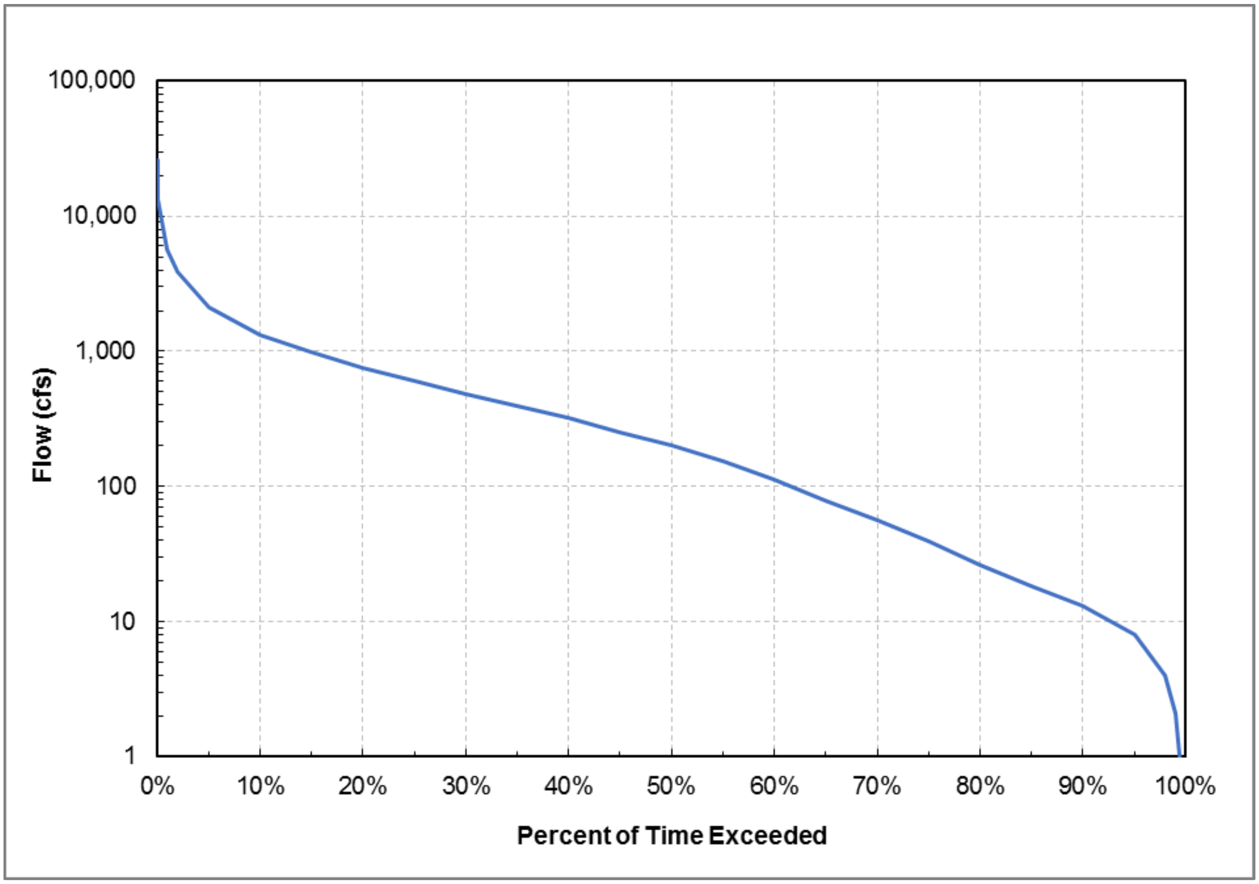

Figure 6. Flow duration curve for USGS gage 05567500, Mackinaw River near Congerville, IL (1944–2016).

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.

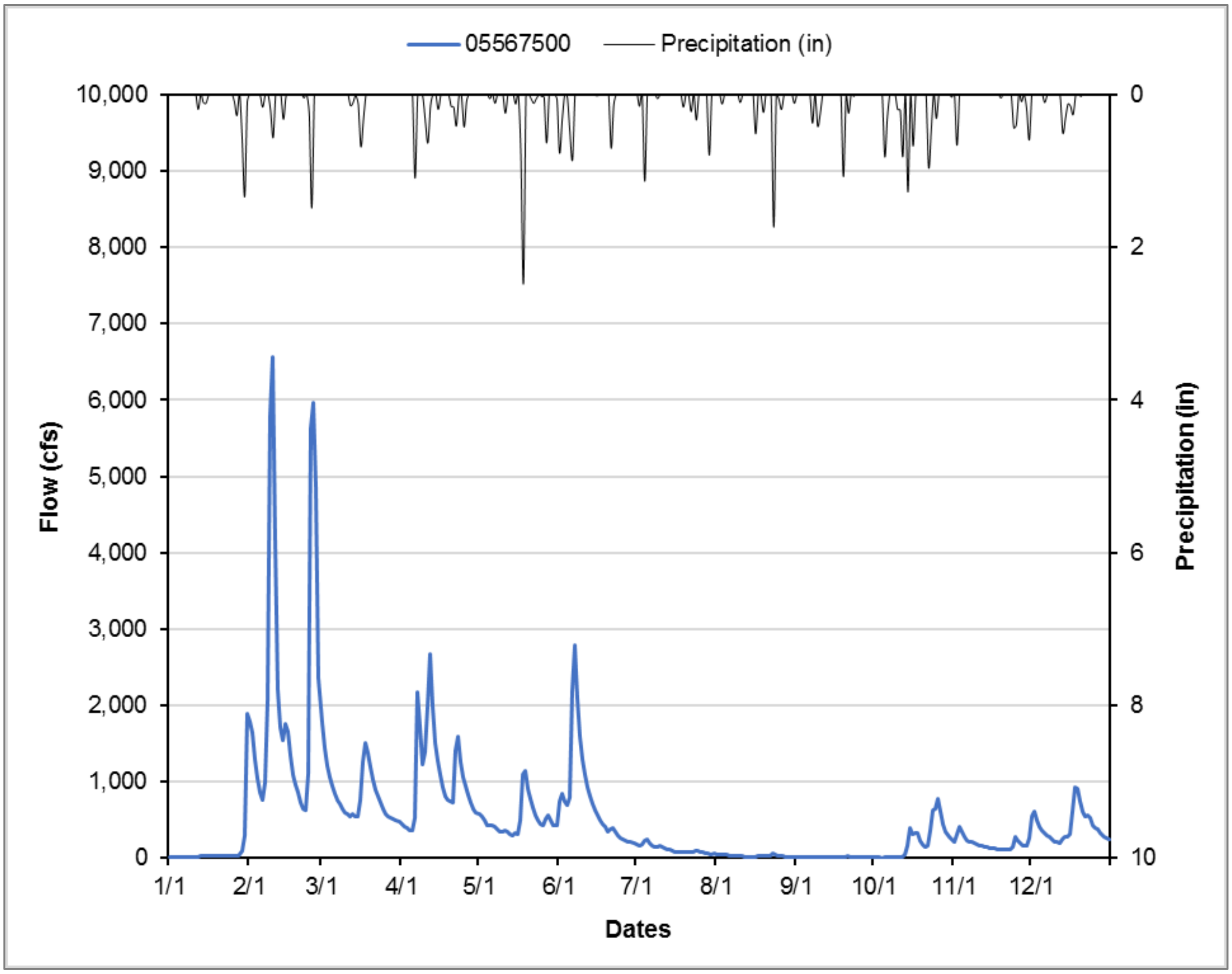

Figure 7. Daily flow in the Mackinaw River with daily precipitation at Normal (USC00116200), 2001.

Tile drainage and channelization of streams throughout the agricultural areas of the Mackinaw River watershed result in altered hydrological regimes. Subsurface drain tiles are typically installed in agricultural areas to drain wet soils and pooled water from precipitation on relatively flat crop fields. Rainwater from precipitation on tile-drained fields will flow through tiles and into ditches much more rapidly than rainwater from precipitation events on crop fields without tile drainage. The subsurface flow moves rapidly through the tiles and discharges to ditches along fields and roads.

Corn and soybean are planted on flat land throughout the Mackinaw River watershed. Frakenberger et al. (2022) estimates that almost 61% of agricultural land is likely or potentially drained (based on the 2011 National Land Cover Database and 2008 Soil Survey Geographic Database).

Ditches and streams are channelized (i.e., straightened and often widened and deepened) to rapidly move water downstream. Water flowing through ditches and channelized streams moves much more rapidly (and with greater stream power) that water flowing in natural stream channels. The more powerful flow can result in increased erosion and flooding. Additionally, more powerful flows can transport larger particles (e.g., sediment, gravel).

Much of the streamflow in the Mackinaw River watershed is in an altered hydrologic regime, where tile drainage results in faster and larger flows than natural flow regimes. As part of the Mackinaw River Watershed TMDL Implementation Plan, development of a tile drainage monitoring plan is recommended to be part of the watershed-based plan(s) development.

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.

- **Lake Bloomington & Evergreen Lake Watershed Plan** (Northwater Consulting 2021)

  This watershed plan “provides a road map to achieve water quality targets and stakeholder goals established under previous plans”, in addition to the Illinois Nutrient Loss Reduction Strategy and the Lake Bloomington and Evergreen Lake TMDL reports. This plan included updated information about water quality, pollutant loading, and watershed characteristics. The plan ranks nutrient and sediment loading as a high priority for watershed plan implementation. It identifies agricultural BMPs as most effective in reducing nutrient loads, considering cost and feasibility. It prioritized in-field practices, especially those that treat tile water, such as cover crops and nutrient management to reduce nutrient and sediment loads. Edge of field and structural practices (e.g., filter strips, wetlands, and grassed waterways) will address higher risk areas and reduce loading, especially for phosphorus and sediment. The total estimated cost for implementing all BMPs in 2021 is $25,164,647.

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.

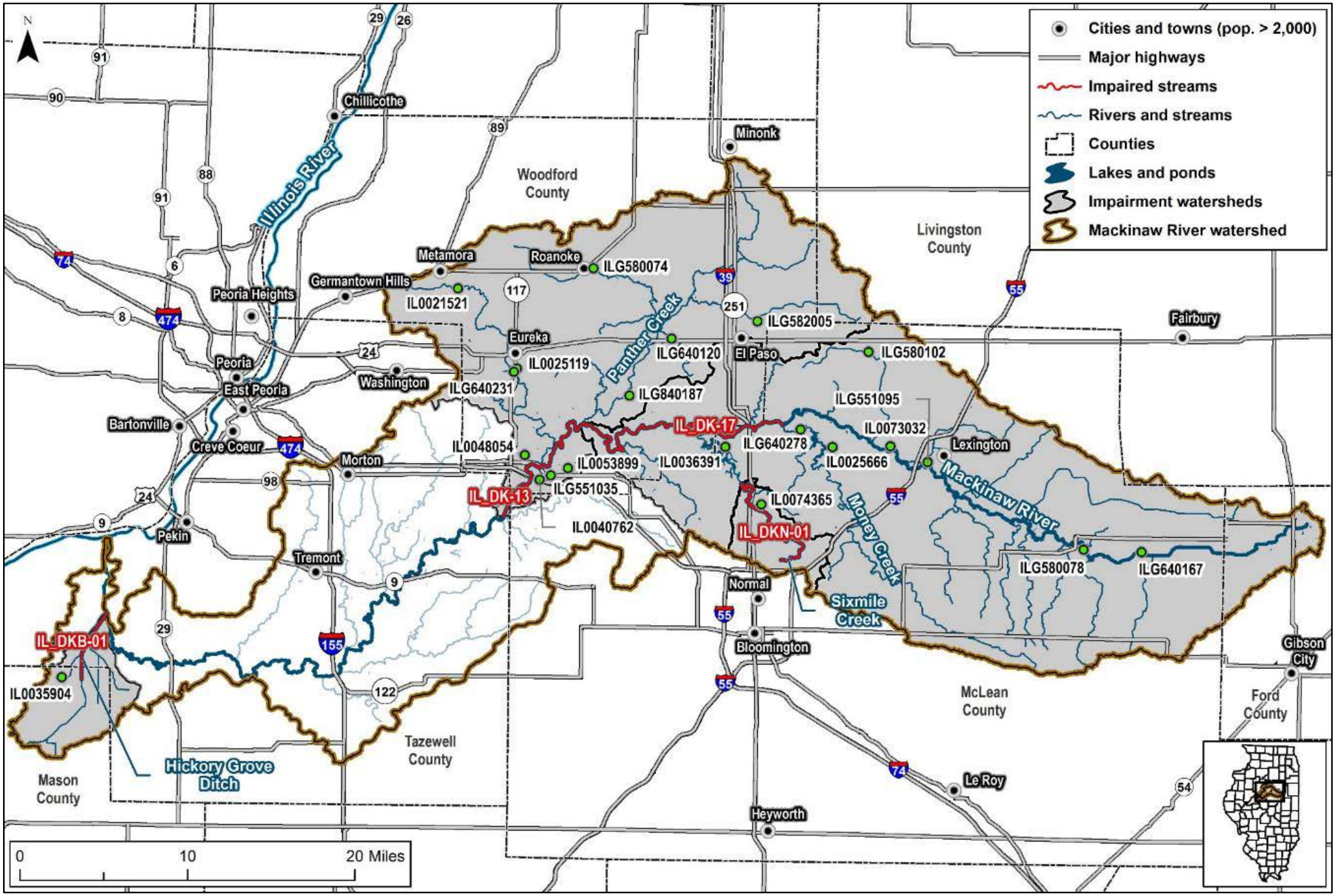

Figure 8. NPDES permitted facilities upstream of impaired segments.

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)

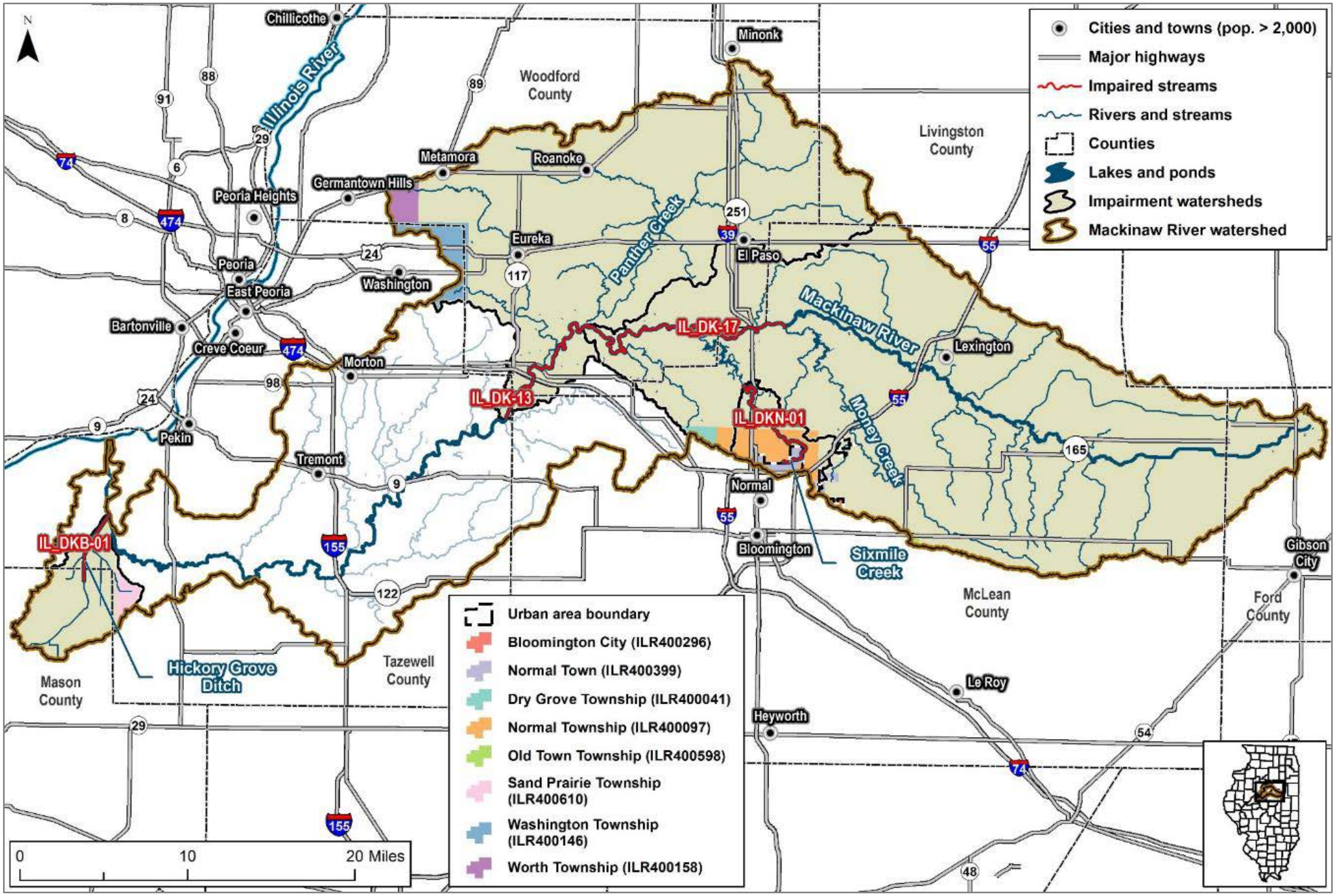

Figure 9. Municipal Separate Storm Sewer Systems (MS4s) in impairment subwatersheds.

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. In the Mackinaw River watershed, almost 61% of agricultural land is identified as likely or potentially drained (Frankenberger et al. 2022). In addition to transporting land-applied fertilizers, drain tiles can transport nutrients leached from nutrient-rich prairie soils.

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.

Refer to the *Lake Bloomington & Evergreen Lake Watershed Plan* (Northwater Consulting 2021) for additional septic systems information.

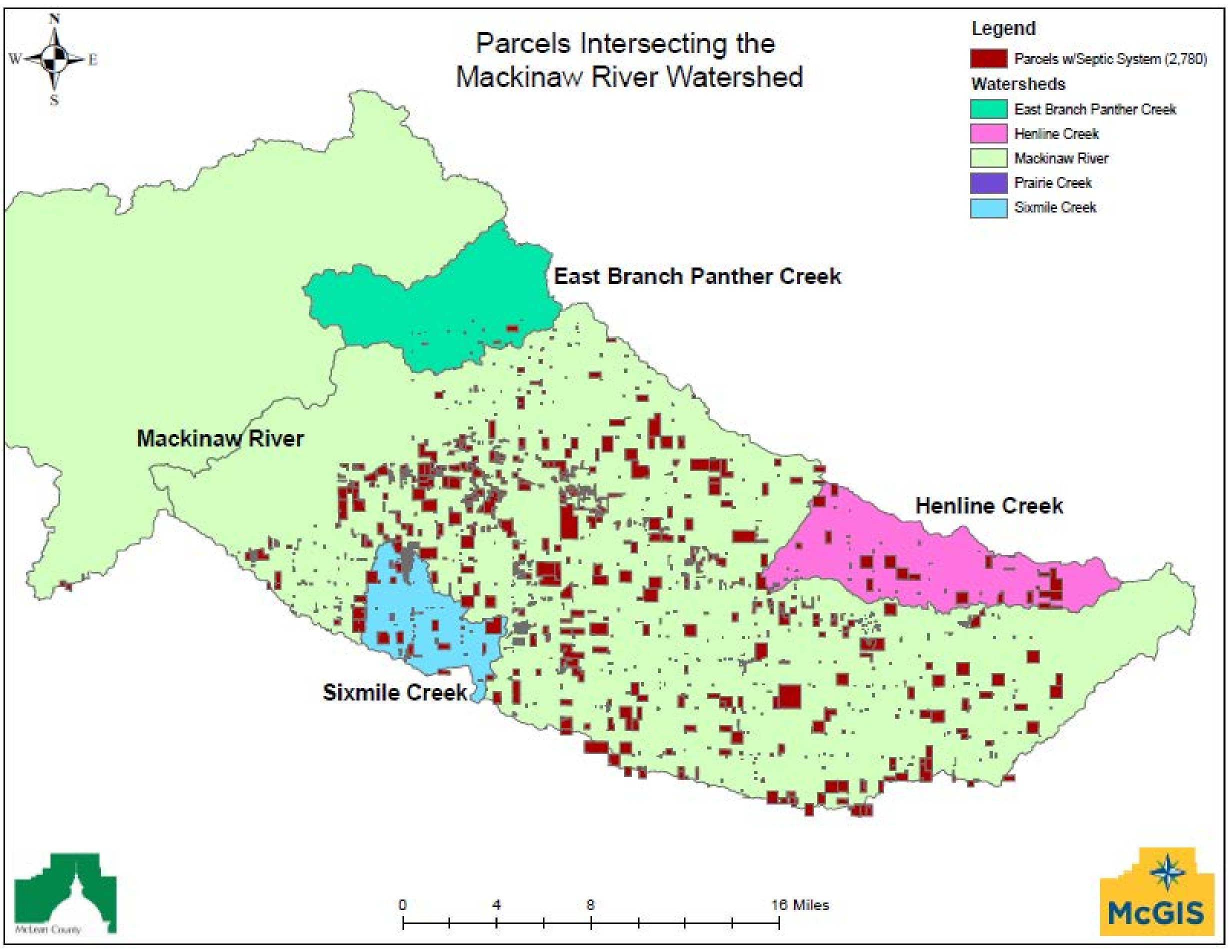

Figure 10. McLean County parcels with septic systems located in the contributing drainage area to impaired streams addressed in this TMDL. Map provided by McLean County GIS department.

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.

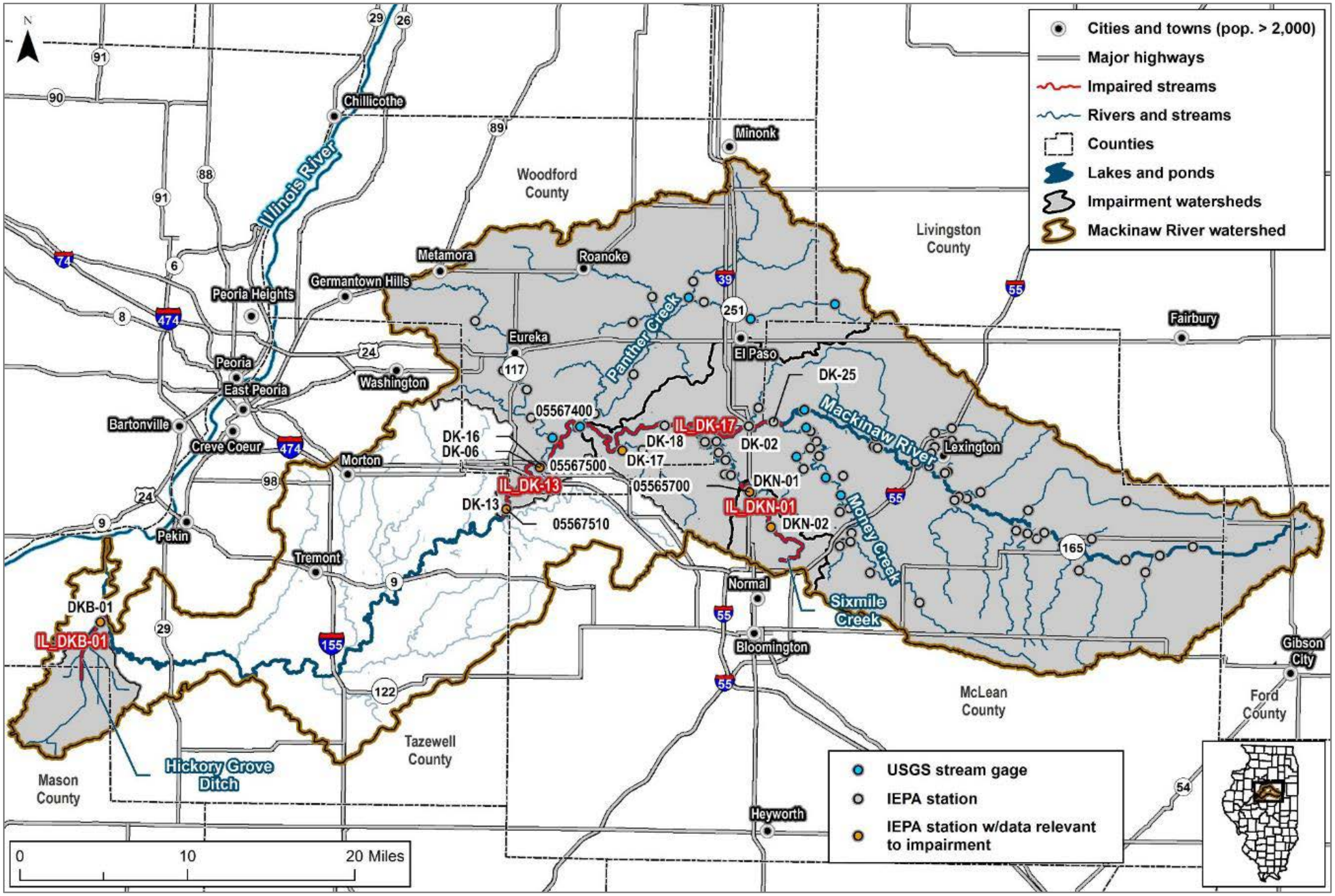

Figure 11. USGS stream gages and IEPA water quality sampling sites in impairment watersheds and along impaired stream segments.
Note: Monitoring stations on impaired segments labeled. IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

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.

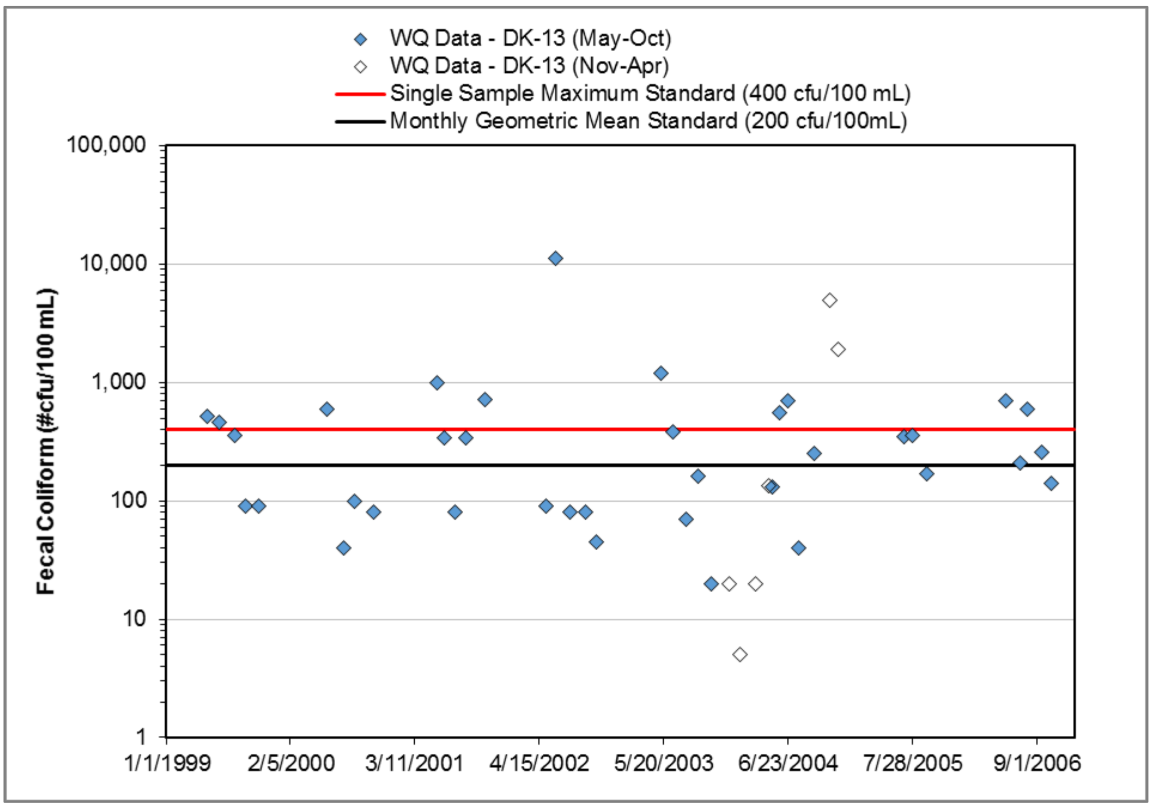

Figure 12. Fecal coliform water quality time series, 1999–2006, Mackinaw River DK-13 segment.

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

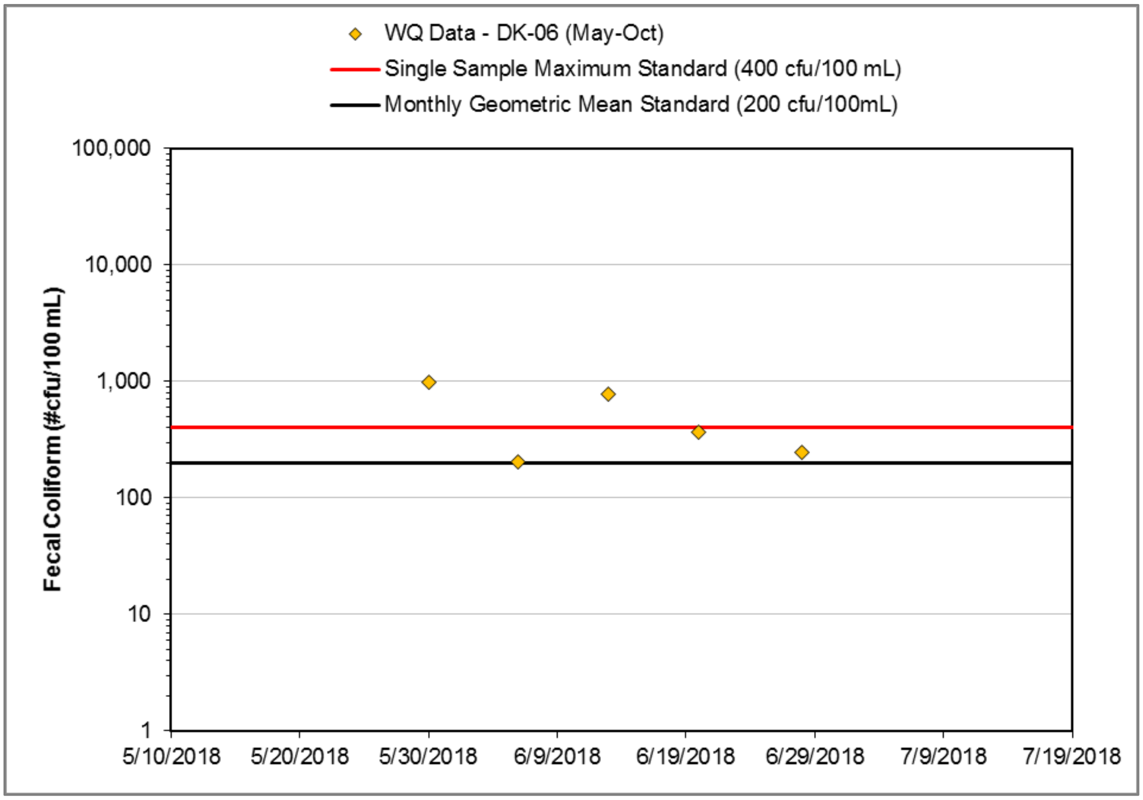

Figure 13. Fecal coliform water quality time series, 2018, Mackinaw River, segment IL_DK-13.

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

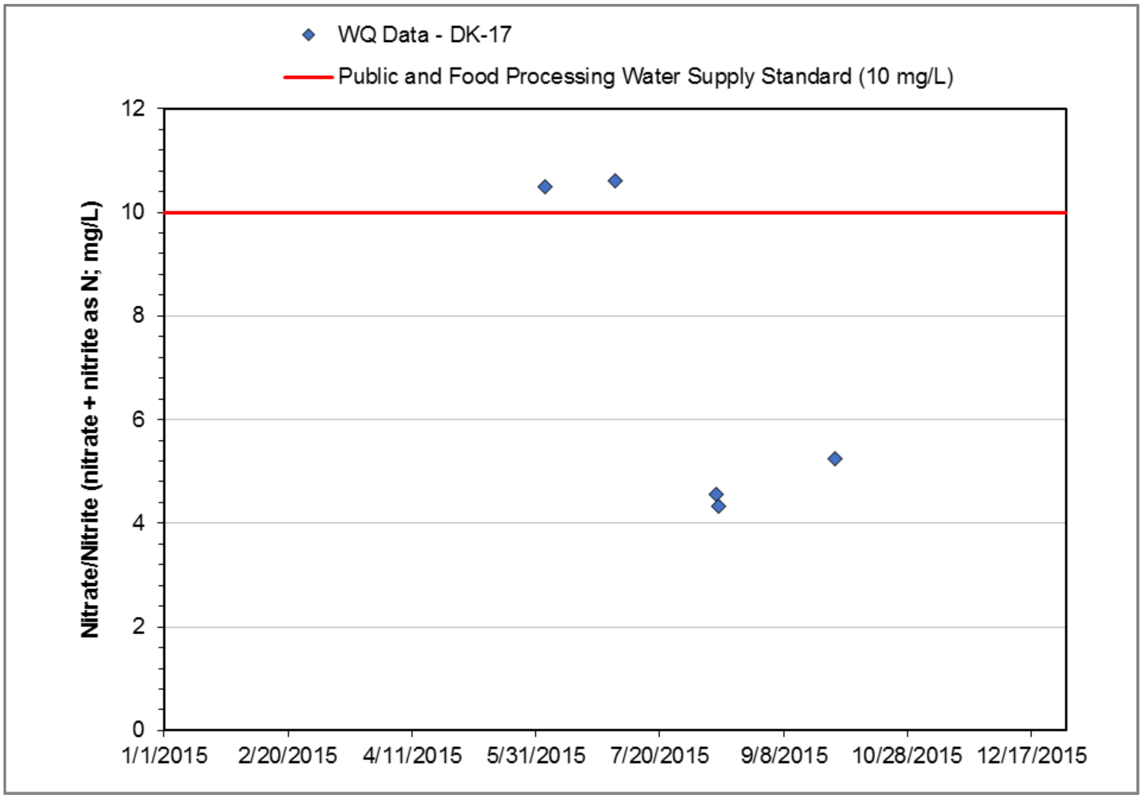

Figure 14. Nitrate water quality time series, Mackinaw River, segment IL_DK-17.

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:

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

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

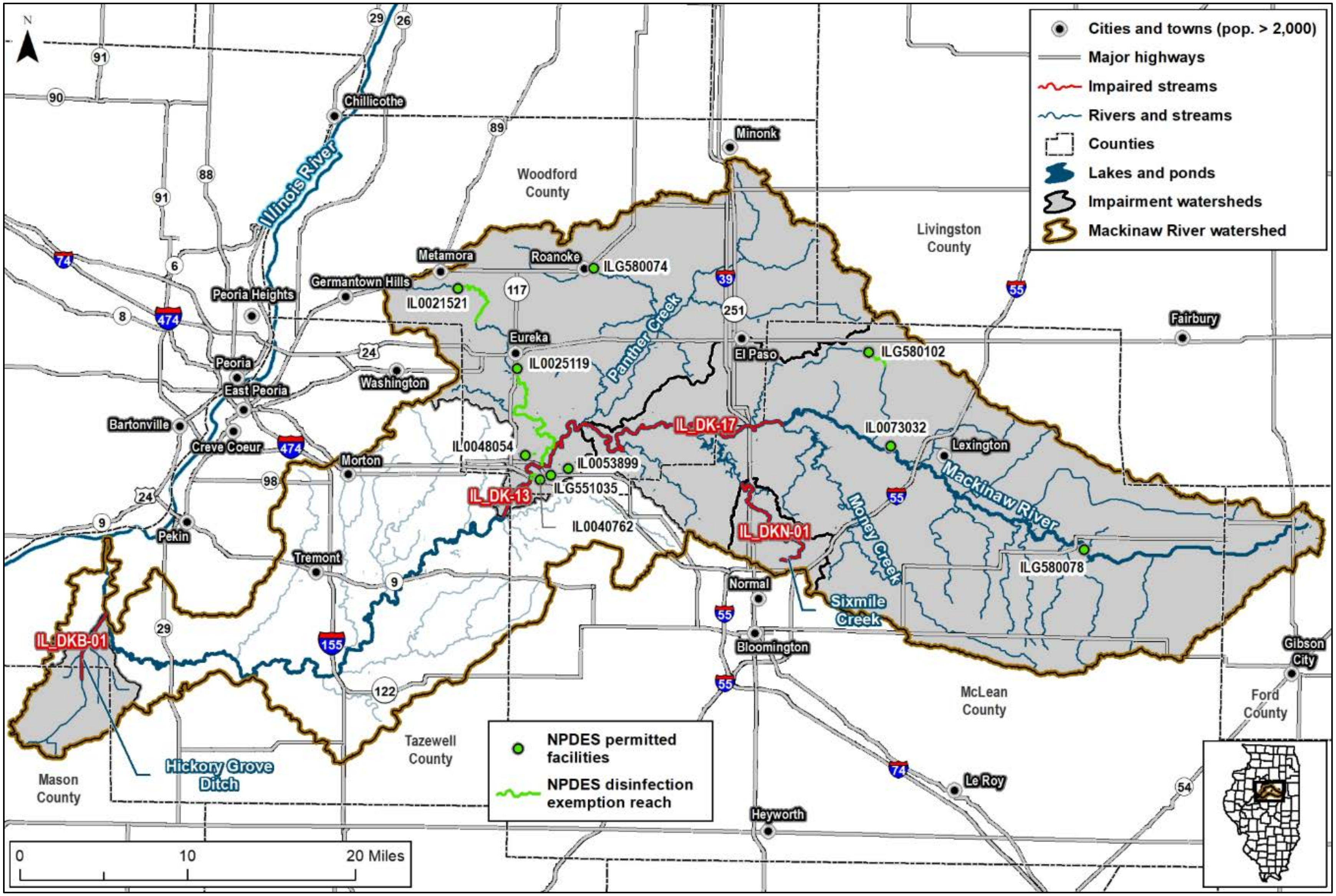

Figure 15. Facilities with disinfection exemption draining to fecal coliform impairment IL_DK-13 on the Mackinaw River.

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

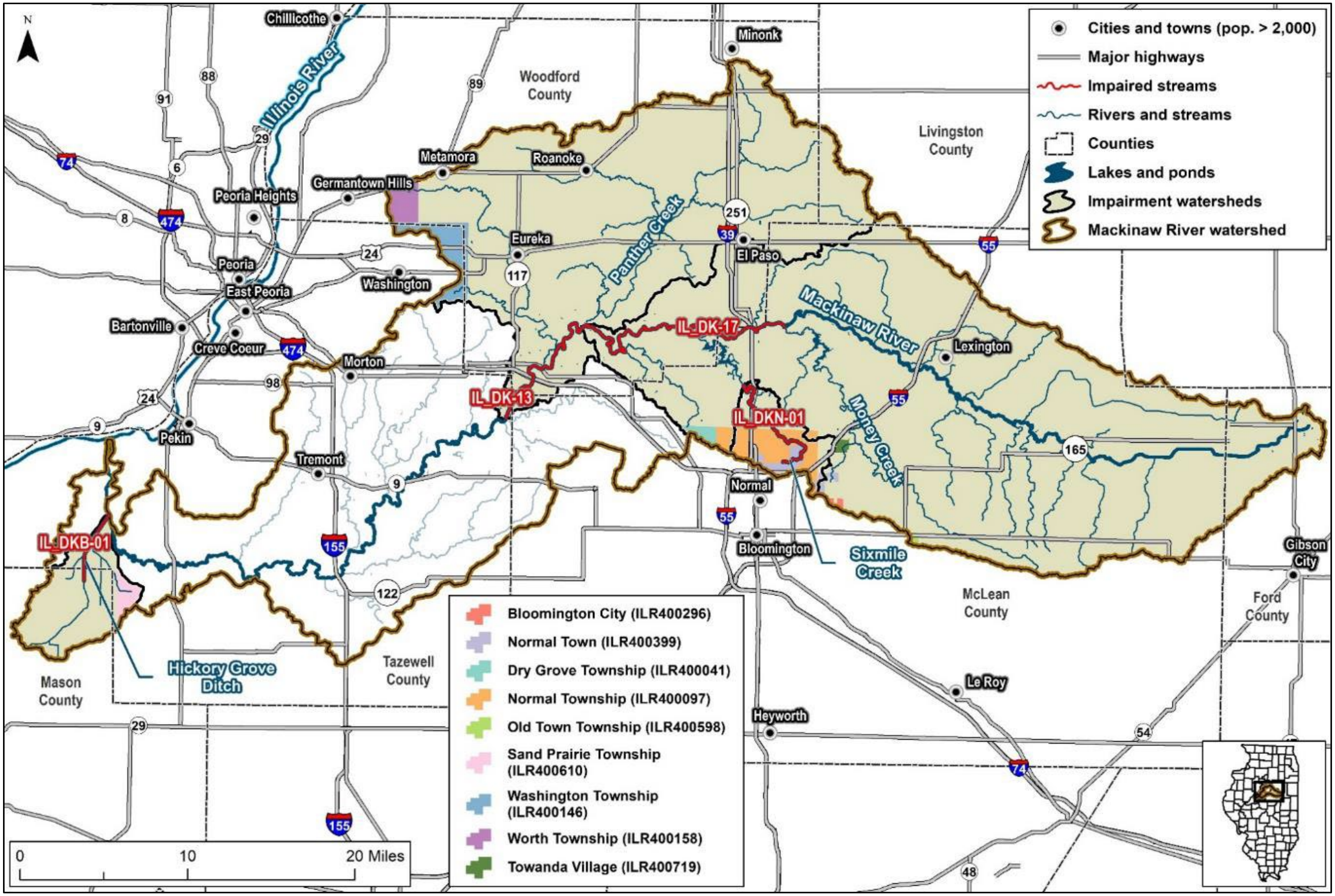

Figure 16. Municipal Separate Storm Sewer Systems (MS4s) in impairment subwatersheds.
Note: IL_DKB-01 and IL_DKN-01 are not addressed in this TMDL document. See Appendix C for more information.

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.

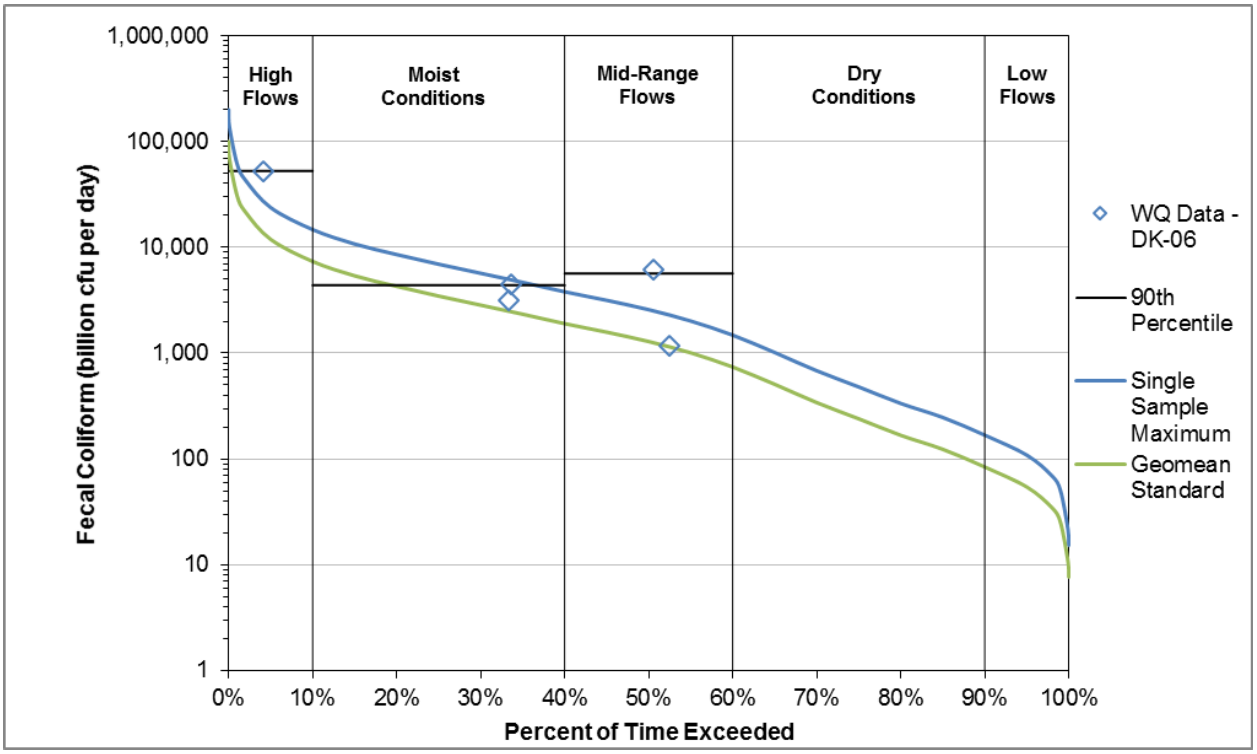

Figure 17. Fecal coliform load duration curve, Mackinaw River (IL_DK-13).
Water quality data presented in the load duration curve were collected in 2018.

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			Moist to Low Flow Conditions		
		Design Maximum Flow (MGD)	Single Sample Maximum Standard	Geomean Standard	Design Average Flow (MGD)	Single Sample Maximum Standard	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.

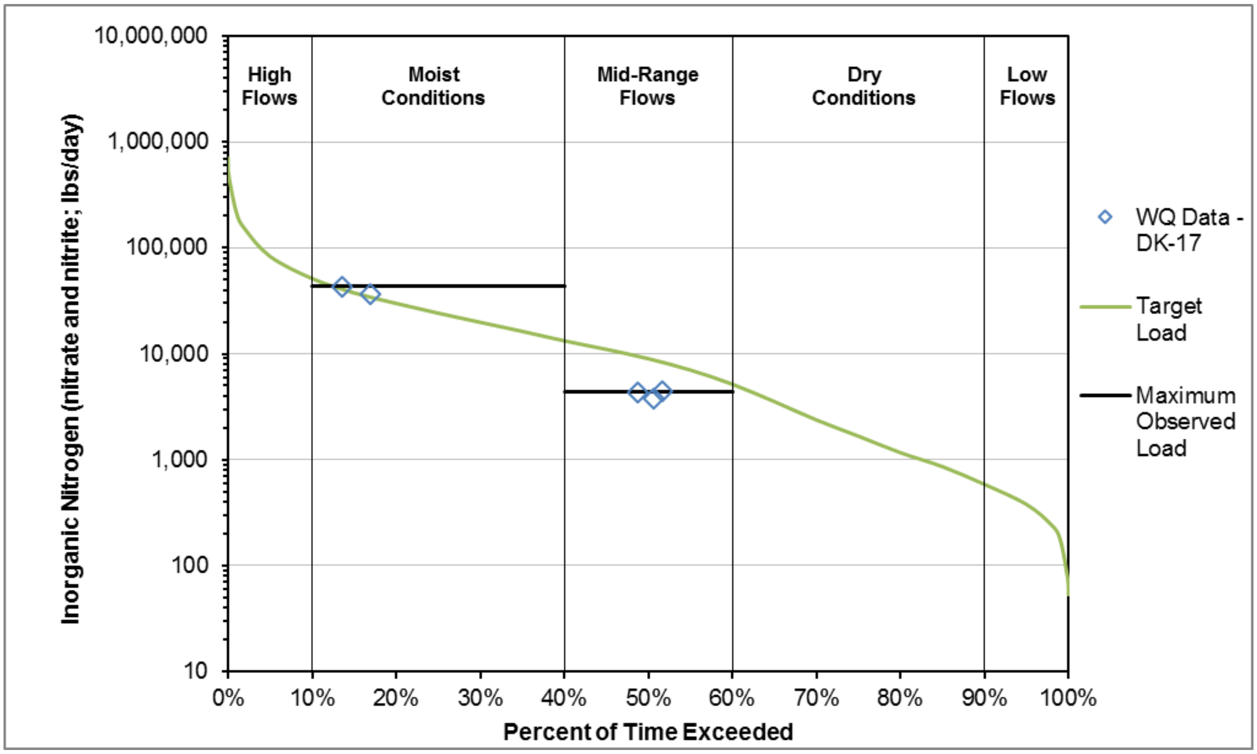

Figure 18. Nitrate load duration curve, Mackinaw River (IL_DK-17).

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.

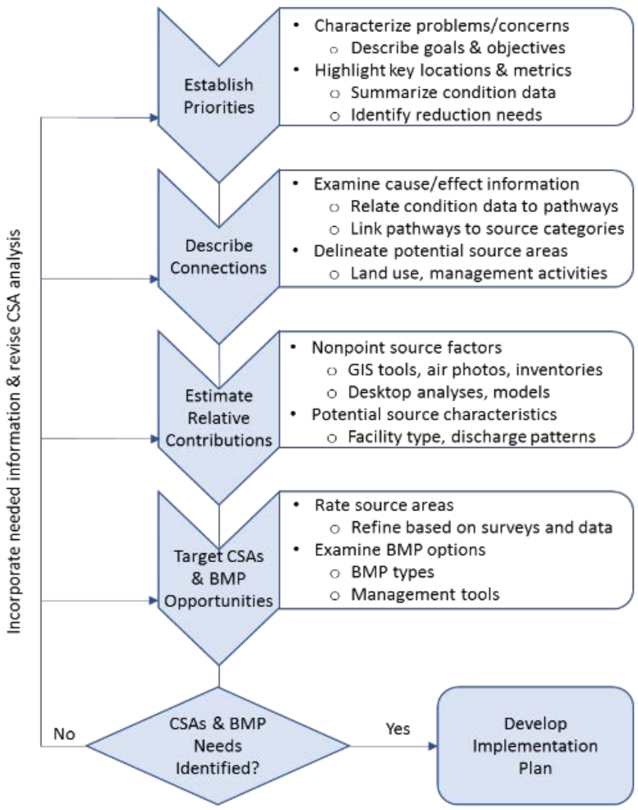

Figure 19. Critical area selection process (U.S. EPA 2018).

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

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.

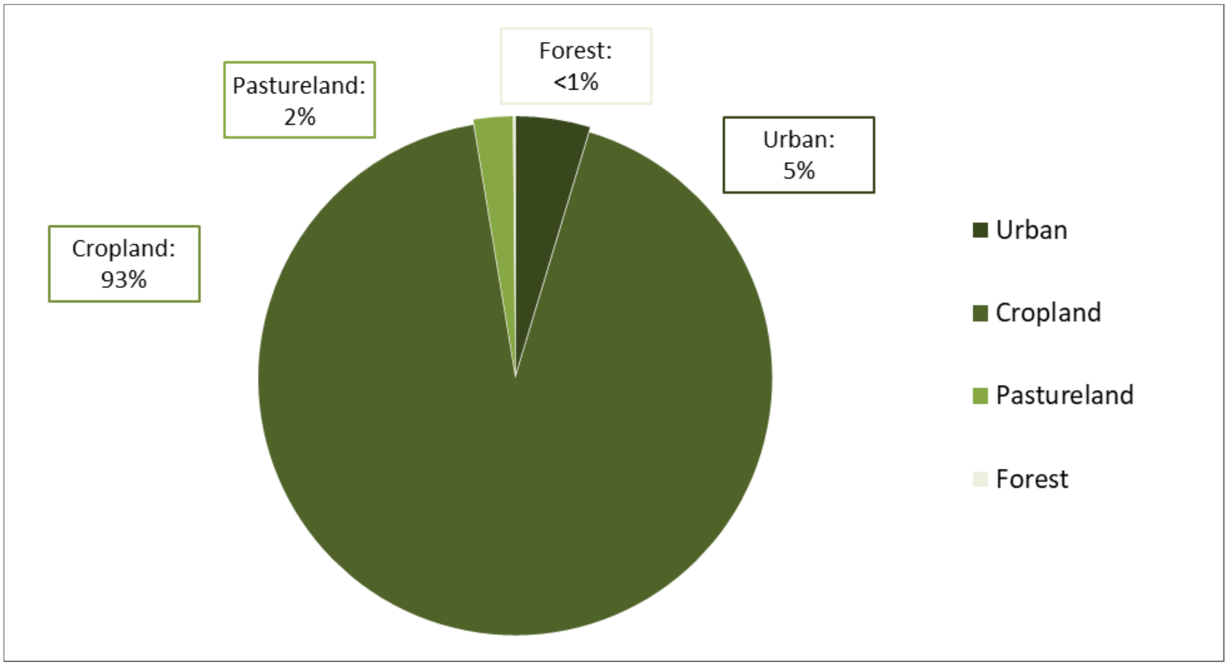

Figure 20. STEPL relative nitrate loading by source category to Mackinaw River (IL_DK-17) (%).

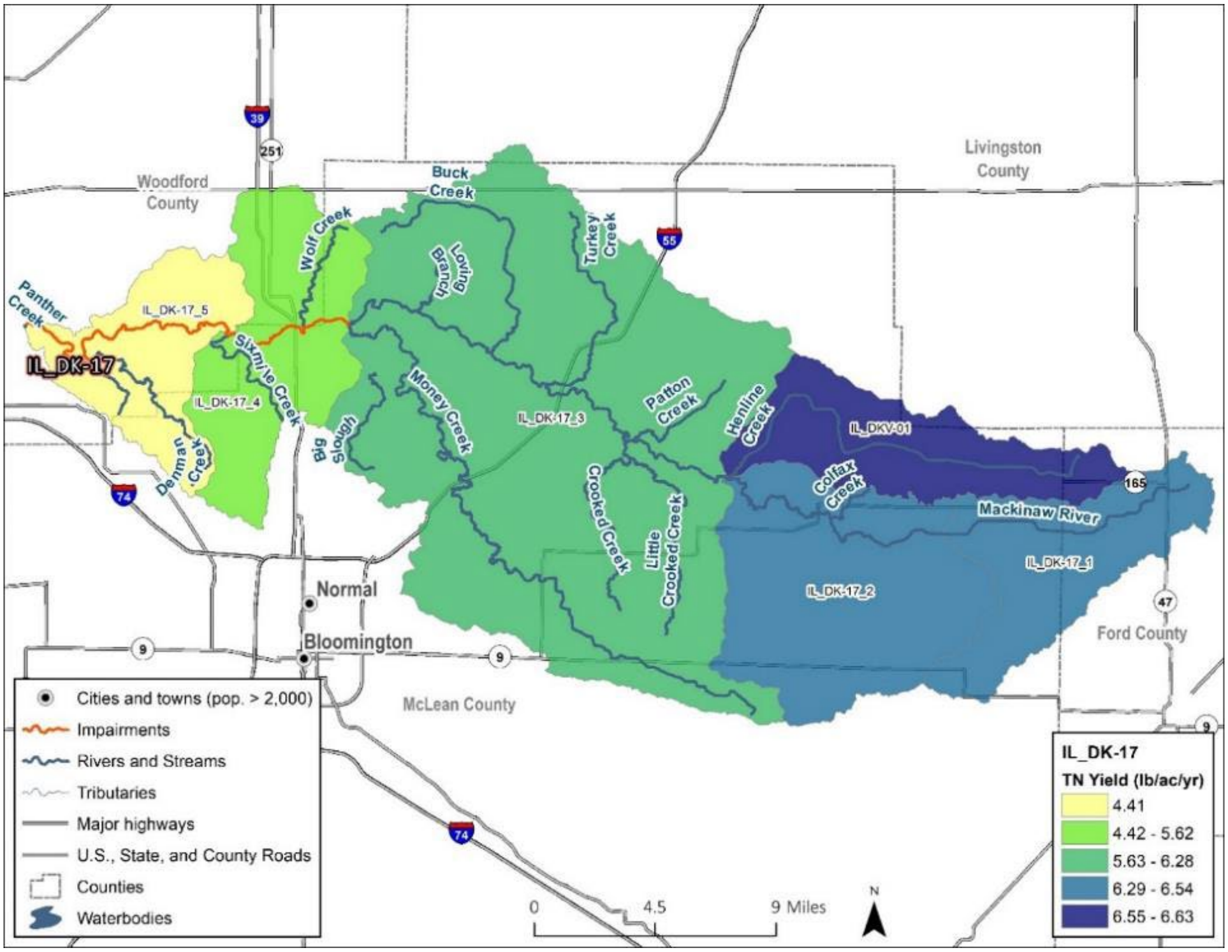

Figure 21. Relative nitrate yields (lb/ac/yr) for drainage areas in Mackinaw River (IL_DK-17).

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.

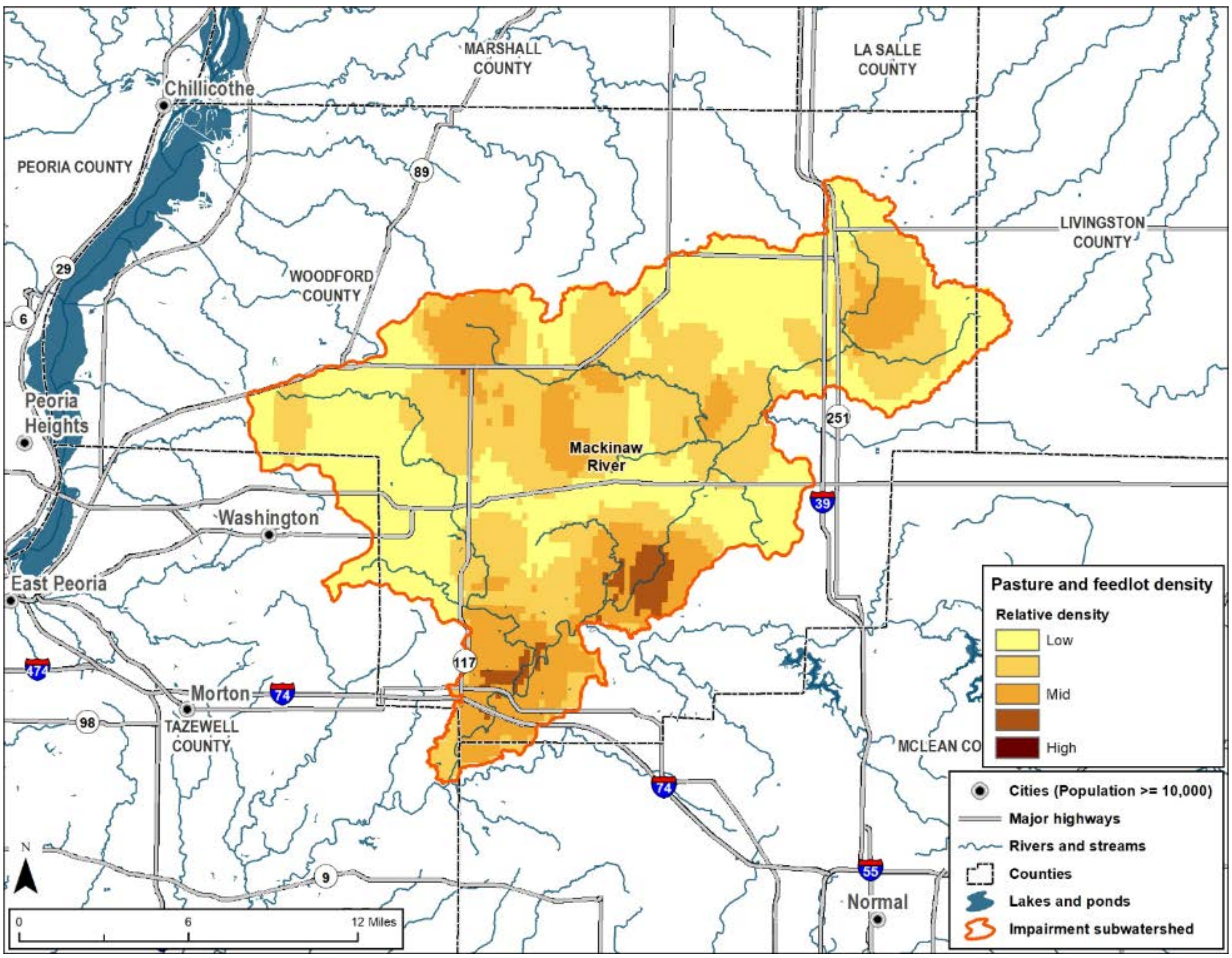

Figure 22. Animal agriculture operations density in Mackinaw River (IL_DK-13).

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; however, other agricultural BMPs discussed in the NLRS are also appropriate for implementation in the Mackinaw River watershed. Other management practices can also be used to achieve the goals of the TMDL and this implementation plan. 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.

The NLRS also recommends the use of nitrification inhibitors and split application of nitrogen fertilizers to reduce nitrate loading to streams from agricultural runoff. Nitrification inhibitors temporarily limit the bacteria that convert ammonia to nitrite and nitrite to nitrate. With split application, instead of applying a larger amount of fertilizer all at once at planting, smaller amounts are applied at planting and later in the growing season. This ensure that excess fertilizer, beyond what the crops need, is not applied and potentially lost to runoff or tile drainage.

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. Vegetated buffers and filter strips will not affect nitrate loading if subsurface tiles bypass the buffers and strips. 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.

Saturated Buffers

In recent years, saturated buffers have been installed at farms across the Midwest to reduce nitrate in agricultural runoff. Saturated buffers are used to divert tile drainage through the soil and shallow groundwater beneath a vegetated buffer along a stream or ditch. This allows natural soil process to convert some of the nitrate in the tile drain water to nitrogen gas that then escapes to the atmosphere.

Implementation of saturated buffers includes installation of a water control structure, a tile beneath the vegetated buffer, an overflow pipe from the water control structure to the stream or ditch, and a vegetated buffer that is not managed as a crop.

Saturated buffers are recommended in the NLRS. Saturated buffers that meet guidelines of NRCS practice code 604 can be eligible for cost-share funding from NRCS.

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
- Illinois Buffer Partnership
- Illinois Department of Agriculture
- Illinois Department of Natural Resources
- Illinois Certified Crop Adviser Program
- 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
- NRCS
- Parklands Foundation
- Soil and Water Conservation District offices
- The Nature Conservancy
- University of Illinois (and Extension units)
- U.S. EPA Region 5

Soil and Water Conservation Districts provide rural and urban citizens alike with both technical assistance and services on several issues including soil health, erosion and sedimentation control, water quality protection, storm water management, green infrastructure, farmland protection, flood prevention, land use issues, environmental protection programs and stream bank stabilization. SWCDs work with private landowners, homeowners, developers, and more on a voluntary basis to address locally identified resource concerns. This is accomplished through educational efforts, by providing technical assistance through trained staff, and offering financial assistance for eligible projects.

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.

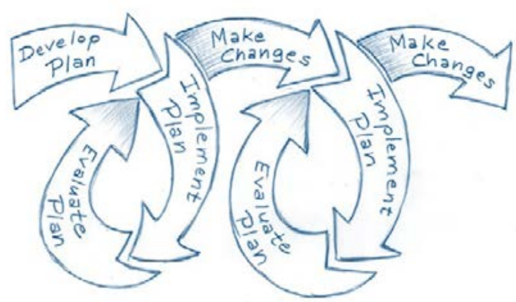

Figure 23. Adaptive management iterative process (U.S. EPA 2008).

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 and the county SWCDs 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:

- **The Nature Conservancy (TNC):** The Nature Conservancy (TNC) has been working closely in the Mackinaw River watershed since 1994 to protect the river and its unique ecological resources, and continues to support outreach, research, implementation related to agricultural practices in the headwater reaches of the watershed. TNC is partnering with the University of Illinois, NRCS, McLean County SWCD, and the Franklin Family to support a research and demonstration farm in the watershed where various conservation practices, including constructed wetlands and winter cover crops, are implemented and monitored. These same partners worked with the City of Bloomington to install and monitor the effectiveness of seven tile-treatment wetlands to reduce nutrient exports to Money Creek. Similarly, TNC has been conducting research to quantify the effectiveness of agricultural practices at a larger watershed-scale using a paired watershed design in the headwaters of the Mackinaw River watershed. Watershed partnerships also include Woodford County SWCD, ParkLands Foundation, Pheasants Forever, IDNR, INHS, and Illinois State University.
- **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 and other 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 IEPA 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 January 11, 2023, to present the Stage 3 report and findings. A public notice was placed on the IEPA website. The public comment period closed on February 10, 2023. Comments and response to comments are provided in Appendix D.

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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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Figures

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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

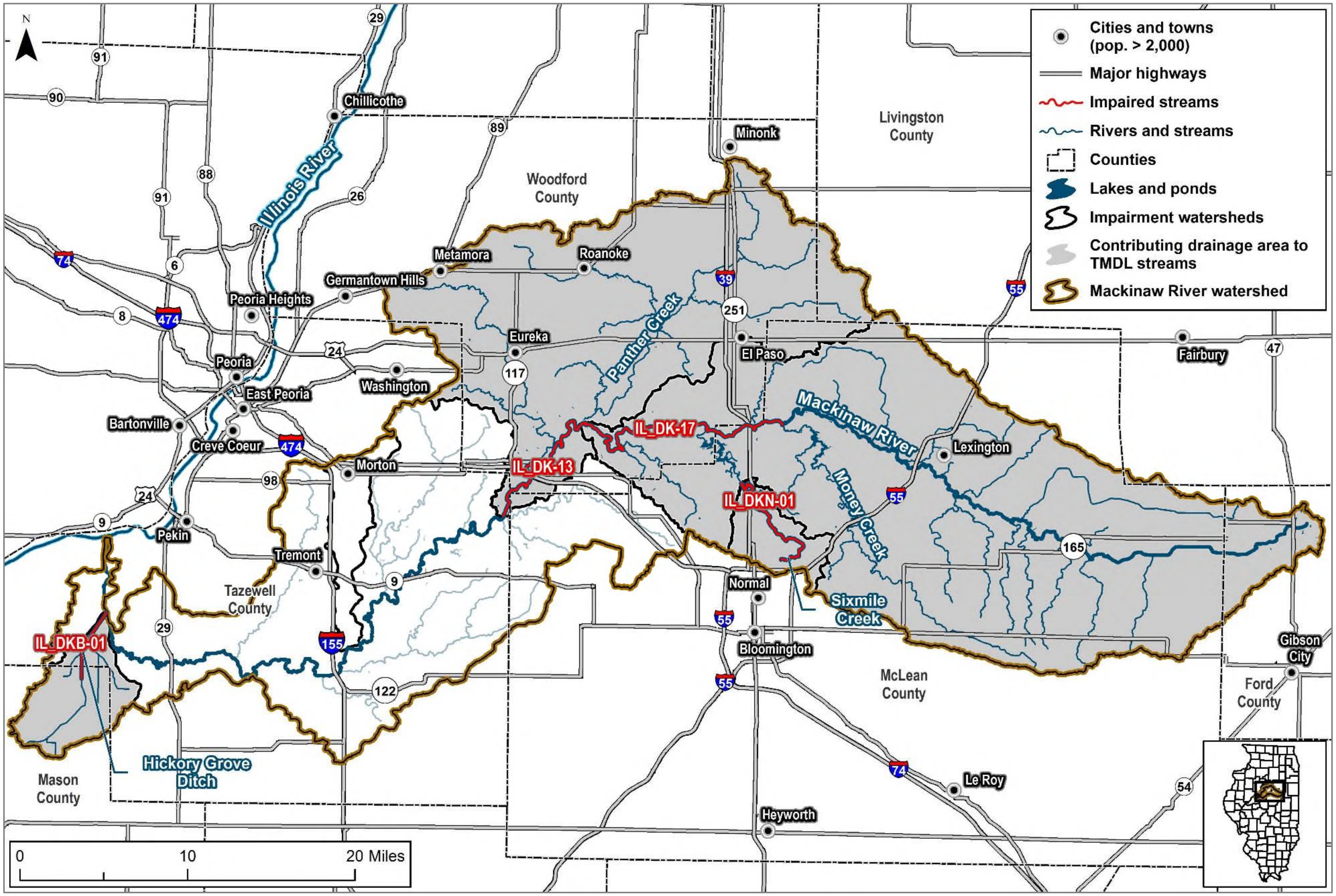

Figure 1. Mackinaw River watershed, TMDL project area.

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 <u>treated</u>-water Maximum Contaminant Level threshold concentration[c] for that substance; and ii) no quarterly average concentration exceeds the <u>treated</u>-water Maximum Contaminant Level threshold concentration[c] for that substance; and iii) no running annual average concentration exceeds the <u>treated</u>-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 <u>treated</u>-water Maximum Contaminant Level threshold concentration[c] for that substance; or ii) the quarterly average concentration exceeds the <u>treated</u>-water Maximum Contaminant Level threshold concentration[c] for that substance; or iii) the running annual average concentration exceeds the <u>treated</u>-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).

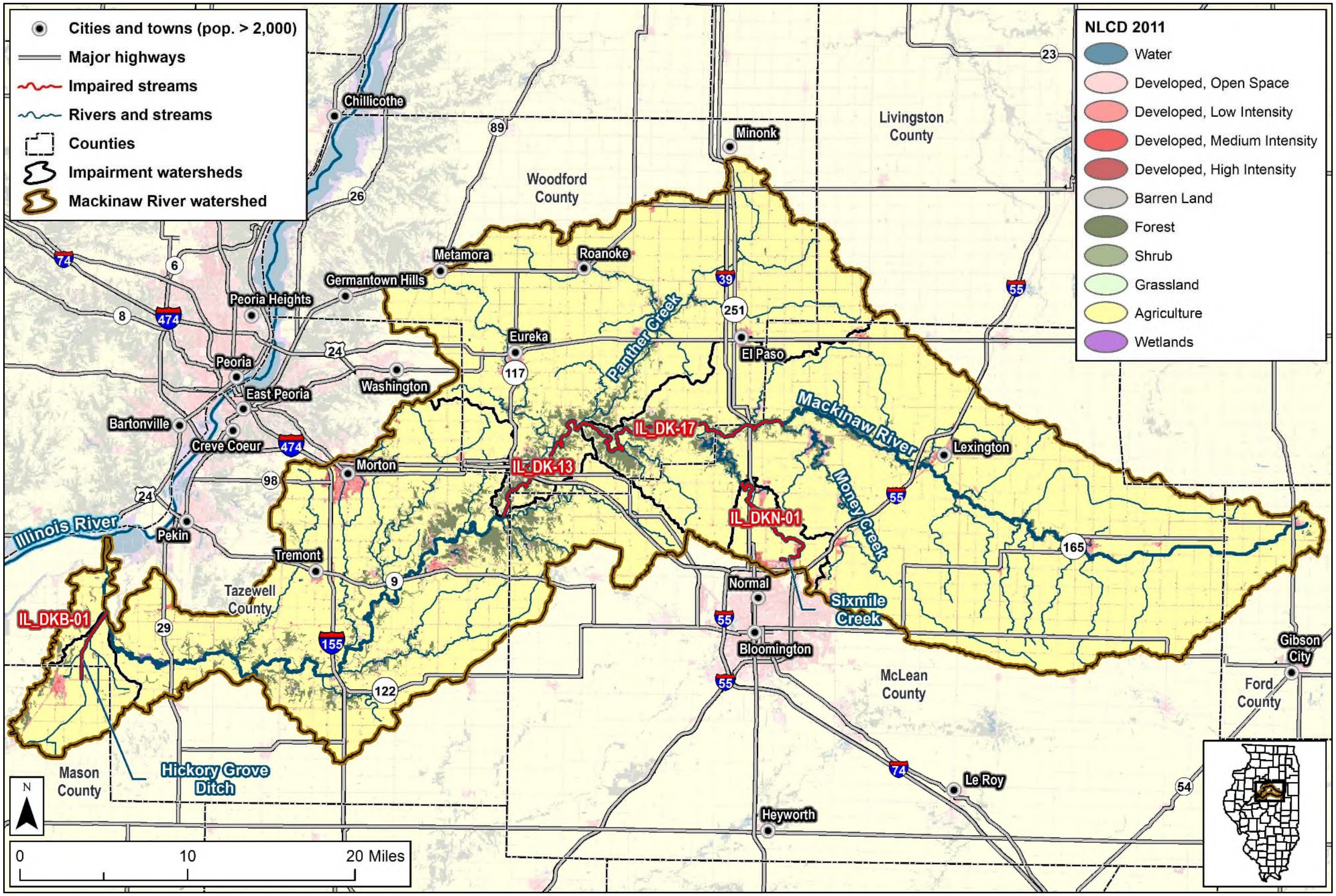

Figure 2. Mackinaw River watershed land cover (2011 National Land Cover Database).

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.

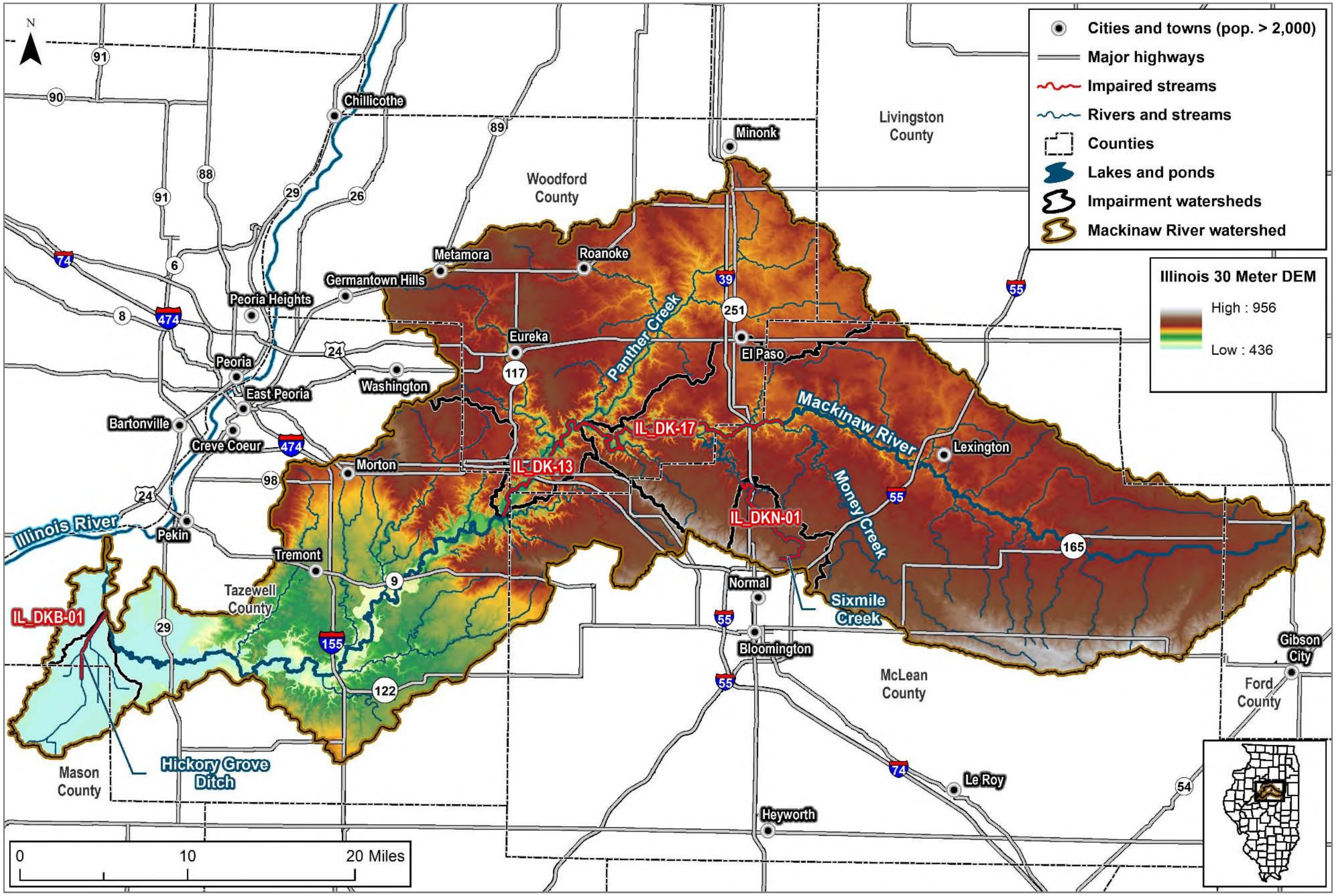

Figure 3. Mackinaw River watershed land elevations (ISGS 2003).

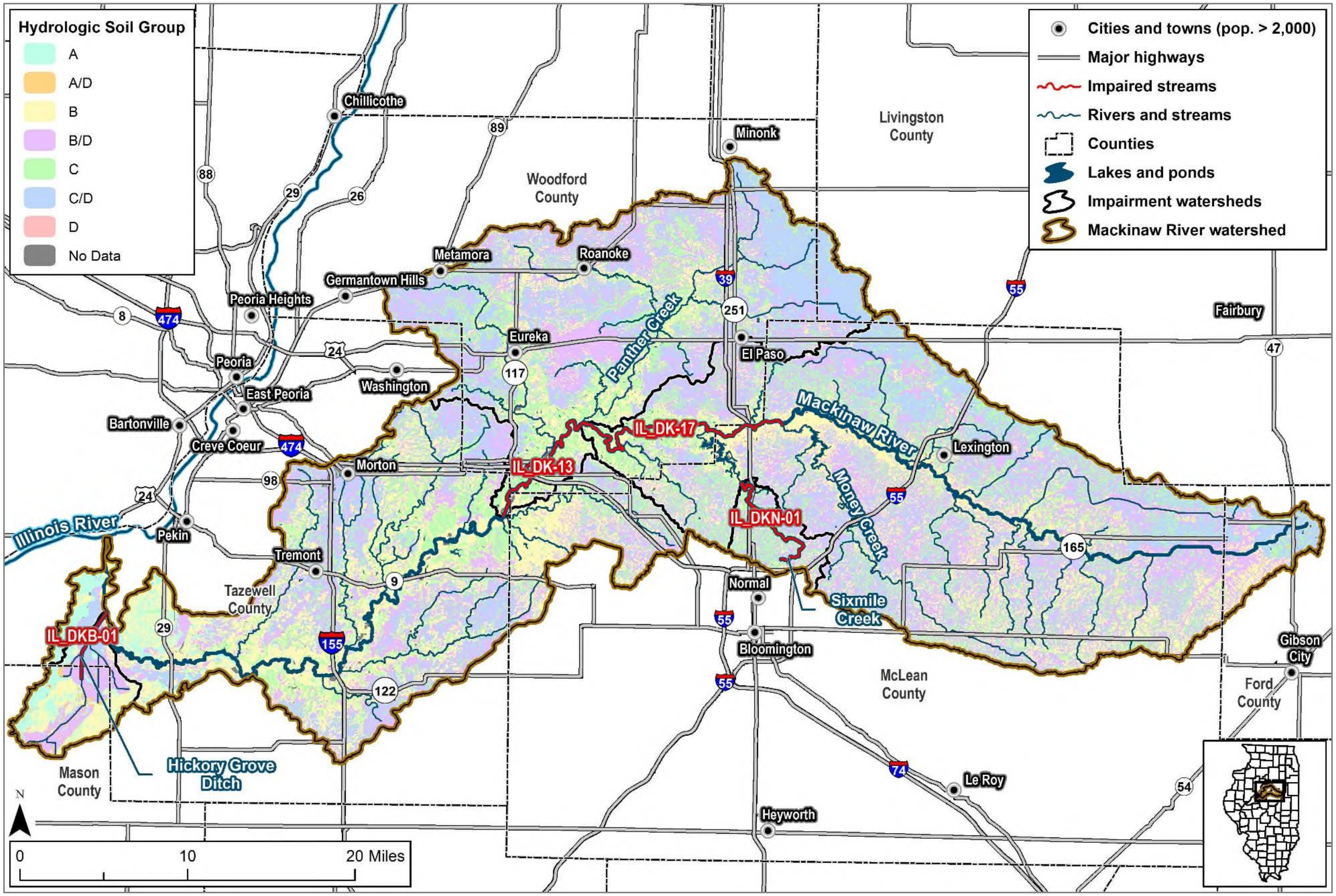

Figure 4. Mackinaw River watershed hydrologic soil groups (Soil Surveys for Ford, Livingston, Mason, McLean, Tazewell and Woodford Counties, Illinois; NRCS SSURGO Database 2011).

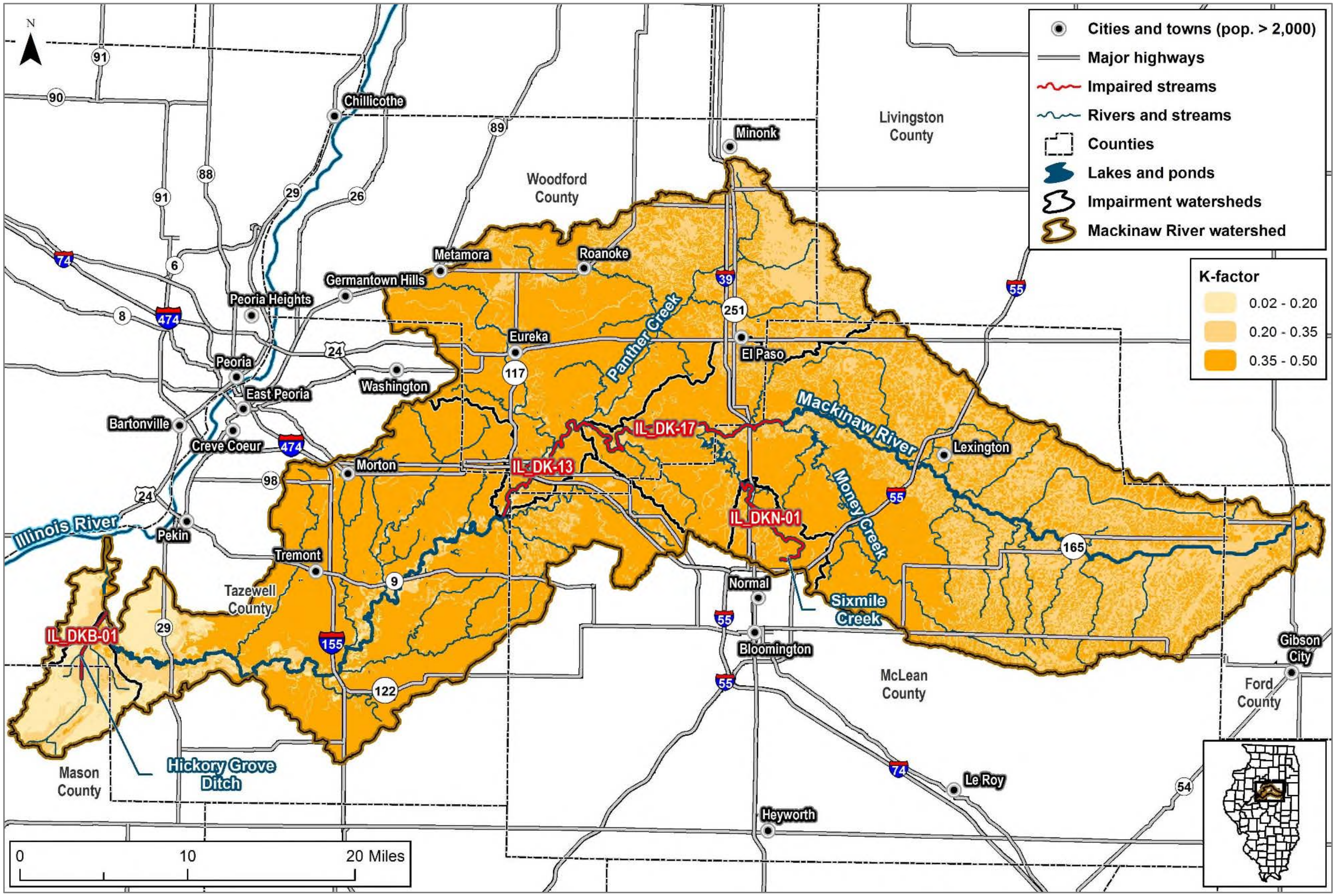

Figure 5. Mackinaw River watershed soil K-factor values (Soil Surveys for Ford, Livingston, Mason, McLean, Tazewell and Woodford Counties, Illinois; NRCS SSURGO Database 2011).

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)

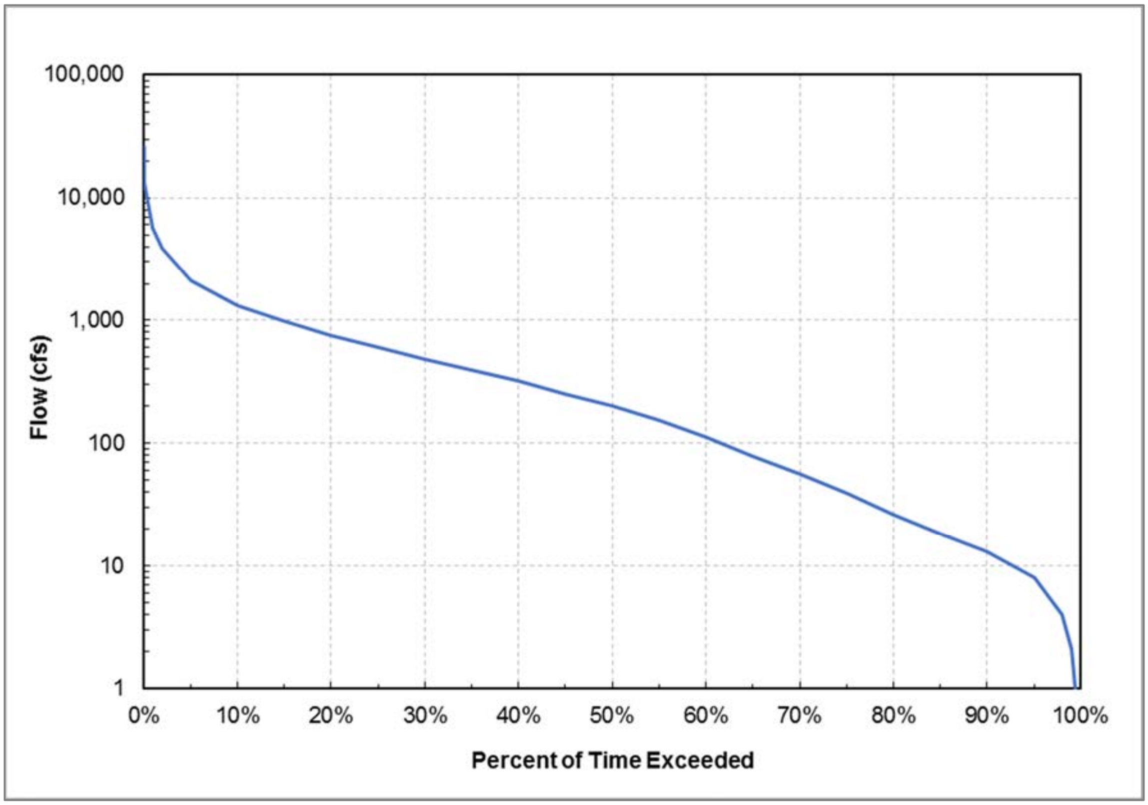

Figure 6. Flow duration curve for USGS gage 05567500, Mackinaw River near Congerville, IL (1944–2016).

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.

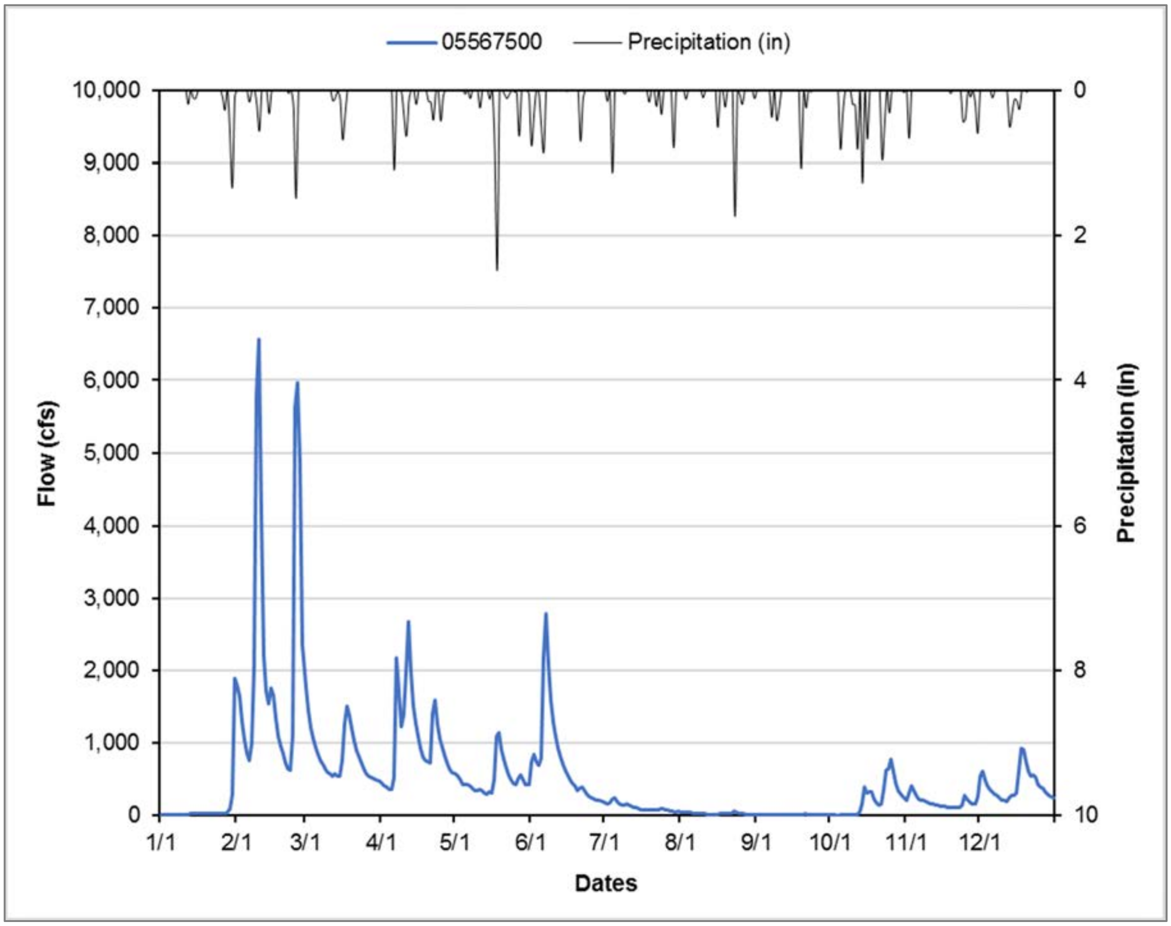

Figure 7. Daily flow in the Mackinaw River with daily precipitation at Normal (USC00116200), 2001.

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

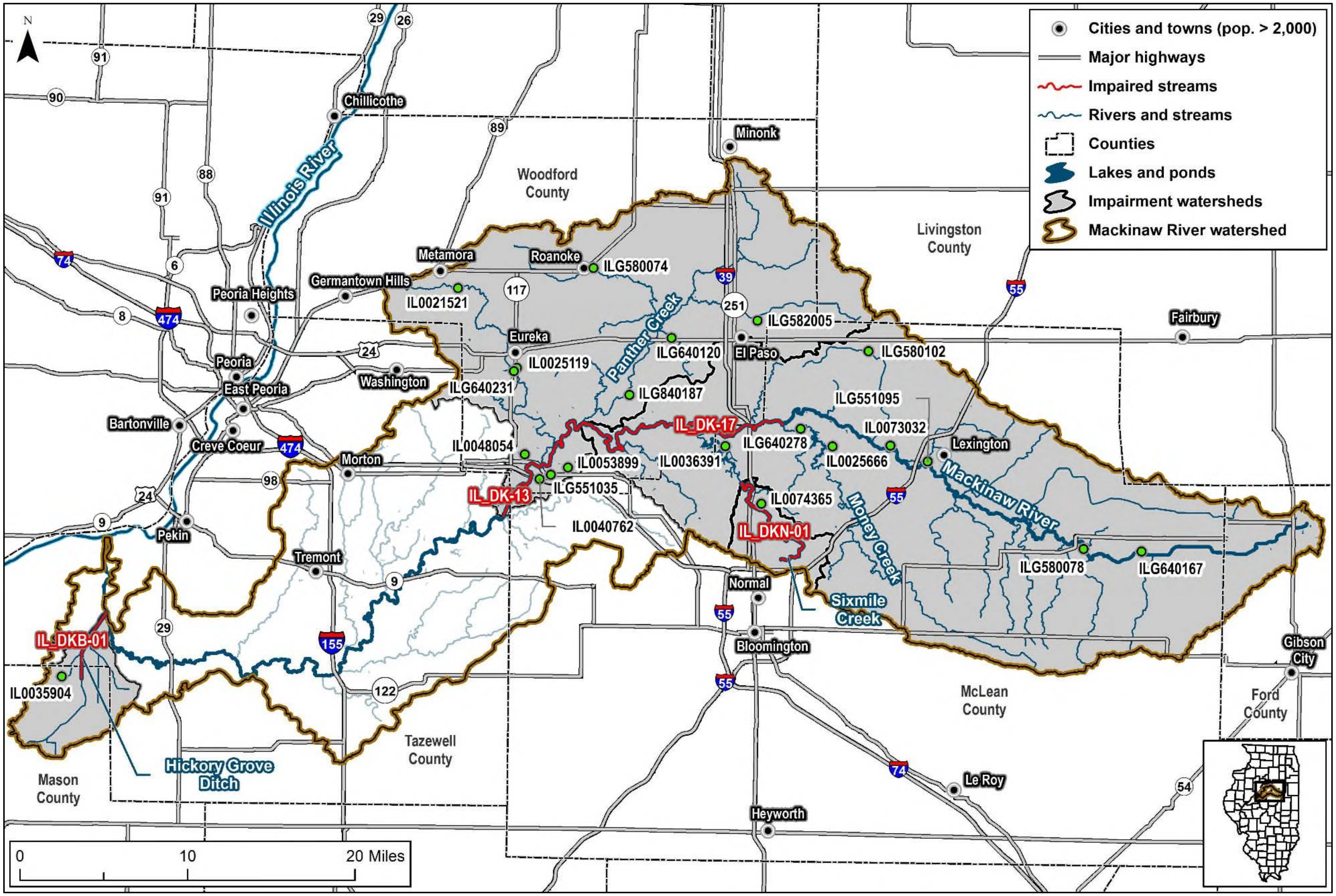

Figure 8. NPDES permitted facilities upstream of impaired segments.

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)

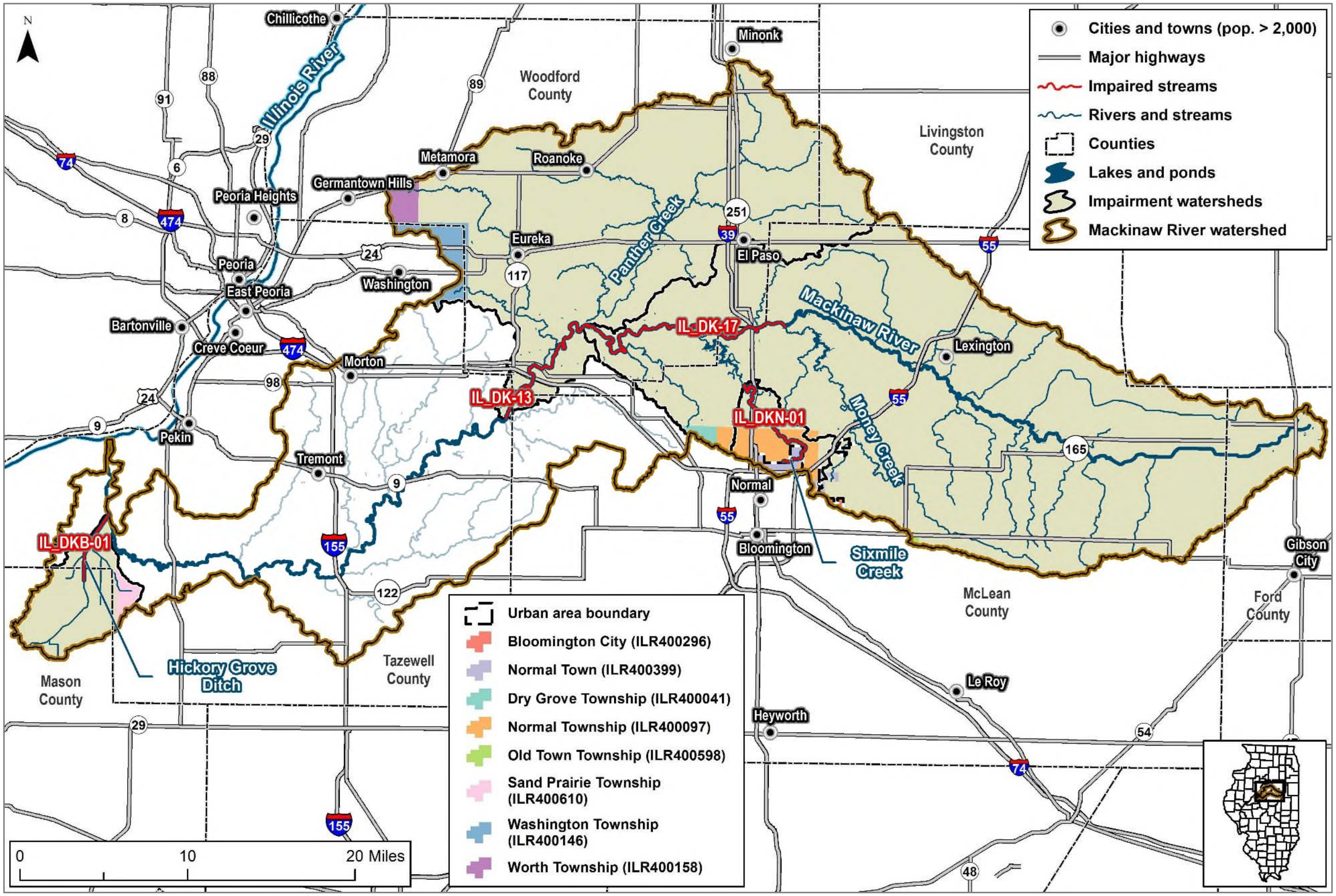

Figure 9. Municipal Separate Storm Sewer Systems (MS4s) in impairment subwatersheds.
McLean County and ILDOT are also regulated MS4s.

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.

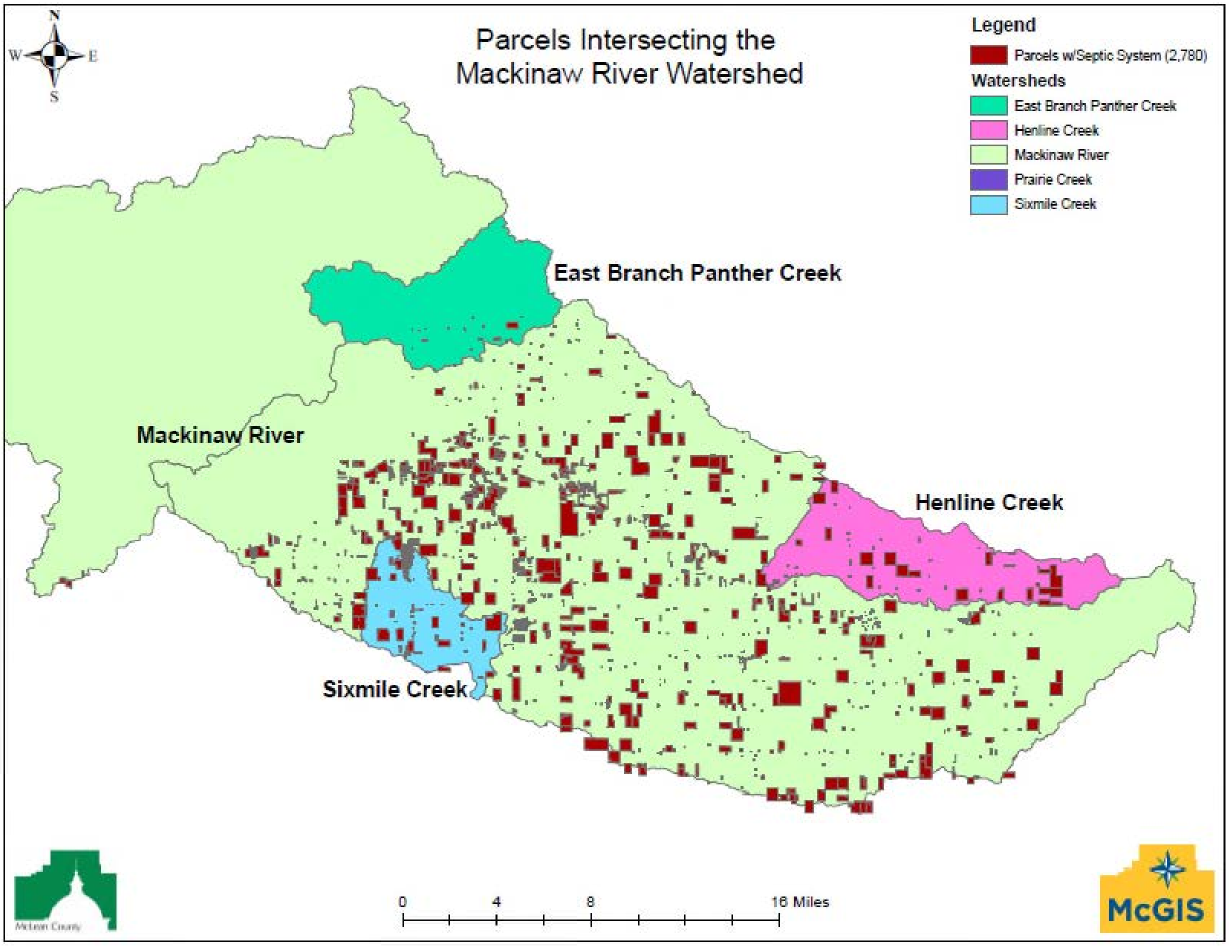

Figure 10. McLean County parcels with septic systems located in the contributing drainage area to impaired streams addressed in this TMDL. Map provided by McLean County GIS department.

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

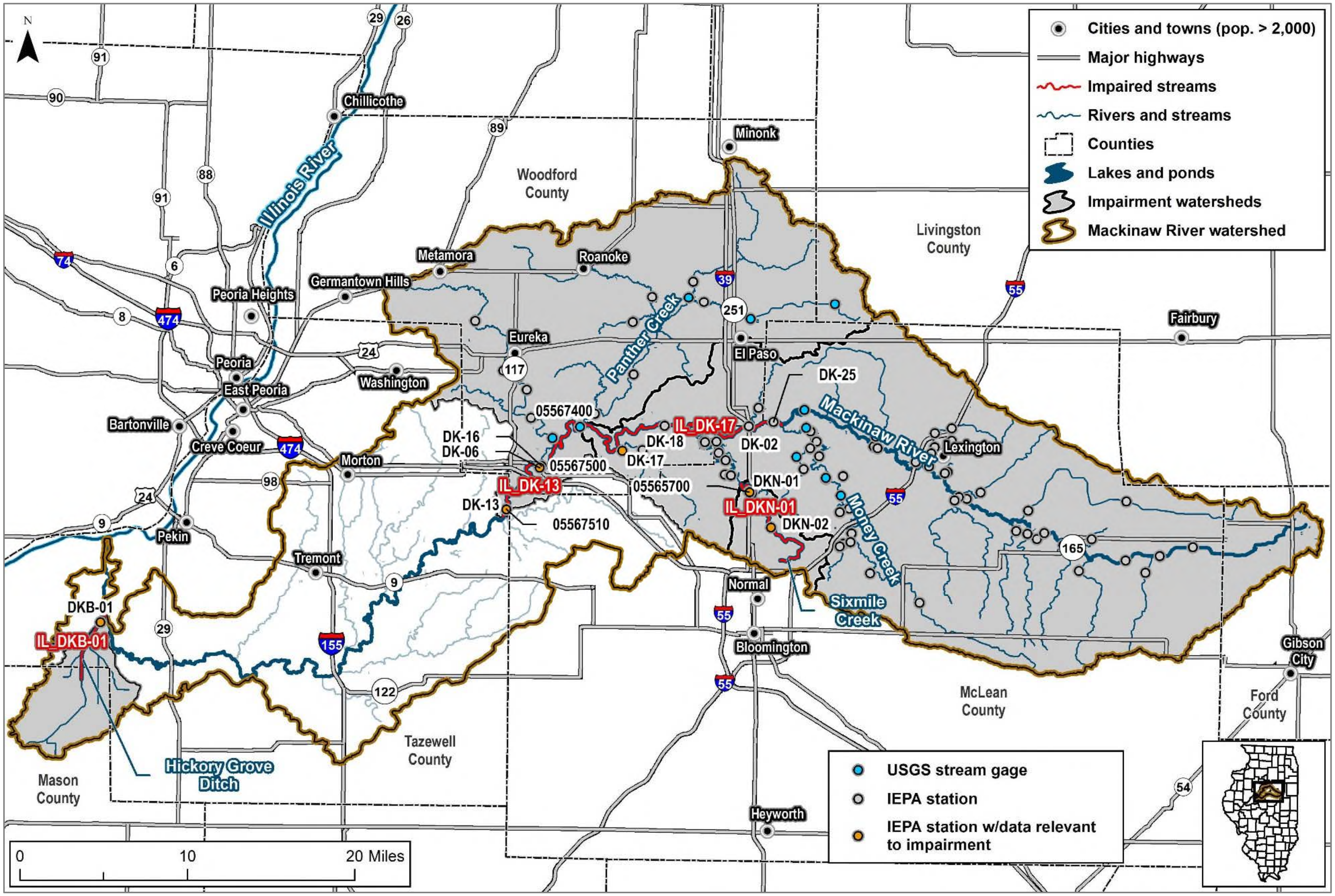

Figure 11. USGS stream gages and Illinois EPA water quality sampling sites in impairment watersheds and along impaired stream segments.
Monitoring stations on impaired segments labeled.

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

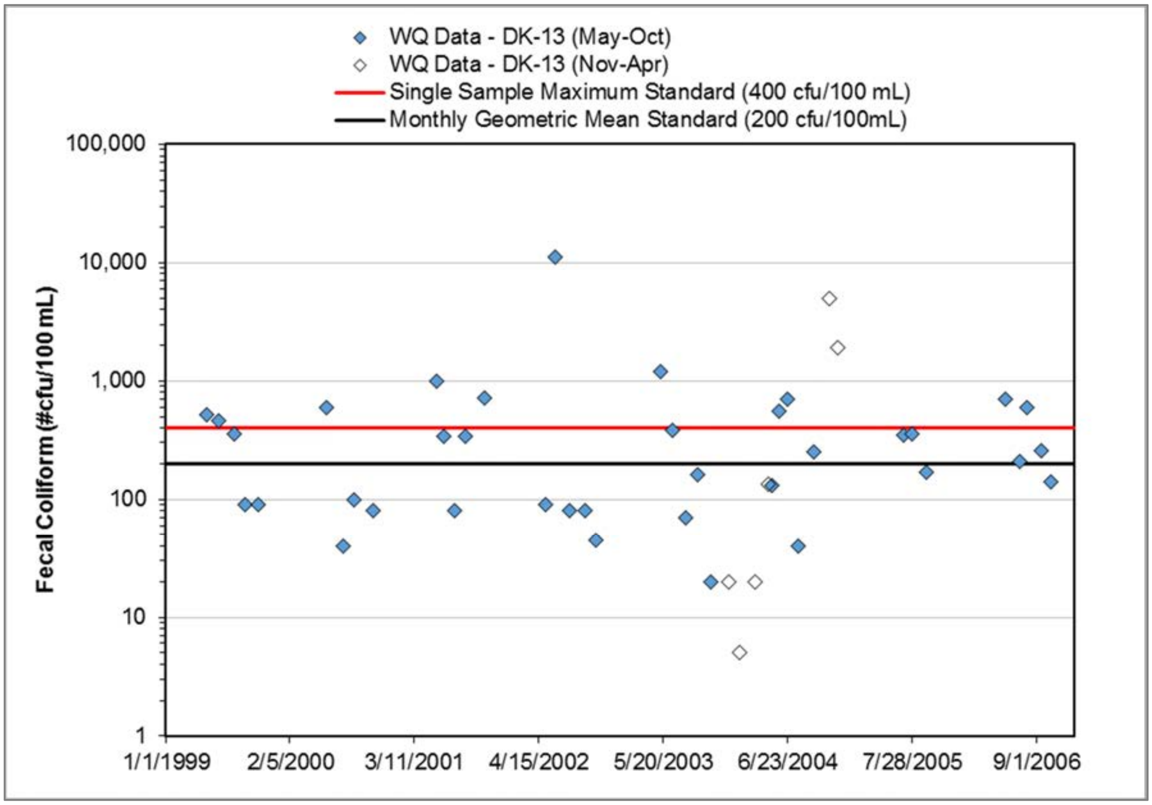

Figure 12. Fecal coliform water quality time series, 1999–2006, Mackinaw River DK-13 segment.

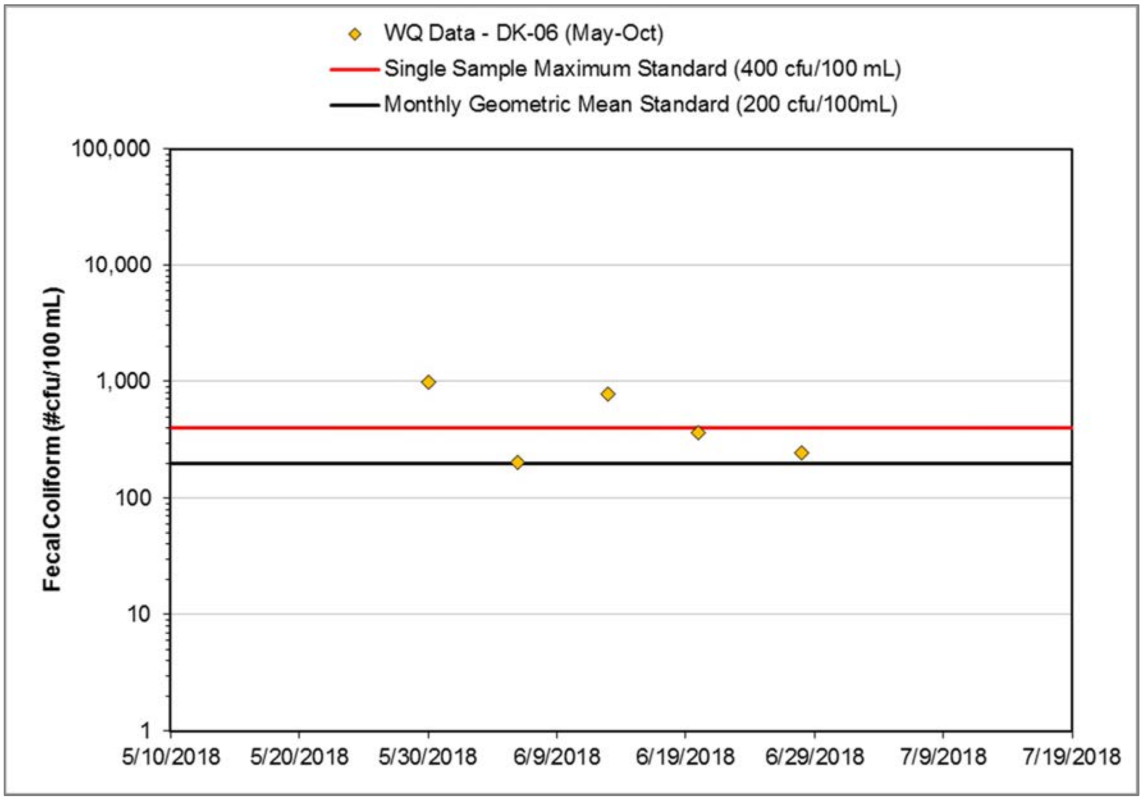

Figure 13. Fecal coliform water quality time series, 2018, Mackinaw River DK-13 segment.

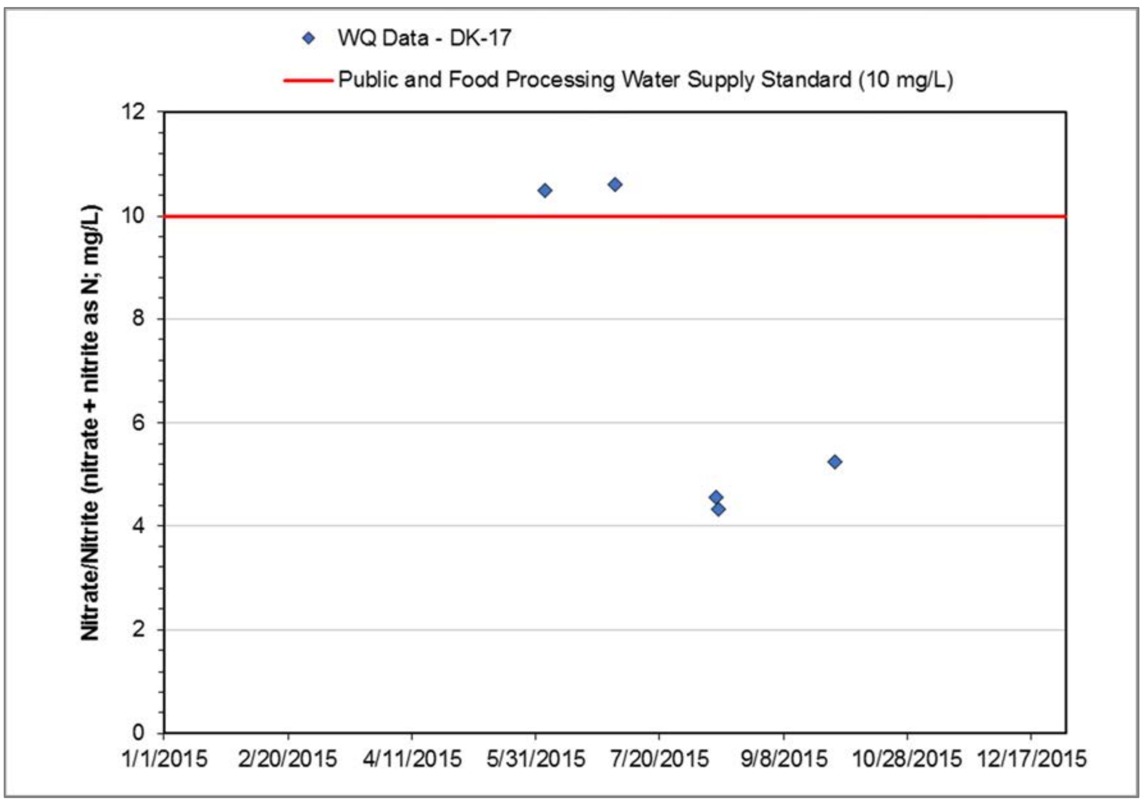

Figure 14. Nitrate water quality time series, Mackinaw River DK-17 segment

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.

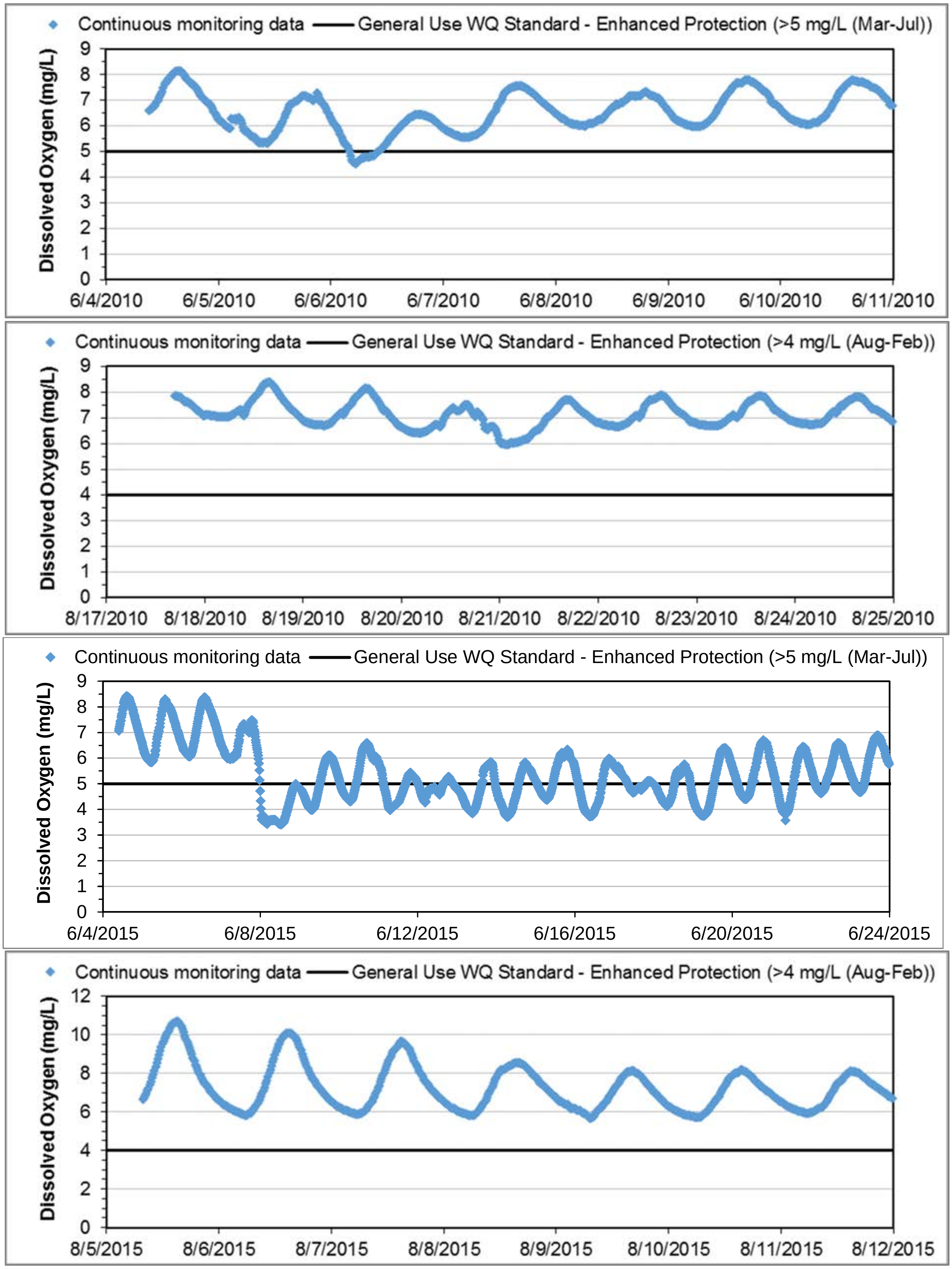

Figure 15. Continuous dissolved oxygen water quality time series, Hickory Grove Ditch DKB-01.

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

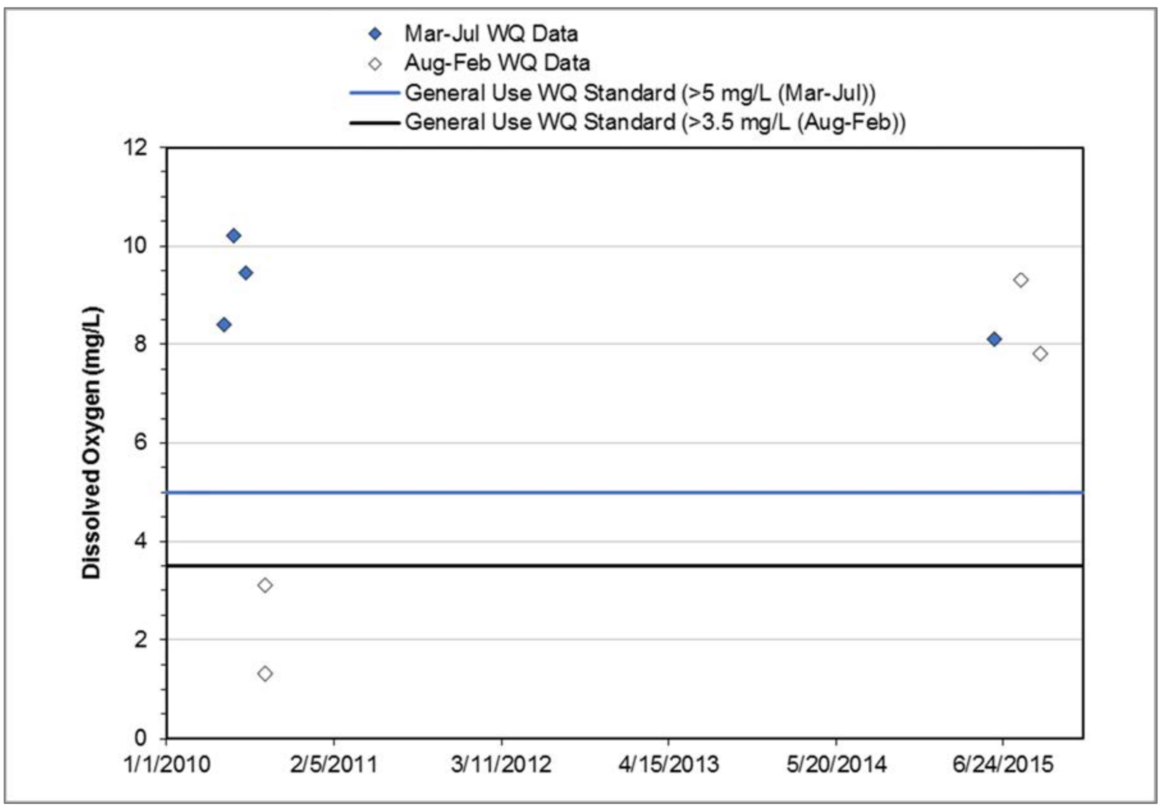

Figure 16. Dissolved oxygen water quality time series, Sixmile Creek DKN-01.

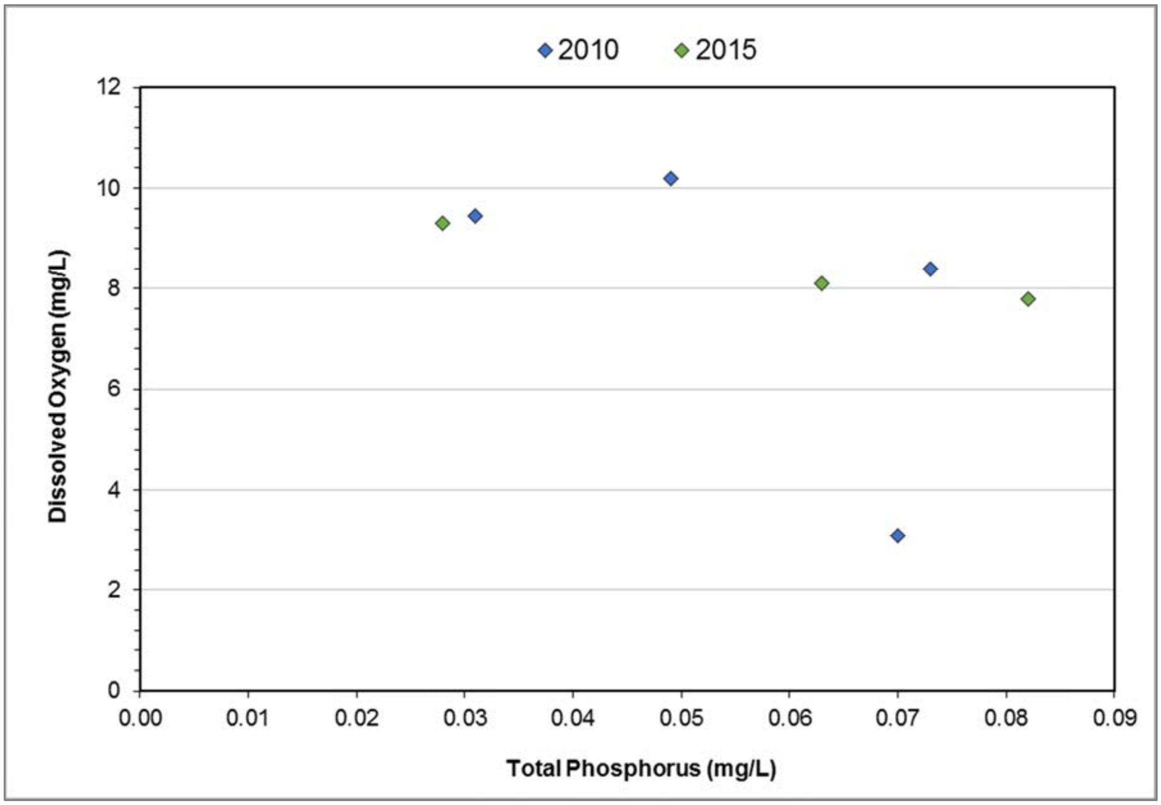

Figure 17. Total phosphorus versus dissolved oxygen, Sixmile Creek DKN-01.

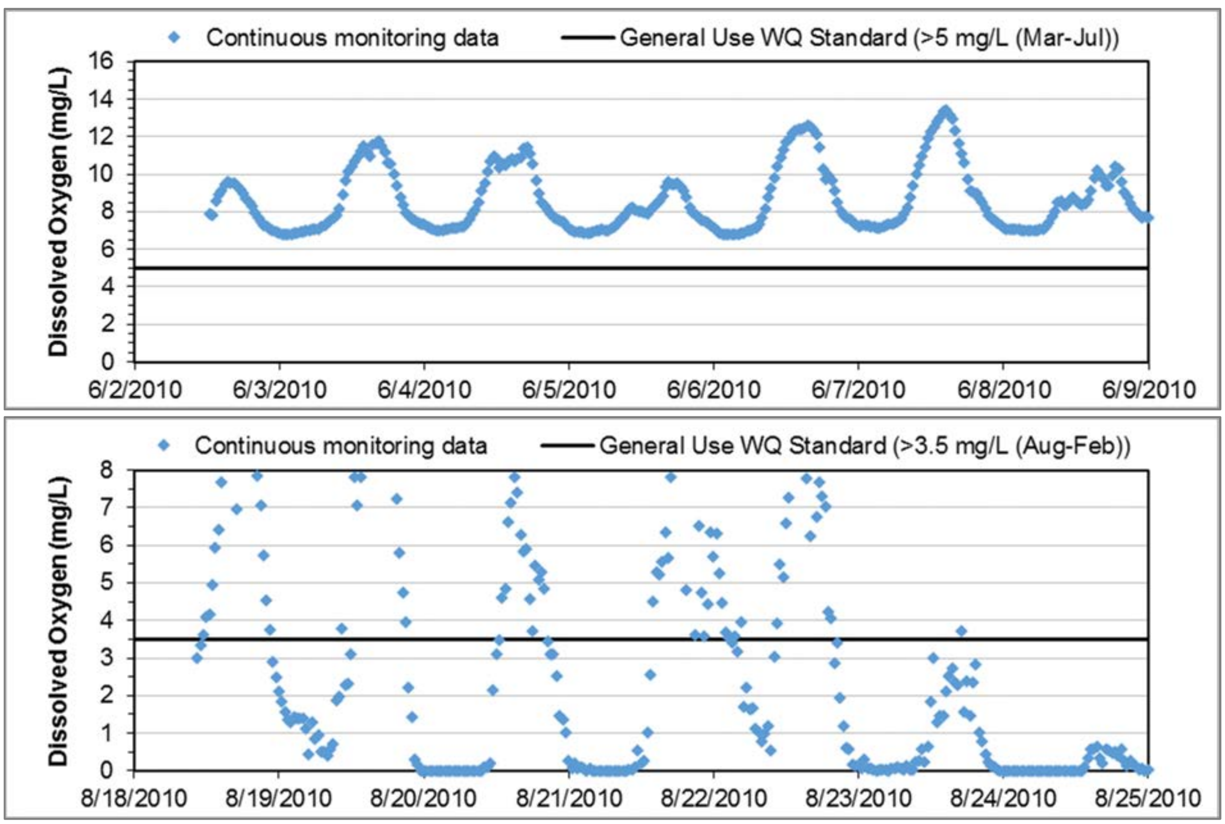

Figure 18. Continuous water quality time series for dissolved oxygen, Sixmile Creek (DKN-01).

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

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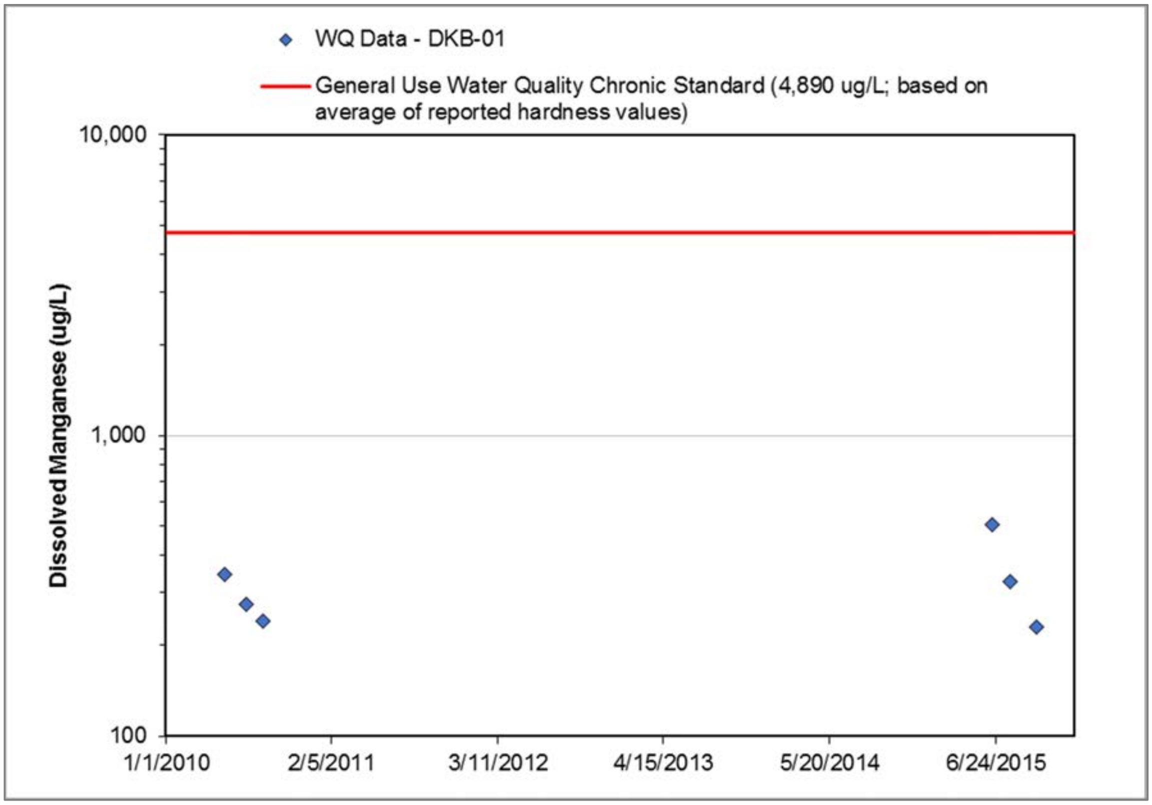
Appendix A – Unimpaired Stream Data Analysis

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

RECEIVED
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

RECEIVED
JAN 10 2019
SWWS/IFAS

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

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Test results meet all requirements of NELAC (accredited by Florida DOH #E37645). If you have any questions about this report, please contact Tom Weiss, Laboratory Manager, at 217.782.9780.

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

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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:	**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
Units: mg/L

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

Prepared: 08/07/19 09:41
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
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:	**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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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
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
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

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

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

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

Units: ug/L

Prepared: 08/20/19 10:13

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
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

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

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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

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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

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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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Illinois Environmental Protection Agency Laboratory

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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

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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:

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

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:	

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

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 11:50

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

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Test results meet all requirements of NELAC (accredited by Florida DOH #E37645). If you have any questions about this report, please contact Tom Weiss, Laboratory Manager, at 217.782.9780.

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

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Test results meet all requirements of NELAC (accredited by Florida DOH #E37645). If you have any questions about this report, please contact Tom Weiss, Laboratory Manager, at 217.782.9780.

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

Prepared: 07/31/19 09:49

Units: mg/L

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

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	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Test results meet all requirements of NELAC (accredited by Florida DOH #E37645). If you have any questions about this report, please contact Tom Weiss, Laboratory Manager, at 217.782.9780.

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

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

* Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Test results meet all requirements of NELAC (accredited by Florida DOH #E37645). If you have any questions about this report, please contact Tom Weiss, Laboratory Manager, at 217.782.9780.

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:	
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

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

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.

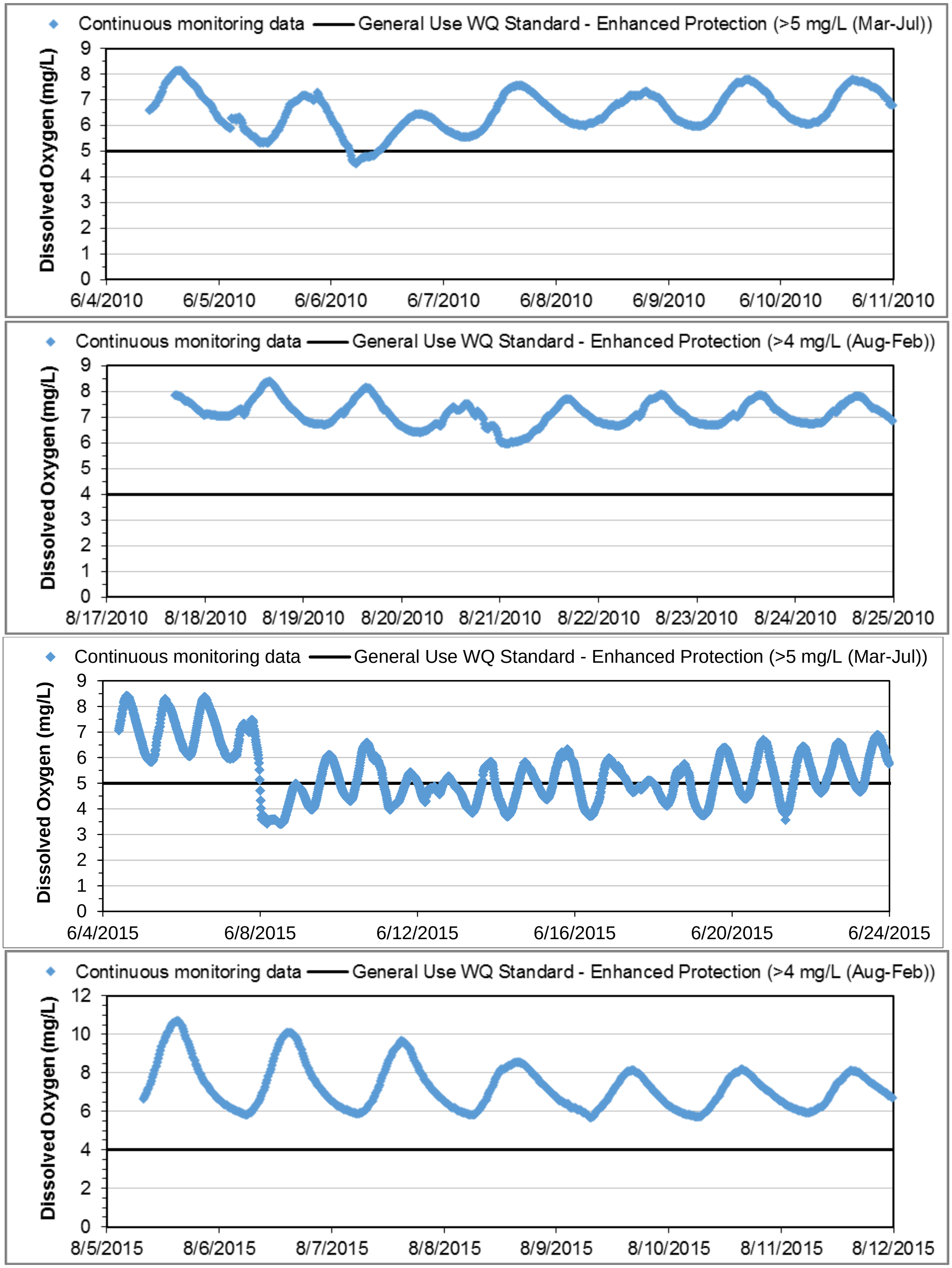

Figure C - 1. Continuous dissolved oxygen water quality time series, Hickory Grove Ditch (IL_DKB-01).

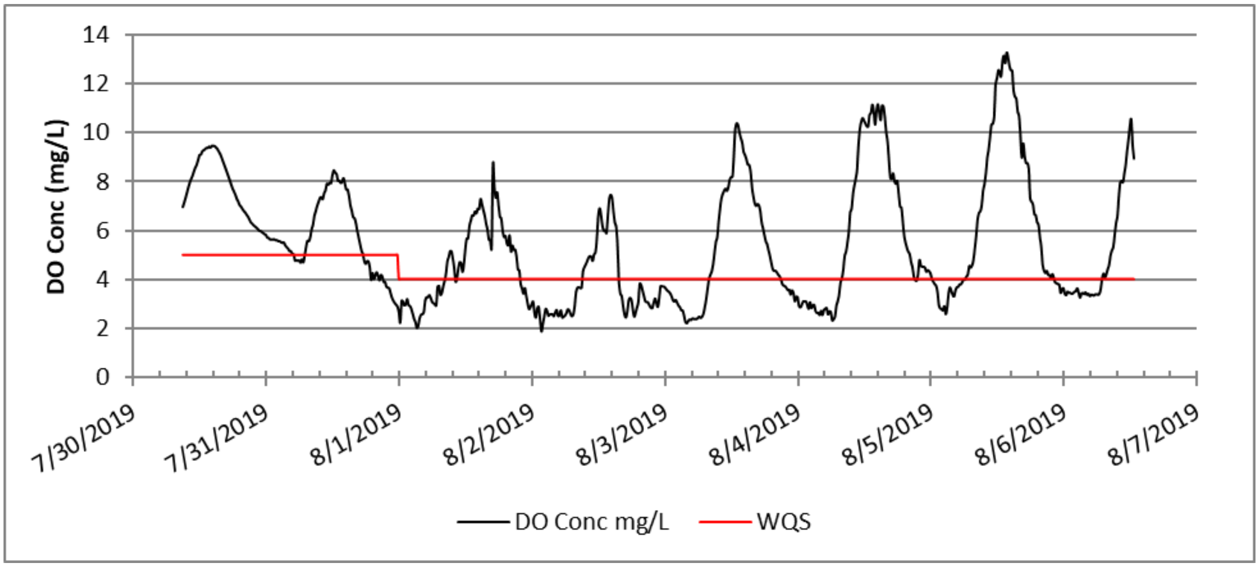

Figure C - 2. Continuous dissolved oxygen data; Hickory Grove Ditch (IL_DKB-01).

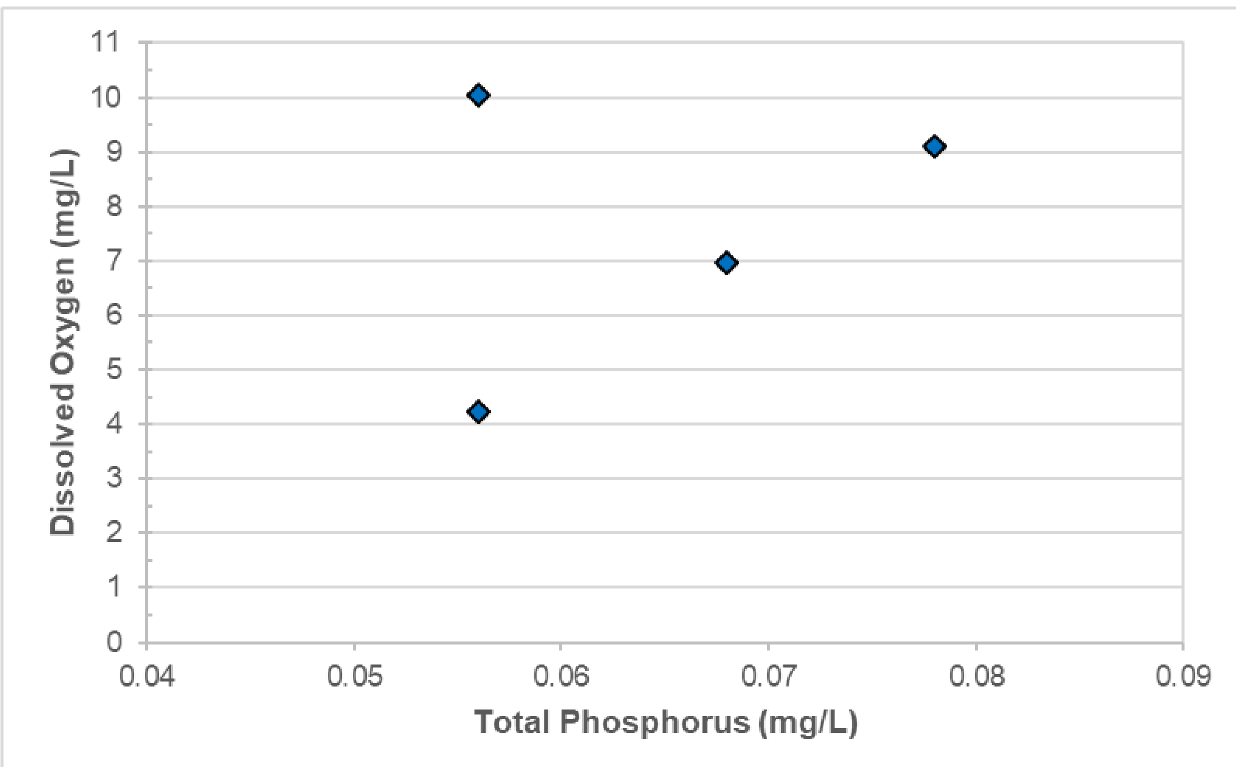

Figure C - 3. Total phosphorus versus dissolved oxygen—2019, Hickory Grove Ditch (IL_DKB-01).

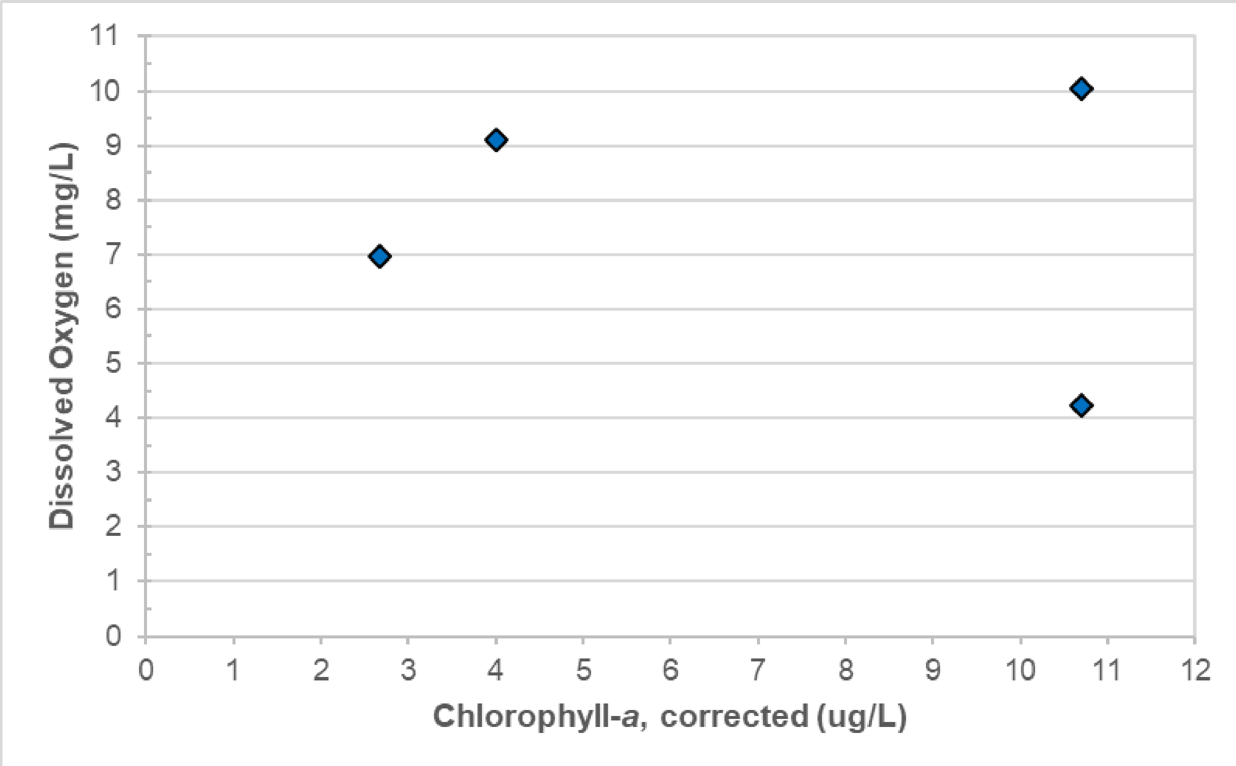

Figure C - 4. Chlorophyll-*a* versus dissolved oxygen—2019, Hickory Grove Ditch (IL_DKB-01).

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

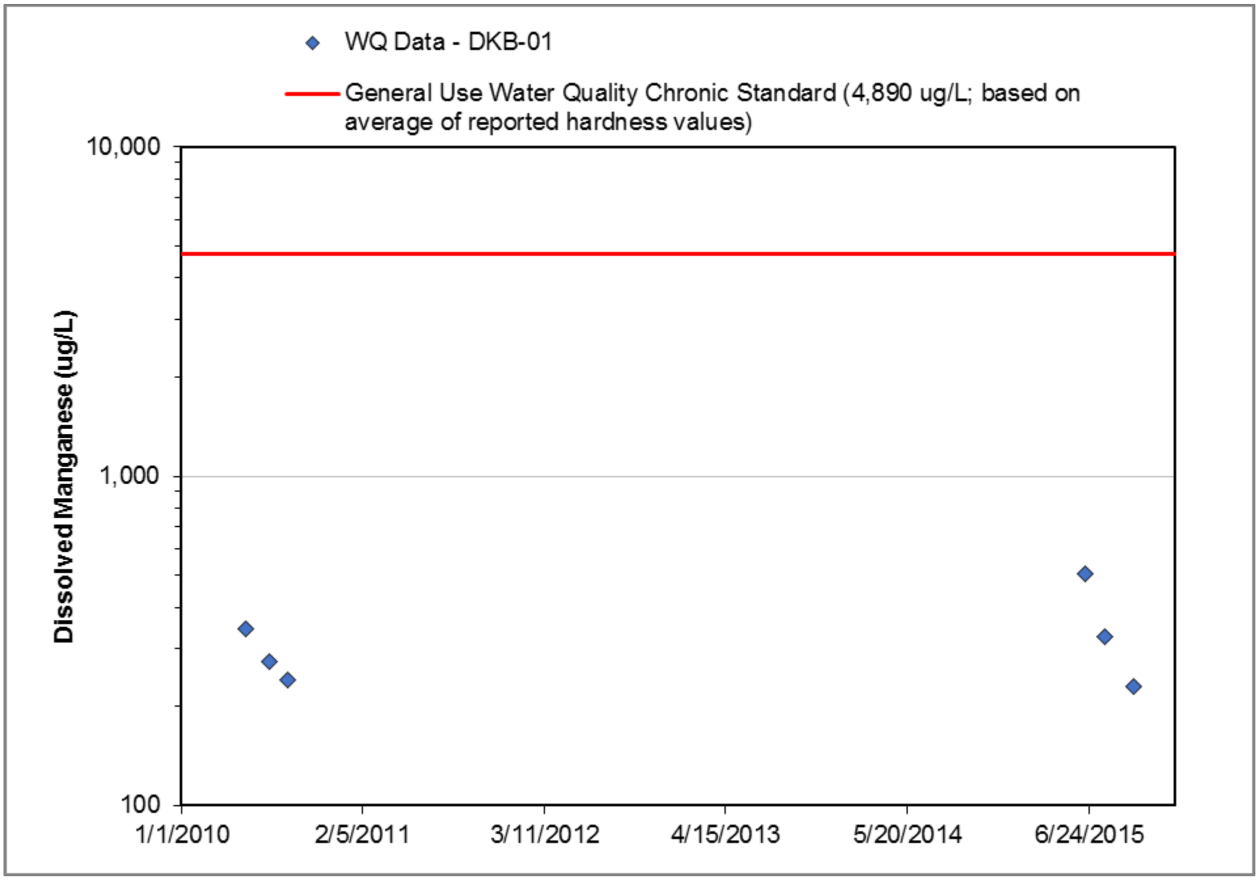

Figure C - 5. Dissolved manganese, Hickory Grove Ditch (IL_DKB-01).

Appendix D – Stage 3 Comments and Responses

Mackinaw River Watershed Total Maximum Daily Load

The responsiveness summary responds to questions and comments received during the public comment period from January 11, 2023, through February 10, 2023.

What is a TMDL?

A Total Maximum Daily Load (TMDL) is the sum of the allowable amount of a pollutant that a water body can receive from all contributing sources and still meet water quality standards or designated uses. The **Mackinaw River Watershed** TMDL report contains a plan detailing the actions necessary to reduce pollutant loads to the impaired water bodies and ensure compliance with applicable water quality standards. The Clean Water Act and U.S. Environmental Protection Agency (U.S. EPA) regulations require that states develop TMDLs for waters on the Section 303(d) List. The Illinois Environmental Protection Agency (IEPA) implements the TMDL program in accordance with Section 303(d) of the federal Clean Water Act and regulations thereunder.

Background

The watershed targeted for TMDL development is the Mackinaw River Watershed located in central Illinois. The watershed is approximately 1,149 square miles and covers land within Ford, Livingston, Mason, McLean, Tazewell, and Woodford Counties. The headwaters flow in a northwesterly direction toward Peoria, the river then flows west near Bloomington, then southwest, and finally due north to the Illinois River (IL_D-31) that eventually discharges to the Mississippi River (IL_J-05).

IEPA contracted with Tetra Tech (TMDL Consultant) to provide technical assistance and to prepare the TMDL report for Mackinaw River Watershed, including a fecal coliform TMDL for Mackinaw River segment (IL_DK-13) and a nitrate-nitrogen TMDL for Mackinaw River segment (IL_DK-17). These TMDLs address impairment listings in the 2016 Illinois Integrated Water Quality Report and Section 303(d) List.

Public Meetings

The Stage-1 public meeting was held on December 13, 2018, at the Davis Lodge in Hudson, IL, and comments received during the subsequent public notice period were addressed and incorporated in the Stage-3 TMDL report. The Stage-3 public meeting was conducted virtually using WebEx on Wednesday, January 11, 2023. The meeting started at 1:30 pm and concluded at 2:40 pm. Approximately 30 people attended the meeting, with the public notice period remaining open until midnight of February 10, 2023. The draft Stage-3 TMDL report was available for review and comment on the IEPA's webpage: **Public Notices (illinois.gov)** In addition, a direct mailing was sent to NPDES permittees and stakeholders in the watershed. The notice gave the date, time, and purpose of the Draft Stage-3 TMDL meeting. The notice also provided references on how to obtain additional information about this specific project, IEPA's Total Maximum Daily Load Program, and other related information.

Questions and Comments Received During Public Notice Period

1. The comment expresses concern over fecal coliform and other pollutants in the Mackinaw River, and the importance of the Mackinaw River for recreational and other activities, and requests IEPA to take appropriate action to address the impairments.

   Response:

   IEPA is committed to ensuring that Illinois' rivers, streams, and lakes meet water quality standards, and support their designated uses, such as, protection of aquatic life, recreation, drinking water supply, and fish consumption. The fecal coliform and nitrate TMDLs presented in this report will help to improve and meet water quality standards in the Mackinaw River, if the watershed stakeholders and local, state, and federal partners work together to install the recommendations of the implementation plan outlined in the TMDL report.

2. The timing of the sampling leads to biased results that misrepresents waters in the Mackinaw River that are impaired for nitrate-nitrogen (NO3-N) because IEPA collected few samples in May through October, when long-term studies indicate that tiles discharge the lowest concentrations. The IEPA should consider this issue when assessing a watershed-based approach to this TMDL.

   Response:

   The IEPA uses data from the Ambient Water Quality Monitoring Network and the 5-year rotating-basin, Intensive Basin Survey Program for assessment of Illinois waters. IEPA will consider the timing of future monitoring regarding tile discharge levels to support subsequent TMDL development. As part of the Mackinaw River Watershed TMDL Implementation Plan, tile drainage monitoring plan is recommended to be included as part of the watershed-based plan(s) development.

3. Please explain, in plain terms, the Public and Food Processing Water Supply **(**PFPWS) designated use in Section 2.1.

   Response:

   The following text was added to Section 2.1 to further explain the Public and Food Processing Water Supply (PFPWS) designated use: "The PFPWS designated use protects human consumption of drinking water and food that is processed using drinking water. As such, the standards are only applicable in a waterbody at the location that water is withdrawn for potable use (i.e., where the water supply intake pipe is located)."

4. Please add climate change information in Section 3.2.

Response:

Climate change has the potential to affect water quality through increased pollutant loads throughout Illinois. The impact and scale due to increase in temperature, precipitation, storm events, and drought conditions vary widely, and it is difficult to account for and to model for these conditions currently. The IEPA will investigate opportunities to incorporate climate change issues into the TMDL program.

5. Section 3.6 does not discuss tile drainage or its impacts on streamflow.

Response:

The following text was added to Section 3.6.

Tile drainage and channelization of streams throughout the agricultural areas of the Mackinaw River watershed result in altered hydrological regimes. Subsurface drain tiles are typically installed in agricultural areas to drain wet soils and pooled water from precipitation on relatively flat crop fields. Rainwater from precipitation on tile-drained fields will flow through tiles and into ditches much more rapidly than rainwater from precipitation events on crop fields without tile drainage. The subsurface flow moves rapidly through the tiles and discharges to ditches along fields and roads.

Corn and soybean are planted on flat land throughout the Mackinaw River watershed. Frakenberger et al. (2022) estimates that almost 61% of agricultural land is likely or potentially drained (based on the 2011 National Land Cover Database and 2008 Soil Survey Geographic Database).

Ditches and streams are channelized (i.e., straightened and often widened and deepened) to rapidly move water downstream. Water flowing through ditches and channelized streams moves much more rapidly (and with greater stream power) that water flowing in natural stream channels. The more powerful flow can result in increased erosion and flooding. Additionally, more powerful flows can transport larger particles (e.g., sediment, gravel).

Much of the streamflow in the Mackinaw River watershed is in an altered hydrologic regime, where tile drainage results in faster and larger flows than natural flow regimes. As part of the Mackinaw River Watershed TMDL Implementation Plan, development of a tile drainage monitoring plan is recommended to be part of the watershed-based plan(s) development.

6. Section 3.7 does not discuss the watershed plans for Evergreen Lake and Lake Bloomington.

Response:

A new bullet was appended to the end of Section 3.7 to summarize the Lake Bloomington and Evergreen Lake Watershed Based Plans (Northwater Consulting 2021).

This watershed plan "provides a road map to achieve water quality targets and stakeholder goals established under previous plans", in addition to the Illinois Nutrient Loss Reduction Strategy and the Lake Bloomington and Evergreen Lake TMDL reports. This plan included updated information about water quality, pollutant loading, and watershed characteristics. The plan ranks nutrient and sediment loading as a high priority for watershed plan implementation. It identifies agricultural BMPs as most effective in reducing nutrient loads, considering cost and feasibility. It prioritized in-field practices, especially those that treat tile water, such as cover crops and nutrient management to reduce nutrient and sediment loads. Edge of field and structural practices (e.g., filter strips, wetlands, and grassed waterways) will address higher risk areas and reduce loading, especially for phosphorus and sediment. The total estimated cost for implementing all BMPs in 2021 is $25,164,647.

7. The IEPA should consider options for a watershed based MS4 permit that could provide greater investment and partnering in green infrastructure to control nutrient runoff".

Response:

The IEPA encourages NPDES Permittees and other stakeholders in the watershed to establish a Watershed Workgroup to address the impairments both from point source and nonpoint source pollution.

The Workgroup may be able to coordinate BMP implementation and monitoring programs on a watershed scale. Currently, there are several Watershed Workgroups (Fox River Watershed Work Group, DuPage River Salt Creek Work Group, Des Plaines River Watershed Workgroup, and North Branch Chicago River Watershed Workgroup) in Illinois that are cooperatively working together to address impairments and MS4 General Permit requirements in their respective watersheds. IEPA recommend reaching out to one of these workgroups for more details.

8. We urge the IEPA to utilize the Likely Extent of Agricultural Drainage database and online GIS tool, which is freely available from the Purdue University Research Repository and the Transforming Drainage Project […]

Further, 4.3.1 has some helpful discussion but does not explain that with rich prairie soils, tile drainage can be a conduit for conveyance of nutrients liberated from the soils themselves, not just applied fertilizer.

Response:

IEPA used the online GIS tool (Frankenberger et al. 2022) to calculate the amount of agricultural land that is likely or potentially drained in the Mackinaw River watershed.

The following text was appended to the end of Section 4.3.1:

In the Mackinaw River watershed, almost 61% of agricultural land is identified as likely or potentially drained (Frankenberger et al. 2022). In addition to transporting land-applied fertilizers, drain tiles can transport nutrients leached from nutrient-rich prairie soils.

9. The report should reference the septic information in the Evergreen Lake and Lake Bloomington watershed plans.

Response:

The watershed-based plan mapped all the identified and likely septic systems in the watershed. Based on modeling, it estimated that there are 279 failing systems, contributing 3,415 pounds of phosphorus into waterways. The City of Bloomington regulates all septic systems in the area surrounding Lake Bloomington. It requires that all septic systems be inspected at point of sale to determine if the system needs to be replaced, and that all systems be pumped and inspected every three years. The City of Bloomington also works with homeowners to ensure that they have adequate information to maintain their systems.

The following paragraph was added to Section 4.3.2:

"Refer to the Lake Bloomington & Evergreen Lake Watershed Based Plan (Northwater Consulting 2021) for additional septic system information."

10. The report should present information from the 2017 Census of Agriculture.

Response:

IEPA reviewed the information from the 2012 Census of Agriculture, which is generally representative of conditions of 2017 and today, as shown in Section 3.1 of the TMDL report.

11. The water quality data is old and the IEPA should contact the USGS for newer data.

Response:

The water quality data in the TMDL Report has been updated based on the 2020 Intensive Basis Survey that became available recently.

The IEPA has included all available data (1944-2016) from USGS monitoring stations, including the data for nitrate-nitrogen (NO3-N). Please refer to Section 3.6 of the TMDL report.

12. The Margin of Safety (MOS) should be adjusted to account for climate change.

Response:

The TMDLs utilize the Load Duration Curve (LDC) approach. If climate change alters precipitation and runoff patterns, and thus increases or decreases flow, the TMDL at that increased or decreased flow will still be appropriate, as the flow is multiplied by the TMDL target and then converted to appropriate units. The 10% MOS used in these TMDLs is appropriate.

13. The TMDL should assess nitrate-nitrogen (NO3-N) concentrations in the fall and spring when the tiles are flowing, and when NO3-N concentrations are high and exceed 10 mg/L on multiple dates.

Response:

See response to #2.

14. This provides helpful discussion of how waste load allocations were calculated but should be revised to provide a clearer understanding of how load calculations were calculated, particularly given that the predominant source of pollution in the watershed is from nonpoint sources.

Response:

Section 6.2 describes that the Load Allocation (LA) that represents nonpoint source pollution is calculated after the Waste Load Allocations (WLAs) for permitted point sources, MOS, and allocation for future growth area are assigned. The amount remaining is the Nonpoint Source load allocation (please refer to Section 3 – Watershed Characterization, and Section 4 - Watershed Source Assessment).

15. The comment urges the IEPA to expand the list of Best Management Practices (BMPs) to include key practices that are responsive to the problem, provide an updated list of possible sources of funding, and include an up-to-date, accurate discussion of the partners working in the watershed.

Response:

The Implementation Plan (Section 8) includes key information to implement the TMDLs and address predominant nonpoint sources of pollution in the Mackinaw River watershed. Section 8.3 presents the recommended key BMPs to address nitrate-nitrogen and fecal coliform from agricultural runoff in the Mackinaw River; these BMPs are being used to implement TMDLs to address nonpoint sources of these pollutants throughout the Midwest.

Section 8.3.1 was updated to discuss using nitrification inhibitors and split nitrogen application in the Nutrient and Fertilizer Management subsection. A discussion was added to a new Saturated Buffers subsection. The Maximum Return to Nitrogen approach and woodchip bioreactors are already discussed.

The potential funding resources have been updated in Section 8.4.2, and Table 36 of the TMDL report.

Section 8.4.3 was updated to delete four organizations (Heartland Conservatory, Illinois Council of Best Management Practices, Illinois Council on Food and Agriculture Research (CFAR), and National Great Rivers Research and Education Center) that are no longer actively focused on the watershed.

16. The list of BMPs in Section 8.3.2 is out of date and missing key practices and should include funding sources beyond Section 319 Funding Program. The IEPA is urged to revise the TMDL plan and the Cropland Implementation Scenario to include all the relevant BMP practices. Doing so will provide landowners with additional options and increase the likelihood that implemented practices provide effective nutrient removal.

Response:

Please refer to Response #15 for discussion of additions to Section 8.3.2. The scenarios in Section 8.3.4 are examples of a suite of BMPs to achieve load reductions. Actual implementation will vary based upon local factors, including landowner engagement, and preference of BMP implementation plans.

The potential funding resources have been updated in Section 8.4.2, and Table 36 of the TMDL report.

The TMDL Implementation Plan was developed to meet U.S. EPA's Nine Elements for Watershed Based Planning. The IEPA recognizes that actual implementation may depend on many programs and watershed restoration may be broader than these specific impairments and TMDLs.

The IEPA encourages local stakeholders to utilize additional information, including site-scale factors, to design localized implementation strategies.

17. Funding sources are out of date and new funding sources were missing.

Response:

The potential funding resources have been updated in Section 8.4.2, and Table 36 of the TMDL report.

18. Several organizations no longer exist or no longer work in the watershed and that the Soil and Water Conservation Districts (SWCDs) are not discussed enough.

Response:

See Response in #15.

The four organizations in Section 8.4.3 that were identified no longer existing or no longer working in the watershed have been removed. The report acknowledges that the SWCDs are key partners for implementing agricultural BMPs.

The following paragraph was added to the end of Section 8.4.3.

Soil and Water Conservation Districts provide rural and urban citizens alike with both technical assistance and services on several issues including soil health, erosion and sedimentation control, water quality protection, storm water management, green infrastructure, farmland protection, flood prevention, land use issues, environmental protection programs and stream bank stabilization. SWCDs work with private landowners, homeowners, developers, and more on a voluntary basis to address locally identified resource concerns. This is accomplished through educational efforts, by providing technical assistance through trained staff, and offering financial assistance for eligible projects.

19. Section 8.7 should include discussion of innovative and pilot watershed projects.

Response:

The IEPA acknowledges that innovative pilot watershed projects can be beneficial for addressing water quality impairments and implementing TMDLs.

Section 8.7 has outlined that 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. Adaptive management approaches could include innovative and pilot projects in the watershed.

20. The schedule and milestones should be revised to reflect partners, BMPs, and funding sources that are available in the watershed. Please include a discussion of how the schedule and milestones were developed and how they compare to baseline.

Response:

The milestones in Table 38 were developed using the implementation scenario presented in Table 33 and a three phased, 25-year timeline. The milestones are for new implementation; the baseline would be the existing BMPs.

The schedule and milestones can be adaptively managed as implementation occurs. For example, the schedule and milestones may be revised if one suite of BMPs are not successfully implemented.

21. The organization descriptions in the Reasonable Assurance section are out of date.

Response:

The IEPA deleted the Illinois Council on Best Management Practices description and updated The Nature Conservancy (TNC) description, as requested.

22. How can kayakers and other members of the public easily find out about fecal coliform impairments, if they are not aware of TMDLs or Illinois' 303(d) list?

Response:

The Illinois Integrated Water Quality Report and Section 303(d) List, 2020/2022 cycle is online and has an interactive map to help find the status of water quality impairments. Here are the links to the report and interactive map:
IEPA - 2020/2022 Integrated Report Web App (arcgis.com)
Illinois 303d List

The USEPA recently developed a web application called How's My Waterway: How's My Waterway | US EPA, to help the public access the water quality status and information on swimming, eating fish, and aquatic life at a community, state, or national scale. This tool may also be accessed from a mobile device by entering an address, zip code or place name.

23. Animal feeding operations, including CAFOs, are lacking in regulatory oversight. Additionally, the commentor has expressed that they have had concerns with manure application for decades.

Response:

Agricultural related pollution for CAFOs is covered under Title 35 Subtitle E of the Illinois Pollution Control Boards regulations. The regulations, which were adapted by the Board in September 2014, set standards for the operation of CAFOs, to reduce the impact of these operations on the environment. These regulations include standards for management of manure.

Livestock management facilities or livestock waste handling facilities must apply for NPDES permit coverage as Concentrated Animal Feeding Operations (CAFOs) if such facilities discharge, propose to discharge, or are operated in such a way that a discharge is possible. The facilities covered under the General Permit CAFO must be complying to meet the NPDES permit requirements.

Illinois's General NPDES Permit for CAFOs establishes criteria for land application of manure that generally prohibit any land application that would result in livestock waste discharging to waters of the state. For example, manure land application is prohibited during precipitation events and when water has ponded on the ground surface.

In addition to regular inspections, IEPA also investigates and enforces complaints of manure land application that leads to livestock waste entering waters of the state.

24. Illinois is behind other states with reducing nitrate and nitrogen to the Mississippi River; farmers should install wetlands to treat tile discharges, and that the Illinois legislature should mandate BMP implementation.

Response:

Please refer to the Illinois Nutrient Loss Reduction Strategy (NLRS), and USDA-NRCS for additional information about wetlands, especially those designed to capture nutrients which can be used by farmers to treat farm tile drainage. Regarding mandating BMP implementation in Illinois, the Illinois General Assembly is the lead entity regarding adaption of legislation efforts associated with BMP implementation. To support volunteer BMP implementation, Illinois has developed the Green Infrastructure Grant Opportunities (GIGO) Program including funding for GIGO program.

25. Segment IL_DKB-01 is not addressed in this TMDL report; CAFOs are impacting water quality; the state permits all animal feeding operations; and the State should deny some CAFO permits.

Response:

Hickory Grove Ditch (IL_DKB-01) is shown as impaired for low dissolved oxygen (DO) in Appendix C. However, DO, TP, and chlorophyll-*a* data indicated that nutrient eutrophication and algal growth and die-off are not the primary causes of low DO. The DO impairment of Hickory Grove Ditch is not related to point source or nonpoint sources, and that's why the waterbody segment (IL_DKB-01) was not addressed by this TMDL. The parameter will be addressed as non-pollutant in the 2024 Cycle of the Illinois Integrated Water Quality Report (IR).

The Illinois General Assembly has only granted IEPA the authority to deny NPDES coverage when an applicant does not meet the permitting and regulatory requirements. The siting and construction of CAFOs are regulated by the Illinois Department of Agriculture.

If an animal feeding operation: (1) applies for coverage under the general NPDES permit for CAFOs and (2) meets all the permitting and regulatory requirements, then the animal feeding operation will be granted permit coverage.

26. Indian Creek has point source discharges.

Response:

The following two point sources are in the Indian Creek sub-watershed, and are covered by individual NPDES permits:

- **Indian Creek Landfill 2 (IL0077259)**
- **Village of Hopedale STP (IL0020737)**

The following four point sources are covered by general NPDES permits:

- **Cullinan & Sons, Inc. (ILR003853; industrial stormwater)**
- **Double K Trucking / Shives Inc. (ILR004491; industrial stormwater)**
- **GFL ENV Services USA, Inc. (ILR006184, ILR006519; industrial stormwater)**
- **Village of Hopedale (ILG870903; pesticides)**

Indian Creek is a tributary of the Mackinaw River but is downstream of the impaired segments (IL_DK-13 and IL_DK-17) addressed by this TMDL.

Indian Creek (IL_DKD-01) is listed as impaired in the Illinois Integrated Water Quality Report and Section 303(d) List, 2020/2022 cycle due to elevated levels of total phosphorus (TP) and total suspended solids (TSS) based on past statistical guidelines that are no longer applied in assessment of Illinois waters. The Mackinaw Watershed TMDL report was initiated based on the 2016 Integrated Report, and that is the reason Indian creek was not identified in the TMDL study.

27. I support the TMDL fecal coliform goals of 50% pollution reduction and nitrogen pollution reduction of 44%. I strongly urge IEPA to provide staffing adequate to ensure these goals are met.

Response:

IEPA is working to fill positions that have been vacated due to retirement and other staff loss. The BOW- Division of Water Pollution Control has filled 15 positions in Permit Section/Field Office Section/Compliance Assurance Section in 2023, and plans are underway to add more staff in several BOW Programs.

IEPA/BOW-Permit Section and Field Office staff will continue working closely with NPDES Permittees through the NPDES permitting/compliance process to address the impairments, and IEPA also encourages stakeholders in the watershed to develop watershed-based plans to implement the BMPs outlined in the TMDL report.

28. Agricultural buffer strips are a proven cost-effective method of reducing nitrogen drainage and should be supported with funding for farming operations with increased BMP monitoring. Application of fertilizer in the appropriate season is especially important and all agriculture operations should be required to demonstrate compliance with this basic method of protecting the watershed.

Response:

Vegetated buffers and filter strips are recommended as BMPs in Section 8.3.2 of the report. The IEPA also supports the 4R fertilizer management approach which provides guidance to producers: specifically, the Right source, Right rate, Right time, and Right place.

29. Food processing and animal agriculture facilities should be closely monitored for compliance with existing BMP regulations. IEPA staffing levels should be increased to reflect this increased monitoring.

Response:

Public and Food Processing Waters Supply facilities must comply with 35 Ill. Adm. Code, Subpart B, Section 303.202 Standards, in addition to water withdrawn for treatment and distribution as potable supply or for food processing. Please refer to Section 2.2.2 of the TMDL report for more details.

Concentrated Animal Feeding Operations (CAFO) and are required to comply with the Illinois Pollution Control Board regulations outlined in 35 Ill. Adm. Code. CAFO facilities that are covered under the General NPDES Permit ILA01 must also follow the terms and conditions of the Subtitle E and NPDES permit Conditions.

IEPA is working to fill positions that have been vacated due to retirement and other staff loss. The BOW- Division of Water Pollution Control has filled 15 positions in Permit Section/Field Office Section/Compliance Assurance Section in 2023, and plans are underway to add more staff in several BOW Programs.

IEPA/BOW-Permit Section and Field Office staff will continue working closely with NPDES Permittees through the NPDES permitting/compliance process to address the impairments, and IEPA also encourages stakeholders in the watershed to develop watershed-based plans to implement the BMPs outlined in the TMDL report.

30. The City of Bloomington operates an approved inlet structure and pump station, permitted through the Army Corps of Engineers, permit number CENCR-OD-S-187141, that allows the City of Bloomington to transfer water from the Mackinaw River directly into Evergreen Lake when certain permitted conditions are met.
How would any TMDLs impact the City of Bloomington's use of the Mackinaw River Pumping Pool to augment the City's water supply? Additional information and further discussion are requested.

Response:

The TMDLs for the Mackinaw River Watershed will not affect the Mackinaw River Pumping Pool. The permit issued by the U.S. Army Corps of Engineers is not altered by the TMDL. The U.S. Army Corps of Engineers may consider the TMDLs and the Implementation Plans during future permit renewals or modifications.

31. Table 35 summarizes the cost, as I understand it, of achieving compliance over the entire watershed, for $10M or less.

1. Exactly who is expected to incur these costs?
2. What percentage of these expenditures are incurred on the farm (by owner/operators) vs. off farm administration, etc.
3. Please indicate how those expenses are distributed over the proposed 25-year grace period.
4. Please explain why that 25-year period delay in compliance cannot be reduced.
5. Please express annual average watershed compliance costs as a percent of annual average farm income.

Response:

The BMPs for addressing nonpoint sources outlined in the TMDL are recommendations to help improve water quality issues in the watershed. Implementation of BMPs to address nonpoint source pollution is voluntary. Developing a watershed-based plan provides a framework for implementing BMPs and details on all expenditures to address the fecal coliform and nitrate impairments in the Mackinaw River watershed.

In the watershed-plan, landowners, and as appropriate, farmland operators, are expected to incur costs for many of the structural and management practices. Local governments also are responsible for practices on publicly owned properties.

1. **Watershed stakeholders, including landowners, farmland operators, and local government are expected to incur the cost of BMP implementation. State and federal financial assistance can be used by watershed stakeholders for implementation.**
2. **The percentage of expenditure is determined on a case-by-case basis for specific watershed.**
3. **The cost distribution for the 25-year implementation schedule will be determined through the development of a watershed plan which provides the framework, including an implementation schedule for BMP implementation to address the fecal coliform and nitrate impairments in the Mackinaw River watershed.**

   The TMDL Implementation-Long Term (16-25 years) plan outlined in Table 38 of the TMDL report is based on studies/projects from similar watersheds, such as the recently approved Vermilion River (Illinois Basin).

   Developing a watershed-based plan\implementation plan\BMP-Effectiveness and monitoring for meeting the recommended load reduction targets is a long process as outlined in Section 8.7 - Progress Benchmarks and Adaptive Management, and full attainment of water quality standards is expected to take approximately 16-25 years.
4. **The implementation timeline is dependent upon actions taken by the watershed stakeholders, and the schedule may be revised based on the progress of BMP implementation. See #3 above.**
5. **An annual average watershed compliance cost as a percent of annual average farm income has not been calculated at this time. The annual average compliance cost in relation to farm income is dependent on the recommendations in the watershed-based plan, the selection of BMPs, available stakeholders matching fund, and other funding sources. The compliance costs of BMPs will be determined at the time the implementation plan takes place.**